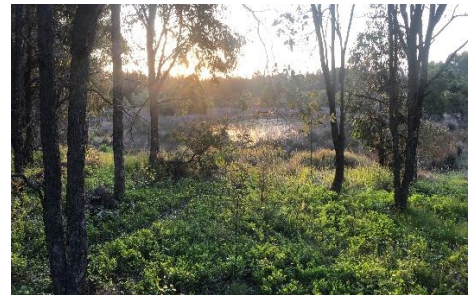
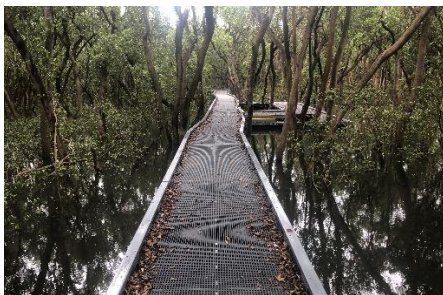


NSW Arbovirus Surveillance & Mosquito Monitoring Program, 2018-2019

Weekly Update: 03 May 2019



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All reports for the season are available at:

<https://www.health.nsw.gov.au/environment/pests/vector/Pages/nswasp-weekly-report-2018-19.aspx>

Please send questions or comments about this report to: Environmental Epidemiology Unit, Environmental Health Branch, Health Protection NSW: nsw-envepi@health.nsw.gov.au

Testing and scientific services were provided by the Department of Medical Entomology, NSW Health Pathology (ICPMR) for the mosquito surveillance, and the Arbovirus Emerging Diseases Unit, NSW Health Pathology (ICPMR) for the sentinel chicken surveillance. Mosquito and wetland images were provided by Michael Onn and Dr Cameron Webb, University of Sydney. Please note that these results remain the property of the NSW Ministry of Health and may not be used or disseminated to unauthorised persons or organisations without permission.

Summary

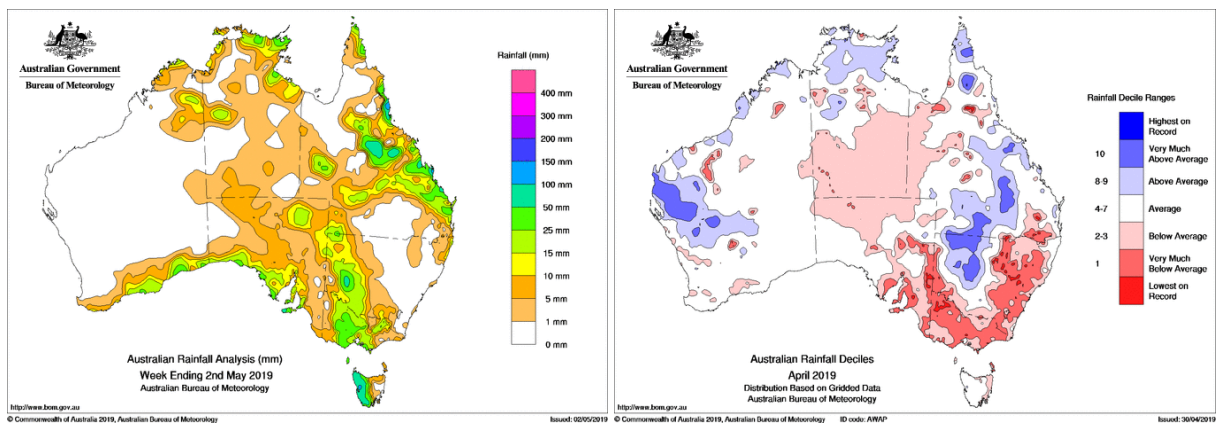
- **Climate:** over the last week, the west of the state had light to moderate rainfall, but rest of the state was dry. For April, rainfall was below average for most of the state, except in the northwest. Maximum and minimum temperatures for the month of March were 2-3 degrees above average.
- **Three Month Forecast:** for May 2019 to July 2019, rainfall for NSW is predicted to be around the historical average. Maximum and minimum temperatures are both predicted to exceed the average. According to the Bureau of Meteorology (BOM) as of 30 April 2019, there is still a 70% chance that an El Niño will form later this year.
- **Tides:** the last series of high tides that occurred over Easter were below predicted and appeared not to have initiated *Aedes vigilax* egg hatching in many areas of the coast. The next series of high tides that may trigger mosquito egg hatching are due to occur over 7-14 May 2019, with heights up to 1.86m forecasted. Another series are due shortly after during 16-22 May 2019, with heights of 1.92m forecasted.
- **Murray Valley Encephalitis virus (MVEV) Models:** the data relevant to both the Forbes' and Nicholls' hypotheses have been updated to March 2019. Neither model is suggestive of an MVEV epidemic.
- **Mosquito Numbers Inland:** surveillance activities have ceased for the season.
- **Mosquito Numbers Coast:** mosquito numbers were similar this week to the last two weeks. Again Ballina had a series of 'very high' (1,000-10,000) collections, with Lindsay Avenue trapping over 2,300 mosquitoes. Freshwater mosquitoes, notably *Aedes multiplex*, dominated the collections. *Aedes vigilax* were 'low' (<50) from all locations.
- **Mosquito Numbers Sydney:** numbers have declined substantially at all sites with only 'medium' numbers (50-100) being captured at the saline trapping sites. Numbers of *Aedes vigilax* were 'low' (<50) from all locations.
- **Arboviral Isolates:** there were two Ross River viral detections from the collections made at Ballina on 23 April 2019.
- **Chicken Sentinel Flocks:** surveillance activities have ceased for the season.
- **Human Notifications:** for the current fiscal year, there have been 439 Ross River virus (RRV) and 52 Barmah Forest virus (BFV) notifications.

Comment: with the recent high tides being below forecasted levels, there was low emergence of *Aedes vigilax* and so numbers of this species have remained 'low' at all sites. As a consequence, those locations around Sydney that produced the large collections this year where *Aedes vigilax* dominated, all had reduced catch numbers. The cooler nights would have also contributed to the lower catches. In the north coast of the state, collections remain 'very high' with several RRV detections in recent weeks.

Environmental Conditions

Rainfall

Rainfall across Australia for the week ending 2 May 2019 is depicted on the left and monthly rainfall deciles for March 2019 are on the right. Over the last week, the west of the state had light to moderate rainfall, elsewhere was dry. For April, rainfall was below average for most of the state, although above average in the northwest. Maximum and minimum temperatures for the month of April were 2-3 degrees above average.



Three Month Rainfall & Temperature Forecast

For May 2019 to July 2019, rainfall for NSW is predicted to be around the historical average.. Maximum and minimum temperatures are both predicted to exceed the average. The following webpages contain graphics of the seasonal outlook:

www.bom.gov.au/climate/outlooks/#/rainfall/median (Rainfall outlook).

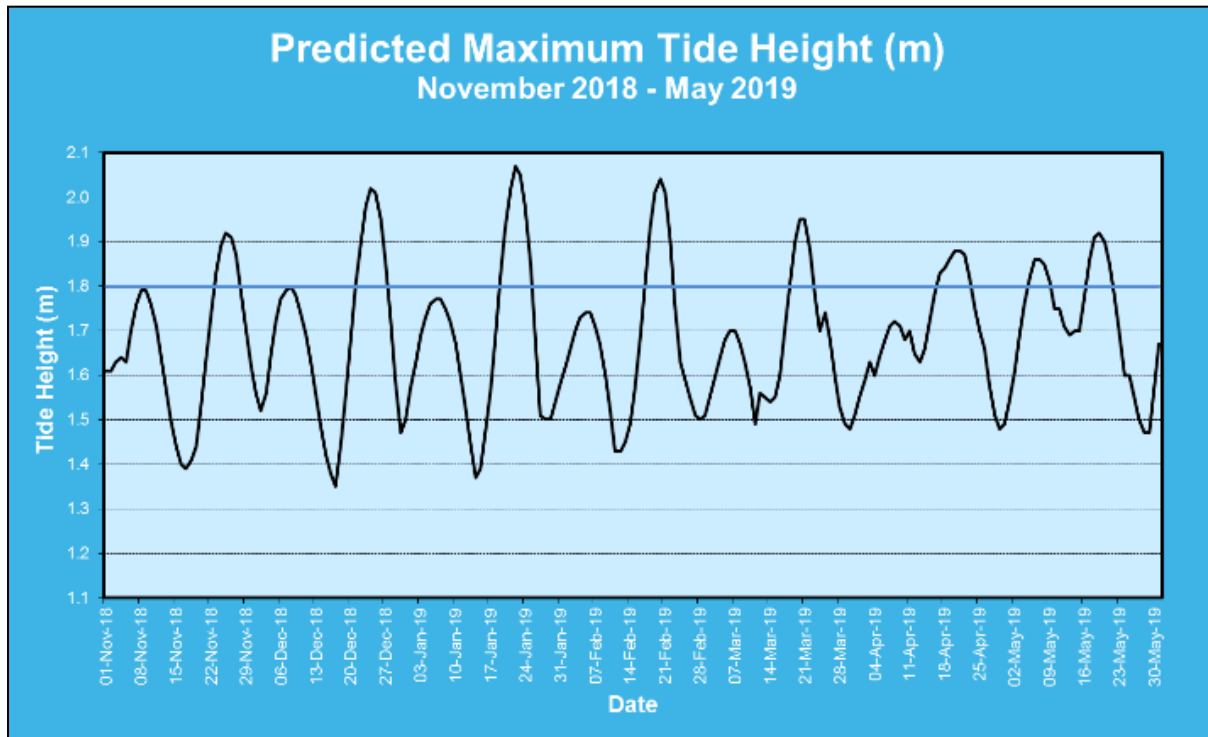
www.bom.gov.au/climate/outlooks/#/temperature/summary (Max & min temperature outlook).

According to the BOM as of 30 April 2019, the El Niño–Southern Oscillation (ENSO) Outlook remains at El Niño ALERT. This means there is a 70% chance of an El Niño developing later in 2019, which is around three times the normal likelihood. The Indian Ocean Dipole (IOD) is currently neutral and expected to remain this way through autumn. Note that the IOD has little influence on the nation’s climate over December to April.

For more information: www.bom.gov.au/climate/enso/ and, www.bom.gov.au/climate/iod/

Tides

Tidal information is relevant for the prediction of the activity of the salt marsh mosquito, *Aedes vigilax*. Typically for NSW, high tides of over 1.8m, as measured at Sydney, can induce hatching of *Aedes vigilax* larvae and the graph below of predicted tide heights can provide some indication of when this is likely to occur. Note this trigger height varies between regions, thus at Batemans Bay, a tide height over 0.8m can initiate egg hatching.



The last series of high tides that occurred over Easter were below predicted and appeared not to have initiated *Aedes vigilax* hatching in many areas of the coast. Thus adult numbers are not expected to rise significantly over the upcoming weeks. The next series of high tides that may trigger hatching are due to occur over 7-14 May 2019, with heights up to 1.86m forecasted. Another series are due shortly after during 16-22 May 2019, with heights of 1.92m forecasted.

Actual tide heights can vary by 0.3m (or more in unusual circumstances) due to variations in atmospheric pressure, rainfall, wind, and other climatic phenomena. Sea level rise with climate change may also result increased tide heights. Thus predicted tide height should be used as a gauge only for potential *Aedes vigilax* activity. The larvae of the saltmarsh mosquito relies on an inundation/drying cycle for the mudflats in which it lives; continual wet weather prevents the drying cycles thereby reducing larval production.

MVEV Climatic Models

Three predictive environmental based models for MVEV activity have been developed; the Forbes' hypothesis (which relies on rainfall in the river catchment basins of Eastern Australia), Nicholls' hypothesis (based on the Southern Oscillation), and the Bennett theory (based on the Indian Ocean Dipole). The latter theory has low reliability and is not considered below. Note that all the predictive models have been developed on a limited data set and do not always forecast activity. There can also be unusual environmental conditions that may lead to the introduction of the virus to south-eastern Australia, such as the movement of low pressure cells from the north to the south of the country during 2008 and 2011. Vertical transmission of the virus (from adult to the egg in *Aedes* species) can result in restricted activity following localised heavy precipitation (as per 2003 at Menindee).

i. Forbes' Model

Rainfall was not above Decile 7 in all of the river catchment basins in eastern Australia for the last quarter of 2017, the first quarter of 2018, the last quarter of 2018, or the first quarter of 2019* (Table 1). Thus Forbes' hypothesis for an MVEV outbreak has not been fulfilled.

Table 1. Rainfall indices for the main catchment basins of eastern Australia as per Forbes' hypothesis, relevant to the 2018-2019 season. Note that a value of 1 equals Decile 7 rainfall.

Catchment Basin	Oct-Dec 2017	Jan-Mar 2018	Oct-Dec 2018	Jan-Mar* 2019
Darling River	0.93	0.52	0.71	0.22
Lachlan/Murrumbidgee/Murray Rivers	1.15	0.70	0.87	0.98
Northern Rivers	0.81	1.07	0.70	0.82
North Lake Eyre system	0.75	0.69	0.56	0.53

*Data for January & February only

ii. Nicholls' Model

Table 2. The seasonal atmospheric pressures (in mm) according to Nicholls' hypothesis, relevant to the 2018-2019 season.

	Autumn 2018	Winter 2018	Spring 2018
2018 Value	1009.27	1011.8	1010.90
Pre past MVEV seasons	<1009.74	<1012.99	<1009.99

The Spring period pertaining to the Nicholls' hypothesis is not in line with past MVEV active years.

Arboviral Isolates

LOCATION – Site	Date Trapped	Detection Method	Virus
BALLINA – North Creek Road	23/Apr/2019	Whole trap grind	Ross River
BALLINA – Pacific Pines	23/Apr/2019	Whole trap grind/FTA Card	Ross River
BALLINA – Pacific Pines	17/Apr/2019	Whole trap grind	Ross River
TWEED – Piggabeen Road	2/Apr/2019	Whole trap grind	Barmah Forest
PORT MACQUARIE – Stevens Street	2/Apr/2019	Whole trap grind	Barmah Forest
GEORGES RIVER – Alfords Point	14/Mar/2019	Whole trap grind	Stratford
CENTRAL COAST – Ourimbah	13/Mar/2019	Whole trap grind	Ross River
PARRAMATTA – Duck River	12/Mar/2019	Whole trap grind	Stratford
PARRAMATTA – Duck River	25/Feb/2019	Whole trap grind	Stratford
GEORGES RIVER – Alfords Point	20/Feb/2019	Whole trap grind	Ross River
SOPA – Haslams Creek	18/Feb/2019	Whole trap grind	Ross River
PARRAMATTA – Duck River	18/Feb/2019	Whole trap grind	Stratford
GEORGES RIVER – Deepwater	12/Feb/2019	Whole trap grind	Ross River
GEORGES RIVER – Deepwater	12/Feb/2019	Whole trap grind	Edge Hill
GEORGES RIVER – Picnic Point	12/Feb/2019	Whole trap grind	Edge Hill
SOPA – Newington	12/Feb/2019	Whole trap grind	Stratford
GEORGES RIVER – Alfords Point	6/Feb/2019	Whole trap grind	Edge Hill
CENTRAL COAST – Ourimbah	4/Feb/2019	Whole trap grind	Stratford
GRIFFITH – Lake Wyangan	29/Jan/2019	Whole trap grind	Edge Hill
GEORGES RIVER – Alfords Point	24/Jan/2019	Whole trap grind	Edge Hill
PARRAMATTA – Duck River	23/Jan/2019	Whole trap grind	Stratford
HILLS – Glenorie	23/Jan/2019	Whole trap grind	Edge Hill
GEORGES RIVER – Picnic Point	23/Jan/2019	Whole trap grind	Edge Hill
BLACKTOWN – Ropes Crossing	22/Jan/2019	Whole trap grind	Edge Hill
GEORGES RIVER – Picnic Point	16/Jan/2019	Whole trap grind	Edge Hill
GEORGES RIVER – Alfords Point	10/Jan/2019	Whole trap grind	Edge Hill
GEORGES RIVER – Picnic Point	9/Jan/2019	Whole trap grind	Edge Hill
GEORGES RIVER – Picnic Point	9/Jan/2019	FTA card	Kokobera

FTA Card = Sugar based surveillance. Whole trap grind = all the mosquitoes are ground (or a subsample of the larger collections) and tested for arboviral nucleic acid.

Exotic Detections

There were two exotic mosquito detections since the last weekly report (18 April 2019). A male *Aedes aegypti* was detected on 23 April 2019 at the Sydney international airport and a female *Aedes aegypti* was detected on 2 May 2019 at an international freight handling facility. Actions for these two exotic mosquito detections included enhanced surveillance, and insecticide treatment (fogging and residual spraying of surfaces) at the sites of the detection.

Human Notifications

Weekly notifications of human mosquito-borne disease infections are available from the NSW Ministry of Health, Communicable Disease Weekly Report and summarized in the Table below* (www.health.nsw.gov.au/Infectious/reports/Pages/CDWR.aspx).

Table 4. Notifications of mosquito-borne disease in NSW, 2018-2019*

Week Ending	RRV	BFV	DENV [†]	Malaria [†]	CHIKV [†]	ZIKV [†]	Total
7-Jul-18	12	1	10	1	0	0	24
14-Jul-18	9	1	2	3	0	0	15
21-Jul-18	5	2	3	2	0	0	12
28-Jul-18	8	1	6	3	0	0	18
4-Aug-18	4	0	8	3	0	0	15
11-Aug-18	8	3	6	1	0	0	18
18-Aug-18	12	0	3	1	0	0	16
25-Aug-18	8	1	2	1	0	0	12
1-Sep-18	8	0	0	0	0	0	8
8-Sep-18	5	1	2	2	0	0	10
15-Sep-18	13	4	1	5	0	0	23
22-Sep-18	5	0	5	1	0	0	11
29-Sep-18	7	2	5	2	0	0	16
6-Oct-18	10	0	2	1	0	0	13
13-Oct-18	9	0	2	4	0	0	15
20-Oct-18	7	0	5	2	1	0	15
27-Oct-18	11	0	8	1	0	0	20
3-Nov-18	10	0	5	0	1	0	16
10-Nov-18	7	3	6	0	3	0	19
17-Nov-18	5	3	9	2	0	0	19
24-Nov-18	4	1	8	0	0	0	13
1-Dec-18	11	1	14	1	1	0	28
8-Dec-18	11	1	5	0	2	0	19
15-Dec-18	1	1	3	0	0	0	5
22-Dec-18	9	0	0	7	0	0	16
29-Dec-18	2	0	0	1	0	0	3
5-Jan-19	10	0	4	1	0	0	15
12-Jan-19	6	0	4	2	0	0	12
19-Jan-19	10	1	11	3	0	0	25
26-Jan-19	4	2	7	0	0	0	13

2-Feb-19	8	3	6	0	0	0	17
9-Feb-19	11	2	11	2	0	0	26
16-Feb-19	8	0	8	1	1	0	18
23-Feb-19	8	2	6	1	0	0	17
2-Mar-19	12	0	2	2	0	0	16
9-Mar-19	11	0	5	1	0	0	17
16-Mar-19	21	1	2	1	0	0	25
23-Mar-19	10	1	6	3	0	0	20
30-Mar-19	27	2	10	0	0	0	39
6-Apr-19	14	5	6	1	0	0	26
13-Apr-19	19	2	4	1	0	0	26
20-Apr-19	13	2	6	1	0	0	22
27-Apr-19	2	0	4	0	0	0	6
Total	395	49	222	64	9	0	711

RRV = Ross River virus; BFV = Barmah Forest virus; DENV = Dengue virus; CHIKV = Chikungunya virus; ZIKV = Zika virus. †All of these viruses are acquired overseas, although some DENV cases may be from North Queensland. *The data in this table is updated once available from the NSW Ministry of Health.

Comment: It should also be noted that notifications are for NSW residents and that the infection may have been acquired elsewhere. Winter notifications of RRV and BFV are unlikely to be recent infections or may be false positives.

Table 4 cont. Notifications of mosquito-borne disease in NSW, 2018-2019***Table 5.** Ross River virus infection notifications in NSW residents, by month of disease onset per fiscal year, July 2013 to Jun 2019*.

Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
2014-2015	38	50	46	67	59	90	117	304	431	265	102	49	1,618
2015-2016	54	60	53	61	69	54	43	61	78	81	66	25	705
2016-2017	14	15	21	19	47	229	430	274	200	142	175	89	1,655
2017-2018	29	37	52	56	37	32	30	38	50	77	96	71	605
2018 - 2019	32	41	33	47	30	27	35	57	80	57	0		439
Ave [†]	33	203	41	50	48	86	131	147	168	124	88	102	1,004

*updated 3 May 2019 (this table is updated at different times to Table 4 above, hence there may be differences in the numbers).

[†]Average for 2014-15 to 2017-18.

Table modified from: <http://www1.health.nsw.gov.au/IDD/#/ROSS>

Table 6. Barmah Forest virus infection notifications in NSW residents, by month of disease onset per fiscal year, July 2014 to Jun 2019*.

Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
2014-2015	10	3	11	11	8	4	12	17	43	43	16	11	189
2015-2016	6	9	7	9	6	3	4	5	2	3	10	2	66
2016-2017	4	3	0	0	1	9	9	5	8	6	24	25	94
2017-2018	8	10	6	8	8	6	5	12	8	10	6	7	94
2018 - 2019	4	6	5	2	5	4	7	4	6	9	0		52
Ave [†]	6	6	6	6	6	5	7	9	13	14	11	11	99

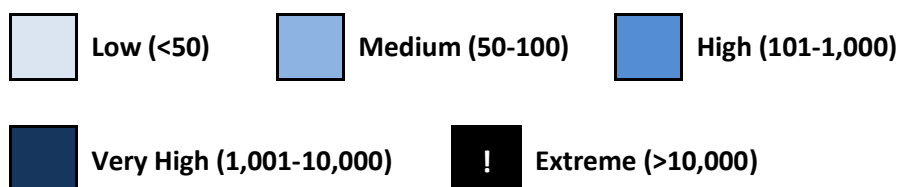
*updated 3 May 2019 (this table is updated at different times to Table 4 above, hence there may be differences in the numbers).

[†]Average for 2014-15 to 2017-18.

Table modified from: <http://www1.health.nsw.gov.au/IDD/#/BF>

Mosquito Results

Mosquito abundance is best described in relative terms, and in keeping with the terminology from previous NSW Arbovirus Surveillance and Mosquito Monitoring Program Annual Reports, mosquito numbers are depicted in the tables below as:



Each location represents the average for all trapping sites at that location.

Inland

Location	Mosquito	Oct-18				Nov				Dec					Jan-19				Feb				Mar					
		7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	3	10	17	24	31	
Albury	<i>Cx. annul</i>																											
	Total Mosq.																											
Bourke	<i>Cx. annul</i>																											
	Total Mosq.																											
Forbes	<i>Cx. annul</i>																											
	Total Mosq.																											
Griffith	<i>Cx. annul</i>																											
	Total Mosq.																											
Leeton	<i>Cx. annul</i>																											
	Total Mosq.																											
Macquarie Marshes	<i>Cx. annul</i>																											
	Total Mosq.																											
Wagga	<i>Cx. annul</i>																											
	Total Mosq.																											

Note that the date represents the Sunday, the start of the week.

Coastal

Location	Mosquito	Dec					Jan-19				Feb				Mar					Apr				May				
		2	9	16	23	30	12	12	12	27	3	10	17	24	3	10	17	24	31	7	14	21	28	5	12	19	26	
Ballina	<i>Ae. vigilax</i>																											
	Total Mosq.																											
Coffs Harbour	<i>Ae. vigilax</i>																											
	Total Mosq.																											
Gosford	<i>Ae. vigilax</i>																											
	Total Mosq.																											
Kempsey	<i>Ae. vigilax</i>																											
	Total Mosq.																											
Lake Macquarie	<i>Ae. vigilax</i>																											
	Total Mosq.																											
Nambucca	<i>Ae. vigilax</i>																											
	Total Mosq.																											
Port Macquarie	<i>Ae. vigilax</i>																											
	Total Mosq.																											
Tweed	<i>Ae. vigilax</i>																											
	Total Mosq.																											
Wyong	<i>Ae. vigilax</i>																											
	Total Mosq.																											

Note that the date represents the Sunday, the start of the week.

Sydney

Location	Mosquito	Dec					Jan-19				Feb				Mar					Apr				May			
		2	9	16	23	30	6	13	20	27	3	10	17	24	3	10	17	24	31	7	14	21	28	5	12	19	26
Banks-town	<i>Ae. vigilax</i>	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Total Mosq.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Blacktown	<i>Ae. vigilax</i>	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Total Mosq.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Georges River	<i>Ae. vigilax</i>	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Total Mosq.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hawkes-bury	<i>Cx. annul</i>	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Total Mosq.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hills Shire	<i>Ae. vigilax</i>	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Total Mosq.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Parramatta	<i>Ae. vigilax</i>	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Total Mosq.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Penrith	<i>Ae. vigilax</i>	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Total Mosq.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Sydney Olympic Park	<i>Ae. vigilax</i>	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Total Mosq.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Note that the date represents the Sunday, the start of the week.

Sentinel Chicken Flocks – MVEV and Kunjin Virus Antibody Test Results

Location	Oct	Nov				Dec					Jan-19				Feb				Mar					Apr			
	28	4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	3	10	17	24	31	7	14	21	28
Deniliquin			15N	15N	15N	15N	15N	15N			15N	15N	14N		15N	15N	15N										
Dubbo								15N		15N	15N	15N		14N	14N	14N	13N	14N	14N	14N	14N	14N	14N	14N	14N	14N	14N
Forbes			12N	12N	12N	14N	15N	15N			14N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N				
Griffith		15N	15N	15N	15N	15N	15N	15N			15N	14N	14N	13N	13N	13N	13N	13N	13N	13N	12N	12N	12N	12N	15N	15N	
Hay		15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	14N	14N	14N	14N	14N	15N		14N	14N	14N	14N			
Leeton	15N	15N	15N	15N	15N	15N	15N		15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N		
Macquarie Marshes		15N		15N	15N	15N	15N	15N	15N	15N		15N	15N	15N	15N	15N		15N	15N	15N		15N	15N	14N	14N		
Menindee		15N		15N	15N	15N	15N				15N	15N	15N		12N	12N	12N	12N	12N	12N	12N	12N	12N		14N		
Moree				15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	15N	

The number represents the number of chickens by test result (N = Negative, M = Positive for MVEV, K = Positive for Kunjin virus). **Positive results will be in bold.** Results are shown by week of sample collection, note that the date represents the Sunday, the start of the week.