ATTACHMENT G – NOTICE OF INTENT

WATER QUALITY ORDER NO. 2011-0002-DWQ
GENERAL PERMIT NO. CAG 990004

STATEWIDE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR BIOLOGICAL AND RESIDUAL PESTICIDE DISCHARGES TO WATERS OF THE UNITED STATES FROM VECTOR CONTROL APPLICATIONS

I. NOTICE OF INTENT STATUS (see Instructions)

Mark only one item ☒A. New Applicator ☐B. Change of Information: WDID# _____

☐C. Change of ownership or responsibility: WDID# _____

II. DISCHARGER INFORMATION

A. Name			
Solano County Mosquito Abatement District			
B. Mailing Address			
2950 Industrial Ct.			
C. City	D. County	E. State	F. Zip Code
Fairfield	Solano	CA	94533-6500
G. Contact Person	H. Email address	I. Title	J. Phone
Jon Blegen	SOLMAD@AOL.COM	Manager	707-437-1116

III. BILLING ADDRESS (Enter Information *only* if different from Section II above)

A. Name			
B. Mailing Address			
C. City	D. County	E. State	F. Zip Code
G. Email address	H. Title	I. Phone	

IV. RECEIVING WATER INFORMATION

A. Biological and residual pesticides discharge to (check all that apply)*:

1. ☐ Canals, ditches, or other constructed conveyance facilities owned and controlled by Discharger.
   Name of the conveyance system: _____

2. ☐ Canals, ditches, or other constructed conveyance facilities owned and controlled by an entity other than the Discharger.
   Owner's name: _____
   Name of the conveyance system: _____

3. ☒ Directly to river, lake, creek, stream, bay, ocean, etc.
   Name of water body: See ATTACHMENT IV. A. 3.

* A map showing the affected areas for items 1 to 3 above may be included.

B. Regional Water Quality Control Board(s) where application areas are located (REGION 1, 2, 3, 4, 5, 6, 7, 8, or 9): Region 2 and 5
(List all regions where pesticide application is proposed.)

A map showing the locations of A1-A3 in each Regional Water Board shall be included.

V. PESTICIDE APPLICATION INFORMATION

A. Target Organisms: X Vector Larvae X Adult Vector

B. Pesticides Used: List name, active ingredients and, if known, degradation by-products

SEE ATTACHMENT V. B.

C. Period of Application: Start Date October 31, 2011 End Date Ongoing

D. Types of Adjuvants Added by the Discharger: None

VI. PESTICIDES APPLICATION PLAN

A. Has a Pesticides Application Plan been prepared?*
☒ Yes ☐ No

If not, when will it be prepared? _____

* A copy of the PAP shall be included with the NOI.

B. Is the applicator familiar with its contents?

☒ Yes ☐ No

VII. NOTIFICATION

Have potentially affected governmental agencies been notified?

☒ Yes ☐ No

* If yes, a copy of the notifications shall be attached to the NOI.

VIII. FEE

Have you included payment of the filing fee (for first-time enrollees only) with this submittal?

☒ Yes ☐ NO ☐ NA

IX. CERTIFICATION

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. Additionally, I certify that the provisions of the General Permit, including developing and implementing a monitoring program, will be complied with."

A. Printed Name: Jon A. Blegen

B. Signature: Jon A Blegen **Date:** June 3, 2011

C. Title: Manager

X. FOR STATE WATER BOARD USE ONLY

WDID:	**Date NOI Received:**	**Date NOI Processed:**
Case Handler's Initial:	**Fee Amount Received:** $	**Check #:**

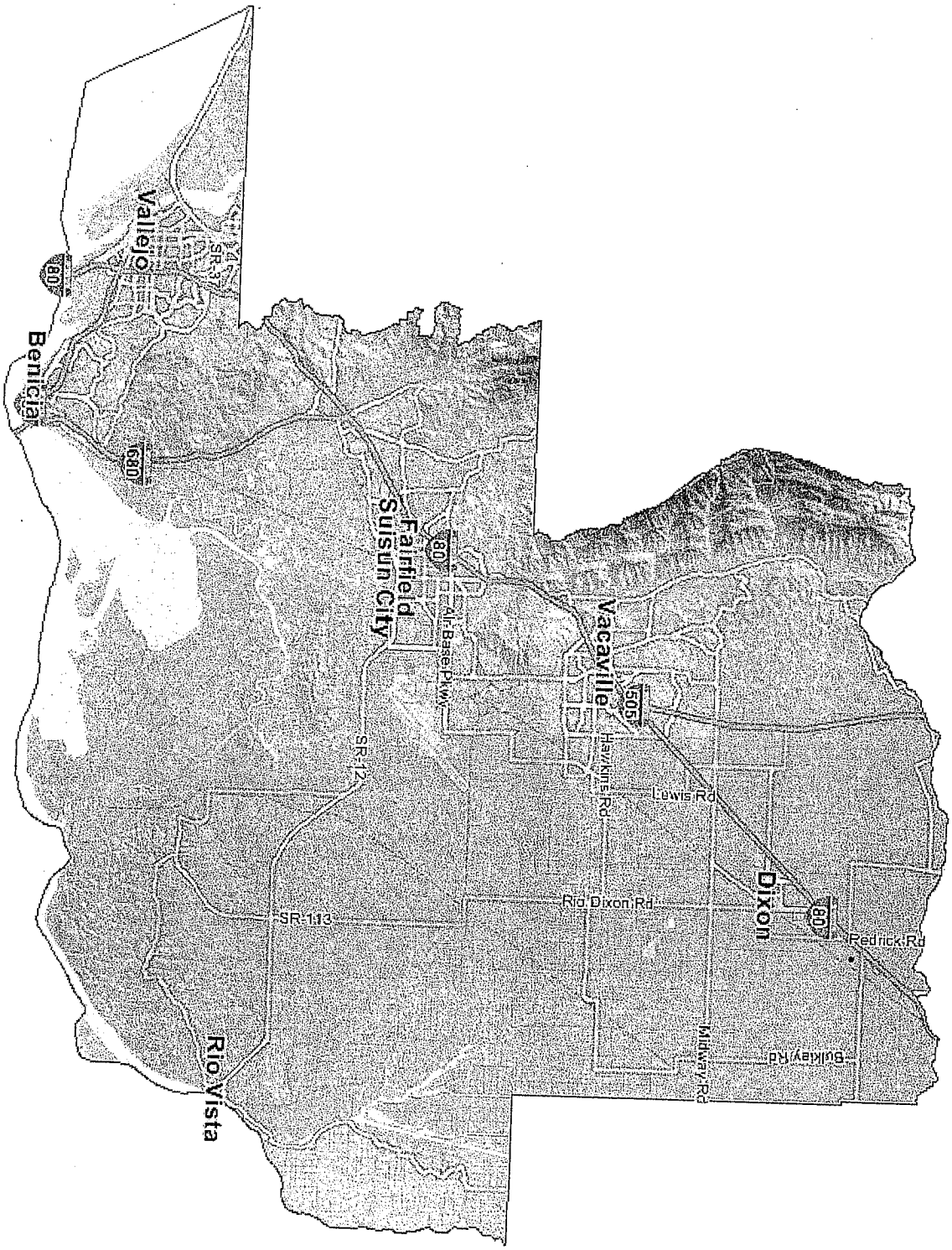
ATTACHMENT IV. A. 3

SAN FRANCISCO BAY REGION

Surface waters and waters of the U.S. located within the portion of Solano County included within the San Francisco Region, including but not limited to: The Sacramento River, its various tributaries, channels and sloughs; Grizzly Bay; Suisun Bay; The Suisun Marsh; Carquinez Strait; Southampton Bay; The Napa River, its various tributaries, channels and sloughs; San Pablo Bay, and; The Mare Island Marsh.

CENTRAL VALLEY REGION

Surface waters and waters of the U. S. located within the portion of Solano County included within the Central Valley Region, including but not limited to: The Sacramento River, its various tributaries, channels and sloughs.


Solano county
Vallejo
Benicia
Fairfield
Suisun City
Vacaville
Dixon
Rio Vista
SR-37
SR-12
SR-113
Air Base Pkwy
Hawkins Rd
Lewis Rd
Rio Dixon Rd
Redrick Rd
Midway Rd
Buckley Rd
80
680
505

ATTACHMENT V. B.

Pesticide Product	EPA Reg. #
ADULTICIDES	
M.G.K. Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7396 A.I. (5% Pyrethrins/25% Piperonyl Butoxide)	1021-1569
Pyrenone 25-5 Public Health Insecticide A.I. (5% Pyrethrins/25% Piperonyl Butoxide)	432-1050
Kontrol 4-4 A.I. (4% Permethrin/4% Piperonyl Butoxide	73748-4
Scourge 18%+54% (18% Resmethrin/54% Piperonyl Butoxide)	432-667
Biomist 4%+12% (4% Permethrin/12% Piperonyl Butoxide)	8329-34
Evergreen Crop Protection EC 60-6 (6% Pyrethrins/60% Piperonyl Butoxide)	1021-1770
Aquahalt Water-Based Adulticide (5% Pyrethin/25% Piperonyl Butoxide)	1021-1803
Pyrenone Crop Spray (6% Pyrethin/60% Piperonyl Butoxide)	432-1033
Prentox Pyronyl Oil Concentrate #525 (5% Pyrethrins/25% Piperonyl Butoxide)	655-471
Anvil 10+10 ULV (10% Sumithrin/10% Piperonyl Butoxide)	1021-1688
Prentox Pyronyl Crop Spray (6% Pyrethrin/60% Piperonyl Butoxide)	655-489
LARVICIDES	
Vectobac 12AS Biological Larvicide (11.61% *Bacillus thuringiensis*, subsp. *israelensis*, strain AM 65-52)	73049-38
Vectobac G Biological Larvicide Granules (2.8% *Bacillus thuringiensis*, subsp. *israelensis*, strain AM 65-52)	73949-10
Vectolex-CG Biological Larvicide Granules (7.5% *Bacillus sphaericus* Serotype H5a5b, strain 2362 Tech. Pwd.)	73049-20
Vectolex-WSP Biological Larvicide (7.5% *Bacillus sphaericus Serotype* H5a5b, strain 2362 Tech. Pwd.)	73049-20
Teknar HP-D (1.6% *Bacillus thuringiensis subspecies israelensis*)	73049-404
Vectomax CG Biological Larvicide (2.7% *Bacillus sphaericus Serotype* H5a5b, strain 2362/ 4.5% *Bacillus thuringiensis*, subsp. *israelensis*, strain Serotype H-14, Strain AM 65-52)	73049-429
Vectomax WSP Biological Larvicide Piperonyl Butoxide (information identical to above)	73049-429
Vectomax G Biological Larvicide (information identical to above)	73949-429
Zoecon Altosid Pellets Mosquito Growth Regulator (4.25% (S)-Methoprene)	2724-448
Zoecon Altosid Liquid Larvicide Mosquito Growth Regulator (5.0% (S)-Methoprene)	2724-392
Zoecon Altosid XR Extended Residual Briquets (2.1% (S)-Methoprene)	2724-421
Zoecon Altosid XR-G (1.5% (S)-Methoprene)	2724-451
Zoecon Altosid SBG Single Brood Granule (0.2% (S)-Methoprene)	2724-489
FourStar Sustained Release 180 Day Microbial Briquets (6.0% *Bacillus sphaericus Serotype* H5a5b, strain 2362/(1.00% *Bacillus thuringiensis*, subsp. *israelensis*, strain BMP 144)	83362-3
Mosquito Larvicide GB-1111 (98.7% Aliphatic Petroleum Hydrocarbons)	8329-72
BVA 2 Mosquito Larvicide Oil (97% Mineral Oil)	70589-1
Agnique MMF Mosquito Larvicide & Pupacide (100% Poly(oxy-1,2-ethanediyl)isooctadecyl-hydroxyl	53263-28
Agnique MMF G Mosquito Larvicide & Pupacide (32.0 % Poly(oxy-1,2-ethanediyl)(C16-20 branched and linear alkyl)-hydroxy	53263-30
Natular 2EC (Spinosad (20.6%) mixture of spinosyn A and spinosyn D)	8329-82
Natular G (Spinosad (0.5%) mixture of spinosyn A and spinosyn D)	8329-80
Natular XRG (Spinosad (2.5%) mixture of spinosyn A and spinosyn D)	8329-83
Natular XRT (Spinosad (6.2%) mixture of spinosyn A and spinosyn D)	8329-84

NOTICE OF INTENT TO APPLY PUBLIC HEALTH PESTICIDES FOR VECTOR CONTROL PURPOSES TO SURFACE WATERS AND WATERS OF THE U.S. WITHIN SOLANO COUNTY, CA

1. Solano County Mosquito Abatement District (the District) intends to apply public health pesticides to surface waters and waters of the U.S. for vector control purposes per the requirements of the General NPDES Permit for Biological and Residual Pesticide Discharges for Vector Control Applications (the Permit) issued by the State Water Resources Control Board (SWRCB).

2. The pesticides anticipated to be used are:

Pesticide Product	E.P.A. REG. #
ADULTICIDES	
M.G.K. Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7396	1021-1569
Pyrenone 25-5 Public Health Insecticide	432-1050
Scourge 18%+54%	432-667
Biomist 4%+12%	8329-34
Evergreen Crop Protection EC 60-6	1021-1770
Aquahalt Water-Based Adulticide	1021-1803
Pyrenone Crop Spray	432-1033
Prentox Pyronyl Oil Concentrate #525	655-471
Anvil 10+10 ULV	1021-1688
Prentox Pyronyl Crop Spray	655-489

LARVICIDES	
Vectobac 12AS Biological Larvicide	73049-38
Vectobac G Biological Larvicide Granules	73949-10
Vectolex-CG Biological Larvicide Granules	73049-20
Vectolex-WSP Biological Larvicide	73049-20
Teknar HP-D	73049-404
Vectomax CG Biological Larvicide	73049-429
Vectomax WSP Biological Larvicide	73049-429
Vectomax G Biological Larvicide	73949-429
Zoecon Altosid Pellets Mosquito Growth Regulator	2724-448
Zoecon Altosid Liquid Larvicide Mosquito Growth Regulator	2724-392
Zoecon Altosid XR Extended Residual Briquets	2724-421
Zoecon Altosid XR-G	2724-451
Zoecon Altosid SBG Single Brood Granule	2724-489
FourStar Sustained Release 180 Day Microbial Briquets	83362-3
Mosquito Larvicide GB-1111	8329-72

Pesticide Product	E.P.A. REG. #
Larvicides (contin.)	
BVA 2 Mosquito Larvicide Oil	70589-1
Agnique MMF Mosquito Larvicide & Pupacide	53263-28
Agnique MMF G	53263-30
Natular 2EC	8329-82
Natular G	8329-80
Natular XRG	8329-83
Natular XRT	8329-84

3. The purpose of the use of the pesticides is to control immature and adult mosquitoes to reduce annoyance and arbovirus transmission.

4. The general time period for the application of pesticides is January through December, 2011. The locations of expected use will be surface waters and waters of the U.S. within Solano County, CA where immature and adult mosquitoes are found at treatment threshold levels.

5. There are no known water use restrictions or precautions during treatment.

6. Interested persons may contact the District at (707) 437-1116 to obtain additional information.

John A. Blegen, Manager
Solano County Mosquito Abatement District
2950 Industrial Way
Fairfield, CA 94533-6500
(707) 437-1116
solmad@aol.com

City of Benicia
250 East L St.
Benicia, CA 94510
(707) 746-4200

City of Dixon
600 East A St.
Dixon, CA 95620
(707) 678-7000

City of Fairfield
1000 Webster St.
Fairfield, CA 94533
(707) 428-7400

City of Rio Vista
1 Main St.
Rio Vista, CA 94571
(707) 374-6451

City of Suisun
701 Civic Center Blvd.
Suisun, CA 94585
(707) 421-7300

City of Vacaville
650 Merchant St.
Vacaville, CA 95688
(707) 448-5100

City of Vallejo
555 Santa Clara St.
Vallejo, CA 94590
(707) 648-4575

County of Solano
675 Texas St. Ste. 6500
Fairfield, CA 94533
(707) 784-6100

SRCD
2544 Grizzly Island Rd.
Suisun, CA 94585
(707) 425-9302

DFG
2544 Grizzly Island Rd.
Suisun, CA 94585
(707) 425-3828

State of California
Dept. of Fish & Game
P.O. Box 47
Yountville, CA 94599
(707) 944-5517

Central Valley RWQCB
11020 Sun Center Dr. Ste. 200
Rancho Cordova, CA 95670-6114
(916) 464-3291

San Francisco RWQCB
1515 Clay St. Ste. 1400
Oakland, CA 94612
(510) 622-2300

U.S. Fish & Wildlife Service
San Pablo Bay National Wildlife Refuge
2100 Hwy. 37
Petaluma, CA 94954
(707) 769-4200

Pesticide Application Plan (PAP) for the NPDES Vector Control Permit Application of the Solano County Mosquito Abatement District

1. Target areas: surface waters and waters of the U.S. within Solano County, CA. Map of Solano County enclosed.

2. Please see the following enclosed references that identify the factors influencing the decision to select pesticide applications for vector control:

   a. **Best Management Practices for Mosquito Control in California. 2010.** California Department of Health Services, Vector-Borne Disease Section http://www.cdph.ca.gov/HealthInfo/discond/Documents/BMPforMosquitoControl 108-10.pdf
   b. **California Mosquito-Borne Virus Surveillance & Response Plan. 2010.** California Department of Health Services, Vector-Borne Disease Section http://www.cdph.ca.gov/HealthInfo/discond/Documents/CA ResponsePlanJuly2010.pdf
   c. **Operational Plan for Emergency Response to Mosquito-Borne Disease Outbreaks. 2010.** California Department of Health Services, Vector-Borne Disease Section. http://www.cdph.ca.gov/HealthInfo/discond/Documents/OpnPlanMosquitoDisEmergency2010.pdf
   d. **Overview of Mosquito Control Practices in California. 2008.** California Department of Health Services, Vector-Borne Disease Section http://www.cdph.ca.gov/HealthInfo/discond/Documents/OverviewofMosquitoControlinCA.pdf
   e. **Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control. 2003.** U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. http://www.gov/nidod/dvbid/westnile/resources/wnvguidelines2003.pdf
   f. **Pesticides and Public Health: Integrated Methods of Mosquito Management. 2001.** U.S. Environmental Protection Agency. http://www.gov/nidod/dvbid/westnile/resources/wnvguidelines2003.pdf
   g. **Solano County Mosquito Abatement District Integrated Management Practices. 2011** (see attachment g.)

3. Pesticide products or types that may be used and the method in which they may be applied:

Pesticide Product	EPA Reg. #	Method of Application
ADULTICIDES		
M.G.K. Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7396	1021-1569	Ultra low volume (ULV), vehicle (ground) and aircraft (air)
Pyrenone 25-5 Public Health Insecticide	432-1050	ULV ground and air
Kontrol 4-4	73748-4	ULV ground and air
Scourge 18%+54%	432-667	ULV ground
Biomist 4%+12%	8329-34	ULV ground
Evergreen Crop Protection EC 60-6	1021-1770	ULV ground and air
Aquahalt Water-Based Adulticide	1021-1803	ULV ground
Pyrenone Crop Spray	432-1033	ULV ground and air

Pesticide Product	EPA Reg. #	Method of Application
ADULTICIDES (contin.)		
Prentox Pyronyl Oil Concentrate #525	655-471	ULV ground and air
Anvil 10+10 ULV	1021-1688	ULV ground and air
Prentox Pyronyl Crop Spray	655-489	ULV ground and air
LARVICIDES		
Vectobac 12AS Biological Larvicide	73049-38	ATV ground/hand/air
Vectobac G Biological Larvicide Granules	73949-10	ATV ground/hand/air
Vectolex-CG Biological Larvicide Granules	73049-20	ATV ground/hand/air
Vectolex-WSP Biological Larvicide	73049-20	hand
Teknar HP-D	73049-404	ATV ground/hand/air
Vectomax CG Biological Larvicide	73049-429	ATV ground/hand/air
Vectomax WSP Biological Larvicide	73049-429	hand
Vectomax G Biological Larvicide	73949-429	ATV ground/hand/air
Zoecon Altosid Pellets Mosquito Growth Regulator	2724-448	ATV ground/hand/air
Zoecon Altosid Liquid Larvicide Mosquito Growth Regulator	2724-392	ATV ground/hand/air
Zoecon Altosid XR Extended Residual Briquets	2724-421	hand
Zoecon Altosid XR-G	2724-451	ATV ground/hand/air
Zoecon Altosid SBG Single Brood Granule	2724-489	ATV ground/hand/air
FourStar Sustained Release 180 Day Microbial Briquets	83362-3	hand
Mosquito Larvicide GB-1111	8329-72	ATV ground/hand
BVA 2 Mosquito Larvicide Oil	70589-1	ATV ground/hand
Agnique MMF Mosquito Larvicide & Pupacide	53263-28	ATV ground/hand/air
Agnique MMF G	53263-30	ATV ground/hand/air
Natular 2EC	8329-82	ATV ground/hand/air
Natular G	8329-80	ATV ground/hand/air
Natular XRG	8329-83	ATV ground/hand/air
Natular XRT	8329-84	hand

4. Following is a general description of the types of application areas (also known as "Source Types" in Solano County that are being planned to be applied or may be applied:

Swimming Pool	Pasture Ditch	Valve Box
Ponds	Flooded Pasture	Waste/Sewer Pond
Water Trough	Strip Check Pasture	Roadside Ditch
Retention Basin	Sump	Depression/Swale
Manmade Pond	Tail Water Drain	Duck Club
Fish Ponds	Septic Tank	Tidal Marsh
Dredge Spoil Pond	Container	Reclaimed Marsh
Permanent Pond	Tires	Streams/Creeks
Alfalfa	Waterline Leak	Treehole
Row Crop	Electrical Box	
Contour Pasture	Catch Basin	

5. The other control strategies used and their limitations include:

A. Biological control

Biological control is the intentional use of natural predators, pathogens or parasites to reduce the size of target mosquito populations to tolerable levels. Biological control agents of mosquito larvae include predatory fish, predatory aquatic invertebrates and mosquito pathogens. Of these only mosquitofish are available in sufficient quantity for use in mosquito control programs. Natural predators may sometimes be present in numbers sufficient to reduce larval mosquito populations. Biological control is sometimes used in conjunction with selective bacterial or chemical insecticides. The use of biological control is a primary method of control if the use of other control methods presents environmental concern and current vector populations are low or tolerable. The use of biological control organisms and strategies is limited to those that have been researched and field tested against target and non-target organisms. In addition, any biological control organism to be considered for use by the District will also be recognized and authorized by appropriate federal, state, and local agencies.

B. Legal abatement

Legal abatement is the process of preventing vectors through the enactment of legislation that enforces control measures or imposes regulations to prevent the production, introduction, or spread of pests and vectors. Legal abatement includes the use of federal, state and local guidelines and laws designed to prevent the creation and/or harborage of pests an vectors. The District regularly enforces the California Health and Safety Code, which specifically addresses the creation and/or harborage of vectors and vector breeding sites.

C. Natural control

Natural control is a pest management strategy in which the environment is disturbed as little as possible. Reliance is placed on naturally occurring parasites, predators, and diseases to control vectors. One scientific definition of natural control is "...the maintenance of a fluctuating population density within definable upper and lower limits over a period by the combined effects of abiotic and biotic elements in the environment." Natural control is sometimes difficult to implement or assess due to the amount of man-made or manipulated vector sources found in the District. Natural control is advocated for sites that are remote and undisturbed, to the least amount practical, for the individual vector species being contemplated for control.

D. Physical control

Physical control, or habitat modification, is achieved by altering the major ecological components of the vector's environment associated with the establishment and production of the mosquito's immature stages. The primary operational objective of physical control is to reduce the vector carrying capacity of a site to preclude the use of control methods that would adversely

impact the environment and wildlife. The District no longer performs any physical control work itself. When cleaning of existing drainageways becomes necessary, the work is performed by another agency having suitable equipment and expertise. Additionally, the District routinely reviews and comments on proposed projects within Solano County being considered by various public entities, thus providing opportunities to "design out" mosquito breeding conditions prior to construction and development.

6. The amount and type of product needed and how this amount was determined is difficult to project on a prospective basis, however, the District can provide the amount and type of products used in 2010 as an estimate of what may be used in 2011 and future years. Below is the 2010 information:

Product Name	EPA REG. #	AMOUNT USED	# OF APPLICATIONS	ACRES TREATED
ADULTICIDES				
M.G.K. Pyrocide for ULV Fogging 7396	1021-1569	115.4086 gal	315	16,979.6561
Pyrenone 25-5 Public Health Insecticide	432-1050	1.4625 gal	2	215.1724
Biomist 4%+12%	8329-34	0.0500 gal	3	3.2000
Aquahalt Water-Based Adulticide	1021-1083	1.0938 gal	3	194.4533
LARVICIDES				
Vectolex-WSP Biological Larvicide	73049-20	5.9000 lb.	12	0.2937
Zoecon Altosid Pellets Mosquito Growth Regulator	2724-448	2,465.3720 lb.	169	821.7907
Zoecon Altosid Liquid Larvicide Mosquito Growth Regulator	2724-392	218.4689 gal.	114	6,991.0048
Zoecon Altosid XR Extended Residual Briquets	2724-421	281.4452 lb.	263	7.7397
Zoecon Altosid SBG Single Brood Granule	2724-489	1,470.00 lb.	4	210.0000
Mosquito Larvicide GB-1111	8329-72	240.5630 lb.	35	48.0300
Agnique MMF Mosquito Larvicide & Pupacide	53263-28	0.3852 gal	4	0.6360

7. Representative monitoring locations and justification for selecting these locations are provided in the MVCAC Coalition Monitoring Plan.

8. Not applicable.

9. Items 2.a. through 2.g. (above) were used in the evaluation of available BMP's for the determination of feasible alternatives to selected pesticide applications that could reduce potential water quality impacts.

10. Items 2.a. through 2.g. (above) describe the BMP's to be implemented.

11. Prior to the first pesticide application covered under the permit that will result in a discharge of biological and residual pesticides to waters of the U.S., and at least once each calendar year thereafter prior to the first pesticide application for that calendar year the District will do the following for each vector management area:

    a. Utilize vector identification and surveillance techniques identified in the Best Management Practices for Mosquito Control in California (item 2.a. above), the California Mosquito-Borne Disease Surveillance and Response Plan (item 2.b. above) to identify vector species in the development of species-specific pest management strategies;
    b. Utilize the District's mosquito surveillance and control record keeping system (Access database), Department of Health's data sets to analyze existing surveillance data for the identification of new or unidentified sources of vector problems as well as areas that may have recurring vector problems.

12. The District will utilize the resources identified in 2.a. through 2.g. (above) in the examination of alternatives to pesticides. If there are no alternatives to pesticides, the District, to the extent practical, will use the least toxic pesticide necessary to control the target vector, and will only apply pesticides when vectors are present at levels identified in the CDPH BMP's (item 2.a.) and CDPH Mosquito-Borne Disease Surveillance and Response Plan (item 2.b. above).

13. The District will ensure that all reasonable precautions are taken to minimize the impacts caused by pesticide applications, and will comply with all regulations related to pesticide application, mixing, storing, and transport. The District is signatory to a Cooperative Agreement administered by the California Department of Public Health (copy attached) regarding pesticides, and agrees to: 1) calibrate all application equipment, 2) seek assistance from the Solano County Agricultural Commissioner (SCAC) for the interpretation of pesticide labeling, 3) maintain records of each pesticide application for two or more years, 4) to submit monthly pesticide use reports to the SCAC. 5) to report to the SCAC and CDPH-VBDS any suspected adverse issues resulting from a pesticide application, 6) to certify and routinely train pesticide applicators, and 7) to be inspected by the SCAC to ensure that our activities are in compliance with the laws and regulations related to pesticide application.

14. Public notices specified in Section VIII.B. of the permit will be posted on the District's *website, www.solanomosquito.com.*

Attachment g.

SOLANO COUNTY MOSQUITO ABATEMENT DISTRICT

INTEGRATED PEST MANAGEMENT PRACTICES

2011

Solano County Mosquito Abatement District
2950 Industrial Court
Fairfield, CA 94533-6500

Solano County Mosquito Abatement District
Integrated Pest Management Practices

INTRODUCTION

The Solano County Mosquito Abatement District ("District") is a special district responsible for mosquito abatement throughout the incorporated and unincorporated areas of Solano County, which covers 829 square miles. It was formed in 1930 (pursuant to California Health and Safety Code Sections 2200-2800) and the mosquito Abatement Act of 1915 by local citizens and government in order to protect the public from the pestiferous *Aedes* mosquitoes that were being produced in the 184 acre Suisun Marsh. The function of the District is to control all mosquitoes, which may bring disease or harassment to humans and domestic animals. This includes vector-borne diseases such as West Nile virus, St. Louis encephalitis, western equine encephalitis, malaria and canine heartworm. The District pursues this goal by a mosquito control program consisting of continual surveillance and monitoring of mosquitoes to ascertain the threat of disease transmission and annoyance levels, and the use and implementation of safe environmentally sensitive integrated pest management and control methods to maintain mosquitoes below those levels. This has been an ongoing and long-standing activity of the District, since 1930.

In order to accomplish long-range, intelligent, and environmentally sound mosquito control, the management and manipulation of mosquitoes must be accomplished using not just one but all available pest control methods. This dynamic combination of methods into one thoughtful, ecologically sensitive program is referred to as Integrated Pest Management (IPM). The District has implemented Best Management Practices (BMP)s based on the philosophy of IPM. The basic components of the programs are: (1) Surveillance of mosquito populations; (2) Determination of treatment thresholds; (3) Selection from a variety of control options including physical, cultural, biological and chemical techniques; (4) Training and certification of applicators and; (5) Public information.

The District uses as guidelines, mosquito prevention criteria that were endorsed by the California Department of Public Health (CDPH) and the San Francisco Bay Conservation and Development Commission (BCDC) in 1978 as part of the Suisun Marsh Protection Plan under AB 1717. The guidelines for mosquito prevention on duck clubs put forth by Dr. Vincent Resh based on research conducted by a number of graduate students from the University of California Berkeley are also employed by the District. These are attached at the end of the document (Appendix A).

Activities of the SCMAD are directed toward control of mosquitoes in their aquatic, larval stage. This approach allows control activities to be concentrated in localized areas using least toxic materials. Adult mosquitoes may occasionally be targeted for control, such as in the case of disease outbreaks. However, this approach requires the use of more potent pesticides applied over a greater area and is therefore avoided whenever possible. There are 19 species of mosquitoes within Solano County (Table 1.) that vary in their seasonality and the type of sources in which their

larvae develop. Mosquitoes are generally weak swimmers and cannot survive in waters with substantial flow or surface disturbance due to wind action. Therefore, larval development is largely restricted to calmer areas within a water body that are sheltered from wind and wave action. The timing and location of pesticide applications follows seasonal changes in distribution of water sources. Many times heavy populations of immature mosquitoes are found in still, shallow water containing dense emergent vegetation. Species vary in their tolerance to salinity, degree of organic pollution and temperature extremes.

Climate and Seasonality

Solano County has weather patterns characterized by both the San Francisco Bay Area (from Fairfield south) and the Sacramento Valley (from Vacaville northeast to Dixon) The cooler portion of the District (SF Bay Area) has a mild, Mediterranean climate, with the preponderance of rain deposited during winter months (November through May). The climate and seasonal patterns of rainfall in this area influence the distribution of mosquitoes and hence the timing and location of pesticide applications. The mild climate of this area allows mosquitoes to develop throughout the year. However, the mosquito species and type of source targeted varies seasonally. For example, creeks and waterways that have substantial flow during winter months are only treated in summer after the water has receded into scattered, isolated pools. Similarly, mosquitoes are generally flushed out of storm drains during winter months. These sources are typically treated only during the summer. In contrast, tidal salt marsh areas, require treatment from late spring through early fall, corresponding to periods of higher than normal tides and the life cycle of *Aedes dorsalis.*
The warmer summer temperatures of the Sacramento Valley are very suitable for the vast agricultural areas found around Dixon and Vacaville. The fastest developing species of mosquito found in Solano County occurs in association with irrigated pastures or areas that were formerly . used for this purpose.

Tremendous strides have been made in the reduction of pesticide usage over the years by educating property owners/managers in the proper methods of water management in potentially large pasture and seasonal waterfowl habitat areas. Periodic meetings with various state and federal resource agencies as well as local irrigation districts have also greatly contributed to this reduced dependency on chemical control methods.

Mosquito abatement districts (MAD's) as well as local governmental agencies that control mosquitoes and other vectors (MVCD's) are indirectly regulated by the Department of Pesticide Regulation (DPR). Supervisors and applicators are licensed by the California Department of Public Health (CDPH). Pesticide use by vector control agencies is reported to the County Agricultural Commissioner's Office (CAC) in accordance with annual Memoranda of Understanding among DPR, CDPH, and the CAC's for the Protection of Human Health from the Adverse Effects of Pesticides and with cooperative agreements entered into between CDPH and vector control agencies, pursuant to the California Health and Safety Code.

Mosquito Biology

The life cycle of mosquitoes includes four developmental stages: egg, larva, pupa and adult. The first three stages are grouped as the immature or aquatic stages.

Those mosquito species that lay their eggs on the surface of water are referred to collectively as "*standing*" water mosquitoes. Those that deposit their eggs in moist areas such as mud or previously submerged vegetation that will eventually become inundated are known as *floodwater* mosquitoes.

The eggs of *standing* water mosquitoes do not hatch immediately. At least 2-3 days is required for embryonic development to occur before hatching takes place. The eggs of *floodwater* mosquitoes must undergo a few weeks to several years of "conditioning" before hatching can occur. When embryonic development is complete, the eggs can hatch within a few minutes to a number of hours after becoming inundated. Eggs of floodwater species can survive extreme temperatures ranging from freezing to very hot dry, weather. Instances of areas being used as irrigated pasture then replanted to a row crop may still produce *Aedes* larvae from eggs deposited in previous years.

During the larval stage, development includes four instar periods with growth occurring during each successive molt. This stage is totally dependent upon water in which to grow. Larvae breathe air from above the water surface. Most hang at an angle from or lay parallel with the surface of the water while consuming small bits of organic matter. When disturbed, larvae will dive or move away. Larvae are also referred to as "wigglers" or "wrigglers" because of the wriggling motions they make in order to swim backwards. The length of time required to complete the larval stage can range from a few days to a few months depending upon the species, temperature, food availability and day length.

The pupal stage is a non-feeding transitional stage during which the mosquito changes from an aquatic form to a winged terrestrial adult form. This stage is also referred to as "tumblers" because of the rolling or tumbling movement that is made when they are disturbed. Breathing is accomplished through a pair of "trumpets" or breathing tubes which penetrate the surface of the water. Some *Aedes* pupae can survive without water for an extended time in a moist environment. This life stage usually lasts from 1-3 days.

Standing water mosquito breeding sites include artificial containers, fish ponds, swimming pools, catch basins, roadside ditches, retention/detention ponds, septic tanks, natural or constructed ponds and wetlands, and along the margins of flowing creeks or streams. Multiple generations of mosquitoes can be produced during a season.

Floodwater mosquito larval development sites include irrigated pastures, seasonally flooded duck clubs and other managed wetlands and tidal marshes. These intermittent or seasonally flooded habitats can be among the most productive sources of mosquitoes because natural predators are either totally absent or not present in sufficient numbers to provide adequate control.

Newly emerged (teneral) adults are still soft and cannot fly long distances for the first 12-14 hours. Adult mosquitoes feed on flower nectar and plant juices. In order to produce eggs, most females

require a blood meal. Some are able to develop eggs without a blood meal (autogeny). Male mosquitoes lack the piercing mouthparts needed to take a blood meal and must subsist solely on flower nectar and plant juices.

1. MOSQUITO SURVEILLANCE

Surveillance of pest populations is essential for assessing the necessity, location, timing and choice of appropriate control measures. It reduces the areal extent and duration of pesticide use, by restricting treatments to areas where mosquito populations exceed established thresholds. The 54 mosquito species known in California differ in their biology, nuisance and disease potential and susceptibility to larvicides. Information on the species, density, and stages present is used to select an appropriate control strategy from integrated pest management alternatives.

A. Larval Mosquito Surveillance

Activities of the District are directed primarily toward the control of mosquitoes in their aquatic, larval stage. This approach allows control activities to be concentrated in localized areas and the use of the least toxic materials. Surveillance of immature mosquitoes is conducted by District mosquito control technicians ("technicians") assigned to specific areas designated as zones within boundaries of Solano County. These technicians maintain a list of known mosquito developmental sites and visit them on a regular basis, generally 7-10 days depending upon the type of habitat and species involved, more frequent inspections may be required at times. When a site is surveyed, water is sampled with a 12 oz. dipper to check for the presence of mosquitoes. Samples are taken back to the laboratory to determine the abundance, species, and life-stage of mosquitoes present. This information is compared to historical records and used as a basis for treatment decisions

B. Adult Mosquito Surveillance

Although larval mosquito control is preferred, it is not possible to identify all larval sources. Therefore, adult mosquito surveillance is needed to pinpoint problem areas and locate previously unrecognized or new larval developmental sites. Adult mosquitoes are sampled using standardized trapping techniques (i.e., New Jersey-style light traps, carbon dioxide-baited traps and gravid traps). Mosquitoes collected by these techniques are counted and identified to species. The spatial and seasonal abundance of adult mosquitoes is monitored on a regular basis and compared to historical data. New Jersey-style light traps are operated through-out Solano County at established locations from mid to late March through mid-November. Collections are made on a 7 day cycle.

Carbon-dioxide baited traps are only operated for one night at a time. These traps are used for a variety of reasons such as; (1) aiding in detecting a previously un-identified mosquito source (2) assessing pre- and post-treatment populations of adult mosquitoes to determine control effectiveness and (3) for collecting *Culex tarsalis* and *Culex pipiens* for West Nile virus testing (see below).

Control technicians make field assessments of adult *Aedes* populations by using the landing rate method which involves counting the number of mosquitoes that land on a person in a given period of time.

C. Arbovirus Surveillance

Culex tarsalis and *Culex pipiens* are collected with CO2 baited traps, identified and sorted into mosquito pools (up to 50 mosquitoes per vial) then delivered to the Center for Vector-Borne disease (CVEC) Lab on the U.C. Davis Campus where they are tested for WNV, WEE and SLE.

The District has been involved in the statewide sentinel chicken testing program since 1984. It was the first mosquito control agency within the nine Bay Area counties to have a flock. This was due to the Central Valley habitat of the northern portion of the District where there were historic records of human cases of WEE. For many years it was not believed that coastal areas had temperatures that were suitable to sustain western equine encephalitis. A second flock was placed on the western side of the Suisun Marsh in the late 1980's followed by a third flock on the eastern side of the marsh. WEE was confirmed in both flocks during a number of years. The District maintains 3 sentinel chicken flocks at 3 locations within the county. Blood specimens are collected on a bi-weekly basis and sent to the CDPH for virus testing.

The District also participates in the Dead Bird Surveillance Program for West Nile virus through the CDPH in conjunction with the California Animal Health & Food Safety Lab and CVEC at U.C. Davis. CDPH notifies the District when suitable birds in the family Corvidae (e.g. American Crows, Common Ravens, Western Scrub-jays and Yellow-billed Magpies) have been found by residents within Solano County. The samples are picked up and brought back to the laboratory where they are tested in-house for West Nile virus. A summary of WNV, WEE and SLE results are found in Table 2. attached to the document.

D. Service Requests

Information on adult mosquito abundance from traps is augmented by tracking mosquito complaints from residents. Analysis of service requests allows district staff to gauge the success of control efforts and locate undetected sources of mosquito development. When such requests are received, technicians visit the area, interview residents and search for sources that may have been missed. Residents are asked to provide a sample of the insect causing the problem. Identification of these samples provides information on the species present and can be helpful in locating the source of the complaint.

2. PRE-TREATMENT DECISION-MAKING

A. Thresholds and factors to consider

Treatment thresholds are established for mosquito developmental sites where potential disease vector and/or nuisance risks are evident. Therefore, only those sources that represent imminent threats to public health or quality of life are treated. The threshold for consideration of some form of larval control among the options available is a density of 0.1 larva per 12 oz. dipper of water. Factors taken into consideration are:

- Mosquito species present
- Mosquito stage of development

- Nuisance or disease potential
- Mosquito abundance
- Flight range
- Proximity to populated areas
- Size of source
- Presence/absence of natural enemies or predators
- Presence of sensitive/endangered species

2. Adult-threshold can vary according to method of capture-various trapping devices vs. citizen complaints and the factors listed below.

- Mosquito species present
- Nuisance or disease potential
- Mosquito abundance
- Flight range
- Proximity to populated areas
- Size of area affected

B. Selection of Control Strategy

When thresholds are exceeded an appropriate control strategy is implemented. Control strategies are selected to minimize potential environmental impacts while maximizing efficacy. The method of control is based on the above threshold criteria but also:

-Habitat type
-Water conditions and quality
-Weather conditions
-Cost
-Site accessibility
-Size of site and number of other developmental sites

3. CONTROL STRATEGIES

A. Source Reduction

Source reduction includes elements such as, physical control, habitat manipulation and water management, and forms an important component of the District's IPM program.
The District currently acts in an advisory capacity only in regard to source reduction activities.

B. Physical Control

The goal of physical control is to eliminate or reduce mosquito production at a particular site through alteration of habitat. Physical control is usually the most effective mosquito control technique because it provides a long-term solution by reducing or eliminating mosquito developmental sites and ultimately reduces the need for chemical applications.

Historically (circa 1903), the first physical control efforts were projects undertaken to reduce the populations of salt marsh mosquitoes in marshes near San Rafael. Two years later, similar work was undertaken in the marshes near San Mateo. Networks of ditches were created by hand to enhance drainage and promote tidal circulation. Since then, various types of machinery have been used to create ditches necessary to promote water circulation. In recent years, a number of environmental modification projects have been undertaken in collaboration with the U.S. Fish and Wildlife Service (USFWS) to reduce potential mosquito developmental sites and enhance wildlife habitat. Re-circulation ditches allow tidewater to enter the marsh at high tide and drain off at low tide. Water remaining in the ditch bottoms at low tide provides habitat for mosquito-eating fish. These projects have reduced the need to apply chemicals on thousands of acres of salt marsh in the San Francisco Bay. Similar projects have been undertaken with other agencies.
Physical control may be categorized into three areas: "maintenance", "new construction", and "cultural practices" such as vegetation management and water management. The District currently acts only in an advisory capacity in regard to physical control projects.

Maintenance activities are conducted within tidal, managed tidal and non-tidal marshes, seasonal wetlands, diked, historic bay lands and in some creeks adjacent to these wetlands. The following activities are classified as maintenance:

* Removal of sediments from existing water circulation ditches
* Repair of existing water control structures
* Removal of debris, weeds and emergent vegetation in natural channels
* Clearance of brush for access to streams tributary to wetland areas
* Filling of existing, non-functional water circulation ditches to achieve required water circulation dynamics and restore ditched wetlands.

The preceding activities are included within the permits required by U.S. Army Corps of Engineers (USACE) and San Francisco Regional Water Quality Control Board (SFRQWB) (Waste Discharge) and coordinated by the California DPH. Additional agencies involved include the Coastal Conservancy and San Francisco Bay Conservation and Development Commission.

New projects, such as wetland restoration, excavation of new ditches, construction of new water control structures, all require application by individual districts directly to the USACE. *Currently, the District does not initiate new physical control projects. Instead, when feasible it offers advice to landowners pertaining to management practices that do not promote mosquito development.* District staff reviews proposals for wetlands construction to assess their impact on mosquito production. *The District then submits guidelines on hydrological design and maintenance that will reduce the production of mosquitoes.* This proactive approach involves a collaborative effort between landowners and the District. Implementation of these standards may include cultural practices such as water management and aquatic vegetation control.

C. Biological control

Biological control agents of mosquito larvae include predatory fish, predatory aquatic invertebrates and mosquito pathogens. Of these, only mosquitofish are available in sufficient quantity for use in mosquito control programs. Natural predators may sometimes be present in numbers sufficient to

reduce larval mosquito populations. Biological control is sometimes used in conjunction with selective bacterial or chemical insecticides.

Mosquitofish (*Gambusia affinis*)

The mosquitofish, *Gambusia affinis*, is a natural predator of mosquito larvae used throughout the world as a biological control agent for mosquitoes. Although not native to California, mosquitofish are now ubiquitous throughout most of the State's waterways and tributaries, where they have become an integral part of aquatic food chains. They can be stocked in mosquito larval sources by trained district technicians or distributed to the public for stocking in backyard ornamental ponds and other artificial containers.

Advantages of using mosquitofish compared with other control methods:
The use of mosquito fish as a component of an IPM program may be environmentally and and economically preferable to habitat modification or the exclusive use of pesticides, particularly in altered or artificial aquatic habitats. Mosquitofish are self-propagating, have a high reproductive potential (200-300 young per season per female possible under favorable conditions) and thrive in shallow, vegetated waters preferred by many mosquito species. They prefer to feed at the surface where mosquito larvae concentrate. Their small size (usually less than 5 cm.) allows for entry into sites of pool-inhabiting mosquito larvae. These fish can be readily mass-reared for stocking or collected seasonally from sources with established populations for redistribution. This species is hardy. A wide range of temperatures and salinity can be tolerated, as well as moderate sewage pollution.

Barriers to Use: Water quality conditions, including temperature, dissolved oxygen, pH and pollutants may reduce or prevent survival and/or reproduction of mosquitofish in certain habitats. Mosquitofish may be preyed upon by other predators. They are opportunistic feeders and may prefer alternative prey when available. Introduction of mosquitofish may modify food chains in small contained pools and have potential impacts on endemic fish and shrimp in such situations. Some wildlife agencies suspect mosquitofish may impact survival of amphibian larvae through predation. Recent research has shown no significant impact on survival of the threatened California red-legged frog (Lawler et al. 1998), but mosquitofish have been shown to negatively impact the survival of the California tiger salamander (Leyse and Lawler 2000).

Solutions to Barriers: Strict stocking guidelines adopted by the District regarding distribution to the public restricts the use of mosquitofish to habitats such as artificial containers, ornamental ponds, abandoned swimming pools, cattle troughs, and stock ponds where water quality is suitable for survival and sensitive or endangered aquatic organisms are not present. Fish are generally stocked at population densities lower than those required for effective mosquito control and allowed to reproduce naturally commensurate with the availability of mosquito larvae and other prey. Guidelines prevent seasonal stocking in natural habitats during times of year when amphibian larvae or other sensitive species/life stages may be present.

Natural predators: aquatic invertebrates

Many aquatic invertebrates, including diving beetles, dragonfly and damselfly naiads, backswimmers, water bugs and hydra are natural predators of mosquito larvae.

Advantages: In situations where natural predators are sufficiently abundant, additional mosquito control measures including application of pesticides may be deemed unnecessary.

Barriers to Use: Predatory aquatic invertebrates are frequently not sufficiently abundant to achieve effective larval control, particularly in disturbed habitats. Most are generalist feeders and may prefer alternative prey to mosquito larvae if available and more accessible. Seasonal abundance and developmental rates often lag behind mosquito populations. Introduction or augmentation of natural predators has been suggested as a means of biological control, however there are currently no commercial sources since suitable mass-rearing techniques are not available.

Solutions to Barriers: The presence and abundance of natural predators is noted and taken into account during the larval surveillance process. Conservation of natural predators, whenever possible, is achieved through use of highly target-specific pesticides including bacterial insecticides, with minimal impacts on non-target taxa.

D. Description of Larvicides and Larviciding Activities:

As previously mentioned, the activities of the District are directed primarily toward the control of mosquitoes in their aquatic, larval stage. This approach allows control activities to be concentrated in localized areas and the use of the least toxic materials.

Larvicides used by the District to control the aquatic stages of mosquitoes fall into the 3 categories: bacterial larvicides (also called bio-rational), methoprene (growth regulator), and surfactants (surface films). Larvicides are applied by aircraft, ATV mounted, and hand-held applicators. Aerial application services are contracted to either fixed-wing or rotary aircraft, depending upon availability.

1. Bacterial insecticides (Bio-rationals)

Bacterial insecticides consist of the spores of certain species of bacteria containing naturally produced bacterial proteins which are toxic to mosquito larvae when ingested in sufficient quantity. Although they are biologically-derived agents, products containing them are labeled and registered by the Environmental Protection Agency (EPA) as pesticides and are considered by some to be a form of Chemical Control.

Bacillus thuringiensis var. *israelensis* (*Bti*)

Product names: Aquabac granules, Teknar HP-D, Vectobac 12AS, Vectobac G,
Vectobac Technical Powder

Advantages: *Bti* is highly target-specific and has been found to have significant effects only on mosquito larvae, and closely related insects (e.g., blackflies and some midges). It is available in a variety of liquid, and granular formulations which provide some flexibility in application methods and equipment. *Bti* has no measurable toxicity to vertebrates and is classified by EPA as "Practically Non-Toxic" (Caution). *Bti* formulations contain a combination of five different proteins with a larger crystal. These proteins have varying modes of action and synergistically act to reduce the likelihood of resistance developing in larval mosquito populations.

Barriers to Use: Bacterial insecticides must be fed upon by larvae in sufficient quantity to be effective. Therefore applications must be carefully timed to coincide with periods in the life cycle when larvae are actively feeding. Pupae and late 4^{th} stage larvae do not feed and therefore will not be controlled by *Bti*. Low water temperature inhibits larval feeding behavior, reducing the effectiveness of *Bti* during the cooler months. The presence of high concentrations of organic material in treated water also reduces the effectiveness of *Bti.*

Solutions to Barriers: Increasing the frequency of surveillance for larvae can ensure that bacterial insecticides are applied during the appropriate stages of development to prevent adult mosquito emergence.

Bacillus sphaericus (*Bs*)

Product names: Vectolex CG, Vectolex WSP, Vectolex WDG

Advantages: *Bs* is another bacterial pesticide with attributes similar to those of *Bti*. The efficacy of this bacterium is not affected by the degree of organic pollution in larval development sites and it may actually cycle in habitats containing high densities of mosquitoes, reducing the need for repeated applications.

Barriers to Use: Like *Bti, Bs* must be consumed by mosquito larvae and is therefore not effective against nonfeeding stages such as late 4th instar larvae or pupae. *Bs* is also ineffective against certain mosquito species such as those developing in saltmarshes, seasonal forest pools or treeholes. Toxicity of *Bs* to mosquitoes is due to a single toxin rather than a complex of several molecules as is the case with *Bti*. Development of resistance has been reported in Brazil, Thailand and France in sites where *Bs* was the sole material applied to control mosquitoes for extended periods of time.

Solutions to Barriers: Information obtained from larval surveillance on the stage and species of mosquitoes present can increase the effectiveness of this material, restricting it use to sources containing susceptible mosquitoes. Development of resistance can be delayed by rotating *Bs* with other mosquitocidal agents.

2. Insect Growth Regulars-Methoprene

Product Names: Altosid Briquets, Altosid Liquid Larvicide, Altosid Pellets, Altosid SBG, Altosid XR Briquets, Altosid XRG

Advantages:

Methoprene is a larvicide that mimics the natural growth regulator used by insects. Methoprene can be applied as liquid or solid formulation or combined with *Bti* or *Bs* to form a "duplex" application. Methoprene is a desirable IPM control strategy since affected larvae remain available as prey items for predators and the rest of the food chain. This material breaks down quickly in sunlight and when applied as a liquid formulation it is effective for only 3 to 5 days. Methoprene has been impregnated into inert, charcoal-based carriers such as pellets and briquettes to meter out a consistent amount that ranges up to 150 days. The availability of different formulations provides options for treatment under a wide range of environmental conditions. Studies on nontarget organisms have found methoprene to be nontoxic to vertebrates and most invertebrates when exposed at concentrations used by mosquito control.

Barriers to Use: Methoprene products must be applied to larval stage mosquitoes since it is not effective against the other life stages. Monitoring for effectiveness is difficult since mortality is delayed. Methoprene use is avoided in vernal pools. There may be toxicity to certain nontarget crustacean and insect species.

Solutions to Barriers: Surveillance and monitoring can provide information on mosquito larval stage present, timing for applications and efficacy of the treatments.

3. Surfactants

Product Names: BVA 2 , Golden Bear 1111, Agnique MMF, Agnique MMF G

Surfactants are "surface-acting agents" that are either petroleum or isostearyl alcohol-based materials that form a thin layer on the water surface. These materials typically kill surface-breathing insects by mechanically blocking the respiratory mechanism.

Advantages: These materials are the only materials efficacious for reducing mosquito pupae since other larviciding strategies (i.e., methoprene, *Bti* and *Bs*) are ineffective to that life stage. Agnique forms an invisible monomolecular film that is visually undetectable. Treatments are simplified due to the spreading action of the surfactant across the water surface and into inaccessible areas. These surfactants are considered "practically nontoxic" by the EPA. Agnique is labeled "safe for use" in drinking water.

Barriers to Use: The drawback of using these agents in habitats where natural enemies are established is that surface-breathing insects, particularly mosquito predators, are similarly affected. GB1111 forms a visible film on the water surface. Aqnique does not work well under unidirectional wind conditions that exceed 10 mph.

Solutions to Barriers: As a general rule, surfactant use is considered after alternate control strategies have been ruled out or in habitats that are not supporting a rich macro-invertebrate community (i.e., manmade sites).

E. Description of Adulticides and Adulticiding Activities:

The application of adulticides is done as a last resort and depends upon a number of factors including:

- Marked increase in mosquito abundance
- Mosquito species present
- Flight range
- Nuisance or disease potential
- Service request-sample of adults obtained
- Proximity to populated areas or agricultural areas raising domestic animals
- Size of area affected
- Evidence of mosquito-borne disease in region
- Climate data

Insecticides that are used to kill adult mosquitoes can be applied by aircraft, vehicle-mounted sprayers and hand held units. The most common form of adulticiding is the application of insecticide aerosols at very low dosages and using little or no diluents. This method is commonly called the ultra-low-volume (ULV) method. Ground adulticiding is almost exclusively conducted with specially designed ULV equipment. The District does not apply adulticides aerially at this time. In the event that this should become necessary (i.e. widespread disease outbreak) the services of a well-known specialized aerial applicator would be contracted.

The efficiency of adulticiding is dependent upon a number of integrated factors. First, the mosquito species to be treated must be susceptible to the insecticide applied. Some species of mosquitoes in Solano County and surrounding areas are resistant to certain classes of pesticides used as adulticides, thus affecting the selection of chemical. Second, the insecticide applications must be made during periods of adult mosquito activity. This factor is variable with species. Some species of mosquitoes are diurnal (daytime biting) while others are crepuscular. Adulticiding should be timed when the mosquitoes are flying and/or exposed to the aerosol mist.

The chemical application has its own set of conditions that determine success or failure. The application must be at a dosage rate that is lethal to the target insect and applied with the correct droplet size. It has been shown that droplets within the 10-25 micron range are most effective in controlling adult mosquitoes.

Whether the treatment is ground or aerially applied, sufficient insecticide must be distributed to cover the prescribed area with an effective dose. Ground applications with densely vegetated habitats may require a higher dosage rate than that of open areas. This is purely a function of wind movement and its ability to sufficiently carry droplets to penetrate foliage. Environmental conditions may also affect the results of adulticiding. Wind determines how the ULV droplets will be moved from the output into the treatment area. Conditions of no wind will result in the material

not moving from the application point. High wind, a condition that inhibits mosquito activity will quickly disperse the insecticide too widely to be effective. Light wind conditions (<10 mph) are the most desirable, moving the material through the treatment area and less inhibiting to mosquito activity. ULV applications are generally avoided during hot daylight hours. Thermal conditions will cause small droplets to rise, moving them away from mosquito habitats and flight zones. Generally, applications are made between sunset and sunrise, depending on mosquito flight activity. This practice minimizes exposure of non-target species such as bees or butterflies. Some mosquitoes (*Aedes* species) are most active during the daytime. Applications for these species should be made during the period of highest activity provided that meteorological conditions are suitable for application and care is made to avoid non-target impacts.

The District conducts area wide ULV treatments in rural areas to control nuisance mosquitoes and disease vectors. Localized treatments using hand-held equipment are done upon request and signature of a Hold Harmless Agreement in residential areas.

The most widely used adulticides by the District are classified as natural pyrethrins. Pyrethrum is a natural insecticide derived from a certain type of chrysanthemum flower that is a neurotoxin. Upon contact during application, adult mosquitoes are rapidly paralyzed and killed. Rapid degradation occurs when the material is exposed to sunlight. These products can be used in agricultural areas.

Product Names: Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7396,
Pyrenone 25-5 Public Health Insecticide

Secondarily adulticides classified as pyrethroids are used. These are manufactured pyrethrins. Although more stable in sunlight, they may not be labeled for use in agricultural areas.

Product Names: Biomist 4%/12% ULV
Kontrol 4%/ 4% ULV

The signal word found on the labels of all adulticides used by the District is "Caution'.

F. Cultural Practices

Wetland design criteria were developed and endorsed by CDPH and the San Francisco Bay Conservation and Development Commission in 1978 as part of the Suisun Marsh Protection Plan under California State Assembly Bill 1717. These criteria have been sent to various governmental agencies and private parties involved in the planning process for projects having the potential of creating mosquito breeding problems. Guidelines for the following source types are included in the above marsh protection plan and may be considered cultural control techniques:

* Drainageway construction and maintenance practices
* Dredge material disposal sites
* Irrigated pastures
* Permanent ponds used as waterfowl habitat
* Permanent Water impoundments
* Salt marsh restoration of exterior levee lands

* Sedimentation ponds and retention basins
* Tidal marshes
* Utility construction practices

The District also provides literature for homeowners and contractors on elimination of mosquito developmental sites from residential property. These sources include rain gutters, artificial containers, ornamental ponds, abandoned swimming pools, tree holes, septic tanks, and other impounded waters.

Water Management consists of techniques to control the timing, quantity and flow rate of water circulation in managed wetlands to minimize mosquito development. The District has established guidelines for water management based on information from University of California Agricultural Extension Service (UCAES). It provides these guidelines to property owners to promote proper irrigation techniques for pastures, duck clubs and other wetlands to reduce mosquito development.

G. Vegetation Management

Vegetation management, one aspect of physical mosquito control, is an effective long-term control strategy. It consists of the removal of vegetation within mosquito developmental sites to promote water circulation, increase access of natural predators such as fish or provide District staff access for surveillance and treatment operations. Currently all forms of vegetation management are achieved through recommendations to the landowner.

This methodology utilizes water management, burning, physical removal, and chemical means to manage vegetation within mosquito developmental sites. The presence of vegetation provides harborage for immature and adult mosquitoes by protecting them from potential predators as well as the effects of wind and wave action, which readily cause mortality. Vegetation reduction not only enhances the effects of predators and abiotic factors, but also reduces the need for chemical control. Several factors can limit the utilization of vegetation management. These include: sensitivity of the habitat, presence of special status species, size of the site, density and type of vegetation, species of mosquito and weather.

4. TRAINING AND CERTIFICATION

All District applicators must be certified to apply public health pesticides. The CDPH Vector-Borne Disease Section administers certification training and testing. All mosquito control personnel applying pesticides or overseeing the application of pesticides must obtain and maintain a Mosquito Control Technician Certificate. The Mosquito and Vector Control Association of California (MVCAC) provides training materials and exams are conducted by the CDPH. All certificate holders must maintain continuing education credit in at least two and as many as four subcategories. Category A (Laws and Regulations) and category B (Mosquito Biology) is mandatory for all certificate holders and requires 12 and 8 continuing education units (CEU) respectively, in a two year period. Category C (Terrestrial Invertebrate Control) and Category D (Vertebrate Control) are optional both with 8 hours of CEU per two-year cycle. All SCMAD mosquito control technicians are also fully certified in Categories C and D.

Training opportunities to accumulate CEU credits are made available by the MVCAC regional committees that develop training programs fine-tuned to the local ecology and unique problems of the region. Training programs are submitted to the MVCAC state training coordinator for approval and then to the California Department of Public Health for final approval. Thirty-six hours of CEU credits are offered each two-year cycle. District conducts a number of in-house educational and safety programs to increase the expertise of the operational staff.

5. OVERSIGHT

Members of the MVCAC operate under the California Health and Safety Code and the California Government Code. In addition, members of the MVCAC that are signatories to the California Department of Public Health Cooperative Agreement (Pursuant to the Health and Safety Code) are required to comply with the following:

1. Calibrate all application equipment using acceptable techniques before using and maintain calibration records for review by the County Agricultural Commissioner (CAC).

2. Maintain for at least two years pesticide use data for review by the CAC, including a record of each pesticide application, showing the target vector, the specific location treated, the size of the source, the formulations and amount of pesticides used, the method and equipment used, the type of habitat treated, the date of the application, and the name of the applicator.

3. Submit to the CAC each month a Pesticide Use Report on Department of Pesticide Regulation form PR-ENF-060. The report shall include the manufacturer and product name, the EPA registration number from the label, the amount of pesticide used, the number of applications of each pesticide, and the total number of applications, per county, per month.

4. Report to the CAC and the CDPH, in a manner specified any conspicuous or suspected adverse effects upon humans, domestic animals and other non-target organisms, or property from pesticide applications.

5. Require appropriate certification of its employees by CDPH in order to verify their competence in using pesticides to control pest and vector organisms, and to maintain continuing education unit information for those employees participating in continuing education.

6. Be inspected by the CAC on a regular basis to ensure that local activities are in compliance with state laws and regulations relating to pesticide use.

Other agencies such as local fire departments, Solano County Resource Management, California Department of Fish and Game, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, and others have jurisdiction and oversight over our activities. We work closely with these agencies to comply with their requirements.

Public Information

An integral part of the District's IPM Plan is to provide information to the public to assist them in resolving their mosquito problems. Information is provided on biological, physical and cultural control methods (i.e., BMPs) that property owners and managers can use to preclude or reduce mosquitoes within their jurisdictions. Mosquito prevention guidelines can be found at the District's ***website: http://www.solanomosquito.com***

Table 1.

Description of Common Mosquito Species Controlled by Solano County Mosquito Abatement District

***Aedes dorsalis* (Salt marsh mosquito)**
This species is found year-round in tidal salt marsh areas. The eggs are laid in the marsh and hatch when the marsh is filled by high tides. Adults are very aggressive, fly moderate distances, and are noticeable near the marshes. This species is capable of producing very high numbers near marsh areas.

Aedes melanimon (Wetlands mosquito)
This species is found in irrigated pastures, alfalfa fields, duck clubs and the seasonal waterfowl habitat associated with reclaimed marsh areas. Eggs are laid on damp soil or at the base of grasses that will be inundated at a later date. Multiple generations are possible during the season (March-Nov.) in agricultural sources. Fewer Eggs can withstand considerable drying and remain viable for a number of years. They do not all hatch with the next flooding or irrigation. The completion of the life cycle from egg to adult can vary from 4 to 10 days depending upon environmental conditions. Female *Aedes melanimon* are vicious biters, attacking human beings and other mammals such as horses, cattle, dogs, and rabbits during the day, evening and especially at dusk if disturbed. They are strong fliers, capable of flights 10 or more miles from a source when assisted by prevailing winds.

***Aedes nigromaculis* (Irrigated-pasture mosquito)**
This species is found primarily in irrigated pastures but can also be found in alfalfa, row crops and rice fields. Eggs are laid on grass stems at or near the ground in moist places. The eggs remain unhatched until flooded by the following irrigation. If water does not flood the eggs, many may remain dormant and viable for a number of years. This species is able to produce a brood following each flooding. Multiple broods can be produced from spring through early fall. Females are vicious biters, attacking human beings and other mammals such as horses, cattle, dogs and rabbits during the day. They are most persistent near twilight. Females are capable of migrating many miles from larval sources seeking a blood meal. Flights between 20-30 miles have been documented. Very high numbers of mosquitoes can be produced in single pasture, resulting in a potential loss of productivity in milk production in cows and weight loss in beef cattle, sheep and poultry.

***Aedes squamiger* (Winter salt marsh mosquito)**
This species is produced in the marshes and impounds along the edges of the Bay. The eggs are laid on the marsh in the spring and hatch as soon as the marsh fills with rainwater in the fall. Adults emerge the following spring. Most of the control effort occurs during the winter. Adults can fly long distances. The adult is a very aggressive biter and is very noticeable to the public. This species is capable of reaching very high numbers.

***Aedes washinoi* (Woodland pool mosquito)**
This mosquito is produced in woodland depressions that fill with water. Eggs are laid on the mud and organic material along the edges of receding water in these areas. Adults, generally present in the early spring, are very aggressive, and may be found in large numbers

***Aedes sierrensis* (Tree hole mosquito)**
This species breeds in tree holes (rot cavities or depressions in tress which hold water). If near trees and partially filled with organic debris, containers such as tires and buckets may produce these mosquitoes. The eggs hatch when the tree hole or container fills with water. The adults hatch in March and remain in the area until early summer. This mosquito has a short flight range, is an aggressive biter, and is the primary vector of Canine Heartworm in California. It is found in any area where suitable tree holes are found.

Table 1.

***Culex pipiens* (House mosquito)**
This mosquito is generally an urban problem. It thrives in small sources and containers with a high concentration of organic material. Storm drains, catch basins, utility vaults, septic tanks, flooded basements, and sumps provide ideal development sites. This species is also commonly found in discarded containers in residential yards that fill with rainwater. Adults can be found all year but are most common during warmer months (spring through fall). These mosquitoes readily enter homes, usually biting at night. This species has been found to carry West Nile virus.

***Culex tarsalis* (Encephalitis mosquito)**
This mosquito is produced in rain pools, marshes, swimming pools, ponds, and other relatively clean fresh-water sources. This species feeds primarily on birds and is only moderately aggressive towards man. However, they are potential vectors of mosquito-borne encephalitis viruses and are therefore of special concern to MVCDs.

***Culex stigmatosoma* (Foul water mosquito)**
This mosquito is referred to as a "foul water" mosquito because it is associated with polluted water. Common sources are sewage, industrial wastes, street drainage, swimming pools, ornamental ponds, containers with fouled water. This species feeds primarily on birds, but occasionally feeds on livestock and rarely on humans. Females are capable of traveling 1-2 miles to seek a host, but are most commonly found near their aquatic habitat.

***Culiseta inornata* (Winter marsh mosquito)**
Females of this species rest during the summer and become active in the fall after the first rains. Eggs are laid on the surface of rain-filled ponds in the fall. Many generations can be produced in a single season. This mosquito bites at dusk in the fall and spring. They are moderately aggressive, quite large, and may reach very high numbers. It is very noticeable to the public because of its size and activity. Adults this species are generally found close to temporary fresh- water sources. Seasonal waterfowl areas(that range from fresh to brackish) produce high numbers of this species during the fall and winter months.

***Culiseta incidens* (Fish pond mosquito)**
Immatures of this species develop in fishponds, creeks, and containers. Adults are moderately aggressive, biting in the evening or shaded areas during the day. Their large size makes this species very noticeable to urban residents. It is primarily a problem of urban and suburban areas.

Table 2.

SOLANO COUNTY MAD----SUMMARY OF ARBO-VIRUS TESTING 1945-2010

SUMMARY OF WEE/SLE 1945-2010

1945-1984 Solano Co. had 7 confirmed human cases of WEE and 3 confirmed human cases of SLE-no human cases 1985 to date

1986/1987 3 sero-conversions for WEE
1993- 17 sero-conversions for WEE—Cordelia (8)/Grizzly Island (9)
1994- 4 sero-conversions for WEE---Cordelia (2)/Grizzly Island (1)
1996- 6 sero-conversions for WEE---Cordelia (6)
1997- 7 sero-conversions for WEE—Cordelia (7)—occurred 3 weeks before Sac/Yolo had sero-conversions. This is the last time we had any evidence of WEE detected.

SUMMARY OF WEST NILE VIRUS RESULTS 2004

Human Cases-0
Horse Cases -(1)-Davis
Chicken Seroconversions-0
Positive Birds-16 Total
Vallejo- (2) Benicia – (1) Vacaville- (9) Dixon- (4) Davis- (1)

SUMMARY OF WEST NILE VIRUS RESULTS 2005

Human Cases-6 confirmed Dixon/Vacaville area
Horse Cases-16 -American Canyon (1) Fairfield area (4) Vacaville area (4) Dixon (1) Winters (3) Davis (3)
Chicken Seroconversions—23- Collinsville Flock 1/12 Vacaville Flock 11/12 Cordelia Flock 11/12
Positive Birds-44
Vallejo - 1 Fairfield -16 Elmira - 1
Benicia - 2 Suisun - 5 Vacaville- 18 Rio Vista- 1
Positive Mosquito Pools- 4 --Davis

SUMMARY OF WEST NILE VIRUS RESULTS 2006

Human Cases-8 cases confirmed according to DHS from Vacaville and Dixon areas.
Horse Cases-0
Chicken Seroconversions---- 22-Collinsville Flock 1 /12 Vacaville Flock 9/12 Cordelia Flock 12 / 12
Positive Birds-17 Vallejo - 2 Fairfield -1 Vacaville - 8 Dixon - 6
Positive Mosquito Pools- 1 - *Davis.*

SUMMARY OF WEST NILE VIRUS RESULTS 2007

Human Cases-0
Horse Cases -0
Chicken Seroconversions---- 7 Collinsville Flock 0 /12 Vacaville Flock 2/12 Cordelia Flock 5/12
Positive Birds-3- Fairfield
Positive Mosquito Pools-0

SUMMARY OF WEST NILE VIRUS RESULTS 2008

Human Cases-1-Vacaville area
Horse Cases- 0
Chicken Seroconversions—7 Collinsville Flock 2/12 Vacaville Flock 2/12 Cordelia Flock 3 / 12
Positive Birds- 7 Suisun -(1) Vacaville - (6)
Positive Mosquito Pools-1-Vacaville

SUMMARY OF WEST NILE VIRUS RESULTS 2009

Human Cases-0
Horse Cases- 1-Dixon
Chicken Seroconversions—12 Collinsville Flock 0/12 Winters Flock 10/12 Cordelia Flock 2 / 12
Positive Birds- 3 Benicia -(1) Dixon -(2)
Positive Mosquito Pools-2-*Dixon*

SUMMARY OF WEST NILE VIRUS RESULTS 2010

Human Cases-0
Horse Cases- 1-Dixon
Chicken Seroconversions-(2) –Cordelia Flock
Positive Birds- 1-Western Scrub-jay-Vacaville
Positive Mosquito Pools-1-Fairfield

APPENDIX A

MOSQUITO PREVENTION CRITERIA

MOSQUITO PREVENTION CRITERIA

Mosquito prevention criteria.- The District provides as guidelines, mosquito prevention criteria that were endorsed by the California Department of Health Services and the San Francisco Bay Conservation and Development Commission in 1978 as part of the Suisun Marsh Protection Plan under California State Assembly Bill 1717.

CRITERIA FOR MOSQUITO PREVENTION IN DRAINAGEWAY CONSTRUCTION AND MAINTENANCE PRACTICES

Background Statement

Mosquitoes breed in creeks and ditches where ponding occurs due to obstructions, overflow of banks, excessive siltation and back-eddys created from low water flow during the dry months. Consequently, modification of drainageways (digging, and filling, etc.) is often necessary to allow free flow of water. Construction of new ditches must be undertaken to maintain adequate circulation of water.

Although obstructions and ponding in creeks and ditches most often occur naturally, alterations to water flow also arise from new construction, refuse deposits and agricultural activities. The correction and costs of such alterations become the responsibility of the person(s) or agency(s) involved when mosquito production results, and abatement expenditures incurred by SCMAD may be billed to the responsible party, pursuant to the procedures set forth in the California Heath and Safety Code, Sections 2060 et. seq.

One type of drainageway used to adequately drain low lands in the marsh is called a spreader ditch. This is a small ditch (18 X 18 inches) which drains into a main ditch or tidal water slough. Main ditches direct flow to a water control structure and thence into a tidal water slough.

Policies For Management of Drainageway Construction and Maintenance

1. Water control structures (flap gates, slide gate, weir box, etc.) should be in working condition to facilitate the flooding and complete draining of managed wetlands.

2. Clear and retrench spreader ditches approximately every three years.

3. Excavate or dredge existing main ditches when necessary.

4. Repair levees and remove debris and vegetation, which are obstructing natural stream channels if suchmaterials create a situation which may endanger public health and safety.

5. Fill isolated potholes (depressions found in marsh areas) which may create mosquito problems and cannot feasibly be connected to circulating water.

6. Connect pools (depressions found in streambeds) to the main flow of water by minor hand ditching when it appears that they are problem mosquito breeding sites.

7. Maintain all access roads and levees in good repair to allow continuous mosquito surveillance, and provide access for control equipment.

8. Install and maintain water control structures whenever possible to expedite flood water removal.

The preceding mosquito prevention criteria are intended only to offer guidance when considering the development of design options during the planning process for projects. Be advised that these practices have been found to be effective, however, once the project has been completed it is essential that conscientious maintenance and management practices be followed to help ensure the successful prevention of mosquito production.

Be further advised that under the California Health and Safety Code (Sections 2060 et. seq.) the responsibility for the cost of mosquito control may fall on the property owner.

CRITERIA FOR MOSQUITO PREVENTION IN DREDGE MATERIAL DISPOSAL SITES

Background Statement

In many instances, land disposal of dredge material creates mosquito-breeding sources. Due to the initial high water content and characteristics of the dredged material, shrinkage cracks occur in the drying process. These shrinkage cracks provide ideal habitat for the production of mosquitoes. Experience by mosquito abatement agencies has shown the use of chemicals to kill mosquito larvae in the cracks is very inefficient and generally not practical. Solutions lie in the water management and periodic manipulation of the surface of the deposited material. Disking the spoil material fills and closes the cracks. Drainage of storm water and keeping the elevation of the ground water below the shrinkage cracks also prevents mosquito problems.

Disposal Site Management

1. Provide ditches and/or water control structures for drainage of surface water. An engineering survey may be necessary.

2. Disking of the areas may be required to close shrinkage cracks.

3. Provide access roads that are capable of supporting maintenance, inspection and mosquito control equipment.

4. Areas designated for permanent water should be constructed and managed for mosquito prevention as necessary for the specific site. Generally, dense aquatic vegetation, algal mats and shallow water bring on mosquito problems.

5. Areas designated for wetland development (saltwater marshes) need ditches to romote and enhance tidal water circulation and/or water control structures (tide gates) to provide water management capabilities. The outboard levee system should be retained until sufficient drying has occurred and all necessary grading and ditching has been finished.

6. Retention of outboard levees and tide gates may be necessary or desirable for water management to prevent excessive production of mosquitoes.

7. Plan and fund a maintenance program for the area to provide for:

    a. Maintenance of ditches and water control structures
    b. Disking as necessary
    c. Maintenance of levees and access roads
    d. Occasional mosquito control with pesticides and/ora biological agent such as mosquito fish

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CRITERIA FOR MOSQUITO PREVENTION IN IRRIGATED PASTURES

General Information

Those irrigation practices which are advantageous to mosquito control are also beneficial to the production of crops. At least 3 days in water are required for mosquitoes to reach the adult stage. With the exception of rice, water which is left standing for more than 24 hours after irrigation is of no benefit to the field in which it remains and usually becomes detrimental to the crop. In most cases, less than 1/2 inch of standing water in a field is removed by means of evaporation, this does not remove the water rapidly enough to promote mosquito control. The extent to which water infiltrates soil varies according to its texture and condition. Soils that are either fine textured, compacted, or excessively tilled, particularly when they are wet, may become almost impervious to water infiltration after a few hours. In this type of situation, the field must be graded with a slope to promote surface drainage for the excess water. Livestock should be kept out of wet fields to reduce compaction.

The proper grading of a field will help promote mosquito control as well as higher crop yield at reduced cost for both water and irrigation labor.

Design Criteria For Irrigated Pastures

All fields subject to irrigation should be leveled according to a designed grade with a minimum of soil movement (cutting and filling) and with a minimum down slope fall of 0.2 percent.

After leveling, the "strip check" or border method of irrigation should be established and utilized on the fields planted to pasture and field crops. The widths of borders should be no greater than 50 feet. Border levees should be constructed in such a way that no borrow pits will be left on their sides to collect and hold water.

The length of runs should be no greater than 1,320 feet. When establishing new head ditches, proper turnouts should be installed along with an outlet for draining the ditch. Tailwater drains should be constructed at the ends of all irrigated fields.

In all instances, water should be applied in quantities and at frequencies that will meet the needs of the crops grown on the particular soil types and that will provide for proper water penetration without erosion. To reduce mosquito production, water should not be allowed to stand in ditches or in fields longer than three (3) days.

The preceding mosquito prevention criteria are intended only to offer guidance when considering the development of design options during the planning process for projects. Be advised that these practices have been found to be effective, however, once the project has been completed it is essential that conscientious maintenance and management practices be followed to help ensure the successful prevention of mosquito production.

Be further advised that under the California Health and Safety Code (Sections 2060 et. seq.) the responsibility for the cost of mosquito control may fall on the property owner

CRITERIA FOR MOSQUITO PREVENTION IN PERMANENT PONDS USED AS WATERFOWL HABITAT

Background Statement

The diversity of waterfowl habitat in the Suisun Marsh is increased by the occurrence of permanent ponds. Permanent ponds, however, should remain a minor part of the marsh habitat because (1) they require specific conditions to provide optimum habitat and (2) other more intensive types of management can generally be carried out that provide for higher yields of waterfowl food.

Seeding of permanent ponds is not necessary since plants such as sago pondweed and widgeongrass should become established in the ponds naturally.

Policies For Management of Permanent Ponds

Establishment:

1. Permanent ponds are recommended only in areas where at least 70% of the total permanent water area will be maintained year round at a minimum depth of 3.5 to 4 feet. This depth limits the occurrence of cattails and tules and stimulates the production of desirable pondweeds.

2. Levees surrounding permanent ponds must have a shelf on which cattails and tules can become established to serve as a buffer against wave action.

3. Permanent ponds should be established only in areas where the gates and ditches can provide maximum circulation of water without fluctuation in water level.

Maintenance:

1. Set gates to allow maximum circulation without change in water level. Maintain circulation year round, but especially during the warmer months (April-Sept.). Poor circulation during these months could increase salinity, mosquito reproduction, and the probability of botulism.

2. Once every five years, completely drain the pond in February and keep it dry through September. This will control carp populations, allow oxidation of the sediment in pond bottoms resulting in the release of nutrients, and allow for mowing or burning of undesirable vegetation. At this time, an inspection of gates and levees will be undertaken and needed repairs will be made.

The preceding mosquito prevention criteria are intended only to offer guidance when considering the development of design options during the planning process for projects. Be advised that these practices have been found to be effective, however, once the project has been completed it is essential that conscientious maintenance and management practices be followed to help ensure the successful prevention of mosquito production.

Be further advised that under the California Health and Safety Code (Sections 2060 et. seq.) the responsibility for the cost of mosquito control may fall on the property owner.

CRITERIA FOR MOSQUITO PREVENTION IN PERMANENT WATER IMPOUNDMENTS

1. Ponds may be any shape but should not have small coves or irregularities around their perimeters.

2. Ponds should be designed to be emptied by gravity or pumping for cleaning or drying and have graded bottoms so all water can be removed.

3. Side slopes of excavations and levees should be as steep as possible, consistent with soil characteristics and risk factors of slope failure.

4. Where steep side slopes cannot be economically achieved, the slopes should be lined with suitable material such as concrete to 3 feet below the water line or sterilized to achieve weed control.

5. The top width of embankments should be a minimum of 12 feet and should be adequately constructed to support maintenance vehicular traffic.

6 An access ramp should be provided on an inside slope for launching a small boat for mosquito control.

7. Ponds designed for long term storage should have a minimum storage depth of four feet.

8. A maintenance program for weed and erosion control along inner slopes is essential.

9. All accumulation of dead algae, vegetation and debris should be routinely removed from the impounded water surface and properly disposed.

Water Conveyance Facilities

1. Ditches must be maintained free of emergent, marginal and floating vegetation.

2. Ditches should be sized and graded for adequate flow and must not be used for water storage.

3. Unpressurized and low pressure pipelines, commonly used in irrigation distribution systems, should be designed to be emptied when not in use and should not be used for water storage because of the mosquito breeding potential in the partially filled pipes.

The preceding mosquito prevention criteria are intended only to offer guidance when considering the development of design options during the planning process for projects. Be advised that these practices have been found to be effective, however, once the project has been completed it is essential that conscientious maintenance and management practices be followed to help ensure the successful prevention of mosquito production.

Be further advised that under the California Health and Safety Code (Sections 2060 et. seq.) the responsibility for the cost of mosquito control may fall on the property owner.

CRITERIA FOR MOSQUITO PREVENTION IN SALT MARSH RESTORATION OF EXTERIOR LEVEE LANDS

Background Statement

These lands were originally tidal marshes, vegetated areas subject to daily tidal action. They were reclaimed for agricultural and other uses by the construction of levees and the installation of one or more water control structures to control the inflow and outflow of water. The Suisun Marsh Protection Plan recommends the restoration of former tidal marshes to tidal action where and when possible.

Salt marsh restoration projects on former exterior areas generally have a great potential for producing large numbers of mosquitoes. At least one mosquito species produced in these types of areas is an aggressive pest of man and is capable of flying in excess of 20 miles. Mosquito control in California has its origin in the San Francisco Bay Area where efforts were undertaken to control this pest by ditching to enhance drainage and water circulation.

Removing or breaching the levee will subject the sites to tidal flow. The extent of tidal flow depends, of course, on the relative elevation of the site to tide. Tidal flushing itself does not create mosquito problems. Mosquito problems arise from the residual tidal and flood waters remaining in depressions and cracked ground.

The following District Practices should be considered prior to removal or breaching of any levee or water control structure.

Policies for Management of Salt Marsh Restoration of Exterior Levee Lands

1. Develop a management program for the control of mosquitoes. Such a plan should be developed in coordination with the Solano County Mosquito Abatement District (SCMAD).

2. If necessary, obtain an engineering survey to locate depressions that would retain tidal water, and to determine the location of ditches for water circulation and drainage.

3 Establish a water recirculation system by interconnecting depressions with ditches that will enhance water movement and provide access for predator fish.

4. Disk or harrow all cracked ground caused by shrinkage and subsidence.

5. Plan and fund a long-term maintenance program on the marsh. The maintenance should include:

    a. Dredging and cleaning of sloughs, spreader ditches and main ditches to provide

    b. Disking of cracked ground as needed.

    c. Maintenance and repair of water control structures.

The preceding mosquito prevention criteria are intended only to offer guidance when considering the development of design options during the planning process for projects. Be advised that these practices have been found to be effective, however, once the project has been completed it is essential that conscientious maintenance and management practices be followed to help ensure the successful prevention of mosquito production.

Be further advised that under the California Health and Safety Code (Sections 2060 et. seq.) the responsibility for the cost of mosquito control may fall on the property owner.

CRITERIA FOR MOSQUITO PREVENTION IN SEDIMENTATION PONDS AND RETENTION BASINS

Background Statement

Sediment basins, sediment traps, diversions or similar required measures shall be installed well in advance of any clearing or grading and maintained by the permit-issuing authority. The design of such structures should account for abating potential mosquito problems.*

1. Sedimentation ponds and retention basins may be any shape but should not have small coves or irregularities around their perimeters.
2. Ponds/basins should be designed to be emptied by gravity or pumping for cleaning or drying and have graded bottoms so all water can be removed.
3. Side slopes of excavations and levees should be as steep as possible, consistent with soil characteristics and risk factors of slope failure.
4. Ponds/basins should be kept dry during the period between April 1 and November 1. This serves to prevent mosquito production and substantially reduce the efforts required to keep the vegetation under control.
5. Where steep side slopes cannot be economically achieved, the slopes should be adequately constructed to support maintenance vehicular traffic.
6. The top width of embankments should be a minimum of 12 feet and should be adequately constructed to support vehicular traffic.
7. An access ramp should be provided on an inside slope for launching a small boat for mosquito control.
8. Ponds designed for long term storage should have a minimum storage depth of 4 feet.
9. A maintenance program for weed and erosion control along inner slopes is essential.
10. All accumulation of dead algae, vegetation and debris should be routinely removed from the impounded water surface and properly disposed.

Water Conveyance Facilities

1. Ditches must be maintained free of emergent, marginal and floating vegetation.
2. Ditches should be sized and graded for adequate flow and must not be used for water storage.
3. Unpressurized and low pressure pipelines, commonly used in irrigation distribution systems, should be designed to be emptied when not in use and should not be used for water storage because of the mosquito breeding potential in the partially filled pipes.

* This ordinance became effective on January 25, 1980 and is binding on all grading and vegetative removal activities in the county. It is Erosion Control Ordinance 1087 and is contained in Chapter 31 of the Solano County Code, Article III, Section 31-300.

The preceding mosquito prevention criteria are intended only to offer guidance when considering the development of design options during the planning process for projects. Be advised that these practices have been found to be effective, however, once the project has been completed it is essential that conscientious maintenance and management practices be followed to help ensure the successful prevention of mosquito production.

Be further advised that under the California Health and Safety Code (Sections 2060 et. seq.) the responsibility for the cost of mosquito control may fall on the property owner.

CRITERIA FOR MOSQUITO PREVENTION IN TIDAL MARSHES

Background Statement

Historically, tidal marshes in Solano County were prolific sources of mosquitoes, an aggressive, migrating, day-biting species. In addition to direct abatement, water management practices have been developed by the Solano County Mosquito Abatement District (SCMAD) to prevent the production of mosquitoes in tidal marshes. The principal prevention method consists of the construction of ditches to circulate tidal water into sloughs and bays to avoid ponding. The following recommendations should be considered to reduce the mosquito production in tidal marshes.

Policies For Tidal Marsh Management

1. All marsh lands should be periodically surveyed to determine if ditches and drainage water control structures are properly placed to ensure effective drainage.

2. Ensure that all spreader ditches are constructed and maintained free and clear of debris and vegetation. Clear and retrench approximately every three years.

3. Spreader ditches should be properly connected to a slough via a main ditch or by having a flap gate, weir box or other adequate water control mechanism.

4. The drainage capacity of the drainage systems (spreader and main ditches) should take no more than 5 days to ensure full removal of water from the surface to the marsh prior to potential mosquito production.

5. To ensure the effectiveness of the drainage system and water control structures for the prevention of mosquitoes, the SCMAD will conduct surveillance after each bi-monthly high tide.

The preceding mosquito prevention criteria are intended only to offer guidance when considering the development of design options during the planning process for projects. Be advised that these practices have been found to be effective, however, once the project has been completed it is essential that conscientious maintenance and management practices be followed to help ensure the successful prevention of mosquito production.

Be further advised that under the California Health and Safety Code (Sections 2060 et. seq.) the responsibility for the cost of mosquito control may fall on the property owner.

CRITERIA FOR MOSQUITO PREVENTION IN UTILITY CONSTRUCTION PRACTICES

Background Statement

Installation of natural gas lines and wells, electrical lines, telephone lines, petroleum pipelines and the like can alter both topography and habitat. Activities which disrupt drainage patterns, obstruct water flow or water control structures, prevent access, or leave mounded debris can cause mosquito production.

Policies For Management of Utility Construction in Marsh Areas

1. SCMAD should be notified of proposed utility construction activities in marsh areas through lead agencies or responsible parties. Such activities should be reviewed by SCMAD at both the project development phase and after the work has been completed to ensure the project is carried out in conformance with SCMAD policies.

2. Installation of utilities should not obstruct water flow or alter drainage patterns without prior notification of SCMAD.

3. Following installation of utilities the topography should be returned to original conditions. Circulation ditches or natural drainageways should drain effectively and levees and/or access roads should be put back in good repair.

4. If mosquitoes are produced as a result of negligent utility construction practices, all costs necessary to abate mosquitoes by SCMAD will be borne by the responsible agencies or property owners, pursuant to the procedures set forth in the California Health and Safety Code, Sections 2060 et. seq.

The preceding mosquito prevention criteria are intended only to ofer guidance when considering the development of design options during the planning process for projects. Be advised that these practices have been found to be effective, however, once the project has been completed it is essential that conscientious maintenance and management practices be followed to help ensure the successful prevention of mosquito production.

Be further advised that under the California Health and Safety Code (Sections 2060 et. seq.) the responsibility for the cost of mosquito control may fall on the property owner.

TECHNIQUES FOR MOSQUITO MANAGEMENT IN DUCK CLUBS BASED ON STUDIES CONDUCTED ON GRIZZLY ISLAND WILDLIFE REFUGE

Vincent H. Resh, Darold P. Batzer, Ferenc A. de Szalay and Eric Schlossberg

Background Statement

The District has been faced with an ever-increasing number of housing developments surrounding the Suisun Marsh that are within the flight range of at least four species of mosquitoes that are important either as disease vectors or pests. *Aedes melanimon* and *Aedes dorsalis* and *Culiseta inornata* are strong fliers that feed on mammals including man quite aggressively. *Aedes dorsalis* is capable of flights over 20 miles while *Aedes melanimon* and *Culiseta inornata* can move at least 10 miles from their sites of emergence. *Culex tarsalis* is the primary vector of the Western equine (WEE) and St. Louis encephalitis (SLE) viruses in California. This species is primarily a bird feeder but does feed on mammals including man at times. This mosquito is capable of flights of at least 5-7 miles. *Aedes melanimon* has been shown to be involved in a secondary maintenance cycle of WEE transmission in the Central Valley.

The brief descriptions of mosquito management techniques mentioned here on based on studies conducted at the California Department of Fish and Game's Grizzly Island Wildlife Area (GIWA) in the Suisun Marsh. These studies were conducted from 1987-1997 by graduate students Darold Batzer, Ferenc A. de Szalay and Eric Schossberg under Vincent H. Resh professor of aquatic entomology with the Department of Environmental Science, Policy, and Management, University of California, Berkeley. The references listed contain extensive descriptions of each of the methods mentioned.

METHODS FOR CONTROL

I. Water Manipulation/Management

Method	Result
Rapid flooding:	Mosquito eggs hatch synchronously and therefore fewer treatments are necessary to kill mosquito larvae.
Stable water levels:	Because fluctuating water levels will cause multiple mosquito hatches when areas are reflooded, stable water levels will also reduce the number of treatments necessary to control mosquito larvae.
Late flooding (***late*** Oct.-Nov.)	Delay flooding until the weather is cooler because fewer adult female mosquitoes are active; therefore oviposition will be lower. However, note that numbers of other beneficial insects (e.g. midges, beetles) may also be lower late in the season and invertebrates important in duck diets may be lower as well. (e.g. de Szalay, Resh 1997 *Envir. Ent.*)

II. Vegetation Management

Reduce the amount of emergent vegetation such as pickleweed, and saltgrass by mowing or discing, because open water is not habitat for mosquito larvae. (e.g. de Szalay, Batzer, Schlossberg, Resh Proc. CMVCA 1995). Additional benefits of these treatments are colonization by plants that produce seeds eaten by waterfowl (e.g. brassbuttons, goosefoot, purselane), and also by invertebrates eaten by ducks (midges, beetles, water boatmen) (de Szalay & Resh 1997 Wetlands and Schlossberg & Resh 1997 Proc. MVCAC).

Treat edges of plant stands at water/land interface to remove emergent plant cover in areas where mosquito larvae are carried by wind and wave action. (Batzer & Resh 1995 Wetlands Article).

Permanently flooded marshes have little emergent plant stands in deeper sections. Therefore, mosquito production is lower than in seasonal marshes.

III. Mosquito Predators

Fish – Native stickleback and also the introduced mosquito fish are predators of mosquito larvae; the latter is more effective. These fish can control mosquito populations in areas with low emergent plant cover. Fish populations are usually higher in permanent wetlands and are not very effective to control mosquitoes in seasonally flooded habitats.

Invertebrate predators are extremely important in controlling mosquito populations. Dragonfly larvae, beetles, and water boatmen all feed on mosquito larvae. These species naturally colonize wetlands and usually reduce mosquito populations 2-4 weeks after the wetlands are first flooded. No specific management methods are necessary, but use of broad-spectrum insecticides should be avoided because these may also kill invertebrate predators. Controlling mosquitoes with bacterial toxins (Bti) or with juvenile hormone mimics (Methoprene) is recommended because these chemicals do not affect predatory invertebrates or wildlife.

IV. Mosquito Abatement Implementation of Recommendations

Each year the District meets with biologists/staff of the California Department of Fish and Game's (Grizzly Island Wildlife Area to discuss upcoming flooding plans for the year. Suggestions are made regarding water control structure or drainage improvements and vegetation management techniques that would help minimize

mosquito production on a pond by pond basis. The types of vegetation and amounts of each specific type can vary greatly. District personnel can advise CDFG staff as to the location, species and density of mosquito larvae found. Beyond that, any actual physical improvements or vegetation management (by discing, mowing or burning) is done by CDFG staff. During the summer and autumn months communication is frequent due to the number of ponds that are flooded earlier in the year for a variety of waterfowl feed. This gives CDFG the option of rapidly draining the pond(s) with mosquito larvae and then quickly reflooding. The water empties from the pond into a larger drain or slough where mosquito predators can consume them. This may not always be feasible due to the large size of a pond and/or the

inability to drain it rapidly. This practice does reduce the need for pesticide applications to control *Ochlerotatus melanimon* or *Ochlerotatus dorsalis* mosquitoes.

A New Jersey light trap is operated on Grizzly Island near CDFG Headquarters to monitor local populations from April through November or December on a weekly basis.

The District also meets with representatives/staff of the Suisun Resource Conservation District (SRCD) to review the flooding and draining capabilities of individual duck clubs before any early flooding commences. A system of notifying the District by phone and/or fax promptly once flooding has started is in place. Often personal communication in the field occurs between District staff and the duck club owners or staff. As with CDFG property, this greatly reduces the need for pesticide applications to control *Ochlerotatus* mosquitoes by giving the club owner the opportunity to quickly drain the pond(s) with mosquito larvae and then rapidly reflood.

RECEIPT No. 336178

DATE 06/13/11

FROM Matthew Freese - DWQ $136.00

DOLLARS

○ FOR RENT
○ FOR Solano County CK#: 12939

ACCT.		
PAID		
DUE		

○ CASH
○ CHECK
○ MONEY ORDER
○ CREDIT CARD

FROM _____ TO _____

BY _____

A-2501
T-46820

RECEIPT No. 336177

DATE 06/13/11

FROM Matthew Freese - DWQ $136.00

DOLLARS

○ FOR RENT
○ FOR Solano County CK#: 12940

ACCT.		
PAID		
DUE		

○ CASH
○ CHECK
○ MONEY ORDER
○ CREDIT CARD

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A-2501
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