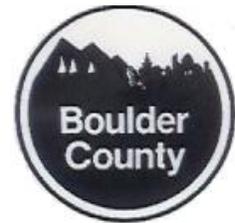


Boulder County Mosquito Control District 2016 Season Report

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SUMMARY

Boulder County Mosquito Control District (BCMCD) and Boulder County Public Health Department (BCPH) contracted OtterTail Environmental, Inc. (OtterTail) to operate an Integrated Mosquito Management (IMM) program to protect public health from the transmission of West Nile Virus (WNV) and other vector-borne diseases, and to suppress local populations of nuisance mosquitoes. On June 26, 2016, OtterTail Environmental's mosquito control assets and operations were acquired by Vector Disease Control International, LLC (VDCI). As such, the operation of the 2016 BCMCD's IMM program prior to June 26 was conducted by OtterTail, while operations conducted after June 26 were conducted by VDCI, with considerable cooperation between both entities throughout the transition.

Through surveillance of potential mosquito breeding sites (larval sites), areas that produced mosquito larvae were identified and treated with control materials known as larvicides. During the 2016 season, 14,181 individual larval site inspections were performed on 1,867 potential sites within the District. Of the sites inspected, 587 were found producing mosquitoes at least once over the course of the season. OtterTail/VDCI conducted 3,026 site treatments covering approximately 634 acres of active mosquito breeding habitat.

Adult mosquito populations and WNV activity were also monitored during the season by using 23 adult mosquito traps placed throughout the project area. Weekly trap collections enabled OtterTail/VDCI to monitor nuisance levels and provide any needed mosquito pools for WNV testing throughout the season. Adult mosquito monitoring also allowed county officials and OtterTail/VDCI to make informed decisions on when and where adult mosquito control should occur.

During the 2016 season, adult control was performed along approximately 446 linear route miles in the BCMCD. OtterTail/VDCI and BCMCD continued to offer a Spray Notification and Shutoff Service as part of the adult control program. During the 2016 season, OtterTail/VDCI received 20 shutoff requests and 28 requests to be notified before spraying. OtterTail/VDCI's shutoff and notification list currently includes 755 households that want to be notified before spraying in their neighborhood and 335 households that have requested spray shutoffs. In 2016, OtterTail/VDCI completed 1,548 notification calls.

The State of Colorado experienced a third consecutive year of relatively low WNV activity in 2016. The climate patterns and temperatures that occurred during the 2016 season caused mosquito populations to remain at average levels throughout the majority of the season; consequently, there was relatively low WNV activity within the region. Boulder County's IMM program coupled with education and personal protection measures, also likely continued to help reduce mosquito populations and WNV activity in the county during 2016.

1.0 INTRODUCTION

Boulder County continued to partner with OtterTail Environmental, Inc. (OtterTail) in 2016 to operate an Integrated Mosquito Management (IMM) program. As explained in the Summary section, VDCI took over the program on June 27, 2016. The county's goals were the same as they were in previous years, which were to protect local residents from the effects of mosquito-borne disease and to suppress the local populations of nuisance mosquitoes.

To accomplish this, specific objectives were established for the program. First, the county wanted to monitor possible mosquito breeding (larval) habitats and treat those sites when mosquito larvae were present. Treatment of these areas with control methods during this stationary larval stage, before mosquitoes become airborne, is the most cost-effective and efficient means to reduce mosquito populations. Secondly, they wanted to monitor adult mosquito populations and use the population numbers as a possible trigger for adult mosquito control to reduce nuisance to the public. The county also wanted to limit the effect on the environment from control materials and be as cost-effective as possible.

This report explains the methods used in the IMM program and provides a detailed summary of the results of this year's effort.

2.0 WEST NILE VIRUS (AND OTHER MOSQUITO-BORNE DISEASE) UPDATE

West Nile is a mosquito-transmitted virus that can cause a wide range of effects, from an asymptomatic infection to a neuroinvasive disease termed West Nile meningitis or encephalitis. West Nile Virus was first detected in the United States during the summer of 1999 in New York City while conducting routine St. Louis Encephalitis (SLE) and Eastern Equine Encephalitis (EEE) surveillance. The virus has since spread across the U.S. and has been confirmed in all continental states. Bird populations act as a reservoir for the virus until a mosquito bites an infected bird. Only then can an infected mosquito pass the virus on to humans, horses and other animals through their bite. While many people who contract WNV experience mild or no symptoms, the more severe cases of West Nile meningitis or encephalitis can result in severe illness and even death.

There are over 50 mosquito species in Colorado, yet only species from the genus *Culex* are known to be effective transmitters of WNV. Mosquitoes and other insects that transmit disease are called vectors; mosquitoes that are not known to transmit a disease are often called nuisance mosquitoes. The most abundant mosquito in Boulder County, *Aedes vexans*, is an aggressive nuisance mosquito. The two primary vector mosquitoes that are most likely to spread WNV in Colorado are *Culex tarsalis* and *Culex pipiens*.

As of October 11, 2016, there were 1,264 WNV human cases and 49 WNV related deaths in 41 states and the District of Columbia (**Table 1**). Colorado ranked fourth in the national case count with 125 human WNV cases and 6 WNV related deaths reported as of October 11th, 2016. Most WNV cases occurred in Colorado within the populous regions of the Front Range (**Table 2**). The Colorado Department of Public Health did not report any mosquito pools, horses, birds or humans as positive for St. Louis Encephalitis or Western Equine Encephalitis during the 2016 season.

As of October 7, 2016 there were 18 WNV related illnesses and no WNV related deaths in Boulder County reported by Colorado Department of Public Health and Environment (CDPHE) (**Table 2**). With

widespread and frequent testing of mosquito pools throughout the county, 21 of the 145 submitted pools of mosquitoes tested WNV positive from Boulder County in 2016.

Adult mosquito surveillance data, submitted mosquito pools, and the resulting WNV infection rates were used by BCPH throughout the season to calculate Vector Index (VI) levels to help city and county 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 higher levels of mosquito prevention and control. With the lower WNV activity in 2016, no widespread emergency spraying was conducted within Boulder County during the season.

The relatively low WNV activity and number of human infections in Colorado may be attributed to the temperature and precipitation patterns observed during the 2016 mosquito season and the affect they had on mosquito populations, as discussed further in **Section 3.0**.

Table 1 West Nile Virus Incidence, 2002 - 2016

Total WNV Human Cases	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Cases in the United States ¹	4,156	9,862	2,539	3,000	4,269	3,630	1,356	720	1,021	712	5,674	2,469	2,205	1,028	1,264
Deaths in the United States ¹	284	264	100	119	177	124	44	32	57	43	286	119	97	54	49
Highest State Count in United States ¹	884	2,947	779	880	996	578	445	115	167	158	1,868	379	801	201	195
Cases in Colorado ¹	13	2,947	291	106	345	578	71	103	81	7	131	317	118	88	125
Deaths in Colorado ¹	0	66	4	2	7	7	1	3	4	0	5	7	3	2	6
Cases in Boulder County ²	0	421	14	5	74	95	18	12	6	2	1	51	10	11	18
Deaths in Boulder County ²	0	7	0	0	1	2	0	0	0	0	0	1	0	0	*
Total WNV Positive Results	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mosquito Pools in Boulder County ²	0	118	8	0	107	55	3	4	1	9	8	69	16	10	21
Birds in Boulder County ²	5	50	0	1	12	2	0	0	1	0	0	0	0	0	1
Horses in Boulder County ²	3	18	0	0	1	0	0	0	0	0	0	0	0	1	0

1. Reported by the Center for Disease and Control (CDC); 2016 data reported as of October 11, 2016.

2. Reported by the Colorado Department of Public Health and Environment (CDPHE); 2016 data reported as of October 7, 2016.

* = data was not available from CDPHE at time of report.

There were no confirmed WNV related deaths in Boulder County and the number of Boulder County cases and WNV positive mosquito pools comprised approximately 15 percent and 10 percent of the state totals, respectively (**Table 2**). When populations of nearby Front Range Counties are taken into account, Boulder County had the fourth highest crude attack rate (cases per 100,000 individuals) in the region (**Table 3**). The relatively low number of human WNV cases and WNV positive mosquito pools suggests that the viral activity in Boulder County was significantly less in 2016 than during previous years with epidemic outbreaks. It is likely that the continued widespread mosquito control efforts to reduce mosquito populations, coupled with public education and personal protection measures, helped reduce the exposure and disease transmission within Boulder County.

Table 2

Colorado WNV Human Cases and WNV Positive Mosquito Pools, 2016

County	Human Cases ¹		Positive Mosquito Pools ²	
	Number	% of State	Number	% of State
Adams	11	8.9%	12	5.8%
Alamosa	0	0.0%	0	0.0%
Arapahoe	7	5.7%	3	1.4%
Bent	2	1.6%	0	0.0%
Boulder	18	14.6%	21	10.1%
Broomfield	5	4.1%	0	0.0%
Costilla	0	0.0%	0	0.0%
Crowley	0	0.0%	0	0.0%
Delta	0	0.0%	2	1.0%
Denver	6	4.9%	7	3.4%
Douglas	1	0.8%	0	0.0%
El Paso	1	0.8%	0	0.0%
Freemont	0	0.0%	0	0.0%
Gunnison	1	0.8%	0	0.0%
Huerfano	1	0.8%	0	0.0%
Jefferson	2	1.6%	0	0.0%
La Plata	1	0.8%	3	1.4%
Larimer	31	25.2%	106	51.2%
Logan	3	2.4%	0	0.0%
Mesa	0	0.0%	1	0.5%
Morgan	1	0.8%	0	0.0%
Otero	3	2.4%	0	0.0%
Pueblo	1	0.8%	2	1.0%
Rio Blanco	1	0.8%	0	0.0%
Rio Grande	0	0.0%	0	0.0%
Sedwick	3	2.4%	0	0.0%
Washington	0	0.0%	0	0.0%
Weld	24	19.5%	50	24.2%
Colorado Totals	123		207	

1. Reported by CDPHE as of October 7, 2016

2. Reported by CDPHE as of August 31, 2016

Table 3 Human WNV Crude Attack Rates¹ of Front Range Counties, 2016

County	Population	# of WNV Cases	% of Front Range Cases by # of Cases	2016 Crude Attack Rates (per 100,000)	% of Front Range Cases by Population	Crude Attack Rank
Adams	441,603	11	10.3%	2.49	6.1%	5
Arapahoe	572,003	7	6.5%	1.22	3.0%	6
Boulder	294,567	18	16.8%	6.11	14.9%	4
Broomfield	55,889	5	4.7%	8.95	21.8%	3
Denver	600,158	6	5.6%	1.00	2.4%	7
Douglas	285,465	1	0.9%	0.35	0.9%	10
El Paso	622,263	1	0.9%	0.16	0.4%	11
Jefferson	534,543	2	1.9%	0.37	0.9%	9
Larimer	299,630	31	29.0%	10.35	25.2%	1
Pueblo	159,063	1	0.9%	0.63	1.5%	8
Weld	252,825	24	22.4%	9.49	23.1%	2

* WNV human case information used for Crude Attack Rate calculations was obtained from CDPHE (CDPHE 2016); Population information for Crude Attack Rate calculations was obtained from U.S. Census Bureau's 2010 Census of Population (USCB 2011); Crude Attack Rates are listed as cases per 100,000 people.

3.0 REGIONAL 2016 CLIMATOLOGICAL DATA AND MOSQUITO ACTIVITY OVERVIEW

The weather patterns leading into and during the mosquito season (April – September) are important factors that influence mosquito abundance and WNV activity. The following section describes the regional climate, weather during the season, and how that may have affected the mosquito populations.

Boulder County is located in a semi-arid environment with elevations in the project area ranging from approximately 4,900 feet to 5,500 feet. The typical mosquito season for the Boulder County area is from April to September. Current and historical climate data from the National Oceanic Atmospheric Administration's (NOAA) Boulder, Colorado weather station was used for regional temperature and precipitation patterns.

Historical records for the mean monthly temperature at the station suggest that temperatures usually have a steady increase from April to July, making July, on average, the hottest month of the year. Typically there is then a steady temperature decrease into September. In 2016, every month of the mosquito season except May and August had temperatures above normal. The month of May experienced the highest variation from normal during the summer with a monthly mean temperature approximately 3.5 degrees below normal (**Figure 1**).

The historical averages for the monthly mean precipitation indicate that April, May and June are usually the wettest months of the year (**Figure 2**). During 2016, the accumulated precipitation from January through September was slightly lower than the historical average for the same period. During this time period in 2016, there was an accumulation of 15.49 inches. This is approximately 1.5 percent less than the normal amount of accumulation when compared to the historical average, which is 15.72 inches. Four of the nine months received precipitation amounts higher than their normal averages. The most significant variations during the mosquito season were the months of March and September. March received approximately 2.25 times more precipitation than average, making it wettest month of 2016, while September received approximately twenty-six percent of its normal precipitation, making it the driest month of the mosquito season in 2016 (NOAA 2016).

Temperatures and precipitation amounts varied throughout the 2016 mosquito season. A drier and cooler than average month of May was followed by a wetter and slightly warmer than average June. The month of July was then drier and warmer than average. These overall temperatures during the first half of the 2016 mosquito season likely caused mosquito larvae to develop at a much faster rate. August and September were then much drier than average, causing many of the sites to quickly dry up during the second half of the season. These climate patterns were the likely causes of the slightly elevated abundance of Culex mosquitoes experienced throughout much the of the 2016 mosquito season.

Figure 1 2016 Monthly Mean Air Temperature and Historical Averages

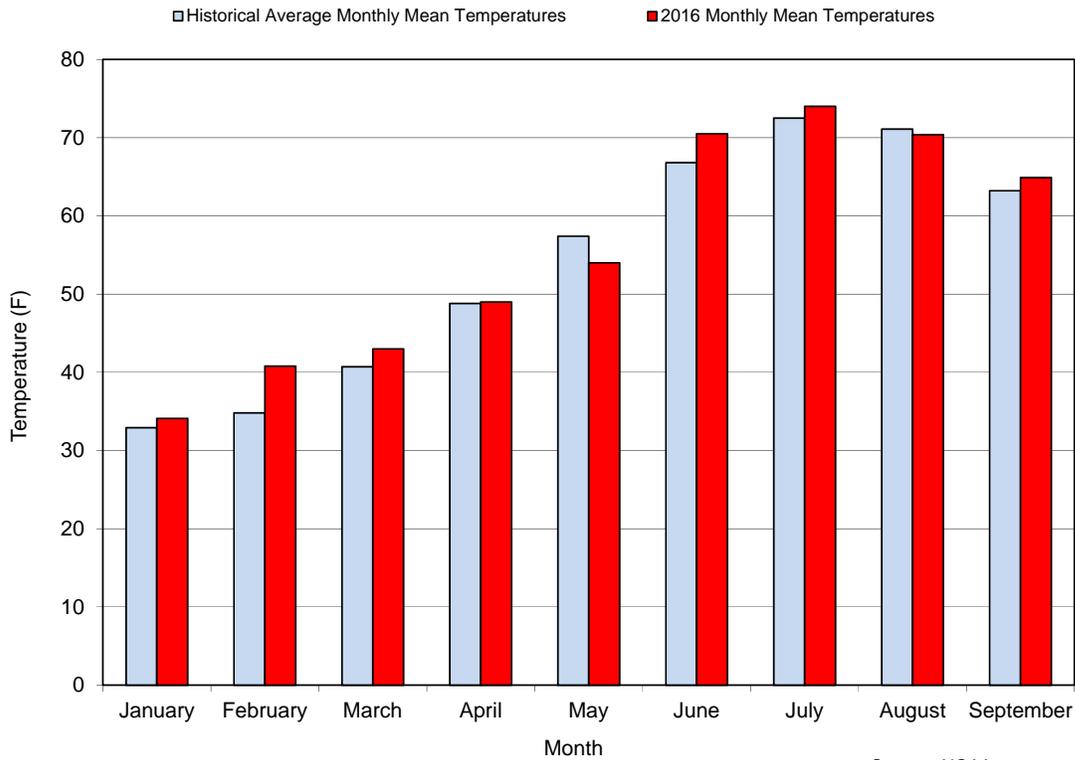
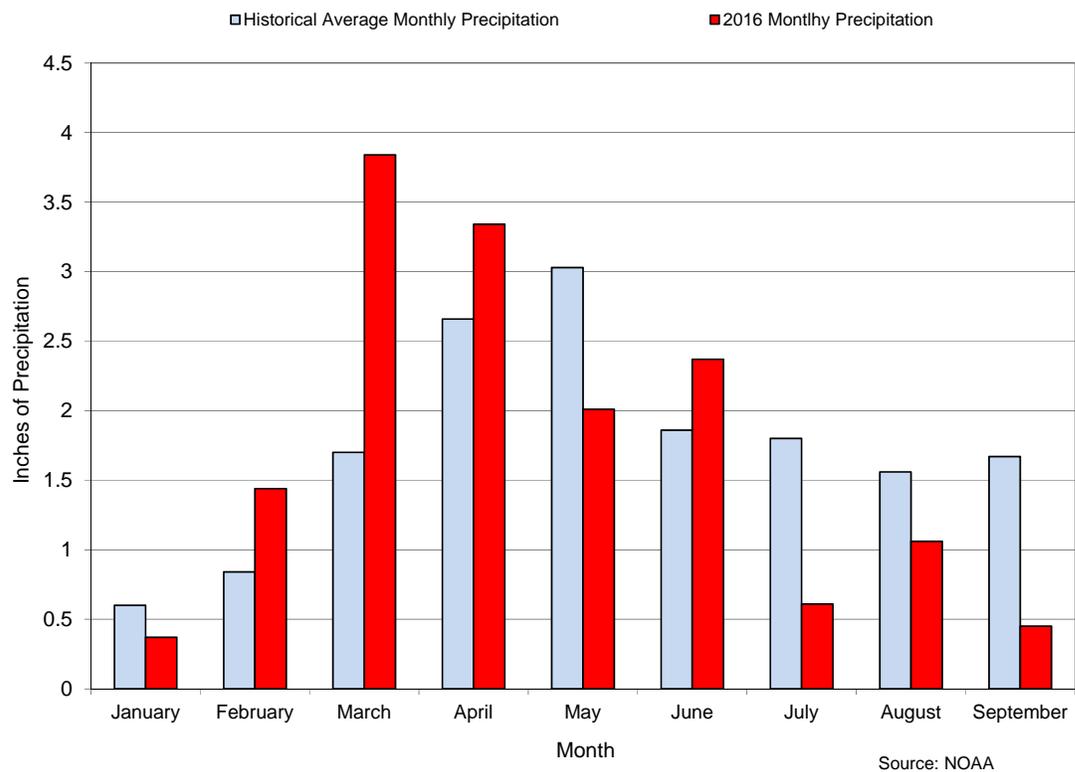


Figure 2 2016 Monthly Total Precipitation Data and Historical Averages



4.0 LARVAL MOSQUITO SURVEILLANCE AND CONTROL

LARVAL SURVEILLANCE METHODOLOGY

To inspect a mosquito source, a plastic dipper cup with a 3-foot wooden handle was used to collect water from the site. Each sample (dip) was closely examined for mosquito larvae presence. Many of the sites inspected had mosquito-sustaining habitat around the perimeter of the site, but the middle remained mosquito free due to water circulation and/or natural predators. At these sites, the dipping effort was completed using a *linear approach* (walking around the perimeter and sampling the margins).

In sites with widespread mosquito habitat, the entire site was methodically sampled using the *surface area approach*. With this approach, sites were dipped approximately every 10 to 20 square feet. Since each site's characteristics could vary as the season progressed (e.g., become drier, wetter, increased vegetation), there were changes made during the field season to adjust the appropriate number of dips.

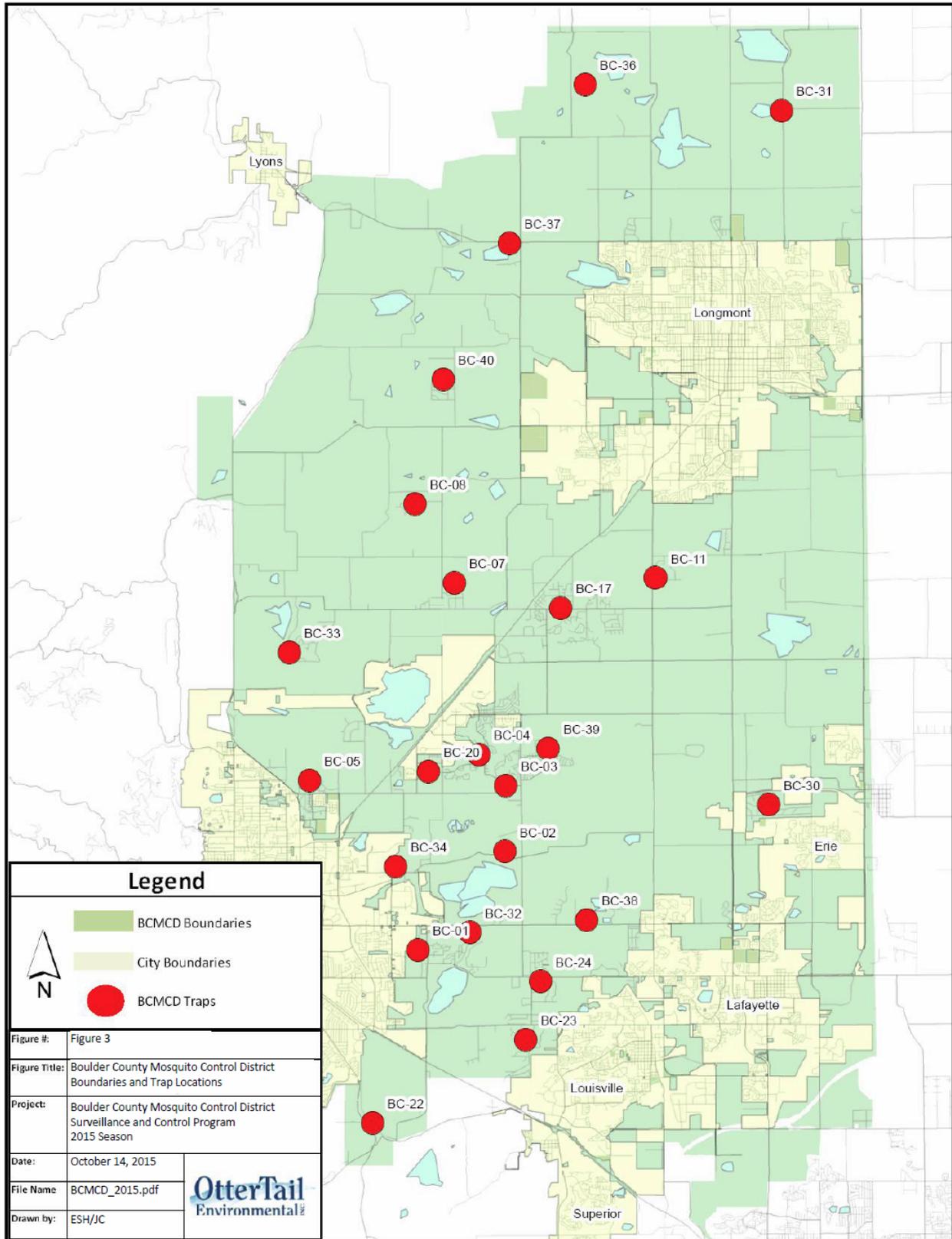


OtterTail staff began the season in April by performing surveillance and control on habitats within the District that have historically been found to be breeding mosquitoes early in the season. This effort increased gradually during the season to a full crew by the beginning of June when several of the sites were producing larvae. Many of the habitats were those with stagnant water high in nutrients and organic matter including: cattail marshes, non-flowing drainage ditches, small stagnant ponds, and temporary pools. Larval habitat sites were routinely inspected throughout the season based on their production potential. Depending on the time of the season, sites found to have a high production potential were generally inspected every 5-10 days. During the height of the mosquito season (late June to mid-August), OtterTail/VDCI re-inspected many of the sites that were found actively producing within 5 days to ensure efficient control. If potential sites were not found to be producing mosquitoes during this time, they were

generally re-inspected in 7-10 days, depending on the site's breeding potential. Habitat sites continued to be added and refined throughout the field season as needed.

When larval mosquito habitat was observed on private property, efforts were made to gain permission to access the land for surveillance and treatment. As directed by the county, OtterTail/VDCI only accessed private property if permission was granted by the owner.

Figure 3 2016 BCMCD Boundaries and Trap Locations



LARVAL CONTROL METHODOLOGY

The primary focus for OtterTail/VDCI's IMM program is to control mosquitoes while they are in the larval stage. Larval mosquito control methods employed by OtterTail/VDCI were aimed at preventing adult mosquito emergence, which reduces the potential of the mosquito-borne disease, WNV, and minimizes the annoyance level of mosquitoes to local residents. To achieve a high level of effectiveness and efficiency of larval control efforts, OtterTail/VDCI identified and inspected mosquito larval habitats on a regular basis. The threshold for larval control was presence of any mosquito larvae. Finding and documenting consistent mosquito-producing sites was an important component of the program because it created a pattern that is monitored and systematically controlled to help understand mosquito populations and WNV trends. Being environmentally sensitive, Boulder County and OtterTail/VDCI believe in concentrating on larval control to reduce the need for adult mosquito control spraying.



The application of *Bacillus thuringiensis israelensis* (*Bti*), *Bacillus sphaericus* (*Bs*) and BVA-2 mosquito larvicide oil (BVA-2) were the primary methods used for larval mosquito control. Control materials were applied within the labeled rates, thereby minimizing any potential adverse impacts to areas being treated. Routine post-treatment checks were conducted to ensure the larval control was effective. If any larvae were found during the post-check, a second application was conducted.

In balancing environmental resources, cost effectiveness, and public health needs, *Bti* was selected as the primary treatment product. *Bti* is a naturally occurring protein that is toxic to mosquito larvae upon its ingestion. It provides a residual treatment that lasts for approximately two days. Since new mosquito larvae may hatch after the product dissipates, the sites must be inspected for mosquito larvae every one to two weeks. The presence of mosquito larvae between monitoring periods has the added benefit of allowing these larvae to continue to be part of the aquatic food web. However, larvae are eliminated before they can emerge as adults. This helps protect the public from potential WNV transmission, while still providing a food source for many aquatic animals.

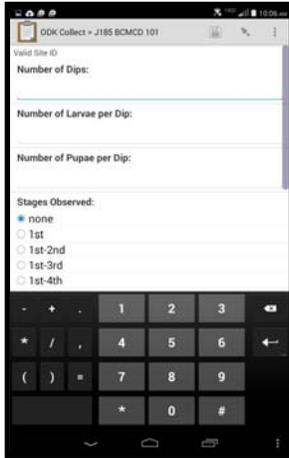
Bacillus sphaericus is a larvicide very similar to *Bti*, but has a longer residual time. The protein in *Bs* products is able to provide continuous treatment of mosquito larvae for up to four weeks and was typically used on sites found to be continuously producing mosquitoes. Although the longer residual time of *Bs* allows for fewer site checks and cost savings in labor and travel, it is only practical in certain situations because it costs substantially more than *Bti*.

Bti and *Bs* are the primary control materials used but they are ineffective if pupae are found at a site. Mosquitoes do not feed during their pupal stage; therefore, the use of *Bti* and *Bs* is ineffective against mosquito pupae since they must ingest the proteins. In these instances of pupae occurrence, BVA-2 is used. BVA-2 is a highly refined mineral oil that creates a thin film on the water surface. The film interrupts the air and water interface during the mosquito's larval and pupal development stages, causing them to drown.

OtterTail/VDCI also used the predatory fathead minnow (*Pimephales promelas*) in limited habitats to serve as a biological control for mosquito larvae. Fathead minnows are a native fish species in Colorado that regularly feed off of surface dwelling aquatic organisms, including mosquito larvae. OtterTail/VDCI provided minnows to residents that had "closed system" habitats such as ornamental ponds or small farm ponds that were isolated from streams or other areas where the fish could not spread out indiscriminately.

LARVAL DATABASE MANAGEMENT

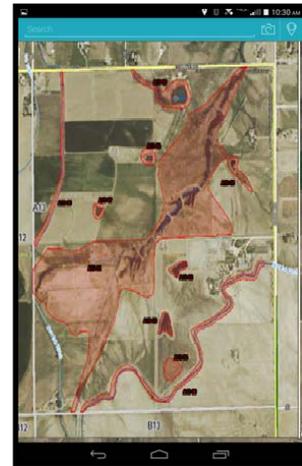
In an effort to improve the larval surveillance and control program, and the efficiency of field operations, OtterTail replaced the previously used handheld Personal Digital Assistants (PDA's) with Android Tablets in 2015. The PDA's had been used during the 2010-2014 seasons, but their use was discontinued prior to the 2015 field season due to advances in mobile applications and cloud data storage technology. Tablets were again used in 2016.



The tablet-based larval surveillance collection and management system was designed in-house by OtterTail's computer database specialist and staff mosquito specialists. The tablets utilize and integrate several mobile and web applications to provide both the managers in the office and the technicians in the field with the resources needed to provide spatially accurate data for mosquito larvae habitat inspections and pesticide applications. The tablet resources include data recording forms, digital maps, web mapping and navigational aids, and access to site specific informational databases. This helps ensure that larval inspections and treatments are being conducted at the correct locations, while also improving the program's surveillance efficiency.

The tablets allow for site inspection and treatment data to be entered in the field at each site location. The data entry form guides the field technician through a step-by-step site-protocol using a series of menus requiring the technician to fill out each section before allowing the entry to be completed. This aids in a more consistent and accurate dataset by minimizing potential data-entry errors. In addition to typical site data that is recorded during a site visit, the tablets utilize Global Positioning System (GPS) technology to include date/time stamp and GPS coordinates for each recorded entry.

The information recorded on each tablet is immediately sent to OtterTail's cloud database. This instant upload of data directly from the tablet into the cloud eliminates the need for the manual electronic data transfer process and provides near real-time data to be available to managers and customer support staff. Although data entry errors can still occur when entering information into the tablets in the field, the new system has significantly increased efficiency in the data transfer process, and allows for immediate review of surveillance and control data.



LARVAL RESULTS AND DISCUSSION

The 2016 larval surveillance season started in April and continued through September. During the season, a total of 14,181 individual larval site inspections were performed on 1,867 sites within the District. Of the sites inspected, 587 sites were found producing mosquitoes at least once over the course of the season. Approximately 4,662 lbs of *Bti*, 30 lbs of *Bs*, and 73.7 gallons of BVA 2 Oil were used to treat approximately 634 acres of actively producing larval habitat. In addition to the control products used, OtterTail/VDCI also distributed approximately 1,900 fathead minnows to District residents for private larval control (Tables 4 and 5).

Table 4 Larval Surveillance and Control Summary, 2009 - 2016

Habitat Site Surveillance & Control	OtterTail Contract								2008	Historical Average	Historical Range
	2016	2015	2014	2013	2012	2011	2010	2009			
Site Inspections ¹	14,181	15,193	17,331	17,542	20,622	19,661	20,395	15,931	5,470	6,836	5,470 - 8,546
Total # Sites Wet ²	10,164	11,649	14,418	12,824	13,289	14,189	13,632	11,711	3,958	4,875	3,958 - 6,123
% of Sites Wet ²	72%	77%	83%	73%	64%	72%	67%	74%	72%	75%	72% - 80%
Site Treatments ¹	3,026	3,051	4,026	3,751	2,872	3,189	2,702	3,273	1,386	2,075	1,386 - 2,637
% Sites Treated ²	30%	26%	28%	29%	22%	22%	20%	28%	35%	37%	35% - 41%
Amount of Acres Treated ¹	634	776	2,056	2,693	1,515	2,341	1,225	1,265	1,128	1,554	1,113 - 2,470

Notes: 1. Historical avg. and range based on 2004 - 2008 BCPH provided data; 2. Historical avg. and range based on 2006 - 2008 BCPH provided data

Table 5 Larval Control Types and Amounts Used, 2009 - 2016

Control Type	2016	2015	2014	2013	2012	2011	2010	2009
AGNIQUE® MMF	N/A	N/A	1.9 gal	13.9 gal	7.5 gal	29.6 gal	22.5 gal	10.6 gal
<i>Bacillus thuringiensis israelensis</i>	4,662 lbs	5,117 lbs	13,477 lbs	16,204 lbs	9,657 lbs	13,696 lbs	7,726 lbs	5,350 lbs
<i>Bacillus sphaericus</i>	30 lbs	25 lbs	135 lbs	203 lbs	20 lbs	498 lbs	353 lbs	792 lbs
Fathead Minnows	1,900 fish	3,900 fish	1,100 fish	1,200 fish	1,200 fish	1,000 fish	1,200 fish	3,000 fish
Methoprene	N/A	N/A	N/A	N/A	6.6 lbs	22 lbs	2.9 lbs	1.4 lbs
BVA 2 Oil	73.7 gal	157 gal	123.6 gal	1.8 gal	N/A	N/A	N/A	N/A

Many of the habitat sites produced mosquito larvae multiple times during the season causing the treated acres at certain sites to be counted multiple times for the season total. As the season progressed, the sites were categorized according to larval abundance and occurrence. Low priority mosquito sites which were not producing mosquitoes had poor habitat or had the presence of aquatic predators. High priority mosquito sites typically had larvae when sampled and consistently produced mosquitoes every seven to ten days during the peak season.

As discussed in the **Boulder County Mosquito Control District 2009 Season Report**, OtterTail staff expended approximately 1,085 labor hours during its 2009 preseason mapping operations that were beyond the required scope of work for the project. This large expenditure of time and resources, along with the continual process of locating and adding additional habitat sites throughout the 2009-2016 seasons, has allowed OtterTail/VDCI to add 730 new unique potential larval habitat sites to the District over the eight year contract period. Despite our intensive mapping effort of 2009, adding 526 sites, OtterTail/VDCI was still able to add another 204 sites between the 2010-2016 seasons. The new sites added to the program far exceeded the BCMCD's goal of a 10 percent annual increase of the contract (Table 6).

Table 6 Results of OtterTail’s Mapping Effort to Find New Larval Breeding Sites, 2009 - 2016

	2016 New Sites ³ Added		2015 New Sites ³ Added		2014 New Sites ³ Added		2013 New Sites ³ Added		2012 New Sites ³ Added		2011 New Sites ³ Added		2010 New Sites ³ Added		2009 New Sites ³ Added		Existing Sites (2008)	Contract Goal Per Year ⁴	
	#Sites	% Increase		#Sites	% Increase														
Total Sites	18	2%	36	3%	34	3%	31	3%	18	2%	13	1%	54	5%	526	49%	1,072	107	10%
Preseason Site Mapping Effort ¹	4	---	3	---	---	---	---	---	---	---	---	---	---	---	457	43%	---	---	---
In-Season Site Mapping Effort ²	14	1%	33	3%	34	3%	31	3%	18	2%	13	1%	54	5%	69	6%	---	---	---
In Season Sites Added by Hotline Calls	8	1%	17	2%	17	2%	13	1%	6	1%	4	0.4%	16	1%	20	2%	---	---	---
In Season Sites added by Field Techs	6	1%	16	1%	17	2%	18	2%	12	1%	9	1%	38	4%	49	5%	---	---	---

Notes:

1. Preseason mapping is defined as an out-of-scope mapping effort that was conducted by full time staff, biologists with multiple years experience in mosquito surveillance and control. Because it was prior to the primary breeding season, they could focus on mapping rather than just during surveillance and control duties as is the standard procedure.
2. In-season mapping effort is defined as the more typical way sites are mapped. This consisted of seasonal field technicians finding new sites while they were out conducting their routine surveillance and control, or by resident calls alerting OtterTail of a possible new site.
3. New site is defined as unique site location completely separate from an existing 2008 site. Only sites that were considered probable mosquito breeding habitat were added as a "new site". The preseason mapping was conducted by experienced staff, because they could readily distinguish between areas worthy of being
4. Contract goal was a 10 percent site increase per year (or 107 sites).

To ensure a comprehensive IMM program, OtterTail/VDCI continued to maintain a toll-free telephone hotline for residents to report areas of concern. Calls received from the hotline resulted in 101 new potential mosquito producing sites being added to the program during the 2009-2016 seasons (Table 6).

5.0 ADULT MOSQUITO SURVEILLANCE AND CONTROL

ADULT SURVEILLANCE METHODOLOGY

Adult mosquito population surveillance is a crucial component of any successful IMM program. Adult surveillance provides information on what types of mosquito species are in an area as well as information on their abundance. Mosquitoes collected in the traps can be tested for a variety of mosquito-borne diseases and are critical for monitoring and forecasting vector threats, particularly WNV.

Most mosquito species prefer to rest during the heat of the day in areas known as harborage areas. A mosquito harborage area is usually a shaded, wind protected and moist area because adult mosquitoes can dehydrate quickly during the daylight hours if they do not have a shady area to rest and escape the heat. Relevant examples are groves of trees with a layer of shrubby undergrowth, dense bushes, tall live grasses, or in residential areas under roof eaves and inside tires. Adult mosquito trapping efforts target these harborage areas to monitor adult mosquito populations.

OtterTail/VDCI used the CDC style carbon dioxide (CO₂) baited light trap to monitor the adult mosquito populations within the District. The CO₂ baited light trap is based on the principle that most adult mosquitoes are attracted to light, CO₂ (via respiration), and heat. The CO₂ baited light trap collects adult female mosquitoes that are seeking a blood meal, so that she may produce eggs. This type of trap is set overnight and, on the following morning, the nets are collected and returned to OtterTail’s laboratory to be identified and counted. Once identified, the mosquitoes were sorted by species and the data were provided to BCPH. A detailed explanation of the trap used during the season can be found in **Appendix A**. Adult mosquito traps were placed and monitored at 23 sites around the county from the first week in June through the second week in September. Traps were set in areas of suitable harborage for adult mosquitoes and were set in the same locations used during previous years of the program (see **Figure 3**).

Boulder County Public Health submits vector mosquitoes collected throughout the county to CDPHE for WNV testing on a weekly basis during each mosquito season. As discussed in **Section 2.0**, the adult mosquito data, submitted mosquito pools, and the resulting WNV infection rates are used by BCPH throughout the season to calculate Vector Index levels to help city and county officials determine local areas of concern for public awareness and safety.

ADULT SURVEILLANCE RESULTS AND DISCUSSION

Over the season, from all 23 traps, there was an average of 72 total adult mosquitoes per trap per night and an average of 29 adult vector mosquitoes per trap per night. The total adult mosquitoes collected during the season resulted in *Aedes/Ochlerotatus* species being the most abundant (56 percent), followed by *Culex* /vector species (40 percent), *Coquillettidia* species (2 percent) and *Culiseta* species (2 percent); (**Table 7**). This results in approximately 60 percent non-vector vs. 40 percent vector adults being collected over the entire season.

As described in **Section 3**, Colorado experienced climate patterns that led to the relatively low mosquito populations during the 2016 season (**Figures 4 - 7**). Temperatures and precipitation amounts varied throughout the 2016 mosquito season. A drier and cooler than average month of May was followed by a wetter and slightly warmer than average June. The month of July was then drier and warmer than average. These overall temperatures during the first half of the 2016 mosquito season likely caused mosquito larvae to develop at a much faster rate. August and September were then much drier than average, causing many of the sites to quickly dry up during the second half of the season. These climate patterns were the likely causes of the below average abundance of nuisance mosquitoes and above average abundances of *Culex* mosquitoes throughout much of the 2016 mosquito season. Detailed seasonal information (including weekly populations and species compositions) for each individual trap can be found in **Appendix B**.

Figure 4 Season-Wide Weekly Adult Trap Counts of All Trap Stations, 2016

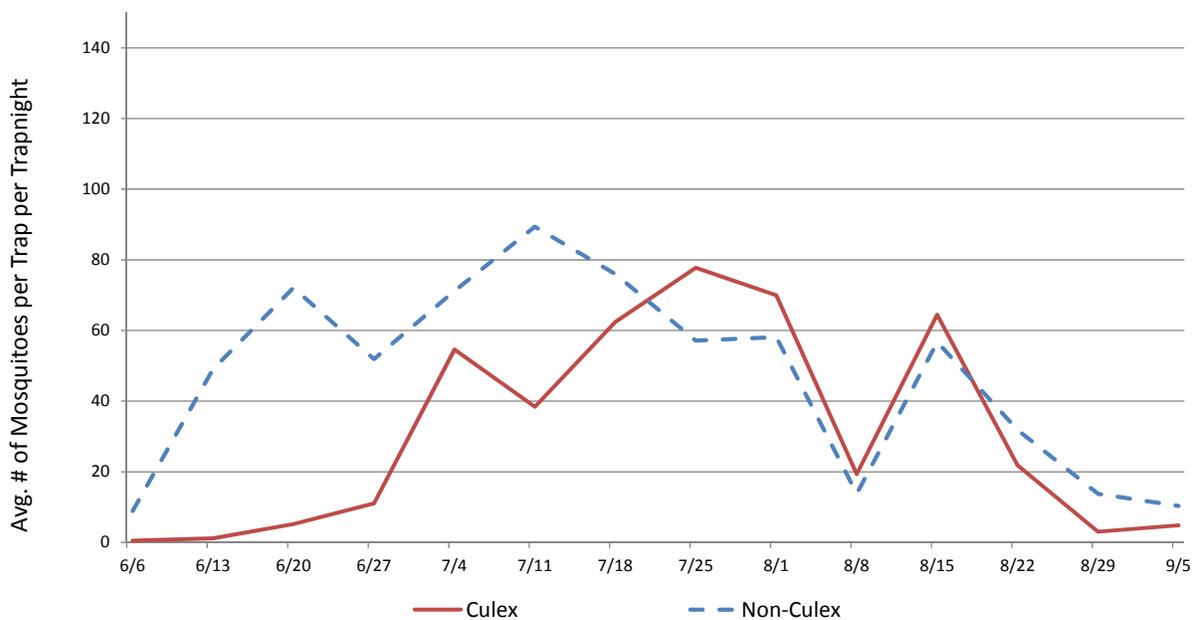


Figure 5 Average Numbers of Non-Culex Mosquitoes, 2016 and 2009 - 2015 Average

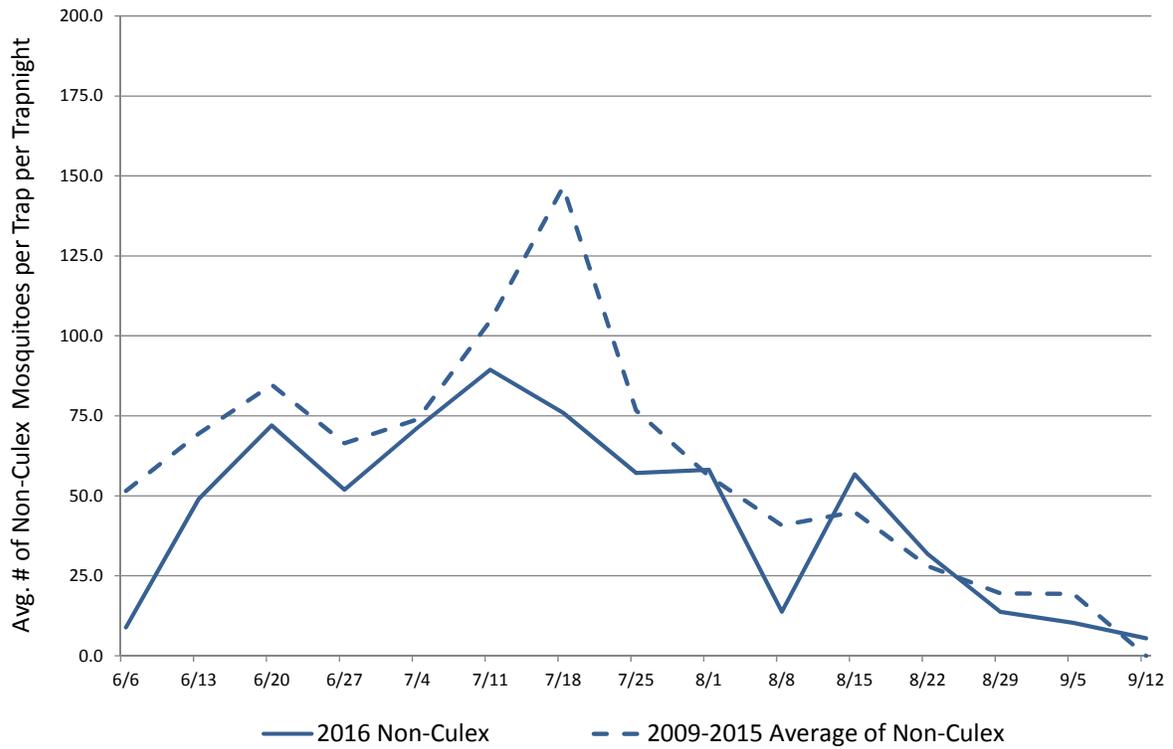


Figure 6 Average Numbers of Culex Mosquitoes, 2016 and 2009 - 2015 Average

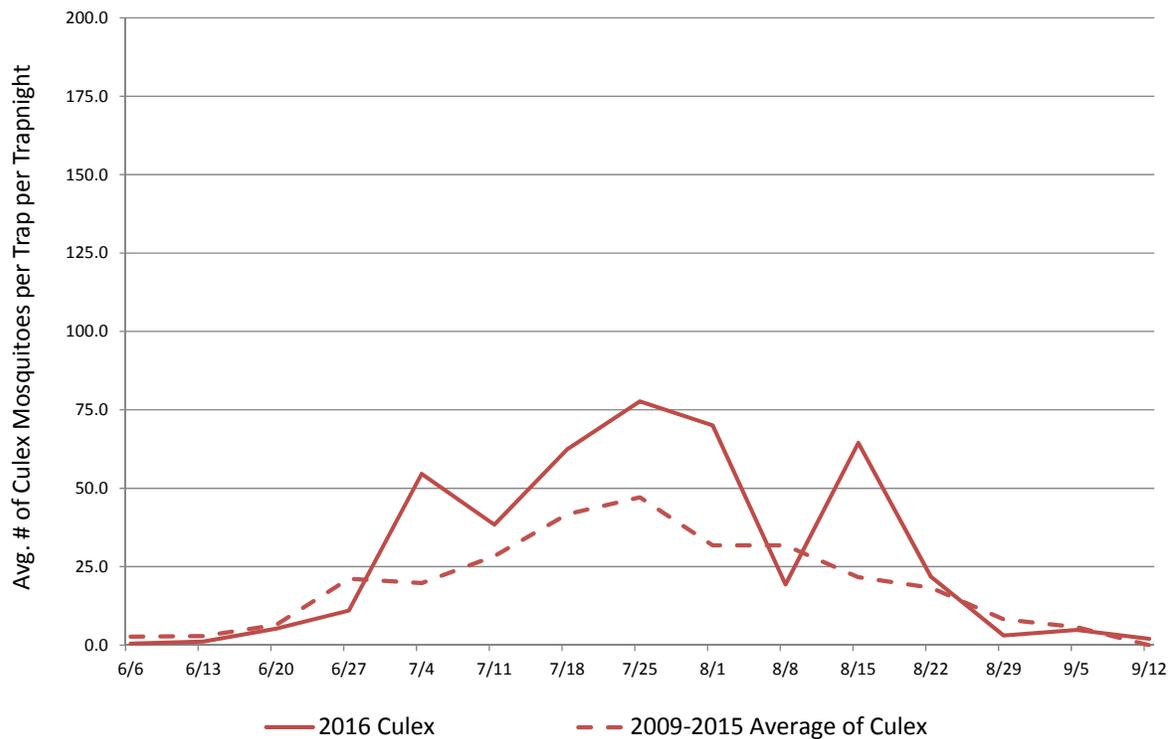
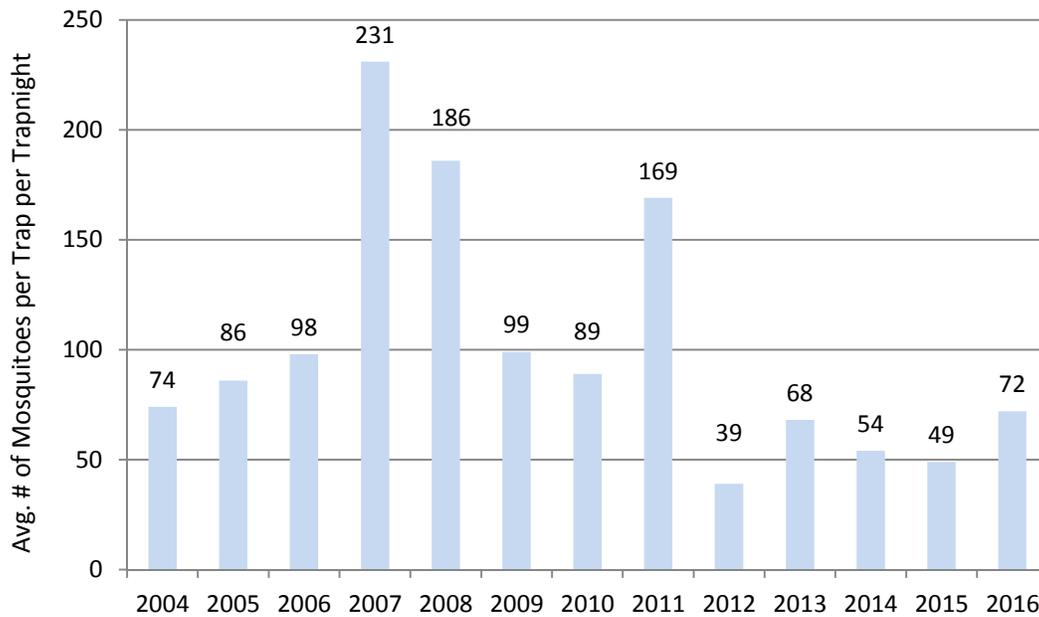


Figure 7 Average Numbers of Mosquitoes, 2004 - 2016*



*Note: 2004 - 2008 data provided by BCPH

Table 7 Total Number of Adult Mosquitoes per Trap for the 2016 Season¹

Trap Name and Location	Culex spp.		Ae./Oc. Spp.		Anopheles spp.		Coquillettidia spp.		Culiseta spp.		Trap Total	Avg. Per Trapnight	Trap %RA	Historical Avg. Per Trap Night	Range of Historical Trap Nights
	#	%RA	#	%RA	#	%RA	#	%RA	#	%RA					
BC-01 ² Old Tale Road	331	52.3	250	39.5	0	0.0%	15	2.4	37	5.8	633	42	2.5	82	23 - 314
BC-02 ² Cottonwood Kennels	676	31.3	1,408	65.2	0	0.0%	19	0.9	58	2.7	2,161	144	8.7	361	56 - 1,018
BC-03 ² Gunbarrel SE-Pali	578	46.7	621	50.2	1	0.1%	15	1.2	23	1.9	1,238	83	5.0	107	39 - 257
BC-04 ² Gunbarrel NW-Igwyild	836	47.4	732	41.5	1	0.1%	169	9.6	25	1.4	1,763	118	7.1	143	42 - 295
BC-05 ² Orange Orchard	257	40.7	352	55.8	0	0.0%	2	0.3	20	3.2	631	42	2.5	103	14 - 271
BC-07 ² Brigadoon Glen	178	16.6	892	83.2	0	0.0%	0	0.0	2	0.2	1,072	71	4.3	121	17 - 327
BC-08 ² Boulder Hills	570	30.1	1,296	68.4	0	0.0%	4	0.2	25	1.3	1,895	126	7.6	151	56 - 448
BC-11 ² Niwot East - Majestic	702	54.8	574	44.8	0	0.0%	2	0.2	4	0.3	1,282	92	5.1	94	25 - 255
BC-17 ² Niwot Central	211	25.5	606	73.3	0	0.0%	0	0.0	10	1.2	827	59	3.3	43	10 - 94
BC-20 ² Willows	402	45.6	448	50.9	0	0.0%	13	1.5	18	2.0	881	59	3.5	88	31 - 194
BC-22 ² Marshall / S.Boulder Creek	102	18.5	220	39.9	0	0.0%	183	33.2	47	8.5	552	37	2.2	134	41 - 422
BC-23 ² Louisville Spanish Hills	241	88.6	24	8.8	2	0.7%	1	0.4	4	1.5	272	18	1.1	32	8 - 63
BC-24 ² Louisville Wewonka Dr.	103	95.4	5	4.6	0	0.0%	0	0.0	0	0.0	108	8	0.4	17	3 - 37
BC-30 ³ Erie/Brownsville Random Ct.	179	32.5	360	65.3	0	0.0%	0	0.0	12	2.2	551	37	2.2	60	22 - 124
BC-31 ³ Divide Reservoir	175	25.3	512	74.1	0	0.0%	1	0.1	3	0.4	691	46	2.8	155	58 - 403
BC-32 ³ Baseline Heights	126	40.5	182	58.5	0	0.0%	1	0.3	2	0.6	311	22	1.2	106	18 - 269
BC-33 ⁴ Lake Valley Estates	164	38.8	251	59.3	0	0.0%	3	0.7	5	1.2	423	28	1.7	76	17 - 238
BC-34 ⁴ Cline Trout Farm	139	20.1	493	71.2	0	0.0%	45	6.5	15	2.2	692	46	2.8	226	90 - 452
BC-36 ⁴ Yellowstone Road	155	22.2	458	65.5	0	0.0%	6	0.9	80	11.4	699	47	2.8	109	39 - 326
BC-37 ⁴ Burch Reservoir	454	29.1	1,059	67.9	1	0.1%	6	0.4	39	2.5	1,559	104	6.2	120	61 - 259
BC-38 ⁴ Willow Glen Teller Lake	2,277	43.6	2,894	55.5	0	0.0%	2	0.0	46	0.9	5,219	348	20.9	188	33 - 575
BC-39 ⁵ Heatherwood	1,001	91.2	92	8.4	0	0.0%	0	0.0	5	0.5	1,098	84	4.4	69	32 - 155
BC-40 ⁵ Chance Acres	134	32.4	271	65.5	1	0.2%	1	0.2	7	1.7	414	28	1.7	43	11 - 108
Total	9,991	40.0	14,000	56.1	6	0.0%	488	2.0	487	2.0	24,972	1,665	100.0	2,628	---
Average	434	---	609	---	0	---	21	---	21	---	1,086	72	---	114	---

Notes: 1. 2016 season includes one trap night per week from June 6 to September 12, 2016 for a total of 338 trap nights; 2. Historical avg.per trapnight and range based on 2004-2015 BCPH data; 3. Historical avg. per trapnight and range based on 2005-2015 BCPH data; 4. Historical avg.per trapnight and range based on 2006-2015 BCPH data; 5. Historical avg.per trapnight and range based on 2009-2015 BCPH data due to new trap locations beginning in 2009; %RA= Percent Relative Abundance; Ae./Oc. = Aedes/Ochlerotatus

ADULT CONTROL METHODOLOGY

The overwhelming majority of the program's efforts are focused on larval control (see **Appendix D**), but many IMM programs still include ultra-low volume (ULV) adult control to enhance control options. Although every effort is made to identify and control all mosquito larval habitats within the District, it is possible that additional mosquito habitats occur in inaccessible lands and locations outside of the project area. Mosquitoes originating from these uncontrolled habitats can migrate into the project area, causing adult populations to exceed local annoyance levels, increase the populations in excess of the BCMCD's threshold level, increase the potential WNV risk, and trigger the need for adult control. OtterTail/VDCI and BCMCD made adult control decisions based on a combination of the weekly trap counts, residential complaints, and WNV activity levels. When trap populations were high and there was a correspondingly high number of residential complaints, OtterTail/VDCI would then perform adult control in those areas of the county with the increased mosquito activity.

OtterTail/VDCI's philosophy with adult control applications is to provide effective control of adult mosquito populations and minimize potential impacts to the public and the environment. OtterTail/VDCI's trained staff follows the appropriate application practices and utilize state-of-the-art equipment for adult control. OtterTail/VDCI uses ULV equipment designed and calibrated to effectively control adult mosquitoes with a minimal amount of active ingredients. ULV delivery techniques, such as timing and weather monitoring, are also designed to minimize environmental and non-target impacts, while at the same time effectively managing populations of adult mosquitoes.

BCMCD recognized the need for increasingly accurate pesticide application and documentation. OtterTail's GPS/GIS based software and hardware implementation for ULV applications was added to the program in 2009 and continued its use through the 2016 season. OtterTail/VDCI maintains a fleet of ULV-equipped vehicles enhanced with the Monitor 4 system, which is a GPS based variable flow pump and sprayer control system. This system gives OtterTail/VDCI the ability to incorporate GPS and GIS into truck-mounted ULV applications, which can dramatically improve several components of an adulticiding program.



In general, this system has increased the accuracy of pesticide applications and documentation. Specific improvements include 1) complete documentation of specific locations and amounts of spray applications; 2) assurance of consistent application rate by its adjustment of spray volume with vehicle speed (including shutoff if vehicle speed exceeds pesticide label recommendations); 3) the ability to report linear miles of actual spraying rather than total vehicle trip miles; 4) the documentation of spray shutoff for residents on "no spray lists"; 5) enhanced GIS data management and reporting efficiency; and 6) the ability to graphically display data in GIS mapping formats. OtterTail's incorporation of these

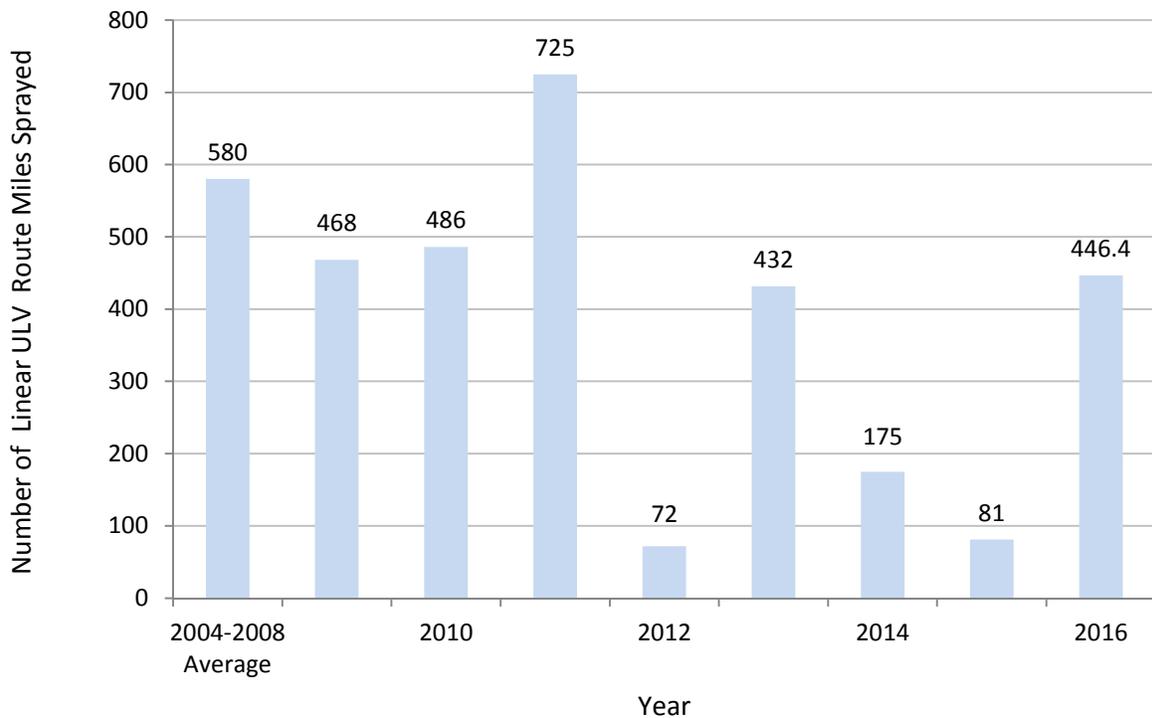
technologies into its entire fleet of ULV trucks has proven to be a valuable improvement to our adulticiding programs.

OtterTail/VDCI’s 2016 adult mosquito control applications were performed with the water-soluble adulticide Aqualuer® 20-20. This product is highly effective for the quick knockdown and control of adult mosquitoes and its water-soluble formulation is safer and easier to work with than more traditional pesticides. The active ingredient in Aqualuer® 20-20 is a synergized permethrin (a synthetic pyrethroid). Synthetic pyrethroids are synthesized derivatives of naturally occurring pyrethrins, which are taken from pyrethrum, an extract of chrysanthemum flowers. These products generally cause rapid knockdown of adult mosquitoes, exhibit low mammalian toxicity, and degrade rapidly in sunlight with little or no residual product.

ADULT CONTROL RESULTS AND DISCUSSION

During the 2016 season, approximately 446.4 linear route miles of adult control were performed for the BCMCD (**Figure 8**). A detailed summary of the District’s 2016 adult treatment applications can be found in **Appendix C**.

Figure 8 Total Linear ULV Route Miles Sprayed, 2004 - 2016*



*Note: 2009-2016 miles reported as route mileage, which includes shutoffs and turnarounds and should be used when comparing 2009-2016 data to historical data; 2004- 2008 data provided by BCPH.

OtterTail/VDCI and BCMCD acknowledge that adult mosquito control can be a sensitive matter to many residents; therefore, we offer a *Spray Notification and Shutoff Service* as part of the adult control program. This allows residents to call OtterTail/VDCI's Mosquito Control Hotline and request that they be notified before adult control applications are performed near their properties and/or request that the ULV sprayer be shutoff in areas bordering their address.

During the 2016 season, OtterTail/VDCI received 20 shutoff requests and 28 requests to be notified before spraying. When these were added into the on-going list, OtterTail/VDCI's shutoff and notification list included 755 households that wanted to be notified before spraying in their neighborhood and 335 households that requested spray shutoffs. OtterTail/VDCI notified residents on both the notification and shutoff lists if their community was scheduled to be sprayed 24 hours in advance using an automated messaging service. In 2016, OtterTail/VDCI completed 1,548 notification calls.

6.0 PUBLIC OUTREACH AND EDUCATION

Public education is an important component to any mosquito control program and is vital in combating WNV. BCPH continued to provide valuable educational materials to residents and the general public through local media outlets, bulletins, pamphlets and their internet website. The educational materials stressed the importance of actions that residents could take to aid in the effort to combat WNV; topics included personal protection, property maintenance for source reduction, and general information related to the WNV disease cycle. BCPH staff also provided insect repellent wipes, with the BCMCD website information printed on packaging, to communities within the county during the 2016 season. BCPH released several press releases throughout the season with detailed information regarding its mosquito control program. BCPH and OtterTail/VDCI staff also conducted numerous interviews and provided an abundance of mosquito control related information to several media outlets throughout the 2016 season.

OtterTail offers an extensive amount of information on its website, including sections on mosquito biology and control, and actions residents and land users could take to help aid the District in its mosquito control efforts. The website provided online spray notifications for the areas where OtterTail/VDCI would be performing adult control applications each week, as well as allowing residents to fill out an online request form to be included in OtterTail/VDCI's *Spray Notification or Shutoff Service*. These notification systems allowed the District to cease running spray location advertisements in local newspapers beginning in 2011, which has provided a substantial cost savings to the District.

OtterTail/VDCI provided a toll-free hotline and email address to residents in order to report mosquito complaints and request services. In 2016, OtterTail/VDCI received 141 Mosquito Hotline calls from households within BCMCD, which were classified into five categories. As shown in **Table 8**, the majority of the calls received in 2016 were to report nuisance mosquito activity (30.5 percent) and to obtain general project information (20.6 percent). Adult mosquito nuisance reports were used to shift surveillance into areas, if needed, and used in conjunction with trap counts to focus adult mosquito control operations. Habitat assessment calls received in 2016 resulted in an increase in monitored sites; 55 percent of these calls were reporting sites already being monitored and 35 percent of the calls resulted in the addition of 8 new mosquito habitat sites to the program (**Table 9**). The total number of hotline calls received in 2016 (141) was significantly lower than the average number of calls typically received in recent years (**Figure 9**), which averaged 275 calls a year from 2009-2015. OtterTail/VDCI provided site inspections and any consequential treatments to potential larval habitat as necessary. If landowners gave permission, then these sources were added to the project site list and incorporated into the surveillance schedule. OtterTail/VDCI field technicians only accessed private properties if permission was granted by the owner.

Educating residents on the need for property maintenance, source reduction, and the use of personal protection measures continued to be crucial in the efforts to control WNV in 2016. Increased awareness and actions taken by the public likely prevented many more WNV cases from occurring in 2016.

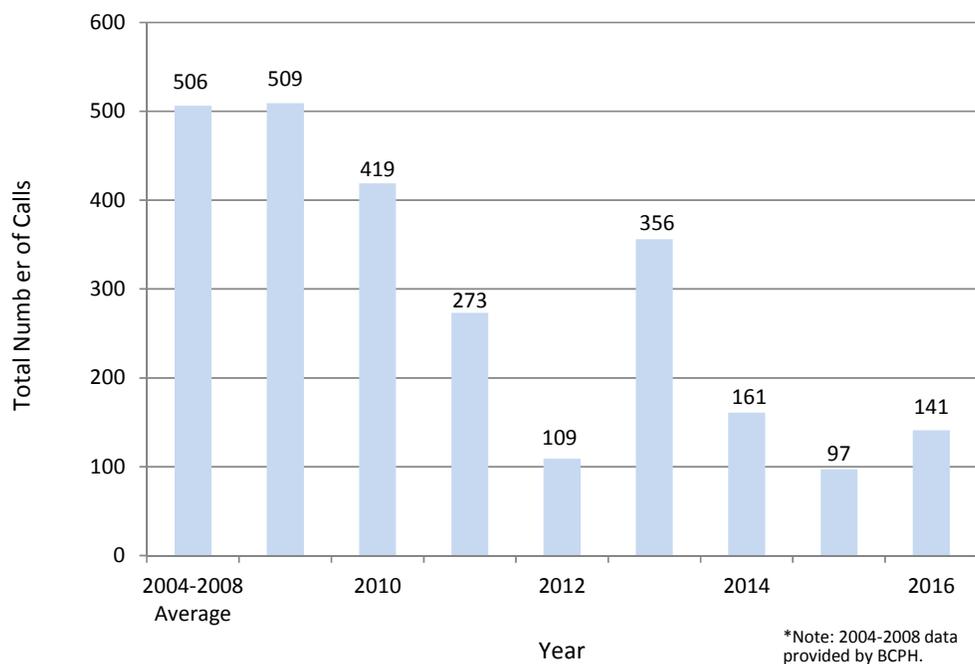
Table 8 Service Requests by Type, 2009 - 2016

Call Types	2016		2009-2015 Average	
	Number of Calls	Percentage	Number of Calls	Percentage
Nuisance Complaint	43	30.5%	131	47.6%
Habitat Assessment	21	14.9%	38	14.0%
Spray ShutOff	20	14.2%	28	10.0%
Spray Notification	28	19.9%	37	13.3%
General Info/Questions	29	20.6%	41	15.1%
Total	141	100.0%	275	100.0%

Table 9 Results of Habitat Inspections from Hotline Calls, 2009 - 2016

Results	2016		2009-2015 Average	
	Number of Calls	Percentage	Number of Calls	Percentage
Pre-Existing Site	11	55.0%	17	48.0%
Added New Site	7	35.0%	12	33.2%
Not a Suitable Site	2	10.0%	7	18.9%
Total	20	100.0%	35	100.0%

Figure 9 Total Number of Hotline Calls, 2004 - 2016



7.0 REFERENCES

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APPENDIX A - ADULT MOSQUITO TRAP DESCRIPTION



For the 2015 season, the carbon dioxide (CO₂) baited Centers for Disease Control (CDC) Light Trap was incorporated into Boulder County's adult mosquito surveillance system. OtterTail followed the CDPHE trapping and handling protocol (CDPHE 2015) for the traps used in its WNV surveillance and testing program. The following is a detailed description of the CO₂ light trap used.

CO₂ Light Trap

To capture the most representative sample of adult mosquitoes in an area, CDC Light Traps are baited with CO₂ in the form of dry ice and set overnight in adult mosquito harborage areas throughout the mosquito season. The traps are designed with the knowledge that the female mosquito species are attracted to light, CO₂, and heat. The number and types of mosquitoes captured in these traps can provide local officials with a valuable early indication of the threat of WNV.

The traps consist of a plastic insulated thermos filled with enough dry ice (CO₂) to last throughout the trapping cycle. Units consist of a light, fan unit, and fine mesh net which hang below the thermos. The device is placed on a tree branch with the thermos approximately five to seven feet off the ground and is suspended by a small chain or rope to allow the thermos and net to hang free. Holes at the base of the thermos allow dissipating CO₂ to be emitted as an attractant around the trap. Batteries run the small fan and light positioned above the net. The light provides further attraction and once the mosquitoes are near the light, they are pulled down into the net by the downward force of the fan.

In the morning, the mosquitoes are removed and frozen to prepare for identification. During the identification process, the mosquitoes are sorted by species and sex. Female vector mosquitoes are routinely submitted to the Colorado Department of Public Health and Environment (CDPHE) lab for WNV testing as needed.



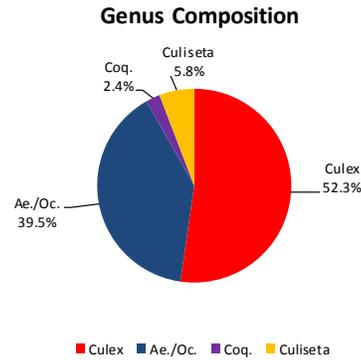
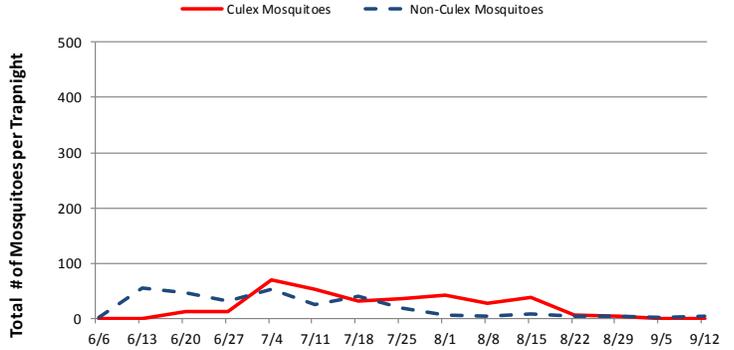
APPENDIX B - 2016 WEEKLY TRAP COUNTS



BC-01 Old Tale Rd

Trap ID/Trap Location	BC-01/Old Tale Rd	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	20	3.2%
<i>Culex tarsalis</i>	311	49.1%
Total Culex	331	52.3%
% RA Culex	52.3%	
<i>Aedes vexans</i>	59	9.3%
<i>Oc. dorsalis</i>	2	0.3%
<i>Oc. increpitus</i>	158	25.0%
<i>Oc. melanimon</i>	5	0.8%
<i>Oc. trivittatus</i>	26	4.1%
Total Aedes/Ochlerotatus (Ae./Oc.)	250	39.5%
% RA Ae./Oc.	39.5%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	15	2.4%
Total Coquillettidia (Coq.)	15	2.4%
% RA Coquillettidia	2.4%	
<i>Culiseta incidens</i>	30	4.7%
<i>Culiseta inornata</i>	7	1.1%
Total Culiseta	37	5.8%
% RA Culiseta	5.8%	
Trap Total	633	100.0%
Average # of Total Mosquitoes per Trapnight	42	
Average # of Culex per Trapnight	22	

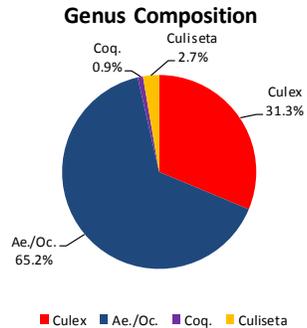
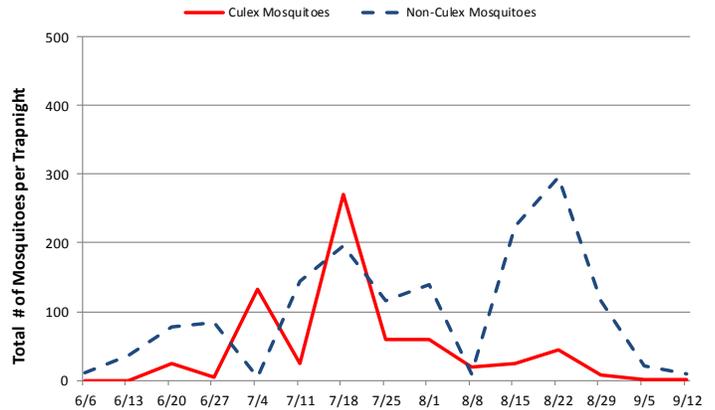
*%RA= Percent Relative Abundance



BC-02 Cottonwood Kennels

Trap ID/Trap Location	BC-02 Cottonwood Kennels	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex erythrorhax</i>	24	1.1%
<i>Culex pipiens</i>	93	4.3%
<i>Culex tarsalis</i>	559	25.9%
Total Culex	676	31.3%
% RA Culex	31.3%	
<i>Aedes vexans</i>	749	34.7%
<i>Oc. dorsalis</i>	4	0.2%
<i>Oc. increpitus</i>	355	16.4%
<i>Oc. melanimon</i>	17	0.8%
<i>Oc. nigromaculis</i>	9	0.4%
<i>Oc. trivittatus</i>	274	12.7%
Total Aedes/Ochlerotatus (Ae./Oc.)	1,408	65.2%
% RA Ae./Oc.	65.2%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	19	0.9%
Total Coquillettidia (Coq.)	19	0.9%
% RA Coquillettidia	0.9%	
<i>Culiseta incidens</i>	41	1.9%
<i>Culiseta inornata</i>	17	0.8%
Total Culiseta	58	2.7%
% RA Culiseta	2.7%	
Trap Total	2,161	100.0%
Average # of Total Mosquitoes per Trapnight	144	
Average # of Culex per Trapnight	45	

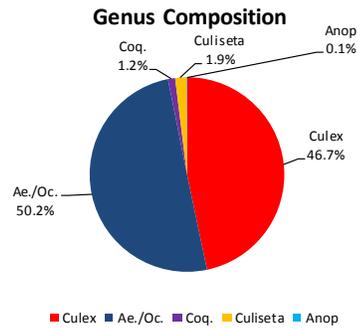
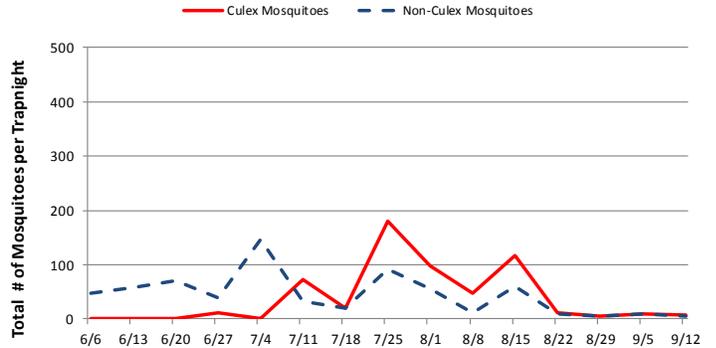
*%RA= Percent Relative Abundance



BC-03 Gunbarrel SE-Pali

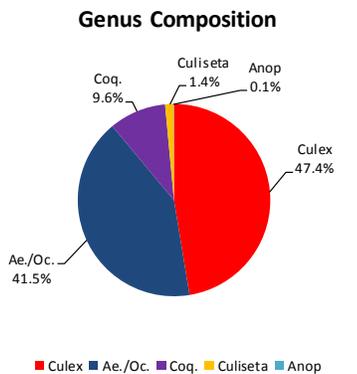
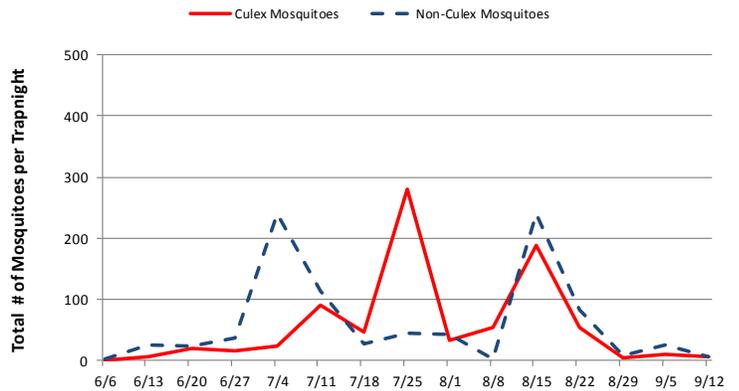
Trap ID/Trap Location	BC-03/Gunbarrel SE-Pali	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	128	10.3%
<i>Culex tarsalis</i>	450	36.3%
Total Culex	578	46.7%
% RA Culex	46.7%	
<i>Aedes vexans</i>	425	34.3%
<i>Oc. dorsalis</i>	3	0.2%
<i>Oc. increpitus</i>	152	12.3%
<i>Oc. melanimon</i>	19	1.5%
<i>Oc. nigromaculis</i>	2	0.2%
<i>Oc. trivittatus</i>	20	1.6%
Total Aedes/Ochlerotatus (Ae./Oc.)	621	50.2%
% RA Ae./Oc.	50.2%	
<i>Anopheles spp.</i>	1	0.1%
Total Anopheles	1	0.1%
% RA Anopheles	0.1%	
<i>Coquillettidia perturbans</i>	15	1.2%
Total Coquillettidia (Coq.)	15	1.2%
% RA Coquillettidia	1.2%	
<i>Culiseta incidens</i>	8	0.6%
<i>Culiseta inornata</i>	15	1.2%
Total Culiseta	23	1.9%
% RA Culiseta	1.9%	
Trap Total	1,238	100.0%
Average # of Total Mosquitoes per Trapnight	83	
Average # of Culex per Trapnight	39	

*%RA= Percent Relative Abundance



BC-04 Gunbarrel NW-Idylwild

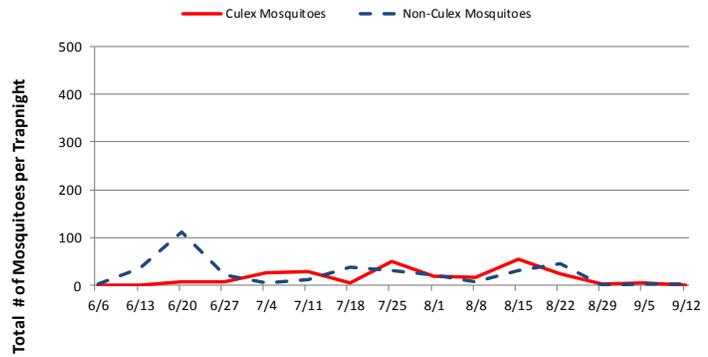
Trap ID/Trap Location	BC-04/Gunbarrel NW-Idylwild	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	297	16.8%
<i>Culex tarsalis</i>	539	30.6%
Total Culex	836	47.4%
% RA Culex	47.4%	
<i>Aedes vexans</i>	323	18.3%
<i>Oc. dorsalis</i>	6	0.3%
<i>Oc. increpitus</i>	351	19.9%
<i>Oc. melanimon</i>	41	2.3%
<i>Oc. nigromaculis</i>	1	0.1%
<i>Oc. trivittatus</i>	10	0.6%
Total Aedes/Ochlerotatus (Ae./Oc.)	732	41.5%
% RA Ae./Oc.	41.5%	
<i>Anopheles spp.</i>	1	0.1%
Total Anopheles	1	0.1%
% RA Anopheles	0.1%	
<i>Coquillettidia perturbans</i>	169	9.6%
Total Coquillettidia (Coq.)	169	9.6%
% RA Coquillettidia	9.6%	
<i>Culiseta incidens</i>	14	0.8%
<i>Culiseta inornata</i>	11	0.6%
Total Culiseta	25	1.4%
% RA Culiseta	1.4%	
Trap Total	1,763	100.0%
Average # of Total Mosquitoes per Trapnight	118	
Average # of Culex per Trapnight	56	



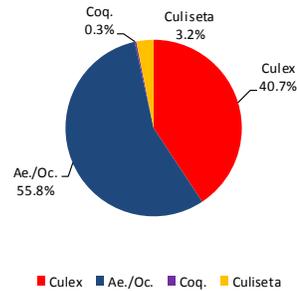
BC-05 Orange Orchard

Trap ID/Trap Location	BC-05/Orange Orchard	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	65	10.3%
<i>Culex tarsalis</i>	192	30.4%
Total Culex	257	40.7%
% RA Culex	40.7%	
<i>Aedes vexans</i>	271	42.9%
<i>Oc. dorsalis</i>	6	1.0%
<i>Oc. increpitus</i>	54	8.6%
<i>Oc. melanimon</i>	7	1.1%
<i>Oc. trivittatus</i>	14	2.2%
Total Aedes/Ochlerotatus (Ae./Oc.)	352	55.8%
% RA Ae./Oc.	55.8%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	2	0.3%
Total Coquillettidia (Coq.)	2	0.3%
% RA Coquillettidia	0.3%	
<i>Culiseta incidens</i>	3	0.5%
<i>Culiseta inornata</i>	17	2.7%
Total Culiseta	20	3.2%
% RA Culiseta	3.2%	
Trap Total	631	100.0%
Average # of Total Mosquitoes per Trapnight	42	
Average # of Culex per Trapnight	17	

*%RA= Percent Relative Abundance



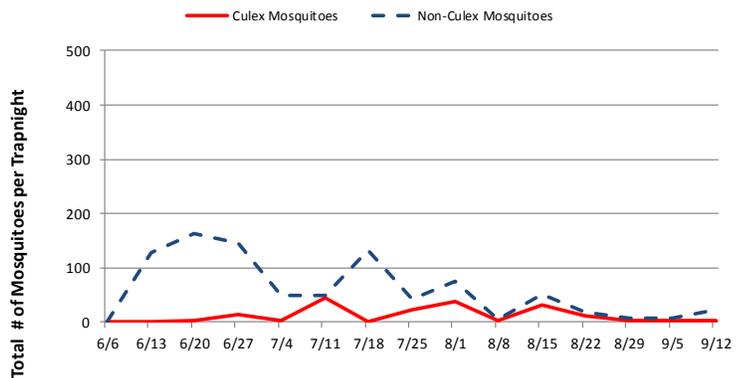
Genus Composition



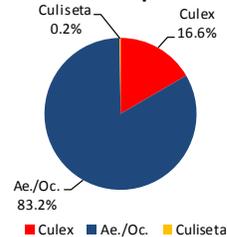
BC-07 Bridgadoon Glen

Trap ID/Trap Location	BC-07/Bridgadoon Glen	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	43	4.0%
<i>Culex tarsalis</i>	135	12.6%
Total Culex	178	16.6%
% RA Culex	16.6%	
<i>Aedes vexans</i>	377	35.2%
<i>Oc. dorsalis</i>	12	1.1%
<i>Oc. increpitus</i>	207	19.3%
<i>Oc. melanimon</i>	28	2.6%
<i>Oc. nigromaculis</i>	5	0.5%
<i>Oc. trivittatus</i>	263	24.5%
Total Aedes/Ochlerotatus (Ae./Oc.)	892	83.2%
% RA Ae./Oc.	83.2%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
Total Coquillettidia (Coq.)	0	0.0%
% RA Coquillettidia	0.0%	
<i>Culiseta inornata</i>	2	0.2%
Total Culiseta	2	0.2%
% RA Culiseta	0.2%	
Trap Total	1,072	100.0%
Average # of Total Mosquitoes per Trapnight	71	
Average # of Culex per Trapnight	12	

*%RA= Percent Relative Abundance



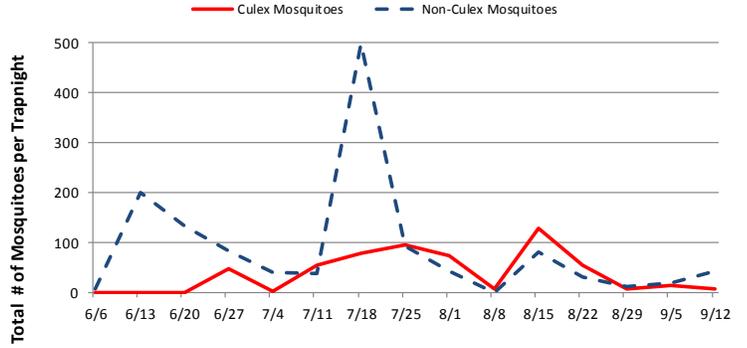
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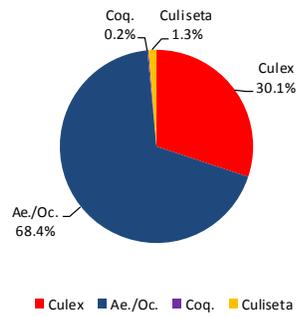
BC-08 Boulder Hills

Trap ID/Trap Location	BC-08/Boulder Hills	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	29	1.5%
<i>Culex tarsalis</i>	541	28.5%
Total Culex	570	30.1%
% RA Culex	30.1%	
<i>Aedes vexans</i>	1,071	56.5%
<i>Oc. dorsalis</i>	1	0.1%
<i>Oc. increpitus</i>	72	3.8%
<i>Oc. melanimon</i>	9	0.5%
<i>Oc. trivittatus</i>	143	7.5%
Total Aedes/Ochlerotatus (Ae./Oc.)	1,296	68.4%
% RA Ae./Oc.	68.4%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	4	0.2%
Total Coquillettidia (Coq.)	4	0.2%
% RA Coquillettidia	0.2%	
<i>Culiseta incidens</i>	8	0.4%
<i>Culiseta inornata</i>	17	0.9%
Total Culiseta	25	1.3%
% RA Culiseta	1.3%	
Trap Total	1,895	100.0%
Average # of Total Mosquitoes per Trapnight	126	
Average # of Culex per Trapnight	38	

*%RA= Percent Relative Abundance



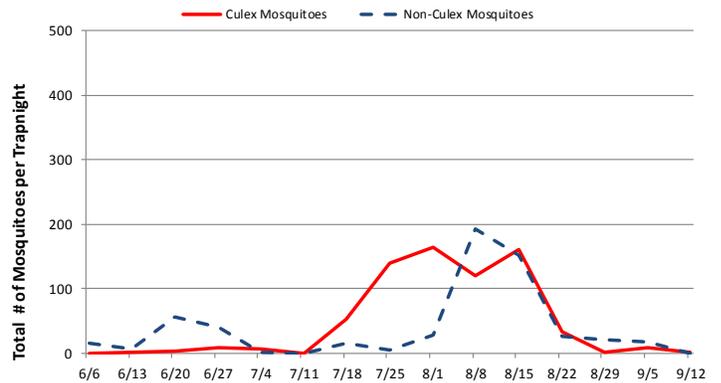
Genus Composition



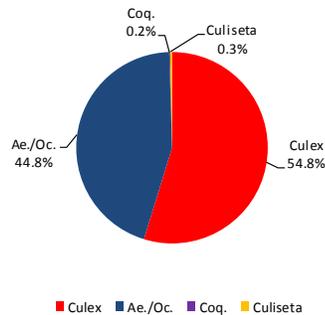
BC-11 Niwot East Majestic

Trap ID/Trap Location	BC-11/Niwot East Majestic	
Trap Type	CDC Light	
Total # of Trapnights	14	
Species	Number	%RA*
<i>Culex pipiens</i>	117	9.1%
<i>Culex tarsalis</i>	585	45.6%
Total Culex	702	54.8%
% RA Culex	54.8%	
<i>Aedes vexans</i>	472	36.8%
<i>Oc. dorsalis</i>	11	0.9%
<i>Oc. increpitus</i>	31	2.4%
<i>Oc. melanimon</i>	11	0.9%
<i>Oc. nigromaculis</i>	1	0.1%
<i>Oc. trivittatus</i>	48	3.7%
Total Aedes/Ochlerotatus (Ae./Oc.)	574	44.8%
% RA Ae./Oc.	44.8%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	2	0.2%
Total Coquillettidia (Coq.)	2	0.2%
% RA Coquillettidia	0.2%	
<i>Culiseta inornata</i>	4	0.3%
Total Culiseta	4	0.3%
% RA Culiseta	0.3%	
Trap Total	1,282	100.0%
Average # of Total Mosquitoes per Trapnight	92	
Average # of Culex per Trapnight	50	

*%RA= Percent Relative Abundance



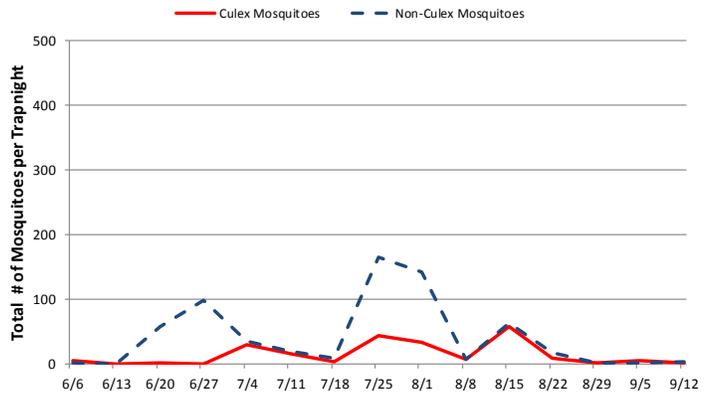
Genus Composition



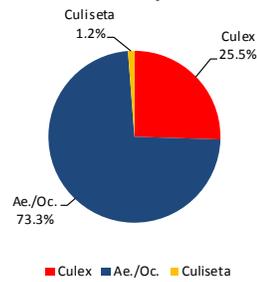
BC-17 Niwot Central

Trap ID/Trap Location	BC-17 Niwot Central	
Trap Type	CDC Light	
Total # of Trapnights	14	
Species	Number	%RA*
<i>Culex pipiens</i>	33	4.0%
<i>Culex tarsalis</i>	178	21.5%
Total Culex	211	25.5%
% RA Culex	25.5%	
<i>Aedes vexans</i>	514	62.2%
<i>Oc. dorsalis</i>	15	1.8%
<i>Oc. increpitus</i>	40	4.8%
<i>Oc. melanimon</i>	11	1.3%
<i>Oc. nigromaculis</i>	3	0.4%
<i>Oc. trivittatus</i>	23	2.8%
Total Aedes/Ochlerotatus (Ae./Oc.)	606	73.3%
% RA Ae./Oc.	73.3%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
Total Coquillettidia (Coq.)	0	0.0%
% RA Coquillettidia	0.0%	
<i>Culiseta incidens</i>	1	0.1%
<i>Culiseta inornata</i>	9	1.1%
Total Culiseta	10	1.2%
% RA Culiseta	1.2%	
Trap Total	827	100.0%
Average # of Total Mosquitoes per Trapnight	59	
Average # of Culex per Trapnight	15	

*%RA= Percent Relative Abundance



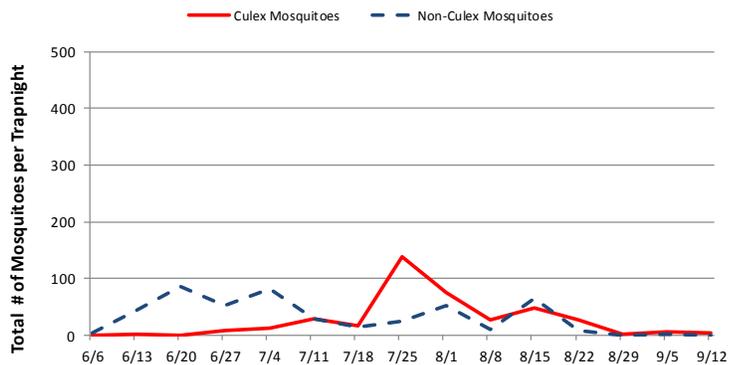
Genus Composition



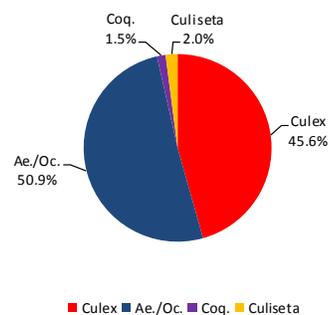
BC-20 Willows

Trap ID/Trap Location	BC-20/Willows	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	140	15.9%
<i>Culex tarsalis</i>	262	29.7%
Total Culex	402	45.6%
% RA Culex	45.6%	
<i>Aedes vexans</i>	227	25.8%
<i>Oc. dorsalis</i>	6	0.7%
<i>Oc. increpitus</i>	194	22.0%
<i>Oc. melanimon</i>	2	0.2%
<i>Oc. nigromaculis</i>	3	0.3%
<i>Oc. trivittatus</i>	16	1.8%
Total Aedes/Ochlerotatus (Ae./Oc.)	448	50.9%
% RA Ae./Oc.	50.9%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	13	1.5%
Total Coquillettidia (Coq.)	13	1.5%
% RA Coquillettidia	1.5%	
<i>Culiseta incidens</i>	12	1.4%
<i>Culiseta inornata</i>	6	0.7%
Total Culiseta	18	2.0%
% RA Culiseta	2.0%	
Trap Total	881	100.0%
Average # of Total Mosquitoes per Trapnight	59	
Average # of Culex per Trapnight	27	

*%RA= Percent Relative Abundance



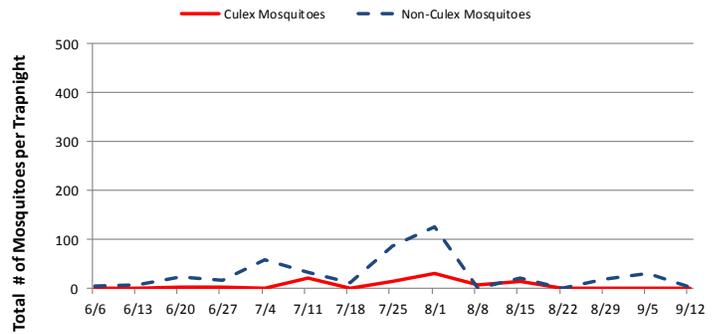
Genus Composition



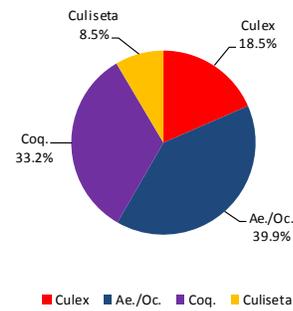
BC-22 Marshall-S Boulder Crk

Trap ID/Trap Location	BC-22/Marshall-S Boulder Crk	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	27	4.9%
<i>Culex tarsalis</i>	75	13.6%
Total Culex	102	18.5%
% RA Culex	18.5%	
<i>Aedes vexans</i>	49	8.9%
<i>Oc. inreptus</i>	110	19.9%
<i>Oc. melaniman</i>	8	1.4%
<i>Oc. trivittatus</i>	53	9.6%
Total Aedes/Ochlerotatus (Ae./Oc.)	220	39.9%
% RA Ae./Oc.	39.9%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	183	33.2%
Total Coquillettidia (Coq.)	183	33.2%
% RA Coquillettidia	33.2%	
<i>Culiseta incidens</i>	46	8.3%
<i>Culiseta inornata</i>	1	0.2%
Total Culiseta	47	8.5%
% RA Culiseta	8.5%	
Trap Total	552	100.0%
Average # of Total Mosquitoes per Trapnight	37	
Average # of Culex per Trapnight	7	

*%RA= Percent Relative Abundance



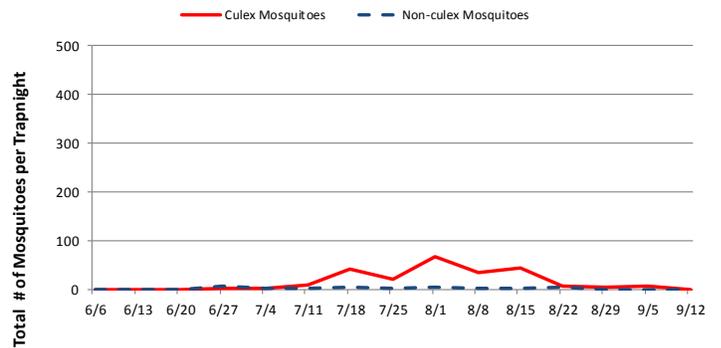
Genus Composition



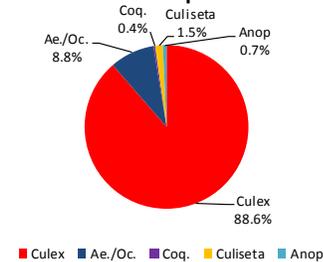
BC-23-Louisville-Spanish Hills

Trap ID/Trap Location	BC-23/Louisville-Spanish Hills	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	43	15.8%
<i>Culex tarsalis</i>	198	72.8%
Total Culex	241	88.6%
% RA Culex	88.6%	
<i>Aedes vexans</i>	18	6.6%
<i>Oc. dorsalis</i>	2	0.7%
<i>Oc. inreptus</i>	2	0.7%
<i>Oc. nigromaculis</i>	2	0.7%
Total Aedes/Ochlerotatus (Ae./Oc.)	24	8.8%
% RA Ae./Oc.	8.8%	
<i>Anopheles spp.</i>	2	0.7%
Total Anopheles	2	0.7%
% RA Anopheles	0.7%	
<i>Coquillettidia perturbans</i>	1	0.4%
Total Coquillettidia (Coq.)	1	0.4%
% RA Coquillettidia	0.4%	
<i>Culiseta inornata</i>	4	1.5%
Total Culiseta	4	1.5%
% RA Culiseta	1.5%	
Trap Total	272	100.0%
Average # of Total Mosquitoes per Trapnight	18	
Average # of Culex per Trapnight	16	

*%RA= Percent Relative Abundance



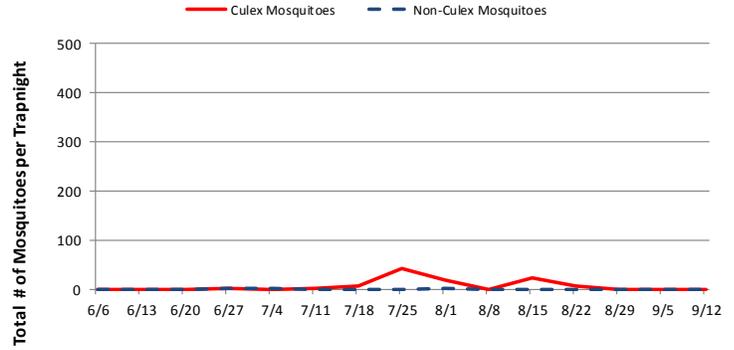
Genus Composition



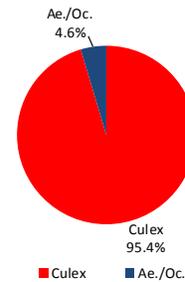
BC-24 Louisville-Wewonka Dr

Trap ID/Trap Location	BC-24/Louisville-Wewonka Dr	
Trap Type	CDC Light	
Total # of Trapnights	13	
Species	Number	%RA*
<i>Culex pipiens</i>	4	3.7%
<i>Culex tarsalis</i>	99	91.7%
Total Culex	103	95.4%
% RA Culex	95.4%	
<i>Aedes vexans</i>	3	2.8%
<i>Oc. increpitus</i>	1	0.9%
<i>Oc. melanimon</i>	1	0.9%
Total Aedes/Ochlerotatus (Ae./Oc.)	5	4.6%
% RA Ae./Oc.	4.6%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
Total Coquillettidia (Coq.)	0	0.0%
% RA Coquillettidia	0.0%	
<i>Culiseta inornata</i>	0	0.0%
Total Culiseta	0	0.0%
% RA Culiseta	0.0%	
Trap Total	108	100.0%
Average # of Total Mosquitoes per Trapnight	8	
Average # of Culex per Trapnight	8	

*%RA= Percent Relative Abundance



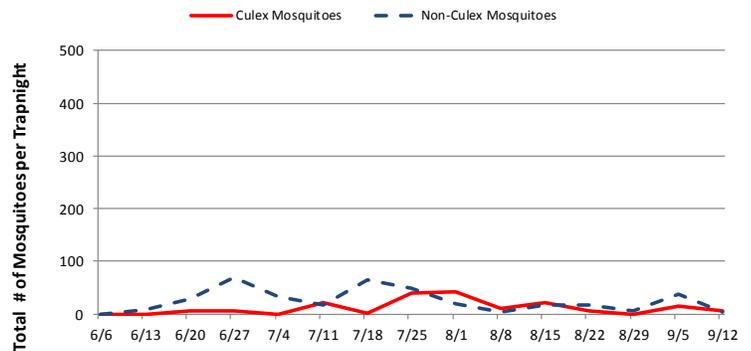
Genus Composition



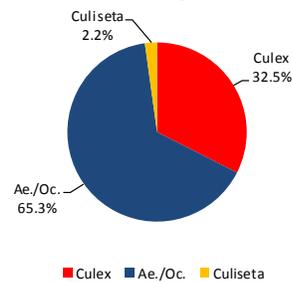
BC-30 Erie-Brownsville Random Ct

Trap ID/Trap Location	BC-30/Erie-Brownsville	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	37	6.7%
<i>Culex tarsalis</i>	142	25.8%
Total Culex	179	32.5%
% RA Culex	32.5%	
<i>Aedes vexans</i>	323	58.6%
<i>Oc. dorsalis</i>	5	0.9%
<i>Oc. increpitus</i>	19	3.4%
<i>Oc. melanimon</i>	9	1.6%
<i>Oc. trivittatus</i>	4	0.7%
Total Aedes/Ochlerotatus (Ae./Oc.)	360	65.3%
% RA Ae./Oc.	65.3%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
Total Coquillettidia (Coq.)	0	0.0%
% RA Coquillettidia	0.0%	
<i>Culiseta inornata</i>	12	2.2%
Total Culiseta	12	2.2%
% RA Culiseta	2.2%	
Trap Total	551	100.0%
Average # of Total Mosquitoes per Trapnight	37	
Average # of Culex per Trapnight	12	

*%RA= Percent Relative Abundance



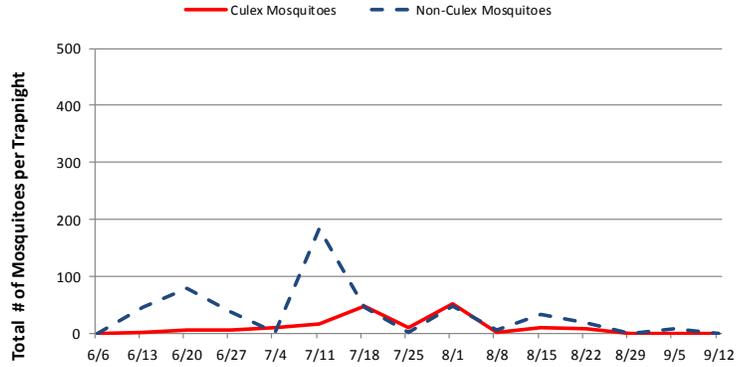
Genus Composition



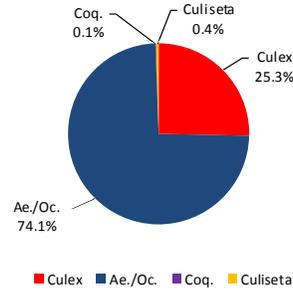
BC-31 Divide Reservoir

Trap ID/Trap Location	BC-31/Divide Reservoir	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	27	3.9%
<i>Culex tarsalis</i>	148	21.4%
Total Culex	175	25.3%
% RA Culex	25.3%	
<i>Aedes cinereus</i>	1	0.1%
<i>Aedes vexans</i>	350	50.7%
<i>Oc. dorsalis</i>	40	5.8%
<i>Oc. inцепitus</i>	47	6.8%
<i>Oc. melanimon</i>	11	1.6%
<i>Oc. nigromaculis</i>	6	0.9%
<i>Oc. trivittatus</i>	57	8.2%
Total Aedes/Ochlerotatus (Ae./Oc.)	512	74.1%
% RA Ae./Oc.	74.1%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	1	0.1%
Total Coquillettidia (Coq.)	1	0.1%
% RA Coquillettidia	0.1%	
<i>Culiseta inornata</i>	3	0.4%
Total Culiseta	3	0.4%
% RA Culiseta	0.4%	
Trap Total	691	100.0%
Average # of Total Mosquitoes per Trapnight	46	
Average # of Culex per Trapnight	12	

*%RA= Percent Relative Abundance



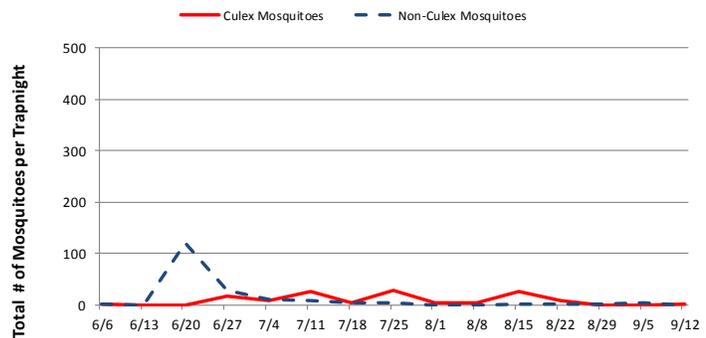
Genus Composition



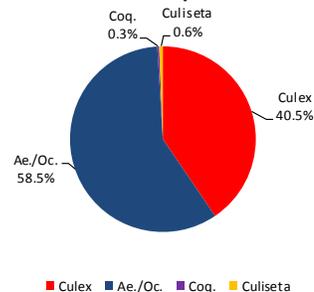
BC-32 Baseline Heights

Trap ID/Trap Location	BC-32/Baseline Heights	
Trap Type	CDC Light	
Total # of Trapnights	14	
Species	Number	%RA*
<i>Culex pipiens</i>	19	6.1%
<i>Culex tarsalis</i>	107	34.4%
Total Culex	126	40.5%
% RA Culex	40.5%	
<i>Aedes vexans</i>	104	33.4%
<i>Oc. dorsalis</i>	26	8.4%
<i>Oc. inцепitus</i>	23	7.4%
<i>Oc. melanimon</i>	27	8.7%
<i>Oc. nigromaculis</i>	1	0.3%
<i>Oc. trivittatus</i>	1	0.3%
Total Aedes/Ochlerotatus (Ae./Oc.)	182	58.5%
% RA Ae./Oc.	58.5%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	1	0.3%
Total Coquillettidia (Coq.)	1	0.3%
% RA Coquillettidia	0.3%	
<i>Culiseta inornata</i>	2	0.6%
Total Culiseta	2	0.6%
% RA Culiseta	0.6%	
Trap Total	311	100.0%
Average # of Total Mosquitoes per Trapnight	22	
Average # of Culex per Trapnight	9	

*%RA= Percent Relative Abundance



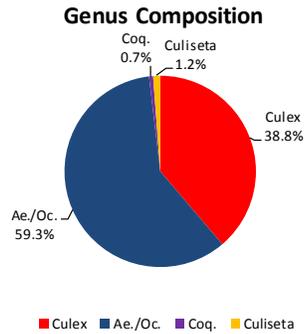
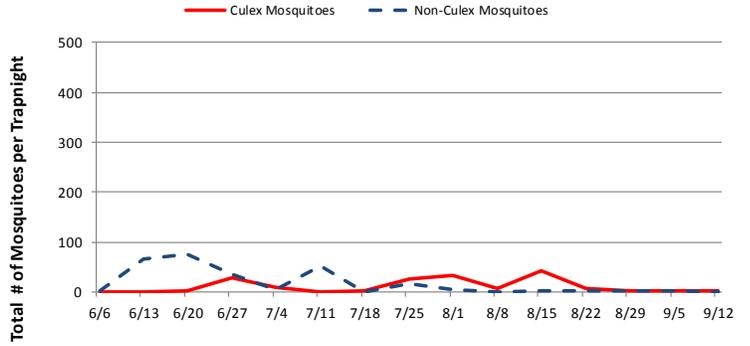
Genus Composition



BC-33 Lake Valley Estates

Trap ID/Trap Location	BC-33/Lake Valley Estates	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	29	6.9%
<i>Culex tarsalis</i>	135	31.9%
Total Culex	164	38.8%
% RA Culex	38.8%	
<i>Aedes vexans</i>	74	17.5%
<i>Oc. dorsalis</i>	1	0.2%
<i>Oc. increpitus</i>	38	9.0%
<i>Oc. melanimon</i>	7	1.7%
<i>Oc. trivittatus</i>	131	31.0%
Total Aedes/Ochlerotatus (Ae./Oc.)	251	59.3%
% RA Ae./Oc.	59.3%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	3	0.7%
Total Coquillettidia (Coq.)	3	0.7%
% RA Coquillettidia	0.7%	
<i>Culiseta inornata</i>	5	1.2%
Total Culiseta	5	1.2%
% RA Culiseta	1.2%	
Trap Total	423	100.0%
Average # of Total Mosquitoes per Trapnight	28	
Average # of Culex per Trapnight	11	

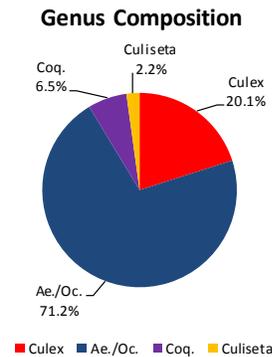
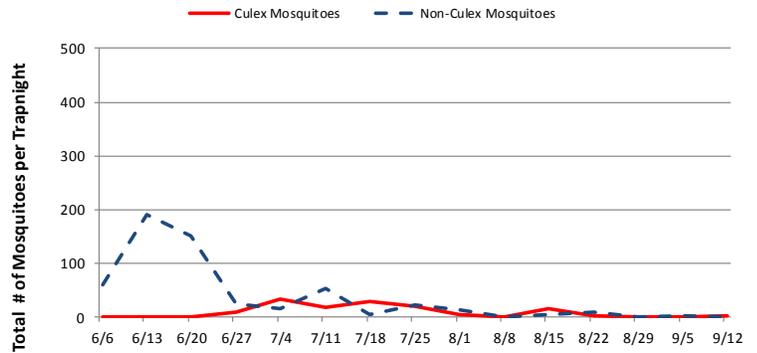
*%RA= Percent Relative Abundance



BC-34 Cline Trout Farm

Trap ID/Trap Location	BC-34 Cline Trout Farm	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	41	5.9%
<i>Culex tarsalis</i>	98	14.2%
Total Culex	139	20.1%
% RA Culex	20.1%	
<i>Aedes vexans</i>	207	29.9%
<i>Oc. dorsalis</i>	5	0.7%
<i>Oc. increpitus</i>	273	39.5%
<i>Oc. melanimon</i>	3	0.4%
<i>Oc. trivittatus</i>	5	0.7%
Total Aedes/Ochlerotatus (Ae./Oc.)	493	71.2%
% RA Ae./Oc.	71.2%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	45	6.5%
Total Coquillettidia (Coq.)	45	6.5%
% RA Coquillettidia	6.5%	
<i>Culiseta incidens</i>	5	0.7%
<i>Culiseta inornata</i>	10	1.4%
Total Culiseta	15	2.2%
% RA Culiseta	2.2%	
Trap Total	692	100.0%
Average # of Total Mosquitoes per Trapnight	46	
Average # of Culex per Trapnight	9	

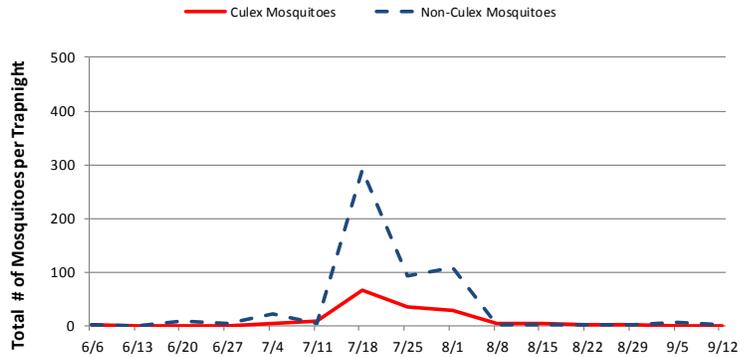
*%RA= Percent Relative Abundance



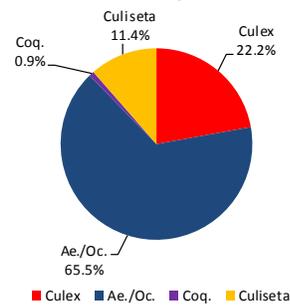
BC-36 Yellowstone

Trap ID/Trap Location	BC-36/Yellowstone	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	5	0.7%
<i>Culex tarsalis</i>	150	21.5%
Total Culex	155	22.2%
% RA Culex	22.2%	
<i>Aedes vexans</i>	381	54.5%
<i>Oc. dorsalis</i>	8	1.1%
<i>Oc. increpitus</i>	23	3.3%
<i>Oc. melanimon</i>	3	0.4%
<i>Oc. nigromaculis</i>	5	0.7%
<i>Oc. trivittatus</i>	38	5.4%
Total Aedes/Ochlerotatus (Ae./Oc.)	458	65.5%
% RA Ae./Oc.	65.5%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	6	0.9%
Total Coquillettidia (Coq.)	6	0.9%
% RA Coquillettidia	0.9%	
<i>Culiseta inornata</i>	80	11.4%
Total Culiseta	80	11.4%
% RA Culiseta	11.4%	
Trap Total	699	100.0%
Average # of Total Mosquitoes per Trapnight	47	
Average # of Culex per Trapnight	10	

*%RA= Percent Relative Abundance



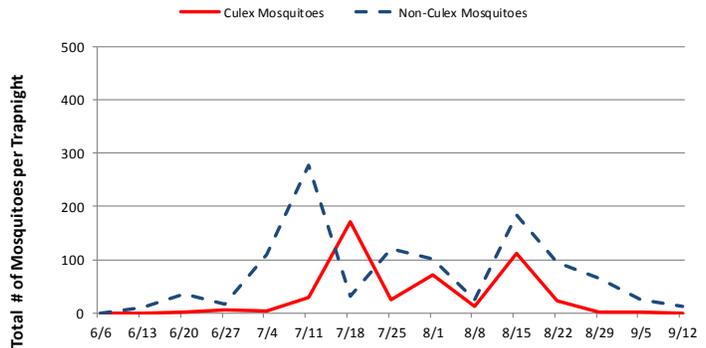
Genus Composition



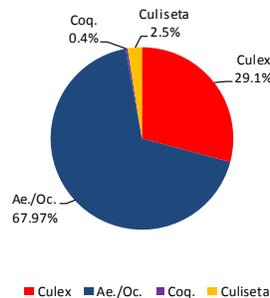
BC-37 Burch Reservoir

Trap ID/Trap Location	BC-37/Burch Reservoir	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	84	5.4%
<i>Culex tarsalis</i>	370	23.7%
Total Culex	454	29.1%
% RA Culex	29.1%	
<i>Aedes vexans</i>	816	52.3%
<i>Oc. dorsalis</i>	1	0.1%
<i>Oc. increpitus</i>	71	4.6%
<i>Oc. melanimon</i>	1	0.1%
<i>Oc. trivittatus</i>	170	10.9%
Total Aedes/Ochlerotatus (Ae./Oc.)	1,059	67.9%
% RA Ae./Oc.	67.9%	
<i>Anopheles spp.</i>	1	0.1%
Total Anopheles	1	0.1%
% RA Anopheles	0.1%	
<i>Coquillettidia perturbans</i>	6	0.4%
Total Coquillettidia (Coq.)	6	0.4%
% RA Coquillettidia	0.4%	
<i>Culiseta incidens</i>	30	1.9%
<i>Culiseta inornata</i>	9	0.6%
Total Culiseta	39	2.5%
% RA Culiseta	2.5%	
Trap Total	1,559	100.0%
Average # of Total Mosquitoes per Trapnight	104	
Average # of Culex per Trapnight	30	

*%RA= Percent Relative Abundance



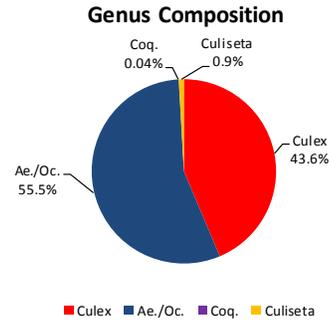
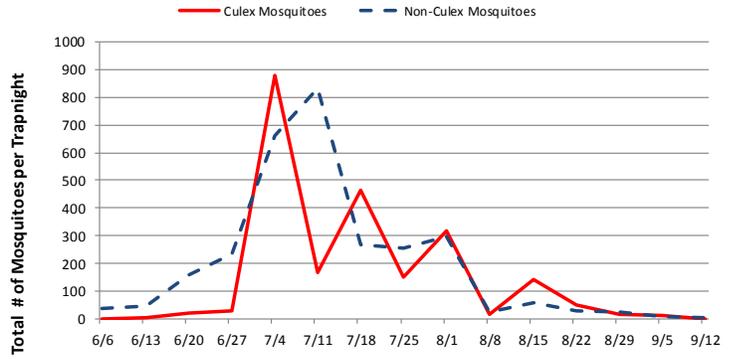
Genus Composition



BC-38 Willow Glen- Teller Lake

Trap ID/Trap Location	BC-38/Willow Glen- Teller Lake	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	348	6.7%
<i>Culex tarsalis</i>	1929	37.0%
Total Culex	2277	43.6%
% RA Culex	43.6%	
<i>Aedes vexans</i>	1,223	23.4%
<i>Oc. dorsalis</i>	50	1.0%
<i>Oc. increpitus</i>	678	13.0%
<i>Oc. melanimon</i>	727	13.9%
<i>Oc. nigromaculis</i>	97	1.9%
<i>Oc. trivittatus</i>	119	2.3%
Total Aedes/Ochlerotatus (Ae./Oc.)	2,894	55.5%
% RA Ae./Oc.	55.5%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
<i>Coquillettidia perturbans</i>	2	0.04%
Total Coquillettidia (Coq.)	2	0.04%
% RA Coquillettidia	0.04%	
<i>Culiseta inornata</i>	46	0.9%
Total Culiseta	46	0.9%
% RA Culiseta	0.9%	
Trap Total	5,219	100.0%
Average # of Total Mosquitoes per Trapnight	348	
Average # of Culex per Trapnight	152	

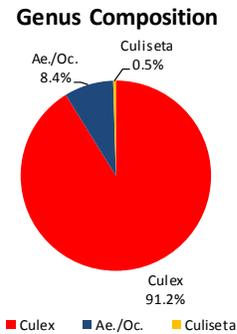
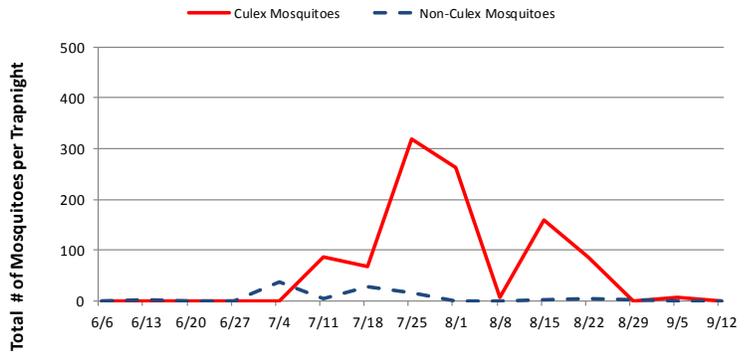
*%RA= Percent Relative Abundance



BC-39 Heatherwood

Trap ID/Trap Location	BC-39/Heatherwood	
Trap Type	CDC Light	
Total # of Trapnights	13	
Species	Number	%RA*
<i>Culex pipiens</i>	363	33.1%
<i>Culex tarsalis</i>	638	58.1%
Total Culex	1,001	91.2%
% RA Culex	91.2%	
<i>Aedes vexans</i>	56	5.1%
<i>Oc. dorsalis</i>	6	0.5%
<i>Oc. increpitus</i>	22	2.0%
<i>Oc. melanimon</i>	3	0.3%
<i>Oc. trivittatus</i>	5	0.5%
Total Aedes/Ochlerotatus (Ae./Oc.)	92	8.4%
% RA Ae./Oc.	8.4%	
Total Anopheles	0	0.0%
% RA Anopheles	0.0%	
Total Coquillettidia (Coq.)	0	0.0%
% RA Coquillettidia	0.0%	
<i>Culiseta incidens</i>	4	0.4%
<i>Culiseta inornata</i>	1	0.1%
Total Culiseta	5	0.5%
% RA Culiseta	0.5%	
Trap Total	1,098	100.0%
Average # of Total Mosquitoes per Trapnight	84	
Average # of Culex per Trapnight	77	

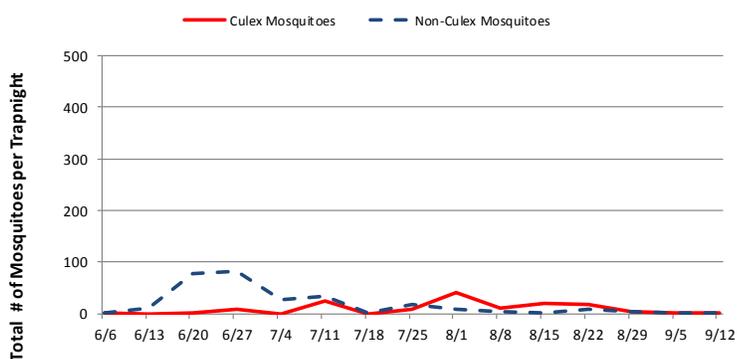
*%RA= Percent Relative Abundance



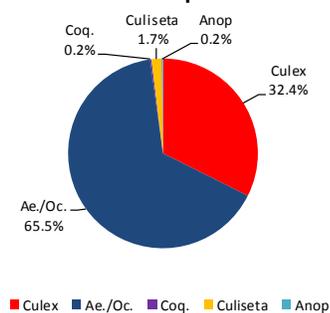
BC-40 Chance Acres

Trap ID/Trap Location	BC-40/Chance Acres	
Trap Type	CDC Light	
Total # of Trapnights	15	
Species	Number	%RA*
<i>Culex pipiens</i>	15	3.6%
<i>Culex tarsalis</i>	119	28.7%
Total Culex	134	32.4%
% RA Culex	32.4%	
<i>Aedes vexans</i>	123	29.7%
<i>Oc. dorsalis</i>	3	0.7%
<i>Oc. inreptus</i>	54	13.0%
<i>Oc. melanimon</i>	34	8.2%
<i>Oc. trivittatus</i>	57	13.8%
Total Aedes/Ochlerotatus (Ae./Oc.)	271	65.5%
% RA Ae./Oc.	65.5%	
<i>Anopheles spp.</i>	1	0.2%
Total Anopheles	1	0.2%
% RA Anopheles	0.2%	
<i>Coquillettidia perturbans</i>	1	0.2%
Total Coquillettidia (Coq.)	1	0.2%
% RA Coquillettidia	0.2%	
<i>Culiseta inornata</i>	7	1.7%
Total Culiseta	7	1.7%
% RA Culiseta	1.7%	
Trap Total	414	100.0%
Average # of Total Mosquitoes per Trapnight	28	
Average # of Culex per Trapnight	9	

*%RA= Percent Relative Abundance



Genus Composition



APPENDIX C - 2016 ADULT CONTROL APPLICATIONS





**Boulder County
Mosquito Control District**

2016 Season

Adult Mosquito Control Summary

Truck Mounted ULV

Area	Material	Start Time	End Time	Route Miles¹	Spray Miles²	Ounces Applied³
Boulder Hills	Aqualuer 20-20	6/15/2016 20:36	6/15/2016 21:16	5.0	2.7	69.6
Brigadoon Glen/Rangeview/Oriole	Aqualuer 20-20	6/15/2016 21:29	6/15/2016 22:35	10.5	4.8	121.7
Boulder Hills	Aqualuer 20-20	6/22/2016 21:17	6/22/2016 21:48	4.9	2.9	72.4
Brigadoon Glen/Rangeview/Oriole	Aqualuer 20-20	6/22/2016 21:56	6/22/2016 22:55	11.1	4.9	125.2
Orange Orchard/Pleasant Ridge	Aqualuer 20-20	6/22/2016 23:11	6/22/2016 23:29	2.9	1.6	39.1
Cottonwood Kennels to 75th	Aqualuer 20-20	6/22/2016 23:45	6/22/2016 23:55	0.6	0.5	11.3
Willow Glen and Fox Run	Aqualuer 20-20	6/23/2016 0:03	6/23/2016 0:16	1.8	1.3	32.5
Crane Hollow Road	Aqualuer 20-20	6/29/2016 20:14	6/29/2016 20:48	1.7	1.1	26.7
Boulder Hills	Aqualuer 20-20	6/29/2016 21:07	6/29/2016 21:43	5.3	3.1	77.8
Brigadoon Glen/Rangeview/Oriole	Aqualuer 20-20	6/29/2016 21:51	6/29/2016 22:50	9.4	4.5	113.9
Willow Glen and Fox Run	Aqualuer 20-20	6/29/2016 23:14	6/29/2016 23:29	1.8	1.2	29.4
Park Lake	Aqualuer 20-20	6/29/2016 23:33	6/29/2016 23:50	2.5	1.4	33.7
Hygiene Heights	Aqualuer 20-20	7/6/2016 20:40	7/6/2016 21:43	10	4.1	104.8
Gunbarrel Green	Aqualuer 20-20	7/6/2016 22:22	7/6/2016 22:52	5.4	3.7	94.1
South Meadow Gunbarrel Green	Aqualuer 20-20	7/6/2016 23:07	7/6/2016 23:29	3.6	2.2	54.9
Valmont and 75th	Aqualuer 20-20	7/6/2016 23:38	7/7/2016 0:20	3.8	2.4	61.8
Willow Glen and Fox Run	Aqualuer 20-20	7/7/2016 0:41	7/7/2016 0:55	2.2	1.5	38.7
Park Lake	Aqualuer 20-20	7/7/2016 1:04	7/7/2016 1:18	2.3	1.5	36.6
Red Fox Hills	Aqualuer 20-20	7/13/2016 20:24	7/13/2016 20:42	2.1	1.1	29.4
Gunbarrel Green	Aqualuer 20-20	7/13/2016 20:51	7/13/2016 21:24	6.1	3.8	96.1
South Meadow Gunbarrel Green	Aqualuer 20-20	7/13/2016 21:31	7/13/2016 21:48	3	1.9	48.7
Valmont and 75th	Aqualuer 20-20	7/13/2016 21:59	7/13/2016 22:21	4.3	2.2	55.7
Park Lake	Aqualuer 20-20	7/13/2016 22:32	7/13/2016 22:51	4	1.9	46.9
Willow Glen and Fox Run	Aqualuer 20-20	7/13/2016 23:01	7/13/2016 23:14	1.8	1.3	31.7
Divide Reservoir	Aqualuer 20-20	7/13/2016 20:18	7/13/2016 20:48	3.8	1.9	46.9
Hygiene Heights	Aqualuer 20-20	7/13/2016 21:08	7/13/2016 21:45	6.1	2.8	72
Boulder Hills	Aqualuer 20-20	7/13/2016 21:58	7/13/2016 22:54	5.9	2.9	74.4
Brigadoon Glen/Rangeview/Oriole	Aqualuer 20-20	7/13/2016 23:03	7/14/2016 0:12	10.1	5	126.9
Boulder Hills	Aqualuer 20-20	7/20/2016 20:16	7/20/2016 20:45	4	2.7	103.1
Brigadoon Glen/Rangeview/Oriole	Aqualuer 20-20	7/20/2016 21:10	7/20/2016 21:33	2.2	0.5	18.9
Valmont and 75th	Aqualuer 20-20	7/20/2016 21:50	7/20/2016 22:13	4.3	2.4	91.8
Park Lake	Aqualuer 20-20	7/20/2016 22:24	7/20/2016 22:45	2.9	1.9	71
Willow Glen and Fox Run	Aqualuer 20-20	7/20/2016 22:52	7/20/2016 23:03	1.8	1.2	46.7
Hygiene Heights	Aqualuer 20-20	7/20/2016 20:31	7/20/2016 21:45	10.5	3.7	140.8
Yellowstone	Aqualuer 20-20	7/20/2016 21:58	7/20/2016 22:26	4.7	4.1	155
Heatherwood	Aqualuer 20-20	7/20/2016 22:57	7/21/2016 0:03	10.2	6.5	246.3
Brigadoon Glen/Rangeview/Oriole	Aqualuer 20-20	7/21/2016 22:54	7/21/2016 23:58	8	3.9	135.7
Boulder Hills	Aqualuer 20-20	7/27/2016 20:13	7/27/2016 20:51	5.4	3.2	121.6
Hygiene Heights	Aqualuer 20-20	7/27/2016 21:11	7/27/2016 21:50	7.1	3.7	140.5



**Boulder County
Mosquito Control District**

2016 Season

Adult Mosquito Control Summary

Truck Mounted ULV

Area	Material	Start Time	End Time	Route Miles ¹	Spray Miles ²	Ounces Applied ³
Niwot SE	Aqualuer 20-20	7/27/2016 22:34	7/27/2016 23:21	8.2	4.9	182.9
Niwot SW	Aqualuer 20-20	7/27/2016 22:06	7/27/2016 22:20	2.1	1.6	60.1
Valmont and 75th	Aqualuer 20-20	7/27/2016 23:36	7/28/2016 0:01	4.2	2.3	84.2
Willow Glen and Fox Run	Aqualuer 20-20	7/28/2016 0:08	7/28/2016 0:24	1.8	1.2	45.3
Park Lake	Aqualuer 20-20	7/28/2016 0:29	7/28/2016 0:49	2.9	1.8	69.3
Marhall Rd/Mesa Valley/Wildflower	Aqualuer 20-20	7/28/2016 1:07	7/28/2016 1:37	5.9	2.4	88.8
Yellowstone	Aqualuer 20-20	7/27/2016 20:51	7/27/2016 21:37	6.7	4.7	176
Hillcrest Heights	Aqualuer 20-20	7/27/2016 21:57	7/27/2016 22:26	4.9	2.6	98.3
Heatherwood	Aqualuer 20-20	7/27/2016 22:37	7/27/2016 23:35	11.5	6.1	229.5
South Meadow Gunbarrel Green	Aqualuer 20-20	7/27/2016 23:45	7/28/2016 0:19	3.9	1.8	62.9
Gunbarrel Green	Aqualuer 20-20	7/28/2016 0:42	7/28/2016 1:15	4.4	3.3	113.5
Red Fox Hills	Aqualuer 20-20	7/28/2016 1:38	7/28/2016 1:52	2	1.2	46.6
Willows	Aqualuer 20-20	7/28/2016 1:59	7/28/2016 2:26	3.1	1	29.7
Niwot NW	Aqualuer 20-20	8/3/2016 20:08	8/3/2016 20:57	5.6	2.8	103.2
Niwot SE	Aqualuer 20-20	8/3/2016 21:15	8/3/2016 22:07	9.1	4.8	180.3
Willows	Aqualuer 20-20	8/3/2016 22:30	8/3/2016 22:44	3.2	1.2	43.8
Gun Barrel Green	Aqualuer 20-20	8/3/2016 22:54	8/3/2016 23:25	4.4	3.4	129.3
Valmont and 75th	Aqualuer 20-20	8/3/2016 23:32	8/3/2016 23:52	4.3	2.2	81.2
Park Lake	Aqualuer 20-20	8/4/2016 0:01	8/4/2016 0:20	2.4	1.7	62.2
Willow Glen and Fox Run	Aqualuer 20-20	8/4/2016 0:25	8/4/2016 0:36	1.8	1.1	43.2
Marshall Rd/Mesa Valley/Wildflower	Aqualuer 20-20	8/4/2016 0:56	8/4/2016 1:19	5.7	2.3	87.2
Divide Reservoir	Aqualuer 20-20	8/3/2016 21:08	8/3/2016 21:38	3.1	1.7	64.8
Yellowstone	Aqualuer 20-20	8/3/2016 21:47	8/3/2016 22:17	4.7	4.1	155.1
Hygiene Heights	Aqualuer 20-20	8/3/2016 22:33	8/3/2016 23:08	6	3.4	127.6
Boulder Hills	Aqualuer 20-20	8/3/2016 23:22	8/3/2016 23:59	5.7	3.2	121.7
Brigadoon Glen/Rangeview/Oriole	Aqualuer 20-20	8/4/2016 0:12	8/4/2016 1:29	13.2	5	186.5
Hillcrest Heights	Aqualuer 20-20	8/4/2016 1:41	8/4/2016 2:08	5	3	111.1
Heatherwood	Aqualuer 20-20	8/4/2016 2:20	8/4/2016 3:19	10	6.6	250.1
Hillcrest Heights	Aqualuer 20-20	8/10/2016 20:28	8/10/2016 20:59	5.8	3	114.1
Boulder Hills	Aqualuer 20-20	8/17/2016 20:26	8/17/2016 20:57	11.9	3.4	128.1
Hygiene Heights	Aqualuer 20-20	8/17/2016 21:15	8/17/2016 21:53	8	3.5	131.2
Anhawa Manor	Aqualuer 20-20	8/17/2016 22:00	8/17/2016 22:30	6.7	3.8	142
Hillcrest Heights	Aqualuer 20-20	8/17/2016 22:45	8/17/2016 23:10	5.3	3.1	116.3
Niwot NW	Aqualuer 20-20	8/17/2016 23:20	8/17/2016 23:54	5.5	3.3	124.8
Niwot SE	Aqualuer 20-20	8/17/2016 23:59	8/18/2016 0:42	8.4	5	188.4
Park Lake	Aqualuer 20-20	8/18/2016 1:00	8/18/2016 1:19	2.9	1.9	70.4
Willow Glen and Fox Run	Aqualuer 20-20	8/18/2016 1:25	8/18/2016 1:35	1.8	1.3	48.2
Heatherwood	Aqualuer 20-20	8/17/2016 20:03	8/17/2016 21:18	11.7	6.9	258.3
South Meadow Gun Barrel Green	Aqualuer 20-20	8/17/2016 21:23	8/17/2016 21:43	3.4	2	73.6
Gun Barrel Green	Aqualuer 20-20	8/17/2016 21:49	8/17/2016 22:17	4.4	3.5	130.2
Red Fox Hills	Aqualuer 20-20	8/17/2016 22:21	8/17/2016 22:35	2	1.2	45.4
Willows	Aqualuer 20-20	8/17/2016 22:49	8/17/2016 23:08	3.4	1.1	42
Valmont and 75th	Aqualuer 20-20	8/17/2016 23:14	8/17/2016 23:37	5.1	2.3	85.2
Hygiene Heights	Aqualuer 20-20	8/24/2016 19:51	8/24/2016 20:28	6.6	3.4	128.1



**Boulder County
Mosquito Control District**

2016 Season

Adult Mosquito Control Summary

Truck Mounted ULV

Area	Material	Start Time	End Time	Route Miles ¹	Spray Miles ²	Ounces Applied ³
Gun Barrel Green	Aqualuer 20-20	8/24/2016 20:53	8/24/2016 21:26	4.5	3.3	122.3
Red Fox Hills	Aqualuer 20-20	8/24/2016 21:32	8/24/2016 21:44	1.9	1.2	44.7
Valmont and 75th	Aqualuer 20-20	8/24/2016 21:50	8/24/2016 22:12	3.9	2.4	88.5
Valmont and 75th	Aqualuer 20-20	8/31/2016 20:15	8/31/2016 20:34	4.3	2.3	85.1

Total:	446.4	243.3	8,245.6
Average:	5.1	2.8	94.8
Minimum:	0.6	0.5	11.3
Maximum:	13.2	6.9	258.3

Notes:

1. Includes entire mileage of route, including both ULV spray-on and spray-off miles; should be used when comparing 2016 data to historical data.
2. Only includes ULV spray-on mileage (excludes shutoffs, turnarounds, etc.)
3. Ounces of Aqualuer 20-20 and water applied at a 1:3 dilution rate

Historical BCMCD Annual Totals

Average	444.9
Minimum	71.6
Maximum	725.2

APPENDIX D - 2016 PROGRAM TIME EXPENDITURES BY CATEGORY



2016 PROGRAM TIME EXPENDITURES BY CATEGORY

<u>Program Category</u>	<u>Approximate Hours</u>	<u>Percentage</u>
Larval Surveillance & Control	9,797	88%
Adult Surveillance & Laboratory	695	6%
Adult ULV Control	196	2%
<u>Public Education/Relations and Reporting</u>	<u>440</u>	<u>4%</u>
Total	11,128	100%