

STANDARD RECOMMENDATIONS TO PREVENT MOSQUITO PROBLEMS IN SALT MARSH RESTORATION PROJECTS

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The Alameda County Mosquito Abatement District (the District) has an interest in restoration projects because of the inherent potential for the creation and/or elimination mosquito breeding habitat. Historically, the District was formed in 1930 to combat the widespread and serious problems created by mosquitoes produced in the salt marshes along the San Francisco Bay. The two primary pest mosquitoes produced in our marshes have long flight ranges and are very aggressive biters (Winter Salt Marsh Mosquito - *Aedes squamiger* and The Salt Marsh Mosquito - *Aedes dorsalis*). Two additional mosquito species are associated with marsh habitats, but prefer fresh to brackish water, and cause more localized problems (Winter Marsh Mosquito - *Culiseta inornata* and Encephalitis Mosquito - *Culex tarsalis*). The control of these species has always been a very high priority for the District.

The goal of the District is to maintain effective mosquito control on the marshes with a minimum of pesticide treatments and the least vehicular intrusion into the salt marshes. Many recent restoration projects have produced a positive effect on overall mosquito control by restoring tidal action to previously isolated marshes. A balance in the planning for environmental concerns for restoration of habitats with the needs of management for mosquito control provides a lasting publicly acceptable solution to marsh restoration.

Factors providing habitat for mosquitoes:

1. The occurrence of isolated pools of water in the upper reaches of the marsh (above mean high water) charged by either high tides or storm water and cracked ground associated with dry-diked marshes and dredge disposal sites create a myriad breeding habitats.
 - a. **Pannes:** Pannes with vegetated edges, lacking access for predators (both salt marsh mosquito species *Aedes dorsalis* and *Aedes squamiger*).
 - b. **Cracked Ground.** Large and deep cracks drying marsh soils provide excellent protected and difficult to treat habitat for mosquitoes (*Aedes dorsalis* and *Aedes squamiger*).
 - c. **Seasonal Wetlands.** Areas set aside for seasonal rainwater flooding (*Culiseta inornata* and *Culex tarsalis*).
 - d. **Vernal Pools.** habitat for *Culiseta inornata* and *Culex tarsalis*
2. The presence of pickleweed (*Salicornia spp.*) and/or saltgrass (*Distichlis spp.*).
3. The absence of effective predators to eat the mosquito larvae.

Standard recommendations to prevent mosquito problems in restoration projects:

1. Conduct a topographic engineering survey to delineate depressions, locate optimum drainage patterns and determine level of land subsidence.
2. Maintain outboard levee system until the marsh restoration project has been reviewed by the Mosquito Abatement District and the planned tidal system has been constructed.
3. Inboard levee systems should be of sufficient height and strength to withstand wind-driven tides.
4. Inboard levee system and any remaining outboard levee systems should be drivable to provide access for needed monitoring, management and mosquito control.

5. The breach in the outboard levee and the marsh sloughs should be designed and constructed in a manner which will reduce problems created by silt deposition.
6. Consider water control structures in the outboard levee as an alternative to open breach to provide control of tidal inflow and outflow.
7. If dredge material is involved, it should be deposited in a manner which does not create isolated pools in the upper reaches of the marsh (above mean high water).
8. Ditches should be excavated to drain existing isolated pools above the mean high water line to allow circulation of salt water from daily tides (Ditches will allow ingress of predator fish)
9. Consider disking or harrowing of cracked ground above the mean high water line before levees are breached will prevent mosquito production and allow reestablishment of desired native vegetation.
10. Long-term maintenance responsibilities should be recognized and funded. A good management program which will keep mosquito production to a minimum would include:
 - a. Levee maintenance to prevent breaches.
 - b. Maintenance of tide gates, culverts and other structures.
 - c. Dredging and cleaning of sloughs and ditches to maintain water circulation. Vegetation needs to be trimmed periodically from the edges of small ditches to maintain water flow and prevent excessive siltation.
 - d. Provision for and maintenance of all-weather vehicle access as close as possible to potential mosquito producing portions of the marsh. This is needed for monitoring and treatments.
 - e. Continuing close communication with the District by personnel responsible for managing the marsh to provide current information on management and special concerns such as endangered or threatened species, nesting seasons and developing problems.

From the mosquito control point of view, the best marsh is one where all areas of the marsh are flooded by tides and drain freely. This allows fish access to all of the marsh and prevents mosquito larvae from surviving. It is realized that the goals of restoration projects require providing for a diversity of plant and animal habitats including some which will potentially produce mosquitoes. District personnel will be happy to assist in planning restoration projects to attain the project goals and minimize potential mosquito problems.

