THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
Department of Agricultural Resources
State Reclamation and Mosquito Control Board
251 Causeway Street, Suite 500, Boston, MA 02114
617-626-1700 fax: 617-626-1850 www.mass.gov/agr

TO: Interim Commissioner Lauren Smith (MA DPH)
Commissioner Gregory C. Watson (MDAR)
Commissioner Ken Kimmell (MA DEP)
Commissioner Edward M. Lambert, Jr. (MA DCR)

FROM: State Reclamation and Mosquito Control Board

DATE: Approved by the Board on January 23, 2013

RE: Final Summary Report: *Aerial adulticiding intervention response to Eastern Equine Encephalitis virus (EEEV), Southeast Massachusetts, 2012*

Introduction

The Massachusetts Department of Agricultural Resources (MDAR), *through the State Reclamation and Mosquito Control Board* (the Board), in collaboration with the Massachusetts Department of Public Health (MA DPH) planned, implemented, and supervised two (2) aerial mosquito control spray operations within Southeastern (SE) Massachusetts during July and August 2012. As outlined in the "*2012 State Reclamation and Mosquito Control Board Operational Response Plan*", the Board hereby submits its final summary report concerning the aerial mosquito control spray response during the summer of 2012.

Two aerial mosquito control spray operations (**Round 1 and 2**) were conducted in response to elevated risk of mosquito-borne Eastern Equine Encephalitis virus (EEEv) transmission. Infection by EEEv often leads to a life-threatening disease of human beings as well as elevated morbidity and mortality in certain mammals and birds. Mortality rates in people are expected to approach 50%. Severe life-long abnormalities can occur in nearly 90% of survivors. The goal of the aerial mosquito control spray response was to cause an immediate reduction in the abundance of adult mosquitoes infected with EEEv that posed a danger to the public. The detection by DPH State Laboratory Institute (DPH-SLI) of EEEv in mammal, as well as bird-biting mosquitoes, sampled in July 2012 indicated an early and elevated risk of EEEv transmission. Subsequent testing by DPH State Laboratory Institute (DPH-SLI) revealed rapid amplification and increased geographic range of EEEv in enzootic and bridge vectors. Infected mosquitoes were sampled from habitats that have historically served as foci of EEEv amplification, particularly in Bristol and Plymouth counties. The elevated temperature (4.5 F degrees above normal) for the month of July was further cause for concern that the potential threat of EEEv could be particularly severe. Indeed, warmer temperature speeds the developmental rate of mosquitoes, increases the frequency of their blood feeding, and reduces the interval required for infected mosquitoes to become infectious. Taken together, the early and dispersed detection of EEEv and the warmer conditions experienced, set the stage for significant risk to the residents of the Commonwealth.

At the behest of the Board and MA DPH, the regional mosquito control projects (MCPs) promptly conducted ground-based Ultra-Low-Volume (ULV) spray operations throughout the area in response to available and ongoing data. Populations of the most relevant mosquitoes continued to rise at rates that exceeded the abilities of the MCPs to effectively suppress them to desired levels. The cattail mosquito (*Coquillettidia perturbans)*, an aggressive mammal biting species was particularly abundant. The sparse network of roads in and around wetland areas in this area of the state made it difficult for ground ULV equipment to reach mosquito habitat and thereby limit the effectiveness of these local efforts.

The unusually early and elevated (and sustained) mosquito infection rates compelled the MA DPH to raise the public risk level to high for several municipalities. The elevated risk stimulated yet additional public health responses including the curtailment of evening activities, supplemental mosquito surveillance efforts, intensified ground ULV spraying, and educational outreach pertaining to personal protective measures to reduce exposure to mosquitoes.

Intensified surveillance led to continued detection of EEEv positive pools of both bird-biting and mammal biting mosquitoes underscoring the concerns pertaining to the increased EEEV risk in 2012 to the public. In accordance with the *2012 MA DPH Arbovirus and Surveillance Plan*, the risks of EEEv transmission to humans exceeded the threshold for aerial adulticide intevention. EEEv transmission dynamics and associated risks surpassed those levels detected in past mosquito seasons (2006 and 2010) when aerial adulticide interventions were similarly deemed necessary.

As a result, the MA Department of Public Health (DPH) announced on July 17, 2012 that aerial spraying for mosquitoes would take place in 11 cities and towns in southeastern Massachusetts including Bridgewater, Carver, Easton, Halifax, Lakeville, Middleborough, Norton, Plympton, Raynham, Taunton, and West Bridgewater. Accordingly, MA DPH Commissioner John Auerbach authorized such an effort on July 17, 2012 by approving the document *Certification of Public Health Hazard That Requires Pesticide Application to Protect Public Health* (**See Appendix 1**) This document certified that the aerial application was necessary to protect the public in portions of SE Massachusetts where infected and infectious adult mosquitoes were most prevalent. The public health certification would remain in effect until September 30, 2012.

In response to the MA DPH authorization for an aerial intervention, the Board held an emergency meeting on July 19, 2012 approving the aerial adulticide intervention to reduce the abundance of adult mosquitoes infected with EEEv. The Board also took into consideration guidance from the Mosquito Advisory Group (MAG), chaired by Dr. Richard Pollack, that stated:

The MAG has carefully examined ecological and epidemiological data from the recent days and weeks and has considered this along with historical data pertinent to EEE risk and intervention options. MAG concludes that current data signify extraordinary risk of EEE transmission throughout large portions of southeastern MA. Furthermore, MAG has advised MDAR and MDPH to pursue aerial adulticide-based interventions as quickly as possible in the affected region. MAG concludes that the benefits to such an application will offer considerable benefit to residents without causing undue risk to people or the environment. Finally, MAG urges MDAR and MDPH to consider a follow-up application of adulticide within 3-4 days to further reduce risk.

In light of the Board's recommendation, the MDAR Commissioner, Gregory C. Watson authorized the immediate procurement of the insecticides and planes needed to conduct aerial adult mosquito spraying in areas of SE Massachusetts as soon as possible. MDAR through the Board immediately began to fulfill its role in carrying out the logistics of the aerial adulticide spray operations. The logistics included procuring planes and insecticides, coordinating GIS mapping, obtaining the Massachusetts Endangered Species Emergency authorization permit, facilitating extensive communications between EOEEA agencies, and providing onsite oversight of the actual operation at the airport/staging area of the operation.

The original EEEv aerial spraying map that included 11 cities and towns was expanded to 21 communities (**See Appendix 2**) as ongoing daily surveillance data confirmed that EEEv had spread to surrounding areas. With the expansion of the spray area, additional equipment, insecticide, and mapping were needed to insure a successful operation. Within three (3) days, the planes, GIS maps, and insecticide were in place and the aerial application began on the evening of Friday, July 20, at 8:15 PM.

The communities in the spray zone now included: Acushnet, Berkley, Bridgewater, Carver, Dighton, East Bridgewater, Easton, Freetown, Halifax, Hanson, Kingston, Lakeville, Middleborough, Norton, Pembroke, Plympton, Raynham, Rehoboth, Rochester, Taunton, and West Bridgewater.

The first round of aerial mosquito control spraying operations began on Friday evening of July 20, 2012. Unfavorable weather conditions caused the suspension of the spray operation in the early morning hours of Saturday, July 21, 2012. The application resumed during the following evening (July 21, 2012), but the weather again quickly proved to be unfavorable to sustain the operation beyond 9 PM. The aerial mosquito control spray operation continued on the next evening (Sunday, July 22$^{nd)}$ and was completed early Monday morning, (July 23$^{rd)}$ at approximately 1 AM.

Description of Aerial Mosquito Control Spray Operation-**July 20-23, 2012 (Round 1)**

As the operation proceeded, the overall mission required a significant effort to bring all parts of the operation together, including but not limited to, insuring timely delivery of sufficient insecticide, deployment of adequate aircraft to cover the approved application area, GIS mapping with exclusion zones, public communication/ messaging, and ultimately, the conduct of the application itself. Due to the expansion of the spray zone, three (3) aircraft were requested by the Board to cover the region as quickly as possible. With 3 aircraft deployed from Dynamic Aviation Company, the operation could be completed within two evenings of spraying, weather dependent. The aircraft employed are modern twin-turbine Beechcraft King Air, Model A90 planes, that fly at a speed on average about 170 mph at 300 feet above ground level, and apply the product across a 1,000 foot swath. The Board coordinated the immediate shipment of Anvil 10+10 ULV, the product of choice from Clarke Mosquito Control. The new acreage estimates required nearly 35 drums. The first 22 drums were shipped to Plymouth for arrival on Friday; the 13 drum balance arrived the next day to ensure adequate insecticide for the entire operation.

MA DPH and the Board considered the rapidly increasing abundance of EEEv infected vectors on the wing to be an unacceptable immediate risk to residents of the Commonwealth. Accordingly, the aerial adulticide calibration and characterization procedure (as had been done during 2006 and 2010) was waived so that the emergency aerial ULV intevention could commence without unnecessary delay. In lieu of such on-site spray apparatus testing, the Board requested the annual documentation for the calibration and characterization of the aircraft being utilized for this mission. This documentation available upon request from MDAR verifies that the contractor has calibrated the aerial spray equipment to ensure that the desired aerial spray application parameters such as amount of active ingredient (a.i.) dispensed per acre and the optimum droplet size were met.

As done in past aerial adulticide operations, the Massachusetts Environmental Police under the command of Colonel Aaron Gross, were stationed on site for the duration of the operation to keep the base of operation secure and to address Biosecurity and Homeland Security concerns pertaining to storage of aircraft and bulk pesticides.

During the Round 1 spraying operation, three (3)-twin turbine Beechcraft King Air (Model A90 numbered N61Q, N78D, and N79W) commenced the aerial mosquito control operation on July 20th with spray on beginning at 8:15 PM for all 3 aircraft. The operation ended with spray off at 12:50 AM for N61Q, 12:52

AM for N78D, and 12:58 for N79W. On the following evening of July 21st, 2012, N61Q and N79W commenced the operation with spray on beginning 8:15 and N78D at 8:16 PM. Due to unfavorable weather conditions on this evening, the operation was suspended with spray off occurring at 9:06 PM for N61Q, 9:10 PM for N79W, and 9:15 PM for N78D. Spraying continued Sunday evening on July 22nd, 2012 with N61Q and N79W commenced the operation with spray on beginning 8:15 and N78D at 8:16 PM. The entire operation was completed on Monday morning of July 23rd, 2012 with spray off occurring at 11:50 PM for N61Q, 12:50 PM for N78D, and 12:55 PM for N79W

The first round of aerial mosquito control operation was divided into 4 spray zones (**See Appendix 3)** and the final map of the area treated encompassed a total of 368,414.9 acres as calculated by the navigational flight system of the aircrafts over defined portions of Bristol and Plymouth County. The treated area included the following 21 municipalities: Acushnet, Berkley, Bridgewater, Carver, Dighton, East Bridgewater, Easton, Freetown, Halifax, Hanson, Kingston, Lakeville, Middleborough, Norton, Pembroke, Plympton, Raynham, Rehoboth, Rochester, Taunton, and West Bridgewater.

The aircraft applied during round 1 a total of 1,784.5 gallons of Anvil 10 +10 ULV (EPA # 1021-1688-8329) during round 1. Anvil 10+10 ULV contains the active ingredients d-phenothrin (sumithrin) and the synergist piperonyl butoxide (PBO). Over the course of the operation, Anvil 10+10 ULV was applied at a rate of 0.62 oz/acre (the maximum allowable amount permitted by the pesticide product label), and at a height of 300 feet above the ground. The aircraft average airspeed ranged from ~ 168.9 – 187.7 mph, and dispensed an aerosol swath width of 1,000 feet.

Weather Conditions for Aerial Adulticide, July 20-23, 2012-Round 1

Reported weather conditions during the July 20-23, 2012 aerial application ranged from less than optimal to acceptable. All weather parameters remained within ranges compatible with the pesticide product label. Pesticide labeling for Anvil 10+10 ULV states that air temperature should be greater than 50 F when conducting all types of applications. These temperatures, in general, reflected conditions favorable to mosquito activity during the application windows. Wind speeds were inconsistent during the hours of operation making deposition less favorable where winds at time decreased during or towards the end of the application with reports ranging from several mph to calm conditions.

Weather Summary

July 20th
Weather conditions were acceptable this evening. After some pre-application light rainfall, temperatures gradually dropped throughout the night, finally dipping below 60 degrees at several stations by midnight with some fog reported. Winds were below 10 mph at the airports, and calm throughout the application at most of the backyard weather stations.

July 21st
Weather conditions were less than optimal this evening for the application. Temperatures fell quickly below 60 degrees shortly after sunset and winds throughout the application were calm at all reporting stations.

July 22nd
Weather conditions were ideal for the application this evening. Temperatures at all reporting stations remained in the middle to upper 60's throughout the application and winds were light (between 3 and 8 mph) out of the south at the airport reporting stations and calm at the backyard reporting stations.

Results of Aerial Mosquito Control Spray Operation- **Round 1**

The aerial mosquito control spray operation results confirmed a marked reduction in the abundance of target mosquitoes. This reduction in mosquito abundance translates to a reduction in risk of enzootic and epizootic EEEv transmission. Meteorological conditions were challenging during this particular operation as verified by droplet collection monitoring during the operation (**See Appendix 4**). Decreasing temperature caused early suspension of spraying on July 20th and again on July 21st, when wind conditions were deemed to be too calm. Despite these meteorological challenges, the mosquito population was measurably reduced as a result of the operation as announced by DPH.

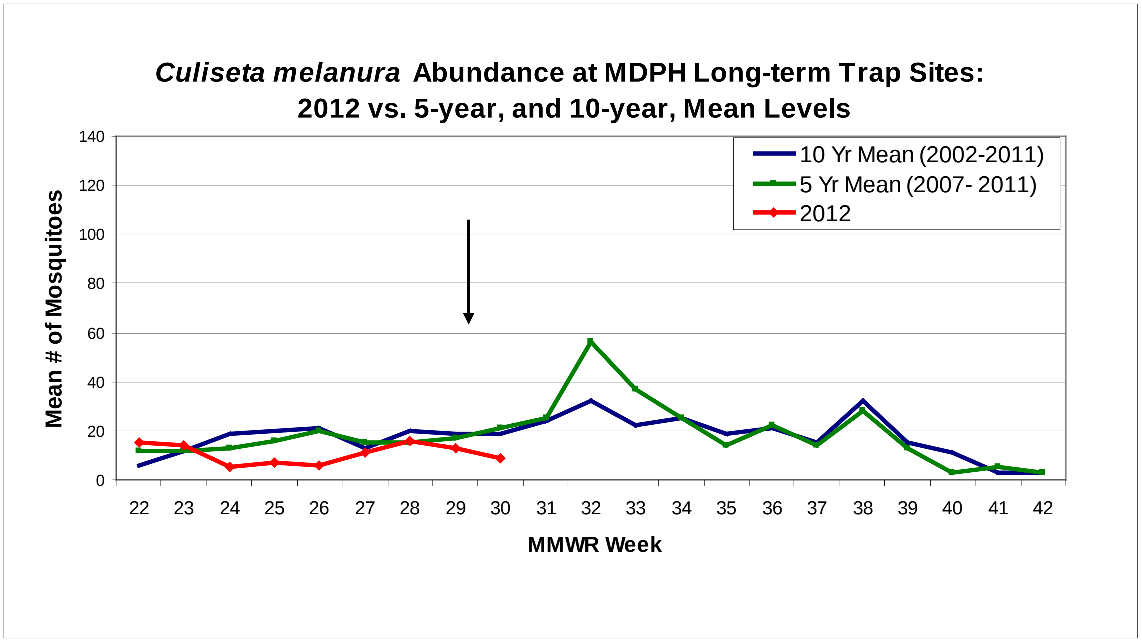
On July 30, 2012, DPH health officials announced (**See Appendix 5**) that there was a significant decline in mosquito population (**see table 1 below**) following aerial spraying in Southeastern Massachusetts with an overall reduction of sixty percent (60%).

Table 1: Reductions reported: Aerial Adulticide Application July 20-22, 2012

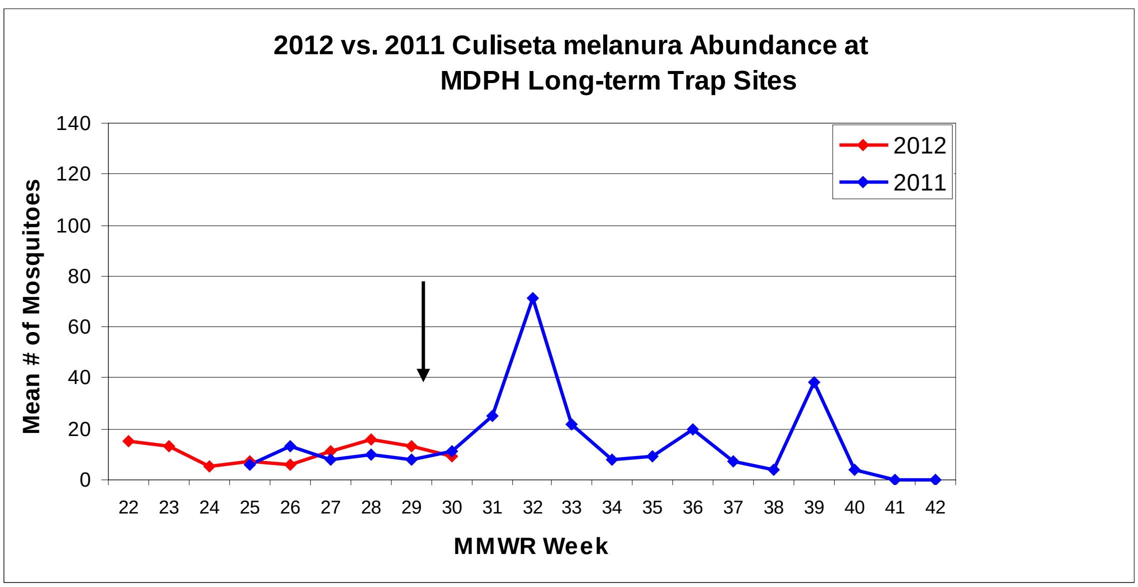
Species	Bristol MCP	Plymouth MCP 7/20 spray	Plymouth MCP 7/21 spray	State Laboratory Institute (SLI), Bristol and Plymouth County (Summary for all data)
Total	**58%**	**81%**	**no control**	**42%**
Cs. melanura	71%	36%	no control	80%
Cq. perturbans	81%	81%	14%	41%
Oc. canadensis	no control	84%	no control	17%
Ae. vexans	no control		no control	
Other				9%

Two kinds of mosquitoes in particular were the focus of this intevention. As observed in previous aerial interventions, the aggressive mammal-feeding *Coquillettidia perturbans* mosquito was the most predominant epizootic species in the EEEv cycle and likely posed the greatest immediate risk to the public. The other targeted mosquito was *Culiseta melanura*, a mainly bird-biting mosquito that serves as the enzootic vector of EEEv. This mosquito is responsible for cycling the virus near particular wetland areas. During 2012, this species had an elevated and sustained infection rate throughout the mosquito season. This mosquito occurs mainly in and near dense wooded cedar wetlands. The density of the tree canopy, however, restricts the deposition of spray droplets and may thereby reduce expected efficacy of an intervention there. Although the aerial adulticide intevention resulted in reducing the abundance of this mosquito and infection rates of this mosquito during the week following the spray (**see MA DPH graphs below**), the sustained infection rate continue to be of concern to MA DPH.

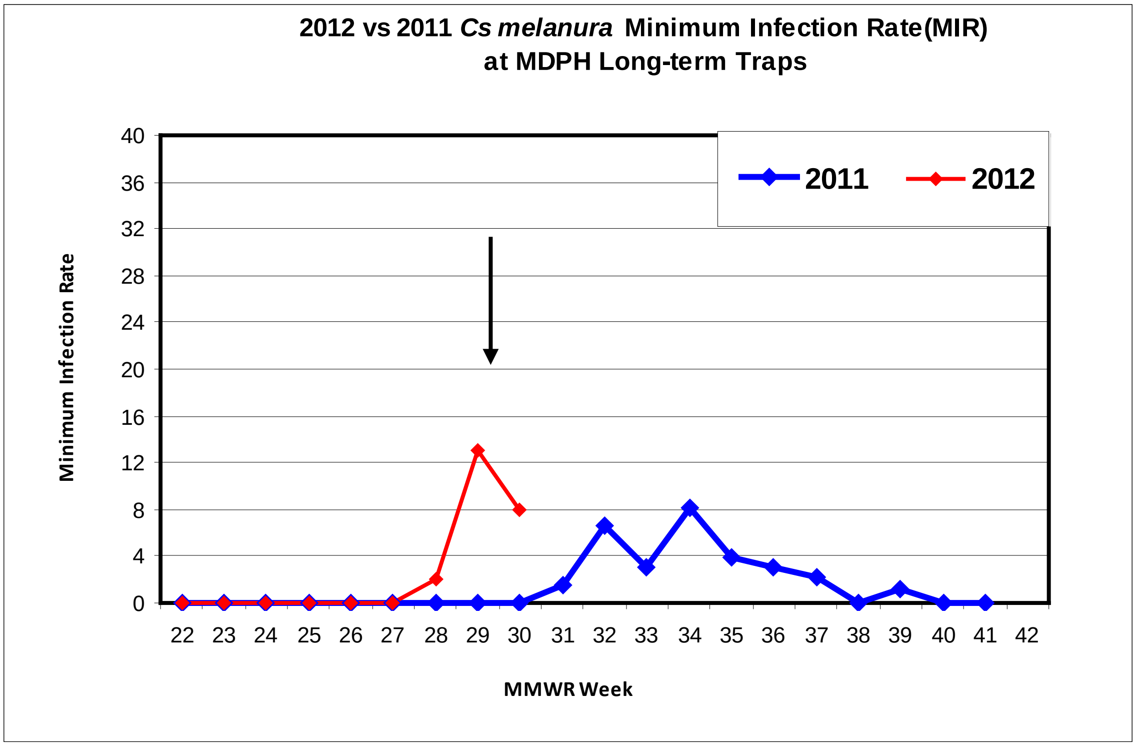
MA DPH GRAPH



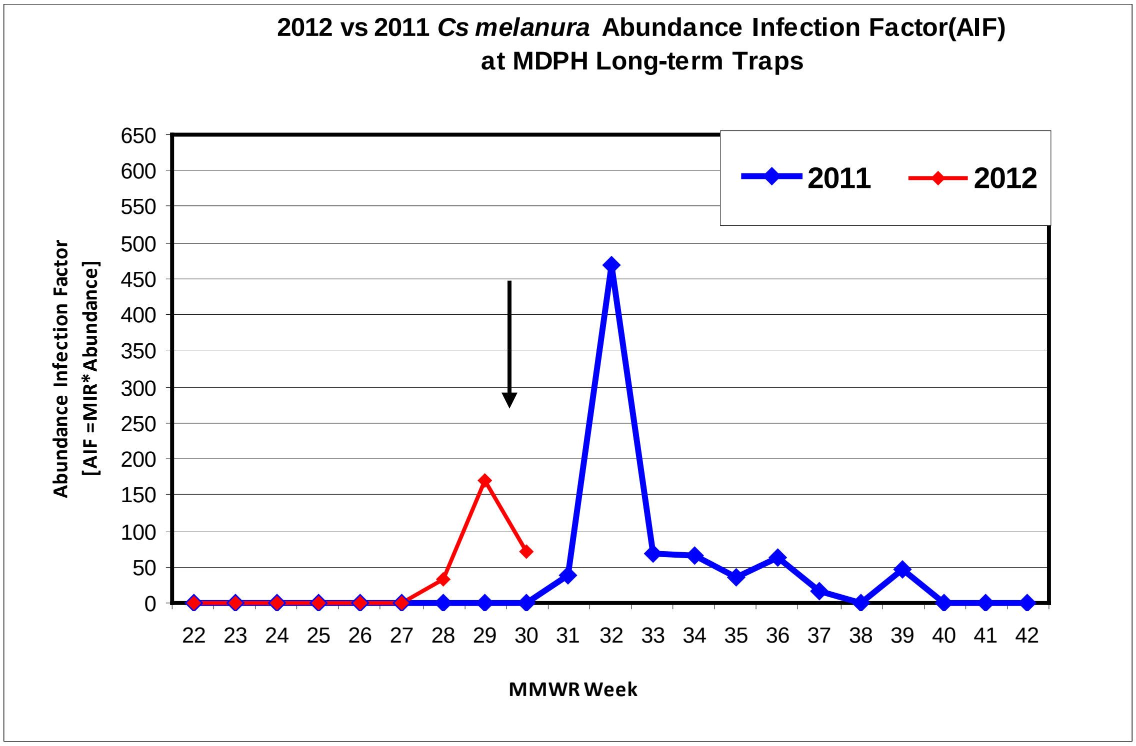
MA DPH GRAPH



MA DPH GRAPH



MA DPH GRAPH



Conclusions regarding the intevention efficacy are generally based upon relative reductions to the abundance of targeted mosquitoes as well as the prevalence of infection amongst those vectors. The extent of any reduction varies due to confounding variables such as location of traps, weather conditions, and operational parameters of the aerial application itself.

Bristol County reported significant variation in abundance reduction depending on trap location **(See Table 2)**. As expected, efficacy was greatest in certain areas without a dense tree canopy. The Easton trap was located in an open field adjacent to a cattail swamp revealed dramatic reductions in the population of targeted mosquitoes. In contrast, no such reductions were noted at heavily wooded Raynham site (close to DPH's Easton site) for *Coquillettidia perturbans*, *Culiseta melanura*, or *Aedes vexans*, though reductions of *Ochleratatus canadensis* were apparent. The Bristol County Mosquito Control Project entomologist contends that weather conditions diminished efficacy during Round 1 application and subsequent collections. Because of the variability between the trap locations the overall calculation of population reduction does not reflect the extent of the actual site-specific reductions realized.

Table 2-*Bristol County Mosquito Control Project*

Trapping results pre and post adulticide for Bristol

Species	Total outside spray area		Total inside spray area	
	Pre	**Post**	**Pre**	**Post**
Cq. perturbans	21.6	5.6	573.8	29
Cs. melanura	39.3	15	17.7	2
Ae. vexans	19.3	6	16.5	8.75
Oc. canadensis	69.6	31	144.5	76
Overall	**178**	**64**	**834.7**	**122.7**

There were four traps in the treatment area and three outside.

Overall: 58%

Cq. perturbans: 81%
Cs. melanura: 71%
Ae. vexans: ND
Oc. canadensis: ND

The Plymouth County Mosquito Control Project entomologist reported good results in the Bridgewater area that was treated on the first night. Results from their 3 trap sites treated on the 3rd, however, did not confirm adequate efficacy. The entomologist reported that only the Hanson trap revealed any control, and this was limited to 34% (**See Table 3 below**)

Table 3-*Plymouth County Mosquito Control*

Percent Control

	Treatment night of 20 July 2012	Treatment night of 22 July 2012
Total	81.1%	No control
Cs. melanura	36%	14%
Cq. perturbans	81%	No control
Oc. canadensis	84%	No control

Note: The extent of the intervention efficacy against Culiseta melanura and Coquillettidia perturbans was confounded by weather conditions. Result differences between the three surveillance specialists may be a function of where each surveillance trap is located. As noted by the entomologists, standard surveillance traps placed in more heavily forested areas with dense canopies tend to limit penetration by the pesticide aerosol. Furthermore, continued emergence of young adult mosquitoes of all species or immigration of adults to a treated area can encumber the interpretation of efficacy assessments that only rely solely upon abundance data. Ultimately, it is clear that Bristol, Plymouth, and DPH all used the same approach and formula to calculate efficacy. Even with variability in some reductions, all of the results reveal that the aerial spray operation resulted in a very positive conclusion in that the absolute abundance of mosquitoes overall were significantly reduced abundance of mosquitoes in the treated spray zone, and reductions were particularly noted for Coquillettidia perturbans the targeted mammal biter species.

Age Structure of the Mosquito Population-**Round 1**

For the first time, an assessment of mosquito age structure was conducted as a further measure of the efficacy of the aerial adulticide intervention. Calculating the age structure can provide yet another means of evaluating the efficacy beyond the traditional measures of mosquito abundance and infection rate. Although an aerial intervention is expected to kill a measurable proportion of the mosquitoes on the wing at the time of the application, certain mosquito populations are expected to rebound within days as a result of continued emergence of mosquitoes from the treated sites as well as from the immigration of mosquitoes that may invade from non-treated sites. One important goal of the aerial adulticide treatment is to quickly reduce the abundance of older (potentially infectious) mosquitoes. A reduction in the population of infectious mosquitoes should translate to an immediate (but possibly transient) reduction in the risk of EEEv transmission to people and domestic animals. The age assessment study was designed to measure the duration of risk reduction as a function of the aerial adulticide intervention.

Mosquitoes were sampled at diverse sites within and beyond the aerial intervention areas and prior to and at intervals after the intervention. Samples of mosquitoes were dissected, and their ovaries examined microscopically, to judge their parity; that is whether each had previously produced a batch of eggs. Evidence of egg production confirms prior blood feeding and indicates an older (and potentially infectious) mosquito. Little or no change in parity was expected immediately post intervention, as the insecticide should affect old (parous) and young (nulliparous) mosquitoes similarly. Continued emergence of young mosquitoes would dilute the overall population and skew the age structure to a measurable extent. The extent and dynamics of that change can provide evidence useful in assessing the overall efficacy of the intervention as well as the duration of protection that may be realized.

Results of the mosquito age profiling revealed a confused view as to the extent of the efficacy realized by the aerial adulticide intervention. The data confirmed a dramatic reduction in the proportion of older mosquitoes several days after the intervention, but this was apparent on treated as well as non-treated sites. Most notably, the age grading results depicted a continuing emergence of enzootic and epizootic (bridge vectors) throughout the area. These findings are important, as they highlight the continued vigilance needed even where and when an intervention is judged to be significantly successful. In particular, such age assessment evaluations can help inform decision makers as to the timing of any supplemental interventions that may be justified. The scientists/entomologists performing this work concluded that a much larger age-grading effort, sustained through the mosquito season - and for additional sites, would have been necessary to better determine the impact of the aerial adulticide intervention.

Aerial Mosquito Control Spray Operation Conclusion-**July 20-23, 2012 (Round 1)**

The round 1 aerial mosquito control spray operation conducted and completed during July 20-23, 2012 achieved positive results despite less than optimal weather conditions, these being the immediate and an overall reduction of the mosquito population, and the lessening of transmission risk of EEEv (**see Appendix 6**).

Description of Aerial Mosquito Control Spray Operation-**August 13-14, 2012 (Round 2)**

Although the Round 1 aerial operation response was prompt and timely, and afforded desired results, the protection afforded was transient. EEEv infection continued to be detected in pools of mosquitoes, and risk of EEEv transmission continued to be of significant concern in bird and mammal biting mosquitoes. Ongoing favorable weather conditions during the summer of 2012 supported the emergence of mosquitoes that were subsequently becoming infected. The overall warmth and periodic rain events promoted and maintained longevity of many mammal biting mosquitoes. As a result, another round of spraying (**Round 2**) was deemed justified. The MA DPH raised the risk level to critical for several of the original 21 communities that had previously been categorized as high risk.

Consequently, MA DPH and MDAR announced a second, targeted aerial spray of mosquitoes in six communities – Bridgewater, Easton, Norton, Raynham, Taunton and West Bridgewater – because of the continued EEEv threat. (**See Appendix 7**).

As done in round 1, MDAR Commissioner Watson authorized the deployment and mobilization of aircraft and pesticide product to MA to spray the evening of August 13th weather dependent. Because of the smaller area to be treated focused on 6 towns (**See Appendix 8**), the objective was to accomplish the mission in one evening with 2 aircraft with spray beginning at dusk, weather dependent.

Prior to the August 13th, 2nd round operation, MDAR/SRMCB requested that the two-step calibration and characterization procedure be conducted to ensure that the desired aerial spray application parameters (such as amount of active ingredient (a.i.) dispensed per acre and the optimum droplet size) were documented to insure maximum efficacy and to be consistent with the product label. As with the earlier application, this procedure was waived so as not to unnecessarily delay the intevention. Although the annual calibration and characterization would satisfy operational parameters and not delay the intervention, the Board and MDAR requested that the testing be done before the 2nd round of spraying. The Board wanted to be sure that every effort was taken to facilitate a successful treatment during round 2 and to document that the planes application equipment was optimal as documented by the annual testing documentation previously submitted to the Board.

The testing was conducted by experienced technical personnel of Clarke Mosquito Control, Dynamic Aviation, representatives from MDAR, as well as those from various mosquito control projects (MCPs)/districts including the Northeastern Massachusetts Mosquito and Wetlands Management District (NMMWMD). In particular, the personnel involved included Fran Krenick, (Good Laboratory Practices Systems Manager, Clarke Mosquito Control), Clarke E. Wood, (Vice President, Clarke Mosquito Control), Wally Terrill (President of the Northeastern Mosquito Control Association (NMCA), Mark S. Buffone, MDAR/SRMCB and Jack Card (Operations Manager (NMMWMD), Robyn Januszewski (Biologist, NMMWMD), Bill Mehaffey, (NMMWMD) and Steve Burns, acting Superintendent of the Bristol County Mosquito Control Project

Calibration and characterization testing occurred at the Plymouth Municipal Airport on the afternoon and early evening of Monday, August 13th and both aircraft met operational specifications (**See Appendix 9**).

Once the testing was completed, two (2)-twin turbine Beechcraft King Air (Model A90 numbered N72J and N79W) commenced the aerial mosquito control operation on August 13th with spray on beginning at 8:05 PM and 7:55 PM, respectively. The operation ended with spray off at 12:50 AM for aircraft N72J and aircraft N79W at 12:54 AM. The round 2 aerial mosquito control operation covered a total area encompassing 103,311.3 acres above defined portions of Bristol and Plymouth County as calculated by the navigational flight system of the aircraft. The treated area included all or parts of the following 6 municipalities: *Bridgewater, Easton, Norton, Raynham, Taunton, and West Bridgewater*

The aircraft applied 496.72 gallons of Anvil 10 +10 ULV (EPA # 1021-1688-8329), at a rate of 0.62 oz/acre (the maximum allowable amount permitted by the pesticide product label), and at a height of 300 feet above the ground. The aircraft average airspeed ranged from ~ 168 - 172.7 mph, and dispensed an aerosol swath width of 1,000 feet for both aircraft. In addition to the actual amount of product applied to reduce the mosquito population, 10 additional gallons of Anvil 10 +10 ULV were employed for droplet size testing of the 2 aircraft prior to the operation. Thus, the total amount of product used for the entire round 2 aerial mosquito control spray operation was 506.7 gallons. Anvil 10+10 ULV contains the active ingredients d-phenothrin (sumithrin) and the synergist piperonyl butoxide (PBO). This particular product and formulation was the product of choice and selected based on prior interagency assessment.

Weather Conditions

Reported weather conditions during August 13, 2012 aerial application ranged from optimal to acceptable. All weather parameters remained within ranges compatible with the pesticide product label. Weather conditions at the onset of the operation were fully acceptable with temperatures in the low seventies and light winds Temperatures held throughout the evening ranging from a high of 75 and low of 66.9 degrees but wind speeds began to diminish becoming lighter with almost calm conditions.

Results of Aerial Mosquito Control Spray Operation **–Round 2**

DPH health officials announced on August 22, 2012 (**See Appendix 10)** that the overall mosquito population following aerial spraying in Southeastern Massachusetts was essentially halved, with greater efficacy revealed for the species of greatest concern (**See Table 4 below**).

TABLE 4: Summary of Efficacy Analysis: Aerial Adulticide Application August 13, 2012 for Key Species of Concern

	MDPH Analysis for State Laboratory Institute (SLI), Bristol and Plymouth County (Summary for all data)	**Plymouth MCP: Reported Reductions**	**Bristol MCP: Reported Reductions**
Species of Concern			
Overall	48%	56%	63%
Cs melanura	70%	74%	82%
Cq perturbans	64%	47%	79%
Oc canadensis	no control	no control	no control
Ae vexans	14%	no control	73%

Entomologists from the Bristol and Plymouth County Mosquito Control Projects reported substantial decreases in mosquito abundance in the areas that were treated. Bristol County reported overall reductions for all species at 63% but dramatic reductions for target species. In particular, Bristol County noted that the aerial spraying reduced the target species (mammal biting species) *Coquillettidia perturbans* by 79% and *Culiseta melanura* by 82% (**See Table 5 below)**.

Table 5-Trapping results pre and post adulticide for Bristol 8/13/12

Species	Total outside spray area (# per trap)		Total inside spray area (# per trap)	
	Pre	**Post**	**Pre**	**Post**
Cq. perturbans	4.25	5.25	49.25	13
Cs. melanura	54.5	75.5	95.25	24.25
Ae. vexans	3	4	24.75	8.75
Oc. canadensis	1.75	1.25	10	11
Culex	2	2	149.25	75.25
Overall	**75.75**	**95**	**336.75**	**154**

There were four traps in the treatment area and four outside.

Overall: 63%

Cq. perturbans: 78.8%
Cs. melanura: 81.8%
Ae. vexans: 73%
Oc. canadensis: ND
Culex: 50%

Plymouth County documented an overall reduction of (56%) of all mosquitoes with somewhat less impressive reductions (47%) for *Coquillettidia perturbans*. (**See Table 6 below**)

Table 6-*Plymouth County Mosquito Control*

Species	**% Control**
Overall	55.5
Cs. melanura	73.5
Cq. perturbans	46.5
Oc. canadensis	No control
Ae. vexans	No control
Cx. Salinarius	62

Age Structure of the Mosquito Population-**Round 2**

Although the age analysis described for Round 1 also pertains to Round 2 spraying, certain samples were of insufficient size for suitable analysis. As a result, the final analysis of that data is still pending.

Aerial Mosquito Control Spray Operation Conclusion-**August 13, 2012 (Round 2)**

The round 2 aerial mosquito control spray operation conducted on August 13th, 2012 also achieved positive results, in further reducing mosquito populations, and particularly to that of the enzootic vector, *Culiseta melanura* (**see Appendix 11)**.

Environmental Monitoring

Environmental monitoring is useful to detect the extent of pesticide deposition to soil, water and other receptors, and for potential collateral effects to non-targets organisms. Bees, drinking water supplies, cranberries, and pesticide illness surveillance have been standard for monitoring potential impacts during prior mosquito-borne public health emergencies. Since no acute effect to aquatic macroinvertebrate communities were detected from any of the past three aerial spray operations (in 1990, 2006, and 2010), MassDEP decided not to monitor in aquatic habitats related to aerial spray operations targeting EEEv vectors. Furthermore, the NHESP representative confirmed that the current version of the Board's operational plan, specifically, Appendix 9: *Monitoring the effects of aerial applications of adulticide insecticides on state listed invertebrates* was adequate as there was a high probability that the NHESP would determine that listed species are not at significant risk and monitoring would not be required. Accordingly, non-target species/rare or state listed rare species were not monitored and/or evaluated as part of the 2012 the aerial mosquito control spray operations. State agencies did, however, coordinate GIS mapping efforts to ensure that several areas of concern for rare and endangered species were excluded from treatment

Biomonitoring of Macroinvertebrates- Department of Environmental Protection

As previously noted the MassDEP did not conduct biological monitoring in aquatic habitats related to aerial spray operations targeting EEEv vectors (mosquitoes). Acute impacts to the aquatic macroinvertebrate communities were not detected in conjunction with any of the past three aerial spray operations in 1990, 2006, and 2010.

Water Supplies-MA Department of Environmental Protection

Wide area aerial spraying with Anvil 10+10 (sumithrin and PBO) did not result in any significant introduction of sumithrin or PBO into surface waters in the spray areas. No sumithrin was detected approximately 12 hours after spraying, nor for several days thereafter. PBO was detected in some locations at low sub ug/L (ppb) concentrations which were well below acute drinking water or aquatic life exposure criteria. These results are consistent with those of previous EEE spraying operations in Massachusetts during 2006 and 2010. The final report from DEP is attached to this report. (**See Appendix 12**)

Bees-MA Department of Agricultural Resources

Round 1- Aerial Mosquito Spray – July 20-23, 2012

When aerial adulticiding is necessary in response to threat of EEEV transmission risk, and in accordance with the Board's Operational Response Plan, MDAR performs environmental monitoring of a random selection of honey bee hives in the proximity of proposed application areas to evaluate colony health before and after the spraying of Anvil 10+10 ULV application.

The Massachusetts Department of Agricultural Resources Apiary Inspection Program made selective inspections and surveys of 57 bee colonies in the aerial mosquito spray area within Bristol and Plymouth Counties in 2012. The colonies were inspected to assess colony strength and health, and flight strength of field bees was observed on July 20 and 21, 2012 prior to aerial spraying. Bed sheets were also placed in front of the hives so that any dead bees could be readily detected after the aerial mosquito spray operation. There were 17 random beekeepers selected for the survey.

The 3 day post spraying inspection on July 24, 2012 found from 1 to 7 dead bees on the sheets, a finding that is normal for honeybee deaths in the absence of pesticide exposure. The hives were equal in strength to what was found in the pre-spray inspection. Therefore, the EEEv resulted in no observable health burden to the bees.

The field force coming in and out of the hives was equal to the field force prior to spraying. The 7 day post spray inspections were conducted on July 26, 2012. There were few additional dead bees observed. The Parker Apiary in Carver had the greatest bee death with just 12 dead bees observed after 1 week but the colonies remained equal in strength to the pre-spray levels. The dead bee numbers ranged from 3 – 15, an amount that is considered within a normal attrition rate. ***After analyzing the bee colonies throughout the week, it was concluded that there was no impact from the Anvil 10+10® that was sprayed***. Many beekeepers covered the entrances to their hives with sheets for added protection. The spraying was well publicized and communicated to the county bee organizations, a step that helped to alleviate concerns.

The bee inspections and monitoring of the bee colonies by the Apiary Inspectors also helped to allay beekeeper's concern regarding the aerial intevention for EEEv. In addition to those surveyed, the Apiary Inspectors called an additional 12 beekeepers to monitor their hives. All returned calls reported no impact to their colonies from spraying. Colonies inspected were all healthy.

Varroa mites were found visually observed in most colonies inspected. All beekeepers cooperated fully with the Apiary Inspectors. A list of the cooperating beekeepers, the number of hives and their locations is available upon request.

Round 2 -Aerial Mosquito Spray – August 13, 2012

The Apiary Inspector was notified that that there would be an aerial application of insecticide to control mosquitoes and that the town of Norton, Easton, Bridgewater, West Bridgewater, Taunton and Raynham would be sprayed on August 13, 2012.

A survey was conducted of 57 colonies at 16 apiaries within the towns that were scheduled to be sprayed. The survey included an assessment of colony strength with a large sheet placed in front of the hive on August 12, and on August 13, 2012. The Apiary Inspector evaluated the colonies of at a minimum, two apiaries in each of the towns being sprayed and 3 – 4 apiaries in several of the towns not sprayed. All the colonies surveyed were determined to be strong colonies.

The 1 – 3 day post spray evaluation was conducted on August 15, 2012. Any dead bee were collected on the sheets MDAR inspectors found 3 – 15 bees per colony on the sheets which is considered a normal attrition rate for a colony. The colonies remained strong and there was no observed affect on the colonies from the aerial mosquito spray on the 3 day post spray survey.

There was a 7 day post spray survey conducted on August 19, 2012 and no additional dead bees were found. It was therefore concluded that the aerial mosquito spray had no effect on bee colonies in the towns that were sprayed for mosquitoes.

A total of 16 beekeepers were surveyed in addition to the towns that the colonies were located. Also, calls were received from 5 other beekeepers reporting that they had no affect on their colonies.

All beekeepers that were contacted said that they were well informed and the spray operation through the press and from their county beekeepers association, and took precautionary measures by hanging sheets over their hives.

Cranberries-Department of Public Health

Results from the testing of cranberries for sumithrin, an active ingredient of the pesticide used for aerial application in southeastern Massachusetts, showed no detectable levels of this compound in any cranberry sample, either pre- or post-application *for both spray events* (Not Detected, ND = 2 ppb). (**See Appendix 13**)

Non-Target Species- MA Division of Fisheries and Wildlife, Natural Heritage & Endangered Species Program

NHESP determined that listed species were not at significant risk in the spray zones and monitoring was not required. As a result, non-target species/rare or state listed rare species were not monitored and/or evaluated by different state agencies during both spray operations.

Division of Crop and Pest Services-Pesticide Enforcement

Pesticide Use Observation 2012

As part of an effort to ensure that the aerial mosquito control operation conducted in southeastern Massachusetts was in compliance with the State Pesticide Control Act and regulations pertaining to pesticide use in Massachusetts, senior pesticide enforcement personnel from the Department of Agricultural Resources, Division of Crop and Pest Services were present during the mixing/loading activities prior to operation for round 1.

On July 20, 2012, Michael McClean, Senior Pesticide Inspector was on site at the Plymouth County Municipal Airport to conduct a routine *Use Observation*. Mr. McClean presented his credentials and a Notice of Inspection to Thomas White IV, pesticide license number 40249 Category 34 (Aerial). Three airplanes were used. The other pilots were Christopher Simpson pesticide license number 40133 Category 34 (Aerial) and William Ross license number 39367 Category 34 (Aerial). In Mr. McClean report, four (4) exhibits are described but not included this report. These documents are available upon request from MDAR Pesticide Enforcement Personnel.

- Exhibit A is a two page document containing copies of the pilots' Pesticide Commercial Certifications and Clark E .Wood's Pesticide Applicator License.
- Exhibit B is the Anvil 10 + 10 ULV product label.
- Exhibit C is a map of the Massachusetts Aerial Spray Region 2012 dated 7/20/12.
- Exhibit D is a three page document containing the Operating Certificate, Certificate of Insurance and Certificate of Good Standing and/or Tax Compliance.

The operation was conducted during a period of three consecutive nights. Mr. McClean was not present for the other two nights. However, Mark Buffone, of MDAR was present on site all three nights of the mission.

A sample was collected from airplane N79W. MWM 120720-1 MWM is 1-500 ml glass amber bottle filled with tank mix. Tank mix consists of Anvil 10 + 10 ULV, EPA Registration number 1021-1688-8329. Each plane was loaded by Clark E Wood from Clarke Mosquito Control Products, Inc. Clark E. Wood Pesticide Commercial Applicators License Number is 34611.

A total of 22- 55 gallon drums from production lot 70-18712-A 3 The pesticide used was Anvil 10 + 10 ULV and was load directly from the 55 gallon drums into the holding tanks of the planes as is (not diluted or mix with any other substance/liquid).

Three (3) planes were used during this operation. Each plane flew at a speed of 150 knots at an altitude of 300 feet. Each plane holds 2-100 gallon poly tanks and each load of 200 gallons covered approximately 41,000 acres per plane per 200 gallons. Each plane applied two loads of Anvil 10 + 10 ULV. The total acres covered during this first night operation were approximately 225,847 acres. The spray swath width is 1000 feet and the application rate is 0.62 oz/acre. The planes were equipped with an Ag Nav Unit with manual control override. The plane's flight pattern was a North to South starting at the furthest West point of the treatment zone and move East.

Spraying began at dusk (approx 8:15 pm) and was complete at approximated 2 am on 7/21/12 for the first night of the operation.

MDAR senior enforcement personnel were satisfied with their inspection noting no violations during their inspection.

<u>GIS: 2012 Mapping, Assessment, and Analysis</u>

Geographic Mapping Information, Communications, and Coordination

GIS (Geographic Information Systems) increasingly are employed in planning and tracking anti-mosquito interventions. Planning, operations, mapping excluded areas, assessment of results, monitoring, and dissemination and distribution of information to the public all rely on accurate and timely GIS data.

One multi-agency response protocol stipulates that the Massachusetts Department of Agricultural Resources (MDAR) shall coordinate the compilation of mosquito treatment sensitive areas GIS data layers (no-spray zones).

Mosquito treatment sensitive areas data layers include:

- Certified organic farms
- Priority habitats for spray sensitive state-listed rare species
- Surface Water Supply resource areas
- Commercial Fish hatcheries/aquaculture

The data layers are developed by MDAR, Department of Fish and Wildlife (DFW) & Natural Heritage & Endangered Species Program (NHESP), and Department of Environmental Protection (DEP) within the designated MA Department of Public Health (DPH) delineated spray area into a final GIS data layer.

For the 2012 aerial spray operations occurring in July and August, each Department involved in the operation was made aware that spraying could occur up to 500 feet (one half the width of the spray swath) inside the exclusion areas, and the borders of the exclusion areas were created with this in mind. MDAR, for instance, buffered organic farms by 535 feet. The aerosol applied by the aircraft is designed to treat the airspace. The droplets are intended to float in the air column. Most would evaporate before impacting the ground. Hence, relatively little insecticide or carrier should be expected to reach crops or other terrestrial and aquatic environments.

The exchange and vetting of map layers between the various state agencies went relatively smoothly. All Departments posted their layers on the SharePoint folder set up by the Information Technology (IT) staff. DPH posted the overall spray area; NHESP posted critical endangered species habitat; DEP posted public water supplies; and MDAR posted a layer of organic farms and fresh water aquaculture. The spray area boundary was constructed to be about 1000 feet inside town boundaries so that no adjacent towns would receive spray, thus simplifying notifications to the public. Coastal exclusion areas were created to protect aquaculture and marshes, and a non-registered organic farm was added. Dynamic Aviation was very flexible and professional and accommodated several last minute change requests.

GIS Mapping and Future Aerial Operations

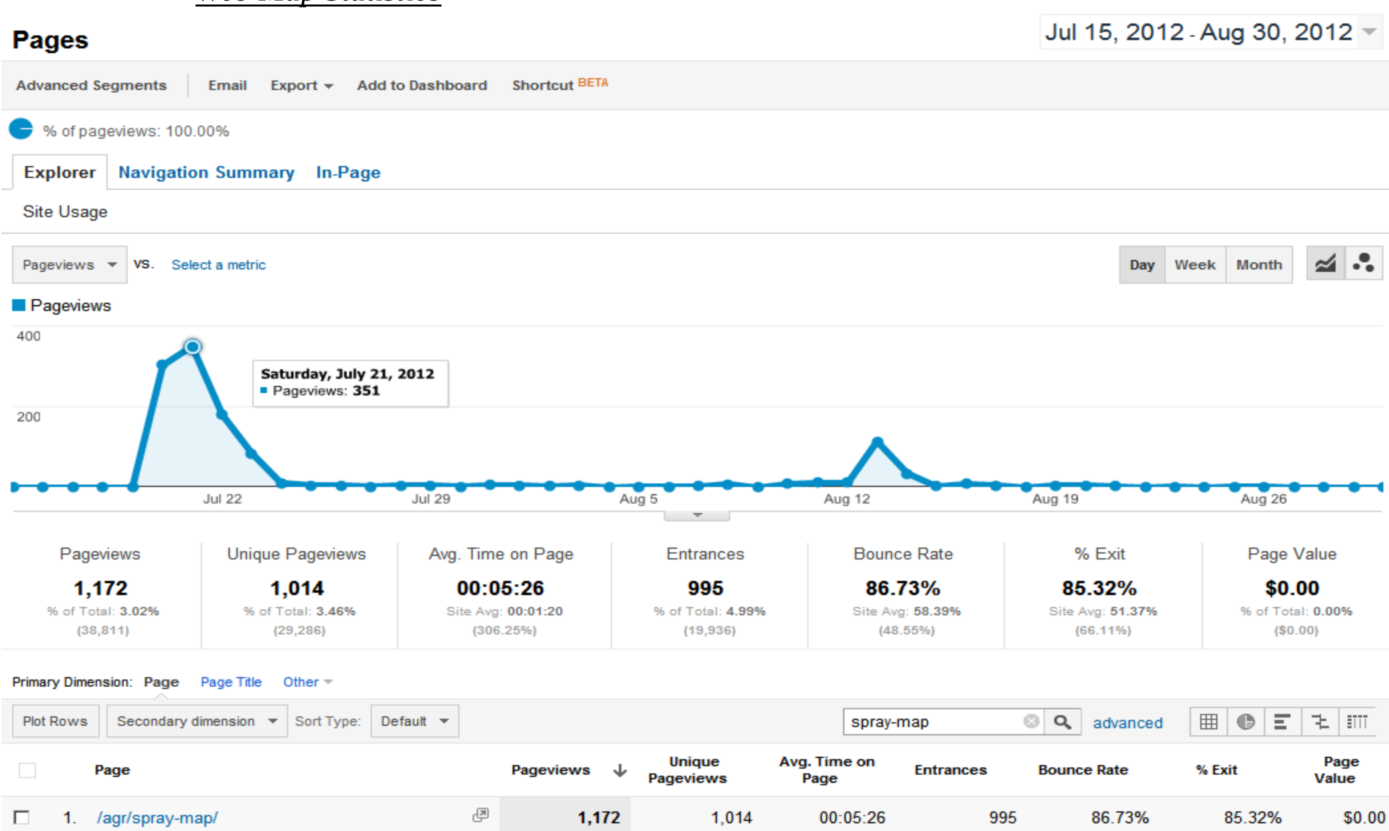
In light of an extremely high frequency and intensity of Eastern Equine Encephalitis virus (EEEv) mosquito pools and human and animal cases throughout the 2012 mosquito season – reports which also came from non-traditional geographical areas in the state -- MDAR's post aerial spray assessment included discussions on ways to further improve the dissemination of information to sister agencies and to its agricultural constituency.

Topics of discussion included spray-on / spray-off areas and how best to articulate defined "buffer zones". MDAR staff also initiated a post-aerial spray conference call with Dynamic Aviation to confirm that all planes are equipped with guidance systems with automatic on/off systems that are configured to shut off over mapped exemption areas. A relatively new software technology called "FlightMaster" is anticipated to be utilized as a further tool to document droplet transport and deposition as operationally appropriate. MDAR and Dynamic Aviation agreed to develop information that would better define the calculated buffer zones that are included into the GIS layers to ensure that excluded areas are not encroached upon. Finally, there was a consensus that the Commonwealth should build into its GIS mapping products appropriate "buffer zones" and to have testing of droplet deposition at both non-target and control sites to document results.

Mapping Products

After each night's spray operation, MDAR created static maps showing the planned spray area and the area actually sprayed. A web map (http://www.mass.gov/agr/spray-map/) was created to allow the public to input their address and see whether they were in a planned spray zone or had already been sprayed. Web map contents were updated regularly to reflect the changing situation. This map proved to be a better communication tool than any used in past years. Between July 15 and August 30, there were 1,172 page views of the map, with a high of 351 on Saturday, July 21, and a smaller spike on August 13. Presumably this information source helped reduce calls to hotlines. Statistics for use of the web map shows 1,172 page views between July 15 and August 30, with most views occurring around the time of the spray operations (see Table below).

Web Map Statistics



NOI: 2012 Notice of Intent for NPDES **Round 1 and 2**

In accordance with National Pollutant Discharge Elimination System (NPDES) permit requirement pursuant to the Clean Water Act (CWA), MDAR/SRMCB would need to file a "Notice of Intent" to comply with current federal requirements. EPA issued its final Pesticide General Permit (PGP) in October 2011 after the U.S. Court of Appeals for the 6th Circuit ruled in 2009 that pesticide applications on or near waters of the United States require permit coverage under the Clean Water Act (CWA)

However, since the DPH Commissioner signed the certificate indicating a public health emergency, the state did not have to apply for a National Pollutant Discharge Elimination System (NPDES) permit from the EPA "prior or before" the spraying took place. This type of permit is a recent EPA requirement that was not in place in 2010, when Massachusetts last declared a public health emergency for aerial spraying of mosquitoes infected with EEEv. The decision to authorize aerial spraying was made within days, based on a public health emergency due to EEEv risk. The first EEEv-positive pools of the season were collected July 9 in the Town of Easton and confirmed on July 11. An inter-agency meeting involving MA DPH and MDARs was held July 16 to scrutinize the need for, and value of, aerial spraying. A decision was made at that time to wait for more data. On July 17, following more EEE-positive results in southeastern Massachusetts; Commissioner Auerbach signed the Certification of a Public Health Hazard, which authorized spraying. The operation commenced on the evening of July 20th.

The Department of Agricultural Resources/ State Reclamation and Mosquito Control Board filed a "Notice of Intent" for a NPDES permit on July 31, 2012 after the emergency aerial spraying occurred.

The NOI that the State submitted for the Pesticides GP is for the original aerial application, but it will also cover any other aerial applications for the duration of this permit (October 2016) provided that such applications occur within the same 21 communities identified in the map. The original NOI to comply with the NPDES requirement was submitted on 7/31/12 and was to be active, or by 8/10/12. My understanding is that the next scheduled application will be in 6 of the original 21 communities and will use the same pesticide; therefore this permit will cover the State. If a future aerial application involved any other communities or pesticides not identified in the original NOI, the State would need to edit its NOI to update such information

My understanding is that MDAR and the State Reclamation and Mosquito Control Board will not need to amend the original NOI submitted or be required to submit anything after the intervention planned for August 13th since;

1. *The current action for a second round of aerial spraying covers a smaller area of the original area sprayed in July but will not cover any new municipalities,*
2. *The same chemical will be used (Anvil 10+10 ULV),*
3. *The same contractors (both Dynamic Aviation and Clarke Mosquito Control Products) will be used,*
4. *The original certification by the Commissioner of Public Health remains in effect until September 30, 2012.*

If a future aerial application needs to take place in any other community or if pesticides not identified in the original NOI are used, MDAR/SRMCB would need to edit its NOI to update such information.

Total Costs of 2012 Aerial Mosquito Control Spray Operation in SE Massachusetts **(Round 1 and 2)**

The entire cost of the aerial mosquito control spray operation in Bristol and Plymouth County totaled $1,176,788 dollars. The following is a breakdown:

Aerial Service	$443,423
Product	$485,738
Aging Study	$ 12,000
Ground ULV Responses	
Bristol County	$ 58,154.10
Plymouth County	$ 138,605.20
MDAR/Board Miscellaneous Costs (Staff Time, Mileage, Hotel, Travel, Mapping)	$ 38,868
Total	**$ 1,176,788 dollars**

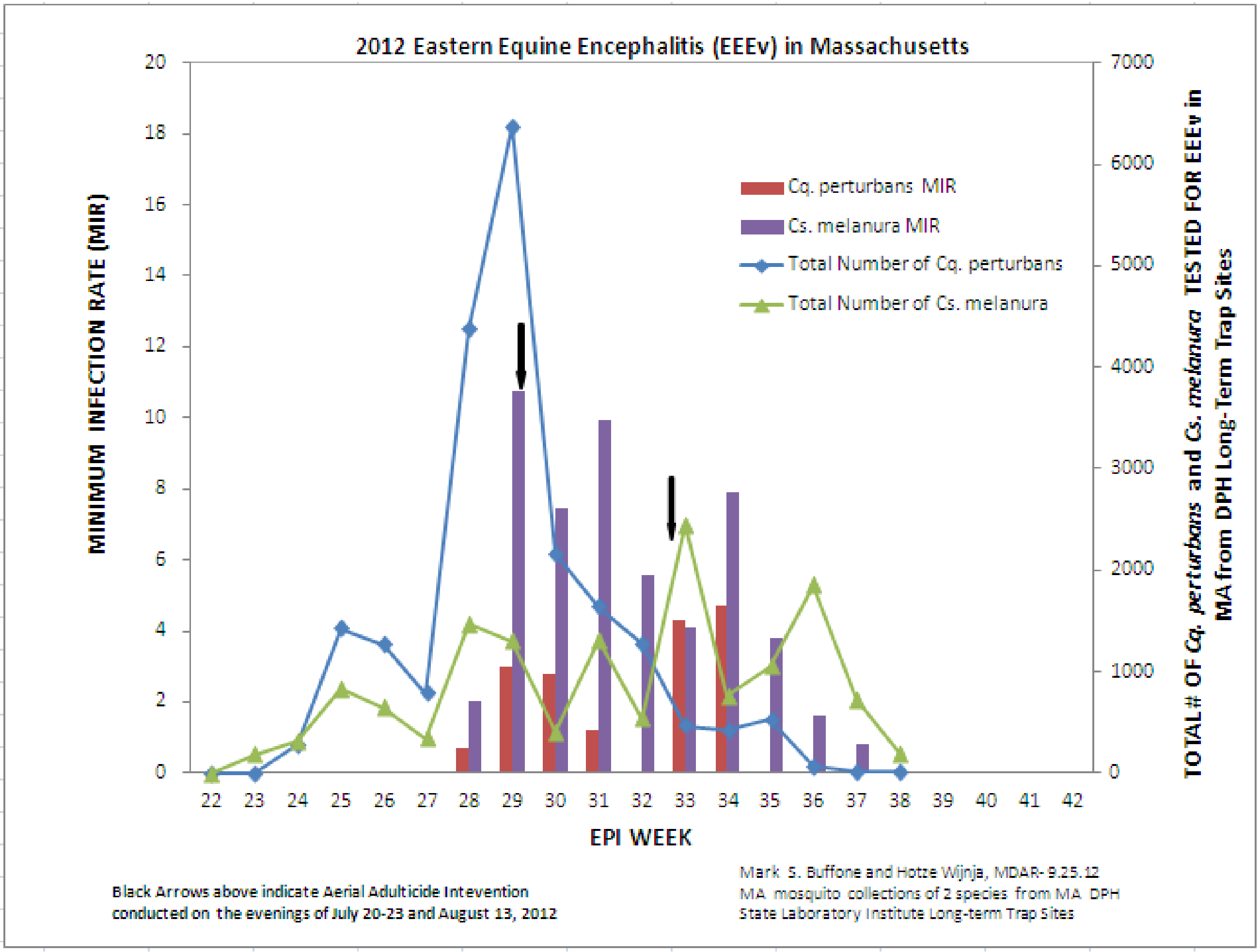
Conclusion of 2012 Aerial Mosquito Control Spray Operation

The 2 rounds of aerial mosquito control spraying operations conducted on July 20-23 and then again on August 13-14, 2012 were deemed necessary and justified to reduce risk of EEEv transmission. The operations resulted in substantial reductions in abundance of key targeted mosquitoes (*Coquillettidia perturbans* and *Culiseta melanura)* in the treated region (**See Graph 1 below**). The prompt timing of the response likely reduced the extent of enzootic as well as epidemic EEEv transmission, and consequently may have prevented yet additional EEEv infections and subsequent disease amongst residents and wildlife in the treated area. Although it is impossible to objectively measure the number of infections averted, the dramatic reduction in vector abundance and infection rates in many areas met the goals intended. As fully expected, infected mosquitoes were not completely eliminated, nor were infection rates suppressed for more than a few days. The second round of spraying resulted in further reductions to the mosquito population, and particularly to that of the enzootic vector, *Culiseta melanura*.

While there were four animals infected with EEEv after the spray within the original 21 community spray zone, no human cases of EEEv were diagnosed within the area. Based on this, the 2012 aerial interventions appear to have resulted in considerable benefit to the residents of the Commonwealth. Significantly, no human cases occurred within the 6 communities that also received a second spray despite persistent identification of EEEv infected mosquitoes. This result may indicate the combined effectiveness of aerial and ground ULV applications by the Board, regional mosquito control projects, and actions taken by the local boards of public health. Furthermore, similar aerial adult mosquito control interventions conducted during 2006 and 2010, environmental monitoring of water supplies, cranberries, and bees were all negative.

In conclusion, the aerial adulticiding intervention response to Eastern Equine Encephalitis virus (EEEv) described herein likely reduced risk of infection to people and domestic animals, and consequently limited the number of EEEv cases of disease.

Graph 1


2012 Eastern Equine Encephalitis (EEEv) in Massachusetts
MINIMUM INFECTION RATE (MIR)
TOTAL # OF Cq. perturbans and Cs. melanura TESTED FOR EEEv in MA from DPH Long-Term Trap Sites
Cq. perturbans MIR
Cs. melanura MIR
Total Number of Cq. perturbans
Total Number of Cs. melanura
EPI WEEK
Black Arrows above indicate Aerial Adulticide Intevention conducted on the evenings of July 20-23 and August 13, 2012
Mark S. Buffone and Hotze Wijnja, MDAR- 9.25.12
MA mosquito collections of 2 species from MA DPH State Laboratory Institute Long-term Trap Sites

Appendix 1-*Certification of Public Health Hazard Certification*

The Commonwealth of Massachusetts
Executive Office of Health and Human Services
Department of Public Health
250 Washington Street, Boston, MA 02108-4619

DEVAL L. PATRICK
GOVERNOR

TIMOTHY P. MURRAY
LIEUTENANT GOVERNOR

JUDYANN BIGBY, MD
SECRETARY

JOHN AUERBACH
COMMISSIONER

CERTIFICATION OF PUBLIC HEALTH HAZARD THAT REQUIRES PESTICIDE APPLICATION TO PROTECT PUBLIC HEALTH

Public health surveillance information indicates an increased risk of eastern equine encephalitis (EEE) in humans in certain parts of Massachusetts. In response to this increased risk, the Department of Public Health has determined that aerial application of pesticides in certain areas is necessary to protect public health In order to apply pesticides in certain legally protected areas, the certification below is necessary.

Property Owner Exclusions

The Massachusetts Pesticide Regulations prescribe the methods by which persons living in or legally in control of lands may designate such lands for exclusion from the application of pesticides (333 CMR 13.03). However, 333 CMR 13.03(3)(a) provides that requests for exclusion shall not be honored in those cases in which "The Commissioner of Public Health has certified that the application is to be made to protect the public health." The effect of this certification is that the applicators engaged in aerial pesticide applications are not required to honor designations for exclusion made by persons living in or legally in control of lands to which the pesticides may be applied.

Endangered Species

Division of Fisheries and Wildlife (DFW) regulations prohibit the taking of any state or federally listed animal or plant species, with limited exceptions (321 CMR 10.04(1)). One exception is to protect human health during the period and within the geographic area of a public health hazard as certified in writing by the Commissioner of Public Health (321 CMR 10.04(3)(e)). Under such circumstances, DFW may issue a permit to take endangered species if it has found that all reasonable efforts have been undertaken to avoid the removal, capture or destruction of such species.

Commissioner Certification

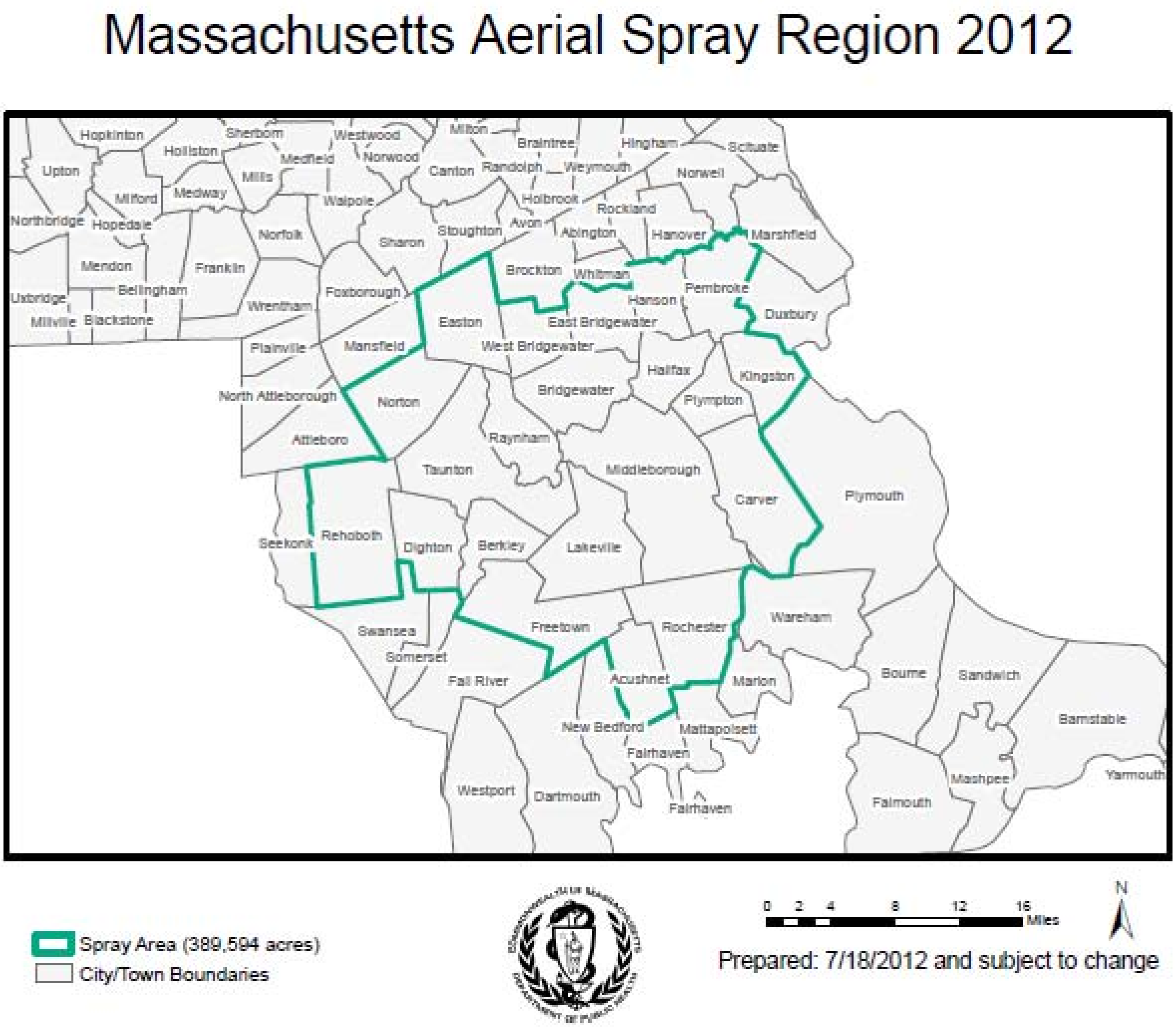
I hereby certify, pursuant to 333 CMR 13.03(3)(a) and 321 CMR 10.04(3)(e), that a public health hazard exists in the areas of Massachusetts specified below and that application of pesticides by aerial spraying in areas known to harbor mosquitoes carrying the EEE virus is necessary to protect the public health.

The areas covered by this certification are high risk areas in Bristol and Plymouth Counties as determined by Department of Public Health surveillance data that warrant aerial pesticide application to protect public health. This certification shall remain in effect until September 30, 2012.

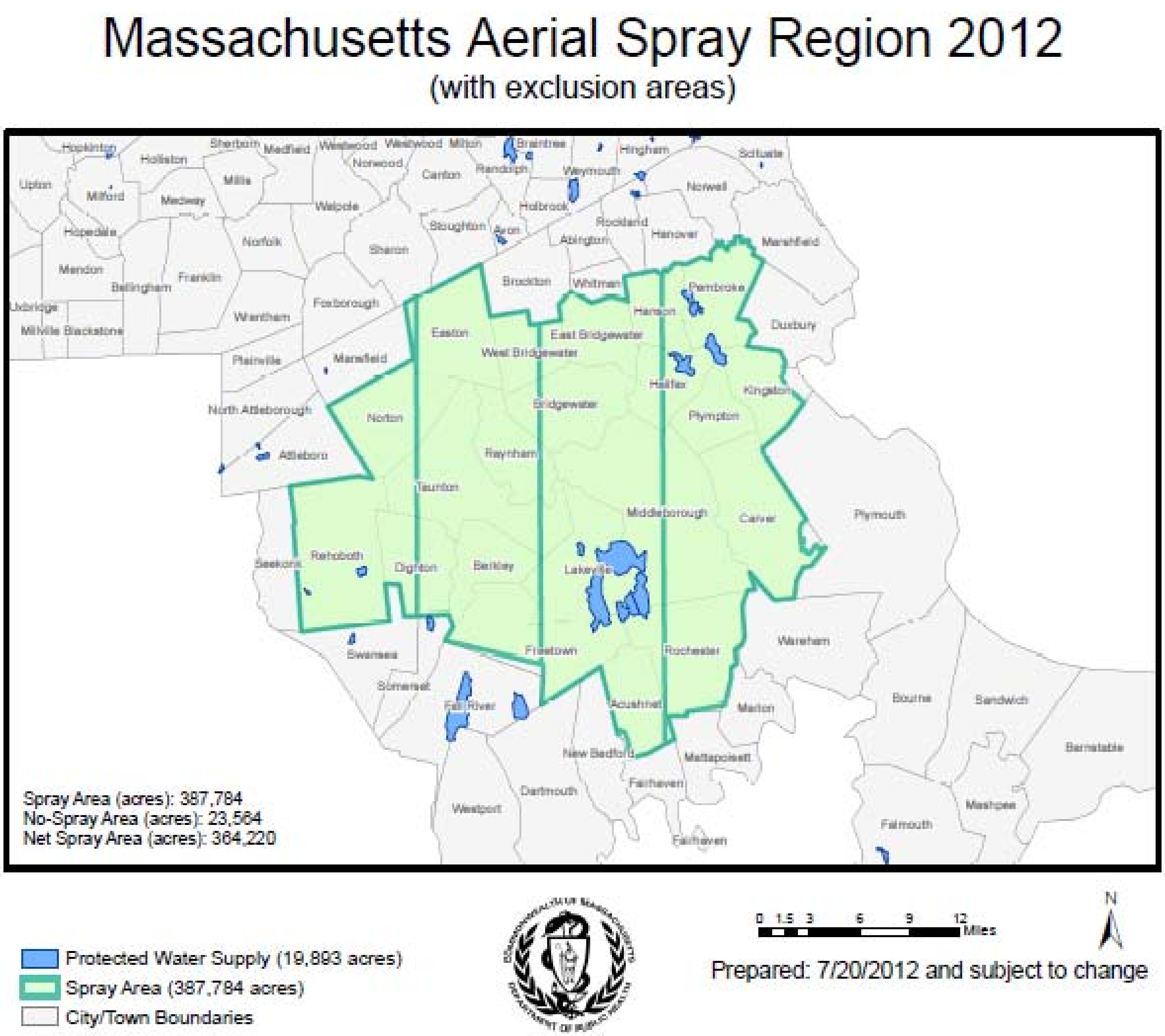
7/17/12
Date

John Auerbach
Commissioner

Appendix 2 -Massachusetts Aerial Spray Region 2012 –Map of Municipalities-Round 1



Appendix 3- Massachusetts Aerial Spray Region 2012 –Map of Spray Blocks



Appendix 4-Droplet Collection and Meteorology in Spray Zones

Massachusetts Aerial Spray
July 20-23, 2012

Droplet Collection and Meteorology Results within Spray Zones

Author: Fran Krenick, GLP Systems Manager
Product Development
Clarke Mosquito Control Products, Inc.
Roselle, IL

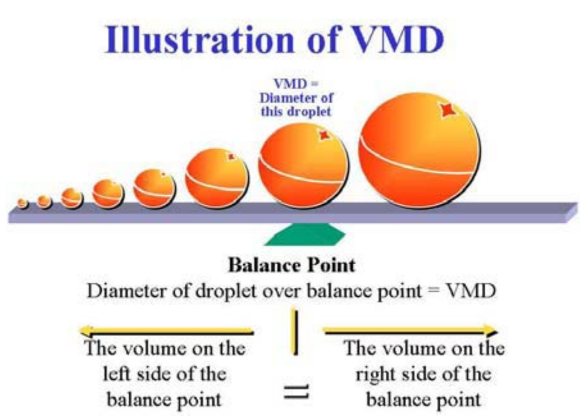
Introduction

Mosquito Control adulticide application is a space spray application, relying on the longevity of small aerosol drops staying airborne and dispersing throughout the target area to be effective in impacting flying adult mosquitoes. The target area is the column of air above the ground in areas where people live, work and play. Research has shown the most efficacious drop sizes for killing adult mosquitoes in the target zone are between 5 and 30 microns in diameter (Latta, 1947), (Weidhaas,1970), (Haile, 1982). The process for aerially applied sprays is very complex as effective applications rely on a combination of aircraft turbulence descent of vortices, atmospheric mixing and droplet disbursement to bring the spray down from spray altitude into the target zone. Using operational evaluations, it has been demonstrated that a range of between 25 and 35 microns as being the optimal VMD for aerial adulticiding sprays. (Latham, 2007)

Volume Median Diameter

The volume median diameter (VMD) is the number that divides the spray into two equal parts by volume (Figure 2), one half containing droplets smaller than this diameter (microns), and the other half containing larger droplets. A few large droplets can significantly change the VMD.

Using the proper droplet size maximizes the efficacy of a spray operation and decreases risk of adverse impacts on non-targets and the environment. The product label determines the micron range required for regulatory compliance; however does not represent the optimum range for best results (25-35 microns; Latham, 2007).



Aerial Application

Aerial spray operations began on the evening of July 20, 2012 and concluded on July 22, 2012. Teams consisting of Fran Krenick (Clarke), Jack Card (NEMMC), Robyn Januszewski (NEMMC), Bill Mehaffey (NEMMC) and Steve Burns (Bristol Co MC) placed rotary impingers with Teflon-coated slides and weather stations in designated areas within the spray blocks to document droplet penetration and meteorological conditions during spray operations.

Summary

Date & Location	Meteorology		Droplet VMD (microns)	Drop Density (Drops/cm^{2})
	Wind (mph)	Temp (ºF)		
7/20 Taunton (TIP)	0-1	57-63	68.1	63.4
7/20 Rehobeth (site 1)	0	59-63	52.1	72.1
7/20 Rehobeth (Site 2)	0	59-63	53.2	81.6
7/22 Middleboro	1-3	65-70	34.2	199.1
7/22 Carver (site 1,Purchase)	1-3	65-70	32.1	107.2
7/22 Carver (site 2,Purchase)	1-3	65-70	29.5	116.1
7/22 Halifax (Crescent St)	2-7	64-71	37.8	174.8
7/22 Kingston (Silver Lake Regional School)	2-7	64-71	29.2	157.1
Aerial application on 7/21 was called off early due to cool temperature and drops collected were not in sufficient numbers to provide credible information.				

Low to no wind conditions recorded during operations on 7/20 did not allow for small drop impingement on the Teflon-coated slides during the spray oerations. Although drops were collected, they were not in the range to produce desired results. It is believed, however, that the spray clouds emitted by the aircraft during that time did in fact produce the the optimum droplet sizes. Both temperatures and wind conditions improved for the spray operation on 7/22 as documented in the above table. Spray droplets and recorded drop densities on the slides were of optimum size and range.

References

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Latham M. and Barber J. 2007. Mosquito Control in Florida with a focus on Aerial Adulticiding. Outlooks on Pest Management, August 2007, 178-183.

Latta, R. et al, 1947. The Effect of Particle Size and Velocity of Movement of DDT Aerosols in a Wind Tunnel on the Mortality of Mosquitoes. Journal of the Washington Academy of Sciences. 37(11): 397-407.

Weidhaas, D.E, M.C. Bowman, G.A. Mount, C.S. Lofgren, and H.R. Ford. 1970. Relationship of Minimum Lethal Dose to the Optimum Size of Droplets of Insecticides for Mosquito Control. Mosquito News. 30(2): 195-200.

Appendix 5-DPH Press Release on Spray Results-Round 1

FOR IMMEDIATE RELEASE:
July 30, 2012

FURTHER INFORMATION:
Anne Roach, (617) 624-5006

State Health Officials Announce Significant Decline in Mosquito Population Following Aerial Spraying in Southeastern Massachusetts

Ground spraying to continue as risk of EEE remains a concern;
Residents urged to take precautions

BOSTON — The Massachusetts Department of Public Health (DPH) today announced that aerial spraying the weekend of July 20-22 reduced the mosquito population by approximately 60 percent within the 21-community spray zone in Southeastern Massachusetts.

Aerial spraying generally only kills mosquitoes in flight during the spray operation, and the risk of Eastern Equine Encephalitis (EEE) remains a concern with the identification of multiple pools of EEE-positive mosquitoes within portions of the spray zone.

"Following aerial spraying, we have seen a significant reduction in the volume of mosquitoes," said Public Health Commissioner John Auerbach. "But as we have seen after past sprays, the public must be mindful that the risk of EEE remains persistent. People are advised to take precautions, including the use of mosquito repellant and avoiding outdoor activities between dusk and dawn, when mosquitoes are most active."

Aerial spraying took place across 21 communities in Southeastern Massachusetts during the evenings of Friday, July 20, Saturday, July 21 and Sunday, July 22.

Seven communities are currently at a high risk level for EEE: Canton, Easton, Lakeville, Raynham, Rehoboth, Taunton and West Bridgewater. Communities deemed "high risk" was advised to curtail evening activities for the remainder of the season. A map of communities and their risk levels can be found at http://westnile.ashtonweb.com/.

Since the spraying operation concluded, EEE-positive mosquito pools have been found in Easton and Hanson. Local mosquito control projects continue to conduct ground spraying throughout the area, and trapping and monitoring have been enhanced to monitor the on-going EEE risk

There have been no human cases of West Nile virus (WNV) or EEE so far this year. There were two cases of EEE in August of last year acquired in Massachusetts; a fatal case in a Bristol County man and an infection in a tourist from out of state. EEE activity in both 2010 and 2011 raised public concern and prompted DPH to work with a panel of experts to evaluate and enhance the state's surveillance and response program. EEE is spread to humans through the bite of an infected mosquito. EEE is a serious disease in all ages and can even cause death.

People have an important role to play in protecting themselves and their loved ones from illnesses caused by mosquitoes.

Avoid Mosquito Bites

- **Apply Insect Repellent when Outdoors.** Use a repellent with DEET (N, N-diethyl-m-toluamide), permethrin, picaridin (KBR 3023), oil of lemon eucalyptus [p-methane 3, 8-diol (PMD)] or IR3535 according to the instructions on the product label. DEET products should not be used on infants under two months of age and should be used in concentrations of 30% or less on older children. Oil of lemon eucalyptus should not be used on children under three years of age.
- **Be Aware of Peak Mosquito Hours.** The hours from dusk to dawn are peak biting times for many mosquitoes. Consider rescheduling outdoor activities that occur during evening or early morning.
- **Clothing Can Help Reduce Mosquito Bites.** Wearing long-sleeves, long pants and socks when outdoors will help keep mosquitoes away from your skin.

Mosquito-Proof Your Home

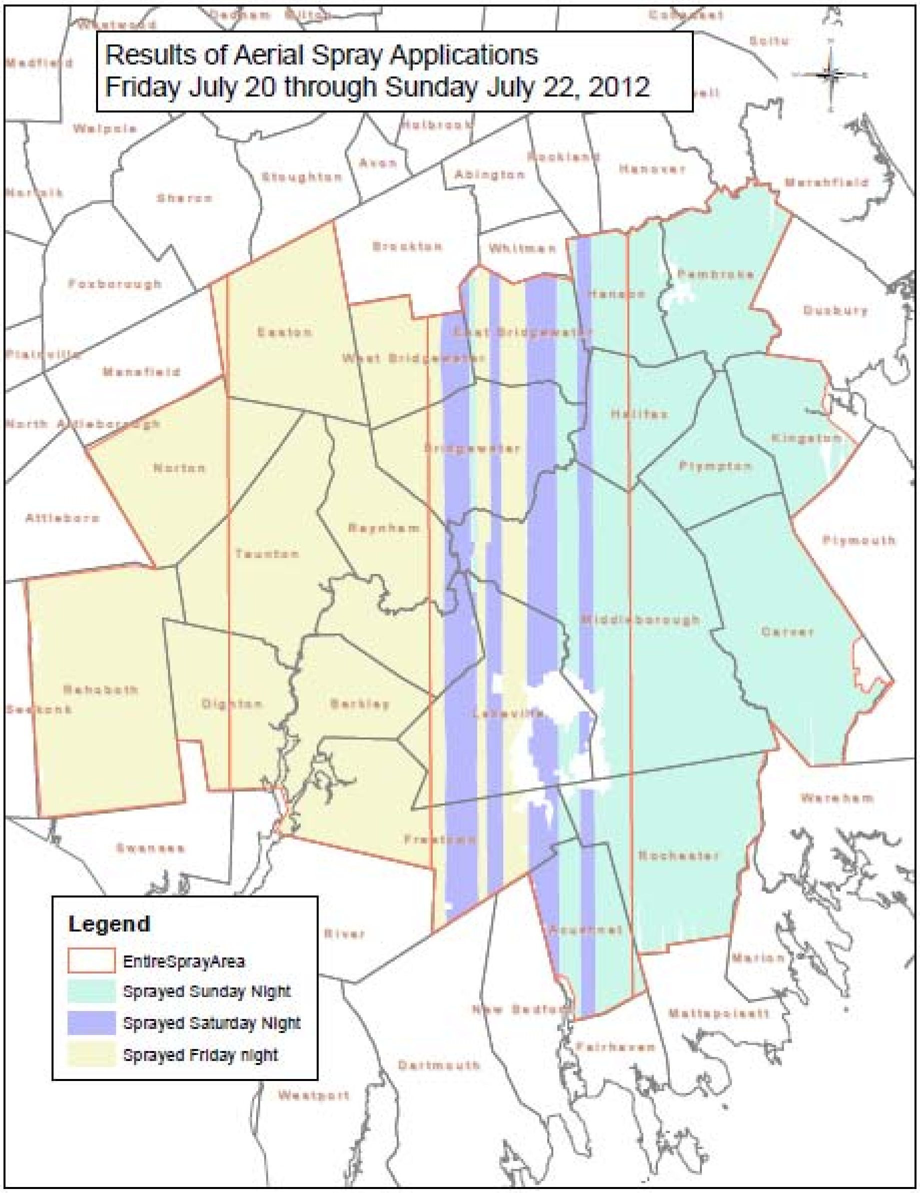
- **Drain Standing Water.** Mosquitoes lay their eggs in standing water. Limit the number of places around your home for mosquitoes to breed by either draining or discarding items that hold water. Check rain gutters and drains. Empty any unused flowerpots and wading pools, and change water in birdbaths frequently.
- **Install or Repair Screens.** Keep mosquitoes outside by having tightly-fitting screens on all of your windows and doors.

Protect Your Animals

Animal owners should reduce potential mosquito breeding sites on their property by eliminating standing water from containers such as buckets, tires, and wading pools — especially after heavy rains. Water troughs provide excellent mosquito breeding habitats and should be flushed out at least once a week during the summer months to reduce mosquitoes near paddock areas. Horse owners should keep horses in indoor stalls at night to reduce their risk of exposure to mosquitoes. If an animal is diagnosed with WNV or EEE, owners are required to report to DAR, Division of Animal Health by calling 617-626-1795 and to the Department of Public Health (DPH) by calling 617-983-6800.

More information, including all WNV and EEE positive results from 2012, can be found on the Arbovirus Surveillance Information web page at www.mass.gov/dph/wnv or by calling the DPH Epidemiology Program at 617-983-6800. The findings of the DPH Eastern Equine Encephalitis Expert Panel can be found here: http://www.mass.gov/eohhs/docs/dph/cdc/arbovirus/eee-expert-panel-report.pdf.

Appendix 6-Spray Results Map-Round 1



Appendix 7-DPH Press Release on Round 2 Spraying

FOR IMMEDIATE RELEASE:
August 10, 2012

FURTHER INFORMATION:
Anne Roach (617) 624-5006

STATE HEALTH OFFICIALS ANNOUNCE SCHEDULE FOR AERIAL SPRAYING FOR MOSQUITOES IN SIX SOUTHEASTERN MASSACHUSETTS TOWNS TO REDUCE RISK OF EEE

Spraying to take place during evening hours on Monday, August 13

BOSTON – The Massachusetts Department of Public Health (DPH) today announced plans to conduct aerial spraying for mosquitoes in **Bridgewater, Easton, Norton, Raynham, Taunton, and West Bridgewater** on Monday, August 13. Spraying will take place from 7:45 p.m. until 2:30 a.m. the next morning. Aerial spraying is heavily dependent on weather conditions, and spraying can be postponed up to the last minute – so residents are urged to check the DPH website at www.mass.gov/dph for the latest updates.

Click here for a searchable spray map.

Watch a YouTube video in American Sign Language: http://www.youtube.com/watch?v=CDI_runJYXc

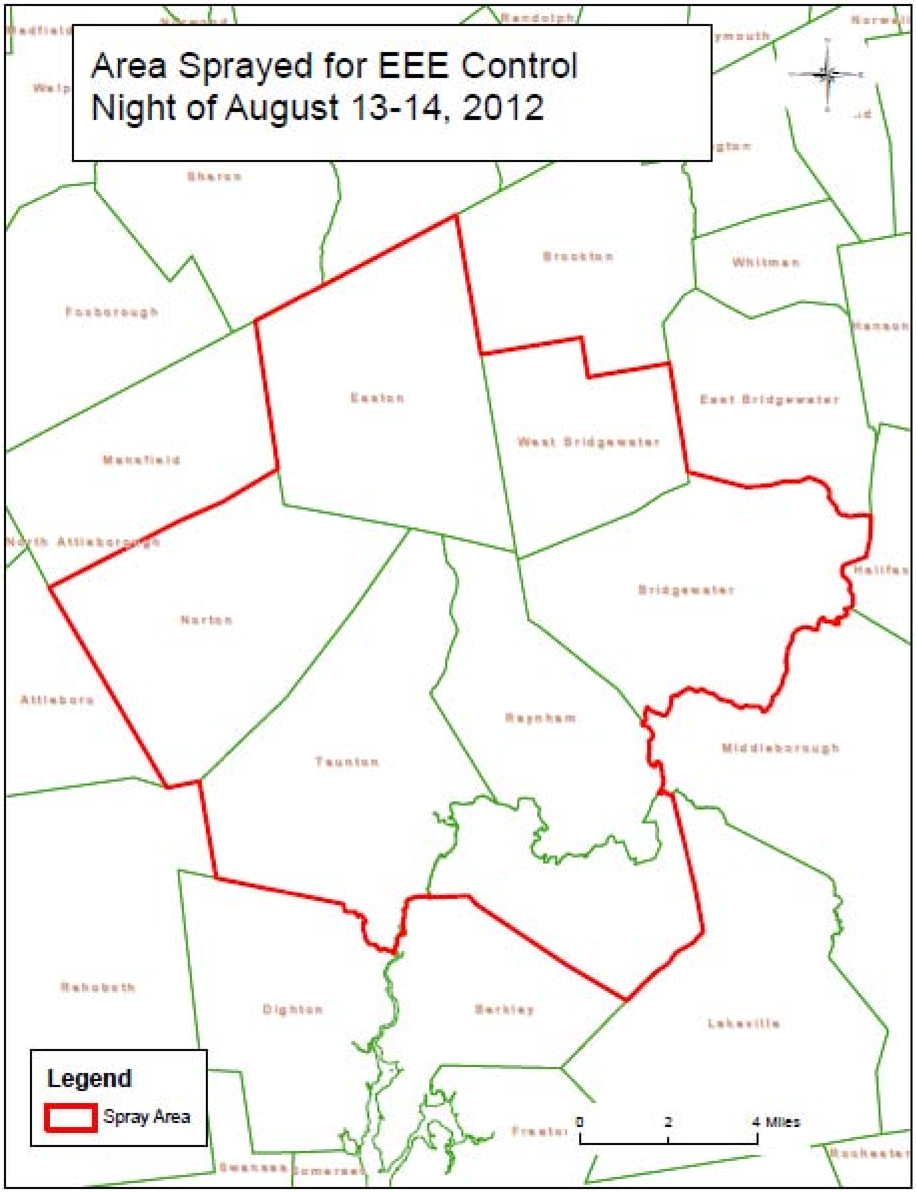
Residents of these communities should take simple precautions to avoid exposure to pesticide during the time that their city or town is scheduled to be sprayed:

- Stay indoors, keep your windows closed, and turn off window fans during the time spraying occurs. If your air conditioner has a fresh air intake feature, you may want to shut off the intake during the time of spraying.
- Keep pets indoors when spraying is occurring in your immediate area to minimize their risk of exposure.
- If skin or clothes or other items are exposed to the sprayed pesticide, wash with soap and water.
- If the spray gets in your eyes, immediately rinse them with water or eye drops, and call your doctor.
- If you have a small ornamental fish pond, you may want to cover it during the night of spraying.
- Following the aerial spray, rinse any homegrown fruits and vegetables with water.

Aerial spraying of pesticides reduces but does not eliminate the risk of mosquito-borne illness. All residents, whether inside or outside the spray zone, are urged to continue taking personal precautions to avoid mosquito bites. These include using insect repellent, covering exposed skin when outside, and avoiding outdoor activities between the hours of dusk and dawn, when mosquitoes are at their most active.

Officials decided to conduct aerial spraying in the six towns following the recent detection of numerous additional EEE-positive mosquito pools collected from sites in Easton and surrounding communities.

Appendix 8 -Massachusetts Aerial Spray Region 2012 –Map of Municipalities-Round 2



Appendix 9-Characterization and Calibration Report of Aircraft-Round 2

Massachusetts Aerial Spray
August 13, 2012

Droplet Collection and Meteorology Results within Spray Zones

Author: Fran Krenick, GLP Systems Manager
Product Development
Clarke Mosquito Control Products, Inc.
Roselle, IL

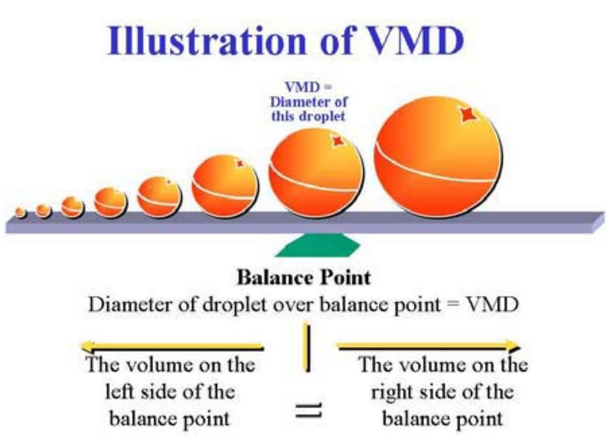
Introduction

Mosquito Control adulticide application is a space spray application, relying on the longevity of small aerosol drops staying airborne and dispersing throughout the target area to be effective in impacting flying adult mosquitoes. The target area is the column of air above the ground in areas where people live, work and play. Research has shown the most efficacious drop sizes for killing adult mosquitoes in the target zone are between 5 and 30 microns in diameter (Latta, 1947), (Weidhaas,1970), (Haile, 1982). The process for aerially applied sprays is very complex as effective applications rely on a combination of aircraft turbulence descent of vortices, atmospheric mixing and droplet disbursement to bring the spray down from spray altitude into the target zone. Using operational evaluations, it has been demonstrated that a range of between 25 and 35 microns as being the optimal VMD for aerial adulticiding sprays. (Latham, 2008)

Volume Median Diameter

The volume median diameter (VMD) is the number that divides the spray into two equal parts by volume (Figure 2), one half containing droplets smaller than this diameter (microns), and the other half containing larger droplets. A few large droplets can significantly change the VMD.

Using the proper droplet size maximizes the efficacy of a spray operation and decreases risk of adverse impacts on non-targets and the environment. The product label determines the micron range required for regulatory compliance; however does not represent the optimum range for best results (25-35 microns; Latham, 2007).



Calibration and Characterization of Aircraft

Flow calibration and droplet characterization of two Dynamic aircraft (72J and 79W) were conducted for aerial application of Anvil 10+10® at an application rate of 0.62oz/acre equilivant to 0.0036 lbs. ai/acre at the Plymouth County Municipal Airport on the afternoon of August 13, 2012. Calibrations and characterizations were conducted by Clarke Mosquito Control and Dynamic Aviation staff. Results are as follows:

Aircraft: Twin Turboprop Beechcraft King Air - 72J and 79W

Aircraft equipped with interior self-contained spray system that acurately pumps desired flow to each nozzle.

Application System

<u>Nozzles:</u> Each aricraft equipped with two Micronair AU 4000 Rotary atomizers (one under each wing) with high speed fins angled at a 35º pitch.

Calibration Results

Each aircraft was calibrated to the following specifications on 8/13/2012 at the Plymouth County Municipal Airport.

Anvil 10+10®

Application Speed (mph)	**172.5**		
Swath (ft)	**1000**		
Acres/min treated	**348.5**		
Nozzle Type:	**Micronair AU 4000**		
No. Nozzles	**2**	**Flow Rate**	
		System / min flow	**Nozzle /min flow**
Rate (oz) (0.0036 lbs/acre)	**0.62 oz/acre**	**216**	**108**
Rate (ml)	**18.33 ml/acre**	**6389**	**3195**

Into Wind Droplet Characterization

An area of approximately 65 acres was used for the droplet sampling. The area was located at the Plymouth County Municipal Airport.

Field Equipment

One wind speed direction instrument (Kestrel), Stakes (to hold impingers), Slide Impingers, Batteries (9 volt) and Teflon coated slides.

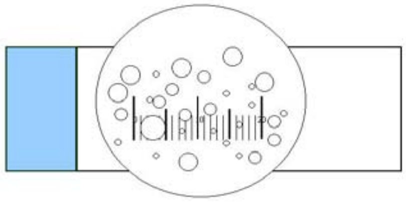
Laboratory Equipment

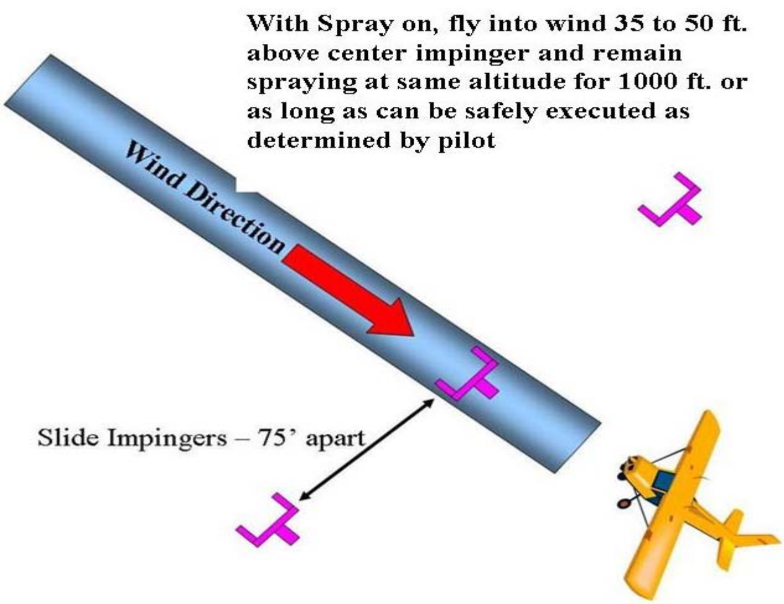
A 100x binocular compound microscope with a calibrated 1mm reticule was used to read slides and droplet analysis software (RemSpc Slide Analysis) was used to caculate data to determine droplet VMD.

Field Droplet Characterization Procedure

Three (3) rotary slide impingers, each containing Teflon-coated slides, were placed on five-foot poles in a straight line at 75 foot intervals perpendicular to the wind. Each aircraft was flown at 50 ft. directly into the wind over the center slide impinger (see diagram). The spray was turned on in advance to insure the system was operating properly and continued beyond the slide impingers for a distance to allow the spray cloud to be adequately sampled. Impingers remained collecting droplets until the spray had dissipated. All slides were placed in a sealed slide box, slides were read and data tabulated within one hour of collection.

<u>Field Characterization Diagram</u>





<u>Droplet Characterization Results</u>

Aircraft	VMD
72 J	33.4µm
79 W	32.7µm

Aerial Application

Aerial spray operations began on the evening of August 13, 2012. Teams consisting of Fran Krenick (Clarke), Jack Card (NEMMC), Robyn Januszewski (NEMMC), Bill Mehaffey (NEMMC) and Steve Burns (Bristol Co MC) placed rotary impingers with Teflon-coated slides and weather stations in designated areas within the spray blocks to document droplet penetration and meteorological conditions during spray operations.

Droplet and Meteorology Results

Date & Location	Meteorology		Droplet VMD (microns)	Drop Density (Drops/cm^2)
	Wind (mph)	Temp (ºF)		
Easton – Purchase St.	0-3	70-72	34.3	214.4
Easton – Dog Track			28.5	68.3
Easton – Golf Country			32.8	148.1
Taunton – Gleeb Cemetary			33.1	55.0
Taunton – St. Joseph's Cem.	0-3	68-71	38.7	103.4
Taunton – Pleasant St.			34.0	105.1
Bridgewater Cemetary			30.1	97.2
Note: Meteorology was recorded at two designated sites within the spray blocks using a Kestrel 4500 weather station with data logger.				

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Appendix 10-DPH Press Release on Spray Results-Round 2

STATE HEALTH OFFICIALS ANNOUNCE DECLINE IN MOSQUITO POPULATION FOLLOWING MOST RECENT AERIAL SPRAYING

Residents urged to continue taking precautions against mosquito bites

BOSTON – August 22, 2012 – The Massachusetts Department of Public Health (DPH) today announced that aerial spraying, which took place in six southeastern Massachusetts communities on August 13, cut the mosquito population in half in the spray area. Aerial spraying generally kills only those mosquitoes that are in flight during the spray operation, and health officials continue to stress the importance of personal protective measures to prevent mosquito bites.

“Today’s results reduce but do not eliminate the public health threat of mosquito-borne illnesses in Massachusetts,” said DPH Commissioner John Auerbach. “It remains vitally important that people continue to take precautions to protect themselves and their families from mosquito bites – use insect repellant, cover exposed skin, and avoid outdoor activities at dusk and after nightfall when mosquitoes are at their most active.”

Officials conducted aerial spraying on August 13 in Bridgewater, Easton, Norton, Raynham, Taunton, and West Bridgewater following the detection of multiple mosquitoes infected with Eastern Equine Encephalitis (EEE) in the area.

There has been one confirmed human case of EEE in a Massachusetts resident this year, a Metrowest resident who may have contracted the disease while traveling out of state. There were two cases of EEE in August of last year acquired in Massachusetts; a fatal case in a Bristol County man and an infection in a tourist from out of state. EEE activity in both 2010 and 2011 raised public concern and prompted DPH to work with a panel of experts to evaluate and enhance the state’s surveillance and response program. EEE is spread to humans through the bite of an infected mosquito. EEE is a serious disease in all ages and can even cause death.

-more-

Results of Aerial Spraying, page 2 of 2

People have an important role to play in protecting themselves and their loved ones from illnesses caused by mosquitoes:

Avoid Mosquito Bites

- **Apply Insect Repellent when Outdoors.** Use a repellent with DEET (N, N-diethyl-m-toluamide), permethrin, picaridin (KBR 3023), oil of lemon eucalyptus [p-methane 3, 8-diol (PMD)] or IR3535 according to the instructions on the product label. DEET products should not be used on infants under two months of age and should be used in concentrations of 30% or less on older children. Oil of lemon eucalyptus should not be used on children under three years of age.
- **Be Aware of Peak Mosquito Hours.** The hours from dusk to dawn are peak biting times for many mosquitoes. Consider rescheduling outdoor activities that occur during evening or early morning.
- **Clothing Can Help Reduce Mosquito Bites.** Wearing long-sleeves, long pants and socks when outdoors will help keep mosquitoes away from your skin.

Mosquito-Proof Your Home

- **Drain Standing Water. Mosquitoes lay their eggs in standing water.** Limit the number of places around your home for mosquitoes to breed by either draining or discarding items that hold water. Check rain gutters and drains. Empty any unused flowerpots and wading pools, and change water in birdbaths frequently.
- **Install or Repair Screens.** Keep mosquitoes outside by having tightly-fitting screens on all of your windows and doors.

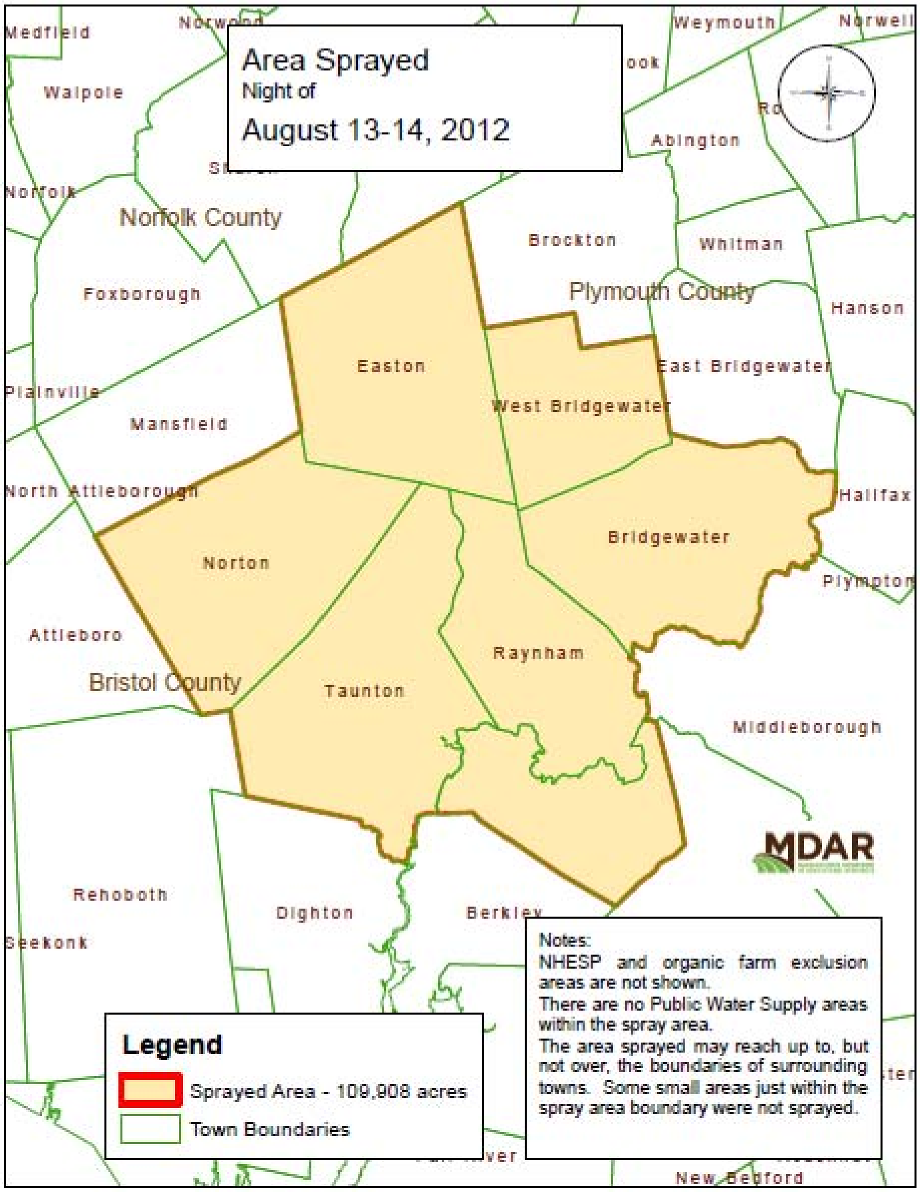
Protect Your Animals

Animal owners should reduce potential mosquito breeding sites on their property by eliminating standing water from containers such as buckets, tires, and wading pools – especially after heavy rains. Water troughs provide excellent mosquito breeding habitats and should be flushed out at least once a week during the summer months to reduce mosquitoes near paddock areas. Horse owners should keep horses in indoor stalls at night to reduce their risk of exposure to mosquitoes. If an animal is diagnosed with WNV or EEE, owners are required to report to DAR, Division of Animal Health by calling 617-626-1795 and to the Department of Public Health (DPH) by calling 617-983-6800.

More information, including all WNV and EEE positive results from 2012, can be found on the Arbovirus Surveillance Information web page at www.mass.gov/dph/wnv or by calling the DPH Epidemiology Program at 617-983-6800. The findings of the DPH Eastern Equine Encephalitis Expert Panel can be found here.

# # #

Appendix 11-Spray Results Map-Round 2



Appendix 12-MA DEP Water Monitoring Report

REPORT

Water Monitoring Results Associated With Aerial Pesticide Spraying for Eastern Equine Encephalitis Infected Mosquitoes in Summer 2012

Massachusetts Department of Environmental Protection
Office of Research and Standards
Boston, MA

September 2012

INTRODUCTION

In the summer of 2012, the prevalence of Eastern Equine Encephalitis (EEE) infected mosquitoes reached a sufficiently high level to warrant wide area aerial spraying to reduce the populations of mosquitoes. Plans followed the 2012 Massachusetts Arbovirus Surveillance and Response Plan (MassDPH, 2012) and were similar to those for spraying that took place in 1990, 2006, and 2010, although a different insecticide (the organophosphate Malathion) was used in 1990.

Two different spraying events took place during the summer. Surface water quality monitoring accompanied both spray events. In the first event of 2012, the sprayed area contained a number of surface water bodies which serve as sources of water for Public Drinking Water Supplies (PWS). Direct spraying onto these resources did not take place. Also sampled were several lakes, ponds and flowing waters not used for drinking water. The second, smaller spray event area did not include any water supply sources, but did include other surface waters.

Spraying in 2006, 2010 and 2012 used Anvil 10+10 which contain the insecticide sumithrin (d-phenothrin) and the synergist piperonyl butoxide (PBO). The purpose of this memorandum is to describe the water quality monitoring program in 2012 and present the results of the program.

MATERIALS AND METHODS

Spraying and sampling took place according to the Commonwealth's operational response plan (MassDAR, 2012). Details of application procedures and flight path information are available from the Massachusetts Department of Agricultural Resources.

The first spray event of 2012 included spraying on 4 evenings in order to cover the entire area, starting on the evening of July 20, 2012 and concluding on July 23, 2012. Areas were only sprayed once using these flight paths. The spray area in southeastern Massachusetts is shown in Figure 1. Flight crews were instructed to spray up to the edges of surface water bodies with no setbacks. Four of the locations where samples were taken were source water for PWS and the remaining seven locations were not. A second spray operation was necessary because of continuing high EEE infected mosquito counts in the towns of Easton, Norton, Taunton, Raynham, Bridgewater and West Bridgewater (Figure 2). This second spray application to this area took place the evening of August 13, 2012.

3

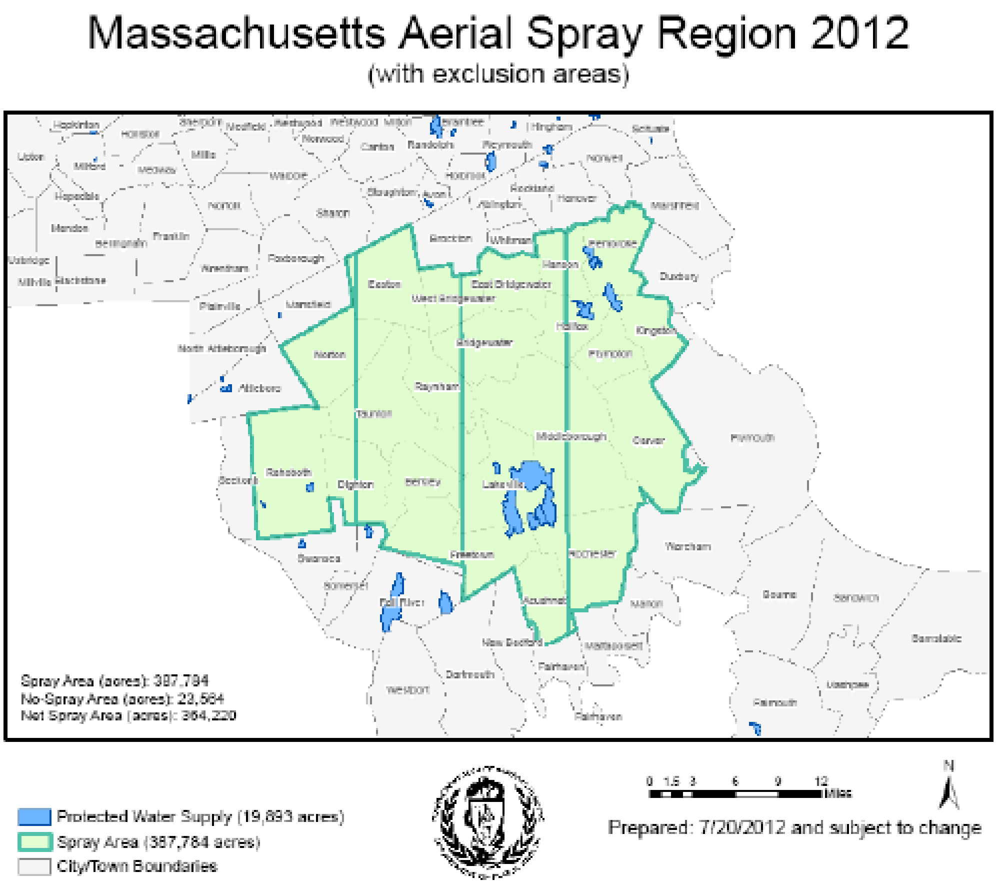


Figure 1. Aerial Spray Pattern for Spray Event 1. July 2012

For samples taken for waters serving PWSs, it should be noted that the PWS name (and sample location code) generally refer to the town that the water serves. In most cases, the water body serving as the source of that water and the associated water treatment plant are in a different town. This information has been noted in Table 1.

Pre-spray background samples were taken from each of the sampling locations on the day before the first spraying event took place. There was no background sampling at stations in advance of the second spray event because of the prior spray event. At all but the Abington/Rockland WTP in Pembroke, the raw water sample was collected from a tap coming into the plant from the waterbody. The Abington/Rockland raw water samples were taken directly from Great Sandy Bottom Lake. All finished water samples at each PWS were taken from a tap in each plant at the completion of treatment. Non-PWS surface water samples were collected directly from the waterbodies.

Water samples were collected at each location by approximately 8 am on the morning after spraying and then again daily for several days. A trip blank was included in the samples provided to the laboratory. Samples were placed on ice and conveyed within hours to the Massachusetts Pesticide Analysis Laboratory at the University of Massachusetts in Amherst where the analytes were extracted within 24 hours and analyzed for sumithrin (d-phenothrin) and PBO within 48 hours: both times within recommended limits for holding prior to extraction and analysis (48 hours and 30 days respectively) (Hladik, Smalling, & Kuivila, 2009). Details of the analytical procedure employed can be obtained from the laboratory. Their method detection limits were 0.02 ug/L and Limits of Quantitation were 0.1 ug/L for both compounds. Quality Control (QC) included determination of percent recoveries of spikes of the target analytes. No data were provided on analyses of replicate samples to indicate the level of precision of the analyses.

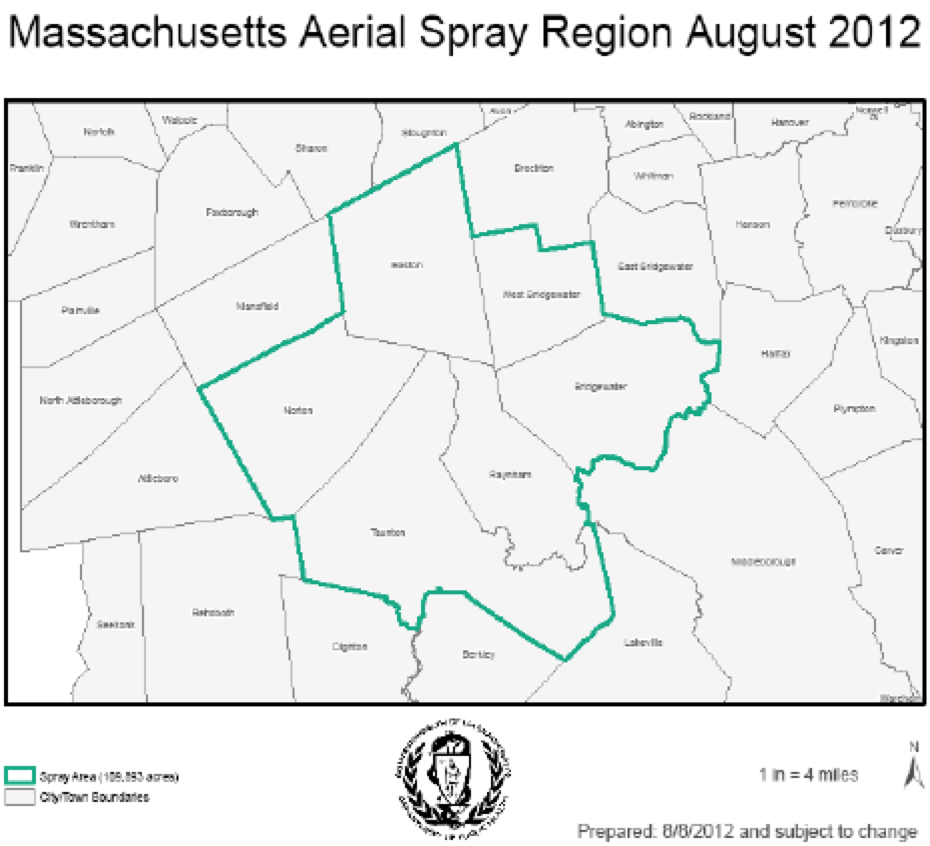


Figure 2. Aerial Spray Pattern for Spray Event 2. August 2012

RESULTS AND DISCUSSION

Water quality sampling results are shown in Table 1. Quality control results for both compounds were within acceptable limits for accuracy. No data were provided on analyses of replicate samples to indicate the level of precision of the analyses. Copies of lab data reports are appended (Appendix 1).

No Sumithrin was detected either before or after spraying in any water sample. Given that sumithrin degrades very quickly in the aquatic environment (US EPA 2008), any unmeasurable amounts of sumithrin present in the water after spraying would quickly degrade to insignificant levels.

PBO was not detected in any samples prior to spraying. PBO was detected in low sub ug/l (parts per billion) concentrations in some raw water samples, not used as PWSs, the morning after spraying in Spray Events 1&2, although it was not detected in any finished water samples during Event 1. It also occurred for the first time in the raw water of some of the PWSs sampled in Event 1 several days after application. Measured concentrations ranged from 0.02 to 0.42 ug/L (Tables 1 and 2). Post spray concentrations of PBO were consistent with those documented in the two prior EEE aerial spraying events in Massachusetts where Anvil 10+10 was employed (Table 2).

None of the reported PBO concentrations approached concentrations that would be of human health concern from either short or long-term exposures (Table 3). The maximum concentration of PBO measured after the two spray events was 150,000 fold lower than the US EPA's acute human health exposure limit for drinking water. It is important to emphasize here once again that PBO was never detected in finished drinking water samples, only in the raw water entering the treatment plants. The acute human health exposure limit is the most appropriate value for comparison with the monitoring data concentrations since PBO degrades rapidly in the aquatic environment (US EPA 2006). Chronic exposures would not therefore occur after these primarily single applications (or two applications in the case of the six towns sprayed a second time). The benchmark represents the U.S. EPA's most recent (2012) assessment of PBO's toxicity.

For the assessment of aquatic life, PBO concentrations were lower than the acute and chronic aquatic life benchmarks for PBO (Table 3), indicating little likelihood of any immediate or long-term toxicity from the episodic short-term PBO exposures after spraying. The acute exposure scenario is the most applicable to these spray events. Maximum PBO concentrations measured after spraying in both events were about 536 fold lower than the acute aquatic life benchmark for the most sensitive aquatic organism group (invertebrates).

6

Table 1. 2012 Sumithrin and PBO Water Monitoring Results for Two Aerial Spraying Events in Southeastern Massachusetts

Spray Event	Sample Location Code	Plant Location	Town Served by PWS	Sumithrin, ug/L					PBO, ug/L				
1				Pre-Spray	Post- Spray				Pre-Spray	Post-Spray			
				7/20	7/21	7/22	7/23	7/24	7/20	7/21	7/22	7/23	7/24
			PWS Surface Water Supply Samples										
	Ab/Rock-002 Raw	Great Sandy Bottom WTP, Pembroke	Abington/Rockland	ND	ND	ND	ND	ND	ND	ND	ND	0.07	0.028
	Ab/Rock 001 Finished	Great Sandy Bottom WTP, Pembroke	Abington/Rockland	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7-20-12 Quittacas raw	Quittacas* WTP	New Bedford	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.04
	7-20-12 Quittacas finished	Quittacas* WTP	New Bedford	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Brockton Silver Lake raw	Silver Lake WTP, Pembroke/ Kingston	Brockton	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03
	Brockton Silver Lake finished	Silver Lake WTP, Pembroke/ Kingston	Brockton	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	021 Elders Pond raw	Elders Pond WTP, Lakeville	Taunton	ND	ND	ND	ND	ND	ND	ND	ND	0.026	0.02
	022 24" finished	Elders Pond WTP, Lakeville	Taunton	ND	ND	ND	ND		ND	ND	ND	ND	ND

* This WTP draws water from 5 ponds in the area: Assawampsett Pond, Great Quittacas Pond, Long Pong, Pocksha Pond and Little Quittacas Pond. Sample was from intake tap.

Table 1 cont. 2012 Sumithrin and PBO Water Monitoring Results for Two Aerial Spraying Events in Southeastern Massachusetts

Spray Event	Sample Location Code	Sample Location	Town	Sumithrin, ug/L					PBO, ug/L				
				Pre-Spray	Post- Spray				Pre-Spray	Post-Spray			
				7/20	7/21	7/22	7/23	7/24	7/20	7/21	7/22	7/23	7/24
Non-PWS Surface Water Samples from Ponds, Impoundments or Rivers													
1	Jones River	Jones River Impoundment	Kingston		ND	ND	ND			ND	ND	0.27	
	Ponkapog (sic) Pond	Ponkapoag Pond	Randolph / Canton		ND	ND	ND			ND	ND	ND	
	Lower Leach Pond		Easton		ND	ND	ND			0.04	0.07	0.03	
	Lake Sabbatia	Lake Sabbatia	Taunton		ND	ND	ND			0.19	0.07	0.11	
	Snipatuit Pond	Snipatuit Pond	Middleborough		ND	ND	ND			ND	ND	0.42	
	Sampson Pond	Sampson Pond	Carver		ND	ND	ND			ND	ND	0.05	
	Nemasket	Nemasket River	Middleborough		ND	ND	ND			ND	ND	ND	
	SERO		trip blank								ND		
2				Pre Spray	Post Spray 8/14				Pre Spray	Post Spray 8/14			
	Leach Pond		Easton	-	ND				-	ND			
	Norton Reservoir		Norton	-	ND				-	0.12			
	Lake Nip	Lake Nippenicket	Bridgewater	-	ND				-	0.37			
	Lake Rico		Taunton	-	ND					0.19			

Table 2. Summary of PBO Concentrations (ug/L) Observed in Massachusetts Surface Waters after Aerial Spraying Events for EEE

Year	Frequency of detection	max	min
2006	7*/77 = 0.06	0.14	0.13
2010	14**/26 = 0.54	0.36	0.11
2012	18/57 = 0.31	0.42	0.02

* includes 3 < LOQ of 0.08 ug/L; ** includes 7 < LOQ of 0.1 ug/L

Table 3. Summer 2012 Updated Drinking Water and Aquatic Life Benchmark Concentrations for Sumithrin and PBO

Receptors	Compound	Exposure Duration	OPP* Aquatic Life Benchmark, ug/L	US EPA Drinking Water Benchmark** ug/L	Source
Humans	Sumithrin	chronic	-	49	US EPA 2012a
		acute	-	990 (females 13-49)	US EPA 2012a
	PBO	chronic	-	1,085	US EPA 2012a
		acute	-	63,000 (children)	US EPA 2012a
Aquatic Animals					
Fish	Sumithrin	acute	7.9	-	US EPA 2012b
Fish		chronic	1.1	-	US EPA 2012b
Inverts		acute	2.2	-	US EPA 2012b
Inverts		chronic	0.47	-	US EPA 2012b
Fish	PBO	acute	950	-	US EPA 2012b
Fish		chronic	40	-	US EPA 2012b
Inverts		acute	225	-	US EPA 2012b
Inverts		chronic	30	-	US EPA 2012b

* OPP = US EPA Office of Pesticide Programs

**ACUTE: The US EPA Formula for deriving the Acute Drinking Water Benchmark = [RfD_{acute} (mg/kg bw/day) x BW (kg) x 1000 (µg/mg)] / [Drinking Water Intake (L/day)] where BW=10 kg for children and 66 kg for females 13-49 years and Drinking Water Intake = 1L/day for children and 2L/day for females 13-49 years. Concentrations for both children and the female group are calculated and the lower of the two is shown as the benchmark with a notation of which group it was based upon. No relative source contribution factor is applied to the acute values.

CHRONIC: The US EPA Formula for deriving the Chronic Drinking Water Benchmark = [$RfD_{chronic}$ (mg/kg bw/day) x BW (kg) x 1000 (µg/mg) x 0.2 RSC] / [Drinking Water Intake (L/day)] where BW=70 kg for general population and 66 kg for females 13-49 years and Drinking Water Intake = 2L/day for general population as well as for females 13-49 years and RSC = Relative Source Contribution assumed as 20%. The general population based Benchmark is shown.

CONCLUSION

Wide area aerial spraying with Anvil 10+10 (sumithrin and PBO) did not result in any significant introduction of sumithrin or PBO into surface waters in the spray areas. No sumithrin was detected approximately 12 hours after spraying, nor for several days thereafter. PBO was detected in some locations at low sub ug/L (ppb) concentrations which were well below acute drinking water or aquatic life exposure criteria. These results are consistent with those of previous EEE spraying operations in Massachusetts.

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ACKNOWLEDGEMENTS

The work described in this report was performed by a number of individuals whose contributions are gratefully acknowledged: Gary Gonyea (MassDEP/Bureau of Resource Protection), MassDEP/Southeast Regional Office staff including Leslie O'Shea, Greg DeCesare, Michael Quink and Jonathan Hobil, MassDepartment of Agricultural Resources staff including Taryn LaScola, staff members of the Public Water Supplies sampled, and Jeff Doherty (The University of Masssachusetts Amherst's Pesticide Analysis Laboratory).

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Massachusetts Pesticide Analysis Laboratory

Morrill 1 N427A
637 North Pleasant Street
University of Massachusetts
Amherst, MA 01003-0230
Phone: 413-545-4369

Massachusetts Department of Environmental Protection

Report of Analysis

Sumithrin/PBO Water Analysis

Reviewed and Approved by:

____

Jeffery J. Doherty
Laboratory Manager

Massachusetts Pesticide Analysis Laboratory

Report Date: 7/23/12
Project: DEP
Container: 1 L amber glass
Preservation: 4°C storage
Matrix: water

Sampled: 7/20/12
Received: 7/20/12
Extracted: 7/21/12
Analyzed: 7/22/12
Analyst: SAM/JJD

	RESULTS	**Background samples**
Sample	**PBO**	**Sumithrin**
Ab/Rock 001Finished	ND	ND
Ab/Rock-002 Raw	ND	ND
7-20-12 Quittacas raw	ND	ND
7-20-12 Quittacas finished	ND	ND
Brockton Silver Lake raw	ND	ND
Brockton Silver Lake finished	ND	ND
021 Elders Pond raw	ND	ND
022 24" finished	ND	ND

Notes:
ND = not detected. The limit of detection is 0.02 µg/L, and the limit of quantitation (LOQ) is 0.1 µg/L.

QC Results		
Parameter	**Recovery**	**QC Limits**
PBO (1 µg/L)	79%	60% -120 %
Sumithrin (1 µg/L)	68%	60% -120 %

Massachusetts Pesticide Analysis Laboratory

Report Date: 7/23/12
Project: DEP
Container: 1 L amber glass
Preservation: 4°C storage
Matrix: water

Sampled: 7/21/12
Received: 7/21/12
Extracted: 7/21-22/12
Analyzed: 7/23/12
Analyst: SAM/JJD

RESULTS

Post spray sample collection of 7/21/12

Sample	PBO	Sumithrin
Ab/Rock 001Finished	ND	ND
Ab/Rock-002 Raw	ND	ND
7-20-12 Quittacas raw	ND	ND
7-20-12 Quittacas finished	ND	ND
Brockton Silver Lake raw	ND	ND
Brockton Silver Lake finished	ND	ND
021 Elders Pond raw	ND	ND
022 24" finished	ND	ND
Jones river	ND	ND
Ponkapog Pond	ND	ND
Lower Leach Pond	**0.04ppb**	ND
Lake Sabbatia	**0.19ppb**	ND
Snipatuit Pond	ND	ND
Sampson Pond	ND	ND
Nemasket	ND	ND

Notes:
ND = not detected. The limit of detection is 0.02 µg/L, and the limit of quantitation (LOQ) is 0.1 µg/L.

QC Results

Parameter	Recovery	QC Limits
PBO (1 µg/L)	107%	60% -120 %
Sumithrin (1 µg/L)	87%	60% -120 %

Massachusetts Pesticide Analysis Laboratory

Report Date: 7/24/12
Project: DEP
Container: 1 L amber glass
Preservation: 4°C storage
Matrix: water

Sampled: 7/22/12
Received: 7/22/12
Extracted: 7/22-23/12
Analyzed: 7/23-24/12
Analyst: SAM/JJD

RESULTS

Post spray sample collection of 7/22/12

Sample	PBO	Sumithrin
Ab/Rock 001Finished	ND	ND
Ab/Rock-002 Raw	ND	ND
7-20-12 Quittacas raw	ND	ND
7-20-12 Quittacas finished	ND	ND
Brockton Silver Lake raw	ND	ND
Brockton Silver Lake finished	ND	ND
021 Elders Pond raw	ND	ND
022 24" finished	ND	ND
Jones river	ND	ND
Ponkapog Pond	ND	ND
Lower Leach Pond	**0.07ppb**	ND
Lake Sabbatia	**0.07ppb**	ND
Snipatuit Pond	ND	ND
Sampson Pond	ND	ND
Nemasket	ND	ND
SERO (trip blank)	ND	ND

Notes:
ND = not detected. The limit of detection is 0.02 µg/L, and the limit of quantitation (LOQ) is 0.1 µg/L.

QC Results

Parameter	Recovery	QC Limits
PBO (1 µg/L)	86%	60% -120 %
Sumithrin (1 µg/L)	87.1%	60% -120 %

Massachusetts Pesticide Analysis Laboratory

Report Date: 7/25/12
Project: DEP
Container: 1 L amber glass
Preservation: 4°C storage
Matrix: water

Sampled: 7/23/12
Received: 7/23/12
Extracted: 7/23-24/12
Analyzed: 7/24/12
Analyst: SAM/JJD

RESULTS

Post spray sample collection of 7/23/12

Sample	PBO	Sumithrin
Ab/Rock 001Finished	ND	ND
Ab/Rock-002 Raw	**0.07ppb**	ND
7-20-12 Quittacas raw	ND	ND
7-20-12 Quittacas finished	ND	ND
Brockton Silver Lake raw	ND	ND
Brockton Silver Lake finished	ND	ND
021 Elders Pond raw	**0.026ppb**	ND
022 24" finished	ND	ND
Jones river	**0.27ppb**	ND
Ponkapog Pond	ND	ND
Lower Leach Pond	**0.03ppb**	ND
Lake Sabbatia	**0.11ppb**	ND
Snipatuit Pond	**0.42ppb**	ND
Sampson Pond	**0.05ppb**	ND
Nemasket	ND	ND

Notes:
ND = not detected. The limit of detection is 0.02 µg/L, and the limit of quantitation (LOQ) is 0.1 µg/L.

QC Results

Parameter	Recovery	QC Limits
PBO (1 µg/L)	119%	60% -120 %
Sumithrin (1 µg/L)	68.7%	60% -120 %

Massachusetts Pesticide Analysis Laboratory

Report Date: 7/26/12
Project: DEP
Container: 1 L amber glass
Preservation: 4°C storage
Matrix: water

Sampled: 7/24/12
Received: 7/24/12
Extracted: 7/24/12
Analyzed: 7/25/12
Analyst: SAM/JJD

RESULTS

Post spray samples 7/24/12

Sample	PBO	Sumithrin
Ab/Rock 001Finished	ND	ND
Ab/Rock-002 Raw	**0.028ppb**	ND
7-20-12 Quittacas raw	**0.04ppb**	ND
7-20-12 Quittacas finished	ND	ND
Brockton Silver Lake raw	**0.03ppb**	ND
Brockton Silver Lake finished	ND	ND
021 Elders Pond raw	**0.02ppb**	ND
022 24" finished	ND	ND

Notes:
ND = not detected. The limit of detection is 0.02 µg/L, and the limit of quantitation (LOQ) is 0.1 µg/L.

QC Results

Parameter	Recovery	QC Limits
PBO (1 µg/L)	117%	60% -120 %
Sumithrin (1 µg/L)	67.7%	60% -120 %

Massachusetts Pesticide Analysis Laboratory

Report Date: 8/16/12
Project: DEP
Container: 1 L amber glass
Preservation: 4°C storage
Matrix: water

Sampled: 8/14/12
Received: 8/14/12
Extracted: 8/14/12
Analyzed: 8/15/12
Analyst: SAM/JJD

RESULTS		
Post spray samples 8/14/12		
Sample	**PBO**	**Sumithrin**
Leach Pond, Easton	ND	ND
Norton Res., Norton	**0.12ppb**	ND
Lake Nip, Bridgewater	**0.37ppb**	ND
Lake Rico, Taunton	**0.19ppb**	ND

Notes:
ND = not detected. The limit of detection is 0.02 µg/L (ppb), and the limit of quantitation (LOQ) is 0.1 µg/L (ppb).

QC Results		
Parameter	**Recovery**	**QC Limits**
PBO (1 µg/L)	109%	60% -120 %
Sumithrin (1 µg/L)	94%	60% -120 %

Appendix 13- Cranberry Sampling for Sumithrin in Southeastern Massachusetts

Cranberry Sampling for Sumithrin in Southeastern Massachusetts

September 2012

Massachusetts Department of Public Health
Bureau of Environmental Health
Environmental Toxicology Program
Boston, Massachusetts 02108

I. BACKGROUND AND STATEMENT OF ISSUES

In response to a public health threat from mosquitoes carrying Eastern equine encephalitis virus (EEE), Massachusetts public health and mosquito control agencies moved forward with aerial pesticide application (ultra-low volume, or ULV) in parts of southeastern Massachusetts where risk has historically been deemed greatest. This area is also home to numerous cranberry bogs. Two aerial applications were carried out; the first was conducted during the nights of July 20 – 22 and the second on the evening of August 13, 2012. The first application treated approximately 386,000 acres in the communities of Acushnet, Berkley, Bridgewater, Carver, Dighton, Easton, East Bridgewater, Freetown, Halifax, Hanson, Kingston, Lakeville, Middleborough, Norton, Pembroke, Plympton, Raynham, Rehoboth, Rochester, Taunton and West Bridgewater and the second application treated approximately 108,000 acres covering the communities of Bridgewater, Easton, Norton, Raynham, Taunton, and West Bridgewater. One of the active ingredients of the pesticide used (Anvil 10+10; EPA registration #1021-1688-8329) is sumithrin, a synthetic pyrethroid compound, which has a federal food tolerance of 10 parts per billion (ppb) (US EPA, 2008a, b, c). Thus, the Massachusetts Department of Public Health, Bureau of Environmental Health (MDPH/BEH) undertook a sampling and analysis effort to ensure that sumithrin residues, if any, would not exceed the food tolerance. This report presents the results of cranberry testing related to the two spray events, along with results for samples taken before and after each aerial application of pesticides over parts of southeastern Massachusetts.

II. METHODS

The MDPH/BEH developed a sampling and analysis plan and coordinated with the Cape Cod Cranberry Growers Association (CCCGA) to design the sampling plan for selected bogs in southeastern Massachusetts and to collect the samples. Sampling of cranberries was conducted both before (July 19) and after (July 25) the first aerial application on the evenings of July 20 – 22, 2012 and before (August 13) and after (August 16) the second aerial application on the evening of August 13, 2012 (application occurred approximately between 7:45 PM and 2:30 AM each night). During the first aerial application, planes were deployed and in the air on the night of the 21st but they quickly returned due to non-conducive weather conditions, thereby delaying completion of first spray event until July 22nd. Cranberries were collected before and after spraying from a control bog (i.e., not geographically near or within the areas sprayed with Anvil 10+10 aerially for mosquito control in either aerial spray event), from six bogs within the first spray area, and from two bogs within the second spray area.

Sample Locations

MDPH/BEH worked with representatives of the CCCGA to identify six cranberry bogs located within the first aerial application zone (see Figure 1) and two within the second aerial application zone (see Figure 2), as well as one bog located outside of the application zones to serve as a control or background. The locations of the bogs for the first aerial application, which covered a much larger geographic area than the second spray event, were as follows (note, location code in parenthesis):

1. Pickens Street, Lakeville (HBB)
2. West Grove Street, Middleborough (WG)
3. West Street, Carver (WARD)
4. Tremont Street/Federal Furnace Road, Carver (duplicate sample collected here) (FF; FFDUP)
5. Purchase Street, Middleborough (PUR)
6. Main Street at Pleasant Street, Plympton (HAR)
7. Long Neck Road, Wareham (control) (PISC)
8.

The locations of the bogs for the second aerial application were as follows (note, location code in parenthesis):

1. Plymouth Street, Bridgewater (duplicate sample collected here) (MNB; MNBDUP)
2. Caswell Street, Taunton (MCY)
3. Long Neck Road, Wareham (control) (PISC)

Figures 1 and 2 depict the general locations of the selected bogs. At the time of sampling, the cranberry crop was not ripe and was not expected to be ready for harvesting for at least another month or more.

Sampling Procedure

Each bog, including the control, was sampled in the same overall manner. Five separate sample jars (subsamples) were collected from approximately the four corners and the center of each bog. Field sample jars were 500 mL in capacity, amber glass, pre-cleaned and certified clean from the manufacturer. Amber (dark) colored bottles were selected because the target analyte (sumithrin) is known to be sensitive to photodegradation. The subsamples from each bog were composited (mixed) in the analytical laboratory, Golden Pacific Laboratories, LLC (GPL), before analysis resulting in a single representative sample from each bog. Therefore, a total of 2500 mL (1 composite sample) of cranberries were collected from each bog. This same protocol was used for pre- and post-spray sampling, including duplicate and control samples (i.e., a grand total of 16 composite samples for the first spray event and 8 composite samples for the second spray event, including field duplicates).

For the first spray event, three teams conducted both pre- and post-spray sampling in order to reach all the required geographical areas in a timely manner. Each team consisted of one member of the CCCGA and two staff members from MDPH/BEH. For the second spray event, two teams conducted the pre- and post-spray sampling. One team consisted of one member of the CCCGA and two staff members from MDPH/BEH and the other team had one staff member from each organization. The cranberries were harvested from the bogs by the members of the CCCGA because of their familiarity with the activity. Cranberries were removed using a traditional cranberry harvesting tool composed of metal and wood in the form of a scoop with teeth (see Figure 3).

The amount of product for typically filling one jar was scooped from the bog by the CCCGA member. The cranberries were then transferred to the glass jar (see Figure 4). Only cranberries were collected in each jar; sticks, vines and other non-cranberry material were excluded to the extent feasible. Each jar was filled to the top, but not packed.

Once they were filled and sealed with the lid, all jars were labeled with the name and code for the bog and the date and time of collection. The same information, along with details about the location of the bog, the locations for the individual samples, and other notes, were collected on a sampling log sheet. Filled jars were placed in a cooler with ice packs.

During sampling for both spray events, duplicate samples were collected in the same manner as the original samples. For the first spray event duplicates were taken at Tremont Street/Federal Furnace Road in Carver and for the second spray event they were taken at Plymouth Street in Bridgewater. Duplicate samples are used to assess the variability in analytical results that originate in the sampling technique or heterogeneity in the bulk material as present in the field. It is a standard quality control practice to collect and analyze duplicate samples for a percentage of sampling sites.

For the purposes of QA/QC, transit control samples (i.e. field blanks consisting of empty, untreated sample containers) were brought along during each sampling round; one in each sample collection cooler for a total of 6 transit controls for the first spray event and 4 for the second spray event. The control location in Wareham (outside of spray areas) was used to prepare laboratory controls and quality control samples.

No specific decontamination procedures were undertaken for the sampling tools used by the other teams; the same tool was used for sample collection without any specific cleaning between bogs. However, in sampling for both spray events, the control bog located in Wareham was sampled before any other bogs that team sampled to reduce the potential for cross contamination from the tools used. Decontamination was not deemed necessary because all the sample bogs were located in the treated areas.

Sample Handling and Shipping

Sample handling and shipping procedures were conducted in the same manner for samples from both spray events. Samples were held in coolers with ice packs until they were delivered later the same day to the MDPH State Laboratory Institute (SLI) in Jamaica Plain for temporary storage and shipment. For each of the four sampling rounds, the range of time between sample collection at the bogs and delivery to SLI was approximately two to four hours. At the SLI, the samples were logged in by staff and placed in freezers. Samples were kept frozen and then repackaged for shipment to the analytical laboratory, GPL, in Fresno, CA, on a day that GPL could receive the samples (e.g., SLI could not ship samples on a Friday because GPL was closed Saturday and Sunday; hence, SLI kept the berries frozen over the weekend until shipment could be made on Monday for Tuesday arrival at GPL). Samples sent to GPL were packaged with dry ice and sent via UPS next morning service. Transit control samples were labeled and shipped with the study samples for analysis. The samples were received the next morning as expected for each of the sampling events. Chain of custody forms were used to transmit the samples to GPL. Once at GPL, the cranberry samples were kept frozen until they were used for analysis.

Sample Analysis

Analysis of cranberries from both spray events was conducted in accordance with EPA, FIFRA, Good Laboratory Practice Standards (GLP); 40 CFR, Part 160, October, 1989. The analysis of sumithrin on cranberries was previously validated by GPL in study 060242 (GPL 2006a, 2006b). The analytical method measured sumithrin using liquid chromatography tandem mass spectrometry. The established limit of quantization (LOQ) is 10 ppb and the limit of detection (LOD) is 2.0 ppb.

The handling and analysis of samples at GPL were conducted in accordance with the written protocol from the laboratory. All analyses were performed in accordance with all Standard Operating Procedures (SOPs) for the lab and all deviations from SOPs were documented by the laboratory and described in the report they prepared for MDPH/BEH (GPL 2012).

III. RESULTS

Results of all analyses of cranberries for sumithrin revealed no detectable levels of sumithrin in any sample, whether taken prior to or after either spray event (see Tables 1 and 2) (GPL 2012)**.** The laboratory reported the Limit of Detection (LOD) was 2 parts per billion (ppb). A LOD is defined as the lowest detectable limit on a given instrument for a given analysis. The limit of quantization (LOQ) for the analysis was 10 ppb. The LOQ is defined as the lowest validated level established during method validation. In addition, the methods developed for the analysis of cranberries for sumithrin residues were successful under the quality assurance and quality control procedures used at the laboratory and were documented in a separate Good Laboratory Practices report to be produced by Golden Pacific Laboratories.

IV. DISCUSSION

Results from the testing of cranberries for sumithrin, an active ingredient of the pesticide used for aerial application in southeastern Massachusetts, showed no detectable levels of this compound in any cranberry sample, either pre- or post-application for both spray events (Not Detected, ND = 2 ppb). This means that the federal food tolerance for sumithrin residues (10 ppb) on cranberries was not exceeded. The post-application samples were taken approximately 72 hours after the final application. Therefore it is not expected that future applications of this pesticide will result in residues.

V. CONCLUSIONS

Since no measurable residues of sumithrin were detected in any of the cranberry samples, the consumption of cranberries harvested from bogs located in the spray areas would not be expected to pose health concerns. MDPH concludes that no exposure opportunities of health concern related to consumption of cranberries would be expected.

VI. RECOMMENDATIONS

The results of the cranberry samplings did not reveal the presence of sumithrin, hence, no specific recommendations or follow-up activities are recommended at this time.

Copies of this report will be provided to the Massachusetts Department of Agricultural Resources, the Cape Cod Cranberry Growers Association, and other interested parties.

VIII. REFERENCES

Golden Pacific Laboratories, LLC. 2006a. Analytical phase report: Determination of residues of sumithrin in cranberry samples, GPL study number 060242. Fresno, CA.

Golden Pacific Laboratories, LLC. 2006b. Study protocol: Determination of residues of sumithrin in cranberry samples, GPL study number 060242. Fresno, CA.

Golden Pacific Laboratories, LLC. 2012. Study protocol: Determination of residues of sumithrin in cranberry samples, GPL study number 120454. Fresno, CA.

United States Environmental Protection Agency (US EPA). 2008a. Memorandum: d-Phenothrin (Sumithrin®) Acute and Chronic Dietary and Drinking Water Exposure and Risk Assessment for the Reregistration Eligibility Decision (RED) and Petition PP# 7F7251 and Associated Section 3 Registration Action. US EPA Office of Prevention, Pesticides, and Toxic Substances, February 6, 2008.

United States Environmental Protection Agency (US EPA). 2008b. Memorandum: d-Phenothrin (Sumithrin®) Reregistration Eligibility Decision (RED) Document PC Code No. 069005; DP Barcode No. 326933 and Petition PP# 7F7251 and Associated Section 3 Registration Action. US EPA Office of Prevention, Pesticides, and Toxic Substances, February 6, 2008.

United States Environmental Protection Agency (US EPA). 2008c. Re-registration eligibility decision for d-Phenothrin. US EPA Office of Prevention, Pesticides, and Toxic Substances, September 25, 2008.

APPENDIX - Figures and Tables

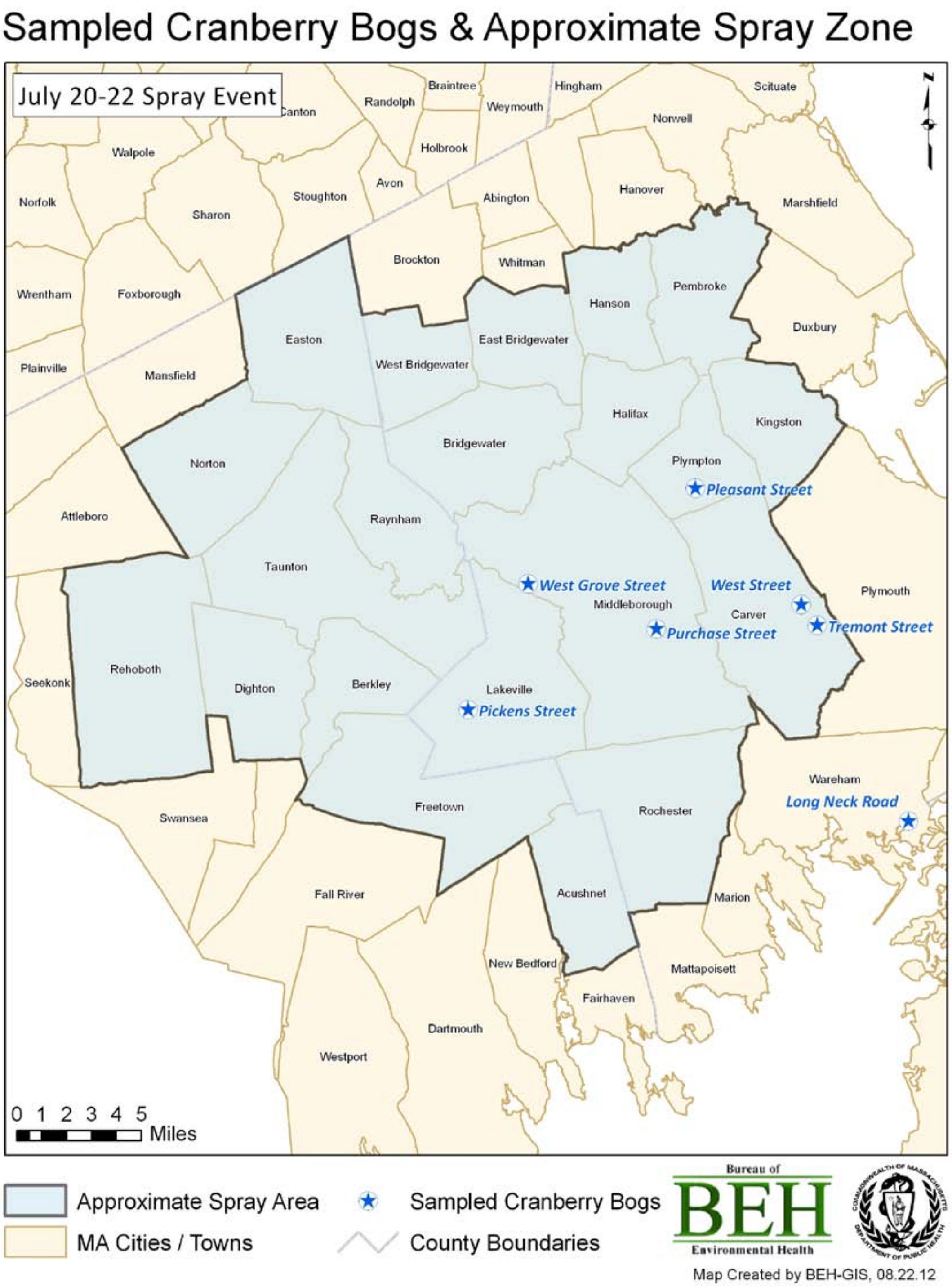

Figure 1: Geographic extent of July 20-22, 2012 aerial application with approximate bog sampling locations, Bristol and Plymouth Counties, MA

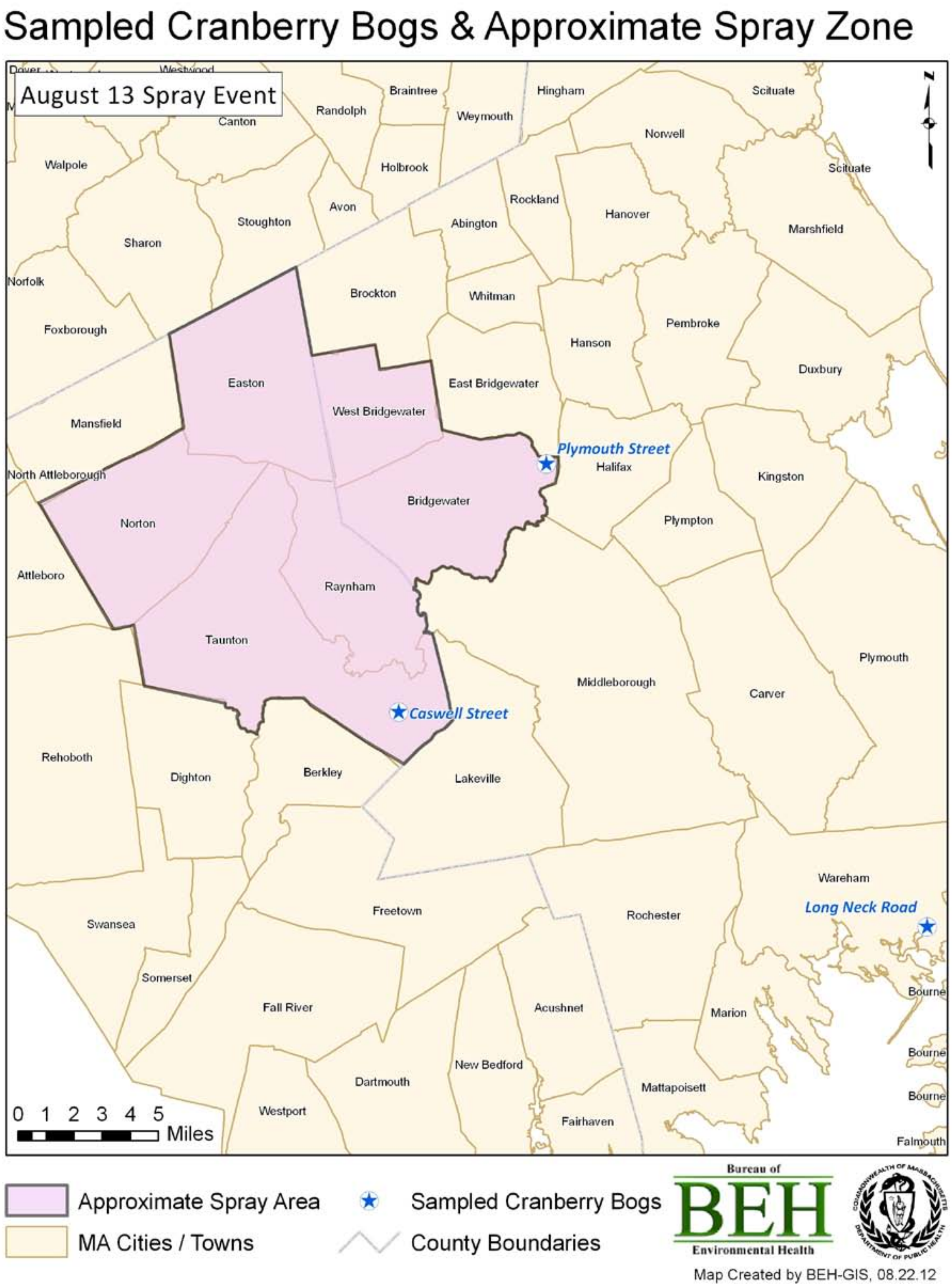

Figure 2: Geographic extent of August 13, 2012 aerial application with approximate bog sampling locations, Bristol and Plymouth Counties, MA

Figure 3: Cranberry Harvesting/Sampling Tool

Figure 4: Procedure for filling sample collection jar

Table 1: Results of pre- and post-spray samples collected July 17 and July 25, 2012

Table 1 of 1

Summary of Analytical Results of Sumithrin Residue in Cranberries

GPL Study # 120454 Sponsor Study # NA

Date Printed: 8/23/2012

Prepared By:

Extraction Set: 454SET01

Analysis Set: 454SET01

Extraction Date: 8/10/2012

Analysis Date: 8/10/2012

Injection Volume: 10 µL

Standard Injections: **Sumithrin**

Standard ID	Standard Amount (ng/mL)	Peak Area	Back Calc of Standard (ng/mL)	RPD
1141-9	0.250	4051.5	0.216	14.6
1141-8	0.500	8266.3	0.524	4.69
1141-7	1.00	15528.8	1.05	4.88
1141-6	2.00	28992.2	2.04	1.98
1141-5	5.00	70013.3	5.04	0.797
1141-4	10.0	135997.5	9.86	1.41
1141-7	1.00	15092.8	1.02	1.98

Curve Equation: $y = ax + b$

where y is response in peak area units

and x is concentration in ng/ml (1/x weighting)

a= 1.37×10^4

b= 1.1×10^3

Coefficient of Determination (r^2): 0.9992

Correlation Coefficient (r): 0.9996

RPD = Relative Percent Difference

where, $RPD = \frac{|\text{Std Back calc - Std Amount}|}{(\text{Std Back calc + Std Amount})} \times 2 \times 100$

NA = Not applicable

LOQ = Limit of Quantitation

ND = Not Detected

Sample Information:

Cranberries Lab ID	Location	Pre or Post Spray	Sample ID	Sample Amount (g)	Final Volume (mL)	Peak Area	Concentration from Curve (ng/mL)	Sample Concentration[1] (ppb)	Fortification Amount (ppb)	Percent Recovery[2] (%)
454SET01-2	Lab Spike	NA = Not applicable	Low Spike (0.01 ppm)	10.03	130	11069.9	0.729	9.45	9.97	94.8
454SET01-3	Lab Spike	NA = Not applicable	High Spike (0.1 ppm)	10.01	1300	11130.7	0.733	95.2	99.9	95.3
454SET01-1	Piscatelli/Onset, Wareham Control	Pre	PISC1 Composite	10.02	130	0.0	<0.250	ND	NA	NA
454SET01-4	Federal Furnace, Carver	Pre	FF1 Composite	10.00	130	0.0	<0.250	ND	NA	NA
454SET01-5	Federal Furnace, Carver Duplicate	Pre	FFDUP1 Composite	10.00	130	0.0	<0.250	ND	NA	NA
454SET01-6	Edgewood, Carver	Pre	WARD1 Composite	9.96	130	0.0	<0.250	ND	NA	NA
454SET01-7	Purchase,	Pre	PUR1 Composite	10.00	130	0.0	<0.250	ND	NA	NA
454SET01-8	Holloway, Plympton	Pre	HBB1 Composite	10.03	130	0.0	<0.250	ND	NA	NA
454SET01-9	West Grove, Middleborough	Pre	WG1 Composite	10.03	130	0.0	<0.250	ND	NA	NA
454SET01-10	Harju, Plympton	Pre	HAR1 Composite	10.03	130	0.0	<0.250	ND	NA	NA
454SET01-11	Piscatelli/Onset, Wareham Control	Post	PISC2 Composite	10.05	130	0.0	<0.250	ND	NA	NA
454SET01-12	Federal Furnace, Carver	Post	FF2 Composite	10.00	130	0.0	<0.250	ND	NA	NA
454SET01-13	Federal Furnace, Carver Duplicate	Post	FFDUP2 Composite	10.02	130	0.0	<0.250	ND	NA	NA
454SET01-14	Edgewood, Carver	Post	WARD2 Composite	10.01	130	3142.6	<0.250	<LOD	NA	NA
454SET01-15	Purchase,	Post	PUR2 Composite	10.00	130	0.0	<0.250	ND	NA	NA
454SET01-16	Holloway, Plympton	Post	HBB2 Composite	10.05	130	2373.8	<0.250	<LOD	NA	NA
454SET01-17	West Grove, Middleborough	Post	WG2 Composite	9.95	130	2398.4	<0.250	<LOD	NA	NA
454SET01-18	Harju, Plympton	Post	HAR2 Composite	10.01	130	0.0	<0.250	ND	NA	NA

[1] Sample Conc. in ppb = (Conc. from curve in ng/mL x Final Volume in mL) ÷ (Sample Amount (g)).

[2] Percent Recovery (%) = Sample Concentration in ppb ÷ Fortification Amount in ppb x 100.

Cranberries LOQ = 10 ppb, LOD = 2.0 ppb

Note: Sample Concentration, Percent Recovery and RPD values are calculated by Excel. All other calculations are performed by Analyst v. 1.5.2

These values are rounded to three significant figures and transcribed to the Excel spreadsheet.

Table 2: Results of pre- and post-spray samples collected August 13 and August 16, 2012

Table 1 of 1

Summary of Analytical Results of Sumithrin Residue in Cranberries

GPL Study # 120454 Sponsor Study # NA

Date Printed:	8/24/2012	Extraction Set:	454SET03
Prepared By:		Analysis Set:	454SET03
		Extraction Date:	8/22/2012
		Analysis Date:	8/22/2012
		Injection Volume:	10 µL

Standard Injections: **Sumithrin**

Standard ID	Standard Amount (ng/mL)	Peak Area	Back Calc of Standard (ng/mL)	RPD
1141-9	0.250	3056.1	0.249	0.401
1141-8	0.500	5807.9	0.480	4.08
1141-7	1.00	12387.7	1.03	2.96
1141-6	2.00	24301.9	2.03	1.49
1141-5	5.00	59979.6	5.02	0.399
1141-4	10.0	118570.0	9.94	0.602

Curve Equation: $y = ax + b$

where y is response in peak area units

and x is concentration in ng/ml (1/x weighting)

$a = 1.19 x 10^{4}$

$b = 88.2$

Coefficient of Determination (r^2): 0.9998

Correlation Coefficient (r): 0.9999

RPD = Relative Percent Difference

where, RPD = |Std Back calc - Std Amount| x 2 x 100 / (Std Back calc + Std Amount)

NA = Not applicable

LOQ = Limit of Quantitation

ND = Not Detected

Sample Information:

Cranberries Lab ID	Location	Pre or Post Spray	Sample ID	Sample Amount (g)	Final Volume (mL)	Peak Area	Concentration from Curve (ng/mL)	Sample Concentration[1] (ppb)	Fortification Amount (ppb)	Percent Recovery[2] (%)
454SET03-2	Lab Spike	NA = Not applicable	Low Spike (0.01 ppm)	10.01	130	8599.2	0.714	9.27	9.99	92.8
454SET03-3	Lab Spike	NA = Not applicable	High Spike (0.1 ppm)	9.98	1300	8834.8	0.734	95.6	100	95.6
454SET03-1	Piscatelli/Onset, Wareham Control	Pre	Control (P1SC3 Composite)	10.00	134	0.0	<0.250	ND	NA	NA
454SET03-4	Caswell Street, Taunton	Pre	MCY3 Composite	10.00	130	0.0	<0.250	ND	NA	NA
454SET03-5	Plymouth Street,	Pre	MNB3 Composite	10.00	130	0.0	<0.250	ND	NA	NA
454SET03-6	Plymouth Street,	Pre	MNBDUP3 Composite	10.00	130	0.0	<0.250	ND	NA	NA
454SET03-7	Piscatelli/Onset, Wareham Control	Post	PISC4 Composite	10.00	130	0.0	<0.250	ND	NA	NA
454SET03-8	Caswell Street, Taunton	Post	MCY4 Composite	10.00	130	0.0	<0.250	ND	NA	NA
454SET03-9	Plymouth Street,	Post	MNB4 Composite	10.01	130	0.0	<0.250	ND	NA	NA
454SET03-10	Plymouth Street,	Post	MNBDUP4 Composite	10.00	130	0.0	<0.250	ND	NA	NA

[1] Sample Conc. in ppb = (Conc. from curve in ng/mL x Final Volume in mL) ÷ (Sample Amount (g)).

[2] Percent Recovery (%) = Sample Concentration in ppb ÷ Fortification Amount in ppb x 100.

Cranberries LOQ = 10 ppb, LOD = 2.0 ppb

Note: Sample Concentration, Percent Recovery and RPD values are calculated by Excel. All other calculations are performed by Analyst v. 1.5.2

These values are rounded to three significant figures and transcribed to the Excel spreadsheet.