2006 West Nile Virus Season Report

Prepared for:

City of Boulder
Office of Environmental Affairs
PO Box 791
Boulder, Colorado 80306

Prepared by:

OtterTail Environmental, Inc.
1045 N. Ford St.
Golden, CO 80403
Phone: 303-858-8350

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EXECUTIVE SUMMARY

For the 2006 mosquito season, the city of Boulder contracted OtterTail Environmental, Inc. to operate a WNV vector control program to protect public health from the effects of West Nile Virus (WNV). This report provides a summary of the 2006 program.

West Nile Virus is a disease that was first detected in the United States during the summer of 1999 in New York City and has since spread westward across the U.S. West Nile Virus is maintained in the bird population. Mosquitoes are usually not carriers of WNV until they bite an infected bird. An infected mosquito may then pass the virus on to humans, horses and other animals through an additional bite. While many of the people who contract WNV experience no or very mild symptoms, WNV infection can result in severe and sometimes fatal illnesses.

There are over 50 species of mosquitoes in Colorado, yet only species from the genus Culex are known to be effective transmitters of the virus, also known as vectors. Following Integrated Pest Management principles, the city of Boulder and OtterTail Environmental focused on controlling vector populations and thereby the protection of the public health from WNV. Through surveillance of potential mosquito breeding sites (e.g., wetland areas, water bodies, stream margins, and ditches), areas identified as containing larvae of the vector species were identified and treated with *Bacillus thuringiensis israelensis* (*Bti).* This method of targeting prevents the mosquitoes from developing into adults and transmitting the virus, and is the most efficient and environmentally friendly way to reduce vector populations. Only the areas where the target vector species were found received Bti treatments; areas with only nonvector species were bypassed. This approach reduced the impact to many wetland environments from repeated applications of *Bti* because many of the mosquito breeding sites only bred Culex mosquitoes for a limited portion of the season. Since sites breeding only nonvector larvae were not treated, control material costs, and the time needed to apply them, were saved. An increase in labor time was needed as compared to nuisance focused control to differentiate between vector vs. nonvector larvae, but these costs are outweighed by the increase in early WNV warning that larval vector identification provides. Because larvae obviously show up before adults, if vector larvae are identified it gives us approximately two weeks more notice than if only adults are identified. In addition, control of larvae limits the possible future need for nonbiological control of adult mosquitoes such as ultra-low volume (ULV) pesticide spraying. Adulticiding is not only typically more harmful to the environment than larviciding; it is also much less effective at reducing mosquito numbers.

The 2006 program started in mid-May with larval surveillance and the first larval treatment occurred on May 31, 2006. At the end of the season, the project area included 473 sites totaling 2,976 acres consisting of city-owned lands within the city limits (approximately 571 acres) and city-owned lands outside of the city limits (approximately 2,405acres). Approximately 2,689 acres were Open Space and Mountain Parks lands (**Appendix A, Map A-1**). Of these 473 sites, 26 sites were found to be breeding only vector species, 64 sites were found to breeding nonvector and vector species, 41 sites were found to be breeding only nonvector species, and 342 potential breeding habitat sites were not found to be breeding mosquitoes over the course of the 2006 season.

In addition to larval mosquito surveillance and control treatments, the city of Boulder monitored adult mosquito activity within the area with 16 adult mosquito traps. These trap collections enabled OtterTail to provide adult mosquito samples to the Colorado Department of Public Health and Environment (CDPHE) which tested mosquitoes weekly for the presence of WNV.

The State of Colorado, Boulder County and the city of Boulder experienced a significant resurgence of WNV activity in 2006. Human WNV case counts and the number of WNV positive mosquito pools were at their highest levels since the epidemic year of 2003. An early high abundance of Culex mosquitoes, along with warmer temperatures throughout the 2006 season, was likely a leading cause for the increase of WNV

activity throughout the region during 2006. Even though there was a significant increase in WNV activity in the region, it is likely that the city of Boulder's intensive larval control program, combined with education and personal protection measures, helped reduce the mosquito populations, the WNV activity levels and the number of cases in the area during 2006.

The public was well aware of the threat of WNV during the 2006 season due to continued public outreach. Widespread distribution of educational materials and periodic press releases to the local media stressed the importance of personal protection and habitat reduction on private properties.

1.0 INTRODUCTION

For the 2006 mosquito season, the city of Boulder contracted OtterTail Environmental, Inc. to operate the West Nile Virus (WNV) vector management program to protect public health and biological resources from the effects of WNV. This was the fourth year of the city of Boulder's vector mosquito control program. For background information about WNV and mosquito control in Boulder, please reference the 2006 City of Boulder West Nile Virus Mosquito Management Plan (WNV MMP) and the 2005 West Nile Virus Season Report (www.environmentalaffairs.com). This report provides a summary of the 2006 efforts.

The city's primary goal was the same as in previous seasons; to protect public health from the effects of WNV. To accomplish this goal, specific objectives have been established for the program. First, the city of Boulder wanted to continue to prioritize mosquito habitats by determining which ones had the highest potential for mosquito breeding and then monitor and treat those sites when vector larvae were present. Second, since vector larvae were being identified, they wanted to use this as a tool to provide an early warning of any upcoming adult vector populations. Third, they wanted to monitor adult mosquito populations. This is done by speciation, population counts, and testing for WNV in trapped vector specimens, to provide an early warning system for the occurrence and severity of WNV activity in the program area. The city 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 integrated mosquito management (IMM) program and provides a detailed summary of the results of this year's effort.

2.0 WEST NILE VIRUS UPDATE

Since the introduction of West Nile Virus to the United States in 1999, the virus quickly spread westward and has been detected in all states except for Alaska and Hawaii. For the 2006 season, there were 4,256 WNV human cases and 165 WNV related deaths in 41 states and the District of Columbia (**Table 1**). This is a 42% increase in national cases from the 2005 season. (CDC 2007)

During the 2003 WNV epidemic, Colorado led the U.S. in WNV cases and then experienced a significant decrease in WNV cases in 2004 and 2005. During the 2006 mosquito season, Colorado had a resurgence of cases and was ranked second only to Idaho in the national case count, reporting 345 WNV human cases and 7 WNV related deaths (CDPHE 2007). This season, WNV cases were sporadically located throughout the state with higher concentrations along the populous regions of the Front Range and Western Slope. Boulder and Weld Counties reported the highest number of cases (74 and 68) in Colorado (CDPHE 2007). Seven WNV related deaths were reported from six Colorado counties in 2006 (**Table 2**).

Table 1 WNV Incidence, 2003-2006

Total WNV Human Cases	2003	2004	2005	2006
Cases in the United States[1]	9,862	2,539	3,000	4,256
Deaths in the United States[1]	264	100	119	165
Cases in Colorado[2]	2,947	291	106	345
Deaths in Colorado[2]	63	4	2	7
Cases in Boulder County[2]	421	14	5	74
Deaths in Boulder County[2]	7	0	0	1
Total WNV Positive Results	**2003**	**2004**	**2005**	**2006**
Mosquito Pools in Boulder County[2]	118	8	0	107
Birds in Boulder County[2]	50	0	1	12
Horses in Boulder County[2]	18	0	0	1
Mosquito Pools in the City of Boulder	43	0	0	12

1. Reported by the Center for Disease and Control (CDC); 2006 data reported as of March 6, 2007.
2. Reported by the Colorado Department of Public Health and Environment (CDPHE); 2006 data reported as of February 12, 2007.

In 2006, the total number of human WNV infections reported in Boulder County was significantly higher than those in 2004 and 2005 (**Table 1**). There was a total of 74 cases and one death reported by the Colorado Department of Public Health and Environment. As in years past, the city of Boulder and Boulder County continued to conduct a very intensive mosquito testing program. With the widespread and frequent testing throughout the county, 107 pools of mosquitoes tested WNV positive, which was significantly more than most other counties in Colorado (**Table 2**). The increase of human infections and WNV activity in Colorado may be attributed to the temperature and precipitation patterns observed during the 2006 mosquito season and the affect they had on mosquito populations, as discussed further in **Section 3.0**.

Table 2 Colorado WNV Human Cases, Human Deaths, and WNV Positive Mosquito Pools, 2006 [1]

County	Human Cases		Human Deaths		Mosquito Pools	
	#	% of Cases	#	% of State	#	% of State
Adams	11	3.2%	0	0.0%	16	3.6%
Alamosa	0	0.0%	0	0.0%	4	0.9%
Arapahoe	2	0.6%	0	0.0%	7	1.6%
Bent	3	0.9%	0	0.0%	1	0.2%
Boulder	74	21.4%	1	14.3%	107	23.9%
Broomfield	6	1.7%	0	0.0%	7	1.6%
Crowley	2	0.6%	0	0.0%	5	1.1%
Delta	34	9.9%	1	14.3%	20	4.5%
Denver	5	1.4%	0	0.0%	5	1.1%
Eagle	1	0.3%	0	0.0%	0	0.0%
Elbert	2	0.6%	0	0.0%	2	0.4%
El Paso	5	1.4%	0	0.0%	4	0.9%
Fremont	1	0.3%	0	0.0%	0	0.0%
Garfield	2	0.6%	0	0.0%	1	0.2%
Jefferson	8	2.3%	1	14.3%	7	1.6%
La Plata	2	0.6%	0	0.0%	1	0.2%
Larimer	42	12.2%	1	14.3%	106	23.7%
Las Animas	0	0.0%	0	0.0%	3	0.7%
Logan	7	2.0%	0	0.0%	0	0.0%
Mesa	38	11.0%	2	28.6%	24	5.4%
Montrose	13	3.8%	0	0.0%	0	0.0%
Morgan	2	0.6%	0	0.0%	5	1.1%
Otero	3	0.9%	0	0.0%	13	2.9%
Phillips	1	0.3%	0	0.0%	0	0.0%
Prowers	5	1.4%	0	0.0%	14	3.1%
Pueblo	7	2.0%	0	0.0%	11	2.5%
Weld	68	19.7%	1	14.3%	85	19.0%
Yuma	1	0.3%	0	0.0%	0	0.0%
Total	**345**		**7**		**448**	

1. Reported by CDPHE as of February 12, 2007

The number of human WNV cases and WNV positive mosquito pools comprised approximately 23.9% and 21.4% of the state totals **(Table 2)**, which was comparable to the viral activity of mosquito pools and case counts of nearby Larimer and Weld Counties, but much higher than other nearby counties along the Front Range. When population is taken into account, the data over the past several years show that Boulder, Weld, and Larimer Counties are consistently higher in viral activity than many other areas along the Front Range. As shown in **Table 3**, these three counties have all ranked in the top five counties with the highest occurrence of human cases in each of the past four years, which suggests that this area is the natural epicenter of WNV activity for the Front Range area. One likely reason for this trend is the large amount of irrigated agricultural lands within these counties. The irrigation process has the potential to create a large

number of mosquito breeding sites which can then stagnate and become conducive to Culex mosquito breeding, as discussed further in **Section 3.0**.

Although there was an obvious increase in activity during 2006, it is likely that widespread larval control efforts combined with education and personal protection measures helped reduce the number of mosquitoes and limit disease transmission within the city of Boulder and Boulder County.

Table 3 Human WNV Crude Attack Rates[1] of Front Range Region Counties, 2003 – 2006

County	2003		2004		2005		2006	
	Crude Attack Rates	Rank	Crude Attack Rates	Rank	Crude Attack Rates	Rank	Crude Attack Rates	Rank
Adams	58.08	7	3.76	3	1.00	7	2.75	7
Arapahoe	26.08	10	0.00	-	0.38	10	0.38	11
Boulder	150.12	4	4.99	2	1.78	5	26.39	2
Broomfield	126.50	5	0.00	-	0.00	12	13.80	4
Denver	29.04	9	0.54	8	0.90	8	0.90	9
Douglas	15.64	12	0.40	9	0.40	9	0.00	12
El Paso	20.16	11	0.35	10	0.18	11	0.88	10
Jefferson	29.80	8	1.52	7	1.14	6	1.52	8
Larimer	200.79	2	6.25	1	4.78	3	15.45	3
Morgan	217.90	1	3.57	4	14.29	1	7.14	5
Pueblo	120.93	6	2.64	6	3.30	4	4.63	6
Weld	175.59	3	3.49	5	7.43	2	29.70	1

1. WNV human case information used for Crude Attack Rate calculations was obtained from CDPHE (CDPHE 2007); Population information for Crude Attack Rate calculations was obtained from U.S. Census Bureau 2005 statistics (USCB 2007); Crude Attack Rates are listed as cases per 100,000 people.

3.0 2006 CLIMATOLOGICAL DATA AND MOSQUITO ACTIVITY OVERVIEW

The weather patterns leading into and during the mosquito breeding season are important factors that influence mosquito abundance and WNV activity. The following section describes the local climate in Boulder, the weather during the season, and how that may have affected the mosquito populations.

The city of Boulder is located in a semi-arid environment at an elevation of approximately 5,340 feet. The mosquito season for the city's program area is from April to October. Current and historical climate data from the National Oceanic and Atmospheric Administration was used for temperature and precipitation patterns. Historical records for the mean monthly temperature show that temperatures usually have a steady increase from April to July, making July, on average, the hottest month of the year. There is then typically a steady decrease into September. Monthly mean precipitation for the same time period indicates that April, May and June are typically the wettest months of the year, with their mean monthly precipitations measuring 2.9, 3.1 and 2.1 inches, respectively. **Figure 1** and **Figure 2** graphically represent the average temperature and precipitation for the period of record and for the year 2006 (NOAA 2007).

During 2006, temperatures were above average throughout the majority of the mosquito season. The key months of April, May and June were significantly warmer with mean temperatures 10%, 5% and 7% higher than the historical averages. The mean monthly average temperatures during the months of July and August continued to be 2% and 1% above normal before decreasing to a below normal average in September.

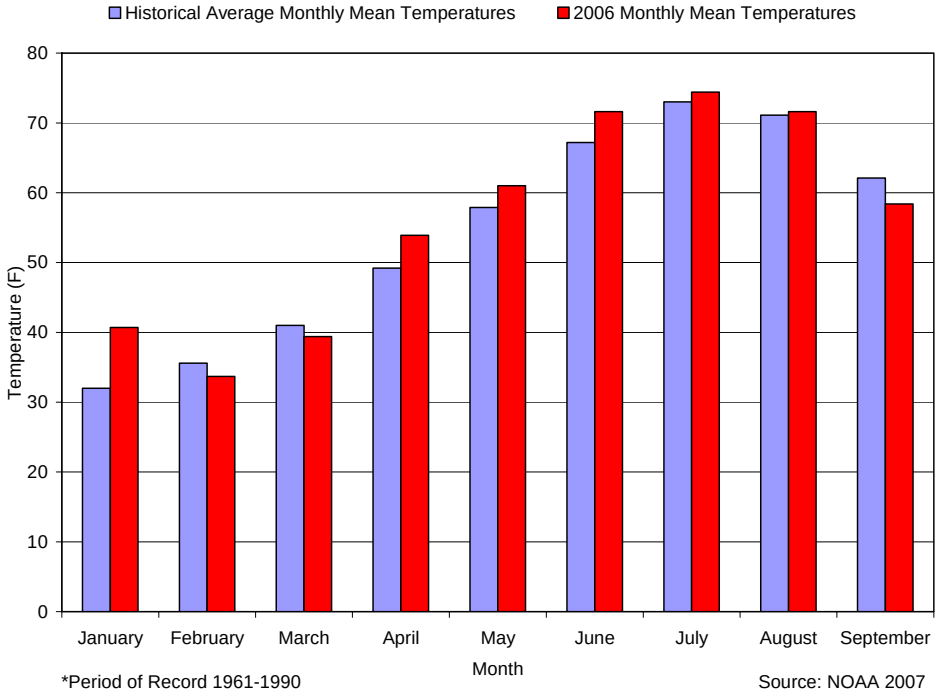
During 2006, the accumulated precipitation from January through September was below the historical average of accumulated precipitation for the same period. From January to September of 2006 there was an accumulation of 11.8 inches. This is approximately 71% of the normal accumulation for this time period when compared to the historical average, which is 16.7 inches. Seven of the nine months received precipitation amounts lower than their normal averages. The most significant variations were the months of April, May, and June which only received 36%, 37%, and 65% of their average amounts. July received 36% more precipitation than average, making it the only month during the mosquito season that received more precipitation than average (NOAA 2007).

The early season was much drier and warmer than normal during 2006. The lack of typical spring rainfalls led to less of the natural floodwater type mosquito habitats being inundated with water. Although there were less habitat areas wet during the early part of the season, a higher percentage of those that were wet were Culex type mosquito habitats. The majority of these habitat areas were marshes, wetlands, and other areas that already had water in them early in the year. As these habitats began to stagnate from the warm temperatures they became much more conducive to breeding Culex mosquitoes. This led to higher Culex populations earlier than normal in the season. The early high abundance of Culex mosquitoes along with the warmer temperatures throughout the 2006 season was likely a leading cause of the resurgence in WNV activity throughout the region during 2006. With the high populations of Culex and warm temperatures during the month of June, the WNV cycle was allowed an earlier start and magnified at a quicker rate than during a year with the typical climatic conditions.

During the early portion of the mosquito season, many of the flood irrigated properties around Boulder were inundated with water, filling potential mosquito breeding habits that were previously dry. Consequently, there was a significant rise in floodwater type mosquito populations in June. July received more precipitation than normal and had several storm events that flooded many of the natural habitat areas that were dry during the early portion of the season. Some of these areas that were filled by flood irrigation and July rainfalls then began to stagnate and produce Culex mosquito larvae during the month of August. This added to the early season Culex populations and helped intensify the late season WNV activity in the area.

Mosquito and WNV activity then decreased sharply in September as the night and day time temperatures decreased.

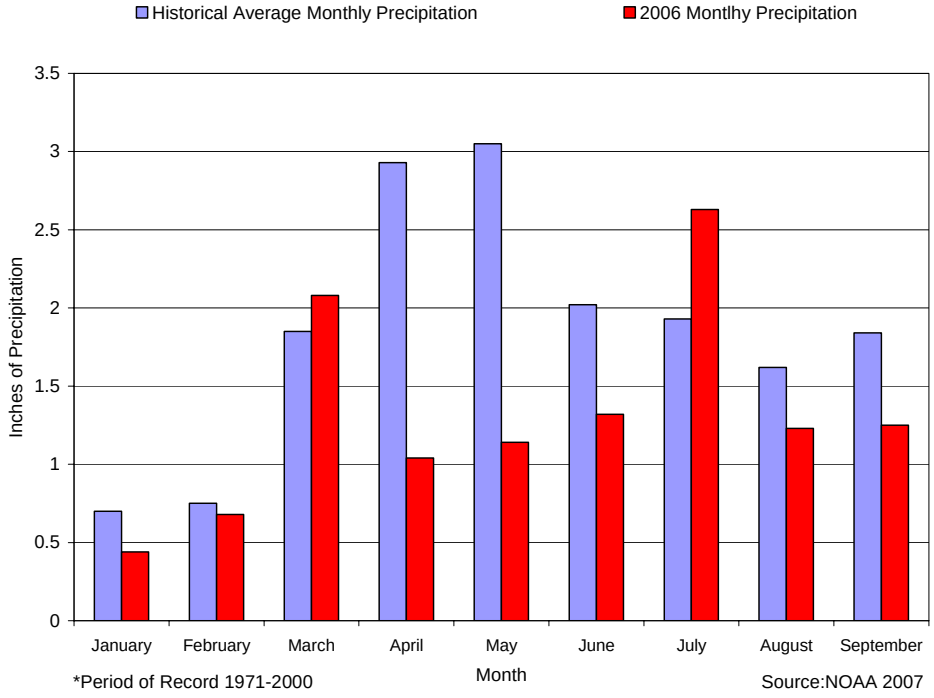
Figure 1 2006 Monthly Mean Air Temperature with the Historical Average*



*Period of Record 1961-1990

Source: NOAA 2007

Figure 2 2006 Monthly Total Precipitation Data with the Historical Average*



*Period of Record 1971-2000

Source:NOAA 2007

4.0 LARVAL MOSQUITO SURVEILLANCE AND CONTROL

LARVAL SURVEILLANCE AND CONTROL RESULTS AND DISCUSSION

The 2006 larval surveillance season started in mid-May and ended in mid-October. Monitoring for larvae throughout the project area and larval species identification determined whether control was needed. Although adult mosquitoes reduce their feeding on mammals following peak season (July - August), OtterTail continued larval surveillance and control until mid-October. This was done to reduce the vector population, which has the ability to overwinter, leading to a potential reduction of the initial population in 2007.

During the season, a total of 473 potential breeding sites were inspected at least once within the entire project area (**Appendix A, Map A-1**) and 3,843 individual larval site visits were performed. Of the total potential breeding sites, 90 sites bred vector mosquito larvae during the 2006 season (see **Table 4**). As the season progressed, the sites were categorized and inspected according to larval abundance and occurrence per the city of Boulder WNV MMP. High priority breeding sites had vector larvae when sampled and were generally inspected every 7 to 10 days during the peak season. Approximately 200 acres of active vector breeding habitat were identified and treated at 90 sites within the entire project area in 2006. Many of these sites bred vector larvae multiple times during the season, causing the treated acres at certain sites to be counted multiple times for the season total. For a detailed explanation of the larval surveillance methodology used during the 2006 season, please see the 2006 City of Boulder West Nile Virus Mosquito Management Plan (www.environmentalaffairs.com).

Table 4 Larval Surveillance Summary, 2003 - 2006

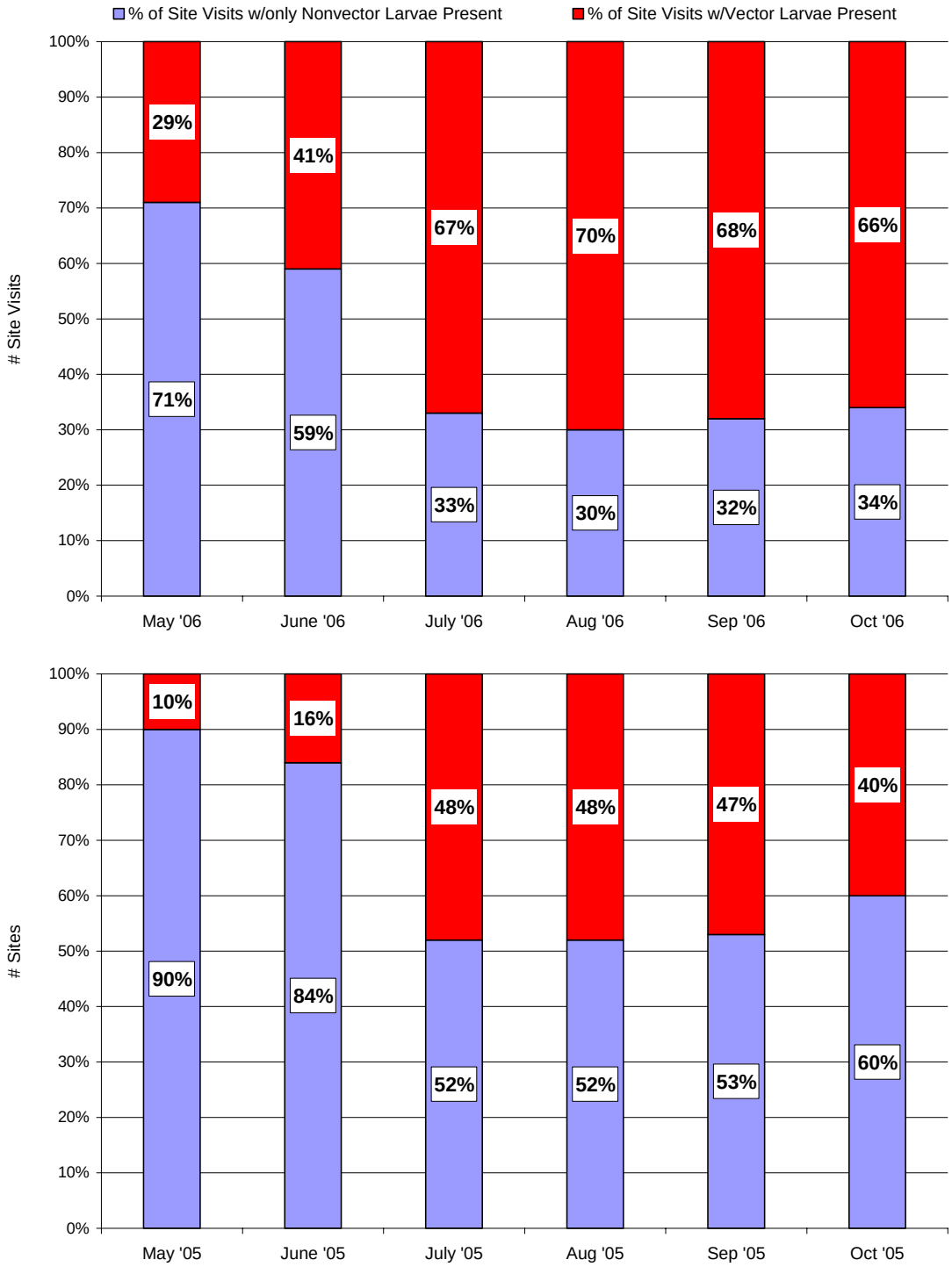
Larval Site Surveillance Totals	2003	2004	2005	2006
Potential breeding sites	278	463	467	473
Actual Total breeding sites (vector and nonvector)	104	222	213	131
Vector breeding sites	74	124	106	90
Site investigations	1,871	3,288	6,308	3,843
Site treatments	196	222	284	266
Potential breeding site acreage	1,949	2,976	2,955	2,976
Treated acreage	294	205	136	200

To help understand patterns of larval species presence throughout the season, the numbers of site visits with larvae present were used to represent relative larval abundance during the season (**Figure 3**). These numbers were compared to the results from the 2005 season, which, based upon past data, is thought to be a relatively normal year for local mosquito activity. The methodology used in the larval surveillance and control program, as previously discussed, is focused towards Culex larval habitat. Therefore, these numbers are biased towards finding a higher prevalence of Culex mosquito larvae and should only be used to compare the abundances between the two years and should not be used in determining the overall larval abundance of the city of Boulder mosquito populations.

In 2006, each month's overall larval numbers show vector mosquitoes having a significantly higher abundance of larvae when compared to what was found in each of those months during 2005. This was particularly significant during the early portion of the season. The overall larval numbers for May and June of 2006 show vector mosquitoes having a higher abundance at 29% and 41% compared to only 10% and 16% for May and June of 2005. The higher early season vector larvae abundance in 2006 is likely due to the dry and warm early portion of the season as discussed in **Section 3.0**. What these high vector percentages suggest is that a substantial number of adult vector mosquitoes would have become airborne, which would have likely increased WNV activity, had the larval control program not been implemented.

The general pattern observed during the season was high abundance of vector larvae during the early part of the season, an increase in floodwater species following the initial flood irrigation events and July rainstorms, followed again by vector species breeding. *Aedes vexans*, the main nonvector floodwater species, was observed directly after the flood irrigation events and after significant storm events in July and August. Vector species were then usually detected 7 to 10 days later if the water was not dried up or flushed thereby becoming stagnant. Natural wetlands followed a filling, drying, and refilling pattern as the season progressed. These breeding sites were mostly wet early in the season then alternately dried up and then refilled during periods of rain later in the summer.

Figure 3 Percentages of Site Visits w/only Nonvector and Vector Larvae per Month, 2005 - 2006



5.0 ADULT MOSQUITO AND WNV SURVEILLANCE

ADULT MOSQUITO SURVEILLANCE RESULTS AND DISCUSSION

Adult mosquito population surveillance is a crucial component of any successful IMM program. Adult surveillance can provide information on what types of mosquito species are in an area as well as information on their abundance. Adult mosquito surveillance is also critical to disease surveillance. Mosquitoes collected from the mosquito traps can be tested for a variety of mosquito borne diseases, including WNV.

Adult mosquito traps were placed and monitored at 16 sites around the city starting the first week in June through the end of 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. Refer to the 2006 City of Boulder West Nile Virus Mosquito Management Plan (www.environmentalaffairs.com) for details about site selection and trap methods.

Four gravid traps and twelve light traps were set so that each would cover an approximately one-mile radius (**Appendix A, Map A-2**). The city cooperated with the University of Colorado (CU) and Boulder County Public Health Department (BCPH) in order to provide complete surveillance coverage for the city. The 16 city traps, in combination with Boulder County and CU traps, provided comprehensive surveillance of the Boulder urban area.

The city of Boulder's adult trapping and testing of mosquito pools began on June 6 and ended on September 26. The 12 light traps collected a variety of mosquito species and the 4 gravid traps collected mostly vector species throughout the season. A total of 22,153 mosquitoes were trapped in these sixteen traps during the 2006 season. The total adults collected during the season resulted in Aedes and Ochlerotatus species (84.7 percent) being the most abundant, followed by Culex (vector) species (12 percent), Culiseta species (2.1 percent), Coquillettida species (1.2 percent), and finally Anopheles species (0.005 percent) as shown in **Table 5**. This results in 12% WNV vector vs. 88% nonvector adults total being collected over the entire season. As shown in **Table 6**, there was an average of 86 total adult mosquitoes per trap per night and an average of 10 adult vector mosquitoes per trap per night, which are the highest numbers since 2003.

The early mosquito season was much drier and warmer than normal during 2006. This lack of the typical spring rainfalls led to less natural floodwater type mosquito habitats being inundated with water and correspondingly resulted in lower early season nonvector adult populations in most areas along the Front Range. However, as shown in **Figure 4**, even though the amount of early season precipitation was much lower than normal, nonvector species adult mosquito populations peaked in mid-June in the city of Boulder. This was much earlier in the season than most other areas along the Front Range, which experienced significantly lower early season populations of nonvector mosquitoes. This large local population of nonvector mosquitoes was likely driven by local flood irrigated lands being inundated with water earlier in the season, causing the population spike. There were then secondary peaks of nonvector species following several storm events with high amounts of precipitation in July and early August.

With the lack of early season rainfall, there were less natural habitat areas wet during the early part of the season, but a higher percentage of those that were present were stagnant Culex type mosquito habitats. This led to higher Culex adult populations earlier in the season than normal. Several storm showers then occurred in July that flooded many of the natural habitat areas that were dry during the early portion of the season. Some of these areas that were filled by the July rainfalls then began to stagnate and produce Culex mosquitoes, which peaked in mid-August. As is typical, populations quickly dropped in September as temperatures decreased (**Figure 4**).

Table 5 Total Number of Adult Mosquitoes per Trap for the Entire 2006 Season[1]

Trap Name, (Type), and Location	*Culex spp.*		*Ae./Oc. Spp.*		*Anopheles spp.*		*Coquillettidia spp.*		*Culiseta spp.*		Trap Total	Trap %RA
	#	%RA	#	%RA	#	%RA	#	%RA	#	%RA		
HO (Light) Rolling Rock Ranch	111	3.1%	3,487	96.2%	0	0.0%	4	0.1%	21	0.6%	**3,623**	16.4%
H2 (Light) Sombrero Marsh	414	6.1%	6,025	88.8%	0	0.0%	3	0.0%	342	5.0%	**6,784**	30.6%
H4 (Light) Papini	195	42.7%	253	55.4%	0	0.0%	1	0.2%	8	1.8%	**457**	2.1%
H5 (Light) Tom Watson Park	312	27.0%	841	72.8%	0	0.0%	2	0.2%	1	0.1%	**1,156**	5.2%
H6 (Light) Sawhill Ponds	231	5.3%	3,849	87.6%	1	0.0%	252	5.7%	63	1.4%	**4,396**	19.8%
C1(Light) Locust/10th	49	50.0%	46	46.9%	0	0.0%	0	0.0%	3	3.1%	**98**	0.4%
C2 (Light) 23rd/Meadow	18	33.3%	34	63.0%	0	0.0%	0	0.0%	2	3.7%	**54**	0.2%
C3 (Light) Christensen Park	355	14.7%	2,050	85.1%	0	0.0%	1	0.0%	2	0.1%	**2,408**	10.9%
C4 (Light) South Boulder Rec. Center	62	16.4%	303	79.9%	0	0.0%	0	0.0%	14	3.7%	**379**	1.7%
C5 (Light) Broadway / Baseline	66	70.2%	27	28.7%	0	0.0%	0	0.0%	1	1.1%	**94**	0.4%
C6 (Light) Broadway / Alpine	1	9.1%	10	90.9%	0	0.0%	0	0.0%	0	0.0%	**11**	0.0%
C7 (Gravid) Table Mesa / Stevens	89	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	**89**	0.4%
C8 (Gravid) 7th / Pennsylvania	145	98.0%	1	0.7%	0	0.0%	0	0.0%	2	1.4%	**148**	0.7%
C9 (Gravid) Columbine Park	57	90.5%	5	7.9%	0	0.0%	0	0.0%	1	1.6%	**63**	0.3%
C10 (Gravid) Comanche / Mohawk Dr.	157	98.7%	1	0.6%	0	0.0%	0	0.0%	1	0.6%	**159**	0.7%
C11 (Light) Stazio Ballfields	405	18.1%	1,822	0.0%	0	0.0%	2	0.1%	5	0.2%	**2,234**	10.1%
Total	**2,667**	**12.0%**	**18,754**	**84.7%**	**1**	**0.0%**	**265**	**1.20%**	**466**	**2.1%**	**22,153**	
Average	167		1172		0.1		17		29		**1385**	

1. Season includes June 6 to September 26 for surveillance traps for a total of 272 trapnights. %RA= Percent Relative Abundance

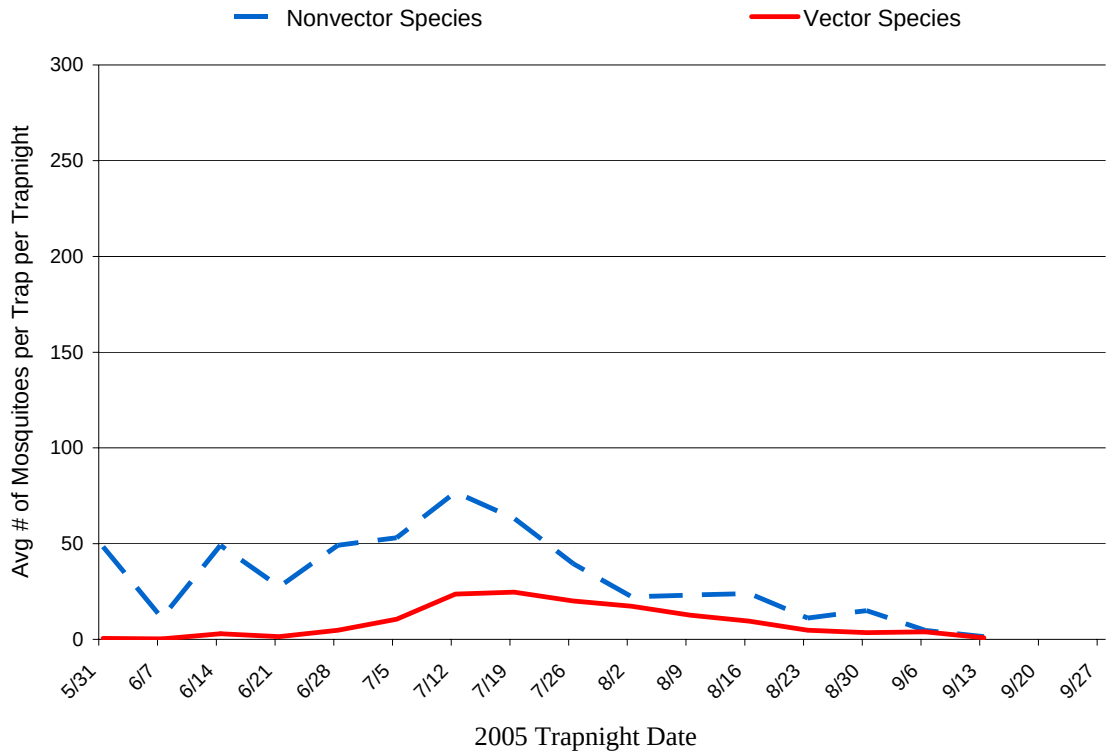
Table 6 Average Number of Mosquitoes, 2003 - 2006

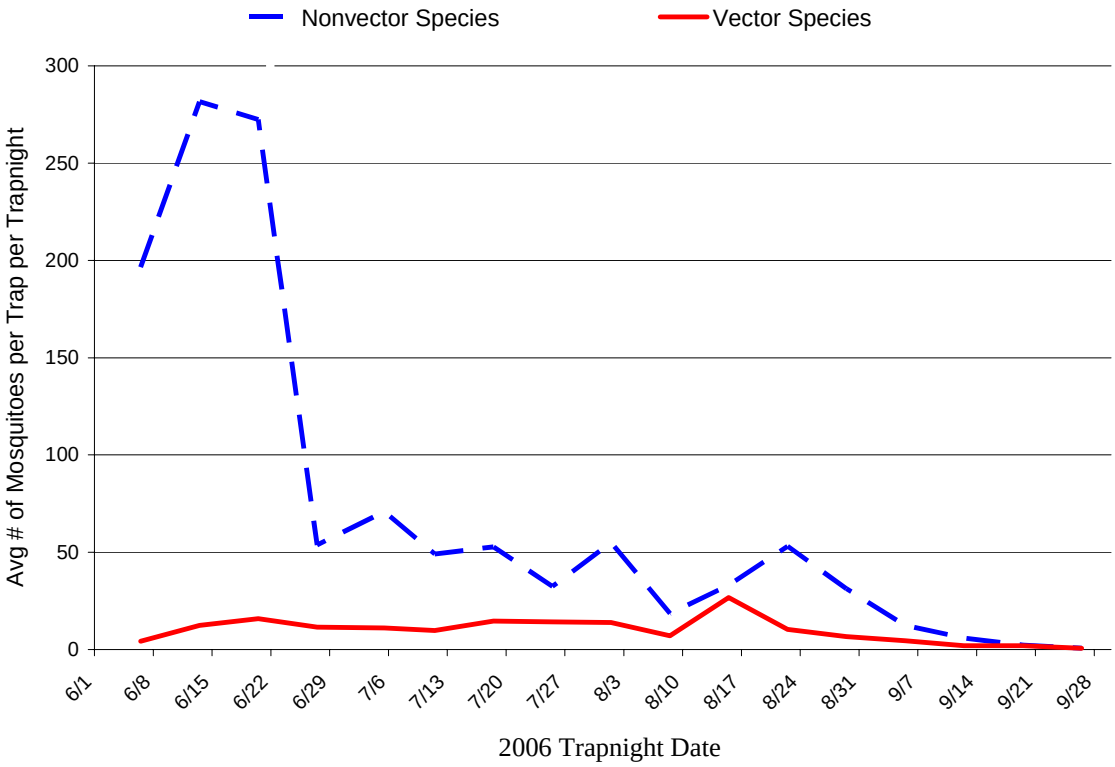
	2003[1]	2004	2005	2006
Average # of Total Mosquitoes (per Trap per Trap Night)	200	32	41	86
Average # of Total Vector Mosquitoes (per Trap per Trap Night)	60	3.6	9	10

1. The 2003 season-wide averages are based upon traps H0-H6 only; traps H0-H6 historically capture significantly more mosquitoes than traps C1-C11 which likely caused the overall 2003 average to be much higher than the following years.

The early high abundance of Culex mosquitoes along with the warmer temperatures throughout the 2006 season was likely a leading cause of the resurgence in WNV activity throughout the region during 2006. When the 2006 Boulder adult mosquito population trends are compared to those of 2005, which had more typical precipitation patterns, it shows that the early Culex populations were more than four times higher in June of 2006 (**Figure 4**). This is likely due to the warm and dry spring, which allowed the natural habitat that was wet during the early part of the season to quickly stagnate in the high temperatures and produce more vector populations than are typical for early in the season.

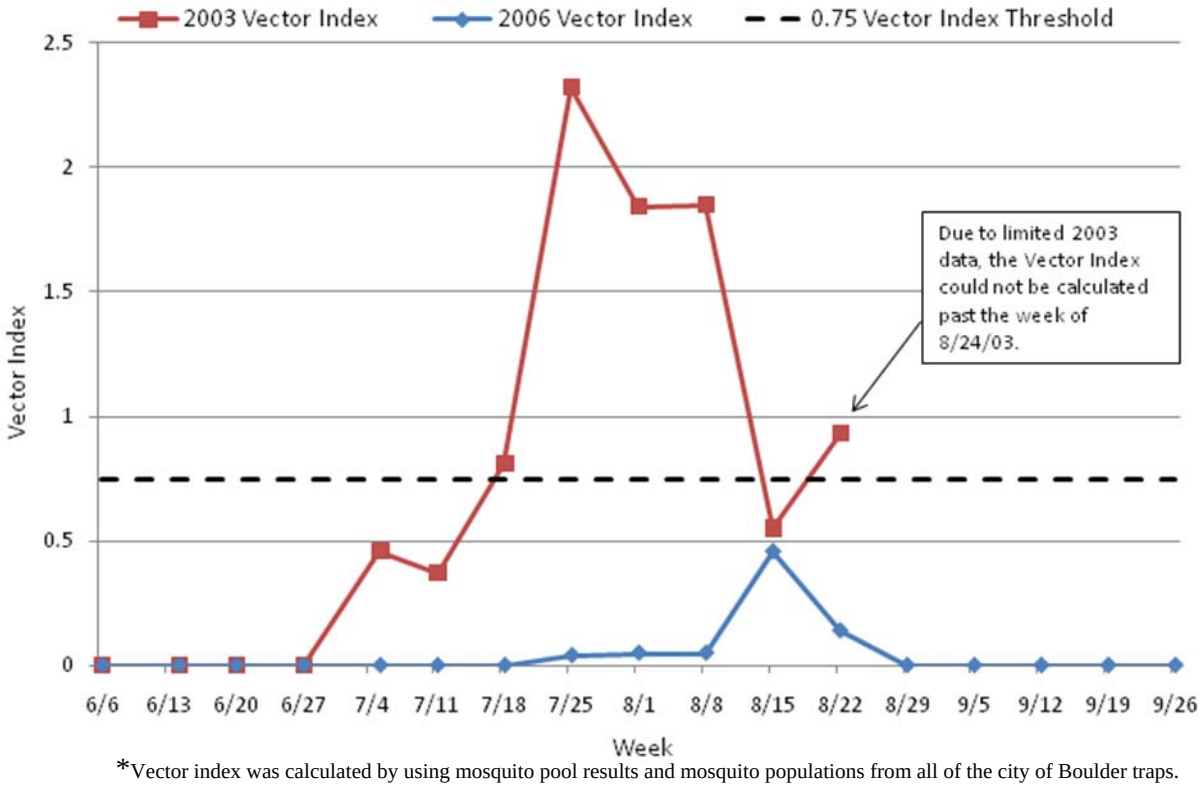
Figure 4 **Season-Wide Weekly Adult Trap Counts of All Trap Stations, 2005 – 2006**





In an effort to save limited resources, CDPHE again requested that counties consolidate their early season mosquito samples being submitted for WNV. To aid in this request, Colorado University and the city of Boulder cooperated by continuing to combine their mosquito samples each week during the season. During the 2006 season, CU identified collections from their campus traps, sorted out the vector species and then submitted the vector mosquitoes to OtterTail. OtterTail then added a representative ratio of the CU vector mosquitoes to the city of Boulder's samples for submission to BCPH, on a weekly basis, for WNV testing. Twelve of the 182 mosquito samples submitted by the city and CU during the course of the season tested positive for WNV. The first sample to test positive for WNV was from mosquitoes captured on July 25th. At least one sample then continued to test positive each week until August 22nd, which was when the final mosquito sample tested WNV positive for the year. The positive mosquito samples were captured from various locations throughout and around the city including areas in the northern, central and southern regions of the city.

Figure 5 City-Wide Vector Index* Levels, 2003 and 2006



*Vector index was calculated by using mosquito pool results and mosquito populations from all of the city of Boulder traps.

The mosquito samples submitted to CDPHE and their results allowed OtterTail to calculate the estimated WNV infection rates within the local mosquito populations. The infection rates, along with mosquito population densities, were then used to calculate the Vector Index. The Vecor Index is a tool that can be used to help determine the risk levels of WNV and can aid officials in the decision making process for any potentential adulticiding activities. Please refer to the 2004 City of Boulder West Nile Virus Season Report for a more detailed explanation of the index and mosquito infection rates. As shown in **Figure 5**, the 2006 Vector Index levels were calculated and compared to the levels found in 2003. During the 2003 season the Vector Index level peaked at 2.32, which was 5 times more than the 2006 peak of 0.46. Although a significant increase in WNV activity occurred in 2006, the Vector Index helps illustrated that the viral activity remained well below the epidemic levels of the 2003 season.

6.0 PUBLIC OUTREACH AND EDUCATION

Public education is an important component to any mosquito control program and is vital in combating West Nile Virus. As in previous years, the *One Bite* campaign, produced by Boulder County Public Health, provided the city of Boulder with posters and flyers for distribution to the general public. The campaign materials contained information about personal protection using the "4 D's" (DEET, Dawn and Dusk, Dress, and Drain) and testimonials from local persons infected with WNV during previous outbreaks. Posters were displayed throughout the city of Boulder, at Open Space and Mountain Parks trailheads, Parks and Recreation facilities, libraries, senior centers and the Municipal Building to raise awareness about WNV in the Boulder community.

The city of Boulder sent out periodic news releases about WNV activity and recommendations for preventing exposure to mosquitoes. A total of six news releases were sent between May and September 2006. The city provided an insert in the July utility bill about WNV. The city's WNV website also contained sections for current WNV activity, frequently asked questions, the city's mosquito control plan, program maps and links to email the city with WNV questions and to join the mosquito spraying email list. The West Nile Virus Hotline, 303-441-4004, which began in the 2004 season, was also continued in 2006 as a resource for city of Boulder residents. Callers were given information from a menu service and could leave a message for city staff to report any WNV or mosquito related concerns.

Educating residents on the need for property maintenance, source reduction, and the use of personal protection measures was crucial in the fight against WNV in 2006. The resulting actions taken by the public likely helped reduce the mosquito populations and the WNV activity levels and cases in the area during 2006.

7.0 REFERENCES

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