



Mosquito Control Guidelines

This appendix presents guidance from the Countywide Program's Vector Control Plan for designing and maintaining stormwater treatment measures to control mosquitoes. Project sponsors are responsible for incorporating in their treatment measure designs and maintenance plans the design and maintenance guidance, presented below. Project plans that include stormwater treatment measures (and their maintenance plans) will be routed by the municipality to the San Mateo County Mosquito Abatement District for review. Project applicants may wish to consult with Mosquito Abatement District staff for guidance.

H.1 Design Guidance for Mosquito Control

The following design considerations were adapted from guidance prepared by the California Department of Health Services,¹ and are provided for project sponsors to use when selecting, designing, and constructing stormwater treatment measures.

General Design Principles

- Preserve natural drainage. Use site design measures to reduce the amount of stormwater runoff and provide for natural on-site runoff control. This will reduce the number of treatment measures required.
- In flat areas, where standing water may occur for more than 72 hours under existing conditions, consider grading to make minor increases in slope to improve surface drainage and prevent standing water.
- Select stormwater management measures based on site-specific conditions. Designs that take into account site conditions tend to improve drainage and limit the occurrence of stagnant water.
- Attend to ponds that temporarily impound water. Careful consideration should be made before intermittently flooded stormwater treatment measures are selected for handling stormwater. Facilities that pond water for an extended period (e.g., extended detention basins and constructed wetlands) must be designed to drain water completely within 72 hours of a storm event. Avoid placement of extended detention basins and underground

¹ Metzger, Marco, Vector-Borne Disease Section, California Department of Health Services. "Managing Mosquitoes in Stormwater Treatment Devices," 2004.

structures in areas where they are likely to remain wet (i.e., high water tables). The principal outlet should have positive drainage.

- When a new stormwater treatment measure is being installed, a selection of a type that does not require a wet pond or other permanent pool of water should be considered.
- Properly design storm drain systems. The sheltered environment inside storm drains can promote mosquito breeding. Pipes should be designed and constructed for a rate of flow that flushes the system of sediment and prevents water backing up in the pipe. Storm drains should be constructed so that the invert out is at the same elevation as the interior bottom to prevent standing water.
- Use grouted rock energy dissipaters instead of loose rock.
- In practice, many stormwater treatment measures, not only wet ponds, hold water for over 72 hours, sometimes due to their outdated designs, and possibly due to improper construction and maintenance. To ensure that public health and safety are maintained, the following suggestions should be considered for any structure that holds water for over 72 hours:
 - Select or design an alternative (or modified) device that provides adequate pollutant removal and complete drainage in 72 hours. This is the most reliable and cost-effective choice.
 - Contact state or local public health or vector control agencies to determine whether local mosquito species and local factors may preclude rapid mosquito emergence, thus safely allowing water residence times to exceed 72 hours. In some areas this may require a detailed study that should be funded by the soliciting party.
 - Provide adequate funds necessary to support routine mosquito monitoring and control and maintenance.
- Per the Vector Control Plan, project plans that include stormwater treatment measures (and their maintenance plans), will be routed to the San Mateo County Mosquito Abatement District for review. Project applicants may wish to consult with Mosquito Abatement District staff for guidance.

General Access Requirements for Mosquito Control

The following requirements are necessary to provide mosquito abatement personnel access to treatment measures for inspection and abatement activities.

- Design stormwater treatment devices to be easily and safely accessible without the need for special requirements (e.g., OSHA requirements for “confined space”).
- If utilizing covers, include in the design spring-loaded or light-weight access hatches that can be opened easily for inspection.
- Provide all-weather road access (with provisions for turning a full-size work vehicle) along at least one side of large above-ground structures that are less than 25 feet wide. For structures that have shoreline-to-shoreline distances in excess of 25 feet, a perimeter road is required for access to all sides.

Dry System Design Principles for Mosquito Control

- Design structures so they do not hold standing water for more than 72 hours.
- 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.
- Use the hydraulic grade line of the site to select a treatment measure 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.
- 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.
- Avoid the use of loose riprap or concrete depressions that may hold standing water.
- Avoid barriers, diversions, or flow spreaders that may retain standing water.
- Use mosquito net to cover sand media filter pump sumps.
- Use aluminum “smoke proof” covers for any vault sedimentation basins.
- Properly design storm drain systems. The sheltered environment inside storm drains can promote mosquito breeding. Pipes should be designed and constructed for a rate of flow that flushes the system of sediment and prevents water backing up in the pipe.

Sumps, Wet Vaults, and Catch Basin Design Principles for Mosquito Control

- Completely seal structures that retain water permanently or longer than 72 hours to prevent entry of adult mosquitoes. Adult female mosquitoes may penetrate openings as small as 1/16 inch (2 mm) to gain access to water for egg laying. Screening (24 mesh screens) can exclude mosquitoes, but it is subject to damage and is not a method of choice.
- If covers are used, they should be tight fitting with maximum allowable gaps or holes of 1/16 inch (2 mm) to exclude entry of adult mosquitoes. Gaskets are a more effective barrier when used properly.
- Any covers or openings to enclosed areas where stagnant water may pool must be large enough (2 feet by 3 feet) to permit access by vector control personnel for surveillance and, if necessary, abatement activities.
- If the sump, vault, or basin is sealed against mosquitoes, with the exception of the inlet and outlet, use a design that will submerge the inlet and outlet completely to reduce the available surface area of water for mosquito egg-laying (female mosquitoes can fly through pipes).
- Creative use of flapper or pinch valves, collapsible tubes and “brush curtains” may be effective for mosquito exclusion in certain designs.
- Design structures with the appropriate pumping, piping, valves, or other necessary equipment to allow for easy dewatering of the unit, if necessary.

Wet Ponds And Wetlands Design Principles for Mosquito Control

- If a wet pond or constructed, modified, or restored wetland must be built, appropriate and adequate funds must be allocated to support long-term site maintenance as well as routine monitoring and management of mosquitoes by a qualified agency.
- Before approving a wet pond or wetland system, evaluate the long-term costs and jurisdictional and maintenance issues associated with the potential establishment of special-status species. If any doubt exists, consider alternate stormwater treatment measures.
- Long-term management of mosquitoes in wet ponds and wetlands should integrate biological control, vegetation management and other physical practices, and chemical control as appropriate.
- Provide for regular inspection of sites for detection of developing mosquito populations. Local factors may influence the overall effectiveness of certain approaches for mosquito reduction.
- Wet ponds and wetlands should maintain water quality sufficient to support surface-feeding fish such as mosquito fish (*Gambusia affinis*), which feed on immature mosquitoes and can aid significantly in mosquito control.
- If large predatory fish are present (e.g., perch and bass), mosquito fish populations may be negatively impacted or eradicated. In this case, careful vegetation management remains the only nonchemical mosquito control measure.
- Where mosquito fish are not allowed, careful vegetation management remains the only nonchemical mosquito control measure. Other predators such as dragonflies, diving beetles, birds, and bats feed on mosquitoes when available, but their effects are generally insufficient to preclude chemical treatment.
- Perform routine maintenance to reduce emergent plant densities. Emergent vegetation provides mosquito larvae with refuge from predators, protection from surface disturbances, and increased nutrient availability while interfering with monitoring and control efforts.
- Whenever possible, maintain wet ponds and wetlands at depths in excess of 4 feet to limit the spread of invasive emergent vegetation such as cattails (*Typha* spp.). Deep, open areas of exposed water are typically unsuitable for mosquito immatures due to surface disturbances and predation. Deep zones also provide refuge areas for fish and beneficial macroinvertebrates should the densely vegetated emergent zones be drained.
- Build shoreline perimeters as steep and uniform as practicable to discourage dense plant growth.
- Use concrete or liners in shallow areas to discourage unwanted plant growth where vegetation is unnecessary.
- Eliminate floating vegetation conducive to mosquito production, such as water hyacinth (*Eichhornia* spp.), duckweed (*Lemna* and *Spirodela* spp.), and filamentous algal mats.

- 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.
- Design and obtain necessary approvals for all wet ponds and wetlands to allow for complete draining when needed.
- Improve designs of permanent pools. Minimize shallow depths and increase circulation in ponds. Permanently flooded systems should be stocked with native *Gambusia* minnows to foster biological predation on mosquito larvae.
- Do not use stormwater structures to meet endangered species mitigation requirements. Aquatic habitat for endangered species should not be created near areas populated by humans.

H.2 Maintenance Guidance for Mosquito Control

Routine and timely maintenance is critical for suppressing mosquito breeding as well as for meeting local water quality goals. If maintenance is neglected or inappropriate for a given site, even structures designed to be the least “mosquito friendly” may become significant breeding sites. Although general principles of vector control are described here, maintenance guidelines for individual treatment measures are often site-specific.

The maintenance principles given below are intended to reduce the mosquito population. These principles should be incorporated, as appropriate, in maintenance plans developed for stormwater treatment control measures and in the ongoing maintenance and inspection of treatment measures.

General Maintenance Principles

- Minimize stagnant water (i.e., maintain constant exchange of water in systems).
- Minimize surface area (i.e., deeper water habitat is preferable).
- With the exception of certain treatment measures designed to hold permanent water, all treatment measures should drain completely within 72 hours to effectively suppress vector production.
- Build perimeter access roads or trails to access wet ponds. Without proper access avenues, the “barbed wire” effect can result where sharp vines prevent vector monitoring and abatement.
- Site inspections of newly constructed projects should be routinely conducted by municipalities to avoid the inadvertent approval of improperly constructed systems.
- Any circumstances that restrict the flow of water from a system as designed should be corrected. Debris or silt build-up obstructing an outfall structure should be removed. Under drains and filtration media should be inspected periodically and cleaned out or replaced as needed.
- Conduct maintenance activities regularly, in accordance with a municipality-approved maintenance plan.

Vegetation Management Maintenance Principles

- Conduct annual vegetative management, such as removing weeds and restricting growth of aquatic vegetation to the periphery of wet ponds.
- Remove grass cuttings, trash and other debris, especially at outlet structures
- Avoid producing ruts when mowing (water may pool in ruts).

Dry System Maintenance Principles for Mosquito Control

- Extended detention basins are usually designed to detain water for periods less than 72 hours. If they detain water for longer than five days, they are poorly maintained.
- If a detention basin has been installed at an inappropriate location (e.g., on a site where the water table is too close to the surface), if elimination of the system isn't possible then mosquitoes must be controlled with larvicides. The larvicide operation, in order to be effective, must be supported by a quality inspection program.

Underground Structure Maintenance Principles for Mosquito Control

- Prevent mosquito access to underground systems that may have standing water (i.e., seal openings that are 1/16-inch in diameter or greater).
- Provide SMCMAAD access to underground systems that may have standing water.

Infiltration and Filtration Device Maintenance Principles for Mosquito Control

- Infiltration trenches and sand filter structures should not hold water for longer than 24 hours. If they retain water for longer than 48 hours, they are poorly maintained.