CITY OF SOUTH PERTH

MOSQUITO MANAGEMENT PLAN

2024–25

City of South Perth

2024-2025

Mosquito Management Plan

Acknowledgments

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The authors also acknowledge the Department of Environment Regulation (now Department of Water and Environmental Regulation), Swan River Trust, Department of Health WA, the mosquito management working group and Mosquito Consulting Services Pty Ltd with the development of the City of South Perth Mosquito Management Plan.

This document was written by officers of the City of South Perth.

Executive Summary

This Mosquito Management Plan (MMP) is an update from the original Plan adopted in August 2010. The Plan itself is reviewed every year and updated by the City of South Perth (the City) following consultation with stakeholders and using the experience and data collected by the City each year.

The Goals, Aims and Objectives of the Plan have not changed since 2010. The actions and methods have been adjusted in the light of experience gained.

For the 2024/25 mosquito season, the Plan proposes the following actions for the control and treatment of mosquito numbers, once larvae/adult densities increase to known nuisance levels:

- Aerial treatment with larvicides as soon as larval densities increase;
- Localised manual treatment with larvicides as soon as larval densities; increase
- Barrier treatments with adulticides in public spaces adjacent to residences as necessary; and

- Fogging with adulticides if excessive numbers of mosquitoes are determined, where endorsed by the Department of Health WA .

The Plan provides for:

- The continued research and learning opportunities for staff integral to this exercise;
- Mechanisms to educate and effectively communicate with residents; and
- The assessment on the effectiveness of the Plan against set Key Performance Indicators (KPIs).

Objectives and Actions Table 1: To monitor and treat the level of larval and adult mosquito activity within the CoSP, summarises the principal components of the Plan for the 2024/25 season.

As part of the continuous improvement cycle, it is envisaged that at some future date the plan will be subjected to an agreed business review process.

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Introduction

THE PURPOSE OF THIS PLAN

The City of South Perth Mosquito Management Plan serves as a guiding Operational Program that was initially documented in its current form in August 2010. It is updated annually in order to:

- Give guidance to the City on the control and management of seasonal mosquitoes
- Create an expectation with residents, particularly within the vicinity of the wetlands along the Canning River, that the City will be taking steps to ensure a reasonable outdoor amenity during the mosquito season
- To work with state agencies, particularly the Department Biodiversity, Conservation & Attractions, Swan River Trust, and the Department of Health WA with regards to the management of mosquitoes within a fragile environment close to residential developments.

As a living document, it is intended that the plan will be subjected to a number of quality initiatives as an annual cycle of continuous improvement. At present the Plan is updated following consultation with a variety of affected stakeholders and using data and experiences gained since 2010. While the present focus of the Plan is to satisfy customer (residents') needs for mosquito minimisation, it is hoped that in future the plan will be subjected to an agreed business review process.

The Geographical Area affected by this Plan

The City of South Perth, the 'Peninsular City', occupies an area of land bordered on three sides by river water. To the north is the Swan River with the wide 'Perth Water'. The City of Perth lies across the river, with the Narrows Bridge as the link between the two sides, carrying the Kwinana Freeway south. The South Perth foreshore comprises of tidal influenced lakes and seasonal perched surface water.

The southern boundary of the City borders the Canning River. Along this boundary is the location of saltmarsh and wetland breeding grounds. This area comprises of a tidal flood plain along the Salter Point, Waterford and Cygnia Cove foreshore that also incorporates part of Bodkin Park.

This management plan has traditionally applied to the areas from Salter Point in the west through to the eastern boundary of Cygnia Cove, Waterford. In 2022 / 2023, mosquito management activities expanded to include areas of the South Perth foreshore and some fresh water bodies. The residents of Waterford, (based on the Mosquito Complaint Register and adult mosquito trapping data) have previously been the most affected by

mosquito numbers within the City and are therefore the primary target audience for this Mosquito Management Plan. However, it is acknowledged in recent years, that complaints have come from South Perth residents (particularly those along the foreshore) and so the scope of the plan has broadened.

The established Mosquito Breeding sites are shown on Page 10.

Waterford is an established residential area. Waterford is bounded by Manning Road, Conlon Street and McKay Street to the north, Centenary Avenue to the east, the Canning River to the south, and Elderfield Road to the west.

Waterford, including Cygnia Cove is a pristine environmental area, surrounded by more than 20 hectares of saltmarsh, mosquito breeding area. Mosquitoes naturally breed on the saltmarsh vegetation, when the weather and tidal conditions are optimum. Summer conditions including humidity, warmth, low rainfall and tidal movements above 1.15m (when measured at the Barrack Street Jetty and Shelly Bridge Canning River 1), create a favourable breeding environment on this wetland. There are also areas within the wetland i.e. Sandon Park that are susceptible to breeding freshwater species as well. Lake Gillon, Karawara is also susceptible to breeding freshwater species.

South Perth Foreshore spans from the Narrows Bridge (west) to Ellam Street (east) and is characterised by large areas of open space used for recreational activity and reserve bookings. A series of water bodies influenced by Swan River Tides including Millers Pool, Lake Douglas and Lake Hurlingham are susceptible to a low level of mosquito breeding at their drains. Lake Tondut, a freshwater lake used to balance Lake Douglas and Lake Hurlingham has not been observed to breed mosquitoes. Perched water on Sir James Mitchell Park near the Scented Gardens paperbark walkway can create a favourable breeding environment for freshwater mosquitoes from August to December, until it dries up.

Scope and Limitations of the Plan

The plan has been prepared by the Officers of the City using information available from:

- State and Commonwealth agencies (e.g. Department of Health WA, CSIRO, Bureau of Meteorology etc.)
- Mosquito Consulting Services Pty Ltd
- Community representatives of the City
- Data accumulated by the City

This plan has the following limitations in that it does not purport to explain the migration patterns of adult mosquitoes within the affected areas, the most effective way to respond to spikes in mosquito activity, and breeding sites beyond the City's boundaries.

Why the need for a Plan

Prior to 2009 a Mosquito Management Program had been developed and written by the Environmental Health Officer (EHO) of the City. The two and half page document covered the Aims, Control, Monitoring and the application of treatments. However, there was no evidence that the document had been developed through a consultative process. The 2009/10 mosquito season was one of the worst seasons that residents could remember as far as mosquitoes were concerned. The number of complaints from residents, along with bad media exposure on the issue culminated in a public meeting in which residents expressed their frustrations at what was seen as the City not doing enough to address the problem. The outcome of this meeting was the establishment of a Waterford in Action Group to liaise informally with the City's Officers in addressing the issue. This resulted in:

- Raising the matter at a formal Council level where resources were directed to addressing the issue
- The development of the first comprehensive Plan for the management of Mosquitoes within the City
- The engagement of an External Consultant to advise the City on the robustness of the Plan and to provide advice on whether there were other matters not covered that needed examination.

Following the change in attention, the City adopted a number of recommendations of the External Consultant on mosquito management.

CSIRO studies predict that South Western Australia will have on average higher temperatures and less than average rainfall. This together with global warming effects on sea levels could mean the mosquito vector will be a continuing challenge for local authorities such as the City. In addition, cyclic weather systems referred to as 'El Nino' and 'La Nina' play a major role in determining how severe a mosquito season will be. A 'La Nina' episode brings about extremely high tides, higher night time temperatures and typically establishes conditions that most suit mosquito breeding. La Nina conditions are associated with significant mosquito nuisance and mosquito borne disease outbreaks. The 2011 and 2012 seasons were particularly severe and were influenced by the La Nina episode.

The long-term trend suggests that the mosquito management will continue to be an issue for the City and for other local authorities with similar proximity to wetlands. Therefore, as

an evolving document, this Plan does not claim to entirely solve the problems of discomfort and nuisance that residents of Waterford and visitors to the area may face from time to time. Nonetheless the Plan aims to learn from practice and through a continuous cycle of improvement the City is committed to reducing the mosquito nuisance to residents. Also, at present there are still a number of unknown factors influencing the breeding rates and the spread of mosquitoes. As a learning document the Plan documents the data and experiences from previous seasons. It is for all these reasons that there continues to be a need for a Plan.

Mosquito management is a complex and often difficult process. The outcomes of mosquito management can be impacted by many variables. Australia wide, mosquito management continues to develop and become more effective however;

“times will still exist when mosquito numbers will exceed desirable levels due to environmental factors and mosquito nuisance will result”. It is also important to acknowledge that mosquitoes play a vital role in wetland ecosystems and it would not be desirable to eradicate all mosquitoes.

Therefore, this Plan does not claim to entirely solve the problems of discomfort and nuisance that residents of Waterford and visitors to the area may face from time to time. Nonetheless the Plan aims to learn from practice and through a continuous cycle of improvement the City is committed to reducing the mosquito nuisance to residents. This Plan takes its cue from the City‘s slogan “Working together to create a City for everyone”. Through community consultation it has adopted the following Vision “A city of active places and beautiful spaces. A connected community with easily accessible, vibrant neighbourhoods and a unique, sustainable natural environment”. In developing this Plan, certain principles have been adopted. These call for:

- Accountability – accountable to all its ratepayers and stakeholders
- Transparency – the processes used are open to scrutiny
- Involvement – of the residents most affected by this Plan and all other stakeholders
- Professional input – based on outside expertise, literature and best practice

Within the City of South Perth, mosquito management is necessary for three reasons:

- Some species of mosquitoes are transmitters or vectors of disease such as Ross River virus (RRV) disease and Barmah Forest virus (BFV) disease. It is important to note that the incidence of both of these viruses within the City is not high enough to be of a public health concern, and therefore the issues experienced within the City are of a nuisance nature at this point in time

- Some Mosquito species are aggressive biters, causing discomfort and pain to affected residents, and can impact significantly on lifestyle
- Residents report effects arising from mosquitoes, including allergic reaction, lack of amenity of parklands and environment that result in reduced outdoor activities

The operations to monitor and control mosquitoes are a seasonal activity from August to April. However, the staff who are involved in the preparation of the operation undertake activities throughout the year in the planning, liaising, communicating and advancing their knowledge of the latest techniques and research in this area.

STATUTORY & STRATEGIC IMPLICATIONS

Statutory Management

- Department of Health:
  Health (Miscellaneous Provisions) Act 1911
- Department of Water & Environmental Regulation:
  Environmental Protection Act 1986
- Swan River Trust:
  Swan and Canning Rivers Management Act 2006; and
  Swan and Canning Rivers (Consequential and Transitional Provisions) Act 2006
- City of South Perth:
  Health (Miscellaneous Provisions) Act 1911 - City of South Perth - Health Local Laws 2002
  Public Health Act 2016
  City of South Perth Public Health Plan

Strategic Implications

In accordance with the City of South Perth, Strategic Community Plan 2020 - 2030, “A City of active places and beautiful spaces”, this Mosquito Management Plan meets or partially addresses the strategic directions of;

- Community - Facilitate and foster a healthy, connected and safe community
- Environment – Facilitate effective management of the Swan and Canning River foreshore

Mosquito Management Plan: Goal, Aims, and Objectives

Goal: to reduce the numbers of nuisance and disease vector species to a level where the impact on the adjacent human populations is kept to an acceptable level.

Aims:

- To meet the requirements of both Section VII of the Health (Miscellaneous Provisions) Act 1911 with respect to nuisances and Part 3 of the Public Health Act 2016 with respect to the general public health duty
- To meet the expectations and requirements of the residents and visitors adjacent to wetlands to have a reasonable quality of outdoor life
- To protect the environment (natural habitat), whilst prioritising mosquito management.

Objectives:

- To monitor and treat larval and adult mosquito activity within the City
- To research and apply other more effective methods for monitoring and treatment of mosquito prone areas
- To conduct an educational/communication program within the City to manage mosquito Infestations
- To review the effectiveness of this plan and embed a cycle of improvement in the operations of the Mosquito Management Plan

Yearly Revisions to this Plan – Principal Developments and Lessons Learnt

Since 2012 this Plan has been updated every year following consultation with various stakeholders. In particular the Plan has been updated:

- To include the specific suggestions made by Mosquito Consulting Services Pty Ltd (the Consultant) in their Report (December 2011);
- By using statistical data on trappings and resident complaints; and
- From anecdotal feedback from residents and gathered by the Waterford in Action Group

The general view of the community is that since the 2012/13 season the mosquito problem has abated. Whether this is due to a different set of weather conditions, to the effectiveness of aerial treatments at larval stages or improved application of treatments is unknown at this stage. The number of Ross River Virus cases in WA was highest in 2011/2012 and 2013/2014. This declined in both 2020/2021 and 2022/2023. 2023/2024 saw cases of Ross River Virus in WA below the long-term mean.

There was anecdotal evidence that in the 2013/14 season, different areas across the Waterford Foreshore experienced different levels of mosquito activity. For instance when the Elderfield Road residents experienced increased activity, the areas around Bodkin and Doneraile Parks appeared relatively free and vice-versa. The localised breeding areas and the dispersal of mosquitoes from breeding sites need to be better understood.

In 2022/2023 there was a significant absence of saltmarsh Aedes mosquitoes in traps and aerial treatments occurred at half the number or less compared with previous years. However, numbers of freshwater mosquitoes dominated and a number of localised breeding areas were identified and treated throughout the season near Elderfield Rd,

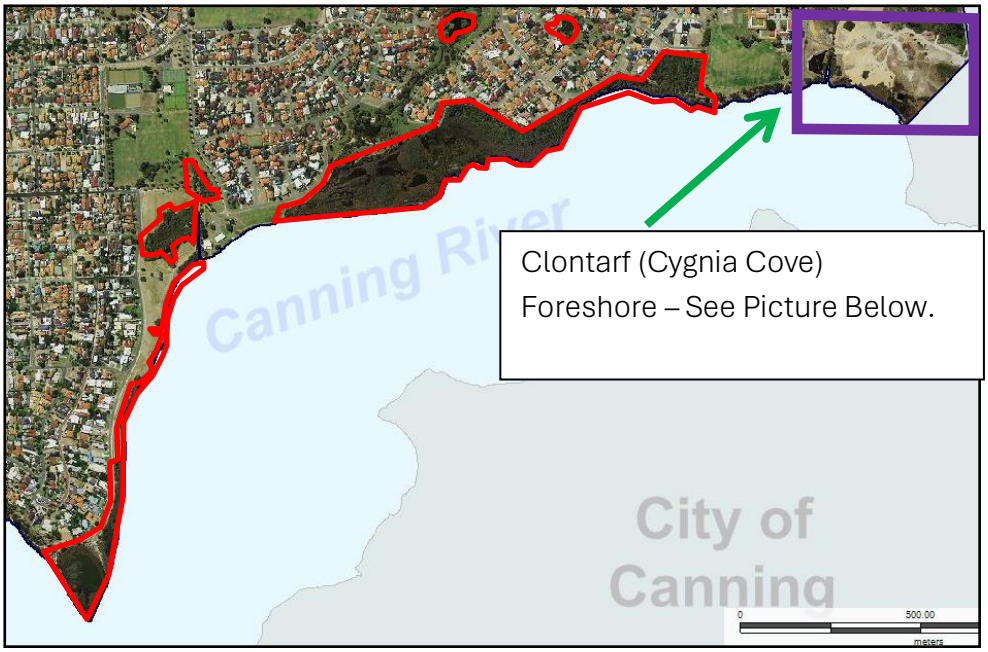
Salter Point Parade and Cygnia Cove. In 2023/2024, there was a noticeable increase in mosquito larval activity, particularly Ae. vigilax breeding in the marshland – a marked increase compared with the previous five years. Ae. vigilax breeds in brackish / salt water and was the dominant species in traps. Since 2022/2023, the City's mosquito management has identified more breeding sources. To support treatments, better quantification of data and understanding differences in mosquito breeding in different areas across the City, has been key.

While the Plan makes provision for residual insecticide barrier treatments in suitable public open spaces, as well as fogging (which both use liquid derived adulticides), these kill mosquitoes and non-target species and are highly toxic to fish and other aquatic organisms. They do not address the source and their efficacy can be short lived. During larval sampling, small fish were often observed and scooped and it is evident that the presence of fish saw the absence or larvae and vice versa. Moving forward, the City expects to only use adulticide options when absolutely necessary and in consultation with the Department of Health WA and other stakeholders.

In 2023/2024. the City conducted twice the number of aerial larvicide treatments compared with the previous season (8 treatments versus 4 treatments). There was increased mosquito larvae and more frequent breeding. Should warm conditions and favourable tides continue in 2024/2025, the City would expect considerable saltmarsh Aedes mosquito activity along the Canning River.

Mosquito Breeding Sites

WATERFORD FORESHORE



Salt marsh - tidal flood plain (Mosquito Breeding Ground Map - Waterford)
Size - Approximately 20 Hectares.

CLONTARF (CYGNIA COVE) FORESHORE

Salt marsh - tidal flood plain (Mosquito Breeding Ground Map - Cygnia Cove - adjacent to Clontarf) Size - Approximately 2 Hectares

Mosquito Management

MOSQUITO MANAGEMENT PROGRAM

In order to be effective, this mosquito management program uses an integrated approach, combining different methods of control and treatments to reduce and control the mosquito numbers and therefore reducing the nuisance and the risk of mosquito-borne disease.

Mosquito monitoring - determining mosquito numbers and the location of breeding sites.

- Larval survey

The sites (tidal wetland and constructed wetlands in Bodkin and Doneraile Parks) will be monitored during the mosquito season (August through April) to ascertain the larval activity. Surveys will occur after a tide of greater than 1.15m. Wetlands may also be inundated by rainfall that can trigger mosquito breeding in fresh and brackish water and hence, surveys will occur following rainfall events during spring/summer. Non-tidal wetlands will be checked periodically and where breeding is established, checked more regularly on a weekly basis. The survey involves taking a water sample with a larval dipper to gather information on both the number of larvae per m2 and what stage the larvae have reached in their life cycle. Water depth and temperature also have a bearing on the frequency of the surveys. Both of these factors influence the numbers of larvae and potentially the number of mosquitoes and how quickly they breed. The findings of these surveys will determine if there is a need for the application of larvicides to minimise mosquito larvae numbers.

- Adult trapping

Adult mosquito traps are used to monitor the numbers and types (species) of adult mosquitoes found in certain areas. Traps utilising dry ice (frozen carbon dioxide) and light will be used at multiple locations including residences, to trap adult mosquitoes. Trapping is a good indicator for monitoring the increase in mosquito populations. The mosquitoes caught in the traps are counted and identified. The traps are set at least fortnightly during the mosquito season, August to April. The adult traps are used to identify if the species are typically fresh or salt water breeders, allowing officers to direct their attention to the relevant breeding sites. Seasonal trapping results can be viewed on the City's website at: https://southperth.wa.gov.au/residents/services/mosquitoes

In addition, there is the potential for backyard mosquito breeding to impact on neighbouring residents. The determination of the mosquito species will allow for controls to be directed to where they are needed.

During the 2012/2013 season, the Department of Health WA undertook a research project to try and understand further the impacts that mosquitoes can have based on distances from a breeding site. This project was based around two main breeding sites: 1 – within the City of Canning and 2 – within the City of Perth (Heirisson Island). Mosquitoes were trapped at each site. These mosquitoes were then dyed either red or blue depending from which site they were trapped. These dyed mosquitoes were then released into the environment to study how they travelled from the respective site. Traps were set on a $1km^2$ grid away from each site, according to the typical wind direction. The City of South Perth assisted the Department of Health WA with the collection and setting of traps. The aim was to recapture any dyed mosquitoes and understand the distance and direction of travel.

The outcome:

> The main implication for mosquito management is that saltmarsh mosquitoes are not the only type of mosquito of significance in the study area. The great number of freshwater and container-breeding mosquito species indicates that local governments and other mosquito managers should broaden surveillance measures and management methods to include the type of habitats occupied by Ae. notoscriptus, Cx. annulirostris and Cx. Quinquefasciatus (Refer to Appendix 4 for further information). These species can breed in backyards (artificial containers/pot plants etc.) and freshwater constructed wetlands. It should be noted that different species of mosquitoes will be present at different times of year.

- Land Use

Ideally, residential developments should be located well away from mosquito breeding sites to minimise contact and impacts with mosquitoes and residents. However, in practice different public agencies are involved in residential land use approval which may mean these ideal criteria are not met. The long-term effects of such decisions are borne by the local councils who need to address the ensuing problems.

Where development occurs within mosquito dispersal distance from breeding sites, residents are essentially living in a wetland environment and this has the obvious attractions of wetland views, proximity to birdlife and attractive foreshore recreation however, on occasions nuisance insects including mosquitoes will be a disadvantage. The objective is to understand that mosquitoes have an important place within this environment and to maintain an ecological balance.

ECOLOGICAL VALUE OF MOSQUITOES IN THE ECOSYSTEM

(City Environment Department Comments)

Mosquitoes play an important role in the ecosystem of any wetland. They are a part of the food chain in adult and larval form. They are an important part of aquatic and terrestrial food webs. They serve nutritious prey for a variety of aquatic and terrestrial invertebrates as well as fish, amphibians, turtles, wader birds, waterfowl and bats. They are a food source for bats, turtles, fish, frogs, wader birds and many other predatory animals including dragon flies and spiders. The removal of mosquitoes on any large scale can affect the balance in the ecosystem and may cause predators to starve. Mosquito larvae are not only an important part of the food chain they also have the ability to assist in the recycling of excess nutrient. The nutrients are often present in wetlands caused by human and natural sources. They are effective filter feeders and have the ability to clean polluted waterways in urban areas. Mosquitoes are just one part of the ecosystem needed to maintain a high biodiversity in any wetland.

The City of South Perth is currently implementing various restoration projects that aim to increase the City's biodiversity, with care taken to protect the fragile ecosystem within our wetlands and improve water quality of the City's waterways. Healthy wetlands sustain natural enemies of mosquitoes. This helps reduce mosquito population by increasing their predatory invertebrates and native fish. In recent years there has been an effort to increase the number of micro-bats within South Perth. This has included the installation and ongoing annual maintenance of 'Bat Boxes'. The number of boxes has increased from an initial 27 boxes to 76 boxes and these have been partly funded by the City and have helped to increase the amount of dwellings on offer to the micro-bats. On average each box can hold up to 100 micro-bats. Micro-bats have been known to eat up to 1,000 adult mosquitoes per night. The main aim of the boxes is to increase the habitat for micro-bats. Increasing the population of micro-bats is an opportunity for the City to engage in a safe and suitable form of biological control for mosquitoes.

Western long-neck turtle as hatchlings have been known to eat mosquito larvae. These turtles feature extensively in the wetlands around South Perth. A turtle habitat enhancement program has been proposed which will protect; and increase the number of turtles living in the wetlands surrounding South Perth. By increasing the number of turtles, the City will effectively enhance a form of biological control to combat mosquitoes which naturally occurs in wetlands throughout Western Australia.

Annually, the City undertakes water quality monitoring in the City's managed waterways and waterbodies to identify water quality issues and to determine the causes of poor water quality. Based on the outcomes of the water quality monitoring program, the City designs and implements projects that treat poor water quality in the City's waterbodies and enhances habitats for mosquito predators that support biological control regimes.

- Cultural Control

Cultural control incorporates education to the public to increase awareness of the mosquito problem and identify some simple measures that can be carried out by the individual householder to reduce adult mosquitoes around the home and eliminate backyard breeding sites. Cultural control includes examining best practice with the Department of Health WA and other Local Governments with similar programs and issues. Cultural control may include signage, media and other articles, including actively promoting the personal protection message:

- avoid outdoor exposure to mosquitoes from dusk and the first few hours after dark.
- ensure insect screens are installed.
- use a personal repellent containing diethyl toluamide (DEET) or picaridin. The most effective and long-lasting formulations are lotions or gels. Most natural or organic repellents are not as effective as DEET or picaridin.
- wear loose, light-colored protective clothing when outdoors.
- ensure infants and children are protected against mosquito bites, with suitable clothing or other forms of insect screening.

A residual barrier treatment may also be useful around the home. For residents experiencing a pest nuisance, including excessive mosquitoes around the home, the application of a residual barrier treatment by a qualified commercial pest control operator may assist in reducing insect numbers however; non-target species may also be impacted. A residual barrier treatment can be applied externally to buildings as well as to vegetation that can harbor pests, using high velocity air streams from motorised mist blowers. Any pests that land on the treated areas will be killed. A residual barrier treatment can last for 3 to 6 months. The City undertakes residual barrier treatments as necessary, along pathways and around vegetation, known to harbor adult mosquitoes (see Appendix 2).

The City of South Perth will record all telephone and written complaints for any given mosquito season and respond/investigate as necessary. Email complaints can be lodged via the City's email address: enquiries@southperth.wa.gov.au or lodged via MySouthPerth via the City's website www.southperth.wa.gov.au

MOSQUITO TREATMENTS

- Chemical control

Chemical control is divided into 3 groups.

1. Larviciding,

2. Adulticiding, and

3. Residual Barrier Treatments.

- Larvicides

Larvicides are products used to kill larvae. Larviciding is promoted as the preferred treatment option due to the current available range of larvicides being target specific and environmentally friendly. Larvicides are also a preferred treatment option as they kill and control mosquitoes before they disperse into the environment and pose a health or nuisance risk by biting.

The larvicides that will be used during a mosquito season in accordance with this management plan; will be *Bacillus thuringiensis israelensis* (Bti), s-methoprene and a synergised product containing the two. Larvicide choice and application is time critical depending on the larval growth stage.

Bti is a crystalline endotoxin that, once ingested by the larvae, leads to death. Bti kills mosquito within 24 hours. When required, Bti will be applied at the recommended dosage rates.

S-methoprene is an insect growth regulator. S-methoprene is absorbed by the larvae and prevents the larvae from emerging from the pupal stage. The City will apply this product in accordance with the required application rates throughout the mosquito season. This product is available in several different formulations, including the slow-release pellets, sand and briquets, which ensure ongoing reliance of the larvicide into inundated wetlands, providing ongoing control.

Bti and S-methoprene combination product provides benefits of both active ingredients and is effective over a wider range of larval growth stages. The City will apply this product in accordance with the required application rates throughout the mosquito season.

Aerial Treatments (Helicopter and Drones)

Given the difficulty of accessing all locations within this wetland area for effective treatments, the City will undertake aerial application of larvicides over this wetland area when the larval densities require treatment. Any areas unable to be treated by air will be treated on the ground.

The City continues to stay abreast of drone treatment technologies in conjunction with the Department of Health WA. As this technology continues to be refined and improved, it may provide greater treatment options which are cost effective for larvicide mosquito control.

Larval density will be assessed as part of a pre-treatment survey following a trigger tide or rainfall event. The larval density trigger for treatment is 2-5 larvae per ladle scoop of water, with consideration of the larval growth stage, further egg hatching and prevailing conditions (water levels and temperature) also factored. Post-treatment efficacy will be checked by officers doing a post-treatment larval density survey and checking for larvae mortality.

This is an evidence-based plan and as such, aerial treatments will be based on the larval densities.

Adulticides

Adulticiding (fogging and residual barrier treatments) refers to the killing of adult mosquitoes. This form of control can be very effective in controlling large numbers of adult mosquitoes. Adulticiding is not target specific and works like a large-scale insect spray, killing other insects, including predators and beneficial insect species and invertebrates.

- Fogging

Adulticiding (hand-held fogging) is weather dependant and cannot be applied in windy conditions. The City of South Perth has applied to the Swan River Trust and the Department of Environment & Conservation for clarification and approval to fog across the wetland area. The responses have been received (see Appendix 1) by the City and state the following;

“The Waterford foreshore wetlands are classified…. as a high priority wetland management area. It is noted that both control products are highly toxic to fish and aquatic organisms. …….’fogging’ should not be implemented in areas with exposed surface water; or where there is a possibility of run-off entering waterways to.”

Fogging will be considered where it is endorsed by the Department of Health WA. Fogging will be applied in appropriate wind conditions and based on advice received from the Department of Environment Regulation. With reference to the *Environmental Protection (Noise) Regulations 1997* , fogging cannot occur prior to 7am (Monday to Saturday) or prior to 9am (Sundays and Public Holidays). Although, species such as Aedes vigilax are highly active throughout the day (all-day biters) the impact of fogging through the day has significant effects on non-target species and limited effects on mosquito numbers.

Undertaking fogging can also potentially be a nuisance in relation to noise impacts on residential premises (as the City must comply with the abovementioned noise legislation) and therefore, every attempt will be made to reduce the noise impact of fogging to residential premises.

For fogging to be effective, the wind speed must be between 5-16 km/hr with the wind direction able to carry the fog to areas of mosquito harbourage. Ideally, no rain should be present and for the best results, a temperature inversion must be present. It is accepted that very rarely, all of these conditions will be met and therefore, City officers will make the decision to fog based on the suitability of the onsite conditions that are present and the average mosquito numbers most recently trapped (Reference MCS 2011).

The City of South Perth acknowledges that currently and historically, there is a low public health risk due to mosquito breeding from this wetland area.

In accordance with the defined threshold, adulticiding will be undertaken where the mosquito numbers are at nuisance levels*.

- The products that will be used by the City in the event of excessive mosquitoes are approved Pyrethrin based fogging chemicals, typically having the active ingredients Pyrethrin & Piperonyl Butoxide.

The chemicals used are safe to large animals including birds, mammals and humans when used in accordance with the label requirements. The chemicals are toxic to fish and insects but are handled in a way that minimises the risks to non-targets.

*Historically, the Plan has set a threshold for fogging based on adult mosquito trap numbers. That threshold was considered low (average of 50 vector mosquitoes over 3 traps) and did not equate to the necessity to fog. The threshold also identified 'vector' mosquitoes as opposed to 'biting' mosquitoes and it must be noted that not all biting mosquitoes are vectors. No fogging has occurred in recent years and the management of mosquitoes has not suffered. It has previously been noted that complaints are typically received by the City from residents when the number of mosquitoes exceeds an average of 200 vector mosquitoes over the 3 set traps. The City has increased its number of traps and monitoring with an aim to address mosquitoes at their source, being the larval stage. Effective management and control at the larval mosquito stage aims to prevent the need for treatment at the adult mosquito stage. Regardless, fogging is not precluded as a management measure of this Plan and state regulators' endorsement would always be sought, prior to proceeding.

The City would use licenced pest controllers to undertake fogging on days where City staff are unavailable.

- Residual Insecticide Barrier treatment

Residual insecticide can be applied to mosquito harborage vegetation at specific human exposure focal locations. It provides effective localised control of adult mosquitoes dispersing from wider environment into the treated location. Existing street landscape features and park landscape provide opportunity for barrier treatment. It moves the focus away from the saltmarsh/marine habitat into less sensitive locations. It can be applied in highly selective situations (say to avoid flowering vegetation and avoiding non-target pollinating insects). Products registered for this use have been approved by Australian Pesticide and Veterinary Medicines Authority with appropriate directions for use. A residual barrier treatment can last for 3 to 6 months. The City undertakes residual barrier treatments as necessary along pathways and around vegetation, known to harbor adult mosquitoes in suitable public open spaces and within close proximity to residences. (see Appendix 2).

CONTIGUOUS LOCAL AUTHORITIES GROUP (CLAG) - SWAN & CANNING RIVERS CLAG

State Government funding of mosquito control activities is available to adjacent local governments to form a CLAG, with the grouping being based on considerations of geography and management of disease vector mosquitoes.

For areas that cannot demonstrate high mosquito-borne disease notifications but still have a mosquito biting nuisance problem, lesser funding arrangements may be available. The general arrangements are:

- Adjoining Local Governments formally enter a CLAG agreement with each other
- Each must have an approved Mosquito Management Plan
- State Govt provides 50% of larvicide cost, training and some other mosquito management related expenses (other 50% by CLAG)
- CLAG provides 100% of other costs (aerial application, surveillance etc. to mosquito disease risk areas).

The City has formed a CLAG agreement. The City of Canning, City of Perth and City of Melville have entered into this agreement with the City. With the introduction of an aerial treatment, chemical usage will increase and CLAG funding will offset up to 50% of the chemical cost. The implementation of this Plan is not dependent upon such funding. The City's attempt to obtain funding is recognition that the mosquito problem is wider than that limited to its boundaries.

Review

After each mosquito season is complete, the City of South Perth Mosquito Management Plan will be reviewed with best practise principles applied to continually improve the program and will measure and report on its performance against the agreed objectives and Key Performance Indicators (KPIs) using this information to review the following season's plan with best practice principles applied to continually improve the program. Such future reviews will involve consultation with a variety of stakeholders, including the representative group of residents affected.

As a living document, it is intended that the plan will be subjected to a number of quality initiatives as an annual cycle of continuous improvement. It is hoped that in future the plan will be subjected to an agreed business review process.

Performance

Two of the three aims will be the primary focus for assessing performance against the plan at the end of the mosquito season (Objectives and Actions Table 4 – To review the effectiveness of this plan and embed a cycle of improvement in the operations of the MMP, numbers 1 and 2). However, a number of additional targets which the City will wish to achieve are also set out in the Objectives and Actions tables.

The City will ensure that the whole process is accountable, transparent and auditable within a cycle of continuous improvement.

Objectives and Actions

Table 1. To monitor and treat the level of larval and adult mosquito activity within the CoSP.

NO.	ACTION	METHOD	FREQUENCY	TARGET
1. Tide height and rainfall monitoring	Desktop monitoring of tide heights and rainfall	Online: Department of Transport storm surge data; Perth (Barrack St & Shelly Bridge Canning River 1) tide gauge.	August to April	Daily
2. Larval	Inspection of known	City officers. Physical inspections	As required after rainfall and after	See map page 11

	breeding sites		tides of >1.15m, where monitoring detects larval trigger.	Waterford Foreshore.
3. Larval	Treatment of larvae	Aerial treatments of wetlands, pre-treatment and post-treatment larval surveys	Once larval densities justify a treatment – generally 2-5 larvae per ladle scoop	Larvicide treatments to target larval stage applied at the next suitable weather conditions, pending availability of helicopter.
3.1 Larval	Treatment of larvae	Ground based treatments - localised e.g. Sandon Park	Once larval densities justify a treatment – generally 2-5 larvae per ladle scoop. Follow up treatments as required.	As required: Treatments applied as soon as is practicable.
3.2 Larval	Treatment of larvae	Ground based treatments using s-methoprene briquets in stormwater drains – Cygnia Cove, Waterford & Salter Point.	November & February where drains hold water	Treatments applied to control breeding in stormwater drains.
4. Adult	Setting mosquito traps during mosquito season	City Officers: Trap locations of Salter Point, Waterford, Cygnia Cove and South Perth Foreshore	August to April	Minimum of Fortnightly trapping – Aug – April – Increasing to weekly during peak.

5. Adult	Undertake fogging treatments	City Officers/contractors	Determined as necessary	Treatments applied at the next suitable weather conditions.
6. Adult	Undertake fogging treatments at weekends or public holidays	City officers/contractors	Determined as necessary	Treatments applied at the next suitable weather conditions.
7. Adult	To record complaints from residents.	City data base	When received	Accurate record of complaints
8. Adult	To apply residual barrier treatments to vegetation.	Licenced pest control contractors	Determined as necessary	Treatments applied at the next suitable weather conditions.

Table 2. To research and apply other more effective methods for monitoring and treatment of mosquito prone areas.

NO	ACTION	METHOD	FREQUENCY	TARGET
1. Larval & Adult	To undertake CLAG requirements in order to develop and improve mosquito management.	In accordance with the Department of health process for CLAGS	3 meetings August – April.	CLAG meetings.
2. Adults	To publish and analyse mosquito trapping date	City's web page	After each trapping date	Trapping results published within one week of trapping.
3. Adults	To analyse resident complaints.	City's web page as part of the review of the MMP	Annually	As part of 4.2 – Review of annual MMP

Table 3. To conduct an educational/communication program within the CoSP to manage mosquito infestations.

NO	ACTION	METHOD	FREQUENCY	TARGET
1	Display aerial larvicide treatment pending signs prior to each treatment.	Temporary signage to be erected along the foreshore.	48 hours prior to a treatment	August to April
2	Mail out to residents of pending season.	City print/Contractor to deliver.	Once	To be received by residents September
3	Mail out to residents – update of general information	City print/Contractor to deliver.	Once	To be received by residents November

4	Mail out to residents – update of season progress.	City print/Contractor to deliver.	Once	January – February.
5	Follow up on resident complaints in relation to localised complaints.	Setting traps to determine freshwater breeders - surveying latest aerial maps for unmaintained swimming pools.	When deemed necessary by City Officers.	August - April

Table 4. To review the effectiveness of this plan and embed a cycle of improvement in the operations of the MMP.

NO	ACTION	METHOD	FREQUENCY	TARGET
1	To assess whether Aim 1 has been met.	Assess all disease notifications from DoH	Once	May
2	To review the MMP	City Officers	Once	June - July
3	To workshop the outcomes and learning's of the completed season with the mosquito working group.	Meeting with Mosquito working group	Minimum once	July - August
4	To create final updated MMP	Following completion of 4(2) & 4(3)	Once	July - August

References

Biological Notes on Mosquitoes, *Mosquito Life Cycle,* viewed on 26 July 2024, http://www.mosquito.org/page/lifecycle

City of Cockburn, *About Midges - Introduction to Managing the Midge,* viewed on 26 July 2024, http://www.cockburn.wa.gov.au/Council_Services/Environment/Midge_Control/ defaults to

City of Cockburn, *Mosquitoes and Midges* https://www.cockburn.wa.gov.au/Mosquitoes-and-Midges

Department of Health, *Mosquito Management Manual,* Department of Health WA 2009

Department of Medical Entomology, *Mosquitoes of Australia,* unable to open 26 July 2024 http://medent.usyd.edu.au/photos/mosquitoesofaustralia.htm alternative below:

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Review City of South Perth Mosquito Management Plan 2011/2012 for City of South Perth by Mosquito Consulting Services Pty Ltd, 6 December 2011

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Stewarts Pest Control, *Mosquito Control and Treatment in Perth,* viewed on 26 July 2024, https://www.stewartspestcontrol.com.au/mosquitoes

Department of Transport, *Perth (Barrack St) tide and Mosquito management tide monitoring Canning River 1 tidal data*, viewed on 26 July 2024,

https://www.transport.wa.gov.au/imarine/perth-barrack-street-tide.asp

https://www.transport.wa.gov.au/imarine/department-of-health-wa-mosquito-management-program.asp

Appendix 1 - Written response from Swan River Trust & Department of Environment & Conservation

SWAN RIVER TRUST

CITY OF SOUTH PERTH
18 APR 2011
Doc ID No:
File No: PH/401
Original To: EH
Action ☑ Info ☐ File ☐

Your Ref PH/401
Our Ref SRT
Enquiries Bart Peters

Mr Jason Jenke
Co-ordinator Environmental Health Services
Cnr Sandgate St & South TceGPO Box C120
SOUTH PERTH WA 6151

Dear Mr Jenke

REQUEST FOR APPROVAL TO UNDERTAKE MOSQUITO FOGGING-WATERFORD FORESHORE - CITY OF SOUTH PERTH

Thank you for providing the Swan River Trust (the Trust) with the opportunity to comment on the above request received on the 8 March 2011.

The request relates to adulticide 'fogging' across the Waterford Foreshore. The Trust understands that 'fogging' is projected to occur in an wetland area that is part of the Trust's Development Control Area (DCA) and is classified by the Department of Environment and Conservation (DEC) Wetland Branch as a highest priority wetland management area.

The Trust is sensitive to the current importance surrounding mosquito control within the catchment and in view of current affairs wishes to advice the City of South Perth (CoSP) that there are no objections to the request. However, the Trust is concerned about the lack of environmental scope regarding the impact of the adulticide 'fogging' on the wetland. The Trust believes that prior to 'fogging' taking place the CoSP should consider possible ecological impacts of adulticide 'fogging' within the wetland and include an impact assessment and management statement in the Mosquito Management plan .

It is assumed that the 'fogging' will take place in accordance with the relevant environment regulations, chemical data sheets and manufacturer's instructions.

The Trust understands that the request has been referred to the DEC and expects that their advice be taken into account.

Should there be any queries regarding this matter, please contact Bart Peters, environmental Officer on 92780995.

Yours sincerely

Paul Stephens
Manager Statutory Planning
31 March 2011

CARING FOR THE SWAN AND CANNING RIVERS
Level 1 Hyatt Centre 20 Terrace Road East Perth Western Australia 6004
PO Box 6829 Hay Street East Perth 6892 Telephone (08) 9278 0900 Fax (08) 9325 7149
www.swanrivertrust.wa.gov.au
wa.gov.au

Government of **Western Australia**
Department of **Environment and Conservation**

Your ref:
Our ref:
Enquiries: Mike Meinema
Phone: 9405 0700
Fax
Email: Mike.Meinema@dec.wa.gov.au

CITY OF SOUTH PERTH
Doc ID No:
File No: PH/401
Original To: EHC

Executive Director
City of South Perth
South Perth Civic Centre
Cnr Sandgate Street & South Terrace
SOUTH PERTH WA 6151

Attn: Mr. Jason Jenke

Dear Sir/Madam

MOSQUITO FOGGING – WATERFORD FORESHORE, CITY OF SOUTH PERTH

I refer to your letter of 16 May 2011 seeking the Department of Environment and Conservation's (DEC) approval to undertake adulticide 'fogging' across the Waterford foreshore wetlands when adult mosquito numbers are excessive.

The Waterford foreshore wetlands are classified by DEC as a high priority wetland management area. DEC would permit the use of adulticide 'fogging' using the products listed (Garrads Drift and Py Fog) in accordance with relevant environmental regulations, chemical data sheets and manufacturer's instructions.

Consideration must be given to the possible ecological impacts of adulticide 'fogging' within the wetland area. It is noted that both control products are highly toxic to fish and aquatic organisms. To avoid unintended Impacts of adulticide 'fogging' within the wetland, 'fogging' should not be implemented in areas with exposed surface water, or where there is a possibility of run-off entering waterways to.

Thank you for informing DEC of this operation.

Yours sincerely.

Paul Brown
REGIONAL MANAGER

30 May 2011

Swan Coastal District
5 Dundebar Road, Wanneroo, Western Australia
Phone: (08) 9405 0700 Fax: (08) 9405 0777
PO Box 459 Wanneroo WA 6946
www.dec.wa.gov.au

Appendix 2 - Residual Barrier Treatments - Defined areas

NEW FOOTPATH (NEAR CLONTARF)

Red Line indicates barrier treatment area.
Green line indicates treatment extent.

TEMPLEMORE GARDENS FOOTPATH/NENAGH GROVE

Red Line indicates barrier treatment area.

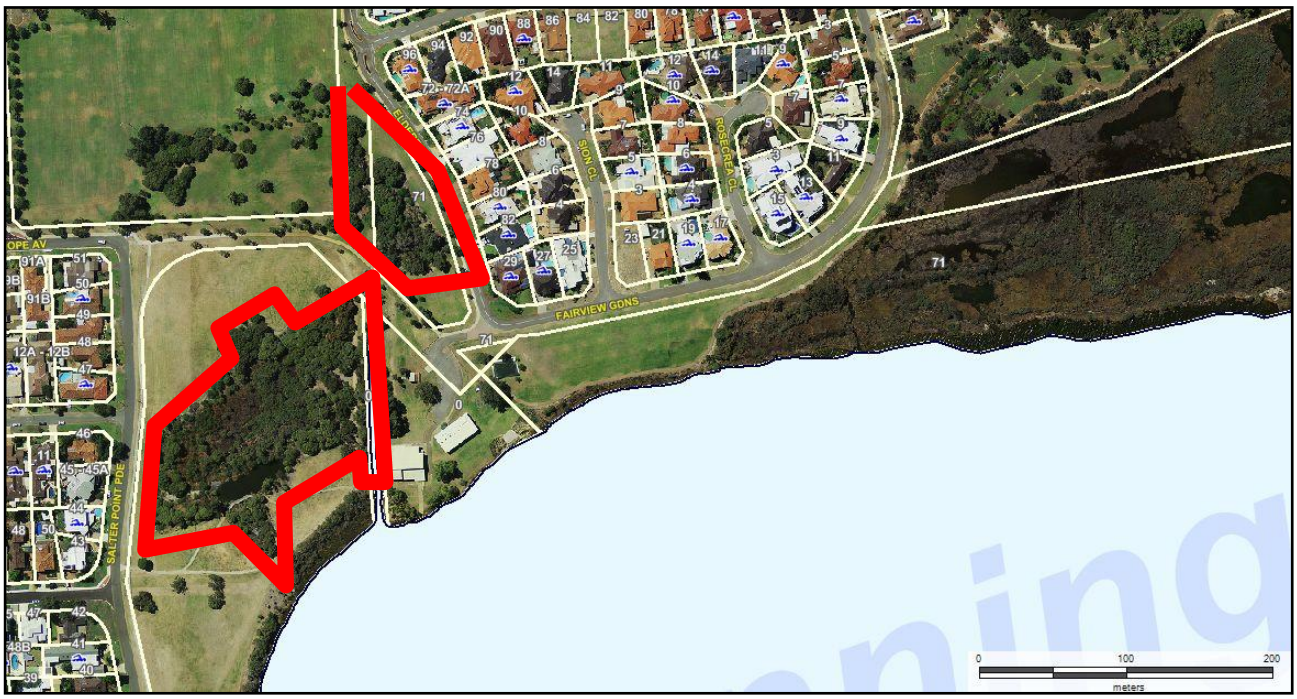
Green line indicates treatment extent.

TOP OF BODKIN PARK

Red Line indicates barrier treatment area.

ELDERFIELD RD, CORNER OF FAIRVIEW GARDEN

Red Line indicates barrier treatment area.



DONERAILE PARK

Red Line indicates barrier treatment area.

Appendix 3

MOSQUITO GENERAL

There are almost 100 species of mosquitoes in Western Australian and many of them can be serious pests, interfering with leisure time and outdoor activities. Mosquito bites cause discomfort and pain, particularly to babies and others with sensitive skin.

Only female mosquitoes bite as they need blood to be able to develop their eggs. While taking blood, infected mosquitoes can pass on disease-causing viruses and parasites. Exposure to large numbers of mosquitoes may increase the chance of being infected with a mosquito-borne disease.

During summer the life cycle from egg to flying adult mosquito takes 7-10 days. In colder months the life cycle may take several weeks.

MOSQUITO LIFE CYCLE

The general life cycle of a mosquito begins with an adult female laying eggs.

Egg: Eggs are laid one at a time and they float on the surface of the water or they are laid on soil or plants or on hard surfaces of containers above water level e.g. Ae notoscriptus. *Culex, Culiseta,* and *Anopheles* lay their eggs on water while *Aedes* lay their eggs on damp soil and on the saltmarsh plant that will be flooded by water. Most eggs hatch into larvae within 48 hours.

Larva: The larva (larvae - plural) lives in the water and come to the surface to breathe. They shed their skin four times, growing larger after each molting. Some larvae have siphon tubes for breathing and hang from the water surface. *Anopheles* larvae do not have a siphon and they lay parallel to the water surface. The larva feed on micro-organisms and organic matter in the water. On the fourth molt the larva changes into a pupa.

Pupa: The pupal stage is a resting, non-feeding stage. This is the time the mosquito turns into an adult. It takes about two days before the adult is fully developed. When development is complete, the pupal skin splits and the mosquito emerges as an adult.

Adult: The newly emerged adult rests on the surface of the water for a short time to allow itself to dry and all its parts to harden. Also, the wings have to spread out and dry properly before it can fly.

Midge: Dense swarms of small black non-biting flies, or midges, are one of the more obvious environmental problems associated with urban wetlands in Perth and other regions in Australia. Midges, which belong to the insect family Chironomidae, are often a nuisance in residential areas near wetlands because they are strongly attracted to lights.

Some species are so small that they can pass through flyscreens. Unlike mosquitoes, they do not bite, and so are not vectors of disease.

MOSQUITO SPECIAL OF INTEREST

Based on the 2023/2024 season the following species were trapped and identified. Except where otherwise stated, pictures below are courtesy of Department of Health WA Medical Entomology.

Anopheles annulipes*

Anopheles annulipes s.l

Anopheles annulipes are known to bite humans and other animals. This species tends to bite predominantly at night. They breed in a variety of freshwater habitats. Not known to transmit Ross River Virus or Barmah Forrest Virus.

Aedes vigilax(S)

Aedes vigilax

Aedes vigilax is a salt water breeder that in saline habitats on mudflats usually behind mangroves. Hatching of eggs is usually in response to tidal movements in a salt marsh, although rainfall can initiate hatching and breeding adults are most abundant in summer months. They attack humans and other animals readily and bite during the day in sheltered areas (or full sunlight in larval habitats), but also at evening and night. This species is a major pest and vector (transmitter) of Ross River virus (RRV) disease and Barmah Forest virus (BFV) (and also dog heartworm). It can disperse 5-20km from a breeding site.

Culex globocoxitus

This species is not likely to be an important vector as it rarely bites humans. The larvae are found in swamps and ground pools and brackish water.

Aedes notoscriptus (f)*

Aedes notoscriptus

This species is mainly a container breeder and also breeds in tree and rock holes, but not so much in roadside drains. This species is known to be a vicious biter readily attack humans by day in shaded areas but also feeds during the evening, night and early morning. It is a vector of dog heartworm and of Ross River Virus and Barmah Forest Virus in urban outbreaks that have bee intriduced from rural areas.

Aedes camptorhynchus(s)

Aedes camptorhynchus

Adults can be active throughout the year and are associated with rainfall and tidal inundation of a saltmarsh. This species is also thought to breed in some freshwater environments. Aedes can disperse 3 - 5 Km in search of blood meals; they can be vicious biters readily attacking humans and other animals including birds, and will feed during the day, at dusk and after sunset. It is a known vector of Ross River Virus and Barmah Forrest Virus and is most abundant during winter, spring and early summer.

Culex annulirostris(f)*

Culex annulirostris

This species is a fresh water breeder that also breeds in constructed water bodies, drains and swales. It prefers heavily vegetated sites. Adults readily feed on humans, and most feeding activity occurs from sunset for about 2 hours and again to a lesser degree at dawn; disperses 5-10 km. It is a known vector of Ross River Virus and Barmah Forrest Virus and is most abundant between December and April in the south of WA.

Culex quinquefasciatus(f)

Culex quinquefasciatus

This species breeds in polluted fresh water drains, ground waters near urban development, backyard containers and roof gutters. Adults are generally active only during the warmer months; they usually bite at dawn/dusk/night. They are a poor vector of disease but are a major pest.

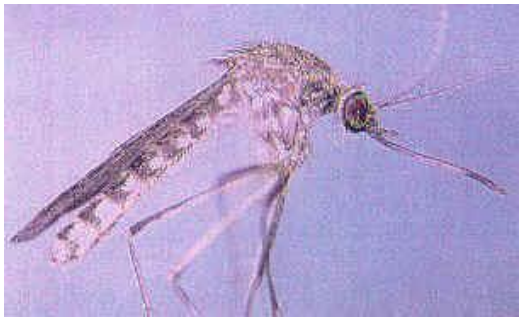
Coquilletidia sp. nr linealis (f)

A mosquito associated with permanent vegetated freshwater. Adults are generally most common from late-spring through summer but periods of peak abundance vary with region; they attack humans readily (as well as other animals), and bite during the day as well as evening and night. They may transmit Ross River Virus.

Aedes alboannulatus (f)

A commonly collected mosquito which will bite throughout the day and is most abundant winter to spring. Breeds in temporary rain-filled ground or rock pools.

Culex australicus (f)



This spevies breeds in freshwater with emergent vegetation, slightly brackish and also slightly polluted waters, including urban drains. Often found with Cx annulirostris and An annulipes. Adults are active from spring through autumn in many areas. This species normally does not attack humans.

Appendix 4 – Mossie Bites Research Article June 2014

Mossie Bites Research Article – June 2014

Mosquito abundance and composition within inner-metropolitan local governments of Perth, WA.

Ryan Janes, Scientific Officer, Mosquito-Borne Disease Control, Enviornmental Health Hazards Unit, Department of Health, WA.

A research project, supported by WA Department of Health, to determine the prevalence of disease vectors was conducted throughout the Swan-Canning Rivers system and nearby suburbs in January 2013. The research focused on the Cities of South Perth, Canning and Town of Victoria Park as they are uniquely situated within close proximity to known saltmarsh habitats along the Swan and Canning Rivers.

The study involved 24-hourly collections of mosquitoes over eight days of trapping from 11th to 18th January 2013 and collected more than 50,000 mosquitoes. A total of 53 trap sites were used, spread over the study area in an approximate 1kmx1km grid pattern using EVS CO_2 traps, with researchers removing and resetting traps around sunrise each day. Specimens were later identified to species level using Liehne (1991).

A total of 11 mosquito species were collected during the study, with four dominant species across the study area including *Aedes vigilax* (36%), *Culex quinquefasciatus* (25%), *Culex annulirostris* (21%) and *Aedes notoscriptus* (15%).

The majority of sampled mosquito species were collected at trap locations within 1km of the river systems, even though the majority of mosquito species were typically associated with freshwater. This demonstrates that productive freshwater breeding habitat can be located along the fringes of the rivers but may not necessarily be part of the river system.

Aedes vigilax was the most abundant species within the study area, comprising 36% of the total sample of mosquitoes collected. A significant relationship was found between the mean number of *Ae. vigilax* mosquitoes collected and proximity to known saltmarsh breeding habitat. *Culex annulirostris* (third most abundant) was also collected in a similar distribution. This data supports the conclusion that the majority of permanent and semi-permanent naturally occurring mosquito breeding habitat is located in close proximity to the river systems. Specimens of both *Ae. vigilax* and *Cx. annulirostris* were collected at further distances but in significantly smaller densities.

The species composition at the centre of the study area comprised mainly *Cx. quinquefasciatus* (second most abundant species) and *Ae. notoscriptus*. The relatively ubiquitous distribution through the study area follows the widespread installation of drainage infrastructure and other water-holding containers. Similarly, great variation in mean trap collections of *Ae. notoscriptus* and *Cx quinquefasciatus* between

adjacent traps across the study area, supported the fact that both species have comparatively limited dispersal range.

As all four predominant mosquito species are known for being anthropophilic, and with the exception of *Cx. quinquefasciatus*, are known vectors or implicated in the transmission of mosquito-borne diseases, the impact on local residents can be severe in some years.

The main implication for mosquito management is that saltmarsh mosquitoes are not the only type of mosquito of significance in the study area. The great number of freshwater and container-breeding mosquito species indicates that local governments and other mosquito managers should broaden surveillance measures and management methods to include the type of habitats occupied by *Ae. notoscriptus*, *Cx. annulirostris* and *Cx. quinquefasciatus*.

References:

Leihne, P. 1991. "An atlas of the Mosquitoes of Western Australia", Health Department of Western Australia.

Mr Ryan Janes marking mosquitoes with a fluorescent blue dye to look at dispersion of mosquitoes across South Perth

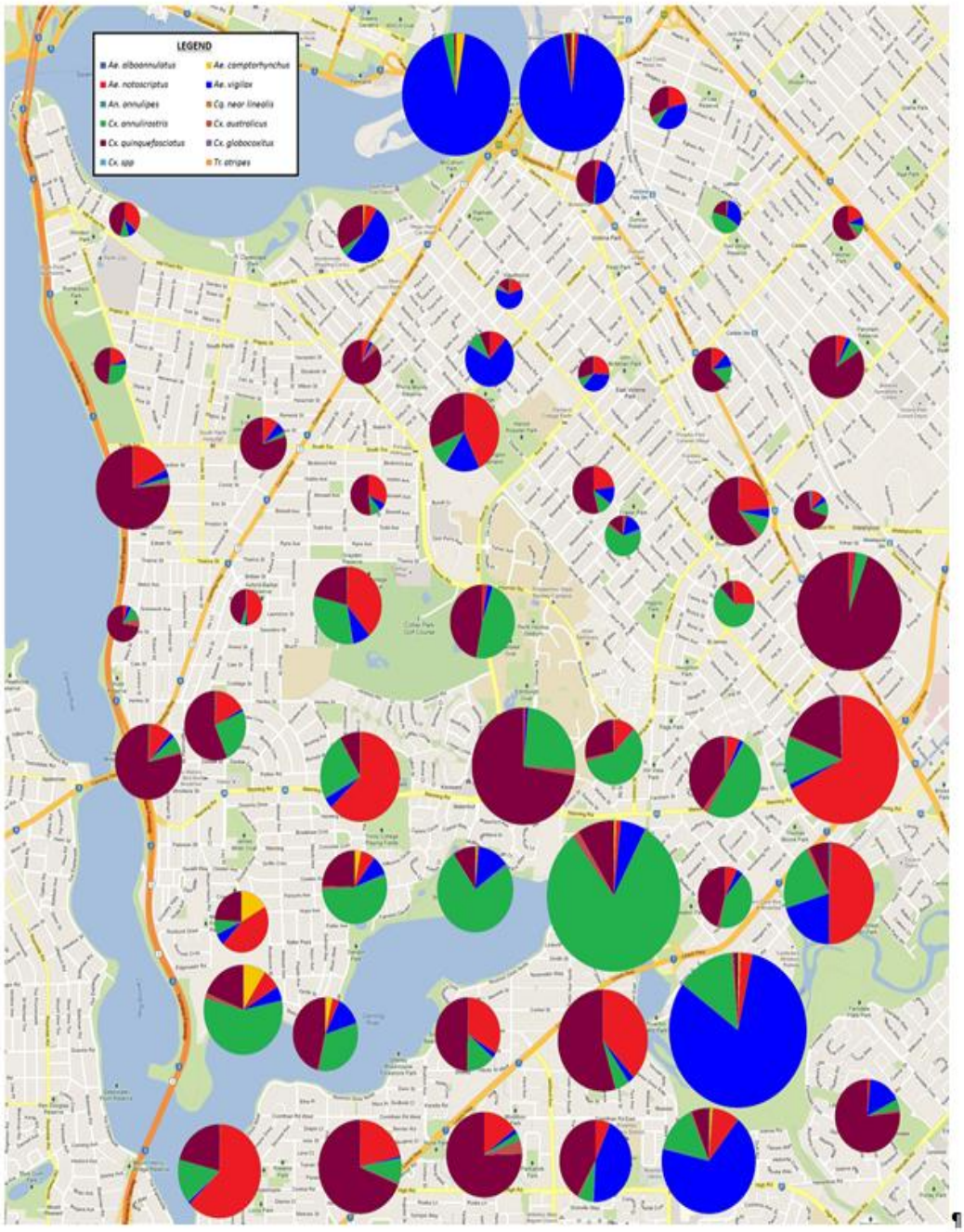


Figure: Map of overall mosquito species abundance and composition collected during the field study at each trap site in study area. Size of the circular pie chart reflects the overall mean number of mosquitoes collected at each trap site — smallest circle size represents collections < 50 mosquitoes, increasing gradually to medium circle size representing 50-250 mosquitoes. Largest circles (located at northern-most trap sites and south-eastern locations) represent > 2000 mosquitoes. Main colours of mosquito species as follows: red (*Ae. notoscriptus*), blue (*Ae. vigilax*), green (*Cx. annulirostris*), brown (*Cx. quinquefasciatus*), yellow (*Ae. Comptorhynchus*).

Section Break (Continuous)

USEFUL CONTACTS

Civic Centre
9474 0777
Cnr Sandgate St & South Tce,
South Perth WA 6151
Fax 9474 2425
southperth.wa.gov.au

Recycling Centre
9474 0970
Hayman Rd & Thelma St, Como
enquiries@southperth.wa.gov.au

Animal Care Facility
9474 0777
199 Thelma St, Como

Ferry Tram
9474 0777
Windsor Park, Cnr Mends St &
Mill Point Rd, South Perth

George Burnett Leisure Centre
9474 0855
Manning Rd, Karawara
leisurecentre@southperth.wa.gov.au

South Perth Library
9474 0800
Cnr Sandgate St & South Tce,
South Perth
southperthlib@southperth.wa.gov.au

Manning Library
9474 0822
2 Conochie Cres, Manning
manninglib@southperth.wa.gov.au

Old Mill
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Melville Pl, South Perth
oldmill@southperth.wa.gov.au

South Perth Senior Citizens
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spsc@bigpond.com

Manning Senior Citizens
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3 Downey Dr (off Ley St),
Manning
manningseniors@bigpond.com

Graffiti Hotline 1800 007 774

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collierparkgolf.com.au