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Mosquito Habitat Report

Muirhead, Northern Territory

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Report prepared for the Aurecon Australia Pty Ltd.

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Executive summary

A survey was undertaken of potential mosquito habitat within a 1.6 km radius around the proposed Muirhead development area. Particular attention was paid to freshwater bodies to the north of the development area, the "investigation area".

Other areas within Casuarina Coastal Reserve, Buffalo Creek and the Leanyer Sewage Ponds were also re-examined. The following key results were found:

- In general, an increased probability of midge or mosquito breeding is evident through the investigation area, and will require improved monitoring and ongoing maintenance. Most water bodies pose a low level of risk.
- Three waterbodies, #8, #12 and #13 pose a low-medium level of risk and may require in-filling.
- The mosquito risk associated with Casuarina Coastal Reserve, Buffalo Creek and the Leanyer Sewage Ponds was found to be medium subject to seasonal inundation from monsoon rains or high tides. Appropriate management of these areas to reduce mosquito risk has already been identified.

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1. Introduction

Defence Housing Australia (DHA) is proposing to develop a 1,211 dwelling residential subdivision on a 167.6 ha land parcel in the northern suburbs of Darwin (the Project Area). DHA proposes to develop the Project Area referred to as the Muirhead residential subdivision for the purpose of a master planned residential community.

The approval for the first stage of the Muirhead Residential Subdivision was granted under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) on 30 March 2011 and includes a range of conditions that Defence Housing Australia (DHA) must satisfy before further development can commence.

Due to the proposed development site and adjacent areas containing potential mosquito breeding sites, and the close proximity of mangrove areas, which are potentially large sources of pest biting midges and some species of mosquito, **ecobiological** was commission by Aurecon Australia Pty Ltd on behalf of Defence Housing Australia to conduct a detailed inspection of possible breeding sites in part of a Biting Insects Management Plan for the proposed development. The aim of this study is to further map possible mosquito breeding habitat in more detail in areas that have not been previously surveyed and to confirm the suitability of habitat in areas of estuary and coastal habitat previously surveyed.

The inspection is to include:

- Ground inspections in adjacent areas to the proposed development site to locate existing actual and potential mosquito breeding sites;
- Geographical referencing of potential breeding habitat;
- Chironomid midge and mosquito risk assessment of water bodies; and
- Verification of the suitability of

The Buffalo Creek Management Area to the far east of the Project Area has previously been identified as breeding habitat and a source of biting insects. As such, certain recommendations have already been made in regards to the area in a Biting Insect Assessment that was conducted by Medical Entomology (ME) unit of the NT Department of Health and Families in February 2008. The numerous mosquito breeding sites in Casuarina Coastal Reserve have also been targeted for rectification in conjunction with the Parks and Wildlife Commission of the NT. Recommendations has been made in references to the habitats. The proximity of

the Project Area to Buffalo Creek indicates that pest biting midges are likely to affect areas of the Project Area within 1.5 km of the mangrove margin.

The northern suburbs of Darwin are seasonally affected by the Northern salt marsh mosquito (*Aedes vigilax*), particularly the edges of the suburbs bordering the Leanyer and Holmes Jungle Swamps. The greatest number of *A. vigilax* was reported to occur in November. The Project Area is located in close proximity to the Leanyer Swamp, which includes Buffalo Creek and associated mangrove and wetland areas. The Project Area is likely to experience seasonally high numbers of mosquitoes, in particular the Northern salt marsh mosquito, which is a known arbovirus vector (Ross River virus and Barmah Forest virus) and vector of dog heartworm.

Likely mosquito species present in the study area and their habitats are described below:

Table 1: Mosquito species and preferred habitats

Species	Habitat
Aedes vigilax (northern salt marsh mosquito)	• Typical breeding sites include salt marshes, brackish water reed swamps, coastal interdune depressions, poorly draining upper tidal mangrove areas, tidally affected stormwater drains and disturbed upper tidal areas (Whelan 1997a). • Breeding sites include depressions on reclaimed and disturbed land, sediment ponds and shallow mud ponds, stormwater drains subject to tide influence, and upper tidal depressions. • Most abundant from September to January (Whelan 1997a). • Has a very long flight range, capable of flying up to 200km, although highest numbers are usually encountered within 5 km of breeding sites (Whelan 1997a). • An aggressive biter and will bite during the daytime in shaded areas as well as at night, and is usually the cause of most of the mosquito pest problems in Urban Darwin and Palmerston.
Culex annulirostris (common banded mosquito)	• Potential breeding areas include all shallow ponding areas with grass and/or semi-aquatic reeds, drains with semi-aquatic vegetation, and mud ponds and sediment ponds with semi-aquatic vegetation. • Most abundant from January to August (Whelan 1997), in which there is usually two peaks in abundance, a short early/mid wet season peak and an extended late wet-mid dry season peak, depending on the characteristics of nearby breeding sites. • Can disperse up to 10km from extensive breeding sites, although are most common within 4km of breeding sites (Whelan 1997a), and there is usually a significant drop in numbers 2 km away from significant breeding sites (Whelan 2004a). • Only bites after sundown at night, and is less aggressive than *Ae. vigilax*.

Aedes notoscriptus (receptacle breeding mosquito)	• Breeds in natural tree holes in undeveloped areas, and in almost any artificial receptacle in urbanised areas. • Levels in natural areas are usually low, with urban areas providing the greatest abundance of breeding sites. • This mosquito has a limited flight range and does not fly far from their breeding sites. • As a receptacle breeding mosquito, this mosquito generally has a wet season abundance. • Pest problems, when they occur, would be mainly in the evening.
Other mosquitoes (*Anopheles* mosquito, *Verrallina funerea, Culex sitiens*)	• *Anopheles* mosquitoes include some species that are potential malaria vectors. Their favoured natural habitat includes large reed swamps. Breeding sites will include depressions and sediment ponds colonised by semi-aquatic reeds. • *Ve. funerea* would mainly be found breeding in brackish water paperbark depressions, tidally affected stormwater drains and any upper tidal mangrove depressions around East Arm. • *Cx. sitiens* is a saline water breeding mosquito, and may breed in Mud ponds, sediment ponds adjacent to tidal areas, upper tidal depressions, and tidally affected drains. • *Ve. funerea* and *Cx. sitiens* generally do not fly far from their breeding sites, but can be appreciable pest mosquitoes near to their respective brackish and saline water breeding sites.

Source: Warchot and Whelan, 2011

The numerous potential mosquito breeding sites identified within the Casuarina Coastal Reserve (the Reserve) are the upper tidal reaches of Sandy Creek and numerous large interdune depressions scattered along the coast from Dripstone Cliffs to the mouth of Buffalo Creek; the Lee Point area contains the majority of these interdune breeding sites. Other potential breeding areas are found in depressions located around the Leanyer Sewage Ponds (Appendix P, Aureon 2010). These areas are targeted for rectification in conjunction with the PMW and the Parks and Wildlife Commission of the NT. This would generally involve the importation of sand from the lower beach to the mosquito breeding depressions, levelling and re-contouring, and revegetation of some areas. These are predominately prone to temporary inundation, though if this occurs during the mosquito breeding season, offer potential risks to residential areas.

1.1. Location

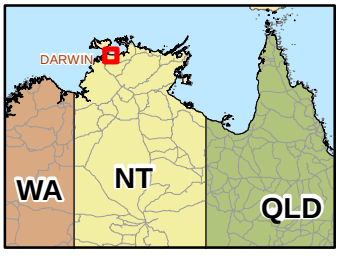
The Project Area, 434 Lee Point Road, Muirhead, is legally described as Lot 9737, Town of Nightcliff and is Commonwealth-owned land. The Project Area is located in the northern suburbs of Darwin near Lee Point, approximately 18 km north-east of the Darwin central business district (Figure 1). The area is largely surrounded by bushland consisting of mangroves, monsoon rainforest, paperbark and eucalyptus forests. Figure 2 defines the areas previously

identified as biting insect breeding habitat in the vicinity of the development area.

The targets for the additional surveys were the freshwater bodies located to the north of the Muirhead development area.

Figure 1 Locality

Study site



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Project Ref:	360-873
Plot Date:	14/09/2011 08:49
Revision:	001 (Glenn)

Map Projection:
GDA 94

Data Sources:
LPMA - 2011
OpenStreetMap - 2011
NearMap - 2011
BingMaps - 2011
ecobiological - 2011

Disclaimer:This is not an official or a legal map but is for informational use only. All data was compiled from the best sources available. All boundaries, scale and geographic points are approximate.

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Figure 2 Previously Surveyed Area

Legend

- Previously Surveyed Area
- Development Area

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Project Ref:	360-873
Plot Date:	26/09/2011 11:35
Revision:	001 (Glenn)

Map Projection:
GDA 94

Data Sources:
NRETAS - 2011
NearMap - 2011
BingMaps - 2011
ecobiological - 2011

Disclaimer:This is not an official or a legal map but is for informational use only. All data was compiled from the best sources available. All boundaries, scale and geographic points are approximate.

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2. Methods

2.1. Examination of freshwater bodies

Information from previous larval mosquito investigations at Muirhead was obtained from the Muirhead Biting Insect Assessment. This information highlighted previous actual and potential breeding sites located nearby the development area. Aerial photos were examined to determine the likely sources of pest bite midges and mosquitoes within 1.6km of the developmental area before ground inspections were conducted. Water bodies identified on topographical maps were noted for further examination. Ground inspections were conducted on the 18 August 2011 in areas adjacent to the Project Area that are not known as sources of biting insects and breeding grounds for mosquitoes. Potential breeding sites were characterised by the presence of water ponding, or by the presence of depressions the ground surface (ephemeral water bodies). Potential breeding sites were photographed and co-ordinates taken using a hand held GPS. A Chironomid midge and mosquito risk assessment for constructed water bodies was undertaken for each potential breeding area identified in the ground survey.

2.2. Examination of brackish water bodies

Potential breeding sites (mainly depressions) located around Casuarina Coastal Reserve and the Leanyer Sewage Ponds were surveyed. Between the 19th and 22nd August 2011 by means of vehicular and foot access.

3. Results

3.1. Freshwater bodies

A total of 13 water bodies were located during the desktop and ground surveys (Figure 3). Through the use of topographical maps 12 water bodies were identified to the north-east of the developmental area. Ground inspections confirmed that these water bodies were still present and contained freshwater. It is suspected that 11 of the water bodies were constructed for a golf course that is in progress of being developed. A disused concrete settling pond was also found to contain water within the boundaries of the golf course. A large dam was identified outside the area of the developing golf course and its purpose is unknown. One additional ephemeral pond in a Paperbark stand was identified in close proximity to the development area and is expected to temporarily fill after rainfall and may pose a risk. Table 1 details the results of the risk assessment conducted for each water body. Design elements which may contribute to the number of nuisance midge and mosquitoes have been selected and assigned various risk ratings. Most water bodies scored 'Low Risk' due to lack of steep walls, but had little aquatic vegetation and some deep waterbodies were in the lower range of this bracket. Large numbers of mosquitoes were observed at the dam (site 13) during the nights of 18 and 19 August and is deemed to have a higher risk (Table 1).

3.2. Brackish water bodies

Potential breeding sites (mainly depressions) located around Casuarina Coastal Reserve and the Leanyer Sewage Ponds were found to pose a medium risk to residential areas subject to seasonal inundation (mainly through the wet season and high and king tides).

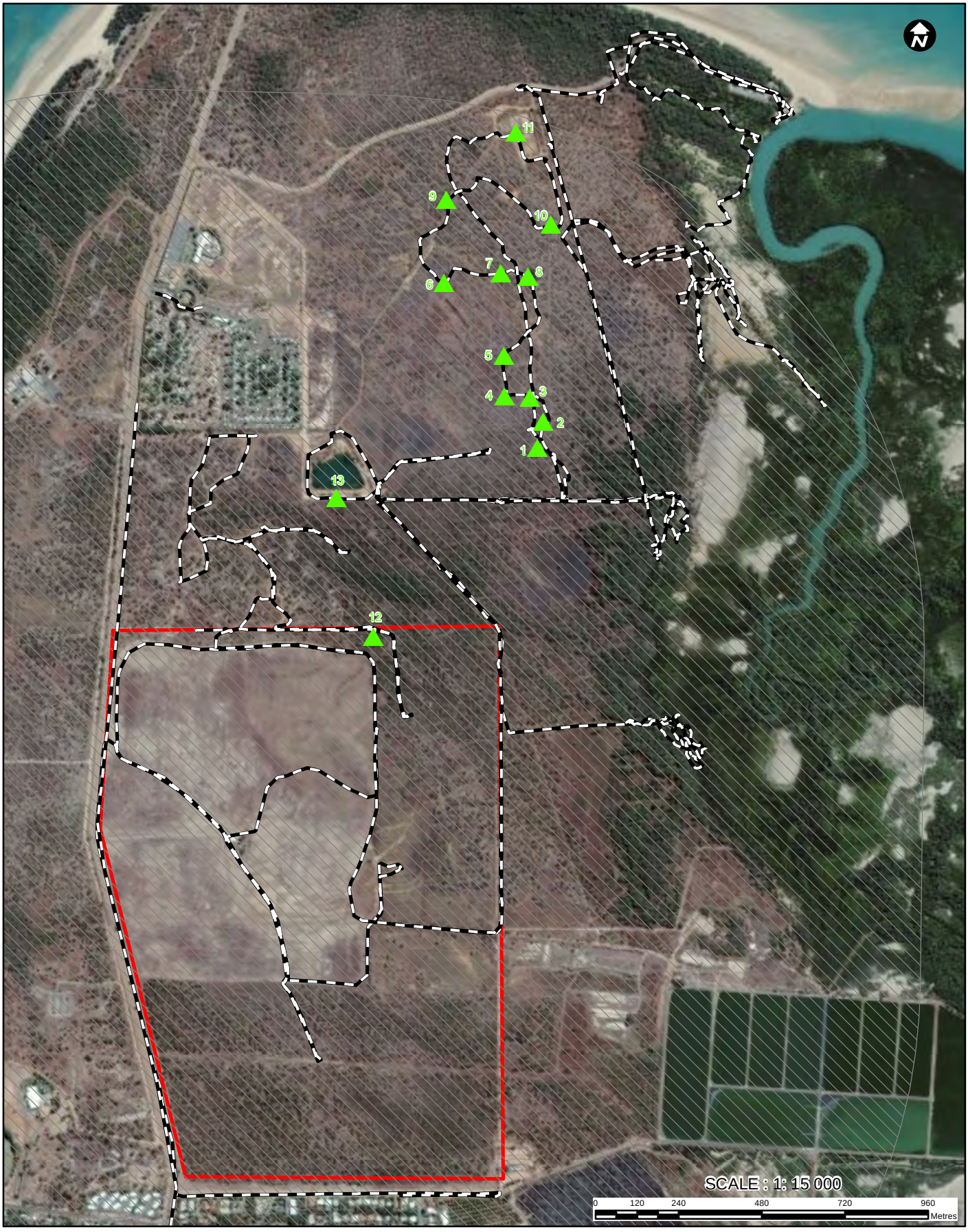

Figure 3 Possible Mosquito Habitat

Legend

- Development Area
- Possible Mosquito Habitat
- Meandering track
- Development Area 1.6km buffer

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Project Ref:	360-873
Plot Date:	15/02/2012 12:41
Revision:	001 (glenn)

Map Projection:
GDA 94

Data Sources:
OpenStreetMap - 2011
NearMap - 2011
BingMaps - 2011
ecobiological - 2011

Disclaimer:This is not an official or a legal map but is for informational use only. All data was compiled from the best sources available. All boundaries, scale and geographic points are approximate.

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Plate 1: Possible Mosquito Habitat 1

Plate 2: Possible Mosquito Habitat 2

Plate 3: Possible Mosquito Habitat 3

Plate 4: Possible Mosquito Habitat 4

Plate 5: Possible Mosquito Habitat 5

Plate 6: Possible Mosquito Habitat 6

Plate 7: Possible Mosquito Habitat 7

Plate 8: Possible Mosquito Habitat 8

Plate 9: Possible Mosquito Habitat 9

Plate 10: Possible Mosquito Habitat 10

Plate 11: Possible Mosquito Habitat 11a

Plate 12: Possible Mosquito Habitat 11b

Plate 13: Possible Mosquito Habitat 12

Plate 14: Possible Mosquito Habitat 13

Table 1: Chironomid midge and mosquito risk assessment for freshwater water bodies (darker cells are indicative of higher risk)

Site	Hydrology	Location to Residential Areas	Form (edge)	Form(depth and shape)	Wind Related Parameters
1	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is simple in order to facilitate good water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature
2	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is simple in order to facilitate good water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature
3	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is simple in order to facilitate good water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature
4	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is simple in order to facilitate good water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature
5	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is simple in order to facilitate good water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature
6	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is simple in order to facilitate good water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature
7	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is simple in order to facilitate good water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature
8	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is intricate or includes angles which may restrict water circulation	The long axis of the water body is perpendicular to know prevailing wind direction
9	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is simple in order to facilitate good water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature
10	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is simple in order to facilitate good water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature
11	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	80-100% of the water body's edge is hard vertical edge thereby maximizing the effect of wave action	Shape of the water body is simple in order to facilitate good water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature
12	Water level fluctuates and dries out	Nearest resident is located between 100m-200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is intricate or includes angles which may restrict water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature
13	Water Body does not dry out and water level fluctuates	Nearest resident is located at least 200m from water's edge	Less than 50% of the water body's edge is hard vertical surface	Shape of the water body is simple in order to facilitate good water circulation	The long axis of the water body is in line with known prevailing wind directions or is of a circular nature

Site	Wind Related Parameters	Depth	Aquatic Vegetation	Terrestrial Vegetation	In Flow Water Quality	Engineering Considerations
1	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Between 60cm and 2m	No aquatic vegetation	Vegetation randomly planted or insufficient quantity to provide an effective buffer	In flow water has low levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures
2	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Between 30cm and 60cm	No aquatic vegetation	Vegetation randomly planted or insufficient quantity to provide an effective buffer	In flow water has low levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures
3	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Between 60cm and 2m	No aquatic vegetation	Vegetation randomly planted or insufficient quantity to provide an effective buffer	In flow water has low levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures
4	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Between 60cm and 2m	No aquatic vegetation	Vegetation randomly planted or insufficient quantity to provide an effective buffer	In flow water has low levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures
5	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Between 30cm and 60cm	No aquatic vegetation	Vegetation randomly planted or insufficient quantity to provide an effective buffer	In flow water has low levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures
6	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Between 60cm and 2m	No aquatic vegetation	Vegetation randomly planted or insufficient quantity to provide an effective buffer	In flow water has low levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures
7	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Between 30cm and 60cm	No aquatic vegetation	Vegetation randomly planted or insufficient quantity to provide an effective buffer	In flow water has medium levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures
8	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Between 60cm and 2m	No aquatic vegetation	Vegetation randomly planted or insufficient quantity to provide an effective buffer	In flow water has low levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures
9	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Between 60cm and 2m	No aquatic vegetation	Vegetation randomly planted or insufficient quantity to provide an effective buffer	In flow water has minimal levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures
10	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Greater than 2m	No aquatic vegetation	Vegetation randomly planted or insufficient quantity to provide an effective buffer	In flow water has minimal levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures
11	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Greater than 2m	No aquatic vegetation	Vegetation randomly planted or insufficient quantity to provide an effective buffer	In flow water has minimal levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures
12	Surrounding land level with water body preventing surface runoff entering and maximizing potential wind action	Seasonal water bodies which dry out	No aquatic vegetation	Buffer vegetation mainly planted downwind of the water body or surrounding entire water body and with clear open space provide buffer between nearest residence	In flow water has minimal levels of nutrients	Access for personnel and machinery restricted
13	Constructed wetland located in a depression so that surrounding land slopes down to the water's edge	Greater than 2m	No aquatic vegetation	Buffer vegetation mainly planted downwind of the water body or surrounding entire water body and with clear open space provide buffer between nearest residence	In flow water has minimal levels of nutrients	Sufficient access for personnel and machinery to undertake routine maintenance or implement control measures

Table 2: Summary of risk assessment for water bodies

Site	Size (m^2)	Overall risk rating	Possible mosquito species
1	769.14	Low	*Culex annulirostris, Aedes notoscriptus*
2	635.38	Low	*Culex annulirostris, Aedes notoscriptus*
3	470.44	Low	*Culex annulirostris, Aedes notoscriptus*
4	859.02	Low	*Culex annulirostris, Aedes notoscriptus*
5	297.01	Low	*Culex annulirostris, Aedes notoscriptus*
6	584.62	Low	*Culex annulirostris, Aedes notoscriptus*
7	548.79	Low	*Culex annulirostris, Aedes notoscriptus*
8	438.34	Low-Medium	*Culex annulirostris, Aedes notoscriptus*
9	376.34	Low	*Culex annulirostris, Aedes notoscriptus*
10	8183.29	Low	*Culex annulirostris, Aedes notoscriptus*
11	3581.85	Low	*Culex annulirostris, Aedes notoscriptus*
12	515.38	Low-medium	*Culex annulirostris, Aedes notoscriptus*
13	11731.54	Medium	*Culex annulirostris, Aedes notoscriptus*
Casuarina Coastal Reserve	Variable	Medium	*Aedes vigilax, Verrallina funerea, Culex sitiens*
Leanyer	variable	Medium	*Aedes vigilax, Verrallina funerea, Culex sitiens*

4. Discussion

In conjunction with previous surveys of both Casuarina Coastal Reserve and Buffalo Creek Management Area all possible mosquito habitat has been identified and mapped within a 1.6km radius of the developmental area.

The determination from the risk assessment was that the 13 freshwater water bodies surrounding the proposed Muirhead development were considered to be on the whole of a low level of risk. One water body (#13) was found to have large numbers of mosquitoes. This body has no emergent aquatic vegetation but has a considerable amount of sub-surface aquatic species and has been classed as having a medium risk. Water body #8 is also thought to have a low-medium risk, due to its shape and orientation. Another dry depression (#12) was deemed to have a low-medium risk due to its close proximity to the Muirhead area.

In general, an increased probability of midge or mosquito breeding is evident through the investigation area and will require improved monitoring and ongoing maintenance. Minor modifications to the design of the water body's (e.g. establishing aquatic plants in appropriate areas and increasing the amount of hard vertical edges) would lower the risk rating and reduce the insect productivity of the water bodies.

Most of the new water bodies examined in this report are thought to offer potentially suitable habitat for the freshwater mosquito species (*Culex annulirostris* and *Aedes notoscriptus*). No areas appear to be suitable habitat for the *Anopheles* mosquito due to a lack of emergent reedy vegetation at the sites examined.

5. References

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Appendix 1: Contributions and qualifications of ecobiological staff

Name	Qualification	Title/Experience	Contribution
Daniel O'Brien	B. Env. Sc. & Mgt. (*Biol.*). (Hons)	Ecologist	Habitat survey (fieldwork), photographer, report writing
Karen Bowland	B. Biol. Sc. (*Ecol.*) (Hons)	Ecologist	Habitat survey (fieldwork)
David Paull	M.Res. Sc.	Senior Ecologist	Habitat survey (desktop) Report Review