ODFW Review of Vector Control District Plans:

ODFW Involvement: Protecting Fish, Wildlife and Their Habitats During Vector Control Activities

December 7, 2004

This document is intended to provide information to vector control districts on ODFW review of and comments on vector control plans. By statute ODFW must approve vector control plans prior to application of pesticides or other chemicals for vector control. (ORS 452.140; ORS 452.245)¹

ODFW recognizes that vector control for disease prevention and containment is a vital function for human health. ODFW’s goal in review and approval of vector control plans is to minimize effects on fish, wildlife and their habitats while not interfering with disease prevention and containment. In our approvals, ODFW reiterates requirements already listed on labels, material safety data sheets (MSDS) or in U.S. EPA advisories that protect fish and aquatic life, wildlife and their habitats from harm by pesticides. In addition, we will advise vector control districts of concern regarding use of particular pesticides, where additional information is available from other reliable sources on impacts to sensitive, threatened or endangered fish and wildlife and sensitive habitats. This advice must be scientifically based and may recommend protections for ODFW’s statutory mandates in ORS 496.012 and 506.109.

When reviewing information on pesticides, ODFW is aware that pesticide formulations used in vector control are generally much less concentrated than those for agricultural pest control. However, vector control districts treat natural habitats and many types of waterways as well as human habitation areas. Where sensitive, threatened or endangered

¹ 452.140 Destroying vectors by spreading chemicals; consent of State Fish and Wildlife Commission needed. The board of trustees of a district:
   (1) Shall not apply insecticides or oil or other chemicals to waters in the district which are frequented by waterfowl or which contain any game fish without first obtaining the approval of the State Fish and Wildlife Commission.
   (2) Shall not spread poisons for rats or public health vectors without first obtaining approval of the State Fish and Wildlife Commission. [Amended by 1959 c.600 §8; 1981 c.640 §2]

452.245 Uses of insecticides, oil, chemicals and poisons limited. In exercising its powers under ORS 452.210 to 452.250, a county court:
   (1) Shall not order the application of insecticides, oil or other chemicals to waters in the county which are frequented by waterfowl or which contain any game fish without first obtaining the approval of the State Fish and Wildlife Commission.
   (2) Shall not order the spreading of poisons for public health vectors without first obtaining the approval of the State Fish and Wildlife Commission. [1981 c.640 §5]
fish or wildlife species occur or sensitive habitats, low concentrations of certain pesticides may accumulate to impact survival of these sensitive species or habitats. Though natural habitats and waterways may be near to fields, agricultural applications are generally not applied to these locations.

ODFW also seeks to encourage least harmful alternatives for vector control, while recognizing that, given a disease outbreak, all possible means of control may be used to contain it to prevent additional harm to human health.

Because of the recent invasion of West Nile virus to the United States, which is transmitted by adult mosquitoes (primarily *Culex* spp.), vector control districts and their plans have become the focus for controlling the spread of this disease.

Vector control is aimed at reducing mosquitoes, rather than attempting to eliminate them. This in turn reduces risk of disease transmission. The State of Oregon endorses an integrated pest management approach (IPM)\(^2\). This includes education of the public and pest control strategies aimed at larval and adult mosquitoes, while minimizing public exposure to substances used for control. Reducing mosquito vectors involves four steps:

1) **Mosquito habitat reduction:** This does not involve extensive changes to natural habitats, but rather focusing on modifying or eliminating standing water breeding areas near inhabited areas. These actions include: minimizing standing water in irrigated areas, eliminating water-filled containers, such as buckets and old tires, cleaning roof gutters, and ensuring water troughs and bird baths are managed to eliminate mosquito breeding.

2) **Mosquito avoidance:** Individuals can reduce their exposure to biting mosquitoes by restricting outdoor activities when mosquitoes are most active (dusk to dawn), wearing long-sleeved shirts and pants, and using repellent.

3) **Larval control:** When water management and water source reduction is not feasible or hasn’t adequately controlled mosquito populations, biological or chemical controls may be required. Each vector control district has programs for monitoring mosquito larvae. Monitoring involves sampling different mosquito habitats using a dip cup or fine mesh net to determine mosquito presence or population levels. Triggers for treatment generally are one larva per dip. In sensitive areas, such as rivers, major wetlands, wildlife refuges or urban parks, many vector control districts indicate they either will not treat these areas or will use only biological or microbial controls. Specifics are discussed below.

4) **Adult mosquito control:** Vector control districts also monitor the level of adult mosquitoes within their districts. Usually a certain number of landings (either on vector control personnel or other devices attractive to mosquitoes) per minute indicate


\(^3\) IPM is defined extensively in literature; an internet link to a legal definition is at http://www.agriculturelaw.com/links/dictionaryg-l.htm
the need for treatment. Complaints can also trigger treatment to reduce adult mosquito populations.

AgriculturalLaw.com defines IPM as “[a] pest control strategy based on the determination of an economic threshold that indicates when a pest population is approaching the level at which control measures are necessary to prevent a decline in net returns. In principle, IPM is an ecologically based strategy that relies on natural mortality factors, such as natural enemies, weather, and crop management, and seeks control tactics that disrupt these factors as little as possible. Also, a USDA/Environmental Protection Agency program that aims to decrease pesticide applications by teaching farmers to use a variety of alternative control techniques to minimize pesticide use. These techniques include biological controls, genetic resistance, tillage, pruning, and [o]thers.”

Other State of Oregon Recommended Measures

1) Protecting Sensitive Areas: Vector control district plans must identify sensitive areas within the vector control district boundaries. These are areas where pest treatments may be harmful to people, fish or wildlife. Most plans identify rivers, lakes, or specific locations, such as wildlife refuges, hospitals or parks. The plans may also indicate additional environmental protections during pest reduction or principles followed for protection of the public from any harmful effects of vector control.

2) Monitoring for Affected Non-target Species: Vector control plans must specify whether they monitor the effects of vector management on non-target species. Most vector control districts have limited budgets for this activity and indicate they will conduct monitoring in the course of other duties.

Types of Mosquito Control and ODFW Concerns

Vector control can target any or all stages of the mosquito life cycle. Below are the specific controls currently in use. These include biological, microbial and chemical controls. The non-biological (pesticide) controls are ranked in order of preference of use. Fish are the primary control in closed water systems, such as ornamental ponds, water troughs, etc. ODFW prefers that larvicides and pupicides are used first, with each product used in appropriate locations according to the label. Certain larvicides should not be used in natural waterways or waters connected to natural waterways, such as wetlands and irrigation canals.

Biological Mosquito Controls

Fish

Fish are the primary human-controlled biological control for mosquito larvae and pupae. Fish species with a preference for still water are one of the primary predators on

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4 At: www.agriculturelaw.com/links/dictionaryg-l.htm, as well as other similar definitions that can be found in the literature and on the internet at agricultural and government sites.
mosquitoes. A favorite for mosquito control world-wide is *Gambusia affinis* (western mosquito fish). Other native fish species may be just as effective, such as Oregon, blue and Tui chubs and juvenile trout. Studies were conducted in California rice fields showed that: 1) Mosquito fish were just as effective in removing mosquito larvae as BT alone, but control lasted longer\(^5\) (however, non-target populations of arthropods were significantly lower in fields stocked with Gambusia than in fields without fish), the two controls together were the most effective; and 2) that other fish that remain in the same size range as Gambusia could be nearly as or more effective as mosquito fish in mosquito control\(^6\).

**ODFW Policy on Use of Fish for Mosquito Control**

According to OAR 635-007-0600, transport, holding or release of live fish, including *Gambusia*, requires a fish transport permit (with the some exceptions listed in rule). In addition OAR 635-007-0620 requires an annual permit for the use of *Gambusia* for vector control. All release sites for *Gambusia* must be ODFW-approved locations or types of sites (such as ornamental ponds not connected to natural waterways). The local ODFW fish biologist must be contacted for issuance and approval of the permits and for approval of locations for release of *Gambusia*. Once a vector control district obtains a fish transportation permit, it may provide individuals with *Gambusia* for stocking in approved locations or types of sites. The vector control district must provide the person receiving *Gambusia* a receipt and provide an ODFW information sheet on where *Gambusia* maybe stocked. The vector control district or county must maintain records of *Gambusia* distribution that are available for inspection by ODFW or the Oregon State Police.

*Fish other than Gambusia do not fall under the annual vector control fish transport permit process, instead they would require permits for each time transported, as with non-vector control activities. Check with the local ODFW office if any other fish are being considered for mosquito control.*

Research supports preventing Gambusia from entering natural waterways, as they are very effective predators and reproduce rapidly, possibly out-competing native fish, including juvenile salmonids or even consuming salmonid or other larval stage fish (also known as “fry”).\(^7\)


**Birds and Bats**

ODFW encourages restoration and enhancement of bat and bird habitat for assisting in adult mosquito control. Local wildlife biologists will be the point of contact for information on providing nesting and roosting sites that encourage mosquito-eating wildlife species.

ODFW does not emphasize this option during review of vector control plans, but will recommend the following strategy in future plan approvals: 1) Vector control districts are not expected to advise the public to maintain bird or bat habitat or install houses for these species. 2) If the public expresses an interest, the vector control district should refer the public to the nearest ODFW office.

**Larvicides and Pupicides**

In natural and sensitive habitats, where game fish, waterfowl and sensitive, threatened or endangered fish or wildlife occur, ODFW recommends the using larvicides that target mosquito larvae, such as the microbial larvicides *Bacillus sphaericus* and *Bacillus thuringiensis israelensis* (commonly known as BT).

Larvicides and pupicides include chemical pesticides, such as temephos, methoprene, oils, and monomolecular films. Larvicide and pupicide treatments of mosquito breeding habitats can significantly reduce adult mosquito populations in nearby areas and reduce or eliminate the need for ground or aerial application of pesticides to kill adult mosquitoes.\(^8\)

**Microbial Larvicides\(^9\)**

*Bacillus thuringiensis israelensis* (*Bti*) is a naturally occurring soil bacterium registered for control of mosquito larvae. *Bti* was first registered by EPA as an insecticide in 1983. Mosquito larvae eat the *Bti* product that is made up of the dormant spore form of the bacterium and an associated pure toxin. The toxin disrupts the gut in the mosquito by binding to receptor cells present in insects, but not in mammals. There are 26 *Bti* products registered for use in the United States. Aquabac, Teknar, Vectobac, and LarvX are examples of common trade names for the mosquito control products.

*Bacillus sphaericus* is a naturally occurring bacterium that is found throughout the world. *B. sphaericus* was initially registered by EPA in 1991 for use against various kinds of mosquito larvae. It functions in the same manner as *Bti*. VectoLex CG and WDG are registered *B. sphaericus* products and are effective for approximately one to four weeks after application.

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\(^8\) From EPA, Topical and Chemical Fact Sheets, Larvicides for Mosquito Control, Apr. 17, 2002 update. At: [www.epa.gov/pesticides/factsheets/larvicides4mosquitos.htm](http://www.epa.gov/pesticides/factsheets/larvicides4mosquitos.htm)

\(^9\) From EPA, Topical and Chemical Fact Sheets, Larvicides for Mosquito Control, Apr. 17, 2002 update. At: [http://www.epa.gov/pesticides/factsheets/larvicides4mosquitos.htm#microbial](http://www.epa.gov/pesticides/factsheets/larvicides4mosquitos.htm#microbial)
Extensive testing shows that microbial larvicides do not pose risks to wildlife, nontarget species, or the environment, when used according to label directions.

The microbial pesticides have undergone extensive testing prior to registration and are essentially nontoxic to humans. There are no known concerns for human health effects with *Bti* or *B. sphaericus* when they are used according to label directions.

**ODFW Recommendations on Use of Microbial Larvicides in Vector Control Plans**

ODFW supports using microbial larvicides and pupicides when needed, rather than adulticides, on ODFW properties and other sensitive areas, including lakes, rivers and tributaries (including wetlands, marshes and swamps). Contact with the local ODFW office should be made prior to using mosquito control agents on ODFW property.

**Chemical Larvicides and Pupicides**

**Methoprene**

Methoprene, first registered by EPA in 1975, it mimics the action of an insect growth-regulating hormone and prevents the normal maturation of insect larvae. *Altosid* briquets, pellets, sand granules, and liquids are the methoprene products used in mosquito control. Methoprene is often used in contained water sources, such as holding ponds and water troughs, though many vector control plans also list natural water locations as possible targets.

**ODFW Recommendations on Use of Methoprene Vector Control Plans**

When used at recommended vector control application dilutions and timing, ODFW considers methoprene to have minimal to no effect on fish, wildlife and aquatic ecosystems.

ODFW did not make any explicit statements in its vector control plan approvals on methoprene. Methoprene is considered a chemical larvicide since it is manufactured from chemical sources, rather than natural sources.

**Molecular Films**

Some vector control districts use molecular films, such as *Agnique MMF* (ethoxylated alcohol). This forms a thin membrane on the water’s surface. It acts by smothering pupae and surface-breathing larvae. It also drowns adult mosquitoes that try to land on water treated by the compound.

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10 From EPA, Topical and Chemical Fact Sheets, Larvicides for Mosquito Control, Apr. 17, 2002 update. At: http://www.epa.gov/pesticides/factsheets/larvicides4mosquitos.htm#methoprene

Ecological Effects

Ethoxylated alcohol molecular films are considered non-toxic to fish, non-surface-breathing aquatic life and wildlife. Agnique is effective for 5 – 22 days. It can be used on potable water, but has not been approved for use on food products. It is best used to control pupae in artificial containers, standing water caused by human activities, old tires and the like. It can be used in standing water around the edges of marshes and wetlands.

ODFW Recommendations on Use of Molecular Films

ODFW did not specify any restrictions or policies on molecular films, such as Agnique. Most vector control districts were using this product to control larvae and pupae on croplands, isolated pools and development sites. Some districts may use molecular films on natural water bodies. This should be done with caution, as it will disrupt aquatic invertebrate life cycles, including smothering surface-breathing invertebrates, potentially smothering emerging insects and drowning flying adults that land on the surface of the water to lay eggs.

Oils

Oils, like films, are pesticides used to form a coating on top of water to drown larvae, pupae, and emerging adult mosquitoes. They are specially derived from petroleum distillates and have been used for many years in the United States to kill aphids on crops and orchard trees, and to control mosquitoes. Trade names for oils used in mosquito control are Bonide, BVA2, and Golden Bear-1111 (GB-1111).

Oils, if misapplied, may be toxic to fish and other aquatic organisms. For that reason, EPA has established specific precautions on the label to reduce such risks. In addition, the U.S. Geological Survey (USGS) conducted a study on the effects on waterfowl in a natural environment. Though the study did not show significant direct effects, the authors cautioned that insecticidal oil applied during waterfowl breeding season, could result in reduced survival of juveniles.

ODFW Recommendations on Use of Oils

Unless no other biological alternatives are available (such as previously listed larvicides and pupicides), ODFW recommends that vector control districts should not use GB-1111, BVA 2 or Bonide during the bird-nesting season (March 1 – June 30) in natural habitats where waterfowl or other native birds occur. Districts should contact locally based ODFW staff for specific timing concerns if any treatments are needed in or near these areas.

BVA 2 also has the following label warning: ‘This product is toxic to fish and other aquatic organisms. Do NOT apply directly to water (except when applied for mosquito

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larvae control; then only in shallow areas around the border.)…**Consult your State Fish and Game Agency before applying this product.**” [emphasis added]” The ODFW district fish and wildlife biologists must be contacted on locations where this product may be used.

**Temephos**

Temephos is an organophosphate (OP) pesticide registered by EPA in 1965 to control mosquito larvae, and it is the only organophosphate with larvicidal use. Temephos is authorized for areas of standing water, shallow ponds, swamps, marshes, and intertidal zones. **Abate** is the trade name of the temephos product used for mosquito control. Typical of other OP insecticides, temephos inhibits the action of the group of enzymes called cholinesterases. These enzymes are most important in the nervous system, the brain, and the musculoskeletal systems in controlling nerve signal transmission.

**ODFW Recommendations on Use of Temephos**

Only two vector control districts proposed this product in their plans. Most likely its only use will be in contained water situations, such as sewage holding ponds, or only if resistance to other pesticides appears. ODFW reiterated the label warning on **Clarke 5% Skeeter Abate** (temephos) in review of the two plans. The following warning must be followed: “This product is toxic to birds and fish. Fish and other aquatic organisms in water treated with this product may be killed. You must consult your State Fish and Game Agency before applying this product to waters or wetlands. Do not contaminate water by cleaning of equipment or disposing of wastes.” ODFW recommends against use of temephos in natural waterways or water connected to natural waterways. Over-reliance on temephos has resulted in resistance in mosquitoes in some locations.

**Adulticides**

Mosquito control applications of adulticides are designed to kill only the adult mosquitoes that contact insecticide droplets, typically applied as an ultra-low volume (ULV) spray, either by truck- or aircraft-mounted sprayers. Once the insecticide fog or spray dissipates, no effective control is present. The local mosquito population will be reduced from a few hours to a day or two, but mosquitoes from other locations will enter the area. This is why the state of Oregon recommends larviciding as the most effective

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14 From EPA, Topical and Chemical Fact Sheets, Larvicides for Mosquito Control, Apr. 17, 2002 update. At: [http://www.epa.gov/pesticides/factsheets/larvicides4mosquitos.htm#temephos](http://www.epa.gov/pesticides/factsheets/larvicides4mosquitos.htm#temephos)

15 Usually the primary active agent in an insecticide is listed in parentheses in this document. Other pesticides are often added to enhance the effect (killing power or longevity) of the primary agent.


method of mosquito control. ODFW also has concerns with the broad spectrum nature of adulticides as beneficial and other non-target insects will be affected by adulticides. This in turn may affect fish and wildlife food supply or disrupt the ecological balance between predators and prey. The following are the adulticides planned for use in Oregon vector control districts.

**Pyrethrins and Pyrethroids**

**Pyrethrins** are natural insecticides produced by certain species of the chrysanthemum plant. The flowers of the plant are harvested shortly after blooming and are either dried and powdered or the oils within the flowers are extracted with solvents. The resulting pyrethrin-containing dusts and extracts usually have an active ingredient content of about 30%. These active insecticidal components are collectively known as pyrethrins.

The natural pyrethrins are contact poisons that quickly penetrate the nerve system of the insect. A few minutes after application, the insect cannot move or fly away. But, a "knockdown dose" does not mean a killing dose. Natural pyrethrins are swiftly detoxified by enzymes in the insect. Thus, some pests will recover. To delay the enzyme action so a lethal dose is assured, organophosphates, carbamates, or synergists may be added to pyrethrins. In the case of vector control pesticides, piperonyl butoxide (PBO) is usually the synergist.

Semi-synthetic derivatives of the chrysanthemumic acids have been developed as insecticides. These are called **pyrethroids** and tend to be more effective than natural pyrethrins while they are less toxic to mammals. Two common synthetic pyrethroids used in vector control are permethrin and resmethrin. PBO’s are also typically added as synergists.

**ODFW Recommendations on use of Pyrethrins and Pyrethroids**

The following are some of the pyrethin-based adulticides, synergized with PBO, proposed for use by vector control districts: **Pyrenone Crop Spray**; **Pyrenone 25-5 Public Health Insecticide**; and **Pyrocide Mosquito Adulticiding Concentrate**. All have label restrictions preventing application “directly to water, or to areas where surface water is present” or otherwise warning against use in waterways. This applies to wetlands, ditches, irrigation canals and any surface water areas that drain to or are connected either directly or by pumps to lakes and streams. To avoid fish kills, this requirement must be strictly adhered to.

The following are some of the synthetic pyrethroids, synergized with PBO, that are proposed for use by vector control districts: **Scourge** (resmethrin); **Scourge with SBP-1382**; **Permanone 10% EC** (permethrin); **Aqua-Reslin** (permethrin); **Aqua-Kontrol** (permethrin); **Anvil 2+2 ULV** (sumithrin); and **Anvil 10+10 ULV**.

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ODFW reiterates label warnings in our approval letters. These warnings apply to wetlands, ditches, irrigation canals and any surface water areas that drain to or are connected either directly or by pumps to lakes and streams. ODFW recommends additional buffers near sensitive habitats and locations where game fish or sensitive, threatened or endangered fish occur.

**Malathion**

Malathion is an OP insecticide that has been registered for use in the United States since 1956. It has been used in agriculture, residential gardens, public recreation areas, and in public health pest control programs. It was one of the earliest OP insecticides developed.

For mosquito control, malathion is applied as an ultra-low volume (ULV) spray, either by truck- or aircraft-mounted sprayers at a maximum rate of 0.23 pounds (or about 2.5 fluid ounces) of active ingredient per acre, which minimizes exposure and risks to people and the environment.

EPA is currently reviewing malathion as part of its reregistration process. The review of malathion was scheduled for completion in 2002, but is currently expected to be completed in 2005. A risk assessment covering all uses of malathion is currently available to the public for review at [http://www.epa.gov/oppsrdr1/op/malathion.htm](http://www.epa.gov/oppsrdr1/op/malathion.htm).

Malathion products used in vector control include: Fyfanon ULV (for adults) and Fyfanon 8 lb. Emulsion (for larvae).

**ODFW Recommendations on Use of Malathion**

Malathion, like other adulticides, whether organophosphate or other, is non-specific. As an ultra low volume (ULV) spray with relatively low concentration of pesticide in the spray, it is designed to minimize the risks to non-target arthropods and other animals. When using adulticides, ODFW recommends pyrethrin-based pesticides be used first where possible. Most of the pyrethrin-based products have labels requiring buffers next to waterways which help prevent accidental entry of pesticide to the water. ODFW recognizes that some vector control pesticides may not be approved for use on food or other agricultural products. ODFW also recognizes that budgets may also restrict the choice of pesticides for vector control.

Some vector control districts placed voluntary buffers along waterways. ODFW encourages this practice and considers that the buffers are needed where any surface water area drains to or is connected either directly or by pumps to lakes and streams, including wetlands, ditches, and irrigation canals. Some vector control districts clearly stated that their use of malathion would be a last resort effort in the case of a West Nile virus disease outbreak.

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Naled

Naled is a Category I OP insecticide that has been registered since 1959 for use in the United States.\(^{20}\) It is used primarily for controlling adult mosquitoes, but naled is also used on food and feed crops, and in greenhouses. In Canada, the manufacturer of naled has discontinued its use in residential areas.\(^{21}\)

In mosquito control programs, naled is applied by truck- or aircraft-mounted sprayers as an ultra-low volume (ULV) spray. For mosquito control, the maximum rate for ground and aerial application is 0.1 lb of active ingredient per acre that minimizes exposure and risks to people and the environment.

EPA is currently reviewing naled as part of its reregistration process for OP insecticides.

Ecological Effects\(^ {22}\)

Naled is a Category I pesticide because it is a corrosive product that must be used with care when applying in the environment. Naled is highly to moderately toxic to birds and fish. Naled is very highly toxic to aquatic invertebrate species. As with most OP pesticides naled is toxic to bees.

ODFW Recommendations on Use of Naled in Vector Control Plans

Only two vector control districts propose the use of naled. ODFW has the following concerns with the use of naled for mosquito control:

The pesticide Trumpet EC (naled) is an extremely toxic and corrosive pesticide that is toxic to fish, aquatic life and wildlife. Contact causes permanent eye and skin damage according to the label. Aerial application of Trumpet EC is the only allowed application method for mosquito abatement. ODFW recommends, if Trumpet EC must be used, it is applied in limited locations where no waterways (including streams, lakes, wetlands, and ditches and canals connected to waterways), wildlife habitat or congregations of wildlife are present. The label for Trumpet EC states: “This pesticide is toxic to fish, aquatic invertebrates and wildlife. Do not apply directly to water except when used over water (emphasis added) as labeled for adult mosquito, blackfly, or housefly control…. Runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. …” If application over water is necessary, please contact the local ODFW office before application. If spraying near water over land, ensure that none of the pesticide enters the water. Other adulticides are preferred at all times over Trumpet EC or other formulations of naled.

Summary

Vector control for disease prevention and containment is a vital function for human health. ODFW’s goal in review and approval of vector control plans is to minimize effects on fish, wildlife and their habitats while not significantly interfering with disease prevention and containment. In our approvals, ODFW reiterates requirements already listed on labels, material safety data sheets (MSDS) or in US EPA advisories that protect fish and aquatic life, wildlife and their habitats from harm by pesticides.

In addition, we will advise vector control districts of concern regarding use of particular pesticides, where additional information is available on impacts to fish, wildlife and habitats from other reliable scientifically creditable sources. This advice must be scientifically based and recommend protections for ODFW’s statutory mandates in ORS 496.012 and 506.109.

When reviewing information on pesticides, ODFW understands that pesticide formulations used in vector control are generally much less concentrated and used at greater dilution rates than those for agricultural pest control. However, vector control treats natural habitats and many types of waterways as well as human habitation areas. Agricultural applications are generally not applied to natural habitats and waterways, though fields may be near to natural habitats and waterways.

ODFW also tries to encourage least harmful alternatives for vector control, while recognizing that, given a disease outbreak, all possible means of control may be used to contain it and prevent additional harm to human health. In addition, some of vector control district’s work involves reducing nuisance insects by responding to complaints about mosquitoes. Using a tiered approach to mosquito control, with public education as the foundation, individual actions to reduce habitat around homes, larviciding, then as a last resort, adulticiding, will reduce any impacts on fish, wildlife and their habitats.

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