PREVENTING MOSQUITOES
Guidelines to Reduce and Eliminate Mosquito Breeding Sites in the Coachella Valley
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INTRODUCTION ................................................................................................. 1

Why Should You Care about Preventing Mosquitoes? ................................ 2

Basic Mosquito Biology .................................................................................. 3
  Standing Water Mosquitoes ....................................................................... 4
  Flood Water Mosquitoes .......................................................................... 5

MOSQUITO REDUCTION
BEST MANAGEMENT PRACTICES (BMPs) .................................................. 7

Universally Applicable Mosquito Control BMPs ......................................... 8

Residential Properties ................................................................................... 9

Tire Storage ..................................................................................................... 12

Pastures and Agricultural Properties .......................................................... 13
  Ditches and Drains .................................................................................. 13
  Irrigated Pastures ................................................................................... 14

Wetlands ......................................................................................................... 15

Storm Water Management and Infrastructures .......................................... 18

ABATEMENT AND HEALTH AND SAFETY CODE .............................. 20
Preventing Mosquitoes: Guidelines to Reduce and Eliminate Mosquito Breeding Sites

INTRODUCTION

Controlling mosquitoes is critical to maintaining both a high quality of life and protecting people from mosquito-transmitted (vectored) diseases such as West Nile virus (WNV). These guidelines provide property owners and managers of homeowner associations (HOAs), country clubs, golf courses, and agricultural land with Best Management Practices for mosquito reduction. By implementing the following best practices property owners and managers can:

- Reduce mosquito production from permanent water sources
- Reduce or eliminate mosquito production from temporary water sources
- Reduce the potential for disease transmission to humans.

These guidelines are based on the California Department of Public Health (CDPH)/Mosquito and Vector Control Association of California (MVCAC) Best Management Practices guide and are intended to assist property owners and managers. The recommended practices, when properly implemented, are in line with best practices for water conservation and can lead to reductions in water usage and cost, while increasing the efficacy of biological and chemical control measures for mosquitoes.
MOSQUITOES VECTOR DISEASE

About 12 mosquito species have been detected in the Coachella Valley. Two of those species currently are vectors (or transmitters) of disease agents to humans within the Coachella Valley. The Encephalitis Mosquito (Culex tarsalis) has been known to transmit West Nile virus, western equine encephalomyelitis, and St. Louis encephalitis. The Southern House Mosquito (Culex quinquefasciatus) can transmit West Nile virus and St. Louis encephalitis. These diseases can have permanent impacts on the nervous system and in rare cases lead to death. The only method to prevent contracting these diseases is to prevent being bitten by mosquitoes. An invasive mosquito species, Aedes aegypti, has also been detected in the Coachella Valley. This mosquito species is capable of transmitting dangerous viruses, such as dengue, chikungunya, and Zika, however, currently there is no local mosquito transmission of these viruses.

MOSQUITOES ARE A NUISANCE THAT WE CAN REDUCE

Immature mosquitoes live in standing water. We can reduce mosquito populations by reducing the amount of standing water present in the Coachella Valley.

MOSQUITO PREVENTION IS THE LAW

Under the California Health and Safety Code, mosquito and vector control districts may legally abate a public 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” (HSC §2002(j)). Abatement can result in civil penalties of up to $1000 per day (HSC §2085(a), §2061).
BASIC MOSQUITO BIOLOGY

Mosquitoes have aquatic stages (larva and pupa) and an aerial stage (adult). Mosquito larvae breathe air from above the water surface and 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 swim down into the water column in a serpentine motion (giving rise to their common names of wigglers and wrigglers).

Mosquitoes then go through a non-feeding stage called a pupa. The easily identified comma-shaped pupae hang from the water surface and move down through the water column in a rolling or tumbling motion when disturbed. This life stage typically lasts about a day, with the mosquito emerging from the back of the pupal case (above the water) as a flying adult mosquito.

All adult mosquitoes feed on plant nectar; however blood is essential for female mosquitoes to produce eggs. To take a blood meal, the female's mouth parts pierce the skin, inject saliva, and suck blood out. It is through the injection of saliva that a mosquito causes the typical itchy bump and can infect a person or domestic animal with a disease causing organism. Depending on an individual's immune response, even a single bite can be a significant nuisance.

Typically, mosquitoes in the Coachella Valley are divided into standing water species and floodwater species.

THE MOSQUITO LIFE CYCLE

![Mosquito Life Cycle Diagram]
STANDING WATER MOSQUITOES

Standing water species are found in areas where water is allowed to pool and stagnate. Adult mosquitoes lay eggs on the water surface. The eggs float for a few hours to a few days until the larvae hatch in the water. These species can develop in containers, neglected swimming pools, catch basins, open ditches, retention/detention ponds, natural or constructed wetlands, storm water management devices, and along the edges of flowing streams.

The **Encephalitis Mosquito** (*Culex tarsalis*) can transmit encephalitis viruses, such as West Nile virus, to humans. It can be found throughout the Coachella Valley. Immature mosquitoes develop in wetlands, duck clubs, irrigated crop fields, and neglected pools. The adult mosquito prefers to feed on birds and mammals. It is most active during spring, summer, and fall.

The **Southern House Mosquito** (*Culex quinquefasciatus*) is a secondary vector of West Nile virus and St. Louis encephalitis. It is common throughout the Coachella Valley. Immature mosquitoes often develop in foul water sources such as wastewater lagoons, storm water drains, neglected pools, and other containers. It prefers to feed on birds but will readily feed on humans. This mosquito is most active during the spring, summer, and fall.
FLOODWATER MOSQUITOES

Psorophora columbiae  Aedes vexans

Floodwater mosquitoes lay eggs on mud or previously submerged vegetation. The eggs can hatch when the area becomes flooded with water, or they may remain dormant for days to years until the right conditions are available. Floodwater mosquito development sites include irrigated pastures and seasonally flooded duck clubs. These intermittent or seasonally flooded habitats can be among the most productive sources of mosquitoes because they are often free of natural predators.

Psorophora columbiae is a severe outdoor pest in rural areas of the Coachella Valley. The primary sources of these mosquitoes are flood irrigated agricultural fields and pastures. It is present from early summer to late fall. This mosquito prefers to feed on large mammals, including humans, and will bite both day and night with a peak of activity at sunrise and sunset. It can complete development from egg to adult within 3 to 5 days during the extreme temperatures of summer, which makes control of this species very difficult.

The Inland Floodwater Mosquito (Aedes vexans) is a secondary vector of dog heartworm and is a severe outdoor pest. It is common in irrigated pastures and in woodland water course pools. The adults feed mainly on mammals. This mosquito is most active in early spring through late fall. They typically bite at dawn and dusk but can also be active during the day.
MOSQUITO REDUCTION
BEST MANAGEMENT PRACTICES (BMPs)

The Coachella Valley Mosquito and Vector Control District (District) uses an Integrated Vector Management (IVM) approach to mosquito and vector control. The IVM approach focuses on site-specific, scientifically sound decisions to target the solution to the problem at hand. Typically, the techniques for controlling vectors are grouped into the following categories:

1. **SOURCE REDUCTION OR PHYSICAL CONTROL** manipulating the habitat to reduce mosquito breeding sites

2. **CULTURAL CONTROL** changing the behavior of people so that their actions prevent the development of mosquitoes or the transmission of vector-borne diseases

3. **BIOLOGICAL CONTROL** adding an animal to the environment that will eat the mosquitoes, for example, adding mosquitofish to a golf course pond

4. **CHEMICAL CONTROL** using larvicides (materials designed to kill immature larval mosquitoes) and adulticides (materials that kill adult mosquitoes)

Every site is unique. After evaluating the source of the mosquitoes, we implement the mosquito control practices applicable to the circumstances. We encourage property owners and managers to also use appropriate best practices as an efficient and effective way to help prevent a mosquito problem. Fortunately, many of the steps in these guidelines are affordable and easy to implement.
UNIVERSALLY APPLICABLE MOSQUITO CONTROL BMPs

GENERAL PRINCIPLES

1. Prevent or eliminate unnecessary standing water that remains for more than 96 hours.

2. Maintain water features such as ponds and fountains to circulate water with pumps that run at least eight hours a day. If the feature has no pump, water should be changed every 96 hours to prevent mosquito breeding and/or pesticide treatment may be necessary.

3. Maintain irrigation systems to avoid excess water use and runoff into storm drains.

4. Apply an EPA-registered mosquito repellent when outdoors; especially around dusk and dawn when mosquitoes are most active.

5. Wear loose-fitting protective clothing including long sleeves and pant legs.

6. Install and properly maintain fine mesh screens on windows and doors to prevent mosquito entry into homes.

7. Contact the District for technical guidance or assistance to prevent a mosquito problem on your property.

8. Maintain access for District staff to monitor and treat mosquito breeding sources.

9. Train and inform homeowners and landscape and maintenance staff about Best Management Practices and personal protective measures such as irrigation and landscape maintenance to reduce mosquito breeding potential of sites commonly found in urban environments.

COLLABORATE WITH LOCAL MOSQUITO CONTROL PROGRAM

1. Contact the District to evaluate your property for mosquito breeding sites to prevent a mosquito problem on your property.

2. Ensure mosquito control technicians are able to easily access and treat mosquito breeding sites.
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RESIDENTIAL PROPERTIES

Urban and suburban mosquito sources are especially problematic because they produce mosquitoes in areas of high population density where many people live and work. This can quickly lead to mosquito-borne disease transmission since mosquitoes and humans are often in close proximity. Follow these guidelines to reduce the chances of people getting sick in your community.

PROPERTY MAINTENANCE – Eliminate man-made mosquito breeding sites and harborage:

1. Examine outdoor areas and drain temporary and unnecessary water that may stand longer than 96 hours.

2. Be aware of containers and objects that are subject to collecting water including pet dishes, potted plant drip trays, boats, birdbaths, and tires and buckets. Change water at least once per week. Mosquitoes can develop in as little as a 1/8” of standing water. Dispose of unwanted or unused artificial containers.

3. If possible, drill drainage holes, cover, or invert any container or object, that holds standing water and must remain outdoors. Be sure to check for containers or trash in places that may be hard to see, such as under bushes or buildings.

4. Ensure regular chlorination of swimming pools and that pumps and filters are operating. Unused or unwanted pools should be kept empty and dry. If a pool or spa is not going to be operational for any reason, notify the District so that the pool or spa can be inspected regularly and treated with an appropriate larvicide and/or stocked with mosquitofish, if needed. These services are provided at no additional charge and are supported by property taxes.
5. Properly dispose of any old tires that may collect water.

6. Clean clogged rain gutters and storm drains. Keep outdoor drains flowing freely and clear of leaves, vegetation, and other debris.

7. Use waterfalls, fountains, aerators and/or mosquitofish in ponds and ornamental water features. Mosquitofish are provided by the District at no charge. For ponds and ornamental water features where mosquitofish cannot be used, landowners should contact the District.

8. Minimize sites mosquitoes can use for refuge (harborage) by thinning branches, trimming and pruning ornamental shrubs and bushes, and keeping grass mowed short.

9. Install screens on small drains and keep them free of water and debris.

10. Back-fill tire ruts or other low areas that hold water for more than 96 hours.
IRRIGATION AND DRAINAGE – Prevent mosquito breeding associated with poorly managed irrigation, drainage, and landscape features:

1. Manage sprinkler and irrigation systems to minimize runoff entering storm water infrastructure. Ensure appropriate sprinkler type and placement for the landscaping, e.g., Variable Arc Nozzle (VAN) sprinklers for small or odd-shaped lawns (should be placed at least 6 inches from sidewalks and streets), drip sprinklers should be used for flowerbeds or desert landscapes to prevent “watering” the streets and sidewalks. Reduce watering time and increase frequency to grass, plants, and trees to provide sufficient time to absorb the water without waste.

2. Routinely inspect, maintain, and repair irrigation system components.

3. All underground drain pipes should be laid to grade to avoid low areas that may hold water for longer than 96 hours.

4. Improve drainage channels and grading to minimize potential for standing water.

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

6. Vegetation should be controlled regularly to prevent overgrowth of emergent vegetation and vegetative barriers for District access. This includes vegetation control to maintain access to lanes and paths, interior pond embankments, and any weed growth that might become established within the pond. Vegetation in water features provides a protected spot for mosquitoes to lay their eggs.

7. Check and repair leaky outdoor faucets.

8. Construct or improve large ditches to a slope of at least 2:1 and a minimum 4-foot wide bottom. Consider a 3:1 slope or greater to discourage burrowing animal damage, potential seepage problems, and prevent unwanted vegetation growth.

9. Design irrigation systems to use water efficiently and drain completely to avoid standing water. Prevent wet areas associated with seepage by repairing leaks in dams, ditches, and drains.

10. Use desert landscape/xeriscape to reduce water usage and wastage. Install curb set-backs to maintain space between turfgrass and the street; these can include placing rocks, a sidewalk or sections of desert landscaping adjacent to the street to minimize the risk of water runoff into the street.
Old tires can quickly become an area for mosquitoes to breed. These storage and inspection techniques will make it easy to control the mosquitoes.

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 or sprinklers. If water does accumulate, it should be dumped immediately.

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 – this allows for inspections of each tire.

3. Waste tires should be picked up by the proper disposal entity on a regular basis.
PASTURES AND AGRICULTURAL PROPERTIES

Most floodwater mosquitoes develop on pasture and agricultural land in the Coachella Valley. Floodwater mosquitoes can become a severe nuisance in the surrounding community (see Basic Mosquito Biology).

DITCHES AND DRAINS

1. Construct or improve ditches with at least 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.

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

3. Design irrigation systems to use water efficiently and drain completely to avoid standing water.
IRRIGATED PASTURES

1. Grade field to achieve efficient use of irrigation water. Use Natural Resources Conservation Service (NRCS) guidelines for irrigated pastures. Initial laser leveling and periodic maintenance to repair damaged areas are needed to maintain efficient water flow.

2. Irrigate only as frequently as is needed to maintain proper soil moisture. Check soil moisture regularly until you know how your pasture behaves.

3. Do not over fertilize. Excess fertilizers can leach into irrigation tail water, making mosquito production more likely in ditches or further downstream.

4. Apply only enough water to wet the soil to the depth of rooting.

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

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.

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.

8. Break 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 periods. It also prevents hoof damage, increases production from irrigated pastures, and helps improve water penetration into the soil by promoting a better root system.
Managed wetlands are found across California. Each wetland may vary in habitat, water quality, and its management goals. Wetlands in the Coachella Valley include permanent wetlands for habitat or species conservation, manmade waste water treatment wetlands, and temporarily flooded duck clubs.

**DESIGN AND MAINTENANCE** – General Guiding Principles to Minimize Mosquitoes:

1. Identify problem locations for mosquito production with the District and work to implement mosquito BMPs. Consult with the District on the design of restoration and enhancement projects that have the possibility of effecting mosquito production or control operations.

2. Maintain all open ditches – regularly remove trash, silt, and vegetation to maintain efficient water delivery and drainage.

3. Ensure mosquito control technicians are able to easily access and treat mosquito breeding sites. 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.
4. 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.

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.

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 over-land flooding and levee erosion.

7. Inspect and repair levees at least annually.

8. Design managed wetland projects to include independent inlets and outlets for each wetland unit.

9. 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.

10. Provide nesting and roosting sites for birds and bats. They can feed on adult mosquitoes to help reduce the population.

11. Whenever possible, maintain wetlands at depths greater than 4 feet (1.2 m) to limit the spread of invasive emergent vegetation such as cattails and bulrush.
MANAGE VEGETATION – Keep the wetland productive and to make mosquito treatments easy:

1. Control floating vegetation conducive to mosquito production.
2. Perform routine maintenance to reduce emergent plant densities to allow mosquito predators (e.g., fish) to move throughout vegetated areas, and to allow good penetration of chemical control agents.

WATER MANAGEMENT – To help reduce mosquitoes:

1. Minimize fluctuations in water level to prevent large areas of intermittently flooded substrate or isolated pools from being created, particularly during mosquito season.
2. Flood managed wetlands with water sources containing mosquitofish or invertebrate predators. Water from permanent ponds can be used to passively introduce mosquito predators.
3. Delay early fall flooding to avoid increased late-season mosquito production. Implement additional BMPs for managed 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.
4. Flood managed wetlands as fast as possible. Coordinate flooding with neighbors or water district to maximize flood-up rate.
5. Encourage water circulation by providing a constant flow of water equal to discharge at drain structure.
6. Flood managed wetland as deep as possible at initial flood-up (18-24").
7. Stock managed wetlands, especially brood ponds or permanent wetlands, with mosquitofish, or encourage habitat for naturalized populations.
8. Where feasible, have an emergency plan that provides for immediate drainage into acceptable areas if a public health emergency occurs.
The size and variability of storm water infrastructure, inconsistent quantity and timing of water flows, and tendency to carry and accumulate sediment, trash, and debris, make these systems highly conducive to holding areas of standing water ideal for production of mosquitoes.

1. Consider mosquito production during the design, construction, and maintenance of storm water infrastructure. Design and maintain systems to fully discharge captured water in 96 hours or less. Include access for maintenance in system design.

2. Design outfalls (discharge points) to prevent scour depressions that can hold standing water.

3. Design structures so that they do not hold standing water for more than 96 hours to prevent mosquito development. Features to prevent or reduce the possibility of clogged discharge orifices (e.g., debris screens, permeable pavers) should be incorporated into the design.

4. Design distribution pumping and containment basins with adequate slopes to drain fully. The design slope should take into consideration buildup of sediment between maintenance periods.

5. Inspect drains regularly for the presence of standing water or immature mosquitoes.
6. Provide proper grades along conveyance structures to ensure that water flows freely.

7. Provide a uniform grade between the inlets and outlets to ensure that all water is discharged in 96 hours or less. Routine inspection and maintenance are crucial to ensuring the grade remains as designed and to remove accumulations of sediment, trash, and debris.

8. Keep inlets free of accumulations of sediment, trash, and debris to prevent standing water from backing up on roadways and gutters.

9. Avoid the use of electric pumps. They are subject to failure and often require permanent-water sumps. Structures that do not require pumping should be favored over those that have this requirement.

10. Install tight-fitting covers and manhole cover inserts to minimize mosquito access to permanent sources of standing water.
ABATEMENT AND HEALTH AND SAFETY CODE

Under the California Health and Safety Code (HSC), mosquito and vector control districts may legally abate a public nuisance, including areas that allow for the development, attraction, or harborage of mosquitoes or other vectors. Abatement can result in civil penalties of up to $1000.00 per day per violation (HSC §2085(a), §2061).

The District begins correcting public nuisances through voluntary compliance from the property owners or parties in possession of property (Responsible Party). Persistent violators may be subject to additional enforcement action such as having the abatement work performed by the District at the Responsible Party’s expense or having civil penalties assessed against the Responsible Party.

The District will inspect property to confirm and document that a public nuisance exists. From there, the District may issue a Request for Compliance, followed by a Notice of Violation if the nuisance is not remedied. If the issue is still not resolved, the District may issue a Notice of Public Nuisance and Order to Abate.
**WHAT HAPPENS WHEN YOU REPORT A MOSQUITO PROBLEM?**

| District Call Center Clerks take a report and enter it into the District’s digital mobile application. | **5,334** calls received by Call Center in 2015  
**757** calls complaining about mosquito problems |
|---|---|
| **24** technicians covering **2,400** square miles  
**63,622** inspections searching for mosquito larvae |
| **276,021** mosquitoes were caught in District traps and of those  
**12** species were identified |
| **District lab technicians will prepare test tubes filled with anywhere from 5 to 50 mosquitoes per sample to be tested for viruses in the District Lab.** |
| **3,903** samples of mosquitoes tested  
**99** positive for West Nile virus  
**37** positive for Saint Louis encephalitis virus |
| **15,860** larvicide treatments were made over **2,968** acres of residential, urban, and rural areas of the Coachella Valley |

Watch the video:  
[www.cvmvcd.org](http://www.cvmvcd.org)  
or  
[www.youtube.com/watch?v=TdTlg2nQs28](http://www.youtube.com/watch?v=TdTlg2nQs28)
The Coachella Valley Mosquito and Vector Control District is a non-enterprise special district accountable to the residents of the Coachella Valley and charged with protecting the public health within its boundaries through the control of vectors (such as mosquitoes) and vector-borne diseases.

The District boundary encompasses 2400 square miles, including Cathedral City, Coachella, Desert Hot Springs, Indian Wells, Indio, La Quinta, Palm Desert, Palm Springs, Rancho Mirage, and unincorporated sections of Riverside County.

The District operates under the California Health and Safety Code, Division 3, Sections 2000-2910 and is governed by an 11-member Board of Trustees. There are 57 full-time employees and 3-6 seasonal staff from April to November.

HELP US HELP YOU PROTECT YOUR COMMUNITY
FIGHT THE BITE!

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