BUTTE COUNTY MOSQUITO AND VECTOR CONTROL DISTRICT'S

BEST MANAGEMENT PRACTICES TO REDUCE MOSQUITOES

Butte County Mosquito & Vector Control District
Since 1948

BEST MANAGEMENT PRACTICES TO REDUCE MOSQUITOES

The Best Management Practices (BMPs) contained in this manual are assembled from a number of sources including scientific literature, state and inter-agency documents, and from experienced vector control professionals. The intended use of this document is to provide general guidance, not site-specific requirements. BMPs that are most applicable to a specific mosquito-breeding source may be selected from the list and incorporated into a specific BMP Implementation Plan for a specific mosquito-breeding source in consultation with the District personnel.

TABLE OF CONTENTS

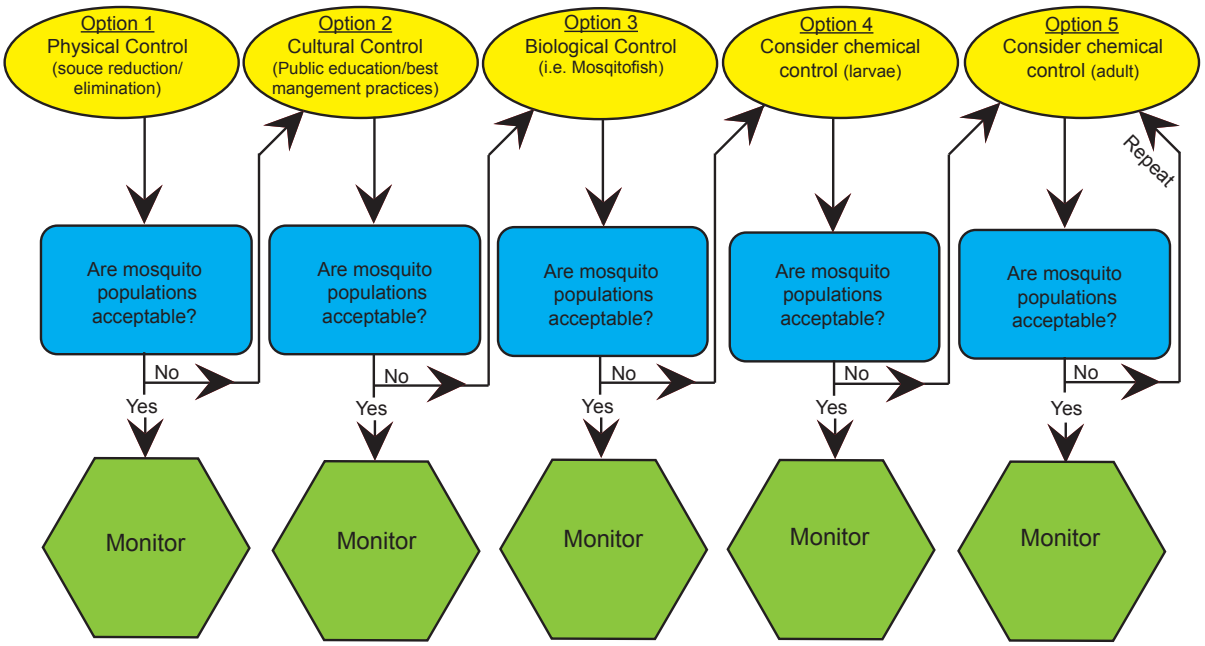
BMP IMPLEMENTATION POLICIES

INTRODUCTION

The Butte County Mosquito and Vector Control District (District) is aware that adjusting land management practices can reduce mosquito populations thereby reducing mosquito control costs, reducing the amount of pesticide used in mosquito control applications, helping to protect the publics health, and contributing to the District's integrated vector management (IVM) approach to mosquito and vector control.

Integrated Vector Management (IVM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. The District's IVM program uses current, comprehensive information on the life cycles of pests and their interaction with the environment. This information is used to manage pest nuisance and public health threats by the most economical means, and with the least possible hazard to people, property, and the environment. The District's IVM includes vector surveillance, source reduction and/or elimination, best management practices, public education, biological control, chemical control and monitoring.

Integrated Vector Management (IVM) Program



There are four different types of mosquito control methods practiced by the District. The first is source reduction and/or elimination, which is a physical control method. Physical control is an environmental manipulation that results in the reduction or elimination of mosquito development sites. Cultural control is designed to change the behavior of the county's residents so that their actions prevent the development of mosquitoes through public education and outreach and by establishing best management practices on known mosquito-breeding sources. Biological mosquito control uses biological agents to reduce larval mosquito populations. The last control method is the use of federal and state registered public health pesticides to control mosquito populations. Two types of public health pesticides are utilized, adulticides which kill adult mosquitoes, and larvicides which are designed to kill immature aquatic stage mosquitoes (larvae) or inhibit development to adult emergence. All chemical applications which may enter waters of the State shall be performed in accordance with the requirements of the Statewide General NPDES Permit for Discharge of Aquatic Pesticides for Vector Control (Water Quality Order 2004-0008-DWG).Each method of control is designed to eliminate or minimize mosquito-breeding sites, reduce mosquito populations, and to reduce transmission of vector-borne disease.

The District is continually striving to enhance its efforts to effectively control mosquitoes by physical, cultural, and biological mosquito control lessening the dependency for chemical control and with the adoption of these policies and procedures this can be achieved. This manual includes the District's guidelines for land management practices that provide landowners and land managers techniques to address any mosquito-breeding problems that may be identified by the District.

The best management practices (BMPs) in this manual can reduce mosquito populations by several methods including: reducing and/or eliminating standing water that serves as mosquito-breeding sources, increasing the efficacy of biological controls such as mosquitofish, increasing the efficacy of chemical controls, and improving access for mosquito control operations. Not all BMPs included in this manual will apply equally to all mosquito-breeding sources, but all BMPs are to be a starting point in the cooperative development of site specific BMP implementation plans that will address the identified mosquito-breeding source(s).

The District recommends to those responsible for creating large mosquito populations by possessing a significant mosquito-breeding source on the identified property to develop and implement a cooperative BMP plan with the District to avoid the need for formal enforcement actions authorized under the California Health and Safety Code. Under the California Health and Safety Code, section 2061, mosquito and vector control districts may legally abate a public health nuisance defined as "Any water that is a breeding place for vectors" and "Any activity that supports the development, attraction, or harborage of vectors, or that facilitates the introduction or spread of vectors." Abatement can result in civil penalties of up to $1,000.00 per day for each day of such violation and the recovery of costs for District activities to control the mosquitoes from a source.

Some circumstances require the District to utilize the California Health and Safety Code to ensure the publics safety and to carry out its responsibilities, but due to past experiences the District believes that a cooperative approach leads to a more effective and long lasting relationship which in turn leads to the overall reduction of mosquitoes and mosquito-breeding sources.

BMP implementation policies in this manual are designed to address significant mosquito-breeding sites including, but not limited to: residential properties, commercial properties, industrial properties, public properties, cemeteries, wastewater facilities, storm water facilities, agricultural production such as rice, orchards, and row crops, pastures, ditches, and managed wetlands. Due to management practices that promote favorable habitat for mosquito production, many of the above listed properties and/or facilities produce a significant population of mosquitoes, which pose a public health nuisance and/or public health risk.

The policies in this manual are designed to address the most significant mosquito-breeding problems throughout Butte County. Mosquito-breeding sources defined as Significant Mosquito-Breeding Sources will be addressed as defined accordingly to the following policies and procedures. Mosquito-breeding sources that do not meet the criteria as a Significant Mosquito-Breeding Source will not be held accountable to the policies and procedures in this manual, but provides an opportunity to the landowner/ land manager to take a proactive approach to mosquito problems and to avoid the development of a property from becoming a significant mosquito-breeding source.

If the adoption and implementation of a BMP creates a significant economic hardship or causes technical difficulties, the District may elect to offer assistance in the form of equipment, labor, technical advice, and/or other resources. Assistance will be considered and offered on a case-by-case basis and is not to be considered a guarantee.

SIGNIFICANT MOSQUITO-BREEDING SOURCES

The following criteria will identify and define a Significant Mosquito-Breeding Source:

- Mosquito production exceeds District adopted treatment thresholds;
- Mosquito production exceeds that of a similar source on a similar land use situation;
- Increased control costs incurred by the District due to the management practices;
- Mosquito production is in close proximity to a populated area; and/or to address that land management practices that could be modified to reduce high populations of mosquitoes and future mosquito production.

As defined by the California Health and Safety Code, a Significant Mosquito-Breeding Source would be considered a public nuisance, if left untreated, and may be subject to civil penalties of up to $1,000.00 a day.

Adult and larval mosquito surveillance data will be gathered before and after the implementation of the Best Management Practice (BMPs) Plan to measure the effectiveness of the program. If current sampling methods and existing surveillance data are not sufficient to determine the effectiveness of the particular BMP, a site-specific monitoring plan will be created to evaluate the Significant Mosquito-Breeding Sources implemented BMP.

When evaluating a Significant Mosquito-Breeding Source as defined above, the District will evaluate other factors such as the proximity to populated areas, the current level of vector-borne disease, mosquito species being produced, control costs, and the efficacy of available control options. Identified Significant Mosquito-Breeding Sources that are in close proximity to populated areas and/or have the highest potential to reduce mosquito production will be selected to adopt a BMP implementation plan compliant with this manual.

Many land management practices can contribute to increased mosquito production. Some of the management practices are, but are not limited to: lack of emergent vegetation control, lack of trash and debris removal, lack of proper maintenance to ensure facility or structural operation as design indicates, poor water management, poor condition of water conveyance or drainage structures, lack of adequate refuge for biological control populations, practices that deny or obstruct access to the source, and the lack of notification of land management practices that would effect mosquito production or mosquito control operations.

BMP IMPLEMENTATION PLAN

If a mosquito-breeding source is located and meets the criteria as a Significant Mosquito-Breeding Source, the District will develop and present a draft BMP Implementation Plan to the responsible land owner and/or manager purposing the course(s) of action(s) based on one or more BMPs that if implemented, will reduce or eliminate the mosquito-breeding source. If appropriate, the District will consult with state and federal biologists and/or other professionals to determine if the BMP being purposed is adequate and environmentally sound.

The draft BMP Implementation Plan will contain, but is not limited to, the following:

- Identification of a Significant Mosquito-Breeding Source
- Justification for the purposed and requested actions
- Clear and precise description of the proposed BMP(s)
- Timing of implementation and specific guidance of purposed BMP(s)
- District resource(s) available to assist with BMP Implementation
- Assessment and surveillance method(s)

To achieve a mutually agreeable BMP Plan, the property owner / land manager will have the opportunity to review and comment on the purposed draft plan. Reasonable adjustments can and may be negotiated between the responsible property owner / land manager and the District during the review process. A reasonable time limit will be allowed during the negotiating process at which time the District will finalize any and all unresolved issues. The time limit itself is subject to an extension if all parties mutually agree and reasonable cause is provided. If the responsible party is unwilling to accept the terms of the cooperative process upon conclusion of the review period, the District may be forced to pursue formal abatement proceedings.

REIMBURSEMENT FOR CONTROL COSTS

The District is authorized by the California Health and Safety Code to recover treatment costs for mosquito control operations. Since most mosquito treated properties in the District pay for a “base” level of mosquito control through the payment of property taxes, the District would consider charging for treatment costs that are above and beyond the normal level of treatment for mosquito control on mosquito-breeding sources with similar land use. Since the primary goal for the creation and use of this BMP manual is to lead to the reduction of pesticide use in Butte County, the District would only consider accepting charges for additional treatment in lieu of BMPs on a case-by-case basis for a limited period of time. As new BMPs are developed and efficacy of existing BMPs is researched further, the expectation would be the charge for treatment portions of the BMP Plans would be replaced by non-pesticide based long-term mosquito management plans. All chemical applications which may enter waters of the State shall be performed in accordance with the requirements of the Statewide General NPDES Permit for Discharge of Aquatic Pesticides for Vector Control (Water Quality Order 2004-0008-DWG).

PROCESS OF APPEALS

The responsible landowner / property manager may submit comments in writing to the Butte County Mosquito and Vector Control District Board of Trustees before the implementation deadline on the Draft BMP Plan. Upon review, the Board of Trustees will issue a determination, which may include no change in the content of the draft BMP Plan, an extension of the implementation deadline, a waiver of reimbursement fees, or other appropriate action. If the responsible landowner / property manager is a state agency, appeals may be made to the California Department of Public Health pursuant to the California Health and Safety Code.

PROCESS TO IMPLEMENT BMP PLAN

Below is a chronological list of progression that will lead to the creation of a BMP Plan for identified properties that meet the criteria for a Significant Mosquito-Breeding Source(s).

1. ***Identification of a Significant Mosquito-Breeding Source(s) -*** The District will identify a significant Mosquito-Breeding Source based on the following criteria:
   - Mosquito production exceeds District treatment thresholds;
   - Mosquito production exceeds that of a similar source on a similar land use situation;
   - Increased control costs incurred by the District due to the management practices;
   - Mosquito production is in close proximately to a populated area; and/or to address that land management practices could be modified to reduce high populations of mosquitoes and future mosquito production.

2. ***Contact responsible landowner –*** The District will contact the responsible landowner of properties in Butte and Glenn Counties that have been identified as a significant mosquito-breeding source(s) that if untreated, would become a public nuisance (California Health and Safety Code section 2061) or a threat to public health. A draft BMP Plan will be provided to the responsible landowner that will include an explanation of why the site was identified as a significant mosquito-breeding source, including mosquito surveillance data and the management practices necessary to reduce mosquito production.

3. ***Negotiate draft BMP Plan –*** District staff will work with the responsible landowner to achieve a mutually agreeable course of action to address the significant mosquito-breeding source. During this stage in the process, specific BMPs, implementation time lines, maintenance requirements, and monitoring plans will be addressed and negotiated. A defined negotiation time line will be designated at the start of this process.

4. ***Acquire additional resources –*** Resources may be made available to assist the responsible landowner to comply with the BMP requirements. If District resources are utilized specific maintenance requirements will be specified in the cooperative agreement. This agreement will contain the name of the landowner utilizing the resource, location of the property, description of work being performed, the cost of work, if any, to be paid by the responsible landowner, and requirements for maintenance to be performed by landowner.

5. ***Coordination with other regulatory agencies –*** Other local, state, federal, and conservation agencies may be brought into the negotiating process to avoid any potential regulatory conflicts with the draft BMP Plan.

6. ***Cooperative agreement –*** The District will generate a cooperative agreement to formalize the relationship between the responsible landowner and the District specifying the terms agreed upon in the BMP Plan. The cooperative agreement will also contain the consequences of non-compliance with the BMP Plan under the California Health and Safety Code.

7. ***Implementation of BMP Plan and monitoring –*** To ensure compliance and continued maintenance the District will continually monitor the property after successful completion and implementation of the BMP. If reasonable mosquito control is not achieved through the initial BMP Plan, the District reserves the right to renegotiate the BMP Plan at any time mosquito production is not reduced. If this happens, the process would return to step #2 (above). No additional charges or penalties will be assessed to the responsible landowner if the party is still compliant with the terms of the cooperative agreement.

8. ***Evaluation of BMP efficacy to reduce mosquitoes*** – The District will continually evaluate each BMP Plan to assess the efficacy and ensure that the BMPs are meeting the needs of the responsible landowner and the District. Based on the evaluation, either party may initiate a review of the BMP plan pursuant to the terms of the cooperative agreement. A mosquito management plan aimed at reducing mosquito populations requires regular assessments and adaptive management to address changing conditions and / or unforeseen effects.

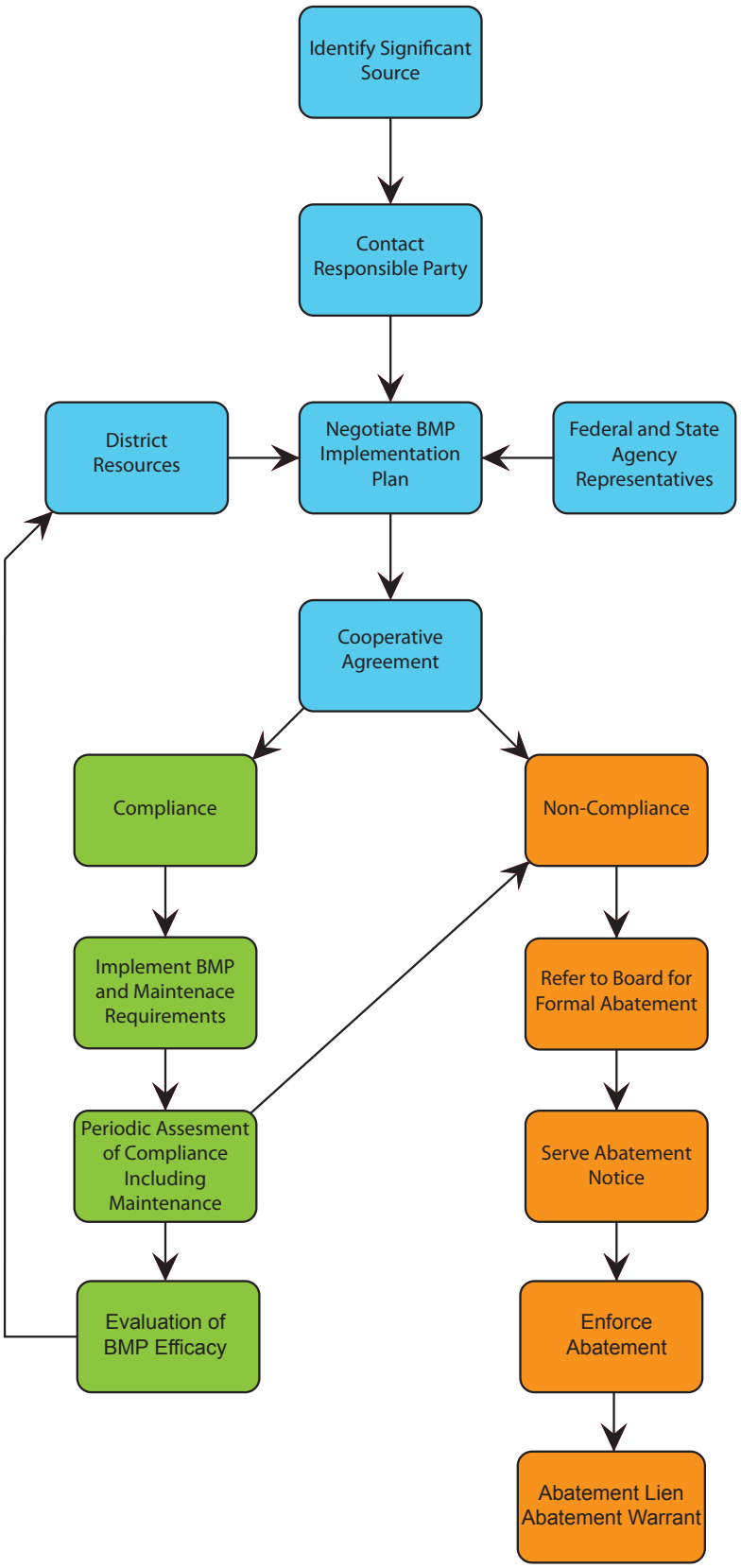
9. ***Formal abatement process*** – If the responsible landowner that has property which has been identified as a significant Mosquito-Breeding Source does not take corrective action or does not provide reasonable explanation for the continued lack of compliance with the cooperative agreement, the case may be brought to the Butte County Mosquito and Vector Control District Board of Trustees to begin the formal abatement process as defined in the California Health and Safety Code, section 2061.

10. ***Serve abatement notice*** – Under direction of the District Board of Trustees, the responsible landowner will be served an abatement notice directing the landowner to comply with the cooperative agreement within the specified timeframe. Non-compliant landowners can be imposed civil penalties of up to $1,000.00 per day for each day while in non-compliance and the recovery costs for District activities to control the mosquitoes from a source pursuant to the California Health and Safety Code, section 2061 and 2063.

11. ***Enforcement of abatement*** – Under direction of the District Board of Trustees, civil penalties and treatment costs not paid within 60 days will be collected “at the same time and in the same manner as ordinary county taxes….and shall be subject to the same procedure and sale in case of delinquency as are provided for ordinary county taxes.” California Health and Safety Code, section 2065(b).

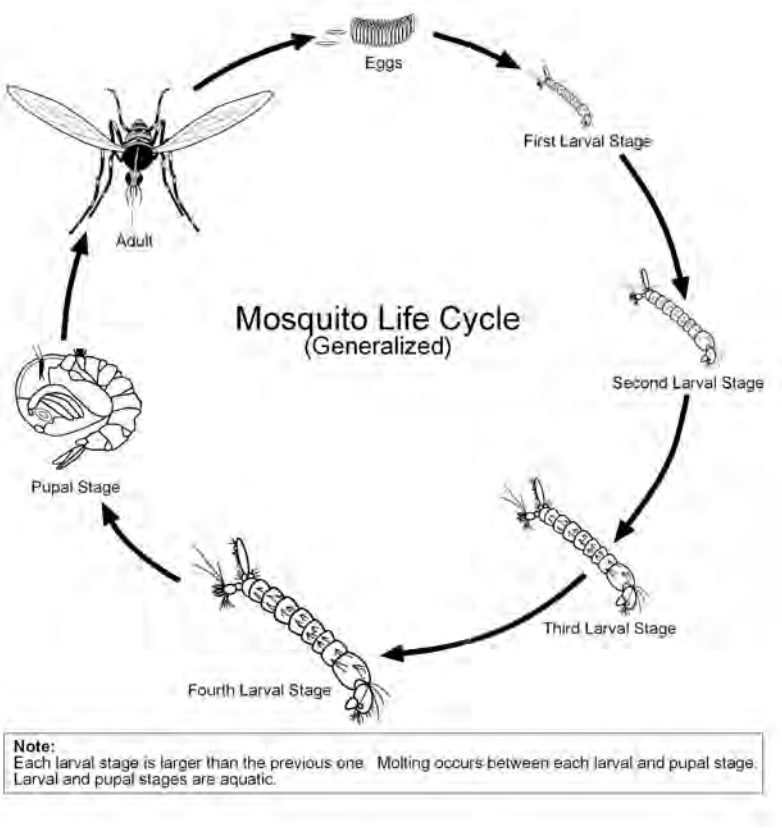
12. ***Additional abatement actions*** – Under direction of the District Board of Trustees, and / or District Manager, other measures such as an abatement warrant or abatement lien may be imposed pursuant to the California Health and Safety Code.

THE BMP PROCESS FLOWCHART



MOSQUITO BIOLOGY AND ASSOCIATED BREEDING HABITATS

There are over 3,000 mosquito species in the world and more than 50 have been identified in California, half of which are commonly found throughout Butte County. Regardless of adult mosquito populations, several species in Butte County are of public health concern including *Culex tarsalis*, *Culex pipiens*, *Aedes melanimon*, *Aedes sierrensis*, and *Anopheles freeborni*. It is important to understand that all mosquito species demand different habitat requirements and behaviors that affect its ability to transmit disease, bite and feed on humans, and be controlled by a specific BMP(s)



As shown above, all mosquitoes share a similar life cycle representing complete metamorphosis. The mosquito life cycle is best described as a two-stage life cycle, which includes the aquatic stage (larvae and pupae) and the aerial stage (adults). Most Best Management Practices (BMPs) aimed at reducing mosquito populations focus on managing the aquatic stages of the mosquito by creating the conditions less favorable for mosquito development or more advantageous biological control agents such as the *Gambusia affinis* (mosquitofish). This usually involves manipulating the amount or timing of standing water, decreasing the amount of vegetation in and/or around standing water, and creating a situation where natural or introduced predators can consume the mosquito larvae. Since each species of mosquitoes have different habitat requirements, it is vital to understand which mosquitoes favor which habitats to realize how a particular BMP is designed to work thereby reducing mosquito production.

To understand the design of different BMPs it is useful to think of mosquitoes belonging to one of three categories, which are, standing-water mosquitoes, floodwater mosquitoes, and container mosquitoes. BMPs designed for the reduction of standing water mosquitoes may not work or be applicable for floodwater mosquitoes and vice versa. Below is a list of each of the three categories of mosquitoes, the most common mosquitoes of concern commonly found, and common BMPs aimed at the reduction of those mosquitoes.

1. ***Standing-Water Mosquitoes*** prefer still water commonly found in ponds, rice fields, lakes, un-maintained swimming pools, etc.

   Mosquito species of concern commonly found in standing-water sources:

   The Northern House Mosquito *(Culex pipiens)* is a major vector of West Nile virus (WNV) and can vector Saint Louis encephalitis (SLE), and the western equine encephalomyelitis (WEE). Larvae prefer polluted or foul water high in organic content. Found in ponds, roadside ditches, artificial containers, storm drains, wastewater ponds, sumps, septic tanks, fountains, birdbaths, and un-maintained swimming pools. Birds are the principal blood meal, but will attack humans and invade their homes. *Culex pipiens* usually breeds in the early spring to late fall in Butte County.

   The Encephalitis Mosquito *(Culex tarsalis)* is the primary vector of West Nile virus (WNV), Saint Louis encephalitis (SLE), and the western equine encephalomyelitis (WEE). *Culex tarsalis* breeds in a variety of aquatic habitats ranging from clean to polluted water sources including, but not limited to flooded agricultural lands, ditches, man made containers, ponds, and urban sources. In Butte County, this mosquito breeds year round and prefers to feed on birds, but does readily attack humans, horses, and cattle.

   Western Malaria Mosquito *(Anopheles freeborni)* is one of Butte County's most abundant pest and is the primary vector of Malaria. Larvae prefer clear, fresh water in sunlit or partially shaded pools. This mosquito is most commonly found in rice fields, managed wetlands, natural wetlands, rain pools, vernal pools and roadside ditches with grass. An aggressive mosquito, most *Anopheles freeborni* commonly feed on mammals or humans and are most active at dawn and dusk.

   Common BMPs to reduce standing-water mosquitoes

   a. Drain any and all standing water
   b. Reduce or eliminate emergent vegetation in and along the edges of water
   c. Maintain water level to encourage natural predators or biological control agents
   d. Contact the District to coordinate mosquito prevention with other mosquito control operations such as chemical and biological control

2. ***Floodwater Mosquitoes*** commonly lay their eggs in moist soil. When the eggs become submerged as in a seasonal wetland, duck club, irrigated pasture, or a flood plane the eggs hatch.

   Mosquito species of concern commonly found in floodwater sources:

   Wetlands Mosquito *(Aedes melanimon)* is not only a major pest within twenty miles of its larval breeding sources, but is a vector of West Nile virus (WNV) and it has been implicated as a secondary vector of western equine encephalomyelitis (WEE) in the Central and Sacramento Valleys. This species is most commonly found in intermittently flooded areas such as managed wetlands. *Aedes melanimon* are day biters that are very aggressive mosquitoes that readily feed on mammals and humans. This species of mosquito can emerge as an adult as soon as five days after eggs hatch.

Inland Floodwater Mosquito *(Aedes vexans)* is a secondary vector for canine heartworm and is a severe outdoor nuisance that is extremely aggressive. It is common in irrigated pastures, orchard drainage, managed wetlands, and in woodland watercourse pools. They feed primarily on mammals and are typically seeking blood meals at dawn and dusk, but will feed all day. This mosquito is most active in early spring through late fall.

Irrigated Pasture Mosquito *(Aedes nigromaculis)* is a mosquito species that is a secondary or suspected vector of western equine encephalomyelitis (WEE) and California group encephalitis. It is commonly found in agricultural sources, especially pastures, managed wetlands, orchards, and in field drains. This mosquito is extremely aggressive and is most active in the spring through fall feeding on mammals in the days and evenings.

Common BMPs to reduce floodwater mosquitoes

a. Flood / irrigate when air temperatures are low and do not encourage rapid mosquito development
b. Reduce or eliminate emergent vegetation by disking or mowing (remove debris)
c. Put water on rapidly and drain rapidly so mosquitoes can not develop
d. Contact the District to coordinate mosquito prevention with other mosquito control operations such as chemical and biological control

3. Container Mosquitoes prefer contained areas of water such as tree holes, buckets, tires, bird baths, fountains, un-maintained swimming pools, rain gutters with clogged down spouts, etc. Many times standing-water mosquitoes will also breed and develop in container sources such as the Northern House Mosquito *(Culex pipiens)* and The Encephalitis Mosquito *(Culex tarsalis)*.

Mosquito species of concern commonly found in container sources:
(Refer to *Culex pipiens* and *Culex tarsalis* above for references as container mosquitoes)

The Western Treehole Mosquito *(Aedes sierrensis)* is a major nuisance mosquito usually associated with the foothill regions in Butte County, but is routinely identified in some valley areas. This mosquito is the primary vector of Dog Heartworm. Larvae are generally found in treeholes and containers that have a lot of leafy material. Eggs hatch with the initial fall rains and over winter as larvae. This species of mosquito is a very small aggressive mosquito that usually surfaces in early spring and will be active into the summer months. *Aedes sierrensis* is a vicious biter of humans and other large mammals.

Asian Tiger Mosquito *(Aedes albopictus)* has not been established in California yet, but is an aggressive exotic species that has invaded the eastern and southern United States. Over the past ten years there have been several cases where this species was found in cargo containers in port areas of Los Angeles and San Francisco. This container breeding mosquito is of serious concern for its potential to vector diseases such as Rift Valley Fever, Chikungunya virus, Dengue fever, and Yellow fever. If *Aedes albopictus* becomes established in California, the need for effective mosquito control practices will be even more important to protect public health. *Aedes albopictus* is an aggressive day biter that will be active in spring, summer, and fall.

Common BMPs to reduce container mosquitoes

a. Drain containers of all standing water
b. Cover, overturn, or create drainage holes that prevent water from standing in containers
c. Identify and prevent sprinklers or other sources of water from refilling containers
d. Contact the District to coordinate mosquito prevention with other mosquito control operations such as chemical and biological control.

IRRIGATION AND DRAINAGE OF AGRICULTURAL SOURCES

The Best Management Practices (BMPs) contained in this manual are assembled from a number of sources including scientific literature, state and inter-agency documents, and from experienced vector control professionals. The intended use of this document is to provide general guidance, not site-specific requirements. BMPs that are most applicable to a specific mosquito-breeding source may be selected from the list and incorporated into a specific BMP Implementation Plan for a specific mosquito-breeding source in consultation with the District personnel.

Common Mosquito-Breeding Sites

- Irrigated pastures
- Low areas caused by improper grading
- Broken or leaky irrigation pipes and/or valves
- Vegetated ditches
- Seepage or flooding of fallow fields
- Blocked ditches and/or culverts
- Irrigation tail water return sumps

Common Mosquito Species Identified In Above Listed Sites

- Clean standing water sources: *Culex tarsalis* & *Anopheles freeborni*
- Water which is highly organic: *Culex pipiens* & *Culex tarsalis*
- Seasonally flooded areas: *Aedes nigromaculis*, *Aedes melanimon*, & *Aedes vexans*

Special Concerns

The District is committed to working with agricultural growers to implement mosquito control practices that coincide with agricultural practices and minimize the impact on the economics or yields of the crops. Agricultural practices vary among growers, locations, and conventional or organic production methods. Pesticide regulations can affect the ability to use chemical control products. The following BMPs to reduce mosquito breeding are offered as tools to balance the economic and agronomic requirements of the growers and landowners with the need for effective mosquito control.

General Practices To Reduce Mosquito Breeding

1. Prevent or eliminate unnecessary standing water that remains for more than 72 hours during mosquito season. Mosquito season starts when the weather warms and ends when the weather cools.
2. Maintain access for District staff to monitor and treat mosquito breeding sources.
3. Minimize emergent vegetation and surface debris on the water.
4. Contact the District for technical guidance and/or assistance in implementing BMPs to reduce mosquito breeding.

BMPS AIMED TO REDUCE MOSQUITO-BREEDING IN AGRICULTURAL SETTINGS

DITCHES AND DRAINS

DD-1. Construct or improve ditches with at least 2:1 slopes and a minimum of a 4 foot bottom. Consider a 3:1 slope or greater to discourage burrowing animal damage, potential seepage problems, and prevent unwanted vegetation growth. Other designs may be approved by the District based on special circumstances.

DD-2. Keep ditches clean and well-maintained. Periodically remove accumulated sediment and vegetation. Maintain ditch grade to prevent areas of standing water.

DD-3. Design irrigation systems to use water efficiently and drain completely to avoid standing water.

IRRIGATED PASTURES

IP-1. Grade field to achieve efficient use of irrigation water. Use NRCS guidelines for irrigated pastures. Initial laser leveling and periodic maintenance to repair damaged areas are needed to maintain efficient water flow (Lawler and Lanzaro, 2005).

IP-2. Irrigate only as frequently as is needed to maintain proper soil moisture. Check soil moisture regularly until you know how your pasture behaves (Lawler and Lanzaro, 2005).

IP-3. Do not over fertilize. Excess fertilizers can leach into irrigation tail water, making mosquito production more likely in ditches or further downstream (Lawler and Lanzaro, 2005).

IP-4. Apply only enough water to wet the soil to the depth of rooting (Lawler and Lanzaro, 2005).

IP-5. Drain excess water from the pasture within 24 hours following each irrigation. This prevents scalding and reduces the number of weeds in the pasture. Good check slopes are needed to achieve drainage. A drainage ditch may be used to remove water from the lower end of the field (Lawler and Lanzaro, 2005).

IP-6. Inspect fields for drainage and broken checks to see whether re-leveling or reconstruction of levees is needed. Small low areas that hold water can be filled and replanted by hand. Broken checks create cross-leakage that provide habitat for mosquitoes (Lawler and Lanzaro, 2005).

IP-7. Keep animals off the pasture while the soil is soft. An ideal mosquito habitat is created in irrigated pastures when water collects in hoof prints of livestock that were run on wet fields or left in the field during irrigation. Keeping animals off wet fields until soils stiffen also protects the roots of the forage crop and prevents soil compaction that interferes with plant growth (Lawler and Lanzaro, 2005).

IP-8. Divide up pastures into a number of smaller fields so that the animals can be rotated from one field to another. This allows fields to dry between irrigations and provides a sufficient growth period between grazing. It also prevents hoof damage (pugging), increases production from irrigated pastures, and helps improve water penetration into the soil by promoting a better root system (Lawler and Lanzaro, 2005).

DAIRIES

Common Mosquito-Breeding Sites

- Wastewater lagoons
- Animal washing areas
- Drain ditches
- Sumps/ponds
- Watering troughs
- Irrigated pastures
- Irrigated crops

Common Mosquito Species Identified In Above Listed Sites

- Clean standing water sources: *Culex tarsalis*
- Nutrient rich water sources: *Culex pipiens* & *Culex stigmatosoma*

Special Concerns

Dairy and associated agricultural practices vary; however, these practices need to take into account mosquito and vector control issues. The Best Management Practices (BMPs) for mosquito reduction below offer options to balance the requirements of the dairy operators with the need for effective mosquito control. The District is committed to working with dairy operators to implement mosquito control practices that are effective and have the least possible impact on the economics and operation of the dairy.

General Practices To Reduce Mosquito Breeding

1. Prevent or eliminate unnecessary standing water that remains for more than 72 hours during mosquito season. Mosquito season starts when the weather warms and ends when the weather cools.
2. Maintain access for District staff to monitor and treat mosquito-breeding sources.
3. Minimize emergent vegetation and surface debris on the water.
4. Contact the District for technical guidance and/or assistance in implementing BMPs to reduce mosquito-breeding.

BMPS AIMED TO REDUCE MOSQUITO-BREEDING IN DAIRIES

DA-1. Wastewater holding ponds should not exceed 150' in width.

DA-2. Paths and/or roads of adequate width to allow safe passage of vector control equipment should surround all holding ponds. This includes keeping the lanes clear of any materials or equipment (e.g. trees, calf pens, hay stacks, silage, tires, equipment, etc.).

DA-3. If fencing is used around the holding ponds, it should be placed on the outside of the paths and/or roads with gates provided for vehicle access.

DA-4. All interior banks of the holding ponds should have a grade of at least 2:1.

DA-5. An effective solids separation system should be utilized such as a mechanical separator or two or more solids separator ponds. If ponds are used, they should not exceed sixty feet in surface width.

DA-6. If two or more ponds are used as drainage and/or solid separators, the landowner/manager must coordinate with the District to purpose a management plan to coordinate the use of these ponds. Such a plan will include, vegetation management, coordinated pond drying, and solids removal.

DA-7. Drainage lines should never by-pass the separator ponds, except those that provide for normal corral run-off and do not contain solids. All drain inlets must be sufficiently graded to prevent solids accumulation.

DA-8. Floating debris should be eliminated on all ponds; mechanical agitators may be used to break up crusts.

DA-9. Vegetation should be controlled regularly to prevent emergent vegetation and barriers to access. This includes access paths and/or roads, interior pond embankments and any weed growth that might become established within the pond surface. An approved vegetation management plan should be on file with the District.

DA-10. Dairy wastewater discharged for irrigation purposes should be managed so that it does not remain for more than 72 hours.

DA-11. All structures and water management practices should meet current California Regional Water Quality Control Board requirements (Creedon, 2006).

DA-12. Tire sidewalls or other objects that will not hold water should be used to hold down tarps (e.g. on silage piles). Whole tires or other water-holding objects should be replaced.

RICE FIELDS

Common Mosquito-Breeding Sites

- Flooded rice fields can always support the development of mosquitoes. As the rice stand develops and grows denser, the production of mosquitoes tends to increase while the ability for chemical control agents to penetrate the canopy decreases.
- Organic rice production limits the available chemical control materials available, so additional attention to BMPs is critical.
- Leaky levees
- Weedy borrow pits and field borders
- Irrigation and drain ditches
- Post harvest re-flooded rice for organic decomposition

Common Mosquito Species Identified In Above Listed Sites

- *Culex tarsalis*
- *Anopheles species*
- *Aedes melanimon* & *Culiseta inornata* (post harvest re-flood)

Special Concerns

Agricultural practices vary among growers, locations, and conventional or organic production methods. Also local differences in environmental conditions may affect mosquito production from field to field. The Best Management Practices (BMPs) below try to balance the economic and agronomic requirements of the growers and landowners with the need for effective mosquito control. The District is committed to continue working with growers, the California Rice Commission and other stakeholders to develop and implement mosquito control practices that coordinate with standard rice production practices, and minimize the impact on the economics or yields of the crop.

The need for close cooperation is important with all rice growers, but is especially important with growers who produce organic rice. At this time, there is only one available mosquito larvicide for organic rice, which leaves biological control (mosquitofish), physical control (weed control) and cultural control (water management) as the only remaining mosquito management tools. Because proper timing and planning is essential for an effective IVM program, the District asks organic rice growers for an added level of commitment to addressing mosquito control issues in a cooperative manner.

BMPS AIMED TO REDUCE MOSQUITO-BREEDING IN RICE FIELDS

Conventional Rice Production

RI-1. Wherever feasible, maintain stable water level during mosquito season by ensuring constant flow of water into pond or rice field to reduce water fluctuation due to evaporation, transpiration, outflow, and seepage (Lawler and Lanzaro, 2005).

RI-2. Inspect and repair levees to minimize seepage (Lanzaro and Lawler, 2005; Lawler, 2005).

RI-3. Drain and eliminate borrow pits and seepage areas external to the fields (Lanzaro and Lawler, 2005; Lawler, 2005).

RI-4. Wherever feasible, maintain at least 4"-6" of water in the rice field after rice seedlings have begun to stand upright. Planned drainages should be coordinated with the District. If an unplanned drainage is necessary, notify the District as soon as possible to coordinate restocking of mosquitofish or to use alternative mosquito control measures.

RI-5. Wherever feasible, remove vegetation on the outer-most portions of field levees and checks, specifically where they interface with standing water (Lanzaro and Lawler, 2005; Lawler, 2005).

RI-6. Control algae and weed growth as effectively as possible (Lawler, 2005).

RI-7. Communicate frequently with your county mosquito control officials regarding your crop management activities. For example: Draw-down of water levels, except drainage for harvest; Any drainage of fields to fallow fields; Initiation of post-harvest flooding for straw management or habitat objectives.

RI-8. Design fields with sufficient borrow pits along each internal levee to promote efficient drainage, and provide refuge for mosquitofish during low water.

RI-9. Notify MVCD prior to any pyrethroid insecticide applications to rice fields stocked with mosquitofish. The pyrethroid insecticides that can be applied to rice fields include lambda cyhalothrin (Warrior® Insecticide, Karate® Insecticide) or s-cypermethrin (Mustang® Insecticide) (Lanzaro and Lawler, 2005; Lawler, 2005).

RI-10. Post harvest rice field re-flooding for organic decomposition should commence after seasonal temperatures have cooled substantially so field conditions are not conducive to mosquito production. Generally after the 2nd Saturday in October.

Organic Rice Production (Includes Fulfilling Required BMPs RI-1 to RI-10)

RI-11. Wherever feasible, maintain borrow pits (12"-18" deep) on both sides of each check throughout rice fields to provide refuge for mosquitofish during low water periods.

RI-12. Signed Organic Rice Production Cooperative Agreement on file with the District specifying desired option, desired management, and/or treatment option.

STORMWATER SYSTEMS

Common Mosquito-Breeding Sites

- Detention/retention basins/ponds
- Treatment wetlands
- Catch basins/storm drains
- Underground water storage devices
- Combined Sewer Systems
- Clogged sediment screens
- Blocked culverts
- Roadside ditches
- Beaver dams

Common Mosquito Species Identified In Above Listed Sites

- Above ground/clean-water sources: *Culex tarsalis*
- Underground/polluted or nutrient rich water: *Culex pipiens*

Special Concerns

The National Pollution Discharge Elimination System (NPDES) permit requirements have established a new emphasis for storm water handling. Storm water facilities are often ideal mosquito development sites and support large populations of vectors of diseases such as West Nile virus in close proximity to urban and residential areas. It is critical to consider mosquito production in storm water structures at the planning stages of new development, and to identify appropriate actions to address mosquito problems in existing facilities. Coordination with the NPDES program will be critical in the success of this endeavor. All chemical applications which may enter waters of the State shall be performed in accordance with the requirements of the Statewide General NPDES Permit for Discharge of Aquatic Pesticides for Vector Control (Water Quality Order 2004-0008-DWG).

General Practices To Reduce Mosquito Breeding

1. Prevent or eliminate unnecessary standing water that stands for more than 72 hours during mosquito season. Mosquito season starts when the weather warms and ends when the weather cools.
2. Maintain access for District staff to monitor and treat mosquito-breeding sources.
3. Minimize emergent vegetation and surface debris on the water.
4. Contact the District for technical guidance and/or assistance in implementing BMPs to reduce mosquito-breeding.

BMPS AIMED TO REDUCE MOSQUITO-BREEDING IN STORMWATER SYSTEMS

Above Ground Storm Water Structures (Retention / Detention Ponds, Storm Water Ponds)

SW-1. Build shoreline perimeters as steep and uniform as practicable to discourage dense plant growth (Metzger, 2004).

SW-2. Whenever possible, maintain storm water ponds and wetlands at depths in excess of 4 feet (1.2 m) to limit the spread of invasive emergent vegetation such as cattails (Typha spp.) (Kwasny et. al., 2004; Metzger, 2004).

SW-3. Eliminate floating vegetation conducive to mosquito production (e.g., water hyacinth, Eichhornia spp., duckweed Lemna and Spirodela spp., and filamentous algal mats) (Metzger, 2004).

SW-4. Perform routine maintenance to reduce emergent plant densities to facilitate the ability of mosquito predators (i.e., mosquitofish) to move throughout vegetated areas (Metzger, 2004).

SW-5. Make shorelines accessible to maintenance and vector control crews for periodic maintenance, control, and removal of emergent vegetation, as well as for routine mosquito monitoring and abatement procedures, if necessary (Metzger, 2004).

SW-6. Design and obtain necessary approvals for all storm water ponds and wetlands to allow for complete draining when needed (Metzger, 2004).

SW-7. The effective swath width of most backpack or truck-mounted larvicide sprayers is approximately 20 feet (6 m) on a windless day. Because of these equipment limitations, all-weather road access (with provisions for turning a full-size work vehicle) should be provided along at least one side of large aboveground structures that are less than 25 feet (7.5 m) wide (Metzger, 2004).

SW-8. Access roads should be built as close to the shoreline as possible. Vegetation or other obstacles should not be permitted between the access road and the storm water treatment device that might obstruct the path of larvicides to the water (Metzger, 2004).

SW-9. Vegetation should be controlled (by removal, thinning, or mowing) periodically to prevent barriers to access (Metzger, 2004).

SW-10. Design structures so they do not hold standing water for more than 72 hours. Special attention to groundwater depth is essential (Metzger, 2004).

SW-11. Use the hydraulic grade line of the site to select a treatment BMP that allows water to flow by gravity through the structure. Pumps are not recommended because they are subject to failure and often require sumps that hold water (Metzger, 2004).

SW-12. Avoid the use of loose riprap or concrete depressions that may hold standing water (Metzger, 2004).

SW-13. Avoid barriers, diversions, or flow spreaders that may retain standing water (Metzger, 2004).

SW-14. Use concrete or liners in shallow areas to discourage unwanted plant growth where vegetation is not necessary (Metzger, 2004).

SW-15. Where feasible, compartmentalize managed treatment wetlands so that the maximum width of ponds does not exceed two times the effective distance (40 feet [12 m]) of land-based application technologies for mosquito control agents (Walton, 2003).

SW-16. Incorporate features that prevent or reduce the possibility of clogged discharge orifices (e.g., debris screens). The use of weep holes is not recommended due to rapid clogging (Metzger, 2004).

SW-17. Design distribution piping and containment basins with adequate slopes to drain fully and prevent standing water. The design slope should take into consideration buildup of sediment between maintenance periods. Compaction during grading may also be needed to avoid slumping and settling (Metzger, 2004).

SW-18. Catch basins, drop inlets, storm drains, and other structures originally designed to not hold water should be regularly checked and maintained to function as designed.

SW-19. Basins designed to be dry but remain wet should be corrected by retrofit, replacement, repair, or more frequent maintenance.

SW-20. Coordinate cleaning of catch basins, drop inlets, or storm drains with mosquito treatment operations.

SW-21. Enforce the prompt removal of silt screens installed during construction when no longer needed to protect water quality.

Underground Storm Water Structures (Drain Inlets, Sumps, Vaults, Catch Basins)

SW-22. Completely seal structures that retain water permanently or longer than 72 hours to prevent entry of adult mosquitoes (Metzger, 2004).

SW-23. Storm water structures utilizing covers should be tight fitting with maximum allowable gaps or 1/16-inch (2 mm) holes of to exclude entry of adult mosquitoes (Metzger, 2004).

SW-24. If the sump, vault, or basin is sealed against mosquitoes, with the exception of the inlet and outlet submerge the inlet and outlet completely to reduce the available surface area of water for mosquito egg-laying (female mosquitoes can fly through pipes) (Metzger, 2004).

SW-25. Design structures with the appropriate pumping, piping, valves, or other necessary equipment to allow for easy dewatering of the unit when necessary (Metzger, 2004).

MANAGED WETLANDS

Common Mosquito-Breeding Sites

- Managed permanent wetlands (flooded year round)
- Managed semi-permanent wetlands (flooded fall through mid-summer)
- Managed seasonal wetlands (flooded fall into spring; generally irrigated late spring/summer)

Common Mosquito Species Identified In Above Listed Sites

- Managed permanent and semi-permanent wetlands: *Culex tarsalis* & *Anopheles freeborni*
- Managed seasonal wetlands: *Aedes melanimon*, *Culex tarsalis*, & *Anopheles freeborni*

Special Concerns

Managed wetlands are being built and restored across northern California. Each varies depending on the habitat, water quality, water availability, recreational, economic, and other management goals, and may be subject to additional regulations including state and federal conservation easements and management plans. Best Management Practices (BMPs) aimed at the reduction of mosquito-breeding attempt to balance the management goals of land managers, landowners, and other regulatory agencies with the need for effective mosquito control. The District is committed to working with wetland managers and state and federal agencies, to implement mosquito control practices in a cooperative manner. Mosquito and Vector Control Association of California (MVCAC) and the California Department of Public Health worked cooperatively with the United States Fish and Wildlife Services, California Department of Fish and Game, and Central Valley Joint Venture to develop a list of potential BMPs (Kwasny et al 2004).

General Practices To Reduce Mosquito Breeding

1. Prevent or eliminate unnecessary standing water that stands for more than 72 hours during mosquito season. Mosquito season starts when the weather warms and ends when the weather cools.
2. Maintain access for District staff to monitor and treat mosquito-breeding sources.
3. Minimize emergent vegetation and surface debris on the water.
4. Contact the District for technical guidance and/or assistance in implementing BMPs to reduce mosquito-breeding.

BMPS AIMED TO REDUCE MOSQUITO-BREEDING IN MANAGED WETLANDS

Wetland Design and Maintenance

MW-1. Maintain all open ditches by periodically regularly removing trash, silt, and vegetation to maintain efficient water delivery and drainage (Kwasny et. al., 2004).

MW-2. Provide reasonable access on existing roads and levees to allow mosquito abatement technicians access for monitoring, abatement, and implementation of BMPs. Make shorelines of natural, agricultural, and constructed water bodies accessible to maintenance and vector control crews for periodic maintenance, control, and removal of emergent vegetation, as well as for routine mosquito monitoring and abatement procedures (Kwasny et. al., 2004).

MW-3. Inspect, repair, and clean water control structures of debris. Remove silt and vegetation build-up in front of structures that impedes drainage or water flow. Completely close, board or mud-up controls to prevent unnecessary water flow, except where water circulation is necessary (Kwasny et. al., 2004).

MW-4. Perform regular pump efficiency testing and make any necessary repairs to maximize output (Kwasny et. al., 2004).

MW-5. Construct, improve, or maintain ditches with 2:1 slopes and a minimum 4-foot bottom. Consider a 3:1 slope or greater to discourage burrowing animal damage, potential seepage problems, and prevent unwanted vegetation growth (Kwasny et. al., 2004). Other designs may be approved by the District depending on special circumstances.

MW-6. Construct, or improve, or maintain levees to quality standard that ensures stability and prevents unwanted seepage. Ideally build levees with >3:1 slopes & >80% compaction; consider >5:1 slope or greater in areas prone to overland flooding and levee erosion (Kwasny et. al., 2004).

MW-7. Ensure adequately sized water control structures are in place. Increase size and number of water control structures if necessary to allow for complete draw-down and rapid flooding (Kwasny et. al., 2004; Walton, 2003).

MW-8. Inspect and repair levees at least annually (Kwasny et. al., 2004).

MW-9. Design managed wetland projects to include independent inlets and outlets for each wetland unit (Kwasny et. al., 2004).

MW-10. Construct or enhance swales so they are sloped from inlet to outlet and allow the majority of the wetland to be drawn down (Kwasny et. al., 2004).

MW-11. Install cross-levees to facilitate more rapid irrigation and flood-up. Build “underwater” levees that isolate irrigation water during the spring, but can be overtopped during fall and winter flooding (Kwasny et. al., 2004).

MW-12. Excavate deep channels or basins to maintain permanent water areas (> 2.5 feet deep) within a portion of seasonal managed wetlands. This provides year-round habitat for mosquito predators which can inoculate seasonal wetlands when they are irrigated or flooded (Kwasny et. al., 2004).

MW-13. Maintain separate permanent water reservoir that conveys water to seasonal wetlands. Provides year-round habitat for mosquito predators which can inoculate seasonal wetlands when they are irrigated or flooded (Kwasny et. al., 2004).

MW-14. Encourage populations of insectivorous birds (e.g. swallows) and bats by preserving nesting and roosting areas (Kwasny et. al., 2004).

Wetland Vegetation Management

MW-15. Control floating vegetation conducive to mosquito production (i.e., water hyacinth, water primrose, parrot's feather Eichhornia spp., duckweed Lemna and Spirodela spp., and filamentous algal mats) (Metzger, 2004).

MW-16. Perform routine maintenance to reduce problematic emergent plant densities to facilitate the ability of mosquito predators (i.e., fish) to move throughout vegetated areas, and allow good penetration of chemical control agents (Kwasny et. al., 2004).

Wetland Water Management

MW-17. Maintain stable water level during mosquito season by ensuring constant flow of water into pond or wetland to reduce water fluctuation due to evaporation, transpiration, outflow, and seepage (Kwasny et. al., 2004; Walton, 2003).

MW-18. Flood managed wetlands with water sources containing mosquitofish or other invertebrate predators. Water from permanent ponds can be used to passively introduce mosquito predators (Kwasny et. al., 2004).

MW-19. Rapidly irrigate wetlands keeping the time water enters the pond to complete drawdown 72 hours.

MW-20. Extended duration irrigations (generally 14-17 days) may be considered for weed control (e.g. cocklebur). Additional measures to offset the potential for increased mosquito production may be needed.

MW-21. Delay fall flooding to avoid increasing late-season mosquito production. (Kwasny et. al., 2004).

MW-22. Implement additional BMPs for wetlands that need to be flooded earlier than recommended in the fall. The wetlands targeted for early fall flooding should not be near urban centers and should not have a history of heavy mosquito production (Kwasny et. al., 2004).

MW-23. Flood managed wetland unit as fast as possible. Coordinate flooding with neighbors or water district to maximize flood-up rate (Kwasny et. al., 2004).

MW-24. Encourage water circulation by providing a constant flow of water equal to discharge at drain structure (Kwasny et. al., 2004).

MW-25. Flood managed wetland as deep as possible at initial flood-up (1 8-24”). Shallow water levels can be maintained outside of the mosquito breeding season. (Kwasny et. al., 2004).

MW-26. Drain irrigation water into ditches or other water bodies with abundant mosquito predators. Prevent free flooding into fallow or dry fields (Kwasny et. al., 2004).

MW-27. Use a flood-drain-flood regime to control floodwater mosquitoes. Flood wetland to hatch larvae in the pond. Drain wetland to borrow or other ditch where larvae can be easily treated, drowned in moving water, or consumed by predators. Immediately re-flood wetland. (Kwasny et. al., 2004). Note: This water management regime should be used only when it does not conflict with water quality regulations.

MW-28. Evaluate necessity of irrigation, especially multiple irrigations, based on spring habitat conditions and plant growth. Reduce number and duration of irrigations when feasible (Kwasny et. al., 2004).

MW-29. Where feasible, draw-down managed wetland in late March or early April. Irrigate in late April or early May when weather is cooler and mosquitoes are less of a problem (Kwasny et. al., 2004).

MW-30. Irrigate managed wetland before soil completely dries to prevent soil cracking between spring draw-down and irrigation (Kwasny et. al., 2004).

MW-31. Stock managed wetlands, especially brood ponds or permanent wetlands, with mosquitofish or encourage habitat for naturalized populations. Utilize water sources with mosquitofish to passively transport predators to newly flooded habitats (Kwasny et. al., 2004).

MW-32. Maintain permanent or semi-permanent water where mosquito predators can develop and be maintained. Discourage use of broad spectrum pesticides (Kwasny et. al., 2004).

MW-33. Where feasible, have an emergency plan that provides for immediate drainage into acceptable areas if a public health emergency occurs (Walton, 2003).

MW-34. Minimize fluctuations in water level to prevent large areas of intermittently flooded substrate or isolated pools from being created, particularly during mosquito season which can start as early as March and extend through October depending on weather (Kwasny et. al., 2004).

Coordination With The District

MW-35. Consult with the District on agency-sponsored habitat management plans on private lands (e.g. Presley Program), and on the timing of wetland flooding on public and private lands — urge private landowners to do the same (Kwasny et. al., 2004).

MW-36. Identify problem locations for mosquito production with the District and work to implement mosquito BMPs. Identify potential cost-share opportunities to implement BMPs (Kwasny et. al., 2004).

MW-37. Consult with the District on the design of restoration and enhancement projects that have the possibility of effecting mosquito production or control operations (Kwasny et. al., 2004).

URBAN AND SUBURBAN MOSQUITO-BREEDING SOURCES

Common Mosquito Breeding Sites

- Un-maintained swimming pools and spas
- Decorative ponds and fountains
- Bird baths
- Water-filled containers
- Clogged rain gutters
- Poorly designed or damaged landscape irrigation systems
- Cemetery vases
- Ornamental and/or Koi ponds
- Stored or waste tires

Common Mosquito Species Identified In Above Listed Sites

- Cleaner water sources: *Culex tarsalis*
- Water with more organic material: *Culex pipiens* & *Culex stigmatosoma*
- Containers with high organic material: *Aedes sierrensis*

Special Concerns

Urban and suburban mosquito sources are especially important because, sources may be in and around private residences which are not easily seen or accessed by mosquito and vector control specialists and produce mosquitoes in areas of high population density. This can quickly lead to vector-borne disease transmission since the vector (mosquito) and host (human) are often in close proximity. Most urban and suburban mosquito species produced are the species of mosquito that is of highest importance due to their more than favorable ability to transmit WNV. Economic or social changes in a neighborhood can result in an increase in mosquito sources such as un-maintained swimming pools. Fortunately, most Best Management Practices (BMPs) for residential areas are relatively inexpensive and easy to implement.

General Practices To Reduce Mosquito Breeding

1. Prevent or eliminate unnecessary standing water that stands for more than 72 hours during mosquito season. Mosquito season starts when the weather warms and ends when the weather cools.
2. Maintain access for District staff to monitor and treat mosquito-breeding sources
3. Minimize emergent vegetation and surface debris on the water
4. Contact the District for technical guidance and/or assistance in implementing BMPs to reduce mosquito-breeding

BMPS AIMED TO REDUCE MOSQUITO-BREEDING IN URBAN AND SUBURBAN SOURCES

Urban & Suburban Residential Areas

US-1. Drain all containers of standing water, including pet dishes, wading pools, potted plant drip trays, boats, birdbaths, tires, and buckets, at least once a week during mosquito season. Keep in mind that mosquitoes can develop in as little as 1 /8" of standing water.

US-2. Use an approved disinfection process (chlorine, bromine) to prevent mosquito breeding in swim-ming pools and spas. Use skimmers and filter systems to re¬move egg rafts and mosquito larvae.

US-3. If a pool or spa is not going to be maintained for any reason, do one of the following: 1) drain the pool or spa completely of any water (note that in-ground pools may be damaged by being completely drained. Above-ground pools and spas generally may be drained without damage), 2) notify the District so that the pool can be inspected regularly and treated with a larvicide and/or stocked with mosquitofish if needed.

US-4. Notify the District of any ponds (including ponds with ornamental fish such as koi or goldfish) with permanent or seasonally permanent water. Allow District technicians to inspect and periodically stock mosquitofish or guppies to biologically control mosquito larvae.

US-5. Landscape irrigation drainage should be managed such that no water stands for more than 72 hours during mosquito-breeding season (generally March-October).

US-6. All underground drain-pipes should be laid to grade to avoid low areas that may hold water for longer than 72 hours.

US-7. Keep rain gutters clear of leaves and debris. Check for standing water in gutters after rain events during mosquito season.

US-8. Provide safe access for District technicians to all pools, spas, ponds, landscape irrigation structures, catch basins, storm drains, drainage pipes, sewer cleanouts, or any other potential mosquito-breeding source.

US-9. Repair leaks or damaged drainage system components to prevent standing water for more than 72 hours during mosquito season.

US-10. Notify District of any condition that may produce mosquitoes on the property such as flooding, broken pipe, damaged septic tank cover, leaking outdoor faucet if unable to be fixed or results in standing water for more than 72 hours during mosquito season.

Tire Storage

TR-1. Never allow water to accumulate in tires. Tires should be stored in a covered location or covered by a tarp in order to prevent the accumulation of water from rain, sprinklers, etc.

TR-2. Tires should never be stored in a pile. Tires should be stored on racks or in a stack not more than two rows wide.

TR-3. Tires should be stored in a manner that allows inspections of each individual tire.

TR-4. Waste tires should be picked up by the proper disposal entity on a regular basis.

TR-5. Those responsible for stored tires should inspect and dump out any water that may have accumulated inside tires on their premises on a weekly basis.

TR-6. Tires used for boundary markers should be cut in half or have one inch or larger holes drilled in lower side walls to prevent water accumulation.

Cemetery Flower Vases

CV-1. Use a water-absorbing polymer material (super-absorbent polyacrylamide) which turn standing water into a gel. This eliminates the chance of mosquito development yet allows cut flowers to remain fresh.

CV-2. Seek alternatives to in-ground or mounted flower vases which can hold water for less than 72 hours.

CV-3. Dump out all vases weekly during the spring, summer, and fall.

REFERENCES

Creedon, P.E., Waste Discharge Requirements General Order for Existing Milk Cow Dairies (Tentative), Central Valley Region-CRWQCB, 2006.

Dever, T., Hagele, C. A., Mellor, K. S., Middleton, K., Are you raising a killer in your cemetery? 2007 American Cemetery, April 2007.

Kwasny, D.C., Wolder, Mike and Isola, Craig R., Technical Guide to Best Management Practices for Mosquito Control in Managed Wetlands, Central Valley Joint Venture, 2004, U.S. Bureau of Reclamation.

Lawler, S.P., UC IPM Pest Management Guidelines: Rice, 2005, UC ANR, Publication #8117.

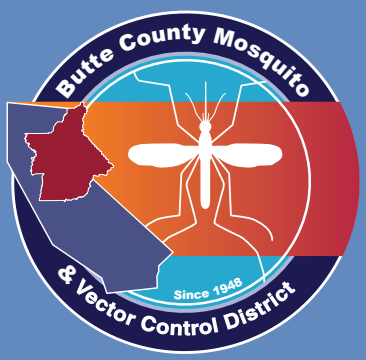
Lawler, S. P., Lanzaro, G.C., Managing Mosquitoes on the Farm, 2005, UC ANR, Publication #8158.

Metzger, M.E., Managing Mosquitoes in Stormwater Treatment Devices, 2004, UC ANR Publication #8125.

Best Management Practices to Minimize Mosquito Breeding in Rice Fields, in Industry Guidance to California Rice Producers. 2005, California Rice Commission. Note: Document expired Dec 2006.

Walton, W.E., Managing Mosquitoes in Surface Flow Constructed Treatment Wetlands, 2003, UC ANR Publication #8117.

Best Management Practices for mosquito control on California state properties. June 2008, California Department of Public Health.



Butte County Mosquito And Vector Control District
5117 Larkin Road
Oroville, CA. 95965
Phone: (530) 533-6038, (530) 342-7350

WWW.BCMVCD.COM