

MARCH 2014



# WEST NILE VIRUS

## Program Manual

# West Nile Virus Program Manual

March 2014



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# Executive Summary

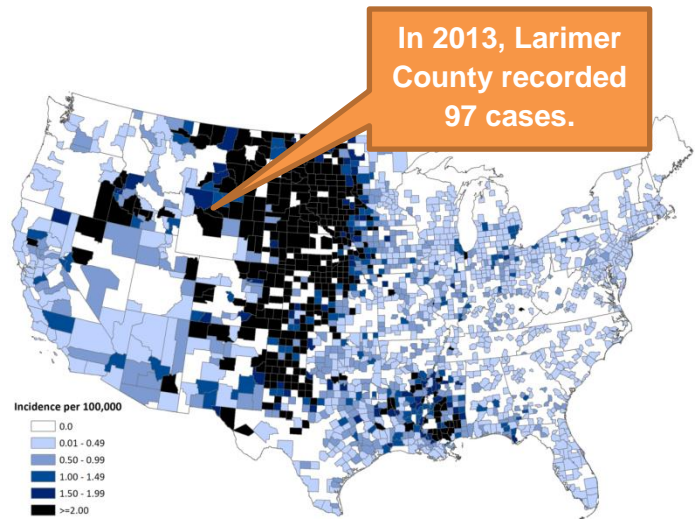
West Nile virus (WNV) is a serious health threat to the residents of Fort Collins. The virus is spread to humans when they are bitten by a mosquito that is infected with the virus. Since the virus is now endemic to the area it requires diligence in staying abreast of the intensity of the virus to prevent long-term effects on the residents. The City of Fort Collins employs an Integrated Pest Management (IPM) approach in responding to the threat of WNV in the community. IPM is the recommended strategy for mitigating the risk of human exposure to WNV by the Environmental Protection Agency (EPA) ([epa.gov/pesticides/factsheets/ipm.htm](http://epa.gov/pesticides/factsheets/ipm.htm)) and the Centers for Disease Control (CDC). ([cdc.gov/westnile/resources/pdfs/wnvguidelines.pdf](http://cdc.gov/westnile/resources/pdfs/wnvguidelines.pdf)) IPM is a common-sense approach that is based on setting thresholds for action based on levels of risk, and on using a variety of evidence-based interventions to maintain risks at low levels.

A key strategy used throughout the history of the program is leveraging local partnerships with individuals and organizations. Initially working with the Larimer County Department of Health and the Environment was a key first step in developing a comprehensive approach to a response of WNV in the community. The proximity of the Centers for Disease Control (CDC) Fort Collins branch, whose specialty is insect-transmitted diseases, and Colorado State University (CSU) provides access to individuals who volunteer as private citizens, but are also national and international experts in the field of managing mosquito-transmitted diseases. In 2007, at the City Manager’s direction a Technical Advisory Committee (TAC) formed to assist with policy development and review of the WNV Management Program. This brought together many of these content experts and concerned citizens to vet the process. The TAC expanded in

2013 with the addition of two individuals who represent the urban farming community and No Spray Fort Collins Facebook page.

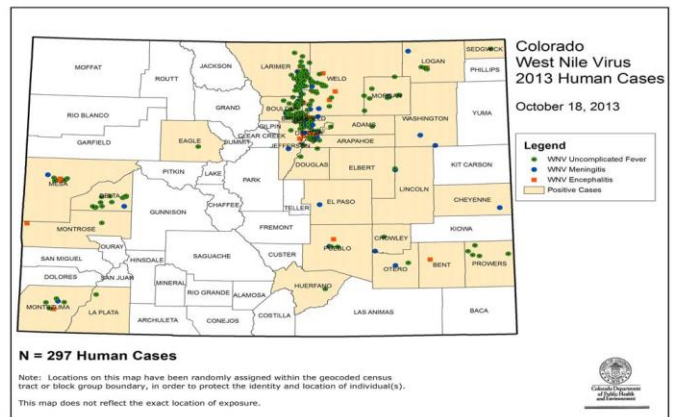
**FIGURE 1 – AVERAGE ANNUAL INCIDENCE OF WEST NILE VIRUS NEUROINVASIVE DISEASE, 1999-2012.**

Source: Centers for Disease Control and Prevention



**FIGURE 2 – COLORADO WEST NILE VIRUS HUMAN CASES OCTOBER 18, 2013.**

Source: Colorado Department of Public Health and Environment



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## Goals and Objectives

The goal of the WNV Management Program is to reduce the risk of human WNV infection while limiting adverse human health and environmental impacts. This goal recognizes there are trade-offs between program efforts to prevent human infection and adverse human health and environmental impacts, as well as the need to balance other human health risks and societal programs.

Several mosquito species in the area bite humans but cannot transmit WNV. The city's mosquito management program is limited only to trying to control those mosquito species (*Culex*) that transmit WNV disease. The City does not provide management for nuisance mosquitoes. The objective is to provide control of the *Culex* species of mosquitoes in the most cost effective and efficient manner in order to reduce the threat of WNV transmission in the community.

Preventing human cases of West Nile virus disease is the shared responsibility of government agencies and the individuals those agencies serve. The City of Fort Collins is responsible for:

1. Developing, implementing, and evaluating a comprehensive WNV Management Plan based on established principles of Integrated Pest Management.
2. Coordinating intra-agency (within City departments) and interagency resources and efforts to maximize the efficacy of the City's Plan.
3. Providing an annual report on the mosquito control strategies implemented by both the City and its mosquito control contractor during the previous mosquito season.
4. Operating with transparency to the public and providing opportunities for public comment regarding the City's WNV Management Plan.

Fort Collins residents are responsible for:

1. Taking personal protection measures (The 4 Ds, described on pg. 8) to avoid contracting WNV Disease.
2. Reporting areas of standing water that may serve as mosquito breeding sites.
3. Participating in the public process regarding the City's WNV Management Plan.

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# Integrated Pest Management

The major principals of IPM are as follows:

1. **Set Action Thresholds:** Determine a point at which pest populations or environmental conditions will trigger control efforts.
2. **Monitor and Identify Pests:** Identify which pest species are present in a given environment and monitor pest populations to determine when an action threshold has been reached.
3. **Prevention:** Manage site conditions to minimize the likelihood of a given pest becoming a threat.
4. **Control:** Initiate control efforts if action thresholds are reached. An integrated pest management approach dictates that the safest and most environmentally-friendly management strategies are used first and stronger, more invasive strategies are used only if initial efforts are unable to control the pest below levels deemed acceptable.

This strategy incorporates many tools for reducing the risk of WNV in the community. The tools available at this time are:

- personal protection
- education
- communication strategies
- source reduction
- mapping
- site inspections
- larviciding
- monitoring
- trapping
- testing
- adult mosquito spraying



*Culex mosquito, which carries and spreads the West Nile virus disease.*

## Background

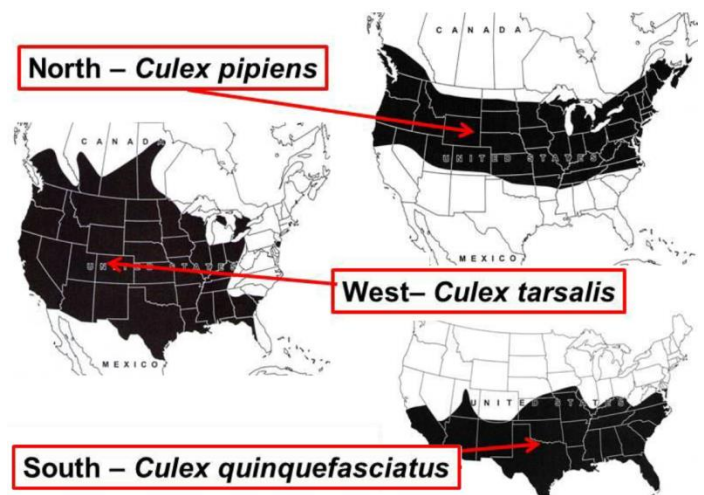
WNV is a virus transmitted by infected mosquitoes. The virus can cause symptoms ranging from flu-like conditions to encephalitis (inflammation of the brain) or meningitis (inflammation of the lining of the brain and spinal cord), resulting in long-term effects up to and including death. The virus was first discovered in Uganda in 1937, but it did not appear in the United States until 1999. In 2002, the virus was first detected in Colorado, with 380 equine cases and 13 human cases reported along the Front Range. In 2003 West Nile virus hit the Fort Collins area and northeastern Colorado particularly hard. That year, Larimer County had 546 reported cases and 10 deaths, while Colorado led the nation with 2,947 cases and 66 WNV-related deaths (CDPHE 2010).

Even though there are 65 species of mosquitoes that can carry WNV in the United States, there are three varieties that drive the transmission of the virus to humans. In Fort Collins two of the three species occur and can be common. These are the *Culex tarsalis* and *Culex pipiens*.

Prior to 2003, the City of Fort Collins did not provide mosquito control for residents. The WNV program philosophy is to reduce the risk of human disease from WNV, and there is no intention to provide control of nuisance mosquitoes not associated with WNV transmission. Mosquitoes are an important part of the food chain for many insects and animals and by limiting control efforts to the species of concern the impact on the environment will be minimized. This strategy also helps reduce the cost and potential negative impacts of pesticides on the environment and the community. WNV will appear annually in Fort Collins during the mosquito season.

FIGURE 3 – PRIMARY WEST NILE VIRUS VECTORS BY REGION

Source: Centers for Disease Control and Prevention





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# History of City of Fort Collins WNV Program

## 2003

Although West Nile virus was detected in this area in horses and birds in 2002, the first human cases of West Nile virus in Fort Collins were reported in 2003. Anticipating a possible human outbreak, the City contracted with Colorado Mosquito Control in 2003 to do an extensive adult mosquito trapping and surveillance system to monitor Culex mosquitoes throughout the city. Unfortunately, testing of the trapped mosquitoes could not be done in real time, but the CDC offered to test all Fort Collins and Loveland mosquitoes trapped that summer, after the season was over, as part of their WNV research. As the number of reported human cases began to rise rapidly, the City responded under Council direction to mitigate its spread through control of the mosquitoes that carried it. Council passed an emergency declaration, Resolution 2003-097. The emergency program in 2003 was composed of stormwater catch basin larviciding citywide and adult mosquito spraying of about a quarter of the city to reduce WNV-infected mosquitoes.

The mission of the Fort Collins West Nile Virus program at its inception was, and still is, to reduce the human impact of West Nile Virus while balancing costs and social and environmental impacts. Since 2003, the City has invested in outreach efforts to educate residents on the importance of personal protection.

In early 2004 the CDC released their analysis of the city's mosquito infection rates compared to the human case onsets, as well as a limited analysis of the sprayed vs. unsprayed areas of the city to examine the effectiveness of the adult mosquito control efforts.

## 2004

In 2004, WNV program guidelines were put into place via resolution 2004-082. This resolution focused on the relationship among the City, Board of Health and the WNV program response plan.

During this year there was also an ad hoc group of concerned residents and representatives from the Air Quality Advisory Board and the Natural Resources Advisory Board that convened to provide feedback on the WNV response.

## 2005 & 2006

Both years were relatively quiet for WNV activity. There were mosquitoes that tested positive in both years, but the monitoring system supported by the City showed that the virus did not amplify as in the previous two years.

## 2007

WNV was more active in 2007, causing another human outbreak and leading to citywide spraying for adult mosquitoes. As in previous years, some residents were concerned about the impact of spraying on human and environmental health. At the conclusion of the 2007 WNV season, the City Manager directed staff to form the citizen Technical Advisory Committee (TAC) made up of community members who are subject matter experts and concerned citizens appointed by the City Manager. The review of the WNV management program began in the fall of 2007.

## 2008

The TAC, formed in late 2007, was comprised of representatives from the Larimer County Department of Health and Environment, Colorado State University, an environmental consultant, members of the Natural Resources and Air Quality Advisory Boards, and the medical community of Larimer County. There is a great depth of local knowledge in the area of infectious

disease and integrated mosquito management. Committee members also included employees of the CDC and US Department of Agriculture (USDA) with expertise in mosquito-transmitted diseases and local ecosystems, though they did not serve as official representatives of the federal government. These individuals brought additional expertise to the group, but were acting as private citizens.

City Council charged the TAC with developing policy recommendations for a WNV mitigation policy. The committee's recommendations were the foundation for comprehensive program guidelines for an Integrated Pest Management approach to preventing human cases of West Nile virus disease.

On July 1, 2008, the TAC's policy recommendations were enacted by City Council.

Resolution 2008-062 became the WNV management policy, which still guides the program today. The resolution included program response guidelines for integrated pest management, including thresholds and actions.

One main program element is for the TAC to meet regularly during the winter and spring months to review the program response guidelines and make recommendations to Council for continuous program improvement. Regardless of the West Nile Virus prevalence in any particular season, the TAC convenes every year to review the data. The committee examines what parts of the season were most active, forecasts the next season, and explores new research and techniques. In the spring, the TAC studies weather patterns, arranges schedules and plans for the season. During the off-season, the committee reviews other parts of the program, such as public outreach and larviciding.

Another group created by the WNV management policy is the WNV Advisory Panel. The panel consists of three members representing the

medical community, the Air Quality Advisory Board and the Natural Resources Advisory Board. They commit to stay current with all information shared during the season and to act as a conduit for this information to be disseminated to their groups. If the County Department of Health Director makes a recommendation to spray adulticides, the panel members provide feedback to the City Manager regarding their agreement or disagreement with the recommendation, including its justification.

In 2008, the CDC provided its last year of free testing of adult mosquitoes for WNV, which forced the program to plan for an alternative vendor to provide this service.

### 2009, 2010, 2011

These three years had relatively low virus activity. There was no adulticiding for three consecutive years, although a significant number of severe WNV human cases occurred in late-season 2009. The TAC did conduct end-of-season reviews each year.

In 2009, due to the CDC elimination of testing services, CSU was selected to test for WNV infection in trapped mosquitoes.

The cost of testing is defrayed partially by partnering with Loveland to access the testing services on a "pay as you test" arrangement.

2009 CSU cost: \$33,296 Loveland portion: \$2,220

2010 CSU cost: \$33,608 Loveland portion: \$3,801

2011 CSU cost: \$22,872 Loveland portion: \$2,597

In 2011, an additional lab in CSU helped to reduce the cost for WNV positive mosquito testing due to an ongoing research project. There was also a significant budget reduction,

which reduced early- and late-season trapping and testing.

In the 2011-2012 budget cycles, due to the significant reduction in the WNV management budget, the TAC created recommendations to address the budget shortfall. This included shortening the season to simply cover June, July and August. The main elements of the program were not impacted, but the season was shortened, and outreach programs were eliminated along with backyard and stormwater inspections to address the reduction.

## 2012

2012 was the first year in which adulticide was used by the City since the adoption of the 2008 WNV management policy. Late in the summer of 2012 thresholds were reached and a recommendation to adulticide came from the Larimer County Department of Health and Environment. The application was completed in two nights to approximately half of the city.

Fulfilling the goal of continuous improvement, the TAC's end-of-season review in 2012 resulted in several recommendations: enhance communication with CSU and PSD, conduct more targeted outreach, increase the level of the risk index (one of the triggers for adulticiding), and reinstate backyard and stormwater drain inspections. The risk index was raised from 0.5 to 0.75 to increase the threshold that must be met to trigger the need for adulticiding. (Due to confusion around the risk index, this point needed to be clarified so that the program response guidelines were consistent.) The definition of the risk index is included in the appendix.

The City also expanded the mosquito trapping network in 2012. Five gravid traps were added, making for a total of 10 in the city. That addition, along with Fort Collins' 43 light traps, makes the City's trapping network among the most

comprehensive in the country. (Please see the Mosquito Trap Description in the appendix.)

## 2013

In 2013, the monitoring system indicated that the prevalence of WNV was high enough to trigger citywide adulticiding. The City sprayed on two nights to reduce the abundance of infected mosquitoes in order to reduce the risk of transmission to people and to break the transmission cycle. After spraying was completed the risk index decreased from 0.85 to 0.29.

## **PARTNERS: COLORADO MOSQUITO CONTROL (CMC), CDC, LARIMER COUNTY, CSU**

Partnerships are a large component of Fort Collins' WNV management program. However, with the exception of the City and the County, the views represented by members of the TAC Committee are their own and do not represent their respective organizations.

The Larimer County Department of Health and Environment is a very close partner in the administration of the City's WNV management program. A representative from the department sits on the TAC, provides advice on response protocol and options, and is the conduit to state health department. When the City must do control measures and outreach, it coordinates with the County and shares information to assist with decision making.

The CDC's Division of Vector-Borne Diseases happens to be located in Fort Collins and has provided consultation and technical assistance regarding West Nile Virus control to communities throughout Colorado and the nation. From 2004-2008, the CDC tested all mosquitoes trapped in Fort Collins and Loveland to research the best predictors of human WNV disease. This research led to the development of several risk indicators, including the vector index to estimate levels of

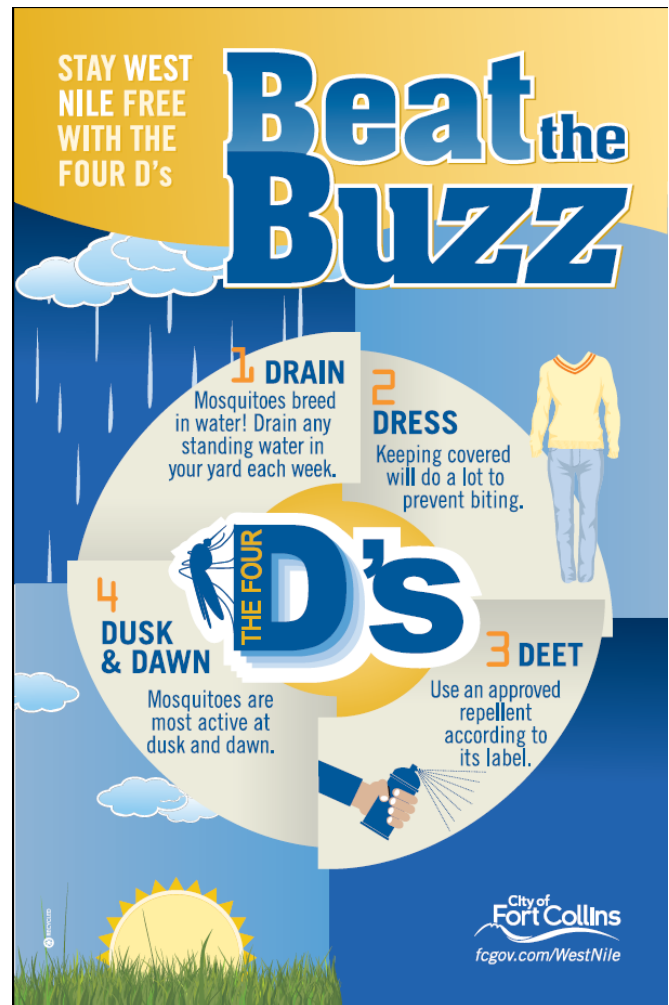
WNV-infected mosquitoes in a community and potential risk of human outbreaks. The City uses the risk index as one element of the action thresholds as described in the program response guidelines. CDC employees have served as TAC members, though not as official representatives of the CDC; they represent their individual views.

CSU contributes to the WNV management program in multiple ways. Since 2009, the university has provided mosquito testing for WNV for a fee, since the CDC no longer performs the service following completion of the project to evaluate the risk index. The City of Loveland also uses these testing services provided by CSU. In addition, CSU faculty have participated on the TAC and shared research findings to aid in decision making.

The City has a contract with Colorado Mosquito Control (CMC) to provide larval site mapping and inspections, larviciding, and adult mosquito trapping and surveillance. When needed, CMC also provides adult mosquito spraying. In 2014, CMC was acquired by Advanced Pest Control of Colorado and a copy of the current contract is in the appendix.

**FIGURE 4 – BEAT THE BUZZ**

Source: City of Fort Collins



## Personal Protection

Personal protection to avoid being bitten by mosquitoes is one of the most effective ways to prevent exposure to WNV. Individuals who believe they have WNV disease symptoms should see a doctor as soon as possible – if you don't get bit you don't get WNV!

Using the 4 Ds to prevent WNV is a strategy the City of Fort Collins employs.

**Drain** – Source reduction (removal of larval habitat) is an effective way to reduce the areas where mosquitoes can breed. Any shallow water left unattended for more than a few days becomes a potential development site for larval mosquitoes.

**Dusk & Dawn** – Limit time outdoors during the dusk and dawn periods when mosquitoes are most active and likely to bite.

**DEET** – Any repellent approved by the EPA is effective if used according to the label. There are several choices of repellents available from local retail stores. Visit their webpage at [cfpub.epa.gov/oppref/insect/#searchform](http://cfpub.epa.gov/oppref/insect/#searchform) to see a list of EPA approved repellents visit

**Dress** – Long sleeves and pants may deter mosquitoes from biting. If the material is light and tight the mosquitoes can bite right through. Appropriate clothing, together with use of a repellent, helps to reduce the risk of mosquito bites.

FIGURE 5 - THE FOUR D'S

Source: City of Fort Collins



## Educational & Community Outreach

Communication and education play an important role in the prevention of WNV. The City of Fort Collins is cooperating with Larimer County and other regional entities to conduct a multi-faceted public education campaign. The purpose of these outreach efforts is to encourage the following actions by the public and by City staff:

- Take personal protection measures to reduce the risk of exposure to WNV, including limiting time spent outdoors from dusk to dawn, wearing appropriate clothing, and using effective insect repellent.
- Reduce mosquito breeding sites by eliminating standing water.

A variety of communication tools and outreach methods will be employed to deliver this message:

### CITY STAFF EDUCATION

- Training Sessions – live and videotaped
- Employee newsletter and online articles
- Updates to front-line staff and WNV liaison team

FIGURE 6 - DON'T GO NAKED

Source: City of Fort Collins



### PUBLIC EDUCATION – VIDEO & ELECTRONIC

- Cable 14 programs and bulletin board
- City website: [fcgov.com/WestNile](http://fcgov.com/WestNile)
- Online notifications
- Facebook, Twitter & Nextdoor

### OTHER PUBLIC EDUCATION/MEDIA RELATIONS

- Information provided at City-sponsored special events
- Staff responses to public concerns
- News releases
- Public service announcements (PSAs)

Ongoing education will be the City's number one priority in our effort to manage West Nile virus.

FIGURE 7 - FCGOV.COM/WESTNILE

Source: City of Fort Collins


The screenshot shows the City of Fort Collins website page for West Nile Virus information. The page features a header with the City of Fort Collins logo and navigation links. The main content area includes a large yellow banner with the text "WEST NILE Virus" and an image of a mosquito. Below the banner is a section titled "West Nile Virus Information" with sub-sections for "What is West Nile Virus?", "West Nile Virus Technical Advisory Committee", and "West Nile Virus Technical Advisory Committee Members". A sign-up box for the Technical Advisory Committee Meeting Minutes is also present. On the right side, there is a "Learn More" sidebar with a list of links and a "Resources" section. At the bottom right, there is a graphic with the text "DON'T GO NAKED" and "WEAR REPELLENT: PROTECT YOURSELF FROM WEST NILE VIRUS".

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# WEST NILE Virus



## West Nile Virus Information

### What is West Nile Virus?

West Nile virus is a disease that is transmitted to humans by mosquitoes. The [symptoms](#) of West Nile range from none to very serious.

### West Nile Virus Technical Advisory Committee

The West Nile Virus (WNV) Technical Advisory Committee (TAC) will meet to discuss the previous WNV season and begin considering recommendations for future response guidelines.

The WNV TAC is composed of City-appointed experts who provide technical expertise and recommendations to City Council regarding the City's West Nile Virus Management Policy.

The meetings are from 4 p.m. - 6 p.m.

- February 26 – City Clerk's large conference room (300 Laporte Ave.)
- March 5 – Parks maintenance shop (413 S. Bryan Ave.)
- March 18th Council work session
- April 2 - Parks maintenance shop (413 S. Bryan Ave.)
- April 5th, 2-6 PM (Tentative)

This is a working meeting, but is open to the public and media to observe. There will be time allotted for public comment at the end of the meeting.

### West Nile Virus Technical Advisory Committee Members


- Lars Eisen
- Boris Kondratieff
- Dana Kunze

**Sign up to receive Technical Advisory Committee Meeting Minutes**

enter email address

#### Learn More

- Overview
- City Action
- Notifications
- Ways to Protect Yourself
- Free Backyard Inspections
- Procedures for Dead Birds
- How to Manage Mosquito Breeding Sites
- Program Contact Information
- 2013 Mosquito Control Report (PDF)
- 2012 Mosquito Control Report (PDF)
- 2011 Mosquito Control Report (PDF)
- 2010 Mosquito Control Report (PDF)
- 2009 Mosquito Control Report (PDF)
- 2008 Mosquito Control Report (PDF)
- 2007 Mosquito Control Report (PDF)
- 2006 Mosquito Control Report (PDF)
- 2005 Mosquito Control Report (PDF)
- 2004 Mosquito Control Report (PDF)
- Resources



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## Program Guidelines

As part of the TAC recommendations the Program Response Guidelines were created. This is the operational document that drives the response to the threat of WNV in the community. There are four response levels outlined in the guidelines, with triggers and associated responses to those triggers. Based on the IPM practice, the most environmentally friendly measures are used early and often. When necessary, as the risk increases, emergency response tools are used to control the amplification of the virus. Please see the attached Program Response Guidelines.

One of the main surveillance indicators used by the City to monitor levels of WNV risk is the Vector Index. This index uses information gathered through the mosquito monitoring and testing system to estimate the average number of infected mosquitoes collected per trap night in the area. By using data from several years of the City's surveillance program and WNV human case reports, the Vector Index provides an estimate of the risk of a WNV outbreak and allows the City to take action before an outbreak occurs.

The sections of the Program Guidelines are summarized:

### OFF SEASON

This time of the year is when the TAC reviews the previous season's data and develops strategies for the next year's program. The continuous improvement model would define this as the Check and Act segments.

### LEVEL 1 (EARLY SEASON)

This time of the season has low WNV activity. While it will be present, it has not been amplified by the mosquito-bird-mosquito transmission cycle to a level of more serious risk. The main activities during this period are: public outreach, larval site inspections, larval site treatments, source reduction, inter-agency communication, and adult mosquito trapping and WNV testing. This period begins in June and could continue through the entire season depending on the amplification of the virus in the natural mosquito-bird-mosquito cycle.

### LEVEL 2 (PEAK SEASON WITH LOW VIRUS ACTIVITY)

During this period, when virus activity is generally low, preparation and larval management efforts are increased. Focusing again on enhanced outreach and control efforts, the program aims to prevent the amplification of the virus by controlling mosquitoes in the larval habitats in an effort to keep adult mosquito abundance low. Human cases may occur during periods of low virus activity, but cases are rare and due to the fact that risk of infection cannot be completely eliminated. During this period, mosquito abundance and infection rates may be increasing during this period, but the Vector Index remains at a lower level, below the threshold for more active intervention. Level 2 can begin as early as mid-June and continue throughout the season.



### LEVEL 3 (PEAK SEASON WITH INCREASING VIRUS ACTIVITY)

There are several triggers that are closely monitored and evaluated in this level. When the number of infected mosquitoes has risen to this level, response actions are intensified. Public outreach is critical to inform people of the elevated risk of infection and disease, and to allow individuals to take preventative measures against exposure to mosquitoes carrying the virus. All regular control efforts are continued to attempt to reduce the production of new mosquitoes and limit the amplification of the virus. Typically during this time, the summer temperatures reach their peak and larvae develop more rapidly, which makes controlling the larvae a challenge. Inter-agency communications intensify and it is usually during this period that evaluation of the surveillance information will lead the Health Department to issue a recommendation for adulticiding operations. Per the City's policy, this triggers a 24-hour feedback period for the WNV Advisory Panel, after which the City Manager will issue the decision for an application. If adulticiding is initiated, the notification system is put into motion and route planning begins while taking into account a comprehensive list of activities that might conflict with the application. Typically this level is not seen until early July and can persist through August, and in some years into early September.

### LEVEL 4 (PEAK SEASON - EMERGENCY LEVEL)

Similar to Level 3, response actions intensify in frequency and magnitude. Triggers are monitored, public outreach is increased, and operations move at the highest speed possible. If the Health Department issues an adulticiding recommendation, the same review process is initiated as in Level 3. In the event of an application of adulticides the same procedures are followed as in Level 3. This level is typically not reached until the end of July and may persist into September.



*CDC light trap used to capture adult mosquitoes.*

## WNV ADVISORY PANEL

In 2008, the Advisory Panel was established with the adoption of the WNV Management Policy (2008-062). This panel is comprised of three individuals from three separate groups (Larimer County medical community, Natural Resources Advisory Board, Air Quality Advisory Board). The group was formed to monitor the WNV activity throughout the season, provide information back to their constituents and, when appropriate, provide feedback on all adulticiding recommendations received from the County Health Department. A comprehensive description is found in the attached appendices. In 2014, following changes to the program, the Advisory Panel was disbanded.

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## Larval Management

Larval management is one of the cornerstones of the mitigation program. Site inspections and treatments are very effective mosquito control methods. Currently the larval treatment season runs from June 1 –Aug. 31 each year. Ten years of data show that this is the most active portion of the year for mosquitoes in Fort Collins. Technicians are trained to identify larvae of local WNV mosquito vectors and apply the appropriate products to control them. The first consideration for any site is the option of source reduction to remove the larval habitat.

To date, there are 950 known active larval mosquito habitats and 457 mandatory sites (weekly or twice per week inspections based on seasonal potential) included in the inspection and larviciding programs for the City of Fort Collins. There were 135 backyard sites included in the 2013 backyard public inspection program. An additional 17 new larval sites were added to the active larval inspection program and 13 new backyard sites were found in the service area for Fort Collins in 2013. Since the inception of the program, 151 sites have been eliminated or physically modified and no longer have the potential to produce mosquito larvae; 294 sites have been mapped and listed as not active due to their low potential to produce mosquito larvae.

Source reduction is achieved by eliminating mosquito breeding sites by draining standing water where possible. There are many areas in town where source reduction has been achieved successfully. Working with the Stormwater Utility to maintain and improve stormwater detention areas so they flow and/or absorb as quickly as possible is an example of source reduction. In other wetland areas source reduction is not feasible as it would have a negative impact on desirable wetland habitat. Each site is evaluated

on an individual basis so the treatment is appropriate for each area.

Another option for larval management is the use of mosquito eating fish. The City's contractor provides fathead minnows to residences with ornamental ponds at no cost to the individual. Each site must be evaluated to assure the minnows will survive and provide mosquito larval control.



*Technician examining a mosquito dipper for larvae.*

When the use of a larvicide is required to control the larva there are several factors that are taken into account so the appropriate product is used. The general philosophy is to use the product that will be as targeted and effective as possible while having the least impact to the environment and human health. The following is the list of products currently used in the program:

**Vectobac - *Bacillus thuringiensis var. Israeli (Bti)*** this bacterial product is the preferred larvicide used in the program. The efficacy, targeted effects and the reduced environmental impacts make this product an ideal choice. These bacteria damage the gut of the mosquito larvae when they eat it, causing the larvae to starve to death.

**Vectolex - *Bacillus sphaericus* (Bs)** This is closely related to *Bti* and has similar benefits but is considered a true biological control due to the fact that it persists through several broods of mosquitoes. Unfortunately it is cost prohibitive at three times the cost of *Bti*.

**Altosid-Methoprene** is a synthetic copy of a juvenile growth hormone in mosquitoes. This keeps the mosquito larva from maturing into an adult. One positive result from this product is that the larva is still available as a food source for other organisms present that feed on larva.

**Bonide** is a light mineral oil that is only used when pupa is found in the larval site. Once the larva reaches the pupa stage it will no longer feed, which eliminates the use of *Bti* or *Bs* products. This product is non-selective in nature as it will eliminate all air-breathing insects in the water until it dissipates. Typically this product is used on newly discovered sites or is an indicator that the reproductive cycles of the mosquitoes are increasing.

Please refer to appendix for the Material Safety Data Sheets and labels for each product.

The contractor performs quality control inspections in the field from June through the first week of July. In 2013, there were a total of 46 sites inspected, with correct estimation of acreage, product selection and application rate, thoroughness of inspection and time spent inspecting occurring at 82.2 percent of the sites. In 2013, the larviciding program eliminated an estimated 7 billion mosquito larvae preventing emergence of biting adults.

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# Adult Mosquito Management

## SURVEILLANCE

Adult mosquito monitoring (also called surveillance) is the foundation of a mosquito management program. The surveillance program tracks the abundance and locations of *Culex* mosquitoes and infection levels when combined with a testing regime for WNV. It serves as an early warning system of increased risk of West Nile virus infections. A network of fixed traps has been placed throughout the city and is used to develop a base of information that allows temporal and spatial evaluation of changes in the mosquito population. Mosquito trapping provides an estimate of the number and species of mosquitoes present within a geographical area. The subsequent testing of *Culex* vector mosquitoes for WNV allows for monitoring WNV infection rates and calculation of the Vector Index. Knowing where WNV-infected mosquitoes occur helps to identify areas of high risk, assess the need for and timing of intervention strategies, and monitor the effectiveness of prevention and control measures. There are 43 light traps and 10 gravid traps (see appendix) currently in operation from June through August each year. Traps are located in a grid pattern throughout the city (Appendix-Map of Traps). These traps are set out one night per week during the season to collect adult mosquitoes. The light and gravid traps are designed to catch the greatest number and diversity of mosquitoes possible. After collecting the traps, the mosquitoes are separated by species, and the two *Culex* species are sent in separate batches from each trap (called mosquito “pools”) for analysis by CSU. This is one of the most extensive municipal trapping networks in the country. The data

produced is essential in the decision-making process.

## TESTING

The second step of the adult mosquito surveillance program involves testing the submitted pools of mosquitoes for West Nile virus infection. In 2013, 1,082 pools comprised of 26,113 *Culex* mosquitoes were tested for WNV infection. When WNV is found in the submitted pools the Vector Index is then calculated (if all mosquito pools are negative for WNV, then the Vector Index is zero). The Vector Index estimates the average number of WNV-infected *Culex* vector mosquitoes collected per trap night for a given area. It is monitored on a weekly basis throughout the season.

In the years when the WNV activity is high a recommendation to provide adult mosquito control may come from the Larimer County public health director, based in large part on the indicators of risk derived from mosquito trapping and testing.

## ADULT MOSQUITO CONTROL

The final element of adult mosquito management is using pesticide spraying to control adult mosquitoes, (also called “adulticiding”). Spraying to reduce the number of infected adult mosquitoes is a controversial topic in Fort Collins. The goal of the current program is to reduce the risk of transmission of WNV to people while limiting the negative environmental and health impacts. The use of adult mosquito control is a decision based on risk management. The Program Response Guidelines are in place to ensure that the level of WNV activity has elevated to a point that has been associated with unacceptable risk of human disease before the use of adulticides is approved.

The use of adult mosquito control has been debated among the TAC since its inception.

Several studies have been referenced to provide the rationale for using ultralow volume (ULV) pesticide spraying when the risk of human transmission has become too great. The topics covered include relative risk analysis, endocrine disruption, effectiveness of adulticiding, the label and safety data sheets of the available products, and general pesticide information. (located in the appendix) It must be noted that the labels and safety data sheets included in the appendix are designed for use by the applicators and do not reflect the level of exposure that a citizen would encounter when these products are applied.

The intent of the WNV Mitigation Program is to prevent adulticide applications by first performing other activities to control mosquitoes and thus prevent the abundance of WNV-infected mosquitoes (Vector Index) from reaching the point where emergency adulticiding is the only remaining option to protect human health. The program has been successful without the use of adulticides in half the years since the WNV appeared in the area. Citywide adult mosquito spraying for WNV was done only in 2007 and 2013. Smaller sections of the city were sprayed in 2003, 2004, and 2012.

Once a recommendation is received by the City, a 24-hour feedback period begins for the WNV Advisory Panel (Appendix-Advisory Panel Guidelines). Once the panel provides feedback, the decision rests with the City Manager whether to initiate control operations. The following flow chart depicts the process following a recommendation from the County.

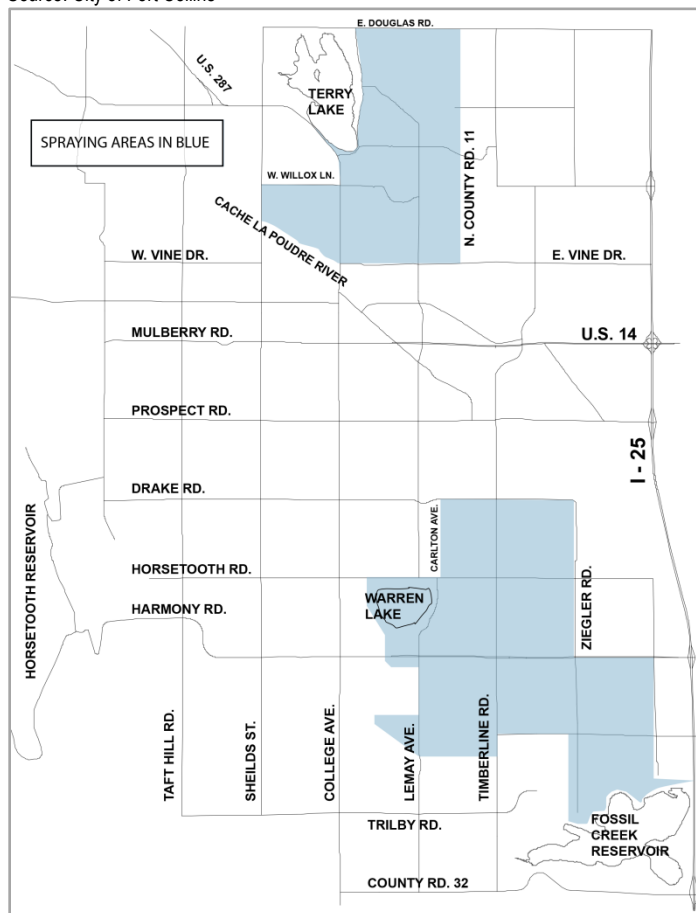
Every application of adulticide is done on a two-night cycle three to five nights apart. This is required due to the life cycle of the mosquito in combination with the extremely low levels of pesticide applied in the control application.

The permethrin-based product used in adulticiding is applied at a rate of 0.0035

pounds/acre. This is half the rate or strength recommended by the manufacturer's label. The label also allows for up to 22 separate applications per season, which is substantially higher than has ever been initiated by the current program. Typically, when adulticiding has been initiated in Fort Collins, there have been no more than two cycles (four nights) of application performed in one season.

**FIGURE 8 - SPRAY MAP**

Source: City of Fort Collins



## INDIVIDUAL PRECAUTIONS

For those concerned about pesticide exposure, residents can stay indoors and keep doors and windows closed for 30-60 minutes after spraying occurs as well as bring pets indoors. A comprehensive list of frequently asked questions (FAQs) is available online by visiting [fcgov.com/westnile/faq.php](http://fcgov.com/westnile/faq.php).

## PESTICIDE SENSITIVE REGISTRY

The program makes accommodations for individuals on the Pesticide Sensitive Registry (PSR). The PSR is maintained by the Colorado Department of Agriculture and requires the endorsement of a Colorado licensed physician to verify the evidence of chemical sensitivity in an individual. The Department of Agriculture specifically exempts the use of the registry for mosquito control. The City of Fort Collins WNV Management Policy uses this registry to provide an enhanced level of protection for individuals that have proven their sensitivity to pesticides.

In 2004, the WNV response program allowed an opt-out option during spraying, but it was extremely challenging to operate, could not guarantee that spray did not drift onto opt-out properties, and likely inhibited the effectiveness of the spraying program, so it was eliminated.

FIGURE 9 - PESTICIDE SENSITIVE REGISTRY

Source: Colorado Department of Agriculture

The screenshot shows the Colorado Department of Agriculture website. The header includes the state logo and navigation links for Home, Animals, Brands, Colorado State Fair, Conservation, Inspection & Consumer Services, Markets, and Plants. The main navigation bar lists: Industrial Hemp, Pest Survey, Nursery, Organic, Pesticides, Plant Exports, Plant Imports, Seed, and Contact Us. The page title is "Pesticide Sensitive Facts & Registry". The content area contains several informational paragraphs:

- Facts about the Pesticide Sensitive Registry and Mosquito and Other Public Health Pesticide Applications**
  - Mosquito spraying is performed by city, county or other local authorities or by companies they hire under their local authority to protect the health of the people in the community.
  - If you don't want your property included in the spraying, you must contact those people and ask them to exclude your property from the program if they are able to do that.
  - Any notification provided to the public during a Public Health Pest Control operation (i.e., mosquito treatment applications) by municipalities and/or commercial applicators, is done as a courtesy to those requesting, not because it is a state law requirement.
  - The registry maintained by the Colorado Department of Agriculture does not pertain to mosquito spraying, or any pesticide applications other than those made to control pests of lawns, trees & shrubs.
  - The pesticide sensitive registry is for people who have or can obtain documentation of sensitivity to pesticide products from a licensed Colorado physician.
  - To be placed on the registry a certificate must be signed, by a physician licensed to practice medicine in the state of Colorado, stating that you have a medical condition that makes you sensitive to pesticides.
  - The registry does not prevent application of pesticides but only requires that commercial applicators (like lawn care companies) notify people on the registry 24 hours before an application is made to abutting property (property that touches yours) so that you can leave for a period of time or make other preparations for the application.
  - The law that outlines the requirements of the Pesticide Sensitive Registry can be found under 35-10-112 of the Pesticide Applicators Act, which can be accessed through the Plant Industry Laws & Regulations page.
  - If you have questions regarding the date, time, or area of an upcoming public health pest control application (i.e., mosquito control) you should contact your local health department.
- Download the Pesticide Sensitive Registry Application:**

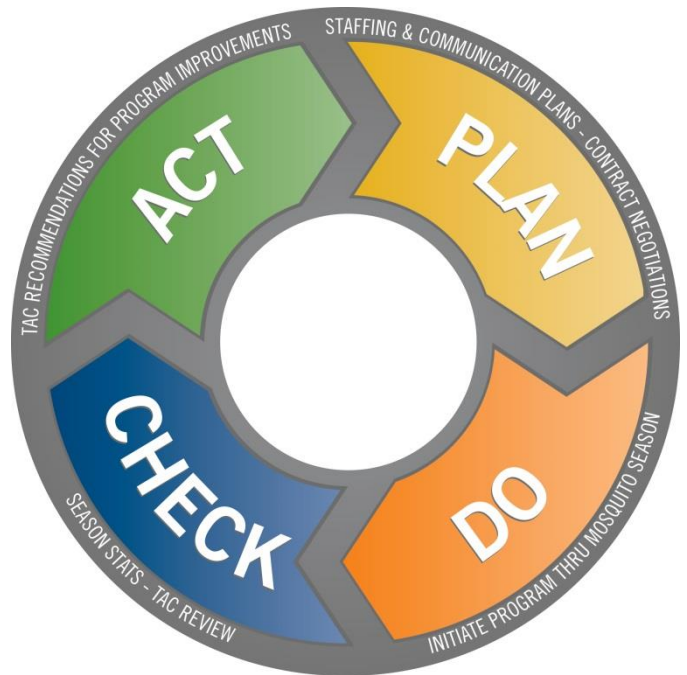
## Continuous Improvement

Per the City's WNV Management Policy the TAC meets on a regular basis to ensure efficacy of the program. Following the precepts of continuous improvement the steps to Plan, Do, Check and Act are initiated to assist with efficacy assurance. In years where adulticides have not been used, the review is fairly simple with a post- and pre-season meeting scheduled. In years when adulticides have been utilized the review is more robust and thorough.

Currently, the Best Management Practice protocols suggested by the states of California, Washington and Florida, and the Xerces Society for Invertebrate Conservation ([xerces.org](http://xerces.org)) are being reviewed. The intent is to incorporate and potentially adopt new ideas and/or procedures to enhance the current program.

The greatest danger is complacency when the virus does not amplify during consecutive seasons. Since the virus is now endemic to the area it requires diligence in staying abreast of the intensity of the virus to prevent long-term effects on the residents.

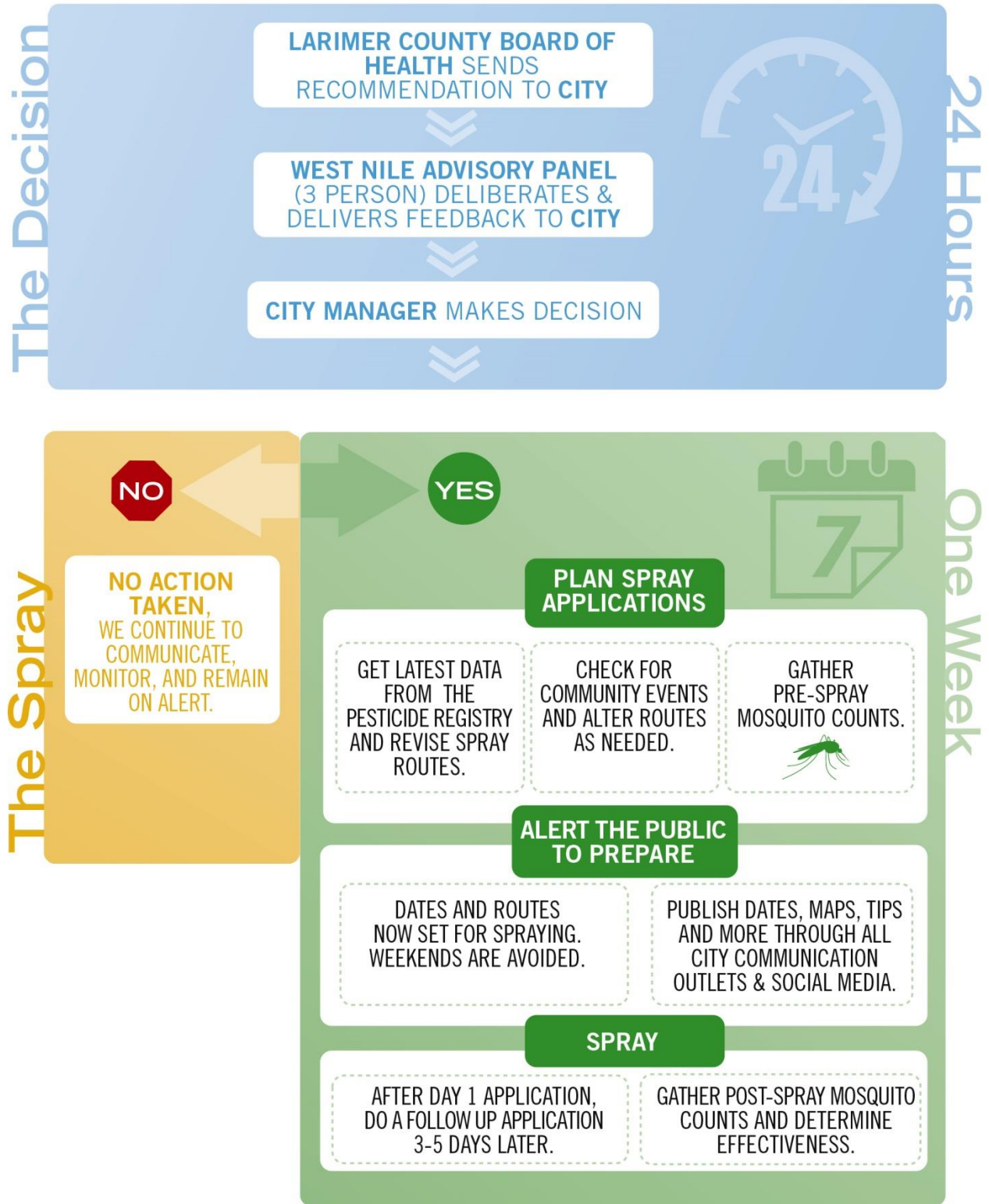
**FIGURE 10 - ANNUAL STEPS FOR PLAN, DO, CHECK & ACT**  
Source: City of Fort Collins





**FIGURE 11 – SPRAY DECISION CHART**

Source: City of Fort Collins



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## Glossary

**Vector** - An insect, animal, etc., that carries germs that cause disease

**Adulticide** - An insecticide used to kill adult insects. The process of applying these products in mosquito control is referred to as fogging.

**Larvicide** - An insecticide that specifically targets the larval life stage of an insect for control. Larvacides may be contact poisons, stomach poisons, growth regulators, or (increasingly) biological agents.

**Light Trap** - Portable sampling device for the collection of mosquitoes. Main components include motor, fan battery, collection bag and cooler for bait. Particularly effective in assessing the presence of *Culex tarsalis*.

**Gravid Trap** - Portable sampling device for the collection of mosquitoes. Main components include collection bag, pan for attractant, motor and fan. Particularly effective in assessing the presence of *Culex pipiens*.

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## Attachments and Appendices

- Program Response Guidelines
- Yearly report(s) from CMC-link to website  
([fcgov.com/westnile/annual-reports.php](http://fcgov.com/westnile/annual-reports.php))
- Communication tools
- Relative Risk Study-Peterson
- Maps of Traps
- Link to TAC documents (agenda, minutes)  
([fcgov.com/westnile/advisory.php](http://fcgov.com/westnile/advisory.php))
- Matrix of program response guidelines  
integrated with communication plan
- NPIC information on chemicals
- Pesticide labels and MSDS's
- Contracts
- WNV Advisory Panel Guidelines
- Studies
- CDC WNV page ([cdc.gov/westnile/index.html](http://cdc.gov/westnile/index.html))