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Executive Summary

Council staff and consultant first started monitoring mosquito numbers in 2001 to try to establish the extent of the major mosquito breeding habitats within the Shire. That preparatory work lead to Council adopting the Shire of Capel Mosquito Management Program in 2006 from which Council staff commenced carrying out the first aerial larviciding in the spring of 2007.

The introduction of the program has been a steep learning curve for staff, both in the organisation of the program and extent of the work required to implement the program. Staff have liaised closely with the Shire of Busselton, Department of Health, Heliwest and the landowners whose properties would be the subject of the program.

Some landowners expressed concerns about the effect the helicopter would have on water birds and stock, especially horses with foals at foot. The other major concern was the effect of the larvicide on stock and the environment. Observations from an ornithologist employed by the Shire of Busselton have found that there was little effect on the water birds; this has been backed up by Council staff observations whilst flying in the helicopter. Similarly, there was very little evidence of stock disturbance during the larviciding flights. The larvicide is based on growth hormone that is target specific to mosquito larvae. No adverse effects were noted on other macro invertebrates during post treatment sampling.

The post treatment follow-up after the aerial larviciding shows that the larviciding has been successful with a reduced number of larvae hatching into adult mosquitoes. Staff members have received good feedback from both the landowners whose properties were treated and local residents who have noted the drop in number of adult mosquitoes.

One area of concern is the large wetland on Minninup Road Stratham where dense vegetation makes it very difficult to access and treat. The problems in this area are compounded by a very low pH, 2.3 and the presence of snakes. Council staff will continue to work with the relevant agencies to achieve a satisfactory outcome in this area.
1 Introduction

Mosquitoes are a fact of life in the southwest of Western Australia; the first settlers in the Capel region noted that there were plagues of both flies and mosquitoes as early as the 1850’s.

The high incidence of the mosquito borne diseases Ross River virus and Barmah Forest virus in the southwest, particularly in the Shire of Capel, presents a potential serious risk to public health. Figures produced by the Department of Health show that Capel has the highest incidence of Ross River virus of any district in the State. The development of the Shire of Capel’s Mosquito Management Plan in 2006 has led to the operation of the larviciding program that was carried out over the winter/spring of 2007.

The program has been developed to meet the risks posed by the mosquito borne diseases. The threat of the diseases has been increased by the rapid urban development within the Shire; Capel is the third fastest growing municipality in Australia. With the spread of urban development closer to the major mosquito breeding areas, there has been a dispersal of rural mosquito species into the urban environment. Urban development also brings more breeding habitats for different species of mosquito, such as backyard breeding in water tanks, effluent disposal systems, stormwater drains and engineered wetlands.

It is simply not possible or environmentally desirable to eradicate mosquitoes as they are an important part of the ecosystem. However, it is possible to manage mosquito populations and the incidence of mosquito borne diseases such as Ross River virus with an effective Mosquito Management Strategy.

An effective Mosquito Management Strategy for the Shire of Capel requires a clear definition of the mosquito problem, determination of practical objectives, the selection of appropriate control measures, procedures for measuring the effectiveness of mosquito control operations and the establishment of a process for evaluating the management strategy.

The major objectives of the strategy are:

- Define the breeding areas for mosquitoes within the Shire;
- Monitor and find an environmentally safe and cost effective method of reducing the numbers of the mosquito.
- To investigate the feasibility of combining with other shires to develop joint public awareness campaigns, sharing resources and management methods.
- Enlist the support of those landholders with mosquito breeding habitats on their properties and develop a strategy where landholders are given warnings before a larvicide treatment occurs.
- The investigation by Council for contribution requirements from developers for the implementation of mosquito management strategies.
2 Background

In 2001/02 after consultation with the Department of Health, Council employed a consultant, Mr Bob Rankine, to assist staff to identify mosquito breeding habitats and develop an effective monitoring system. The identification of the mosquito breeding habitat has involved extensive background research and monitoring. This involved both the setting up of 17 mosquitoes monitoring trap sites throughout the Shire and utilizing the services of the Department of Health and staff from the University of Western Australia’s Arbovirus Research Laboratory.

This background work has identified the mosquito species responsible for the high nuisance levels and those that carry Ross River virus and Barmah Forrest virus (see appendix A) the investigation also identified the extent of the mosquito breeding habitat west of Bussell highway. Further work done by Council staff, Colin Dent and Carla Webster, has further defined the areas of potential mosquito breeding habitat, with a total of eight hundred hectares being identified (see appendix B).

The water from the wetlands south of the Capel River flow into the Vasse Wonnerup estuary, a Ramsar declared wetland (Ramsar wetlands have international significance for their unique habitat and for migratory birds) As result the Shire of Capel had to make an application to the Federal Department of Environment and Heritage to operate a mosquito management strategy in this area which is protected under the provisions of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. The application was approved on 14 March 2006.

In 2006 the total rainfall from January to October was 321.5mm with 50 rain days; in 2007 the total rainfall for that same time period was 769.5mm with 95 rain days. The decreased amount of rain in 2006 is the reason Council did not treat for mosquitoes as the area was very dry and did not warrant treatment.

3 Mosquito Monitoring

3.1 Larvae Monitoring Method

Larvae monitoring is conducted 1-4 times a week, depending on the water level in the wetlands during the peak mosquito breeding season, usually July to November. Various factors are observed during the monitoring including the water level, extent of the breeding area, number of larvae per square metre, what growth stage the larvae have reached, temperature, colder weather can slow the development of the larvae, and the presence of other fauna and vegetation.

Once the breeding areas have been identified monitoring is increased to observe the development rate of the larvae, what stage of development they have reached the density per square metre and the total areas they are present in. A breakdown of the hours spent monitoring is in section 6.
The equipment used to monitor the larvae levels in the wetlands are a dipper (similar to a large soup ladle), specimen container, waders or gumboots and temperature gauge. All data is recorded on a larval monitoring report, an example is in appendix C. The dipper is used to take regular samples at 10 metre intervals, each sample is examined for mosquito larvae and if present the growth stages are then recorded as a percentage and also the estimated number of larvae per metre$^2$. A sample of one of these scoops is kept in a jar for further analysis of pH and conductivity. The temperature of the water is recorded on the monitoring report form. Other observations made are the depth of the water, the distribution of the larvae, the estimated total area and the estimated total area with larvae. Comments are also made on the presence of other macro invertebrates, water birds, rate of water rise/fall, and condition of water or any event that relates to the health or impact on the wetland and mosquito larvae.

Once back at the office the water samples are checked for pH and conductivity using a TPS WP-81 meter. These results are also included on the form. The form is then sent to the Mosquito Borne Disease Control Branch of the WA Department of Health for their information.

One aspect of the monitoring is the correct identification of the mosquito species. As not all mosquitoes are vectors for Ross River Virus and Barmah Forest Virus the identification of the species is required before a decision is made on whether to conduct aerial larviciding. The aerial treatment is only carried out when there are known vectors of the disease present. Each mosquito species has its own characteristic which can only be identified by using a high powered microscope.
3.2 Adult Trapping

An adult trap consists of a modified insulated tin that contains dry ice, hanging off this is a small motor that operates a light and a fan to suck the mosquitoes down into the catch bags attached to the bottom of the motor assembly. Mosquitoes are attracted to the CO$_2$ gas given off by the dry ice. The traps are set in the afternoon and picked up the following morning. When the traps are collected the collection bags are removed and placed in eskies and taken back to the office. At the office the mosquitoes are decanted into a sterilised container and weighed to obtain a rough count. Once the mosquitoes are weighed they are placed in a foam esky and sent to Bob Rankine for proper identification and count.

The trap sites are mainly located along the western side of Bussell Highway where the major mosquito breeding sites have been identified (Appendix E). During the peak mosquito season, June to December, adult trapping is carried out every fortnight. It is carried out monthly from January to June. The trapping results are used as a follow-up after a treatment as well as monitoring species numbers, with the aim of identifying breeding patterns and the distribution of the adult mosquitoes.

See Appendix F for a summary of the species and numbers caught.

4 Mosquito Control Methods

4.1 Aerial Treatment
Aerial treatment is conducted in a coordinated effort between the Mosquito Borne Disease Control Branch of the Department of Health and the Shires of Capel and Busselton. The Department of Health has a contract with Heliwest who provide the helicopters used in aerial larviciding programs; the Department meet the costs of supplying the helicopters.

The aerial treatment poses logistical difficulties for Shire staff. After an extensive survey of potential landing sites it was decided to use the Peppermint Grove Community Centre as the base of aerial larviciding within the Shire. The site was chosen for both its proximity to the major mosquito breeding areas, a clear area to land the helicopter safely and the facilities provided by the Community Centre. In addition the fuel needed for the helicopter can be stored in the Peppermint Grove Bush Fire shed.

During the larviciding operation the helicopter uses two, two hundred litre drums of aviation fuel. The fuel is delivered by Heliwest, usually four two hundred litre drums at a time. Prior to the aerial larviciding commencing the drums of fuel have to be moved from the bush fire shed to the landing ground. This can only be done by using the Shire’s John Deere tractor which has a front end loader attachment.

The larvicide is stored in the chemical shed at the depot and has to be transported from the depot to the landing ground. This means loading 800 kilograms of larvicide, in 20 litre buckets, onto a hired tandem axle trailer and taking them to Peppermint Grove.

The aerial treatment requires a minimum of two Shire staff; one loads the larvicide into the hoppers while the other acts as the navigator. The loading of the hoppers is conducted with the helicopter engine running. The helicopter pilot refuels the machine whilst the Shire officers load the twenty kilo buckets of larvicide into the hoppers. The helicopter engine is turbo powered and once turned off requires approximately twenty minutes to cool down before it can be restarted. The appropriate safety equipment earmuffs, fire retardant clothing etc must be worn during the refilling of the hoppers and during the flight. The operation is physically tiring with the combination of air sickness and emptying over thirty; twenty kilogram buckets into the hoppers during a normal larviciding operation.

The helicopter carries two hoppers, one on either side of the machine. The amount of larvicide put out from the hoppers is controlled by the pilot in flight. Before each days flight the hoppers have to be individually calibrated to make sure the larvicide is being applied at the correct rate of 4.0kg/ha, this is done by placing a bag over the outlet to the hopper and collecting the amount of larvicide coming out over a given period, usually thirty seconds. The larvicide is then weighed and the result compared to a table which sets out amount required. As the hoppers are electrical rather than mechanical, the helicopter engine must be running during this test.

The hoppers carry 80Kg each for a full treatment, making a total of 160 kilograms (the amount of larvicide that can be carried can be varied by the helicopter pilot depending on the weight of the navigator, size of area
needing treating and the weight of the fuel used to cover the distance
between the treatment areas, but the amount is never over 160
kilograms) The larvicide is applied from a height of approximately 10/15
metres which give a swath width of 20 metres.

As a further assessment of the amount of larvicide being put out catch
bags are placed in the wetlands to determine how much larvicide is
reaching the ground. The bags are on a metal frame, which are a metre
square and a meter high, the bags are placed a set distance apart in the
wetland. The larvicide caught in the bags is collected and weighed to
assess what rate the larvicide has been applied.

Before each aerial treatment the areas that need to be treated are
identified by Council staff with the information being transferred to maps
which are used by the navigator to direct the pilot where to drop the
larvicide. The maps are also used for other information, powerlines, tall
trees, roads and the location of flighty livestock.

The larvicide used is Prosand Prolink (MSDS is in Appendix D) at a rate of
3.5kg – 4.0kg per Ha. The active ingredient in Prosand is S-methoprene,
an insect growth regulator which works by mimicking a juvenile hormone
that is present in the larval stage of the mosquito’s life cycle. The larvicide
is target specific to mosquitoes; no other species has been found to be
affected by the hormone.

The Shire has carried out a total of 5 aerial treatments and 2 hand
treatments from the 13th September 2007 to the 21st December 2007.
The treatments were coordinated to fit in with other shires i.e. Busselton,
Harvey and Dardanup to make the most cost effective use of the
helicopter.

3960 kilograms of larvicide has been applied to a total area of 1131Ha.
Table 1 shows the number of treatments that occurred for each wetland.

Table 1: Number of treatments at each wetland.

<table>
<thead>
<tr>
<th>Wetland</th>
<th>Number of Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland 2 – Piacentini’s</td>
<td>4</td>
</tr>
<tr>
<td>Wetland 3 – Killerbys</td>
<td>4</td>
</tr>
<tr>
<td>Wetland 4 – Bill Scott’s Dairy</td>
<td>5</td>
</tr>
<tr>
<td>Wetland 5 – DPI</td>
<td>4</td>
</tr>
<tr>
<td>Wetland 6 – Rich Rd</td>
<td>3</td>
</tr>
<tr>
<td>Wetland 7 – Fisherman’s Rd</td>
<td>1</td>
</tr>
<tr>
<td>Wetland 8 – Stirling Beach</td>
<td>1</td>
</tr>
<tr>
<td>Wetland 11 – Mallokup Bridge</td>
<td>2</td>
</tr>
<tr>
<td>Wetland 12 – Peppermint Grove</td>
<td>4</td>
</tr>
<tr>
<td>Wetland 13 – Higgins Cut</td>
<td>5</td>
</tr>
<tr>
<td>Wetland 14 – Ludlow North Rd</td>
<td>5</td>
</tr>
<tr>
<td>Wetland 15 – Breeze End</td>
<td>1</td>
</tr>
</tbody>
</table>
The Shire of Capel and the Shire of Busselton staff worked together for the majority of the treatments i.e. loading of chopper and to prepare for the first treatment in Forrest beach which can be done on the way up to the Peppermint Grove base.

4.2 Hand Application

Hand application is only considered necessary in drains around the urban areas of the Shire or in small areas that still have larvae in them at the end of the season. In December 2007 the outlet drain to the Capel River at Peppermint Grove was closed, raising the water levels in the wetlands around Peppermint Grove. Shortly after on the 16th and 17th of December Capel received 17mm of rain which was enough to push the water levels up further which resulted in an increased number of larva in a small section.

As a result hand treatment was done on the 13th December 2007; a total area of 2Ha was treated. An additional treatment was conducted on the 21st December in areas that were not ready to treat the first time; the total area treated was .2 Ha.

4.3 Fogging

Fogging is not considered as an option for the Shire of Capel.

4.4 Post Treatment Hatching Results

Post treatment monitoring is conducted two to three days after the aerial treatment. The monitoring observations include the number of mosquito larvae that appear to have been affected by the larvicide, presence of macro invertebrates and their condition, the presence and activity of the bird life, weather conditions and any other observations that are considered significant to the process.

Representative samples of larvae are collected from each treated area as part of the post treatment survey. The larvae are taken back to the Shire office where they are taken through to maturity. The number of adults that emerge from the samples is used to work out the effectiveness of the larvicide operations. The post treatment surveys have revealed that the larviciding treatments achieved a reduction in the number of larvae hatching into adults at a rate varying from 64-90%.

<table>
<thead>
<tr>
<th>Date of Treatment</th>
<th>Average % Not Hatched</th>
</tr>
</thead>
<tbody>
<tr>
<td>13/09/07</td>
<td>64%</td>
</tr>
<tr>
<td>28/09/07</td>
<td>90%</td>
</tr>
<tr>
<td>13/10/07</td>
<td>79%</td>
</tr>
<tr>
<td>2/11/07</td>
<td>69%</td>
</tr>
<tr>
<td>24/11/07</td>
<td>Sample not taken due to lack of larvae present</td>
</tr>
<tr>
<td>13/12/07 Hand Treatment</td>
<td>89%</td>
</tr>
<tr>
<td>21/12/07 Hand Treatment</td>
<td>Samples not taken due to the Christmas break</td>
</tr>
</tbody>
</table>
The low effectiveness of several treatments has been put down to environmental conditions, strong winds and heavy rain immediately after the larviciding which tended to rapidly disperse the larvicide.

Wetland 5, Minninup Road, has proved difficult to treat as there is a large amount of vegetation in the wetland, mainly bracken and melaleuca’s. The cover has made the area difficult to treat as the larvicide cannot penetrate through to the water.

6 ADMINISTRATION

6.1 Hours Breakdown

The following pie chart shows the breakdown of the hours spent implementing the mosquito control strategy for 2007 by the environmental officer. As demonstrated the actual treatment of the larvae is only a small fraction of the program. The biggest section is larvae monitoring with a total of 54.5 hours spent out in the wetlands, adult trapping is the next biggest consumer of hours with 32.5 and surprisingly a total of 24.75 hours was spent preparing for a treatment.

Preparation for a treatment included the notification of landholders that the aerial treatment would involve their property, picking up of supplies, organising larvicide and setting out catch bags.
During this season’s treatment program, it became evident that with only 2 trained officers it leaves the operation open to disruption if one officer becomes ill. Staff are continuing discussions with the Shire of Busselton regarding the sharing of officers under a Contiguous Local Authority Government arrangement.

### 6.2 Finance

The 2006/2007 financial year budget for the mosquito program details are:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint TV Advertising Campaign with South West Councils</td>
<td>2,500</td>
</tr>
<tr>
<td>Mosquito Trapping</td>
<td>10,000</td>
</tr>
<tr>
<td>Mosquito Monitoring</td>
<td>65,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>77,500</strong></td>
</tr>
</tbody>
</table>

Funds that are not used from the 2006/2007 budget are placed in the CLAG reserve. These funds are then available for unexpected or increased costs for mosquito management in the coming years.

As previously mentioned the Health Department, through the Mosquito Control Advisory Committee, pay for the cost of the helicopter, a grant for 50% of the cost of the larvicide is also available.
APPENDICIS

APPENDIX A:

SPECIES DESCRIPTION

The following section contains a brief description of the main mosquitoes found in the area and their relation to Ross River virus and Barmah Forrest virus (The following information was extracted from the *An Atlas of the Mosquitoes of Western Australia* by Peter Liehne, 1991).

*Aedes camptorhynchus* (*Western saltmarsh mosquito*)
Breeds in coastal brackish water or salt affected waters and temporary fresh ground water in inland areas. It can be found throughout the year but the greater numbers are in June to August. This species plays a high role in the distribution of RRv & BFv. The species also readily bites man throughout the day but more so at dawn and dusk. This is the predominant species found within the Shire of Capel and can make up to 90% of the total number of mosquitoes.

*Aedes alboannulatus*
This species was found in small numbers in this seasons trapping, it breeds in temporary rain filled ground or rock pools. The adults do bite but it has not any known association with any human transmitted viruses.

*Aedes notoscriptus*
Found breeding in any natural tree hole, rock hole or artificial container. Eggs are laid at the waterline and are resistant to desiccation. The species has not yet been proven to be a vector of human diseases.

*Aedes ratcliffei*
Ratcliffei breeds in fresh ground pools that are with or without vegetation. Adults are active in spring and usually only have one generation a year. It has no known or suspected relationship to disease.

*Aedes clelandi*
Like ratcliffei they are also found in open fresh clear water devoid of vegetation or flooded rabbit burrows. The adults bite throughout the day, but there is no known relation to human disease. The adults generally emerge from April to October.

*Aedes hesperontius*
Only the adult females have been caught of this species, there is little known about the biology of the species. They seem to appear for a brief period in September/October. There is no known or suspected link to the disease.

*Culex globocoxitus*
This species generally does not bite man, and is most active from July to November. Common in coastal areas in the south west it breeds in open swamps and is collected in brackish waters. There is no known link to Ross River virus or Barmah Forrest virus.
**Culex australicu**
This species feeds mainly on birds and small mammals, they do tend to swarm around man and may land on them but hardly ever bite. They breed in open fresh water and will tolerate slightly polluted waters. It is also commonly found in drains in urban areas. It is not known to be a transmitter of Ross River virus or Barmah Forrest virus.

**Anopheles annulipes**
This is an opportunistic species and will breed in virtually any water conditions and habitats. It is found throughout the year and has its peak breeding time in summer. They readily bite man during the day with peak biting time after sunset. The disease relation for this species remains uncertain.

**APPENDIX B:**

**DESCRIPTION OF AREAS MONITORED**

**Wetland 1 – Dalyellup Central Lakes**
A small wetland with a total area of 4Ha (lots 9071 and 9006) Due to its location within the Dalyellup residential zone, aerial treatment of this area is not possible. There is a significant population of gambusia, a non-native fish known to predate on mosquito larvae, which has been introduced by the developers in the central lake.

**Wetland 2 – Piacentini’s Block**
Wetland 2 is located at the southern end of Harewoods Rd in Dalyellup. It is situated on locations 497, 313, 314, 315 and 316 and is occasionally grazed by cattle and sheep. The vegetation structure is predominantly Typha Grass with small outcrops of paperbark. On the western side of the wetland is there a 5 metre high ridge. This is where the deepest water is located. The total potential area for the wetland is an estimated 80ha, much of which is inaccessible by foot. The main access point is at the end of Harewoods Rd, via a fence and walking 1 km to the first part of the wetland.

**Wetland 3 - Killerbys**
Wetland 3 is located at the northern end of Minninup Rd opposite Killerbys Winery and is on lots 41 and 6. Wetlands 2 & 3 were originally one system but were bisected when the then Public Works Department installed the Five Mile Brook in the middle of the last century. It is regularly grazed by cattle and can become very muddy throughout the season making monitoring challenging. The wetland covers an estimated area of 21ha with the vegetation being predominantly pasture with typha grass. The northern end of the wetland also contains *Pteriduim esculentum* (bracken fern). The water is very acidic with a Ph of 2-3. To gain access to the wetland you have to climb over the gate and walk about 500m to the first part of the wetland and an additional 500m to the other side of the wetland which is located in another paddock.
Wetland 4 – Bill Scott Dairy
Wetland 4 is located along Minninup Rd starting at the southern side of Five Mile Brook and finishing at the causeway that divides it from wetland 5, locations 6, 201, 9, 11, 10 and 637. It is regularly grazed by cattle and can become very inaccessible due to the muddy conditions. The vegetation is varied along this wetland which covers a total area of 28ha. The first stage of the wetland (the northern end) is predominantly typha grass, *Pteriduim esculentum* (bracken fern), *Zantedeschia aethiopica* (arum lily) and scatterings of paperbark. The middle of the wetland is similar but typha and bracken are more dominant. The final stage has more of an abundance of Paperbark and the vegetation is very thick making treatment difficult. The pH of the water can range from 1.5 to 3. Access to this wetland can be via the southern side of Five Mile Brook, a causeway between locations 6 and 10 or the causeway between lots 9 and 10 on the Department of Planning and Infrastructure land.

Wetland 5 – Department of Planning and infrastructure
Wetland 5 is located predominantly on Department of Planning and Infrastructure land (lot 11) and covers a total area of 45Ha. Access to this wetland is via the causeway which covers the rear (western side) of the wetland. Due to the thick vegetation there are limited access points for monitoring and limited view points to determine any changes in water levels in the area. Vegetation is made up of typha, *Zantedeschia aethiopica* (arum lily) and paperbark.

Wetlands 3, 4 and 5 are the most difficult to monitor due to the thickness of vegetation and the muddy, acidic conditions.

Wetland 6 – Rich Rd
Wetland 6 is one of the smaller wetlands covering an estimated area of 13Ha and is located on lots 41 and 17. This wetland is deceptively deep and has not seen much activity as far as mosquito breeding goes due to the lack of water level change and the presence of natural predators. The vegetation is predominantly paperbark and grasses.

Wetland 7 – Minninup Road, south of Fisherman’s Rd
Wetland 7 covers a total area of 101Ha (lots 19, 10, 3 and 68) and the vegetation is made up of flooded pasture and typha grass. The area is kept drained to allow cattle access to the pasture. Access to the wetland is via the southern junction of Minninup Road and Harewoods Road. There are stockyards 500m south of the intersection where access is available to the paddock and walk down about 1.5km to the start of the flooded pasture.

Wetland 8 – Stirling Beach
Wetland 8 is predominantly pastured and covers an area of 17Ha (lot 2). Access is via the end of Mangles Rd. The area is regularly grazed by cattle and has not shown much mosquito breeding activity.
Wetland 9 – Mangles Rd West
Wetland 9 is predominantly flooded pasture and covers an area of 41Ha. Access is via Mangles Rd West lot numbers 14, 135, 17 and 340. The area is regularly grazed by cattle & horses and has not shown much mosquito breeding activity.

Wetland 10 – King Rd
Located on lot numbers 71, 101, 143, 144 and 145, running along Mangles Rd, over Roberts Road and down King Road. Wetland 10 covers an estimated 56Ha. Consisting of flooded pasture this wetland was not considered a mosquito breeding area this season.

Wetland 11 – Edwards End and Mallokup Bridge
Wetland 11 is one of the largest wetlands with a total of 87Ha (lots 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86 and 87). The dominant vegetation is typha grass. The area is regularly grazed by cattle and has not shown much mosquito breeding activity this season. Access is either via Edwards Road or Capel Farms Property on the northern side of Mallokup Bridge.

Wetland 12 – Peppermint Grove East and West
Wetland 12 is the largest wetland and surrounds the settlement of Peppermint Grove and covers a total area of 203Ha (lots 102, 97, 96, 101, 1, 2, 100, 99, 98, 88 and 89). The vegetation in this area is mainly samphire with scatterings of paperbark along the edge. Access to the eastern side is via a laneway on Ludlow North Road, halfway between Mallokup Road and Peppermint Grove Road.

Access to the western side is the Peppermint Grove Community Centre in Hayfield Drive or the Sand Dune Drive entrance onto Peppermint Grove Terrace. This gives a better idea as to the level of mosquito breeding in the wetland.

Wetland 13 – Higgins Cut
Wetland 13 is a long narrow wetland that runs from Peppermint Grove Rd to Location 109 on Ludlow North Rd (lots 103, 104, 106, 107, 108 and 109). Vegetation is predominantly samphire with scatterings of paperbark. It covers a total area of 150Ha and goes through 5 properties. Access is via Harper’s (location 108 Ludlow North Road). There are no issues with visibility or access, although there are some issues with property owners on the treatment that is occurring on their property. These concerns are more directed towards the larvicide used and the effect it will have on their stock.

Wetland 14 – Ludlow North Rd
Wetland 14 ends at Forrest Beach Road, lot numbers 110, 111, 112, 1 and 114. The total area is 35Ha, and runs through 5 properties. The dominant vegetation is samphire with small outcrops of paperbark. Access to wetland 14 is via a paddock on Dick Vincent’s property (Location 1 Ludlow North Road) as with Wetland 13 there are no issues with access or visibility.
**Wetland 15 – Breeze End and McCourt’s Rd**

Wetland 15 backs onto the Busselton Shire and the Vasse Wonnerup estuary which is covered by the Convention on Wetlands (Ramsar, Iran 1971). It covers a total area of 50Ha and goes through 4 properties lot numbers 115, 118, 117 and 1. The predominant vegetation is samphire, with a few outcrops of paperbark on the eastern side of McCourt’s Rd. The main focus area for the monitoring is on the edge in the samphire vegetation. Access to this wetland is relatively straight forward.
### APPENDIX C: EXAMPLE MONITORING FORM

**Mosquito Management Program - 2007**

<table>
<thead>
<tr>
<th>Site name or number</th>
<th>Water Depth</th>
<th>Water Quality</th>
<th>Larval Density (l/m²)</th>
<th>Distribution</th>
<th>Mosquitos (N)</th>
<th>Species</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m</td>
<td>ft</td>
<td>cm</td>
<td>°C</td>
<td>pH</td>
<td>Conductivity</td>
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<td>W13 - Potato Cut</td>
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<tr>
<td>W14 - Cawston Mill</td>
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<td>W15 - herself hat</td>
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</tr>
</tbody>
</table>

**Notes:**
- Rains (inches): 3 weeks prior to survey.
- Wind: Direction (°), Speed (mph).
- Temperature (°C): Air, Humidity.

**Totals:**
- Rainfall (inches): 3 weeks prior to survey.
- Wind: Direction (°), Speed (mph).
- Temperature (°C): Air, Humidity.
APPENDIX D:

MSDS FOR PROLINK PROSAND

MATERIAL SAFETY DATA SHEET
ProLink Prosand Mosquito Growth Regulator May 2006

SECTION 1 IDENTIFICATION OF THE MATERIAL AND SUPPLIER
Product Name: ProLink ProSand Mosquito Growth Regulator
Other Names: (S)-Methoprene.
Use: Mosquito Growth Regulator.
Company: Pacific BioLogics Pty Ltd.
Address: 35 Beach Street, Kippa Ring, QLD, 4020.
Telephone Number: 07 3283 5077 Fax Number: 07 3283 5088
Emergency Telephone Number: 07 3283 5077 (8.30 am to 5.30pm EST Mon - Fri).

SECTION 2 HAZARDS IDENTIFICATION
Classified as hazardous according to criteria of NOHSC.
Not classified as a Dangerous Good according to the ADG Code.
No Risk Phrases have been established by NOHSC.
Safety phrases: S2 Keep out of reach of children.
S24/25 Avoid contact with skin and eyes.
S36/37 Wear suitable protective clothing and gloves.

SECTION 3 COMPOSITION/INFORMATION ON INGREDIENTS
Ingredients:
CHEMICAL CAS NUMBER PROPORTION (% w/w)
(S)-Methoprene 65733-16-6 0.4 % w/w
Sand - > 90 %w/w
Other ingredients determined to be non hazardous balance

SECTION 4 FIRST AID MEASURES
FIRST AID
Ingestion: If poisoning occurs, contact a doctor or Poisons Information Centre. Phone Australia 131126. Give 1-2 glasses of water.
Eye contact: Flush gently with water for at least 15 minutes. If irritation occurs and persists, Obtain medical attention.
Skin contact: Wash skin thoroughly with soap and water.
Inhalation: Remove to fresh air.
Advice to Doctor: Treatment should be symptomatic and supportive care.

SECTION 5 FIRE FIGHTING MEASURES
This product is non-flammable.
Extinguishing media: Use water spray, foam, CO2 or dry chemical. Contain all runoff.
Hazards from combustion products: When exposed to high temperatures, toxic fumes may be emitted.
Precautions for fire-fighters and special protective equipment: Isolate fire area. Evacuate downwind. Wear full protective clothing and self-contained breathing apparatus. Do not breathe or contact smoke, gases or vapours generated.
SECTION 6 ACCIDENTAL RELEASE MEASURES
Emergency procedures: Isolate and post spill area. Wear prescribed protective clothing and equipment. Large spills should be dyked or covered to prevent dispersal. Vacuum or shovel spilled material into an approved container and if unable to use as directed on the label, dispose of as directed in section 13.
Material and methods for containment and cleanup procedures: To clean spill area, tools and equipment, wash with a solution of soap, water and acetic acid/vinegar. Follow this with a neutralisation step of washing the area with a bleach or caustic soda ash solution. Finally, wash with a strong soap and water solution. Absorb, as above, any excess liquid and add both solutions to the drums of waste already collected. Keep out unprotected persons and animals.

SECTION 7 HANDLING AND STORAGE
Precautions for safe Handling: Ensure containers are kept intact until using product. When using product wear cotton overalls buttoned to the neck and wrist (or equivalent clothing) and elbow length PVC gloves. If dust is present wear face shield or goggles and disposable dust mask. After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use, wash gloves and contaminated clothing.
Conditions for safe Storage: Store in the closed, original container in a well ventilated area, out of direct sunlight. Store in a room or place away from children, animals, food and feed stuffs.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION
National Exposure Standards:
No exposure standard has been established by NOHSC Australia. However a general standard of 10 mg/m³ (TWA) is applicable for dusts. This dust concentration is unlikely to be encountered when using this product.
Biological Limit Values:
No biological limits have been established for this product.
Engineering controls:
Use in ventilated area only. Use local exhaust at all process locations where dust may be emitted. Ventilate all transport vehicles prior to unloading.
Personal Protective equipment (PPE):
Work Clothing: Wear long-sleeved uniform of coveralls and chemical resistant gloves.
Eye Protection: If dust is present, wear chemical protective goggles or face shield.
Respiratory Protection: For dust exposure, wear a properly fitted half-face or full-face air-purifying respirator which is approved for pesticides (Australian Standards). Gloves: Wear chemical protective gloves when handling this product. Inspect regularly for leaks. Thoroughly wash the outside of gloves with soap and water prior to removal.
Personal Hygiene: Clean water should be available for washing in case of eye or skin contamination. Wash skin before eating, drinking or smoking. Shower at the end of the workday.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES
Appearance: Grey sand based granule, with a slight odour.
Boiling point: Granule - not applicable.
Freezing point: Granule - not applicable.
Bulk Density: 1.56 g/mL.
Solubility in Water: Active concentrate coated on sand granule, disperses in water.
PpH: Not applicable.
Flammability: Not flammable.
Corrosive hazard: Non corrosive.
Flashpoint (°C): Not applicable - granule.
Poisons Schedule: Not a scheduled poison.

SECTION 10 STABILITY AND REACTIVITY
Chemical Stability: Product is considered stable in ambient conditions for a period of at least 2 years after manufacture.
Conditions to avoid: No particular conditions to avoid.
Incompatible materials: No particular materials to avoid.
Hazardous decomposition products: When the product is heated to high temperatures, the active constituent will decompose and emit toxic fumes.
Hazardous reactions: No particular reactions to avoid.

SECTION 11 TOXICOLOGICAL INFORMATION
Potential Health Effects:
Swallowed: This product has low toxicity if swallowed. Acute Oral LD50 (rat) > 5000 mg/kg.
Eye Contact: Possibly irritating to eyes due to the physical irritation of the sand granules.
Skin Contact: This product has low toxicity by the dermal route. Acute Dermal LD50 (rabbit) > 2000 mg/kg.
Inhaled: The active ingredient in this product has low toxicity if inhaled.
Chronic: No data available on this formulation. In studies with laboratory animals, Methoprene Technical did not cause teratogenicity, reproductive toxicity or carcinogenicity.

SECTION 12 ECOLOGICAL INFORMATION
Environmental Properties: No data is available on this product. Toxicity data is on the active constituent, (S)-Methoprene, has a half-life in soil of approximately 10 days which varies with soil type. The hydrolysis half-life > 4 weeks. Photolysis half-life is < 10 hours. Water solubility is < 2 mg/L.
Environmental Toxicology: With fish LC50 values of > 370 mg/L to 760 mg/L, (S)-methoprene is considered moderately toxic to fish. [Note: Acute fish toxicity would not be expected during control programmes as the concentration of methoprene in water at any one time is unlikely to exceed 0.002 mg/L.] (S)-methoprene has low toxicity to birds and is practically non-toxic to adult bees.

SECTION 13 DISPOSAL CONSIDERATIONS
Disposal: Dispose of waste in accordance with the requirements of Local or State Waste Management Authorities or according to Australian Standard 2507 - Storage & Handling of Pesticides. Wear protective clothing such as full body cover barrier suit, eg. a rubber rain suit. Keep out unprotected persons and animals.
Disposal of empty containers: Break, crush, puncture and bury empty containers in a local authority landfill. If not available bury the containers below 500 mm in a disposal pit specifically marked and set up for this purpose clear of waterways, vegetation and roots. Empty containers and product should not be burnt.

SECTION 14 TRANSPORT INFORMATION
Storage & Transport: This product is not classified as a Dangerous Good. Store and transport in the closed, original container in a well ventilated area, out of direct sunlight. Store in a room or place away from children, animals, food, feed stuffs, seeds and fertilisers.

SECTION 15 REGULATORY INFORMATION
Not classified as a hazardous substance according to criteria of NOHSC Australia. Under the Standard for Uniform Scheduling of Drugs and Poisons (SUSDP), this product is not a scheduled poison.
This product is registered under the Agricultural and Veterinary Chemicals Code Act 1994.
Product Registration No. 59598.
Product is not classified as a Dangerous Good according to the ADG Code (6th Ed).

SECTION 16 OTHER INFORMATION

Issue Date: 10 May 2006 (Typographical corrections).

Key to abbreviations and acronyms used in this MSDS:
ADG Code Australian Dangerous Goods Code (for the transport of dangerous goods by Road and Rail).
Carcinogen An agent which is responsible for the formation of a cancer.
Geno toxic Capable of causing damage to genetic material, such as DNA.
PPE Personal protective equipment.
Teratogen An agent capable of causing abnormalities in a developing foetus.
TWA The Time Weighted Average airborne concentration over an eight-hour working day, for a five day working week over an entire working life.

References

This MSDS summarises our best knowledge of the health and safety hazard information of the product and how to safely handle and use the product in the workplace. Each user should read this MSDS and consider the information in the context of how the product will be handled and used in the workplace including in conjunction with other products. If clarification or further information is needed to ensure that an appropriate risk assessment can be made, the user should contact this company.

End of MSDS.
APPENDIX E:

MOSQUITO BREEDING SITES
APPENDIX F:

SUMMARY OF QUANTITY CAUGHT IN ADULT TRAPS

The following table is a summary of the number of mosquitoes caught for each species. Each one of these mosquitoes is identified and counted by Bob Rankine, this vital service helps to keep track of mosquito levels in the community and identifies where cohorts may have been missed and how that can be prevented in the long run. This level over the years also provides insight into any patterns that may be emerging and breeding rates with particular weather situations. As previously mentioned Aedes camptorhynchus is our biggest species caught, the aim of the treatments would is to reduce these numbers down to a more manageable level.

Summary of Quantity Caught per Species

<table>
<thead>
<tr>
<th>Species</th>
<th>Quantity Caught 2007</th>
</tr>
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<tbody>
<tr>
<td>Aedes camptorhynchus</td>
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<tr>
<td>Culex globocoxitus</td>
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<tr>
<td>Culex australicus</td>
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<tr>
<td>Aedes notoscriptus</td>
<td>190</td>
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<tr>
<td>Aedes ratciffei</td>
<td>163</td>
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<tr>
<td>Aedes alboannulatus</td>
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<tr>
<td>Anopheles annulipes</td>
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<tr>
<td>Aedes clelandi</td>
<td>14</td>
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<tr>
<td>Aedes hesperontius</td>
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As demonstrated in the above table Capel Golf Course and Gun Club Road had the largest trap numbers. This is firstly believed to be due to the ideal environment that is created for the mosquitoes with a high amount of vegetation especially Peppermint trees and the presence of a ready blood meal in kangaroos, and humans. The mosquitoes appear to come from Wetlands 4 and 5 on Minninup Road (See appendix D). An additional trapping was conducted on Minninup Road and at the Silk Factory to determine where the main streams of mosquitoes were coming from. The trapping numbers showed that both wetlands do produce a large number of mosquitoes, confirmation on the total number trapped and species type are still to come. This has led to the recommendation that Cokelup Swamp be included in the monitoring and treating rounds for this season. There will be a particular focus on the edges of Cokelup Swamp after the first rains of the season.