## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter from the General Manager</td>
<td>2</td>
</tr>
<tr>
<td>Mission Statement</td>
<td>3</td>
</tr>
<tr>
<td>History</td>
<td>3</td>
</tr>
<tr>
<td>Board of Trustees</td>
<td>4</td>
</tr>
<tr>
<td>Personnel</td>
<td>5</td>
</tr>
<tr>
<td>Independent Special Districts</td>
<td>6</td>
</tr>
<tr>
<td>Mosquito Biology &amp; Development</td>
<td>7</td>
</tr>
<tr>
<td>Integrated Vector Management (IVM) Program</td>
<td>9</td>
</tr>
<tr>
<td>2019 Mosquito Surveillance</td>
<td>15</td>
</tr>
<tr>
<td>2019 West Nile Virus Activity</td>
<td>20</td>
</tr>
<tr>
<td>Policy Issues</td>
<td>27</td>
</tr>
<tr>
<td>Financial Statement</td>
<td>33</td>
</tr>
</tbody>
</table>
Letter from the General Manager

On behalf of the Board of Trustees and the staff of the Turlock Mosquito Abatement District, it is my pleasure to present to you the 2019 Annual Report.

2019 was a challenging year in terms of West Nile virus activity in the District. The Minimum Infection Rate (MIR) of vector mosquitoes was almost double in 2019 than the 5-year average; hence, the District experienced its most human cases (11) since 2005. We believe a cooling of temperatures in mid-August and September meant more folks outside which increased the interaction between humans and mosquitoes and further reinforces the importance of wearing repellant. The increased WNV activity is believed to be a result of the river flooding and seepage from snowmelt that occurred through June. This resulted in much higher than normal numbers of mosquitoes throughout the District early in the summer. Although we were successful in bringing these numbers back down, the increased abundance resulted in amplifying the level of WNV transmission.

In addition, District mosquito surveillance efforts were successful in discovering the invasive mosquito *Aedes aegypti* in the town of Newman. After extensive trapping, we determined that *Aedes aegypti* was fairly widespread in Newman, although at low levels. Following this discovery, the mosquito was then found in Modesto, San Joaquin County, Sacramento County, and Placer County. We expect that at some point *Aedes aegypti* will find its way into most neighborhoods within the District. This mosquito is very active during the day and may have a substantial impact on quality of life for residents. We plan to utilize every tool we have to fight the presence of this mosquito; however, it really is dependent on each property owner doing their part in removing any and all sources of standing water. District staff will continue to educate the public in the identification of this mosquito and the importance of taking time each week to dump, drain and remove water-holding containers from their yards.

As typical, the District continues to aggressively control unmaintained/abandoned swimming pools, catch basins, storm drains, retention ponds and works in partnership with other federal, state, local agencies and governments. The District’s Aggressive Source Reduction and MOU program continues to be successful in finding properties that are causing the most mosquito breeding and holding those property owners responsible.

The following Annual Report is testament to the long hours and hard work accomplished by staff that focused not only on controlling mosquitoes but providing the best service to you and your families.

Sincerely,

David Heft, General Manager
Mission Statement
The Turlock Mosquito Abatement District is dedicated to enhancing the quality of life for our community by providing effective and environmentally sound mosquito control and disease prevention through timely and efficient surveillance, control and public awareness.

History

The Turlock Mosquito Abatement District was formed in January 1946, at the behest of the Turlock Rotary Club, to protect the public from mosquitoes and the diseases they can transmit. Mosquitoes were not a new problem to California, first mention of them having been made in 1772 by Spanish missionaries. As early as 1903 abatement work was discussed to fight malaria in Marin County, and in 1910 abatement work was actually undertaken in Placer County. The California legislature provided for the formation of abatement Districts by laws it passed in 1915. Originally serving the Turlock, Denair and Ceres communities, cities such as Hughson, Newman, Patterson, and the community of Crows Landing quickly petitioned the Board of Trustees for annexation into the District.
Board of Trustees

President
Michael Mitchell
Hughson

Vice President
Aaron Hackler
Turlock

Secretary
Lynn Apland
Patterson
Rodman Hooker
County-at-Large
Kern Hunewill
Newman
Dan Peterson
County-at-Large
L. Kevin Showen
Ceres
Everett Souza, Jr.
County-at-Large
Turlock Mosquito Abatement District
4412 N. Washington Rd.
Turlock, CA 95380
209-634-1234

www.turlockmosquito.org

Personnel

Administration
General Manager: David Heft
Administrative Assistant/Clerk of the Board: Deborah Battista

Vector Biology/Laboratory
Vector Biologist: Monica Patterson

Operations
Mosquito Control Supervisor: Roger Jorge
Mosquito Control Lead: Richard Oberholtzer
Mosquito Control Operators:
Alex Avila
Tim Brazil
Alisa Dahl
Francisco Lemus
Jim Oliveira
Justin Pinney
Mel Pinney
Ron Reforma
Independent Special Districts

The Turlock Mosquito Abatement District is classified as an independent special District and is not part of Stanislaus County’s governmental system. Each city within the District’s jurisdiction may appoint one board of trustee member to represent their community; the county-at-large is given three board of trustee member appointments to represent citizens in the unincorporated areas of the District’s jurisdiction. Special Districts are:

- Formed by local residents to provide local services
- Sanctioned by the State of California Government Code
- Often the most economical means of providing public service
- Independent, self-governed agencies governed by a board of trustees
- Operated as non-profit organizations
- Responsible directly to the people
- Accountable - Accessible - Efficient
Mosquito Biology & Development

There are approximately 3,500 species of mosquitoes distributed worldwide. In California, there are 53 species of mosquitoes and 24 of these are commonly found within the District. Like other insects, mosquitoes have four stages in their life cycle: egg, larvae, pupa, and adult.

Mosquito eggs are laid on the surface of water or moist soil. Some mosquitoes lay their eggs in clusters called “egg rafts” while others lay their eggs singularly.

Larvae hatch from mosquito eggs. They are also sometimes referred to as “wigglers” since they are worm-like in appearance and their swimming behavior gives them a “wiggling” appearance. Mosquito larvae are aquatic and require water to live throughout the larval stage. Mosquito larvae feed on algae, bacteria and organic debris in the water. Although entirely aquatic, mosquito larvae must breathe air using their siphon which acts as a “snorkel device”. Larvae go through four instars or molts each time getting successively larger. After the 4th instar, the larvae enter the pupal stage.

Mosquito pupae are also entirely aquatic and are commonly referred to as “tumblers” due to their bulky appearance and tumbling swimming motion. Pupae, like larvae, must also breathe air and do so through two snorkel-like devices called trumpets. The pupae have no mouthparts and do not eat; however, big changes are taking place within the main pupal chamber as the adult mosquito develops.
The adult mosquito needs flat water and calm air as it cautiously emerges from the pupal casing to dry its wings on the surface of the water. An adult mosquito’s body is divided into three distinct areas: head, thorax and abdomen. The head contains the eyes, antennae, and proboscis. The antennae allow the mosquito to hear and smell while the proboscis is a long “straw-like” device used to pierce the skin of host animals and to draw blood. It’s important to note that only female mosquitoes ingest blood and this blood isn’t used as “food” but rather the female mosquito needs the proteins found in blood to make her eggs. All mosquitoes drink nectar from flowers as food/energy source. Attached to the thorax are two wings and six legs while most of the mosquito’s vital organs are contained in the abdomen.

Adult female mosquitoes find a blood source by initially tracking the carbon dioxide (CO$_2$) exhaled by animals and then using heat and body odors once within the general vicinity of the host.
Integrated Vector Management (IVM) Program

Integrated Vector Management (IVM) is an effective and environmentally sensitive approach to vector management based on scientifically established procedures. Effective IVM begins with an assessment of the mosquito population and the various factors influencing their development. The best strategies for control are then implemented to minimize the mosquito’s threat in the most economical and environmentally sensitive way possible. The District’s IVM program includes public education, surveillance, source reduction, biological control and chemical control.

Each time a breeding source is located and inspected the District’s control operators assess the site and determine the appropriate course of action, much like the flow chart above illustrates.

Source Reduction

The most effective method of mosquito control is source elimination or the removal of mosquito breeding sites. This strategy removes the need for other methods of control and often provides a long-term solution. There are three levels of physical control:
• **Source Elimination:** This approach completely eliminates potential habitats for mosquitoes to develop in. Source elimination can be as simple as repairing leaky faucets, cleaning out gutters, maintaining swimming pools, and filling in areas that pond or puddle.

• **Source Reduction:** This strategy involves altering habitats available for mosquito development. Water may not be totally eliminated but it is greatly reduced in space and/or time. By reducing the larval habitat, the opportunities for adult mosquitoes to develop and spread disease are decreased. Examples of source reduction include: eliminating vegetation along ditches, construction of water holding ponds using steep sides to prevent vegetation growth, the use of drip system irrigation reducing the amount of standing water, proper irrigation methods and not over-irrigating.

• **Source Maintenance:** Maintaining a source may be necessary when it cannot be eliminated or altered to reduce mosquito breeding. Source maintenance can include water management, vegetation management, wetland infrastructure maintenance, and wetland restoration. Source maintenance requires frequent monitoring for mosquito breeding along with plans for managing mosquitoes at each maintained site.
Public Education

The Turlock Mosquito Abatement District continues to make a concerted effort to broaden the impact of the public education portion of its IVM program. The District invested in a mobile display that can be used at local events such as fairs, harvest festivals, schools, etc. summarizing the District’s programs and educating the public concerning the importance of mosquito control and the dangers regarding West Nile virus. In addition, the District produced a short video that was played before every movie at the theater in Turlock advising the public about District services and the importance of notifying us if they are being affected by mosquitoes or find dead birds. This movie theater serves as the only theater for the entire District allowing us to reach a huge potential audience. In addition, the District partnered with the East Side Mosquito Abatement District and the San Joaquin Mosquito & Vector Control District to run ads on popular local radio stations to remind the public regarding how to prevent the transmission of West Nile virus through the use of repellants. Finally, the District redesigned its web site making it much easier for the public to submit requests for service and to find more information quickly regarding local mosquito control activities.

Biological Control

Biological control is a method of controlling pests (mosquitoes) using other organisms. The District uses the mosquitofish, *Gambusia affinis*, to provide biological control of mosquitoes through direct predation of larvae. Control operators collect fish from several natural sources throughout the summer season and return the fish to the District pond at our headquarters. From there, these fish are either planted directly in irrigation ditches, ornamental and artificial ponds, unmaintained swimming pools, etc. or are handed out freely to the public for use. Stocking by District personnel complies with strict guidelines designed to ensure that no significant impacts can occur to native species.

Mosquitofish are omnivorous, extremely tolerant to most conditions, and have a voracious appetite for
mosquito larvae. The mosquitofish’s mouth is adapted for feeding on the surface of the water where mosquito larvae must go to breathe. A fully grown female mosquitofish can consume up to 500 mosquito larvae per day!

**Chemical Control**

When physical and biological control methods are not viable, the District must employ the use of chemical control measures to reduce or maintain mosquito populations at tolerable levels and to protect public health. The ultimate goal is to control mosquitoes in their larval, aquatic stage when they are confined to a known and defined location. There are two categories of chemicals used by the District, larvicides and adulticides.

**Mosquito Larvicides**

Mosquito larvicides are primarily divided into two categories, biorational and chemical larvicides.

**Biorational Larvicides**

Biorational pesticides refer to pesticides of a natural origin, developed from bacteria for instance, that have limited or no adverse effects on the environment or beneficial organisms. In terms of mosquito control, the biorational used most often is called Bti (*Bacillus thuringiensis* var. *israelensis*) which is a bacterium that is ingested by larval mosquitoes and disrupts their gut lining, leading to death before pupation. Bti is applied by the District as a liquid or bonded in solid formulations such as granules, pellets or briquettes. Persistence is low in the environment and efficacy depends on careful timing of application relative to the larval growth stage. Therefore, use of Bti requires frequent inspections of larval sources during periods of larval production, and may require frequent applications. Applications can be made by hand, ATV, or aircraft. *Baccilus sphaericus* (Bs) is similar to Bti but has a longer persistence allowing for longer duration of control. Spinosad (“Natular”) is a bacterial fermentation product which acts on the nervous system of mosquito larvae and is also available in several liquid and solid formulations. All three materials have very low toxicity to non-target organisms.

**Chemical Larvicides**

Chemical larvicides used routinely by the District include methoprene (Altosid) and larvicidal oils. Methoprene (Altosid) is a synthetic insect hormone designed to disrupt the transformation of a larval mosquito into an adult. It is applied either in response to observed high populations of mosquito larvae at a site, or as a sustained-release product that can persist for up to 3-months. Applications can be made by hand, ATV, or aircraft. While highly effective against mosquitoes, it has very low toxicity to non-target organisms. However, both biorational larvicides and methoprene (insect growth regulator) are ineffective against pupae. Pupae do not eat so they do not ingest the biorational larvicides and the pupal stage is generally too late in development for an insect growth regulator like methoprene to be effective. In instances where a control operator finds a breeding site with an abundance of late-stage mosquito larvae and pupae the only effective method of control is larvicidal oil.
Larvicidal oils are petroleum distillates (mineral oil) with low toxicity to plants and designed for fast environmental breakdown by sunlight. The oil forms a thin film on the water and kills the larvae through suffocation and/or direct toxicity. It is typically applied by hand, ATV, or truck. Unlike other larvicides, this material is also effective against mosquito pupae.

2018 Larvicide Use

<table>
<thead>
<tr>
<th>Product</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altosid Briquettes</td>
<td>4,861 ea</td>
</tr>
<tr>
<td>Altosid Liquid Larvicde</td>
<td>0.3 gal</td>
</tr>
<tr>
<td>Altosid XRG</td>
<td>1,379 lb</td>
</tr>
<tr>
<td>CocoBear Larvicde Oil</td>
<td>2,048 gal</td>
</tr>
<tr>
<td>Fourstar CRG Bti</td>
<td>12 lb</td>
</tr>
<tr>
<td>Natular 2EC</td>
<td>11.2 gal</td>
</tr>
<tr>
<td>Natular DT</td>
<td>4 ea</td>
</tr>
<tr>
<td>Natular G</td>
<td>32 lb</td>
</tr>
<tr>
<td>Natular G30</td>
<td>360 lb</td>
</tr>
<tr>
<td>Natular XRT</td>
<td>356 ea</td>
</tr>
<tr>
<td>VectoBac 12AS</td>
<td>34.4 gal</td>
</tr>
<tr>
<td>VectoLex WDG</td>
<td>117.1 lb</td>
</tr>
<tr>
<td>VectoLex WSP</td>
<td>9,974 ea</td>
</tr>
<tr>
<td>VectoMax FG</td>
<td>450 lb</td>
</tr>
</tbody>
</table>

Mosquito Adulticides

In addition to chemical control of mosquito larvae, the District also makes aerosol applications of pesticides for the control of adult mosquitoes; however, spraying for adult mosquitoes is only conducted when specific criteria are met, including: population density, species composition, and disease risk. As with larvicides, adulticides are applied in strict accordance with the pesticide’s label requirements. Commonly used adulticide products include natural pyrethrins (derived from the chrysanthemum plant) and synthetic pyrethroids (molecules similar to natural pyrethrins except manufactured in the lab). Both contain the synergist PBO (piperonyl butoxide) which improves their effectiveness against adult mosquitoes while reducing the amount of active ingredient needed. Both materials are applied as ultra-low-volume (ULV) fogs by truck or potentially by aircraft. In addition to having low toxicity to humans and other animals, these materials are applied in very small amounts (approximately 1-2 oz. of active ingredient per acre) and break down rapidly in sunlight. Applications are conducted at night, just before dawn, when the target mosquitoes are active, but bees and other non-target organisms would not be exposed.

2018 Adulticide Use

<table>
<thead>
<tr>
<th>Product</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dibrom</td>
<td>953.5 gal</td>
</tr>
<tr>
<td>Pyrocide 7395</td>
<td>64.4 gal</td>
</tr>
</tbody>
</table>

2018 Herbicide Use

<table>
<thead>
<tr>
<th>Product</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>CropSmart Glyphosate 41%</td>
<td>278.3 gal</td>
</tr>
</tbody>
</table>
Residential Services
The District received (566) requests for services in 2019 (609:2017). The services required on most residential properties consist of identification of a mosquito sample provided by resident, an inspection of the property or surrounding community for potential mosquito sources, and recommendations on how to alleviate a current mosquito problem and prevent future mosquito problems from occurring. Typically, a trap will be placed to ascertain the level of mosquito abundance and to help determine what species of mosquito is causing the problem. Depending on the trap and inspection results, follow-up larvicide and/or adulticide applications may be warranted.

<table>
<thead>
<tr>
<th>Product</th>
<th>Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finale</td>
<td>52.1</td>
</tr>
<tr>
<td>Goal 2XL</td>
<td>14.4</td>
</tr>
<tr>
<td>Glystar Plus</td>
<td>144.6</td>
</tr>
<tr>
<td>Lifeline</td>
<td>93.2</td>
</tr>
</tbody>
</table>
2019 Mosquito Surveillance

In 2019, late water releases due to snowmelt had a significant impact on mosquito populations in Stanislaus County. River seepage and flooding created thousands of acres of mosquito breeding habitat creating a significant number of adult mosquitoes early in the mosquito season. This early large population of mosquitoes increased the amplification of the virus resulting in higher mosquito infection rates (MIR) later in the summer and increased human infection. In addition to this increased WNV activity, the invasive mosquito *Aedes aegypti* significantly increased its range in California in 2019 being detected in Stanislaus, San Joaquin, Sacramento and Placer Counties. In terms of the Turlock Mosquito Abatement District, the mosquito was found throughout the east side of Newman, although in relatively low numbers.

2019 Trap Sites
Currently, there are (25) different species of mosquitoes that occur in Stanislaus County. Each species differs in its habitat preferences, biting patterns, preferred host, and ability to transmit disease. It is important to understand the characteristics of each mosquito species in order to determine the most effective trap type to use and strategies for control. Within an IVM program, the surveillance component is essential to understanding the changes in distribution of the various mosquito species and the diseases they carry. This surveillance data is reviewed and the information provided is used to coordinate control measures to effectively protect the public from biting mosquitoes and disease transmission.
The two species which occur most frequently are *Culex pipiens* and *Culex tarsalis*. These two species are of greater concern not only because of their high abundance but also because of their ability to transmit diseases such as West Nile Virus and Saint Louis Encephalitis Virus.

Overall, mosquito abundance peaked in June/early-July due to river flooding and seepage on the west side of the county. Large populations of *Aedes melanimon*, *Aedes vexans*, and *Culex tarsalis* dominated these early collections. By mid-July we were successful in returning these populations to the 5-year average. This high early population may have resulted in the increased WNV infection rate we observed later in the season.
2019 TMAD Mosquito Abundance

Mosquitoes per Trap Night

2019
5 Year Avg
2019 West Nile Virus Activity

Virus activity is monitored through the testing of mosquitoes, dead birds and humans. Mosquitoes which are collected from a variety of areas in the District are brought to the lab for species identification and virus testing. Birds that are collected from the field are also identified by species and tested for WNV. The mosquitoes, dead bird and human results can be a reflection of the level of virus activity in the District and can indicate new areas of virus emergence.

The “2019 Virus Activity” table below displays the timing of WNV activity in mosquitoes, dead birds, and humans. The Minimum Infection Rate (MIR) is a tool used to measure the amount of WNV in collected mosquitoes each year. Basically, it is the frequency of WNV positive mosquitoes out of 1,000 collected mosquitoes.

Reviewing the graph labeled “2019 Minimum Infection Rate by Disease Week”, the level of WNV was almost double for 2019 compared to the 5-year average. This indicates WNV was prevalent in much our District during the months of August and early September. During early August, the virus was most likely amplified due to the high temperatures occurring at that time. Around mid-August there was a drop in the temperatures which brought relief to residents but unfortunately the WNV had already built up in the mosquito populations. Residents were most likely enjoying the break from the heat wave outdoors increasing the opportunities for people to interact with infected mosquitoes. The temperatures dropped again by the second week of September and so did the MIR but at that time humans were enjoying the cooler weather, (3) additional cases of WNV occurred. It is a reminder that even into October there are still infected mosquitoes lingering and precautions need to be taken to avoid mosquito bites.
Saint Louis Encephalitis

Saint Louis Encephalitis Virus (SLEV) returned to TMAD during 2019, after no SLEV was detected in 2018. The prevalence of SLEV was significantly less than WNV; however, it is still contributing to encephalitis human cases. During 2019, 11 mosquito samples tested positive for SLEV along with 1 human case. In some instances, SLEV occurred at the same trap sites on the same day as a WNV positive sample; showing the newer strain...
of SLEV is much more competitive with WNV than the old strain. On 2 occasions a specific mosquito sample tested positive for both WNV and SLEV.
Invasive Species Monitoring

California has been dealing with a couple of invasive mosquitoes, *Aedes albopictus* (Asian Tiger Mosquito) and *Aedes aegypti* (Yellow Fever Mosquito). *Ae. Albopictus* arrived in 2011 and *Ae. Aegypti* arrived in 2014. Although both of these species have been spreading, *Ae. aegypti* has spread much further and faster in California. Currently, *Ae. aegypti* are found in 248 cities in California while *Ae. albopictus* are found in 72 cities. These species are a concern because they live in urban habitats, like to feed on people and are capable of spreading diseases such as dengue, chikungunya and Zika Viruses.

Starting in 2014, the District began utilizing new traps designed to be more attractive to the invasive species that are being found in other areas of California. These traps are designed to attract ovipositing (egg-laying) females which differ from the CO₂-baited traps the District uses for native species. In 2019, *Aedes aegypti* expanded its range in California significantly being detected in Stanislaus, San Joaquin, Sacramento and Placer counties. The District was successful in finding a small but widespread population of *Aedes aegypti* in the east side of Newman, CA.
Our first invasive mosquito sample, a single *Ae. aegypti*, was collected on August 14th, 2019 in the city of Newman at one of our regular trap sites. From that date on, the District ramped up our *Ae. aegypti* surveillance in Newman in an effort to determine the distribution and size of the population. We increased staff and public outreach in the area and utilized the BG sentinel traps along with ovipositional cups. The BG sentinel traps were best for determining the size of the population because they collect host seeking *Ae. Aegypti* females and occasionally male adults. The ovipositional cups are easy to deploy and place in locations questionable for BG traps or in areas for a quick check for *Ae. aegypti* activity. The ovipositional cups provide a place for females to lay eggs. Although the eggs don’t equate to the size of the mosquito population, they aid in determining the presence or absence of *Ae. aegypti* in an area. When eggs were collected, we tried to follow up with BG Sentinel Traps to assess the population size in a given area.

After roughly 2 months of trapping throughout Newman, it appeared the *Aedes aegypti* population was small in comparison to other cities. The population at that time was almost exclusively east of Highway 33. *Ae. aegypti* were collected in (41) out of (223) BG sentinel trap sites. A total of (88) *Ae. aegypti*; (50) females and (38) males were collected over the entire city of Newman during the 2-month period. Eggs were
collected at (22) of the (87) ovipositional cup sites. This indicates that females are breeding nearby. The collections ranged from 1 to 275 eggs per site.

It’s important to remember how difficult Ae. aegypti are to monitor and control because they breed in small cryptic sources and live near homes where it can be hard to access or get permission to enter the property. In addition, they are most active during the day when people and other beneficial are active, making the control of these mosquitoes much more complex. Once established in a neighborhood, residents can expect to be significantly impacted from their biting behavior. Based on Ae. aegypti’s expansion in California, we anticipate additional finds in other communities within the District.

Public Outreach
Public outreach remains a critical part of our mosquito control program. Through outreach we can remind residents how they can prevent breeding on their properties and report mosquito issues in their community. We speak to various organizations and schools, in our District, along with having an outreach booth at community street fairs and the Stanislaus County Fair. Through our interactions with students and residents we are able to educate them about the threats of mosquito borne viruses, how to protect themselves, and how to prevent mosquito breeding at home.
Reminding residents to report daytime biting mosquitoes especially in town has become one of our key messages. *Ae. aegypti* are known for being an aggressive daytime biter, and has often been discovered in other cities through reports from residents. This was not the case this year in Newman, but could likely occur in our other cities. We have developed informative print materials along with an invasive mosquito brochure to provide to residents. Advertising on buses, on the radio and in movie theatres also aid us in getting messages out to citizens to prevent WNV by avoiding mosquito bites and to report any daytime biting mosquitoes.
Policy Issues

Aggressive Source Reduction Program

The Board of Trustees and District management continue to review policy issues at the federal, state and local levels and how these issues will impact the future of mosquito control. For the most part, all policy issues tend to make the job of mosquito control more difficult and costlier.

Primarily, the District has focused in on (3) policy issues that we believe will have the biggest impact on future mosquito control activities:

- Regulations
- Climate Change
- Resistance

The layering and overlapping of state and federal regulations continue to have a great impact on effectiveness and costs of mosquito control. For instance, all pesticides are controlled by the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). This law establishes the system to protect applicators, consumers and the environment in regards to pesticides and their application. In 2011, the District was made to register and comply with a National Pollution Discharge Elimination System (NPDES) permit for any pesticide applications that may leave a residue in water - specifically aimed at Waters of the US. The safety, application rates, and procedures have already been tested and approved by FIFRA - requiring Districts to track, test, monitor applications that are already regulated and approved by FIFRA is a costly and overlapping regulatory burden that is unnecessary.
Whatever the cause of “climate change”, whether it represents natural cycles or is caused by the effects of manmade pollution, it is universally accepted that temperatures have increased dramatically over the past decade or two. In response, there has been more change within the mosquito control industry over the past decade than what was observed over the previous century. We have seen diseases such as West Nile virus become established in California as well as invasive species such as *Aedes aegypti* and *Aedes albopictus* which can transmit diseases such as: Zika, Dengue and Chikungunya virus. With the arrival of each new public health threat, a local district may see a small, temporary grant to deal with this new issue; but eventually the local district is expected to control this new threat with no new funding source. In 2019, a small but widespread population of *Aedes aegypti* were found in Newman, CA.

Finally, the levels of resistance to pyrethrin/pyrethroid based pesticides have reached critical levels in local mosquitoes. Unfortunately, the cost of registering chemicals and associated regulatory burdens have severely limited the options for adult mosquito control. Currently, there is only one other class of chemical available for adult mosquito control in California beside pyrtherin-based pesticides, and those are organophosphates. The District has begun utilizing Dibrom (naled - organophosphate) to reduce the applications of pyrethrin-based pesticides, but Dibrom must be applied only via aircraft which is very effective, but also costly.

In reviewing these and other policy issues, it became clear that the District needed to evolve and modify its control policies and program. The District invested in the MapVision© program, a geospatial database designed exclusively for mosquito control activities. District staff could now track exactly where and when applications were being made in real time as well as print and file reports to meet the growing regulatory burdens in an efficient manner. In addition, we could now more easily track costs and where the District was spending its money and more clearly make distinctions about the “outcomes” of that money. In response, the District designed and implemented the Aggressive Source Reduction Program to identify properties where the District was spending an excessive amount of time and money when compared to comparable properties. Owners of these properties were then contacted and were given (2) options:

- Reimburse the District for labor and materials in controlling the public nuisance on their property, or
- Permanently fix the conditions causing the public nuisance or a public abatement would be filed.

In 2019, the District collected $42,380 in control costs and collected $2,275 in abatement charges.
Insecticide Resistance

Perhaps the biggest policy issue affecting mosquito control in California concerns pyrethrin/pyrethroid resistance in adult mosquitoes. In 2014, the District sent in approximately (1000) mosquitoes to the California Department of Public Health to be tested using PCR techniques for the presence of the *kdr* mutation in a mosquito’s DNA that would confer pyrethrin resistance in adult mosquitoes. The name of the mutation is *kdr* which stands for “knock down resistance” since mosquitoes with this gene are initially “knocked down” by the pyrethrin/pyrethroid insecticide, but not killed.

Over 90% of the *Cx. pipiens* mosquitoes submitted for testing were homozygous for *kdr* resistance. This result tells us that the vast majority of the wild population of mosquitoes are resistant and very few susceptible individuals remain in the population - which is certainly not promising results! As such, this issue will have a large impact on the District’s future control program:

- Experts recommend that the District use an alternative adulticide with a completely different mode of action than pyrethrin/pyrethroids;
- Use of pyrethrin/pyrethroids will need to be much more controlled and on a much smaller scale;
- Increased emphasis on larviciding activities (i.e. killing the mosquitoes before they become adults);
- Increased emphasis on source reduction and elimination - which may include an increased use of the District’s abatement powers.

In 2015, the District made several changes to its mosquito control guidelines in response to pyrethrin resistance. These policy decisions must balance judicious use of pyrethrins...
to ensure the pesticide remains effective for as long as possible; but, also the importance of protecting public health. For the first time in 2015, the District began aerially applying naled which is an alternative class of chemical called organophosphates and has a completely different mode of action than pyrethrin. By utilizing an alternative pesticide, the intent is to reduce the genetic selection pressure against pyrethrins while also killing any adult mosquitoes which may be surviving our pyrethrin applications.

Pyrethrin applications were much more limited and occurred on smaller scales - when possible we tried to rely on our aerial applications of naled to provide control of adult mosquitoes. In addition, mosquito control operators continue to place much more emphasis on larviciding and source elimination realizing that adulticiding activities are truly a last resort.

**Neglected Swimming Pools**

Typically, during the months of April and July, the District conducts a flyover of urban/suburban neighborhoods to identify neglected or unmaintained swimming pools. Since its inception, the District’s aerial photographs have identified thousands of unmaintained swimming pools. Just one swimming pool can produce more than 1 million mosquitoes capable of transmitting WNV and affecting people up to five miles away.

In 2019, District staff inspected (440) pools as green and potentially breeding mosquitoes. District control staff inspected each one of these pools and treated those that were found to be breeding mosquitoes. Although these pools were successfully treated, in all instances, the owners of the pools are notified that District control
measures are just a temporary solution and that the pools will need to be maintained on a permanent basis. Owners with repeat violations will be abated subjecting them to reimbursing the District’s control costs and up to $1000 per day in civil penalties.

**Regulatory Compliance**

**National Pollution Discharge Elimination System (NPDES)**

In recent years, there have been a few lawsuits involved with the release of pesticides or their residues (termed “pollutants”) into waters of the United States. On November 27, 2006 EPA issued a final rule clarifying two specific circumstances in which a Clean Water Act (CWA) permit is not required to apply pesticides to or around water. They are: 1) the application of pesticides directly to water to control pests; and 2) the application of pesticides to control pests that are present over or near water, where a portion of the pesticides will unavoidably be deposited to the water to target the pests. The action put into effect a rule that confirms EPA’s past operating approach that pesticides legally registered under FIFRA for application to or near aquatic environments, and legally applied to control pests at those sites, are not subject to NPDES permit requirements.

In 2008, this rule was challenged by several environmental groups and the U.S. Sixth Circuit Court of Appeals held that this rule was not a proper interpretation of the Clean Water Act. The Sixth Circuit ruled that a CWA permit would be required for all biological and chemical pesticide applications that leave a residue in water. After a couple lengthy stays granted by the court, this mandate went into effect October 31, 2011. No further legal appeals are expected, so any further help regarding this matter would be legislative in nature.

To comply with permit requirements established by the California State Water Resources Control Board, the District was required to record all applications made to or near waters of the United States. In 2019, District personnel made (59) applications to waters of the U.S.
Financial Statement
The District depends on property tax revenue in Stanislaus County to fund its operations. Property tax revenue is only now starting to approximate levels seen before the housing crisis. Additionally, local property tax revenue earmarked for the District is annually diverted to the State of California’s Educational Revenue Augmentation Fund (ERAF). As such, for the past several years, District expenditures have outpaced property tax revenue decreasing the District’s fund balance reserves. In 2012, confident that the District reserve accounts should not be depleted any further, the Board of Trustees decided to implement the District’s Special Tax to generate much needed additional revenue.

In 1981, residents within the District passed Measure “C”, District Resolution 5-81, giving the District the authority to collect a “Special Tax” to augment District funds. Subsequent to Proposition 13, the District was not collecting adequate funds solely from property taxes to provide the level of mosquito control and service that the public wanted; so, Measure C was placed on the ballot to provide the District additional revenue needed for a more robust mosquito control program. The decision to re-implement the Special Tax is made on a year-to-year basis and only as needed.

Statement of Finances: FY 2018-19 (June 30, 2019)

<table>
<thead>
<tr>
<th>ASSETS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash &amp; Investments</td>
<td>$2,141,590</td>
</tr>
<tr>
<td>Accts. Rec. &amp; Inventory</td>
<td>$3,440</td>
</tr>
<tr>
<td>Deposits, non-current</td>
<td>$225,386</td>
</tr>
<tr>
<td>Capital Assets, net</td>
<td>$178,535</td>
</tr>
<tr>
<td>TOTAL ASSETS</td>
<td>$2,977,848</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LIABILITIES &amp; FUND BALANCES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Liabilities</td>
<td>$29,530</td>
</tr>
<tr>
<td>Total Fund Balance</td>
<td>$2,769,783</td>
</tr>
<tr>
<td>TOTAL LIABILITIES &amp; FUND BALANCE</td>
<td>$2,799,313</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REVENUES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Taxes</td>
<td>$2,347,402</td>
</tr>
<tr>
<td>Other Governmental Revenue</td>
<td>$131,983</td>
</tr>
<tr>
<td>Interest &amp; Miscellaneous</td>
<td>$217,681</td>
</tr>
<tr>
<td>TOTAL REVENUES</td>
<td>$2,787,066</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPENDITURES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries &amp; Benefits</td>
<td>$1,379,183</td>
</tr>
<tr>
<td>Services &amp; Supplies</td>
<td>$984,069</td>
</tr>
<tr>
<td>Capital Outlay</td>
<td></td>
</tr>
<tr>
<td>TOTAL EXPENDITURES</td>
<td>$2,363,252</td>
</tr>
</tbody>
</table>
TURLOCK MOSQUITO ABATEMENT DISTRICT

Protecting the Public from Mosquito Borne Diseases Since 1946

The Turlock Mosquito Abatement District is dedicated to enhancing the quality of life for our community by providing effective and environmentally sound mosquito control and disease prevention through timely and efficient surveillance, control and public awareness programs.

SERVICES PROVIDED

MOSQUITOES
Inspection & Control

MOSQUITOFISH
For Residential & Agricultural Sites

PUBLIC EDUCATION
Literature, Presentations, Website, News & Spray Alerts

WNV DEAD BIRD TESTING
Report to: 1-877-968-2473

MOSQUITO SURVEILLANCE
Local & Invasive Mosquito Species