CLACKAMAS COUNTY BOARD OF COUNTY COMMISSIONERS
Policy Session Worksheet

Presentation Date:	Approximate Start Time:	Approximate Length:
4 April 2017	10:30 am	30 minutes

Presentation Title: Annual Work Program for Clackamas County Vector Control District

Department: Vector Control (Special District)

Presenters: George Peck (District Director), Theresa Micallef (Office Manager)

Other Invitees: Dan Green (District Board President), Lowell Hannah (Board Treasurer), Gordon Young (Board Secretary), John Borden (Board Vice President), and Mike Bondi (Board member).

WHAT ACTION ARE YOU REQUESTING FROM THE BOARD?
Approval of the 2017 Annual Work Program and the 2016 Annual Report.

EXECUTIVE SUMMARY (why and why now): The Clackamas County Vector Control District, pursuant to ORS 452.120, is required to furnish by 1 February of each year a proposed Annual Work Program which shall include an estimate of funds required for the next year, a description of the work contemplated, and the methods to be employed by the district. The Board, after consultation with the District officers, shall approve the Annual Work Program of the district. Further, the District shall furnish to the Board by 1 February of each year an Annual Report covering moneys expended, methods employed, and work accomplished during the past fiscal year.

FINANCIAL IMPLICATIONS (current year and ongoing): The District passed a five year local option levy of 0.025 per thousand in 2014. Thus, 2016 was year two of five years of the District's local option levy, securing stable funding until 2019.

STRATEGIC PLAN ALIGNMENT: Not applicable.

LEGAL/POLICY REQUIREMENTS: Not applicable.

PUBLIC/GOVERNMENTAL PARTICIPATION: Not applicable.

OPTIONS: Not applicable.

RECOMMENDATION: The Board of the Clackamas County Vector Control District is recommending the approval of the 2017 Annual Work Program and the 2016 Annual Report. Robust vector control programs are crucial to public health protection. Emerging vector borne diseases and invasive mosquitoes are ever present threats to Oregon.

ATTACHMENTS: Cover letter, Power Point Presentation, 2017 Annual Work Program, and 2016 Annual Report.

SUBMITTED BY:
Division Director/Head Approval _________________
Department Director/Head Approval *George W. Peck* George W. Peck, Director CCVCD

For information on this issue or copies of attachments, please contact George Peck @ 503-655-8394

CLACKAMAS COUNTY
VECTOR CONTROL DISTRICT

STAFF REPORT

April 4, 2017
Clackamas County
Board of Commissioners
2051 Kaen Road
Oregon City, OR 97045

Members of the Board:

IN THE MATTER OF ACCEPTING THE 2016 ANNUAL REPORT
AND THE 2017 ANNUAL WORK PROGRAM
FOR CLACKAMAS COUNTY VECTOR CONTROL DISTRICT

The Clackamas County Vector Control District, pursuant to ORS 452.120, is required to furnish by 1 February of each year a proposed annual work program which shall include an estimate of funds required for the next year, a description of the work contemplated, and the methods to be employed by the district. The Board, after consultation with the District officers, shall approve the annual work program of the district. Further, the District shall furnish to the Board by 1 February of each year an annual report covering moneys expended, methods employed and work accomplished during the past fiscal year.

To comply with these requirements, the District will meet with the Clackamas County Board of Commissioners in policy session on 4 April, 2017 at 11:30 p.m.

RECOMMENDATION
The Board of the Clackamas County Vector Control District is recommending the approval of the 2017 Annual Work Program and the 2016 Annual Report.

Sincerely,

George W. Peck

George W. Peck, PhD
Director

1102 Abernethy Road
Oregon City, Oregon 97045 • 503.655.8394
www.clackamas.us/vector

2016 Annual Report

Clackamas County Vector Control District
1102 Abernethy Road, Oregon City, Oregon 97045
(503) 655-8394
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CLACKAMAS COUNTY VECTOR CONTROL DISTRICT

1102 ABERNETHY ROAD

OREGON CITY, OREGON 97045

FORTY-EIGHTH ANNUAL REPORT

FOR THE YEAR 2016

COMPILED BY

George Peck
District Executive Director

Theresa Micallef
Office Manager

Richard Imholt
Field Manager

Josh Jacobson
Biologist

Jensen Price
Assistant Biologist

Executive Summary

Dear Clackamas County Citizens,

It is my pleasure to present to you the 2016 Clackamas County Vector Control District Annual Report. We hope you find this document enlightening and informative.

Under ORS 452, the Clackamas County Vector Control District generates revenue through two types of taxes on property: a permanent levy of $0.0065 per $1,000 of assessed property value and a local option levy of $0.025 per $1,000 of assessed property value. The local option levy was re-approved in 2014 and will expire in 2019. In 2016, actual District expenditures were $956,576.

As of December, 2016, the mosquito vectors of **Zika Virus** had not invaded Oregon, although it is expanding its range in California. We conducted surveillance for the Zika vectors throughout the summer of 2016. There were no reported cases of local transmission of Zika in Oregon, however, there were 49 Oregon-wide travel-associated Zika cases in 2016, but none of these were reported from Clackamas County. There was no **West Nile Virus** (WNV) activity detected in Clackamas County in 2016 (Figure 1). However, there were four human WNV cases reported in Oregon, one each from Deschutes, Malheur, Jefferson, and Klamath Counties, respectively. Mosquitoes, birds, and horses are competent hosts of WNV, and Oregon had its share in each category; however, none of this activity was reported from Clackamas County and its adjacent Counties (Figure 1).

The District charter mandates a focus on mosquito and fly control within the county, and in 2016, the District focused on two general areas of mosquito management: 1) larval mosquito surveillance and larval mosquito insecticide treatments, and 2) adult mosquito surveillance and adult mosquito control. The District answered **770 citizen requests** for mosquito control assistance, and a total of **2,830 mosquito treatments** conducted county-wide. 5 fly treatments were conducted throughout the county. Our mosquito surveillance program processed **20,051 larval mosquito samples** and **4,495 adult mosquito samples**. The District received 1 dead bird collection request. The District continues to maintain a paper database and an electronic database for mosquito source mapping and mosquito source treatments.

The District promotes biologically-based suppression of mosquito and fly populations where feasible and practical. The use of *Gambusia* *affinis*, the 'mosquito fish', for biological control of mosquito larvae remains an important part of the mosquito control program. **3,186 individual fish** were distributed into appropriate aquatic environments in 2016. We have improved our mosquitofish rearing program in 2016, adding additional fish rearing capacity and technical precision to the rearing environment.

Mosquito and fly disease-vector information was provided by the District throughout the control season to interested citizens. The District received **96 requests for information** on a wide variety of pest species this year. Printed information or consultation was provided in each of these cases. Informational programs on mosquito and fly control were provided for schools, service clubs and any other interested group within the County.

Other District milestones in 2016 include hiring an assistant biologist, establishing an experimental mosquito and fly colonies, and drafting a long-term plan for the District. 2016 was year two of five for the District's local option levy. We continue to share data and expertise with the County department of Water and Environmental Services and we will continue to work closely with other organizations within the county to ensure that the public is protected from vector borne diseases such as Zika and WNV.

Sincerely,

George Peck, PhD

Director, Clackamas County Vector Control District

Figure 1. Oregon County map of West Nile Virus activity in 2016.

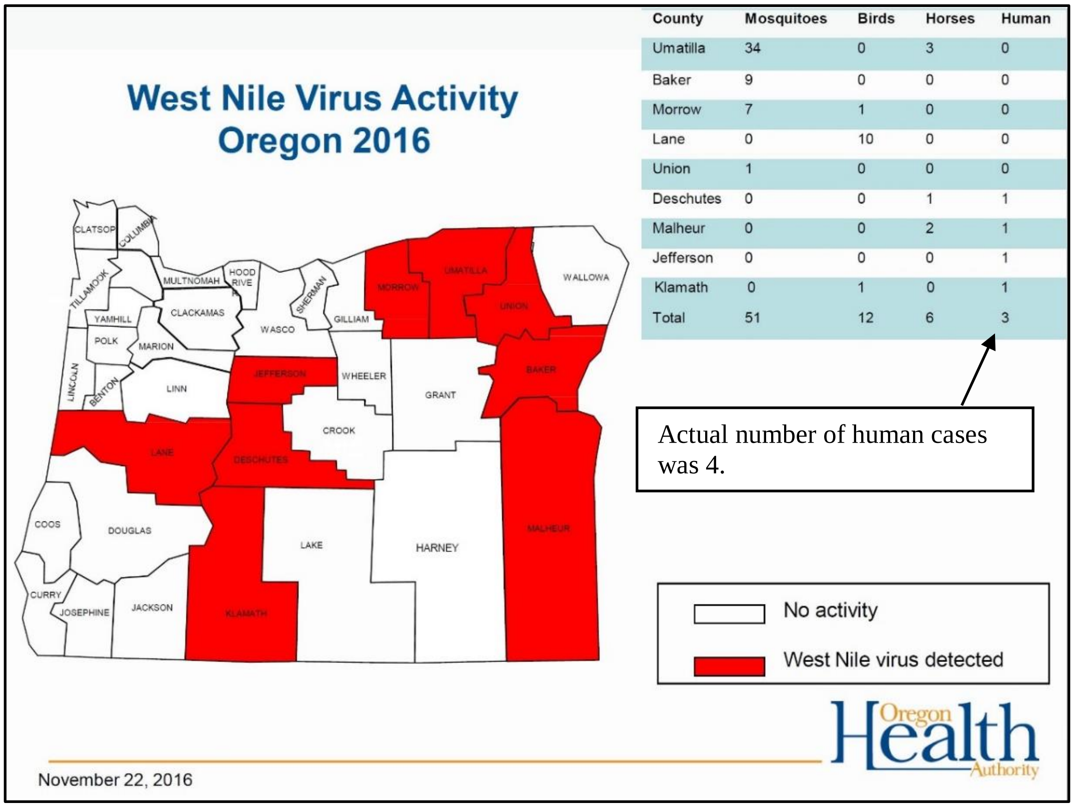

Table 1. Board of Trustees

District operations are supervised by a five-member board appointed to four year terms by the County Commissioners. Vector Control Board meetings are held the second Tuesday of each month at 2:30 p.m. in the Vector Control District office.

Member	Term Expiration Date
Dan Green, Board Chairman	November 24, 2019
John Borden, Vice Chairman	November 16, 2018
Lowell Hanna, Treasurer	November 16, 2020
Gordon Young, Secretary	November 16, 2017
Michael Bondi, Member	November 16, 2020

Board members receive $50 per month as compensation for services performed as a member of the governing body.

Table 2. District Staff

Employee	Title
George Peck	District Director
Theresa Micallef	Office Manager
Josh Jacobson	Biologist
Jensen Price	Asst. Biologist
Rich Imholt	Field Manager
George Cashdollar	Biologist (PRN)*
Seasonal Employees (5 to 10)	Technician

All personnel employed by the District receive pesticide usage and safety training and are Licensed Public Pesticide Operators by the Oregon Department of Agriculture.
* *Pro re nata*; on call during peak mosquito season.

Vision Statement
To progress towards a future free of vector borne disease using all the scientific, technical and educational tools available.

Mission Statement
The control of public health vectors within Clackamas County using an environmentally friendly approach that aims to limit the number of mosquitoes and flies, reducing annoyance and vector-borne disease.

Core Values
Clackamas County Vector Control District employees work towards the goal of protecting the public from vector borne diseases. In that spirit, we pledge to hold ourselves to the same standards as all Clackamas County employees.
Core values are embodied in six key concepts:
S*ervice,* ***P****rofessionalism,* ***I****ntegrity,* ***R****espect,* ***I****ndividual Accountability and* ***T****rust*

Legislative Guidance
Under the authority of ORS 452.120, Clackamas County Vector Control District shall provide the two following documents to the Clackamas County Commissioners in the first quarter of each calendar year: 1) a proposed Annual Work Program to include an estimate of funds required for the next year, a description of the work contemplated, and the methods to be employed by CCDCD; 2) an Annual Report covering monies expended, methods employed, and work accomplished during the past fiscal year. Thus, to fulfill 2), this Annual Report.

Table 3. Control and Surveillance 2016 Statistics. The overall service statistics for the District are displayed below.

Service type	Service description	Statistic
Distribution of mosquitofish (*Gambusia affinis*)	Individual fish	3,186
Mosquito and fly control	Service calls fielded	770
Miscellaneous calls	Advice over the phone	96
Mosquito control operations	Total treatments (including multiple at same site)	2,830
	Acres treated (adult control)	19.6
	Acres treated (larval control)	12.3
Larval mosquito surveillance	Total larvae collected for identification	20,051
Adult mosquito surveillance	Total adults collected for identification	4,495
Arbovirus surveillance	Dead bird collections	1

Table 4. Summary of 2016 Insecticide Treatments. The active ingredients, trade names, and amounts of mosquito larvicides and mosquito adulticides used during control operations of the District are summarized below.

Insecticide type	Active Ingredient	Trade Name	EPA Reg. No.	Amount of formulation used
Larvacide				
	Long chain oxy-hydrocarbons	Agnique MMF (liquid)	53263-28	26.6 oz
	Long chain oxy-hydrocarbons	Agnique MMF (granules)	53263-30	0.1 lbs.
	Bacillus thuringiensis var. israelensis (*Bti*)	AquaBac (granules)	62637-3	8.0 lbs.
	Bti bacteria	Summitt *Bti* briquettes	6218-47	811
	Methoprene	Altosid Briquets (30 Day)	2724-375	329
	Bti and *Bs* bacteria	4 Star 45 day Briquettes	83362-3	1,256

	Bti and *Bs* bacteria	4 Star 90 day Briquettes	88362-3	732
Adulticide				
	Pyrethrins	Pyrocide 100	1021-1424	33.8 oz.
	Plant oils	EcoExempt	N/A	68.8 oz.
	Tau-fluvalinate	Mavrik Aquaflow	2724-478	87.0 oz.

Table 5. Adult mosquito surveillance: 2016 CO_2 encephalitis virus surveillance trap species composition. The table below shows the number of each adult mosquito species collected and identified from traps baited with carbon dioxide and set out overnight.

Genus	species	Number collected	% of total collection
Aedes		139	3.09
	sierrensis	17	0.38
	sticticus	8	0.18
	vexans	48	1.07
	washinoi	58	1.29
	Ae. species	8	0.18
Anopheles		263	5.85
	freeborni	67	1.49
	punctipennis	195	4.34
	An. species	1	0.02
Culex		1,910	42.49
	erythrothorax	7	0.16
	pipiens	1,541	34.28
	stigmatosoma	78	1.74
	tarsalis	279	6.21
	Cx. species	5	0.11
Culiseta		2,183	48.57
	incidens	2,180	48.50
	inornata	3	0.07
Total	collected	4,495	100.00

Table 6. Larval mosquito surveillance: 2016 larval dipper sample species composition. The table below shows the number of each larval mosquito species collected and identified from 'dipper' samples.

Genus	species	number collected	% of total collection
Aedes		72	0.36
	cinereus	0	0.00
	japonicus	62	0.31
	sierrensis	1	0.00
	sticitus	9	0.04
	vexans	0	0.00
	washinoi	0	0.00
	Ae. species	0	0.00
Anopheles		90	0.45
	freeborni	4	0.02
	punctipennis	86	0.43
	An. species	0	0.00
Culex		7,211	35.96
	boharti	109	0.54
	pipiens	6,363	31.71
	stigmatosoma	371	1.85
	tarsalis	95	0.47
	territans	232	1.16
	Cx species	41	0.20
Culiseta		7,658	38.19
	incidens	7,641	38.11
	inornata	0	0.00
	particeps	0	0.00
	Cs. species	17	0.08
Unidentified species		5,020	25.04
Total		20,051	100.00

Figure 2. Vector Control Zone Map. Clackamas County is divided into 10 vector control zones. Technicians are assigned a zone of responsibility during the control season (March through September). Zone 0 is mostly federal lands not requiring mosquito control.

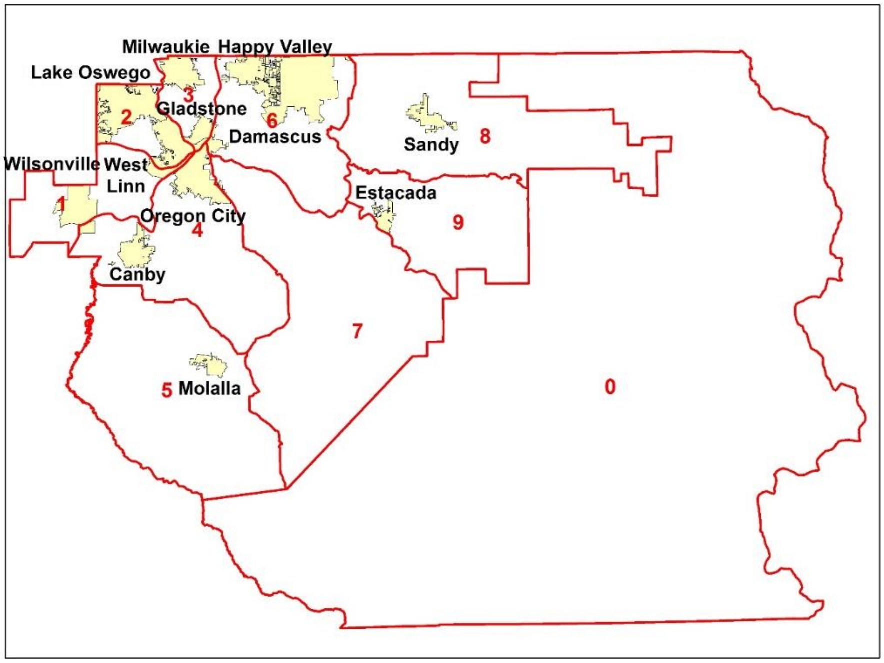

Figure 3. Vector Control Treatment Map. Bold outline is the boundary of the mosquito-producing zones of Clackamas County. Dark solid circles are sites receiving treatments during 2016.

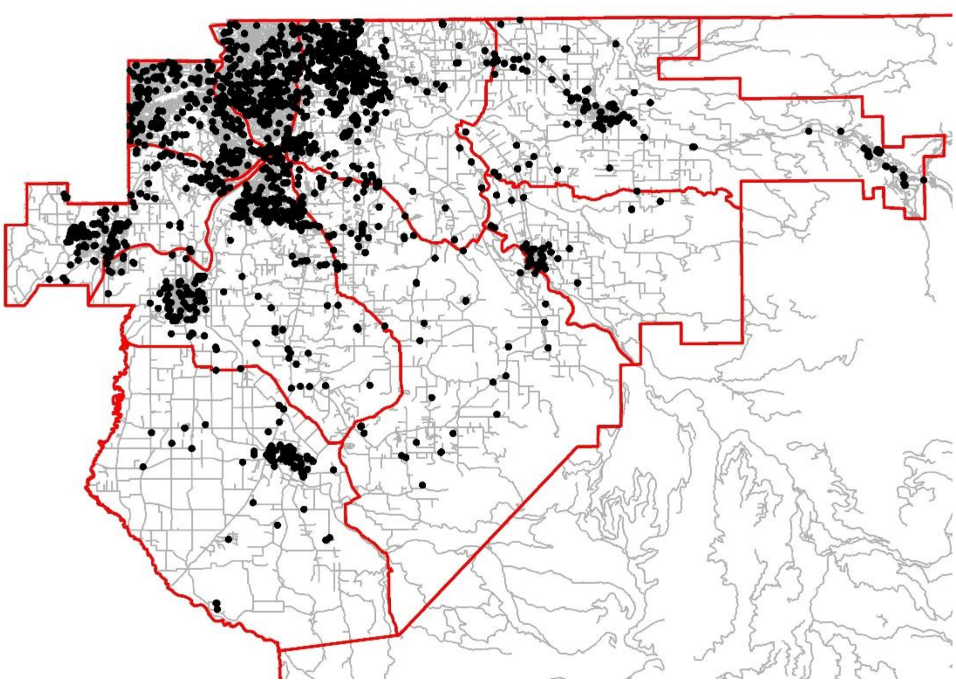

Figure 4. Most abundant adult mosquito species by zone in 2016. Variation in abundance due primarily to zone ecology and sampling effort.

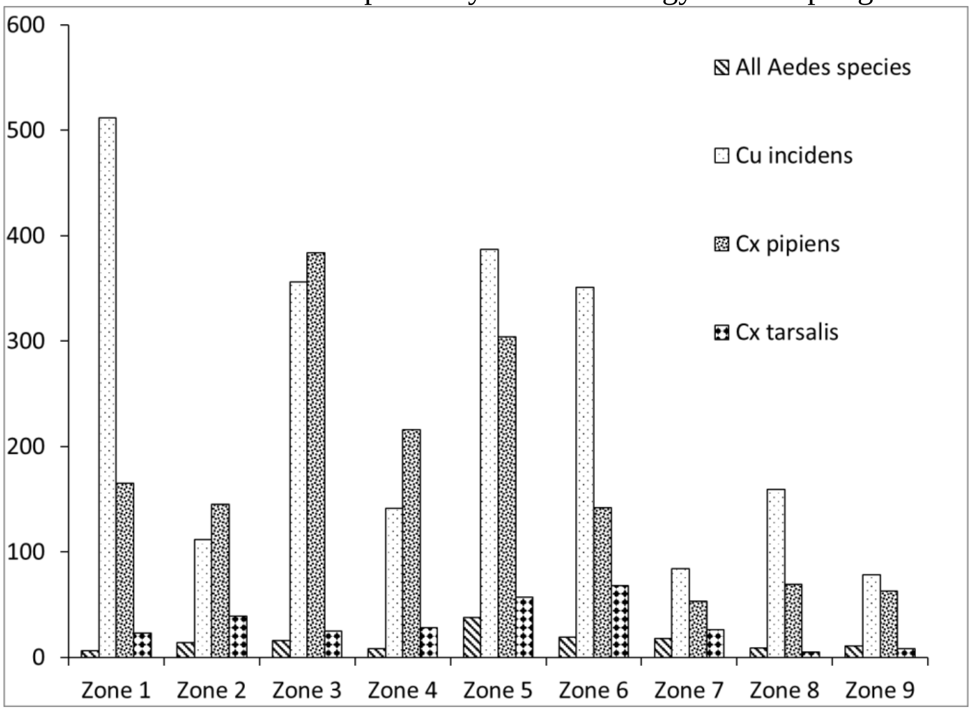

Figure 5. Most abundant adult mosquitoes collected over entire District: 2005 to 2016. Note increasing *Culiseta incidens* and decreasing *Culex pipiens* over the last few years. This may be due to general warming trends in Oregon (climate change) over the winter and spring months.

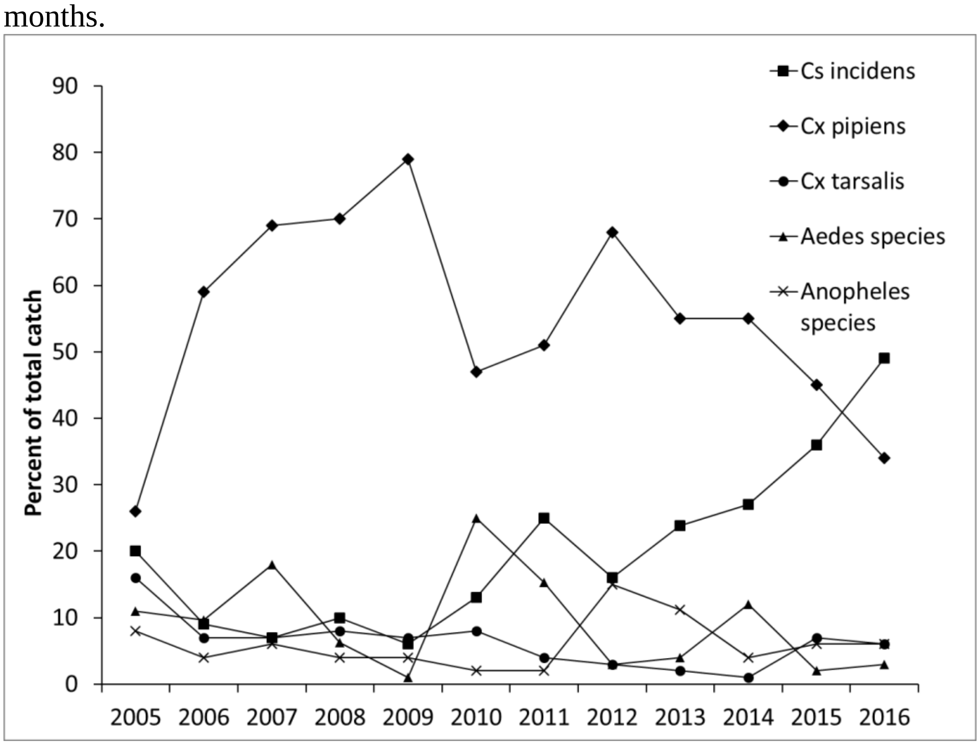

Figure 6. Total number of adult dry ice traps set by year: 2005 – 2016. Due to new policies adopted in 2016, 148 (26%) of trap sets were pre-spray evaluations of county resident adulticide barrier spray requests.

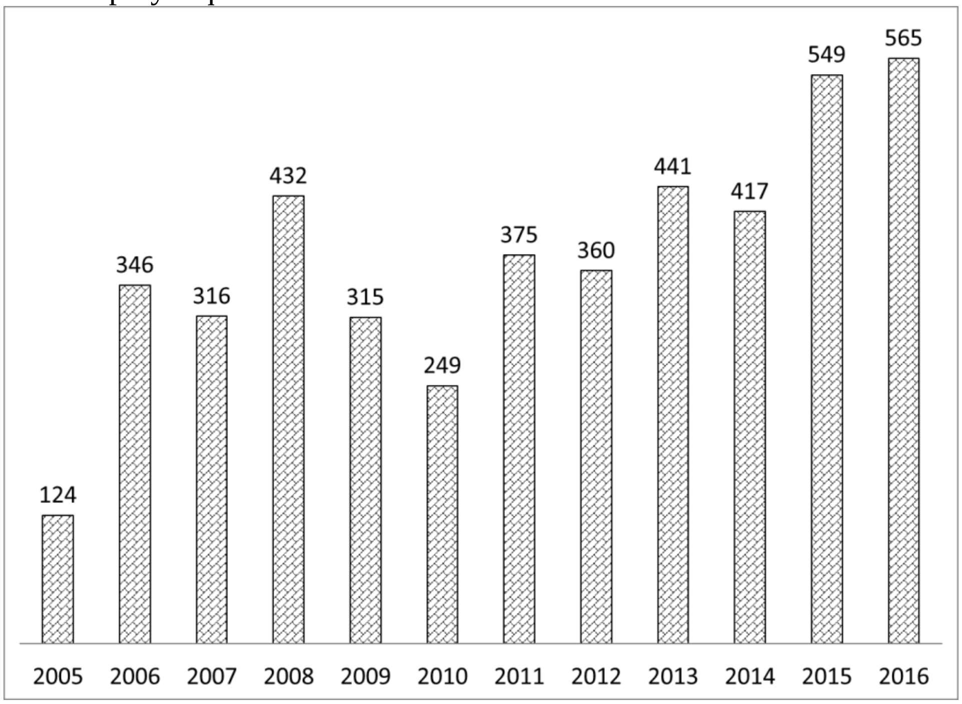

Figure 7. 2016 larval mosquito collection by zone. Variation in abundance due primarily to zone ecology and sampling effort.

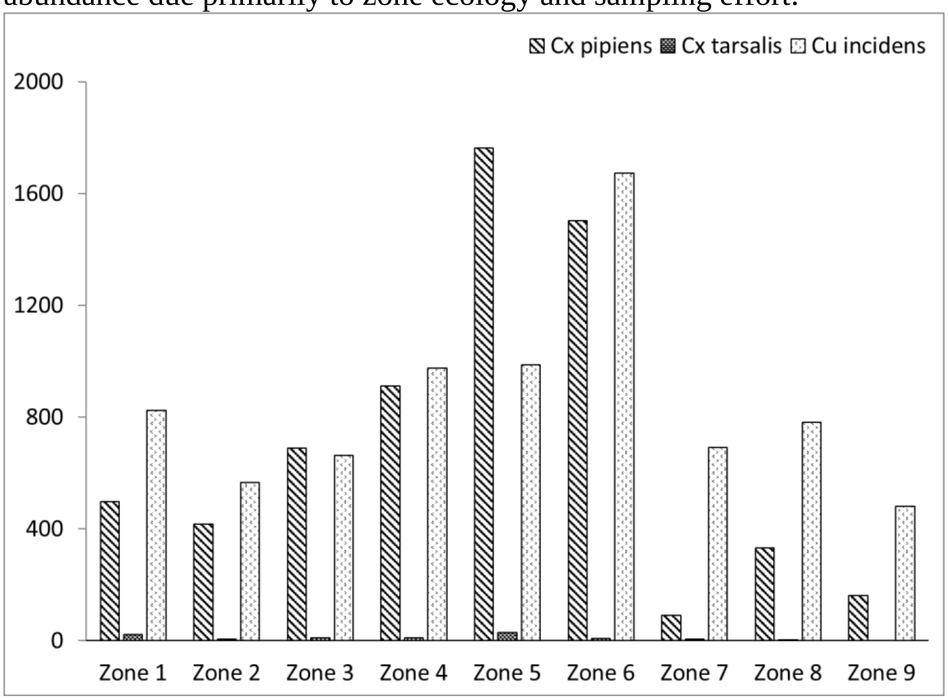

Figure 8. Larval mosquito collections by year: 2010 – 2016. Continuation of regular pattern seen, with *Culex pipiens* and *Culiseta incidens* being the dominant species in all samples.

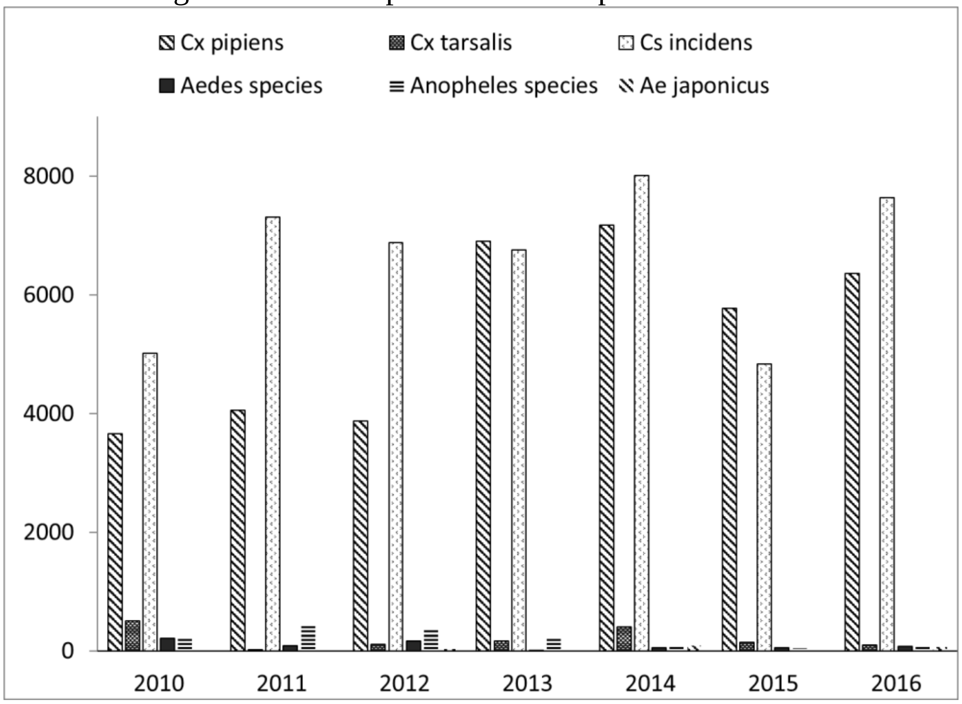

Table 7. Miscellaneous service calls (96 total). The Vector Control District receives numerous requests for information on miscellaneous pest problems. The species and number of inquiries about each received in 2016 are listed below.

Pest	# of Calls	Pest	# of Calls
Ant	2	Indian Meal Moth	0
Aphid	0	Mole	0
Bat	0	Mouse	4
Beaver	0	Nutria	3
Bed Bugs	1	Opossum	4
Bee	7	Raccoon	6
Box Elder Bug	0	Rat	24
Carpenter Ant	0	Silverfish	0
Cockroach	0	Skunk	9
Coyote	0	Spider	5
Crane Fly	0	Squirrel	1
Flea	0	Stink bug	6
Gnat	0	Tick	0
Gopher	0	Vole	1
Hornet	0	Other	23

Table 8. Public Outreach Events for 2016. The District is always happy to give presentations to local entities on vector ecology and mosquito/fly control.

Event	Location	Date	Participants
Oregon Equestrian Trials Dinner	Elmer's in Clackamas	5 April	George
"Wild Things Day" at Lewelling Elementary School	Seth Lewelling Elementary, Milwaukie	26 May	Josh, Jensen, Maggie
Master Gardener's Spring Garden Fair	CC Fairgrounds, Canby	30 May to 1 June	Theresa, Josh
Clackamas River Water Providers	14275 S. Clackamas River Drive, Oregon City	3 August	George
Clackamas County Fair	CC Fairgrounds, Canby	16-21 August	Entire CCVCD staff

Table 9. Ongoing Public Outreach in 2016. This list includes efforts that continue throughout the calendar year.

Effort	Scope	Elements	Timeline
CC Vector Control District Web Site	World-wide	Public information, District Educational Documents for Teachers, Mosquito Control Videos, News	Continuous
CC Vector Control District Face Book Page	World-wide	Updates, news, other items relevant to vector control and the Citizens of CC	Continuous
CC Vector Control District Calendar	Clackamas County	Mosquito control tips in calendar	2016
Turtle Dove Clemens PR Firm	Clackamas County	A range of efforts*	2016

* Banners, Television, Pandora, Google AdWords, YouTube, Comcast Pre-Roll, Digital Community Newspapers, Remarketing, Bill-Boards, Social Media posts, School Mailings, CCTV TV, email blasts, Garden Centers, Festivals.

Table 10. Continuing Education and Training in 2016. Professional development is a key aspect of staff training, and the District supports this through travel grants and support for various educational venues.

Event	Location	Date	Participants
OSU—Urban Pest Management	CCC, Oregon City Campus	2/3	Rich
SDAO – Annual Conference	Sun River, OR	2/4	Lowell Hanna, George P., Mike Bondi, Theresa
AMCA Annual Meeting	Savannah, GA	2/7 – 2/11	Josh J.
OMVCA Spring Conference/Tick ID	Central Point, OR	3/29	Rich
Columbia County Drainage Truck Rodeo, St. Helens	Columbia County Drainage	4/7	Steven, Loren
NWMVCA Spring Workshop	Richland, WA	4/20 – 4/21	Rich
SDAO – Board and Managers Training	Tigard, OR	8/23	George P., Theresa
International Conference of Entomology - ESA	Orlando, FL	9/24 – 9/30	George P., George C., Josh J., Theresa
NWMVCA Annual Meeting	Welches, OR	10/5	George P., George C., Rich, Theresa, Josh
OMVCA Meeting and Recertification Workshop	Newport, Oregon	11/9 - 11/10	Rich, George P. and Theresa

Biological Control efforts for 2016

Biological control through distribution of _Gambusia_ _affinis_, the mosquito fish, was promoted as the preferred means of mosquito control conducted by the District. Bio-rational insecticides, such as bacterial agents (*Bti* and *Bs*; Table 2), we utilized in situations were long lasting larval control was needed (swales, retention/detention ponds, storm drains, etc.).

Gambusia affinis is not native to the Pacific Northwest and therefore cannot be introduced into any aquatic habitats that connect with the larger Willamette watershed. Citizens are advised of this during the distribution process.

Zika Virus Vector Surveillance

As of December, 2016, the mosquitoes that transmit Zika Virus had not been detected in Clackamas County, and the entire state of Oregon. However, these invasive mosquitoes continue to expand their ranges throughout the western United States. Presently, they have invaded the northern San Joaquin Valley, but the Siskiyou Mountain range seems to be a geographical barrier to their spread north into Oregon. Zika vector surveillance was conducted in Clackamas County with ovi-traps. These traps allow the invasive *Aedes* mosquitoes that transmit Zika virus to lay eggs. Traps are inspected weekly and any eggs collected are brought back to the laboratory for hatching. We did not detect any *Aedes albopictus* or *Aedes aegypti* (the two invasive Zika vectors that are rapidly enlarging their range) during the 2016 mosquito season. However, we did find numerous *Aedes japonicus* eggs in our traps. *Ae. japonicus* invaded the Willamette valley in 2006 and has persisted since in small numbers.

Novel Mosquito Trap Evaluations

We tested a live chicken-baited trap over the 2016 mosquito season. We compared the catch rate and diversity of catch with a standard carbon dioxide (CO_2) trap in three locations within a pristine wetland area of Milwaukie. Seven species were detected in the CO_2 trap, while six of the seven species were detected in the chicken trap. The CO_2 traps caught between 1.3 to 4.1-times more mosquitoes. Consistency is more important than large rates of capture; we seek to find a linear relationship between CO_2 trap catch and chicken trap catch for all relevant species.

Integrated Pest Management

The Northwest Mosquito and Vector Control Association supports management of vector populations when and where necessary by means of an integrated program (IPM) designed to benefit or to have minimal adverse effects on people, domestic animals, wildlife and the environment. The integrated pest management policy recognizes that vector populations cannot be eliminated, but may be suppressed to tolerable levels for the well-being of humans, domestic animals and wildlife, and that the selection of scientifically sound suppression methods must be based upon consideration of what is ecologically and economically beneficial in the long-term interest of humankind.

The following IPM principles are to be followed[1]:

- Vector control measures should only be undertaken when there is adequate justification based upon surveillance data.

- The combination of methods of vector control should be chosen after careful consideration of the efficacy, health benefits, ecological effects and cost versus benefits of the various options; including public education, legal action, natural and biological control, elimination of larval mosquito sources, and insecticide applications.

- Larval mosquito habitats producing vectors, whether natural or created by human activity, should be altered in such a manner as to reduce their capacity to produce mosquitoes, while causing the least impact on the environment.

- Insecticides and application methods should be used in the most efficient and least hazardous manner in accordance with all applicable laws, regulations and available scientific data. The registered label requirements for insecticide use should be followed. When choices are available among effective insecticides, those offering the least hazard to non-target organisms should be used. Insecticides should be chosen and used in a manner that will minimize the development of resistance to a given insecticide in vector populations.

- Personnel involved in the vector control program are properly trained and supervised, certified in accordance with relevant laws and regulations, and are required to keep current with improvements in management techniques through continuing education and/or training programs.

[1] All methods and materials used by the District are based on these principals supported by the Northwest Mosquito and Vector Control Association and the American Mosquito Control Association.

Collaborating Organizations. The Clackamas County Vector Control District collaborates with the following organizations:

The American Society of Tropical Medicine and Hygiene

Advancing global health since 1903

OREGON VECTOR CONTROL ASSOCIATION

SOVE

Society For Vector Ecology

est. 1968

Entomological Society of America

Sharing Insect Science Globally

Annual Work Program

Fiscal Year 2017 - 2018

Clackamas County Vector Control District

1102 Abernethy Road, Oregon City, Oregon 97045
(503) 655-8394
www.clackamas.us/vector

Prepared by: District Staff
In collaboration with Clackamas County Vector Control Board of Trustees
Submitted to the Clackamas County Commissioners

Table of Contents

Executive Summary

It is our pleasure to provide the Clackamas County Board of Commissioners this **Annual Work Program** (AWP) covering the proposed work to be accomplished by the Clackamas County Vector Control District (CCVCD) during the mosquito season of 2017. This AWP also outlines the District response plan when an outbreak of mosquito-borne disease is eminent. Under the authority of ORS 452.120, the District shall provide to the Commissioners a proposed Annual Work Program to include an estimate of funds required for the upcoming year, a description of the work contemplated, and the methods to be employed to control vectors of public importance. The Annual Work Program provides guidelines for District staff and the District Board of Trustees, and information to stakeholders regarding decisions and responses the District will utilize in the prevention and control of **West Nile Virus** (WNV) or other mosquito-borne and fly-borne disease that may threaten the citizens of Clackamas County.

The District will conduct **surveillance for mosquito-borne viruses** in various ways during the 2017 season. The larval mosquito surveillance will involve taking 'dipper' samples of water from all known mosquito habitats, checking the water for the presence of mosquito larvae, and taking these larval samples back to the District laboratory for identification to the species level where possible. Adult mosquito surveillance will involve deploying various types of mosquito traps within the County. Our primary trap is a carbon dioxide-baited trap (CO2 traps), capable of attracting many species of mosquitoes. Captured adult mosquitoes are taken back to the District laboratory for identification and for WNV testing. Detection of Zika-virus transmitting mosquitoes is performed with ova-traps (egg traps).

The Oregon winter of 2016-2017 continues to be influenced by a strong **La Niña weather pattern**. In general, this pattern brings below average temperatures and increased rainfall. Lower temperatures through the spring means mosquitoes will be less active, however, increased rainfall means more mosquito habitat (aquatic) when temperatures finally increase to typical seasonal levels. The District will begin inspections of larval and adult mosquito habitats in early March and will increase inspection intensity as temperatures increase. Inspections will continue until temperatures and day length signal the end of mosquito production in the County.

District's **active partnerships** with public and private stakeholders including local county and city officials and staff, state and federal agencies, environmental groups, agricultural interests, community groups and Clackamas County residents is of the utmost importance. During peak mosquito season, the District participates in weekly conference calls with the Oregon Health Authority and other mosquito control entities throughout Oregon. The District monitors WNV reports throughout Oregon, including human and livestock cases. This regular monitoring of disease statistics provides the District with actionable information and guides the control management of mosquitoes and mosquito-borne diseases that threaten Clackamas County. A **Mosquito-Borne Virus Surveillance and Response Plan** is provided here as evidence of exhaustive and comprehensive guidance in the event of a disease outbreak.

The District uses **Integrated Mosquito Management** (IMM) principles in its program. These principles will be the basis of all decisions and responses used by the District. The IMM program will include: public education, community outreach, surveillance, and control activities that use the least toxic and most environmentally friendly methods available.

Respectfully,

George W. Peck, Ph.D.

Executive Director, Clackamas County Vector Control District

Background and Introduction

The Clackamas County Vector Control District (CCVCD) was established in 1968 by voter referendum to provide County residents with mosquito and fly control services. The funding generated by the original tax base was adequate to meet minimal service requirements prior to the arrival of West Nile Virus (WNV) in Oregon. With the arrival of WNV in November 2004, the Clackamas County voters approved a five-year option levy for enhanced vector control operations in 2009, and again in 2014. This increased funding allows the District to prepare for and minimize the impact of West Nile Virus in Clackamas County. This enhanced vector control program has been implemented since 2004 and will be implemented again in 2017. This Annual Work Plan is submitted yearly to the Clackamas County Board of Commissioners for review and approval as required by Oregon Revised Statute 452.120.

The Clackamas County Vector Control District is organized and operates under the authority of ORS 452, generating revenue through two types of taxes on property: a permanent levy of $0.0065 per $1,000 of assessed property value and a local option levy of $0.025 per $1,000 of assessed property value. The local option levy was re-approved in 2014 and will expire in 2019. The 2016 actual District expenditures were $956,576. The FY18 approved budget for the District is given in *Appendix 1*.

This Annual Work Program consists of two parts: the first addresses the current program; the second, a Mosquito-Borne Virus Surveillance and Response Plan. It is expected, through continual community involvement, that the Annual Work Program will be a fluid, ever-changing document —its primary goal being to reduce the threat of West Nile Virus and other mosquito-borne diseases to Clackamas County residents using IMM, thus using the least toxic and most environmentally friendly methods available.

Program Overview

The guiding **vision** of the CCVCD is “to progress towards a future free of vector borne disease using all the scientific, technical and educational tools available”. The general **mission** of the CCVCD is “the control of public health vectors within Clackamas County using an environmentally friendly approach that aims to limit the number of mosquitoes and flies, reducing annoyance and vector-borne disease”. CCVCD employees come to work each day with the goal of protecting the public from vector borne diseases. In that spirit, we pledge to hold ourselves to the same standards as all Clackamas County employees (http://www.clackamas.us/admin/values.html). These Core Values are embodied in six key concepts: ***S****ervice,* ***P****rofessionalism,* ***I****ntegrity,* ***R****espect,* ***I****ndividual Accountability* and ***T****rust.*

Under the authority of ORS 452.120, Clackamas County Vector Control District shall provide the two documents to the Clackamas County Commissioners in the first quarter of each calendar year: 1) a proposed Annual Work Program to include an estimate of funds required for the next year, a description of the work contemplated, and the methods to be employed by CCVCD; 2) an Annual Report covering monies expended, methods employed, and work accomplished during the past fiscal year. Thus, to fulfill 1), this Annual Work Program report.

District Objectives

The overall objectives of the District align with the mission: The control of public health vectors within Clackamas County using an environmentally friendly approach that aims to limit the number of mosquitoes and flies, reducing annoyance and vector-borne disease. Control of public health vectors is a constant battle. As long as there are healthy wetlands and rain-filled flood control structures, there will be mosquitoes breeding in them. Therefore, the goal of total eradication of all mosquitoes and flies within Clackamas County is not obtainable. Instead, we support the use of environmentally friendly approaches to pest population suppression, such as an integrated mosquito management approach.

District Structure

The District has three main programmatic units: office, laboratory, and field. Office personnel focus on administrative tasks, including budget formulation and bookkeeping, accounting, human resource functions, logistical planning and support and overall supervision of district operations. Laboratory personnel focus on areas of scientific expertise, including entomological identification of insects collected, analysis of insects for pathogens of human disease, designing and executing mosquito and fly surveillance operations, and other fundamental and applied scientific tasks. Field personnel conduct mosquito surveillance by discovering, documenting, investigating and sampling mosquito and fly production areas. They are also responsible for applying mosquito and fly suppressing chemicals in a safe and legal manner. They are also ambassadors and ecologists, advising citizens on best practices for reducing the risk of mosquito borne disease and physical practices that aim to reduce the suitability of aquatic habitats for mosquito breeding. All three programmatic units work synergistically to accomplish the District mission.

In addition to WNV, Oregon is vulnerable to introduction of other highly virulent mosquito-borne viruses of public and veterinary health concern, such as Japanese encephalitis, dengue, Zika, chikungunya, yellow fever, Rift Valley fever, and Venezuelan equine encephalitis viruses. If an existing or introduced virus is detected, it is critical that local and state agencies are prepared to respond in a concerted effort to protect people and animals from infection and disease. The plan below describes an enhanced surveillance and response program for mosquito-borne viruses in Clackamas County and is applicable to all of Oregon and adjacent western states. Its contents are drawn from previous CCVCD Annual Work Programs and from response guidelines published by the California Department of Public Health (CDPH), the Mosquito and Vector Control Association of California (MVCAC), and the University of California at Davis (UCD)[1].

CLACKAMAS COUNTY VECTOR CONTROL DISTRICT MOSQUITO-BORNE VIRUS SURVEILLANCE AND RESPONSE PLAN

Objectives

The Clackamas County Vector Control District Mosquito-borne Virus Surveillance and Response Plan was developed to meet several objectives. Specifically, the Plan:

- Provides guidelines and information on the surveillance and control of mosquito-borne viruses in Clackamas County, including West Nile, Zika and other mosquito - borne viruses;
- Incorporates surveillance data into risk assessment models;
- Prompts surveillance and control activities associated with virus transmission risk level;
- Provides CCVCD, local and state agencies with a decision support system; and
- Outlines the roles and responsibilities of CCVCD, local and state agencies involved with mosquito-borne virus surveillance and response.

This document provides CCVCD guidelines, but can be modified to meet regional and state-wide conditions.

Background and Introduction

CCVCD has a comprehensive mosquito-borne disease surveillance program that has monitored mosquito abundance and mosquito-borne virus activity since 1968 and is an integral part of integrated mosquito management programs (IMM) encompassing all of Oregon, working in collaboration with local and regional mosquito and vector control agencies. Surveillance and response guidelines for CCVCD have been published annually as a component of the Annual Work Program per ORS 452.120. If an existing or introduced virus is detected, it is critical that local and state agencies are prepared to respond in a concerted effort to protect people and animals from infection and disease.

West Nile Virus was first detected in the United States in New York City in 1999. This virus, a mosquito transmitted disease, had never been detected in the Western Hemisphere. Since 1999, WNV has rapidly spread throughout the continental United States. Eastern Oregon first experienced the disease in early August 2004 when dead birds and equines were found positive with the disease. Approximately three weeks later the first human case was diagnosed. West Nile Virus was first detected in Clackamas County in August 2007, with 3 birds testing positive for the virus, however, it has not been detected since. It is anticipated that West Nile Virus will be found in Oregon again in 2017, although the likelihood of the disease being detected in Clackamas County is low, with most disease incidence occurring in the eastern and southern parts of the state[2].

Since 2005, there have been 176 WNV human cases and 46 horse cases in Oregon. Consequently, the CCVCD Arbovirus Surveillance Program emphasizes monitoring and providing early warning for temporal and spatial activity of WNV and other mosquito-borne viruses. These viruses are maintained in wild bird-mosquito cycles that do not depend upon infections of humans or domestic animals to persist. Surveillance and control activities focus on this maintenance cycle, which involves primarily *Culex* mosquitoes, such as the common house mosquito, *Culex pipiens*, and birds such as crows, jays, house finches and house sparrows.

Immature stages (called larvae and pupae) of *Culex* mosquitoes can be found throughout Clackamas County in a wide variety of aquatic sources, ranging from clean to highly polluted waters. Most such water is associated with rain water detention, retention ponds, swales, storm water sumps, and other urban wastewater. Species such as *Culex pipiens, Culex tarsalis*, and *Culex stigmatosoma*, play an important role in the transmission cycles of WNV and other viruses in urban and suburban areas. Additional mosquitoes such as *Aedes vexans* and *Culex* *erythrothorax* also could be important bridge (i.e. bird to mammal) vectors in transmission. Lastly, *Aedes albopictus* and *Ae. aegypti* mosquitoes, important vectors of Zika, dengue and chikungunya viruses in other parts of the world, have been detected in several locations in California in recent years and may invade Oregon in the near future.

Since its 1947 discovery in a Ugandan forest, Zika virus has been simmering quietly, with small but noteworthy outbreaks in Micronesia and French Polynesia in the last decade. However, in October 2015, Brazilian health authorities reported an unusual number of microcephaly cases and by November 2015 Brazil had declared a national health emergency. Throughout late 2015 and early 2016 Zika virus infection was detected in multiple central and south American counties, and research data from multiple laboratories began to implicate the virus as a putative cause of multiple birth defects and complications. Throughout the spring and summer of 2016 more evidence of Zika infection arose in an ever-increasing web of travel-related spread and evidence of sexual transmission of the virus, the first ever arthropod-borne sexually transmitted disease. The continental United States saw over 5,000 travel-related Zika cases, and Oregon reported 50 travel-related cases. Alarmingly, in 2016 Florida (216) and Texas (6) reported locally-acquired Zika cases, suggesting that mosquitoes were actively transmitting Zika on US soil. As of March, 2017, the mosquitoes that transmit Zika Virus (Zika vectors) had not been detected in Oregon, including Clackamas County. However, these invasive mosquitoes continue to expand their ranges throughout the western United States[2]. Presently, they have invaded the northern San Joaquin Valley, but the Siskiyou Mountain range seems to be a geographical barrier to their spread north into Oregon. Zika vector surveillance will be conducted in Clackamas County with ova-traps. These traps attract the invasive *Aedes* mosquitoes that transmit Zika virus, inducing them to lay eggs within the trap on a popsicle stick. Traps will be inspected weekly and any eggs collected are brought back to the laboratory for hatching. We will be looking for *Aedes albopictus* and *Aedes aegypti* (the two invasive Zika vectors that are rapidly enlarging their range) during the 2017 mosquito season.

Mosquito control is the only practical method of protecting the human population from infection. There are no specific treatments or cures for diseases caused by these viruses, and vaccines are not licensed for human use. Illness caused by Zika tends to be most serious in pregnant mothers, including microcephaly and other complications, whereas WNV and other viruses are more likely to cause severe disease in the elderly. WNV also kills a wide variety of native and non-native birds. Vaccine for WNV is available to protect horses that are vulnerable to severe neurological disease caused by these viruses. Mosquito borne disease prevention strategies must be based on a well-planned integrated mosquito management (IMM) program that uses near-real-time surveillance to detect problem areas, focus control, and evaluate operational efficacy. The primary components of an IMM program include education, surveillance, and mosquito control.

Education

Citizens can play an important role in reducing the number of adult mosquitoes by eliminating standing water that may support the development of immature mosquitoes. For instance, home and business owners can help by properly disposing of discarded tires, cans, or buckets; emptying plastic or unused swimming pools; and unclogging blocked rain gutters around buildings. Farmers and ranchers can be instructed to use irrigation practices that do not allow water to stand for extended periods, and wetland managers or duck club owners can work with mosquito control agencies to determine optimal flooding schedules. Educating the general public to curtail outdoor activities during peak mosquito biting times, use insect repellents, and wear long-sleeved clothing will help reduce exposure to mosquitoes. Clinical surveillance is enhanced through education of the medical and veterinary communities to recognize the symptoms of WNV, Zika and other viruses, and to request appropriate laboratory tests. Public health officials need to be alerted if a mosquito-borne viral disease case is detected, especially if the public health risk is high.

Surveillance

Surveillance includes monitoring, visualization, and analysis of data on climatic factors, immature and adult mosquito abundance, and virus activity measured by testing mosquitoes, sentinel chickens, dead birds, horses, and humans for evidence of infection. For zoonotic viruses such as West Nile virus, surveillance of the mosquitoes and vertebrate hosts (e.g., birds) that transmit the virus is particularly important for early warning of human disease risk. Surveillance must focus not only on mosquito-borne viruses known to exist in Oregon, but be sufficiently broad to detect newly introduced arboviruses (arthropod-borne viruses). This is especially important since the recent detection of the globally important arboviral vectors, *Aedes aegypti* and *Aedes albopictus,* in California; both are competent vectors of Zika virus.

Climate Variation

Oregon's predictable variation in climate allows forecasting mosquito abundance and arbovirus activity by region. In eastern Oregon, most precipitation falls during winter as rain at lower elevations or as snow at higher elevations. Spring and summer temperatures then influence the rate of snow melt and runoff, mosquito population growth, the frequency of blood feeding, the rate of virus development in the mosquito, and therefore the intensity of virus transmission. In general, WNV outbreaks have occurred in eastern and southern Oregon when wet winters are followed by warm summers, and outbreaks have been linked to warm, dry conditions that lead to large populations of *Culex*. Within the Willamette valley, cold wet winters are followed by temperate, wet springs that work to suppress the WNV enzoonotic cycle. Although climate variation may forecast conditions conducive for virus amplification, a critical sequence of events is required for amplification to reach outbreak levels. In the interest of a complete forecasting appraisal, it should be mentioned that as climate warms the two important Zika virus vectors, *Aedes aegypti* and *Aedes albopictus*, will almost certainly find a foot-hold in southern and eastern Oregon.

Mosquito Abundance

Mosquito abundance can be estimated through collection of immature or adult mosquitoes. The immature stages (larvae and pupae) can be collected from water sources where mosquitoes lay their eggs. A long-handled ladle ("dipper") is used to collect water samples and the number of immature mosquitoes per "dip" can lead to an estimates of population density in each habitat. At CCVCD, technicians search for new sources and inspect known habitats for mosquitoes on a 7 to 14-day cycle. These data are used to direct control operations. Maintaining careful records of immature mosquito occurrence and abundance, developmental stages treated, source sizes, and control effectiveness can be useful for estimating the expected size of future adult populations. Ova-cups are now being used to detect the presence of the Zika vectors *Aedes aegypti* and *Aedes albopictus* within Clackamas County. Mosquito eggs are deposited in these cups and reared in the laboratory to identify the species of mosquito that deposited the eggs.

Adult mosquito abundance is a key factor contributing to the risk of virus transmission. Monitoring the abundance of adult mosquito populations provides important information on the size of the vector population as it responds to changing climatic factors and to control efforts. Four adult mosquito sampling methods are currently used for *Culex* in California: New Jersey light traps, carbon dioxide-baited traps, gravid female traps, and resting adult mosquito collections. *Aedes aegypti* and *Aedes albopictus*, the Zika vectors that have invaded California, are attracted to special traps designed for their biological preferences. The advantages and disadvantages of these sampling methods, and guidelines for the design, operation, and processing of the traps have been discussed in Guidelines for Integrated Mosquito Surveillance[1].

Mosquito Infections

Virus activity can be monitored by testing adult mosquitoes for virus infection. Because *Culex tarsalis* is the primary rural vector of WNV, and *Culex pipiens* is the primary urban vector of WNV, surveillance efforts emphasize the testing of these species. Another species that should be tested is *Culex stigmatosoma*, which is a highly competent but less widely distributed vector of WNV that feeds on birds and is probably important in enzootic transmission where it is found in high abundance. The two invasive Zika virus vectors, *Aedes aegypti* and *Aedes albopictus*, should also be tested if and when they are detected in Oregon. Female mosquitoes are trapped, usually using carbon dioxide-baited or gravid traps, identified to species, and counted into groups (pools) of ≤ 50 females each for testing in the CCVCD laboratory or by local agencies that pass annual proficiency tests. Procedures for submitting and processing mosquitoes for detecting virus infection are available at the OSU VDL[4]. The current surveillance system at CCVCD is designed to detect infection with WNV. Future plans include a PCR pipeline that will measure levels of infection with WNV and other mosquito-borne viruses. Mosquito testing typically begins early in the season and, with adequate trapping and testing effort, provides early warning of virus activity. Testing adult mosquitoes for infection is also one of the best methods to detect newly introduced or emerging mosquito-borne viruses. Testing mosquito species other than *Culex* may be necessary to detect the introduction of arboviruses that do not have a primary *Culex*-bird transmission cycle, notably Zika, dengue and chikungunya viruses transmitted between humans by *Ae. aegypti* and *Ae. albopictus*.

Avian Infections

Detection of arboviral transmission within bird populations can be accomplished by 1) using caged chickens as sentinels and bleeding them routinely to detect viral antibodies (seroconversions), 2) testing dead birds reported by the public for WNV, and 3) collecting and bleeding wild birds to detect viral antibodies (seroprevalence). In a typical surveillance design, flocks of 6-10 chickens are placed in locations where mosquito abundance is known to be high or where there is a history of virus activity. Each chicken is bled every two weeks by pricking the comb and collecting blood on a filter paper strip. The blood is tested in a diagnostic laboratory

(CCVCD is designing such a facility) for antibodies to WNV and other arboviruses. Positive samples may be sent to Oregon Veterinary Diagnostic Laboratory (OVDL) for confirmation and official reporting. Because St. Louis Encephalitis virus (SLEV) cross-reacts with WNV in antibody testing, SLEV or WNV positive chickens are confirmed and the infecting virus is identified by western blot or cross-neutralization tests. Frequent testing of strategically placed flocks of sentinel chickens provides an effective method to monitor encephalitis virus transmission in an area, particularly as a surrogate for human risk because information on human cases often arrives too late for mosquito control decisions. Because chickens are continuously available to host-seeking mosquitoes, they are not subject to the night-to-night variation associated with mosquito trapping, and their stationary location provides a specific spatial indication of transmission when seroconversions occur. Sentinel housing, bleeding instructions, and testing protocols are available[1].

West Nile Virus frequently causes death in North American birds, especially those in the family Corvidae (e.g. crows, ravens, magpies, jays). Dead bird surveillance was initiated by CCVCD in 2005 to provide early detection of WNV. Dead bird surveillance has been shown to be one of the earliest and most cost-effective indicators of WNV activity where susceptible bird species are abundant and many Oregon vector control agencies promote this program. Dead birds that meet criteria for species and condition are collected by CCVCD for WNV testing. Typical an oral sample is collected by swabbing the oropharyngeal cavity of the bird and pressing the swab onto an RNA preservation card that preserves nucleic acids. The cards are analyzed for WNV RNA testing by RT-PCR. Local agencies may also test American Crows in-house using rapid antigen tests (RAMP?) provided they have passed annual proficiency panels. Dead birds can also be shipped to Oregon Veterinary Diagnostic Laboratory (OVDL) for WNV testing[3]. The communication and testing algorithm for the dead bird surveillance program is detailed at the OHA website[3].

Virus activity in wild bird populations can be monitored by bleeding young (hatching year) birds to detect initial virus infection or by bleeding a cross-section of birds in an area and comparing sero-prevalence among age strata to determine if the prevalence of the virus in the region has changed. Elevated sero-prevalence levels ("herd immunity") among key species during spring may limit virus transmission and dampen amplification. New infections also can be detected by bleeding banded birds in a capture-recapture scheme. In contrast to the convenience of using sentinel chickens, the repeated collection and bleeding of wild birds is labor intensive, technically difficult (especially with mist netting), and too expensive for most local mosquito control agencies to perform routinely, although regular stationary traps can be cost effective. In addition, the actual place where a wild bird became infected is rarely known, because birds may travel over relatively long distances, and usually are collected during daytime foraging flights and not at nighttime roosting sites where they are bitten by mosquitoes.

Equine Infections

Currently, equine disease due to WNV Western Equine Encephalitis Virus (WEEV) is no longer a sensitive indicator of epizootic activity (unusually high incidence of infections in animals other than humans) in Oregon because of the widespread vaccination or natural immunization of equids (horses, donkeys, and mules). Nevertheless, confirmed cases in horses can indicate that WEEV or WNV has amplified to levels where tangential transmission has occurred and risk to humans is elevated in that region of the state. Numerous infectious and non-infectious causes, including other mosquito-borne viruses, can contribute to encephalitis and neurologic signs in horses. Testing of equine specimens for these possible etiologies is available through the Oregon Veterinary Diagnostic Laboratory (OVDL). Complete information on specimen collection and submission is available on the Oregon Veterinary Diagnostic Laboratory (OVDL) website at: http://vetmed.oregonstate.edu/diagnostic/available-tests.

Human Infections

Local mosquito control agencies need information from the rapid detection and reporting of confirmed human cases to plan and implement emergency control activities to prevent additional infections. However, human cases of arboviral infection are an insensitive surveillance indicator of virus activity because most persons who become infected develop no or mild symptoms. For those individuals who do become ill, it may take up to two weeks for symptoms to appear, followed by additional time until the case is recognized and reported. A total of 176 cases of WNV have been reported in Oregon from 2005 to 2015. No human cases of SLEV or WEEV have been reported in Oregon in recent years, agreeing with negative enzootic surveillance findings. Development of this section is just beginning with relevant agencies. However, CCVCD does periodically contact OHA for human case updates[2] as well as the Clackamas County Public Health Division regarding WNV human case prevalence.

Mosquito Control

Problems detected by surveillance are mitigated through larval and adult mosquito control. Mosquito control is the only public health method of protecting people from mosquito-borne diseases. Mosquito control in Oregon is conducted by approximately 20 local agencies, including mosquito and vector control districts, county environmental and health departments, and county agriculture departments. Agencies applying pesticides directly to a water of the United States, or where deposition may enter a water of the United States, must obtain a National Pollutant Discharge Elimination System (NPDES) Permit for Biological and Residual Pesticide Discharges to Waters of the United States from Vector Control Applications (Vector Control Permit). Agencies must comply with provisions of the permit. http://www.oregon.gov/deq/wq/wqpermits/Pages/Pesticide.aspx Compounds currently approved for larval and adult mosquito control in Oregon are listed in *Appendix 4*.

The Clackamas County Vector Control District uses an Integrated Mosquito Management (IMM) approach to control mosquito vector populations. Integrated pest management programs incorporate multiple modalities to accomplish their ultimate goals. For the District, the modalities include **cultural control, physical control, biological control and chemical control**. Cultural control includes an informed public that takes precautions to protect themselves and their neighbors from mosquito borne disease. Specific cultural control actions would include dumping rainwater-filled pots, keeping drainage channels open, repairing window screens, wearing mosquito repellent, and sharing information that empowers others to protect themselves. Physical control includes careful planning of watershed drainage systems, maintenance of storm water retention ponds and swales, proper design of artificial ponds and wetlands, and creating positive collaborative relationships with governmental agencies and private property owners that have jurisdiction and responsibility for any of these physical systems. Biological control includes using mosquito-eating fish (*Gambusia affinis*) to control larval mosquito populations in a select class of water containment systems, including animal watering troughs, private ornamental ponds, and similar aquatic habitats. Water containment systems receiving mosquito fish cannot drain into the greater Willamette watershed. Chemical control includes the use of bacterial toxins and growth hormone mimics that target larval mosquitoes directly in their aquatic environments. It also includes the use of a broad range of relatively benign insecticides to control adult mosquitoes. Bacterial toxins are dispersed as small blocks or pellets directly into the aquatic habitat where they dissolve and are ingested by larval mosquitoes, causing disruption of the digestive membrane and a subsequent lethal leakage effect within the larval gut. The growth hormone products are also dispersed as solid blocks or pellets that dissolve slowly in the aquatic environment, releasing a juvenile hormone that effectively prevents the larvae from developing into adult mosquitoes. Another useful larval suppressant is a monomolecular surface film, sprayed in small amounts onto larval habitats that are extremely enriched in organic debris (dairy milking ponds, septic tanks, etc.). These films essentially asphyxiate all aquatic organisms that breath though the water surface, and can have unintended non-target effects. Thus, surface films are only occasionally used in very specific larval habitats. Adult mosquito control is achieved using relatively benign insecticides that include pyrethroids, a class of insecticides that degrade rapidly in the environment and can be applied in residential settings as a barrier spray. Other adult insecticides with similar rapid degradation properties are also used, including environmentally friendly blends of essential plant extracts, e.g., mint oil blends.

Response Levels

The Clackamas County Vector Control District Mosquito-borne Virus Surveillance and Response Plan was developed to provide a semi-quantitative measure of virus transmission risk to humans that could be used by staff and other local mosquito control agencies to plan and modulate control activities. Independent models are presented for WEEV, SLEV and WNV to accommodate the different ecological dynamics of these viruses[5]. Models for **Zika** virus are being developed but are not presented here. SLEV and WNV are closely related, require similar environmental conditions, and employ the same *Culex* vectors. **Seven surveillance factors** are measured and analyzed to determine the level of risk for human involvement and thereby gauge the appropriate response level:

1. Environmental or climatic conditions (snowpack, rainfall, temperature, season)
2. Adult *Culex* vector abundance
3. Virus infection rate in *Culex* mosquito vectors
4. Sentinel chicken seroconversions
5. Fatal infections in birds (WNV only)
6. Infections in humans
7. Proximity of detected virus activity to urban or suburban regions (WEEV only)

Each factor included is scored on an ordinal scale from 1 (lowest risk) to 5 (highest risk). The mean score calculated from these factors corresponds to a response level as follows: normal season (1.0 to 2.5), emergency planning (2.6 to 4.0), and epidemic (4.1 to 5.0). Table 1 provides a worksheet to assist in determining the appropriate rating for each of the risk factors for each of the three viruses. Surveillance data can be managed and risk level calculated in time and space using computer models such as the Surveillance Gateway in California[1].

Risk calculations should be applied within a defined area, typically encompassing a local mosquito and vector control district. Use of smaller spatial units (e.g., city boundaries) is ideal due to spatial variation in virus activity. Due to spatial variation in the distributions of humans and the dominant vector species, *Cx. tarsalis* and the *Cx. pipiens* complex, separate calculation of risk for urban and rural areas is encouraged where applicable.

For surveillance factor 2 (vector abundance), abundance is expressed as a percentage of normal by comparing the current level for an area to the average over the previous 5 years for the same area and two-week period. The mosquito virus infection rate should be calculated using the most recent data (prior two week period) and expressed as the minimum infection rate (MIR) per 1,000 female mosquitoes tested. Calculations may also use maximum likelihood estimates that account for varying numbers of specimens in pools and the possibility that more than one mosquito could be infected in each positive pool when infection rates are high. For WNV and SLEV, risk may be estimated separately for *Cx. tarsalis* and the *Cx. pipiens* complex, respectively, because these species generally have different habitat requirements and therefore spatial distributions (e.g., rural vs. urban).

Each of the three viruses differs in its response to ecological conditions. WEEV activity typically is greatest during El Niño conditions of wet winters, excessive run-off and flooding, cool springs, and increased *Culex tarsalis* abundance. In contrast, SLEV and perhaps WNV activity appears to be greatest during La Niña conditions of drought and hot summer temperatures, because both SLEV and WNV transmission risk increases when temperatures are above normal. Abundance and infection of the *Culex pipiens* complex are included in both SLEV and WNV estimates of risk because these mosquito species are important vectors, particularly in suburban/urban environments. The occurrence of dead bird infections is included as a risk factor in the WNV calculations. For surveillance factors 4-6 (chickens, birds, humans), the specific region is defined as the area within the agency’s boundary and the broad region includes the area within 150 miles (~241 km) of the agency’s boundary.

Proximity of virus activity to human population centers is considered an important risk factor for all three viruses of public health concern. In the risk assessment model in Table 1 this was accommodated in two different ways. WEE virus transmitted by *Culex tarsalis* typically amplifies first in rural areas and may eventually spread into small and then larger communities. A risk score was included to account for where virus activity was detected. WNV and SLEV may be amplified concurrently or sequentially in rural and urban cycles. The rural cycle is similar to WEE virus and is transmitted primarily by *Cx. tarsalis*, whereas the urban cycle is transmitted primarily by members of the *Culex pipiens* complex. If the spatial distributions of key *Culex* species differ within an area (e.g., rural vs. urban), it may be advantageous to assess risk separately by species for abundance and infection rates in *Cx. tarsalis* and the *Cx. pipiens* complex. This would result in two estimates of overall risk for the areas dominated by each species.

Each of these surveillance factors can differ in impact and significance according to time of year and geographic region. Climate is used prospectively to forecast risk during the coming season. Climatic factors provide the earliest indication of the potential for increased mosquito abundance and virus transmission and constitute the only risk factor actually measured from the start of the calendar year through mid-spring when enzootic surveillance commences in most areas. Other factors that may inform control efforts as the season progresses are typically, in chronological order: mosquito abundance, infections in non-humans (e.g., dead birds for WNV, mosquitoes, sentinel chickens), and infections in humans. Enzootic indicators measure virus amplification within the *Culex*-bird cycle and provide nowcasts of risk, whereas human infections document tangential transmission and are the outcome measure of forecasts and nowcasts. Response to the calculated risk level should consider the time of year; e.g., epidemic conditions in October would warrant a less aggressive response compared to epidemic conditions in July because cooler weather in late fall will contribute to declining risk of arbovirus transmission.

The ratings listed in Table 1 are benchmarks only and may be modified as appropriate to the conditions in each specific region or biome of the state. Calculation and mapping of risk has been enabled by tools for local agency use included in the CalSurv Gateway. Roles and responsibilities of key agencies involved in carrying out the surveillance and response plan are outlined in "Key Agency Responsibilities."

Table 1. Mosquito-borne Virus Risk Assessment.

WNV Surveillance Factor Assessment	**Assessment Value**	**Benchmark**	**Assigned Value**
Environmental Conditions High-risk environmental conditions include above-normal temperatures with or without above-normal rainfall, runoff, or snowpack.	1	Avg daily temperature during prior 2 weeks ≤ 56 °F	
	2	Avg daily temperature during prior 2 weeks 57 – 65 °F	
	3	Avg daily temperature during prior 2 weeks 66 – 72 °F	
	4	Avg daily temperature during prior 2 weeks 73 – 79 °F	
	5	Avg daily temperature during prior 2 weeks > 79 ° F	
Adult *Cx.pipiens* relative abundance Determined by trapping adults, enumerating them by species, and comparing numbers to those previously documented for an area for the prior 2-week period.	1	Vector abundance well below average (≤ 50%)	
	2	Vector abundance below average (51 - 90%)	
	3	Vector abundance average (91 - 150%)	
	4	Vector abundance above average (151 - 300%)	
	5	Vector abundance well above average (> 300%)	
Virus infection rate in *Cx. pipiens* Mosquitoes Tested in pools of 50. Test results expressed as minimum infection rate per 1,000 female mosquitoes tested (MIR) for the prior 2-week period.	1	MIR = 0	
	2	MIR = 0.1 - 1.0	
	3	MIR = 1.1 - 2.0	
	4	MIR = 2.1 - 5.0	
	5	MIR > 5.0	
Sentinel chicken seroconversion Number of chickens in a flock that develop antibodies to WNV during the prior 2-week period. If more than one flock is present in a region, number of flocks with seropositive chickens is an additional consideration. Typically 10 chickens per flock.	1	No seroconversions in broad region	
	2	One or more seroconversions in broad region	
	3	One or two seroconversions in a single flock in specific region	
	4	More than two seroconversions in a single flock or two flocks with one or two seroconversions in specific region	
	5	More than two seroconversions per flock in multiple flocks in specific region	
Dead bird infection Number of birds that have tested positive (recent infections only) for WNV during the prior 3-month period. This longer time period reduces the impact of zip code closures during periods of increased WNV transmission.	1	No positive dead birds in broad region	
	2	One or more positive dead birds in broad region	
	3	One positive dead bird in specific region	
	4	Two to five positive dead birds in specific region	
	5	More than five positive dead birds in specific region	
Human cases Do not include this factor in calculations if no cases are detected in region.	3	One or more human infections in broad region	
	4	One human infection in specific region	
	5	More than one human infection in specific region	
Response Level / Average Rating Normal Season (1.0 to 2.5) Emergency Planning (2.6 to 4.0) Epidemic (4.1 to 5.0)		TOTAL	
		AVERAGE	

General suggestions for applying the risk assessment model at the county, city, or local level

- Use a consistent time period for environmental conditions, adult mosquito abundance, mosquito infection rates, and human cases. If you use a period that differs from the prior two-week period defined in the risk assessment, such as the prior month, use the same period for all other relevant measures. Note that sentinel chicken seroconversions may need special treatment to accommodate bleeding schedules and dead bird data need to accommodate zip code closures. For sentinel seroconversions, use data from the most recent collection.
- If you have multiple trap types in your surveillance program, determine the vector abundance anomaly (Table 1) for each trap type and species and use the most sensitive trap type's value in the risk assessment, with trap sensitivity being defined as the most attractive to the species of interest in a given location.
- When determining the vector abundance anomaly, there should be at least two and preferably five years of prior data to provide a comparative baseline for the particular trap type. Ideally, the prior years should use the same or very similar trap locations. If mosquito breeding occurs continuously, as it might with increasing temperatures due to climate change, analysis of data from previous years should use the same or very similar trap locations and immediately precede the time period being evaluated.

Characterization of Conditions and Responses for CCVCD and other agencies

Level 1: Normal Season
Risk rating: 1.0 to 2.5

CONDITIONS

- Cool to moderate seasonal temperatures (< 65°F)
- *Culex* mosquito abundance at or below five-year average (key indicator vector adults)
- No virus infection detected in mosquitoes
- No seroconversions in sentinel chickens
- No recently infected WNV-positive dead birds
- No human cases

RESPONSE

- Conduct routine public education (eliminate standing water around homes, use personal protection measures)
- Conduct routine mosquito and virus surveillance activities
- Comply with National Pollutant Discharge Eliminations System (NPDES) permit if applying pesticides to waters of the United States
- Conduct routine mosquito control with emphasis on larval control
- Inventory pesticides and equipment
- Evaluate pesticide resistance in vector species
- Ensure adequate emergency funding
- Release routine press notices
- Send routine notifications to physicians and veterinarians
- Establish and maintain routine communication with local office of emergency services personnel; obtain Standardized Emergency Management System (SEMS) training

Level 2: Emergency Planning
Risk rating: 2.6 to 4.0

CONDITIONS

- Temperature above average (66–79°F)
- Adult *Culex* mosquito abundance greater than 5-year average (150% to 300% above normal)
- One or more virus infections detected in *Culex* mosquitoes (MIR < 5 per 1,000 tested)
- One or more seroconversions in single flock or one to two seroconversions in multiple flocks in specific region
- One to five recently infected WNV-positive dead birds in specific region
- One human case in broad or specific region
- WEEV detected in small towns or suburban area

RESPONSE

- Review epidemic response plan
- Enhance public education (include messages on the signs and symptoms of encephalitis; seek medical care if needed; inform public about pesticide applications if appropriate)
- Enhance information to public health providers
- Conduct epidemiological investigations of cases of equine or human disease
- Increase surveillance and control of mosquito larvae
- Increase adult mosquito surveillance
- Increase number of mosquito pools tested for virus
- Conduct or increase localized chemical control of adult mosquitoes as appropriate
- Contact commercial applicators in anticipation of large scale adulticiding
- Review candidate pesticides for availability and susceptibility of vector mosquito species
- Ensure notification of key agencies of presence of viral activity, including the local office of emergency services

Level 3: Epidemic Conditions

Risk rating: 4.1 to 5.0

CONDITIONS

- Temperature well above average (> 79°F)
- Adult vector population extremely high (> 300% above normal)
- Virus infections detected in multiple pools of *Culex tarsalis* or *Cx. pipiens* mosquitoes (MIR > 5 per 1,000 tested)
- More than two seroconversions per flock in multiple flocks in specific region
- More than five recently infected WNV-positive dead birds and multiple reports of dead birds in specific region
- More than one human case in specific region
- WEE virus detection in urban or suburban areas

RESPONSE

- Conduct full-scale media campaign
- Alert physicians and veterinarians to expect cases
- Conduct active human case detection
- Conduct epidemiological investigations of cases of equine or human disease
- Continue enhanced larval surveillance and control of immature mosquitoes
- Broaden geographic coverage of adult mosquito surveillance
- Accelerate adult mosquito control as appropriate by ground and/or air
- Coordinate the response with the local Office of Emergency Services or if activated, the Emergency Operation Center (EOC)
- Initiate mosquito surveillance and control in geographic regions without an organized vector control program
- Determine whether declaration of a local emergency should be considered by the County Commissioners (or Local Health Officer)
- Determine whether declaration of a "State of Emergency" should be considered by the Oregon Governor at the request of designated county or city officials
- Ensure state funds and resources are available to assist local agencies at their request

- Determine whether to activate a Standardized Emergency Management System (SEMS) plan at the local or state level
- Continue mosquito education and control programs until mosquito abundance and enzootic virus activity is substantially reduced and no additional human cases are detected

Key Agency Responsibilities

CCVCD and other local Mosquito and Vector Control Agencies

- Acquire and interpret local climate and weather data.
- Monitor abundance of immature and adult mosquitoes.
- Collect and submit mosquito pools for virus detection at OSU Vet Path or local laboratories.
- Maintain sentinel chicken flocks, obtain blood samples, and send samples to OSU Vet Path.
- Pick-up and sample dead birds by oral swabs using RNA preservation cards for WNV testing, or test oral swabs from suitable bird species locally via RT-PCR or RAMP® screening assays.
- Update the CCVCD database (and any OR state database) weekly to record all birds that are independently reported and/or tested by RAMP® or RT-PCR.
- Update the Oregon Health Authority weekly to report mosquito pool results that are independently tested by RAMP® or RT-PCR.
- Conduct routine control of immature mosquitoes.
- Comply with NPDES permit if applying pesticides to waters of the United States.
- Conduct control of adult mosquitoes when needed.
- Educate public on mosquito avoidance and reduction of mosquito breeding sites.
- Coordinate with local Office of Emergency Services personnel.
- Communicate regularly with neighboring agencies.

Mosquito and Vector Control Association of Oregon

- Coordinate purchase of sentinel chickens.
- Receive, track, and disburse payment for mosquito surveillance expenses.
- Coordinate surveillance and response activities among member agencies.
- Serve as spokesperson for member agencies.
- Establish liaisons with press and government officials.

Oregon Health Authority Vector Borne Disease Section

- Collate adult mosquito abundance data submitted by local agencies; provide summary of data to local agencies.
- Maintain a WNV information and dead bird reporting system: https://public.health.oregon.gov/DiseasesConditions/DiseasesAZ/WestNileVirus/Pages/wnvprevent.aspx .
- Coordinate submission of specimens for virus testing.
- Provide supplies for sentinel chicken diagnostic specimens.
- Test sentinel chicken sera for viral antibodies.
- Test human specimens for virus.
- Distribute a weekly bulletin summarizing surveillance test results.
- Report weekly surveillance results to the CDC ArboNET surveillance system.
- Immediately notify local vector control agency and public health officials when evidence of virus activity is found.
- Conduct epidemiological investigations of cases of human disease.
- Coordinate and participate in a regional emergency response in conjunction with Oregon Emergency Management Agency.
- Conduct surveillance for human cases.

- Provide oversight to local jurisdictions without defined vector-borne disease control program.
- Maintain inventory of antigens, antisera, and RNA assays to detect exotic viruses.
- Provide confirmation of tests done by local agencies.

End of Mosquito-Borne Virus Surveillance and Response Plan

Training and Professional Development

All CCVCD permanent and seasonal staff must pass an Oregon Department of Agriculture Public Pesticide Applicator Licensing test, including excellence in general pesticide safety and pesticide laws and a section specific to the safe delivery of public health pesticides. To keep their license current, all staff must accumulate yearly quotas of continuing educational units. These units are awarded by attendance at relevant meetings and other activities. Permanent staff are encouraged to attend regional and national meetings focused on the biology and control of vector-borne diseases, including any technological breakthroughs, and the District offers financial support for these activities. Specialized training in mosquito identification and surveillance, public education and community outreach, equipment maintenance and use, and other training will be provided to staff as needs are identified. CCVCD supports advanced professional development with college tuition assistance, as well as career counseling.

Public Education

A professional, well-organized public education program is an essential part of all District vector-borne disease prevention and vector control programs. The District has contracted with a local public relations firm since 2014. This partnership has allowed the District and its mission to reach a large audience of stakeholders throughout Clackamas County and beyond. Deliverables include freeway billboards, advertisements on Tri-Met buses, electronic media blitzes, social media informational updates, District Calendars, other give-away items, and a highly rated user-friendly website (www.fightthebites.com).

Public education is crucial in the battle to prevent mosquito-borne disease transmission. When citizens understand mosquito biology, they are empowered to make decisions that protect their families and neighbors from deadly diseases such as West Nile Virus and Zika Virus. The "Hit Mosquitoes Where They Live" section of the CCVCD website gives simple, actionable advice that all citizens can use to stop the breeding of mosquitoes in their immediate environments. If the vectors that transmit Zika invade Oregon, public education will be even more important than it is now. While the West Nile mosquitoes prefer large open wetlands, the mosquitoes that transmit Zika can breed in very small containers of water, a common occurrence in many yards.

Glossary/Acronyms

Adulticide	Insecticides used to kill adult mosquitoes. All must be approved by EPA and state
Arboviral	Having to do with arthropods that transmit viruses affecting humans and other animals
AWP	Annual Work Plan
Breeding Site	An aquatic habitat where immature mosquitoes hatch and develop into adults
CCCH	Clackamas County Community Health
CCVCD	The ‘District’ - Clackamas County Vector Control District
Community Outreach	Information – verbal, written or other – provided to all residents in the community
EPA	Environmental Protection Agency
Equine	Horse
epizootic	relating to or denoting a disease that is temporarily prevalent and widespread in an animal population.
EVS Trap	Encephalitis viral surveillance trap
High-Risk Areas	Areas in Clackamas County where human health appears threatened due to positive test results for West Nile Virus
Immature Mosquitoes	The larval and pupal forms of mosquitoes. All are found in aquatic habitats
Insecticide Label	Information sheet required by EPA for all insecticides. Mosquito control agencies must have copies of each, for all insecticides used by that agency
Integrated Mosquito Management	The best management practices used by mosquito control agencies that include: surveillance, public education, community outreach, source reduction, and the use of insecticides in the most environmentally friendly ways possible

Larvae	The aquatic, immature stages of a mosquito that undergoes four molts then changes into the pupal stage
Larvicide	Insecticides used to kill immature mosquitoes. All must be approved by EPA and state
MSDS	Material Safety Data Sheet
Nuisance Mosquitoes	Mosquitoes that bite but are not considered important vectors to humans
ODA	Oregon Department of Agriculture
ODFW	Oregon Department of Fish and Wildlife
ODHS	Oregon Department of Health Services
PCR	Polymerase chain reaction: a technique used in molecular biology to amplify a single copy or a few copies of a segment of DNA across several orders of magnitude, generating thousands to millions of copies of a particular DNA sequence.
PUP	Pesticide Use Permit. A yearly report required of all Oregon mosquito control programs and sent to ODFW and ODHS
Pupae	The aquatic, immature form of a mosquito prior to emerging as an adult
RAMP	Rapid Analyte Measurement Platform (RAMP), a test used to detect WNV in mosquitoes and dead birds. The RAMP system is an immunoassay test for West Nile virus (WNV) detection. RAMP uses WNV-specific antibodies, conjugated to fluorescent latex particles, to determine the status of a sample. For details see https://www.ncbi.nlm.nih.gov/pubmed/22855771
RT-PCR	Real time polymerase chain reaction: RT-PCR is used to clone expressed genes by reverse transcribing the RNA of interest into its DNA complement using reverse transcriptase. Subsequently, the newly synthesized cDNA is amplified using traditional PCR.

ULV	Ultra Low Volume. The term used to describe insecticide spray units that break up spray particles into micron size units, typically 15-25 microns. Insecticide labels state micron size allowable for that particular material.
VCZ	Vector Control Zone. Specific areas in Clackamas County used as geographical markers by CCVCD to plan all operational programs
Vector	An organism, usually an insect or other arthropod, capable of carrying and transmitting a disease agent from one host to another
WNV	West Nile Virus
WNVIE	West Nile Virus Information Exchange. A group of public or private agencies, community organizations and individual stakeholders in Clackamas County that was formed in 2006 to collaborate and exchange information on WNV
Zoonosis	**Zoonoses** are infectious diseases of animals (usually vertebrates) that can naturally be transmitted to humans. Includes Ebola, salmonella, Zika, WNV, Dengue, Lyme Disease and many others.

References cited

1. California Department of Public Health, Vector Borne Disease Section https://www.cdph.ca.gov/programs/vbds/Pages/default.aspx
2. Oregon Health Authority West Nile Archive https://public.health.oregon.gov/DiseasesConditions/DiseasesAZ/WestNileVirus/Pages/survey.aspx
3. Oregon Health Authority WNV reporting page https://public.health.oregon.gov/DiseasesConditions/DiseasesAZ/WestNileVirus/Pages/clinicians.aspx
4. Oregon State University Veterinary Diagnostic Laboratory http://vetmed.oregonstate.edu/diagnostic
5. Barker, C. M., W. K. Reisen, and V. L. Kramer. 2003. California State Mosquito-borne Virus Surveillance and Response Plan: A retrospective evaluation using conditional simulations. Am. J. Trop. Med. Hyg. 68: 508-518.

Appendix 1
Proposed Budget Fiscal Year 2018

PERSONNEL SERVICES	**$839,190**

Director
Office Manager
Field Supervisor
Biologist
Assistant Biologist
Seasonal Employees
Retirement
Social Security & Unemployment
State Compensation (SAIF)
Health Insurance
Tri Met Tax

MATERIALS AND SERVICES	**$177,000**

Insecticides
Vehicle & Equipment Maintenance
General Supplies
Office Supplies
Insurance & Bonds
Utilities

CONTRACTUAL SERVICES	**$364,000**

Protective Clothing
Audit & Filing
Legal & Licensing
Building Maintenance & Grounds
West Nile Virus Prevention
Public Education & Awareness

OTHER	**$39,000**

Publishing & Literature
Association Dues
Travel & Conferences

CAPITAL OUTLAY	**$540,000**

Building Repairs
Control Equipment
Vehicle

RESERVE FUND (Land & Buildings)	**$500,000**
OPERATING CONTINGENCIES	**$100,000**
UNAPPROPRIATED FUND	**$1,623,258**
Total Budget Requirements	**$3,782,449**

2/ The District follows Oregon budget law. The actual budget for FY18 will be adopted by the District's Board in June, 2017

Appendix 2

Integrated Mosquito Management

The Clackamas County Vector Control District uses an Integrated Mosquito Management (IMM) approach to control mosquito vector populations. Integrated pest management programs incorporate multiple modalities to accomplish their ultimate goals. For the District, the modalities include **cultural control, physical control, biological control and chemical control**. Cultural control includes an informed public that takes precautions to protect themselves and their neighbors from mosquito borne disease. Specific cultural control actions would include dumping rainwater-filled pots, keeping drainage channels open, repairing window screens, wearing mosquito repellent, and sharing information that empowers others to protect themselves. Physical control includes careful planning of watershed drainage systems, maintenance of storm water retention ponds and swales, proper design of artificial ponds and wetlands, and creating positive collaborative relationships with governmental agencies and private property owners that have jurisdiction and responsibility for any of these physical systems. Biological control includes using mosquito-eating fish to control larval mosquito populations in a select class of water containment systems, including animal watering troughs, private ornamental ponds, and similar aquatic habitats. Water containment systems receiving mosquito fish cannot drain into the greater Willamette watershed. Chemical control includes the use of bacterial toxins and growth hormone mimics that target larval mosquitoes directly in their aquatic environments. It also includes the use of a broad range of relatively benign insecticides to control adult mosquitoes. Bacterial toxins are dispersed as small blocks or pellets directly into the aquatic habitat where they dissolve and are ingested by larval mosquitoes, causing disruption of the digestive membrane and a subsequent lethal leakage effect within the larval gut. The growth hormone products are also dispersed as solid blocks or pellets that dissolve slowly in the aquatic environment, releasing a juvenile hormone that effectively prevents the larvae from developing into adult mosquitoes. Another useful larval suppressant is a monomolecular surface film, sprayed in small amounts onto larval habitats that are extremely enriched in organic debris (dairy milking ponds, septic tanks, etc.). These films essentially asphyxiate all aquatic organisms that breath though the water surface, and can have unintended non-target effects. Thus, surface films are only occasionally used in very specific larval habitats. Adult mosquito control is achieved using relatively benign insecticides that include pyrethroids, a class of insecticides that degrade rapidly in the environment and can be applied in residential settings as a barrier spray. Other adult insecticides with similar rapid degradation properties are also used, including environmentally friendly blends of essential plant extracts, e.g., mint oil blends.

IMM methods suggest an approach to each instance of mosquito control that follows a series of steps. The first step (after mosquitoes have been positively detected at a given site) is to ask if cultural controls can be implemented to solve the problem of excessive abundance of mosquitoes. If cultural controls are not possible then physical controls are suggested, sometimes simultaneously. If stakeholders need immediate action (with cultural and/or physical controls to follow), then biological and/or chemical control actions may be indicated.

The following principles are to be followed when:

1. Vector control measures should only be undertaken when there is adequate justification based upon surveillance data.

2. The combination of methods for vector control should be chosen after careful consideration of the efficacy, health effects, ecological effects and cost versus benefits of the various options; including public education, legal action, natural and biological control, elimination of the breeding sources, and pesticide applications.

3. Vector breeding sources, whether natural or created by human activity, should be altered in such a manner as to cause the least undesirable impact on the environment.

4. Pesticides and application methods should be used in the most efficient and least hazardous manner in accordance with all applicable laws, regulations and available scientific data. The registered label requirements for pesticide use should be followed. When choices are available among effective pesticides, those offering the least hazard to non-target organisms should be used. Pesticides should be chosen and used in a manner that will minimize the development of resistance in vector populations.

5. Personnel involved in the Vector Control program should be properly trained and supervised, certified in accordance with relevant laws and regulations, and should keep current with improvements in management techniques through continuing education and/or training programs.

Appendix 3

Key Agencies / Clackamas County Vector District

1. Key Agencies

This list identifies key agencies with West Nile Virus responsibilities and interests in Clackamas County and Oregon. The websites of these agencies can provide further information regarding their role and functions involving West Nile Virus.

- Clackamas County Vector Control District, (503) 655-8394, **www.vectorclackamas.com**

- Clackamas County Community Health, (503) 655-8350. **www.co.clackamas.or.us/ph/westnile**

- Clackamas County Dept. of Public and Government Relations, (503) 742-5911, **www.co.clackamas.or.us/pgr**

- Clackamas County Water Environment Services, (503) 353-4597, **www.co.clackamas.or.us/wes**

- State of Oregon, Public Health Department, Disease Prevention, (503) 731-4024, **www.ohd.hr.state.or.us/acd/wnile/index.cfm**

- Oregon Department of Agriculture, Don Hansen, (503) 986-4680, **http://egov.oregon.gov/ODA/AHID**

- OSU Extension Service – Clackamas County, (503) 655-8631 **www.oregonstate.edu/clackamas**

- Oregon Department of Fish and Wildlife, Habitat Division, (503) 947-6092 **www.dfw.state.or.us/lands**

- County Health Officer – Gary Oxman (tri-county) 503-988-3674 **www.co.multnomah.or.us/health/**

Appendix 4

Larvicides and Adulticides

Larvicides/Pupacides

These insecticides are applied directly to the water or to habitats that routinely flood to kill immature mosquitoes. The larvicides and pupacides given below will be used by the District. Complete product information, including details for use, labels and material safety data sheets is available at the listed websites.

- **Altosid** (methoprene) – *Manufactured by: Wellmark International/Zoecon Professional Product*. An insect growth regulator (IGR) containing the active ingredient methoprene. Larvae exposed to this product develop normally to the pupal stage where they die. www.altosid.com

- ***Bti*** (*Bacillus thuringiensis var. israelinsis*) - *Manufactured by: Summit Chemical*. A mosquito and blackfly larvicide containing the active ingredient Bacillus thuringiensis, var. israelensis. A sustained release formulation offering activity against mosquito larvae for thirty days or more. The floating quality of the briquet provides for release of the active ingredient at the water's surface where it affects surface feeding larvae, and as it sinks slowly through the water column, the active ingredient also becomes available to those larvae feeding in this area as well. www.clarkemosquito.com

- **Vectolex - *Bs*** (*Bacillus sphaericus*) - www.clarkemosquito.com *Bacillus sphaericus* is a rod-shaped, strictly aerobic, Gram positive bacterium which is used as an insecticide against larval mosquitoes. The benefit of using *B. sphaericus* as a mosquito larvicide versus other commercially available pesticides is that it is virtually non-toxic to pets, birds, fish, other worms and insects, humans, and the environment. Because it can form spores, it can persist in a mosquito habitat for months because it is recycled through mosquito life cycles.

- **Agnique MMF** (monomolecular surface film) - Manufactured *by Cognis Corporation.* Agnique MMF is a larvicide and pupacide with an alternative mode of action. It is ideally suited for mosquito control programs and environmentally sensitive situations. www.adapcoinc.com

Adulticides

These insecticides are applied into the air to kill flying mosquitoes. Three classes of insecticides may be used by the District as adulticides. These are pyrethroids and natural Pyrethrins, various pyrethroids such as permethrin (Permanone), Anvil (sumithrin), as well as a variety of natural pyrethrins. Complete product information including detail for use, labels and material safety data sheets is available at the websites listed below. Perimeter sprays are included as these are commonly used by request on the scale of single family residences.

- **Anvil** 2+ 2(permethrin, natural pyrethrin) - Anvil® is particularly effective against most known vector species, including organophosphate-resistant species. The active ingredient in Anvil is sumithrin, a synthetic pyrethroid formulation that replicates the mosquito fighting properties of pyrethrum, an extract of the chrysanthemum flower.

- **Mavrik** (perimeter spray formulation). Active ingredient is Tau-fluvalinate, a synthetic pyrethroid. Industry-standard perimeter spray for mosquito control. High toxicity to mosquitoes means small amounts of the active ingredient are used, thus minimizing risk of spillage, run-off, and other types of environmental leakage. Applied directly to plants around homes on request, efficacious for two weeks barring rain.

- **Eco-Exempt** (natural plant oil extract formulation). Environmentally friendly product (exempt from EPA registration as an insecticide) for use as a barrier spray on plants around homes by request. Highly effective against adult mosquitoes that find harborage on plant surfaces. Excellent alternative for County residents that want mosquito control but also want to have minimal impact on non-target species and the general ecosystem.

All larvicides and adulticides used by the District will be EPA approved materials. Additionally, the insecticides will be approved by ODHS and ODFW through the PUP. This is a required yearly report for all mosquito control programs in Oregon.