CONTRA COSTA MOSQUITO & VECTOR CONTROL DISTRICT
Protecting Public Health Since 1927
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Pesticides Application Plan (PAP) – June 2011

1. **Description of ALL target areas, if different from the water body of the target area, in to which larvicides and adulticides are being planned to be applied or may be applied to control vectors. The description shall include adjacent areas, if different from the water body of the target areas**:
   Map attached (Appendix 1). Potential target area includes all areas within the boundaries of Contra Costa County, and Roe and Ryer Islands (Solano County), including, but not limited to the following watersheds; Walnut Creek, Marsh Creek, East County Delta Drainages; San Ramon Creek; San Pablo Creek; Alamo/Tassajara Creek; Brushy Creek; Mount Diablo Creek; Kellogg Creek; Pine/Galindo Creek; Las Trampas Creek; Willow Creek and Coastal Drainages; San Leandro/Moraga Creek; Grayson/Murderers Creek; Alhambra Creek; Kirker Creek; Pinole Creek; South San Ramon Creek; West Antioch Creek; East Antioch Creek; Wildcat Creek; Rodeo Creek; Carquinez Area Drainages; Baxter Creek; West Richmond Drainages; Cayetano Creek; Peyton Slough; Garrity Creek; Refugio Creek; Rheem Creek; Cerrito Creek.

2. **Discussion of the factors influencing the decision to select pesticide applications for mosquito control:**
   The District's activities are conducted utilizing general principles and policies including identification of vector problems; responsive actions to control existing populations of vectors, prevent new sources of vectors from developing, and manage habitat to minimize vector production; education of land-owners and others on measures to minimize vector production or interaction with vectors; and provision and administration of funding and institutional support necessary to accomplish these goals.

   In order to accomplish effective and environmentally sound vector management, the manipulation and control of vectors must be based on careful surveillance of their abundance, habitat (potential abundance), pathogen load, and/or potential contact with people; the establishment of treatment criteria (thresholds); and appropriate selection from a wide range of control methods. This dynamic combination of surveillance, treatment criteria, and selection between multiple control activities in coordinated program is generally known as Integrated Pest Management (IPM).

   The District's Vector Management Program, like any other IPM program, by definition involves procedures for minimizing potential environmental impacts. The District employs IPM principles by first determining the species and abundance of vectors through evaluation of public service requests and field surveys of immature and adult pest populations; and then, if the populations exceed predetermined criteria, using the most efficient, effective, and environmentally sensitive means of control. For all vector species, public education is an important control strategy. In some situations, water management or other physical control activities (historically known as “source reduction” or “permanent control”) can be instituted to reduce vector breeding sites. The District also uses biological control such as the planting of mosquitofish in some settings. When these approaches are not effective or are otherwise inappropriate, then pesticides are used to treat specific vector-producing or vector-harboring areas or vector populations.

In order to maximize familiarity by the operational staff with specific vector sources, the District is divided into mosquito zones (currently ten). Each mosquito zone is assigned a full-time employee, whose responsibilities include minor physical control, inspection and treatment of known vector sources, finding and controlling new sources, and responding to service requests from the public.

Vector control activities are conducted at a wide variety of sites throughout the District’s Project area. Examples include Tidal Marshes, Duck Clubs, Other Diked Marshes, Lakes and Ponds, Rivers and Streams, Vernal Pools and other Seasonal Wetlands, Stormwater Detention Basins, Flood Control Channels, Spreading Grounds, Street Drains and Gutters, Wash Drains, Irrigated Pastures, Agricultural Ditches, Animal Troughs, Artificial Containers, Tire Piles, Fountains, Ornamental Fish Ponds, Swimming Pools, and Animal Waste Detention Ponds.

The intensity of chemical, biological, or physical control activities in the District Service Area in general, or in any particular vector source, varies seasonally and from year to year because of weather conditions, size and distribution of vector populations, disease patterns, to discourage pesticide resistance, and in response to other variables. Therefore, the scopes of work discussed below are illustrative of typical District activities levels, but they are expected to show continuing variation in the future.

The District’s responsibility to protect public health and welfare involves monitoring the abundance of vectors, vector habitat, vector-borne pathogens, and interactions between vectors and people over time and space. Collectively, these monitoring activities are termed Vector Surveillance. Vector surveillance provides the District with valuable information on what vector species are present or likely to occur, when they occur, where they occur, how many there are, and if they are carrying disease or otherwise affecting humans. Vector surveillance is critical to an Integrated Vector Management Program because the information it provides is evaluated against treatment criteria to decide when and where to institute vector control measures. Equally important is the use of vector surveillance in evaluating the efficacy, cost effectiveness, and environmental impacts of specific vector control actions.

The District routinely uses a variety of traps for surveillance of adult mosquitoes, regular field investigation of known vector sources, flocks of sentinel chickens for arboviruses, public service requests for vertebrate pests, adult mosquitoes, and other insect pests; and low ground pressure all-terrain vehicles to access these sites.

The District's vector and disease surveillance activities are conducted in compliance with accepted Federal and State guidelines. These guidelines recognize that local conditions vary, and are thus flexible in the selection and specific application of methods.

The District's outreach program educates and informs the public about mosquitoes and other vectors along with their associated diseases. Much emphasis is placed on prevention methods and reducing the risk of illness. The District utilizes the media, various advertising outlets extensively, and the District's website. Staff provides presentations to a plethora of groups and community organizations and disseminates health messages through events, health fairs, community newsletters, social media, city and county partnerships, and local groups.

The District incorporates source reduction practices such as plan review, engineering, and other physical changes to the land that can reduce mosquito production directly by improving water circulation or drainage, indirectly by improving habitat values for predators of larval mosquitoes, including fish and many invertebrates, or by otherwise reducing a site's habitat value for mosquito larvae. The District performs these physical control activities in accord with all appropriate environmental regulations (wetland fill and dredge permits, endangered species review, water quality review, etc.), and in a manner that generally maintains or improves habitat values for desirable species. Major physical control activities or projects (beyond the scope of the District's five-year regional wetlands permits with the U.S. Army Corps of Engineers and the S.F. Bay Conservation and Development Commission) receive individual CEQA review. These vary substantially from year to year, but typically consist of up to 2,000' of ditch maintenance. Under the regional permits, the District's work plans are reviewed annually by trustee and other responsible agencies prior to initiation of the planned work.

The District uses the mosquitofish *Gambusia affinis* in some types of mosquito larval habitat to provide biological control of mosquitoes through direct predation of larvae. Stocking by District personnel complies with strict guidelines designed to ensure that no significant impacts can occur to native species. On average, the District releases about 40 pounds of mosquitofish and distributes an additional 10 pounds to the public.

Other biological control methods available to the District include the application of the fungus *Lagenidium giganteum*, and the biological insecticide *Bacillus sphaericus* (B sphaericus). *Lagenidium giganteum* is not used operationally by the District at this time, but might be adopted in the future for specific applications.

When field inspections indicate the presence of vector populations which meet District criteria for chemical control (including abundance, density, species composition, proximity to human settlements, water temperature, presence of predators, and others), District staff apply pesticides to the site in strict accordance with the pesticide label instructions .

Mosquito Larvicides: Depending on time of year, water temperature, organic content, mosquito species present, larval density, and other variables, pesticide applications may be repeated at any site at recurrence intervals ranging from annually to weekly.

Mosquito Adulticides: In addition to chemical control of mosquito larvae, the District also makes aerosol applications of pesticides for control of adult mosquitoes if specific criteria are met, including species composition, population density (as measured by landing count or other quantitative method), proximity to human populations, and/or human disease risk. As with larvicides, adulticides are applied in strict conformance with label requirements.

3. **Pesticide products or types expected to be used and if known, their degradation by-products, the method in which they are applied, and if applicable, the adjuvents and surfactants used**: The following list of products may be used by the District for larval or adult control. This list is directly from Attachment E and F within the NPDES Permit for Biological and Residual Pesticide Discharges to Waters of the U.S. for Vector Control Applications. All of these products are used according to label directions and may be applied by ground (hand, truck, ATV, backpack, etc) or by air (helicopter or fixed wing aircraft).

List of Permitted Larvicide Products

Larvicide Product Name	Registration Number
Vectolex CG Biological Larvicide	73049-20
Vectolex WDG Biological Larvicide	73049-57
Vectolex WSP Biological Larvicide	73049-20
Vectobac Technical Powder	73049-13
Vectobac-12 AS	73049-38
Aquabac 200G	62637-3
Teknar HP-D	73049-404
Vectobac-G Biological Mosquito Larvicide Granules	73049-10
Vectomax CG Biological Larvicide	73049-429
Vectomax WSP Biological Larvicide	73049-429
Vectomax G Biological Larvicide/Granules	73949-429
Zoecon Altosid Pellets	2724-448
Zoecon Altosid Briquets	2724-375
Zoecon Altosid Liquid Larvicide Mosquito Growth Regulator	2724-392

Larvicide Product Name	Registration Number
Zoecon Altosid XR Extended Residual Briquets	2724-421
Zoecon Altosid Liquid Larvicide Concentrate	2724-446
Zoecon Altosid XR-G	2724-451
Zoecon Altosid SBG Single Brood Granule	2724-489
Mosquito Larvicide GB-1111	8329-72
BVA 2 Mosquito Larvicide Oil	70589-1
BVA Spray 13	55206-2
Agnique MMF Mosquito Larvicide & Pupicide	53263-28
Agnique MMF G	53263-30
Abate 2-BG	8329-71
5% Skeeter Abate	8329-70
Natular 2EC	8329-82
Natular G	8329-80
Natular XRG	8329-83
Natular XRT	8329-84
FourStar Briquets	83362-3
FourStar SBG	85685-1
Aquabac xt	62637-1
Spheratax SPH (50 G) WSP	84268-2
Spheratax SPH (50 G)	84268-2

List of Permitted Adulticide Products

Adulticide Product Name	Registration Number
Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7395	1021-1570
Evergreen Crop Protection EC 60-6	1021-1770
Pyrenone Crop Spray	432-1033
Prentox Pyronyl Crop Spray	655-489
Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7396	1021-1569
Aquahalt Water-Based Adulticide	1021-1803
Pyrocide Mosquito Adulticide 7453	1021-1803
Pyrenone 25-5 Public Health Insecticide	432-1050

Adulticide Product Name	Registration Number
Prentox Pyronyl Oil Concentrate #525	655-471
Prentox Pyronyl Oil Concentrate or 3610A	655-501
Permanone 31-66	432-1250
Kontrol 30-30 Concentrate	73748-5
Aqualuer 20-20	769-985
Aqua-Reslin	432-796
Aqua-Kontrol Concentrate	73748-1
Kontrol 4-4	73748-4
Biomist 4+12 ULV	8329-34
Permanone RTU 4%	432-1277
Prentox Perm-X UL 4-4	655-898
Allpro Evoluer 4-4 ULV	769-982
Biomist 4+4	8329-35
Kontrol 2-2	73748-3
Scourge Insecticide with Resmethrin/Piperonyl Butoxide 18%+54% MF Formula II	432-667
Scourge Insecticide with Resmethrin/Piperonyl Butoxide 4%+12% MF Formula II	432-716
Anvil 10+10 ULV	1021-1688
AquaANVIL Water-based Adulticide	1021-1807
Duet Dual-Action Adulticide	1021-1795
Anvil 2+2 ULV	1021-1687
Zenivex E20	2724-791
Trumpet EC Insecticide	5481-481
Fyfanon ULV Mosquito	67760-34

4. **Description of ALL the application areas* and the target areas in the system that are being planned for pesticide applications. Provide a map showing these areas:**
Map attached (Appendix 1). Any site that holds water for more than 96 hours (4 days) can produce mosquitoes. Source reduction is the District's preferred solution, and whenever possible the District works with property owners to affect long-term solutions to reduce or eliminate the need for continued applications as described in item 2 above. Mosquito breeding sources and areas that require adult mosquito control are difficult to predict from year to year based on weather and variations in local environmental conditions. However,

the typical sources treated by this District include: Artificial containers, catch basins, channels, intermittent water (rainwater or irrigation water), marshes, ponds, swimming pools, tree holes throughout Contra Costa County. In previous years, the district has periodically applied treatments to all areas within the boundaries of Contra Costa County, and Roe and Ryer Islands (Solano County), including, but not limited to the following watersheds; Walnut Creek, Marsh Creek, East County Delta Drainages; San Ramon Creek; San Pablo Creek; Alamo/Tassajara Creek; Brushy Creek; Mount Diablo Creek; Kellogg Creek; Pine/Galindo Creek; Las Trampas Creek; Willow Creek and Coastal Drainages; San Leandro/Moraga Creek; Grayson/Murderers Creek; Alhambra Creek; Kirker Creek; Pinole Creek; South San Ramon Creek; West Antioch Creek; East Antioch Creek; Wildcat Creek; Rodeo Creek; Carquinez Area Drainages; Baxter Creek; West Richmond Drainages; Cayetano Creek; Peyton Slough; Garrity Creek; Refugio Creek; Rheem Creek; Cerrito Creek.

5. **Other control methods used (alternatives) and their limitations:**
   With any source of mosquitoes or other vectors, the District's first goal is to look for ways to eliminate the source, or if that is not possible, for ways to reduce the potential for vectors. The most commonly used methods and their limitations are included in the Best Management Practices for Mosquito Control in California.

   The District employs IPM principles by first determining the species and abundance of vectors through evaluation of public service requests and field surveys of immature and adult pest populations; and then, if the populations exceed predetermined criteria, using the most efficient, effective, and environmentally sensitive means of control. For all vector species, public education is an important control strategy. In some situations, water management or other physical control activities (historically known as "source reduction" or "permanent control") can be instituted to reduce vector breeding sites. The District also uses biological control such as the planting of mosquitofish in some settings. When these approaches are not effective or are otherwise inappropriate, then pesticides are used to treat specific vector-producing or vector-harboring areas or vector populations.

   However, there are numerous onerous regulations that restrict a land owner's ability to make physical changes to their property or make such work a monumental undertaking. This District does not have the resources to carry out large physical control projects and under the Heath and Safety code, such projects are the responsibility of the land owner.

6. **How much product is needed and how this amount was determined:**
   The need to apply product is determined by surveillance. Actual use varies annually depending on the mosquito activity.

   When field inspections indicate the presence of vector populations which meet District criteria for chemical control (including abundance, density, species composition, proximity to human settlements, water temperature, presence of predators, and others), District staff apply pesticides to the site in strict accordance with the pesticide label instructions .

Table 1. Mosquito larvicide usage by material in 2010 compared with previous years

Number of Applications

Pesticide (units)	95-99 mean	00-02 mean	2003	2004	2005	2006	2007	2008	2009	2010	00-09 mean
Mosquito Larvicides											
Agnique (lbs)		**84**	**63**	**139**	**148**	**104**	**76**	**192**	**436**	**226**	**141**
Agnique (gal)		84	63	139	148	104	76	192	436	226	141
Methoprene (lbs)	**154**	**352**	**1,541**	**1,884**	**1,846**	**1,620**	**1,726**	**2,496**	**2,741**	**1,642**	**1491**
Altosid Briquets & XR (lbs)	101	178	501	877	574	1039	628	379	232	156	**476**
Altosid XR Briquets (lbs)							437	1049	1329	547	**938**
Aquaprene XL CB Briquets							121	18	0	0	**46**
Altosid Granules (lbs)		1	0	5	4	3	1	0	0	0	**2**
Altosid XR Granules (lbs)							2	0	0	0	**1**
Altosid Pellets (lbs)	50	62	144	150	252	145	171	281	249	399	**158**
Altosid Pellets WSP (lbs)							55	107	137	135	**100**
Aquaprene Tossits (lbs)							3	8	9	0	**7**
Altosid Liquid (gal)	3	111	896	852	1016	433	308	654	785	405	**528**
Larvicidal Oils (lbs)	**2,067**	**782**	**526**	**685**	**481**	**1,128**	**1133**	**1,360**	574	567	**823**
Golden Bear 1111 (gal)	2067	782	526	685	481	1128	1133	1360	574	539	823
BVA Larvicidal Oil (gal)										28	
Bti (lbs)	**308**	**1,542**	**2,981**	**3,536**	**3,818**	**2,753**	**1,696**	**2,415**	**1,352**	**1,546**	**2318**
Acrobe (gal)	304	3	0	0	0	0	0	0	0	0	**1**
Bactimos WP (lbs)			3	0	0	0	1	0	0	0	**1**
Vectobac 12 AS (gal)		1517	2877	3379	3672	2734	1674	2385	1311	1432	**2258**
Vectobac Granules (lbs)	4	22	101	157	146	19	21	30	40	86	**58**
VectoMax CG* (lbs)									1	28	**1**
B. sphaericus (lbs)		**46**	**179**	**236**	**690**	**895**	**447**	**1228**	**1033**	**894**	**485**
Vectolex Granules (lbs)		46	161	194	383	363	368	793	758	710	**316**
Vectolex WDG (lbs)							3	32	61	13	**32**
Vectolex WSP (lbs)			18	42	307	532	76	403	214	143	**227**
VectoMax CG* (lbs)									1	28	**1**
Spinosad (lbs)									4	1	**4**
Natular T30 (lbs)									3	0	**3**
Natular G (lbs)									1	0	**1**
Natular XRG (lbs)										1	
Carbamate	0	0	0	0	0	0	0	0	0	0	**0**
Organophosphate	1	0	0	0	0	0	0	0	0	0	**0**

Quantity Applied (Active Ingredient)

Pesticide (units)	95-99 mean	00-02 mean	2003	2004	2005	2006	2007	2008	2009	2010	00-09 mean
Mosquito Larvicides											
Agnique (lbs)	**0**	**62**	**17**	**9**	**16**	**13**	**5**	**6**	**16**	**18**	**27**
Agnique (gal)		8.3	2.3	1.2	2.2	1.8	0.718	0.752	2.14	2.44	**4**
Methoprene (lbs)	**11**	**197**	**54**	**88**	**200**	**135**	**151**	**179**	**130**	**149**	**153**
Altosid Briquets & XR (lbs)	3.28	5.60	19.05	32.50	23.62	51.46	3.80	1.29	1.21	0.84	**15**
Altosid XR Briquets (lbs)							15.96	12.34	37.86	9.90	**22**
Aquaprene XL CB Briquets							2.12	0.08	0.00	0.00	**1**
Altosid Granules (lbs)		0.20	0.00	0.33	0.32	0.07	0.23	0.00	0.00	0.00	**0**
Altosid XR Granules (lbs)							0.002	0.000	0.000	0.000	**0**
Altosid Pellets (lbs)	7.44	11.35	25.50	48.62	167.96	69.15	120.53	161.43	88.15	134.47	**72**
Altosid Pellets WSP (lbs)							0.11	0.25	0.20	0.34	**0**
Aquaprene Tossits (lbs)							0.04	0.25	0.04	0.00	**0**
Altosid Liquid (gal)	0.01	20.90	1.07	0.75	1.00	1.65	0.95	0.47	0.26	0.41	**7**
Larvicidal Oils (lbs)	**30,045**	**25,403**	**35,897**	**12,782**	**12,841**	**30,940**	**21,392**	**45,329**	**13,248**	**10,881**	**24864**
Golden Bear 1111 (gal)	4044	3419	4831	1720	1728	4164	2879	6101	1783	1463	**3346**
BVA Larvicidal Oil (gal)										1	
Bti (lbs)	**130**	**309**	**281**	**249**	**398**	**89**	**26**	**90**	**56**	**198**	**211**
Acrobe (gal)	16.25	1.04	0	0	0	0	0	0	0	0	**0**
Bactimos WP (lbs)			0.08	0	0	0	0.5	0.5	0	0	**0**
Vectobac 12 AS (gal)		37.15	31.11	19.74	50.62	11.24	2.73	11.09	6.72	3.15	**24**
Vectobac Granules (lbs)	0.42	18.93	45.30	99.71	14.53	3.88	4.41	5.72	3.73	19.28	**23**
VectoMax CG* (lbs)									1.80	155.35	**2**
B. sphaericus (lbs)		**7**	**16**	**108**	**895**	**282**	**478**	**222**	**585**	**263**	**261**
Vectolex Granules (lbs)		7.28	15.53	107.70	890.10	266.78	477.54	115.48	433.95	155.97	**233**
Vectolex WDG (lbs)							0.27	101.38	148.22	12.35	**83**
Vectolex WSP (lbs)			0.03	0.08	5.10	14.98	0.45	5.09	1.73	1.06	**4**
VectoMax CG* (lbs)									1.08	93.20	**1**
Spinosad (lbs)									0.06	0.04	**0**
Natular T30 (lbs)									0.01	0.00	**0**
Natular G (lbs)									0.05	0.00	**0**
Natular XRG (lbs)										0.04	
Carbamate	0	0	0	0	0	0	0	0	0	0	**0**
Organophosphate	1	0	0	0	0	0	0	0	0	0	**0**

*VectoMax is a combination of Bti and B. sphaericus. Active ingredients listed separately.

Table 2. Other pesticide usage by material type during 2010 compared with previous years

Number of Applications

Pesticide (units)	95-99 mean	00-02 mean	2003	2004	2005	2006	2007	2008	2009	2010	00-09 mean
Mosquito Adulticides											
Natural Pyrethrins (lbs)	**10**	**93**	**27**	**260**	**175**	**259**	**122**	**237**	**169**	**30**	**153**
Pyrenone 25-5 (gal)	1	52	27	258	174	259	112	236	134	4	**136**
Pyrocide 7396 (gal)	9	41	0	2	1	0	0	1	35	26	**16**
Pyronyl Crop Spray (gal)							10	0	0	0	**3**
Synthetic Pyrethroids (lbs)	44	46	122	19	28	70	0	17	0	15	**39**
Scourge (gal)	44	46	122	19	28	70	0	17	0	15	**39**
Synergists* (lbs)											
Piperonyl butoxide (gal)	54	139	149	279	203	329	122	254	169	45	**192**
Other Insecticides											
Total (lbs)	**324**	**509**	**649**	**926**	**534**	**464**	**567**	**559**	**374**	**542**	**560**
Drione (lbs)	320	502	640	907	528	463	563	555	374	541	**554**
M-Pede (gal)	4	7	9	19	6	1	4	4	0	1	**6**
Rodenticides											
Total (lbs)	**103**	**665**	**613**	**717**	**1525**	**1308**	**1156**	**950**	**1216**	**1018**	**948**
Bromethalin (lbs)	0	19	5	15	13	22	2	0	0	0	**11**
Contrac Blox (lbs)	79	342	434	536	1171	1182	1038	761	1007	945	**716**
Ditrac Blox (lbs)	24	154	171	166	341	104	116	189	209	73	**176**
Diphacinon (lbs)	0	150	3	0	0	0	0	0	0	0	**45**

Quantity Applied (Active Ingredients)

Pesticide (units)	95-99 mean	00-02 mean	2003	2004	2005	2006	2007	2008	2009	2010	00-09 mean
Mosquito Adulticides											
Natural Pyrethrins (lbs)	**5.24**	**15.15**	**2.36**	**21.38**	**13.95**	**41.58**	**12.01**	**26.19**	**18.68**	**3.15**	**18.16**
Pyrenone 25-5 (gal)	0.01	0.55	0.32	2.90	1.89	5.65	1.63	3.55	2.06	0.01	**1.96**
Pyrocide 7396 (gal)	0.70	1.50	0.00	0.01	0.01	0.00	0.00	0.01	0.48	0.42	**0.50**
Pyronyl Crop Spray (gal)							0.00	0.00	0.00	0.00	**0.00**
Synthetic Pyrethroids (lbs)	6.36	11.28	9.23	2.75	5.26	4.63	0.00	3.34	0.00	2.02	**5.90**
Scourge (gal)	0.88	1.56	1.28	0.38	0.73	0.64	0.00	0.46	0.00	0.28	**0.82**
Synergists* (lbs)	**45.73**	**110.48**	**40.17**	**115.92**	**86.28**	**223.26**	**60.40**	**141.92**	**93.80**	**21.97**	**109.32**
Piperonyl butoxide (gal)	6.18	14.93	5.43	15.67	11.66	30.17	8.16	19.18	12.68	2.97	**14.77**
Other Insecticides											
Total (lbs)	**4.6**	**3.7**	**4.0**	**7.7**	**4.5**	**3.0**	**3.0**	**1.8**	**1.4**	**6.0**	**3.7**
Drione (lbs)	1.98	2.97	2.86	4.29	2.20	2.97	2.64	1.76	1.42	4.30	**2.706**
M-Pede (gal)	0.34	0.10	0.15	0.44	0.29	0.00	0.04	0.00	0.00	0.23	**0.123**
Rodenticides											
Total (lbs)	**0.02**	**0.05**	**0.04**	**0.04**	**0.05**	**0.04**	**0.04**	**0.03**	**0.04**	**0.03**	**0.04**
Bromethalin (lbs)	0.0000	0.0012	0.0003	0.0004	0.0001	0.0006	0.0001	0.0000	0.0000	0.0000	**0.0005**
Contrac Blox (lbs)	0.015	0.027	0.022	0.026	0.030	0.033	0.033	0.021	0.030	0.029	**0.0278**
Ditrac Blox (lbs)	0.002	0.018	0.015	0.013	0.017	0.006	0.006	0.010	0.010	0.004	**0.0132**
Diphacinon (lbs)	0.0000	0.0004	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0001**

*PBO is a component of pyrethroid adulticides. Not listed seperately prior to 2009

7. **Representative monitoring locations and the justification for selecting these monitoring locations:**
   Please see the MVCAC NPDES Coalition Monitoring Plan

8. **Evaluation of available BMPs to determine if there are feasible alternatives to the selected pesticide application project that could reduce potential water quality impacts:**

   The District has long emphasized environmental stewardship while accomplishing its public health mission, primarily through strict adherence to an IPM (Integrated Pest Management) approach to the control of mosquitoes and other vectors of human disease. As such, District policies emphasize training, vector and pathogen surveillance, the integration of biological and physical control practices with chemical control (pesticides), and the judicious use of appropriate control tools only when vectors exceed specific thresholds. During 2010, as the District continued to respond to an ongoing local and regional outbreak of West Nile Virus, there were no new or extraordinary District activities or substantial changes in District policies. However, a significant change in regard to interpretation of the Clean Water Act has imposed additional regulatory requirements upon District operations.

   Biological Control of Mosquitoes

   The District places a high priority on collaborating with and augmenting natural phenomena that help limit the production of mosquitoes. District staff have traditionally implemented a four-pronged approach to biological control of mosquitoes. The general elements of biological control used by the District are 1) rearing, stocking, and providing for limited pubic use the mosquitofish (*Gambusia affinis*) to eat larval mosquitoes in sites where mosquitofish are unlikely to cause significant adverse impacts on native species; 2) a program to identify, develop, and evaluate additional biocontrol agents that can be produced at reasonable cost; 3) collaboration with land-owners and managers to implement land and water management practices that protect and support populations and dispersal of native mosquito predators; and 4) policies and training designed to protect native predators.

   In 2010, District staff stocked out approximately 69,000 mosquitofish. Stocking in swimming pools continues to be a critical tool for addressing West Nile virus in urban and suburban areas with substantial distressed property and multiple foreclosures. Year-to-year variations in stocking in natural waters and other traditional sites (horse troughs, etc.) are due primarily to weather patterns that change the extent of appropriate stocking sites. Although the District continues to study potential use of Sacramento Perch and other native fish for mosquito control, mosquitofish stocking in natural sites will most likely continue at similar rates in upcoming years.

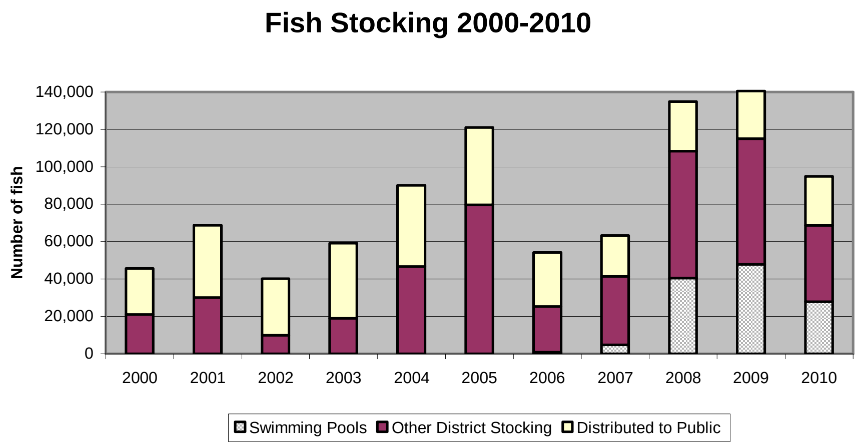

Figure 1: Use of mosquitofish for biological control, 2000 - 2010.

The District also dispersed approximately 26,000 mosquitofish to members of the public during this period, with instructions that these were for use only in contained water bodies (ornamental ponds, horse troughs, etc.). This number was consistent with last year and slightly lower than the annual dispersal for the last five years, probably due to declining media coverage of West Nile virus. All public “walk-ins” requesting fish are logged by the District, with the mosquito habitat type and number of fish recorded as well as the name and address of the person obtaining fish. This information is now being tracked electronically through our VXS database, which enables mapping of locations where fish are being stocked by the public (Fig. 2). To ensure that fish releases are appropriate, the District provides information on appropriate stocking locations and densities to the public at the time of fish dispersal.

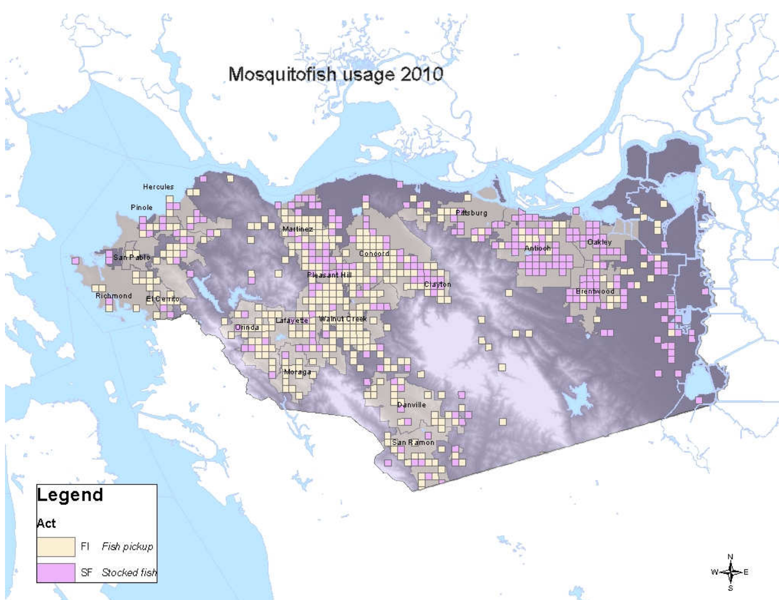

Fig. 2. Locations (map coordinates) where mosquitofish were stocked by district technicians or by the public ("Fish Pickup") in 2010

The District continues to be a lead agency for research on aquaculture and biological control capacity for the California native Sacramento Perch. This fish, which is a Species of Concern for the CA. Dept. of Fish and Game (DFG) due to the loss of much of its traditional range, has been the key new experimental biocontrol agent for the District over the last eight years. Because it is a native species, the District has been exploring its potential to replace or augment mosquitofish and other aquatic mosquito predators in various sites, and significant in-house production and a large number of field releases have led to successful establishment in many moderate-sized permanent water bodies where the adults should be able to establish sustainable breeding populations over time. In addition, our staff biologist has initiated similar studies with other native fish species including Sacramento Blackfish and California Roach. California Roach were successfully spawned in captivity for the first time at our fish rearing facility in 2010. The District is working closely with the DFG, the University of California at Davis, the East Bay Regional Parks District, and the CA. Dept. of Water Resources on this project, and these collaborators are helping design protocols to ensure that any releases will not jeopardize the population genetics of the species or non-target organisms.

A high priority of the District is collaboration with land-owners on improving land and water management to reduce mosquito production while maintaining other desirable ecological functions of the sites, and a major focus of this work is manipulating habitats to promote the survival, reproduction, and dispersal of natural aquatic predators, including fish and aquatic invertebrates such as water beetles and juvenile dragonflies. Target sites include refinery ponds, stormwater treatment facilities, irrigated pastures, duck clubs, sewer treatment marshes, etc. Environmental protection in these projects is ensured through close collaborations with resource and permitting agencies (DFG, the Regional Water Quality Control Board (RWQCB), the Army Corps of Engineers (ACE), the Bay Conservation and Development Commission (BCDC), etc.), as well as with land-owners. Two sub-activities, Physical Control/Source Reduction and Vegetation Management, have been traditionally distinguished, and are discussed below.

Finally, training and treatment protocols for pesticide use emphasize protection of predators when they are present in sites with mosquito larvae. The District's larvicide treatment protocols request field inspectors to determine whether a mosquito-producing site also has the presence of any significant populations of predators, and if so, to avoid pesticides or to use the pesticide with the least possible impact on natural predators if mosquito populations are sufficient to require prompt treatment.

Physical Control

The District routinely conducts several "physical control" or "source reduction" projects each year under permits issued by ACE, RWQCB, and/or BCDC, intended to encourage flooding regimes, water circulation, and/or predator dispersal in sites that are likely to produce consistently high mosquito populations otherwise. These permits were renewed in spring 2007, with the CA. Dept. of Public Health (DPH) as Lead Agency, to allow maintenance work in 2007-2011 to continue on marshland channels. In addition, the District and DPH are working with the permitting agencies to craft new regional general permits for rehabilitation and restoration of tidal channels where they have been disturbed, and to routinely allow for removal of contaminated sediment and accumulated vegetation clogging stormwater facilities (both channels and basins). There is currently a mandate from the RWQCB to create many new stormwater facilities in new developments throughout the Bay Area; the District is actively working with RWQCB, Contra Costa County Clean Water Program (CCCWP) and other agency staff on these permits to facilitate maintenance of conditions that encourage desirable species while discouraging mosquitoes, and also to reduce the need for staff time (for inspection and control) and for chemical pesticides in sites where maintenance is not consistent.

Vegetation Management

The amount of herbicides used by the District for vegetation thinning in selected high-producing mosquito sites has traditionally been very limited. Vegetation management is conducted with hand tools ("brushing") as needed to allow access for vector surveillance.

Chemical Control (Pesticides)

Pesticide use patterns in the District this year are shown in Tables 1 and 2. Year-to-year variations in vector populations and environmental conditions mean that the annual use of any specific active ingredient or formulation can vary considerably.

The attached tables compare 2010 pesticide use with the previous seven years individually and with longer-term averages. The quantity applied is reported as the total amount of active ingredients applied. Overall, pesticide use decreased by about 20% in 2010 vs. 2009, due to lower mosquito and West Nile virus activity as well as continued reduction in the use of a single mosquito larvicide, Golden Bear 1111 (GB-1111), in favor of bacterial larvicides and growth regulators (Table 1). With the exception of larvicidal oils, chemical usage in 2010 was similar to average values since West Nile virus became endemic in the County, and within the typical range of inter-annual variation, especially when compared to the previous three years. There was a substantial increase in the use of the bacterial larvicide *Bacillus thuringiensis israelensis* (Bti), due to the availability of new formulations as well as the decrease in GB-1111 usage. Adulticides are applied in very small quantities in some rural and residential areas (for example in Antioch, Oakley, Brentwood and Holland Tract), where West Nile virus risk and adult mosquito counts were elevated (Fig. 3).

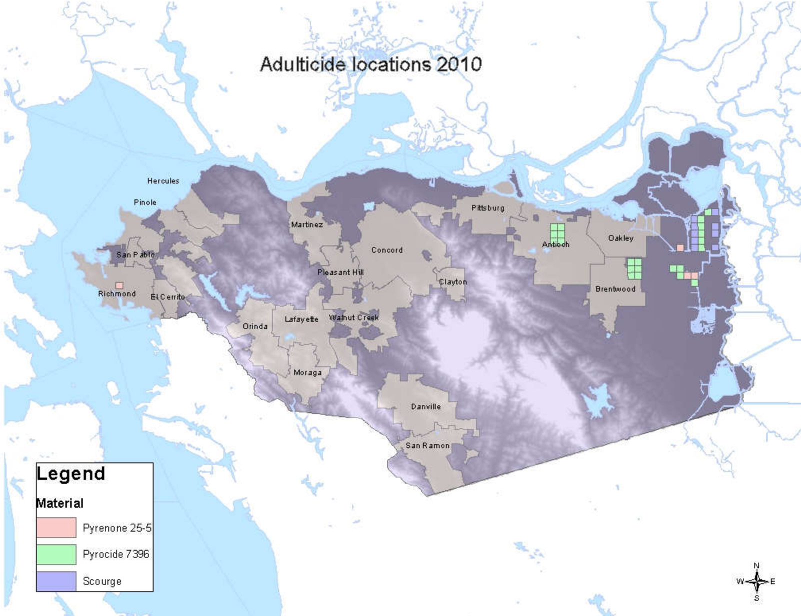

Fig. 3. Map coordinates within which adulticides were used in 2010, by material

Mosquito larvicides dominate the District's pesticide applications, and four active ingredients dominate the District's larvicide applications. In terms of number of applications, the insect growth regulator Methoprene and the bacterial pesticides *Bacillus thuringiensis israelensis* (Bti), and *Bacillus sphaericus* (Bs), all considered "biopesticides" by EPA and "least toxic pesticides" by virtually all regulators, are the larvicides of first choice at the District. These products continue to replace our historical primary larvicide, Golden Bear 1111 oil. This light mineral oil, in contrast to all other products, is considered virtually 100% active ingredient, and is applied at much higher quantities per acre (up to five gallons/acre in dense vegetation), and thus continues to dominate Figure 5, which shows pounds of each product applied (total product, including all inert or other ingredients) each year. The oil forms a single-molecule film on the water surface and then rapidly and completely breaks down. Although manufacture of GB-1111 has been interrupted, the similar product BVA Larvicidal Oil (BVA) continues to be registered both by USEPA and the state for aquatic applications. BVA is the only product currently used by the District that reliably controls mosquito pupae, and therefore this or similar products may continue to be used whenever mosquito pupae are encountered at densities higher than our control thresholds, although increasing familiarity with biopesticides continues to reduce the likelihood that mosquito populations will reach the pupa stage.

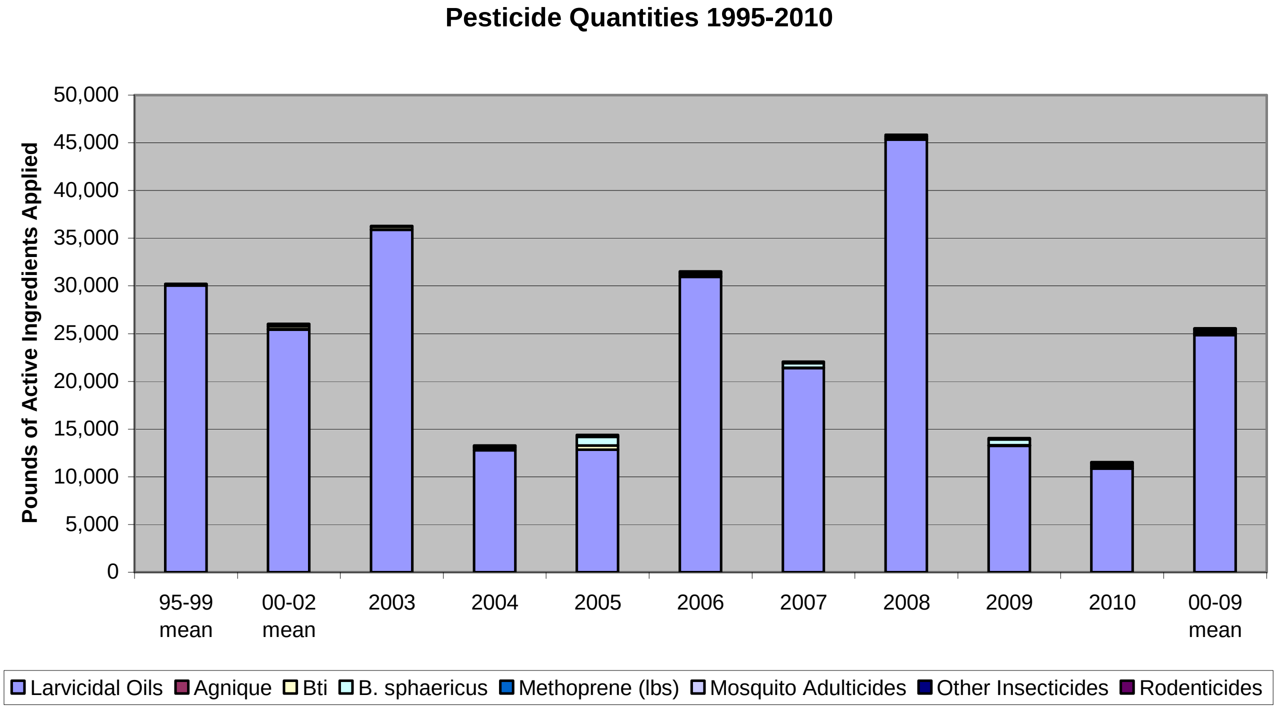

Fig. 5. Amount of pesticide applied by material (pounds of active ingredient)

Because of the dominance of larvicidal oils in terms of pounds of active ingredient used annually, Figure 6 shows pesticide quantities with this product excluded to better compare the other products. Agnique, an alternative non-oil based surface film, was used in moderate quantities in 2010 (it can work well in swimming pools and other 'artificial containers' but not in open-water situations where wind and emergent vegetation tend to disrupt the film). Some new formulations of methoprene and *B. sphaericus* have been introduced in recent years, for specific sites such as catch basins. In 2009, we conducted small-scale field trials of two new larvicides, Natular™ T30 and Natular™ G, containing the active ingredient spinosad. The results of the field trials were promising and small amounts of spinosad products were used operationally during 2010. Usage of these materials may increase as they become more readily available. During 2010, we conducted a field trial and initiated operational use of VectoMax CG, a new product which combines Bti toxins and *B. sphaericus* toxins for higher efficacy, longer duration of control and management of potential resistance issues. Preliminary results showed that the material performed 'as advertised'.

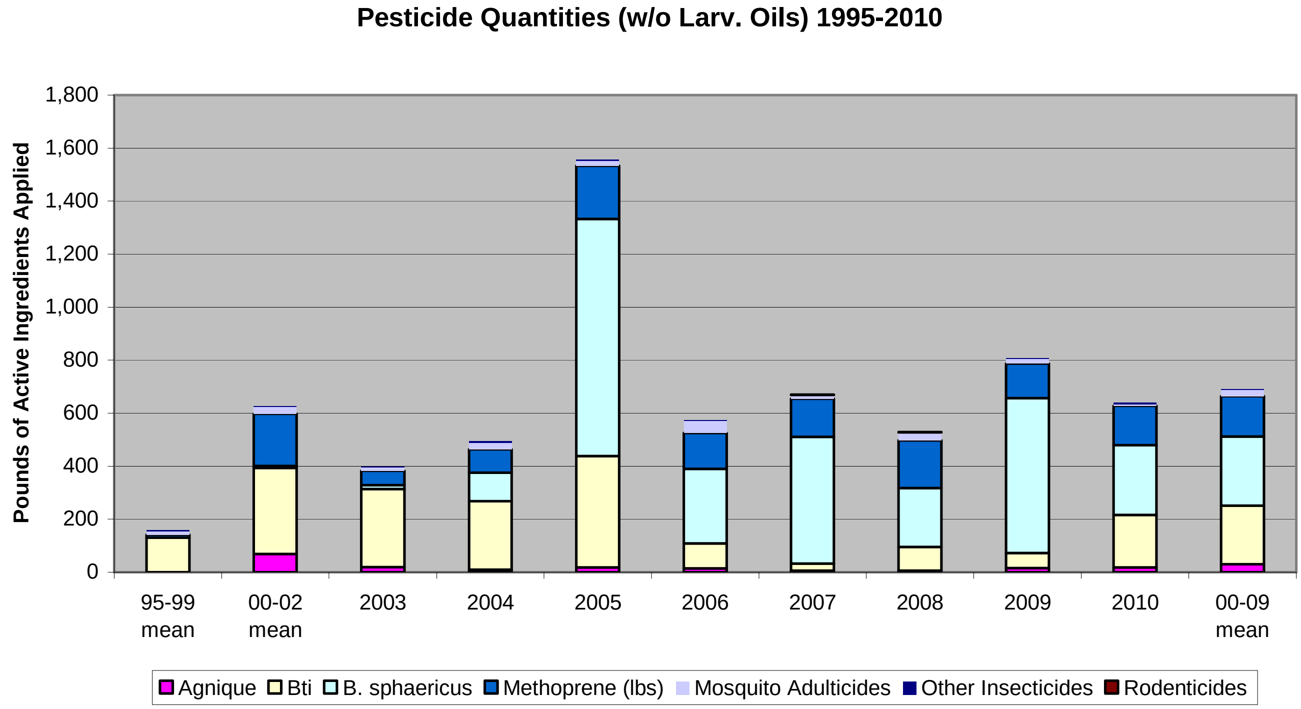

Fig. 6. Amount of pesticide applied by material (pounds of active ingredient), excluding GB-1111

District use of mosquito adulticides was lower in 2010 than in 2009 due to lower WNV and mosquito activity. Overall, use of adulticides continues to be very small in comparison with larvicide use, in terms of the number of applications (Fig. 4), the total amount of active ingredient applied (Fig. 6), and the area treated, in keeping with the District's policy of preventing adult mosquito outbreaks thru larval control whenever possible.

Adulticides used during 2010 included natural pyrethrins (Pyrenone, Pyrocide) and the synthetic pyrethroid resmethrin (Scourge), all of which contain the synergist piperonyl butoxide (PBO) to enhance effectiveness.

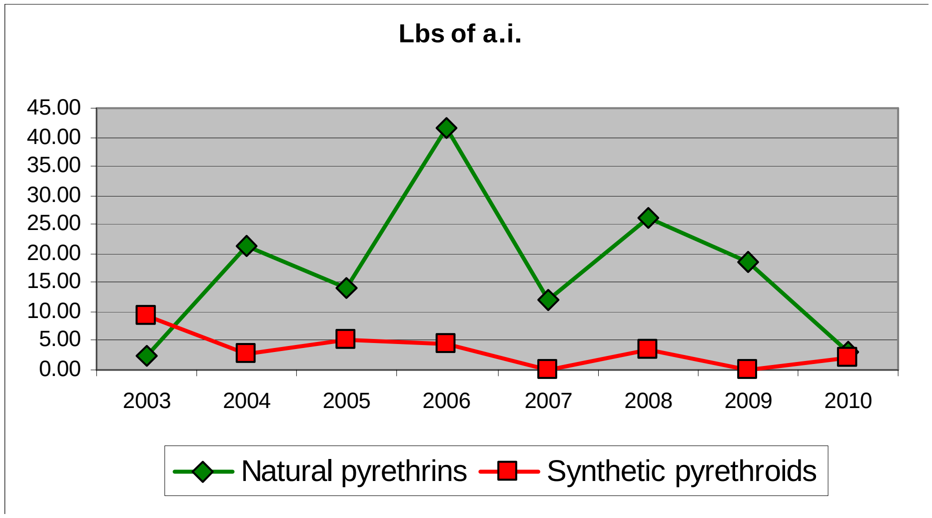

Fig. 7b. Amount of a.i. applied by class of material

The District currently uses pyrethrins and/or their synthetic analogues (pyrethroids) when adult mosquito control is required, however, development of insecticide resistance due to repeated use of a single class of materials could require the District to use alternative registered adulticides in the future.

9. **Description of the BMPs to be implemented.** The District's BMPs are described in items 2 and 8 above. Specific elements have been highlighted below under items a-f.
   a. **measures to prevent pesticide spill**
   All pesticide applicators receive annual spill prevention and response training. District employees ensure daily that application equipment is in proper working order. Spill mitigation devices are placed in all vehicles and pesticide storage areas.

   b. **measures to ensure that only a minimum and consistent amount is used**
   Application equipment is calibrated at least annually as required by the Department of Pesticide Regulations (DPR) and the terms of a cooperative agreement with the California Department of Public Health (CDPH).

   c. **a plan to educate Coalition's or Discharger's staff and pesticide applicator on any potential adverse effects to waters of the U.S. from the pesticide application**
   This is included in our pesticide applicators annual pesticide application and safety training, continuing education programs, and/or regional NPDES Permit training programs.

   d. **descriptions of specific BMPs for each application mode, e.g. aerial, truck, hand, etc.**
   The Contra Costa Mosquito & Vector Control District calibrates truck-mounted and handheld larviciding equipment each year to meet application specifications. Supervisors review application records daily to ensure appropriate amounts of

material are being used. Ultra-low volume (ULV) application equipment is calibrated for output and droplet size to meet label requirements. Aerial larviciding equipment is calibrated by the Contractor. Aerial adulticide equipment is calibrated regularly and droplet size will be monitored by the District to ensure droplets meet label requirements. Airplanes used in urban ULV applications and the primary airplane used for rural ULV application is equipped with advanced guidance and drift management equipment to ensure the best available technology is being used to place product in the intended area. If a secondary airplane is used in rural ULV applications it will be equipped with an advanced guidance system.

e. descriptions of specific BMPs for each pesticide product used

Please see the Best Management Practices for Mosquito Control in California and appendix 2 for general pesticide application BMPs, and the current approved pesticide labels for application BMPs for specific products.

f. descriptions of specific BMPs for each type of environmental setting (agricultural, urban, and wetland).

General BMP's communicated to property owners include;
1. Eliminate Artificial Mosquito Breeding Sites and Harborage
• Examine outdoor areas and drain temporary and unnecessary water that may stand longer than 96 hours.
• Dispose of unwanted or unused artificial containers.
• Properly dispose of old tires.
• If possible, drill drainage holes, cover, or invert any container or object that holds standing water that must remain outdoors. Be sure to check for containers or trash in places that may be hard to see, such as under bushes or buildings.
• Clean clogged rain gutters and storm drains. Keep outdoor drains flowing freely and clear of leaves, vegetation, and other debris.
• Aerate ornamental ponds to avoid letting water stagnate.
• Change water in birdbaths, fountains, and animal troughs at least once per week.
• Ensure rain and/or irrigation water does not stand in plant containers, trash cans, boats or other containers on commercial or residential properties.
• Regularly chlorinate swimming pools and keep pumps and filters operating. Unused or unwanted pools should be kept empty and dry, or buried.
• Maintain irrigation systems to avoid excess water use and runoff into storm drains.
• Minimize sites mosquitoes can use for refuge (harborage) by thinning branches, trimming and pruning ornamental shrubs and bushes, and keeping grass mowed short.

2. Use Personal Protective Measures
• Apply an EPA-registered mosquito repellent when outdoors; especially around dusk and dawn when mosquitoes are most active (see Appendix F for additional information on insect repellents).
• Wearing loose-fitting protective clothing including long sleeves and pant legs.
• Install and properly maintain fine mesh screens on windows and doors to prevent mosquito entry into homes.

3. Provide Mosquito Management Related Information to Property Managers

• Off-site landowners should provide property managers with basic information about mosquitoes and appropriate measures to minimize mosquito habitats.

4. Contact Local Mosquito Control Program
• Contact the local mosquito control program to evaluate your property for mosquito breeding sites and work cooperatively to prevent a mosquito problem on your property.

5. Mosquito Control BMPs for Residential and Landscaped Properties
Many residential and commercial properties have potential mosquito sources around buildings and grounds associated with excess or poorly managed irrigation, poor drainage, and miscellaneous landscape features. Mosquitoes can develop in the standing water associated with over-irrigation, irrigation breaks and/or runoff, clogged gutters, stormwater management structures, ornamental ponds, swimming pools, trash cans and flower pots, low areas or holes in turf where water collects and stands and low areas underneath pier and beam homes or buildings. Mosquito sources can be minimized by taking precautions such as regular inspection and proper maintenance of irrigation systems and other water features, and elimination of unwanted standing water.
• Avoid over-irrigating to prevent excess pooling and runoff.
• Routinely inspect, maintain, and repair irrigation system components.
• All underground drain pipes should be laid to grade to avoid low areas that may hold water for longer than 96 hours.
• Back-fill tire ruts or other low areas that hold water for more than 96 hours.
• Improve drainage channels and grading to minimize potential for standing water.
• Keep drainage ditches free of excessive vegetation and debris to provide rapid drainage.
• Check and repair leaky outdoor faucets.
• Report any evidence of standing water to responsible maintenance personnel.
• Use waterfalls, fountains, aerators and/or mosquitofish in ponds and ornamental water features. Land owners must consult with the local mosquito control agencies or California Fish and Game regarding proper use of mosquitofish.
• Prevent mosquito breeding in rain barrels by properly screening all openings, preventing mosquito access to the stored water.
• For ponds and ornamental water features where mosquitofish cannot be used, landowners should use one of several readily available larval mosquito control products to treat water when they see immature mosquitoes. Landowners should also review stormwater runoff because building rooftops, parking lots, etc. may have associated stormwater management features that produce mosquitoes.

6. Mosquito Control BMPs for Rural Properties
Mosquito breeding on rural properties is highly variable due to differences in location, terrain, and land use. This list is intended to provide general guidance, not site-specific requirements. BMPs that are most applicable and relevant to a specific mosquito source may be selected from the list and incorporated into the overall property management plan. Ideally, activities should be coordinated with those of a local mosquito control program.

Flood irrigation is a common practice in rural areas throughout California and always poses the potential for creating mosquito breeding sites. Mosquitoes commonly develop within irrigation infrastructure including in ditches clogged with vegetation, irrigation tail water areas and return sumps, blocked ditches or culverts, vegetated ditches; and leaking irrigation pipes, head gates, pumps, stand pipes, etc. The fields, orchards, and pastures being irrigated may also produce mosquitoes, particularly where natural undulation or poor grading create low lying areas where water collects and stands.

7. Mosquito Control BMPs for Ditches and Drains

- Construct or improve large ditches to a slope of at least 2:1 and a minimum 4 foot wide bottom. Consider a 3:1 slope or greater to discourage burrowing animal damage, potential seepage problems, and prevent unwanted vegetation growth.
- Keep ditches clean and well-maintained. Periodically remove accumulated sediment and vegetation. Maintain ditch grade and prevent areas of standing water.
- Design irrigation systems to use water efficiently and drain completely to avoid standing water.
- Prevent wet areas associated with seepage by repairing leaks in dams, ditches, and drains.

8. Mosquito Control BMPs for Irrigated Pastures and Cropland

- Grade to eliminate standing water from pastures and fields. Use Natural Resource Conservation Service (NRCS) guidelines: Laser leveling and periodic maintenance may be needed to allow proper drainage, efficient water flow, and reduce low-lying areas where standing water may accumulate.
- Reuse wastewater through return flow systems to effectively minimize mosquito production and conserve water. Eliminate and reuse excess water that may typically stagnate and collect at lower levels of irrigated fields.
- Irrigate only as frequently as is needed to maintain proper soil moisture. Check soil moisture regularly.
- Drain water as quickly as possible following irrigation. Check slopes may be used to direct water movement and drainage. Drainage ditches may be used to remove water from the lower end of the field.
- Install surface drains to remove excess water that collects at lower levels of irrigated fields.
- Inspect fields for drainage and broken checks to see whether re-leveling or reconstruction of levees is needed. Broken checks create cross-leakage that may provide habitat for mosquitoes.
- If possible, use closed conduits instead of open canals for water conveyance.
- Do not over fertilize. Over-fertilization can leach into irrigation run-off making mosquito production more likely in ditches or further downstream.
- When possible, use sprinklers or drip systems rather than flood irrigation.
- Keep animals off the pasture while the soil is soft. Mosquito habitat is created in irrigated pastures when water collects in hoof prints.

9. Mosquito Control BMPs for Rice Fields

Flooded rice fields can always support the development of mosquitoes. As the rice stand develops and grows denser, the production of mosquitoes tends to increase while the ability for chemical control agents to penetrate the canopy decreases. The BMPs presented in this section attempt to balance the needs of the grower with the need to control mosquitoes. In California there is a long-standing cooperative effort among the Rice Commission, individual growers, and mosquito control agencies to manage mosquitoes on rice lands. Close cooperation between growers and vector control is particularly important with organic rice producers. With severe limits on chemical control options and greater expense for organic-compatible larvicides, organic rice growers should implement as many mosquito control BMPs as possible.

• Wherever feasible, maintain stable water levels during mosquito season by ensuring constant flow of water into ponds or rice fields to reduce water fluctuation due to evaporation, transpiration, outflow, and seepage.
• Inspect and repair levees to minimize seepage.
• Drain and fill in borrow pits and seepage areas external to the fields.
• Wherever feasible, maintain at least 4” – 6” (10-15 cm) of water in the rice field after rice seedlings have begun to stand upright. Any drainage should be coordinated with local vector control (where possible). Restocking of mosquitofish or use of alternative mosquito control measures should be instituted as soon as possible when fields are re-flooded.
• Whenever feasible, remove vegetation on the outer-most portions of field levees and checks, specifically where they interface with standing water.
• Control algae and weed growth as effectively as possible.
• Communicate frequently with your local mosquito control program regarding your crop management activities.
• Wherever feasible, maintain borrow pits (12” – 18” deep) (30-45 cm) on both sides of each check throughout rice fields to provide refuge for mosquitofish during low water periods.
• If a pyrethroid pesticide is to be applied to the fields stocked with mosquitofish, contact your local mosquito control program for advice on minimizing fish mortality.
• If a pesticide is applied, fields should be inspected for mosquitofish afterward and if needed, fish should be restocked as soon as feasible.

10. Mosquito Control BMPs for Dairies and Animal Holding Operations

Frequently infrastructure associated with dairies, feedlots, or other animal holding facilities can produce mosquitoes. Watering troughs and irrigated fields associated with the operation can create mosquito problems. Animal washing areas may also create mosquito problems, particularly drains and ditches, sumps, ponds, and wastewater lagoons.

The following activities can reduce mosquito production and simplify control activities around dairies and animal holding operations:

• All holding ponds should be surrounded by lanes of adequate width to allow safe passage of mosquito control equipment. This includes keeping the lanes clear of any materials or equipment (e.g. trees, calf pens, hay stacks, silage, tires, equipment, etc.).
• If fencing is used around the holding ponds, it should be placed on the outside of the lanes with gates provided for vehicle access.
• All interior banks of the holding ponds should have a grade of at least 2:1.
• An effective solids separation system should be utilized such as a mechanical separator or two or more solids separator ponds. If ponds are used, they should not exceed 60’ (18m) in surface width.
• Drainage lines should never by-pass the separator ponds, except those that provide for normal corral run-off and do not contain solids. All drain inlets must be sufficiently graded to prevent solids accumulation.
• Floating debris should be eliminated on all ponds; mechanical agitators may be used to break up crusts.

• Vegetation should be controlled regularly to prevent emergent vegetation and barriers to access. This includes access lanes, interior pond embankments, and any weed growth that might become established within the pond surface.
• Dairy wastewater discharge for irrigation purposes should be managed so it does not stand for more than 4 days.
• Tire sidewalls or other objects that will not hold water should be used to hold down tarps (e.g. on silage piles). Whole tires or other water-holding objects should be replaced.

11. Mosquito Control BMPs for Wetlands
Wetlands are an important source of mosquito production on public and privately owned lands. Under the California Wildlife Protection Act, the term "wetlands" is defined as any lands which may be covered periodically or permanently with shallow water, which include freshwater and saltwater marshes, open or closed brackish water marshes, swamps, mudflats, fens, and vernal pools (Fish & Game Code Section 2785). Many wetlands are protected by federal and state laws. By definition, “natural” wetlands are not intensely managed and options for implementing mosquito control BMPs in these areas are very limited. Even in managed wetlands, not all BMPs listed below may be suitable for use in all wetlands. It is the responsibility of the landowner to become informed on timing and extent of acceptable
activities in a given wetland habitat. Intermittently or seasonally flooded wetlands can produce formidable numbers of mosquitoes, whereas well-managed semi-permanent and permanent wetlands usually produce fewer mosquitoes because of their limited acreage, stable water levels, and abundance of natural predators of mosquito larvae.

Due to the delicate and sometimes protected wetlands ecosystems, landowners, biologists, managers, and staff from mosquito control programs should collaborate to control mosquitoes. Source reduction and source maintenance can be combined with the judicious use of specific larvicides to minimize mosquito production from these wetlands. Based on the site activities and potential for mosquito production, the existing BMPs may need to be modified or supplemented to address public health risk, goals and management strategy issues, and requirements of California Department of Fish and Game (DFG), the local mosquito and vector control program, and CDPH.

12. General Mosquito Control BMPs for Wetlands
• Manage vegetation routinely; activities such as annual thinning of rushes and cattails and removing excess vegetative debris enables natural predators to hunt mosquito larvae more effectively in permanent wetlands. Vegetation in shallow, temporary wetlands can be mowed when dry.
• Time flooding of seasonal wetlands to reduce overlap with peak mosquito activity.
• Flood wetlands from permanent water sources containing mosquito predators (e.g., mosquito-eating fish or invertebrate predators) to passively introduce mosquito predators. Permanent wetlands and brood ponds can be stocked with mosquitofish or native predatory species.
• Maintain permanent or semi-permanent water within the wetland to maintain populations of larval mosquito predators. Discourage the use of broad spectrum pesticides.

• Use fertilizers conservatively and manage irrigation drainage to prevent or minimize fertilizer and/or manure flowing into wetlands. Buffers between agriculture fields and wetlands should be established.
• Comply with all Federal and State Environmental Laws and the California Health and Safety Code to prevent environmental harm while reducing or eliminating mosquito production.

13. Mosquito Control BMPs for Design and Maintenance of Wetlands
• Provide reasonable access on existing roads and levees to allow for monitoring, abatement, and implementation of BMPs. Make shorelines of natural, agricultural, and constructed water bodies accessible for periodic maintenance, mosquito monitoring and abatement procedures, and removal of emergent vegetation.
• Construct, improve, or maintain ditches with 2:1 slopes and a minimum 4 foot (1.2 m) width at the bottom. Consider a 3:1 slope or greater to discourage burrowing animal damage, potential seepage problems, and prevent unwanted vegetation growth.
• Construct, improve, or maintain levees to quality standards that ensure stability and prevent unwanted seepage. Ideally build levees with >3:1 slopes and > 80% compaction; consider 5:1 slope or greater in areas prone to overland flooding and levee erosion.
• Provide adequate water control structures for complete draw-down and rapid flooding.
• When possible, include independent inlets and outlets in the design of each wetland unit.
• Construct or enhance swales so they are sloped from inlet to outlet and allow maximum draw-down.
• Excavate deep channels or basins to maintain permanent water areas (>2.5 feet deep) within a portion of seasonal managed wetlands. This provides year-round habitat for mosquito predators that can inoculate seasonal wetlands when they are irrigated or flooded.

14. Wetland Infrastructure Maintenance Mosquito Control BMPs
• Inspect levees at least annually and repair as needed.
• Periodically inspect, repair, and clean water control structures.
• Remove all debris, including silt and vegetation, which can impede drainage and water flow.
• Ensure water control structures are watertight to prevent unnecessary water flow or seepage.
• Regularly remove trash, silt and vegetation from water delivery ditches to allow efficient water delivery and drainage.
• Remove problem vegetation that inhibits water flow using herbicides or periodic dredging.
• If possible, use closed conduits instead of open canals for water conveyance.
• Periodically test and repair pumps used for wetland flooding to maximize pump output.

15. Water Management Mosquito Control BMPs for Seasonal Wetlands
• Timing of flooding
• Delay or “phase” fall flooding of wetlands as long as possible in consultation with local vector control agencies. Fall flooding is known to produce large numbers of

mosquitoes and/or those in close proximity to urban areas to minimize late season mosquito production.

- Strategically locate wetlands identified for early flooding. Wetlands that are flooded in early fall should not be close to urban areas or historically produce great numbers of mosquitoes.
- When possible, water in managed wetlands should be drawn-down in late March or early April.
- Use a flood-drain-flood regime to control floodwater mosquitoes; flood to trigger hatching of dormant mosquito eggs, drain water and larvae into an area where they can be easily treated, drowned in moving water, or consumed by predators, and immediately re-flood wetland. This water management regime should be used only when it does not conflict with water quality regulations.
- Speed of flooding
- Flood wetlands as quickly as possible to reduce the potential for large numbers of mosquitoes. Coordinate flooding with neighbors and/or the water district to maximize flood-up rate.
- Water source
- Flood wetlands with water from permanent water sources containing mosquito predators (i.e., mosquito-eating fish or invertebrate predators) to passively introduce mosquito predators. Permanent wetlands and brood ponds used as flooding sources can be stocked with mosquito-eating fish or maintained to encourage natural predator populations.
- Maintain a separate permanent water reservoir that conveys water to seasonal wetlands that provides year-round habitat for mosquito predators that can inoculate seasonal wetlands when they are irrigated or flooded.
- Frequency and duration of irrigation
- When possible, reduce the number and duration of irrigations to minimize standing water. The need to irrigate should be evaluated based on spring habitat conditions and plant growth. If extended duration irrigation (generally 14-21 days) is considered for weed control (e.g., cocklebur), additional measures to offset the potential for increased mosquito production may be needed.
- Irrigate managed wetlands before soil completely dries after spring drawdown to discourage floodwater mosquitoes from laying eggs in the dry, cracked substrate.
- Drain irrigation water into ditches or other water sources with mosquito predators instead of nearby dry fields.
- Maintain high ground water levels by keeping channels or deep swales permanently flooded for subsurface irrigation to reduce the amount of irrigation water needed during the mosquito season.
- Communicate with your local mosquito control agency
- Advise your local mosquito control agency when you intend to flood so that they can make timely applications of larvicide if necessary
- Emergency preparedness
- Whenever feasible, have an emergency plan that provides for immediate drainage into acceptable areas if a mosquito-borne disease related public health emergency occurs.

16. Vegetation Management Mosquito Control BMPs

- Control floating vegetation conducive to mosquito production (i.e., water hyacinth, water primrose, parrot feather, duckweed, and filamentous algae mats).

• Perform routine maintenance to reduce problematic emergent plant densities to facilitate the ability of mosquito-eating fish to move through vegetated areas and allow good penetration of chemical control agents.
• Manage vegetation based on local land management objectives and associated habitat uses to minimize mosquito production. Methods of vegetation control for managed wetlands include mowing, burning, disking, and grazing.
• Manage the spread and density of invasive, non-native emergent wetland vegetation to increase native plant diversity, increase the mobility of larval mosquito predators, and allow for more efficient penetration of chemical control agents.

17. Additional Water Management BMPs for Permanent Wetlands
• Maintain stable water levels in wetlands that are flooded during summer and early spring to prevent intermittent flooding of shoreline areas favorable to mosquito production. Water level fluctuation can be minimized by continuing a constant flow of water into the wetland.
• Circulate water to avoid stagnation (e.g., provide a constant influx of water equal to the net loss or discharge of water).
• Maintain water depths as deep as possible (18” – 24” [45-60 cm] or more) during the initial flood-up to minimize shallow habitats preferred by mosquito larvae. Shallow water levels can be maintained outside of the mosquito breeding season.

18. Additional Mosquito Control BMPs for Saltwater Marsh
• Improving water flow through the wetland system minimizes stagnant water and facilitates movement of fish and other natural predators. For example, mosquitoes in coastal tidal wetlands can be managed by constructing and maintaining ditches that drain off the water when the tide falls.

19. Mosquito Control BMPs for Stormwater Management and Associated Infrastructure
Federal and state environmental regulations require mitigation of the harmful effects of runoff water from storms, irrigation or other sources prior to entering natural waterways from point and non-point sources. Mitigation may include water capture, slowing flow velocity, reducing volume, and removal of pollutants. The term “stormwater” is used as a generic term for runoff water, regardless of source. Stormwater infrastructure typically includes conveyance systems (e.g. drain inlets, catch basins, pipes, and channels), storage and infiltration systems (e.g. flood control basins, percolation basins), and more recently, structural treatment devices designed and installed specifically to remove suspended and dissolved pollutants from runoff (e.g., vegetated swales, dry detention basins, ponds and constructed wetlands, media filtration devices, and trash capturing devices). The size and variability of stormwater infrastructure, inconsistent quantity and timing of water flows, and propensity to carry and accumulate sediment, trash, and debris, makes these systems highly conducive to holding areas of standing water ideal for production of mosquitoes. Identification of the potential mosquito sources (often belowground) found within stormwater infrastructure is often more difficult than the solutions needed to minimize mosquitoes.

20. General Stormwater Management Mosquito Control BMPs
• Manage sprinkler and irrigation systems to minimize runoff entering stormwater infrastructure.

• Avoid intentionally running water into stormwater systems by not washing sidewalks and driveways, washing cars on streets or driveways, etc.
• Inspect facilities weekly during warm weather for the presence of standing water or immature mosquitoes.
• Remove emergent vegetation and debris from gutters and channels that accumulate water.
• Consider mosquito production during the design, construction, and maintenance of stormwater infrastructure.
• Design and maintain systems to fully discharge captured water in 96 hours or less.
• Include access for maintenance in system design.
• Design systems with permanent water sources such as wetlands, ponds, sumps, and basins to minimize mosquito habitat and plan for routine larval mosquito inspection and control activities with the assistance of a local mosquito control program.

21. Stormwater Conveyance
• Provide proper grades along conveyance structures to ensure that water flows freely.
• Inspect on a routine basis to ensure the grade remains as designed and to remove accumulations of sediment, trash, and debris.
• Keep inlets free of accumulations of sediment, trash, and debris to prevent standing water from backing up on roadways and gutters.
• Design outfalls to prevent scour depressions that can hold standing water.
Stormwater Storage and Infiltration Systems (Aboveground)
• Design structures so that they do not hold standing water for more than 96 hours to prevent mosquito development. Features to prevent or reduce the possibility of clogged discharge orifices (e.g., debris screens) should be incorporated into the design. The use of weep holes is not recommended due to rapid clogging.
• Provide a uniform grade between the inlets and outlets to ensure that all water is discharged in 96 hours or less. Routine inspection and maintenance are crucial to ensuring the grade remains as designed.
• Avoid the use of electric pumps. They are subject to failure and often require permanent-water sumps. Structures that do not require pumping should be favored over those that have this requirement.
• Avoid the use of loose rock rip-rap that may hold standing water.
• Design distribution pumping and containment basins with adequate slopes to drain fully. The design slope should take into consideration buildup of sediment between maintenance periods.

22. Stormwater Structures with Permanent-Water Sumps or Basins (Belowground)
• Where possible, seal access holes (e.g., pickholes in manhole covers) to belowground structures designed to retain water in sumps or basins to minimize entry of adult mosquitoes. If using covers or screens, maximum allowable gaps 15 of 1/16 inch (2 mm) will exclude entry of adult mosquitoes. Inspect barriers frequently and replace when needed.
• If the sump or basin is completely sealed against mosquitoes, with the exception of the inlet and outlet, the inlet and outlet should be completely submerged to reduce the available surface area of water for mosquitoes to lay eggs (female mosquitoes can fly through pipes).
• Where possible, design belowground sumps with the equipment necessary to allow for easy dewatering of the unit.

• Contact the local mosquito control program for advice with problem systems.

23. Stormwater Treatment Ponds and Constructed Treatment Wetlands
• Whenever possible, stock stormwater ponds and constructed wetlands with mosquito-eating fish available from local mosquito control programs.
• Design and maintain accessible shorelines to allow for periodic maintenance and/or control of emergent and shoreline vegetation, and routine monitoring and control of mosquitoes. Emergent plant density should be routinely managed so mosquito predators can move throughout the vegetated areas and are not excluded from pond edges.
• Whenever possible, design and maintain deep zones in excess of four feet (1.2 m) to limit the spread of invasive emergent vegetation such as cattails. The edges below the water surface should be as steep as practicable and uniform to discourage dense plant growth that may provide immature mosquitoes with refuge from predators and increased nutrient availability.
• Use concrete or liners in shallow areas to discourage plant growth where vegetation is not necessary.
• Whenever possible, provide a means for easy dewatering if needed.
• Manage the spread and density of floating and submerged vegetation that encourages mosquito production (i.e., water hyacinth, water primrose, parrot's feather, duckweed, and filamentous algal mats).
• If possible, compartmentalize managed treatment wetlands so the maximum width of ponds does not exceed two times the effective distance (40 feet [12 m]) of land-based application technologies for mosquito control agents.

24. General Access Requirements for Stormwater Treatment Structures
• All structures should be easily and safely accessible, without the need for special requirements (e.g., Occupational Safety and Health Administration - OSHA - requirements for "confined space"). This will allow for monitoring and, if necessary, abatement of mosquitoes.
• If utilizing covers, the design should include spring-loaded or lightweight access hatches that can be easily opened.
• Provide all-weather road access (with provisions for turning a full-size work vehicle) along at least one side of large aboveground structures that are less than seven meters wide, or both sides if shore-to-shore distance is greater than seven meters. Note: Mosquito larvicides are applied with hand held equipment at small sites and with backpack or truck mounted high-pressure sprayers at large sites. The effective swath width of most backpack or truck-mounted larvicide sprayers is approximately 20-25 feet (6-7meters) on a windless day.
• Build access roads as close to the shoreline as possible to allow for maintenance and vector control crews to periodically maintain, control and remove emergent vegetation and conduct routine mosquito monitoring and abatement. Remove vegetation and/or other obstacles between the access road and the structure that might obstruct the path of larvicides to the water.
• Control vegetation (by removal, thinning, or mowing) periodically to prevent barriers to access.

25. Mosquito Control BMPs for Wastewater Treatment Facilities
Wastewater treatment facilities are designed to collect, treat, and release nutrient rich highly organic water. These facilities implement practices appropriate to removing contaminants from wastewater, but which may be in direct conflict with

BMPs intended to prevent development of mosquito larvae. Further, managers are under intense pressure to meet water quality standards in effluent water and are frequently concerned that mosquito control BMPs will jeopardize compliance with effluent standards. Wastewater facilities often include features that can produce mosquitoes. Examples include: 1) a series of treatment or evaporation ponds, 2) the use of tules or other emergent vegetation to remove contaminants, 3) aerated and non-aerated ponds with emergent vegetation around the edges or throughout, 4) cracks and openings in crusted waste matter on the surface of treatment ponds, and 5) abandoned or unused pond basins that frequently hold shallow water. Certain activities may also create or enhance mosquito habitat including: 1) allowing evaporation of wastewater from treatment ponds for maintenance or as a standard treatment method, 2) release of wastewater into marshes or floodplains for evaporation or infiltration, and 3) distribution of sludge onto irrigated agricultural lands. For mosquito control around buildings and grounds, consult the residential and landscape section of this document. Similarly, many BMPs included in the wetlands and dairy sections of this document are pertinent to wastewater management facilities, particularly those sections related to construction and management of treatment ponds and wetlands and the use and distribution of wastewater or sludge onto agricultural lands. For mosquito control related to wastewater collection, conveyance, and distribution consult the stormwater management section.

- Monitor all treatment ponds for mosquito larvae – particularly in areas of emergent vegetation.
- Remove emergent vegetation from edges of aerated ponds.
- Immediately incorporate sludge into soil through plowing or disking.
- Insure all water distributed onto evaporation ponds dries completely in less than 96 hours.
- Check abandoned ponds or tanks weekly to ensure they are completely dry.
- Use mechanical agitation to prevent the formation of any crust on treatment ponds or tanks.
- Work closely with a local vector control program. If there is no local vector control agency, consult the closest vector control program, the local public health officer, or CDPH to prevent or abate a mosquito problem from the facility.

26. Mosquito Control BMPs for Wildlands – Undeveloped Areas

California encompasses about 100 million acres (40 million hectares) of land. Approximately 75 million acres (30 million hectares) are classified as wildlands, which include all undeveloped and non-cultivated property in the state. In many cases the properties are remote and mosquito control is neither feasible nor warranted. However, if you own a property that is near a town or are aware of a mosquito problem at the property, you may wish to contact the closest vector control program or CDPH to determine what if anything can be done to alleviate the problem.

27. Mosquito Control BMPs that May be Applicable to Wildlands

- Conduct routine mosquito surveillance by looking for immature mosquitoes in the water. Apply EPA-registered products (typically containing Bti, Bs, or methoprene) to control mosquito larvae.
- Evaluate reports of mosquito annoyance from visitors or the public, and if possible work with a local mosquito control program to be notified if there is an adult mosquito problem on or near your property.

• After a rainfall, pay particular attention to temporary water sources and ponds that rise.

28. Treat sources with mosquito control products if needed.
• Stock ornamental ponds and other water features with mosquitofish available from local mosquito control programs. However, their use is restricted in natural bodies of water or in water features that drain into natural bodies of water. Land managers must consult with the local mosquito control agencies regarding proper use of mosquitofish or other available biological control agents. Work closely with a local mosquito control program to accurately identify, map, and monitor areas that may produce mosquitoes; and tailor control measures for each site, contingent on the species of mosquitoes that are present.
• Implement personal protective measures
• Provide visitors and guests with information regarding the risk of mosquito-borne disease transmission and personal protective measures.
• Install and maintain tight-fitting window and door screens on buildings.
• If possible, minimize outdoor activities at dawn and dusk when mosquitoes are the most active.
• Wear protective clothing such as long-sleeved shirts and long pants when going into mosquito-infested areas.
• Use mosquito repellent when necessary, carefully following the directions on the label.

29. Evaluation of the Efficacy of BMPs
Landowners can easily evaluate the efficacy of the mosquito control BMPs they have implemented. A simple evaluation is as follows:
• Immature mosquitoes: Look for immature mosquitoes in standing water on your property – if the number is decreasing noticeably or immature mosquitoes cannot be found, the BMPs you have implemented are working.
• Adult mosquitoes: Simply be aware of the level of mosquito annoyance you experience and ask guests or employees about their experience with regard to mosquitoes. People become accustomed to a certain level of mosquito activity and commonly notice increases or decreases in that level. If the annoyance level is increasing, you have more work to do; if the number is decreasing or mosquitoes are not noticeable the BMPs implemented are working.

The best way to evaluate the effectiveness of BMPs is through a comprehensive surveillance program of larval dipping and adult mosquito trapping, including species identification. Some important strengths of local mosquito control programs are their ability to evaluate treatment options, estimate treatment costs, recommend and implement those BMPs most appropriate for a property. Local mosquito abatement programs also are familiar with indigenous mosquito species and therefore know the type of habitat those mosquitoes come from, often monitor adult populations, and can identify a mosquito problem in a particular area. Landowners can make substantial progress in solving mosquito problems on their own, but if possible, they should work closely with a local mosquito control program to implement and evaluate a mosquito control program.

10. Identification of the problem. Prior to first pesticide application covered under this General Permit that will result in a discharge of biological and residual pesticides to waters of the US, and at least once each calendar year thereafter prior to the first

pesticide application for that calendar year, the Discharger must do the following for each vector management area:

a. If applicable, establish densities for larval and adult vector populations to serve as action threshold(s) for implementing pest management strategies;

The Contra Costa Mosquito & Vector Control District staff only apply pesticides to sources of mosquitoes that represent imminent threats to public health or quality of life. The presence of any mosquito may necessitate treatment, however higher thresholds may be applied depending on the District's resources, disease activity, or local needs. Treatment thresholds are based on a combination of one or more of the following criteria:

- Mosquito species present
- Mosquito stage of development
- Pest, nuisance, or disease potential
- Disease activity
- Mosquito abundance
- Flight range
- Proximity to populated areas
- Size of source
- Presence/absence of natural enemies or predators
- Presence of sensitive/endangered species or habitats.

b. Identify target vector species to develop species-specific pest management strategies based on developmental and behavioral considerations for each species:

Mosquito-borne viruses belong to a group of viruses commonly referred to as arboviruses (for **ar**thropod-**bo**rne). Although 12 mosquito-borne viruses are known to occur in California, only WNV, western equine encephalomyelitis virus (WEE) and St. Louis encephalitis virus (SLE) are significant causes of human disease. WNV is having a serious impact upon the health of humans, horses, and wild birds as it becomes established statewide. Since 2004, there have been 2,985 human cases with 101 deaths and 1,152 horse cases. Consequently, the California Arbovirus Surveillance Program emphasizes forecasting and monitoring the temporal and spatial activity of WNV, WEE, and SLE. These viruses are maintained in nature 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 western encephalitis mosquito, *Culex tarsalis*, and birds such as house finches and sparrows.

Immature stages (called larvae and pupae) of *Culex tarsalis* can be found throughout California in a wide variety of aquatic sources, ranging from clean to highly polluted waters. Most such water is associated with irrigation of agricultural crops or urban wastewater. Other mosquito species, such as *Culex pipiens* and *Culex quinquefasciatus*, play an important role in WNV, and possibly SLE, transmission cycles in urban and suburban areas. *Aedes melanimon*, a floodwater mosquito, plays a role in a secondary transmission cycle of WEE involving rabbits. Additional mosquitoes such as *Aedes vexans* and *Culex erythrothorax* could be important bridge (i.e. bird to mammal) vectors in transmission.

Mosquito control is the only practical method of protecting people and animals. There are no known specific treatments or cures for diseases caused by these viruses. Vaccines are not available for public use. Infection by WEE virus tends to be most serious in very young children, whereas infection caused by SLE and WNV viruses affects elderly people most seriously. WEE and WNV can be an important disease in horses and emus, and kills a wide variety of endemic and imported birds. There are WEE and WNV vaccines available to protect horses.

Mosquito-borne disease prevention strategies must be based on a well-planned, area-wide integrated pest management (IPM) based program. The primary components of an IPM program include education, surveillance, and mosquito control.

Education

Residents, farmers, and duck club owners 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, residents can help by properly disposing of discarded tires, cans, or buckets; emptying plastic or unused swimming pools; and unclogging blocked rain gutters around homes or businesses. Farmers and ranchers can be instructed to use irrigation practices that do not allow water to stand for extended periods, and duck club owners can work with mosquito control agencies to determine optimum flooding schedules. Educating the general public regarding curtailing outdoor activities during peak mosquito biting times, using insect repellents, and wearing long-sleeved clothing will help reduce exposure to mosquitoes. Clinical surveillance is enhanced through education of the medical community to recognize the symptoms of WEE, SLE, and WNV and to request appropriate laboratory tests. Public health officials need to be alerted if a mosquito-borne viral disease is detected, especially if the public health risk is high.

Surveillance

Surveillance includes the monitoring of climatic factors, estimating immature and adult mosquito abundance, and assessing virus activity by testing mosquitoes, sentinel chickens, wild birds (including dead birds for WNV), horses, and humans for evidence of infection. Surveillance must focus not only on mosquito-borne viruses known to exist in California, but be sufficiently broad to also detect newly introduced viruses.

Climate Variation

The California Mediterranean climate provides ideal opportunities for forecasting mosquito abundance and arbovirus activity, because most precipitation falls during the winter, as rain at lower elevations or as snow in higher elevations. Spring and summer temperatures then determine the rate of snow pack melt and runoff, mosquito population growth, the frequency of blood feeding, the rate of virus development in the mosquito, and therefore the frequency of virus transmission. In general, WEE virus outbreaks have occurred in the Central Valley when wet winters are followed by warm summers, where SLE and WN virus outbreaks seemed linked to warm dry conditions that lead to large populations of urban *Culex*. Although climate variation may forecast conditions conducive for virus amplification, a critical sequence of events is required for amplification to reach outbreak levels.

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" estimated. In most local mosquito control agencies, 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, developmental stages treated, source size, and control effectiveness can provide an early warning to forecast the size of the adult population.

Adult mosquito abundance is a key factor contributing to the risk of disease 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 on the effectiveness of larval control efforts. Four adult mosquito sampling methods are currently used in California: New Jersey light traps, carbon dioxide-baited traps, gravid (egg-laying) traps, and resting adult mosquito collections. The advantages and disadvantages of these sampling methods, and guidelines for the design, operation, and processing of the traps have been discussed in the recently published Guidelines for Integrated Mosquito Surveillance (Meyer et al. 2003) and are summarized in Appendix A.

Mosquito Infestations

Early detection of virus activity may be accomplished by testing adult mosquitoes for virus infection. Because *Culex tarsalis* is the primary amplifying vector of WEE and SLE and most likely WNV, surveillance efforts emphasize the testing of this species. Other species that should be tested, especially for WNV and WEE, include *Culex quinquefasciatus*, *Culex pipiens*, and *Aedes melanimon.* Female mosquitoes are trapped, usually using carbon dioxide-baited or gravid traps, and pooled into groups of 50 females each for testing at the Center for Vectorborne Diseases (CVEC) at UC Davis. Procedures for processing mosquitoes for virus infection are detailed in Appendix B. The current surveillance system is designed to detect WNV and other vector-borne viruses, in addition to SLE and WEE. Although generally less sensitive than sentinel chickens, mosquito infections may be detected earlier in the season than chicken seroconversions and therefore provide an early warning of virus activity. Testing adult mosquitoes for infection is one of the best methods to detect newly introduced mosquito-borne viruses that would not otherwise be expected to be present in the state. Sampling mosquito species other than *Culex tarsalis* may be necessary to detect the introduction of viruses that do not have a primary avian-*Culex* transmission cycle.

Avian Infections

Detection of arboviral transmission in bird populations can be accomplished by 1) testing dead birds for WNV, 2) using caged chickens as sentinels and bleeding them routinely to detect viral antibodies (seroconversions), and 3) collecting and bleeding wild birds to detect viral antibodies.

In California, flocks of ten 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 at CDHS Vector-Borne disease Section for antibodies to SLE, WEE, and WNV. Some agencies conduct their own testing, but send positive samples to CDHS for confirmation and official reporting. Because SLE cross-reacts with WNV in antibody testing, SLE 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 the most sensitive and cost-effective method to monitor encephalitis virus activity in an area. Because chickens are continuously available to host-seeking mosquitoes, they are usually exposed to more mosquitoes than can be collected by trapping, especially when adult mosquito abundance is low. Sentinel housing, bleeding instructions, and testing protocols are provided in Appendix C.

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 seroprevalence among age strata to determine if the prevalence of the virus in the region has changed. Elevated seroprevalence 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 generally is too labor intensive, technically difficult, and expensive for local mosquito control agencies to perform routinely. In addition, the actual place where a wild bird became infected is rarely known, because birds usually are collected during daylight foraging flights and not at nocturnal roosting sites where they are most frequently bitten by mosquitoes.

Unlike WEE and SLE, WNV 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 CDHS in 2000 to provide early detection of WNV. Dead bird surveillance has been shown to be one of the earliest indicators of WNV activity in a new area. Birds that meet certain criteria are necropsied at the California Animal Health and Food Safety Laboratory and kidney snips tested for WNV RNA by RT-PCR at CVEC or oral swabs of American crows tested by rapid antigen tests by local agencies. Dead birds are reported to CDPH's dead bird hotline (1-877-WNV-BIRD) or via the website http://westnile.ca.gov. Beginning in 2010, results from RT-PCR testing at CVEC distinguished between WNV recent and chronic positive birds based on cycle threshold (cT) values. In general, birds tested by RT-PCR with a Ct value <30 and those positive by antigen tests are considered to be recently infected, whereas those with cT values>30 are considered to have been chronically infected and the time since infection unknown. Chronic positive birds did not likely die from WNV infection and are of limited value for surveillance. The communication and testing algorithm for the dead bird surveillance program is detailed in Appendix D.

Equine Infections

Currently, equine disease due to WEE is not a sensitive indicator of epizootic (the occurrence of infections in animals other than humans) activity in California because of the widespread vaccination of equines (horses, donkeys, and mules) against WEE virus. A similar scenario may unfold for WNV as horse owners begin vaccinating to protect their horses. If confirmed cases do occur, it is a strong indication that WEE or WNV is active in that region of the State. Veterinarians are contacted annually by DHS and the California Department of Agriculture (CDFA) to advocate equine vaccination and to describe diagnostic services that are available in the event of a suspected case of WEE or WNV encephalitis. Other mosquito-borne viruses may also cause encephalitis in horses; testing of equine specimens for other viruses is available.

Human Infections

Local mosquito control agencies rely on 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 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. No human cases of WEE or SLE have been reported in California in recent years. However, a total of 2,988 human cases of WNV have been reported in California from 2003-2010.

To enhance human WNV testing and surveillance efforts throughout the state, a regional public health laboratory network was established in 2002. The laboratory network consists of the state Viral and Rickettsial Disease Laboratory (VRDL) as well as 26 county public health laboratories that are able to conduct WNV testing. Providers are encouraged to submit specimens for suspected WNV cases to their local public health laboratories. Specimens for patients with encephalitis may also be submitted directly to the California Encephalitis Project, which is based in the VRDL and offers diagnostic testing for many agents known to cause encephalitis, including WNV virus and other arboviruses. In addition, VRDL collaborates with reference laboratories such as the regional laboratories of Kaiser Permanente to ascertain additional suspect WNV cases.

In accordance with Title 17 of the California Code of Regulation (Sections 2500 and 2505), physicians and laboratories are required to report cases of WNV infection or positive test results to their local health department. Positive WNV or other arbovirus test results are investigated by local health department officials to determine whether a patient meets the clinical and laboratory criteria for a WNV diagnosis. If so, the local health department collects demographic and clinical information on the patient using a standardized West Nile virus infection case report, and forwards the report to the state health department. The local health department also determines whether the infection was acquired locally, imported from a region outside the patient's residence, or acquired by a non-mosquito route of transmission such as blood transfusion or organ transplantation. Appendix F contains the protocol for submission of specimens to the regional public health laboratory network for WNV testing. Appendix G provides the national surveillance case definition for arboviral disease, including WNV infection.

Mosquito Control

Problems detected by surveillance are mitigated through larval and adult mosquito control. Mosquito control is the only practical method of protecting people from mosquito-borne diseases. Mosquito control in California is conducted by approximately 80 local agencies, including mosquito and vector control districts, county environmental and health departments, and county agriculture departments. Compounds currently approved for larval and adult mosquito control in California are listed in Appendix H. Considerations regarding adult mosquito control in urban areas are described in Appendix I.

Larval Control

Mosquito larvae and pupal control methods are target specific and prevent the emergence of adult mosquitoes which are capable of transmitting pathogens, causing discomfort, and ultimately producing another generation of mosquitoes. For these reasons, most mosquito control agencies in California target the immature stages rather than the adult stage of the mosquito. Larval mosquito control has three key components: environmental management, biological control, and chemical control.

Environmental management decreases habitat availability or suitability for immature mosquitoes, and may include water management, such as increasing the water disposal rate through evaporation, percolation, recirculation, or drainage. Laser-leveling of fields minimizes pooling at low spots, allows even distribution of irrigation water, and precludes standing water for long periods. Controlled irrigation or the careful timing of wetland flooding for waterfowl can reduce mosquito production or limit emergence to times of the year when virus activity is unlikely. Environmental management also may include vegetation management because emergent vegetation provides food and refuge for mosquito larvae. Management strategies include the periodic removal or thinning of vegetation, restricting growth of vegetation, and controlling algae.

Biological control uses natural predators, parasites, or pathogens to reduce immature mosquito numbers. Mosquitofish, *Gambusia affinis*, are the most widely used biological control agent in California. These fish are released annually in a variety of habitats, such as rice fields, small ponds, and canals.

There are several mosquito control products that are highly specific and thus have minimal impact on non-target organisms. These include microbial control agents, such as *Bacillus thuringiensis israelensis* (Bti) and *Bacillus sphaericus* and insect growth regulators, such as methoprene, that prevent immature mosquitoes from developing into adults. Surface films are very effective against both larvae and pupae, but also may suffocate other surface breathing aquatic insects.

Adult Control

When larval control is not possible or more immediate control measures are needed, adult mosquito control may be required to suppress populations of infected mosquitoes and interrupt epidemic virus transmission. Adult mosquito control products may be applied using ground-based equipment, fixed wing airplanes, or helicopters. Products are applied in ultralow volume (ULV) formulations and dosages include organophosphates, such as malathion and naled, pyrethroids, such as resmethrin, sumithrin, and permethrin, and pyrethrins. Factors to consider when selecting a pesticide include: 1) efficacy against the target species or life cycle stage, 2) resistance status, 3) pesticide label requirements, 4) availability of pesticide and application equipment, 5) environmental conditions, 6) cost, and 7) toxicity to non-target species, including humans.

For more information about mosquito control see “Best Management Practices for Mosquito Control in California”. www.westnile.ca.gov/resources.php

Response Levels

The Contra Costa MVCD Mosquito-borne Virus Surveillance and Response Plan was developed to provide a semi-quantitative measure of virus transmission risk that could be used to plan and modulate control activities. Independent models are presented for WEE, SLE, and WNV to accommodate the different ecological dynamics of the three viruses. SLE and WN viruses 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 virus 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 (WEE only)

Each factor 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. Appendix J shows sources of data useful in the calculation of risk in Table 1.

For surveillance factor 2 (vector abundance), abundance is scaled as an anomaly and compared to the area average over 5 years for the same preceding two week period. The mosquito virus infection rate should be calculated using the most current data (prior two week period) and expressed as minimum infection rate (MIR) per 1,000 female mosquitoes tested. Calculations can also use maximum likelihood estimate (Biggerstaff 2003), which accounts for varying numbers of specimens in pools and the possibility that more than one mosquito could be infected in each pool when infection rates are high. For WNV and SLE, 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. WEE activity typically is greatest during El Niño conditions of wet winters, excessive run-off, cool springs, and increased *Culex tarsalis* abundance. Historically, WEE virus spillover into a secondary *Aedes*-rabbit cycle was common in the Central Valley, but has not been detected for the past 25 years. In contrast, SLE and perhaps WNV activity appears to be greatest during La Niña conditions of drought and hot summer temperatures and both SLE and WNV transmission risk increases when temperatures are above normal. Abundance and infection of the *Culex pipiens* complex are included in both SLE 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.

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 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 SLE virus 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 access 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 same areas dominated by each species.

Each of these surveillance factors can differ in impact and significance according to time of year and geographic region. 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. Climate is used prospectively to forecast risk during the coming season. 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 the cooler weather of 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 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 Responsibilites.”

Table 1. Mosquito-borne Virus Risk Assessment

WNV Surveillance Factor	Assessment Value	Benchmark	Assigned Value
1. **Environmental Conditions** High-risk environmental conditions include above normal temperatures with or without above normal rainfall, snow pack, or runoff. Weather data link: Ipm.ucdavis.edu	1	Avg daily temperature during prior 2 weeks $\leq$56 ^{o}F	
	2	Avg daily temperature during prior 2 weeks 57-65 ^{o}F	
	3	Avg daily temperature during prior 2 weeks 66-72 ^{o}F	
	4	Avg daily temperature during prior 2 weeks 73-79 ^{o}F	
	5	Avg daily temperature during prior 2 weeks >79 ^{o}F	
2**. Adult *Culex tarsalis and Aedes melanimon*** (bridge vector) **abundance** Determined by trapping adults, identifying them to species, and comparing numbers to averages previously documented for an area for current time period	1	*Cx. tarsalis* abundance well below average (<50%)	
	2	*Cx. tarsalis* abundance below average (50-90%)	
	3	*Cx. tarsalis* abundance average (90-150%)	
	4	*Cx. tarsalis* and *Ae. melanimon* abundance above average (150-300%)	
	5	*Cx. tarsalis and Ae. melanimon* abundance well above average (>300%)	
3. **Virus isolation rate in *Cx. tarsalis and Ae. melanimon* mosquitoes** Tested in pools of 50. Test results expressed as minimum infection rate (MIR) per 1,000 female mosquitoes tested (or per 20 pools).	1	*Cx. tarsalis* MIR / 1000 = 0	
	2	*Cx. tarsalis* MIR / 1000 = 0 - 1.0	
	3	*Cx. tarsalis* MIR / 1000 = 1.1 - 2.0	
	4	*Cx. tarsalis* MIR / 1000 = 2.1 - 5.0 and/or *Ae. melanimon* MIR/1000 > 0	
	5	*Cx. tarsalis* MIR / 1000 > 5.0 and *Ae. melanimon* MIR/1000 >0	
4. **Sentinel chicken seroconversion** Number of chickens in a flock that develop antibodies to WEE virus. 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	
	2	One seroconversion in single flock over broad region	
	3	One to two seroconversions in a single flock in specific region	
	4	More than two seroconversions in single flock or one to two seroconversions in multiple flocks in specific region	
	5	More than two seroconversions per flock in multiple flocks in specific region	
5. **Infections in equines or ratites**	1	No cases	
	3	One case in broad region	
	4	One or two cases in specific region	
	5	More than two cases in specific region	
6. **Human cases**	1	No human cases	
	3	One human case in broad region	
	4	One human case in specific region	
	5	More than one human case in specific region	
7. **Proximity to urban or suburban regions** (score only if virus activity detected) Risk of outbreak is highest in urban areas because of high likelihood of contact between humans and vectors.	1	Virus detected in remote area	
	2	Virus detected in rural areas	
	3	Virus detected in small towns	
	4	Virus detected in suburban areas	
	5	Virus detected in urban area	
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	

SLE Surveillance Factor	Assessment Value	Benchmark	Assigned Value
1. **Environmental Conditions** Favorable environmental conditions include above normal temperatures with or without above normal water conditions of rainfall, snow pack, and runoff. Urban mosquitoes breeding in municipal water systems may benefit from below normal rainfall.	1	Avg daily temperature during preceding month <56^o F	
	2	Avg daily temperature during preceding month 57-65^o F	
	3	Avg daily temperature during preceding month 66-74^o F	
	4	Avg daily temperature during preceding month 75-83^o F	
	5	Avg daily temperature during preceding month >83^o F	
2. **Adult *Culex tarsalis* or *pipiens complex* abundance** Determined by trapping adults, identifying them to species, and comparing numbers to those previously documented for an area.	1	Vector abundance well below average (<50%)	
	2	Vector abundance below average (50-90%)	
	3	Vector abundance average (90-150%)	
	4	Vector abundance above average (150-300%)	
	5	Vector abundance well above average (>300%)	
3. **Virus isolation rate in *Culex tarsalis* and *Cx. pipiens complex* mosquitoes** Tested in pools of 50. Test results expressed as minimum infection rate (MIR) per 1,000 female mosquitoes tested (or per 20 pools).	1	MIR / 1000 = 0	
	2	MIR / 1000 = 0-1.0	
	3	MIR / 1000 = 1.1-2.0	
	4	MIR / 1000 = 2.1-5.0	
	5	MIR / 1000 > 5.0	
4. **Sentinel chicken seroconversion** Number of chickens in a flock that develop antibodies to SLE virus. 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	
	2	One seroconversion in single flock over broad region	
	3	One to two seroconversions in a single flock in specific region	
	4	More than two seroconversions in single flock or one to two seroconversions in multiple flocks in specific region	
	5	More than two seroconversions per flock in multiple flocks in specific region	
5. **Human cases**	1	No human cases	
	3	One human case in broad region	
	4	One human case in specific region	
	5	More than one human case in specific region	
6. **Proximity to urban or suburban regions** (score only if virus activity detected) Risk of outbreak is highest in urban areas because of high likelihood of contact between humans and vectors.	1	Virus detected in remote area	
	2	Virus detected in rural areas	
	3	Virus detected in small towns	
	4	Virus detected in suburban areas	
	5	Virus detected in urban area	
<u>Response Level / Average Rating:</u> Normal Season (1.0 to 2.5) Emergency Planning (2.6 to 4.0) Epidemic (4.1 to 5.0)		**TOTAL**	
		AVERAGE	

WNV Surveillance Factor	Assessment Value	Benchmark AVERAGE	Assigned Value
1. **Environmental Conditions** Favorable environmental conditions in California unknown. Rural transmission may favor El Niño conditions, whereas urban transmission may favor La Niña conditions.	1	Cumulative rainfall and runoff well below average	
	2	Cumulative rainfall and runoff below average	
	3	Cumulative rainfall and runoff average	
	4	Cumulative rainfall and runoff above average	
	5	Cumulative rainfall and runoff well above average	
2. **Adult *Culex tarsalis* and *Cx. pipiens complex* abundance** Determined by trapping adults, identifying them to species, and comparing numbers to those previously documented for an area.	1	Vector abundance well below average (<50%)	
	2	Vector abundance below average (50-90%)	
	3	Vector abundance average (90-150%)	
	4	Vector abundance above average (150-300%)	
	5	Vector abundance well above average (>300%)	
3. **Virus isolation in *Culex tarsalis* and *Cx. pipiens* complex mosquitoes** Tested in pools of 50.	1	No positive pools	
	2	A positive pool in California	
	3	A positive pool in the region	
	4	A positive pool in Contra Costa County	
	5	Multiple positive pools in Contra Costa County	
4. **Sentinel chicken seroconversion** Number of chickens in a flock that develop antibodies to WNV. 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 California	
	2	One seroconversion in California	
	3	One seroconversion in region	
	4	Seroconversions in single flock in Contra Costa County	
	5	Seroconversions in multiple flocks in Contra Costa County	
5. **Dead bird infection** Includes zoo collections.	1	No WNV positive dead birds in California	
	2	One WNV positive dead bird in California	
	3	One WNV positive dead bird in region	
	4	One WNV positive dead bird in Contra Costa County	
	5	Multiple WNV positive dead birds in Contra Costa County	
6. **Equine cases**	1	No equine cases	
	2	One equine case in broad region	
	3	One equine case in region	
	4	One equine case in Contra Costa County	
	5	Multiple equine case in Contra Costa County	
7. **Human cases**	1	No human cases	
	2	One human case statewide (not in region)	
	3	One human case in region	
	4	One human case in Contra Costa County	
	5	Multiple human cases in Contra Costa County	
8. **Proximity to urban or suburban regions** (score only if virus activity detected) Risk of outbreak is highest in urban areas because of high likelihood of contact between humans and vectors.			
	3	Virus detected in rural area of Contra Costa County	
	4	Virus detected in urban area of Contra Costa County	
	5	Virus detected in multiple areas of Contra Costa County	
<u>Response Level / Average Rating:</u> Normal Season (1.0 to 2.5)		**TOTAL**	

Characterization of Conditions and Responses

Level 1: Normal Season

Risk rating: 1.0 to 2.5

CONDITIONS
• Average or below average snowpack and rainfall; average seasonal temperatures • Mosquito abundance at or below five year average (key indicator = adults of vector species) • No virus isolations from mosquitoes • No seroconversions in sentinel chickens • No WNV infected dead birds • No equine cases • No human cases
RESPONSE
• Conduct routine public education (eliminate standing water around homes, use personal protection measures) • Conduct routine mosquito and virus surveillance activities • Conduct routine mosquito larval control • Inventory pesticides and equipment • Evaluate pesticide resistance in vector species • 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
• Snowpack and rainfall and/or temperature above average • Adult mosquito abundance greater than 5-year average (150% to 300%) • One or more virus isolations from mosquitoes (MIR / 1000 is <5) • Seroconversions in any flock in Northern California • One WNV positive dead birds in Northern California • One or two equine cases in Northern California • One human case statewide • Virus detection in small towns or suburban area
RESPONSE

- Review epidemic response plan
- Consult communication 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
- Increase surveillance and control of mosquito larvae
- Increase adult mosquito surveillance
- Increase number of mosquito pools tested for virus
- Conduct localized chemical control of adult mosquitoes
- 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
• Snowpack, rainfall, and water release rates from flood control dams and/or temperature well above average • Adult vector population extremely high (>300%) • Virus isolates from pools of mosquitoes in Contra Costa County • Seroconversions in sentinel flock in Contra Costa County • Multiple WNV positive dead birds in Contra Costa County • One or more equine cases in Contra Costa County • One or more human case in Contra Costa County
RESPONSE
• Consult Communication Plan • Enhance media campaign • Alert physicians and veterinarians • Continue enhanced larval surveillance and control of immature mosquitoes • Broaden geographic coverage of adult mosquito surveillance • Accelerate adult mosquito control if appropriate • Coordinate the response with the local Office of Emergency Services or if activated, the Emergency Operation Center (EOC) • Determine whether declaration of a local emergency should be considered by the County Board of Supervisors (or Local Health Officer) • Determine whether declaration of a "State of Emergency" should be considered by the Governor at the request of designated county or city officials • Continue mosquito education and control programs until mosquito abundance is substantially reduced and no additional human cases are detected

For more detailed information on responding to a mosquito-borne disease outbreak, please refer to:

Operational Plan for Emergency Response to Mosquito-Borne Disease Outbreaks, California Department of Health Services (supplement to California Mosquito-Borne Virus Surveillance and Response Plan). http://westnile.ca.gov/publications.htm

LARVAL SOURCE TREATMENT GUIDELINES* (Level 1)

Problem Mosquito Species	Distance to Populated Area[1]	Total L/P Density Other Factors Involved
Ae. nigromaculis	0-10 yds.	.1/dp.
Ae. melanimon	100-500 yds.	.1/dp.
Ae.. squamiger	500yds-2 miles	.1/dp. and source 1/4 acre or more
Ae. washinoi	2 miles-10 miles	3+/dp. and source acre or more
Ae. Dorsalis		
Ae. sierrensis	0-500 yards	1 per slurp w/turkey baster
	greater than 500 yards	no treatment
Cx. tarsalis	0-100 yds.	.1/dp.
An. freeborni	100-500 yds.	.1/dp.
	500yds-1 mile	.1/dp.
	1 mile-2 miles	5+/dp. and source 1/4 acre or more
Cx. stigmatasoma	0-100 yds.	.1/dp.
Cx. pipiens	100-500 yds.	.1/dp.
Cx. erythrothorax	500yds-1 mile	3-5/dp. and source 1/4 acre or more
Cx. apicalis	1 mile-2 mile	5+/dp. and source 1/4 acre or more
Cs. incidens	0-100 yds.	.1/dp.
Cs. inornata	100-500 yds.	10-25/dp.
Cs. particeps	500yds-1 mile	25-100/dp. and source > .5 acre
	1 mile-2 mile	no treatment
An. franciscanus	0-100 yds.	.1/dp.
An. punctipennis	100-500 yds.	10-25/dp.
An. occidentalis	500yds-1 mile	25+/dp.
	1 mile-2 mile	no treatment

* Also consider environmental conditions (e.g. probable duration of flooding, presence of natural predators, past history of source) before making a treatment decision. Consult material choice guidelines in Operations manual for choice of treatment methods. Sources with higher disease potential (e.g. *Culex* species) may be assigned higher priority if multiple sites require treatment. [1]Populated area refers mainly to residential areas but could also include picnic areas in parks, marinas and other recreational areas where public exposure to mosquitoes may be high

Note: Collect larval sample prior to each treatment. Please preserve sample in alcohol and submit to the lab on the same day of collection.

ENHANCED LARVAL TREATMENT GUIDELINES*

(Level 2/Level 3)

SPECIES	DISTANCE TO POPULATED AREA[1]	TOTAL L/P DENSITY OTHER FACTORS *
Aedes (except sierrensis)	0-500 yds 500 yds-1 mile 1-3 miles 3-5 miles	1 per 10 dips 1 per 5 dips 1 per dip 10 per dip
Ae. sierrensis	0-500 yds Greater than 500 yds	1 per slurp with turkey baster Do not treat
Culex, Anopheles	0-500 yds 500 yds-1 mile 1-3 miles 3-5 miles	Greater than zero 1 per 10 dips 1 per dip 5 per dip
Culiseta	0-500 yds 500 yds-1 mile Greater than 1 mile	3 per dip 5 per dip Do not treat

* Also consider environmental conditions (e.g. probable duration of flooding, presence of natural predators, past history of source) before making a treatment decision. Consult material choice guidelines in Operations manual for choice of treatment methods. Sources with higher disease potential (e.g. *Culex* species) may be assigned higher priority if multiple sites require treatment.

[1]Populated area refers mainly to residential areas but could also include picnic areas in parks, marinas and other recreational areas where public exposure to mosquitoes may be high

Note: Collect larval sample prior to each treatment. Please preserve sample in alcohol and submit to the lab on the same day of collection.

LARVICIDE SELECTION CRITERIA

X = DO NOT USE			X = DO NOT USE			X = DO NOT USE			
CONDITION	LIQUIDS					GRANULES/PELLETS			FISH
	AGNIQUE	**ALTOSID**	**BTI**	**DUPLEX**	**OIL**	**ALTOSID**	**BTI**	**BS**	
Water Temp <65			X		X		X	X	***
Water Temp>65				*					
Larval Instar 1^{st}	****	X			X				
Lrv Instar 2^{nd} -3^{rd}	****				X				
Larval Instar 4^{th}	****		X				X		
Pupae	****	X	X	X		X	X	X	
Creek	*****	*****		*****	*****	*****	*****	*****	
Brackish Water	X		****		****		****	****	
Low Orgnic Load				*					
High Orgnc Load	X		X		****		X		
Low Vegetation									
High Vegetation		X	X	X	****				
Endangered Species Absent									
Endangered Species Present					X				X***
Hazardous Terrain		X	X	X			X		

*Consult your Supervisor: **Site must have two mosquito species breeding, back to back (*Aedes-Culex*), after flooding, or a multiple flood cycle with hazardous terrain: ***Consult Biologist: ****Use higher rate: *****Pooled water only

NO VIRUS DETECTED IN REGION[1,2,3] (Level 1)			
Culex		**Aedes/Culiseta**	
Landing count greater than_ 20/min **OR** EVS count greater than 200/NIGHT **OR** NJLT count greater than 20/night **IN RURAL AREA**	Treat; set EVS traps in area after each treatment Continue until count below threshold	Landing count greater than 50/minute **OR** EVS count greater than 500/night **OR** NJLT count greater than 50/night **IN RURAL AREA**	Treat; set EVS traps in area after each treatment Continue until count below threshold
Landing count greater than 10/minute **OR** EVS count greater than 100/night **OR** NJLT count greater than 10/night **W/IN 2 MILES OF RESIDENTIAL AREA**	Treat; set EVS traps in area after each treatment Continue until count below threshold	Landing count greater than 10/minute **OR** EVS count greater than 100/night **OR** NJLT count greater than 10/night **W/IN 2 MILES OF RESIDENTIAL AREA**	Treat; set EVS traps in area after each treatment Continue until count below threshold
Landing count greater than 5/minute **OR** EVS count greater than 50/night **OR** NJLT count greater than 5/night **IN A RESIDENTIAL AREA**	No adulticiding Set EVS trap to determine species Refer to larval sample database Attempt to locate and treat sources; doortag if backyard	Landing count greater than 5/minute **OR** EVS count greater than 50/night **OR** NJLT count greater than 5/night **IN A RESIDENTIAL AREA**	No adulticiding Set EVS trap to determine species Refer to larval sample database Attempt to locate and treat sources; doortag if backyard

VIRUS DETECTED IN REGION[1,2,3] (Level 2)			
Culex		**Aedes/Culiseta**	
Landing count greater than_ 10/min **OR** EVS count greater than 100/NIGHT OR NJLT count greater than 10/night **IN RURAL AREA**	Treat; set EVS traps in area after each treatment Submit pools for testing if possible Continue until count below threshold	Landing count greater than 20/min in rural area **OR** EVS count greater than 200/night **OR** NJLT count greater than 20/night **IN RURAL AREA**	Treat; set EVS traps in area after each treatment Continue until count below threshold
Landing count greater than 5/minute **OR** EVS count greater than 50/night **OR** NJLT count greater than 5/night **W/IN 2 MILES OF RESIDENTIAL AREA**	Treat; set EVS traps in area after each treatment Submit pools for testing if possible Continue until count below threshold	Landing count greater than 10/minute **OR** EVS count greater than 100/night **OR** NJLT count greater than 10/night **W/IN 2 MILES OF RESIDENTIAL AREA**	Treat; set EVS traps in area after each treatment Continue until count below threshold
Landing count greater than 2/minute **OR** EVS count greater than 20/night **OR** NJLT count greater than 2/night **IN RESIDENTIAL AREA**	Treat; set EVS traps in area after each treatment Submit pools for testing if possible Continue until count below threshold	Landing count greater than 5/minute **OR** EVS count greater than 50/night **OR** NJLT count greater than 5/night **IN RESIDENTIAL AREA**	Treat; set EVS traps in area after each treatment Continue until count below threshold

VIRUS DETECTED IN COUNTY[1,2,3] (Level 3)			
Culex		**Aedes/Culiseta**	
Landing count greater than_ 5/min **OR** EVS count greater than 50/NIGHT **OR** NJLT count greater than 5/night **IN RURAL AREA**	Treat; set EVS traps (2 or more) in area of positive human or animal case, sentinel or pool Submit pools for testing if possible Continue until count below threshold	Landing count greater than 20/min in rural area **OR** EVS count greater than 200/night **OR** NJLT count greater than 20/night **IN RURAL AREA**	Treat; set EVS traps in area after each treatment Continue until count below threshold
Landing count greater than 2/minute **OR** EVS count greater than 20/night **OR** NJLT count greater than 2/night **W/IN 2 MILES OF RESIDENTIAL AREA**	Treat; set EVS traps (2 or more) in area of positive human or animal case, sentinel or pool Submit pools for testing if possible Continue until count below threshold	Landing count greater than 10/minute **OR** EVS count greater than 100/night **OR** NJLT count greater than 10/night **W/IN 2 MILES OF RESIDENTIAL AREA**	Treat; set EVS traps in area after each treatment Continue until count below threshold
Landing count greater than 1/minute **OR** EVS count greater than 10/night **OR** NJLT count greater than 1/night **IN RESIDENTIAL AREA**	Treat; set EVS traps (2 or more) in area of positive human or animal case, sentinel or pool Submit pools for testing if possible Continue until count below threshold	Landing count greater than 5/minute **OR** EVS count greater than 50/night **OR** NJLT count greater than 5/night **IN RESIDENTIAL AREA**	Treat; set EVS traps in area after each treatment Continue until count below threshold

[1] These are general minimum mosquito population thresholds to trigger adulticide use. Other factors will be considered before any particular adulticide application is utilized. Examples of factors include, weather, species, and pesticide resistance.

[2] A Region@ includes MVCAC Coastal Region districts, plus San Joaquin, Sacramento-Yolo and Lake Counties.

[3] A Rural area@ excludes remote areas like marshes, industrial areas that are not inhabited and out of normal flight range from populated areas (e.g. Rhodia, Point Edith). These will be considered on a case-by-case basis.

c. **Identify known breeding areas for source reduction, larval control program, and habitat management:**
Any site that holds water for more than 96 hours (4 days) can produce mosquitoes. Source reduction is the District's preferred solution, and whenever possible the District works with property owners to implement long-term solutions to reduce or eliminate the need for continued applications as described in 9f and in the Best Management Practices for Mosquito Control in California.

d. **Analyze existing surveillance data to identify new or unidentified sources of vector problems as well as areas that have recurring vector problems:**
This is discussed in 10b and included in the Best Management Practices for Mosquito Control in California and the California Mosquito-borne Virus Surveillance and Response Plan that the Districts uses. The District continually collects adult and larval mosquito surveillance data, dead bird reports, and sentinel chicken test results and uses these data to guide mosquito control activities.

11. **Examination of Alternatives. Dischargers shall continue to examine alternatives to pesticide use in order to reduce the need for applying larvicides that contain temephos and for spraying adulticides. Such methods include:**
    a. **Evaluating the following management options, in which the impact to water quality, impact to non-target organisms, vector resistance, feasibility, and cost effectiveness should be considered:**
        - **No action**
        - **Prevention**
        - **Mechanical or physical methods**
        - **Cultural methods**
        - **Biological control agents**
        - **Pesticides**

    If there are no alternatives to pesticides, dischargers shall use the least amount of pesticide necessary to effectively control the target pest.

    The Contra Costa Mosquito & Vector Control District uses the principles and practices of integrated vector management (IVM) as described on pages 26 and 27 of Best Management Practices for Mosquito Control in California and is discussed in item 2 above. As stated in item #10 above, locations where vectors may exist are assessed, and the potential for using alternatives to pesticides is determined on a case-by-case basis. Commonly considered alternatives include: 1) Eliminate artificial sources of standing water; 2) Ensure temporary sources of surface water drain within four days (96 hours) to prevent adult mosquitoes from developing; 3) Control plant growth in ponds, ditches, and shallow wetlands; 4) Design facilities and water conveyance and/or holding structures to minimize the potential for producing mosquitoes; and 5) Use appropriate biological control methods that are available. Additional alternatives to using pesticides for managing mosquitoes are listed on pages 4-19 of the Best Management Practices for Mosquito Control in California.

Implementing preferred alternatives depends on a variety of factors including availability of agency resources, cooperation with stakeholders, coordination with other regulatory agencies, and the efficacy of the alternative. If a pesticide-free alternative does not sufficiently reduce the risk to public health, pesticides are considered, beginning with the least amount necessary to effectively control the target vector.

b. Applying pesticides only when vectors are present at a level that will constitute a nuisance:

Contra Costa Mosquito & Vector Control District follows an existing integrated vector management (IVM) program described in items 2 and 10b above.

A "nuisance" is specifically defined in California Health and Safety Code (HSC) §2002(j). This definition allows vector control agencies to address situations where even a low level of vectors may pose a substantial threat to public health. In practice, the definition of a "nuisance" is generally only part of a decision to apply pesticides to areas covered under this permit. As summarized in the California Mosquito-borne Virus Surveillance and Response Plan, the overall risk to the public when vectors and/or vector-borne diseases are present is used to select an available and appropriate material, rate, and application method to address that risk in the context of our IVM program.

12. Correct Use of Pesticides
Coalition's or Discharger's use of pesticides must ensure that all reasonable precautions are taken to minimize the impacts caused by pesticide applications. Reasonable precautions include using the right spraying techniques and equipment, taking account of weather conditions and the need to protect the environment:

This is an existing practice of the Contra Costa Mosquito & Vector Control District and is required to comply with the Department of Pesticide Regulation's (DPR) requirements and the terms of our California Department of Public Health (CDPH) Cooperative Agreement. All pesticide applicators receive annual safety and spill training in addition to their regular continuing education.

13. If applicable, specify a website where public notices, required in Section VIII.B, may be found:

www.ContraCostaMosquito.com

References:

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