Massachusetts Department of Public Health

2008 MASSACHUSETTS ARBOVIRUS SURVEILLANCE AND RESPONSE PLAN

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Executive Summary

The 2008 MDPH Massachusetts Arbovirus Surveillance and Response plan provides surveillance and phased response guidance for both West Nile virus (WNV) and eastern equine encephalitis virus (EEE). The year 2007 was witness to continued West Nile virus activity across the state. In the past five years there have thirty-four cases of WNV infection reported in Massachusetts and thirteen human cases of EEE resulting in six deaths. This plan reflects a comprehensive review of surveillance activities, mosquito control efforts, public information and risk communication related to arbovirus control in Massachusetts.

The purpose of the plan is to provide guidance on operational aspects of surveillance and response by state and local agencies responsible for the prevention of mosquito-borne disease in the 2008 season. The Department of Public Health will continue to seek advice from its partners and collaborators and modify the plan, as appropriate. This document is open to continual review and evaluation. Information is provided to guide planning and actions to reduce the risk of human disease from EEE virus and WNV.

Key objectives contained in this plan provide for:

- the monitoring of trends in EEE virus and WNV activity in Massachusetts;
- the timely collection and dissemination of information on the distribution and intensity of WNV and EEE virus in the environment;
- the laboratory diagnosis of WNV and EEE cases in humans, horses and other mammals;
- the effective communication, advice and support of activities that may reduce risk of infection.

This document provides information about EEE and WNV disease and program goals, and specific guidelines for mosquito, avian, equine and human surveillance. Additionally, this document provides guidance for the dissemination of information, including routine information; media advisories of positive EEE virus and WNV findings in birds and mosquitoes, as well as public health alerts related to positive EEE and WNV human cases.

This plan describes MDPH's public outreach efforts to provide helpful and accurate communications to Massachusetts' citizens about their risk from arboviral diseases and specific actions that individuals and communities can take to reduce this risk.

Recommendations regarding the WNV phased response plan appear in Table 1 and incorporate components presented in the "Massachusetts Surveillance and Response Plan for Mosquito-Borne Disease", May 2004; as well as those presented in the Centers for Disease Control and Prevention (CDC) document, "Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance Prevention, and Control", 3rd Revision, 2003. Recommendations regarding the EEE virus phased response plan appear in Table 2 and incorporate information provided in the MDPH document, "Vector Control Plan to Prevent Eastern (Equine) Encephalitis", 1991, as well as analyses of additional surveillance data collected in Massachusetts since that time.

I. INTRODUCTION

The Massachusetts Department of Public Health (MDPH), in collaboration with regional mosquito control projects (MCPs), conducts surveillance for mosquito-borne viruses that pose a risk to human health. The Massachusetts Arbovirus Surveillance Program (MASP)

- tests mosquitoes, birds, veterinary specimens from horses and other mammals, and humans for evidence of infection; identifies areas of disease risk;
- provides information to guide decision-making to reduce the risk of disease;
- informs the public of where and when there is an increased risk of infection.

The MASP currently focuses on West Nile (WNV) and eastern equine encephalitis (EEE) viruses, which are found in the local environment and are capable of causing serious illness and death in human, horses and other mammals.

The 2008 Massachusetts Surveillance and Response Plan for mosquito-borne diseases is based on a comprehensive plan initially developed for WNV in 2001 in collaboration with local health agencies, other state agencies, academic institutions, the Centers for Disease Control and Prevention (CDC), and interested groups and individuals. It incorporates components of the state's EEE surveillance activities, which began in the 1950's and have continued since that time. The Massachusetts Arbovirus Surveillance Program (MASP) began monitoring for WNV following a 1999 outbreak of human WNV disease in the New York City area, the first known occurrence of this disease in North America. WNV was identified in birds and mosquitoes in Massachusetts during the summer of 2000 and has been found during each consecutive season.

The updated 2008 plan is the result of analyses of surveillance data collected in Massachusetts and the United States. In addition, in order to manage the complexity of the human disease risk posed by these viruses, MDPH convened four workgroups that advised MDPH and promoted collaborative efforts by multiple agencies and interest groups. The purpose of the plan is to provide guidance on operational aspects of surveillance and response by the state and local agencies with responsibilities for the prevention of mosquito-borne disease. MDPH will continue to seek advice from its partners and collaborators and modify the plan, as appropriate. This document is open to continual review and evaluation with changes made when there is opportunity for improvement.

II. DISEASE BACKGROUND

The two principal mosquito-borne viruses (also known as arboviruses, for **ar**thropod-**bo**rne viruses) recognized in Massachusetts and known to cause human and animal disease are eastern equine encephalitis virus with the first human cases identified in both the United States and Massachusetts in 1938, and West Nile virus, with the first human case identified in the United States in 1999, and in Massachusetts in 2001.

Eastern Equine Encephalitis Virus

Background

Eastern equine encephalitis is a serious disease with 30-50% mortality and lifelong neurological disability among many survivors, which occurs sporadically in Massachusetts. The first symptoms of EEE are fever (often 103º to106ºF), stiff neck, headache, and lack of energy. These symptoms show up three to ten days after a bite from an infected mosquito. Inflammation and swelling of the brain, called encephalitis, is the most dangerous and frequent serious complication. The disease gets worse quickly

and some patients may go into coma within a week. There is no treatment for EEE. In Massachusetts, approximately half of the people identified with EEE have died from the infection. People who survive this disease will often be permanently disabled. Few people recover completely.

Historically, clusters of human cases have occurred in cycles lasting 2-3 years, with a hiatus of 10-20 years between outbreaks. In the years between outbreaks, isolated cases may occur. Outbreaks of human EEE disease in Massachusetts occurred in 1938-39 (35 cases, 25 deaths), 1955-56 (16 cases, 9 deaths), 1972-74 (6 cases, 4 deaths), 1982-84 (10 cases, 3 deaths), 1990-92 (4 cases, 1 death), 2004-06 (13 cases, 6 deaths).

Massachusetts Eastern Equine Encephalitis Experience		
Year(s)	Human EEE Cases	Human EEE Deaths
1938-39	35	25
1955-56	16	9
1972-74	6	4
1982-84	10	3
1990-92	4	1
2004-06	13	6

The Massachusetts Department of Public Health, with CDC funding, initiated a field surveillance program in 1957; following a 1955-56 outbreak of EEE. The purpose of the program was to gather data to guide prevention and risk reduction of this disease.

Risk Factors for Disease Transmission

Eastern equine encephalitis virus is an alphavirus enzootic in some passerine bird species found in fresh-water swamp habitats. The virus is transmitted among wild birds in these areas primarily by *Culiseta melanura*, a mosquito species that feeds predominantly on birds. This mosquito-borne virus has a cycle of natural infection among bird populations with occasional ‘‘incidental” symptomatic infections of humans, horses, llamas, alpacas, emus and ostriches. The prevalence of infection among birds is related to the prevalence in bird-feeding mosquitoes. When infections become more prevalent among birds, infection rates may also rise in mosquitoes that feed indiscriminately on birds and other animals. Thus, infection within these bridge vector mosquitoes seems to enhance the risk of infection to people.

Outbreaks involving two or more human infections associated temporally and spatially; occur with the convergence of several factors. A major factor that affects the risk of disease in humans is the prevalence of immunity to EEE virus in the birds that serve as the enzootic reservoir of the virus. EEE virus infection in passerine birds usually results in a mild infection. Following infection, birds become immune to the virus and will not harbor it. Following a year of increased viral transmission, the prevalence of EEE immunity in birds increases and in subsequent years, the virus may not be able to spread rapidly among these reservoir hosts due to the establishment of ‘herd immunity’. Thus, elevated levels of herd immunity in birds reduce the amplification of EEE virus in the bird-mosquito-bird cycle, which in turn reduces the chance of incidental infections in humans.

The risk of infection in humans is a function of exposure to infected human-biting mosquitoes. Certain kinds of mosquitoes are highly selective as to the kind of host they will seek and feed upon. *Culiseta melanura* (*Cs. melanura*) mosquitoes feed primarily on birds and are recognized as the predominant vector of EEE virus transmission between the passerine birds that are the reservoir of the virus. Thus, the intensity of enzootic EEE virus transmission correlates with the abundance of this enzootic vector. If the herd immunity level against EEE virus of these birds is high, (i.e. few susceptible birds) due to several years of prior exposure, then there is little opportunity for the virus to perpetuate or amplify within the bird population. When herd immunity is low and there are many susceptible birds; EEE virus infections can spread more rapidly and more widely among the birds. This condition may enhance the potential for

transfer of EEE virus to humans by a 'bridge vector' mosquito, i.e., a species that is indiscriminant and will feed on birds or humans, such as *Coquillettidia perturbans, Ochlerotatus canadensis, Aedes vexans and Culex species.*

The risk of EEE virus infection in humans varies by geographical area in Massachusetts, as well as in the United States. EEE is more prevalent in areas that support dense populations of passerine birds and have favorable breeding conditions for the enzootic vector. In Massachusetts, these areas consist mainly of large wetlands containing mature white cedar and red maple swamps that are more common in southeastern Massachusetts. The majority of EEE cases have occurred in Norfolk, Bristol, and Plymouth counties with some cases also occurring in Middlesex County, rarely in Essex County and very rarely in Worcester County or further west. Historically, Cape Cod and the Islands of Martha's Vineyard and Nantucket have not had human cases of EEE.

Other major factors that affect the risk of EEE virus infections for humans are the abundance of specific kinds of mosquitoes at critical periods of the transmission season, groundwater levels and the timing of rainfall and flooding during the mosquito season. Participation in outdoor activities increases the risk of exposure while the use of personal protective measures (e.g., avoidance of mosquitoes, use of repellent) helps to reduce the risk of exposure.

Long-term weather patterns during the fall and winter that include high ground water levels and snow cover may enhance survival of *Cs. melanura* larval populations. The abundance of these larval populations may serve as an early indicator of the potential for human disease later in the year. Multiple factors affect the development, survival, and abundance of mosquitoes. It is not currently possible to predict either the abundance of mosquitoes or the risks of encountering an infected vector later in the season. The best control approach to reduce these vectors must consider multiple factors. One approach calls for beginning integrated pest management (IPM) control activities early in the season and targeting both the enzootic and human biting vector species.

West Nile Virus

Background

West Nile Virus (WNV) first appeared in the United States in 1999. Since its initial outbreak in New York City, the virus has spread across the US from East to West. WNV infection may be asymptomatic in some people, but it leads to morbidity and mortality in others. WNV causes sporadic disease of humans, and occasionally results in significant outbreaks. Nationally, over 3600 human cases of WNV neuroinvasive disease (West Nile meningitis and West Nile encephalitis) and WNV fever were reported to the CDC in 2007.

The majority of people who are infected with WNV (approximately 80%) will have no symptoms. A smaller number of people who become infected (~ 20%) will have symptoms such as fever, headache, body aches, nausea, vomiting, and sometimes swollen lymph glands. They may also develop a skin rash on the chest, stomach and back. Less than 1% of people infected with WNV will develop severe illness, including encephalitis or meningitis. The symptoms of severe illness can include high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness and paralysis. Persons older than 50 years of age have a higher risk of developing severe illness. In Massachusetts, there were six fatal WNV human cases identified between 2001-2007, all in individuals eighty years of age or older.

Following the identification of WNV in birds and mosquitoes in Massachusetts during the summer of 2000, MDPH arranged meetings between local, state and federal officials, academicians and the public to develop recommendations to improve and strengthen key aspects of the state plan for mosquito-borne

virus surveillance and prevention of mosquito-borne disease. Four workgroups addressed the issues of surveillance, risk reduction interventions, pesticide toxicity and communication.

Risk Factors for Disease Transmission

West Nile (WN) virus is amplified by a cycle of continuous transmission between mosquito vectors and bird reservoir hosts. Infectious mosquitoes carry virus particles and infect susceptible bird species. WNV infection is often fatal in some species of birds, particularly American crows and blue jays (corvids). Confirmation of WNV in dead birds provides sentinel information useful for assessing risk of human WNV infections.

The principal mosquito vector for West Nile virus on the East coast is the Culex species. These species may be abundant in urban areas, breeding easily in artificial containers such as birdbaths, discarded tires, buckets, clogged gutters, and other standing water sources. *Culex pipiens* feeds mainly on birds and occasionally on mammals. It will bite humans, typically from dusk into the evening. *Culex restuans* feeds almost primarily on birds but has been known to bite humans on occasion. Brackish and freshwater wetlands are the preferred habitat for *Culex salinarius* which feeds on birds, mammals, and amphibians and is well known for biting humans. *Ochlerotatus japonicus* may be involved in the transmission of both WNV and EEE virus. Natural and artificial containers such as tires, catch basins, and rock pools are the preferred larval habitat of this mosquito. It feeds mainly on mammals and is a fierce human biter.

Activity of the West Nile virus zoonotic cycle varies from year to year. When a large number of infected birds and a high rate of infected mosquitoes are found in a relatively small geographic area, the risk of transmission of virus to humans will increase.

A summary of current and historical surveillance information for EEE virus and WNV in Massachusetts is available at **www.mass.gov/dph**.

III. PROGRAM GOALS

Timely and accurate information provided by the MDPH based on surveillance information can be used to provide an indication of the level of risk of human disease from WNV and EEE. Based on this surveillance information, plans and actions to reduce risk can be developed and implemented when needed.

Specific Program Priorities

1. Test mosquitoes, birds, horses, humans and other animals to identify EEE virus and WNV infections.
2. Track trends in incidence and prevalence of EEE virus and WNV infections by geographic area.
3. Estimate viral infection rates in birds and mosquitoes.
4. Stratify risk o geographic areas as a function of their relative risk of human disease.
5. Conduct surveillance for human and equine disease.
6. Educate human and animal medical practitioners on the appropriate procedures for detecting and identifying infections and disease caused by mosquito-borne viruses.
7. Recommend measures to reduce virus transmission and disease risk.
8. Provide information to the public on mosquito-borne diseases and disease risk, and on common-sense precautions to reduce the risk of infection.
9. Participate in the national Arbovirus surveillance network coordinated by the CDC.

Roles

1. Massachusetts Department of Public Health (MDPH)
The central purpose of the Massachusetts Arbovirus Surveillance Program (MASP) is to provide information that will guide planning and actions to reduce the risk of human disease from EEE virus and WNV. To achieve this, the main objectives are to monitor trends in EEE virus and WNV in Massachusetts; provide timely information on the distribution and intensity of WNV and EEE virus in the environment; perform laboratory diagnosis of WNV and EEE cases in humans, horses and other mammals; communicate effectively with officials and the public; provide guidelines, advice and support on activities that effectively reduce risk of disease; and provide information on the safety, anticipated benefits and potential adverse effects of proposed prevention interventions.

MDPH works cooperatively with the Massachusetts State Reclamation and Mosquito Control Board (SRMCB) and with regional mosquito control projects to identify and support the use of safe and effective mosquito control measures based on integrated pest management (IPM) principles. The application of pesticides as a means to reduce human risk is one of several methods/strategies to attain this goal.

2. State Reclamation and Mosquito Control Board (SRMCB)

The State Reclamation and Mosquito Control Board (SRMCB) oversees mosquito control in the Commonwealth of Massachusetts. The SRMCB consists of three (3) members representing the Department of Agricultural Resources (DAR), Department of Conservation and Recreation (DCR), and Department of Environmental Protection (DEP). Additionally, the SRMCB advises its respective state agency Commissioners on actions to reduce mosquito populations based on MDPH findings and characterization of risk.

The SRMCB 'Operational Response Plan to Reduce the Risk of Mosquito-Borne Disease in Massachusetts' addresses the issues related to the operational aspect of adult mosquito surveillance and control to prevent and/or reduce the risk of mosquito-borne diseases.

In 2006, the SRMCB created an SRMCB Mosquito Advisory Group (MAG). The MAG provides independent scientific advice to the SRMCB to assist them in evaluating and assessing data from both DPH and mosquito control projects

3. Mosquito Control Projects (MCP)
There are nine (9) organized mosquito control projects or districts located throughout Massachusetts. All of the mosquito control activities of these organized agencies are performed under the aegis of the State Reclamation and Mosquito Control Board (SRMCB). Mosquito Control Projects collaborate with local boards of health in their jurisdictions to control mosquitoes. These locally authorized efforts employ a variety of targeted activities for source reduction, larviciding and adulticiding that are in compliance with the SRMCB Operational Response plan.

IV. SURVEILLANCE

A. Mosquito Surveillance for West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE) Virus

Surveillance of mosquitoes for arboviruses is one of the core functions of the MASP. Monitoring mosquitoes for the presence of virus provides a direct estimate of risk to humans. Massachusetts has a long-term field surveillance program that was initiated in 1957 for EEE virus and was modified in 2000 to include WNV surveillance. The extensive experience in Massachusetts with surveillance for mosquito-borne disease provides expertise and capacity to guide risk reduction efforts. The MASP uses a

comprehensive and flexible strategy that modifies certain surveillance activities in response to trends in disease risk.

On an ongoing basis, MASP will continue to monitor national and regional surveillance data and current scientific literature to assess risk of newly emerging arboviruses in Massachusetts. In addition, defined subsets of mosquito pools will be evaluated by MDPH for the presence of new or emerging viruses

1. Fixed and Long-Term Trap Sites: MASP will collect mosquitoes from areas with activity during the previous year, and from long-term trap sites maintained in the EEE virus high-risk areas of southeastern and eastern Massachusetts (Figure 1). Trapping of gravid mosquitoes for testing of WNV is conducted both by mosquito control projects and MDPH staff at various locations throughout the state during the arbovirus season. At the State Laboratory Institute (SLI), samples (pools of 1- 50 specimens) of trapped mosquito collections are assayed for WNV and EEE virus. Test results from routine mosquito collections are available within 24-48 hours. Fixed and long-term trap sites provide the best available baseline information for detecting trends in mosquito abundance and virus prevalence and for estimating the relative risk of human infection from EEE virus and WNV. MDPH will monitor larvae from select sites in late fall and early spring to determine end-season and pre-season larval abundance. Monitoring of larval abundance from these sites will continue on a weekly basis during the arbovirus season.

2. Supplemental Trap Sites: When EEE virus or WNV activity, or increased WNV bird deaths, are detected in an area, additional trap sites and/or trap types will be used to obtain more information regarding the intensity of virus activity in mosquitoes. The following risk indicators may result in the implementation of more intensive mosquito trapping: 1) virus isolations in mosquitoes; 2) increasing or significant numbers of bird deaths associated with WNV; 3) emergence of large numbers of human-biting mosquitoes in an area with a high rate of virus activity and 4) human or equine cases

3. Mosquito Control Project Trap Sites: Massachusetts mosquito control projects (MCP's), are organized under the State Reclamation and Mosquito Control Board (SRMCB), located within Department of Agricultural Resources. The SRMCB is composed of three members; representing the Department of Agricultural Resources; the Department of Environmental Protection; and the Department of Conservation and Recreation. MCP's and the SRMCB communicate collaboratively with the MASP. The mosquito control projects employ comprehensive, integrated mosquito management (IMM) programs based on integrated pest management (IPM) principles.

The IMM program uses a variety of available control strategies to impact mosquito abundance. Monitoring mosquito abundance is accomplished through various surveillance methods including but not limited to larval dip counts, the use of light/ CO_2 baited traps and gravid traps.

B. Avian Surveillance: West Nile Virus (WNV) and Eastern Equine Encephalitis Virus (EEE virus)

1. Dead Bird Reports: Because WNV causes death in certain species of birds, and the mortality rate from infection for the American crow is high, we expect that dead birds may be the first warning of WNV activity in an area. The association between corvid deaths and WNV activity is well established. The MASP tracks dead bird reports provided by local and state officials, and from the public. MASP will request that crows and blue jays, representing the species most likely to experience mortality due to WNV, be submitted for testing, and will provide a pickup service for designated regional repositories to assist local communities in the transport of specimens to MDPH. Most kinds of birds that are infected with EEE virus survive the viremia, making dead bird EEE virus monitoring impractical. Thus, MASP does not utilize dead bird reports for EEE virus monitoring.

MASP will record and analyze dead bird reports, which will be used to identify areas for intensified surveillance of WNV activity including bird testing, and mosquito trapping. Reports of dead birds are taken via a toll-free telephone number at MDPH (866 MASS WNV, or 866-627-7968), which may be used by local officials and the public. At the time of the report, information on the location and type of bird will be collected and entered into a surveillance database. The caller will be informed if the reported bird is to be tested, and arrangements will made for pickup and delivery if needed. Otherwise the caller will be informed of proper disposal procedures for the dead bird.

These reports are summarized daily and provided to local health agents, the public and the media via a public website (**www.mass.gov/dp**h.)

2. Laboratory Testing of Dead Wild Birds for West Nile Virus (WNV) and Eastern Equine Encephalitis Virus (EEE virus): The MASP will collect and test dead birds, primarily crows and blue jays, for WNV. Routine testing is generally completed within 24-48 hours. Confirmatory testing, when necessary, may take approximately four working days**.** After WNV infection of a bird population has been established by confirmation of two WNV avian specimens within a focal area, further routine bird testing will discontinued in that area. Boston and areas defined as 'Boston neighborhoods' are considered to be one geographic focal area. Therefore, avian testing will continue until two positives are identified within this focal area. Following the finding of two WNV specimens, and in the presence of continued bird deaths, a limited sample of dead birds may be tested to confirm that additional bird deaths are the result of WNV infection. In addition, ongoing evaluation of reports of dead birds may indicate the need for increased testing of birds and/or mosquitoes to better assess virus transmission among the bird and mosquito populations at particular times throughout the season.

Most birds that are infected with EEE virus generally survive the viremia, making dead bird EEE virus monitoring impractical. MASP does not conduct routine surveillance of EEE in birds for public health surveillance purposes because it does not provide additional information useful for determining levels of human risk. Testing of individual bird specimens for EEE infection will be determined on an as-needed basis as determined by the MDPH Public Health Veterinarian and the MASP. The MDPH Pubic Health Veterinarian will determine the appropriateness of testing specimens from dead bird clusters for both for WNV and EEE infections.

3. Laboratory Testing of Live Birds: The MASP may capture, bleed and release birds during the season to collect supplemental information about virus activity in an area where infections in birds are increasing.

C. Animal Surveillance: West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE) Virus

Testing for WNV and EEE virus: Specimens from horses and other domestic animals that have severe neurological disease suspected of being caused by EEE virus or WNV infection are tested at SLI. Confirmatory testing, when necessary, may take up to nine working days. Massachusetts' veterinarians, the state Department of Agricultural Resources, USDA and Tufts University School of Veterinary Medicine collaborate with the MASP to identify and report suspect animal cases. In addition, blood samples from other sources such as zoos, horse stables or wild animals may be tested. Current information on WNV and EEE virus infections in horses along with clinical specimen submission procedures are disseminated to large animal veterinarians, stable owners, and other populations as needed, through mailings and postings on the MDPH Arbovirus website at www.mass.gov/dph. Many horses are immunized against infection with WNV and EEE virus with available veterinary vaccines. This is the primary means of preventing infection in horses.

D. Human Surveillance

1. Passive surveillance: Specimens from clinical cases of encephalitis and meningo-encephalitis are submitted to MDPH and screened for possible causes of infection, including WNV and EEE virus. Confirmatory testing, when necessary, may take three to seven working days. Selected cases of other human disease, such as aseptic meningitis, may be screened, if appropriate. Current information on WNV and EEE virus infections in humans along with clinical specimen submission procedures are disseminated to physicians (infectious disease, emergency medicine and primary care), emergency room directors and hospital infection control practitioners through mailings, broadcast faxes, and postings on the MDPH Arbovirus website at www.mass.gov/dph.

2. Active surveillance: If surveillance data indicate a high risk of human disease, active surveillance may be instituted in targeted areas. Active surveillance involves regularly contacting local health care facilities to communicate current surveillance information, prevention strategies and specimen submission procedures. HHAN (Health and Homeland Alert Network) alerts are sent to local boards of health upon confirmation of EEE virus or WNV virus in any specimen; health care facilities are advised of increased risk status and the corresponding need to send specimens to SLI for testing.

3. Pesticide related surveillance: Outreach on pesticide illness reporting will be coordinated by the MDPH Bureau of Environmental Health. In the event of an aerial pesticide application, active surveillance efforts will be implemented with emergency departments and intensified outreach efforts will be made to health care providers.

V. Prevention and Control

The MASP will provide information to guide planning and actions to reduce the risk of human disease from EEE virus and WNV. MDPH works to identify and support the use of risk reduction and disease prevention methods that are specific to the causes of disease; and supports planning and practices which incorporate the most appropriate prevention methods and appropriate use of pesticides.

Communication of Information

1. Routine Information:

Prior to the beginning of the Arbovirus season, general disease information and specimen submission procedures will be provided to local boards of health via electronic messages from the Massachusetts Health and Homeland Alert Network (HHAN). General information and fact sheets are posted on the MDPH Arbovirus website and available for Mosquito Control Projects, physicians, veterinarians, animal control officers, and other agencies.

2. Positive EEE Virus and WNV Findings in Mosquitoes, Birds, Horses (and other Veterinary Specimens), and Humans:

Laboratory confirmation of a human WNV or EEE case is immediately reported by telephone to the submitting physician, and Local Board of Health (LBOH) in the town where the case resides. If the LBOH cannot be reached via telephone in a timely manner, a severe level HHAN alert will be sent.

Laboratory confirmation of a horse (or other veterinary specimen) with WNV or EEE virus infection will be immediately reported by telephone to the submitting veterinarian, the Department of Agricultural Resources- Bureau of Animal Health, Biosecurity and Dairy Services and the LBOH. As with human cases, if the LBOH cannot be reached in a timely manner, a severe level HHAN alert will be sent.

Initial positive findings in birds (WNV) and mosquitoes (WNV and EEE) from a given town will be reported to the LBOH by telephone. Adjacent towns will be notified via a moderate level HHAN alert. Any

additional positive findings in birds or mosquitoes will be reported simultaneously to the town and adjacent towns via a moderate level HHAN alert.

At the time of notification, MDPH will encourage local Boards of Health to share the information with other local agencies and high-risk populations in their community as appropriate. MDPH provides local Boards of Health with sample press releases for their use. Depending on the circumstances, MDPH may also issue a public health alert. In addition, weekly summaries of results from avian samples submitted and tested will be posted as News Items on the HHAN by town.

All laboratory confirmed results for WNV and EEE virus in humans, horses, other veterinary specimens, mosquitoes and birds are provided to the regional health department representative, mosquito control projects and members of the State Reclamation and Mosquito Control Board (SRMCB) once the LBOH has been notified.

After all appropriate individuals and agencies have been sent notification, positive surveillance findings are made available to the media and general public on the MDPH Arbovirus website at www.mass.gov/dph. This website, which also includes a variety of educational materials related to preventing mosquito-borne diseases, is updated on a daily basis throughout the Arbovirus season. Results are also reported to the CDC's Arbonet reporting system.

3. Public Health Alerts and Media Advisories: MDPH issues public health alerts through the media when surveillance information indicates an increased risk of human disease or if a significant surveillance event occurs (for example, the first arbovirus activity of the season). In general, alerts will include current surveillance information and emphasize prevention strategies. Alerts will be drafted in consultation with outside state and local agencies, as indicated.

VI. Recommendations for a Phased Response to EEE virus and WNV Surveillance Data

The recommendations provided here are based on current knowledge of risk and appropriateness of available interventions to reduce the risk for human disease. Multiple factors contribute to the risk of mosquito-transmitted human disease. Decisions on risk reduction measures should be made after consideration of all surveillance information for that area at that time.

Recommendations regarding the WNV phased response plan (Table 1) incorporate several components presented in the "Massachusetts Surveillance and Response Plan for Mosquito-Borne Disease", May 2004, as well as those presented in the CDC document, "Epidemic/Epizootic West Nile virus in the United States: Guidelines for Surveillance Prevention, and Control", 3rd Revision, 2003.

Recommendations regarding the EEE virus phased response plan (Table 2) incorporate information provided in the MDPH document, "Vector Control Plan to Prevent Eastern (Equine) Encephalitis", 1991, and results of analyses of additional surveillance data collected in Massachusetts since that time.

Public awareness of what can be done to reduce risk of infection is of utmost importance. The level of EEE virus and WNV activity may occasionally present a potential for increased virus transmission to humans. Typically, risk is expected to be relatively low, and the routine precautions taken by individuals may be sufficient to reduce opportunities for infection. These guidelines take into consideration the complexity of reducing risk of human disease from EEE virus and WNV infection and form a framework for decision-making.

2. Phased response

General guidelines are provided for an array of situations that are noted in the Surveillance and Response Plan Tables that follow. Specific situations must be evaluated individually and options discussed before final decisions on specific actions are made. The assessment of risk from mosquito-borne disease is complex and many factors modify specific risk factors. MDPH works with local public health agencies, mosquito control projects, and the SRMCB to develop the most appropriate prevention activities to reduce the risk of human disease. There is no single indicator that can provide a precise measure of risk, and no single action that can assure prevention of infection.

When recommending the use of mosquito larvicides or adulticide, MDPH works collaboratively with SRMCB and with regional mosquito control projects to identify and support the use of safe and effective mosquito control measures based on integrated pest management (IPM) principles.

A. MDPH Guidance:

The MDPH Arbovirus Program will determine human risk levels as outlined in the phased response tables of this plan. Risk levels are defined for focal areas. "Focal Areas" may incorporate multiple communities, towns or cities. Factors considered in the determination of human risk in a focal area include: mosquito habitat, prior isolations, human population densities, timing of recent isolations of virus in mosquitoes, the cyclical nature of human outbreaks (EEE), current and predicted weather and seasonal conditions needed to present risk of human disease.

If the risk of an outbreak is widespread and covers multiple jurisdictions, MDPH will confer with local health agencies, SRMCB, MCP's, and MAG to discuss the use of intensive mosquito control methods and determine whether measures need to be taken by the agencies to allow for and assure that the most appropriate mosquito control interventions are applied to reduce risk of human infection. These interventions may include state-funded aerial application of mosquito adulticide. Factors to be considered in making this decision include the cyclical, seasonal and biological conditions needed to present a continuing high risk of WNV or EEE human disease.

Once significant human risk has been identified in a focal area by MDPH, MDPH will coordinate with the SRMCB to determine the adulticide activities that should be considered and implemented in response. The SRMCB will provide recommendations on appropriate pesticide(s), extent, route and means of treatment, and the location of specific treatment areas.
Based on historical experience with EEE virus, MDPH has identified specific critical indicators for EEE virus and provides specific risk reduction and prevention guidance for seasons with an anticipated increased EEE risk.

3. Risk Reduction and Prevention Guidance for Seasons with Indicators of Increased EEE Risk:

a. MDPH may increase the number of public health alerts throughout the season to remind the public of the steps to take to reduce their risk of exposure to mosquitoes.

b. MCP's may increase their source reduction activities to reduce mosquito-breeding habitats and to reduce adult mosquito abundance. This may include ground and aerial larviciding.

c. After sustained findings of positive mosquito isolates, if not already in progress, adult mosquito control efforts including targeted ground adulticiding operations should be considered. The decision to use ground-based adult mosquito control will depend on critical modifying variables including the time of year, mosquito population abundance and proximity of virus activity to at-risk populations.

d. Other intensified efforts may be implemented following coordinated recommendations from MDPH and other agencies including DEP, MDAR, and DCR.

Table 1. Guidelines for Phased Response to WNV Surveillance Data

Risk Category	Probability of human outbreak	Definition of Risk Category for a Focal Area[1]	Recommended Response
1	Remote	All of the following conditions must be met: <u>Prior Year</u> No prior year WNV activity detected in the focal area. And <u>Current Year</u> No current surveillance findings indicating WNV activity in birds or mosquitoes in the focal area And No horse or human cases.	1. MDPH staff provides educational materials and clinical specimen submission protocols to targeted groups involved in arbovirus surveillance, including, but not limited to, local boards of health, physicians, veterinarians, animal control officers, and stable owners. 2. Educational efforts directed to the general public on personal prevention steps and source reduction, particularly to those populations at higher risk for severe disease (e.g., the elderly). 3. Routine avian surveillance activities: Dead bird reporting and recorded information via MDPH Public Health Information Line. 4. Assess mosquito populations, monitor larval and adult mosquito density. 5. Routine collection and testing of mosquitoes. 6. Initiate source reduction; use larvicides at specific sites identified by entomologic survey. In making a decision to use larvicide consider the abundance of *Culex* larvae, intensity of prior virus activity and weather. 7. Locally established, standard, adult mosquito control activities are implemented. No specific supplemental control efforts are recommended. 8. Passive human and horse surveillance. 9. Emphasize the need for schools to comply with MA requirements for filing outdoor IPM plans.

[1] Focal Area- May incorporate multiple communities, towns or cities. Factors considered in determination of human risk in a focal area include mosquito habitat, prior isolations, human population densities, timing of current isolations of virus in mosquitoes, the cyclical and seasonal conditions needed to present risk of human disease

2	Low	Prior Year Any WNV activity in birds or mosquitoes in the community or focal area Or Current Year Sporadic WNV activity in mosquitoes in the focal area. Sporadic activity is defined when 1-2 isolates are found within 1-2 weeks of routine collections; or, one WNV positive bird And No horse or human cases	Response as in category 1, plus: 1. Expand community outreach and public education programs, particularly among high-risk populations, focused on risk potential and personal protection, emphasizing source reduction. 2. Increase larval control and source reduction measures. 3. Public health alert sent out by MDPH in response to first WNV virus positive bird and mosquito pool detected during the season. The alert will summarize current surveillance information and emphasize personal prevention strategies. 4. Locally established standard adult mosquito control activities continue.
3	Moderate	Prior Year Confirmation of one or more human or horse WNV cases; or sustained WNV activity in mosquitoes and/ or birds for 2 or more weeks. Or Current year Sustained WNV activity for 2 or more weeks in birds* and /or mosquitoes (<15 mosquito isolates from routine collections) * Two confirmed WNV positive birds in a community or focal area And No horse or human WNV cases	Response as in category 2, plus: 1. Outreach and public health educational efforts are intensified including media alerts as needed. 2. If not already in progress, standard, locally established adult mosquito control efforts including targeted ground adulticiding operations should be considered against *Culex* mosquitoes and other potential vectors, as appropriate. The decision to use ground-based adult mosquito control will depend on critical modifying variables including the time of year, mosquito population abundance and proximity of virus activity to at-risk populations. 3. Duly authorized local officials may request that DPH Commissioner issue a certification that pesticide application is necessary to protect public health in order to preempt homeowner private property no-spray requests. 4. Supplemental mosquito trapping and testing may be performed in areas with positive WNV findings. 5. Local boards of health are contacted via phone or HHAN (Health and Homeland Alert Network) upon confirmation of WNV in any specimen. Advise health care facilities of increased risk status and corresponding needs to send specimens to SLI for testing.

4	High	Current Year Sustained or increasing WNV activity in mosquitoes with mosquito isolates ≥ 15 from routine collections in a community or focal area. Sustained elevated minimum infection rates for MDPH WNV trap sites And/or MDPH confirmation of WNV in a horse at any time And/or, MDPH confirmation of WNV in a human at any time	Response as in category 3, plus: 1. Intensify public education on personal protection measures including avoiding outdoor activity during peak mosquito hours, wearing appropriate clothing, using repellents and source reduction. a. Utilize multimedia messages including public health alerts from MDPH, press releases from local boards of health, local newspaper articles, cable channel interviews, etc. b. Encourage local boards of health to actively seek out high-risk populations in their communities (nursing homes, schools, etc.) and educate them on personal protection d. Advisory information on pesticides provided by MDPH Center for Environmental Health. e. Urge towns and schools to consider rescheduling outdoor events. 2. Intensify and expand active surveillance for human cases. 3. Intensify larviciding and/or adulticiding control measures where surveillance indicates human risk. Local, ground- based ULV applications of adulticide may be repeated as necessary to achieve adequate mosquito control. Town or city may request preemption of homeowner private property no-spray requests. 4. Local officials should evaluate all quantitative indicators including population density and time of year and may proceed with focal area aerial adulticiding. 5. Duly authorized local officials may request that the DPH Commissioner issue a certification that pesticide application is necessary to protect public health in order to preempt homeowner private property no-spray requests. 6. MDPH will confer with local health officials, SRMCB and Mosquito Control Projects to determine if the risk of disease transmission threatens to cause multiple human cases and warrants classification as level 5.

5	Critical	<u>Current Year</u> More than 1 confirmed human case in a community or focal area Or More than 1 confirmed horse case in a community or focal area Multiple quantitative measures indicating critical risk of human infection (e.g. early season positive surveillance indicators, and sustained elevated field mosquito infection rates, and horse or mammal cases indicating escalating epizootic activity)	Response as in category 4, plus: 1. Continued highly intensified public outreach messages on personal protective measures. Frequent media updates and intensified community level education an outreach efforts. 2. The MDPH Arbovirus Program will determine human risk levels as outlined in this plan. If risk of outbreak is widespread and covers multiple jurisdictions, MDPH will confer with local health agencies, SRMCB and Mosquito Control Projects to discuss the use of intensive mosquito control methods and determine if measures need to be taken by the agencies to allow for and assure that the most appropriate mosquito control interventions are applied to reduce risk of human infection. These interventions may include state-funded aerial application of mosquito adulticide. Factors to be considered in making this decision include the cyclical, seasonal and biological conditions needed to present a continuing high risk of WNV human disease. Once critical human risk has been identified, the SRMCB will determine the adulticide activities that should be implemented in response to identified risk by making recommendations on: A. Appropriate pesticide B. Extent, route and means of treatment C. Targeted treatment areas 3. MDPH Center for Environmental Health (CEH) will initiate active surveillance via emergency departments and with health care provides only if aerial spraying commences. 4. MDPH will designate high-risk areas where it has issued a certification that pesticide application is necessary to protect public health in order to preempt homeowner private property no-spray requests. If this becomes necessary, notification will be given to the public. 5. MDPH recommends restriction of group outdoor activities, during peak mosquito activity hours, in areas of intensive virus activity. 6. MDPH will communicate with health care providers in the affected area regarding surveillance findings and encourage prompt sample submission from all clinically suspect cases.

Table 2. Guidelines for Phased Response to EEE virus Surveillance Data

Risk Category	Probability of human outbreak	Definition of Risk Category for a Focal Area[2]	Recommended Response
1	Remote	All of the following conditions must be met: Prior Year No EEE virus activity detected in a community or focal area And Current Year Sporadic EEE virus activity in mosquitoes after August 1. Virus activity is considered to be sporadic when 1-2 isolates in *Cs. melanura* are found within 1-2 weeks of routine collections. And No animal or human EEE cases.	1. MDPH staff provides educational materials and clinical specimen submission protocols to targeted groups involved in Arbovirus surveillance, including, but not limited to, local boards of health, physicians, veterinarians, animal control officers, and stable owners. 2. Educational efforts directed to the general public on personal prevention steps and source reduction, particularly to those populations at higher risk for severe disease (e.g., the elderly). 3. Routine collection and testing of mosquitoes. 4. Assess mosquito populations, monitor larval and adult mosquito density. 5. Initiate source reduction; use larvicides at specific sites identified by entomologic survey and targeted at the likely amplifying bridge vector species. In making a decision to use larvicide consider the prevalence of Culiseta and bridge vector larvae, intensity of prior virus activity, and weather. 6. Locally established, standard, adult mosquito control activities are implemented. No specific supplemental control efforts are recommended. 7. Passive human and horse surveillance. 8. Emphasize the need for schools to comply with MA requirements for filing outdoor IPM plans.

[2] Focal Area- May incorporate multiple communities, towns or cities. Factors considered in the determination of human risk in a focal area include: mosquito habitat, prior isolations, human population densities, timing of current isolations of virus in mosquitoes, and the cyclical nature of human EEE outbreaks, current weather and seasonal conditions needed to present risk of human disease.

2	Low	Prior Year EEE virus activity in mosquitoes in the prior year in the focal area Or Current Year Sporadic EEE Cs. melanura mosquito activity in the community or focal area between July 1-July31. Virus activity is considered to be sporadic when 1-2 isolates in *Cs. melanura* are found within 1-2 weeks of routine collections And No animal or human cases.	Response as in category 1, plus: 1. Expand community outreach and public education programs, particularly among high-risk populations, focused on risk potential and personal protection, emphasizing source reduction. 2. Increase larval control and source reduction measures. 3. Locally established standard adult mosquito control activities continue 4. Public health alert sent out by MDPH in response to first EEE mosquito isolate detected during the season. The alert will summarize current surveillance information and emphasize personal prevention strategies.
3	Moderate	Prior Year Confirmation of one human EEE case in the community or focal area; or 1 or more EEE horse case(s); or sustained EEE virus activity in mosquitoes. Sustained activity' is defined as 2 or more positive isolations found for 2 or more weeks. Or Current year No animal or human EEE cases in current year And Total EEEV isolates in *Cs. melanura* found after July 1 as a result of routine collections are between 10-15 in the community or focal area Or A single EEEV isolate from mosquitoes likely to bite humans (bridge vector species) Or A single EEEV isolate in mosquitoes of any species, prior to July 1.	Response as in category 2, plus: 1. Outreach and public health educational efforts are intensified including media alerts as needed. 2. If not already in progress, standard, locally established adult mosquito control efforts including targeted ground adulticiding operations should be considered. The decision to use ground-based adult mosquito control will depend on critical modifying variables including the time of year, mosquito population abundance and proximity of virus activity to at-risk populations. 3. Duly authorized local officials may request that the DPH Commissioner issue a certification that pesticide application is necessary to protect public health in order to preempt homeowner private property no-spray requests. 4. Supplemental mosquito trapping and testing in areas with positive EEEV findings. Notify all boards of health of positive findings. 5. Public health alert sent out by MDPH in response to first pool of EEE virus positive mammal-biting mosquitoes detected during the season. The alert will summarize current surveillance information and emphasize personal prevention strategies. 6. HHAN (Health and Homeland Alert Network) alerts or phone calls are provided to local boards of health upon confirmation of EEE virus in any specimen; advise health care facilities of increased risk status and corresponding needs to send specimens to SLI for testing.

4	High	<u>Current Year</u> Total EEEV mosquito isolates numbering more than 15 from routine collections with sustained or increasing activity in the community or focal area. Sustained elevated weekly mosquito minimum infection rates. Virus activity is considered to be sustained when isolates are found for 2 or more consecutive weeks. And/or Isolation of EEEV in more than 1 pool of bridge vector mosquitoes And/or Confirmation of EEE in an animal at any time And/or Confirmation of EEE in a human at any time	Response as in category 3, plus: 1. Intensify public education on personal protection measures including avoiding outdoor activity during peak mosquito hours, wearing appropriate clothing, using repellents and source reduction. a. Utilize multimedia messages including public health alerts from MDPH, press releases from local boards of health, local newspaper articles, cable channel interviews, etc. b. Encourage local boards of health to actively seek out high-risk populations in their communities (nursing homes, schools, workers employed in outdoor occupations, etc.) and educate them on personal protection d. Advisory information on pesticides provided by MDPH Center for Environmental Health. e. Urge towns and schools to consider rescheduling outdoor events. 2. Intensify larviciding and/or adulticiding control measures where surveillance indicates human risk. Local, ground- based ULV applications of adulticide may be repeated as necessary to achieve adequate mosquito control. Town or city may request preemption of homeowner private property no-spray requests. 3. Active surveillance for human cases is intensified. Health care facilities are advised of increased risk status and corresponding needs to send specimens to SLI for testing. 4. Local officials should evaluate all quantitative indicators including population density and time of year and may proceed with focal area aerial adulticiding. 5. Duly authorized local officials may request that the DPH Commissioner issue a certification that pesticide application is necessary to protect public health in order to preempt homeowner private property no-spray requests. 6. MDPH will confer with local health officials, SRMCB and Mosquito Control Projects to determine if the risk of disease transmission threatens to cause multiple human cases and warrants classification as level 5.

5	Critical	<u>Current Year</u> More than 1 confirmed human EEE case Or Multiple EEE animal cases Or Multiple quantitative measures indicating critical risk of human infection (e.g. early season positive surveillance indicators, and sustained high mosquito infection rates, and horse or mammal case indicating escalating epizootic activity)	Response as in category 4, plus: 1. Continued highly intensified public outreach messages on personal protective measures. Frequent media updates and intensified community level education an outreach efforts. 2. The MDPH Arbovirus Program will determine human risk levels as outlined in this plan. If risk of outbreak is widespread and covers multiple jurisdictions, MDPH will confer with local health agencies, SRMCB and Mosquito Control Projects to discuss the use of intensive mosquito control methods and determine the measures needed to be taken by the agencies to allow for and assure that the most appropriate mosquito control interventions are applied to reduce risk of human infection. These interventions may include state-funded aerial application of mosquito adulticide. Factors to be considered in making this decision include the cyclical, seasonal and biological conditions needed to present a continuing high risk of EEE human disease. Once critical human risk has been identified, the SRMCB will determine the adulticide activities that should be implemented in response to identified risk by making recommendations on: A. Appropriate pesticide B. Extent, route and means of treatment C. Targeted treatment areas 3. MDPH Center for Environmental Health (CEH) will initiate active surveillance via emergency departments and with health care provides only if aerial spraying commences. 4. MDPH will designate high-risk areas where individual no spray requests may be preempted by local and state officials based on this risk level. If this becomes necessary, notification will be given to the public. 5. MDPH recommends restriction of group outdoor activities, during peak mosquito activity hours, in areas of intensive virus activity. 6. MDPH will communicate with health care providers in the affected area regarding surveillance findings and encourage prompt sample submission from all clinically suspect cases.

Appendix 1: Mosquitoes Associated with Arboviral Activity in Massachusetts

Aedes vexans – Is a common nuisance mosquito. Temporary flooded areas such as woodland pools and natural depressions are the preferred larval habitat of this mosquito. It feeds on mammals and is a fierce human biter. This species is typically collected from May to October. *Ae vexans* is an epizootic vector of Eastern Equine Encephalitis (EEE) Virus.

Coquillettidia perturbans - Cattail marshes are the primary larval habitat of this mosquito. It feeds on both birds and mammals. It is a persistent human biter and one of the most common mosquitoes in Massachusetts. This species is typically collected from June to September. *Cq perturbans* is an epizootic vector of EEE Virus.

Culex pipiens – Artificial containers are the preferred larval habitat of this mosquito. It feeds mainly on birds and occasionally on mammals. It will bite humans, typically from dusk into the evening. This species is regularly collected from May to October but can be found year round as it readily overwinters in man-made structures. *Cx pipiens* has been implicated as a vector of West Nile Virus (WNV).

Culex restuans – Natural and artificial containers are the preferred larval habitat of this mosquito. It feeds almost primarily on birds but has been known to bite humans on occasion. This species is typically collected from May to October but can be found year round as it readily overwinters in man-made structures. *Cx restuans* has been implicated as a vector of WNV.

Culex salinarius – Brackish and freshwater wetlands are the preferred habitat of this mosquito. It feeds on birds, mammals, and amphibians and is well known for biting humans. This species is typically collected from May to October but can be found year round as it readily overwinters in natural and man-made structures. *Cx salinarius* may be involved in the transmission of both WNV and EEE virus.

Culiseta melanura –White Cedar and Red Maple swamps are the preferred larval habitat of this mosquito. It feeds almost exclusively on birds. This species is typically collected from May to October. *Cs melanura* is the primary enzootic vector of EEE virus.

Ochlerotatus canadensis – Shaded woodland pools are the preferred larval habitat of this mosquito. It feeds mainly on birds and mammals but is also known to take blood meals from amphibians and reptiles. This mosquito can be a fierce human biter near it larval habitat. This species is typically collected from May to October. *Oc canadensis* is an epizootic vector of EEE virus.

Ochlerotatus japonicus – Natural and artificial containers such as tires, catch basins, and rock pools are the preferred larval habitat of this mosquito. It feeds mainly on mammals and is a fierce human biter. This species is typically collected from May to October. *Oc japonicus* may be involved in the transmission of both WNV and EEE virus.

Figure 1: Location of MDPH EEE virus Mosquito Trap Sites