ONSHORE LNG FACILITY BITING INSECT MANAGEMENT PLAN

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NOTICE

1 INTRODUCTION

1.1 Overview

Coastal areas in the Northern Territory, and especially those with mangrove communities, provide attractive habitats for many species of biting insects, notably mosquitoes and biting midges. As there are substantial tracts of mangroves and of seasonally inundated land in the vicinity of the Ichthys LNG onshore processing plant (ILNG) at Bladin Point as well as around the shores of Darwin Habour and Darwin itself, it is clear that these areas can be expected to be significant sources of biting insects affecting ILNG personnel.

Mosquitoes are a serious potential public health issue, both as pest insects inflicting painful and irritating bites and as vectors of a number of arbovirus diseases affecting humans. These include the potentially fatal disease Murray Valley encephalitis and several other debilitating diseases, such as those caused by the Ross River virus, Barmah Forest virus, and Kunjin virus.

Biting midges, although not carriers of human diseases in the Northern Territory, can also be a significant nuisance and can cause non-disease-related health problems (e.g. intense itching, infection and scarring around bite sites), depending on the sensitivity of the individual being bitten.

Mosquitoes and biting midges are likely to impact on ILNG personnel and visitors to the processing plant at Bladin Point. The severity of the impact will depend on the time of year, the levels of immunity of individuals to the bites of the different species, the levels of use of appropriate personal protective equipment (PPE) (including repellents) and the provision of suitably protected working environments.

1.2 Purpose

The purpose of this Biting Insect Management Plan (BIMP) is as follows:

- to provide awareness of the potential health problems posed by biting insects
- to provide guidelines on how to prevent or reduce the development of biting-insect breeding sites
- to provide procedures for responding to incidents related to biting insects.

The distribution and abundance of biting insects at the onshore processing plant will vary according to seasonal and other changes in habitat and food availability. The risk of being bitten and/or of transmission of disease to humans will vary in relation to breeding cycles, insect abundance and species-specific feeding ecology, for example with respect to differing feeding times—some species of mosquito tend to feed around sunset while others prefer to feed at night. Biting midges are more active for a period of six days around the full and new moons, and during the two hours around sunset and sunrise.

1.3 Application

This management plan applies to all INPEX personnel (including contractors and subcontractors) and visitors to ILNG at Bladin Point.

2 APPLICABLE LEGISLATION, REGULATIONS AND GUIDELINES

Legislation applicable to biting insect management at ILNG includes the following Acts and Regulations:

- *Work Health and Safety (National Uniform Legislation) Act 2011* (NT)
- *Public and Environmental Health Act* (NT)
- Public and Environmental Health Regulations (NT).

Medical Entomology, a unit of the Centre for Disease Control in the Northern Territory's Department of Health, has produced a series of guidelines and fact sheets to manage and mitigate biting-insect impacts during the planning, construction and operation phases of developments in areas that have the potential to generate breeding habitats for biting midges and mosquitoes.

The guideline and fact-sheet titles are listed below and full references to these documents and related materials are provided in Appendix A.

- Mosquito-borne diseases (Centre for Disease Control 2014a)
- Guidelines for preventing mosquito breeding associated with construction practice near tidal areas in the NT (Whelan 2011a)
- Previous mosquito problems in the Top End of the NT created by construction practice (Appendix 1 in Whelan 2011a)
- Guidelines for preventing biting insect problems for urban residential developments or subdivisions in the Top End of the NT (Medical Entomology 2014)
- Guidelines on urban mosquito control drains (Appendix 1 in Medical Entomology 2014)
- Guidelines for preventing biting insect problems for new rural residential developments or subdivisions in the Top End of the NT (Whelan 2009)
- Constructed wetlands in the Northern Territory: guidelines to prevent mosquito breeding (Warchot & Whelan 2008)
- Mosquito breeding and sewage pond treatment in the Northern Territory (Whelan & Warchot 2009).

All personnel, contractors and visitors to the onshore processing plant site are required to be aware of the control and prevention measures detailed in this document and must use appropriate personal protective equipment (PPE) (including insect repellents) to minimise the impact of biting insects on humans working at or visiting the site.

3 PEST SPECIES

3.1 Mosquitoes

The most commonly recorded mosquitoes in the Darwin and Palmerston areas are species of the genera *Aedes* and *Culex*, some of which are known carriers of Ross River virus, the most commonly recorded disease-causing arbovirus in the Northern Territory. (See Appendix B for an account of the Territory's disease-causing arboviruses and their mosquito vectors.).
Photo courtesy of NT Department of Health.

Although there are no extensive breeding habitats for mosquitoes in the vicinity of ILNG, small localised populations do occur and they include disease-carrying species. In addition, mosquitoes may travel several kilometres searching for suitable hosts.

The time taken for eggs to hatch or individuals to reach maturity varies between species. In the Northern Territory most species mature from egg hatch through the larval stage to adult within 10 to 14 days. Species with transient larval habitats such as tidal pools or ephemeral inland flooded areas can mature in around six days.

The longevity of biting-insect species can influence their potential to transmit disease. A common disease-carrying mosquito, the northern saltmarsh mosquito *Aedes vigilax*, is longer-lived from December to January and poses a higher risk of transmitting Ross River virus and Barmah Forest virus during this time than in other months.

Aedes vigilax will be present around the ILNG facility in low and possibly moderate numbers during the late dry and early wet season between September and January. It is likely to breed in poorly draining upper tidal areas, in pools in seepage areas and other seasonally flooded depressions, as well as in areas of restricted tidal drainage. It will also breed in vehicle-disturbed areas along the landward mangrove margin, for example in pools in the ruts created by vehicle tyres.

Mosquitoes such as *Culex annulirostris*, *Culex sitiens*, various species of *Anopheles* and *Coquillettidia xanthogaster* will be seasonally present in minor numbers during the wet season. Breeding sites will be restricted to the margins of seepage areas.

Nearby monsoon vine forests are likely to contain some areas of wet-season ponding and breeding sites for *Verrallina funerea*, and possibly also for *Aedes vigilax* in the tide-influenced depressions near the landward mangrove margin.

Overall, however, mosquito numbers at the ILNG facility are expected to be low, with *Aedes vigilax* the only mosquito likely to be numerous enough to cause a problem. It is an aggressive biter, biting during the daytime in shaded areas as well as at night. It is expected to present a seasonally low but possibly moderate pest problem.

Aedes vigilax will pose a low but possibly moderate risk of Ross River virus and Barmah Forest virus transmission during the months September to January, with December and January being the months of highest risk because of increased mosquito longevity and abundance. *Culex annulirostris*, *Culex sitiens* and *Verrallina funerea* will pose a minor risk of Ross River virus transmission as a result of expected minor abundance, while *Culex annulirostris* will also pose a minor risk of Barmah Forest virus, Murray Valley encephalitis virus and Kunjin virus transmission.

On the whole, the risk of malaria transmission at Bladin Point is negligible, because of the expected low numbers of the necessary vectors of the mosquito genus *Anopheles* and because Australia has been declared clear of malaria since 1981 (see Appendix C).

3.2 Midges

There are a number of marine biting-midge pest species around the coast of the Northern Territory, and they can be appreciable pests in or close to their particular breeding sites. The mangrove biting midge, *Culicoides ornatus*, causes the greatest pest problems around the coast of northern Australia. The regions mostly affected are extensive coastal and tidal river mangrove communities and adjacent areas up to 3 km inland from the landward margin of mangrove areas (Whelan 2003). Photo courtesy of NT Department of Health.

Reactions to bites generally include itching, nuisance and discomfort. This can become acutely uncomfortable if a rate of one to five bites per hour is experienced by someone unaccustomed to them. A greater health risk is posed should bites progress to skin infections, or are inflicted on individuals who are allergic to biting-midge bites.

Although *Culicoides ornatus* is only around 1 mm in length, the problems it causes are severe and almost unbearable for people without personal protection. This is particularly so during the two hours around sunset and sunrise over the six days around the full and new moons. The pest problem posed by biting midges is significantly greater in the dry season than in the wet season, and is especially bad during the late dry season. Peak periods for

biting for this species are roughly for three days on either side of the full and new moons, with numbers around the new moon being about half of those recorded on the nearest full moon.

The mangrove biting midge is widespread throughout Middle Arm Peninsula and Bladin Point and is present in extremely high numbers during the late dry season (August to November). Very high numbers are also present during the early to middle dry season (April to July), while high numbers occur during the wet season.

Midge pest problems can seriously disrupt the activities of a workforce as the midge bites cause secondary effects such as intense itching, infection and scarring. Newcomers to northern Australia may be particularly affected as they are likely to lack immunity to midge bites.

3.3 Biting-insect habitat

There are differences between the habitats used by biting midges and those used by mosquitoes. Tidal mangrove areas provide habitat for biting midges, while coastal plains, shallow lagoons, ponds, floodplains and depressions associated with rivers and creeks provide the important habitats for mosquito breeding.

Biting insects breed opportunistically when habitat and food sources are available. Mosquito breeding generally occurs in areas with shallow-water pooling, with semiaquatic vegetation providing protection from predators. Activities or events that increase the area of ponding and/or semiaquatic vegetation growth are likely to increase the breeding of mosquitoes. This may include ecosystem-wide events, such as tidal inundation, or localised events, such as direct disturbance by vehicles and machinery, blockage of tidal flows by roads and other embankments, erosion from stormwater flows or the creation of mud waves by filling activities.

3.3.1 Midges

The mangrove biting midge may be a nuisance all around the Northern Territory coast within two kilometres of extensive areas of coastal mangroves containing numerous small feeder creeks.

Suitable breeding sites for biting midges do occur across the intertidal area fringing Bladin Point. *Culicoides ornatus* breeds in the mud under dense mangrove canopies. Breeding densities are greatest on narrow creek banks around the upper neap-tide level.

The midges at these breeding sites cannot be controlled with insecticides. Effective control of *Culicoides ornatus* would be to remove their tidal mangrove breeding sites by permanently flooding or filling their breeding sites from the mean high-water spring-tide mark to below the level of the seaward fringe of the mangrove community.

Biting-midge abundance varies greatly during the month, with the highest numbers occurring two to three days on either side of the full moon and to a lesser extent three days on either side of the new moon. Numbers also vary during the year, with relatively low numbers during the wet season, an increase from April to July, and the highest numbers occurring between August and December. The increase in numbers coincides with the increase in the highest tide levels each month from the mid to the late dry season. The period of least biting activity is in the nine to four days preceding full or new moons.

The Northern Territory Department of Health's Medical Entomology unit produces an annual biting-midge pest calendar for the coastal Top End of the Northern Territory that is available online (Medical Entomology 2015a—see Appendix A). A sample extract from the 2015 calendar can be seen in Appendix D.

3.3.2 Self-protection against biting midges

Personal protection, such as full-length trousers, long-sleeved shirts, socks and shoes, and the use of insect repellents whose active ingredients are DEET or picaridin, will generally be required, particularly during peak activity time for biting midges. The precautionary and application advice on product labels should be carefully followed.

3.3.3 Mosquitoes

Bladin Point lacks suitable natural habitat for large-scale breeding of mosquitoes, such as marshes, creeks and rivers. However, as it is now an industrial site there is the clear potential for the creation of man-made mosquito breeding habitat such as depressions created by construction works, stormwater drains and outfalls, as well as artificial receptacles such as empty containers, pipes, blocked drains and evaporation ponds. Storm surges and heavy downpours of rain will also lead to temporary water-ponding.
Artificial receptacles could in particular be potential breeding sites for the exotic dengue-carrying mosquito *Aedes aegypti*, which breeds in stagnant water around human habitations in any form of small container such as guttering, old tyres, buckets and the like. Items of rubbish washed on to the shoreline around Bladin Point could become breeding sites for both the exotic dengue mosquito and for native mosquitoes carrying endemic arboviruses. Any vessel or piece of equipment that can contain water for one to two weeks could become a potential breeding site. While the lack of extensive natural habitat for mosquitoes across the area around the Bladin Point processing plant lessens the requirement for a mosquito control program using insecticides, this assumes that new breeding sites are not created.

The Northern Territory Department of Health's Medical Entomology unit produces an annual northern saltmarsh mosquito pest calendar for the coastal Top End of the Northern Territory, which is available online (Medical Entomology 2015b—see Appendix A). A sample extract from the 2015 calendar can be seen in Appendix D.

3.3.4 Self protection against mosquitoes

Personal protection, such as full-length trousers, long-sleeved shirts, socks and shoes, and the use of insect repellents whose active ingredients are DEET or picaridin, will generally be required, particularly during peak activity time for mosquitoes. The precautionary and application advice on product labels should be carefully followed.

4 KEY ACTIVITIES, IMPACTS AND RISKS

The key activities, potential impacts and residual risk levels identified for biting insects, especially mosquitoes, for the ILNG area are listed in Table 4.1.

Table 4.1: Key activities, impacts and residual risk levels for environmental and human health management

Activity	Potential environmental and human health impact	Residual risk level
Introduction of malaria by staff arriving from high-risk countries	Transmission of malaria parasites to local species of *Anopheles* mosquitoes from infected human carriers.	Low
Use of heavy equipment on unpaved surfaces	Creation of breeding habitat for mosquitoes through the formation of depressions and ruts in soils and mud.	Low
Inappropriate disposal of waste on site	Creation of breeding habitat for mosquitoes in man-made containers and waste items left on site that are capable of ponding water.	Medium
Poorly managed surface-water management systems, e.g. drains, pits, culverts, storage ponds, bunds and skip bins	Creation of breeding habitat for mosquitoes in areas that can pond water and become congested with waste material such as vegetation, rubbish and sediment.	Medium
General activities around the site	Recruits to the workforce having low levels of immunity to biting insects.	Low

5 OBJECTIVES, TARGETS AND INDICATORS

The objectives, targets and indicators for biting-insect management that have been established for ILNG are outlined in Table 5.1.

Table 5.1: Key performance indicators

Objective	Target	Indicator
To prevent the creation of pools of stagnant water that could become breeding habitat for mosquitoes	• No stagnant pools or ponds on site. • No drainage lines, ponds, depressions or drains to contain vegetation, sediment or other waste material which could cause the obstruction of water flow and the pooling of water. • No man-made containers and waste items left on site that are capable of ponding water.	• The number of reported stagnant pools or ponds. • Records of treatment of ponds for mosquitoes. • The number of drainage lines, depressions or drains not being kept clear on the site. • The number of reported man-made receptacles left on site that are capable of ponding water. • The numbers of recorded mosquito pest problems.
To decrease the potential for the spread of mosquito-borne diseases to site personnel	No mosquito–transmitted diseases infecting site personnel.	The number of personnel reported as having been infected with mosquito-transmitted disease.
To decrease the pest problems associated with the presence of biting midges	No workers significantly affected by midge bites	The number of personnel reported as having been adversely affected by biting midges.

6 MANAGEMENT MEASURES

6.1 Control and prevention measures

Mosquitoes and biting midges are likely to adversely affect personnel and visitors at ILNG facility at Bladin Point. The severity of the impact will depend on the time of the year, the levels of immunity of individuals to the various species of biting insect, the issue and use of appropriate PPE and the provision of suitably protected working environments. Sleeves and collars should be kept buttoned Whelan 2011b). Protection is very necessary near areas of salt marsh, mangroves, or large freshwater swamps where the various species of mosquitoes may be very abundant both during the day in shaded situations as well as at night.

Where applicable the best method of avoiding attack is to stay inside insect-screened administration buildings. Screens can be made of galvanised iron, copper, bronze, aluminium or plastic. They should be of the correct mesh, fit tightly and be in good repair. Biting insects frequently follow people into buildings and for this reason screen doors should open outward and have automatic closing devices (Whelan 2011b). Insecticides such as permethrin, deltamethrin, bifenthrin, or alpha-cypermethrin sprayed on or around screens may give added protection against mosquitoes or biting midges, but care is needed as some insecticides can damage and degrade screens, especially those made of plastic.

Relief from biting-insect attack may be obtained by applying repellents to the skin and clothing. Some repellents, for example DEET, can degrade plastics and synthetic fibres such as rayon and care is needed when applying them near mucous membranes such as those around the eyes and lips.

Proprietary formulations containing insect-repelling chemicals such as DEET (*N*,*N*-Diethyl-*m*-toluamide or diethyltoluamide for short) or picaridin (1-Piperidinecarboxylic acid, 2-(2-hydroxyethyl)-1-methylpropyl ester) give good protection, with DEET-based repellents considered to be the most effective. There are a number of plant-derived preparations, but these do not offer sufficient protection. Some repellent products, such as standard Aerogard, which are formulated to repel flies, are generally not efficient against mosquitoes or biting midges. However, brands containing DEET, such as Rid, Tropical Strength Aerogard, Bushman, and Muskol, or products with picaridin such as Repel, are specifically designed to be effective against biting insects. Products with higher amounts of DEET or picaridin are, not surprisingly, usually the more efficient.

Protection from mosquito penetration through open-weave or close-fitting clothes can be obtained by applying a light application of aerosol repellent to the outer surfaces of clothing. Repellents, however, should be employed as a supplement to protective clothing and not as a substitute for clothing.

Personal biting-insect repellents are available as gels, creams or sprays. The gels are best, and creams usually last longer than the aerosol spray formulations. Repellents can prevent bites from one to four hours, depending on the nature of the repellent, the species of biting insect, and the level of physical activity of the user. In general, aerosol alcohol-based repellents will only give one hour's protection in the tropics and therefore reapplications will be necessary. The label "low irritant" on aerosol products generally means that they contain less active ingredient.

Many mosquito and biting-midge species are attracted to white light. The use of yellow or, even better, red incandescent bulbs or fluorescent tubes rather than bulbs or tubes emitting white light will reduce the attractiveness of lights to insects, while lightproof curtains or similar screening can also be very effective in reducing the numbers of biting insects which are attracted to areas that are illuminated at night.

Although the onshore processing plant site is designed to drain freely, care must still be taken to prevent the accidental creation of mosquito breeding sites. All areas of the site—including drains, bunds, and hardstands—must remain free of standing water to prevent mosquitoes from breeding. Any container, receptacle or other item capable of holding water must be prevented from retaining water or must be drained of water on a regular basis.

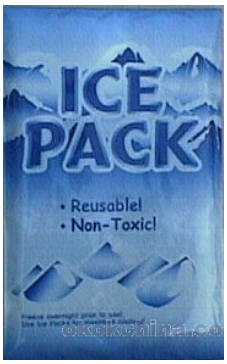
Table 6.1 General insect-bite prevention measures

Measure	Details
Avoidance	Avoid being exposed during peak mosquito feeding periods. For mosquitoes, biting usually takes place from sunset to sunrise with peak biting activity usually in the hour or two after sundown and the hour or two before sunrise. Depending on the season, mosquitoes which bite by day are also likely to affect the site.
Wearing appropriate clothing	Full-length trousers, socks, shoes, and long-sleeved shirts are to be worn by all personnel and visitors at the Bladin Point site. Lighter-coloured clothing is less attractive to mosquitoes than dark clothing. Clothing impregnated with insecticides such as permethrin or bifenthrin will offer more substantial protection.

Measure	Details
Use of repellents	Repellents that are effective include those made up of at least 10% DEET (diethyltoluamide) or 9% picaridin as the active constituent. Repellents have a limited duration of effectiveness and need to be reapplied every one to four hours depending on the nature of the repellent, the species of biting insect, and the level of physical activity of the user.
Use of lights	Many mosquito and biting-midge species are attracted to white light. Yellow or red lighting around buildings will reduce their attractiveness to biting insects.

6.2 Treatment of bites

Relief from bites and the prevention of secondary infection can be obtained by the application of various proprietary ointments, lotions, etc., direct to the skin. The efficacy of these is variable, and depends on individual reactions. Skin application products include Eurax, Stingose, Medicreme, Katers Lotion, Dermacaine and Paraderm cream as well as topical antihistamine sprays and creams and non-proprietary products such as tea tree oil, eucalyptus oil, aloe vera gel, ice, and methylated spirits. Some people have had good results from the application of pawpaw ointment following bite reactions, both in reducing the itching and in facilitating the healing process.



Ice packs applied to the general bite sites will usually provide immediate relief from painful, itchy bites and swellings or blisters from mosquitoes and biting midges in particular. The sooner the ice pack is applied after bites or reactions to bites, the more effective the relief; this can often prevent more intense reactions.

Other off the shelf products for more general symptoms include oral antihistamine products such as Phenergan, Telfast and Vallergan. A doctor or pharmacist should be consulted for advice on the latest products and for safety information.

Table 6.2 details the appropriate actions to take to address human-health issues associated with biting insects at the Bladen Point onshore processing plant.

Table 6.2: Biting-insect mitigation measures

No.	Mitigation measure	Reference	Timing	Responsibility
	INDUCTIONS			
6.1	The health, safety, environment and security (HSES) site induction will explain the biting-insect risks, outline the PPE required to minimise the impact of biting insects and advise on the availability and use of personal repellents. It will also inform personnel and visitors of any current or expected severe biting-insect problems at the Bladin Point onshore processing plant as indicated by the biting-midge and salt marsh mosquito pest calendars produced by the Northern Territory's Department of Health (Medical Entomology 2015a, 2015b).	Good international industry practice (GIIP) Department of Health (DoH)	All ILNG personnel and visitors to undertake induction prior to entering the processing-plant site.	HSE Team Lead
6.2	Records will be maintained for all facility inductions.	GIIP	After each induction.	HSE Team Lead
6.3	Biting-insect pest calendars will be made available to all staff and visitors to inform them of high-risk periods for mosquitoes and biting midges during the year. These periods are associated with tidal cycles, lunar cycles and seasons.	GIIP DoH	At all times.	HSE Team Lead
6.4	Personnel and visitors will be told how to identify the early symptoms of mosquito-transmitted diseases and will be advised on the reporting mechanism to notify management of any suspected illness.	GIIP DoH	As required.	HSE Team Lead
	PERSONAL PROTECTIVE EQUIPMENT			
6.5	All site personnel and visitors shall wear appropriate PPE at all times.	GIIP DoH	Appropriate PPE to be worn at all times.	All site personnel and visitors

No.	Mitigation measure	Reference	Timing	Responsibility
	SAFE INDOOR WORKING ENVIRONMENTS			
6.6	Where practicable all offices, mess rooms, guardhouses and similar facilities will be fully sealed and air-conditioned. They should have doors that open outwards as this helps to prevent the entry of biting insects.	GIIP DoH	At all times.	HSE Team Lead/Maintenance Manager
6.7	Were applicable windows will have midge mesh fitted to them to exclude biting insects.	GIIP DoH	At all times.	HSE Team Lead/Maintenance Manager
	INTRODUCTION OF DISEASES			
6.8	Staff returning from countries which are deemed to be high-risk for malaria and who exhibit fever symptoms will be required to leave the Bladin Point site until medically cleared of carrying malaria.	GIIP DoH	As required.	All site personnel
	BITING INSECT HABITAT			
6.9	Where practicable depressions in the ground that pond with tidal water or rainwater will be filled in or have a drainage system installed to eliminate potential sites for mosquito-breeding.	GIIP DoH	At all times.	Maintenance Manager
6.10	Where practicable ground will be graded to be free of depressions capable of ponding water for periods greater than three consecutive days in tidal areas and five days in onshore areas, to prevent the possibility of mosquitoes breeding.	GIIP	At all times.	Maintenance Manager or Production Manager
6.11	Any form of receptacle containing ponded water should be disposed of, stored under cover, have drainage holes drilled in it, or treated with an appropriate insecticide on an appropriate schedule.	GIIP DoH	As required.	All site personnel

No.	Mitigation measure	Reference	Timing	Responsibility
6.12	Storage and evaporation ponds will be inspected weekly and appropriate treatment measures will be undertaken (by using larvicides or draining the water) if insect larvae are detected.	GIIP DoH	Weekly.	HSE Team Lead/Production Manager
6.13	Water storage ponds will be designed with steep sides (with a 1:2 slope or greater) and will be relatively deep (>1 metre), to minimise the potential for semiaquatic vegetation to develop and for mosquito-breeding to occur.	GIIP DoH	As required.	HSE Team Lead/Production Manager
6.14	Drains will be kept free of vegetation and other flow obstructions, and regular monitoring will be scheduled to ensure that this is done.	GIIP DoH	At all times.	Maintenance Manager
	MONITORING AND INSPECTIONS			
6.15	Regular inspections for mosquito larvae in high-risk areas will be conducted, for example in temporary sedimentation basins, and controls will be implemented as required.	GIIP DoH	Weekly.	HSE Team Lead/Maintenance Manager
6.16	Inspections of PPE use by onshore processing plant personnel and visitors. Records will be maintained of all site inspections.	GIIP DoH	Vigilance must be exercised during the peak periods for biting-insect activity. Weekly inspections of staff and visitors' PPE.	HSE Team Lead

No.	Mitigation measure	Reference	Timing	Responsibility
6.17	Inspections of buildings will be carried out to repair insect screens and/or window and door seals and to assess if there is ponding of water around and underneath buildings and other structures.	GIIP DoH	Monthly inspections of buildings for security of insect screens and seals, and to check for ponding water around structures.	Maintenance Manager
6.18	Regular wet-season site inspections of man-made containers and waste items that are capable of ponding water.	GIIP DoH	Once a week during the wet season and during regular inspections of the plant facilities during the year.	Maintenance Manager /Production Manager/Waste contractor
6.19	A maintenance program will be established to de-silt or clear vegetation from stormwater drains and to remediate any erosion in drains and discharge sites.	GIP DoH	Annually and as required.	HSE Team Lead/Maintenance Manager

7 TRIGGER–ACTION–RESPONSE PLAN

Where visual inspections and/or monitoring indicate that there is a deviation from expected results, the trigger–action–response plan (TARP) described in Table 7.1 will be initiated.

Table 7.1: Biting-insects management trigger–action–response plan (TARP)

Responsibility	Normal situation	Level 1	Level 2
	• Personnel and/or visitors are not affected by biting insects. • No new breeding habitats are created. • Existing populations of biting insects are managed effectively. • No exotic mosquito-transmitted diseases are introduced on site.	**Trigger:** • Personnel and/or visitors report nuisance of biting insects. • Ponding water is noted on site that cannot be immediately rectified. • Biting-insect control management methods are not effective.	**Trigger:** • Personnel and/or visitors become ill after being bitten by insects. • Breeding of insects is noted in ponded water. • Biting-insect control management methods are not effective.
Site personnel and visitors	• Wear PPE and monitor biting insects. • Advise HSE Team Lead if recently returned from an overseas country with know mosquito-transmitted diseases.	Report to the HSE Team Lead.	• Report to the HSE Team Lead. • Follow instructions from the HSE Team Lead to remove ponded water. • Attend the site first-aid facility or, if advised by first-aid staff, a medical clinic or the nearest hospital.
HSE Team Lead/Production Manager/Mainteance Manager	Wear PPE and monitor biting insects.	• Review PPE issue and use. • Drain ponded water from site. • Review site operations that might create breeding	• Staff who are ill on site are to be taken to a first-aid facility and, if so advised by first-aid staff, are to be transported to the closest medical centre or hospital. • Communicate any

Responsibility	Normal situation	Level 1	Level 2
		habitat.	reported illness caused by biting insects to all staff and identify symptoms that they can self-assess for. • Consult with the Department of Health regarding the illness caused by biting insects. • Engage suitably trained person/s to undertake a site survey of biting insects. • Undertake biting-insect control to actively remove new breeding habitats.

8 APPENDICES

APPENDIX A: REFERENCE LIST FOR GUIDELINES, FACT SHEETS, ETC., DEALING WITH BITING INSECTS IN THE NORTHERN TERRITORY

APPENDIX B: DISEASE-CAUSING ARBOVIRUSES AND THEIR MOSQUITO VECTORS IN THE NORTHERN TERRITORY

APPENDIX C: MALARIA IN THE NORTHERN TERRITORY

APPENDIX D: SAMPLES OF BITING-MIDGE AND SALT MARSH MOSQUITO PEST CALENDARS FOR THE COASTAL TOP END OF THE NORTHERN TERRITORY FOR 2015

Appendix A: Reference list for guidelines, fact sheets, etc., dealing with biting insects in the Northern Territory

The following guidelines and related sources of information are available from the Medical Entomology unit of the Centre for Disease Control in the Northern Territory's Department of Health in relation to biting insects, their prevention and their control.

Centre for Disease Control. 2012. *Malaria*. Fact sheet prepared by the Medical Entomology unit, Centre for Disease Control, Department of Health, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://health.nt.gov.au/Centre_for_Disease_Control/Publications/CDC_Factsheets/index.aspx>.

Centre for Disease Control. 2013a. *Murray Valley encephalitis (MVE)*. Fact sheet prepared by the Medical Entomology unit, Centre for Disease Control, Department of Health, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://health.nt.gov.au/Centre_for_Disease_Control/Publications/CDC_Factsheets/index.aspx>.

Centre for Disease Control. 2013b. *Ross River virus*. Fact sheet prepared by the Medical Entomology unit, Centre for Disease Control, Department of Health, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://health.nt.gov.au/Centre_for_Disease_Control/Publications/CDC_Factsheets/index.aspx>.

Centre for Disease Control. 2013c. *Barmah Forest virus*. Fact sheet prepared by the Medical Entomology unit, Centre for Disease Control, Department of Health, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://health.nt.gov.au/Centre_for_Disease_Control/Publications/CDC_Factsheets/index.aspx>.

Centre for Disease Control. 2014a. *Mosquito-borne diseases*. Fact sheet prepared by the Medical Entomology unit, Centre for Disease Control, Department of Health, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://health.nt.gov.au/library/scripts/objectifyMedia.aspx?file=pdf/45/02.pdf&siteID=1&str_title=Mosquitoes.pdf>.

Centre for Disease Control. 2014b. *Dengue fever*. Fact sheet prepared by the Medical Entomology unit, Centre for Disease Control, Department of Health, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://health.nt.gov.au/Centre_for_Disease_Control/Publications/CDC_Factsheets/index.aspx>.

Department of Health. 2012. Imported malaria in the Northern Territory, Australia—428 consecutive cases. *Communicable Diseases Intelligence* 36(1):

107–113. Viewed online on 24 February 2015 at <http://www.ncbi.nlm.nih.gov/pubmed/23153087>.

Jeffery, J.A.L., Kay, B.H. and Ryan, P.A. 2006. Role of *Verrallina funerea* (Diptera: Culicidae) in transmission of Barmah Forest virus and Ross River virus in coastal areas of eastern Australia. *Journal of Medical Entomology* 43(6): 1239–1247. Viewed online on 24 February 2015 at <http://www.ncbi.nlm.nih.gov/pubmed/17162959>.

Medical Entomology. 2014. *Guidelines for preventing biting insect problems for urban residential developments or subdivisions in the Top End of the NT*. Guidelines prepared for the Department of Health, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://www.health.nt.gov.au/library/scripts/objectifyMedia.aspx?file=pdf/32/39.pdf&siteID=1&str_title=Guidelines for preventing biting insect problems for urban residential developments and subdivisions.pdf>. [Appendix 1 to these guidelines is the report *Guidelines on urban mosquito control drains*.]

Medical Entomology. 2015a. *Biting midge pest calendar for the coastal Top End NT 2015*. Report prepared by the Medical Entomology unit, Centre for Disease Control, Department of Health, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://www.health.nt.gov.au/medical_entomology/insect_pest_periods/index.aspx>.

Medical Entomology. 2015b. *Salt marsh mosquito pest calendar for the coastal Top End NT 2015*. Report prepared by the Medical Entomology unit, Centre for Disease Control, Department of Health, Darwin, Northern Territory. Viewed online on 24 February 2014 at <http://www.health.nt.gov.au/medical_entomology/insect_pest_periods/index.aspx>.

New South Wales Government. 2012. *Kunjin virus disease*. Communicable Diseases Factsheet prepared by the Ministry of Health, New South Wales Government, Sydney, New South Wales. Viewed online on 24 February 2015 at <http://www.health.nsw.gov.au/Infectious/factsheets/Pages/Kunjin_virus.aspx>.

Russell, R. C. and Kay, B.H. 2004. Medical entomology: changes in the spectrum of mosquito-borne disease in Australia and other vector threats and risks, 1972–2004. *Australian Journal of Entomology* 43(3): 271–282. Viewed online on 24 February 2015 at <http://espace.library.uq.edu.au/view/UQ:201260>.

University of Queensland. (Undated). *Arboviruses*. School of Biological Sciences, University of Queensland, St Lucia, Brisbane, Queensland. Viewed online on 24 February 2014 at <http://www.biology.uq.edu.au/arboviruses>.

URS Australia Pty Ltd. 2011. *East Arm Wharf Expansion Project: draft environmental impact statement*. Report prepared by URS Australia Pty Ltd, Darwin, for the Department of Lands and Planning, Darwin, Northern Territory.

Chapter 19 viewed online on 24 February 2015 at <http://www.ntepa.nt.gov.au/__data/assets/pdf_file/0017/7442/ch19.pdf>.

Warchot, A. and Whelan, P.I. 2008. *Constructed wetlands in the Northern Territory: guidelines to prevent mosquito breeding*. Guidelines prepared for the Department of Health and Families, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://www.health.nt.gov.au/library/scripts/objectifyMedia.aspx?file=pdf/32/38.pdf&siteID=1&str_title=Constructed Wetlands in the NT - guidelines to preventing mosquito breeding.pdf>.

Whelan, P.I. 1997a. *Problem mosquito species in the Top End of the NT: pest and vector status, habitats and breeding sites*. Report prepared for the Medical Entomology Branch, Department of Health and Community Services, Northern Territory Government, Darwin, Northern Territory.

Whelan, P.I. 1997b. *Arbovirus disease risk periods in the Northern Territory*. Report prepared for the Medical Entomology Branch, Department of Health and Community Services, Northern Territory Government, Darwin, Northern Territory.

Whelan, P.I. 2003. Biting midges or 'sandflies' in the Northern Territory. *The Northern Territory Disease Control Bulletin* 10(3): 1–9. Viewed online on 24 February 2015 at <http://www.education.nt.gov.au/__data/assets/pdf_file/0014/3713/BitingMidge.pdf>.

Whelan, P.I. 2009. *Guidelines for preventing biting insect problems for new rural residential developments or subdivisions in the Top End of the NT*. Guidelines prepared for the Department of Health and Families, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://www.health.nt.gov.au/library/scripts/objectifyMedia.aspx?file=pdf/41/38.pdf&siteID=1&str_title=Guidelines%20for%20preventing%20mosquito%20problems%20for%20new%20rural%20residential.pdf>.

Whelan, P.I. 2011a. *Guidelines for preventing mosquito breeding associated with construction practice near tidal areas in the NT*. Guidelines prepared for the Department of Health, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://www.health.nt.gov.au/library/scripts/objectifyMedia.aspx?file=pdf/32/37.pdf&siteID=1&str_title=Construction practice near tidal areas - guidelines to prevent mosquito breeding.pdf>. [Appendix 1 to these guidelines is the report *Previous mosquito problems in the Top End of the NT created by construction practice*.]

Whelan, P.I. 2011b. *Personal protection from mosquitoes and biting midges in the NT*. Report prepared for the Department of Health and Families, Northern Territory Government, Darwin Northern Territory. Viewed online on 24 February 2015 at

<http://digitallibrary.health.nt.gov.au/prodjspui/bitstream/10137/264/3/Personal%20protection%20from%20mosquitoes%20and%20%20biting%20midges%20in%20the%20NT%2025%20OCT%202011_5_doc.pdf>.

Whelan, P.I. and Warchot, A. 2009. *Mosquito breeding and sewage pond treatment in the Northern Territory*. Fact sheet prepared for the Department of Health and Families, Northern Territory Government, Darwin, Northern Territory. Viewed online on 24 February 2015 at <http://www.health.nt.gov.au/library/scripts/objectifyMedia.aspx?file=pdf/41/54.pdf&siteID=1&str_title=Mosquito%20breeding%20and%20sewage%20pond%20treatment%20in%20the%20NT.pdf>.

Appendix B: Disease-causing arboviruses and their mosquito vectors in the Northern Territory

The principal vectors of arboviruses (*ar*thropod-*bo*rne *viruses*) in Australia are mosquitoes. However, of the approximately 100 mosquito species found in the Northern Territory only about 20 are pest or problem species (Centre for Disease Control 2014a). Some of these are capable of spreading arboviruses.

In terms of their potential to transmit arboviruses to humans, the most important mosquitoes in the Territory are the following:

- *Aedes normanensis* (floodwater mosquito)
- *Aedes notoscriptus* (backyard mosquito)
- *Aedes vigilax* (northern saltmarsh mosquito)
- *Culex annulirostris* (common banded mosquito)
- *Culex sitiens* (saltwater culex mosquito)
- *Verrallina funerea* (brackish water mosquito).

Murray Valley encephalitis virus, Kunjin virus, Ross River virus and Barmah Forest virus are the arboviruses known to cause human disease in the Territory. These are discussed below, along with dengue virus which is currently absent from the Northern Territory.

Murray Valley encephalitis virus (MVEV)

Vector: The principal vector of Murray Valley encephalitis virus is *Culex annulirostris* (the common banded mosquito) (Whelan 1997a).

Description: Murray Valley encephalitis is the most serious of the arbovirus diseases encountered in the Northern Territory. Outbreaks are rare, however, and only occur towards the end of the wet season and the beginning of the dry season (Centre for Disease Control 2013a, 2014a).

Symptoms: The majority of MVEV infections are subclinical, that is, they do not produce disease symptoms, although some people may experience a mild form of the disease with symptoms such as fever, headaches, nausea and vomiting; only a very small number of these cases go on to develop Murray Valley encephalitis. It has been estimated that only 1 in 800–1000 of all infections result in the full-blown disease and there are usually only one or two cases of the disease each year in the Territory (Centre for Disease Control 2014a). Typical symptoms include a severe initial fever that may lead to seizures (especially in young children), potentially leading to delirium, coma or permanent brain

damage. The disease is fatal in about one-third of clinical cases (University of Queensland undated).

Risk period: The probable main risk period is from January to July, with a peak from March to May (Whelan 1997b).

Kunjin virus (KUNV)

Vector: The principal vector of Kunjin virus is *Culex annulirostris* (the common banded mosquito).

Description: Kunjin virus disease is a rare arbovirus disease similar to but generally milder than Murray Valley encephalitis (Centre for Disease Control 2014a). It occurs widely in Australia but is mostly reported from Western Australia and the Northern Territory.

Symptoms: The vast majority of infections do not show symptoms. A small number of people develop mild illness, with fever, enlarged lymph nodes, rashes, swollen and aching joints, headaches, muscle weakness and fatigue. Some people with Kunjin virus disease may develop encephalitis, a severe brain infection which may require hospitalisation (New South Wales Government 2012). However, it has not been responsible for fatalities in the Northern Territory (Russell & Kay 2004). The risk of infection by the Kunjin virus is similar to that of the Murray Valley encephalitis virus.

Risk period: The probable main risk period is from January to July, with a peak from March to May (Whelan 1997b).

Ross River virus (RRV)

Vector: The principal vectors of Ross River virus are *Aedes vigilax* (the northern saltmarsh mosquito) and *Culex annulirostris* (the common banded mosquito). *Verrallina funerea* (Jeffery, Kay & Ryan 2006), *Culex sitiens* and *Aedes notoscriptus* are also potential vectors.

Description: Ross River virus disease is the most common of the arbovirus diseases encountered in the Northern Territory and, indeed, Australia (Russell & Kay 2004). The risk of human infection is high because of the abundance and wide distribution of the animal hosts of RRV (usually marsupials such as kangaroos and wallabies) in the coastal areas of the Northern Territory. There

are usually between 250 and 450 cases a year in the Territory (Centre for Disease Control 2014a).

Symptoms: The symptoms of Ross River virus disease vary from person to person and may appear within 3 days to 3 weeks of the bite being inflicted, most commonly within 7 to 14 days. The illness generally begins with painful (sometimes swollen) joints and muscle and tendon pain. The most commonly affected joints are the ankles, fingers, knees and wrists. The pain usually develops rapidly, may be intense, and may be more severe in different joints at different times. Other symptoms include a raised red rash (affecting mostly the limbs and trunk), fever, fatigue, headache, light intolerance and swollen glands. Less-common symptoms include sore eyes and throat, nausea and tingling in the palms of the hands or soles of the feet. Fever, nausea and the skin rash usually disappear within the first one or two weeks of illness. Joint, muscle and tendon pain may last much longer, and can be distressing. Some people also have lingering fatigue, lethargy and depression (Centre for Disease Control 2013b).

Risk period: In the Northern Territory, the main risk season for Ross River virus infection is from December to March inclusive, with the highest risk period in January when large numbers of mosquitoes appear as a result of either high tides or increased rainfall (Centre for Disease Control 2013b).

Barmah Forest virus (BFV)

Vector: The principal vectors of Barmah Forest virus in the Northern Territory are *Aedes vigilax* (the northern saltmarsh mosquito), *Culex annulirostris* (the common banded mosquito), *Aedes normanensis* (the floodwater mosquito) and *Aedes notoscriptus* (the backyard mosquito) (Centre for Disease Control 2013c). *Verrallina funerea* is also a potential vector (Jeffery, Kay & Ryan 2006).

Description: Barmah Forest virus disease is the second most common arbovirus disease after Ross River virus disease in the Northern Territory. It is characterised by painful or swollen joints lasting from days to months. The symptoms usually settle by themselves. There are usually 50 to 130 cases a year in the Northern Territory (Centre for Disease Control 2014a).

Symptoms: The symptoms of Barmah Forest virus disease vary from person to person and most commonly appear within 3 to 11 days of the bite being inflicted. Although the symptoms of the disease are similar to those of Ross River virus disease, the effects are generally milder. Symptoms include painful (sometimes swollen) joints along with muscle and tendon pain. The most commonly affected joints are the ankles, fingers, knees and wrists. Other

symptoms include a raised red rash affecting the limbs and trunk (this may be more florid than the rash of Ross River virus disease), fever, fatigue, and headache. The fever, nausea and skin rash usually disappear within the first one or two weeks of illness. In a minority of cases lethargy, joint, muscle and tendon pain may last for over six months. Symptoms subside eventually and leave few or no after-effects. It is not possible at present to say how long an individual will take to get better (Centre for Disease Control 2013c).

Risk period: The main risk season for Barmah Forest virus infection is from October to July, with a peak in January to March; it should be noted, however, that transmission of the virus can occur during all months (Whelan 1997b).

Dengue virus (DENV)

Vector: The principal vector of dengue virus is *Aedes aegypti* (the dengue mosquito).

Description: Dengue fever is a viral illness caused by infection with any one of four types of the dengue virus. *Aedes aegypti*, the mosquito which acts as a vector for dengue virus, disappeared from the Northern Territory in the 1950s with no cases of dengue fever having been transmitted in the Territory since then. The mosquito is found in nearby countries and in northern Queensland and could potentially be accidentally reintroduced into the Territory (Centre for Disease Control 2014a). It is imported periodically into Darwin on overseas vessels such as foreign fishing vessels and cargo ships, but has been detected and eliminated each time. It was imported into Tennant Creek from Queensland in 2004 and 2011 and on to Groote Eylandt in 2006. Surveys continue in the Territory to ensure the early detection and identification of any importation of the mosquito. For the past 60 years all persons notified with dengue fever in the Territory have been interviewed to confirm that the disease was acquired in known dengue endemic areas overseas or in north Queensland. Between 2003 and 2013, 404 cases of dengue were notified in the Northern Territory. These infections were acquired mostly in Indonesia or East Timor (Centre for Disease Control 2014b).

Symptoms: It usually takes 3 to 14 days (commonly 4 to 7 days) between getting bitten by a dengue-infected mosquito and becoming sick. Dengue fever is more commonly seen in older children and adults. It is characterised by abrupt onset of high fever lasting 3 to 7 days, severe frontal headache, pain behind the eyes and muscle and joint pains. Other symptoms may include loss of appetite, nausea, vomiting and diarrhoea, a blanching rash and sometimes minor bleeding (for example from the nose and gums). The acute symptoms of

dengue fever last up to 10 days. Some people may experience repeated episodes of fever. Full recovery may be slow and associated with weakness and depression. It is rarely fatal. Dengue haemorrhagic fever on the other hand is most commonly seen in children under 15 years of age but can also occur in adults. It begins with the same symptoms as dengue fever but is followed by rapid deterioration, bleeding and cardiovascular collapse 2 to 5 days later. The duration of dengue haemorrhagic fever depends on the severity of the illness and response to treatment. It can be fatal (Centre for Disease Control 2014b).

Risk period: Although the mosquito vector *Aedes aegypti* and the dengue virus do not presently occur in the Northern Territory, if the vector and virus should reappear, the risk period would be the wet-season summer months from November to March.

Appendix C: Malaria in the Northern Territory

Malaria is not caused by a virus but by a protozoan parasite of the genus *Plasmodium*. The most common forms of human malaria in the countries around Australia are caused by the species *Plasmodium ovale*, *P. malariae*, *P. knowlesi*, *P. vivax*, and *P. falciparum* (Centre for Disease Control 2012).

The last local malaria case occurred in the Northern Territory in 1962 and Australia was certified malaria-free in 1981. While mosquitoes capable of spreading the malaria parasite are present in the Territory, the disease itself has been eliminated. The parasite could be reintroduced into the Territory by infected people returning or visiting from overseas and infecting local *Anopheles* mosquitoes (Centre for Disease Control 2014a). As an average of 600 cases occur in Australia each year in travellers or refugees infected elsewhere (Department of Health 2012), this is a situation that has to be monitored.

Vector: The principal potential vectors of malaria in the Northern Territory are all members of the genus *Anopheles*: *A. farauti*, *A. annulipes*, *A. hilli*, *A. bancroftii*, and *A. amictus* (URS Australia Pty Ltd 2011).

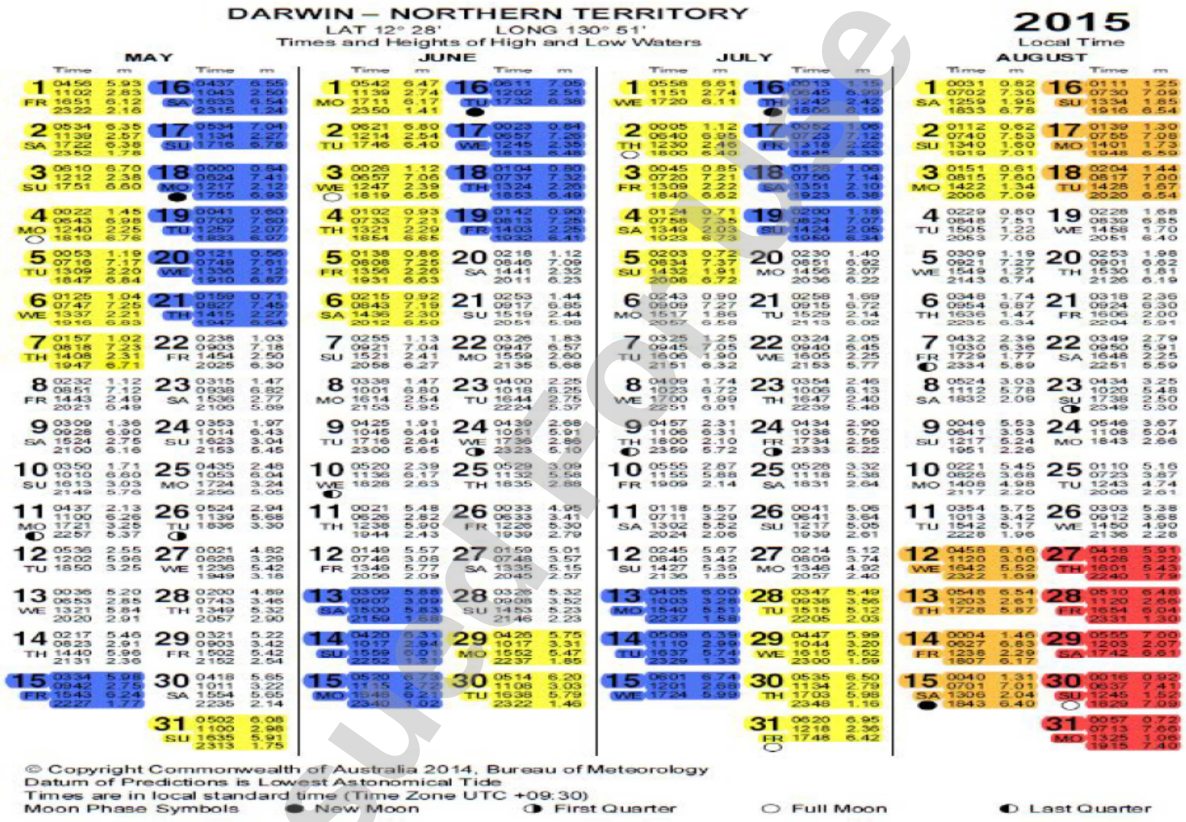
Symptoms: Symptoms appear about 9 to 14 days after a bite from an infected mosquito, and coincide with the rupture of red blood cells. Symptoms are often delayed in people who have lived in malarious areas and who may have developed some immunity. Typically malaria produces fever, rigours (shakes), sweating, headache, vomiting and other flu-like symptoms. Sometimes there is a two- or three-day period of reduced symptoms before a recurrence on the third or fourth day. Untreated, infection can progress rapidly and become life-threatening. Malaria can kill by destroying red blood cells (causing anaemia) and by altering the function of vital organs such as the brain (in "cerebral" malaria), the lungs or the kidneys (Centre for Disease Control 2012).

Risk period: Although malaria parasites do not presently occur in the *Anopheles* mosquitoes of the Northern Territory, if they should become established, the high-risk period would be the wet-season summer months from November to June.

Appendix D: Samples of biting-midge and saltmarsh mosquito pest calendars for the coastal Top End of the Northern Territory for 2015

The calendar pages reproduced in sections 8.4.1 and 8.4.2 have been abstracted from Medical Entomology (2015a) and Medical Entomology (2015b) (see Appendix A above). The calendars are updated annually.

Sample of the biting-midge pest calendar for the coastal Top End of the Northern Territory: May–August 2015



DARWIN – NORTHERN TERRITORY

LAT 12° 28' LONG 130° 51'

Times and Heights of High and Low Waters

2015

Local Time

MAY

	Time	m		Time	m
1 FR	0456	5.93	16 SA	0437	6.55
	1102	2.83		1043	2.50
	1651	5.12		1635	6.54
	2322	2.16		2315	1.24
2 SA	0534	6.35	17 SU	0534	7.04
	1139	2.57		1134	2.27
	1722	6.38		1716	6.78
	2352	1.78			
3 SU	0610	6.70	18 MO	0000	0.84
	1212	2.38		0624	7.41
	1751	6.60		1217	2.12
				1755	6.93
4 MO	0022	1.45	19 TU	0041	0.60
	0643	6.98		0709	7.60
	1240	2.25		1257	2.07
	1824	6.78		1834	6.97
5 TU	0053	1.19	20 WE	0121	0.56
	0716	7.17		0749	7.61
	1309	2.20		1336	2.12
	1847	6.84		1910	6.87
6 WE	0125	1.04	21 TH	0159	0.71
	0747	7.25		0827	7.45
	1337	2.21		1415	2.27
	1916	6.83		1947	6.64
7 TH	0157	1.02	22 FR	0238	1.03
	0818	7.23		0903	7.18
	1408	2.31		1454	2.50
	1947	6.71		2025	6.30
8 FR	0232	1.12	23 SA	0315	1.47
	0851	7.12		0938	6.82
	1443	2.49		1536	2.77
	2021	6.49		2100	5.89
9 SA	0309	1.36	24 SU	0353	1.97
	0928	6.90		1014	6.43
	1524	2.75		1623	3.04
	2100	6.16		2153	5.45
10 SU	0350	1.71	25 MO	0435	2.48
	1010	6.60		1053	3.04
	1613	3.03		1724	3.24
	2149	5.78		2256	5.05
11 MO	0437	2.13	26 TU	0524	2.94
	1100	6.29		1139	5.65
	1721	3.25		1836	3.30
	2257	5.37			
12 TU	0538	2.55	27 WE	0021	4.82
	1202	5.96		0628	3.29
	1850	3.25		1236	5.42
				1949	3.18
13 WE	0036	5.20	28 TH	0200	4.89
	0653	2.85		0743	3.46
	1321	5.84		1349	5.32
	2020	2.91		2057	2.90
14 TH	0217	5.46	29 FR	0321	5.22
	0823	2.91		0903	3.42
	1440	5.98		1502	5.42
	2131	2.36		2152	2.54
15 FR	0334	5.98	30 SA	0418	5.65
	0942	2.79		1011	3.22
	1543	6.24		1554	5.65
	2227	1.73		2235	2.14
			31 SU	0502	6.08
				1100	2.98
				1635	5.91
				2313	1.75

JUNE

	Time	m		Time	m
1 MO	0542	6.47	16 TU	0611	7.05
	1139	2.74		1202	2.51
	1711	6.17		1732	6.38
	2350	1.41			
2 TU	0621	6.80	17 WE	0023	0.84
	1214	2.54		0657	7.28
	1746	6.40		1245	2.35
				1813	6.48
3 WE	0028	1.12	18 TH	0104	0.80
	0657	7.06		0737	7.32
	1247	2.39		1324	2.20
	1819	6.56		1853	6.49
4 TH	0102	0.93	19 FR	0142	0.90
	0733	7.21		0813	7.25
	1321	2.29		1403	2.15
	1854	6.65		1933	6.43
5 FR	0138	0.86	20 SA	0218	1.12
	0808	7.25		0846	7.09
	1356	2.26		1441	2.32
	1931	6.63		2011	6.23
6 SA	0215	0.92	21 SU	0253	1.44
	0843	7.19		0917	6.85
	1436	2.30		1519	2.44
	2012	6.50		2051	5.99
7 SU	0255	1.13	22 MO	0326	1.83
	0921	7.04		0947	6.57
	1521	2.41		1559	2.60
	2058	6.27		2135	5.68
8 MO	0338	1.47	23 TU	0409	2.25
	1001	6.80		1018	6.25
	1614	2.54		1644	2.75
	2153	5.95		2224	5.37
9 TU	0425	1.91	24 WE	0439	2.66
	1045	6.49		1051	5.91
	1716	2.64		1736	2.86
	2300	5.65		2323	5.10
10 WE	0520	2.39	25 TH	0529	3.09
	1138	6.17		1132	5.58
	1828	2.83		1835	2.88
11 TH	0021	5.48	26 FR	0033	4.95
	0628	2.82		0633	3.41
	1238	5.99		1226	5.30
	1944	2.43		1939	2.79
12 FR	0149	5.57	27 SA	0159	5.01
	0748	3.08		0748	3.57
	1349	5.77		1335	5.15
	2058	2.09		2045	2.57
13 SA	0309	5.88	28 SU	0328	5.32
	0907	3.09		0908	3.52
	1500	5.83		1453	5.23
	2150	1.88		2146	2.23
14 SU	0420	6.31	29 MO	0426	5.75
	1017	2.94		1017	5.31
	1559	6.01		1552	5.47
	2252	1.61		2237	1.85
15 MO	0520	6.73	30 TU	0514	6.20
	1115	2.82		1108	5.03
	1648	6.23		1638	5.79
	2340	1.02		2322	1.46

JULY

	Time	m		Time	m
1 WE	0558	6.61	16 TH	0013	1.15
	1151	2.74		0645	5.99
	1720	6.11		1242	2.42
				1805	5.78
2 TH	0005	1.12	17 FR	0052	1.06
	0640	6.95		0723	7.12
	1230	2.46		1318	2.22
	1800	6.40		1845	6.48
3 FR	0045	0.85	18 SA	0133	1.06
	0720	7.21		0756	7.14
	1309	2.22		1351	2.10
	1840	6.62		1923	6.38
4 SA	0124	0.71	19 SU	0200	1.18
	0758	7.35		0824	7.07
	1349	2.03		1424	2.05
	1923	6.73		1950	6.34
5 SU	0203	0.72	20 MO	0230	1.40
	0834	7.37		0851	6.92
	1432	1.91		1456	2.07
	2008	6.72		2036	6.22
6 MO	0243	0.90	21 TU	0258	1.69
	0909	7.27		0915	6.72
	1517	1.86		1529	2.14
	2057	6.58		2113	6.02
7 TU	0325	1.25	22 WE	0324	2.05
	0945	7.05		0940	6.45
	1606	1.90		1605	2.25
	2151	6.32		2153	5.77
8 WE	0409	1.74	23 TH	0354	2.46
	1023	6.72		1006	6.13
	1700	1.99		1647	2.40
	2251	6.01		2239	5.48
9 TH	0457	2.31	24 FR	0434	2.90
	1106	6.31		1038	5.78
	1800	2.10		1734	2.55
	2359	5.72		2333	5.22
10 FR	0555	2.87	25 SA	0528	3.32
	1155	5.88		1126	5.38
	1909	2.14		1831	2.64
11 SA	0118	5.57	26 SU	0041	5.06
	0711	3.29		0641	3.64
	1302	5.52		1217	5.05
	2024	2.09		1939	2.61
12 SU	0245	5.67	27 MO	0214	5.12
	0840	3.42		0809	3.74
	1427	5.39		1346	4.92
	2136	1.85		2057	2.40
13 MO	0405	6.00	28 TU	0347	5.49
	1003	3.28		0938	3.56
	1540	5.51		1515	5.12
	2237	1.58		2205	2.03
14 TU	0509	6.39	29 WE	0447	5.99
	1110	3.09		1044	3.20
	1637	5.74		1615	5.52
	2329	1.33		2300	1.59
15 WE	0601	6.74	30 TH	0535	6.50
	1201	2.88		1134	2.78
	1724	5.99		1703	5.98
				2348	1.16
			31 FR	0620	6.95
				1218	2.38
				1748	6.42

AUGUST

	Time	m		Time	m
1 SA	0031	0.82	16 SU	0111	1.25
	0702	7.30		0730	7.09
	1259	1.95		1334	1.85
	1853	6.78		1916	6.54
2 SU	0112	0.62	17 MO	0139	1.30
	0740	7.53		0755	7.08
	1349	1.60		1401	1.73
	1919	7.01		1948	6.59
3 MO	0151	0.61	18 TU	0204	1.44
	0815	7.60		0817	7.00
	1422	1.34		1428	1.67
	2006	7.09		2029	6.54
4 TU	0229	0.60	19 WE	0228	1.68
	0848	7.51		0839	6.85
	1505	1.22		1458	1.70
	2053	7.00		2051	6.40
5 WE	0309	1.19	20 TH	0253	1.98
	0921	7.27		0901	6.62
	1549	1.27		1530	1.81
	2143	6.74		2126	6.19
6 TH	0348	1.74	21 FR	0318	2.36
	0954	6.87		0924	6.30
	1636	1.47		1606	2.00
	2235	6.34		2204	5.91
7 FR	0432	2.39	22 SA	0349	2.79
	1030	6.36		0950	5.91
	1729	1.77		1648	2.25
	2334	5.89		2251	5.59
8 SA	0524	3.03	23 SU	0434	3.25
	1112	5.78		1020	5.48
	1832	2.09		1738	2.50
				2349	5.30
9 SU	0046	5.53	24 MO	0546	3.67
	0641	3.53		1108	5.04
	1217	5.24		1843	2.66
	1951	2.26			
10 MO	0221	5.45	25 TU	0110	5.16
	0826	3.68		0723	3.87
	1408	4.98		1243	4.74
	2117	2.20		2008	2.61
11 TU	0354	5.75	26 WE	0303	5.38
	1013	3.42		0912	3.68
	1542	5.17		1450	4.90
	2228	1.96		2136	2.28
12 WE	0458	6.16	27 TH	0418	5.91
	1120	3.00		1028	3.22
	1642	5.52		1601	5.43
	2322	1.69		2240	1.78
13 TH	0548	6.54	28 FR	0510	6.48
	1203	2.61		1120	2.69
	1728	5.87		1654	6.04
				2331	1.30
14 FR	0004	1.46	29 SA	0555	7.00
	0627	6.83		1203	2.09
	1238	2.29		1742	6.61
	1807	6.17			
15 SA	0040	1.31	30 SU	0016	0.92
	0701	7.01		0637	7.41
	1306	2.04		1245	1.52
	1843	6.40		1829	7.09
			31 MO	0057	0.73
				0713	7.68
				1325	1.09
				1915	7.40

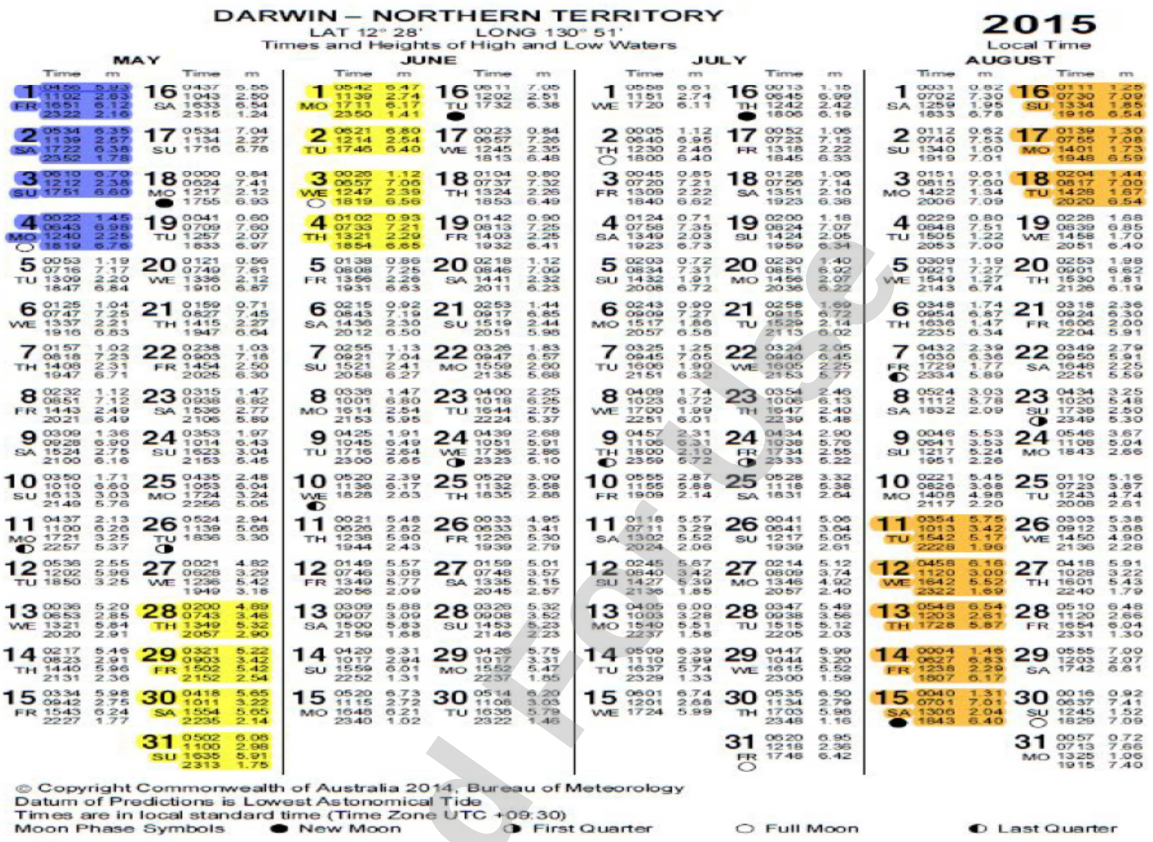
Datum of Predictions is Lowest Astronomical Tide

Times are in local standard time (Time Zone UTC +09:30)

Moon Phase Symbols ● New Moon ◑ First Quarter ○ Full Moon ◐ Last Quarter

(Available online at <http://www.health.nt.gov.au/medical_entomology/insect_pest_periods/index.aspx>.)

Sample of the saltmarsh mosquito pest calendar for the coastal Top End of the Northern Territory: May–August 2015



DARWIN – NORTHERN TERRITORY

LAT 12° 28' LONG 130° 51'

Times and Heights of High and Low Waters

2015

Local Time

MAY

	Time	m		Time	m
1 FR	0456	5.93	16 SA	0437	6.55
	1102	2.83		1043	2.50
	1651	6.12		1633	6.54
	2322	2.16		2315	1.24
2 SA	0534	6.35	17 SU	0534	7.04
	1139	2.57		1134	2.27
	1722	6.38		1716	6.78
	2352	1.78			
3 SU	0610	6.70	18 MO ●	0000	0.84
	1212	2.38		0624	7.41
	1751	6.60		1217	2.12
				1755	6.93
4 MO ○	0022	1.46	19 TU	0041	0.60
	0643	6.98		0709	7.60
	1240	2.25		1257	2.07
	1819	6.79		1833	6.97
5 TU	0053	1.19	20 WE	0121	0.56
	0716	7.17		0749	7.61
	1309	2.20		1336	2.12
	1847	6.84		1910	6.87
6 WE	0125	1.04	21 TH	0159	0.71
	0747	7.25		0827	7.45
	1337	2.21		1415	2.27
	1916	6.83		1947	6.64
7 TH	0157	1.02	22 FR	0238	1.03
	0818	7.23		0903	7.18
	1408	2.31		1454	2.50
	1947	6.71		2025	6.30
8 FR	0232	1.12	23 SA	0315	1.47
	0851	7.12		0938	6.82
	1443	2.49		1536	2.77
	2021	6.49		2106	5.89
9 SA	0309	1.36	24 SU	0353	1.97
	0928	6.99		1014	6.43
	1524	2.75		1623	3.04
	2100	6.16		2153	5.45
10 SU	0350	1.71	25 MO	0435	2.48
	1010	6.80		1053	6.04
	1613	3.03		1724	3.24
	2149	5.76		2256	5.05
11 MO ◐	0437	2.13	26 TU ◑	0524	2.94
	1100	6.56		1139	5.66
	1721	3.25		1836	3.30
	2257	5.37			
12 TU	0536	2.55	27 WE	0021	4.82
	1202	5.96		0628	3.29
	1850	3.25		1236	5.42
				1949	3.18
13 WE	0036	5.20	28 TH	0200	4.89
	0653	2.85		0743	3.46
	1321	5.84		1349	5.32
	2029	2.91		2057	2.90
14 TH	0217	5.46	29 FR	0321	5.22
	0823	2.91		0903	3.42
	1440	5.96		1502	5.43
	2131	2.36		2152	2.54
15 FR	0334	5.98	30 SA	0418	5.65
	0942	2.75		1011	3.22
	1543	6.24		1554	5.65
	2227	1.77		2235	2.14
			31 SU	0502	6.08
				1100	2.98
				1635	5.91
				2313	1.75

JUNE

	Time	m		Time	m
1 MO	0542	6.47	16 TU ●	0611	7.05
	1139	2.74		1202	2.51
	1711	6.17		1732	6.38
	2350	1.41			
2 TU	0621	6.80	17 WE	0023	0.84
	1214	2.54		0657	7.26
	1746	6.40		1245	2.35
				1813	6.48
3 WE ○	0026	1.12	18 TH	0104	0.80
	0657	7.06		0737	7.32
	1247	2.38		1324	2.26
	1819	6.58		1853	6.49
4 TH	0102	0.93	19 FR	0142	0.90
	0733	7.21		0813	7.25
	1321	2.29		1403	2.25
	1854	6.65		1932	6.41
5 FR	0138	0.86	20 SA	0218	1.12
	0808	7.25		0846	7.09
	1356	2.26		1441	2.32
	1931	6.63		2011	6.23
6 SA	0215	0.92	21 SU	0253	1.44
	0843	7.19		0917	6.85
	1436	2.30		1519	2.44
	2012	6.50		2051	5.98
7 SU	0255	1.13	22 MO	0326	1.83
	0921	7.04		0947	6.57
	1521	2.41		1559	2.60
	2058	6.27		2135	5.68
8 MO	0338	1.47	23 TU	0400	2.25
	1001	6.80		1018	6.25
	1614	2.54		1644	2.75
	2153	5.95		2224	5.37
9 TU	0425	1.91	24 WE ◑	0439	2.68
	1045	6.49		1051	5.91
	1716	2.64		1736	2.86
	2300	5.65		2323	5.10
10 WE ◐	0520	2.39	25 TH	0529	3.09
	1136	6.17		1132	5.58
	1828	2.63		1835	2.88
11 TH	0021	5.48	26 FR	0033	4.95
	0626	2.82		0633	3.41
	1238	5.90		1226	5.30
	1944	2.43		1939	2.79
12 FR	0149	5.57	27 SA	0159	5.01
	0746	3.08		0748	3.57
	1349	5.77		1335	5.15
	2056	2.09		2045	2.57
13 SA	0309	5.88	28 SU	0326	5.32
	0907	3.09		0908	3.52
	1500	5.83		1453	5.23
	2159	1.68		2146	2.23
14 SU	0420	6.31	29 MO	0426	5.75
	1017	2.94		1017	3.31
	1559	6.01		1552	5.47
	2252	1.51		2237	1.85
15 MO	0520	6.73	30 TU	0514	6.20
	1115	2.72		1106	3.03
	1648	6.21		1636	5.79
	2340	1.02		2322	1.46

JULY

	Time	m		Time	m
1 WE	0558	6.61	16 TH ●	0013	1.15
	1151	2.74		0645	6.99
	1720	6.11		1242	2.42
				1805	6.19
2 TH ○	0005	1.12	17 FR	0052	1.06
	0640	6.95		0723	7.12
	1230	2.46		1318	2.22
	1800	6.40		1845	6.33
3 FR	0045	0.85	18 SA	0128	1.05
	0720	7.21		0756	7.14
	1309	2.22		1351	2.10
	1840	6.62		1923	6.38
4 SA	0124	0.71	19 SU	0200	1.18
	0758	7.35		0824	7.07
	1349	2.03		1424	2.05
	1923	6.73		1959	6.34
5 SU	0203	0.72	20 MO	0230	1.40
	0834	7.37		0851	6.92
	1432	1.91		1456	2.07
	2008	6.72		2036	6.22
6 MO	0243	0.90	21 TU	0258	1.69
	0909	7.27		0915	6.72
	1517	1.86		1529	2.14
	2057	6.58		2113	6.02
7 TU	0325	1.25	22 WE	0324	2.05
	0945	7.05		0940	6.45
	1606	1.90		1605	2.25
	2151	6.32		2153	5.77
8 WE	0409	1.74	23 TH	0354	2.46
	1023	6.72		1006	6.13
	1709	1.99		1647	2.40
	2251	6.01		2239	5.48
9 TH ◐	0457	2.31	24 FR ◑	0434	2.90
	1106	6.31		1038	5.78
	1800	2.10		1734	2.55
	2359	5.72		2333	5.22
10 FR	0555	2.87	25 SA	0528	3.32
	1155	5.88		1118	5.38
	1909	2.14		1831	2.64
11 SA	0118	5.57	26 SU	0041	5.06
	0711	3.29		0541	3.64
	1302	5.52		1217	5.05
	2024	2.06		1939	2.61
12 SU	0245	5.67	27 MO	0214	5.12
	0840	3.42		0809	3.74
	1427	5.39		1346	4.92
	2136	1.85		2057	2.40
13 MO	0405	6.00	28 TU	0347	5.49
	1003	3.28		0938	3.56
	1540	5.51		1515	5.12
	2237	1.58		2205	2.03
14 TU	0509	6.39	29 WE	0447	5.99
	1110	2.99		1044	3.20
	1637	5.74		1615	5.52
	2329	1.33		2300	1.59
15 WE	0601	6.74	30 TH	0535	6.50
	1201	2.68		1134	2.79
	1724	5.99		1703	5.98
				2348	1.16
			31 FR ○	0620	6.95
				1218	2.35
				1748	6.42

AUGUST

	Time	m		Time	m
1 SA	0031	0.82	16 SU	0111	1.25
	0702	7.30		0730	7.09
	1259	1.95		1334	1.85
	1833	6.78		1916	6.54
2 SU	0112	0.62	17 MO	0139	1.30
	0740	7.53		0755	7.08
	1340	1.60		1401	1.73
	1919	7.01		1948	6.59
3 MO	0151	0.61	18 TU	0204	1.44
	0815	7.60		0817	7.00
	1422	1.34		1428	1.67
	2006	7.09		2020	6.54
4 TU	0229	0.80	19 WE	0228	1.68
	0848	7.51		0839	6.85
	1505	1.22		1458	1.70
	2053	7.00		2051	6.40
5 WE	0309	1.19	20 TH	0253	1.98
	0921	7.27		0901	6.62
	1549	1.27		1530	1.81
	2143	6.74		2126	6.19
6 TH	0348	1.74	21 FR	0318	2.36
	0954	6.87		0924	6.30
	1636	1.47		1606	2.00
	2235	6.34		2204	5.91
7 FR ◐	0432	2.39	22 SA	0349	2.79
	1030	6.36		0950	5.91
	1729	1.77		1648	2.25
	2334	5.89		2251	5.59
8 SA	0524	3.03	23 SU ◑	0434	3.25
	1112	5.78		1038	5.48
	1832	2.09		1738	2.50
				2349	5.30
9 SU	0046	5.53	24 MO	0546	3.67
	0641	3.53		1139	5.04
	1217	5.24		1843	2.66
	1951	2.26			
10 MO	0221	5.45	25 TU	0110	5.16
	0826	3.68		0723	3.87
	1408	4.95		1243	4.74
	2117	2.20		2008	2.61
11 TU	0354	5.75	26 WE	0303	5.38
	1013	3.42		0912	3.68
	1542	5.17		1450	4.90
	2228	1.96		2136	2.28
12 WE	0458	6.16	27 TH	0418	5.91
	1120	3.00		1028	3.22
	1642	5.52		1601	5.43
	2322	1.69		2240	1.79
13 TH	0548	6.54	28 FR	0510	6.48
	1203	2.61		1120	2.66
	1728	5.87		1654	6.04
				2331	1.30
14 FR	0004	1.46	29 SA	0555	7.00
	0627	6.83		1203	2.07
	1238	2.29		1742	6.61
	1807	6.17			
15 SA ●	0040	1.31	30 SU ○	0016	0.92
	0701	7.01		0637	7.41
	1306	2.04		1245	1.52
	1843	6.40		1829	7.09
			31 MO	0057	0.72
				0713	7.66
				1325	1.06
				1915	7.40

Datum of Predictions is Lowest Astronomical Tide

Times are in local standard time (Time Zone UTC +09:30)

Moon Phase Symbols ● New Moon ◑ First Quarter ○ Full Moon ◐ Last Quarter

(Available online at <http://www.health.nt.gov.au/medical_entomology/insect_pest_periods/index.aspx>.)

Document Endorsement and Approvals

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Document Identification

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C	14/09/2016 06:42	Approve with Endorsement

Delegation of Authority

From Name	To Name	Date and Time	Action

Name	Title

Electronic Endorsement and Approval

Electronic approval of this document complies with the issued INPEX Electronic Approval Standard (0000-A9-STD-60011) and records evidence that the applicable person has either endorsed and/or approved the content contained within this document. The reviewers of this document are recorded in the DMS.

Name	Title	Date and Time	Action
David Dann	General Manager Onshore	16/09/2016 11:23	Endorsed
Glen Bajars	General Manager Onshore	07/10/2016 05:54	Approved
Mark Wilson	Maintenance Manager	20/09/2016 14:27	Endorsed
Lance Kenny	HSE Team Lead	16/09/2016 07:43	Endorsed