

BOC Kooragang Mosquito Management Plan

BOC Limited Kooragang Island

19 June 2017



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1 Introduction

1.1 BOC Limited Kooragang Island

The following Mosquito Management Plan has been prepared by MJM Environmental Pty Ltd for BOC Limited Kooragang Island, herein referred to as BOC Kooragang. The report is intended for internal usage, and may be submitted to NSW Health as required.

BOC Limited Kooragang Island, herein referred to as BOC Kooragang, owns and operates a gas facility for the production and supply of gas products located at Lot 5 DP 1015754 9 Egret Street Kooragang, New South Wales. The facility operates 24 hours per day, 7 days per week. BOC Kooragang holds NSW Environmental Protection Authority (EPA) Environmental Protection Licence (EPL) 20165.

1.2 Irrigation process

BOC Kooragang currently possess two (2) cooling towers onsite. Currently the cooling tower blowdown (waste) water is produced at a rate of 18,200 litres per week. BOC Kooragang have performed internal investigations regarding the feasibility of utilising the cooling tower wastewater for irrigation purposes in grassed areas of the site.

BOC Kooragang's site is located within the 'Lease Area' of the *State Environmental Planning Policy (Three Ports) 2013* (SEPP Three Ports 2013). Therefore, the Department of Planning and Environment (the Department) is the consent authority for modifications and development approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act) intended for submission to the Department. On 20 March 2017 BOC Kooragang submitted a Development Application (DA) to the Department under *DA 8354 BOC Kooragang Irrigation of Cooling Tower Effluent*.

As a response to the DA NSW Health Hunter New England Local Health District (NSW Health) requested the following:

HNEPH recommends that a mosquito management plan focusing on exotic species identification should be included in a vector management strategy. A mosquito risks assessment should be included in the EIS to ensure any potential mosquito breeding sites are identified e.g. natural or constructed wetlands, stormwater drains, lagoons, ponds and low-lying areas. The mosquito management plan will also assist to prevent both nuisance biting mosquitoes and disease transmitting mosquitoes affecting employees, visitors and the local population.

1.3 Purpose of document

The following documentation presents a mosquito management plan for the BOC Kooragang site. The objectives of the mosquito management plan are:

- Utilise a balanced approach to consider health and environmental considerations for the control of mosquitoes onsite.
- Provide management for disease control in the first instance, while also reducing nuisance mosquitoes.
- Identify potential breeding areas and conditions.
- Encourage awareness and management for employees, contractors and visitors to BOC Kooragang.
- Assist to prevent both nuisance biting mosquitoes and disease transmitting mosquitoes affecting employees, visitors and the local population.
- Aim to limit mosquito populations onsite at BOC Kooragang through best practice methods and techniques.
- To ensure the operations and activities performed onsite at BOC Kooragang, including irrigation, do not increase adverse impacts upon health and environment due to mosquitoes.

2 Applicable Mosquito Information and Biology

2.1 Reference material and expert advice

It is understood that part of NSW Health's responsibility includes raising awareness of the role of mosquitoes in the environment along with biting and public health risks. The NSW Health page on Mosquitoes was referred to, focusing on the provided linked mosquito management strategy *Living with Mosquitoes in the Hunter and Lower Mid-North Coast Region of*

NSW - *Second edition* by Dr Cameron Webb and Prof C Russell December (2009). Dr Cameron Webb is considered an expert in the field of entomology.

The document, herein referred to as *Living with Mosquitoes* is aimed at an area applicable for use for BOC Kooragang, as it focuses on the lower Hunter region and the likely increased contact between people and mosquitoes as populations increase, especially in residential areas. The document will be referenced throughout the plan.

2.2 General

Mosquitoes provide some environmental benefit, such as food sources for animals living in wetland areas including birds, bats, frogs and fish. Therefore, it is not considered desirable to eradicate mosquitoes completely. It is also acknowledged that mosquitoes can provide nuisance through biting; however a small fraction of the species can also spread diseases such as Ross River virus and other arboviruses. Therefore the management of mosquitoes is to take into account potential health risks in the first instance, and environmental impacts.

It is also acknowledged that a number of factors such as climate change, urban development and wetland management may impact upon potential for mosquito-borne illnesses.

Living with Mosquitoes states that the life-cycle of mosquitoes are dependent on free-standing water. The adult female mosquito will lay eggs in or near a water source, which can include soil, wetlands, and standing water collected in containers after rainfall including items such as leaves, tins and litter. Eggs remain in the water and hatch after approximately three (3) days, and the mosquito can live for up to three (3) weeks.

Adult mosquitoes tend to remain near breeding grounds such as a wetland; however some breeds can travel much further from 5 to 50 kilometres.

2.3 Types of mosquitoes known in Kooragang

BOC Kooragang is located on Kooragang Island, and site-specific monitoring has been performed in the Kooragang Island wetlands area. It is noted in the document that the majority (>80%) of mosquitoes recorded at Kooragang Island are estuarine mosquitoes which reflects the wetlands present in the area, with a smaller fraction of freshwater mosquitoes and urban mosquitoes also present.

Preferred habitats of mosquitoes are grouped into:

- Estuarine
- Freshwater
- Floodwater
- Urban

Research performed in the lower Hunter and mid-north coast of NSW has recorded up to 55 species of mosquitoes. The species noted from the NSW monitoring programs to 2009 show 23 different species of mosquito in Newcastle, as shown in Table 1 of the *Living with Mosquitoes* document.

As BOC Kooragang is not located in an urban area, the small fraction of urban mosquitoes that may be present are not specifically covered in this document.

2.3.1 ESTUARINE MOSQUITOES KNOWN IN KOORAGANG

Estuarine mosquitoes as a broad group can be potential sources (vectors) of arboviruses including the following three significant species as referenced from the *Living with Mosquitoes* document.

- *Aedes vigilax*: A dark, medium sized mosquito with pale bands on the legs. Larvae of this species are usually associated with tidally influenced saltmarsh, mangroves, saline and brackish water habitats such as flooded sedgeland and forests. Population increase occur during high tides and major rainfall events. The species is considered a severe nuisance biting pest and a major vector of arboviruses.
- *Aedes alternans* (Hexham Grey or Scotch Grey): Large, sandy coloured mosquito. Known to cause significant nuisance biting close to breeding habitats, but not considered a significant arbovirus vector. Population increases

of this species are also linked to the tidal and rainfall inundations that trigger increases in *Aedes vigilax* populations.



Figure 2-1: *Aedes vigilax*; *Aedes alternans* (Hexham Grey) (Webb, 2009)

- *Culex sitiens*: Dark, medium sized mosquito, abundant during the late summer and early autumn. The larvae of are commonly found in permanently inundated saline to brackish habitats, including saltmarsh and mangroves. It is not considered a significant pest or vector. Birds prey on this species. The species can exist in estuarine wetlands.



Figure 2-2: *Culex sitiens* (ticksafe.com.au)

2.3.2 FRESHWATER MOSQUITOES KNOWN IN KOORAGANG

Mosquitoes associated with freshwater habitats should be considered potentially significant pests. The following species are known in Kooragang based upon the *Living with Mosquitoes* document.

- *Culex annulirostris*: A medium sized, light to dark coloured mosquito with a banded proboscis. Considered a major nuisance biting and vector species throughout inland NSW, particularly in river basins and irrigation areas. Larvae are present in freshwater habitats from flooded grasslands to permanent, well-vegetated wetlands. Presence in constructed freshwater wetlands incorporated into urban development's mean this species is becoming a greater concern.
- *Coquillettidia linealis*: A medium sized, dark mosquito with golden scales on the thorax. This species has the potential for this species to be an occasionally significant nuisance biter although little is known regarding arbovirus transmission. They are abundant in early spring and mid-summer.



Figure 2-3: *Culex annulirostris*; *Coquillettia linealis* (Webb, 2009)

- *Culex australicus*: A medium sized, light to dark coloured mosquito abundant in the Hunter region during spring and autumn. The species carries no risk of nuisance biting or arbovirus transmission as this mosquito generally does not bite humans and prefers birds and smaller mammals.



Figure 2-4: *Culex australicus* (<http://medent.usyd.edu.au>)

2.3.3 EXOTIC MOSQUITOES

BOC Kooragang is located on Kooragang Island, and the island includes a port and is in the vicinity of the Williamstown airport. Therefore, it is theoretically possible for exotic mosquitoes to be present through such transport and import areas.

Surveillance programs are performed by Australian Quarantine and Inspection Service (AQIS) around international ports as part of World Health Organisation (WHO) regulations, including around Port of Newcastle. Mosquitoes are targeted by inspecting vessels for presence of mosquitoes and potential breeding sites, focusing on Import (can present risks if introduced to Australia) and Export species (would present risks if transported from Australia to overseas). AQIS therefore perform important work to prevent quarantine risks.

The *Living with Mosquitoes* document identifies two (2) types of potential exotic mosquitoes to be aware of in the lower Hunter. The two types are not currently known to exist in NSW, and are shown below. However as above it is possible for potential migration in ports and airports.

- *Aedes Aegypti* (Yellow fever mosquito): Day-biting nuisance mosquito which can transmit Dengue Fever. The species is believed to be restricted to north Queensland where Dengue Fever management plans are in place. More recently it is known to spread Zika virus. The species has a wing length ranging from 1.67 to 3.83 mm depending upon habitat, and white markings on legs and a 'lyre' on its upper thorax.



Figure 2-5: Aegis Aegypti or Yellow Fever mosquito (National Geographic)

- Aedes albopictus (Asian tiger mosquito): Nuisance mosquito which can be a secondary vector for Dengue Fever. The species is believed to be restricted to Torres Strait and Papua New Guinea. The species has a body length up to 10 mm, with black and white striped body and legs.



Figure 2-6: Aedes albopictus or Asian Tiger mosquito (Webb, 2009)

2.3.4 HEALTH RISKS

In general mosquitoes provide more nuisance risks through biting and resultant itching, and tolerances can differ for each individual. Nuisance biting can have negative impacts upon amenity of an area.

Exotic mosquitoes can be vectors for transmitting diseases (arboviruses) such as, but not excluded to, the following:

- Ross River virus: Acute symptoms include fever, rash, joint pain and fatigue. It is believed that virus infection could also cause chronic illness such as arthritic pain and depression, depending on the severity of the acute illness. The disease is diagnosed by a blood test.
- Barmah Forest virus: The virus is the second most common arbovirus in Australia. Acute symptoms include fever, malaise rash, joint pain and muscle tenderness, similar to Ross River virus. Most cases recover within weeks however in some people can continue for months to a year. The disease is diagnosed by a blood exam.

- **Dengue Fever:** The virus includes symptoms such as fever, intense headache, muscle and joint pain, red rash on arms and legs, and minor bleeding. The symptoms can last for 2 days or up to a week, and may go unnoticed or in very severe cases can be fatal.
- More localised diseases include Malaria, Edge Hill Virus, Gan Gan virus, and Sindbis virus.

There are no specific cures or vaccines available for the above diseases. Therefore, for both nuisance and health considerations, mosquito management is considered beneficial for health and comfort of individuals.

3 Mosquito Management Plan

3.1 General approach to mosquito management

Mosquito management generally considers four (4) approaches:

- Physical control, such as reducing potential for breeding sites by modifying the environmental and site conditions.
- Larval chemical control, i.e. use of larvicides to control mosquitoes in the larval stage.
- Adult chemical control, i.e. use of adulticides to control adult populations.
- Education and awareness for employees, contractors and visitors.

Large-scale mosquito control programs should be an integrated process, with multidisciplinary strategy and consideration for sustainability. Therefore, such controls should be performed, when necessary, in line with Codes of Practice by the appropriate authorities such as Councils and Local Governments with the input of local and state health agencies.

It is illegal to utilise a pesticide unless the substance is registered appropriately.

Therefore, it is not considered appropriate for BOC Kooragang to perform larval and adult chemical mosquito control programs based upon legislation in place and the large-scale implications of such a program.

However, BOC Kooragang can provide positive benefits by performing an internal mosquito management program.

3.2 Potential breeding conditions and sites risk assessment

Potential breeding conditions and sites for mosquitoes include the following as presented in Table 3-1, utilising the *Living With Mosquitoes* document and literature research.

The potential for each condition or risk is evaluated for BOC Kooragang.

Table 3-1: Potential mosquito breeding conditions risk assessment

Potential site / condition / risk	Potential at BOC Kooragang and vicinity
Natural or constructed wetlands	Not present onsite; however, wetlands do exist on Kooragang Island as part of the Kooragang Wetland Rehabilitation Project which is located to the north-east and north of the Kooragang Industrial Area. Therefore, risk of mosquito breeding and migration from the wetland area exists.
Stormwater drains	Yes. BOC Kooragang possess stormwater drains, pits and an absorption trench. Stormwater retention can contain free-standing water. A properly designed stormwater pit should: <ul style="list-style-type: none"> - Be self-draining and drain freely - Depth should be appropriate to encourage evaporation - Organic material and silt accumulation minimised
Lagoons, ponds and low-lying areas	Surface water does not exist onsite but does exist on neighbouring facilities. Therefore, risk of mosquito breeding and migration exists.
Containers that may fill with rainwater (pot plants, litter, other containers)	Yes; container may potentially be present from: <ul style="list-style-type: none"> - housekeeping

Potential site / condition / risk	Potential at BOC Kooragang and vicinity
	<ul style="list-style-type: none"> - littering around boundary of site from public - containers in use at BOC Kooragang
Open tanks (water tanks, septic tanks)	<p>Yes; potentially from current process units at BOC Kooragang.</p> <p>Septic tanks and water storage tanks exist and are in use.</p> <p>Open or damaged tanks can encourage mosquito breeding.</p> <p>The nature and operation of septic tanks does not allow for use of larvicides as this hinders the organic operation.</p>
Standing water	<p>Yes – for instance if:</p> <ul style="list-style-type: none"> - Pooling occurs in shallow areas for a number of days at a time - irrigation area is not managed appropriately and water is allowed to pool.
Warm weather which enables mosquitoes to survive longer	Yes
Extended rainfall conditions	Yes
Long grasses where adult mosquitoes can take refuge	Yes
Potential for exposure to employees and contractors	Yes – A significant portion of BOC Kooragang’s site processes are located outside.

The risks in Table 3-1 have been included in the following section which outlines management of mosquitoes at BOC Kooragang.

3.3 Environmentally sustainable management of mosquitoes at BOC Kooragang

As aforementioned it is not considered appropriate for BOC Kooragang to perform chemical or large-scale mosquito control programs based upon legislation in place. However, BOC Kooragang can provide positive benefits by performing an internal mosquito management program as part of their operations which are summarised in Table 3-2.

The management practices have taken into account:

- Site-specific characteristics
- Site processes
- Personnel and contractors onsite
- Location and climate
- Location of site relative to potential mosquito populations (e.g. wetlands)

The management plan does not cover operation of the Kooragang Wetland Rehabilitation Project, or any future proposed development or project, which is not part of BOC Kooragang’s boundaries.

Table 3-2: Mosquito management and mitigation practices implemented at BOC Kooragang

Risk area	Mosquito Management and Mitigation Practice	Benefit / Outcome
Irrigation area	<p>Continue appropriate irrigation practices in line with the irrigation management plan including:</p> <ul style="list-style-type: none"> - Daily inspections of irrigation area to ensure pooling and waterlogging is not occurring - Regular inspections of irrigation process from storage through to drip irrigation on ground <p>BOC's irrigation practices include a contingency plan for if pooling or flooding is noticed despite the above practices, including but not excluded to:</p> <ul style="list-style-type: none"> - Irrigation will immediately be ceased. - If pooling appears to be draining offsite or presents a risk of runoff, appropriate bunding will immediately be installed to prevent runoff occurring. - Irrigation will only be recommenced once pooling has evaporated and drained. - If pooling or flooding is extreme, pump out and disposal with an appropriate contractor will occur. 	Successfully mitigate the possibility of flooding and pooling of effluent onsite, removing potential habitat for mosquito breeding and controls potential larval populations.
Stormwater drains and trenches	<p>Current site inspections to continue to incorporate regular inspections of stormwater drains and absorption trenches in use to ensure:</p> <ul style="list-style-type: none"> - Water is draining appropriately and freely - Depth of water collection appropriate to encourage evaporation - Organic material and silt accumulation minimised, and pit cleaned out as necessary - Debris removed regularly to avoid blocking up of pit - Additional inspections to be performed after rainfall and hot weather 	Avoids potential for standing water and thereby controls potential larval populations.
Septic tanks and water storage tanks	<p>Septic and water tanks will be inspected as part of regular site inspections to ensure no egress for mosquitoes to enter, such as:</p> <ul style="list-style-type: none"> - Open or damaged tops are not present - Pipework remains intact and undamaged - Repairs are performed as required - Additional inspections to be performed after rainfall and hot weather - Consideration of installation of mosquito proof screens if necessary 	Removing potential habitat for mosquito breeding and controls potential larval populations.
Site (general)	<p>Current site inspections to continue to ensure:</p> <ul style="list-style-type: none"> - Free-standing water is not collecting in any containers, including process containers, tarpaulins, and items such as pot plants - If container cannot be removed, covers shall be obtained to enable water to drain off container - Standing water is emptied appropriately from any container collected 	Avoids potential for standing water and thereby controls potential larval populations.

Risk area	Mosquito Management and Mitigation Practice	Benefit / Outcome
	<ul style="list-style-type: none"> - Organic material and silt accumulation minimised, and pit cleaned out as necessary on regular basis - Additional inspections to be performed after rainfall and hot weather - Low lying areas are inspected, both hardstand and grassed, to ensure free-standing water is not collecting. - If free standing water is collecting, emptying and/or pump out as appropriate. - Public areas including site boundaries will also be inspected for potential litter, containers that may be able to collect water. The containers will be emptied and disposed of appropriately. - Ensure debris is removed from any blockages, such as drains and pipes. 	
Vegetation	Continue regular mowing of lawns as performed currently.	Remove habitat of long grasses where adult mosquitoes can take refuge.
Warm weather	Inspections of all above risk areas will be increased according to weather.	Monitoring in order to avoid potential habitat for mosquito breeding and controls potential larval populations.
Extended rainfall conditions	<p>Irrigation will be ceased as per above contingency plan.</p> <p>Inspections of all above risk areas will be increased following cessation of rainfall.</p>	Successfully mitigate the possibility of flooding and pooling of effluent onsite, removing potential habitat for mosquito breeding and controls potential larval populations.
Exposure to employees and contractors	<p>All employees will be trained in all aspects of the mosquito management plan. Employees are encouraged to discuss experiences onsite and report any unusual activity such as nuisance biting.</p> <p>Contractors will be notified about the plan and also encouraged to discuss experiences onsite and report activities such as nuisance biting.</p> <p>Insect repellent will be provided and encouraged for use for employees and contractors.</p> <p>Employees and contractors will be encouraged to keep wearing long sleeves and pants as per current site procedures.</p> <p>Buildings are currently air conditioned 24 hours per day therefore doors and windows remain closed during operations.</p> <p>Consideration will be given to fly screens on doors and windows if not already in place.</p> <p>Display appropriate mosquito information on bulletin boards.</p> <p>Education about symptoms of arboviruses transmitted by mosquitoes and encouraging employees to seek medical attention when necessary.</p>	<p>Knowledge and training of the mosquito management plan put into practice.</p> <p>Health protection for employees and contractors.</p>

3.4 Potentially significant events and mitigation

As previously explained it is not appropriate for BOC Kooragang to be responsible for large-scale or chemical mosquito control programs.

It is expected that the management and mitigation practices shown in Table 3-2 will assist in preventing mosquito breeding within the boundaries of the site from BOC Kooragang's normal operations, including irrigation.

A significant increase in mosquito presence at a site may be in the form of increased nuisance biting experienced. If a significant increase in mosquito presence at the site or vicinity is noticed despite practices in place, BOC Kooragang will seek advice of an appropriately licensed pest technician. It is understood that additional controls can include commercial mosquito traps.

Any further required reporting of a mosquito event(s) will be performed by BOC Kooragang based upon the advice of the pest technician contracted.

3.5 Reporting of exotic mosquito identification

If a BOC Kooragang employee or contractor identify an exotic mosquito as flagged in *Section 2.3.3 Exotic Mosquitoes* at the site or vicinity of site, BOC Kooragang will alert the following agencies in the first instance for further information and advice:

- AQIS
- Newcastle City Council
- NSW Health

If specimens are able to be captured they can be sent to AQIS for identification.

4 Conclusion

The mosquito management plan has been prepared for BOC Kooragang. It is believed that the mosquito management plan provides appropriate information on the following:

- Common mosquitoes found in the local environment
- Exotic vector mosquitoes that are a risk to the local environment and health of community
- Mosquito risk assessment for the BOC Kooragang site, including operations such as the irrigation area
- Mosquito management plan practices and mitigation controls

5 References

Living with Mosquitoes in the Hunter and Lower Mid-North Coast Region of NSW - Second edition. Dr Cameron Webb and Prof C Russell (December 2009).