6 Ecological Health

This chapter evaluates the potential impacts of the Program alternatives specifically on ecological health. The impact analysis relies heavily on Appendix B, *Ecological & Human Health Assessment Report*. Results of the evaluation are provided at the programmatic level. Section 6.1, Environmental Setting, presents an overview of hazards, toxicity, and exposure concepts, and contains federal, state, and local ordinances and regulations that are applicable to the Districts. Section 6.2, Environmental Impacts and Consequences, presents the following:

> Environmental concerns and evaluation criteria

> Discussion of methods and assumptions important to the environmental impact analysis

> Discussion of potential impacts of the Program alternatives

> Cumulative impacts summary

> A summary of ecological impacts

Ecological health is the integral relationship between the health and well-being of humans and the natural environment. This chapter places a particular emphasis on potential ecological receptors, in the broad sense, that may or may not be at risk from Program alternatives. Chapters 4 and 5 provide evaluations of the potential impacts to species and groups of species (nontarget organisms), as well as habitats associated with aquatic and terrestrial resources, respectively. These two chapters also address the ecological health topics covered herein. Chapter 7 evaluates the potential human health impacts related to the Program alternatives.

6.1 Environmental Setting

The Program Area is defined as the Marin/Sonoma Mosquito and Vector Control District (MSMVCD or the District) and surrounding counties including Lake, Mendocino, Napa, and Solano where the District could be asked to assist the county with control of by unwanted vectors. Earlier in this PEIR, Section 4.1 provides a description of the environmental setting for aquatic biological resources including explanations of the following components: aquatic and wetlands resources, special-status species, regulatory setting, and HCPs/NCCPs in the Program Area. Similarly, Section 5.1 provides a description of the terrestrial biological resources. The following section provides background information on the environmental fate and toxicity of pesticides and an overview of the regulatory setting with respect to chemical treatments and the use of pesticides.

6.1.1 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 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."

Many chemicals are widely used in agriculture, commercial pest control, residential landscape/garden habitats, land management by public agencies, and vector control operations to control unwanted pests/vectors and vegetation. These chemicals are developed to effectively impact those pest/vector targets with little to no health risk. To assure the relative safety of these chemicals to humans and wildlife, commercially available chemicals are submitted to numerous laboratory tests by the chemical company, the USEPA (which has final oversight and approval), and state and international agencies to identify possible unintended adverse effects to nontarget humans and wildlife.

Risk assessments conducted to estimate potential adverse impacts to wildlife include testing and consideration of nontarget species that may be more sensitive to the chemical or have special adverse effects (i.e., endocrine disruption) than shown in the laboratory tests. The battery of tests includes birds, mammals, fish, invertebrates, reptiles, and bees. The ecological risk component usually includes evaluation of the potential for endocrine disruption and the potential for the chemical to accumulate in the exposed receptors (bioaccumulation). The product label also suggests additional procedures to minimize the potential effects to nontarget biota that may be inadvertently exposed. In the case of many chemicals, extra consideration is given to animals that may or are known to inhabit the proposed treated areas and could be inadvertently exposed. In general, this issue is addressed by several additional batteries of toxicity tests using several surrogate nontarget receptors such as beneficial insects, invertebrates, and wildlife that may be exposed via prey items.

6.1.1.1 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 the following:

- exposure, including the specific amount of the compound that reaches an organism's tissues (i.e., the dose)
- duration of time over which a dose is received, the potency of the chemical for eliciting a toxic effect (i.e., the response), and
- sensitivity of the organism receiving the dose of the chemical.

Toxicity effects are measured in controlled laboratory tests on a dose/response scale, in which the probability of a toxic response generally increases as the 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 in all circumstances. Thus, toxicity and adverse effects can be mitigated by limiting potential exposure to a dose less than the amount that may result in adverse health effects.

The toxicity data included in the tables and charts in this PEIR 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 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). These two levels are used to describe the potential range of exposures that could result in adverse effects, including the highest dose with no observed effects.

However, these and other coordinated and focused laboratory tests are designed to document the effects of the chemical using a continuous, controlled laboratory exposure that does not realistically reflect the likely patchy exposures typical of the District field application scenarios. As such, the toxicity information generated using laboratory tests (and some limited field tests) are intended as an overview of potential issues that might be associated with maximum direct exposures. This information is used to develop and recommend guidance for use that should provide maximum exposure levels of applications that are protective of ecological health. These guidelines include numerous "safety margins" in the toxicity calculations that are intended to provide adequate efficacy to target organisms while not adversely impacting humans or nontarget plant and animal species. In some instances, the regulatory guidance may include additional suggestions for protective application to assure no significant adverse effect on nontarget species and humans.

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 material safety data sheets (MSDSs),[1] in actual practice, the amounts actually applied by the District within the District's Program Area for vector control are substantially less than the amounts used in the laboratory toxicity studies. Because of the 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 for vector control. 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 is 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 careful use of BMPs and advance planning by the District.

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.

6.1.1.2 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. In general, when a compound or its breakdown products decompose rapidly in the environment and do not persist for extended periods, then the compound or product poses a lower risk to nontarget species and a lower potential for environmental pollution. Appendix B provides a discussion of the environmental fate of the pesticide active ingredients and other chemicals associated with specific pesticide formulations used in the Program alternatives.

[1] Although the MSDS format is referenced in this document, it should be noted 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).

6.1.1.3 Bioaccumulation and Biomagnification

Bioaccumulation is the increase in concentration of a chemical from the environment to the first organism in a food chain, while biomagnification is the increase in concentration of a chemical from one trophic level in the food chain to another. In addition to direct exposures, the issues of bioaccumulation of some chemicals (they have all been categorized by USEPA) and their persistence in the environment are all included in the risk calculations wherever the data are available. Several chemicals are identified as persistent, meaning that they remain in the media of application for relatively long periods (i.e., weeks, months). However, most pesticides currently used by the District are selected preferentially for much shorter half-lives of hours to days. These physio/chemical characteristics of the chemicals selected for vector control are always considered early in the risk calculation process. Only in some special situations such as an USEPA Section 18 “emergency” are the older, more persistent products allowed. These emergency situations are intended for and only to stop dramatic and sometimes potentially catastrophic vector infestations.

Biologically persistent chemicals (and bioaccumulation) by definition address the potential for a chemical to move up the food chain and even increase the tissue concentration (biomagnification) in higher trophic animals. The chemicals known to elicit bioaccumulation and/or biomagnification are specifically addressed in the assessment as each of the “higher” (predator) receptor species is considered. As a result of this focus on biological and chemical properties of selected pesticides, the risk assessment process provides the best, conservative estimate of any potential unwanted adverse effects.

Some chemicals have the potential to be retained in the fatty tissues of organisms and accumulate after their prolonged exposure to contaminated sources (bioaccumulation), resulting in a higher concentration in the organism over time. In some cases chemicals can even exist in organisms above the exposure media concentrations (biomagnification). However, biomagnification is correlated with an organism that is associated with continued exposure to a contaminated environment (e.g., usually sediments and water) and is not typically associated with the chemical exposures that might result from District applications for vector control. Even chemicals that have a potential to bioaccumulate do not exhibit this phenomenon in all biota, since toxic chemicals are selectively taken up by fat (e.g., a chemical may bioaccumulate in fish but not in all animals). Many toxic substances are excreted or metabolized after ingestion such that bioaccumulation is dependent on the physio/chemical characteristics of the chemical (persistence and toxicity), the concentration of the chemical, and the specific organism exposed.

With the exception of a small number of pesticides currently used or planned for use by the District, the majority do not bioaccumulate. The herbicide adjuvants nonylphenol and short-chain nonylphenol ethoxylates are discussed in Section 6.2.5.1.2. See Section 6.2.7 under the Chemical Control Alternative for a discussion of four pesticides with potential for bioaccumulation. The persistence, bioaccumulation, and the toxicity of each of the chemicals used or planned for use by the District are presented in each of the respective sections addressing these chemicals in Appendix B and in Appendix B, Table 6-1.

6.1.2 <u>Program Pesticides and the Environment</u>

The pesticide and herbicide active ingredients included in the Program are listed in Table 6-1 and Table 6-2, respectively. The herbicides are used infrequently, and the District may consider additional use in the future in collaboration with other agencies for vegetation management. Appendix B provides the results of review and evaluations of the active ingredients and adjuvants the District currently uses or proposes to use.

Table 6-1 Pesticide Active Ingredients

Active Ingredient	Vector
Biodegradable Alcohol Ethoxylated Surfactant	Mosquito (larvae and pupae)
Aliphatic Solvents (e.g., mineral oil, aliphatic petroleum hydrocarbons)	Mosquito (larvae and pupae)
Methoprene	Mosquito (larvae)
Bacillus sphaericus (Bs)	Mosquito (larvae)
Bacillus thuringiensis israelensis (Bti)	Mosquito (larvae)
Spinosad	Mosquito (larvae)
Deltamethrin	Yellow jacket wasp, ticks
Tetramethrin	Yellow jacket wasp
Permethrin	Mosquito (adults)
Pyrethrins	Mosquito (adults) / yellow jacket wasp
Resmethrin	Mosquito (adults)
Phenothrin	Mosquito / yellow jacket wasp
Allethrins and d-*trans*-allethrin	Yellow jacket wasp, ticks
Prallethrin	Mosquito (adults)
Esfenvalerate	Yellow jacket wasp, tick
Etofenprox	Mosquito(adults) / yellow jacket wasp
Piperonyl Butoxide (PBO)	Mosquito (adults) / yellow jacket wasp

Table 6-2 Herbicide Active Ingredients and Adjuvants

Active Ingredient	Vector
Imazapyr	Vegetation
Glyphosate	Vegetation
Triclopyr	Vegetation
Alkyl Phenol Ethoxylates (APEs)	Vegetation
Modified Plant Oil and Methylated Seed Oil	Vegetation
Lecithin (phosphatidylcholine)	Vegetation
Aliphatic Polycarboxylate	Vegetation

6.1.3 Regulatory Setting

Formulations proposed for the Vegetation Management and Chemical Control Alternatives 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.

6.1.3.1 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 the safety of a registered pesticide, 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).

6.1.3.1.1 Federal Insecticide, Fungicide, and Rodenticide Act

FIFRA defines a pesticide as "any substance intended for preventing, destroying, repelling, or mitigating any pest." FIFRA 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.

6.1.3.1.2 Clean Water Act and National Pollutant Discharge Elimination System

The Clean Water Act (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.

6.1.3.1.3 California Toxics Rule

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

6.1.3.1.4 Stipulated Injunction and Order, Protection of California Red-Legged Frog from Pesticides

On October 20, 2006, the US District Court for the Northern District of California imposed no-use buffer zones around California red-legged frog upland and aquatic habitats for certain pesticides. This injunction and order will remain in effect for each pesticide listed in the injunction until the USEPA goes through formal 7(A)(2) consultation with the USFWS on each of the 66 active ingredients, and the USFWS issues a Biological Opinion including a "not likely to adversely affect" statement for the pesticides. Under the injunction and order, no-use buffer zones of 60 feet for ground applications and 200 feet for aerial applications apply from the edge of the following California red-legged frog habitats as defined by the USFWS and the Center for Biological Diversity: Aquatic Feature, Aquatic Breeding Habitat, Nonbreeding Aquatic Habitat, and Upland Habitat. These habitats are found in 33 counties of California including Marin and Sonoma counties.

Of the 66 pesticides listed in the injunction, the District may employ esfenvalerate, methoprene, and permethrin for vector control. Esfenvalerate may be used for yellow jacket wasp and tick control in response to public complaints. Methoprene is used for larval mosquito control, and permethrin is may be used for adult mosquito control. However, vector control programs are exempt. Specifically, for applications of a pesticide for purposes of public health vector control under a program administered by a public entity, the injunction does not apply. The District may use the following herbicides listed in the injunction: glyphosate, imazapyr, and triclopyr. Where used for vegetation management for control of mosquito-breeding habitat, the injunction would not apply. If these herbicides were to be used for invasive species management to assist other agencies or landowners, then the injunction generally applies until such time that the material has been reviewed by USEPA and USFWS determines that it does not apply or the following "exceptions for invasive species and noxious weed programs" can be met:

- You are applying a pesticide for purposes of controlling state-designated invasive species and noxious weeds under a program administered by a public entity; and
- You do not apply the pesticide within 15 feet of aquatic breeding critical habitat or nonbreeding aquatic critical habitat within critical habitat areas, or within 15 feet of aquatic features within noncritical habitat sections subject to the injunction; and
- Application is limited to localized spot treatment using hand-held devices; and
- Precipitation is not occurring or forecast to occur within 24 hours; and
- You are a certified applicator or working under the direct supervision of a certified applicator; and
- If using 2,4-D or triclopyr, you are using only the amine formulations (USEPA 2014a).

6.1.3.2 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 registration of pesticides and commercial chemicals in California is regulated by the California Environmental Protection Agency (Cal/EPA). Within the 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 offsite 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.

6.1.3.2.1 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 according to the active ingredients in products and some formulations. Users of specific registered and approved larvicide and adulticide 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.

6.1.3.2.2 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.

6.1.3.2.3 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.

6.2 Environmental Impacts and Mitigation Measures

This section evaluates the potential ecological impacts from the Program alternatives, which is primarily focused on the use of active ingredients in herbicides and/or pesticides under the Vegetation Management and Chemical Control Alternatives.

6.2.1 Evaluation Concerns and Criteria

The public has requested that the PEIR evaluate the following issues and concerns related to ecological health, which were identified during the project scoping process. These concerns are addressed briefly below and in this chapter. While not required, the responses to the concerns help to direct the reader to the appropriate section or an appendix, or they provide explanatory information in concise form.

- What are the impacts associated with the Surveillance Alternative?
  - The impacts to ecological health are addressed briefly in Section 6.2.3. The question was meant to address CDFW's concern that biological impacts be addressed by habitat type. This type of analysis was conducted for aquatic biology in Chapter 4 and for terrestrial biology in Chapter 5. The discussion herein is at a programmatic level for the broad issue of environmental disturbance from people and equipment in conducting surveillance and monitoring activities.
- Describe the effects of all chemicals that are used and/or proposed for use on wildlife and natural ecosystems, including insect prey, birds, mammals, fish, vegetation, and site topography. The loss of prey for birds is a particular concern.
  - The toxicity of the active ingredients and adjuvants is evaluated in Appendix B, and select pesticides are discussed in Section 6.2.7, including an evaluation of the major classes of active ingredients and potential impacts to nontarget ecological receptors.
- Discuss the potential impact of *Bacillus sphaericus* (Bs is a bacterium whose spores can persist in the environment for several weeks to months) on native species. What would justify its use? What native species would be impacted?
  - Bs is a naturally occurring soil bacterium. Data indicate a high degree of specificity with Bs (and Bti) for mosquitoes and demonstrate no toxicity to chironomid larvae at any mosquito control application rate. Bs is capable of cycling in the aquatic environment providing weeks of effective mosquito control after a single dose. It is very effective in water with high organic content and limited efficacy in brackish and saline waters. The use, fate and transport, and potential toxicity of Bs is discussed in Section 6.2.7 and described in detail in Appendix B.
- Discuss impacts on bees from chemicals in treatment applications.
  - Potential impacts on nontarget receptors, including bees, are discussed in Section 6.2.7 and Appendix B.
- Concern over the "inactive" portion of the pesticides. What effects will the carrier portion of the chemicals have on the environment?
  - FIFRA primarily regulates active ingredients; however, the toxicity studies performed under FIFRA also may evaluate the entire product formulation. Cal/EPA and CDPR have approved the inactive ingredients in the Mosquito Vector Control Association of California's formulations in the NPDES permit. Thus, the potential additive or synergistic effect of inert ingredients is addressed through required laboratory testing protocols, which is beyond the scope of this PEIR.

> Discuss the effects of pesticides on the natural predators of mosquitoes.

  – As part of its IVMP, the District uses pesticides with high mosquito specificity and low toxicity to nontarget species whenever possible. The District also strictly adheres to labeling requirements supplemented with the use of strict BMPs to avoid nontarget species exposure. Additional information on natural predators of mosquitoes is contained in Appendix E, *Alternatives Analysis Report*.

> The continued spray program leads to survival of mosquitoes resistant to pesticides – “the pest mill.”

  – The IVM approach the District uses to control mosquitoes is designed to minimize the potential for resistance to pesticides in the Program Area. Using this approach, the District implements the following practices: vegetative and biological control of mosquito populations, use of pesticides only when necessary, specific and localized applications, ULV applications, use of pesticides with low persistence, and rotation of pesticides.

> Describe the role of mosquitoes within the food chain, and subsequent impacts if they were removed in terms of amphibians, birds, reptiles, fish, and insects.

  – Although larval and adult mosquitoes serve a role as potential prey items for some invertebrates, fish, avian insectivores, bats, small reptiles, and amphibians, the loss or reduction of a focus area (population of mosquitoes) will not affect the predator populations overall. Many species of mosquitoes are short lived or seasonal, so they generally serve as only one or many possible prey sources for predators. The decline in one prey species generally means that a predator will shift its food preference. No predators are known that must rely exclusively on mosquitoes (larval or adult) for prey.

> Upon application and broadcast of pesticides, what is the fate and transport of these chemicals? Look at droplet size, dispersal patterns given wind, conversion products (both in storage and environment), and impacts of conversion products. Discuss the persistence of proposed treatment substances in the environment as well as the potential for bioaccumulation.

  – The use, fate, and transport of each pesticide included in the Program are described in detail in Appendix B, and results are incorporated into the environmental impact analyses in this chapter. Most products sold as herbicides and pesticides are evaluated 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 treatment, the impacts are weighed against the proximity and timing of each application. If products with a similar or different active ingredient are applied simultaneously, it is likely that the net effect could be the sum of the total active ingredient that is available for uptake by the vector. Although a synergy is possible in this scenario, it is typically not an approach used in or directed by the BMPs for that scenario. Because most pesticides and herbicides now in use have considerably less half-life (persistence) than earlier formulations, the overlap that would produce a residual exposure to a product would not occur unless the timing of applications is inappropriately close, i.e., hours rather than several days apart. Actual applications do not generally occur that close together. Many products can be evaluated for synergy and potential additive effects using the CDPR templates for calculation, which provide a means of estimating the potential effects of multiple chemicals used in one application.

> The PEIR should include monitoring programs that are designed to validate assumptions regarding the environmental fate and transport of materials.

  – The Surveillance Alternative is described in Section 6.2.3. Mitigation and monitoring is described in Section 6.2.11; the District also conducts surveillance and monitoring of treatment results on a routine basis. Additional monitoring programs are beyond the scope of the PEIR and not needed based on information that suggests that the Program would not have a significant adverse effect on biological resources. See Appendix B for fate and transport information on the materials considered for use under the District’s IVMP. However, District staff will monitor sites post-treatment to determine if the target vector or target vegetation was 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.

> The PEIR should include a detailed description and complete assessment of the chemical control impacts (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants) and ensure CEQA requirements are met.

  - Potential chemical control impacts are discussed in Section 6.2.7 and Appendix B. Potential impacts to special-status aquatic and terrestrial species are discussed in Chapters 4 and 5, respectively which both address the HCP and NCCP activities in the Program Area

> The PEIR should include a detailed description and complete assessment of the biological control impacts (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants) and ensure CEQA requirements are met.

  - Potential biological control impacts are discussed in Section 6.2.6 (mosquitofish), and biologically based pathogens (the mosquito larvicides Bs, Bti, and spinosad) are discussed in Section 6.2.7.1 and Appendix B. Potential impacts to special-status aquatic and terrestrial species are discussed in Chapters 4 and 5, respectively.

The CEQA Guidelines Appendix G, *Environmental Checklist Form*, does not contain criteria for determining significance of impacts to ecological health from the use of pesticides and herbicides. The closest criteria are those contained in Section 4.2.1.2 for biological resources. In short, the determination of significance is based on the potential to degrade the quality of the environment for natural communities and the species therein based on existing data and application methods. The specific concern is whether the activities used to control vectors could result in direct or indirect impacts to other organisms that may be present which are called nontarget ecological receptors.

6.2.2 Evaluation Methods and Assumptions

Pesticides the District uses were investigated to provide an assessment of the potential impacts to nontarget ecological receptors.

6.2.2.1 Evaluation Methods

An ecological health assessment was the principal method used to evaluate concerns associated with the Program alternatives (discussed in detail in Appendix B). A comprehensive literature review of published toxicity and fate and transport information was conducted. In addition, the District supplied information specific to pesticide and herbicide product use in the Program Area to support the potential exposure and toxicity assessment. Information collected included the following:

> Pesticides the District uses or may use

> Pesticide label requirements

> Types of application sites (e.g., habitat types)

> Application procedures

> Estimated applications and sites

> Estimated total amount used per quarter

> Physicochemical properties of the pesticides/active ingredients

> Pesticide target vector efficacy

> Reported adverse effects (e.g., reproductive, developmental, carcinogenic).

Pesticides identified as warranting further evaluation in Appendix B are known to exhibit at least one parameter that appears to exhibit a potential or perceived risk. Toxicity levels (e.g., slight, low, moderate, high, etc.) are used prevalently in the published literature but are not uniformly 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 under CEQA.

The pesticide application scenarios that result in reasonable efficacy with minimal unwanted estimated risk are preferred and are the basis of IVM approaches and BMPs the District employs. All BMPs are listed comprehensively as part of the Proposed Program in Chapter 2 (Table 2-6), and relevant ones to ecological health are repeated below.

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

> District staff will implement site access selection criteria to minimize equipment use in sensitive habitats including active nesting areas and to use the proper vehicles for onroad and offroad conditions. (BMP A9)

> Properly train all staff, contractors, and volunteer help to prevent spreading weeds and pests to other sites. The District headquarters contains wash rack facilities (including high-pressure washers) to regularly (in many cases daily) and thoroughly clean equipment to prevent the spread of weeds. (BMP A10)

For five of the Program alternatives, excluding Biological Control's use of mosquitofish, the District uses the following BMPs:

> District staff will work with care and caution to minimize potential disturbance to wildlife while performing surveillance and vector treatment/population management activities. (BMP A6)

> 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)

> The District will minimize the use of equipment (e.g., ARGOs) in tidal marshes and wetlands. When feasible and appropriate, surveillance and control work will be performed on foot with handheld equipment. Aerial treatment (helicopter and fixed-wing) treatments will be used, when feasible and appropriate, to minimize the disturbance of the marsh during pesticide applications. When ATVs (e.g., ARGOs) are used, techniques will be employed that limit impacts to the marsh, including slow speeds; slow, several point turns; using existing levees or upland to travel through sites when possible; using existing pathways or limiting the number of travel pathways used. (BMP B2)

> District staff will minimize the potential for the introduction and spread of spartina, perennial pepperweed, and other invasive plant species by cleaning all equipment, vehicles, personal gear, clothing, and boots of soil, seeds, and plant material prior to entering the marsh, and avoiding walking and driving through patches of perennial pepperweed to the maximum extent feasible. (BMP B4)

For four of the Program alternatives, excluding Biological Control and Other Nonchemical Control/Trapping Alternatives, the following BMPs apply:

> Identify probable (based on historical experience) treatment sites that may contain habitat for special-status species every year prior to work to determine the potential presence of special-status flora and fauna using the CNDDB, relevant HCPs, NOAA Fisheries and USFWS websites, CAlfish.org, and other biological information developed for other permits. Establish a buffer of reasonable distance, when feasible, from known special-status species locations and do not allow application of pesticides/herbicides within this buffer without further agency consultations. Nonchemical methods are

acceptable within the buffer zone when designed to avoid damage to any identified and documented flora and fauna. (BMP A7)

> District will minimize travel along tidal channels and sloughs to reduce impacts to vegetation used as habitat (e.g., Ridgway's rail nesting and escape habitat). (BMP B3)

For Vegetation Management and Chemical Control Alternatives only, the following BMPs apply:

> 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)

> District will avoid use of surfactants when possible in sites with aquatic nontargets or natural enemies of mosquitoes present such as nymphal damselflies and dragonflies, dytiscids, hydrophilids, corixids, notonectids, and ephydrids. Surfactants are the only tool used to treat sources of pupae to prevent adult mosquitos' emergence. The District will use a microbial larvicide (Bti, Bs) or insect growth regulator (e.g., methoprene) instead or another alternative when possible. (BMP H2)

> 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 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 (e.g., within 24 inches of vegetation for hand application) or vectors. Adjusting droplet size would only apply to larvicides, herbicides, and non-ULV applications. Use ULV applications 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)

> Special-Status Aquatic Wildlife Species (BMP H10):

  - A CNDDB search was conducted in 2012 and the results incorporated into Appendix A, *Biological Resources Technical Report*, for this PEIR. An update was completed in November 2014 and the results incorporated into Section 4.1.2 of this PEIR. District staff communicates with state, federal, and county agencies regarding sites that have potential to support special-status species. Staff has visited many sites where the District performs surveillance and control work for many years and staff is highly knowledgeable about the sites and habitat present. If new sites or site features are discovered that have potential habitat for special-status species, the appropriate agency or landowner is contacted and communication initiated.

- Use only pesticides, herbicides, and adjuvants approved for aquatic areas or manual treatments within a predetermined distance from aquatic features (e.g., within 15 feet of aquatic features). Aquatic features are defined as any natural or man-made lake, pond, river, creek, drainage way, ditch, spring, saturated soils, or similar feature that holds water at the time of treatment or typically becomes inundated during winter rains.
- If suitable habitat for special-status species is found, including vernal pools, and if aquatic-approved pesticides, herbicides, and adjuvants treatment methods have the potential for affecting the potential species, then the District will coordinate with the CDFW, USFWS, and/or NMFS before conducting treatment activities within this boundary or cancel activities in this area. If the District determines no suitable habitat is present, treatment activities may occur without further agency consultation.

> 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)

> Do not apply pesticides that could affect insect pollinators in liquid or spray/fog forms over large areas (more than 0.25 acre) during the day when honeybees are present and active or when other pollinators are active. Preferred applications of these specific pesticides are to occur in areas with little or no honeybees or pollinator activity or after dark. These treatments may be applied over smaller areas (with handheld equipment), but the technician will first inspect the area for the presence of bees and other pollinators. If pollinators are present in substantial numbers, the treatment will be made at an alternative time when these pollinators are inactive or absent. (BMP H12)

> 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 infrequently applies or participates in the application of herbicides in areas other than District facilities. (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)

Several BMPs in Table 2-6 apply primarily to the Physical Control Alternative. Key BMPs include the following for avoiding or minimizing impacts to ecological health:

> All maintenance work will be done at times that minimize adverse impacts to nesting birds, anadromous fish, and other species of concern, in consultation with USFWS, NMFS, and CDFW. Work conducted will, whenever possible, be conducted during approved in-water work periods for that habitat, considering the species likely to be present. For example, tidal marsh work will be conducted between September 1 and January 31, where possible, and not contraindicated by the presence of other special-status species. Similarly, in-water work in waterbodies that support anadromous fish will be conducted between July 1 and September 30. (BMP G3)

> Care will be taken to minimize the risk of potential disruption to the indigenous aquatic life of a waterbody in which ditch maintenance is to take place, including those aquatic organisms that migrate through the area. (BMP G4)

6.2.2.2 Assumptions

This evaluation assumes that all pesticides are applied in accordance with product label instructions and USEPA and CDPR requirements (and in consideration of the local context for that area, i.e., nearby area land uses and habitats). 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 listing of the 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 does not include assumptions about which alternative treatment strategy(ies) would be applied in any given area. Guidelines used to trigger a particular alternative based on vector abundance and other variables are included in the District's operating procedures. This PEIR evaluation assumes that important parameters, such as soil or sediment 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, or the application of multiple pesticides at the same time in a specific area, 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. When two approved products are used that contain two active ingredients, this scenario is possible, but the product usually already contains two active ingredients. If products with similar or even different active ingredients are applied simultaneously, it is likely that the net effect could be the sum of the effects of the active ingredients to impact the vector. However, for vector control applications materials with the same active ingredient are not applied to the same specific area simultaneously at a given site. The need for reapplication of mosquito larvicides or adulticides is surveillance driven and performed per the label directions. The District can apply larvicide materials with different active ingredients during a single application. This type of application is necessary if multiple hatches of mosquito larvae occur and results in mosquito populations occurring at different stages of the life cycle. An example of this occurs when liquid Bti and methoprene are applied simultaneously. When this occurs the combination of the material is a product called Duplex, and the mixture of the materials and active ingredients is provided for on the product labels. Another example, for the District includes a pre-application of a liquid trans allethrin and phenothrin spray product may be used to minimize the hazard of approaching a yellow jacket nest. Situations that would produce a residual exposure adequate to cause harm to humans would not occur unless the application(s) were inappropriate or the timing of applications is inappropriately close. Actual applications do not generally occur that close together unless there is a problem with treatment effectiveness. A material is applied followed by post treatment inspection to determine effectiveness. Only if the vectors (mosquitoes) have not been sufficiently killed would the District go back into the area and reapply a pesticide.

This environmental impact evaluation also does not include an analysis of impacts to specific food webs. While it is important to evaluate the potential adverse impacts of a pesticide application to potentially affected nontarget species, it is not practical to evaluate those potential impacts to all of the food webs present in the various ecosystems under consideration. An ecological food web is represented in the illustration representing some of the multitude of possible biotic and food uptake interactions in an ecosystem. Figure 6-1 depicts a highly simplified food web. In an ecological system, each level in the food web is occupied by dozens or hundreds of species, with consumers using those resources (in this case species from a lower trophic level) in different ways depending on availability and competition for those resources. Their utilization of these resources shifts by time of day and season, and multiple resources being used simultaneously or alternatively. If the availability of one resource deceases, the consumer can generally replace that with another resource. Each of the possible connections between species is also associated with other interactions, such as competitive release, where the abundance of a species increases in response to the decline in a competitor's abundance, or competitive interactions between consumers where one consumer can use a particular resource better than its competitor.

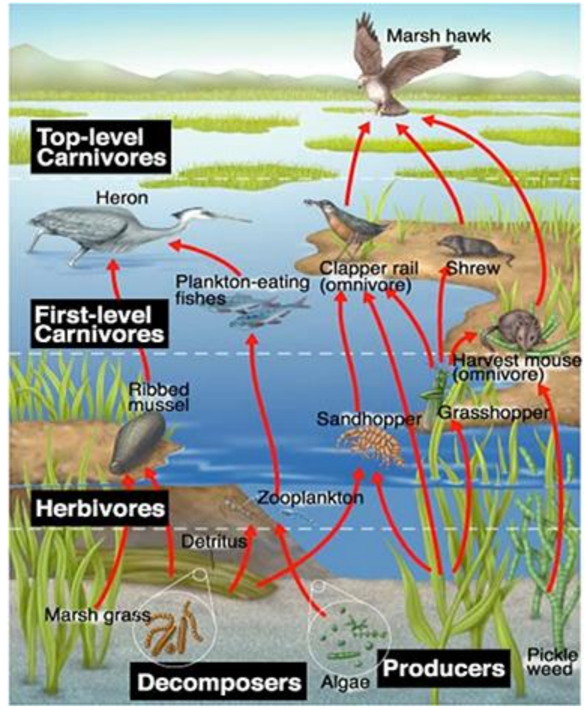

Figure 6-1 Ecological Food Web Concept

Although ecological food webs could be used to describe the complex system interactions that might be associated with District pesticide application scenarios, it is neither feasible nor practical to evaluate those potential impacts using a food-web approach. The numerous interactions in typical food webs are highly complex and would be subject to substantial uncertainty, making it exceedingly difficult to confidently assess relevant impacts. Because of these constraints and complexity, it would be neither practical nor productive to attempt to predict food-web interactions for each of the numerous application scenarios the District uses. It is appropriate, however, to use a food-web analysis to identify and consider the first level of potentially adverse effects to nontarget species that might result from a pesticide application. This information is used to assure a minimal impact to nontarget species and is typically a part of the MSDS and Toxicology profiles, providing the basis for the more reasonable, technically feasible approach to consider the possible nontarget impacts prior to use and the compatibility of each proposed pesticide in the overall approach to the typical vector control by the District.

6.2.3 Surveillance Alternative

Vector surveillance is critical to IVM 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 & Response Plan* [CDPH et al. 2013] and *Best Management Practices for Mosquito Control in California* [CDPH and MVCAC 2012]) contained in Appendix F, *Supplemental IVMP Information*. These guidelines allow for some reasonable flexibility in selection and specific application of control methods because local areas vary.

The Surveillance Alternative would be a continuation of existing activities using applicable techniques, equipment, vehicles, and watercraft. Surveillance activities involve monitoring the abundance of adult and larval mosquitoes, field inspection of mosquito habitat, testing for the presence of SLE, WEE, and WNV antibodies in sentinel chickens or wild birds, collection and testing of ticks, small rodent (i.e., primarily rats and mice) trapping, and/or response to public service requests regarding nuisance animals or insects (e.g., yellow jacket wasps).

Small impacts to terrestrial and aquatic habitats could occur when the District is required to maintain paths and clearings to access surveillance sites and facilitate sampling. A number of the BMPs listed in Section 6.2.2.1 above apply to surveillance activities to minimize disturbance to habitats and the species present or potentially present from the use of equipment and walking by District biologists and technicians to obtain samples.

Trapping activities conducted to assess the presence and abundance of rodent populations could lead to capture and mortality of nontarget organisms. The District uses preexisting roads, trails, and walkways for most surveillance activities. Therefore, habitat disturbance is minimal to negligible, reducing the potential indirect impacts to nontarget species and their habitat. Trapping to assess rodent presence and abundance is infrequently conducted to reduce the chance of nontarget species capture.

> **Impact ECO-1:** The Surveillance Alternative would have a **less-than-significant** impact on nontarget ecological receptors, including native or special-status plants and animals and mitigation is not required.

6.2.4 Physical Control Alternative

The Physical Control Alternative would be a continuation of existing activities using applicable techniques, equipment, vehicles, and watercraft. 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. 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), 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 District site inspections to determine conditions promoting infestation, and property owners are provided educational materials on control measures that include information about the removal of food sources and harborage sites and professionals to contact to remove the infestation. For physical control measures used for onsite wastewater treatment systems, see Section 9.2.4.

The Physical Control Alternative would not likely result in measurable adverse impacts to ecological receptors, including terrestrial and aquatic species. This alternative employs physical modifications to the natural and engineered environment providing a long-term solution to mosquito control while reducing the dependence on chemical controls. In addition, these practices are conducted to improve habitat for desirable species, such as native and special-status plants and animals. Chapter 4 discusses in greater detail the potential impacts of the Physical Control Alternative on aquatic resources, including special-status species. Chapter 5 discusses impacts to terrestrial resources.

The District employs a number of BMPs when implementing actions under the Physical Control Alternative. For example, all ditch maintenance work will be done at times that minimize adverse impacts to nesting birds, anadromous fish, and other species of concern, in consultation with USFWS, NMFS, and CDFW. As well as the BMPs listed herein in Section 6.2.2.1, the District implements additional BMPs to avoid or minimize impacts to the marsh-specific plants and animals, the salt marsh harvest mouse, Ridgway's rail, and soft bird's beak (see Table 4-6). The District performs these activities in accordance with all appropriate environmental regulations and in a manner that generally maintains or improves habitat for desirable species. Most of these activities occur in aquatic rather than terrestrial habitats. District staff communicates with state, federal, and county agencies regarding sites (aquatic, terrestrial, and temporary habitats [e.g., vernal pools]) that have potential to support special-status species. Many sites where the District performs source control work have been visited by staff for many years, and staff is intimately knowledgeable about the sites and habitat present. If new sites or site features are discovered that have potential habitat for special-status species, the appropriate agency or landowner is contacted and communication initiated. Vernal pools can provide breeding habitat for mosquitoes but also provide habitat for many special-status species in California. Therefore, destruction or impairment of vernal pool habitat is avoided under the Physical Control Alternative. The presence of special-status species at aquatic or terrestrial sites or the presence of suitable habitat for special-status species would result in cancellation or strategic planning with other agencies to perform work at a time or in a manner that does not negatively impact habitat or special-status species.

> **Impact ECO-2:** The Physical Control Alternative would have a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.5 Vegetation Management Alternative

The Vegetation Management Alternative would be a continuation of existing activities using applicable techniques, equipment, vehicles, and watercraft. Vegetation management (including noxious weeds and/or invasive plants) is conducted to facilitate access to vector habitat, improve efficiency and effectiveness of mosquito control operations, and as a source reduction measure.

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 may apply herbicides to improve surveillance or reduce vector habitats. Vegetation removal or thinning primarily occurs in aquatic habitats to assist with the control of mosquitoes and in terrestrial habitats to 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 weeds and other obstructing vegetation in wetlands and retention basins (or request the structures' owners to perform this task). Pre-project planning such as, surveys for special-status plants, coordination with the landowner, and acquisition of necessary permits are completed before any work is undertaken by the District. The District also encourages landowners to coordinate with regulatory agencies regarding necessary permits required for work they may perform. In some sensitive habitats and/or where special-status species concerns exist, vegetation removal and maintenance actions would be restricted to those months or times of the year that minimize disturbance/impacts. Vegetation management is also performed to assist other agencies and landowners with the management of invasive and/or nonnative vegetation. These actions are typically performed under the direction of the concerned agency, which also maintains any required permits.

Vegetation management in the form of physical removal could include the use of weed-whackers, chain saws, and shovels. These activities are conducted with a pre-planning understanding of the possible location of onsite and near-by special-status terrestrial plants and animals. The District applies BMPs to reduce potential impacts, including the identification of special-status species in treatment areas prior to commencing vegetation removal actions. The nonherbicide component of the Vegetation Management Alternative is not expected to result in adverse ecological effects. These activities are generally coordinated with and monitored by public agencies and conducted during times to alleviate potential impacts to nontarget organisms.

> **Impact ECO-3:** The employment of a nonherbicide Vegetation Management Alternative in the form of physical removal would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

The District infrequently applies herbicides in collaboration with other agencies and may apply herbicides in conjunction with source reduction and/or site access in the future. Table 6-3 presents the herbicides the District may consider for future use for vegetation management, as well as the section of Appendix B where they are described in detail.

Table 6-3 Herbicide Control Options for Vegetation Management

Active Ingredient/Adjuvant	Appendix B
Imazapyr	Section 4.6.1
Glyphosate*	Section 4.6.2
Triclopyr	Section 4.6.3

*Identified for further evaluation in Appendix B and described below.

The District may consider using selected herbicides in the future to control vegetation in and around mosquito habitats to improve surveillance and reduce suitable breeding habitats. Herbicides are typically classified into the following major categories: pre-emergent herbicides (applied to the soil to prevent seedlings from germinating and emerging; post-emergent herbicides (applied after seedlings have emerged and control actively growing plants via contact damage or systemic impacts); contact herbicides (cause physical injury to the plant upon contact); and systemic herbicides (damage the internal functioning of the plant). Herbicides that may be integrated into 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) and generally function by inhibiting growth. Herbicides used against annual broadleaf weeds are generally of the post-emergent variety, such as triclopyr. In addition, imazapyr, is a systematic, nonselective, pre- and post-emergent herbicide used for a broad range of terrestrial and aquatic weeds. Glyphosate represents a commonly used herbicide for the control and elimination of grass weeds and sedges. Most of the herbicides are moderately persistent in soil and water (for each herbicide’s half-life in soil and water, please refer to Appendix B).

Herbicides the District may consider for future use are characterized by different modes of action against target vegetation and, therefore, may exhibit unique toxicity to nontarget species, including aquatic and terrestrial organisms (see Appendix B for further details regarding toxicity and fate and transport characteristics of Program herbicides). Certain herbicides may exhibit toxicity to some nontarget ecological receptors. Although no risks exist of concern to terrestrial birds, mammals, and bees or aquatic invertebrates and fish, imazapyr may pose an ecological risk to nontarget terrestrial and aquatic vascular plants (USEPA 2006b).

The District would apply BMPs to minimize the impact of herbicides on ecological receptors, including nontarget special-status terrestrial plants. In particular, the District takes action to minimize drift of sprays to nontarget areas, which is accomplished by carefully considering weather variables such as wind velocity and direction and chance of precipitation. To prevent potential impacts to aquatic systems, applications are conducted when wind is below 5 mph, the spray is carefully directed to the target vegetation, and when an adequate buffer to water sources is maintained. Typically, herbicide application does not occur within 15 feet of a crop or sensitive habitat, e.g., a winery waste/treatment plant pond as the treatment area with sensitive habitat nearby.

> **Impact ECO-4**: The use of any of the selected herbicides as a vegetation management technique would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

The majority of herbicides under consideration exhibit little to no toxicity to mammals, birds, and terrestrial invertebrates (see Chapter 5). See Chapter 4 for a discussion of potential impacts to aquatic receptors.

When the District was investigating herbicides for use in its IVMP, glyphosate was identified for further evaluation based on use patterns and toxicity (Appendix B) and is discussed in further detail below.

6.2.5.1.1 Glyphosate

Glyphosate is a nonselective, post-emergent, and systemic herbicide registered for use in agricultural and nonagricultural areas. Currently, the District periodically uses glyphosate. Although some recent concerns have been expressed about possible sublethal effects of glyphosate products, it is virtually nontoxic to mammals and practically nontoxic to birds, fish, and invertebrates. USEPA has identified glyphosate as a candidate for evaluation as a potential endocrine disruptor (USEPA 2009a); see Section 7.2.5.1 for more on this issue and human health. Claims that glyphosate is destroying bee and butterfly populations have not been substantiated. The use of glyphosate to control milkweed, which is a severe problem for farmers, may be connected to loss of foraging vegetation and, thereby, indirectly impacting butterfly populations. However, this effect is an indirect effect and not actually toxicity to the butterflies. Every effort is also made to minimize treatments that could affect milkweed, a plant important to Monarch butterfly populations.

Although at low treatment levels glyphosate has been shown to be essentially nontoxic to mammals and humans; based on ancillary issues it is likely that USEPA may provide an updated review of its potential risks in 2015. In contrast to these other issues, the USEPA has recently renewed the approval of a glyphosate and 2-4-D combination product for use for unwanted vegetation. This additional supporting information indicates that USEPA has not received significant data to negate the decision (USEPA 2014a). Glyphosate products are effective, low risk products widely used for control of unwanted vegetation (Gertsberg 2011). Some reports in the press of sublethal effects on disease resistance, biological diversity, or enzyme activity, as a result of ingestion/uptake of genetically engineered foods are interesting but without clear mechanisms that can be related directly to glyphosate (Gertsberg 2011).

The District strictly adheres to its BMPs and product label requirements, including the restriction of glyphosate application to target areas outside an approved (by USFWS) or other commonly used buffer zone separating the treatment from water sources, which reduces the potential for impacts to special-status species or other nontarget receptors. It is further mediated by the techniques used for application. Typically, spraying does not occur when wind is 5 mph or greater or within 15 feet of a crop area or sensitive habitat. Targeted, small-scale treatments are conducted to minimize post-application drift and runoff.

> **Impact ECO-5:** The use of glyphosate would result in a **less-than-significant impact** to nontarget ecological receptors and mitigation is not required.

6.2.5.1.2 Adjuvants

An adjuvant is any compound that is added to a pesticide formulation (including herbicides) or tank mix to facilitate the mixing, application, or effectiveness of that pesticide/herbicide. Adjuvants can either enhance activity of an herbicide's active ingredient (activator adjuvant) or offset any problems associated with spray application, such as adverse water quality or wind (special purpose or utility modifiers). Activator adjuvants include surfactants, wetting agents, sticker-spreaders, and penetrants. Adjuvants that may be considered for future use for mosquito habitat control and weed control are presented in Table 6-4. The environmental fate and toxicity of these adjuvants is described in detail in Appendix B. A subset of these adjuvants was identified for further examination based upon use patterns and toxicity (Appendix B) and is discussed below.

Table 6-4 Adjuvants Employed for Weed Abatement

Active Ingredient	Appendix B
APEs	Section 4.7.1
Modified Plant Oil and Methylated Seed Oil	Section 4.7.3

Lecithin (phosphatidylcholine)	Section 4.7.4
Aliphatic Polycarboxylate	Not included

Alkylphenol ethoxylates (APEs) include a broad range of chemicals that tend to bind strongly to particulates and persist in sediments. Nonylphenol and short-chain nonylphenol ethoxylates are considered to be moderately bioaccumulative and extremely toxic to aquatic organisms at high exposures. In reality, these chemicals are highly diluted, as they are typically added to an herbicide using only a few ounces in 100 gallons (Gossamer Threads Inc., 1998). At these low dilution concentrations, combined with the limited areas of application, the exposure to nontarget biota is not sufficient to result in adverse effects. Aside from use in agricultural herbicide mixtures, APEs are commonly present in detergents, cleaners, food packaging, and cosmetics. The acute toxicity of APEs to mammals is low. Some think they may be possible estrogen-mimics. Although these chemicals have been used in numerous common products (generally regulated by the Food and Drug Administration), the USEPA has recently recommended that this suite of chemicals be evaluated further due to their widespread use (past and present). Current information about APEs is based on Food and Drug Administration evaluations, but regardless, In order to be conservatively cautious, USEPA has speculated that they may pose a risk to nontarget terrestrial organisms (USEPA 2010).

Plant-derived oils are of two types: triglycerides or methylated oils. Triglycerides are essentially oil-surfactant hybrids and are generally called seed oils. 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. Although toxicity and environmental fate information is scarce for these oils, using BMP application practices including appropriate weather parameters to minimize draft, these products should not result in unwanted adverse effects.

Little is known about the toxicity or environmental fate of lecithins. Lecithins are naturally occurring phospholipids in biological cell membranes (Bakke 2007). Although toxicity and environmental fate information for these products is scarce, using BMP application practices including application at the lowest effective concentration for a specific set of vectors and environmental conditions, use of lecithins should not result in unwanted adverse effects to nontarget terrestrial organisms.

Aliphatic polycarboxlyates are another category of adjuvants that are essentially nontoxic to biota and are used as an additive to enhance the efficacy of several other products. They are listed as having no known toxicity or adverse biological impacts as a polymer additive with no hazard indications in any of the typical categories used to define toxicity by regulators. (Kegley et al. 2014)

BMPs the District employs include using adjuvants in limited amounts in areas that do not contain special-status species, coordination with CDFW, USFWS, and/or NMFS before conducting management activities in sensitive habitat, keeping spray nozzles within a predetermined maximum distance of target insect (or weeds), and preventing exposures to nontarget habitats (post-application).

> **Impact ECO-6:** The use of adjuvants would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.6 Biological Control Alternative

The Biological Control Alternative would be a continuation of existing activities focused on mosquitofish using applicable techniques, equipment, and vehicles.

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 employed as a method to protect the public from mosquitoes and associated diseases using mosquito parasites, pathogens, and predators. Mosquito parasites are not currently available in the commercial market. Some of the pesticides used on mosquito larvae are bacteria and a form of biological control. These products are not considered chemical treatment; however, they are registered and regulated by

USEPA and are, therefore, covered thoroughly in Section 6.2.7, Chemical Control Alternative. A discussion of mosquitofish as a biological control action and potential impacts to aquatic resources is discussed in Chapter 4.

6.2.6.1 Mosquito Larvae Pathogens

Mosquito pathogens are highly host-specific bacteria or viruses that are ingested during filter-feeding behavior of mosquito larvae in aquatic environments. 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 subsequently ingested by other mosquito larvae. The District uses two types of pathogenic bacteria, including Bs, strains of Bti, and may use *Saacharopolyspora spinosa* in the future. 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. Bs can reproduce in natural settings for some time following release. Bti materials do not contain live organisms, but only spores made up of specific protein molecules.

All three bacteria are naturally occurring soil organisms, which are commercially produced as mosquito larvicides. Because these forms of biological control are applied in a similar manner to chemical pesticides, they are evaluated under Section 6.2.7, Chemical Control Alternative, including the discussion of potential impacts. The environmental fate and toxicity of these control agents are described in detail in Appendix B.

6.2.6.2 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 artificial habitats including ornamental fish ponds, water troughs, water gardens, fountains, unmaintained swimming pools, and other types of isolated man-made ponds that are not connected to natural waterways. Limiting the introduction of the mosquitofish to these sources is sufficient to avoid impacts to sensitive species in natural habitats.

> **Impact ECO-7:** The use of mosquitofish as a Biological Control Alternative would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7 <u>Chemical Control Alternative</u>

The Chemical Control Alternative would be a continuation of existing activities using applicable techniques, equipment, vehicles, watercraft, and aircraft.

Chemical control is a Program tool that consists of the application of nonpersistent insecticide products demonstrated to reduce populations of larval or adult mosquitoes and other invertebrates (e.g., yellow jacket wasps, ticks). If and when inspections reveal that mosquitoes or other vector populations are present at levels that trigger the District's guidelines for chemical control – based on the vector's abundance, density, species composition, proximity to human settlements, water temperature, presence of predators and other factors – staff will apply pesticides to the site in strict accordance with the pesticide label instructions and the BMPs listed in Section 6.2.2.1. The threshold guidelines for these response triggers are based on previous documentation and monitoring/current surveillance of likely vector outbreaks or expansions of mosquito populations. Additional response triggers are based on verified mosquito populations, outbreaks, discomfort and irritation issues for humans and animals, and public concern about vectors.

The chemicals the District uses for vector control are presented in Tables 6-1 and 6-2 in Section 6.1.2. These pesticides are approved for commercial use by the USEPA and CDPR and, when applied with strict adherence to product label requirements, should not result in adverse effects to nontarget organisms. Detailed discussions of the environmental fate and toxicity of these active ingredients are provided in Appendix B. A subset of these chemicals was selected for further examination based upon potential issues regarding appropriate use patterns, documented environmental fate, or toxicity characteristics of the primary active ingredients (Table 6-5, excluding herbicides discussed previously in Section 6.2.5). These chemicals are discussed in the following section specifically in reference to potential ecological health impacts associated with their use for vector control.

Table 6-5 Chemicals Identified for Further Evaluation in Appendix B

Active Ingredient	Vector	Potential Issue
Methoprene	Mosquitoes	Prevalent use; toxicity to aquatic insects
Etofenprox	Mosquitoes, yellow jacket wasps	Toxicity to aquatic organisms; no synergist required
Bti	Mosquitoes	Prevalent use; public concerns
Pyrethrins	Mosquitoes	Prevalent use; requires synergist (PBO)
Resmethrin	Mosquitoes	Requires synergist (e.g., PBO); potential endocrine disruptor
Aliphatic solvents Plant-derived oil/mineral oil/mix	Mosquitoes	Contains low percentage of petroleum distillate
Permethrin	Mosquitoes	Toxicity to aquatic organisms; potential endocrine disruptor

A few of these pesticides used by the District have the potential to bioaccumulate to varying degrees. Pesticides in use identified as having the potential to bioaccumulate under some conditions are listed below in Table 6-6.

Table 6-6 Pesticides with Potential to Bioaccumulate

Active Ingredient	Vector	Potential to Bioaccumulate
Methoprene	Mosquito (larvae)	Yes
Spinosad	Mosquito (larvae)	Yes
Esfenvalerate	Yellow jacket wasp, tick	Yes
Etofenprox	Mosquito(adults) / yellow jacket wasp	Yes

Although these active ingredients have the potential to bioaccumulate, the conditions in which they are used include the use of ULV application methods for adult mosquito control and highly localized applications for yellow jackets and ticks. The larvicides methoprene and spinosad have been designated as bioaccumulators, but the environmental conditions on the ground and in water after an application of one of these pesticides by the District generally does not provide the continuous exposure needed for substantial bioaccumulation in a nontarget organism with no subsequent biomagnification. Therefore, the impact is less than significant.

6.2.7.1 Mosquito Larvicides

Larvicides are used to manage immature life stages of mosquitoes including larvae and pupae in aquatic habitats. For example, larvicide application(s) can be necessary in temporary aquatic habitats that do not have adequate populations of predators (e.g., fish) or habitats with dense and/or abundant populations of emergent or floating vegetation that can support mosquito production. The larvicides are applied using ground application equipment, watercraft, fixed-wing aircraft, and rotary aircraft. District criteria for selecting larvicide application methods are predicated upon access, efficiency and effectiveness of application, size of the area to be treated, and the density and type of vegetation present at the application site (i.e., the likelihood of success in applying the material to the target area). All of the potential treatment options are considered and weighed to select the most appropriate options prior to use, and physical control and chemical treatment may both be used in the target area. District staff may choose to treat soil and/or surface water in the vicinity of an onsite wastewater treatment system that appears to have failed or malfunctioned due to improper lid seals, cracks, or missing vent screens and/or due to drain fields where water ponds on the surface. In this situation, the District may provide selected mosquito larvicide treatment to the tank and/or the septic leach/drain field and system environs. The larvicides currently used include materials not known to adversely impact septic system bacteria: *Bacillus sphaericus* as an active ingredient (e.g., VectoLex), methoprene (e.g., Altosid briquets), larvicide oils (e.g., BVA 2 and CocoBear), and monomolecular films (e.g., Agnique MMF).

The mosquito larvicides the District uses include bacterial larvicides, hydrocarbon esters, and surfactants (Table 6-7). The toxicity of Bs, Bti, spinosad, methoprene, and monomolecular films are discussed in detail in Appendix B. The District employs practices that alleviate the potential for exposure and adverse effects to nontarget organisms (see Chapter 4 for an inventory of special-status species inhabiting the Program Area).

Table 6-7 Chemicals Employed for Larval Mosquito Abatement

Chemical Classification	Active Ingredient	Appendix B
Bacterial larvicide	Bs	Section 4.3.1
Bacterial larvicide	Bti	Section 4.3.2
Bacterial larvicide	Spinosad	Section 4.3.3
Hydrocarbon ester	Methoprene	Section 4.3.4
Surfactant	Alcohol Ethoxylated Surfactant (monomolecular film)	Section 4.3.5
Surfactant	Aliphatic Hydrocarbons (mineral oil)	Section 4.3.6
Surfactant	Plant-Derived Oils	Section 4.7.3

6.2.7.1.1 Bacterial Larvicides (Bs, Bti, and Spinosad)

Bacterial larvicides such as Bs and Bti are highly effective microbial pesticides (for mosquitoes) that, when ingested, produce gut toxins that cause destruction of the insect gut wall leading to paralysis and death. These microbial agents are delivered as endospores in granular, powder, or liquid concentrate formulations. The District applies Bs and Bti directly to mosquito habitats (marshes, wetlands, ditches, channels, standing water, ponds, waterways, sewers, and storm drains rather than to terrestrial environments. Bs and Bti are practically nontoxic to terrestrial organisms, including birds, bees, and mammals. Microbial larvicides are one of the most environmentally compatible forms of natural pesticides available for commercial use. Bti is a naturally occurring toxicant of mosquito larvae and, therefore, does not pose risk to nontarget ecological receptors.

Spinosad is a natural insecticide derived from the fermentation of a common soil micro-organism, *Saacharopolyspora spinosa*. Spinosad alters nicotine acetylcholine receptors in insects causing constant involuntary nervous system impacts, ultimately leading to paralysis and death. It is of low acute toxicity to birds, but is very highly toxic to moths and butterflies.

The District strictly adheres to product label requirements and BMPs for the protection of ecological health. In particular, only pesticides approved for aquatic areas or manual treatments within a predetermined distance from aquatic features are employed (BMP H10). Pesticides that could affect insect pollinators are not applied over large areas (more than 0.25 acre) during the day when honeybees are present and active (BMP H12).

> **Impact ECO-8:** The use of bacterial larvicides would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.1.2 Hydrocarbon Esters (Methoprene)

The District widely uses methoprene, an insect growth regulator that is a demonstrated and targeted larvicide when applied at rates labeled for mosquito control. Only when used at rates considerably higher than rates used by the District for mosquito control, can methoprene exhibit some toxicity to some nontarget aquatic invertebrates and some insects such as moths, butterflies, and beetles. Methoprene has also been reported to be moderately toxic to fish; but at the concentrations used for mosquito larvae control, District applications are unlikely to affect nontarget aquatic species.

Although methoprene can exhibit some toxicity to aquatic organisms and insects, it is effective at much lower concentrations than alternative larvicide products. Lower concentrations can translate to reduced acute exposures to nontarget organisms, as well as potential effects to a limited number of midges and chironomids. Extended release forms including granular and briquette varieties are also available (e.g., 30-day briquettes), which are longer lasting and require fewer applications. This product may be more residual in the environment; however, the methoprene active ingredient in this formulation has a short half-life in water and does not migrate through soil, significantly reducing the potential for groundwater impacts.

The District uses methoprene prevalently during each season of the year. Liquid and granular forms are used in residential and ornamental pond application scenarios. Treatments to wetlands including marshes, at times require the granular form (e.g., Altosid pellets) to penetrate dense aquatic vegetation including cattails and tules. See Section 9.2.7.1 for discussion of use of methoprene in malfunctioning onsite wastewater treatment systems.

In some instances, it is necessary to use combinations of products to achieve a more effective vector control that knocks down all larval stages simultaneously. Thus, methoprene is sometimes co-applied with Bti (i.e., Duplex) to maximize the impact to the larval stages and to prevent resistance that might result when only Bti is used for control. Also, larvicide oil and methoprene (e.g., methoprene briquets) may be used together to knock down pupae and achieve residual larval control.

The larger droplet sizes of aerial (e.g., helicopter) larvicide applications (e.g., methoprene) can reduce the potential for unwanted drift (compared to that of ULV applications). In addition, aerial treatments are restricted to times when wind is non-existent or at acceptable levels. Methoprene is generally applied in extremely small amounts during larval treatments due to its efficacy against mosquitoes, even at low concentrations. For example, the District applies it at a maximum concentration of 4.8 µg/L, which is then further diluted in the waterbody to which it is applied. At this application rate, little to no toxicity occurs to nontarget aquatic organisms with the possible exception of some midges (*Chironomidae*) and blackflies (*Simuliidaes*) (Chapter 4; Appendix B). Methoprene has a low toxicity to fish, as evidenced by the lowest 50 percent lethal concentration ($LC_{50,}$ of 4.62 mg/L for bluegill) is several orders of magnitude higher than the concentrations used to control mosquitoes (e.g., 1,000 times concentration, even prior to dilution that occurs in the waterbody) (Maffei, pers. comm., 2013). When handled and applied using District BMPs, methoprene is one of the most environmentally compatible larvicides available.

Impact ECO-9: The use of methoprene for mosquito larvae would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.1.3 Surfactants

Alcohol ethoxylated surfactants (monomolecular films) and aliphatic solvents (mineral oil) are low-toxicity pesticides that spread a thin film on the surface of water that makes it difficult for mosquito larvae, pupae, and emerging adults to attach to the water's surface, causing them to drown (USEPA 2007). The films also disrupt larval respiration of some other classes of air-breathing aquatic insects. They are used on an assortment of waterbodies including ornamental ponds, pastures, irrigation systems, drainage systems, and drinking water systems (CDPR 2010). Monomolecular films are not environmentally persistent and may typically degrade within 21 days.

Surfactants could result in temporary reductions to populations of surface-breathing insects (other than mosquitoes) during treatment; however, it is unlikely that these reductions would result in lasting or observable effects on nontarget organisms when applied within product label limits (Peterson et. al., 2006). In addition, populations recover quickly following recolonization from adjacent and neighboring sites and habitats (Lawler and Lanzaro 2005).

Aliphatic solvents such as mineral oil are applied to water surfaces to form a coating on top of water surfaces to drown larvae, pupae, and emerging adult mosquitoes. They are the product of petroleum distillation and, thus, are complex mixtures of long-chain aliphatic compounds. They are applied to a variety of waterbodies, including swamps, marshes, and intermittently flooded areas (CDPR 2010a). Aliphatic solvents are often used when monomolecular films (alcohol ethoxylated surfactants) do not provide sufficient mosquito control. They also break down more rapidly (2 to 3 days) and are practically nontoxic to most nontarget organisms. Therefore, mineral oil should not result in adverse ecological effects when applied using District BMPs. These BMPs include coordination with CDFW, USFWS, and/or NMFS before conducting treatment activities in suitable habitat for special-status species including vernal pools (BMP H10). Applications will be postponed or cease when predetermined weather parameters exceed product label specifications (BMP H6).

Plant oil mixes include the use of a small amount of a mineral oil alcohol ethoxylated surfactant and a blend of methyl esters of fatty acids.

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 oil 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 milligrams per kilogram (mg/kg), acute dermal toxicity to rats is >5,050 mg/kg, and acute inhalation toxicity to rats is >2.16 mg/L (Clarke 2014).

Impact ECO-10: The use of surfactants for the control of mosquito larvae would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.2 *Mosquito Adulticides*

In addition to chemical control of mosquito larvae, the District may use pesticides for control of adult mosquitoes as a component of the IVMP for example, when other tools are not effective or appropriate and adult mosquito control guidelines are met, including species composition, abundance (as measured by landing count or other quantitative method), proximity to human populations, and/or human disease risk. Adulticide materials are used as needed to control adult mosquito populations.

Adulticides the District potentially uses include pyrethrins, synthetic pyrethroids, pyrethroid-like compounds, and synergists. Table 6-8 lists the adulticides the District uses for mosquito abatement. Several of these active ingredients are also used for the control of yellow jacket wasps (Table 6-8 and this section and Section 6.2.7.3). A subset of these active ingredients required further evaluation in Appendix B and further discussion is provided below. A detailed discussion of the environmental fate and toxicity of these pesticides is provided in Appendix B.

Table 6-8 Chemicals Employed for Adult Vector/Insect Abatement

Chemical Classification	Active Ingredient	Vector	Appendix B
Pyrethrin	Pyrethrins	Mosquito, yellow jacket wasp	Section 4.1.1
Pyrethroid	Allethrins and d-*trans* allethrin	Yellow jacket wasp, tick	Section 4.1.2
Pyrethroid	Phenothrin (sumithrin or d-phenothrin)	Mosquito, yellow jacket wasp	Section 4.1.3
Pyrethroid	Prallethrin	Mosquito	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	Resmethrin	Mosquito	Section 4.1.8
Pyrethroid	Tetramethrin	Yellow jacket wasp	Section 4.1.9
Pyrethroid	Permethrin	Mosquito	Section 4.1.10
Pyrethroid-like compound	Etofenprox	Mosquito, yellow jacket wasp	Section 4.1.11
Synergist	PBO	Mosquito, yellow jacket wasp	Section 4.1.12

6.2.7.2.1 Pyrethrins

Pyrethrins are naturally occurring products distilled from the flowers of certain Chrysanthemum species. Pyrethrins readily degrade in water and soil, but may persist under anoxic conditions. They tend to strongly adsorb to soil surfaces and, hence, have low potential to leach into groundwater. Pyrethrins may be highly toxic to fish (freshwater, estuarine, marine) and invertebrates, although exposures would likely be low during and following ULV applications, which are designed to prevent environmental persistence and potential impacts to nontarget ecological receptors.

The District uses pyrethrin for mosquito and/or yellow jacket wasp control. For yellow jacket wasp control, pyrethrin is applied around parks, landscaping, and directly into ground nests. For mosquito control, pyrethrin is applied to man-made and natural sites but not directly to water.

Pyrethrins are of concern because they are used prevalently and often include the use of the synergist PBO, for greater efficacy, which can then be toxic to aquatic invertebrates. For this reason, and because some suggest that it may be an endocrine disrupter, it is currently under further evaluation by USEPA. (Section 6.2.7.2.2). However, the District uses pyrethrins only when absolutely necessary and, even then, minimal amounts are applied (ULV application), thus reducing the potential for impacts to nontarget ecological receptors (BMPs H3, H4, H11). As an additional measure, pyrethrin applications are canceled during less than ideal wind and potential drift conditions (BMP H6). For wasp (yellow jacket and paper wasps) control, the District applies pyrethrins in minute volumes directly to ground nests and tree nests if necessary, which essentially negates any impact to nontarget species. The District ensures that all applications are made in accordance with label specifications and USEPA and CDPR recommendations for use with mosquitoes. Other practices that can alleviate risk to aquatic receptors include minimizing the amount, frequency, and area with which these pesticides are applied over waterbodies, especially those with the potential to contain special-status species. The District also minimizes the amount, frequency, and area with which these pesticides are applied over waters draining directly to the waters above. In addition, the risks to nontarget insects such as honeybees are reduced by restricting pyrethrin applications to nighttime, pre-dawn, and dusk hours when bees and other pollinators are inactive (BMP H12). In actual field applications, the hazard to bees is often lessened because bees are repelled by pyrethrins, which can reduce their contact with plant surfaces that have recently been sprayed. Reduced contact with plant surfaces decreases the chance of bees receiving a toxic dose. Also, note that pyrethrins are available in aerosol can form to the public but not in vessels used for ULV applications.

> **Impact ECO-11:** The use of pyrethrins for adult mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors including aquatic organisms and bees and mitigation is not required.

6.2.7.2.2 Pyrethroids and Pyrethroid-like Compounds

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

First generation or “Type I” pyrethroids include d-allethrin, phenothrin (sumithrin), prallethrin, resmethrin, and tetramethrin. These pyrethroids are used to control flying and crawling insects in a number of commercial and horticultural applications and are sold for residential use and application on pets to control fleas and ticks. They have effective insect knock-down capabilities but are unstable in sunlight (highly photosensitive). 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, 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.

Resmethrin

Resmethrin is a pyrethroid (a synthetic class of compounds modified from pyrethrins to increase stability and insecticidal specificity) and the active ingredient in Scourge®. It is a restricted-use pesticide due to its toxicity to fish and is available for this use only by certified pesticide applicators or persons under their direct supervision.

Resmethrin may also be persistent in environments free of light (e.g., bound to organic matter in anoxic soils and sediments). Due to the potential for persistence and high toxicity to both aquatic and estuarine/marine fish and invertebrates, use with PBO, as well as the potential for endocrine disruption, resmethrin may be of concern from an ecological health perspective.

The District infrequently applies resmethrin only when necessary to sites that can include residential areas near reclaimed marshes, wetlands, sewage treatment facilities, and industrial areas for mosquito control. Studies have shown rapid dissipation/low persistence and no observed aquatic fish and invertebrate toxicity following aerial ULV applications. Scourge® may be phased out with a nonresmethrin alternative, making this product less problematic. The District uses resmethrin only when absolutely necessary and then in ULV applications so that the rapid degradation of the products reduces the potential for impacts to nontarget ecological receptors.

Permethrin

Permethrin is a pyrethroid that may persist in environments free of light (e.g., bound to organic matter in anoxic soils and sediments). Due the potential for persistence and high toxicity to both aquatic and estuarine/marine fish and invertebrates, use with PBO, as well as the potential for endocrine disruption, permethrin may be of concern from an ecological health perspective. Although potentially toxic effects would occur to some aquatic species, risk assessments provided in support of registration indicate that the acute and chronic risk quotients for terrestrial avian species are below the USEPA's levels of concern. The acute risk quotients for terrestrial mammals are also below the USEPA's acute levels of concern. (USEPA 2009b).

The District may use permethrin for mosquito control (e.g., marshes, wetlands) and uses permethrin for yellow jacket wasp (residential areas, parks) control during spring, summer, and fall. Permethrin products are used in areas adjacent to areas including reclaimed marshes, sewage treatment plants, wetlands, around residences, and directly to ground nests of yellow jacket wasps.

Studies have shown rapid dissipation/low persistence and no observed aquatic fish and invertebrate toxicity following aerial ULV applications. Based on its potential for endocrine disruption and usage patterns, this product is generally used with careful and strict BMP techniques such as in very small, localized applications. Permethrin use is restricted to situations when it is absolutely necessary and in ULV applications that are designed to degrade rapidly and, thus, reduce the potential for impacts to nontarget ecological receptors.

Etofenprox

Etofenprox is a pyrethroid-like insecticide that is the active ingredient in Zenivex®. It is frequently applied to backyards and patios and sometimes directly to domestic pets. Etofenprox does not tend to persist in the environment or appear to pose a risk to mammals. It does exhibit some toxicity to fish and aquatic invertebrates; however, it degrades rapidly in surface waters, thereby reducing the potential for long-term exposures and adverse effects. Zenivex® does not require synergists such as PBO; therefore, it likely exhibits less toxicity than others that require co-application. In addition, the District strictly adheres to application BMPs, such as monitoring weather conditions during applications (BMPs H6, H7), and product label requirements. Etofenprox is generally applied during the nighttime hours, pre-dawn and at dusk when sensitive receptors such as honeybees are not active (BMP H12).

> **Impact ECO-12:** The use of pyrethroids and pyrethroid-like compounds (e.g., resmethrin, permethrin, and etofenprox) for mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.2.3 Synergists (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 2006a). 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 but exhibits toxicity to fish and aquatic invertebrates. As a synergist, PBO is applied using the same guidelines as those for pyrethroids and pyrethrins as indicated by the District: ULV application (to prevent environmental persistence and adverse ecological effects) with a backpack mister or ATV-mounted or handheld ULV, and it is applied as directed on product labels relative to wind conditions.

> **Impact ECO-13:** The use of synergists (PBO) for mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.3 Yellow Jacket Wasp and Tick Adulticides

The District also selectively applies chemicals to control ground-nesting yellow jacket wasps, as well as wasps that nest in trees. This activity is generally triggered by public requests for District assistance or action rather than as a result of regular surveillance of their populations. Yellow jacket nests that are off the ground would be treated under special circumstances to protect public health and safety of residents. Whenever District technicians learn that a nest is situated inside or on a structure or is above ground, the resident(s) are encouraged to contact a private pest control company that is licensed to perform this work. When a 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 District technicians deem 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, tamper-resistant traps or bait stations, selective for the target insect, could be employed in the immediate environment of the vector.

Pyrethrin and pyrethroid-based chemicals are typically used against ground-nesting yellow jackets. The District does not currently perform control work with respect to tick populations but may potentially do a limited amount of control work in the future using synthetic pyrethroid products such as allethrin and deltamethrin. The potential environmental impacts of these materials is minimal due to two factors: (1) their active ingredients consist largely of pyrethrins (a photosensitive natural insecticide manufactured from a Chrysanthemum species), or allethrin, and phenothrin (first generation synthetic pyrethroids with similar photosensitive, nonpersistent characteristics as pyrethrin); and (2) the mode of their application for yellow jacket population control (i.e., directly into the underground nest), which prevents drift and further reduces the potential for inadvertent exposure to these materials. The pesticides the District uses to control yellow jacket wasps are shown in Table 6-8.

> **Impact ECO-14:** The use of pyrethroids and pyrethroid-like compounds for yellow jacket wasps and ticks would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.8 <u>Other Nonchemical Control/Trapping Alternative</u>

The trapping of rodents and/or yellow jackets may be conducted in the future when these organisms pose a threat to public health and welfare. For both vector species, District staff may 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 requests are made, residents are referred to the local animal control or to a directory of private pest control companies. The District conducts limited trapping for vectors (e.g., wood rats, deer mice, and other rats), employing mechanisms and baits specific to target animals to reduce the potential impacts to nontarget ecological receptors.

> **Impact ECO-15:** The Other Nonchemical Control/Trapping Alternative would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.9 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 ecological health include past, present, and reasonably foreseeable actions that potentially impact aquatic/terrestrial mammalian and avian wildlife, herptiles, aquatic organisms, nontarget invertebrates and pollinators, and botanical resources. 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 13.4 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 nontarget ecological receptors. It includes Table 13-1, Historical Pesticide Use within the Marin-Sonoma Mosquito and Vector Control District's Program Area for 2006–2010 and Table 13-2, Pesticide Use within the Marin/Sonoma Mosquito and Vector Control District's Service Area. From Table 13-1, the total pounds of active ingredients by all users in the District's two-county Service Area was approximately 1,989,143 pounds. Table 13-2 reports on pounds of total product in all cases and pounds of active ingredient for some other products actually used by the District. While the two tables are not directly comparable for overall use, the active ingredient in several cases is only about one-tenth of the amount of the total product. Therefore, the District's pesticide use is only a small fraction of total use in Marin and Sonoma counties.

The incremental effects of the District's use of four pesticides with the potential to bioaccumulate in the environment (i.e., including methoprene and spinosad for mosquito larvae; esfenvalerate and etofenprox for adult mosquitoes/yellow jackets/ticks) do not contribute substantially to large-scale bioaccumulation and regional impacts to ecological health. The limited number and use of the adult insect products (esfenvalerate and etofenprox) in relation to the area of application is inconsequential in the context of existing organisms not being subject to continuous exposure. Although spinosad and methoprene have been designated as potential bioaccumulators, the environmental conditions on the ground and in water after an application of one of these pesticides by the District generally does not provide the continuous exposure needed for substantial bioaccumulation in nontarget organisms. The impact of District applications of these pesticides that could contribute to the bioaccumulation of these pesticides in nontarget animals and the environment is short-lived with such a small fraction of their overall normal exposure to outside stress as to be unremarkable. The four pesticides that have the potential to bioaccumulate are used in such low doses, usually with special application restrictions, and in such prescribed areas as to not substantially impact the regional environment and are not cumulatively considerable.

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 District uses BMPs in their pesticide applications for mosquito and vector control and is attempting to reduce total pesticide use where possible consistent with IVM practices.

The District's incremental contributions to overall pesticide use within its Program Area are not substantial and too low to trigger a cumulatively considerable impact. While overall use of pesticides throughout the Program Area may be considered cumulatively significant, the District's incremental contributions to this impact are not cumulatively significant given use of BMPs to mitigate potential impacts. Therefore, the **Program's long-term activities including chemical applications would not contribute considerably to nontarget ecological receptor impacts.** The Program alternatives would not result in significant cumulative impacts to the ecological health of the region.

6.2.10 Environmental Impacts Summary

Table 6-9 presents a summary of impacts to ecological health associated with the six alternatives compared to existing conditions.

Table 6-9 Summary of Ecological Health Impacts by Alternative

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical/ Trapping
Effects on Ecological Health						
Impact ECO-1: The Surveillance Alternative would have a **less-than-significant** impact on nontarget ecological receptors, including native or special-status plants and animals and mitigation is not required.	LS	na	na	na	na	na
Impact ECO-2: The Physical Control Alternative would have a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	LS	na	na	na	na
Impact ECO-3: The employment of a nonherbicide Vegetation Management Alternative in the form of physical removal would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	LS	na	na	na
Impact ECO-4: The use of any of the selected herbicides as a vegetation management technique would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	LS	na	na	na
Impact ECO-5: The use of glyphosate would result in a **less-than-significant impact** to nontarget ecological receptors and mitigation is not required.	na	na	LS	na	na	na
Impact ECO-6: The use of adjuvants would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	LS	na	na	na
Impact ECO-7: The use of mosquitofish as a Biological Control Alternative would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	LS	na	na
Impact ECO-8: The use of bacterial larvicides would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-9: The use of methoprene for mosquito larvae would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na

Table 6-9 Summary of Ecological Health Impacts by Alternative

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical/ Trapping
Impact ECO-10: The use of surfactants for the control of mosquito larvae would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-11: The use of pyrethrins for adult mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors including aquatic organisms and bees and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-12: The use of pyrethroids and pyrethroid-like compounds (e.g., resmethrin, permethrin, and etofenprox) for mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-13: The use of synergists (PBO) for mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-14: The use of pyrethroids and pyrethroid-like compounds for yellow jacket wasps and ticks would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-15: The Other Nonchemical Control/Trapping Alternative would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	na	LS

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

6.2.11 Mitigation and Monitoring

Although application scenarios are conducted using rigorous, strict BMPs and treatment schedules that avoid periods when the nontarget receptors may be more sensitive to stresses (nesting, breeding, migration, known movements between habitats [small mammals and reptiles]), the District also conducts surveillance and monitoring of results on a routine basis. Receipt of information about vector outbreaks or unwanted population expansion of vectors of concern is dealt with on a case-by-case basis. Pesticide use is conducted according to the verified requirements and guidance in the product labels (mandated by the USEPA) for the nonhazardous use of labeled products and the ultimate protection of both humans and ecological receptors.

Because all impacts to ecological health are less than significant, no mitigation is required.