

West Nile Virus Public Health Preparedness, Surveillance, and Response Guide



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I. Executive Summary—West Nile Virus Public Health Preparedness, Surveillance, and Response Guide

Objectives

- To provide background information and guidelines for surveillance and control of West Nile virus (WNV), a mosquito-borne viral disease, in Texas;
- To prompt surveillance and control activities appropriate for estimated virus transmission risk levels;
- To provide local and state public health agencies with a decision support system; and
- To define the roles and responsibilities of local and state public health agencies involved in WNV surveillance and response activities.

Operational Activities

- Local responsibilities
 - To monitor the levels and types of vector mosquito populations in their jurisdiction;
 - To develop and coordinate vector control plans and activities to effectively use available resources such as surveillance, risk communication, and equipment;
 - To coordinate with local emergency management to better utilize local expertise and communication infrastructures.
- State responsibilities
 - To assist local jurisdictions with surveillance data, technical assistance, education, and resources as required and warranted;
 - To act as coordinating entity of a large scale response to include surveillance of human and animal cases, case definitions, data analysis, and laboratory testing;
 - To act as liaison to other involved state and federal agencies.

Resource Commitment

- The authorized use of PHEP funding from existing budgets at the local level for surveillance activities;
- Local jurisdictions will be expected to expend \$.40 (40 cents) per capita in any outbreak abatement effort prior to requesting assistance from the state;
- DSHS reserves the right to decide whether to enter into cost-sharing contracts or agreements with local jurisdictions before providing mosquito abatement resources.

Decision Matrix

- Local and state response is predicated on increasing severity stages—*Increased Readiness Conditions, Escalated Response Conditions, Emergency Conditions*—measured by key components:
 - Mosquito larval counts
 - Adult vector mosquito abundance
 - Positive mosquito pools
 - Human case levels
- Conditions within each severity stage have recommended activities focused on:
 - Surveillance
 - Education
 - Control activities
- The scalability of the decision matrix affords local and state officials key decision points upon which to base a jurisdiction's response and to gauge the severity or potential severity of an outbreak.

II. Texas 2015 West Nile Virus Public Health Preparedness, Surveillance, and Response Guide – An Overview

West Nile Virus Detection, Data Sharing, and Response Activities for 2015

Surveillance

A variety of West Nile virus (WNV) surveillance activities will be conducted in Texas by the Department of State Health Services (DSHS) and local jurisdictions in 2015. In some jurisdictions, the level of activity is expanded in comparison with previous. As was done in 2014, lab reports in NEDSS will be monitored by DSHS staff to enhance the ability to identify case trends. Surveillance for WNV vector mosquito abundance and infection rates will be conducted by a variety of local jurisdictions around the state, as has been done in the past. In some cases, increased sampling will be done. The DSHS laboratory in Austin has maintained its capacity for mosquito testing this year and will be accepting specimens from submitters in the DSHS Arbovirus Surveillance Network. DSHS mosquito identification and testing will be free of charge as long as agency resources allow. Testing of live chickens and dead wild birds will continue to be conducted in some jurisdictions. DSHS will continue to test rabies-negative brain tissue from horses, and the Texas Veterinary Medical Diagnostic Laboratory (TVMDL) will continue to test horses for WNV as ordered by attending veterinarians. Blood donor specimens from donation facilities around the state that are identified with presumptive WNV infection will continue to be reported to DSHS.

Centralized receipt, compilation, and distribution of surveillance data

All entities in the state conducting the WNV surveillance activities described above are asked to report their findings to DSHS Austin. Local jurisdictions conducting mosquito surveillance will be requested to submit mosquito data, including vector abundance and WNV test results, by email to WNV@DSHS.Texas.gov. All surveillance data submitted to DSHS will be compiled, analyzed, and organized into a variety of formats, as appropriate, including tables, graphs, and maps. The findings will be published in a timely manner on the DSHS website and included in the weekly arbovirus update report distributed by email to public health stakeholders throughout the state. This sharing of information statewide will greatly enhance the ability of all entities to amend their activities in response to timely surveillance data, if they judge such action necessary.

Education and mosquito control activities

Educational activities conducted by DSHS and local jurisdictions will be continued as they have during previous years and enhanced whenever surveillance findings indicate additional educational activities might be beneficial. Mosquito control activities, which are conducted by local jurisdictions, will be continued and expanded in some areas of the state.

Responses to West Nile virus activity

Local jurisdictions will continue their surveillance, education, and vector control activities as they have in the past. Some local jurisdictions will be expanding their activities or taking on new ones. Staff in DSHS regional offices will be closely tracking WNV surveillance findings in the counties comprising their jurisdictions and discussing possible responses with local jurisdictions as indicated.

If a jurisdiction experiences a high level of WNV activity in 2015, they may request assistance from DSHS. Support for local responses would be considered after a local jurisdiction has already expended a specified per capita level of funds. Funding requests will be evaluated

based on the severity and geographic characteristics of the outbreak, the amount of funds available at DSHS, and other factors.

III. West Nile Public Health Preparedness, Surveillance, and Response Guide

The Texas DSHS “2015 West Nile Virus Public Health Preparedness, Surveillance, and Response Guide” describes appropriate WNV surveillance activities, possible findings of surveillance, and responses that should be considered for different levels of WNV activity detected.

A. Objectives

- To provide background information and guidelines for surveillance and control of WNV, a mosquito-borne viral disease, in Texas;
- To prompt surveillance and control activities appropriate for estimated virus transmission risk levels;
- To provide local and state public health agencies with a decision support system; and
- To define the roles and responsibilities of local and state public health agencies involved in WNV surveillance and response activities.

B. Background

Mosquito-borne viruses belong to a group of viruses commonly referred to as arboviruses (for **arthropod-borne**). ([See Attachment 1](#)) The West Nile arbovirus has had a serious impact on the health of humans, horses, and certain wild birds throughout the state. Since 2002, when the first cases were detected in Texas, through 2014, more than 4,600 human cases of WNV disease have been reported; of these, 244 (5.3%) died. Human cases have been reported from 198 (78%) of the 254 counties in the state, while WNV activity of any kind (mosquito, bird, horse, or human) has been reported from 239 (94%) Texas counties. According to the Centers for Disease Control and Prevention (CDC), WNV has become enzootic in, and human cases have been reported from, all 48 contiguous United States. Outbreaks occur regularly and, so far, unpredictably.

WNV is maintained in an enzootic mosquito-bird-mosquito cycle. The virus can infect humans as incidental hosts, primarily when mosquito infection rates are high. Surveillance and control activities focus on this enzootic cycle, which involves primarily *Culex* mosquitoes, mainly *Cx. quinquefasciatus* (Southern house mosquito) and *Cx. tarsalis* (Western equine encephalitis mosquito), and a wide range of bird species including corvid birds such as crows, ravens, and blue jays. Corvid birds can experience high mortality and suggest that transmission of WNV is occurring in specific areas of the state.

Immature stages of mosquitoes (larvae and pupae) can be found throughout the state in a wide variety of aquatic sources, ranging from clean to highly polluted waters. Most such water is associated with urban wastewater, stagnant water sources, and irrigation of agricultural crops. Adult female mosquitoes may overwinter in culverts, catch basins and similar environments.

Mosquito control and mosquito bite avoidance strategies are considered the only practical methods currently available for protecting humans from WNV infection. There are no known

specific treatments or cures for WNV disease, and a vaccine for humans is not yet available. Mosquito-borne disease prevention strategies must be based on well-planned vector management strategies that use real-time surveillance to detect problem areas, focus control efforts, and evaluate operational efficacy. The primary components of a WNV public health prevention program include education, surveillance, and mosquito control. Implementation and long-term maintenance of such programs are particularly important in areas with large populations and documented histories of WNV activity.

C. Components

Education

The public can play an important role in reducing the number of adult mosquitoes by eliminating standing water that may support the development of immature mosquitoes. For instance, residents can help by properly disposing of old tires, cans, or buckets; emptying plastic or unused swimming pools; and unclogging blocked rain gutters around homes or businesses. Messaging that includes explanation of the value of these efforts should be distributed on a regular basis and increased as the season nears or has begun. Educating the general public to curtail outdoor activities during peak mosquito biting times, eliminate mosquito breeding sites, wear long-sleeved clothing outdoors, and use insect repellents helps reduce exposure to mosquitoes and the diseases they carry.

These recommendations are also known as the “Four Ds”:

- Dawn and Dusk: Stay indoors as much as possible at dawn, dusk, and early evening when vector mosquitoes are most active.
- Drain: Do not allow water to stagnate in old tires, flowerpots, trash containers, swimming pools, birdbaths, pet bowls, etc. Mosquitoes need very little water to reproduce.
- Dress: Wear light-colored, long-sleeved shirts and long pants whenever you are outdoors.
- Defend: Use an EPA-approved mosquito repellent whenever you are outdoors. ([See Attachment 2](#))

The continuing education of medical and veterinary communities to recognize the symptoms of WNV disease enhances clinical surveillance by increasing the ordering of appropriate laboratory tests and the reporting of positive results to the appropriate health department. The reporting of all laboratory-confirmed cases is critical for detecting virus activity so that appropriate response activities can be conducted.

Surveillance

Surveillance for WNV activity may include the monitoring, visualization, and analysis of the following types of data:

- climate conditions;
- immature and adult vector mosquito abundance;
- mosquito infection rates;
- monitoring and testing for infection in select avian species;
- equine disease cases;
- human disease cases; and
- infected but asymptomatic humans detected and reported by blood banks.

Based upon resources, arbovirus surveillance activities might be expanded in scale to enhance the timely detection of all such viruses, both endemic and novel.

Climate

Very little analysis of Texas-specific historical climate data is available to enable incorporation of climate data into WNV risk models designed to forecast disease trends. Temperature and rainfall influence mosquito reproduction and growth, but their exact effects on vector mosquito abundance and infectivity in Texas are currently undetermined. Because Texas has many different ecological zones, climate data from across the state will need to be evaluated for possible incorporation into WNV risk models.

Mosquito Abundance

Vector mosquito abundance can be estimated by local mosquito control authorities through collection of immature and/or adult mosquitoes ([See Attachments 3-5](#)). The immature stages (larvae and pupae) can be collected from water sources where mosquitoes lay their eggs. Adult vector mosquito abundance is a key factor contributing to the risk of virus transmission. Monitoring the abundance of adult vector mosquito populations provides important information on the size of the vector population as it responds to changing climate factors and larval control efforts.

Local mosquito control technicians should search for new breeding areas. They should also sample fixed mosquito collecting sites on a 7 to 14-day cycle. The resulting sampling data can be used in decision making regarding mosquito control measures. Maintaining careful records of immature mosquito occurrence, developmental stages treated, size of breeding areas, and control effectiveness can provide valuable forecasts of adult population size in the near future.

Mosquito Infections

The proportion of infected mosquitos is another key factor contributing to human and other animal infections. Because *Cx. quinquefasciatus* is an important urban vector for WNV and *Cx. tarsalis* is the primary rural vector, surveillance efforts should emphasize the testing of these species. Female mosquitoes are trapped, usually using carbon dioxide-baited light traps or gravid traps, identified by species, and counted into groups (pools) of a maximum of 50 females each for testing.

Sampling should be done on the same 7- to 14-day cycle at fixed collecting sites. Jurisdictions that are members of the DSHS Arbovirus Surveillance Network ([See Attachment 6](#)) should submit mosquito samples to the DSHS laboratory. Other jurisdictions will be accommodated by DSHS to the extent possible. In-house testing, use of a private contractor and/or laboratory, and submission of specimens to the Texas Veterinary Medical Diagnostic Laboratory (TVMDL) may also be options for local jurisdictions.

Mosquito abundance and infection rate data can be combined to calculate a vector index (VI). VI has been shown to be a better predictor of WNV risk than either abundance or infection rate measures alone. (See CDC's formulas for calculating VI in Appendix 2 of <http://www.cdc.gov/westnile/resources/pdfs/wnvguidelines.pdf>)

Avian Infections

There are many causes of mortality in birds, including WNV infection. Reporting of select species of dead birds may have value on a local level, such as to prompt focused and/or intensified mosquito surveillance. ([See Attachment 7](#)) Likewise, testing select species of dead birds for WNV can provide an additional source of data to inform intervention decisions at the local level. Due to potential long range movement of birds from the point of infection, positive mosquito pools are more reflective of virus circulation in a limited geographic area. Positive bird testing results have seldom pre-dated positive mosquito pool results in Texas. Consequently,

resumption of bird testing by DSHS is not considered cost-effective. Testing of dead birds is available to local jurisdictions for a fee through the TVMDL. Some jurisdictions may choose to do serologic testing of birds, such as sentinel chickens, and incorporate the findings in their surveillance program.

Equine Disease

Equines, like humans, are incidental hosts of WNV that are infected primarily when there are high levels of infected vectors. Ill equines are tested for arboviruses at the direction of the attending veterinarian. TVMDL performs serologic and molecular testing of animal specimens on a fee-basis for veterinarians and their clients. DSHS tests equine brain tissue for arboviruses when the tissue is submitted for rabies testing and found to be negative for rabies. In some WNV seasons, equine cases have provided the first indication of WNV activity in an area.

Human Disease

Arbovirus abatement programs rely in part on the rapid detection and reporting of confirmed human cases in order to plan and implement emergency control activities to prevent additional infections. However, human cases of WNV disease are an insensitive surveillance indicator of virus activity because most persons who become infected do not develop symptoms. For those individuals who do become ill, it may take up to two weeks for symptoms to appear, with additional time delays for laboratory testing, case investigation, and reporting. DSHS does not conduct routine testing of human samples, but does receive WNV positive laboratory reports from clinical and other laboratories through the National Electronic Disease Surveillance System (NEDSS).

Human Blood Donor Infections

Donated blood is subjected to a nucleic acid test to detect WNV. A positive test result indicates that the donor was infected with WNV at the time of specimen collection and may develop WNV illness or remain asymptomatic. Blood donation centers are required by law to report positive test results to public health authorities. All blood collection centers have been contacted to encourage WNV positive result reporting to DSHS and local health departments. DSHS will assure that all positive donor reports received at DSHS are also made available to the local jurisdictions for investigation.

Data Analysis and Reporting of Human Cases

Surveillance indicators are monitored by Zoonosis Control Branch (ZCB) staff and a summary of findings are communicated weekly during periods of WNV activity to interested public health partners. Human cases are tracked utilizing the statewide surveillance system, NEDSS. Utilizing a shared data system allows local and state staff to view the status of each investigation and the number of confirmed cases. Case data are compared to a referent period to identify increased activity in the regions. A positive laboratory report is usually the first notification of suspected human cases. Electronic laboratory reports are uploaded into NEDSS as they are received each workday. Reports that are not provided electronically are manually entered into NEDSS. These are immediately available on queues in the jurisdiction assigned by patient address and the ZCB. Laboratory reports are used to monitor trends over time and by location ahead of case investigation completion.

Mosquito Control

Elevated vector mosquito abundance and infection levels detected by mosquito surveillance are mitigated through environmental management and by larval and adult mosquito control. Mosquito control in Texas is the responsibility of local authorities and is conducted by local

agencies, including mosquito control districts, county and city health departments, and public works departments. The preferred approach is to follow the principles of Integrated Pest Management (IPM) where pesticide application is conducted as a last resort. DSHS may provide support for mosquito control when key criteria of disease burden, local need, and local expenditure are met.

Environmental Management

Environmental management should be the first measure in an effective mosquito vector control program. Effective management decreases habitat availability or suitability for immature mosquitoes and may include water management activities such as increasing the water disposal rate through evaporation, percolation, recirculation, or drainage. Environmental management may also include vegetation management because emergent vegetation provides food and refuge for mosquito larvae. Management strategies should include the periodic removal or thinning of vegetation, restricting growth of vegetation, and algal control.

Environmental management is greatly dependent on a local jurisdiction's knowledge of the geography and history of the area. Surveillance data and experience are major factors in determining mosquito trap placement, standing water control, and other control measures.

Larval Control

Mosquito larval and pupal control methods are target-specific and prevent the emergence of adult female mosquitoes capable of transmitting pathogens to humans and other animals, causing discomfort, and ultimately producing another generation of mosquitoes. For these reasons, controls should target the immature stages rather than the adult stage of the mosquito. Larval mosquito control has the following key components: environmental management, biological control, and chemical control.

Biological control uses natural predators, parasites, or pathogens to reduce immature mosquito numbers. Mosquitofish, *Gambusia affinis*, are effective biological control agents. These fish can be released annually in a variety of habitats, such as rice fields, small ponds, and canals.

There are several mosquito control products that are highly specific and thus have minimal impact on non-target organisms. These include microbial control agents, such as *Bacillus thuringiensis israelensis* and *Bacillus sphaericus*, and insect growth regulators, such as methoprene, that prevent immature mosquitoes from developing into adults. Surface films are very effective against both larvae and pupae, but these may also suffocate other surface breathing aquatic insects. Larval control or larviciding—after environmental management—is by far the best preventive measure for vector control.

Adult Control

Adult control, or adulticiding, is an integral part of mosquito abatement which should be based largely on surveillance data. Adult mosquito control may be required to suppress populations of infected mosquitoes and interrupt virus transmission in an epidemic. It is important to time the application of adulticide to match the peak activity periods of the target species.

Adult mosquito control products may be applied using ground based equipment, airplanes, or helicopters. Products applied in ultralow volume (ULV) formulations and dosages include organophosphates such as malathion and naled; pyrethroids such as resmethrin, sumithrin, and permethrin; and pyrethrins. Factors to consider when selecting an adulticide include: 1) efficacy against the target species or life cycle stage, 2) resistance status, 3) pesticide label requirements, 4) availability of pesticide and application equipment, 5) environmental conditions,

6) evidence from surveillance programs that enzootic WNV activity is at a level suggesting a high risk of human infection with the presence of abundant adult mosquito vectors, and 7) cost.

Ground-based Spraying

Ground-based spraying is appropriate for the application of adulticide chemicals over areas where the road infrastructure allows access. Treatments should be conducted multiple times per week in areas with disease activity. Treatments should continue until positive mosquito pools from the affected area are no longer detected.

Aerial Spraying

Aerial spraying is appropriate for the application of adulticide chemicals over large areas in a short period of time. Aerial spraying is less prone to patchy coverage than ground-based application in areas where road coverage is not adequate. It is a valuable tool for reducing human WNV infection risk during an ongoing outbreak or when a large population area is at elevated risk because of high levels of WNV vector mosquito abundance and infection. Aerial spraying should generally be limited to the immediate area where the infected vector population has been documented to exist through vector surveillance, and to adjacent areas considered at risk for imminent disease transmission.

Note: The State of Texas has developed an emergency management contract for pest control, including aerial spraying for mosquitoes. Local jurisdictions can access this contract thru the Texas Procurement and Support Services Cooperative Purchasing Program (State of Texas CO-OP). Contract # 988-M1 <http://www.txsmartbuy.com/contracts/view/239>

IV. Operational Activities of the West Nile Virus Guide

The operational activities of this WNV guide involve the following three levels: Increased Readiness Conditions, Escalated Response Conditions, and Emergency Conditions. These operational levels are determined by assessments of various parameters: mosquito larval counts, adult vector mosquito abundance, number of WNV positive mosquito pools, and human infection (clinical case and blood donor) data. Some jurisdictions may also use assessments of living or dead bird findings, and ill horse findings. Qualitative measures, such as “below average,” “average,” and “above average,” are provided for most variables. The specific data used to calculate averages should be determined by the jurisdiction to which it applies. Jurisdictional staff can use the data collected to estimate the level of WNV activity and determine the appropriate level of response. Recommended responses for DSHS and local jurisdictions at each operational level are also included. Some jurisdictions will not have data for all of the variables. Nonetheless, each jurisdiction will have a tool it can use to guide decisions regarding environmental management, education of the general public and health care providers, and biological and chemical measures for control of mosquito vectors.

Each operational level is first defined by the existing conditions for the variables specified above. All of these conditions do not need to be attained for a specific operational level to be reached. In addition, a change in a single condition does not necessarily cause the operational level to be raised. The conditions should be considered together when determinations are being made on appropriate response activities.

A. Local Jurisdiction Operational Levels and Indicators

Increased Readiness Conditions

Routine activities focused on surveillance, education, and prevention

Conditions in monitored local jurisdiction

- Vector mosquito larval counts average or below average
- Adult vector abundance average or below average
- No mosquito pools positive for WNV
- No human WNV disease cases reported

Where surveillance for other WNV activity indicators is broadly conducted, the following conditions are detected:

- No WNV infected birds identified
- No laboratory-confirmed equine cases of WNV disease reported
- No WNV-positive blood donors reported

Recommended activities

Surveillance

- Collect mosquito larvae and analyze abundance data
- Collect and identify adult mosquitoes and test vector species for arboviruses
- Analyze trends in adult vector mosquito abundance and infection
- Report mosquito data to DSHS by email to WNV@DSHS.Texas.gov
- Monitor laboratory reports indicating possible human cases
- Investigate any suspect human cases and report confirmed and probable cases to DSHS through NEDSS

Education

- Conduct appropriate community outreach and public education
- Communicate with health care providers

Mosquito Control

- Conduct appropriate vector control plan activities
- Reduce mosquito habitat
- Conduct appropriate larviciding based on larval presence and abundance

Escalated Response Conditions

Enhanced activities adjusted in response to detected WNV activity

Conditions in monitored local jurisdiction

- Adult vector abundance above average
- Positive mosquito pools confirmed
- Human WNV disease case(s) reported
- Vector mosquito larval count above average

Where surveillance for other WNV activity indicators is broadly conducted, the following conditions are detected:

- WNV-infected birds identified
- Laboratory-confirmed equine cases of WNV disease reported
- WNV-positive blood donors reported

Recommended activities

Surveillance

- Collect and analyze trends in infected vector mosquito data
- Collect and analyze infected bird data
- Receive and analyze equine disease data
- Conduct geospatial analysis of surveillance data
- Continue to collect mosquito larvae and analyze abundance data
- Continue to collect and identify adult mosquitoes and test vector species for arboviruses
- Continue to analyze trends in adult vector mosquito abundance and infection
- Continue to report mosquito data to the to DSHS by email to WNV@DSHS.Texas.gov
- Continue to monitor laboratory reports indicating possible human cases
- Continue to investigate suspected human cases
- Report human disease cases to DSHS through NEDSS within one business day of completion of investigation or request DSHS assistance

Education

- Increase community outreach and public education
- Enhance communications with health care providers
- Increase communication and coordination between local officials and public health
- Provide information to local media representatives and encourage its distribution
- Partner with local community-based organizations to target outreach to high-risk populations unable to mitigate mosquito bite associated risk without assistance, such as persons who are home-bound, elderly, or disabled
- Enhance community access to information

Mosquito Control

- Enhance vector mosquito habitat reduction, larviciding, and adulticiding as informed by surveillance data analysis
- Consider enhancing mosquito pool testing in targeted areas as informed by surveillance data
- Assess effectiveness of larviciding and adulticiding measures by post-intervention comparisons of surveillance data

Emergency Conditions

Highly elevated and additional activities to control a WNV epidemic

Conditions in monitored local jurisdiction

- Vector mosquito larval counts above average even with vector control measures implemented
- Adult vector abundance above average even with vector control measures implemented
- Positive mosquito pools increasing in geographic distribution or continuing to test positive even with control measures implemented
- Number of human WNV disease cases above historical baseline and/or spreading in geographic distribution

Where surveillance for other WNV activity indicators is broadly conducted, the following conditions are detected:

- Climate conditions conducive to mosquito proliferation
- WNV-infected birds continue to be identified
- Laboratory-confirmed equine cases of WNV disease continue to be reported
- Continued reports of WNV-positive blood donors

Recommended activities

Surveillance

- Continue to collect and analyze trends in infected vector mosquito data
- Continue to collect and analyze infected bird data
- Continue to receive and analyze equine disease data
- Continue to conduct geospatial analysis of surveillance data
- Continue to collect mosquito larvae and analyze abundance data
- Continue to collect and identify adult mosquitoes and test vector species for arboviruses
- Continue to analyze trends in adult vector mosquito abundance and infection
- Continue to report mosquito data to the to DSHS by email to WNV@DSHS.Texas.gov
- Continue to monitor laboratory reports indicating possible human cases
- Continue to investigate suspected human cases and request DSHS assistance if needed
- Continue to report human WNV disease cases to DSHS through NEDSS within one business day of completion of investigations or request DSHS assistance

Education

- Continue increased community outreach and public education
- Continue enhanced communications with health care providers
- Continue increased communication and coordination between local officials and public health
- Continue providing information to local media representatives and encourage its distribution
- Continue partnering with local community-based organizations to target outreach to high-risk populations organizations unable to mitigate mosquito bite associated risk without assistance, such as persons who are home-bound, elderly, or disabled
- Enhance community access to information including information about planned adulticide spraying activities

Mosquito Control

- Continue to conduct appropriate vector control plan activities including enhancement of

mosquito surveillance around human or animal cases

- Continue vector mosquito habitat reduction, larviciding, and adulticiding as informed by surveillance data analysis
- Consider pesticide resistance testing, if indicated
- Consider enhancing mosquito pool testing in targeted areas as informed by surveillance data
- Conduct mosquito adulticiding by ground and/or air

Coordination

- Declare a local disaster is occurring, if appropriate
- Request state resources, as applicable and according to protocols

B. DSHS Operational Levels and Indicators

Increased Readiness Conditions

Routine activities focused on surveillance, education, and prevention

Conditions monitored in state

- Number of human cases in a single Health Service Region (HSR) is average
- Number of human cases in a single jurisdiction is average
- Mosquito pools positive for WNV in any one HSR is average
- Jurisdictions reporting emergency response operations 0 or 1

Recommended activities

Surveillance

- Compile adult vector mosquito abundance data submitted by local jurisdictions
- Conduct culture-based mosquito testing of specimens from Arbovirus Mosquito Surveillance Network submitters
- Compile mosquito test result data from all sources
- Compile equine disease reports
- Compile bird test reports
- Map counties reporting WNV activity
- Monitor and analyze human disease cases reported in NEDSS
- Monitor all data sources for WNV activity
- Initiate production and distribution of weekly arbovirus activity report on May 1

Education

- Prepare standard community outreach material
- Maintain and post weekly arbovirus activity reports on website starting May 1
- Respond to media inquiries
- Coordinate prevention messaging with local public information offices
- Educate clinicians and veterinarians on WNV disease signs and symptoms

Coordination

- Identify and/or confirm subject matter expert contact information
- Compile and submit reports to inform agency leadership

Escalated Response Conditions

Enhanced activities adjusted in response to detected WNV activity

Conditions monitored in state

- Number of human cases in a single Health Service Region (HSR) is above average
- Number of human cases in a single jurisdiction is above average
- Mosquito pools positive for WNV in any one HSR is above average
- Two to three jurisdictions reporting emergency response operations for WNV

Recommended activities

Surveillance

- Continue to compile adult vector mosquito abundance data submitted by local jurisdictions
- Continue to conduct cell culture-based mosquito testing of specimens from Arbovirus Surveillance Network submitters
- Continue to compile mosquito test result data from all sources
- Continue to compile equine disease reports
- Continue to compile bird test data
- Continue to map counties reporting WNV activity
- Continue to monitor and analyze human disease cases reported in NEDSS
- Continue distributing weekly arbovirus activity reports
- Assist local jurisdictions with case investigations as requested
- Assist jurisdictions with NEDSS data entry as requested
- Augment existing lab and epidemiology staff as needed to support response activities

Education

- Modify community outreach material, if needed
- Modify information for clinicians and veterinarians as appropriate
- Initiate public service and campaign messaging with media outlets
- Continue to maintain and post weekly arbovirus activity reports on website
- Continue to respond to media inquiries
- Continue to coordinate prevention messaging with local information offices

Mosquito Control

- Identify resources for adulticiding and larviciding

Coordination

- Initiate or increase coordination calls with regional and local jurisdictions
- Inform and coordinate with federal partners
- Continue to compile and submit reports to inform agency leadership

Emergency Conditions

Highly elevated and additional activities to control a WNV epidemic

Conditions monitored in state

- Number of human cases in a single Health Service Region (HSR) is significantly above average
- Number of human cases in a single jurisdiction is significantly above average
- Mosquito pools positive for WNV in any one HSR is significantly above average
- Four or more jurisdictions reporting emergency response operations for WNV

Recommended activities

Surveillance

- Coordinate additional laboratory capacity for mosquito testing for current and possibly new submitters
- Perform PCR testing of vector mosquitoes if indicated and as approved by the DSHS Laboratory
- Continue to compile adult vector mosquito abundance data submitted by local jurisdictions
- Continue to conduct cell culture-based mosquito testing of specimens from Arbovirus Surveillance Network submitters
- Continue to compile mosquito test result data from all sources
- Continue to compile equine disease reports
- Continue to compile bird test data
- Continue to map counties reporting WNV activity
- Continue to monitor and analyze human disease cases reported in NEDSS
- Continue distributing weekly arbovirus activity reports
- Continue to assist local jurisdictions with case investigations as requested
- Continue to assist jurisdictions with NEDSS data entry as requested
- Augment existing laboratory and epidemiology staff as needed to support response activities

Education

- Modify community outreach material, if needed
- Modify information for clinicians and veterinarians as appropriate
- Continue public service and campaign messaging with media outlets
- Continue to maintain and post weekly WNV activity reports on website
- Continue to respond to media inquiries
- Continue to coordinate prevention messaging with local information offices

Mosquito Control

- Activate appropriate contracts to support mosquito control response efforts

Coordination

- Activate State Medical Operations Center and appropriate staff, if indicated
- Provide resources, possibly including staff, to local jurisdictions when requested and available
- Increase coordination calls with regional and local jurisdictions
- Continue to compile and submit reports to inform agency leadership
- Continue to inform and coordinate with federal partners

V. Expectations and Criteria for DSHS Assistance with Mosquito Control Activities

Local resources will be expended prior to submission of a request for state financial assistance. If local resources are exhausted and needs exceed existing capacity, a resource request can be submitted through the emergency management channels.

DSHS has established a per capita (per person) expenditure of \$.40 (forty cents) as a qualifying criterion for requesting state assistance. It is expected that local jurisdictions will meet this expenditure criterion prior to requesting state assistance. As always, each resource request will be considered on a case-by-case basis. DSHS reserves the right to decide whether to enter in to cost-sharing contracts or agreements with local jurisdictions before providing mosquito abatement resources.

Public Health Emergency Preparedness Fund Use Guidelines

Public Health Emergency Preparedness (PHEP) grant recipients can utilize available grant funds for the following vector surveillance activities:

- Adult mosquito surveillance (trapping, quantifying vector species, and/or testing of pools)
- Other surveillance activities (e.g., mosquito larvae monitoring, bird reporting and/or testing)

Local jurisdictions should consult with their regional PHEP coordinator for details and advice.

VI. Limitations of the Texas 2015 West Nile Virus Public Health Preparedness, Surveillance, and Response Guide

The factors that are considered important indicators of WNV activity include local climate, abundance of mosquitos, infected mosquitos, infected birds, ill horses, and infected humans. When climate conditions are conducive to the proliferation of mosquitos, mosquito control measures are the most effective way to prevent illnesses and deaths in humans and other animals. Thus, surveillance for both vector mosquito abundance and infection levels, followed by implementation of appropriate control measures when these factors are elevated, is the preferred and optimum method of disease prevention. By the time infections are detected in birds, horses, or humans, control of WNV spread is more difficult.

Texas does not currently have a statewide mosquito vector control program. There are 17 mosquito districts in Texas, as well as certain other entities that conduct vector surveillance and control activities. Testing of mosquitoes, for both abundance and infectivity, is conducted at the DSHS laboratory, certain local health department laboratories, and some private laboratories. The data collected by these entities have not been compiled in a centralized database to date, so neither DSHS nor local health department staff can readily access information about mosquito activity across the state. In addition, different kinds of surveillance and testing are done by different entities in the state. Without a statewide mosquito vector control program, gaps in the ability to detect WNV activity before humans and other animals demonstrate infection will remain limited.

Surveillance for human cases of WNV infection occurs statewide. However, the potentially long incubation period of the virus, as well as the inherent delays associated with specimen testing, reporting, and case confirmation limit the value of these surveillance efforts for prevention and

control of outbreaks. This is true even if electronic laboratory reports of presumptive cases are used as predictors of human cases.

Surveillance for WNV infection in birds, horses and asymptomatic people is less comprehensive. Ill horses and birds from across the state are tested for arboviruses by the TVMDL for veterinarians and their clients on a fee basis, and positive results are reported to DSHS. Harris County reports mosquito and bird WNV test results to DSHS. Infected blood donors, presumably asymptomatic, are an indicator of WNV transmission to humans; letters were sent to blood collection centers across the state in 2013, 2014, and 2015 to enhance required reporting of viremic donors.

Because of the piecemeal surveillance for the indicators of WNV activity, particularly vector mosquito abundance and infectivity rates, there are significant gaps across the state of Texas in the ability to detect ongoing WNV activity and predict future activity.

Quantified surveillance data triggers for levels of response activities have not been established in Texas. While other states have quantified these trigger levels, it cannot be assumed that the same levels are appropriate for Texas. In Texas, due to its size and diversity of ecosystems, triggering events or conditions may vary by area. The ability to calibrate local triggering events will depend on availability of data and level of monitoring in each area.

VII. Texas West Nile Virus Prevention and Response Activities: Changes for 2015

Some jurisdictions have made a significant investment in their vector-mosquito control programs and are making better use of the data they collect, e.g. calculating metrics to guide intervention activities. Continued data collection over the coming years will provide leadership at DSHS and in local jurisdictions with information that will better inform their decision making processes regarding WNV control and prevention.

A. Surveillance Changes

Local jurisdictions that do in-house testing or test through a non-DSHS laboratory are being encouraged to report all mosquito pool test data to WNV@DSHS.Texas.gov and to make full use of the data they collect, e.g. using data to set action triggers that are appropriate to the jurisdiction.

B. Education Changes

In partnership with DSHS, the Texas A&M University Department of Entomology and Texas AgriLife Extension Service developed training and educational materials for local jurisdictions on all aspects of vector mosquito management. This information is captured in a manual that is available for online purchase. Online training is being developed, and the webinar "*Chikungunya, Dengue, West Nile, and Texas*" is available on the DSHS WNV website, www.TxWestNile.org.

The DSHS website will continue to be updated with the latest information regarding WNV activity across the state, and DSHS will continue to have downloadable public education materials.

VIII. Texas West Nile Virus Prevention and Response Activities: Plans for 2016 and Beyond

DSHS will work with local jurisdictions to strengthen vector mosquito surveillance activities across the state. These activities will involve ongoing collaborative programs with key partners, such as Texas AgriLife Extension Service, to provide educational materials.

IX. Attachments

- ATTACHMENT 1 – Arboviral Diseases and Mosquito Vector Species Reported in Texas
- ATTACHMENT 2 – CDC Information on Insect Repellents
- ATTACHMENT 3 – Arbovirus Field Surveillance Techniques
- ATTACHMENT 4 – Mosquito Larval Surveillance Guidelines and Form
- ATTACHMENT 5 – DSHS Mosquito Identification and Testing (Letter)
- ATTACHMENT 6 – DSHS Arbovirus Surveillance Network
- ATTACHMENT 7 – Dead Bird Reporting and Testing as a Surveillance Tool for West Nile Virus

Attachment 1 – Arboviral Diseases and Mosquito Vector Species Reported in Texas

Seven major arboviruses/virus groups (arthropod-borne viruses) that infect humans are endemic in or can be involved in local acquisition in Texas, including West Nile virus (WNV), St. Louis encephalitis virus, eastern equine encephalitis virus, western equine encephalitis virus, California serogroup viruses, chikungunya virus and dengue virus. Mosquito species that serve as vectors for these viruses are listed in Table 1.

Table 2 provides the number of human cases associated with these diseases in a 5-year reporting period from 2010 to 2014. West Nile virus is overwhelmingly the most common arbovirus causing reported human infections in Texas. Dengue infections in Texas are almost all travel-associated, with very few acquired in Texas sporadically reported from South Texas. Travel-associated chikungunya cases increased in Texas during 2014 but local transmission has the potential to occur where the vector mosquitoes are found.

Human cases of malaria, caused by a protozoa, are also reported yearly, however all of these, with rare exception, are travel-associated. At least 13 species of *Anopheles* mosquitoes (the genus of mosquitoes that transmit malaria) are endemic to Texas.

TABLE 1: Major Mosquito Vector Species Associated with Arboviral Diseases Reported in Texas

Arbovirus	Major Mosquito Vector Species
California serogroup viruses	<i>Aedes triseriatus</i>
Chikungunya virus	<i>Ae. aegypti</i> , <i>Ae. albopictus</i>
Dengue virus	<i>Ae. aegypti</i> , <i>Ae. albopictus</i>
Eastern equine encephalitis virus	<i>Aedes vexans</i> , <i>Coquillettidia perturbans</i>
St. Louis encephalitis virus	<i>Culex quinquefasciatus</i> , <i>Cx. tarsalis</i> , <i>Cx. nigripalpus</i>
West Nile virus	<i>Cx. quinquefasciatus</i> , <i>Cx. tarsalis</i>
Western equine encephalitis virus	<i>Cx. tarsalis</i>

TABLE 2: Human Cases of Arboviral Disease Reported in Texas, 2010-2014

Disease	2010	2011	2012	2013	2014
California encephalitis	1	0	3	0	0
Chikungunya	1	0	0	0	114
Dengue	19	7	16	95	32
Eastern equine encephalitis	0	0	0	0	0
St. Louis encephalitis	3	0	3	1	4
West Nile encephalitis	77	20	844	113	253
West Nile fever	12	7	1024	70	126
Western equine encephalitis	0	0	0	0	0

General Effects of Major Storms and Flood Events on Mosquito Populations and Arboviral Disease Transmission

Flooding tends to flush out both mosquito larvae and their predators from established mosquito breeding areas. Mosquitoes tend to recolonize faster than the predators dependent upon them, so following a flood a predictable pattern of heavy die-off of mosquitoes, followed by a spike in numbers, is commonly seen. The reasons mosquito populations rebound after storm or flood events vary with their genus-specific breeding habits, summarized below.

Anopheles spp. mosquitoes lay their eggs directly in clean, standing water; consequently existing larvae are washed away during floods and as floodwaters recede, leftover pools are used as breeding sites. *Anopheles* spp. mosquitoes will also lay their eggs in a wide range of environments (e.g., shady/sunny, flood pools, streams, irrigated lands, marshes, etc.), so events like hurricanes that cover a large area will yield massive breeding potential. It is predictably common to see spikes in *Anopheles* spp. populations following hurricanes and/or flood events. In Texas, *Anopheles* spp. don't currently serve as disease vectors, so they are more of a nuisance concern than a public health threat following a storm.

Aedes spp. mosquitoes lay eggs specifically in places that will be either subject to flooding (in the ground around streams for example) or in places affected by an increase in rainwater (like the sides of flower pots that will fill upon rainfall). Their eggs can sit for several months prior to such an event, thus heavy rains are an integral part of their reproductive strategy and a spike in *Aedes* spp. numbers can always be expected after a hurricane or excessive rains that lead to flooding. *Ochlerotatus* spp. and *Psorophora* spp. are also flood-dependent breeders. West Nile virus and La Crosse virus (in the California serogroup) are carried by some *Ochlerotatus* spp., but *Psorophora* spp. are nuisance mosquitoes only and are not vectors of human disease.

Culex spp. require stagnant water specifically (i.e. the kind often found accumulated in old tires, bird-baths, rusty coffee cans in landfills, etc.). Since heavy rains will fill up such items, an inevitable increase in *Culex* spp. populations is to be expected following rainfall events.

All mosquito species lifecycle times are dependent upon temperature; the warmer the temperature the faster they will reproduce. Although it varies by species and region, a good rule of thumb is that in a tropical environment you can expect a spike in adult mosquito numbers 10-15 days following the end of heavy rainfall.

Because WNV infection is currently the most commonly occurring arboviral infection in Texas, increases in the *Culex* spp. vector populations present the biggest public health concern. Post-hurricane/flood mosquito control strategies should focus on getting the public to dump out containers on their property that may have collected water. Larviciding is typically the best and most-efficient control strategy to minimize adult mosquito populations, however during outbreaks of WNV or other arboviral diseases, adulticiding results in more rapid control of adult mosquito populations and thus more effectively decreases disease transmission. If no disease is present following an observed post-storm spike in mosquito numbers, then control methods will depend and focus on the particular need to control nuisance mosquito populations that may hinder recovery efforts.

Attachment 2 – CDC Information on Insect Repellents

From <http://www.cdc.gov/westnile/resources/pdfs/wnvguidelines.pdf>

Repellents

CDC recommends the use of products containing active ingredients which have been registered by the U.S. Environmental Protection Agency (EPA) for use as repellents applied to skin and clothing. EPA registration of repellent active ingredients indicates the materials have been reviewed and approved for efficacy and human safety when applied according to the instructions on the label.

Repellents for use on skin and clothing: CDC evaluation of information contained in peer-reviewed scientific literature and data available from EPA has identified several EPA-registered products that provide repellent activity sufficient to help people avoid the bites of disease carrying mosquitoes. Products containing these active ingredients typically provide reasonably long-lasting protection:

- DEET (Chemical Name: N,N-diethyl-m-toluamide or N,N-diethyl-3-methyl-benzamide)
- Picaridin (KBR 3023, Chemical Name: 2-(2-hydroxyethyl)-1-piperidinecarboxylic acid 1-methylpropyl ester)
- Oil of Lemon Eucalyptus* or PMD (Chemical Name: para-Menthane-3,8-diol) the synthesized version of oil of lemon eucalyptus
- IR3535 (Chemical Name: 3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester)

* Note: This recommendation refers to EPA-registered repellent products containing the active ingredient oil of lemon eucalyptus (or PMD). “Pure” oil of lemon eucalyptus (e.g. essential oil) has not received similar, validated testing for safety and efficacy, is not registered with EPA as an insect repellent, and is not covered by this CDC recommendation.

EPA characterizes the active ingredients DEET and Picaridin as “conventional repellents” and Oil of Lemon Eucalyptus, PMD, and IR3535 as “biopesticide repellents”, which are derived from natural materials. For more information on repellent active ingredients see (<http://www2.epa.gov/mosquitocontrol>).

Published data indicate that repellent efficacy and duration of protection vary considerably among products and among mosquito species, and are markedly affected by ambient temperature, amount of perspiration, exposure to water, abrasive removal, and other factors. In general, higher concentrations of active ingredient provide longer duration of protection, regardless of the active ingredient, although concentrations above ~50% do not offer a marked increase in protection time. Products with <10% active ingredient may offer only limited protection, often from 1-2 hours. Products that offer sustained release or controlled release (micro-encapsulated) formulations, even with lower active ingredient concentrations, may provide longer protection times.

Repellents for use on clothing: Certain products containing permethrin are recommended for use on clothing, shoes, bed nets, and camping gear, and are registered with EPA for this use. Permethrin is highly effective as an insecticide and as a repellent. Permethrin-treated clothing repels mosquitoes, and retains this effect after repeated laundering. The permethrin repellents should be reapplied following the label instructions. Some commercial clothing products are available pretreated with permethrin. Additional information about CDC’s repellent

recommendations is available at
(<http://www.cdc.gov/ncidod/dvbid/westnile/RepellentUpdates.htm>).

Mosquito bites can be avoided simply by not going outdoors when mosquitoes are biting, and recommendations to avoid outdoor activity when and where high WNV activity levels have been detected are a component of prevention programs. Recommendations to avoid being outdoors from dusk to dawn may conflict with neighborhood social patterns, community events, or the practices of persons without air-conditioning. It is important to communicate that the primary WNV vectors are active from dusk until dawn. Emphasize that repellent use is protective, and should be used when outdoors during the prime mosquito-biting hours.

Attachment 3 – Arbovirus Field Surveillance Techniques

From www.dshs.state.tx.us/lab/arboFieldSurveillance.shtm

The following information is presented to introduce the basic procedures of field surveillance. Completion of proper training and adherence to procedures as listed under the guidelines is necessary for participation in the Arbovirus Surveillance Program. Field training for new program participants should be arranged with other established program participants or their appropriate HSR.

Pathogenic mosquito-borne encephalitis viruses affect the well-being of humans in Texas and are a continuing public health threat. Although most attention is given to this infectious group of diseases when explosive outbreaks occur, scattered cases are reported each year.

A. PURPOSES

1. Collection of vector mosquitoes to be shipped to the Laboratory for identification and arboviral isolation studies.
2. Determination of vector mosquito breeding sites.

B. MATERIALS

1. Adult mosquitoes
 - a. Mosquito collection traps
 - b. Mechanical aspirators
 - c. Flashlight
 - d. Labeled mosquito shipping boxes
 - e. Mosquito collection cartons
 - f. Newspaper or other packing material
 - g. One (1) quart plastic container filled with water and frozen prior to sending mosquitoes, or polar packs

C. PREPARATION OF MATERIALS (SUPPLIED BY THE LABORATORY)

1. Mosquito shipping boxes

These boxes consist of an outer and inner box, which are separated by fiber insulation. A return- addressed label is attached to the mosquito shipping box. A box may be used repeatedly. Plastic containers with ice or polar packs along with newspaper are placed in each box.

 - a. MOSQUITO COLLECTION CARTONS

These cartons are made from pint, plastic containers with lids especially prepared for proper airflow. A corked hole is located on the side of the container. A mosquito submission form must accompany each container. Attach it to the container with a rubber band.

D. METHODS

1. An overall perspective of the area to be surveyed is possible by consulting location (county, city, area) maps, discussing mosquito problems and cases of encephalitis with local officials (sanitarians, mosquito control personnel, Zoonosis Control investigators),

and reviewing any records pertaining to mosquito activities in that area. Areas where mosquitoes are most likely to pose problems are circled on the map and/or recorded on a referral list (preferably in convenient order of investigation).

2. A map and/or referral list is carried with field investigators when they begin fieldwork. Materials for live adult mosquito collections are collection traps, insulated mosquito shipping boxes, mosquito collection cartons with attached mosquito report forms, aspirators, flashlights, and frozen containers that are kept in the shipping boxes. Adults should never be placed in alcohol or other fluid as this will alter important taxonomic characteristics and will not be processed.
3. Each area marked on the map or list should be investigated. Although the amount of time spent at each site will vary, one should allow sufficient time for sites separated by a considerable distance. Random surveying of sites in scheduled areas may prove productive.
4. Permission from the property owner or other authorized person must be secured prior to surveying any site. It is usually most practical to seek such permission at the time of arrival at that site. Sometimes due to long travel distances, permission may be sought by telephone prior to leaving headquarters.
5. Suitable mosquito collecting locations at a site may be found by:
 - a. Questioning a resident or property owner about recent mosquito activity.
 - b. Observing any attempts to feed by daytime biting mosquitoes.
 - c. Examining any fairly open structures that have areas or corners somewhat protected from sun and wind; some frequently productive collecting locations are garages, chicken houses, barns, stables, under bridges, and large diameter storm drains. Any structure housing chickens and/or livestock is particularly suitable because many species of mosquitoes are attracted to chickens and will readily feed on them. Diurnal or evening biters are most often found at these locations. Therefore, surveying at sites not listed but where these animals are noticed can be productive.
6. Daytime biters that are encountered while surveying may be removed from the person (such as from the pants leg) by using an aspirator. Several specimens may be collected at a time (making certain that either suction is maintained or the open end of rigid tubing is covered to prevent specimens from escaping) and then blown into the mosquito collection containers. The mosquitoes are introduced into the containers by removing the cork, blowing the mosquitoes through the hole, and rapidly reinserting the cork to prevent loss of specimens.
7. Mosquitoes found in structures are removed from their resting sites (webbing, boards, tires, walls, etc.) and placed in the cartons. Because most specimens found in this type of habitat are frequently in the darkest and most protected corners or containers, a flashlight is necessary to locate individual specimens.
8. Separate cartons should be used for different collecting locations at a site. For instance, mosquitoes collected from the pants leg while surveying the grass at a site should be in a different carton than those collected from a chicken coop at the same site. Of course, different sites will also require separate cartons. Collect about 50 mosquitoes at a site; then enter all collection information on the mosquito submission form that accompanies the carton. Please use a ballpoint pen. Attach the form to the carton with a rubber band.

NOTE: The above method is most often used; however, if precise information pertaining to location and site is not important to the investigator, mosquitoes may be combined in the same cartons and labeled as desired (such as county, city, block, or code number).

9. Collected specimens are placed into a cooler that also contains several frozen containers. This will keep the live specimens cool and relatively inactive during the remainder of the survey.
10. Following surveillance activities, the collected mosquitoes are returned to headquarters. Plastic containers with frozen water or polar packs are placed into the shipping box with the collecting cartons.

IMPORTANT: Several moistened paper towels or moistened newspaper should be added to the inner box to keep humidity at a high level. Avoid saturating the paper because excess water in the cartons will damage the mosquitoes.

11. The prepared shipping box is then labeled for proper transit to the DSHS Laboratory. Shipment by bus has proven most efficient for the majority of program participants.

E. QUALITY CONTROL: LIVE, ADULT MOSQUITO SHIPMENTS

1. Handling

The most critical part of submitting satisfactory specimens is in shipping techniques.

a. Temperatures

Sustained high temperatures are very detrimental to mosquitoes. Plastic containers with frozen water or polar packs should be used during both collection and submission stages.

b. Humidity:

This is another important aspect that can be easily overlooked. High humidity is necessary and can be achieved by placing several moistened paper towels or moistened newspaper into the inner box. Avoid saturating the paper because excess water in the cartons will damage the mosquitoes.

c. Proper labeling

Collection data should be written on forms. Lack of proper information can decrease the value of arboviral isolation studies, particularly if arbovirus positive mosquito specimens have been collected.

d. Holding specimens

Although variable, the natural life span of a typical adult, female mosquito is quite short (about a month). In captivity, mortality increases significantly after two or three days. **Therefore, specimens being sent for arboviral isolation studies should be sent as soon after collection as possible - preferably the same day as collected.** It is also detrimental to unnecessarily handle the specimens, such as by conducting "pre-identifications." All mosquito specimens submitted are identified and, therefore such handling by the submitter does not assist the laboratory process but often increases the mortality rate of the mosquitoes during transit.

- e. Shipping arrangements
It is always preferable to ensure specimens are received Monday – Friday 8 am – 5 pm. Shipments late in the week may not be received until Saturday. Because mosquito processing is not routinely conducted on a weekend, a delay may occur that could damage the quality of the specimens. State holidays should also be taken into consideration. Whenever an emergency situation (such as an outbreak) develops, please call the DSHS Arbovirus/Entomology Laboratory (888-963-7111 ext. 7615 toll free) to arrange for special pickup and/or processing of such specimens.
- f. Contamination
Mosquitoes for arboviral isolation studies are quite susceptible to pesticides; contact should be avoided or damage to the shipment will occur. This should be kept in mind when storing equipment and supplies.

2. Sampling methods

- a. Sampling patterns
It is most productive to routinely sample all areas of concern. Whether a city, county, or other designated area, a schedule for routine sampling should be established. Few programs are comprehensive enough to cover all areas at the same time; therefore, quadrants or some other subdividing of the area may be necessary. Each subdivision of the area can then be surveyed at regular intervals.
- b. Pool size
Although a total of one mosquito can be tested for encephalitis viruses, an ideal pool for arbovirus testing consists of about 50 mosquitoes. Having too many mosquitoes in a carton will stress them and can compromise the identification process. **Therefore, no more than 100 mosquitoes should be placed in one (1) carton.**
- c. Time of day
The time of day that collections are made can be very significant. Although daytime biters can be collected at almost any time during the daylight hours, evening biters may present a problem if survey times are not properly scheduled. Collection of evening biters, which includes *Culex quinquefasciatus*, the primary vector of West Nile and St. Louis encephalitis, is usually made in protected areas where these mosquitoes rest during the day. Generally, collection traps are placed in the late afternoon and checked early the next morning.
- d. Habitats
The primary vectors of West Nile, St. Louis encephalitis, and western equine encephalitis are frequently found in resting shelters during the day. Potential vectors of eastern equine encephalitis include some daytime biters that may be difficult to find in such places. These factors are important when surveying for particular types of encephalitis vectors.
- e. Light trap for collecting adult mosquitoes
The CDC miniature light trap is productive for surveillance of some vector species but counterproductive for others. Scheduling for setting out light traps and picking up collected specimens may present some problems. An important drawback of this method is the lack of proper species collected when surveying for West Nile and St. Louis encephalitis viruses; the primary vector in Texas *Cx. quinquefasciatus*, is only

weakly attracted to light. The attachment of carbon dioxide in the form of dry ice will increase the yield of the primary vector, but the results can still be very unsatisfactory. However, light traps can be effective tools when surveying storm sewers, collecting potential vectors of La Crosse encephalitis, eastern or western equine encephalitis, or determining the presence of some mosquito species that are seldom collected by other methods.

f. Gravid trap for collecting adult mosquitoes

The gravid trap provides a more effective and economical sampling system for female *Culex* mosquitoes as they come to oviposit. It is therefore selective for females that have already taken at least one blood meal and the chance of isolating an arbovirus is greatly increased.

Attachment 4 – Mosquito Larval Surveillance Guidelines and Form

Background Information

Look for mosquito breeding (egg or larval) habitats. The more common breeding sites include: highly polluted water, artificial containers, tree holes, pastures that temporarily flood, drainage ditches, woodland pools, and man-made ponds. There is not much mosquito breeding in natural ponds, lakes, bayous or any bodies of water that flow. These habitats normally have many predators such as fish or other aquatic insects.

Materials

- a. White dipper with 3-4 foot long handle (a specific dipper volume is not as important as using a consistent volume}
- b. Mosquito Larval Surveillance Forms

Optional:

- c. Vials, 6 dram with screw caps (or other vials with secure lids)
- d. Disposable bulb pipets ("eye dropper")
- e. Alcohol, 70% isopropyl

Methods

Examine standing water to collect larval mosquitoes. The following types of water are most often productive:

- a. Roadside ditches and other drainage water
- b. Artificial containers (such as birdbaths, discarded or stacked tires, vases, watering troughs, barrels)
- c. Ponds, stock tanks, creeks. The amount of larvae present will in large part, depend on the amount of aquatic predators that may be present
- d. Other areas. Almost any water that stands for several days may be productive. It can be worthwhile checking such habitats as tree holes, livestock tracks (following rain), and clogged rain gutters.

Carefully approach the water and avoid casting a shadow across the sampling site. To determine the presence of larvae, take a sample of water using the dipper. If larvae are observed, take 10 dips at various locations at the site and count the larvae and/or pupae in each dipper sample; record on the Mosquito Larval Surveillance Form.

Some jurisdictions may wish to collect samples of the larvae for further identification at their facility. Larvae can be removed from the dipper with a bulb pipet and placed in a vial. Immature specimens (1st through 3rd instar) are quite small and may lack taxonomic characteristics true to the mature larval stages of species. Therefore, these specimens can be left in the collection water for a day or two until they develop into mature larvae. If larvae are mature (4th instar), alcohol should be placed in the vial to preserve specimens until they can be identified. Alcohol should be composed of at least 50 percent (estimated) of the liquid volume; therefore, it may be necessary to drain off some of the collected water. The loss of specimens that may occur while draining the water from the vial can be avoided by placing a small piece of cheesecloth, filter paper, or paper toweling over the mouth of the vial when pouring off water or by using a bulb pipet to remove water.

Mosquito Larval Surveillance Form

PLEASE PRINT CLEARLY

CITY/ZONE: _____
 COUNTY: _____

DATE: _____(DD/MM/YYYY)
 INSPECTOR: _____

Site	Location (GPS coordinates or physical address)	Dip 1	Dip 2	Dip 3	Dip 4	Dip 5	Dip 6	Dip 7	Dip 8	Dip 9	Dip 10	* Index of Abundance	Comments (estimated area covered by standing water, larvicide applied, etc.)
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													

* Index of Abundance equals the average of a 10-dipper count

Instructions

Using a white dipper with a 3'-4' long handle attached to it:

1. Select site with standing water. Record the location (physical address or, preferably, GPS coordinates).
2. Carefully approach the water and avoid casting a shadow across sampling site; take 10 dips at various locations at the site.
3. Count the larvae and/or pupae in each dipper sample and record on form.
4. Add the total number of larvae and/or pupae collected in all dipper samples and divide it by the number of dips taken to compute the average number of larvae and/or pupae per dip.
5. If the Index of Larval Abundance is above the established threshold, apply an appropriate larvicide per label directions.

NOTE: A specific dipper volume is not as important as using the same-sized dipper for repeated measurements over time.

Attachment 5 – DSHS Mosquito Identification and Testing (Letter)



TEXAS DEPARTMENT OF STATE HEALTH SERVICES

P.O. Box 149347
Austin, Texas 78714-9347
1-888-963-7111
TTY: 1-800-735-2989
www.dshs.state.tx.us

Kirk Cole
INTERIM COMMISSIONER

April 9, 2015

Dear Submitter,

The Department of State Health Services (DSHS) Arbovirus Laboratory is designed to detect the presence of a variety of arboviruses in mosquito populations. This season, DSHS will not be providing RT-PCR as a diagnostic tool in order to focus on cell culture services which will target detection of important human pathogens including: West Nile virus, St. Louis encephalitis virus, Eastern equine encephalitis virus, Western equine encephalitis virus, Venezuelan equine encephalitis virus, Highlands J virus, California group viruses (including La Crosse virus), Tensaw virus, Chikungunya virus and other emerging arbovirus species. The services provided will consist of mosquito species identification (year-round) and virus detection by cell culture only (May-November).

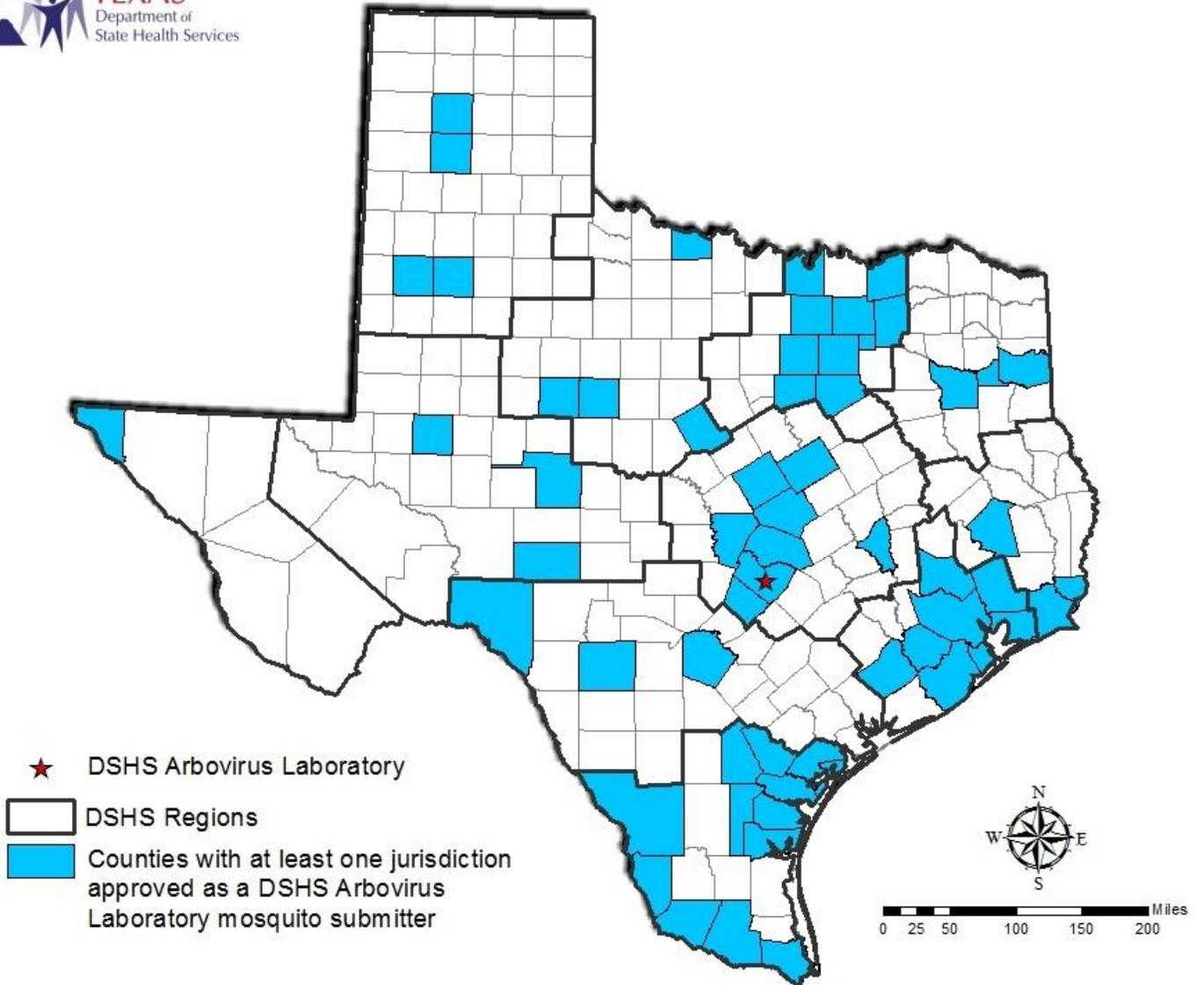
During the testing season, submitters are contacted by telephone when a virus-positive mosquito pool is detected from their collections, and an email containing a preliminary virus isolation report is sent to the submitter, the corresponding Health Service Region, and internal DSHS management.

DSHS will continue efforts to provide an informative arbovirus surveillance program that promotes public health and safety for Texans. We have limited capacity; thus to accommodate submissions from representative geographic locations throughout the state, please contact DSHS if you anticipate any changes to your submission volume. Staff at the Zoonosis Control Branch, the Infectious Disease Control Unit, and the Laboratory Operations Unit will analyze and monitor arbovirus activity throughout the year to determine the need for additional surveillance activities.

Thank you for participating in the Arbovirus Surveillance Program. DSHS will begin accepting mosquitoes for testing during the first full week of May. Please contact Bethany Bolling at 512.776.2442 or bethany.bolling@dshs.state.tx.us if you need additional or replacement shipping materials before the season begins or if you have any questions. Your efforts to collect mosquitoes and submit them to our testing laboratory in good condition are appreciated.

Sincerely,
Grace Kubin, Ph.D.
Director, Laboratory Services Section

Attachment 6 – DSHS Arbovirus Surveillance Network



Attachment 7 – Dead Bird Reporting and Testing as a Surveillance Tool for West Nile Virus

Since the first detection of West Nile virus (WNV) in the United States in 1999, many jurisdictions have incorporated the reporting and testing of dead birds as a method to detect WNV activity. In more recent years, however, most have discontinued dead bird surveillance because of the endemic status of WNV and the need to involve the public for this type of surveillance to be effective.

According to the U.S. Centers for Disease Control and Prevention (www.cdc.gov/westnile) over 325 species of birds have tested positive for WNV. However, many species of birds do not reliably become ill from WNV infection and thus do not make efficient sentinels for WNV surveillance. Members of the *Corvidae* family are generally the best candidates for WNV surveillance in dead birds, as they are consistently among the most likely species to exhibit overt illness and/or death due to WNV infection. Corvid species found in Texas include crows (3 species), ravens (2 species), jays (6 species), and magpies (1 species). The photos immediately below show the most common species found in Texas.

Great-tailed Grackles are abundant in Texas, are frequently infected with WNV, and die at a fairly high rate in experimental infections studies. Dead grackles should be investigated for WNV infection, if WNV has not yet been detected in the area.



American Crow

Blue Jay

Common Raven

Great-tailed Grackle

THE PURPOSE OF AVIAN MORTALITY SURVEILLANCE IS TO ALERT THE COMMUNITY TO NEW AREAS OF VIRUS ACTIVITY. This is particularly important where organized mosquito surveillance and control activities are absent. If WNV has already been detected in the local community, testing dead birds is not essential.

The CDC recommends testing either breast feathers or oral swabs as the safest and most cost efficient means of detecting WNV in bird carcasses. The Texas Veterinary Medical Diagnostic Laboratory (TVMDL) offers fee-based polymerase chain reaction (PCR) testing for WNV in dead birds. Birds may be submitted whole (subject to an additional necropsy fee) or the brain, heart, or liver may be submitted for testing. Complete information may be found on the TVMDL website at <http://tvmdl.tamu.edu/> or by calling the laboratory at (888) 646-5623. The Texas A&M University Department of Entomology also offers fee-based PCR testing of dead birds; contact Dr. Gabriel Hamer at 979-862-4067 or ghamer@tamu.edu for additional information. Other commercial laboratories may provide fee-based testing services and point-of-use tests may also be available commercially.

Additional information about WNV in Texas is available at www.TxWestNile.org.