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Development
Biting Insect Management
Plan**

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1 Project background

1.1 Project description

Defence Housing Australia (DHA) (the Proponent) is proposing to develop a 1,211 dwelling residential subdivision (the Proposed Development) on a 167.6 ha land parcel in the northern suburbs of Darwin, NT (the Project Area).

On 2 July 2010, the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (formally Department of the Environment, Water, Heritage and the Arts - DEWHA) advised that it had determined that the Proposed Development is a Controlled Action and will need to be assessed through Preliminary Documentation.

The Proposed Development was determined to have the potential to have a significant impact on the environment through a Commonwealth action under Section 28 of the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) and is therefore defined as a Controlled action. In a letter dated 19 July 2010, DEWHA / SEWPaC requested additional information in relation to potential impacts of the Proposed Development. In particular, SEWPaC raised specific concerns about the impacts on Buffalo Creek, the native vegetation, the indigenous heritage values of the area, and the impact of biting insects.

1.1.1 Description of the area


The Buffalo Creek Management Area to the east of the Project Area is a known source of biting insects and breeding grounds for mosquitoes. 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 and other nearby existing residential areas are located in close proximity to the Leanyer Swamp, which includes Buffalo Creek and associated mangrove and wetland areas. As with the general Darwin residential 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.

The proximity of the Project Area to Buffalo Creek increases the risk that pest biting midges are likely to affect areas of the Project Area within 1.5 km of the mangrove margin. Biting midges are not known to transmit human disease in Australia, but can impact on quality of life by their painful bites and associated secondary reactions such as the associated intense itching.

An assessment of the area was undertaken by Medical Entomology (ME) unit of the NT Department of Health and Families in February 2008. The assessment identified two biting midge species *Culicoides ornatus* and *Culicoides* species near *subimmaculatus* (northern form) that will be seasonally present in high numbers across the Project Area and existing established suburbs. The Northern salt marsh mosquito was also identified as the most abundant mosquito in the Project Area, with seasonally high to very high populations expected.

1.1.2 Issues raised during approval negotiations

The Preliminary Documentation for the project included an assessment that concluded that the risk from biting insects was not significantly different compared to existing residential developments, and



that areas of high insect breeding potential were unlikely to be present in surrounding environments. In the approval conditions SEWPac asked for further investigations to confirm this finding. DHA sought clarifications on the intent of the approval conditions relating to Biting Insect Management on 18 March 2011, and a response was provided by SEWPAC on 23 March 2011. The clarification noted that the areas to be covered in this management plan would focus on areas

During discussions with the EPBC unit of SEWPAC, concerns were raised regarding the potential for the management of insect breeding areas to further impact on environmental values, particularly for habitat modification in areas outside the direct footprint of impact from the development.

1.1.2.1 Potential impacts on Casuarina Coastal Reserve

The nearby Casuarina Recreation Reserve was identified as one area where indicative vegetation mapping suggested that high risk habitat may be present. It should be noted that detailed habitat surveys for biting insects were not carried out as part of the preparation of the Preliminary Documentation, as the main focus was on identifying direct impacts across the site.

There was some discussion on the potential for habitat modification within this area. The principal management agency for the area is Northern Territory Parks and Wildlife Commission, and the Chief Ranger for the Reserve provided some comment on the potential for habitat modification.

Paul Cawood, Chief District Ranger, informed Aurecon that Parks and Wildlife Commission of the NT is currently working with the Casuarina Coastal Reserve Landcare Group to seek funding to undertake rectification work. The location of rectification work is yet to be determined but would be selected under the advice of the ME unit. Each area would require a site by site evaluation to determine the most appropriate rectification method, which is generally likely to involve the importation of sand from the lower beach area to the interdune depressions, in a similar manner to what was previously carried out in other areas of Casuarina Coastal Reserve. (Muirhead Preliminary Documentation, p.62)

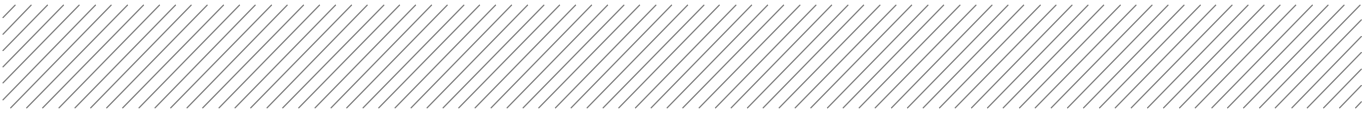
The Preliminary Documentation also noted that twenty one (21) threatened species had been recorded in the vicinity of the Casuarina Coastal Reserve. As a result SEWPAC was concerned that these works could result in a subsequent impact on the environment. Whilst noting that these works were on-going works largely independent of the Muirhead Development, SEWPAC asked for further information to be provided on the exact nature and extent of potential impacts within the reserve. In particular, there was a desire to complete the initial stages of the rectification work noted above – namely the mapping of potential rectification areas on a site by site basis.

As part of the preparation of this management plan, detailed site surveys were carried out to more accurately map the actual habitat areas for biting insects against the known species within the region. These surveys included direct site visits on 19-22 August 2011 and involved direct inspections of the areas within the Casuarina Reserve identified as potential habitat, including intertidal areas alongside Buffalo Creek. No suitable habitat for biting insect breeding was detected within the reserve. (Appendix A section 2.2 and Figure 3).

1.1.2.2 Areas surrounding Leanyer-Sanderson Sewage Treatment Plant

The management of potential breeding habitat within the nearby Leanyer Sanderson Sewage Treatment Plant was also considered in the discussion of impacts in section 10.3.3. This analysis of habitat was undertaken based on vegetation mapping data, and detailed habitat analysis for potential biting insect breeding sites was not carried out. The management of the sewage treatment ponds themselves are wholly the responsibility of the Northern Territory Power and Water Corporation, however some potential breeding areas were identified and shown at Figure 7 within the Preliminary Documentation (Muirhead Preliminary Documentation p.58).

As part of the preparation of this management plan, detailed site surveys were carried out to more accurately map the actual habitat areas for biting insects against the known species within the region.



These surveys included direct site visits on 19-22 August 2011 and involved direct inspections of the areas identified as potential habitat. No potential breeding habitat was identified in the areas surrounding the Leanyer-Sanderson facility, and it is possible that these areas had already been treated by PWC (Appendix A section 2.2 and Figure 3).

It should also be noted that the Leanyer Sanderson facility is due to be upgraded in the near future, and letters to that effect were provided to the Commonwealth by the Northern Territory Government during the development of approval conditions.

1.2 Approval Conditions

1.2.1 Biting Insect Management Plans

On 31 March 2011, the Department of SEWPaC issued an EPBC approval which outlined the following conditions regarding Biting Insect Management Plans:

4. The person taking the action must develop a Biting Insect Management Plan, to avoid adverse impacts on human health, for the Minister's approval. The plan must address the following requirements:
 - a) Details of implementation of the recommendations from the *Muirhead Biting Insect Assessment*, February 2008 for which DHA is the responsible party (as Described in Table 7 in section 10.3.1 of the preliminary documentation, dated 29 November 2010);
 - b) A plan to rectify the biting insect breeding sites identified in Figure 6 in Section 10.3.3 of the preliminary documentation, dated 29 November 2010, that occur within 1 km of the project boundary;
 - c) Demonstrate that all reasonable efforts have been made to gain agreement with the relevant authority/s to proceed with 4.b);
 - d) Adequate funding must be offered to the relevant authority/s to achieve 4.b); and
 - e) A plan to assess and manage the environmental impacts associated with 4.b).

The Biting Insect Management Plan must be approved by the Minister before the person taking the action commences and works beyond Muirhead Stage 1.

The approved plan must also be implemented appropriately.

In response to this condition of approval, DHA has commissioned Aurecon Australia Pty Ltd (Aurecon) to manage additional biting insect habitat assessments and develop this plan to manage any areas identified as having a high breeding potential.

The most significant action undertaken to address concerns about biting insect impacts was a detailed survey of biting insect habitat in areas close to the development site. The original assessment of high risk sites within the Preliminary Documentation was based on analysis of vegetation and topography, with limited site investigation. To determine the exact nature and extent of biting insect habitat throughout the project area and surrounds a details habitat study was commissioned. The results of this study are at Appendix A. The principal finding of this study was that no high risk habitat for biting insects was present in either the Casuarina Recreation Reserve or in the immediate surrounds of the Leanyer-Sanderson Sewage Treatment Plant. Some Low-medium risk habitat was identified, but this was almost exclusively associated with farm dams for local stock, and did not provide substantial breeding opportunities. A small area of potential breeding habitat was identified within the project site, and this is the focus of remedial works within this plan of management.

A reconciliation of approval conditions against these conditions of approval is provided at Table 1 below:

Table 1: Cross reference of approval conditions		
Approval condition	Intent of the condition	Section where this is addressed
4a) Details of implementation of the recommendations from the Muirhead Biting Insect Assessment, February 2008 for which DHA is the responsible party (as Described in Table 7 in section 10.3.1 of the preliminary documentation, dated 29 November 2010);	<p>The original proposal included measures to reduce the likelihood of biting insects impacting on residents. These covered the following broad areas:</p> <ul style="list-style-type: none"> - Arrangement of rural residential lots on the outer areas of the development to increase airflow and minimise density of residents - An open wind buffer on the perimeter of the east boundary - Disturbed seepage areas to be redressed. - Modify Stormwater management - Modify Water Sensitive Urban Design 	<p>The position of rural residential lots on the perimeter of the Development is shown in the Lot Plans at Appendix B of this Plan.</p> <p>Disturbed Seepage area to be redressed through placement of fill (see Section 3.3 below)</p> <p>Stormwater Management and Water Sensitive Urban Design across the site has been designed to eliminate any areas of standing water that could provide breeding opportunities for biting insects.</p>
4b) A plan to rectify the biting insect breeding sites identified in Figure 6 in Section 10.3.3 of the preliminary documentation, dated 29 November 2010, that occur within 1 km of the project boundary;	Prepare a plan to clarify the actual risk to residents and plan habitat modification for any high risk sites	<p>Detailed biting insect habitat assessment commissioned to determine actual level of risk. Report provided at Appendix A</p> <p>This plan has been subsequently developed, noting that no high risk sites were detected.</p>
4c) Demonstrate that all reasonable efforts have been made to gain agreement with the relevant authority/s to proceed with 4.b);	Manage risk to residents from external areas and plan habitat modification for any high risk sites	Detailed biting insect habitat assessment is provided at Appendix A. No high risk sites identified in external areas.
4d) Adequate funding must be offered to the relevant authority/s to achieve 4.b); and	Ensure that adequate resources are available to meet reasonable efforts at managing high risk sites.	Detailed biting insect habitat assessment is provided at Appendix A. No high risk sites identified in external areas.
4e) A plan to assess and manage the environmental impacts associated with 4.b).	Manage and avoid any environmental impacts from habitat modification.	Detailed biting insect habitat assessment is provided at Appendix A. No high risk sites were detected, and habitat modification will be limited to the existing footprint of development (Section 3.3 below).


Table 1 | Cross-reference to approval conditions

1.2.2 Relationship to other plans

The EPBC Approval conditions also require the preparation of the following plans that cover the study site:

- Buffalo Creek Water Quality Improvement Plan
- Buffalo Creek Nutrient Fate Model
- Water Mouse Habitat Utilisation Study
- Stormwater Management Plan

Two of these plans have interactions with this plan. The detailed assessment of biting insect habitat potential was conducted concurrently with the Water Mouse Habitat Utilisation Study, as this required



the placement of traps in the intertidal areas of Buffalo Creek and around the Leanyer-Sanderson Sewage Treatment Plant.

The management of standing water within the design of Stormwater and Water Sensitive Urban Design systems was also explicitly addressed on page 35 of this Plan. The specific performance requirement is that no areas of open standing water that could provide habitat for biting insect breeding is created. The current designs meet this performance criteria.

2 Existing environment

2.1 Biting Insect species

As part of the detailed biting insect habitat assessment presented at [Appendix A](#), an analysis of the potential species and their habitat requirements was carried out. Likely mosquito species present in the study area and their habitats are described below:

Table 2: Mosquito species and preferred habitats

Species	Habitat
<i>Aedes vigilax</i> (northern salt marsh mosquito)	<ul style="list-style-type: none"> • 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.
<i>Culex annulirostris</i> (common banded mosquito)	<ul style="list-style-type: none"> • 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 <i>Ae. vigilax</i>.
<i>Aedes notoscriptus</i> (receptacle breeding mosquito)	<ul style="list-style-type: none"> • 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, <i>Verrallina</i>)	<ul style="list-style-type: none"> • 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

<i>funerea, Culex sitiens</i>)	<p>semi-aquatic reeds.</p> <ul style="list-style-type: none"> • 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.
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Source: Warchot and Whelan, 2011

2.2 Potential Habitat

2.2.1 Areas within the Muirhead Development Site

One dry depression area assessed to be a low-medium risk habitat was identified within the proposed Muirhead Development area. A photo of the possible mosquito habitat can be seen in Figure 1 and the aerial image in Figure 2 shows the location of the site relative to the proposed development (Site 12).



Figure 1 | Possible Mosquito habitat identified within the proposed development area (Site 12)

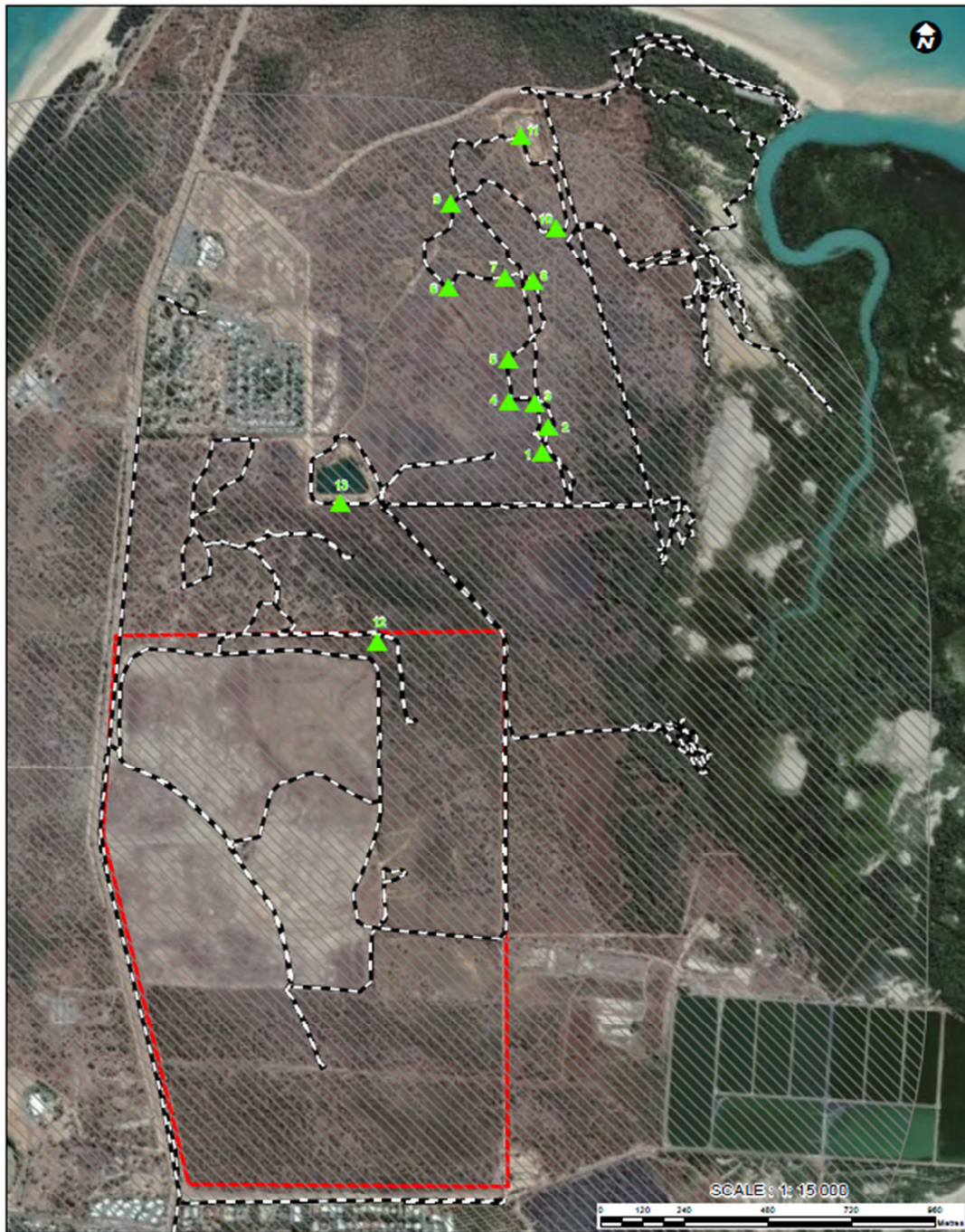


Figure 3 Possible Mosquito Habitat

Legend

- Development Area
- ▲ Possible Mosquito Habitat
- Meandering track
- Development Area 1.5km buffer



Map Projection:
GDA 94

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

Project Ref: 360-873

Plot Date: 15/02/2012 12:41

Revision: 001 (glenn)

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.

Figure 2 | Aerial photo of the possible mosquito habitat

Site 12 shows the only potential mosquito habitat that was identified within the proposed development area



2.2.2 Areas external to the Development Site

The analysis of habitat areas has confirmed that no high risk areas of high breeding potential for biting insects exist within or close to the project area. As a result no works are expected or likely for areas outside the direct development footprint.

3 Proposed actions

3.1 Control requirements

The habitat investigations to date concluded that there were thirteen (13) freshwater bodies and boggy areas within and surrounding the Muirhead development site with some degree of mosquito breeding potential. Only one of these sites was within the direct footprint of the proposed works, with the balance of sites located on private land directly to the north of the project area.

A risk assessment was carried out as part of the habitat assessment based on the following factors:

- Hydrology
- Location relative to residential areas
- Form (water's edge, depth, shape)
- Wind related factors
- Water depth
- Aquatic vegetation
- Terrestrial vegetation
- Inflow water quality
- Engineering considerations

This overall conclusion of the risk assessment confirmed the initial findings of the Preliminary Documentation, prepared as part of the environmental assessment process for the project. There is an overall low risk to residents from biting insect habitat in areas immediately surrounding the site, and in particular no significant habitat was found within the riparian and tidal zones alongside Buffalo Creek.

3.2 Available control treatments

The low-medium risk habitat areas directly within the project boundary (Site 12) have been assessed as not having significant habitat values, and are available for modification. One option would be to use this area to stockpile fill material once construction moves to within 500m of the potential breeding site. This would interrupt breeding potential without a significant impact on aquatic or riparian habitat. The final landform should also be managed to prevent water ponding or pooling in this area.


Areas outside the footprint of the works are generally farm dams and recreational water bodies. DHA has no direct control or ownership of these areas, and these are generally being used for commercial enterprises (grazing, camping areas). As a result, off-site habitat modification works are unlikely to be viable and are not warranted given the low overall risk of this breeding habitat.

3.3 Construction phase works

3.3.1 Habitat modification

At the commencement of Stage 5 (approx. 2016) the following actions will be undertaken.

- Fill to be placed on habitat Possible Mosquito Habitat Site 12 during construction:
 - o Sediment and erosion controls to prevent loss of material from this stockpile site during rain events. If sediment loss is detected within this area, the site manager is to be notified as soon as possible and remediation works initiated.

- 
- Final landform to be checked to confirm that no standing water persists beyond 24 hours following rain events.
 - Storm water systems to minimise standing water, as per the existing Stormwater Management Plan (p.35).

3.4 On-going monitoring

3.4.1 Monitoring requirements

Any stockpiled material within the development boundary must be checked on a monthly basis by the site environmental manager to confirm that the proposed controls are effective. Any loss of soil or sediment from this area must be reported to the site manager and rectified as soon as practicable.

Once a final landform has been created on the modified habitat area 12 will be checked monthly during the Darwin wet season to confirm that significant ponding or pooling of water is not occurring on this site.

Ponding or pooling must be addressed through the placement of additional material to shed water from this section of land.

Appendices





Appendix A

Biting Insect Habitat Report



Appendix B

Layout Plan Stages 2,3,4



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