ALAMEDA COUNTY
MOSQUITO ABATEMENT DISTRICT

85th and 86th Annual Report
2016 –2017

Dedicated to the Memory of

Ronald Quinn
Union City Board Member
2001-2017
Passed Away December 2017

LEADING THE WAY

The last two years has felt like a “golden age” for the District, an era I am proud to be a part of. The Alameda County Mosquito Abatement District (ACMAD) has an impressive history and solid foundation to build upon, and we have continued our successful and unique traditions. These include a focus on larval-based mosquito control, fiscal responsibility, collaborative decision-making, interagency partnerships, and a supportive working environment for the employees. We built on our strengths through investment in technology innovations, research initiatives, operational cooperation, transparency, and public outreach. These advances were done without raising taxes, legal abatement, or service fees, and with existing staff that follows the direction of its Board of Trustees. Strategic planning will allow us to build off our assets while anticipating future challenges.

A contributing factor to the District's effectiveness is the longevity of its staff and Board of Trustees who are working towards continual District and professional improvement. This institutional knowledge, along with accurate record keeping and storage, allows staff and Trustees to rely on both experience and research for its decision-making. A major initiative during the past two years was the integration of information technology into all aspects of the District workflows to improve record keeping and analyses.

The District now uses tablets in the field to record information on mosquito abundance and treatments which are integrated with GPS location data. These data are stored in the cloud, along with all District data, which allows for data security and improved access. The improvements in quality and accessibility of information allows field staff to make data-driven decisions via live dashboarding, saving resources through data-entry automation and report generation.

For the first time since 2011, the District acquired all of the necessary approvals for mosquito breeding source reduction work in the San Francisco Bay tidal wetlands, because of these improved reporting capabilities. This process began with the certification of the Programmatic Environmental Impact Report in 2016 (which began in 2010), followed by approvals from the San Francisco Bay Regional Water Quality Control Board, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, California Department of Fish and Wildlife, and the San Francisco Bay Conservation and Development Commission. While no ditching occurred during this reporting period, the District is poised to resume bay tidal drainage ditching during the 2018-19 season. The District was prepared for and supportive of ballot measure AA in 2016 (The San Francisco Bay Clean Water, Pollution Prevention and Habitat Restoration Measure). With its passage, the District successfully had one of our staff appointed to the Bay Restoration Authority's advisory committee, which advises the Board on implementation of the measure's mission to fund shoreline project that will protect, restore, and enhance the San Francisco Bay using property tax funds collected from the nine bay area counties represented by the authority.

Advances in drone technology now allow for mosquito abundance assessment and treatments using unmanned aircraft systems (UAS, or “drones”). One of the first UAS mission proposals includes measuring the impact of sea level rise on marshland restoration projects. In 2017 the Board of Trustees authorized funding for drone technology and sent staff for flight training. As of this report, two employees are certified Federal Aviation Administration UAS pilots, after passing a rigorous exam.

UAS assessment of marsh restoration efforts and mosquito abundance will augment an already robust research program that already includes insecticide resistance testing, field evaluations of mosquito assessment technologies, and mosquito genome sequencing. As a publicly funded agency, the District laboratory staff must creatively find solutions to major problems. Partnerships with large non-profits (e.g., Chan Zuckerburg Biohub), universities (e.g. UC Berkeley and Cal State East Bay), and other mosquito control agencies allow the lab to continue its existing research mandates with cutting edge research.

Over the past two years, the District has presented several posters and talks at the annual Mosquito and

Vector Control Association of California (MVCAC) conference, as well as a publication in the peer-reviewed *Journal of the American Mosquito Control Association*. Operations staff also presented, both orally and through posters, at both MVCAC conferences, locally at continuing education trainings, and at the California Stormwater Quality Association conference, in 2017. The focus of much of this outreach was the impact trash capture devices are having on mosquito control in California. ACMAD is a leader in the state in this regulatory area.

Our staff have consistently attended monthly county emergency meetings and subsequent trainings as a proactive planning measure. The District's emergency manager also manages its safety, the aquaculture program, along with facility, vehicle, and equipment maintenance. The Board ensues financial support for equipment reliability in the form of a balanced budget, capital planning, and adequate reserve allocations.

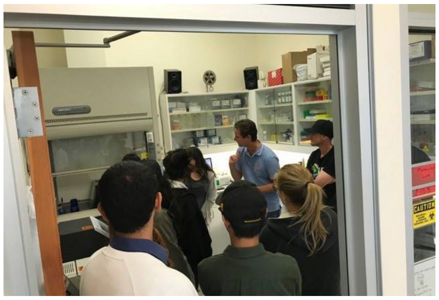
In 2017 the District overhauled its reserve accounts by opening new interest-earning accounts with California Asset Management Program (i.e., operational, capital planning, repair and replace, public health emergency), and Public Agency Retirement Services (i.e., pension rate stabilization). This foresight will allow the District to continue its high-quality level of service to Alameda County residents without interruption and distraction from property value fluctuations, and rising pension and health care costs.

The public would be unaware of these accomplishments and value they receive without effective communication and outreach programs. The District continues to participate in public outreach at community events, and also utilizes many forms of media (e.g., billboard advertisements, newsletters, and social media platforms) to inform the public on the services that the District provides.

If you are reading this report, you are a part of the District either directly, or through partnerships. If not, contact us to be a part of solving problems that affect us all—mosquitoes and the diseases that they spread.

Ryan Clausnitzer
General Manager

TABLE OF CONTENTS



GOVERNING BOARD

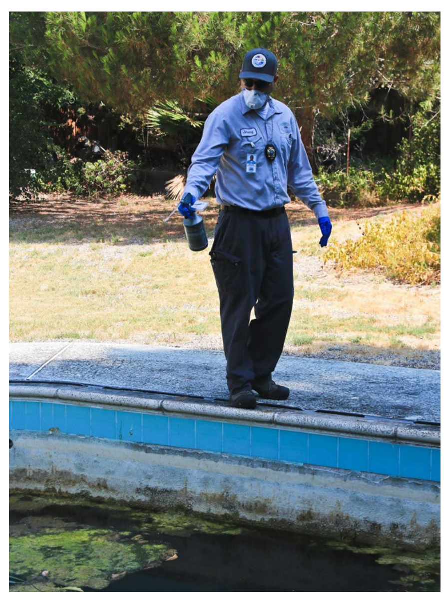
The Alameda County Board of Supervisors and each of the elected councils of the 13 cities within the District appoint one trustee to represent its constituency on the governing board of the Alameda County Mosquito Abatement District. The Board of Trustees consists of individuals dedicated to community service and willing to accrue the knowledge required to govern a mosquito abatement district effectively. The District's Board members possess a variety of skills and expertise in academia, agriculture, art, business, chemical engineering, education, electrical engineering, entomology, environmental health, environmental health and safety, insurance, finance, government, human resources, mechanical engineering, and scientific research.

The diversity of knowledge possessed by the Trustees provides a broad, conceptual framework within which the Board decision-making occurs. This knowledge base provided by the Trustees is an invaluable resource.

Trustees serve two-year terms without compensation; however, they do receive allowances for expenses incurred while attending business meetings of the Board. The regular Board meetings are held on the second Wednesday of each month at the District office (23187 Connecticut Street, Hayward at 5:00 p.m.), and these meetings are open to the public.

TRUSTEES FOR THE YEARS 2016 & 2017

Trustee	Representing	Years of Service
Scott Paulsen	County-at-large (2016)	2.0
Humberto Izquierdo	County-at-large (2016-2017)	1.5
Wendi Poulson	Alameda	2.5
Robert Beatty	Berkeley	1.5
Richard Guarienti	Dublin	4.5
Scott Donahue	Emeryville	2.0
Betsy Cooley	Emeryville (2017)	1.0
George Young	Fremont	5.0
Elisa Marquez	Hayward	3.0
James N. Doggett	Livermore	41.0
Jan O. Washburn	Oakland (Berkeley)	2.5 (21.0)
Eric Hentschke	Newark	2.0
Robert Dickinson	Piedmont	4.0
Kathy Narum	Pleasanton	4.5
Ursula Reed	San Leandro (2016)	1.0
Ed Hernandez	San Leandro (2017)	1.0
Ronald E. Quinn	Union City	16.0



COMMITTEE ASSIGNMENTS AS OF DECEMBER 2017

FINANCIAL COMMITTEE

Purpose: The Finance Committee is a standing committee tasked with reviewing the annual budget, assessing the District's long-term capital needs, making recommendations for designating reserves, and evaluating the allocation of the OPEB Trust.
Membership: Cooley, Dickinson, Hernandez, Narum, Young

POLICY COMMITTEE

Purpose: The Policy Committee evaluates the District's Policies and updates and adds policies as needed. All District policies must be approved by a majority of the Board after staff review.
Membership: Doggett, Hernandez, Marquez

MANAGER EVALUATION COMMITTEE

Purpose: The primary task of the Manager Evaluation Committee is to complete an annual review on the performance of the District Manager. Reviews are completed by the June meeting of the Board and used for determining compensation changes and contract adjustments, annually by the June board meeting. Compensation changes and contract adjustments will be based on this evaluation.
Membership: Past, present, and future Board Presidents: Narum, Marquez, Poulson

PUBLIC HEALTH EMERGENCY COMMITTEE

Purpose: The Public Health Emergency Committee meets with the District Manager and/or Staff to review District surveillance and treatment information pertaining to current or emerging public health threats and make recommendations to the board if necessary.
Membership: Washburn, Doggett, Poulson
Status: This committee only meets on an as needed basis.

PERSONNEL COMMITTEE

Purpose: The Personnel Committee meets as needed if personnel issues rise to the level of an appeal to the board.
Membership: Current Board Officers: Marquez, Poulson, Hentschke, Beatty
Status: This committee only meets on an as needed basis.

SUSTAINABILITY COMMITTEE

Purpose: The Sustainability Committee evaluates areas the District can improve its sustainability such as solar energy, refuse reduction, and fuel efficiency.
Membership: Izquierdo, Marquez, Poulson, Washburn
Status: This committee only meets on an as needed basis.

STRATEGIC PLANNING COMMITTEE

Purpose: The Strategic Planning Committee assesses the future opportunities and challenges facing the District, the committee will review the current Mission and Vision and develop a five-year strategic plan that aligns the Mission and Vision with forecasted challenges in finance, technology, infrastructure, regulation, climate change and personnel.
Membership: Beatty, Hernandez, Poulson, Washburn, Young

DISTRICT PERSONNEL

Name of Employee	Position	Years of Service
Dereje Alemayehu	Biological Specialist	18.5
Nick Appice	Mosquito Control Technician (Zone 2)	3.5
John Busam	Vector Biologist (Zone 9)	15.5
Cornelius Campbell	Vector Biologist (Zone 8)	14.0
Miguel Cardenas	Vector Biologist (Zone 6)	6.0
Erika Castillo	Regulatory & Public Affairs Director	15.5
Ryan Clausnitzer	General Manager	2.5
Sarah Erspamer	Mosquito Control Technician (Zone 1)	2.5
Robert Ferdan	Information Technology Director	2.5
Eric Haas-Stapleton	Laboratory Director	2.5
Joseph Huston	Field Operations Supervisor	26.5
Clarence Lam	Administrative/Financial Manager	14.0
Michelle Matthes	Accounting Associate	1.5
Tom McMahon	Vector Biologist (Zone 10)	16.0
Ben Rusmisel	Vector Biologist (Zone 3 & 4)	2.5
Jeremy Sette	Mosquito Control Technician (Zones 5 & 7)	2.5
Jan Washburn	Interim District Manager	.5
Mark Wieland	Mechanical Specialist	3.0

Seasonal Employees

2016: Danny Avila, Allen Esterly, Jacob Ferdan, Starla House, Kevin Huffstutler, Michelle Matthes

2017: Danny Avila, Miguel Berreto, Allen Esterly, Brandon Garcia, Mel Go, Jacob Ferdan, Starla House, Rajni Lakha, Joanna Roacho, Jaime Sweeney

REPRESENTATION ACTIVITIES

The District is one of 63 agencies that conduct mosquito control in California and is a member of the Mosquito and Vector Control Association of California (MVCAC). The District participates in the activities of the MVCAC and the American Mosquito Control Association (AMCA) to promote coordination of our common goals and to increase our knowledge of mosquito control.

The District is also a member of the California Special District Association (CSDA) which has over 1,000 members state-wide and promotes good-governance and improved core local services through professional development, advocacy, and other services for all types of independent special districts The District participates in other organizations to promote the role of special districts and mosquito management and to remain aware of emerging technologies. The following is a list of District employees who have participated in regional, statewide or national organizations:

Erika Castillo – MVCAC Public Relations Committee (2016 and 2017 Chair), MVCAC Regulatory Affairs Committee, San Francisco Bay Joint Venture Conservation Delivery Committee, San Francisco Bay Restoration Authority Advisory Committee

Ryan Clausnitzer – Alameda County Special District Association Board Member-at-large, California Special Districts Association Board (2017 Treasurer)

Sarah Erspamer – Alameda County Emergency Managers Association, American Mosquito Control Association Young Professional (2018 Industry Shadowing Program)

Robert Ferdan – MVCAC Information Technologies Committee

Eric Haas-Stapleton – Entomological Society of America, MVCAC Laboratory Technologies Committee, MVCAC Vector Control Research Committee (2017 Chair), Society for Invertebrate Pathology

Mark Wieland – Alameda County Emergency Managers Association, Alameda County Voluntary Organizations Active in Disasters

OPERATIONAL DATA

	2013	2014	2015	2016	2017
PHYSICAL CONTROL OPERATIONS					
Maintenance of ditches (lineal feet)	0	0	0	0	0
MOSQUITOFISH OPERATIONS					
Total number of sites stocked with *Gambusia*	761	691	606	891	762
Total number of fish planted	15,986	13,445	10,664	13,099	11,656
CHEMICAL CONTROL OPERATIONS					
Pyrenone 25-5 adulticide (oz)	2	820	159	0	0
SURFACE AGENTS					
BVA2 larvicidal oil (gallons)	1,937	1,540	2,170	1,011	638
Cocobear (Gallons)	0	0.3	0.42	0	0
BIORATIONAL LARVICIDES					
Bacillus thuringiensis israelensis (B.t.i.)					
Vectobac 12AS liquid concentrate (gallons)	54	58	103	232	243
Vectobac GS (pounds)	0	0	481	1	0
Vectobac G granular (pounds)	2,741	2,464	3,923	7,894	5,493
Bacillus sphaericus (B.s.)					
Vectolex CG (pounds)	1,094	659	1,460	2,783	868
Vectolex WSP (pounds)	16	6	34	1.14	0
Vectolex WDG (pounds)	54	108	140	5	1
FourStar 180 day Briquets (pounds)	93	54	5	33	0
B.t.i. and B.s.					
Vectomax WSP (Pounds)	0	0	2	5	2
Vectomax FG (pounds)	0	0	4,927	1,917	2,496
Spinosad					
Natular XRT (pounds)	153	581	1,277	1,098	833
Natular G30 (pounds)	916	29	1	80	5
Insect growth regulator (methoprene)					
Altosid Liquid Larvicide 20% (ounces)	311	275	626	1,024	1,152
Altosid Briquets (each)	1,903	1,685	3,072	1,873	1,566
Altosid XR Briquets (each)	247	3910	2,510	2,793	3,535
Altosid Pellets (ounces)	3,094	6,369	2,289	2,514	5,706
Altosid WSP (Pounds)	0	0	0	5	2

OPERATIONS REPORT

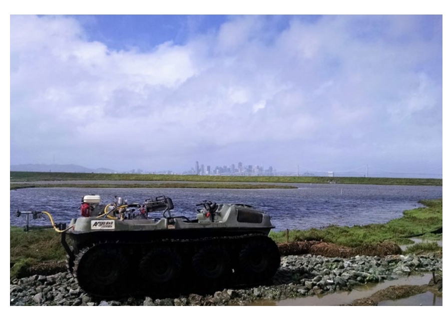
OVERVIEW OF ACMAD OPERATIONS

Access to mosquito breeding sources, timing of inspections, selection of treatment products, and timing of treatments is critical in maintaining a successful larval control program. Environmental factors such as temperature and rainfall can also affect the efficacy of treatments and the rate of mosquito development. Alameda County has 22 mosquito species. Each species has a suite of biological characteristics (e.g., breeding habitat, duration of time from egg to adult, and temporal pattern of adult activity) that must be well understood to deliver the correct product at the proper time for effective mosquito control. This requires the Operations staff to identify each species correctly and to have a thorough understanding of their biology and life history.

Effective mosquito control became even more challenging in 2016-2017 when Alameda County experience a record rainfall. After many years of drought, the winter seasons of 2016 and 2017 saw substantial and prolonged periods of rain, surpassing averages throughout the County. This resulted in more standing water that persisted for months longer than it had during the previous decade. Based on the number of adult mosquitoes that were collected in traps, the types and percentages of materials utilized, and the number of mosquito biting complaints received by the District, Operations staff executed ACMAD's larval program and environmental goals effectively under unusually difficult circumstances.

MOSQUITO CONTROL TREATMENTS

Alameda County Mosquito Abatement District has a long-standing strategy for controlling potential disease transmitting and nuisance mosquito species as larvae via environmentally conscientious measures. Despite many challenges, the District's operational staff continued these practices in 2016 and 2017. Treating mosquito larvae in aquatic sources reduces adult mosquito emergence and dispersal into the surrounding environments. Many mosquito species have long flight ranges and trying to control adult mosquitoes can be logistically difficult. All the District's treatments during this two-year period were for mosquito larvae in aquatic sources.



The products ACMAD uses for larval mosquito control are very effective and highly mosquito specific. Mosquito larvae hatch from an egg, move through four stages know as instars, molt into pupae, and if left untreated, emerge as adult mosquitoes. During the first three instars and partially into the 4th instar, mosquito larvae are actively feeding in their aquatic environment. When mosquito larvae reach the later stage of the 4th instar, they cease feeding and prepare to pupate. Bacterial products for control must be applied when larvae are still actively feeding for them to be ingested and kill the larvae. Growth regulators mimic an insect juvenile hormone and must penetrate the larvae's cuticle before they develop into the non-feeding pupa stage of the mosquito life cycle. Mosquito larvae that are exposed to juvenile hormone are prevents from completing development and emerging as adults. Once the larvae pupate, bacterial products and growth regulators are no longer effective, and surfactants must be utilized to prevent emergence. Surfactants coat the water surface and suffocate the mosquito larvae by preventing them from breathing. When applied at the EPA-approved label rate, almost all the bacterial products and growth regulators do not harm populations of non-target aquatic organisms, many of which prey on mosquito larvae. This natural predator complex helps to keep the mosquito population from quickly rebounding after treatments are applied and further enhances mosquito control.

During 2016 and 2017 a total of 8,683 acres of aquatic habitat were treated for mosquito larvae. When broken down by product type, 5,680 acres (65%) were treated with bacterial products, 2,689 acres (31%) were treated with growth regulators, and 314 acres (4%) were treated with surfactants (Figure 1). As mentioned above, operations were not conducted for controlling adult mosquitoes during 2016 and 2017.

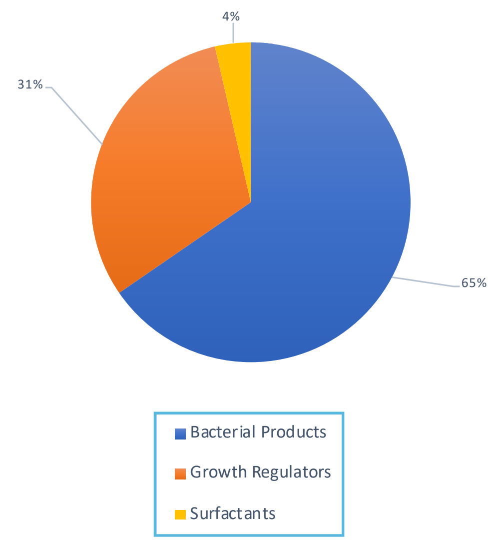


FIGURE 1: Product usage for 2016 and 2017 based on acreage

MOSQUITOFISH

Mosquitofish (*Gambusia affinis*) also play an important role in ACMAD's larval based integrated vector management (IVM) program. They have been utilized in California as a biological control agent for mosquito larvae since the early 1900's. Mosquitofish are not native to this region and are used by ACMAD exclusively in sources created by humans and their activities (e.g. ornamental fish ponds, fountains, unmaintained swimming pools, and livestock/horse watering troughs). Most introductions of mosquitofish result in self-sustaining fish populations that provide effective biological control for many years. Mosquitofish are an excellent long-term solution for controlling mosquito breeding in a diversity of settings. During 2016 and 2017, Operations staff introduced mosquitofish into 1,657 breeding sites; in total, ~ 25,000 fish were planted into ornamental ponds, fountains, unmaintained swimming pools, and watering troughs (roughly 10 acres of habitat).

SERVICE REQUESTS

Service requests represent the primary interaction between District staff and the residents of Alameda County. Residents of the County can either call the District or submit a request through the District website to receive service. These communications are categorized as requests to resolve mosquito biting issues, to inspect standing water and potential mosquito breeding sources, to report a dead bird or squirrel (which is tested in the District's lab for the presence of arboviruses), to identify an unknown insect or arachnid, and to request mosquitofish. The percentages of each of these request types are represented in Figure 2.

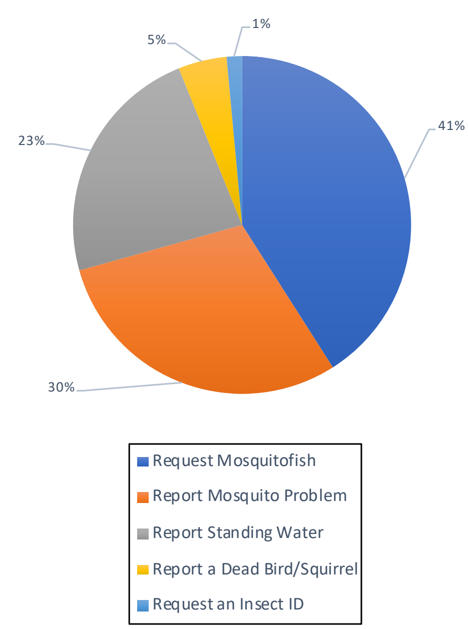


FIGURE 2: Product usage for 2016 and 2017 based on acreage

The number of service requests from the public varied by local during the past two years. The numbers of calls received by residents of a city are typically a reflection of the actual population of the city and the awareness of the city's residents about our program. Figure 3 depicts a comparison of the number of service requests received during 2016 and 2017 from the cities we serve. Figure 4 breaks down the service requests for each city by request type and also shows the population of each city.

ENVIRONMENTAL COMPLIANCE AND PERMITTING

June 2016 marked the completion, certification, and adoption of ACMAD's Programmatic Environmental Impact Report (PEIR), a multiyear project. The PEIR analyzed the potential environmental impacts of all District equipment, facilities, and activities. Apart from the potential use of an organophosphate adulticide, a necessary tool to protect public health when pyrethroid resistant arbovirus carrying adult mosquitoes are present, District activities were determined to be less than significant. Among the activities analyzed was the District's source reduction program which involves the routine maintenance of circulation ditches in tidal marsh habitats. The PEIR was a required step to renew the permits necessary to reinstate source reduction work in tidal marshes. The final permits were submitted in the fall of 2017 and approved in early 2018.

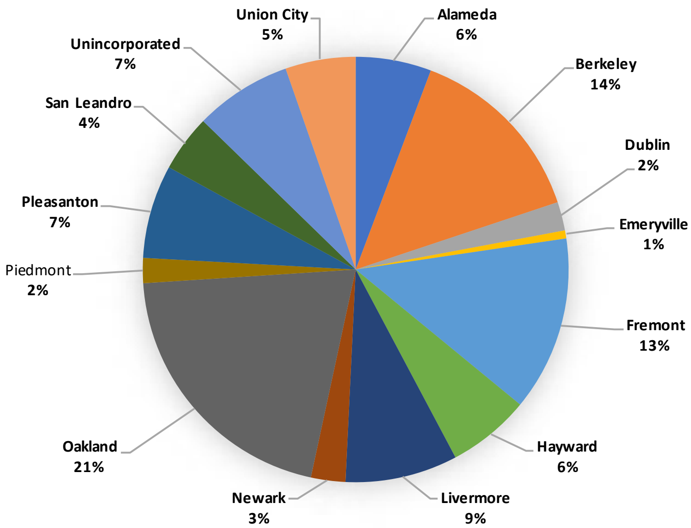


FIGURE 3: 2016-2017 Service Requests by city

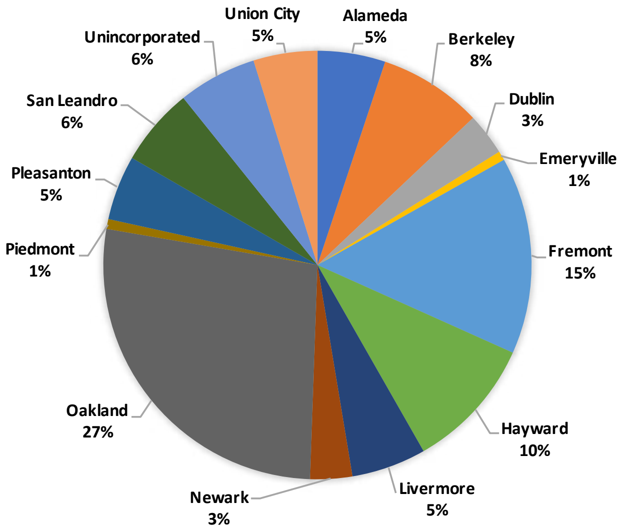


FIGURE 4: Alameda County population breakdown

LABORATORY REPORT

OVERVIEW OF ACMAD LAB ACTIVITIES

The Lab at ACMAD is principally responsible for assessing the abundance of adult mosquitoes, testing for the presence of arboviruses (arthropod-borne viruses) in birds and mosquitoes, evaluating mosquito resistance to insecticides, surveying habitats for the presence of invasive mosquitoes, and conducting research that supports the assessment of mosquito abundance and mosquito control. West Nile virus (WNV), Saint Louis encephalitis virus (SLEV) and Western equine encephalitis virus (WEEV) are arboviruses that can be transmitted to humans and birds by mosquitoes that are native to Alameda County. The prevalence of WNV, SLEV, and WEEV are assessed by testing dead birds and most collected mosquitoes that have the capability to transmit these viruses. Mosquito resistance to insecticides is evaluated using functional, biochemical, and genetic assays to ensure that products used for mosquito control are efficacious. The presence of invasive *Aedes* mosquitoes in California that can transmit Zika virus (ZIKV), dengue virus (DENV), and chikungunya virus (CHIKV) prompted intensified monitoring for these mosquitoes in Alameda County; an effort that was supported in part by the Centers for Disease Control and Prevention (CDC). Research during 2016 and 2017 included developing improved traps for detecting invasive *Aedes* mosquitoes, evaluating *Culex erythrothorax* abundance and control efforts at Hayward Regional Shoreline, and collaborating with Chan Zuckerberg Biohub on sequencing the genome of mosquitoes that occur in California. Publications and conference presentations based on research conducted by the ACMAD Lab from 2016 – 2017 include one peer-reviewed research article published in the *Journal of the American Mosquito Control Association*, four oral presentations, and six research poster presentations at the Annual Meetings of the Mosquito and Vector Control Association of California (MVCAC). Additionally, laboratory personnel published ten abstracts in the Proceedings of the MVCAC during 2016 and 2017.

MOSQUITO ABUNDANCE ASSESSMENTS

OVERVIEW OF ASSESSING ABUNDANCE

The ACMAD Lab assesses mosquito abundance by placing traps that capture adult mosquitoes or the eggs they lay (i.e., after oviposition) throughout Alameda County. Several trap types are used because they employ different attractants and collect different mosquito species. They include: light traps (light attractant), CDC carbon dioxide (CO_2) encephalitis virus surveillance traps (CO_2 traps; CO_2 attractant), oviposition traps (water attractant), Mosquito Magnet traps (MMT; CO_2, heat, and water vapor attractants), and BG-Sentinel traps (BGST; artificial human scent attractant).

WEATHER IN ALAMEDA COUNTY DURING 2016 AND 2017

Because mosquitoes are ectothermic animals, environmental temperature plays a major role in their development from aquatic larvae to flying and biting adults. In general, temperature and development time are inversely correlated for mosquitoes; thus, higher temperatures can correlate with high mosquito abundance. Environmental temperatures that fall below 50°F slow mosquito development. Growing Degree Days base 50°F (GDD) is a summary heat index that measures heat accumulation in the environment when surface temperatures exceed 50°F, conditions that facilitate rapid mosquito growth. There was no substantial difference in GDD for 2015, 2016, and 2017 (3928, 3957, and 4013 GDD, respectively as measured in Hayward, CA). Mean annual temperatures during 2015 – 2017 were identical (61°F). Rainfall can also affect mosquito abundance by providing larger or long-lasting breeding sites for larvae, or depending upon the intensity of the rainfall, kill adult mosquitoes. Rainfall during 2015 (total of 7.75 inches) was lower than what was recorded for 2016 and 2017 (total of 14.43 and 15.42 inches, respectively).

ASSESSING MOSQUITO ABUNDANCE USING LIGHT TRAPS

Fourteen light traps (LT) were deployed during 2016 and 2017 to monitor adult mosquito abundance. The locations of LT are indicated on the trap site Google Map by red lightning bolt icons (Figure 5). LT at each site operate continuously throughout the year; trap contents are collected every seven days and analyzed. LT capture adult male and female mosquitoes. During 2016 and 2017, a total of 11,766 and 12,071 adult mosquitoes, respectively, were collected in LT and identified to species (Figure 6). *Culiseta incidens* was the most abundant species in LT collections during both years, representing 48% of the mosquitoes caught in LT during 2016 and 35% during 2017. This species does not transmit arboviruses to humans and breeds year-round in freshwater and urban habitats. Two other common species that were collected in LT during 2016 and 2017 were *Culex erythrothorax* and Culex *tarsalis* (percent of total mosquitoes captured in LT during 2016 and 2017: *Cx. erythrothorax*: 10% and 30%; *Cx. tarsalis*: 24% and 24%). In the absence of mosquito control efforts, both species breed intensively in marsh habitats and can transmit WNV, SLEV, and WEEV to birds and humans.

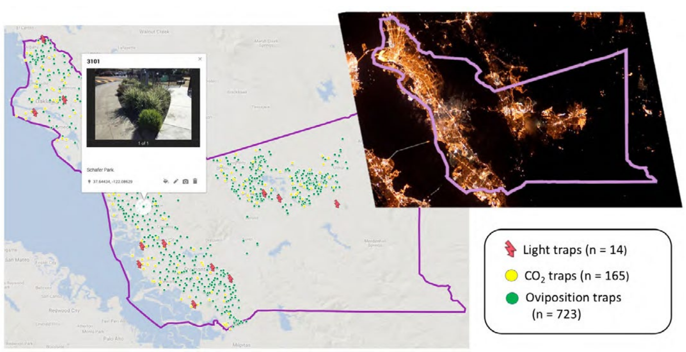
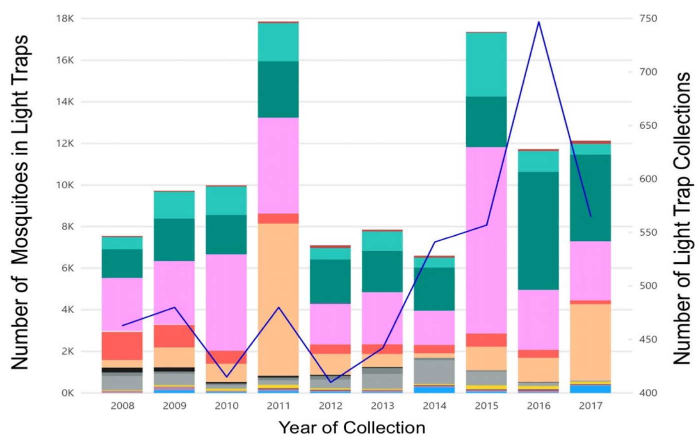


FIGURE 5: Location of the trap sites in Alameda County during 2017.

The boundary of Alameda County is indicated in purple. The popup image on the map shows photographs added to Google Maps that aid staff in locating the traps.

The inserted nighttime image of the Bay Area taken by an astronaut aboard the International Space Station is provided to illustrate that mosquito trap placements correlate with population density in Alameda County (astronaut photograph ISS037-E-2064 taken by Expedition 37 crew).



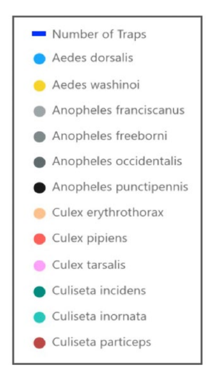


FIGURE 6: Mosquito monitoring in Alameda County using Light Traps.

Left axis shows the number of mosquitoes collected in LT each year for 2008 – 2017. Stacked bars indicate the distribution of mosquito species captured in LT. Right axis shows the number of LT collections for each year.

ASSESSING MOSQUITO ABUNDANCE USING CDC CO_2 ENCEPHALITIS VIRUS SURVEILLANCE TRAPS (CO_2 TRAPS)

During 2016 and 2017, over 150 sites in Alameda County were monitored for mosquito abundance using CO_2 traps (Figure 5). Because adult mosquito abundance in Alameda County is typically very low when the weather is cool, mosquito monitoring using CO_2 traps occurred predominantly from April – October. The traps were baited with dry ice that sublimates to release CO_2 gas that primarily attracts adult female mosquitoes seeking a blood meal. Traps were placed at sites for one day to capture adult mosquitoes when they are most active (i.e., the hours surrounding sunset and sunrise). Relative to 2014, the number of CO_2 traps placed and analyzed for mosquitoes was increased more than seven-fold for 2016 and more than twelve–fold for 2017 [Figure 7; Year (number of trap collections for the year): 2014 (131), 2015 (837), 2016 (967), and 2017 (1648)]. During 2016, a total of 33,330 adult mosquitoes were captured in CO_2 traps and identified to species, while 27,998 mosquitoes were captured during 2017. The most highly represented species in CO_2 traps for 2016 and 2017 were *Cx. erythrothorax*, *Cx. tarsalis*, and *Culex pipiens* (Figure 7, Table 1). While *Cx. erythrothorax* are restricted to marsh habitats, *Cx. tarsalis* can breed in marsh and urban environments, and *Cx. pipiens* breed predominantly in urban and suburban habitats. The number of mosquitoes per trap night is another widely used measure of mosquito abundance, and *Cx. erythrothorax* was the most abundant species during both 2016 and 2017 (Table 1). The abundance of *Cx. erythrothorax* in a marsh was the focus of a study to determine the efficacy of larvicide products and is described in the Mosquito Research section.

ASSESSING MOSQUITO ABUNDANCE USING MOSQUITO MAGNET TRAPS (MMT).

High abundance of *Cx. erythrothorax* in a marsh that abuts the San Francisco Bay provided an opportunity to determine whether this species is better attracted by MMT or CO_2 traps. The results are described in the Mosquito Research section; in summary, the MMT collected significantly more *Cx. erythrothorax* relative to CO_2 traps.

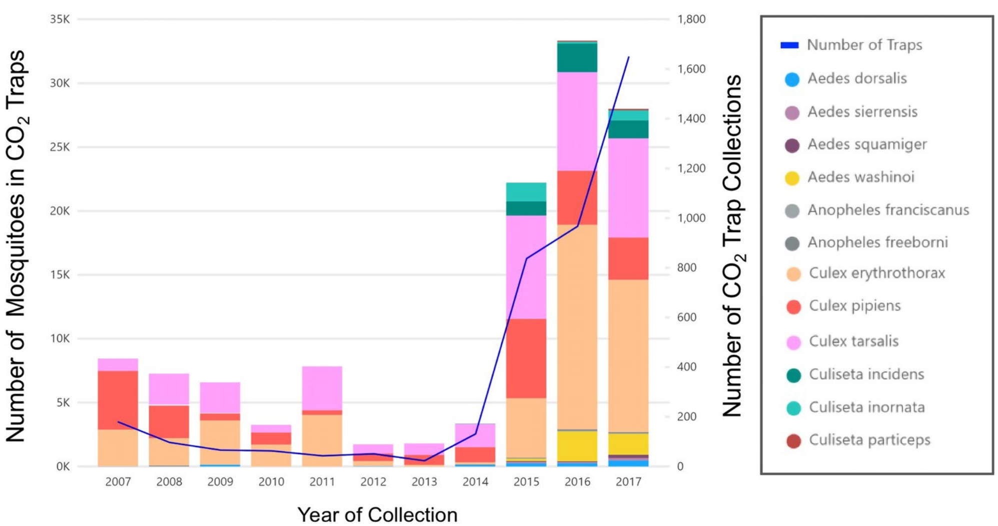


FIGURE 7: Mosquito monitoring in Alameda County using CO_2 traps.

Left axis shows the numbers of mosquitoes collected in CO_2 traps each year for 2008 – 2017.

Stacked bars indicate the distribution of mosquito species captured in CO_2 traps. Right axis shows the number of CO_2 trap collections for each year.

TABLE 1: Highest abundance species of mosquito collected in CO_2 traps during 2016 and 2017.

	2016		2017	
SPECIES	% of total	Mosquitoes per trap night	% of total	Mosquitoes per trap night
Cx. erythrothorax	48%	16.6	43%	7.2
Cx. tarsalis	23%	8.0	28%	4.7
Cx. pipiens	13%	4.4	12%	2.0

INVASIVE AEDES ASSESSMENT PROGRAM

The establishment of invasive *Aedes* mosquitoes (*Ae. aegypti* and *Ae. albopictus*) in the southern and central valley regions of California prompted intensified efforts by the ACMAD Lab to monitor the County for the presence of these mosquitoes. This increased effort was supported in part with funds awarded by the CDC for invasive *Aedes* monitoring and outreach programs. During 2016 invasive *Aedes* monitoring relied upon oviposition cup traps (OCT) and CDC autocidal gravid traps (AGO). Use of OCT in an extensive network of invasive *Aedes* mosquito traps is labor intensive because they need to be inspected approximately twice a week to replace the mosquito attractant, while the AGO are relatively costly and easy to damage. Consequently, we developed an oviposition bucket trap (OBT) that can be inspected once a month and are not costly to manufacture ($2.80 for materials and 3 minutes of work effort). The abilities of OBT and OCT to collect *Ae. aegypti* eggs were evaluated in Madera, CA, in collaboration with the staff of the Madera County Mosquito and Vector Control District (MCMVCD). The study results are described in the Mosquito Research section and show that the OBT collected significantly more *Ae. aegypti* eggs relative to OCT. Moreover, the use of OBT in a network of invasive *Aedes* traps required significantly less work effort at a reduced cost. During 2017 the ACMAD Lab deployed a network of invasive *Aedes* traps throughout the County, establishing higher trap densities in areas at higher risk for introduction and establishment of invasive *Aedes* mosquitoes (Figure 5). Over 700 traps were deployed in the County and inspected at approximately one month time intervals. In addition to OBT, AGO traps were placed in high-risk areas (e.g., container opening facilities and large pottery distributors) and when possible, near sites of travel-related human arbovirus cases. Invasive *Aedes* mosquitoes were not found in any mosquito trap placed in Alameda County during 2016 or 2017. The use of OBT in the mosquito assessment program was presented by the Laboratory Director as an oral presentation at the 2018 Annual Meeting of the MVCAC.

ARBOVIRUS ASSESSMENT IN MOSQUITOES AND BIRDS

Since 2015, the ACMAD Lab has conducted routine arbovirus monitoring of all mosquitoes captured in CO_2 traps placed throughout the County. More than 90% of arbovirus-competent species of mosquito that were collected in CO_2 traps were tested in-house for the presence of WNV, SLEV, and WEEV using quantitative polymerase chain reaction (QPCR). Whenever a dead bird was determined to be infected with WNV, lab personnel placed 25 to 30 CO_2 traps in an area no more than a quarter of a mile from where the dead bird was found. The lab tested most vector-competent species of mosquitoes that were collected in the CO_2 traps for WNV, SLEV, and WEEV. During 2016, eleven birds and one collection of mosquitoes were found to contain WNV; during 2017, two birds and none of the trapped mosquitoes contained WNV (Figure 8).

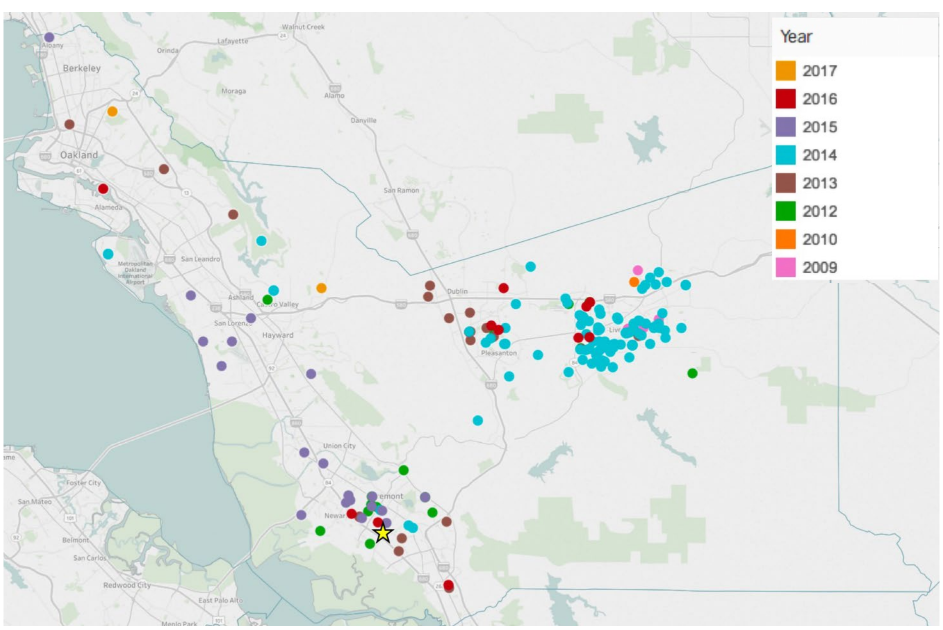


FIGURE 8: Location of WNV-infected birds collected from Alameda County, 2009 to 2017.

The location of WNV-infected birds is indicated with colored circles that correspond to the year shown in the figure legend. WNV was not detected in any bird during 2011.

The location of the WNV-infected mosquitoes collected during 2016 is indicated by a yellow star. To date (December 2017), no bird or mosquito in the County has been found to contain SLEV or WEEV.

MOSQUITO RESISTANCE TO INSECTICIDES

District staff rarely use insecticides that target the adult stages of mosquitoes. However, when adult mosquitoes are found to contain arboviruses, to protect public health, insecticides may be used to reduce mosquito abundance. To develop an insecticide resistance assessment program, Lab staff participated in a resistance workshop at the Sacramento-Yolo Mosquito and Vector Control District. There, they developed expertise in assays that: (1) assess functional resistance to insecticides which quantify the concentration of insecticides that kill mosquitoes (i.e., CDC bottle bioassay); (2) measure the activity of enzymes in mosquitoes that affect insecticide resistance by metabolizing and detoxifying insecticides (i.e., microtiter plate assays); and (3) evaluate insecticide target site insensitivity in the voltage gated sodium channel voltage gated channel (VGSC-1) of neurons using QPCR. The QPCR assay assesses resistance to the widely used insecticide, permethrin, that is mediated by a mutation in the knockdown resistance (*kdr*) loci of VGSC-1 that can confer complete resistance to permethrin-based insecticides. While the CDC bottle bioassay and microtiter plate assays can be conducted using any species of mosquito, the QPCR *kdr* assay is currently available only for *Cx. pipiens*.

The Lab began evaluating insecticide resistance in *Cx. erythrothorax*, a species that can be highly abundant in marsh habitats. Because it is very challenging to establish an inbred colony of *Cx. erythrothorax* for resistance testing, comparisons were made to an established colony of *Cx. pipiens* that is sensitive to insecticides. Results of the CDC bottle bioassay showed that *Cx. erythrothorax* were 6.1-fold more sensitive to permethrin relative to the sensitive lab colony of *Cx. pipiens* (Figure 9A). Piperonyl butoxide (PBO) is a chemical that can be added to an insecticide to inhibit the enzymes that metabolize and inactivate insecticides. When PBO was added to the CDC bottle assay, significantly fewer *Cx. erythrothorax* were alive after exposure to permethrin relative to tests made in the absence of PBO (Figure 9B). The time to knockdown (a measure of insecticide efficacy) was significantly reduced when PBO was included with 0.5 μg permethrin in the CDC bottle bioassay (Figure 9C). Field-caught *Cx. erythrothorax* were highly sensitive to both resmethrin, etofenprox, and naled, relative to the susceptible lab colony of *Cx. pipiens* (not shown).

Biochemical activity assays for enzymes in *Cx. erythrothorax* that metabolize insecticides demonstrated this species had significantly increased activity of oxidase, glutathione transferase, alpha esterase, and

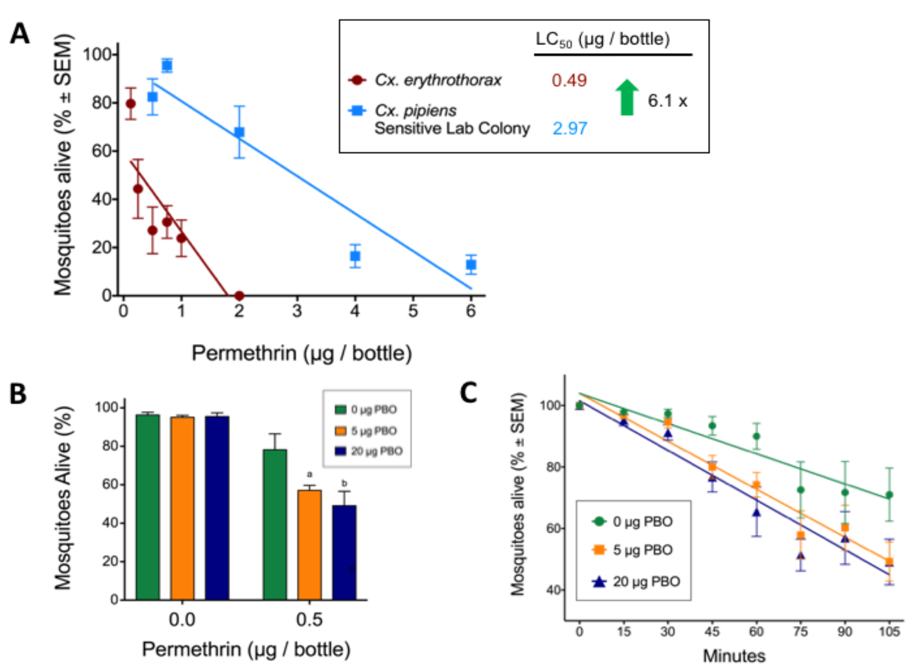


FIGURE 9: Resistance of *Cx. erythrothorax* to permethrin in the presence of PBO.

(A) Using a CDC bottle bioassay, adult *Cx. erythrothorax* were more susceptible to permethrin relative to a lab colony of *Cx. pipiens* that are susceptible to insecticides (linear regressions, R2 > 0.73).

(B) Inclusion of PBO significantly increased the susceptibility of *Cx. erythrothorax* to permethrin in a CDC bottle bioassay. Bars with letters indicate significant differences between treatments with and without PBO (paired t-tests, $P < .05$).

(C) Time to knockdown of *Cx. erythrothorax* exposed to 0.5 μg of permethrin, with or without PBO in a CDC bottle bioassay (ANCOVA, slope: $P < 0.013$).

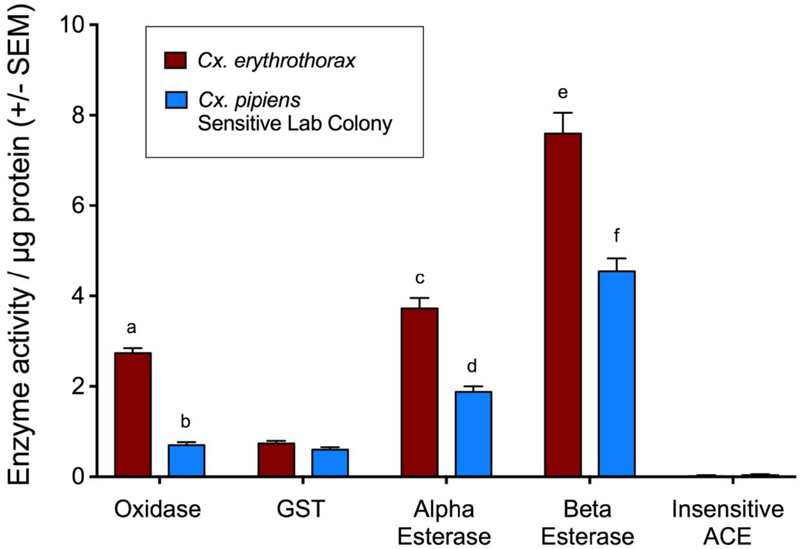


FIGURE 10: Activity of enzymes that metabolize insecticides in adult *Cx. erythrothorax* and a lab colony of *Cx. pipiens* that is sensitive to insecticides.

Bars with letters indicate significant differences between *Cx. erythrothorax* and *Cx. pipiens* for the enzyme activity tested (paired test, P < 001; N > 20 mosquitoes of each species tested for each enzyme).

beta esterase relative to *Cx. pipiens* from a susceptible lab colony (Figure 10; unpaired t tests, P < 001). Glutathione S-Transferase (GST), activity was similar for both species (unpaired t tests, P > 0.9) while levels of insensitive acetylcholinesterase were negligible (Figure 10). Results from our studies of insecticide resistance in *Cx. erythrothorax* were presented by a Seasonal Lab Technician in a talk at the 2017 Annual Meeting of the MVCAC.

Culex tarsalis

To assess insecticide resistance in *Cx. tarsalis*, we conducted CDC bottle bioassays and enzyme activity assays using adult *Cx. tarsalis* that were collected in the field. The field-collected *Cx. tarsalis* were 3 – 16 times more resistant to permethrin relative to *Cx. pipiens* from the susceptible lab colony. Beta-esterase and oxidase enzyme activities were significantly higher in field-collected *Cx. tarsalis* relative to lab colony *Cx. pipiens* (not shown). The activity of alpha-esterase was significantly higher in *Cx. tarsalis* relative to lab colony *Cx. pipiens* (not shown). Interestingly, the activity of acetylcholinesterase was significantly lower in *Cx. tarsalis*, and insensitive acetylcholinesterase was not detected (not shown), suggesting that the tested *Cx. tarsalis* may be highly sensitive to organophosphate-based insecticides. The results of this study were presented by a Seasonal Lab Technician as a poster presentation at the 2018 Annual Meeting of the MVCAC.

Culex pipiens

QPCR genetic tests of pyrethroid resistance in *Cx. pipiens* have been successfully implemented in the ACMAD Lab. This genetic test determines whether mosquitoes have one or two copies of the mutant VGSC-1 gene, termed heterozygous or homozygous mutant, respectively, for the *kdr* allele. Mosquitoes that are heterozygous for *kdr* are considered partially susceptible to permethrin insecticides, while those that are homozygous mutant are considered fully resistant and may not be killed by pyrethroids. QPCR test of the *kdr* allele of the VGSC-1 gene in adult *Cx. pipiens* that were captured from four locations during 2017 showed that more than a third were heterozygous for the mutation that is associated with permethrin resistance (i.e., *kdr*), and approximately 5% were homozygous for the resistance-associated allele. The results of this study were presented by a Seasonal Lab Technician as a poster presentation at the 2018 Annual Meeting of the MVCAC.

MOSQUITO RESEARCH

Publications and conference presentations based on research conducted from 2016 – 2017 include one peer-reviewed research article published in the *Journal of the American Mosquito Control Association*, four oral presentations and six research poster presentations at the Annual Meetings of the MVCAC, and 10 research abstracts published in the Proceedings of the MVCAC.

IMPROVED TRAPS TO ASSESS INVASIVE *AEDES* ABUNDANCE: OVIPOSITION CUP AND BUCKET TRAPS

Research during 2016 and 2017 focused primarily upon developing and testing improved traps for detecting invasive *Aedes* mosquitoes. The Lab redesigned the oviposition cup trap (OCT) that is widely used to detect invasive *Aedes* eggs in the environment. Use of OCT for a county-wide invasive *Aedes* trap network is limiting because each OCT requires weekly inspections for eggs and replacement of the water that attracts the mosquitoes. We developed a larger sized OCT based on a larger bucket-sized container, called an oviposition bucket trap (OBT; Figure 11A), which we tested in Madera, CA in collaboration with MCMVCD. The OBT collected significantly more *Ae. aegypti* eggs relative to the OCT (Figure 11B). Significantly more OBT contained *Aedes* eggs relative to the OCT (not shown; 83% of OBT and 65% of OCT; Fisher's exact test, P = 0.0214). Rearing collected *Aedes* eggs to adults in the lab at MCMVCD confirmed that eggs collected in OCT and OBT were *Ae. aegypti*. The results of this study were presented by the Biological Specialist in an oral presentation at the 2017 Annual Meeting of the MVCAC and published in the *Journal of the American Mosquito Control Association* (http://mosquito-jamca.org/doi/full/10.2987/17-6647.1). Because we demonstrated that OBT captured more *Aedes* eggs than OCT, and use of OBT required less work effort to place and inspect the traps, OBT were used for the invasive *Aedes* trap network that was deployed by the Lab during 2017 (Figure 5).

CULEX ERYTHROTHORAX: EVALUATION OF CONTROL MEASURES AND TRAPPING METHODS

Culex erythrothorax are competent vectors of WNV and can be highly abundant in marsh habitats with dense stands of tule and other vegetation. CO_2 traps were used to evaluate the impact of larvicide applications in a marsh over a one year period. During the months of May and June of 2016, a very high abundance of *Cx. erythrothorax* was observed at the marsh site. During late June Operations implemented intensified applications of larvicides aimed at reducing the populations of developing mosquito larvae at the site. Weekly applications were made of larvicide products, and the products were rotated each week (VectoMax, VectoBac G, or VectoLex CG). Within the first two weeks of the program (week 26 – 27), there was a substantial reduction in adult *Cx. erythrothorax* that were trapped at the site (Figure 12A). During week 35, mosquito abundance began to increase and returned to pre-treatment levels by week 37. Uncontrolled *Cx. erythrothorax* breeding at the site encouraged East Bay Regional Park District to remove much of the tule plants from the marsh. Removal of the tule from the site resulted in a substantial reduction in the number of adult *Cx. erythrothorax* at that site for the remainder of 2016 (Figure 12A) and 2017 (not shown).

Prior to the removal of the tule, the ability of MMT

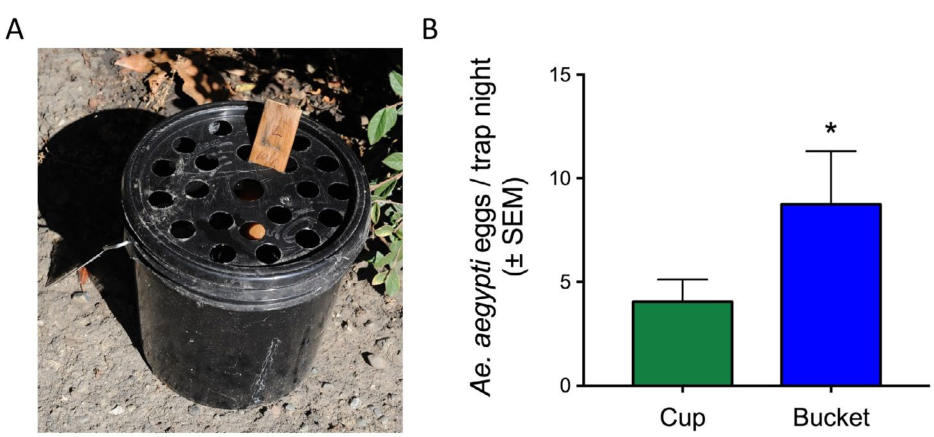


FIGURE 11: Comparison of the ACMAD OBT to the CDC OCT for detecting *Aedes aegypti* in Madera, CA.

(A) OBT placed in the field to attract invasive *Aedes* mosquitoes.

(B) The OBT collected significantly more *Ae. aegypti* eggs relative to the OCT (8.8 ± 2.6 and 4.1 ± 1.1 *Ae. aegypti* eggs / trap night, respectively; * paired t-test, P = 076).

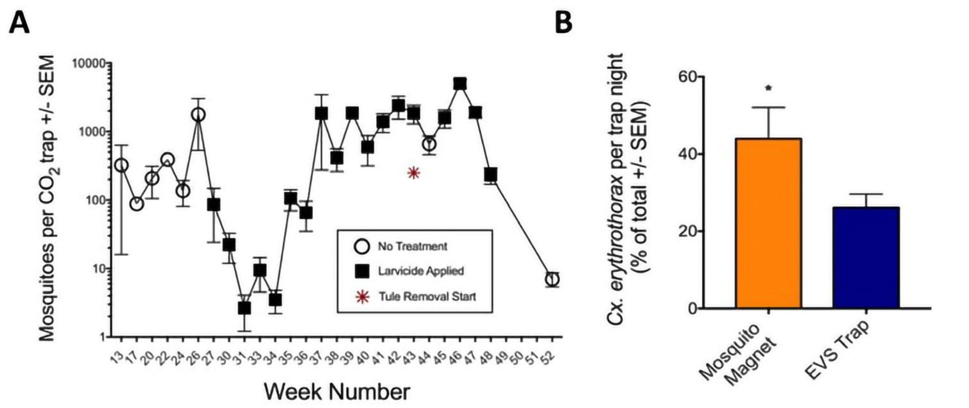


FIGURE 12: Larvicide impact on *Cx. erythrothorax* in a marsh and comparison of MMT with CO_2 traps for capturing *Cx. erythrothorax.*

(A) Larvicide applications in a marsh reduced *Cx. erythrothorax* for several weeks, but abundance increased until tule, a refuge for larval and adult *Cx. erythrothorax*, was removed.

(B) MMT captured significantly more adult *Cx. erythrothorax*, in a marsh relative to CO_2 traps (paired t tests, $P < 0.05$).

to capture *Cx. erythrothorax* was compared against CO_2 traps, with the aim of using MMT to suppress *Cx. erythrothorax* abundance, should the need arise. The MMT captured significantly more *Cx. erythrothorax* relative to what was collected by CO_2 traps (Figure 12B), suggesting the MMT may be useful for reducing the number of adult *Cx. erythrothorax* in the environment. The results of this study were presented by a Vector Biologist in a poster presentation at the 2017 Annual Meeting of the MVCAC.

GENOME AND METAGENOME SEQUENCING OF MOSQUITOES IN CALIFORNIA WITH CHAN ZUCKERBERG BIOHUB.

The Lab is collaborating with the Chan Zuckerberg Biohub (CZ Biohub) to collect mosquitoes throughout Alameda County so that the genome and metagenome of each species can be sequenced. Recently, six other vector control agencies in California have joined the mosquito collection effort. The genome is the genetic code of the mosquito, while the metagenome is the genome of the microorganisms (e.g., bacteria and viruses) that inhabit the mosquitoes. The overall aims of the project as it relates to vector control agencies are: (1) to sequence the genomes of mosquitoes that need to be controlled because they transmit disease or are a nuisance, (2) discover genetic markers for insecticide resistance, and (3) screen mosquito populations for resistance prior to insecticide applications. CZ Biohub is interested in discovering novel microorganisms that inhabit mosquitoes and that may contribute to human disease in ways that are not currently appreciated (e.g., causing sub-acute infections in humans that increase susceptibility or severity of unrelated diseases). Genetic sequencing has been focused on *Cx. tarsalis* because high numbers of specimens were provided by ACMAD to develop nucleic acid isolation methods. To date the complete mitochondrial genome of *Cx. tarsalis* has been sequenced, as have several genes involved with insecticide resistance (e.g., VGSC-1, esterase, and oxidase genes). Sequencing has uncovered several microorganisms in *Cx. tarsalis* including viruses (e.g., members of flavivirus, bunyavirus, and orthormyxovirus familiies), trypanosomes, spirochetes, and borrelia. The preliminary results of this study were presented by the Laboratory Director as an oral presentation at the 2018 Annual Meeting of the MVCAC.

PUBLIC OUTREACH

MEDIA OUTREACH

In 2016 and 2017 the District concentrated on increasing public outreach efforts through digital platforms. Internet advertisements during the summer months focused on draining standing water, reporting neglected swimming pools, and personal preventive measures to avoid mosquito bites. However, advertisements in the PennySaver publication and posters in Bay Area Rapid Transit (BART) stations were replaced by movie theater ads and an electronic billboard by the Oakland Coliseum (Figure 13). The billboard was made possible by federal Zika funding and focused on invasive *Aedes* awareness.

FIGURE 13: Oakland Coliseum Complex billboard.

Efforts were also made to increase the District's social media presence. Starting in the summer of 2017, seasonal staff was hired to provide support for public education efforts, including social media. By the end of 2017, the District was regularly posting on both Facebook and Twitter (Figure 14). The District's social media presence further increased in 2016 with the creation of an Instagram account. The District's social media accounts can be found by searching each platform for AlamedaMosquito.

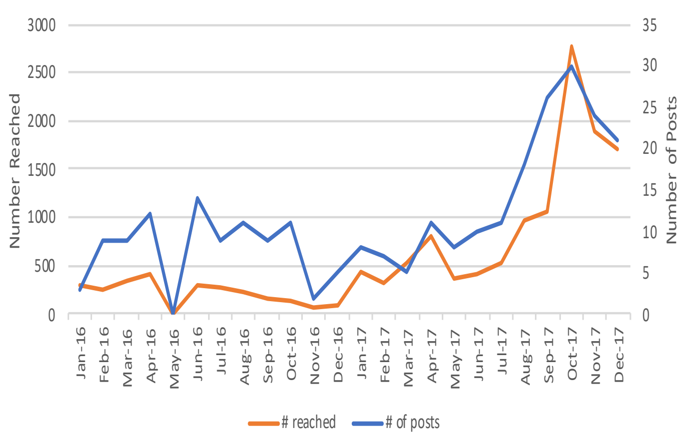


FIGURE 14: Facebook activity for 2016 and 2017.

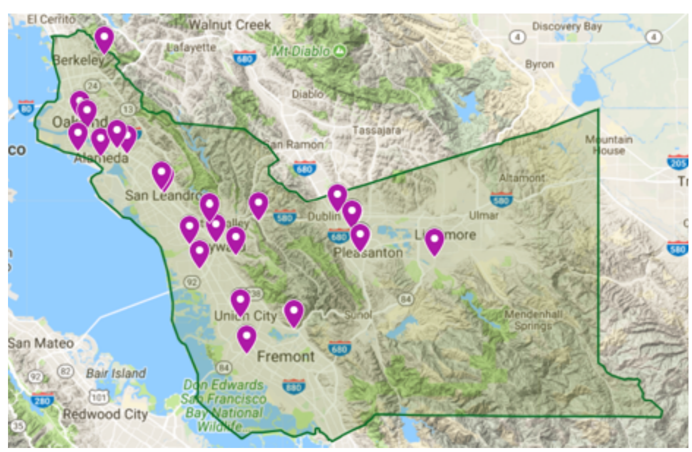


FIGURE 15: Geographic distribution of public education events during 2016 and 2017.

PRESENTATIONS

In addition to an increased digital presence, District employees gave over 30 presentations in 2016 and 2017. Presentations were provided to local schools (preschool through college), city council meetings, other agencies (East Bay Municipal Utility District, East Bay Parks and Recreation District, Livermore Area Parks and Recreation Department), community groups (Lions clubs, Sons in Community Emergency Response Team Retirement, Community Emergency Response Teams) and for conferences and trainings (California Stormwater Quality Association, Coastal Region continuing education meetings).

The focus of these presentations was on the District's mosquito assessment and control activities, with a highlight on invasive species of mosquito and the diseases they transmit. Also during 2016, the Lab Director and Regulatory & Public Affairs Director provided materials and guidance to staff at the San Francisco Exploratorium in support of their hands-on Teacher Institute Workshop entitled "The Deadliest Animals on Earth: Mosquitoes!". The document resulting from that workshop can be found at: http://tinyurl.com/timosquitoes. During 2016 and 2017, the Laboratory Director provided lectures on mosquito biology and the arboviruses they transmit at UC Berkeley and the University of Arizona, Tucson.

PARTNERSHIPS

During 2016 and 2017, the ACMAD Lab partnered with the Fremont Math and Science Nucleus where we provided training and mosquito traps to advanced high school students so they could participate in monitoring for invasive species of *Aedes*. During 2016, the ACMAD General Manager and Laboratory Director served on a Panel Discussion for the UC Berkeley Zika Symposium: Frontline Update that was entitled "From Global to Local: California's Response to Zika" (http://cgph.globalhealth.berkeley.edu/102916-uc-berkeley-zika-symposium-frontline-update/). The Panel was moderated by Dr. Stefano Bertozzi, the Dean of the School of Public Health at UC Berkeley, and included Dr. James Watt, the Chief of the Division of Communicable Disease Control, California Department of Public Health. Afterwards, we were interviewed by the UC Berkeley Radio Station, KALX (90.7 FM). The ACMAD Lab sponsored a project to develop a novel invasive *Aedes* mosquito trap with the Hacking 4 Impact course at UC Berkeley during 2017 (course instructor: Professor Amy Herr; website: http://hacking4impact.berkeley.edu/). The role of the Lab was to connect the team with stakeholders in public health and vector control, and guide the team in trap design. The outcome was a trap design that identified in real time the species of the mosquito captured using wing beat frequency and images of the trapped insects. The resulting data were transmitted via public and private WiFi to vector control agencies. A UC Berkeley graduate student aims to produce a trap prototype that the Lab has agreed to test at our research sites outside of Alameda County where there are already established populations of *Ae. aegypti*.

PUBLIC EDUCATION EVENTS

Public outreach through participation in local fairs and community events continued to be a staple of the District's public education program. Events the District participated in are listed in Table 2.

2016	2017
Thomas Hart STEAM Science night	Thomas Hart STEAM Science night
Alameda County Spring Home & Garden Show	Alameda County Spring Home & Garden Show
Dublin St. Patrick's Day Festival	Dublin St. Patrick's Day Festival
Oakland Earth Expo	Oakland Earth Expo
San Leandro Earth Day & Watershed Festival	Peralta Colleges Sustainability Eco Festival
CSUEB Hack Day	Alameda Earth Day Festival
Chabot College Return of the Swallows Festival	Hayward Cinco de Mayo Festival
Peralta Colleges Sustainability Eco Festival	Alden Lane Nursery Fish Giveaway
Alameda Earth Day Festival	Palomares Elementary School Science Expo & Watershed Festival
Tropics Mobile Home Park Senior Resource Fair (2)	Niles Wildflower, Art, Garden, & Quilt Show
Alden Lane Nursery Fish Giveaway	Share the Love Festival, Bridges Academy
Hayward Cinco de Mayo Festival	San Leandro Cherry Festival
Niles Wildflower, Art, Garden, & Quilt Festival	Alameda County Fair
Palomares Elementary School Science Expo & Watershed Fest	United for Safety, San Leandro Police Department
San Leandro Cherry Festival	Alameda Art & Wine Festival
UCB Botanical Garden "Bug Days"	Newark Days Festival
Alameda County Fair	Urban Shield (3 Crosses, CV)
Hayward Zucchini Festival	Alameda County Fall Home & Garden Show
Newark Days Festival	CSUEB Discovery Day Science Fair
Alameda County Fall Home & Garden Show	Acsend Fall Festival (Oakland)

TABLE 2: Public education events ACMAD attended in 2016 and 2017.

INFORMATION TECHNOLOGY UPDATE

ACMAD has been modernizing its Information Technology (IT) infrastructure, workflows, and analytical processes during the past 2 years. Our objectives are to increase fiscal responsibility and efficiency, and to imporve transparency of the District's operations to its employees, the Board of Trustees, and the public.

In 2016, we analyzed the District operations model and developed solutions to enhance daily tasks through modern technology (Figure 16). Internal systems, policies, and processes were systematically inspected. As a result, ACMAD changed its operational model from a cumbersome paper-based organization, to a cloud-based environment. To utilize fiscal resources more effectively, we renegotiated service contracts by partnering with larger entities to reduce cost.

Through the IT infrastructure upgrade, the District moved storage, human resources (HR), mosquitofish management and geodatabases into the cloud. Office 365 has given employees the ability to communicate with their supervisors and coworkers via email and video conference from anywhere in the County. We have eliminated onsite servers and now utilize Microsoft Cloud Services to store and keep our data safe. The District also has a completely upgraded network including Mesh WIFI, high speed internet, and enterprise grade firewall and routers. Through reducing reliance for hardware at the District headquarters, there is less need for IT resources. By adding redundancies to connecting systems, we now have access to the system 24 hours a day, 365 days a year from any location.

In 2016, we moved from a DOS-based timecard system and excel spreadsheets to an automated HR solution. OnePoint - Kronos total HR solution allows employees to clock in and out, request time off, and view paycheck status from their phones and tablets (Figure 18). The system also tracks our complicated flex time schedule, ensuring compliance with all federal and state labor laws. With this system, all aspects of human capital management can be handled in one interface.

The District has implemented an enhanced geo-database that allows collaboration between departments (e.g., operations and laboratory). Information now flows instantly among support staff, field operations, and laboratory personnel. This means that service requests are now automatically and instantly assigned to technicians. Thus, a technician can now respond almost immediately after the office receives a call for service. We are now exploring innovations in satellite imagery, virtualization, unmanned aircraft systems, and artificial intelligence to improve our operations in the ever-changing landscape of mosquito control.

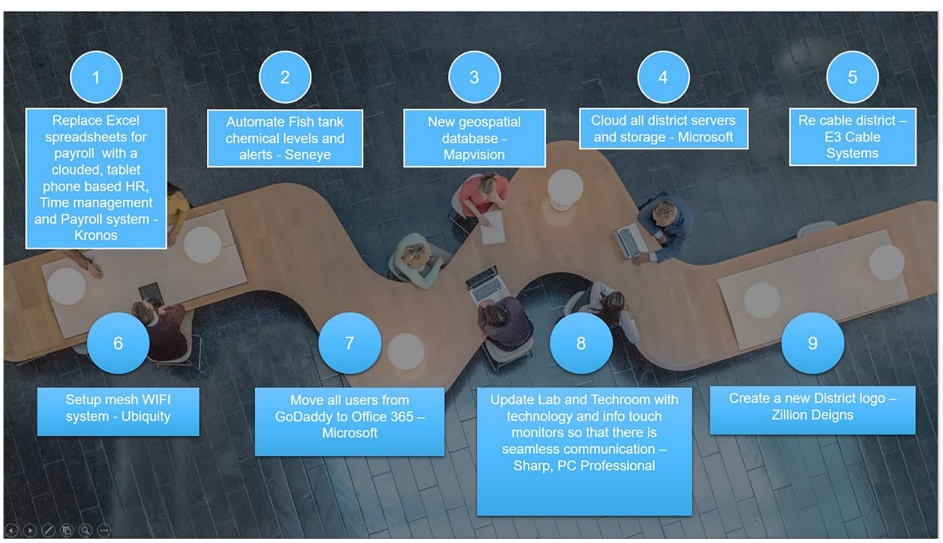


FIGURE 16: 2016-2017 IT Roadmap

The roadmap was a created to layout the IT goals and to guide the District through complex projects.

With the help of the roadmap innovative technologies were implemented furthering the District's goal of efficient and effective operations.

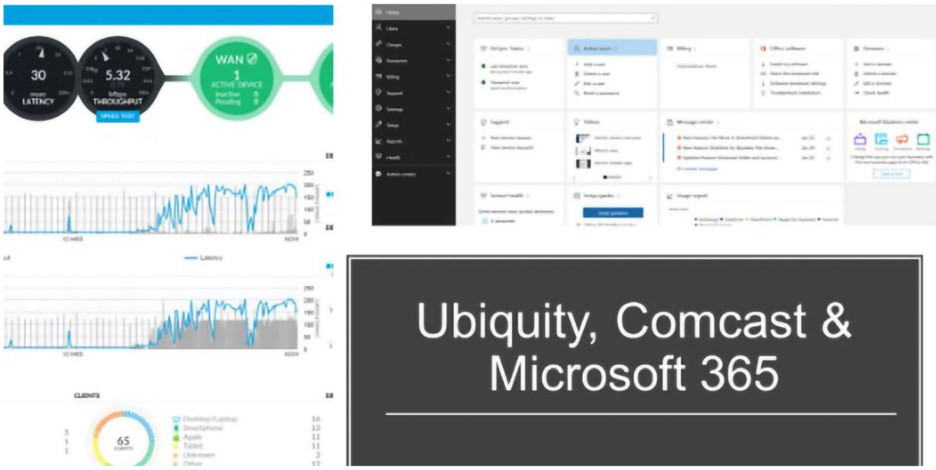


FIGURE 17: Infrastructure and Software Upgrades

Realtime Graphical Network and Office 365 statistics allow monitoring of the District's IT infrastructure at all times from any location.

With Office 365 District employees have access to the newest innovations in document management.

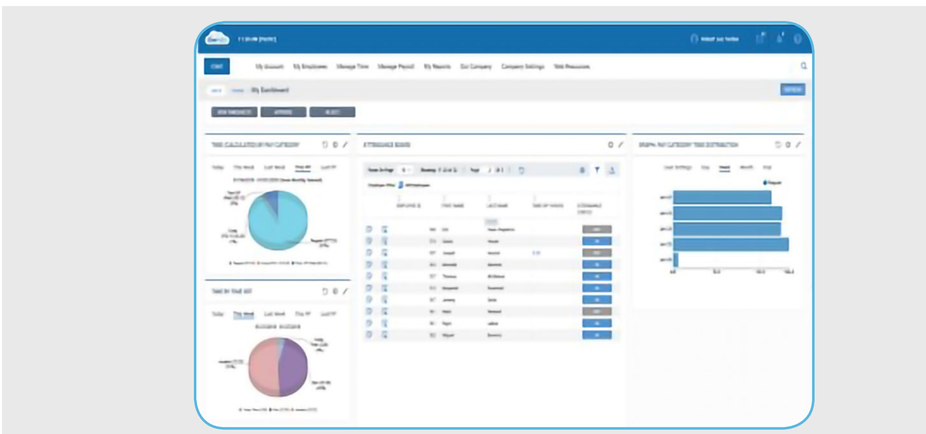


FIGURE 18: Web-based Enterprise HR System Upgrade

We Replaced the existing spreadsheet HR system with Kronos Human Capital Management HR system.

With this change time managment is automated and mobile.

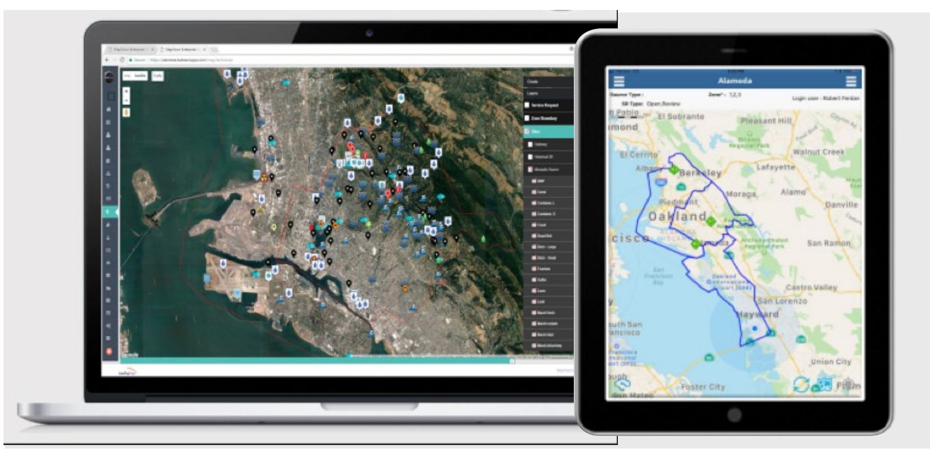


FIGURE 19: Geospatial Mobile Database - MapVision

MapVision enables geographical realtime work management.

This allows District staff to respond to the community needs in a more effecient and effective manner.

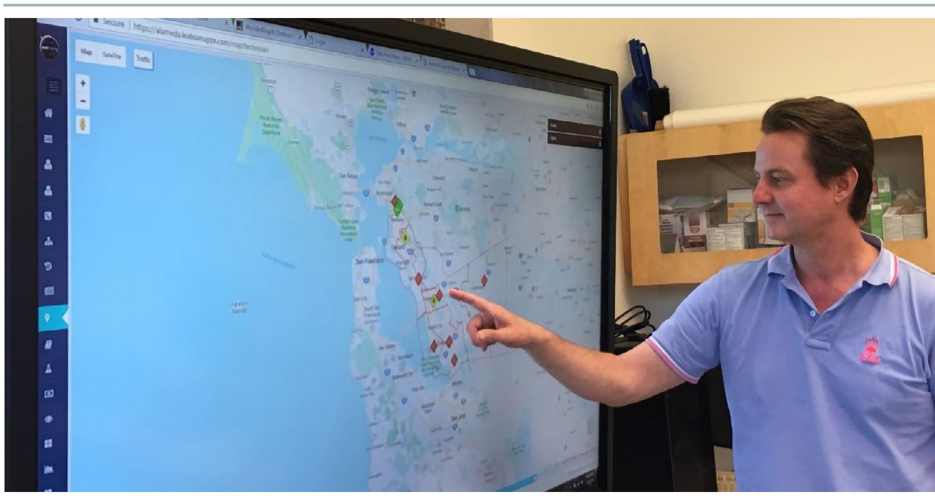


FIGURE 20: Touchscreen Technology

The District technician room now houses a 70" touch screen information system to deliver live content to operational staff.

This dashboard facilitates the incorporation of data into the mosquito control decision making process.

FACILITY AND EQUIPMENT IMPROVEMENTS

LOCKER ROOM EXPANSION

Due to additional full-time District staff positions and an increase in our Lab Seasonal staff, it was necessary to expand the Men's Locker Room. Utilizing available space from the facility's original Tech-Room, an interior wall was relocated to provide more square footage for additional lockers and benches (Figure 21).

LOW ENERGY SWING DOOR OPERATOR (MAIN LOBBY)

The need to repair the front door lock assembly gave the District an opportunity to upgrade the front door for ADA compliance. The Low-E Operator opens the door by use of a push button (inside and outside), or the door will open fully when the user begins opening it from either direction (Figures 22 and 23).

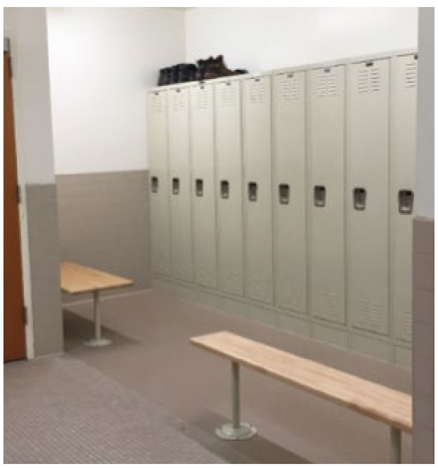


FIGURE 21

FIGURE 22

FIGURE 23

LANDSCAPING

Sometimes even the simple things make a difference. Moving some rock and installing of landscape edging were easy solutions for a quick cleanup and refreshed look for the District headquarters. In addition, recycling the mulch from the trimmings of two Liquid Ambers and two Sycamores provided excellent ground covering (Figures 24 and 25).

FIGURE 24: Before Landscaping

FIGURE 25: After Landscaping

STORAGE SHED

The new pesticide and equipment storage shed was completed in 2017. There have been many changes over the years regarding underground supply and containment, as well as the types of pesticide and equipment used. The new storage shed has room to grow and adapt to the District's future needs. Maximizing the location of the original shed, the District was able to nearly double the square footage and at the same time update the shed's occupancy classification from an H-3 (High-Hazard contents and volumes) to an S-1 (Non-Hazardous per volume). Included are low wattage LED lighting and an upgraded ventilation system with thermostat control and exterior emergency shut-off.

FIGURE 26: Pesticide storage shed remodel project

(A) Demolition of the old pesticide storage shed.

(B) Construction of the foundation for the new lager pesticide storage shed.

(C) Completion of the foundation and walls for the new shed.

(D) Hoisting the steel beams for the roof of the new shed.

(E) Interior view of the completed pesticide shed.

ARGO TRAILER NURSE TANK

Water is not always accessible for Operations personnel in the field, especially in large quantities, and even more so in the marsh areas. In some instances, returning to the District Facility was the only practical means to obtain water, taking valuable time out of the day. Nurse tanks are a customary solution to on-site water needs. A nurse tank is an additional water source for refilling tanks that are typically mounted on a dedicated trailer or dropped off near the required location. Instead of an additional trailer or truck hosting a nurse tank, the existing Argo trailer was found to have the load capacity and room for a 100-gallon tank.

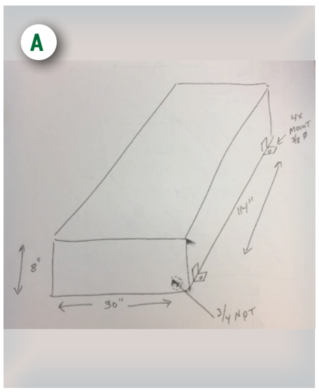


FIGURE 27: Argo trailer nurse tank

(A) Research and development quick sketch (B) Tailgate view
(C) Easy access (D) Modified plumbing for pump transfer.

WASH RACK PRESSURE WASHER

Argo and vehicle preventative maintenance starts in the wash rack and removal of debris from the field is the first step. Brackish water, mud, tule, and pickle weed are major contributors to equipment failure when not removed immediately and thoroughly. Hot water, environmentally safe detergent, and high pressure start the preventative maintennce process. The addition of an air supply hose reel and an eye wash station complete the wash rack.

FIGURE 28: Wash rack improvements

(A) New pressure washer system. (B) New eye wash station.

FINANCIAL REPORT

FOR FISCAL YEARS ENDING JUNE 30, 2016 AND JUNE 30, 2017

	2017	2016
REVENUES :		
Property taxes	$ 2,029,078	$ 1,892,482
Redevelopment distribution	$ 180,474	$ 171,178
Special Assessments	$ 1,916,198	$ 1,903,257
Homeowners Property Tax Relief, State Subvention	$ 15,954	$ 15,662
Transfer from OPEB Trust	$ 170,219	$ 149,986
Interest	$ 34,156	$ 27,303
Miscellaneous	$ 20,824	$ 20,963
TOTAL REVENUES	**$ 4,366,903**	**$ 4,180,831**
EXPENDITURES :		
Salaries and fringe benefits	$ 2,369,690	$ 2,133,833
Materials, supplies and services	$ 833,192	$ 780,944
Transfer to OPEB trust	$ 0	$ 0
Capital outlay	$ 276,828	$ 117,486
TOTAL EXPENDITURES	**$ 3,479,710**	**$ 3,032,263**
NET CHANGE IN FUND BALANCES	$ 887,193	$ 1,148,568
FUND BALANCES, BEGINNING OF PERIOD	$ 5,526,318	$ 4,377,750
FUND BALANCES, END OF PERIOD	**$ 6,413,511**	**$ 5,526,318**

ALAMEDA COUNTY MOSQUITO ABATEMENT DISTRICT COMBINED BALANCE SHEET FOR THE YEARS ENDING JUNE 30, 2016 AND JUNE 30, 2017

		JUNE 30, 2017		JUNE 30, 2016
ASSETS				
Current and Investments	$	6,255,478	$	5,425,074
Prepaid retirement expense	$	190,148	$	200,000
Accounts receivable	$	0	$	0
Capital Assets (Net)				
Non-depreciable assets	$	61,406	$	61,406
Depreciable assets, net	$	2,542,715	$	2,498,723
Net OPEB asset	$	1,999,232	$	2,219,351
TOTAL ASSETS	**$**	**11,048,979**	**$**	**10,404,554**
		============		============
Deferred Outflow	$	505,352	$	215,830
LIABILITIES				
Account Payable	$	32,115	$	98,756
Compensated Absences	$	139,906	$	124,597
Net Pension Liability	$	2,551,572	$	2,028,906
TOTAL LIABILITIES	**$**	**2,723,593**	**$**	**2,252,259**
		============		============
NET ASSETS				
Invested in Capital Assets	$	2,604,121	$	2,560,129
Unrestricted	$	5,317,714	$	5,244,509
TOTAL NET ASSETS	**$**	**7,921,835**	**$**	**7,804,638**
		============		============


ALAMEDA COUNTY
MOSQUITO
ABATEMENT DISTRICT

ALAMEDA COUNTY
MOSQUITO ABATEMENT DISTRICT

An Independent Special District Protecting Public Health Since 1930

The Alameda County Mosquito Abatement District (ACMAD) has provided control of mosquitoes for the citizens of Alameda County (except Albany) since 1930. ACMAD is an independent special district governed by a Board of Trustees comprised of one representative from each city in our service area and the County-at-large. Funding is provided by a combination of property tax, a special tax authorized by more than two thirds of the voters in 1982, and a benefit assessment approved in 2008.

ACMAD works closely with other public agencies and park districts to provide ecologically sound mosquito control programs. The District also works with planning agencies to minimize mosquito production in wetland restoration and enhancement projects.

510-783-7744

www.mosquitoes.org

Alameda County Mosquito Abatement District

@AlamedaMosquito

www.mosquitoes.org