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2 Program Description

2.1 Program Area and Vicinity

The Alameda County Mosquito Abatement District (Lead Agency and Program Sponsor) is preparing this Programmatic Environmental Impact Report (PEIR) to evaluate the effects of the continued implementation of a suite of control strategies and methods prescribed in its Integrated Mosquito Management Program (IMMP or Program). The District implements its Program primarily within a jurisdiction or Service Area of 812 square miles. The activities described herein are conducted throughout Alameda County.

Located in the eastern part of the San Francisco Bay Area, Alameda County is bordered by the San Francisco Bay and Contra Costa, San Joaquin, Santa Clara and a small part of Stanislaus Counties. The District serves a population of approximately 1.5 million people and its Service Area includes the cities of Alameda, Berkeley, Dublin, Emeryville, Fremont, Hayward, Livermore, Newark, Oakland, Piedmont, Pleasanton, San Leandro, Union City and the unincorporated communities of Ashland, Castro Valley, Cherryland, Fairview, San Lorenzo, and Sunol. The geography ranges from urban cities to open spaces with rolling hills or marshlands. A portion of the Don Edwards National Wildlife Refuge also falls within the District boundary.

The environmental impact analysis of the Program will focus on the potential for impacts within the County from the District's proposed Program and identify the potential for control activities within the Service Area to affect any adjacent jurisdictions. Under California law, the District also can take direct but limited action in adjacent areas bordering its Service Area (the city of Albany and Santa Clara, Contra Costa, Stanislaus and San Joaquin Counties), if needed to provide control of mosquitoes originating in adjacent areas for the health and safety of residents of the immediate Service Area [California Health and Safety Code Section 2053(b)]. Control activities may also be provided in adjacent areas upon request of the adjacent jurisdictions to protect the health and safety of residents in adjacent jurisdictions. Actions that would be taken outside of the Service Area are the same types of actions undertaken within the Service Area and in similar types of habitats or sites. In summary, the Program occurs in an area that is somewhat larger than the District's Service Area; this larger area is called the Program Area, the area in which potential impacts could occur. The Program Area and its location within the State of California are shown on Figure 2-1, Alameda County Mosquito Abatement District Program Area.

Mosquito control activities are conducted at a wide variety of locations or sites throughout the District's Service Area, including tidal marshes, duck clubs, other diked marshes, lakes and ponds, rivers and streams, vernal pools and other seasonal wetlands, stormwater detention basins, flood control channels, spreading grounds, street drains and gutters, wash drains, irrigated pastures, or agricultural ditches, as well as animal troughs, artificial containers, tire piles, fountains, ornamental fishponds, swimming pools, liquid waste detention ponds. Within the larger Program Area, activities would be conducted at similar sites.

2.2 Program Objectives

2.2.1 Purpose and Need

The District was established in 1930 to reduce the risk of mosquito-borne disease and discomfort to the residents of its Service Area. In addition to being problematic by disrupting human activities and enjoyment of public and private areas, certain mosquito species are vectors that can transmit a number of diseases. A vector is defined by the State of California as "any animal capable of transmitting the causative agent of human disease or capable of producing human discomfort or injury, including, but not

limited to, mosquitoes, flies, other insects, ticks, mites, and rats, but not including any domesticated animal…" [California Health and Safety Code Section 2002(k)]. The diseases of most concern in the Program Area are West Nile virus (WNV), western equine encephalomyelitis (WEE), St. Louis Encephalitis (SLE), dog heartworm, and malaria.

Depending on the disease, both human and domestic animal health can be at risk of disability, illness, and/or death. Furthermore, potential exists for introduction and transmission of new diseases by current mosquito species and for new mosquito species capable of vectoring disease to be introduced into the District's Service Area. Examples include the discovery of populations of *Aedes albopictus* (Asian tiger mosquito) and *Aedes aegypti* (yellow fever mosquito) in central and southern California. These mosquito species are effective vectors of the causative agents of diseases such as chickungunya, dengue fever, and yellow fever.

Yellow jacket wasps and several mosquito species within the Program Area are not known to commonly transmit disease pathogens but are still considered vectors [California Health and Safety Code Section 2200(f)] because they can inflict significant discomfort and injury (e.g., secondary infections and severe reactions including anaphylaxis) to residents, pets, and livestock. For example, employing the District's IMMP to conduct surveillance and control for mosquito species such as *Aedes dorsalis* (summer salt marsh mosquito), *Aedes sierrensis* (western treehole mosquito), *Aedes squamiger* (California salt marsh mosquito), and *Aedes washinoi* (woodland pond mosquito) is important to minimize populations of these mosquitoes that would otherwise cause discomfort and injury-related issues with citizens, businesses, schools, agricultural operations, etc. The District was formed in 1930 initially to address significant economic and discomfort-related issues involving large populations of mosquitoes, especially the marsh mosquitoes *Ae. dorsalis*, *Ae. squamiger*, and *Culiseta inornata*.

2.2.2 Program Objectives

The District undertakes activities through its Program to control and/or provide information on mosquitoes, vectors of disease and/or discomfort, in the Program Area. The District also performs vegetation management (including control of noxious and/or invasive plants) to facilitate access to mosquito habitat, improve efficiency and effectiveness of mosquito control operations, and as a source reduction measure.

The Proposed Program's specific objectives are as follows:

> Reduce the potential for human and animal disease caused by mosquitoes

> Reduce the potential for human and animal discomfort or injury from mosquitoes

> Accomplish effective and environmentally sound mosquito management by means of:

- Surveying for mosquito abundance/human contact
- Establishing treatment criteria
- Appropriately selecting from a wide range of Program tools or components

Most of the relevant mosquito species are quite mobile and cause the greatest hazard or discomfort at a distance from where they breed. Each species has a unique life cycle, and most of them occupy several types of habitats. To effectively control them an IMMP must be employed. District policy is to identify those species that are currently vectors, to recommend techniques for their prevention and control, and to anticipate and minimize any new interactions between mosquitoes and humans or domestic animals.

Figure 2-1 Alameda County Mosquito Abatement District

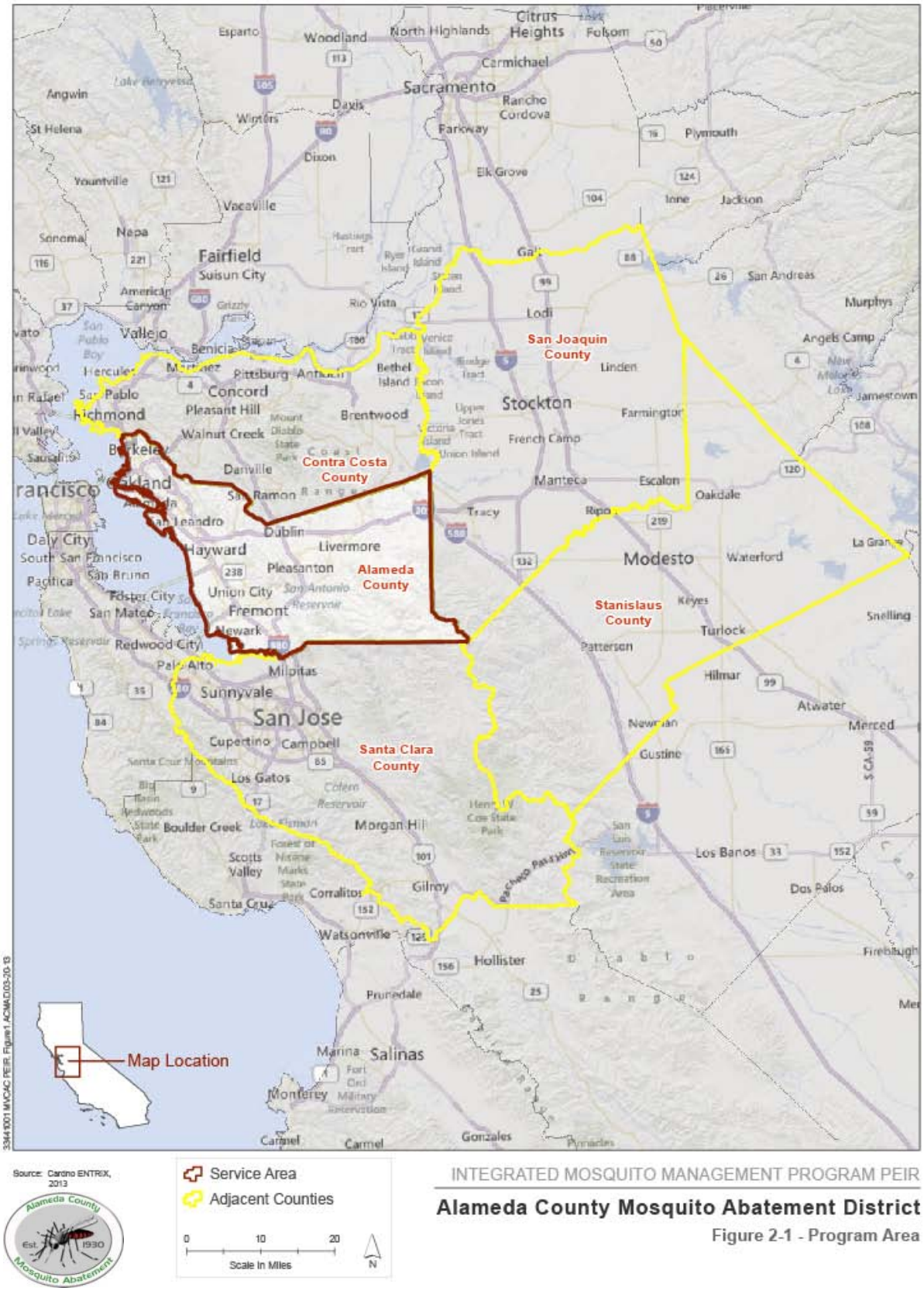

Figure 2-1 BACK

2.3 Proposed Program

The District's Program is an ongoing series of related actions for control of mosquitoes, vectors of human disease and discomfort. The District's activities involve the identification of mosquito problems; responsive actions to control existing populations of mosquitoes, prevent new sources of mosquitoes from developing, and manage habitat to minimize mosquito production; education of landowners and land managers on measures to minimize mosquito production or interaction with mosquitoes; and provision and administration of funding and institutional support necessary to accomplish District objectives.

The District has, since its inception, taken an integrated systems approach to mosquito control, utilizing a suite of tools that consist of surveillance, vegetation management, and physical, biological, and chemical controls along with public education. These Program "tools" or components are described in the subsequent subsection as "Program alternatives" for the CEQA process (except for public education, which is exempt from CEQA). Program implementation incorporates vegetation management and physical and biological control, in part, to reduce the need for chemical control. To realize effective and environmentally sound mosquito management, mosquito control must be based on several factors:

> Carefully monitoring or surveying mosquito abundance and/or potential contact with people

> Carefully monitoring and surveying for mosquito diseases and their antecedent factors that initiate and/or amplify disease

> Establishing treatment criteria (thresholds)

> Selecting appropriate tools from a wide range of control methods

This Program consists of a dynamic combination of surveillance, treatment criteria, and use of multiple control activities in a coordinated program with public education that is generally known as Integrated Pest Management (IPM) or Integrated Mosquito Management (IMM).

While these Program components or tools together encompass the District's Program, it is important to acknowledge that the specific tools District staff use vary from day to day and from site to site in response to the mosquito species that are active, their population size or density, their age structure, location, time of year, local climate and weather, potential for mosquito-borne disease, proximity to human populations, including (a) proximity to sensitive receptors, (b) District staff's access to mosquito habitat, (c) abundance of natural predators, (d) availability and cost of control methods, (e) effectiveness of previous control efforts at the site, (f) potential for development of resistance in mosquito populations, (g) landowner policies or concerns, (h) proximity to special status species, and (i) applicability of Endangered Species Recovery Plans, Habitat Conservation Plans (HCPs), Natural Community Conservation Plans (NCCPs), and local community concerns, among other variables. Therefore, the specific actions taken in response to current or potential mosquito activity at a specific place and time depend on factors of mosquito and pathogen biology, physical and biotic environment, human settlement patterns, local standards, available control methods, and institutional and legal constraints. While some consistent mosquito sources are exposed to repeated control activity, many areas with minor mosquito activity are not routinely treated, and most of the land within the District's Service Area has never been directly treated for mosquitoes.

The District's IMM Program (or IMMP), like any IPM program, seeks by definition to use procedures that will minimize potential environmental impacts. The District's IMMP employs IPM principles by first determining the species and abundance of mosquitoes through evaluation of public service requests and field surveys of immature and adult mosquito populations and, then, if the populations exceed predetermined criteria, using the most efficient, effective, and environmentally sensitive means of control. For all mosquito species, public education is an important control strategy. In some situations, water management or other physical control activities can be instituted to reduce or eliminate mosquito-breeding sites. The District also uses biological control such as the planting of mosquitofish in some settings: ornamental fish ponds, water troughs, water gardens, fountains, and unmaintained swimming

pools. When these approaches are not effective, or are otherwise deemed inappropriate, then pesticides are used to treat specific mosquito-producing or mosquito-harboring areas.

Three core tenets are essential to the success of a sound IMMP.

> First, a proactive approach is necessary to minimize impacts and maximize successful mosquito management. Elements such as thorough surveillance and a strong public education program make all the difference in reducing potential human-mosquito interactions.

> Second, long-term environmentally based solutions (e.g., water management, reduction of harborage, exclusion, and enhancement of predators and parasites) are optimal as they reduce the potential pesticide load in the environment as well as other potential long- and short-term impacts.

> Lastly, utilizing the full array of options and tools (public education, surveillance, physical control, biological control, and when necessary chemical control) in an informed and coordinated approach supports the overall goal of an environmentally sensitive mosquito management program.

The District's Program consists of the following alternatives, which are general types of coordinated and component activities, as described below. The Proposed Program is a combination of these alternatives with the potential for all of these alternatives to be used in their entirety along with public education.

Chemical methods to control mosquitoes (and potentially yellow jackets or weeds), under the Vegetation Management and Chemical Control alternatives described below, are employed independently at specific application sites. The pesticides used/suggested as part of the District's Proposed Program are/would be applied at low concentrations to avoid potential impacts to nontarget organisms from acute and/or chronic exposures. Manufacturers carefully establish application amounts mandated by product use requirements for treatment efficacy and low potential risk to nontarget organisms and they are substantially below the thresholds used for toxicity studies in the laboratory. The pesticides the District selects are designed to degrade rapidly in the environment, thereby reducing the opportunity for residual presence and environmental persistence. As different chemicals are selected for potential rotational use in a given area (i.e., larvicides first, followed by adulticides if needed), District staff take care both in the selection of the chemicals used and the application process so that co-exposures to nontarget receptors are highly unlikely. This type of practice reduces the probability of additive or synergistic effects that could occur as a result of simultaneous exposures to more than one chemical.

Synergists, and in some cases adjuvants (used with herbicides to also facilitate mixing and application), may be applied to increase the efficacy of some chemical control measures. This application could lead to co-exposures of synergists such as piperonyl butoxide (PBO) and primary chemical treatments. However, synergists allow for reduced treatment amounts of primary pesticide chemicals, since their performance is improved via conjunctive use. Another example of chemicals sometimes used together is the co-application of methoprene and Bti. This particular treatment is employed to prevent pesticide resistance and to ensure the control of all larval stages of nuisance mosquitoes while minimizing the potential for impacts to nontarget receptors from co-exposures.

2.3.1 Surveillance Alternative

Mosquito surveillance, which is an integral part of the District's responsibility to protect public health and welfare, involves monitoring mosquito populations and habitat, their disease pathogens, and human-mosquito interactions. Surveillance provides the District with valuable information on what mosquito species are present or likely to occur, when they occur, where they occur, how many they are, and if they are carrying disease or otherwise affecting humans. Surveillance is critical to an IMMP because the information it provides is evaluated against treatment criteria to decide when and where to institute mosquito control measures. Information gained is used to help form action plans that can also assist in reducing the risk of mosquito-borne disease transmission and the occurance of discomfort and injury to

humans, pets, livestock, and wildlife. Equally important is the use of mosquito surveillance in evaluating the efficacy, cost effectiveness, and environmental impacts of specific mosquito control actions.

2.3.1.1 Surveillance Methodologies

Mosquitoes in nature are distributed within their environment in a pattern that maximizes their survival to guarantee reproductive success. Immature stages develop in water and later mature to a winged adult that is capable of both long- and short-range dispersal. This duality of their life history presents mosquito control agencies with unique circumstances that require separate surveillance strategies for the aquatic versus terrestrial life stages.

Surveillance involves monitoring the abundance of mosquito populations, their habitat, mosquito-borne disease pathogens, and the interactions between mosquitoes and people over time and space. The District routinely uses a variety of traps for surveillance of adult mosquitoes, regular field investigation of known mosquito sources for direct sampling for immature stages, public service requests for adult mosquitoes, and low ground pressure All-Terrain Vehicles (ATVs) to access these sites when necessary. The District conducts surveillance by way of a variety of activities that include:

> **Field inspection of known or suspected habitats** where mosquitoes breed. Mosquito immatures include eggs, four larval stages, and a transitional pupal stage. Mosquito control agencies routinely target the larval and pupal stages to preclude an emergence of adults. Operation evaluation of the presence and abundance of immature mosquitoes includes the egg, larval, and pupal stages. Sampling and collection of the immature stages (egg, four larval stages, and a transitional pupal stage) involves the use of a 1-pint dipper (a standardized small plastic pot or cup-like container on the end of a 36-inch wooden or extendable aluminum handle), which scoops up a small amount of water from the mosquito-breeding site. Sites where water can collect, be stored, or remain standing for more than a few days are potential habitats for mosquito breeding that require continuous inspection and surveillance. Water runoff into catch basins and stormwater detention systems from land uses including, but not limited to, residential communities, parks and recreation areas, and industrial sites, as well as ornamental ponds, unmaintained swimming pools, seepages, seasonal wetlands, tidal and diked marshes, freshwater marshes, wastewater ponds, sewer plants, agricultural ponds, managed waterfowl ponds, canals, creeks, streams, tree holes, tires, man-made containers, flooded basements/crawl spaces, and other standing waters are likely sources. Operationally, the abundance of the immatures in any identifiable “breeding” source is measured through direct sampling, which provides relative local abundance as the number of immatures per unit volume area of the sampling device otherwise known as the number of larvae per dip. This method requires access by field personnel to within about 3 feet of larval sites at least every 2 weeks in warm weather. The spatial patchiness of larvae requires access to multiple locations within each source, rather than to single stations.

> **Field counting/trapping of adult mosquitoes**, to evaluate population densities along with the laboratory analysis of their pathogens and potential disease threats (such as WNV, WEE, and SLE). Sampling of presence and abundance of mosquito populations tends to occur in areas where the citizenry would have a likelihood of exposure to them. The District routinely uses a variety of traps for surveillance of adult mosquitoes. Four kinds of traps: host-seeking traps, light traps, gravid traps, and oviposition traps, are used as described below:

  - Host-seeking traps use propane or dry ice (carbon dioxide), octenol, human scent, or combinations thereof to attract female mosquitoes seeking a host on which to blood feed. The trap’s components include a battery or power source, a low ampere motor/fan combination, and a collection container for holding captured adults. Depending on the trap, it may also include a dry ice container, an LED light source, or propane tank. Examples of this trap type are Encephalitis Vector Survey (EVS) traps, BG Sentinel traps, and the Mosquito Magnet.

- Light traps (commonly called New Jersey Light traps) use a source of photo-attraction such as an incandescent lamp (25 watt) or compact fluorescent lamp (7 watt) where mosquitoes are pulled in by the suction provided by an electric (110 v AC) appliance motor/fan combination. Mosquitoes picked up by the suction are directed downward (via screened cone) inside the trap body to a plastic or glass collection jar containing a 1-inch strip of Vapona, Hot Shot®, or No-Pest® strip (dichlorvos). The collection jar is enclosed within an expanded metal cage with a hinged trap door that is padlocked.
- Gravid traps are used to collect adult mosquitoes that have fed on hosts and are seeking a place to deposit eggs. As an example, they may use 5-day-old hay-infused water contained in a small plastic dish pan that has a 6-volt battery-operated fan directly above to draw the gravid female mosquitoes into the small collection net. Another example is the Autocidal Gravid Ovitrap (AGO). This device is a black 5 gallon bucket and lid with a black bottomless 1 gallon bucket inserted in the center. The 5 gallon bucket can hold upto 2.5 gallons of an attractant, such as water and decaying vegetation. The top of the one gallon container is covered with a ¾" mesh netting to allow mosquitoes to enter and exclude large debris. The bottom of the one gallon container is fitted with window screen on the bottom to keep adult mosquitoes from accessing the water in the 5 gallon bucket below. The sides of the 1 gallon bucket are coated with a nontoxic adhesive to capture the adult mosquitoes for identification.
- Oviposition traps are a passive surveillance tool for detecting the presence of container-inhabiting mosquitoes, and for providing a relative measure of temporal changes in adult abundance. These are usually small cups, partially filled with water, with a strip of filter paper just above the water level. Adult females lay their eggs on the surface of the filter paper.

> **"Arbovirus"[1] surveillance to determine the likelihood and occurrence of mosquito-borne illness** is primarily focused on the detection of three viruses, WNV, WEE and SLE. Birds are the primary reservoir of all three viruses and transmission to humans can occur through the bite of an infected mosquito. Surveillance is accomplished by three methods commonly used in California.

- Dead Bird Testing. Dead bird reports and testing are a part of a statewide surveillance program. Birds in the corvid family (crows, ravens, magpies and jays) are most likely to die from WNV, however, infections have been reported in over 225 bird species. Dead birds can be reported by the public to the California Department of Public Health WNV Hotline or website. Reports are screened and suitable birds are picked up by District staff. Corvids are tested in-house via an oral swab sample that is tested using a Rapid Analyte Measurement Platform (RAMP) machine. Non corvids are sent to the Center for Vectorborne Diseases (CVEC) at the University of California, Davis to be tested via reverse transcription polymerase chain reaction (RT-PCR) for WNV.
- Sentinel Chickens. The District places caged chickens as "sentinel birds." Since the viruses of major concern (WNV, WEE, and SLE) are diseases actively transmitted by mosquitoes to both birds and to humans through bites, caged chickens' routine blood samples will reveal whether one or more of the virus-specific antibodies are present. The chickens are placed generally 7 to a caged area (at least 6 by 12 feet or larger), are humanely handled, and are provided ample shelter with nest boxes, water, and feed. Chickens are used as the early detection system for virus transmission, as they are unaffected by the presence of these viruses in their systems. At the end of the mosquito season, the chickens are adopted out.
- Mosquito Pools. This method involves the use of host-seeking traps to capture female vector mosquitoes. Captured females are sorted into groups of up to 50 (called pools) and submitted to CVEC to test for the presence of mosquito-borne viruses.

[1] Arthropod-borne viruses. The primary reservoir for the pathogens that cause these diseases is wild birds, and humans only become exposed as a consequence of an accidental exposure to the bite of infective mosquito vectors.

- **Analysis of public service requests and surveys** and other methods of data collection. The District's mosquito surveillance activities are conducted in compliance with accepted federal and state guidelines, in particular the *California Mosquito-borne Virus Surveillance and Response Plan* (CDPH et. al 2015) and *Best Management Practices for Mosquito Control in California* (CDPH 2012b). These guidelines recognize that local conditions will necessarily vary and, thus, call for flexibility in selection and specific application of control methods.
- **Maintenance of paths and clearings** to facilitate sampling and to provide access to mosquito habitat. It is District policy that, whenever feasible, staff utilizes preexisting roads, trails, walkways, and open areas to conduct routine and essential surveillance activities with the least impact on the environment. However, periodic vegetation management may be necessary to maintain accessibility to water bodies. Most access for inspection is conducted on foot. Surveillance may occasionally be conducted using ATVs, but offroad access is minimized and used only when roads and trails are not available.

2.3.1.2 Yellow Jackets and Other Wasps

Routine surveillance for venomous biting insects is not conducted by the District, however, encounters while inspecting mosquito sources may occasionally require District staff's response. While these insect stings may potentially induce life-threatening allergic reactions and pain, overall, these insects serve beneficial roles as pollinators and biological control agents.

2.3.2 Physical Control Alternative

Managing vector habitat to reduce vector production or migration, either directly or through public education is often the most cost-effective and environmentally benign element of an IPM program. This approach to the control of vectors and other pests is often called "physical control" to distinguish it from those management activities that directly rely on application of chemical pesticides (chemical control) or the introduction or relocation of living agents (biological control). Other terms that have been used for vector habitat management include "source reduction," which emphasizes the significance of reducing the habitat value of an area for vectors, or "permanent control," to contrast with the temporary effectiveness of pesticide applications.[2] Vector habitat management is important because its use can virtually eliminate the need for pesticide use in and adjacent to the affected habitat and, in some situations, can virtually eliminate vector production from specific areas for long periods of time, reducing the potential disturbances associated with frequent biological or chemical control activities. The intent is to reduce the abundance of vectors produced or sheltered by an area while protecting or enhancing the habitat values of the area for desirable species. In many cases, physical control activities involve restoration and enhancement of natural ecological functioning, including production and dispersal of special status species and/or predators of vectors.

2.3.2.1 Mosquitoes

Physical control for mosquitoes consists of the management of mosquito-producing habitat (including freshwater marshes and ponds, saltwater marshes, temporary standing water for 1 week or more, and wastewater treatment facilities) especially through water control and maintenance or improvement of channels, tide gates, levees, and other water control facilities. Physical control is usually the most effective mosquito control technique because it provides a long-term solution by reducing or eliminating mosquito developmental sites and ultimately reduces and potentially eliminates the need for chemical applications. The physical control practices may be categorized into three groups: maintenance, new construction, and cultural practices.

Maintenance activities are conducted within tidal, managed tidal, and nontidal marshes, seasonal wetlands, diked, historic baylands, and in some creeks adjacent to these wetlands. They include

[2] This terminology can be misleading if periodic maintenance is needed for physical control devices or structure.

connection of backwaters or isolated pools on floodplains to the main channels of creeks and streams and increased circulation rates in managed wetlands. The following activities are classified as maintenance:

> Removal of sediments from existing water circulation ditches

> Repair of existing water control structures

> Removal of debris, weeds, and emergent vegetation in natural channels

> Trimming, and removal of brush for access to streams tributary to wetland areas

> Filling of existing, nonfunctional water circulation ditches to achieve required water circulation dynamics and restore ditched wetlands

New construction typically involves the creation of new ditches to enhance tidal flow preventing stagnant water. This is a tool that was historically used by the District and remains a valuable alternative if the need should arise.

Cultural practices, often a part of proper design which should be incorporated into the planning process of projects, include vegetation and water management, placing culverts or other engineering works, and making other physical changes to the land. They reduce mosquito production directly by improving water circulation and indirectly by improving habitat values for predators of larval mosquitoes (fish and invertebrates), or by otherwise reducing a site's habitat value to mosquito larvae.

The District performs these physical control activities in accordance with all appropriate environmental regulations (e.g., wetland fill and dredge permits, endangered species review, water quality review, streambed alteration permits, see Section 2.8), and in a manner that generally maintains or improves habitat values for desirable species. Major physical control activities or projects (beyond the scope of the District's 5-year regional wetlands permits with the United States Army Corps of Engineers (USACE), San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) and San Francisco Bay Conservation and Development Commission (BCDC)) are not currently being undertaken. Minor physical control activities (covered by the regional wetlands permits) are addressed in this PEIR. They vary from year to year, but typically consist of up to 10,000/15,000 linear feet of ditch maintenance done between the months of September to January to avoid key nesting seasons. Work is done primarily using hand tools (i.e. shovels, pitch forks, gas powered weed cutters, etc.). Under the regional permits, the District's work plans are reviewed annually by trustee and other responsible agencies prior to initiation of the planned work. USACE, USFWS, CDFW, and other responsible agencies can inspect completed work.

The District may recommend that landowners and stewards maintain and clear debris from drainage channels and waterways; excavate built-up spoil material; remove water from tires and other urban containers; cut, trim, mow, and harvest aquatic and riparian plants (but not including any mature trees, special status[3] plant species, or sensitive habitat areas); and install minor trenching and ditching. The District may provide guidance for mosquito abatement activities to landowners and stewards. However, it will be the responsibility of the landowner to determine and comply with all legal requirements necessary to perform the activity, including consultation with resource agencies and acquisition of permits that may be needed prior to commencement of any work.

The remainder of this subsection describes physical control or "source reduction" practices by type of potential mosquito habitat.

[3] Special status species are those that are listed as endangered, threatened or candidate species under the federal Endangered Species Act, endangered or threatened under the California Endangered Species Act, or listed as species of special concern by the State of California.

2.3.2.1.1 Freshwater Habitats

The District Service Area includes a number of areas, generally man-made, that are permanently ponded with fresh water. Examples include the margins of reservoirs with shallow water and emergent vegetation, artificial ponds for holding drinking water for livestock, and retention ponds created for holding of rainwater. Some retention ponds have been constructed within freeway interchanges and others have been built in cities and towns to provide wildlife habitat and flood protection. Natural lakes are usually not a mosquito problem because most of the water is deep, and little emergent vegetation may exist.

Source reduction activities to control mosquito populations in freshwater habitats, i.e., marshes and ponds, generally consist of consultation with landowners or land stewards to implement measures including constructing and maintaining channels to reduce mosquito production in floodplains and marshes. The primary principle governing source reduction is to manipulate water levels in low-lying areas to eliminate or reduce the need for chemical control applications. Physical control of mosquitoes in nontidal habitats typically involves improving the habitat value or dispersal potential of the site for mosquito predators; reducing the habitat value for mosquitoes through vegetation management, increased circulation, steepening banks, or changes in water quality; or by reducing the duration of standing water in areas that produce mosquitoes by filling small areas or improving drainage. Filling or draining artificially ponded areas (low spots in flood-irrigated fields, etc.) can be cost-effective and environmentally acceptable, but is not an appropriate strategy in natural areas (however small), large permanent water bodies, or in areas set aside for stormwater or wastewater retention. In such situations, the other options are more appropriate. At this time, the District is rarely involved in new drainage projects. However, the District may maintain or assist with the maintenance of some existing drainage systems. This maintenance may include upkeep of gates and other water control structures, excavating accumulated spoil materials, and vegetation management such as cutting, mowing, clearing debris, and/or herbiciding overgrown vegetation (see Section 2.3.3 for vegetation management including the use of herbicides).

Ditches are a traditional technique for mosquito control, and they function in a number of ways. In addition to increasing water circulation, ditches can serve as a larvivorous fish (i.e., fish that eat mosquito larvae) reservoir. As rainfall increases, larvivorous fish move outward to adjacent areas to prey on immature mosquitoes, and as water levels decrease, larvivorous fish retreat to water in the ditches. Also, sills or weirs constructed in ditches can intentionally decrease water flow, decrease emergent aquatic weeds, prevent depletion of the water table, and allow larvivorous fish year-round refuge. Over the past several decades, urban development has occurred in areas where mosquito control circulation ditches have existed as the primary drainage systems. In many cases, maintenance responsibility for mosquito control projects has been taken over by city and county public works departments and integrated into their comprehensive stormwater management programs.

The District considers two mosquito control strategies when advising on freshwater source reduction for mosquito habitat. One strategy involves reducing the amount of standing water or reducing the length of time that water can stand in low areas following significant rainfall or artificial flooding events. In light of this strategy, District staff may advise landowners to construct channels or ditches with control elevations low enough to allow for a certain amount of water to leave an area before immature mosquitoes can complete their life cycle. However, the District does not encourage land managers and/or owners to alter vernal pool and seasonal wetland habitats, especially those managed for waterfowl. The other strategy relies on vegetation management (see Section 2.3.3). District staff may advise landowners to remove or thin vegetation to improve surveillance or reduce mosquito habitats.

As environmental laws, including Clean Water Act Section 404, greatly restrict mosquito habitat manipulations in freshwater habitats, the District is generally precluded from undertaking permanent physical control of these areas. Consequently, the District does not usually undertake physical control projects in freshwater bodies including marshes and ponds.

2.3.2.1.2 Seasonal Wetlands and Vernal Pools

The Service Area's Mediterranean climate results in large numbers of seasonally flooded areas, which may produce large numbers of mosquitoes during part of the year. Vernal pools are a specific type of seasonally flooded wetland, distinguished by a subsurface hardpan and often an assemblage of protected plants and invertebrates. Peripheral areas of tidal and historically tidal marshes can produce mosquitoes in response to seasonal rains, as well as following unusually high tides. Physical control methods include those described above for nontidal habitats.

2.3.2.1.3 Freshwater Marshes and Duck Clubs

Within federal and state property, a number of marshes have been created and operated to provide aquatic habitats for wildlife, especially waterfowl. Some of these marshes are drained and refilled periodically to enhance the primary productivity of the habitat, and under certain circumstances, can result in large populations of mosquitoes. Physical control methods include those described above for nontidal habitats.

2.3.2.1.4 Saline and Brackish Habitats

Saline and brackish marsh habitats of concern are along the edge of San Francisco Bay that are subject to tidal action, but they can include reclaimed or other brackish/salt marshes that are not subject to natural tidal action. These brackish areas are usually contained by levees, rotary ditches, or other water control structures. Physical control measures are those used for freshwater marshes (nontidal) and increasing tidal circulation such as:

> Circulation ditches to enhance drainage or to allow larvivorous fish access to mosquito breeding locations (with enhancement through the creation of permanent water bodies that act as predatory fish reservoirs)

> Small ditches formed by a speed scavel or hand dug that are up to 18 inches wide and 18 inches deep to enhance water circulation

> Ditching, which involves the construction or maintenance of shallow ditches usually 2 feet wide and 18 inches deep primarily using hand tools (i.e. shovels, pitch forks, gas powered weed cutters, etc.) and sometimes up to 4 feet wide and 3 feet deep, using high-speed rotary equipment with the spoil material evenly distributed in a very thin layer over the marsh surface, with limitations on its use based on the size of ditch needed, soil types, access, adjacent terrain, and vegetation present

> Impoundments that involve keeping a sheet of water across a salt-marsh substrate

> Rotational impoundment management (RIM), which is a formal strategy of impoundment management that achieves multipurpose management by allowing the impoundment to (1) control salt-marsh mosquito production from the marsh through means other than insecticides, (2) promote survival and revegetation by maintaining open periods and sufficiently low water levels during the summer flooding period, and (3) allow marine life to use the previously unavailable impounded high marsh

> Excavation using a low ground pressure excavator

These ecologically sensitive areas require careful implementation of any physical modifications to avoid damage to the habitat and sensitive species that may be present. Physical control measures can reduce salt-marsh mosquito production through enhancement of the frequency and duration of tidal inundation or through other water management strategies.

2.3.2.1.5 Temporary Standing Water and Artificial Ponds

Temporary standing water can occur from a variety of conditions including leaky pipes, irrigation of parks, golf courses, and agricultural fields in addition to ponding from rainfall events in natural areas. Control measures include working with landowners to identify leaky pipes, improved draining, minimizing emergent and standing vegetation, and maintaining steep banks. For areas that require artificial watering, proper water management, land preparation, and adequate drainage are the most effective means of physically controlling mosquitoes. The District provides advice to landowners who are interested in reducing mosquitoes by developing effective water management systems on certain lands.

As environmental laws generally prevent/restrict permanent draining or filling of small artificial ponds, the District employs other options that are effective in controlling mosquitoes. Pond management options that are effective in controlling mosquitoes include periodic draining, providing deepwater sanctuary for larvivorous fish, and advising management to minimize emergent and standing vegetation and maintain steep banks. The District advises landowners on the BMPs for ponds to reduce mosquito development.

2.3.2.1.6 Riparian Areas

Control measures will vary depending on the density of the human population, proximity of sensitive species, the vector potential of the mosquito causing the complaint, and access to the larval breeding or adult resting habitat. Minor physical control activities with insignificant environmental impacts can be accomplished using hand tools to connect small ponded areas to the channel along the edge of streams with highly variable flows. Generally, thick brush and complex microtopography preclude extensive physical control in these areas, or chemical control is generally more effective.

2.3.2.1.7 Tree Holes

Control measures are very limited here due to the large numbers of tree holes in most impacted areas, difficulties in access, concerns for staff safety, and in some cases the age and size of the tree (heritage trees). The control methods used are also dependent on the location and numbers of people and pets affected by the mosquitoes produced from this habitat. Current control measures include chemical control (larvicides or adulticides), educating the public about filling the holes with sand or other inert materials (absorbent gel) to displace larval habitat, or advising they contact a licensed tree service to trim the tree when holes occur on the branches.

2.3.2.1.8 Wastewater Treatment Facilities/Septic Systems

Wastewater recycling and reuse help to conserve and replenish freshwater supplies. Concern for water quality conditions in lakes, rivers, and marine areas has resulted in the enactment of new state laws that will greatly limit future disposal of wastewater into these aquatic systems. To adjust to these changing conditions, many communities must implement wastewater reuse and recycling programs. Mosquito problems are frequently associated with some of the conventional wastewater treatment operations, and the expanded use of wastewater recycling and reuse by both municipal and commercial/industrial operations may inadvertently create even more mosquito habitats.

Pond management options that are effective in controlling mosquitoes include periodic draining, providing deepwater sanctuary for larvivorous fish, minimizing emergent and standing vegetation, and maintaining steep banks. The District routinely advises property owners on the BMPs for ponds to reduce mosquito development. In addition, the District may provide localized vegetation management on ponds to discourage mosquito oviposition sites.

Onsite treatment systems, such as septic tanks and associated drain fields, can flow laterally into nearby swales and ditches, especially in rural areas. Physical control requires maintenance and repair of these systems by the property owner and ditch maintenance where lateral flow occurs.

2.3.2.1.9 Artificial Container Habitats

Artificial containers, such as flowerpots, cans, barrels, and tires, provide opportunities for mosquitoes to breed in urban areas. A container-breeding mosquito problem can be solved by properly disposing of such materials, covering them, or tipping them over to ensure that they do not collect water. The District greatly encourages these physical control methods through a variety of means such as brochures, press releases, and public education campaigns. The District may undertake physical control measures in a limited area on a house-to-house basis to address urban container-breeding mosquito problems.

2.3.2.2 Yellows Jackets and Other Wasps

Physical control for yellow jackets and other wasps is not conducted by the District.

2.3.3 Vegetation Management Alternative

The species composition and density of vegetation are basic elements of the habitat value of any area for mosquitoes, for predators of mosquitoes, and for protected flora and fauna. District staff periodically undertake vegetation management activities, or advise others to do so on their property, as a tool to reduce the habitat value of sites for mosquitoes or to aid production or dispersal of mosquito predators, as well as to allow District staff's access to mosquito habitat for surveillance and other control activities. District staff's direct vegetation management generally consists of activities to reduce the mosquito habitat value of sites by improving water circulation or access by fish and other predators, or to allow District staff's access to standing water for inspections and treatment.

For vegetation management, the District uses hand tools and may potentially use other mechanical means (i.e., heavy equipment) for vegetation removal or thinning, and could potentially apply herbicides (chemical pesticides with specific toxicity to plants) to improve surveillance or reduce vector habitats. Vegetation removal or thinning primarily occurs in aquatic habitats to assist with the control of mosquitoes and in terrestrial habitats to improve access. To reduce the potential for mosquito breeding associated with water retention and infiltration structures, District staff may systematically clear weeds and other obstructing vegetation in wetlands and retention basins (or request the structures' owners to perform this task). In particular, thinning and removal of emergent vegetation overgrowth (e.g., cattails) would be done to provide a maximum surface coverage of 30 percent or less. In some sensitive habitats and/or where special species concerns exist, vegetation removal and maintenance actions would be restricted to those months or times of the year that minimize disturbance/impacts. Vegetation management is also performed to assist other agencies and landowners with the management of invasive/nonnative weeds (e.g., spartina, pepperweed, arundo, tamarix, and ailanthus). These actions are typically performed under the direction of the concerned agency, which also maintains any required permits.

Tools ranging from shovels and pruners to chain saws and "weed-whackers" up to heavy equipment can all be used at times to clear plant matter that either prevent access to mosquito breeding sites or that prevent good water management practices that would minimize mosquito populations. Generally, however, District "brushing" activities rely almost entirely on hand tools. Trimmed vegetation is either removed and disposed of properly from the site or broadcast in such a way as to minimize visual degradation of the habitat. Trimming is also kept to a minimum to reduce the possibility of the invasion of exotic species of plants and animals. Surveys for special status plants using the California Natural Diversity Database (CNDD) and other online sources of information including relevant HCPs, coordination with the landowner, and acquisition of necessary permits are completed before any work is undertaken. Follow-up surveys are also conducted to verify that the work undertaken was effective and that the physical manipulation of the vegetation did not result in any unintended overall habitat degradation.

In addition, the use of water management to control vegetation is in some ways an extension of physical control, in that water control structures created as part of a physical control project may be used to directly manipulate hydroperiod (flood frequency, duration, and depth) as a tool for vegetation

management. Where potential evapotranspiration rates are high, water management can also become a mechanism for salinity management and, indirectly, vegetation management through another path.

Table 2-1 (Herbicides and Adjuvants Potentially Used by the Alameda County Mosquito Abatement District for Weed Control) identifies the herbicides the District may potentially use to manage vegetation for control of mosquito populations and/or to control invasive plant species (noxious weeds). Both Aquamaster (labeled for aquatic applications) and Roundup (labeled for terrestrial applications) may be used for spot control of actively growing vegetation. All herbicides would be applied in strict conformance with labeldirections and applicable Federal and State requirements. Additional information on herbicides proposed for possible future use is contained in Appendix B (Table 3-2, Table 4-1, Section 4.6, and Attachment A, Tables A1 – A4).

Table 2-1 Herbicides and Adjuvants Potentially Used by the Alameda County Mosquito Abatement District for Weed Control

Herbicide Product Name	Common Name / Active Ingredients	CAS or EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
R-11 Spreader Activator	Alkylphenol Ethoxylates / Butyl alcohol 90%	CAS #2935-50142	Adjuvant	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
No Foam A	Alkylphenol Ethoxylates / Isopropanol 90%	CAS #1050775-50015	Adjuvant	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Pro-Spreader Activator	Alkylphenol Ethoxylates / Isopropanol 90%	CAS #1050775-50022-AA	Adjuvant	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Alligare Glyphosate 4 Plus	Glyphosate 41%	EPA # 81927-9	Shikimic acid pathway disrupter	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Alligare Glyphossate 5.4	Glyphosate 53.8%	EPA # 81927-8	Shikimic acid pathway disrupter	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Aquamaster	Glyphosate 53.8%	EPA #524-343	Shikimic acid pathway disruptor	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Buccaneer	Glyphosate 41%	EPA #55467-10	Shikimic acid pathway disruptor	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Rodeo ®	Glyphosate 53.8%	EPA #62719-324	Shikimic acid pathway disruptor	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Undesirable floating and emergent aquatic vegetation

Table 2-1 Herbicides and Adjuvants Potentially Used by the Alameda County Mosquito Abatement District for Weed Control

Herbicide Product Name	Common Name / Active Ingredients	CAS or EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Roundup Pro®	Glyphosate 41%	EPA #524-475	Shikimic acid pathway disruptor	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Roundup Pro Max®	Glyphosate 48.7%	EPA #524-579	Shikimic acid pathway disruptor	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Ecomazapyr 2 SL	Imazapyr 27.8%	EPA # 81927-22	Amino acid synthesis inhibitor	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Habitat	Imazapyr 28.7%	EPA #241-426	Amino acid synthesis inhibitor	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Undesirable floating and emergent aquatic vegetation
Imazapyr 4 SL	Imazapyr 52.6%	EPA # 81927-24	Amino acid synthesis inhibitor	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Polaris	Imazapyr 27.7%	EPA #228-534	Amino acid synthesis inhibitor	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
MSO	Methylated seed oil of Soybean 100%	Reg #28385	Adjuvant	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Competitor	Modified Vegetable Oil 98%	CAS #2935-50173	Adjuvant	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways

Table 2-1 Herbicides and Adjuvants Potentially Used by the Alameda County Mosquito Abatement District for Weed Control

Herbicide Product Name	Common Name / Active Ingredients	CAS or EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Tripleline Foam-Away	Polydimethylsiloxane 10%	CAS #1050775-50023-AA	Adjuvant	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
No Foam Defoamer	Polydimethylsiloxane & Silicon 10%	CAS #2935-50183	Adjuvant	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Blazon Pattern Indicator	Polymeric Colorant (proprietary) 100%	Exempt	N/A	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Turf Trax Blue	Polymeric Colorant (proprietary) 100%	Exempt	N/A	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
BullsEye Pattern Indicator	Proprietary Colorant 100%	Exempt	N/A	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Oust XP	Sulfometuron Methyl 75%	EPA #352-601	Amino acid synthesis inhibitor	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Alligare Triclopyr 3	Triclopyr 44.4%	EPA # 81927-13	Auxin mimic	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways
Garlon-3A	Triclopyr 44.4%	EPA #62719-37	Auxin mimic	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways

Table 2-1 Herbicides and Adjuvants Potentially Used by the Alameda County Mosquito Abatement District for Weed Control

Herbicide Product Name	Common Name / Active Ingredients	CAS or EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Renovate 3	Triclopyr 44.4%	EPA # 62719-37-67690	Auxin mimic	Spring-Fall	Vehicle mounted sprayer, backpack sprayer, hand can	Ditches, interior margins of wastewater ponds; marshes; access roads; levees; right-of-ways

CAS Number = Chemical Abstracts Service Registry Number
EPA Number = Registered with the US Environmental Protection Agency N/A = Not Available

2.3.4 Biological Control Alternative

Biological control of mosquitoes involves the intentional use of mosquito pathogens (diseases), parasites, and/or predators to reduce the population size of target mosquitoes. It is one of the principal components of a rational and integrated pest management program. The effectiveness of a mosquito biological control agent lies in its ability to reduce mosquito numbers as quickly as possible. An ideal biological agent feeds preferentially on mosquitoes, exhibits an extremely efficient hunting or parasitizing strategy and reproduces quickly. Biological control is used as a method of protecting the public from mosquitoes and the diseases they transmit without the use of pesticides and potential problem of pesticide resistance; however, the use of pathogens involves USEPA-registered materials regulated and labeled as chemical insecticides. The different types of biological controls are described in the following paragraphs.

2.3.4.1 Mosquito Pathogens

Mosquito pathogens include an assortment of viruses and bacteria. Pathogens are highly host-specific and usually infect mosquito larvae when they are ingested. Upon entering the host, these pathogens multiply rapidly, destroying internal organs and consuming nutrients. The pathogen can be spread to other mosquito larvae in some cases when larval tissue disintegrates and the pathogens are released into the water to be ingested by uninfected larvae. Examples of viruses that can infect mosquitoes are mosquito iridoviruses, densonucleosis viruses, nuclear polyhedrosis viruses, cytoplasmic polyhedrosis viruses, and entomopoxviruses. Examples of bacteria pathogenic to mosquitoes are *Bacillus sphaericus* (Bs), the several strains of *Bacillus thuringiensis israelensis* (Bti), and *Saacharopolyspora spinosa*. Two bacteria, Bs and Bti, produce proteins that are toxic to most mosquito larvae, while *Saacharopolyspora spinosa* produces compounds known as spinosysns, which effectively control all larval mosquitoes. Bs can reproduce in natural settings for some time following release. Bti materials the District applies do not contain live organisms, but only spores made up of specific protein molecules.

All three bacteria are naturally occurring soil organisms that are commercially produced as mosquito larvicides. Because the potential environmental impacts of Bs or Bti application are generally similar to those of chemical pesticide applications, these materials and Spinosad are evaluated below under the Chemical Control Alternative in Section 2.3.5 and are evaluated for environmental impacts in the resources sections primarily under the Chemical Control Alternative. Note for technical accuracy though that Bs is applied as a live organism for the management of immature mosquito populations and is, therefore, a mosquito pathogen or biological control agent. For the same reasoning, because the by-products (protein crystals and spinosyns), and not the live organisms, of Bti and *Saacharopolyspora spinosa* are used to control immature mosquitoes, these mosquito larvicides would actually be deemed chemical control agents.

2.3.4.2 Mosquito Parasites

The life cycles of mosquito parasites are biologically more complex than those of mosquito pathogens and involve intermediate hosts, organisms other than mosquitoes. Mosquito parasites are ingested by the feeding larva or actively penetrate the larval cuticle to gain access to the host interior. Once inside the host, parasites consume the internal organs and food reserves until the parasite's developmental process is complete. The host is killed when the parasite reaches maturity and leaves the host (*Romanomermis culicivorax*) or reproduces (*Lagenidium giganteum*). Once free of the host, the parasite can remain dormant in the environment until it can begin its developmental cycle in another host. Examples of mosquito parasites are the fungi *Coelomomyces* spp., *Lagenidium giganteum, Culicinomyces clavosporus*, and *Metarhizium anisopliae*; the protozoa *Nosema algerae, Hazardia milleh, Vavraia culicis, Helicosporidium* spp*., Amblyospora californica, Lambornella clarki*, and *Tetrahymena* spp.; and the nematode *Romanomermis culicivorax*. These parasites are not generally available commercially for mosquito control at present.

2.3.4.3 Mosquito Predators

Mosquito predators are represented by highly complex organisms, such as insects, fish, birds, and bats that consume larval or adult mosquitoes as prey. Within a typical aquatic environment that produces mosquitoes, predators are distributed among different substrates. For example the surface of the pond supports water striders, planaria and spiders. Below the water surface, backswimmers, predaceous diving beetles and water scavenger beetles live and feed. If the pond contains vegetation, then the plant surfaces (periphyton) will support Hydra, damselfly and dragonfly nymphs, and giant water bug nymphs and adults. The benthos supports dragonfly and damselfly nymphs. Together the different predators form a special network that accounts for predation throughout the aquatic environment. Greater potential for an acceptable level of mosquito control exists when more predators are present. Predators are opportunistic in their feeding habits and typically forage on a variety of prey types, which allows them to build and maintain populations at levels sufficient to control mosquitoes, even when mosquitoes are scarce. Examples of mosquito predators include representatives from a wide variety of taxa: coelenterates, *Hydra* spp.; platyhelminths, *Dugesia dorotocephala, Mesostoma lingua, and Planaria* spp.; insects, *Anisoptera, Zygoptera, Belostomidae, Geridae, Notonectidae, Veliidae, Dytiscidae, and Hydrophilidae*; arachnids, *Pardosa* spp.; mosquitofish, *Gambusia affinis*, *Gasterosteus aculeatus*; bats; and birds, *anseriformes, apodiformes, charadriiformes, and passeriformes*. Only mosquitofish are commercially available to use at present, or able to be reproduced/reared (also see Section 15.2).

The District's rearing and stocking of mosquitofish in mosquito habitat is the most commonly used biological control agent for mosquitoes in the world. These fish are ideal control agents for several reasons. They feed primarily at the water's surface, where larvae can be found, and their small size enables them to penetrate vegetated and shallow areas. They can tolerate a significant range in water temperature and water quality. They are also easy to handle, transport, stock, and monitor. Correct use of this fish can provide safe, effective, and persistent suppression of a variety of mosquito species in many types of mosquito sources. As with all safe and effective control agents, the use of mosquitofish requires a good knowledge of operational techniques and ecological implications, careful evaluation of stocking sites, use of appropriate stocking methods, and regular monitoring of stocked fish. Mosquitofish reproduce in natural settings, for at least some time after release. Due to concerns that mosquitofish may potentially impact red-legged frog and tiger salamander populations, District policy is to limit the use of mosquitofish to artificial water bodies including ornamental fish ponds, water troughs, water gardens, fountains, and unmaintained swimming pools. Limiting the introduction of the mosquitofish to these sources should prevent their migration into habitats used by threatened, endangered, or rare species.

On average, the District releases about 21 pounds of mosquitofish annually. The District's rearing and stocking program occurs at District offices. The small-scale fish holding tanks produce a discharge that averages 300 gallons per week, and this wastewater is placed into the sanitary sewer system.

2.3.4.4 Yellows Jackets and Other Wasps

Currently, no commercial biological control agents or products are available for wasp and yellow jacket control.

2.3.5 Chemical Control Alternative

Chemical control is a Program tool that consists of the application of nonpersistent selective insecticides (and potentially herbicides noted in Section 2.3.3 above) to directly reduce populations of larval or adult mosquitoes and other invertebrate threats to public health (e.g., yellow jackets). If and when inspections reveal that mosquitoes are present at levels that trigger the District's criteria for chemical control – based on the mosquito's abundance, density, species composition, proximity to human settlements, water temperature, presence of predators and other factors – District staff will apply pesticides to the site in strict accordance with the pesticide label instructions and any applicable federal and state requirements.

The total number of applications and weight or volumes of specific pesticides the District applied in Summer 2011 through Spring 2012 are presented in Appendix B, Attachment A of this PEIR.

2.3.5.1 Mosquito Abatement

The vast majority of chemical control tools are used for mosquito abatement. The primary pesticides used can be divided between "larvicides," which are specifically toxic to mosquito larvae, and "adulticides," which are used to control adult mosquito populations. These pesticides and their applications are described in the following paragraphs.

2.3.5.1.1 Mosquito Larvicides

Larvicides are applied when the chemical control criteria for mosquito larvae are present and application rates vary according to time of year, water temperature, the level of organic content in the water, the type of mosquito species present, larval density, and other variables. Larvicide applications may be repeated at any site at recurrence intervals ranging from annually to weekly.

Larvicides the District routinely uses include Bti, Bs, Methoprene (Altosid), CoCoBear Oil, BVA-2, *Saacharopolyspora spinosa* (Spinosad) (Natular), and Agnique.

> **Bti** is a chemical larvicide derived from the bacterium *Bacillus thuringiensis israelensis*. This bacterium produces protein crystals that when ingested by mosquito larvae, disrupts their gut lining, leading to death before pupation. Bti is a highly target-specific bacterium that has been found to have significant effects only on mosquito larvae and closely related insects (e.g. black flies and midges). Products containing Bti are ideally suited for use in IMMPs because the active ingredient does not interrupt activities of most beneficial insects and predators. Each Bti organism may produce, if the environmental conditions are favorable, five different microscopic protein pro-toxins packaged inside one larger protein container or crystal. The crystal is commonly referred to as delta (d-) endotoxin. When the d-endotoxin is ingested, these five proteins are released in the alkaline environment of an insect larva's gut. The proteins are converted into five different toxins if specific enzymes also are present in the gut. Once converted, these toxins work alone or in combination to destroy the gut wall, leading to paralysis and death of the larvae. Bti has no measureable toxicity to vertebrates and is classified by the EPA as "Practically Non Toxic" (i.e. Caution). The District applies Bti as a liquid or bonded to an inert substrate (sand or corncob granules) to assist penetration of vegetation. Persistence is low in the environment, and efficacy depends on careful timing of application to coincide with periods in the life cycle when larvae are actively feeding. Pupae and late fourth stage larvae do not feed, therefore, will not be controlled by Bti. Low water temperature inhibits larval feeding behavior, reducing the effectiveness of Bti during very cold periods. High organic conditions also reduce the effectiveness of Bti. Therefore, use of Bti requires frequent inspections of larval sources during periods of larval production, and may require frequent applications of material. Application can be by hand, or from an ATV, watercraft, a truck, or aircraft (e.g., helicopter).

> **Bs** is a biological larvicide. Bs is a commonly occurring spore-forming bacterium found throughout the world in soil and aquatic environments. When ingested by mosquito larvae its mode of action is similar to that of Bti. It produces microbial gut toxins that destroy the insect gut wall, leading to paralysis and death. Bs, in contrast to Bti, is virtually non-toxic to black flies. Bs is a biological larvicide the District applies as a liquid or bonded to an inert substrate (corncob granule) to assist penetration of vegetation. Bs may be used more than Bti in some sites because of its higher effectiveness in water with higher organic content and residual properties that allow longer larvicidal action. Persistence is low in the environment, and efficacy depends on careful timing of application to coincide with periods in the life cycle when larvae are actively feeding. Pupae and late fourth stage larvae do not feed and, therefore, will not be controlled by Bs. Low water temperature inhibits larval feeding behavior, reducing the effectiveness of Bs during very cold periods. Bs is also ineffective against certain mosquito species such as those in the genus *Aedes*. Knowing the stage and species present is vital to the effectiveness

of this material. Therefore, use of Bs requires frequent inspections of larval sources during periods of larval production and may require frequent applications of material. Application can be by hand, or from an ATV, watercraft, a truck, or aircraft.

> **Spinosad** is an Organic Materials Review Institute-Listed Dow AgroSciences active ingredient that is a fermentation product of bacteria first discovered in an old rum distillery. Spinosad is a fermentation product of the naturally occurring soil bacterium *Saacharopolyspora spinosa*. It causes excitation of the mosquito's nervous system, ultimately leading to paralysis and death. This mode of action makes this pesticide a good option for rotational use in the prevention of resistance. Its action on the target organism is either by contact or by ingestion, and as with other bacterial larvicides, activity can be reduced in highly organic water. The District applies spinosad as a liquid or as a sustained-release product that can persist for up to 30 or 180 days. It is applied either in response to high observed populations of mosquito larvae at a site or as a sustained-release product that can persist for up to about 4 months. This product has very low potential for accumulation in soil or groundwater contamination. Application can be performed by hand, or from an ATV, watercraft, a truck, or aircraft.

> **Methoprene** is a synthetic insect juvenile hormone that is designed to disrupt the transformation of a juvenile mosquito into an adult. Juvenile hormone is found during aquatic life stages of the mosquito and in other insects, but is most prevalent during the early instars. As mosquito larvae mature, the level of juvenile hormone steadily declines until the fourth instar molt, when levels are very low. This is a sensitive period when all the physical features of the adult begin to develop. Methoprene in the aquatic habitat can be absorbed on contact and the insect's hormone system becomes inbalanced. When this happens during the sensitive period, the imbalance interferes with fourth instar larval development. One effect is to prevent adults from emerging. Since pupae do not eat, they eventually deplete body stores of essential nutrients and then starve to death. Methoprene products must be applied (or be present, if using a slow release formula) to the late instar (e.g., third and fourth) stages of mosquitoes. It is not effective against other life stages. Methoprene can be applied in a granular, liquid, pellet, or briquet formulation. Sustained-release products can persist for up to 30 or 150 days. Application can be performed by hand, or from an ATV, watercraft, a truck, or aircraft.

> **BVA-2** and Masterline Mosquito Larvicide are highly refined petroleum distillates (mineral oil). These new larvicides demonstrate a low level of toxicity to plant growth (phytotoxicity) and rapid environmental breakdown. BVA-2 larvicide/pupacide oil has a water-white clear color and is also practically odorless. It forms a thin film on water and kills larvae through suffocation and/or direct toxicity. It is typically applied at application rates of 3 to 5 gallons per acre and can be applied by hand, or from an ATV, watercraft, a truck, or aircraft.

> **Agnique** is the trade name for a surface film larvicide, comprised of ethoxylated alcohol that kills mosquito larvae and pupae. Agnique forms an invisible monomolecular film that is odorless and visually undetectable. This film interrupts the critical air-water interface (surface tension) in the mosquito's larval and pupal development cycle causing them to drown. Because the layer is thin, larvae can still temporarily penetrate the film to get air allowing for them to survive for up to 5 days. Mortality rate is somewhat dependent on life cycle stage. Larvae are typically killed within 2 to 3 days; however, with some species and under certain environmental conditions (such as cool temperatures when development is slow) larval control may take upwards of 5 days. Water temperature will affect oxygen demands and rate of maturation, thus slowing control. Pupae are typically controlled within 1 to 3 days, and any pupae that attempt to emerge will be controlled due to the presence of the film. The District may use Agnique as an alternative to BVA-2 although costs, limits of application, and effective duration are issues of concern. Because the application rate of Agnique is much lower than that of BVA-2, 0.35 to 1 gallon per acre, this potential shift would not include an increase in volume of materials applied. Application can be performed by hand, or from an ATV, watercraft, a truck, or aircraft.

> **CoCoBear Oil** is a white mineral oil that has replaced the discontinued Golden Bear Oil 1111. This new larvicide/pupacide has reduced the level of mineral oil to 10 percent. It has similar characteristics and properties to Golden Bear Oil 1111 in that it also demonstrates low-level toxicity to plant growth (phytotoxicity) and rapid environmental breakdown. It forms a thin film on water and kills immature mosquitoes through suffocation and/or direct toxicity. It is typically applied at application rates of 3 to 5 gallons per acre and can be applied by hand, or from an ATV, watercraft, a truck, or aircraft.

Mosquito pathogens and other larvicides most likely to be used are listed in Table 2-2 (Pathogens and Other Larvicides Alameda County Mosquito Abatement District Uses for Mosquito Abatement).

Larviciding Techniques

Because of the wide range of mosquito sources in the Service Area, and the variety of pesticide formulations described above, the District uses a variety of techniques and equipment to apply larvicides, including handheld sprayers, backpack sprayers and blowers, truck-or-ATV-mounted spray rigs, watercraft, and helicopters or other aircraft. See Section 2.6 for more detailed information on equipment the District uses. District criteria for selecting application methods are predicated upon access, efficiency, and effectiveness of application, size of the area to be treated, and the density and type of vegetation present at the application site (i.e., the likelihood of success in applying the materials to the target area).

Ground Larviciding Techniques

The District uses conventional pickup trucks, Polaris ATVs, and ARGO ATVs as larvicide vehicles. A chemical container tank, high-pressure, low-volume electric or gas pump, and spray nozzle are mounted in the back of the truck bed, with a switch and extension hose allowing the driver to operate the equipment and apply the larvicide. The ATVs have a chemical container mounted on the vehicle, a 12-volt electric pump supplying high-pressure, low-volume flow, and booms and/or hose and spray tips allowing for application while steering the vehicle. ATVs are ideal for treating areas such as agricultural fields, pastures, and other offroad sites. Additional training in minimizing habitat impacts, recognizing sensitive flora and fauna, and ATV safety and handling is provided to employees before operating these machines.

Additional equipment used in ground applications of liquid formulations includes handheld sprayers (handcans or spray bottles), and backpack sprayers and blowers. Handheld sprayers (handcans) are standard 2-3-gallon garden style pump-up sprayers used to treat very small isolated areas. Backpack sprayers are either hand pump-up for liquid applications and have a 2- to 5-gallon tank or are gas powered with a chemical tank and calibrated proportioning slot. Generally, a pellet or small granular material is applied by hand or with a gas-powered backpack sprayer, blower, ATV-mounted Herd Seeder, or hand crank "belly grinder" machine designed to evenly distribute the pellets or granules.

Using ground application equipment, both when on foot and when conveyed by vehicles, has several advantages. Ground larviciding allows applications while in close proximity to the actual treatment area and, consequently, treatments occur to only those microhabitats where larvae are actually present. This reduces unnecessary pesticide load on the environment and the financial cost of the amount of material used and its application. Both the initial and the maintenance costs of ground equipment are generally less than for aerial equipment. Furthermore, ground larviciding applications are less affected by weather conditions than are aerial applications.

However, ground larviciding is impractical for large or densely vegetated areas. Damage may occur from the use of a ground vehicle in some natural areas. Ruts and vegetation damage may occur, although both these conditions are reversible and generally short-lived. Technicians are trained to recognize sensitive habitat areas and to use good judgment to avoid impacting these areas.

Table 2-2 Pathogens and Other Larvicides Alameda County Mosquito Abatement District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	Chemical Type	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites*
Pathogens / Biological Control							
VectoLex CG	Bs 7.5% granule	Microbial	EPA 73049-20	Larvicide: when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]
VectoLex WDG	Bs 51.2% water dispersible granule	Microbial	EPA 73049-57	Larvicide: when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Canals, creeks, ditches, marshes, natural ponds, rainwater, urban underground water
VectoLex WSP	Bs 7.5% granule in water soluble packets	Microbial	EPA 73049-20	Larvicide: when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand	Most habitats[1]
FourStar 45 Bti	Bs 6% Bti 1% 45 day briquet	Microbial	EPA 83362-3	Larvicide: when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand	Most habitats[1]
FourStar 90 Bti	Bs 6% Bti 1% 90 day briquet	Microbial	EPA 83362-3	Larvicide: when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand	Most habitats[1]
FourStar 180 Bs	Bs 6% Bti 1% 180 day briquet	Microbial	EPA 83362-3	Larvicide: when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand	Most habitats[1]
VectoMax CG	Bs 2.7% Bti 4.5% granules	Microbial	EPA 73049-429	Larvicide: when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]

Table 2-2 Pathogens and Other Larvicides Alameda County Mosquito Abatement District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	Chemical Type	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites*
Other Larvicides							
BVA 2	Aliphatic petroleum hydrocarbons (mineral oil) 97%	Larviciding Oil	EPA 70589-1	Larvicide/pupacide: oil spreads over surface and suffocates larvae as they are unable to break the water surface with their breathing tubes (prevents adult emergence).	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Most habitats[1]
CoCoBear Oil	Aliphatic petroleum hydrocarbons (white mineral oil) 10%	Larviciding Oil	EPA 8329-93	Larvicide/pupacide; oil spreads over surface and suffocates larvae as they are unable to break the water surface with their breathing tubes (prevents adult emergence).	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Most habitats[1]
Golden Bear Oil[2]	Aliphatic petroleum hydrocarbons (mineral oil) 98.7%	Larviciding Oil	EPA 8329-72	Larvicide/pupacide; oil spreads over surface and suffocates larvae as they are unable to break the water surface with their breathing tubes (prevents adult emergence).	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Canals, catch basins, containers, ditches, gutters, ornamental ponds, rainwater, sanitary, seepages, storm drains, swimming pools, urban underground water
Agnique MMF	Biodegradable ethoxylated alcohol surfactant 100%	Larviciding Surface Film	EPA 53263-28	Larvicide/pupacide; film spreads over standing water surface and reduces surface tension causing larvae to drown (prevents adult emergence).	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Containers, marshes, ornamental ponds, rainwater, tree holes
VectoBac 12AS	Bti 11.61% liquid	Microbial	EPA 73049-38	Larvicide: when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Canals, creeks, ditches, marshes, natural ponds, rainwater, sanitary, urban underground water

Table 2-2 Pathogens and Other Larvicides Alameda County Mosquito Abatement District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	Chemical Type	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites*
VectoBac G	Bti 2.8% granule	Microbial	EPA 73049-10	Larvicide: when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]
Altosid Briquets	(S)-Methoprene 8.62% 30 day	Insect Growth Regulator	EPA 2724-375	Hormone analogue that interferes with larval development (insect growth regulator).	Jan.-Dec.	Hand	Most habitats[1]
Altosid Liquid conc.	(S)-Methoprene 20% liquid con.	Insect Growth Regulator	EPA 2724-466	Hormone analogue that interferes with larval development (insect growth regulator).	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Canals, creeks, ditches, marshes, natural ponds, rainwater, sanitary, urban underground water
Altosid Pellets	(S)-Methoprene 4.25% pellet 30 days	Insect Growth Regulator	EPA 2724-448	Hormone analogue that interferes with larval development (insect growth regulator).	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]
Altosid SBG	(S)-Methoprene 0.2% granule 5-10 days	Insect Growth Regulator	EPA 2724-489	Hormone analogue that interferes with larval development (insect growth regulator).	Jan.-Dec.	Hand / Blower / Aerial	Canal, creeks, ditches, marshes, natural ponds
Altosid WSP (pellets)	(S)-Methoprene 4.25% granule in water soluble packs 30 days	Insect Growth Regulator	EPA 2724-448	Hormone analogue that interferes with larval development (insect growth regulator).	Jan.-Dec.	Hand	Canals, creeks, ditches, natural ponds, ornamental ponds, seepages, swimming pools, urban underground water
Altosid XR-Briquets	(S)-Methoprene 2.1% 150 day	Insect Growth Regulator	EPA 2724-421	Hormone analogue that interferes with larval development (insect growth regulator).	Jan.-Dec.	Hand	Most habitats[1]

Table 2-2 Pathogens and Other Larvicides Alameda County Mosquito Abatement District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	Chemical Type	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites*
Altosid XR-G (granules)	(S)-Methoprene 1.5% granule 21 days	Insect Growth Regulator	EPA 2724-451	Hormone analogue that interferes with larval development (insect growth regulator).	Jan.-Dec.	Hand / Blower / Aerial	Creeks, marshes
Natular G30	Spinosad 2.5% granules 30 days	Microbial	EPA 8329-83	Larvicide; alters acetylcholine receptors causing involuntary neurological impacts.	Jan.-Dec.	Hand / Blower / Aerial	Canals, creeks, ditches, marshes, rainwater, seepages
Natular XRT	Spinosad 6.25% tablets 180 days	Microbial	EPA 8329-84	Larvicide; alters acetylcholine receptors causing involuntary neurological impacts.	Jan.-Dec.	Hand	Most habitats[1]
5% Skeeter Abate[2]	Temephos 5%	Pellet	EPA 8329-70	Cholinesterase inhibitor	Jan.-Dec.	Hand / Blower	Canals, rainwater, sanitary
Larvicides Alameda County Mosquito Abatement District May Use in the Future							
Kontrol Mosquito Larvicide	Aliphatic petroleum hydrocarbons (mineral oil) 98%	Larvicide/Pupacide Oil	EPA 737-48-10	Larvicide/pupacide: oil spreads over surface and suffocates larvae as they are unable to break the water surface with their breathing tubes (prevents adult emergence).	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Most habitats[1]
Agnique MMF G	Biodegradable alcohol ethoxylated surfactant 100% granule	Larvicide/Pupacide Surface Film	EPA 53263-30	Larvicide/pupacide; film spreads over standing water surface and reduces surface tension causing larvae to drown (prevents adult emergence).	Jan.-Dec.	Hand / Blower / Aerial	Containers, marshes, ornamental ponds, rainwater, tree holes
Agnique MMF G Pak 35	Biodegradable alcohol ethoxylated surfactant 100% granule –water soluble pouch	Larvicide/Pupacide Surface Film	EPA 53263-30	Larvicide/pupacide; film spreads over standing water surface and reduces surface tension causing larvae to drown (prevents adult emergence).	Jan.-Dec.	Hand	Most habitats[1]

Table 2-2 Pathogens and Other Larvicides Alameda County Mosquito Abatement District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	Chemical Type	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites*
Spheratax SPH (50 G)	Bs 5% granule	Microbial	EPA 84268-2	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]
Spheratax SPH (50 G) WSP	Bs 5.0% granule in water soluble packets	Microbial	EPA 84268-2	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand	Most habitats[1]
VectoMax G	Bs 2.7% Bti 4.5% granule	Microbial	EPA 73949-429	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]
VectoMax WSP	Bs 2.7% Bti 4.5% granule	Microbial	EPA 73049-429	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand	Most habitats[1]
AquaBac 200G	Bti 2.86% granule	Microbial	EPA 62637-3	Larvicide: when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]
AquaBac 400G	Bti 5.71% granule	Microbial	EPA 62637-13	Larvicide: when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]
AquaBac xt	Bti 8.0% liquid	Microbial	EPA 62637-1	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Canals, creeks, ditches, marshes, natural ponds, rainwater, sanitary, urban underground water

Table 2-2 Pathogens and Other Larvicides Alameda County Mosquito Abatement District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	Chemical Type	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites*
FFAST Bti	Bti 10% liquid	Microbial	EPA 432-1515	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Canals, creeks, ditches, marshes, natural ponds, rainwater, sanitary, urban underground water
FourStar SBG	Bti 2.15% granule	Microbial	EPA 85685-1	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]
Teknar SC	Bti 5.6% liquid	Microbial	EPA 73049-435	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Canals, creeks, ditches, marshes, natural ponds, rainwater, sanitary, urban underground water
VectoBac GR	Bti 2.8% granule	Microbial	TBA	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]
VectoBac GS	Bti 2.8% granule	Microbial	EPA 73049-10	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]
VectoBac WDG	Bti 37.4% water dispersible granule	Microbial	EPA 73049-56	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Canals, creeks, ditches, marshes, natural ponds, rainwater, sanitary, urban underground water

Table 2-2 Pathogens and Other Larvicides Alameda County Mosquito Abatement District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	Chemical Type	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites*
Altosid Liquid Larvicide	(S)-Methoprene 5%	Insect Growth Regulator	EPA 2724-392	Hormone analogue that interferes with larval development (insect growth regulator).	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig / Aerial	Canals, creeks, ditches, marshes, natural ponds, rainwater, sanitary, urban underground water
MetaLarv S-PT	(S)-Methoprene 4.25% granule	Insect Growth Regulator	EPA 73049-475	Hormone analogue that interferes with larval development (insect growth regulator).	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]
Natular 2EC	Spinosad 20.6% liquid	Microbial	EPA 8329-82	Larvicide; alters acetylcholine receptors causing involuntary neurological impacts.	Jan.-Dec.	Hand / Vehicle mounted gas or electric spray rig	Canals, creeks, ditches, marshes, natural ponds, rainwater, sanitary, urban underground water
Natular G	Spinosad 0.5% granule	Microbial	EPA 8329-80	Larvicide; microbial alters acetylcholine receptors causing involuntary neurological impacts.	Jan.-Dec.	Hand / Blower / Aerial	Most habitats[1]

EPA Number = Registered with the US Environmental Protection Agency

TBA = To be announced

* Only the most commonly treated habitats are listed. Treatments are not restricted to those habitats.

[1] Habitat types can include canals, containers, creeks, ditches, marshes, natural ponds, ornamental ponds, rainwater, sanitary, seepages, swimming pools, tires, treeholes, urban underground water, and wells

[2] No longer in use by ACMAD

Aerial Larviciding Techniques

When large areas or areas difficult to reach are simultaneously producing mosquito larvae at densities exceeding District treatment thresholds, then the District may use a helicopter or other aircraft to apply any of the larvicides discussed above or listed in Table 2-2. The District contracts with independent flying services to perform aerial applications, with guidance to the target site District staff provides. Aerial application of larvicides is a relatively infrequent activity for the District, typically occurring only a few times each year/once every few years, with each application covering around 100 to 1,000 acres. However, larval production can vary substantially, and the District is capable of undertaking more frequent or extensive operations if necessary.

The larvicides, excluding granular and pellet formulations, are typically combined with water and applied as a low-volume wet spray mix at 2 gallons per acre. Depending on weather conditions, the volume of final mix can be increased to 5 gallons (or more) per acre without changing the actual amount of larvicidal active ingredient that is applied per acre. Adjusting the final mix volume per acre to 5 gallons (or more) has the advantage of increasing the droplet size to help minimize potential drift and the disadvantage of substantially increasing the flying time, which also increases costs. Aerial application of liquid larvicides typically occurs during daylight hours and at an altitude above the treatment site of less than 40 feet.

Granular and pellet formulations of larvicides are applied using a large mechanical spreader with a bucket (or hopper) that is beneath the aircraft or pods positioned on the sides of the aircraft with spreaders that can hold several hundred pounds of granules/material beneath the aircraft. Granular and pellet formulations are generally much more expensive than liquid formulations of larvicides and are used to penetrate dense vegetation. Label application rates range between 2.5 and 10 pounds per acre for Altosid pellets impregnated with 4.25% methoprene. Applications of methoprene pellets above 5 pounds per acre are highly unlikely due to the high cost. Applications are around 10 pounds per acre for corncob granules impregnated with Bti or Bs. The maximum label application rate rate for Vectobac G, a 2.8% Bti product, and Vectolex CG, a 7.5% Bs product, is 20 pounds per acre. Rates depend on the density of vegetative cover and the organic content of the mosquito breeding water being treated. It is also significant to note that granular applications occur during daylight hours and are at an altitude that is less than 50 feet.

Using aerial application equipment has several advantages compared to ground application. First, it can be more economical for large target areas with extensive mosquito production. Second, by covering large areas more quickly, it can free District staff to conduct other needed surveillance or control. Third, it can be more practical for remote or inaccessible areas, such as islands, large marshes, and densely vegetated tule areas, than ground larviciding. However, risk of drift is greater with aerial applications, especially with liquid or ultralow volume (ULV) aerial larviciding and, consequently, more potential risk of nontarget exposure exists. In addition, accuracy in hitting the target area temporarily requires additional manpower for flagging or electronic guidance systems, which can increase costs. Finally, in addition to the timing constraints inherent in most larvicide use, the potential application window can be very narrow for aerial activities due to weather conditions.

2.3.5.1.2 Mosquito Adulticides

In addition to chemical control of mosquito larvae, the District may use pesticides for control of adult mosquitoes when no other tools are available and if specific criteria are met, including species composition, population density (as measured by landing count or other quantitative method), proximity to human populations, and/or human disease risk. As with larvicides, adulticides are applied in strict conformance with label requirements and any applicable federal and state requirements(Appendix B). Adulticides the District may potentially use include pyrethrins; and the synthetic pyrethroids Resmethrin, Sumithrin, Deltamethrin, Etofenprox and Permethrin. Table 2-3 lists the adulticides the District may use for mosquito abatement for 2014 and beyond. Adulticide materials are used infrequently and only when necessary to control mosquito populations.

Ground Adulticiding Techniques

The most common form of adulticide application is via insecticide aerosols at very low dosages. This method is commonly referred to as the ULV method. This method employs specially designed ULV equipment mounted on trucks and ATVs, or handheld for ground applications. Barrier or residual treatments for adult mosquitoes consist of an application using a material generally applied with a compressed air sprayer to the preferred foliage, buildings, or resting areas of the mosquito species. Barrier treatments are not currently used by the District but may be necessary in the future.

Cold aerosol generators, cold foggers, and ULV aerosol machines were developed to eliminate the need for great quantities of petroleum oil diluents necessary for earlier fogging techniques. These units are constructed by mounting a vortex nozzle on the forced air blower of a thermal fogger. Insecticide is applied as technical material or at moderately high concentrations (as is common with the pyrethroids), which translates to very small quantities per acre and is, therefore, referred to as ULV. In agriculture, this rate is assumed less than 36 ounces per acre, but mosquito control ground adulticiding operations rarely exceed 1 ounce per acre. The optimum sized droplet for mosquito control with cold aerosols applied at ground level has been determined to be in the range of 5 to 20 microns.

Adulticiding is the only known effective measure of reducing an adult mosquito population in a timely manner. All mosquito adulticiding activities follow reasonable guidelines to avoid affecting nontarget species including bees. Timing of applications (when mosquitoes are most active), avoiding sensitive habitat areas, working and coordinating efforts with property owners and other agencies (e.g.,CDFW, USFWS or the County Agricultural Commissioners office) when appropriate, and following label instructions and any applicable federal and state requirements all result in environmentally sound mosquito control practices.

Aerial Adulticiding Techniques

Aerial applications may be the only reliable means of obtaining effective control in areas bordered by extensive mosquito production sites or with a small, narrow, or inaccessible network of roads. Aerial adulticiding is often the only means available to cover a very large area quickly in case of severe mosquito outbreaks or mosquito-borne disease epidemics. The District has never performed aerial adulticiding, but could use this technique in the future to deal with a severe outbreak or risk of mosquito-borne disease transmission.

Two aerial adulticiding techniques are used in California: low-volume spraying and ULV aerosols. Low-volume (<2-gallon-per-acre) sprays are applied with the pesticide diluted in light petroleum oils or water and applied as a rather wet spray. The size of the droplets reduces drift, thus limiting swath widths, and may not be ideal under certain circumstances for impinging on mosquitoes. The technique is compatible with equipment commonly used for aerial liquid larviciding.

The other and more common aerial adulticiding technique applies the insecticide in a technical concentrate or in a very high concentration formulation as a ULV cold aerosol. Lighter aircraft, including helicopters, can be used because the insecticide load is a fraction of the other techniques. If the aircraft are capable of >120 knots, fine droplets can be created by the high-speed air stream impacting the flow from hydraulic nozzles. Slower aircraft and most helicopters typically use some variety of rotary atomizers to create the required droplet spectrum. ULV applications can be difficult to accurately place with any regularity. Without the visual cues, drift and settling characteristics can be difficult to assess.

The flight parameters differ by source and target species. Some operations fly during hours of daylight so their applications begin either at morning's first light or before sunset and work into twilight. At these times, the pilots should be able to see towers and other obstructions as well as keep track of the spray plume. The aircraft can be flown at less than a 200-foot altitude, which may make it easier to hit the target area.

Other operations may be conducted in the dark of the night, typically after twilight or early in the morning before dawn. The aircraft typically are flown between a 200- and 300-foot altitude. Swath widths vary from operation to operation but are normally set somewhere between 400 and 1,200 feet. Most mosquito flight activity is crepuscular, so these flights catch the adults at their peak activity.

Swaths are flown as close to perpendicular with the wind as is possible, working into the wind and commonly forming a long, tight S pattern. A number of factors affect the spray-drift offset and settling such as wind speed, droplet size, aircraft wake turbulence, altitude, and even characteristics of the individual aircraft. Pilots rely somewhat on experience for determining this offset, and some use telltale smoke or paper markers for swath alignment.

Aerial applications may be conducted over, but are not limited to, the following land uses within the Program Area: salt marsh, diked marsh, and seasonal wetlands; evaporation ponds and wastewater ponds; and agricultural, residential, commercial, industrial, and recreational areas. Urban and suburban areas would only be treated in the event of a severe risk of disease transmission. The District has not performed aerial applications over urban and suburban areas.

Table 2-3 Adulticides Alameda County Mosquito Abatement District Uses for Mosquito Abatement*

Pesticide Product Name	Common Name / Active Ingredients	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Zenivex E4 RTU	Etofenprox 4%	EPA 2724-807	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Pyrenone 25-5	Pyrethrins 5% Piperonyl Butoxide 25%	EPA 432-1050	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Scourge 4%	Resmethrin 4.14% Piperonyl Butoxide Technical 12.42%	EPA 432-716	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Adulticides Alameda County Mosquito Abatement District May Use in the Future						
Zenivex E20	Etofenprox 20%	EPA 2724-791	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
AMVAC Dibrom 8 Emulsive Naled Insecticide	Naled 62.0%	EPA 5481-479	Cholinesterase inhibitor	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
AllPro Evoluer 4-4 ULV	Permethrin 4% Piperonyl Butoxide Technical 4%	EPA 769-982	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
AllPro Evoluer 30-30 ULV	Permethrin 30 % Piperonyl Butoxide Technical 30%	EPA 769-983	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Aqua-Kontrol Concentrate	Permethrin 20% Piperonyl Butoxide Technical 20%	EPA 73748-1	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Aqualuer 20-20	Permethrin 20.6% Piperonyl Butoxide 20.6%	EPA 769-985	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Aqua-Reslin	Permethrin 20% Piperonyl Butoxide Technical 20%	EPA 432-796	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.

Table 2-3 Adulticides Alameda County Mosquito Abatement District Uses for Mosquito Abatement*

Pesticide Product Name	Common Name / Active Ingredients	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Biomist 4+4 ULV	Permethrin 4% Piperonyl Butoxide Technical 4%	EPA 8329-35	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Biomist 4+12 ULV	Permethrin 4% Piperonyl Butoxide Technical 12%	EPA 8329-34	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Kontrol 2-2	Permethrin 2% Piperonyl Butoxide Technical 2%	EPA 73748-3	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Kontrol 4-4	Permethrin 4.6% Piperonyl Butoxide Technical 4.6%	EPA 73748-4	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Kontrol 30-30 concentrate	Permethrin 30% Piperonyl Butoxide Technical 30%	EPA 73748-5	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Permanone 31-66	Permethrin 31.28% Piperonyl Butoxide 66%	EPA 432-1250	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Permanone RTU	Permethrin 3.98% Piperonyl Butoxide Technical 8.48%	EPA 432-1277	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Perm-X UL 4-4	Permethrin 4% Piperonyl Butoxide Technical 4%	EPA 655-898	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Aquahalt Water-Based Adulticide	Pyrethrins 5% Piperonyl Butoxide Technical 25%	EPA 1021-1803	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Evergreen Crop Protection EC 60-6	Pyrethrins 6% Piperonyl Butoxide Technical 60%	EPA 1021-1770	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.

Table 2-3 Adulticides Alameda County Mosquito Abatement District Uses for Mosquito Abatement*

Pesticide Product Name	Common Name / Active Ingredients	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Prentox Pyronyl Crop Spray	Pyrethrins 6% Piperonyl Butoxide Technical 60%	EPA 655-489	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Prentox Pyronyl Oil Concentrate or 3610A	Pyrethrins 3% Piperonyl Butoxide Technical 6%	EPA 655-501	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Prentox Pyronyl Oil Concentrate #525	Pyrethrins 5% Piperonyl Butoxide Technical 25%	EPA 655-471	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Pyrenone Crop Spray	Pyrethrins 6% Piperonyl Butoxide Technical 60%	EPA 432-1033	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Pyrocide Fogging Formula 7067 for ULV Mosquito Adulticiding	Pyrethrins 5% Piperonyl Butoxide Technical 25%	EPA 1021-1199	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7395	Pyrethrins 12% Piperonyl Butoxide Technical 60%	EPA 1021-1570	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7396	Pyrethrins 5% Piperonyl Butoxide Technical 25%	EPA 1021-1569	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Pyrocide Mosquito Adulticide 7453	Pyrethrins 5% Piperonyl Butoxide Technical 25%	EPA 1021-1803	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Scourge 18%	Resmethrin 18% Piperonyl Butoxide Technical 54%	EPA 432-667	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.

Table 2-3 Adulticides Alameda County Mosquito Abatement District Uses for Mosquito Abatement*

Pesticide Product Name	Common Name / Active Ingredients	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Anvil 2+2 ULV	Sumithrin (d-phenothrin) 2% Piperonyl Butoxide Technical 2%	EPA 1021-1687-8329	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Anvil 10+10 ULV	Sumithrin (d-phenothrin) 10.0% Piperonyl Butoxide 10.0%	EPA 1021-1688	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
AquaANVIL Water-based Adulticide	Sumithrin (d-phenothrin) 10% Piperonyl Butoxide Technical 10%	EPA 1021-1807-8329	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Duet Dual-Action Adulticide	Sumithrin (d-phenothrin) 5% Prallethrin 1% Piperonyl Butoxide Technical 5%	EPA 1021-1795-8329	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.
Barrier Sprays						
Suspend SC	Deltamethrin	EPA 432-763	Interferes with operation of sodium channels in insect neurons	Apr.-Sept.	ULV ground (handheld or truck mounted)	e.g., Residential, industrial, recreational areas, municipalities, etc.

EPA Number = Registered with the US Environmental Protection Agency

* Alameda County Mosquito Abatement District rarely does adulticiding treatments. Adulticides are used occasionally in urban settings with handheld foggers under and around buildings when adult mosquitoes emerge from water under buildings or in areas inaccessible to vehicles. Adulticides have also been applied to limited areas to bring down mosquitoes emerging from treeholes near residences. Adulticides are applied by truck-mounted foggers in the event of increased WNV activity or a significant fly-off of salt marsh mosquitoes if larval treatment fails or District staff cannot gain access to sources of larval development. Timing of application and sites information is based on historical data. Treatments are not restricted to those durations or habitats.

2.3.5.2 Yellow Jacket Abatement

Besides using insecticides for mosquito populations, the District may selectively apply them to control ground-nesting yellow jackets. This activity is generally triggered by the need for access to mosquito sources. The District excludes from its yellow jacket control program populations of this vector that are located in or on a structure. Yellow jacket nests that are off the ground would be treated under special circumstances to protect the health and safety of the District's employees. If a District technician deems it appropriate to treat yellow jackets, they will apply the insecticide directly within the nest in accordance with the District's policies to avoid drift of the insecticide or harm to other organisms.

Pyrethroid-based chemicals, some containing silica gel dusts, are typically used against ground-nesting yellow jackets. The potential environmental impacts of these materials is minimal due to two factors: (1) their active ingredients consist largely of Pyrethrin (a photosensitive natural insecticide manufactured from a Chrysanthemum species), or Allethrin and Phenothrin (first generation synthetic pyrethroids with similar photosensitive, nonpersistent characteristics as Pyrethrin), and (2) the mode of their application for yellow jacket population control (i.e., directly into the underground nest) prevents drift and further reduces the potential for inadvertent exposure to these materials. The pesticides the District may potentially use to control yellow jacket populations are shown in Table 2-4 (Pesticides Alameda County Mosquito Abatement District May Use for Yellow Jacket Wasp Abatement).

Table 2-4 Pesticides Alameda County Mosquito Abatement District May Use for Yellow Jacket Wasp Abatement

Pesticide Product Name	Common Name / Active Ingredients	EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Delta Dust	Deltamethrin 0.05%	EPA 432-772	Interferes with operation of sodium channels in insect neurons	Jan.-Dec.	Hand held duster	Residential, Commercial, Agriculture
Wasp – X	Etofenprox 0.5% Tetramethrin 0.2% Piperonyl Butoxide 1%	EPA 2724-786	Interferes with operation of sodium channels in insect neurons	Jan.-Dec.	Aerosol can	Residential, Commercial, Agriculture
Hot Shot Flying Insect Killer	Permethrin .15% d-trans Allethrin .25%	EPA 46515-48-8845	Interferes with operation of sodium channels in insect neurons	Jan.-Dec.	Aerosol can	Residential, Commercial, Agriculture
Spectracide Pro®	Permethrin .25% Tetramethrin .1% Piperonyl Butoxide .5%	EPA 9688-141-8845	Interferes with operation of sodium channels in insect neurons	Jan.-Dec.	Aerosol can	Residential, Commercial, Agriculture
Wasp Freeze	Phenothrin 0.120% d-trans Allethrin 0.129%	EPA 499-362	Interferes with operation of sodium channels in insect neurons	Jan.-Dec.	Aerosol can	Residential, Commercial, Agriculture
Spectracide® Wasp and Hornet Killer	Prallethrin .025% Lambda-cyhalothrin .010%	EPA 9688-190-8845	Interferes with operation of sodium channels in insect neurons	Jan.-Dec.	Aerosol can	Residential, Commercial, Agriculture
Drione Dust	Pyrethrin 1% Piperonyl Butoxide 10% Amorphous Silica Gel 40%	EPA 432-992	Interferes with operation of sodium channels in insect neurons	Jan.-Dec.	Hand held duster	Residential, Commercial, Agriculture

EPA Number = Registered with the US Environmental Protection Agency

2.4 Public Education

Public education is a key component that is used to encourage and assist reduction and prevention of mosquito habitats on private and public property. While this component is a critical element of the District's Program, public education activities are categorically exempt from CEQA review (CEQA Guidelines Section 15322) based on a finding by the State Secretary of Resources that these activities do not have a significant effect on the environment. Therefore, these activities will not be further reviewed in this document.

A well rounded mosquito prevention program includes good public education. The District's education program teaches the public how to recognize, prevent, and suppress mosquito breeding on their property. This part of the project is accomplished through the distribution of brochures, fact sheets, newsletters, participation in local events and fairs, presentations to community organizations, newspaper and radio advertising, public service announcements, social media, the District website, and contact with District staff in response to service requests. Public education also includes school presentations that teach future adults to be responsible by preventing and/or eliminating mosquito breeding sources and educates their parents or guardians about District services and how they can reduce mosquito-human interaction.

Educational activities also include making recommendations on specific property development and land and water management practices or proposals, in response to ongoing or proposed developments or management practices that may create sources of mosquitoes. To ensure that the District does not indirectly encourage environmental impacts without CEQA review, the District informs landowners and others who might modify the physical environment in response to our educational programs that they have specific environmental obligations, including compliance with CEQA and permit requirements. The District is not a permitting agency and it is not responsible for implementing or approving the recommendations; therefore, property owners or developers are required to prepare and submit their own documents for projects, which may require CEQA review. See also Section 1.8 on future CEQA compliance following completion, certification, and approval of this PEIR.

2.5 Emergency Activities

In the event of emergency conditions, comprising an actual or imminent disease outbreak declared by the CDPH, the District's Program activities will temporarily vary from its routine operational tools through increases in scope or intensity of methods, and potentially through use of legal pesticides, in strict conformance with label requirements and any applicable federal and state requirements, that the District does not routinely use. Because of their temporary nature and their similarity to routine activities, emergency activities are not evaluated separately in this PEIR. In addition, the state has recognized that emergency conditions may require prompt action of a nature or intensity above typical levels as a means to protect public health, welfare, safety, or property, and has exempted these activities from requirements for further environmental review (CEQA Guidelines Sections 15269, 15359).

2.6 Vehicles and Equipment Used to Implement the Program

Equipment listed and described herein are those mechanized items with engines or applicators that have the potential to affect air quality, greenhouse gas emissions, noise, or hazard evaluations for the environmental impact analyses. The specific types of District vehicles and equipment, and aerial equipment used by other pesticide applicators under contract, used in its Program are listed in Table 2-5 (Alameda County Mosquito Abatement District Vehicles and Equipment). The list includes vehicles, vehicle-borne pesticide applicators, personnel-borne applicators, and power tools. Nonmechanized equipment, such as trailers and hand rakes, are not included.

Table 2-5 Alameda County Mosquito Abatement District Vehicles and Equipment

Type of Vehicle/Equipment	Engine	Fuel Type
Ground Surveillance and Applications/Management		
Pickup Truck	5.4L V8	Gasoline
Pickup Truck	5.0L V8	Gasoline
Pickup Truck	4.6L V8	Gasoline
Pickup Truck	4.3L V6	Gasoline
Cargo Van	4.2L V6	Gasoline
Jeep	4.0L Inline V6	Gasoline
Pickup Truck	4.0L V6	Gasoline
SUV	4.0L V6	Gasoline
Pickup Truck	3.0L V6	Gasoline
2001 6x6 Polaris ATV	500cc, liquid cooled, 4 stroke	Gasoline
2005/2008 ARGO 8/Wheel Avenger	674cc, liquid cooled, 4 stroke carburetor	Gasoline
2010/2012 ARGO 8/Wheel 750 HDI EFI	747cc, liquid cooled, 4 stroke EFI	Gasoline
2005 Hydro Traxx 6/wheel	1100cc, liquid cooled, 4 cycle, 4 stroke	Gasoline
Hydro centrifugal hydraulic spray pump	N/A	N/A
Maruyama Mist Duster MD155DX	Kawasaki 40.2cc, 2 cycle	Gasoline
Gas Spray Rig	Honda HX120, 4 stroke	Gasoline
Leaf Blower	Type #135R, 2 cycle	Gas/Oil Mix
Brush Cutter	Kawasaki 33.33cc, 2 cycle	Gas/Oil Mix
Chainsaw	59cc,	Gas/Oil Mix
Electric Spray Rig	SHURflow electric pumps	Electric
Hudson X-Pert Stainless Steel 3 gal. sprayer	N/A	N/A
Chapin Premier Pro+ 2 gal sprayer Model 21220	N/A	N/A
Chapin Premier Series 3 gal polyethylene sprayer Model 2123	N/A	N/A
Birchmeier Flox 5 gal backpack sprayer	N/A	N/A
Birchmeier Flox 2.5 gal backpack sprayer	N/A	N/A
1 Qt. spray bottle	N/A	N/A
Water Surveillance and Applications/Management		
2005/2008 ARGO 8/Wheel Avenger	674cc, liquid cooled, 4 stroke carburetor	Gasoline
2010/2012 ARGO 8/Wheel 750 HDI EFI	747cc, liquid cooled, 4 stroke EFI	Gasoline
2005 Hydro Traxx 6/wheel	1100cc, liquid cooled, 4 cycle, 4 stroke	Gasoline
Hydro centrifugal hydraulic spray pump	N/A	N/A
Gas Spray Rig	Honda HX120, 4 stroke	Gasoline

Table 2-5 Alameda County Mosquito Abatement District Vehicles and Equipment

Type of Vehicle/Equipment	Engine	Fuel Type
Aerial Applications		
1968 Bell 206 Jet Ranger helicopter (Operated by Alpine Helicopter – Contractor) 120 gal material tank	Allison 250-C20J turboshaft, 420 shp	Jet fuel
1989 Bell 206 Jet Ranger helicopter (Operated by Alpine Helicopter – Contractor) 120 gal material tank	Allison 250-C20J turboshaft, 420 shp	Jet fuel
1960 Hiller Soloy helicopter (Operated by Alpine Helicopter – Contractor) 120 gal material tank	Allison 250-C20J turboshaft, 420 shp	Jet fuel
Isolair Air spray system model 3900 (helicopter-mounted)	N/A	N/A
Isolair 4400 bucket system (helicopter-mounted)	N/A	N/A
Isolair 4500 broadcaster (helicopter-mounted)	N/A	N/A

2.6.1 Vehicles and Equipment for Ground Surveillance and Chemical Application

The District uses open bed 4-wheel drive pickup trucks that have been modified for the particular Program activity. Generally, a chemical container tank, high-pressure, low-volume electric or gas pump, and spray nozzle are mounted in the back of the bed, with a switch and extension hose allowing the driver to operate the equipment and apply larvicides or ULV equipment mounted in the back bed, with a control switch in the interior cab in the case of adulticides. When treatment sites cannot be accessed by roads, access is by way of ATVs or by foot (if vehicle access is prohibited), and treatments are made using ATV-mounted equipment, handheld sprayers, backpack sprayers, or backpack blowers (for granular or pellet formulations) or by hand. Some situations where flooding and wetlands preclude access by 4-wheel drive vehicles or reasonable walking distance in waders/boots do require the use of an approved ATV. District staff do not use ATVs where environmental conditions (e.g., impenetrable vegetation/terrain, endangered/threatened plants, sensitive habitat) can result in causing an accident, personal injury, or significant environmental damage. When used, ATVs are fitted with a chemical container mounted on the vehicle, a 12-volt electric- or gasoline-engine-powered pump supplying high-pressure, low-volume flow, and a hose and spray tip allowing for application while steering the vehicle. ATVs are ideal for treating areas like agricultural fields, pastures, salt marshes, and other offroad sites.

Additional equipment used in ground applications includes handheld sprayers, seeders, and backpack sprayers/blowers. Handheld sprayers (handcans) are standard 2- or 3-gallon garden style pump-up sprayers used to treat small isolated areas with precision. Backpack sprayers are either gas or hand powered and are fitted with chemical tanks that can hold granular or pellet formulations in addition to liquid. Generally, for smaller areas, pellet or small granular material is applied by hand or with a mechanical hand-crank spreader, seeder, or backpack blower.

The manual removal of vegetation is the primary method used for vegetation management within and around a waterbody and would be performed using hand pruners, trimmers, handsaws, chainsaws, and weed eaters. The use of heavy equipment for vegetation management in waterways supporting native or special status fish species would only be used with the following BMPs: consultation with resource agencies; not operating such equipment in the water; providing appropriate containment and cleanup systems to avoid, contain, and clean up any leakage of toxic chemicals into the aquatic environment; controlling turbidity; and minimizing the area that is affected by the vegetation management activity. In Section 2.9, see Table 2-6 for a complete listing of BMPs used by the District at present and in the future.

2.6.2 Boats for Water Surveillance and Application

In the future, District personnel may use an aluminum outboard-motor boat or an airboat to inspect and treat large deepwater bodies and islands. They most likely would be utilized to access sloughs without useable levee roads. A boat is the best access to inspect and treat certain aquatic plant mats, algae mats, and islands for mosquitoes. Boat use minimizes vehicle travel in offroad areas of the creek beds and hazardous terrain along shorelines for carrying treatment equipment on foot. Further, boat operations do not have lasting environmental impacts.

2.6.3 Aerial Application

The District uses a contract agricultural application service to provide helicopter and potentially fixed-wing[4] treatments to large or problematic/difficult access source areas (around 100 to 1,000 acres). Helicopter and fixed-wing operations are done at very low altitude in areas away from people. An advantage of using aircraft is the high rate of application to large areas without contact with the ground surface (no disturbance of vegetation) at a reasonable per acre cost. A helicopter can treat up to 200 acres per hour. Helicopter treatments occur during daylight hours, typically before noontime when little or no wind occurs, and at an altitude that is less than 40 feet above the surface of the site being treated. A 120-gallon tank is used with a typical application rate of 2 gallons of final mix per acre. Although very cost prohibitive, the application rate can exceed 5 gallons per acre in "special" circumstances when a larger droplet size is desired to further minimize potential drift issues or penetrate vegetation. Typically, aerial larvicide treatments done using granular Bs and Bti formulations are at a target rate of 10 to 20 pounds per acre and methoprene formulations at 2.5 to 10 pounds per acre depending on the density of vegetation. If dense vegetation is present, application rates may reflect the higher end of the target rate. Agricultural aircraft pesticide applicators are regulated by CDPR and the County Agricultural Commissioner's Office.

2.7 Program Alternatives

The District has developed a range of project alternatives partially as result of input from the scoping process, and these alternatives and others are briefly described and evaluated in a technical report to the PEIR (Appendix E). This technical report is also summarized in Chapter 15 of this PEIR.

2.7.1 No Program Alternative

CEQA Guidelines require an analysis of the "No Project" Alternative, which is defined as what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services [Section 15126.6, Subdivision (e)(2)]. For Program purposes, the No Project Alternative would be equivalent to "no action" or to discontinue the Program described above. In the absence of continuing the current Program, the District would not exist solely to engage in public education control activities. See Section 15.2.2 for more information on the No Program Alternative.

2.7.2 Alternatives Eliminated from Further Consideration

These alternatives are identified and evaluated in the District's Alternatives Report (Appendix E) and summarized in Section 15.2 of this PEIR. In summary, the District determined that of the 19 potential tools, the following 8 methods were not immediately available or viable for use in its IMMP:

- **Biological Control (Viruses).** None of the mosquito viruses listed (in Appendix E, Section 2.5) are generally commercially available in California for mosquito control at present and there are currently many efficacy related issues.

[4] The District does not currently use any fixed-wing aircraft for aerial treatments but could do so in the future if the need arose.

- **Biological Control (Parasites).** None of the mosquito parasites listed (in Appendix E, Section 2.7) are generally available commercially in California for mosquito control at present. Research on the use of parasites for mosquito control has also shown several limitations related to efficacy. Although the use of parasites as a means for managing vector populations shows promise, much work concerning their biology, cultivation, mass production, transport, and release remains to be done.
- **Biological Control Plants (Carnivorous Plants).** Whether terrestrial or aquatic, carnivorous plants use a wide range of invertebrate prey and are not specific predators of mosquitoes. What little data exist indicates that carnivorous plants, especially terrestrial species, are inefficient for the control of mosquitoes and other invertebrate vectors.
- **Mass Trapping.** This tool is not considered by the District to be a practical, effective, reliable method of controlling mosquito populations. Operational difficulties exist in placing out and retrieving large numbers of traps, the least of which are the volume of traps required, numbers of staff, amount of staff time, access, and travel necessary for this tool to be effective. Mass trapping of mosquitoes has proven to be both costly and in most instances ineffective.
- **Attract and Kill.** This is not considered by the District to be a practical, effective, reliable, method of controlling mosquito populations. The technology is limited, and effectiveness is either not obtained or is inconsistent. Nontarget insects can be impacted. The District is aware of one commercially available attractive toxic sugar bait (ATSB) product, Terminix® AllClear ATSB Mosquito Bait Concentrate. The District still needs to operationally test this material, as well as other potential ATSBs, to determine those circumstances where their use may be effective while also having little or no nontarget species impacts.
- **Inundative Releases.** This tool is not considered by the District to be a practical or a currently feasible method of controlling mosquito populations. Genetically modified mosquitoes are still experimental. They are also not commercially available at this time. The use of any genetically altered organisms, even mosquitoes, may also not be acceptable to the public.
- **Regulatory Control.** This is not considered feasible because adoption of regulations is lengthy, time intensive, expensive and uncertain as to the regulatory outcome. This approach is not focused sufficiently on control of existing populations. Moreover, regulatory controls are dependent upon state and federal agencies to initiate and implement, and thus this approach cannot assure that any project objectives would be achieved. Additionally, regulatory actions have the potential to create as well as eliminate additional mosquito habitats.
- **Repellents.** Have no value as a control tool; they are strictly a personal protective measure. Although effective for small-scale use by humans and animals, they are not part of the overall Program control strategy because they merely displace the problem and do not reduce the mosquito population in an area.

2.7.3 Other Alternatives

While no other alternatives are considered feasible or appropriate to achieve the District's Program objectives, including the No Chemical Alternative, and all of the Program alternatives would be combined into the District's Proposed Program, potential options or alternative methods within some of the Program alternatives could be used to modify those alternatives, thus minimizing impacts to the environment or replacing chemical treatments previously used.

2.7.4 Environmentally Superior Alternative

Table S-1 presents a summary of all of the impacts associated with each Program Alternative and, therefore, the overall Program of all of the alternatives combined. For Surveillance, Physical Control, Vegetation Management, and Biological Control, the impacts are either "less than significant" (LS) or "no

impact" (N). The Chemical Control Alternative has one potentially significant impact which can be mitigated to less than significant and one significant and unavoidable impact.

- The Chemical Control Alternative has significant and unavoidable impacts to surface water resources from the application of naled as a mosquito adulticide. Potential future applications of naled would be infrequent but potentially necessary to protect public health in areas where mosquito populations have developed resistance to pyrethroids.
- The Chemical Control Alternative could also subject people to objectionable odors. Impacts even with BMPs implemented could be **potentially significant but mitigable.** Certain VOCs emit characteristic odors when they evaporate (volatilize) into air, even at very low concentrations well within safety limits. Pesticides currently used or proposed for future emit phenols (e.g., lambda-cyhalothrin, deltamethrin, etofenprox, permethrin, resmethrin, or naled). Materials such as the adulticides pyrethrin and permethrin have an odor. Due to limited applicability, small quantities of these types of substances are typically used. The human sense of smell (olfactory system) is sensitive to these types of compounds as a warning mechanism, and some individuals are more sensitive than others. The Chemical Control Alternative would apply certain types of odorous treatments using hydraulic spraying and atomizing (fogging), which could result in drift of small droplets and gaseous vapors. Depending on atmospheric conditions (i.e., wind direction, wind speed, stability class), this drift could subject people to objectionable odors near a treatment area.

Section 15.4 describes two "Reduced Program Alternatives:" Reduced Chemical Control and No Chemical Control.

- **Reduced Chemical Control**: To the extent the District can modify elements of the Chemical Control Alternative to mitigate identified impacts by avoiding completely the potentially significant impacts associated with some pesticide products by using other, less odorous products, then the environmentally superior alternative would be a Program incorporating these modifications to this alternative as components of the overall IMMP. Excluding air quality and the odor issue, the impacts to all of the other resources would be the same as for the proposed Program. Since naled would only used when absolutely necessary to protect public health, there is no reduced chemical option.
- **No Chemical Control**: This alternative would completely remove the chemical treatment options under the Vegetation Management and Chemical Control Alternatives. It would not have any of the significant and unavoidable or less-than-significant impacts associated with herbicide and pesticide use. However, it was determined to be inconsistent with Program objectives and IMM principles, and it could lead to substantial impacts to human health due to the reduced effectiveness of the Program in controlling mosquito populations.

The No Program Alternative is not the environmentally superior alternative due to its potentially significant impacts to the following resources and concerns identified in Section 15.3: urban and rural land uses, aquatic and terrestrial biological resources, ecological health, human health, and public services and hazard response.

2.8 Other Required Permits and Agency Coordination

2.8.1 Required Permits

2.8.1.1 California Department of Public Health

The District's Program as a whole, including the registration and continuing education of state-certified field personnel, is reviewed and approved by the CDPH, through a formal Cooperative Agreement that is renewed annually. The CDPH also performs onsite annual inspection of the District's equipment, operations, safety training, and records.

2.8.1.2 Statewide General NPDES Permit for Vector Control

The application of pesticides at, near, or over waters of the US that results in discharges of pollutants requires coverage under a National Pollutant Discharge Elimination System (NPDES) permit. In response to the Sixth Circuit Court's decisions and previous decisions by other courts on pesticide regulation, the State Water Resources Control Board (SWRCB) has adopted four Pesticide Permits. Water Quality Order No. 2011-0002-DWQ (General Permit No. CAG 990004) is the Permit for Biological and Residual Pesticide Discharges to waters of the United States from vector control applications (SWRCB 2001a). The District completed application requirements, including preparation of a Pesticide Application Plan (PAP) and public notice requirements, and received permit approval on October 31, 2011 (Alameda County Mosquito Abatement District 2011b).

This General Permit covers the point source discharge of biological and residual pesticides resulting from direct to water and spray applications for vector control using (1) larvicides containing monomolecular films, methoprene, Bti, Bs, temephos, petroleum distillates, or spinosad; and (2) adulticides containing malathion, naled, pyrethrin, permethrin, resmethrin, sumithrin, prallethrin, PBO (an inert ingredient), etofenprox, or N-octyl bicycloheptene dicarboximide (or MGK-264). Users of products containing these active ingredients (and the inert PBO) are required to obtain coverage under this General Permit prior to application to waters of the United States. This General Permit only covers the discharge of larvicides and adulticides that are currently registered in California.

Pursuant to California Water Code Section 13389, SWRCB and Regional Water Resources Control Boards (RWQCBs) are exempt from the requirement to comply with Public Resources Code, Chapter 3, Division 13 when adopting NPDES permits (SWRCB 2011b).

2.8.1.3 Statewide General NPDES Permit for Algae and Aquatic Weed Control

This General Permit regulates the discharge of aquatic pesticides (algaecides and aquatic herbicides) used for algae and aquatic weed control to waters of the United States. These are algaecides and aquatic herbicides with registration labels that explicitly allow direct application to water bodies. This General Permit becomes effective on December 1, 2013.

Except for discharges on tribal lands that are regulated by a federal permit, this General Permit covers the point source discharge to waters of the United States of residues resulting from pesticide applications using products containing 2,4-dichlorophenoxyacetic acid (2,4-D), acrolein, copper, diquat, endothall, fluridone, glyphosate, imazamox, imazapyr, penoxsulam, sodium carbonate peroxyhydrate, and triclopyr-based algaecides and aquatic herbicides, and adjuvants containing ingredients represented by the surrogate nonylphenol. This General Permit covers only discharges of algaecides, and aquatic herbicides that are currently registered for use in California, or that become registered for use and contain the above-listed active ingredients and ingredients represented by the surrogate of nonylphenol.

A Discharger under this General Permit includes any entity involved in the application of algaecides and aquatic herbicides that results in a discharge of algaecides and aquatic herbicides and their residues and degradation byproducts to waters of the United States, and meets either or both of the following two criteria:

> The entity has control over the financing for or the decision to perform algaecide and aquatic herbicide applications that result in discharges, including the ability to modify those decisions; or

> The entity has day-to-day control of algaecide and aquatic herbicide applications or performs activities that are necessary to ensure compliance with this General Permit. For example, the entity is authorized to direct workers to carry out activities required by this General Permit or perform such activities themselves.

2.8.1.4 United States Army Corps of Engineers

For minor physical control activities, the District obtains 5-year regional permits from the USACE, SWRCB, and BCDC (with review by the USFWS, CDFW, National Marine Fisheries Service (NMFS), and other agencies as needed). The current USACE permit runs through February 1, 2013, and the BCDC permit runs through April 1, 2014. The District is working collaboratively with the CDPH and other Coastal Region Districts toward renewing the USACE source reduction permit.

2.8.1.5 United States Fish and Wildlife Service

The District is required to submit an annual Pesticide Use Proposal (PUP) and apply for a Supplemental Use Permit (SUP) whenever performing mosquito control activities on USFWS lands. Depending on the location and nature of the work, the District may also be required to consult with the USFWS under Section 7 of the federal Endangered Species Act to address potential impacts to sensitive species and habitats. In addition to SUPs and PUPs, the USFWS reviews and may also comment on the District's proposed annual minor physical control projects (see Section 2.8.1.4 above on the USACE permit).

2.8.1.6 Alameda County Agricultural Commissioner

County Agricultural Commissioners also regulate sale and use of pesticides in California. In addition, County Agricultural Commissioners issue Use Permits for applications of pesticides that are deemed as restricted materials by CDPR. For chemical control activities, the District reports to and is periodically reviewed by the Alameda County Agricultural Commissioner. The County Agricultural Commissioner's Office also performs onsite annual inspection of the District's equipment, operations, safety training, and records, as well as impromptu field inspections. The District's Use Permit Operator ID Number is issued annually each year.

During the permitting process, County Agricultural Commissioners staff determine if the pesticide use will result in substantial adverse environmental impact, whether appropriate alternatives were considered, and if any potential adverse effects are mitigated. The Use Permit conditions contain minimum measures necessary to protect people and the environment. The County Agricultural Commissioners may choose to rely on this PEIR in making their determination.

2.8.2 Agency Coordination

For work on State of California lands and riparian zones, wetlands, or other sensitive habitats, the District coordinates, reviews activities, and often collaborates with several agencies including the USFWS, CDFW, and Alameda County agencies, municipalities, and property owners. The District works with land managers and resource agency staff on a regular basis to minimize the impacts of their activities on the environment as explained in Section 2.9.2 below.

2.9 Best Management Practices

The District has implemented a number of procedures and practices under current Program activities that would continue into the future for the Proposed Program. These BMPs represent measures to avoid, minimize, eliminate, rectify, or compensate for potential adverse effects on the human, biological, and physical environments and District Staff. Additional BMPs are part of the District's public education program and outreach to landowners and land managers. They represent mosquito control measures used by public and private property owners within the District's Service Area.

2.9.1 District Program BMPs

While similar to mitigation measures under CEQA, these BMPs are already in use and would continue to be used as part of the Proposed Program. Subsequent environmental impact assessments in this PEIR reflect the continued use of these measures, which are included in Table 2-6, Alameda County Mosquito

Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative, and organized under the following categories:

> General BMPs

> Tidal Marsh-Specific BMPs

> Salt Marsh Harvest Mouse (SMHM)

> Ridgway's Rail (RR) (Maley 2014)

> California Least Tern (CLT)

> Western Snowy Plover (WSnPl)

> California Tiger Salamander (CTS)

> Vernal Pool Tadpole Shrimp (VPTS)

> Contra Costa Goldfields (CCG)

> Palmate-Bracted Bird's Beak (PBBB)

> Vegetation Management

> Maintenance/Construction and Repair of Tide Gates and Water Structures in Waters of the U.S.

> Applications of Pesticides, Surfactants, and/or Herbicides

> Hazardous Materials Spill Management

> Worker Illness and Injury Prevention Program and Emergency Response

The District will observe all state and federal regulations. The District will follow all appropriate laws and regulations pertaining to the use of pesticides and herbicides and safety standards for employees and the public, as governed by the USEPA, CDPR, and local jurisdictions (with some exceptions). Although the products the District uses are all tested, registered, and approved for use by the USEPA and/or CDPR, the District provides additional margins of safety with the adherence to additional internal guidance based on BMPs and the principles embodied in District IMMP policies, where applicable.

> Ensure all District and contracted applicators are appropriately licensed by the state.

> District staff or contractors will coordinate with the Alameda County Agricultural Commissioner, and obtain and verify all required licenses and permits as current prior to pesticide/herbicide application.

All applicators and handlers will use proper personal protective equipment.

2.9.1.1 California Pesticide Regulatory Program

CDPR regulates the sale and use of pesticides in California. CDPR is responsible for reviewing the toxic effects of pesticide formulations and determining whether a pesticide is suitable for use in California through a registration process. Although CDPR cannot require manufacturers to make changes in labels, it can refuse to register products in California unless manufacturers address unmitigated hazards by amending the pesticide label. Consequently, many pesticide labels that are already approved by USEPA also contain California-specific requirements. Pesticide labels defining the registered applications and uses of a chemical are mandated by USEPA as a condition of registration. The label includes instructions telling users how to make sure the product is applied only to intended target pests and includes precautions the applicator should take to protect human health and the environment. For example, product labels may contain such measures as restrictions for applications in certain land uses and weather (i.e., wind speed) parameters.

2.9.2 Other BMPs for Mosquito Control

Many BMPs the District recommends to landowners and land managers can be found in the *Best Management Practices for Mosquito Control in California* (CDPH 2012b). These BMPS are incorporated by reference into this PEIR ; it is available at the following web address: **http://www.cdph.ca.gov/HealthInfo/discond/Documents/BMPforMosquitoControl07-12.pdf.**

Table 2-7 Alameda County Mosquito Abatement District List of Recommended BMPs for Mosquito Management by Landowners/Land Managers, contains the practices most often recommended for use in Alameda County.

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
A. General BMPs					
1. District staff has had long standing and continues to have cooperative, collaborative relationships with federal, state, and local agencies. The District regularly communicates with agencies regarding the District's operations and/or the necessity and opportunity for increased access for surveillance, source reduction, habitat enhancement, and the presence of special status species and wildlife. The District often participates in and contributes to interagency projects. The District will continue to foster these relationships, communication, and collaboration.	√	√	√	√	√
2. In particular, District staff will regularly communicate with resource agency staff regarding mosquito management operations, habitat, and flora and fauna in sensitive habitats. Such communications will include wildlife studies and occurrences of sensitive species in areas that may be subject to mosquito management activities.	√	√	√	√	√
3. When walking or using small equipment in marshes, riparian corridors, or other sensitive habitats, existing trails, levees and access roads will be used whenever possible to minimize or avoid impacts to species of concern and sensitive habitats. Specific care will be taken when walking and performing surveillance in the vicinity of natural and manmade ditches or sloughs or in the vicinity of tidal marsh habitat.	√	√	√	*[5]	√
4. District staff has received training from USFWS and CDFW biologists regarding endangered species, endangered species habitat, and wildlife/wildlife habitat recognition and avoidance measures. District supervisory staff frequently engages staff on these subjects. For example, District staff has become familiar with Ridgway's Rail call recordings to invoke avoidance measures if these calls are heard in the field. District staff is trained to be observant, proceed carefully, and practice avoidance measures if needed when accessing areas that may serve as bird nesting habitat (e.g., watch for flushing birds that may indicate a nest is nearby). Emphasis will be placed on species and habitats of concern where mosquito management activities might occur (e.g., SMHM, RR, special status plants, vernal pools, tidal marsh, etc.). These training sessions will be included as a part of the required continuing education training records that are kept by mosquito control agencies.	√	√	√	*	√
5. Conduct worker environmental awareness training for all treatment field crews and contractors for special status species and sensitive natural communities that a qualified person (e.g., District biologist) determines to have the potential to occur on the treatment site. Conduct the education training prior to starting work at the treatment site and upon the arrival of any new worker onto sites with the potential for special status species or sensitive natural communities.	√	√	√	*	√

[5] Means not available at this time. Should a viable biocontrol agent become available, evaluation of BMP measures would occur and be implemented.

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
6. District staff will work with care and caution to minimize potential disturbance to wildlife while performing surveillance and mosquito treatment/population management activities (see 1 through 5 above).	√	√	√	*	√
7. Identify probable (based on historical experience) treatment sites that may contain habitat for special status species every year prior to work to determine the potential presence of special status flora and fauna using the CNDDB, relevant Habitat Conservation Plans (HCPs), NOAA Fisheries and USFWS websites, Calfish.org, and other biological information developed for other permits. Establish a buffer of reasonable distance, when feasible, from known special status species locations and do not allow application of pesticides/herbicides within this buffer whenever possible. Nonchemical methods are acceptable within the buffer zone when designed to avoid damage to any identified and documented rare flora and fauna.	√	√	√	*	√
8. Vehicles driving on levees to travel through tidal marsh or to access sloughs or channels for surveillance or treatment activities will travel at speeds no greater than 10 miles per hour to minimize noise and dust disturbance.	√	√	√	*	√
9. District staff will implement site access selection guidelines to minimize equipment use in sensitive habitats including active nesting areas and to use the proper vehicles for onroad and offroad conditions.	√	√	√	*	√
10. Properly train all staff, contractors, and volunteer help to prevent spreading weeds and pests to other sites. The District headquarters contains wash rack facilities (including high-pressure washers) to regularly (in many cases daily) and thoroughly clean equipment to prevent the spread of weeds.	√	√	√	√	√
11. Operation of noise-generating equipment (e.g., chainsaws, brushcutters) will abide by the time-of-day restrictions established by the applicable local jurisdiction (i.e., City and/or County) if such noise activities would be audible to receptors (e.g., residential land uses, schools, hospitals, places of worship) located in the applicable local jurisdiction. Shut down all motorized equipment when not in use.	√	√	√	√	√
12. For operations that generate noise expected to be of concern to the public, the following measures will be implemented: – Measure 1: Provide Advance Notices: A variety of measures are implemented depending on the magnitude/nature of the activities undertaken by the District, and may include but are not limited to press releases, the District website, social media, and posted signs. Public agencies and elected officials also may be notified of the nature and duration of the activities, including the Board of Supervisors or City Council, environmental health and agricultural agencies, emergency service providers, and airports. – Measure 2: Provide Mechanism to Address Complaints: District staff is available during regular business hours to respond to service calls and address concerns about nighttime operations.	√	√	√	√	√

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
13. The District will perform public education and outreach activities.	√	√	√	√	√
14. Engine idling times will be minimized either by shutting equipment and vehicles off when not in use or reducing the maximum idling time to 5 minutes. Correct tire inflation will be maintained in accordance with manufacturer's specifications on wheeled equipment and vehicles to prevent excessive rolling resistance. All equipment and vehicles will be maintained and properly tuned in accordance with manufacturer's specifications. All equipment will be checked by a certified visible emissions evaluator if visible emissions are apparent to onsite staff.	√	√	√	√	√
B. Tidal Marsh-Specific BMPs					
1. District staff will continue to implement the measures in the USFWS's "Walking in the Marsh: Methods to Increase Safety and Reduce Impacts to Wildlife/Plants." District staff will receive annual training and review of this document to remain up to date and current on this document and its methodologies for protecting sensitive species and the marsh habitat.	√	√	√	*	√
2. District will minimize the use of equipment (e.g., ARGOs) in tidal marshes and wetlands. When feasible and appropriate, surveillance and control work will be performed on-foot with handheld equipment. Aerial treatment (helicopter) treatments will be utilized when feasible and appropriate to minimize the disturbance of the marsh during pesticide applications. When ATVs (e.g., ARGOs) are utilized techniques will be employed that limit impacts to the marsh including: slow speeds; slow, several point turns; using existing levees or upland to travel through sites when possible; use existing pathways or limit the number of travel pathways used.	√	√	√	*	√
3. District will use reasonable measures to minimize travel along tidal channels and sloughs in order to reduce impacts to vegetation used as habitat (e.g., rail nesting and escape habitat).	√	√	√	*	√
4. District staff will minimize the potential for the introduction and spread of *Spartina*, perennial pepperweed and other invasive plant species by cleaning all equipment, vehicles, personal gear, clothing, and boots of soil, seeds, and plant material prior to entering the marsh, and avoiding walking and driving through patches of perennial pepperweed to the maximum extent feasible.	√	√	√	*	√
5. When feasible, boats will be used to access marsh areas for surveillance and treatment of mosquitoes to further reduce the risk of potential impacts that may occur when using ATVs to conduct mosquito management activities.	√	√	√	*	√

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
6. The District currently references and provides staff training relevant to the USFWS "Walking in the Marsh: Methods to Increase Safety and Reduce Impacts to Wildlife/Plants" guidelines (USFWS undated). – District staff is trained to walk carefully in the marsh and to continuously look ahead of themselves to avoid potential wildlife disturbance (e.g., carefully make observations in their surroundings to detect flushing birds and nests). Specific care is taken when walking and performing surveillance in the vicinity of natural and manmade ditches or sloughs or in vicinity of cord grass habitat (e.g., rack line). – When walking in marshes District staff utilizes existing trails when possible (i.e., deer trails and other preexisting trails).	√	√	√	*	√
C. Salt Marsh Harvest Mouse (SMHM)					
1. Activities [surveillance, treatment (excluding aerial applications), source reduction] within or adjacent to harvest mouse habitat will not occur within two hours before or after extreme high tides of 6.9 feet National Geodetic Vertical Datum (NGVD) or above as measured at the Golden Gate Bridge (corrected for time and tide height for the site) or when the marsh plain is completely inundated because suitable upland refugia cover is limited and potentially disturbance-creating activities could prevent mice from reaching available cover.	√	√	√	*	√
2. Vegetation removal is limited to the minimum amount necessary to allow for surveillance, treatment, and mosquito habitat reduction (vegetation management) to minimize or avoid loss of SMHM. Similarly, excavation, fill, or construction activities will also be limited to the minimum amount necessary to minimize/avoid loss of SMHM.		√	√		
3. Vegetation clearing will be conducted systematically within the project area to ensure that SMHM are encouraged to move toward remaining vegetation and are not trapped in islands of vegetation subject to removal and far from suitable cover.		√	√		
4. To the extent feasible, physical control, vegetation management and other mosquito habitat reduction activities will be conducted between December 1 and February 28 (outside of the SMHM breeding season). Surveillance, chemical control, biological control, and public education activities occur year-round and are therefore carefully coordinated with resource agencies to minimize potential impacts to SMHMs and their habitats.		√	√		
5. When walking in the marsh, existing trails will be used whenever possible. Specific care will be taken when walking and performing surveillance in the vicinity of natural and manmade ditches or sloughs or in the vicinity of tidal marsh habitat to avoid potential disturbance of SMHM.	√	√	√	*	√
6. District staff will receive training on measures to avoid impacts to SMHM.	√	√	√	*	√

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
7. If SMHM nests or adults are encountered during mosquito management activities, avoidance measures will be immediately implemented and findings will be reported to the appropriate resource agency.	√	√	√	*	√
D. Ridgway's Rail (RR)					
1. Activities [surveillance, treatment (excuding aerial applications), source reduction] within or adjacent to Ridgway's Rail habitat will not occur within two hours before or after extreme high tides of 6.9 feet National Geodetic Vertical Datum (NGVD) or above as measured at the Golden Gate Bridge (corrected for time and tide height for the site) or when the marsh plain is completely inundated because suitable upland refugia cover is limited and potentially disturbance-creating activities could prevent clapper Ridgway's Rails from reaching available cover.	√	√	√	*	√
2. Vegetation removal is limited to the minimum amount necessary to allow for surveillance, treatment, and mosquito habitat reduction (vegetation management) to minimize or avoid loss of RR. Similarly, excavation, fill, or construction activities will also be limited to the minimum amount necessary to minimize/avoid loss of RR.	√	√	√	*	√
3. To the extent feasible, physical control, vegetation management and other mosquito habitat reduction activities will be conducted between September 1 and January 31 (outside of the RR breeding season). Surveillance, chemical control, biological control, and public education activities occur year-round and are therefore carefully coordinated with resource agencies to minimize potential impacts to RRs and their habitats.		√	√		√
4. District staff will notify the appropriate resource agency prior to entering potential RR habitats and will regularly coordinate with the resource agency(ies) on the locations of breeding RRs and avoid breeding RRs to the extent feasible. Any observations of adverse effects to RRs will be reported by District staff.	√	√	√	*	√
5. When walking in the marsh District staff will use existing trails whenever possible. Specific care will be taken when walking and performing surveillance in the vicinity of natural and manmade ditches or sloughs or in the vicinity of tidal marsh habitat to avoid potential disturbance of RRs.	√	√	√	*	√
6. Entry into suitable breeding habitat for RR will be minimized. When entry is required, the preferred method will be by foot. Other entry methods will be based on consultation with the appropriate resource agency.	√	√	√	*	√
7. District staff will receive training on measures to avoid impacts to RRs	√	√	√	*	√
8. If RR nests or adults are encountered during mosquito management activities, avoidance measures, as provided during training from the resource agencies, will be immediately implemented and findings will be reported to the appropriate resource agency.	√	√	√	*	√

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
E. California Least Tern (CLT)					
1. District staff will notify the appropriate resource agency prior to entering potential CLT habitats between April 15 and August 31 (breeding season) and will regularly coordinate with the resource agency(ies) on the locations of breeding CLTs and avoid breeding CLTs to the extent feasible. Any observations of adverse effects to CLTs will be reported by District staff.	√			*	√
2. Entry into suitable breeding habitat for CLT will be minimized. When entry is required, vehicle speed will be reduced to 5mph and peripheral paths will be utilized to the extent feasible. Other entry methods will be based on consultation with the appropriate resource agency.	√			*	√
3. District staff will receive training on measures to avoid impacts to CLTs	√			*	√
4. If CLT nests or adults are encountered during mosquito management activities, avoidance measures, as provided during training from the resource agencies, will be immediately implemented and findings will be reported to the appropriate resource agency.	√			*	√
F. Western Snowy Plover (WSnPl)					
1. District staff will notify the appropriate resource agency prior to entering potential WSnPl habitats between March 1 and September 15 (breeding season) and will regularly coordinate with the resource agency(ies) on the locations of breeding WSnPls and avoid breeding WSnPls to the extent feasible. Any observations of adverse effects to WSPs will be reported by District staff.	√			*	√
2. Entry into suitable breeding habitat for WSnPl will be minimized. When entry is required, vehicle speed will be reduced to 5mph and peripheral paths will be utilized to the extent feasible. Other entry methods will be based on consultation with the appropriate resource agency.	√			*	√
3. District staff will receive training on measures to avoid impacts to WSnPls	√			*	√
4. If WSnPl nests or adults are encountered during mosquito management activities, avoidance measures, as provided during training from the resource agencies, will be immediately implemented and findings will be reported to the appropriate resource agency.	√			*	√
G. California Tiger Salamander (CTS)					
1. Trucks and ARGOs will be restricted to established roads and berms in vernal pool areas. Only small ATVs (e.g. Polaris) will be utilized near vernal pools.	√			*	√

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
2. Methoprene, monomolecular films, and adulticides will not be used in vernal pool areas.				*	√
3. District staff will receive training on measures to avoid impacts to CTS	√			*	√
H. Vernal Pool Tadpole Shrimp (VPTS)					
1. Trucks and ARGOs will be restricted to established roads and berms in vernal pool areas. Only small ATVs (e.g. Polaris) will be utilized near vernal pools.	√			*	√
2. Methoprene, monomolecular films, and adulticides will not be used in vernal pool areas.				*	√
3. District staff will receive training on measures to avoid impacts to VPTS	√			*	√
I. Contra Costa Goldfields (CCG)					
1. District staff will receive training on the identification, biology and preferred habitat of Contra Costa goldfields.	√			*	√
2. When possible, project actions to be conducted in areas containing suitable habitat for this species will occur during the time period when CCG is in bloom and identifiable (March-June), so that any CCG plants observed can be avoided and documented.	√			*	√
3. District staff will coordinate with CDFW and USFWS regarding the locations of known CCG populations, so that these populations can be avoided. Flagging may be used to identify the boundaries of known CCG populations.	√			*	√
4. Trucks and ARGOs will be restricted to established roads and berms in vernal pool areas. Only small ATVs (e.g. Polaris) will be utilized near vernal pools. When feasible, mosquito management activities will be conducted on foot using hand equipment.	√			*	√
J. Palmate-Bracted Bird's Beak (PBBB)					
1. District staff will receive training on the identification, biology and preferred habitat of palmate-bracted bird's beak.	√			*	√
2. When possible, project actions to be conducted in areas containing suitable habitat for this species will occur during the time period when palmate-bracted bird's beak is in bloom and identifiable (May-October), so that any palmate-bracted bird's beaks plants observed can be avoided and documented.	√			*	√
3. District staff will coordinate with CDFW and USFWS regarding the locations of known palmate-bracted bird's beak populations, so that these populations can be avoided. Flagging will be used to identify the boundaries of known palmate-bracted bird's beak populations.	√			*	√

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
4. When possible, mosquito management activities will be conducted on foot using hand equipment.	√			*	√
K. Vegetation Management					
1. Consultations will be made with the appropriate resource agency to discuss proposed vegetation management work, determine potential presence of sensitive species and areas of concern, and any required permits.		√	√		
2. Vegetation management work performed will typically be by hand, using handheld tools, to provide access to mosquito habitat for surveillance, and when needed control activities. Tools used include: machetes, small garden variety chain saw, hedge trimmers and "weed-eaters."		√	√		
3. District will consult and coordinate with resource agencies as well as have all necessary permits prior to the commencement of work using heavy equipment (e.g., larger than handheld/garden variety tools such as small excavators with rotary mowers) in riparian areas.		√	√		
4. Minor trimming of vegetation (e.g., willow branches approximately three inches in diameter or less, blackberry bushes, and poison oak) to the minimum extent necessary will occur to maintain existing paths or create access points through dense riparian vegetation into mosquito habitat. This may include minor trimming of overhanging limbs, brush and blackberry thickets that obstruct the ability to walk within creek channels. Paths to be maintained will not be a cut as a defined corridor but rather a path maintained by selective trimming of overhanging or intrusive vegetation. Paths to be maintained will range in width from 3 to 6 feet across.		√	√		
5. Downed trees and large limbs that have fallen due to storm events or disease will be cut only to the extent necessary to maintain existing access points or to allow access to mosquito habitats.		√	√		
6. Every effort will be made to complete vegetation management in riparian corridors prior to the onset of heavy rains. Maintenance work to be done in early spring will be limited to trimming of access routes to new tree shoots, poison oak, blackberries, and downed trees that block these paths.		√	√		
7. District staff will work with care and caution to minimize potential disturbance to wildlife, while performing vegetation management activities within or near riparian corridors.		√	√		
8. If suitable habitat necessary for special status species is found and if nonchemical physical and vegetation management control methods have the potential for affecting special status species, then the District will coordinate with the CDFW, USFWS, and/or NMFS before conducting control activities within this boundary or cancel activities in this area. If the District determines no suitable habitat is present, control activities may occur without further agency consultations.		√	√		

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
9. If using heavy equipment for vegetation management, District staff (and contractors) will minimize the area that is affected by the activity and employ all appropriate measures to minimize and contain turbidity. Heavy equipment will not be operated in the water and appropriate containment and cleanup systems will be in place on site to avoid, contain, and clean up any leakage of toxic chemicals.		√	√		
L. Maintenance / Construction and Repair of Tide Gates and Water Structures in Waters of the U.S.					
1. District staff will consult with appropriate resource agencies (USACE, USFWS, CDFW, NMFS, BCDC, Regional Water Quality Control Board) and obtain all required permits prior to the commencement of ditch maintenance or construction within tidal marshes.		√			
2. Work plans for the upcoming season' proposed work as well as a summary of the last season' completed work will be submitted for review and comment to USACE, USFWS, NMFS, CDFW, BCDC and the Regional Water Quality Control Board no later than July 1 of each year for which work is being proposed. The work plan will include a delineation of all proposed ditching overlain on topographic maps at a minimum of 1" = 1000' scale, with accompanying vicinity maps. The plan will also indicate the dominant vegetation of the site, based on subjective estimates, the length and width of the ditches to be maintained, cleared or filled, and the estimated date the work will be carried out.		√			
3. All maintenance work will be done at times that minimize adverse impacts to nesting birds, anadromous fish, and other species of concern, in consultation with USFWS, NMFS, and CDFW. Work conducted will, whenever possible, be conducted during approved in water work periods for that habitat, considering the species likely to be present. For example, tidal marsh work will be conducted between September 1 and January 31, where possible and not contraindicated by the presence of other sensitive species. Similarly, in water work in waterbodies that support anadromous fish, work will be conducted between July 1 and September 30[6].		√			
4. Care will be taken to minimize the risk of potential disruption to the indigenous aquatic life of a waterbody in which ditch maintenance is to take place, including those aquatic organisms that migrate through the area.		√			
5. Staging of equipment will occur on upland sites.		√			
6. Mats or other measures will be taken to minimize soil disturbance (e.g., use of low ground pressure equipment) when heavy equipment is used.		√			

[6] Dates are from District's USACE source reduction permit. July 31, 2007.

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
7. All projects will be evaluated prior to bringing mechanical equipment on site, in order to identify and flag sensitive sites, select the best access route to the work site consistent with protection of sensitive areas, and clearly demarcate work areas.		√			
8. Measures will be taken to minimize impacts from mechanical equipment, such as hand ditching as much as possible; reducing turns by track-type vehicles, taking a minimum number of passes with equipment, varying points of entry, driving vehicles at low speed, and not driving on open mud and other soft areas.		√			
9. Discharges of dredged or fill material into tidal waters will be minimized or avoided to the maximum extent possible at the project site and will be consistent with all permit requirements for such activity. No discharge of unsuitable material (e.g., trash) will be made into waters of the United States, and material that is discharged will be free of toxic pollutants in toxic amounts (see section 307 of the Clean Water Act). Measures will be taken to avoid disruption of the natural drainage patterns in wetland areas.		√			
10. Discovery of historic or archeological remains will be reported to USACE and all work stopped until authorized to proceed by the appropriate regulatory authorities/resource agencies.		√			
11. Ditching that drains high marsh ponds will be minimized to the extent possible in order to protect the habitat of native salt pan species.		√			
12. No spoils sidecast adjacent to circulation ditches will exceed 8 inches above the marsh plain to minimize risk of colonization of spoils by invasive, nonnative plants and/or the spoils lines from becoming access corridors for unwanted predators (e.g., dogs, cats, red fox). Sidecast spoil lines exceeding 4 inches in height above the marsh plain will extend no more than 6 feet from the nearest ditch margin. Any spoils in excess of these dimensions will be hydraulically redispersed on site (e.g., by rotary ditcher), or removed to designated upland sites (per conditions of resource agency issued permits). Sidecast spoil lines will be breached at appropriate intervals to prevent local impediments to water circulation.		√			
13. If review of the proposed work plan by USACE, USFWS, or CDFW determines the proposed maintenance is likely to destroy or damage substantial amounts of shrubby or sub-shrubby vegetation (e.g., coyote brush, gumplant) on old sidecast spoils, the District will provide a quantitative estimate of the extent and quality of the vegetation, and provide a revegetation plan for the impacted species prepared by a biologist/botanist with expertise in marsh vegetation. The Corps approved revegetation plan will be implemented prior to April 1 of the year following the impacts.		√			

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
14. Small ditch maintenance work will be performed by hand, whenever possible, using handheld shovels, pitch forks, etc., and small trimmers such as "weed-eaters". (Note: the majority of small ditch work performed by the District is by hand.)		√			
15. When feasible, work will be done at low tide (for tidal areas) and times of entry will be planned to minimize disruption to wildlife.		√			
16. In marshes which contain populations of invasive nonnative vegetation such as pepperweed or introduced *Spartina*, sidecast spoils will be surveyed for the frequency of establishment of these species during the first growing season following deposition of the spoils. The results of the surveys will be reported to the USACE, USFWS and CDFW. If it is determined the sidecasting of spoils resulted in a substantial increase in the distribution or abundance of the nonnative vegetation which is detrimental to the marsh, the District will implement appropriate abatement measures after consultation with the USACE, USFWS and CDFW.		√			
17. When possible (i.e., with existing labor and vehicles), refuse such as tires, plastic, and man-made containers found at the work site will be removed and properly discarded.		√			
M. Applications of Pesticides, Surfactants, and/or Herbicides					
1. District staff will conduct applications with strict adherence to product label directions that include approved application rates and methods, storage, transportation, mixing, and container disposal.			√		√
2. District will avoid use of surfactants when possible in sites with aquatic nontargets or natural enemies of mosquitoes present such as nymphal damselflies and dragonflies, dytiscids, hydrophilids, corixids, notonectids, ephydrids, etc. Surfactants are a least preferred method but must be used with pupae to prevent adult mosquito emergence. The District will use a microbial larvicide (Bti, Bs) or IGR (e.g., methoprene) instead or another alternative when possible.					√
3. Materials will be applied at the lowest effective concentration for a specific mosquito species and environmental conditions. Application rates will never exceed the maximum label application rate.			√		√
4. To minimize application of pesticides, applications will be determined by surveillance and monitoring of mosquito populations.			√		√
5. District staff will follow label requirements for storage, loading, and mixing of pesticides and herbicides. Handle all mixing and transferring of pesticides and herbicides within a contained area.			√		√

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
6. Postpone or cease application when predetermined weather parameters exceed product label specifications, when wind speeds exceed the velocity as stated on the product label, or when a high chance of rain is predicted and rain is determining factor on the label of the material to be applied.			√		√
7. Applicators will remain aware of wind conditions prior to and during application events to minimize any possible unwanted drift to waterbodies, and other areas adjacent to the application areas.			√		√
8. Clean containers at an approved site and dispose of at a legal dumpsite or recycle in accordance with manufacturer's instructions if available.			√		√
9. Special Status Aquatic Wildlife Species: – A CNDDB search was conducted in 2012 and the results incorporated into Appendix A for this PEIR. District staff communicates with state, federal, and county agencies regarding sites that have potential to support special status species. Many sites where the District performs surveillance and control work have been visited by staff for many years and staff is highly knowledgeable about the sites and habitat present. If new sites or site features are discovered that have potential to be habitat for special status species, the appropriate agency and/or landowner is contacted and communication initiated. – Use only pesticides, herbicides, and adjuvants approved for aquatic areas or manual treatments within a predetermined distance from aquatic features (e.g., within 15 feet of aquatic features). Aquatic features are defined as any natural or man-made lake, pond, river, creek, drainage way, ditch, spring, saturated soils, or similar feature that holds water at the time of treatment or typically becomes inundated during winter rains. – If suitable habitat for special status species is found, including vernal pools, and if aquatic-approved pesticide, herbicide, and adjuvant treatment methods have the potential for affecting the potential species, then the District will coordinate with the CDFW, USFWS, and/or National Marine Fisheries Service (NMFS) before conducting treatment activities within this boundary or cancel activities in this area. If the District determines no suitable habitat is present, treatment activities may occur without further agency consultation.			√		√
10. District staff will monitor sites post-treatment to determine if the target mosquito population or weeds were effectively controlled with minimum effect to the environment and nontarget organisms. This information will be used to help design future treatment methods in the same season or future years to respond to changes in site conditions.			√		√

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
11. Do not apply pesticides that could affect insect pollinators in liquid or spray/fog forms over large areas (more than 0.25 acres) during the day when honeybees are present and active or when other pollinators are active. Preferred applications of these specific pesticides are to occur in areas with little or no honeybee or pollinator activity or after dark. These treatments may be applied over smaller areas (with hand held equipment), but the technician will first inspect the area for the presence of bees and other pollinators. If pollinators are present in substantial numbers, the treatment will be made at an alternative time when these pollinators are inactive or absent.			√		√
12. The District will provide notification to the public (as soon as operationally possible) and/or appropriate agency(ies) when applying pesticides or herbicides for large-scale treatments (e.g., fixed-wing aircraft or helicopters) that will occur in close proximity to homes, heavily populated, high traffic, and sensitive areas. The District infrequently applies or participates in the application of herbicides in areas other than District facilities.			√		√
13. Prior to adulticide applications, the location of the application area will be reviewed with respect to the proximity to 303(d) listed impaired waterbodies for pyrethroids or sediment toxicity. If impaired, application of permethrin and resmethrin would not be conducted in these locations.					√
N. Hazardous Materials and Spill Management					
1. Exercise adequate caution to prevent spillage of pesticides during storage, transportation, mixing or application of pesticides. All pesticide spills and cleanups (excepting cases where dry materials may be returned to the container or application equipment) will be reported to the Field Operations Supervisor and District Manager and recorded in the District safety and incident file.			√		√
2. Maintain a pesticide spill cleanup kit and proper protective equipment at the District's Service Yard and in each vehicle used for pesticide application or transport.			√		√
3. Manage the spill site to prevent entry by unauthorized personnel. Contain and control the spill by stopping it from leaking or spreading to surrounding areas, cover dry spills with polyethylene or plastic tarpaulin, and absorb liquid spills with appropriate absorbent materials.			√		√
4. Properly secure the spilled material, label the bags with service container labels identifying the pesticide, and deliver them to the District/Field Operations Supervisor for disposal.			√		√
5. A hazardous spill plan will be developed, maintained, made available, and staff trained on implementation and notification for petroleum-based or other chemical-based materials prior to commencement of mosquito treatment activities.			√		√

Table 2-6 Alameda County Mosquito Abatement District BMPs to Avoid/Minimize Environmental Impacts by Alternative

Best Management Practice (BMP)	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
6. Field-based mixing and loading operations will occur in such a manner as to minimize the risk of accidental spill or release of pesticides.			√		√
O. Worker Illness and Injury Prevention and Emergency Response					
1. Equip all vehicles used in wildland areas with a shovel and a fire extinguisher at all times.	√	√	√	√	√
2. Train employees on the safe use of tools, equipment and machinery, including vehicle operation.	√	√	√	√	√
3. District will regularly review and update their existing health and safety plan to maintain compliance with all applicable standards. Employees will be required to review these materials annually.	√	√	√	√	√

Table 2-7 Alameda County Mosquito Abatement District List of Recommended BMPs for Mosquito Management by Landowners/Land Managers

General/Universal BMPs

Managing Mosquito Breeding Sites and Harborage

1. Manage outdoor areas for mosquito harborage and any places that have standing water for more than 96 hours. Make certain to consult with resource agencies to identify potential sensitive habitats and species of concern and acquire required permits before commencing mosquito management activities in nondomestic mosquito habitats.
2. Properly dispose of unwanted or unused man-made containers.
3. Properly dispose of old tires.
4. When possible and appropriate, drill drainage holes, cover, or invert any container or object that holds standing water that must remain outdoors. Check containers or trash in places that may be hard to see, such as under bushes or buildings.
5. Clean clogged rain gutters and storm drains. Keep outdoor drains flowing freely and clear of leaves, vegetation, silt, and other debris.
6. Aerate ornamental ponds and water gardens to avoid letting water stagnate.
7. Change water in birdbaths, fountains, and animal watering troughs at least once per week.
8. Ensure rain and/or irrigation water does not stand in plant containers, trashcans, boats, or other containers on commercial and residential properties.
9. Regularly chlorinate swimming pools and spas and keep pumps and filters operating properly. Keep unused or unwanted pools empty and dry or buried. Keep unused spas tightly covered.
10. Maintain irrigation systems to avoid excess water use and runoff into storm drains.
11. Comply with all federal and state environmental laws and the California Health and Safety Code to prevent environmental harm while reducing or eliminating mosquito production.

Personal Protective Measures

1. Install and properly maintain fine mesh screens on windows and doors to prevent mosquito entry into homes.
2. Wear loose fitting protective clothing including long sleeves and pants to reduce exposure to mosquito biting activity.
3. Apply a USEPA-registered mosquito repellent to the body when outdoors. Spray repellents can be used on the outside of outer clothing as well as sparingly on the skin. Consult with a medical professional, if needed, prior to use and closely follow label directions for optimal effectiveness and safety.
4. If possible, minimize outdoor activities at dawn and dusk when mosquitoes are the most active.

BMPs for Residential/Commercial Properties

1. Avoid over-irrigation to prevent excess pooling and runoff.
2. Routinely inspect, maintain, and repair irrigation system components.
3. Make certain that underground drain pipes are laid to grade to avoid low areas that may hold water for more than 96 hours.
4. Backfill tire ruts and other man-made/artificial low areas that hold water for more than 96 hours.
5. Prevent mosquito breeding in rain water storage containers by properly screening all openings to prevent mosquito access to stored water.
6. Check and repair leaky plumbing, outdoor faucets, and gray or recycled water systems.
7. Maintain sumps, drains, and drainage ditches. Minimize standing water by managing buildup of debris, silt, and vegetation.
8. Maintain proper functioning of stormwater detention systems, managing water, accumulation of silt and debris, and when appropriate vegetation, to minimize mosquito production. Make sure access is maintained to allow for timely surveillance by the District and, when needed, District use of least toxic techniques and materials (e.g., Bti, Bs, Methoprene) to abate immature mosquitoes when water management requirements result in mosquito breeding. Maintain communication and coordination with District and applicable regulatory authorities as required.
9. Use waterfalls, fountains, aerators, and/or mosquitofish in ponds and ornamental water features. When considering the use of mosquitofish, landowners and land managers must consult with their local mosquito control agency and/or the CDFW regarding proper use of mosquitofish.

Table 2-7 Alameda County Mosquito Abatement District List of Recommended BMPs for Mosquito Management by Landowners/Land Managers

10. For ponds and ornamental water features where mosquitofish cannot be used, consult with the District to determine other possible techniques and/or nontoxic mosquito control products that can be used to prevent mosquito breeding.

BMPs for Agricultural Ditches and Drains

1. Design and maintain irrigation systems to use water efficiently, drain properly, and avoid standing water.
2. Keep ditches and drains well maintained. Periodically remove accumulated sediment and vegetation. Maintain ditch grade to minimize areas of standing water.
3. Prevent wet areas associated with seepage by repairing leaks in dams, ditches, and drains.
4. Construct or improve large ditches to a slope of at least 2:1 (vertical: horizontal) and a minimum 4-foot-wide bottom. Consider a 3:1 slope or greater to discourage burrowing animal damage, avoid potential seepage problems, and prevent unwanted vegetative growth.

BMPs for Vineyards and Orchards

1. When possible, use drip systems to irrigate.
2. Irrigate only as frequently as is needed to maintain proper soil moisture. Check soil moisture regularly.
3. Use Natural Resource Conservation Service guidelines when grading or regrading to minimize the potential for low-lying areas where standing water may accumulate.
4. Check and maintain ditches or drains and use applicable BMPs for ditches and drains to reduce potential for mosquito breeding.
5. Inspect vineyards and orchards for unwanted accumulations of water as a result of irrigation.

BMPs for Dairies and Animal Holding Operations

1. Surround all holding ponds with lanes of adequate width to allow safe passage of mosquito control equipment including keeping the lanes clear of any materials or equipment (e.g., trees, calf pens, hay stacks, silage, tires).
2. If fencing is used around the holding ponds, place it on the outside of the lanes with gates provided for vehicle access.
3. Divide large ponds into a series of smaller ponds that can be drained for removal of solid waste material.
4. Make ponds and lagoons narrow enough to allow solid waste removal after drying.
5. Ensure all interior banks of the holding ponds have a grade of at least 2:1.
6. If possible, use an effective solids separation system such as a mechanical separator or two or more solid separator ponds. If ponds are used, do not exceed 60 feet (18 meters) in surface width.
7. Never allow drainage lines to bypass the separator ponds, except those that provide for normal corral run-off and do not contain solids.
8. When possible, remove floating debris from ponds prior to crust formation.
9. If a thick crust exists (grass growing on crust), leave it intact until the pond can be drained and the solid material removed.
10. Routinely manage vegetation to prevent emergent vegetation and barriers to access. This BMP applies to access lanes, interior pond embankments, and any weed growth that might become established within the pond surface.
11. Manage dairy wastewater discharge for irrigation purposes so it does not stand for more than 4 days.
12. Use tire sidewalls or other objects that will not hold water to hold down tarps (e.g., on silage piles). Replace whole tires or other water-holding objects.

General BMPs for Wetlands

1. Manage vegetation routinely; Activities such as annual thinning of cattails and rushes and removing excess vegetative debris enables natural predators to hunt mosquito larvae more effectively in permanent wetlands. Vegetation in shallow, temporary wetlands can be mowed when dry.
2. Time flooding of seasonal wetlands to reduce overlap with peak mosquito activity.
3. Flood wetlands from permanent-water sources containing mosquito predators (e.g., mosquito-eating fish or invertebrate predators) to passively introduce mosquito predators. Permanent wetlands and brood ponds can be stocked with predatory mosquito species.

Table 2-7 Alameda County Mosquito Abatement District List of Recommended BMPs for Mosquito Management by Landowners/Land Managers

4. Maintain permanent or semipermanent water within the wetland to maintain populations of larval mosquito predators. Discourage the use of broad spectrum pesticides.
5. Establish buffers between agricultural fields and wetlands whenever possible. Use fertilizers conservatively and manage irrigation drainage to minimize fertilizer and/or manure flowing into wetlands.
6. Comply with all federal and state environmental laws and the California Health and Safety Code to prevent environmental harm while reducing or eliminating mosquito production.

BMPs for Design and Maintenance of Wetlands

1. Provide reasonable access on existing roads and levees to allow for surveillance, mosquito abatement, and implementation of BMPs. Make shorelines of natural, agricultural, and constructed waterbodies accessible for periodic maintenance, mosquito monitoring and abatement procedures, and removal of emergent vegetation.
2. Construct, improve, or maintain ditches with 2:1 slope and a minimum - foot (1.2-meter) width at the bottom. Consider a 3:1 slope or greater to discourage burrowing animal damage, potential seepage problems, and prevent unwanted vegetative growth.
3. Construct, improve, or maintain levees to quality standards that ensure stability and prevent unwanted seepage. Ideally build levees with 3:1 slopes and > 80 percent compaction; consider 5:1 slope or greater in areas prone to overland flooding and levee erosion.
4. Provide adequate water control structures for complete drawdown and rapid flooding.
5. When possible, include independent inlets and outlets in the design of each wetland unit.
6. Construct or enhance swales so they are sloped from inlet to outlet and allow maximum drawdown.
7. Excavate deep channels or basins to maintain permanent water areas (>2.5 feet deep) within a portion of seasonal managed wetlands. This BMP provides year-round habitat for mosquito predators that can inoculate seasonal wetlands when they are irrigated or flooded.

BMPs for Wetland Infrastructure and Maintenance

1. Inspect levees at least annually and repair as needed.
2. Periodically inspect, repair, and clean water control structures. Remove all debris, including silt and vegetation, which can impede drainage and water flow. Ensure water control structures are watertight to prevent unnecessary water flow or seepage.
3. Regularly remove trash, silt and vegetation from water delivery ditches to allow efficient water delivery and drainage. Remove problem vegetation that inhibits waterflow using herbicides, dredging, or by hand. If possible, use closed conduits instead of open canals for water conveyance.
4. Periodically test and repair pumps used for wetland flooding to maximize pump output.

Water Management BMPs for Seasonal Wetlands

1. Advise District when you intend to flood so that they can make timely inspections and, when needed, applications of mosquito larvicides.
2. Whenever feasible, have an emergency plan that provides for immediate drainage into accessible areas if a mosquito-borne disease/related public health emergency occurs.
3. Timing of flooding:
    - Delay or “phase” fall flooding of wetlands as along as possible in consultation with local mosquito control agencies to minimize mosquito production. Fall flooding is known to produce large numbers of mosquitoes.
    - Strategically locate wetlands identified for early flooding. Do not flood wetlands in early fall that are close to urban areas or historically produce great numbers of mosquitoes.
    - When possible, draw down water in managed wetlands in late March or early April.
    - Use a flood-drain-flood regime to control floodwater mosquitoes; flood to trigger hatching of dormant mosquito eggs, drain water and larvae into an area where they can be easily treated, drowned in moving water, or consumed by predators, and immediately reflood wetland. Use this water management regime only when it does not conflict with water quality regulations.
4. Speed of flooding:
    - Flood wetlands as quickly as possible to reduce the potential for large numbers of mosquitoes. Coordinate flooding with neighbors and/or the water district to maximize flood up rate.

Table 2-7 Alameda County Mosquito Abatement District List of Recommended BMPs for Mosquito Management by Landowners/Land Managers

5. Water source:
    - Flood wetlands with water from permanent water sources containing mosquito predators (i.e., mosquito-eating fish or invertebrate predators) to passively introduce mosquito predators. Permanent wetlands and brood ponds used as flooding sources can be stocked with mosquito-eating fish or maintained to encourage natural predator populations.
    - Maintain a separate permanent water reservoir that conveys water to seasonal wetlands that provides year-round habitat for mosquito predators that can inoculate seasonal wetlands when they are irrigated or flooded.
6. Frequency and duration of irrigation:
    - When possible, reduce the number and duration of irrigations to minimize standing water. Evaluate the need to irrigate based on spring habitat conditions and plant growth. If extended duration irrigation (generally 14-21 days) is considered for weed control (e.g., cocklebur), additional measures to offset the potential for increased mosquito production may be needed.
    - Irrigate managed wetlands before soil completely dries after spring drawdown to discourage floodwater mosquitoes from laying eggs in the dry, cracked substrate.
    - Drain irrigation water into ditches or other water sources with mosquito predators instead of nearby dry fields.
    - Maintain high groundwater levels by keeping channels or deep swales permanently flooded for subsurface irrigation to reduce the amount of irrigation water needed during the mosquito season.

Vegetation Management BMPs

1. Control floating vegetation conducive to mosquito production (i.e., water hyacinth, water primrose, parrot feather, duckweed, and filamentous algae mats).
2. Perform routine maintenance to reduce problematic emergent plant densities to facilitate the ability of mosquito-eating fish and other mosquito predators to move through vegetated areas and allow good penetration of chemical control agents.
3. Manage vegetation based on local land management objectives and associated habitat uses to minimize mosquito production. Methods of vegetation control for managed wetlands include mowing, burning, disking, and grazing.
4. Manage the spread and density of invasive, nonnative emergent wetland vegetation to increase native plant diversity, increase the mobility of larval mosquito predators, and allow for more efficient penetration of chemical control agents.

Additional Water Management BMPs for Permanent Wetlands

1. Maintain stable water levels in wetlands that are flooded during summer and early spring to prevent intermittent flooding of shoreline areas favorable to mosquito production. Water-level fluctuation can be minimized by continuing a constant flow of water into the wetland.
2. Circulate water to avoid stagnation (e.g., provide a constant influx of water equal to the net loss or discharge of water).
3. Maintain water depths as deep as possible (18 to 24 inches [45-60 centimeters] or more) during the initial floodup to minimize shallow habitats preferred by mosquito larvae. Shallow water levels can be maintained outside of the mosquito breeding season.

Additional BMPs for Saltwater Marsh

1. Improving water flow through the wetland system minimizes stagnant water and facilitates movement of fish and other natural predators. For example, mosquitoes in coastal tidal wetlands can be managed by constructing and/or maintaining ditches that drain off the water when the tide falls.

General Stormwater Management BMPs

1. Manage sprinkler and irrigation systems to minimize runoff entering stormwater infrastructure.
2. Avoid intentionally running water into stormwater systems by not washing sidewalks and driveways, cars on streets and driveways, etc.
3. Inspect facilities weekly during warm weather for the presence of standing water or immature mosquitoes.
4. Remove emergent vegetation and debris from gutters and channels that accumulate water.

Table 2-7 Alameda County Mosquito Abatement District List of Recommended BMPs for Mosquito Management by Landowners/Land Managers

5. Consider mosquito production during the design, construction, and maintenance of stormwater infrastructure.
6. Design and maintain systems to fully discharge captured water in 96 hours or less.
7. Include access for maintenance in system design.
8. Design systems with permanent water sources such as wetlands, ponds, sumps, and basins to minimize mosquito habitat and plan for routine larval mosquito inspection and control activities with the assistance of the District's mosquito control program.

Stormwater Conveyance BMPs

1. Provide proper grades along conveyance structures to ensure that water flows freely.
2. Inspect on a routine basis to ensure the grade remains as designed and to remove accumulations or sediment, trash, and debris.
3. Keep inlets free of accumulations of sediment, trash, and debris to prevent standing water from backing up on roadways and gutters.
4. Design outfalls to prevent scour depressions that can hold standing water.

Aboveground Stormwater Storage and Infiltration System BMPs

1. Design structures so they do not hold standing water for more than 96 hours to prevent mosquito development. Incorporate into the design features to 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.
2. 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.
3. Avoid the use of electric pumps. They are subject to failure and often require permanent-water sumps. Favor structures that do not require pumping over those that require pumping.
4. Avoid the use of loose rock riprap that may hold standing water.
5. Design distribution pumping and containment basins with adequate slopes to drain fully. For the design slope take into consideration buildup of sediment between maintenance periods.

Below Ground Stormwater Structures with Permanent-Water Sumps and Basins BMPs

1. Where possible, seal access holes (e.g., pickholes in manhole covers) to belowground structures designed to retain water in sumps or basins to minimize entry of adult mosquitoes. If using covers or screens, maximum allowable gaps of 1/16 inch (2 millimeters) will exclude entry of adult mosquitoes. Inspect barriers frequently and replace when needed.
2. If the sump or basin is completely sealed against mosquitoes, with the exception of the inlet and outlet, completely submerge the inlet and outlet to reduce the available surface area of water for mosquitoes to lay eggs (female mosquitoes can fly through pipes).
3. Where possible, design below ground sumps with the equipment necessary to allow for easy dewatering of the unit.
4. Contact District for advice with problem systems.

Stormwater Treatment Ponds and Constructed Treatment Wetland BMPs

1. Whenever possible and appropriate, stock stormwater ponds and constructed wetlands with mosquito-eating fish.
2. Design and maintain accessible shorelines to allow for periodic maintenance and/or control of emergent and shoreline vegetation, and routine monitoring and control of mosquitoes. Routinely manage emergent plant density so mosquito predators can move throughout the vegetated areas and are not excluded from pond edges.
3. Whenever possible, design and maintain deep zones in excess of 4 feet (1.2 meters) to limit the spread of invasive emergent vegetation such as cattails. Keep the edges below the water surface as steep as practicable and uniform to discourage dense plant growth that may provide immature mosquitoes with refuge from predators and increased nutrient availability.
4. Use concrete or liners in shallow areas to discourage plant growth where vegetation is not necessary.
5. Whenever possible, provide a means for easy dewatering.
6. Manage the spread and density of floating and submerged vegetation that encourages mosquito production

Table 2-7 Alameda County Mosquito Abatement District List of Recommended BMPs for Mosquito Management by Landowners/Land Managers

(i.e., water hyacinth, water primrose, parrot's feather, duckweed, and filamentous algal mats).

7. If possible, compartmentalize managed treatment wetlands so the maximum width of ponds does not exceed 2 times the effective distance (40 feet [12 meters]) of land-based application technologies for mosquito control agents.

Stormwater Treatment Structures General Access Requirements

1. Make all structures easily and safely accessible, without the need for special requirements (e.g., Occupational Safety and Health Administration requirements for "confined space"). This will allow for monitoring and, if necessary, abatement of mosquitoes.
2. If utilizing covers, include in the design spring-loaded or lightweight access hatches that can be easily opened.
3. Provide all-weather road access (with provisions for turning a full-size work vehicle) along at least one side of large aboveground structures that are less than 7 meters wide, or both sides if shore-to-shore distance is greater than 7 meters. Note: mosquito larvicides are applied with handheld equipment at small sites and with backpack or truck-mounted high-pressure sprayers at large sites. The effective swath width of most backpack or truck-mounted larvicide sprayers is approximately 20 feet (6 meters) on a windless day.
4. Build access roads as close to the shoreline as possible to allow for maintenance and mosquito control crews to periodically maintain, control, and remove emergent vegetation and conduct routine mosquito monitoring and abatement. Remove vegetation and/or other obstacles between the access road and the structure that might obstruct the path of larvicides to the water.
5. Control vegetation (by removal, thinning, or mowing) periodically to prevent barriers to access.

BMPs for Right-of-Ways and Easements

1. Inspect property for standing water or evidence of standing water that may become mosquito sources.
2. See BMPs for Residential and Landscaped Properties if property is in an urban area and is managed as a commercial property.
3. See BMPs for Rural Properties and BMPs for Wetlands if the property is associated with an irrigation canal or similar rural water conveyance, railroad right-of-way, or pipeline.
4. See Stormwater Management BMPs if the property is associated with a roadway or other structure that would require management of runoff water.

BMPs for Wastewater Treatment Facilities

1. Monitor all treatment ponds for mosquito larvae – particularly in areas of emergent vegetation.
2. Remove emergent vegetation from edges of ponds.
3. Immediately incorporate sludge into soil through plowing or disking.
4. Insure all water distributed onto evaporation ponds dries completely in less than 96 hours.
5. Check abandoned ponds or tanks weekly to ensure they are completely dry.
6. Use mechanical agitation to prevent the formation of any crust on treatment ponds or tanks.
7. Work closely with the District to prevent or abate a mosquito problem from the facility.

BMPs for Wildlands

1. Evaluate reports of mosquito annoyance from visitors or the public and, if possible, work with the District's mosquito control program to be notified if an adult mosquito problem occurs on or near your property.
2. After rainfall, pay particular attention to temporary water sources and ponds that rise. Work with the District to treat sources with mosquito control products, if needed.
3. Stock ornamental ponds and other water features with mosquitofish available from local mosquito control programs. However, their use is restricted in natural bodies of water or in water features that drain or have the potential to drain into natural bodies of water. Land managers must consult with the District or CDFW regarding proper use of mosquitofish or other biological control agents. Work closely with the District to accurately identify, map, and monitor areas that may produce mosquitoes; and tailor control measures for each site, contingent on the species of mosquitoes that are present, sensitive species presence, and any restrictions that may apply to concerning the sensitive nature of the habitat.
4. Where applicable, implement personal protective measures:
    - provide visitors and guests with information regarding the risk of mosquito-borne disease and

Table 2-7 Alameda County Mosquito Abatement District List of Recommended BMPs for Mosquito Management by Landowners/Land Managers

	personal protective measures • install and maintain tight-fitting window and door screens • when possible, minimize outdoor activities at dawn and dusk when mosquitoes are most active • wear protective clothing such as long-sleeved shirts and long pants when going into mosquito-infested areas • use repellents when necessary, carefully following directions on the label

Source: California Department of Public Health (CDPH) and Mosquito and Vector Control Association of California (MVCAC). 2012. Best Management Practices for Mosquito Control in California - Recommendations. July.

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