

Shortland Waters Development Shortland, NSW For

Aveo Malvern East, VIC

Prepared by

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1.0 Introduction

In April 2015, Aveo commissioned Mosquito Consulting Services Pty Lty to undertake a baseline mosquito population survey and develop mosquito management recommendations for its proposed retirement village located within the Shortland Waters Golf Course lands at Shortland, NSW. Field work was conducted on site 15-17 April and immediately before the major weather event impacting heavily on the Hunter Region commencing about 20 April. The baseline mosquito population survey is to provide physical evidence of species abundance at the time of the survey. It is not intended to be an exhaustive population study over long-term observations. The baseline data is used to provide a general characterisation of the mosquito fauna under the sampling conditions at the time and along with observations of mosquito breeding habitat relevant to the site, provide a basis for interpretation of typical human exposure at the site.

The context of the proposed development informs the method of assessing likely mosquito risk. Plate 1 shows the development site (red circle) in context with existing major wetland reserves.



Plate 1: Shortland Waters Locality

The gazetted wetland reserves identified in Plate 1 all have documented histories of mosquito activity (Webb and Russell 2005). Mosquito abundance at any given time is largely governed by the availability of suitable conditions for breeding. Wet conditions with mild to warm weather generally causes higher production

than cool and/or dry conditions or very hot dry conditions. In addition to detailed data provided in Webb and Russell (2005), the NSW Government maintains state-wide mosquito surveillance to monitor for mosquito borne human disease. Within that program, traps are periodically deployed at locations including Empire Bay and Killcare Heights (as being the closest in proximity to the Shortland Waters site). The NSW mosquito trap collections are characterised for abundance using standardised descriptors from "Low" (0-50 mosquitoes per trap night) to "Extreme" (> 10,000 per trap).

Historically based on Webb and Russell (2005), the locality that includes the Shortland Waters site has been generally characterised as having mosquito abundance during summers meeting the criteria for "high" and sometimes becoming "extreme" under favourable mosquito breeding conditions.

The specific siting of residential units in proximity to adjoining wetland habitat is relevant when choosing mosquito surveillance locations. Plate 2 shows the current Shortland Waters Master Plan overlayed on existing aerial photography with the red oval showing the site of residential units.



Plate 2: Shortland Waters Master Plan

2.0 Mosquito Survey Methodology

The timing of this study was fortunately during a period of high mosquito activity with weather conditions considered near ideal for collecting adult mosquitoes. Table 1is BOM weather observations data for Newcastle for April 2015.

Newcastle, New South Wales														ernment							
Nost observations from Nobbys Head, but some Newcastle University.																					
	Temps Data F					0	Max wind gust 9am								3pm						
Date	Day	Min	Max	Rain	Evap	Sun	Dim	Spd	Time	Temp	RH	Cld	Dim	Spd	MSLP	Temp	RH	Cld	Dim	Spd	MSLP
		•C	•C	mm	mm	hours		km/h	local	•C	%	elghths		km/h	hPa	•C	%	eighths		km⁄h	hPa
1	We	17.6	26.1	9.4			ENE	37	14:18	19.5	97	7	N	4		23.6	75		ENE	26	
2	Th	18.6	27.7	0			SW	24	22:52	20.9	75	7	NNW	11		25.0	71	6	ENE	17	
3	Fr	20.7	21.8	0			S	57	02:11	21.0	80	8	S	35		21.2	78	8	S	24	
4	Sa	18.8	20.4	33.0			S	65	15:45	20.1	95	8	NE	9		18.8	96	-	SE	33	
5	Su	16.4	22.5	28.0			SSW	35	00:15	18.4	85		wsw	15		21.6	70	5	SSE	9	
	MO	10.0	28.1				SVV	59	10:22	21.7	12		NNVV	20		23.9	12	0	ENE	20	
	N/a	14.8	24.8	9.0			VVINVV	78	13:28	18.3	82	-	NINVV	- 4		21.8	48	0	VVINVV	30	
	vve Th	14.8	23.0	0				74	14-52	17.0	61			39		22.3	44 50	4	vv c	33	
10	5	18.2	21.2	0			6 W22	49	00:20	10.0	71	4	SW	18		20.0	09	5	0 0	24	
11	Sa	16.3	21.2	0			5517	24	13-23	10.0	70	8	NNW	6		20.0	75	8	99E	17	
12	04	14.2	21.7					42	18.20	10.0	01		NINY	20		20.4	73		COM	26	
12	Mo	18.1	24.7	0			U/22	35	12-25	10.8	74	4	W22	10		20.0		6	SSE	20	
14	Tu	13.4	217	Ŭ			0011		12.20	18.6	72	2	WNW	6		20.5	64	1	ESE	15	
15	We	14.5	24.1	0			w	39	22-44	19.0	75	1	NNW	13		22.0	78	1	ENE	17	
16	Th	18.2	31.5	o			SSW	46	23:38	21.9	70	1	N	17		30.7	39	5	NW	11	
17	Fr	20.7	23.3	0						22.1	83	5	SSW	11		22.1	85	7	s	13	
18	Sa	18.4	25.1	0			WNW	35	23:38	19.9	94	8	N	13		23.4	73	8	ENE	15	-
19	Su	17.8	24.0	3.8			S	65	23:41	19.6	85	6	WNW	20		19.7	81	7	S	41	
20	Mo	13.7	19.3	8.2			SSE	102	22:24	14.9	94	7	SW	20		18.6	83	8	S	26	
21	Tu	14.8	18.9	99.2			N	135	05:00	17.9	99			54		15.2	98				
22	We	13.6	19.6	65.2				48	00:15	17.1	94					17.1	93				
23	Th	14.4	20.9	16.8						17.7	88	6				20.6	79	6			
24	Fr	14.9	25.4	0.2			NW	39	13:33	17.4	87	7	NNW	17		25.3	50	3	NW	24	
25	Sa	16.3	25.4	0			w	56	18:36	20.1	64	4	NW	13		25.0	43	1	NW	19	
26	Su	12.2	18.0	11.4			W	48	13:57	13.9	76	8	WNW	31		17.9	63	7	WSW	28	
27	Mo	12.5	19.9	0			S	35	18:46	17.4	65	4	WNW	15		17.5	54	2	S	22	
28	Tu	13.5	18.8	0			S	44	12:57	16.9	61	1	SW	19		18.3	66	5	SSW	31	
29	We	13.6	18.8	7.2						16.9	81	6	SW	15		18.3	78	5	S	20	
30	Th	15.0	19.3	3.8			S	33	13:17	16.7	87		SSW	13		19.0	73	6	S	24	
Mean 10.8 22.7 1 18.6 80 5 17 21.1 70 5 23																					
	Lowest	12.2	18.0					40-		13.9	61	0	#	4		15.2	39	1	SSE	9	
	Highest	20.7	31.5	99.2			N	135		22.1	99	8		54		30.7	98	8	S	41	
L	rotal			295.2																	

Table 1: Weather Observations Relevant To Shortland Waters Mosquito Survey

In the two weeks prior to the mosquito survey, about 72mm of rainfall was recorded. Temperatures during April were mild, between mid-teens to mid-twenties. Wind observations prior and during the survey itself show no conditions likely to adversely affect mosquito flight activity. Mosquito collecting conditions were considered near ideal.

Adult mosquitoes were collected between early evening (about 16:00 hrs) to midmorning (approx. 07:00 hrs) the following day. Traps (Standfast type New Jersey design) for collecting adult mosquitoes were deployed at 4 sites within the golf course. Traps were equipped with high intensity green LED light sources and baited with carbon dioxide (as 1kg dry ice per trap per night) and the chemattractant (1-octen-3-ol). Mosquitoes captured by the traps were sequestered into 70% alcohol for preservation and transport to the laboratory for identification to species and counting. Subject to the apparent abundance of mosquitoes found in traps, collections were sub-sampled by increments of 1/1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, before identification. Plate 3 shows traps used for mosquito sampling at Shortland Waters.



Plate 3: Mosquito Trap and Collected Mosquitoes

The golf course was inspected for presence of habitats likely to contribute to mosquito production. Following approximately 72mm of rain approx. 10 days before sampling, any likely habitat should have been evident. Plate 4 shows the golf course survey GPS tracks and locations of adult mosquito trap positions.



Plate 4: Shortland Waters Golf Course Mosquito Survey Map 2015.

3.0 Results

Trapping at Shortland Waters in April collected 12 mosquito species from 7 genera. The table below shows mosquito abundance by trap location and mosquito species.

												-	
	Trap Night	15-16 Apri	il			Trap Night	16-17 Apri	I		Trap Night			
Species	Trap Site	SW1	SW2	SW3	SW4	Sp subtot	SW1	SW2	SW3	SW4	Sp subtot	Sp tot	Sp %
Aedes	multiplex	0	4	. 0	0	4	0	8	0	0	8	12	0.1
	notoscriptus	0	0	0	0	0	0	0	4	0	4	4	0.0
	procax	4	. 4	. 0	0	8	4	0	0	0	4	12	0.1
	vigilax	948	748	408	1044	3148	836	716	1036	616	3204	6352	51.7
Anopheles	annulipies	8	0	16	12	36	12	8	20	0	40	76	0.6
Coquillettidia	linealis	392	80	60	44	576	260	124	128	52	564	1140	9.3
	xanthogaster	8	0	4	0	12	8	0	8	0	16	28	0.2
Culex	annulirostris	628	496	544	196	1864	396	412	1484	160	2452	4316	35.1
	orbostiensis	4	. 8	8	0	20	4	12	4	16	36	56	0.5
Mansonia	uniformus	32	60	52	12	156	4	28	80	4	116	272	2.2
Mimomyia	elegans	4	. 0	4	0	8	0	0	0	0	0	8	0.1
Verrallina	funerea	0	4	. 0	0	4	0	0	0	0	0	4	0.0
	Site total	2028	1404	1096	1308	5836	1524	1308	2764	848	6444	12280	100.0
	Site %	34.7	24.1	18.8	22.4	100	23.6	20.3	42.9	13.2	100.0		

Shortland Waters Mosquito Trap Collection April 2015

Out of the 7 mosquito species collected, two species represented about 87% of the total collection. These were *Aedes vigilax* and *Culex annulirostris* at 51.7% and 35.1% respectively. Only two additional speces were present in abundance worthy of note. These were *Coquillettidia linealis* (9.3%) and *Mansonia uniformus* (2.2%). A total of 12,280 mosquitoes were collected over 8 trap nights producing a mean nightly collection of 1,535 mosquitoes per tarp. This order of abundance would be considered high enough to be of serious nuisance biting risk in almost any context involving residential occupation. It is further regarded that this level of abundance would be fairly typical at this location during the warmer months with average rainfall and temperatures.

Inspection of the golf course revealed several water features including ponds and a relatively large lake. All of the observed water features were mostly engineered with sharp edges producing a plunging shoreline. There was limited fringing and emergent vegetation present in the water bodies. As they stand, the existing water features within the golf course provide poor habitat for mosquito breeding. Some breeding of *Coquillettidia* and *Mansonia* species may be present within the course water features associated with reeds and lilies however it is considered that would be negligible compared with the opportunities for mosquito production in the adjacent wetland reserves.

The most abundant adult species, *Ae vigilax* is adapted to breed primarily in tidal salt-marsh habitat. A significant amount of saltmarsh exists within the Hexham Swamp and Koorangang Island Wetland Reserves. There was no evidence of *Ae vigilax* habitat within the golf course or immediately adjoining wetland.

Culex annulirostris breeds in relatively fresh water associated with flooded grassy pasture, stormwater flooded grass land and the grassy shallow margins of permanent freshwater ponds. There was little evidence of suitable habitat for this species within the golf course grounds. Significant rain prior to the site inspection had evidently drained from the golf course within the week to 10 days between heavy falls about the 4-5 April to the survey of 15-17 April. The surveys of the golf course provide a level of comfort that it is free of significant mosquito breeding.

4.0 Discussion

The adult mosquito trapping at the Shortland Waters Golf Course provides a snapshot of mosquito activity. The conditions at the time were very favourable for mosquitoes and this was reflected in high numbers captured in the four traps used. It is not unusual for a wide range of mosquito species to be identified within collections but for only one or three to represent the bulk of the numbers. The Shortland Waters collections were typical in that regard with *Ae vigilax* and *Cx annulirostris* dominating the collections (87%). To a lesser degree, *Cq linealis* (9.3%) is also an important species to take into account.

In addition to the high abundance of mosquito species known to cause serious biting nuisance to humans, the three most abundant species are also confirmed as highly effective vectors (arthropods capable of transmission of disease) of Ross River virus and/or Barmah Forest virus.

4.1 **Problem Definition**

The following factors contribute to defining the likely problem regarding mosquitoes at the Shortland Waters development site:

- Mosquitoes of both nuisance and medical importance are highly abundant during at least part of the year under normal seasonal conditions.
- Almost all of these mosquitoes are dispersing into the development site from outside the golf course land.
- Residents of aged care facilities are at higher risk of adverse impacts caused by nuisance biting mosquitoes. Secondary health impacts may also be more acute due to high skin sensitivity to irritating bites and also physiological distress to high biting insect abundance. (It is a common complaint that aged residents in biting insect prone locations find increased reluctance by family and friends to visit and consequently feelings of isolation are compounded.)
- There is no provision for controlling mosquitoes breeding in adjacent wetlands and there are no prospects for a natural or artificial reduction in mosquito populations entering the development site into the future.
- Seasonal variation in mosquito abundance results in almost no problem in winter but a very large problem in summer.

An uncontrolled situation that exposes future residents to existing seasonal mosquito populations will (without doubt) produce a highly unsatisfactory outcome for those residents. There will be subsequent commercial risks regarding the desirability of uptake or retention of residential tenancies.

5.0 Considerations of Appropriate Control Approaches

Integrated Mosquito Management (IMM) is a management approach that aims to achieve effective risk reduction by selected use of physical interventions to minimise exposure of residents to excessive mosquito biting. Physical control includes use of insecticides to control adult or immature mosquito stages. Information provided to residents on how mosquitoes affect their wellbeing and what measures are useful around the home also allows for risk minimisation.

The very high and high risk mosquito species identified at Shortland Waters are:

- Aedes vigilax
- Culex annulirostris and,
- Coquillettidia linealis.

A common attribute of these species is they breed in areas outside the boundary of the development site. Notwithstanding that the organisation cannot act outside of its land, at a technical level, control of mosquito breeding sites by use of larvicides is not a practical control option as breeding is too widely dispersed and/or too distant to effectively manage within reasonable cost or for the context of the relatively small development footprint. There is however good opportunity to utilise existing technology to minimise adult mosquito movement between source and the residential dwelling units proposed for Shortland Waters.

Traditional mosquito fogging (large scale aerosol application of insecticide) at Shortland Waters <u>is not recommended</u> as such treatments typically produce only short term (< 48hrs) respite from mosquito activity. Regular and frequent fogging would be required to maintain control. Fogging is generally only possible under specific weather conditions. It requires a low level temperature inversion to be present to trap the fog (insecticide aerosol cloud) within 2-4 meters of the ground with a breeze moving the cloud through the treatment area to kill mosquitoes actively flying. These stable conditions generally present only at early morning or early evening. Fogging operations produce high level noise due to the nature of the equipment. It is a significant impact on the residential amenity to deploy very noisy equipment in a residential area early morning/late afternoon. There are also issues of non-mosquito insects being killed by fogging over a relatively wide treatment area. More recent techniques have been developed using residual insecticide selectively applied to intervening landscape vegetation to produce a barrier around residential allotments and dispersing mosquitoes. Residual barrier treatments involve use of residual insecticides originally developed for horticulture/crop protection. The use of these specific products has been adapted to be applied in strategic locations around the perimeter of residential allotments to intercept dispersing mosquitoes (also biting midge & other biting insects). This technique has been in use for more than 12 years and has been widely adopted for managing biting insects in similar contexts to Shortland Waters. Plate 2 shows typical application of mosquito barrier treatments.

Plate 5: Application of mosquito barrier treatment to landscape vegetation adjacent accommodation and recreation facilities at Byron at Byron Resort, Byron Bay



Barrier treatments have a number of clear advantages over "fogging". These include:

- The control agent is based on a crop protection product that is specifically designed to provide extended control outdoors with exposure to high UV, rainfall and to breakdown safely.
- Applications typically remain effective for up to 6 weeks.
- Backpack blower (per horticulture treatments) is used to provide effective cover of barrier vegetation.
- Treatments are not dependent on early morning/late evening conditions and can be timed to be of minimum disruption to residential amenity.

- Narrow (typically 2-3 meter) strips of landscape vegetation are treated thereby minimising the amount of insecticide applied and limits impact on non-mosquito insects at large.
- Further non-mosquito impacts are minimised by avoiding treatment of vegetation in flower.
- Typical control efficacy is in the order of 80-90% reduction in passage of mosquitoes.

5.1 Specific Management Actions for Shortland Waters

The mosquito management plan for Shortland Waters is based on creation of residual insecticide barriers along strategically located landscape vegetation. Installation of landscape features will be designed to provide a medium for seasonal application of residual insecticide to minimise intrusion of mosquitoes into residential units, common outdoor areas and recreational spaces. Specific actions are as follow:

- A detailed landscape design that includes provision for features to be used as mosquito barriers should be produced as part of the overall landscape design for the development. This should be done in consultation with Mosquito Consulting Services Pty Ltd.
- Seasonal treatments will be to landscaping vegetation including shrubs and garden plantings in defined locations according to a detailed protocol to be developed for ongoing operation.
- No product will be allowed to enter waterways.
- Treatments will be applied with a back-pack type blower sprayer only.
- The blower sprayer will be operated at low speed to produce droplets > 200 μ and operated in a way that prevents drift occurring.
- Applications will not be made if rain is expected within 3 hours of application.
- The treatment requires drying time before it is rain-fast. Treatments should be repeated no less than 6 weeks apart.
- Great care will be taken to prevent any material entering stormwater systems or otherwise entering waterways.
- Treatments are required to be made by appropriately qualified and licensed Pest Management Operators.
- They will be responsible for making treatment reports and maintaining records of treatments.
- The product recommended for application for the mosquito barrier treatment is:
 - **Brigade T&O** Multi-Insecticide produced by FMC Australasia Pty Ltd (ex USA) and containing 100 g/L Bifenthrin (or equivalent).
- The product will be applied as a 0.1% A.I. aqueous formulation in accordance with the registered label direction for use.

There would appear to be an opportunity to engage the existing ground staff maintaining the golf course to also provide periodic barrier treatment services for the development. Existing staff are qualified and experienced at pesticide application and provision of barrier treatments could be integrated into other golf course pest management tasks.

5.2 Community Feedback

The community will be the best judge of the success of the mosquito treatments. Regular contact with the community group by the organisation will be useful in providing feedback on the effectiveness of treatments. Commencement and cessation of the treatment program will be dependent on seasonal factors affecting the abundance of mosquitoes. Formal monitoring of mosquitoes at the development site is recommended as community feedback indicates a need for treatment. This will provide objective information to report back on treatment efficacy.

5.3 Review

At the completion of the seasonal treatment program or as otherwise necessary, a review should be held with the facility operator and Community to consider any improvements/additions/deletions that may be indicated. From these reviews, valuable information may be documented that may have application on other facilities with similar mosquito issues.

Darryl McGinn Mosquito Consulting Services Pty Ltd