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7 Human Health

Chapter 7 evaluates potential impacts of the Program on human health. Results of the evaluation are provided at the programmatic level. Section 7.1, Environmental Setting, presents an overview of the District's human population and growth estimates and the federal and state regulations that are applicable to the Program. Section 7.2, Environmental Impacts and Mitigation Measures, presents the following:

- > Environmental concerns and evaluation criteria: A discussion of whether the Program alternatives would cause any potentially significant impacts to human health and addressing concerns from the public scoping
- > Discussion of methods and assumptions
- > Discussion of potential impacts of the Program alternatives, and mitigation measures, if necessary, for those impacts
- > Cumulative impacts summary
- > A summary of estimated impacts to human health
- > Potential ecological impacts are addressed in Chapter 6

7.1 Environmental Setting

The Program Area is defined as the Alameda County Mosquito Abatement District which is impacted by mosquitoes that must be managed to minimize adverse effects, disease, and environmental impacts. The following section provides the population characteristics of the Program Area, background information on the environmental fate and toxicity of pesticides, and an overview of the regulatory setting with respect to chemical and biological pesticides.

7.1.1 Population Characteristics of the Program Area

The size of the population in the District's Service Area and the larger Program Area is shown in the following table. In 2010, the population of California was estimated at 37.3 million (US Census Bureau, (<http://www.bayareacensus.ca.gov/counties/counties.htm>)). The population of the five counties in the Districts' Program Area is approximately 5.54 million, which represents 15 percent of the statewide total (see Table 7-1).

Table 7-1 Population and Growth in the Program Area (1990–2010)

County / Area	Population			Population Growth (Compound Annual Average)	
	1990	2000	2010	1990–2000	2000–2010
Alameda	1,279,182	1,443,741	1,510,271	1.22%	0.45%
Contra Costa	803,732	948,816	1,049,025	1.67%	1.01%
San Joaquin	480,628	567,885	685,306	1.68%	1.90%
Santa Clara	1,497,577	1,682,585	1,781,642	1.17%	0.57%
Stanislaus	370,552	449,471	514,453	1.95%	1.36%
Five-County Area	4,431,671	5,092,498	5,540,697	1.40%	0.85%
Statewide Area	29,760,021	33,871,648	37,253,956	1.30%	0.96%

The California Department of Finance projects steady population growth in the future, with total state population reaching over 44 million by 2030. These projections represent a compound annual average population growth of 0.86 percent.

7.1.2 Hazards, Toxicity, and Exposure in the Environmental Setting

A “hazardous material” is defined in California Health and Safety Code Section 25501 (p): as “any material that, because of its quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment.” “Hazardous materials” include, but are not limited to, “hazardous substances, hazardous waste, and any material that a handler or the administering agency has a reasonable basis for believing that it would be injurious to the health and safety of persons or harmful to the environment if released into the workplace or the environment.” Any liquid, solid, gas, sludge, synthetic product, or commodity that exhibits characteristics of toxicity, ignitability, corrosiveness, or reactivity has the potential to be considered a “hazardous material.”

7.1.2.1 Toxicity and Exposure

Toxicology is the study of a compound’s potential to elicit an adverse effect in an organism. The toxicity of a compound is dependent upon exposure, including the specific amount of the compound that reaches an organism’s tissues (i.e., the dose), the duration of time over which a dose is received, the potency of the chemical for eliciting a toxic effect (i.e., the response), and the sensitivity of the organism receiving the dose of the chemical. Toxicity effects are measured in controlled laboratory tests on a dose/response scale, whereby the probability of a toxic response increases as dose increases. Exposure to a compound is necessary for potential toxic effects to occur. However, exposure does not, in itself, imply that toxicity will occur. Thus, toxic hazards can be mitigated by limiting potential exposure to ensure that doses are less than the amount that may result in adverse health effects.

The toxicity data included in the numerous tables and charts in this document are generally derived from rigidly controlled laboratory animal studies designed to determine the potential adverse effects of the chemical under several possible routes of exposure. In these studies, the species of interest is exposed to 100 percent chemical at several doses to determine useful information such as the lowest concentration resulting in a predetermined adverse effect (LOAEL) on numerous selected physiological and behavioral systems. The second component of these tests is to determine the highest concentration of chemical that results in no measurable adverse effect (NOAEL).

However, these, and other, coordinated and focused laboratory tests are designed to document the effects of the chemical when a continuous, controlled, exposure exists and do not realistically reflect the likely exposures or toxicity in the District field application scenarios. As such, the toxicity information is intended as an overview of potential issues and guidance for understanding the completely “safe” maximum exposure levels of applications that would not adversely impact humans or nontarget plant and animal species.

Although the regulatory community uses this basic information to provide a relative comparison of the potential for a chemical to result in unwanted adverse effects and this information is reflected in the approved usage labels and MSDSs, in actual practice, the amounts applied in the District’s Program Area are often substantially less than the amounts used in the laboratory toxicity studies. Because of these large safety factors used to develop recommended product label application rates, the amount of chemical resulting in demonstrated toxicity in the laboratory is much higher than the low exposure levels associated with an actual application. The application concentrations consistent with the labels or MSDSs are designed to be protective of the health of humans and other nontarget species (i.e., low enough to not kill them, weaken them, or cause them to fail to reproduce). However, adverse effects may still occur to some nontarget organisms.

Although laboratory toxicity testing focuses on tiered concentrations of chemical exposure, the results of these tests produce a series of toxicity estimates of concentrations less than those that produce mortality. Extrapolation of these data is used to generate estimates of chronic toxicity or possible effects of lower doses that may result in sublethal effects such as reproduction or metabolic changes. In reality, these low-dose exposures need to be sustained over longer periods than are relevant to typical application scenarios for vector control including multiple applications in an area such as a wetland.

7.1.2.2 **Chemistry, Fate, and Transport**

Various biological, chemical, and physical parameters affect the behavior of a compound in the environment and its potential toxicity. The chemistry, fate, and transport of a compound must be analyzed to fully estimate potential exposure. The fate and transport of a compound is determined by the physical and chemical properties of the compound itself and the environment in which it is released. Thus, the following characteristics of a compound must be evaluated: its half-life in various environmental media (e.g., sediment, water, air); photolytic half-life; lipid and water solubility; adsorption to sediments and plants; and volatilization. Environmental factors that affect fate and transport processes include temperature, rainfall, wind, sunlight, water turbidity, and water and soil pH. Information pertaining to these parameters allows evaluation of how compounds may be transported between environmental media (e.g., from sediments to biota), how a compound may be degraded into various breakdown products, and how long a compound or its breakdown products may persist in different environmental media. Appendix B, Ecological and Human Health Risk Assessment, provides a discussion of the environmental fate of the pesticide active ingredients and other chemicals associated with specific pesticide formulations used in the Program alternatives.

7.1.3 **Pesticides and the Environment**

The pesticide and herbicide formulations included in the Proposed Program are listed in Tables 7-2 and Table 7-3, respectively, including the active ingredient, target vector, and District use. Appendix B provides results of review and evaluations of the active ingredients and adjuvants the District currently uses or proposes to use.

Table 7-2 Pesticide Options for Insect Abatement

Active Ingredient	Vector	Currently In Use
Aliphatic Petroleum Hydrocarbons	Mosquito	Yes
Biodegradable Alcohol Ethoxylated Surfactant	Mosquito	Yes
Bacillus sphaericus (Bs)	Mosquito	Yes
Bacillus thuringiensis israelensis (Bti)	Mosquito	Yes
Deltamethrin	Mosquito/ Yellow jacket wasp	No
d-trans Allethrin	Yellow jacket wasp	No
Etofenprox	Mosquito	Yes
Etofenprox	Yellow jacket wasp	No
Lambda-cyhalothrin	Yellow jacket wasp	No
Methoprene	Mosquito	Yes
Naled	Mosquito	No
Permethrin	Mosquito/ Yellow jacket wasp	No
Phenothrin	Yellow jacket wasp	No
Piperonyl butoxide (PBO)	Mosquito	Yes

Table 7-2 Pesticide Options for Insect Abatement

Active Ingredient	Vector	Currently In Use
Piperonyl butoxide (PBO)	Yellow jacket wasp	No
Prallethrin	Yellow jacket wasp	No
Pyrethrin	Yellow jacket wasp	No
Pyrethrin	Mosquito	Yes
Resmethrin	Mosquito	Yes
Spinosad	Mosquito	Yes
Sumithrin	Mosquito	No
Temephos	Mosquito	No
Tetramethrin	Yellow jacket wasp	No

Table 7-3 Herbicide and Adjuvant Options for Weed Control

Active Ingredient	Vector	Currently In Use
Alkyl phenol ethoxylate	Weed	No
Glyphosate	Weed	No
Imazapyr	Weed	No
Methylated seed oil of Soybean	Weed	No
Modified Vegetable Oil	Weed	No
Polydimethylsiloxane	Weed	No
Sulfometuron Methyl	Weed	No
Triclopyr	Weed	No

7.1.4 Regulatory Environment

Formulations proposed for each Program alternative for mosquito control are and would be used according to federal and state regulatory requirements for the registration, transportation, and use of pesticides. The regulatory framework pertaining to the use of pesticides is discussed below.

7.1.4.1 Federal

The USEPA regulates pesticides under two major statutes: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA). Under these acts, the USEPA mandates extensive scientific research to assess risks to humans, domestic animals, wildlife, plants, groundwater, and beneficial insects before granting registration for a pesticide. These studies allow the USEPA to assess the potential for human and ecological health effects. When new data raise concern about a registered pesticide’s safety, the USEPA may take action to suspend or cancel its registration. The USEPA may also perform an extensive special review of a pesticide’s risks and benefits

and/or work with manufacturers and users to implement changes in a pesticide's approved use (e.g., reducing application rates).

7.1.4.1.1 Federal Insecticide, Fungicide, and Rodenticide Act

FIFRA defines a pesticide as "any substance intended for preventing, destroying, repelling, or mitigating any pest." The act requires USEPA registration of pesticides prior to their distribution for use in the US, sets registration criteria (testing guidelines), and mandates that pesticides perform their intended functions without causing unreasonable adverse effects on people and the environment when used according to USEPA-approved label directions. FIFRA defines an "unreasonable adverse effect on the environment" as "(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of the pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under Section 408 of the Federal Food, Drug, and Cosmetic Act (21 USC 346a)."

FIFRA regulates only the active ingredients of pesticides, not inert ingredients, which manufacturers are not required to reveal. However, toxicity studies conducted under FIFRA are required to evaluate the active ingredient and the entire product formulation, through which any potential additive or synergistic effects of inert ingredients are established.

7.1.4.1.2 Federal Food, Drug, and Cosmetic Act

The FFDCFA authorizes the USEPA to set tolerances (i.e., maximum allowable amounts) for pesticide residues in/on food. Thus, the FFDCFA does not expressly regulate pesticide use, but exceedance of tolerances may result in prosecution or changes in the approved use of a pesticide regulated under FIFRA.

7.1.4.1.3 Clean Water Act and National Pollutant Discharge Elimination System

The CWA establishes the principal federal statutes for water quality protection "to restore and maintain the chemical, physical, and biological integrity of the nation's water, to achieve a level of water quality which provides for recreation in and on the water, and for the propagation of fish and wildlife."

- > Section 303(d) requires each state to provide a list of impaired waters that do not meet or are expected not to meet state water quality standards as defined by that section. The CWA regulates potentially toxic discharges through the NPDES and ambient water quality through numeric and narrative water quality standards. The release of aquatic pesticides into waters of any state may require an NPDES permit, depending on the pesticide considered, and the conditions proposed for application.
- > Section 402, the NPDES, requires permits for pollution discharges (except dredge or fill material) into US waters, such that the permitted discharge does not cause a violation of federal and state water quality standards. Biological and residual pesticides discharged into surface waters constitute pollutants and require coverage under an NPDES permit. In California, NPDES permits are issued by the SWRCB or the RWQCBs.

7.1.4.1.4 Safe Drinking Water Act of 1974

Under the Safe Drinking Water Act of 1974, the USEPA establishes Maximum Contaminant Levels (MCLs), which are specific concentrations that cannot be exceeded for a given contaminant in surface water or groundwater. USEPA has the ability to enforce these nationwide standards or delegate administration and enforcement duties to state agencies. The CDPH administers the federal Safe Drinking Water Act in California.

7.1.4.1.5 California Toxics Rule

In 2000, the USEPA developed water quality criteria for priority toxic pollutants to protect human health and the environment when a gap in California's water quality standards was created when the state's water

quality control plans containing water quality criteria for priority toxic pollutants were overturned in 1994 (thus causing California to be out of compliance with the CWA). These established criteria are to be applied to inland surface waters, enclosed bays, and estuaries in California. The rule includes aquatic life criteria for 23 priority toxic pollutants, human health criteria for 57 priority toxics, and a compliance schedule.

7.1.4.2 State of California

California's programs for the registration of pesticides and commercial chemicals parallel federal programs, but many of California's requirements are stricter than federal requirements. The Cal/EPA regulates registration of pesticides and commercial chemicals in California. Within Cal/EPA, the CDPR oversees pesticide evaluation and registration through use enforcement, environmental monitoring, residue testing, and reevaluation. The CDPR works with County Agricultural Commissioners, who evaluate, develop conditions of use, approve, or deny permits for restricted-use pesticides; certify private applicators; conduct compliance inspections; and take formal compliance or enforcement actions. The Secretary of Resources has certified California's pesticide regulatory program as meeting CEQA requirements (CDPR 2006).

California also requires commercial growers and pesticide applicators to report commercial pesticide applications to local county agricultural commissioners. The CDPR compiles this information in annual pesticide use reports. The CDPR's Environmental Hazards Assessment Program collects and analyzes environmental pesticide residue data, characterizes drift and other off-site pesticide movement, and evaluates the effect of application methods on movement of pesticides in air. If a pesticide is determined to be a toxic air contaminant, appropriate control measures are developed with the California Air Resources Board to reduce emissions to levels that adequately protect public health. Control measures may include product label amendments, applicator training, restrictions on use patterns or locations, and product cancellations.

7.1.4.2.1 Porter-Cologne Act and State NPDES Permitting

Under the Porter-Cologne Act (California Water Code Section 13000) the SWRCB, and the state's nine RWQCBs that it oversees, are responsible for administering federal and state water quality regulation and permitting duties.

The SWRCB oversees pesticide NPDES permitting in California. Users of specific larvicide and adulticide registered products are required to obtain coverage under the Statewide NPDES Permit for Biological and Residual Pesticide Discharges to Waters of the US from Vector Control Applications (SWRCB Water Quality Order No. 2012-0003-DWQ; NPDES No. CAG 990004; Vector Control Permit). Users of certain aquatic herbicides are required to obtain coverage under the Statewide General NPDES Permit for the Discharge of Aquatic Pesticides for Aquatic Weed Control in Waters of the US (SWRCB Water Quality Order No. 2004-0009-DWQ; NPDES No. CAG 990005; Aquatic Weed Control Permit). Pesticides and herbicides that require state NPDES permitting include Bti, Bs, temephos, spinosad, petroleum distillates, naled, pyrethrin, permethrin, resmethrin, prallethrin, PBO, etofenprox, glyphosate, imazapyr, and triclopyr. Both permits are discussed in detail in Chapter 9, Section 9.1.2.2.9.

7.1.4.2.2 Safe Drinking Water Act 1976

The CDPH administers the federal Safe Drinking Water Act in California. In addition to enforcing the primary MCLs (discussed above in Section 7.1.4.1), CDPH uses as guidelines Secondary MCLs that regulate constituents that affect water quality aesthetics (such as taste, odor, or color).

Additionally, under the California Safe Drinking Water Act, Cal/EPA's Office of Environmental Health Hazard Assessment develops Public Health Goals (PHGs) for contaminants in California's publicly supplied drinking water. PHGs are concentrations of drinking water contaminants that pose no significant health risk if consumed for a lifetime, based on current risk assessment principles, practices, and

methods. Public water systems use PHGs to provide information about drinking water contaminants in their annual Consumer Confidence Reports.

7.1.4.2.3 The Safe Drinking Water and Toxic Enforcement Act (Proposition 65)

This act, passed as a ballot initiative in 1986, requires the state to annually publish a list of chemicals known to the state to cause cancer or reproductive toxicity so that the public and workers are informed about exposures to potentially harmful compounds. Cal/EPA's Office of Environmental Health Hazard Assessment administers the act and evaluates additions of new substances to the list. Proposition 65 requires companies to notify the public about chemicals in the products they sell or release into the environment, such as through warning labels on products or signs in affected areas, and prohibits them from knowingly releasing significant amounts of listed chemicals into drinking water sources.

7.1.4.2.4 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 the 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 in certain land uses and weather (i.e., wind speed) parameters.

7.2 Environmental Impacts and Mitigation Measures

This section evaluates the potential impacts from the Program alternatives, focusing on the human health impacts specific to the use of selected chemical and biological pesticides.

7.2.1 Evaluation Concerns and Criteria

The public has indicated concerns about some of the following issues. While not required, the responses to the concerns help to direct the reader to the appropriate section or Appendix B, *Ecological and Human Health Assessment Report*, or they provide explanatory information in concise form.

- > The PEIR should address Program impacts on people and pets through ingestion and absorption pathways and proposed mitigation. Address impacts on chemically sensitive people and sensitive populations such as children, the elderly, pregnant women. Exposure to pesticides can result in compromised immune system, which would allow for development of allergies or autoimmune disorders.
 - Potential Chemical Control Alternative impacts are discussed in Section 7.2.7, and toxicity of individual active ingredients is evaluated in greater detail in Appendix B, Human and Ecological Health Assessment Report.
- > The PEIR must list any and all biological or chemical agents proposed for use.
 - The biological and chemical pesticide formulations included in the Program are listed in Table 7-2, Pesticide Options for Insect Abatement and Table 7-3, Herbicide and Adjuvant Options for Weed Control.
- > CDPH should be consulted to ensure all potential risks are identified, characterized, and evaluated.

- The PEIR document and information will be made publicly available and will be reviewed by the appropriate regulatory bodies.
- > Supply additional information regarding chemical agents in sanitary sewers concerning components and effects. Could pose a significant impact on the operation of wastewater treatment plant.
 - Pesticide applications are discussed in Section 7.2.7 and evaluated in greater detail in Appendix B.
- > Concern expressed over public safety and health with regards to existing vegetable gardens and fruit trees within the project area. Local swimming holes could be a potential habitat for breeding mosquitoes, and chemical treatment could impact humans.
 - BMPs to reduce exposure to nontarget species and areas are discussed in Chapter 2, Section 7.2.7, summarized in several other relevant chapters, and evaluated in greater detail in Appendix B.
- > Concerned with use of Zenivex; it mimics chrysanthemums but is a neurotoxin.
 - Etofenprox, the active ingredient in Zenivex, is discussed in Section 7.2.7.2.2 and evaluated in greater detail in Appendix B. It does not require concomitant use of a synergist, such as PBO. Therefore, it likely exhibits less toxicity than others that require co-application with other chemicals. Based on toxicity, environmental fate, and usage patterns, etofenprox is not likely to result in unwanted adverse impacts to humans when BMPs are used.
- > Concerned that adulticides may present a danger to humans, as many are known carcinogens and endocrine disruptors.
 - The District's BMPs provide that adulticides are generally applied as aerosols using ULV techniques to minimize exposure to nontarget species. Aerial and ground application techniques are used to distribute the insecticides. The potential toxicity of the various adulticides included in the Program are discussed in Section 7.2.7 and evaluated in greater detail in Appendix B.
- > Concerned that pyrethrins disrupt the normal functioning of sex hormones while PBO affects the functioning of hormone-related organs.
 - The District generally uses pyrethrins in ULV applications, which are designed to prevent environmental persistence and potential impacts to nontarget species.
 - As a synergist for pyrethrins and pyrethroids, PBO is also generally applied in ULV, and it degrades rapidly in soil and water. Its potential toxicity is discussed in Appendix B.
- > How long are pesticides retained in humans (young infant through elderly), pets, home garden vegetables and fruit, etc.?
 - The half-lives of the active ingredients and adjuvants included in the Program alternatives are listed in Appendix B.
- > In addition to short-term effects, what are the long-term effects of repeated exposure to these chemicals?
 - The chronic effects of the various pesticides are discussed in detail in Appendix B.

The CEQA Guidelines Appendix G, Environmental Checklist Form, does not contain criteria for determining significance of impacts to human health from the use of pesticides and herbicides. The criteria for hazards and hazardous materials (Checklist Section VIII) are primarily addressed in Chapter 8. However, the first criterion is partly applicable and asks would the project:

- a. Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?

The applicability is for the use of these chemicals. In short, the determination of significance is based on the potential to adversely affect human health based on existing data and application methods including label requirements, any applicable federal and state requirements, and additional BMPs employed by the District (see Section 2.9). The specific concern is whether the activities used to control pest species could result in direct or indirect impacts to human populations in a treatment area in the short term (i.e., acute toxicity) or over the long term (i.e., chronic toxicity).

7.2.2 Evaluation Methods and Assumptions

Pesticides the District uses or proposes to use were investigated to provide a preliminary assessment of the potential impacts to humans (discussed in detail in Appendix B). A comprehensive literature review was conducted and the District supplied information to assess potential exposure and toxicity using the following:

- > Pesticides the District uses or proposes to use
- > Pesticide label recommendations
- > Types of application sites (e.g., habitat types)
- > Application procedures
- > Number of treatments per application site
- > Total amount used per treatment for each application site, based on yearly totals
- > Physicochemical properties of the pesticides/active ingredients
- > Efficacy of the pesticide to eradicate the target pest
- > Reported adverse effects (e.g., reproductive, developmental, carcinogenic)

The pesticide application scenarios that result in reasonable efficacy with minimal unwanted estimated risk are preferred and are the basis of IPM approaches the District practices. Each of the pesticides identified as warranting further evaluation in Appendix B are known to exhibit at least one parameter that appears to drive potential or perceived risk. Toxicity levels (e.g., slight, low, moderate, high, etc.) are used prevalently in the published literature but are not standardized or representative of specific criteria. They qualitatively describe toxicity in relative terms in the evaluations of herbicides and pesticides in this PEIR and in Appendix B. Toxicity levels are helpful in making significance determinations.

The pesticide application scenarios that result in reasonable efficacy with minimal unwanted estimated risk are preferred and are the basis of IPM approaches and BMPs the District employs. All BMPs are described in Chapter 2 (Table 2-6), and the most relevant BMPs for avoidance or minimization of impacts to human health are repeated below.

For all five Program alternatives, the District uses the following BMPs:

- > Operation of noise-generating equipment (e.g., chainsaws, brush-cutters) 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. (Table 2-6, BMP A11)
- > For operations that generate noise expected to be of concern to the public, the following measures will be implemented: (Table 2-6, BMP A12)
 - Measure 1: Provide Advance Notices: A variety of measures are implemented depending on the magnitude/nature of the activities the District undertakes and may include, but are not limited to, press releases, hand-delivered flyers, 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.
- > The District will perform public education and outreach activities. (Table 2-6, BMP A13)
- > To minimize air and GHG emissions, 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. (Table 2-6, BMP A14)
- > 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, BMP N5)
- > Equip all vehicles used in wildland areas with a shovel and a fire extinguisher at all times. (Table 2-6, BMP O1)
- > Train employees on the safe use of tools, equipment and machinery, including vehicle operation. (Table 2-6, BMP O2)
- > 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 2-6, BMP O3)

For four Program alternatives, only excluding Biological Control, the following BMPs are protective of human health:

- > 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. (Table 2-6, BMP A8)

For the Vegetation Management and Chemical Control Alternatives, the District uses the following BMPs:

- > 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. (Table 2-6, BMP M1)
- > 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. (Table 2-6, BMP M3)
- > To minimize application of pesticides, application of pesticides will be determined by surveillance and monitoring of mosquito populations. (Table 2-6, BMP M4)
- > District staff will follow label requirements for storage, loading, and mixing of pesticides and herbicides. Handle all mixing and transferring of herbicides within a contained area. (Table 2-6, BMP M5)
- > 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. (Table 2-6, BMP M6)

- > 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. (Table 2-6, BMP M7)
- > Clean containers at an approved site and dispose of at a legal dumpsite or recycle in accordance with manufacturer's instructions if available. (Table 2-6, BMP M8)
- > 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, BMP M10)
- > 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 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. (Table 2-6, BMP M12)
- > Exercise adequate caution to prevent spillage of pesticides during storage, transportation, mixing, or application of pesticides. Report all pesticide spills and cleanups (excepting cases where dry materials may be returned to the container or application equipment). (Table 2-6, BMP N1)
- > 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. (Table 2-6, BMP N2)
- > 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. (Table 2-6, BMP N3)
- > Properly secure the spilled material, label the bags with service container labels identifying the pesticide, and deliver them to a District Supervisor for disposal. (Table 2-6, BMP N4)
- > Field-based mixing and loading operations will occur in such a manner as to minimize the risk of accidental spill or release of pesticides. (Table 2-6, BMP N6)

This evaluation assumes that all pesticides are applied in accordance with label instructions and USEPA and Cal/EPA requirements. The USEPA requires mandatory statements to be included on pesticide product labels that include directions for use; precautions for avoiding certain dangerous actions; and where, when, and how the pesticide should be applied. This guidance is designed to ensure proper use of the pesticide and prevent unreasonable adverse effects to humans and the environment. All pesticide labels are required to include the name and percentage by weight of each active ingredient in the product/formulation. Toxicity categories for product hazards and appropriate first-aid measures must be properly and prominently displayed. Pesticide labels also outline proper use, storage, and disposal procedures, as well as precautions to protect applicators. The directions for use indicate target organism (pest), appropriate application sites, application rates or dosages, contact times, and required application equipment for the pesticide. Warnings regarding appropriate wind speeds, droplet sizes, or habitats to avoid during application are also prominently displayed.

This evaluation does not include assumptions about which alternative treatment strategy(ies) would be applied in any given area. This evaluation assumes that important parameters, such as media half-life, are dependent on the specific conditions at the time of pesticide application, and values listed herein serve as reference values.

Concerning the application of multiple chemical treatments in the same area, such as larvicides followed by adulticides (i.e., not likely to occur under normal circumstances), or the application of multiple pesticides at the same time in a specific area (e.g., usually multiple active ingredients in the formulation such as VectoMax which combines Bti and Bs), the following information applies:

Most products sold as herbicides and pesticides are evaluated herein both for the active ingredient and for the adjuvants and surfactants used to make the product more useful. When multiple products are used in a mosquito control application, the impacts are weighed against the proximity and timing of each application. If products with an identical active ingredient are applied simultaneously, it is likely that the net effect could be the sum of the total active ingredient that is available for uptake by the mosquitoes. Although a synergy is possible in this scenario, it is typically not an approach used and is limited by the BMPs for that scenario. Because most pesticides and herbicides now have considerably less half-life (persistence), the overlap that would produce a residual exposure to a product would not occur unless the timing of applications is inappropriately close. Actual applications do not generally occur that close together unless there is a problem with treatment effectiveness. A material is applied followed by post treatment inspection to determine effectiveness. Only if the mosquitoes have not been sufficiently killed would the District go back into the area and reapply a pesticide.

7.2.3 Surveillance Alternative

Vector surveillance is critical to IPM strategies because it provides information that is used to determine when and where to institute other vector control measures. The District's mosquito surveillance activities are conducted in compliance with accepted federal and state guidelines (e.g., *California Mosquito-Borne Virus Surveillance and Response Plan* (CDPH et al. 2013) and *Best Management Practices for Mosquito Control in California* (CDPH 2010b)). These guidelines allow for flexibility in selection and specific application of control methods because local areas vary. Surveillance activities involve monitoring the abundance of adult and larval mosquitoes, field inspection of mosquito habitat, testing for the presence of encephalitis virus-specific antibodies in sentinel chickens or wild birds, and/or response to public service requests regarding mosquitoes. Surveillance of potential areas of concern is a critical element for directing and responding to potential outbreaks of mosquitoes and the potential for conveying mosquito-borne diseases.

Impact HH-1: No impact would occur to human health from the use of the Surveillance Alternative.

7.2.4 Physical Control Alternative

Physical Control for mosquitoes consists of the management of mosquito-producing habitat (including freshwater marshes and lakes, saltwater marshes, temporary standing water, 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 the need for chemical applications. The physical control practices may be categorized into three groups: maintenance, new construction, and cultural practices. The District performs these physical control activities in accordance with all appropriate environmental regulations (wetland fill and dredge permits, endangered species review, water quality review, etc.), and in a manner that generally maintains or improves habitat values for desirable species. Physical control techniques have minimal impact on humans due to prior identification and avoidance of potential problem areas and wildlife habitats by publishing scheduled treatment times and locations.

Impact HH-2: Impacts to human health from use of the Physical Control Alternative would be **less than significant** and mitigation is not required.

7.2.5 Vegetation Management Alternative

The District uses hand tools (e.g., shovels, pruners, chain saws, and weed-whackers) and potentially heavy equipment if necessary for vegetation removal or thinning and may apply herbicides 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 access mosquito producing sources.

To reduce the potential for mosquito breeding associated with water retention and infiltration structures, District staff may systematically clear or trim weeds and other obstructing vegetation in wetlands and retention basins (or request the structures' owners to perform this task). These tasks are performed in conjunction with discussions with appropriate agencies (including CDFW) about special status species, and their habitats that must be acknowledged and protected prior to these activities. Vegetation management may also be performed to assist other agencies and landowners with the management of invasive/nonnative weeds. These actions are typically performed under the direction of the concerned agency, which also maintains any required permits. These activities are conducted during predetermined times of recreational inactivity to provide an additional measure of safety to the public.

Impact HH-3: No impact would occur to human health from the nonherbicide Vegetation Management Alternative.

7.2.5.1 Herbicides

Any herbicides the District may use would be applied in strict conformance with label requirements and any applicable federal and state requirements. Herbicides the District proposes to use are discussed in Appendix B, and those that have been identified for additional evaluation are described below.

The District may use herbicides to control vegetation in and around mosquito habitats to improve access needed for surveillance and to reduce potential habitat for mosquitoes. The herbicides the District may use and where they are discussed in detail in Appendix B are listed in Table 7-4.

Table 7-4 Herbicides Potentially Used for Mosquito Abatement

Active Ingredient	Appendix B
Imazapyr	Section 4.6.1
Glyphosate	Section 4.6.2
Triclopyr	Section 4.6.3
Sulfometuron methyl	Section 4.6.5

Herbicides included in the Program have diverse chemical structures, act through distinct modes of action, and exhibit varying levels of potential toxicity to humans. Certain herbicides are nonselective and broad-spectrum (e.g., imazapyr, sulfometuron methyl), while others are selective for certain plants. Herbicides function by inhibiting growth but do so in a multitude of ways. For example, sulfometuron methyl retards or stops root and shoot development (USEPA 2005). Most of the herbicides are moderately persistent in soil and water (for each herbicide's half-life in soil and water, please refer to Appendix B). The following have been shown to exhibit no/low toxicity to humans: imazapyr (USEPA 2006a), triclopyr (USEPA 1998), and sulfometuron methyl (USEPA 2008).

Impact HH-4: Impacts to human health from the herbicides imazapyr, sulfometuron methyl, and triclopyr would be **less than significant** because the actual use and human exposure in the field is far less than tested in the laboratory and much higher volumes (exposure) would be needed to result in toxicity. Mitigation is not required.

The herbicides that were identified for further evaluation in Appendix B are discussed in further detail below.

7.2.5.1.1 Glyphosate

Glyphosate is a nonselective, post-emergent, and systemic herbicide that is the active ingredient (as an acid or salt) in Alligare, Aquamaster, Buccaneer, and Roundup® products. It is designed to target the shikimic acid pathway, which is specific to plants and some microorganisms; therefore, glyphosate is

thought to have very low toxicity to mammals (USEPA 1993). The District would employ an adequate buffer to water sources if it applies glyphosate.

The USEPA classifies glyphosate as Category III for oral and dermal toxicity (USEPA 1993), and the isopropylamine and ammonium salts exhibit low toxicity to mammals via the oral and dermal routes. No scientific evidence indicates that glyphosate is carcinogenic or mutagenic (USEPA 1993). It is poorly biotransformed in rats and is excreted via feces and urine; neither the parent compound nor its major breakdown product bioaccumulates in animal tissue (Williams et al. 2000). It is further mediated by the techniques used for application. Typically, spraying does not occur when wind is 5 mph or greater or within 15 feet of a crop area or sensitive habitat.

Despite the apparent lack of toxicity to mammals, concerns have been raised about glyphosate’s long-term developmental and reproductive effects. Although still in review, glyphosate is included in the final list of chemicals for screening under USEPA’s Endocrine Disruptor Screening Program (USEPA 2009). The issue of endocrine-disrupting compounds is a topic of current scientific concern and inquiry but insufficient information is available to reach any conclusion about significance or potential adverse impacts. Recently, the USEPA renewed the temporary approval of a glyphosate and 2-4-D combination product (Enlist-Duo) for use with weed vectors, indicating it has not received significant adverse data to negate the decision (USEPA 2014b). This situation is true of all “potential” endocrine-disrupting compounds. Claims of endocrine disruption by dozens of chemicals are still an active area of research. Only very high exposures to those chemicals suggested as endocrine disruptors can be shown to suggest a linkage. Because this exposure linkage is so high, endocrine disruption in a human would require, if real, exposure to substantially higher levels of chemical than used for vector control.

It is likely that USEPA will provide an updated review of its potential risks in 2015; however, current data indicate that glyphosate is nontoxic to humans.

Impact HH-5: Impacts to human health from the use of glyphosate would be **less than significant** and mitigation is not required.

7.2.5.2 Adjuvants

An adjuvant is any compound that is added to a pesticide/herbicide formulation or tank mix to facilitate the mixing, application, or effectiveness of that product. FIFRA does not require testing and registration of adjuvants. As such, little information on their fate, transport, and toxicity exists, other than that provided by the manufacturer or published by the scientific community (Bakke 2007; Tu et al. 2001). CDPR does require the registration of adjuvants that are considered to increase the action of the pesticides with which they are used (Bakke 2007). The adjuvants the District may employ and where they are discussed in detail in Appendix B are listed in Table 7-5.

Table 7-5 Adjuvants Potentially Used for Insect Abatement

Active Ingredient	Appendix B
APEs	Section 4.7.1
Polydimethylsiloxane Fluids	Section 4.7.2
Modified Vegetable Oil and Methylated Seed Oil	Section 4.7.3

APEs are used as detergents, dispersants, emulsifiers, solubilizers, and foaming and wetting agents. Primary degradation of APEs in the environment generates more persistent shorter chain compounds, some of which may mimic natural hormones and disrupt endocrine function in humans (Ying et al. 2002). Nonylphenol and nonylphenol ethoxylate, which are produced in large volumes and widely used, exhibit

low acute oral and dermal toxicity but are highly irritating and corrosive to the skin and eyes (USEPA 2010). The acute toxicity of APEs to mammals is low; however, concern exists regarding the estrogen-mimicking behaviors of these compounds, particularly nonylphenol and nonylphenol ethoxylate (USEPA 2010). The USEPA (2010) has recently recommended that this suite of chemicals be evaluated further due to their widespread use, persistence, and possible estrogen-mimicking behavior.

Vegetable-derived oils (from soybeans, cottonseeds, etc.) decrease surface tension, but they are not as effective as other surfactants at increasing spreading, sticking, or penetration. Modified vegetable oils and methylated seed oils are essentially nontoxic to most organisms, including plants. Little is known of the environmental fate of these adjuvants.

Polydimethylsiloxanes are insoluble in water and typically sorb to particulates. Degradation time varies depending on moisture in soils. These chemicals appear to be relatively nontoxic to most organisms, but information is scarce regarding the toxicity and environmental fate of polydimethylsiloxanes.

Impact HH-6: Impacts to human health from the use of pesticide adjuvants would be **less than significant** and mitigation is not required.

7.2.6 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. Biological control is used as a method of protecting the public from mosquitoes and the diseases using mosquito parasites, pathogens, and predators. At present, mosquito parasites are not commercially available for mosquito control.

7.2.6.1 *Mosquito Larvae Pathogens*

As part of the Biological Control Alternative, the District employs bacterial larvicides that are highly specific to mosquitoes. These biological controls include Bs, Bti, and spinosad. Bs is the only live pathogen being used; Bti and spinosad pesticides are the by-products of bacterial organisms.

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 Section 7.2.7, Chemical Control Alternative. The environmental fate and toxicity of these control agents is discussed in Appendix B.

7.2.6.2 *Mosquito Predators*

Mosquitofish (*Gambusia affinis*) are presently the only commercially available mosquito predators. The District's rearing and stocking of these fish in mosquito habitats is the most commonly used biological control agent for mosquitoes in the world. Used correctly, this fish can provide safe, effective, and persistent suppression in various mosquito sources. However, due to concerns that mosquitofish may potentially impact red-legged frog and tiger salamander populations, the District limits the use of mosquitofish to ornamental fish ponds, water troughs, water gardens, fountains, and unmaintained swimming pools.

Impact HH-7: No impact would occur to human health from the use of mosquitofish.

7.2.6.3 *Other Vectors*

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

7.2.7 Chemical Control Alternative

Chemical control involves the application of nonpersistent selective insecticides to directly reduce populations of mosquitoes and other invertebrate threats to public health. If and when inspections reveal that mosquitoes or other vector populations are present at levels that trigger the District's criteria for

chemical control – based on the vector’s abundance/density, species composition, proximity to human settlements, water temperature, or presence of predators – the District applies pesticides to the site in strict accordance with label instructions and federal and state guidelines.

Most of the chemical controls the Program uses are for mosquito abatement and are classified as larvicides or adulticides. Below is a discussion of the larvicides and adulticides the District uses or may potentially use. The active ingredients that were identified as warranting further evaluation in Appendix B due to their potential toxicity and/or prevalent use/public concern are listed in Table 7-6 (including herbicides discussed previously in Section 7.2.5).

Table 7-6 Active Ingredients Identified for Further Evaluation in Appendix B

Active Ingredient	Vector	Potential Issue
Methoprene	Mosquitoes	Prevalent use; toxicity to aquatics and insects
Etofenprox	Mosquitoes/yellow jacket wasps	Toxicity to aquatic organisms; no synergist required
Bti	Mosquitoes	Prevalent use; public concerns
Pyrethrins	Mosquitoes/yellow jacket wasps	Prevalent use; requires synergist (PBO)
Resmethrin	Mosquitoes	Requires synergist (e.g., PBO); potential endocrine disruptor
Vegetable Oil (coconut oil)/mix	Mosquitoes	Contains low percentage of petroleum distillate
Permethrin	Mosquitoes/yellow jacket wasps	Toxicity to aquatic organisms; potential endocrine disruptor
Lambda-cyhalothrin	Yellow jacket wasp	Toxicity to aquatic organisms; potential to bioaccumulate
APEs	Weeds	Toxicity to aquatic organisms; moderately bioaccumulative
Glyphosate	Weeds	Prevalent use; possible endocrine disruptor

7.2.7.1 Mosquito Larvicides

Larvicides are used to manage immature life stages of mosquitoes including larvae and pupae in aquatic habitats. Temporary aquatic habitats are usually targeted because permanent waterbodies generally support natural mosquito predators such as fish. The larvicides are applied using ground application equipment, fixed wing aircraft, and rotary aircraft. The mosquito larvicides the District may use and where they are discussed in detail in Appendix B are listed in Table 7-7.

Table 7-7 Chemical Options for Larval Mosquito Abatement

Chemical Classification	Active Ingredient	Appendix B
Organophosphate	Temephos	Section 4.2.2
Bacterial larvicide	Bs	Section 4.3.1
Bacterial larvicide	Bti	Section 4.3.2
Bacterial larvicide	Spinosad	Section 4.3.3
Hydrocarbon ester	Methoprene	Section 4.3.4
Surfactant	Alcohol Ethoxylated Surfactant (monomolecular film)	Section 4.3.5
Surfactant	Aliphatic Solvent (mineral oil)	Section 4.3.6

7.2.7.1.1 Bacterial Larvicides (Bs, Bti, and spinosad)

These bacterial larvicides as applied are highly mosquito-specific bacteria that usually infect mosquito larvae when they are ingested. These pathogens multiply rapidly in the host, 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 and are ingested by uninfected larvae. Bs and Bti, produce proteins that are toxic to most mosquito larvae, while the fermentation of *S. spinosa* produces spinosyns, which are highly effective mosquito neurotoxicants. All three bacteria are naturally occurring soil organisms and are commercially produced as mosquito larvicides. Bs can reproduce in natural settings for some time following release. Bs and Bti can be applied on a variety of crops and standing waterbodies, Bti materials the District applies do not contain live organisms, only spores. The spores of Bs and Bti can persist in the environment for months, but the endotoxins are readily degraded by UV light and persist only for a few hours to a maximum of a few days. Bacterial spores of Bti are uniquely toxic to nematoceran Diptera (mosquitoes, midges, blackflies, psychodids, and ceratopogonids) (Lacey and Mulla 1990) and do not exhibit any human toxicity.

Spinosad alters nicotine acetylcholine receptors in insects, causing constant involuntary nervous system impacts ultimately leading to paralysis and death. It is used on various crops, animal husbandry premises, recreation areas, rights-of-way, and local residences. The USEPA has classified spinosad as a “reduced risk” compound because it is an alternative to more toxic, OP insecticides (CDPR 2002). It exhibits very acute toxicity by all exposure routes and has not been shown to elicit chronic toxicity in humans.

Impact HH-8: No impact would occur to human health from the use of bacterial larvicides.

7.2.7.1.2 Hydrocarbon Ester - Methoprene

Methoprene is an insect growth regulator and selective larvicide. It used in a variety of settings including indoors and outdoors at residences, animal husbandry premises, industrial sites, irrigation systems, and standing waterbodies. It is applied either in response to observed high populations of mosquito larvae at a site, or as a sustained-release product that can persist for 4 months or longer if a site has limited accessibility and has regularly produced immature mosquitoes in the past. It is applied by hand, from an ATV, from watercraft, or from aircraft, including low-flying helicopters (particularly for marshes and other highly vegetated areas) but never when winds exceed 10 mph to prevent drift.

Methoprene has very low acute toxicity to humans and mammals by all routes (USEPA 1991a). No potentially significant impact exists to humans by exposure to typical levels of methoprene. To achieve toxicity to humans, exposures hundreds of times higher than what is legally allowed for use in mosquito control would be required and such exposure would need to be extensive. Methoprene is of public concern due to its potential ecological effects and widespread use (discussed in Chapter 6, Section 6.2.7.1.2).

Impact HH-9: No impact would occur to human health from the use of the mosquito larvicide methoprene.

7.2.7.1.3 Alcohol Ethoxylated Surfactant (monomolecular film)

The monomolecular film formulation used as a surfactant in California for mosquito larvae control is Agnique. Monomolecular films spread a thin film on the water surface that makes it difficult for mosquito larvae, pupae, and emerging adults to attach to the water’s surface, causing them to drown (USEPA 2007a). The films also disrupt larval respiration of some other classes of air-breathing aquatic insects. They are used on an assortment of waterbodies including ornamental ponds, pastures, irrigation systems, drainage systems, and drinking water systems (CDPR 2010a). No evidence supports that these surfactants are toxic to humans.

7.2.7.1.4 Aliphatic Solvents (Mineral Oil)

Monomolecular films are alcohol ethoxylated surfactants (such as BVA-2), which are low-toxicity pesticides that spread a thin film on the surface of water that makes it difficult for mosquito larvae, pupae, and emerging adults to attach to the water’s surface, causing them to drown (USEPA 2007a). The films also disrupt larval respiration of some other classes of air-breathing aquatic insects. They are used on an assortment of waterbodies including ornamental ponds, pastures, irrigation systems, drainage systems, and drinking water systems (CDPR 2010a).

Aliphatic solvents such as mineral oil are applied to water surfaces to form a coating on top of water surfaces to drown larvae, pupae, and emerging adult mosquitoes. They are the product of petroleum distillation and, thus, are complex mixtures of long-chain aliphatic compounds. They are applied to a variety of waterbodies, including swamps, marshes, and intermittently flooded areas (CDPR 2010a).

Aliphatic solvents are often used when monomolecular films (alcohol ethoxylated surfactants) do not provide sufficient mosquito control. They also break down more rapidly (2 to 3 days) and are practically nontoxic to most nontarget organisms. They have a low degree of acute toxicity to mammals. Therefore, mineral oil should not result in adverse effects to human health when applied using District BMPs.

Impact HH-10: No impact would occur to human health from the use of surfactant larvicide.

7.2.7.1.5 Temephos

Temephos is the only OP with larvicidal use and can be used to help prevent mosquitoes from developing resistance to the bacterial larvicides. It was used prevalently in California for mosquito abatement from 1965 into the mid-1980s; however, microbial pesticides (e.g., Bs, Bti, spinosad), methoprene, and surface oils are used much more frequently now. The District is not currently using temephos. Nonetheless, it can be used in various waterbodies including lakes, marshes, drainage systems, irrigation systems, and polluted and stagnant water; it is not used on agricultural lands (CDPR 2010a). Temephos has extremely low water solubility and binds strongly to soils. It has low toxicity for vertebrates at the levels used for mosquito control (USEPA 2000). The USEPA (2000) states that people are likely not exposed to temephos in drinking water or from residential use.

Impact HH-11: Impacts to human health from the use of temephos would be **less than significant** and mitigation is not required.

7.2.7.2 Mosquito Adulticides

The District may use pesticides to control adult mosquitoes when no other tools are available and if specific criteria are met, including species composition, population density, proximity to human populations, and/or human disease risk. Adulticide materials are used infrequently and only when necessary to control mosquito populations. The adulticides the District may use to control mosquito and yellow jacket wasps and where they are discussed in detail in Appendix B are listed in Table 7-8.

Table 7-8 Chemical Options for Adult Insect Abatement

Chemical Classification	Active Ingredient	Vector	Appendix B
Pyrethrin	Pyrethrins	Mosquito; yellow jacket	Section 4.1.1
Pyrethroid	Allethrins and d-trans allethrin	Yellow jacket	Section 4.1.2
Pyrethroid	Phenothrin (sumithrin or d-phenothrin)	Mosquito; yellow jacket	Section 4.1.3
Pyrethroid	Prallethrin	Mosquito; yellow jacket	Section 4.1.4
Pyrethroid	Deltamethrin	Mosquito; yellow jacket	Section 4.1.5
Pyrethroid	Lambda-cyhalothrin	Yellow jacket	Section 4.1.7

Table 7-8 Chemical Options for Adult Insect Abatement

Chemical Classification	Active Ingredient	Vector	Appendix B
Pyrethroid	Resmethrin	Mosquito	Section 4.1.8
Pyrethroid	Tetramethrin	Yellow jacket	Section 4.1.9
Pyrethroid	Permethrin	Mosquito; yellow jacket	Section 4.1.10
Pyrethroid	Etofenprox	Mosquito; yellow jacket	Section 4.1.11
Synergist	PBO	Mosquito; yellow jacket	Section 4.1.12
Organophosphate	Naled	Mosquito	Section 4.2.1

7.2.7.2.1 Pyrethrins

Pyrethrins are naturally occurring compounds the flowers of the *Chrysanthemum* species produce. They effectively induce temporary paralysis in insects but are not acutely lethal by themselves; thus, they are used concomitantly with the synergist PBO, which inhibits metabolism of the pyrethrins so that a lethal dose is assured (USEPA 2006c). The District may use pyrethrins for wide-area mosquito abatement in areas that include aquatic habitats.

Pyrethrins have low to moderate acute mammalian toxicity via the oral, dermal, and inhalation routes (Categories III and IV). They are a moderate eye irritant (Category III), a mild dermal irritant (Category IV), and not a skin sensitizer. The effects of pyrethrins are (1) neurobehavioral effects following acute, short-term, and chronic exposure, with nervous system lesions observed in the rat and mouse following acute exposure; (2) thyroid effects, following chronic exposure in the rat and dog; and (3) liver effects, following short- and long-term exposure in the rat, dog, and mouse. The neurobehavioral effects are considered relevant to humans because the effects are observed in both the rat and mouse, and the mode of action affects a basic function of the nervous system that is common to all animals (USEPA 2006c).

They are of concern because they are used prevalently by the general population and require the use of the synergist PBO, a potential endocrine disruptor (USEPA 2009). However, the District uses pyrethrins only when absolutely necessary in ULV applications that are designed to break down rapidly, resulting in very low potential exposure to humans.

Impact HH-12: Impacts to human health from the use of pyrethrins would be **less than significant** and mitigation is not required.

7.2.7.2.2 Pyrethroids, Pyrethroid-Like Compounds, and Synergists

Pyrethroids are synthetic compounds that are chemically similar to the pyrethrins but have been modified to increase stability and activity against insects. Pyrethroids bind to neuronal voltage-gated sodium channels, preventing them from closing; this persistent activation of the channels then leads to paralysis.

First generation or "Type I" pyrethroids include d-allethrin, phenothrin (sumithrin), prallethrin, resmethrin, and tetramethrin. These pyrethroids are used to control flying and crawling insects in a number of commercial and horticultural applications and are sold for residential use and application on pets to control fleas and ticks. They have effective insect knock-down capabilities but are unstable as they are highly photosensitive (i.e., easily degraded by light). The newer second-generation/"Type II" pyrethroids contain an α -cyano group, which reduces their photosensitivity, thereby increasing their persistence and toxicity. The active ingredients that fall into this group include deltamethrin, lambda-cyhalothrin, and permethrin.

Some synthetic insecticides are similar to pyrethroids, such as etofenprox, but have a slightly different chemical composition. The pyrethroids that were identified for further evaluation in Appendix B are discussed below.

7.2.7.2.3 Resmethrin

Resmethrin is the active ingredient in Scourge®. It is a restricted-use pesticide due to its toxicity to fish and is available for use only by certified pesticide applicators or persons under their direct supervision.

Resmethrin has low acute toxicity via the oral (Category III), dermal (Category III), and inhalation (Category IV) routes of exposure. Resmethrin is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009).

Though public concern regarding the potential effects of resmethrin exists because of its possible endocrine-disrupting properties and concomitant use of PBO, Scourge® is rarely used and is being phased out of the District's program and replaced with a nonresmethrin alternative.

7.2.7.2.4 Permethrin

Permethrin is also a pyrethroid. Dermal exposure in humans can cause tingling and pruritus with blotchy erythema on exposed skin (ATSDR 2003). In humans, acute effects observed subsequent to ingestion of permethrin included nausea, vomiting, abdominal pain, headache, dizziness, anorexia, and hypersalivation. Reports of severe poisoning are rare and usually follow ingestion of substantial, but poorly described, amounts of permethrin. Symptoms of severe poisoning include impaired consciousness, muscle fasciculation, convulsions, and noncardiogenic pulmonary edema (ATSDR 2003). Systemic effects are similar to those seen in acute and chronic ingestion with prolonged contact or contact with high concentrations of permethrin. Acute toxicity to permethrin via inhalation has been shown to be very small. The USEPA (2006c) has classified permethrin as Category III for acute oral and acute dermal toxicity, Category III for eye irritation potential, and Category IV for dermal irritation potential. Although often used for residential insect control, products containing permethrin are considered very low risk to humans. Acute, chronic noncancer, and cancer dietary risks from permethrin have been shown to be below the USEPA's level of concern. Occupational (handler/applicator) uses are also below USEPA noncancer levels of concern for typical uses, and typical personal protective equipment may be used.

Because permethrin is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009), it is of concern to the public. However, the District is not currently using it. If applied, it would be through ULV application with a backpack mister or hand can/duster and not during high winds.

7.2.7.2.5 Etofenprox

Etofenprox is a pyrethroid-like insecticide that is the active ingredient in Zenivex. It differs in structure from pyrethroids in that it lacks a carbonyl group and has an ether moiety, whereas pyrethroids contain ester moieties. It is used by the general public indoors, as a spot treatment for pets, and as an outdoor fogger to control flying and crawling insect pests. It is frequently applied to backyards and patios and sometimes directly to domestic pets. As with many other pyrethroids, etofenprox has low acute toxicity to humans and mammals and has shown to be below the USEPA level of concern under appropriate uses. The public's concerns regarding the ecological impacts of etofenprox are primarily due to the concern that it may be an endocrine disruptor. It is further discussed in Chapter 6, Section 6.2.7.2.5.

Impact HH-13: Impacts to human health from the use of pyrethroids and pyrethroid-like compounds as mosquito adulticides would be **less than significant** and mitigation is not required.

7.2.7.2.6 Piperonyl Butoxide

PBO is a pesticide synergist that enhances the effectiveness of pesticide active ingredients, such as pyrethrins and pyrethroids, by inhibiting microsomal enzymes and, thus, the breakdown of the other active ingredient(s) (USEPA 2006b). It is a registered active ingredient in products used to control flying and crawling insects and arthropods in agricultural, residential, commercial, industrial, and public health settings. No products contain only PBO. It degrades quickly in soil and water. PBO has a low acute toxicity by oral, inhalation, and dermal routes, but it is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009). As a synergist, PBO is applied using the same guidelines as those for pyrethroids and pyrethrins: ULV application with a backpack mister or hand can/duster, and it is not applied during high winds.

Impact HH-14: Impacts to human health from the use of the synergist PBO in mosquito adulticides would be **less than significant** and mitigation is not required.

7.2.7.2.7 Organophosphates

OP insecticides irreversibly block acetylcholinesterase activity, which causes accumulation of the neurotransmitter acetylcholine in the central nervous system, leading to excessive neuronal stimulation and then depression. OPs are quickly degraded and exhibit very low environmental persistence. The District may use OPs in rotation with other active ingredients to avoid the development of resistance.

Naled

Naled is an indoor and outdoor general use pesticide, used on food and feed crops, farms, dairies, pastureland, and in greenhouses and over standing water (CDPR 2010a). It can be used in rotation with pyrethrins or pyrethroids to avoid the development of resistance. It is moderately toxic to mammals; however, the District is not currently using it. If the District does, it would strictly adhere to BMPs and product label requirements, including the restriction of naled application to targets outside adequate buffer zones around permanent waterbodies to reduce runoff. It would be applied aerially using ULV, and potential drift is prevented because it is not applied during moderate/high winds. In addition, spray setbacks would be established to reduce spray drift for agricultural uses.

Impact HH-15: Impacts to human health from the use of naled would be **less than significant** and mitigation is not required.

7.2.7.3 Yellow Jacket Wasp Adulticides

The District may selectively apply insecticides to control ground-nesting yellow jackets populations that pose an imminent threat to employees. This activity is generally triggered by access needs to mosquito breeding sources rather than as a result of regular surveillance of their populations. The District does not apply pesticides to yellow jacket populations that are located in or on a structure. Yellow jacket nests that are off the ground would be treated only under special circumstances to protect the health and safety of the District's employees. When a District technician encounters a honeybee swarm or unwanted hive, they contact the County Agricultural Commissioner's Office, which maintains a referral list of beekeepers that can safely remove the bees. If a District technician deems it appropriate to treat stinging insects, 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 are typically used against ground-nesting yellow jackets and are applied directly into the underground nest, which prevents drift and further reduces the potential for nontarget exposure to these compounds. In addition to the pyrethrins and pyrethroids discussed above, the District may use lambda-cyhalothrin to control yellow jacket wasps.

7.2.7.3.1 Lambda-cyhalothrin

Lambda-cyhalothrin is the active ingredient in Spectracide®, used to control yellow jacket wasps. It is moderately toxic to mammals via acute oral, dermal, and inhalation routes (National Pesticide Information Center 2001). Acute exposure to lambda-cyhalothrin has been linked with changes in neurological function when administered at high doses (USEPA 2002). Chronic studies of lambda-cyhalothrin and cyhalothrin have repeatedly and consistently documented decreased body weight gain and reduced food consumption. Signs of neurotoxicity and changes in organ weights are also common effects of chronic exposure to lambda-cyhalothrin and cyhalothrin (USEPA 2002, 2004a, 2007b, c). No genotoxicity data for cyhalothrin or lambda-cyhalothrin were identified in recent USEPA pesticide tolerance documents (USEPA 2002, 2004a, 2007b, c).

The potential for persistence of lambda-cyhalothrin and its toxicity to mammals is of concern from a potential human health impact perspective. However, the District may use strictly controlled applications of lambda-cyhalothrin directly to wasp's nests with a hand can/duster in minute amounts. The District would give notification when this pesticide is used on/near a resident's home. Lambda-cyhalothrin use would be restricted and not applied to vernal pools.

Impact HH-16: Impacts to human health from the use of lambda-cyhalothrin would be **less than significant** and mitigation is not required.

7.2.8 Cumulative Impacts

"Cumulative impacts" are defined as "two or more individual effects which, when considered together, are considerable or compound or increase other environmental impacts (CEQA Guidelines, Section 15355). Cumulative impacts, as they relate to human health, include past, present, and reasonably foreseeable actions that potentially impact humans. Cumulative impacts can result from individually minor, but collectively significant, projects taking place over a period of time. The cumulative impact analysis is contained in Section 13.5 and focuses on the potential for the use of pesticides for mosquito control to contribute to regional pesticide use which is of concern for its potential impacts to the health of human populations. It includes Table 13-1, Historical Pesticide Use within the Alameda County Mosquito Abatement District's Program Area for 2006-2010 and Table 13-2, Pesticide Use within the Alameda County Mosquito Abatement District Service Area.

Although large uncertainty and high variation exist in the reported amounts of pesticide use within the District's Program Area counties, they vary according to particular needs, majority of habitat type, and seasonal mosquito outbreaks. The public is aware of these pesticide uses and, in general, is pressuring agencies within these counties to use less pesticide whenever possible. The District uses very strict and thorough BMPs in their pesticide applications for mosquito control and is attempting to reduce total pesticide use where possible consistent with IPM practices.

The District's small incremental contributions to overall pesticide use within its Program Area do not trigger a cumulatively considerable impact on pesticide use. While overall use of pesticides throughout the Program Area may be considered cumulatively significant, the District's small incremental contributions to this impact are not cumulatively significant. Therefore, the **Program's long-term activities including chemical applications would not contribute considerably to human health impacts**. The Program alternatives would not result in significant cumulative impacts to the human health condition of the region.

7.2.9 Environmental Impacts Summary

Table 7-10 presents a summary of human health impacts associated with the five alternatives. The human health impacts correspond to those in Sections 7.2.3 through 7.2.8. All of the impacts were determined to be either "no impact" or a "less-than-significant impact."

Table 7-9 Summary of Alternative Human Health Impacts

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
Effects on Human Health					
Impact HH-1: No impact would occur to human health from the use of the Surveillance Alternative.	N	na	na	na	na
Impact HH-2: Impacts to human health from use of the Physical Control Alternative would be less than significant and mitigation is not required.	na	LS	na	na	na
Impact HH-3: No impact would occur to human health from the nonherbicide Vegetation Management Alternative.	na	na	N	na	na
Impact HH-4: Impacts to human health from the herbicides imazapyr, sulfometuron methyl, and triclopyr would be less than significant because the actual use and human exposure in the field is far less than tested in the laboratory and much higher volumes (exposure) would be needed to result in toxicity. Mitigation is not required.	na	na	LS	na	na
Impact HH-5: Impacts to human health from the use of glyphosate would be less than significant and mitigation is not required.	na	na	LS	na	na
Impact HH-6: Impacts to human health from the use of pesticide adjuvants would be less than significant and mitigation is not required.	na	na	LS	na	na
Impact HH-7: No impact would occur to human health from the use of mosquitofish.	na	na	na	N	na
Impact HH-8: No impact would occur to human health from the use of bacterial larvicides.	na	na	na	na	N
Impact HH-9: No impact would occur to human health from the use of the mosquito larvicide methoprene.	na	na	na	na	N
Impact HH-10: No impact would occur to human health from the use of surfactant larvicide.	na	na	na	na	N
Impact HH-11: Impacts to human health from the use of temephos would be less than significant and mitigation is not required.	na	na	na	na	LS
Impact HH-12: Impacts to human health from the use of pyrethrins would be less than significant and mitigation is not required.	na	na	na	na	LS

Table 7-9 Summary of Alternative Human Health Impacts

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
Impact HH-13: Impacts to human health from the use of pyrethroids and pyrethroid-like compounds as mosquito adulticides would be less than significant and mitigation is not required.	na	na	na	na	LS
Impact HH-14: Impacts to human health from the use of the synergist PBO in mosquito adulticides would be less than significant and mitigation is not required.	na	na	na	na	LS
Impact HH-15: Impacts to human health from the use of naled would be less than significant and mitigation is not required.	na	na	na	na	LS
Impact HH-16: Impacts to human health from the use of lambda-cyhalothrin would be less than significant and mitigation is not required.	na	na	na	na	LS

LS = Less-than-significant impact

N = No impact

na = Not applicable

SM = Potentially significant but mitigable impact

SU = Significant and unavoidable impact

7.2.10 Mitigation and Monitoring

All impacts to human health are identified as either “no impact” or a “less-than-significant impact.” Therefore, mitigation measures are not applicable to the insignificant impacts identified for all of the Program alternatives described.