COLLIER MOSQUITO CONTROL DISTRICT REVIEW FINAL REPORT

September 2023

Prepared for

The Florida Legislature

Prepared by

The Balmoral Group

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Executive Summary

Collier Mosquito Control District (Collier MCD) serves 401 square miles of Collier County, Florida. The population of Collier County is 397,994 in 2022 according to the U.S. Census Bureau. While eastern Collier County is largely rural, development is encroaching rapidly on previously undeveloped areas, and Collier MCD is in the process of pursuing expansion to include residential developments outside of its current service area. The eastern half of the county also abuts several federal and state-owned protection areas that produce mosquitoes, but pose associated restrictions on Collier MCD operations. The official boundaries of Collier MCD do not include the entirety of Collier County, rather only encompassing the main populated areas in the western regions of the county. About 240,000 households paid ad valorem taxes to support Collier MCD operations in Fiscal Year (FY) 2022-23; in the most recent budget year, this included about $120 billion in taxable property value from October 1, 2022, through September 30, 2023.

Collier MCD was established in 1950, and over the years has expanded and incorporated more communities into its service area. The district currently provides services to the majority of populated areas in Collier County and, as a result of expanded development and population growth, has recently been working towards incorporating the Ave Maria community, Azure at Hacienda Lake, Naples Reserve, Port of the Isles, and several other communities. The board is actively engaged in the review of operational success, financial stewardship, and public information activities.

SCOPE

Section 189.0695, *Florida Statutes,* requires the conduct of performance reviews of Independent Mosquito Control Districts. The Balmoral Group was selected by the Office of Program Policy Analysis and Government Accountability to perform the review, which evaluates the district's programs, activities, and functions, including

- evaluating the district board's primary function and governance;
- assessing service delivery and comparing similar services provided by municipal or county governments located within the district's boundaries;
- describing district purpose, goals, objectives, performance measures, and performance standards and evaluating the extent to which they are achieved;
- analyzing resources, revenues, and costs of programs and activities; and
- providing recommendations for statutory or budgetary changes to improve the special district's program operations, reduce costs, or reduce duplication.

With continuing development, Collier MCD is researching more effective methodologies and practices to better suit the demands of the rapidly changing environment. With developments encroaching on state and federal lands (such as the Everglades), complicating Collier MCD's ability to treat newly developed areas, Collier MCD has begun using an Unmanned Aerial System, known as UAS (drones), to more efficiently treat regions as well as to conduct surveillance in regions not easily accessible. As a result of rising property values, Collier MCD improved its facilities despite Hurricane Ian's damages in the area and is now able to further invest in developing and expanding its service capabilities. Along with refurbishing its aerial fleet through a multi-year process, Collier MCD makes efficient use of its operational capability by staging and operating the fleet in multiple locations.

The Balmoral Group worked in consultation with a mosquito control expert in the course of this review and found that Collier MCD follows industry standards for Integrated Pest Management (IPM) and provides an array of mosquito control services consistent with the district's charter and statute; no local governments located within Collier MCD provide similar mosquito control services. Collier MCD is managing its resources in an efficient and effective manner to achieve its goals and objectives. Collier MCD has clearly stated goals and objectives that are

measurable and appropriate to meet the district's purpose but lacks additional, measurable performance standards with which to assess how well it meets goals and objectives.

Based on its review, The Balmoral Group presents the following recommendations for the improvement of mosquito control services in the Collier MCD:

- The district should continue coordination with and outreach to environmental groups and other stakeholders.
- The district could formalize additional performance measures and standards that would allow the district to monitor and track progress toward all its goals and objectives. Such performance information would facilitate the district in consistently monitoring its progress.
- The Legislature could consider amending s. 388.46*, Florida Statutes*, to direct the Florida Coordinating Council on Mosquito Control to form a subcommittee consisting of mosquito professionals and researchers from around the state to develop model goals, objectives, and performance measures and standards to assist MCDs with performance monitoring.

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1. Background

District Description

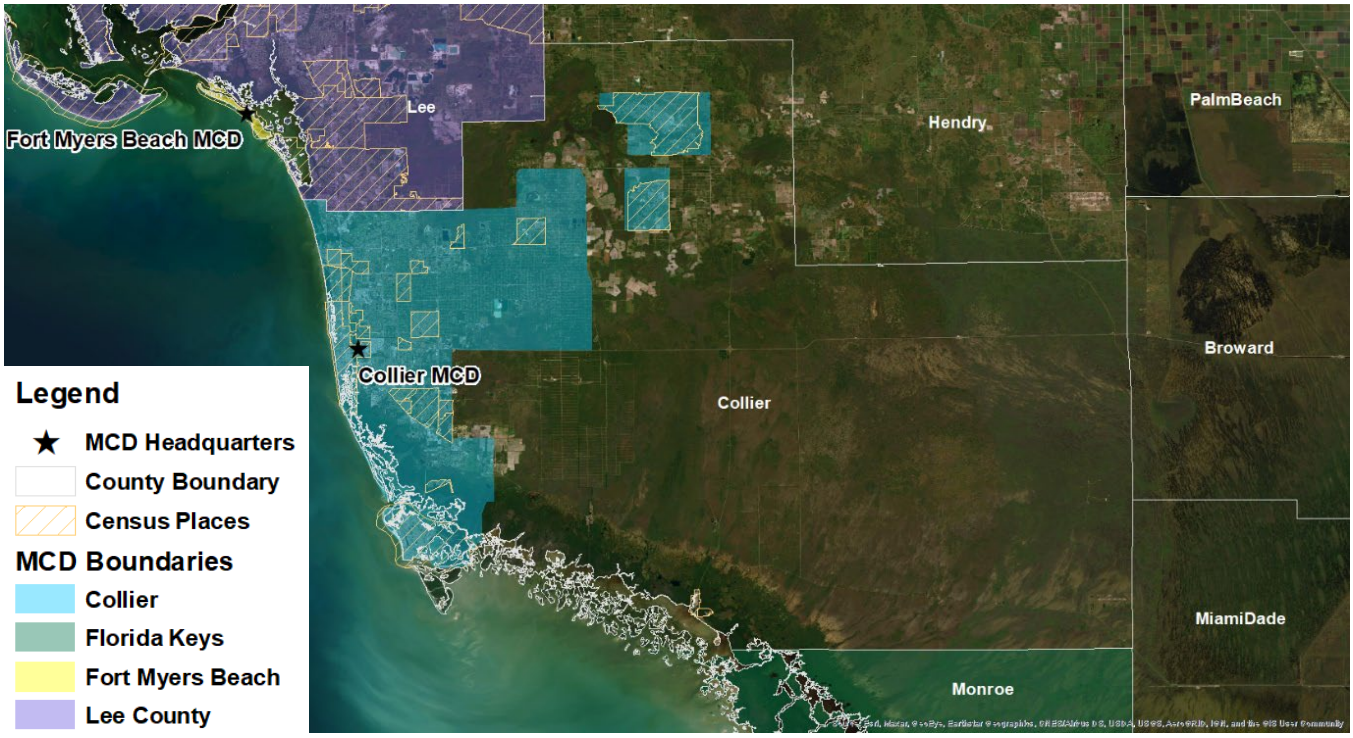
District Purpose

According to district representatives, the purpose of Collier Mosquito Control District (Collier MCD), as established in 1950, is to control the nuisance and disease-carrying mosquito population within Collier County, Florida for the health and welfare of district residents. Since inception, Collier MCD's goals have aligned with promoting the health, safety, and welfare of Collier County residents and visitors through an ever-evolving program of integrated pest management practices and technological advancements.

Service Area

Collier MCD provides service to 401 square miles of Collier County. Originally founded to treat 6 square miles, Collier MCD has expanded to provide service from the Lee County line south to Marco Island including Naples, Goodland, and Golden Gate. Collier MCD also covers the Immokalee area, with the community of Ave Maria under contracted service as well. Collier MCD's headquarters is located at 600 North Road, Naples, Florida, 34104-3464. **Figure 1** shows a map of the Collier MCD boundary, with the county boundary, and MCD headquarters marked as defined by Collier MCD.

Figure 1. Map of District Boundaries and Headquarters Location

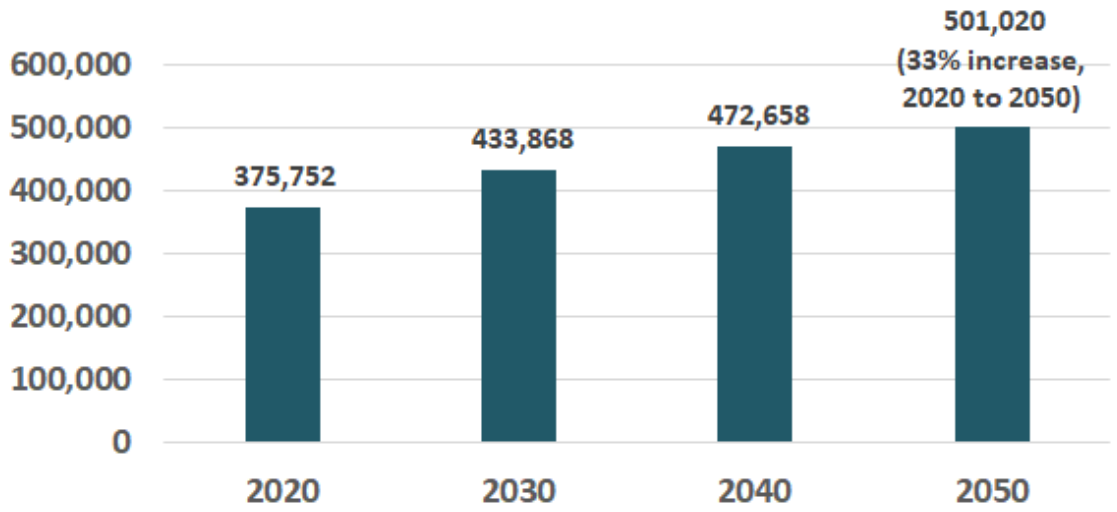


Source: TBG Work Product, ESRI, US Census, MCDs.

Population

Collier County's population was estimated at 397,994 persons in 2022 according to the U.S. Census.[1] The Florida Legislature's Office of Economic and Demographic Research[2] (EDR) projects Collier County's population to increase by 33% through 2050 to 501,020 residents compared to a 2020 baseline. **Figure 2** shows Collier County's projected population estimates calculated by EDR.

Figure 2. Collier County Population Projection



Source: TBG Work Product, EDR.

District Characteristics

Collier County is located on the west coast of Florida, and while it is the largest county in Florida by land mass, a large southeastern portion of the county is occupied by the Big Cypress National Preserve. Adjacent counties include Lee, Hendry, Broward, Miami-Dade, and Monroe. The average annual temperature is 77 degrees Fahrenheit and the area received about 50 inches of rain in 2022. Controlling mosquito populations in densely populated areas, including the barrier islands rimmed with mangrove areas and natural preserves that house mosquito larval habitat, is critical to quality of life in both the coastal and inland portions of the county. Collier MCD manages both salt and freshwater mosquito populations.

Eastern Collier County is largely rural, but development is encroaching rapidly on remaining undeveloped areas. The eastern half also abuts the Everglades and Big Cypress National Preserve, as well as several federal and state protection areas, which produce mosquitoes prolifically and have associated restrictions on operations. In 2021, Collier MCD sought to expand its boundaries to include newly developing areas as well as the Ave Maria community, to which Collier MCD is already providing services. The expansion met opposition from environmental groups that were concerned about the impact of treatment on sensitive areas. However, Collier MCD has worked closely with the Board of County Commissioners, land managers, and non-governmental organizations on an agreement on how best to handle state and federal lands. While research permits issued by DEP to allow the district to conduct mosquito research and monitoring activities on state park lands exist for Collier-Seminole State

[1] Population Estimates, July 1, 2022 retrieved from U.S. Census Bureau QuickFacts: United States.
[2] Based on 2021 Estimates, Population: 1970-2050, County projections retrieved from Population and Demographic Data - Florida Products (state.fl.us).

Park, Collier MCD does not anticipate the need to perform treatments in Collier Seminole State Park. Additionally, Collier MCD does not foresee a need for treatments in Ten Thousand Islands National Wildlife Refuge, Fakahatchee Strand Preserve State Park, Big Cypress National Preserve, the Everglades National Park, and others. Collier MCD also is working to create amendments to a historical Arthropod Control Plan (ACP) with Rookery Bay National Estuarine Research Reserve. Treatments are currently performed in Delnor-Wiggins Pass State Park, and Rookery Bay National Estuarine Research Reserve in collaboration with the Florida Department of Environmental Protection (DEP).

Meteorology is the primary driving force for producing mosquitoes with heavy rainfall events creating standing pools of water that serve as habitats for producing mosquito species capable of transmitting several arboviruses. Changing water levels through tidal events can also produce such pools. Humans contribute to the problem by allowing water to stand in waste containers, garden pots, tires, and other vessels.

The characteristics of the natural areas of the district, combined with the growing population in urban areas, and the meteorological conditions described above, create an environment conducive to extensive mosquito habitats that require constant mosquito control. The services needed to control mosquitoes include routine surveillance of mosquito-producing habitats, source reduction through aerial and ground treatments to treat mosquito breeding sites (juvenile stage) and adult mosquito populations, and regular testing for disease presence in mosquito populations.

Real Property Data

Collier MCD receives ad valorem taxes to fund district operations. The total taxable value of properties within Collier MCD was almost $120 billion in FY 2022-23 under a millage rate of 0.1609 (**Table 1**). Real property parcels subject to district millage exceed 240,000 parcels in FY 2022-23, with the previous three fiscal years all exceeding 230,000 parcels (**Table 2**). Taxable value of real property parcels increased 31% in FY 2022-23 compared to FY 2019-20.

Table 1. Millage Rates and Total Taxable Value of Properties Subject to Collier MCD Millage

Collier MCD	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Millage Rate	0.1720	0.1662	0.1609	0.1609
Taxable Value of Parcels ($Mil.)	$89,841	$95,499	$100,701	$117,479
Taxable Value of Accounts ($Mil.)	$1,959	$2,105	$2,194	$2,407
Taxable Value of Centrally Assessed Property ($Mil.)	$0	$0	$0	$0
Total Taxable Value ($Mil.)	**$91,800**	**$97,604**	**$102,895**	**$119,886**

Source: Florida Department of Revenue (FDOR).
[1] Centrally assessed property includes railroad and private carline company assessments as defined in Rule 12D-2.011, *F.A.C.*

Table 2. Real Property Parcels Subject to Collier MCD Millage

Collier MCD	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Just Value of Parcels ($Mil.)	$112,117	$118,514	$124,894	$177,327
Real Property Parcels Subject to Millage	233,815	235,933	237,392	240,055
Taxable Value of Parcels ($Mil.)	$89,841	$95,499	$100,701	$117,479

Source: FDOR.

Tangible Personal Property Data

In addition to real property, tangible personal property accounts subject to district millage total 18,270 accounts in FY 2022-23, down 8% since FY 2019-20 (**Table 3**). However, the taxable value of tangible personal property accounts increased in FY 2022-23 by 23% compared to FY 2019-20 due to higher valuation.

Table 3. Tangible Personal Property Accounts Subject to Collier MCD Millage

Collier MCD	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23
Just Value of Accounts ($Mil.)	$2,438	$2,574	$2,651	$2,863
Tangible Personal Property Accounts Subject to District Millage	19,762	19,197	18,648	18,270
Taxable Value of Accounts ($Mil.)	$1,959	$2,105	$2,194	$2,407

Source: FDOR.

History and Composition

According to district representatives, Collier MCD was established in 1950 as an independent special district to control mosquito populations in Collier County, Florida. The district's charter was re-created and reenacted by the Legislature in Chapter 2001-298, *Laws of Florida,* as amended by Chapter 2004-425, *Laws of Florida*. These chapter laws are the most recent legislative enactments governing the district. The district is also subject to Chapter 189, *Florida Statutes*, given its status as an independent special district; Chapter 388, *Florida Statutes,* setting forth the requirements for creating and operating MCDs in this state; and Chapter 5E-13, *Florida Administrative Code*, setting forth rules adopted by the Department of Agriculture and Consumer Services (DACS) for mosquito control program administration.

The Collier MCD Board of Commissioners is comprised of five commissioners. Members of the board must be resident registered electors. The positions include a chairperson, secretary/vice chairperson, and treasurer. Board members are elected to serve four-year terms, with the current board sitting at full capacity at the time of this report.

Pursuant to Chapter 388, *Florida Statutes*, and the district's chapter law, the powers and duties of the board of commissioners include:

- Performing all duties necessary for the control and elimination of mosquitoes and other arthropods of public health importance.
- Being authorized to provide for the construction of canals, ditches, drains, dikes, fills, and other necessary works, and to install and maintain pumps, excavators, and other machinery and equipment.
- Preparing and adopting a district budget.
- Being authorized to hold, control, and acquire by gift or purchase for district use any real or personal property.
- Having all the powers of a body corporate, including the power to contract; to employ a director, employees, and others; to purchase liability insurance; and to provide group insurance for its board members and employees.

As required by s. 388.151, *Florida Statutes,* the board of commissioners has scheduled meetings at least monthly during the current fiscal year and past three fiscal years, with all meetings held as scheduled in FY 2021-22 and FY 2022-23 to date. One regular board meeting was missed in March of FY 2019-20 due to the COVID-19 public health emergency, according to documentation provided by Collier MCD. In addition to regular monthly meetings, special meetings may be called to discuss the draft and final budget for the upcoming fiscal year, as well as special topics such as district banking practices and aerial activities. Collier MCD monthly meetings are open to the public and noticed and conducted in accordance with s. 189.015, *Florida Statutes*, with minutes and agendas for the last year published online following each assembly alongside the schedule of meetings (**Table 4**).[3]

Table 4. Collier MCD Commissioner Meeting Counts

Commissioner Meetings	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[2]
Monthly Meetings	11	12	12	7
Special Meetings[1]	7	7	7	3

Source: TBG Work Product, Collier MCD.
[1] Special meetings include quarterly trustee meetings, special budget meetings, retiree benefit trust meetings, and other special meetings as needed.
[2] 2023 YTD through April.

Intergovernmental Interactions

Treatment for mosquitoes is made difficult in parts of the district due to the geography of the area, as many of the state and federal lands surrounding Collier MCD tend to be prime mosquito habitats. Hence, Collier MCD coordinates with DEP to occasionally larvicide in those areas. Additionally, as stated above, DEP has issued research permits to the district for Collier-Seminole State Park and ACPs for Delnor-Wiggins State Park, and DACS has approved an ACP for Picayune Strand State Forest. Collier MCD also works with the US Fish and Wildlife Service to ensure compliance with chemical use and the Endangered Species Act.

Resources for Fiscal Year 2021-22

The published FY 2021-22 millage rate established by Collier MCD was 0.1609. Collier MCD received $17.82 million in revenues and spent $15.28 million in FY 2021-22. Collier MCD had 62 paid staff and owned 43 vehicles and 4 buildings in FY 2021-22. A summary of Collier MCD resources for Fiscal Year 2021-22 is shown in **Table 5**.

[3] The District Board Meeting Information | Collier Mosquito Control District (cmcd.org).

Table 5. Collier MCD Resources for FY 2021-22

Resource Item	FY 2021-22 Amount
Millage Rate	0.1609
Revenues	$17.82 million
Expenditures	$15.28 million
Number of Paid Staff	62
Vehicles	7 aircraft, 1 boat, 35 ground vehicles
Equipment	Field equipment: 61 Lab equipment: 23 Office equipment: 76 Surveillance equipment: 142
Facilities	2 facilities, 4 buildings

Source: TBG Work Product, Collier MCD

2. Findings

Service Delivery

Collier MCD follows industry standards for Integrated Pest Management (IPM) and provides an array of mosquito control services consistent with the district's chapter law and the Florida Statutes; other local government entities located wholly or partially within Collier MCD do not provide similar mosquito control services. To assess the delivery of services in the district, TBG requested information on the geographic characteristics of the district; other local governments to which the district provides services or with which it coordinates efforts; the services provided by the district; similar services provided by other entities; district studies or evaluations of alternative service delivery methods including consolidation of services with other government entities; unique contributions from the district relative to the county or municipalities; and local stakeholder perceptions of the relative value of the district's services. In addition, TBG requested information from representatives of the Board of County Commissioners, local health department, and local parks and recreation department on their perceptions of the district's service delivery and efficiency.

Overview of Services

Most mosquito control programs use an IPM approach to control mosquito populations, which targets the different stages of a mosquito's life cycle with various prevention and control measures. IPM addresses eight areas. Surveillance of mosquito populations is an essential component of all IPM programs with chemical treatments based on the surveillance findings. IPM can also include source reduction (e.g., container disposal, water/impoundment management), larviciding and adulticiding (using ground and/or aerial treatments), biological and alternative control, and disease surveillance. Research and education are also important components of IPM programs. See attachment titled, "Integrated Pest Management" for more information. Collier MCD conducts activities in each of the eight areas of IPM

TBG reviewed documentation provided by Collier MCD, interviewed staff and management, and conducted internet research on Collier MCD's services to assess delivery of services.

Collier MCD conducts daily surveillance of landing rate counts, conducted either in the morning or at dusk depending on what mosquitoes are currently being targeted. Ground and aerial surveillance are used to pinpoint areas of concern as well as identify mosquito species to determine appropriate treatment methods. Different types of traps are also set up by field technicians and biologists to determine the general population and types of mosquitoes in the area. Mosquitoes are then tested from the traps for mosquito-borne disease using in-house lab testing, and if the results indicate the presence of mosquito-borne disease in the district, the appropriate treatments are determined within 48 hours in order to maximize the effectiveness of the chemicals used as well as to determine how the district can best combat rising resistance to chemical usage. Field technicians perform aerial inspections by traveling to remote areas of the county via helicopter to check natural habitats for mosquito breeding. Field technicians also perform ground inspections to look for larval habitats throughout the county and respond to service requests from citizens. In addition, Collier MCD uses a network of automated mosquito traps that relay mosquito activity to district staff every 15 minutes, which is a highly efficient method of collecting data.

Collier MCD conducts source reduction by emptying containers when responding to resident service requests and providing community education on the importance of source reduction. The district also monitors properties for the presence of waste tires but does not collect tires itself. When tires are discovered that district staff determine could produce mosquitoes, the district reports this to the Collier County Solid and Hazardous Waste Department or Code Enforcement Division, which will collect and dispose of the tires. The district reported that it also has historically participated with the county's Solid and Hazardous Waste Department's tire collection events.

Larvicide and adulticide operations include using rotary wing aircraft to reach wetlands, mangrove marshes, and barrier islands, to conduct surveillance and application of granular and liquid material targeting mosquito larvae. Liquid larvicide is also applied using ground delivery vehicles to reach roadside ditches and containers of standing water. Adulticide is distributed using fixed-wing and rotary wing aircraft to deliver ultra-low volume (ULV) applications.

Collier MCD continually researches new methods and technologies to improve the efficiency of treatments, including the development of drone equipment to deliver larvicide to areas not easily accessible by foot or helicopter, and the breeding of gambusia mosquito fish to promote biological mosquito control via a program to give residents of Collier County free mosquito fish upon request.

The district established an insecticide resistance monitoring program in 2017 to conduct research to identify mosquitoes with resistance to certain insecticides. As part of this research, the district conducts pesticide resistance testing to identify the locations and species of mosquitoes that demonstrate resistance to certain pesticides and works to develop strategies to combat resistance in mosquitoes, including the addition of new adulticides and increasing larvicide efforts. Collier MCD reported that it regularly collaborates with chemical manufacturers to test the efficacy of products and conducts research using chemicals that are available in the market or available under a special Experimental Use Permit issued by the United States Environmental Protection Agency.

Collier MCD's outreach and education activities include school-based education programs that teach Collier students about mosquitoes and mosquito control, as well as presentations to local civic groups and homeowners'

associations, tours of district headquarters, and direct contact lines of phone and email. The district also solicits feedback through its website, social media, and numerous community events.

A summary of the eight areas of IPM in which Collier MCD conducts activities is set forth in **Table 6**.

Table 6. Collier MCD Services Overview

Integrated Pest Management Service	Collier County MCD Services Provided
Mosquito Surveillance	Daily ground and aerial surveillance using trap collection, landing rate counts, and other analysis
Disease Surveillance	Mosquito pools are tested for arbovirus presence
Source Reduction	Emptying containers when responding to resident service requests and community education on source reduction
Larviciding	Application of larvicides using trucks or helicopters; oils and films, soil bacterium, and insect growth regulators
Adulticiding	Delivery of ULV insecticide performed through fixed-wing or rotary-wing aircraft.
Biological and Alternative Control	Mosquito-eating fish hatchery (gambusia)
Mosquito Control Research	Ongoing research efforts to identify new methods and technologies to improve treatment efficiency
Outreach and Education	Education and outreach facilitated through schools, summer camps, resident service requests, and public meetings

Source: TBG Work Product, Collier MCD.

Analysis of Delivery of Services

Collier MCD delivers services that are within the scope of its charter and purposes outlined in applicable laws and regulations. Collier MCD provides services in eight areas of IPM as described above, and all district services are directed toward the abatement and control of mosquitoes. No services were noted that fall outside the district's charter or applicable laws and regulations. As described above, Collier MCD's service area includes rapidly developing urban areas surrounded by rural lands and extensive natural areas including several federally and state-protected parks and preserves, which produce mosquitoes prolifically. The mosquito control expert retained by TBG for this review did not identify any alternative methods for providing the district's services that would reduce the district's costs or improve the district's performance.

Comparison to Other Services

Other local government entities located wholly or partially within Collier MCD do not provide similar mosquito control services. TBG interviewed staff from Collier MCD, the local health and parks and recreation departments, and the Board of County Commissioners, and reviewed documents available online to establish if services could be or are redundant to or overlapping with county and municipal government services. Services similar to those provided by Collier MCD are not provided by county and municipal governments located within the district. Collier MCD operations are fairly sophisticated, and local government is likely not equipped to deliver the services that Collier MCD oversees and administers. In addition, the Board of County Commissioners provided TBG with a letter expressing its support for the operations of the Collier MCD, finding the district to be a highly efficient organization that provides focused and valuable services to protect public health and comfort. The board fully supports keeping the Collier MCD as an independent special district as its operations would not be well-suited for county management and it operates effectively as it is currently structured.

Considerations for Consolidations

Consolidation of operations is not recommended for Collier MCD based on the findings of this review. Collier MCD does not operate throughout the entirety of Collier County, but there is no other MCD in the county and therefore no comparable service has been identified for consolidation.

Resource Management

Collier MCD is managing its resources in an efficient and effective manner to achieve its goals and objectives.

To assess the district's resource management, TBG analyzed information on revenue sources, revenue and expenditure trends and their possible causes; analyzed staffing trends and their possible causes; requested data on services delivered by district staff versus third-party contractors for the last three fiscal years; analyzed equipment inventory and capital investment trends; reviewed the activities the district conducts to manage costs and plan personnel; requested information on resident feedback survey data related to finances and spending by the district; reviewed performance reviews and audits; and interviewed district staff and board members.

Current and Historic Revenues and Expenditures

Collier MCD's annual revenues and expenditures rose steadily during the current and past three fiscal years; revenues have exceeded expenditures in FYs 2019-20 through 2021-22. Collier MCD's funding is primarily comprised of ad valorem taxes. The Collier County Property Appraiser, with approval from the Florida Department of Revenue (FDOR), certifies the county's tax roll each year and provides the information to the Collier County Tax Collector, which in turn collects monies authorized under Collier MCD's taxing authority. Millage rates are set each year by Collier MCD's board of commissioners. Collier MCD's FY begins October 1 and ends September 30. Collier MCD received funding via Federal Emergency Management Agency (FEMA) grants in FY 2018-19 and FY 2020-21.

To review current and historic revenues and expenditures of Collier MCD, TBG requested and received financial information from Collier MCD for FY 2019-20 through FY 2022-23. In addition, TBG interviewed Collier MCD staff and reviewed documentation both online and as provided from district accounting and operation systems. Revenues increased steadily from $16.1 million in FY 2019-20 to $19.3 in FY 2022-23, with the vast majority coming from ad valorem taxes and a small amount from other sources (**Table 7**). Expenditures increased from $14.06 million in FY 2019-20 to $15.28 million in FY 2021-22 and were $6.58 million as of March 2023. Revenues exceeded expenditures in each year of the review period.

Historically, revenue sources include ad valorem and other sources including grants and donations, interest and earnings, sale of equipment (including aircraft), refunds, and income from the community of Ave Maria. Collier MCD has an ongoing interlocal agreement with Ave Maria Stewardship Community District, an area that sits outside of Collier MCD boundaries but within the borders of Collier County. This contract has been continually renewed since 2007. Collier MCD wants to officially incorporate the Ave Maria community into its boundaries in the future. The district received county voter approval on August 23, 2022, to officially incorporate the community as well as several other areas, including Azure at Hacienda Lakes, Naples Reserve, Port of the Isles, Brightshore Village, Rivergrass Village, Longwater Village, Bellmar Village, and developments within Ave Maria. For the expansion to occur, it must be approved by the Florida Legislature; however, legislation filed for the 2023 Regular

Session to expand the district's boundaries died in committee.[4] The district continues to provide services to Ave Maria on a contractual basis.

Table 7. Revenue and Expenditures

Revenues and Expenditures (in $Mil.)	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[1]
Revenues	**$16.12**	**$16.51**	**$17.82**	**$19.34**
Ad Valorem	$15.26	$15.71	$16.06	$17.66
Other Sources	$0.87	$0.80	$1.76	$1.68
Expenditures	**$14.06**	**$14.39**	**$15.28**	**$6.58**
Administrative Costs	$1.12	$1.22	$1.20	$0.80
Direct Program and Activity Costs	$12.93	$13.15	$14.05	$5.73
Other Expenditures	$0.01	$0.03	$0.03	$0.04

Source: Collier MCD Income Statements.
[1] 2023 YTD through March.

Collier MCD has demonstrated careful management of its funds, as evidenced by the historical trends showing that the district balances its revenues and expenses well, and that the district lowered millage rates while keeping revenues in excess of expenditures by over $1.5 million for FYs 2019-20 through 2021-22. Given rising property value along with the increasing expansions and developments, the revenue streams are sustainable for Collier MCD's scope of activity. Expenditures continue to rise in order to provide the same level of service to new developments, but efforts by Collier MCD to improve operational efficiency lead to less operational expenses.

Administrative Costs

Expenditures on administrative staff and other costs were relatively consistent, ranging between $1.1 and $1.2 million from FYs 2019-20 through 2021-22, accounting for about 9% of total expenditures on average. As requested by TBG, Collier MCD provided a breakdown of total expenditures by administrative and other program costs such depreciation for FY 2019-20 through March of FY 2022-23.

Administrative costs to Collier MCD fell into several categories, with the majority being in the categories of personal services (salaries) and benefits (**Table 8**). For supplies and materials, the main items were computer equipment, subscriptions/memberships, and training. For the travel, utilities, repair, and maintenance category the main items included are utilities and general maintenance. As of March in FY 2022-23, the total administrative costs were $803,113. Unlike other MCDs reviewed by TBG, Collier MCD reported that no operating expenses fall under administrative expenses.

[4] House Bill 1173 (2023) (proposing to amend Collier MCD's boundaries).

Table 8. Administrative Cost Data

Expenditure Category[1]	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[2]
Personal Services	$531,459	$602,963	$633,376	$365,296
Personal Services Benefits	$447,603	$440,938	$374,390	$240,421
Operating Expenses	$0	$0	$0	$0
Travel, Utilities, Repair, and Maintenance	$38,896	$44,659	$58,021	$46,234
Supplies and Materials	$99,519	$126,871	$129,499	$151,160
Capital Outlay	$0	$0	$0	$0
Total	**$1,117,476**	**$1,215,431**	**$1,195,287**	**$803,113**

Source: Collier MCD Annual Financial Reports.
[1] Categorization of direct program costs was completed by Collier MCD based on an outline provided by TBG to ensure consistency across reports.
[2] 2023 YTD through March.

Direct Program Costs

Expenditures on direct program costs increased by about $1 million FY 2019-20 through FY 2021-22, accounting for about 91% of total expenditures on average. As requested by TBG, Collier MCD provided a breakdown of total expenditures by direct program costs for FY 2019-20 through March of FY 2022-23. Direct program costs for these years fell into several categories, and most direct costs fell into the capital outlay, supplies and materials, and direct personal services categories (**Table 9**). Most categories have seen double-digit increases from FY 2019-20 to FY 2021-22

One point of concern for most MCDs, with Collier MCD being no exception, is the increasing cost of chemicals used for spraying operations. Chemical costs were more than $3 million in FY 2020-21 and FY 2021-22, comprising the majority of supplies and materials costs. As chemical costs rise, Collier MCD has improved the efficiency of its operations by developing more effective treatment mixtures, improving targeting and delivery from drones, and utilizing natural methods of management like Gambusia fish. Capital outlay expenditures have fluctuated between $3.4 and $4.4 million. Expenditures for FY 2022-23 were $5.7 million through March, with capital outlay spending being significantly lower compared to previous years.

Table 9. Direct Program Cost Data

Expenditure Category[1]	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[2]
Personal Services	$2,119,718	$2,460,534	$2,644,196	$1,519,185
Personal Service Benefits	$1,908,203	$1,763,753	$1,596,083	$1,024,954
Operating Expenses	$544,022	$785,490	$766,094	$554,211
Travel, Utilities, Repair, & Maintenance	$866,040	$991,868	$1,203,539	$1,318,431
Supplies and Materials	$3,037,147	$3,725,569	$3,752,360	$1,170,862
Capital Outlay	$4,458,076	$3,427,758	$4,091,160	$147,047
Total	**$12,933,206**	**$13,154,972**	**$14,053,432**	**$5,734,690**

Source: Collier MCD Income Statement.
[1] Categorization of direct program costs was completed by Collier MCD based on an outline provided by TBG to ensure consistency across reports.
[2] 2023 YTD through March.

Contracts for Services

Collier MCD is contracted to service the Ave Maria Stewardship Community District. TBG reviewed documentation provided by Collier MCD and interviewed Collier MCD staff to determine if Collier MCD has any contracts and the associated costs. Collier MCD has an ongoing contract with the Ave Maria Stewardship Community District in Collier County to provide mosquito control services. The total revenue Collier MCD has received from the spraying contract with Ave Maria was $1,526,713 during the current and previous three fiscal years under review (**Table 10**).

Table 10. Summary of Contracted Services

	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[1]
Ave Maria Contract	$328,262	$509,267	$455,716	$233,468

Source: TBG Work Product, Collier MCD.
[1] 2023 YTD through April.

Staff

Collier MCD employed 62 in-house staff members in Fiscal Year 2021-22 with a range of responsibilities and expertise. TBG reviewed and analyzed documentation provided by Collier MCD to determine the number and positions of those employed by Collier MCD and interviewed management. Of the numerous positions Collier MCD employs, seven positions were in administrative roles. Additionally, Collier MCD employs five commissioners. Staff positions are outlined in **Table 11.**

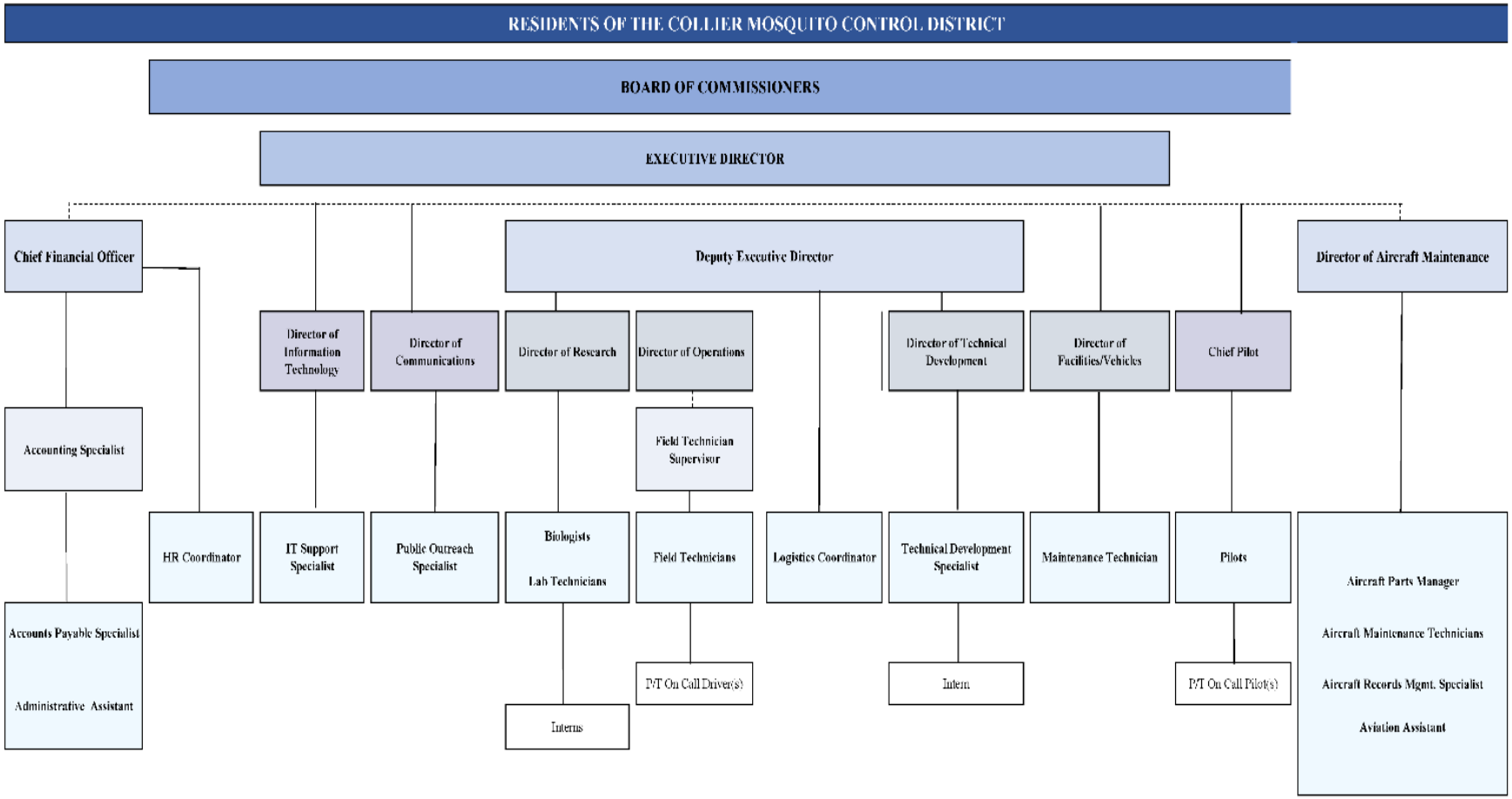
Table 11. Collier MCD Staff Positions

• Commissioners • Executive Director • Deputy Executive Director • Chief Financial Officer • Accounting Specialist • Accounts Payable Specialist • Human Resource Associate • Office Coordinator/Admin Assistant • Director of Operations • IT Manager • System Administrator • Logistics Coordinator	• Student Intern • Technical Development Manager • Technical Development Specialist • Technical Development Intern • Director of Communications • Public Outreach Specialist • Director of Research • Research Entomologist Biologist	• Lab Technician • Director of Aircraft Maintenance • AC Mechanic • Aviation Assistant • Aviation Records Specialist • Aircraft Parts Manager • Chief Pilot • Pilot • Field Technician Supervisor • Field Technician • Seasonal/Part-Time Employees

Source: Collier MCD Detailed Work Plan filed with FDACS.

An organizational chart is provided in **Figure 3**.

Figure 3. Collier MCD Organizational Chart



Source: Collier MCD.

Analysis of Program Staffing Levels

Collier MCD staffing levels fluctuated slightly from FY 2019-20 through FY 2020-21; staffing trends for the current and past fiscal year are not possible to determine due to lack of data. To assess program staffing levels, TBG reviewed documentation provided by Collier MCD and interviewed district staff. As previously noted, part of Collier MCD's strategy for operational efficiency includes expanding drone operations to allow for increased treatments without increasing staff. The new drone legislation authorizing the use of drones from approved manufacturers only will complicate this strategy, but program staffing levels are not expected to be affected in the short run. Collier MCD had 62 paid, in-house staff members in FY 2021-22 with a wide range of responsibilities and expertise. Collier MCD had no volunteers or contracted staff in FY 2021-22 (**Table 12**). Turnover rates were minimal from FY 2019-20 and FY 2021-22. The turnover rate increased in FY 2022-23, but is still less than 9% and lower than other MCDs of its size. For example, in the same period of review Lee County MCD reported turnover rates between 10-15%, and Florida Keys MCD reported turnover rates of up to 15%.[5]

Table 12. Collier MCD Staff Counts

Employee Counts	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[1]
Commissioners	5	5	5	5
Full Time	47	52	56	47
Part Time/Seasonal	1	1	1	4
Contracted	0	0	0	0
Volunteers	0	0	0	0
Vacancies	1	5	4	8
Total Filled Positions	**53**	**58**	**62**	**56**
Annual Termination	1	0	0	5
Turnover Rate	2.0%	0%	0%	8.9%

Source: TBG Work Product, Collier MCD.
[1] 2023 YTD through April.

Equipment and Facilities

Equipment and facilities of Collier MCD are currently sufficient for operations, with equipment serviced regularly to maintain and maximize efficiency in operational capabilities. To review the equipment and facility trends of Collier MCD, TBG analyzed documentation provided by Collier MCD and interviewed Collier MCD staff.

Collier MCD progressed its goal of upgrading equipment and facilities to keep pace with expanding development, ensure sufficient capacity for current operations, and reduce repair outages and maintenance costs. To increase efficiency, more drone-operated tasks were being implemented, but the new drone legislation will require Collier MCD to revisit its drone-related goals and objectives in light of the increased costs to comply with the prohibitions against the use of drone equipment from unapproved manufacturers.

[5] TBG reviewed FY 2021-22 expenditures and total available staff positions across the 15 MCDs as part of this review and categorized districts as follows: very small districts are those with expenditures less than $1 million and staff under 10 (Buckhead Ridge, Fort Myers Beach, and Moore Haven MCDs); small districts are those with expenditures between $1 and $5 million and staff between 11 and 49 (Amelia Island, Beach, Citrus, East Flagler, Indian River, and South Walton County MCDs); moderately-sized districts are those with expenditures between $5 and $10 million and staff between 11 and 49 (Anastasia, Manatee, and Pasco MCDs); and large districts are those with expenditures over $11 million and more than 50 staff positions (Collier, Keys, and Lee MCDs).

Collier MCD owned 3 fixed wing aircraft, 4 rotary wing aircraft, 24 trucks, 5 SUVs, 2 cars, 1 boat, and 7 other vehicles in FY 2021-22 (**Table 13**). In addition, Collier MCD leased four buildings in FY 2021-22: the headquarters location in Naples and the substation location in Immokalee comprised of three buildings.

Table 13. District Vehicles, Equipment, and Facilities

	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[1]
Vehicles	**40**	**42**	**43**	**47**
Airplanes	3	4	3	3
Helicopters	3	3	4	4
Boats	1	1	1	2
Trucks and Vans	29	30	31	34
Campers and Buses	0	0	0	0
ATVs and Utility Vehicles	4	4	4	4
Equipment	**195**	**188**	**160**	**176**
Field Equipment	65	63	61	64
Lab Equipment	30	26	23	25
Office Equipment	100	99	76	87
Facilities	**2**	**2**	**2**	**2**
Buildings	2	2	4	4

Source: TBG Work Product, Collier MCD.
[1] 2023 YTD through April.

Collier MCD also has different types of surveillance equipment, including several types of mosquito traps. According to interviews, Collier MCD does not have a sentinel chicken program. The supply of mosquito traps has increased from 91 in FY 2019-20 to 145 in FY 2022-23 (**Table 14**).

Table 14. Surveillance Equipment

Equipment	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23[1]
Mosquito Traps	**91**	**96**	**133**	**145**
BG-Counter Traps	31	33	31	31
BG-Sentinel Traps	25	16	32	44
CDC-Light Traps	21	32	37	37
Emergence Traps	6	6	25	25
Gravid Traps	8	9	8	8
Sentinel Chicken Coops	0	0	0	0
Chicken Counts	0	0	0	0

Source: TBG Work Product, Collier MCD.
[1] 2023 YTD through April.

Strategic or Other Formal Plans for the District's Future

Collier MCD has created a five-year strategic plan outlining its goals for 2021-25, setting goals and objectives to achieve in the near future and steps to achieve them. To assess the formal plans for Collier MCD's future, TBG reviewed documentation provided by Collier MCD to determine the full scope of Collier MCD's strategic plan.

Collier MCD has a strategic plan in place for 2021-25, with the main purpose of accomplishing the following:

1. Establish a new lease on a parcel of land at the Immokalee Airport

2. Construct a hurricane-proof hangar facility at the Immokalee Airport with adequate space for all operational needs in a post-disaster scenario
3. Expand its boundaries to include areas of anticipated community growth in the county with emphasis on
    a. Refinement of IPM to be location specific, genera specific, and environmentally sound
    b. Creative approaches to improve efficacy with minimal increases in revenue
    c. Establishment of Arthropod Management Plans with public land managers
4. Supplant majority of current aircraft fleet with well-supported, reliably dispatchable, mission capable, and technically advanced fixed and rotor-wing ships
5. Expand and continue to implement wider-scope-of-mission Unmanned Aerial Vehicles (UAVs) to support district operations
    a. Pursue and implement research and development of Teros UAV for mapping and inspection, to include Laser Imaging, Detecting and Ranging (LIDAR)
    b. Begin safe and effective larger scale larvicide and adulticide with UAVs

This strategic plan includes an action plan as well as a financial plan and details the purpose of each of the departments of Collier MCD. The departments include Administration (including executive management), Aviation Maintenance, Communications, Facilities, Flight, Mosquito Control, Operations, Research, and Technical Development. Collier MCD also created a set of objectives for each department in 2022 detailing the objectives each department is currently working towards to advance the 2021-2025 strategic plan.

Collier MCD is pursuing expansion plans to incorporate the community of Ave Maria and other areas into its official district boundaries in response to development that has been occurring in parts of Collier County that were previously rural or natural lands. The proposed expansion has required extensive coordination between the district and numerous stakeholders to address stakeholder concerns about environmentally sensitive areas, which resulted in revised proposed expansion boundaries that do not include any public lands or Areas of Critical State Concern. As discussed in a previous section of this report, the legislation necessary to complete the boundary expansion was filed in the 2023 Regular Session of the Florida Legislature but was not adopted. The district maintains Board Policy #2019-02 on its website, which speaks to the potential need and justification for district expansion.[6] In addition, district staff reported to TBG that the district intends to continue to pursue incorporation of Ave Maria and other areas into its boundaries during the 2024 Session of the Florida Legislature. Furthermore, district staff reported that the proposed expansion requires continued communication and coordination between the district and many stakeholders due to the concerns about mosquito control activities occurring on or near the numerous environmentally sensitive federal, state, and private lands in the area, and that the district plans to continue to engage in this extensive stakeholder coordination.

Collier MCD is also in the middle of a seven-to-nine-year refurbishment program of its aerial fleet, as the aircraft they use are severely outdated and harder to source parts for as they age. Current helicopters are either being refurbished to like-new condition or replaced by new models.

[6] https://cmcd.org/about-the-district/policies-reports/

Previous Performance Reviews, Financial Audit Findings, and Results of Resident Feedback Surveys

Collier MCD audits report no material findings nor weakness in internal controls or financial audits; no performance reviews were provided and resident feedback seems to be positive. TBG reviewed Collier MCD's financial audits from FYs 2018-19 through 2020-21. The audits found that Collier MCD's financial statements had no findings and fairly represented the district's financial position. Collier MCD's revenues cover costs. At the time of this writing, the FY 2021-22 audit had not been released, but Collier MCD has historically upheld a high standard of reporting.

TBG did not receive performance reviews or results of resident feedback surveys from Collier MCD. Collier MCD staff provided some items of feedback received from the public from social media, emails, and school visits that indicated a positive perception of the district's work. Examples of positive feedback the district received include several letters of praise from middle school students and teachers who attended educational programs the Collier MCD provides.

Analysis of Management Reports/Data and Performance Information

Collier MCD actively manages performance success or failure of its operations and administration against goals and has effective reporting mechanisms in place to measure results on a timely basis. To assess management reporting and performance information, TBG reviewed documentation provided by Collier MCD as well as board packets, which include operational results. Extensive information was provided by Collier MCD, and board and workshop packets also include detailed information. The board minutes and agendas reviewed reflect regular monitoring of performance, identification of issues as they arise, and discussion of opportunities to improve efficiency and effectiveness. For example, the March 24, 2022, meeting minutes detailed a review of the newly produced strategic plan, a discussion of surplus health insurance funds, a report of arbovirus testing, and a discussion of the lease of the Immokalee facility, among other topics.

Evaluation of Cost, Timing, and Quality of Current Program Efforts

Collier MCD demonstrates effective and efficient management of program costs and routinely monitors programs to ensure effectiveness and improve the quality of program activities. To assess cost, timing, and quality of program efforts, TBG reviewed documentation provided by Collier MCD and publicly available data and reports, and interviewed district staff.

Collier MCD has demonstrated effective management of costs, as evidenced by the historical trends showing that the district balances its revenues and expenses well, and that the district lowered millage rates while keeping revenues in excess of expenditures by over $1.5 million for FYs 2019-20 through 2021-22.

The district also reported that it continuously monitors its program to ensure that its activities are effective. Examples include the monitoring of adulticide and larvicide operations and of insect resistance to specific chemicals, as well as the refurbishment of the district's aerial fleet. The district also maintains its own lab, which allows for the treatment of areas within 48 hours of identification of arbovirus positive mosquitoes, research into insecticide resistance, and calibration of equipment.

Further, as noted above, the district is seeking to incorporate the Ave Maria community and others into Collier MCD's boundaries to streamline the district's operations. Formal inclusion of Ave Maria and other communities

would allow for stable ad valorem revenues, and efficiencies in operational crews, surveillance, and missions. It is expected that the addition of Ave Maria to the district will improve operations and potentially reduce costs.

The district has also developed and continually monitors general goals and numerous detailed objectives that aim to improve district operations across areas of administration, facilities management, aviation maintenance, flight, and others. These are discussed in more detail in the following section.

Goals, Objectives, and Performance Measures and Standards

Collier MCD has established some fairly general goals as well as a set of specific objectives across functional areas that are measurable and appropriate to meet the district's purpose and has some performance measures and standards with which to assess how well it meets goals and objectives; arbovirus counts have decreased in the current and past three calendar years.

To assess the district's goals, objectives, performance standards, and performance measures, TBG requested and reviewed the district's charter and strategic plan; requested information on performance measures and standards, the last three years of annual reports, records of measures and standards for the review period, and records of success or failure to meet the standards; and evaluated the district's actual performance in meeting its goals and objectives. TBG requested previous performance reviews and requested and reviewed audits. In addition, TBG interviewed district staff and relevant local government entities about district performance and requested any available results of district-generated resident feedback surveys conducted during the current and previous three fiscal years.

Goals

Collier MCD has defined some general goals that guide its activities. Collier MCD's general goals include the following:

- To provide valuable service to the community through suppression of both disease-carrying and pestiferous mosquito populations;
- To provide mosquito control services through the safest and most economical means available; and
- To provide mosquito control services using a variety of IPM methods in a manner consistent with the highest level of safety and minimal adverse impact on humans, wildlife, environmental, and non-target organisms.

District staff reported that the district's measurement of success is determined by the executive director's review of the current strategic plan goals in assessing progress toward the goals every six months. General standards by which the district director assesses progress toward meeting district goals include monitoring financial results, assessing whether five-year projections on operations are progressing toward the goals, and assessing whether the district is on track to achieve its mission.

Objectives

Collier MCD has defined numerous specific objectives across functional areas, which include Administration, Facilities, Flight Management, Communications, Technical Development, Operations and Research, and

Education. Collier MCD has nearly 150 objectives across its functional areas including Administration (which includes Human Resources, Information Technology and Executive Director), Facilities Management, Aviation Maintenance, Communications (which includes Public Relations and Education/Outreach), Flight Department, Operations, Research, and Technical Development. The objectives are adequately defined, clearly stated, and appropriate for Collier MCD's purpose. **Table 15** presents a summary of the nearly 150 objectives established by the district.

Table 15. Objectives for Collier MCD

Department	Objectives

Administration – Including Human Resources, Information Technology and Executive Director	• Facilitate the creation of an interdepartmental project plan for Immokalee Hangar/Facility
	• Commence Immokalee Hangar/Facility project via the following:
	  ○ Execute lease with Collier County Airport Authority
	  ○ CCAA approval of conceptual design
	  ○ RFQ and board acceptance of an architectural firm
	  ○ Board approval of design/build, and
	  ○ Site preparation
	• Oversee and facilitate the return of employees into the remodeled areas of the administration and vehicle storage buildings
	• Streamline the budgeting process
	  ○ Work directly with supervisory staff to produce working draft
	  ○ Integrate budgeting process with future year projected/expected expenses for planning purposes
	• Investigate options for software to manage contracts and agreements
	• Obtain new software for purchase orders that encompasses Hangar and the rest of the organization all in one
	• Hire two new employees (accounting specialist, 6 months; receptionist, 12 months)
	• Upgrade Epicor – Kinetic 2022

Human Resources	• Hire and onboard new human resources director • Create a centralized hub for recruitment/advertisement, management of applications, and onboarding after candidate is selected by department head • Update job descriptions and exempt versus non-exempt positions • Create training program for supervisors regarding managing employees
Information Technology	• Update flight records, P-card, aerial treatment and hangar inventory to a web-based application • Conduct Windows 11 upgrades with hardware upgrades • Implement multi-factor authentication • Implement zero trust model to guide IT and server access moving forward • Support build-out in Immokalee • Update DADS program • Hire web developer for app development and Collier MCD website (contractor)
Facilities Management	• Evaluate, purchase, and implement software to manage maintenance due dates for generators, a/c units, etc.

Department	Objectives
	• Oversee the Immokalee facility construction project (as CMCD representative on-site) • Assist supervisors with departmental needs • Work with executive director to establish and execute best practices/standard operating procedures for maintenance projects • Coordinate the purchase and exchange of vehicles, as needed and appropriate

Aviation Maintenance	• Continue (flight safety entitlement courses with X-2 purchase) maintenance training for fixed-wing mechanics on
	  ○ PT6 (Twin Otter X-2 engine/powerplant)
	  ○ DHC-6 (Twin Otter X-2 airframe) (Canada – distance learning option)
	• Continue purge of surplus and outdated parts and equipment
	• Continue acquisition of Twin Otter parts (spares) and tooling
	• Augment technical manual/publication library for Twin Otter to include DHC6-300 specifications
	• Play integral role in evaluation of and improvements to Isolair (liquid) adulticide system to be installed on second Bell 407

Communications–Including Public Relations and Education/ Outreach	**Public Relations**
	• Continue creation and fostering of relationships with community partners, elected officials, and other leaders in the county and state
	• Conduct presentations with civic groups, homeowners' associations, etc., upon request
	• Participate with displays at community events (e.g., parades, Collier County Sheriff's Office Safe Community Week, and other community partner events)
	• Boost community and citizen engagement via Collier MCD's mosquitofish program by
	  ○ Inclusion of tanks for fish transport on a Collier MCD truck (to events and the field)
	  ○ Wrap the truck to promote Collier MCD's mosquitofish program
	• Remain visible at leadership events to continue establishment of Collier MCD's status as a community partner
	• Manage media relations for timely coverage of news and events
	
	Education/Outreach
	• Create an outdoor education/meeting area on Collier MCD headquarters grounds
	• Obtain a new Bell 407 model of appropriate size for the district's float (as a replacement for the Skyvan model)
	• Produce short educational videos for social media
	• Continue the expansion of in-school classroom presentations by establishing programs for additional grade levels
	• Employ a student intern for the spring semester to assist in the above
	• Refresh/add educational signage and supplies for classrooms, displays, and local events

Flight	• Develop currency and proficiency across all aircraft types, as appropriate on a pilot-by-pilot basis • Develop operational limitations/procedures for the Twin Otter X-2

Department	Objectives
	• Update hangar manual to include new aircraft and pesticides • Support delivery and implementation of new Bell 407 to include spray system installation, calibration, and establishment of operating limitations and procedures • Improve treatment block efficiency by and through effective communication and feedback with/to Operations, Research, and Technical Development • Establish guidelines and best practices for use of drones in obtaining accurate spray altitude winds (azimuth and velocity) • Provide piloting assistance, as appropriate, for drone operations • Remain available for community engagement and events involving aircraft and/or pilot expertise
Operations	• Engage in collaborative efforts with Research department to investigate the utility of and begin barrier treatments on Keewaydin Island • Achieve full operational status with helicopter hopper/granular larvicide loader (nee agricultural seeder) • Create database of larval hotspots in Fieldseeker to track larval abundance and larvicide efficacy • Assist in achievement of full integration of new aircraft (Bell 407 and Twin Otter) into aerial adulticide program • Establish surveillance program focusing on marine environments (mangrove, saltmarsh) in previously inaccessible areas • Continue expansion of aquatic weed (mosquito) habitat identification and mapping • Establish and foster working relationships with land/agricultural owners/managers • Increase wide area ground-based and aerial larviciding programs (as resources permit) for control of container inhabiting mosquito species
Research	• Update and create new data-driven treatment action thresholds (5E-13 Compliant) to guide operational decision making • Evaluate efficacy of barrier treatments for mosquito control on Keewaydin Island • Evaluate efficacy of new products with novel modes of action against local mosquito populations • Assess naled resistance in *Aedes aegypti* populations from various locations across the district • Augment operational surveillance by increasing number of mosquito pools tested for arboviruses • Investigate opportunities for optimizing arbovirus testing methods • Improve mosquito species and distribution surveillance by adding new trap sites in protected areas including Picayune Strand State Park, Rookery Bay National Estuarine Research Reserve, and Delnor-Wiggins Pass State Park • Enhance *Mansonia spp.* knowledge through continued, focused surveillance using emergence traps and visual inspections
Technical Development	**Unmanned Aerial Systems** • Conduct aerial trials with various, currently available adulticiding materials to ○ Prove safety and efficacy

Department	Objectives
	○ Collaborate with product manufacturers on product label language for drone use ○ Fulfill necessary parameters to provide treatments “over people” • Increase drone wind collection flights to (provide azimuth and velocity data) to more than 80% of aerial missions • Present collected drone wind data for analysis and comparison to tower wind data • Improve communications and workflow with Operations for smoother drone mission execution • Map Ave Maria (43 square miles) • Calibrate (larvicide treatment) drone for three types of granular larvicide products • Provide aerial meteorological data for at least 50% of adulticide missions • Host training for UAS ground school • Explore new technologies in UAS for mapping and inspection • Employ use of 3D printer for drone attachments to allow for remote trap placement **General** • Gather and provide data to research department for the purpose of making improvements to current drift models ○ Provide information/data for collaboration with Environmental Protection Agency to improve drift • Host and provide training for UAS ground school, advanced aerial techniques, and drone use in control efforts • Provide Research and Operations departments with support by and through collection of data including ○ Aerial mapping ○ Drone-based inspection ○ Weather data collection ○ GIS • Publish Operational Note or article in peer-reviewed industry journal and/or Wingbeats • Hire additional full-time employee • Present at American Mosquito Control Association, Florida Mosquito Control Association, and locally via Communications/Outreach • Collaboratively establish presence within FAA UAS programs • Attend UAS symposia • Improve (enhance efficiency) for FieldSeeker treatment planning • Train Operations personnel in the use of various treatment software **Aquatics** • Provide direct assistance to research department for advancement of aquatic weed program via ○ Aerial mapping services ○ Drone use for aerial larviciding missions

Department	Objectives
	• Increase the number (to the extent reasonable) of drone deployable emergence traps for use in hard-to-reach areas • Design and build a floating, portable, GPS-enabled weather station for aquatic weed program research/data collection • Provide mapping of areas of interest to Research pertaining to aquatic weeds • Investigate and determine possible treatment platforms for aquatic weed (mosquito) treatments

Source: TBG Work Product, Collier MCD.

Performance Measures and Standards

Collier MCD monitors performance using information on responses to citizen requests, timeliness of in-house arbovirus testing, and reductions in adult and larval mosquito populations after mosquito control efforts are made. Through Collier MCD's strategic planning process, it developed clear, measurable goals and objectives as described in the previous section. The district could further define additional performance measures and standards to monitor how well the district achieves its goals and objectives in the future. Currently Collier MCD monitors performance using the following performance standards and measures, which have been in place during the current and past three fiscal years.

1. **Standard:** Address citizen requests for mosquito control efforts in a timely manner.

   Measure: Number of service requests received and addressed with improved average response time.

2. **Standard:** Perform arbovirus testing in a timely manner (within 48 hours of placement of a citizen request) for operational decision making.

   Measure: Average number of days to conduct tests of mosquitoes from district mosquito pools for presence of arbovirus is less than two.

3. **Standard:** Obtain an effectiveness rating of 60% or higher for mosquito adulticide missions.

   Measure: Average percent reduction in adult mosquito population is above 60%.

4. **Standard:** Obtain an effectiveness rating of 95% or higher for granular larvicide missions.

   Measure: Average percent reduction in larval mosquito abundance is above 95%.

The district also reports that it compiles information continuously for management purposes and reports information on operations regularly to the board, and that the strategic plan is regularly reviewed for progress. Board agendas reflect detailed review of operational and fiscal activity. While these four measures are appropriate for the scale and scope of Collier MCD's operations, the district could define additional standards and measures to tie more closely to its goals and objectives to allow the district and the board to track progress.

Analysis of Goals, Objectives, and Performance Measures

Collier MCD has established clearly defined goals and objectives and has a few performance standards and measures; lack of data prevents full performance assessment and the district lacks additional performance measures and standards to allow it to measure progress toward all of its goals; local arbovirus counts declined over the review period. TBG reviewed Collier MCD's Fiscal Year 2022-23 Strategic Plan review, 2021-2025

Strategic Plan documents, and interviewed staff. As noted, Collier MCD has stated goals and objectives, but it could develop additional performance measures and standards to monitor progress toward its goals.

The district currently monitors performance through responses to service calls, average time to test mosquitoes from mosquito pools for presence of arbovirus, and the average percent reduction in the adult and larval mosquito populations as a result of adulticiding and larviciding missions, respectively. The district has upheld its standard to conduct arbovirus testing within 48 hours for mosquitoes tested from mosquito pools in two of the prior three fiscal years. District staff reported that the district has seen an average percent reduction in the adult mosquito population of 60%, but it is not possible to fully assess performance on this standard due to a lack of annual data provided by the district. Similarly, district staff reported that the district has seen an average percent reduction above 95% in the larval mosquito population, but it is not possible to fully assess performance on this standard due to a lack of annual data provided by the district.

While the district reported that counts of arbovirus cases acquired in Florida and identified in the district are not part of its performance standards or measures, TBG reviewed publicly available information on arbovirus case counts for the past four calendar years and identified several human travel-related cases and cases originating in Collier County between calendar year 2020-21 and calendar year 2022-23, but cases have declined over the review period from seven cases acquired in Florida in calendar year 2020 to one in calendar year 2022 and zero thus far in calendar year 2023. No deaths occurred as a result of infection during the review period. Collier MCD analyzes FDOH reports to measure the success of the district's disease prevention efforts. Collier MCD reported a 100% response rate for resident service calls from the current and past three fiscal years, but did not report the average response times for resident service calls.

Table 16 illustrates performance measures that were able to be quantified by Collier MCD for the current and past three calendar or fiscal years, as applicable, including documented human arbovirus cases from FDOH and district service calls and responses.

Table 16. Performance Measures for Collier MCD

Performance Measures	CY 2020[1]	CY 2021[1]	CY 2022[1]	CY 2023[1]
Arbovirus Cases (Florida)	7	4	1	0
Arbovirus Cases (Travel)	1	1	11	2
Arbovirus Deaths	0	0	0	0
	FY 2019-20	**FY 2020-21**	**FY 2021-22**	**FY 2022-23[2]**
Average Number of Days to Conduct Mosquito Pool Arbovirus Tests	<1	3.81	<1	Not provided
Mosquito Reports[3]	1,856	2,292	1,546	608
Service Calls	473	165	128	46
Service Responses	473	165	128	46

Source: TBG Work Product, Collier MCD, DOH.
[1] Florida DOH data is provided by calendar year (CY).
[2] 2023 YTD through April.
[3] Citizens can report a mosquito problem without requesting a technician to visit their home.

Table 17 summarizes the performance measures and standards.

Table 17. Assessment of Performance Measures and Standards for Collier MCD

Performance Measure	Performance Standard	Assessment
Mean number of days to conduct mosquito pool arbovirus tests	Perform arbovirus testing in a timely manner (within 48 hours of placement of a citizen request) for operational decision making	Standard met in FY 2019-20 and FY 2021-22; standard not met for FY 2020-21; indeterminate for FY 2022-23.
Number of service requests received and addressed with improved average response time	Address citizen requests for mosquito control efforts in a timely manner	Standard met for responding to all service requests; indeterminate for improved average response times due to lack of data.
Average percent reduction in adult mosquito population above 60%	Obtain an effectiveness rating of 60% or higher for mosquito adulticide missions	Indeterminate due to lack of data but district reports average reduction of 60% for adult mosquito population.
Average percent reduction in larval mosquito abundance above 95%	Obtain an effectiveness rating of 95% or higher for granular larvicide missions	Indeterminate due to lack of data but district reports average reduction of over 95% for larval mosquito population.

Source: TBG Work Product, based on review of information provided by Collier MCD.

Perceptions of the District's Performance by Local Government Stakeholders, Residents, and Other Relevant Local Stakeholders

Perceptions of Collier County MCD's performance by stakeholders is generally positive. In interviews with Collier MCD staff, TBG determined that Collier MCD's level of communications with the public, schools, and homeowners' associations is substantial and includes outreach to parents of students, which has resulted in positive feedback. For example, the district reported that it has achieved a level of respect for effective performance by local residents and community organizations. Because Collier MCD abuts federal and state lands, a high degree of coordination with adjacent landowners has required an investment of time and energy to build relationships with state and federal land managers. There have, however, also been reports of some conflict with environmental groups related to the recent boundary expansion efforts of the district that would potentially include environmentally sensitive areas.

TBG requested information from representatives of the Board of County Commissioners, local health department, and local parks and recreation department on their perceptions of the district's service delivery and efficiency. Information was not received from the local health department or local parks and recreation department after multiple contacts. The Board of County Commissioners expressed their support of the operations of the Collier MCD, finding them to be a streamlined organization providing highly focused and valuable services to protect public health and comfort, with a minimum number of employees. The Board of County Commissioners fully supported keeping the Collier MCD as an independent special district as its operations would not be well-suited for county management and it operates effectively as currently structured.

3. Recommendations

Discussion and Analysis

TBG analyzed findings by fiscal year to determine if revisions to district organization or administration can improve the efficiency, effectiveness, and/or economical operation of the district and presents three recommendations. TBG presents recommendations for the district to continue coordination with and outreach to environmental groups regarding the expansion to Ave Maria and other areas and to develop formal performance measures and standards with which to measure progress towards achieving goals and objectives outlined in its strategic plan.

Stakeholder Outreach: Collier MCD has been providing services to Ave Maria under contract for several years. Formal inclusion of Ave Maria and other areas would allow stable ad valorem revenues and efficiencies in operational crews, surveillance, and missions. It is expected that the addition of Ave Maria and other areas to the district will improve operations and potentially reduce costs, since development is encroaching into areas that create prolific mosquito habitat. This expansion was opposed by environmental groups that were concerned about treatments near sensitive areas, where protected birds and wildlife rely on mosquitoes directly or indirectly for part of their diet. Collier MCD has worked extensively with stakeholders to adjust their plans in response to concerns and will need to continue to work closely with stakeholders to ensure the successful management of areas that are adjacent to sensitive environmental areas. The district will need to continue to conduct a collaborative decision-making to include the perspectives of different stakeholder groups, including environmental groups and other stakeholders, to identify expansion strategies that minimize the impacts of expanding Collier MCD's boundaries into environmentally sensitive areas.

Performance Standards and Measures: Collier MCD has developed a formal strategic plan with clear goals and objectives but has not developed formal performance measures and standards tied to each district goal and objective. The district could establish clearly defined performance measures and standards with which to assess its progress toward achieving its goals and objectives.

Florida Coordinating Council on Mosquito Control: During TBG's review of the 15 independent MCDs, TBG found that most districts have not developed sufficient goals, objectives, or performance measures and standards. The Florida Coordinating Council on Mosquito Control was established by the Legislature to foster maximum efficient use of existing resources and to assist entities involved in mosquito control with best management practices. Membership on the council includes the agency heads for DACS, DEP, and the Fish and Wildlife Conservation Commission, the State Surgeon General, as well as representatives of federal agencies, the University of Florida's Florida Medical Entomology Laboratory, Florida MCDs, and others. The Legislature could direct the council to form a subcommittee consisting of mosquito professionals and researchers from around the state to develop model MCD goals, objectives, and performance measures and standards to assist MCDs with performance monitoring.[7]

Recommendations

A summary of recommendations is provided in **Table 18**.

[7] Section 388.46, *F.S.*

Table 18. Recommendations with Associated Considerations

Recommendation	Considerations
The district should continue coordination with and outreach to environmental groups and other stakeholders.	• This recommendation would require district staff time to coordinate communications and facilitate meetings with various stakeholders and could cause the district to incur additional administrative costs.
The district could formalize additional performance measures and standards that would allow the district to monitor and track progress toward all its goals and objectives. Such performance information would facilitate the district in consistently monitoring its progress.	• This recommendation would require additional staff time and may result in additional administrative costs to the district.
The Legislature could consider amending s. 388.46, *Florida Statutes*, to direct the Florida Coordinating Council on Mosquito Control to form a subcommittee consisting of mosquito professionals and researchers from around the state to develop model goals, objectives, and performance measures and standards to assist MCDs with performance monitoring.	• This recommendation would require a statutory change. • This recommendation would impose additional workload on council members and staff. • The council's membership could assemble a subcommittee with a broad range of expertise that could be ideal for the development of such model performance information. • While this guidance will assist all MCDs, it will be of particular benefit to MCDs that lack staff resources for the development of such performance information.

Source: TBG Work Product, based on review of information provided by Collier MCD.

4. District Response

Each independent MCD under concurrent review by TBG was provided the option of submitting a formal response letter for inclusion in the final published report. Collier MCD did not provide TBG with a response letter for inclusion in the final report.

Attachment 1

GLOSSARY OF TERMS
MOSQUITO CONTROL DISTRICT REVIEWS

September 2023

Prepared for

The Florida Legislature

Prepared by

The Balmoral Group

165 Lincoln Avenue

Winter Park, FL 32789

Attachment 1

Term	Definition
Adulticide	A chemical that kills adult insects, which is usually applied as a spray; depending on the circumstances, adulticide applications can be made from the ground (most commonly with ultra-low volume spray trucks) or from the air (with either fixed- or rotary-wing aircraft or helicopters)
***Aedes aegypti* mosquitoes**	The primary type of mosquitoes (commonly referred to as yellow fever mosquitoes) that spread Zika, dengue, chikungunya, and other viruses; because these mosquitoes live near and prefer to feed on humans, they are more likely to spread these viruses to humans than other types of mosquitoes
***Aedes albopictus* mosquitoes**	Although competent vectors of dengue, eastern equine encephalitis, and other viruses that affect humans, these mosquitoes (commonly referred to as Asian tiger mosquitoes) feed on animals as well as humans and are, thus, less likely to spread viruses to humans than *Aedes aegypti* mosquitoes
Altosid	The trade name for a mosquito larvicide that contains a synthetic version of the juvenile hormone insect growth regulator methoprene as the active ingredient
American Mosquito Control Association (AMCA)	A professional association that includes individuals working for mosquito control programs, academics conducting research on mosquitoes and other disease vectors, and industry representatives who support mosquito control efforts around the world; the AMCA is active in member training and educating the public on the health importance of mosquito control in the U.S. and beyond; the association is international in scope and has approximately 1,500 members
***Anopheles* mosquitoes**	A genus of mosquitoes with more than 400 species; female mosquitoes in approximately 40 of these species transmit malaria; this is the only genus of mosquitoes that can transmit malaria
Arbovirus	Arthropod-borne viruses that are transmitted to humans primarily through the bites of infected mosquitoes, ticks, sand flies, or midges; includes West Nile virus, eastern equine encephalitis virus, St. Louis encephalitis virus, dengue, chikungunya, Zika, California encephalitis group viruses, and malaria
Arthropod	As defined in Ch. 388, *Florida Statutes*, titled "Mosquito Control," "arthropods" are insects of public health or nuisance importance, including all mosquitoes, midges, sand flies, dog flies, yellow flies, and house flies

Term	Definition
Barrier island	Land that separates the ocean from the mainland; frequently an estuary or a lagoon will be located between the barrier island and mainland
Biogents	A company that produces mosquito traps with the goal of reducing mosquito populations that are produced in container-type habitats
***Bacillus thuringiensis israelensis* (*Bti*)**	A naturally occurring bacteria commonly used as a mosquito larvicide since the 1980s
Chikungunya	A mosquito-transmitted disease caused by a virus that originated in Africa and is transmitted by *Aedes* mosquitoes; symptoms include fever, joint pain, and rash; the name chikungunya comes from the African Makonde language and means "to bend over in pain," which is the stance that many who contract this disease exhibit
***Culex* mosquitoes**	A genus of mosquitoes, several species of which serve as vectors of one or more important diseases of birds, humans, and other animals; the diseases they vector include West Nile virus, Japanese encephalitis, and St. Louis encephalitis.
***Culiseta melanura* mosquitoes**	A species of mosquitoes (commonly referred to as the black-tailed mosquito) that is significant due to its role in the transmission cycle of eastern equine encephalitis virus and potentially West Nile virus; these mosquitoes primarily feed on birds but can spread arboviruses to mammals as well
Dengue	A mosquito-transmitted virus that causes sudden fever and acute joint pain; occasionally occurs in Florida where the mosquito vector is *Aedes aegypti* or *Aedes albopictus*
Dibrom	The trade name for an organophosphate insecticide with the active ingredient naled; used in mosquito control as an adulticide and is typically applied with aircraft
Dipper	An approximately 300 ml container attached to an extension pole that is used to sample for the presence of mosquito larvae in aquatic habitats
Eastern equine encephalitis virus (EEEV)	A mosquito-transmitted virus that is rare but very dangerous when contracted by a horse, human, or other mammal; an average of 13 cases per year were reported in the United States from 2018-2022; approximately 30% of people with EEEV die and many survivors have ongoing neurologic

Term	Definition
	problems; in Florida, the freshwater swamp inhabiting mosquito *Culiseta melanura* is the primary vector of this disease
Fixed-wing aircraft	Commonly referred to as an airplane, these aircraft include stationary wings that provide lift for the aircraft; in mosquito control, these aircraft are commonly used for larvicide and adulticide applications
Florida Coordinating Council on Mosquito Control	An interagency council created in Ch. 388, *Florida Statutes,* in 1986, primarily to address issues concerning mosquito control applications, possible environmental impacts of control actions, and mosquito control management on State of Florida-owned lands
Florida Department of Agriculture and Consumer Services	The state agency that oversees and regulates mosquito control programs in Florida
Florida Department of Environmental Protection	The state agency responsible for coordinating efforts for intensified mosquito control on protected public lands when needed
Florida Department of Health (DOH)	The state agency responsible for implementing the Florida Sentinel Chicken Surveillance Program, reporting weekly data on the prevalence of arboviruses in this state, issuing public health arbovirus advisories and alerts, conducting or participating in arbovirus epidemiologic investigations, distributing weekly arbovirus epidemiology summary reports for mosquito control agencies, healthcare agencies, researchers, and others, and reporting human and animal arbovirus cases to the national arbovirus surveillance database
Florida Fish and Wildlife Conservation Commission	The state agency responsible for maintaining a database that enables the surveillance of bird mortality from arboviruses and for providing assistance and information on arboviruses in wildlife
Florida Medical Entomology Laboratory	A University of Florida laboratory (within the Institute of Food & Agricultural Sciences) that conducts research primarily on the control of mosquitoes; for the past 70 years, research at this lab has been instrumental in assisting mosquito control programs in Florida and elsewhere
Florida Mosquito Control Association (FMCA)	Created in the 1920s, the FMCA is Florida's professional association that includes individuals working for mosquito control programs, academic personnel conducting research on mosquitoes and other disease vectors,

Term	Definition
	and industry, which supports mosquito control efforts in Florida; the FMCA is active in the training of members and educating the public on the public health importance of mosquito control
Florida Sentinel Chicken Arboviral Surveillance Program	A program of the DOH that provides laboratory assistance to local agencies to monitor for the transmission of mosquito-transmitted viruses; sentinel chickens are stationed at locations throughout the state; when the chicken is bit by an arbovirus-transmitting mosquito, the chicken develops antibodies to the virus (the chicken does not become sick and cannot spread the virus to other mosquitoes); blood samples obtained from the sentinel chickens are submitted to DOH's lab in Tampa to be examined for the presence of antibodies; when present, the results indicate that arbovirus-transmitting mosquitoes are circulating in the location, enabling the increase of mosquito control efforts to reduce the risk of humans and animals from becoming ill
Genetically modified mosquitoes	*Ae. aegypti* mosquitoes that have been genetically modified to carry two genes: 1) a self-limiting gene that prevents female mosquito offspring from surviving to adulthood; and 2) a fluorescent marker gene that glows under a special red light, thereby allowing researchers to identify the genetically modified mosquitoes in the wild; because the female offspring die before becoming adults, the population of *Ae. aegypti* mosquitoes decreases
Geographic Information System (GIS)	Integrated computer hardware and software that stores, manages, analyzes, and visualizes geographic information
Good Laboratory Practices Program (GLP)	The goal of GLP is to ensure the quality and integrity of test data related to non-clinical safety studies
Granular application	Granular applications of chemicals differ from liquid applications by having a solid particle carrying the insecticide, which can better penetrate vegetation; this application is primarily used for larvicides to deliver mosquito toxin to the water where mosquito larvae are developing
Impoundment	Impoundments along Florida's central-east coast were created in the 1950s and 1960s by building earthen dikes around salt marshes known to produce mosquitoes; this allows the mosquito control program to manage the water level within the impoundment to prevent saltmarsh mosquitoes from laying

Term	Definition
	their eggs in these areas, thus effectively reducing their populations with a minimum need for pesticides; approximately 40,000 acres of impoundments were constructed from Volusia County south to Martin County; the impoundments remain a source reduction control method in the region
Landing rates	A surveillance method to determine the extent of a mosquito problem, where a person stands in a specific location and counts the number of mosquitoes that land on them within a designated period (such as 60 seconds)
Larvicide	A chemical that kills insects in their larval stages; for mosquitoes, larvicide must be introduced into the water where the larvae are developing; depending on the circumstances, larvicide applications can be made from the ground or from the air with either fixed- or rotary-wing aircraft or drones
Light Detection and Ranging (LiDAR)	A remote sensing technology used to precisely detect objects, such as mosquitoes, in real space
Malaria	A life-threatening illness transmitted primarily in tropical locations by female mosquitoes in the genus *Anopheles* primarily in tropical locations; symptoms include fever, headache, and chills and usually occur within 10-15 days after a bite
Methoprene	A synthetic juvenile hormone, which is an insect growth regulator, that has been used as a larvicide since the mid-1970s
Millage	A tax rate on property expressed as the number of dollars assessed for each $1000 of property value; for example, the property owner of a house valued at $250,000, which is assessed at a millage rate of 1.0, would be charged $250
Mosquito Control District	A local government entity enabled through a voter-approved local or state legislative act to provide mosquito control services in a geographically defined area
Mosquito counts	Surveillance of mosquito populations using a variety of techniques (*e.g.*, traps or landing rates); this term is usually used in reference to adult mosquitoes rather than immature ones
Natular	The trade name for a larvicide that includes the bacteria spinosid as its active ingredient

Term	Definition
Nuisance mosquito	A term used to designate a mosquito that typically does not transmit a pathogen such as a virus; these mosquitoes are in contrast to disease-transmitting mosquitoes that are readily capable of transmitting a pathogen
Pest resistance	The situation in which mosquitoes are no longer killed by the standard dose of an insecticide or manage to avoid coming into contact with the insecticide
Pyrethrum	A biochemical derived from a chrysanthemum plant that contains insecticidal properties; typically used in mosquito control as an adulticide
Rotary-wing aircraft	Aircraft that use a rotary blade rather than wings; a helicopter is the most common example
Rotational impoundment management	A management technique common in saltmarsh impoundments along Florida's Indian River Lagoon where the impoundment is artificially flooded during part of the spring and summer to prevent mosquitoes from laying their eggs in the marsh and is opened for the remainder of the year through culvert pipes to provide a hydrological connection between the impounded marsh and adjacent estuary or lagoon
Saint Louis encephalitis virus	A virus most commonly transmitted by *Culex* mosquitoes that can affect the central nervous system when a human is infected
Source reduction	Refers to the elimination of habitats that can produce mosquitoes; ranges from the proper disposal of waste containers to the complicated management of impoundments
Spinosid	A naturally occurring bacteria that contains insecticidal properties; is commonly applied as a larvicide; Natular is a commercial product that uses spinosid as its active ingredient
Sterile Insect Technique	A method whereby male insects are sterilized by radiation or other means; when the sterilized male mates with the female insect, viable offspring are not produced
Subcommittee on Managed Marshes	An interagency committee created in 1986 by the Florida Legislature in Ch. 388, *Florida Statutes,* to promote the wise management of Florida's wetlands for the mutual benefit of mosquito control and environmental enhancement
Ultra-low volume	A technique to dispense extremely small droplets of insecticide; while historically used for adulticiding, in some instances the technique is now used for larviciding

Term	Definition
United States Department of Agriculture (USDA)	Through its national Agricultural Research Service, the USDA participates in Florida mosquito control efforts largely with the Center for Medical, Agricultural and Veterinary Entomology, a laboratory in Gainesville, Florida, that conducts research on the biology and control of mosquitoes and other insects
United States Environmental Protection Agency	The federal agency that regulates mosquito control in Florida primarily through their approval and enforcement of chemical labels for insecticides
Unmanned Aerial System (UAS)	Aerial vehicles and associated equipment that do not carry a human operator and are remotely piloted or fly autonomously; drones are an example of a UAS
Vector	A living organism that transmits a pathogen (*e.g.*, virus, plasmodium, nematode) from an infected animal to a human or another animal; mosquitoes are an example of a vector
Vector surveillance	Monitoring for vectors that can be accomplished in several ways (e.g., various types of traps or landing rates)
Waste tires	Vehicle tires that are no longer of value and that have been improperly disposed in a manner that allows water to collect in the tires; some species of mosquitoes (e.g., *Aedes aeypti* or *Aedes albopictus*) lay their eggs in the standing water where the immature mosquitoes will develop to adulthood
Water management	In mosquito control, this term refers to a source reduction technique to minimize the production of mosquitoes in a particular aquatic habitat; the management of saltmarsh impoundments and some ditches are examples of water management projects
West Nile virus (WNV)	Introduced into the United States in New York around 2000, the virus is carried by birds and primarily transmitted by *Culex* mosquitoes; humans who contract the virus can develop a fever and other symptoms including headache, body aches, joint pains, and rash; most recover completely but symptoms can linger for weeks to months
Yellow fly trap	A sticky-type trap used to entangle yellow flies, a type of biting fly that occurs regularly in the Florida Panhandle, to reduce their population without insecticides

Term	Definition
Zika virus	A virus that originated in the Zika region of Africa and is transmitted by the mosquitoes *Aedes aegypti* and *Aedes albopictus;* humans who contract the virus can have symptoms similar to dengue such as fever, rash, headache, and joint pain; Zika passed from a pregnant woman to her fetus can result in birth defects including microcephaly and other brain abnormalities

Source: TBG work product.

Attachment 2

INTEGRATED PEST MANAGEMENT SUMMARY

September 2023

Prepared for

The Florida Legislature

Prepared by

The Balmoral Group

165 Lincoln Avenue

Winter Park, FL 32789

Attachment 2

Term	Summary
Integrated Pest Management	Most mosquito control programs use an Integrated Pest Management (IPM) approach to control mosquito populations, which targets the different stages of a mosquito's life cycle with various prevention and control measures. IPM addresses eight areas. Surveillance of mosquito populations is an essential component of all IPM programs with chemical treatments based on the surveillance findings. IPM can also include source reduction (e.g., container disposal and water/impoundment management), larviciding and adulticiding (using ground and/or aerial treatments), biological and alternative controls, and disease surveillance. Research and education are also important components of IPM programs.
Mosquito Surveillance	The general approach to surveillance is to define area-specific problems with mosquitoes through the establishment of a mosquito surveillance program. The program assists in determining the types of mosquito control efforts needed in each area so that pesticide applications are used only when necessary. Service requests made to mosquito control programs serve as one means of surveillance. Other means for adult mosquito surveillance include monitoring the landing rates and counts of mosquitoes in traps to determine when and where they are most prevalent and observing the effects of adulticide, larvicide, and source reduction efforts. Immature mosquito surveillance is conducted by collecting eggs, larvae, and pupae. Surveillance may also include inventorying and mapping data and using emerging technologies such as geo-referenced maps, geographic information systems (GIS), smart traps (e.g., a trap with an electronic device that differentiates mosquitoes from other insects, counts them, and wirelessly transmits the results), and unmanned aerial vehicles.
Source Reduction	Source reduction, also known as physical or permanent control, is considered the most effective mosquito control technique and is accomplished by eliminating larval habitats in salt marshes, freshwater habitats, temporarily flooded locations, and containers. Current saltmarsh source reduction techniques in Florida include • construction of shallow ditches that enhance drainage and thus eliminate mosquito-producing sites and create connectivity among water bodies to allow larvivorous fish (fish that feed upon insect larvae) access to mosquito habitats; and • management of impoundments by maintaining a sheet of water across a saltmarsh to prevent mosquitoes from laying eggs on the soil; this achieves saltmarsh mosquito control with minimum insecticide use.

Term	Summary
	Source reduction is also conducted in freshwater habitats and is based on the principle that manipulating water levels in low-lying areas will eliminate or reduce the need for insecticide use. The primary strategy used is reducing the amount of standing water or reducing the length of time that water can stand in low areas following significant rainfall. Another important area of source reduction is through aquatic plant management, which can be accomplished using chemical, biological, or mechanical control methods. Waste tire management is also a significant activity for many mosquito control districts because the proliferation and accumulation of discarded tires throughout the state continues to create habitats highly favored by mosquitoes, and these tires can be costly and labor-intensive to remove. Removing any receptacles that can contain water is beneficial in controlling mosquitoes.
Larvicides and Larviciding	Larvicides are insecticides used to kill insects in the larval stage. Most mosquitoes spend three to five days of their life cycle in the larval stage when they are highly susceptible to predation and control efforts; therefore, well-planned and timed larviciding is important for efficient operations to save labor costs and reduce chemical use. This also requires understanding the local mosquito ecology and patterns of arbovirus transmission to select the appropriate control techniques. Equipment used for ground application of larvicide can include trucks with sprayers mounted on the front bumper, all-terrain vehicles (ATVs), boats, and various hand-held and backpack sprayers. Aerial application uses various devices such as nozzles and metered systems that are attached to fixed-wing or rotary-wing aircraft (i.e., helicopters).
Adulticides and Adulticiding	Adulticides are insecticides used to kill adult mosquitoes. The majority of adulticiding in Florida is conducted using ultra-low volume (ULV) spraying during which an aerosol spray is released by specialized spray equipment mounted in aircraft, on the back of trucks or ATVs, or carried by hand or in a backpack. The spray drifts through the air and is effective only while it remains airborne; thus, having a short-term effect only. Where a longer-term effect is needed, residual sprays are applied to barriers or surfaces such as a stadium, park, or resident's yard and are often applied with a modified vehicle-mounted hydraulic sprayer. The mosquito must land on the surface where the residual insecticide has been deposited for it to be effective. Equipment operators must be properly trained in equipment maintenance and adulticide application because timing, targets, and thresholds for the application are based on numerous factors and can be challenging to establish.

Term	Summary
Biological and Alternative Control	Biological control agents include microbial control agents (e.g., bacteria, such as *Bacillus thuringiensis* or *Bt*, that can be sprayed over waterbodies to kill developing mosquito larvae), invertebrate arthropod mosquito predators (e.g., small aquatic crustaceans, such as copepods, that eat insect larvae), and vertebrate mosquito predators (e.g., larvivorous fish and birds). It is common for mosquito control districts in Florida to provide larvivorous fish as a service to the public. For example, Collier Mosquito Control District provides Gambusia mosquitofish to Collier County residents to release in standing water on their property to manage mosquito larvae. Alternative control methods include the sterile insect technique, trapping, repellents, and bug zappers.
Disease surveillance	Because of its geographic location and proximity to the Caribbean, Florida is vulnerable to the introduction of new vector-borne pathogens as occurred with the introduction of Zika virus in 2016 in South Florida. Disease surveillance includes monitoring for human cases of mosquito-borne arboviral diseases including dengue, chikungunya, West Nile virus, St. Louis encephalitis, and others. In addition, many mosquito control programs conduct regular blood testing of sentinel chickens. The state established the Florida Sentinel Chicken Arboviral Surveillance Program (FSCASP) in 1977 to provide laboratory services to local agencies to monitor the transmission of certain vector-borne diseases. The services are primarily used by mosquito control programs around the state. The programs submit sentinel chicken blood samples to the Florida Department of Health's Bureau of Laboratories in Tampa, where an antibody test is performed to identify if the chicken has been exposed to one of several viruses. Results are provided to participating agencies on a weekly basis.
Mosquito Control Research	Mosquito control programs must base their activities on sound and up-to-date scientific research in order to provide safe, effective, and efficient mosquito control services. Research that is either conducted or reviewed by mosquito control programs is essential to developing and implementing new and innovative methods and technologies. Numerous federal, state, and other entities conduct mosquito control research, as do several mosquito control districts in this state.
Outreach and Education	Increasing the public's understanding of the work of the mosquito control districts is an important component of overall mosquito control efforts. Public education helps people understand what is involved in mosquito control, the biology of mosquitoes, ecological issues, arboviral disease transmission, and actions that can be taken to prevent mosquito bites and reduce mosquitoes in yards and

Term	Summary
	neighborhoods. When adequately informed, the public is in a better position to protect themselves and support mosquito control efforts. This state's mosquito control programs and other entities, such as the Florida Department of Agriculture and Consumer Services, Florida Mosquito Control Association, and the University of Florida's, Institute of Food and Agricultural Sciences-Florida Medical Entomology Laboratory, dedicate significant efforts toward education.

Source: TBG work product.