NSW GOVERNMENT

Manly Hydraulics Laboratory

NSW COASTAL RAINFALL ANNUAL SUMMARY
2018–2019

Report MHL2694
November 2019

Prepared for:

NSW Department of Planning, Industry and Environment
Climate Change and Sustainability Division

Cover photograph: Yarramalong rainfall station, Macquarie-Tuggerah Lakes region

NSW COASTAL RAINFALL ANNUAL SUMMARY
2018–2019

Report MHL2694
November 2019

Michael Galloway
Hydrometric Team Leader
110b King Street
Manly Vale NSW 2093
T: 02 9949 0200
E: michael.galloway@mhl.nsw.gov.au
W: www.mhl.nsw.gov.au

Document Control

Issue/ Revision	Author	Reviewer	Approved for Issue	
			Name	Date
Draft	B Tse	S Dakin	A Joyner	29/10/2019
Final	B Tse	M Fitzhenry (DPIE CCSD), S Dakin	A Joyner	18/11/2019

Report No. MHL2694
ISSN: 2205-5568 (Print)
ISSN: 2205-5576 (Online)
First published November 2019

Manly Hydraulics Laboratory is Quality System Certified to AS/NZS ISO 9001:2015

110B King Street
Manly Vale NSW 2093
T 02 9949 0200
ABN 20 770 707 468 www.mhl.nsw.gov.au

Foreword

Manly Hydraulics Laboratory (MHL) is a business unit within the Water Group of NSW Department of Planning, Industry and Environment[1]. The NSW rainfall database has been developed to support a number of programs associated with coastal, floodplain and estuary management for the Climate Change and Sustainability Division[2] of NSW Department of Planning, Industry and Environment. The monitoring service is available to local government and other organisations, both in Australia and overseas.

This annual summary presents the results of rainfall monitoring obtained by the automatic rainfall recording stations along the coastal estuaries and rivers of New South Wales over the period 1 July 2018 to 30 June 2019, and catalogues data collected in NSW by MHL.

This summary has been prepared to provide ready access to MHL's rainfall database and its data analysis capabilities.

Requests for further information should be directed to:

Manager Environmental Data
Manly Hydraulics Laboratory
110b King Street
Manly Vale NSW 2093

Email : data-request@mhl.nsw.gov.au
WWW : http://www.mhl.nsw.gov.au/
Telephone : (02) 9949 0200

Other annual summaries in this series include:

- NSW Estuary and River Water Levels
  Annual Summary 2018–2019
  Manly Hydraulics Laboratory
  Report No. MHL2692
  ISSN: 2205-5525 (Print)
  ISSN: 2205-5533 (Online)
- NSW Wave Climate and Coastal Air Pressure
  Annual Summary 2018–2019
  Manly Hydraulics Laboratory
  Report No. MHL2695
  ISSN: 2205-5584 (Print)
  ISSN: 2205-5592 (online)
- NSW Ocean and River Entrance Tidal Levels
  Annual Summary 2018–2019
  Manly Hydraulics Laboratory
  Report No. MHL2693
  ISSN: 2205-5541 (Print)
  ISSN: 2205-555X (Online)
- NSW Estuary and River Water Quality
  Annual Summary 2018–2019
  Manly Hydraulics Laboratory
  Report No. MHL2696
  ISSN: 2205-5606 (Print)
  ISSN: 2205-5614 (Online)

Electronic copies of the reports in this series can be downloaded at http://www.mhl.nsw.gov.au/ under the 'Publications' link.

[1] From 1 July 2019, Manly Hydraulics Laboratory is part of the newly formed Department of Planning, Industry and Environment.

[2] Formerly NSW Office of Environment and Heritage (OEH).

Executive summary

The NSW coastal rainfall annual summary 2018–2019 presents the results of rainfall monitoring obtained by the automatic rainfall recording stations along the coastal estuaries and rivers of New South Wales over the period 1 July 2018 to 30 June 2019.

During this period, the overall data capture across the network, for data processed to within ±10% of calibration, was 98.9%.

This report contains:

- a brief description of the coastal rainfall monitoring program
- guidelines on how to use this report
- information on how to access the database
- a review of significant program developments and rainfall events in 2018–2019
- a list of all stations for which MHL collected rainfall data in 2018–2019 (Table 5.1)
- the annual data summaries for each station
- Appendix A, which details the rainfall data available
- Appendix B, outlining some of the data analysis suites and presentation formats available
- Appendix C, a list of publications which may be of interest.

Contents

1. Rainfall monitoring program

This report presents the thirty-fourth year of rainfall data collected by Manly Hydraulics Laboratory (MHL). The network of automatic recorders and the associated analysis routines enable efficient delivery of near real time rainfall data from stations across NSW. Extracts from the historical database of rainfall data can also be made available on request (refer to Appendix A).

The present program is based on a network of automatic rainfall recording stations installed at various coastal sites (see Section 5 Station Location Maps). The network consists of 73 permanent stations funded by NSW Department of Planning, Industry and Environment, Climate Change and Sustainability Division (CCSD). The network supplements the coverage provided by the Bureau of Meteorology's rainfall network. The system utilises 0.2 mm, 0.5 mm and 1.0 mm tipping buckets and data loggers, as shown in Figure 1.

Rainfall data is transferred to MHL's databases, located in the NSW Government Data Centre, using a variety of telemetry techniques including internet protocols (IP), landline telephone, cellular networks and event-reporting radio telemetry system (ERTS). The incoming raw data is then made available in near real time to external users to view online as shown in Figure 2. The upper image displays the existing data transfer process, while the lower image displays the new data transfer process which stations are currently being transitioned to.

Data is stored in a database and subject to a quality assurance process which involves several control steps to maintain data quality as well as assignment of data quality codes. Computer programs are used to further format and analyse data.

Data is backed up daily and archived to offline storage at regular intervals.

2. How to use this report

This report aims to streamline access to MHL's services and to the rainfall database.

The NSW coastline has been divided into geographic regions based on river systems. Location maps display the station locations and the annual plots confirm the availability and suitability of data for the particular period of interest. A list of rainfall station data collected and stored online is included in Appendix A.

Once a choice has been made for the period of information required, data and services can be obtained in a variety of formats, according to their intended use. All data presented in this report are in Australian Eastern Standard Time (EST). Allowance for daylight saving time needs to be made by the user of the data if required.

Appendix B provides examples of data analysis and presentation formats available from MHL. Available rainfall products include:

Tabulated output

- daily totals
- intensity/duration tables
- time of tips of rain gauge or short period fixed time step data.

Graphical plots

- hourly, daily, monthly and yearly hyetographs (a graphical representation of rainfall distribution over a period of time)
- intensity-frequency-duration curves.

3. How to access the data

MHL provides a full online data access service via the internet for its clients, and a limited service for the general public at http://www.mhl.nsw.gov.au/.

Typically the last seven days of data are available online in a non-quality controlled form to aid the fastest possible access to data records. The online service for clients can provide access to all data catalogued in Appendix A.

Quality controlled data may be ordered via the MHL web page (http://www.mhl.nsw.gov.au), by emailing data-request@mhl.nsw.gov.au, or via customised decision support tools that can be provided on request.

4. Significant events and developments

Significant events and developments which have influenced rainfall data monitoring during the 2018–2019 reporting period are detailed in Table 4.1 below.

Table 4.1 Rainfall station upgrades 2018–2019

Station name	Date	Issue			Comments
		Data quality/ capture	WHS	Cloud data transfer/ hosting	
Perry Drive	Feb-19			✓	Station upgraded to cloud data transfer/hosting and high frequency transfer, replacing legacy systems.
Shephards Lane	Feb-19			✓	Station upgraded to cloud data transfer/hosting and high frequency transfer, replacing legacy systems.
Red Hill	Feb-19			✓	Station upgraded to cloud data transfer/hosting and high frequency transfer, replacing legacy systems.
Newports Creek	Feb-19	✓			Relocated nearby for better clearance to improve data capture.
Mount George	Jun-19			✓	Station upgraded to cloud data transfer/hosting and high frequency transfer, replacing legacy systems.
Yarramalong	Feb-19	✓		✓	Station upgraded to cloud data transfer/hosting and high frequency transfer, replacing legacy systems. Relocated nearby away from trees to improve data capture.
Lisarow	Feb-19			✓	Station upgraded to cloud data transfer/hosting and high frequency transfer, replacing legacy systems.
Kincumber	Sep-19	✓			Failed calibration before and after cleaning, replaced rain gauge.
Russell Vale	Oct-18	✓			Replaced deteriorated cabinet and mounting bracket.
Dombarton Loop	Feb-19	✓			Installed new instrument housing to protect against the elements.
Port Kembla	Jan-19	✓			Installed new instrument housing to protect against the elements.
Huntley Colliery	Feb-19	✓			Installed new instrument housing to protect against the elements.
Clover Hill	Jan-19	✓			Installed new instrument housing to protect against the elements.
North Macquarie	Jan-19	✓			Installed new instrument housing to protect against the elements.

In the 2018–2019 fiscal year, the maximum recorded rainfall intensities for 11 durations between 5 minutes and 72 hours occurred at three different stations across the CCSD rainfall network (Table 4.2). To determine the significance of a rainfall event, the intensities are compared against the Annual Exceedance Probability (AEP), where the AEP is the probability of an event occurring in any one year at a particular duration. An event with a 1% AEP (or the 100-year rainfall) is an event that has a 1% chance of being equalled or exceeded in any one year.

A summary of rainfall events for each month during 2018–2019 on the NSW east coast is provided in Table 4.3. 100 mm of rain falling in a 24-hour period is adopted to define a significant rain event.

The maximum recorded rainfall for durations of 5 minutes to 72 hours at each station for 2018–2019 is presented in Table 4.4.

Table 4.2 Maximum recorded intensities for all stations

Duration	Station	Date	Rainfall (mm)	Rainfall (mm/hr)	AEP (%)
5min	Green Valley	7/11/2018	15.5	186.0	~20
10min	Cudgera	17/11/2018	26.0	156.0	~20
20min	Nurrewin	17/11/2018	48.5	145.5	~5
30min	Nurrewin	28/11/2018	64.0	128.0	~2
60min	Nurrewin	28/11/2018	80.5	80.5	~5
3hrs	Nurrewin	28/11/2018	124.0	41.3	~5
6hrs	Nurrewin	28/11/2018	155.5	25.9	~10
12hrs	Kooroowi	26/12/2018	222.5	18.5	~5
24hrs	Kooroowi	26/12/2018	226.0	9.4	~50
48hrs	Kooroowi	26/12/2018	226.5	4.7	~50
72hrs	Kooroowi	26/12/2018	227.0	3.2	~50

Table 4.3 2018–2019 Summary of rainfall events

Month	Summary of rainfall events
July 2018	No events exceeding 100 mm in 24 hours.
August 2018	No events exceeding 100 mm in 24 hours.
September 2018	Daily rainfall exceeding 100 mm in 24 hours occurred at one station in the Richmond River region.
October 2018	Daily rainfall exceeding 100 mm in 24 hours occurred at one station in the Tweed River region and one station in the Macquarie-Tuggerah Lakes region.
November 2018	Daily rainfall exceeding 100 mm in 24 hours occurred at eight stations in the Macquarie-Tuggerah Lakes region, three stations in the Wollongong Coastal region and one station in the South Coast region.
December 2018	Daily rainfall exceeding 100 mm in 24 hours occurred at one station in the Tweed River region and nine stations in the Bellinger region.
January 2019	No events exceeding 100 mm in 24 hours.
February 2019	Daily rainfall exceeding 100 mm in 24 hours occurred at two stations in the Karuah River region.
March 2019	Daily rainfall exceeding 100 mm in 24 hours occurred at six stations in the Macquarie-Tuggerah Lakes region, one station in the Sydney region and two stations in the Wollongong region.
April 2019	No events exceeding 100 mm in 24 hours.
May 2019	No events exceeding 100 mm in 24 hours.
June 2019	No events exceeding 100 mm in 24 hours.

Table 4.4 2018–2019 Maximum recorded rainfall (mm)

Station	Duration											Total yearly rainfall
	5 min	10 min	20 min	30 min	60 min	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs	
Cudgera[1]	17/11/2018 14.5	17/11/2018 26.0	17/11/2018 40.5	17/11/2018 44.0	17/11/2018 48.5	13/10/2018 57.0	13/10/2018 78.0	5/12/2018 102.0	14/10/2018 106.0	15/10/2018 122.0	15/10/2018 154.0	1351.5
Main Arm	17/11/2018 11.5	17/11/2018 19.5	17/11/2018 32.5	17/11/2018 41.5	17/11/2018 47.5	7/03/2019 72.0	7/03/2019 75.5	8/03/2019 78.5	8/03/2019 84.0	15/10/2018 125.5	16/10/2018 166.5	1354.5
Huonbrook	17/11/2018 10.5	17/11/2018 18.0	17/11/2018 31.0	17/11/2018 38.0	17/11/2018 41.0	7/03/2019 71.0	7/03/2019 78.5	8/03/2019 87.0	15/10/2018 96.0	15/10/2018 153.0	16/10/2018 207.5	1380.5
Myocum	6/09/2019 10.0	6/09/2019 19.5	6/09/2019 33.0	6/09/2019 42.5	6/09/2019 54.0	6/09/2019 77.0	6/09/2019 78.5	6/09/2019 83.0	6/09/2019 90.0	26/06/2019 111.0	6/09/2018 144.5	1338.0
Lake Ainsworth	17/11/2018 11.5	17/11/2018 21.0	17/11/2018 34.5	17/11/2018 38.5	17/11/2018 48.5	17/11/2018 62.0	18/11/2018 79.0	18/11/2018 85.0	4/09/2018 107.0	5/09/2018 177.0	5/09/2018 216.5	1226.5
Wooli Caravan Park	7/09/2018 8.0	7/09/2018 12.5	16/04/2019 30.5	16/04/2019 24.5	17/12/2018 31.5	17/12/2018 69.5	17/12/2018 93.5	17/12/2018 131.5	17/12/2018 135.0	17/12/2018 135.0	17/12/2018 135.5	937.5
Perry Drive	15/12/2018 6.0	26/06/2019 10.0	26/06/2019 14.0	26/06/2019 18.0	16/12/2018 30.0	16/12/2018 67.5	16/12/2018 92.0	17/12/2018 145.5	17/12/2018 151.5	17/12/2018 168.5	29/06/2019 169.0	1314.5
Shephards Lane	9/10/2018 8.0	9/10/2018 14.0	9/10/2018 25.0	9/10/2018 28.0	16/12/2018 31.5	16/12/2018 65.5	16/12/2018 91.5	17/12/2018 145.0	17/12/2018 154.0	17/12/2018 170.5	29/06/2019 170.5	1316.0
Red Hill[1]	26/03/2018 7.5	26/03/2018 12.0	26/03/2018 20.5	24/08/2018 23.0	24/08/2018 36.5	24/08/2018 55.0	16/12/2018 79.0	17/12/2018 133.0	17/12/2018 139.0	17/12/2018 159.0	17/12/2018 159.0	1204.5
Newports Creek	10/10/2018 10.5	26/03/2019 14.0	26/03/2019 21.5	26/03/2019 26.0	26/03/2019 46.0	26/03/2019 64.5	16/12/2018 84.0	17/12/2018 138.5	17/12/2018 143.0	17/12/2018 168.5	17/12/2018 169.0	1437.0
Middle Boambee	10/10/2018 11.0	10/10/2018 17.0	26/03/2019 23.5	26/03/2019 33.5	26/03/2019 57.0	26/03/2019 73.0	16/12/2018 88.0	17/12/2018 145.5	17/12/2018 150.0	17/12/2018 171.0	17/12/2018 171.5	1463.5
North Bonville	7/11/2018 6.0	7/11/2018 11.5	7/11/2018 18.5	7/11/2018 19.5	7/11/2018 21.5	16/12/2018 46.0	16/12/2018 75.0	17/12/2018 113.5	17/12/2018 116.0	17/12/2018 142.0	17/12/2018 142.0	1245.0
Kooroowi	6/03/2019 11.5	6/03/2019 20.0	16/12/2018 21.5	16/12/2018 30.5	16/12/2018 52.5	16/12/2018 92.5	16/12/2018 141.5	16/12/2018 222.5	16/12/2018 226.0	16/12/2018 226.5	16/12/2018 227.0	1239.0
Stuarts Island Downstream	19/03/2019 8.5	19/03/2019 14.5	17/03/2019 18.0	9/02/2019 25.5	9/02/2019 29.5	16/12/2018 49.0	16/12/2018 68.5	16/12/2018 104.0	17/12/2018 107.5	17/12/2018 108.5	27/06/2019 109.5	1088.5
Utungun	19/03/2019 11.0	19/03/2019 21.5	19/03/2019 29.5	19/03/2019 30.0	19/03/2019 33.0	19/03/2019 34.5	16/12/2018 41.0	16/12/2018 81.0	17/12/2018 89.0	17/12/2018 89.0	15/10/2018 100.0	863.0
Aldavilla Downstream	7/11/2018 8.0	7/11/2018 13.0	21/02/2019 18.0	21/02/2019 22.0	17/10/2018 26.0	17/10/2018 37.0	18/10/2018 38.0	18/10/2018 38.0	17/10/2018 46.0	17/10/2018 52.0	17/10/2018 71.5	544.0

Station	Duration											Total yearly rainfall
	5 min	10 min	20 min	30 min	60 min	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs	
Green Valley	7/11/2018 15.5	7/11/2018 25.5	7/11/2018 29.0	7/11/2018 30.0	7/11/2018 30.0	7/11/2018 35.0	10/10/2018 36.5	11/10/2018 42.5	8/11/2018 55.0	27/06/2019 77.0	27/06/2019 87.0	676.0
Telegraph Point[1]	7/11/2018 5.5	21/02/2019 8.5	10/10/2018 12.5	10/10/2018 14.5	10/10/2018 20.5	10/10/2018 35.0	10/10/2018 38.0	11/10/2018 51.0	11/10/2018 55.5	12/10/2018 59.0	13/10/2018 70.0	628.5
Logans Crossing	14/12/2018 5.0	21/02/2019 9.5	21/02/2019 18.0	21/02/2019 24.5	21/02/2019 30.0	21/02/2019 31.0	21/02/2019 31.5	21/02/2019 32.0	11/10/2018 41.5	12/10/2018 42.0	13/10/2018 48.0	590.5
Mount George[1]	14/12/2018 12.0	14/12/2018 20.0	14/12/2018 31.5	14/12/2018 38.5	14/12/2018 43.5	15/12/2018 64.5	15/12/2018 69.0	15/12/2018 69.0	16/12/2018 93.5	16/12/2018 155.5	5/06/2019 162.5	638.5
Nabiac	26/08/2018 11.5	26/08/2018 19.0	15/12/2018 30.0	1/02/2019 37.0	2/02/2019 64.5	2/02/2019 94.5	2/02/2019 99.5	2/02/2019 107.0	2/02/2019 107.0	2/02/2019 107.0	2/02/2019 107.5	771.5
Tuncurry Downstream	2/02/2019 11.0	2/02/2019 20.5	2/02/2019 33.0	2/02/2019 41.0	2/02/2019 58.0	2/02/2019 78.0	2/02/2019 81.5	2/02/2019 87.5	2/02/2019 88.5	2/02/2019 89.0	16/03/2019 93.5	864.5
Pacific Palms Wharf[1]	28/11/2018 10.0	28/11/2018 16.0	16/03/2019 22.5	16/03/2019 32.5	16/03/2019 38.5	16/03/2019 48.5	16/03/2019 53.5	6/10/2019 58.5	5/06/2019 74.0	5/06/2019 88.5	5/06/2019 92.0	885.0
Tarbuck Bay	2/02/2019 8.0	2/02/2019 13.5	2/02/2019 23.0	2/02/2019 31.5	2/02/2019 47.0	2/02/2019 66.5	2/02/2019 104.0	2/02/2019 116.5	2/02/2019 117.5	2/02/2019 119.0	2/02/2019 119.0	1080.0
Bulahdelah	8/02/2019 9.5	8/02/2019 19.0	8/02/2019 32.0	8/02/2019 34.5	8/02/2019 35.0	8/02/2019 35.0	8/02/2019 35.0	8/02/2019 38.0	5/06/2019 43.0	6/10/2018 48.0	5/06/2019 49.0	660.0
Gostwyck[1]	13/12/2018 8.0	13/12/2018 11.5	13/12/2018 15.0	16/03/2019 16.0	16/03/2019 19.0	30/03/2019 33.0	30/03/2019 51.0	30/03/2019 52.5	5/10/2018 68.5	6/10/2018 95.0	6/10/2018 95.0	627.5
Seaham	28/11/2018 12.5	28/11/2018 20.0	28/11/2018 22.5	28/11/2018 24.5	28/11/2018 26.0	30/03/2019 37.0	28/11/2018 56.0	28/11/2018 75.0	28/11/2018 81.0	6/10/2018 98.5	7/10/2018 99.5	779.0
Belmore Bridge	28/11/2019 8.5	9/03/2019 11.5	9/03/2019 20.0	9/03/2019 23.5	9/03/2019 27.5	9/03/2019 40.5	30/03/2019 56.5	30/03/2019 59.0	30/03/2019 59.0	1/04/2019 59.0	27/06/2019 63.5	618.0
Hexham Bridge	16/03/2019 5.5	16/03/2019 9.0	28/11/2018 15.0	28/11/2018 17.0	16/03/2019 24.5	16/03/2019 36.5	30/03/2019 44.0	30/03/2019 45.5	17/03/2019 50.5	6/10/2018 52.5	4/06/2019 60.0	624.0
Barnsley	16/03/2019 9.5	16/03/2019 17.0	16/12/2018 26.0	16/03/2019 32.0	16/03/2019 61.0	16/03/2019 110.0	16/03/2019 126.0	16/03/2019 128.5	17/03/2019 152.5	18/03/2019 158.0	18/03/2019 159.0	868.5
Martinsville	23/03/2019 12.5	16/03/2019 19.0	23/03/2019 25.0	16/03/2019 34.0	16/03/2019 40.0	16/03/2019 63.0	16/03/2019 82.5	16/03/2019 88.5	17/03/2019 113.5	17/03/2019 140.5	17/03/2019 144.0	971.5
Mandalong	23/03/2019 8.5	23/03/2019 13.0	23/03/2019 17.5	28/11/2018 20.0	28/11/2018 30.5	16/03/2019 48.0	16/03/2019 62.5	28/11/2018 77.0	29/11/2018 94.5	17/03/2019 104.5	17/03/2019 115.0	1027.0
Wyee	18/10/2018 13.5	18/10/2018 21.5	19/12/2018 35.0	19/12/2018 41.0	18/10/2018 45.0	28/11/2018 48.5	28/11/2018 66.0	28/11/2018 93.0	29/11/2018 109.5	29/11/2018 111.5	29/11/2018 111.5	1090.5

Station	Duration											Total yearly rainfall
	5 min	10 min	20 min	30 min	60 min	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs	
Whitemans Ridge	19/12/2018 8.5	28/11/2018 13.0	28/11/2018 21.5	28/11/2018 27.0	28/11/2018 42.0	28/11/2018 89.5	28/11/2018 104.5	28/11/2018 128.5	28/11/2018 134.5	29/11/2018 141.5	29/11/2018 142.0	1104.5
Yarramalong	15/12/2018 10.5	15/12/2018 12.5	28/11/2018 19.5	28/11/2018 26.5	28/11/2018 44.5	28/11/2018 73.5	28/11/2018 82.5	28/11/2018 96.5	28/11/2018 111.0	29/11/2018 118.0	29/11/2018 118.0	940.5
Kulnura	19/12/2018 7.5	19/12/2018 12.5	19/12/2018 19.0	19/12/2018 22.0	16/03/2019 28.0	16/03/2019 43.5	16/03/2019 52.0	16/03/2019 58.0	17/03/2019 64.5	18/03/2019 98.5	18/03/2019 108.5	829.0
Toukley	20/10/2018 8.5	20/10/2018 13.0	28/11/2018 22.0	28/11/2018 27.0	17/03/2019 37.0	17/03/2019 61.0	17/03/2019 64.5	17/03/2019 72.5	28/11/2018 79.5	29/11/2018 81.5	17/03/2019 84.0	771.0
Hamlyn Terrace	19/12/2018 9.5	19/12/2018 16.0	19/12/2018 23.0	19/12/2018 24.5	18/10/2018 27.5	28/11/2018 46.5	17/03/2019 54.0	28/11/2018 78.5	29/11/2018 92.0	17/03/2019 100.0	26/06/2019 108.5	1100.0
Mardi Dam	28/11/2018 7.5	28/11/2018 13.5	28/11/2018 21.5	28/11/2018 26.0	28/11/2018 38.0	28/11/2018 73.5	28/11/2018 92.5	28/11/2018 128.0	28/11/2018 145.5	29/11/2018 157.5	29/11/2018 157.5	1003.5
Sterland	28/11/2018 9.0	28/11/2018 17.5	28/11/2018 29.5	28/11/2018 35.0	28/11/2018 53.5	28/11/2018 82.5	28/11/2018 95.0	28/11/2018 120.0	28/11/2018 137.0	29/11/2018 144.5	29/11/2018 144.5	1132.5
Kangy Angy	20/10/2018 8.5	20/10/2018 14.5	28/11/2018 20.0	28/11/2018 26.5	28/11/2018 44.0	28/11/2018 66.5	28/11/2018 74.5	28/11/2018 118.0	28/11/2018 134.0	29/11/2018 148.0	29/11/2018 148.5	1049.0
Berkeley Vale	8/02/2019 8.0	28/11/2018 14.0	21/01/2019 16.0	21/01/2019 19.5	28/11/2018 32.5	28/11/2018 51.0	28/11/2018 61.5	28/11/2018 89.5	28/11/2018 108.5	29/11/2019 119.0	29/11/2019 119.0	938.0
Bateau Bay	8/09/2018 12.0	8/09/2018 18.5	8/09/2018 22.0	8/09/2018 22.5	5/01/2019 27.0	5/01/2019 41.0	14/10/2018 68.5	14/10/2018 79.5	14/10/2018 82.5	14/10/2018 86.0	14/10/2018 87.0	1020.0
Lisarow	12/03/2019 8.5	12/03/2019 13.0	28/11/2018 17.5	17/03/2019 19.0	8/02/2019 28.0	28/11/2018 44.5	17/03/2019 72.5	28/11/2019 94.0	28/11/2018 109.5	29/11/2019 123.5	17/03/2019 134.5	1204.0
Strickland	18/10/2018 10.0	18/10/2018 20.0	18/10/2018 25.0	8/02/2019 26.5	8/02/2019 41.0	8/02/2019 51.5	17/03/2019 77.5	17/03/2019 86.5	17/03/2019 109.5	17/03/2019 131.0	17/03/2019 145.5	1111.0
Narara	14/12/2018 9.0	14/12/2018 14.5	14/12/2018 19.0	17/03/2019 22.0	17/03/2019 40.5	17/03/2019 64.0	17/03/2019 86.5	17/03/2019 94.0	17/03/2019 122.0	17/03/2019 144.0	17/03/2019 156.0	1094.0
Mount Elliot	18/10/2018 9.5	18/10/2018 19.0	18/10/2018 27.5	17/03/2019 30.5	17/03/2019 41.0	17/03/2019 63.5	17/03/2019 79.5	17/03/2019 85.5	17/03/2019 93.0	17/03/2019 120.5	17/03/2019 137.0	1242.0
Wyoming	16/03/2019 9.0	18/10/2018 15.0	18/10/2018 20.0	16/03/2019 25.5	17/03/2019 35.0	17/03/2019 61.5	17/03/2019 95.5	17/03/2019 102.5	17/03/2019 139.5	17/03/2019 169.0	17/03/2019 189.5	1175.5
Kincumber	16/03/2019 10.0	16/03/2019 14.0	14/03/2019 21.0	14/03/2019 27.0	14/03/2019 34.0	17/03/2019 51.0	17/03/2019 95.0	17/03/2019 105.0	17/03/2019 112.0	17/03/2019 160.5	17/03/2019 200.0	1124.5
Webbs Creek	17/10/2018 10.0	17/10/2018 17.0	17/10/2018 26.8	17/10/2018 34.2	17/10/2018 38.8	17/10/2018 51.2	17/10/2018 52.2	17/10/2018 52.4	18/10/2018 52.6	18/03/2019 74.4	18/03/2019 80.0	716.4

Station	Duration											Total yearly rainfall
	5 min	10 min	20 min	30 min	60 min	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs	
Colo Junction[1]	19/12/2018 9.4	19/12/2018 17.6	19/12/2018 21.2	19/12/2018 22.8	19/12/2018 22.8	17/10/2018 26.6	19/12/2018 36.2	19/12/2018 41.0	19/12/2018 44.8	18/03/2019 55.2	18/03/2019 62.6	639.2
Sackville Downstream[1]	9/01/2019 4.2	9/01/2019 6.2	9/01/2019 7.2	9/01/2019 7.2	30/03/2019 11.6	30/03/2019 29.8	30/03/2019 35.2	30/03/2019 35.4	17/03/2019 46.6	18/03/2019 67.2	18/03/2019 72.0	297.4
Curl Curl	28/11/2018 10.5	28/11/2018 19.5	28/11/2018 26.0	28/11/2018 27.5	14/03/2019 39.0	14/03/2019 68.0	17/03/2019 86.0	17/03/2019 101.0	17/03/2019 110.0	17/03/2019 120.5	17/03/2019 190.0	1054.0
Kelso Creek	8/02/2019 9.5	8/02/2019 17.5	8/02/2019 25.5	30/03/2019 27.0	30/03/2019 33.5	30/03/2019 43.0	30/03/2019 50.0	30/03/2019 50.0	17/03/2019 51.5	18/03/2019 59.5	17/03/2019 77.0	695.0
Rixons Pass	27/03/2019 8.5	27/03/2019 16.5	8/01/2019 20.0	8/01/2019 23.5	4/10/2018 29.0	4/10/2018 52.5	4/10/2018 65.5	28/11/2018 73.5	28/11/2018 85.0	29/11/2018 96.0	19/03/2019 112.5	1060.5
Russell Vale	27/11/2018 9.0	27/11/2018 11.0	8/01/2019 17.0	8/01/2019 20.5	19/03/2019 31.0	4/10/2018 46.5	4/10/2018 58.0	5/10/2018 63.0	5/10/2018 71.0	29/11/2018 83.5	19/03/2019 102.0	915.0
Mount Pleasant	14/03/2019 12.5	27/11/2018 19.5	8/02/2019 27.5	8/02/2019 31.5	18/03/2019 37.5	4/10/2018 48.0	4/10/2018 67.0	28/11/2018 86.0	28/11/2018 103.5	29/11/2018 123.0	19/03/2019 137.0	1096.5
Mount Kembla	14/03/2019 7.5	18/03/2019 14.5	18/03/2019 24.0	18/03/2019 31.0	18/03/2019 58.0	18/03/2019 108.5	18/03/2019 114.0	19/03/2019 114.5	19/03/2019 117.5	18/03/2019 150.5	18/03/2019 171.5	917.0
Dombarton Loop	14/03/2019 11.5	14/03/2019 20.0	14/03/2019 32.0	14/03/2019 36.0	14/03/2019 40.0	14/03/2019 40.5	28/11/2018 47.0	28/11/2018 66.5	28/11/2018 72.0	17/03/2019 92.5	17/03/2019 132.0	951.5
Wongawilli	8/02/2019 9.0	8/02/2019 12.0	8/02/2019 19.0	8/02/2019 22.5	8/02/2019 26.5	19/03/2019 32.0	4/06/2019 40.5	4/06/2019 41.0	4/06/2019 49.0	19/03/2019 66.0	19/03/2019 89.5	653.5
Port Kembla	28/11/2018 9.5	14/03/2019 17.0	14/03/2019 28.0	14/03/2019 38.5	14/03/2019 46.5	18/03/2019 62.5	18/03/2019 65.0	18/03/2019 65.5	19/03/2019 72.0	18/03/2019 91.0	18/03/2019 109.5	910.0
Darkes Road	14/03/2019 6.0	14/03/2019 12.0	14/03/2019 17.5	14/03/2019 19.5	4/06/2019 28.5	4/06/2019 38.5	4/06/2019 48.0	4/06/2019 48.5	5/06/2019 55.0	5/06/2019 61.0	19/03/2019 78.0	687.0
Cleveland Road	19/03/2019 6.0	19/03/2019 9.5	18/03/2019 14.0	4/06/2019 16.5	4/06/2019 21.5	4/06/2019 31.0	4/06/2019 43.5	4/06/2019 43.5	4/06/2019 50.5	4/06/2019 58.0	4/06/2019 73.5	638.5
Huntley Colliery	18/10/2018 11.0	18/10/2018 21.0	18/10/2018 24.0	18/10/2018 27.0	18/10/2018 27.5	18/10/2018 27.5	28/11/2018 36.5	28/11/2018 54.0	28/11/2018 65.0	28/11/2018 78.0	17/03/2019 82.0	779.0
Upper Calderwood	15/12/2018 9.0	5/01/2019 16.0	5/01/2019 28.5	5/01/2019 31.5	5/01/2019 33.5	5/01/2019 73.0	5/01/2019 91.0	5/01/2019 99.0	5/01/2019 99.0	5/01/2019 99.0	8/01/2019 102.0	749.0
Little Lake Entrance	23/04/2019 8.0	8/02/2019 13.0	14/03/2019 20.5	23/04/2019 28.5	14/03/2019 36.0	14/03/2019 40.0	4/06/2019 44.5	4/06/2019 45.5	4/06/2019 54.0	5/06/2019 70.0	17/03/2019 89.5	754.5
Nurrewin	28/11/2018 13.0	28/11/2018 25.5	28/11/2018 48.5	28/11/2018 64.0	28/11/2018 80.5	28/11/2018 124.0	28/11/2018 155.5	28/11/2018 176.0	28/11/2018 184.5	29/11/2018 194.5	29/11/2018 194.5	1023.5

Station	Duration											Total yearly rainfall
	5 min	10 min	20 min	30 min	60 min	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs	
Clover Hill	28/11/2018 9.0	28/11/2018 17.5	28/11/2018 30.5	28/11/2018 39.5	28/11/2018 49.5	28/11/2018 81.0	28/11/2018 112.5	28/11/2018 135.5	28/11/2018 147.5	29/11/2018 158.5	29/11/2018 159.0	988.5
North Macquarie	5/01/2019 7.5	5/01/2019 13.5	5/01/2019 20.5	5/01/2019 26.5	5/01/2019 28.0	5/01/2019 66.0	5/01/2019 83.5	5/01/2019 89.5	5/01/2019 89.5	6/01/2019 90.0	8/01/2019 92.0	676.5
Yellow Rock Road	7/11/2018 10.5	13/12/2018 15.0	13/12/2018 25.5	13/12/2018 29.0	13/12/2018 32.0	5/01/2019 40.5	5/01/2019 54.5	28/11/2018 66.0	28/11/2018 76.5	29/11/2018 79.5	28/11/2018 83.0	858.5
Lake Conjola Downstream	22/04/2019 9.0	22/04/2019 13.5	28/11/2018 22.0	28/11/2018 30.0	28/11/2018 37.5	28/11/2018 56.5	28/11/2018 72.5	28/11/2018 93.0	28/11/2018 117.0	29/11/2018 119.5	29/11/2018 119.5	744.0
Barlows Bay	15/12/2018 8.0	11/01/2019 14.0	11/01/2019 19.5	11/01/2019 21.0	14/03/2019 26.0	14/03/2019 43.0	4/06/2019 50.5	4/06/2019 66.0	4/06/2019 66.5	4/06/2019 66.5	15/12/2018 67.0	767.0
Regatta Point	15/12/2018 8.5	15/12/2018 14.0	15/12/2018 27.0	15/12/2018 32.5	15/12/2018 34.5	27/11/2018 55.0	28/11/2018 77.0	28/11/2018 92.5	28/11/2018 95.5	28/11/2018 95.5	28/11/2018 96.0	696.0

[1] Some measure of data loss occurred at these stations. See individual plots for further details.
Note – the date listed refers to the time that the recorded total rainfall ends.

4.1 Southern Oscillation Index

The Southern Oscillation Index (SOI) is a calculation of monthly or seasonal shifts in the air pressure between Darwin and Tahiti (source: Bureau of Meteorology). As well as being linked to the temperature of the Pacific Ocean and the strength of Pacific trade winds, the SOI is also associated with rainfall and can be used to predict whether higher or lower than average rainfall may occur in northern and eastern Australia.

A La Niña episode occurs when there are ongoing positive SOI values, and increases the probability of higher than average rainfall in northern and eastern Australia. Sustained negative SOI values have been coined El Niño events, and are associated with a reduction in rainfall over northern and eastern Australia. Even low to moderate El Niño events can lead to severe droughts in Australia. The SOI for the period July 1999 to June 2019 is graphically represented in Figure 3.

4.2 Data provision

Rainfall data is provided to the public on behalf of CCSD via the following methods:

- MHL's public internet home pages, providing near real time access to a limited sample of data/email correspondence and File Transfer Protocol (FTP)
- MHL provides CCSD and NSW State Emergency Service officers access to near real time environmental data and our 'quality assured' historical database through the CCSD information portal, which is password protected
- NSW SES officers also receive automated notifications from flood warning systems in NSW
- a web-based data request system is available where electronic requests can be submitted via MHL's homepage at http://www.mhl.nsw.gov.au under the data request menu.

During 2018-2019:

- MHL received in excess of 75,000 visitors per month to its website
- MHL served in excess of 152,000 webpage hits per month to customers and to the public
- approximately 1,800,000 webpage hits were recorded from the public (excluding customers) in 2018–2019.

Data access also continues to assist the Bureau of Meteorology, local government authorities, State Emergency Service, NSW Police, WaterNSW, NSW Surf Life Saving Association, universities, the NSW court system, private consultancies, NSW Roads and Maritime Services and the Natural Resources Commission.

4.3 Data capture performance

Rainfall data presented by MHL is collected, analysed and subjected to a strict quality assurance process in accordance with MHL's internal standards and work instructions. This process results in a quality code which is assigned to all rainfall data, as described in Table 4.5 below.

During 2018–2019, the overall data capture across the network, for data with a quality code of 105 or better, was 98.9%. Table 5.1 *Index of figures* provides data capture percentages for each rainfall region. Missing or 208 quality coded data can result in gaps in the data record. This can be caused by a range of reasons, such as equipment damage or failure, power failure, or site specific environmental issues.

Automatic recorded rainfall data is recorded to a resolution equal to the size of the tipping bucket (0.2 mm, 0.5 mm or 1.0 mm). Each record or tip of the bucket is triggered when the tipping bucket is filled, which may occur over a period of time.

Table 4.5 MHL data quality code descriptions

Quality code		Rainfall*
5	Records processed to	±3% of calibration
55	Records processed to	±5% of calibration
100	Data from previous MHL database, processed to	±3% of calibration
105	Records processed to	±10% of calibration
208	Records processed to greater than	<-10% or >10% of calibration
150	Uncoded – data not yet quality controlled	Raw data from the instrument with only preliminary quality checks performed
1, 204, 205, 206, 207, 255	Data loss/data missing	

* A quality code is assigned based on infield status verification checks.

5. Rainfall monitoring summary

This section documents locality maps and quality assured rainfall monitoring summaries for each station. Table 5.1 and Table 5.2 provide indexes to the figures presented. The rainfall plots shown in Figure 5 to Figure 92 are presented as daily rainfall totals from midnight to midnight.

Table 5.1 Index of figures

	Figure
Typical pluviometer station	1
Data transfer schematic – existing and design state	2
Southern Oscillation Index, June 1999–June 2019	3

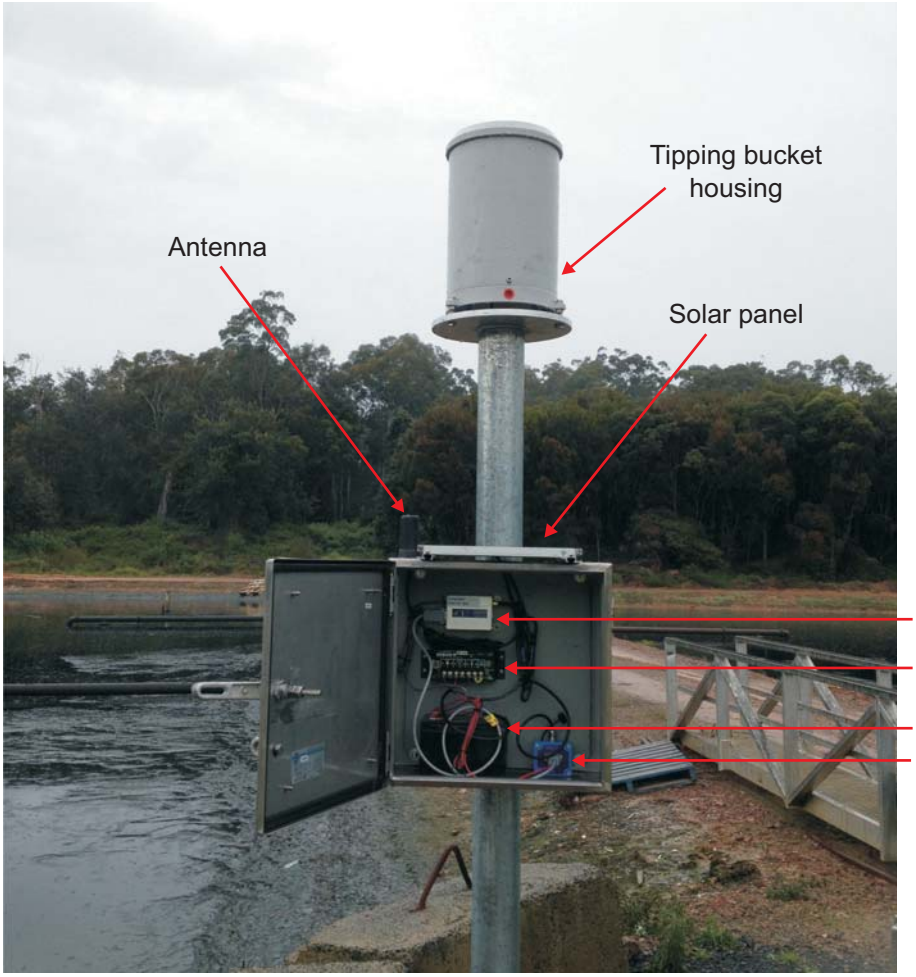
Region	Station short name	Station no.	MGA	Easting	Northing	Capture %	Figure
Station Locality Map	Tweed River and Brunswick River Regions					97.7%	4
Tweed	Cudgera	558046	56	549668	6859164		5
Brunswick	Main Arm	558053	56	542469	6847276		6
Brunswick	Huonbrook	558049	56	537723	6841573		7
Brunswick	Myocum	558036	56	550528	6837390		8
Station Locality Map	Richmond River Region					100.0%	9
Richmond	Lake Ainsworth	203455	56	557863	6816160		10
Station Locality Map	Bellinger River Region (North)					100.0%	11
Bellinger	Wooli Caravan Park	205463	56	524551	6697797		12
Station Locality Map	Bellinger River Region (South)					99.5%	13
Bellinger	Perry Drive	559019	56	510142	6650416		14
Bellinger	Shephards Lane	559017	56	508196	6650884		15
Bellinger	Red Hill	559016	56	506635	6649672		16
Bellinger	Newports Creek	559051	56	505893	6646680		17
Bellinger	Middle Boambee	559048	56	504720	6645291		18
Bellinger	North Bonville	559050	56	500593	6641143		19
Bellinger	Kooroowi	205440	56	482967	6629647		20
Station Locality Map	Nambucca River Region					100.0%	21
Nambucca	Stuarts Island Downstream	205466	56	499519	6608564		22
Nambucca	Utungun	205414	56	485800	6600344		23
Station Locality Map	Macleay River and Hastings River Regions					96.9%	24
Macleay	Aldavilla Downstream	206459	56	479318	6561231		25
Hastings	Green Valley	207406	56	486416	6540068		26
Hastings	Telegraph Point	207415	56	481082	6534512		27

Region	Station short name	Station no.	MGA	Easting	Northing	Capture %	Figure
Station Locality Map	Camden Haven Region					97.4%	28
Camden Haven	Logans Crossing	207428	56	470913	6502295		29
Manning	Mount George	208440	56	419229	6472262		30
Station Locality Map	Karuah River Region					100.0%	31
Karuah	Nabiac	209404	56	436831	6446432		32
Karuah	Tuncurry Downstream	209401D	56	450368	6441819		33
Karuah	Pacific Palms Wharf	209406	56	455401	6422551		34
Karuah	Tarbuck Bay	209465	56	451548	6417906		35
Karuah	Bulahdelah	209460	56	425442	6413407		36
Station Locality Map	Hunter River Region					97.5%	37
Hunter	Gostwyck	210402	56	369088	6396074		38
Hunter	Seaham	210462	56	381105	6385316		39
Hunter	Belmore Bridge	210458	56	364492	6377780		40
Hunter	Hexham Bridge	210448	56	376568	6368156		41
Station Locality Map	Macquarie-Tuggerah Lakes (North) Region					100.0%	42
Macquarie-Tuggerah Lakes	Barnsley	561067	56	367906	6355834		43
Macquarie-Tuggerah Lakes	Martinsville	561083	56	351239	6341583		44
Macquarie-Tuggerah Lakes	Mandalong	561081	56	355224	6335165		45
Macquarie-Tuggerah Lakes	Wyee	561097	56	358608	6328268		46
Station Locality Map	Macquarie-Tuggerah Lakes (South), Brisbane Water Regions					100.0%	47
Macquarie-Tuggerah Lakes	Whitemans Ridge	561026	56	343653	6324899		48
Macquarie-Tuggerah Lakes	Yarramalong	561137	56	338869	6322377		49
Macquarie-Tuggerah Lakes	Kulnura	561078	56	333796	6321517		50
Macquarie-Tuggerah Lakes	Toukley	211401	56	362599	6318531		51
Macquarie-Tuggerah Lakes	Hamlyn Terrace	561133	56	357399	6319854		52
Macquarie-Tuggerah Lakes	Mardi Dam	561082	56	351038	6314555		53
Macquarie-Tuggerah Lakes	Sterland	567138	56	342433	6315335		54
Macquarie-Tuggerah Lakes	Kangy Angy	561132	56	350168	6310609		55
Macquarie-Tuggerah Lakes	Berkeley Vale	561134	56	353191	6309376		56
Macquarie-Tuggerah Lakes	Bateau Bay	561069	56	358098	6305653		57
Macquarie-Tuggerah Lakes	Lisarow	561079	56	348900	6305317		58
Macquarie-Tuggerah Lakes	Strickland	561136	56	345377	6305541		59
Brisbane Water	Narara	561085	56	344310	6304220		60
Brisbane Water	Mount Elliot	561084	56	350646	6302980		61
Brisbane Water	Wyoming	561098	56	346415	6302026		62
Brisbane Water	Kincumber	561077	56	350387	6294461		63
Station Locality Map	Hawkesbury River Region					84.2%	64
Hawkesbury	Webbs Creek	212408	56	312331	6303939		65
Hawkesbury	Colo Junction	212407	56	303223	6298183		66
Hawkesbury	Sackville Downstream	212438	56	302769	6291566		67

Region	Station short name	Station no.	MGA	Easting	Northing	Capture %	Figure
Station Locality Map	Sydney Coastal Region					100.0%	68
Sydney Coastal	Curl Curl	213426	56	342094	6262459		69
Sydney Coastal	Kelso Creek	213430	56	313782	6241020		70
Station Locality Map	Wollongong Coastal Region					100.0%	71
Wollongong Coastal	Rixons Pass	568317	56	305281	6196889		72
Wollongong Coastal	Russell Vale	568318	56	306377	6196135		73
Wollongong Coastal	Mount Pleasant	568229	56	303026	6191630		74
Wollongong Coastal	Mount Kembla	568314	56	299550	6186441		75
Wollongong Coastal	Dombarton Loop	568307	56	294719	6185605		76
Wollongong Coastal	Wongawilli	568320	56	293261	6182388		77
Wollongong Coastal	Port Kembla	568316	56	306636	6182719		78
Wollongong Coastal	Darkes Road	568309	56	297450	6182477		79
Wollongong Coastal	Cleveland Road	568308	56	295800	6179726		80
Wollongong Coastal	Huntley Colliery	568311	56	290648	6178905		81
Wollongong Coastal	Upper Calderwood	568319	56	288750	6175160		82
Wollongong Coastal	Little Lake Entrance	214467	56	304250	6173571		83
Wollongong Coastal	Nurrewin	568228	56	284567	6173437		84
Wollongong Coastal	Clover Hill	568310	56	284233	6172392		85
Wollongong Coastal	North Macquarie	568315	56	291440	6171492		86
Wollongong Coastal	Yellow Rock Road	568321	56	292886	6167649		87
Station Locality Map	South Coast (North) Region					100.0%	88
South Coast	Lake Conjola Downstream	216420	56	272446	6094316		89
Station Locality Map	South Coast (Mid) Region					100.0%	90
South Coast	Barlows Bay	218415	56	239464	5988955		91
South Coast	Regatta Point	219405	56	236881	5971060		92

Table 5.2 Index of Appendix B figures

Sample rainfall data outputs	Figure
Sample daily and monthly rainfall plots	B1
Sample Intensity-Frequency-Duration formulated in 1987	B2
Sample Intensity-Frequency-Duration formulated in 2016	B3
Sample rain gauge tip times	B4



NSW GOVERNMENT

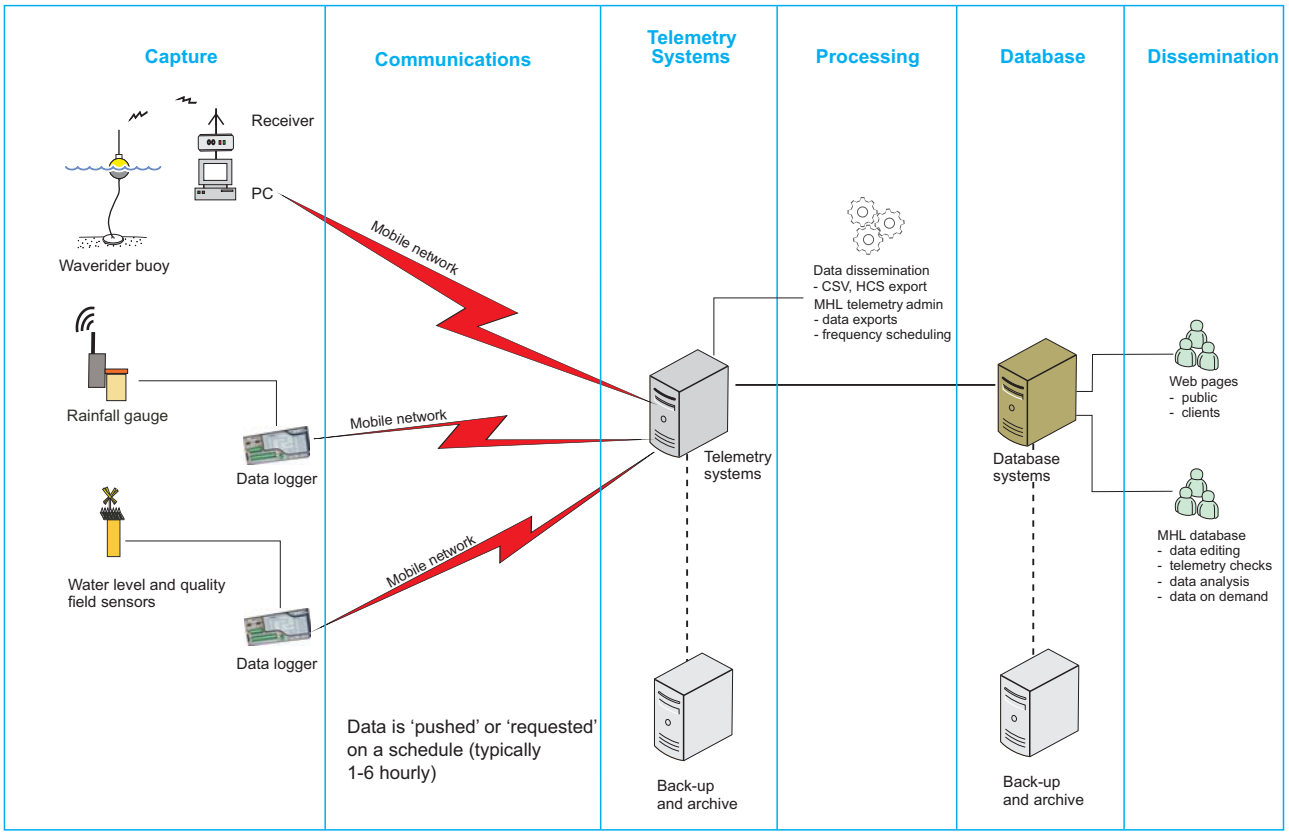
TYPICAL PLUVIOMETER STATION

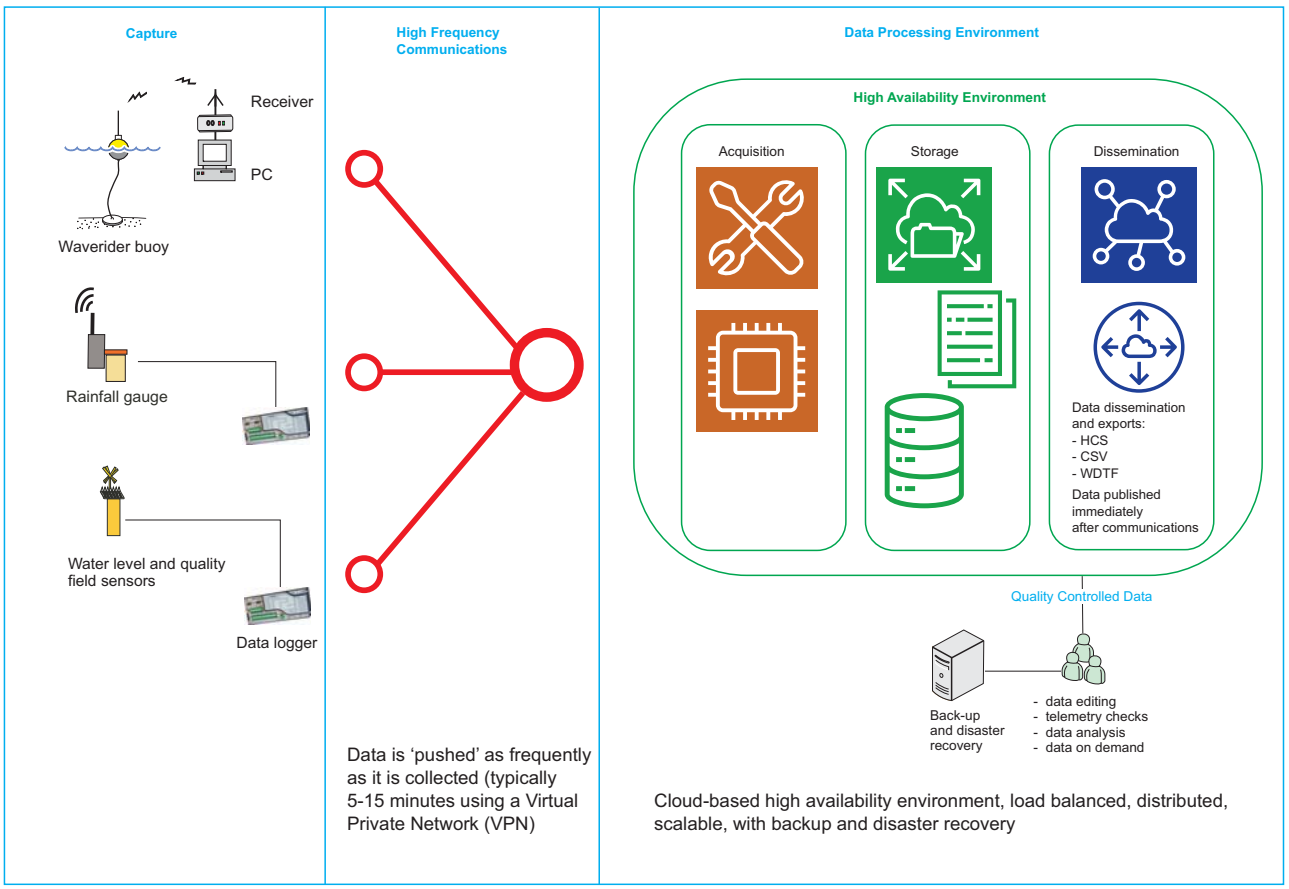
Manly Hydraulics Laboratory

Report MHL2694

Figure 1

DRAWING 2694-01.cdr





NSW GOVERNMENT

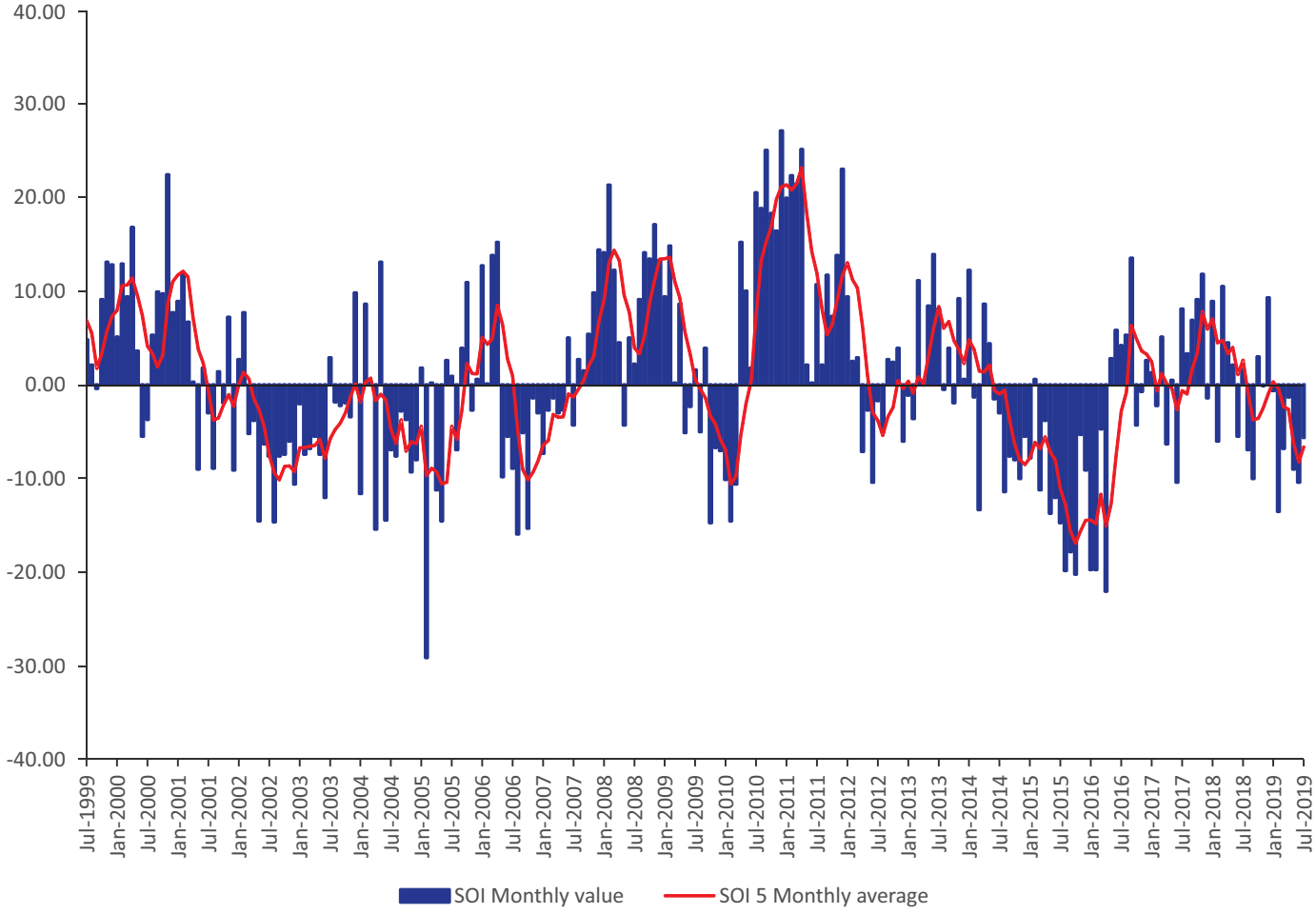
DATA TRANSFER SCHEMATIC
EXISTING (upper) AND DESIGN STATE (lower)

Manly Hydraulics Laboratory

Report MHL2694

Figure 2

DRAWING 2694-02.cdr



NSW GOVERNMENT

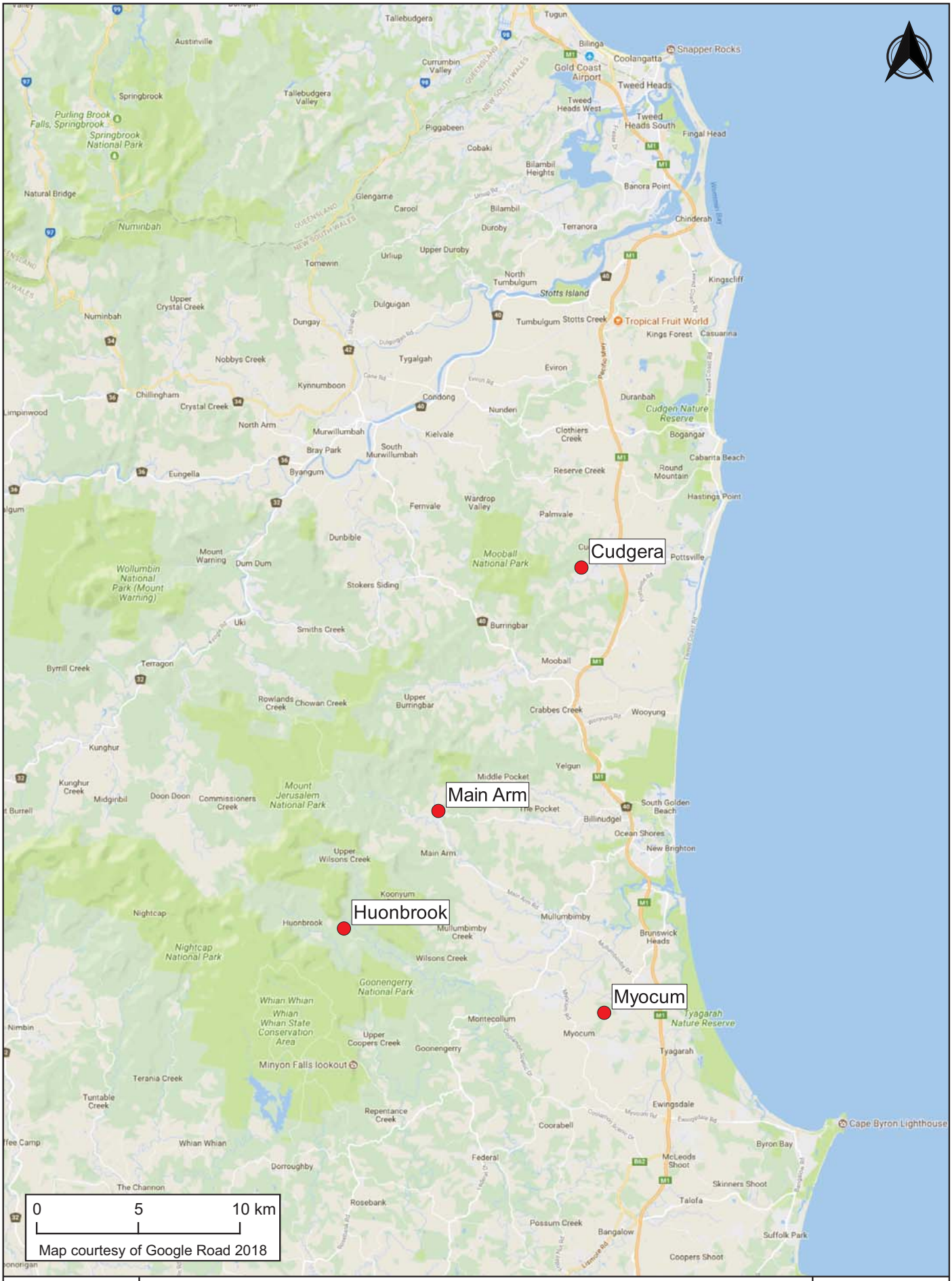
SOUTHERN OSCILLATION INDEX
JULY 1999–JUNE 2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 3

DRAWING 2694-03.cdr



NSW GOVERNMENT

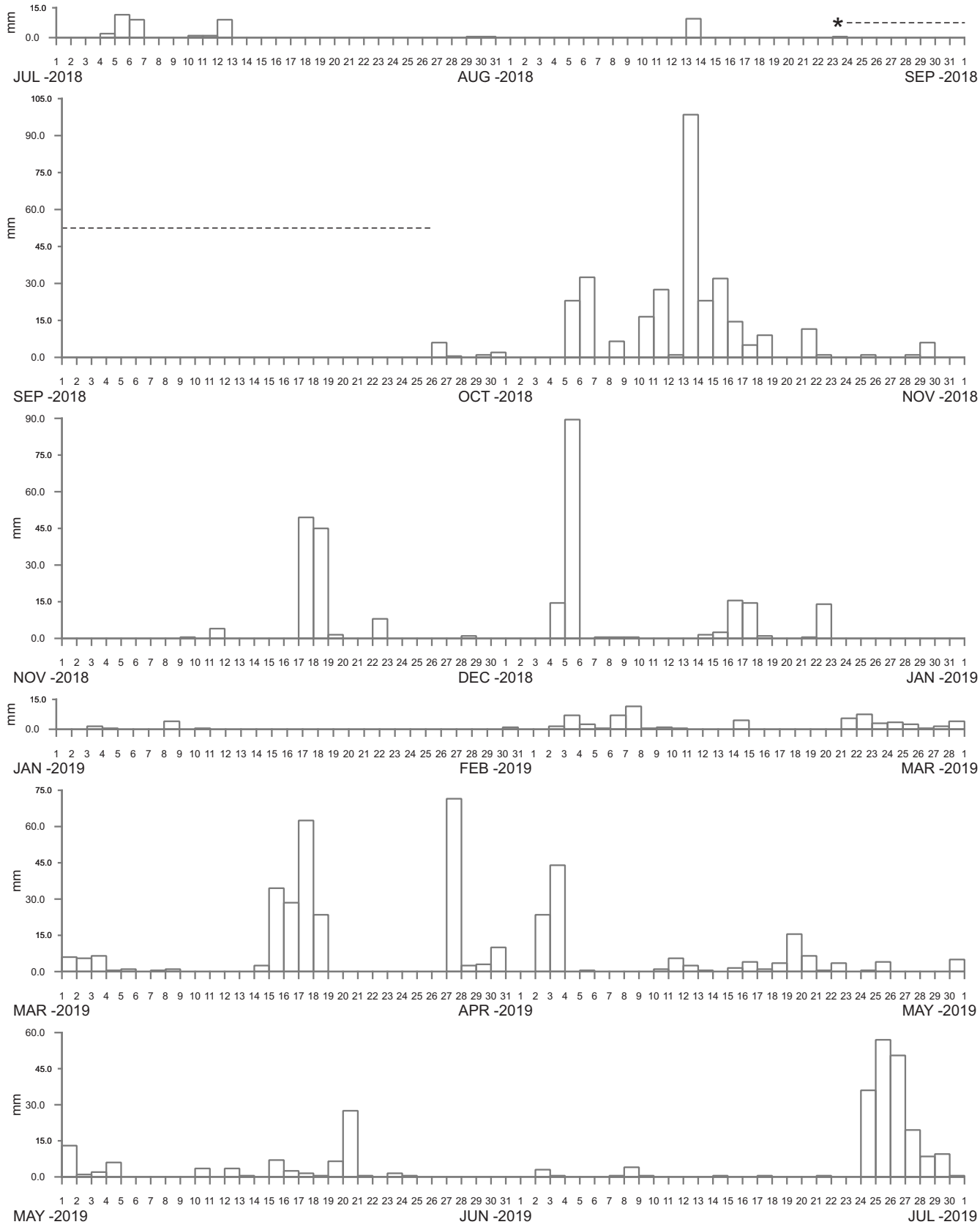
RAINFALL STATION LOCATIONS
TWEED RIVER AND BRUNSWICK RIVER REGIONS

Manly Hydraulics Laboratory

Report MHL2694

Figure 4

DRAWING 2694-04.cdr



DATA LOSS

*Data loss due to battery failure

NSW GOVERNMENT

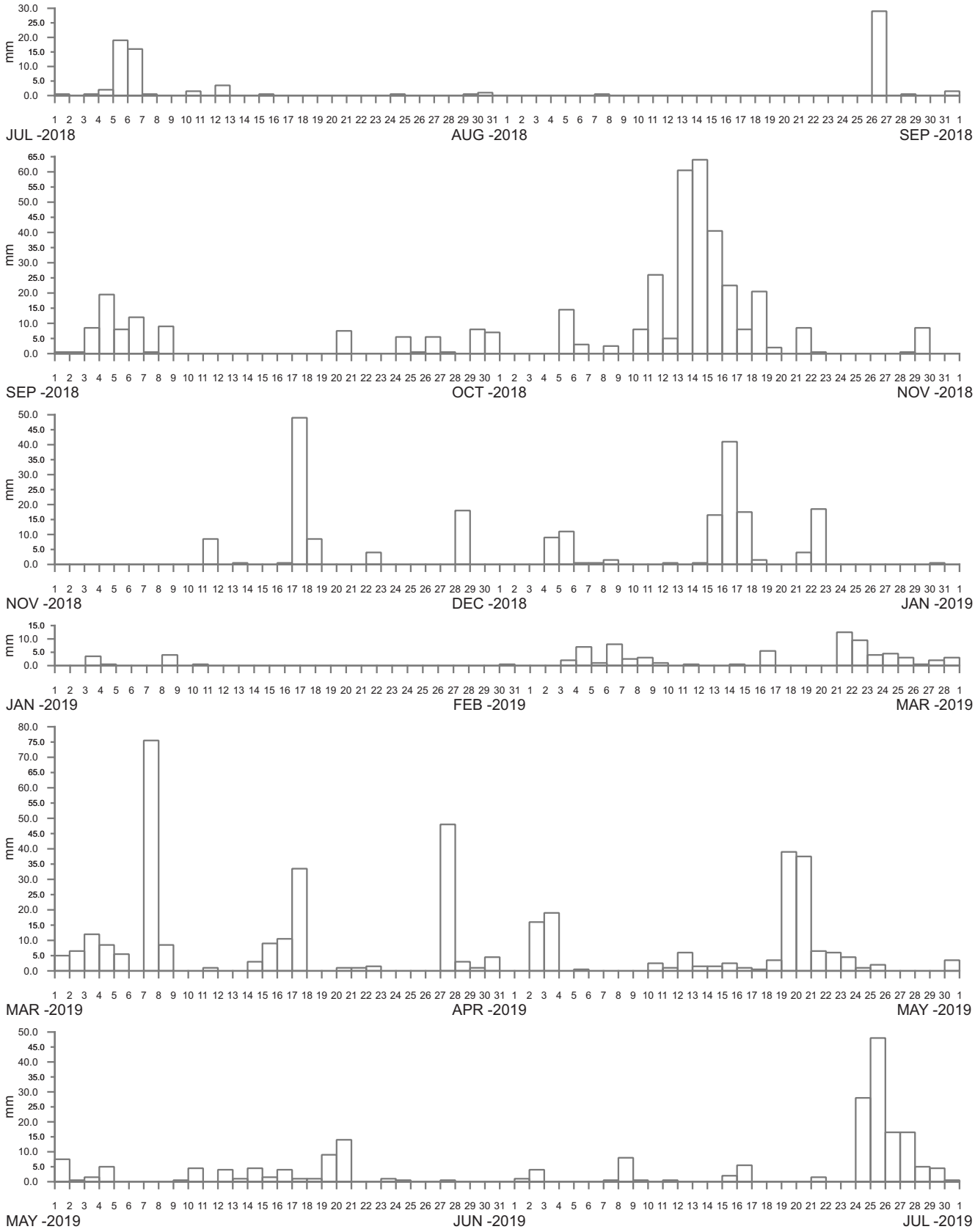
CUDGERA AT CABBAGE GUM ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 5

DRAWING 2694-05.cdr



DATA LOSS

NSW GOVERNMENT

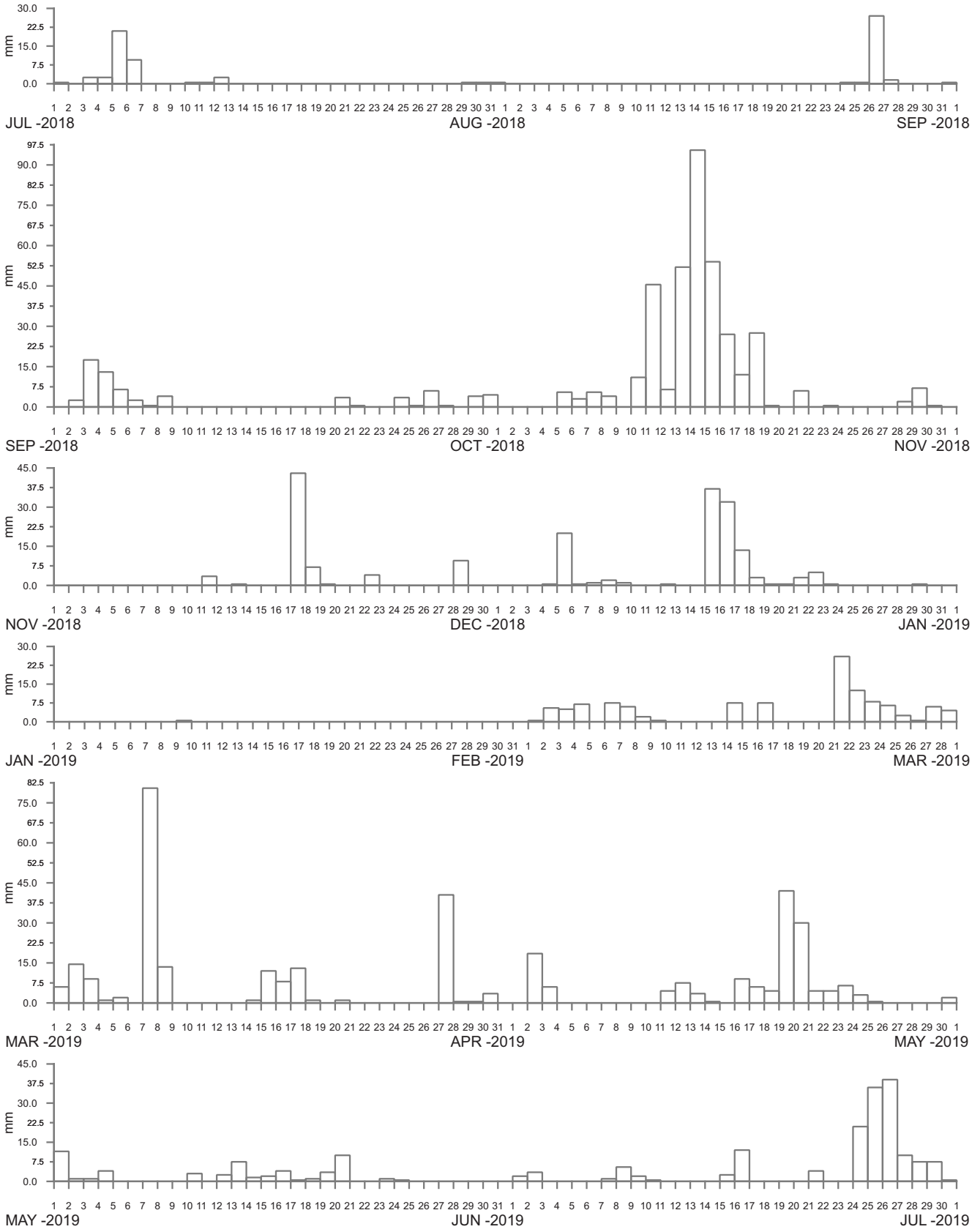
MAIN ARM AT MAIN ARM ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 6

DRAWING 2694-06.cdr



DATA LOSS

NSW GOVERNMENT

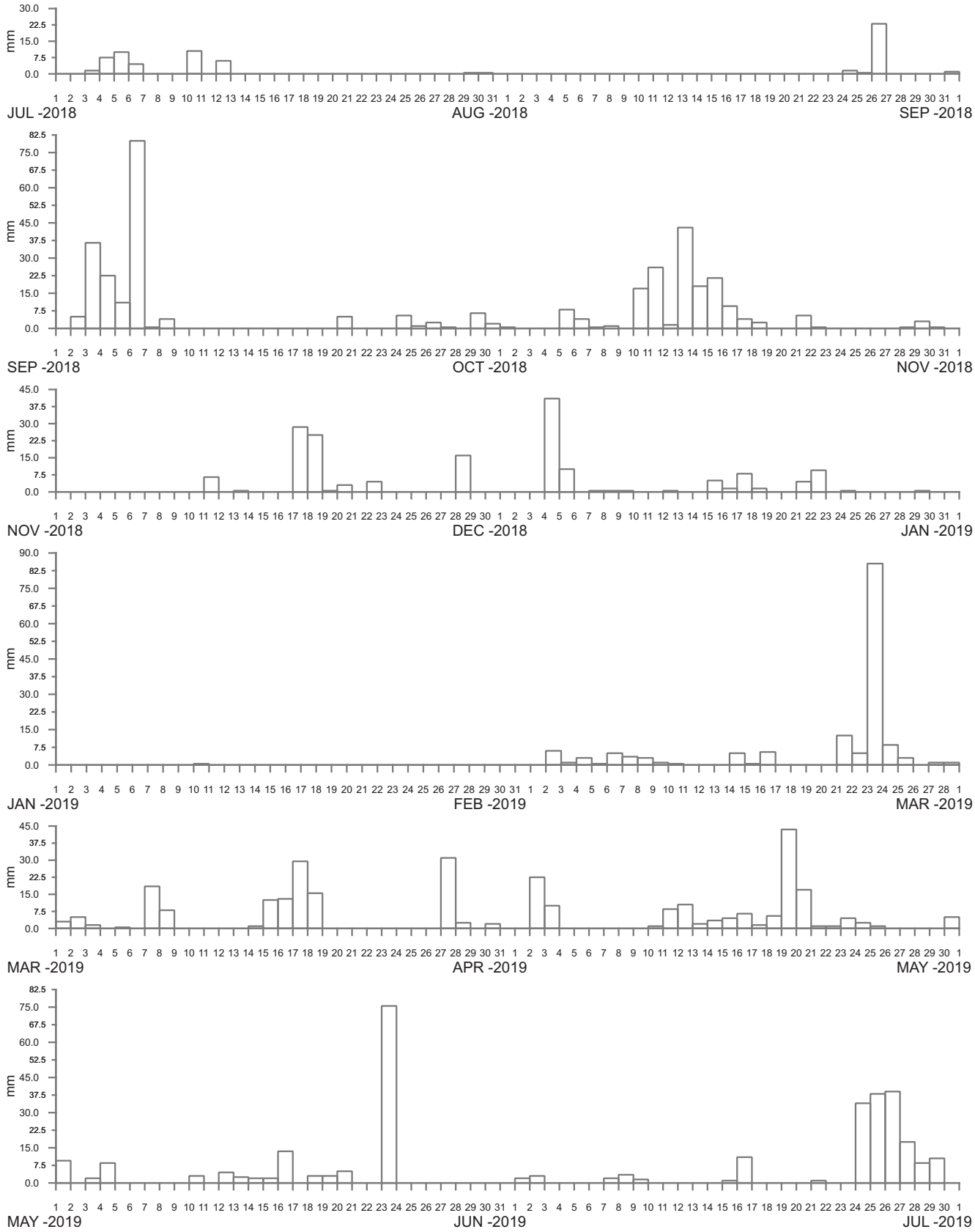
HUONBROOK AT WILSONS CREEK ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 7

DRAWING 2694-07.cdr



DATA LOSS

NSW GOVERNMENT

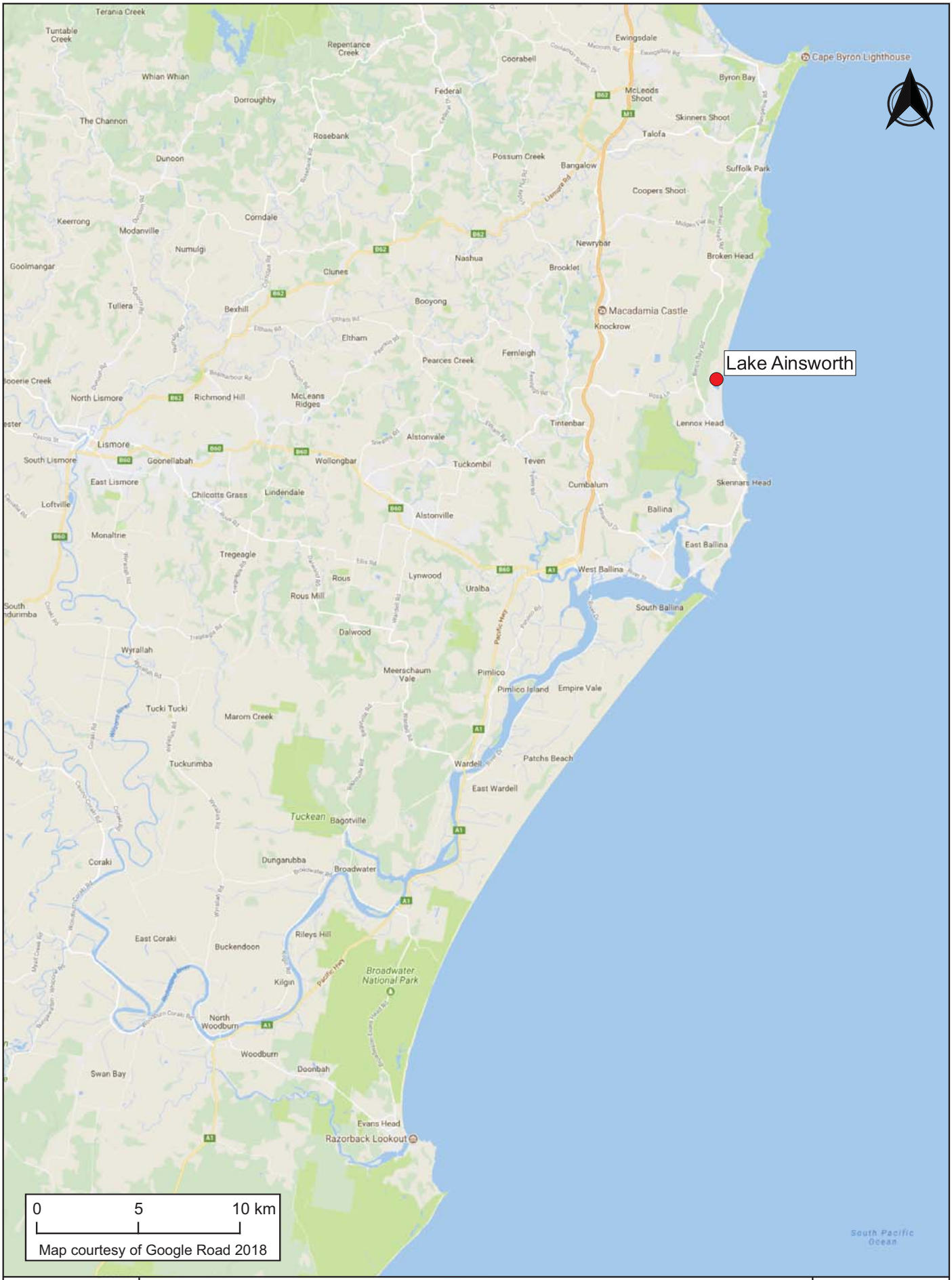
MYOCUM AT KINGSVALE ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 8

DRAWING 2694-08.cdr



NSW GOVERNMENT

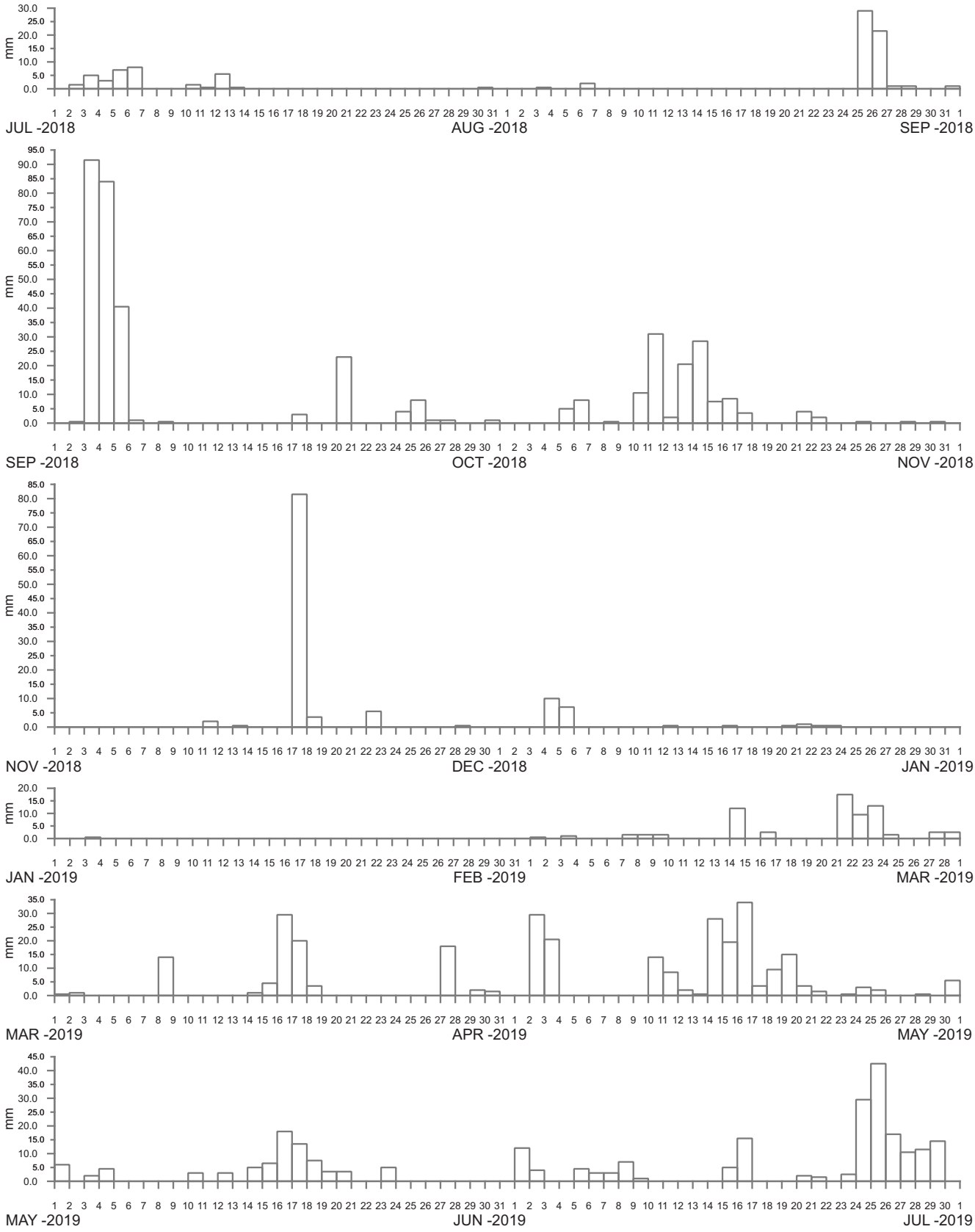
RAINFALL STATION LOCATIONS
RICHMOND RIVER REGION

Manly Hydraulics Laboratory

Report MHL2694

Figure 9

DRAWING 2694-09.cdr



DATA LOSS

NSW GOVERNMENT

LAKE AINSWORTH AT LENNOX HEAD
2018–2019

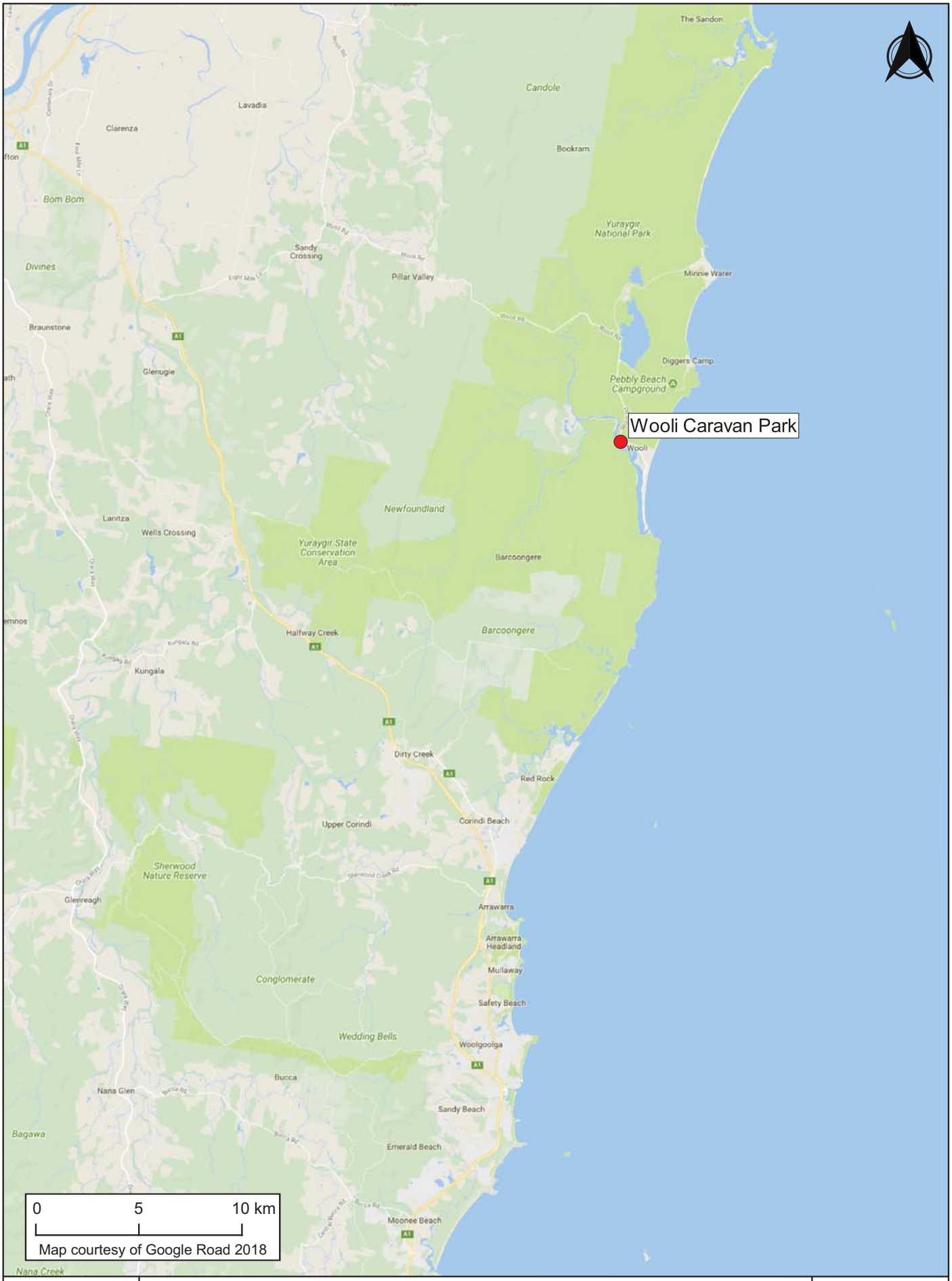
Manly Hydraulics Laboratory

Report MHL2694

Figure

10

DRAWING 2694-10.cdr



NSW GOVERNMENT

RAINFALL STATION LOCATIONS
BELLINGER RIVER REGION (NORTH)

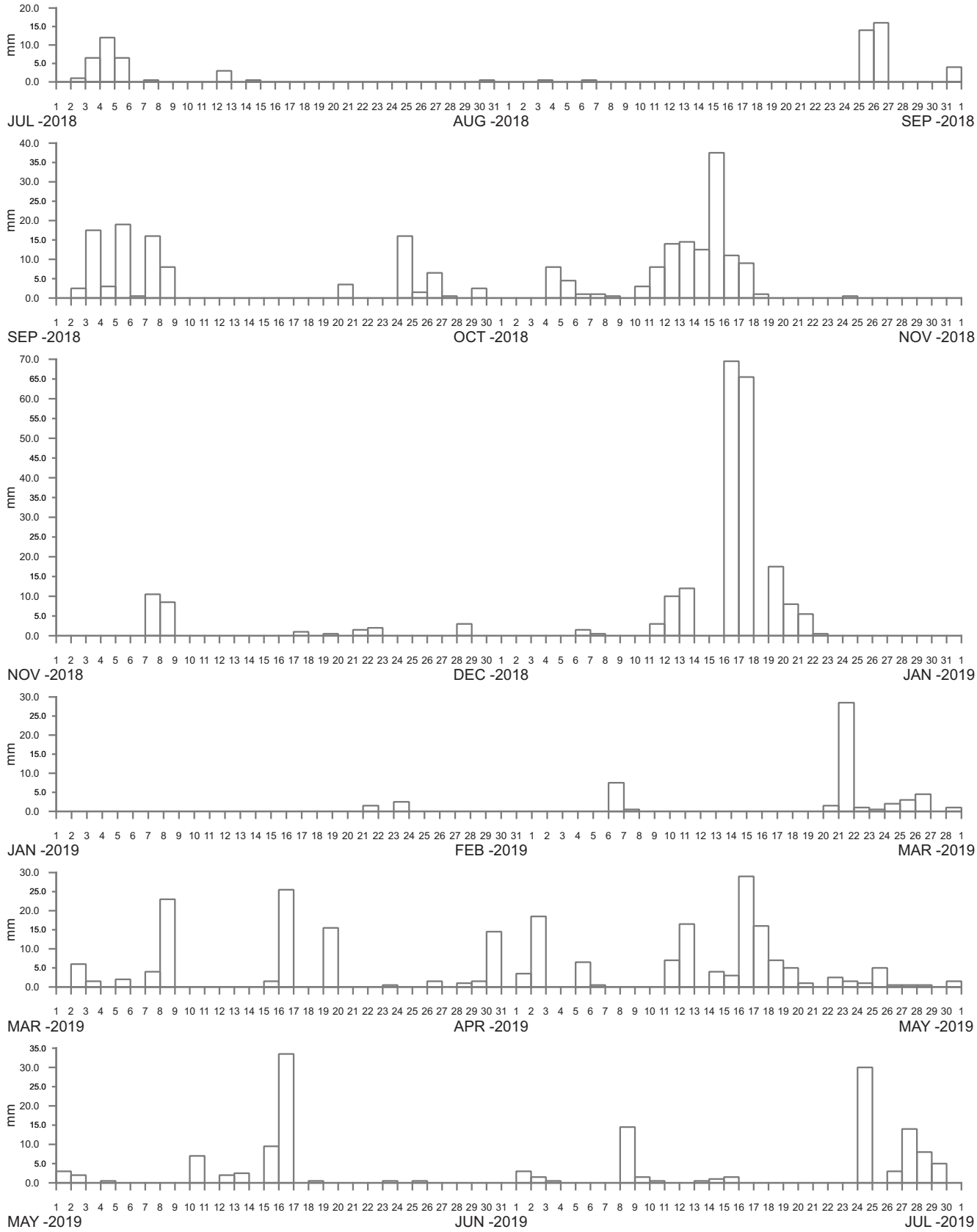
Manly Hydraulics Laboratory

Report MHL2694

Figure

11

DRAWING 2694-11.cdr



DATA LOSS

NSW GOVERNMENT

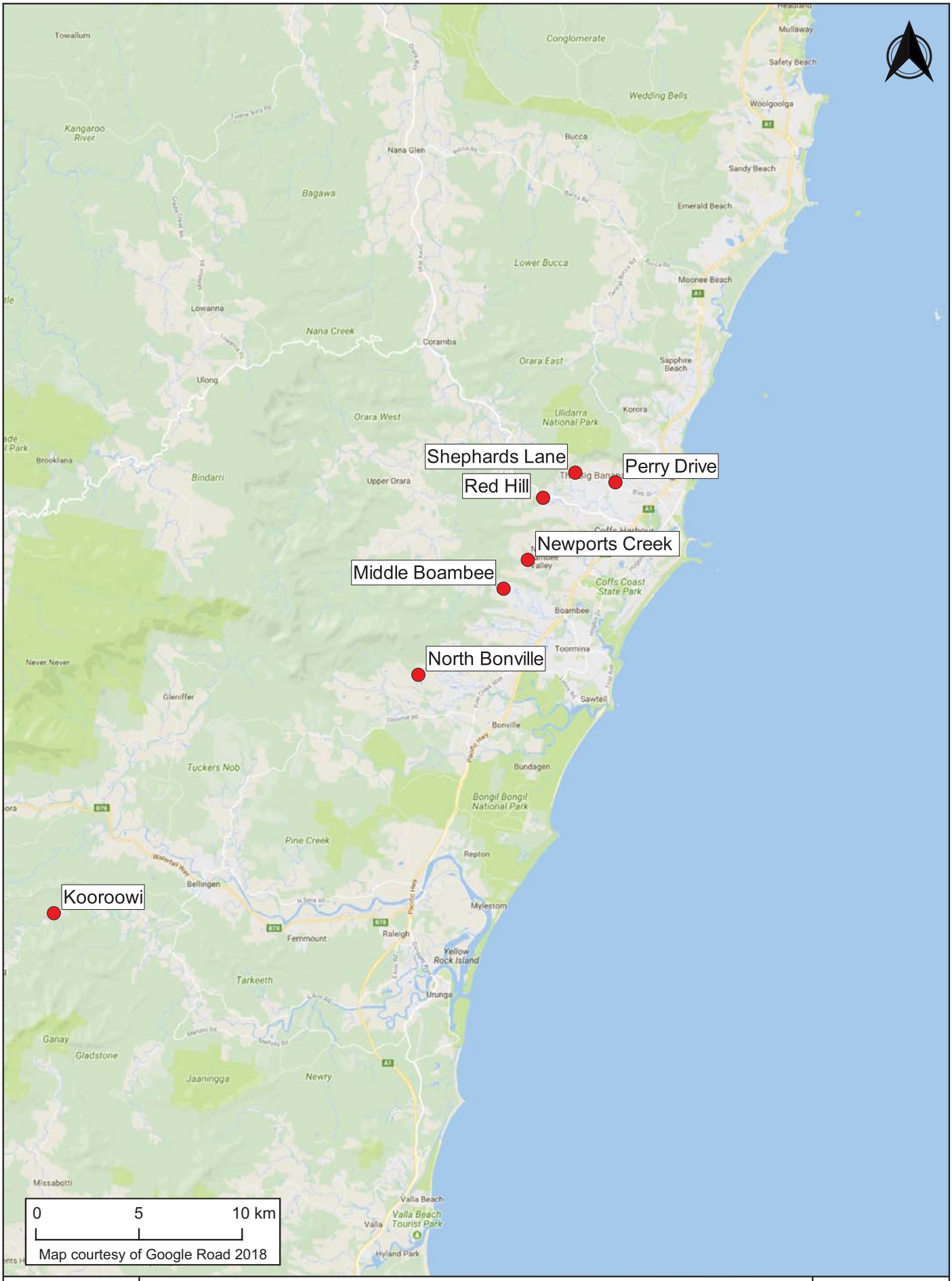
WOOLI CARAVAN PARK AT WOOLI RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 12

DRAWING 2694-12.cdr



NSW GOVERNMENT

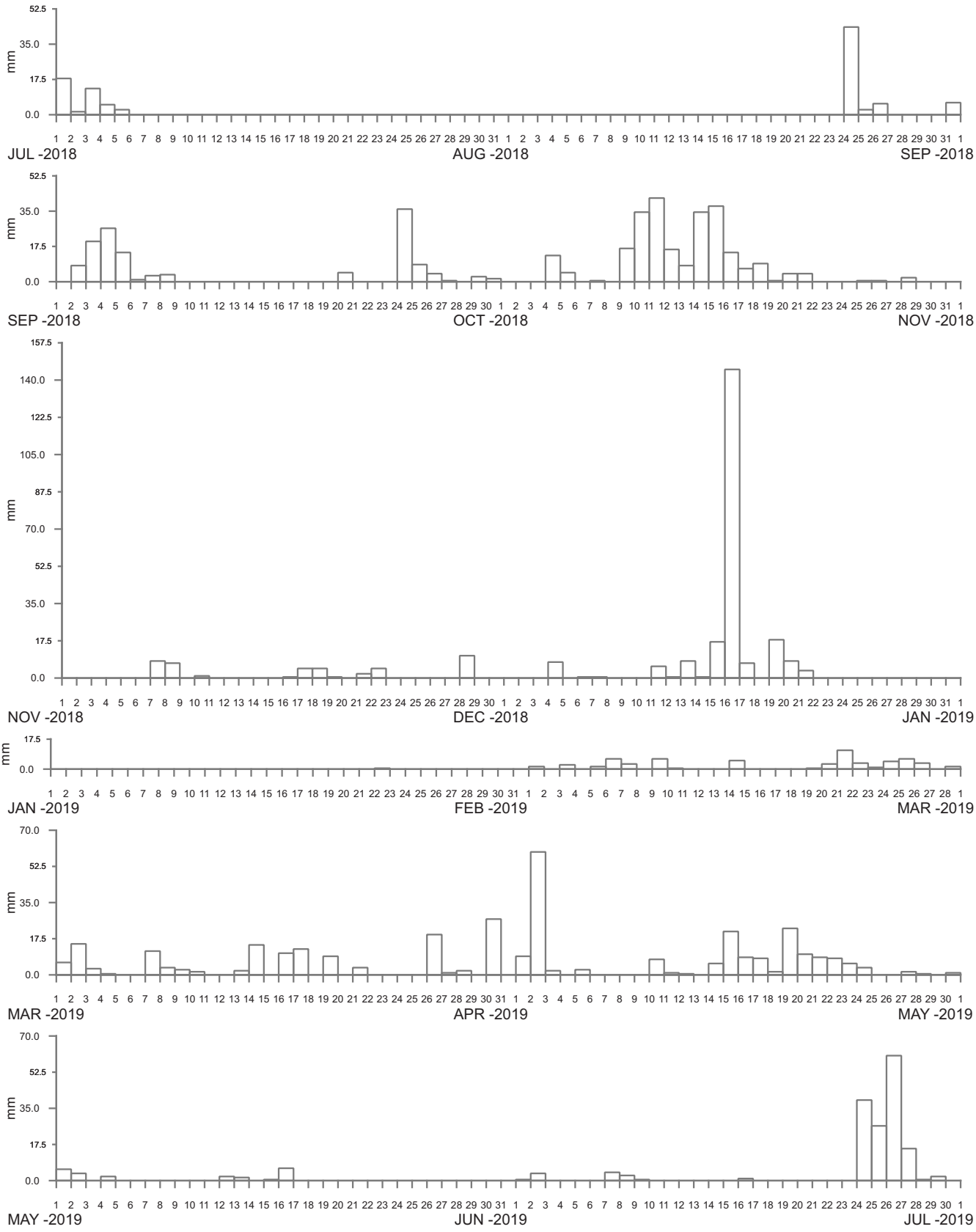
RAINFALL STATION LOCATIONS
BELLINGER RIVER REGION (SOUTH)

Manly Hydraulics Laboratory

Report MHL2694

Figure 13

DRAWING 2694-13.cdr



DATA LOSS

NSW GOVERNMENT

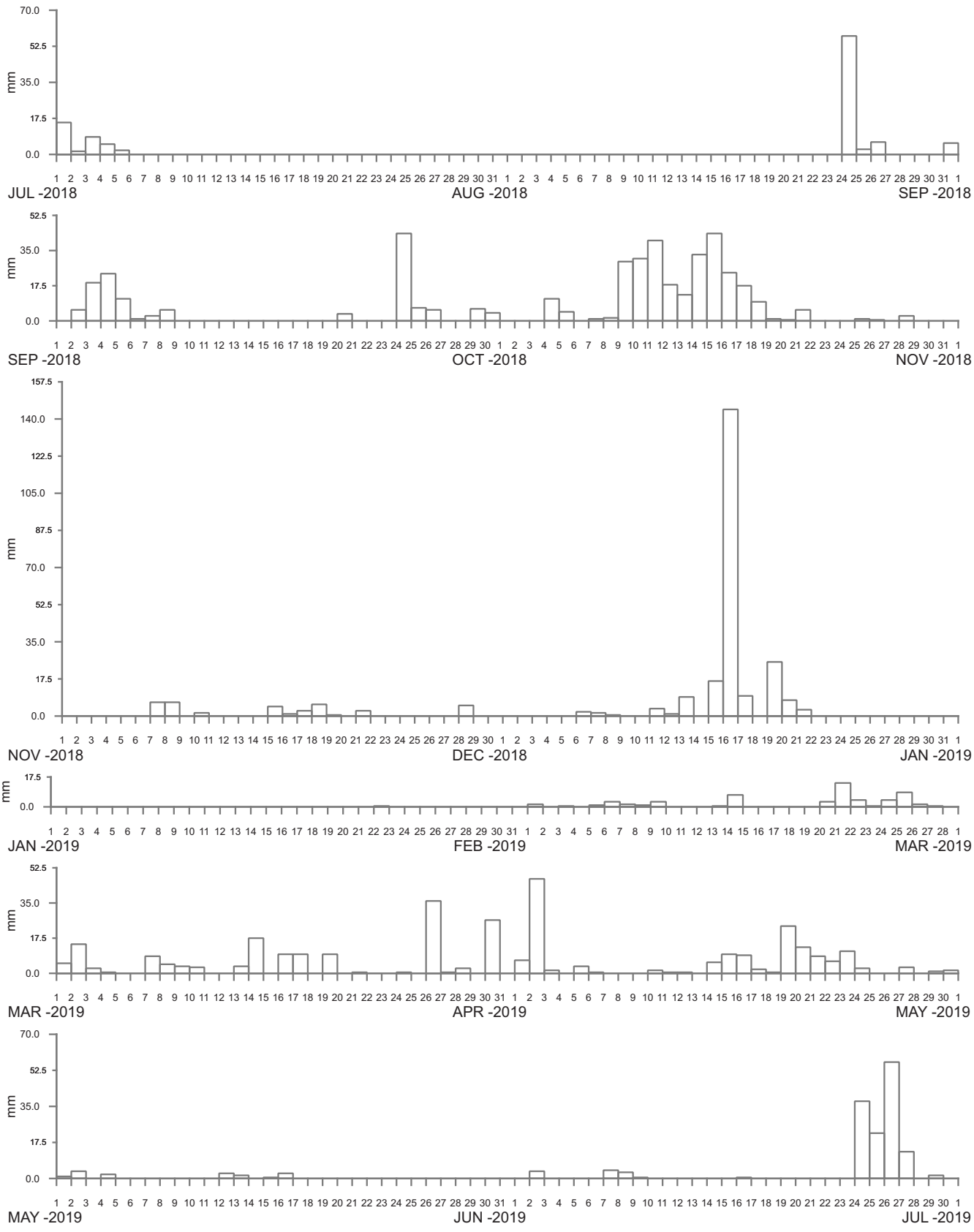
PERRY DRIVE AT COFFS HARBOUR
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 14

DRAWING 2694-14.cdr



DATA LOSS

NSW GOVERNMENT

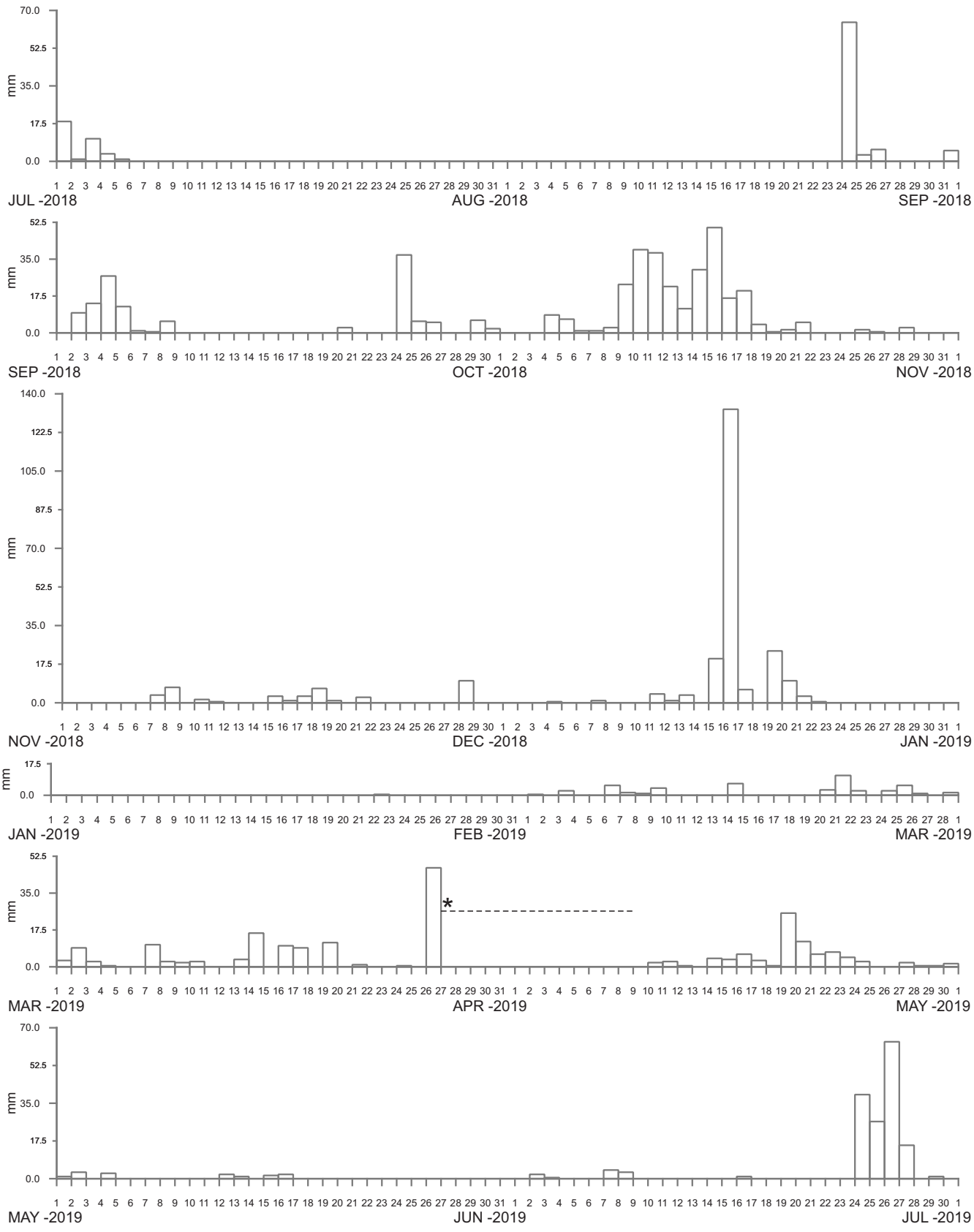
SHEPHARDS LANE AT COFFS HARBOUR
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 15

DRAWING 2694-15.cdr



DATA LOSS

*Data loss due to program anomaly

NSW GOVERNMENT

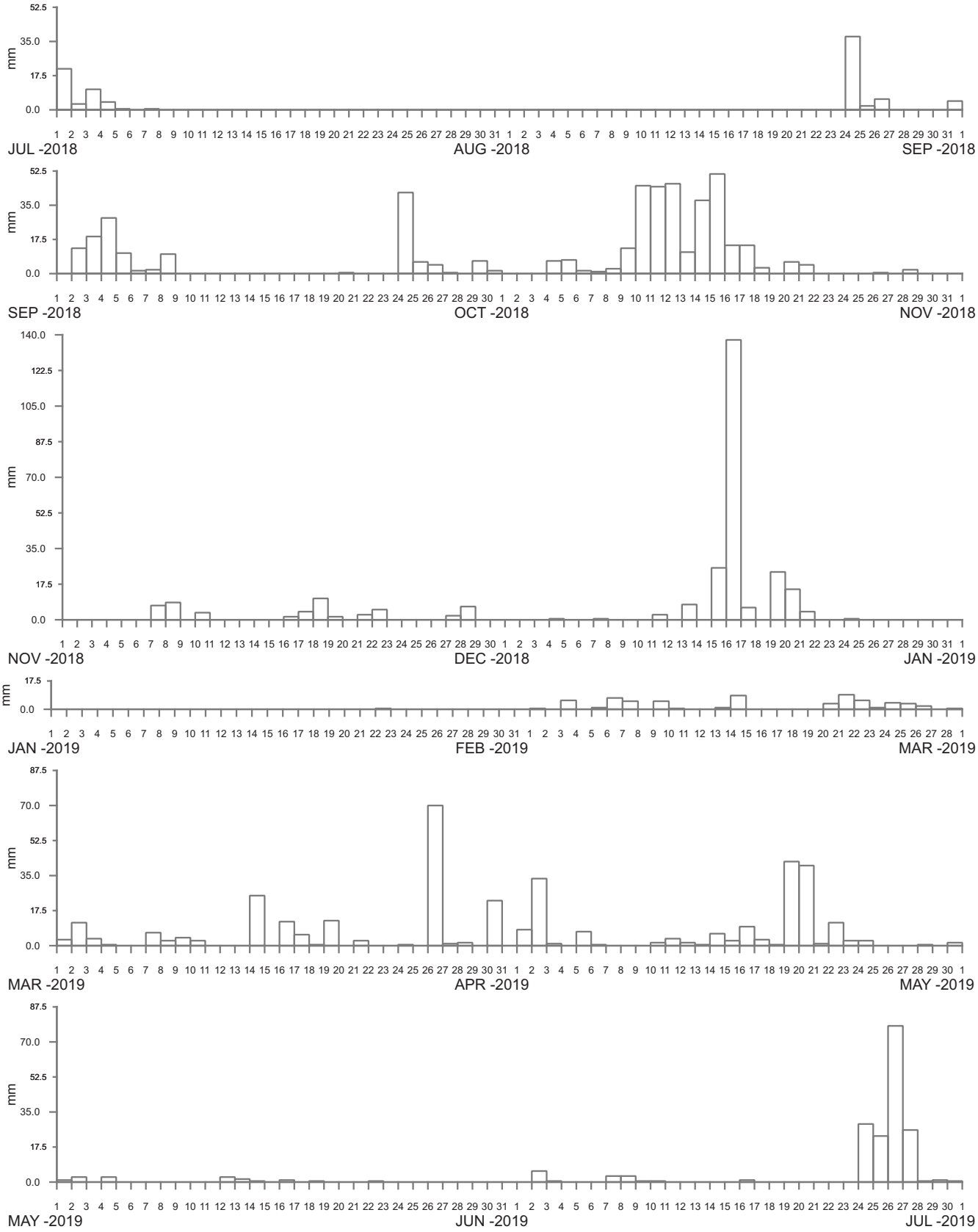
RED HILL AT COFFS HARBOUR
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 16

DRAWING 2694-16.cdr



DATA LOSS

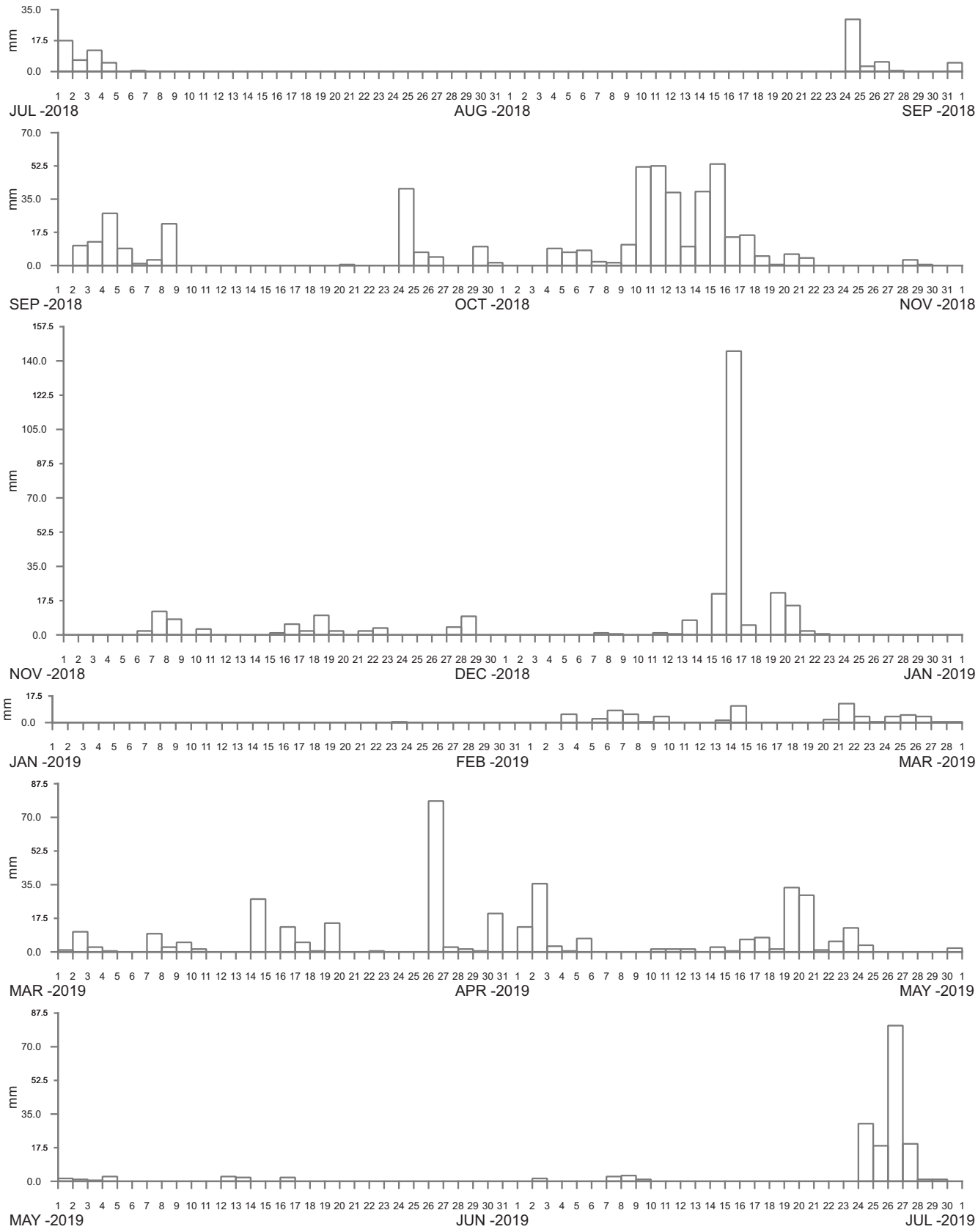
NEWPORTS CREEK AT ENGLANDS ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 17

DRAWING 2694-17.cdr



NSW GOVERNMENT

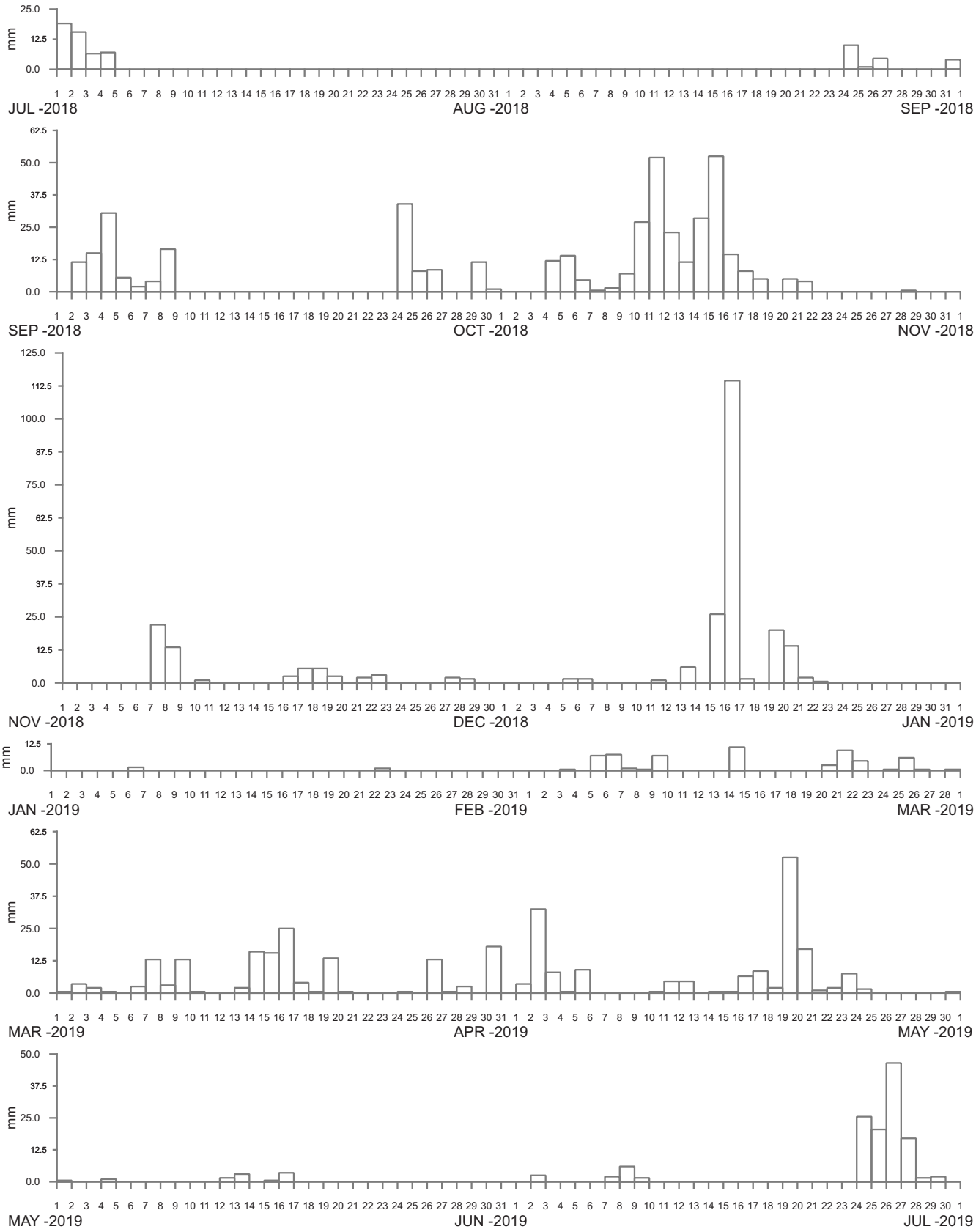
MIDDLE BOAMBEE AT CEDARVALE ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 18

DRAWING 2694-18.cdr



NSW GOVERNMENT

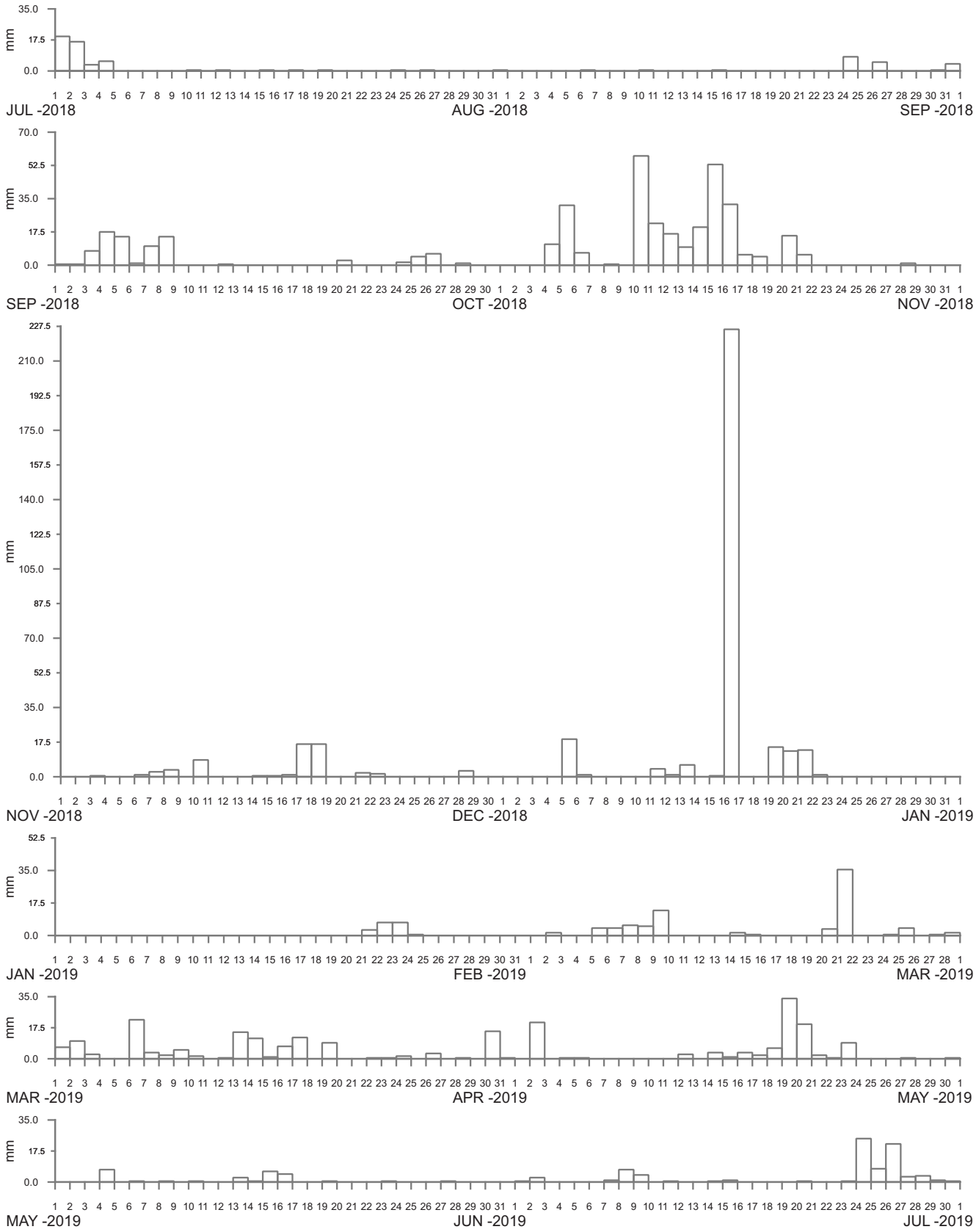
NORTH BONVILLE AT NORTH BONVILLE ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 19

DRAWING 2694-19.cdr



DATA LOSS

NSW GOVERNMENT

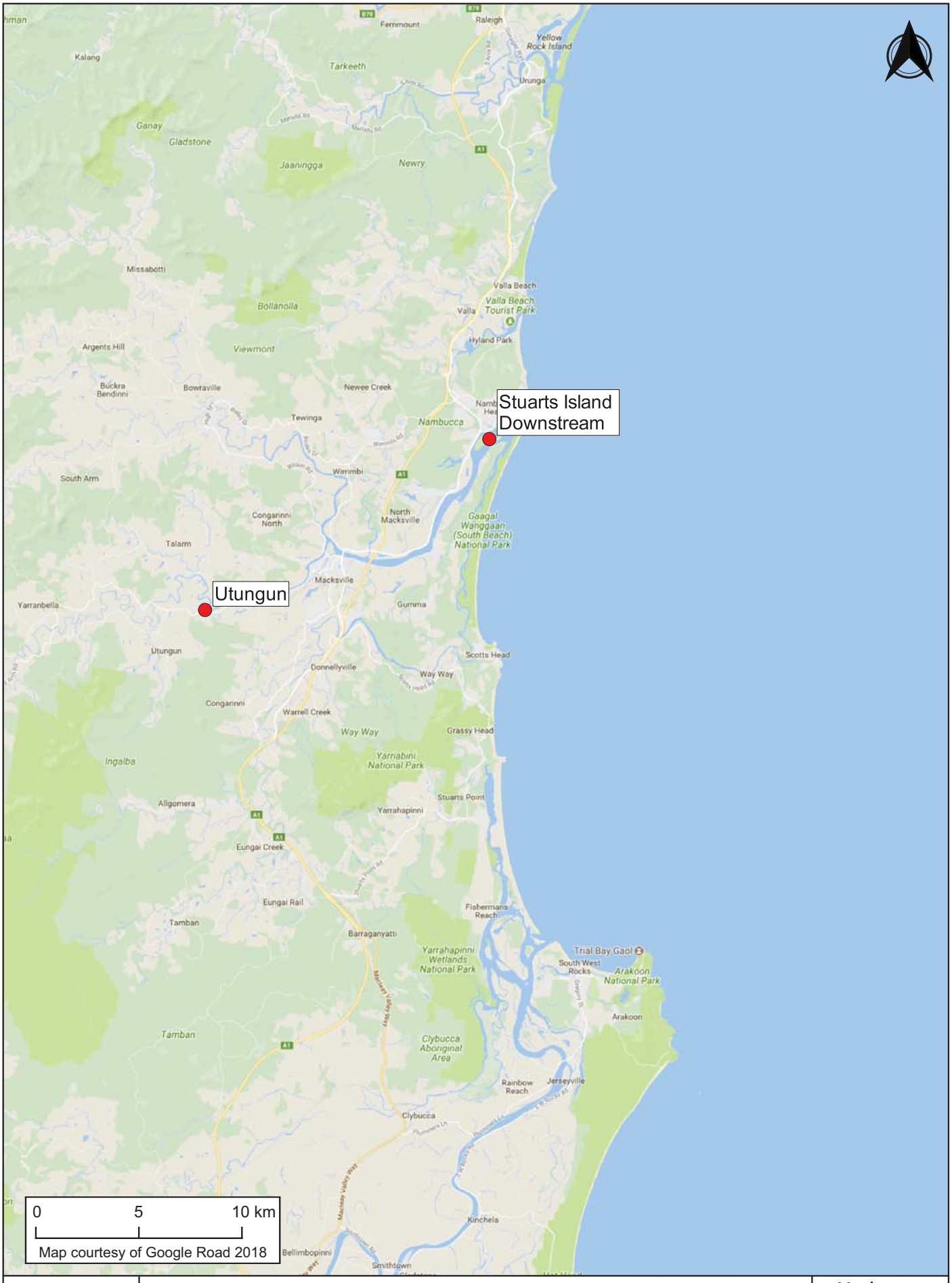
KOOROOWI AT KALANG RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 20

DRAWING 2694-20.cdr



NSW GOVERNMENT

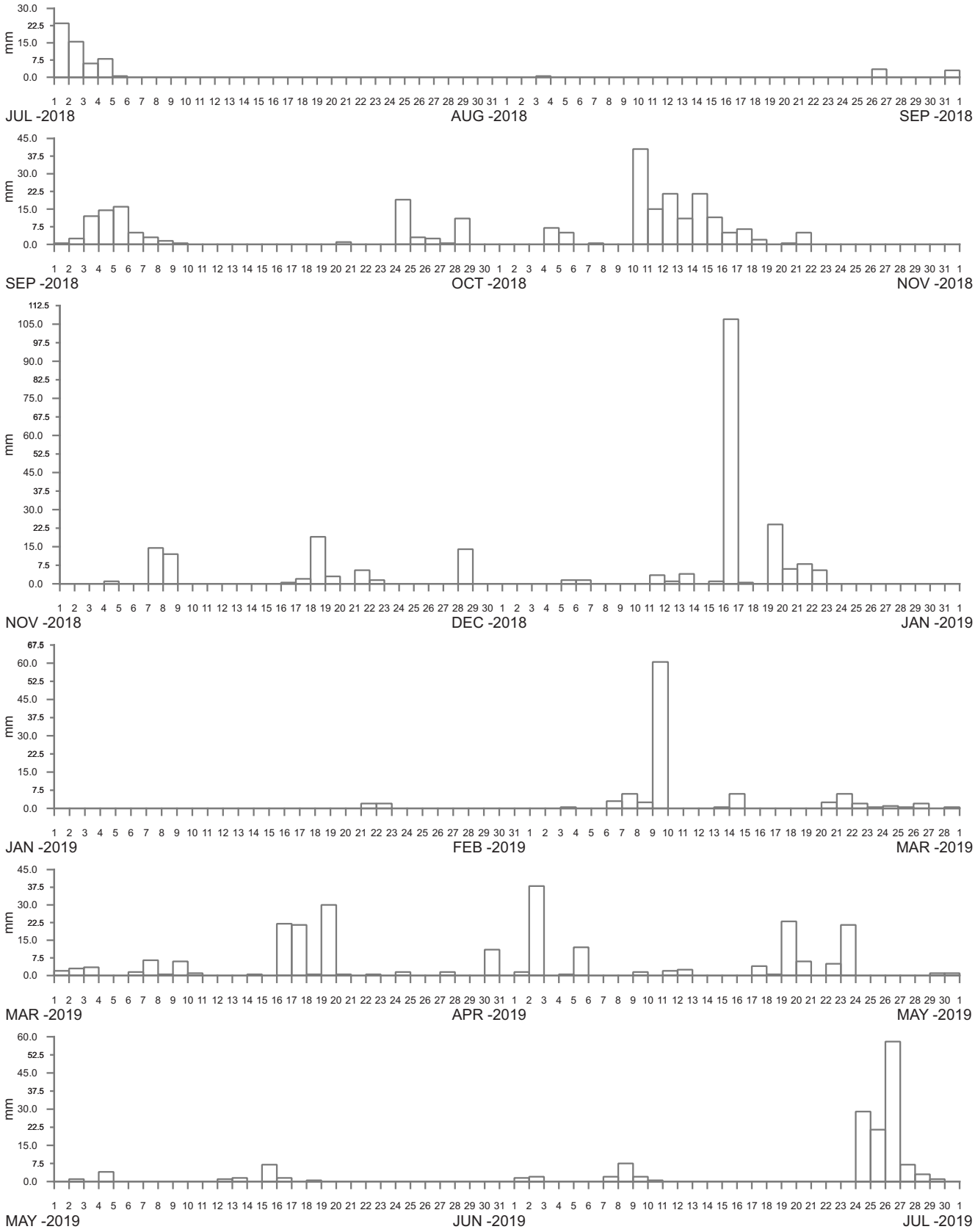
RAINFALL STATION LOCATIONS
NAMBUCCA RIVER REGION

Manly Hydraulics Laboratory

Report MHL2694

Figure 21

DRAWING 2694-21.cdr



DATA LOSS

NSW GOVERNMENT

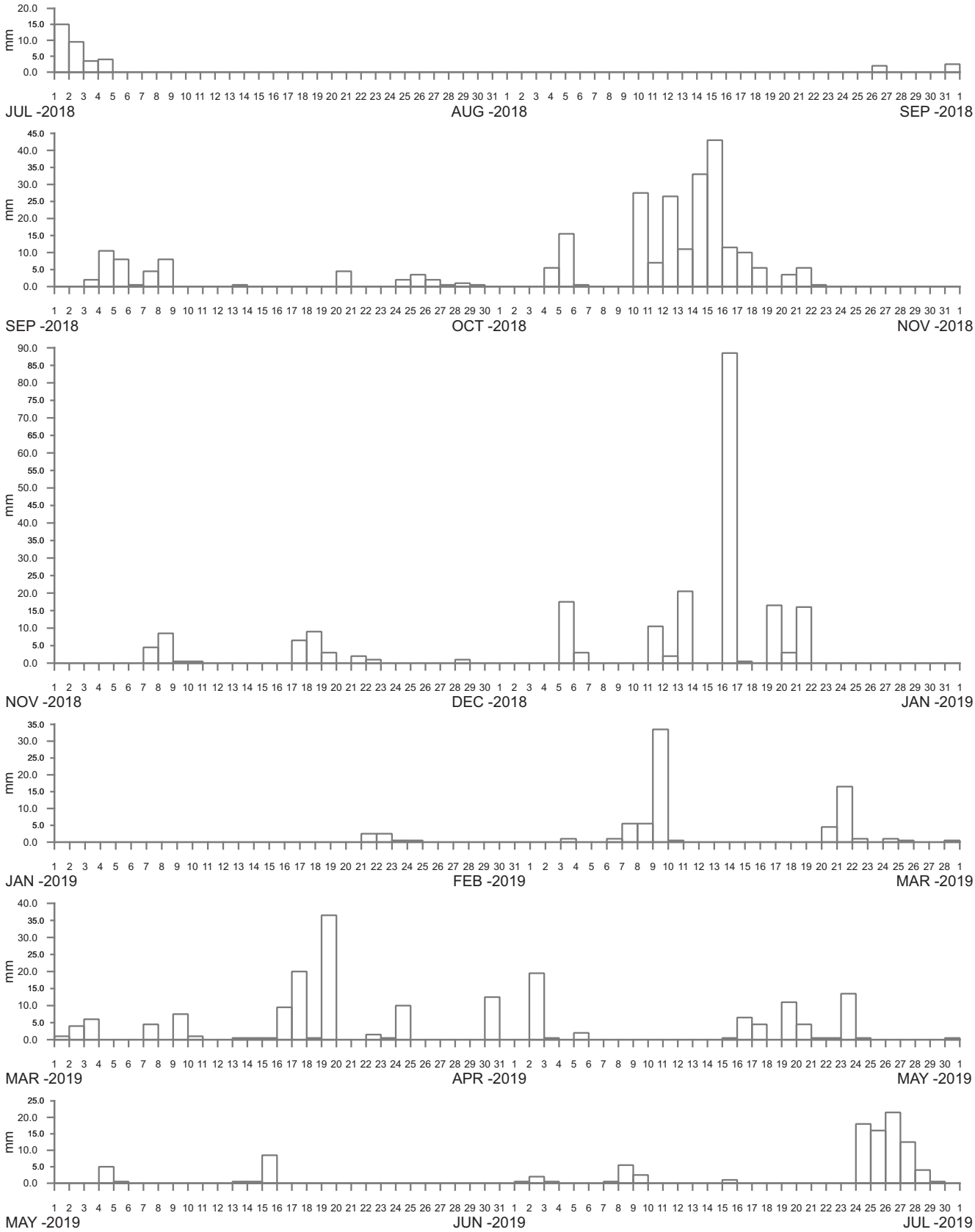
STUARTS ISLAND DOWNSTREAM AT NAMBUCCA HEADS 2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 22

DRAWING 2694-22.cdr



DATA LOSS

NSW GOVERNMENT

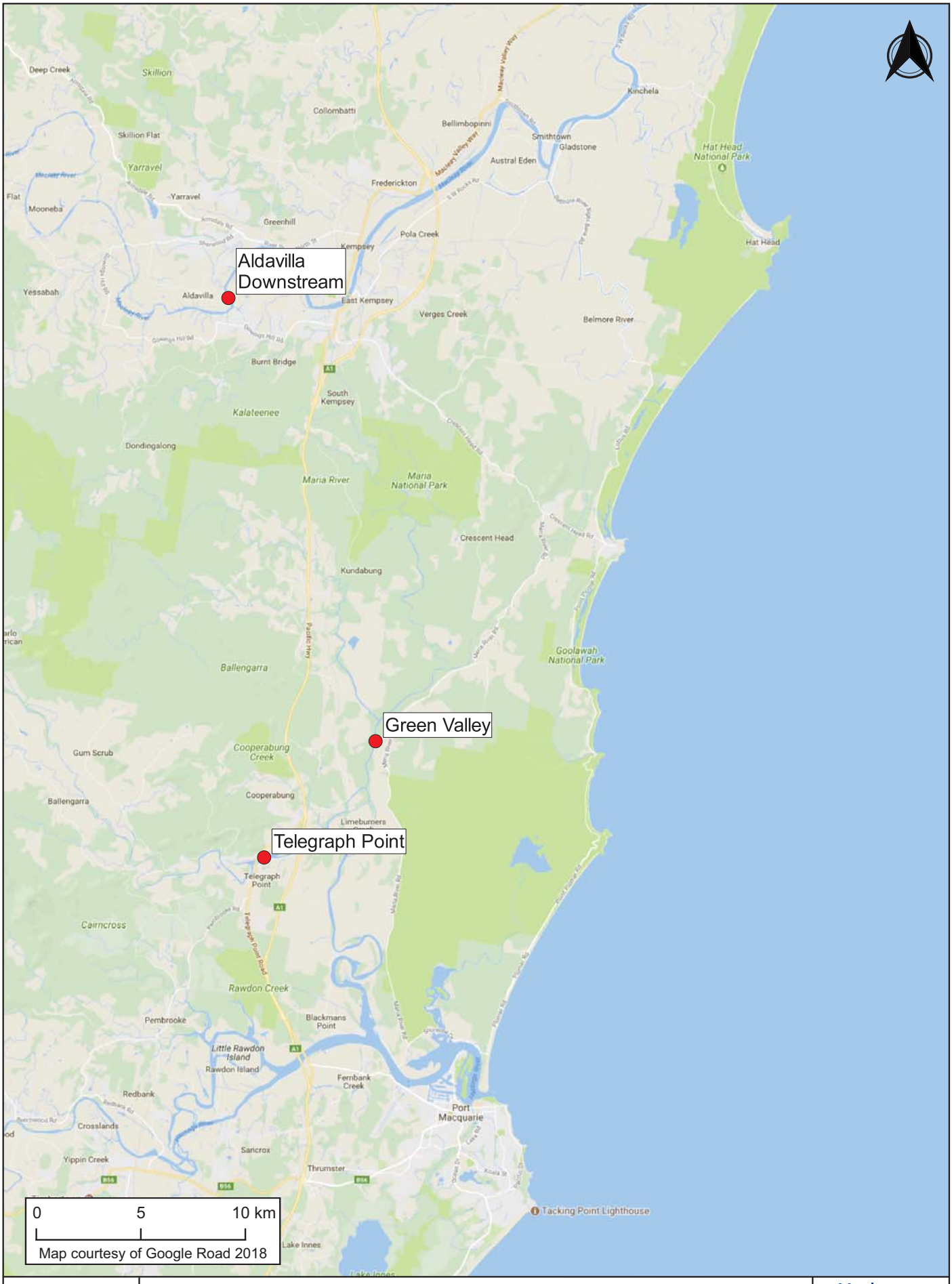
UTUNGUN AT TAYLORS ARM
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 23

DRAWING 2694-23.cdr



NSW GOVERNMENT

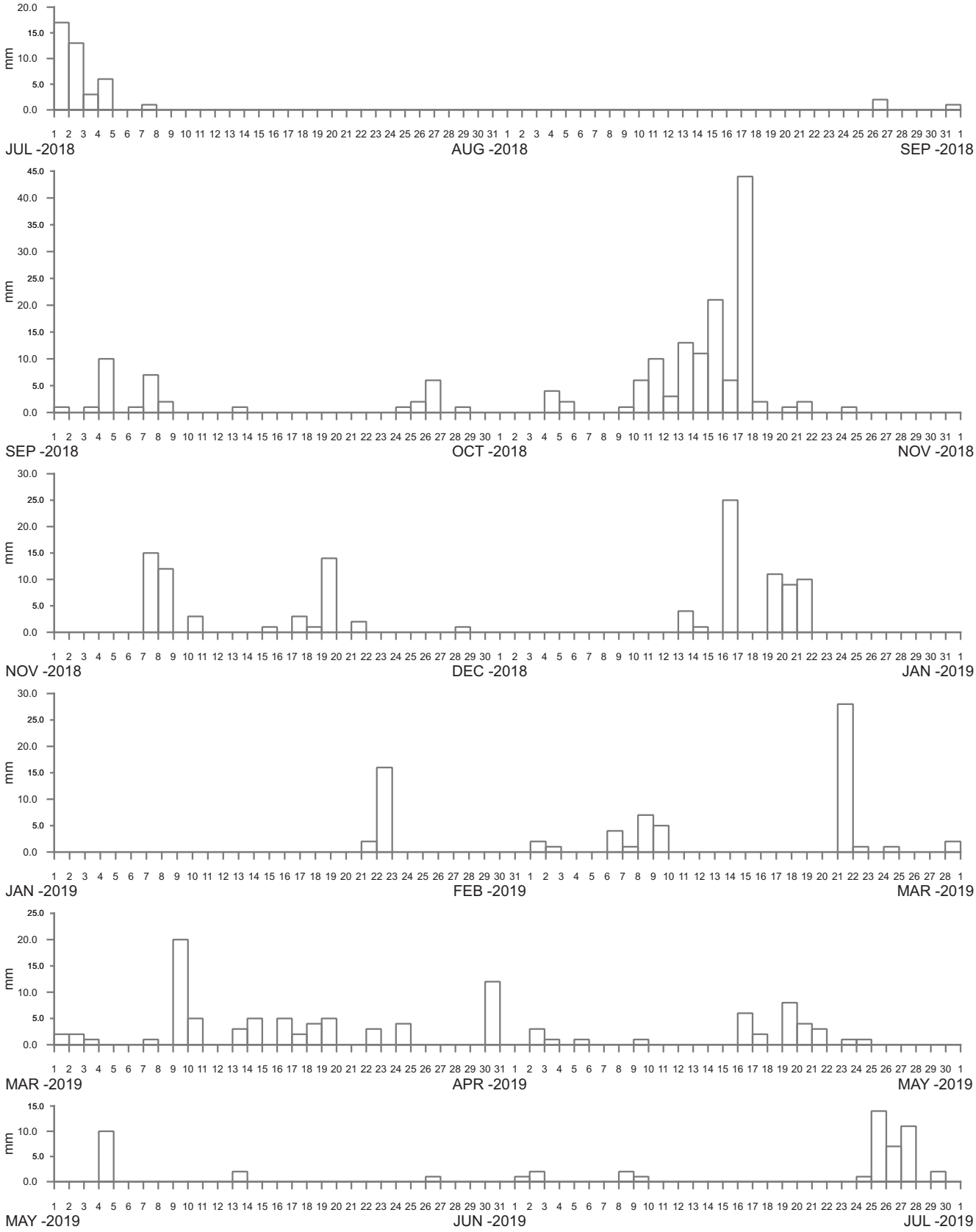
RAINFALL STATION LOCATIONS
MACLEAY RIVER AND HASTINGS RIVER REGIONS

Manly Hydraulics Laboratory

Report MHL2694

Figure 24

DRAWING 2694-24.cdr



DATA LOSS

NSW GOVERNMENT

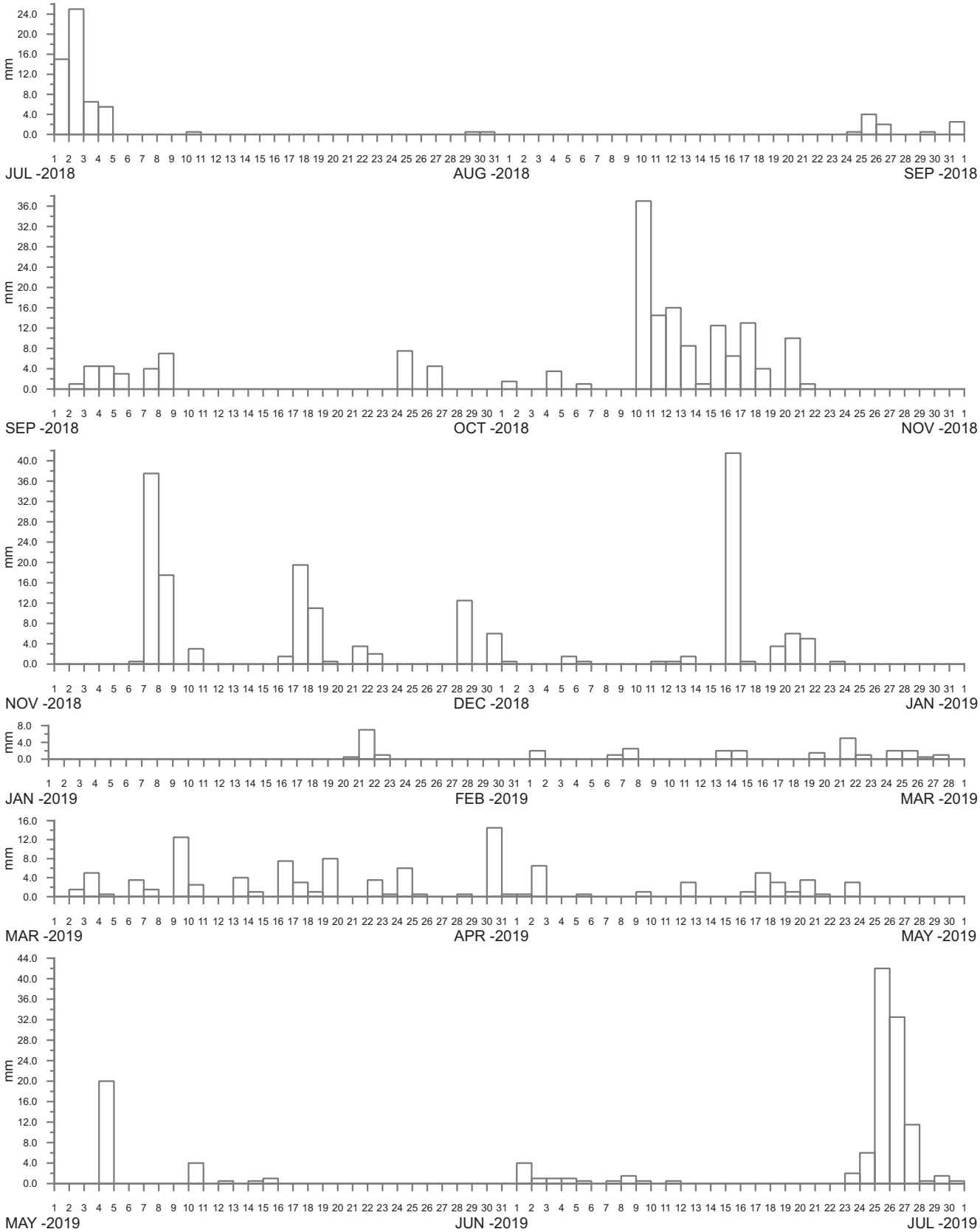
ALDAVILLA DOWNSTREAM AT MACLEAY RIVER 2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 25

DRAWING 2694-25.cdr



DATA LOSS

NSW GOVERNMENT

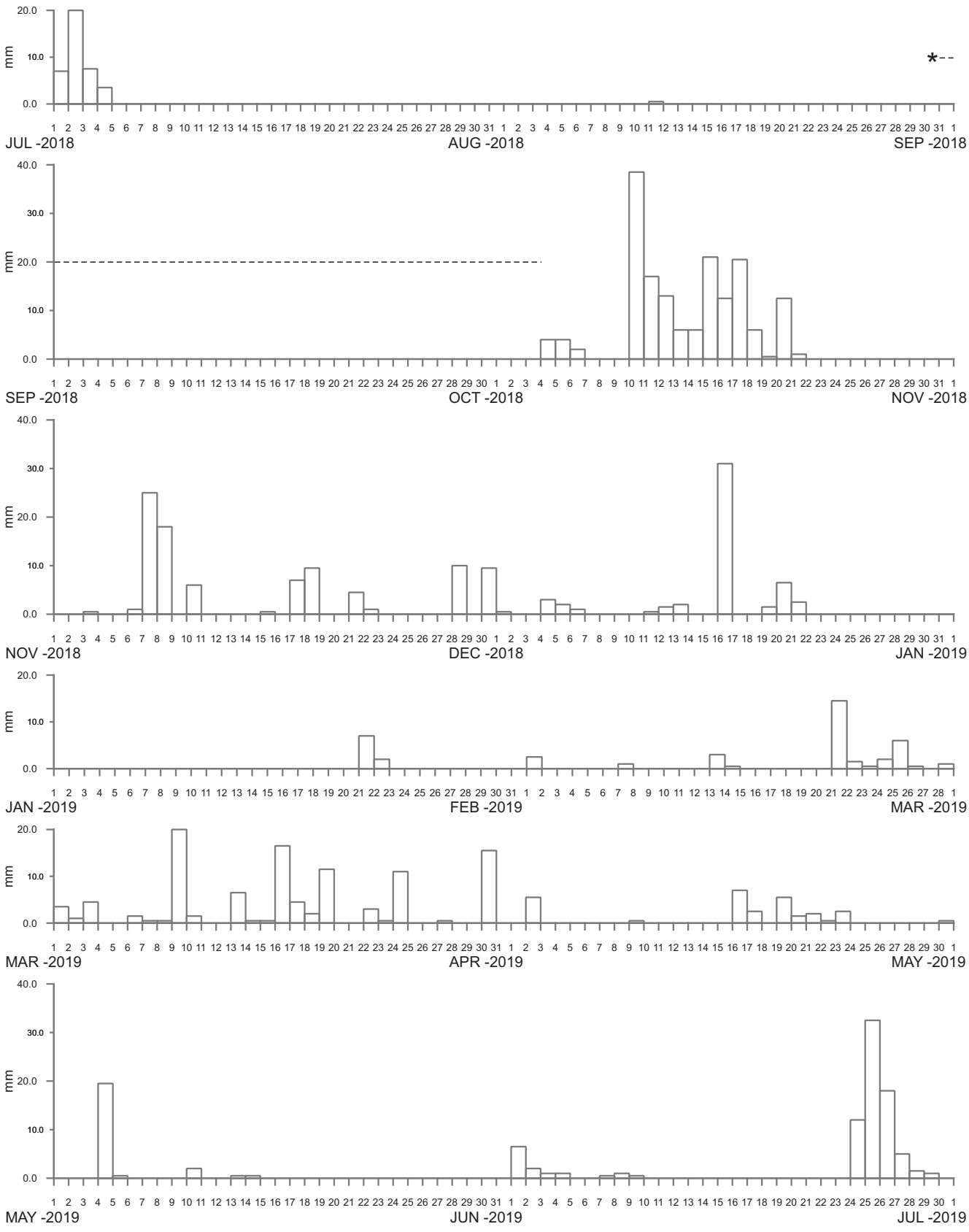
GREEN VALLEY AT MARIA RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 26

DRAWING 2694-26.cdr



---------- DATA LOSS

*Data loss due to damaged wiring caused by bushfire

NSW GOVERNMENT

TELEGRAPH POINT AT WILSONS RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 27

DRAWING 2694-27.cdr

NSW GOVERNMENT

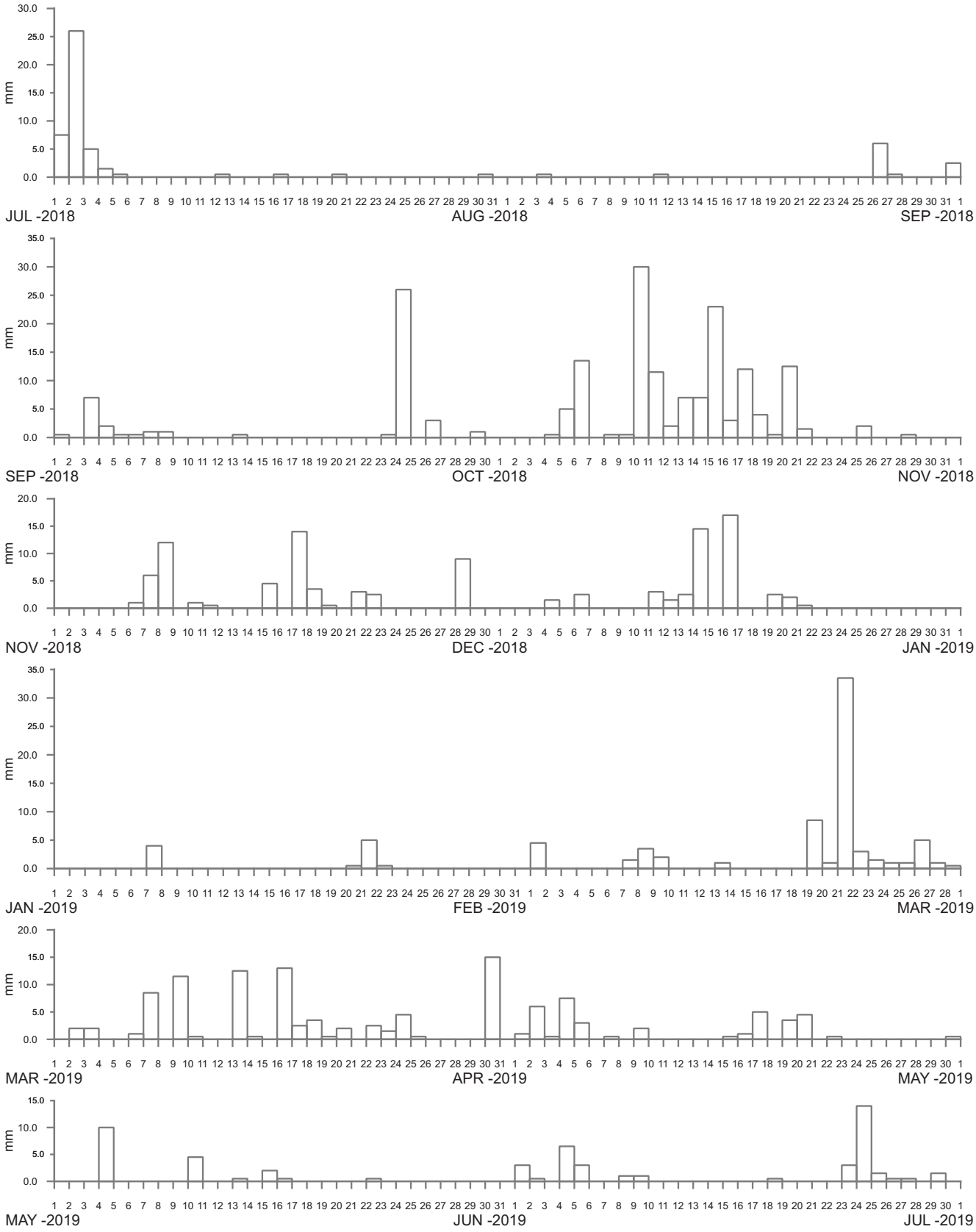
RAINFALL STATION LOCATIONS
CAMDEN HAVEN REGION

Manly Hydraulics Laboratory

Report MHL2694

Figure 28

DRAWING 2694-28.cdr



DATA LOSS

NSW GOVERNMENT

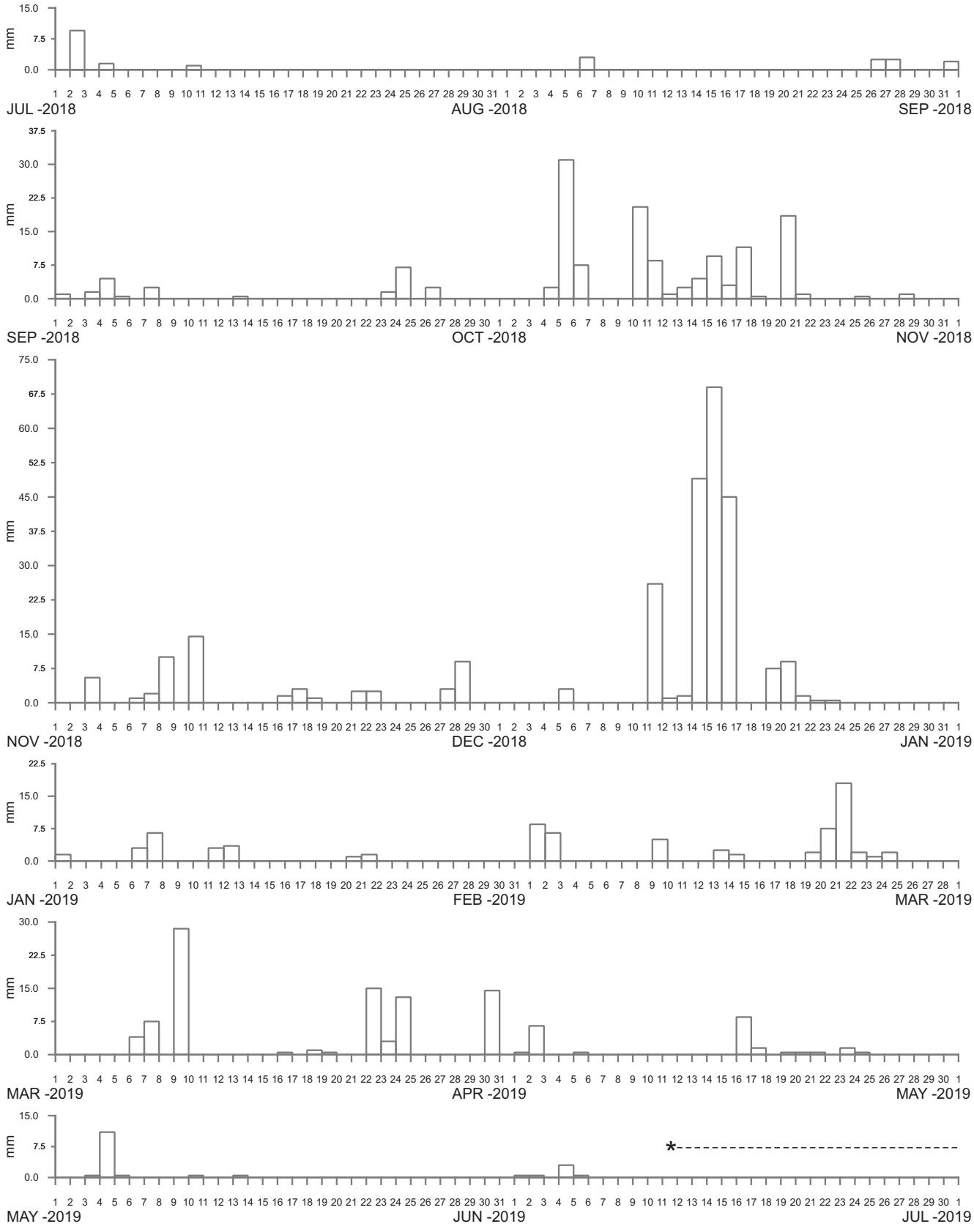
LOGANS CROSSING AT CAMDEN HAVEN
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 29

DRAWING 2694-29.cdr



---------- DATA LOSS

*Data loss due to wiring error during site upgrade

NSW GOVERNMENT

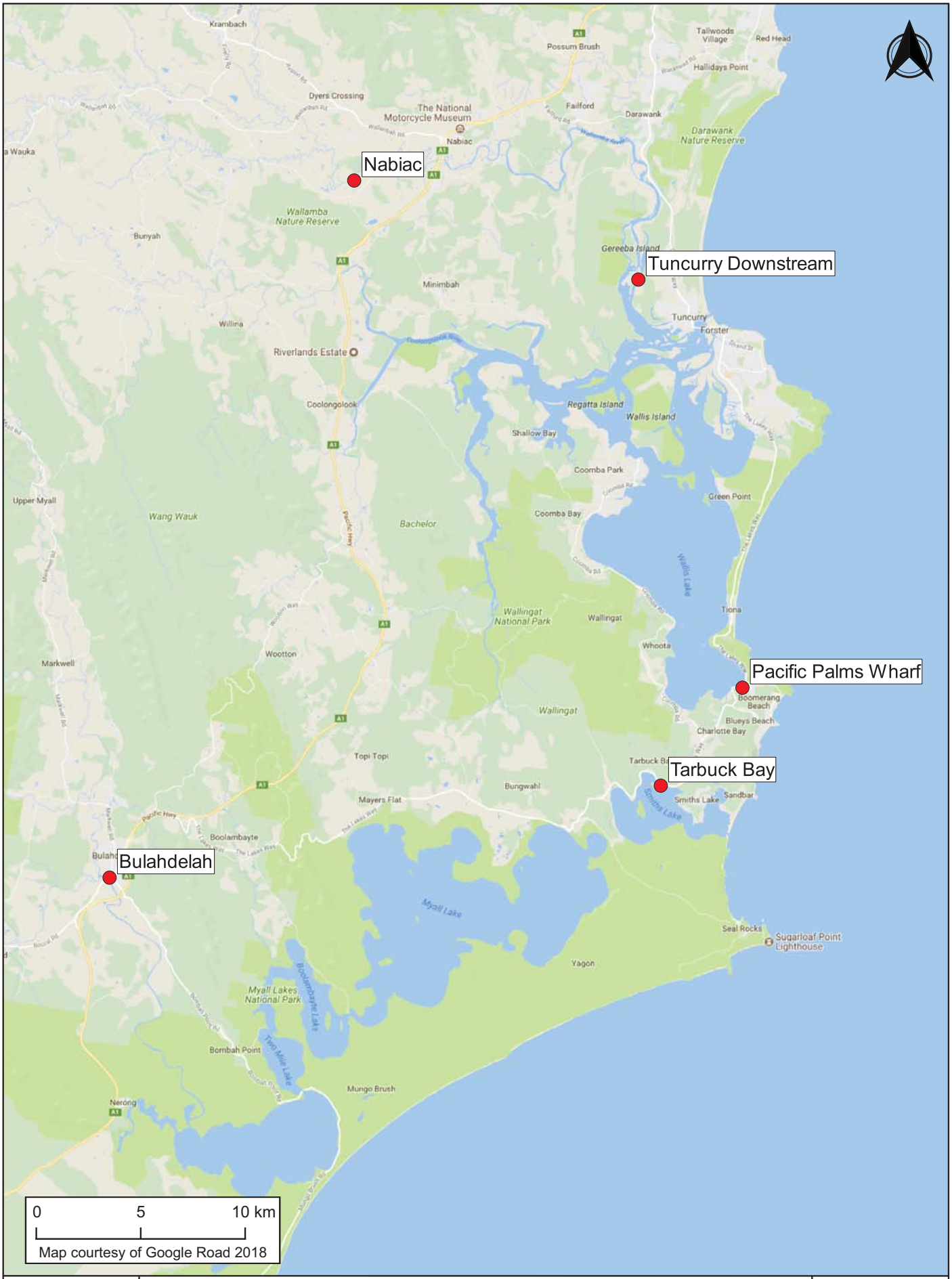
MOUNT GEORGE AT MANNING RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 30

DRAWING 2694-30.cdr



NSW GOVERNMENT

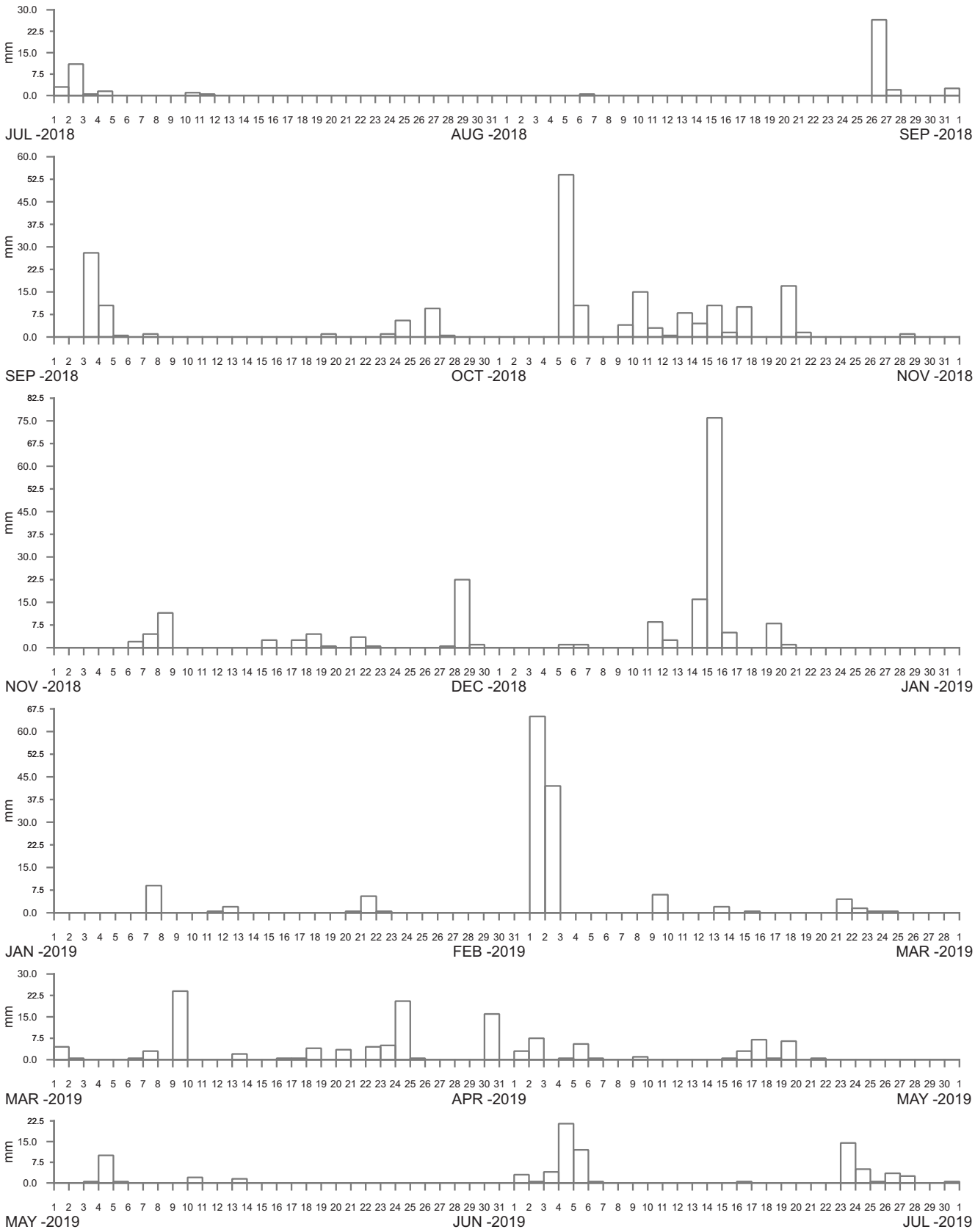
RAINFALL STATION LOCATIONS
KARUAH RIVER REGION

Manly Hydraulics Laboratory

Report MHL2694

Figure 31

DRAWING 2694-31.cdr



DATA LOSS

NSW GOVERNMENT

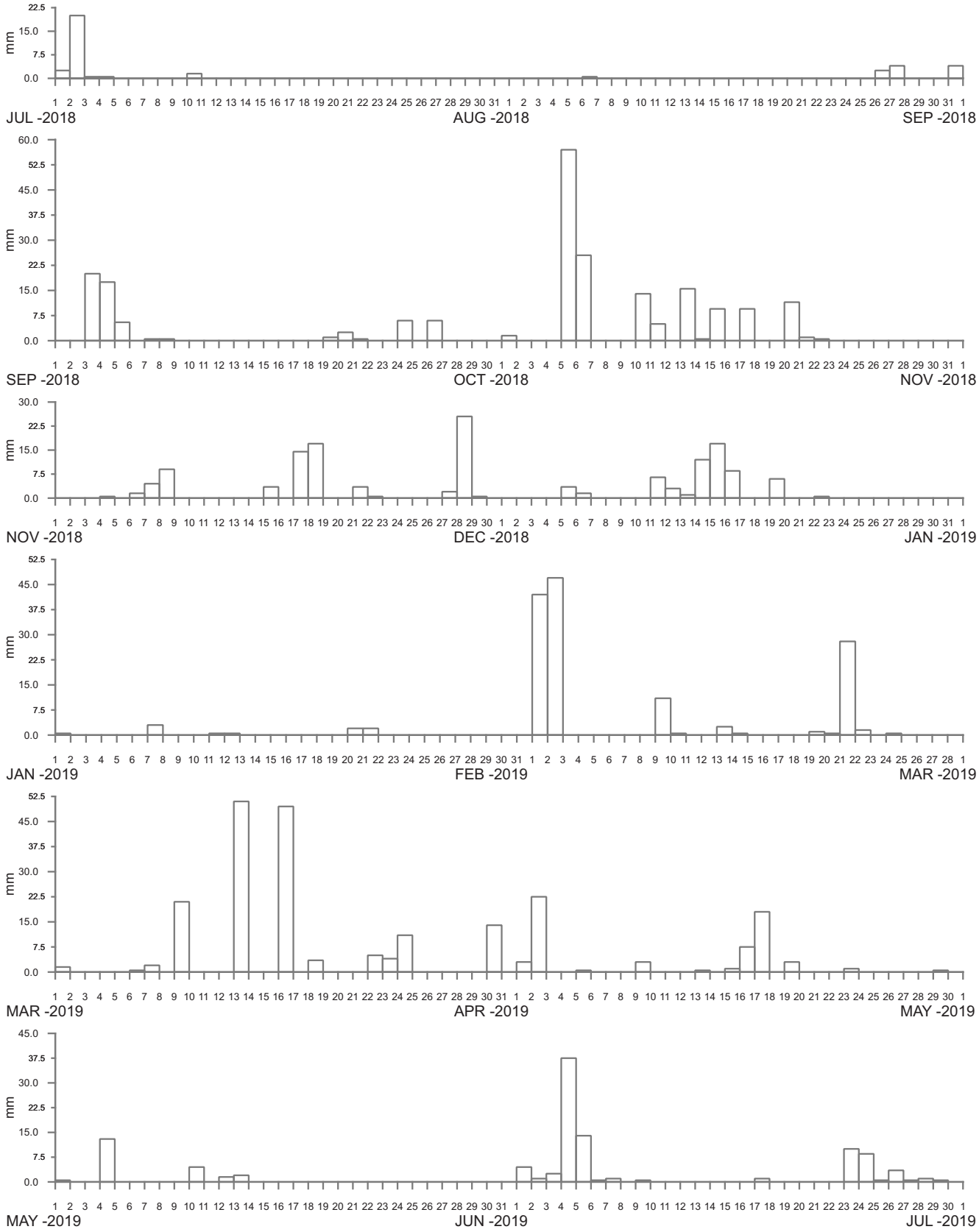
NABIAC AT WALLAMBA RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 32

DRAWING 2694-32.cdr



DATA LOSS

NSW GOVERNMENT

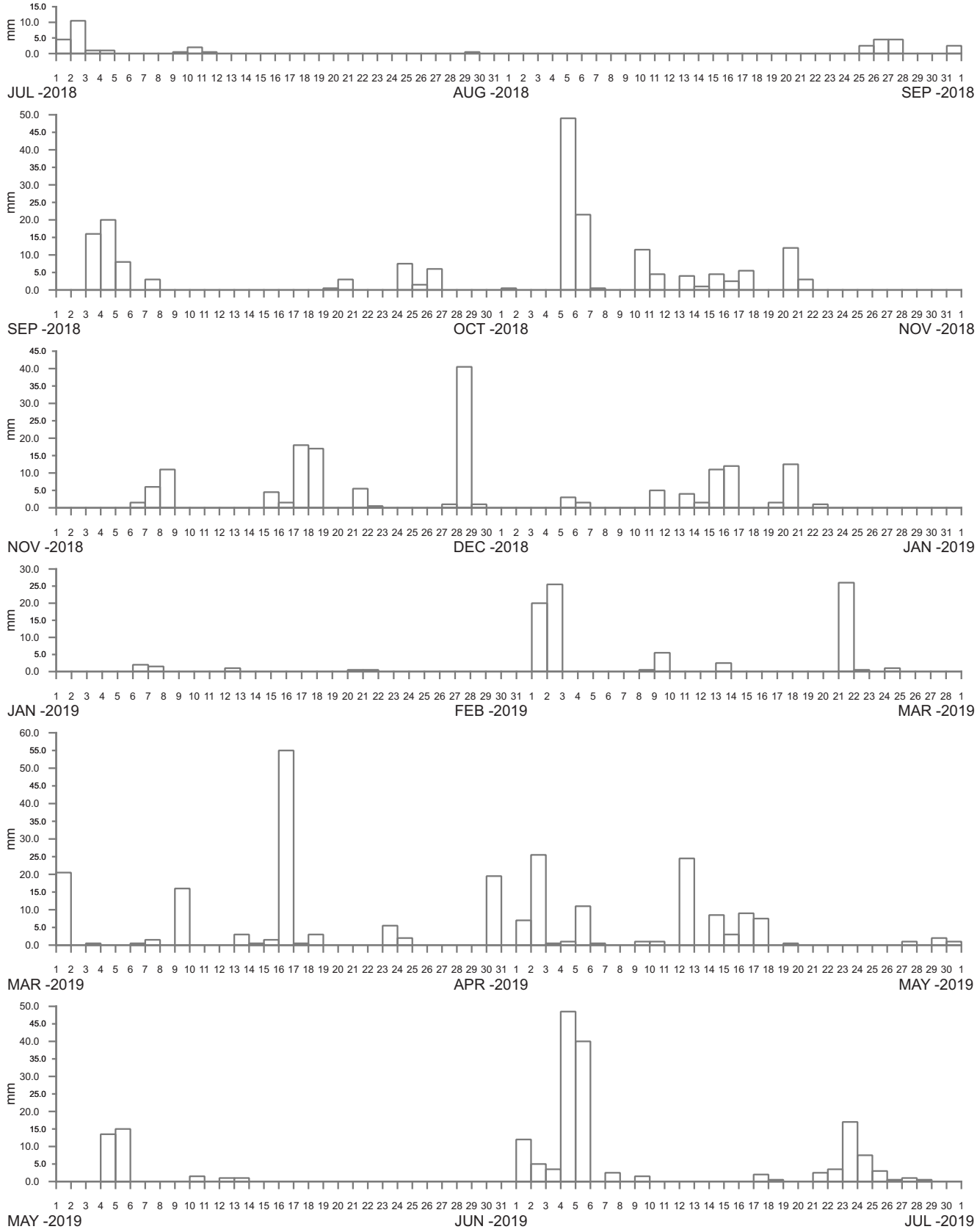
TUNCURRY DOWNSTREAM AT WALLAMBA RIVER 2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 33

DRAWING 2694-33.cdr



DATA LOSS

NSW GOVERNMENT

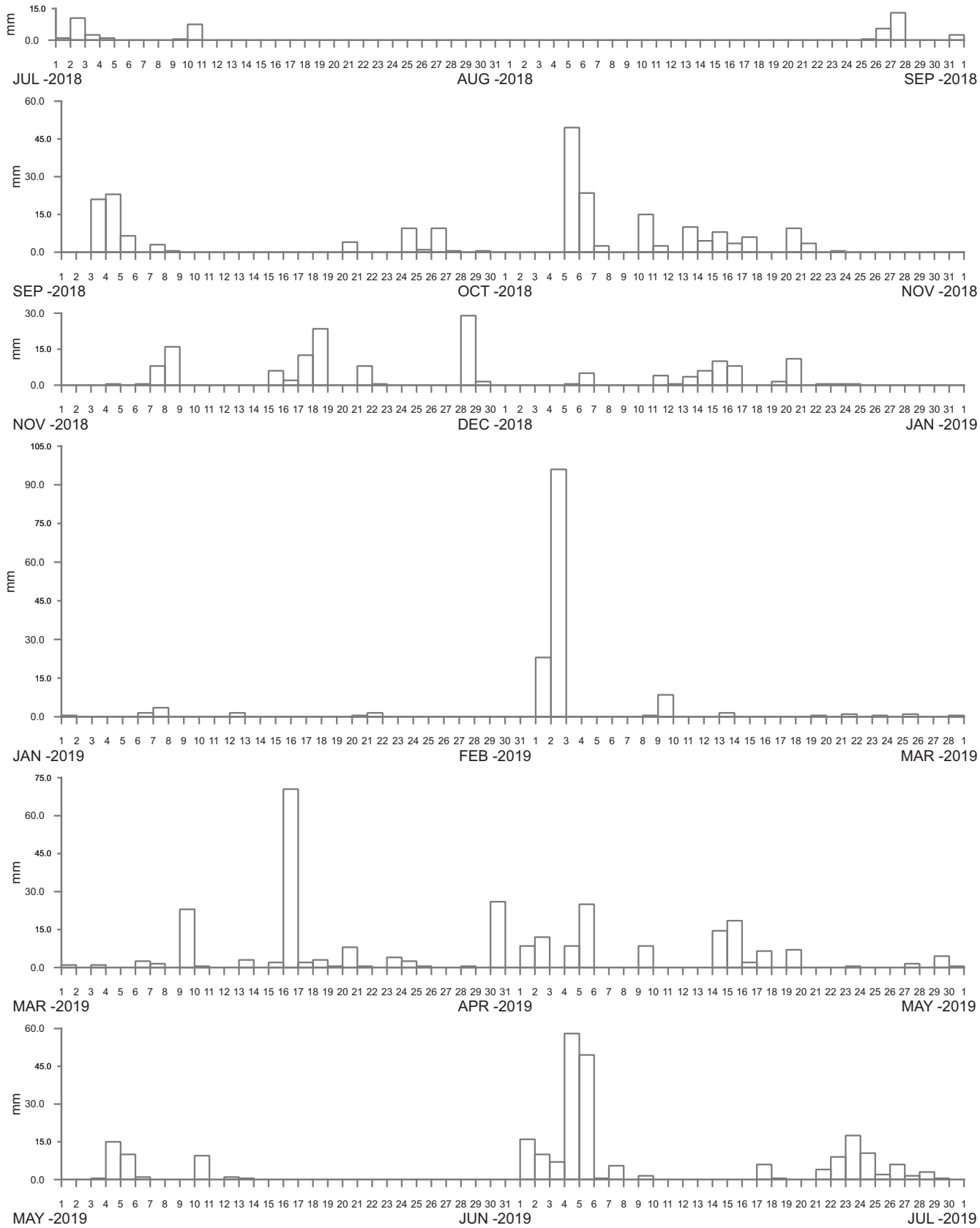
PACIFIC PALMS WHARF AT WALLIS LAKES
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 34

DRAWING 2694-34.cdr



DATA LOSS

NSW GOVERNMENT

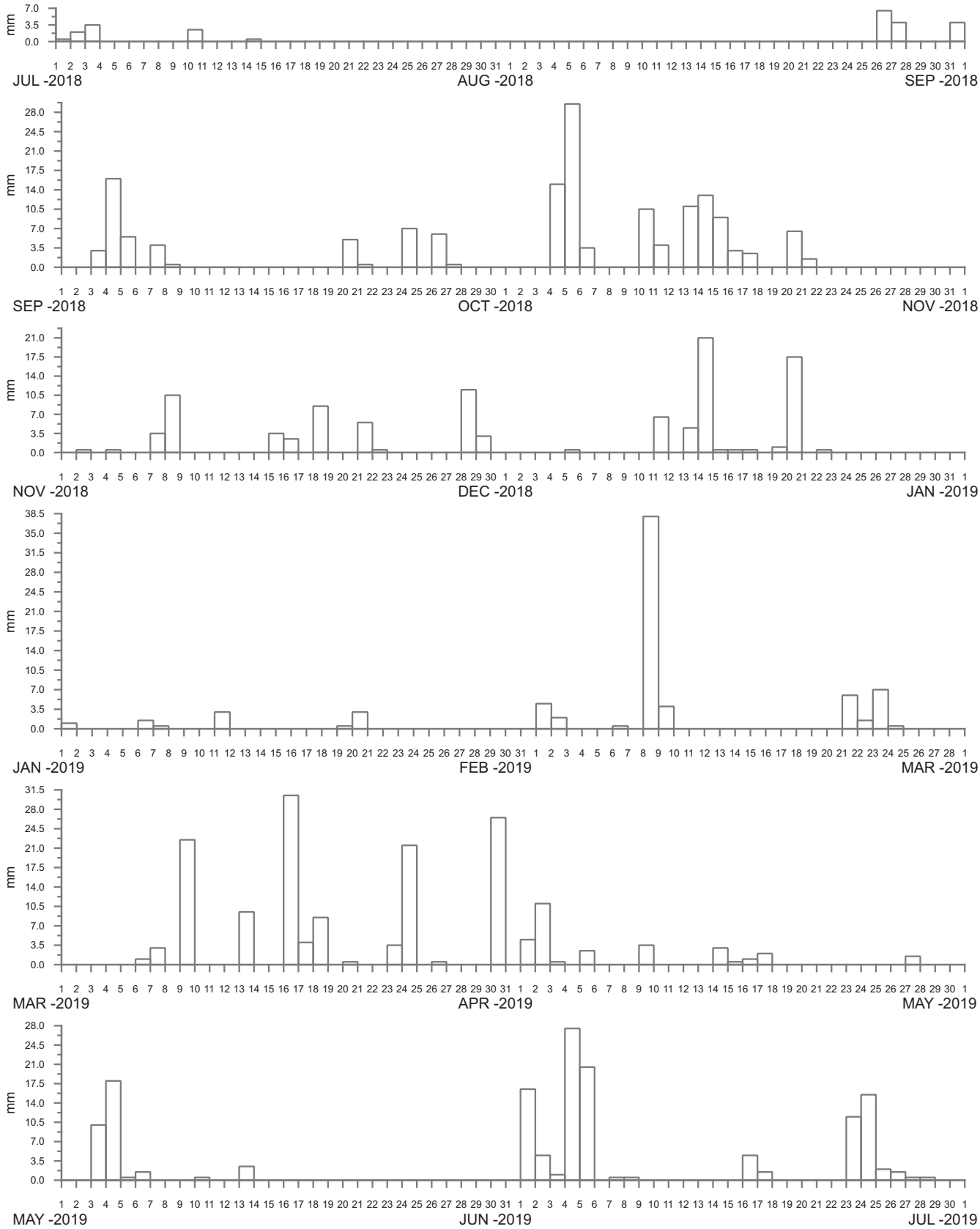
TARBUCK BAY AT SMITHS LAKE
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 35

DRAWING 2694-35.cdr



DATA LOSS

NSW GOVERNMENT

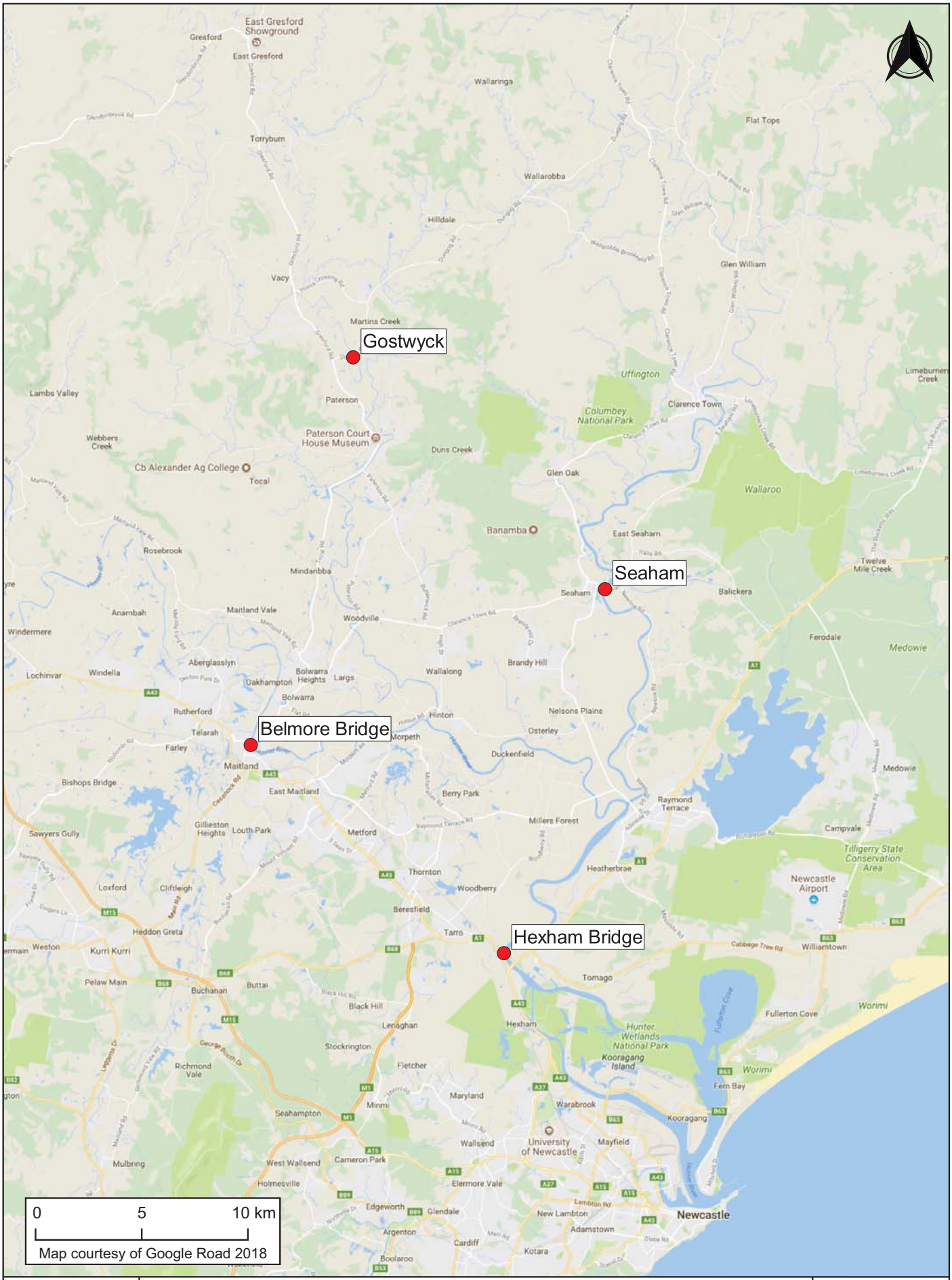
BULAHDELAH AT MYALL RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 36

DRAWING 2694-36.cdr



NSW GOVERNMENT

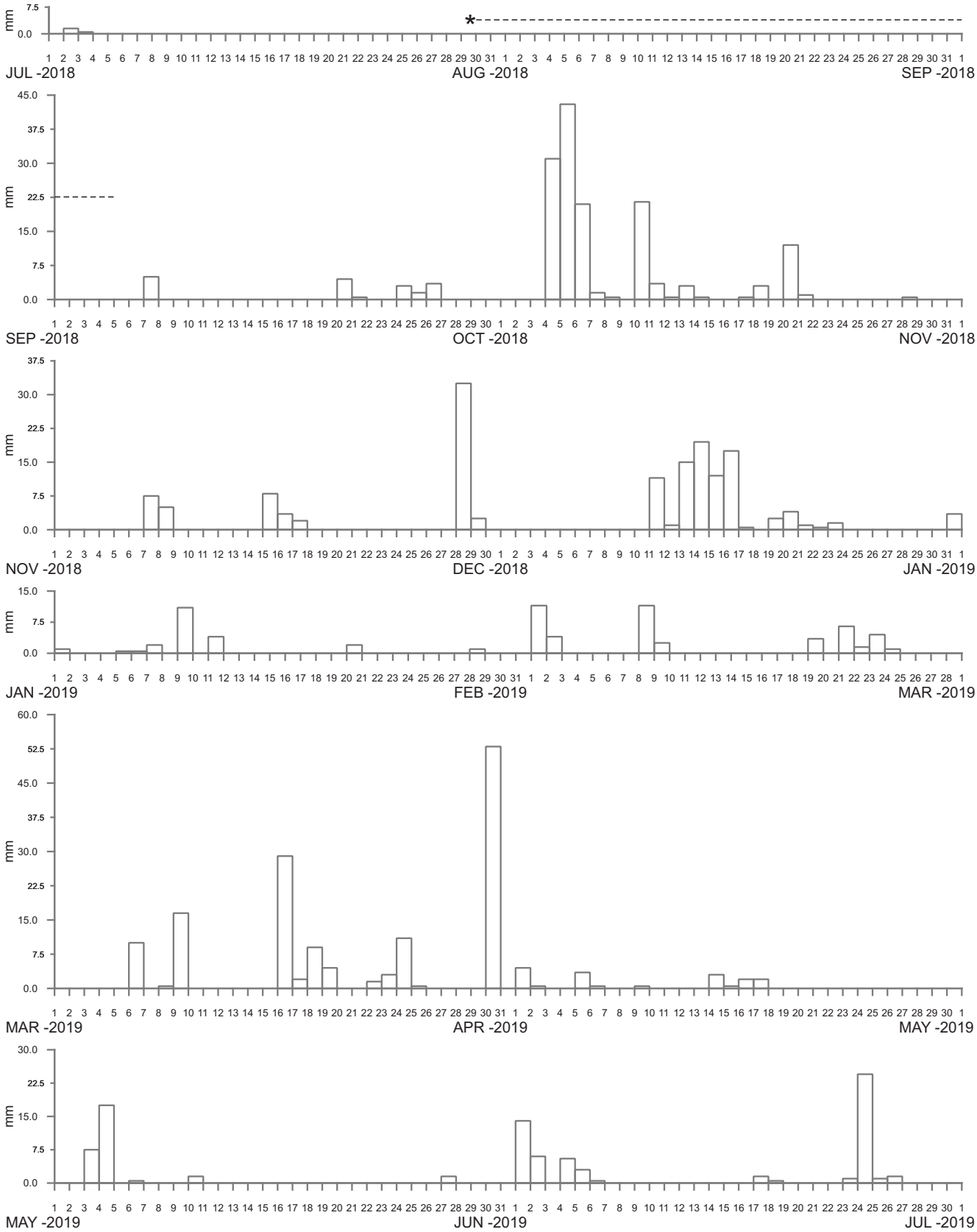
RAINFALL STATION LOCATIONS
HUNTER RIVER REGION

Manly Hydraulics Laboratory

Report MHL2694

Figure 37

DRAWING 2694-37.cdr



DATA LOSS

*Data loss due to positioning of feed hose following calibration

NSW GOVERNMENT

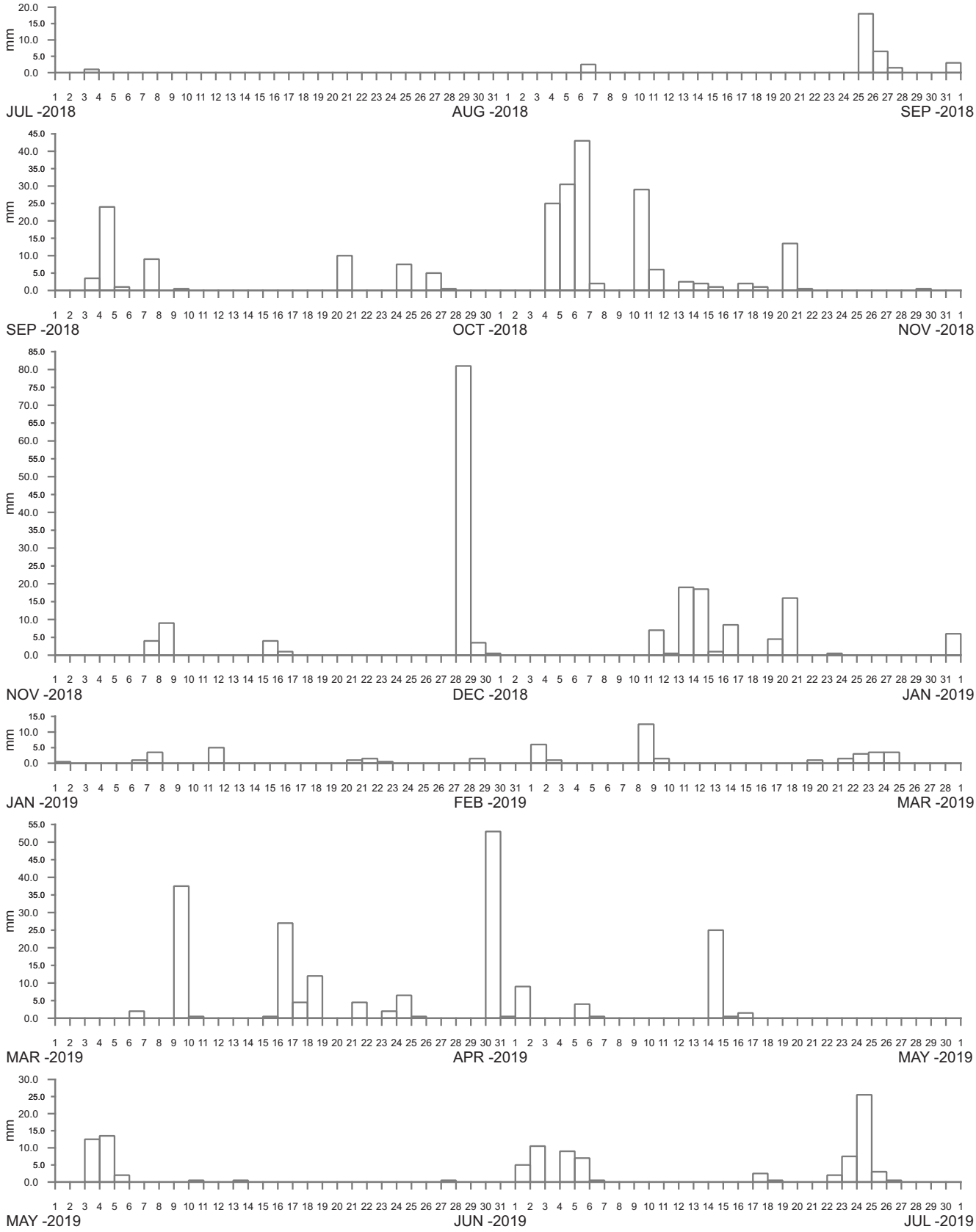
GOSTWYCK AT PATERSON RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 38

DRAWING 2694-38.cdr



DATA LOSS

NSW GOVERNMENT

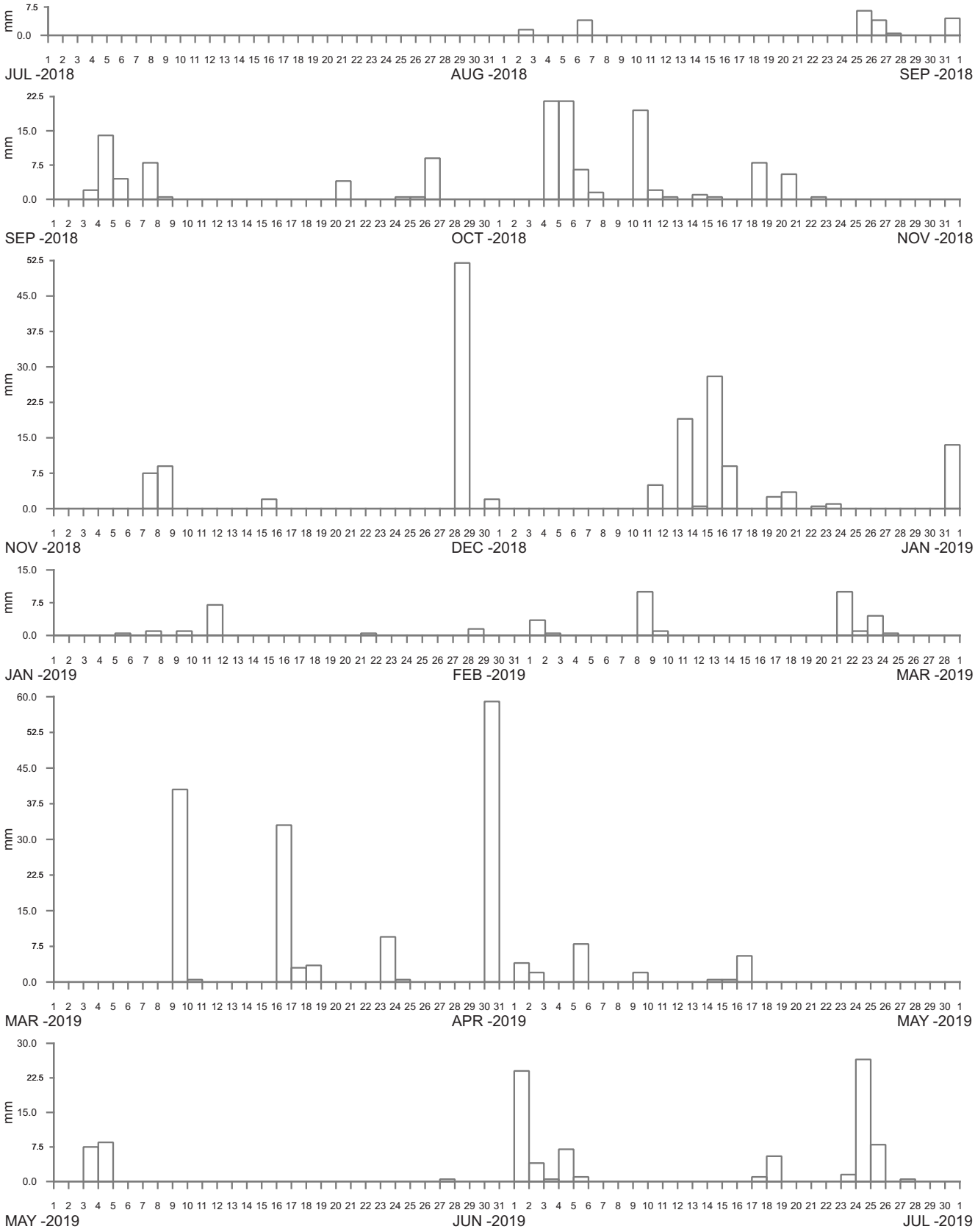
SEAHAM AT WILLIAMS RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 39

DRAWING 2694-39.cdr



DATA LOSS

NSW GOVERNMENT

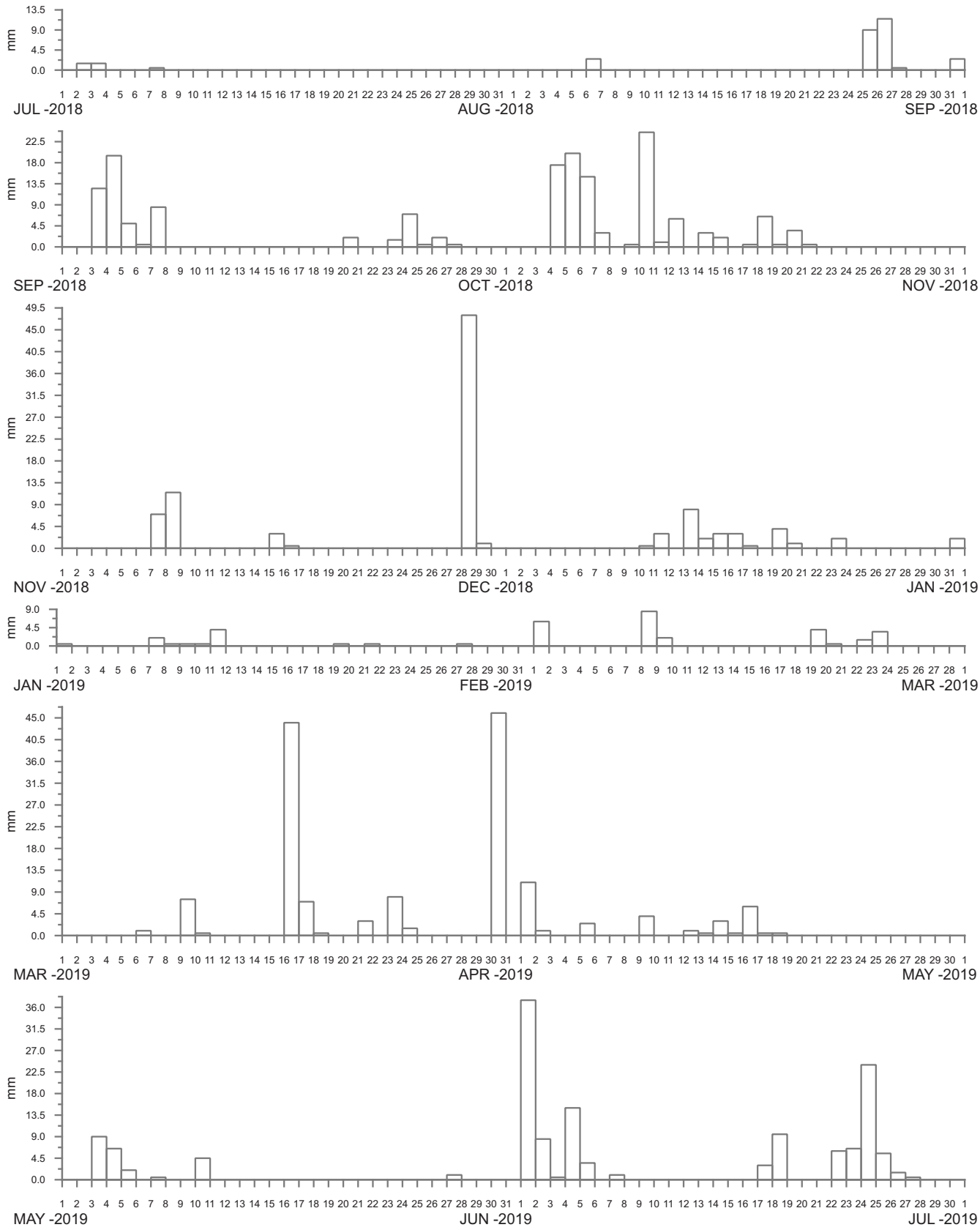
BELMORE BRIDGE AT HUNTER RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 40

DRAWING 2694-40.cdr



DATA LOSS

NSW GOVERNMENT

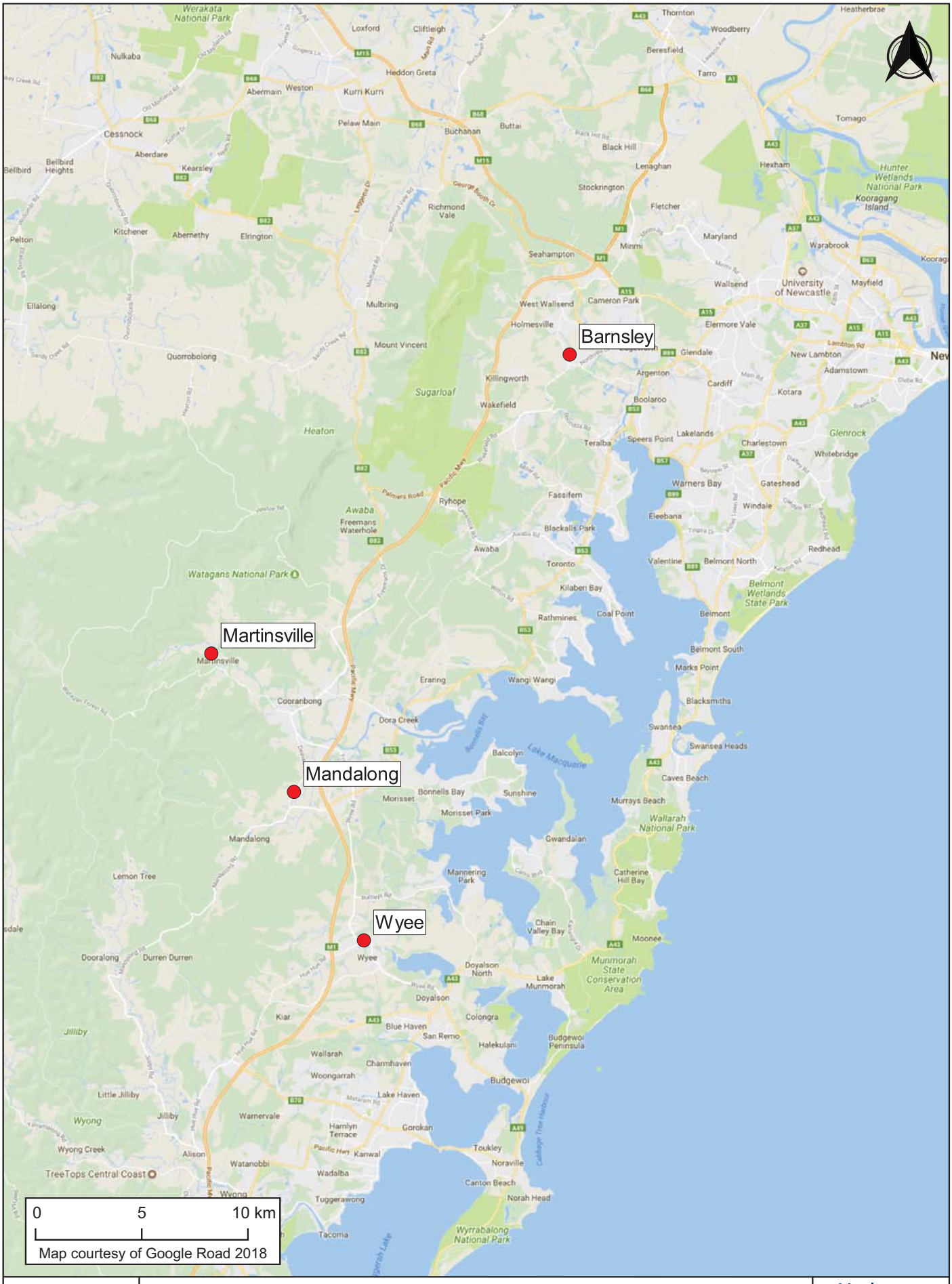
HEXHAM BRIDGE AT HUNTER RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 41

DRAWING 2694-41.cdr



NSW GOVERNMENT

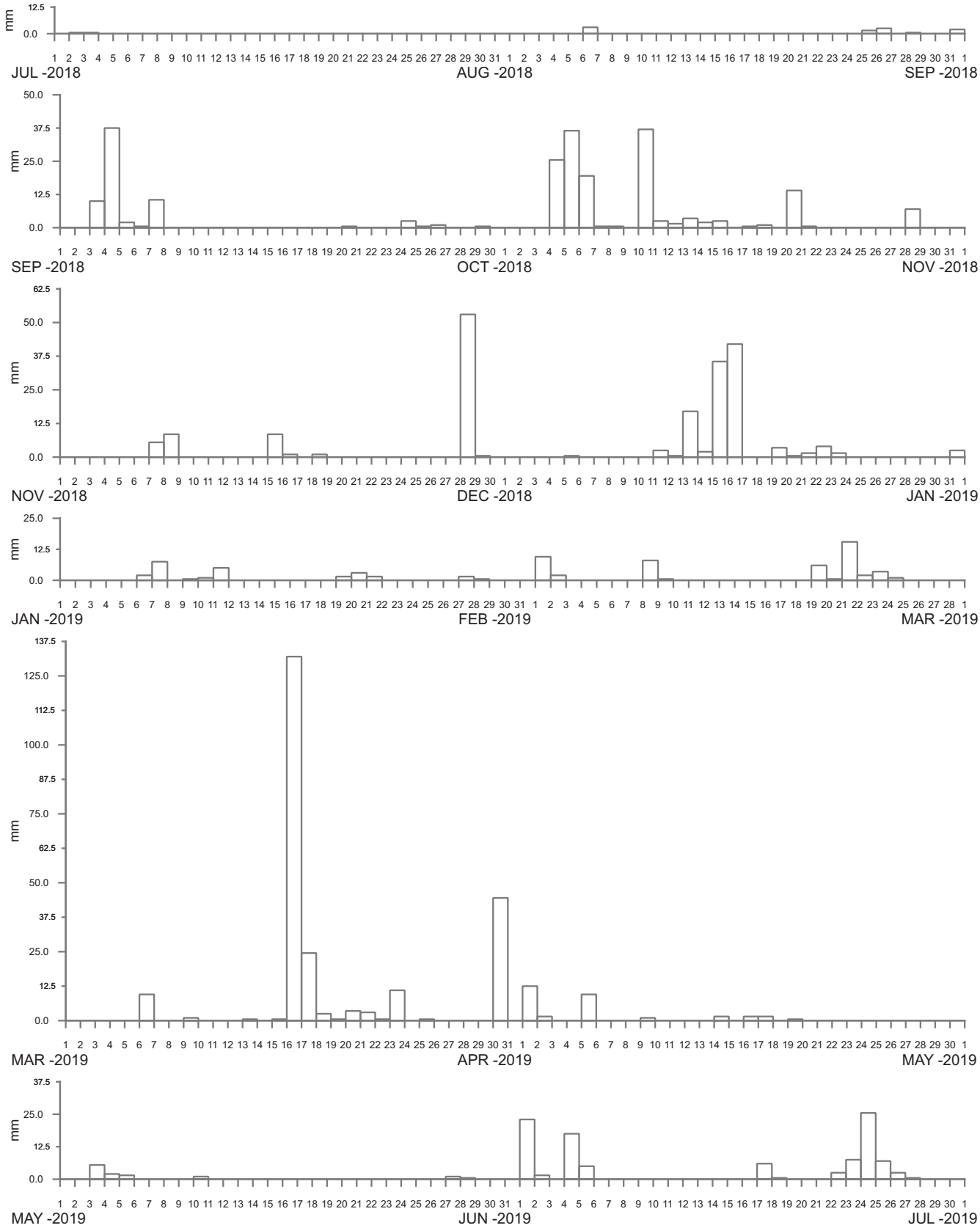
RAINFALL STATION LOCATIONS
MACQUARIE-TUGGERAH LAKES (NORTH) REGION

Manly Hydraulics Laboratory

Report MHL2694

Figure 42

DRAWING 2694-42.cdr



DATA LOSS

NSW GOVERNMENT

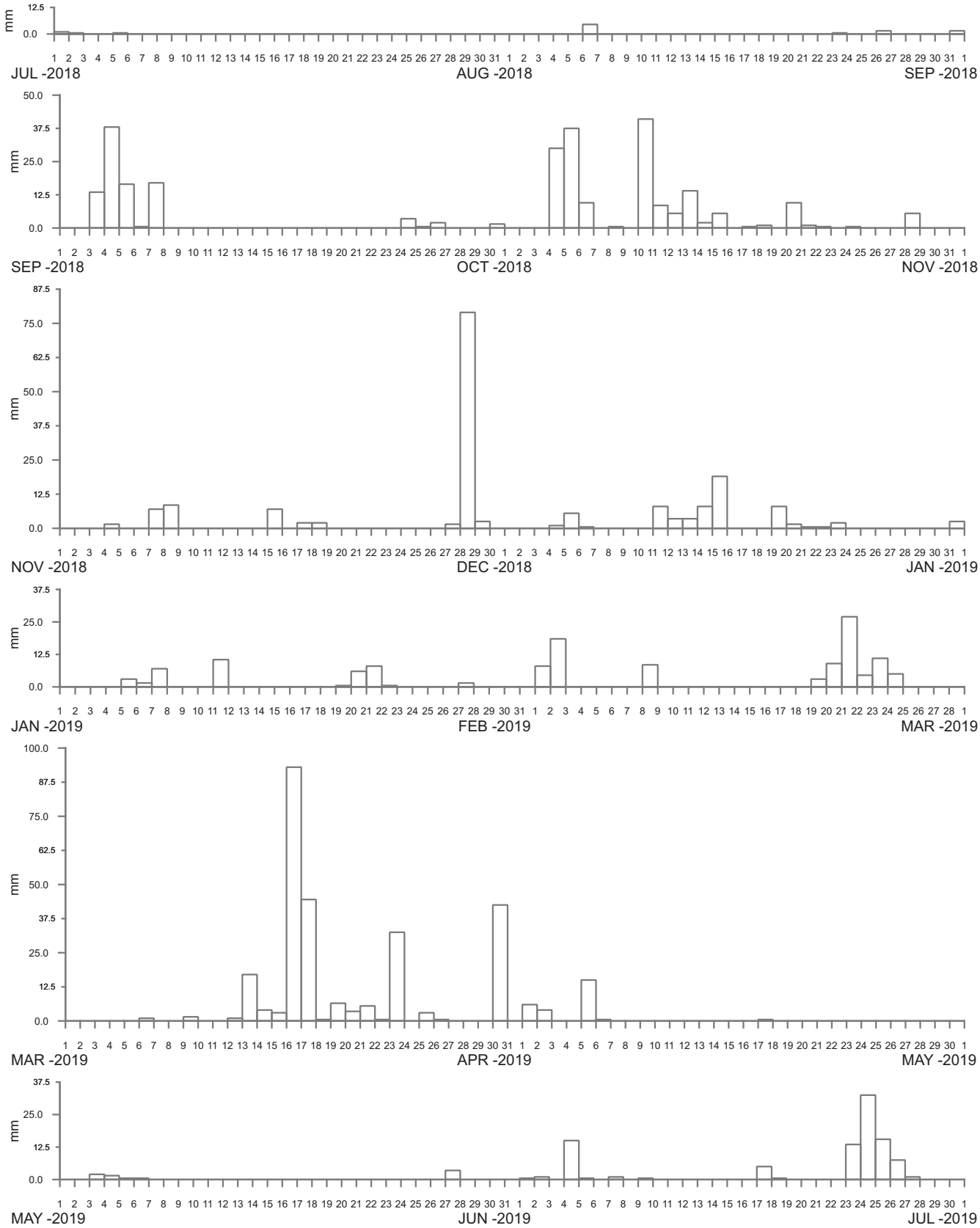
BARNSLEY AT JOHNSON AVENUE
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 43

DRAWING 2694-43.cdr



DATA LOSS

NSW GOVERNMENT

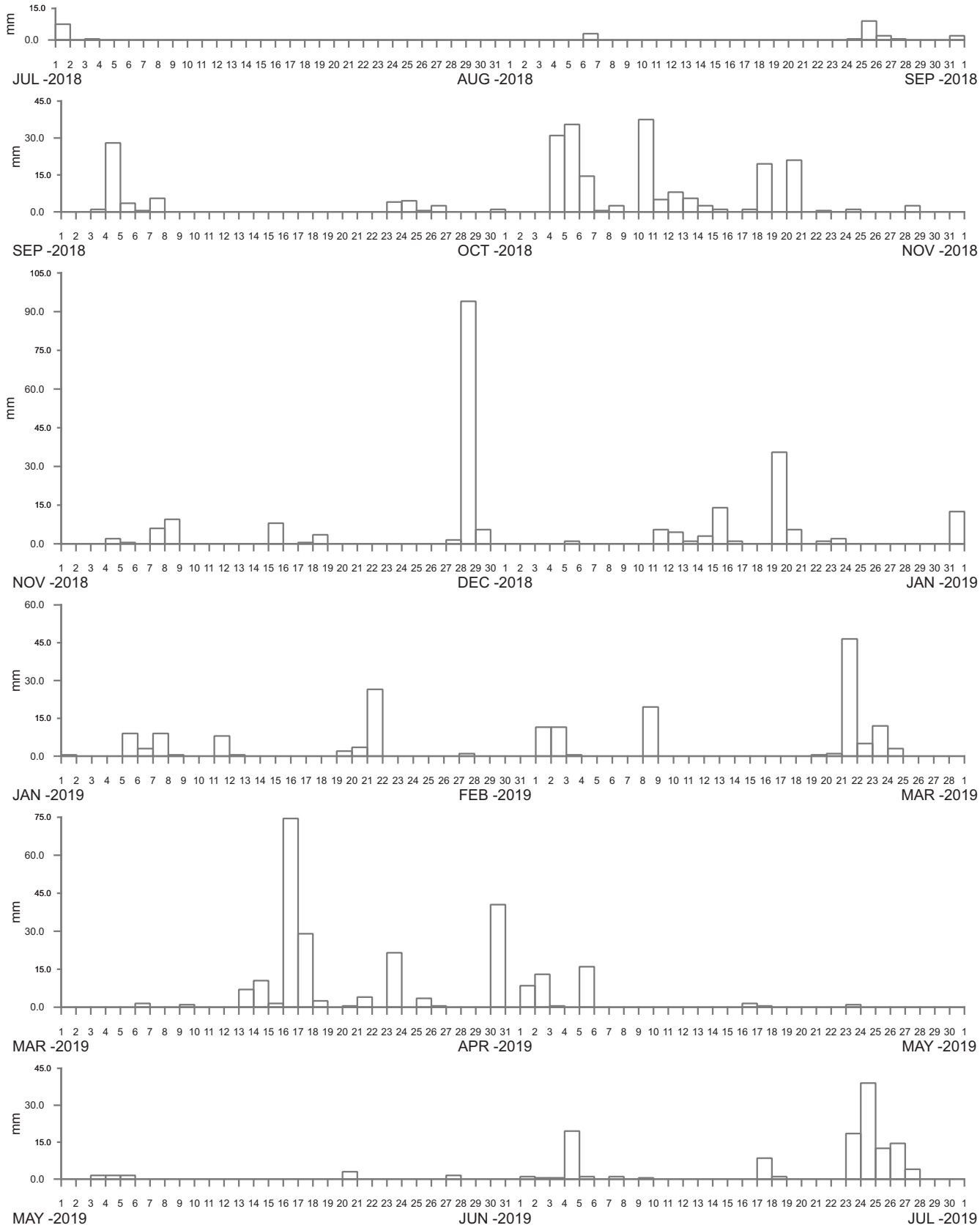
MARTINSVILLE AT MARTINSVILLE ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 44

DRAWING 2694-44.cdr



DATA LOSS

NSW GOVERNMENT

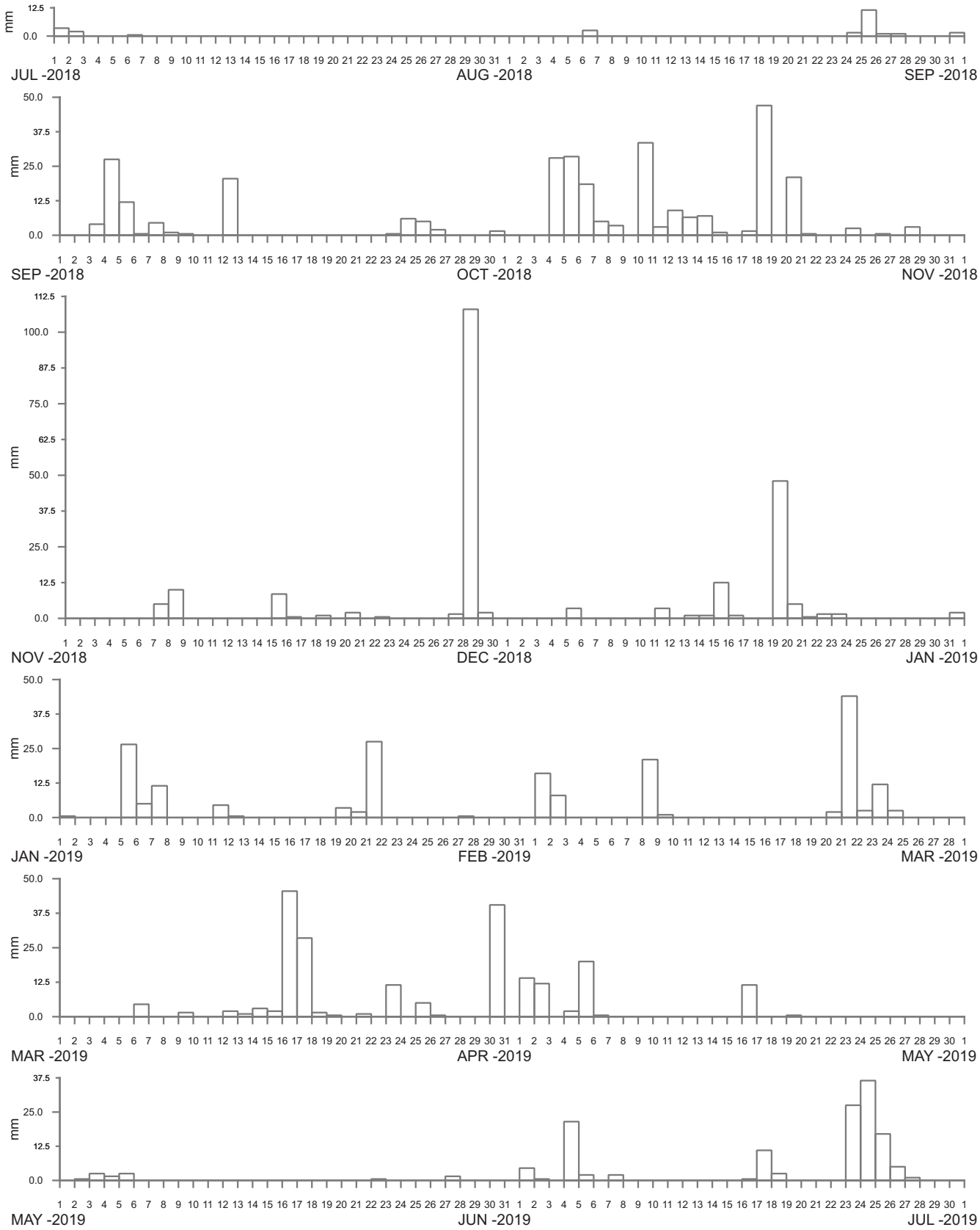
MANDALONG AT DEAVES ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 45

DRAWING 2694-45.cdr



DATA LOSS

NSW GOVERNMENT

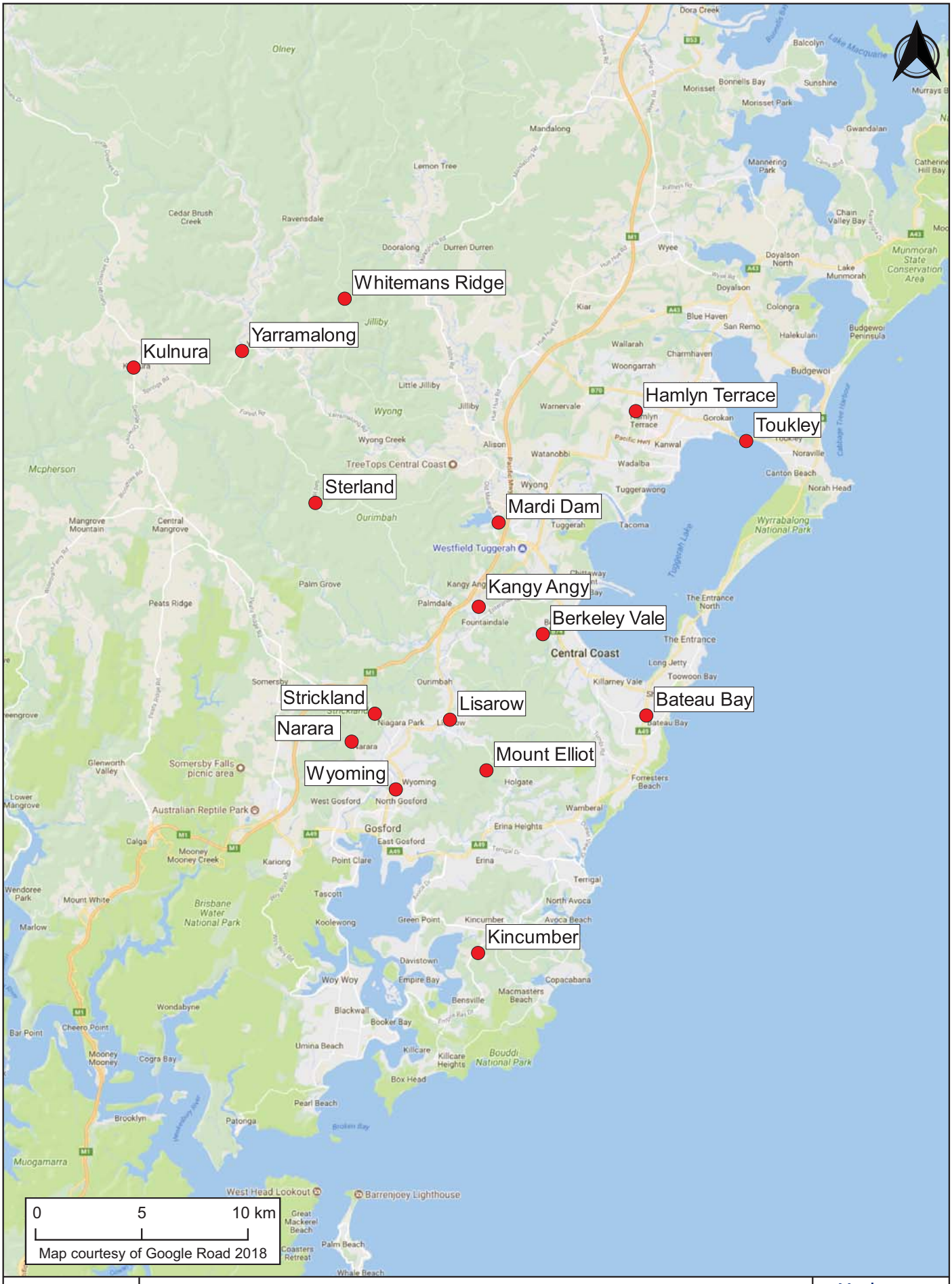
WYEE AT COLLUNGRA STREET
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 46

DRAWING 2694-46.cdr



NSW GOVERNMENT

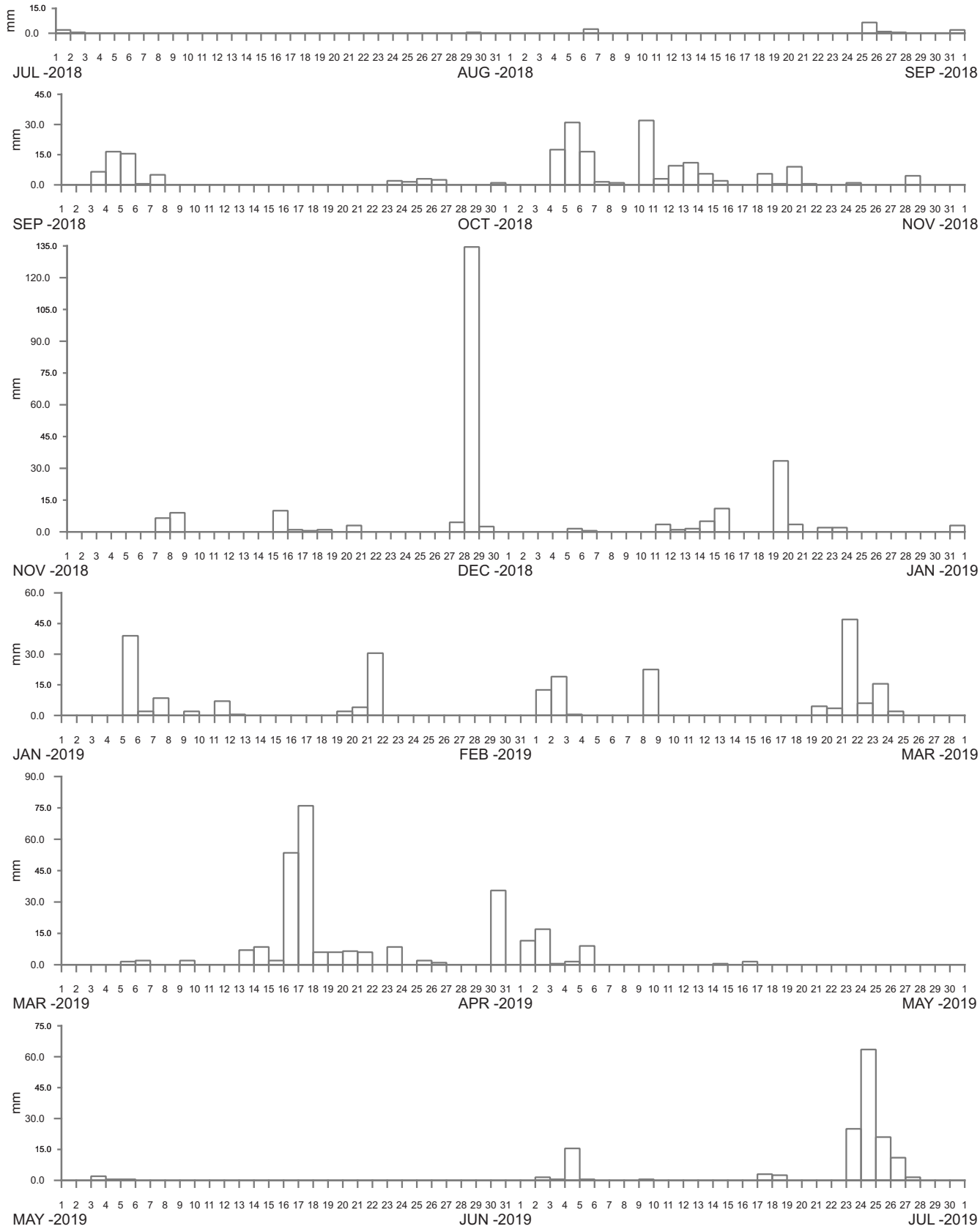
RAINFALL STATION LOCATIONS
MACQUARIE-TUGGERAH LAKES (SOUTH) AND BRISBANE WATER REGIONS

Manly Hydraulics Laboratory

Report MHL2694

Figure 47

DRAWING 2694-47.cdr



DATA LOSS

NSW GOVERNMENT

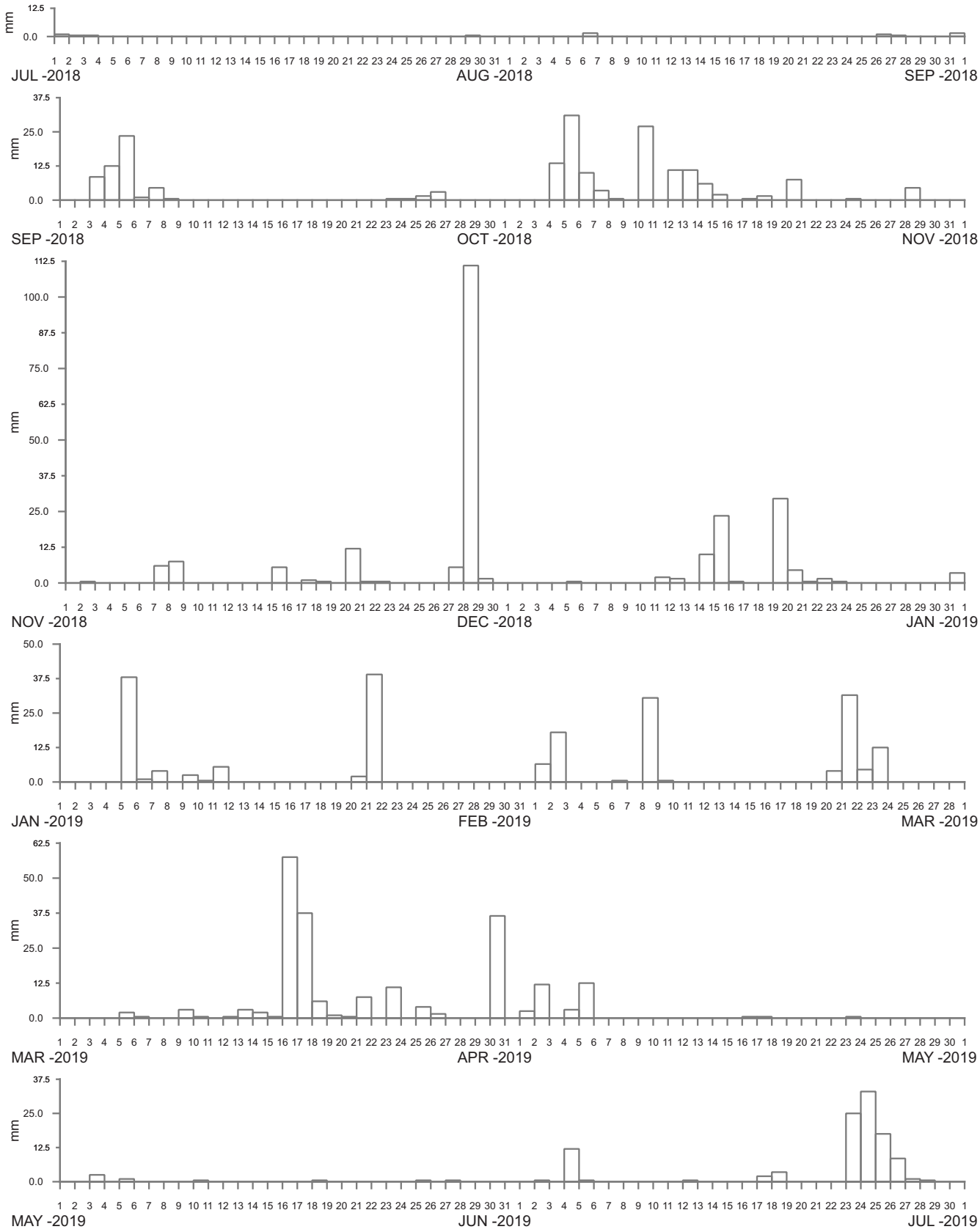
WHITEMANS RIDGE AT WATAGANS FOREST DRIVE 2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 48

DRAWING 2694-48.cdr



DATA LOSS

NSW GOVERNMENT

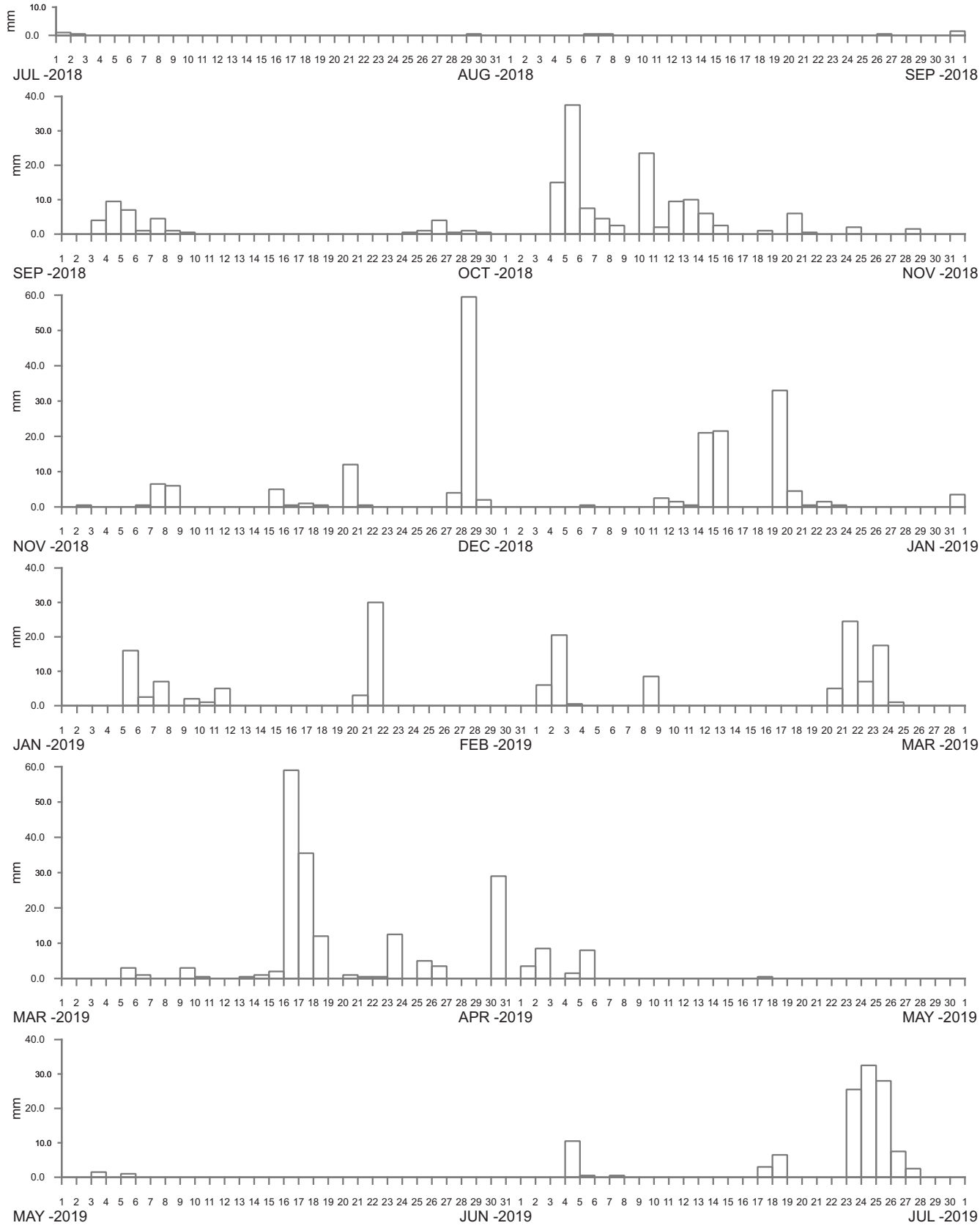
YARRAMALONG AT BUMBLE HILL ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 49

DRAWING 2694-49.cdr



DATA LOSS

NSW GOVERNMENT

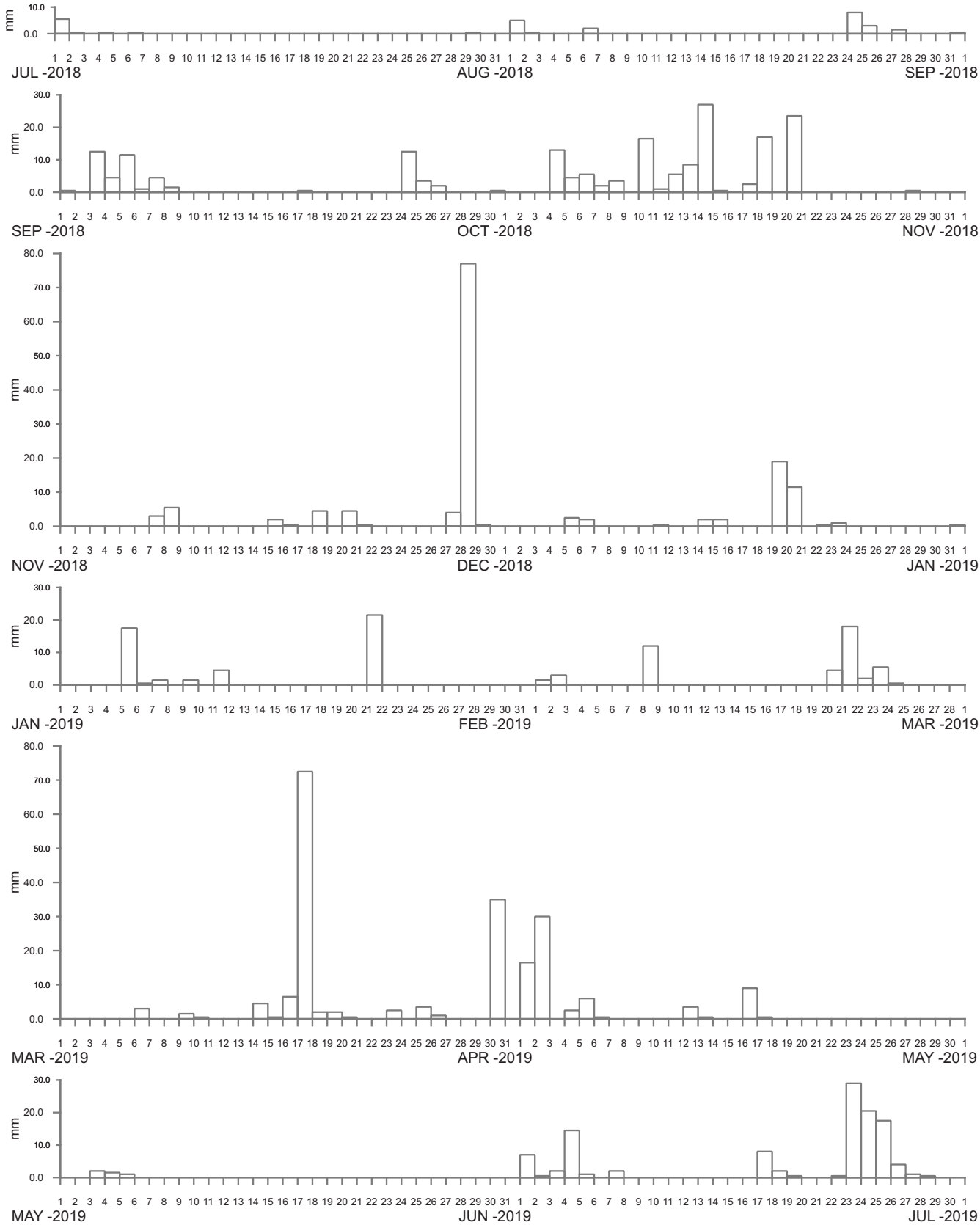
KULNURA AT GEORGE DOWNS DRIVE
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 50

DRAWING 2694-50.cdr



DATA LOSS

NSW GOVERNMENT

TOUKLEY AT TUGGERAH LAKE
2018–2019

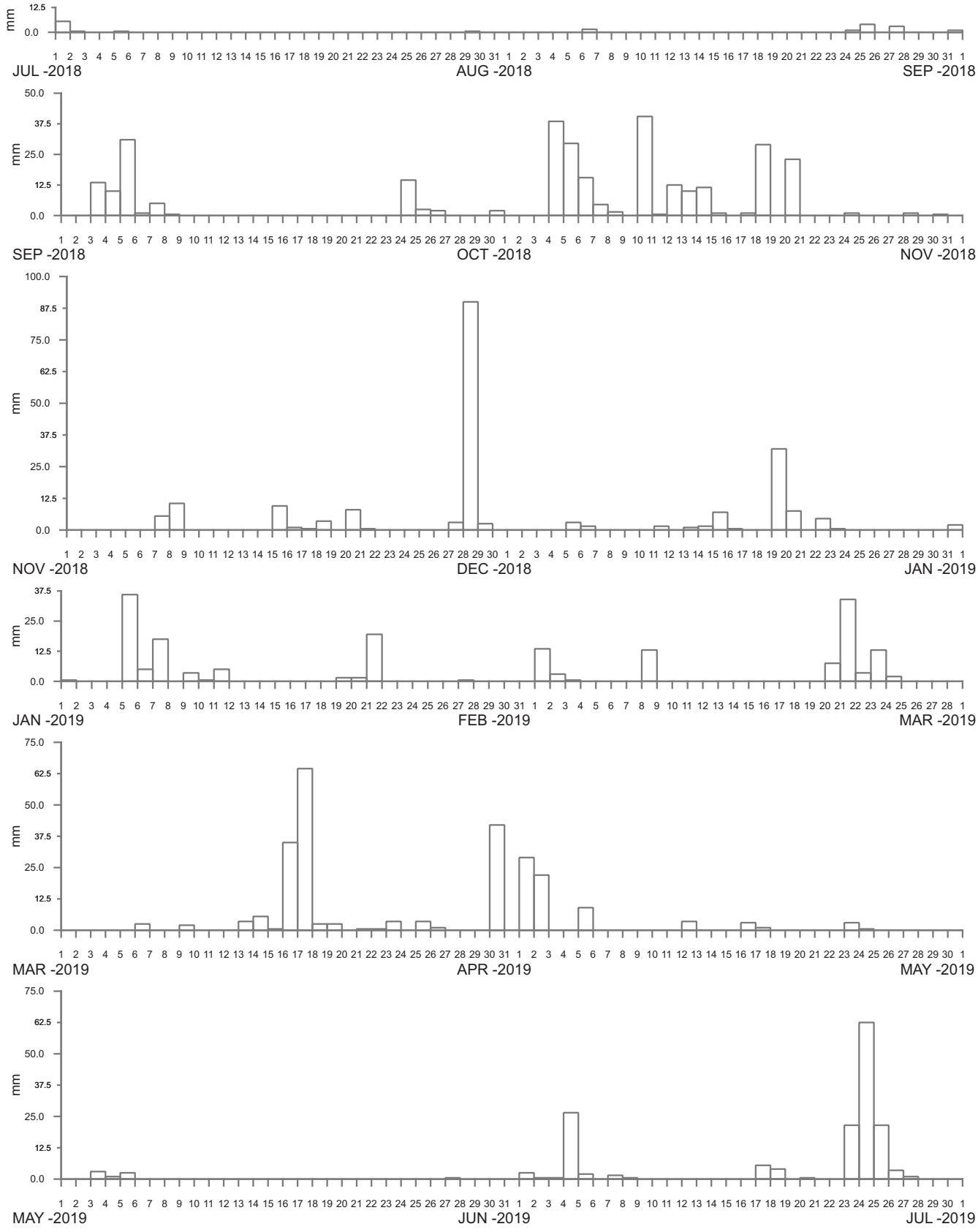
Manly Hydraulics Laboratory

Report MHL2694

Figure

51

DRAWING 2694-51.cdr



NSW GOVERNMENT

HAMLYN TERRACE AT WARNERVALE ROAD
2018–2019

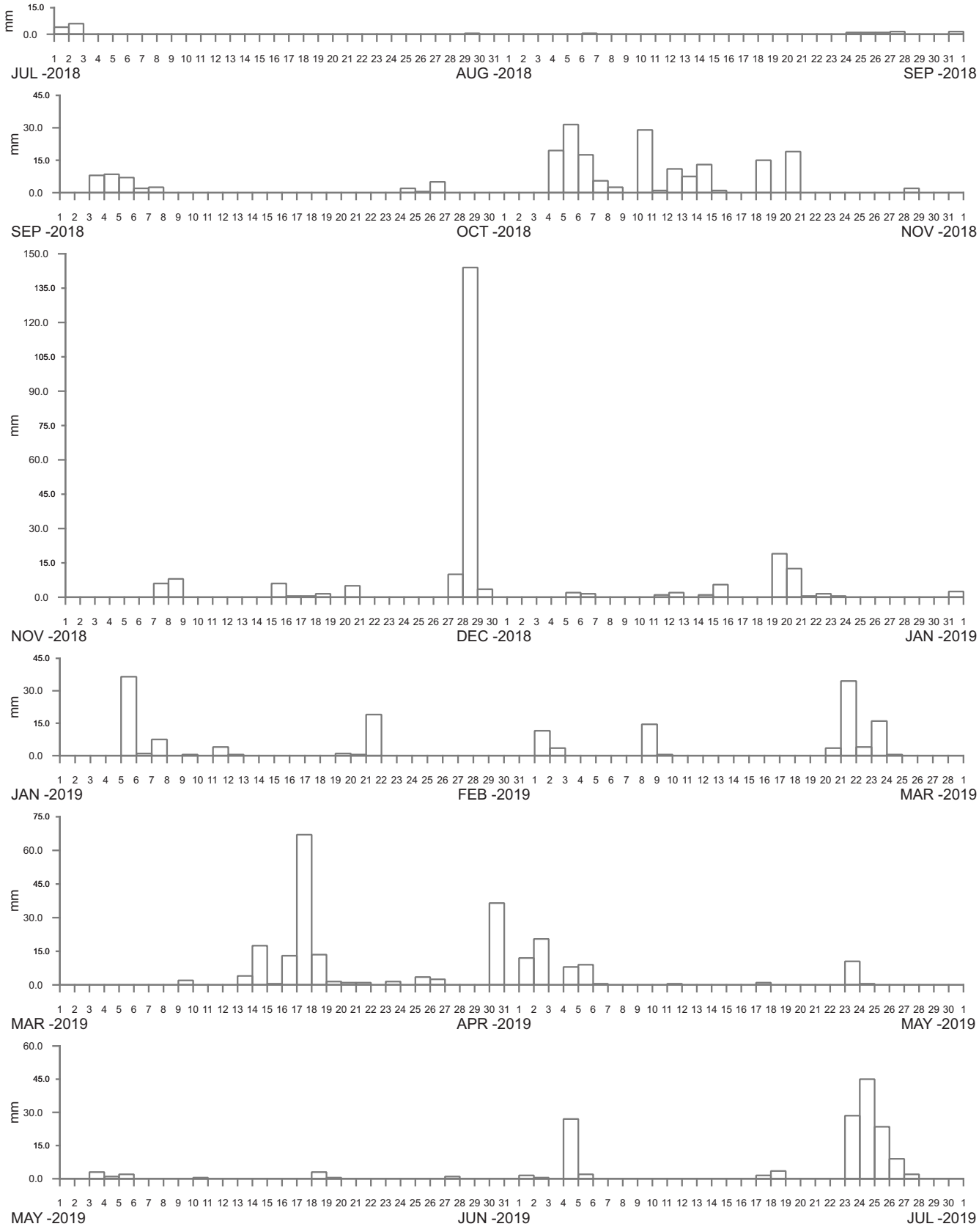
Manly Hydraulics Laboratory

Report MHL2694

Figure

52

DRAWING 2694-52.cdr



NSW GOVERNMENT

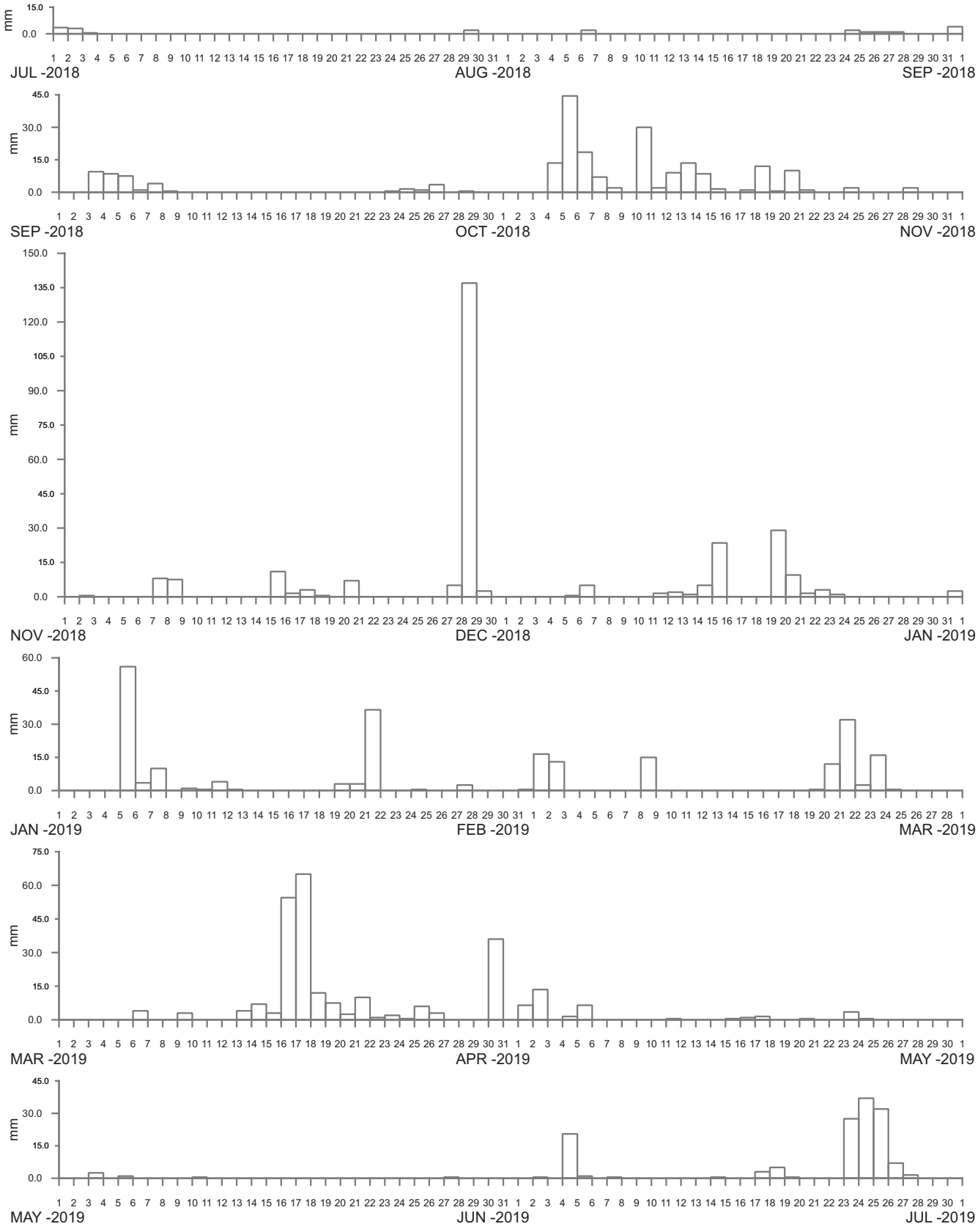
MARDI DAM AT OLD MAITLAND ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 53

DRAWING 2694-53.cdr



DATA LOSS

NSW GOVERNMENT

STERLAND AT RED HILL FOREST ROAD
2018–2019

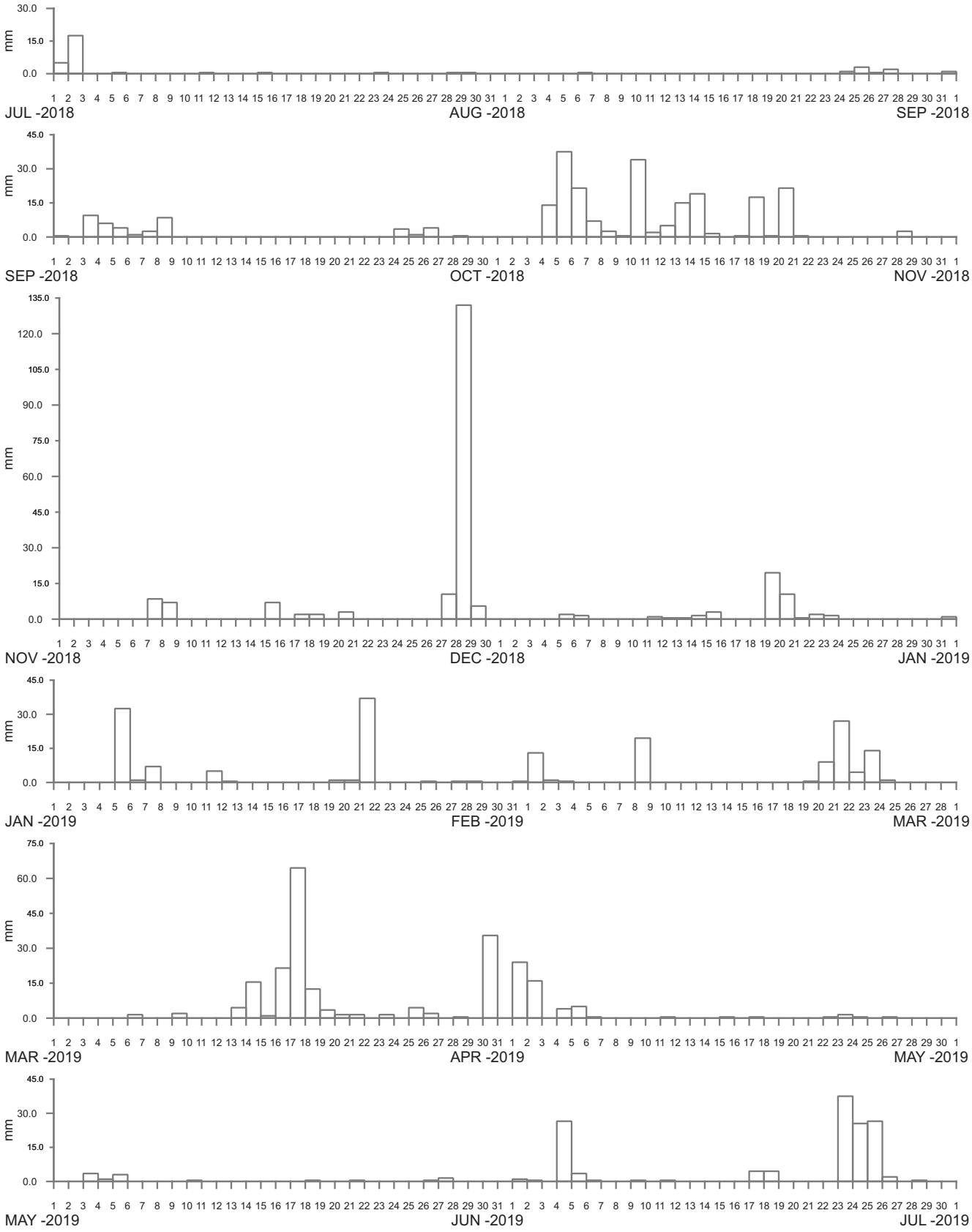
Manly Hydraulics Laboratory

Report MHL2694

Figure

54

DRAWING 2694-54.cdr



DATA LOSS

NSW GOVERNMENT

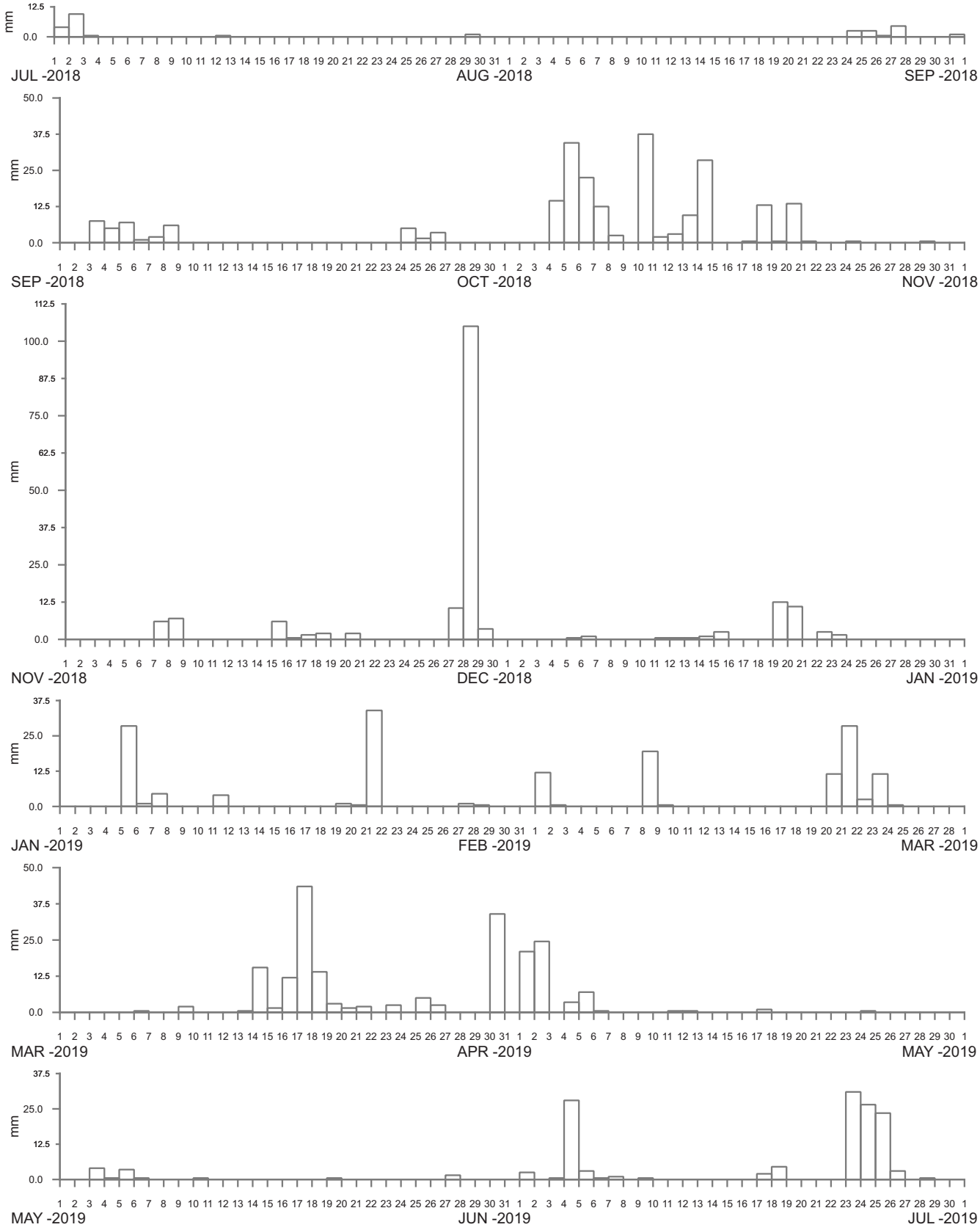
KANGY ANGY AT ORCHARD ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 55

DRAWING 2694-55.cdr



NSW GOVERNMENT

BERKELEY VALE AT BERKELEY VALE ROAD
2018–2019

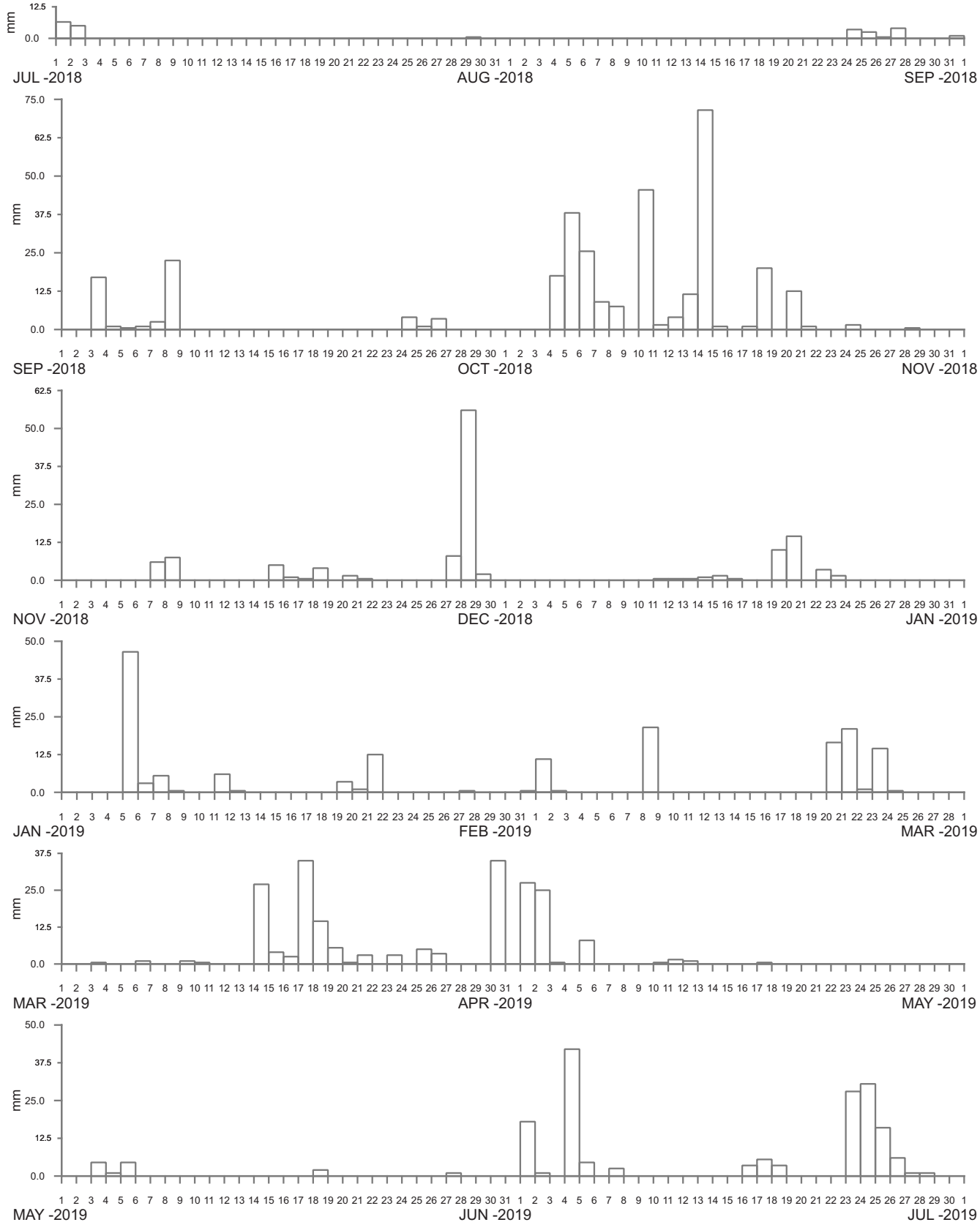
Manly Hydraulics Laboratory

Report MHL2694

Figure

56

DRAWING 2694-56.cdr



NSW GOVERNMENT

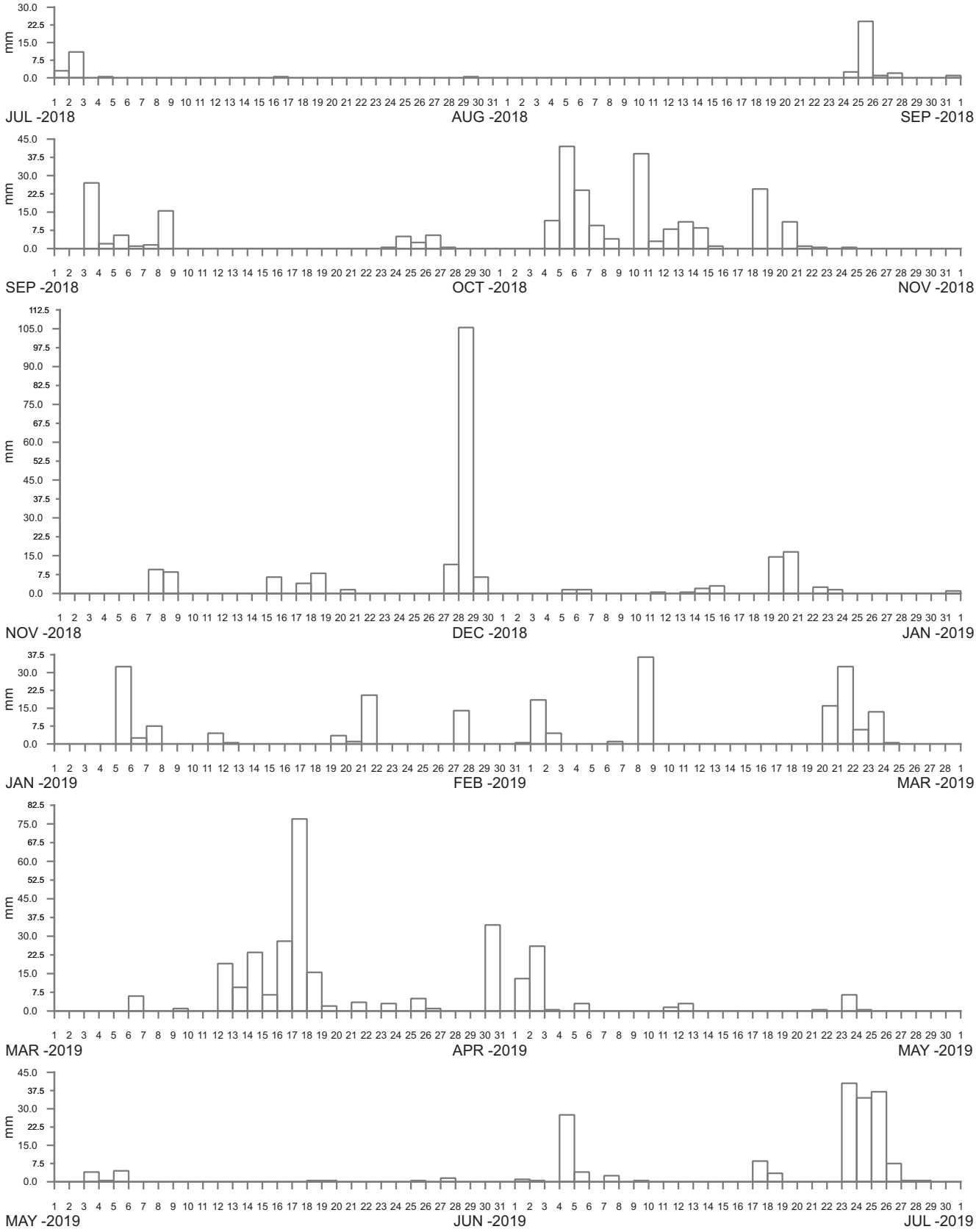
BATEAU BAY AT SEWAGE TREATMENT WORKS
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 57

DRAWING 2694-57.cdr



DATA LOSS

NSW GOVERNMENT

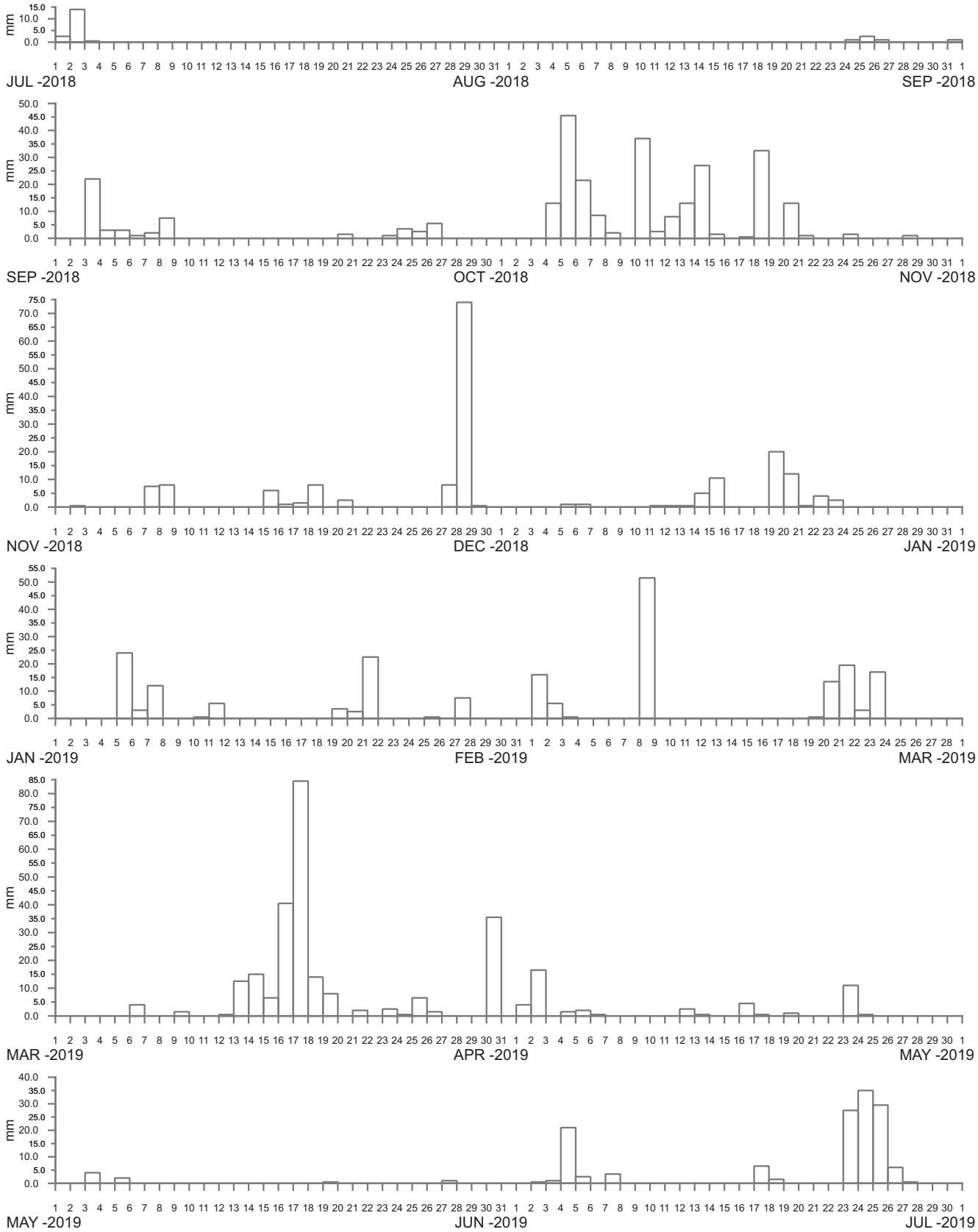
LISAROW AT FAGANS ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 58

DRAWING 2694-58.cdr



DATA LOSS

NSW GOVERNMENT

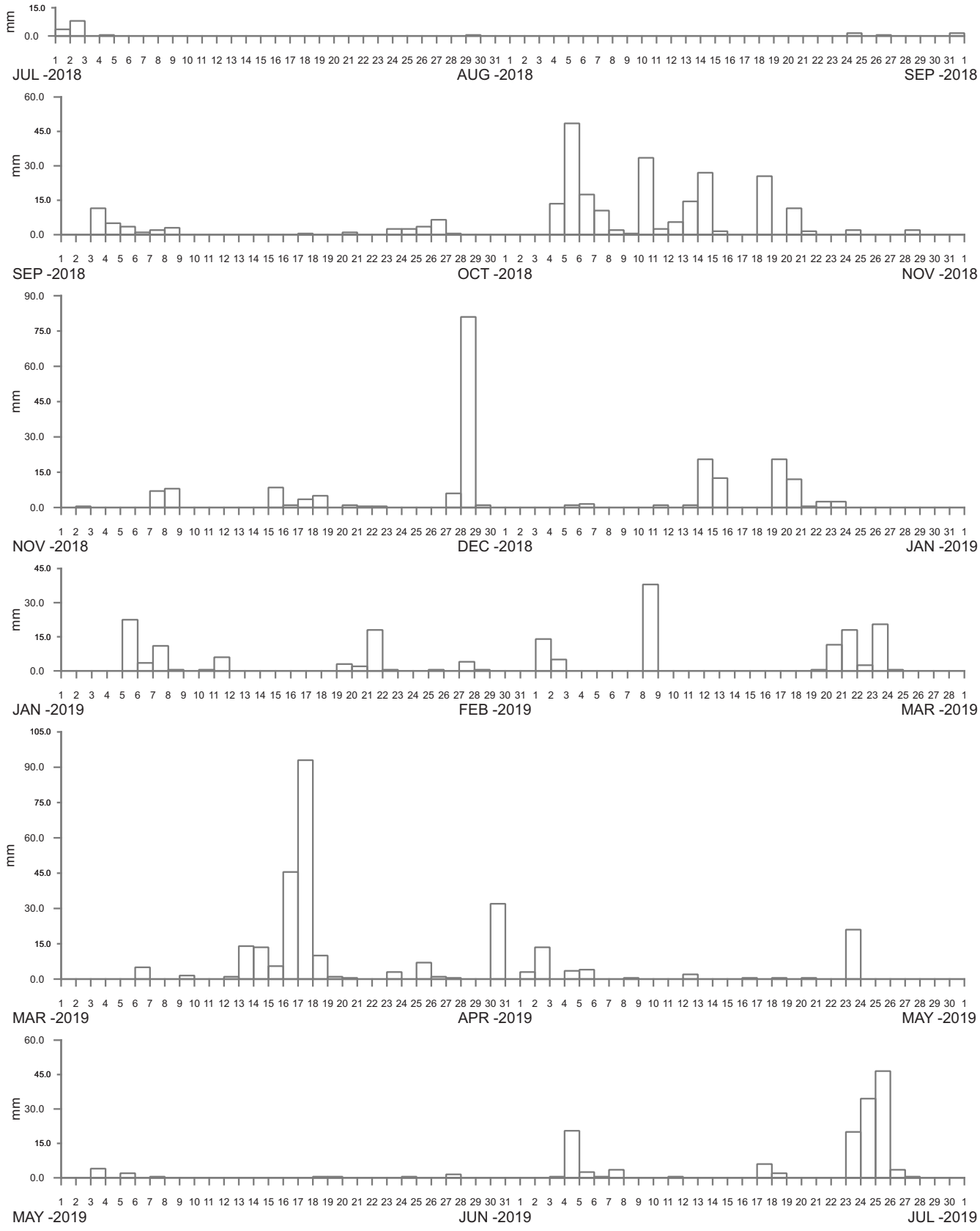
STRICKLAND AT MANGROVE ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 59

DRAWING 2694-59.cdr



DATA LOSS

NSW GOVERNMENT

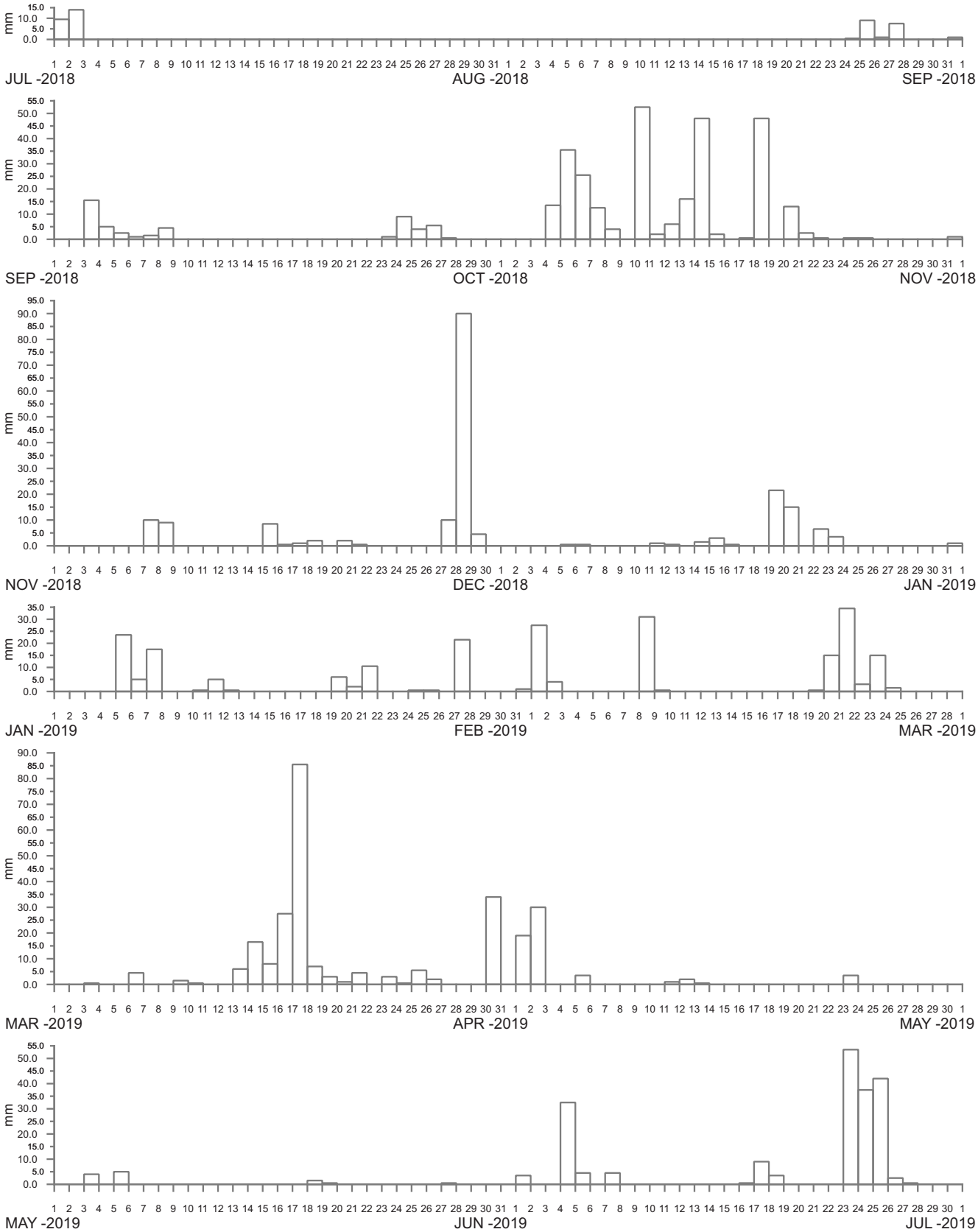
NARARA AT RESEARCH ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 60

DRAWING 2694-60.cdr



DATA LOSS

NSW GOVERNMENT

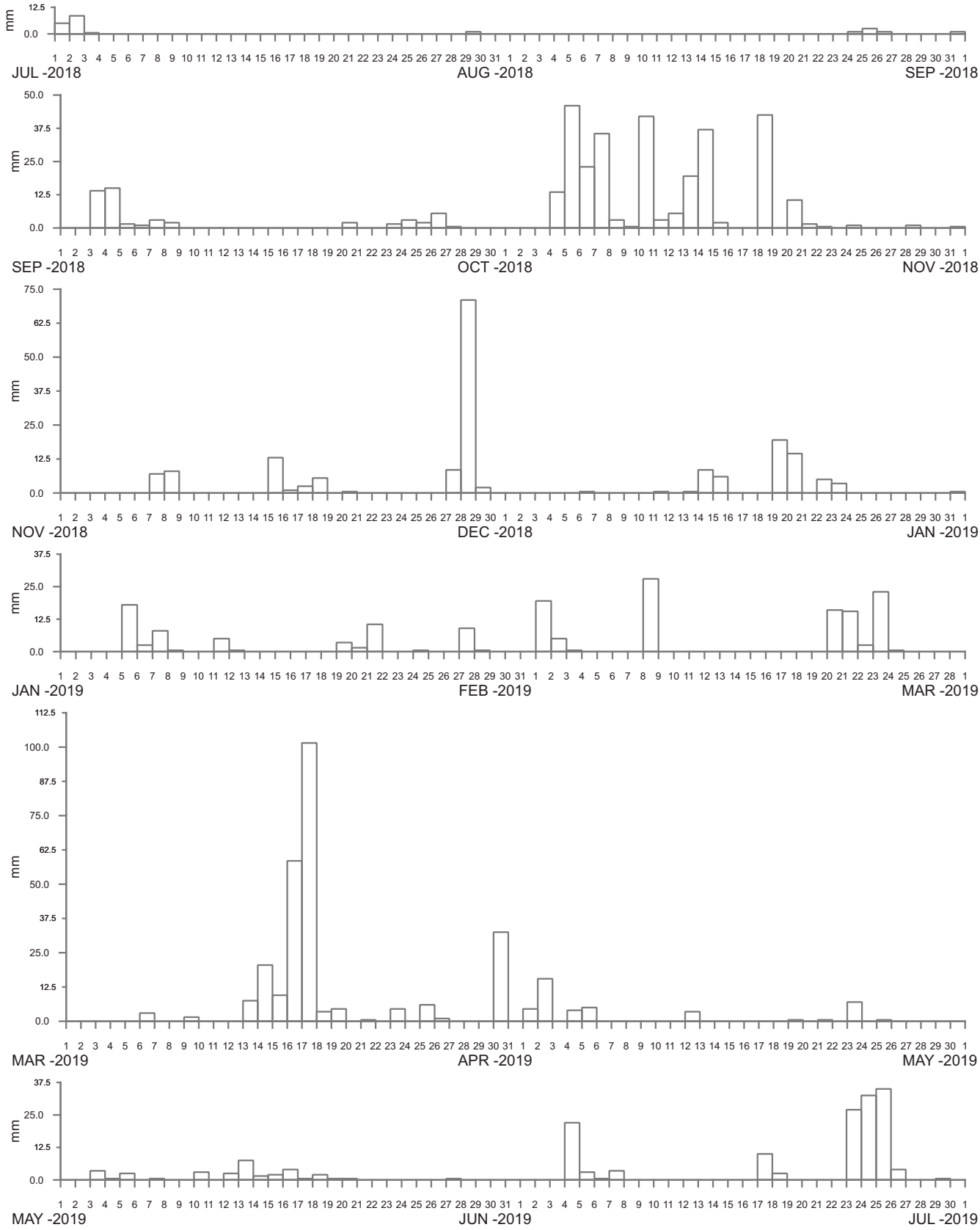
MOUNT ELLIOT AT TOOMEYS ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 61

DRAWING 2694-61.cdr



NSW GOVERNMENT

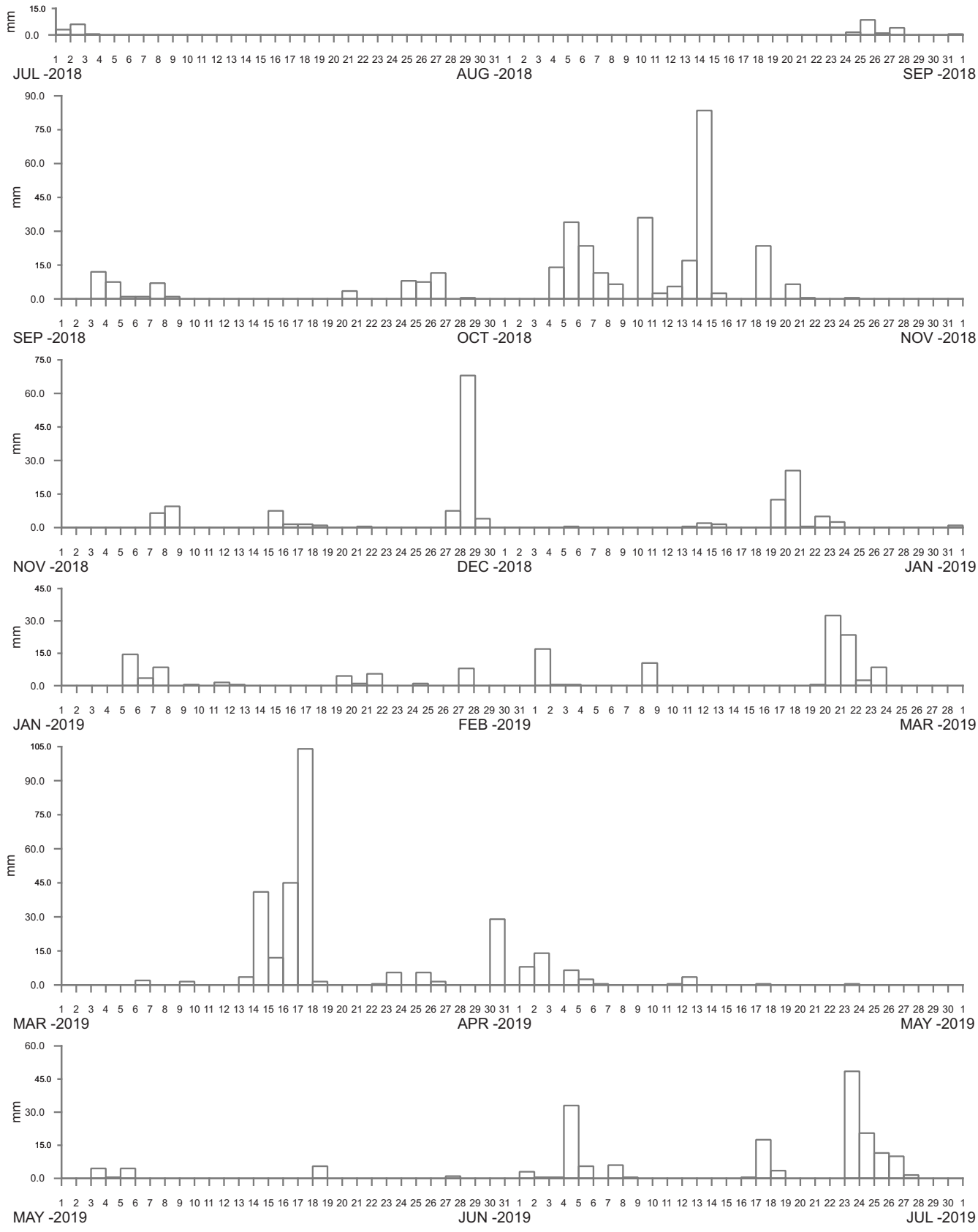
WYOMING AT LAYCOCK STREET
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 62

DRAWING 2694-62.cdr



DATA LOSS

NSW GOVERNMENT

KINCUMBER AT DOYLE STREET
2018–2019

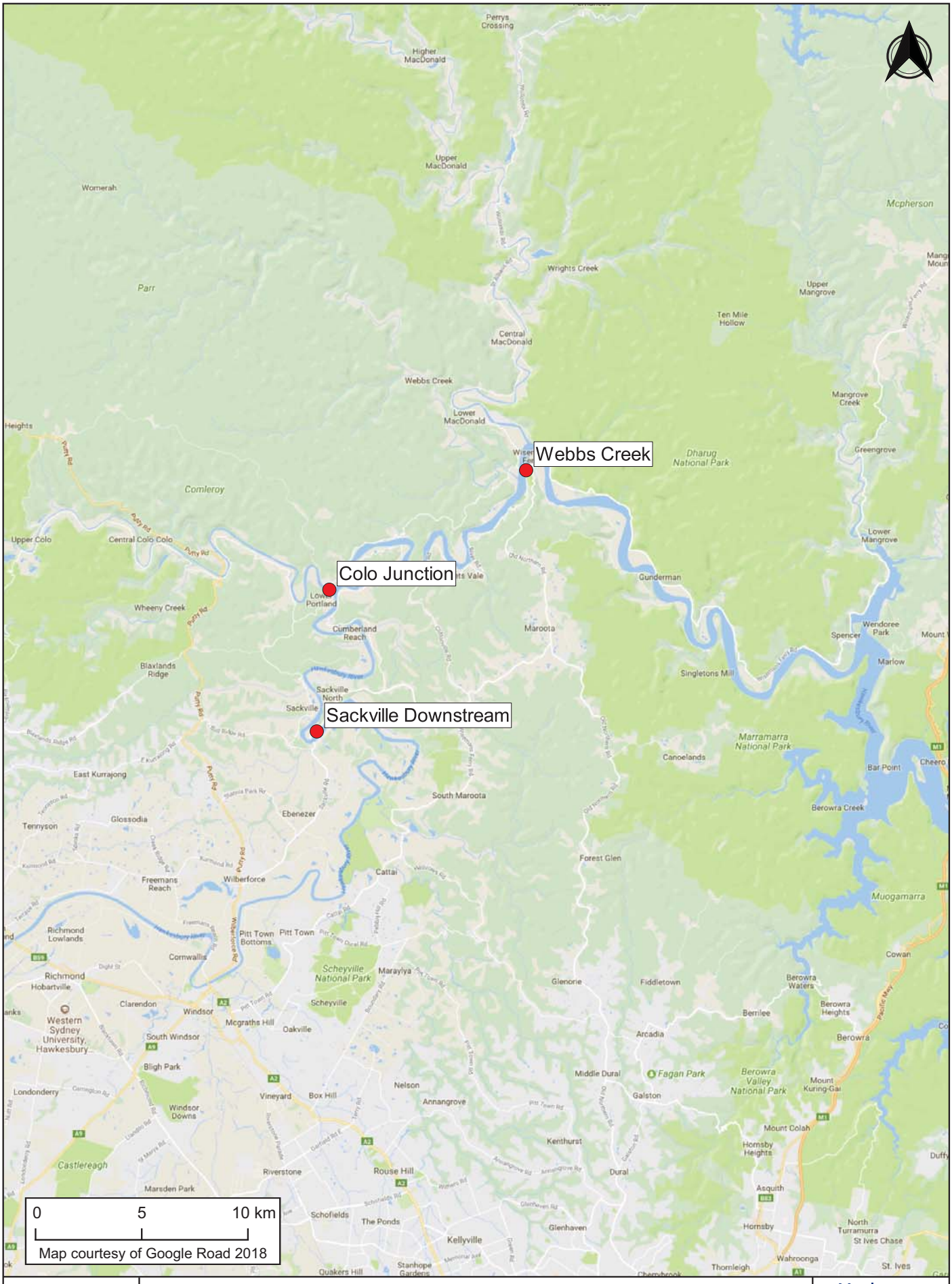
Manly Hydraulics Laboratory

Report MHL2694

Figure

63

DRAWING 2694-63.cdr



NSW GOVERNMENT

RAINFALL STATION LOCATIONS
HAWKESBURY RIVER REGION

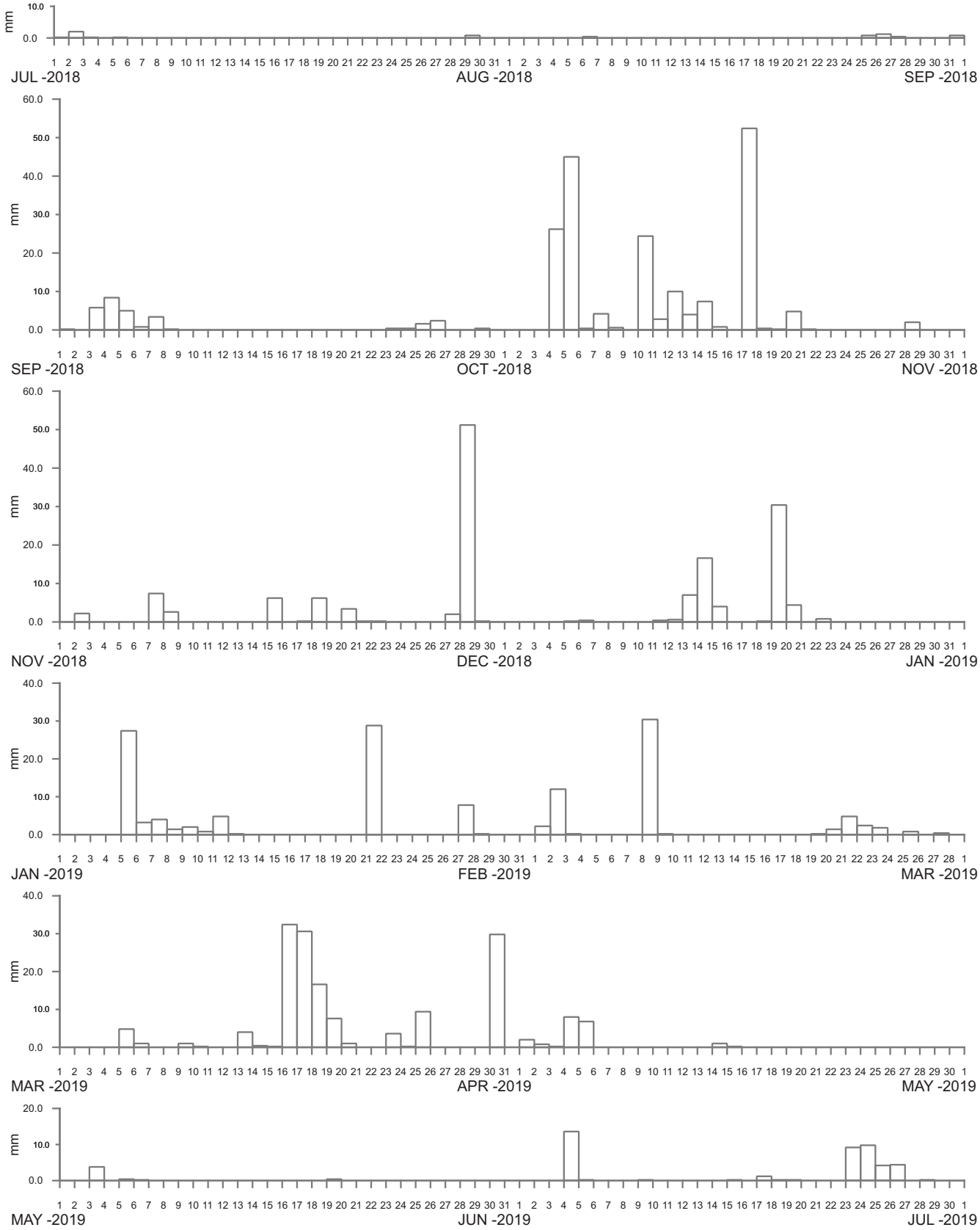
Manly Hydraulics Laboratory

Report MHL2694

Figure

64

DRAWING 2694-64.cdr



DATA LOSS

NSW GOVERNMENT

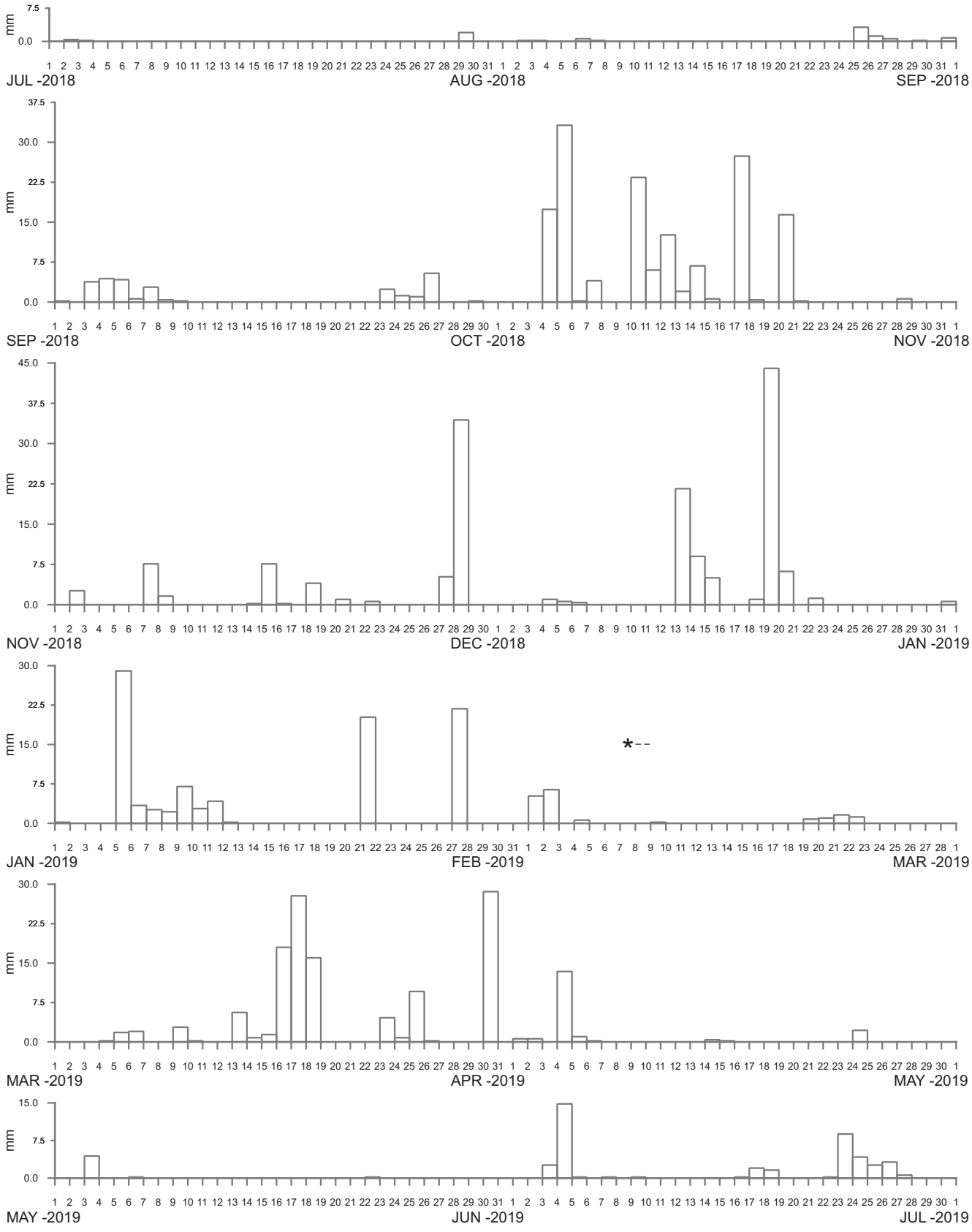
WEBBS CREEK AT HAWKESBURY RIVER
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 65

DRAWING 2694-65.cdr



---------- DATA LOSS

*Switch closure mechanism jammed

NSW GOVERNMENT

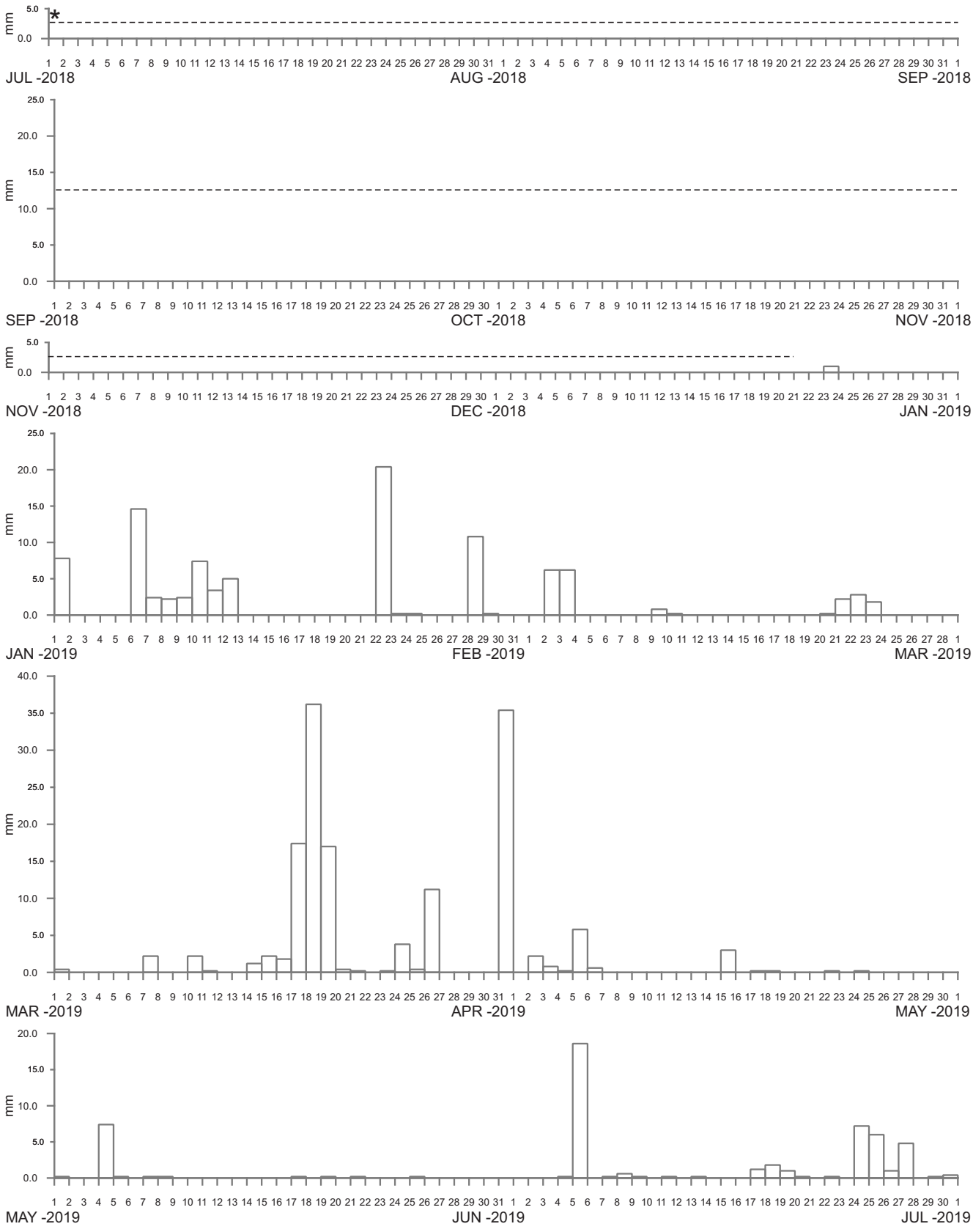
COLO JUNCTION AT HAWKESBURY RIVER 2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 66

DRAWING 2694-66.cdr



---------- DATA LOSS *Telemetered data received, however, rain gauge failed calibration at scheduled check

NSW GOVERNMENT

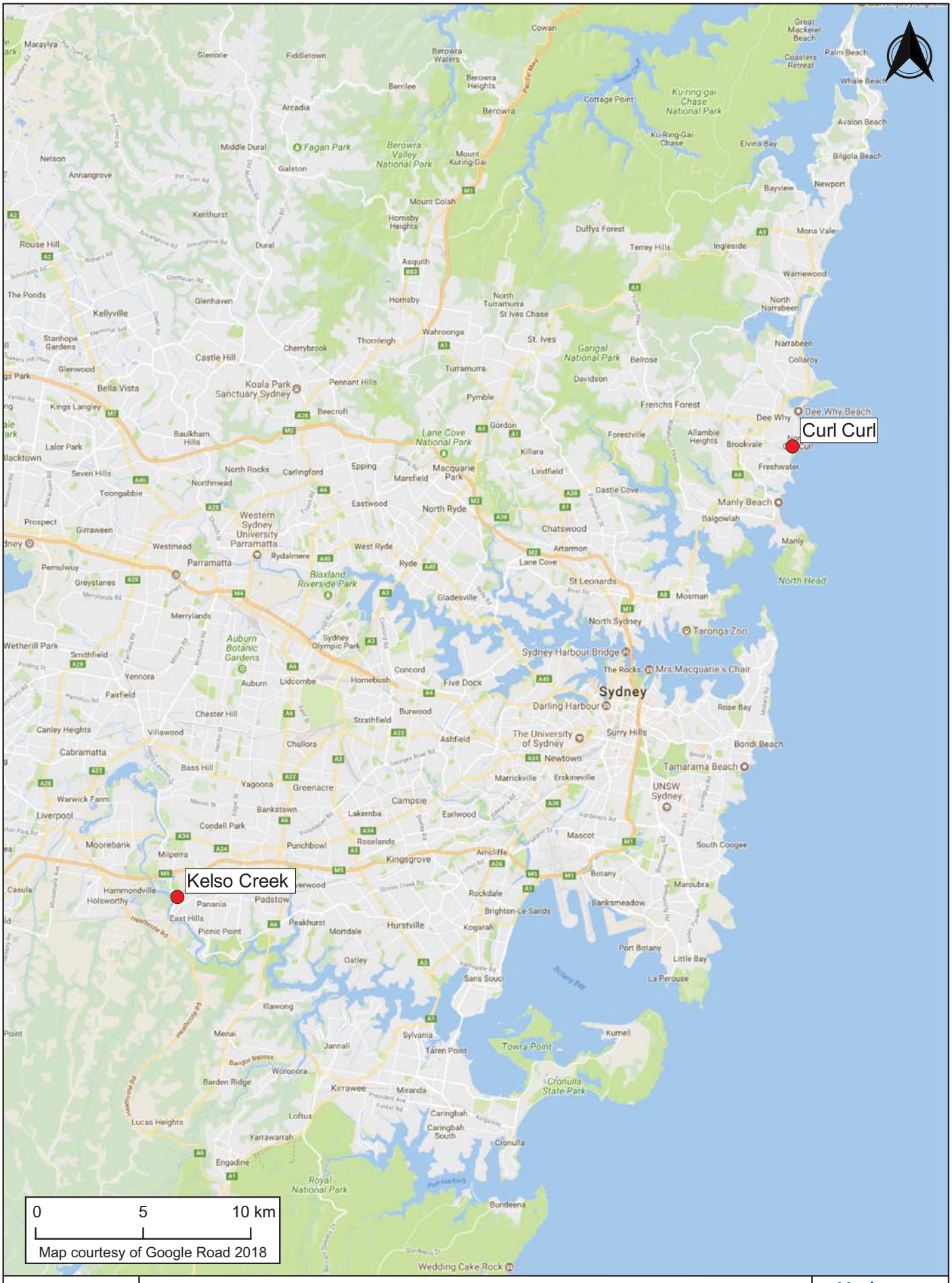
SACKVILLE DOWNSTREAM AT HAWKESBURY RIVER 2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 67

DRAWING 2694-67.cdr



NSW GOVERNMENT

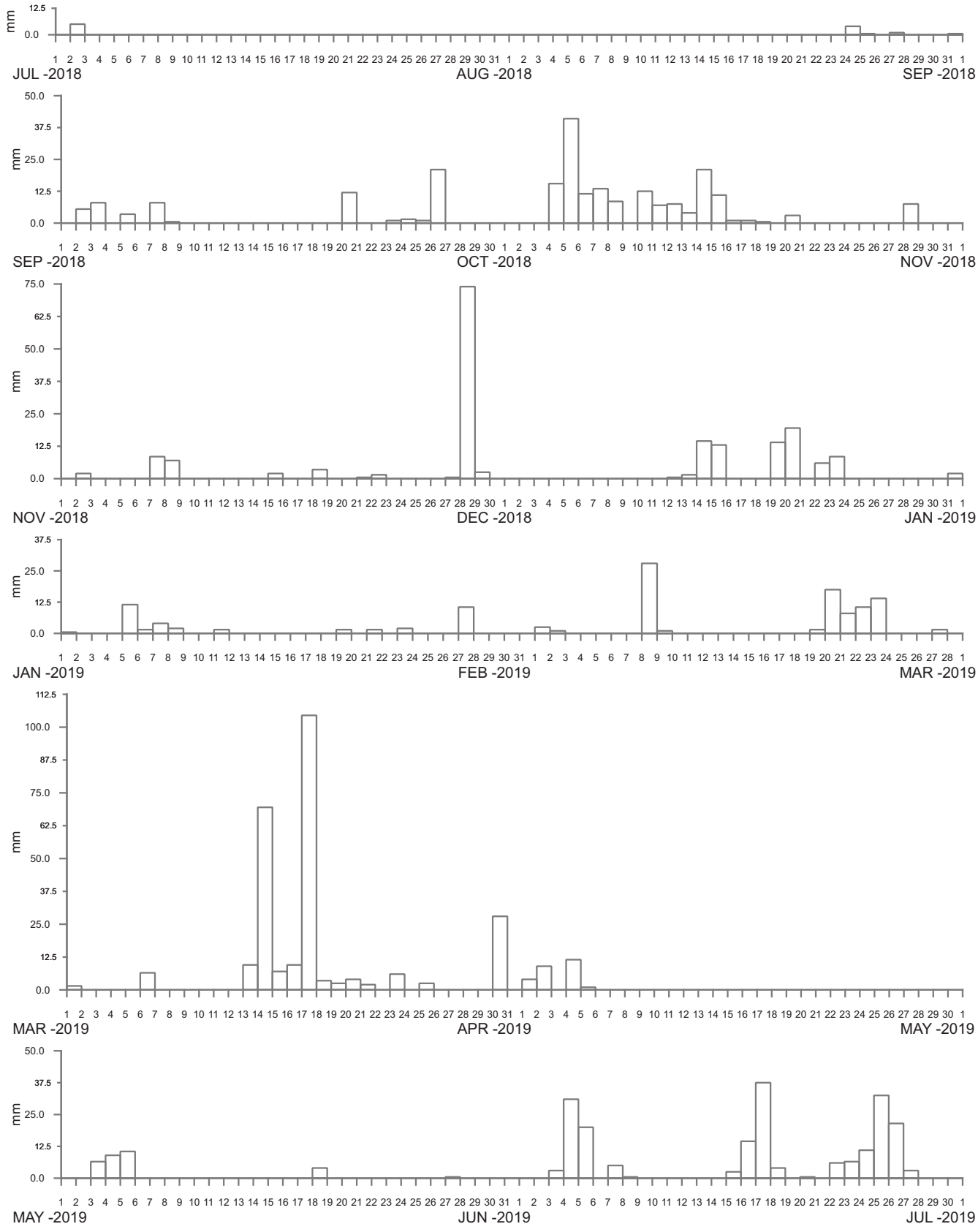
RAINFALL STATION LOCATIONS
SYDNEY COASTAL REGION

Manly Hydraulics Laboratory

Report MHL2694

Figure 68

DRAWING 2694-68.cdr



DATA LOSS

NSW GOVERNMENT

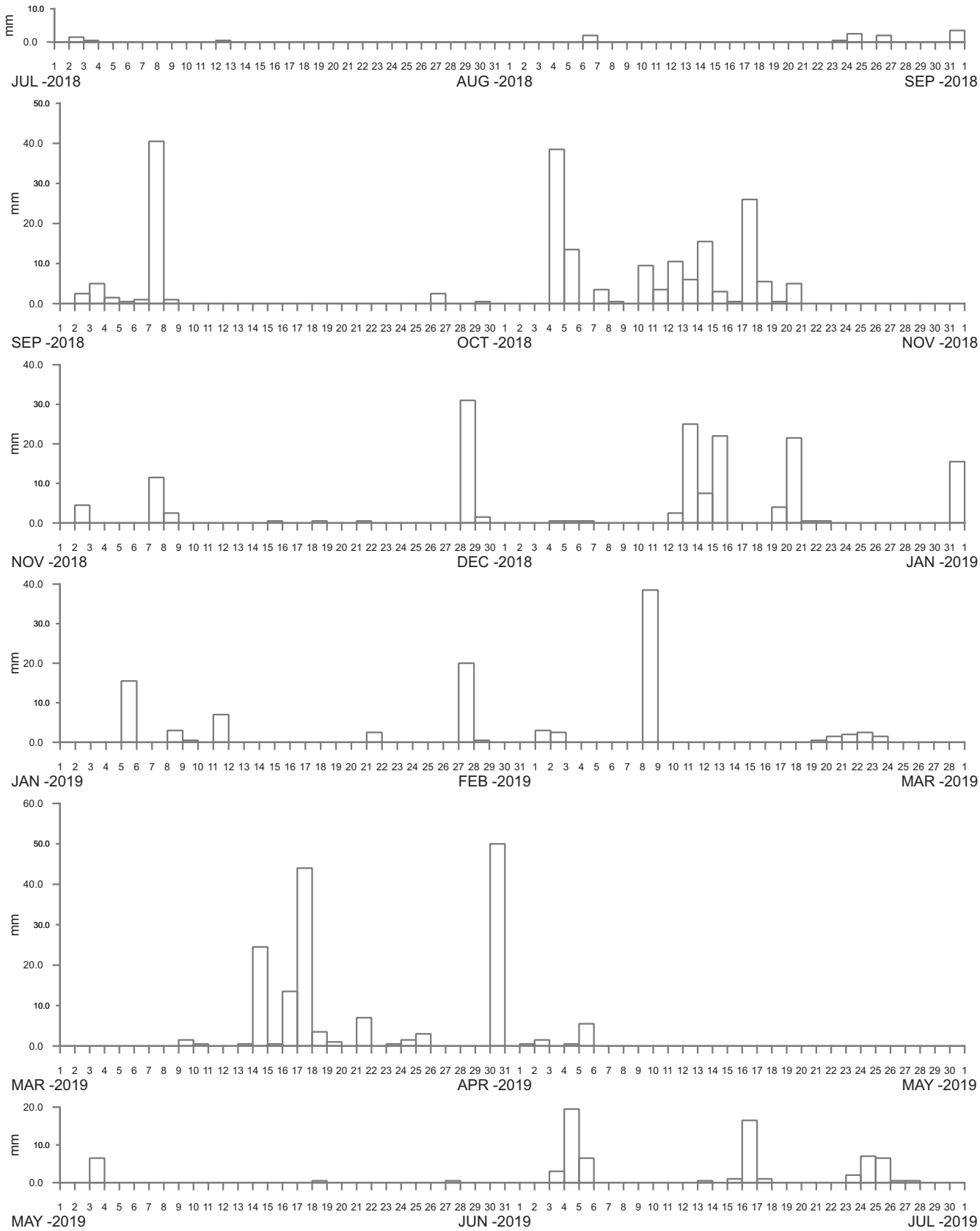
CURL CURL AT CURL CURL LAGOON
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 69

DRAWING 2694-69.cdr



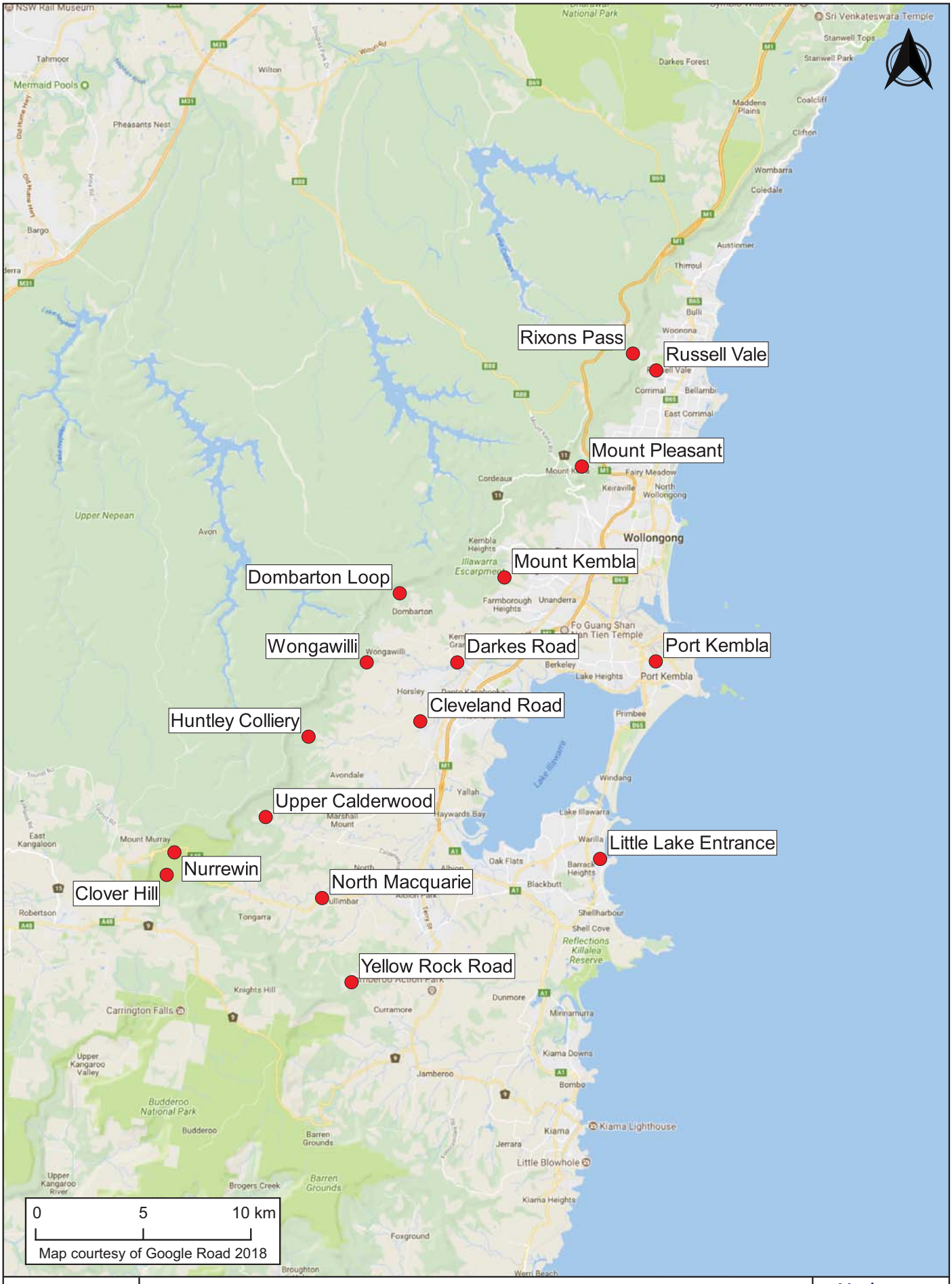
KELSO CREEK AT KELSO CREEK
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 70

DRAWING 2694-70.cdr



NSW GOVERNMENT

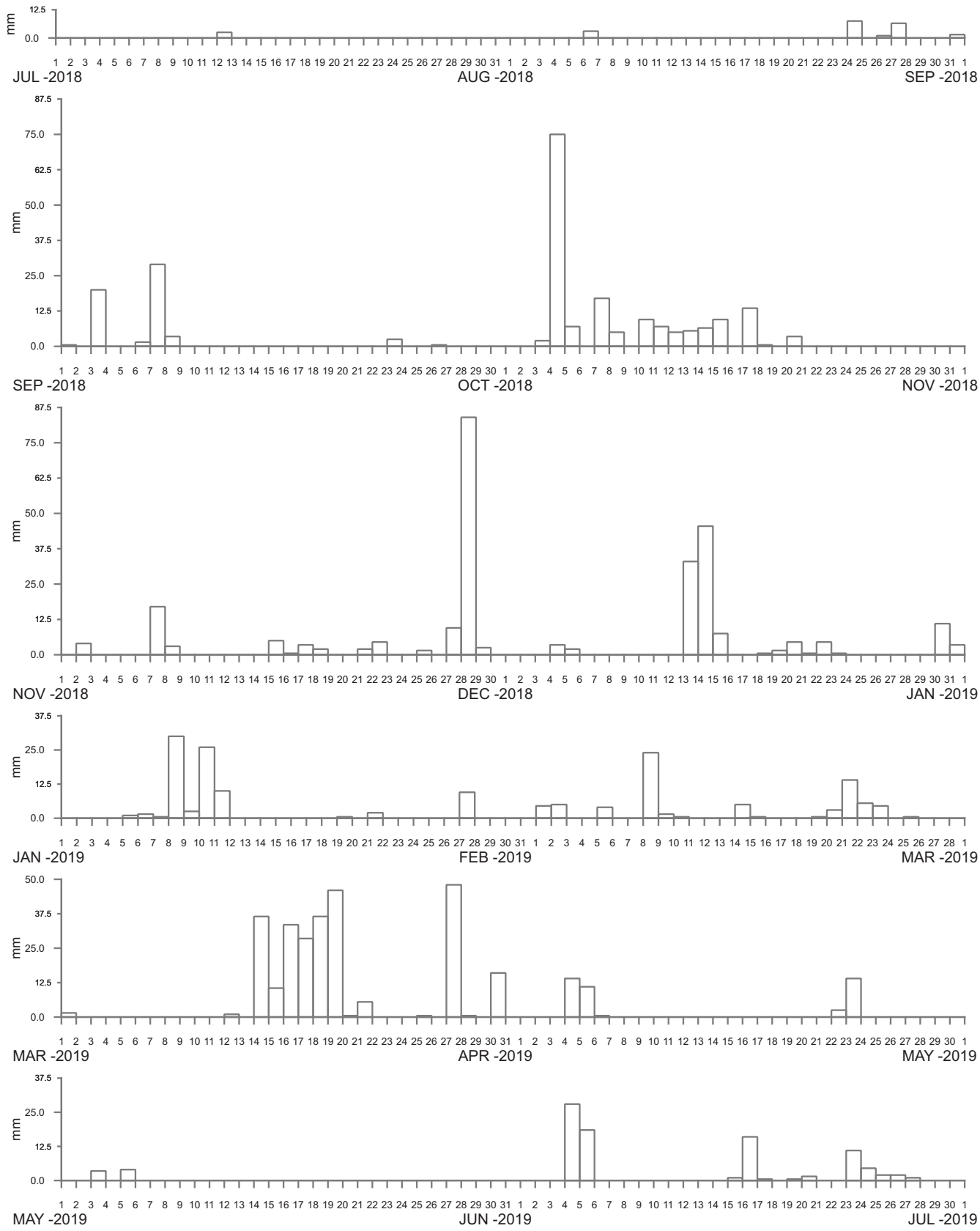
RAINFALL STATION LOCATIONS
WOLLONGONG COASTAL REGION

Manly Hydraulics Laboratory

Report MHL2694

Figure 71

DRAWING 2694-71.cdr



NSW GOVERNMENT

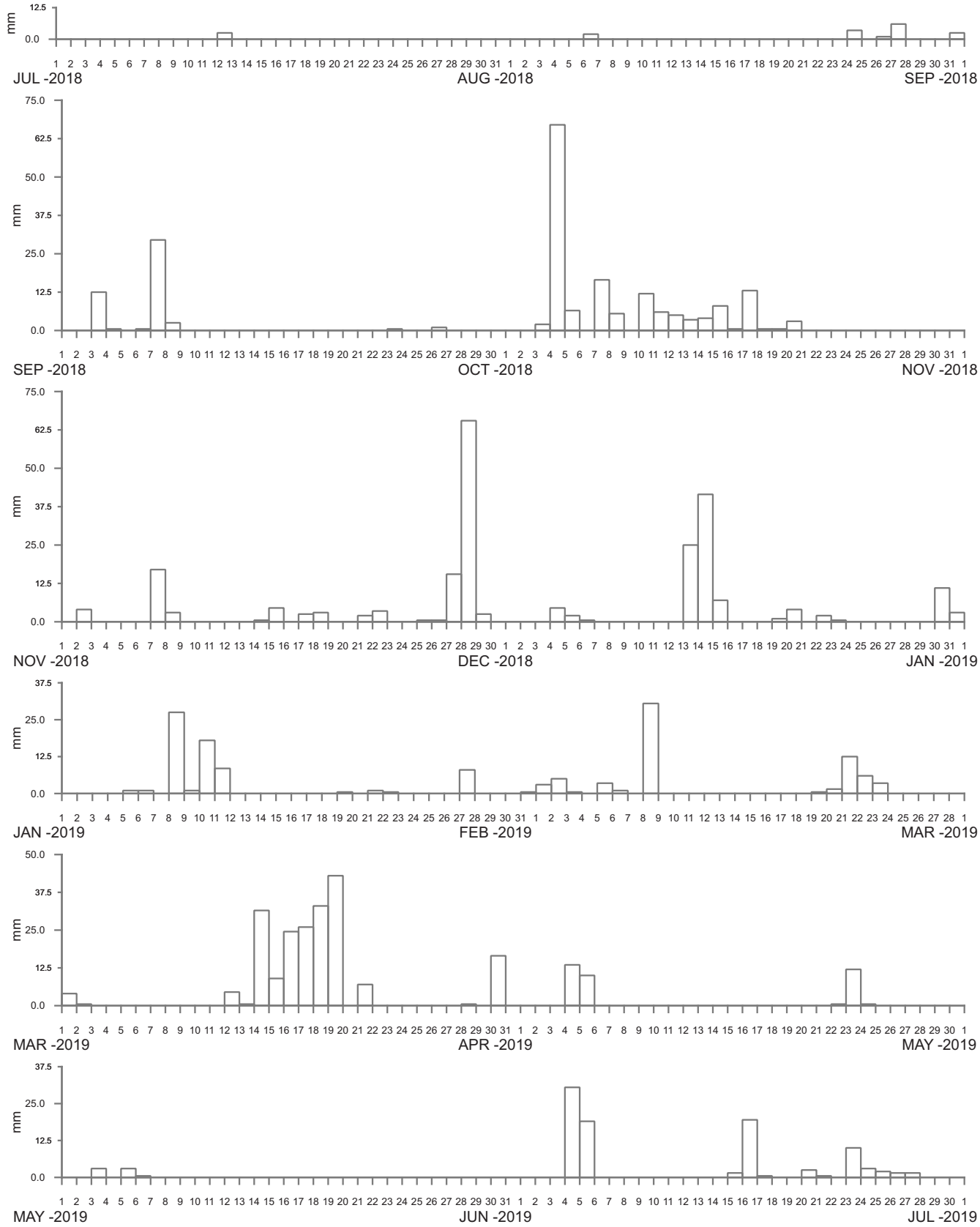
RIXONS PASS AT RIXONS PASS ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 72

DRAWING 2694-72.cdr



DATA LOSS

NSW GOVERNMENT

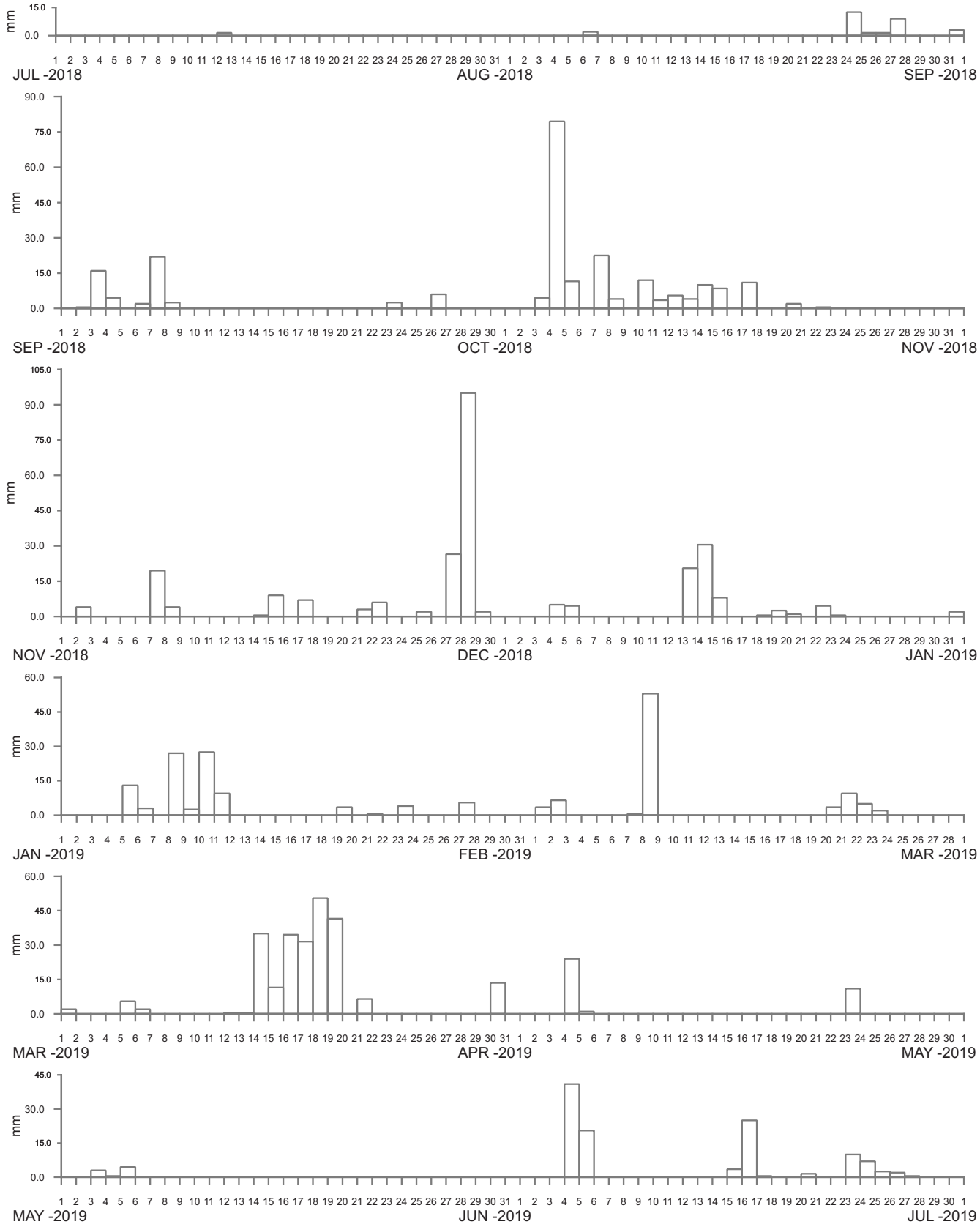
RUSSELL VALE AT WHITING CRESCENT
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 73

DRAWING 2694-73.cdr



NSW GOVERNMENT

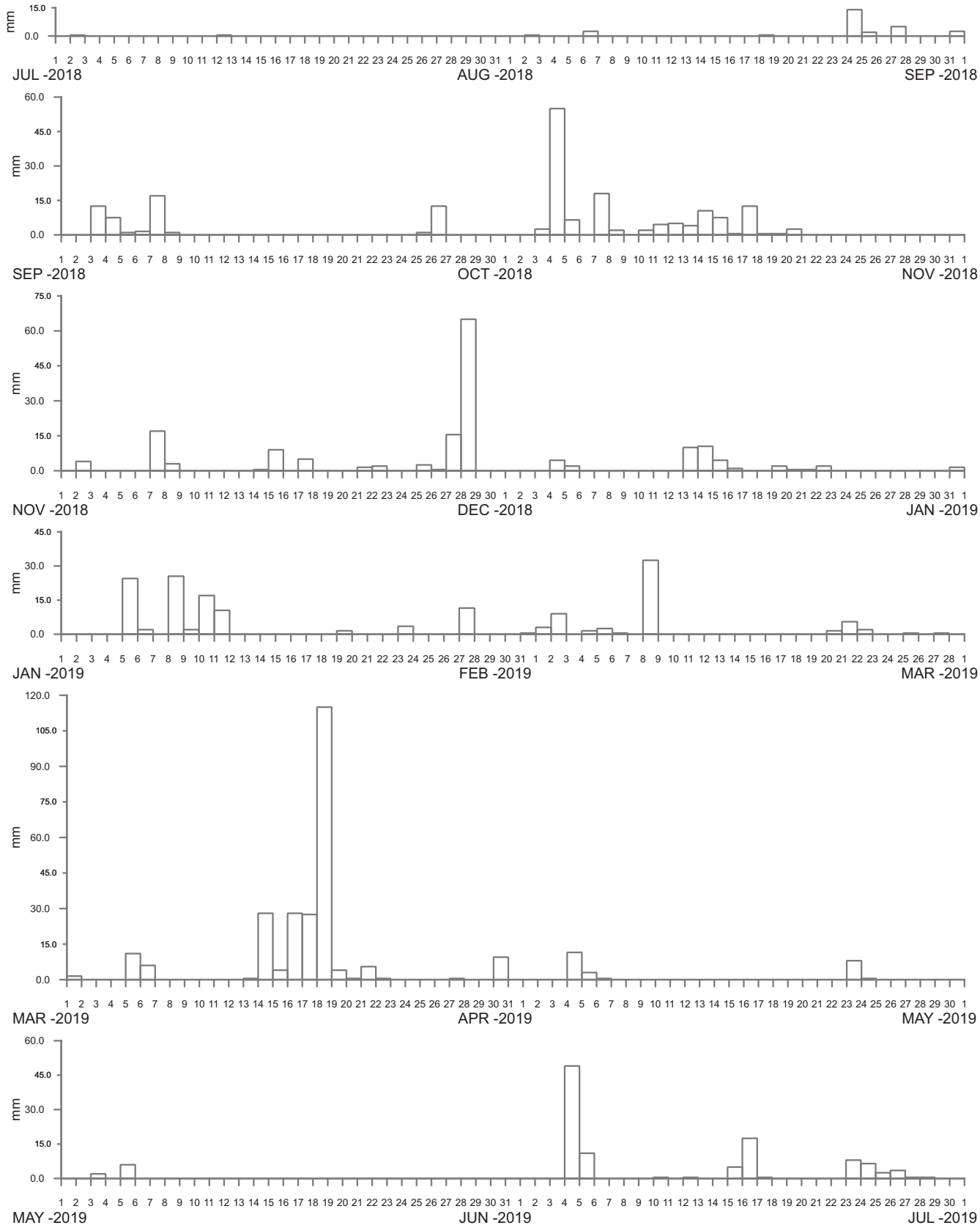
MOUNT PLEASANT AT PARRISH AVENUE
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 74

DRAWING 2694-74.cdr



DATA LOSS

NSW GOVERNMENT

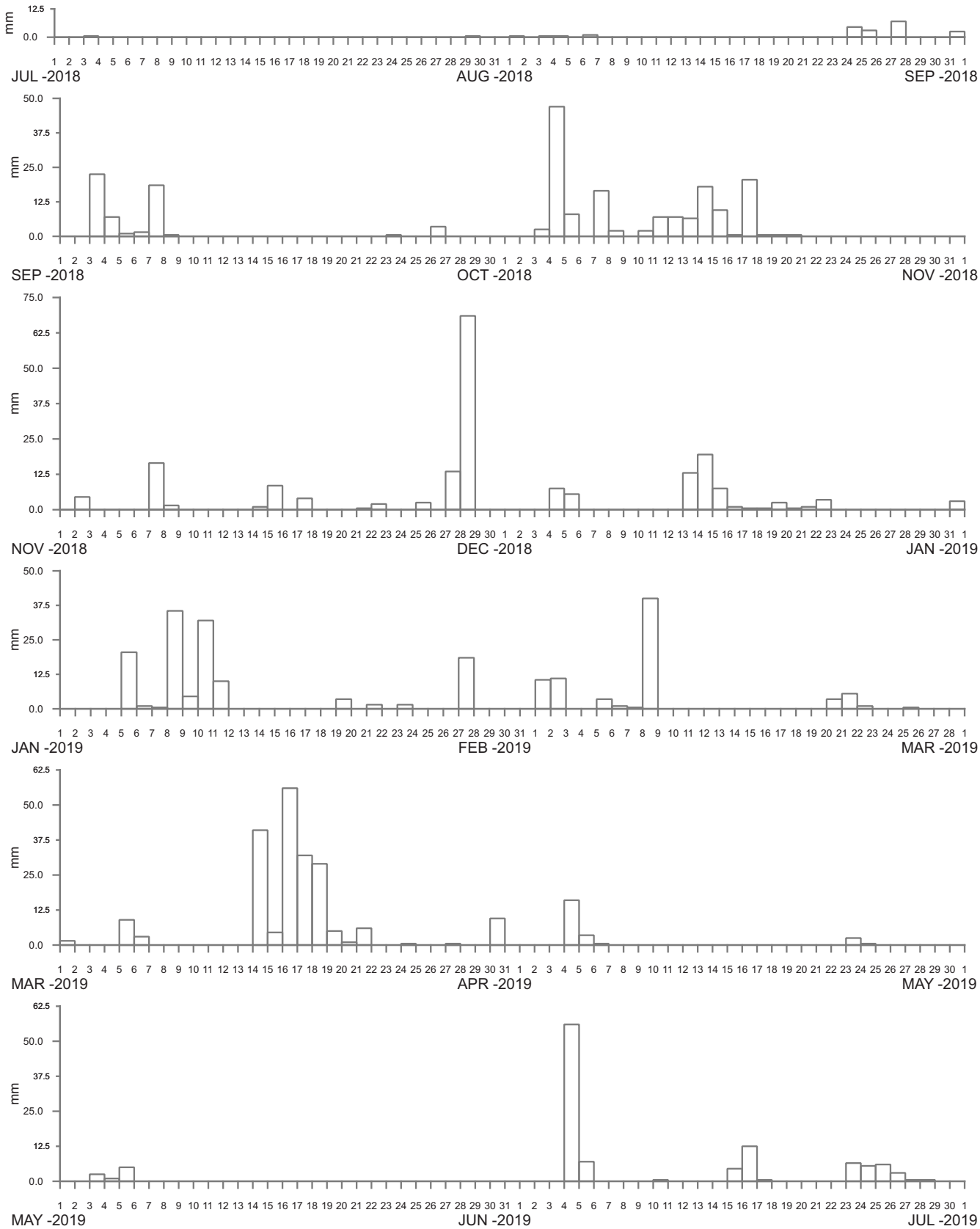
MOUNT KEMBLA AT STAFF ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 75

DRAWING 2694-75.cdr



DATA LOSS

NSW GOVERNMENT

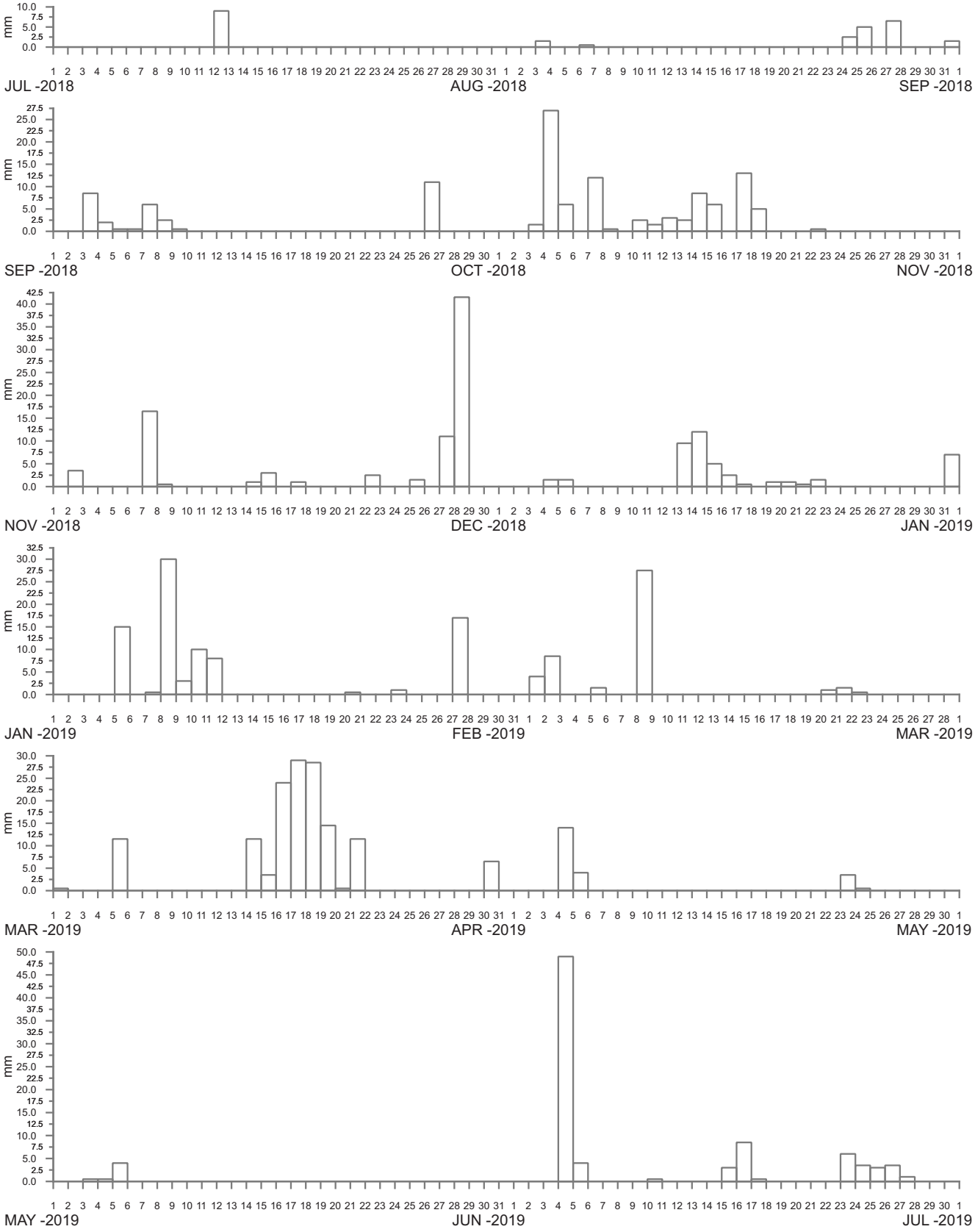
DOMBARTON LOOP AT PAYNES ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 76

DRAWING 2694-76.cdr



DATA LOSS

NSW GOVERNMENT

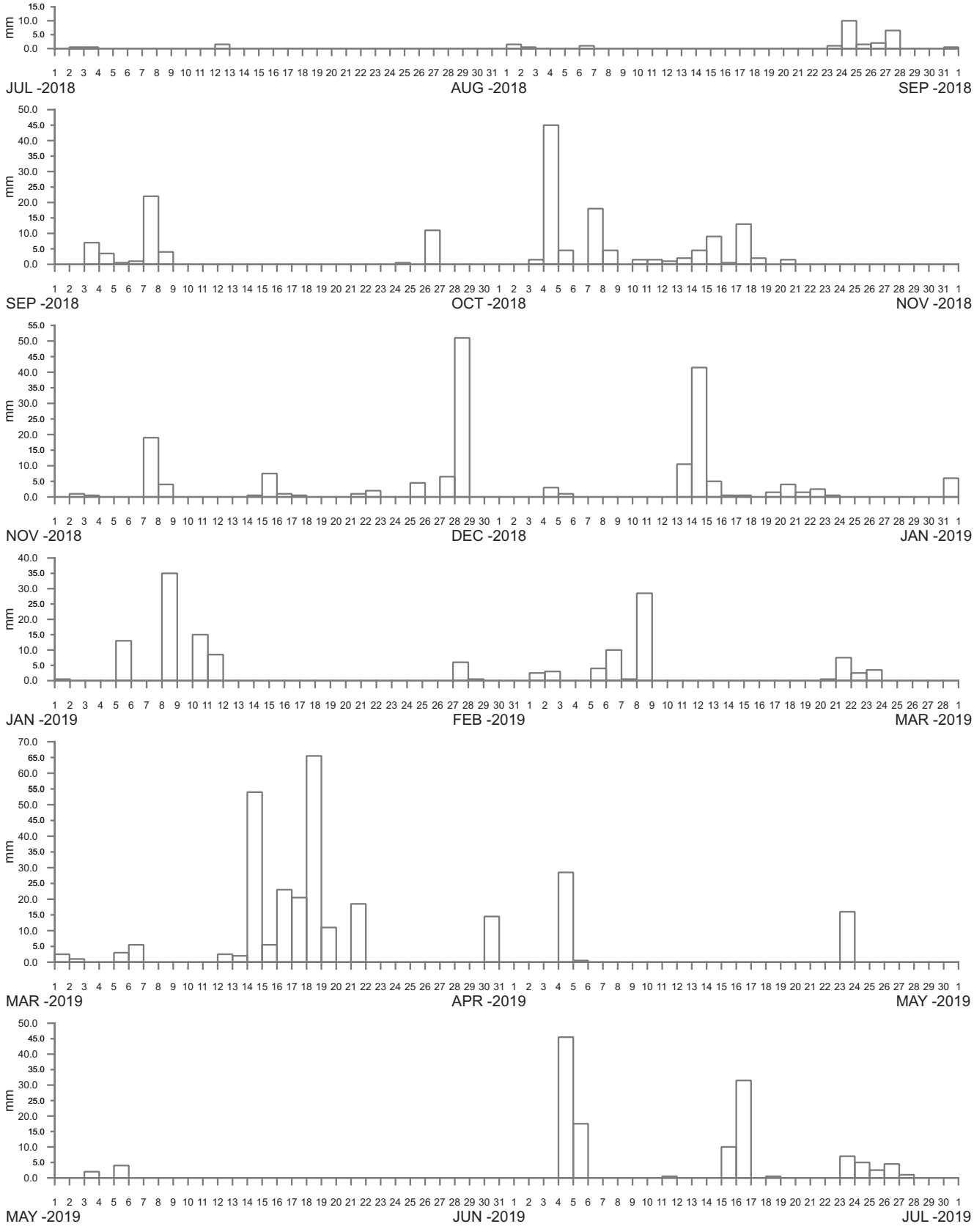
WONGAWILLI AT JERSEY FARM ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 77

DRAWING 2694-77.cdr



DATA LOSS

NSW GOVERNMENT

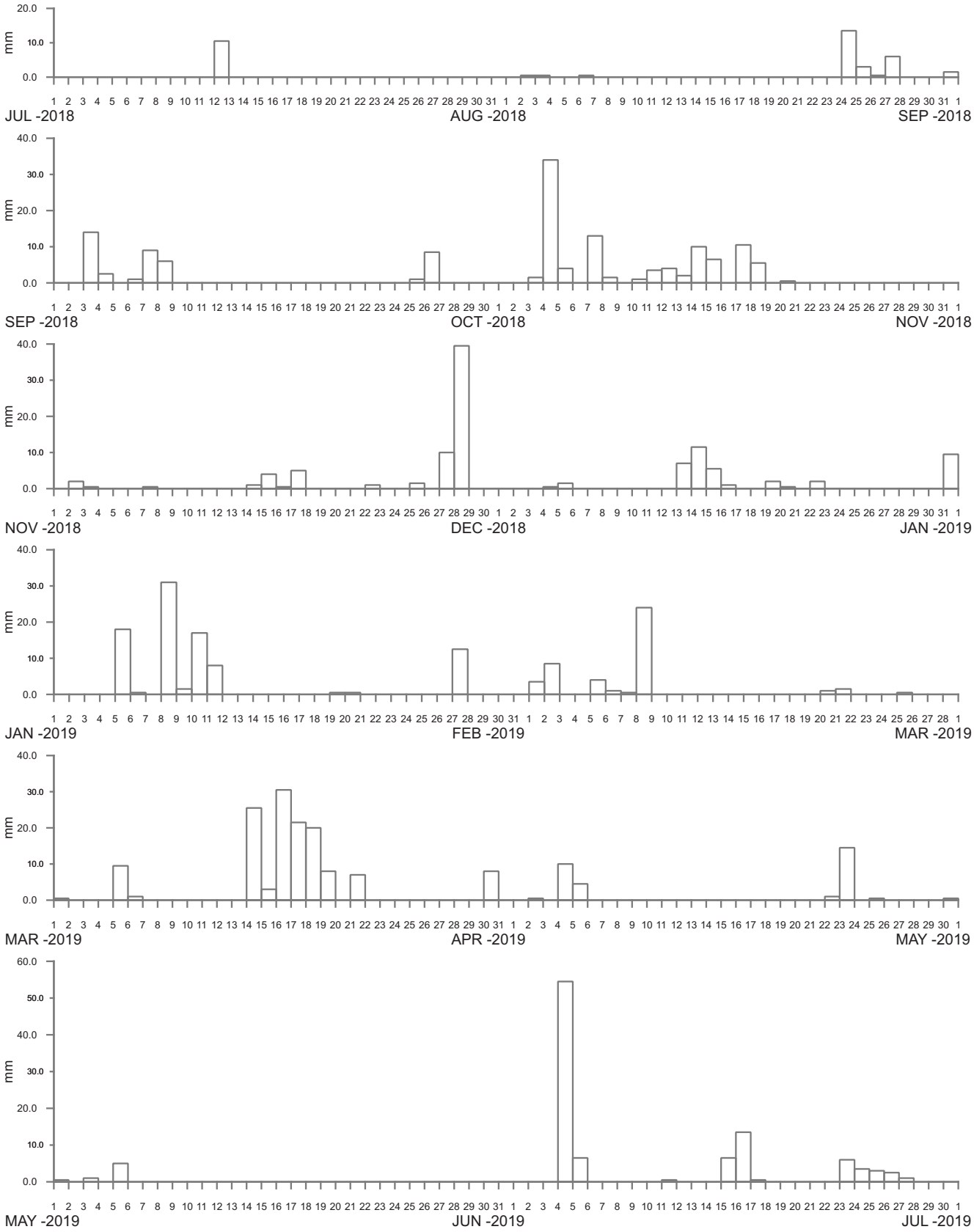
PORT KEMBLA AT FIVE ISLANDS ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 78

DRAWING 2694-78.cdr



DATA LOSS

NSW GOVERNMENT

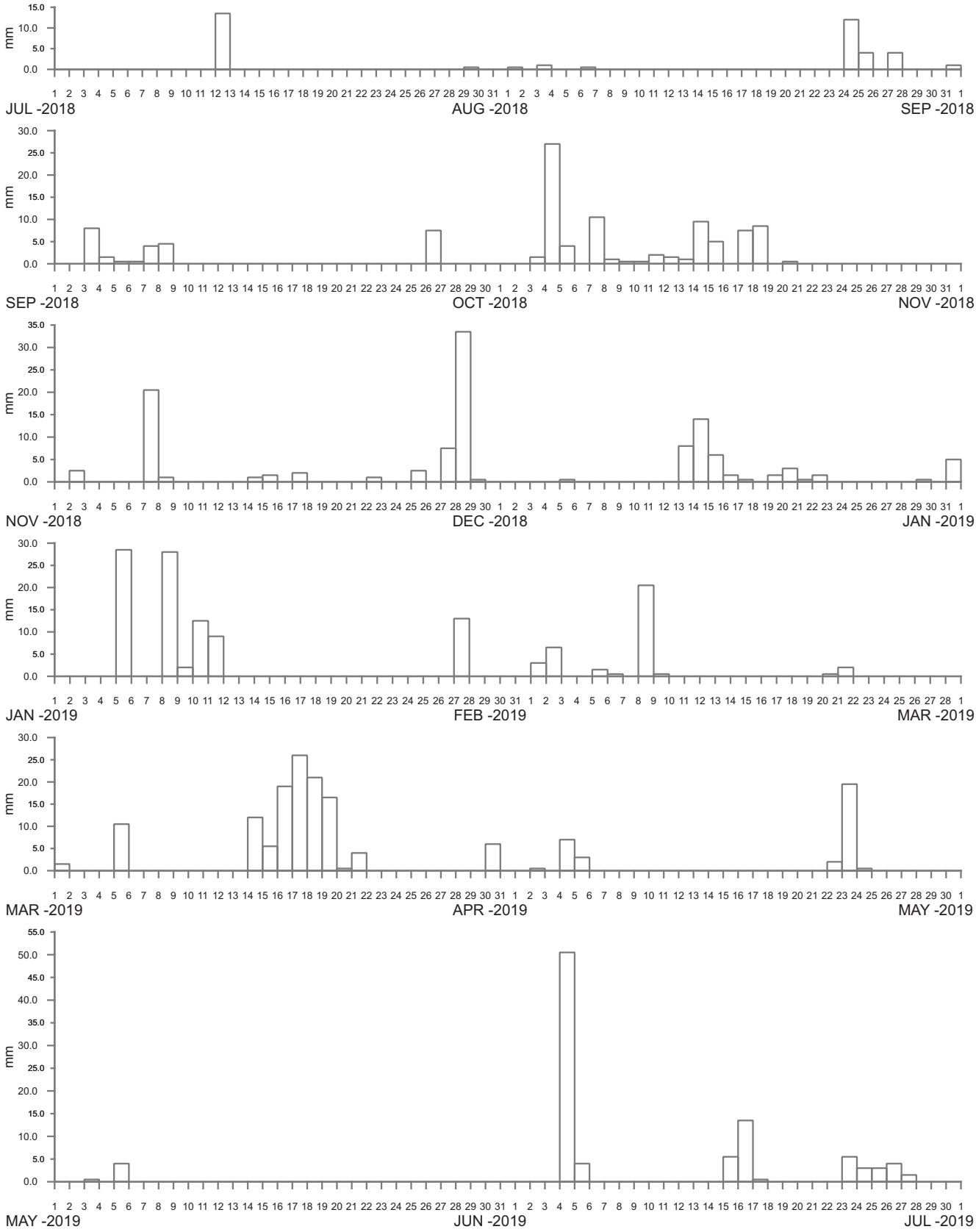
DARKES ROAD AT DAPTO
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 79

DRAWING 2694-79.cdr



DATA LOSS

NSW GOVERNMENT

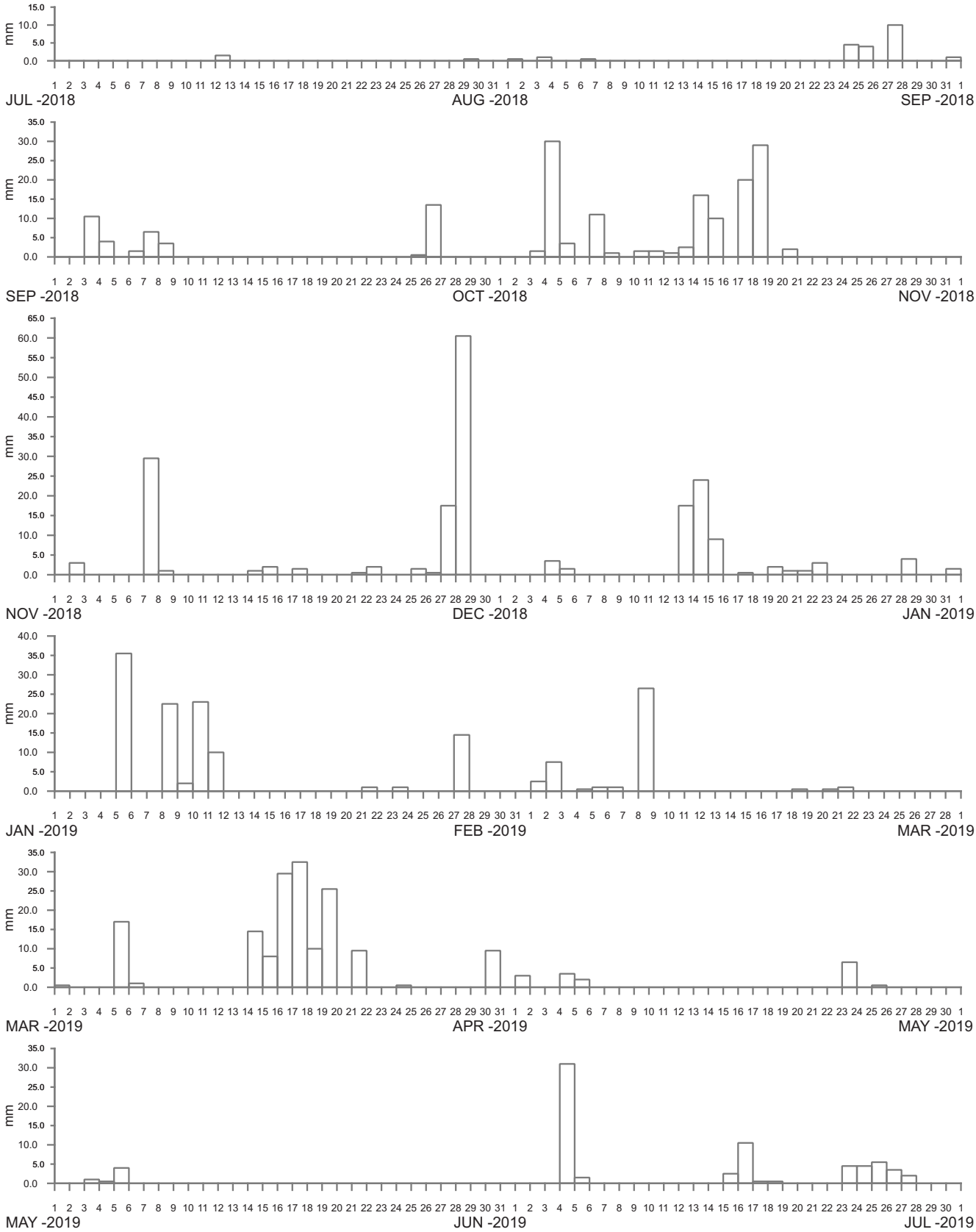
CLEVELAND ROAD AT CLEVELAND ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 80

DRAWING 2694-80.cdr



DATA LOSS

NSW GOVERNMENT

HUNTLEY COLLIERY AT AVONDALE ROAD
2018–2019

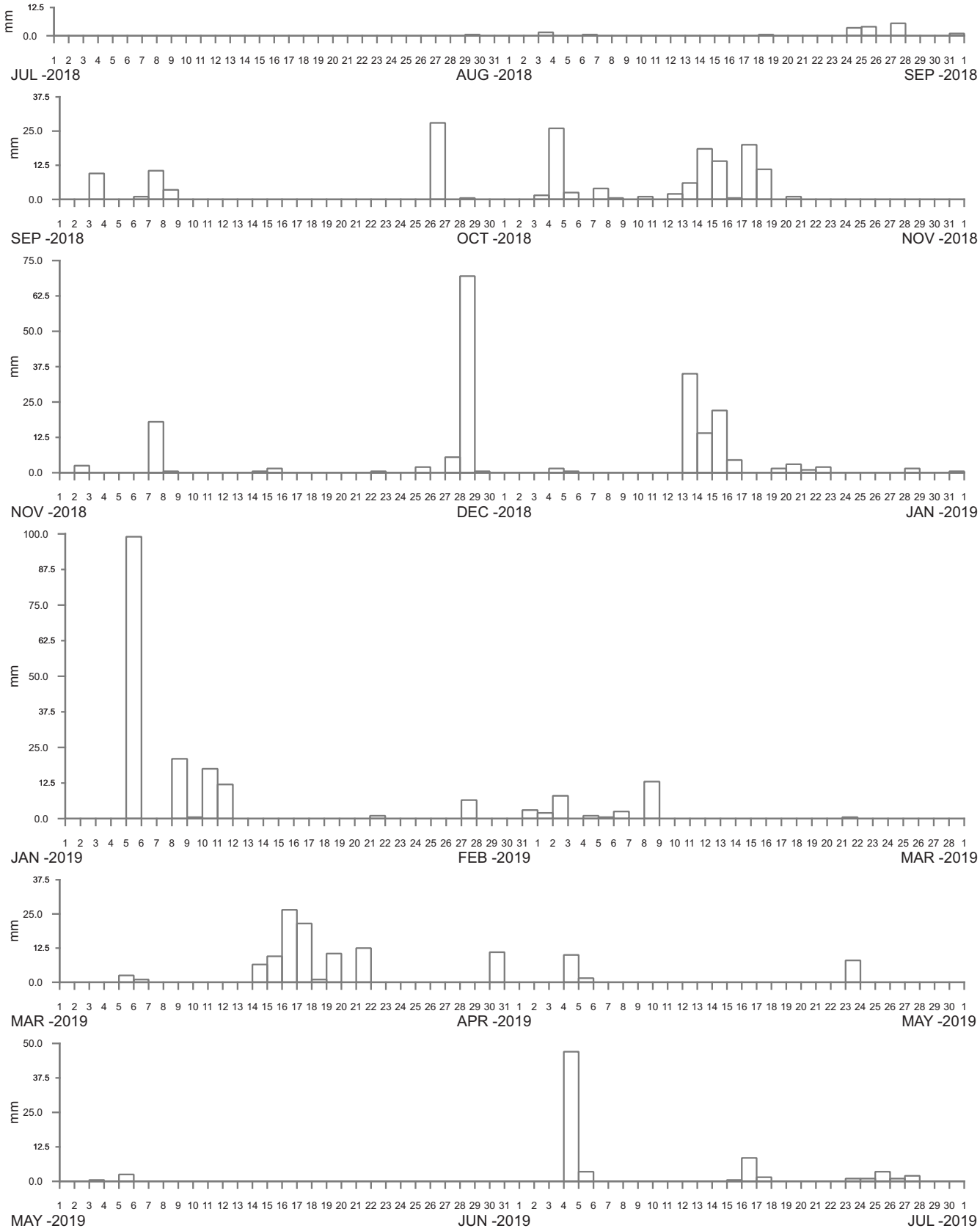
Manly Hydraulics Laboratory

Report MHL2694

Figure

81

DRAWING 2694-81.cdr



DATA LOSS

NSW GOVERNMENT

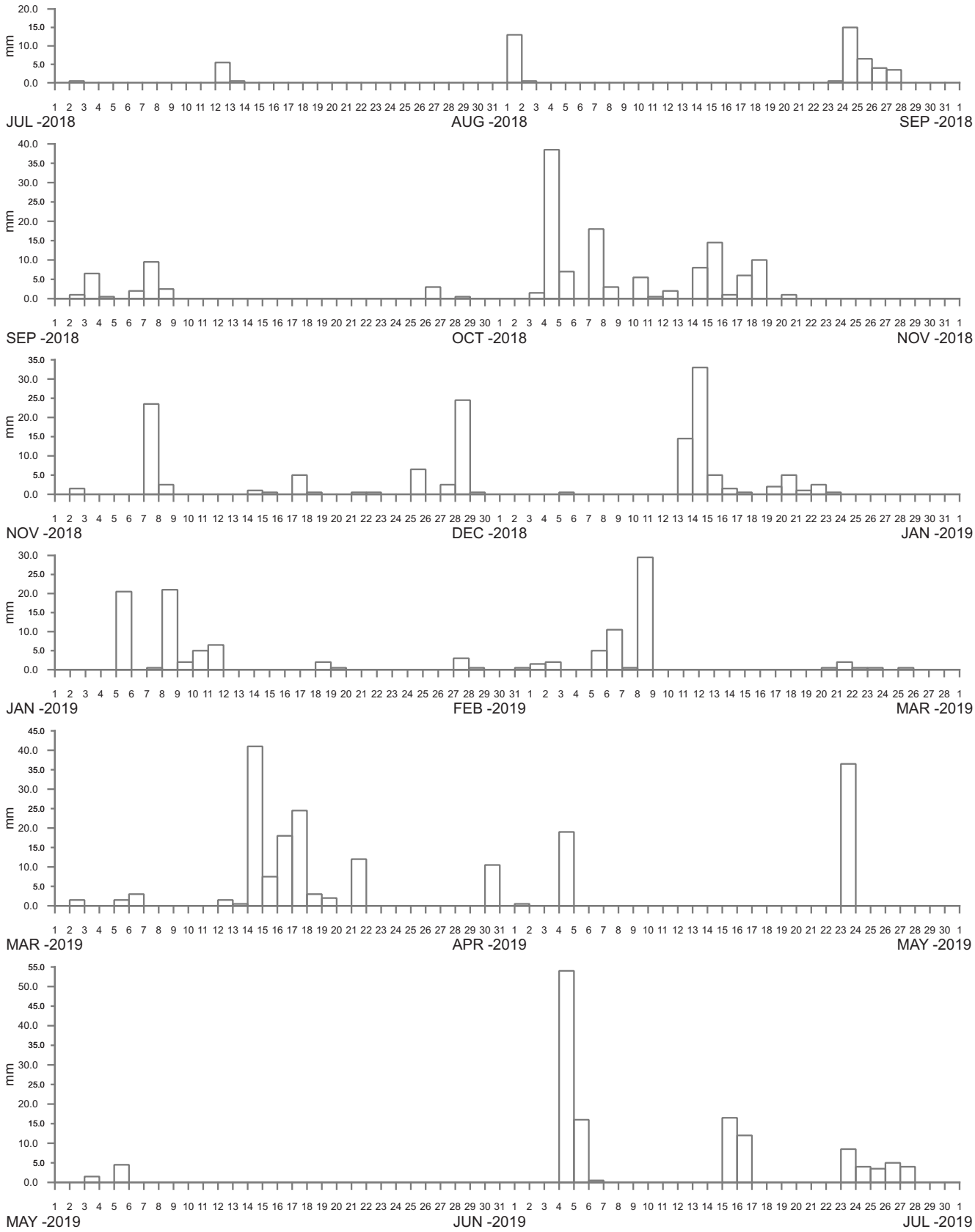
UPPER CALDERWOOD AT CALDERWOOD ROAD 2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 82

DRAWING 2694-82.cdr



DATA LOSS

NSW GOVERNMENT

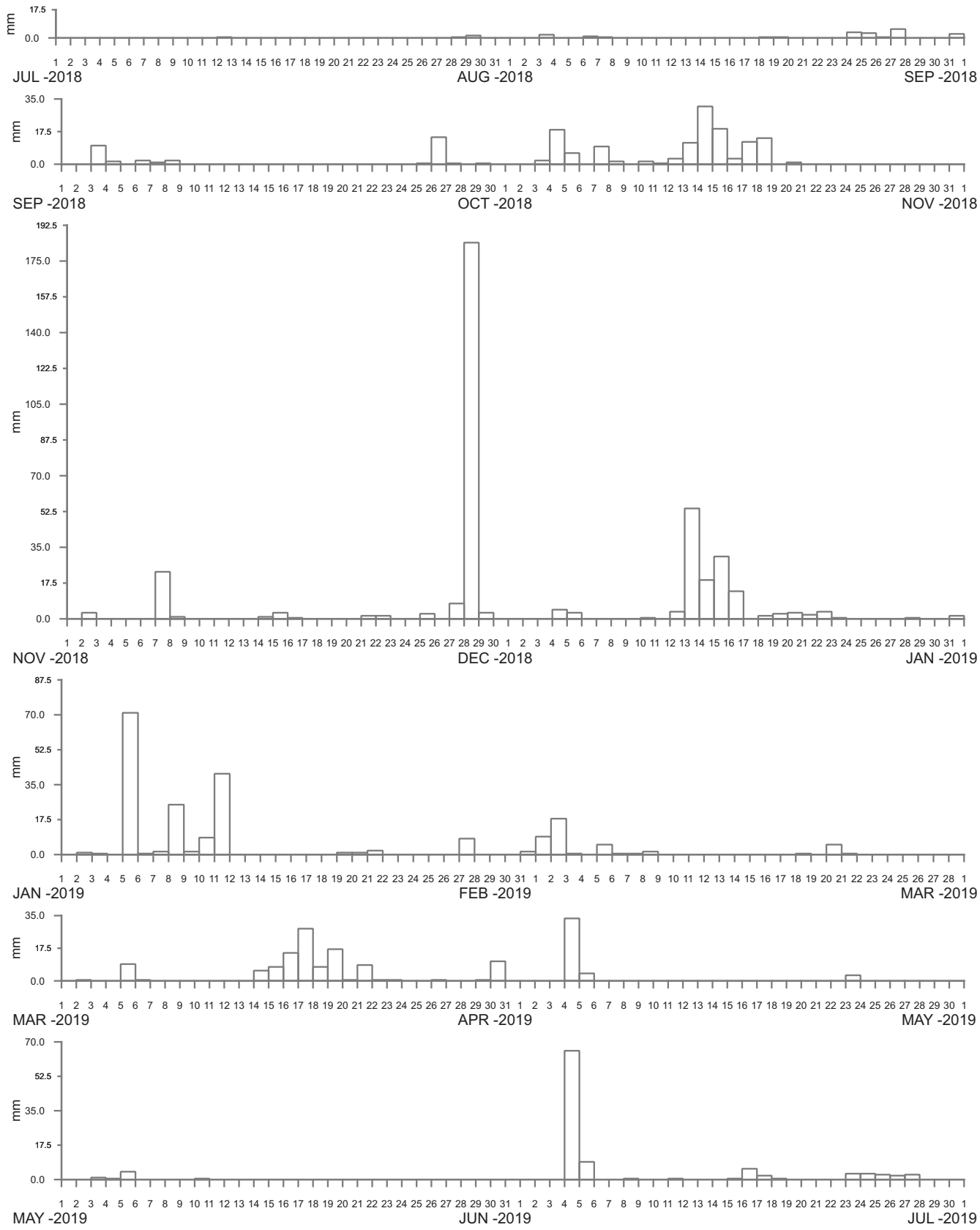
LITTLE LAKE ENTRANCE AT LITTLE LAKE
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 83

DRAWING 2694-83.cdr



NSW GOVERNMENT

NURREWIN AT ILLAWARRA HIGHWAY
2018–2019

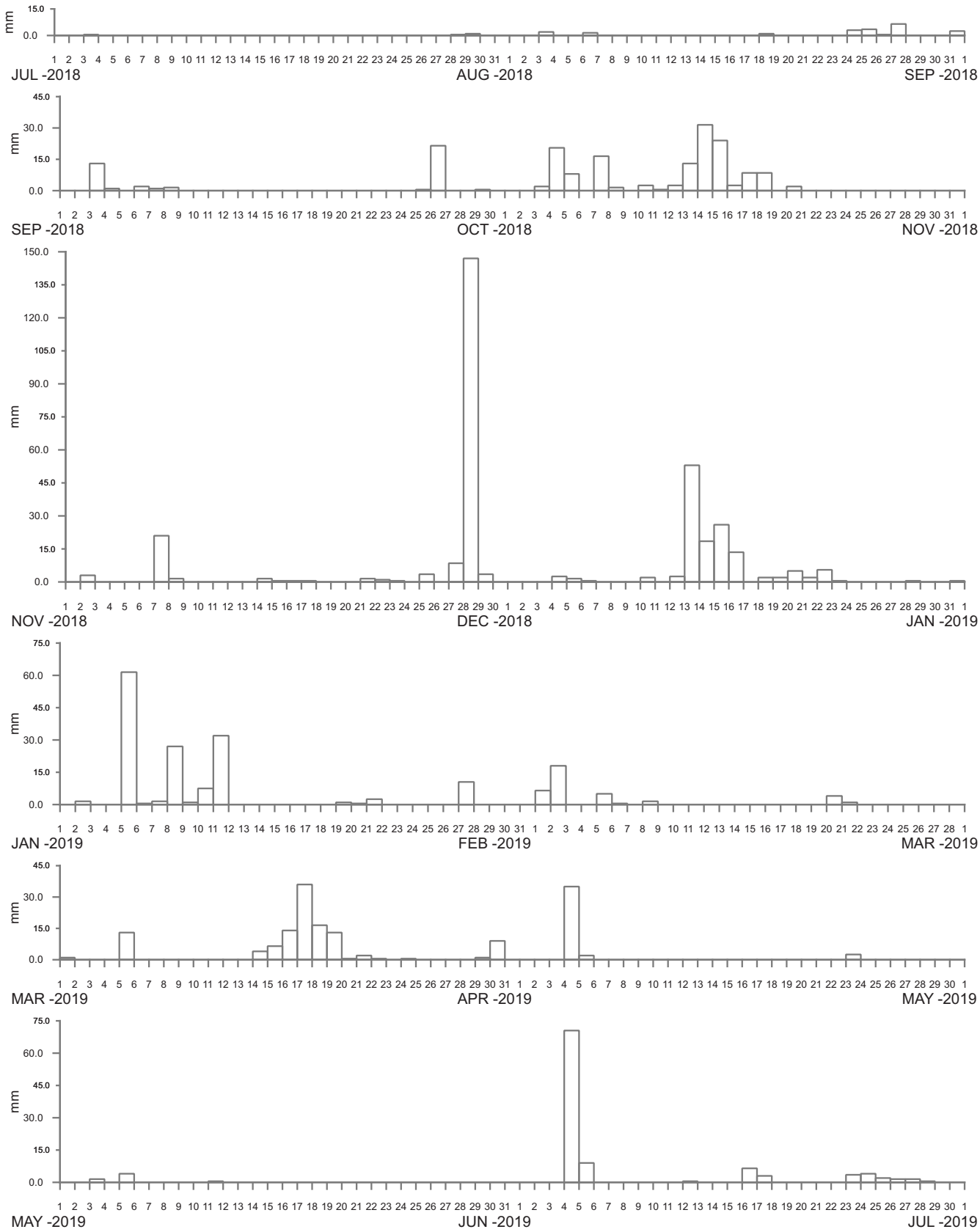
Manly Hydraulics Laboratory

Report MHL2694

Figure

84

DRAWING 2694-84.cdr



DATA LOSS

NSW GOVERNMENT

CLOVER HILL AT CLOVER HILL ROAD
2018–2019

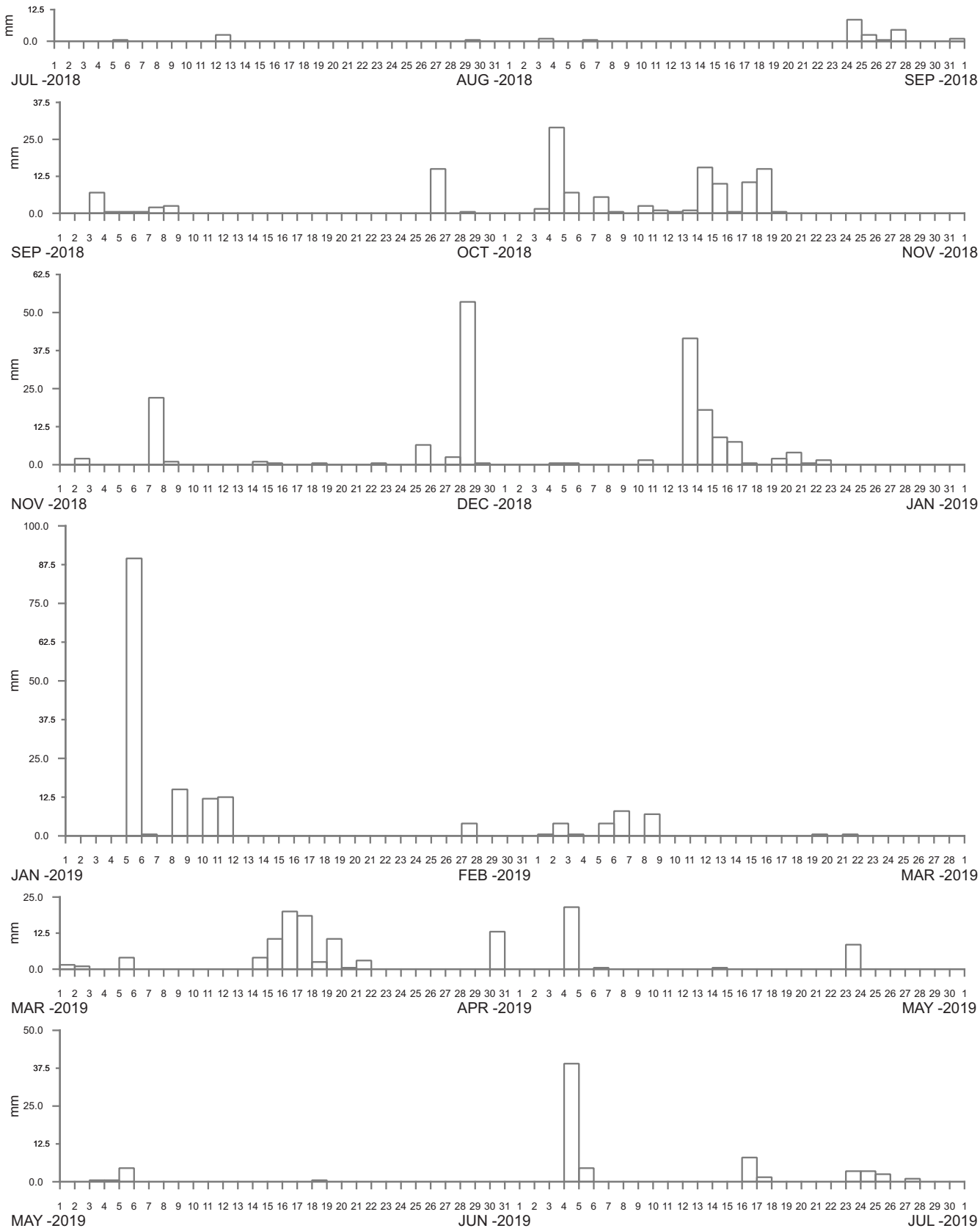
Manly Hydraulics Laboratory

Report MHL2694

Figure

85

DRAWING 2694-85.cdr



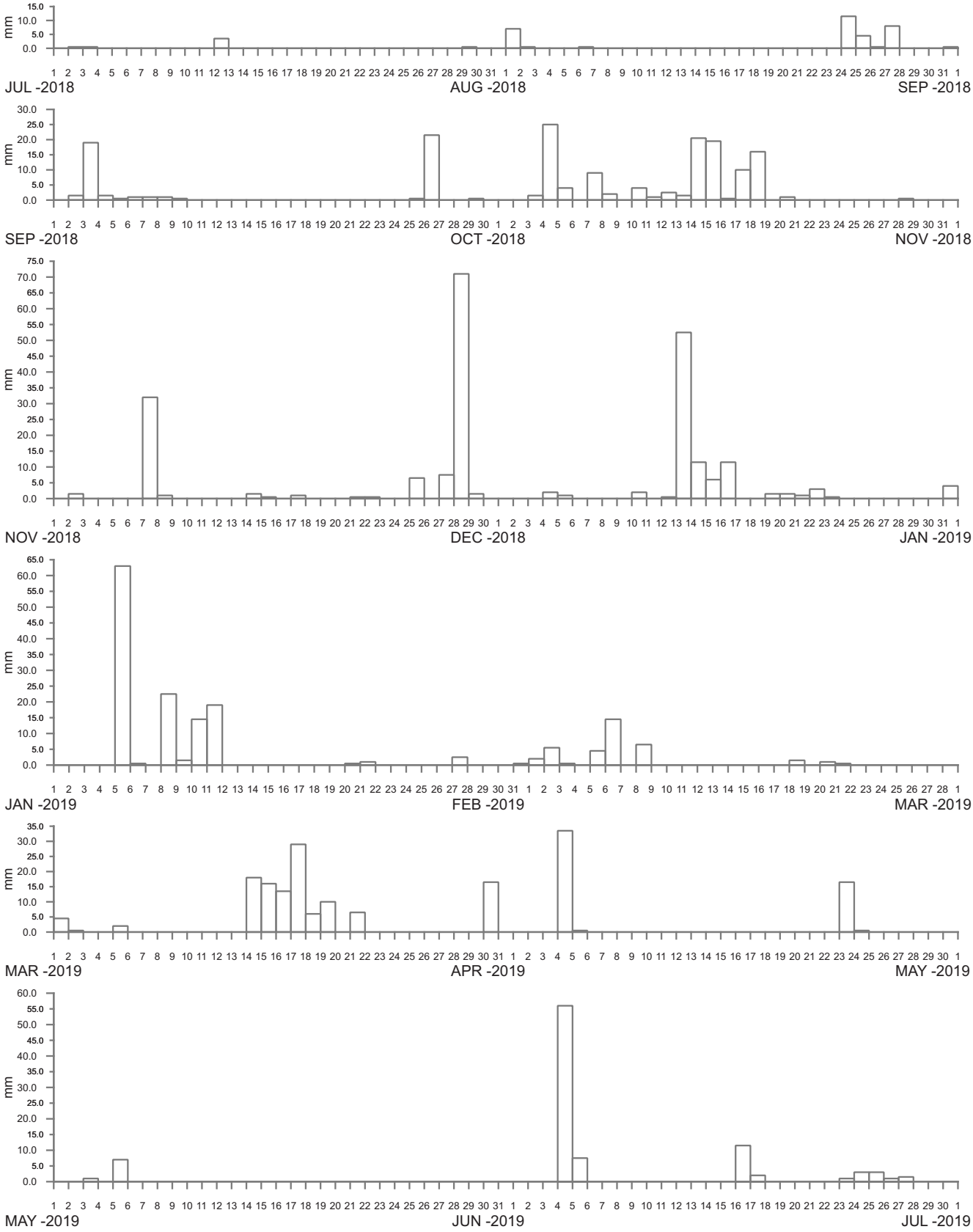
NORTH MACQUARIE AT NORTH MACQUARIE ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 86

DRAWING 2694-86.cdr



DATA LOSS

NSW GOVERNMENT

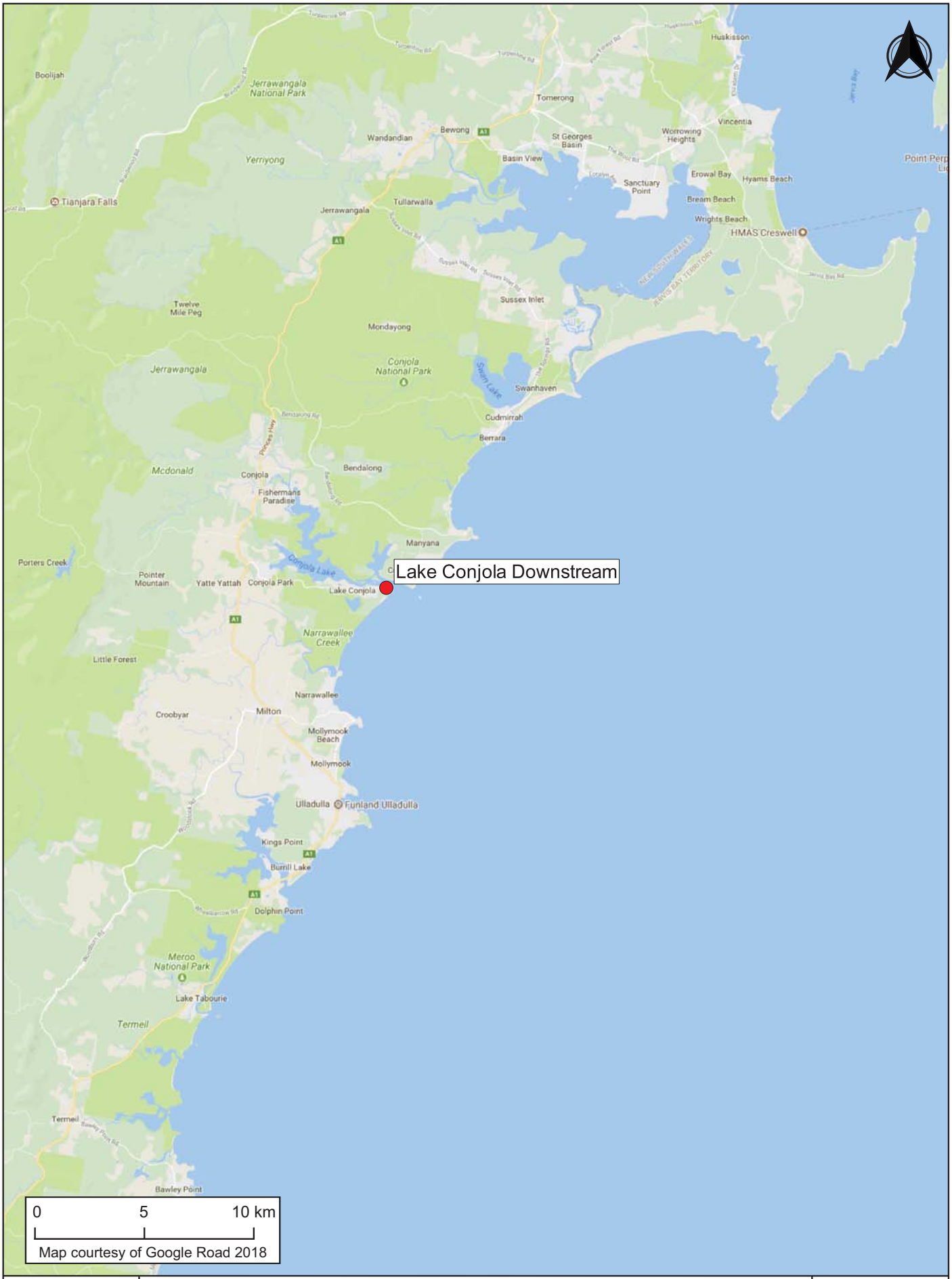
YELLOW ROCK ROAD AT YELLOW ROCK ROAD
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 87

DRAWING 2694-87.cdr



NSW GOVERNMENT

RAINFALL STATION LOCATIONS
SOUTH COAST (NORTH) REGION

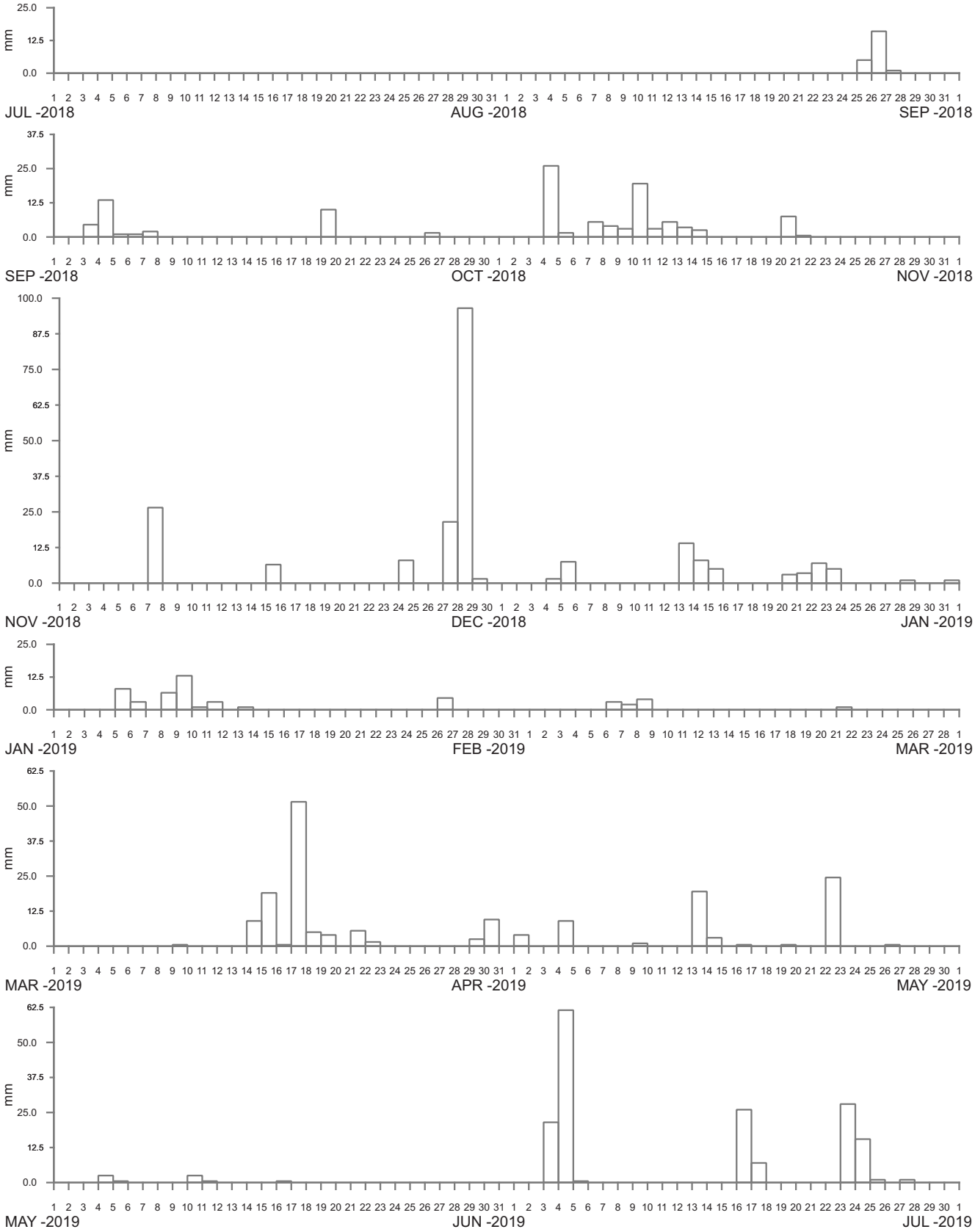
Manly Hydraulics Laboratory

Report MHL2694

Figure

88

DRAWING 2694-88.cdr



DATA LOSS

NSW GOVERNMENT

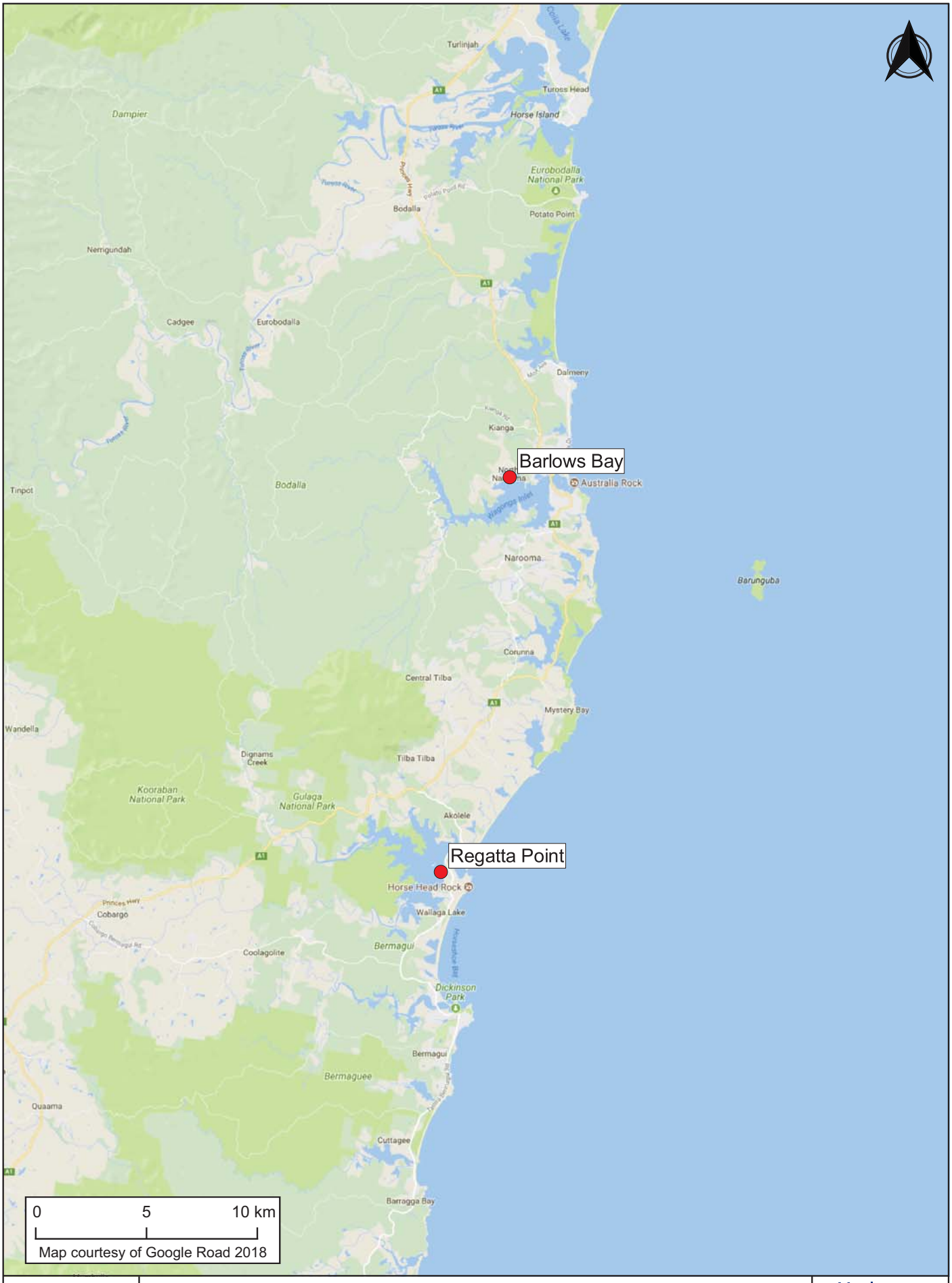
LAKE CONJOLA DOWNSTREAM AT CONJOLA LAKE 2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 89

DRAWING 2694-89.cdr



NSW GOVERNMENT

RAINFALL STATION LOCATIONS
SOUTH COAST (MID) REGION

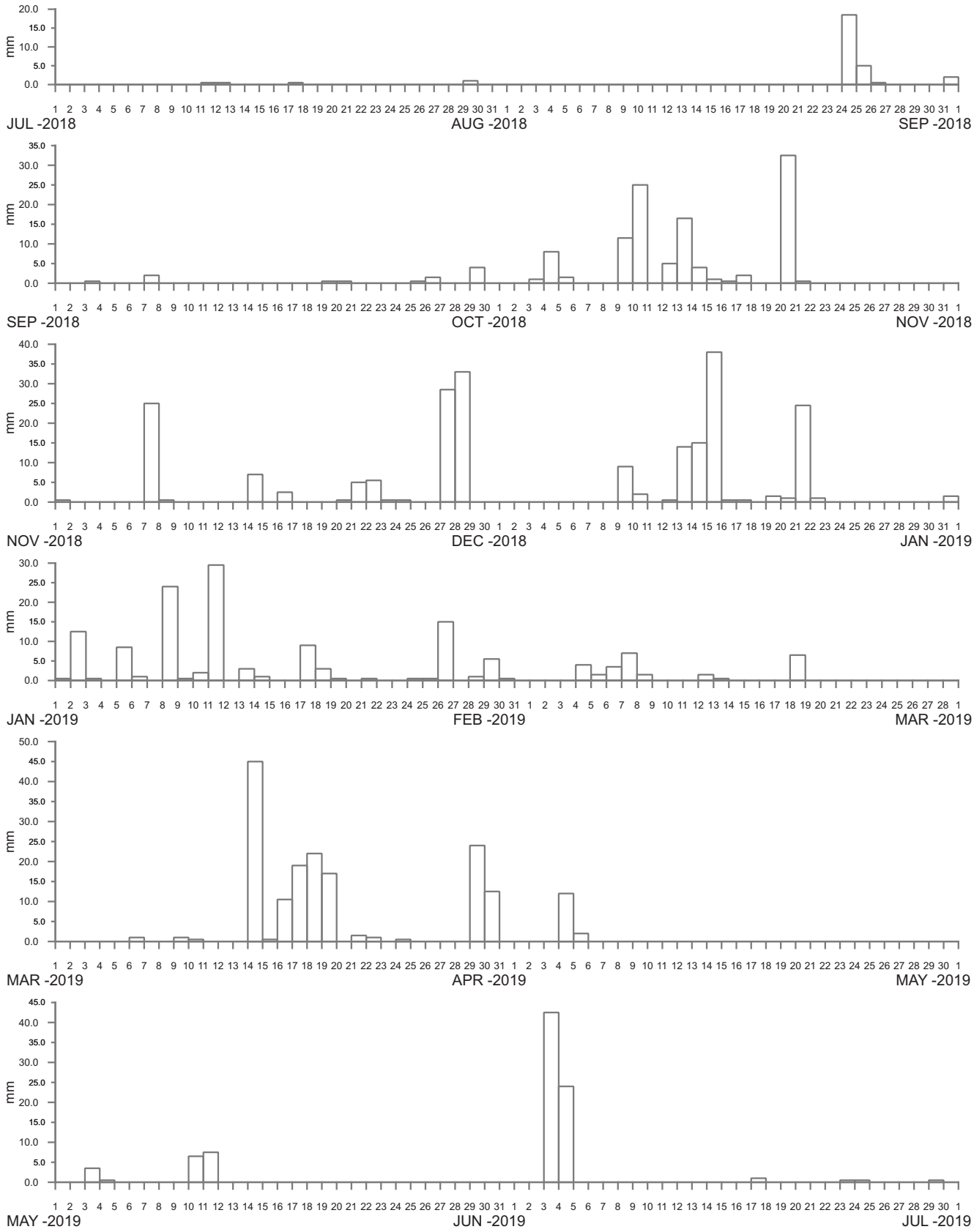
Manly Hydraulics Laboratory

Report MHL2694

Figure

90

DRAWING 2694-90.cdr



DATA LOSS

NSW GOVERNMENT

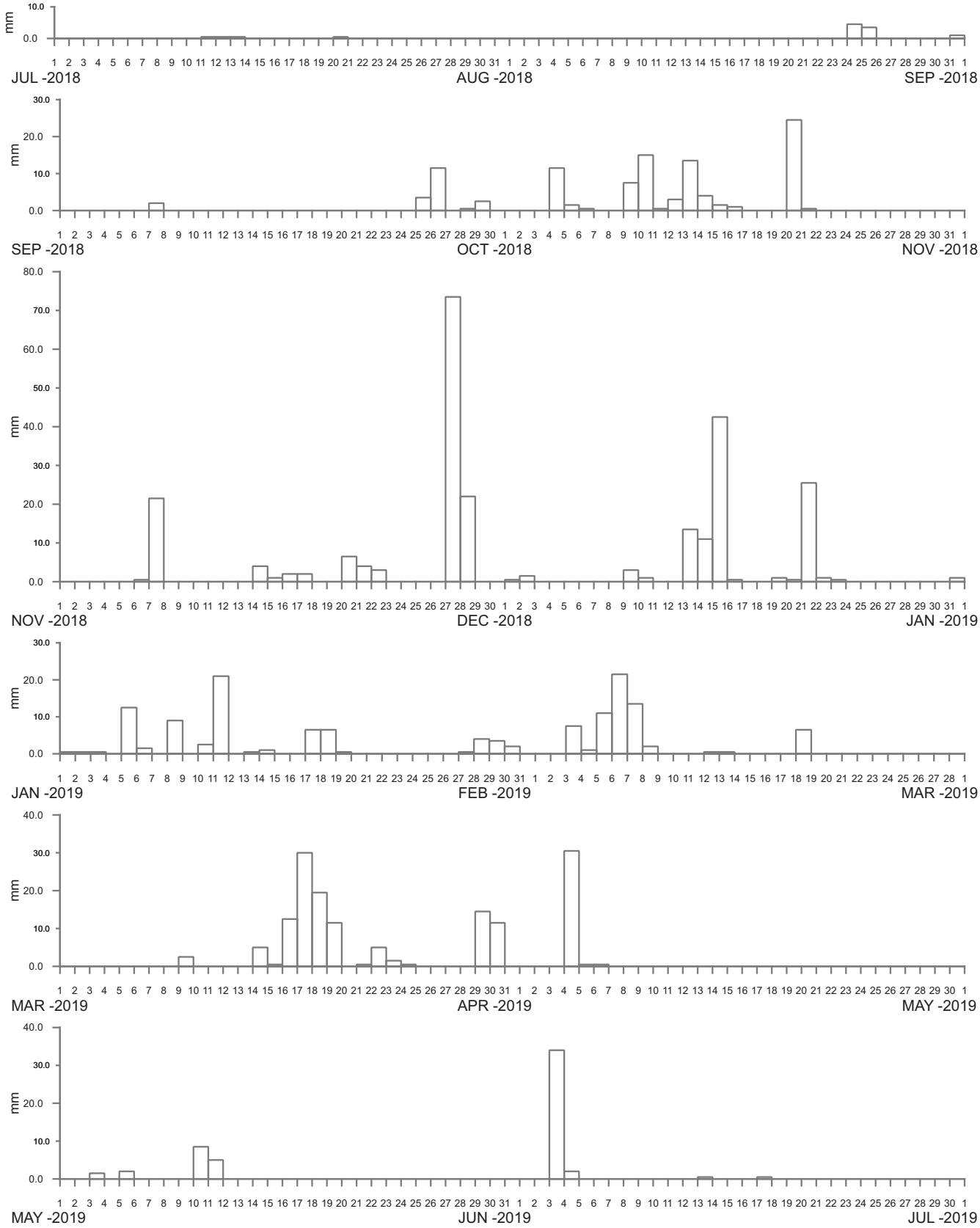
BARLOWS BAY AT WAGONGA INLET
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 91

DRAWING 2694-91.cdr



DATA LOSS

NSW GOVERNMENT

REGATTA POINT AT WALLAGA LAKE
2018–2019

Manly Hydraulics Laboratory

Report MHL2694

Figure 92

DRAWING 2694-92.cdr

Appendix A Station data online

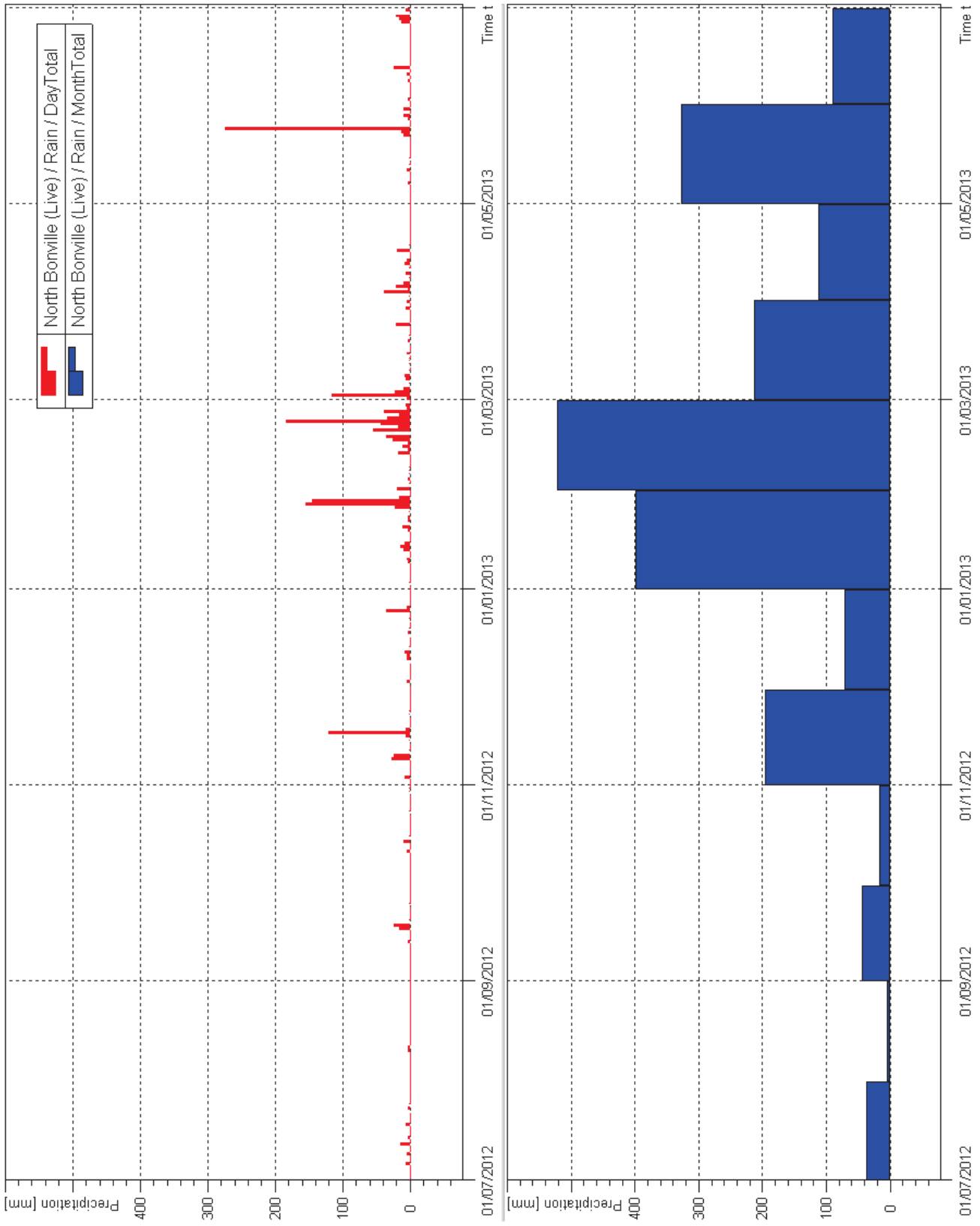
Table A1 Station data online

Region	Station	Period of data
Tweed	Cudgera	Aug 1983–ongoing
Brunswick	Main Arm	Sep 1983–ongoing
Brunswick	Huonbrook	May 1986–ongoing
Brunswick	Myocum	Feb 1986–ongoing
Richmond	Lake Ainsworth	Oct 1994–ongoing
Richmond	Empire Vale	May 1998–Jul 2000
Richmond	Wollongbar	Jul 1992–Jul 1994
Clarence	Yamba	Apr 2002–ongoing
Clarence	Wyndora	Jan 1990–Jun 1991
Clarence	Roberts Creek	May 1994–Jun 1996
Clarence	Shannon Creek	Nov 2000–May 2008
Bellinger	Wooli Caravan Park	Jun 1997–ongoing
Bellinger	Perry Drive	Dec 1998–ongoing
Bellinger	Shephards Lane	Dec 1998–ongoing
Bellinger	Red Hill	Nov 1998–ongoing
Bellinger	Newports Creek	Dec 1990–ongoing
Bellinger	Middle Boambee	Dec 1990–ongoing
Bellinger	South Boambee	Apr 1991–April 2015
Bellinger	North Bonville	Dec 1990–ongoing
Bellinger	Gleniffer	Aug 1993–Feb 2007
Bellinger	Bellinger Council	Apr 1993–Jun 2001
Bellinger	Kooroowi	May 1991–ongoing
Bellinger	Thora	Feb 1993–ongoing
Nambucca	Bowraville	Jun 1993–Oct 2001
Nambucca	Stuarts Island Downstream	Oct 1998–ongoing
Nambucca	Utungun	Nov 1991–ongoing
Macleay	Euroka Upstream	Jul 1990–June 2011
Macleay	Aldavilla Downstream	Dec 2011–ongoing
Maria	Green Valley	Sep 1994–ongoing
Hastings	Telegraph Point	Nov 1990–ongoing
Hastings	Lake Cathie	Aug 1993–Jun 2001
Hastings	Ellenborough	Jun 1991–Sep 1999
Camden Haven	Logans Crossing	Dec 1989–ongoing
Manning	Mount George	Mar 1991–ongoing
Karuah	Nabiac	Jun 1983–ongoing
Karuah	Tuncurry	Aug 2002– Feb 2018
Karuah	Tuncurry Downstream	Jun 2016-ongoing
Karuah	Tiona	Jun 2002–Sep 2015
Karuah	Pacific Palms Wharf	Oct 2013–ongoing
Karuah	Tarbuck Bay	May 1996–ongoing
Karuah	Bulahdelah	Aug 1996–ongoing
Hunter	Gostwyck	Oct 1999–ongoing
Hunter	Seaham	Sep 1999–ongoing
Hunter	Hexham Bridge	May 1998–ongoing
Hunter	Belmore Bridge	Sep 1995–ongoing

Region	Station	Period of data
Hunter	Cardiff	Mar 1991–Dec 1995
Macquarie-Tuggerah Lakes	Barnsley	Jan 1988–ongoing
Macquarie-Tuggerah Lakes	Fassifern	Jan 1992–Dec 1997
Macquarie-Tuggerah Lakes	Dora Creek	May 1992–Jul 1999
Macquarie-Tuggerah Lakes	Martinsville	Mar 1988–ongoing
Macquarie-Tuggerah Lakes	Mandalong	Dec 1988–ongoing
Macquarie-Tuggerah Lakes	Wyee	May 1992–ongoing
Macquarie-Tuggerah Lakes	Whitemans Ridge	Apr 1989–ongoing
Macquarie-Tuggerah Lakes	Yarramalong	Nov 1988–ongoing
Macquarie-Tuggerah Lakes	Kulnura	Jun 1989–ongoing
Macquarie-Tuggerah Lakes	Toukley	Feb 1985–ongoing
Macquarie-Tuggerah Lakes	Warnervale	Jan 1986–Apr 2010
Macquarie-Tuggerah lakes	Hamlyn Terrace	Mar 2010–ongoing
Macquarie-Tuggerah Lakes	Wyong Weir Upstream	Jan 1986–Apr 2008
Macquarie-Tuggerah Lakes	Wyong	Jan 1986–Apr 1991
Macquarie-Tuggerah Lakes	Kangy Angy	Aug 2010–ongoing
Macquarie-Tuggerah Lakes	Chittaway	Dec 1989–Aug 2010
Macquarie-Tuggerah Lakes	Berkeley Vale	Jun 1988–ongoing
Macquarie-Tuggerah Lakes	Mardi Dam	Oct 1988–ongoing
Macquarie-Tuggerah Lakes	Sterland	Apr 1989–ongoing
Macquarie-Tuggerah Lakes	Long Jetty	Sept 1992–Sept 1998
Macquarie-Tuggerah Lakes	Bateau Bay	Jan 1980–ongoing
Macquarie-Tuggerah Lakes	Lisarow	Apr 1989–ongoing
Brisbane Water	Strickland	Dec 1985–ongoing
Brisbane Water	Narara	Apr 1989–ongoing
Brisbane Water	Mount Elliot	Dec 1985–ongoing
Brisbane Water	Wyoming	Oct 1988–ongoing
Brisbane Water	Kincumber	May 1987–ongoing
Hawkesbury	Webbs Creek	Jul 1999–ongoing
Hawkesbury	Colo Junction	Jul 1999–ongoing
Hawkesbury	Sackville Downstream	Jun 1999–ongoing
Hawkesbury	Woy Woy	Jul 1991–Jul 1996
Hawkesbury	Brooklyn	Apr 1991–Dec 1995
Hawkesbury	Cowan	Jun 1991–Dec 1995
Hawkesbury	Penrith	Dec 1994–Jan 1995
Hawkesbury	Narellan Creek	Jan 1994–Sep 1996
Hawkesbury	Camden Life Centre	Mar 1994–Sep 1996
Hawkesbury	Mt Annan School	Feb 1994–Sep 1996
Blue Mountains	Mount Boyce	Nov 1992–Feb 1995
Blue Mountains	Clarence	Nov 1992–Feb 1995
Blue Mountains	Zig Zag	Nov 1992–Feb 1995
Sydney Coastal	Kuringai	Jan 1991–Sep 1996
Sydney Coastal	Wahroonga	Nov 1990–Dec 1995
Sydney Coastal	Beecroft	Sep 1992–Jul 1996
Sydney Coastal	Avalon	Jun 1994–ongoing
Sydney Coastal	Mona Vale	Jun 1994–ongoing
Sydney Coastal	Narrabeen Creek	May 1998–Sep 2010
Sydney Coastal	Middle Creek	Apr 1995–ongoing
Sydney Coastal	Cromer	Mar 1994–ongoing
Sydney Coastal	Belrose	May 1994–ongoing

Region	Station	Period of data
Sydney Coastal	Allambie	Jun 1999–ongoing
Sydney Coastal	Balgowlah	Aug 1999–Jul 2005
Sydney Coastal	Curl Curl	Feb 2014–ongoing
Sydney Coastal	North Manly	May 1995–ongoing
Sydney Coastal	Manly Dam	Nov 1995–ongoing
Sydney Coastal	Chatswood	Sep 1992–Jul 1996
Sydney Coastal	Denistone	Jan 1990–Jun 1996
Sydney Coastal	M4 Motorway	Jun 1993–Dec 1995
Sydney Coastal	Homebush Bay	Feb 1993–Mar 1994
Sydney Coastal	Kelso Creek	Nov 1996–ongoing
Wollongong Coastal	Bulli Pass	Jan 1983–Oct 1998
Wollongong Coastal	Rixons Pass	Jun 1985–ongoing
Wollongong Coastal	Russell Vale	Jul 1982–ongoing
Wollongong Coastal	Corrimal Colliery	Jun 1985–Dec 1993
Wollongong Coastal	Mount Pleasant	Jun 1997–ongoing
Wollongong Coastal	Mount Nebo	Nov 1982–Feb 1997
Wollongong Coastal	Mount Kembla	Jun 1985–ongoing
Wollongong Coastal	Dombarton Loop	Jun 1985–ongoing
Wollongong Coastal	Wongawilli	Jan 1983–ongoing
Wollongong Coastal	Port Kembla BHP	Jan 1993–ongoing
Wollongong Coastal	Port Kembla	Sep 1982–ongoing
Wollongong Coastal	Darkes Road	Feb 1994–ongoing
Wollongong Coastal	Cleveland Road	Jun 1985–ongoing
Wollongong Coastal	Huntley Colliery	Jan 1983–ongoing
Wollongong Coastal	Calderwood	Jan 1983–Jun 1985
Wollongong Coastal	Upper Calderwood	Jun 1985–ongoing
Wollongong Coastal	Little Lake	May 1992–Oct 2014
Wollongong Coastal	Little Lake Entrance	May 2014–ongoing
Wollongong Coastal	Airport	Jun 1991–Mar 1995
Wollongong Coastal	North Macquarie	Jul 1985–ongoing
Wollongong Coastal	Clover Hill	Dec 1985–ongoing
Wollongong Coastal	Nurrewin	Jan 2006–ongoing
Wollongong Coastal	Yellow Rock Road	Jan 1983–ongoing
Wollongong Coastal	Balgownie	Jul 1982–Jun 1987
Wollongong Coastal	Woonona	Jul 1982–Jun 1985
South Coast	Lake Wollumboola	Feb 1999–Oct 2000
South Coast	Lake Conjola Downstream	Jul 2016–ongoing
South Coast	Lake Conjola	Jan 1999–Jul 2017
South Coast	Barlows Bay (Narooma)	Jul 1999–ongoing
South Coast	Regatta Point	Jan 1999–ongoing
South Coast	Merimbula Wharf	Aug 1997–Sep 2001
South Coast	Agnew Wharf	Aug 1997–Jun 2000

Appendix B Sample rainfall data outputs



NSW GOVERNMENT

SAMPLE DAILY AND MONTHLY RAINFALL PLOTS

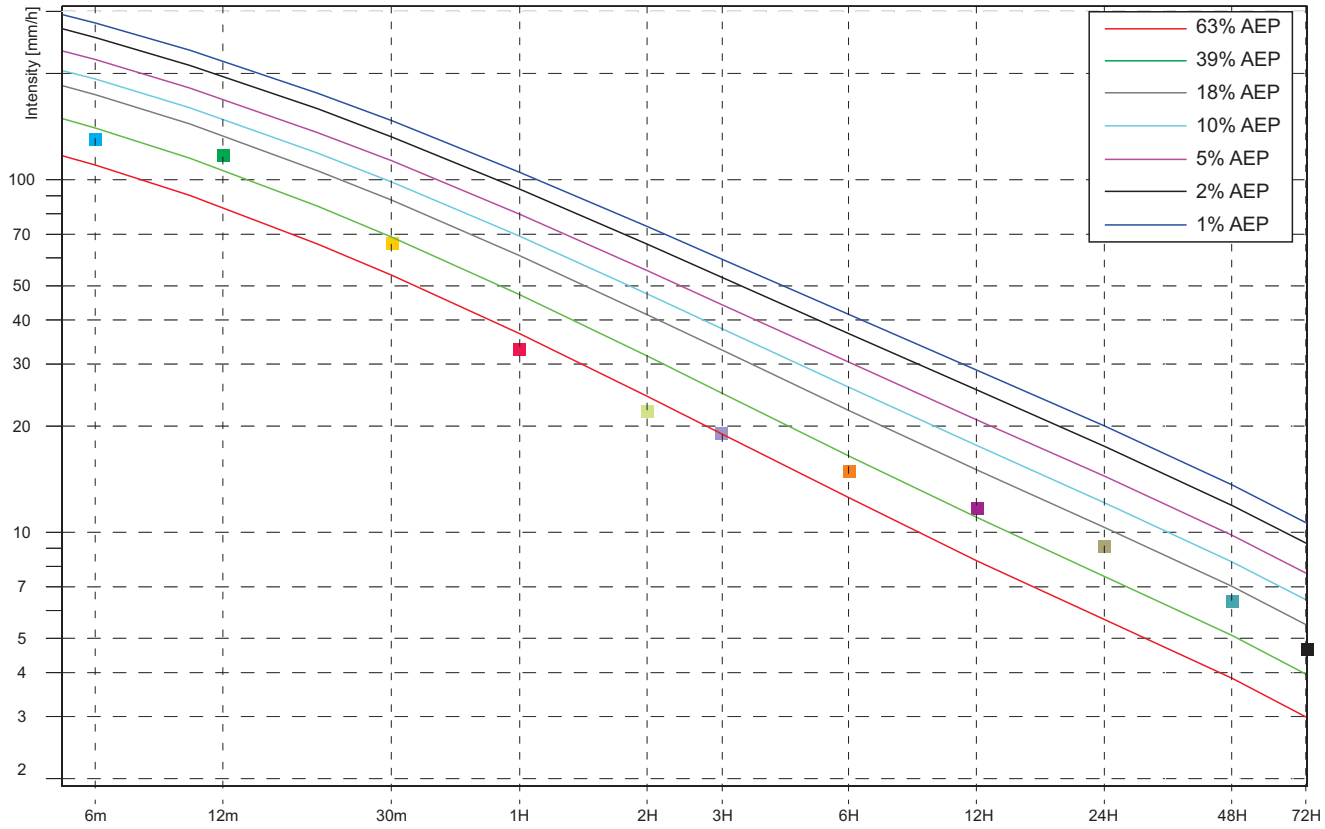
Manly Hydraulics Laboratory

Report MHL2694

Figure

B1

DRAWING 2694-B1.cdr



Reference: Australian Rainfall and Runoff 1987

North Bonville Rainfall Intensity 21 January-21 March 2013		
Duration (minutes: m) (hours: H)	**Intensity (mm/hr)**	**Time/Date**
6m	130.00	17:14_17/02/2013
12m	117.50	17:14_17/02/2013
30m	66.00	17:26_17/02/2013
1H	33.00	17:26_17/02/2013
2H	22.00	14:44_22/02/2013
3H	19.00	14:42_22/02/2013
6H	14.83	16:40_22/02/2013
12H	11.67	19:56_22/02/2013
24H	9.08	11:12_28/01/2013
48H	6.35	21:46_28/01/2013
72H	4.64	05:54_29/01/2013

Australian Rainfall and Runoff (Institute of Engineers Australia 1987) states:

Use of the terms 'recurrence interval' and 'return period' has been criticised as leading to confusion in the minds of some decision-makers and members of the public. Although the terms are simple superficially, they are sometimes misinterpreted as implying that the associated magnitude is only exceeded at regular intervals, and that they are referring to the elapsed time to the next exceedance.

The use of the term 'Average Recurrence Interval' (ARI) can lead to confusion. It is preferable, therefore, to express the rarity of a rainfall event in terms of Annual Exceedance Probability (AEP). For example, 'a rainfall total of 60mm falling in 3 hours at Cudgera has a 0.010 (i.e. 1%) probability of being equalled or exceeded in any one year' can be easier to understand than the equivalent statement of 'rainfall total of 60mm in 3 hours has an ARI of 100 years'.

Adapted from: http://www.bom.gov.au/water/designRainfalls/ifd/glossary.shtml

NSW GOVERNMENT

SAMPLE INTENSITY-FREQUENCY-DURATION FORMULATED IN 1987

Manly Hydraulics Laboratory

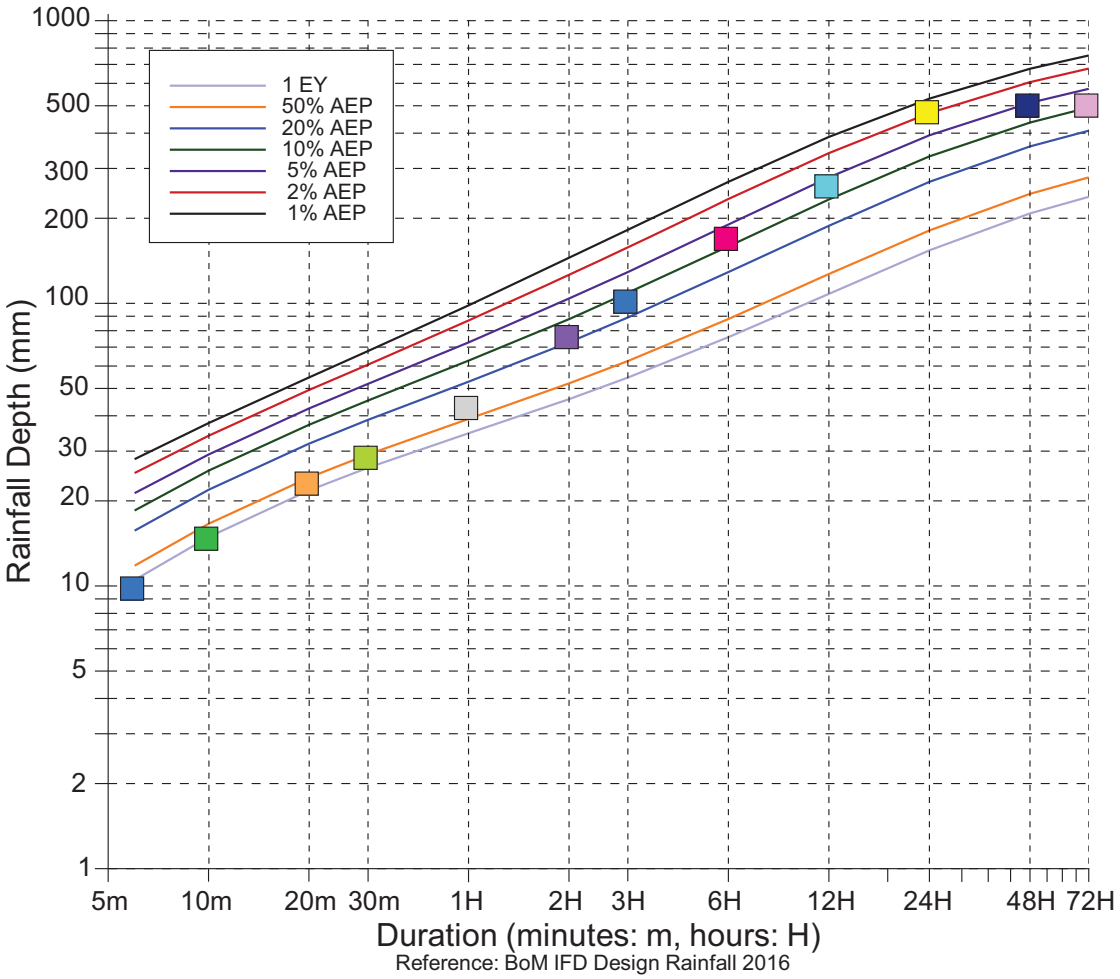
Report MHL2694

Figure B2

DRAWING 2694-B2.cdr

Site Owner: OEH/MHL Latitude: -28.5521 Longitude: 153.3856

AEP = Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2016

Duration (minutes:m) (Hours: H)	Rainfall Depth (mm)	Time/Date
6m	10.0	05:12_15/03/2017
10m	15.0	05:12_15/03/2017
20m	23.5	05:10_15/03/2017
30m	29.0	03:14_30/03/2017
1H	43.5	23:04_30/03/2017
2H	77.5	22:32_30/03/2017
3H	103.5	21:32_30/03/2017
6H	172.5	18:50_30/03/2017
12H	264.5	01:22_30/03/2017
24H	484.0	01:18_30/03/2017
48H	511.0	18:00_29/03/2017
72H	511.0	18:00_29/03/2017

The probability terminology used for the 2016 design rainfalls is consistent with the probability terminology for the new edition of Australian Rainfall and Runoff (ARR2016). Further details on the new probability terminology can be found in Book 1; Chapter 2; Section 2.2 Terminology of ARR2016 http://arr.ga.gov.au/arr-guideline.The main terms used to describe design rainfalls are:
- *Exceedances per year (EY):* the number of times an event is likely to occur or be exceeded within any given year.
- *Annual exceedance probability (AEP):* the probability or likelihood of an event occurring or being exceeded within any given year, usually expressed as a percentage.
For further information refer to BoM frequently asked questions: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

NSW GOVERNMENT

SAMPLE INTENSITY-FREQUENCY-DURATION FORMULATED IN 2016

Manly Hydraulics Laboratory

Report MHL2694

Figure B3

DRAWING 2694-B3.cdr

Station Name	North Bonville (Live)
Station Number	559050
MGA Easting (m zone 56)	500592.91
MGA Northing (m zone 56)	6641143.16

Date	Time	Value [mm]	State of value
26/01/2013	2:35:17	0.5	5 (Very Good)
26/01/2013	2:40:12	0.5	5 (Very Good)
26/01/2013	4:04:04	0.5	5 (Very Good)
26/01/2013	4:04:53	0.5	5 (Very Good)
26/01/2013	4:07:48	0.5	5 (Very Good)
26/01/2013	5:56:18	0.5	5 (Very Good)
26/01/2013	5:57:42	0.5	5 (Very Good)
26/01/2013	5:59:16	0.5	5 (Very Good)
26/01/2013	6:00:32	0.5	5 (Very Good)
26/01/2013	6:01:22	0.5	5 (Very Good)
26/01/2013	6:02:22	0.5	5 (Very Good)
26/01/2013	12:20:33	0.5	5 (Very Good)
26/01/2013	12:20:51	0.5	5 (Very Good)
26/01/2013	12:21:32	0.5	5 (Very Good)
26/01/2013	12:22:02	0.5	5 (Very Good)
26/01/2013	12:22:42	0.5	5 (Very Good)
26/01/2013	12:23:49	0.5	5 (Very Good)
26/01/2013	12:24:37	0.5	5 (Very Good)
26/01/2013	12:25:42	0.5	5 (Very Good)
26/01/2013	12:35:17	0.5	5 (Very Good)
26/01/2013	19:16:58	0.5	5 (Very Good)
26/01/2013	19:49:01	0.5	5 (Very Good)
26/01/2013	19:51:13	0.5	5 (Very Good)
26/01/2013	21:12:07	0.5	5 (Very Good)
26/01/2013	21:55:36	0.5	5 (Very Good)
26/01/2013	22:01:34	0.5	5 (Very Good)
26/01/2013	22:05:28	0.5	5 (Very Good)
26/01/2013	22:10:31	0.5	5 (Very Good)
26/01/2013	22:12:16	0.5	5 (Very Good)
26/01/2013	22:13:47	0.5	5 (Very Good)
26/01/2013	22:15:34	0.5	5 (Very Good)
26/01/2013	22:17:57	0.5	5 (Very Good)

Appendix C Publications of interest

Data Reports

MHL Annual Coastal Rainfall Summaries available:

MHL Report Nos. 610 (90–91), .624 (91–92), 660 (92–93), 699 (93–94), 730 (94–95), 776 (95–96), 874 (96–97), 946 (97–98), 1015 (98–99), 1071 (99–00), 1131 (00–01), 1207 (01–02), 1278 (02–03), 1348 (03–04), 1424 (04–05), 1513 (05–06), 1765 (06–07), 1849 (07–08), 1934 (08–09), 2011 (09–10), 2090 (10–11), 2159 (11–12), 2220 (12–13), 2293 (13–14), 2385 (14–15), 2476 (15–16), 2575 (16–17), 2619 (17–18).

MHL Annual Estuary and River Water Levels Summaries available:

MHL Report Nos. 555 (87–88), 564 (88–89), 582 (89–90), 601 (90–91), 625 (91–92), 659 (92–93), 698 (93–94), 731 (94–95), 778 (95–96), 875 (96–97), 947 (97–98), 1014 (98–99), 1070 (99–00), 1130 (00–01), 1206 (01–02), 1276 (02–03), 1346 (03–04), 1422 (04–05), 1511 (05–06), 1763 (06–07), 1847 (07–08), 1932 (08–09), 2009 (09–10), 2088 (10–11), 2157 (11–12), 2218 (12–13) 2291(13–14), 2383 (14–15), 2474 (15–16), 2573 (16–17), 2617 (17–18).

MHL Annual Ocean Tide Levels Summaries available:

MHL Report Nos. 515 (86–87), 544 (87–88), 563 (88–89), 585 (89–90), 602 (90–91), 628 (91–92), 658 (92–93), 697 (93–94), 732 (94–95), 777 (95–96), 876 (96–97), 947 (97–98), 1013 (98–99), 1069 (99–00, 1129 (00–01), 1205 (01–02), 1277 (02–03), 1347 (03–04), 1423 (04–05), 1512 (05–06), 1764 (06–07), 1848 (07–08), 1933 (08–09), 2010 (09–10), 2089 (10–11), 2158 (11–12), 2219 (12–13) 2292 (13–14), 2384 (14–15), 2475 (15–16), 2574 (16–17), 2618 (17–18).

MHL Annual Wave Climate and Coastal Air Pressure Summaries available:

MHL Report Nos. 547 (87–88), 560 (88–89), 581 (89–90), 600 (90–91), 627 (91–92), 655 (92–93), 695 (93–94), 733 (94–95), 779 (95–96), 877 (96–97), 948 (97–98), 1016 (98–99), 1072 (99–00), 1132 (00–01), 1208 (01–02), 1279 (02–03), 1349 (03–04), 1425 (04–05), 1514 (05–06),1766 (06–07), 1850 (07–08), 1935 (08–09), 2012 (09–10), 2091 (10–11), 2160 (11–12), 2221 (12–13) 2294 (13–14), 2386 (14–15), 2477 (15–16), 2576 (16–17), 2620 (17–18).

Flood Reports

MHL Flood Reports:

- *New South Wales North Coast Flood Summary June 2005*, MHL Report No. 1426
- *Marshalls Creek Flood Event 30 June 2005,* MHL Report No. 1435
- *New South Wales North Coast January 2006 Flood Summary*, MHL Report No. 1469
- *New South Wales North Coast March 2006 Flood Summary*, MHL Report No. 1482
- *New South Wales Central Coast June 2007 Flood Summary*, MHL Report No. 1754
- *New South Wales Hunter Valley, Wallamba River and Myall River June 2007 Flood Summary*, MHL Report No. 1755

- *New South Wales Hawkesbury and Nepean June 2007 Flood Summary*, MHL Report No. 1756
- *New South Wales Tweed River January 2008 Flood Summary*, MHL Report No. 1801
- *New South Wales Richmond River January 2008 Flood Summary*, MHL Report No. 1802
- *New South Wales Clarence River January 2008 Flood Summary*, MHL Report No. 1803
- *New South Wales Coffs Harbour and Bellinger River Region January 2008 Flood Summary*, MHL Report No. 1804
- *New South Wales Coffs Harbour, Bellinger River and Nambucca River Regions February 2009 Flood Summary*, MHL Report No. 1908
- *New South Wales Coffs Harbour and Bellinger River Regions April 2009 Flood Summary*, MHL Report No. 1913
- *NSW Northern Rivers May 2009 Flood Report*, MHL Report No. 1965
- *NSW North Coast Flood Summary January–March 2013*, MHL Report No. 2202
- *NSW Hunter and Central Coast Flood Summary April–May 2015,* MHL Report No. 2364
- *NSW South Coast Flood Summary August 2015,* MHL Report No. 2397
- *NSW North Coast Flood Summary March 2017*, MHL Report No. 2535

Other references

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) 2016, *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia,

Bureau of Meteorology, *Climate Glossary – Southern Oscillation Index*, retrieved on 04 October 2010 from http://www.bom.gov.au/climate/glossary/soi.shtml

The Institution of Engineers, Australia 1987, '*Australian Rainfall and Runoff: A Guide to Flood Estimation'*, Institute of Engineers, Australia

Manly
Hydraulics
Laboratory

110B King Street
Manly Vale NSW 2093

www.mhl.nsw.gov.au