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

> 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 San Mateo County Mosquito and Vector control District (SMCMVCD) Service Area (San Mateo County) and the adjacent counties where control activities may be provided upon request (which include San Francisco, Santa Clara, and Santa Cruz counties) that are impacted by unwanted vectors that must be controlled to minimize adverse effects, disease, and environmental impacts. The following section provides the background information on the 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 are shown in the following two tables. In 2010, the population of California was estimated at 37.3 million (US Census Bureau (2010). The population of San Mateo County was 718,451, which represents 1.9 percent of the statewide total (see Table 7-1a).

Table 7-1a Population and Growth in the District (1990–2010)

	Population			Population Growth (Compound Annual Average)	
County / Area	**1990**	**2000**	**2010**	**1990–2000**	**2000–2010**
San Mateo	649,623	707,161	718,451	0.85%	0.16%
San Francisco Bay Area	5,665,278	6,410,017	6,760,561	1.26%	0.53%
Statewide Area	**29,760,021**	**33,871,648**	**37,253,956**	**1.30%**	**0.96%**

Table 7-1b provides the population counts and projected growth in the three counties adjacent to the District's Service Area that are included in the District's Program Area.

Table 7-1b Population and Growth in the Three Counties Adjacent to the District (1990–2010)

	Population			Population Growth (Compound Annual Average)	
County / Area	**1990**	**2000**	**2010**	**1990–2000**	**2000–2010**
Santa Clara	1,497,577	1,682,585	1,781,642	1.17%	0.57%
Santa Cruz	229,734	255,835	262,382	1.08%	0.25%
San Francisco	723,959	776,764	805,235	0.71%	0.36%
Adjacent County Total	2,451,270	2,715,184	2,849,259	1.03%	0.48%
Statewide Total	**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.” The discussion below explains the background information and issues/concerns associated with the use of chemical treatments, while the analysis of potential impacts occurs later in Sections 7.2.5 and 7.2.7.)

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[1],, 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). Although numerous precautions (BMPs) and use of recommended application guidance are intended to provide efficacy without adverse effects to nontarget organisms, misapplication or unexpected weather conditions may still result in effects on some nontarget organisms in the exposure area. This potential impact is ameliorated by the application concentrations consistent with the labels or MSDSs designed to be protective of the health of humans and other nontarget species, careful use of the other pesticide application BMPs, and advance planning by the District (see Sections 7.2.5 and 7.2.7 where the potential impact analyses are provided).

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 Assessment Report, provides a discussion of the environmental fate of the pesticide active ingredients and other chemicals associated with specific pesticide formulations used, or that may be used, in the Program alternatives.

[1] Although the MSDS format is referenced in this document, note that under the international Globally Harmonized System, the MSDS format has been substantially revised and is now largely replaced by standardized Safety Data Sheets (SDSs).

7.1.3 Pesticides and the Environment

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

Table 7-2 Pesticide Active Ingredients

Active Ingredient	Vector
Bacillus sphaericus (Bs)	Mosquito (larvae)
Bacillus thuringiensis israelensis (Bti)	Mosquito (larvae)
Spinosad	Mosquito (larvae)
Water soluble surface film	Mosquito (larvae)
Biodegradable alcohol ethoxylated surfactant	Mosquito (larvae and pupae)
Methoprene	Mosquito (larvae)
Mineral oil. Plant-derived oils	Mosquito (larvae and pupae)
Refined petroleum distillate	Mosquito (larvae)
Aliphatic petroleum hydrocarbons	Mosquito (larvae)
Temephos	Mosquito (larvae)
Pyrethrins	Mosquito (adults)
Piperonyl butoxide (PBO)	Mosquito (adults)
Phenothrin (sumithrin)	Mosquito (adults)
Permethrin	Mosquito (adults)
Prallethrin	Mosquito (adults)
Resmethrin	Mosquito (adults)
Etofenprox	Mosquito (adults)
Naled	Mosquito (adults)
Permethrin	Yellow jacket wasp
Deltamethrin	Yellow jacket wasp
Pyrethrins	Yellow jacket wasp
Piperonyl butoxide (PBO)	Yellow jacket wasp
Resmethrin	Yellow jacket wasp
Lambda-cyhalothrin	Yellow jacket wasp
Prallethrin	Yellow jacket wasp
Tetramethrin	Yellow jacket wasp
Etofenprox	Yellow jacket wasp
Esfenvalerate	Yellow jacket wasp
Potassium salts of fatty acids	Yellow jacket wasp

[2] Chapter 2 Program Description contains the comprehensive tables for pesticides and herbicides, including the product names. The impact analyses are organized by active ingredient and vector, and these are shown here.

Active Ingredient	Vector
d-trans Allethrin	Yellow jacket wasp
Phenothrin	Yellow jacket wasp
Permethrin	Tick
Pyrethrin	Tick
Piperonyl butoxide (PBO)	Tick
Deltamethrin	Tick
Esfenvalerate	Tick
Bromadiolone	Rat
Diphacinone	Rat
Brodifacoum	Rat
Cholecalciferol	Rat
Bromethalin	Rat
Difethialone	Rat
Sodium nitrate	Rat
Sulfur	Rat
Chlorophacinone	Rat

Table 7-3 Herbicide Active Ingredients and Adjuvants

Active Ingredient	Vector
Benefin	Weeds
Oryzalin	Weeds
DCPA	Weeds
Dithiopyr	Weeds
Glyphosate	Weeds
Lecithin	Weeds
Methyl esters of fatty acids	Weeds
Alcohol ethoxylate	Weeds
Modified vegetable oil	Weeds
Triclopyr	Weeds
Sulfometuron methyl	Weeds
Imazapyr	Weeds
APE	Weeds
Diuron	Weeds

7.1.4 Regulatory Environment

Formulations proposed for each Program alternative for vector 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 FFDCA authorizes the USEPA to set tolerances (i.e., maximum allowable amounts) for pesticide residues in/on food. Thus, the FFDCA 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, 2,4-D, 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.

> 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 Active Ingredients and Table 7-3, Herbicide Active Ingredients and Adjuvants.

> 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 bait blocks, chemical agents, and poisons in sanitary sewers concerning components and effects. Could pose a significant impact on the operation of wastewater treatment plant.

- The use of bait blocks and other 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 Program 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.

> Concern expressed with use of Zenivex; it mimes chrysanthemums but is a harmful neurotoxin.

- Etofenprox, the active ingredient in Zenivex, is discussed in Section 7.2.7.2.5 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.

> Concern expressed that adulticides present 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.

> Concern expressed 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.

> In addition to short-term effects, what are the long-term effects of repeated exposure to these chemicals?

The chemical characteristics, including fate and transport and half-lives, of the various pesticides are discussed in detail in Appendix B. Pesticides applied by the District are primarily nonpersistent compounds that degrade within a few hours to a few weeks when exposed to sunlight, moisture and soil, so they are unlikely to accumulate or produce long-term impacts.

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 and additional BMPs employed by the District (see Chapter 2, 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 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

> 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

> Pesticide target vector efficacy

> 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 is 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/IVM approaches and BMPs the District practices. All BMPs are described in Chapter 2 (Table 2-8), and the most relevant BMPs for avoidance or minimization of impacts to human health are repeated below.

For all six of the Program alternatives, the District uses the following BMPs:

> Operation of noise-generating equipment (e.g., chainsaws, wood chippers, brush-cutters, pickup trucks) 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. (BMP A11)

> For operations that generate noise expected to be of concern to the public, the following measures will be implemented: (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. (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. (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 vector treatment activities. (Table 2-8, BMP I5)

> Equip all vehicles used in wildland areas with a shovel and a fire extinguisher at all times. (BMP J1)

> Train employees on the safe use of equipment and machinery, including vehicle operation. (BMP J2)

> 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. (BMP J3)

For five of the 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. (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. (BMP H1)

> Materials will be applied at the lowest effective concentration for a specific set of vectors and environmental conditions. Application rates will never exceed the maximum label application rate.(BMP H3)

> To minimize application of pesticides, application of pesticides will be informed by surveillance and monitoring of vector populations. (BMP H4)

> 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. (BMP H5)

- 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. (BMP H6)
- 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. (BMP H7)
- Spray nozzles for the application of larvicides or herbicides will be adjusted to produce larger droplet size rather than smaller droplet size. Use low nozzle pressures where possible (e.g., 30 to 70 pounds per square inch). Keep spray nozzles within a predetermined maximum distance of target weeds or pests (e.g., within 24 inches of vegetation during spraying). For application of adulticides, use ULV sprays that are calibrated to be effective and environmentally compatible at the proper droplet size (about 10-30 microns). (BMP H8)
- Clean containers at an approved site and dispose of at a legal dumpsite or recycle in accordance with manufacturer's instructions if available. (BMP H9)
- District staff will monitor sites post-treatment to determine if the target vector 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. (BMP H11)
- The District will provide notification to the public (24 to 48 hours in advance, if 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 applies or participates in the application of herbicides in areas other than District facilities when a joint effort is most effective and/or efficient.(BMP H13)
- 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). (BMP I1)
- 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. (BMP I2)
- 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. (BMP I3)
- Properly secure the spilled material, label the bags with service container labels identifying the pesticide, and deliver them to a District Supervisor for disposal. (BMP I4)
- Field-based mixing and loading operations will occur in such a manner as to minimize the risk of accidental spill or release of pesticides. (BMP I6)

This evaluation assumes that all pesticides are applied in accordance with product label instructions and USEPA and CDPR. 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, 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 herein does not include assumptions about which alternative treatment strategy(ies) would be applied in any given area. Criteria used to trigger a particular alternative based on vector abundance and other variables are included in the District's operating procedures. 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 references 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 vector control application, the impacts are weighed against the proximity and timing of each application. Some commercial products actually contain more than one active ingredient (e.g., FourStar Briquets contain Bs and Bti), and these products are evaluated for toxicity. If products with identical or different active ingredients are applied simultaneously, the potential toxicity of each is summed to estimate potential adverse effects. 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 (e.g., larvicide and the adulticide) is inappropriately close. Actual applications do not generally occur that close together unless a problem with treatment effectiveness occurs. After a material is applied, post-treatment inspection is performed to determine effectiveness. Only if the vectors have not been sufficiently killed would the District go back into the area and reapply a pesticide to the same area.

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 and MVCAC 2012). 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 (e.g., dead specimens brought to the District), collection and testing of ticks, small rodent trapping, and/or response to public service requests regarding nuisance animals or insects (e.g., yellow jacket wasps). 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.

Tick surveillance is conducted by collection of ticks in public contact areas and submission and identification of ticks brought in by the public. The District responds to public service requests and provides recommendations and control on nonstructural pest populations of yellow jacket wasps.

The District conducts a year-round survey of local rat populations to assess species distribution and population control needs. Trapping activities conducted to assess the presence and abundance of rodent populations could lead to capture and mortality of nontarget organisms and, thus, trapping is used infrequently, usually only for HPS surveillance. The District provides informational material to citizens on how to prevent and control yellow jacket wasp and rodent populations around their property and also disseminate information on tick-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, streambed alteration permits, etc.), and in a manner that generally maintains or improves habitat values for desirable species. Physical control for other vectors such as rodents is based on the District's site inspections to determine conditions promoting infestation, and property owners are provided educational materials on control measures that include removal of food sources and professionals to contact to remove the infestation. 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 heavy equipment where necessary for vegetation removal or thinning and sometimes applies 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 help with the control of other vectors. 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 resource agencies (e.g., US Department of Fish and Wildlife [USFWS] and California Department of Fish and Wildlife [CDFW]) about special status species, and their habitats that must be acknowledged and protected prior to these activities. Vegetation management is also 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 provides 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

The herbicides the District uses are applied in strict conformance with label requirements. Herbicides the District uses 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. They may be used to assist public agencies (such as the Coastal Conservancy) with the management of invasive species and to control noxious weeds, The herbicides the District uses and where they are discussed in detail in Appendix B are listed in Table 7-4.

Table 7-4 Herbicides 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
Diuron	Section 4.6.7
Benfluralin (Benefin)	Section 4.6.8
Oryzalin	Section 4.6.9
DCPA	Section 4.6.10
Dithiopyr	Section 4.6.11

Herbicides included in the Program have diverse chemical structures, act through distinct modes of action, and exhibit varying levels of potential toxicity to humans and nontarget species, Certain herbicides are nonselective and broad-spectrum (e.g., imazapyr, sulfometuron methyl, DCPA), while others are selective for certain plants (e.g., oryzalin, dithiopyr). Herbicides function by inhibiting growth but do so in a multitude of ways. For example, sulfometuron methyl retards or stops root and shoot development, and oryzalin inhibits cell division during seed germination (USEPA 2005). Most of the herbicides are moderately persistent in soil and water (for each herbicide's half-life in soil and water, refer to Appendix B).

The following have been shown to exhibit no/low toxicity to humans: imazapyr (USEPA 2006a), triclopyr (USEPA 1998b), sulfometuron methyl (USEPA 2008c), oryzalin (USEPA 1994), and dithiopyr (Ward 1993). Certain herbicides may exhibit adverse effects to humans at high doses so USEPA continues to evaluate them (USEPA 2009a). DCPA is included in the final list of chemicals for screening under the USEPA's Endocrine Disruptor Screening Program (USEPA 2009a). However, 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

> **Impact HH-4:** Impacts to human health from several of the herbicides would be **less than significant** and mitigation is not required.

The herbicides that were identified for further evaluation based on use patterns and toxicity are discussed in further detail below: glyphosate, diuron, and benfluralin. Adjuvants used in some of the herbicides are discussed as well.

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 no to very low toxicity to mammals (USEPA 1993). Extra measures of safety are provided by the BMPs (Table 2-8, Category H, and listed in Section 7.2.2) and by product label requirements,

Glyphosate has come under increased scrutiny in the last few years as claims of carcinogenicity and endocrine disruption have been reported in the popular media. These two areas of public concern about the possible effects of glyphosate to humans are discussed below.

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.

Although no scientific evidence had indicated that glyphosate is carcinogenic or mutagenic (USEPA 1993), a recent report by the World Health Organization (WHO 2015) suggests that it "*may probably be carcinogenic*" although these researchers fail to report a statistically significant finding. Use of the term "probably" generally indicates the linkage is not statistically defensible. The WHO report is a summary of a panel review convened specifically to update information on several chemicals, including the herbicides tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate, in order to evaluate the existing information about the potential for adverse effects.

The lack of a definitive, or more positive statement about linkage of glyphosate to cancer by the WHO panel (2015) is due, in part, because the information and data provided in the updated reports contain numerous confounding factors (such as interactions with personal care products, medications with estrogenic activity, and even the estrogenic activity in some foods and vegetables) that could contribute to the reported results. Because the WHO publication has received so much attention, this claim should be considered, but it is clearly not supported by the work of several other researchers (Rhomberg et al. 2012; Mink et al. 2012) who do not attribute any carcinogenic effects to humans from potential exposure to glyphosate. Glyphosate 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).

Despite the apparent lack of toxicity to mammals, concerns have been raised by some groups about the possibility that glyphosate may have long-term developmental and reproductive effects. Although still in review by USEPA, glyphosate is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program that evaluates dozens of "*possible human systems affected by possible ED chemicals*" (USEPA 2009a). The issue of endocrine-disrupting compounds is a topic of current scientific concern and inquiry. 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). In fact, only very high exposures of laboratory animals to those chemicals suggested as endocrine disruptors can be shown to suggest any link to effects on the endocrine system. Because the exposure used in those tests is so unrealistically high, endocrine disruption in a human would require, if real, exposure to substantially higher levels of the chemical than that used for vector control.

For the last several years, USEPA has had an ongoing concern that some chemicals might be endocrine disruptors and began a screening evaluation of more than 10,000 chemicals for the potential for endocrine disruption. Since the effort began in the 1990s, the USEPA and the Organization for Economic Co-operation and Development have released numerous lists of chemicals (USEPA 2015a; OECD 2012) they are reviewing or plan to review. As one example, on June 14, 2013, USEPA published one of the lists as the *Revised Second List of Chemicals* for Tier 1 Screening in a Federal Register notice. This revised second list consists of 109 identified chemicals, 41 of which are pesticide active ingredients. The list includes chemicals that have some potential for endocrine disruption based on information provided internally in the USEPA but without rigorous testing or evaluation. Although the list continues to include some of those chemicals that may have endocrine-disrupting potential, the screening has produced conflicting results and a lack of consistency in the tests utilized to date. On July 30, 2015, USEPA (2014c, 2015) released an updated review of its newer ("cutting edge") processes proposed for evaluation of Tier 1 endocrine-disrupting screening results for 52 chemicals. USEPA hopes that more definitive, defensible recommendations for linking specific chemicals to potential endocrine-disrupting effects will result. At this time, the USEPA has developed no definitive recommendations for the pesticides on the list.

Clearly, current data indicate that glyphosate is nontoxic to humans, and the endocrine disruption issue in humans has not been demonstrated with human exposure scenarios that are realistic and typical for vector control. Glyphosate products are effective, widely used, generally low risk products for weed

control (Gertsberg 2011). Some ancillary reports in the press of sublethal effects on disease resistance, biological diversity, or enzyme activity as a result of ingestion/uptake of glyphosate are interesting but without clear mechanisms that can be related directly to glyphosate (Gertsberg 2011).

Because of recent concern expressed in some mainstream articles and a few recent scientific publications, it is important here to provide some perspective on the potential risks to humans from chemicals that are said to be potential endocrine disruptors, and particularly the herbicide glyphosate. While some groups suggest that herbicide products containing glyphosate (Roundup and several formulations using glyphosate) are toxic to animals, defensible links are not clear. Without links to potential human exposures that might be associated with herbicide applications, claims of toxicity cannot be substantiated. Regardless of the lack of defensible links (Rhomberg et al. 2012; De Roos et al. 2005) to adverse effects, some antipesticide advocates continue to suggest that glyphosate is linked to endocrine disruption in humans.

To provide some additional perspective on the potential for the claims of endocrine disruption in humans from synthetic chemicals, including glyphosate, during the past several decades researchers have shown that over 173 plants and 43 common foods in the human diet are estrogenically active ("endocrine disruptors"). These results, based on laboratory tests, suggest that carrots, celery, coffee, oats, hops, corn, cumin, beans, barley, garlic, olive oil, peanut oil, plums, peas, rice, sage, soy, cinnamon, beets, grapefruit, parsley, pineapple, wheat germ, potatoes, cherries, and others may show estrogenic effects. The phytoestrogens occurring naturally in our foods are up to 10,000 times more potent than synthetic estrogens (Linder 1976). Even if endocrine disruption is claimed to be a result of exposure to glyphosate, no studies or reports attribute any effects, including endocrine disruption, by glyphosate exposures at the very low levels that occur as a result of typical District herbicide applications. The laboratory studies that report endocrine effects expose laboratory animals to doses, without alternative food choices, that are hundreds to thousands of times greater than could be experienced in humans during District vector control.

Twenty years of research on the potential adverse effects of endocrine-disrupting chemicals by USEPA (2009a) and many research groups has not produced any defensible information that supports a linkage to endocrine disruption associated with reasonable exposure to humans. In a recent publication by a multinational team of toxicology experts, the relative potential for endocrine disruption is provided in a comprehensive summary of data, claims, and media reports. After consideration of the wide range and large number of reports, these authors concluded that "human health risks from a typical exposure to endocrine-disruptors, even cocktails of chemical exposures, remains an unproven and unlikely hypothesis" (Nohynek et al. 2013).

When comparing the District use rates and carefully designed application techniques used for glyphosate for vegetation control, it is clear that the potential exposures after District applications at all application volumes are far below any level of exposure that could remotely result in adverse effects of this herbicide. The patchy and non-uniform applications, the use of label rate dilutions, and special BMPs provide a substantial gap between application and possible human exposures.

While no reports or information have demonstrated relevant toxicity, endocrine disruption, or carcinogenicity, it is likely that USEPA will continue to provide updated reviews of the potential risks in the next several years, but 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.

7.2.5.1.2 Diuron

Diuron, the active ingredient in Karmex SP, is used as a pre- and post-emergent herbicide in crop and noncrop areas, a mildewcide and preservative in paints and stains, and an algaecide in commercial fish production, residential ponds, and aquariums. It is one of the most commonly used pesticides in

California. Due to its mobility and persistence, it has the potential to leach into surface and groundwater (Moncada 2004; USEPA 2003).

Diuron has low acute toxicity (Category III or IV) to mammals by oral, dermal, or inhalation exposure routes, and it is not irritating to eyes or skin. Diuron has been classified as a "known/likely" human carcinogen based on urinary bladder carcinomas in rats. However, the District's use of BMP application techniques (e.g., adequate buffer zones between application sites and groundwater) will reduce exposure.

> **Impact HH-6:** Impacts to human health from the use of diuron are not associated with the field application scenarios and, thus, diuron exposures would be **less than significant** and mitigation is not required.

7.2.5.1.3 Benfluralin (Benefin)

Benfluralin is a pre-emergent herbicide used to control grasses on commercial and residential turf. It volatilizes rapidly, but application practices and granular formulations are designed to slow volatilization (USEPA 2004a).

Benfluralin is classified as practically nontoxic (Category IV) to mammals by acute oral and dermal routes and low toxicity (Category III) for skin and eye irritation. The chemical is toxic to the kidneys, liver, and thyroid in longer-term studies. It has not been assessed for carcinogenicity in humans. Benfluralin is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009a). Minimal impacts to human health are expected when benfluralin is used according to label guidelines and BMP application techniques.

> **Impact HH-7:** Impacts to human health from the use of benfluralin would be **less than significant** and mitigation is not required.

7.2.5.2 Adjuvants

An adjuvant is any compound that is added to an herbicide formulation or tank mix to facilitate the mixing, application, or effectiveness of that herbicide. 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 employs and where they are discussed in detail in Appendix B are listed in Table 7-5.

Table 7-5 Adjuvants Used for Insect Abatement

Active Ingredient	Appendix B
APEs	Section 4.7.1
Modified Plant-Derived Oils	Section 4.7.3
Lecithin	Section 4.7.4

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.

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

Similarly, little is known about the toxicity or environmental fate of lecithins, which are a commonly used amphoteric surfactant derived from soybeans. Although toxicity and environmental fate information is scarce for these oils, using BMP application practices, these products should not result in unwanted adverse effects.

> **Impact HH-8:** 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 and other vectors involves the intentional use of vector pathogens (diseases), parasites, and/or predators to reduce the population size of target vectors. 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. The Biological Control Alternative as the district practices it at present would be a continuation of existing activities focused on use of predators (e.g. mosquitofish) and pathogens using applicable techniques, equipment, vehicles, and watercraft.

7.2.6.1 Mosquito Larvae Pathogens

As part of their Biological Control Alternative, the District employs bacterial larvicides that are highly specific to mosquitoes. These biological controls include Bs, Bti, and spinosad. 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 unused swimming pools.

> **Impact HH-9: No impact** would occur to human health from the use of mosquitofish.

7.2.6.3 Other Vectors

No effective natural predators exist to control high rodent populations. Domestic and feral cats may provide short-term control when the rodent population is low, but they can also impact bird populations. The District does not employ cats for rat control. 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 (e.g., yellow jacket wasps and ticks) threats to public health and the use of rodenticides to control rats and mice. 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 and the BMPs listed in section 7.2.2 and Chapter 2, Table 2-8.

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, adulticides, and rodenticides the District uses. 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.

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

Active Ingredient	Vector	Potential Issue
Methoprene	Mosquito	Prevalent use; toxicity to aquatics and insects
Etofenprox	Mosquito	Toxicity to aquatic organisms; no synergist required
Bti	Mosquito	Prevalent use; public concerns
Pyrethrins	Mosquito, yellow jacket wasp	Prevalent use; requires synergist (PBO)
Resmethrin	Mosquito, yellow jacket wasp	Requires synergist (e.g., PBO); potential endocrine disruptor
Permethrin	Mosquito, yellow jacket wasp	Toxicity to aquatic organisms; potential endocrine disruptor
Lambda-cyhalothrin, Esfenvalerate	Yellow jacket wasp; tick	Toxicity to aquatic organisms; potential to bioaccumulate
Bromadiolone	Rodents	Toxicity to nontarget organisms including mammals, birds, aquatics
Difethialone	Rodents	Toxicity to nontarget organisms including mammals, birds, aquatics

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 water bodies 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 uses and where they are discussed in detail in Appendix B are listed in Table 7-7.

Table 7-7 Chemicals Employed 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 (aliphatic hydrocarbon ester)	Methoprene	Section 4.3.4
Surfactant	Biodegradable Alcohol Ethoxylated Surfactant (monomolecular film, BVA-2, CoCoBear)	Section 4.3.5

7.2.7.1.1 Bacterial Larvicides (Bs, Bti, and spinosad)

These bacterial larvicides 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 spinosysns, 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 are applied on a variety of crops and standing and moving water bodies, 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 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-10a: 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 water bodies. 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 using hand canisters or by 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 1991c). 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 vector control would be required and such exposure would need to be extensive. It is of public concern due to its potential ecological effects and widespread use (discussed in Chapter 6, Section 6.2.7.1.3).

> **Impact HH-10b: No impact** would occur to human health from the use of the mosquito larvicide methoprene.

Surfactants Biodegradable Alcohol Ethoxylated Surfactant (Monomolecular Film)

The biodegradable monomolecular film formulation used 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 water bodies including ornamental ponds, pastures, irrigation systems, drainage systems, and drinking water systems (CDPR 2010a). No evidence supports that these surfactants are toxic to humans.

Aliphatic Solvents (Mineral Oil)

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) are not available or 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.

Plant-Derived Oils

Plant-derived oils, whether vegetable or fruit, can be used as adjuvants that enhance the effectiveness of herbicides or as surfactants for the management of vectors, especially immature mosquitoes. Plant-derived oils are generally of two types: triglycerides or methylated oils. CocoBear Mosquito Larvicide Oil is the only plant-based oil that is currently available for use in the District's Program (also see Section 4.3.6.4 in Appendix B). This product consists mostly of a modified coconut oil (75 percent or more by volume) combined with 10 percent by volume mineral oil and a very small amount of nonionic surfactant and other proprietary ingredients. This material can be used in various waterbodies such as ditches, stagnant pools, swamps, marshes, temporary rainwater pools and intermittently flooded areas, ponds, catch basins, and man-made containers for the management of immature mosquitoes. CoCoBear has no reported significant toxicity to any receptors likely to be exposed during or after use as a larvicide. Acute oral toxicity to rats is >5,000 mg/kg, acute dermal toxicity to rats is > 5,050 mg/kg, and acute inhalation toxicity to rats is >2.16 mg/L (Clarke Mosquito Products MSDS, 2014).

> **Impact HH-10c:** A **less-than-significant** impact would occur to human health from the use of alcohol ethoxylated, aliphatic solvent, and plant-derived oil surfactant larvicides. No mitigation is required.

7.2.7.1.3 Temephos

Temephos is the only OP with larvicidal use and is 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. It is used in various water bodies including lakes, marshes, drainage systems, irrigation systems, and polluted and stagnant water; it is not used on agricultural lands

(CDPR 2010a). The District primarily applies temephos to man-made sources such as tire piles, utility vaults, and cemetery urns. 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 uses to control mosquito, yellow jacket wasps, and ticks and where they are discussed in detail in Appendix B are listed in Table 7-8.

Table 7-8 Chemicals Employed for Adult Insect Abatement

Chemical Classification	Active Ingredient	Vector	Appendix B
Pyrethrin	Pyrethrins	Mosquito, yellow jacket wasp, tick	Section 4.1.1
Pyrethroid	d-*trans* allethrin	Yellow jacket wasp	Section 4.1.2
Pyrethroid	Phenothrin (sumithrin or d-phenothrin)	Yellow jacket wasp	Section 4.1.3
Pyrethroid	Prallethrin	Mosquito, yellow jacket wasp	Section 4.1.4
Pyrethroid	Deltamethrin	Yellow jacket wasp, tick	Section 4.1.5
Pyrethroid	Esfenvalerate	Yellow jacket wasp, tick	Section 4.1.6
Pyrethroid	Lambda-cyhalothrin	Yellow jacket wasp	Section 4.1.7
Pyrethroid	Resmethrin	Mosquito, yellow jacket wasp	Section 4.1.8
Pyrethroid	Tetramethrin	Yellow jacket wasp	Section 4.1.9
Pyrethroid	Permethrin	Mosquito, yellow jacket wasp, tick	Section 4.1.10
Pyrethroid	Etofenprox	Mosquito, yellow jacket wasp	Section 4.1.11
Synergist	PBO	Mosquito, yellow jacket, tick	Section 4.1.12
Organophosphate	Naled	Mosquito	Section 4.2.1
Potassium salt	Potassium salts	Yellow jacket wasp	Section 4.4.1

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 uses pyrethrins on crops, animal husbandry premises and pastures, outdoor household areas, and 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 and require the use of the synergist PBO, a potential endocrine disruptor (USEPA 2009a). 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 for mosquito, yellow jacket wasp and tick control 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-trans 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, esfenvalerate, 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 2009a).

Though public concern regarding resmethrin exists because of its potential 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.

Because permethrin is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009a), it is of concern to the public. However, the District rarely uses it, applies it through ULV application with a backpack mister or hand can/duster, and does not apply 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 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. It has low acute toxicity to humans and mammals. The public's concerns regarding the ecological impacts of etofenprox are discussed in Chapter 6, Section 6.2.7.2.2

> **Impact HH-13:** Impacts to human health from the use of pyrethroids and pyrethroid-like compounds for mosquito, yellow jacket wasp, and tick control 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 2009a). 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 and yellow jacket wasp 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 OP pesticide, used on food and feed crops, farms, dairies, pastureland, and in greenhouses and over standing water (CDPR 2010a). It is used in rotation with pyrethrins or pyrethroids to avoid the development of resistance. It is moderately toxic to mammals; however, the District uses it infrequently. When the District does, it strictly adheres to BMPs and product label requirements, including the restriction of naled application to targets outside adequate buffer zones around permanent water bodies to reduce runoff. It is applied aerially using ULV, and potential drift is prevented because it is not applied during moderate/high winds. In addition, spray setbacks are established to reduce spray drift for agricultural uses.

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

7.2.7.3 Yellow Jacket Wasp and Tick Abatement

The District selectively applies insecticides to control ground-nesting yellow jackets and tick populations that pose an imminent threat to people or pets. This activity is generally triggered by public requests for District assistance or action 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. Whenever the District learns that a hive is situated in or on a structure or is above ground, the resident(s) are encouraged to contact a private pest control company that is licensed to treat the infestation. Yellow jacket nests that are off the ground would be treated only under special circumstances to protect public health and safety of the District's residents. When a District technician encounters a honeybee swarm or unwanted hive, residents are referred to 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. Alternatively, they will place tamper-resistant traps or bait stations, selective for the target insect in the immediate environment of the vector.

Pyrethroid-based chemicals are typically used against ground-nesting yellow jackets and ticks (when a risk of tick-borne disease exists) 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 uses lambda-cyhalothrin and potassium salts to control yellow jackets and 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, 2004b, 2007b, c). No genotoxicity data for cyhalothrin or lambda-cyhalothrin were identified in recent USEPA pesticide tolerance documents (USEPA 2002, 2004b, 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 uses strictly controlled applications of lambda-cyhalothrin directly to wasp nests as a courtesy to residents with a hand can/duster in minute amounts. The District gives notification when this pesticide is used on/near a resident's home. Lambda-cyhalothrin use is restricted to in yards, gardens, and home exteriors, and it is 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.

7.2.7.3.2 Potassium Salts

Potassium salts of fatty acids are used as insecticides and herbicides. They are used to control numerous insects and weeds, in/on crops, in residential yards, and on pets. The fatty acids disrupt the cell membranes of an insect, leading to dehydration. Soft-bodied insects, such as aphids, are more susceptible as are immature insects. These salts degrade quickly in soil by microbes and do not persist in the environment (USEPA 1992). They are classified as Category IV (lowest level of toxicity) for acute effects to humans, and the District use them very infrequently.

Impact HH-17: No impact would occur to human health from the use of potassium salts.

7.2.7.4 Rodenticides

The District has more recently developed a rat population control program to serve residents in the Program Area. The limited use of rodenticides by the District is not performed as result of surveillance, but in response to resident requests. Table 7-9 lists the pesticides the District used or proposed for use for control of rats. The District may use two different groups of anticoagulant rodenticides, including first-generation and second-generation rodenticides, for rapid knockdown of rat populations. First-generation rodenticides require consecutive multiple doses or feedings over a number of days to be effective. Second-generation rodenticides are more acutely toxic and are lethal after one dose. These products are effective against rodents that have become resistant to first-generation rodenticides. A neurotoxin type of rodenticide may also be used where rapid breakdown of the active ingredient is desired to minimize the potential for secondary poisoning of nontarget animals. The description of the District rodent abatement program is provided in Section 2.3.5.3, and key activities and practices are repeated below.

Table 7-9 Chemicals Employed for Rodent Abatement

Chemical Classification	Active Ingredient	Appendix B
First-generation anticoagulant	Chlorophacinone*	Section 4.5.1
First-generation anticoagulant	Diphacinone	Section 4.5.2
Second-generation anticoagulant	Brodifacoum	Section 4.5.3
Second-generation anticoagulant	Bromadiolone	Section 4.5.4
Neurotoxicant	Bromethalin	Section 4.5.5
Second-generation anticoagulant	Difethialone*	Section 4.5.6
Sterol	Cholecalciferol*	Section 4.5.7
Fumigant	Sulfur*	Section 4.5.8
Fumigant	Sodium nitrate*	Section 4.5.9

*Under consideration for future use.

The District may conduct rodent baiting at underground sites such as sewers, storm drains, or catch basins. Secure bait stations or other accepted methods of rodent baiting are conducted in areas with severe rodent infestations. In sewer baiting, bait blocks containing a rodenticide are suspended by wire above the water line to encourage rodent feeding. For rodent burrows, rodenticides may be blown into the burrows. The rodenticides the District uses and where they are discussed in detail in Appendix B are listed in Table 7-9 above.

The District takes part in a control program that consists of baiting along aboveground public storm control waterways, primarily in residential and commercial areas including urban creeks and not in open-space or recreational areas where children may play. Bait stations may be placed at the edge of public areas, such as an untraveled edge along a fence that separates the public area from homes, or a fenceline in a remote section of a park The bait is placed in an anchored tamper-proof bait station that only allows the target animal (mostly rats) to enter to eat the bait and then to leave the station to die. If the entrance size is compromised from animal gnawing, then the bait station is disposed of and replaced with a new one. All stations are labeled with a caution sticker, contents, and District information. All bait stations must be

located a safe distance above the water line, and every effort is made to take advantage of natural vegetation and other factors to conceal the stations from children to the greatest extent possible.

All stations are placed within 50 feet of a man-made structure unless a "feature" is associated with the site beyond 50 feet that is harboring rodents that could infest the main structure. Under no circumstances are bait stations placed in areas where children are known to play. In areas where it is obvious that children do not play, the bait stations must still be adequately concealed so they are not conspicuous to the ordinary child. In addition, the areas being baited are in heavily residential and commercial areas that contain very few predatory birds and no foxes, mountain lions, or other predators. If predatory animals are present, the technician will select a less toxic bait (i.e., bromethalin, a neurotoxin that works on the nervous system to reduce the likelihood of acute death) that reduces the chance of secondary poisoning. Dead rodents are picked up and disposed of if seen during inspection periods. The baits are applied largely by a third party PCO, and the District acts as a quality control component. In certain circumstances, District staff will place the bait stations themselves. The bait is monitored regularly and, depending on results, may be moved to other locations if rodent activity is low. Bait stations may also be placed in public rights-of-way and on public property but not where children play.

7.2.7.4.1 Anticoagulant Rodenticides

As their name suggests, anticoagulants function by inhibiting the production of blood-clotting factors. First-generation (e.g., chlorophacinone, diphacinone) anticoagulants require multiple doses (typically ranging from 0.005 to 0.1 percent) to achieve lethality in rodent pests. Chlorophacinone is currently registered for the control of rodents in and around buildings and residences, industrial areas, and food processing, handling, and storage areas and facilities. Diphacinone baits are placed in areas adjacent to buildings and similar man-made structures. These compounds have very low water solubility and are moderately persistent in soils. First-generation rodenticides are classified as Category I (highly toxic) to mammals for oral, dermal, and inhalation toxicity (USEPA 1998c).

Second-generation (e.g., brodifacoum, bromadiolone, difethialone) compounds have the same mode of action as first-generation anticoagulants but are more acutely toxic (often fatal after a single dose of typically 0.001 to 0.005 percent) than the first-generation anticoagulants because they are retained much longer in body tissues of primary consumers (Hartless and Jones 2011). Brodifacoum has the greatest acute toxicity of the Program rodenticides, but it is used very infrequently. The District will remove dead rodents in aboveground areas if seen when checking on bait stations, and stations are not placed in wildlife refuges or habitat conservation areas. The focus is on controlling rats in residential and commercial areas, urban creek corridors, and sewer vaults.

Products containing second-generation active ingredients are no longer available to the general public. These products remain available to professional pest control personnel, and strict adherence to product label requirements and District BMPs (especially BMPs H15 and H16) can ensure their safe use for controlling and eradicating nuisance rodent populations. Some of the ways to reduce adverse impacts includes the use of tamper-proof bait stations; securing bait stations at deployment locations to prevent disruption and/or removal by wildlife, children, or domestic animals; and proper education of citizens including residents about the potential risk to pets, wildlife, and children.

> **Impact HH-18:** Impacts to human health from the use of anticoagulant rodenticides would be **less than significant** and mitigation is not required.

The anticoagulant rodenticides (bromadiolone and difethialone) that have been selected for further evaluation in Appendix B are discussed individually below.

Bromadiolone

Bromadiolone, the active ingredient in Contrac products, is a second-generation anticoagulant rodenticide that is used in and around buildings and in transport vehicles, alleys, and sewers. It is highly toxic to

mammals, including humans, by acute oral, dermal, and inhalation exposure (USEPA 1998c). Bromadiolone is listed as Category III for eye irritation and Category IV for skin dermal irritation (USEPA 1998c).

Bromadiolone is a concern to the public due to its high mammalian toxicity. However, bromadiolone is usually wax-encased (e.g., Contrac Blox) in block form, which has exceptionally low water solubility and low leaching potential. Furthermore, when the District applies bromadiolone blocks in sewers, usually below manhole covers, it is suspended by a string. This method of bait deployment reduces the probability of exposure to humans and pets. When bromadiolone is used around residences, usually at a homeowner's request, the District places bromadiolone in tamper-proof bait stations, which are anchored at treatment locations (e.g., wires, stakes) to ensure that they cannot be dragged away by children or pets. The District educates citizens about the locations of bait blocks and potential risks to pets and children.

> **Impact HH-19:** Impacts to human health from the use of bromadiolone would be **less than significant** and mitigation is not required.

Difethialone

Difethialone is also a second-generation anticoagulant rodenticide that is the active ingredient in FirstStrike® Soft Bait. It is very toxic to mammals, including humans, domestic pets, and nontarget mammalian wildlife, by all acute exposure routes. Difethialone is not known to cause skin or eye irritation. No genotoxic or carcinogenic effects have been noted (Annex I - Norway 2007).

Difethialone is also of public concern because of its high mammalian toxicity and because it is used in areas frequented by humans and domestic animals (residential areas, urban creeks, and sewer vaults) during much of the year. As with bromadiolone, the District would use difethialone in tamper-proof bait stations, which are anchored at treatment locations (e.g., wires, stakes) to ensure that they cannot be dragged away by children or pets (BMP H16). The rodenticides are used at historical baiting sites when food competition occurs to increase the likelihood of exposure to only target rodents. The District would educate citizens about the locations of bait blocks and potential risks to pets and children. If the District expands use in the future or additional issues arise regarding the use of this rodenticide, new, more protective rodenticide bait station alternatives the USEPA reports could be considered (http://www.epa.gov/pesticides/mice-and-rats/rodent-bait-station.html).

> **Impact HH-20:** Impacts to human health from the use of difethialone would be **less than significant** and mitigation is not required.

7.2.7.4.2 Neurotoxicant Rodenticide (Bromethalin)

Bromethalin is used to kill rodents that have become resistant to anticoagulants. Because its name resembles that of the anticoagulant baits bromadiolone and brodifacoum, bromethalin is often mistaken for anticoagulant bait (Dunayer 2003). The mode of action for bromethalin is the uncoupling of oxidative phosphorylation, which leads to decreased cellular ATP production and failure of Na+, K+-ATPase pumps. Bromethalin is highly toxic to mammals and birds. Some bromethalin products meet USEPA's new, more protective risk reduction standards. When applied properly, these products present a lower risk of accidental exposure to children, pets, and wildlife; and USEPA has proposed them as safer alternatives to anticoagulants. They would be applied in tamper-resistant and weather-resistant bait stations (USEPA 2013a), which prevent entry by small mammals and birds. Bait stations are secured to the ground or structures to avoid wildlife dragging them away from deployment locations. The District educates citizens about the locations of deployed bait stations and potential risks to pets.

> **Impact HH-21:** Impacts to human health from the use of bromethalin would be **less than significant** and mitigation is not required.

7.2.7.4.3 Sterol – Cholecalciferol

Cholecalciferol is used in and around homes, industrial buildings, and similar man-made structures, agricultural buildings, transport vehicles, port and terminal buildings; and in alleys. Formulation types include pellets and blocks (Clock-Rust and Sutton 2011). It is essentially insoluble in water and immobile in soils. Cholecalciferol is vitamin D3, and ingestion of high amounts results in hypercalcemia from mobilization of calcium from bone matrix into blood plasma leading to soft tissue mineralization resulting in loss of functionality of kidneys, cardiac muscle, etc. (Morrow 2001). It is not acutely toxic to humans at the doses used in bait stations. Residential treatments by the District would involve bait station deployment within 50 feet of the home.

> **Impact HH-22:** Impacts to human health from the use of cholecalciferol would be **less than significant** and mitigation is not required.

7.2.7.4.4 Fumigants

Sulfur

Sulfur is one of the active ingredients in four fumigant (gas-producing) cartridge products that are used for rodent control on lawns, on golf courses, and in gardens. Carbon, sodium and potassium nitrates, sawdust, and sulfur are used in the pyrotechnic fumigant gas-producing cartridge products. After the cartridges are ignited, they produce toxic gases that cause asphyxiation of the pests. The gases displace the oxygen in the burrows, creating an unbreathable atmosphere, causing asphyxiation of the target organisms (USEPA 2008b).

Elemental sulfur, when applied as a pesticide, will become incorporated into the natural sulfur cycle. The main processes and dissipation of elemental sulfur are oxidation into sulfate and reduction into sulfide. These processes are mainly mediated by microbes (USEPA 2008b). Sulfur is nontoxic to mammals.

Sodium Nitrate

Sodium nitrate fumigants work by the combustion of charcoal in the formulation of each product. Pyrolysis of these sodium nitrate products results in simple organic and inorganic compounds, mostly in the form of gases such as nitrous oxide and carbon monoxide, which eventually diffuse through burrow openings or into the soil, causing organisms to die of asphyxiation (USEPA 1991a). The only people exposed to sodium nitrates should be pesticide applicators and only minimally (USEPA 1991b). The USEPA believes that sodium nitrates, when used as indicated, do not present any unreasonable adverse effects to humans.

> **Impact HH-23:** Impacts to human health from the use of sulfur and sodium nitrate as fumigants would be **less than significant** and mitigation is not required.

7.2.8 Other Nonchemical Control/Trapping Alternative

The trapping of rodents and/or yellow jackets is conducted when these organisms pose a threat to public health and welfare. For both vector species, District staff place the tamper-resistant or baited trap(s) primarily at the request of the property owner or manager. The District does not remove rats or yellow jackets that are in or on structures. When these structural requests are made, residents are referred to the local animal control or to a directory of private pest control companies. Trapping is also used for the removal of nuisance wildlife such as raccoon, skunk, and opossum when these animals pose a threat to public health and safety. No impact to human health is expected from the District's use of this alternative.

> **Impact HH-24: No impact** would occur to human health from the District's use of the Other Nonchemical Control/Trapping Alternative.

7.2.9 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 and vector 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 SMCMVCD's Program Area for 2006, 2008, and 2010 and Table 13-2, Pesticide Use within the SMCMVCD's 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 vector 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 and vector 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.

7.2.10 Environmental Impacts Summary

Table 7-10 presents a summary of human health impacts associated with the six Program alternatives that together comprise the Proposed Program. 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 7-10 Summary of Human Health Impacts by Alternative

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical/ Trapping
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	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	na
Impact HH-3: No impact would occur to human health from the nonherbicide Vegetation Management Alternative.	na	na	N	na	na	na
Impact HH-4: Impacts to human health from several of the herbicides would be **less than significant** and mitigation is not required.	na	na	LS	na	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	na
Impact HH-6: Impacts to human health from the use of diuron are not associated with the field application scenarios and, thus, diuron exposures would be **less than significant** and mitigation is not required**.**	na	na	LS	na	na	na
Impact HH-7: Impacts to human health from the use of benfluralin would be **less than significant** and mitigation is not required.	na	na	LS	na	na	na
Impact HH-8: 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	na
Impact HH-9: No impact would occur to human health from the use of mosquitofish.	na	na	na	N	na	na
Impact HH-10a: No impact would occur to human health from the use of bacterial larvicides.	na	na	na	na	N	na
Impact HH-10b: No impact would occur to human health from the use of the mosquito larvicide methoprene.	na	na	na	na	N	na

Table 7-10 Summary of Human Health Impacts by Alternative

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical/ Trapping
Impact HH-10c: A **less-than-significant** impact would occur to human health from the use of alcohol ethoxylated, aliphatic solvent, and plant-derived oil surfactant larvicides. No mitigation is required.	na	na	na	na	LS	na
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	na
Impact HH-12: Impacts to human health from the use of pyrethrins for mosquito, yellow jacket wasp and tick control would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na
Impact HH-13: Impacts to human health from the use of pyrethroids and pyrethroid-like compounds for mosquito, yellow jacket wasp, and tick control would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na
Impact HH-14: Impacts to human health from the use of the synergist PBO in mosquito and yellow jacket wasp adulticides would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na
Impact HH-15: Impacts to human health from the use of naled for mosquito control would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na
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	na
Impact HH-17: No impact would occur to human health from the use of potassium salts**.**	na	na	na	na	N	na
Impact HH-18: Impacts to human health from the use of anticoagulant rodenticides would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na

Table 7-10 Summary of Human Health Impacts by Alternative

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical/ Trapping
Impact HH-19: Impacts to human health from the use of bromadiolone would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na
Impact HH-20: Impacts to human health from the use of difethialone would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na
Impact HH-21: Impacts to human health from the use of bromethalin would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na
Impact HH-22: Impacts to human health from the use of cholecalciferol would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na
Impact HH-23: Impacts to human health from the use of sulfur and sodium nitrate as fumigants would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na
Impact HH-24: No impact would occur to human health from the District's use of the Other Nonchemical Control/Trapping Alternative.	na	na	na	na	na	N

LS = Less-than-significant impact
N = No impact
na = Not applicable
SM = Potentially significant but mitigable impact
SU = Significant and unavoidable impact

7.2.11 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.

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