



Mosquito Management Plan



Foreword

The need for a mosquito management plan (MMP) is usually triggered by a known or potential risk of mosquito nuisance and/or increased mosquito-borne disease activity.

Baseline investigation has been carried out by City Mosquito Officers and the Environmental Health Officers to provide evidence to support the need for a MMP and assist with developing a general idea of the types of problems being faced, and the potential management strategies to be employed. Ongoing mosquito management during peak season provides answers to the following:

- the species of mosquitoes present in the area
- the types of environmental events or triggers leading to mosquito breeding
- locations of breeding sites
- presence of disease

Mosquito management and investigation at the City involves basic groundwork through adult and larval mosquito monitoring through trapping and dipping, as well as investigative research. The research component involves using aerial photography/Intramaps to assist with locating and mapping potential breeding sites. Collaborating with local biosecurity control groups (BCG) for specimen study of known hosts of mosquito-borne diseases.

The City relies on other forms of data for locating problem areas such as complaints from the community, advice from other agencies such as the Department of Health (DoH) and/or nearby LGs who are able to provide further information. The monitoring of environmental conditions that influence mosquito and associated virus activity, such as rainfall/air temperature/water temperature are also important in maintaining a strong preventative approach.

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1.0 Introduction/Executive Summary

The City of Kalamunda is a local government area in the eastern metropolitan region of the Western Australian capital city of Perth about 25 kilometres east of Perth’s central business district. The area covers 324 square kilometers, much of which is state forest rising into the Darling Scarp to the east.

The population of the City is 58,762 with a population density of 188.9 persons per square km.

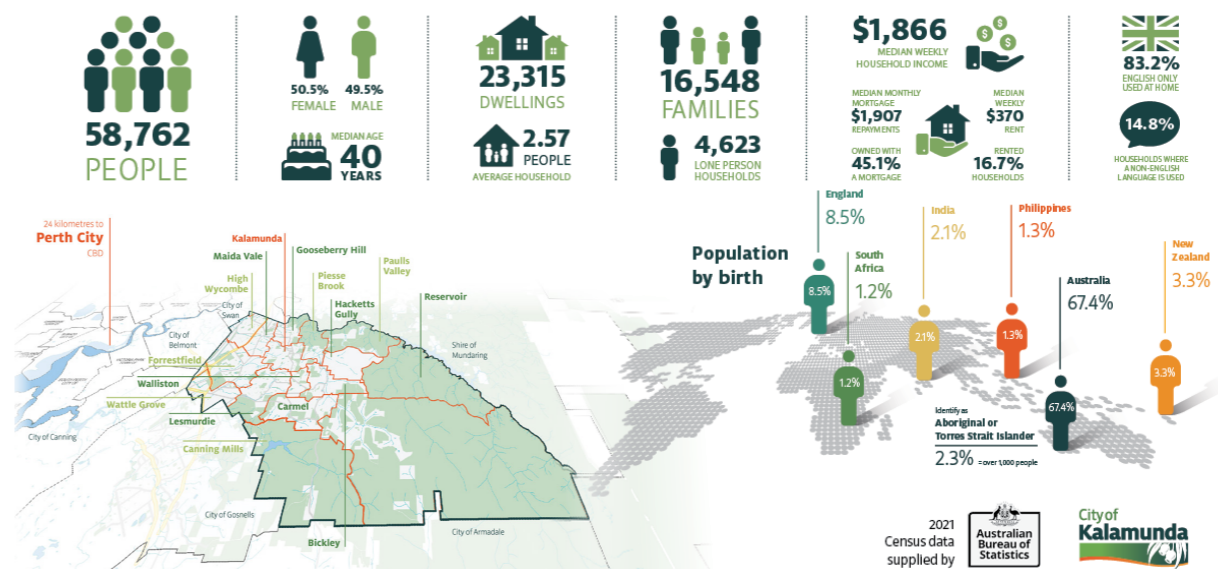


Figure 1 Infographics: Australian Bureau of Statistics Census 2021 data

- The City is made up of many varied environments including both built and natural. From the Bickley wine region, large outdoor recreational facilities throughout, waterways, bushland, hills and residential areas;
- The City of Kalamunda is captured in the East Metropolitan Health Region for mosquito-borne disease notifications which includes Armadale, Mundaring and Swan.
- Types of mosquito breeding sites vary based on species types; from vegetation to naturally occurring/constructed water bodies; stormwater infrastructure/sewage tanks, and poorly maintained swimming pools/ponds;
- The region is home to waterways and the Middle Helena Water Catchment zone. Its groundwater resources support important groundwater dependent ecosystems.
- The last four decades has seen a long-term decline in rainfall leading to decreased storage levels and aquifer recharge. This has resulted in a decrease of water levels in ephemeral creeks.

2.0 Program Objectives

The principles governing this MMP are:

- Mosquito management incorporates the health, environmental and socio-economic values across the City.
- While disease control is the primary focus, reduction of nuisance mosquitoes is a legitimate aspect of improved community wellbeing.
- Mosquitoes are an important part of the ecosystem, and their treatment may have both positive and negative impacts on the environment. All efforts will be made to ensure management strategies minimise negative impacts on the environment (built and natural).
- Effective mosquito management requires the cooperation and coordination of all stakeholders.
- Provide educational information to the community via school incursions, DoH 'Fight the Bite' campaign materials, press releases, website and social media channels.
- Other agencies such as government and non-government shall be engaged and assisted in efforts to manage and monitor mosquito-borne diseases.
- Treatment of mosquito larvae and/or adults is an on-going activity that requires continual surveillance and review.
- Establishing strategic links and relationships with local, state, and national plans and policies that impact community health and safety, aligning our efforts with broader goals.

The objectives governing this MMP are:

- to identify breeding areas and potential breeding locations.
- to provide an easy access document to convey information to new Health staff.
- to inform, guide and assist developers, consultants, landowners, residents, council staff and the public of the City's mosquito management actions and guidelines to work with other local governments in the region to ensure mosquito management is carried out in a cooperative manner.
- to strategically guide the financial direction of mosquito management.

3.0 Strategic Implications

The City Environmental Health Services has been undertaking mosquito management in a semi-formal manner for many years in the form of engaging a mosquito officer to carry out monitoring, complaint management and treatment. An MMP will allow for the management of mosquitoes in the area to take place in a formal, methodical and measurable manner.

In accordance with the City's Safe and Health Kalamunda 2023- 2028 Plan our Mission is to support and enhance the community's ability to lead healthy, productive and rewarding lives.

The MMP strives to address the following strategic directions:

- Provide a safe and healthy place to live, work and play
- Prevent illness and harm through the provision of a safe environment
- Implement Action 3.1.3 Keep the City's mosquito population to acceptable levels through education and project delivery.



4.0 Statutory Management and Legislation

Under provisions within the WA Local Government Act 1995, the City has adopted measures specific to the prevention and control of mosquito-borne diseases which are contained in the *Shire of Kalamunda Health Local Laws 2001*.

5.0 Mosquito Biology and Ecology

Mosquitoes go through four development stages - egg, larva, pupa and adult. This whole cycle from hatching egg to flying adult can take as little as 5-7 days in summer. During colder months the life cycle may take several weeks. Mosquitoes can breed in any type of standing water. Different species of mosquitoes will breed in different environments, from vegetation to natural and man-made water bodies to a variety of water-holding containers, and from fresh to brackish or even saltwater. The City and its surrounds are home to an abundance of marsupials who also play a role as hosts to mosquito-borne diseases such as Ross River Virus.

Some species of adult mosquitoes are known to travel up to 10 kilometres from a breeding site in search of a blood meal. As a result, residents living at a distance from the breeding sites (as well as those close by) may be affected.

There are approximately 100 species of mosquitoes in WA and many of them can be serious pests. In addition to being a nuisance, mosquitoes can also pass on viruses when they bite. The main viruses transmitted by mosquitoes in WA are:

- Ross River virus (RRV) - this is the most common virus transmitted by mosquitoes in WA. It is spread when a mosquito bites an infected animal or human and then this mosquito bites a human. Symptoms of RRV disease include joint pain and swelling, sore muscles, rash, fever and fatigue. Symptoms may persist for several weeks to months.
- Barmah Forest virus (BFV) - BFV disease has similar symptoms to RRV disease but is not as common.
- Murray Valley encephalitis (MVE) virus - MVE is a rare but potentially fatal disease that occurs mainly in the northern two thirds of WA. Symptoms include fever, drowsiness, confusion, headaches and stiff neck, nausea and vomiting, muscle tremors and dizziness. In severe cases brain damage, paralysis or death may result.
- Japanese Encephalitis (JEV) virus - Most JEV cases are mild. Rarely, it causes serious brain swelling with a sudden headache, high fever, disorientation and death. There is a vaccine available.
- West Nile virus (Kunjin subtype) (WNVKUN) - This has previously been known as Kunjin virus or KUNV. While the symptoms of this rare but serious disease can be similar to MVE, illness is generally milder and not life threatening.

There are no specific cures or registered vaccines for many of these diseases, so managing mosquitoes and human/mosquito interaction via an integrated mosquito management program is the only way to reduce the risk of mosquito-borne disease transmission.



Figure 2: Ross River virus is transmitted by a variety of mosquito species; the life cycle principally requires mosquito vectors and marsupial hosts.

6.0 Breeding Sites

Significant breeding sites within the City of Kalamunda and surrounds include:

- The many connective waterways leading to the Middle Helena Catchment Area, most of these waterways are ephemeral and can become stagnant throughout the summer months.
- Irrigation ponds for golf courses, sporting ovals and farmland.
- Private properties with poorly maintained swimming pools, ponds, tanks, gutters and other reservoirs for water.
- City assets such as drainage easements and stormwater gulleys.



Picture: Woodlupine Brook in Wattle Grove and Forrestfield is one example of one of the many waterways within the City that can become a breeding ground for mosquitoes in the warmer months. Picture courtesy of the City of Kalamunda ecological-corridor-project.

7.0 Nuisance/Disease Risk

It has been well documented that known vectors of mosquito-borne diseases, such as Ross River virus (RRV), and Barmah Forest virus (BFV) have been present within the City of Kalamunda. The data provided by the Mosquito-Borne Disease Control Branch, WA Department of Health through doctor submissions of notifiable disease notification forms confirms this.

Western Australian Notifiable Infectious Diseases Database and Enhanced Surveillance Data (ESD) (includes information from follow-ups from Environmental Health Officers; patient interviews; Doctor's comments on notification forms). The date and location of exposure will often be different to information provided on notification forms, and therefore data is more accurate when follow up surveys are completed.

RRV is most active between September and May in the metro region of WA, especially when above-average rainfall or unusually high tides create large mosquito breeding habitats. However, a small number of cases are also reported during winter.

While BFV is also active during these periods, evidence indicates that this virus may be active in slightly cooler temperatures when there is sufficient rainfall.

- **Public complaints:** The following table summarises the where the majority of mosquito nuisance complaints originate from in the 2023/24 period.

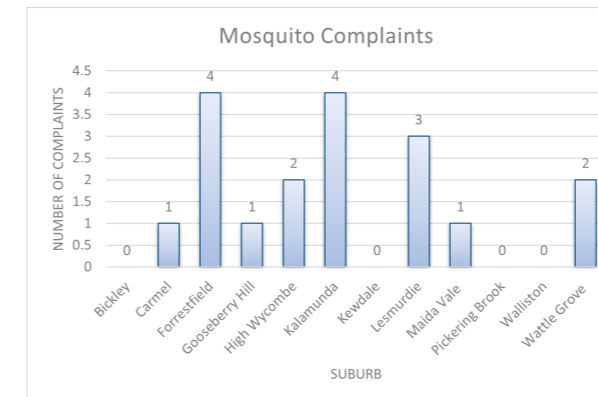


Table 1: Breakdown of mosquito complaints by suburb. Kalamunda and Forrestfield had the highest level of complaints.



Figure 3: Aerial snapshot of complaints for 2023/24 season.

- **Adult trap results:** Annual trapping results have provided the City with a database of information such as dominant species, historical changes due to changes to the environment, abundance, weather and climatic changes and other useful data.
 - *Aedes notoscriptus*, *Culex Quinquefasciatus*, *Culex annulirostris* and *Culex globocoxitus*. All dominant species are known to be vectors of disease.
 - Over 35 trap sites have been used throughout the City over the past five years to monitor species abundance.

Abundance Map detailing the dominant species trapped within the region.

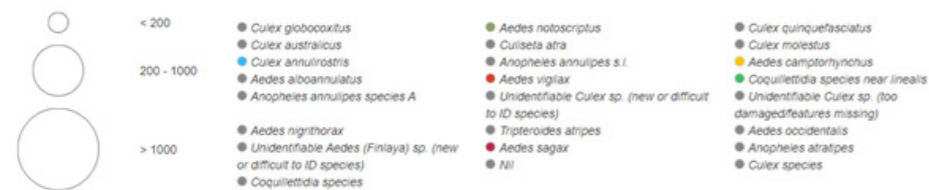
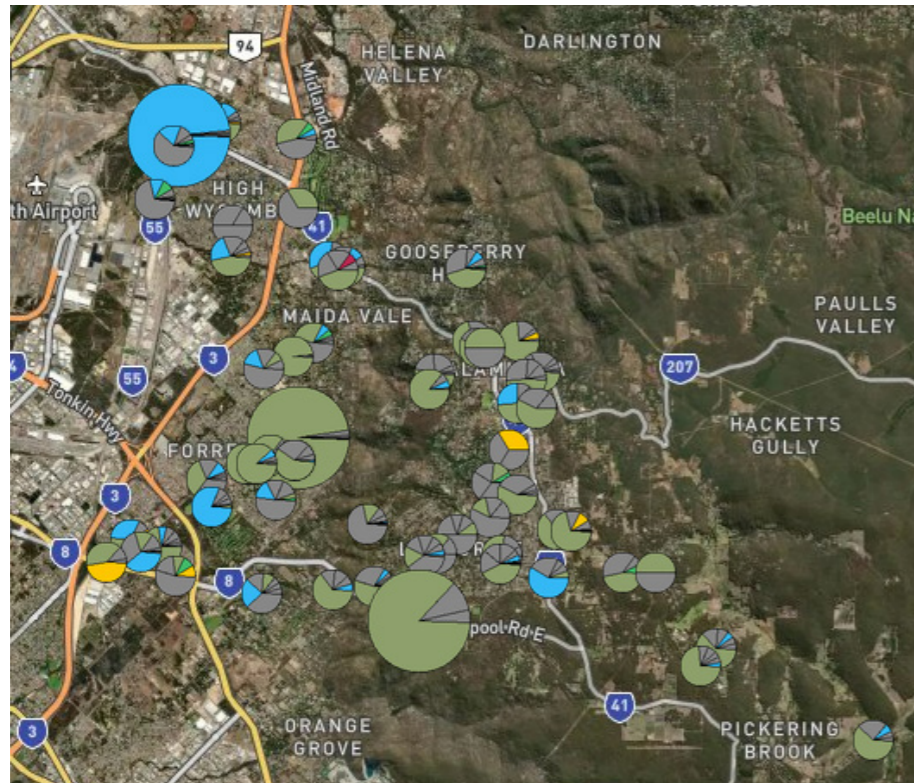


Figure 4: Species abundance map, data collected through the Atlas of Environmental Health Medical Entomology Mosquito Monitoring details the variation of species and sample sizes.

- **Notified (locally acquired) mosquito-borne disease case data:** Ross River virus is the more prevalent mosquito disease in the City and greater metro area. The long term mean for Ross River virus cases in the region is 143 per year (DoH). The long term mean for Barmah Forrest virus (BFV) is 2 (DoH).
- **Virus detection data:** Compiled by the Mosquito-Borne Disease Control Branch, WA Department of Health through clinical submissions of notifiable disease notification forms.
- Kalamunda and Gooseberry Hill have reported the highest number of disease notifications for RRV, with Forrestfield and High Wycombe an equal third.

Ross River Cases

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual total	
Organism	Ross River virus (Multiple Items)													
FinYr	2023													
Health Region	East Metro													
Government of Western Australia Department of Health														
Location	Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Kalamunda (C)		2	1	3	2	1	5	9	11	4	4	9	1	52

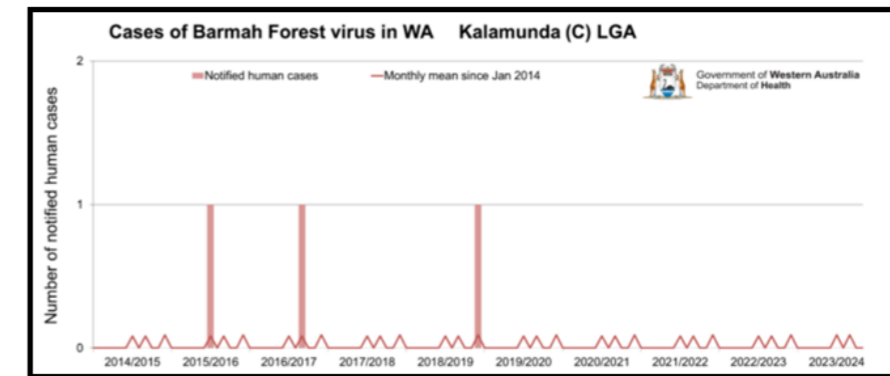
Table 4: Ross River cases by suburb for the past five years. 52 cases in total (Department of Health, 2024).

Attack rates for RRV for the City of Kalamunda- 2021/22 and 2023/24 FY period.

Financial Year	Cases	Standard Rate per 100,000 persons	Standard Rate Ratio compared to WA
2021/23	26	Not available	Not available
2022/23	4	6.48	0.80
2023/24	2	3.25	0.29

Note the major increase in cases during the 2021/22 period. This may have been due to Covid restrictions and persons being outdoors/ at home more frequently and travel around the state of WA to high-risk zones.

- **Barmah Forest Virus (BFV) Cases:** The City of Kalamunda has reported three cases of Barmah Forest Virus in the nine years. The last BFV case was detected in 2018/19.



8.0 Baseline Survey/Existing Data

Like many other sections of the MMP, the information provided here will be different for a LG that has been carrying out mosquito management for a long time compared with a LG developing a new program or extending their program as the result of a new development.

Existing programs will report on the findings from previous baseline investigations and/or the results of ongoing monitoring and surveillance.

New programs may propose what needs to be carried out to undertake a baseline survey, reporting on baseline investigations or outlining a plan for future mosquito monitoring and surveillance.

Baseline investigations are very important when establishing a new program or assessing the risk of mosquito nuisance and mosquito-borne disease in new developments. The data obtained will be used to inform initial control strategies and compare future surveys against when assessing the impact of management activities. See page 8 of Part B for specific examples.

Adult and larval mosquito monitoring

The baseline investigation should include regular adult and larval monitoring at permanent locations. Standard operating procedures on how to undertake adult mosquito trapping and mosquito identification can be accessed on the Department's website.

The frequency of sampling will vary depending on the type of breeding sites and what the triggers for breeding may be. As a general guide, weekly larval and fortnightly adult monitoring should be undertaken over the average mosquito breeding season. This can be reduced to fortnightly larval and monthly adult monitoring over the off-season. In the southern third of WA the average mosquito breeding season is approximately August to April. In the north of WA, the average mosquito breeding season will coincide with the wet season (usually January to May). The larval monitoring regime may be altered as you become more aware of environmental triggers (see below).

Environmental data

January and February are historically the months of year where spikes in mosquito-borne diseases are noted throughout the metro area. The warmer weather allows for ideal breeding conditions and people generally spend more time outdoors.

Breeding triggers related to the environment can include:

- Late onset of rainfall during warmer months
- El Nino- Southern Oscillation (ENSO) and La Nino may increase tropical like climatic conditions, or drought conditions when neutral levels are not met. The ENSO outlook changes in cycles.

- Warming climate: warmer July to September days and nights have been increasing with time, lengthening the ideal breeding temperatures for many species of mosquitoes.

The hill's surrounding Perth has a Mediterranean climate with hot, dry summers and mild, wet winters. February is the hottest month of the year, with an average high of 31.6 °C, and July is the coldest month of the year, with an average low of 7.9 °C. 77% of rain in Perth falls between May and September (BoM).

Environmental investigations are conducted annually by City mosquito officers, to monitor seasonal changes to mosquito habitats. The start to the season allows initial control strategies to be developed based on environmental factors such as perched water, long grasses, or stormwater drains remaining full of water. If this work is being undertaken to assess the risk of mosquito nuisance and/or mosquito-borne disease for new developments, a longer period of investigation of three years or more will account for seasonal changes both within the year and from one year to the next.

Longer baseline investigations conducted by City mosquito officers are particularly beneficial in observing variation in mosquito breeding habitat over time. Control strategies can be adapted to accommodate for this variation and monitored for effectiveness. For example, the City may only experience minimal mosquito breeding (e.g. in containers and drains etc) in years where environmental conditions are average or dry however may be subject to substantial increases due to unseasonably late rains over summer.

9.0 Mosquito Management Strategies

Summary of the strategies to manage mosquitoes in the City of Kalamunda

Chemical control (larvicides):

It is more efficient to treat mosquitoes as larvae, while they are contained within an aquatic environment, rather than as flying adults. Larvicides kill mosquito larvae and/or prevent the larvae developing into adult mosquitoes. They are also target-specific when applied at the label rate, reducing the impact on the environment.

The following larvicides are currently used as part of the City's mosquito management program:

S-methoprene: insect growth regulator that is absorbed by the larvae and prevents the larvae from emerging from the pupal stage. The product is preferred as it is species-targeted and safe for other aquatic life and predators within the food-web.

The City applies this product in accordance with the safety data sheet (SDS) application rates throughout the mosquito season. This product is available in several different formulations, including slow release briquets and pellet form, which can provide ongoing control for up to 150 days under certain environmental conditions. The most common use of S-methoprene is through dropping briquets into stormwater drains and large water bodies.

Limitations of chemical use: Chemical controls that the City will not be undertaking on a routine basis include fogging, and the use of Pyrethroids for the control of insects in flight. The environmental impact, particularly on natural wetland areas can be significant and is undesirable mostly due to the non-target organisms that can be caught up in the mist/spray. Fogging and the use of adulticides is short lived and will only knock down mosquitoes encountered at the time it is applied

Cultural: The identifies that the public are a vital stakeholder for this MMP and have a responsibility in any integrated program to manage mosquitoes on their own properties.

The City is actively involved in promoting the Department of Health’s Fight the Bite campaign through school incursions, pamphlets and info sheets at front counter and social media platforms. The mosquito officer ensures that school incursions take place for both primary and upper school students at least twice throughout the school year.

Biological: Allowing mosquitoes natural predators such as micro-bats, birds, fish, frogs and other aquatic life to thrive will ensure that natural methods remain in place. The City’s Environmental team focus on preserving natural areas and keeping vegetation that accommodates native fauna.

Physical: Physical management methods being used include the removal or filling in of perched water tables/waterlogged areas on City land. Issuing conditions for developers to include drainage considerations in their plans prior to approval. Approving wastewater permits based on conditions to be met for use of mosquito culling and other restrictions for access into the wastewater containment.

Integrated management:

The City’s environmental health department work with City Planners to ensure the implications of mosquito-borne disease risk are considered when assessing residential development applications. Where appropriate, developers are required to submit their own MMP to ensure this has been considered. Man-made water bodies must also be designed and managed to discourage mosquito breeding; for example, water agitators shall be included in man-made ponds.

Drainage easements are carefully constructed and well thought out by engineering and modelled to best protect the natural flow and movement of water in such a way that allows adequate drainage without risk of flooding or excessive pooling of water.

10.0 Ongoing Monitoring and Surveillance

Once management strategies have been implemented, it is essential that ongoing monitoring and surveillance is carried out to measure efficacy rates and more. All works shall be recorded and measurable. This work is critical to the overall program and will include:

- the season for engaging a Mosquito Officer shall remain September to March (climate dependant).
- effectiveness of management strategies to be assessed through monthly data review;
- known breeding sites to be defined early in the season and reviewed again monthly for treatment efficacy.
- identification of potential new breeding sites adding them to the register for monitoring if necessary; and
- the City will continue to assist with disease monitoring and collaborating through DoH endorsed programs such as the JEV Feral pig surveillance program.

Ongoing monitoring and surveillance should be carried out in a similar manner to the baseline data investigation, with standard sites regularly sampled for comparison. Larval, adult and environmental conditions should all form part of the ongoing monitoring program. Over time, this will enhance the knowledge of mosquito ecology within the area, providing a clearer understanding of the way populations change over time in response to environmental variables.

Mosquito monitoring commences, pending winter rainfall, from September through to late March. Mosquito population spikes can occur throughout the season, due to summer rainfall events, environmental conditions, nutrient availability and/or numbers of natural predators. It should also be noted that certain environmental conditions are more conducive to increased populations of specific species.

Adult (EVS/CO2) trapping at historical sites is conducted weekly throughout the season, with traps set late in the afternoon and retrieved early morning on the following day. Traps are generally in the field for between 14 and 16 hours. Where a localised complaint is received, an adult trap is set either at the resident’s property or at a nearby protected area. In all cases, environmental conditions such as predicted wind speed/direction and rainfall should be considered prior to setting adult traps. Trapped adult mosquitoes are identified to species and counted, with all data being entered into a spreadsheet, which in turn produces a graphical presentation of the data.

Larval monitoring is conducted prior to any physical, biological or chemical control. Larval surveys have also proven important in identifying numbers and species in stormwater infrastructure and privately-owned properties. Species can be identified through the onsite collection of larval samples and the use of a microscope. Alternatively, pupal samples may be reared in a collection/rearing container and emergent adults can then be identified.

Ongoing monitoring and surveillance are vital to ensure the correct timing of chemical control and to assess the effectiveness of the control program. Previous years data can be compared and measured for increases or decreases alike. The ATLAS of Medical Entomology online mapping and surveillance system shall be used to manage the data.



Figure 8: Disused swimming pool with heavy larval activity

11.0 Public Education

During the mosquito season, the following public education activities are undertaken:

- posters/display boxes with brochures placed at strategic locations throughout the City
- school incursions including interactive activities and overnight trapping and mosquito identification relevant to their area.
- social media is used to promote the campaign and inform the community about local government mosquito management activities
- active engagement with community at various events throughout mosquito season to promote Fight the Bite and awareness of health risk associated with mosquitoes.

The City uses the Fight the Bite campaign materials in order to keep the message simple and supported by the Department of Health.

A 2023/24 social media mosquito awareness campaign reached over 10,000 community members over a four-week summer campaign period. The posts focused on educating members of the public of the dangers of mosquitoes and how to prevent mosquito-borne diseases.

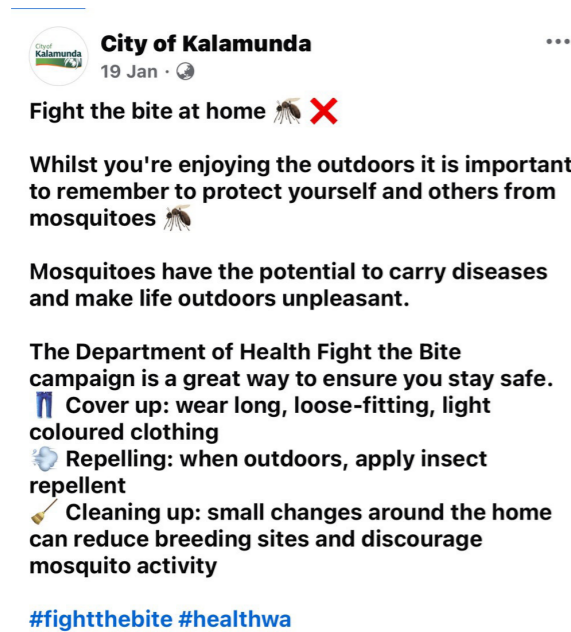


Figure 6: Content from the mosquito awareness media campaign January 2023.



Figure 7: Fight the Bite campaign material on display at the City administration building.

12.0 Stakeholders

Effective mosquito management requires consultation and collaboration with a range of internal and external stakeholders. Within the City, mosquito management is facilitated through monitoring and the treatment of breeding areas within the City's boundaries. Unfortunately, mosquitoes don't recognise these boundaries and coordinated efforts with neighbouring local government areas is needed to effectively manage mosquito-borne diseases.

Cooperation is supported and instigated by the City and is either in place, or steps are taken to plan for the following to occur through various avenues.

12.1 Internal stakeholders

Mosquito management is predominantly the responsibility of the City's Environmental Health section. However, it is critical that there is an internal working relationship between the Environmental Health team, Planning (land-use development), and Engineering (water management). This will ensure all parties within the LG consider the potential for mosquito breeding and the mosquito management implications when approving development applications and managing infrastructure.

12.2 External Stakeholders

At times, external parties play a role in ensuring the MMP is effective. This is particularly important in areas where mosquitoes may cross borders from one LG to another. Where LGs sharing common borders and a common mosquito problem agree to work in partnership to manage mosquitoes, they may be able to form a CLAG (Contiguous Local Authority Group).

Contiguous Local Authorities Group (CLAG) Mosquito Management Program: The City will be requesting that adjoining LGA's formally join the City to form the East Metro Hills CLAG. This partnership entitles the combined areas to financial support from the Department of Health for 50% of larvicide costs for hand treatments, training resources that can be used in the community and more. The City proposes to be in a CLAG partnership for the 2024/25 season.

Recognised Biosecurity Groups (RBGs) are community-based independent associations that are recognised by the Minister for Agriculture and Food under section 169 of the Biosecurity and Agriculture Management Act 2007 (BAM Act). Local agricultural groups, Registered Wildlife groups, and other agencies who manage land including Water Corporation, Friends Groups. (A Friends Group is a group of people that work in partnership with the City to manage their local bushland reserve).

The City has many large natural reserves and forests which are primarily managed by the Department of Biosecurity and Conservation and Attractions (DBCA). DBCA allow access to their land to undertake disease monitoring through the JEV Feral Pig Surveillance Program.

Where external stakeholders may be responsible for land within the City where mosquito breeding is problematic (e.g. Water Corporation; Department of Biodiversity, Conservation and Attractions, Department of Planning, Lands and Heritage). These stakeholders may be approached to determine their capacity to undertake mosquito management.

13.0 New Developments

New developments can significantly impact a MMP. It is therefore critical for the Planning and Environmental Health teams within a LG to discuss development applications and consider the mosquito management implications prior to the approval process being finalised.

Although unlikely under the current environmental status within the City and surrounds, new developments are likely to require consideration within a MMP if residents will be located within close proximity to a natural mosquito breeding habitat. There may be potential for the development itself to create mosquito problems through the introduction of constructed water bodies and other water holding infrastructure. Both can significantly impact on the mosquito management budget and required resourcing.

The Western Australian Planning Commission (WAPC) Statement of Planning Policy No. 1: State Planning Framework provides a number of 'General Principles for Land Use Planning and Development'. Environmental principle IV states: 'The protection of environmental assets and the wise use and management of resources are essential to encourage more ecologically sustainable land use and development planning should contribute to a more sustainable future by adopting a risk-management approach which aims to avoid or minimise environmental degradation and hazards. This principle is most relevant when considering appropriate planning for mosquito management.

The WAPC has the power to impose a memorial on land titles that are newly created through the process of subdivision and are potentially affected by a relatively permanent hazard. Similar to midge memorials, nuisance and disease risk associated with mosquitoes could be captured through use of a Section 12A (Town Planning Act and Development Act 1928) memorial notifying prospective purchasers of the hazard. This option will be considered by the City's Development Services Division.

There needs to be clear decisions made about who is responsible for mosquito management within a new land development (e.g. the developer/land owner or the City). For development areas where the risk of mosquito nuisance and/or mosquito-borne disease is not clearly defined, then as a minimum, a baseline investigation (as per section 8) should be undertaken. This work needs to be carried out over a minimum of 12 months (preferably three years or more) to establish changing patterns in mosquito abundance over time, in response to seasonal variation. Consideration needs to be given to who will undertake the baseline investigation as it is important to ensure the work is carried out by appropriately trained personnel. The developer may fund an investigation undertaken by the LG or an out-sourced, external consultant.

In cases where the development is proposed to be near existing natural wetlands or an artificial water body created, the proponent may be required to submit to the Environmental Protection Authority (EPA) for assessment. At the minimum, proponents should adopt the principles and standards within EPA Guidance Statement No. 40 - Guidance Statement for Management of Mosquitoes by Land Developers. Increased stormwater catchment, treatment and final disposal/containment methods associated with development should be given due consideration by developers and the City. Implementing principles of water sensitive urban design with best practice/latest technologies may assist in reducing potential mosquito breeding sites and minimise the risk to the public.

For areas where the risk of mosquito nuisance and/or mosquito-borne disease has been clearly defined, a MMP may be a requirement prior to the initiation of the development. The MMP needs to clearly indicate who will be responsible for implementing and resourcing the plan.

14.0 Record Keeping

Maintaining ongoing records is another critical component of a MMP. Enterprise Content Management (ECM) is the software program the City uses to generate, monitor and record mosquito borne disease notifications, nuisance complaints and financial records are recorded in the software program Synergy. the Atlas of Medical Entomology (AME) is the software program endorsed by DoH that records the adult and larval mosquito monitoring from trapping and dipping. The Atlas also records environmental data such as weather trends. Both software programs enable long term data to be recorded and analysed to further enhance the MMP. The mosquito officer for each season shall record data weekly in order to prepare and submit a season summary report to the Environmental Health Coordinator. The report shall include all findings and records of trap numbers, chemicals used, budget considerations and plans for the upcoming season.

It is critical that good record keeping practices are carried out. The following records (but not limited to) are kept on the City's systems:

- annual complaint register (ECM)
- disease notifications and interview documentation (ECM)
- adult and complaint-based trapping results (AME)
- larval sampling surveys (AME)
- chemical/bio-larvicide treatments (Mosquito Officer report)
- reports (ECM)
- media releases (ECM)
- financial data (Synergy)

The records within ECM, Synergy and Mosquito Officer Reports should ensure current staff and any future employee/s involved with delivering the MMP have access to background knowledge. An annual report will also be prepared in July each year to summarise the mosquito management actions that have taken place throughout the previous mosquito season.

CLAG Annual Reporting, CLAGs have a formal requirement to complete and submit an annual report to the Department each year, in order to access CLAG funding. This is a requirement to ensure each CLAG remains eligible to receive Departmental funding. An annual report template will be sent out to each CLAG required to submit an annual report.



15.0 Budget and Resource Requirements

Operating and implementing an effective mosquito management program is a costly exercise requiring large amounts of human and operational resources. Once a CLAG is in place the DoH may cover 50% of the larvicide used to reduce mosquito numbers, which goes some way to reduce costs.

To ensure the continued improvement and implementation of the program, a source of sustainable financing needs to be secured. Without this, areas of the program will start to deteriorate and due to the nature of integrated mosquito management, once one component is lost, the program starts to lose its effectiveness. Due to the nature of mosquito management and the large variations that can occur from one season to the next, there is also a need for funding to reflect this and be able to be adjusted accordingly.

Currently the program requires a minimum of one officer at 0.6 FTE between September and January and one officer at 0.2 FTE during the remainder of the year (likely an Environmental Health Officer).

A dedicated 4WD vehicle is also required to be used for all mosquito management work. Due to environmental variations from year to year; the budget will need to be dynamic and adjusted according to the current season.

The purchasing account used currently for the mosquito related activities, training and consumables is the Health Account 370710.527 Purchases- Consumables.

A typical year of consumables associated with the MMP may look like this:

Item	Cost	CLAG 50%
Prolink XR Briquets (larvicide)	\$5,896	Yes
Freight	\$132.00	No
Training	\$1,200	Yes
Batteries	\$118.00	Yes
Dry Ice	\$136.40	Already subsidised
Total	\$7,482.40	

Note: The costs associated with labour hours are not included.

16.0 Training and Staff Development

It is essential that personnel involved in the operational aspects of the MMP are suitably qualified, trained and/or supervised. It is essential for more than one person to be trained in mosquito management (this may include staff other than environmental health officers, such as depot and/or parks and garden staff).

Skills/knowledge required include:

- basic mosquito ecology
- principles of integrated mosquito management
- surveillance/monitoring techniques
- collection and recording of mosquito samples
- standard operating procedures for equipment
- safe storage, handling and application of chemicals/larvicides in accordance with product labelling and MSDS
- use of appropriate PPE in accordance with labelling, SDS and environmental conditions
- calibration techniques
- information technologies/geographical information systems
- budget management
- first aid.

The Department of Health offers an in-depth mosquito management course approximately every two years which teaches most skills and competencies required. All staff working in the area of mosquito management should undertake this training when available. The Department of Health is also available to offer advice and assistance regarding the MMP and its execution. This section should be used to gain support for training of staff members.

DoH runs a series of mosquito identification and management related courses that are highly recommended for staff to attend who are new to mosquito management. In house training through the City's Keep Growing in-house Staff Training, Knowledge Sharing and Development Program shall incorporate annual staff training where relevant departments such as depot and/or parks and garden staff can learn about the principles of mosquito management.

17.0 Standard Operating Procedure (SOP) Manual

The daily procedures involved in performing mosquito management by the Mosquito Management Officer shall be found on Pro Maps (KalaNet) using the search words 'Mosquito Management Program'.

Trapping: Trapping by use of the EVS/CO2 mosquito traps shall be completed in accordance with the Adult mosquito trapping: EVS/CO2 trap standard operating procedure <https://www.health.wa.gov.au/-/media/Files/Corporate/general-documents/Mosquitoes/PDF/Mosquito-ID/EVS-CO2-trap-standard-operating-procedure.pdf>

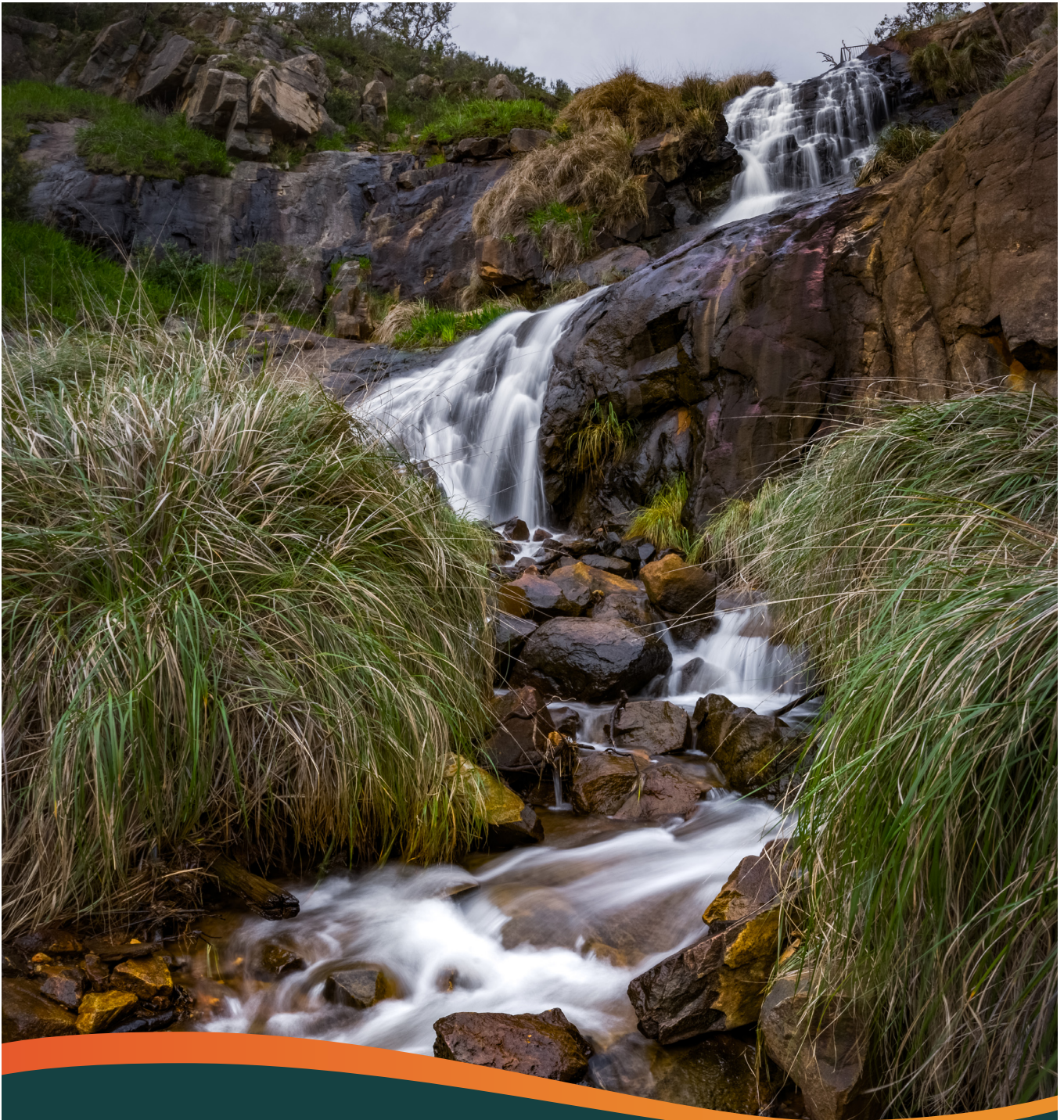
JEV Feral Pig Surveillance: JEV disease surveillance shall be conducted in accordance with the WHS-F-EHO 2 SAFE WORK INSTRUCTION-Feral pig blood and tonsil sampling safe working procedure and the Feral Pig Surveillance Program JEV slideshow found under the M Drive- Projects- Mosquito Management- Feral Pig Surveillance Program.

18.0 Review of Mosquito management plan

The MMP will need to be reviewed every three to five years. Due to the nature of mosquito management, there will be an ongoing need to review and refine this document and the related procedure manual as required when updates become known. This will allow both documents to accommodate new and/or changing mosquito breeding sites that may be identified from year to year depending on rainfall, climate change and human activity.

Furthermore, alternative approaches and new innovations to mosquito management may become available or desirable for the region. It is also necessary to periodically review achievements and results from consecutive seasons to identify emerging trends or risks.





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