

**Mosquito Impact Assessment
EPIQ – Super Lot 5
Lennox Head, Ballina**

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Prepared by

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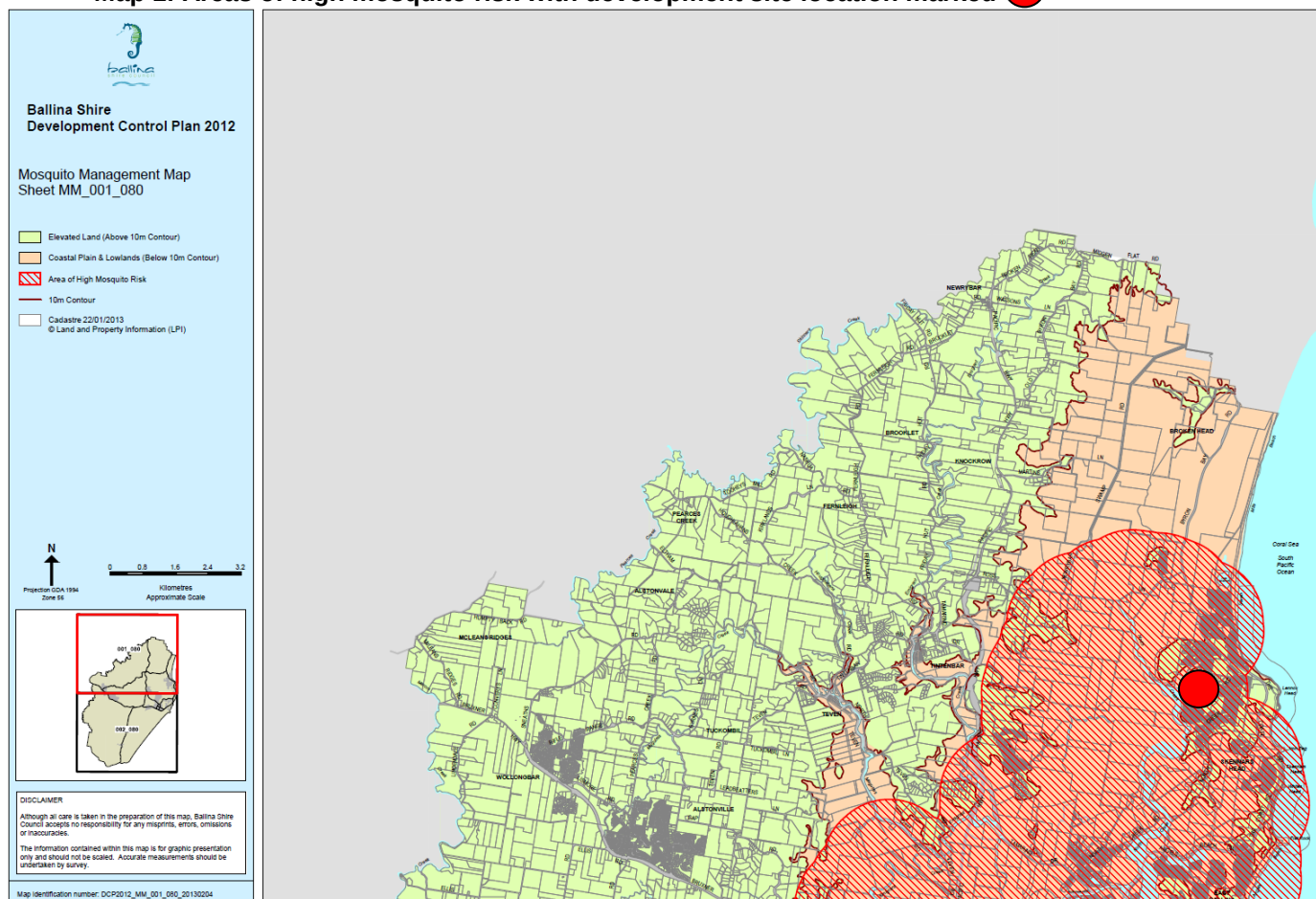
1.0 Introduction

In August 2018, Clarence Property engaged Mosquito Consulting Services Pty Ltd to prepare a mosquito impact assessment on its proposed development site known as EPIQ Lennox Head, Super-lot 5, Hutley Drive. Mosquito Consulting Services Pty Ltd has previously undertaken mosquito impact assessments and development of management plans associated with previous concept planning for Petrac Lennox Head Pty Ltd in 2011. This report relies on mosquito collection data gathered during the May 2011 assessment and on further works conducted on adjacent land (Henderson farm) in September 2003. No new mosquito collection analysis was undertaken as part of this 2018 impact assessment.

2.0 Regulatory context for the mosquito impact assessment.

Ballina Shire Council addresses the potential risk of mosquito related impacts of development through the Ballina Shire Development Control Plan 2012: Chapter 2: Part 3.6 – Mosquito Management. Through its DCP, the council seeks that the issue of mosquitoes appropriately considered at all relevant stages of the planning process including concept planning and development application. This impact assessment has considered the DCP in formulating the risk assessment and recommendations for mosquito management on this site. The development site is located within lands identified by the DCP as subject to high mosquito risk (Map 1).

Map 1: Areas of high mosquito risk with development site location marked ●



3.0 Mosquito Management Design Philosophy

The design philosophy relative to mosquito management is to demonstrate consistency with DCP for mosquito management and optimise the amenity of the development for residents and neighbours. Mosquito related risks will be characterised in terms of likely exposure people may experience within the development. Mosquito populations fluctuate in their seasonal abundance. When considering this, the report aims to characterise likely exposure of people within the development under normal seasonal conditions. From time to time, climatic conditions may increase mosquito abundance to unusually high levels. At such times increased exposure to mosquitoes may be experienced.

Controls for mosquito risk management are based in Integrated Pest Management. This uses several strategies together including physical layout of developments, stormwater management, and active mosquito control, to achieve control of risks. Maximum use of passive control and minimum use of active mosquito control has been adopted for risk minimisation within this report.

4.0 Investigation Methodology

4.1 Mosquito Adult Collections

Mosquitos were collected in May 2007 from the wider (old Pacific Pines) site using light traps set over 6 locations (Plate 2). The traps (Plate 1) were baited with CO₂ (as dry ice) and the mosquito chemo-attractant, Octenol. On a given night, 4 light traps were operated between 4 pm to 8 am on 4 occasions between 16 May and 29 May 2007. Adult mosquitoes were identified to species by microscopy by the author.

Plate 1: EPIQ Lennox Head (Pacific Pines 2007) Light Trap Sites 3, 4 and 5.



Plate 2: Location map and light trap survey points 2007 and 2003



5.0 Mosquito Collections (Pac Pines 2007 and Henderson Farm 2003)

5.1 Adult Mosquito Trapping

The mosquito species collected on each trapping night at each site location are presented in Table 3.

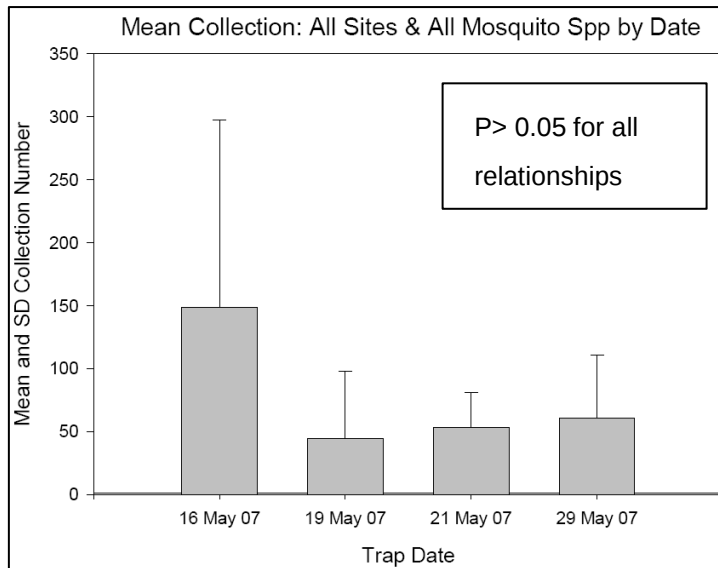
	16-17/05/07				19-20/06/07				21-22/05/07				28-29/05/07								
Species / Trap Site	No 1	No 2	No 3	Spp	No 1	No 2	No 3	No 4	Spp	No 1	No 2	No 3	No 4	Spp	No 3	No 4	No 5	No 6	Spp	TSpp	%
<i>Ae ghanacola</i>				0				T	0				1	1	2	2		1	5	6	0.6
<i>Ae multiplex</i>	10	8	28	46	1		14	R	15	7	8	18	26	59	4	8	12	18	42	162	15.7
<i>Ae notoscriptus</i>			14	14			5	A	5			1	6	7		9			9	35	3.4
<i>Ae procax</i>	1		27	28			8	P	8	1	1	4	3	9	1	1			2	47	4.6
<i>Ae vigilax</i>	10	5	136	151	13	2	44		59	23	2	31	7	63	3	2	1	8	14	287	27.8
<i>An annulipies</i>			2	2				F	0					0		1		1	2	4	0.4
<i>Cq linealis</i>			3	3			1	A	1		1	2		3					0	7	0.7
<i>Cq xanthogaster</i>				0				I	0		1			1	1				1	2	0.2
<i>Cx annulirostris</i>	5	3	23	31	1	2	8	L	11			3	3	6	7	5	1	8	21	69	6.7
<i>Cx australicus</i>		1		1				U	0	1				1					0	2	0.2
<i>Cx edwardsi</i>		17	24	41	2		22	R	24	5	3	22	15	45	5	1			6	116	11.2
<i>Cx orbstiensis</i>			6	6				E	0					0			6	6	12	18	1.7
<i>Cx sitiens</i>	6	3	26	35			3		3	1	4	4	2	11	3	3	3	34	43	92	8.9
<i>Mi elegans</i>				0					0			1		1					0	1	0.1
<i>Ve funerea</i>	41	15	31	87	4	2			6	5				5			27	58	85	183	17.7
<i>Ve sp Marks 122</i>	1			1					0					0					0	1	0.1
Trap Total	74	52	320	446	21	6	105	0	132	43	20	86	63	212	26	32	50	134	242	1032	100.0

In 14 trap-nights of collecting from EPIQ Lennox Head, a total of 1,032 mosquitoes from 6 genera and 16 species were collected across 6 locations in CO₂ and Octenol baited light traps. The four most abundant adult mosquitoes (accounting for 72.4% of the total) collected over the 14 trap-nights (by percentage and average per trap respectively) were *Aedes vigilax* (27.8% @ 21/trap), *Verrallina funerea* (17.7% @ 13/trap), *Aedes multiplex* (15.7% @ 12/trap) and *Culex edwardsi* (11.2% @ 8/trap).

A mosquito impact assessment undertaken on the adjacent site in September 2003 used three sites generally relevant to the EPIQ Lennox Head project in the context of also being on the interface with the Ballina Nature Reserve (see Plate 1 showing these trap locations in red). Data from each of these sites over 4 nights in September 2003 (using identical traps) showed they collected 400, 785 and 225 mosquitoes of all species respectively. The 4 most prevalent species from these traps were *Aedes multiplex* (49%), *Culex annulirostris* (19%), *Anopheles annulipies* (13%) and *Culex sitiens* (8.5%). The high-risk mosquito *Aedes vigilax* represented only 1% of mosquitoes from these three traps.

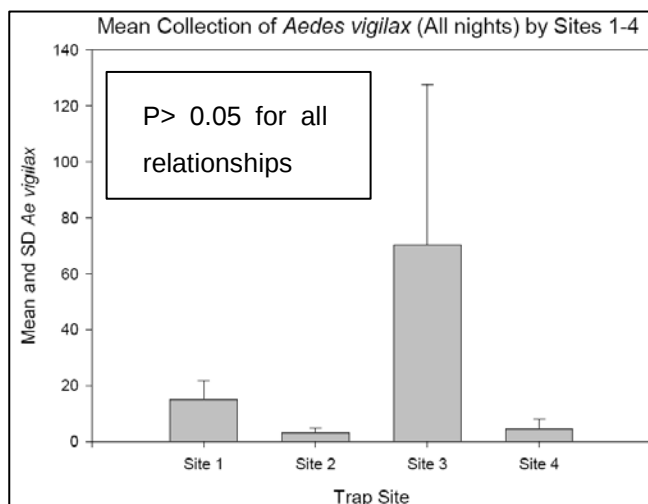
Statistical analysis of the 2007 Pacific Pines collections was undertaken to assess the consistency of data across the study. Graph 1 is the mean collections of all mosquito species for each trap date. Analysis by t-test produced P values greater than 0.05 for collections across all dates and shows there is no statistical difference in mosquito abundance between any of the collecting nights. This suggests there were no important weather differences acting to significantly suppress or amplify mosquito activity over the study period. This is consistent with the recorded similar temperature and relative humidity records for the collecting nights.

Graph 1:



Aedes vigilax is considered one of the high-risk mosquito species along coastal Australia for both biting attack and disease transmission. This species was most highly represented in the study collections. This species however has a very wide distribution and its ability to disperse over many kilometres from its salt-marsh breeding habitat makes it a regional problem. The intensity of *Aedes vigilax* biting attack reduces somewhat as a function of distance from breeding habitat until a general background level of activity across a wider region is experienced. Analysis of *Aedes vigilax* collections across 4 sites on Pacific Pines was undertaken to assess if it was present in reducing intensity with increased distance from the Ballina Nature Reserve (a potential local source of breeding and harbourage) or if it was present more as generally uniform background activity. Graph 2 is the mean *Aedes vigilax* collections by trap location. Analysis by t-test showed there was no significant difference ($P > 0.05$) in its abundance across the 4 sites from which it is concluded to be representative of a more general background level of activity.

Graph 2:



5.2 Mosquito Larvae Collections (information from 2007)

On-site mosquito habitat was sampled for presence of breeding. Drains, remnant wetlands, the existing water course adjacent to proposed playing fields and the Ballina Nature Reserve boundary interface were inspected and sampled. Sampling showed that *Culex annulirostris* was breeding in grassy ground pools including the margins of portions of drains (Plate 3.)

Plate 3. Grassy margins to farm drains with *Cx annulirostris*



Remnant wetlands located around trap site 2 (Plate 2) provides potential habitat for a wide range of mosquitoes. Species from several genera including *Culex*, *Verrallina*, *Aedes*, and *Coquillettidia* were represented in trap 2. While trap 2 did not produce very large numbers of mosquitoes the potential of this habitat to produce pest numbers when flooded is regarded as high.

The DCP identifies a known breeding site south west of the development. This site was investigated and found to have greatest potential for production of *Verrallina funerea* (Plate 4). Relatively high numbers of *Aedes multiplex* trapped at the development site and previously on land adjoining the Ballina Nature Reserve suggest this designated site may also produce this species. There is a known association between these two species (Lee, 1984). The designated habitat does not appear suitable for significant production of *Aedes vigilax*. This conclusion is also supported by light trap from the development site and studies on adjoining land.

Plate 4. Brackish habitat suitable for *Verrallina funerea*



No *Verrallina funerea* breeding was found in this habitat during the study however the largest abundance adults of this species were collected in trap site 6 located at this site. This site is considered highly likely to produce *Verrallina funerea* from time to time. The habitat transitions into a small area of salt marsh. This area was considered for potential to produce *Aedes vigilax* but was assessed as very low-grade habitat. Recent flooding from spring tides around 17 May 07 had flooded the site. No breeding of *Aedes vigilax* was detected. The relatively low numbers of this species recovered in traps 5 and 6 supports the conclusion that this habitat is of low productivity for *Aedes vigilax*.

A watercourse east of the proposed playing fields (Plate 5) was, in 2007) ideal habitat for *Culex annulirostris*. Relatively shallow water provides opportunity for emergent grass and reeds to provide excellent breeding opportunity also for *Mansoina* and *Coquillettidia* species.

Plate 5. The Hutley Drive watercourse (2007) provided excellent habitat for *Culex annulirostris*



5.3 Update of Mosquito Breeding Habitat 2018

In mid-2018, Mosquito Consulting Services Pty Ltd undertook a review of EPIQ Release 2 to certify compliance with mosquito management conditions of consent. A substantial portion of the overall site was found to be in various phases of construction. Three important infrastructure components, the playing fields, watercourse and stormwater detention ponds had been substantially completed and were considered compliant with the recommendations of the 2007 Mosquito Impact Assessment (Plate 6). Remanent farm drains and ground pool habitat identified in 2007 remained intact in some portions of the overall site not yet subject to re-engineering. These ground water habitats will continue to be a source of mosquito breeding until they no longer exist in their present form.

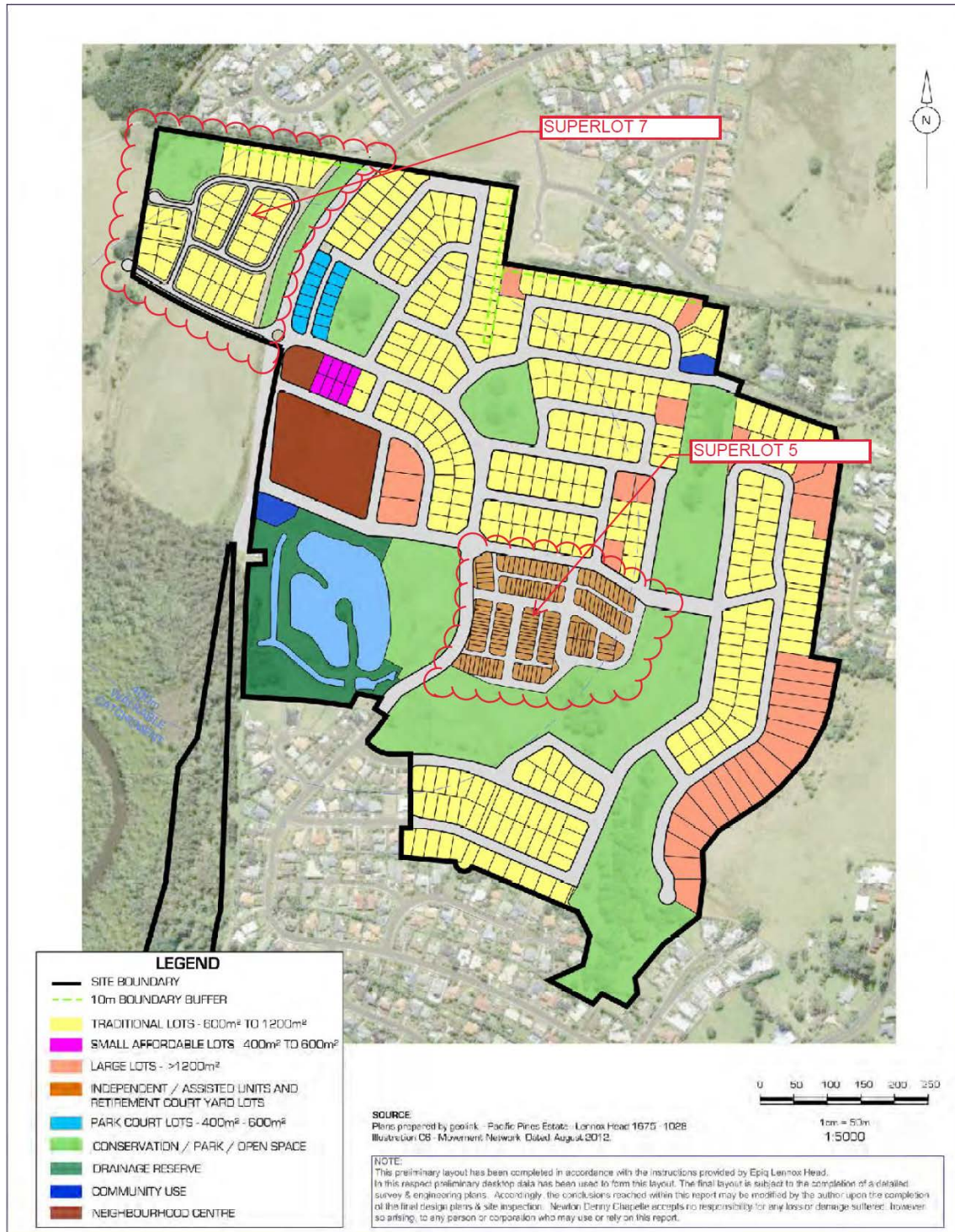
Plate 6: Re-engineered watercourse, Playing fields and Stormwater Detention Ponds



Plate 7: Proposed Urban Design Super-lot 5



Plate 8: EPIQ Lennox Head Super-lots 5 and 7



The proposed Development Master Plan (Plate 8) has several features relevant to considering potential mosquito impacts to future residents. These features include:

- A 200m minimum (approx.) separation between the nearest residential allotments (Independent/Assisted Units and Retirement Court Yard Lots) and the Ballina Nature Reserve and DCP designated mosquito breeding sites (see Plate 1).
- Mosquito habitat around trap 2 and existing farm drains identified as potential risk will be eliminated by the development.
- The extension of Hutley Drive alignment between the Nature Reserve and Water Quality Improvement Pond increases mosquito buffering.
- A large clear space buffer will be created between residential allotments and the Nature Reserve by playing fields and the existing Water Quality Improvement Pond.
- Re-engineering of the water course per the existing DA: 2004/1113 has reduced mosquito breeding risk.

Plate 9 shows the re-engineered watercourse.

Plate 9. Typical view of re-engineered watercourse as constructed



Much of the normal flow within the watercourse has now been directed into a relatively narrow channel opening onto wider ponds. The watercourse contains relatively little emergent vegetation and edge vegetation is restricted to a narrow band. Much of the flow is restricted to a sharp-edged narrow channel.

6.0 Results Discussion

Weather data recorded over the duration of the study shows that conditions were suitable for collecting adult mosquitoes with evening temperatures generally ranging in the teens and with high relative humidity. Of the known high-risk mosquitoes likely to occur within Ballina Shire, only *Aedes vigilax* and *Verrallina funerea* were collected in significant numbers. Two species also in relative abundance were *Aedes multiplex* and *Culex edwardsi* but are considered of negligible risk.

High-risk species that were not well represented in light trap collections but for which breeding habitat was identified on-site include *Culex annulirostris* and *Aedes procax*. Habitat for *Verrallina funerea* was identified on the site boundary with the Ballina Nature Reserve adjacent to the Water Quality Improvement Pond (Plate 4). No significant salt marsh habitat likely to produce *Aedes vigilax* was found in breeding sites designated by Ballina Shire Council's DCP and adjacent to the development site. Light trap collections from the Pacific Pines site and adjacent Henderson Land (from study in 2003) shows a relatively low and more or less even distribution of *Aedes vigilax* that suggests the site is subject to typical background exposure to this very widely dispersing species from typical salt-marsh breeding sites located lower in the lower reaches of the Richmond River and North Creek.

Much of the grassy ground pool habitat identified on the site for the high-risk species, *Culex annulirostris* and *Aedes procax* will be eliminated by earth works associated with the development. However, habitat identified for *Verrallina funerea* adjacent to the Nature Reserve boundary will remain into the future and be preserved. Due to its presence as adults in relatively high numbers – particularly immediately adjacent to suitable breeding habitat on the Nature Reserve boundary, *Verrallina funerea* is considered likely to continue to be produced in relatively high abundance into the future. The existing watercourse adjacent to the playing fields is a source of *Culex annulirostris*. These two species are included in the assessment of future risk that will be managed by passive urban design.

7.0 Mosquito Risk Assessment

Mosquito risks for this development were assessed using the Australian and NZ standard for risk management 31000: 2009. It gives a framework to consider risk in a disciplined approach that can be repeated in the future to evaluate changes in risk and measure outcomes. The risk management framework follows the basic steps:

- **Identify the Hazard** (Mosquito borne disease, nuisance biting, public complaints)
- **In what Context** (The site's exposure to potential mosquito breeding, the design of the development including stormwater management systems)

- **Identify the Risks** (as a product of hazard and the likelihood of exposure)
- **Prioritise Risks** (What risks are important,)
- **Control the Important Risks**
- **Evaluate control effectiveness.**

7.1 Hazard Identification & Characterisation.

The identifiable hazards to the future residents of the development and the community at large include:

- Mosquito-borne disease including Ross River virus, Barmah Forest virus.
- Loss of amenity from mosquito biting activity.
- Potential future complaints to Ballina Shire Council.
- Sub-optimal economic return on property sales.

7.2 The Context of the Site Relative to the Hazards

The context of the site relative to mosquito hazards includes:

- The abundance of one important mosquito species, *Verrallina funerea* was moderate during the study but likely to become occasionally high due to good quality breeding habitat identified on the adjacent Ballina Nature Reserve boundary.
- The important species, *Aedes vigilax* was present in moderate abundance. Due to the uniform distribution across the site, it is characterised as being like the general seasonal background abundance for this species across the region.
- The abundance of other important mosquito species during the study was relatively low with *Aedes procax*, and *Culex annulirostris* present but not in significant numbers.
- Each of the above species is regarded as a public health risk as vectors of mosquito borne disease including Ross River virus.
- Development will eliminate most of the remaining mosquito breeding habitat identified on-site.
- Placement of playing fields, the Water Quality Improvement Pond, roadways and other open space provides a minimum 300m clear buffer between the Ballina Nature Reserve and identified *Verrallina funerea* breeding habitat and the nearest residential allotment within Super-lot 5.
- *Verrallina funerea* dispersal is significantly attenuated by open space between breeding and harbourage habitat and sensitive receiving environment (residential allotments). Clear separations greater than 25 meters have been shown to significantly attenuate passage of this species.
- The completed watercourse has been constructed with a series of deep steep sided ponds connected with narrow low-flow channel

consistent with the original concept drawings subject to review in 2007.

7.3 Risk Assessment

The EPIQ Lennox Head Super-lot 5 development site presents a moderate risk of exposure to several the important mosquito species. *Verrallina funerea* is considered the greater risk due to presence of suitable breeding habitat near to the development. Potential habitat for *Culex annulirostris* and *Aedes procax* present moderate exposure to risk also. Background abundance of *Aedes vigilax* presents a moderate risk also.

The proposed urban design of the development significantly reduces the identified risks associated with *Verrallina funerea*, *Culex annulirostris* and *Aedes procax* either due to physical separation of minimum 300m of clear open space between identified breeding habitat for the former species and residential allotments and/or elimination of breeding sites (of the former two species) within the development through urban engineering works.

The risk posed by the salt-marsh breeding *Aedes vigilax* is general and relatively common as with much of the coastal plain within Ballina Shire. Because of the long dispersal range (several kilometres) of this species, buffering of any practical dimension is of limited effectiveness. Minimisation of exposure to *Aedes vigilax* is desirable however due to its biting nuisance and disease vector status. Controls including minimising the mosquito attractiveness of street lighting, fitting insect screening to external windows and doors of dwellings and awareness of mosquito avoidance practices by residence will do much to manage this risk specifically and against all mosquitoes generally.

Mosquito production and hence the relative risk of exposure is sensitive to seasonal weather patterns. Prolonged wet weather in the warmer months can increase mosquito activity to extreme levels for periods extending from days to weeks. During such events, increased reliance on personal protection from biting mosquitoes will be necessary across the public in the Ballina Shire region including residents of EPIQ Lennox Head.

7.4 Risk Management Recommendations

- Exposure to *Verrallina funerea*, *Culex annulirostris* and *Aedes procax* will be effectively managed by development of the remaining site eliminating ground pool breeding sites or interposing clear open space between breeding sites and residential allotments.
- Exposure to *Aedes vigilax* and mosquitoes in general will be effectively managed in residential allotments by standard type mosquito screening

fitted to residential dwelling windows and external doors to restrict entry of mosquitoes during occasional periods of high mosquito numbers.

- Mosquito awareness materials should be made available to residents of EPIQ Lennox Head – as recommended generally within the Ballina coastal region.
- Rainwater tanks included (potentially) within the development should be protected by having mosquito proof screens fitted to openings including inspection openings and overflows. Such screens should be made of durable material such as stainless steel. The mesh size should not provide an aperture of more than 1mm.

8.0 Conclusions

The development of EPIQ Lennox Head Super-lot 5 provides a continuation of the opportunity to eliminate a portion of the existing fresh water mosquito breeding from this land. Management of the remaining mosquito risks to the proposed development is through its design to provide open space buffers clear of any significant vegetation (apart from mown grass) using playing fields, roadways and the Water Quality Improvement Pond and other open space between residential allotments and site boundary. Conventional use of screening on housing within the development should be a given and should be required by Council at the building application stage.

From time to time, Ballina in general experiences high numbers of mosquitoes – in particular, *Aedes vigilax* and *Culex annulirostris*. This site may also experience similarly high numbers of these mosquitoes on occasions. However, the evidence of mosquito collections and its location indicates the development site currently has moderate exposure reducing to relatively low exposure in its developed form. The author considers that within the limitations and savings of this report, and by following its recommendations the potential mosquito risk will be adequately managed to meet the intent of Ballina Shire Development Control Plan 2012: Chapter 2: Part 3.6 – Mosquito Management.



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