

# **City of Louisville Integrated Mosquito Management Program 2017 Annual Report**

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**City of Louisville**

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October 2017

**City of Louisville  
Integrated Mosquito Management Program**

**2017 Annual Report**

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## ***Program Objectives***

City of Louisville (Louisville) contracted Vector Disease Control International, LLC (VDCI) to operate an Integrated Mosquito Management (IMM) program in 2017. The primary objective of Louisville's IMM Program is to monitor and reduce mosquito populations through the use of environmentally sound control techniques in order to protect its residents from the threat of mosquito-borne diseases and suppress local populations of nuisance mosquitoes. VDCI prioritizes the detection and elimination of larval mosquitoes in aquatic habitats, in conjunction with the monitoring of adult mosquito populations through routine surveillance, in order to assess West Nile virus vector species abundance in the area.

Open communication is maintained by VDCI between Louisville, residents, HOAs, Property Management Companies, County and State Departments of Health & Environment, and surrounding municipalities in order to ensure that the highest level of mosquito control and epizootic response is achieved. This diligent and cooperative communication is important to the City of Louisville mosquito management program and provides significant benefit to public health throughout the entire area.

## ***VDCI's Commitment***

Vector Disease Control International is a company built on the foundations of public health, ethics, professionalism, and technical expertise. VDCI is committed to providing our customers with scientifically based, environmentally sensitive and technologically advanced Integrated Mosquito Management (IMM) programs of the highest quality. All of our employees are committed to excellence in vector control and public health and strive to improve the quality of human life in communities through public education and the control of mosquitoes and the diseases they can transmit. VDCI currently has programs across the state of Colorado, providing services for towns, cities, counties, homeowners associations, and encephalitis surveillance monitoring programs for county health departments.

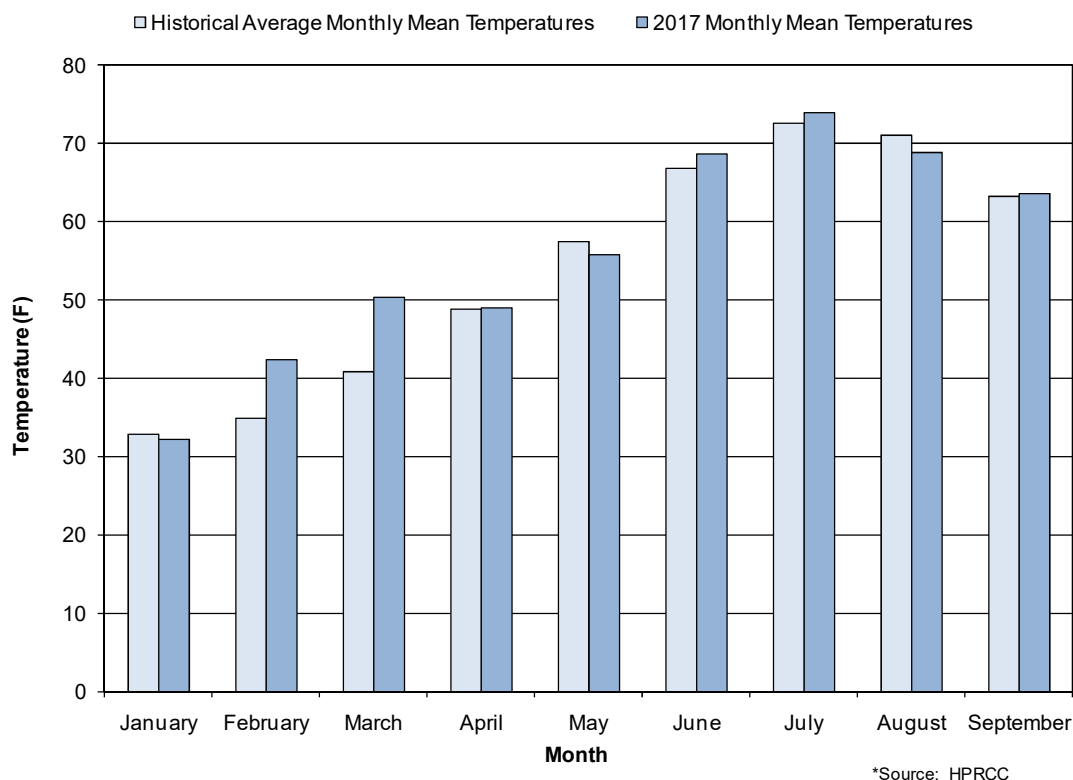
Vector Disease Control International, as the contractor for the City of Louisville, will continue to use proven scientific Integrated Mosquito Management techniques to survey and control local mosquito populations using biorational larval controls and limited low-toxicity insecticide applications. All of the methods and materials used have been reviewed and registered by the US Environmental Protection Agency, the Centers for Disease Control, the Colorado Department of Agriculture and the American Mosquito Control Association.

## 2017 Season Perspective and Climate Data

At VDCI we have come to expect each Colorado summer to present a unique set of temperature, precipitation, irrigation, and human interactions that combine to create new and different challenges in both mosquito control and mosquito-borne disease proliferation. The City of Louisville is located in a semi-arid environment with elevation in the project area approximately 5,335 feet above sea level. The typical mosquito season for Louisville is from late May to September. Current and historical climate data from the National Oceanic Atmospheric Administration's (NOAA) High Plains Regional Climate Center's (HPRCC) Boulder, Colorado weather station was used to monitor regional temperature and precipitation patterns throughout the season.

In 2017, every month of the mosquito season, except May and August, had temperatures at or above normal (**Figure 1**). The months of February and March experienced the highest deviation from average, +7.5 and +9.5 degrees respectively, during the year while June and July were only slightly above normal at +1.5-2.0 degrees higher than average. May and August had mean monthly temperatures that were approximately -2.0 degrees below normal. Overall, the 2017 season was approximately 3.7 percent warmer than the previous year.

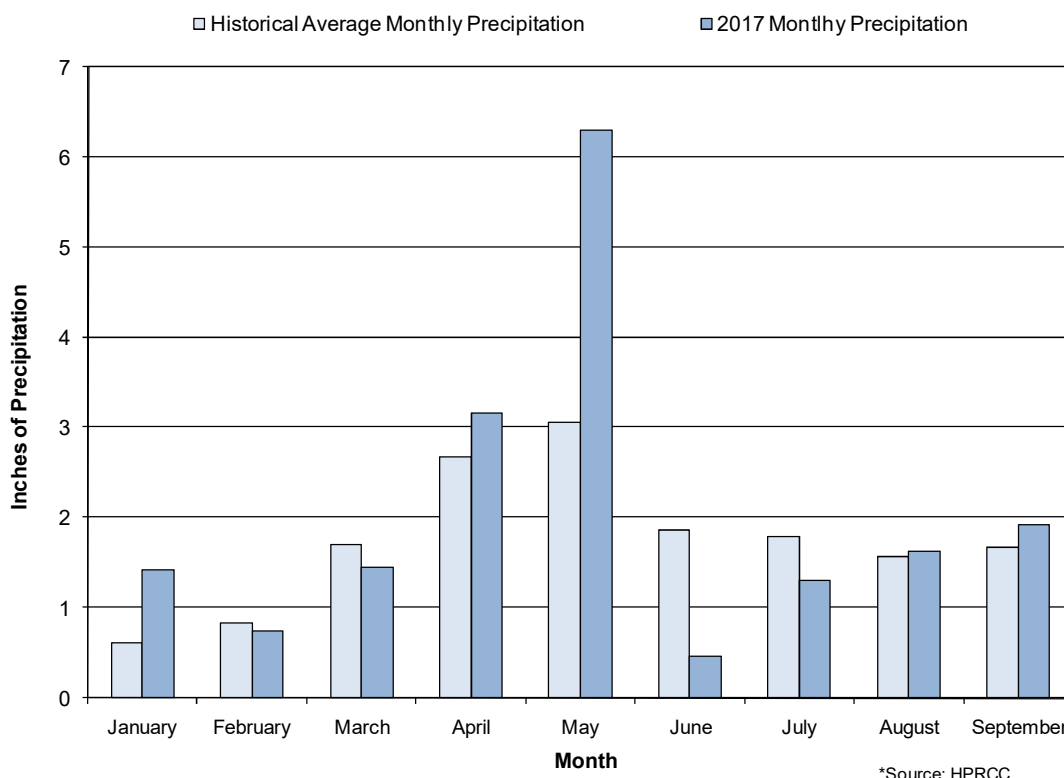
**Figure 1** 2017 Monthly Mean Air Temperature and Historical Averages



The historical averages for monthly mean precipitation indicate that April, May and June are usually the wettest months of the year. During 2017, the accumulated precipitation from January through September was significantly higher than the historical average for the same period with a total of 18.32 inches (**Figure 2**). This is approximately 16.5 percent more precipitation than the historical average of 15.72 inches. The most significant variation during the mosquito season was the month of May which received more than twice (6.29 inches) the average (3.05 inches) amount of precipitation, making it the

wettest month of 2017. By contrast, June received approximately 24 percent of its normal precipitation, making it the driest month of the mosquito season in 2017.

**Figure 2 2017 Monthly Total Precipitation Data and Historical Averages\***



The overall increase in precipitation and higher than normal temperatures during the first half of the 2017 mosquito season likely caused mosquito larvae to develop at a much faster rate which influenced both the nuisance and vector mosquito populations. While the drier than usual June and July, coupled with a cooler August presumably caused the elevated abundance of *Culex* species mosquitoes experienced throughout much of the 2017 mosquito season, it also allowed for lower than average levels of West Nile virus to be detected throughout the area.

## West Nile Virus Season

Since the introduction of West Nile virus to the United States in 1999, the virus has made a complete westward expansion to the West Coast. Starting in the Northeastern parts of the United States, the virus steadily spread through the South, the Midwest, the Rocky Mountain region and to the Western States. This extensive distribution is due to the ability of WNV to establish and persist in the wide variety of ecosystems present across the country. WNV has been detected in 65 different mosquito species in the U.S., though it appears that only a few *Culex* species drive epizootic and epidemic transmission (WNV Guidelines CDC 2013). Although West Nile virus has been endemic to the United States since 1999, researchers continue to seek an understanding for some of the factors which contribute to region specific spikes in vector abundance and human risk. We still do not understand why some humans develop West Nile fever while other infections develop into more serious West Nile encephalitis or West Nile meningitis cases. Additionally, physicians and researchers continue to seek answers to the variable

recovery times and occurrence of deaths that result with some infections. WNV has expanded to the point that it can now be found in all 48 contiguous states and has produced two additional, large nationwide epidemics in 2003 and 2012 (WNV Guidelines CDC 2013).

As of October 17, 2017, a total of 47 states and the District of Columbia have reported West Nile virus infections in people, birds, or mosquitoes in 2017 (**Figure 3**). Overall, 1,502 cases of West Nile virus disease in humans have been reported to CDC. Of these, 987 (66%) were classified as neuroinvasive disease (such as meningitis or encephalitis) and 515 (34%) were classified as non-neuroinvasive disease (**Figure 4**) and a total of 86 deaths have resulted from these infections.

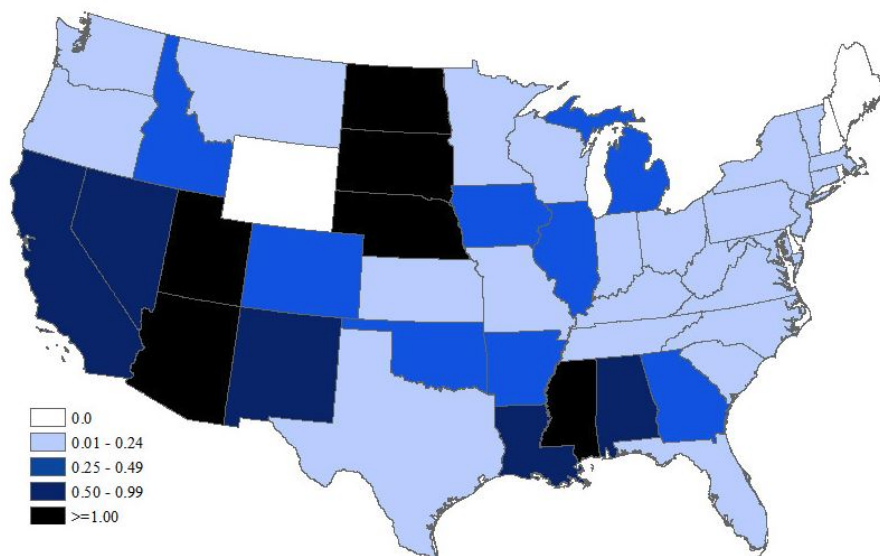
**Figure 3 West Nile Virus Activity by State – United States, 2017** (as of October 17, 2017)\*

\*CDC image <https://www.cdc.gov/westnile/statsmaps/preliminarymapsdata2017/activitystate>



**Figure 4 West Nile Virus Neuroinvasive Disease Incidence by State – United States, 2017** (as of October 17, 2017)\*

\*CDC image <https://www.cdc.gov/westnile/statsmaps/preliminarymapsdata2017/incidencestate>

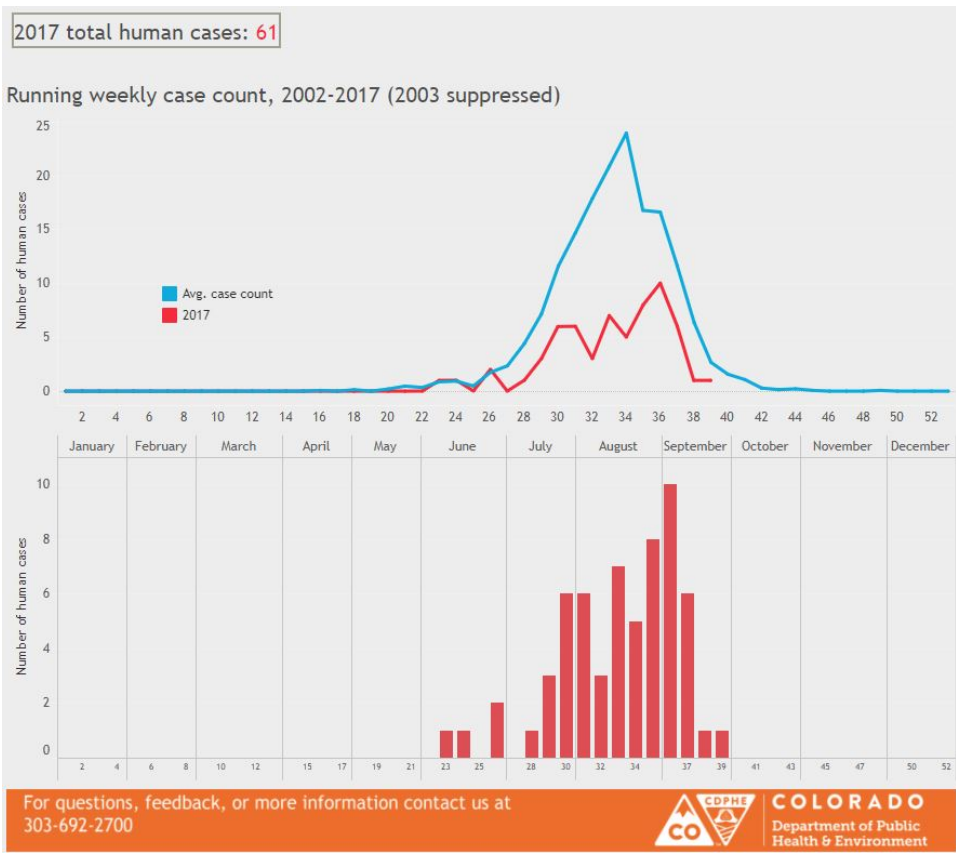


This map shows the incidence of human West Nile virus neuroinvasive disease (e.g., meningitis, encephalitis, or acute flaccid paralysis) by state for 2017 with shading ranging from 0.01–0.24, 0.25–0.49, 0.50–0.99, and greater than 1.00 per 100,000 population.

Colorado 2017

As of October 23, 2017 The Colorado Department of Health and Environment has identified 61 cases of human West Nile virus (WNV) infections in Colorado (**Figure 5**). The CDC reports only 60 cases as of October 17<sup>th</sup> with 4 (6%) asymptomatic blood donors, 25 (39%) neuroinvasive cases including symptoms of meningitis or encephalitis (including meningoencephalitis), and 35 (55%) non-neuroinvasive which includes cases where individuals are non-symptomatic or present with fever and other minor symptoms (**Figure 6**). There have been 4 deaths (**Figure 6**) associated with West Nile virus infections from undisclosed locations in Colorado during the 2017 season. The discrepancy between CDPHE data and CDC data is likely due to lag time in the communication between these entities.

**Figure 5 Weekly WNV Human Case Count, 2002-2017 (2003 suppressed)\***  
\*CDPHE image <https://www.colorado.gov/pacific/cdphe/west-nile-virus-data>



**Figure 6 West Nile Virus Disease Cases and Presumptive Viremic Blood Donors by State – United States, 2017 (as of October 17, 2017)\***

| State    | Neuroinvasive Disease Cases* | Non-neuroinvasive Disease Cases | Total cases | Deaths | Presumptive viremic blood donors‡ |
|----------|------------------------------|---------------------------------|-------------|--------|-----------------------------------|
| Colorado | 25                           | 35                              | 60          | 4      | 4                                 |

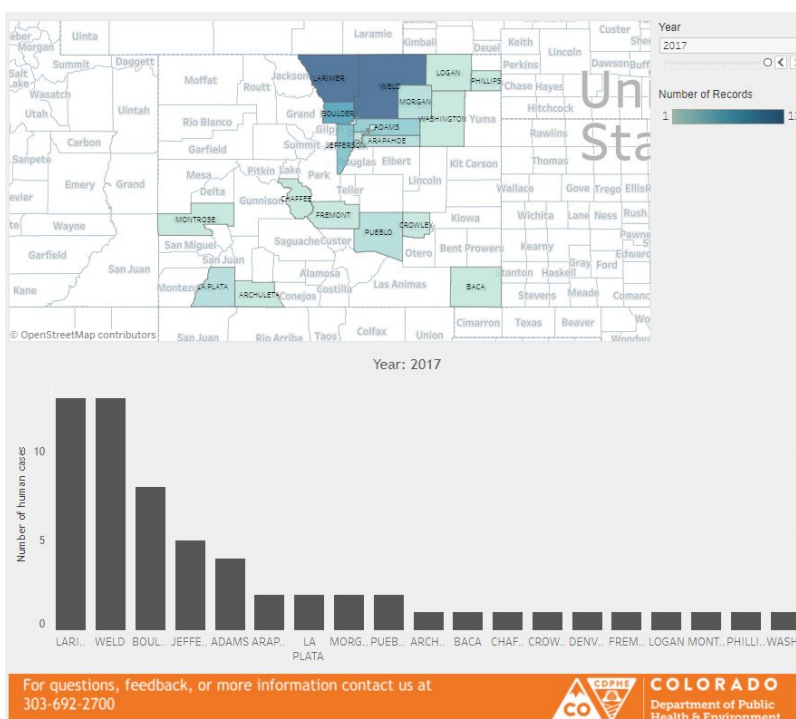
\*CDC image <https://www.cdc.gov/westnile/statsmaps/preliminarymapsdata2017/disease-cases-state.html>

## Boulder County 2017

CDPHE data currently ranks Boulder County 3<sup>rd</sup> in the number of West Nile virus human cases in the state (8 cases), while both Larimer County and Weld County have reported the most human cases (13) (**Figure 7**).

**Figure 7 Colorado WNV Human Cases by County, 2017\***

\*CDPHE image <https://www.colorado.gov/pacific/cdphe/west-nile-virus-data>



Adult mosquito surveillance data, submitted mosquito pools, and the resulting WNV infection rates were used by Boulder County Public Health (BCPH) throughout the season to calculate Vector Index (VI) levels in order to help Louisville officials determine local areas of concern for public awareness and safety. The VI is a tool used by health officials that takes into account the presence and density of *Culex* mosquitoes and their WNV infection rates, resulting in an early indicator for the risk of human WNV infection. Once the VI reaches levels above 0.75, state and local health departments typically recommend communities take additional action to control both larval and adult mosquitoes, increase public awareness, and encourage personal protection measures.

The actual 2017 weekly Vector Index rates, as calculated by BCPH, for sentinel zones 1, 2 and 3 are illustrated below (**Table 1**). Due to below average WNV activity in 2017, no emergency spraying was conducted in Louisville during the 2017 mosquito season.



**Table 1 Vector Index, Boulder County Sentinel Zones 1 - 3, 2017**

| Boulder County Vector Index 2017 <sup>1</sup> |                              |                              |                              |
|-----------------------------------------------|------------------------------|------------------------------|------------------------------|
|                                               | Sentinel Zone 1 <sup>2</sup> | Sentinel Zone 2 <sup>3</sup> | Sentinel Zone 3 <sup>4</sup> |
| Season Week                                   | Vector Index                 | Vector Index                 | Vector Index                 |
| Week 21                                       | ----                         | ----                         | ----                         |
| Week 22                                       | ----                         | ----                         | ----                         |
| Week 23                                       | ----                         | ----                         | ----                         |
| Week 24                                       | 0.00                         | 0.00                         | 0.00                         |
| Week 25                                       | 0.00                         | 0.00                         | 0.00                         |
| Week 26                                       | 0.00                         | 0.00                         | 0.00                         |
| Week 27                                       | 0.00                         | 0.00                         | 0.00                         |
| Week 28                                       | 0.00                         | 0.00                         | 0.00                         |
| Week 29                                       | 0.00                         | 0.00                         | 0.20                         |
| Week 30                                       | 0.00                         | 0.36                         | 0.38                         |
| Week 31                                       | 0.80                         | 0.00                         | 0.55                         |
| Week 32                                       | 0.00                         | 0.00                         | 0.00                         |
| Week 33                                       | 0.40                         | 0.00                         | 0.20                         |
| Week 34                                       | 0.20                         | 0.00                         | 0.19                         |
| Week 35                                       | ----                         | ----                         | ----                         |
| Week 36                                       | ----                         | ----                         | ----                         |

1. Reported by BCPH as of September 15, 2017

2. City of Boulder; 3. Longmont; 4. Erie, Lafayette, Louisville, Superior

## Larval Mosquito Control

Larval mosquito control is the foundation of the City of Louisville's Mosquito Control program and can be an extremely effective way to manage mosquitoes, thereby reducing the number of potential disease vectors and annoyances associated with biting adults. Years of research and practical experience have shown that the most effective way to control mosquito populations is through an aggressive Integrated Mosquito Management (IMM) approach. This approach aims at using a variety of concepts, tools, and products to reduce mosquito populations to a tolerable level.

Pre-season larval control work involved ground truthing GIS maps and remapping areas where new development had altered the landscape. VDCI began larval site inspections in many areas in May. Hiring of seasonal field technicians began in March and continued into May. VDCI's Annual Field Technician Classroom Training Day took place on May 22nd with over 80 new and returning field technicians in attendance. Field training by VDCI management and veteran employees lasted through May and full time field activities were in force by early June.



In 2017 Vector Disease Control International performed 243 larval site inspections at 74 documented breeding sites throughout the City. Of these individual inspections, 121 sites (49.8%) were wet upon inspection and 45 (37.2%) were producing mosquito larvae in the City of Louisville. These inspections resulted in 45 treatments in which VDCI applied 17.9 lbs. of VectoBac G (*Bti*), 1.7 lbs. of VectoLex FG (*Bs*), and 1.8 gallons of BVA 2 larvicide oil (**Table 2; Figures 8 and 9**) to 3.0 acres of land within the City of Louisville.

Larval mosquito control can be achieved in several ways including biological, biochemical, chemical, and mechanical means. No single larvicide product will work effectively in every habitat where mosquito larvae are found, so a variety of products and methods should be employed. Additionally, although there are a variety of methods for reducing larval populations, some may have negative consequences that outweigh their benefits. Mechanical or physical habitat modification is a technique which VDCI uses on relatively small scale projects, as the area to be modified must be carefully reviewed.

VDCI's favored method of larval mosquito control is through the use of bacterial bio-rational products. The main product used by VDCI is a variety of bacteria (*Bacillus thuringiensis* var. *israeliensis*). *Bti*, as it is known, has become the cornerstone of mosquito control programs throughout the world. The benefits include its efficacy and lack of environmental impacts. When used in accordance with its label, successful control of mosquito larvae can be achieved without impact to non-target species such as other aquatic invertebrates, birds, mammals, fish, amphibians, reptiles, or humans. The label allows for the use of the product in the majority of the habitats throughout the service area. Another bacterial product closely related to *Bti* is *Bacillus sphaericus* (*Bs*). *Bs* provides similar benefits to *Bti* while also providing residual control of certain species of mosquitoes. It is used specifically in difficult to treat areas where *Culex* larvae are the predominant species due to its limitations and high cost.



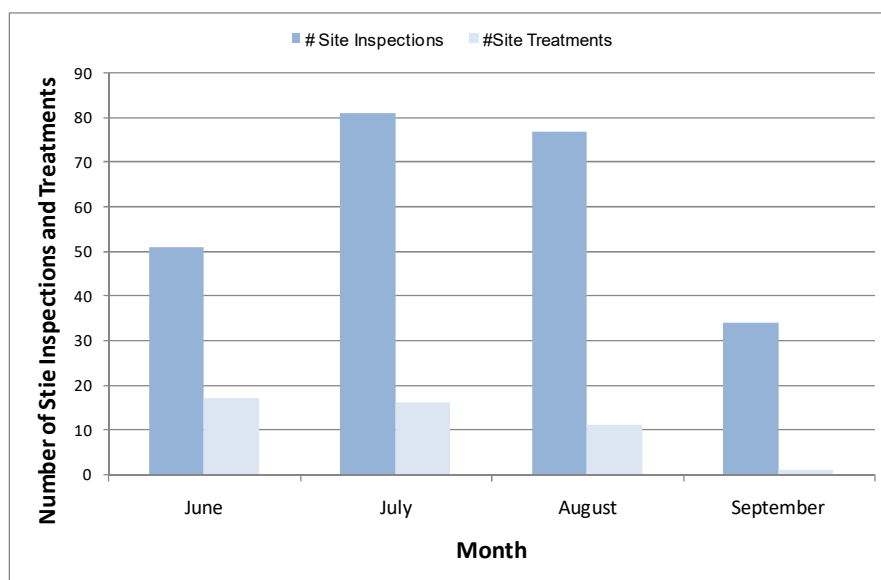
Other larval control products include the insect growth regulator methoprene (Altosid), and light mineral oils (BVA 2 larvicide oil). Methoprene is a synthetic version of a juvenile growth hormone in larval

mosquitoes. The hormone prevents the normal development of larval mosquitoes into pupae and adults, eventually causing death. VDCI limits the use of chemical larvicides to areas with little biodiversity, such as road side ditches, or areas that chronically produce high mosquito populations. They are only used after a thorough assessment has been made of any habitat where their use is being considered. Mineral oil is the only product effective in controlling mosquito pupae and therefore is an essential tool when pupae are present.

**Table 2            2017 Summary of Larval Control Product Applications by Type**

| 2017 Larval Control Product Types                      |                    | Amount Applied |
|--------------------------------------------------------|--------------------|----------------|
| <b><i>Bacillus thuringiensis israelensis (Bti)</i></b> |                    | <b>lbs</b>     |
| Vectobac G                                             | EPA Reg. #73049-10 | 17.9           |
| <b><i>Bacillus sphaericus (Bs)</i></b>                 |                    | <b>lbs</b>     |
| Vectolex FG                                            | EPA Reg. #73049-20 | 1.7            |
| <b>Methoprene</b>                                      |                    | <b>briquet</b> |
| Altosid XR briquet                                     | EPA Reg. #2724-421 | 0.0            |
| <b>Mineral Oil</b>                                     |                    | <b>gallon</b>  |
| BVA 2 Larvicide Oil                                    | EPA Reg. #70589-1  | 1.8            |

**Figure 8            2017 Larval Site Inspections and Treatments by Month**



**Figure 9**      **Comparison of Larval Site Inspections and Treatments by Year**



### ***VDCI Adult Mosquito Surveillance and Laboratory***

Information about mosquito abundance and species diversity is essential to any IMM program. Vector Disease Control International's most commonly used adult mosquito surveillance tool is the CDC light trap which uses carbon-dioxide from dry ice as bait to attract female mosquitoes seeking a blood meal from a breathing animal. Once attracted by the CO<sub>2</sub>, the mosquitoes are lured by a small light to a fan that pulls them into a net for collection. Traps are set overnight at carefully selected sites with abundant harborage. They are collected the following morning and returned to VDCI's laboratory, where the contents of the trap nets are counted and speciated by trained technicians.

In 2017, Vector Disease Control International monitored a statewide network of hundreds of weekly trap sites, collecting 761,858 adult mosquitoes that were counted and identified to species by the VDCI Surveillance Laboratories. While individual traps provide current seasonal information, trap data can be interpreted in the context of historical records for the same trap site if such data is available. Individual traps are also compared to other traps from around the region that were set on the same night and therefore exposed to similar weather conditions. Technicians working in the Surveillance Laboratories at Vector Disease Control International are trained to provide accurate species-level identification of both larval and adult mosquitoes.



Additionally, the VDCI Surveillance Laboratory conducts an intensive larval identification program with larval mosquito samples collected by field technicians. This information is now invaluable in targeting mosquito control efforts as we gain a greater understanding of the habitat types preferred by Colorado mosquito species and the seasonality of these habitats as sites for mosquito development.

Specimens and data collected from these traps and larval identification are used in:

-  Determining the effect of larval control efforts. Each mosquito species prefers specific types of habitats for larval development. If a trap includes large numbers, it could indicate the presence of an unknown larval habitat and, based on the species identification and known habitat preference for that species, direct field technicians as to possible sources of the mosquitoes collected.
-  Determining larval and adult mosquito species. This helps to illustrate the threat of mosquito-borne disease amplification and transmission because different mosquito species can vector different diseases to people and animals.
-  Determining where adult control efforts were necessary. While mosquito eradication is impossible, significant population reduction is achievable. In places where larval control is insufficient, such as neighborhoods where adult mosquitoes have migrated in from outside of the control area, it may be necessary to use adulticide methods, such as ULV truck fogging or barrier sprays of harborage areas. Trap counts that exceed an acceptable threshold for an area may trigger adult control measures.
-  Surveillance for Mosquito-borne Disease. Historically, VDCI efforts were targeted primarily at controlling mosquito nuisance problems with limited disease surveillance. However, since the arrival of the West Nile virus in Colorado in August of 2002, the paradigm has shifted toward disease prevention and control. Accurate species identification of the mosquitoes in the traps is important when monitoring species population trends. It also is necessary for evaluating whether a population spike represents an actual increase in disease transmission potential or only an increased nuisance level.

#### **CITY OF LOUISVILLE ADULT SURVEILLANCE LIGHT TRAP DATA**

In 2017, an average of three (3) surveillance light traps monitored adult mosquito populations within the City of Louisville on a weekly basis. Surveillance trapping began the first week of June and concluded on August 28<sup>th</sup> per the City of Louisville's contract and actual adult mosquito activity.

There were 38 CDC light surveillance trap nights set within City of Louisville during the 2017 season. These traps collected a total of 2,444 mosquitoes. There was an average of 64 mosquitoes caught per trap per night and an average 32 *Culex spp.* mosquitoes per trap per night. The composition of mosquitoes collected was 49.1% (1,201) *Culex spp.*, 50.2% (1,228) *Aedes/Ochlerotatus spp.*, <1% (1) *Coquillettia spp.*, and <1% (14) *Culiseta spp.* (**Figure 10**). Please refer to **Appendix A** for Louisville's Individual Light Trap Summaries.

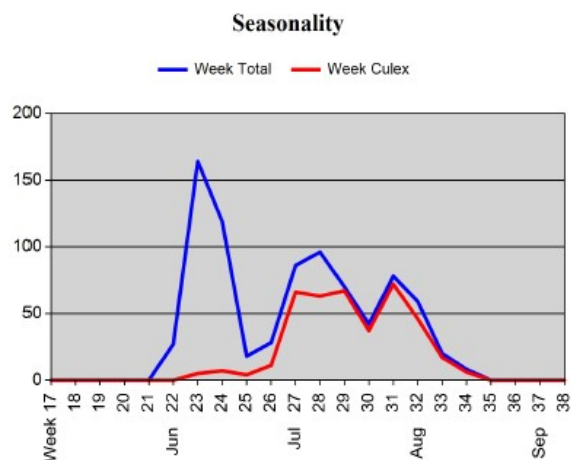
A total of 12 species were represented in 2017 in Louisville. No exotic/introduced species (such as Asian Tiger Mosquitoes) were collected this season.

**Figure 10 2017 City of Louisville Light Trap Composite Data**

Total number of trap/nights set: 38  
 Total number of mosquitoes collected: 2,444  
 Average mosquitoes per trap/night: 64  
 Average Culex per trap/night: 32

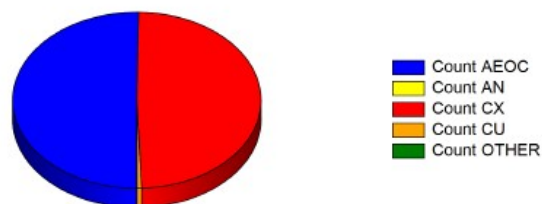
**Species collected and abundance:**

|                                  |      |        |
|----------------------------------|------|--------|
| <i>Aedes (Oc.) dorsalis</i>      | 7    | 0.3 %  |
| <i>Aedes (Oc.) hendersoni</i>    | 1    | 0.0 %  |
| <i>Aedes (Oc.) increpitus</i>    | 35   | 1.4 %  |
| <i>Aedes (Oc.) melanimon</i>     | 90   | 3.7 %  |
| <i>Aedes (Oc.) nigromaculis</i>  | 4    | 0.2 %  |
| <i>Aedes (Oc.) trivittatus</i>   | 33   | 1.4 %  |
| <i>Aedes vexans</i>              | 1058 | 43.3 % |
| <i>Coquillettidia perturbans</i> | 1    | 0.0 %  |
| <i>Culex pipiens</i>             | 129  | 5.3 %  |
| <i>Culex salinarius</i>          | 20   | 0.8 %  |
| <i>Culex tarsalis</i>            | 1052 | 43.0 % |
| <i>Culiseta inornata</i>         | 14   | 0.6 %  |



**Genus proportions:**

| Genus                     | Number | Percent of Total |
|---------------------------|--------|------------------|
| <i>Aedes/Ochlerotatus</i> | 1,228  | 50.2 %           |
| <i>Anopheles</i>          | 0      | 0.0 %            |
| <i>Culex</i>              | 1,201  | 49.1 %           |
| <i>Culiseta</i>           | 14     | 0.6 %            |
| Other                     | 1      | 0.0 %            |



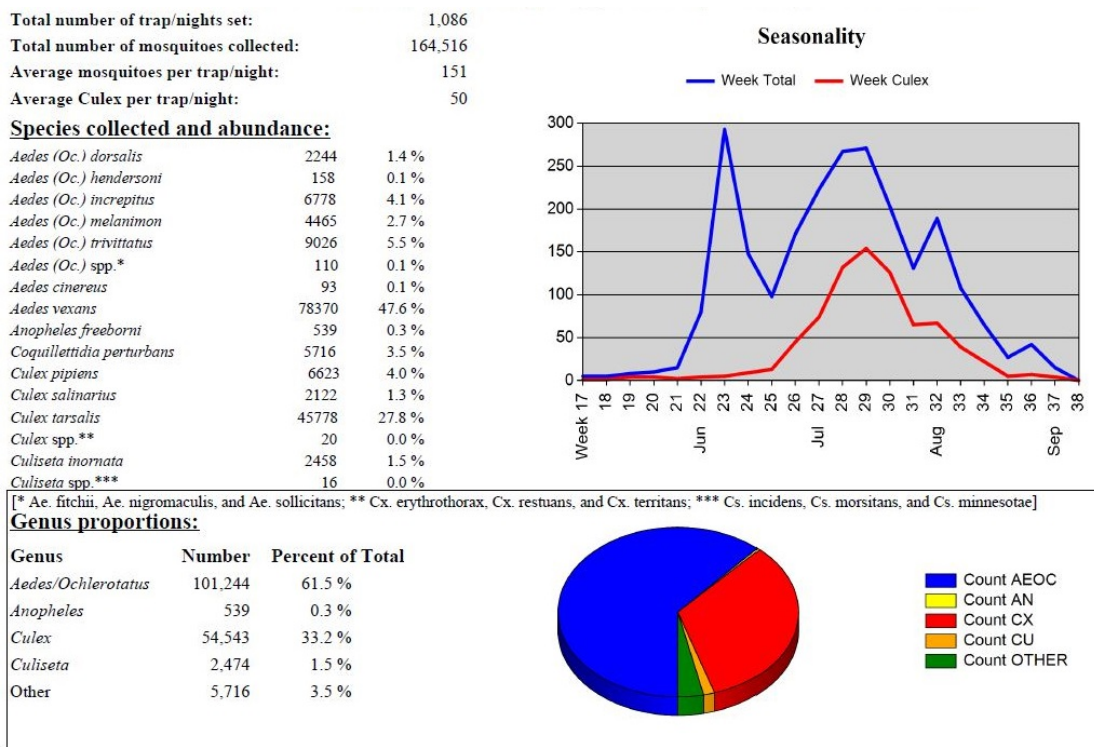
©2017 Vector Disease Control International

There were 1,086 CDC light surveillance trap nights set within Boulder County during the 2017 season. These traps collected a total of 164,516 mosquitoes. There was an average of 151 mosquitoes caught per trap per night and an average 50 *Culex spp.* mosquitoes per trap per night. The composition of mosquitoes collected was 33.2% (54,543) *Culex spp.*, 61.5% (101,244) *Aedes/Ochlerotatus spp.*, 3.5% (5,716) *Coquillettidia spp.*, <1% (539) *Anopheles spp.*, and 1.5% (2,474) *Culiseta spp.* (**Figure 11**).

A total of 22 species were represented in 2017 in Boulder County. No exotic/introduced species (such as Asian Tiger Mosquitoes) were collected this season.



**Figure 11 2017 Boulder County Light Trap Composite Data**



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## WEST NILE VIRUS MOSQUITO SAMPLE TESTING RESULTS - BOULDER COUNTY

VDCI and Louisville used the adult mosquito data collected to help determine local areas of concern for public awareness and safety as well as to monitor the local vector mosquito populations. Many local health departments have moved towards mosquito-based surveillance indicators to assess the weekly risk of West Nile transmission and guide response decisions for adult mosquito control applications. The vector index and infection rate is derived by testing the mosquitoes VDCI collects for the presence of West Nile virus. This value is closely monitored by the CDPHE and local health departments to evaluate the risk posed by the vector mosquito population.

As defined in the CDC guidelines for West Nile virus surveillance, prevention and control, the vector index (VI) is an estimate of the number of West Nile virus infected mosquitoes in an area. This number can serve as a human health risk value. An operational value of 0.75, which was derived from the comparison of historical data for human infections, as well as relative abundance and infection in mosquitoes, serves as an indicator of high risk for West Nile virus transmission to humans in the corresponding area. As the value of the vector index increases there is a corresponding risk of human disease and this value can be used to offset epidemics.

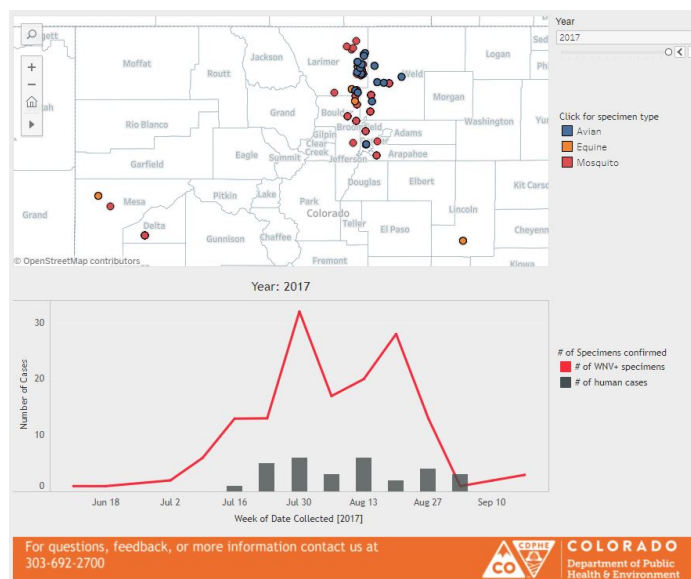
Due to budget cutbacks associated with West Nile virus surveillance in recent years, the CDPHE does not have the ability to test mosquitoes from every trap set across the state. As a result, there is select testing done within three sentinel zones in Boulder County. *Culex species* mosquito samples are sent to CDPHE

for WNV testing on a weekly basis as part of the state’s Sentinel Encephalitis Surveillance program (**Figure 12**), which VDCI is contracted separately through BCPH to perform.

As of September 15<sup>th</sup>, 2017 CDPHE has tested a total of 188 mosquito pools from Boulder County. Of the tested mosquito pools, 15 pools tested positive for West Nile virus from all three sentinel zones (**Appendix B**). The first Boulder County West Nile virus positive mosquito sample pool of the 2017 season was on July 17, 2017.

**Figure 12**      **Number of Colorado Positive WNV Specimens 2017 (animal and mosquito)\***

\*CDPHE image <https://www.colorado.gov/pacific/cdphe/west-nile-virus-data>



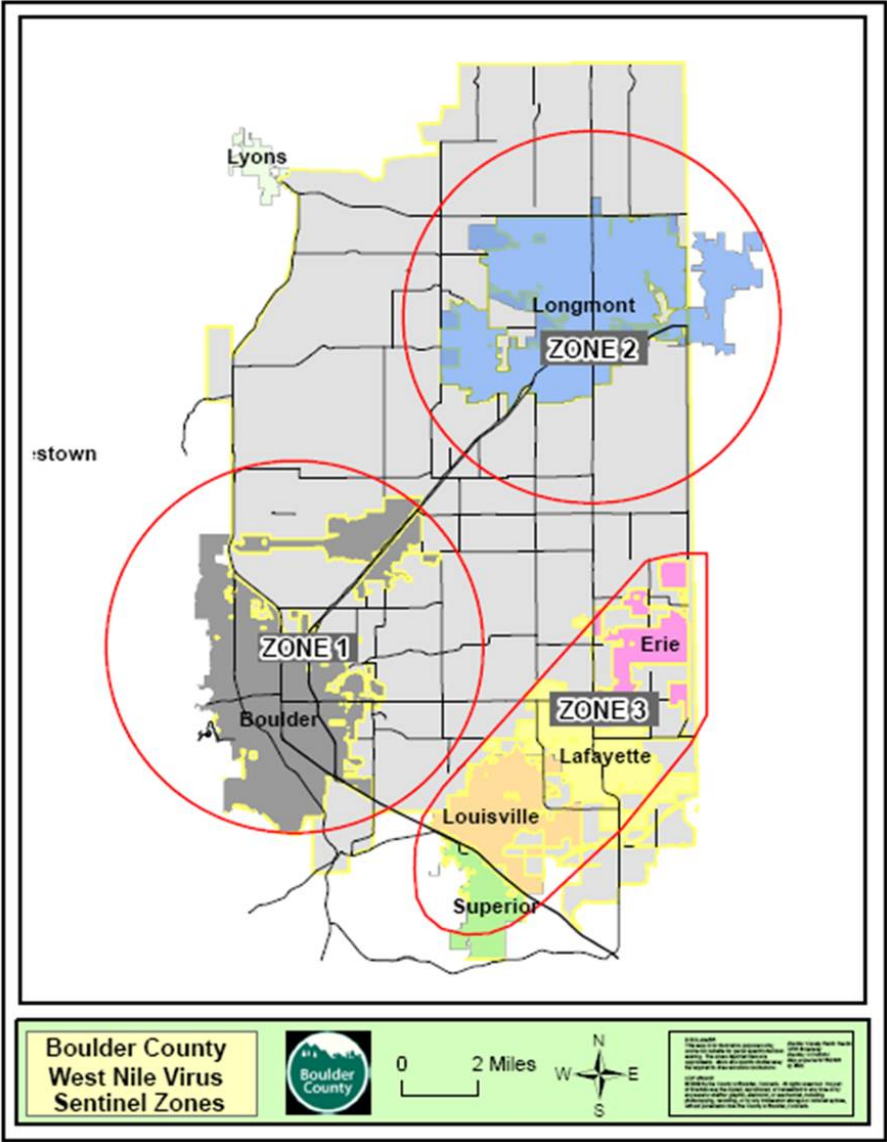
### Boulder County Public Health Adult Mosquito Sentinel Zones

The Sentinel Encephalitis Surveillance Program was funded by the Colorado Department of Public Health and Environment and Boulder County Public Health in 2017. VDCI maintained the sentinel system with five surveillance traps at permanent locations in each of three Boulder County Sentinel Zones: City of Boulder (BCZ1); City of Longmont (BCZ2); Town of Erie, City of Lafayette, City of Louisville, Town of Superior (BCZ3) (**Figure 13**). The sentinel light traps were set once a week from May 29<sup>th</sup> to September 19<sup>th</sup>.

In 2017 there were 82 sentinel surveillance trap nights set which collected 10,683 adult mosquitoes in BCZ1; 69 sentinel surveillance trap nights set which collected 10,276 adult mosquitoes in BCZ2; and 70 sentinel surveillance trap nights set which collected 9,807 adult mosquitoes in BCZ3. Please refer to **Appendix C** for a summary of species collected and abundance.



Figure 13      **Boulder County Public Health Sentinel Surveillance Zone Map**



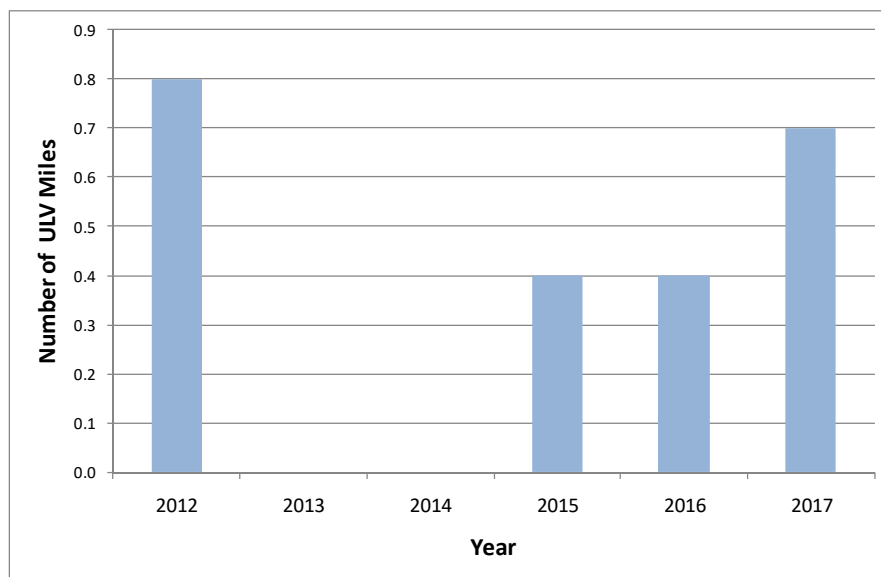
## ADULT MOSQUITO CONTROL

The goal of Vector Disease Control International is to provide our customers with the best options for safe, effective, modern mosquito management. The primary emphasis of Louisville's Integrated Mosquito Management Program is to control mosquitoes in the larval stage, using safe biological control products. When mosquito counts surpass nuisance thresholds of 100 mosquitoes, VDCI uses EPA and CDC approved adulticides to reduce mosquito populations. During the 2017 season a total of 0.7 Ultra Low Volume (ULV) miles of roads and access paths in the City of Louisville were sprayed using the adulticide Aqualuer® 20-20 (Active Ingredient – Permethrin) (**Figure 14**). In addition, a total of 71 gallons of Talstar Pro (Active Ingredient – Bifenthrin) were applied as daytime backpack barrier applications. A detailed summary of adulticide applications, by neighborhood, can be found in **Appendix D**.

VDCI uses state of the art technology, calibrated application timing, and least-toxic products to minimize non-target impacts. Adult mosquito control applications are accomplished using Ultra Low Volume (ULV) spray equipment and performed after dusk when the majority of mosquito species are most active. This type of equipment produces droplets averaging 10-25 microns in diameter and allows for a minimal amount of product to be put into the environment. These treatments take place in the evening when mosquitoes are flying in the greatest numbers and non-target insect activity (for example, day-flying pollinators like bees) is greatly reduced. Using this application technique, the overall goal of minimal environmental impact and effective adult control is achieved in the targeted area.



**Figure 14** Comparison of ULV Adulticide Miles by Year



## **CALL NOTIFICATION & SHUTOFF SYSTEM**

Both VDCI and Louisville acknowledge that adult mosquito control can be a sensitive matter to many residents; therefore a Spray Shutoff and/or Notification request option was available to the public. Residents were able to call VDCI's MosquitoLine™ or submit a website request to be notified before adult control applications were performed and/or request that the ULV sprayer be shutoff in front of their address.

At the beginning of the 2017 season, VDCI sent out 30 letters to all historical shutoff and notification households in order to establish an updated list for the 2017 season. VDCI received 5 shutoff only requests, 34 shut off and notification requests, and 11 notification only requests. The 2017 season shutoff and notification list concluded with 50 households. Residents on the shutoff and notification list were notified 24 hours in advance when their community was scheduled to be sprayed. VDCI used an automated message service to contact residents and listed weekly ULV spray events on VDCI's website which utilized Google Calendar.

**DAILY POSTING OF ULV SPRAY ZONES** were maintained and updated online by 5 pm at VDCI's Colorado specific website: [www.vdci.net/colorado-schedules](http://www.vdci.net/colorado-schedules)

## ***Public Relations and Education***

VDCI is dedicated to providing strong Public Outreach and Education Programs to residents in all of our communities. Citizen complaints, inquiry, information and satisfaction surveys can aid in evaluating the effectiveness of a program. VDCI constantly looks for ways to better serve the communities we work with and encourages both the citizen and local media involvement in order to increase the effectiveness of our programs. We have clearly demonstrated that commitment and belief by proactively serving City of Louisville (and all of our contracted communities) with numerous innovative programs, activities and services.

Customer service is always a high priority for VDCI. We take pride in training each and every technician so that they have the knowledge to provide residents with the correct answers to their questions. Each field technician spends part of their day responding to resident concerns in their work area. This in-field customer service personalizes the mosquito control program, provides VDCI with local information on mosquito activity and presents a valuable opportunity to educate our residents about mosquito biology and control.

### **MosquitoLine™**

VDCI maintains a toll-free telephone line specific to Boulder County, (888) 774-2161 and a local line (303) 466-1892 to accept calls from the public concerning:

- ✧ Information requests about mosquito biology and source reduction of mosquito habitats
- ✧ Information on program components, operations and monitoring
- ✧ Seasonal West Nile virus activity
- ✧ Personal protection options for mosquito annoyances and West Nile virus risk

- \* Reports about mosquitoes and possible larval mosquito habitats
- \* Requests to perform larvicide applications and/or opt-out of any adulticide spraying
- \* Request notification when adulticide spraying is planned in their neighborhood
- \* Request health and safety information about mosquito control operations and pesticide products used

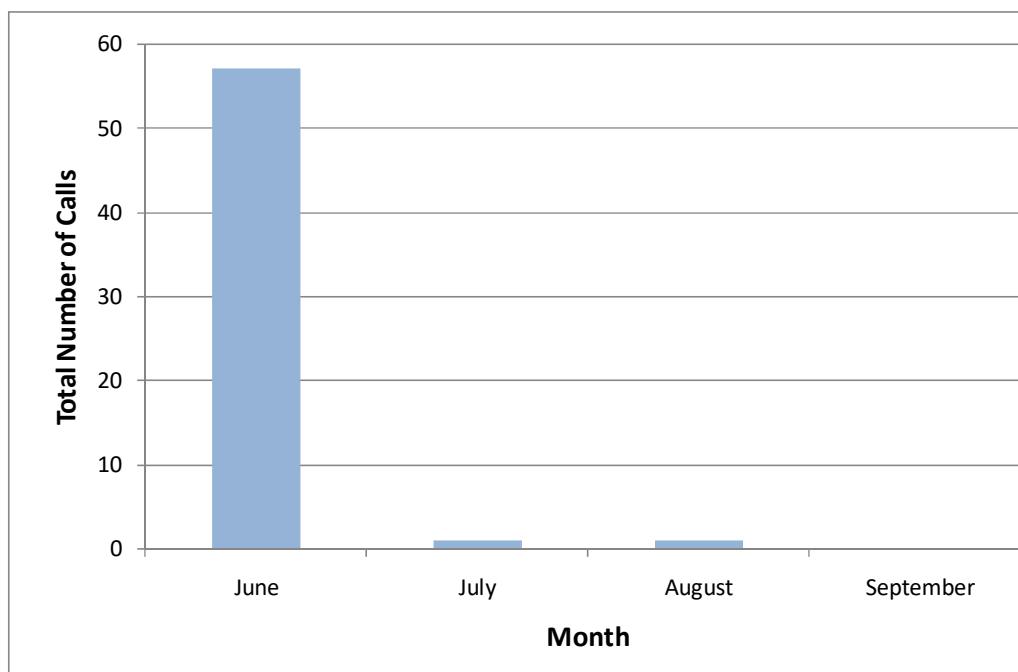
VDCI has provided Mosquito Hotlines to the residents in communities which we are contracted to also reduce workload by municipal personnel. This enables direct communication and response by mosquito control employees to resident's concerns about West Nile virus and larval site activity and treatment. VDCI maintains a log of calls received and will summarize call activity in monthly and annual reports.

In 2017 VDCI received 59 phone calls from residents of Louisville. The majority of these calls (50) were requests for sprayer shutoffs and/or call notifications prior to spraying. Of the rest, 5 calls were adult mosquito complaints, 3 calls were requests to have habitat inspected for mosquito larvae and one request for general information (**Table 3; Figures 15 and 16**).

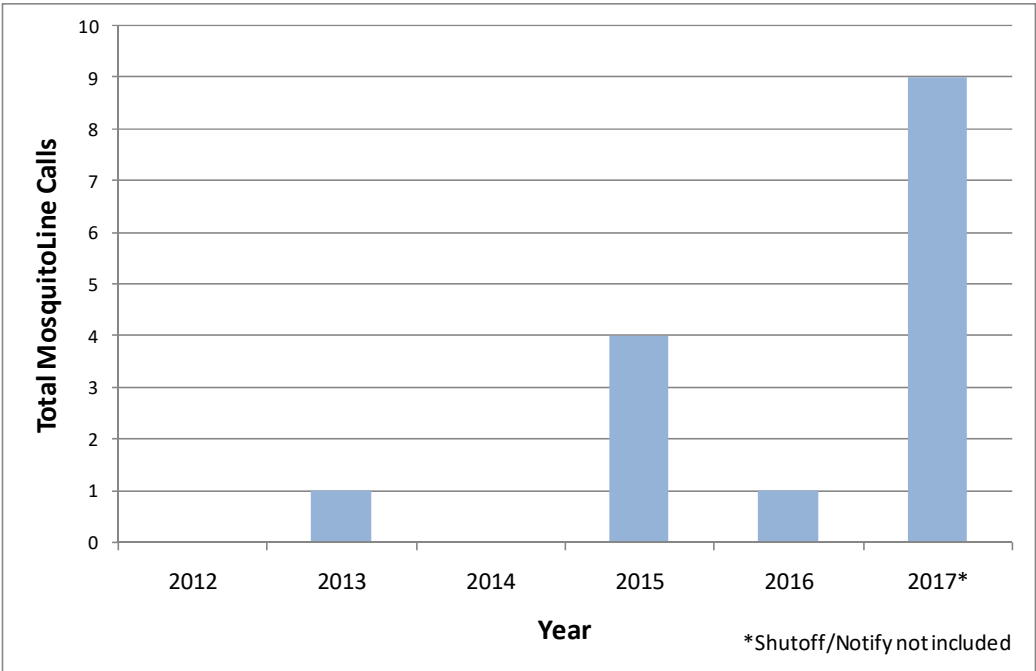
**Table 3      2017 Mosquito Control Calls by Category**

| Call Category        | 2017            |               |
|----------------------|-----------------|---------------|
|                      | Number of Calls | Percentage    |
| Adult Complaint      | 5               | 8.5%          |
| Habitat Assessment   | 3               | 5.1%          |
| Shutoff/Notification | 39              | 66.1%         |
| Notification         | 11              | 18.6%         |
| General Info/Other   | 1               | 1.7%          |
| <b>Total</b>         | <b>59</b>       | <b>100.0%</b> |

**Figure 15      2017 Mosquito Control Calls by Month**



**Figure 16      Comparison of Total Mosquito Control Calls by Year**



## Appendix A: City of Louisville Individual Light Trap Summaries

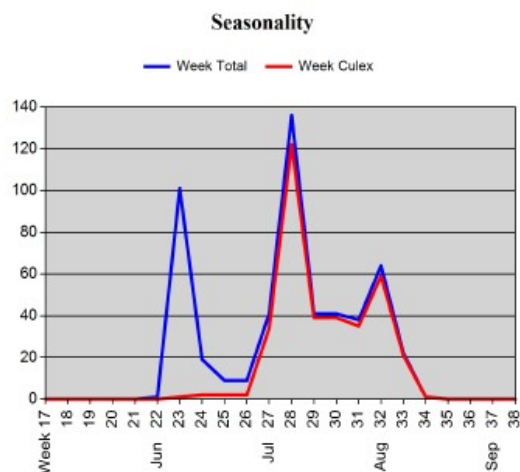
### LO-01: Coal Creek Golf Course

Season: 2017  
 Trap Type: Light/CO2  
 Location: Dillon Road at bridge over Coal Creek  
 GPS: N39° 57.465', W105° 9.120'

Total number of trap/nights set: 12  
 Total number of mosquitoes collected: 514  
 Average mosquitoes per trap/night: 43  
 Average Culex per trap/night: 30

#### Species collected and abundance:

|                                  |     |        |
|----------------------------------|-----|--------|
| <i>Aedes (Oc.) dorsalis</i>      | 4   | 0.8 %  |
| <i>Aedes (Oc.) melanimon</i>     | 8   | 1.6 %  |
| <i>Aedes (Oc.) trivittatus</i>   | 3   | 0.6 %  |
| <i>Aedes vexans</i>              | 142 | 27.6 % |
| <i>Coquillettidia perturbans</i> | 1   | 0.2 %  |
| <i>Culex pipiens</i>             | 21  | 4.1 %  |
| <i>Culex tarsalis</i>            | 334 | 65.0 % |
| <i>Culiseta inornata</i>         | 1   | 0.2 %  |



#### Genus Proportions:

| Genus                     | Number | Percent of Total |
|---------------------------|--------|------------------|
| <i>Aedes/Ochlerotatus</i> | 157    | 30.5 %           |
| <i>Anopheles</i>          | 0      | 0.0 %            |
| <i>Culex</i>              | 355    | 69.1 %           |
| <i>Culiseta</i>           | 1      | 0.2 %            |
| Other                     | 1      | 0.2 %            |



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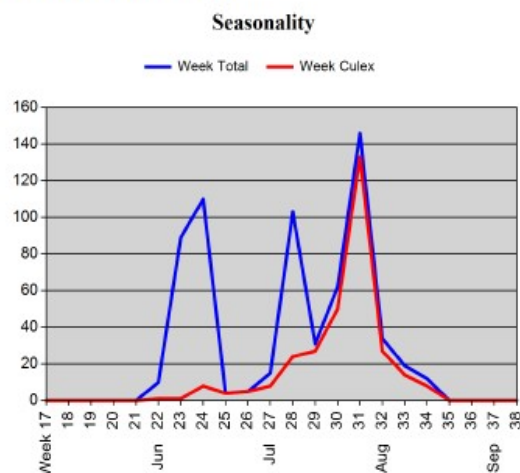
### LO-04: Annette A. Brand Park

Season: 2017  
 Trap Type: Light/CO2  
 Location: Annette A. Brand Park at entrance to Louisville Res.  
 GPS: N39° 59.415', W105° 9.495'

Total number of trap/nights set: 13  
 Total number of mosquitoes collected: 640  
 Average mosquitoes per trap/night: 49  
 Average Culex per trap/night: 24

#### Species collected and abundance:

|                                |     |        |
|--------------------------------|-----|--------|
| <i>Aedes (Oc.) dorsalis</i>    | 2   | 0.3 %  |
| <i>Aedes (Oc.) increpitus</i>  | 17  | 2.7 %  |
| <i>Aedes (Oc.) melanimon</i>   | 7   | 1.1 %  |
| <i>Aedes (Oc.) trivittatus</i> | 1   | 0.2 %  |
| <i>Aedes vexans</i>            | 300 | 46.9 % |
| <i>Culex pipiens</i>           | 49  | 7.7 %  |
| <i>Culex salinarius</i>        | 1   | 0.2 %  |
| <i>Culex tarsalis</i>          | 256 | 40.0 % |
| <i>Culiseta inornata</i>       | 7   | 1.1 %  |



#### Genus Proportions:

| Genus                     | Number | Percent of Total |
|---------------------------|--------|------------------|
| <i>Aedes/Ochlerotatus</i> | 327    | 51.1 %           |
| <i>Anopheles</i>          | 0      | 0.0 %            |
| <i>Culex</i>              | 306    | 47.8 %           |
| <i>Culiseta</i>           | 7      | 1.1 %            |
| Other                     | 0      | 0.0 %            |



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## LO-08: Coal Creek Trail

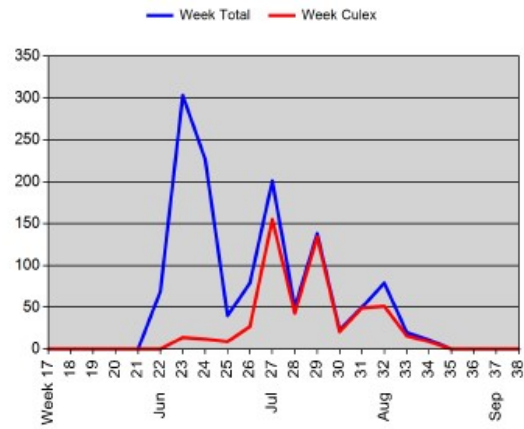
Season: 2017  
 Trap Type: Light/CO2  
 Location: Coal Creek Trailhead off Aspen Way  
 GPS: N39° 58.115', W105° 8.000'

Total number of trap/nights set: 13  
 Total number of mosquitoes collected: 1,290  
 Average mosquitoes per trap/night: 99  
 Average Culex per trap/night: 42

### Species collected and abundance:

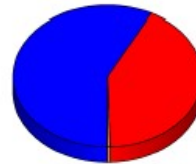
|                                 |     |        |
|---------------------------------|-----|--------|
| <i>Aedes (Oc.) dorsalis</i>     | 1   | 0.1 %  |
| <i>Aedes (Oc.) hendersoni</i>   | 1   | 0.1 %  |
| <i>Aedes (Oc.) inaequalis</i>   | 18  | 1.4 %  |
| <i>Aedes (Oc.) melanotarsus</i> | 75  | 5.8 %  |
| <i>Aedes (Oc.) nigromaculis</i> | 4   | 0.3 %  |
| <i>Aedes (Oc.) trivittatus</i>  | 29  | 2.2 %  |
| <i>Aedes vexans</i>             | 616 | 47.8 % |
| <i>Culex pipiens</i>            | 59  | 4.6 %  |
| <i>Culex salinarius</i>         | 19  | 1.5 %  |
| <i>Culex tarsalis</i>           | 462 | 35.8 % |
| <i>Culiseta inornata</i>        | 6   | 0.5 %  |

### Seasonality



### Genus Proportions:

| Genus                     | Number | Percent of Total |
|---------------------------|--------|------------------|
| <i>Aedes/Ochlerotatus</i> | 744    | 57.7 %           |
| <i>Anopheles</i>          | 0      | 0.0 %            |
| <i>Culex</i>              | 540    | 41.9 %           |
| <i>Culiseta</i>           | 6      | 0.5 %            |
| Other                     | 0      | 0.0 %            |



Count AEOC  
 Count AN  
 Count CX  
 Count CU  
 Count OTHER

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## Appendix B: Adult Sample Pool Test Results for West Nile Virus Positive Locations

### Vector Disease Control International

### Mosquito Pool Testing

| Sample        | Collection | Trap             | Quantity | Species        | Type  | Notes | Results  | MIR    |
|---------------|------------|------------------|----------|----------------|-------|-------|----------|--------|
| S319895a      | 07/24/2017 | Boulder<br>LM-03 | 65       | Culex tarsalis | LIGHT | BCZ2  | POSITIVE | 0.000  |
| Total in pool |            |                  |          |                |       |       | 65       |        |
| S319911a      | 07/24/2017 | Boulder<br>LA-11 | 51       | Culex tarsalis | LIGHT | BCZ3  | POSITIVE | 0.000  |
| Total in pool |            |                  |          |                |       |       | 51       |        |
| S319970a      | 07/31/2017 | Boulder<br>ER-03 | 65       | Culex tarsalis | LIGHT | BCZ3  | POSITIVE | 11.000 |
| Total in pool |            |                  |          |                |       |       | 65       |        |
| S319972a      | 07/31/2017 | Boulder<br>ER-03 | 65       | Culex tarsalis | LIGHT | BCZ3  | POSITIVE | 11.000 |
| Total in pool |            |                  |          |                |       |       | 65       |        |
| S319983a      | 08/01/2017 | Boulder<br>BO-25 | 65       | Culex tarsalis | LIGHT | BCZ1  | POSITIVE | 11.000 |
| Total in pool |            |                  |          |                |       |       | 65       |        |
| S319985a      | 08/01/2017 | Boulder<br>BO-01 | 42       | Culex tarsalis | LIGHT | BCZ1  | POSITIVE | 11.000 |
| 08/01/2017    | BO-25      |                  | 23       | Culex tarsalis | LIGHT | BCZ1  | POSITIVE | 11.000 |
| Total in pool |            |                  |          |                |       |       | 65       |        |
| S320088a      | 08/14/2017 | Boulder<br>LO-01 | 49       | Culex tarsalis | LIGHT | BCZ3  | POSITIVE | 0.000  |
| 08/14/2017    | LO-08      |                  | 16       | Culex tarsalis | LIGHT | BCZ3  | POSITIVE | 0.000  |
| Total in pool |            |                  |          |                |       |       | 65       |        |
| S320092a      | 08/15/2017 | Boulder<br>BO-03 | 33       | Culex tarsalis | LIGHT | BCZ1  | POSITIVE | 0.000  |
| 08/15/2017    | BO-11      |                  | 32       | Culex tarsalis | LIGHT | BCZ1  | POSITIVE | 0.000  |
| Total in pool |            |                  |          |                |       |       | 65       |        |
| S320094a      | 08/15/2017 | Boulder<br>BO-03 | 63       | Culex pipiens  | LIGHT | BCZ1  | POSITIVE | 0.000  |
| Total in pool |            |                  |          |                |       |       | 63       |        |
| S320134a      | 08/21/2017 | Boulder<br>LM-42 | 65       | Culex tarsalis | LIGHT | BCZ2  | POSITIVE | 0.000  |
| Total in pool |            |                  |          |                |       |       | 65       |        |
| S320135a      | 08/21/2017 | Boulder<br>LM-03 | 43       | Culex tarsalis | LIGHT | BCZ2  | POSITIVE | 0.000  |
| Total in pool |            |                  |          |                |       |       | 43       |        |
| S320138a      | 08/21/2017 | Boulder<br>LM-03 | 5        | Culex pipiens  | LIGHT | BCZ2  | POSITIVE | 0.000  |
| 08/21/2017    | LM-17      |                  | 1        | Culex pipiens  | LIGHT | BCZ2  | POSITIVE | 0.000  |
| 08/21/2017    | LM-28      |                  | 36       | Culex pipiens  | LIGHT | BCZ2  | POSITIVE | 0.000  |
| 08/21/2017    | LM-34      |                  | 8        | Culex pipiens  | LIGHT | BCZ2  | POSITIVE | 0.000  |
| 08/21/2017    | LM-42      |                  | 12       | Culex pipiens  | LIGHT | BCZ2  | POSITIVE | 0.000  |
| Total in pool |            |                  |          |                |       |       | 62       |        |
| S320139a      | 08/21/2017 | Boulder<br>ER-03 | 59       | Culex tarsalis | LIGHT | BCZ3  | POSITIVE | 0.000  |
| Total in pool |            |                  |          |                |       |       | 59       |        |
| S320145a      | 08/22/2017 | Boulder<br>BO-01 | 3        | Culex pipiens  | LIGHT | BCZ1  | POSITIVE | 0.000  |
| 08/22/2017    | BO-03      |                  | 2        | Culex pipiens  | LIGHT | BCZ1  | POSITIVE | 0.000  |
| 08/22/2017    | BO-04      |                  | 4        | Culex pipiens  | LIGHT | BCZ1  | POSITIVE | 0.000  |
| 08/22/2017    | BO-25      |                  | 6        | Culex pipiens  | LIGHT | BCZ1  | POSITIVE | 0.000  |
| Total in pool |            |                  |          |                |       |       | 15       |        |
| S320328a      | 07/17/2017 | Boulder<br>LA-11 | 65       | Culex tarsalis | LIGHT | BCZ3  | POSITIVE | 0.000  |
| Total in pool |            |                  |          |                |       |       | 65       |        |

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## Appendix C: Boulder County Public Health Sentinel Zones 1-3 Light Trap Summaries

### 2017 BCZ1 Sentinel Zone Trap Composite Data

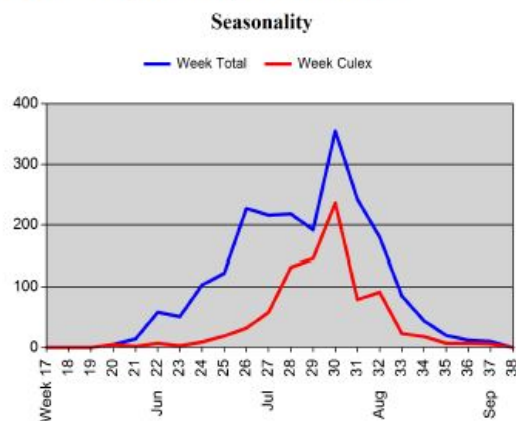
Total number of trap/nights set: 82  
Total number of mosquitoes collected: 10,683  
Average mosquitoes per trap/night: 130  
Average Culex per trap/night: 53

#### Species collected and abundance:

|                                                      |      |        |
|------------------------------------------------------|------|--------|
| <i>Aedes (Oc.) dorsalis</i>                          | 76   | 0.7 %  |
| <i>Aedes (Oc.) fitchii</i>                           | 1    | 0.0 %  |
| <i>Aedes (Oc.) hendersoni</i>                        | 14   | 0.1 %  |
| <i>Aedes (Oc.) inaequalis</i>                        | 253  | 2.4 %  |
| <i>Aedes (Oc.) melanotarsus</i>                      | 274  | 2.6 %  |
| <i>Aedes (Oc.) nigromaculis</i>                      | 4    | 0.0 %  |
| <i>Aedes (Oc.) trivittatus</i>                       | 563  | 5.3 %  |
| <i>Aedes cinereus</i>                                | 2    | 0.0 %  |
| <i>Aedes vexans</i>                                  | 3233 | 30.3 % |
| <i>Anopheles freeborni</i>                           | 19   | 0.2 %  |
| <i>Coquillettidia perturbans</i>                     | 1623 | 15.2 % |
| <i>Culex pipiens</i>                                 | 814  | 7.6 %  |
| <i>Culex salinarius</i>                              | 283  | 2.6 %  |
| <i>Culex tarsalis</i>                                | 3272 | 30.6 % |
| <i>Culiseta incidens</i>                             | 4    | 0.0 %  |
| <i>Culiseta incidens</i> (4) & <i>inornata</i> (248) | 252  | 2.4 %  |

#### Genus proportions:

| Genus                     | Number | Percent of Total |
|---------------------------|--------|------------------|
| <i>Aedes/Ochlerotatus</i> | 4,420  | 41.4 %           |
| <i>Anopheles</i>          | 19     | 0.2 %            |
| <i>Culex</i>              | 4,369  | 40.9 %           |
| <i>Culiseta</i>           | 252    | 2.4 %            |
| Other                     | 1,623  | 15.2 %           |



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### 2017 BCZ2 Sentinel Zone Trap Composite Data

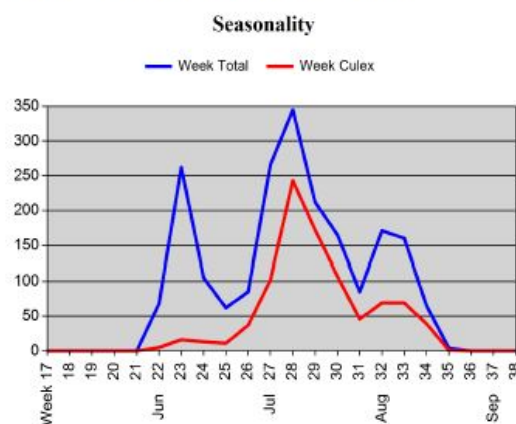
Total number of trap/nights set: 69  
Total number of mosquitoes collected: 10,276  
Average mosquitoes per trap/night: 149  
Average Culex per trap/night: 67

#### Species collected and abundance:

|                                  |      |        |
|----------------------------------|------|--------|
| <i>Aedes (Oc.) dorsalis</i>      | 456  | 4.4 %  |
| <i>Aedes (Oc.) fitchii</i>       | 1    | 0.0 %  |
| <i>Aedes (Oc.) hendersoni</i>    | 1    | 0.0 %  |
| <i>Aedes (Oc.) inaequalis</i>    | 16   | 0.2 %  |
| <i>Aedes (Oc.) melanotarsus</i>  | 36   | 0.4 %  |
| <i>Aedes (Oc.) nigromaculis</i>  | 4    | 0.0 %  |
| <i>Aedes (Oc.) trivittatus</i>   | 59   | 0.6 %  |
| <i>Aedes cinereus</i>            | 3    | 0.0 %  |
| <i>Aedes vexans</i>              | 4991 | 48.6 % |
| <i>Coquillettidia perturbans</i> | 3    | 0.0 %  |
| <i>Culex pipiens</i>             | 518  | 5.0 %  |
| <i>Culex salinarius</i>          | 226  | 2.2 %  |
| <i>Culex tarsalis</i>            | 3903 | 38.0 % |
| <i>Culiseta inornata</i>         | 59   | 0.6 %  |

#### Genus proportions:

| Genus                     | Number | Percent of Total |
|---------------------------|--------|------------------|
| <i>Aedes/Ochlerotatus</i> | 5,567  | 54.2 %           |
| <i>Anopheles</i>          | 0      | 0.0 %            |
| <i>Culex</i>              | 4,647  | 45.2 %           |
| <i>Culiseta</i>           | 59     | 0.6 %            |
| Other                     | 3      | 0.0 %            |



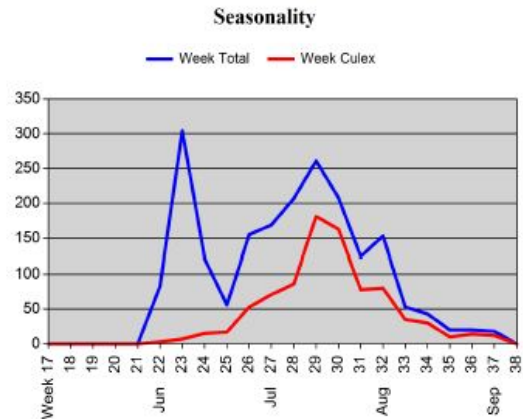
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## 2017 BCZ3 Sentinel Zone Trap Composite Data

Total number of trap/nights set: 70  
 Total number of mosquitoes collected: 9,807  
 Average mosquitoes per trap/night: 140  
 Average Culex per trap/night: 59

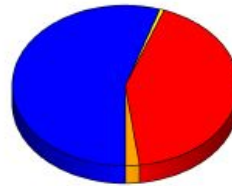
### Species collected and abundance:

|                                  |      |        |
|----------------------------------|------|--------|
| <i>Aedes (Oc.) dorsalis</i>      | 23   | 0.2 %  |
| <i>Aedes (Oc.) fitchii</i>       | 4    | 0.0 %  |
| <i>Aedes (Oc.) hendersoni</i>    | 3    | 0.0 %  |
| <i>Aedes (Oc.) inaequalis</i>    | 79   | 0.8 %  |
| <i>Aedes (Oc.) melanotarsus</i>  | 447  | 4.6 %  |
| <i>Aedes (Oc.) nigromaculis</i>  | 6    | 0.1 %  |
| <i>Aedes (Oc.) trivittatus</i>   | 163  | 1.7 %  |
| <i>Aedes cinereus</i>            | 5    | 0.1 %  |
| <i>Aedes vexans</i>              | 4661 | 47.5 % |
| <i>Anopheles freeborni</i>       | 59   | 0.6 %  |
| <i>Coquillettidia perturbans</i> | 3    | 0.0 %  |
| <i>Culex pipiens</i>             | 593  | 6.0 %  |
| <i>Culex salinarius</i>          | 149  | 1.5 %  |
| <i>Culex tarsalis</i>            | 3418 | 34.9 % |
| <i>Culiseta inornata</i>         | 194  | 2.0 %  |



### Genus proportions:

| Genus                     | Number | Percent of Total |
|---------------------------|--------|------------------|
| <i>Aedes/Ochlerotatus</i> | 5,391  | 55.0 %           |
| <i>Anopheles</i>          | 59     | 0.6 %            |
| <i>Culex</i>              | 4,160  | 42.4 %           |
| <i>Culiseta</i>           | 194    | 2.0 %            |
| Other                     | 3      | 0.0 %            |



Count AEOC  
 Count AN  
 Count CX  
 Count CU  
 Count OTHER

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## Appendix D: City of Louisville Adulticide Application Data - ULV



Ground Adulticide Applications  
Start Date: 6/1/2017 End Date: 9/30/2017

|                                                                              |           |              |                             |           |            |             |             | Louisville      |
|------------------------------------------------------------------------------|-----------|--------------|-----------------------------|-----------|------------|-------------|-------------|-----------------|
| Month                                                                        | Date      | Municipality | Chemical                    | Mix Ratio | Trip Miles | Spray Miles | Spray Acres | Gallons Sprayed |
| <b>Treatment Area Coal Creek GC/Clubhouse Parking Lot Applications</b>       |           |              |                             |           |            |             |             |                 |
| June 2017                                                                    | 6/14/2017 |              | Aqualuer 20-20<br>(769-985) | 1:3       | 5.0        | 0.2         | 5.7         | 0.1             |
| <i>Total Aqualuer 20-20 Applied:</i>                                         |           |              |                             |           |            |             |             | <i>0.1</i>      |
| <i>Clubhouse Parking Lot Totals:</i>                                         |           |              |                             |           | <i>5.0</i> | <i>0.2</i>  | <i>5.7</i>  | <i>0.1</i>      |
| <b>Treatment Area Coal Creek Trail/Chestnut St to Aspen Way Applications</b> |           |              |                             |           |            |             |             |                 |
| June 2017                                                                    | 6/14/2017 |              | Aqualuer 20-20<br>(769-985) | 1:3       | 3.0        | 0.5         | 19.4        | 0.2             |
| <i>Total Aqualuer 20-20 Applied:</i>                                         |           |              |                             |           |            |             |             | <i>0.2</i>      |
| <i>Chestnut St to Aspen Way Totals:</i>                                      |           |              |                             |           | <i>3.0</i> | <i>0.5</i>  | <i>19.4</i> | <i>0.2</i>      |
| <i>Grand Totals:</i>                                                         |           |              |                             |           | <i>8.0</i> | <i>0.7</i>  | <i>25.1</i> | <i>0.2</i>      |

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## City of Louisville Adulticide Application Data - Barrier



Ground Adulticide Applications  
Start Date: 6/1/2017 End Date: 9/30/2017

Louisville

| Month                                                 | Date      | Municipality | Chemical               | Mix Ratio | Trip Miles | Spray Miles | Spray Acres                       | Gallons Sprayed |
|-------------------------------------------------------|-----------|--------------|------------------------|-----------|------------|-------------|-----------------------------------|-----------------|
| <b>Treatment Area Annette Brand Park Applications</b> |           |              |                        |           |            |             |                                   |                 |
| June 2017                                             | 6/21/2017 |              | Talstar Pro (279-3206) | 1:1       |            |             | 0.1                               | 4.0             |
|                                                       |           |              |                        |           |            |             | <i>Total Talstar Pro Applied:</i> | 4.0             |
| July 2017                                             | 7/19/2017 |              | Talstar Pro (279-3206) | 1:1       |            |             | 0.1                               | 4.0             |
|                                                       |           |              |                        |           |            |             | <i>Total Talstar Pro Applied:</i> | 4.0             |
| August 2017                                           | 8/11/2017 |              | Talstar Pro (279-3206) | 1:1       |            |             | 0.1                               | 4.0             |
|                                                       |           |              |                        |           |            |             | <i>Total Talstar Pro Applied:</i> | 4.0             |
| <i>ne Annette Brand Park Totals:</i>                  |           |              |                        |           |            |             | 0.3                               | 12.0            |
| <b>Treatment Area Coal Creek GC Path Applications</b> |           |              |                        |           |            |             |                                   |                 |
| July 2017                                             | 7/19/2017 |              | Talstar Pro (279-3206) | 1:1       |            |             | 0.2                               | 7.0             |
|                                                       |           |              |                        |           |            |             | <i>Total Talstar Pro Applied:</i> | 7.0             |
| August 2017                                           | 8/18/2017 |              | Talstar Pro (279-3206) | 1:1       |            |             | 0.2                               | 10.0            |
|                                                       |           |              |                        |           |            |             | <i>Total Talstar Pro Applied:</i> | 10.0            |
| <i>ne Coal Creek GC Path Totals:</i>                  |           |              |                        |           |            |             | 0.4                               | 17.0            |
| <b>Treatment Area Coal Creek Trail Applications</b>   |           |              |                        |           |            |             |                                   |                 |
| June 2017                                             | 6/21/2017 |              | Talstar Pro (279-3206) | 1:1       |            |             | 0.1                               | 4.0             |
|                                                       |           |              |                        |           |            |             | <i>Total Talstar Pro Applied:</i> | 4.0             |
| July 2017                                             | 7/12/2017 |              | Talstar Pro (279-3206) | 1:1       |            |             | 0.3                               | 12.0            |
|                                                       | 7/26/2017 |              | Talstar Pro (279-3206) | 1:1       |            |             | 0.3                               | 12.0            |
|                                                       |           |              |                        |           |            |             | <i>Total Talstar Pro Applied:</i> | 24.0            |
| August 2017                                           | 8/18/2017 |              | Talstar Pro (279-3206) | 1:1       |            |             | 0.3                               | 14.0            |
|                                                       |           |              |                        |           |            |             | <i>Total Talstar Pro Applied:</i> | 14.0            |
| <i>Zone Coal Creek Trail Totals:</i>                  |           |              |                        |           |            |             | 1.0                               | 42.0            |
| <i>Grand Totals:</i>                                  |           |              |                        |           |            |             | 1.6                               | 71.0            |

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