

Mansfield Mosquito Surveillance & Control Policy



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1.0 INTRODUCTION

Mosquitoes are insects that belong to the order Diptera, or True Flies. Female mosquitoes have modified mouthparts that form a long piercing-sucking proboscis, while male mosquitoes have mouthparts that are incapable of piercing skin. There are over 2500 different species of mosquitoes that have been identified throughout the world, with approximately 150 species occurring in the United States. The Texas Department of Health estimates that there are approximately 82-84 mosquito species in the State of Texas, although only about 12 of these mosquito species have been implicated in the transmission of serious diseases.

Mosquitoes typically need still, stagnant water that is isolated from fish or other small predators to complete their metamorphosis from egg to adult. Larval habitats can range from marshes, freshwater wetlands, and tree holes to human-made structures like catchments, gutters, and discarded tires. Not all species feed on humans and other mammals, and many species feed mostly on birds, amphibians, or reptiles. Only a small percentage of the known mosquito species are considered to be disease vectors.

Although only a small percentage of mosquito species are capable of transmitting diseases, mosquitoes are still considered to be a very important vector for disease transmission. Within the United States, the occurrences of mosquito-borne illnesses have been relatively rare in recent years. However, epidemics of mosquito-borne diseases were once common in the United States. Outbreaks of Yellow Fever have been recorded as far north as Philadelphia during the Colonial Period, and Dengue fever was prevalent along the Gulf Coast until the mid-1940s. At one time, malaria was well established in the continental United States, especially in the south. Other mosquito-borne illnesses like LaCrosse, St. Louis, and Eastern Equine Encephalitis are still threats in certain areas of the country. Although many of these historical mosquito-borne diseases have been eliminated or at least controlled, the introduction and subsequent rapid spread of West Nile Virus within the United States is a topic of current concern.

Mosquitoes may be controlled through a variety of different physical, chemical, and biological methods. Physical methods usually involve source reduction, which is simply the physical removal of mosquito breeding habitats. Biological measures mainly center on the use of bacteria that kill mosquito larvae or the use of natural mosquito predators.

Chemical treatment typically involves the application of pesticides to attempt to control adult mosquito populations. Mosquito control pesticides are applied by various means, depending on the type and size of the area being treated. No matter how pesticides are applied, however, pesticides have the potential to impact non-target species, including

humans. Potential impacts may be in the form of acute or chronic toxicity, reproductive and / or developmental effects, and indirect effects through the food chain and pollination. The tests required for the registration of pesticides also do not address many forms of non-target impacts that may be of concern. Information is particularly weak with regard to the effects of inert ingredients in pesticide formulations, food chain effects, multi-generational effects, and the interaction of specific pesticides with other chemicals in the environment. It is therefore important to realize that there are risks associated with the use of pesticides just as there are risks associated with the potential for human or animal infection by a mosquito-borne illness. The purpose of this response plan is to provide a systematic way to consider and balance the risks associated with mosquito control measures.

2.0 West Nile Virus (WNV) and Other Mosquito Borne Pathogens

West Nile Virus was first recorded in North America during August 1999 shortly following the Center for Disease Control and Prevention (CDC) and the New York City Department of Health responses to an unusual outbreak of encephalitis in northern Queens, New York. The cause of the observed illnesses was determined to be West Nile virus. During 1999, approximately sixty people were diagnosed with West Nile virus and seven elderly residents died from the infection. During the summer of 2000, WNV activity was detected again in New York City and appeared to be spreading. Fourteen people in the City of New York were diagnosed with acute WNV infection, six were identified in New Jersey, and 1 was reported from Connecticut. Outside of New York, WNV was detected in 12 states and in the District of Columbia. During 2001, the virus appeared again in New York City, causing seven cases that required hospitalization. In 2001, a total of 66 human cases with nine fatalities were reported throughout the nation, mostly spread throughout the eastern United States. During 2002, there were 4156 laboratory-positive human cases and 284 deaths. The number of cases increased dramatically in 2003 as the disease spread westward, with 9862 cases and 264 deaths.

During 2004 there were 2539 cases with 100 deaths, and in 2005 there were 3000 cases with 119 deaths. The 2006 season had 4269 human cases of the disease and 177 deaths.

The relatively rapid spread of West Nile virus and the increase in disease incidence indicates that WNV is permanently established in the United States. It is likely that the virus survives the winter either within birds that remain in the area or possibly within mosquitoes that survive the winter in the adult stage. When spring returns, the virus re-emerges within the birds and is readily passed to early season mosquitoes. As mosquito populations increase, mosquitoes begin to feed more frequently on birds, causing an increasing number of birds and mosquitoes to become infected. If environmental conditions are favorable for transmission, the virus will amplify to a theoretical point of

spillover. At spillover, the virus can bridge out of the enzootic, bird-mosquito cycle through mosquitoes that feed on birds, humans, and other animals. At the point of spillover, transmission to humans becomes more likely unless a mosquito control program is implemented.

Mosquitoes are capable of transmitting other pathogens from one host species to another. Diseases such as Dengue fever, Malaria, Yellow fever, and several varieties of encephalitis that infect humans, horses and cattle can be carried by mosquitoes and infect individuals.

The past experience of numerous mosquito control districts suggests that a mosquito control program should be based on the principals of Integrated Pest Management (IPM).

The principals of IPM are:

- Knowledge of mosquito biology and the epidemiology of the mosquito-borne diseases;
- Surveillance and monitoring efforts for the detection and status assessment of mosquito populations and / or mosquito-borne diseases;
- A multifaceted prevention and control program comprised of a system of control tactics which are compatible with each other and which are proven effective;
- Continued program evaluations and updates to ensure that the best methods are being used to meet the prevention and control objectives of the program; and

- Continued education of the public to create awareness, understanding, and support.

These general guidelines have been used to develop the threshold-level responses of this surveillance and response plan.

3.0 Mansfield Surveillance Program

The risk of mosquito-borne diseases depends on the size of mosquito populations and the incidence rate of the disease. Collecting information on adult mosquito populations is thus important for both targeting control measures and gauging the potential for disease outbreak. An adult mosquito surveillance program for Mansfield has been developed and implemented since 2005.

This surveillance program collects adult mosquitoes from public properties, easements, or rights of way through the use of gravid traps, or other methods as they become available. Captured mosquitoes will be sent to a laboratory capable of performing the West Nile Virus presence test. Each sample or pool will consist of female mosquitoes that are collected at a

single collection site using a single type of trap. The information obtained from these surveillance efforts will be used to map mosquito populations, provide public information, and to determine the incidence of WNV or other mosquito borne pathogen.

The mosquito surveillance efforts that have been designed for the City of Mansfield will allow analysts to map potential mosquito breeding grounds. Using this information, more targeted efforts towards habitat disruption, source reduction, larviciding operations, and other control mechanisms are possible. An effective surveillance and control program should therefore allow analysts to detect the presence of WNV or other mosquito-borne pathogens during the amplification phase. If targeted mosquito controls are implemented at the amplification stage, the likelihood of bridging can be minimized, thus reducing the risk of human transmission. Depending on results, trapping may be expanded or contracted and the trapping season may be lengthened or shortened. If control measures are applied, trapping may be used more frequently to evaluate the effectiveness of the control measures.

The overall goal of the mosquito surveillance program is the use data on mosquito populations and mosquito virus infections rates to:

- Assess the threat of human disease;
- Determine the geographical areas of highest risk;
- Assess the need for and timing of intervention events;
- Identify larval habitats that are in need of targeted control;
- Monitor the effectiveness of control measures; and
- Develop a better understanding of transmission cycles and potential vector species.

Adult surveillance methods should:

- Use both fixed and flexible trap positions if possible
 - Fixed positions allow for the development of a database so year to year comparisons are possible
 - Flexible sites allow for responses to epidemiological and natural events.
- Use a variety of trapping methods (CDC light traps, gravid traps, etc...)
- Account for different influencing factors, including:
 - Habitat size and diversity
 - Resource availability
 - Proximity to human population centers and / or recreational areas
 - Flight ranges of vector species

Advantages of using adult mosquito surveys can include:

- May provide the earliest evidence of viral activity in an area
- Helpful for determining if viral activity is local and / or restricted to a few areas
- Provides information on potential mosquito vector species
- Provides an estimate of vector species abundance
- Provides information on virus infection rates for different mosquito species;
- Provides information on the potential risks to humans and animals;
- Provides baseline data that can be used to guide emergency controls.

Disadvantages of using adult mosquito surveys:

- Labor intensive and can be expensive
- Substantial expertise is required for collecting and handling mosquitoes
- Collectors may be at risk from mosquito bites, although using personal protection methods can minimize risks.

3.1 Adult Mosquito Collections

The adult mosquito surveys implemented by the City of Mansfield are designed to determine the relative abundance of various species present during the sampling period as well as the incidence of arthropod-borne virus/diseases within the captured specimens. Using this information, City of Mansfield personnel can determine the need for various control measures, conduct more effective searches for larval breeding places, assess the extent of the problem, and potentially gauge the effectiveness of control measures. Reports concerning the incidence rates of arthropod-borne virus/diseases and the relative risks to citizens may also be produced. Currently, the majority of collections are likely going to be made using gravid traps, as they are the most effective collection method for the *Culex sp.* mosquitoes most likely to cause human health risks.

4.0 Mosquito Control Strategies

Human activities can greatly affect the ecology of mosquito populations. Large concentrations of people or animals, for example, can increase exposure rates and the probability of disease outbreak. The use of irrigation, development of drainage networks, elimination of mosquito predators, prevalence of improperly maintained birdbaths and other water holding containers can increase the numbers of certain types of mosquitoes.

Expanding international trade and travel has increased the chance of introducing new mosquito species into our areas, as has recently happened with the Asian Tiger Mosquito (*Aedes albopictus*).

Mosquito control strategies have changed dramatically over the last few decades. Diesel oil, inorganic poisons, and source reduction using ditching operations were the basic tools of early mosquito control programs. Chlorinated hydrocarbons, organophosphates, pyrethrins, monomolecular oils, bacteria, and natural predators are more recent additions to mosquito control efforts. With the growth of ecological consciousness and environmental science, people began to realize the environmental damage that accompanied the use of broad-spectrum chemical control agents, particularly those that did not readily break down in nature. Concerns were also raised because many mosquito populations also appeared to develop resistance to the more commonly utilized chemical control agents.

Over the past few years, major advances have been made in the areas of biological mosquito control. Biological control strategies may include using natural predators like *Gambusia affinis* (Mosquito fish), fungi, protozoans, round worms, flat worms, and bacterial agents such as *Bacillus thuringiensis israelensis* (Bti). Each biological control agent has certain benefits and restrictions. In order to use a biological control agent successfully, the applicator must have a basic knowledge of biology associated with the control agent. Some biological control mechanisms, for example, are limited by salinity, temperature, or organic pollution and some mosquito species are much more susceptible to specific types of biological control agents. All of these factors must be considered when choosing and applying biological control agents.

The perfect pesticide is one that is easily applied, reasonably inexpensive, non-toxic to non-target organisms, and eliminates the pest quickly before it becomes a threat. Although no single pesticide can combine all of these factors, certain types of *Bacillus* bacteria have been developed into pesticides that are very close to the perfect pesticide model. *Bacillus thuringiensis israelensis* (Bti), for example, is a naturally occurring soil bacteria that produces a poison capable of killing mosquito larvae. Bti is considered ideal for mosquito management because of its specificity for mosquito larvae and because of the lack of toxicity to non-target organisms. These bacteria form asexual reproductive cells, called spores, which enable them to survive in adverse conditions. The endospores of *Bacillus thuringiensis israelensis* also contain crystals of an insecticidal protein toxin called delta endotoxin. Once ingested by a mosquito, the alkaline conditions of the stomach dissolve the crystal and release the delta-endotoxin. The toxin has an affinity for the stomach wall lining causing the cells to first swell then rupture. When enough stomach cells burst, the alkaline fluid of the midgut can enter the blood. This movement of stomach fluid increases

the alkalinity of the blood and results in a general paralysis. Death typically occurs a few hours after digestion. Currently, Bti is commercially available in powder, liquid, granular, capsule, and briquette formulations.

4.1 Larviciding vs. Adulthood:

In the past, many mosquito control programs have relied heavily upon adult mosquito controls using chemical agents. In certain areas, routine mosquito spraying has been an integral component of mosquito control strategies. However, even near-continuous exposures to pesticides may not kill all mosquitoes. Mosquitoes that are genetically able to resist higher pesticide concentrations may survive and pass on this resistance to future generations. Eventually, the pesticide becomes less effective as resistance increases in the mosquito populations.

The onset of resistance, however, can be minimized through the "Management by Moderation" approach. Management by moderation is an attempt to prevent the onset of resistance by:

- using doses that are no lower than the lowest level rate to avoid genetic selection.
- using less frequent applications
- using chemicals of short environmental persistence
- avoiding the use of slow release formulations
- applying pesticides to only hot spots. Area-wide treatments should only be considered during imminent public health threats.
- leaving certain generations, populations, or population segments untreated
- establishing action thresholds that accentuate control mechanisms other than chemical control of adult mosquitoes..

Although management by moderation is a viable means of minimizing resistance, there are other environmental and human health concerns associated with the application of pesticides for adult mosquito control. Routine mosquito spraying, for example, has the potential to continuously expose the public to pesticides. In some cases, effects on humans are possible, particularly for people who already suffer from asthma or other respiratory problems. If proper safety precautions are not followed, applicator personnel may also be in danger of overexposure. Managers must therefore decide whether mosquitoes or the chemicals used to control mosquitoes represent the biggest threat to humans.

All mosquitoes begin their lives in water. Prime breeding sites include discarded tires left outdoors, poorly maintained bird baths, clogged rain gutters, unused swimming pools and plastic wading pools, pet dishes, or any other container capable of holding water for more

than 1 week. Mosquito breeding can therefore be prevented by either eliminating the source of water (source reduction) or by killing larvae (larviciding). Larviciding programs use a combination of source reduction, biological, and possibly chemical measures to control mosquito larvae before they develop into biting adults. If properly implemented, this strategy can be the most effective, economical and safest method for mosquito control because mosquito larvae are minimized, thus reducing the need for adult mosquito control and subsequently reducing the impacts of control measures on non-target organisms. Larviciding programs also offer the opportunity to use biological controls, which minimizes the impacts of the control program on non-target organisms and lessens the risk of chemical exposures to the public. Using biological controls also minimizes the chance of pesticide resistance in the mosquito populations. Experience suggests that the most effective and economical way to reduce mosquito populations is by larval source reduction through aggressive public education about the need to remove standing water sources around homes and a locally funded abatement program. The goal of this program should be to monitor mosquito populations and initiate controls before diseases are transmitted to humans or domestic animals (CDC, 2001).

4.2 Rationale for different treatment methods

Chemical usage should not be viewed as a long-term control strategy, and should be only implemented when there are occasional episodes of heavy uncontrolled breeding concurrent with a high degree of public health risk. This strategy is most appropriate because prolonged use will lead to the development of resistance in mosquito populations, thereby limiting overall management options (Tabashnik, 1990). However, some chemical treatment methods do have lower risks for human health or the environment than others. The insect growth regulator methoprene, for example, is a juvenile hormone mimic that is environmentally benign because of its relative specificity for mosquitoes (Main and Mulla, 1982). The organophosphate, temephos, is a pesticide that is relatively target specific for mosquitoes and is generally suitable for use in environmentally sensitive freshwater wetlands (Moreau, 1988). However, because of effectiveness issues, weekly use may be required during summer months (Tennessee, 1993), and persistence can be reduced to just a few days in polluted or colloidal waters.

The most efficient and effective program is one in which mosquito larvae are prevented from becoming biting adults through the use of biological control agents. The bacterium *Bacillus thuringiensis israelensis* (B.t.i) or the bacterium *Bacillus sphaericus* (B.s.) are considered to be among the most environmentally acceptable commercially available biological control agents because of their relative specificity for mosquitoes and negligible toxicity for vertebrates (Rishikesh et al., 1983). Larvivorous fish can also be a valuable

component of an integrated control program, either alone or together with chemical control agents (Walton et al., 1990; Walton and Mulla, 1991; Reed et al., 1995)

4.3 Integrated Pest Management (IPM)

Integrated pest management dictates that control efforts should be dependent on threshold levels. This means simply that a certain defined risk needs to exist before particular control measures are recommended. Levels of risk are based on knowledge of mosquito biology, the epidemiology of the mosquito-borne diseases, and monitoring efforts for the status assessment of mosquitoes and/or mosquito-borne diseases. Risks levels are then used to design multi-tactic prevention and control programs that are comprised of a system of control tactics which are compatible with each other and which are proven for their effectiveness. Continual program evaluations and updates are used to ensure that the best methods are being used to meet the prevention and control objectives of the program and continued public education is used to create awareness, understanding, and support. Frequent sampling will allow analysts to map potential mosquito breeding grounds. Using this information, more targeted efforts towards habitat disruption, source reduction, larviciding operations, and other control mechanisms are possible.

5.0 Mansfield Mosquito Control Plan:

The primary objective of mosquito control is to decrease the risk of mosquito-borne human diseases. This objective should be accomplished by:

- Continuing to stress source reduction as a viable means of control
- Larviciding where such activities are feasible, practical, and likely to be effective.
- Using personal mosquito protection measures, especially for the elderly and those individuals with compromised immune systems.

5.1 Adult Mosquito Control Procedures

Adult mosquito control procedures, particularly spraying of adulticides, should and will be considered a supplemental control measure of last resort. The decision to spray should be based on the considerations listed (in no particular order) below.

5.1.1 Triggers For adult mosquito control procedures

Adult control procedures should be considered only when there is evidence of WNV activity at a level suggesting a potential for a high rate of human infection (high dead bird densities, high mosquito infection rates, multiple positive mosquito species, horse or

mammal cases indicating escalating transmission, or human cases with evidence of epizootic activity). Finding a single WNV-positive bird or mosquito pool does not by itself constitute evidence of an imminent threat to human health and does not warrant escalating to adult control procedures. However, information about the mosquito populations of area cities should also be used in the determination of the need to conduct adult mosquito control activities, as well as locations where those activities should take place.

5.1.2 When to use adult mosquito control procedures:

The goal of spraying is to reduce the risk of human diseases by decreasing the number of vector adult mosquitoes as much as possible. However, the pesticide is only effective if it physically contacts the mosquito, which is most likely to happen when mosquitoes are actively flying. This typically will mean that spraying be conducted between dusk and dawn. It is also important to realize that weather conditions, including air temperature, have a large influence on the effectiveness of adulticides. In general, adulticides should only be applied when it is likely their use will maximize a reduction in risk to human health.

5.1.3 Where to use adult mosquito control procedures:

The terrain of the proposed spraying area has a major impact on the pesticide effectiveness. If there is substantial vegetation, dense shrubbery, trees, or hedges, pesticide applications can be rendered ineffective. The density of houses and other physical obstructions can also influence the effectiveness of pesticides. Surveillance information about locations of large mosquito populations, positive pool locations, proximity to dense human populations/recreation areas and similar information should also be considered in determining where to apply adulticides, as well as which method to use. In general, adulticides should only be applied in locations where the application will maximize a reduction in risk to human health.

5.1.4 Human population density considerations:

The human population density in an area where there is evidence of intense epizootic activity should also be considered. If the area in question is rural and does not contain many people, the cost and potential risk associated with spraying may not justify its use. If the area in question is more densely populated, adult mosquito control is more justified as there is a much higher likelihood of reducing risk of human infection, long as adequate protection measures are taken.

5.1.5 Mosquito population considerations:

Information from mosquito surveillance can be helpful in determining when to conduct adult mosquito control and in determining the effectiveness of control measures, as well as which method(s) to use. It is also important to know the numbers and species of the vector populations in specific localities. The best way to obtain this information is through mosquito trapping efforts. The City of Mansfield has trained personnel on staff who perform the mosquito trapping, and may augment trapping activities with private contractors if deemed necessary.

5.1.5.1 Lag Time:

It is important to realize that determining the presence of diseases within surveillance specimens requires some processing time after collection. In the time between collection and the date of test results, circumstances may have occurred which would alter a decision to implement adult mosquito control procedures. For example, weather conditions may have adversely affected mosquito populations, local mosquito habitats may have been altered, or larviciding efforts may have reduced the number of newly emerged adults. All of these occurrences may result in a reduced need to implement adult mosquito control procedures.

5.1.5.2 Surveillance results over time:

Surveillance information can be considered through time to determine the progress of diseases. Information collected using a routine surveillance program can also be used to determine the relative risk of disease and to gauge the effectiveness of control measures. The available survey information should therefore always be considered before enacting adulticidal activities. It may be necessary to use mobile trap locations, or relocate existing trap locations to assist in the determination of adulticiding activity effectiveness.

5.1.6 Local perspectives on spraying:

Different communities have different perspectives on the benefits and risks associated with adult mosquito control activities. While these perspectives are valid and should be considered, individuals are likely to have strong opinions on either side of the issue. The City of Mansfield has tried to incorporate a rational framework within the mosquito control program that is designed to be protective of both human health and the environment. The decision to spray, however, is a complex issue that will likely be faced without complete information. Thus, there will be citizens that do not believe that the City of Mansfield has done a good job with regards to reducing public health and

environmental risks. The mosquito control program should therefore remain flexible and should attempt to address citizen complaints through public education and dialogue.

5.1.7 Mansfield adult mosquito control operations

Once arbovirus activity is detected and the decision is made to implement mosquito control using adulticides, the size of the area to treat must be determined. Unfortunately, there is no simple formula for determining how large of an area to treat around a positive surveillance indicator, nor is there adequate information to guide decisions about the degree of vector population suppression that must be attained, or for how long this suppression must be maintained to reduce the risk of disease. The CDC (2001) suggests considering the following factors when deciding the scope of the adulticiding effort:

- the general ecology of the area
- the flight range of vectors that are known or are believed to be of importance in the area
- the population density of the vectors
- the length of time since virus-positive mosquito pools were collected
- the potential risk to the human population (including the age demographics of the area) as well as the community perception of the relative risk of pesticides versus the risk of arbovirus infection.
- the season of the year - how much time the transmission risk can be expected to persist until the vector(s) enter diapause.

It is very likely that some of these factors will be unknown or only poorly known, and practical experience in conducting a mosquito control program is needed to refine control recommendations. If adulticiding operations are conducted, the following parameters should be monitored (CDC, 2001):

- Pre and post spray mosquito densities inside and outside the control area using light traps and/or gravid traps
- Mosquito infection rates pre and post spray, both inside and outside the application area.
- Weather conditions during the application (temperature, wind speed, wind direction, etc...).
- Droplet size and flow rate of Ultra-Low Volume applications
- Population age structure of key mosquito species (if practical).

If the application of adulticides is deemed necessary, the public must be informed. The following actions/activities will take place before adulticides are applied:

- Information will be released 48 hours in advance through the media and through the city of Mansfield's web site. Under certain conditions in park areas,

applications may take place in less than 48 hours notice. For these cases, the facility will be closed to the public during and a few hours after application.

- If needed, police department escorts will accompany applicator's trucks to announce that adulticiding is about to take place. The police escorts will encourage people to go indoors to reduce pesticide exposures.

5.2 Public Education Concerning Mosquito Control

Public education is a key component of a successful mosquito control program. Since the appearance of the West Nile Virus in the United States, the City of Mansfield has provided information on the city web page concerning this disease. In the event of a Risk Level 3 or higher (see Section 5.3 for rating criteria), the following key information will be conveyed to the public:

- The public will be informed about the comprehensive prevention strategies and activities used by the City of Mansfield to address the threat of West Nile Virus and to minimize the necessity of pesticide applications for adult mosquitoes.
- The public will be advised to eliminate standing water sites by removing all materials that can hold water for longer than 1 week. The public will also be urged to change the water and clean bird baths at least once a week, to clean and chlorinate swimming pools or drain and / or cover if not in use, and to unclog gutters and downspouts.
- The public will be informed about the symptoms of West Nile Virus (headache, high fever, muscle pain, weakness, and disorientation) and that persons over 50 years of age are more likely to experience significant clinical disease from West Nile infection.
- If appropriate, the public will be informed about the importance of reporting dead birds for surveillance purposes and that not all birds that are reported will be picked up. Information about the species of birds being prioritized for testing, how to properly dispose of birds not being retrieved, and the potential association between the high density of dead birds (especially crows) and the potential risk of West Nile virus will be disseminated.

Techniques used to disseminate information may include any of the following:

- City produced public information tools such as the Citizen Newsletter/e-Newsletter, City website, and MCTV Channel 27
- News media (television, radio, newspaper)
- Posters, brochures, and/or door hangers to be distributed in affected communities
- Brochures and/or fact sheets to be distributed to community-based organizations, community boards, elected officials, schools, nursing homes, libraries, outdoor activity sites, etc...

- Presentations to elected officials and/or community groups concerning mosquito breeding reduction and related activities
- News releases describing West Nile, or other pathogen, virus response activities.

6.0 City of Mansfield Response Plan

The purpose of this response plan is to:

1. Minimize human illness through public education and vector control;
2. Map the density of mosquitoes and the incidence of the virus within the City of Mansfield and examine the relationship between mosquito density and land uses.
3. Identify areas where the incidence of disease is high and post the appropriate warnings to the citizens of Mansfield.
4. Identify the key vector species that carry diseases within Mansfield.

The prevention of West Nile virus, as with many diseases, is most efficiently accomplished by ensuring that prompt, accurate information reaches the public. If the appropriate information reaches the public in a timely manner, personal protective measures may be implemented without panic and confusion.

The City of Mansfield will provide continuous information on the city web page concerning West Nile virus frequently asked questions (FAQs), disease symptoms, personal preventative measures, and points of contact for additional information. If a sampled mosquito pool tests positive for arthropod-borne virus/diseases, information describing the location of the sampling event, the date, and other pertinent information will be provided.

This response plan is partially based on Department of State Health Services recommendations. This response plan is also in line with the Tarrant County Public Health guidelines for a phased response to mosquito surveillance. It should be noted that the City of Mansfield retains the right to implement measures as it sees best fit for the residents based on health risks within the city limits.

The plan is divided into 5 levels based on the risk of human disease. Each risk level is described below, along with specific recommended responses. In accordance with the principals of Integrated Pest Management Control measures are recommended for each level.

6.1 Risk Level 0 – No Risk

Condition: No evidence of mosquito or viral activity

Trigger: No or lower than normal mosquito activity and no evidence of arthropod-borne virus/disease detected during the past 6 weeks in vectors, humans, or other hosts.

Recommended Response:

Surveillance:

If possible, conduct routine surveillance of adult mosquito populations using light traps baited with CO₂ and/or gravid traps (at minimum). Collected mosquito species should be identified to species level and mosquito pools should be screened for the presence of arboviruses.

Public Information / Education:

Publicize methods for mosquito reduction and personal protection prior to the main season for mosquito activity and outdoor human activities.

Control Measures

Use public information to promote source reduction and personal protection. Conduct standard larviciding approaches using effective measures for the location and *Gambusia affinis* (mosquito fish), when they may be used. No adulticide spraying will occur at this response level.

Rationale:

Larviciding and source reduction/elimination are considered to be the most effective long-term solution for mosquito control. The control measures are designed to accomplish mosquito control by preventing larval mosquitoes from becoming biting adults.

6.2 Risk Level 1 – Normal Response

Condition: Probability of human outbreak is remote

Trigger: Normal mosquito activity with no evidence of arthropod-borne virus/disease detected during the past 6 weeks in vectors, humans, or other hosts.

Recommended Response:

Surveillance:

If possible, conduct routine surveillance of adult mosquito populations using light traps baited with CO₂ and/or gravid traps (at minimum). Collected mosquito species should be

identified to species level and mosquito pools should be screened for the presence of arboviruses.

Public Information / Education:

Publicize methods for mosquito reduction and personal protection prior to the main season for mosquito activity and outdoor human activities.

Control Measures

Use public information to promote source reduction and personal protection. Conduct standard larviciding approaches using effective measures for the location and *Gambusia affinis* (mosquito fish), when they may be used. No adulticide spraying will occur at this response level.

Rationale:

Larviciding and source reduction/elimination are considered to be the most effective long-term solution for mosquito control. The control measures are designed to accomplish mosquito control by preventing larval mosquitoes from becoming biting adults.

6.3 Risk Level 2 - Enhanced Response

Condition: Probability of human outbreak is low to moderate

Trigger: Normal mosquito activity with little or no evidence of arthropod-borne virus/disease. Arthropod-borne virus/disease isolated from mosquitoes collected during trapping activities. Seropositive equine with a history that indicates that exposure likely occurred locally. Enhanced response level is due to recent historical presence of arthropod-borne virus/disease in vectors, humans, or other hosts within the vicinity of Mansfield (approximately 10 miles).

Recommended Response:

Surveillance:

If possible, conduct routine surveillance of adult mosquito populations using light traps baited with CO₂ and/or gravid traps (at minimum). Collected mosquito species should be identified to species level and mosquito pools should be screened for the presence of arboviruses. Use geographic information systems to plot the location of positive samples and confirmed cases.

Public Information / Education:

Publicize methods for mosquito reduction and personal protection prior to the main season for mosquito activity and outdoor human activities. Deliver reminders periodically throughout mosquito season.

Control Measures:

Use public information to promote source reduction and personal protection. Conduct standard larviciding approaches using effective measures for the location and *Gambusia affinis* (mosquito fish). Increase efforts in areas where positive mosquito pools are detected. Control measures will be implemented based on the following IPM criteria: time of year, the extent of previous mosquito control activities, the current level of mosquito activity, weather conditions, and surveillance results. Consider adult mosquito control procedures in and around area of positive sample locations. Adult control procedures should only be implemented if it is determined there is a highly dense adult mosquito population, as determined by surveillance activities, around are to be treated. Response emphasis should remain on larvicide and habitat removal activities, but may include some isolated adult mosquito control procedures to maximize risk reduction for human health.

Rationale:

Larviciding and source reduction/elimination are considered to be the most effective long-term solution for mosquito control. The control measures are designed to accomplish mosquito control by preventing larval mosquitoes from becoming biting adults. Isolated adult mosquito control procedures may prevent amplification of West Nile Virus.

6.4 Risk Level 3 - Public Health Warning

Condition: Probability of human outbreak is moderate to high

Trigger: Multiple mosquito pools collected at different times and locations test positive for arthropod-borne virus/diseases. Probable human or equine cases supported by laboratory testing (see definition, Page ii).

Recommended Response:

Surveillance:

Continue to conduct routine surveillance of mosquito populations. If resources allow, increase surveillance in areas where arthropod-borne virus/disease positive samples were collected. Use geographic information systems to plot the location of positive samples and confirmed cases.

Public Information / Education:

Alert medical professionals, veterinarians, and public health officials.

Increase public education, emphasizing source reduction, personal protection, and disease symptoms. Targeted public education concerning vector control methods and personal protection.

Control Measures

Use public information to promote source reduction and personal protection. Intensify larviciding efforts using effective measures for the location and *Gambusia affinis* (mosquito fish), when they may be used. Consider using insect growth regulators (example methoprene) or monomolecular oils in targeted areas. Increase efforts in areas where positive mosquito pools were detected, if applicable. Control measures will be implemented based on the following IPM criteria: time of year, the extent of previous mosquito control activities, the current level of mosquito activity, weather conditions, and surveillance results.

Once surveillance results determine the presence of West Nile Virus or other mosquito borne pathogens in multiple pools and/or multiple birds tested in the same vicinity the threat to human health is considered imminent and if larvicides are not reducing the threat to an acceptable level, the Public Works Director, or a designated representative, shall determine the need to consider targeted adult mosquito controls, such as ground-based Ultra-Low Volume (ULV) applications of pyrethroids such as permethrins (preferred), or other suitable pesticides and methods. The decision to spray should be based on the effectiveness of spraying adulticides and risks to the health of residents. The decision shall not be made based upon complaints from residents. Spraying efforts should be implemented only in the vicinity (approximately 1/4 mile or more) of areas where mosquito traps and bird tests indicate a dense pathogen bearing mosquito population or where positive tests are located near dense human populations. The Mansfield City Council shall be notified at the next regularly scheduled Council meeting if a decision to spray was made. The notification shall include the surveillance results that led to the decision, the area that was sprayed, and any additional steps that have been taken to reduce risks to public health.

Control measures will be implemented based on the following IPM criteria: time of year, the extent of previous mosquito control activities, the current level of mosquito activity, weather conditions, the species of mosquitoes that test positive for disease, the number of local mosquito pools which test positively for disease, the likely time until a killing frost, the density of roads or other access to mosquito breeding grounds, and the density of human populations. **If public health emergencies are declared at the county or state level,**

the recommended responses associated with the declaration may be considered as part of the control plan of the City of Mansfield.

Rationale:

Larviciding and source reduction/elimination are considered to be the most effective long-term solution for mosquito control. Increasing these measures in areas where positive mosquito pools are detected offers an additional degree of risk reduction. Targeted adult mosquito controls can reduce the number of adults on the wing while waiting for larvicide and source reduction/elimination methods to reduce future biting adults.

6.5 Risk Level 4 - Public Health Alert

Condition: Multiple human cases confirmed.

Trigger: Multiple human cases confirmed by laboratory testing and continued viral mosquito activity.

Recommended Response:

Surveillance:

Continue to conduct routine surveillance of mosquito populations. If resources allow, increase surveillance in areas where arthropod-borne virus/disease positive samples were collected. If possible, increase dead bird and/or equine surveillance in areas where viruses were isolated. Use geographic information systems to plot the location of positive samples and confirmed cases.

Public Information / Education:

Alert medical professionals, veterinarians, and public health officials.

Increase public education, emphasizing source reduction, personal protection, and disease symptoms. Public education should emphasize vector control methods and personal protection.

Control Measures

Use public information to promote source reduction and personal protection. Intensify larviciding efforts using effective measures for the location and *Gambusia affinis* (mosquito fish), when they may be used. Use insect growth regulators (example methoprene) or monomolecular oils in targeted areas to reduce larvae.

Once a confirmed positive, human case of West Nile Virus or other mosquito borne pathogens has been discovered and if larvicides are not reducing the reducing the threat to an acceptable level, the Public Works Director, or a designated representative, shall

determine the need to consider targeted adult mosquito controls, such as ground-based Ultra-Low Volume (ULV) applications of pyrethroids such as permethrins (preferred), or other suitable pesticides and methods. The decision to spray should be based on the effectiveness of spraying adulticides and risks to the health of residents. The decision shall not be made based upon complaints from residents. Spraying efforts should be implemented only in the vicinity (approximately 1/4 mile or more) of areas where mosquito traps and bird tests indicate a dense pathogen bearing mosquito population or where positive tests are located near dense human populations. The Mansfield City Council shall be notified at the next regularly scheduled Council meeting if a decision to spray was made. The notification shall include the surveillance results that led to the decision, the area that was sprayed, and any additional steps that have been taken to reduce risks to public health.

Control measures will be implemented based on the following IPM criteria: time of year, the extent of previous mosquito control activities, the current level of mosquito activity, weather conditions, the species of mosquitoes that test positive for disease, the number of local mosquito pools which test positively for disease, the likely time until a killing frost, the density of roads or other access to mosquito breeding grounds, and the density of human populations. **If conditions exist to warrant a local public health emergency, the City Council will be notified of the potential and a request be made for the Mayor to declare a public health emergency. If public health emergencies are declared at the county or state level, the recommended responses associated with the declaration may be considered as part of the control plan of the City of Mansfield.**

Rationale:

Larviciding and source reduction/elimination is considered to be the most effective long-term solution for mosquito control. Increasing these measures in areas where positive mosquito pools are detected offers an additional degree of risk reduction. If adulticides are deemed necessary, the pyrethroids are likely to be the most effective and least environmentally damaging compounds available. Targeted adult mosquito controls can reduce the number of adults on the wing while waiting for larvicide and source reduction/elimination methods to reduce future biting adults.

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Definitions:

Consideration: Consideration involves the following factors: habitat; time of year; weather conditions; the level of documented viral activity/presence; the distribution, density, and infection rate of the vector population; and the proximity of human populations. In neighborhoods with increased positive surveillance results, green areas (parks, cemeteries, golf courses) will have higher priority for adulticide activity since these areas represent likely habitat for viral amplification via transmission among hosts (birds).

Confirmed case: A confirmed case of West Nile encephalitis is defined as a febrile illness associated with neurological manifestations ranging from headache to aseptic meningitis or encephalitis, plus at least one of the following:

- Isolation of WNV from, or demonstration of WNV antigen or genomic sequences in tissue, blood, CSF, or other body fluid;
- Demonstration of IgM antibody to WNV in CSF by IgM-capture EIA;
- A P4-fold serial change in plaque-reduction neutralizing (PRNT) antibody titer to WNV in paired, appropriately timed serum or CSF samples;
- Demonstration of both WNV-specific IgM (by EIA) and IgG (screened by EIA or HI and confirmed by PRNT) antibody in a single serum specimen.

Probable Case: A probable case is defined as a compatible illness (as above) that does not meet any of the above laboratory criteria, plus at least one of the following:

- Demonstration of serum IgM antibody against WNV (by EIA);
- Demonstration of an elevated titer of WNV-specific IgG antibody in convalescent phase serum (screened by EIA or HI and confirmed by PRNT).

Non-Case: A non-case is defined as an illness that does not meet any of the above laboratory criteria, plus:

A negative test for IgM antibody to WNV (by EIA, HI, or PRNT);

and/or

A negative test for IgG antibody to WN virus (by EIA, HI or PRNT) in serum collected P22 days after onset of illness.

Glossary:

Adulticide: A type of pesticide designed to kill adult mosquitoes

arbovirus: shortened form of **arthropod-borne virus**. A virus that is transmitted by arthropods.

Arthropods: A group of animals that do not have a backbone and have jointed walking appendages, such as insects.

***Bacillus thuringiensis israelensis (BTi)*:** a type of biological pesticide used to control mosquito larvae in water (mosquito larvae die after ingesting this material).

bridge vector: For West Nile Virus, an organism (mosquitoes) which serve as a major viral transmission mechanism between the reservoir (birds) and humans.

DEET: The active ingredient in many insect repellent products (N,N-diethyl-metatoluamide).

Eastern Equine Encephalitis (EEE): A mosquito-borne viral disease that causes inflammation of the brain similar to West Nile Virus.

EIA - Enzyme immunoassay

encephalitis: inflammation of the brain, which can be caused by numerous different bacteria and viruses, including West Nile Virus

gravid traps: mosquito traps designed to attract pregnant female mosquitoes.

HI: Haemagglutination inhibition

IgG: Immunoglobulin G

IgM: Immunoglobulin M

landing rate counts: a measure of the number of adult mosquitoes landing on an individual's body during a predetermined time interval. Used to assess the abundance of host-seeking mosquitoes.

larvae: Immature mosquitoes that live in water; the stage after the egg hatches but before pupation.

larvicide: A type of pesticide used to control immature or larval mosquitoes

light traps: mosquito trap outfitted with a light to attract mosquitoes

malathion: A commonly used organophosphate pesticide used to control adult mosquitoes.

meningitis: Inflammation of the lining of the brain and spinal cord that can be caused by a virus or bacteria

methoprene: a type of insect growth regulator used to control larval mosquitoes; growth regulators prevent mosquito larvae from developing into mature adults.

mosquito breeding site: a location where mosquitoes lay eggs; usually stagnant water with high organic content.

mosquito pools: A group of mosquitoes of the same species, collected in the same area, that are combined in the laboratory to test for West Nile and related diseases.

outbreak: A rapid increase in the frequency or distribution of a disease.

permethrin: a synthetic pyrethroid pesticide used to control adult mosquito populations

pesticide: A substance used to kill pests such as insects, mice, and rats; an insecticide is a form of pesticide.

PRNT: Plaque reduction and neutralization testing

source reduction: the removal or reduction of larval mosquito habitats.

St. Louis encephalitis: mosquito-borne viral disease that causes inflammation of the brain. Very similar to West Nile Virus.

vector: An organism (usually an insect) that is capable of carrying and transmitting a disease-causing agent from one host to another.

viral: Of, or relating to, a virus

viral encephalitis: Inflammation of the brain caused by a virus.

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