Public Works
Manly Hydraulics Laboratory

NSW HUNTER AND CENTRAL COAST FLOOD SUMMARY APRIL – MAY 2015

Report MHL2364
June 2015

Prepared for:

Office of Environment & Heritage

Additional data provided by:

Department of Primary Industries Office of Water

Australian Government Bureau of Meteorology

HUNTER WATER

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NSW Hunter and Central Coast Flood Summary April – May 2015

Report MHL2364
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Cover Photograph: Belmore Bridge, Hunter River, taken by S Maddox 22/4/2015

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Foreword

This report was commissioned by the NSW Office of Environment and Heritage (OEH) to summarise the April 2015 flood events in the Hunter and Central Coast Region including the Hunter, Paterson and Williams Rivers, Macquarie and Tuggerah Lakes, and Brisbane Water of New South Wales. OEH manages an extensive data network in the NSW coastal zone. The coastal data network is operated and maintained by Manly Hydraulics Laboratory (MHL) under an annual contract to OEH.

Additional flood data for this report has been provided by NSW Office of Water (NOW), Bureau of Meteorology (BoM) and Hunter Water Corporation (HWC). Data analysis and reporting was undertaken by Bernard Tse, Zoran Tripovic and Sarah-Kate Dakin of MHL. The report was overseen by Martin Fitzhenry from the Environment Programs Branch, OEH.

An electronic copy of this report can be downloaded at www.mhl.nsw.gov.au.

Summary

In April 2015 severe weather conditions were caused by an intense low pressure system, referred to as an East Coast Low. Early in the morning of the 22nd April 2015 the low pressure system was situated just offshore of Newcastle and was moving slowly south. The system stayed close to the heavily populated coastal regions of the Paterson and Hunter River regions and the Central Coast region. The strongest wind gusts recorded were 135km/h at Norah Head on the Hunter Coast and at Wattamolla to the south of Sydney, on the 21st April 2015. Flood Warnings were issued by BoM for the Hunter River, Hawkesbury and Nepean Rivers, Wyong River and Tuggerah Lake, Lake Macquarie, Paterson and Williams Rivers and Upper Myall River. The system gradually weakened as it passed Sydney and reached Wollongong.

During the flood period of 20th April to 5th May 2015, MHL staff were able to monitor the situation via real-time data network and provided clients and the public with real time access to rainfall, wave, wind and water levels via customised webpages and MHL's public webpage at www.mhl.nsw.gov.au. MHL deployed two field teams in flood-affected areas to obtain flood status checks and to be available to remedy any system failures from Friday 1st May to Sunday 3rd May.

During the flood events, BoM used water level and rainfall data, Quantitative Precipitation Forecasts (QPF) and radar information to generate predicted water levels at warning locations on the flood-affected rivers. The water level predictions were used by the BoM to issue flood watches, flood warnings and Severe Weather Warnings for heavy rain and local flooding. MHL staff also provided data and advice to the SES.

This report presents water level, wave and rainfall hydrometric data collected during the 20th April to 5th May 2015 flood event in the Hunter and Central Coast regions of NSW. This report incorporates water level and rainfall data provided from BoM, Office of Water (NOW) and Hunter Water (HWC). Data collection, storage and presentation were undertaken by MHL for OEH.

During the 20th April to 5th May 2015 flood event the Hunter River at Denman experienced less than a minor flood, whereas in Dungog major flooding occurred and the rainfall at Dungog recorded a peak intensity of 180.0 mm/h, which is an annual exceedance probability of less than 1%. In the Lower Hunter Region, Singleton experienced less than a minor flood and in the Lower Paterson, Hunter and Williams Rivers the flooding ranged from minor to major. Flooding in the Lake Macquarie ranged from moderate to major, whilst at Tuggerah Lakes flooding was minor.

During the storm event the highest ever individual wave (Maximum Wave Height) of 14.9 m was recorded since monitoring began in 1974 by the Sydney Waverider buoy. Based on over 22 years of wave data recorded at the Sydney Waverider buoy station, the estimated Average Recurrence Interval for the 8.1 m peak storm Significant Wave Height that was

recorded during the storm was 1 in 20 years.

Please note that all data has only had preliminary checks performed and data in this report is not quality controlled to a specified error margin.

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1. Introduction

In April 2015 an intense low pressure system caused severe storm conditions and flash flooding in the Hunter and Central Coast regions of NSW.

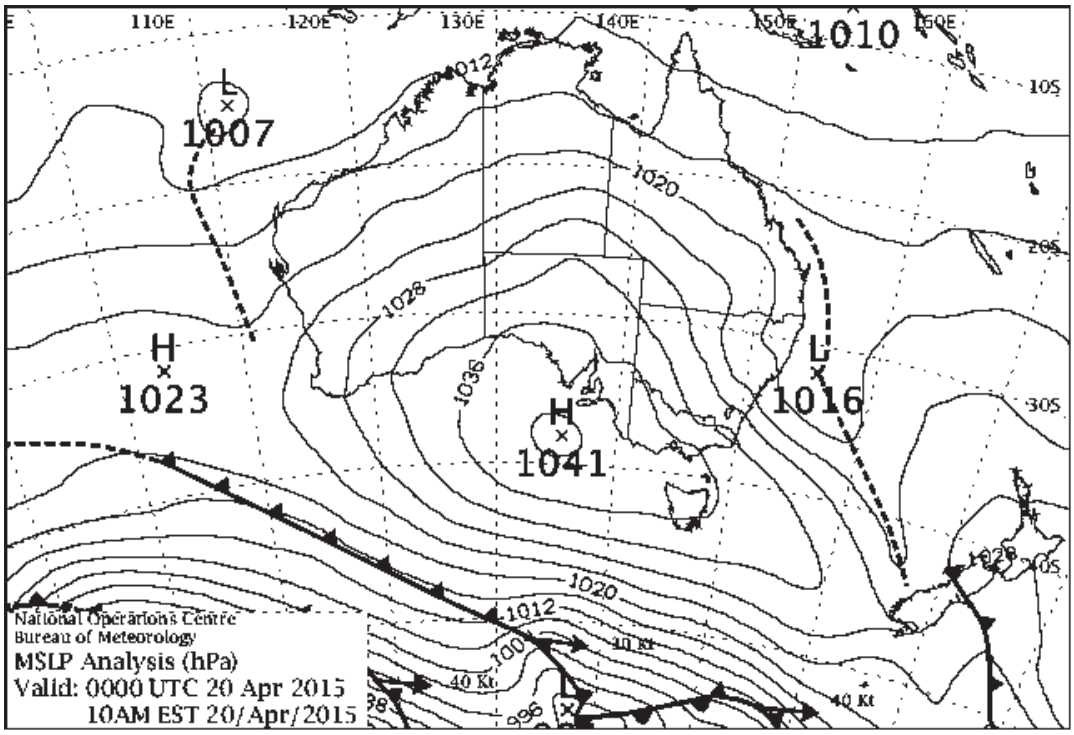
Figure 1.1 presents atmospheric pressure charts from 20th-24th of April 2015. The movement of the east coast low can be observed moving south from the Queensland border.

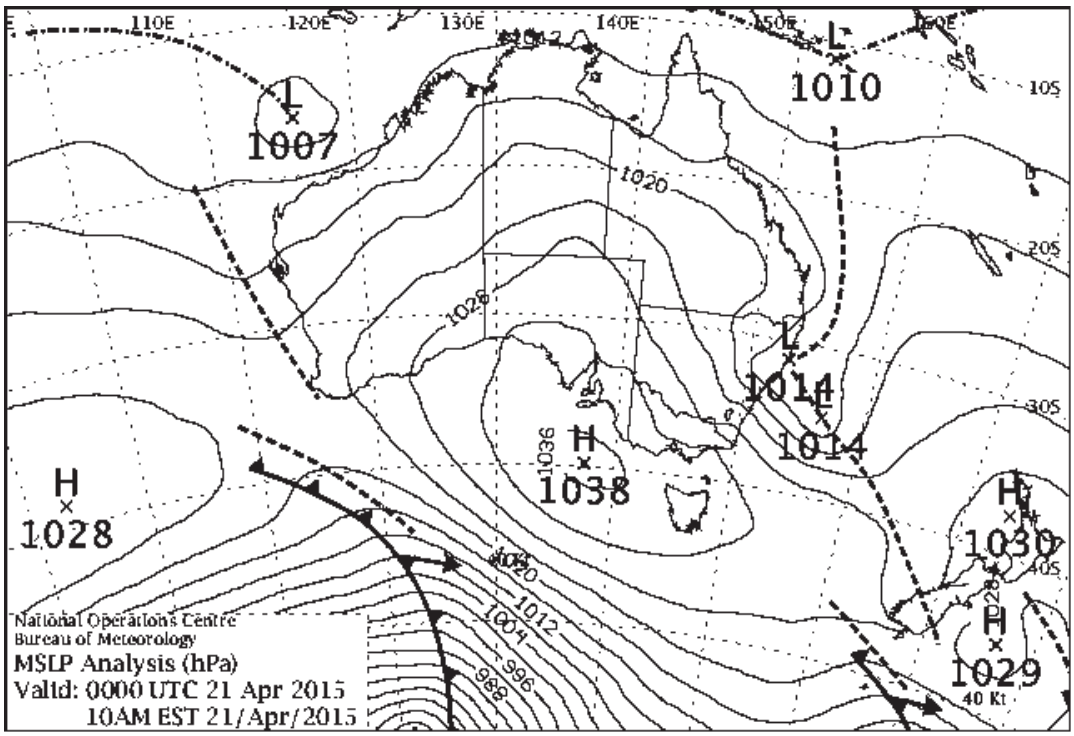
Seventeen local government areas were declared natural disaster areas as a result of the storms that commenced on the 20 April 2015. Figure 1.2 shows the total rainfall recorded across NSW during April 2015. Figure 1.3 displays a wind rose from Williamtown Station for the month of April where the majority of the winds blew from the south, with a maximum wind gust of 113km/h recorded on 21st April 2015.

During the flood events, the monitoring networks of water level recorders and rainfall gauges operated by MHL, on behalf of OEH, were used extensively by the BoM, SES and local councils to generate flood warnings, emergency response and delivery of services. Rainfall and water level data captured during the event is summarised by river region in Sections 3 to 7 of this report. Station performance during the events is summarised in Appendix A. Photographs taken during the event are presented in Appendix B.

MHL was commissioned by OEH to prepare a report to summarise the April 2015 flood event, which includes supplementary flood data provided from BoM, NOW and HWC. Maps of the study areas by river regions are found in Sections 3 to 7 of this report.

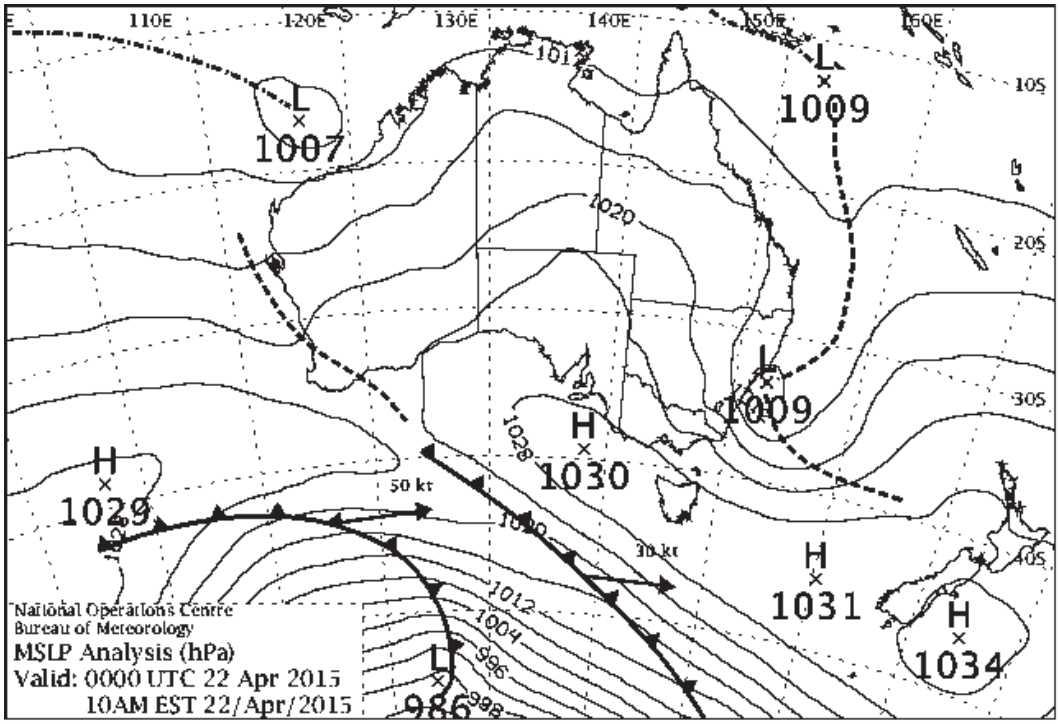
Rainfall Intensity Frequency Duration (IFD) curves have been generated using the Australian Rainfall and Runoff 1987 format in millimetres per hour. In addition IFD curves have been generated using the new IFD format (BoM IFD Design Rainfall, 2013) with results in millimetres (refer to Appendix C). This will allow this flood summary report to be comparable with past reports and future reports as we transition the IFD format to the BoM IFD Design Rainfall, 2013 version.

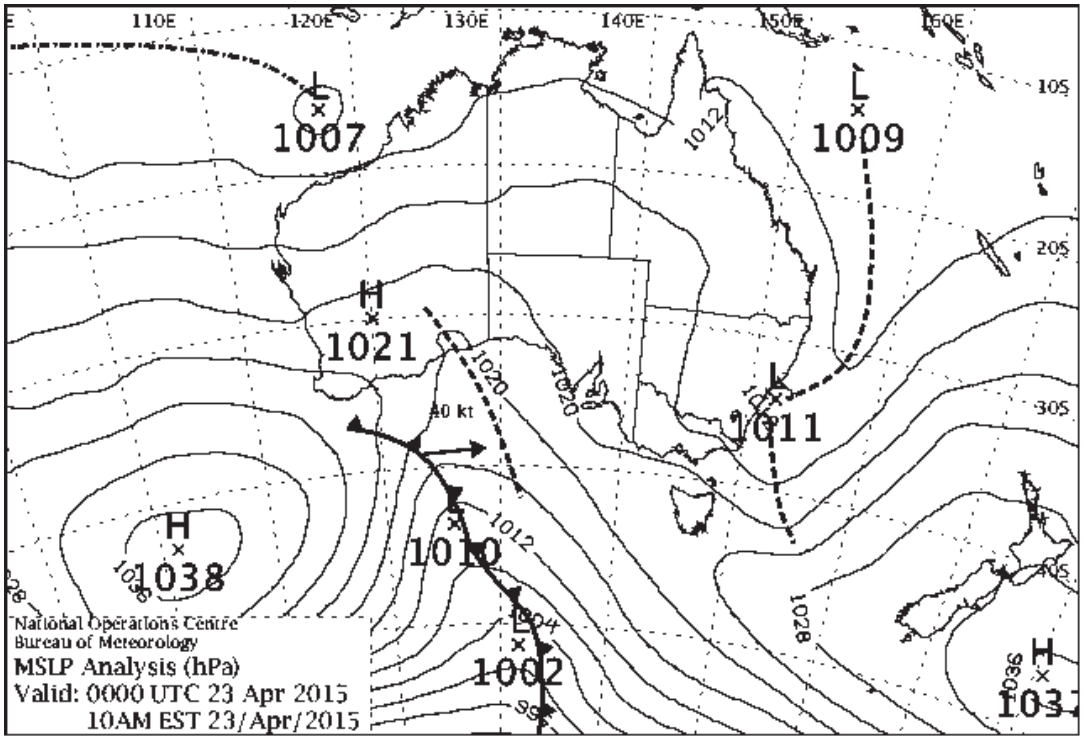




Source: Australian Bureau of Meteorology 2015

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory	MEAN SEA LEVEL PRESSURE 20-21 APRIL 2015	MHL Report 2364 Figure 1.1a DRAWING 2364-01-01.cdr





Source: Australian Bureau of Meteorology 2015

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MEAN SEA LEVEL PRESSURE
22-23 APRIL 2015

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Figure 1.1b
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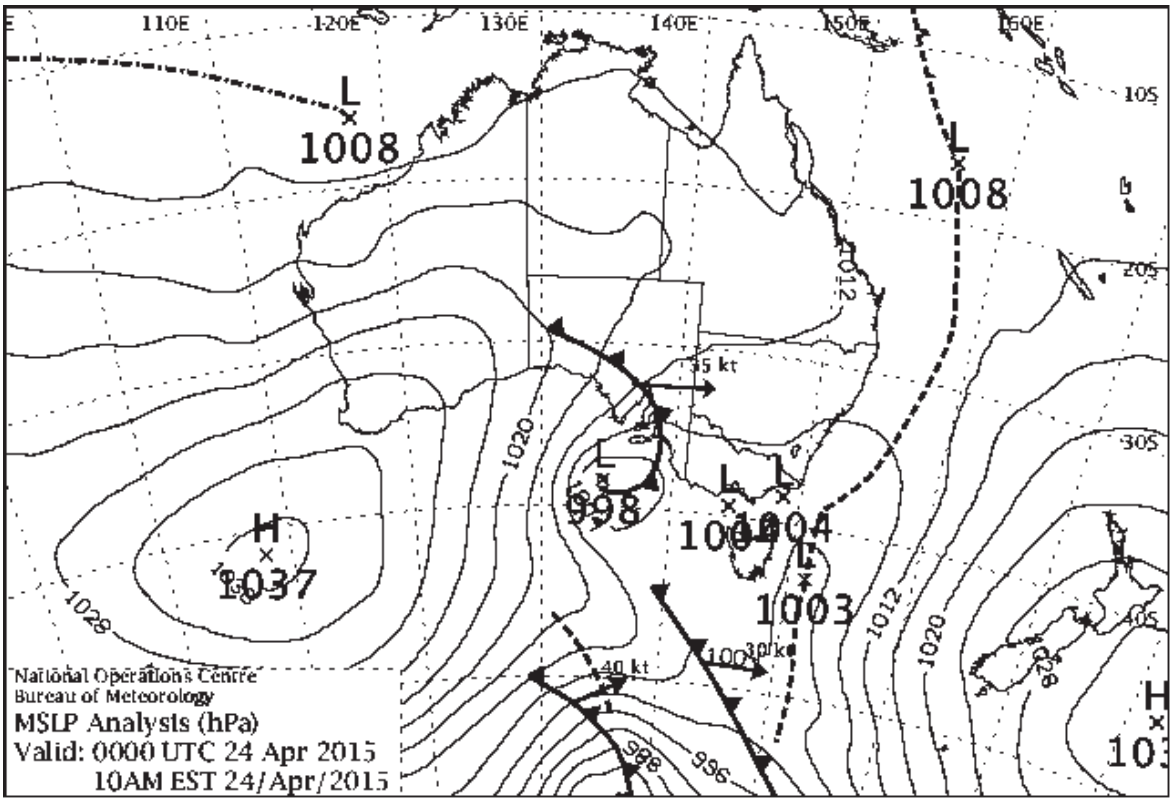
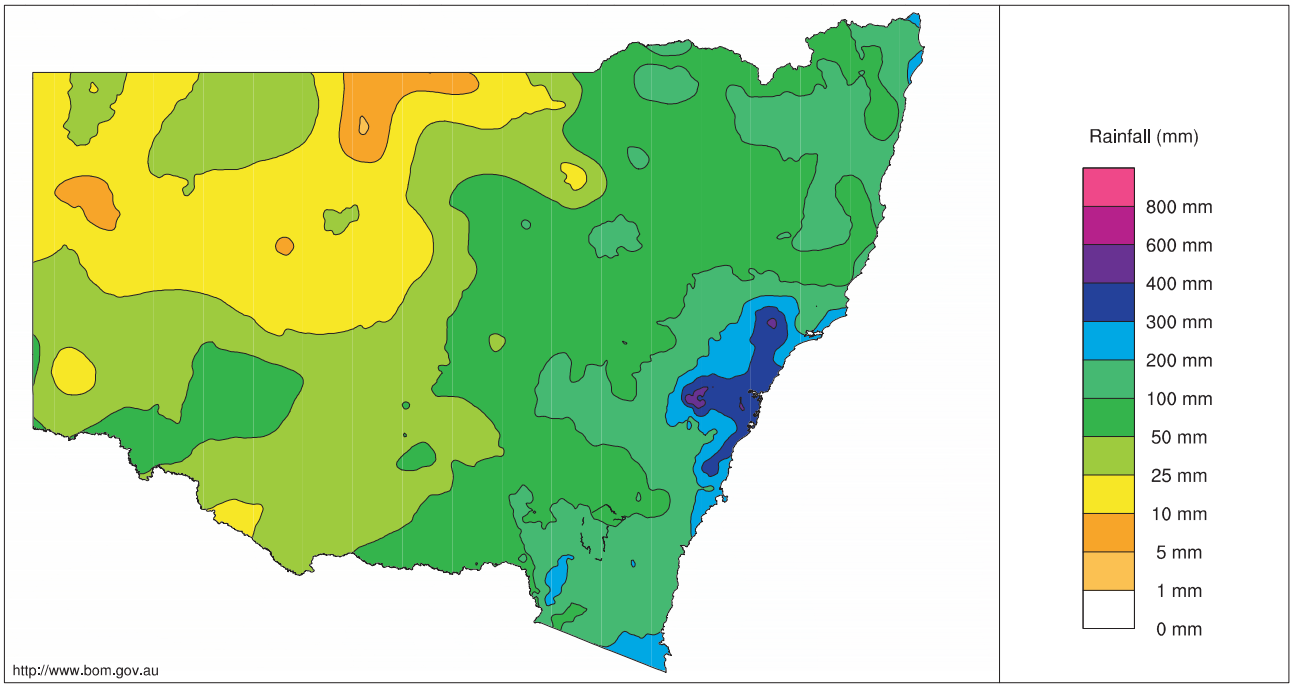


Source: Australian Bureau of Meteorology 2015

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory	MEAN SEA LEVEL PRESSURE 24 APRIL 2015	MHL Report 2364 Figure 1.1c DRAWING 2364-01-01.cdr

New South Wales Rainfall Totals (mm) April 2015

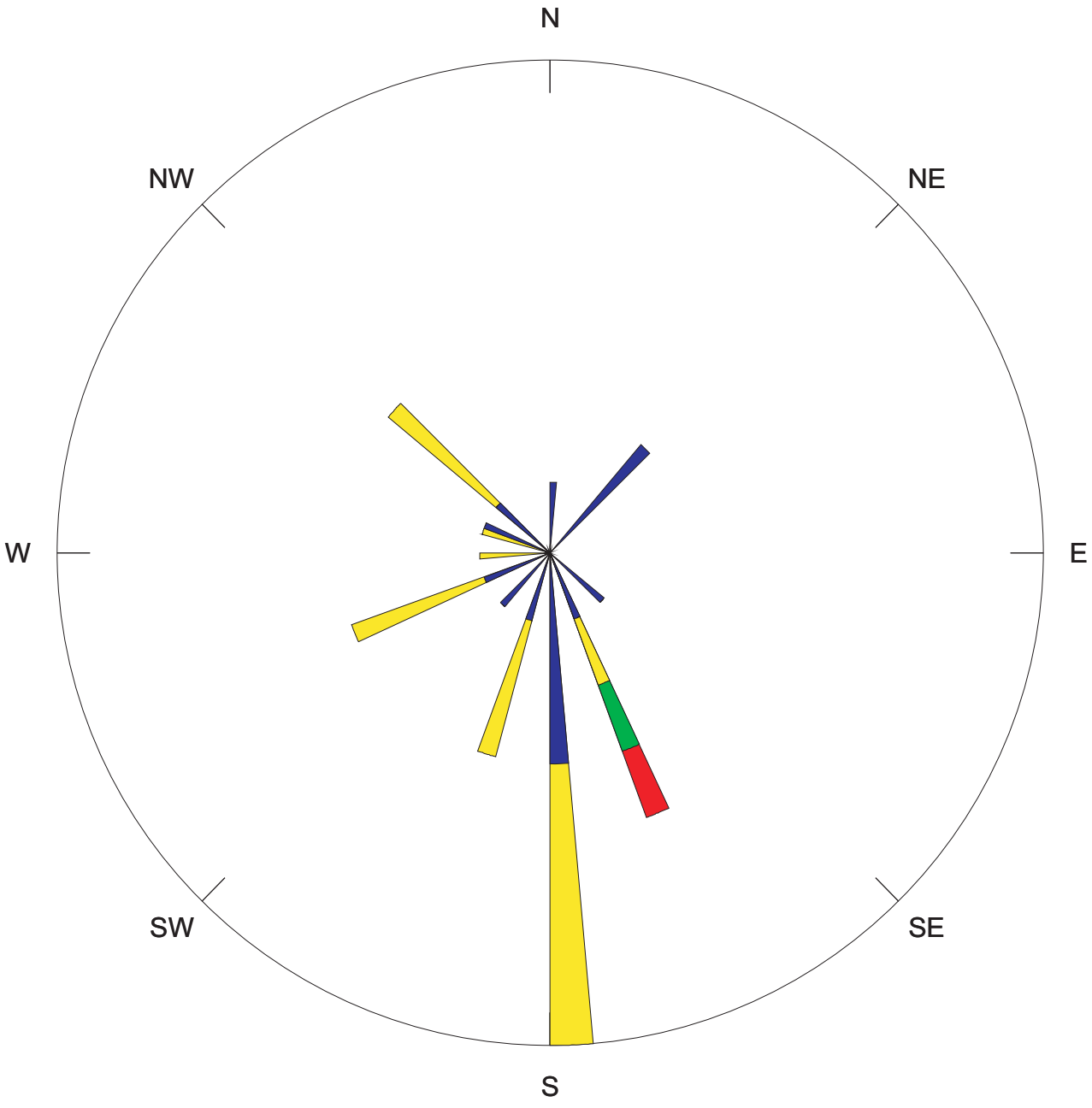
Australian Bureau of Meteorology



  ID code: AWAP Issued: 03/05/2015

Source: Australian Bureau of Meteorology 2015

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory	NEW SOUTH WALES RAINFALL ANALYSIS APRIL 2015	MHL Report 2364 Figure 1.2 DRAWING 2364-01-02.cdr



Maximum Daily Wind Gust (km/h)

- <=40
- >40 - 80
- >80 - 100
- >100

Source: Australian Bureau of Meteorology 2015

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WIND ROSE FROM WILLIAMTOWN STATION
APRIL 2015

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Figure 1.3

DRAWING 2364-01-03.cdr

2. Offshore Wave Data

Ocean wave conditions have been monitored by the NSW OEH Waverider buoy network along the NSW coast since 1974. The severe storm wave conditions in April- May 2015 were generated by a small, intense low pressure system that developed just off the mid north coast of NSW. During the storm event the highest ever individual wave (Maximum Wave Height) of 14.9 m was recorded since monitoring began in 1974 by the Sydney Waverider buoy. Based on over 22 years of wave data recorded at the Sydney Waverider buoy station, the estimated Average Recurrence Interval for the 8.1 m peak storm Significant Wave Height was 1 in 20 years.

A summary of the ocean wave conditions recorded at Sydney and Crowdy Head Waverider buoys during the April- May 2015 flood events is presented in Table 2.1 and Table 2.2 for Sydney and Crowdy Head. Refer to Figure 2.1 for a location map of Sydney and Crowdy Head Waverider buoys. Time series plots of wave height, period and direction for each Waverider buoy station for the period 1 April to 05 May 2015 are presented in Figure 2.2.

Table 2.1 Ocean Wave Storm Summary – 19 April to 22 April 2015

Wave Conditions	Sydney	Crowdy Head
Peak Significant Wave Height (m)	8.1	4.5
Date and Time of Peak Significant Wave Height (hrs EST)	21/4/2015 @ 1600 hrs	21/4/2015 @ 1400 hrs
Peak Maximum Wave Height (m)	14.9	8.5
Spectral Peak wave period at storm peak (secs)	14.9	12.9
Wave Direction at Storm Peak (º TN)	147	154
Storm Duration for Hsig greater than 4 m (hrs)	42	6
Storm Duration for Hsig greater than 6 m (hrs)	27	-
Average Recurrence Interval for Storm Peak Hsig (years)	20	0.3

Table 2.2 Ocean Wave Storm Summary – 1 May to 2 May 2015

Wave Conditions	Sydney [1]	Crowdy Head
Peak Significant Wave Height (m)	2.9	4.5
Date and Time of Peak Significant Wave Height (hrs EST)	2/5/2015 @ 1400 hrs	2/5/2015 @ 0600 hrs
Peak Maximum Wave Height (m)	6.1	7.9
Spectral Peak wave period at storm peak (secs)	10.3	10.3
Wave Direction at Storm Peak (º TN)	86	92
Storm Duration for Hsig greater than 4 m (hrs)	0	3
Average Recurrence Interval for Storm Peak Hsig (years)	NA	0.3

[1] Significant wave height did not exceed 3 m and not classified as a storm event at Sydney

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STATION LOCATIONS
WAVERIDER BOUYS

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Figure 2.1

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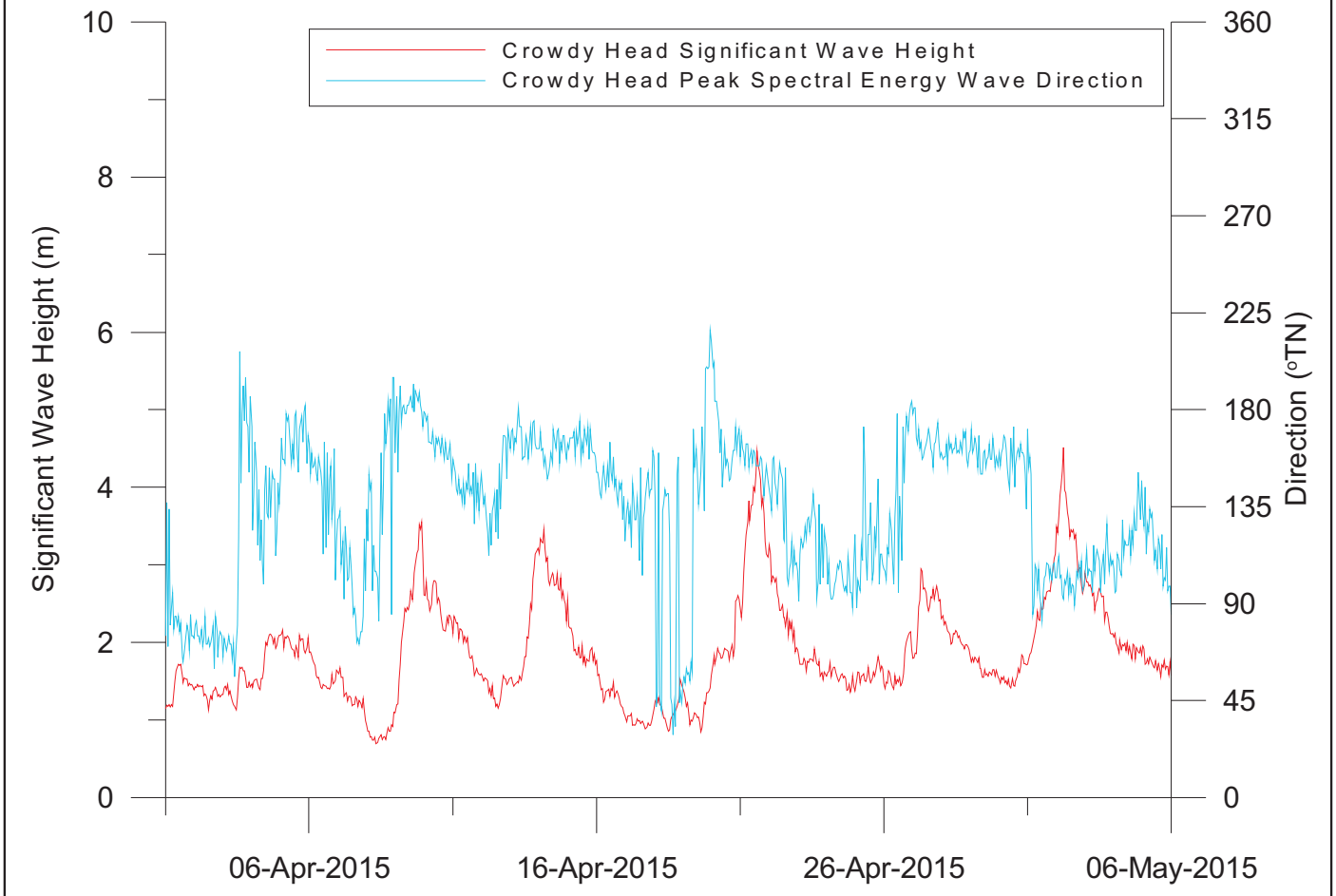

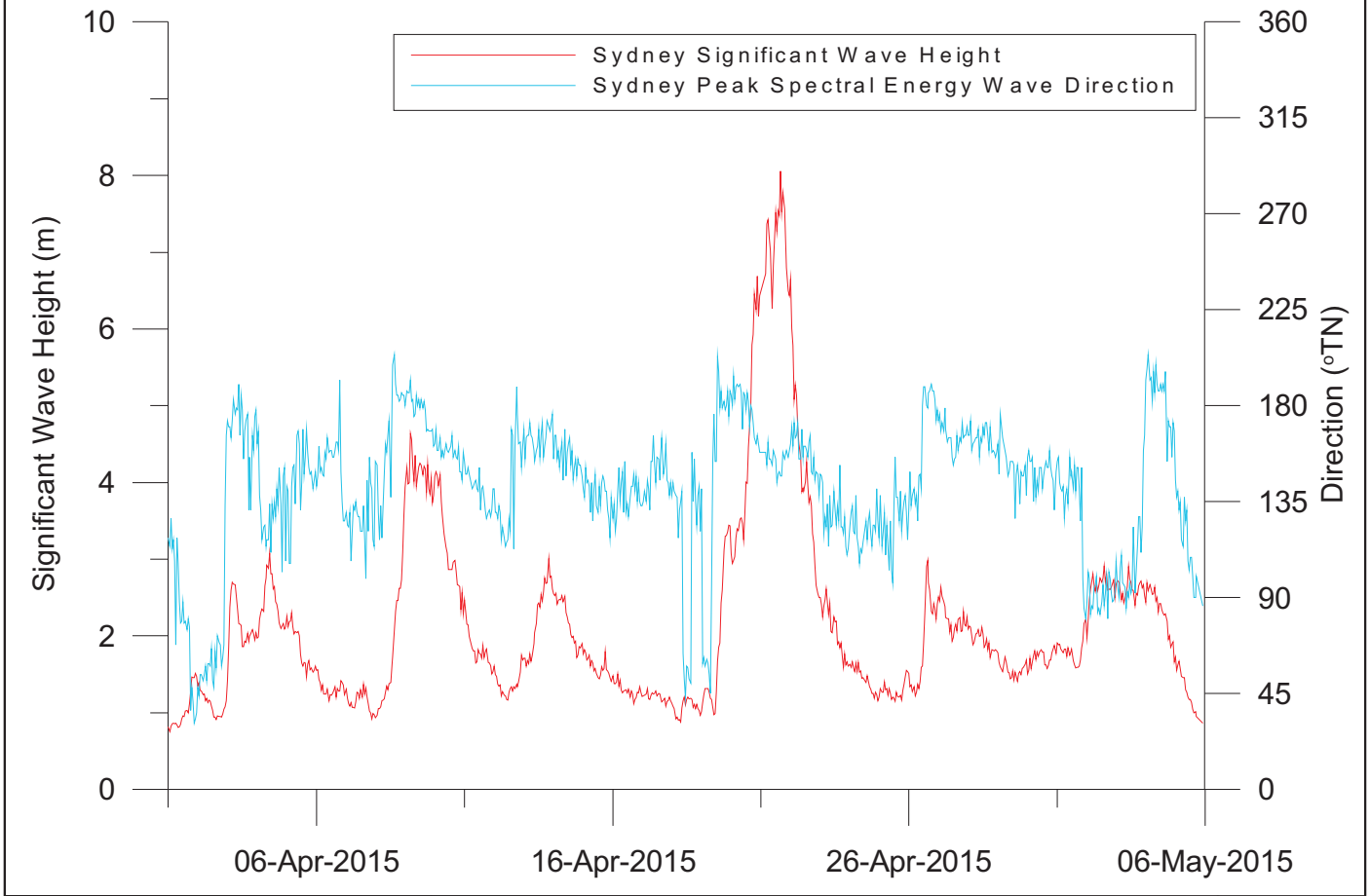

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CROWDY HEAD AND SYDNEY WAVERIDER BUOY
SIGNIFICANT WAVE HEIGHT AND WAVE DIRECTION
01 APRIL - 05 MAY 2015

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Figure 2.2

DRAWING 2364-02-02.cdr

3. Water Level and Rainfall Data

3.1 Water Level and Rainfall Overview

In the Paterson and Hunter River Region, Macquarie and Tuggerah Lakes River Region, and the Brisbane Waters Region MHL operates a total of 73 stations, the Office of Water operates a total of 63 stations, the BoM operates a total of 50 rainfall stations and Hunter Water operates a total of 52 rainfall stations. Following an initial data review and consultation with NOW, BoM and HWC this report presents data from 71 MHL operated stations, 54 NOW operated stations, 32 BoM operated rainfall stations and 23 Hunter Water operated rainfall stations. A summary of the sites presented in this report is provided in Table 3.1. A full list of stations for which data has been presented in this report is provided in Appendix A. Appendix C provides a table of offsets to convert local gauge datum to AHD for the NOW water level stations.

Table 3.1 Water Level and Rainfall Site Summary

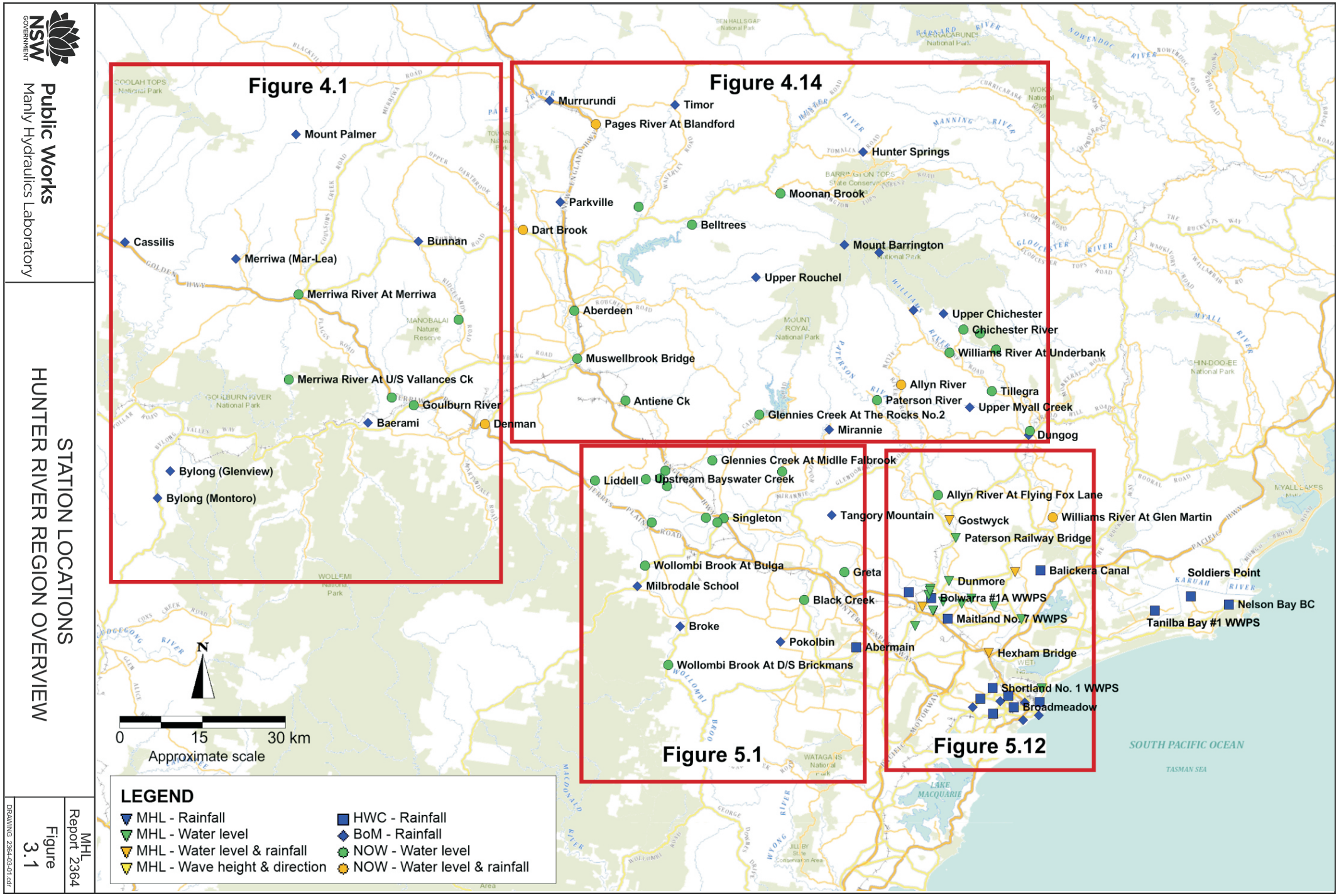
Site Type	Paterson, Williams and Hunter Region				Macquarie and Tuggerah Lakes			Brisbane Waters Region	
	MHL	NOW	BoM	HWC	MHL	NOW	HWC	MHL	NOW
Flood and Estuaries	19	42			13	7		10	
Rainfall	4	5	32	17	13		6	12	
Total	23	47	32	17	26	7	6	22	0

3.2 Hunter, Paterson and Williams River Region

An overview of water level and rainfall stations in the Hunter, Williams and Paterson River Region is provided in Figure 3.1. This figure makes reference to subset station location maps for the Upper Hunter River Region and the Lower Hunter River Region, namely:

Upper Hunter River Region
– Merriwa
– Williams

Lower Hunter River Region
– Singleton
– Lower Hunter, Paterson and Williams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STATION LOCATIONS
HUNTER RIVER REGION OVERVIEW
MHL Report 2364
Figure 3.1
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Figure 4.1
Figure 4.14
Figure 5.1
Figure 5.12
Mount Palmer
Cassilis
Bunnan
Merriwa (Mar-Lea)
Merriwa River At Merriwa
Merriwa River At U/S Vallances Ck
Goulburn River
Baerami
Denman
Bylong (Glenview)
Bylong (Montoro)
Murrurundi
Timor
Pages River At Blandford
Hunter Springs
Moonan Brook
Parkville
Dart Brook
Belltrees
Mount Barrington
Upper Rouchel
Aberdeen
Upper Chichester
Chichester River
Williams River At Underbank
Muswellbrook Bridge
Allyn River
Tillegra
Paterson River
Upper Myall Creek
Antiene Ck
Glennies Creek At The Rocks No.2
Mirannie
Dungog
Glennies Creek At Midlle Falbrook
Liddell
Upstream Bayswater Creek
Singleton
Tangory Mountain
Allyn River At Flying Fox Lane
Gostwyck
Williams River At Glen Martin
Paterson Railway Bridge
Wollombi Brook At Bulga
Greta
Milbrodale School
Black Creek
Broke
Pokolbin
Abermain
Wollombi Brook At D/S Brickmans
Balickera Canal
Dunmore
Bolwarra #1A WWPS
Maitland No.7 WWPS
Hexham Bridge
Shortland No. 1 WWPS
Broadmeadow
Soldiers Point
Nelson Bay BC
Tanilba Bay #1 WWPS
N
0
15
30 km
Approximate scale
LEGEND
MHL - Rainfall
MHL - Water level
MHL - Water level & rainfall
MHL - Wave height & direction
HWC - Rainfall
BoM - Rainfall
NOW - Water level
NOW - Water level & rainfall
SOUTH PACIFIC OCEAN
TASMAN SEA

4. Hunter River Region - Upper

4.1 Upper Hunter River Region - Merriwa Water Level

The locations of water level stations within the Merriwa River region are shown in Figure 4.1. The water level data for the period 01 April to 05 May 2015 are displayed graphically in Figures 4.2 and 4.3. The peak observed water levels are listed in Table 4.1.

Table 4.2 lists the State Emergency Services (SES) Flood Classifications reference for Denman. The SES flood classification scheme indicates the flood peak for Denman was classified as a less than a minor flood during the April 2015 event.

Table 4.1 Merriwa River Region Flood Peaks

Station Name	Station No.	Site Owner	Datum	Peak level (m)
Merriwa River Upstream Vallance	210066	NOW	Local Gauge Datum	0.35
Merriwa River at Merriwa	210091	NOW	Local Gauge Datum	0.70
Halls Creek at Upstream Giants Creek	210146	NOW	Local Gauge Datum	0.85
Wybong Creek at Manobalai	210147	NOW	Local Gauge Datum	0.34
Hunter River Denman	210055	NOW	Local Gauge Datum	3.20
Goulbourn Sandy Hollow	210031	NOW	Local Gauge Datum	3.45

Table 4.2 SES Flood Classification for Denman

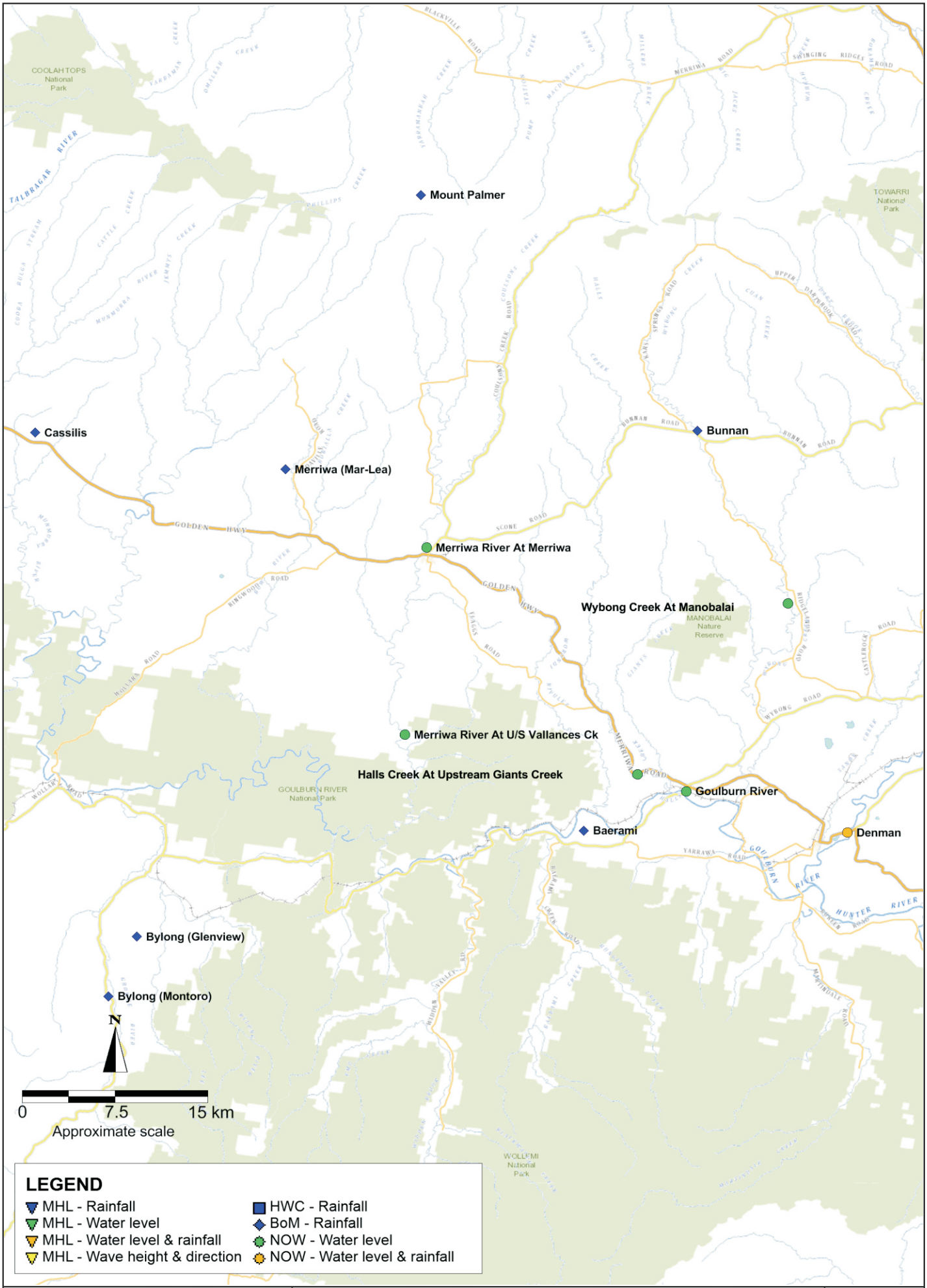
Station	Classification			Peak (m)	Classification
	Minor	Moderate	Major		
	Water Level (m Local Gauge Datum)				
Hunter River Denman	5.5	6.9	8.0	3.20 (02:15 23/04/15)	< Minor

4.2 Upper Hunter River Region - Merriwa Rainfall

9.00 a.m. daily rainfall totals are displayed in Table 4.3, Figure 4.4 and Figure 4.5 for the period 20th April to 5th May 2015. The rainfall data and intensities are displayed graphically in Figures 4.6 to 4.13.

Table 4.3 Merriwa River Region Daily Rainfall Totals

Date	Cassilis (mm)	Merriwa (Mar-Lea) (mm)	Bunnan (mm)	Baerami (mm)	Glenview (mm)	Montoro (mm)	Mt Palmer (mm)	Denman (mm)
	BOM	BOM	BOM	BOM	BOM	BOM	BOM	NOW
20/04/2015	5.0	7.0	11.0	6.0	4.0	4.0		8.6
21/04/2015	23.0	27.0	21.0	35.0	16.0	14.0	22.0	49.2
22/04/2015	8.0	8.0	13.0	13.0	25.0	30.0	9.0	15.4
23/04/2015	1.0	3.0	5.0	6.0	2.0	0.0	2.0	9.2
24/04/2015	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.2
25/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26/04/2015	2.0	1.0	1.0	0.0	4.0	2.0	1.0	1.2
27/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
01/05/2015	1.0	2.0	2.0	1.0	0.0	0.0	6.0	0.8
02/05/2015	2.0	2.0	2.0	1.0	0.0	0.0	6.0	5.0
03/05/2015	0.0	1.0	2.0	0.0	0.0	0.0	3.0	1.0
04/05/2015	5.0	1.0	2.0	1.0	5.0	0.0	8.0	.2
05/05/2015	0.0	0.0	0.0	0.0	0.0	0.0	1.0	
Total	**47.0**	**52.0**	**60.0**	**63.0**	**56.0**	**50.0**	**58.0**	**91.2**



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STATION LOCATIONS
RICHMOND RIVER REGION
MERRIWA

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Figure 4.1

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UPPER HUNTER RIVER REGION MERRIWA WATER LEVEL 01 APRIL – 05 MAY 2015

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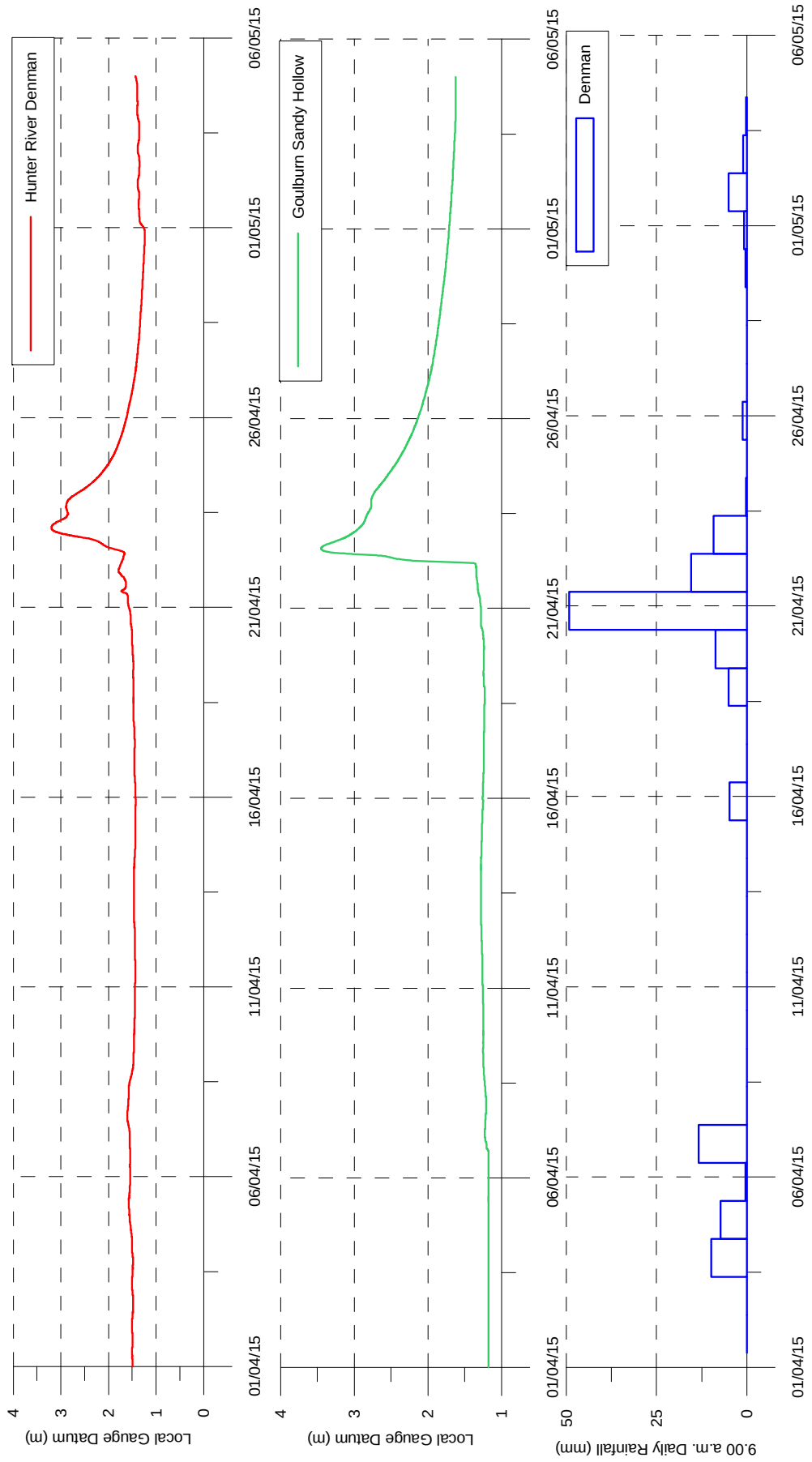
Figure 4.2



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UPPER HUNTER RIVER REGION MERRIWA WATER LEVEL 01 APRIL – 05 MAY 2015

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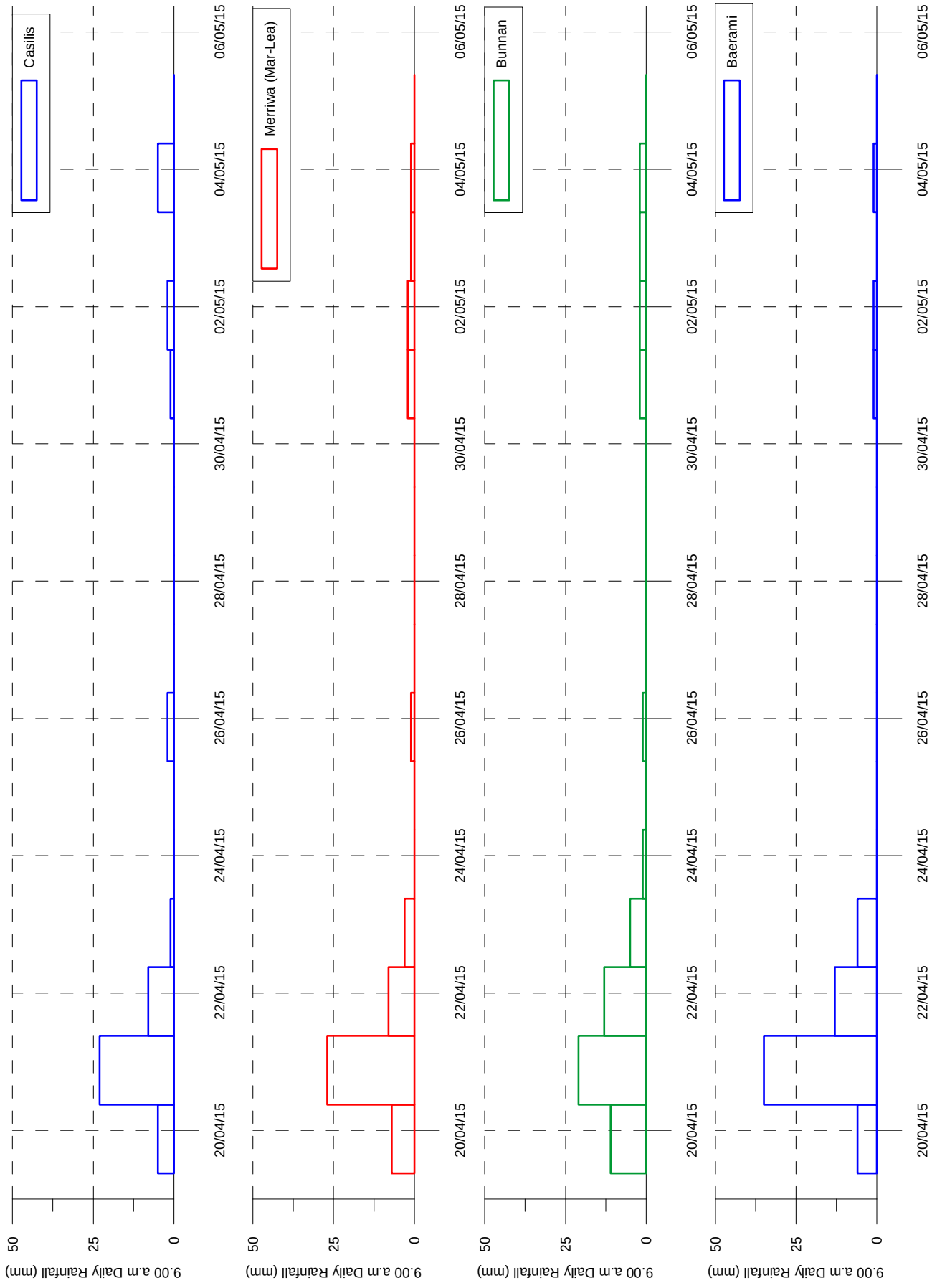
Figure 4.3



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UPPER HUNTER RIVER REGION MERRIWA RAINFALL
01 APRIL – 05 MAY 2015

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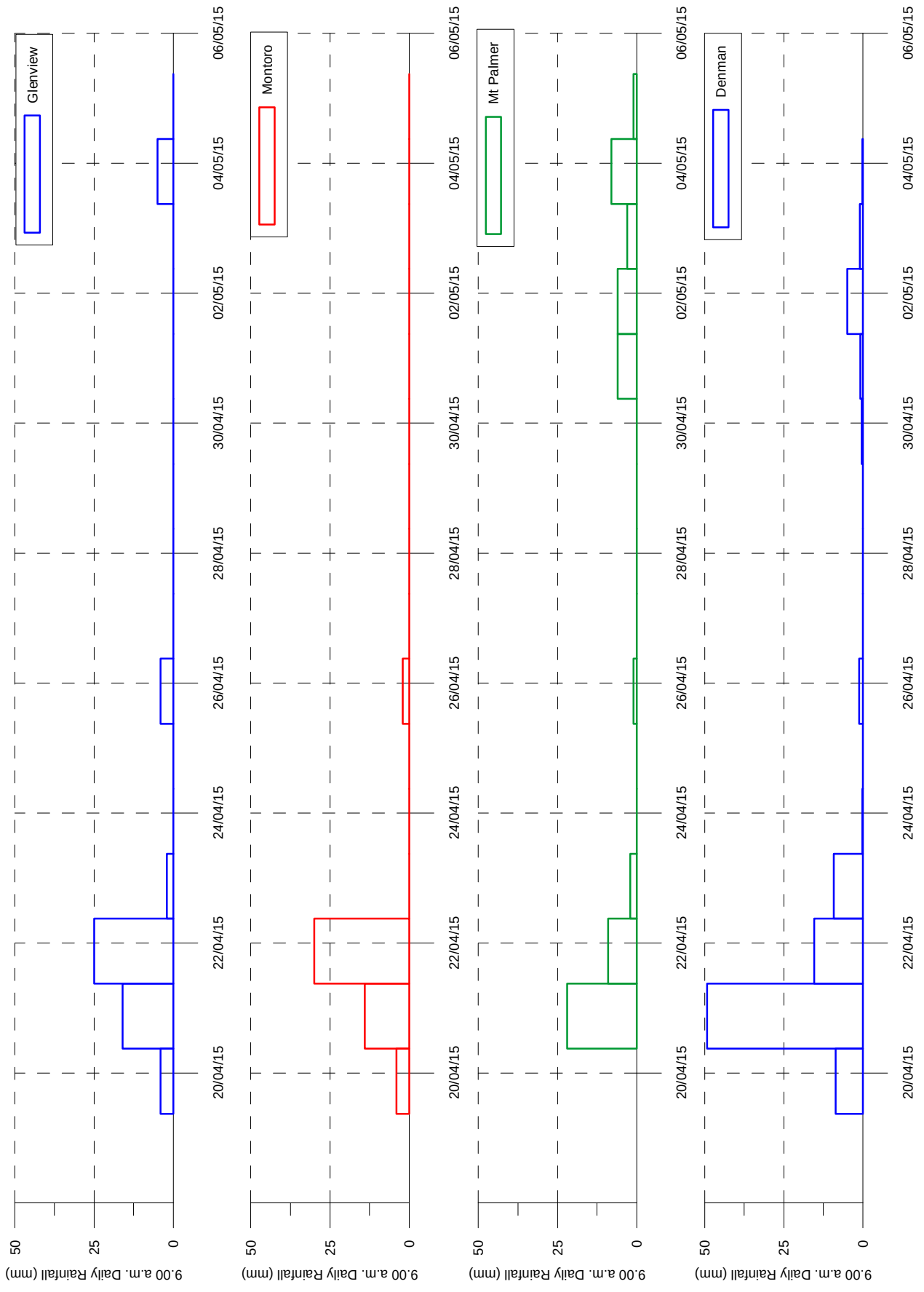
Figure 4.4



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UPPER HUNTER RIVER REGION MERRIWA RAINFALL
01 APRIL – 05 MAY 2015

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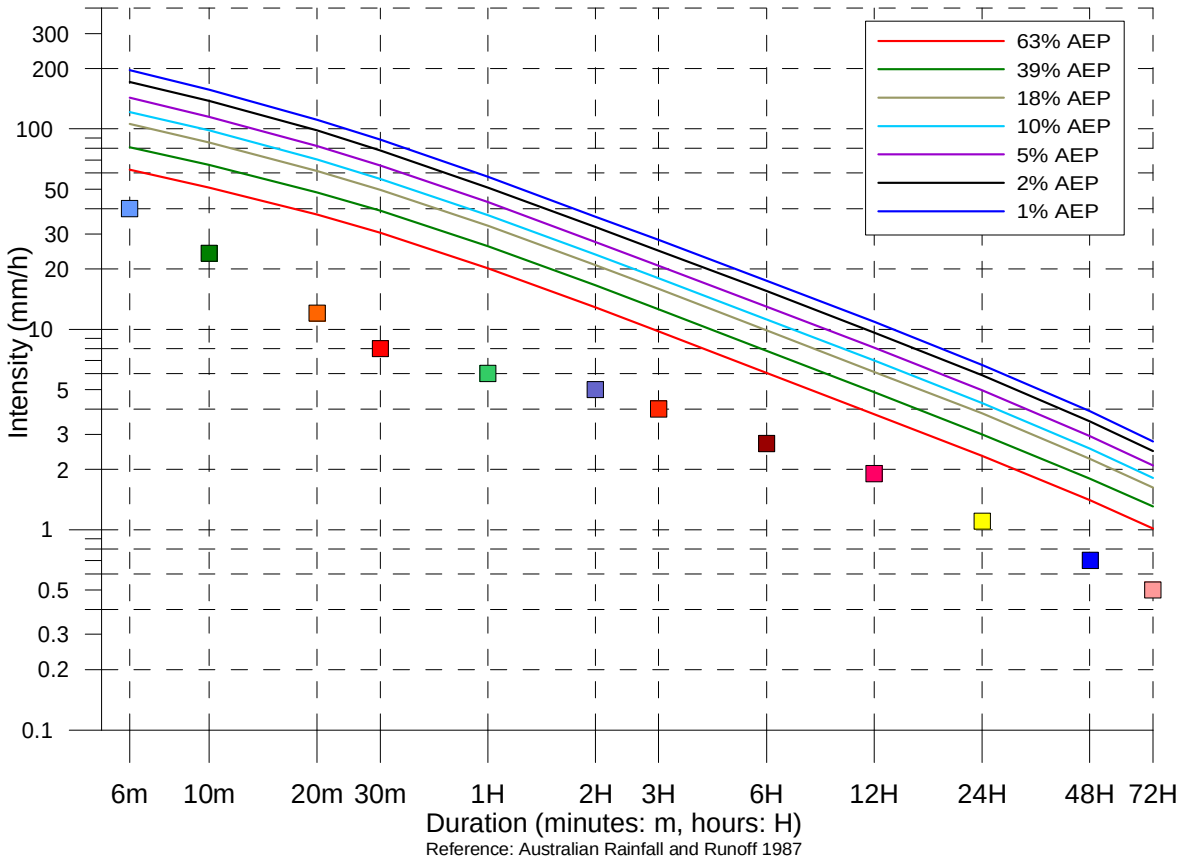
Figure 4.5

Site owner: BoM Latitude: -32.0348 Longitude: 150.0191

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Cassilis Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Intensity (mm/h)**	**Time/Date**
6m	40.0	15:16_03/05/2015
10m	24.0	15:16_03/05/2015
20m	12.0	15:16_03/05/2015
30m	8.0	15:16_03/05/2015
1H	6.0	09:40_21/04/2015
2H	5.0	08:16_21/04/2015
3H	4.0	08:16_21/04/2015
6H	2.7	05:14_21/04/2015
12H	1.9	02:02_21/04/2015
24H	1.1	11:04_20/04/2015
48H	0.7	04:42_20/04/2015
72H	0.5	04:42_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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CASSILIS INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

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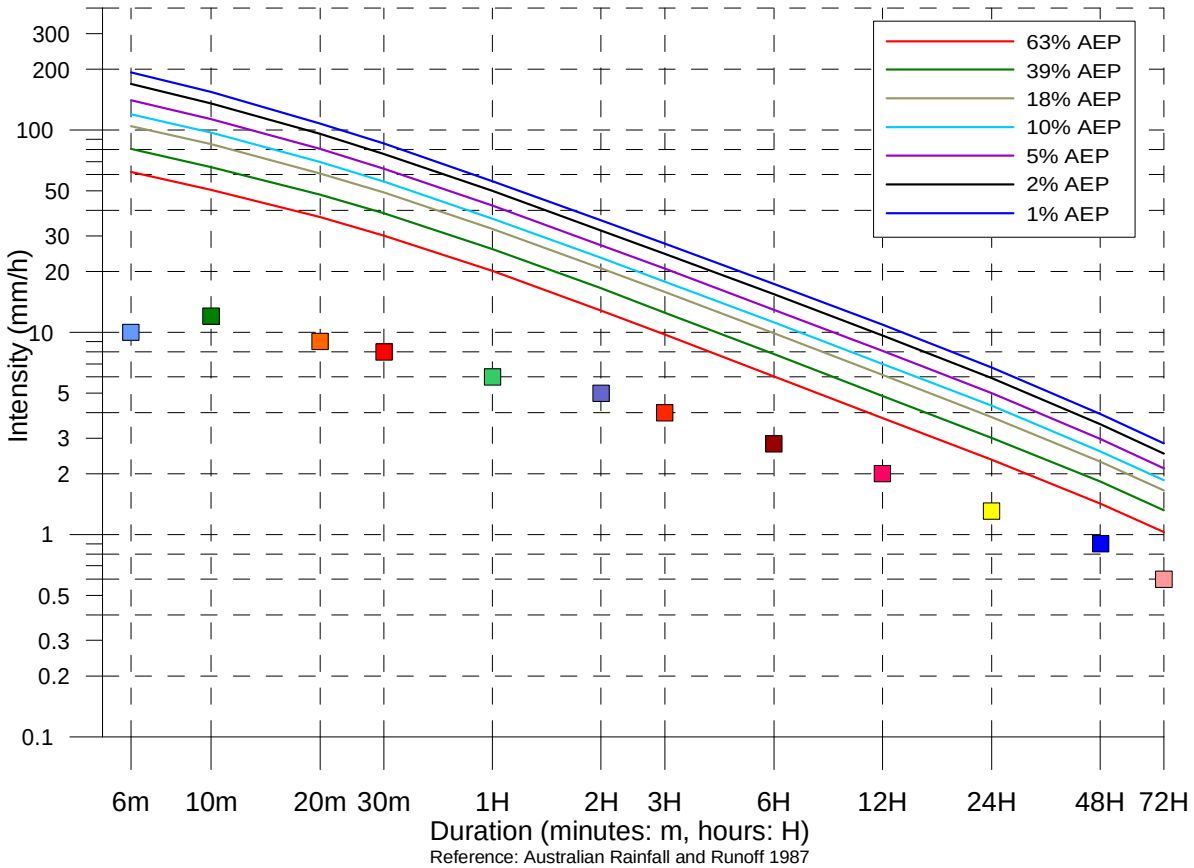
Figure 4.6

Site owner: BoM Latitude: -32.0666 Longitude: 150.2326

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Merriwa Mar-Lea Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		10.0	21:38_03/05/2015
10m		12.0	09:44_21/04/2015
20m		9.0	09:44_21/04/2015
30m		8.0	09:36_21/04/2015
1H		6.0	09:18_21/04/2015
2H		5.0	08:08_21/04/2015
3H		4.0	08:08_21/04/2015
6H		2.8	05:02_21/04/2015
12H		2.0	23:56_20/04/2015
24H		1.3	10:06_20/04/2015
48H		0.9	04:16_20/04/2015
72H		0.6	04:16_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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MERRIWA MAR-LEA INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

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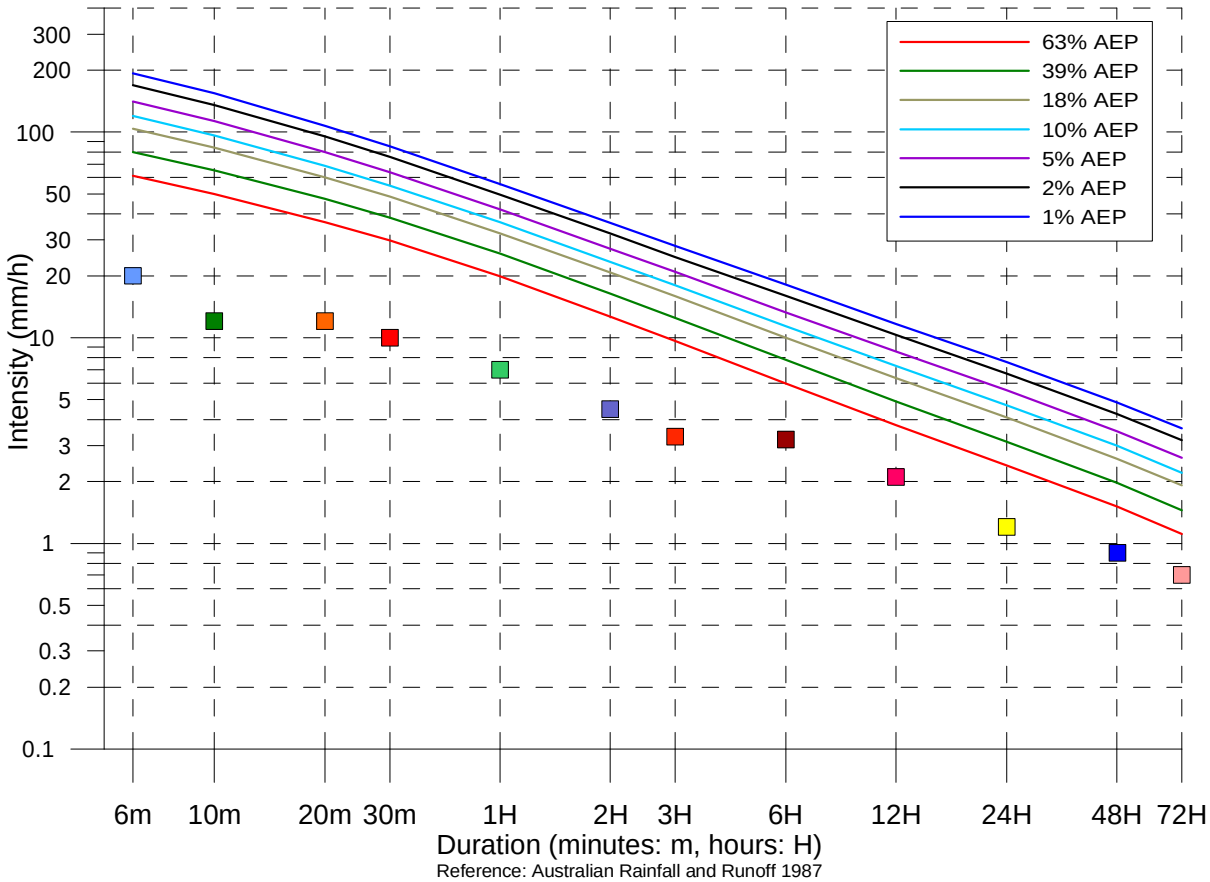
Figure 4.7

Site owner: BoM Latitude: -32.0332 Longitude: 150.5836

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Bunnan Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	20.0	06:08_21/04/2015
10m	12.0	06:12_21/04/2015
20m	12.0	06:02_21/04/2015
30m	10.0	05:52_21/04/2015
1H	7.0	09:02_21/04/2015
2H	4.5	08:50_21/04/2015
3H	3.3	07:54_21/04/2015
6H	3.2	05:12_21/04/2015
12H	2.1	00:14_21/04/2015
24H	1.2	10:38_20/04/2015
48H	0.9	02:02_20/04/2015
72H	0.7	02:02_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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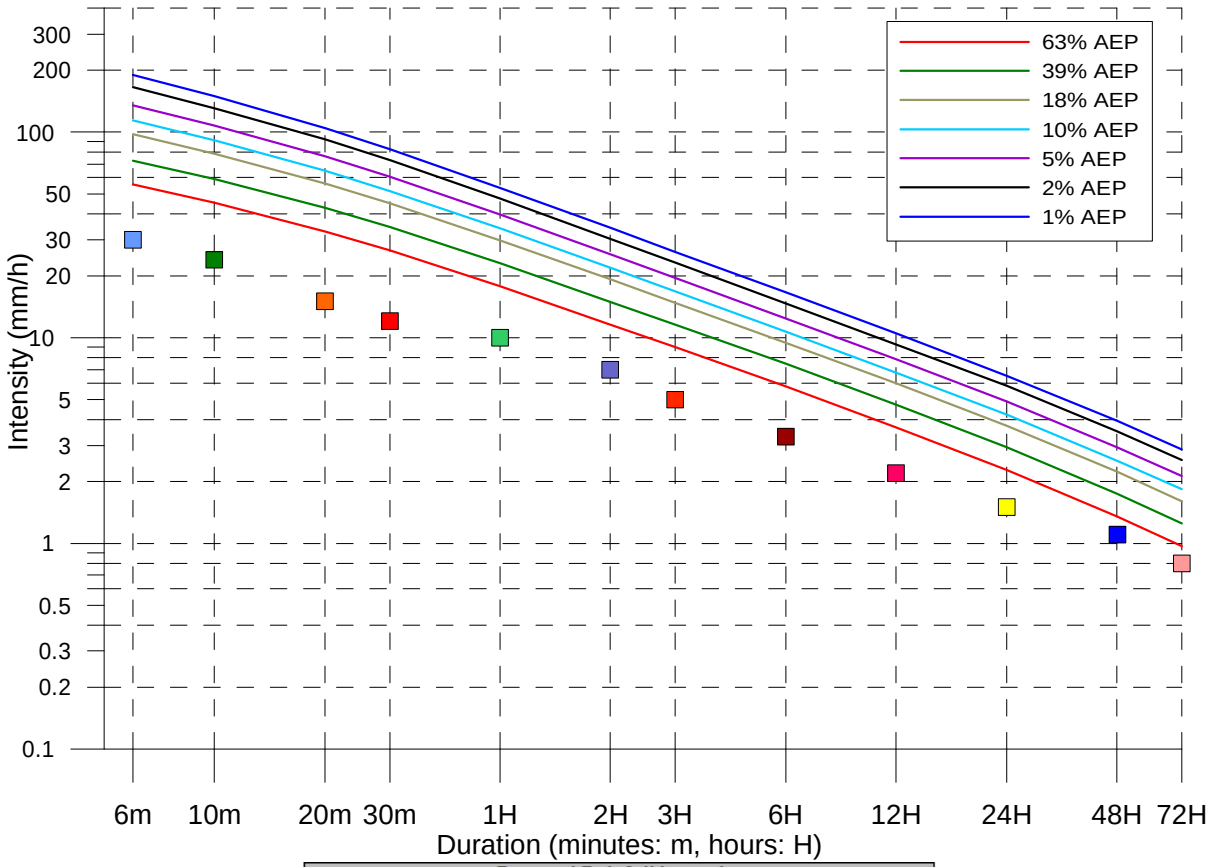
BUNNAN INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.8

Site owner: BoM Latitude: -32.3792 Longitude: 150.4868

AEP= Annual Exceedance Probability



Baerami Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	30.0	08:16_21/04/2015
10m	24.0	08:16_21/04/2015
20m	15.0	08:10_21/04/2015
30m	12.0	08:00_21/04/2015
1H	10.0	07:28_21/04/2015
2H	7.0	06:28_21/04/2015
3H	5.0	06:28_21/04/2015
6H	3.3	02:48_21/04/2015
12H	2.2	22:08_20/04/2015
24H	1.5	22:08_20/04/2015
48H	1.1	05:52_20/04/2015
72H	0.8	03:02_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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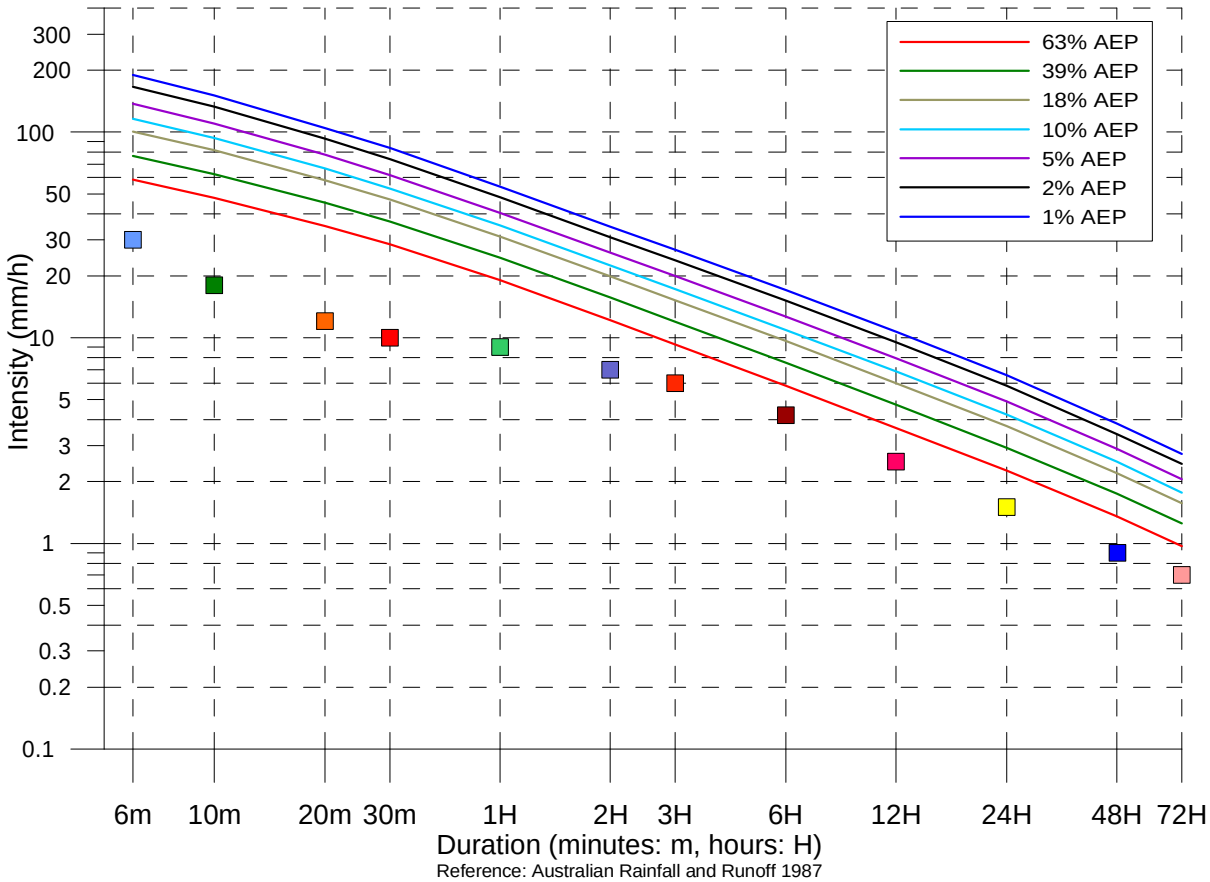
BAERAMI INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.9

Site owner: BoM Latitude: -32.471 Longitude: 150.1059

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Bylong Glenview Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		30.0	14:24_25/04/2015
10m		18.0	14:24_25/04/2015
20m		12.0	12:26_21/04/2015
30m		10.0	12:26_21/04/2015
1H		9.0	11:58_21/04/2015
2H		7.0	11:18_21/04/2015
3H		6.0	11:18_21/04/2015
6H		4.2	08:28_21/04/2015
12H		2.5	07:46_21/04/2015
24H		1.5	23:30_20/04/2015
48H		0.9	04:10_20/04/2015
72H		0.7	04:10_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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BYLONG GLENVIEW INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

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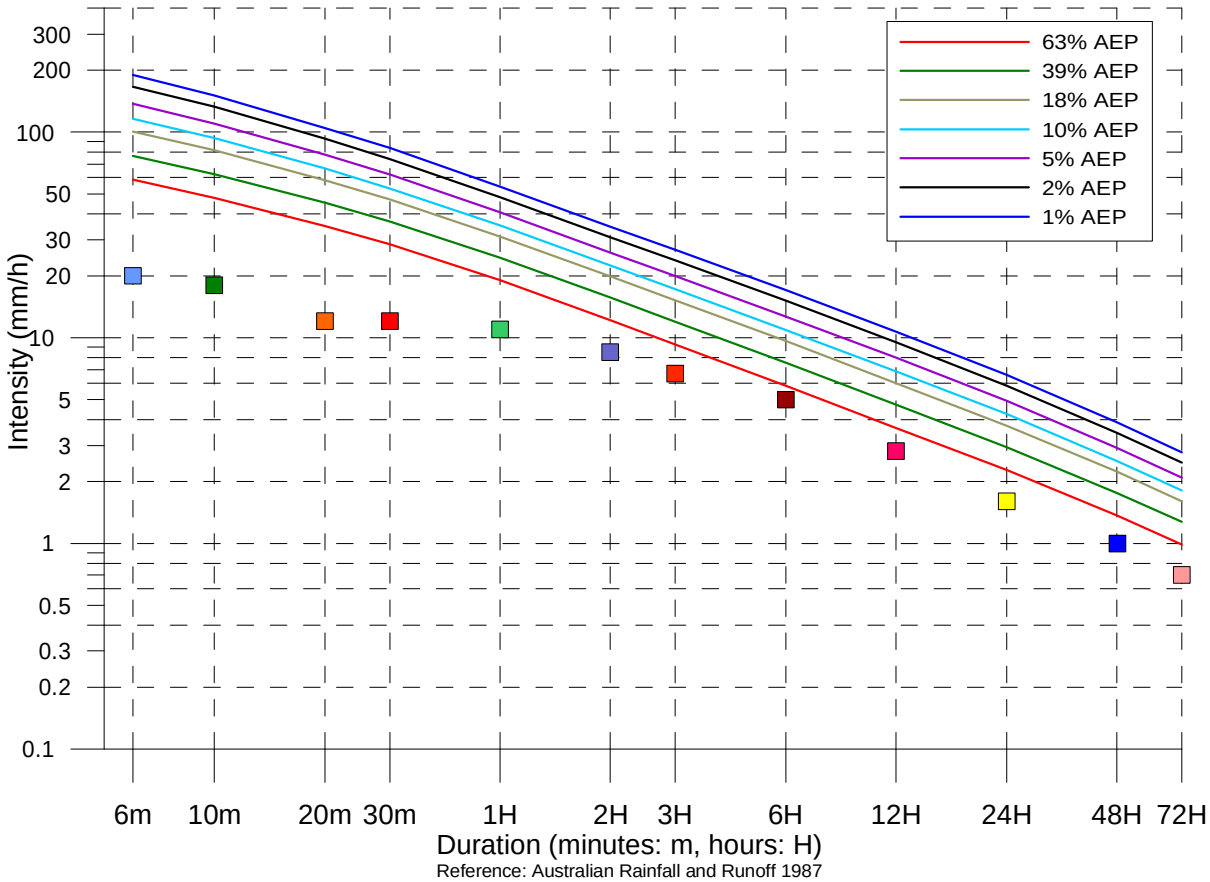
Figure 4.10

Site owner: BoM Latitude: -32.5204 Longitude: 150.0817

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Bylong Montoro Rainfall Intensity
01 April 2015 – 05 May 2015

Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	20.0	12:38_21/04/2015
10m	18.0	12:32_21/04/2015
20m	12.0	12:32_21/04/2015
30m	12.0	12:20_21/04/2015
1H	11.0	11:50_21/04/2015
2H	8.5	11:08_21/04/2015
3H	6.7	10:58_21/04/2015
6H	5.0	07:58_21/04/2015
12H	2.8	07:28_21/04/2015
24H	1.6	23:10_20/04/2015
48H	1.0	04:46_20/04/2015
72H	0.7	04:46_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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Manly Hydraulics Laboratory

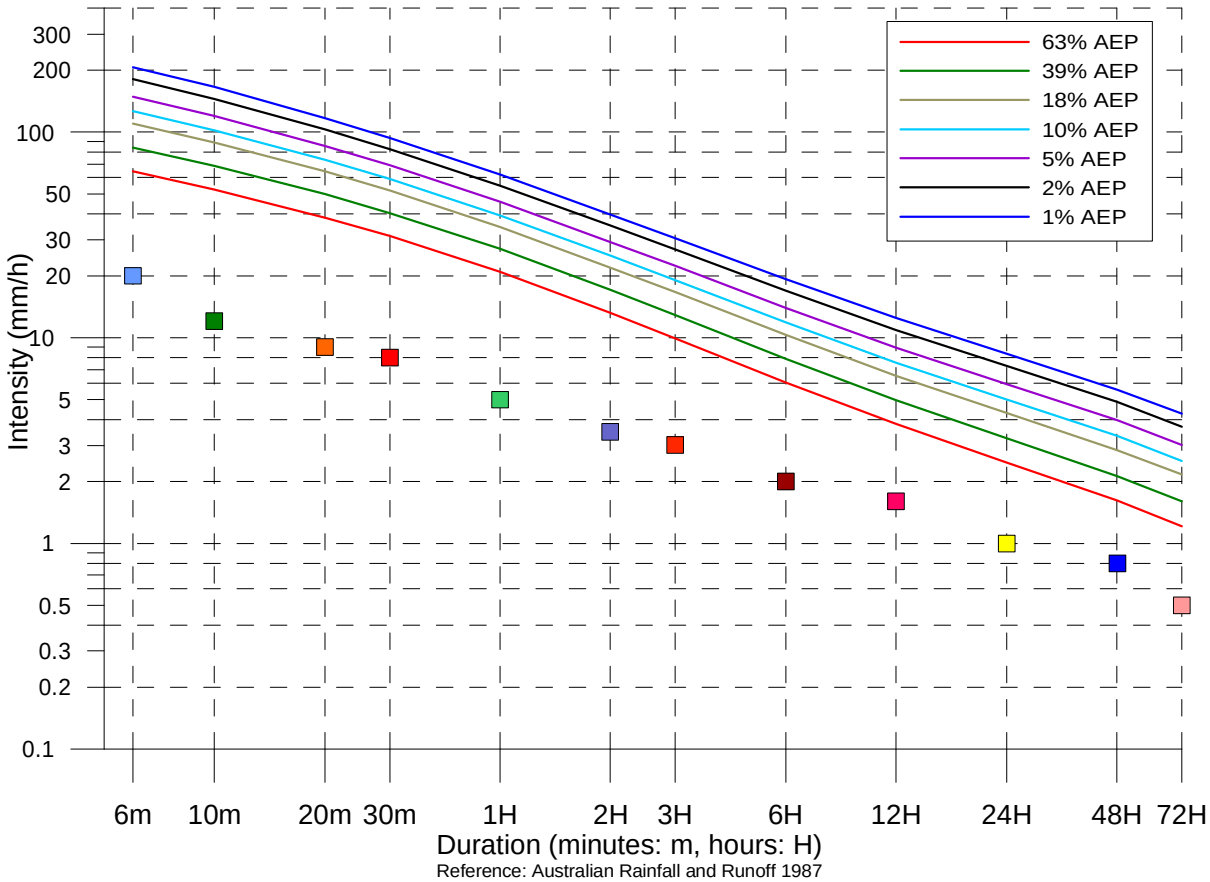
BYLONG MONTORO INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.11

Site owner: BoM Latitude: -31.8293 Longitude: 150.3479

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Mount Palmer Rainfall Intensity 01 April 2015 – 05 May 2015			
	Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
	6m	20.0	05:56_20/04/2015
	10m	12.0	07:08_21/04/2015
	20m	9.0	06:56_21/04/2015
	30m	8.0	06:48_21/04/2015
	1H	5.0	06:48_21/04/2015
	2H	3.5	06:20_21/04/2015
	3H	3.0	06:20_21/04/2015
	6H	2.0	06:20_21/04/2015
	12H	1.6	01:48_21/04/2015
	24H	1.0	22:18_20/04/2015
	48H	0.8	03:56_20/04/2015
	72H	0.5	03:56_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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MOUNT PALMER INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

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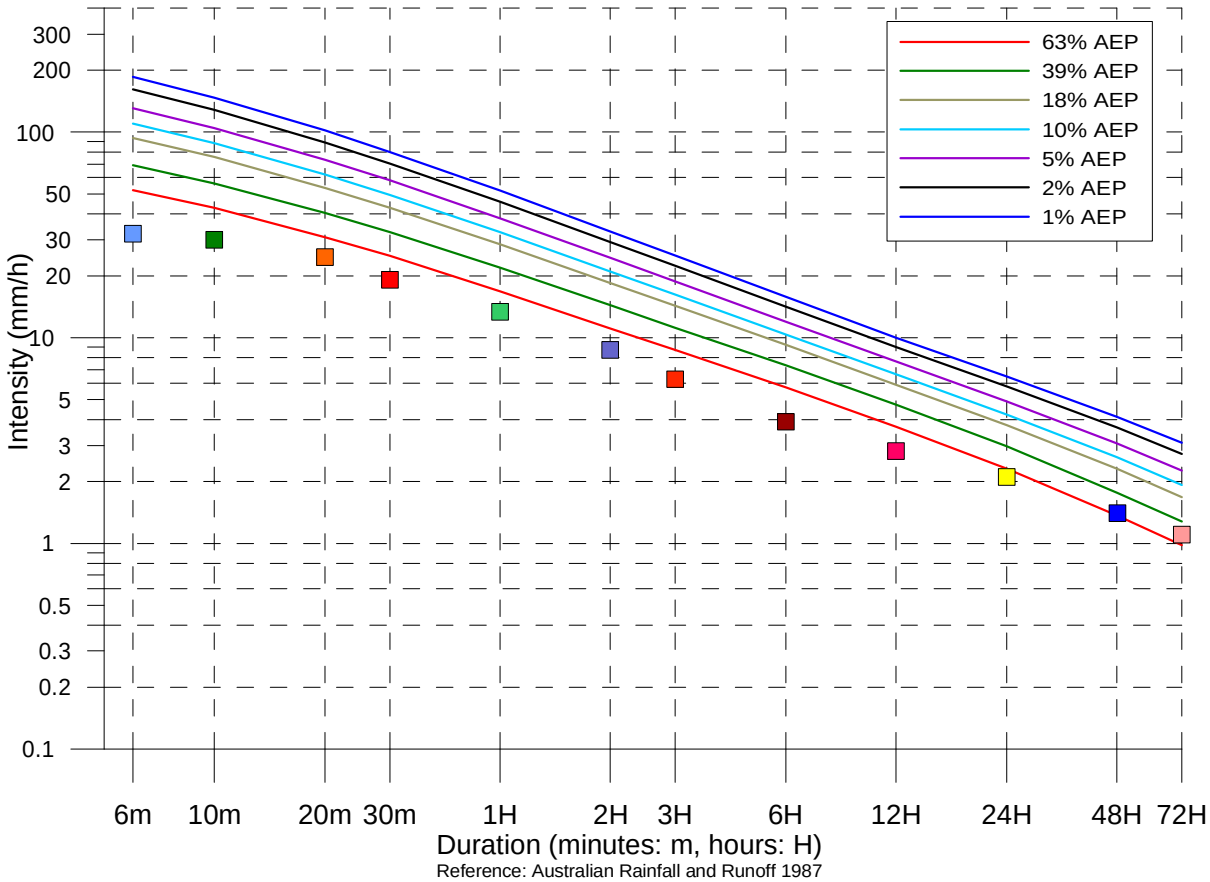
Figure 4.12

Site owner: NOW Latitude: -32.3809 Longitude: 150.7114

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Denman Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	32.0	08:00_21/04/2015
10m	30.0	07:56_21/04/2015
20m	24.6	07:50_21/04/2015
30m	19.2	07:42_21/04/2015
1H	13.4	07:14_21/04/2015
2H	8.7	06:22_21/04/2015
3H	6.3	05:22_21/04/2015
6H	3.9	04:46_21/04/2015
12H	2.8	21:34_20/04/2015
24H	2.1	09:06_20/04/2015
48H	1.4	00:50_20/04/2015
72H	1.1	00:50_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

DENMAN INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.13

4.3 Upper Hunter River Region - Williams Water Level

The locations of water level stations within the Williams River region are shown in Figure 4.14. The water level data for the period 01 April to 05 May 2015 are displayed graphically in Figures 4.15 to 4.19. The peak observed water levels are listed in Table 4.4.

Table 4.5 lists the SES Flood Classifications for Dungog. The SES classification scheme indicates the flood peak for Dungog was classified as a major flood during the April 2015 event.

Table 4.4 Upper Hunter River Region - Williams Flood Peaks

Station Name	Station No.	Site Owner	Datum	Peak level (m)
Pages River Upstream Kewell Creek	210142	NOW	Local Gauge Datum	0.59
Pages River at Blandford	210061	NOW	Local Gauge Datum	0.82
Dart Brook at Yarrandi Bridge	210124	NOW	Local Gauge Datum	0.65
Hunter River at Belltrees	210039	NOW	Local Gauge Datum	1.06
Moonan Brook	210017	NOW	Local Gauge Datum	1.05
Hunter River at Aberdeen	210056	NOW	Local Gauge Datum	3.65
Hunter River at Muswellbrook Bridge	210002	NOW	Local Gauge Datum	2.99
Antiene Creek at Liddell	210076	NOW	Local Gauge Datum	1.44
Glennies Creek at Middle Falbrook	210044	NOW	Local Gauge Datum	6.12
Glennies The Rocks 2	210084	NOW	Local Gauge Datum	1.26
Paterson River at Downstream Lostock Dam	210021	NOW	Local Gauge Datum	3.37
Allyn River at Halton	210022	NOW	Local Gauge Datum	4.66
Chichester River at Chichester	210136	NOW	Local Gauge Datum	2.87
Wangat River at Wangat	210137	NOW	Local Gauge Datum	1.50
Chichester River at Cipolletti Weir	210150	NOW	Local Gauge Datum	2.90
Williams River at Tillegra	210011	NOW	Local Gauge Datum	7.58
Williams River at Underbank	210144	NOW	Local Gauge Datum	3.97
Williams River at Dungog	210903	NOW	Local Gauge Datum	8.68

Table 4.5 SES Flood Classification for Dungog

Station	Classification			Peak (m)	Classification
	Minor	Moderate	Major		
	Water Level (m Local Gauge Datum)				
Dungog	4.9	7.6	8.5	8.68 (10:30 21/04/15)	Major

4.4 Upper Hunter River Region - Williams Rainfall

9.00 a.m. daily rainfall totals are displayed in Table 4.6 and Table 4.7 and Figures 4.20 to 4.24 for the period 20th April to 5th May 2015. The rainfall data and intensities are displayed graphically in Figures 4.25 – 4.40.

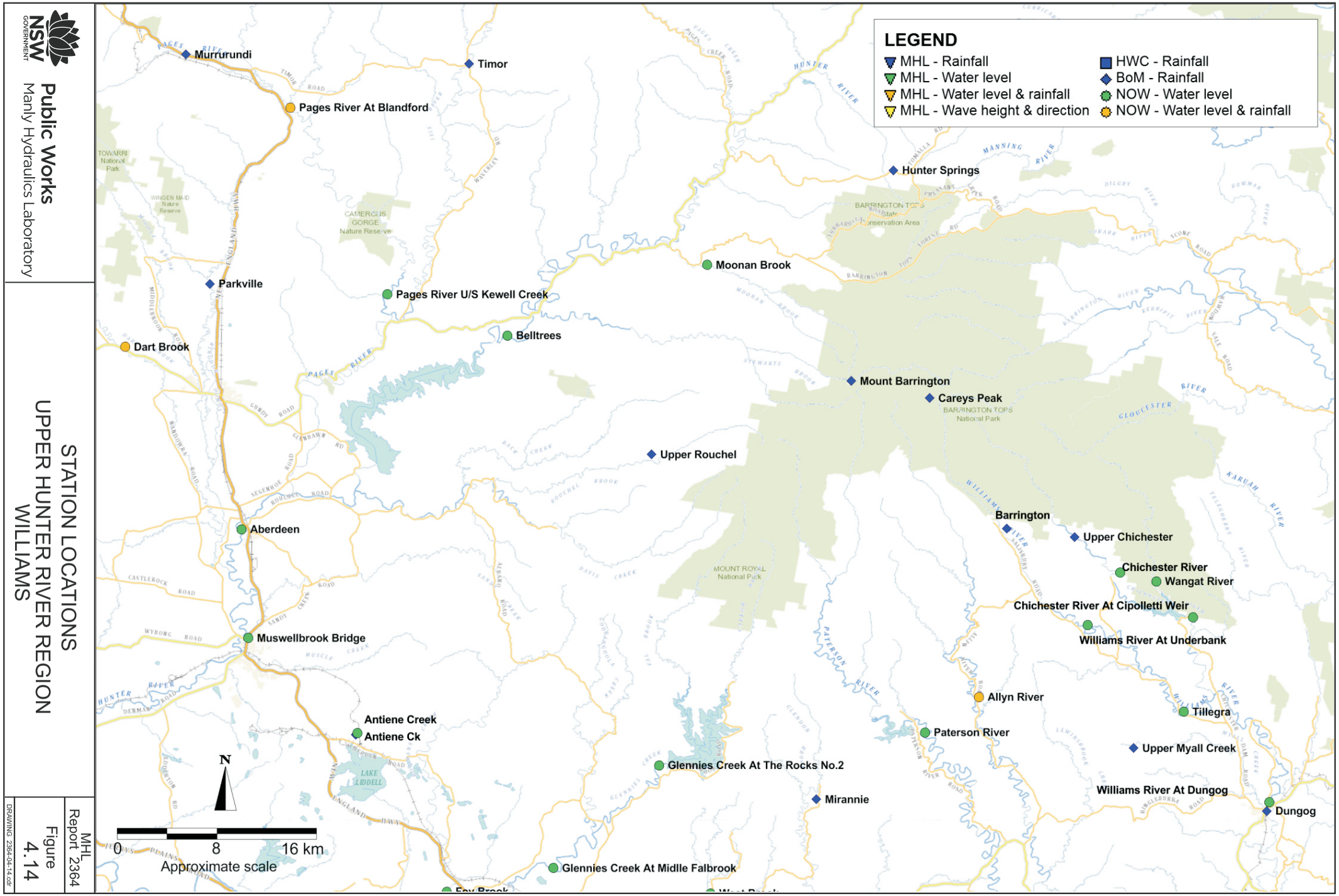
Table 4.6 Upper Hunter River Region – Williams East Daily Rainfall Totals

Date	Murrurundi (mm)	Timor (mm)	Antiene Ck (mm)	Blandford (mm)	Parkville (mm)	Dart Brook (mm)	Allyn River (mm)	Upper Rouchel (mm)
	BOM	BOM	BOM	NOW	BOM	NOW	NOW	BOM
20/04/2015	9.2	4.6	16.8	19.2	11.8	13.8	19.0	0.0
21/04/2015	12.0	49.2	84.4	11.4	26.4	18.6	156.0	0.0
22/04/2015	14.2	15.8	26.4	14.0	14.4	10.2	39.0	0.2
23/04/2015	2.4	3.2	13.8	2.8	5.2	6.0	6.0	26.6
24/04/2015	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.0
25/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26/04/2015	2.2	2.4	8.0	0.4	1.2	1.0	0.0	1.4
27/04/2015	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.6
28/04/2015	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
29/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30/04/2015	0.0	0.2	0.0	0.0	0.0	0.0	6.0	0.0
01/05/2015	1.2	0.2	2.8	0.6	0.4	1.0	4.5	0.2
02/05/2015	2.2	2.4	4.6	2.2	2.0	2.2	12.5	5.2
03/05/2015	1.6	3.6	7.4	2.0	1.4	0.8	16.5	1.2
04/05/2015	1.0	15.0	6.2	1.4	5.2	4.0	11.0	5.2
05/05/2015	0.0	0.0	0.2	0.0	0.0			0.0
Total	**46.0**	**96.8**	**171.0**	**54.4**	**68.0**	**57.8**	**270.5**	**40.6**

\

Table 4.7 Upper Hunter River Region - Williams West River Region Daily Rainfall Totals

Date	Hunter Springs (mm)	Mt Barrington (mm)	Careys Peak (mm)	Barrington (mm)	Mirannie (mm)	Upper Chichester (mm)	Upper Myall Ck (mm)	Dungog (mm)
	BOM	BOM	BOM	BOM	BOM	BOM	BOM	BOM
20/04/2015	1.2	2.0	2.0	21.0	11.0	20.4	6.0	13.2
21/04/2015	3.6	52.0	52.0	105.0	169.0	101.4	250.0	311.8
22/04/2015	20.2	57.0	57.0	49.0	39.0	45.8	45.0	40.2
23/04/2015	17.8	18.0	18.0	6.0	11.0	2.8	7.0	3.4
24/04/2015	0.4	1.0	1.0	1.0	0.0	0.0	1.0	0.0
25/04/2015	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
26/04/2015	8.2	0.0	0.0	0.0	0.0	0.4	0.0	0.0
27/04/2015	1.8	2.0	2.0	0.0	0.0	0.0	0.0	0.0
28/04/2015	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29/04/2015	0.0	2.0	2.0	1.0	1.0	2.4	1.0	2.4
30/04/2015	0.6	0.0	0.0	0.0	1.0	1.4	2.0	3.0
01/05/2015	3.0	2.0	2.0	7.0	2.0	0.8	5.0	2.0
02/05/2015	35.2	0.0	0.0	13.0	11.0	1.8	14.0	13.6
03/05/2015	6.6	0.0	0.0	36.0	9.0	2.4	27.0	24.8
04/05/2015	6.8	0.0	0.0	18.0	3.0	10.6	5.0	4.6
05/05/2015	0.4	0.0	0.0	6.0	0.0	0.8	0.0	0.0
Total	**106.6**	**136.0**	**136.0**	**263.0**	**257.0**	**191.0**	**363.0**	**419.2**



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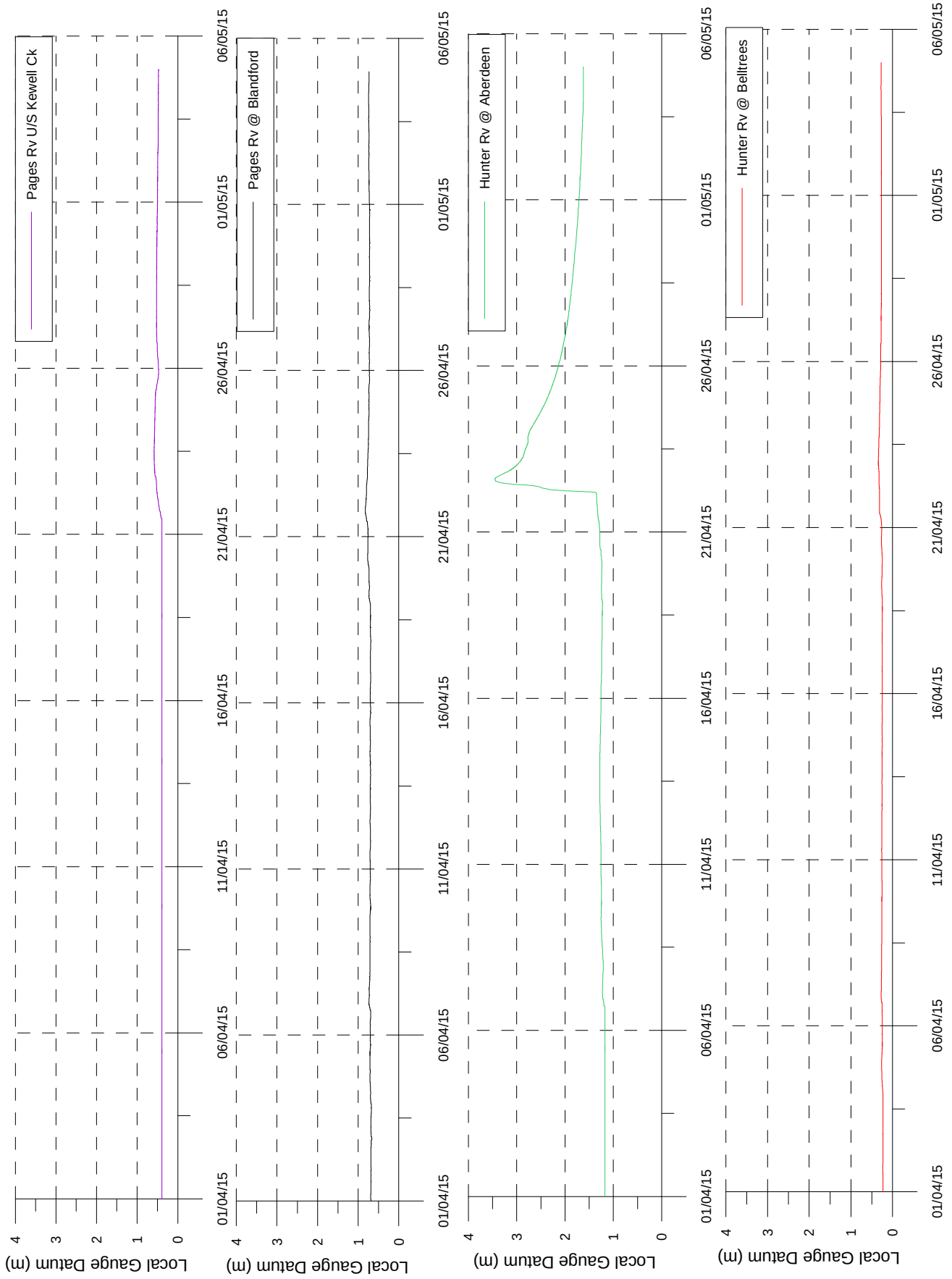
STATION LOCATIONS
UPPER HUNTER RIVER REGION
WILLIAMS

MHL Report 2364
Figure 4.14

DRAWING: 2364-04-14.cdr



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UPPER HUNTER RIVER REGION - WILLIAMS
WATER LEVEL
01 APRIL – 05 MAY 2015

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Figure
4.15

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UPPER HUNTER RIVER REGION - WILLIAMS
WATER LEVEL
01 APRIL – 05 MAY 2015

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REPORT 2364

Figure
4.16

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UPPER HUNTER RIVER REGION - WILLIAMS
WATER LEVEL
01 APRIL – 05 MAY 2015

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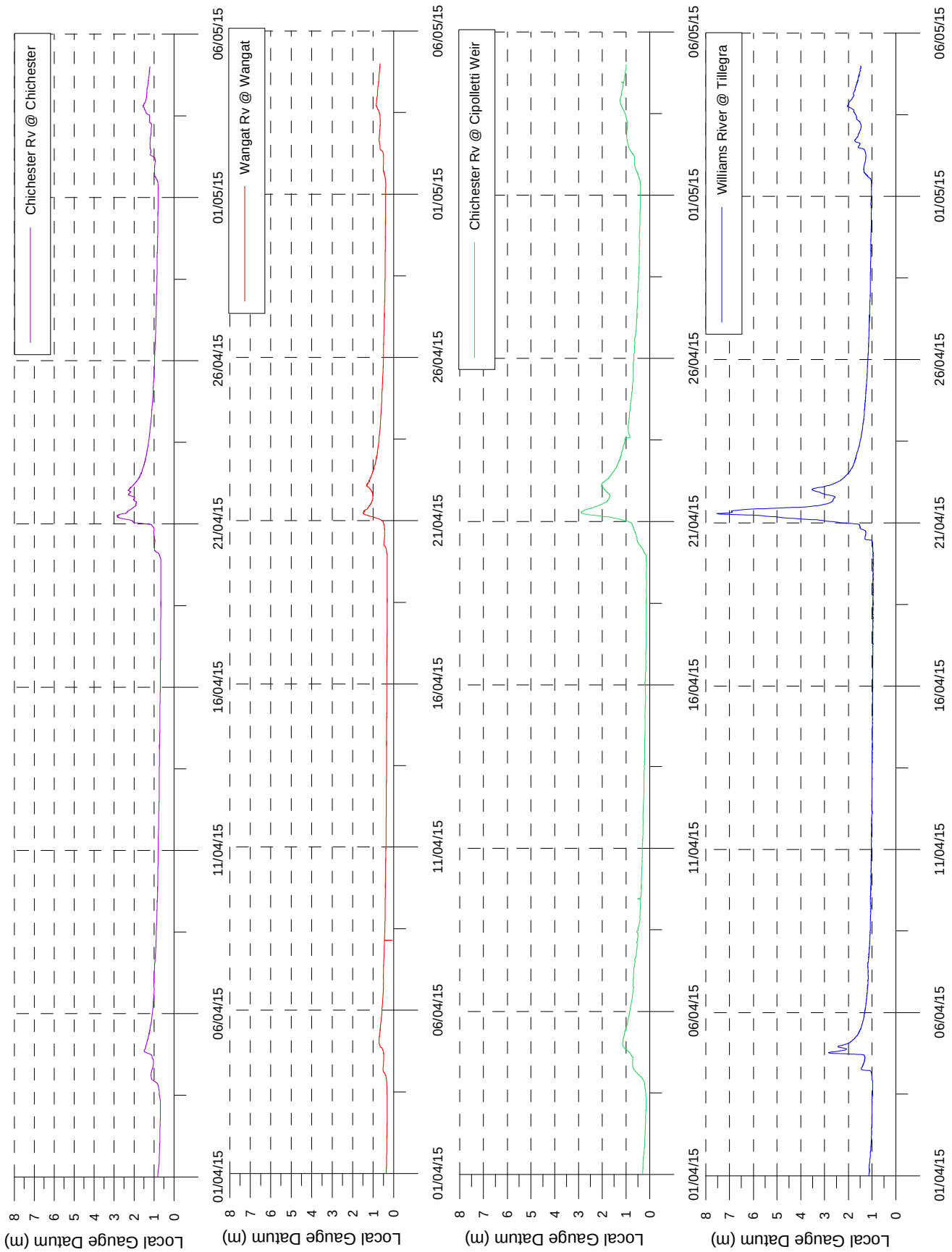
Figure
4.17

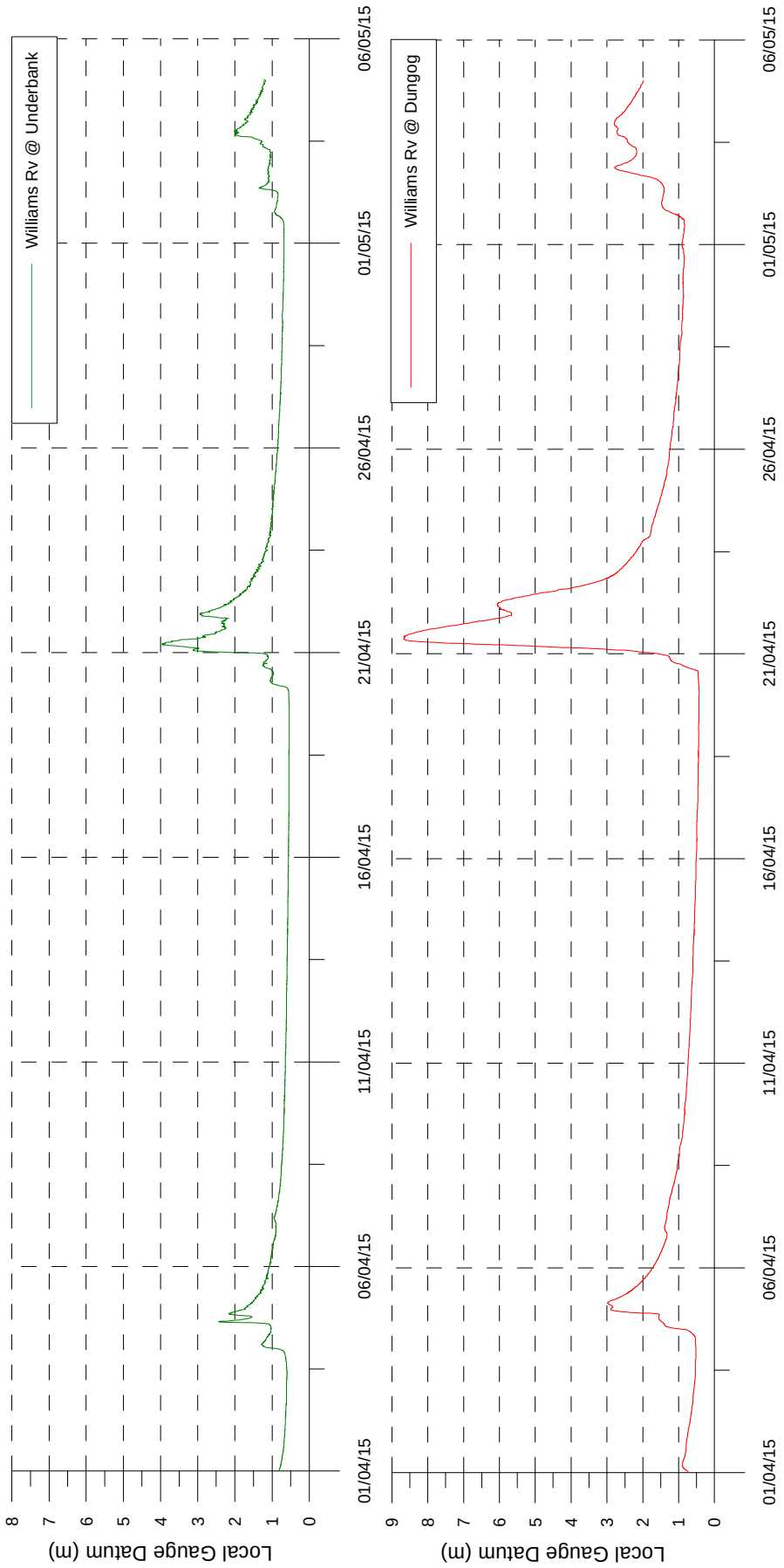


Public Works
Manly Hydraulics Laboratory

UPPER HUNTER RIVER REGION - WILLIAMS WATER LEVEL
01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.18

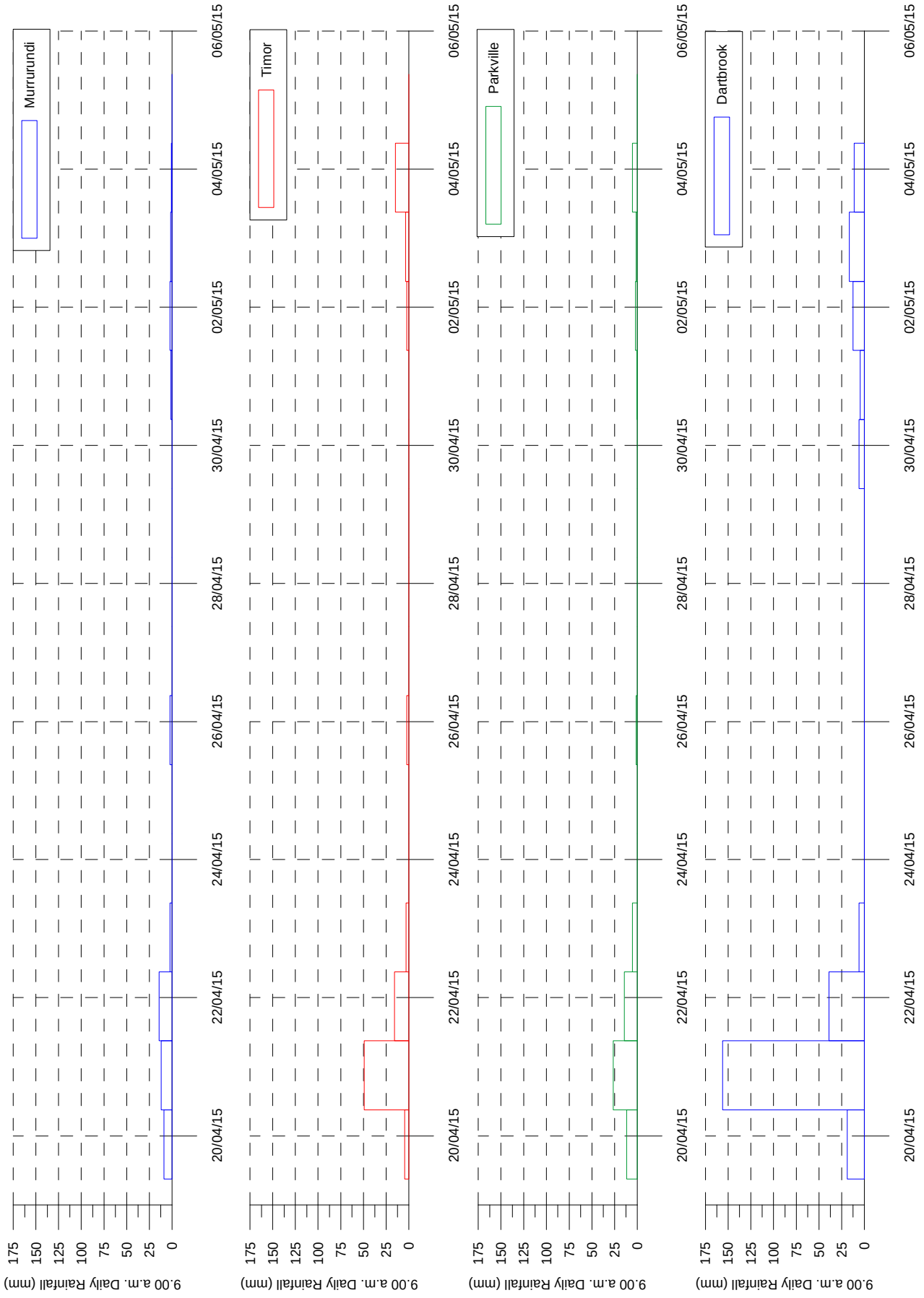


NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

UPPER HUNTER RIVER REGION - WILLIAMS WATER LEVEL
01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.19



Public Works
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UPPER HUNTER RIVER REGION - WILLIAMS RAINFALL
20 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.20

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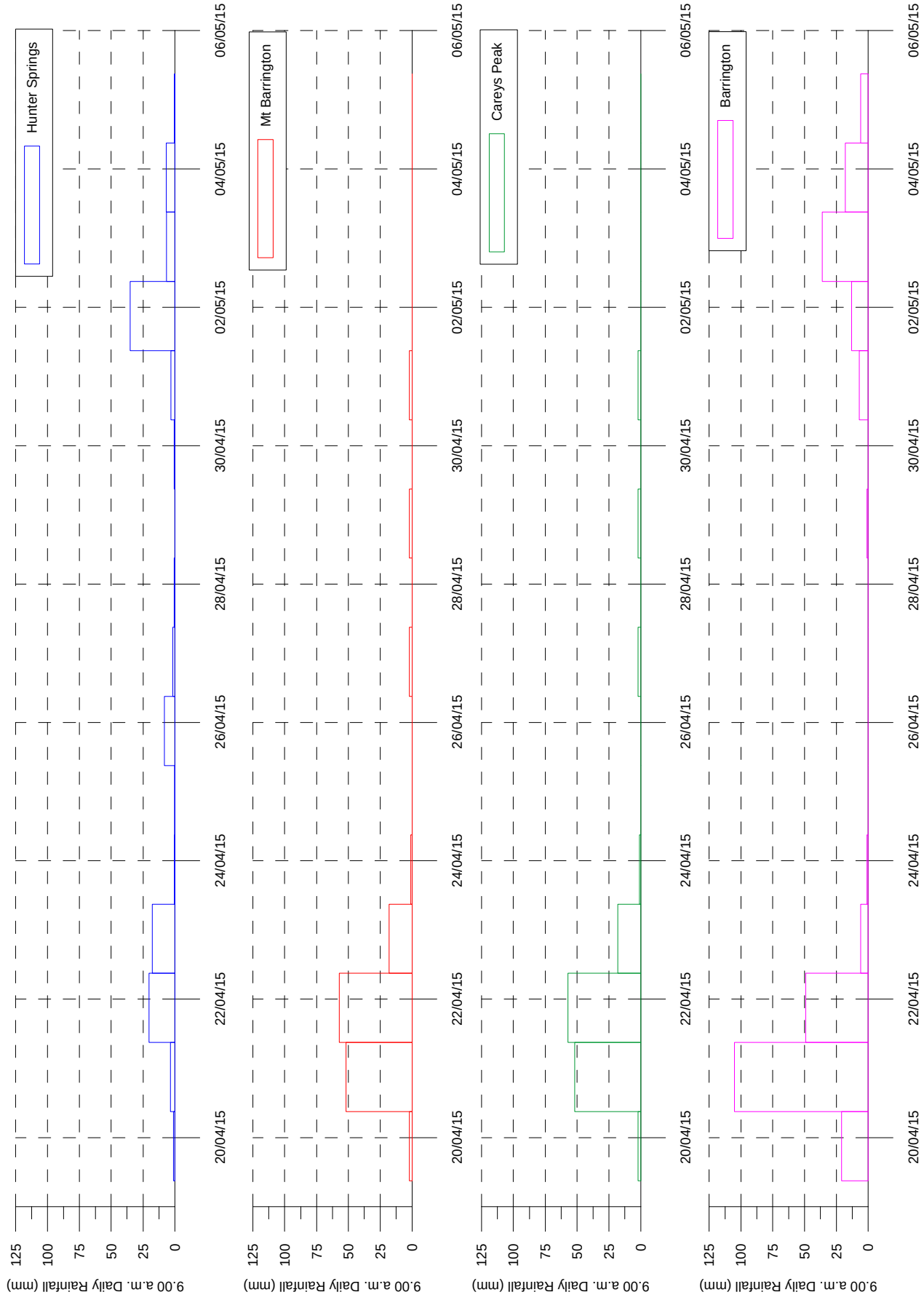
UPPER HUNTER RIVER REGION - WILLIAMS RAINFALL
20 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.21



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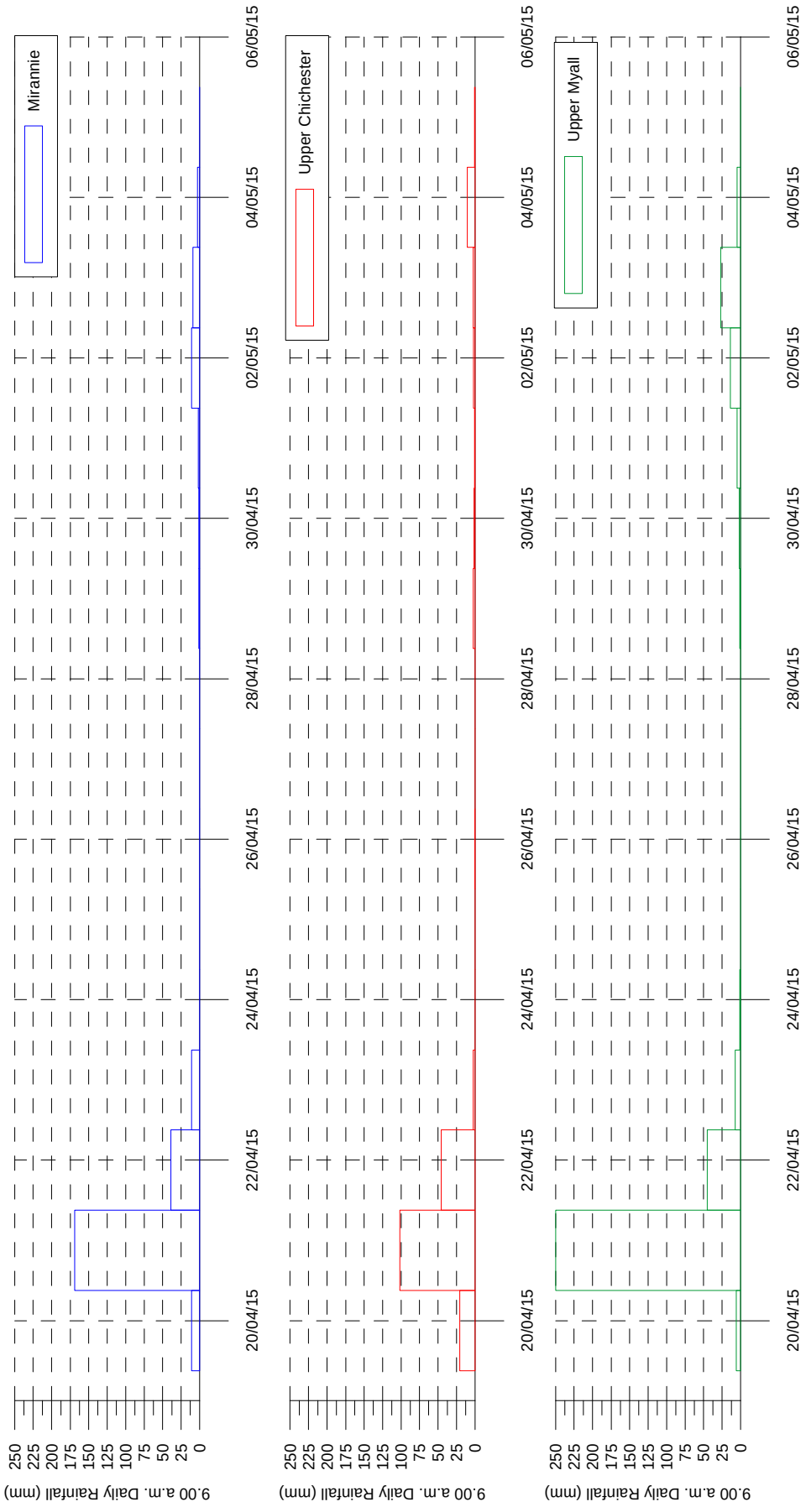
UPPER HUNTER RIVER REGION - WILLIAMS RAINFALL
20 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.22



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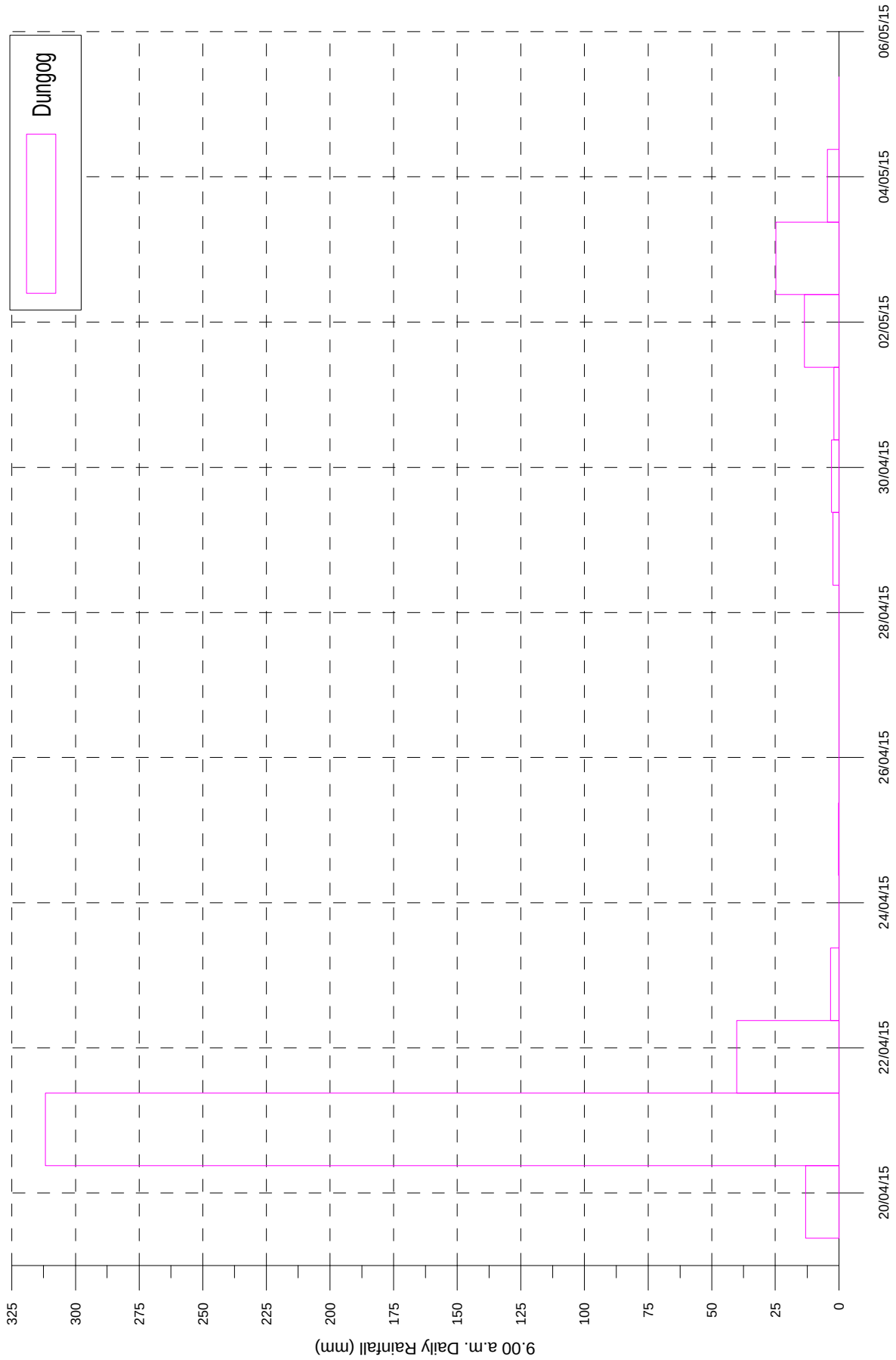
UPPER HUNTER RIVER REGION - WILLIAMS RAINFALL
20 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.23



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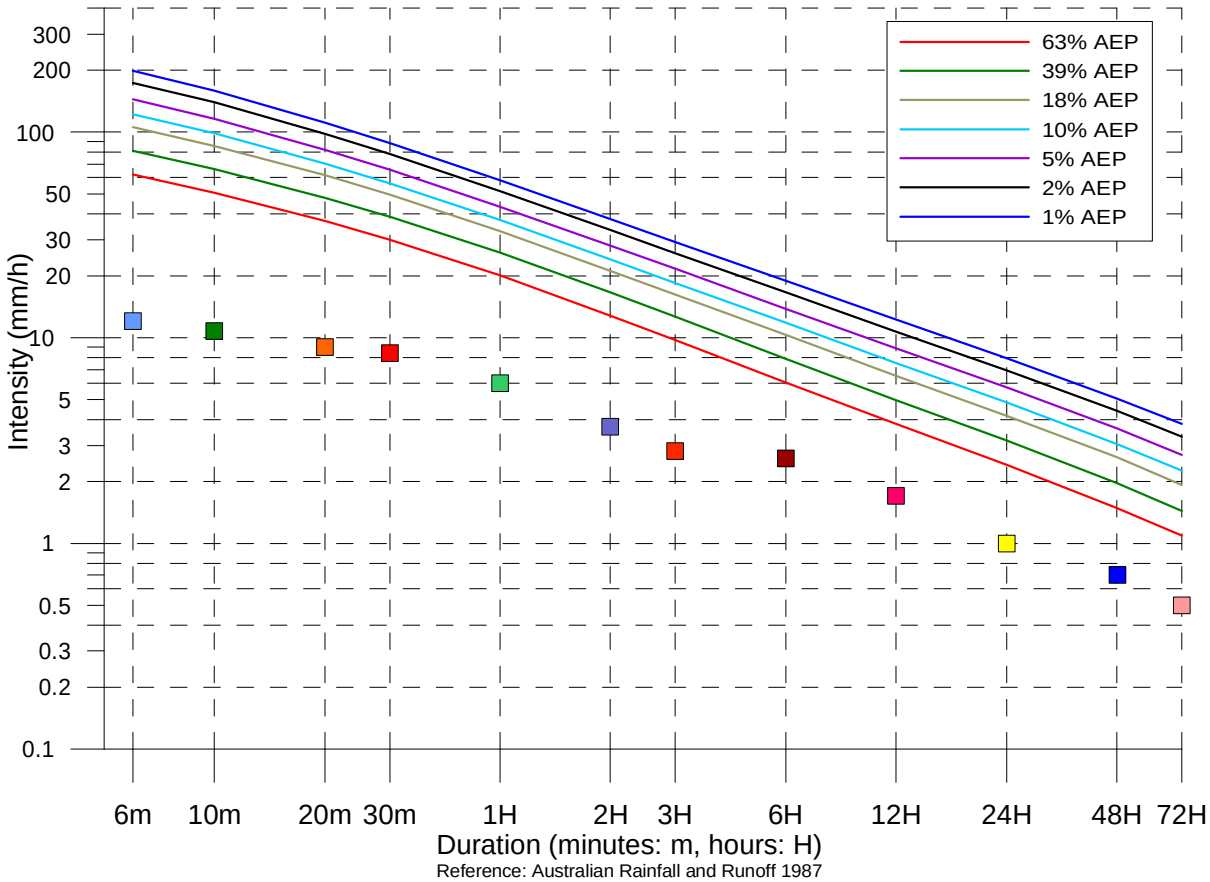
UPPER HUNTER RIVER REGION - WILLIAMS RAINFALL
20 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.24

Site owner: BoM Latitude: -31.7651 Longitude: 150.8363

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Murrurundi Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	12.0	10:56_21/04/2015
10m	10.8	10:52_21/04/2015
20m	9.0	10:56_21/04/2015
30m	8.4	10:46_21/04/2015
1H	6.0	10:38_21/04/2015
2H	3.7	09:58_21/04/2015
3H	2.8	05:40_21/04/2015
6H	2.6	06:18_21/04/2015
12H	1.7	05:40_21/04/2015
24H	1.0	23:12_20/04/2015
48H	0.7	00:40_20/04/2015
72H	0.5	00:40_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

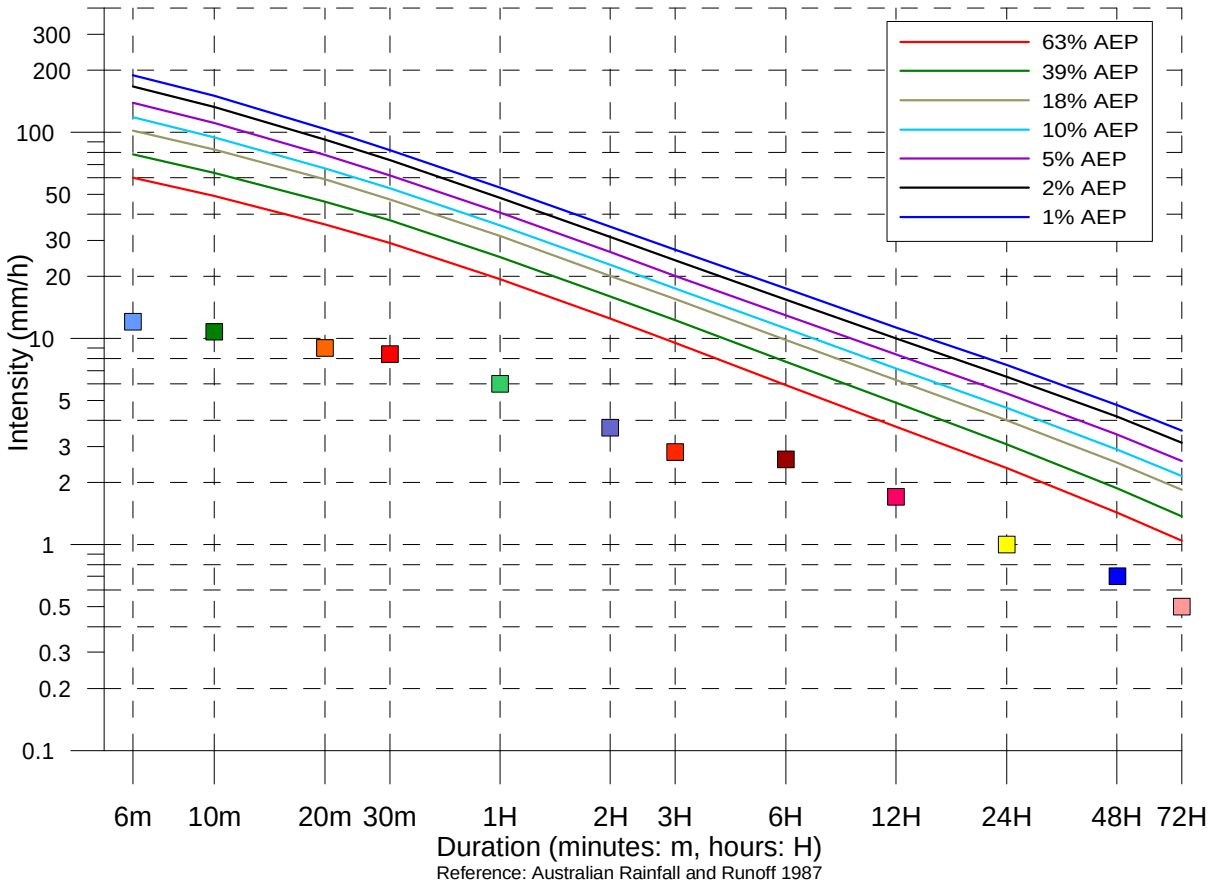
MURRURUNDI INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.25

Site owner: BoM Latitude: -31.773 Longitude: 151.0776

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Timor Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	12.0	10:56_21/04/2015
10m	10.8	10:52_21/04/2015
20m	9.0	10:56_21/04/2015
30m	8.4	10:46_21/04/2015
1H	6.0	10:38_21/04/2015
2H	3.7	09:58_21/04/2015
3H	2.8	05:40_21/04/2015
6H	2.6	06:18_21/04/2015
12H	1.7	05:40_21/04/2015
24H	1.0	23:12_20/04/2015
48H	0.7	00:40_20/04/2015
72H	0.5	00:40_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

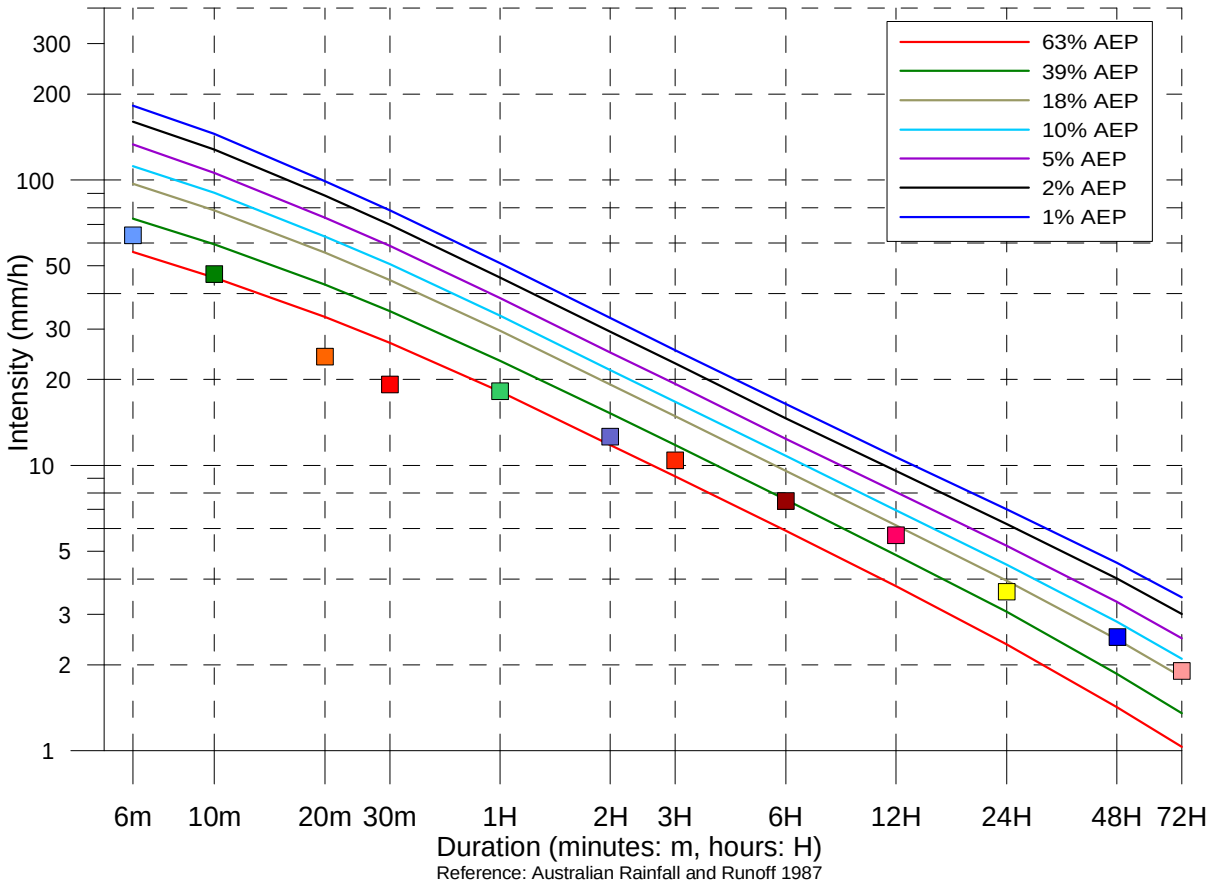
TIMOR
INTENSITY-FREQUENCY-DURATION
01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.26

Site owner: BoM Latitude: -32.338 Longitude: 150.9811

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Antiene Creek Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	64.0	17:04_25/04/2015
10m	46.8	17:02_25/04/2015
20m	24.0	17:02_25/04/2015
30m	19.2	07:04_21/04/2015
1H	18.2	06:34_21/04/2015
2H	12.6	05:50_21/04/2015
3H	10.4	04:52_21/04/2015
6H	7.5	01:48_21/04/2015
12H	5.7	21:32_20/04/2015
24H	3.6	07:56_20/04/2015
48H	2.5	01:30_20/04/2015
72H	1.9	00:26_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

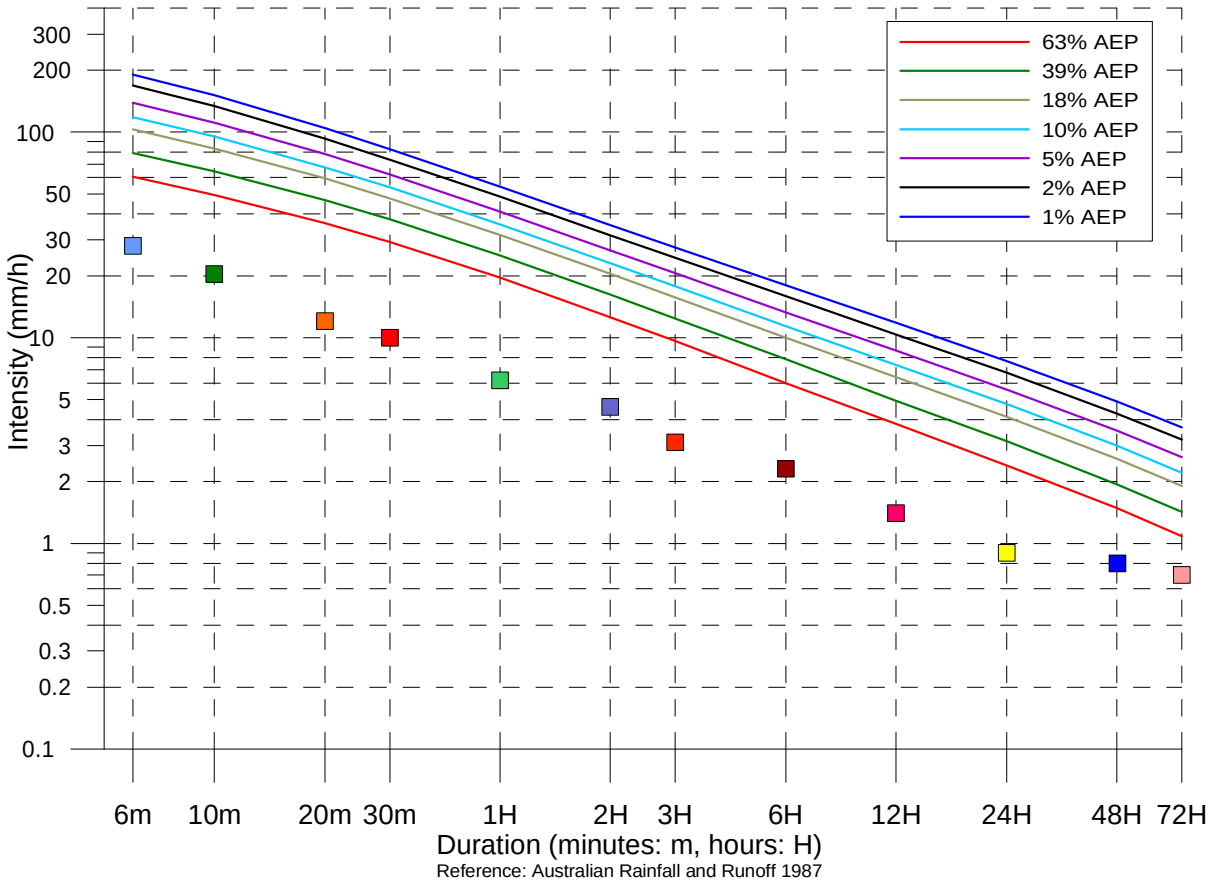
ANTIENE CREEK INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.27

Site owner: NOW Latitude: -31.8098 Longitude: 150.9252

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Pages River at Blandford Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Intensity (mm/h)**	**Time/Date**
6m	28.0	12:28_19/04/2015
10m	20.4	12:28_19/04/2015
20m	12.0	10:56_21/04/2015
30m	10.0	10:48_21/04/2015
1H	6.2	10:36_21/04/2015
2H	4.6	16:48_06/04/2015
3H	3.1	16:58_06/04/2015
6H	2.3	16:48_06/04/2015
12H	1.4	00:26_21/04/2015
24H	0.9	21:18_20/04/2015
48H	0.8	12:04_19/04/2015
72H	0.7	22:54_18/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

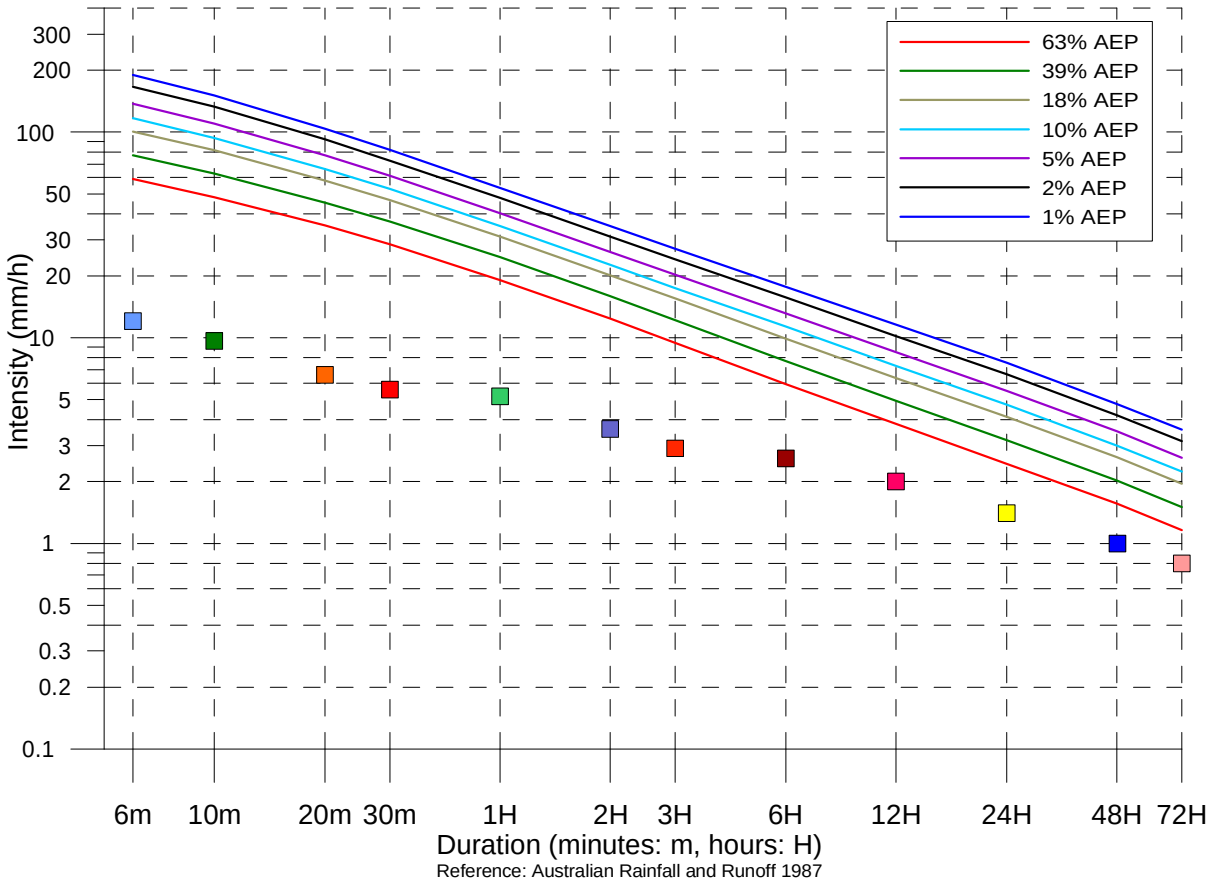
PAGES RIVER AT BLANDFORD INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.28

Site owner: BoM Latitude: -31.9583 Longitude: 150.8567

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Parkville Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	12.0	20:24_22/04/2015
10m	9.6	02:48_21/04/2015
20m	6.6	02:48_21/04/2015
30m	5.6	05:34_21/04/2015
1H	5.2	05:24_21/04/2015
2H	3.6	05:04_21/04/2015
3H	2.9	03:28_21/04/2015
6H	2.6	00:18_21/04/2015
12H	2.0	21:02_20/04/2015
24H	1.4	20:48_20/04/2015
48H	1.0	00:18_20/04/2015
72H	0.8	00:08_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

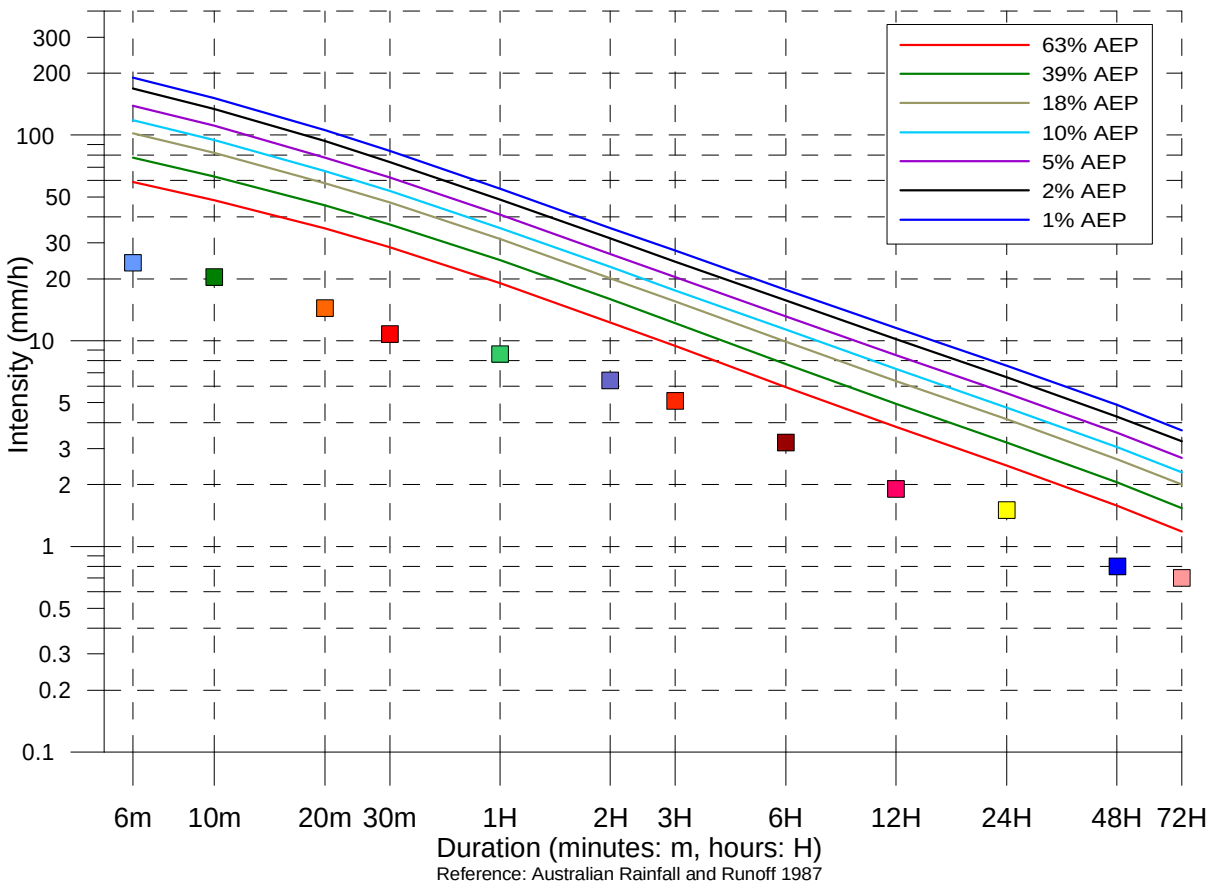
PARKVILLE INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.29

Site owner: NOW Latitude: -32.0113 Longitude: 150.7846

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Dart Brook at Yarrandi Bridge Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Intensity (mm/h)**	**Time/Date**
6m	24	15:36_06/04/2015
10m	20.4	15:38_06/04/2015
20m	14.4	15:32_06/04/2015
30m	10.8	15:28_06/04/2015
1H	8.6	14:10_04/04/2015
2H	6.4	13:58_04/04/2015
3H	5.1	15:02_06/04/2015
6H	3.2	14:50_06/04/2015
12H	1.9	05:02_04/04/2015
24H	1.5	19:08_03/04/2015
48H	0.8	23:52_19/04/2015
72H	0.7	19:08_03/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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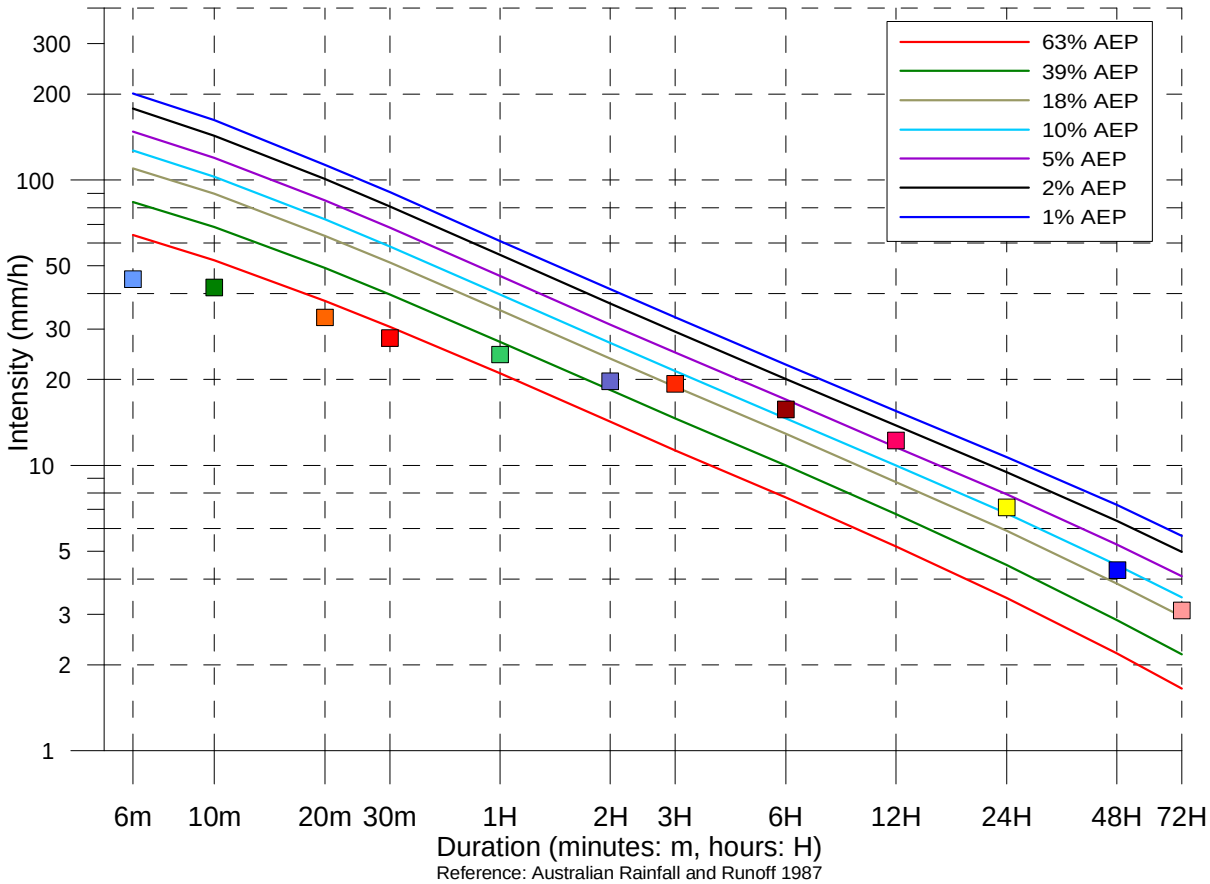
DART BROOK AT YARRANDI BRIDGE INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.30

Site owner: BoM Latitude: -32.3063 Longitude: 150.5129

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Allyn River Rainfall Intensity 01 April 2015 – 05 May 2015			
	Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
	6m	45.0	06:38_21/04/2015
	10m	42.0	06:34_21/04/2015
	20m	33.0	06:28_21/04/2015
	30m	28.0	06:18_21/04/2015
	1H	24.5	05:48_21/04/2015
	2H	19.7	04:48_21/04/2015
	3H	19.3	03:48_21/04/2015
	6H	15.7	00:52_21/04/2015
	12H	12.2	21:32_20/04/2015
	24H	7.1	21:10_20/04/2015
	48H	4.3	00:34_20/04/2015
	72H	3.1	22:08_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

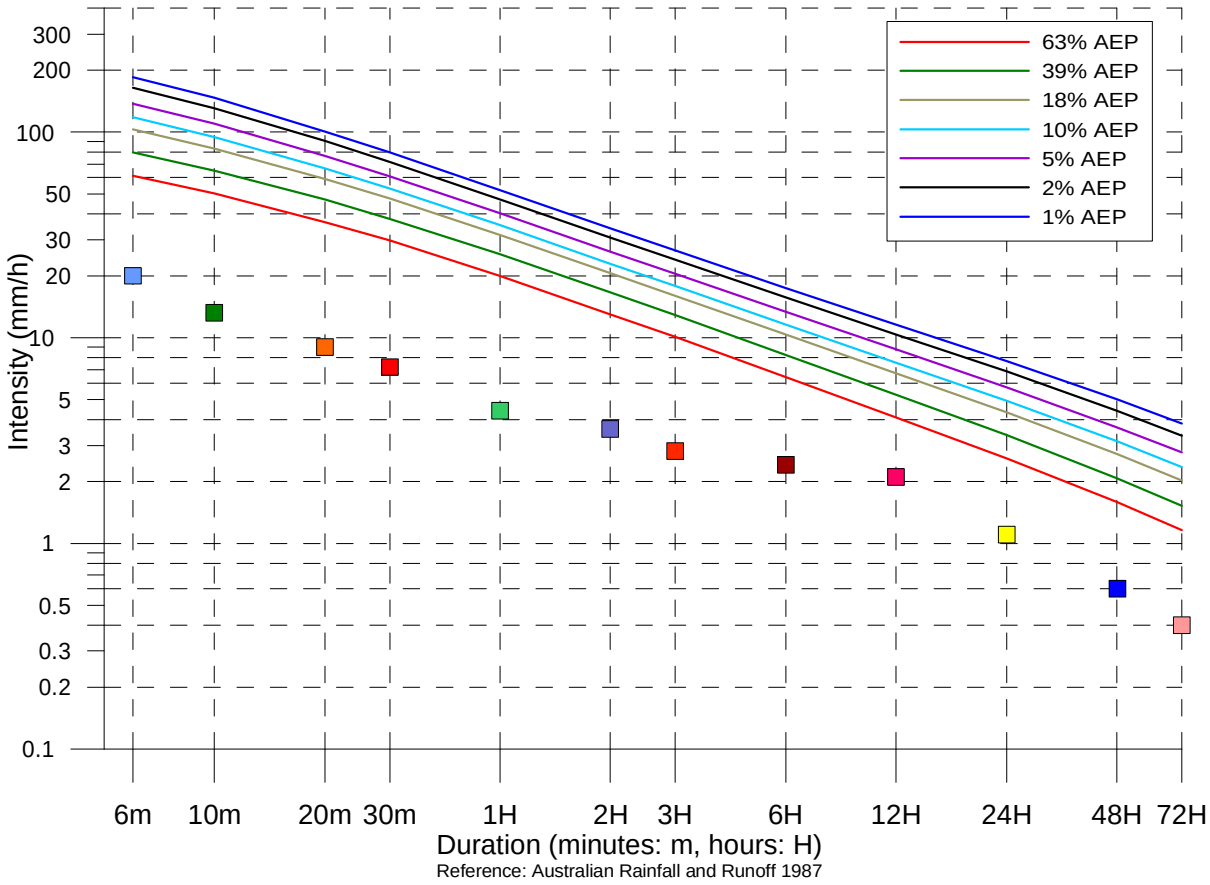
ALLYN RIVER INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.31

Site owner: BoM Latitude: -32.1018 Longitude: 151.2333

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Upper Rouchel Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	20.0	21:46_22/04/2015
10m	13.2	21:46_22/04/2015
20m	9.0	21:36_22/04/2015
30m	7.2	14:56_22/04/2015
1H	4.4	21:38_22/04/2015
2H	3.6	13:24_22/04/2015
3H	2.8	12:44_22/04/2015
6H	2.4	11:40_22/04/2015
12H	2.1	11:32_22/04/2015
24H	1.1	08:58_22/04/2015
48H	0.6	08:58_22/04/2015
72H	0.4	08:58_22/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

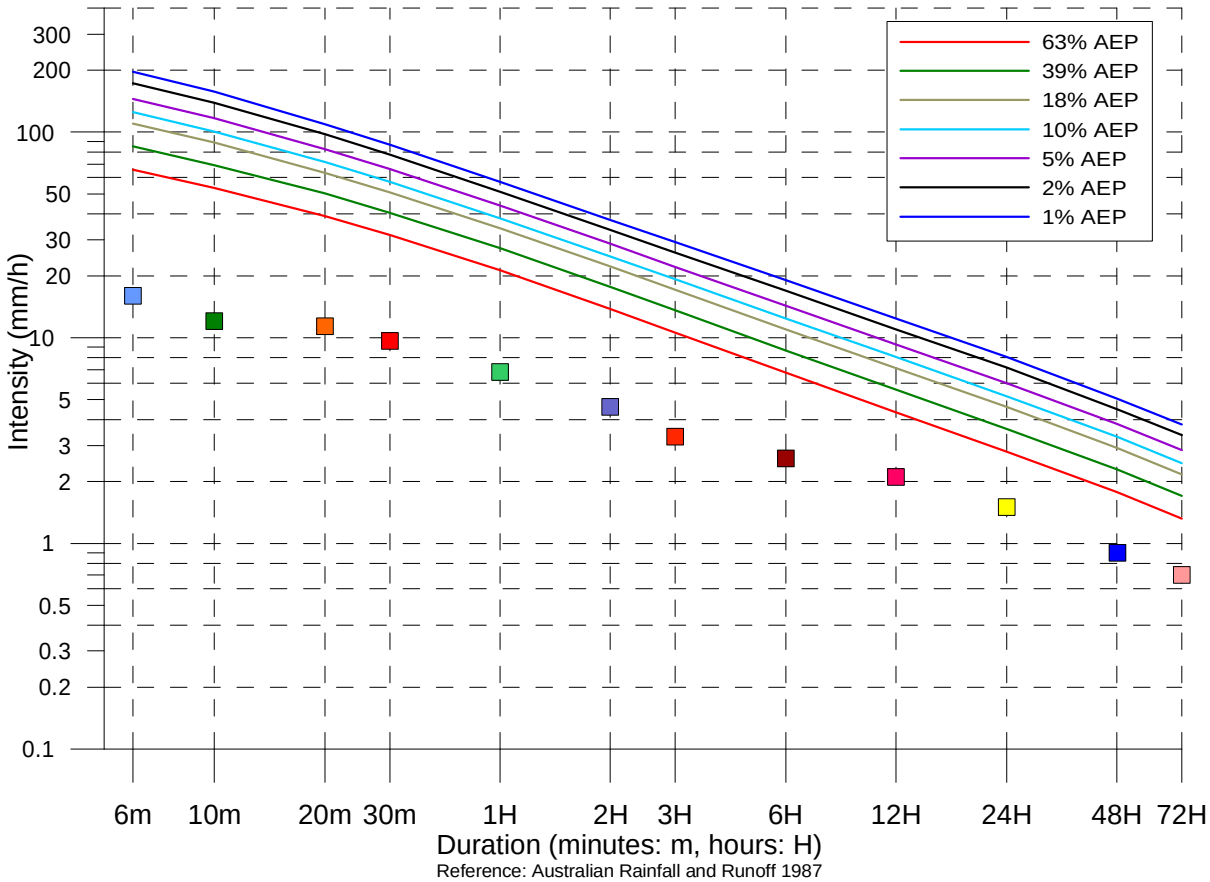
UPPER ROUCHEL INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.32

Site owner: BoM Latitude: -31.8626 Longitude: 151.4398

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Hunter Springs Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	16.0	15:10_03/05/2015
10m	12.0	15:06_03/05/2015
20m	11.4	15:00_03/05/2015
30m	9.6	14:48_03/05/2015
1H	6.8	21:04_21/04/2015
2H	4.6	20:48_21/04/2015
3H	3.3	15:02_01/05/2015
6H	2.6	12:44_01/05/2015
12H	2.1	08:52_01/05/2015
24H	1.5	08:10_01/05/2015
48H	0.9	03:14_01/05/2015
72H	0.7	19:00_30/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

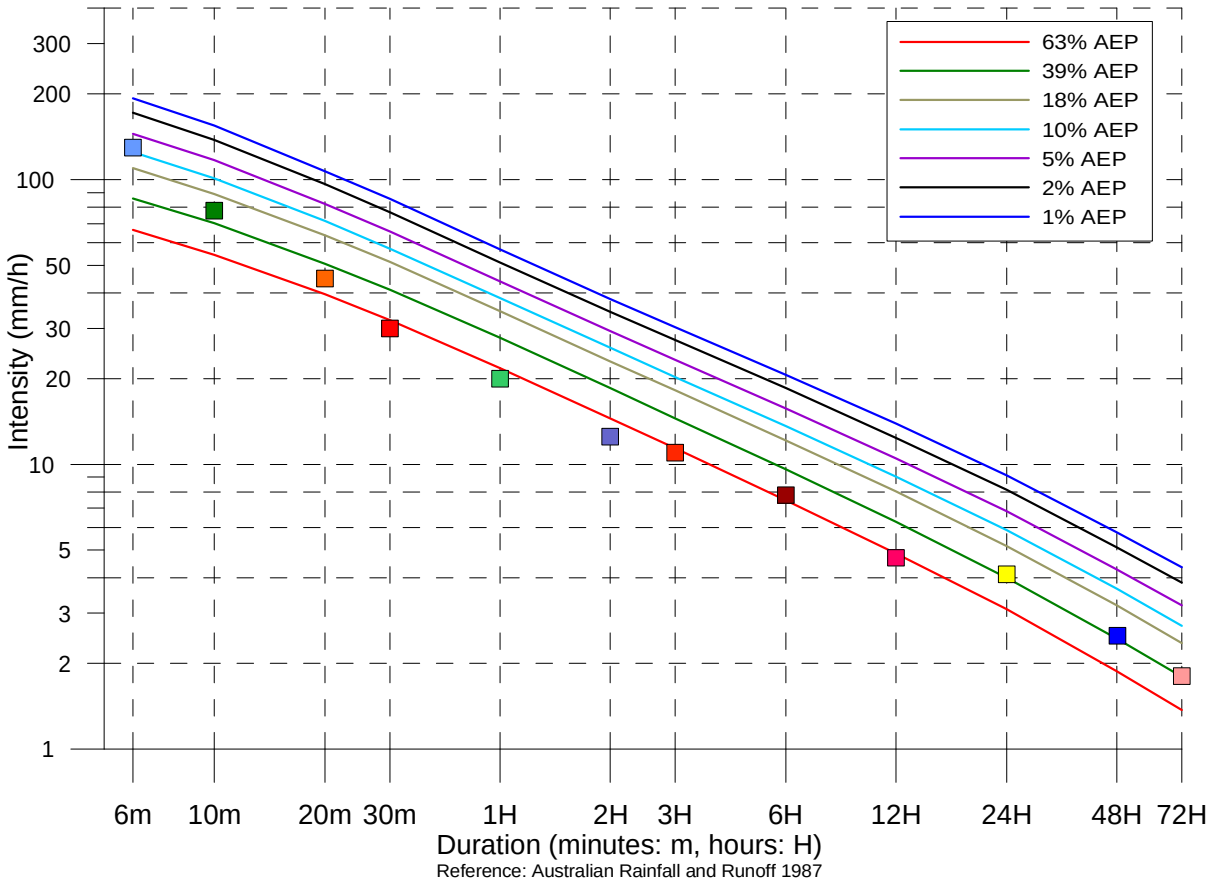
HUNTER SPRINGS INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.33

Site owner: BoM Latitude: -32.04 Longitude: 150.4039

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Mount Barrington Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	130.0	20:48_21/04/2015
10m	78.0	20:48_21/04/2015
20m	45.0	20:48_21/04/2015
30m	30.0	20:48_21/04/2015
1H	20.0	20:48_21/04/2015
2H	12.5	20:48_21/04/2015
3H	11.0	20:48_21/04/2015
6H	7.8	23:12_20/04/2015
12H	4.7	13:02_21/04/2015
24H	4.1	23:12_20/04/2015
48H	2.5	23:12_20/04/2015
72H	1.8	07:52_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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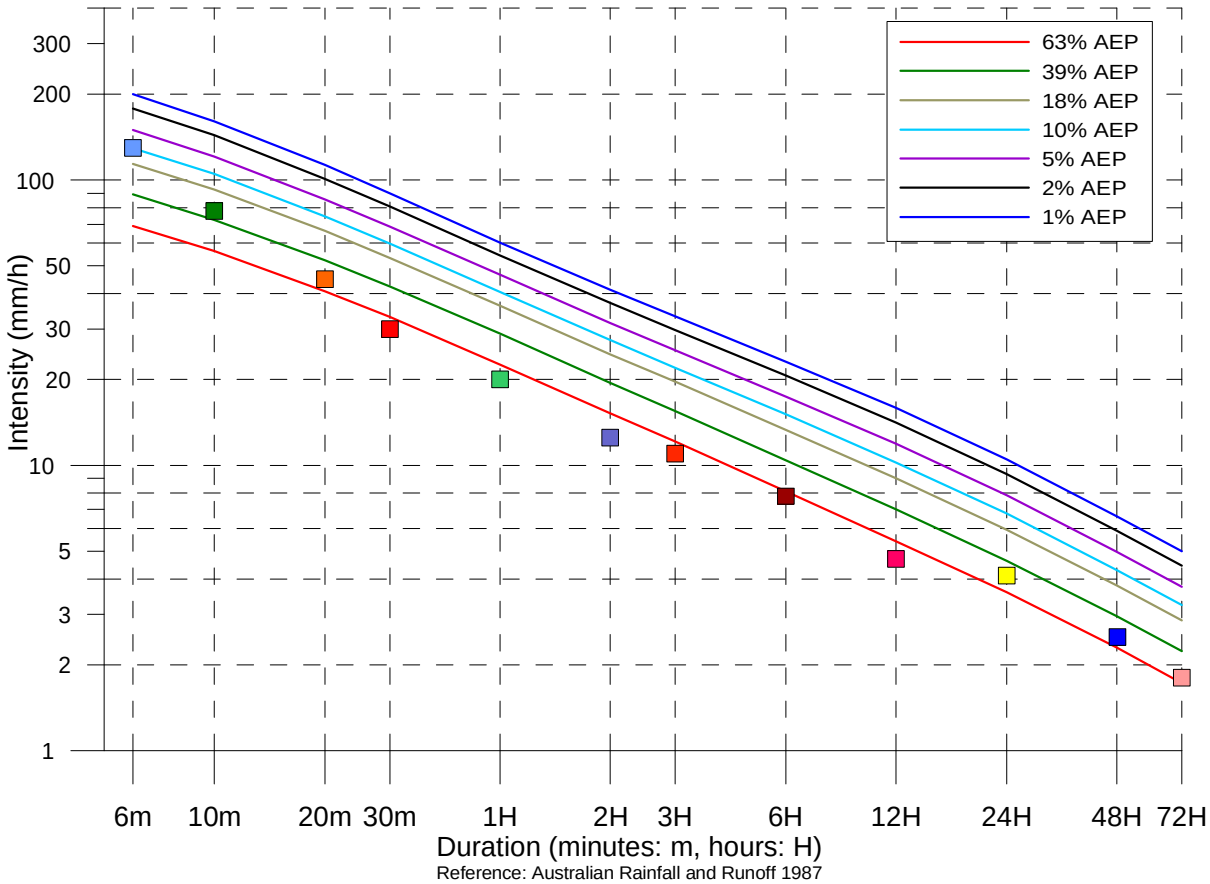
MOUNT BARRINGTON INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.34

Site owner: BoM Latitude: -32.0544 Longitude: 151.4706

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Careys Peak Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		130.0	20:48_21/04/2015
10m		78.0	20:48_21/04/2015
20m		45.0	20:48_21/04/2015
30m		30.0	20:48_21/04/2015
1H		20.0	20:48_21/04/2015
2H		12.5	20:48_21/04/2015
3H		11.0	20:48_21/04/2015
6H		7.8	23:12_20/04/2015
12H		4.7	13:02_21/04/2015
24H		4.1	23:12_20/04/2015
48H		2.5	23:12_20/04/2015
72H		1.8	07:52_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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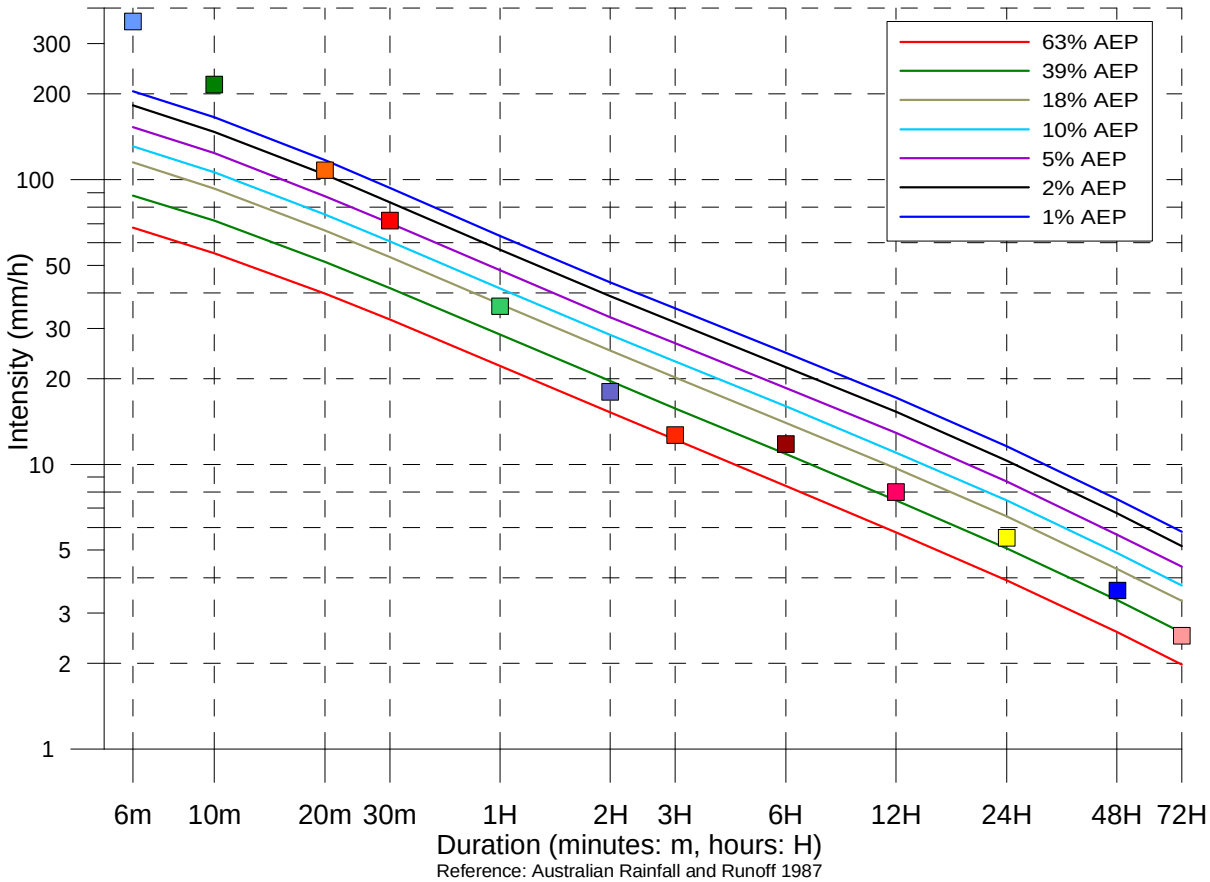
CAREYS PEAK INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.35

Site owner: BoM Latitude: -32.1645 Longitude: 151.5366

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Barrington Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	360.0	06:54_03/05/2015
10m	216.0	06:54_03/05/2015
20m	108.0	06:54_03/05/2015
30m	72.0	06:54_03/05/2015
1H	36.0	06:54_03/05/2015
2H	18.0	06:54_03/05/2015
3H	12.7	22:54_20/04/2015
6H	11.8	22:54_20/04/2015
12H	8.0	21:40_20/04/2015
24H	5.5	22:12_20/04/2015
48H	3.6	00:18_20/04/2015
72H	2.5	00:18_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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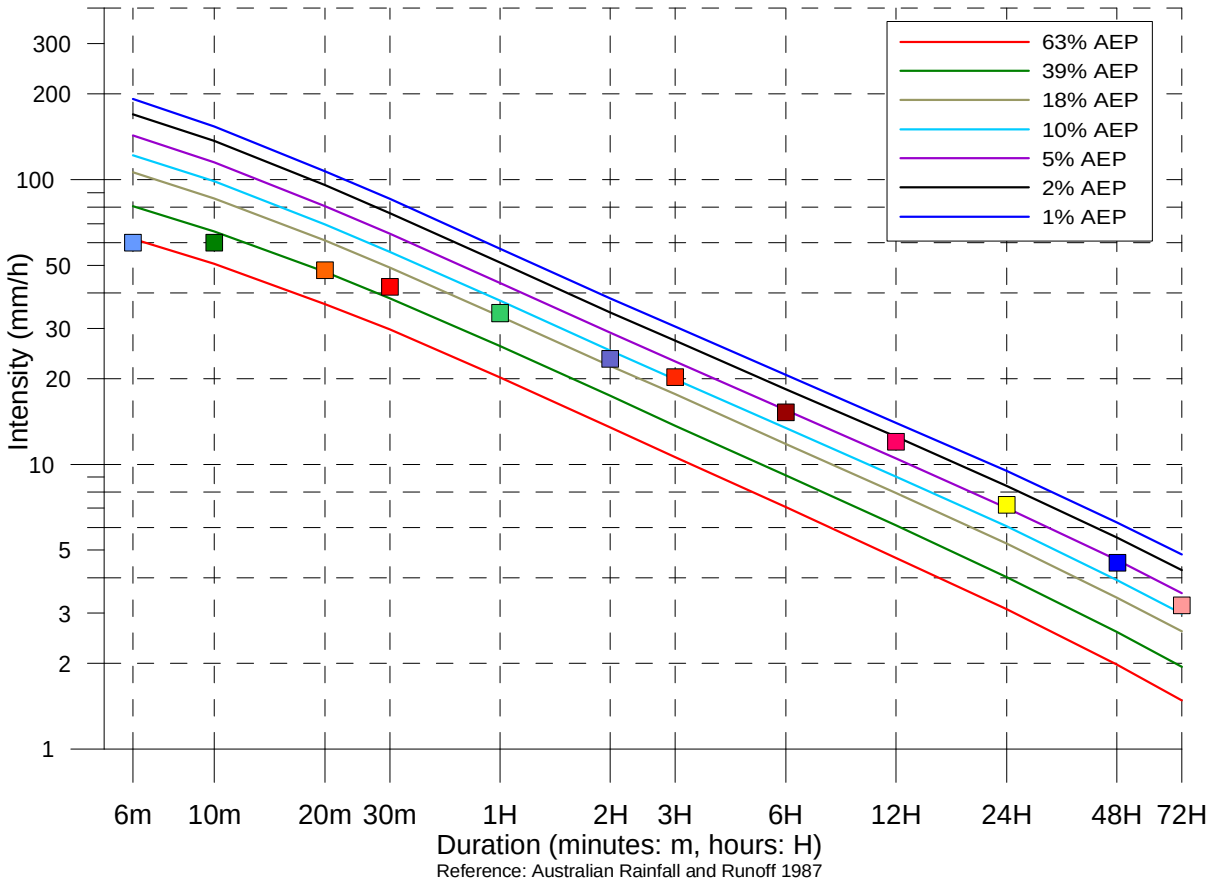
BARRINGTON INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.36

Site owner: BoM Latitude: -32.3923 Longitude: 151.3740

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Mirannie Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	60.0	06:58_21/04/2015
10m	60.0	06:54_21/04/2015
20m	48.0	06:46_21/04/2015
30m	42.0	06:36_21/04/2015
1H	34.0	06:14_21/04/2015
2H	23.5	05:14_21/04/2015
3H	20.3	04:14_21/04/2015
6H	15.2	02:20_21/04/2015
12H	12.0	20:58_20/04/2015
24H	7.2	20:58_20/04/2015
48H	4.5	02:38_20/04/2015
72H	3.2	02:38_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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MIRANNIE INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

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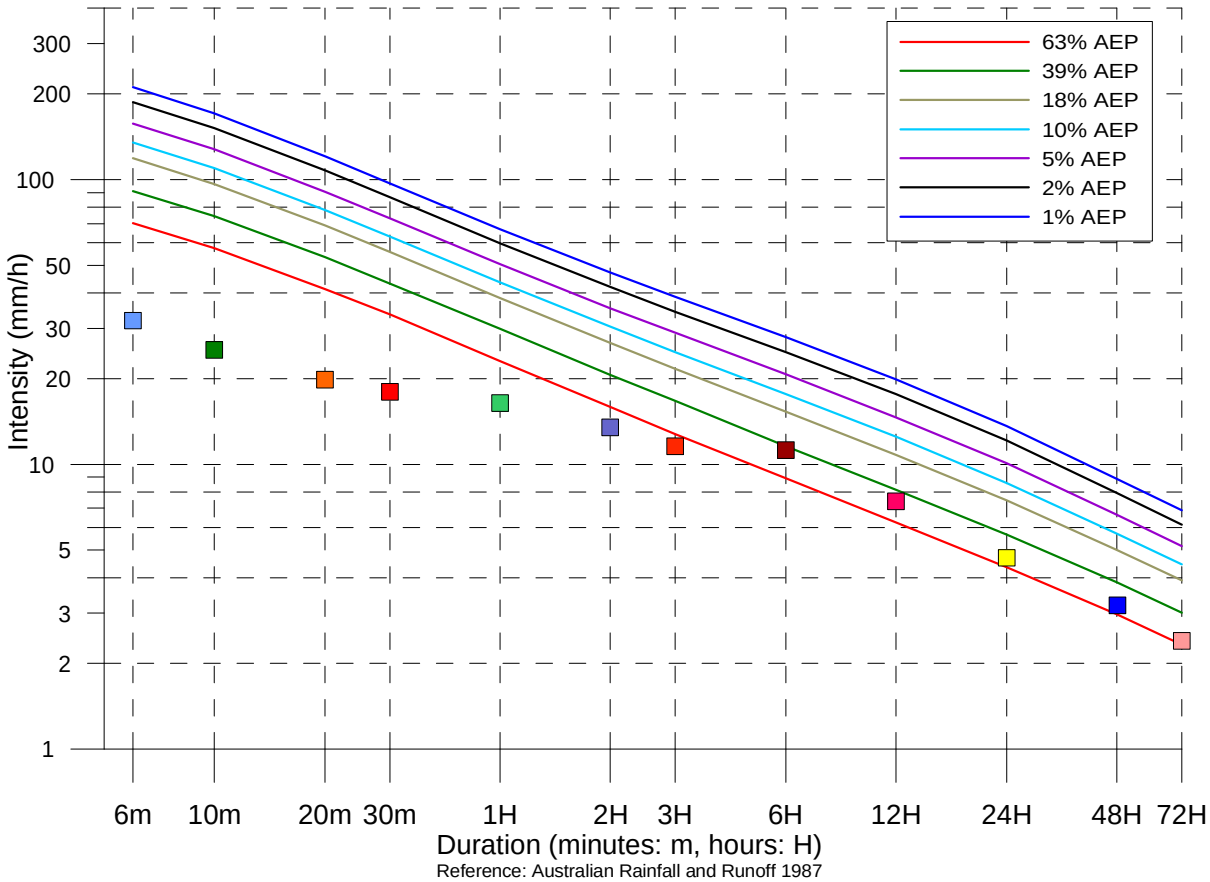
Figure 4.37

Site owner: NOW Latitude: -32.1714 Longitude: 151.5942

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Upper Chichester Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	32.0	23:16_20/04/2015
10m	25.2	23:16_20/04/2015
20m	19.8	23:16_20/04/2015
30m	18.0	23:14_20/04/2015
1H	16.4	23:00_20/04/2015
2H	13.5	22:40_20/04/2015
3H	11.6	22:34_20/04/2015
6H	11.2	22:40_20/04/2015
12H	7.4	21:06_20/04/2015
24H	4.7	22:04_20/04/2015
48H	3.2	00:44_20/04/2015
72H	2.4	00:02_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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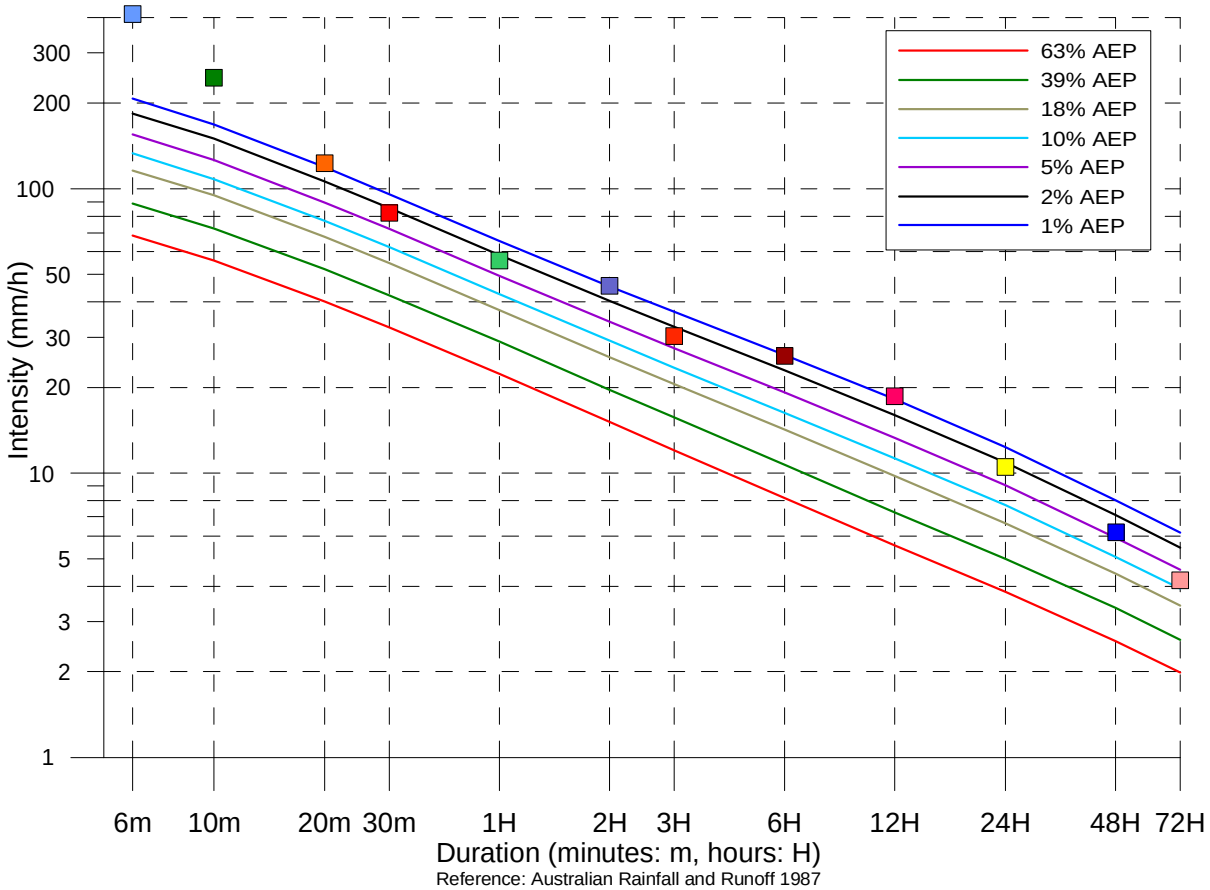
UPPER CHICHESTER INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.38

Site owner: BoM Latitude: -32.3492 Longitude: 151.6447

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Upper Myall Creek Rainfall Intensity
01 April 2015 – 05 May 2015

Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	410.0	07:56_21/04/2015
10m	246.0	07:56_21/04/2015
20m	123.0	07:56_21/04/2015
30m	82.0	07:56_21/04/2015
1H	56.0	04:22_21/04/2015
2H	45.5	04:22_21/04/2015
3H	30.3	04:22_21/04/2015
6H	25.8	02:04_21/04/2015
12H	18.6	20:04_20/04/2015
24H	10.5	22:58_20/04/2015
48H	6.2	01:16_20/04/2015
72H	4.2	01:16_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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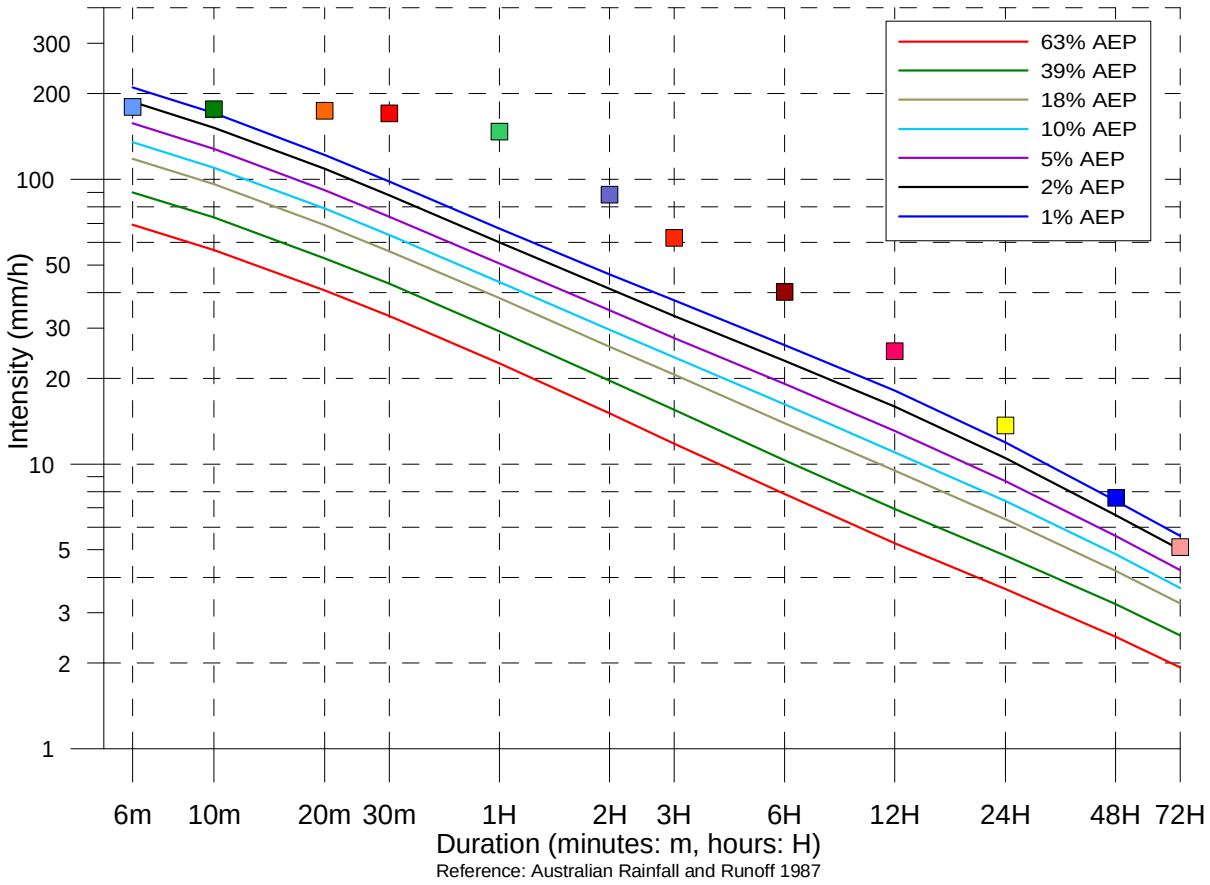
UPPER MYALL CREEK INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 4.39

Site owner: BoM Latitude: -32.4022 Longitude: 151.7582

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Dungog Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	180.0	05:56_21/04/2015
10m	176.4	05:56_21/04/2015
20m	174.6	05:50_21/04/2015
30m	170.4	05:40_21/04/2015
1H	147.2	05:16_21/04/2015
2H	88.2	04:32_21/04/2015
3H	62.4	03:34_21/04/2015
6H	40.2	00:34_21/04/2015
12H	24.9	19:42_20/04/2015
24H	13.7	19:46_20/04/2015
48H	7.6	01:38_20/04/2015
72H	5.1	01:38_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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DUNGOG INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

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Figure 4.40

5. Hunter River Region – Lower

5.1 Lower Hunter River Region - Singleton Water Level

The locations of water level stations within the Lower Hunter River region Singleton are shown in Figure 5.1. The water level data for the period 01 April to 05 May 2015 are displayed graphically in Figures 5.2 to 5.5. The peak observed water levels are listed in Table 5.1.

Table 5.2 lists the SES Flood Classifications for Singleton. The SES classification scheme indicates the flood peak for Singleton was classified as a less than minor flood during the April 2015 event.

Table 5.1 Lower Hunter River Region – Singleton Flood Peaks

Station Name	Station No.	Site Owner	Datum	Peak level (m)
Hunter River at Liddell	210083	NOW	Local Gauge Datum	7.17
Foy Brook at Downstream Bowmans Creek Bridge	210130	NOW	Local Gauge Datum	1.26
Upstream Foy Brook	210126	NOW	Local Gauge Datum	3.47
Upstream Bayswater Creek	210125	NOW	Local Gauge Datum	4.72
Hunter River Upstream Glennies Creek	210127	NOW	Local Gauge Datum	5.56
West Brook Upstream Glendon	210080	NOW	Local Gauge Datum	4.87
Hunter River at Long Point	210134	NOW	Local Gauge Datum	7.99
Hunter River at Singleton	210001	NOW	Local Gauge Datum	9.34
Hunter River at Mason Dieu	210128	NOW	Local Gauge Datum	6.27
Hunter River Upstream Singleton	210129	NOW	Local Gauge Datum	8.34
Wollombi Brook Downstream Brickmans Bridge	210135	NOW	Local Gauge Datum	10.28
Wollombi Brook at Bulga	210028	NOW	Local Gauge Datum	7.24
Wollombi Brook at Warkworth	210004	NOW	Local Gauge Datum	7.69
Hunter River at Greta	210064	NOW	Local Gauge Datum	11.94
Black Creek at Rothbury	210089	NOW	Local Gauge Datum	8.10*

*Please note the peak height was surveyed in post flood event and the data estimated.

Table 5.2 SES Flood Classification for Singleton

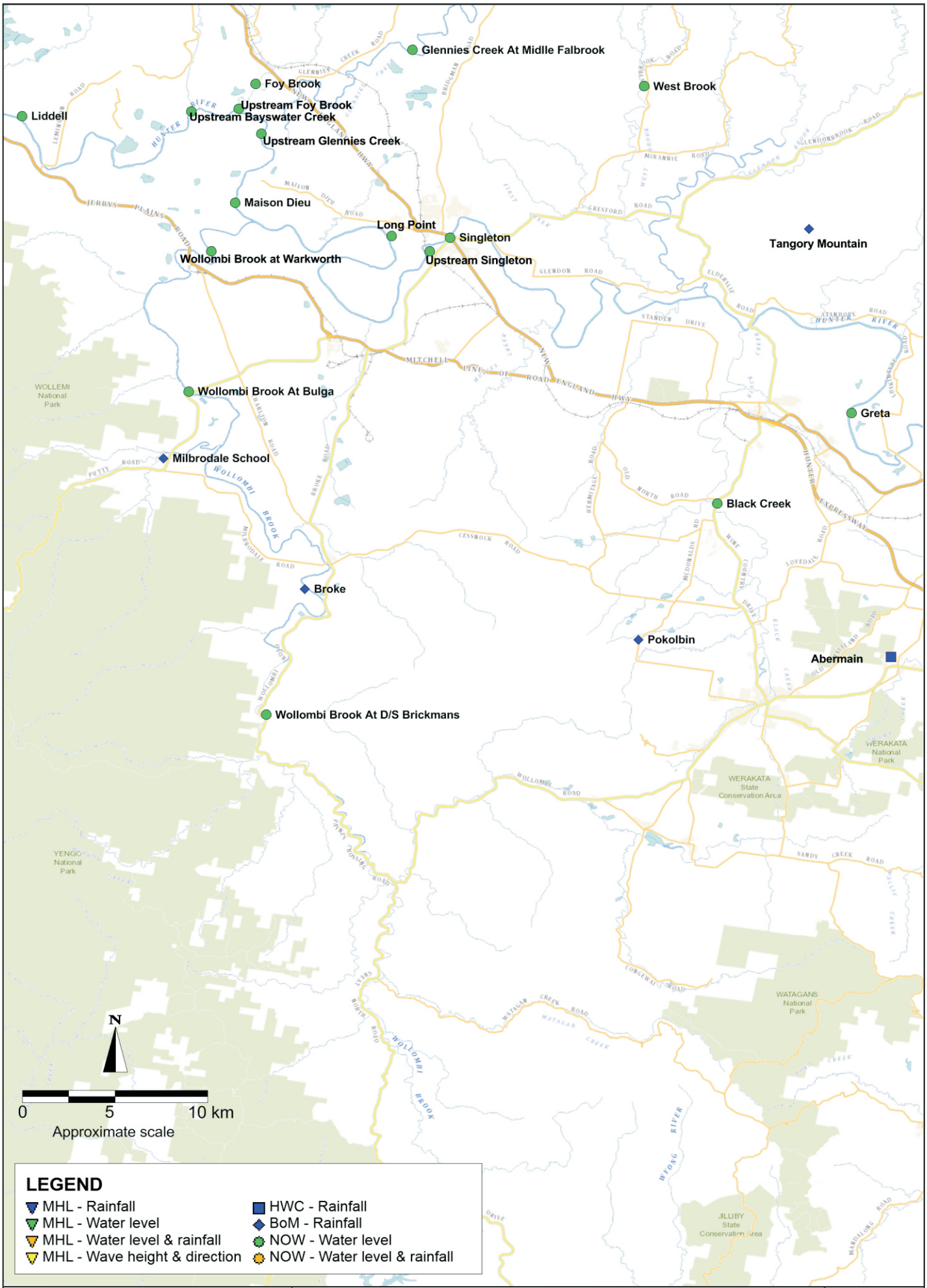
Station	Classification			Peak (m)	Classification
	Minor	Moderate	Major		
	Water Level (m Local Gauge Datum)				
Singleton	10.0	11.5	13.0	9.34 (07:15 24/04/15)	<Minor

5.2 Lower Hunter River Region - Singleton Rainfall

9.00 a.m. daily rainfall totals are displayed in Table 5.3 and Figure 5.6 and 5.7 for the period 20th April to 5th May 2015. The rainfall data and intensities are displayed graphically in Figures 5.8 to 5.12.

Table 5.3 Lower Hunter River Region – Singleton Daily Rainfall Totals

Date	Tangory Mt (mm)	Milbrodale (mm)	Broke (mm)	Pokolbin (mm)	Abermain (mm)
	BOM	BOM	BOM	BOM	HWC
20/04/2015	9.0	9.0	8.0	3.8	2.0
21/04/2015	236.2	56.0	56.6	59.6	94.6
22/04/2015	96.8	103.0	110.0	137.2	171.2
23/04/2015	25.8	6.0	12.8	11.6	13.6
24/04/2015	0.0	0.0	0.2	0.0	0.2
25/04/2015	0.0	0.0	0.0	0.2	0.0
26/04/2015	0.0	1.0	0.2	1.0	5.4
27/04/2015	0.0	0.0	0.0	0.0	0.0
28/04/2015	0.0	0.0	0.2	0.0	0.0
29/04/2015	0.6	0.0	0.0	0.0	0.4
30/04/2015	1.0	0.0	0.0	0.2	1.6
01/05/2015	0.8	0.0	0.4	1.4	1.4
02/05/2015	12.0	12.0	4.4	12.6	12.6
03/05/2015	13.2	9.0	12.2	19.8	28.8
04/05/2015	9.2	2.0	2.6	10.8	8.6
05/05/2015	1.4	0.0	0.2	0.4	
Total	**406.0**	**198.0**	**207.8**	**258.6**	**340.4**



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STATION LOCATIONS
LOWER HUNTER RIVER REGION
SINGLETON

MHL Report 2364

Figure 5.1

DRAWING 2364-05-01.cdr

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LOWER HUNTER RIVER REGION - SINGLETON WATER LEVEL
01 APRIL – 05 MAY 2015

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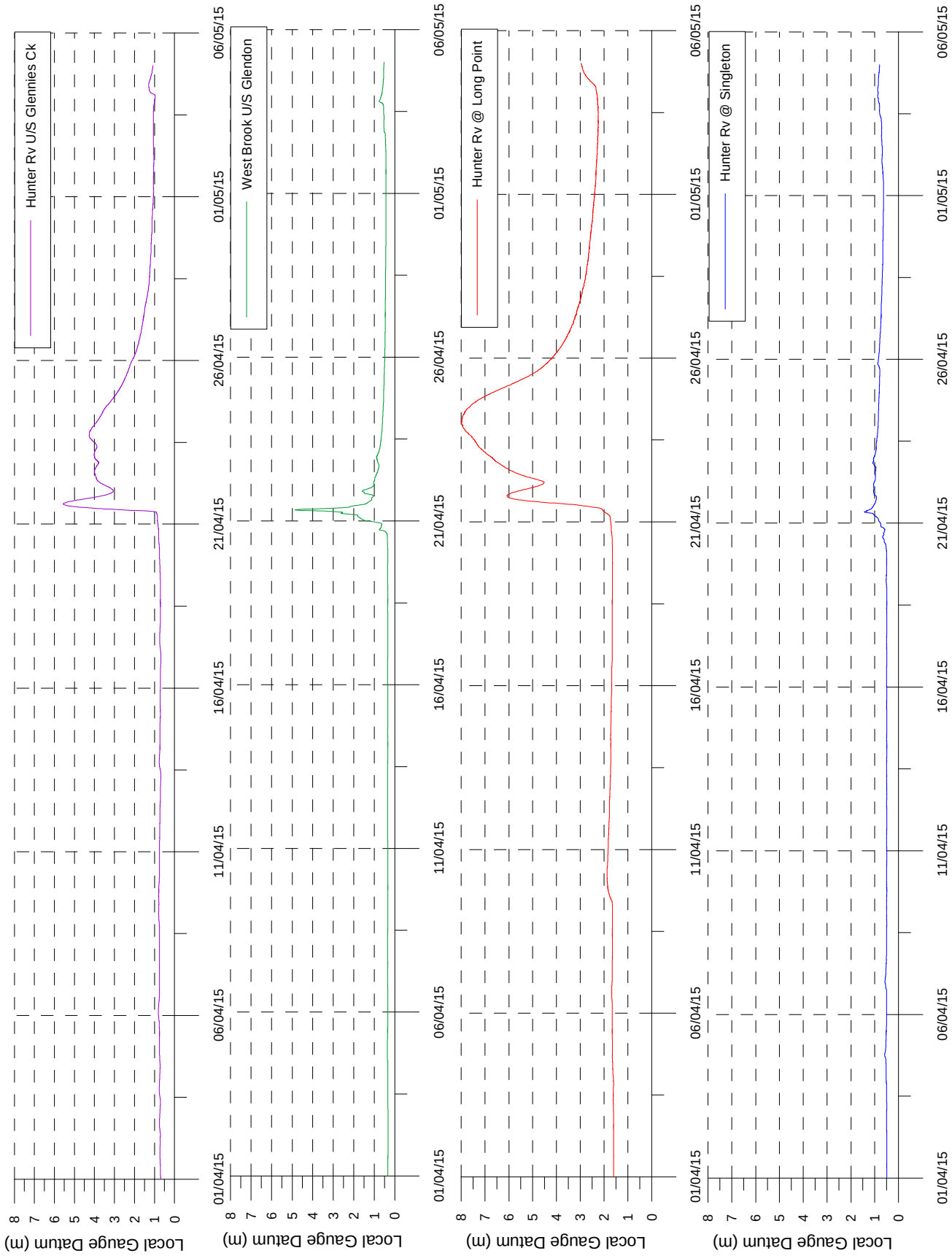
Figure 5.2



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LOWER HUNTER RIVER REGION - SINGLETON WATER LEVEL
01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.3

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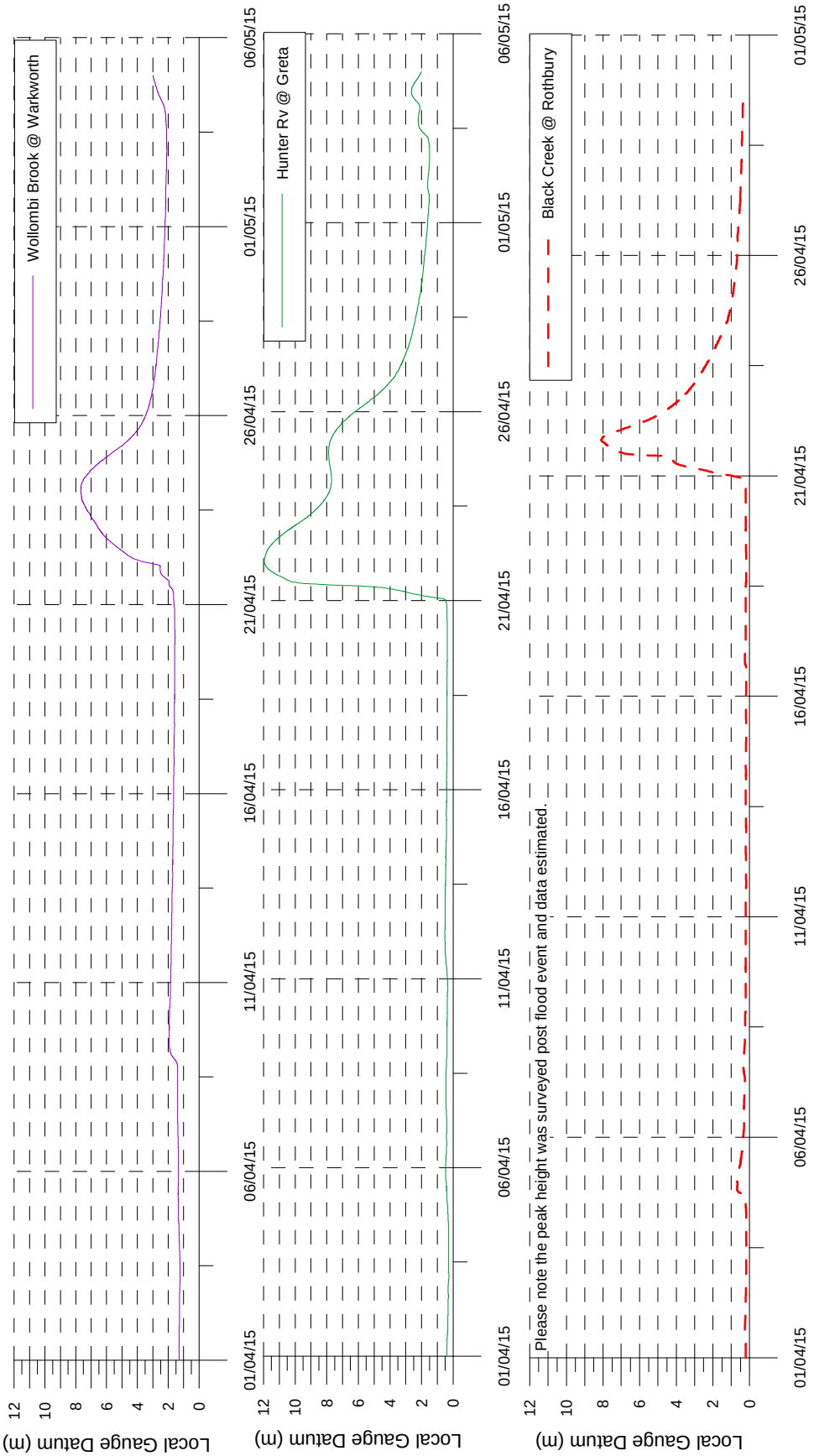
LOWER HUNTER RIVER REGION - SINGLETON WATER LEVEL 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.4



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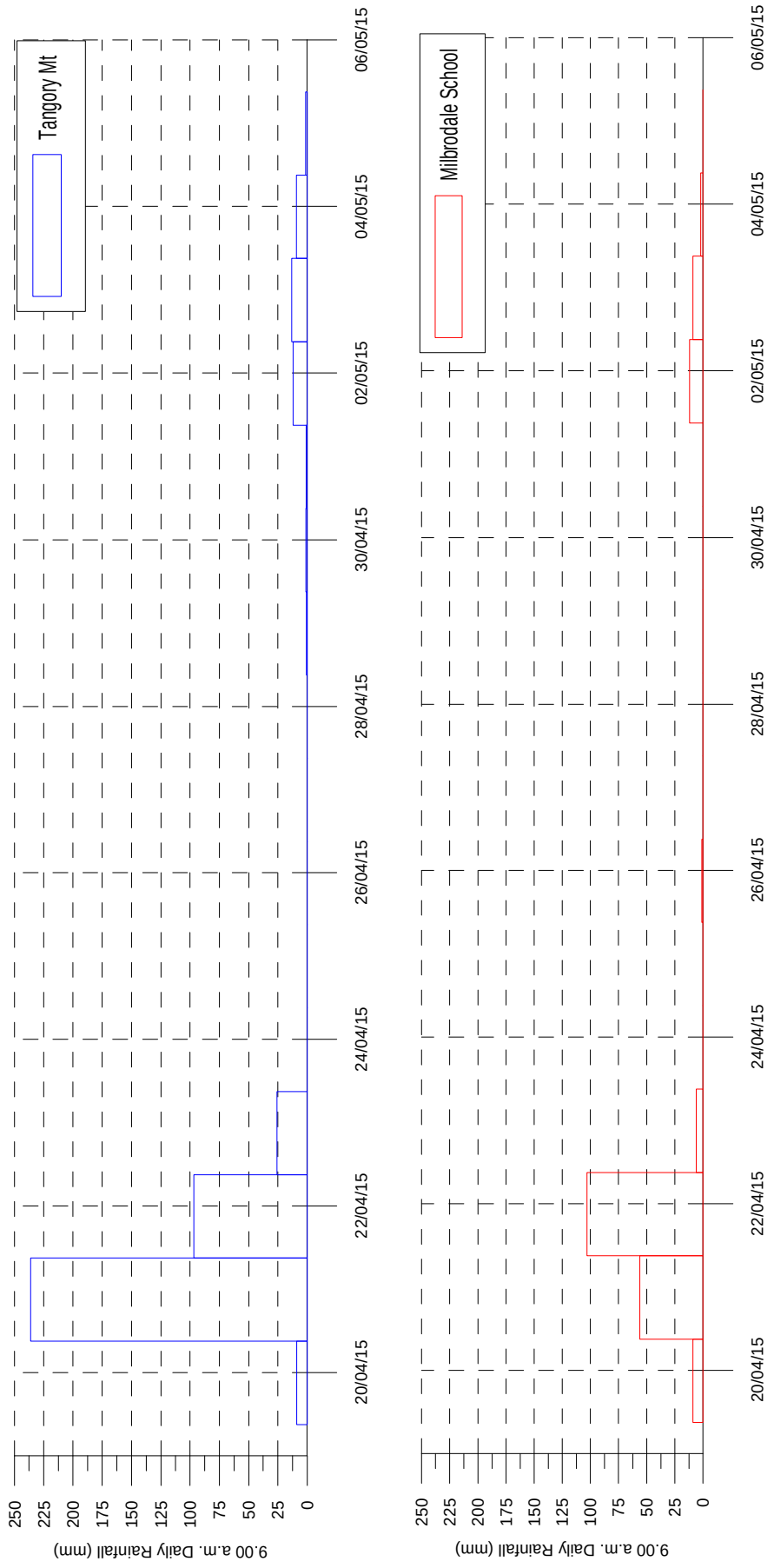
LOWER HUNTER RIVER REGION - SINGLETON WATER LEVEL
01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.5



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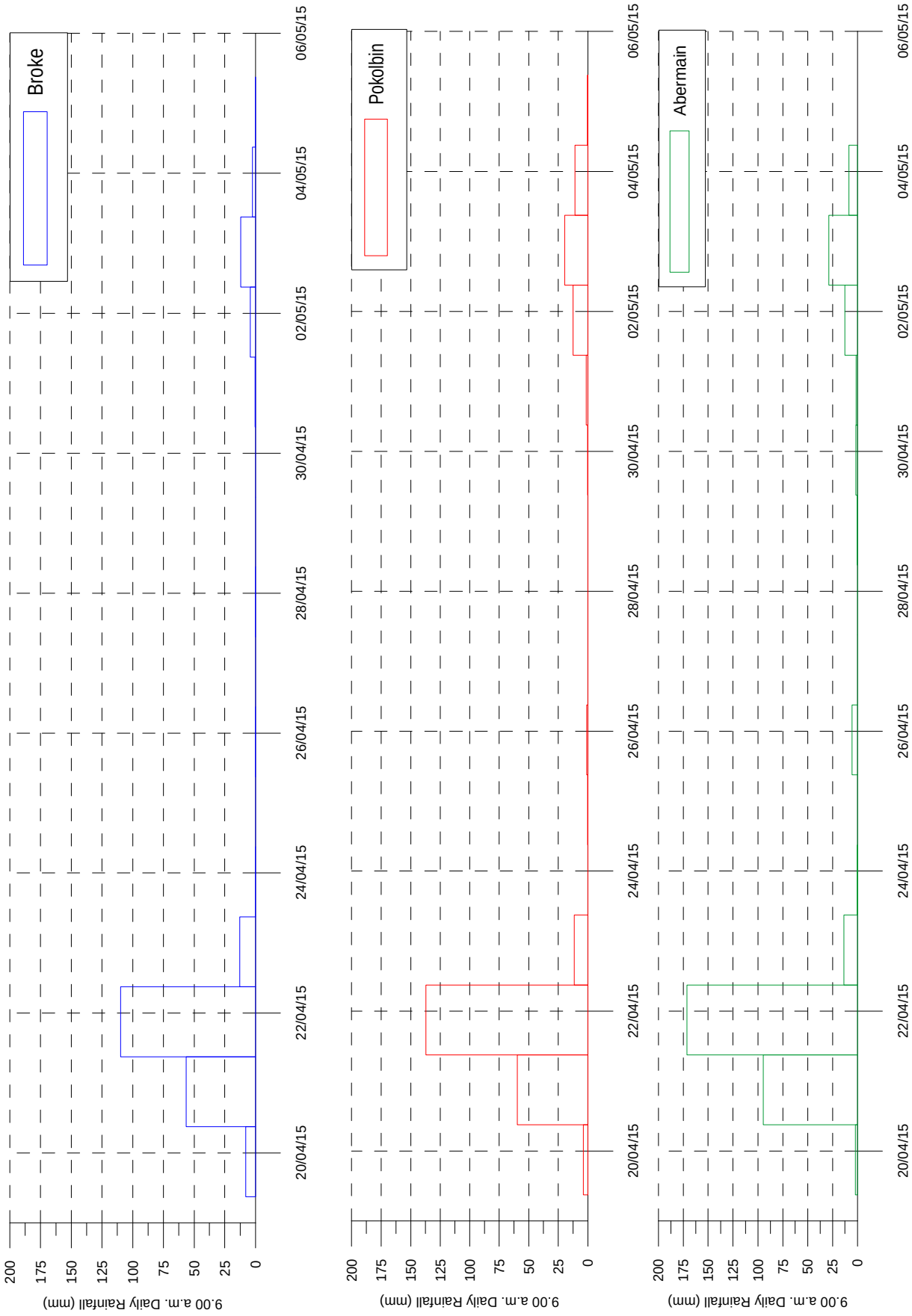
LOWER HUNTER RIVER REGION - SINGLETON RAINFALL
20 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.6



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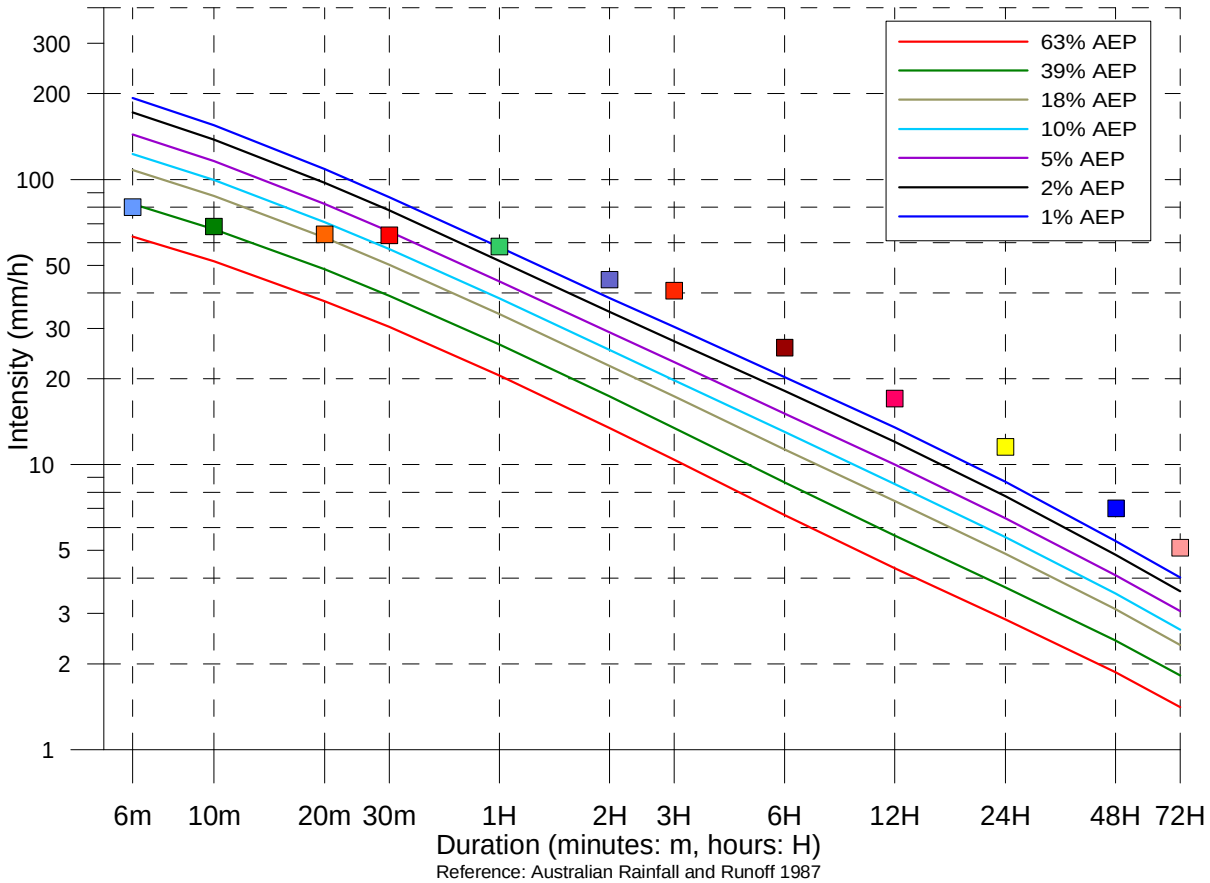
LOWER HUNTER RIVER REGION - SINGLETON RAINFALL
20 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.7

Site owner: BoM Latitude: -32.5553 Longitude: 151.3790

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Tangory Mountain Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		80.0	07:30_21/04/2015
10m		68.4	07:26_21/04/2015
20m		64.2	07:30_21/04/2015
30m		63.6	07:28_21/04/2015
1H		58.2	07:10_21/04/2015
2H		44.6	07:10_21/04/2015
3H		40.8	07:06_21/04/2015
6H		25.7	05:06_21/04/2015
12H		17.0	22:22_20/04/2015
24H		11.5	19:08_20/04/2015
48H		7.0	06:14_20/04/2015
72H		5.1	00:56_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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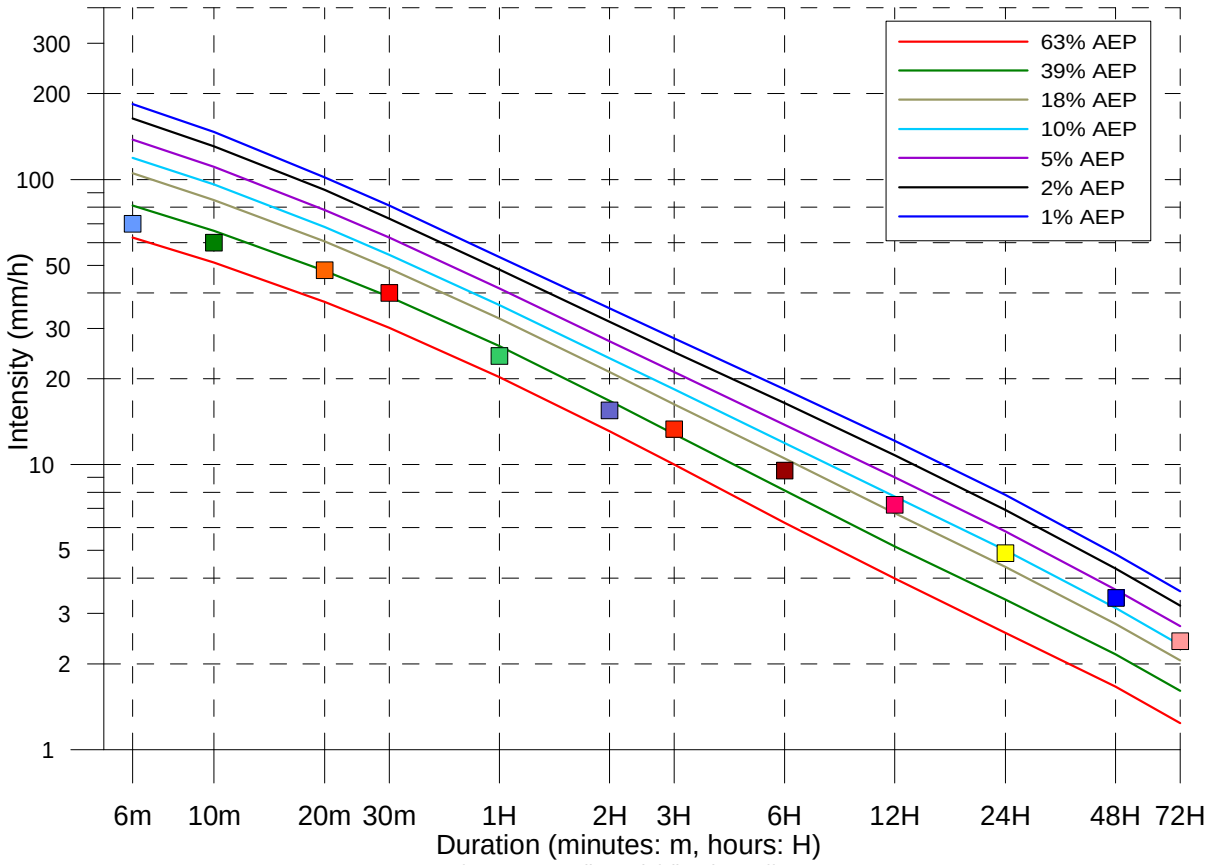
TANGORY MOUNTAIN INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.8

Site owner: BoM Latitude: -32.59 Longitude: 151.0053

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Milbrodale School Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	70.0	10:58_21/04/2015
10m	60.0	10:58_21/04/2015
20m	48.0	10:52_21/04/2015
30m	40.0	10:50_21/04/2015
1H	24.0	10:50_21/04/2015
2H	15.5	10:50_21/04/2015
3H	13.3	10:36_21/04/2015
6H	9.5	09:22_21/04/2015
12H	7.2	06:00_21/04/2015
24H	4.9	20:36_20/04/2015
48H	3.4	08:00_20/04/2015
72H	2.4	01:52_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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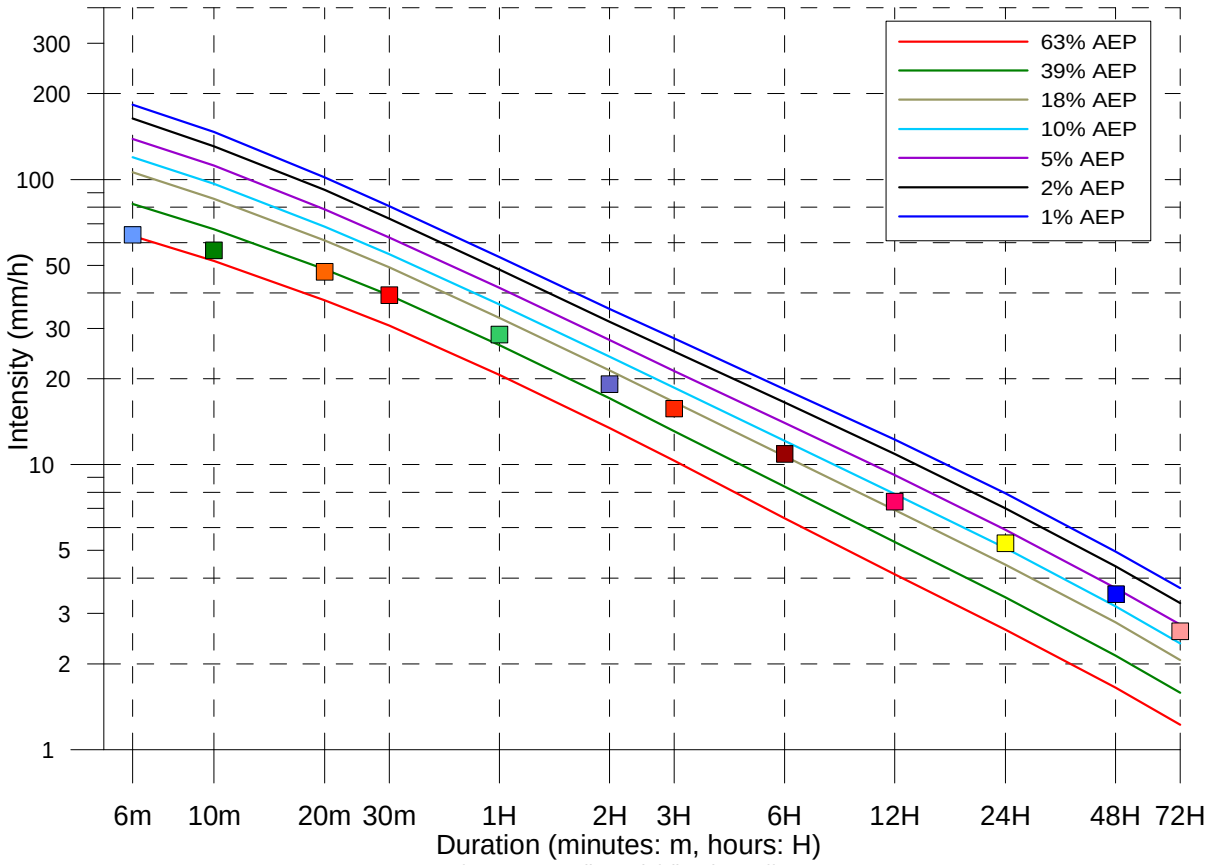
MILBRODALE SCHOOL INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.9

Site owner: BoM Latitude: -32.7667 Longitude: 151.0872

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Broke Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	64.0	11:08_21/04/2015
10m	56.4	11:08_21/04/2015
20m	47.4	11:06_21/04/2015
30m	39.2	10:56_21/04/2015
1H	28.6	10:46_21/04/2015
2H	19.1	10:46_21/04/2015
3H	15.7	10:42_21/04/2015
6H	10.9	10:50_21/04/2015
12H	7.4	05:36_21/04/2015
24H	5.3	20:14_20/04/2015
48H	3.5	07:16_20/04/2015
72H	2.6	01:50_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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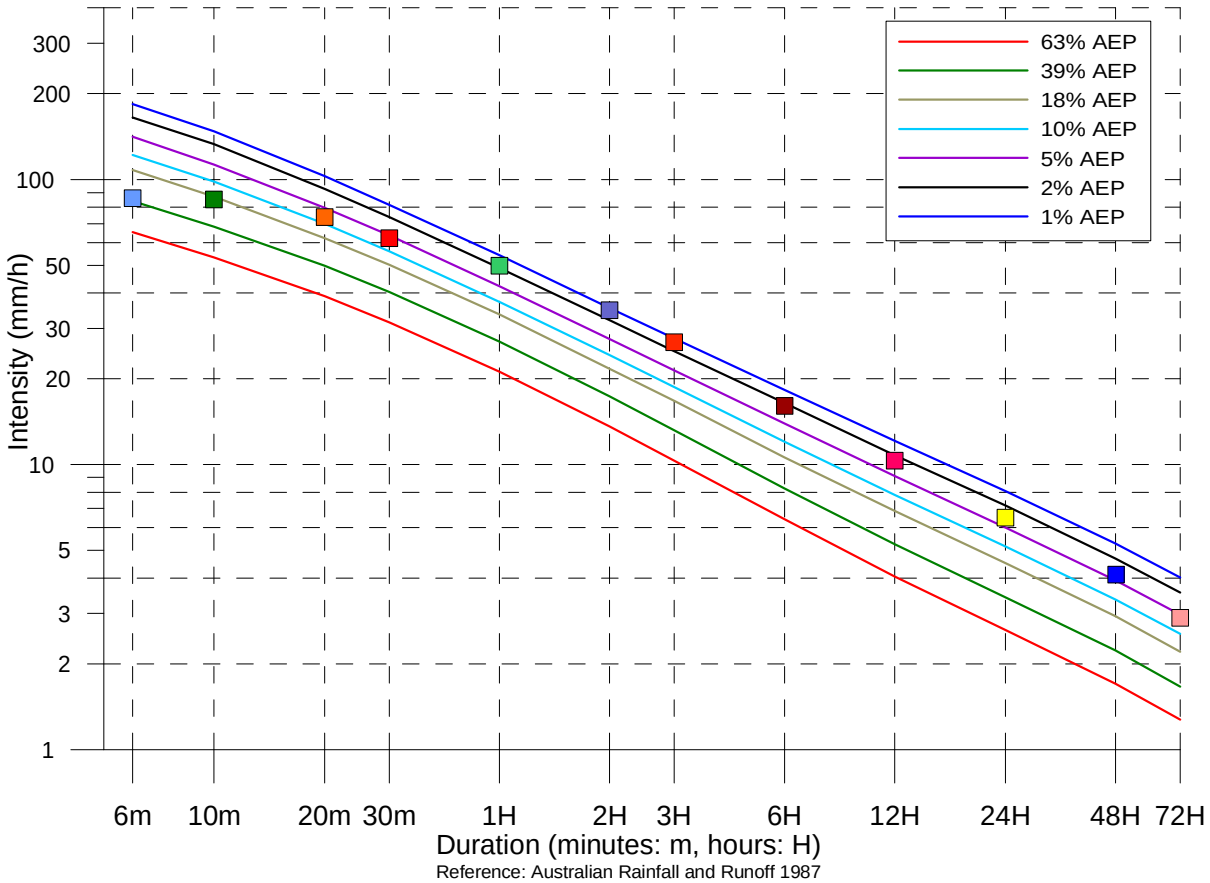
BROKE INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.10

Site owner: BoM Latitude: -32.7965 Longitude: 151.2804

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Pokolbin Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		86.0	10:58_21/04/2015
10m		85.2	10:58_21/04/2015
20m		73.8	10:56_21/04/2015
30m		62.4	10:56_21/04/2015
1H		49.8	10:56_21/04/2015
2H		34.8	10:48_21/04/2015
3H		26.9	10:42_21/04/2015
6H		16.1	10:40_21/04/2015
12H		10.3	10:40_21/04/2015
24H		6.5	19:50_20/04/2015
48H		4.1	07:04_20/04/2015
72H		2.9	01:08_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

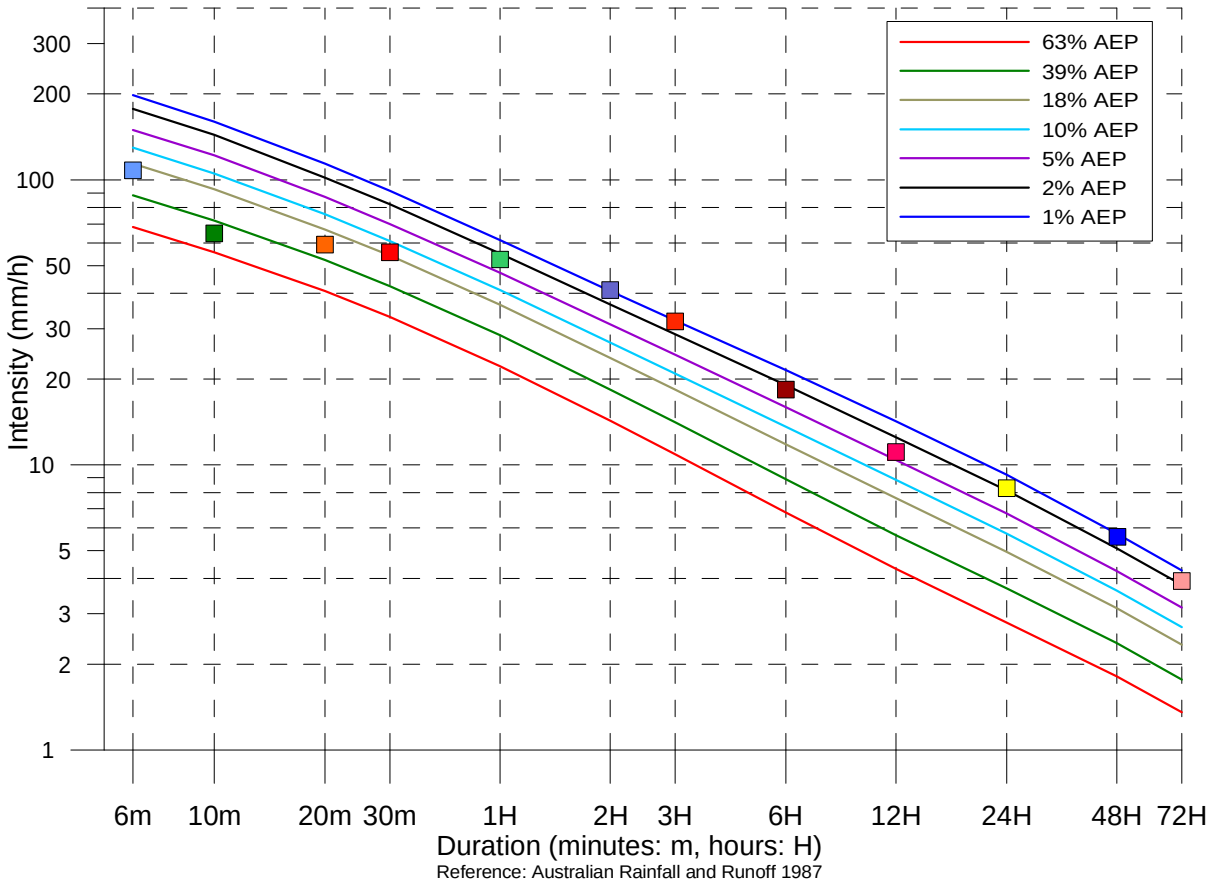
POKOLBIN INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.11

Site owner: HWC Latitude: -32.0666 Longitude: 150.2326

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Abermain Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	108.0	11:00_21/04/2015
10m	64.8	11:00_21/04/2015
20m	59.4	11:00_21/04/2015
30m	55.6	10:54_21/04/2015
1H	52.6	11:00_21/04/2015
2H	41.1	10:40_21/04/2015
3H	31.9	10:44_21/04/2015
6H	18.4	10:40_21/04/2015
12H	11.1	09:40_21/04/2015
24H	8.3	19:04_20/04/2015
48H	5.6	07:24_20/04/2015
72H	3.9	04:30_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

ABERMAIN INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

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Figure 5.12

5.3 Lower Hunter, Paterson and Williams River Region Water Level

The locations of water level stations within the Lower Hunter, Paterson and Williams River region are shown in Figure 5.13. The water level data for the period 01 April to 05 May 2015 are displayed graphically in Figures 5.14 to 5.17. The peak observed water levels are listed in Table 5.4.

Table 5.5 lists the SES Flood Classifications for Gostwyck, Paterson, Raymond Terrace, Hexham and Stockton. The SES classification scheme indicates the flood peak for Gostwyck and Paterson were classified as a major flood, Stockton was classified as a moderate flood, Raymond Terrace was classified as a minor flood and Hexham was classified as less than a minor flood during the April 2015 event.

Table 5.4 Lower Hunter, Paterson and Williams River Region Flood Peaks

Station Name	Station No.	Site Owner	Datum	Peak level (m)
Allyn River at Flying Fox Lane	210143	NOW	Local Gauge Datum	12.58
Gostwyck	210402	MHL	AHD	16.12
Williams River at Glen Martin	210010	NOW	Local Gauge Datum	12.13
Paterson Railway Bridge	210406	MHL	AHD	12.00
Seaham	210462	MHL	AHD	3.90
Dunmore	210409	MHL	AHD	6.06
Oakhampton Railway Bridge	210475	MHL	AHD	10.43
Bolwarra Upstream	210459	MHL	AHD	10.03
Bolwarra Downstream	210451	MHL	AHD	9.96
Hinton Bridge	210410	MHL	AHD	5.76
McKimms Corner	210455	MHL	AHD	7.33
Morpeth	210430	MHL	AHD	6.11
Belmore Bridge	210458	MHL	AHD	8.92
Wallis Creek Upstream	210428	MHL	AHD	6.67
Wallis Creek Downstream	210457	MHL	AHD	8.37
Green Rocks	210432	MHL	AHD	4.37
Raymond Terrace	210452	MHL	AHD	3.06
Louth Park	210453	MHL	AHD	6.68
Hexham Bridge	210448	MHL	AHD	1.88
Stockton Bridge	210456	MHL	AHD	1.37

Table 5.5 SES Flood Classification for Gostwyck Bridge, Paterson, Raymond Terrace, Hexham and Stockton

Station	Classification			Peak (m)	Classification
	Minor	Moderate	Major		
	Water Level (m AHD)				
Gostwyck Bridge	9.1	10.7	12.2	16.12 (14:30 21/04/15)	Major
Paterson	6.1	7.6	9.1	12.00 (15:45 21/04/15)	Major
Raymond Terrace	2.5	3.1	3.5	3.06 (15:30 22/04/15)	Minor
Hexham	1.9	2.9	3.8	1.88 (01:45 23/04/15)	<Minor
Stockton	1.2	1.3	1.7	1.37 (22:45 21/04/15)	Moderate

5.4 Lower Hunter, Paterson and Williams River Region Rainfall

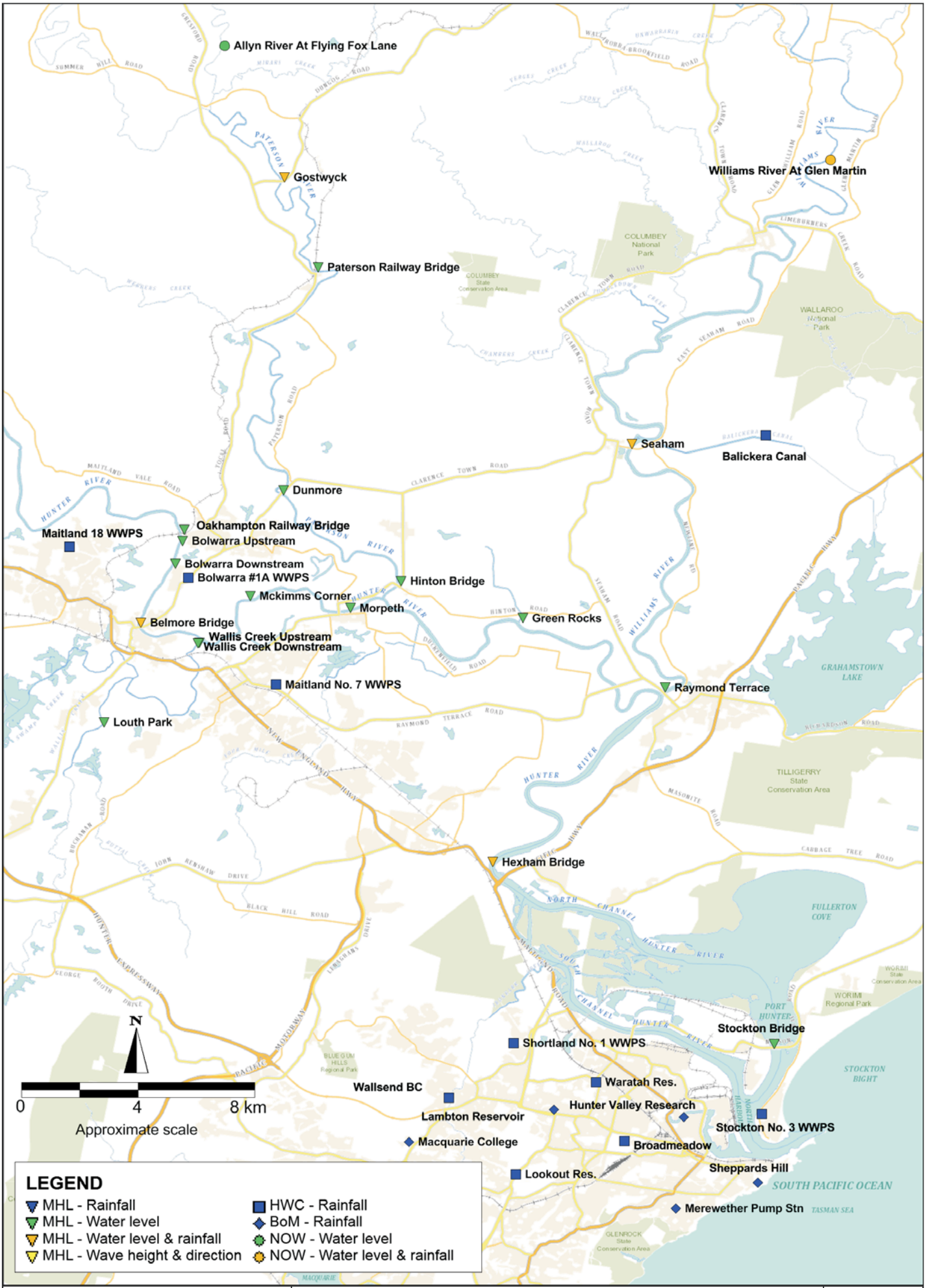
9.00 a.m. daily rainfall totals are displayed in Tables 5.6 and 5.7 and in Figures 5.18 to 5.21 for the period 20th April to 5th May 2015. The rainfall data and intensities are displayed graphically in Figures 5.22 to 5.42.

Table 5.6 Lower Hunter, Paterson and Williams River Region Daily Rainfall Totals - Northern

Date	Gostwyck (mm)	Belmore Bridge (mm)	Hexham Bridge (mm)	Seaham (mm)	Maitland 18 (mm)	Bolwarra (mm)	Maitland 7 (mm)	Broadmeadow (mm)	Soldiers Pt (mm)	Tanilba Bay (mm)	Nelson Bay (mm)
	MHL	MHL	MHL	MHL	HWC	HWC	HWC	HWC	HWC	HWC	HWC
20/04/2015	9.0	2.5	1.0	4.5	3.8	3.2	0.2	5.0	17.4	22.4	19.2
21/04/2015	299.5	128.5	143.5	213.0	122.0	133.4	44.8	127.0	144.8	128.6	160.8
22/04/2015	108.5	307.5	119.5	197.5	265.6	234.6	96.0	98.0	108.8	163.2	132.2
23/04/2015	12.5	14.0	19.5	19.5	19.2	16.0	5.6	9.4	50.0	37.2	25.0
24/04/2015	0.0	2.5	0.0	0.0	0.4	0.2	0.2	0.2	0.0	0.0	0.0
25/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26/04/2015	0.0	0.0	12.5	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0
27/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.2	7.4
28/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29/04/2015	0.5	0.0	3.5	3.5	0.4	0.2	0.2	6.8	12.0	5.8	0.0
30/04/2015	5.0	0.0	0.5	1.0	1.4	0.2	1.0	2.8	7.2	1.8	36.8
01/05/2015	1.0	1.0	2.5	3.0	2.0	1.6	0.6	9.8	11.8	1.2	18.2
02/05/2015	16.0	10.5	16.0	22.5	17.8	14.4	3.8	13.8	17.6	1.4	21.0
03/05/2015	17.5	28.5	41.0	46.5	27.2	27.8	12.0	22.8	34.4	1.2	34.6
04/05/2015	2.0	1.0	0.0	0.0	1.4	0.0	0.4	0.0	3.0	1.4	4.8
05/05/2015	0.0	0.0	0.0	0.0							
Total	**471.5**	**496.0**	**359.5**	**511.0**	**461.2**	**431.6**	**165.4**	**295.6**	**407.6**	**364.4**	**460.0**

Table 5.7 Lower Hunter, Paterson and Williams River Region Daily Rainfall Totals - Southern

Date	Shortland (mm)	Waratah Res (mm)	Wallsend BC (mm)	Lambton Res (mm)	Macquarie College (mm)	Hunter Valley Research (mm)	Stockton 3 (mm)	Lookout Res (mm)	Sheppards Hill (mm)	Merewether Pump Station (mm)
	HWC	HWC	HWC	HWC	HWC	BOM	HWC	HWC	BOM	BOM
20/04/2015	4.0	4.2	12.8	3.5	6.5	4.0	7.8	7.8	6.0	5.6
21/04/2015	170.2	123.6	191.8	156.5	154.5	124.5	123.8	172.0	89.0	143.8
22/04/2015	127.2	94.8	133.6	123.5	118.0	97.0	84.6	24.4	86.5	129.2
23/04/2015	16.6	11.6	18.4	18.5	21.0	8.0	15.6	16.2	23.5	7.0
24/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
25/04/2015	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0
26/04/2015	10.8	11.0	15.8	10.5	10.0	18.0	10.4	12.6	14.5	14.6
27/04/2015	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.2	0.0	0.0
28/04/2015	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29/04/2015	3.4	9.0	0.4	0.0	0.0	2.5	2.6	0.0	3.0	7.6
30/04/2015	4.6	4.2	7.0	0.5	13.5	2.5	5.4	13.4	0.5	1.0
01/05/2015	8.2	12.0	16.4	0.0	9.5	11.5	17.2	7.2	15.0	14.8
02/05/2015	21.4	15.6	12.4	0.5	12.0	17.0	17.8	10.6	9.5	8.4
03/05/2015	28.2	32.6	33.2	0.0	31.5	37.0	33.0	31.0	25.5	30.8
04/05/2015	0.4	0.0	2.0	0.5	1.5	0.0	0.4	2.4	0.0	0.4
05/05/2015						0.0			0.5	0.2
Total	**395.0**	**318.8**	**444.4**	**316.5**	**378.0**	**322.0**	**318.8**	**298.0**	**273.5**	**363.4**



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STATION LOCATIONS
LOWER HUNTER RIVER, PATERSON AND WILLIAMS RIVER REGION

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Figure 5.13

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Manly Hydraulics Laboratory

LOWER PATERSON RIVER REGION
WATER LEVEL
01 APRIL – 05 MAY 2015

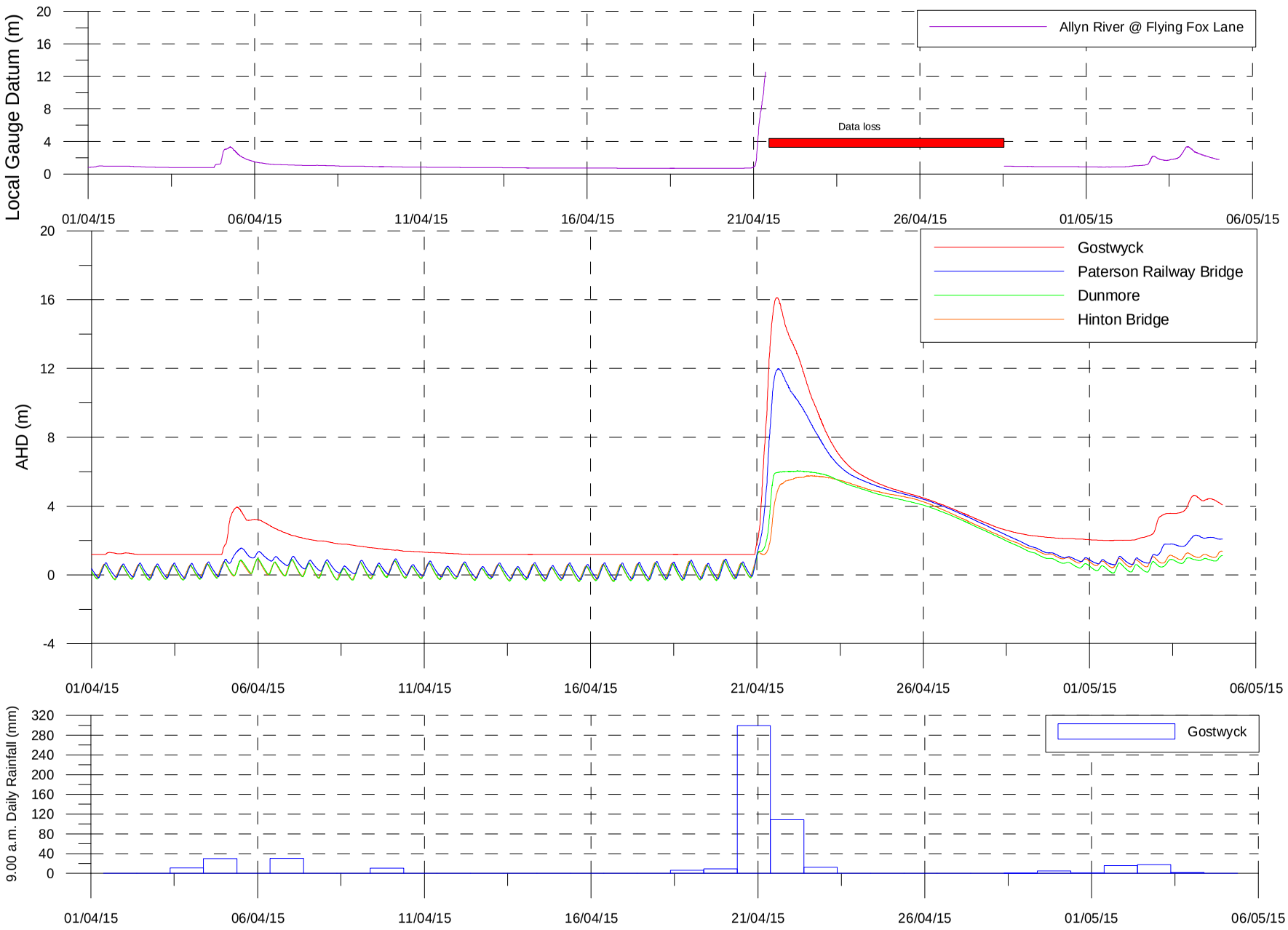

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Figure 5.14

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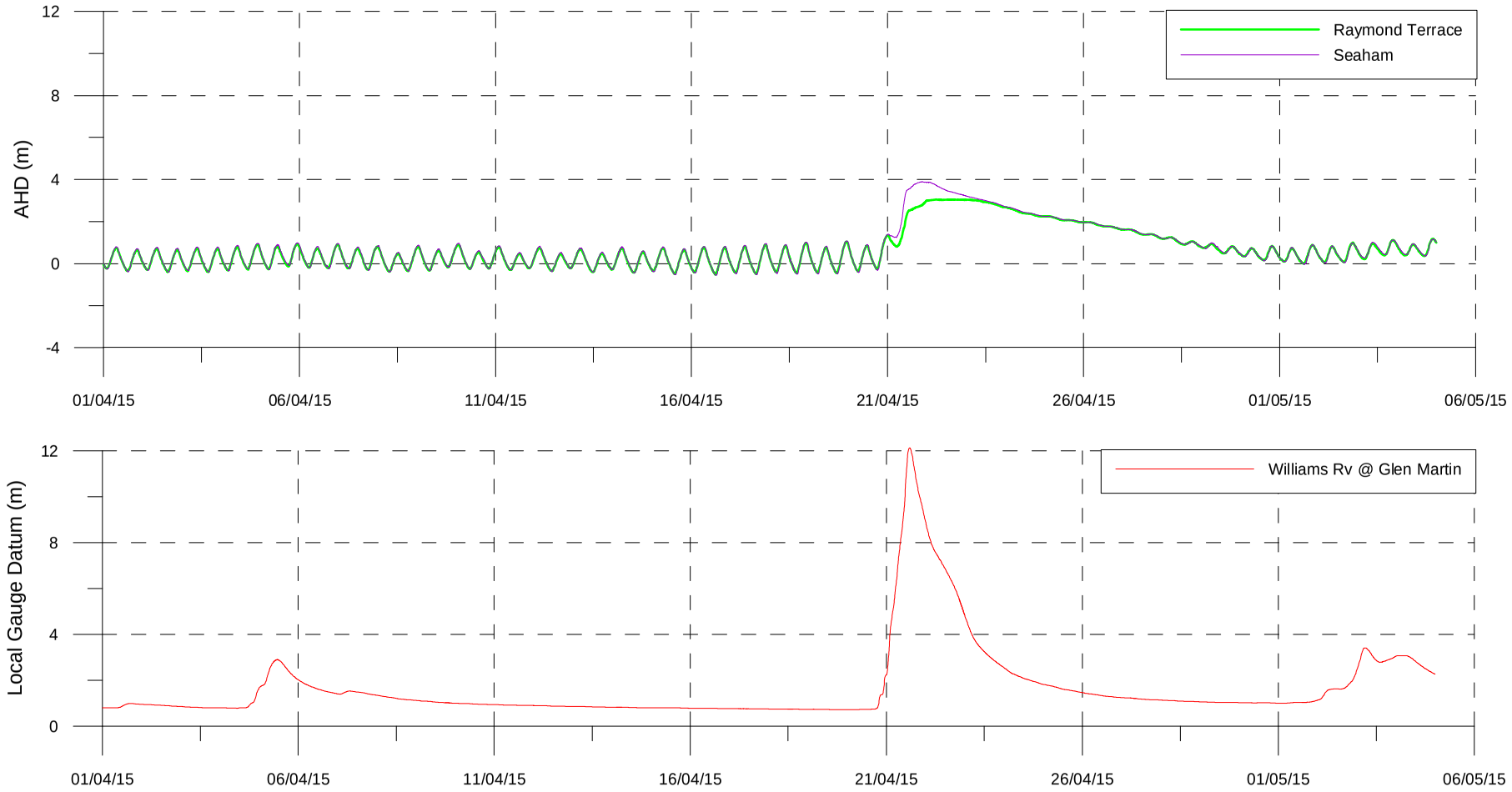
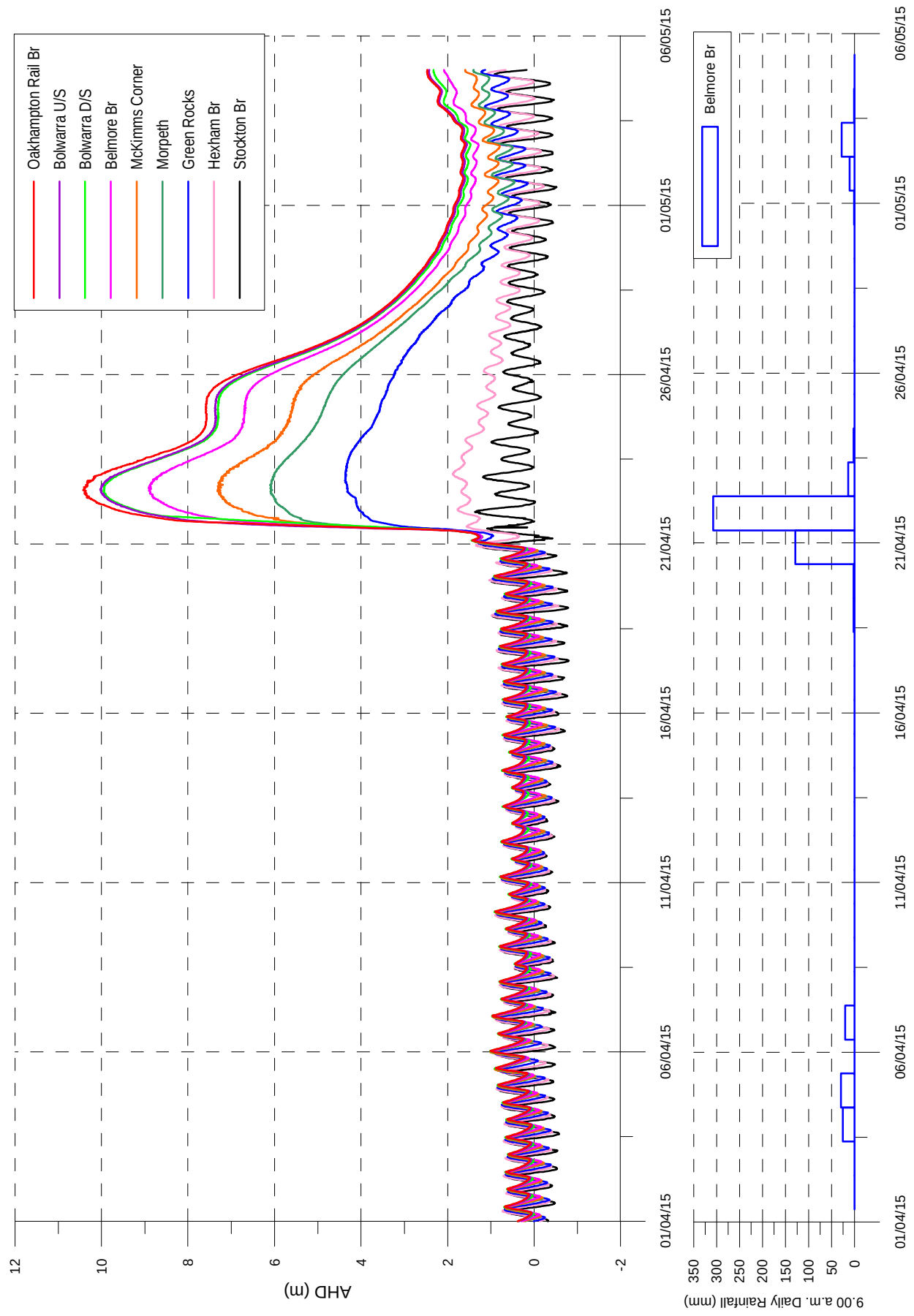
LOWER WILLIAMS RIVER REGION
WATER LEVEL
01 APRIL – 05 MAY 2015



MHL REPORT 2364

Figure 5.15



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LOWER HUNTER RIVER REGION
WATER LEVEL
01 APRIL – 05 MAY 2015

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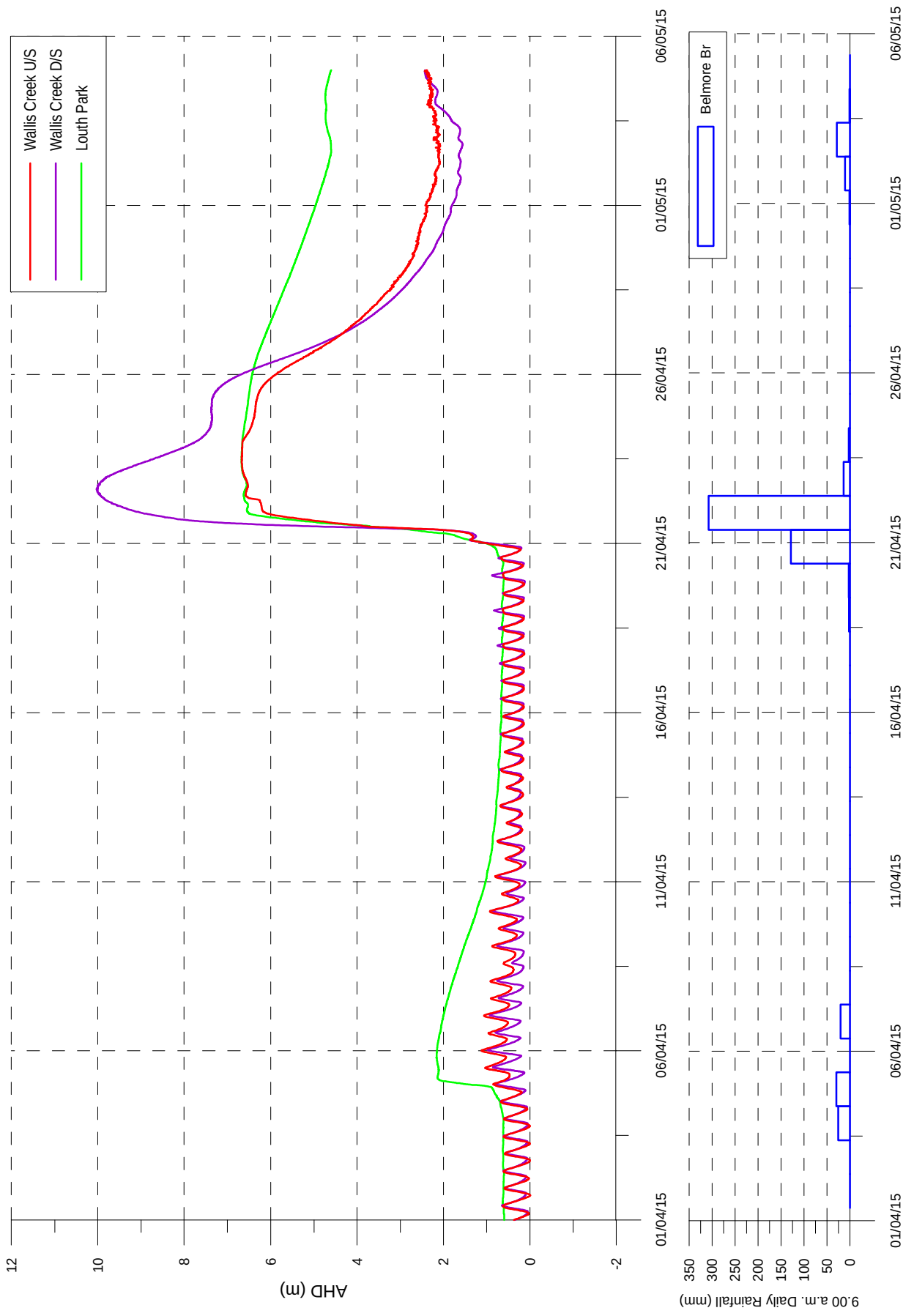
Figure
5.16



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WALLIS CREEK RIVER REGION
WATER LEVEL
01 APRIL – 05 MAY 2015

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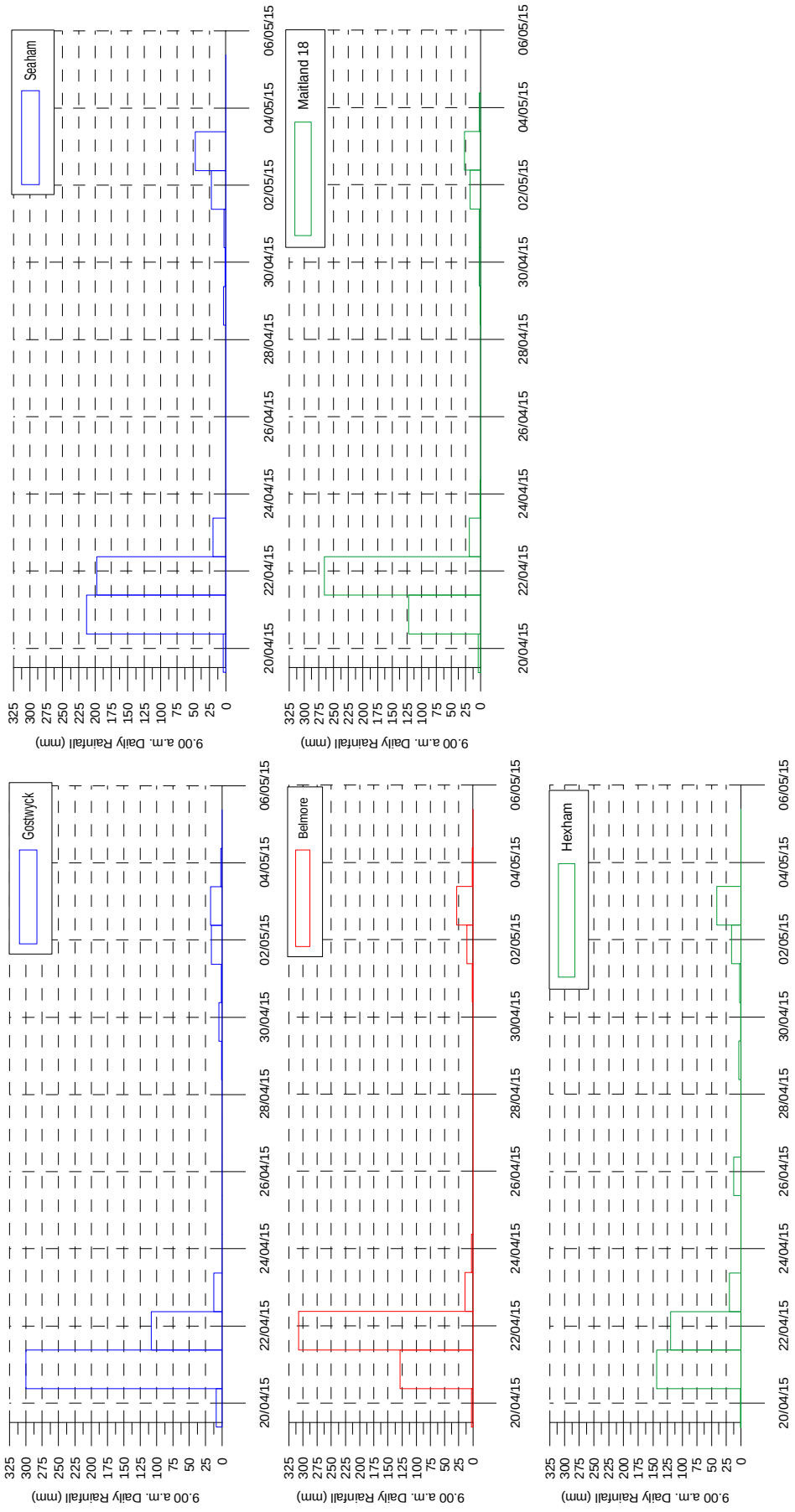
Figure
5.17



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LOWER HUNTER RIVER REGION
RAINFALL
20 APRIL – 05 MAY 2015

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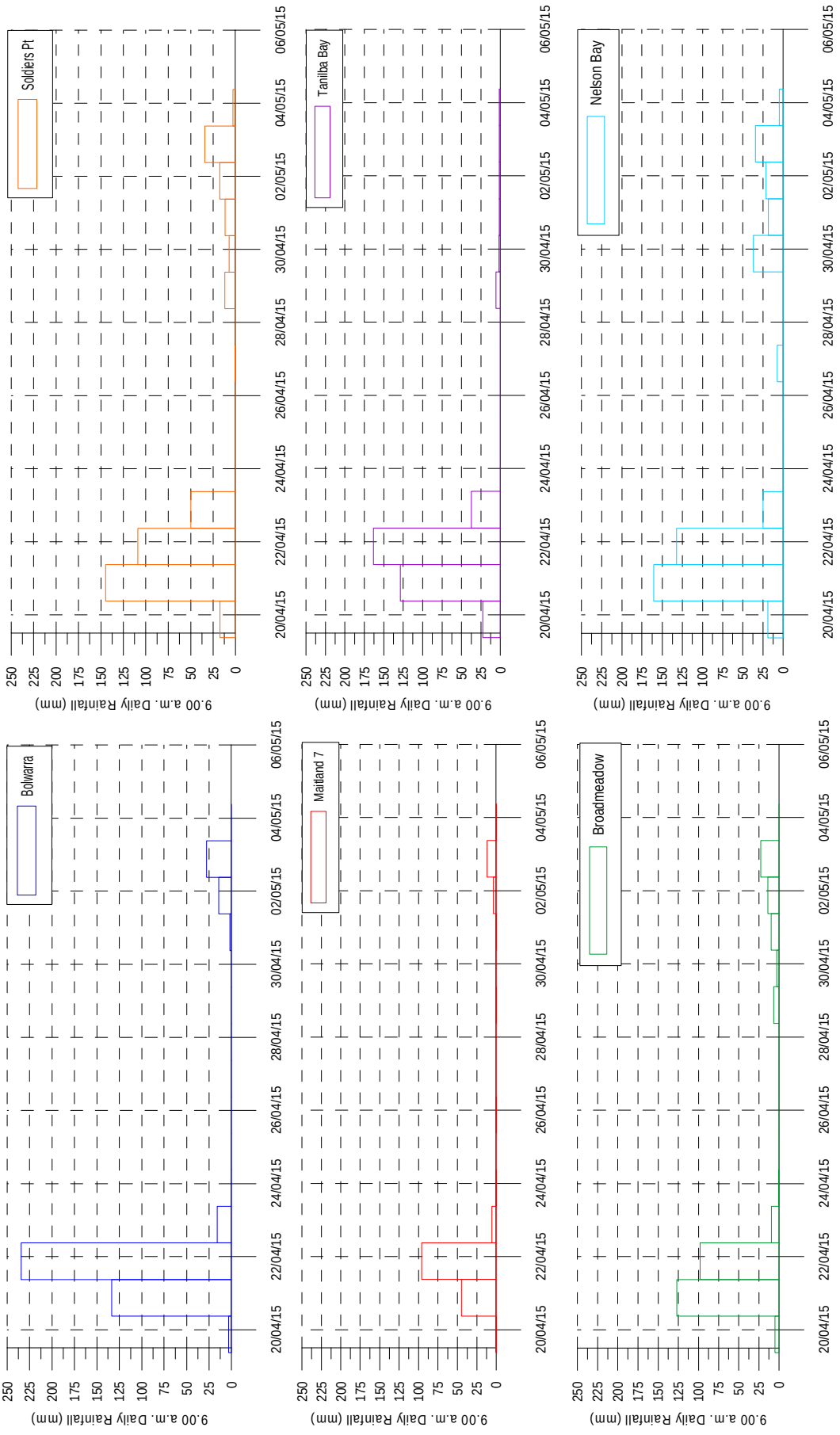
Figure
5.18



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LOWER HUNTER RIVER REGION
RAINFALL
20 APRIL – 05 MAY 2015

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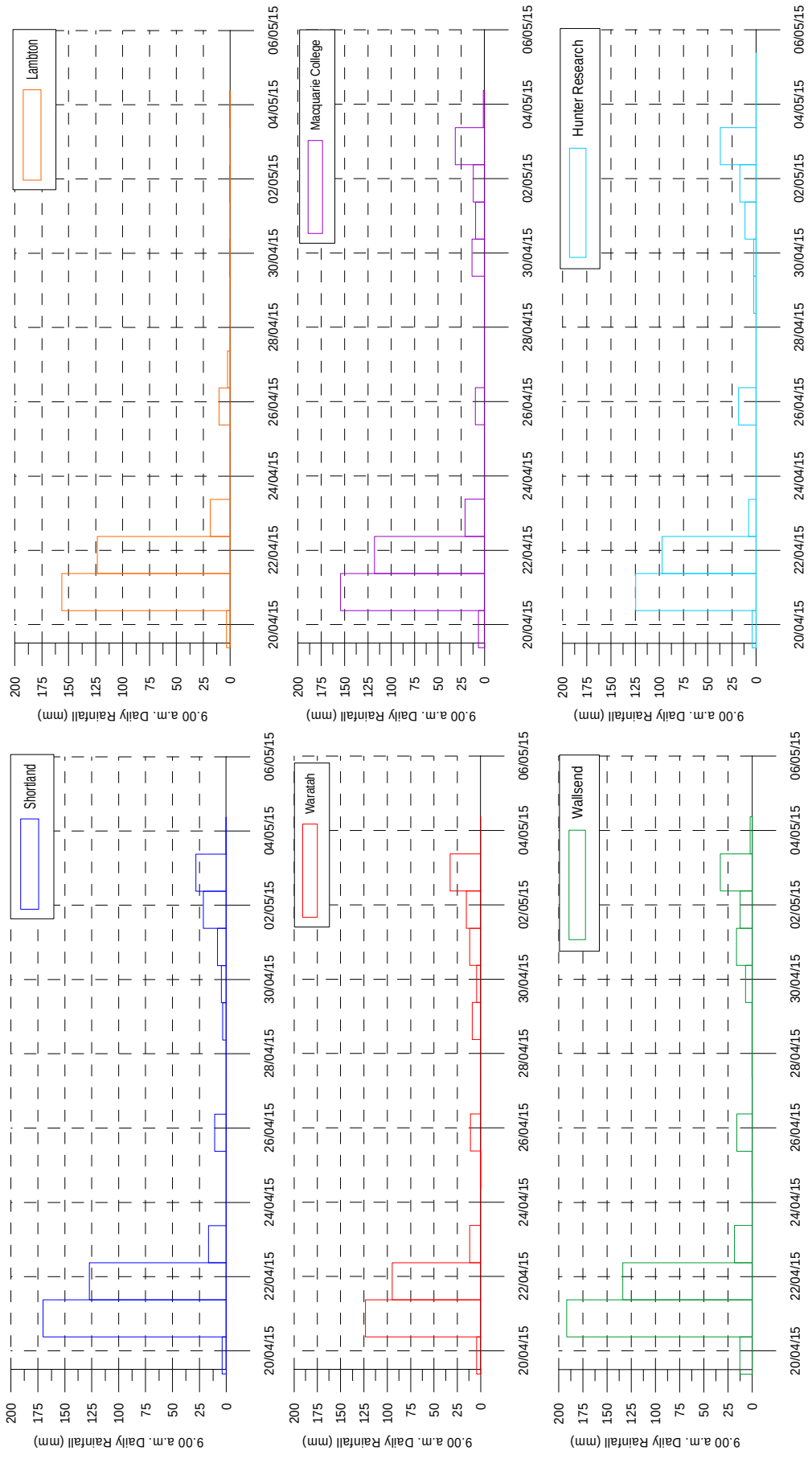
Figure
5.19



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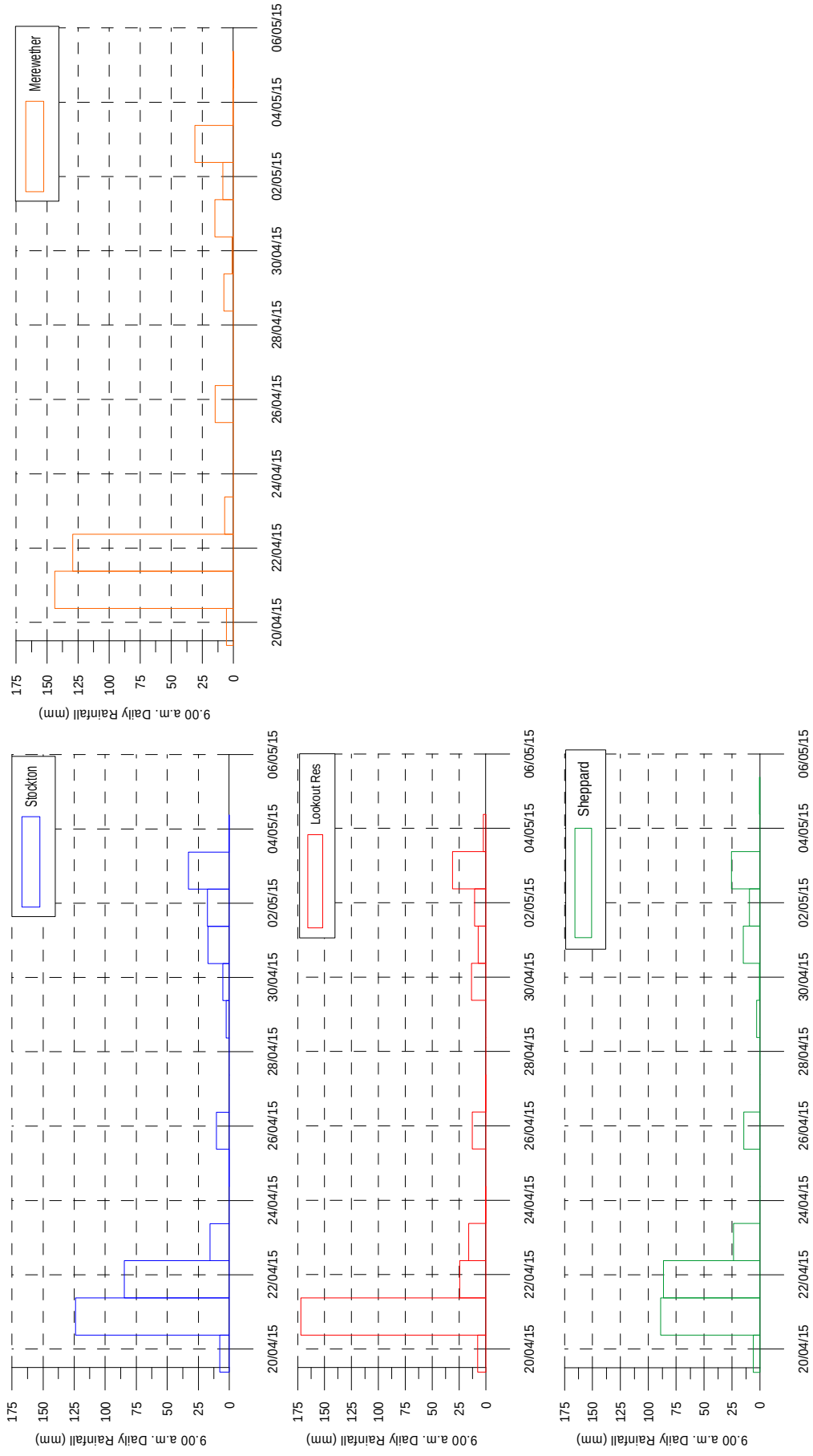
LOWER HUNTER RIVER REGION
RAINFALL
20 APRIL – 05 MAY 2015

MHL
REPORT 2364

Figure
5.20



Public Works
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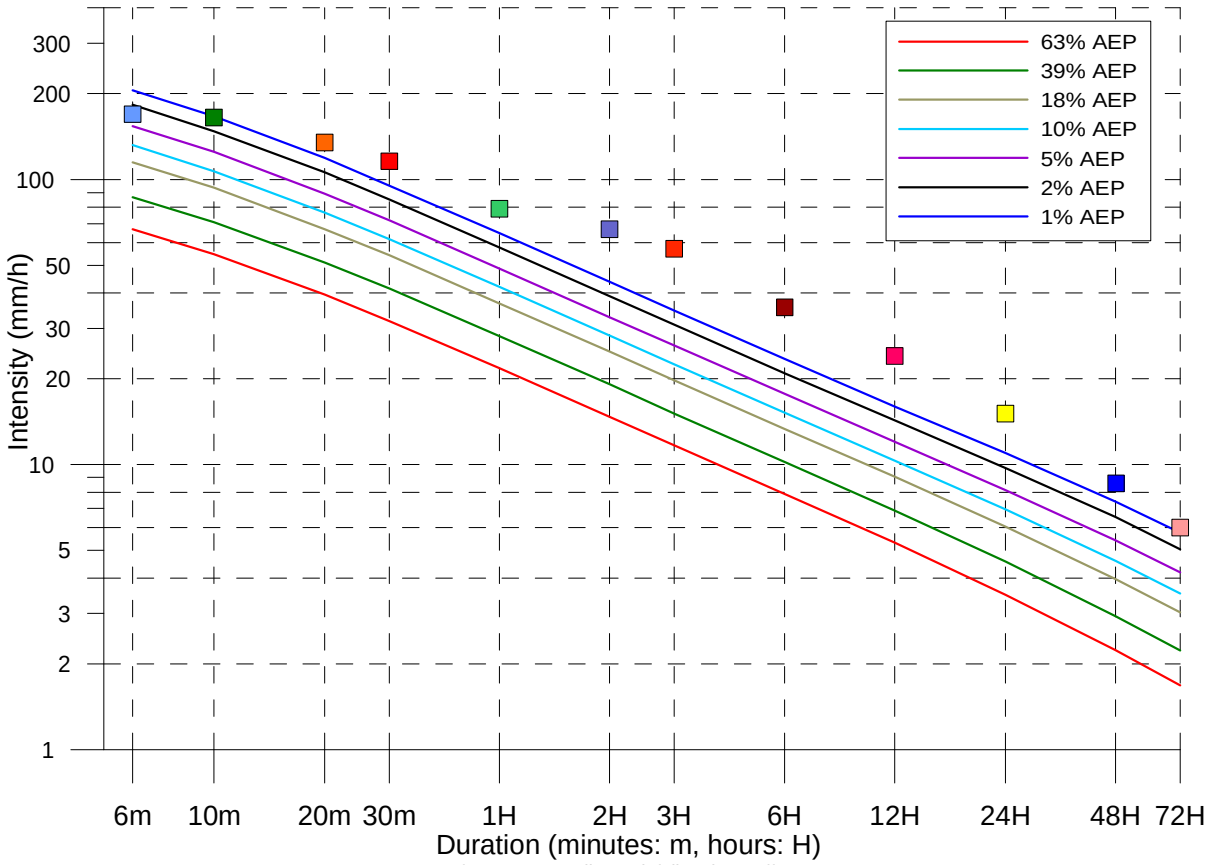
LOWER HUNTER RIVER REGION
RAINFALL
20 APRIL – 05 MAY 2015

MHL
REPORT 2364

Figure
5.21

Site owner: MHL Latitude: -32.5651 Longitude: 151.6056

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Gostwyck Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	170.0	07:26_21/04/2015
10m	165.0	07:22_21/04/2015
20m	135.0	07:14_21/04/2015
30m	116.0	07:04_21/04/2015
1H	79.0	06:42_21/04/2015
2H	67.0	06:42_21/04/2015
3H	57.2	06:28_21/04/2015
6H	35.6	03:54_21/04/2015
12H	24.0	21:46_20/04/2015
24H	15.1	21:10_20/04/2015
48H	8.6	02:14_20/04/2015
72H	6.0	01:18_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

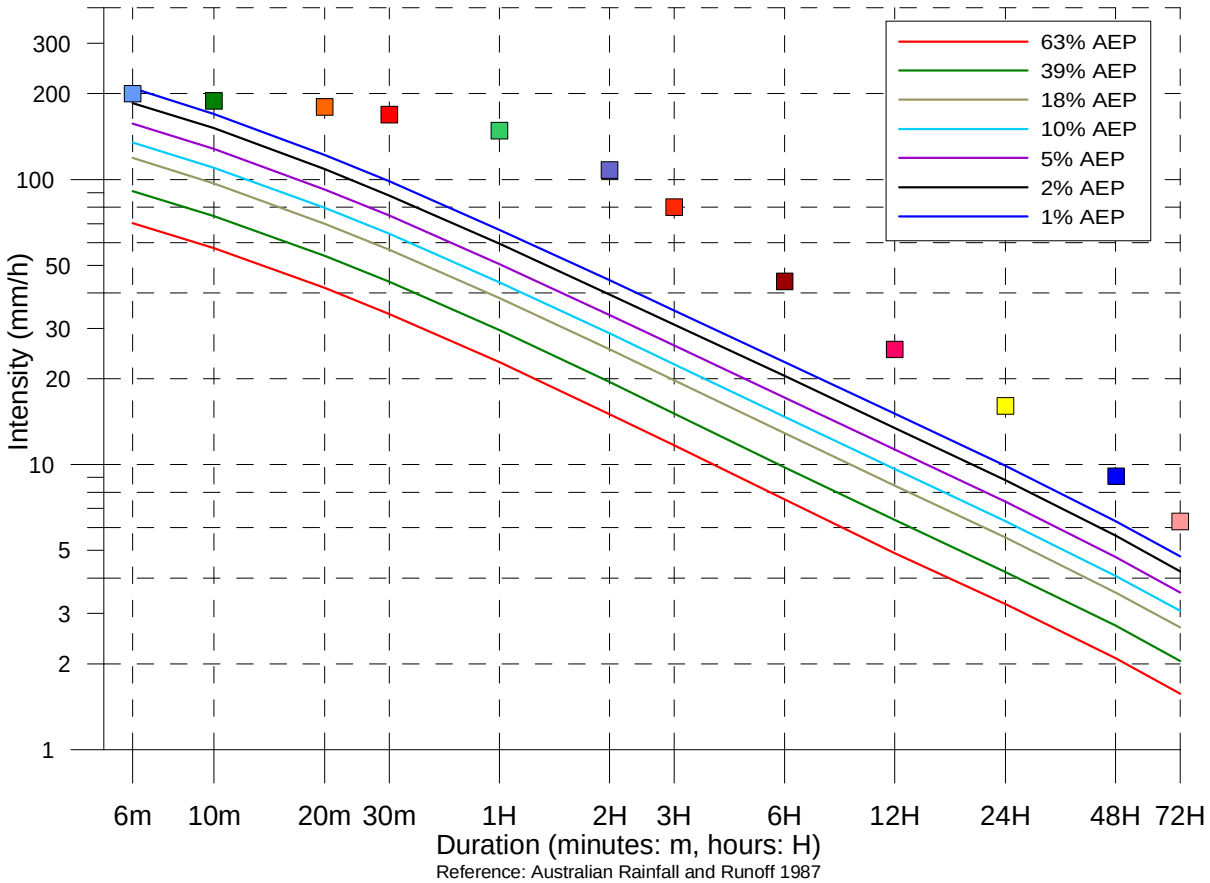
GOSTWYCK INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.22

Site owner: MHL Latitude: -32.7294 Longitude: 151.5533

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Belmore Bridge Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	200.0	10:34_21/04/2015
10m	189.0	10:30_21/04/2015
20m	180.0	10:30_21/04/2015
30m	169.0	10:22_21/04/2015
1H	148.5	09:58_21/04/2015
2H	108.0	09:56_21/04/2015
3H	80.0	09:40_21/04/2015
6H	44.0	07:56_21/04/2015
12H	25.4	08:06_21/04/2015
24H	16.1	18:48_20/04/2015
48H	9.1	06:04_20/04/2015
72H	6.3	05:20_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

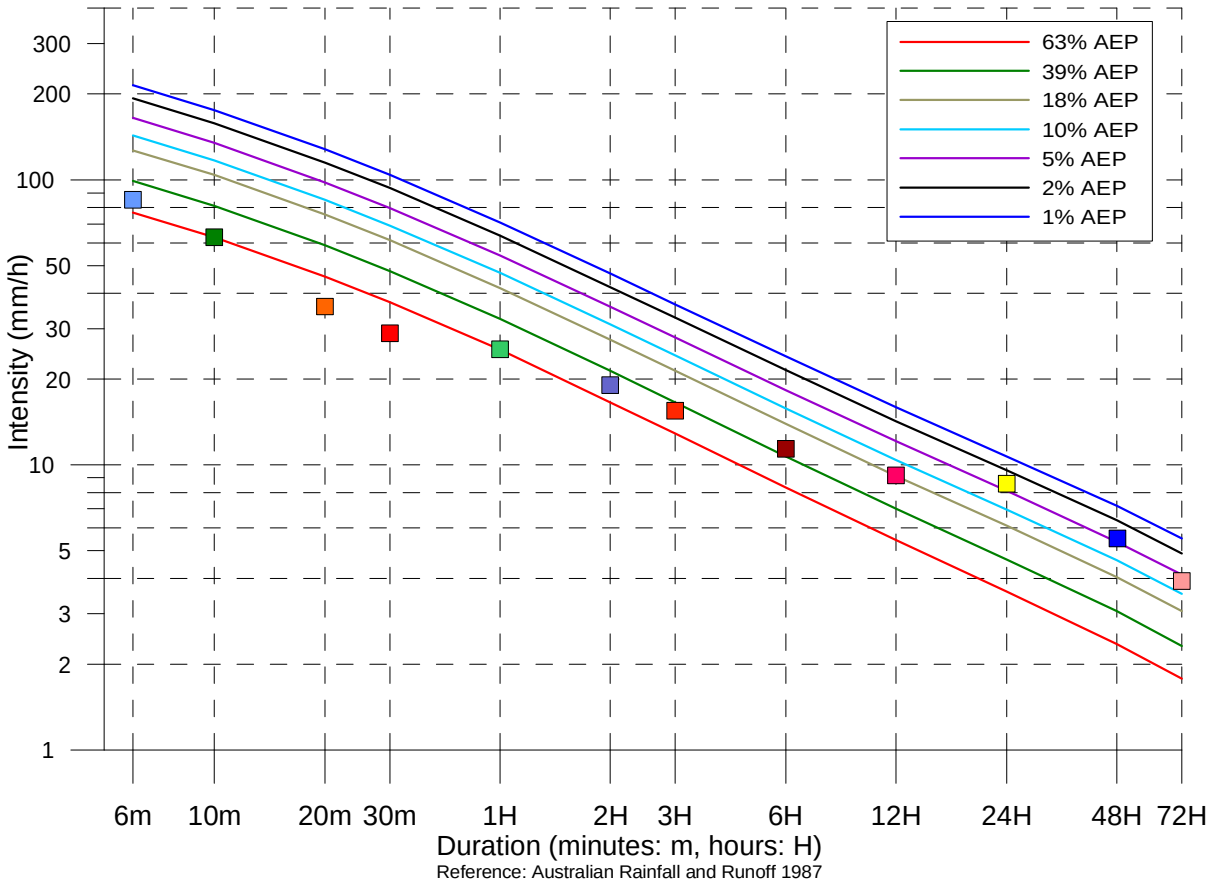
BELMORE BRIDGE INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.23

Site owner: MHL Latitude: -32.8177 Longitude: 151.6814

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Hexham Bridge Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	85.0	18:24_25/04/2015
10m	63.0	18:24_25/04/2015
20m	36.0	18:18_25/04/2015
30m	29.0	04:42_21/04/2015
1H	25.5	11:52_21/04/2015
2H	19.0	10:54_21/04/2015
3H	15.5	10:28_21/04/2015
6H	11.4	19:48_20/04/2015
12H	9.2	08:18_21/04/2015
24H	8.6	20:08_20/04/2015
48H	5.5	08:00_20/04/2015
72H	3.9	02:42_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

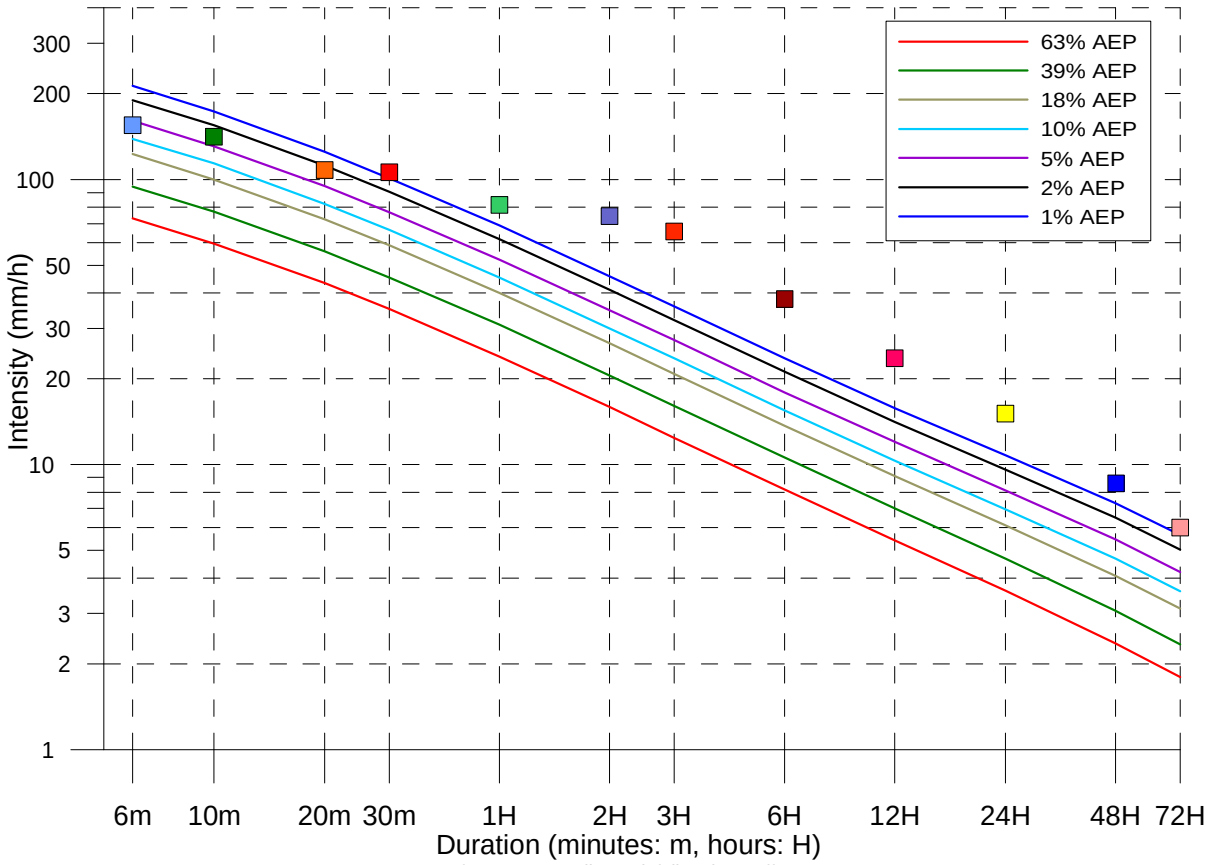
HEXHAM BRIDGE INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.24

Site owner: HWC Latitude: -32.6634 Longitude: 151.7321

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Seaham Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	155.0	09:38_21/04/2015
10m	141.0	09:34_21/04/2015
20m	108.0	09:34_21/04/2015
30m	106.0	09:18_21/04/2015
1H	81.5	08:46_21/04/2015
2H	74.5	08:26_21/04/2015
3H	65.7	08:22_21/04/2015
6H	38.0	06:06_21/04/2015
12H	23.6	23:24_20/04/2015
24H	15.1	12:10_20/04/2015
48H	8.6	05:12_20/04/2015
72H	6.0	04:22_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

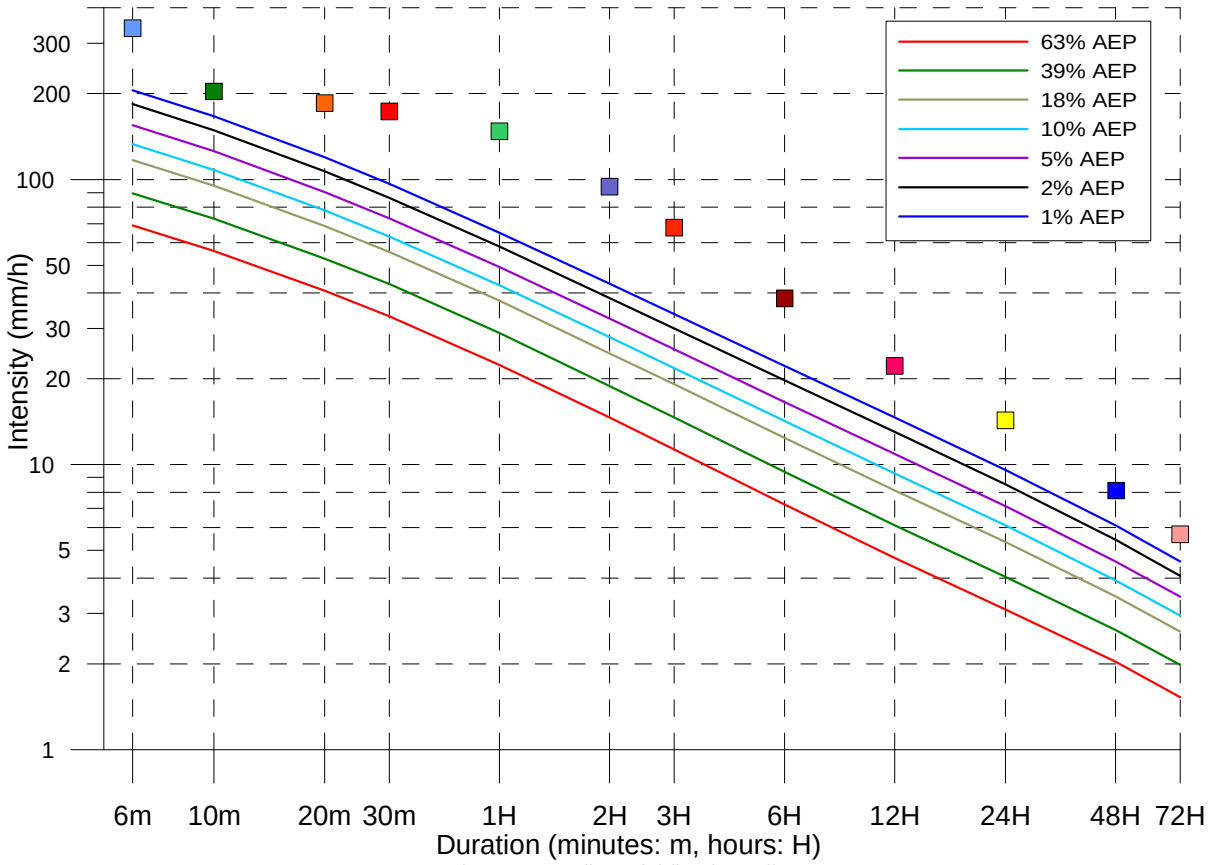
SEAHAM INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.25

Site owner: HWC Latitude: -32.7014 Longitude: 151.5274

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Maitland 18 WWPS Canal Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		340.0	10:10_21/04/2015
10m		204.0	10:10_21/04/2015
20m		186.0	10:04_21/04/2015
30m		174.0	10:00_21/04/2015
1H		147.4	09:54_21/04/2015
2H		94.6	09:50_21/04/2015
3H		67.8	09:24_21/04/2015
6H		38.2	08:10_21/04/2015
12H		22.2	07:00_21/04/2015
24H		14.3	18:54_20/04/2015
48H		8.1	05:54_20/04/2015
72H		5.7	02:20_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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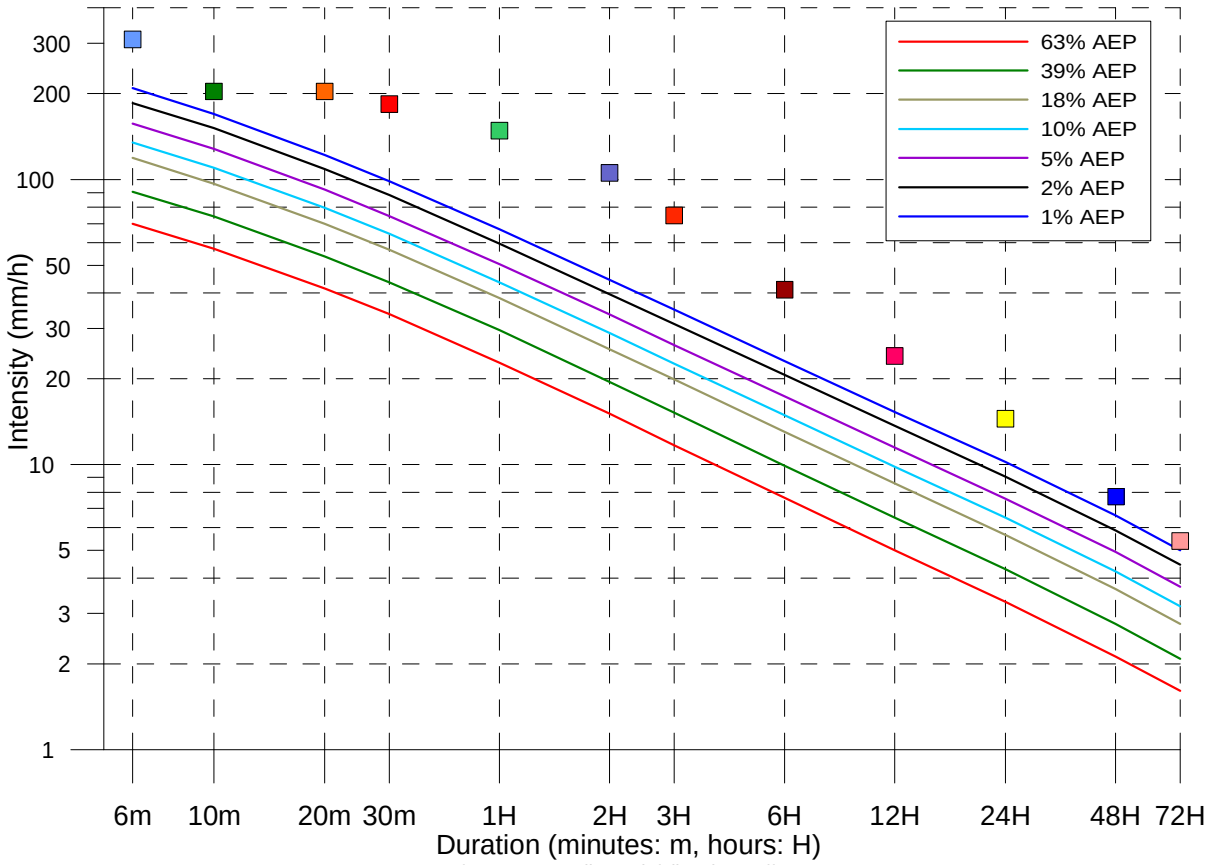
MAITLAND 18 WWPS INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.26

Site owner: HWC Latitude: -32.7128 Longitude: 151.5707

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Bolwarra Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	310.0	10:44_21/04/2015
10m	204.0	10:38_21/04/2015
20m	204.0	10:28_21/04/2015
30m	184.0	10:24_21/04/2015
1H	148.6	09:58_21/04/2015
2H	105.6	09:44_21/04/2015
3H	74.9	09:18_21/04/2015
6H	41.1	06:08_21/04/2015
12H	24.0	00:08_21/04/2015
24H	14.5	12:08_20/04/2015
48H	7.7	05:34_20/04/2015
72H	5.4	01:28_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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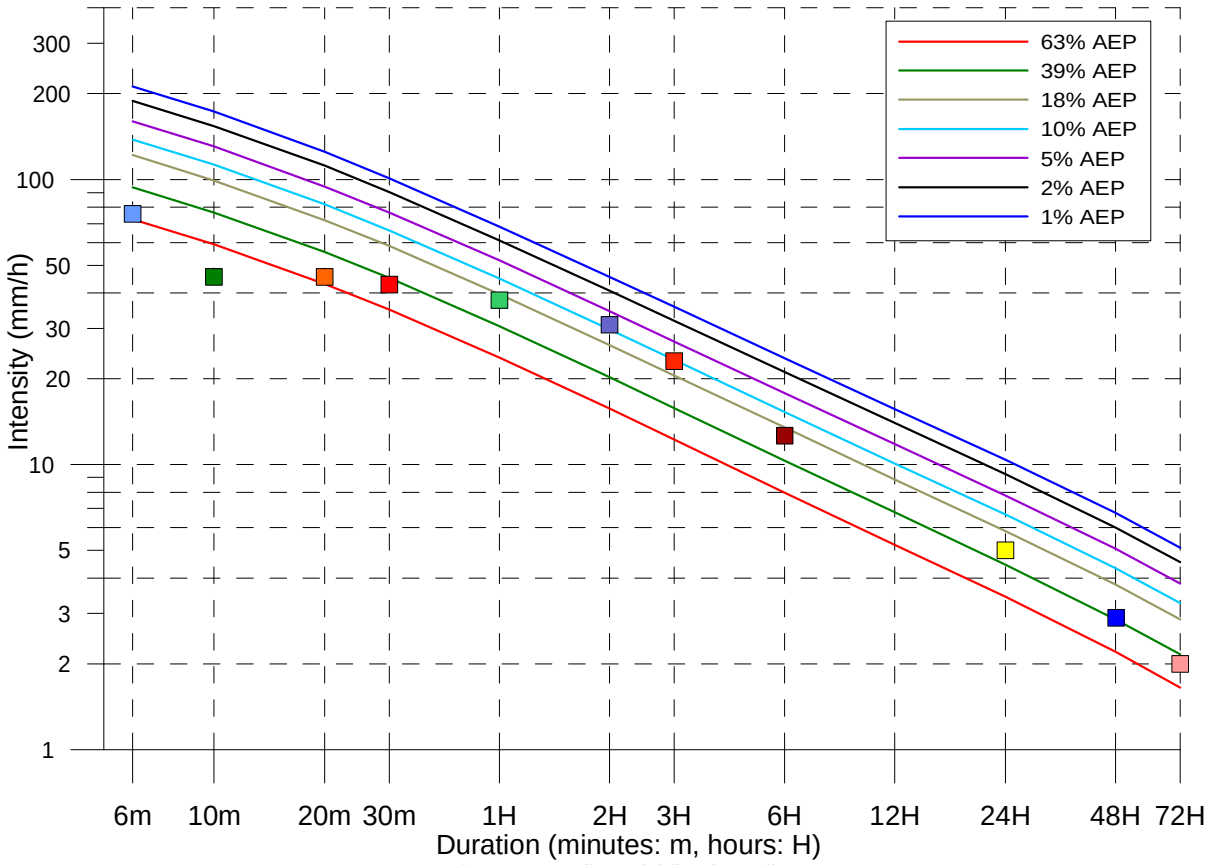
BOLWARRA INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.27

Site owner: HWC Latitude: -32.7522 Longitude: 151.6025

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Maitland 7 WWPS Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	76.0	11:30_21/04/2015
10m	45.6	11:04_21/04/2015
20m	45.6	11:34_21/04/2015
30m	42.8	11:30_21/04/2015
1H	37.8	11:00_21/04/2015
2H	30.9	10:30_21/04/2015
3H	23.1	09:44_21/04/2015
6H	12.6	09:44_21/04/2015
12H	7.7	09:04_21/04/2015
24H	5.0	20:40_20/04/2015
48H	2.9	09:50_20/04/2015
72H	2.0	01:50_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

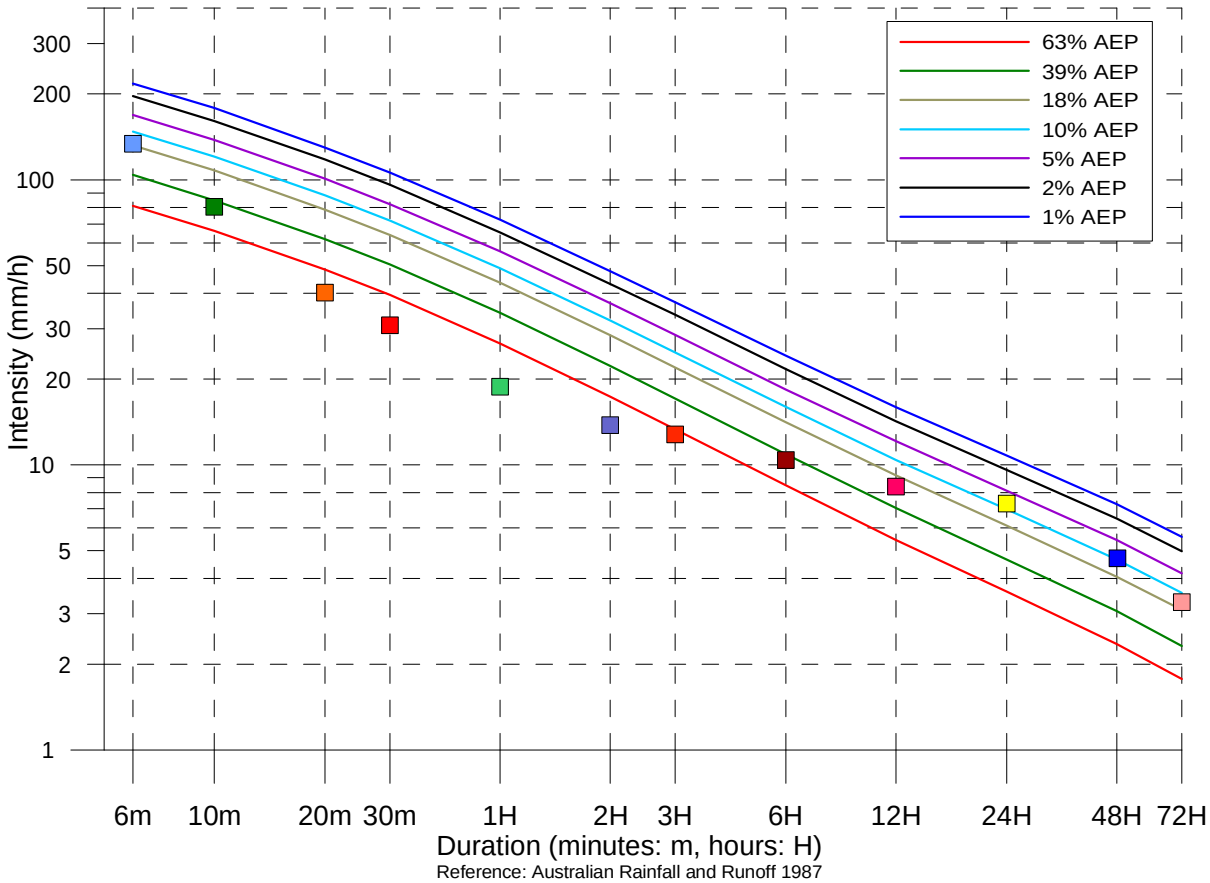
MAITLAND 7 WWPS INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.28

Site owner: HWC Latitude: -32.9206 Longitude: 151.7293

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Broadmeadow Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	134.0	05:34_04/04/2015
10m	80.4	05:34_04/04/2015
20m	40.2	05:34_04/04/2015
30m	30.8	05:34_04/04/2015
1H	18.8	04:44_04/04/2015
2H	13.8	15:34_21/04/2015
3H	12.8	14:38_21/04/2015
6H	10.4	14:04_21/04/2015
12H	8.4	08:08_21/04/2015
24H	7.3	20:18_20/04/2015
48H	4.7	07:18_20/04/2015
72H	3.3	21:34_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

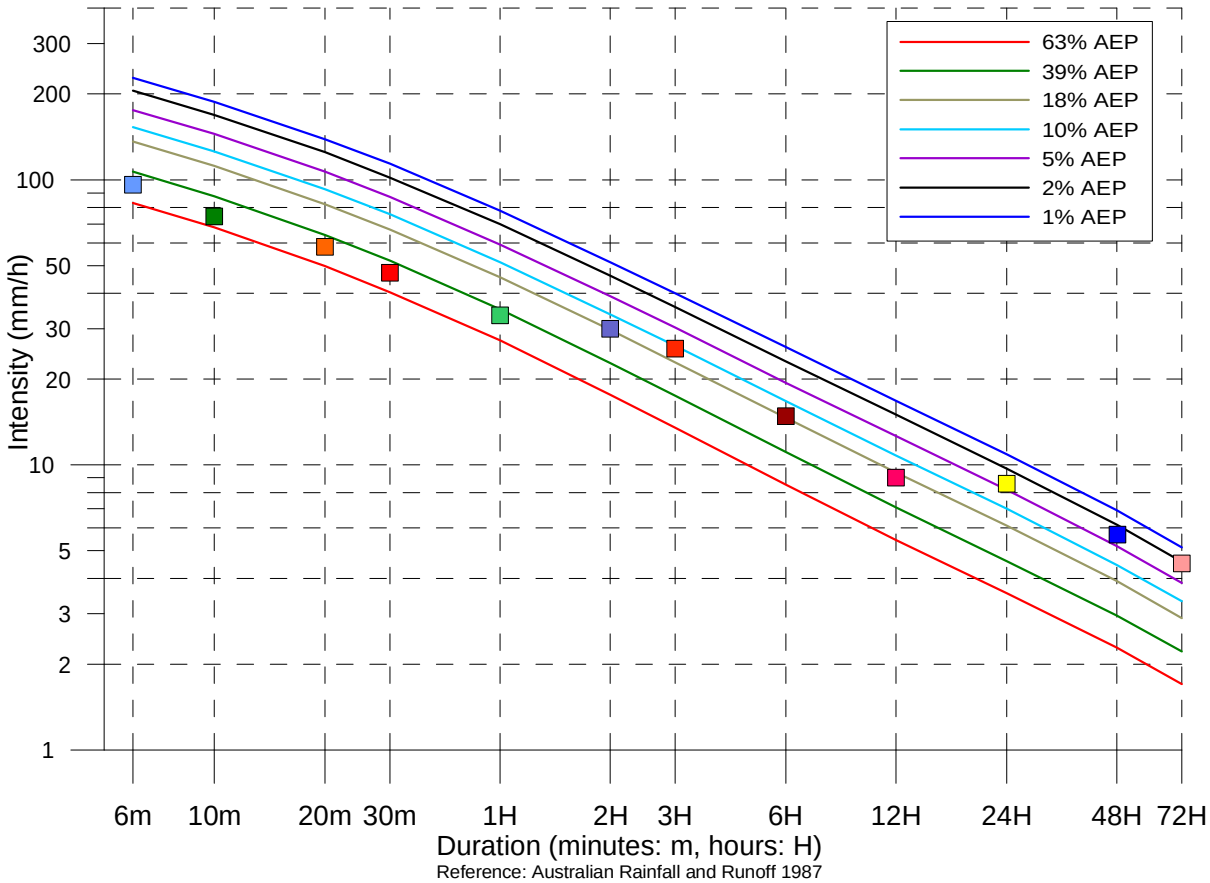
BROADMEADOW INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.29

Site owner: HWC Latitude: -32.7101 Longitude: 152.0702

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Soldiers Point Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		96.0	13:50_21/04/2015
10m		74.4	17:14_04/04/2015
20m		58.2	13:44_21/04/2015
30m		47.2	17:14_04/04/2015
1H		33.4	17:04_04/04/2015
2H		30.1	23:20_20/04/2015
3H		25.6	22:24_20/04/2015
6H		14.8	20:20_20/04/2015
12H		9.0	08:30_21/04/2015
24H		8.6	20:20_20/04/2015
48H		5.7	15:54_20/04/2015
72H		4.5	02:50_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

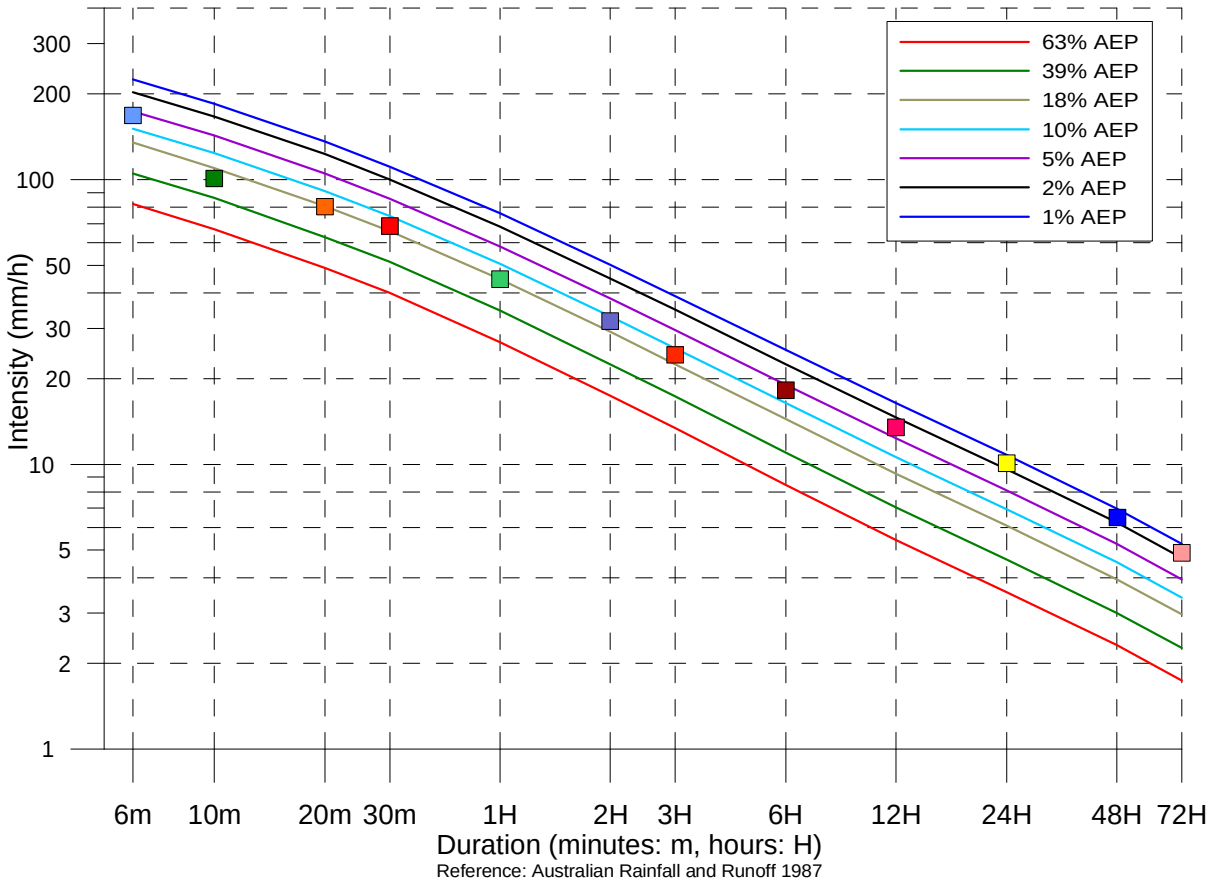
SOLDIERS POINT INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.30

Site owner: HWC Latitude: -32.73693 Longitude: 152.0008

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Tanilba Bay Rainfall Intensity 01 April 2015 – 05 May 2015			
	Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
	6m	168.0	13:40_21/04/2015
	10m	100.8	13:40_21/04/2015
	20m	80.4	13:30_21/04/2015
	30m	68.8	13:20_21/04/2015
	1H	44.8	13:04_21/04/2015
	2H	31.8	11:50_21/04/2015
	3H	24.2	16:50_21/04/2015
	6H	18.2	13:14_21/04/2015
	12H	13.5	09:34_21/04/2015
	24H	10.1	20:10_20/04/2015
	48H	6.5	04:44_20/04/2015
	72H	4.9	04:44_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

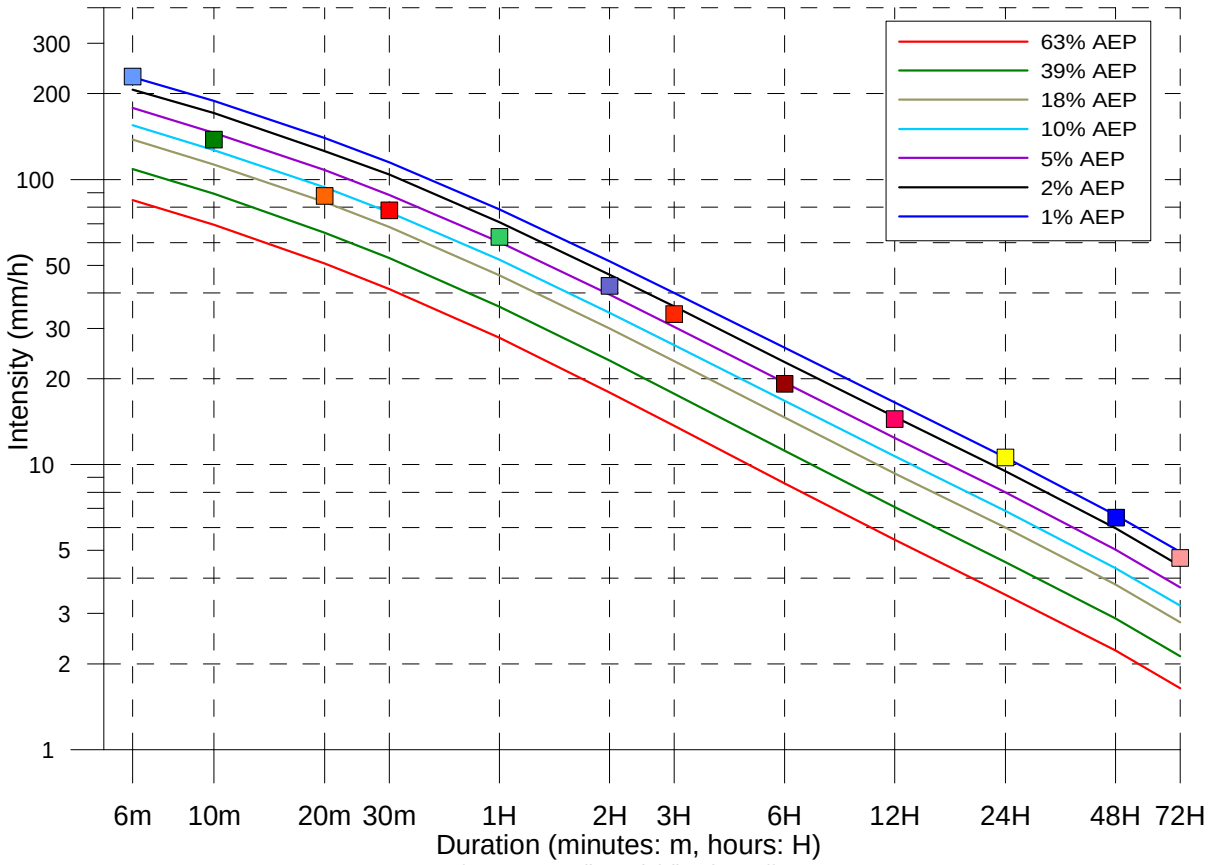
TANILBA BAY INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.31

Site owner: HWC Latitude: -32.7252 Longitude: 152.1438

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Nelson Bay Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
	6m	230.0	13:50_29/04/2015
	10m	138.0	13:50_29/04/2015
	20m	87.6	10:44_21/04/2015
	30m	78.0	10:40_21/04/2015
	1H	62.8	10:30_21/04/2015
	2H	42.4	23:20_20/04/2015
	3H	33.7	22:54_20/04/2015
	6H	19.2	19:44_20/04/2015
	12H	14.4	23:44_20/04/2015
	24H	10.6	19:44_20/04/2015
	48H	6.5	04:20_20/04/2015
	72H	4.7	04:20_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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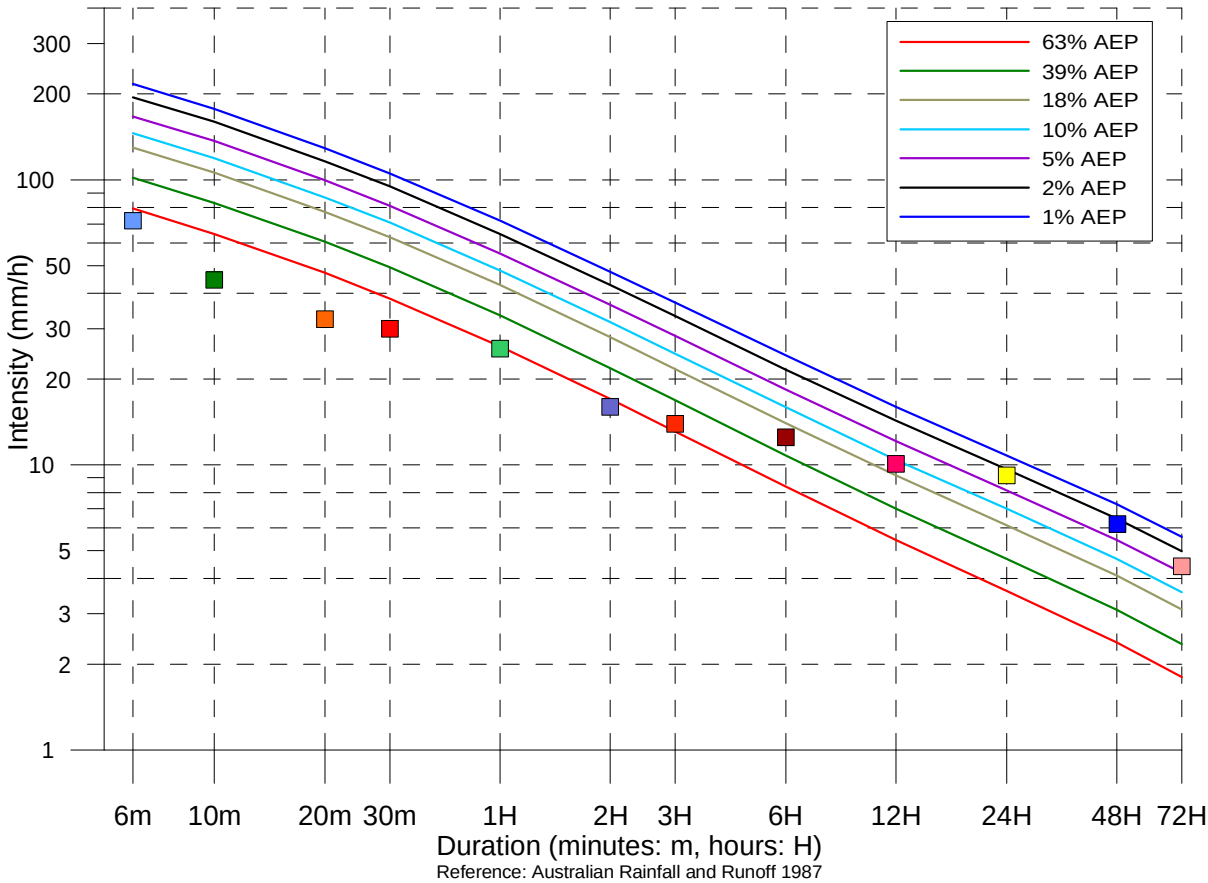
NELSON BAY INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.32

Site owner: HWC Latitude: -32.8845 Longitude: 151.6889

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Shortland Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	72.0	03:10_04/04/2015
10m	44.4	19:54_21/04/2015
20m	32.4	20:00_21/04/2015
30m	30.0	19:54_21/04/2015
1H	25.6	19:20_21/04/2015
2H	16.0	18:24_21/04/2015
3H	13.9	17:20_21/04/2015
6H	12.5	14:24_21/04/2015
12H	10.1	14:14_20/04/2015
24H	9.2	20:20_20/04/2015
48H	6.2	07:50_20/04/2015
72H	4.4	18:54_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

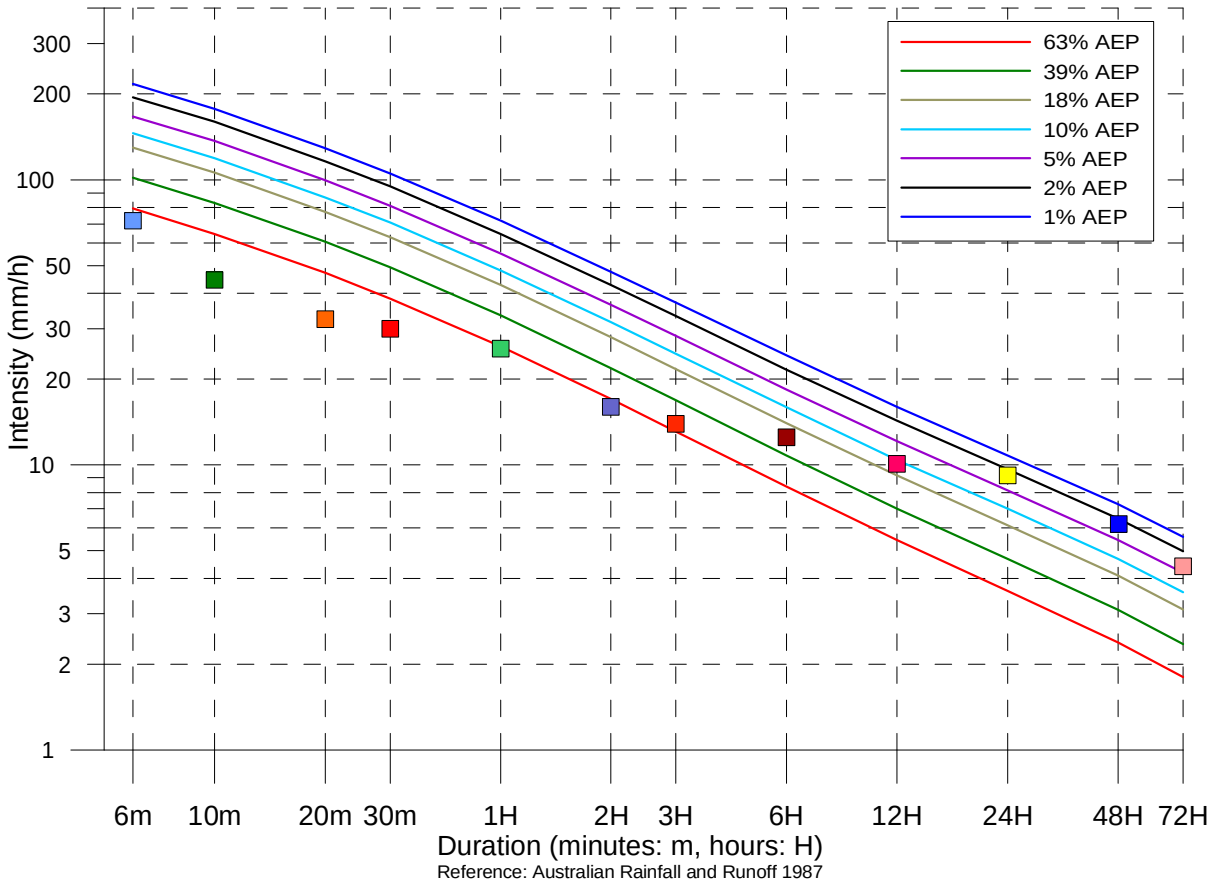
SHORTLAND INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.33

Site owner: HWC Latitude: -32.8988 Longitude: 151.7189

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Waratah Reservoir Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		56.0	03:00_04/04/2015
10m		40.8	19:34_21/04/2015
20m		25.8	04:44_21/04/2015
30m		20.8	17:10_21/04/2015
1H		14.8	16:44_21/04/2015
2H		13.4	15:40_21/04/2015
3H		12.1	14:44_21/04/2015
6H		10.1	14:10_21/04/2015
12H		7.9	08:10_21/04/2015
24H		6.9	20:10_20/04/2015
48H		4.6	07:44_20/04/2015
72H		3.2	21:14_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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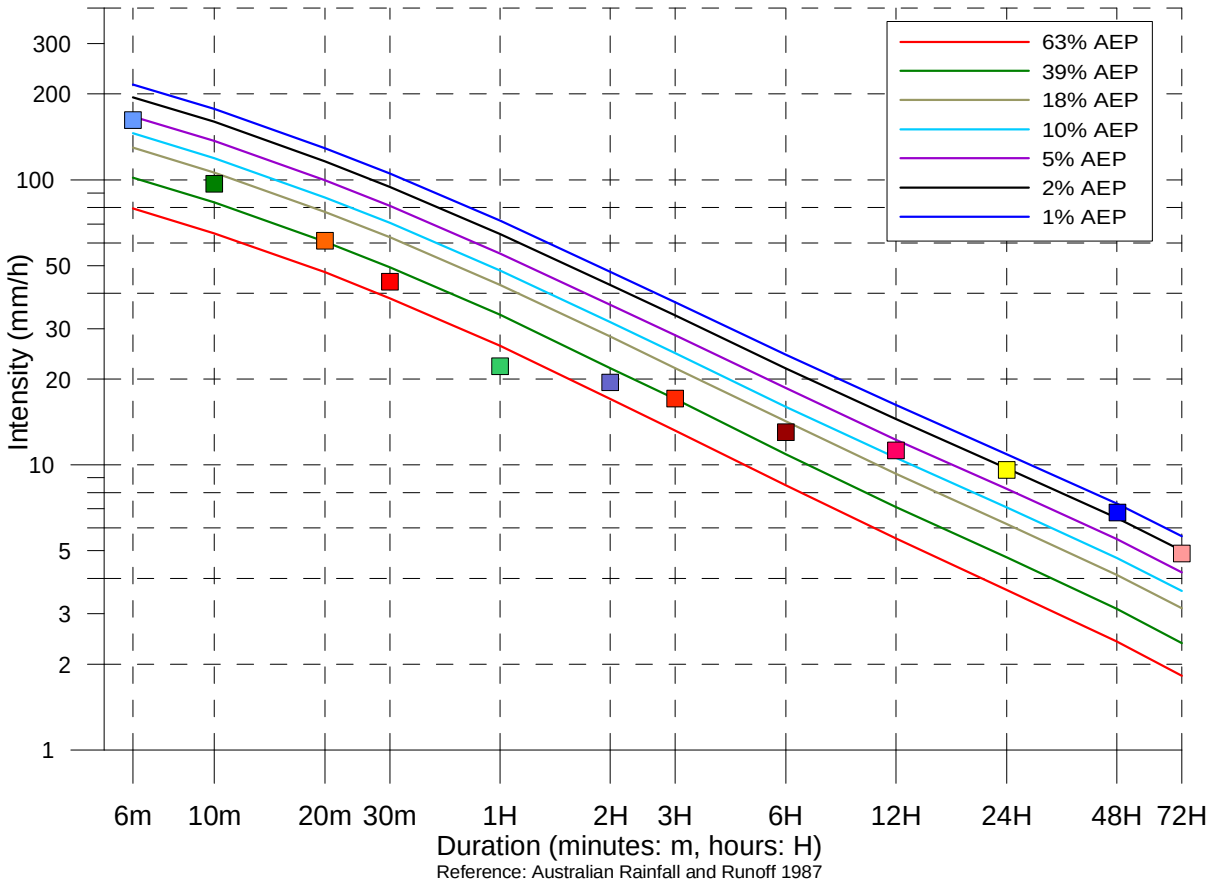
WARATAH RESERVOIR INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.34

Site owner: HWC Latitude: -32.9046 Longitude: 151.6654

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Wallsend Bowling Club Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	162.0	20:00_21/04/2015
10m	97.2	20:00_21/04/2015
20m	61.2	20:00_21/04/2015
30m	44.0	20:00_21/04/2015
1H	22.2	20:00_21/04/2015
2H	19.5	15:34_20/04/2015
3H	17.1	15:34_20/04/2015
6H	13.0	15:34_20/04/2015
12H	11.2	14:20_20/04/2015
24H	9.6	15:34_20/04/2015
48H	6.8	05:40_20/04/2015
72H	4.9	19:04_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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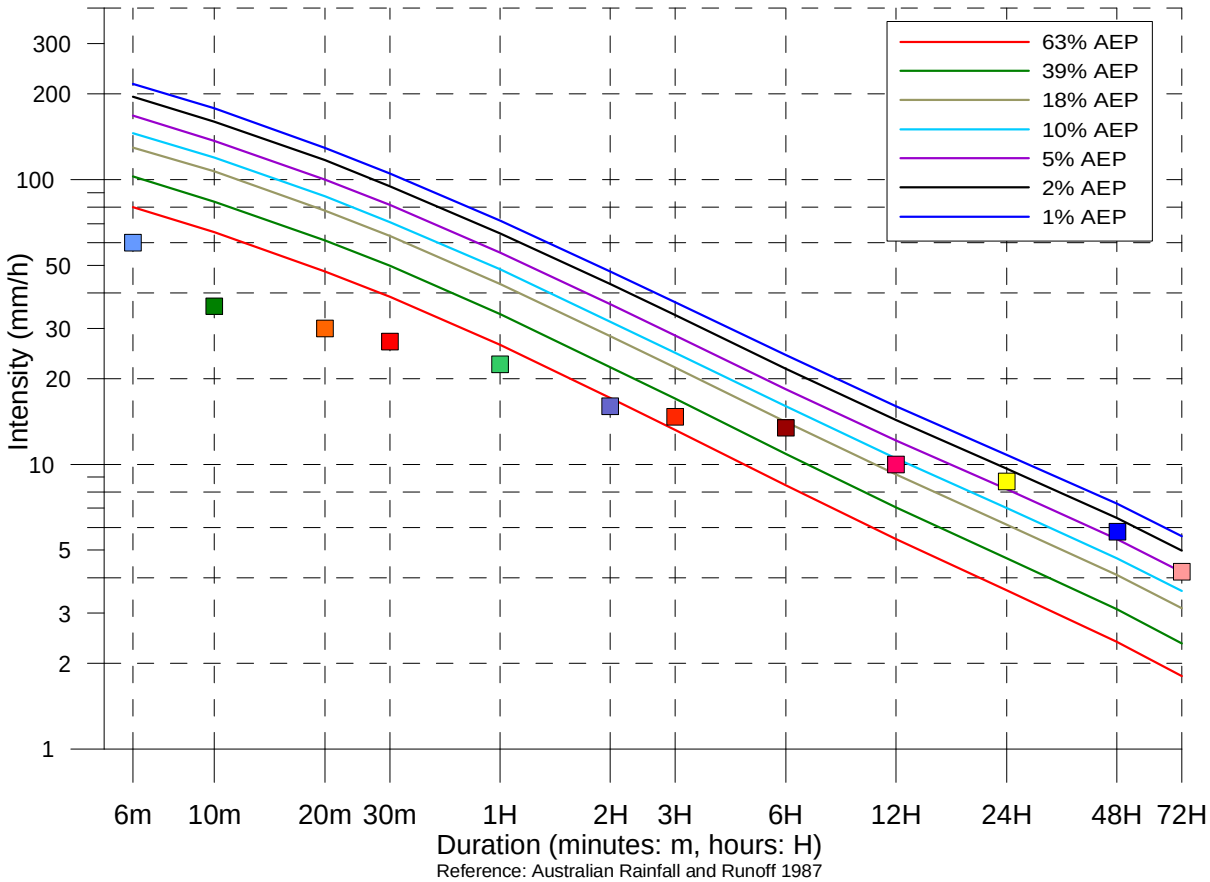
WALLSEND BOWLING CLUB INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.35

Site owner: BoM Latitude: -32.9091 Longitude: 151.7036

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Lambton Reservoir Club Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	60.0	01:24_21/04/2015
10m	36.0	04:58_21/04/2015
20m	30.0	20:08_21/04/2015
30m	27.0	19:58_21/04/2015
1H	22.5	19:28_21/04/2015
2H	16.0	15:48_21/04/2015
3H	14.7	14:54_21/04/2015
6H	13.4	14:28_21/04/2015
12H	10.0	08:28_21/04/2015
24H	8.7	20:28_20/04/2015
48H	5.8	07:54_20/04/2015
72H	4.2	21:08_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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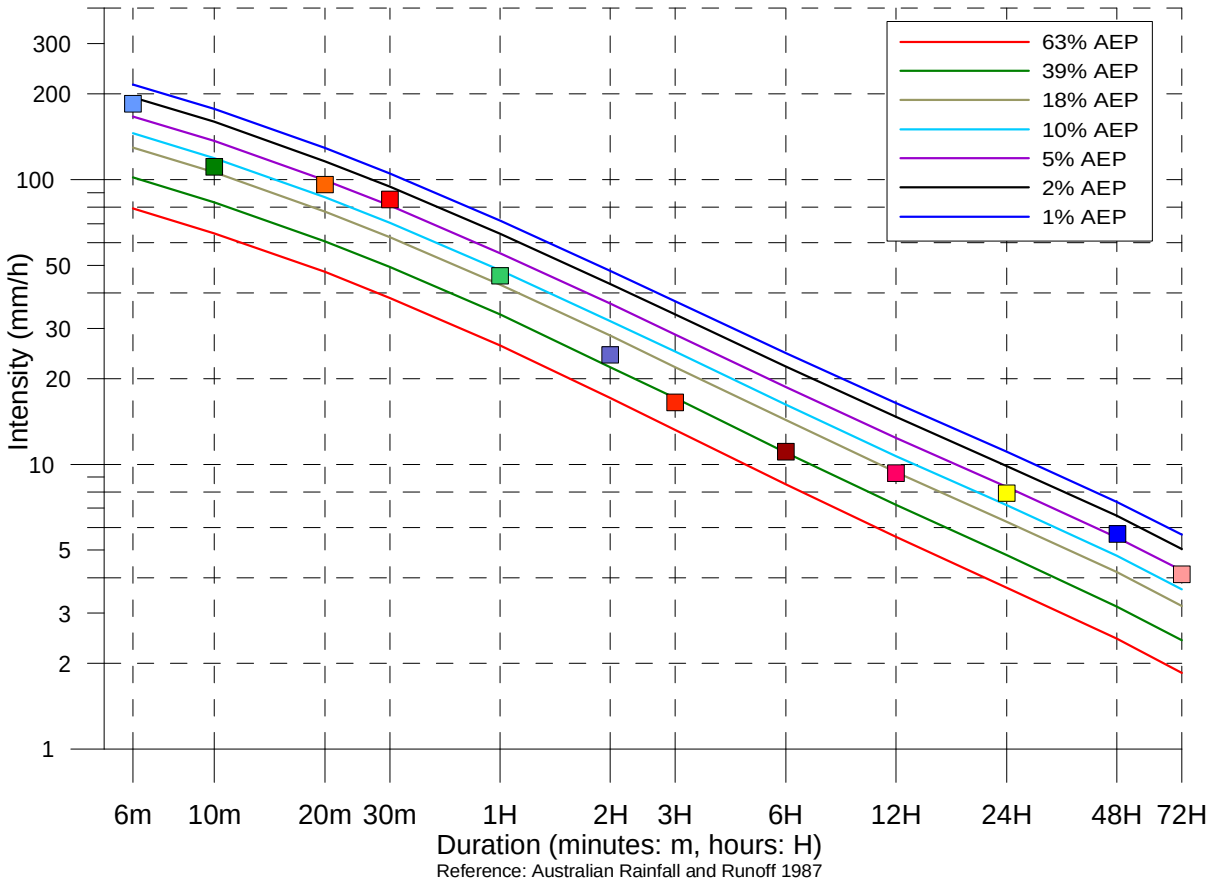
LAMBTON RESERVOIR INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.36

Site owner: BoM Latitude: -32.9209 Longitude: 151.6510

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Macquarie College Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	185.0	15:54_06/04/2015
10m	111.0	15:58_06/04/2015
20m	96.0	15:54_06/04/2015
30m	85.0	15:54_06/04/2015
1H	46.0	15:54_06/04/2015
2H	24.2	15:48_06/04/2015
3H	16.5	15:48_06/04/2015
6H	11.1	15:48_20/04/2015
12H	9.3	14:28_20/04/2015
24H	7.9	15:48_20/04/2015
48H	5.7	07:38_20/04/2015
72H	4.1	20:44_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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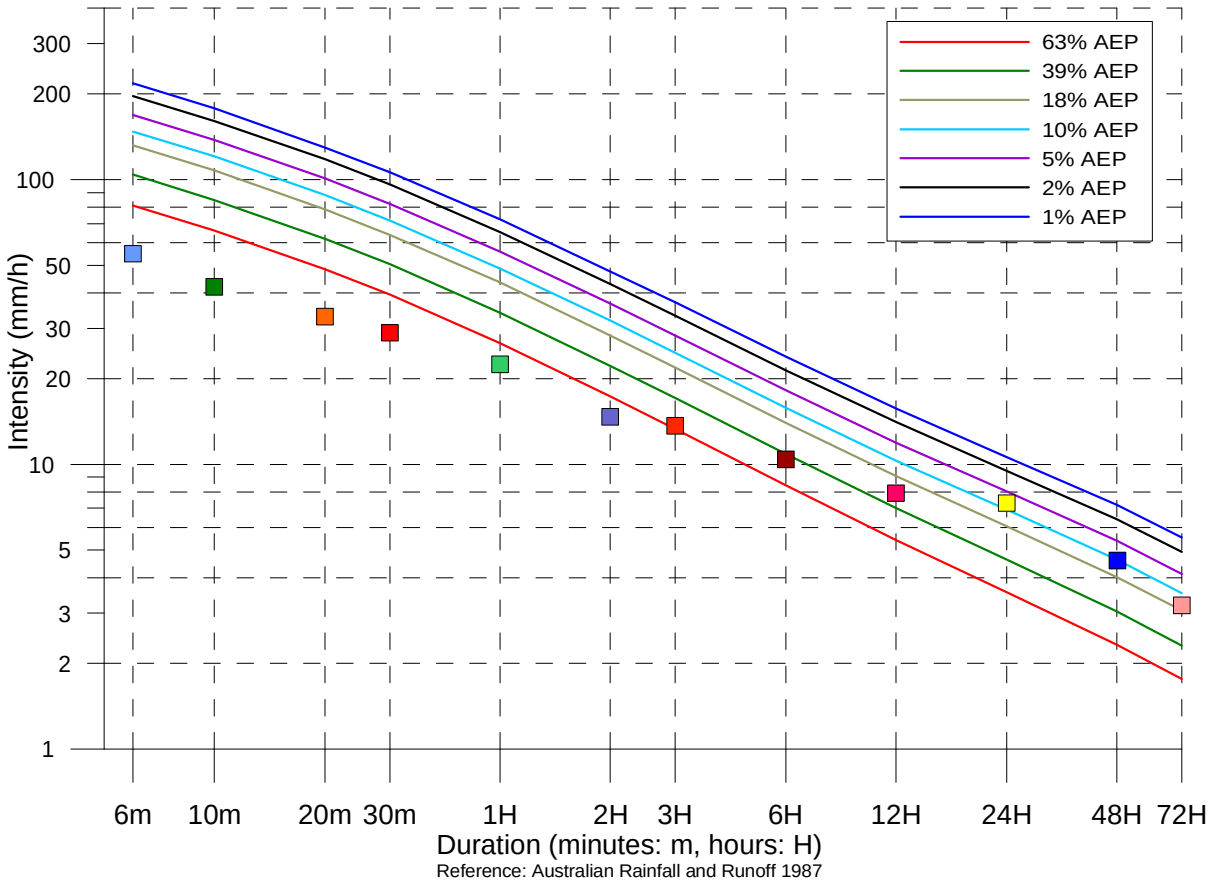
MACQUARIE COLLEGE INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.37

Site owner: BoM Latitude: -32.9117 Longitude: 151.7509

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Hunter Valley Research Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
	6m	55.0	01:42_26/04/2015
	10m	42.0	20:28_20/04/2015
	20m	33.0	20:28_20/04/2015
	30m	29.0	20:26_20/04/2015
	1H	22.5	20:02_20/04/2015
	2H	14.7	15:26_21/04/2015
	3H	13.7	14:40_21/04/2015
	6H	10.4	13:50_21/04/2015
	12H	7.9	08:04_21/04/2015
	24H	7.3	19:36_20/04/2015
	48H	4.6	07:36_20/04/2015
	72H	3.2	01:00_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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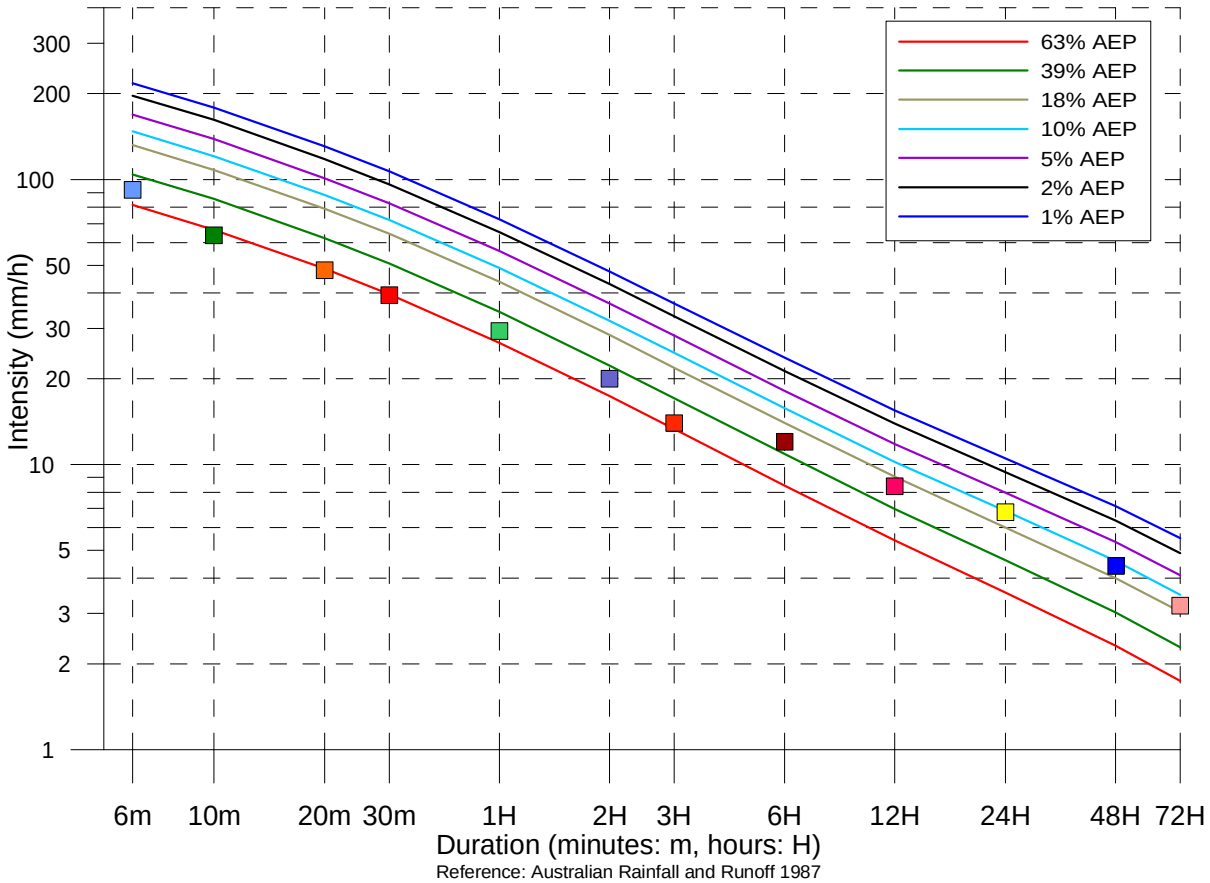
HUNTER VALLEY RESEARCH INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.38

Site owner: HWC Latitude: -32.8849 Longitude: 151.7838

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Stockton 3 WWPS Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		92.0	20:40_20/04/2015
10m		63.6	20:34_20/04/2015
20m		48.0	20:34_20/04/2015
30m		39.2	20:30_20/04/2015
1H		29.4	20:00_20/04/2015
2H		20.0	19:10_20/04/2015
3H		14.0	18:20_20/04/2015
6H		12.0	19:34_20/04/2015
12H		8.4	15:14_20/04/2015
24H		6.8	19:34_20/04/2015
48H		4.4	09:14_20/04/2015
72H		3.2	18:50_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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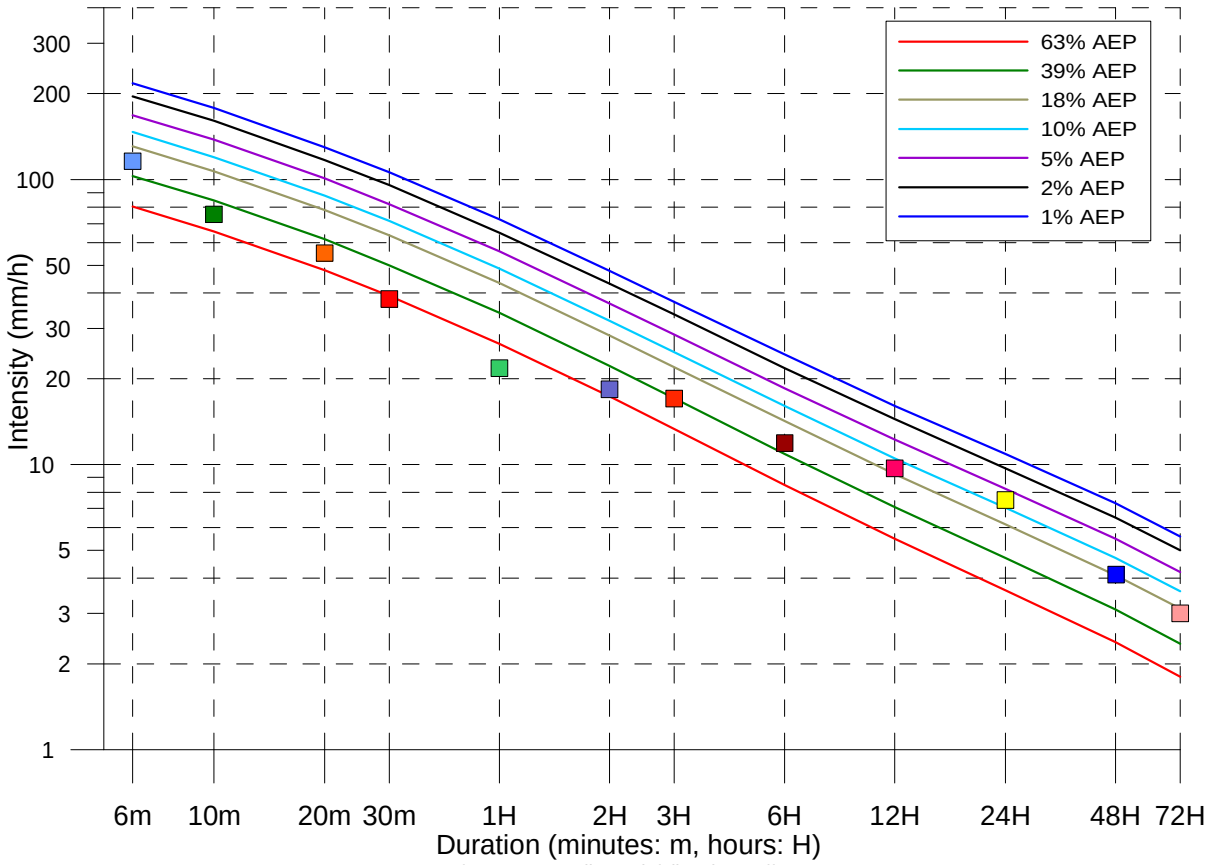
STOCKTON 3 WWPS INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.39

Site owner: HWC Latitude: -32.9328 Longitude: 151.6898

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Lookout Reservoir Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	116.0	16:04_06/04/2015
10m	75.6	15:58_06/04/2015
20m	55.2	15:54_06/04/2015
30m	38.0	15:48_06/04/2015
1H	21.8	08:38_21/04/2015
2H	18.4	16:08_20/04/2015
3H	17.0	15:24_20/04/2015
6H	11.9	15:24_20/04/2015
12H	9.7	14:18_20/04/2015
24H	7.5	10:24_20/04/2015
48H	4.1	07:24_20/04/2015
72H	3.0	18:38_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

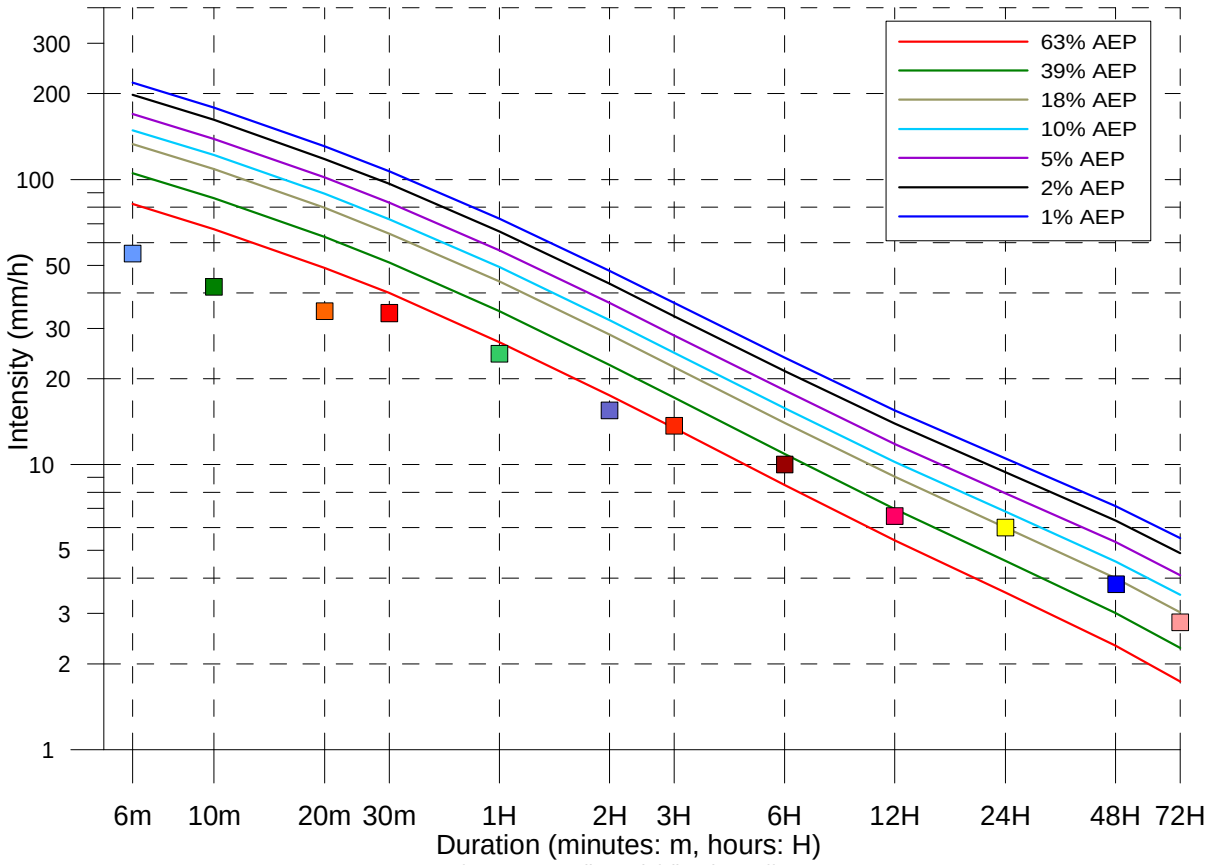
LOOKOUT RESERVOIR INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.40

Site owner: BoM Latitude: -32.936 Longitude: 151.7779

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Sheppard's Hill Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		55.0	17:10_21/04/2015
10m		42.0	17:06_21/04/2015
20m		34.5	20:16_20/04/2015
30m		34.0	20:06_20/04/2015
1H		24.5	19:56_20/04/2015
2H		15.5	15:20_21/04/2015
3H		13.7	14:30_21/04/2015
6H		10.0	13:58_21/04/2015
12H		6.6	08:08_21/04/2015
24H		6.0	19:26_20/04/2015
48H		3.8	17:26_20/04/2015
72H		2.8	00:26_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

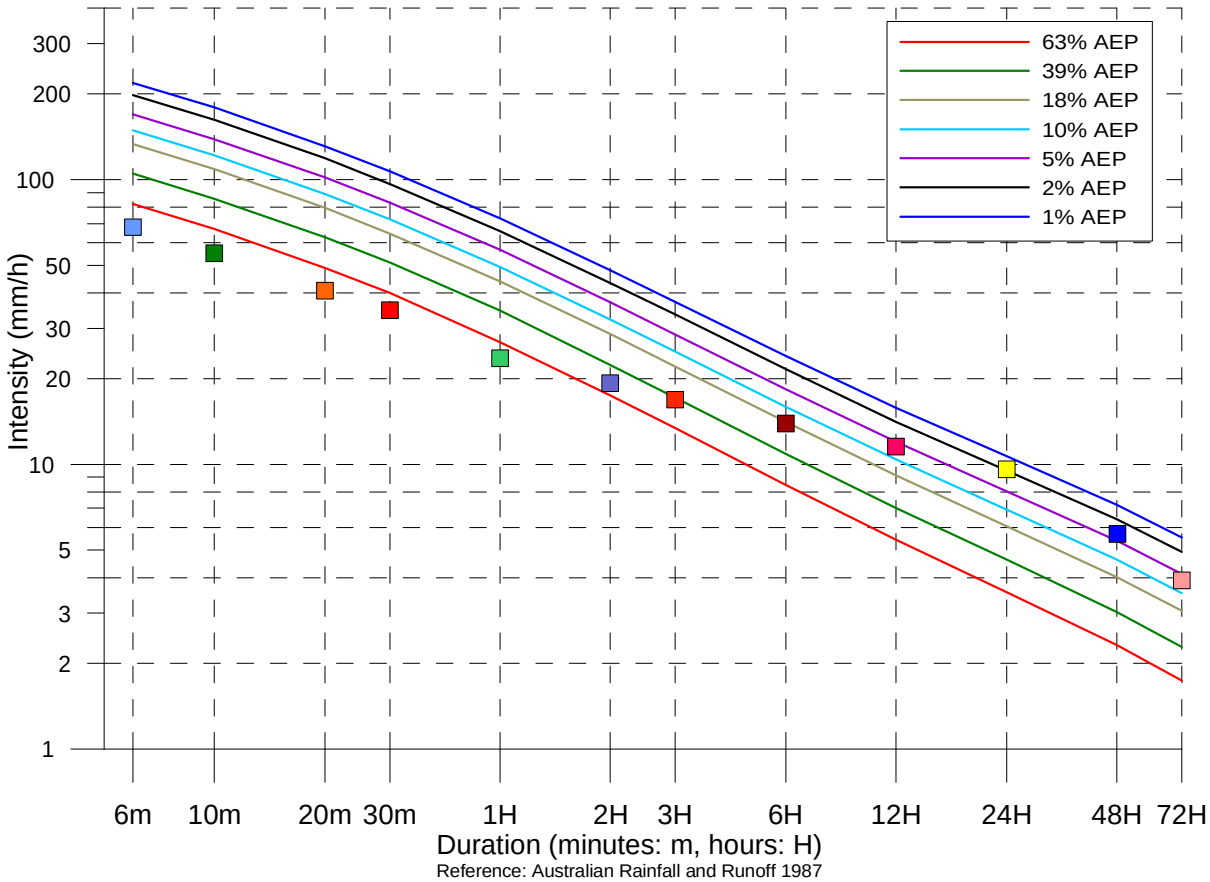
SHEPPARD'S HILL INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.41

Site owner: BoM Latitude: -32.9454 Longitude: 151.7480

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Merewether Pump Station Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		68.0	08:48_21/04/2015
10m		55.2	19:28_21/04/2015
20m		40.8	17:02_21/04/2015
30m		34.8	16:52_21/04/2015
1H		23.6	16:32_21/04/2015
2H		19.3	15:22_21/04/2015
3H		16.9	14:32_21/04/2015
6H		13.9	13:56_21/04/2015
12H		11.5	08:00_21/04/2015
24H		9.6	19:58_20/04/2015
48H		5.7	09:16_20/04/2015
72H		3.9	00:20_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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MEREWETHER PUMP STATION INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 5.42

6. Macquarie and Tuggerah Lakes Region

6.1 Lake Macquarie Region Water Level

The locations of water level stations within the Lake Macquarie region are shown in Figure 6.1. The water level data for the period 01 April to 05 May 2015 are displayed graphically in Figure 6.2. The peak observed water levels are listed in Table 6.1.

Table 6.2 lists the SES Flood Classifications for Lake Macquarie. The SES classification scheme indicates the flood peak for Lake Macquarie was classified as a moderate flood for Marmong Point and Belmont and a major flood for Swansea Channel during the April event.

Table 6.1 Lake Macquarie River Region Flood Peaks

Station Name	Station No.	Site Owner	Datum	Peak level (m)
Barnsley Vale	211450	MHL	AHD	2.36
Cockle Railway Station	211455	MHL	AHD	1.22
Marmong Point	211460	MHL	AHD	1.05
Belmont	211461	MHL	AHD	1.01
Jigadee Creek at Avondale	211008	NOW	Local Gauge Datum	3.31
Cooranbong	211470	MHL	AHD	4.41
Kalang Road	211475	MHL	AHD	1.69
Swansea Channel	211462	MHL	AHD	1.13
Morrisset	211480	MHL	AHD	1.91

Table 6.2 SES Flood Classification for Lake Macquarie

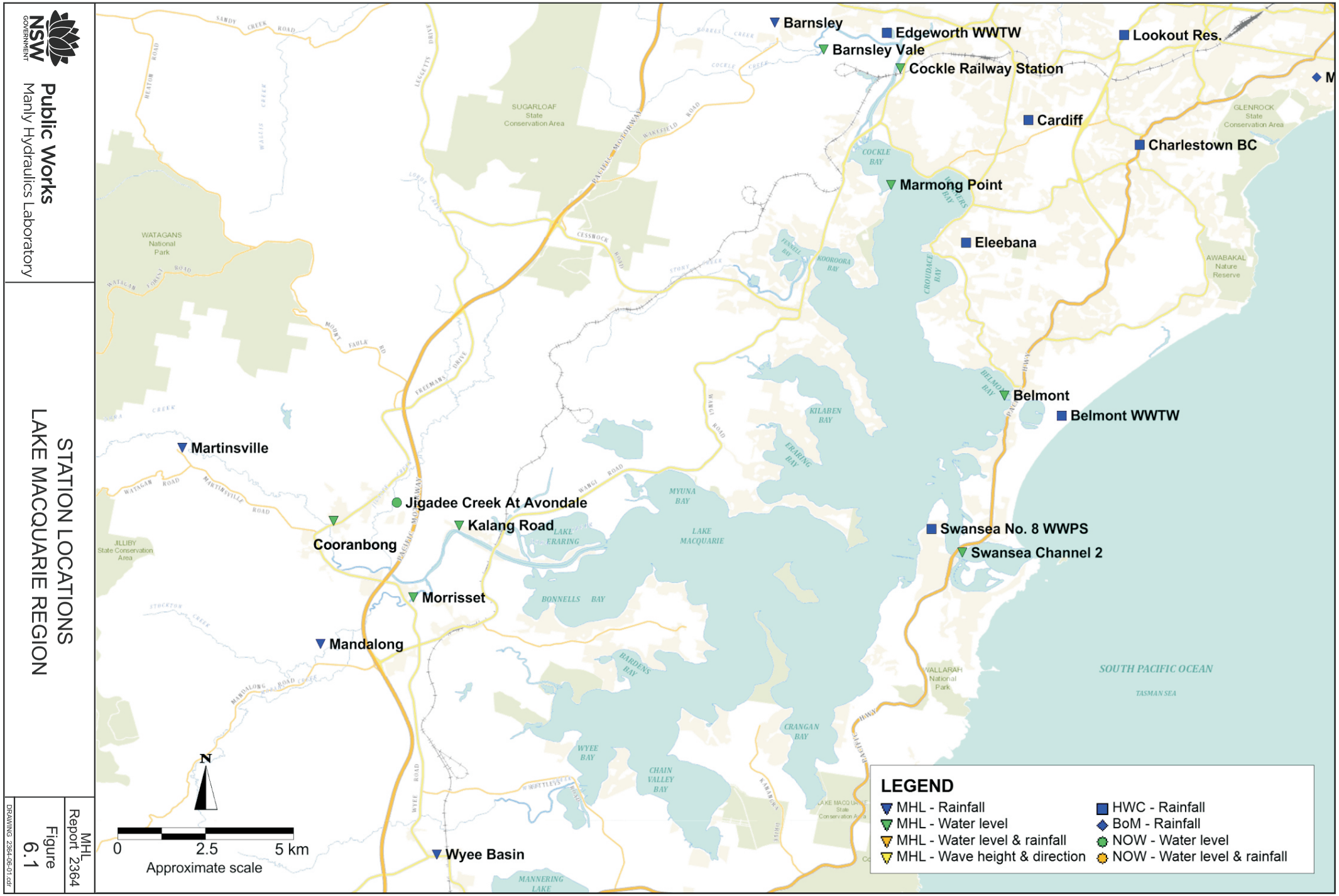
Station	Classification			Peak (m)	Classification
	Minor	Moderate	Major		
	Water Level (m AHD)				
Marmong Point	0.7	0.9	1.1	1.05 (01:00 22/04/15)	Moderate
Swansea Channel	0.7	0.9	1.1	1.13 (22:45 21/04/15)	Major
Belmont	0.7	0.9	1.1	1.01 (00:45 22/04/15)	Moderate

6.2 Lake Macquarie River Region Rainfall

9.00 a.m. daily rainfall totals are displayed in Table 6.3 and in Figures 6.3 and 6.4 for the period 20th April to 5th May 2015. The rainfall data and intensities are displayed graphically in Figures 6.5 to 6.14.

Table 6.3 Tuggerah Lake River Region Daily Rainfall Totals

Date	Edgeworth (mm)	Cardiff (mm)	Charlestown BC (mm)	Eleebana (mm)	Belmont (mm)	Swansea 8 (mm)	Barnsley (mm)	Martinsville (mm)	Mandalong (mm)	Wyee Basin (mm)
	HWC	HWC	HWC	HWC	HWC	HWC	MHL	MHL	MHL	MHL
20/04/2015	5.2	12.4	10.6	4.2	5.6	8.0	2.0	6.0	7.0	10.5
21/04/2015	162.4	186.6	191.0	136.2	113.4	91.2	125.5	131.5	115.5	94.5
22/04/2015	66.2	134.8	129.2	92.4	87.8	96.4	110.0	105.0	130.0	116.0
23/04/2015	37.0	27.2	18.0	22.4	19.6	59.4	33.5	10.5	8.5	10.5
24/04/2015	0.6	0.0	0.2	0.0	0.0	1.4	0.0	0.0	2.5	0.0
25/04/2015	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26/04/2015	13.0	7.8	9.2	2.4	2.8	5.4	6.5	6.5	5.5	4.0
27/04/2015	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.5
28/04/2015	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
29/04/2015	0.4	1.2	0.8	0.6	2.2	0.2	0.0	0.0	0.0	0.0
30/04/2015	6.0	12.2	5.0	8.4	13.0	18.2	4.5	3.0	5.5	15.5
01/05/2015	11.8	4.6	6.0	9.2	21.4	11.4	9.0	7.0	6.5	18.0
02/05/2015	3.2	8.2	11.4	6.0	0.8	0.8	11.0	15.5	3.5	4.0
03/05/2015	3.6	24.4	31.4	34.0	46.8	61.6	25.5	52.5	49.0	57.0
04/05/2015	42.2	2.0	0.8	4.8	1.8	3.6	9.0	10.5	12.0	11.5
05/05/2015							0.5	0.0	0.0	0.5
Total	**351.6**	**421.8**	**413.8**	**320.6**	**315.2**	**358.0**	**337.0**	**348.0**	**345.5**	**342.5**



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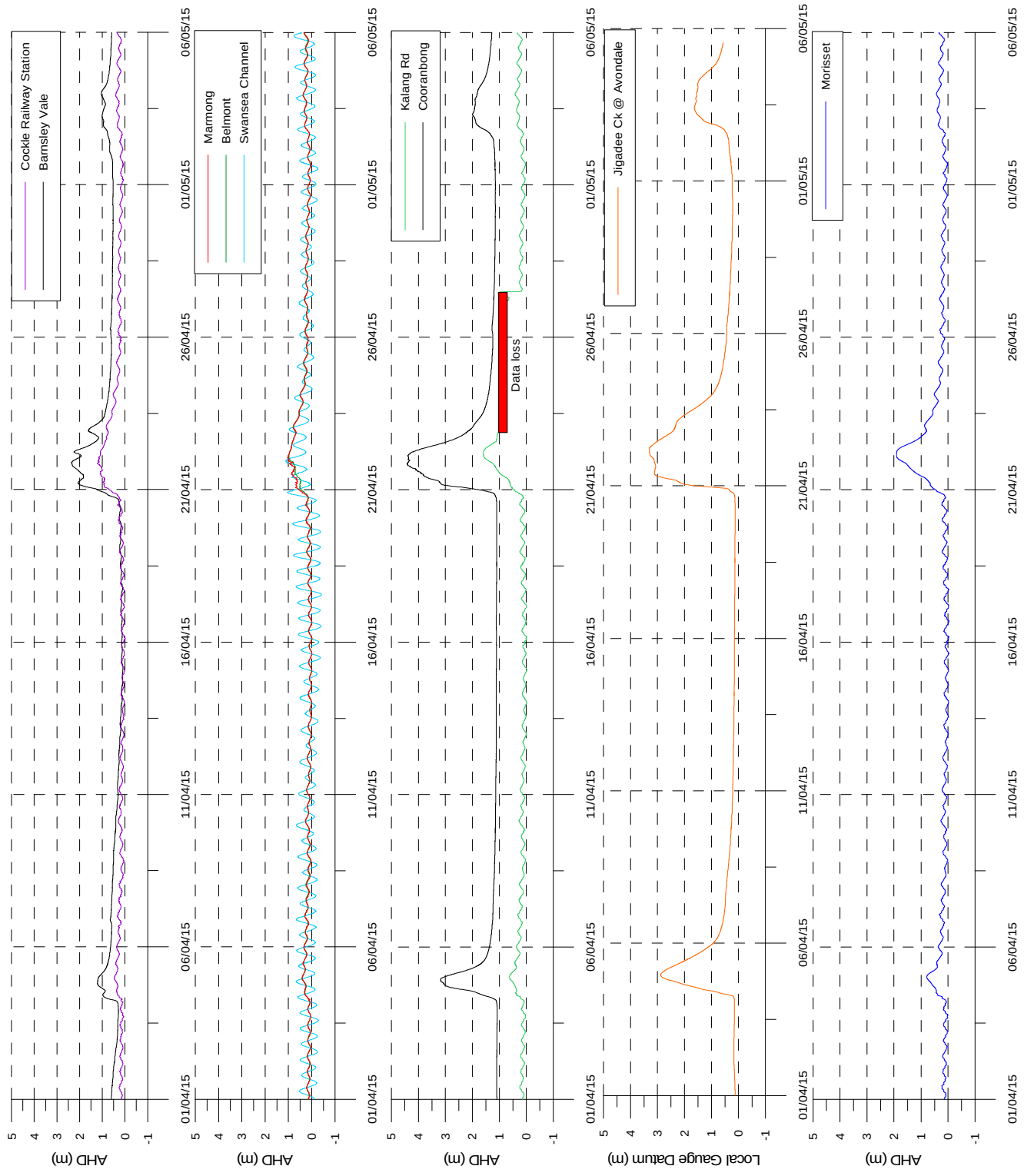
STATION LOCATIONS
LAKE MACQUARIE REGION

MHL Report 2364

Figure 6.1

DRAWING: 2364-06-01.cdr



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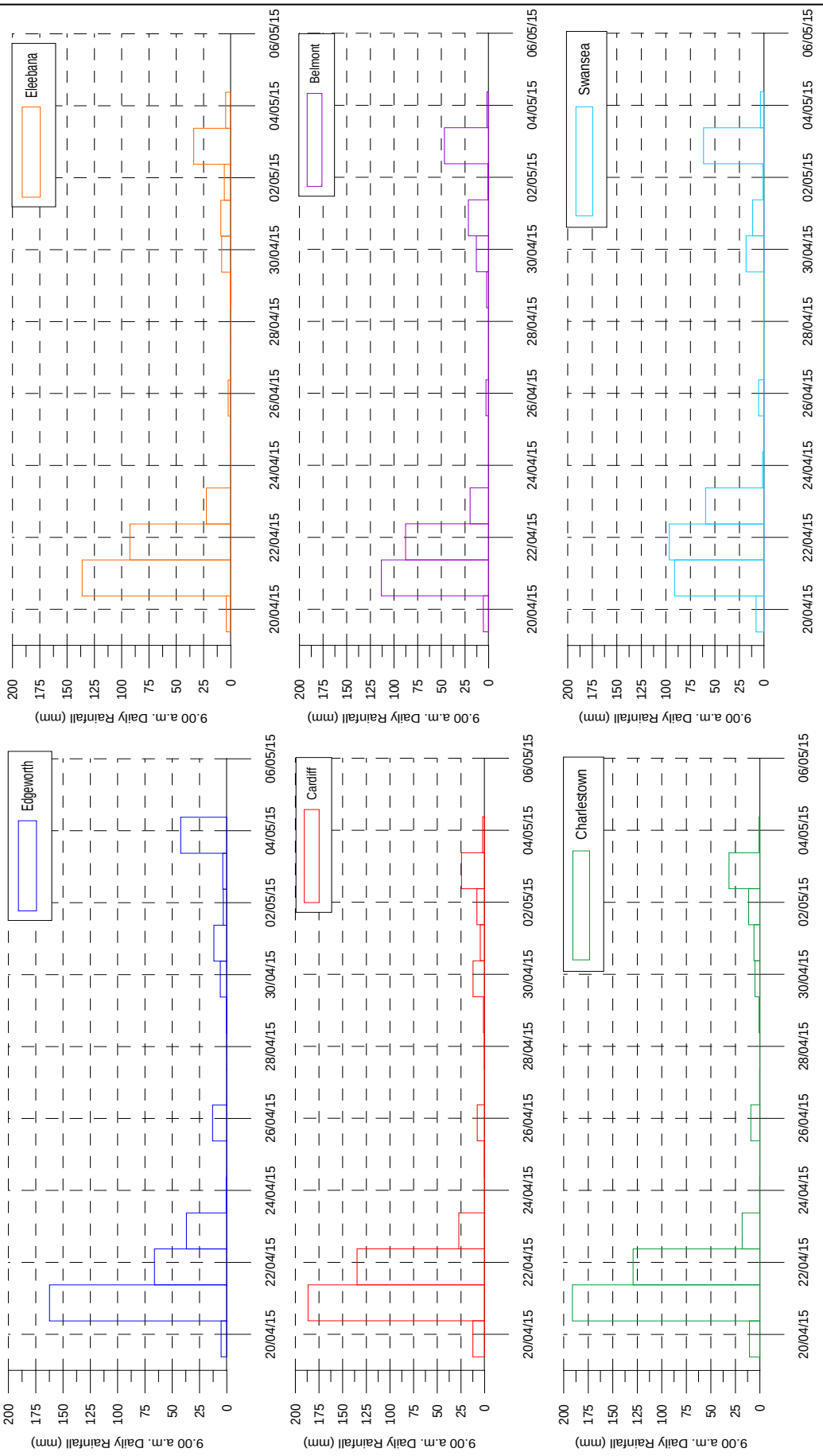
LAKE MACQUARIE REGION
WATER LEVEL
01 APRIL – 05 MAY 2015

MHL
REPORT 2364

Figure
6.2



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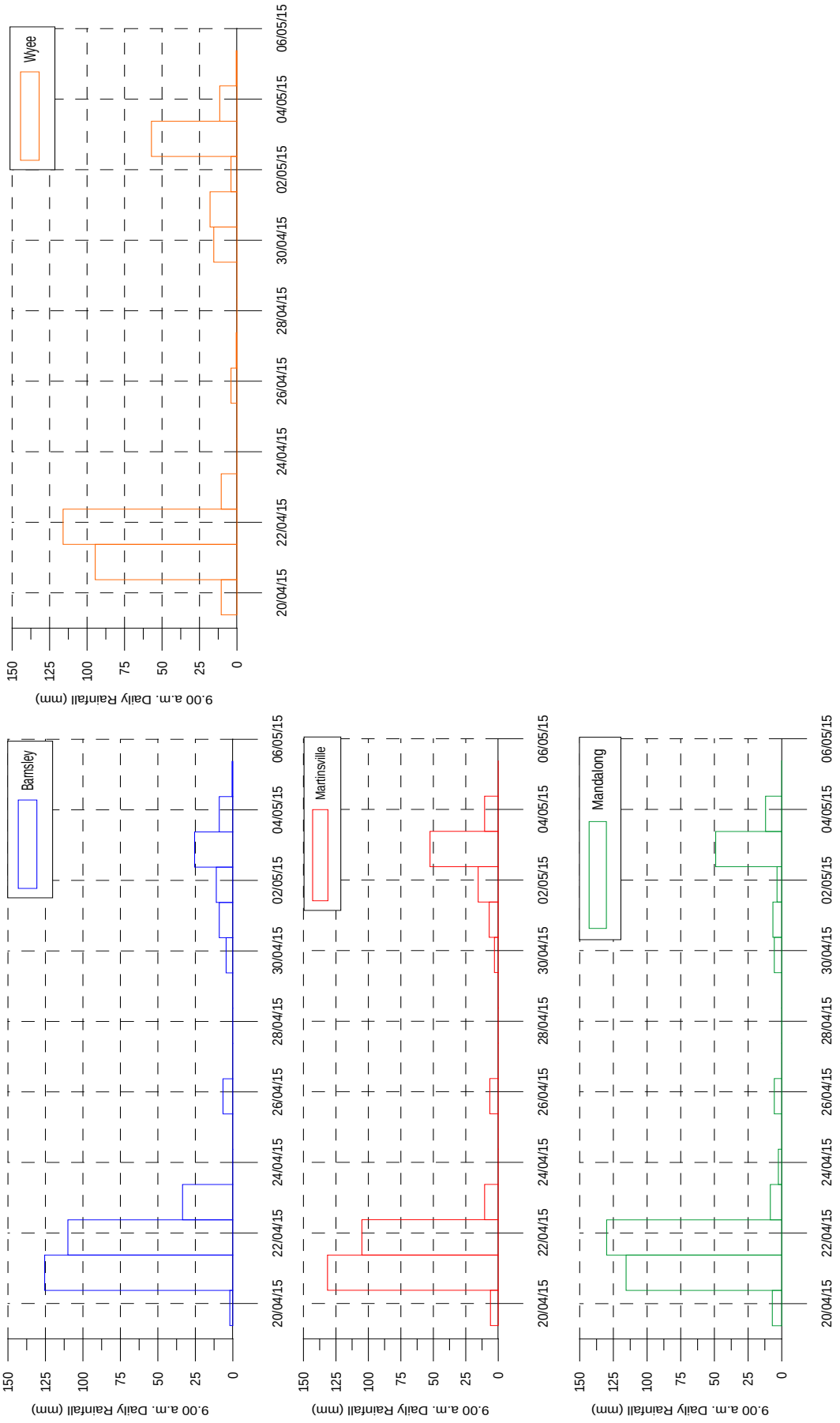
LAKE MACQUARIE REGION
RAINFALL
20 APRIL – 05 MAY 2015

MHL
REPORT 2364

Figure
6.3



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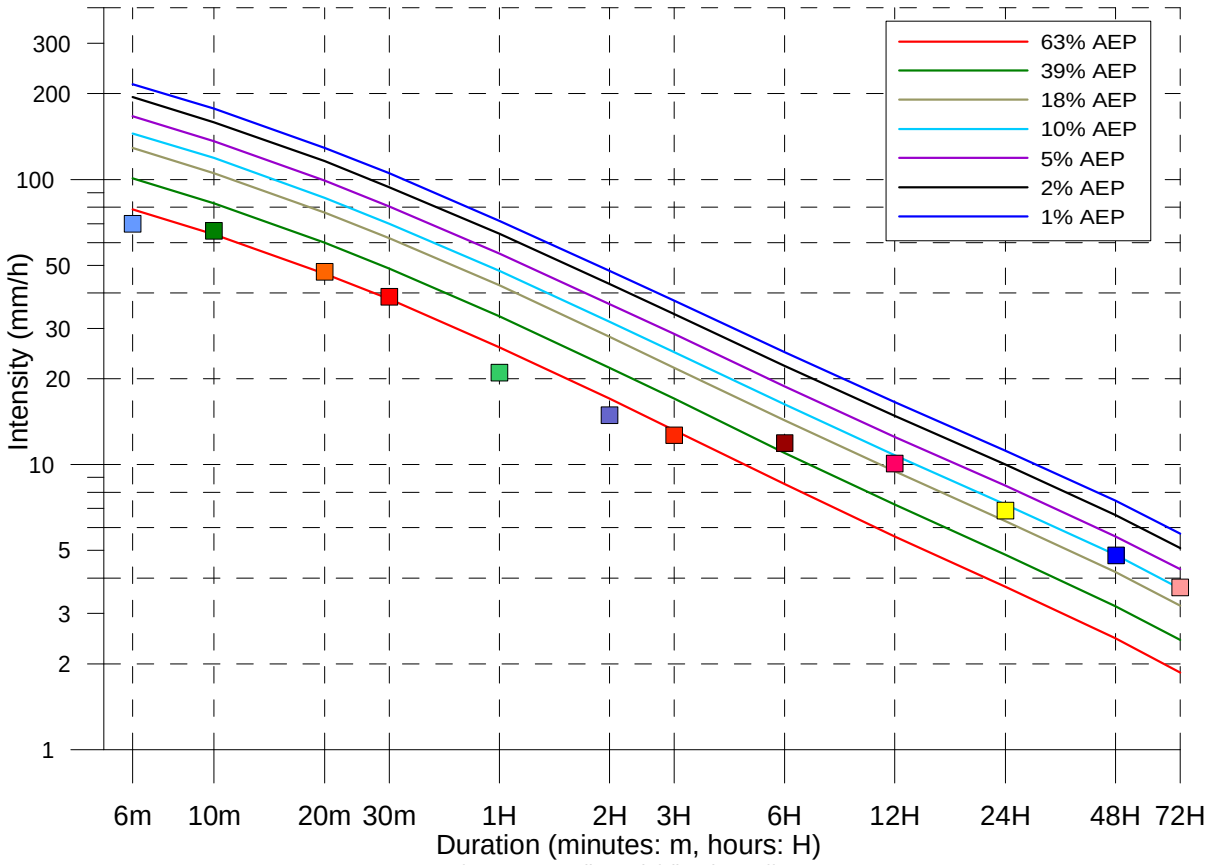
LAKE MACQUARIE REGION
RAINFALL
20 APRIL – 05 MAY 2015

MHL
REPORT 2364

Figure
6.4

Site owner: HWC Latitude: -32.9321 Longitude: 151.6182

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Edgeworth Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	70.0	16:00_06/04/2015
10m	66.0	15:54_06/04/2015
20m	47.4	15:44_06/04/2015
30m	38.8	15:40_06/04/2015
1H	21.0	15:40_06/04/2015
2H	14.9	20:10_20/04/2015
3H	12.7	15:44_20/04/2015
6H	11.9	20:10_20/04/2015
12H	10.1	14:30_20/04/2015
24H	6.9	07:34_20/04/2015
48H	4.8	07:34_20/04/2015
72H	3.7	19:10_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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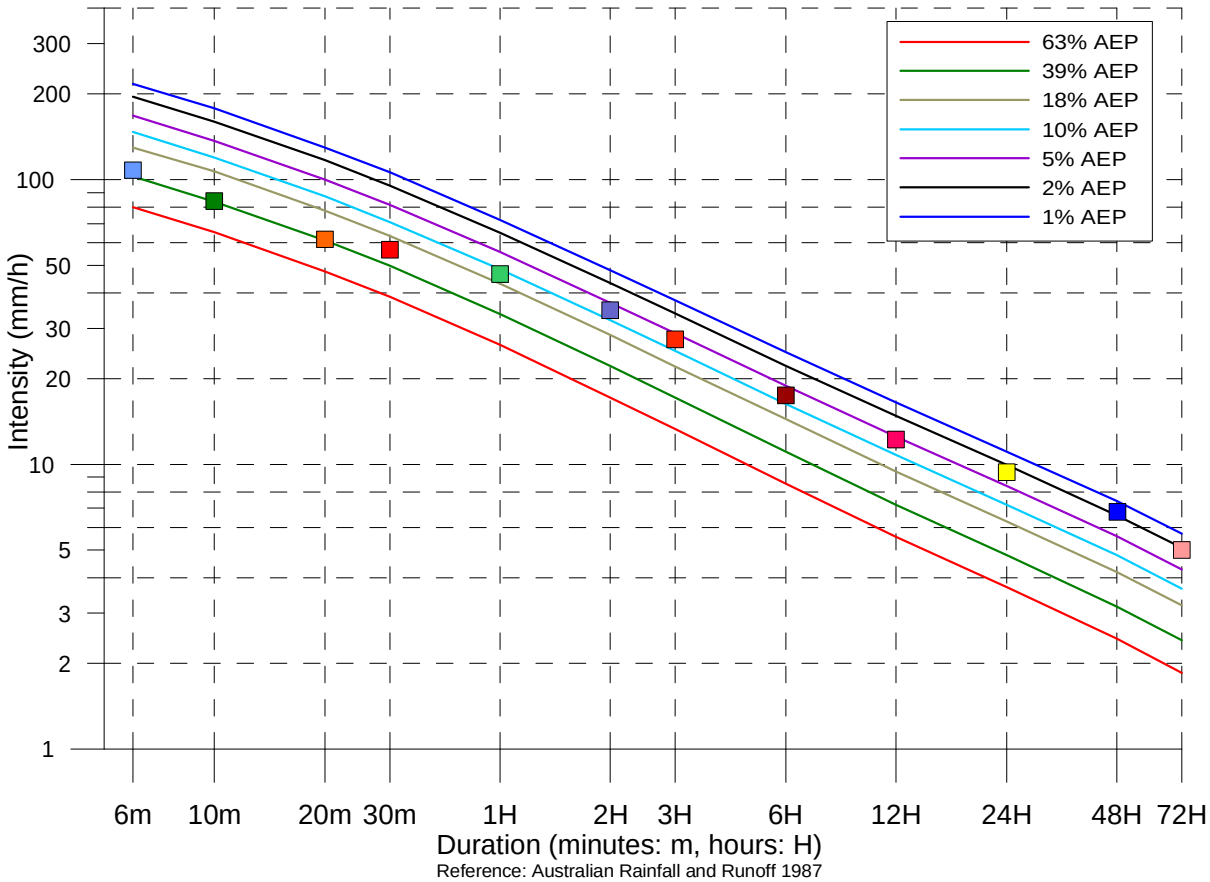
EDGEWORTH INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.5

Site owner: HWC Latitude: -32.9581 Longitude: 151.6609

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Cardiff Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		108.0	17:04_20/04/2015
10m		84.0	09:18_21/04/2015
20m		61.8	16:48_20/04/2015
30m		56.8	16:38_20/04/2015
1H		46.6	16:28_20/04/2015
2H		34.9	15:44_20/04/2015
3H		27.5	15:34_20/04/2015
6H		17.5	15:34_20/04/2015
12H		12.2	14:34_20/04/2015
24H		9.4	15:38_20/04/2015
48H		6.8	05:24_20/04/2015
72H		5.0	18:58_19/04/2015

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).

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

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CARDIFF INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

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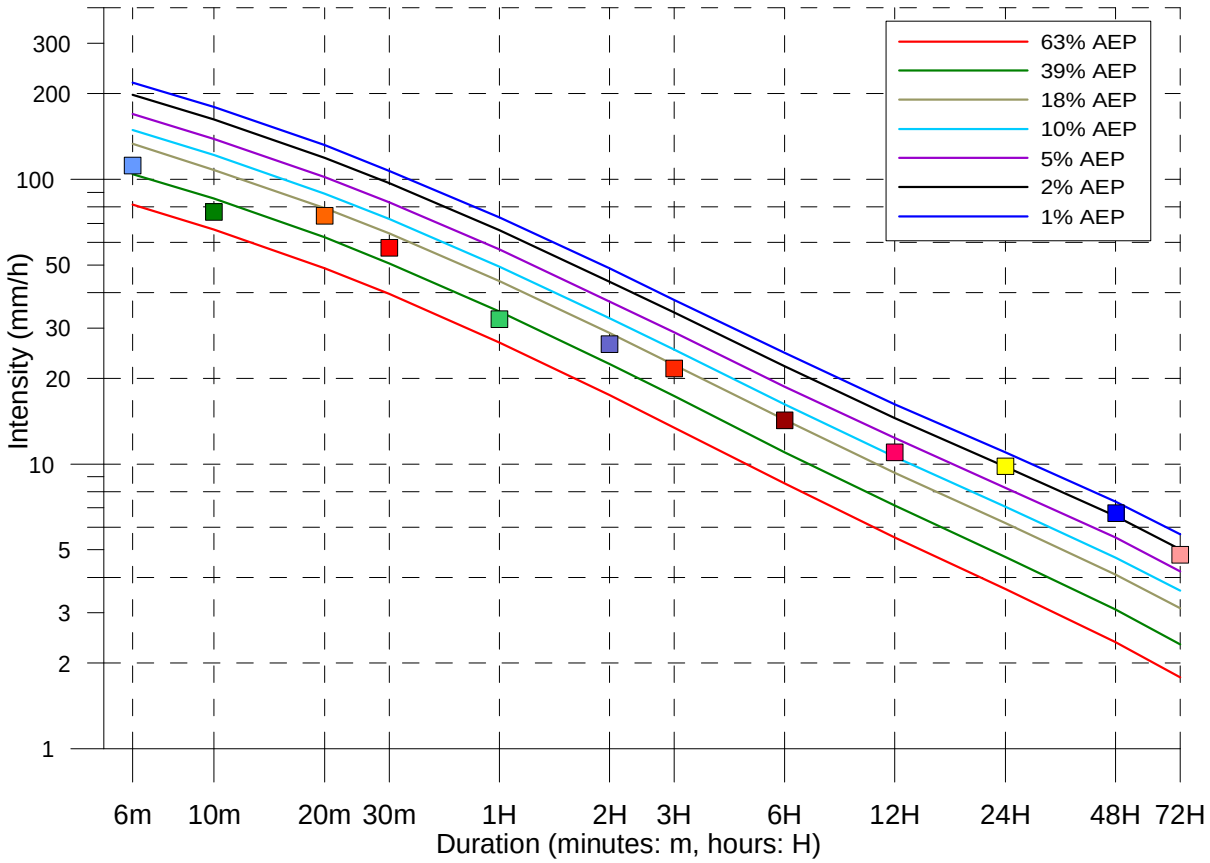
Figure 6.6

Site owner: HWC Latitude: -32.9655 Longitude: 151.6945

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Charlestown Bowling Club Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		112.0	16:10_06/04/2015
10m		76.8	16:04_06/04/2015
20m		74.4	16:04_06/04/2015
30m		57.6	16:00_06/04/2015
1H		32.2	15:54_06/04/2015
2H		26.4	16:00_20/04/2015
3H		21.7	15:24_20/04/2015
6H		14.2	15:30_20/04/2015
12H		11.0	08:20_21/04/2015
24H		9.8	15:34_20/04/2015
48H		6.7	06:54_20/04/2015
72H		4.8	18:40_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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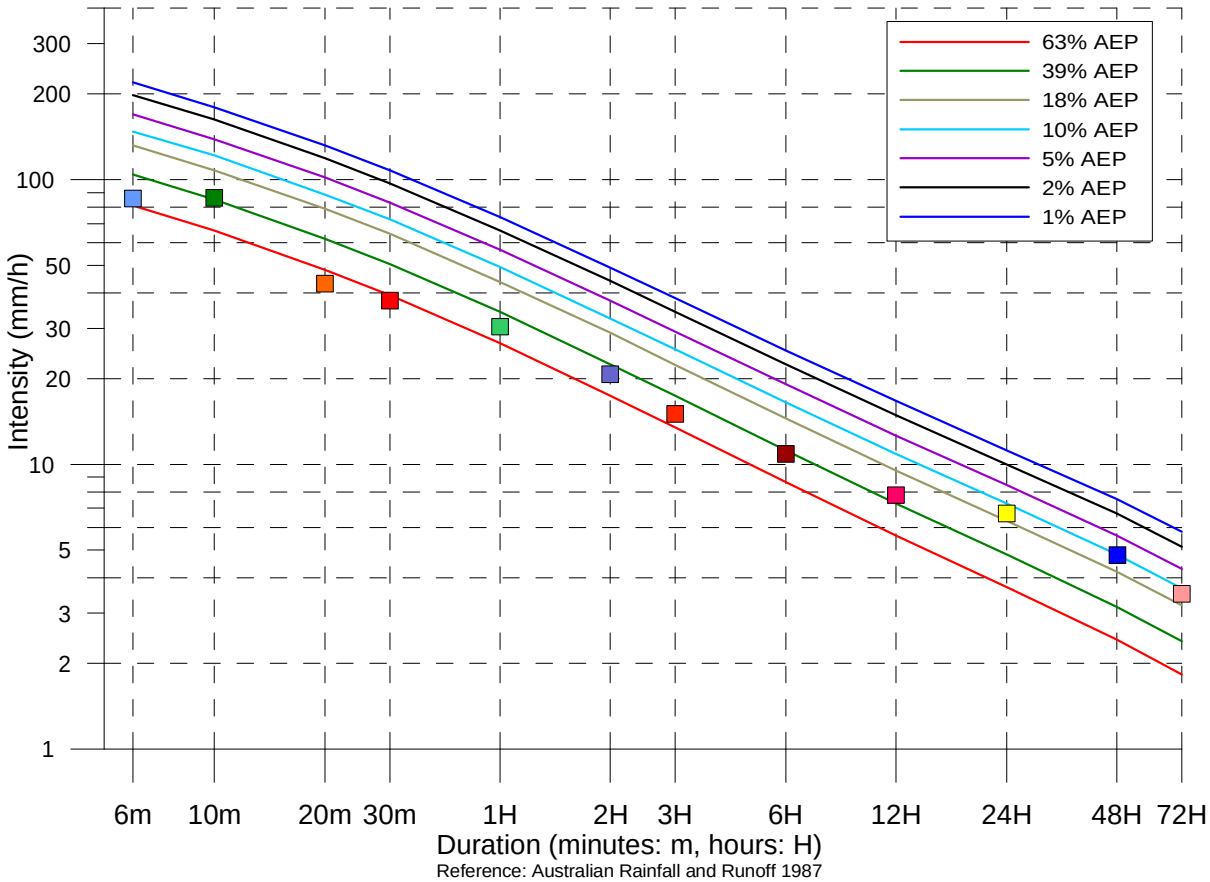
CHARLESTOWN BOWLING CLUB INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.7

Site owner: HWC Latitude: -32.9946 Longitude: 151.6421

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Eleebana Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		86.0	16:44_20/04/2015
10m		86.4	05:08_21/04/2015
20m		43.2	05:08_21/04/2015
30m		37.6	16:28_20/04/2015
1H		30.4	16:14_20/04/2015
2H		20.7	15:38_20/04/2015
3H		15.0	15:34_20/04/2015
6H		11.6	15:28_20/04/2015
12H		10.9	15:34_20/04/2015
24H		7.8	14:48_20/04/2015
48H		7.4	15:38_20/04/2015
72H		6.7	15:38_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

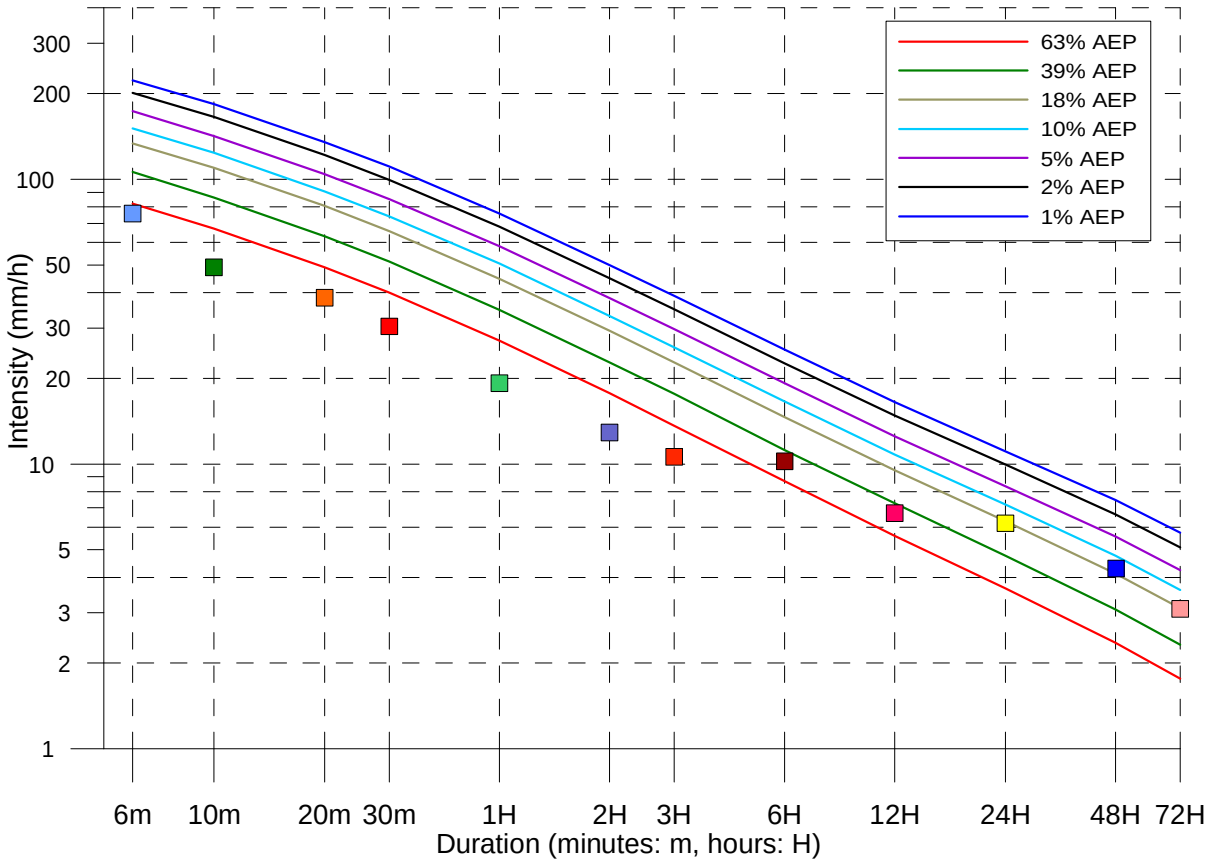
ELEEBANA INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.8

Site owner: MHL Latitude: -33.0401 Longitude: 151.6537

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Belmont Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	76.0	04:04_22/04/2015
10m	49.2	03:58_22/04/2015
20m	38.4	07:28_04/04/2015
30m	30.4	07:18_04/04/2015
1H	19.2	20:28_20/04/2015
2H	12.9	19:54_20/04/2015
3H	10.6	20:08_20/04/2015
6H	10.2	19:58_20/04/2015
12H	6.7	19:04_20/04/2015
24H	6.2	20:08_20/04/2015
48H	4.3	05:08_20/04/2015
72H	3.1	07:24_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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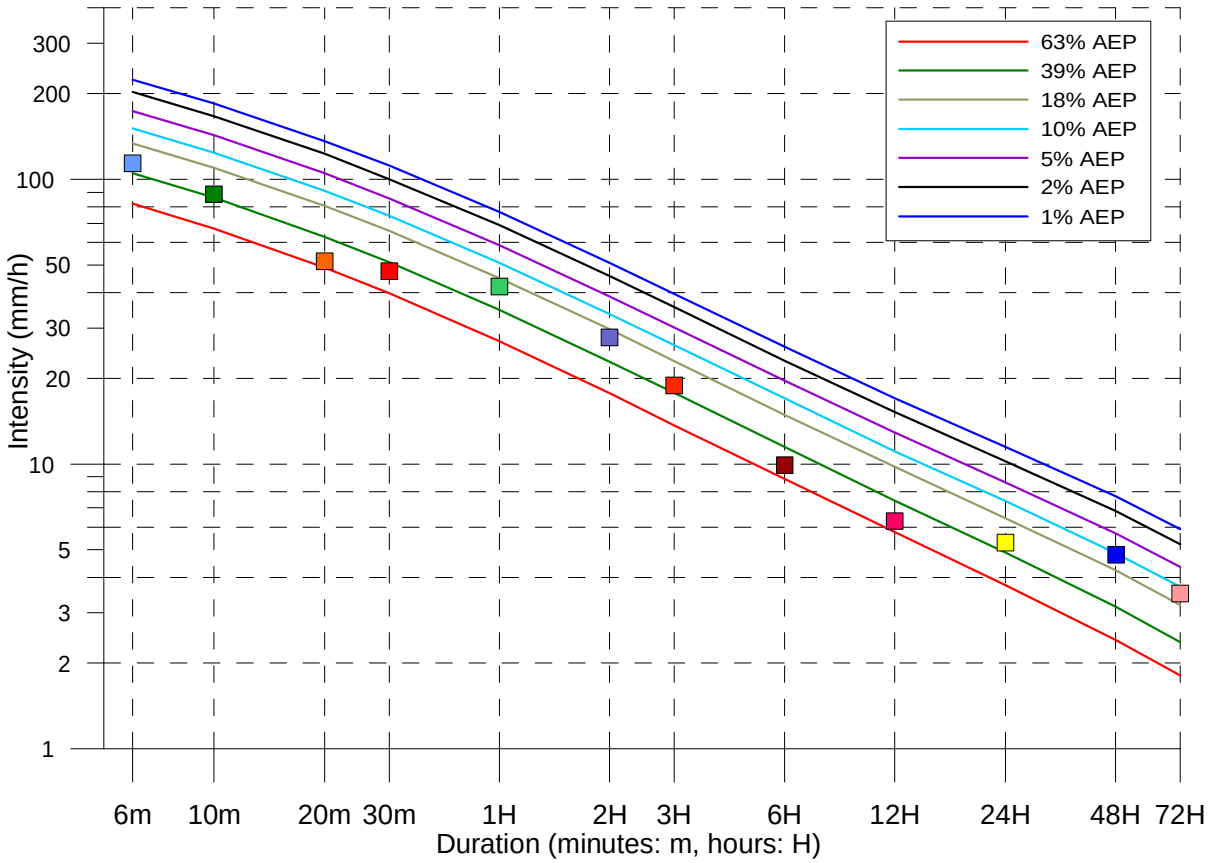
BELMONT WWTW INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.9

Site owner: HWC Latitude: -33.0798 Longitude: 151.6317

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Swansea 8 WWTP Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	114.0	16:20_22/04/2015
10m	88.8	15:24_06/04/2015
20m	51.6	16:10_22/04/2015
30m	47.6	16:24_22/04/2015
1H	42.0	15:54_22/04/2015
2H	27.8	15:00_22/04/2015
3H	18.9	14:24_22/04/2015
6H	9.9	13:34_22/04/2015
12H	6.3	03:10_04/04/2015
24H	5.3	20:50_20/04/2015
48H	4.8	17:24_20/04/2015
72H	3.5	20:24_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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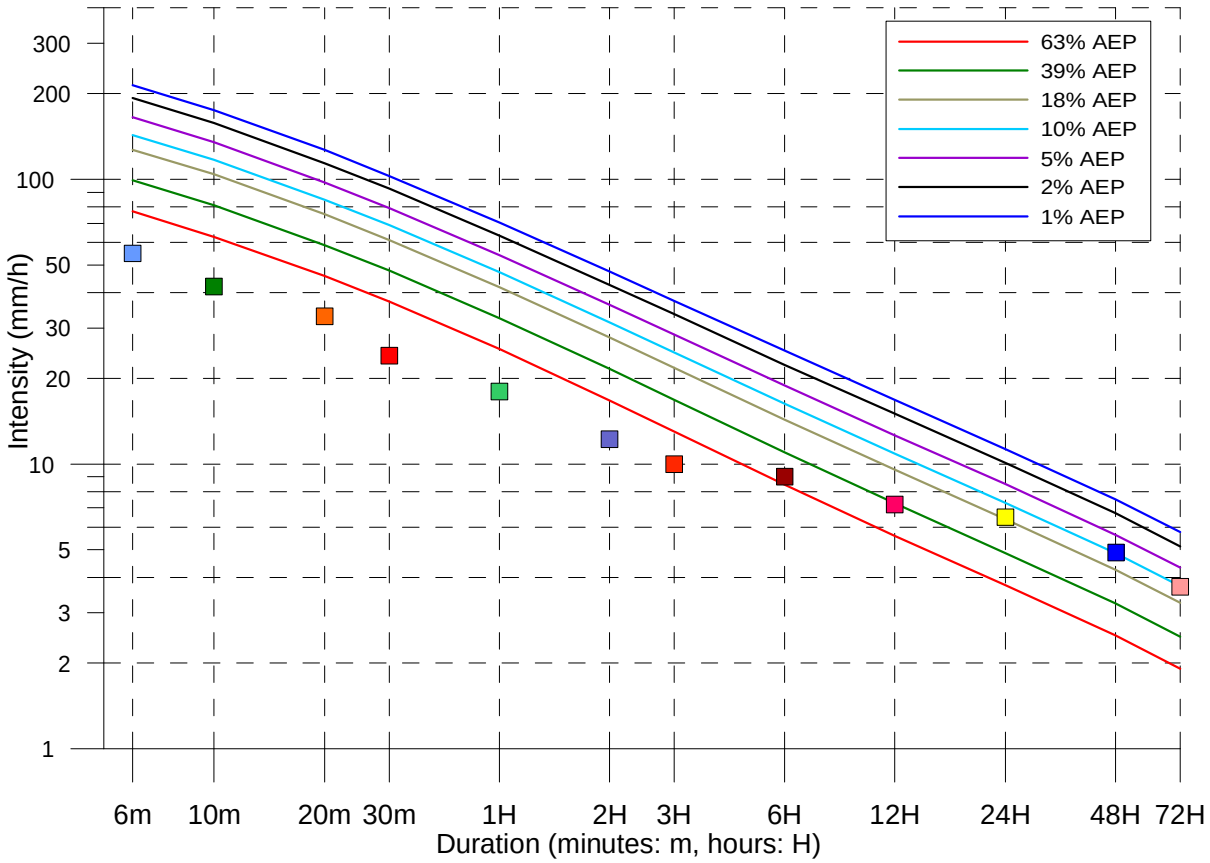
SWANSEA 8 WWTP INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.10

Site owner: MHL Latitude: -32.9275 Longitude: 151.5855

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Barnsley Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		55.0	15:50_06/04/2015
10m		42.0	17:04_22/04/2015
20m		33.0	00:12_22/04/2015
30m		24.0	00:12_22/04/2015
1H		18.0	16:18_22/04/2015
2H		12.2	20:16_20/04/2015
3H		10.0	19:04_20/04/2015
6H		9.0	20:16_20/04/2015
12H		7.2	14:16_20/04/2015
24H		6.5	17:44_20/04/2015
48H		4.9	07:36_20/04/2015
72H		3.7	08:08_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

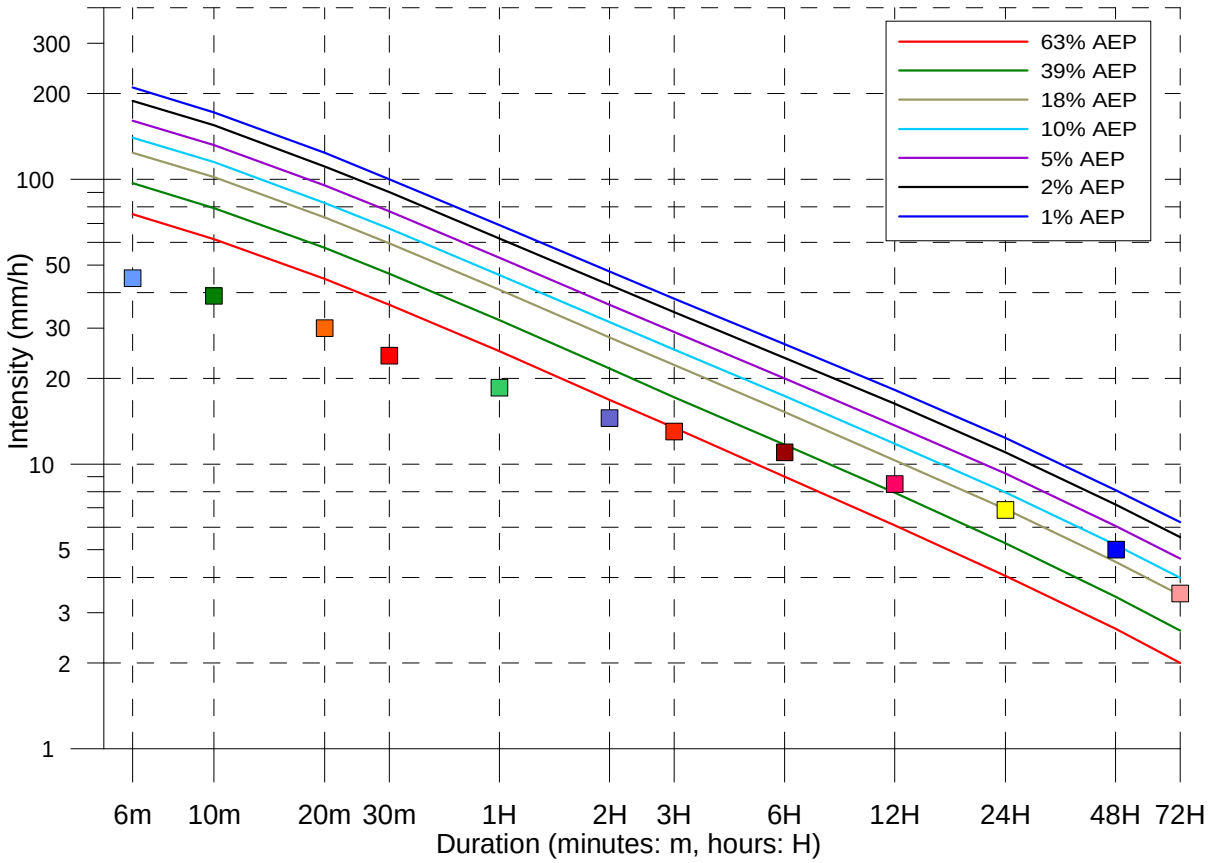
BARNSLEY INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.11

Site owner: MHL Latitude: -33.0541 Longitude: 151.4066

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Barnsley Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
	6m	45.0	06:22_04/04/2015
	10m	39.0	06:18_04/04/2015
	20m	30.0	06:18_04/04/2015
	30m	24.0	06:18_04/04/2015
	1H	18.5	06:18_04/04/2015
	2H	14.5	20:12_20/04/2015
	3H	13.0	06:18_04/04/2015
	6H	11.0	20:00_20/04/2015
	12H	8.5	03:22_04/04/2015
	24H	6.9	16:42_20/04/2015
	48H	5.0	07:00_20/04/2015
	72H	3.5	01:38_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

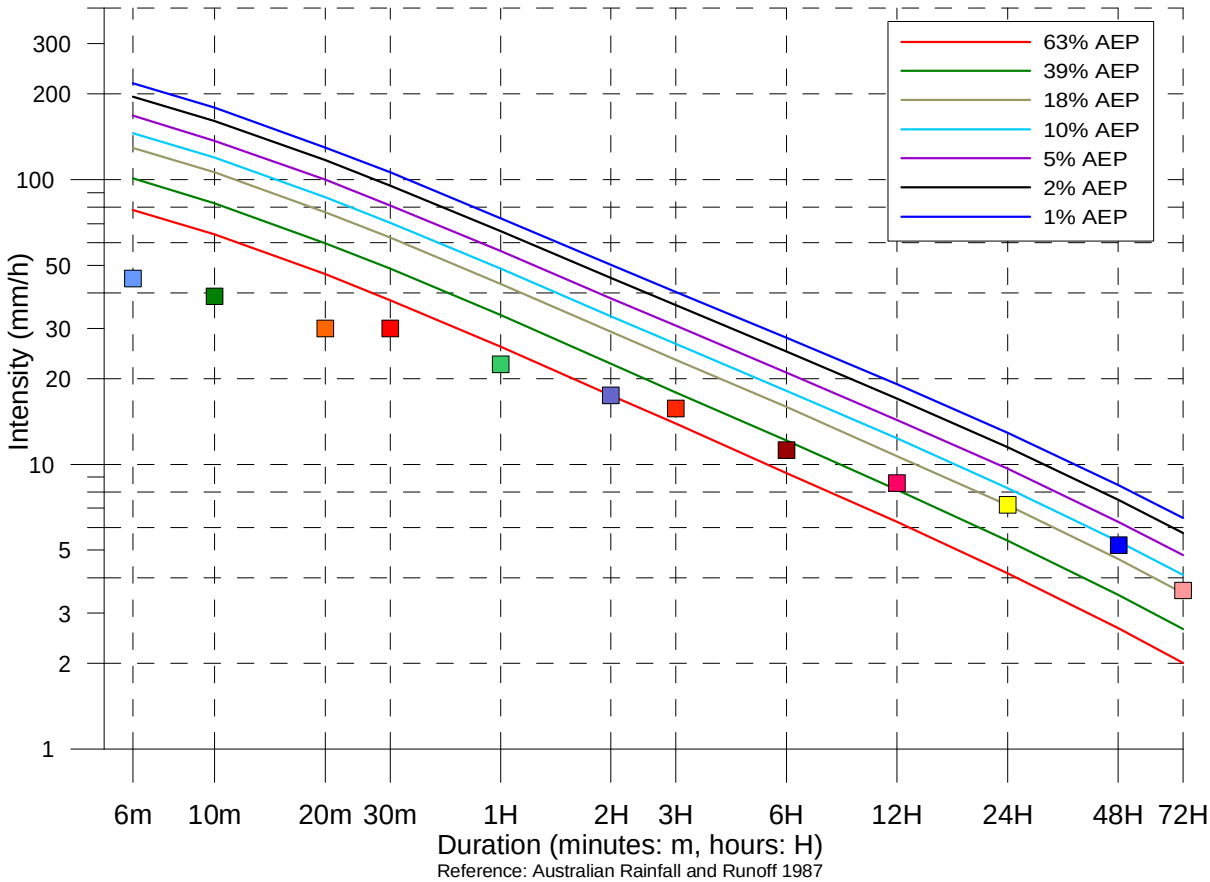
MARTINSVILLE INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.12

Site owner: MHL Latitude: -33.1125 Longitude: 151.4483

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Mandalong Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	45.0	21:22_21/04/2015
10m	39.0	21:22_21/04/2015
20m	30.0	21:28_20/04/2015
30m	30.0	21:04_21/04/2015
1H	22.5	21:08_20/04/2015
2H	17.5	20:08_20/04/2015
3H	15.7	20:36_21/04/2015
6H	11.2	20:08_20/04/2015
12H	8.6	11:38_21/04/2015
24H	7.2	23:40_20/04/2015
48H	5.2	07:44_20/04/2015
72H	3.6	01:44_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

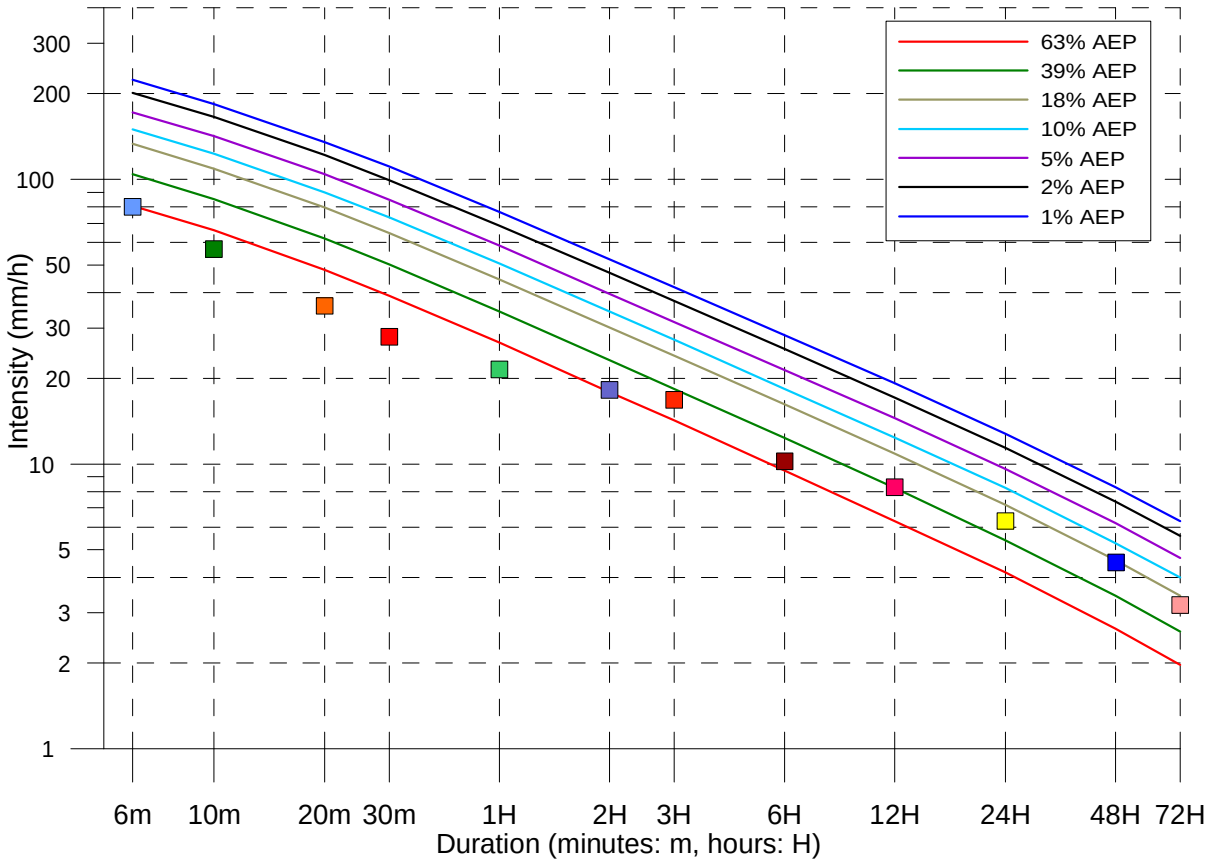
MANDALONG INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.13

Site owner: MHL Latitude: -33.1752 Longitude: 151.4835

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Wyee Basin Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	80.0	01:24_04/04/2015
10m	57.0	01:20_04/04/2015
20m	36.0	01:12_04/04/2015
30m	28.0	20:56_21/04/2015
1H	21.5	20:58_20/04/2015
2H	18.2	20:16_21/04/2015
3H	16.8	20:14_21/04/2015
6H	10.2	20:00_20/04/2015
12H	8.3	01:16_04/04/2015
24H	6.3	23:22_20/04/2015
48H	4.5	01:48_20/04/2015
72H	3.2	22:36_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

WYEE BASIN INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.14

6.3 Tuggerah Lake Region Water Level

The locations of water level stations within the Tuggerah Lake region are shown in Figure 6.15. The water level data for the period 01 April to 05 May 2015 are displayed graphically in Figures 6.16 to 6.18. The peak observed water levels are listed in Table 6.4.

Table 6.5 lists the SES Flood Classifications for Tuggerah Lake. The SES classification scheme indicates the flood peak for Tuggerah Lakes was classified as a minor flood during the April 2015 event.

Table 6.4 Tuggerah Lake River Region Flood Peaks

Station Name	Station No.	Site Owner	Datum	Peak level (m)
Wyong River at Yarramalong	211014	NOW	Local Gauge Datum	7.04
Wallarah Creek Bridge	211420	MHL	AHD	1.45
Jilliby Creek Upstream Wyong	211010	NOW	Local Gauge Datum	4.83
Wyong River at Gracemere	211009	NOW	Local Gauge Datum	7.99
Toukley	211401	MHL	AHD	0.93
Wyong Weir Upstream	211417	MHL	AHD	5.08
Ourimbah Creek Downstream Bangalow Creek	211015	NOW	Local Gauge Datum	7.72
Wyong River at Wyong Fishway	211017	NOW	Local Gauge Datum	5.08
Ourimbah Creek at Upstream Weir	211013	NOW	Local Gauge Datum	6.72
Tuggerah Lake at Long Jetty	211418	MHL	AHD	1.46
Tumbi Umbi	211419	MHL	AHD	1.81
Lees Bridge	211425	MHL	AHD	1.88

Table 6.5 SES Flood Classification for Tuggerah Lake

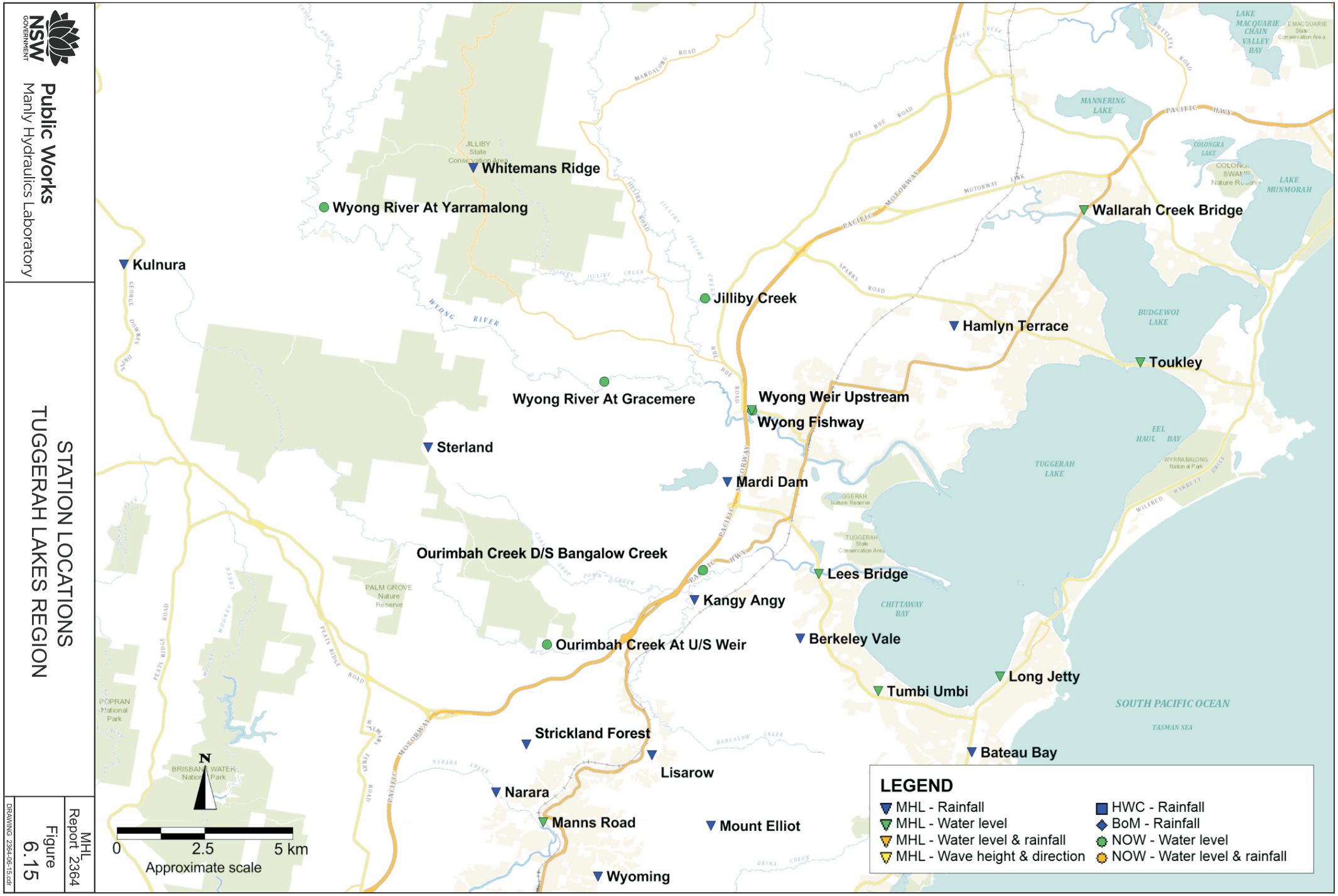
Station	Classification			Peak (m)	Classification
	Minor	Moderate	Major		
	Water Level (m AHD)				
Tuggerah Lake	0.9	1.8	2.2	1.46	Minor

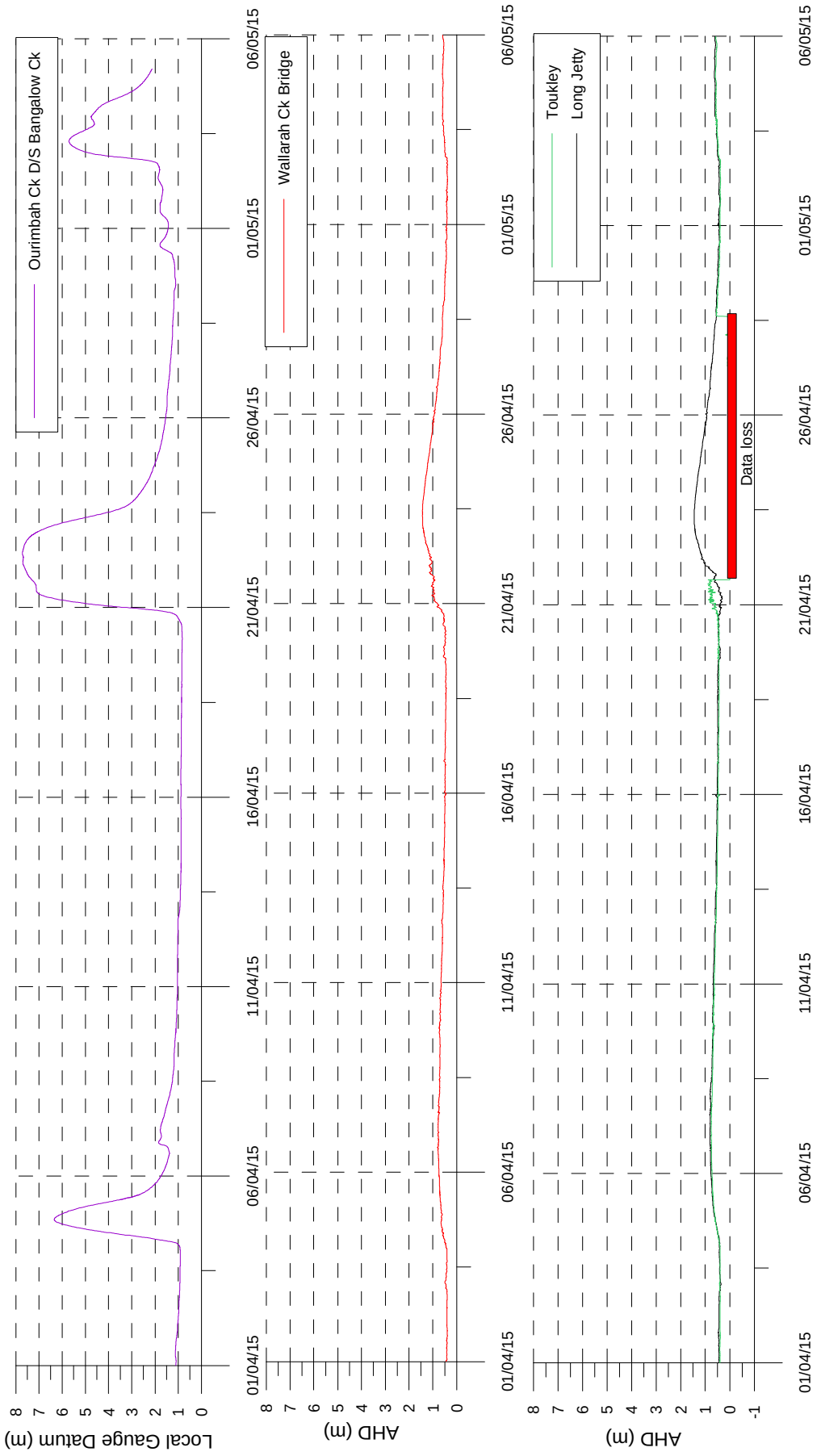
6.4 Tuggerah Lake River Region Rainfall

9.00 a.m. daily rainfall totals are displayed in Table 6.6 and in Figures 6.19 and 6.20 for the period 20th April to 5th May 2015. The rainfall data and intensities are displayed graphically in Figures 6.21 to 6.32.

Table 6.5 Tuggerah Lake Region Daily Rainfall Totals

Date	Toukley (mm)	Sterland (mm)	Stickland Forest (mm)	Lisarow (mm)	Narara (mm)	Kulnura (mm)	Whitemans Ridge (mm)	Kangy Angy (mm)	Hamlyn Terrace (mm)	Mardi Dam (mm)	Berkeley Vale (mm)	Bateau Bay (mm)
	MHL	MHL	MHL	MHL	MHL	MHL	MHL	MHL	MHL	MHL	MHL	MHL
20/04/2015	6.5	14.0	15.0	17.0	14.5	10.0	16.0	13.0	16.5	14.0	18.5	31.0
21/04/2015	14.5	147.0	113.0	94.0	123.0	151.5	105.0	62.5	74.5	86.0	80.5	79.5
22/04/2015	27.0	138.0	121.5	118.0	124.0	120.5	100.0	120.5	99.5	117.0	103.5	93.0
23/04/2015	16.5	11.0	18.0	13.5	14.5	14.0	10.5	12.5	18.0	22.0	15.5	24.5
24/04/2015	0.5	0.5	3.0	0.5	3.0	0.0	0.0	8.0	0.0	3.5	0.5	0.5
25/04/2015	0.0	0.0	7.0	0.0	0.0	0.5	0.0	0.5	0.0	0.5	0.0	0.0
26/04/2015	1.0	4.5	1.5	1.0	10.5	12.5	1.5	5.5	3.5	8.0	5.5	3.5
27/04/2015	0.5	0.5	1.0	1.5	1.0	0.0	0.0	1.0	1.0	1.0	2.0	2.0
28/04/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29/04/2015	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	1.0	1.5	0.5
30/04/2015	17.0	11.0	18.5	21.5	15.0	6.5	5.0	8.0	9.0	5.5	7.5	46.5
01/05/2015	26.0	12.5	12.0	13.0	13.5	21.0	15.0	8.5	22.0	22.5	17.0	12.5
02/05/2015	6.0	10.5	5.5	9.0	12.0	6.0	6.5	10.0	12.0	4.5	12.5	4.5
03/05/2015	58.0	56.0	65.5	52.5	52.0	49.5	58.0	49.5	53.5	53.5	45.5	66.5
04/05/2015	3.5	20.5	15.5	11.0	15.0	16.5	16.5	15.5	11.0	10.5	8.0	7.0
05/05/2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**179.0**	**426.0**	**397.0**	**352.5**	**398.0**	**408.5**	**334.0**	**316.0**	**321.0**	**349.5**	**318.0**	**371.5**


Public Works
Manly Hydraulics Laboratory
STATION LOCATIONS
TUGGERAH LAKES REGION
MHL Report 2364
Figure 6.15
DRAWING: 2364-06-15.cdr
Whitemans Ridge
Wyong River At Yarramalong
Kulnura
Jilliby Creek
Wallarah Creek Bridge
Hamlyn Terrace
Toukley
Wyong River At Gracemere
Wyong Weir Upstream
Wyong Fishway
Sterland
Mardi Dam
Ourimbah Creek D/S Bangalow Creek
Lees Bridge
Kangy Angy
Ourimbah Creek At U/S Weir
Berkeley Vale
Long Jetty
Tumbi Umbi
Strickland Forest
Lisarow
Bateau Bay
Narara
Manns Road
Mount Elliot
Wyoming
N
0
2.5
5 km
Approximate scale
LEGEND
MHL - Rainfall
MHL - Water level
MHL - Water level & rainfall
MHL - Wave height & direction
HWC - Rainfall
BoM - Rainfall
NOW - Water level
NOW - Water level & rainfall



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TUGGERAH LAKE REGION
WATER LEVEL
01 APRIL – 05 MAY 2015

MHL
REPORT 2364

Figure
6.16

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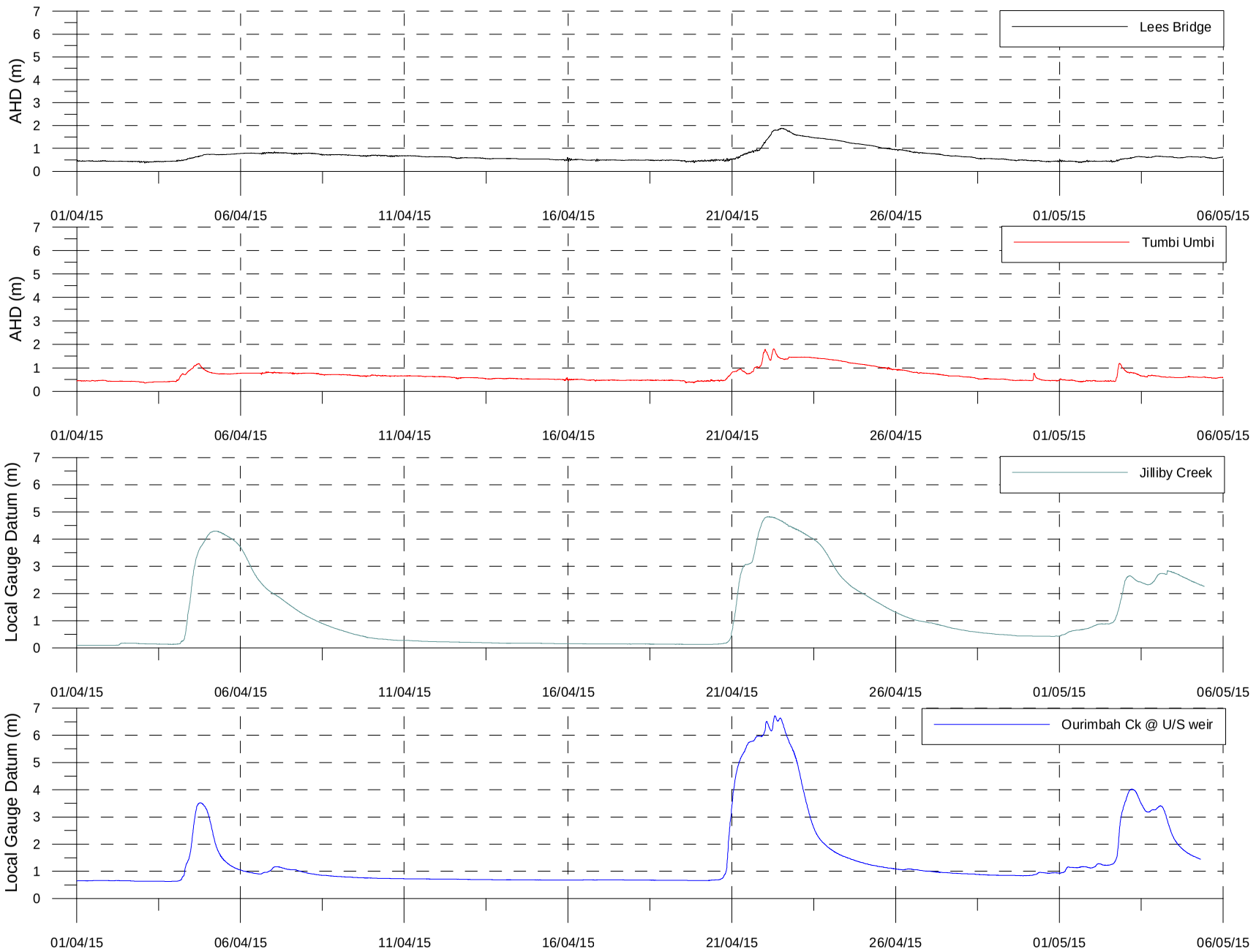
TUGGERAH LAKE REGION
WATER LEVEL
01 APRIL – 05 MAY 2015

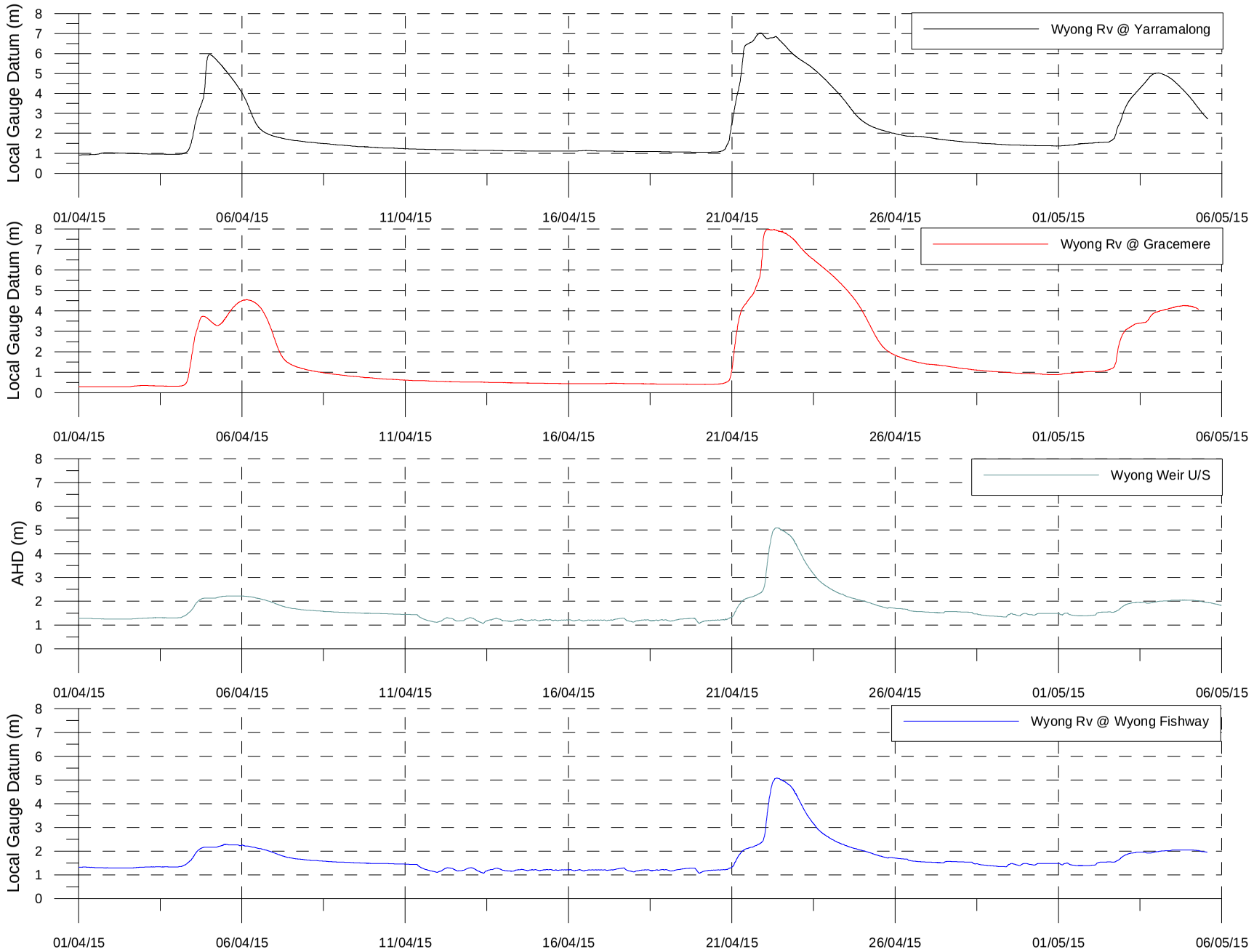


MHL REPORT 2364

Figure 6.17

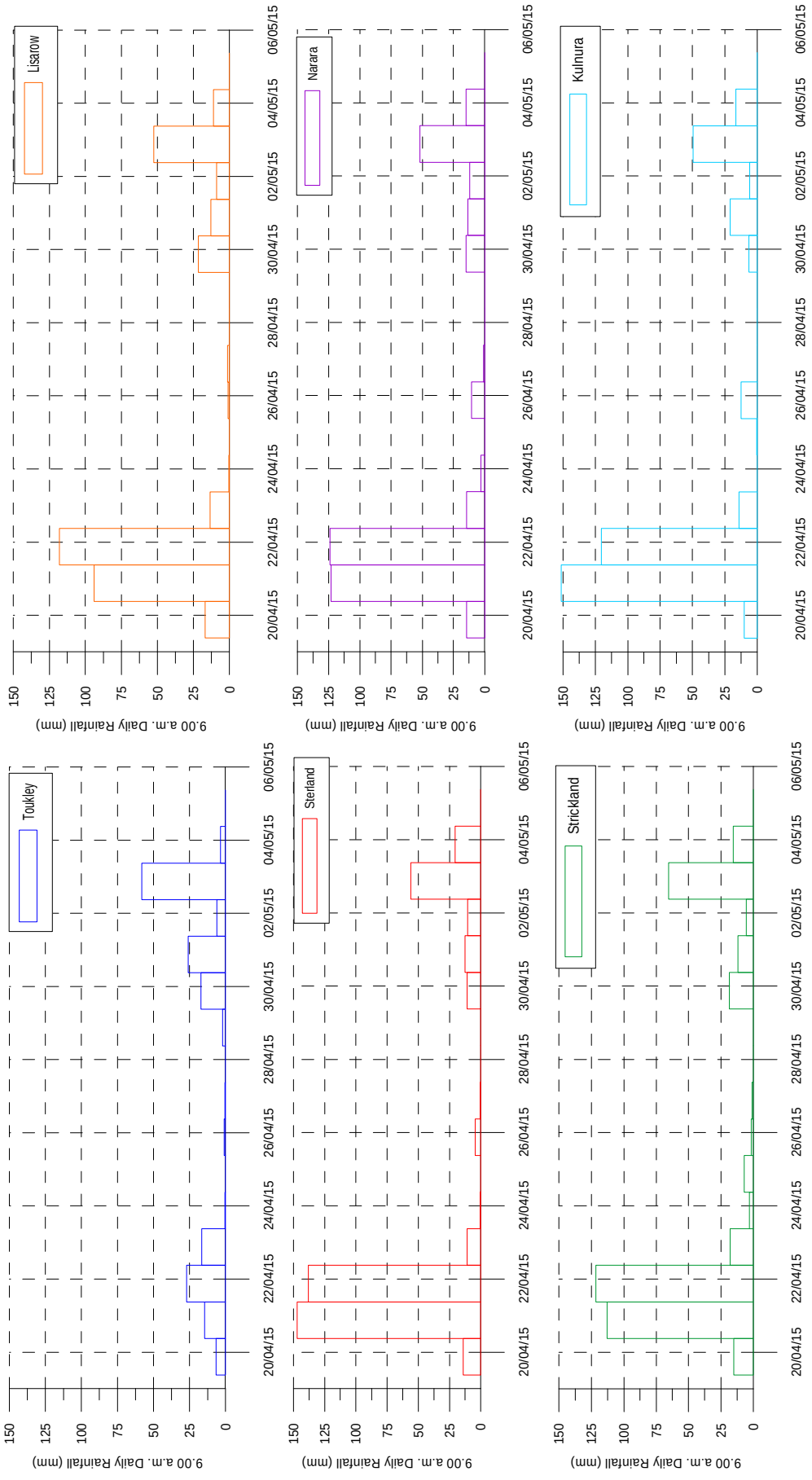
NSW GOVERNMENT
Public Works
Manly Hydraulics Laboratory

TUGGERAH LAKE REGION
WATER LEVEL
01 APRIL – 05 MAY 2015



MHL REPORT 2364

Figure 6.18



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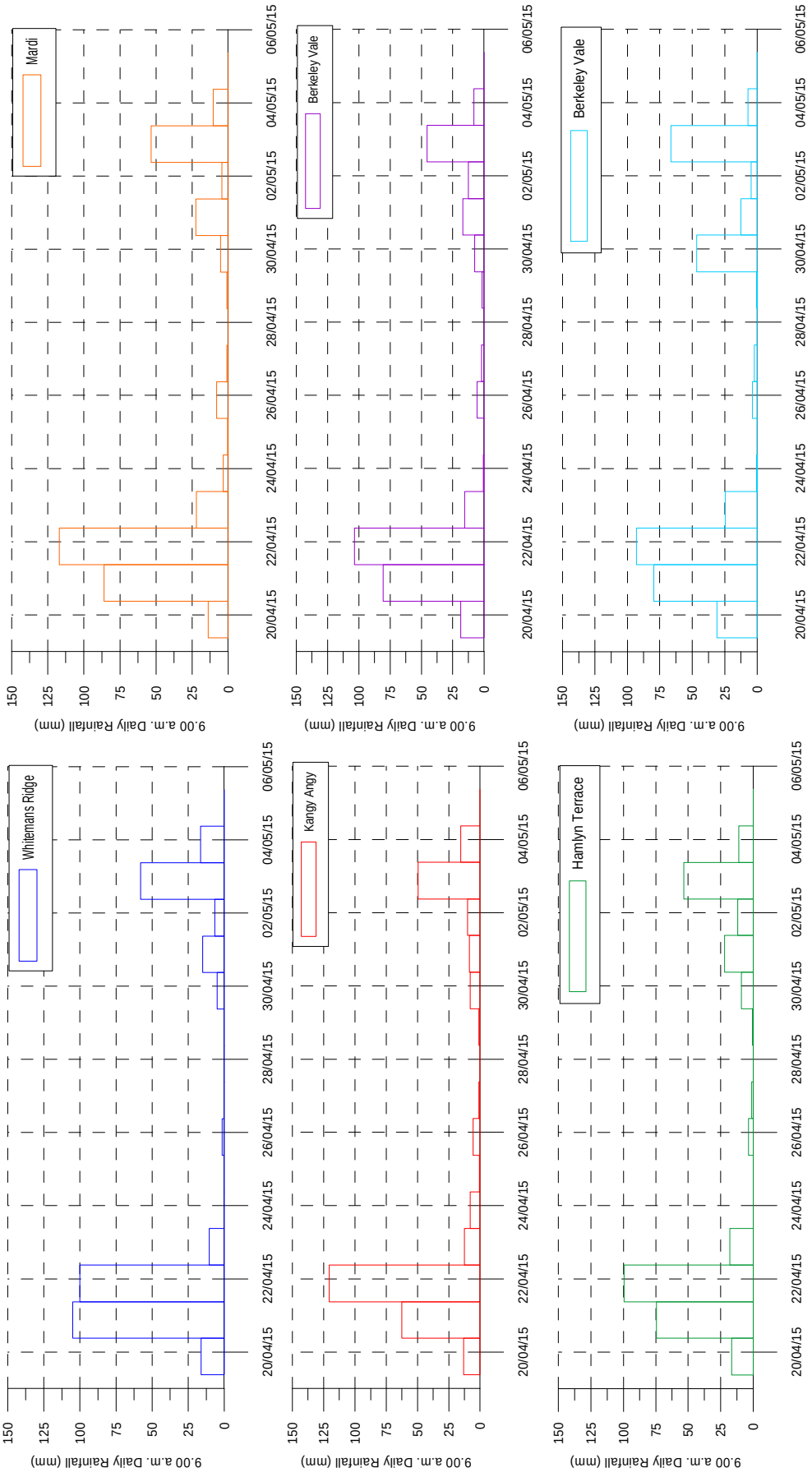
TUGGERAH LAKE REGION
RAINFALL
20 APRIL – 05 MAY 2015

MHL
REPORT 2364

Figure
6.19



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Manly Hydraulics Laboratory

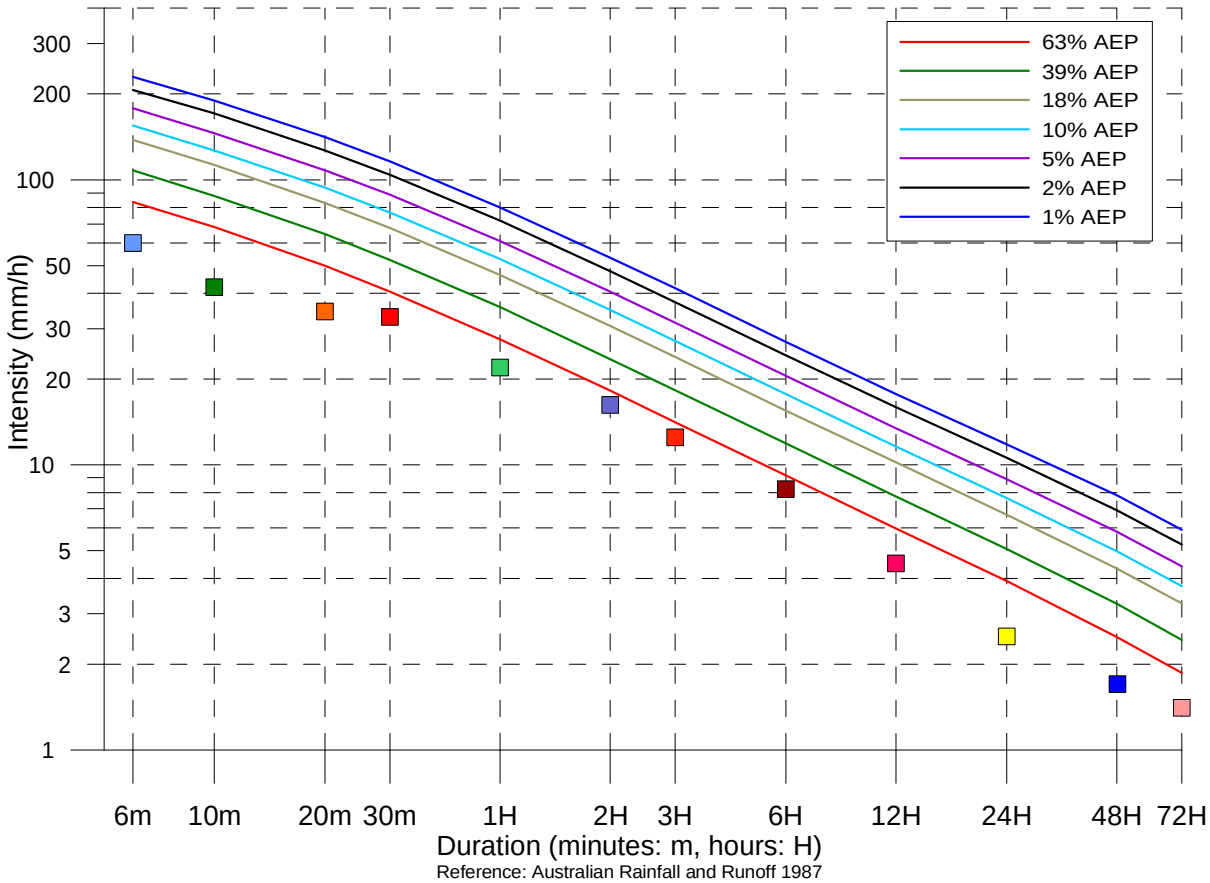
TUGGERAH LAKE REGION
RAINFALL
20 APRIL – 05 MAY 2015

MHL
REPORT 2364

Figure
6.20

Site owner: MHL Latitude: -33.2635 Longitude: 151.5248

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Toukley Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	60.0	23:48_30/04/2015
10m	42.0	23:44_30/04/2015
20m	34.5	16:50_02/05/2015
30m	33.0	16:46_02/05/2015
1H	22.0	16:40_02/05/2015
2H	16.2	16:40_02/05/2015
3H	12.5	16:02_02/05/2015
6H	8.2	15:00_02/05/2015
12H	4.5	10:52_02/05/2015
24H	2.5	15:54_03/04/2015
48H	1.7	22:06_30/04/2015
72H	1.4	22:00_29/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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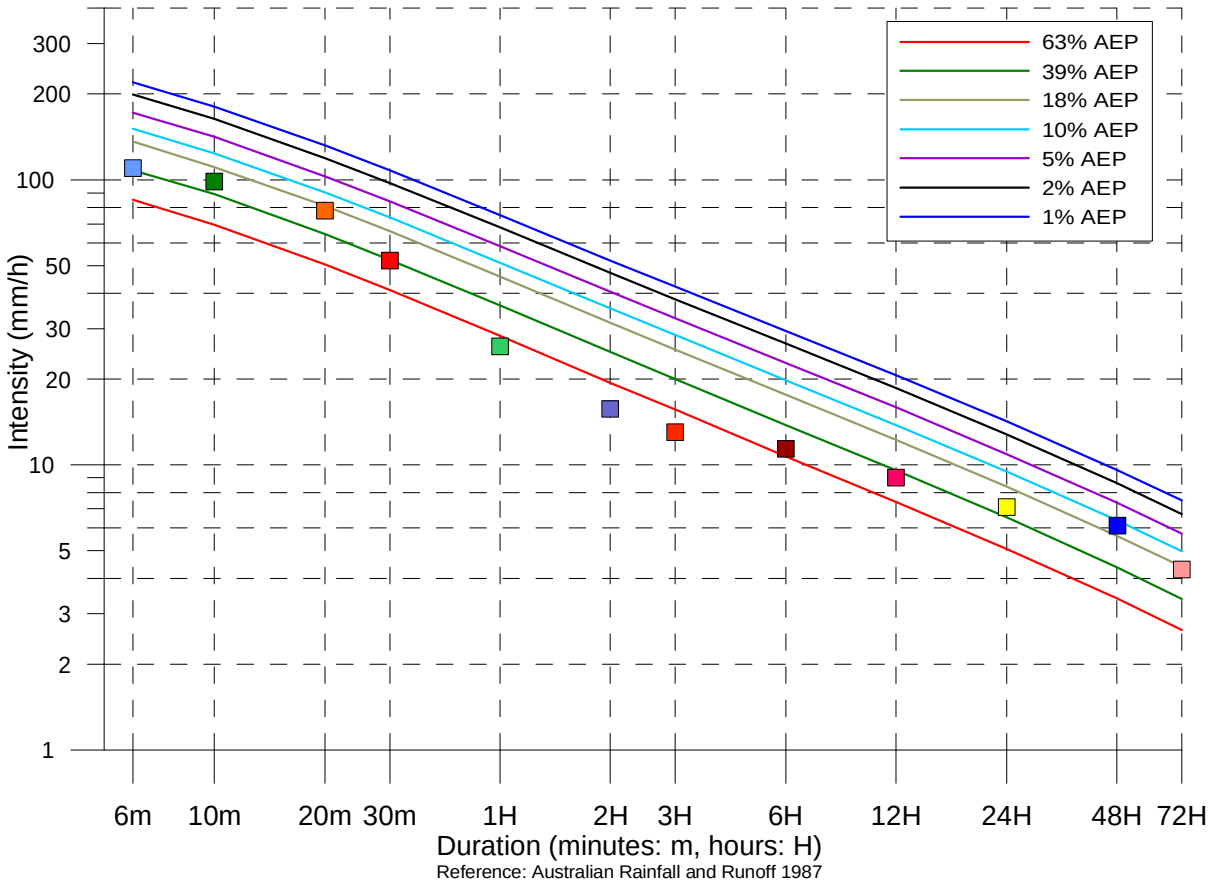
TOUKLEY INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.21

Site owner: MHL Latitude: -33.289 Longitude: 151.3078

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Sterland Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	110.0	14:12_06/04/2015
10m	99.0	14:12_06/04/2015
20m	78.0	14:06_06/04/2015
30m	52.0	14:06_06/04/2015
1H	26.0	14:06_06/04/2015
2H	15.7	19:32_20/04/2015
3H	13.0	19:30_20/04/2015
6H	11.4	19:30_20/04/2015
12H	9.0	19:30_20/04/2015
24H	7.1	19:30_20/04/2015
48H	6.1	06:38_20/04/2015
72H	4.3	02:22_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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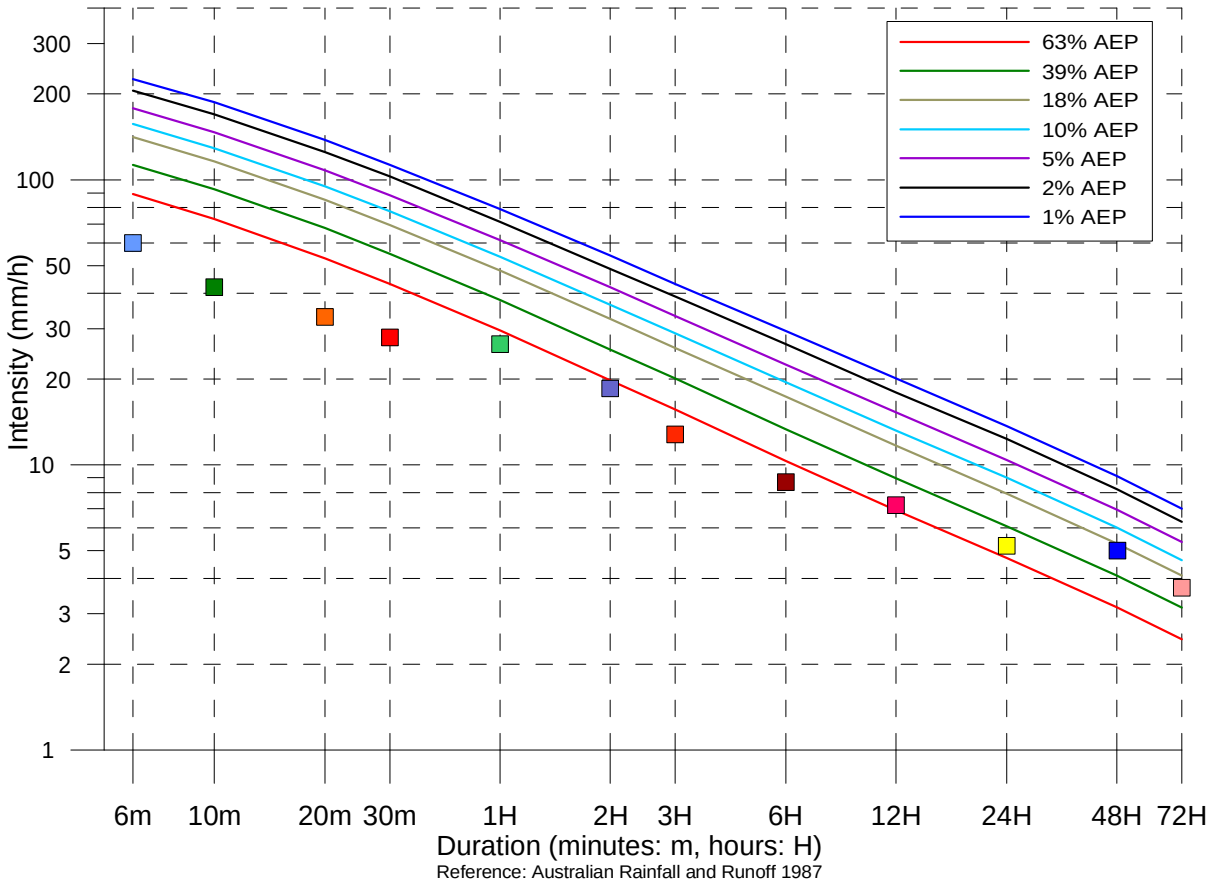
STERLAND INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.22

Site owner: MHL Latitude: -33.3782 Longitude: 151.3377

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Strickland Forest Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	60.0	19:28_20/04/2015
10m	42.0	19:28_20/04/2015
20m	33.0	05:32_22/04/2015
30m	28.0	05:26_22/04/2015
1H	26.5	04:48_22/04/2015
2H	18.5	04:48_22/04/2015
3H	12.8	04:48_22/04/2015
6H	8.7	19:24_20/04/2015
12H	7.2	18:18_21/04/2015
24H	5.2	10:54_21/04/2015
48H	5.0	08:12_20/04/2015
72H	3.7	04:24_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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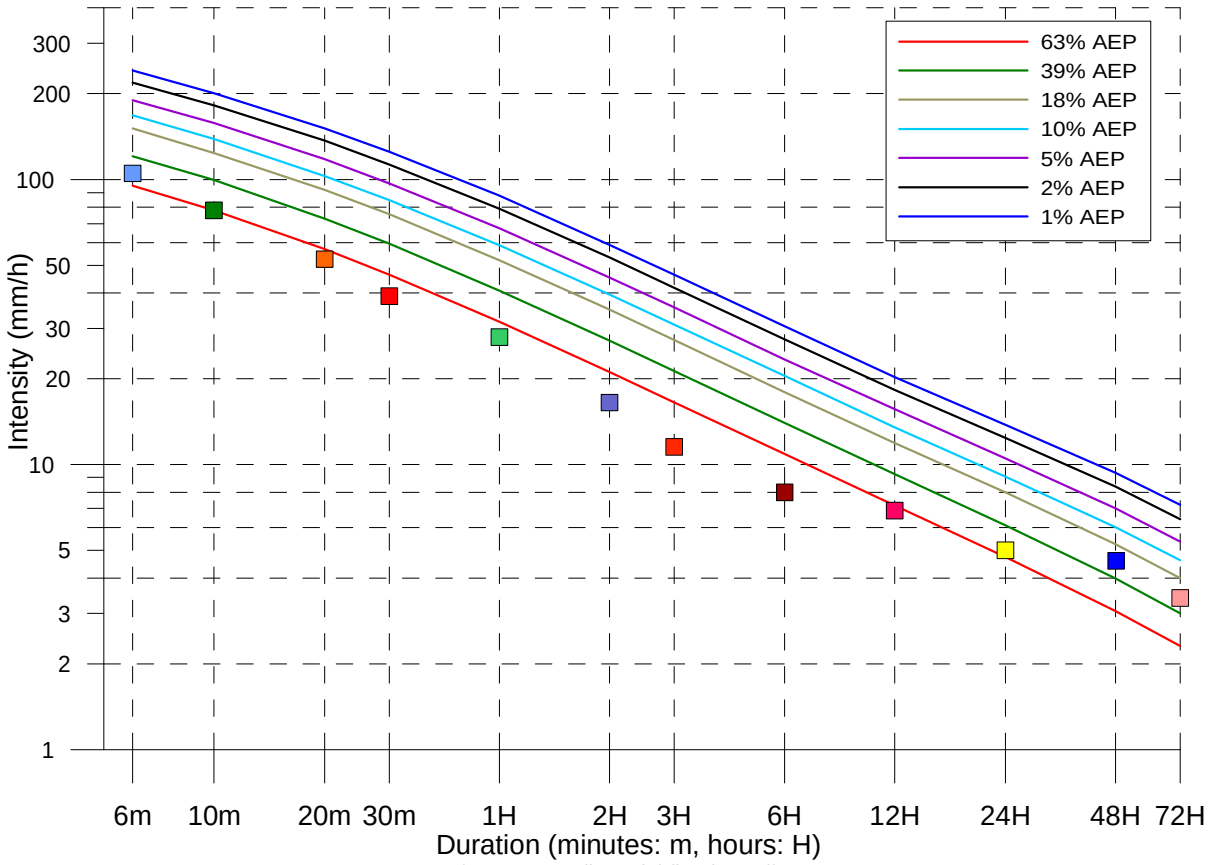
STRICKLAND FOREST INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.23

Site owner: MHL Latitude: -33.3814 Longitude: 151.3759

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Lisarow Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	105.0	04:44_22/04/2015
10m	78.0	04:44_22/04/2015
20m	52.5	04:44_22/04/2015
30m	39.0	04:44_22/04/2015
1H	28.0	04:44_22/04/2015
2H	16.5	04:44_22/04/2015
3H	11.5	04:44_22/04/2015
6H	8.0	18:12_21/04/2015
12H	6.9	18:08_21/04/2015
24H	5.0	08:26_21/04/2015
48H	4.6	08:06_20/04/2015
72H	3.4	23:36_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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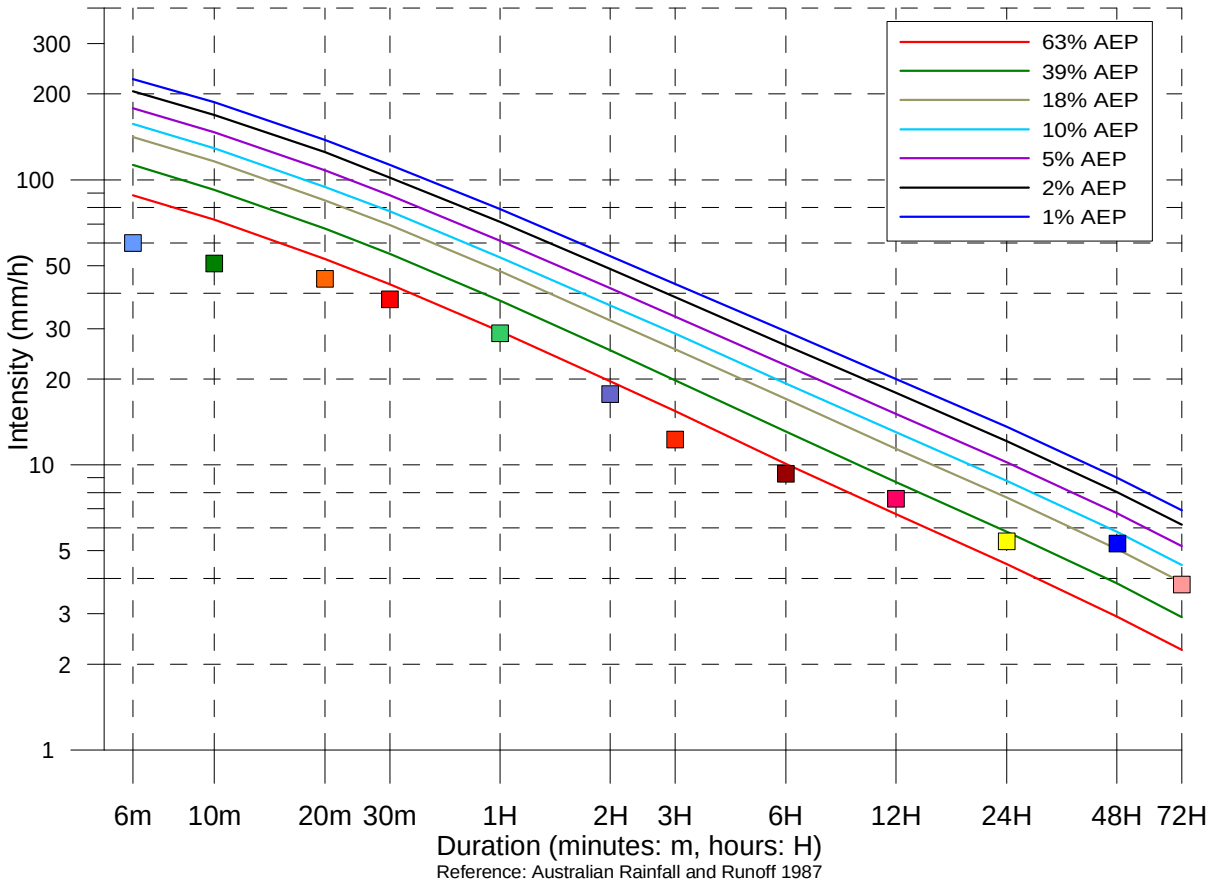
LISAROW INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.24

Site owner: MHL Latitude: -33.3926 Longitude: 151.3284

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Narara Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	60.0	06:04_22/04/2015
10m	51.0	05:30_22/04/2015
20m	45.0	05:30_22/04/2015
30m	38.0	05:30_22/04/2015
1H	29.0	05:14_22/04/2015
2H	17.7	04:52_22/04/2015
3H	12.3	04:52_22/04/2015
6H	9.3	19:16_20/04/2015
12H	7.6	16:42_20/04/2015
24H	5.4	16:38_20/04/2015
48H	5.3	08:12_20/04/2015
72H	3.8	02:46_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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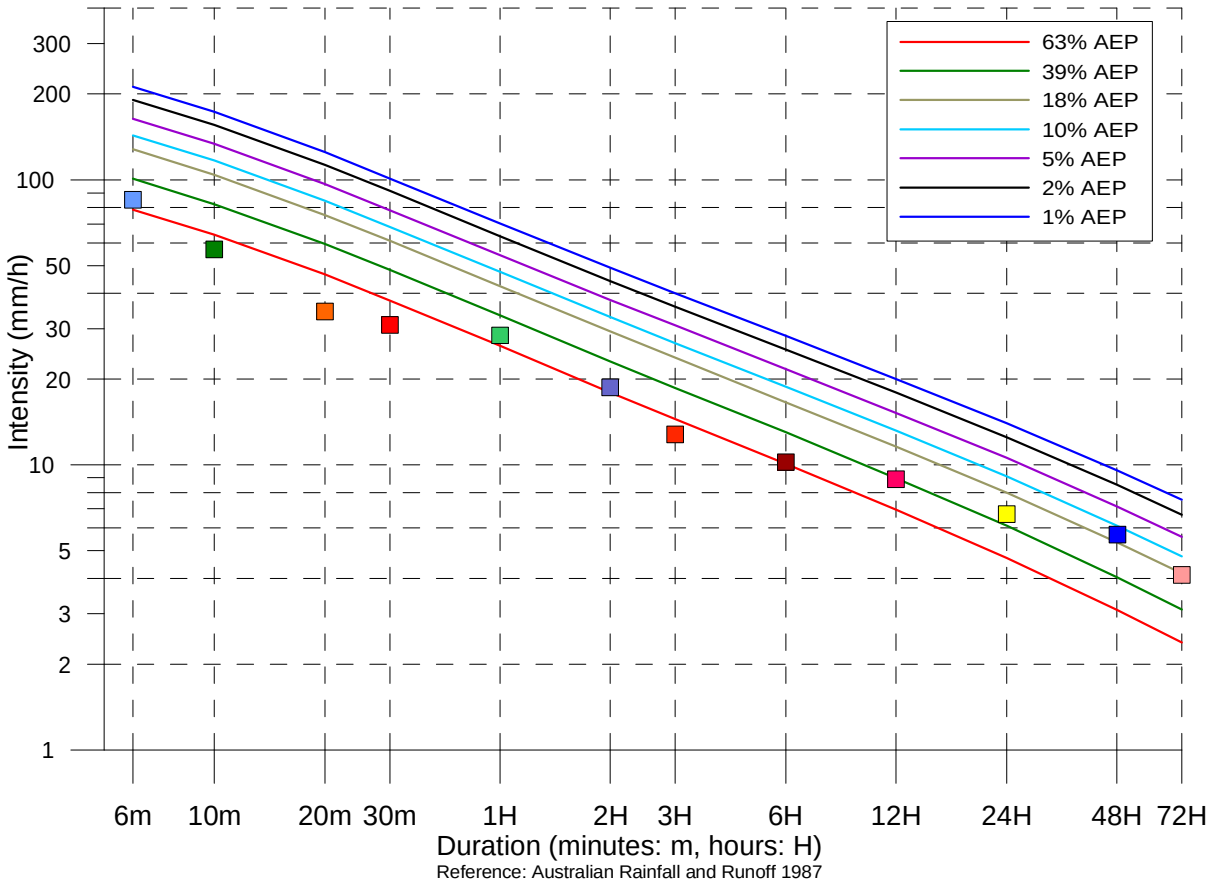
NARARA INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.25

Site owner: MHL Latitude: -33.2325 Longitude: 151.2162

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Kulnura Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	85.0	16:52_25/04/2015
10m	57.0	16:52_25/04/2015
20m	34.5	17:02_02/05/2015
30m	31.0	05:02_22/04/2015
1H	28.5	05:02_22/04/2015
2H	18.7	04:44_22/04/2015
3H	12.8	03:38_22/04/2015
6H	10.2	19:46_20/04/2015
12H	8.9	14:40_20/04/2015
24H	6.7	15:14_20/04/2015
48H	5.7	07:52_20/04/2015
72H	4.1	22:46_19/04/2015

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

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ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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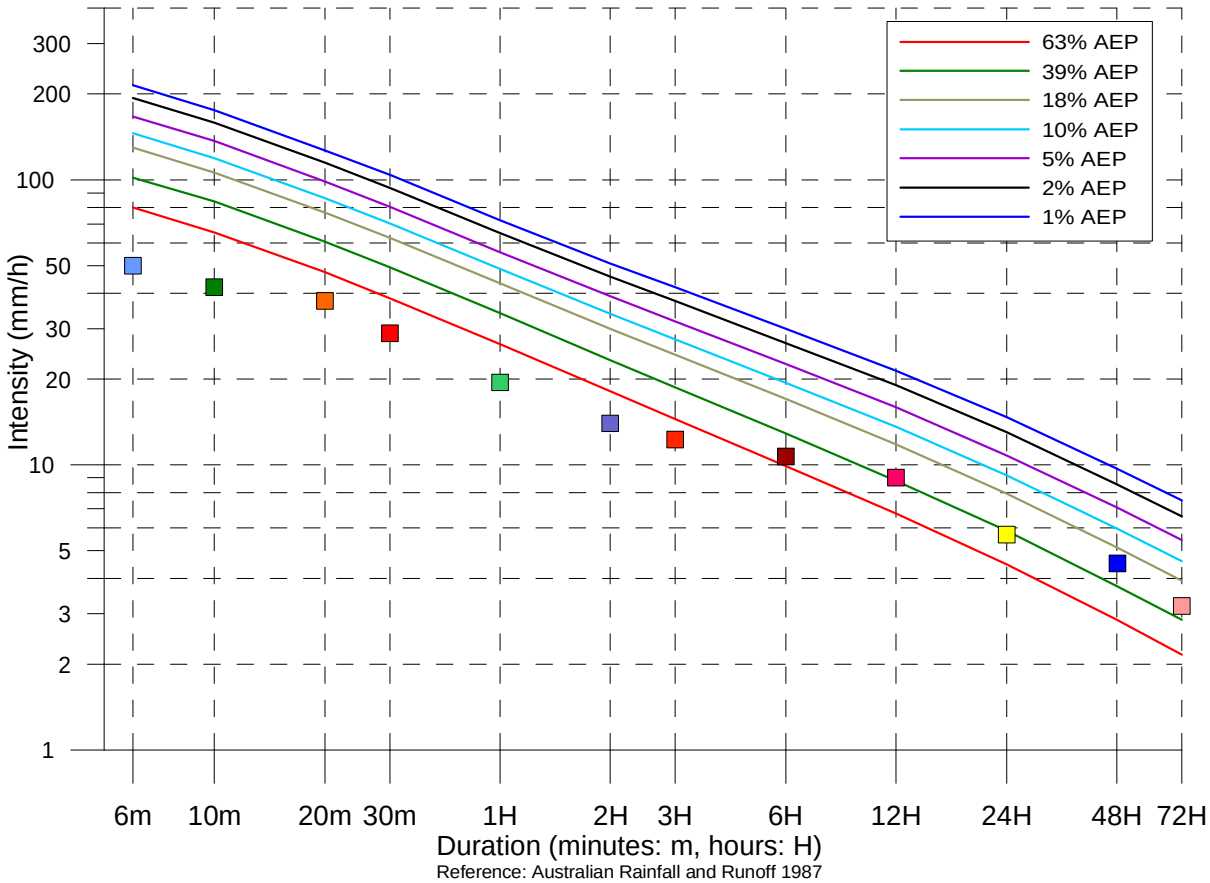
KULNURA INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.26

Site owner: MHL Latitude: -33.2035 Longitude: 151.3227

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Whitemans Ridge Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	50.0	16:56_02/05/2015
10m	42.0	04:54_22/04/2015
20m	37.5	16:42_02/05/2015
30m	29.0	16:40_02/05/2015
1H	19.5	03:34_04/04/2015
2H	14.0	03:18_04/04/2015
3H	12.3	03:52_04/04/2015
6H	10.7	03:30_04/04/2015
12H	9.0	03:30_04/04/2015
24H	5.7	21:04_03/04/2015
48H	4.5	06:30_20/04/2015
72H	3.2	23:12_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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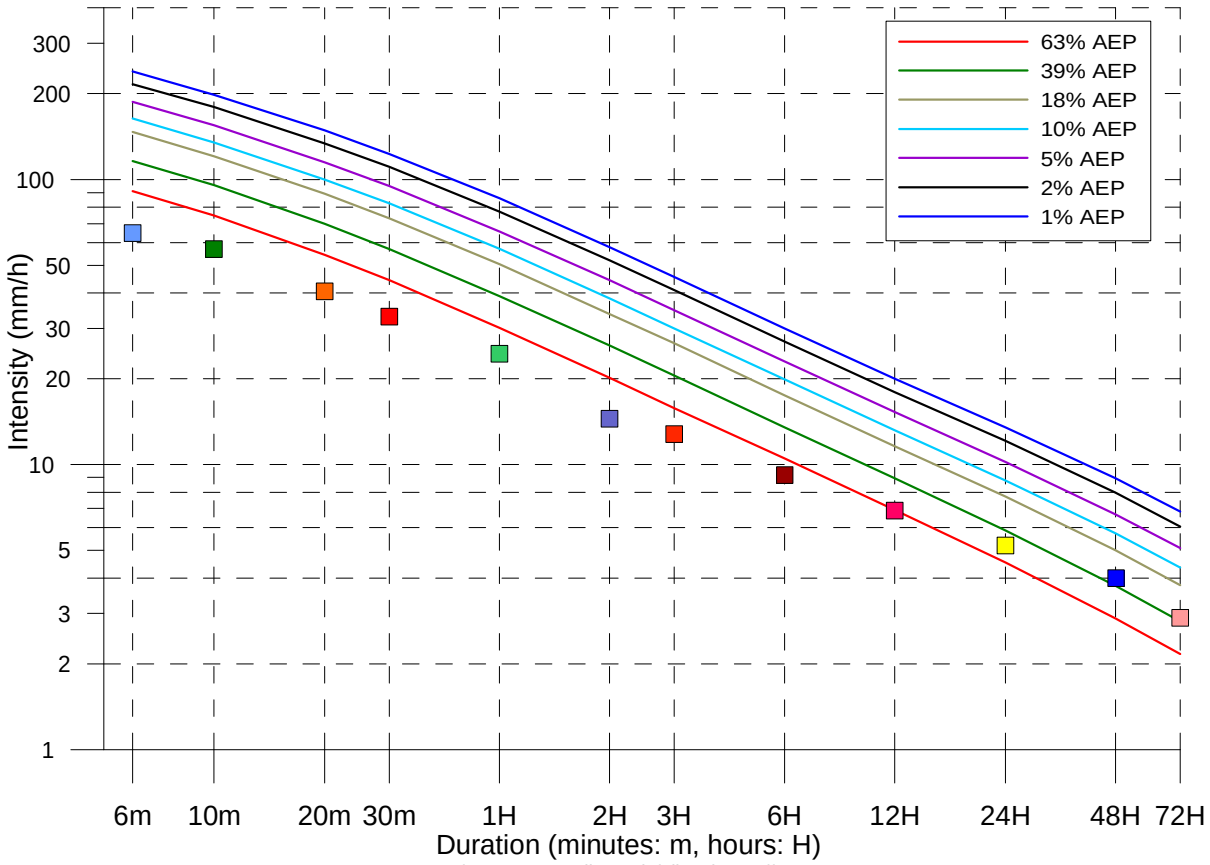
WHITEMANS RIDGE INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.27

Site owner: MHL Latitude: -33.3333 Longitude: 151.3900

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Kangy Angy Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	65.0	14:24_06/04/2015
10m	57.0	14:26_06/04/2015
20m	40.5	04:38_22/04/2015
30m	33.0	04:38_22/04/2015
1H	24.5	04:38_22/04/2015
2H	14.5	21:18_21/04/2015
3H	12.8	21:18_21/04/2015
6H	9.2	18:14_21/04/2015
12H	6.9	18:08_21/04/2015
24H	5.2	06:00_21/04/2015
48H	4.0	06:46_20/04/2015
72H	2.9	00:22_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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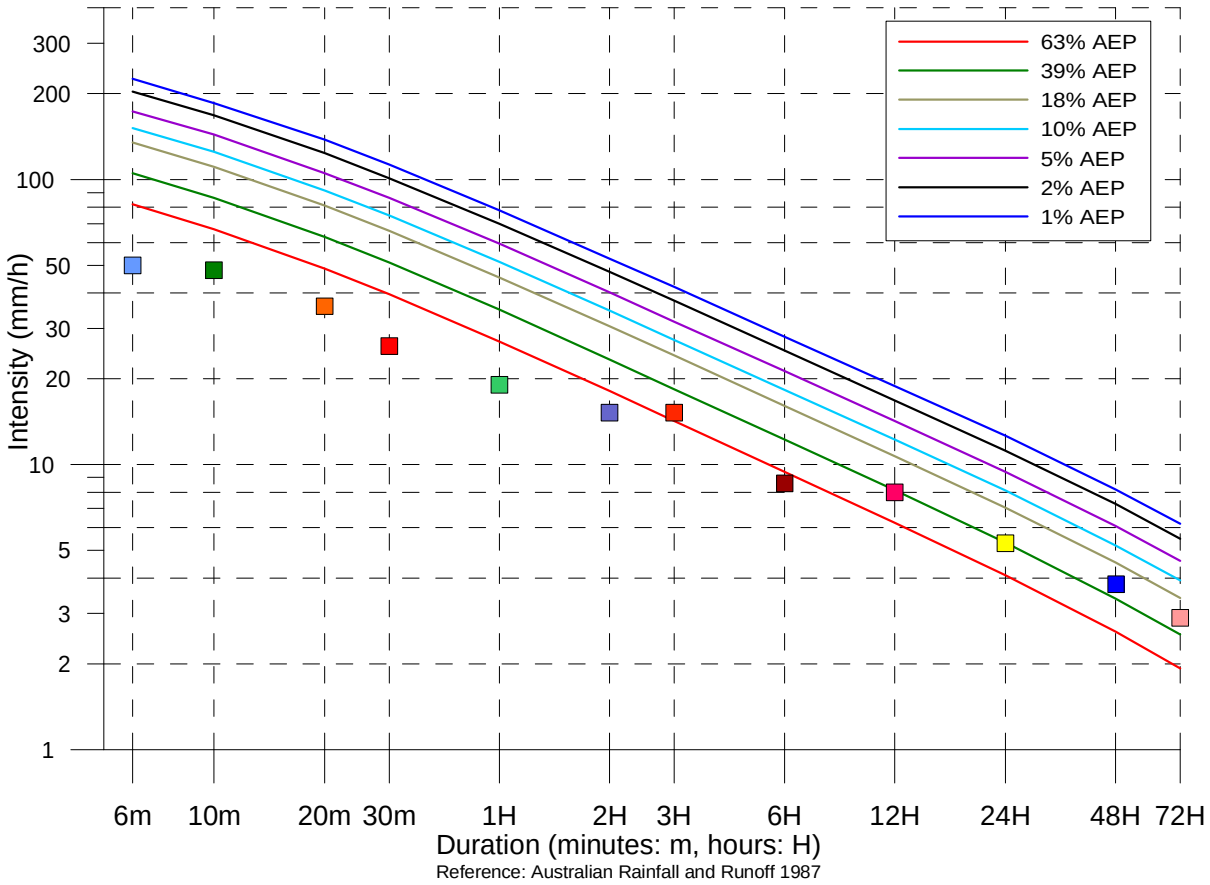
KANGY ANGY INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.28

Site owner: MHL Latitude: -33.2509 Longitude: 151.4692

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Hamlyn Terrace Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		50.0	17:22_22/04/2015
10m		48.0	17:18_22/04/2015
20m		36.0	17:12_22/04/2015
30m		26.0	22:36_21/04/2015
1H		19.0	20:46_21/04/2015
2H		15.2	21:08_21/04/2015
3H		15.2	20:08_21/04/2015
6H		8.6	18:30_21/04/2015
12H		8.0	02:44_04/04/2015
24H		5.3	23:06_20/04/2015
48H		3.8	06:22_20/04/2015
72H		2.9	22:42_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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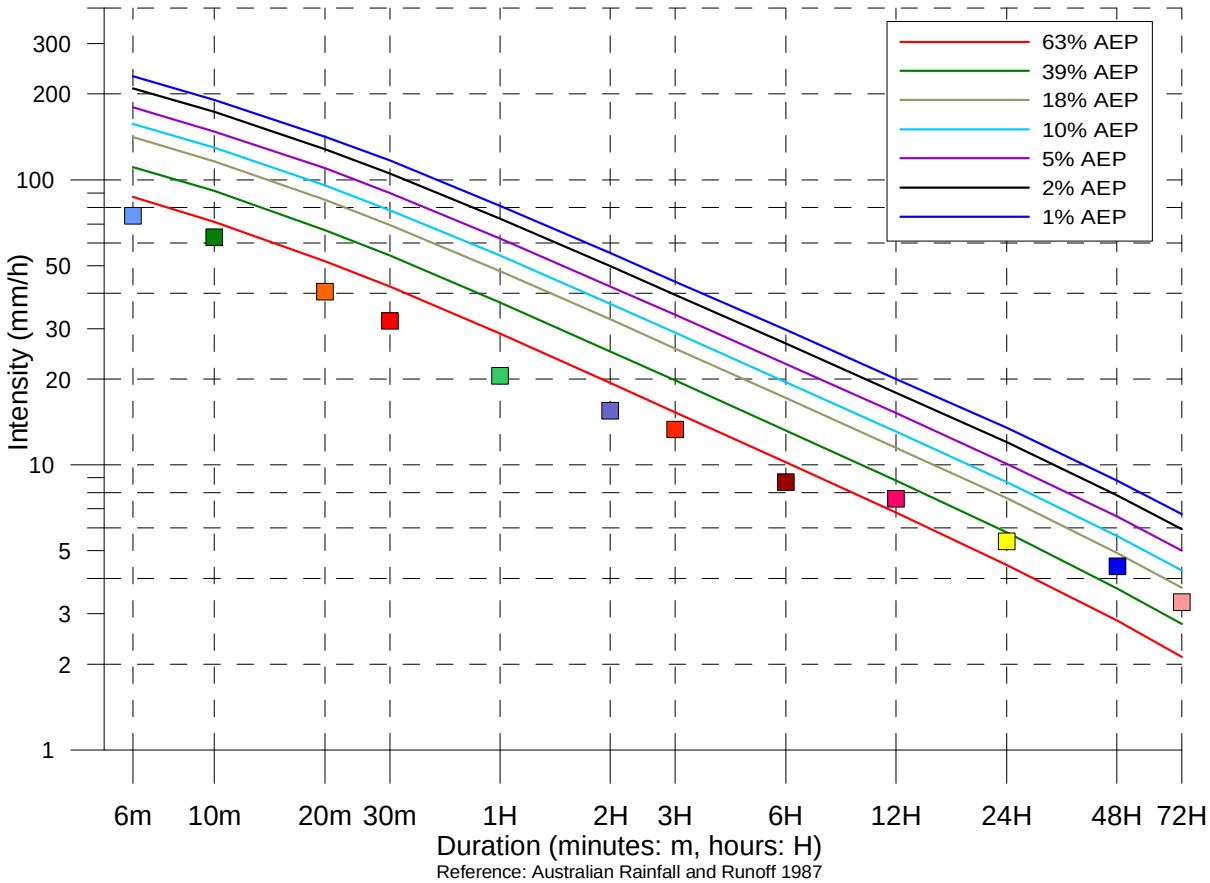
HAMLYN TERRACE INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.29

Site owner: MHL Latitude: -33.2978 Longitude: 151.4001

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Mardi Dam Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	75.0	04:28_22/04/2015
10m	63.0	04:28_22/04/2015
20m	40.5	04:24_22/04/2015
30m	32.0	04:26_22/04/2015
1H	20.5	04:24_22/04/2015
2H	15.5	21:06_21/04/2015
3H	13.3	20:40_21/04/2015
6H	8.7	18:02_21/04/2015
12H	7.6	02:36_04/04/2015
24H	5.4	23:06_20/04/2015
48H	4.4	06:34_20/04/2015
72H	3.3	04:08_20/04/2015

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).

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

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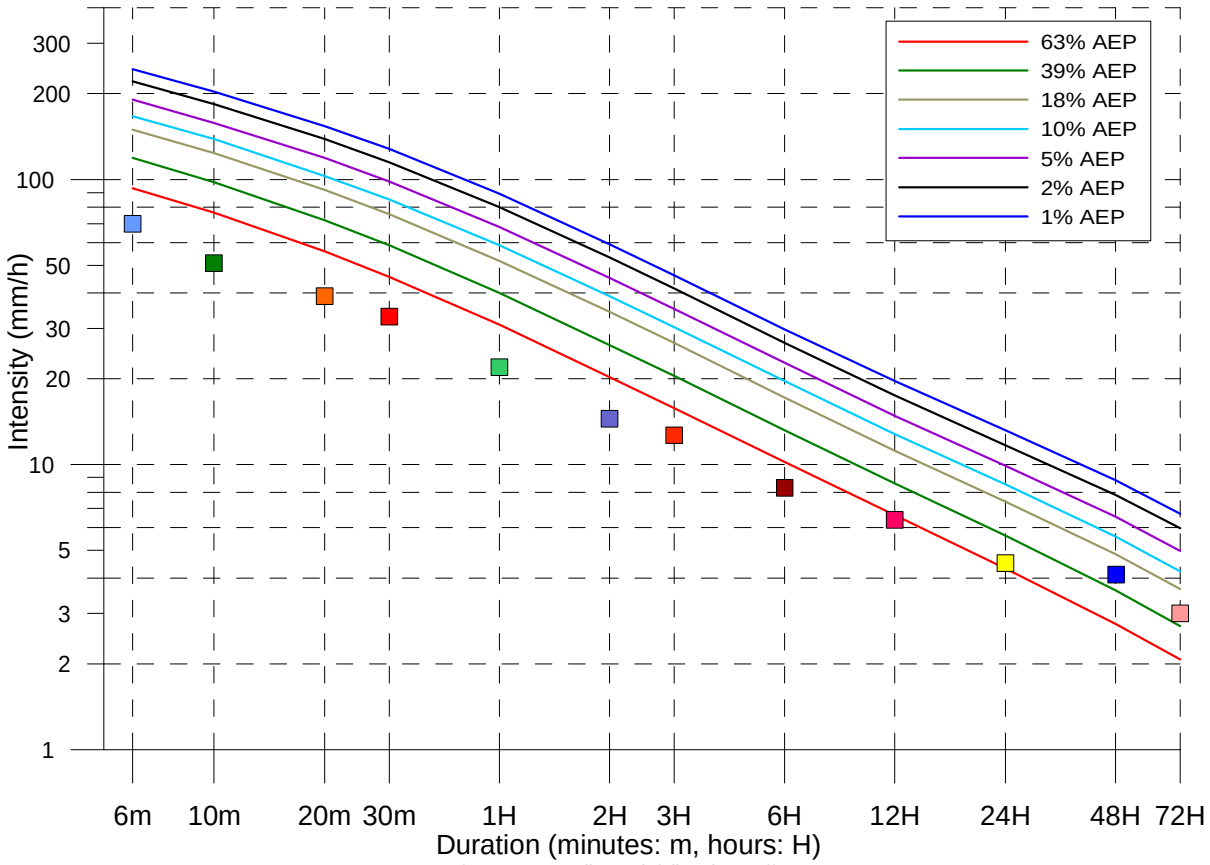
MARDI DAM INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.30

Site owner: MHL Latitude: -33.3448 Longitude: 151.4223

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Berkeley Vale Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	70.0	23:32_01/05/2015
10m	51.0	04:38_22/04/2015
20m	39.0	04:38_22/04/2015
30m	33.0	04:34_22/04/2015
1H	22.0	04:32_22/04/2015
2H	14.5	21:10_21/04/2015
3H	12.7	20:46_21/04/2015
6H	8.3	18:08_21/04/2015
12H	6.4	00:44_04/04/2015
24H	4.5	00:00_21/04/2015
48H	4.1	06:40_20/04/2015
72H	3.0	02:42_20/04/2015

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).

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

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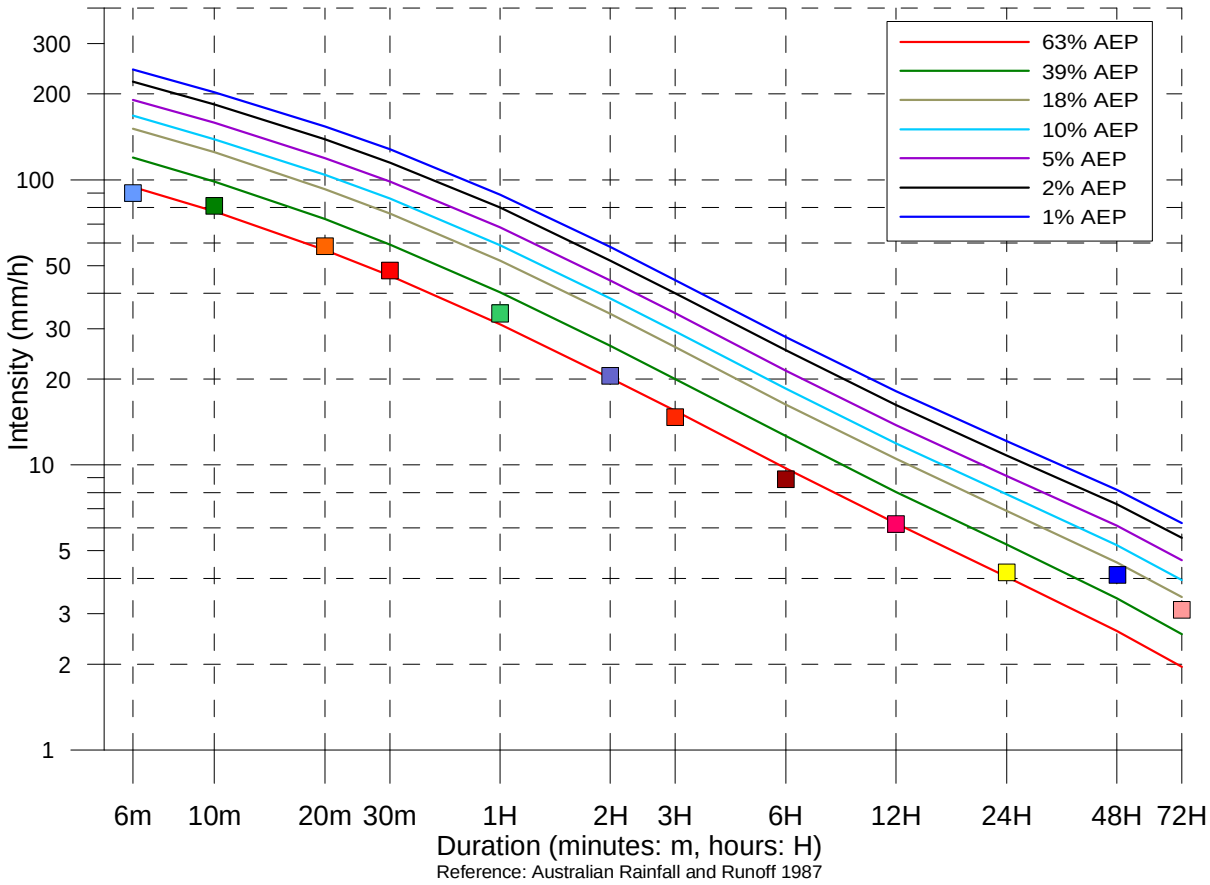
BERKELEY VALE INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.31

Site owner: MHL Latitude: -33.3790 Longitude: 151.4745

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Bateau Bay Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	90.0	04:30_22/04/2015
10m	81.0	08:12_20/04/2015
20m	58.5	17:12_02/05/2015
30m	48.0	17:08_02/05/2015
1H	34.0	16:58_02/05/2015
2H	20.5	16:34_02/05/2015
3H	14.7	16:22_02/05/2015
6H	8.9	16:22_02/05/2015
12H	6.2	02:16_04/04/2015
24H	4.2	20:28_03/04/2015
48H	4.1	05:46_20/04/2015
72H	3.1	23:38_19/04/2015

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

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ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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BATEAU BAY INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 6.32

7. Brisbane Water River Region

7.1 Brisbane Water River Region Water Level

The locations of water level stations within the Brisbane Water River region are shown in Figure 7.1. The water level data for the period 01 April to 05 May 2015 are displayed graphically in Figures 7.2 to 7.4. The peak observed water levels are listed in Table 7.1.

Currently there are no SES Flood Classifications for Brisbane Water.

Table 7.1 Brisbane Water River Region Flood Peaks

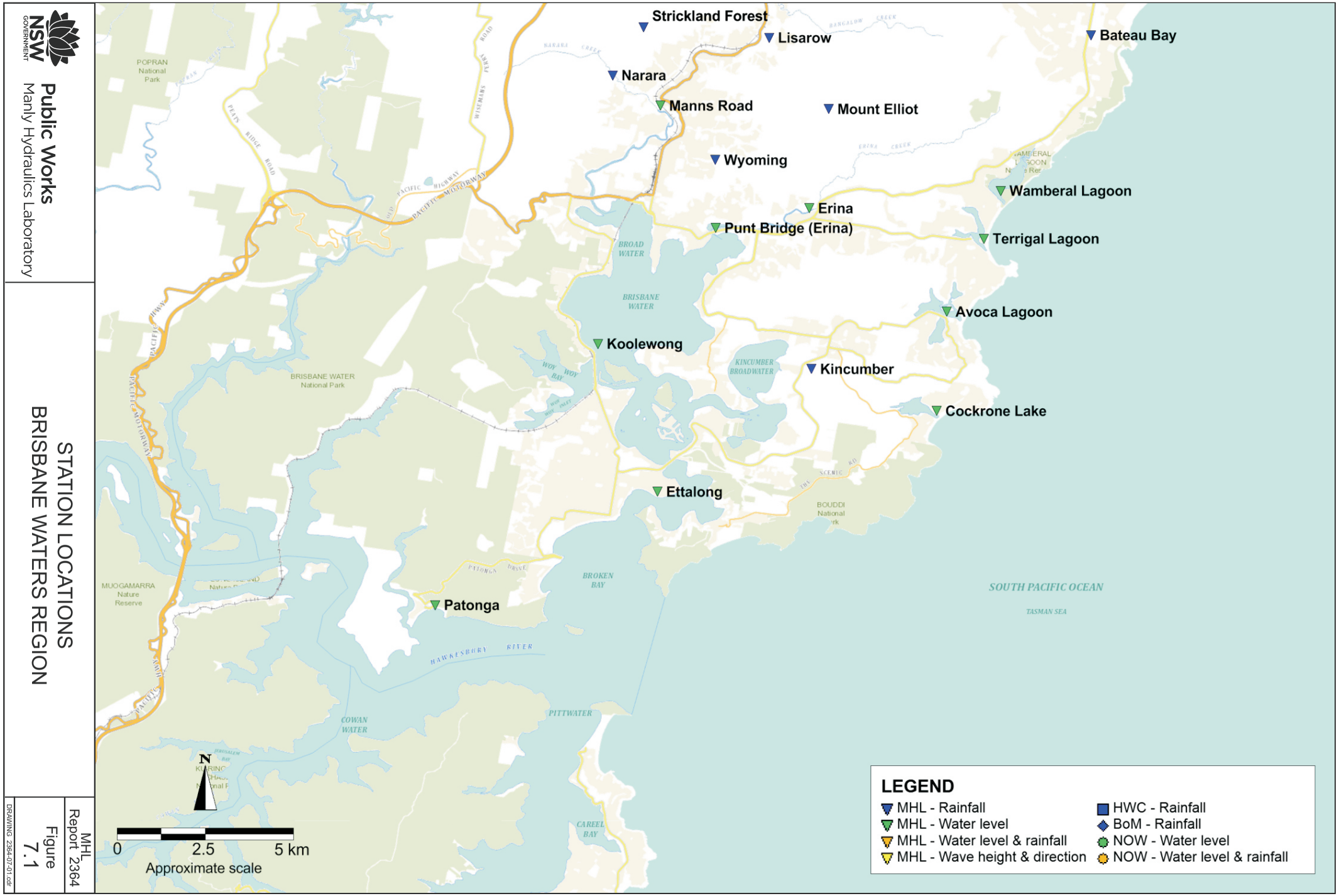
Station Name	Station No.	Site Owner	Datum	Peak level (m)
Manns Road	211435	MHL	AHD	2.52
Erina	212436	MHL	AHD	1.82
Punt Bridge	212433	MHL	AHD	1.38
Wamberal Lagoon	212450	MHL	AHD	2.54
Terrigal Bridge	212455	MHL	AHD	1.86
Avoca Lagoon	212452	MHL	AHD	4.15
Koolewong	212422	MHL	AHD	1.27
Cockrone Lake	212453	MHL	AHD	2.78
Ettalong	212423	MHL	AHD	1.26
Patonga	212440	MHL	AHD	1.38

7.2 Brisbane Water River Region Rainfall

9.00 a.m. daily rainfall totals are displayed in Figure 7.2 to 7.4 and Table 7.2 for the period 20th April to 5th May 2015. The rainfall data and intensities are displayed graphically in Figures 7.5 to 7.7.

Table 7.2 Brisbane Water River Region Daily Rainfall Totals

Date	Mt Elliot (mm)	Wyoming (mm)	Kincumber (mm)
	MHL	MHL	MHL
20/04/2015	18.5	20.0	24.5
21/04/2015	99.5	141.5	109.5
22/04/2015	116.0	131.5	109.5
23/04/2015	12.0	20.0	12.0
24/04/2015	0.0	0.0	0.0
25/04/2015	0.0	0.0	0.0
26/04/2015	2.5	11.5	7.5
27/04/2015	2.5	0.5	2.5
28/04/2015	0.0	0.5	0.0
29/04/2015	0.0	0.0	0.0
30/04/2015	26.5	15.0	17.0
01/05/2015	13.5	15.5	9.5
02/05/2015	4.0	5.5	10.5
03/05/2015	69.0	59.5	47.5
04/05/2015	10.5	16.5	12.5
05/05/2015	0.5	0.0	0.5
Total	375.0	437.5	363.0



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STATION LOCATIONS
BRISBANE WATERS REGION

MHL Report 2364
Figure 7.1

DRAWING: 2364-07-01.cdr

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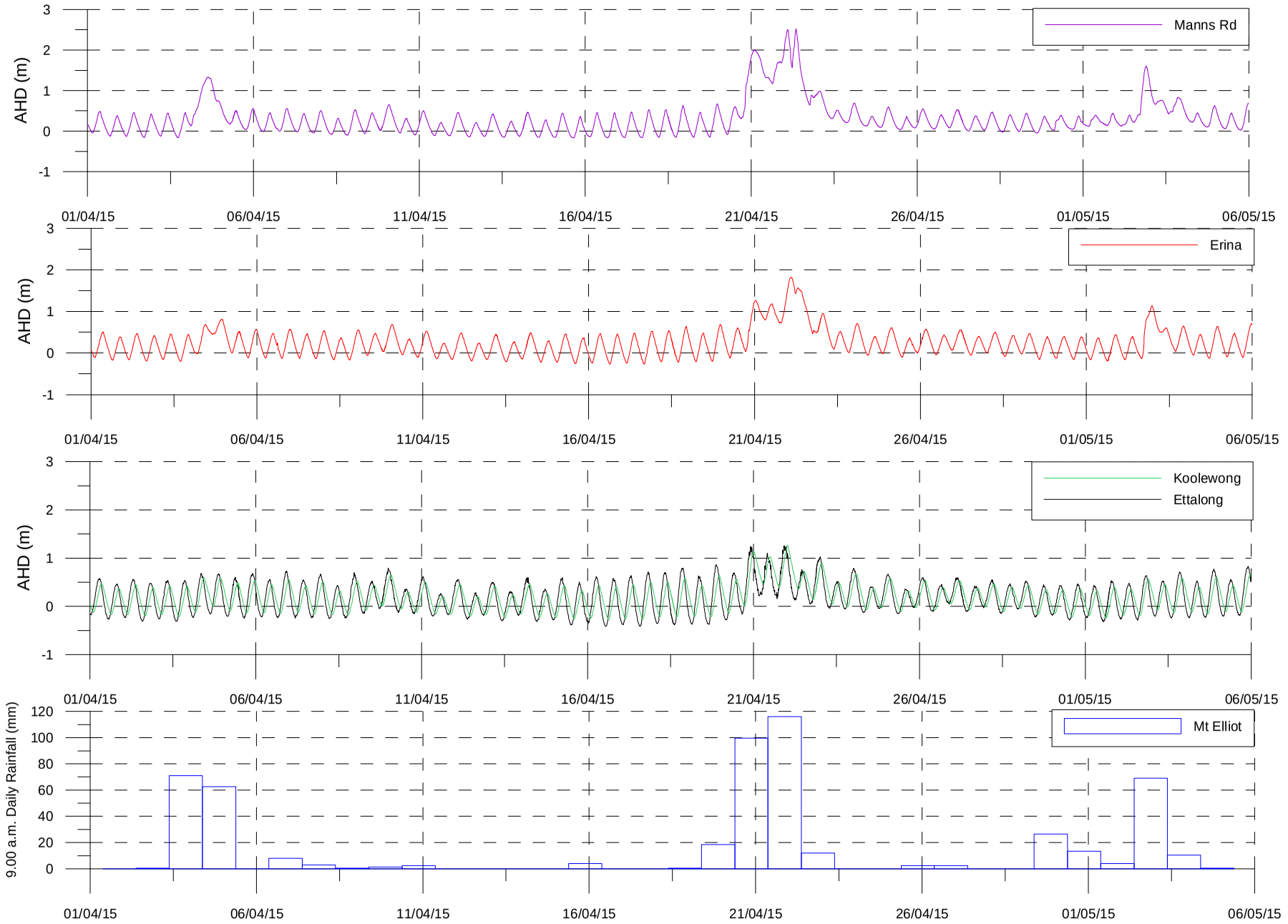
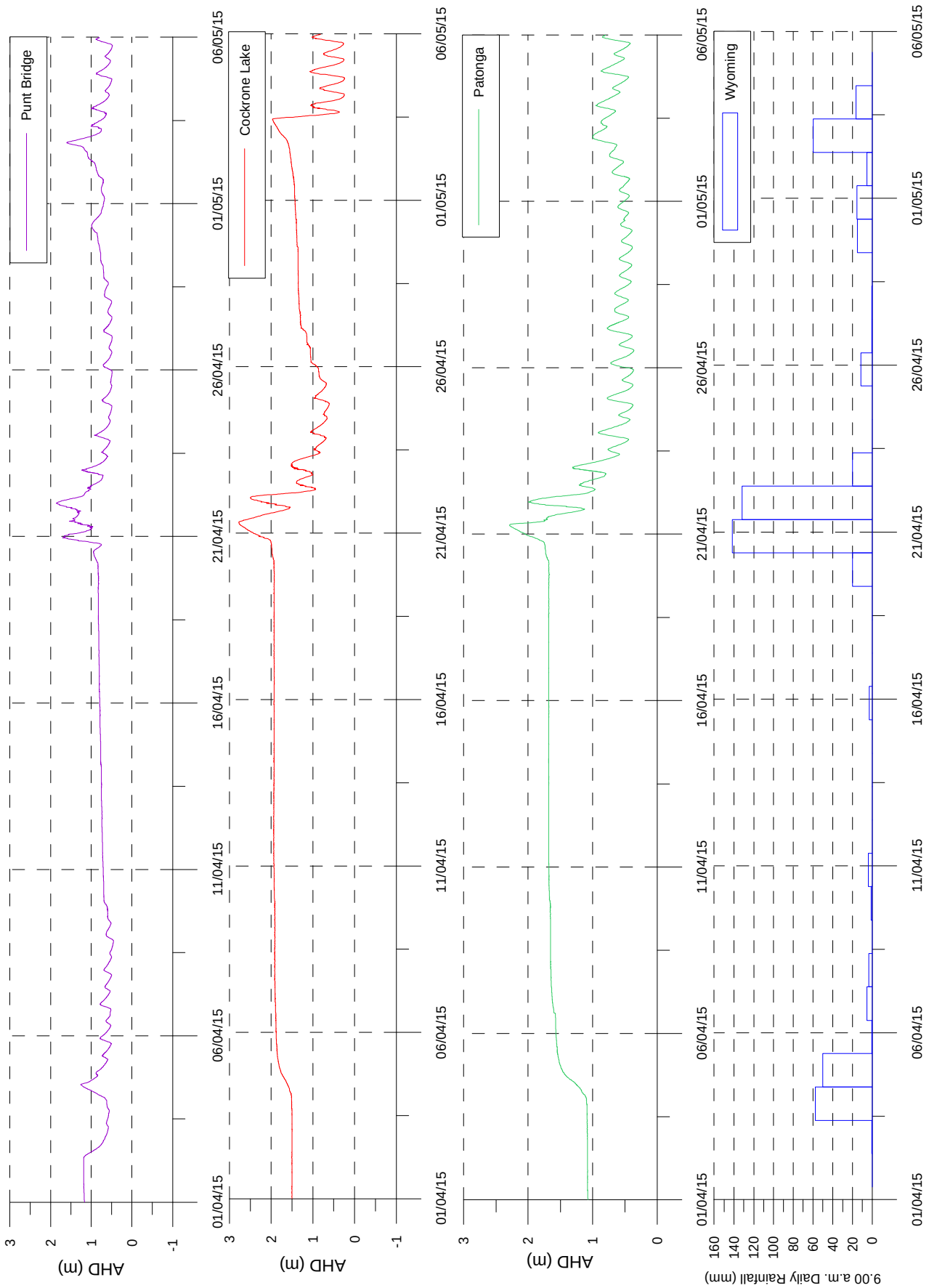
BRISBANE WATERS REGION
WATER LEVEL
01 APRIL – 05 MAY 2015



MHL REPORT 2364

Figure 7.2



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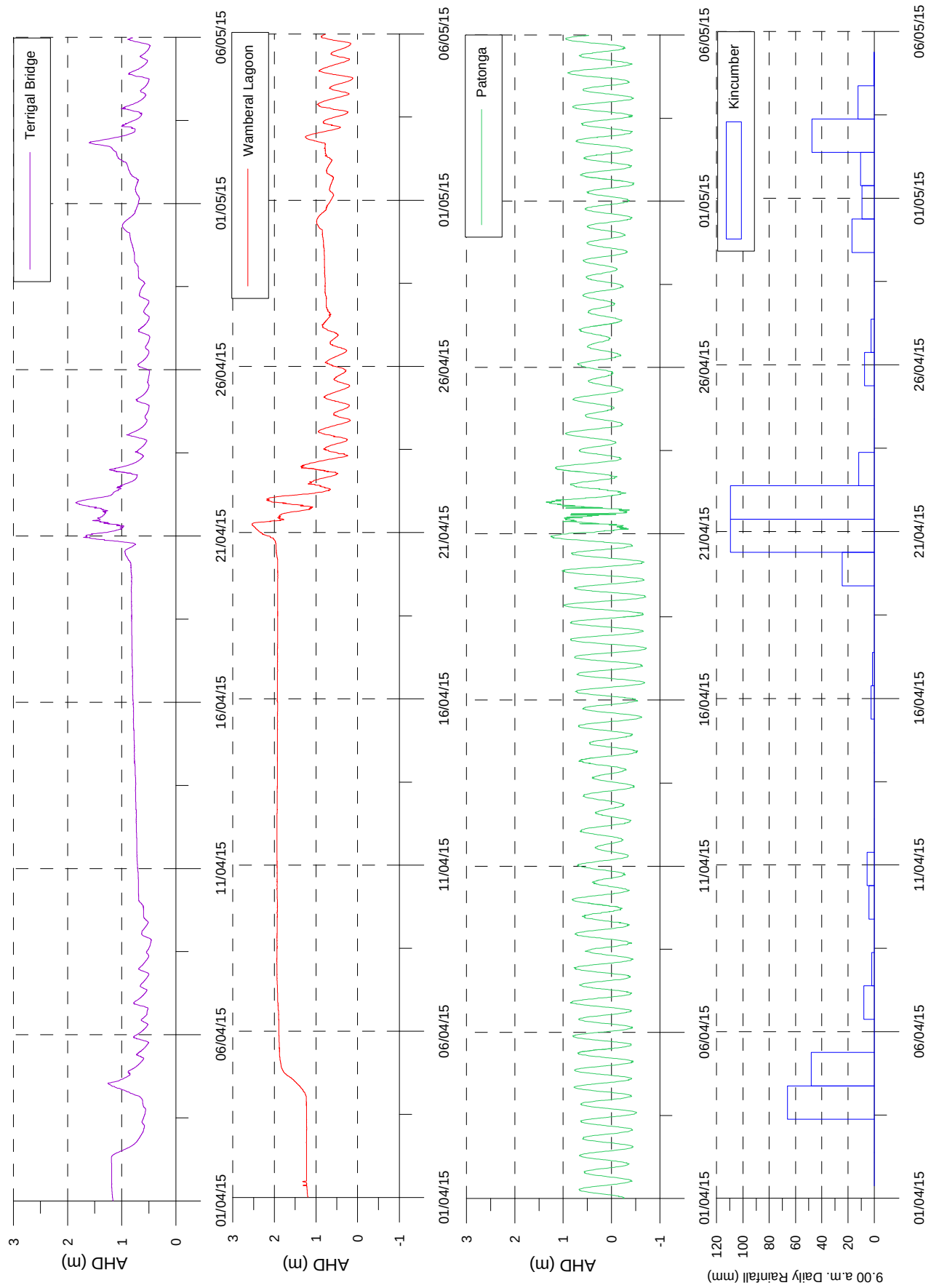
BRISBANE WATERS REGION
WATER LEVEL
01 APRIL – 05 MAY 2015

MHL
REPORT 2364

Figure
7.3



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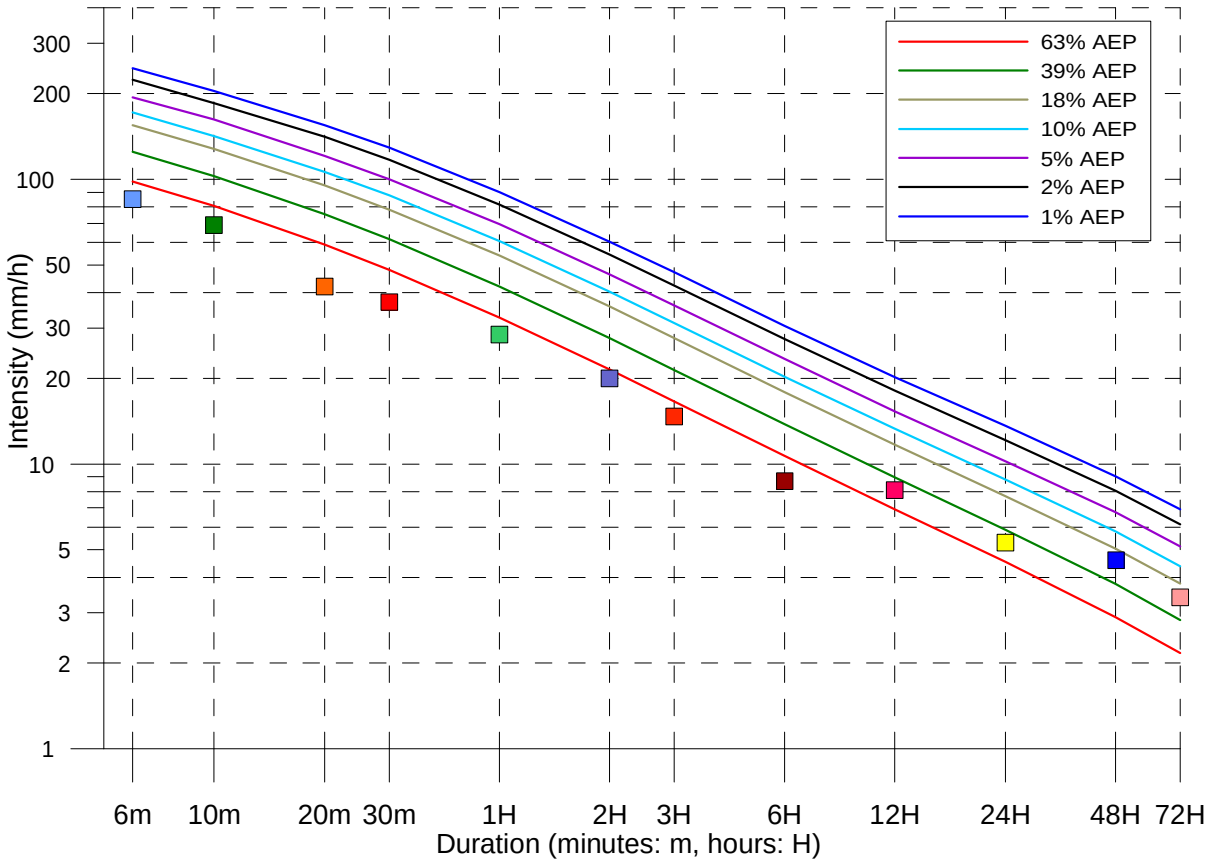
BRISBANE WATERS REGION
WATER LEVEL
01 APRIL – 05 MAY 2015

MHL
REPORT 2364

Figure
7.4

Site owner: MHL Latitude: -33.4026 Longitude: 151.3939

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Mt Elliot Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		85.0	04:42_22/04/2015
10m		69.0	04:42_22/04/2015
20m		42.0	04:42_22/04/2015
30m		37.0	17:14_02/05/2015
1H		28.5	16:50_02/05/2015
2H		20.0	16:46_02/05/2015
3H		14.7	16:36_02/05/2015
6H		8.7	16:36_02/05/2015
12H		8.1	02:52_04/04/2015
24H		5.3	22:06_03/04/2015
48H		4.6	08:00_20/04/2015
72H		3.4	22:24_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

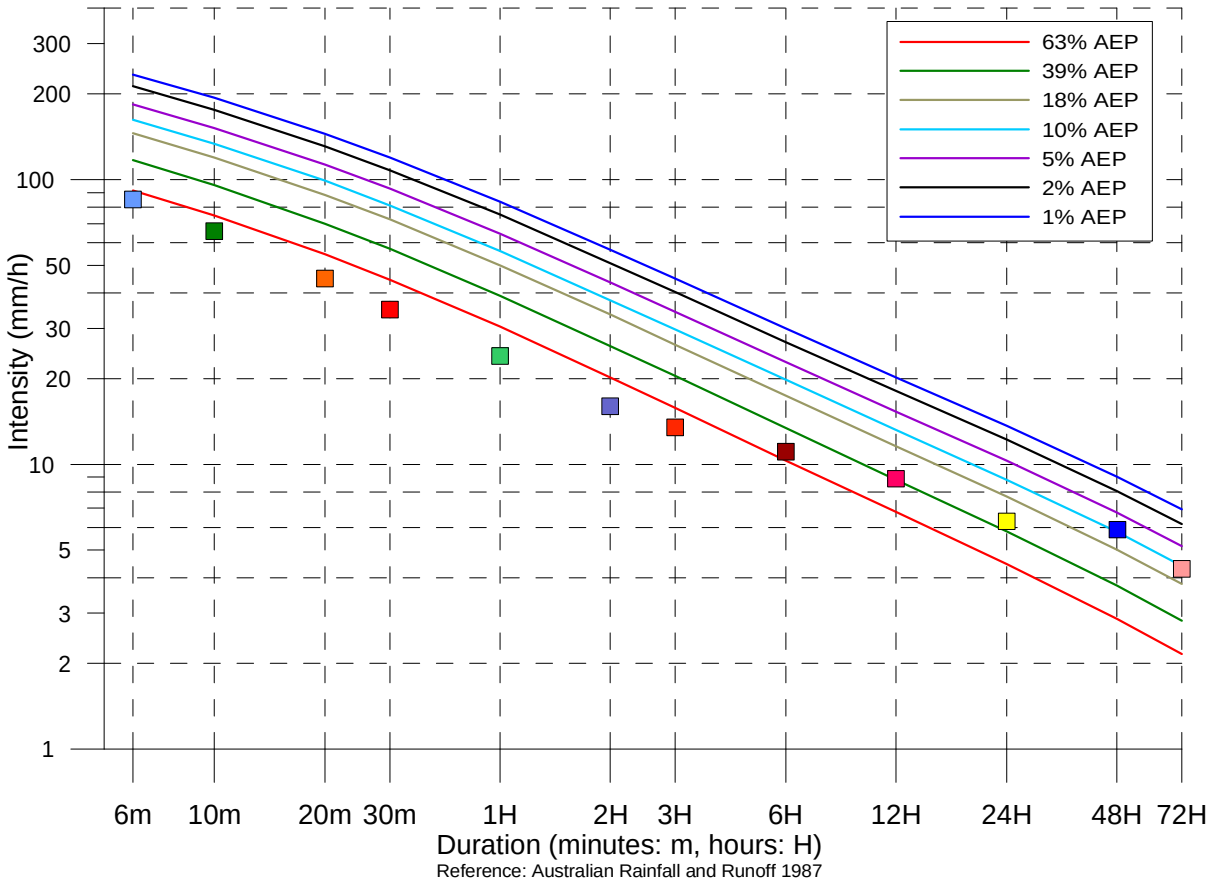
MT ELLIOT INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 7.5

Site owner: MHL Latitude: -33.4179 Longitude: 151.3595

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Wyoming Rainfall Intensity 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	Rainfall Intensity (mm/h)	Time/Date
6m	85.0	19:22_20/04/2015
10m	66.0	19:20_20/04/2015
20m	45.0	19:18_20/04/2015
30m	35.0	05:34_22/04/2015
1H	24.0	05:10_22/04/2015
2H	16.0	22:08_21/04/2015
3H	13.5	21:20_21/04/2015
6H	11.1	17:30_20/04/2015
12H	8.9	17:30_20/04/2015
24H	6.3	17:30_20/04/2015
48H	5.9	08:04_20/04/2015
72H	4.3	02:42_20/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

NSW GOVERNMENT Public Works Manly Hydraulics Laboratory

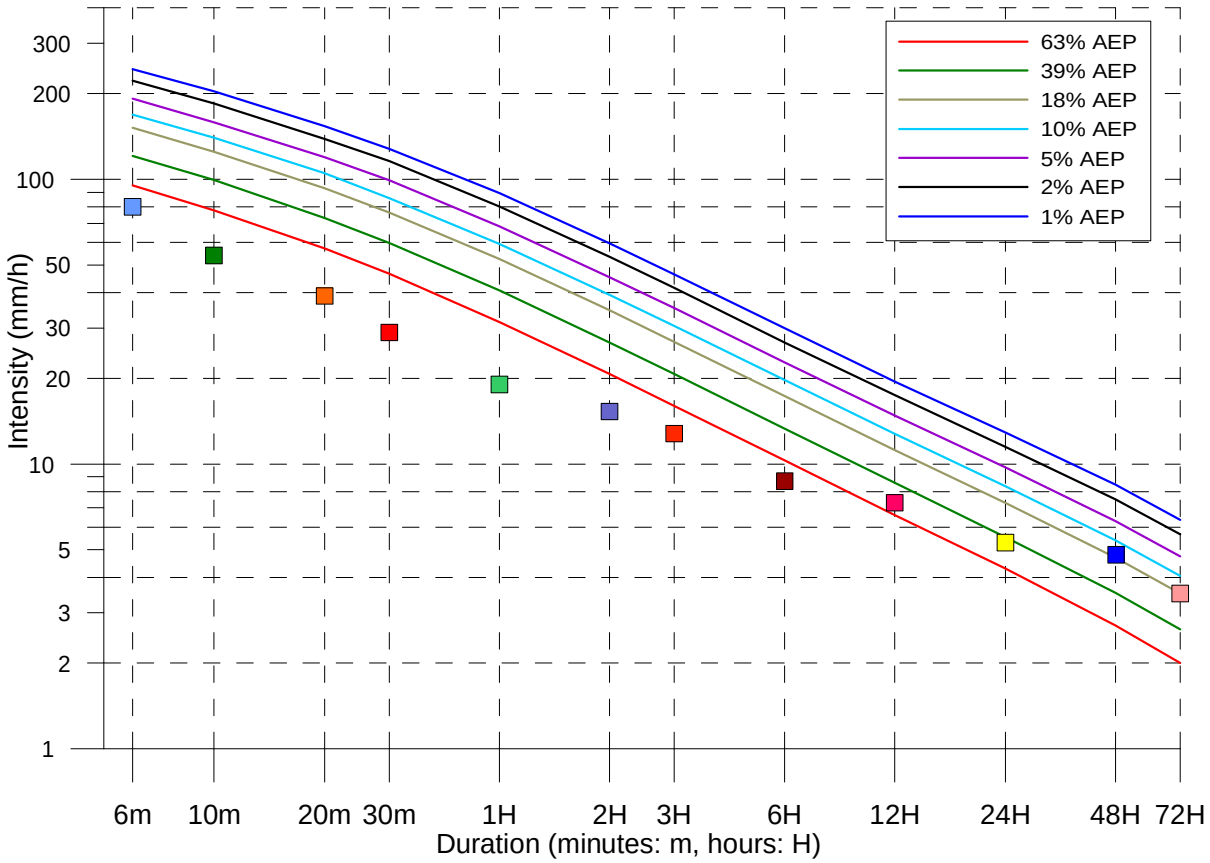
WYOMING INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 7.6

Site owner: MHL Latitude: -33.4788 Longitude: 151.3898

AEP= Annual Exceedance Probability



Reference: Australian Rainfall and Runoff 1987

Kincumber Rainfall Intensity 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Intensity (mm/h)	Time/Date
6m		80.0	19:12_20/04/2015
10m		54.0	05:28_22/04/2015
20m		39.0	05:28_22/04/2015
30m		29.0	05:26_22/04/2015
1H		19.0	18:52_20/04/2015
2H		15.3	17:48_20/04/2015
3H		12.8	21:10_21/04/2015
6H		8.7	17:46_20/04/2015
12H		7.3	16:26_20/04/2015
24H		5.3	16:24_20/04/2015
48H		4.8	06:06_20/04/2015
72H		3.5	23:12_19/04/2015

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).

ARIs of 10 years or greater are very closely approximated by the reciprocal of the AEP. For example, 'a rainfall total of 141.4mm falling within 3 hours at Toukley 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 141.4mm in 3 hours has an ARI of 100 years'.

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

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KINCUMBER INTENSITY-FREQUENCY-DURATION 01 APRIL – 05 MAY 2015

MHL REPORT 2364

Figure 7.7

Appendix A

Station Performance

Table A1 Station Performance

Station Name	Station Type	Owner	April Data Capture (%)	Explanation for Data Lost
Hunter River Region				
Crowdy Head	Wave Height and Direction	MHL	100	
Dungog	Rainfall	BoM	100	
Upper Myall Creek	Rainfall	BoM	100	
Upper Chichester	Rainfall	BoM	100	
Barrington (Bonnie Doon)	Rainfall	BoM	100	
Hunter at Singleton	Water Level	NOW	100	
Hunter at Muswell Brg	Water Level	NOW	100	
Wollombi Bridge at Warkwrth	Water Level	NOW	100	
Williams River at Glen Martin	Water Level and Rainfall	NOW	100/0	Rainfall tipping bucket failed
Williams at Tillegra	Water Level	NOW	100	
Moonan Brook	Water Level	NOW	100	
Paterson River Downstream Lostock	Water Level	NOW	100	
Allyn River at Halton	Water Level and Rainfall	NOW	100/100	
Mount Barrington	Rainfall	BoM	100	
Careys Peak	Rainfall	BoM	100	
Upper Allyn	Rainfall	BoM	0	Rainfall tipping bucket failed
Wollombi Brook at Bulga	Water Level	NOW	100	
Goulburn Sandy Hollw	Water Level	NOW	100	
Mount Palmer	Rainfall	BoM	100	
Cassilis (Thistledale)	Rainfall	BoM	100	
Merriwa (Mar-Lea)	Rainfall	BoM	100	
Merriwa	Rainfall	BoM	100	
Bunnan	Rainfall	BoM	100	
Bylong (Glenview)	Rainfall	BoM	100	
Bylong (Montoro)	Rainfall	BoM	100	
Baerami (The Old Dairy)	Rainfall	BoM	100	
Hunter River at Belltrees	Water Level	NOW	100	
Middle Falbrook	Water Level	NOW	100	
Upper Rouchel	Rainfall	BoM	100	
Parkville	Rainfall	BoM	100	
Hunter Springs	Rainfall	BoM	100	
Timor	Rainfall	BoM	100	
Murrurundi	Rainfall	BoM	100	
Hunter River Denman	Water Level and Rainfall	NOW	100/100	
Hunter River at Aberdeen	Water Level	NOW	100	
Pages River at Blandford	Water Level and Rainfall	NOW	100/100	
Hunter River at Greta	Water Level	NOW	100	
Merriwa Upstream Vallance	Water Level	NOW	100	
Antiene Creek at Liddell	Water Level	NOW	100	
West Brook Upstream Glendon	Water Level	NOW	100	
Hunter River at Liddell	Water Level	NOW	100	

Station Name	Station Type	Owner	April Data Capture (%)	Explanation for Data Lost
Glennies The Rocks 2	Water Level	NOW	100	
Black Creek at Rothbury	Water Level	NOW	75	Instrumentation was flooded. Peak height was surveyed in and data estimated.
Merriwa River at Merriwa	Water Level	NOW	100	
Wollombi	Rainfall	BoM	0	Rainfall tipping bucket failed
Milbrodale School	Rainfall	BoM	100	
Broke (Harrowby)	Rainfall	BoM	100	
Carrow Brook	Water Level	NOW	0	Data file was corrupted
Dart Brook at Yarrandi Bridge	Water Level and Rainfall	NOW	100/100	
Antiene Ck (Liddell)	Rainfall	BoM	100	
Carrowbrook	Rainfall	BoM	100	
Tangory Mountain	Rainfall	BoM	100	
Mirannie (Maeranie Station)	Rainfall	BoM	100	
Pokolbin	Rainfall	BoM	100	
Abermain HWC	Rainfall	HWC	100	
Upstream Bayswater	Water Level	NOW	100	
Upstream Foy Brook	Water Level	NOW	100	
Hunter River Upstream Glennies Creek	Water Level	NOW	100	
Hunter River at Mason Dieu	Water Level	NOW	100	
Hunter Upstream Singleton	Water Level	NOW	100	
Downstream Bowmans	Water Level	NOW	100	
Hunter River at Long Point	Water Level	NOW	100	
Wollombi Bridge Downstream Bric	Water Level	NOW	100	
Chichester River at Chichester	Water Level	NOW	100	
Wangat at Wangat	Water Level	NOW	100	
Pages River Upstream Kewell	Water Level	NOW	100	
Allyn at Flyingfox Ln	Water Level	NOW	79	Equipment failure
Williams At Under	Water Level	NOW	100	
Halls Creek Upstream Giants	Water Level	NOW	100	
Wybong at Manobalai	Water Level	NOW	100	
Chichester River at Weir	Water Level	NOW	100	
Williams River at Dungog	Water Level	NOW	100	
Soldiers Pt 1 WWPS HWC	Rainfall	HWC	100	
Tanilba Bay 1 WWPS HWC	Rainfall	HWC	100	
Nelson Bay	Rainfall	HWC	100	
Stockton 3 WWPS HWC	Rainfall	HWC	100	
Stockton Bridge	Water Level	MHL	100	
Hexham Bridge	Water Level and Rainfall	MHL	100/100	
Raymond Terrace	Water Level	MHL	100	
Seaham	Water Level and Rainfall	MHL	100/100	
Green Rocks	Water Level	MHL	100	
Hinton Bridge	Water Level	MHL	100	

Station Name	Station Type	Owner	April Data Capture (%)	Explanation for Data Lost
Dunmore	Water Level	MHL	100	
Paterson Railway Bridge	Water Level	MHL	100	
Gostwyck	Water Level and Rainfall	MHL	100/100	
Maitland 18 WWPS	Rainfall	HWC	100	
Maitland 7 WWPS	Rainfall	HWC	100	
Bolwarra 1A HWC	Rainfall	HWC	100	
Morpeth	Water Level	MHL	100	
Mckimms Corner	Water Level	MHL	100	
Wallis Creek Downstream	Water Level	MHL	100	
Wallis Creek Upstream	Water Level	MHL	100	
Louth Park	Water Level	MHL	100	
Belmore Bridge	Water Level and Rainfall	MHL	100/100	
Bolwarra Downstream	Water Level	MHL	100	
Shortland 1 WWPS HWC	Rainfall	HWC	100	
Oakhampton Railway Bridge	Water Level	MHL	100	
Bolwarra Upstream	Water Level	MHL	100	
Swansea Channel 2	Water Level	MHL	100	
Swansea 8 WWPS HWC	Rainfall	HWC	100	
Wallsend Bowling Club	Rainfall	HWC	100	
Macquarie College	Rainfall	HWC	100	
Lookout 2 Reservoir	Rainfall	HWC	100	
Lambton Reservoir	Rainfall	HWC	100	
Waratah Reservoir	Rainfall	HWC	100	
Wallsend HWC	Rainfall	HWC	100	
Hunter Valley Research	Rainfall	BOM	100	
Merewether Pump Stn	Rainfall	BOM	100	
Sheppards Hill	Rainfall	BOM	100	
Macquarie and Tuggerah Lakes River Region				
Broadmeadow	Rainfall	HWC	100	
Cardiff Chlorinator	Rainfall	HWC	100	
Edgeworth WWTW	Rainfall	HWC	100	
Barnsley Vale	Water Level	MHL	100	
Charlestown	Rainfall	HWC	100	
Cockle Railway Station	Water Level	MHL	100	
Marmong Point	Water Level	MHL	100	
Eleebana HWC	Rainfall	HWC	100	
Belmont WWTW HWC	Rainfall	HWC	100	
Belmont	Water Level	MHL	100	
Kalang Road	Water Level	MHL	86	Instrument failure
Barnsley	Rainfall	MHL	100	
Martinsville	Rainfall	MHL	100	
Cooranbong	Water Level	MHL	100	
Morrisset	Water Level	MHL	100	

Station Name	Station Type	Owner	April Data Capture (%)	Explanation for Data Lost
Mandalong	Rainfall	MHL	100	
Wallarah Creek Bridge	Water Level	MHL	100	
Wyee Basin	Rainfall	MHL	100	
Whitemans Ridge	Rainfall	MHL	100	
Kulnura	Rainfall	MHL	100	
Toukley	Water Level and Rainfall	MHL	80/100	Water level gas line damaged due to bank scouring during storm event.
Hamlyn Terrace	Rainfall	MHL	100	
Mardi Dam	Rainfall	MHL	100	
Kangy Angy	Rainfall	MHL	100	
Berkeley Vale	Rainfall	MHL	100	
Bateau Bay	Rainfall	MHL	100	
Kincumber	Rainfall	MHL	100	
Wyong Weir Upstream	Water Level	MHL	100	
Jigadee Creek at Avondale	Water Level	NOW	100	
Wyong River at Gracemere	Water Level	NOW	100	
Jilliby Creek Upstream Wyong	Water Level	NOW	100	
Ourimbah Creek Upstream Weir	Water Level	NOW	100	
Wyong River at Yarramalong	Water Level	NOW	100	
Lees Bridge	Water Level	MHL	100	
Ourimbah Creek Downstream Bang	Water Level	NOW	100	
Wyong at Fishway	Water Level	NOW	100	
Long Jetty	Water Level	MHL	100	
Tumbi Umbi	Water Level	MHL	100	
Brisbane Water Region				
Wamberal Lagoon	Water Level	MHL	100	
Terrigal Lagoon	Water Level	MHL	100	
Avoca Lagoon	Water Level	MHL	100	
Cockrone Lake	Water Level	MHL	100	
Manns Road	Water Level	MHL	100	
Punt Bridge (Erina)	Water Level	MHL	100	
Erina	Water Level	MHL	100	
Ettalong	Water Level	MHL	100	
Koolewong	Water Level	MHL	100	
Patonga	Water Level	MHL	100	
Lisa Row	Rainfall	MHL	100	
Narara	Rainfall	MHL	100	
Mount Elliot	Rainfall	MHL	100	
Sterland	Rainfall	MHL	100	
Strickland Forest	Rainfall	MHL	100	
Wyoming	Rainfall	MHL	100	
Sydney	Wave Height and Direction	MHL	100	

Appendix B

Flood Photographs April 2015 Event

Paterson River, 3:39pm, 26/05/2015 (post flood)

Gostwyck, Paterson River, 3:04pm, 26/05/2015 (post flood)

Wallis Creek Downstream, Wallis Creek, 8:43am 22/04/2015 (8.257m)

Gostwyck, Paterson River, 3:01pm, 26/05/2015 (post flood)

Gostwyck, Paterson River, 3:02pm, 26/05/2015 (post flood)

Belmore Bridge, Hunter River, 7:41am, 22/04/2015 (8.747m)

Bolwarra Downstream, Hunter River, 9:43am 22/04/2015 (9.880m)

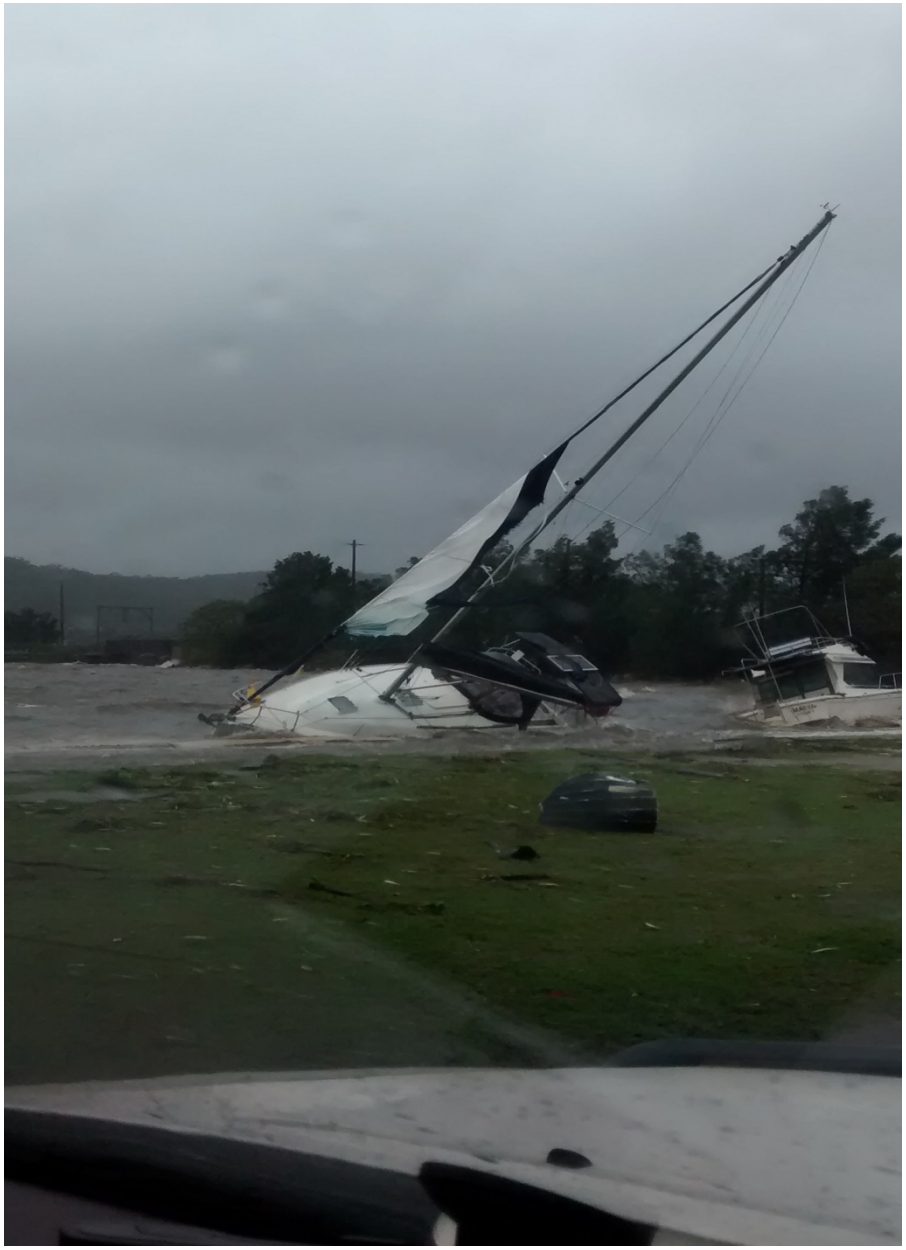
Bolwarra Downstream (South to Lorn), Hunter River, 2:04pm 20/05/2015 (9.880m)

Bolwarra Downstream, Hunter River, 2:04pm 20/05/2015 (post flood)

Lorn, Hunter River, 10:07am 22/04/2015

Green Rocks, Hunter River, 12:27pm, 25/05/2015 (post flood)

Tall Timbers Estate, Lisarow, 12:11pm, 21/04/2015



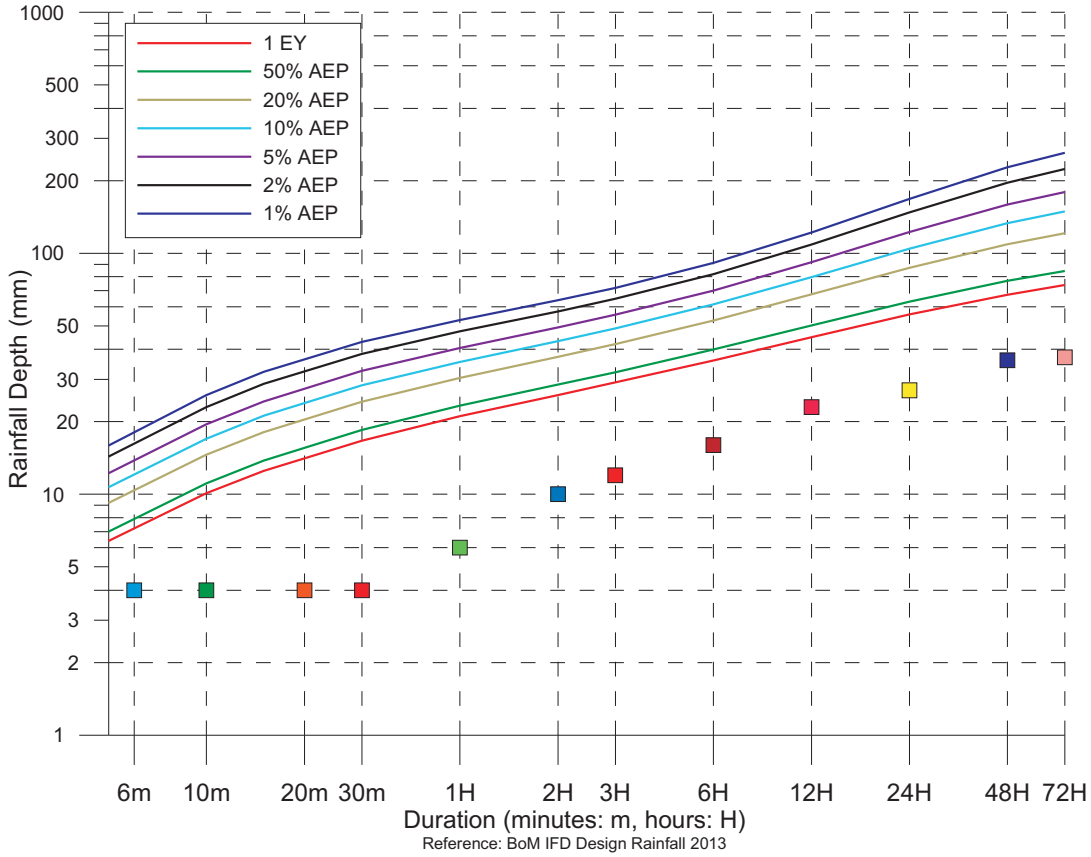
Brisbane Water, Gosford, 09:41am, 21/04/2015

Appendix C

Intensity-Frequency-Duration
New AEP Version Formulated in 2013

Site owner: BoM Latitude: -32.0348 Longitude: 150.0191

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Cassilis Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	4.0	15:16_03/05/2015
10m	4.0	15:16_03/05/2015
20m	4.0	15:16_03/05/2015
30m	4.0	15:16_03/05/2015
1H	6.0	09:40_21/04/2015
2H	10.0	08:16_21/04/2015
3H	12.0	08:16_21/04/2015
6H	16.0	05:14_21/04/2015
12H	23.0	02:02_21/04/2015
24H	27.0	11:04_20/04/2015
48H	36.0	04:42_20/04/2015
72H	37.0	04:42_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

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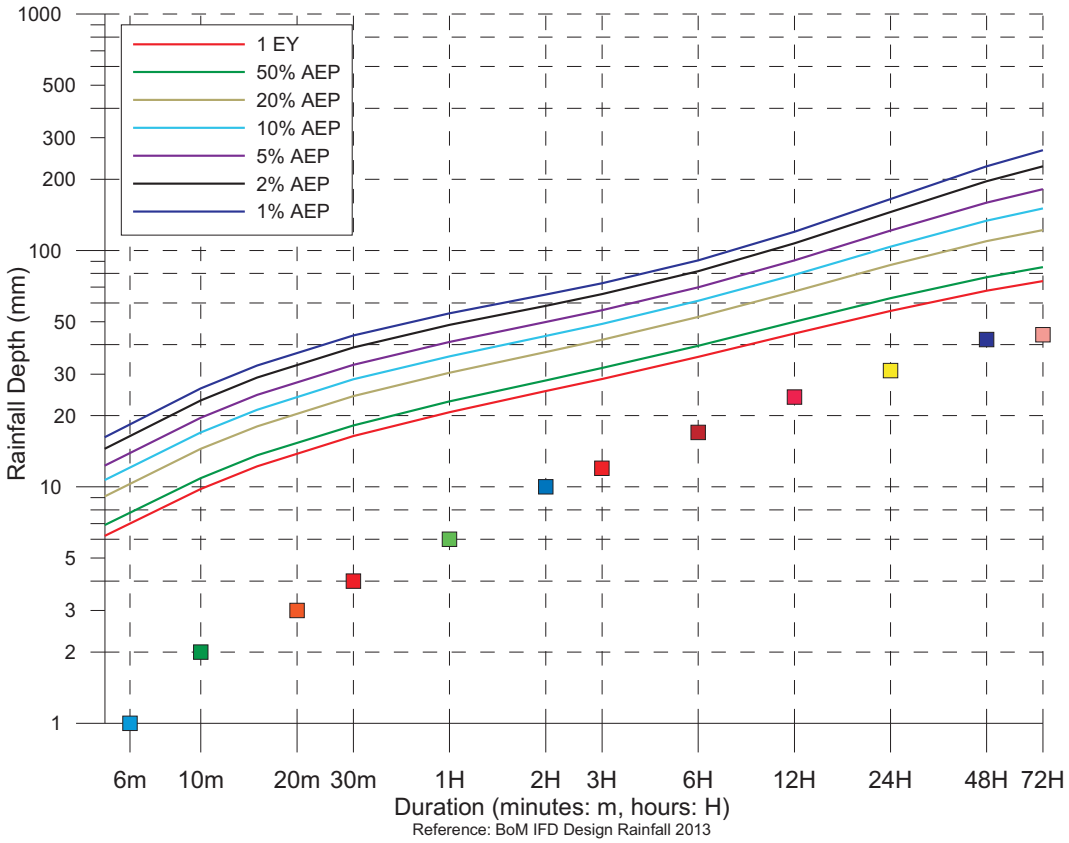
CASSILIS
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C01
DRAWING 2364-C01

Site owner: BoM Latitude: -32.0666 Longitude: 150.2326

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Merriwa (Mar-Lea) Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	1.0	21:38_03/05/2015
	10m	2.0	09:44_21/04/2015
	20m	3.0	09:44_21/04/2015
	30m	4.0	09:36_21/04/2015
	1H	6.0	09:18_21/04/2015
	2H	10.0	08:08_21/04/2015
	3H	12.0	08:08_21/04/2015
	6H	17.0	05:02_21/04/2015
	12H	24.0	23:56_20/04/2015
	24H	31.0	10:06_20/04/2015
	48H	42.0	04:16_20/04/2015
	72H	44.0	04:16_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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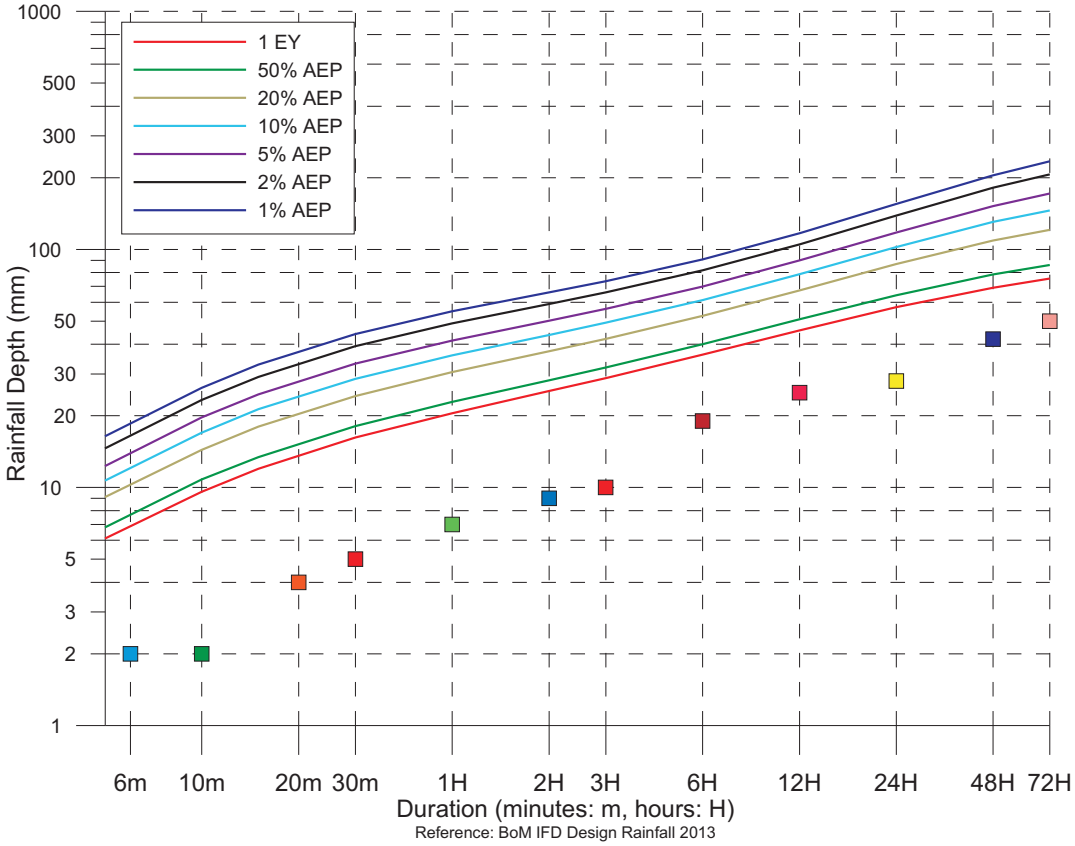
MERRIWA (MAR-LEA)
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C02
DRAWING 2364-C02

Site owner: BoM Latitude: -32.0332 Longitude: 150.5836

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Bunnan Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	2.0	06:08_21/04/2015
	10m	2.0	06:12_21/04/2015
	20m	4.0	06:02_21/04/2015
	30m	5.0	05:52_21/04/2015
	1H	7.0	09:02_21/04/2015
	2H	9.0	08:50_21/04/2015
	3H	10.0	07:54_21/04/2015
	6H	19.0	05:12_21/04/2015
	12H	25.0	00:14_21/04/2015
	24H	28.0	10:38_20/04/2015
	48H	42.0	02:02_20/04/2015
	72H	50.0	02:02_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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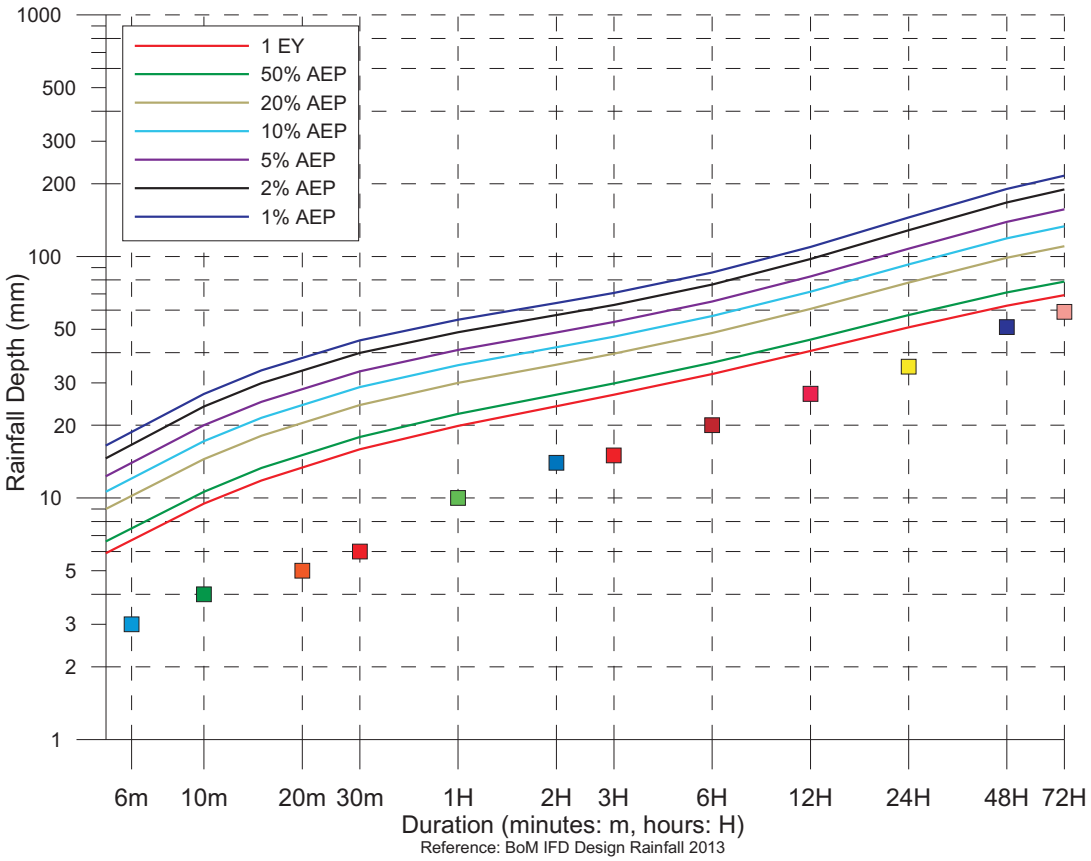
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

BUNNAN
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C03
DRAWING 2364-C03

Site owner: BoM Latitude: -32.3792 Longitude: 150.4868

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

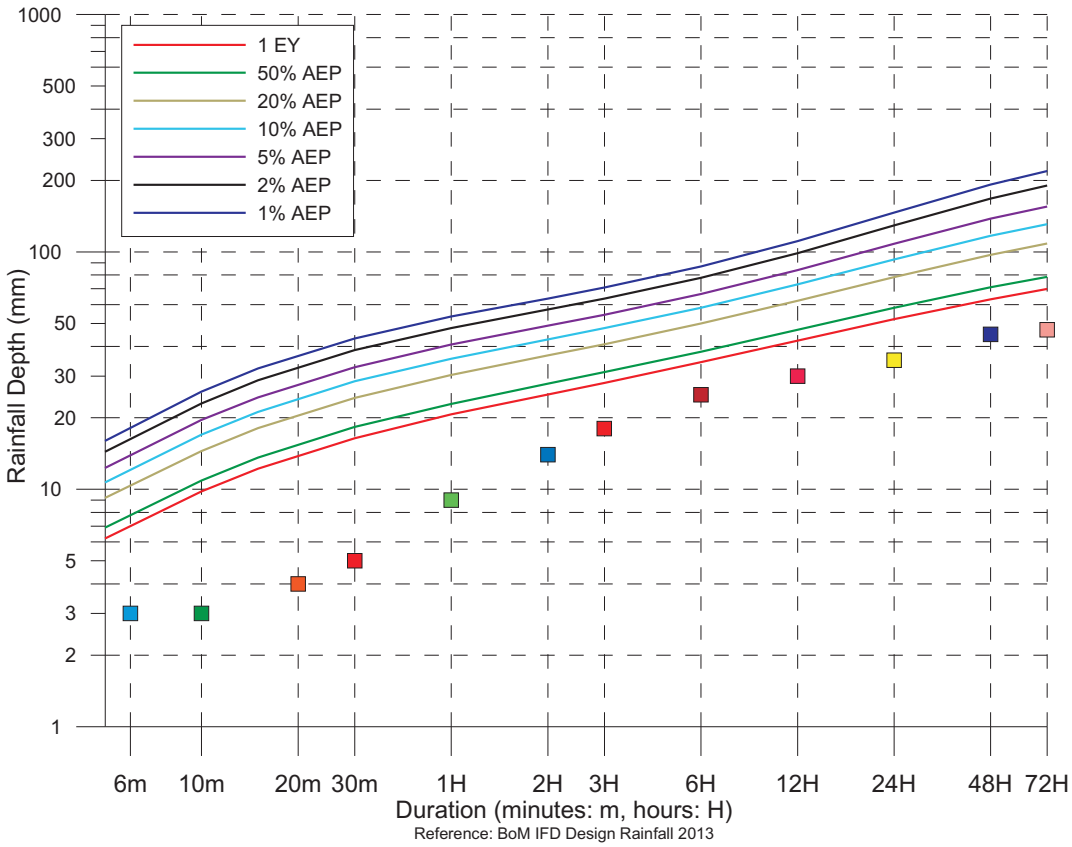
Baerami Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	3.0	08:16_21/04/2015
	10m	4.0	08:16_21/04/2015
	20m	5.0	08:10_21/04/2015
	30m	6.0	08:00_21/04/2015
	1H	10.0	07:28_21/04/2015
	2H	14.0	06:28_21/04/2015
	3H	15.0	06:28_21/04/2015
	6H	20.0	02:48_21/04/2015
	12H	27.0	22:08_20/04/2015
	24H	35.0	22:08_20/04/2015
	48H	51.0	05:52_20/04/2015
	72H	59.0	03:02_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

Site owner: BoM Latitude: -32.471 Longitude: 150.1059

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Bylong Glenview Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
6m		3.0	14:24_25/04/2015
10m		3.0	14:24_25/04/2015
20m		4.0	12:26_21/04/2015
30m		5.0	12:26_21/04/2015
1H		9.0	11:58_21/04/2015
2H		14.0	11:18_21/04/2015
3H		18.0	11:18_21/04/2015
6H		25.0	08:28_21/04/2015
12H		30.0	07:46_21/04/2015
24H		35.0	23:30_20/04/2015
48H		45.0	04:10_20/04/2015
72H		47.0	04:10_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

BYLONG GLENVIEW
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

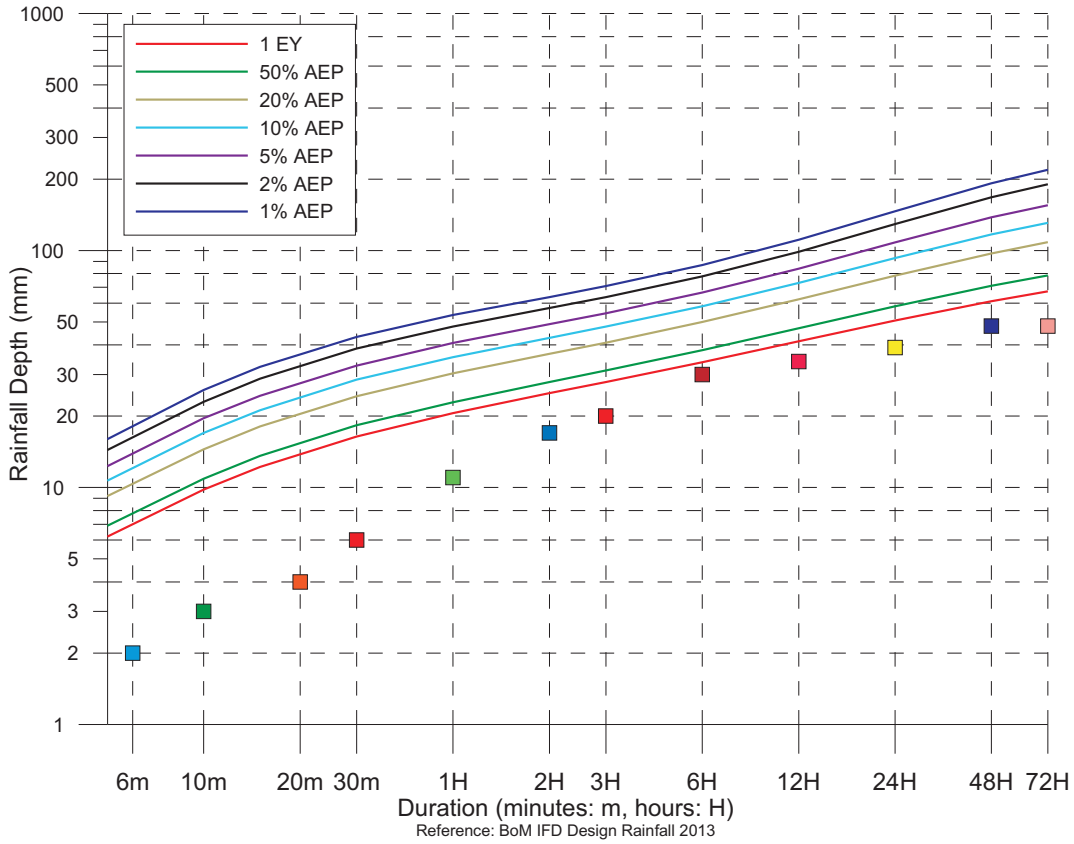
MHL Report 2364

Figure C05

DRAWING 2364-C05

Site owner: BoM Latitude: -32.5204 Longitude: 150.0817

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Bylong Montoro Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	2.0	12:38_21/04/2015
10m	3.0	12:32_21/04/2015
20m	4.0	12:32_21/04/2015
30m	6.0	12:20_21/04/2015
1H	11.0	11:50_21/04/2015
2H	17.0	11:08_21/04/2015
3H	20.0	10:58_21/04/2015
6H	30.0	07:58_21/04/2015
12H	34.0	07:28_21/04/2015
24H	39.0	23:10_20/04/2015
48H	48.0	04:46_20/04/2015
72H	48.0	04:46_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

BYLONG MONTORO
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

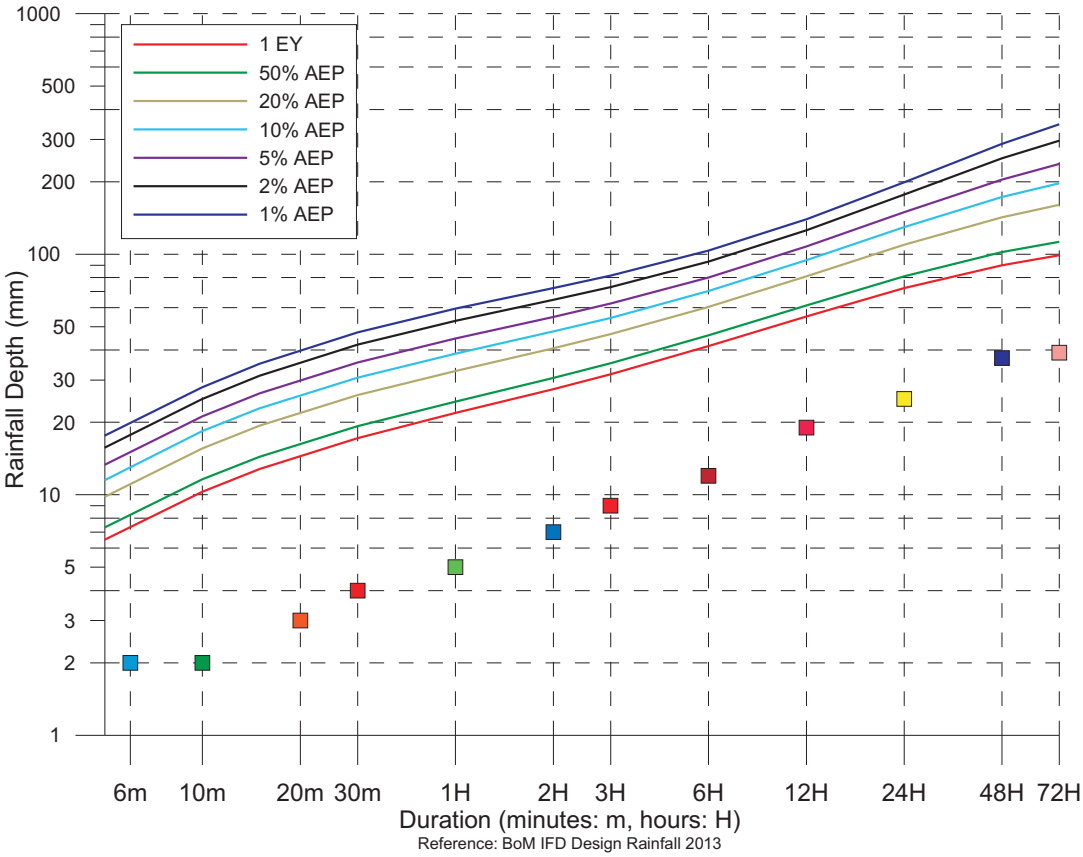
MHL Report 2364

Figure C06

DRAWING 2364-C06

Site owner: BoM Latitude: -31.8293 Longitude: 150.3479

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

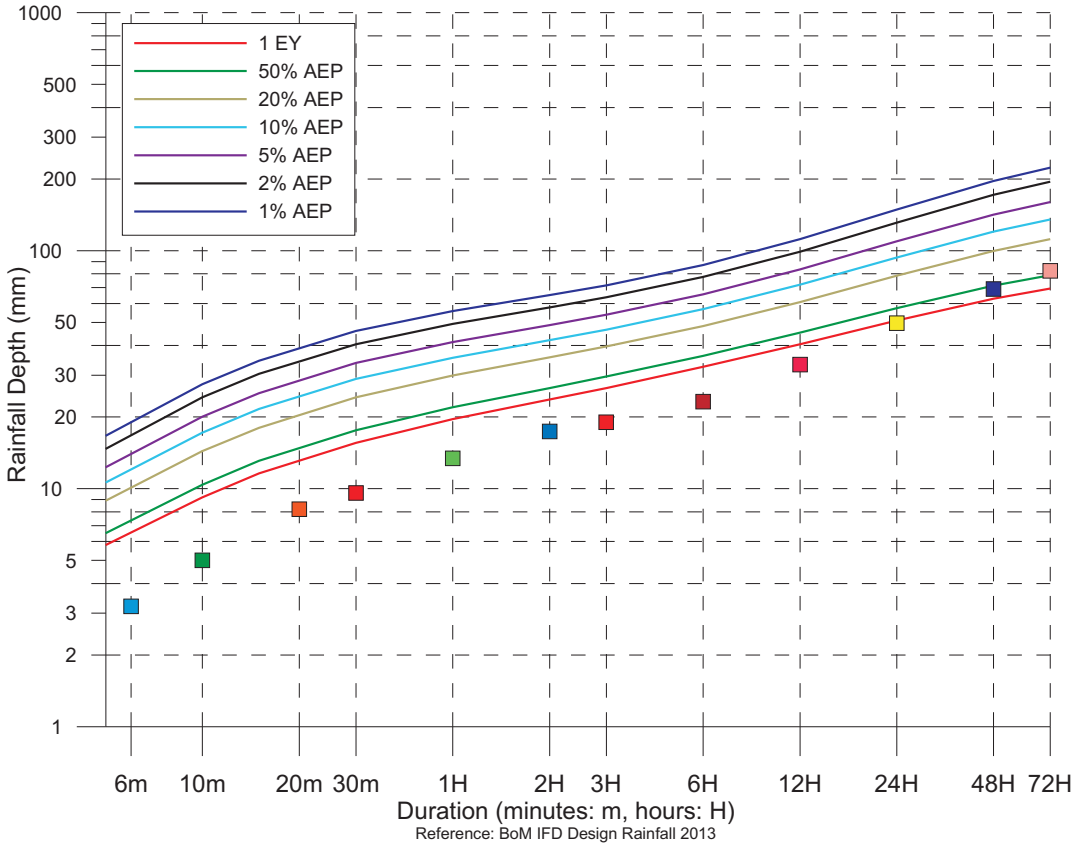
Mount Palmer Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	2.0	05:56_20/04/2015
10m	2.0	07:08_21/04/2015
20m	3.0	06:56_21/04/2015
30m	4.0	06:48_21/04/2015
1H	5.0	06:48_21/04/2015
2H	7.0	06:20_21/04/2015
3H	9.0	06:20_21/04/2015
6H	12.0	06:20_21/04/2015
12H	19.0	01:48_21/04/2015
24H	25.0	22:18_20/04/2015
48H	37.0	03:56_20/04/2015
72H	39.0	03:56_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

Site owner: NOW Latitude: -32.3809 Longitude: 150.7114

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Hunter River at Denman Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	3.2	08:00_21/04/2015
	10m	5.0	07:56_21/04/2015
	20m	8.2	07:50_21/04/2015
	30m	9.6	07:42_21/04/2015
	1H	13.4	07:14_21/04/2015
	2H	17.4	06:22_21/04/2015
	3H	19.0	05:22_21/04/2015
	6H	23.2	04:46_21/04/2015
	12H	33.2	21:34_20/04/2015
	24H	49.6	09:06_20/04/2015
	48H	69.0	00:50_20/04/2015
	72H	82.4	00:50_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

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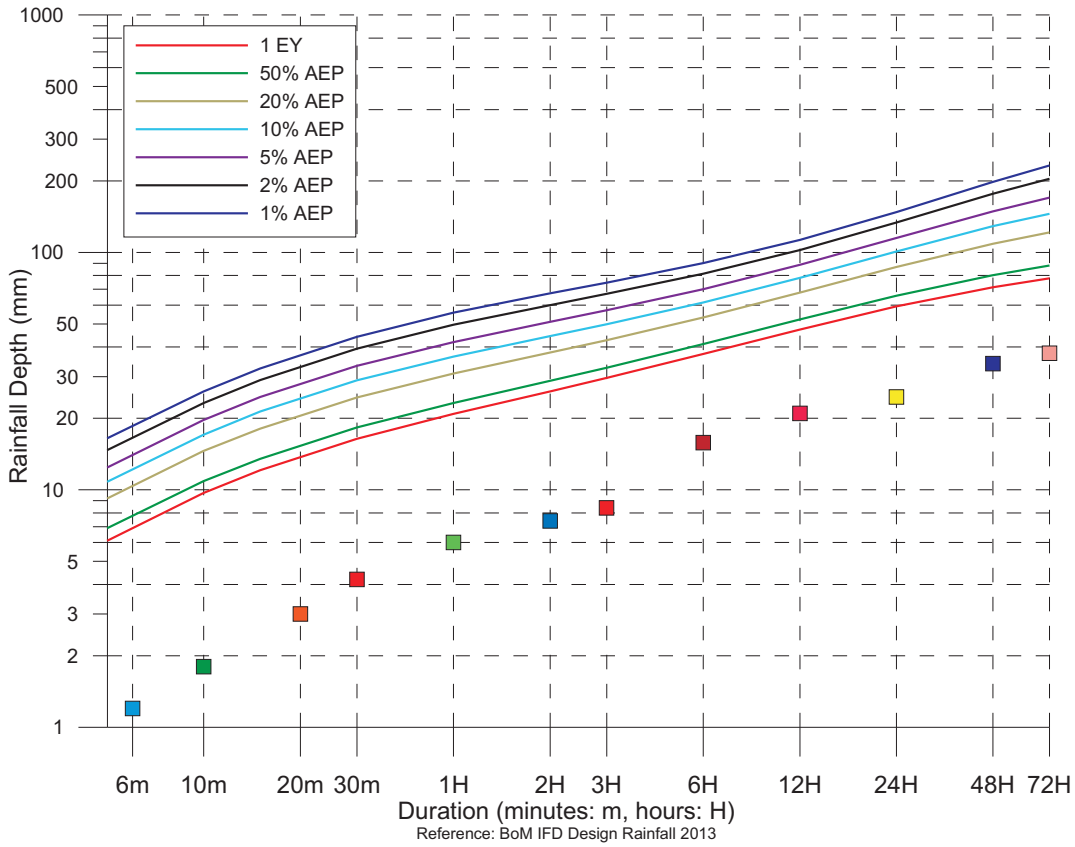
DENMAN
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C08
DRAWING 2364-C08

Site owner: BoM Latitude: -31.7651 Longitude: 150.8363

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Murrurundi Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
6m		1.2	10:56_21/04/2015
10m		1.8	10:52_21/04/2015
20m		3.0	10:56_21/04/2015
30m		4.2	10:46_21/04/2015
1H		6.0	10:38_21/04/2015
2H		7.4	09:58_21/04/2015
3H		8.4	05:40_21/04/2015
6H		15.8	06:18_21/04/2015
12H		21.0	05:40_21/04/2015
24H		24.6	23:12_20/04/2015
48H		34.0	00:40_20/04/2015
72H		37.6	00:40_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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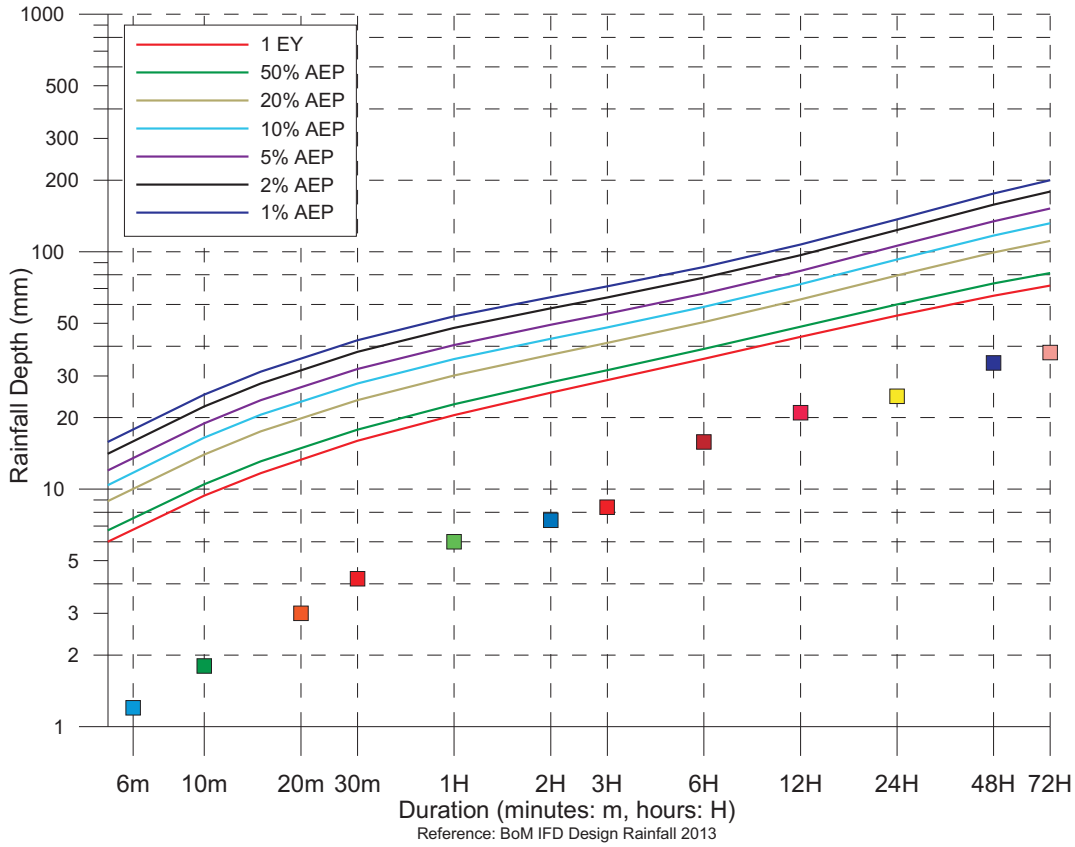
Site owner: BoM Latitude: -31.773 Longitude: 151.0776

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Timor Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	1.2	10:56_21/04/2015
	10m	1.8	10:52_21/04/2015
	20m	3.0	10:56_21/04/2015
	30m	4.2	10:46_21/04/2015
	1H	6.0	10:38_21/04/2015
	2H	7.4	09:58_21/04/2015
	3H	8.4	05:40_21/04/2015
	6H	15.8	06:18_21/04/2015
	12H	21.0	05:40_21/04/2015
	24H	24.6	23:12_20/04/2015
	48H	34.0	00:40_20/04/2015
	72H	37.6	00:40_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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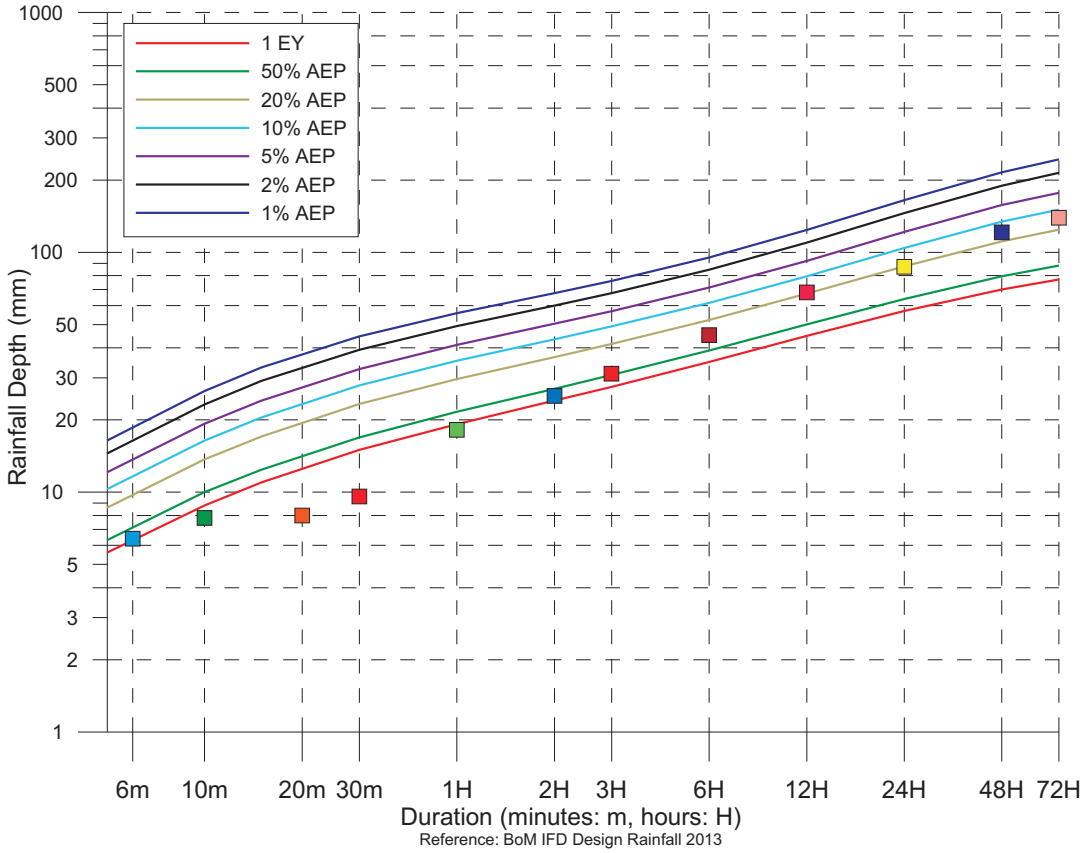
Site owner: BoM Latitude: -32.338 Longitude: 150.9811

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Antiene Creek at Liddell Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	6.4	17:04_25/04/2015
	10m	7.8	17:02_25/04/2015
	20m	8.0	17:02_25/04/2015
	30m	9.6	07:04_21/04/2015
	1H	18.2	06:34_21/04/2015
	2H	25.2	05:50_21/04/2015
	3H	31.2	04:52_21/04/2015
	6H	45.2	01:48_21/04/2015
	12H	68.0	21:32_20/04/2015
	24H	87.0	07:56_20/04/2015
	48H	121.2	01:30_20/04/2015
	72H	139.6	00:26_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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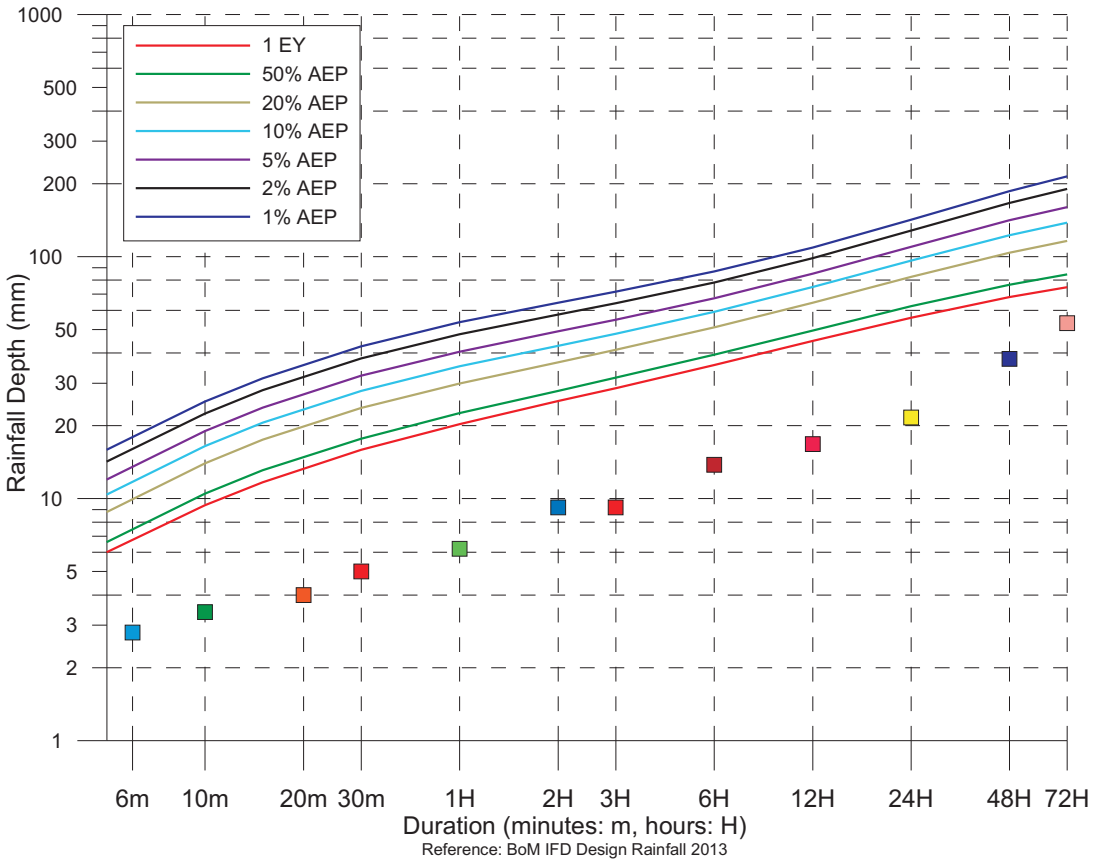
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

ANTIENE CREEK
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C11
DRAWING 2364-C11

Site owner: NOW Latitude: -31.8098 Longitude: 150.9252

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Pages River at Blandford Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	2.8	12:28_19/04/2015
10m	3.4	12:28_19/04/2015
20m	4.0	10:56_21/04/2015
30m	5.0	10:48_21/04/2015
1H	6.2	10:36_21/04/2015
2H	9.2	16:48_06/04/2015
3H	9.2	16:58_06/04/2015
6H	13.8	16:48_06/04/2015
12H	16.8	00:26_21/04/2015
24H	21.6	21:18_20/04/2015
48H	37.8	12:04_19/04/2015
72H	53.0	22:54_18/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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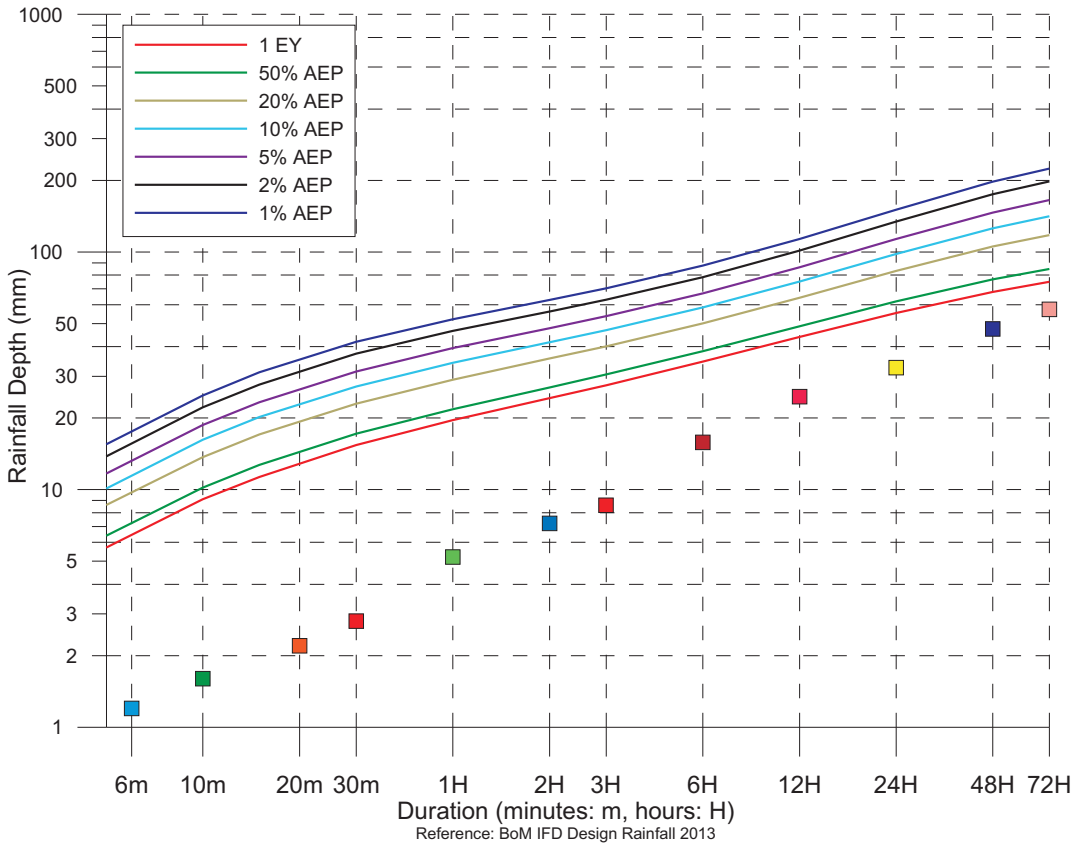
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

BLANDFORD
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C12
DRAWING 2364-C12

Site owner: BoM Latitude: -31.9583 Longitude: 150.8567

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Parkville Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	1.2	20:24_22/04/2015
	10m	1.6	02:48_21/04/2015
	20m	2.2	02:48_21/04/2015
	30m	2.8	05:34_21/04/2015
	1H	5.2	05:24_21/04/2015
	2H	7.2	05:04_21/04/2015
	3H	8.6	03:28_21/04/2015
	6H	15.8	00:18_21/04/2015
	12H	24.6	21:02_20/04/2015
	24H	32.6	20:48_20/04/2015
	48H	47.4	00:18_20/04/2015
	72H	57.4	00:08_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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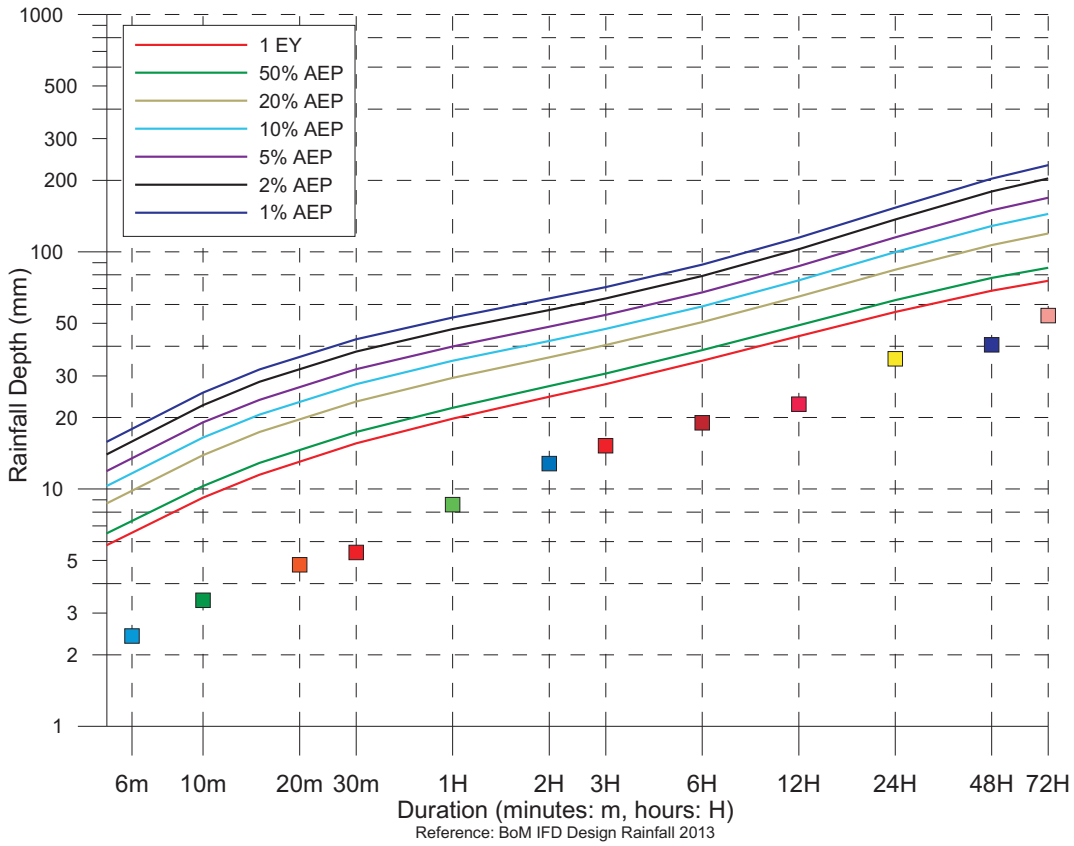
Site owner: NOW Latitude: -32.0113 Longitude: 150.7846

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Dart Brook at Yarrandi Bridge Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	2.4	15:36_06/04/2015
	10m	3.4	15:38_06/04/2015
	20m	4.8	15:32_06/04/2015
	30m	5.4	15:28_06/04/2015
	1H	8.6	14:10_04/04/2015
	2H	12.8	13:58_04/04/2015
	3H	15.2	15:02_06/04/2015
	6H	19.0	14:50_06/04/2015
	12H	22.8	05:02_04/04/2015
	24H	35.4	19:08_03/04/2015
	48H	40.6	23:52_19/04/2015
	72H	53.8	19:08_03/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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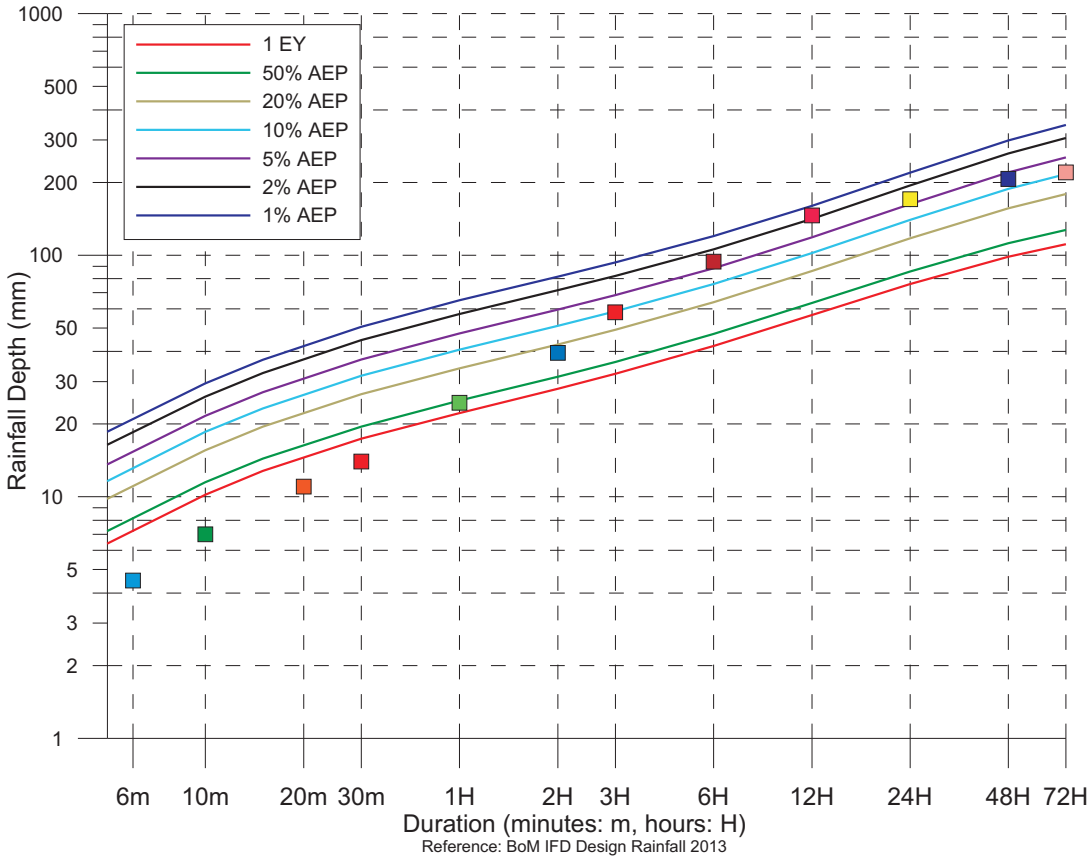
Site owner: NOW Latitude: -32.5166 Longitude: 151.5838

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Allyn River at Halton Rainfall Depth 01 April 2015 – 05 May 2015			
	Duration (minutes: m) (hours: H)	Rainfall Depth (mm)	Time/Date
	6m	4.5	06:38_21/04/2015
	10m	7.0	06:34_21/04/2015
	20m	11.0	06:28_21/04/2015
	30m	14.0	06:18_21/04/2015
	1H	24.5	05:48_21/04/2015
	2H	39.5	04:48_21/04/2015
	3H	58.0	03:48_21/04/2015
	6H	94.0	00:52_21/04/2015
	12H	146.0	21:32_20/04/2015
	24H	170.5	21:10_20/04/2015
	48H	207.0	00:34_20/04/2015
	72H	218.0	00:22_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

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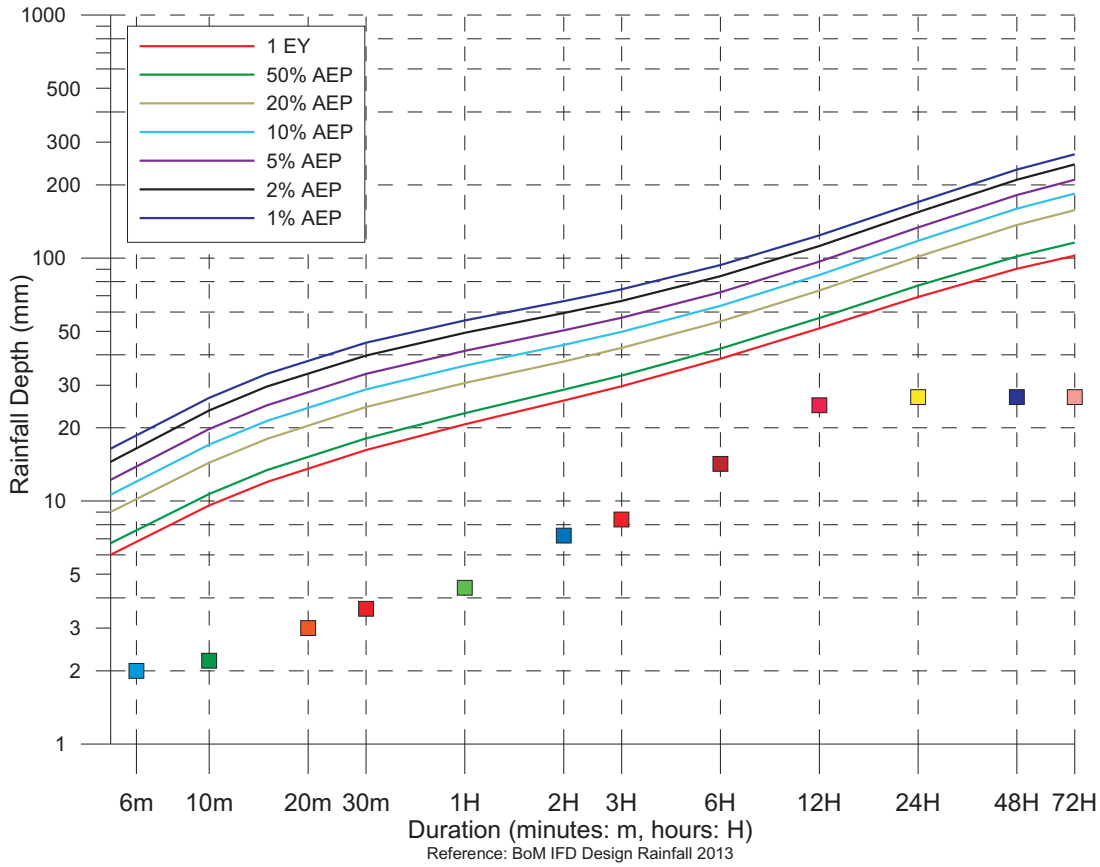
ALLYN RIVER
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C15
DRAWING 2364-C15

Site owner: BoM Latitude: -32.1018 Longitude: 151.2333

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Upper Rouchel Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	2.0	21:46_22/04/2015
	10m	2.2	21:46_22/04/2015
	20m	3.0	21:36_22/04/2015
	30m	3.6	14:56_22/04/2015
	1H	4.4	21:38_22/04/2015
	2H	7.2	13:24_22/04/2015
	3H	8.4	12:44_22/04/2015
	6H	14.2	11:40_22/04/2015
	12H	24.8	11:32_22/04/2015
	24H	26.8	08:58_22/04/2015
	48H	26.8	08:58_22/04/2015
	72H	26.8	08:58_22/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

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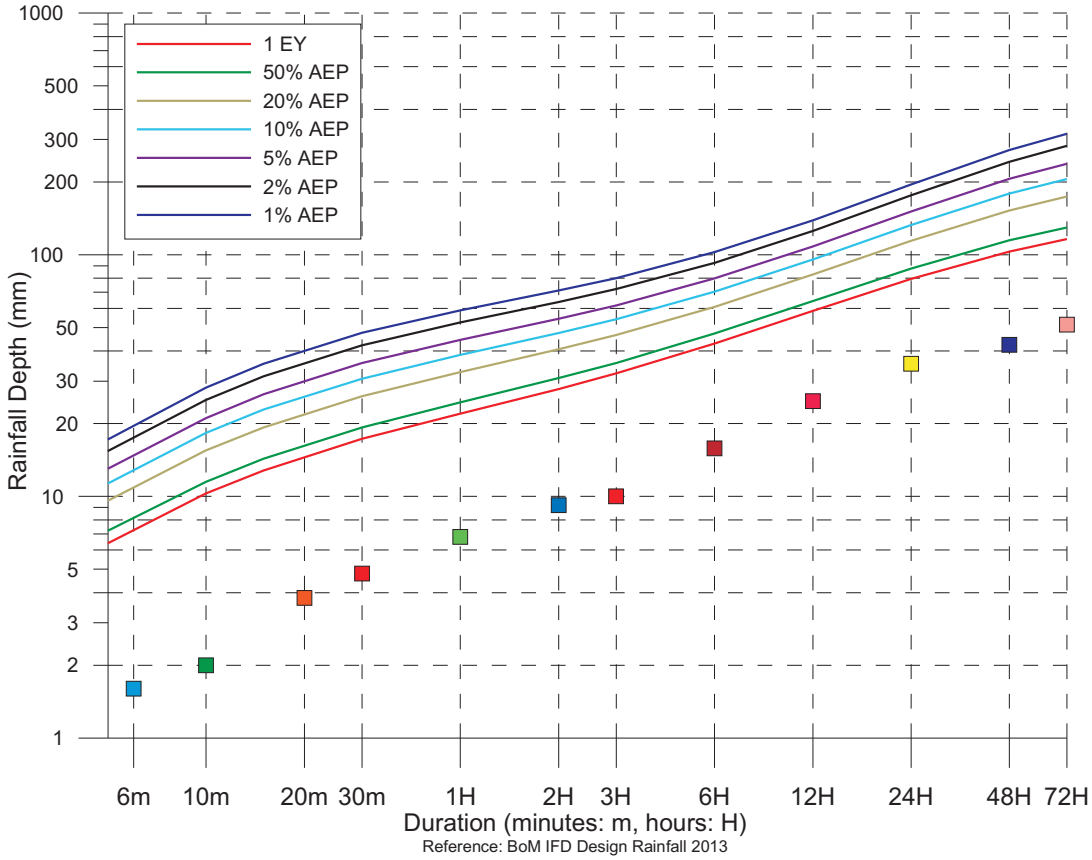
UPPER ROUCHEL
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C16
DRAWING 2364-C16

Site owner: BoM Latitude: -31.8626 Longitude: 150.4398

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Hunter Springs Rainfall Depth 01 April 2015 – 05 May 2015			
	Duration (minutes: m) (hours: H)	Rainfall Depth (mm)	Time/Date
	6m	1.6	15:10_03/05/2015
	10m	2.0	15:06_03/05/2015
	20m	3.8	15:00_03/05/2015
	30m	4.8	14:48_03/05/2015
	1H	6.8	21:04_21/04/2015
	2H	9.2	20:48_21/04/2015
	3H	10.0	15:02_01/05/2015
	6H	15.8	12:44_01/05/2015
	12H	24.8	08:52_01/05/2015
	24H	35.4	08:10_01/05/2015
	48H	42.4	03:14_01/05/2015
	72H	51.4	19:00_30/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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Manly Hydraulics Laboratory

HUNTER SPRINGS
INTENSITY-FREQUENCY-DURATION
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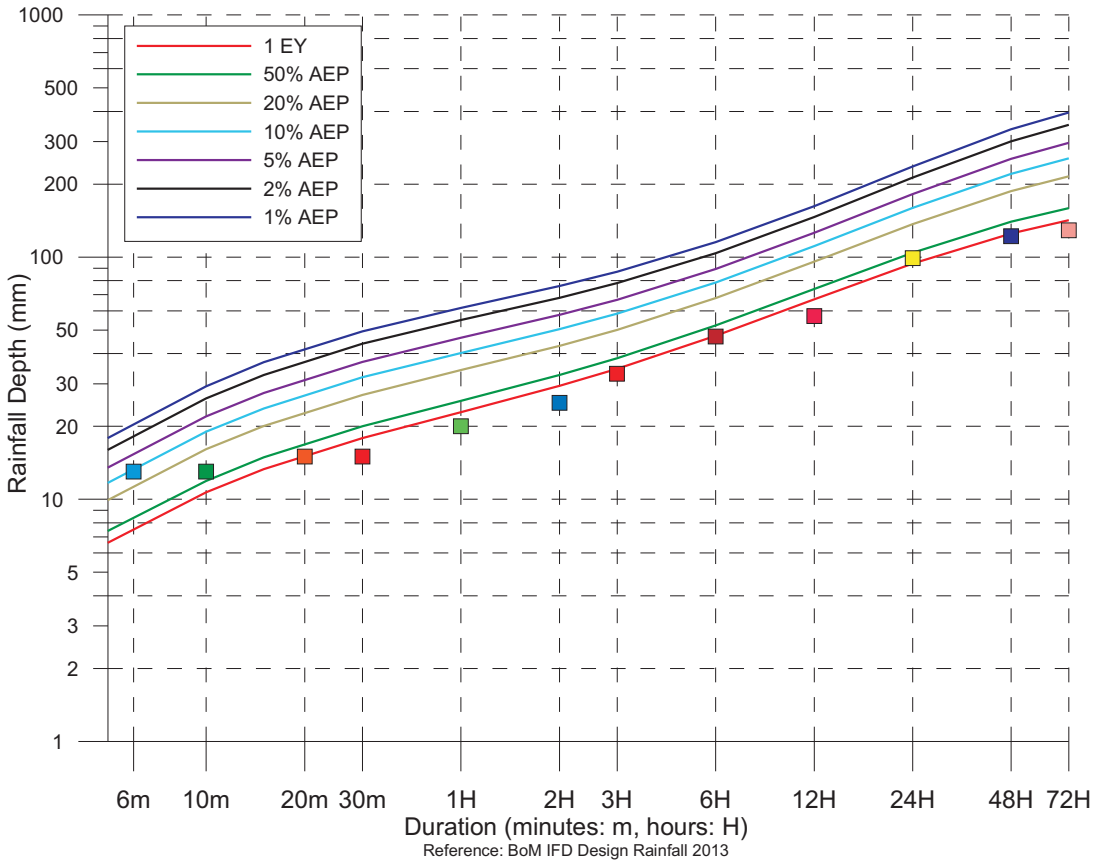
MHL Report 2364

Figure C17

DRAWING 2364-C17

Site owner: BoM Latitude: -32.04 Longitude: 151.4039

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Mt Barrington Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	13.0	20:48_21/04/2015
	10m	13.0	20:48_21/04/2015
	20m	15.0	20:48_21/04/2015
	30m	15.0	20:48_21/04/2015
	1H	20.0	20:48_21/04/2015
	2H	25.0	20:48_21/04/2015
	3H	33.0	20:48_21/04/2015
	6H	47.0	23:12_20/04/2015
	12H	57.0	13:02_21/04/2015
	24H	99.0	23:12_20/04/2015
	48H	122.0	23:12_20/04/2015
	72H	129.0	07:52_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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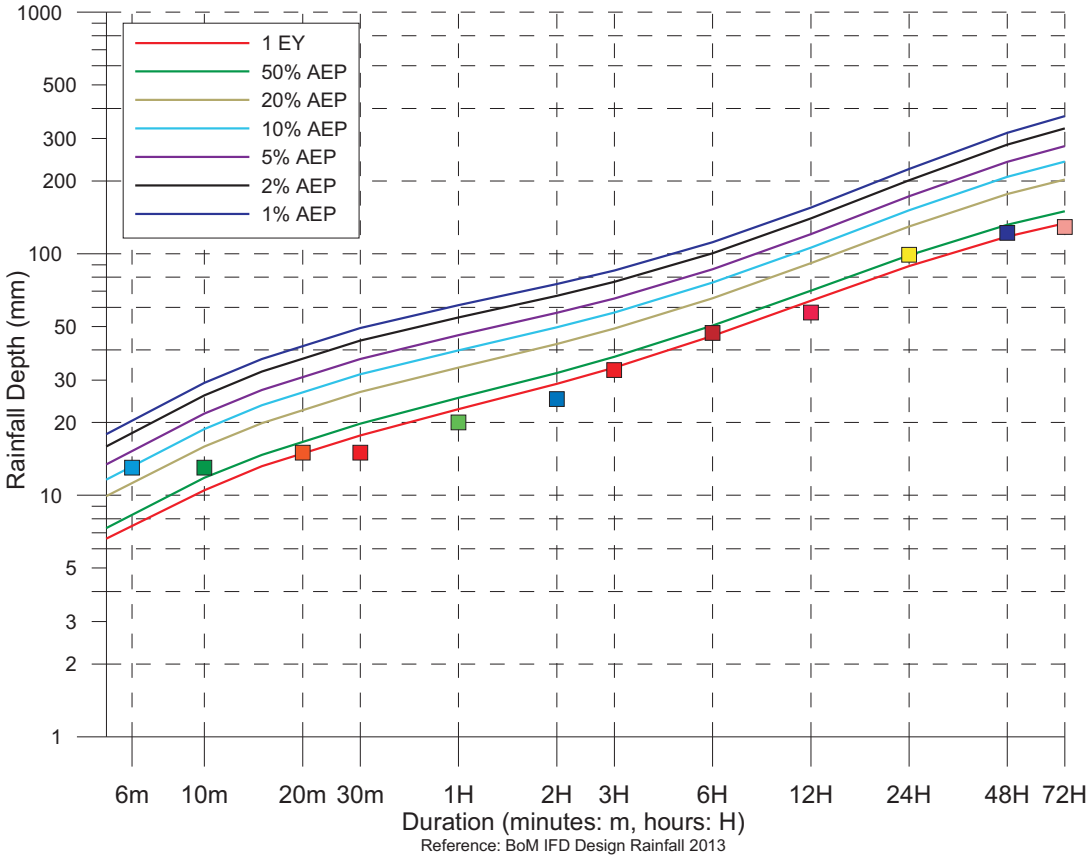
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

MOUNT BARRINGTON
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C18
DRAWING 2364-C18

Site owner: BoM Latitude: -32.0544 Longitude: 151.4706

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Carey's Peak Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	13.0	20:48_21/04/2015
10m	13.0	20:48_21/04/2015
20m	15.0	20:48_21/04/2015
30m	15.0	20:48_21/04/2015
1H	20.0	20:48_21/04/2015
2H	25.0	20:48_21/04/2015
3H	33.0	20:48_21/04/2015
6H	47.0	23:12_20/04/2015
12H	57.0	13:02_21/04/2015
24H	99.0	23:12_20/04/2015
48H	122.0	23:12_20/04/2015
72H	129.0	07:52_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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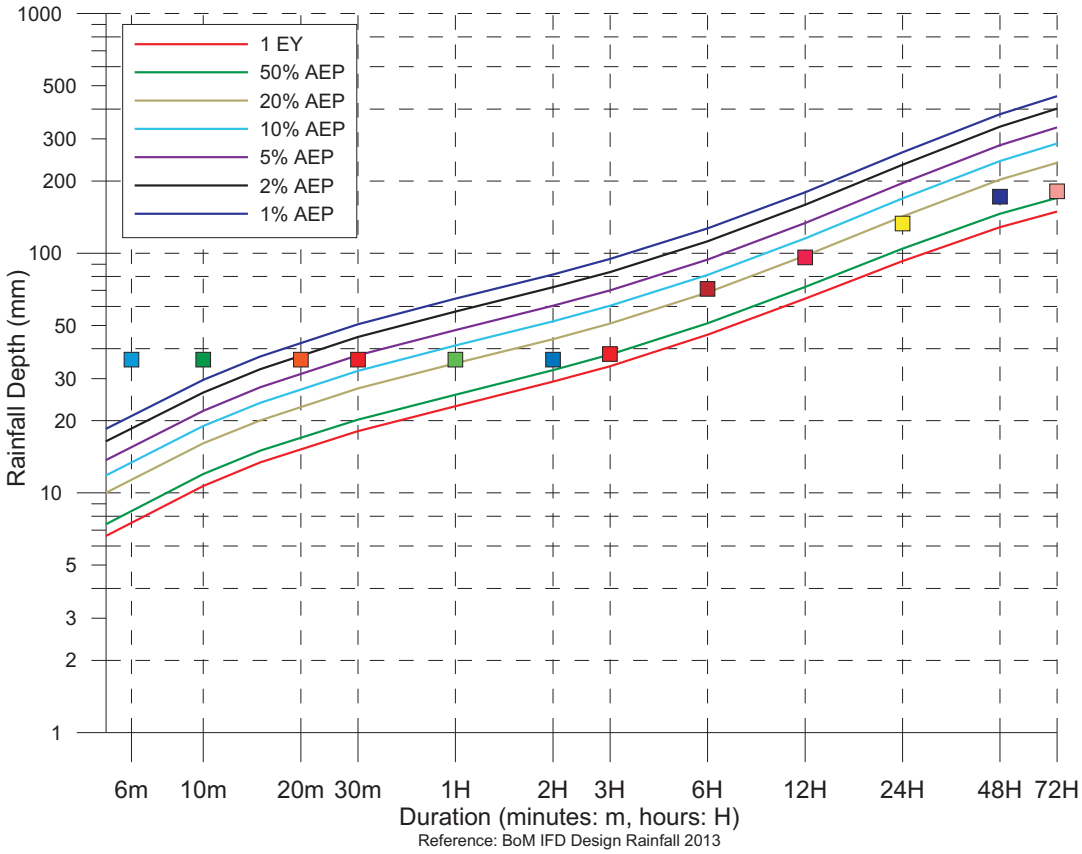
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

CAREY'S PEAK
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C19
DRAWING 2364-C19

Site owner: BoM Latitude: -32.1645 Longitude: 151.5366

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Barrington Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	36.0	06:54_03/05/2015
	10m	36.0	06:54_03/05/2015
	20m	36.0	06:54_03/05/2015
	30m	36.0	06:54_03/05/2015
	1H	36.0	06:54_03/05/2015
	2H	36.0	06:54_03/05/2015
	3H	38.0	22:54_20/04/2015
	6H	71.0	22:54_20/04/2015
	12H	96.0	21:40_20/04/2015
	24H	133.0	22:12_20/04/2015
	48H	172.0	00:18_20/04/2015
	72H	181.0	00:18_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*

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NSW GOVERNMENT Public Works
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BARRINGTON
INTENSITY-FREQUENCY-DURATION
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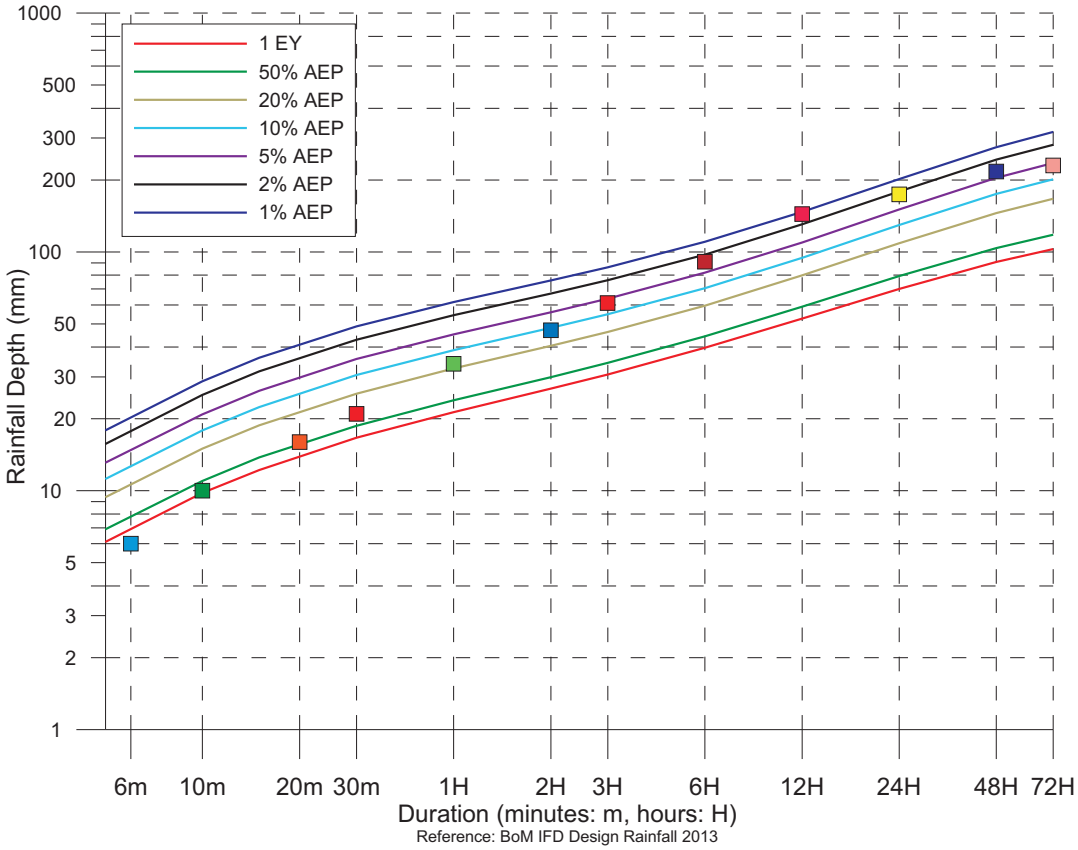
MHL Report 2364

Figure C20

DRAWING 2364-C20

Site owner: BoM Latitude: -32.3923 Longitude: 151.374

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Mirannie Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	6.0	06:58_21/04/2015
	10m	10.0	06:54_21/04/2015
	20m	16.0	06:46_21/04/2015
	30m	21.0	06:36_21/04/2015
	1H	34.0	06:14_21/04/2015
	2H	47.0	05:14_21/04/2015
	3H	61.0	04:14_21/04/2015
	6H	91.0	02:20_21/04/2015
	12H	144.0	20:58_20/04/2015
	24H	174.0	20:58_20/04/2015
	48H	217.0	02:38_20/04/2015
	72H	230.0	02:38_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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NSW GOVERNMENT Public Works
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MIRANNIE
INTENSITY-FREQUENCY-DURATION
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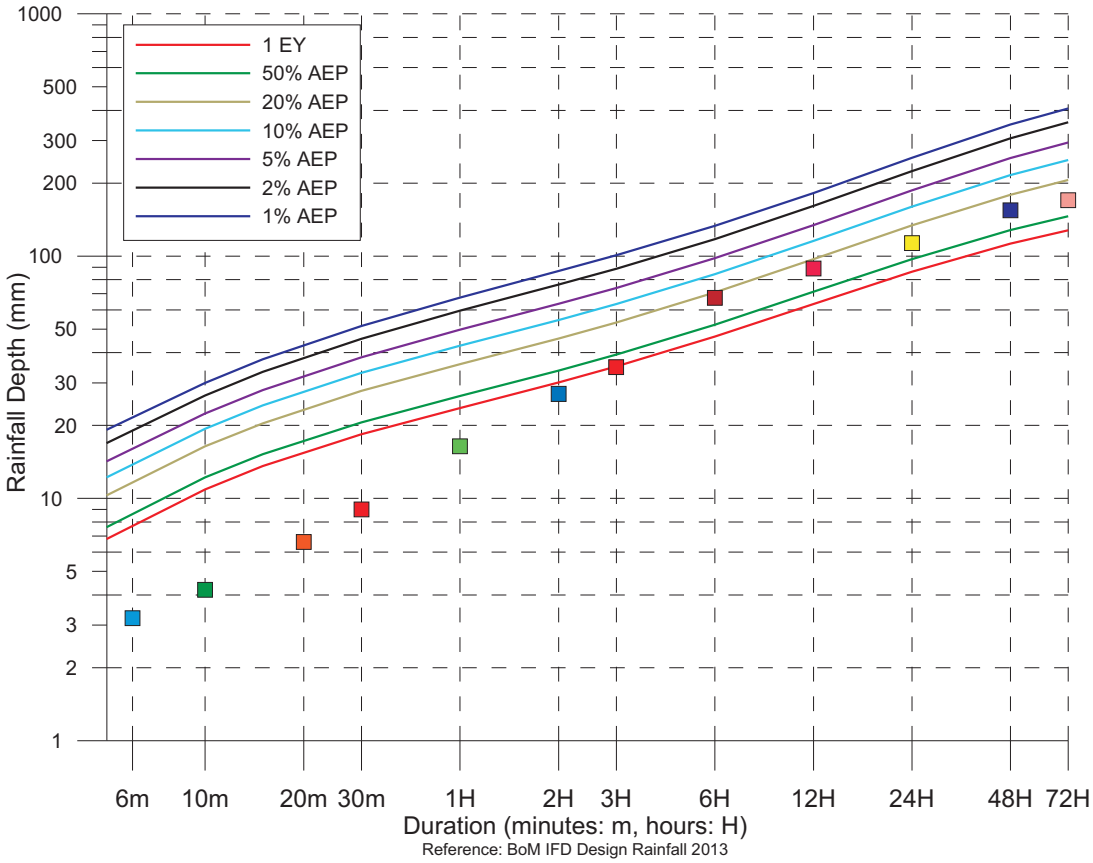
MHL Report 2364
Figure C21
DRAWING 2364-C21

Site owner: NOW Latitude: -32.2012 Longitude: 151.6331

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Upper Chichester Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	3.2	23:16_20/04/2015
10m	4.2	23:16_20/04/2015
20m	6.6	23:16_20/04/2015
30m	9.0	23:14_20/04/2015
1H	16.4	23:00_20/04/2015
2H	27.0	22:40_20/04/2015
3H	34.8	22:34_20/04/2015
6H	67.2	22:40_20/04/2015
12H	89.0	21:06_20/04/2015
24H	113.0	22:04_20/04/2015
48H	154.4	00:44_20/04/2015
72H	170.2	00:02_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

UPPER CHICHESTER
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

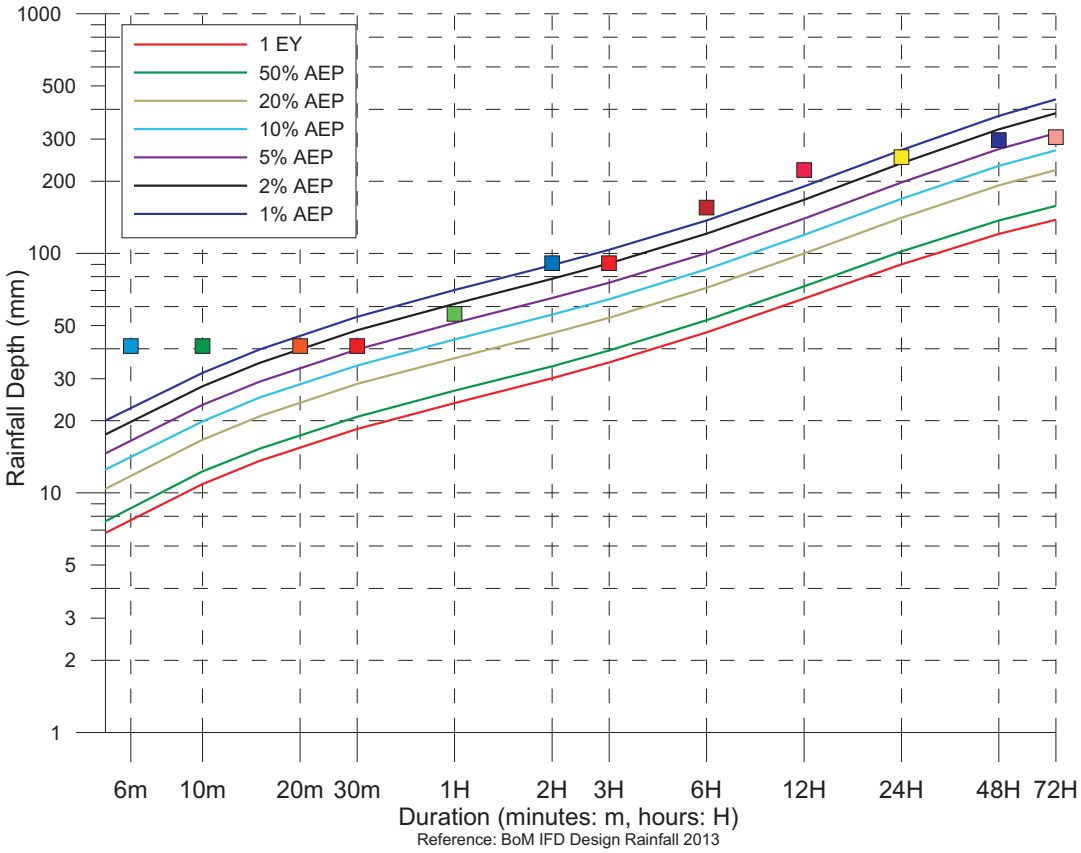
MHL Report 2364

Figure C22

DRAWING 2364-C22

Site owner: BoM Latitude: -32.3492 Longitude: 151.6447

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Upper Myall Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	41.0	07:56_21/04/2015
	10m	41.0	07:56_21/04/2015
	20m	41.0	07:56_21/04/2015
	30m	41.0	07:56_21/04/2015
	1H	56.0	04:22_21/04/2015
	2H	91.0	04:22_21/04/2015
	3H	91.0	04:22_21/04/2015
	6H	155.0	02:04_21/04/2015
	12H	223.0	20:04_20/04/2015
	24H	252.0	22:58_20/04/2015
	48H	297.0	01:16_20/04/2015
	72H	306.0	01:16_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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UPPER MYALL
INTENSITY-FREQUENCY-DURATION
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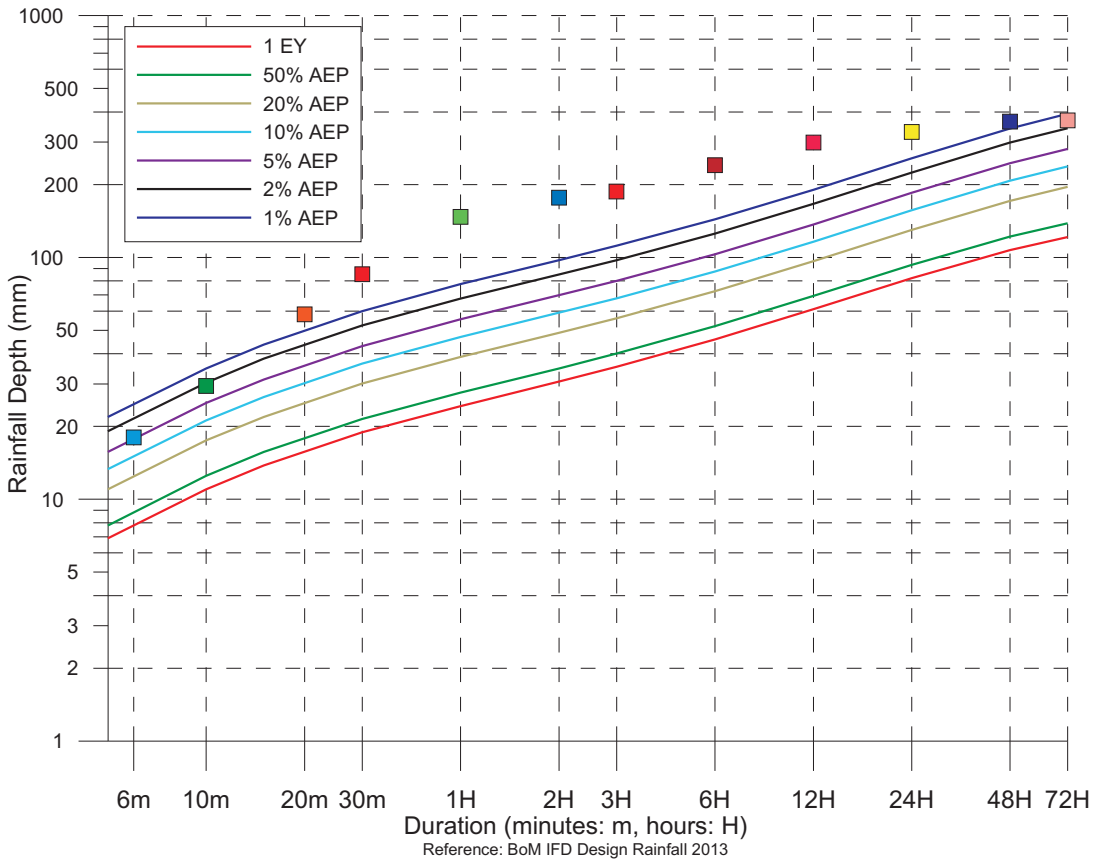
MHL Report 2364
Figure C23
DRAWING 2364-C23

Site owner: BoM Latitude: -32.4022 Longitude: 151.7582

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Dungog Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
6m		18.0	05:56_21/04/2015
10m		29.4	05:56_21/04/2015
20m		58.2	05:50_21/04/2015
30m		85.2	05:40_21/04/2015
1H		147.2	05:16_21/04/2015
2H		176.4	04:32_21/04/2015
3H		187.2	03:34_21/04/2015
6H		241.0	00:34_21/04/2015
12H		298.6	19:42_20/04/2015
24H		330.0	19:46_20/04/2015
48H		364.4	01:38_20/04/2015
72H		368.4	01:38_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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NSW GOVERNMENT Public Works
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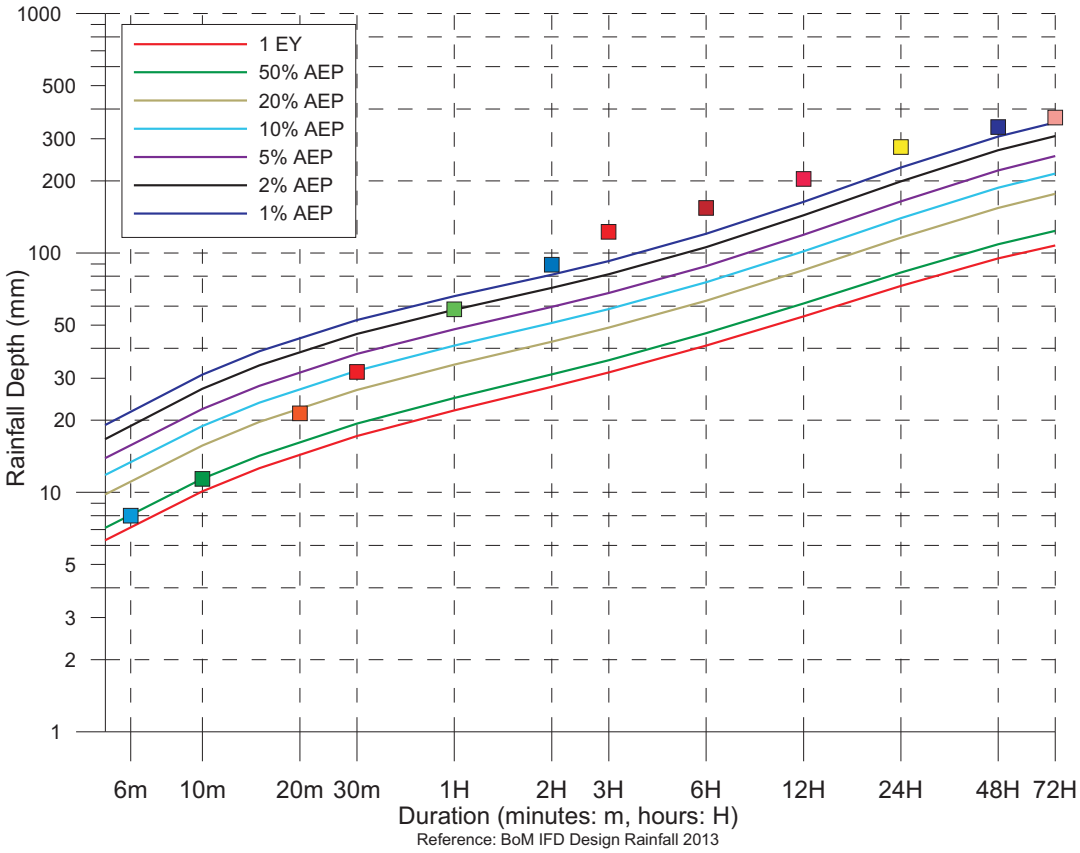
DUNGOG
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C24
DRAWING 2364-C24

Site owner: BoM Latitude: -32.5553 Longitude: 151.3790

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Tangory Mountain Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	8.0	07:30_21/04/2015
10m	11.4	07:26_21/04/2015
20m	21.4	07:30_21/04/2015
30m	31.8	07:28_21/04/2015
1H	58.2	07:10_21/04/2015
2H	89.2	07:10_21/04/2015
3H	122.4	07:06_21/04/2015
6H	154.2	05:06_21/04/2015
12H	203.6	22:22_20/04/2015
24H	276.8	19:08_20/04/2015
48H	335.8	06:14_20/04/2015
72H	367.6	00:56_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

NSW GOVERNMENT Public Works
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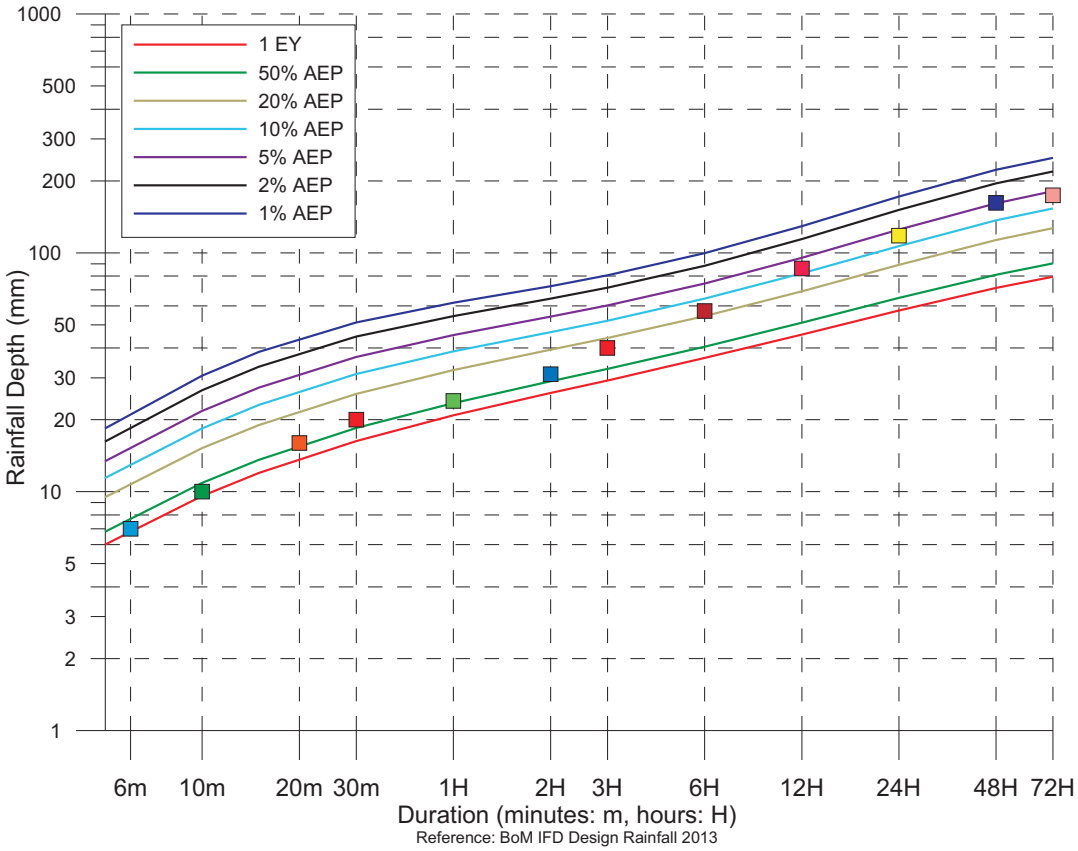
TANGORY MOUNTAIN
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C25
DRAWING 2364-C25

Site owner: BoM Latitude: -31.7651 Longitude: 150.8363

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Milbrodale Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	7.0	10:58_21/04/2015
	10m	10.0	10:58_21/04/2015
	20m	16.0	10:52_21/04/2015
	30m	20.0	10:50_21/04/2015
	1H	24.0	10:50_21/04/2015
	2H	31.0	10:50_21/04/2015
	3H	40.0	10:36_21/04/2015
	6H	46.0	10:24_21/04/2015
	12H	57.0	09:22_21/04/2015
	24H	86.0	06:00_21/04/2015
	48H	102.0	00:00_21/04/2015
	72H	118.0	20:36_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

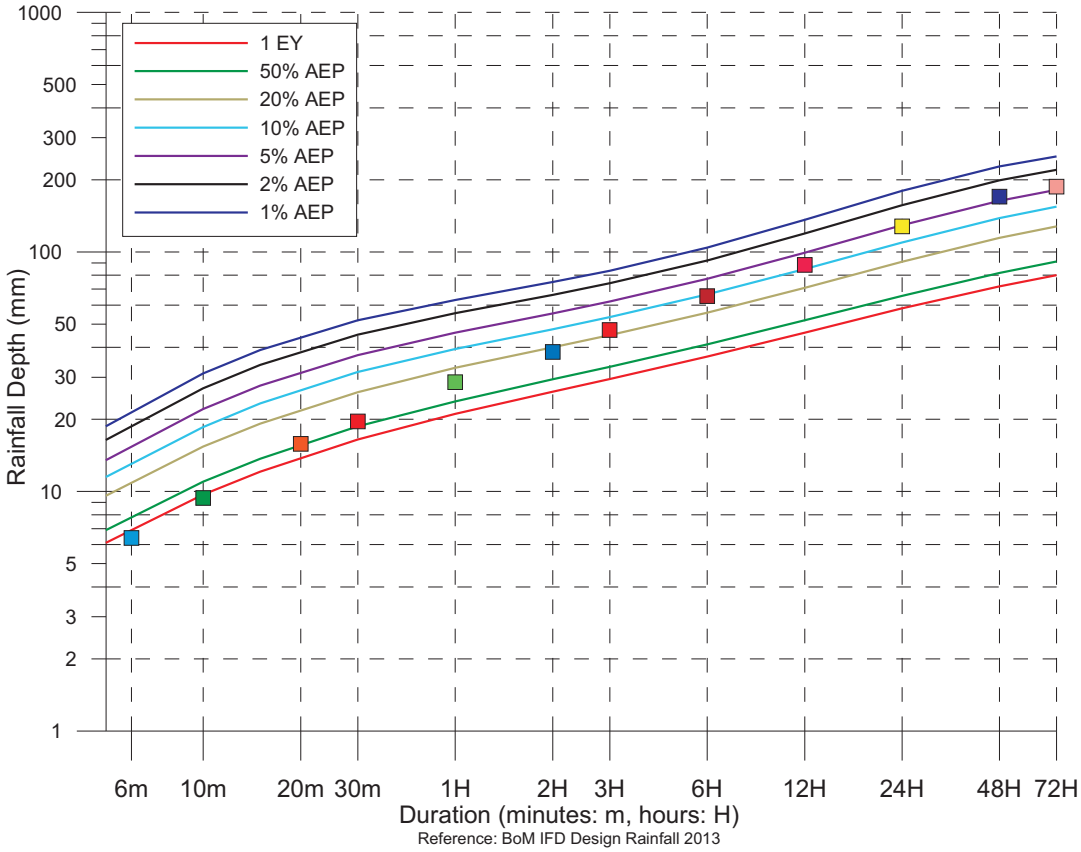
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

MILBRODALE
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C26
DRAWING 2364-C26

Site owner: BoM Latitude: -32.7667 Longitude: 151.0872

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

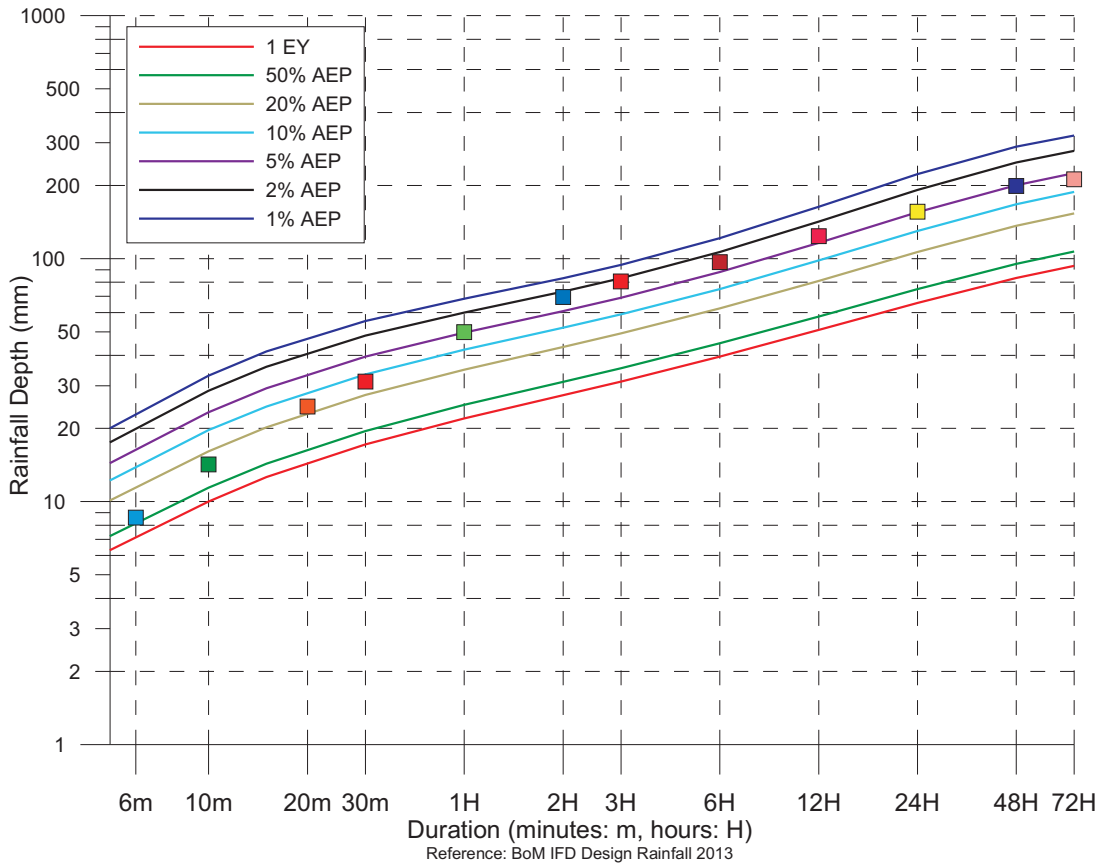
Broke Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	6.4	11:08_21/04/2015
10m	9.4	11:08_21/04/2015
20m	15.8	11:06_21/04/2015
30m	19.6	10:56_21/04/2015
1H	28.6	10:46_21/04/2015
2H	38.2	10:46_21/04/2015
3H	47.2	10:42_21/04/2015
6H	65.4	10:50_21/04/2015
12H	88.2	05:36_21/04/2015
24H	127.6	20:14_20/04/2015
48H	170.2	07:16_20/04/2015
72H	187.2	01:50_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

Site owner: BoM Latitude: -32.7965 Longitude: 151.2804

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Pokolbin Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
6m		8.6	10:58_21/04/2015
10m		14.2	10:58_21/04/2015
20m		24.6	10:56_21/04/2015
30m		31.2	10:56_21/04/2015
1H		49.8	10:56_21/04/2015
2H		69.6	10:48_21/04/2015
3H		80.6	10:42_21/04/2015
6H		96.8	10:40_21/04/2015
12H		123.6	10:40_21/04/2015
24H		156.0	19:50_20/04/2015
48H		198.8	07:04_20/04/2015
72H		212.2	01:08_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

POKOLBIN
INTENSITY-FREQUENCY-DURATION
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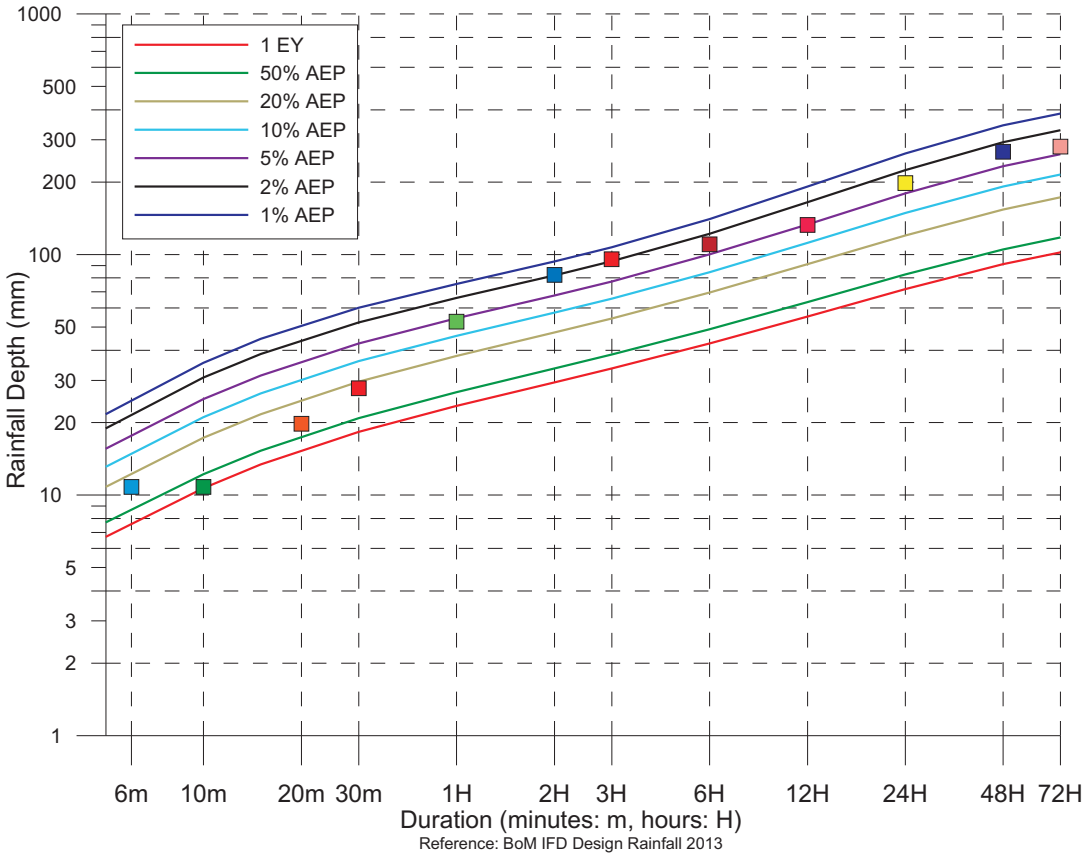
MHL Report 2364
Figure C28
DRAWING 2364-C28

Site owner: HWC Latitude: -32.8066 Longitude: 151.4267

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Abermain Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	10.8	11:00_21/04/2015
	10m	10.8	11:00_21/04/2015
	20m	19.8	11:00_21/04/2015
	30m	27.8	10:54_21/04/2015
	1H	52.6	11:00_21/04/2015
	2H	82.2	10:40_21/04/2015
	3H	95.6	10:44_21/04/2015
	6H	110.4	10:40_21/04/2015
	12H	132.8	09:40_21/04/2015
	24H	198.2	19:04_20/04/2015
	48H	267.4	07:24_20/04/2015
	72H	281.2	04:30_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

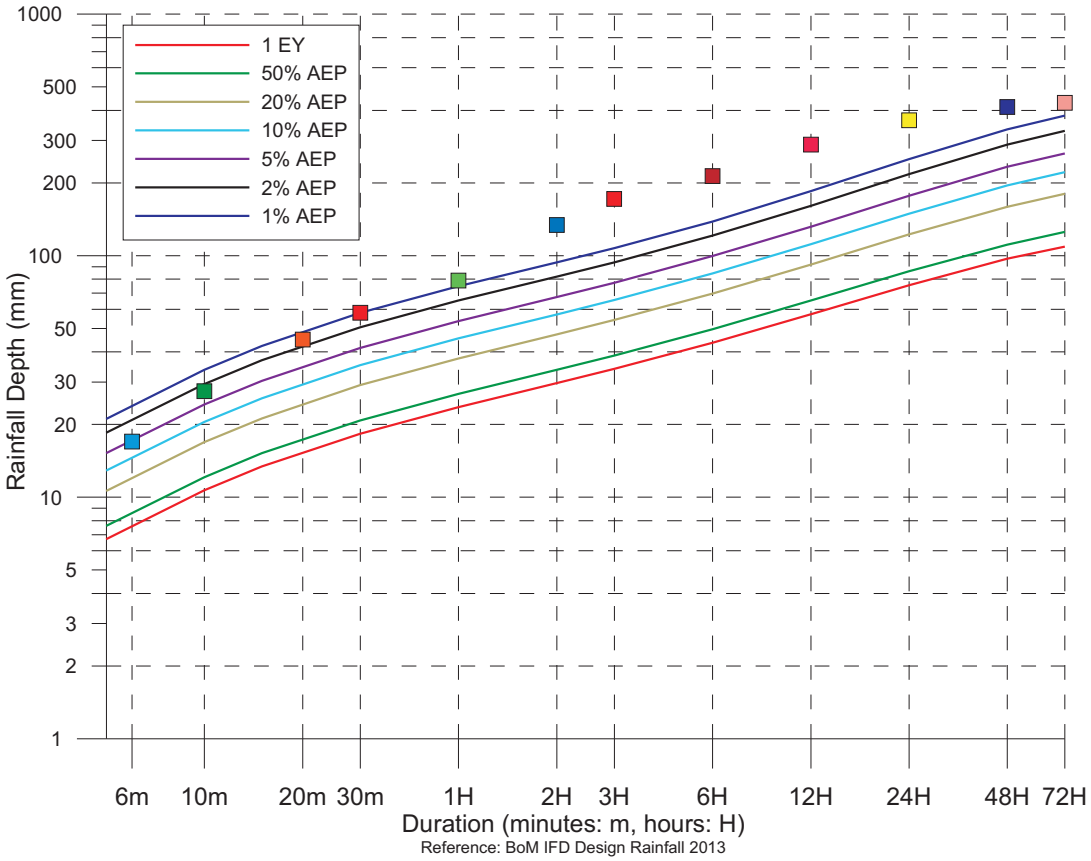
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

ABERMAIN
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C29
DRAWING 2364-C29

Site owner: MHL Latitude: -32.5651 Longitude: 151.6056

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

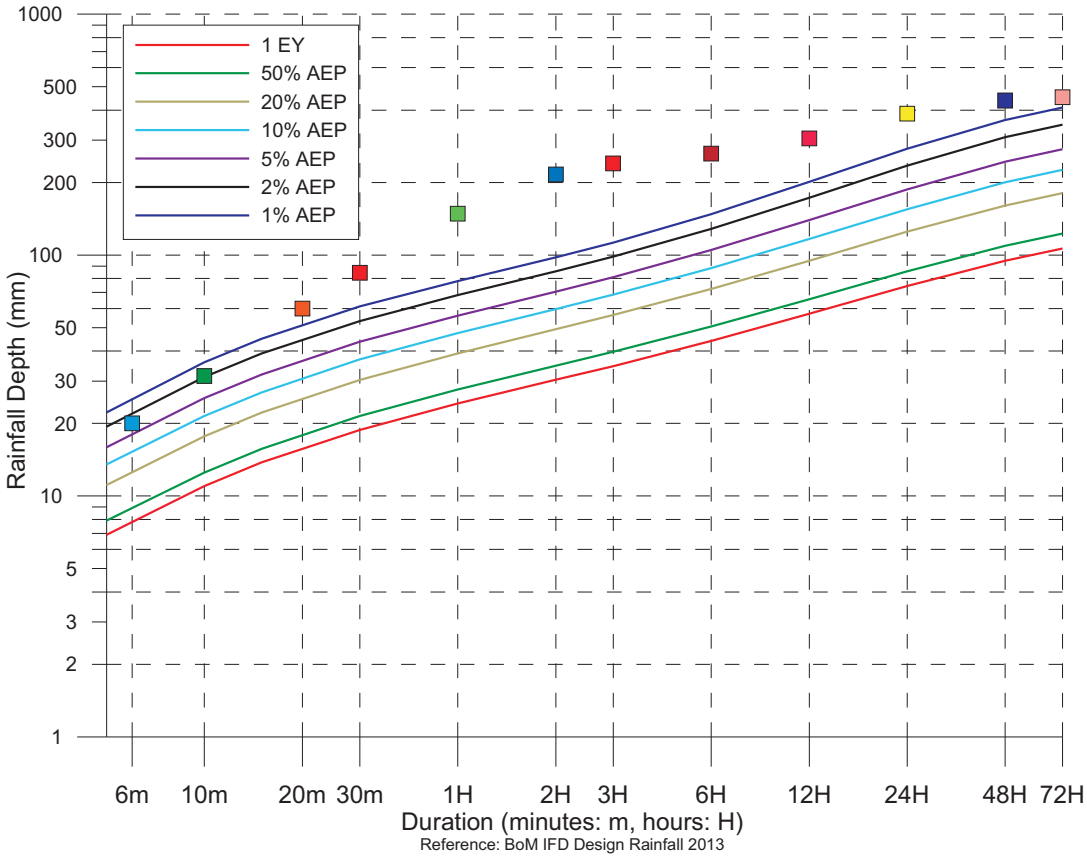
Gostwyck Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	17.0	07:26_21/04/2015
10m	27.5	07:22_21/04/2015
20m	45.0	07:14_21/04/2015
30m	58.0	07:04_21/04/2015
1H	79.0	06:42_21/04/2015
2H	134.0	06:42_21/04/2015
3H	171.5	06:28_21/04/2015
6H	213.5	03:54_21/04/2015
12H	288.0	21:46_20/04/2015
24H	363.0	21:10_20/04/2015
48H	413.0	02:14_20/04/2015
72H	429.5	01:18_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

Site owner: MHL Latitude: -32.7294 Longitude: 151.5533

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Belmore Bridge Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	20.0	10:34_21/04/2015
	10m	31.5	10:30_21/04/2015
	20m	60.0	10:30_21/04/2015
	30m	84.5	10:22_21/04/2015
	1H	148.5	09:58_21/04/2015
	2H	216.0	09:56_21/04/2015
	3H	240.0	09:40_21/04/2015
	6H	264.0	07:56_21/04/2015
	12H	305.0	08:06_21/04/2015
	24H	386.5	18:48_20/04/2015
	48H	438.0	06:04_20/04/2015
	72H	452.5	05:20_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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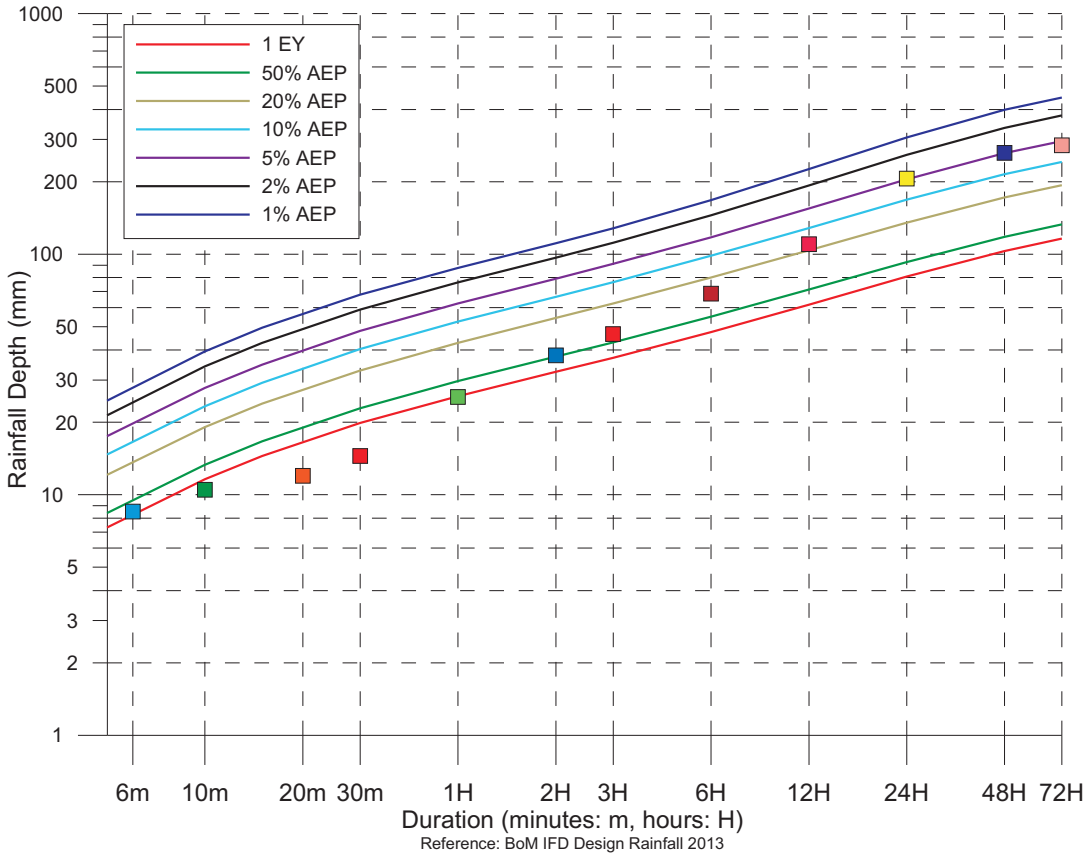
Site owner: MHL Latitude: -32.8177 Longitude: 151.6814

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Hexham Bridge Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	8.5	18:24_25/04/2015
10m	10.5	18:24_25/04/2015
20m	12.0	18:18_25/04/2015
30m	14.5	04:42_21/04/2015
1H	25.5	11:52_21/04/2015
2H	38.0	10:54_21/04/2015
3H	46.5	10:28_21/04/2015
6H	49.0	09:30_21/04/2015
12H	68.5	19:48_20/04/2015
24H	110.0	08:18_21/04/2015
48H	155.5	19:40_20/04/2015
72H	206.0	20:08_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
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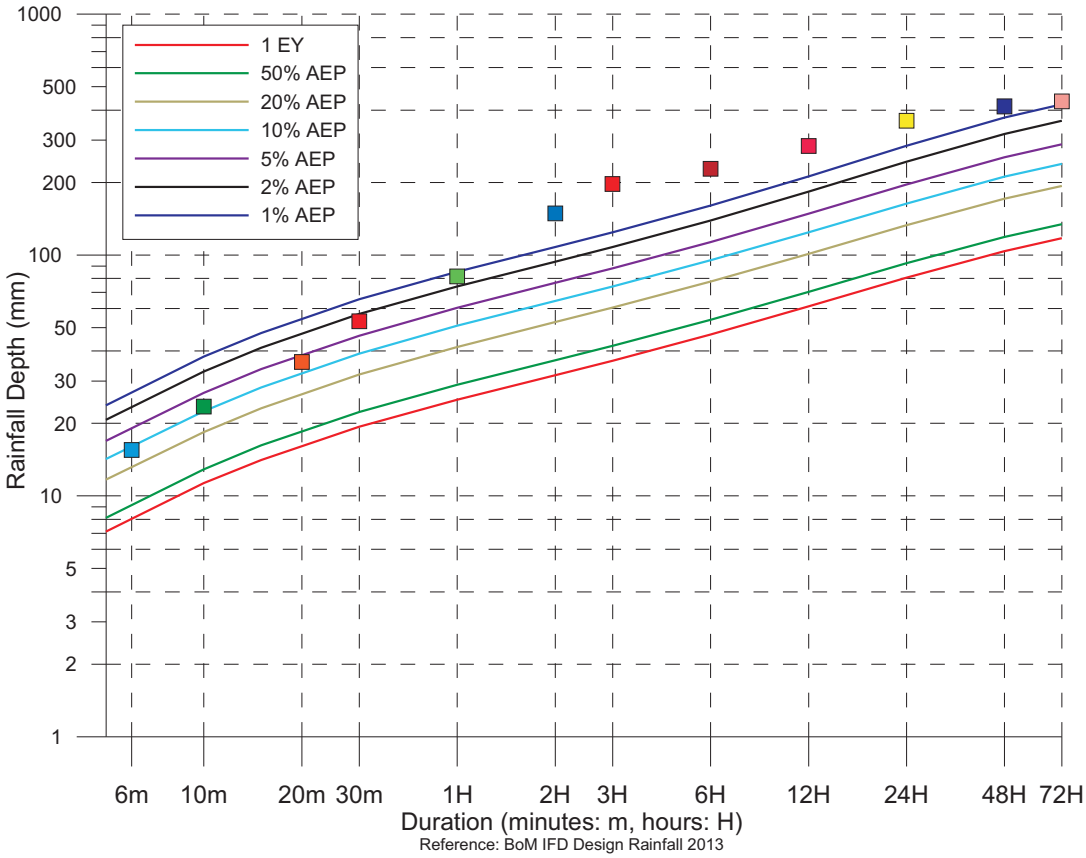
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

HEXHAM BRIDGE
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C32
DRAWING 2364-C32

Site owner: MHL Latitude: -32.6634 Longitude: 151.7321

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Seaham Rainfall Depth 01 April 2015 – 05 May 2015			
	Duration (minutes: m) (hours: H)	Rainfall Depth (mm)	Time/Date
	6m	15.5	09:38_21/04/2015
	10m	23.5	09:34_21/04/2015
	20m	36.0	09:34_21/04/2015
	30m	53.0	09:18_21/04/2015
	1H	81.5	08:46_21/04/2015
	2H	149.0	08:26_21/04/2015
	3H	197.0	08:22_21/04/2015
	6H	228.0	06:06_21/04/2015
	12H	283.5	23:24_20/04/2015
	24H	361.5	12:10_20/04/2015
	48H	414.0	05:12_20/04/2015
	72H	434.5	04:22_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
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For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

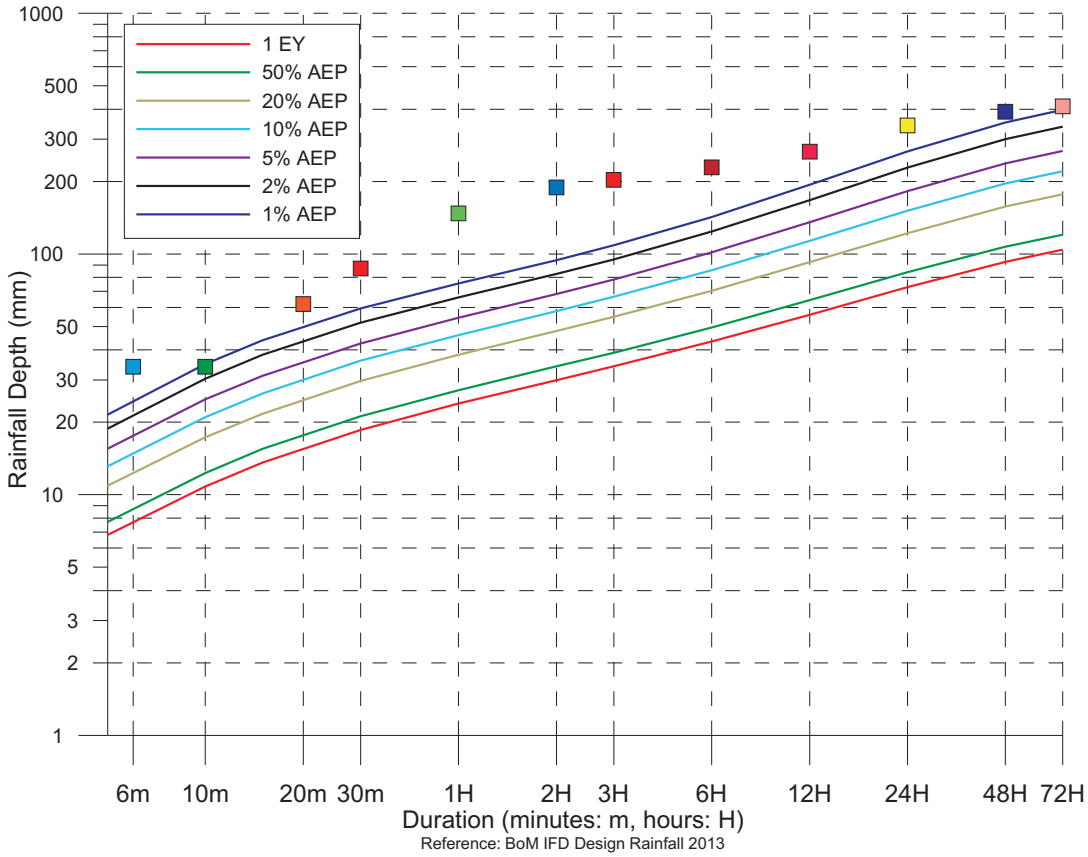
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

SEAHAM
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C33
DRAWING 2364-C33

Site owner: HWC Latitude: -32.7014 Longitude: 151.5274

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Maitland 18 WWPS Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	34.0	10:10_21/04/2015
	10m	34.0	10:10_21/04/2015
	20m	62.0	10:04_21/04/2015
	30m	87.0	10:00_21/04/2015
	1H	147.4	09:54_21/04/2015
	2H	189.2	09:50_21/04/2015
	3H	203.4	09:24_21/04/2015
	6H	229.4	08:10_21/04/2015
	12H	266.0	07:00_21/04/2015
	24H	342.2	18:54_20/04/2015
	48H	389.6	05:54_20/04/2015
	72H	410.6	02:20_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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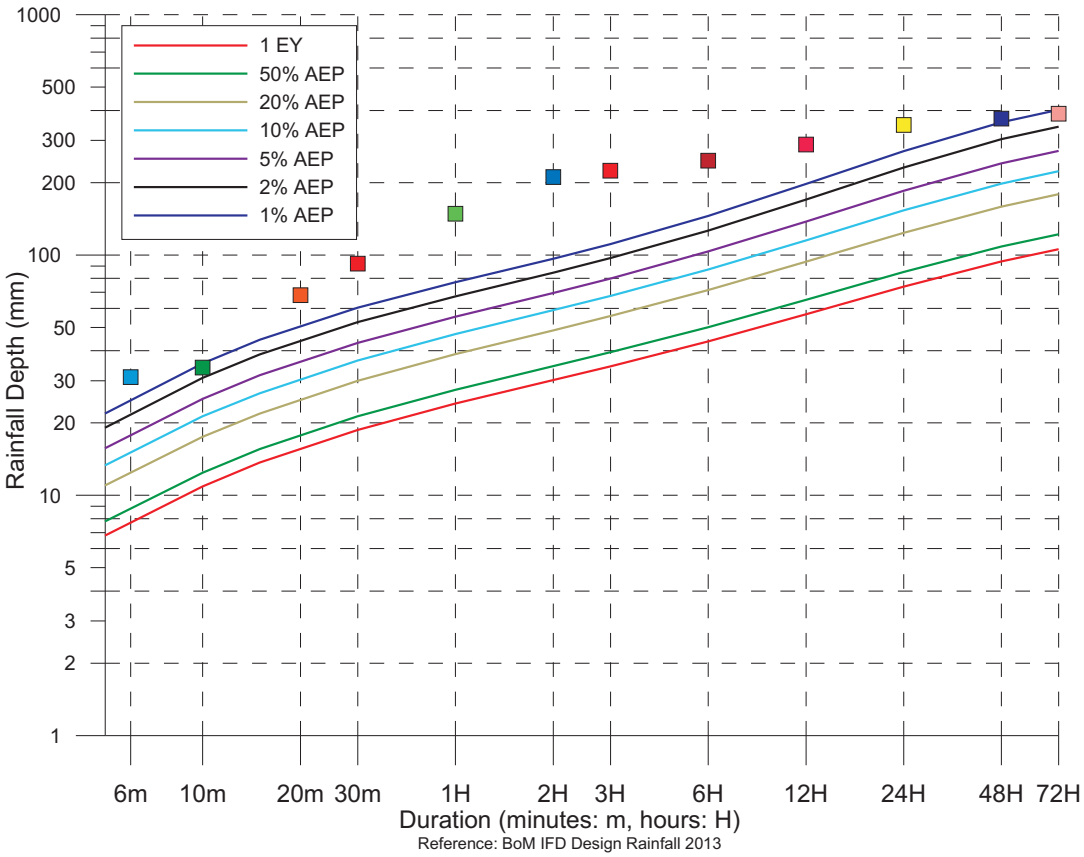
Site owner: HWC Latitude: -32.7128 Longitude: 151.5707

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Bolwarra 1A Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	31.0	10:44_21/04/2015
10m	34.0	10:38_21/04/2015
20m	68.0	10:28_21/04/2015
30m	92.0	10:24_21/04/2015
1H	148.6	09:58_21/04/2015
2H	211.2	09:44_21/04/2015
3H	224.6	09:18_21/04/2015
6H	246.6	06:08_21/04/2015
12H	288.2	00:08_21/04/2015
24H	347.8	12:08_20/04/2015
48H	370.0	05:34_20/04/2015
72H	387.0	01:28_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
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For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

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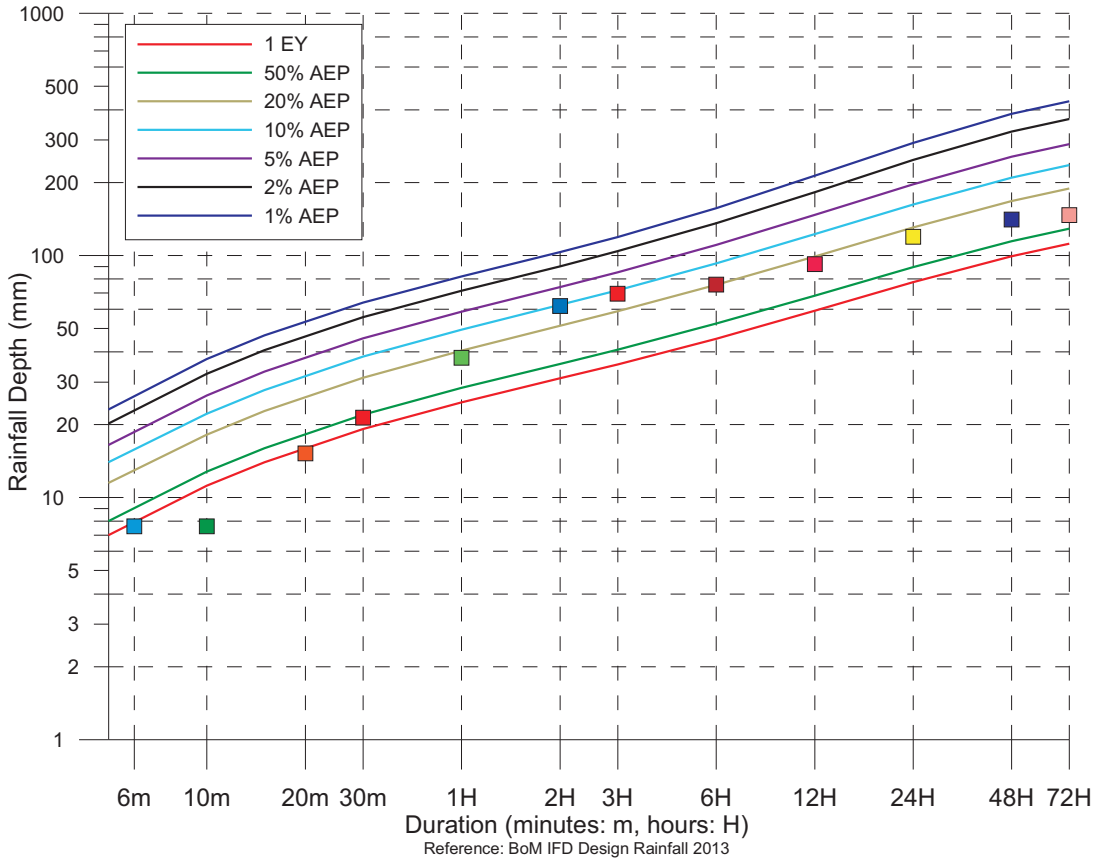
Manly Hydraulics Laboratory

BOLWARRA
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C36
DRAWING 2364-C36

Site owner: HWC Latitude: -32.7522 Longitude: 151.6025

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

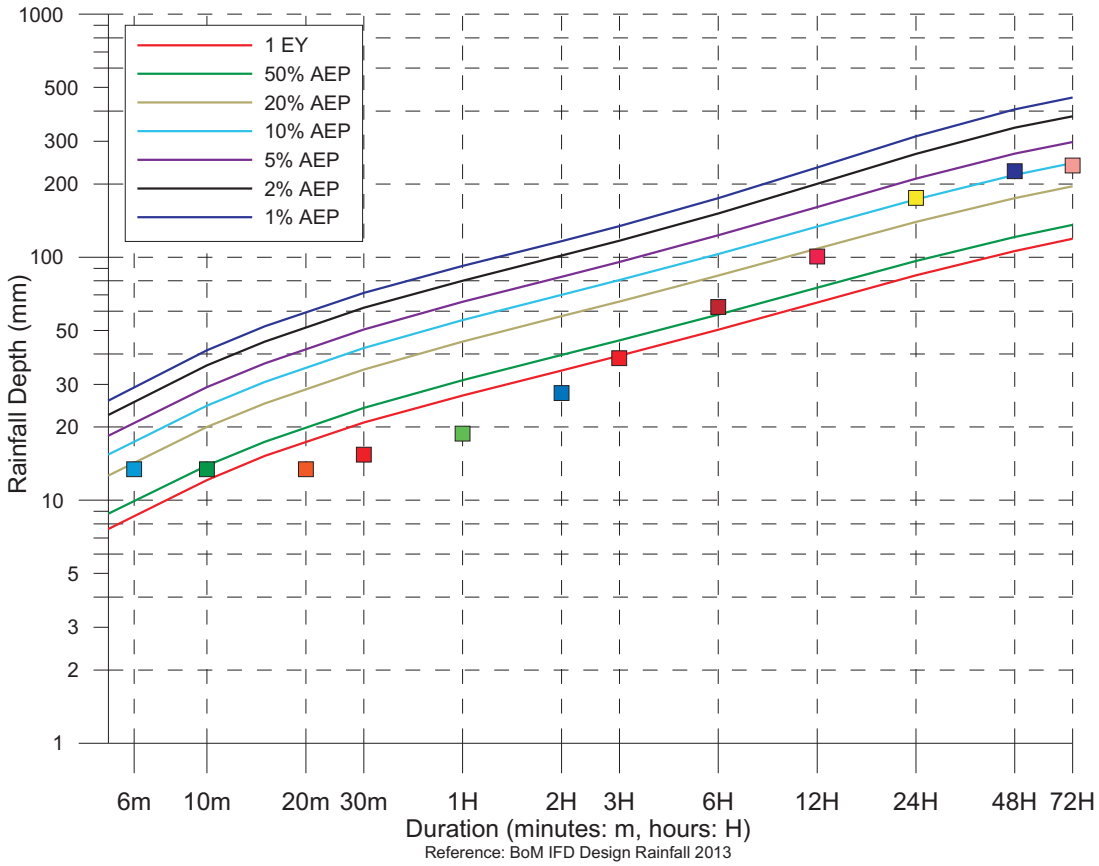
Maitland 7 WWPS Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	7.6	11:30_21/04/2015
	10m	7.6	11:04_21/04/2015
	20m	15.2	11:34_21/04/2015
	30m	21.4	11:30_21/04/2015
	1H	37.8	11:00_21/04/2015
	2H	61.8	10:30_21/04/2015
	3H	69.4	09:44_21/04/2015
	6H	75.8	09:44_21/04/2015
	12H	92.2	09:04_21/04/2015
	24H	119.4	20:40_20/04/2015
	48H	140.8	09:50_20/04/2015
	72H	146.6	01:50_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

Site owner: HWC Latitude: -32.9206 Longitude: 151.7293

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

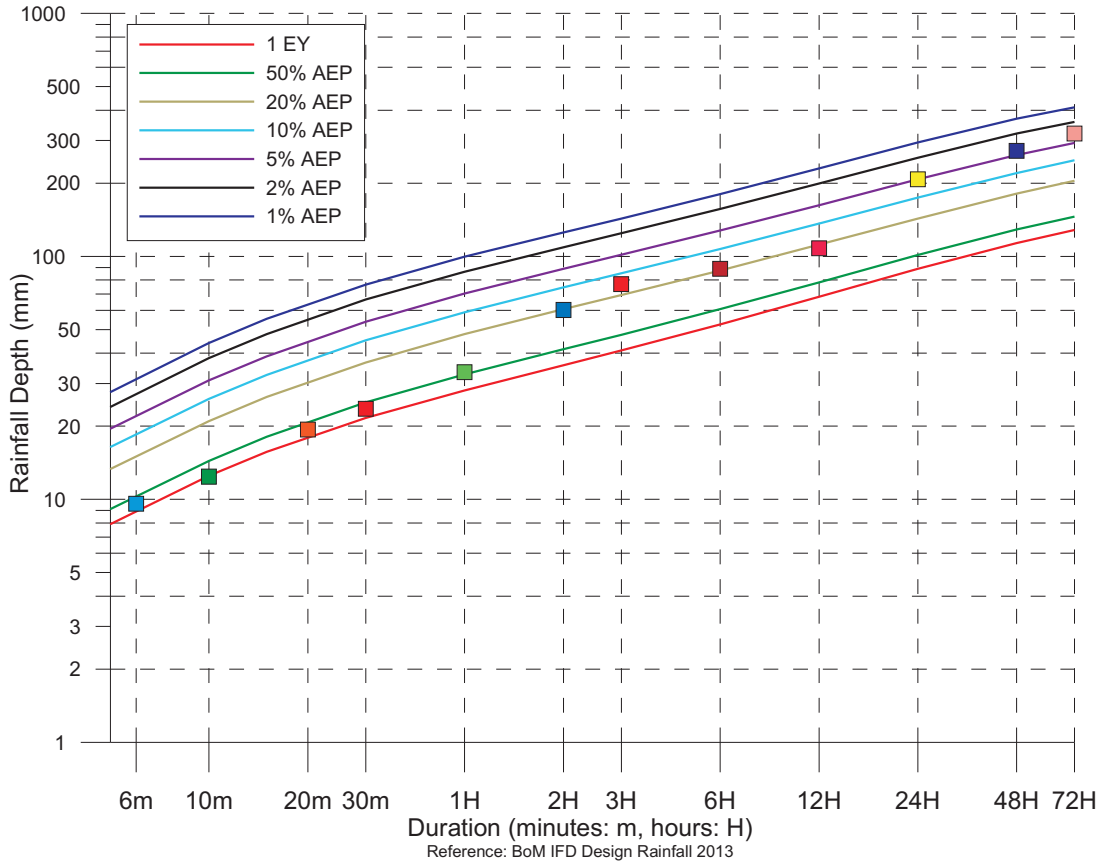
Broadmeadow Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	13.4	05:34_04/04/2015
10m	13.4	05:34_04/04/2015
20m	13.4	05:34_04/04/2015
30m	15.4	05:34_04/04/2015
1H	18.8	04:44_04/04/2015
2H	27.6	15:34_21/04/2015
3H	38.4	14:38_21/04/2015
6H	62.4	14:04_21/04/2015
12H	100.6	08:08_21/04/2015
24H	175.6	20:18_20/04/2015
48H	225.8	07:18_20/04/2015
72H	238.4	21:34_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

Site owner: HWC Latitude: -32.7101 Longitude: 152.0702

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Soldiers Point Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	9.6	13:50_21/04/2015
10m	12.4	17:14_04/04/2015
20m	19.4	13:44_21/04/2015
30m	23.6	17:14_04/04/2015
1H	33.4	17:04_04/04/2015
2H	60.2	23:20_20/04/2015
3H	76.8	22:24_20/04/2015
6H	88.8	20:20_20/04/2015
12H	108.0	08:30_21/04/2015
24H	207.4	20:20_20/04/2015
48H	272.0	15:54_20/04/2015
72H	320.8	02:50_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

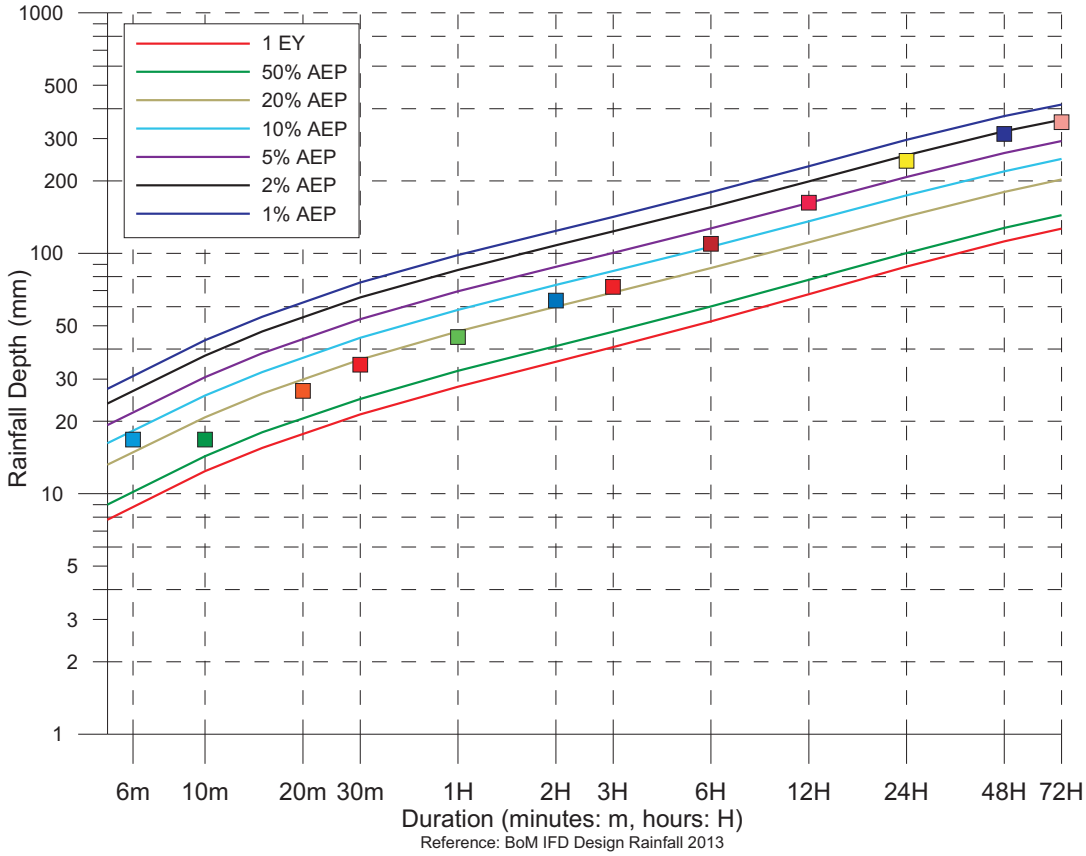
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

SOLDIERS POINT
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C39
DRAWING 2364-C39

Site owner: HWC Latitude: -32.7369 Longitude: 150.0008

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

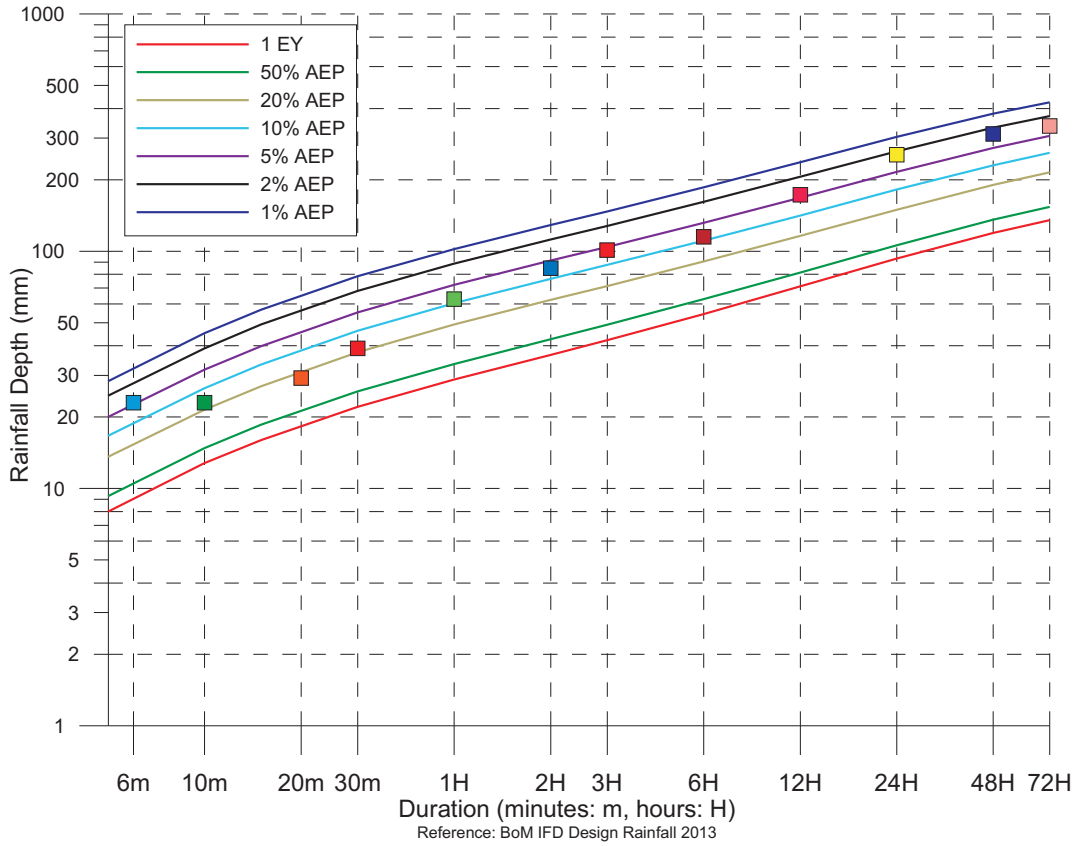
Tanilba Bay Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	16.8	13:40_21/04/2015
	10m	16.8	13:40_21/04/2015
	20m	26.8	13:30_21/04/2015
	30m	34.4	13:20_21/04/2015
	1H	44.8	13:04_21/04/2015
	2H	63.6	11:50_21/04/2015
	3H	72.6	16:50_21/04/2015
	6H	109.4	13:14_21/04/2015
	12H	162.6	09:34_21/04/2015
	24H	242.6	20:10_20/04/2015
	48H	313.4	04:44_20/04/2015
	72H	351.0	04:44_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

Site owner: HWC Latitude: -32.7252 Longitude: 152.1438

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Nelson Bay Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	23.0	13:50_29/04/2015
10m	23.0	13:50_29/04/2015
20m	29.2	10:44_21/04/2015
30m	39.0	10:40_21/04/2015
1H	62.8	10:30_21/04/2015
2H	84.8	23:20_20/04/2015
3H	101.2	22:54_20/04/2015
6H	115.0	19:44_20/04/2015
12H	172.8	23:44_20/04/2015
24H	255.2	19:44_20/04/2015
48H	312.0	04:20_20/04/2015
72H	336.8	04:20_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

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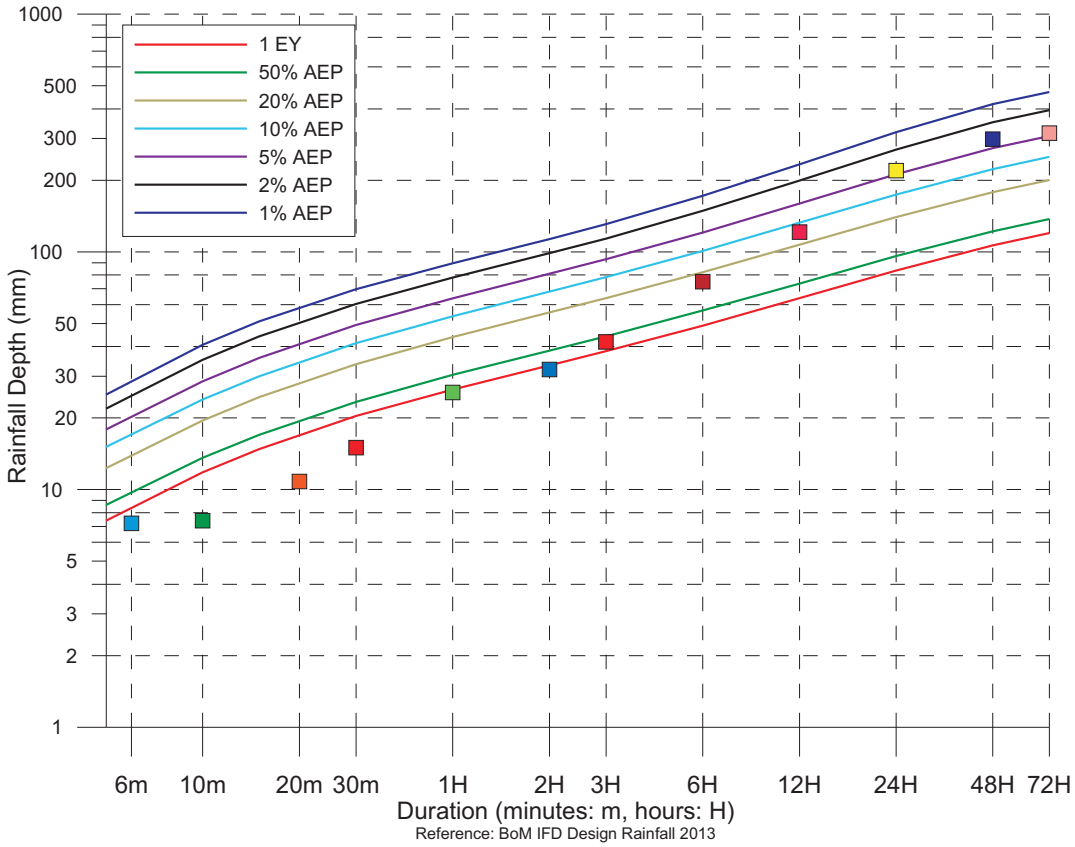
Manly Hydraulics Laboratory

NELSON BAY
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C41
DRAWING 2364-C41

Site owner: HWC Latitude: -32.8845 Longitude: 151.6889

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Shortland Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	7.2	03:10_04/04/2015
	10m	7.4	19:54_21/04/2015
	20m	10.8	20:00_21/04/2015
	30m	15.0	19:54_21/04/2015
	1H	25.6	19:20_21/04/2015
	2H	32.0	18:24_21/04/2015
	3H	41.8	17:20_21/04/2015
	6H	75.0	14:24_21/04/2015
	12H	121.2	14:14_20/04/2015
	24H	219.6	20:20_20/04/2015
	48H	298.0	07:50_20/04/2015
	72H	315.6	18:54_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

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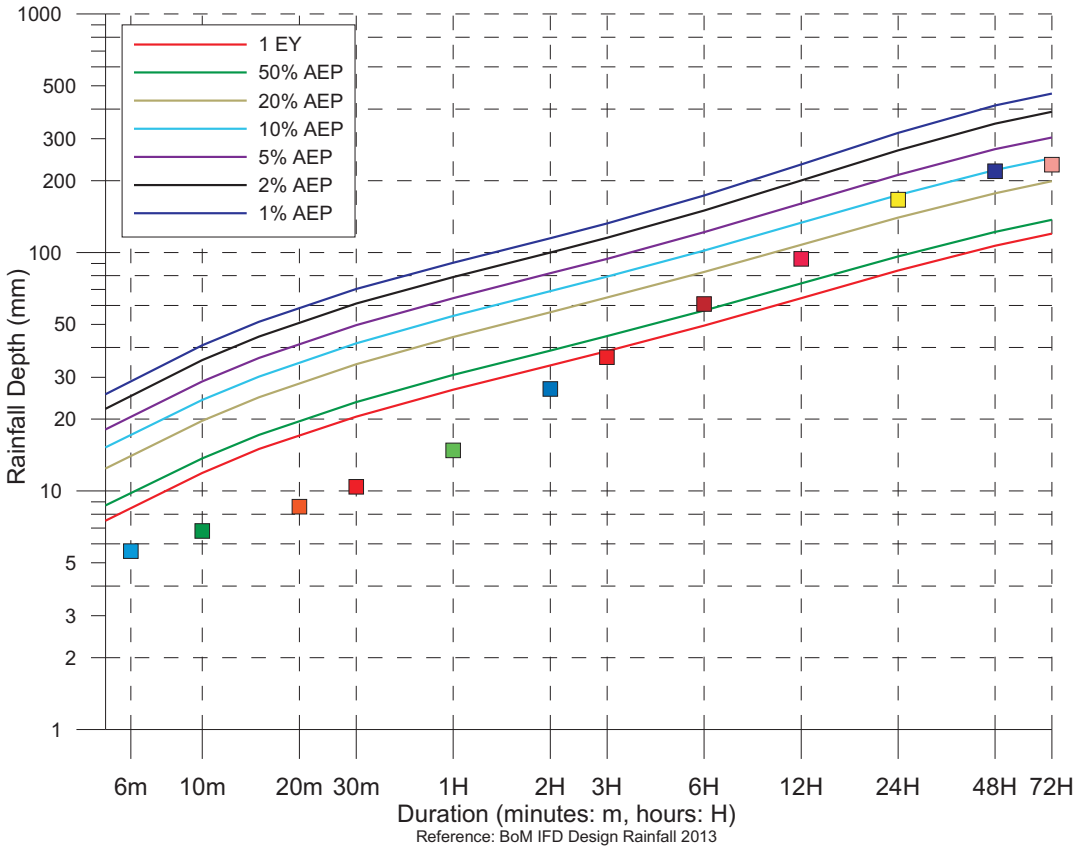
SHORTLAND
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C42
DRAWING 2364-C42

Site owner: HWC Latitude: -32.8988 Longitude: 151.7189

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Waratah Reservoir Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
6m		5.6	03:00_04/04/2015
10m		6.8	19:34_21/04/2015
20m		8.6	04:44_21/04/2015
30m		10.4	17:10_21/04/2015
1H		14.8	16:44_21/04/2015
2H		26.8	15:40_21/04/2015
3H		36.4	14:44_21/04/2015
6H		60.8	14:10_21/04/2015
12H		94.2	08:10_21/04/2015
24H		166.4	20:10_20/04/2015
48H		219.4	07:44_20/04/2015
72H		233.6	21:14_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

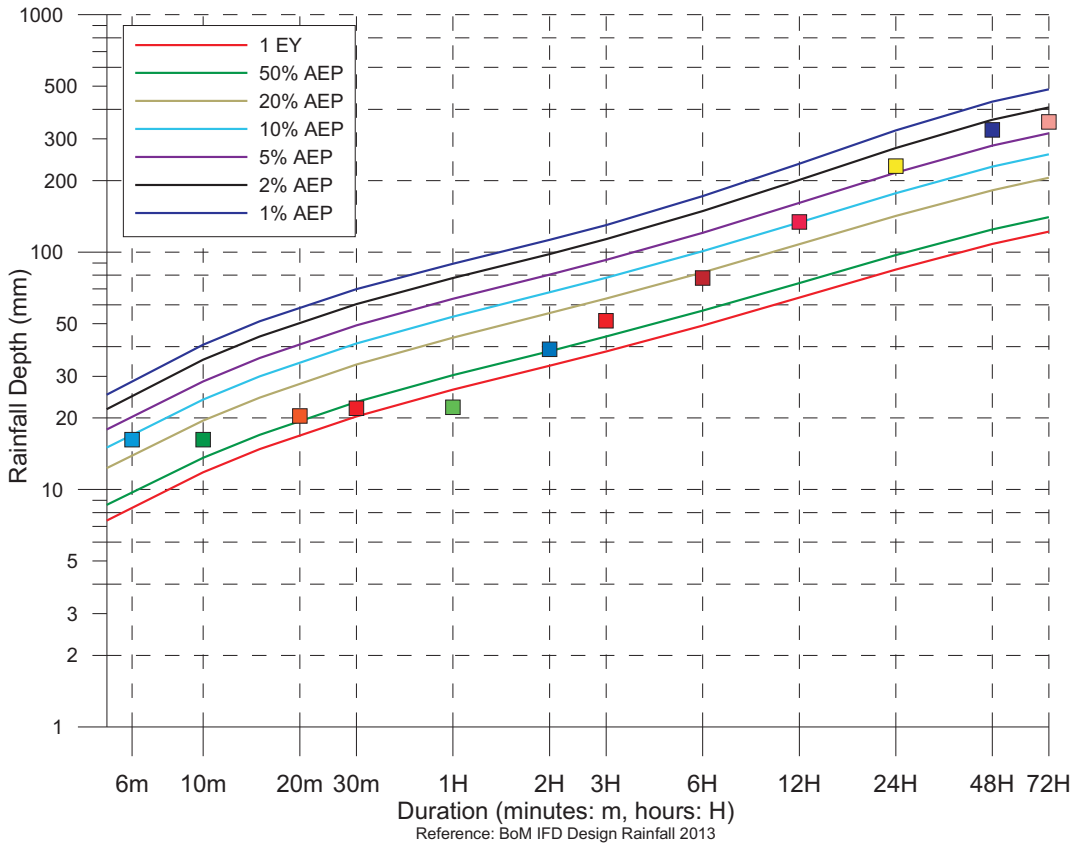
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

WARATAH RESERVOIR
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C43
DRAWING 2364-C43

Site owner: HWC Latitude: -32.9046 Longitude: 151.6654

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Wallsend Bowling Club Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	16.2	20:00_21/04/2015
	10m	16.2	20:00_21/04/2015
	20m	20.4	20:00_21/04/2015
	30m	22.0	20:00_21/04/2015
	1H	22.2	20:00_21/04/2015
	2H	39.0	15:34_20/04/2015
	3H	51.4	15:34_20/04/2015
	6H	77.8	15:34_20/04/2015
	12H	134.0	14:20_20/04/2015
	24H	229.8	15:34_20/04/2015
	48H	327.2	05:40_20/04/2015
	72H	353.0	19:04_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

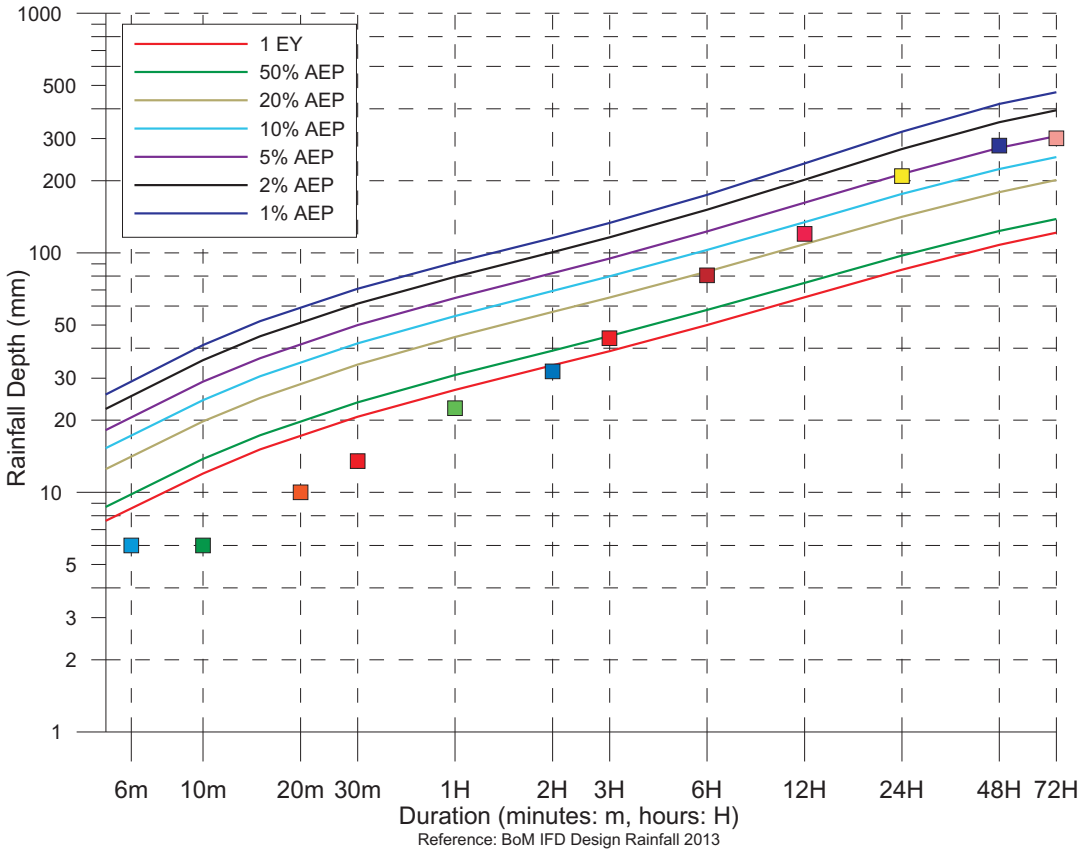
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

WALLSEND BC
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C44
DRAWING 2364-C44

Site owner: BoM Latitude: -32.9091 Longitude: 151.7036

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Lambton Reservoir Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	6.0	01:24_21/04/2015
	10m	6.0	04:58_21/04/2015
	20m	10.0	20:08_21/04/2015
	30m	13.5	19:58_21/04/2015
	1H	22.5	19:28_21/04/2015
	2H	32.0	15:48_21/04/2015
	3H	44.0	14:54_21/04/2015
	6H	80.5	14:28_21/04/2015
	12H	120.0	08:28_21/04/2015
	24H	209.0	20:28_20/04/2015
	48H	280.5	07:54_20/04/2015
	72H	301.0	21:08_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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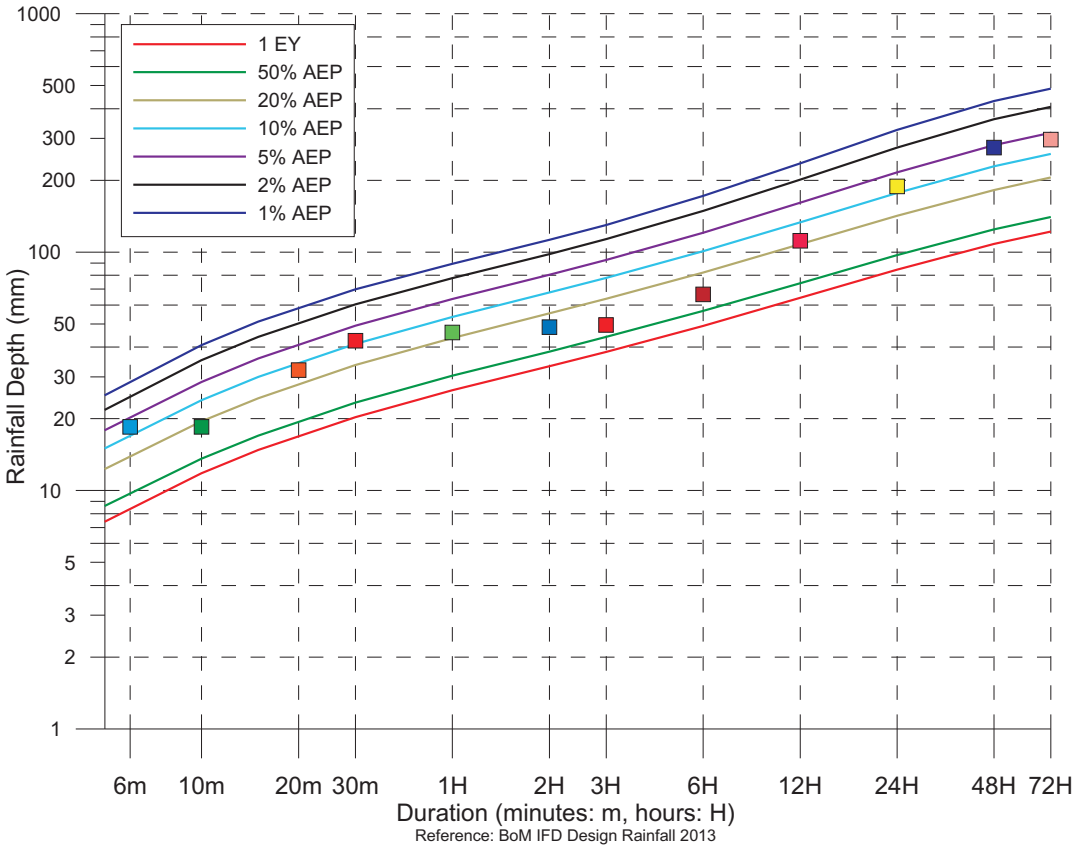
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

LAMBTON
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C45
DRAWING 2364-C45

Site owner: BoM Latitude: -32.9209 Longitude: 151.6510

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Macquarie College Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	18.5	15:54_06/04/2015
10m	18.5	15:58_06/04/2015
20m	32.0	15:54_06/04/2015
30m	42.5	15:54_06/04/2015
1H	46.0	15:54_06/04/2015
2H	48.5	15:48_06/04/2015
3H	49.5	15:48_06/04/2015
6H	66.5	15:48_20/04/2015
12H	111.5	14:28_20/04/2015
24H	188.5	15:48_20/04/2015
48H	274.5	07:38_20/04/2015
72H	296.5	20:44_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
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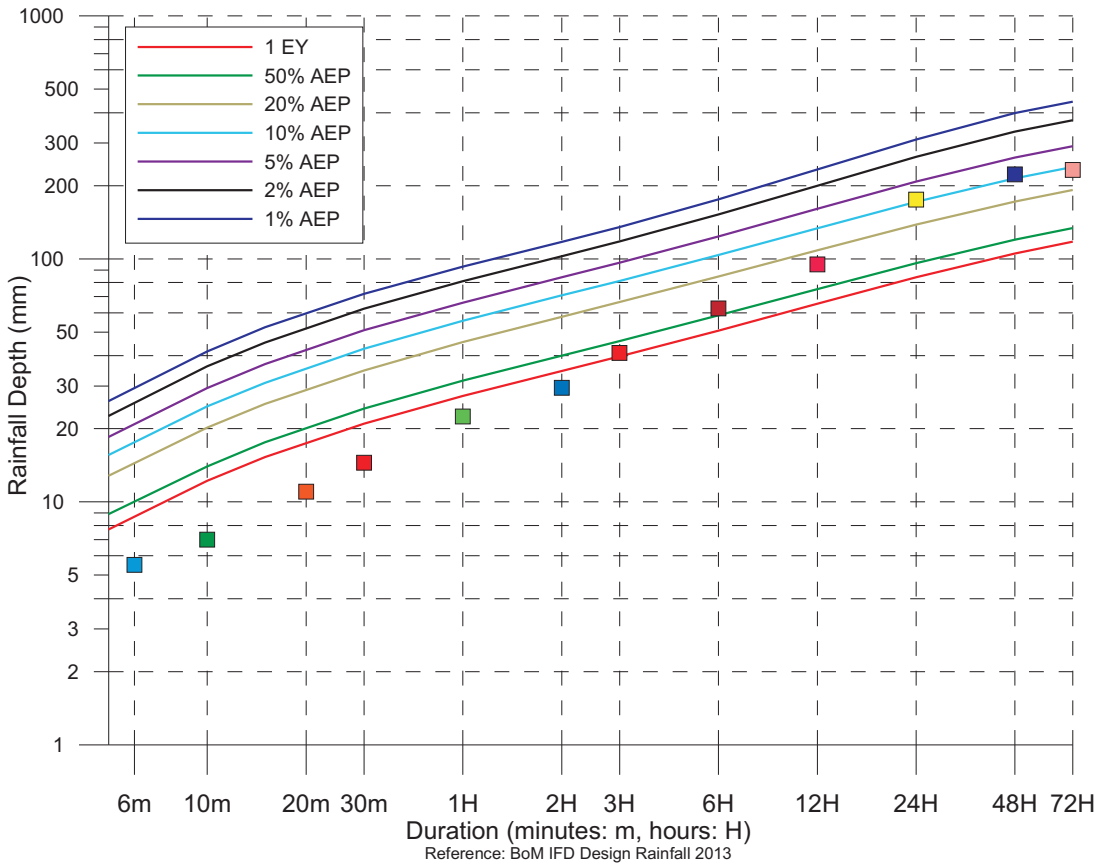
Site owner: BoM Latitude: -32.9117 Longitude: 151.7509

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Hunter Valley Research Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	5.5	01:42_26/04/2015
10m	7.0	20:28_20/04/2015
20m	11.0	20:28_20/04/2015
30m	14.5	20:26_20/04/2015
1H	22.5	20:02_20/04/2015
2H	29.5	15:26_21/04/2015
3H	41.0	14:40_21/04/2015
6H	62.5	13:50_21/04/2015
12H	95.0	08:04_21/04/2015
24H	175.5	19:36_20/04/2015
48H	222.5	07:36_20/04/2015
72H	232.5	01:00_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

HUNTER VALLEY RESEARCH
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

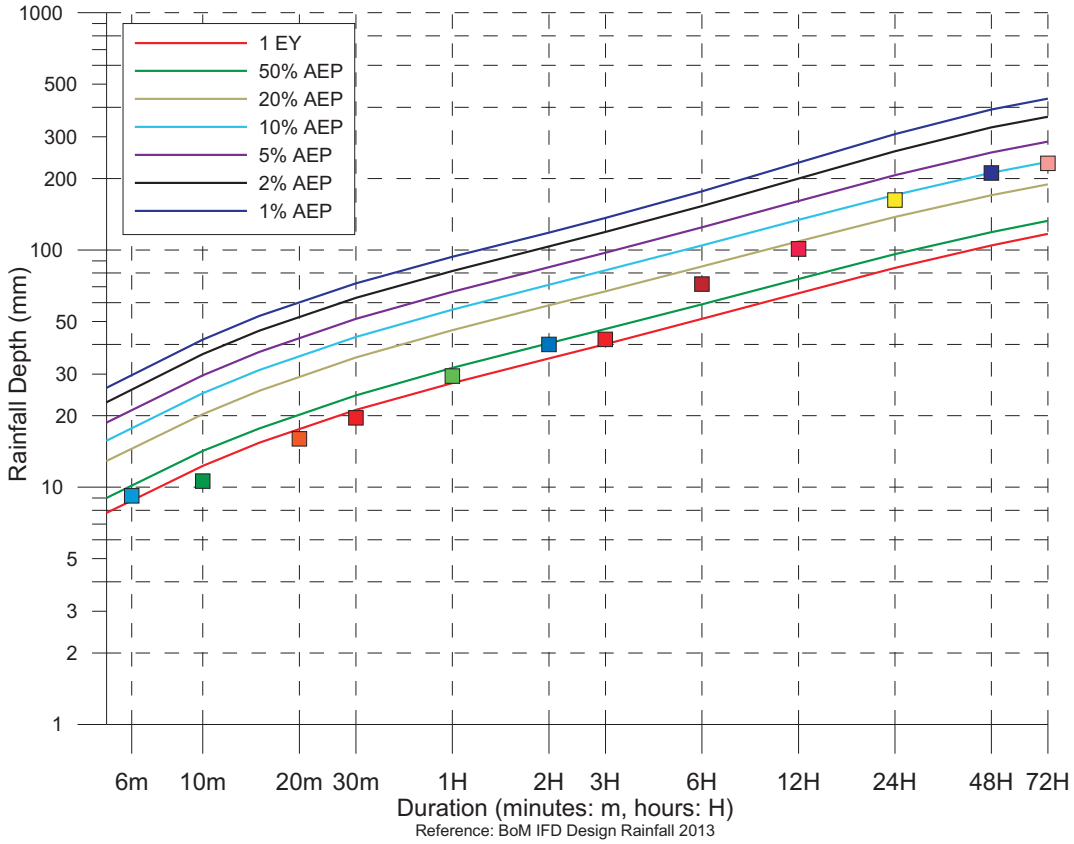
MHL Report 2364

Figure C47

DRAWING 2364-C47

Site owner: HWC Latitude: -32.9107 Longitude: 151.7792

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Stockton 3 WWPS Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
6m		9.2	20:40_20/04/2015
10m		10.6	20:34_20/04/2015
20m		16.0	20:34_20/04/2015
30m		19.6	20:30_20/04/2015
1H		29.4	20:00_20/04/2015
2H		40.0	19:10_20/04/2015
3H		42.0	18:20_20/04/2015
6H		71.8	19:34_20/04/2015
12H		101.0	15:14_20/04/2015
24H		162.4	19:34_20/04/2015
48H		211.2	09:14_20/04/2015
72H		231.4	18:50_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

NSW GOVERNMENT Public Works
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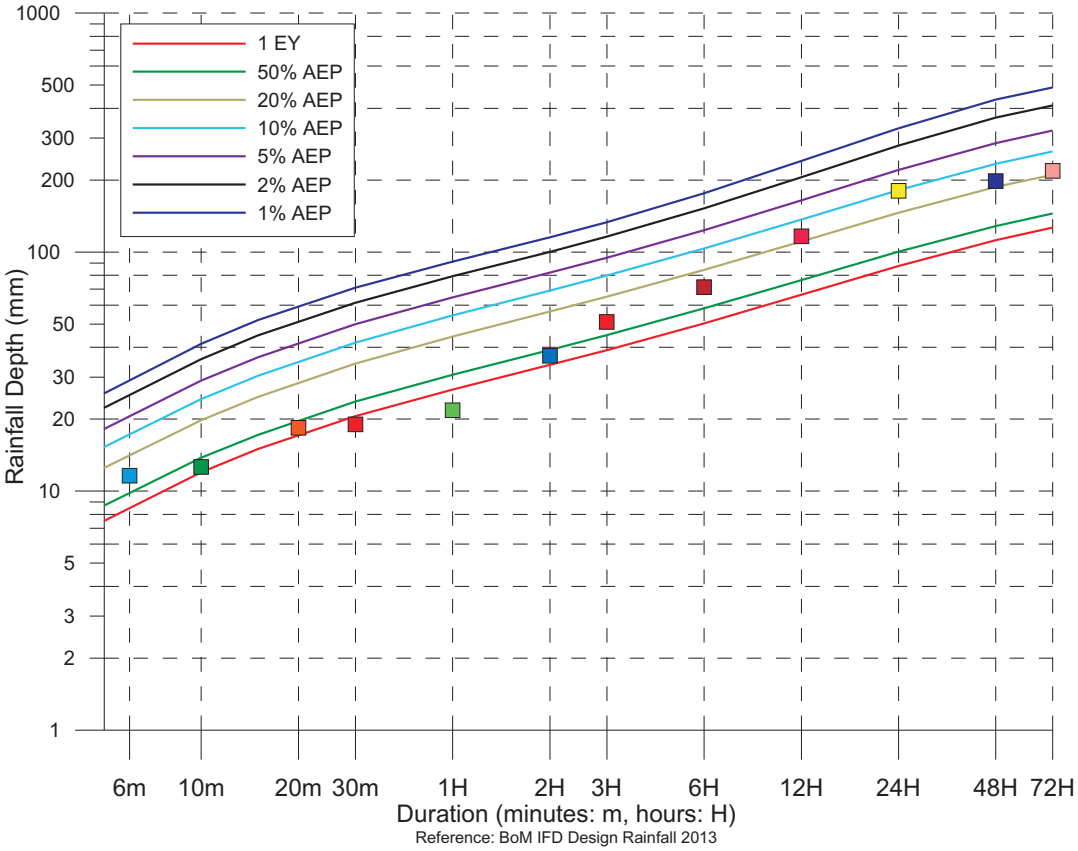
STOCKTON 3
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C48
DRAWING 2364-C48

Site owner: HWC Latitude: -32.9328 Longitude: 151.6898

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Lookout Reservoir Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	11.6	16:04_06/04/2015
10m	12.6	15:58_06/04/2015
20m	18.4	15:54_06/04/2015
30m	19.0	15:48_06/04/2015
1H	21.8	08:38_21/04/2015
2H	36.8	16:08_20/04/2015
3H	51.0	15:24_20/04/2015
6H	71.4	15:24_20/04/2015
12H	116.4	14:18_20/04/2015
24H	180.4	10:24_20/04/2015
48H	198.2	07:24_20/04/2015
72H	218.4	18:38_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

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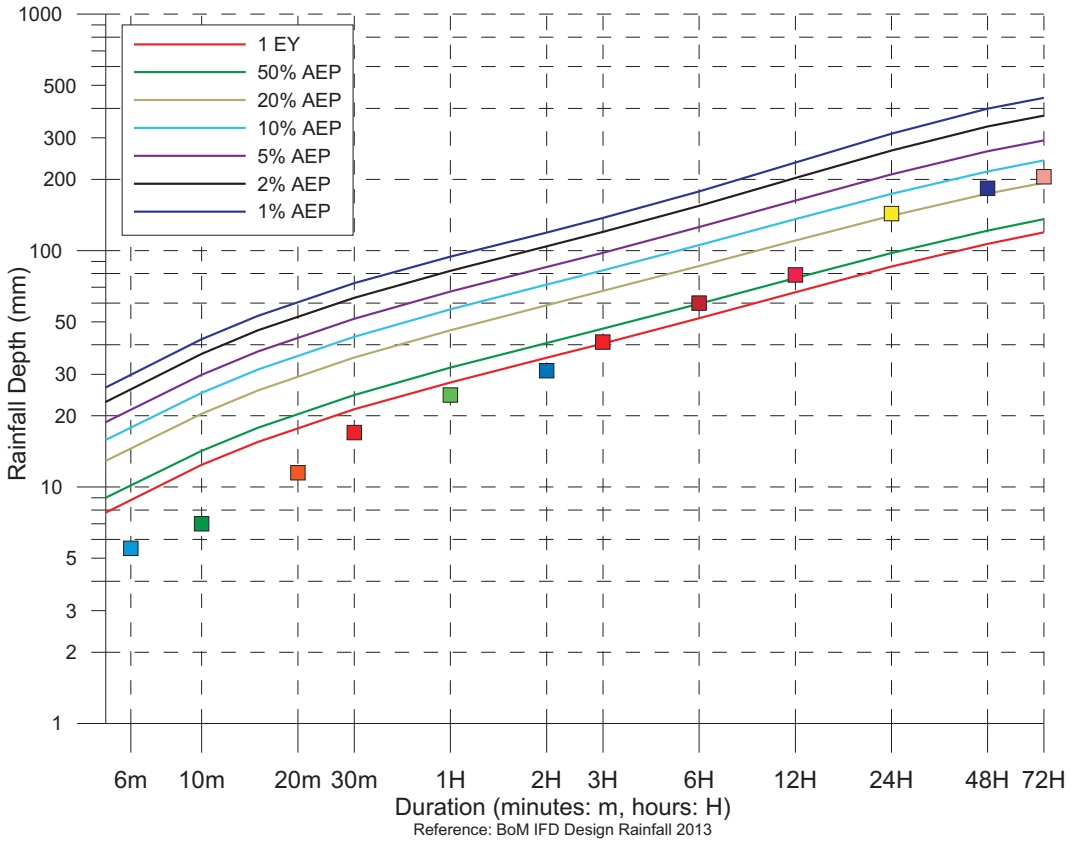
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

LOOKOUT RESERVOIR
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C49
DRAWING 2364-C49

Site owner: BoM Latitude: -32.936 Longitude: 151.7779

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Sheppard's Hill Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	5.5	17:10_21/04/2015
	10m	7.0	17:06_21/04/2015
	20m	11.5	20:16_20/04/2015
	30m	17.0	20:06_20/04/2015
	1H	24.5	19:56_20/04/2015
	2H	31.0	15:20_21/04/2015
	3H	41.0	14:30_21/04/2015
	6H	60.0	13:58_21/04/2015
	12H	79.0	08:08_21/04/2015
	24H	143.5	19:26_20/04/2015
	48H	183.5	17:26_20/04/2015
	72H	205.0	00:26_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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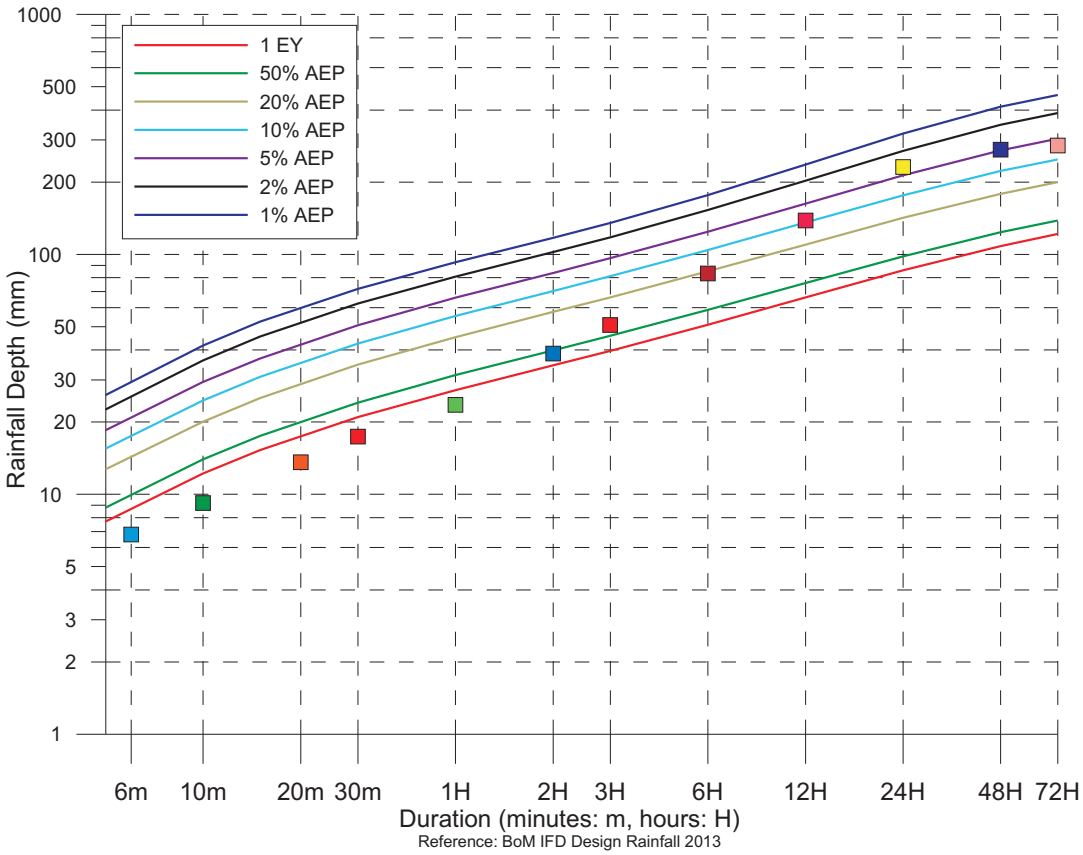
Manly Hydraulics Laboratory

SHEPPARD'S HILL
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C50
DRAWING 2364-C50

Site owner: BoM Latitude: -32.9454 Longitude: 151.748

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Merewether Pump Station Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	6.8	08:48_21/04/2015
	10m	9.2	19:28_21/04/2015
	20m	13.6	17:02_21/04/2015
	30m	17.4	16:52_21/04/2015
	1H	23.6	16:32_21/04/2015
	2H	38.6	15:22_21/04/2015
	3H	50.8	14:32_21/04/2015
	6H	83.2	13:56_21/04/2015
	12H	138.4	08:00_21/04/2015
	24H	231.2	19:58_20/04/2015
	48H	273.4	09:16_20/04/2015
	72H	283.8	00:20_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
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Manly Hydraulics Laboratory

MEREWETHER PUMP STATION
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

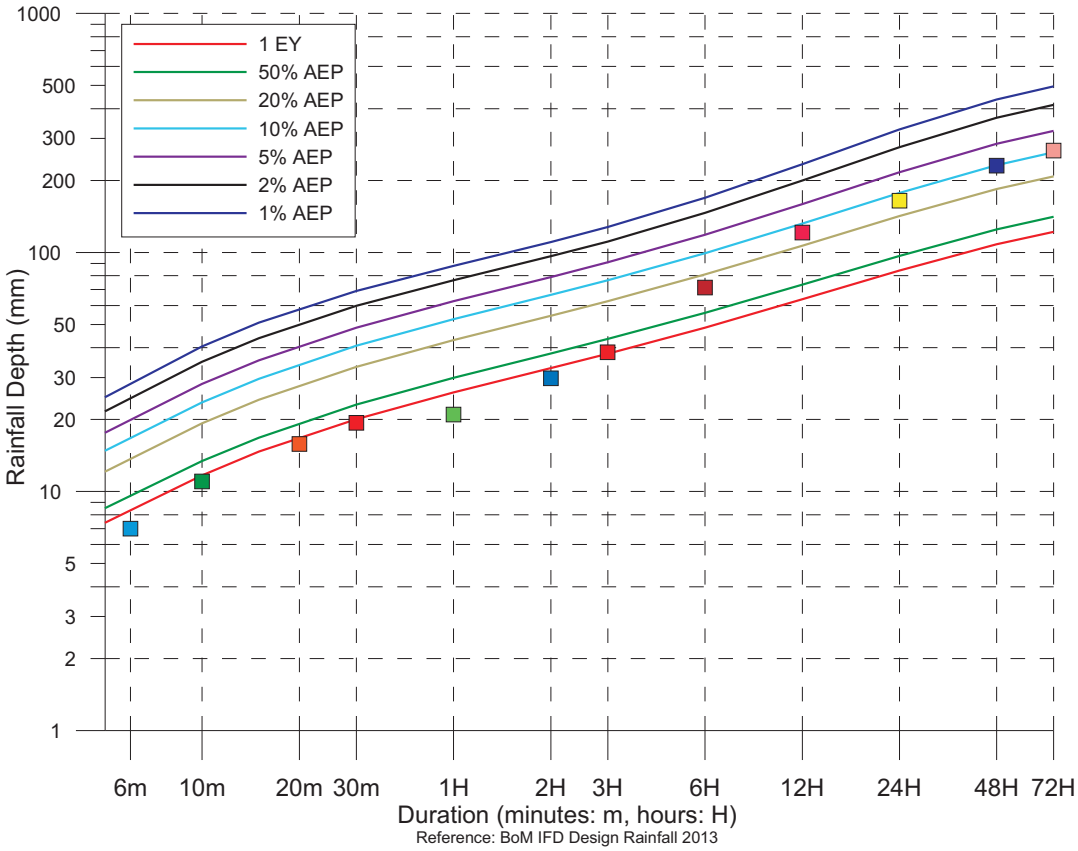
MHL Report 2364

Figure C51

DRAWING 2364-C51

Site owner: HWC Latitude: -32.9321 Longitude: 151.6182

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Edgeworth WWTW Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	7.0	16:00_06/04/2015
	10m	11.0	15:54_06/04/2015
	20m	15.8	15:44_06/04/2015
	30m	19.4	15:40_06/04/2015
	1H	21.0	15:40_06/04/2015
	2H	29.8	20:10_20/04/2015
	3H	38.2	15:44_20/04/2015
	6H	71.2	20:10_20/04/2015
	12H	121.2	14:30_20/04/2015
	24H	164.6	07:34_20/04/2015
	48H	230.8	07:34_20/04/2015
	72H	267.0	19:10_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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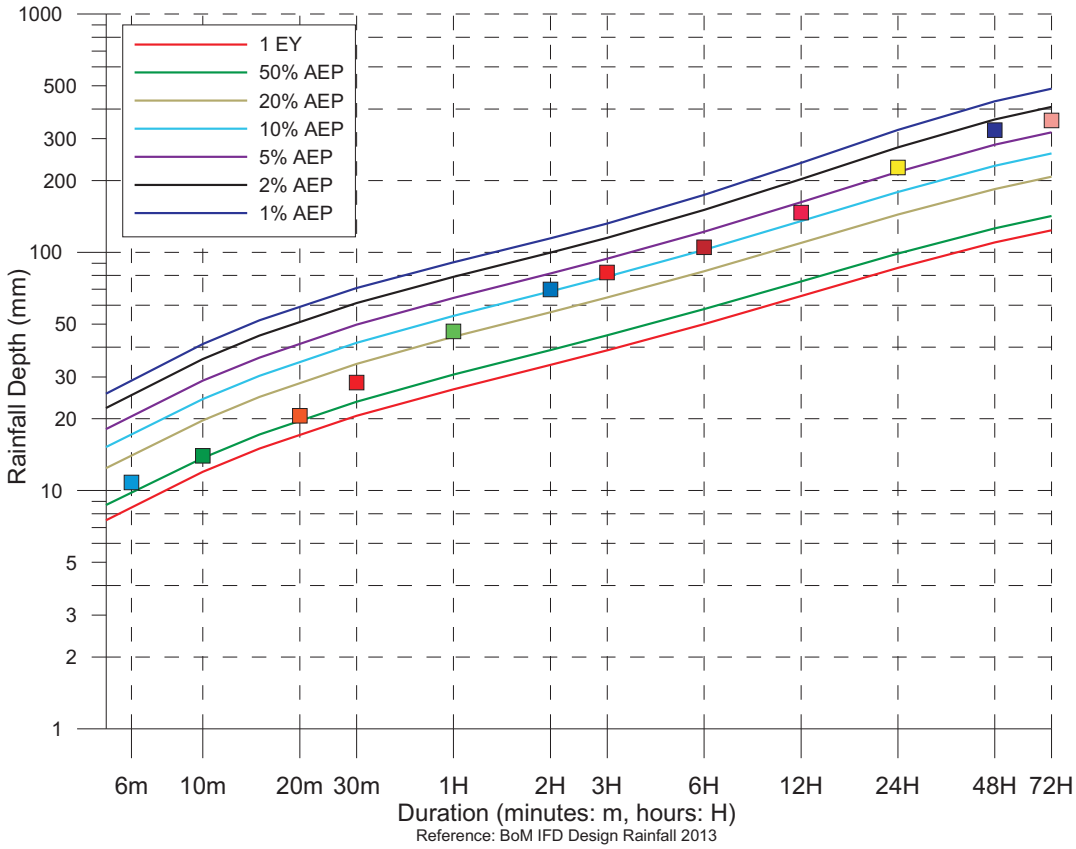
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

EDGEWORTH
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C52
DRAWING 2364-C52

Site owner: HWC Latitude: -32.9581 Longitude: 150.6609

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Cardiff Chlorinator Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	10.8	17:04_20/04/2015
10m	14	09:18_21/04/2015
20m	20.6	16:48_20/04/2015
30m	28.4	16:38_20/04/2015
1H	46.6	16:28_20/04/2015
2H	69.8	15:44_20/04/2015
3H	82.4	15:34_20/04/2015
6H	104.8	15:34_20/04/2015
12H	146.8	14:34_20/04/2015
24H	226.6	15:38_20/04/2015
48H	325.4	05:24_20/04/2015
72H	357.8	18:58_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
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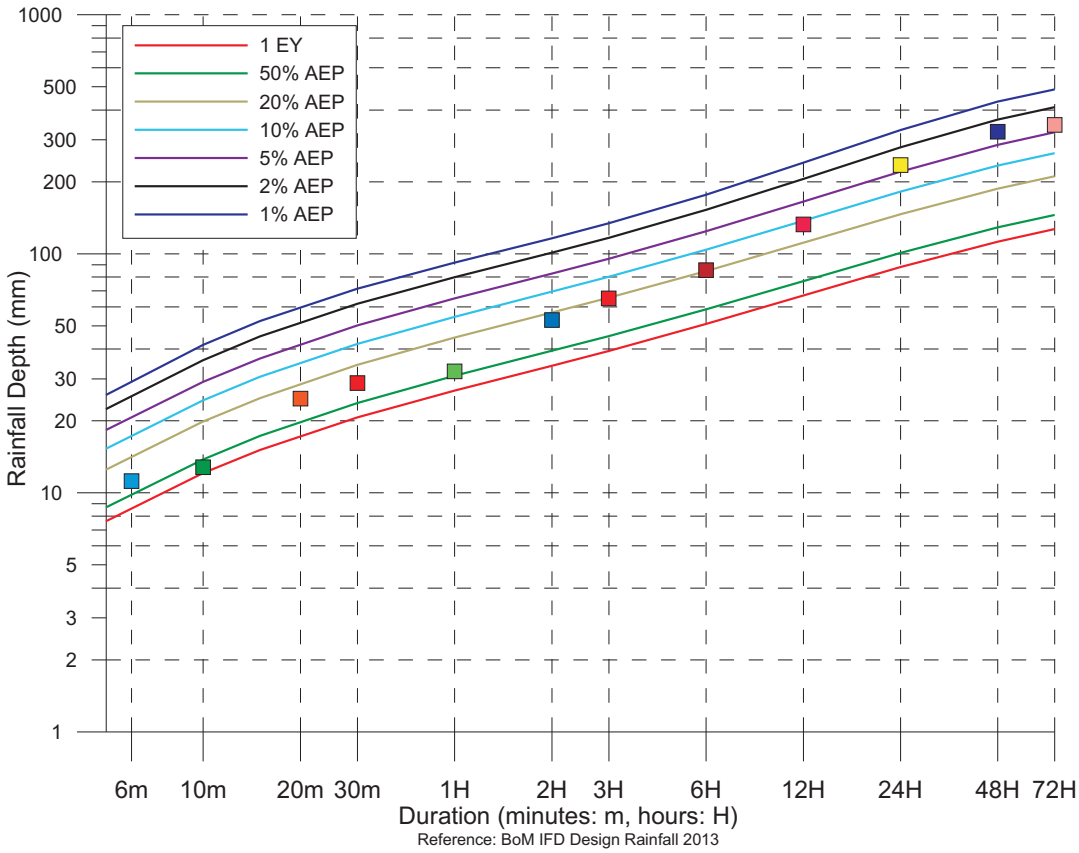
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

CARDIFF
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C53
DRAWING 2364-C53

Site owner: HWC Latitude: -32.9655 Longitude: 151.6945

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Charlestown Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	11.2	16:10_06/04/2015
10m	12.8	16:04_06/04/2015
20m	24.8	16:04_06/04/2015
30m	28.8	16:00_06/04/2015
1H	32.2	15:54_06/04/2015
2H	52.8	16:00_20/04/2015
3H	65.0	15:24_20/04/2015
6H	85.4	15:30_20/04/2015
12H	132.6	08:20_21/04/2015
24H	234.6	15:34_20/04/2015
48H	323.8	06:54_20/04/2015
72H	346.2	18:40_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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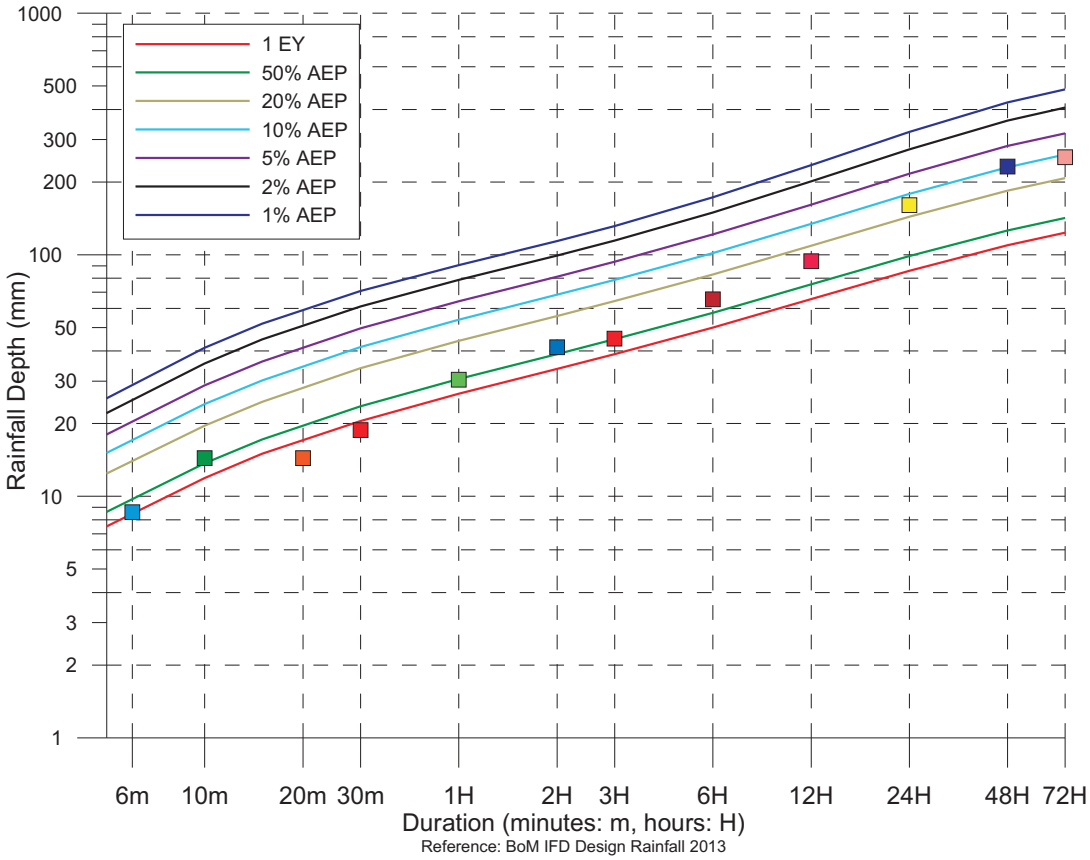
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

CHARLESTOWN BC
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C54
DRAWING 2364-C54

Site owner: HWC Latitude: -32.9946 Longitude: 151.6421

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Eleebana Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
6m		8.6	16:44_20/04/2015
10m		14.4	05:08_21/04/2015
20m		14.4	05:08_21/04/2015
30m		18.8	16:28_20/04/2015
1H		30.4	16:14_20/04/2015
2H		41.4	15:38_20/04/2015
3H		45.0	15:34_20/04/2015
6H		65.4	15:34_20/04/2015
12H		94.2	14:48_20/04/2015
24H		160.6	15:38_20/04/2015
48H		231.4	05:58_20/04/2015
72H		253.6	07:44_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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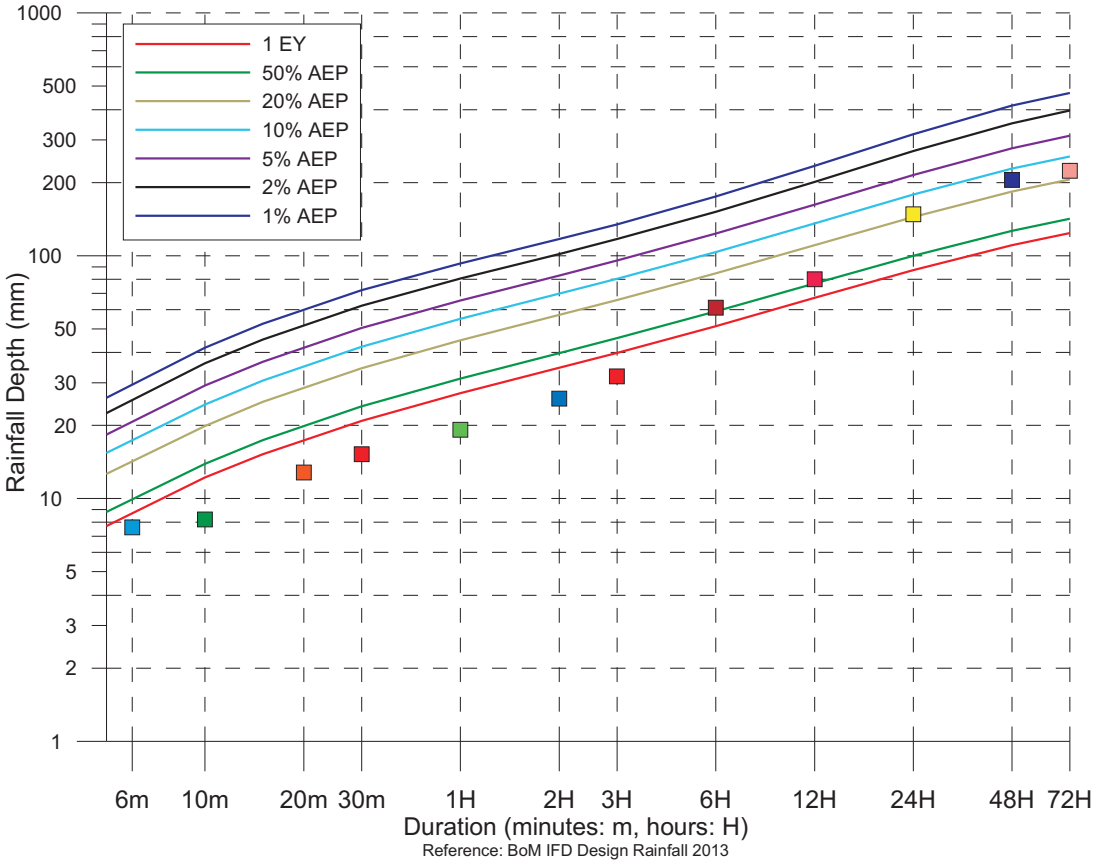
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

ELEEBANA
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C55
DRAWING 2364-C55

Site owner: MHL Latitude: -33.0461 Longitude: 151.6710

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Belmont WWTW Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	7.6	04:04_22/04/2015
10m	8.2	03:58_22/04/2015
20m	12.8	07:28_04/04/2015
30m	15.2	07:18_04/04/2015
1H	19.2	20:28_20/04/2015
2H	25.8	19:54_20/04/2015
3H	31.8	20:08_20/04/2015
6H	61.0	19:58_20/04/2015
12H	80.0	19:04_20/04/2015
24H	148.2	20:08_20/04/2015
48H	205.0	05:08_20/04/2015
72H	224.0	07:24_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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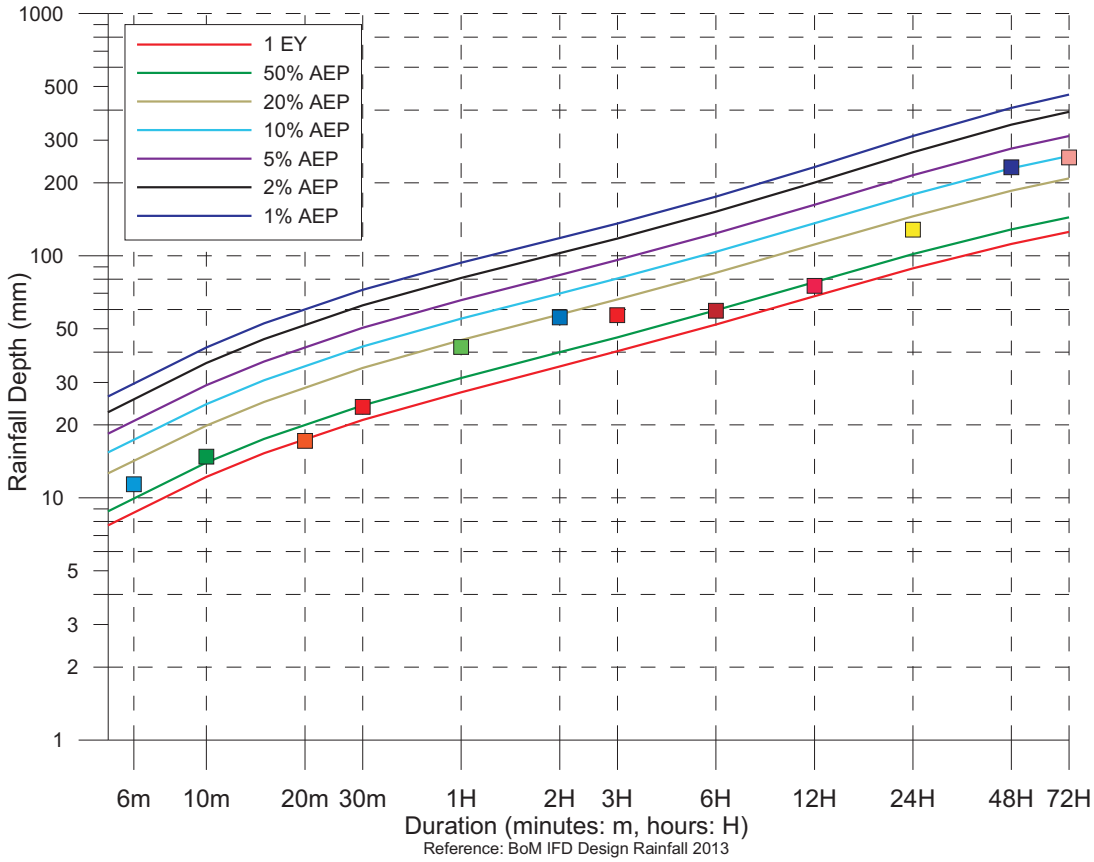
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

BELMONT
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C56
DRAWING 2364-C56

Site owner: BoM Latitude: -33.0798 Longitude: 151.6317

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Swansea 8 WWPS Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	11.4	16:20_22/04/2015
10m	14.8	15:24_06/04/2015
20m	17.2	16:10_22/04/2015
30m	23.8	16:24_22/04/2015
1H	42.0	15:54_22/04/2015
2H	55.6	15:00_22/04/2015
3H	56.8	14:24_22/04/2015
6H	59.2	13:34_22/04/2015
12H	75.2	03:10_04/04/2015
24H	128.2	20:50_20/04/2015
48H	231.8	17:24_20/04/2015
72H	254.8	20:24_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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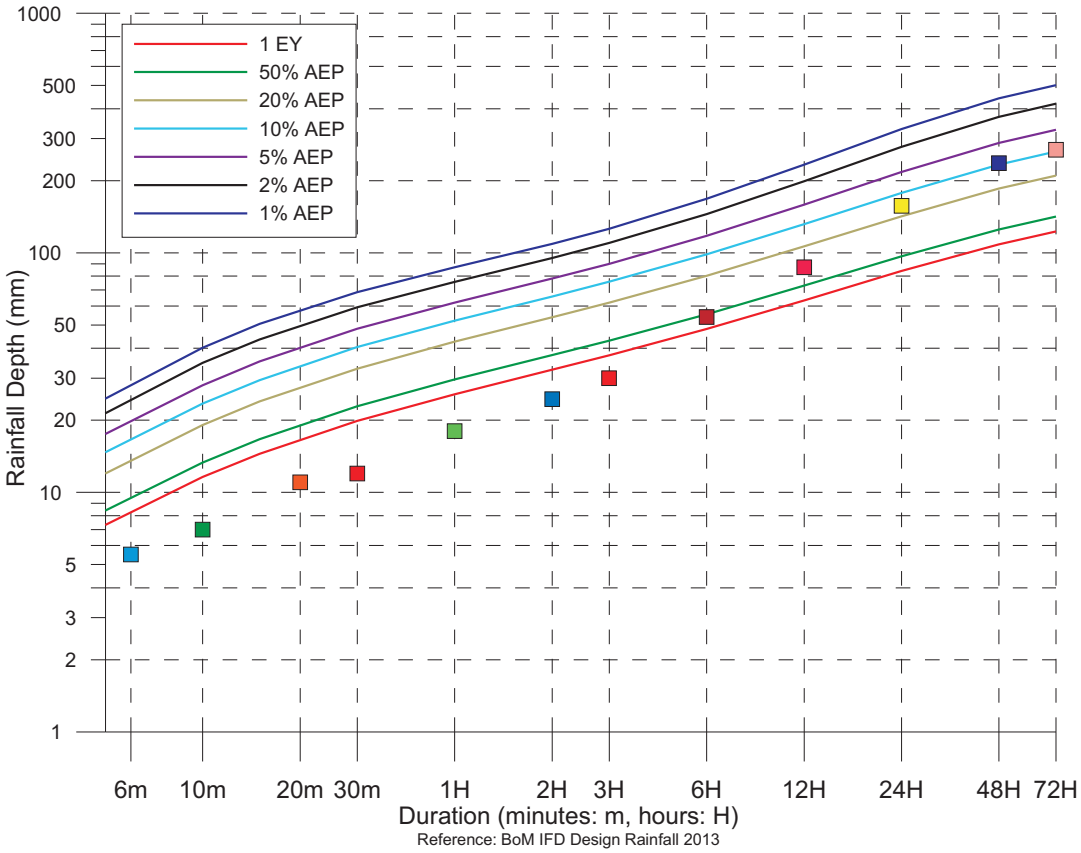
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

SWANSEA 8
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C57
DRAWING 2364-C57

Site owner: MHL Latitude: -32.9275 Longitude: 151.5855

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Barnsley Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	5.5	15:50_06/04/2015
	10m	7.0	17:04_22/04/2015
	20m	11.0	00:12_22/04/2015
	30m	12.0	00:12_22/04/2015
	1H	18.0	16:18_22/04/2015
	2H	24.5	20:16_20/04/2015
	3H	30.0	19:04_20/04/2015
	6H	54.0	20:16_20/04/2015
	12H	87.0	14:16_20/04/2015
	24H	157.0	17:44_20/04/2015
	48H	236.5	07:36_20/04/2015
	72H	269.5	08:08_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

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BARNSLEY
INTENSITY-FREQUENCY-DURATION
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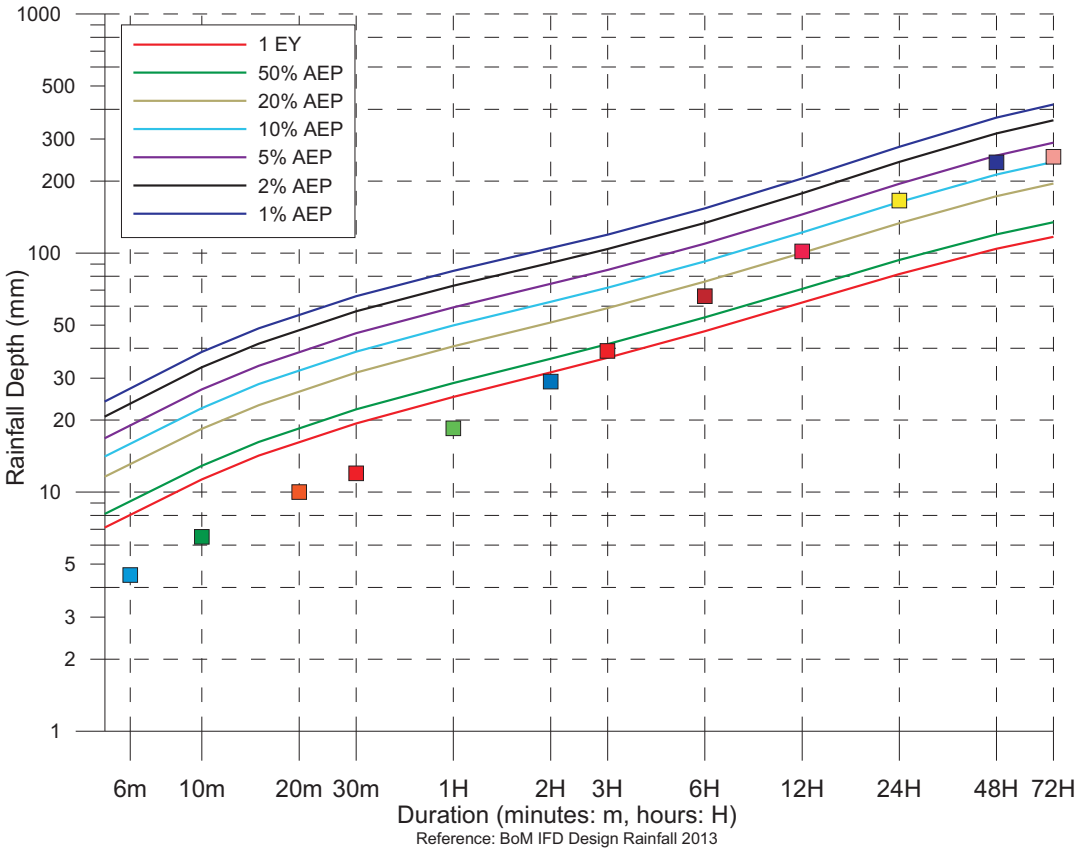
MHL Report 2364
Figure C58
DRAWING 2364-C58

Site owner: MHL Latitude: -33.0541 Longitude: 151.4066

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Martinsville Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	4.5	06:22_04/04/2015
	10m	6.5	06:18_04/04/2015
	20m	10.0	06:18_04/04/2015
	30m	12.0	06:18_04/04/2015
	1H	18.5	06:18_04/04/2015
	2H	29.0	20:12_20/04/2015
	3H	39.0	06:18_04/04/2015
	6H	66.0	20:00_20/04/2015
	12H	101.5	03:22_04/04/2015
	24H	165.5	16:42_20/04/2015
	48H	239.5	07:00_20/04/2015
	72H	252.5	01:38_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

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MARTINSVILLE
INTENSITY-FREQUENCY-DURATION
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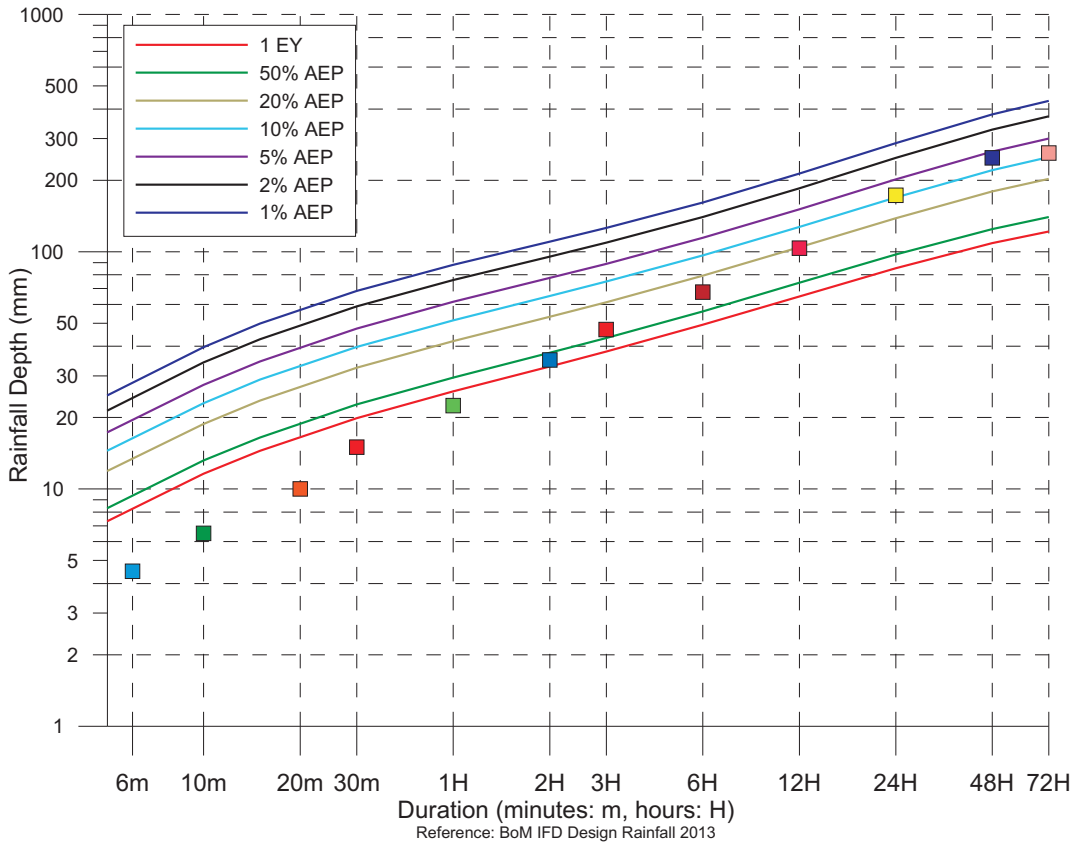
MHL Report 2364
Figure C59
DRAWING 2364-C59

Site owner: MHL Latitude: -33.1125 Longitude: 151.4483

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Mandalong Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
6m		4.5	21:22_21/04/2015
10m		6.5	21:22_21/04/2015
20m		10.0	21:28_20/04/2015
30m		15.0	21:04_21/04/2015
1H		22.5	21:08_20/04/2015
2H		35.0	20:08_20/04/2015
3H		47.0	20:36_21/04/2015
6H		67.5	20:08_20/04/2015
12H		103.5	11:38_21/04/2015
24H		173.0	23:40_20/04/2015
48H		249.0	07:44_20/04/2015
72H		260.5	01:44_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
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MANDALONG
INTENSITY-FREQUENCY-DURATION
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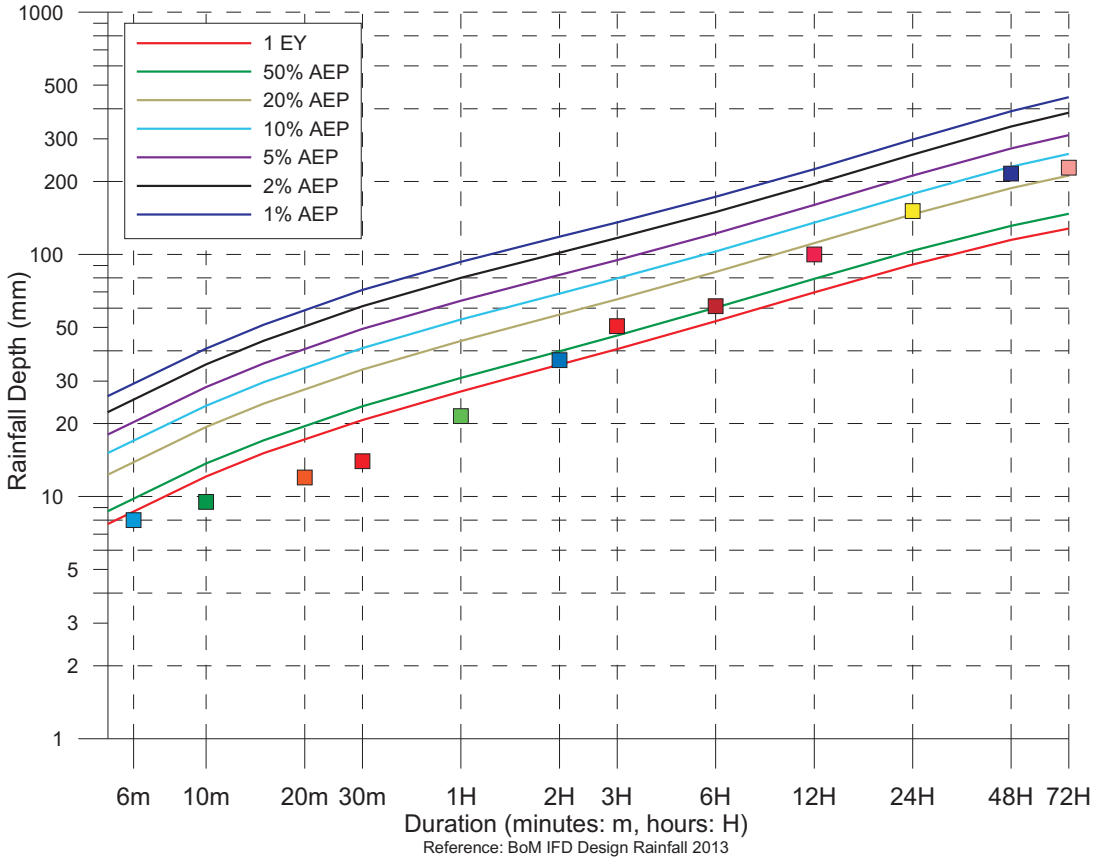
MHL Report 2364
Figure C60
DRAWING 2364-C60

Site owner: MHL Latitude: -33.1752 Longitude: 151.4835

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Wyee Basin Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	8.0	01:24_04/04/2015
	10m	9.5	01:20_04/04/2015
	20m	12.0	01:12_04/04/2015
	30m	14.0	20:56_21/04/2015
	1H	21.5	20:58_20/04/2015
	2H	36.5	20:16_21/04/2015
	3H	50.5	20:14_21/04/2015
	6H	61.0	20:00_20/04/2015
	12H	100.0	01:16_04/04/2015
	24H	151.0	23:22_20/04/2015
	48H	215.5	01:48_20/04/2015
	72H	228.0	22:36_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

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WYEE BASIN
INTENSITY-FREQUENCY-DURATION
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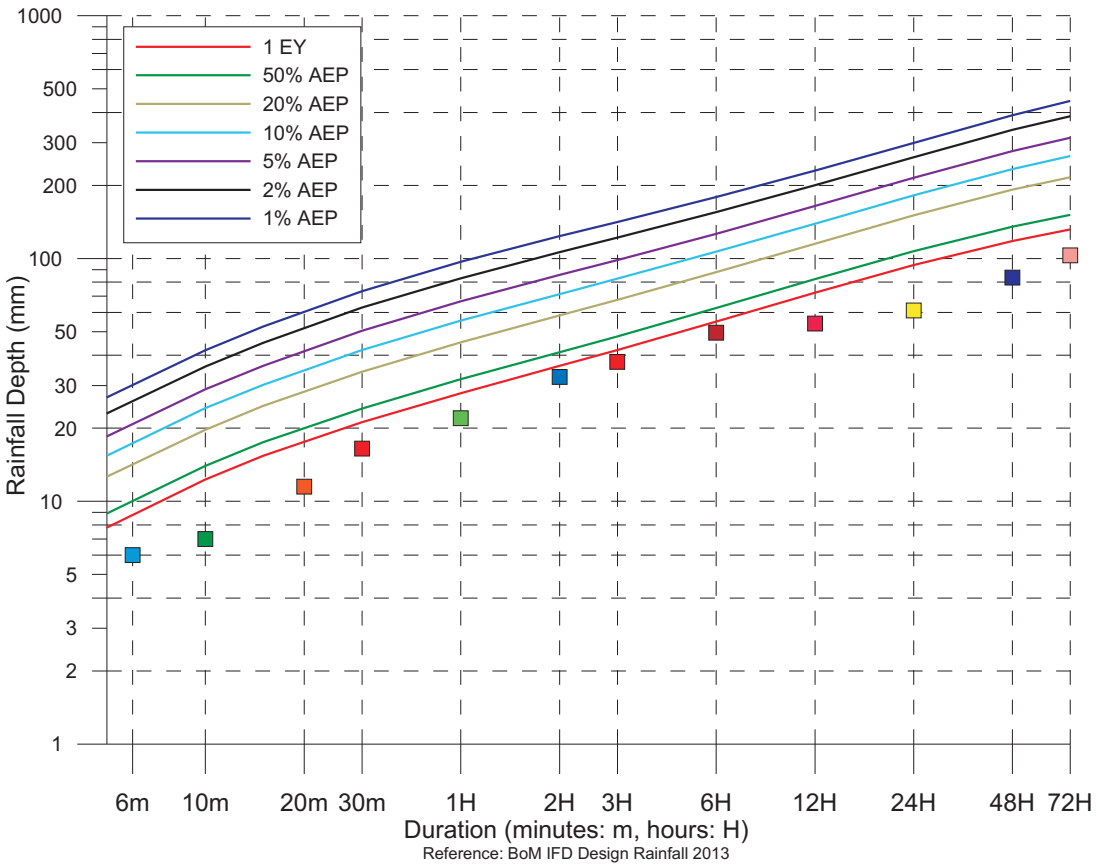
MHL Report 2364
Figure C61
DRAWING 2364-C61

Site owner: MHL Latitude: -33.2635 Longitude: 151.5248

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Toukley Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	6.0	23:48_30/04/2015
10m	7.0	23:44_30/04/2015
20m	11.5	16:50_02/05/2015
30m	16.5	16:46_02/05/2015
1H	22.0	16:40_02/05/2015
2H	32.5	16:40_02/05/2015
3H	37.5	16:02_02/05/2015
6H	49.5	15:00_02/05/2015
12H	54.0	10:52_02/05/2015
24H	61.0	15:54_03/04/2015
48H	83.5	22:06_30/04/2015
72H	103.0	22:00_29/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
- The use of Average Recurrence Interval (ARI) is discouraged as it is problematic for frequent events in seasonal climates and leads to confusion with the public for rare events.

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TOUKLEY
INTENSITY-FREQUENCY-DURATION
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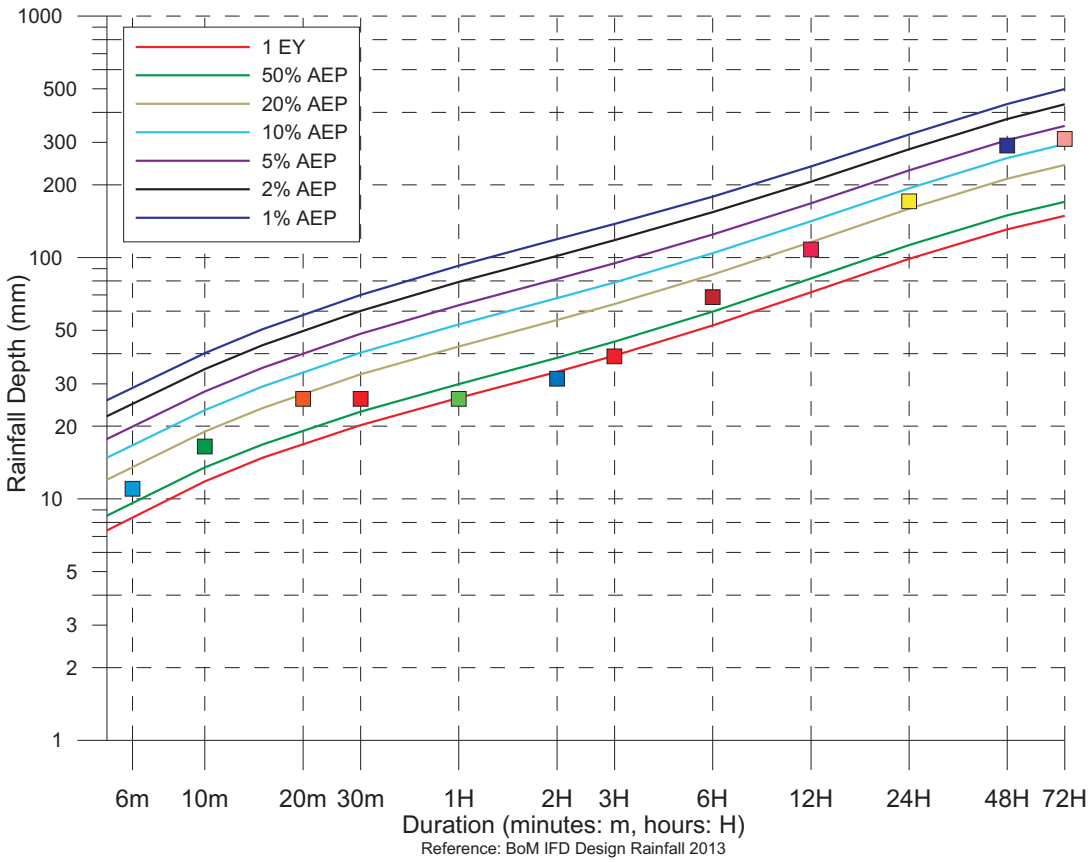
MHL Report 2364
Figure C62
DRAWING 2364-C62

Site owner: MHL Latitude: -33.2890 Longitude: 151.3078

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Sterland Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
6m		11.0	14:12_06/04/2015
10m		16.5	14:12_06/04/2015
20m		26.0	14:06_06/04/2015
30m		26.0	14:06_06/04/2015
1H		26.0	14:06_06/04/2015
2H		31.5	19:32_20/04/2015
3H		39.0	19:30_20/04/2015
6H		68.5	19:30_20/04/2015
12H		108.0	19:30_20/04/2015
24H		171.0	19:30_20/04/2015
48H		291.5	06:38_20/04/2015
72H		310.0	02:22_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
- Events that are more frequent than those with a 50% AEP will be expressed as X Exceedances per Year (EY). For example, a design event (rainfall or flood) with a 6 month recurrence interval will be expressed as having 2 Exceedances per Year (2EY).
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NSW GOVERNMENT Public Works
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STERLAND
INTENSITY-FREQUENCY-DURATION
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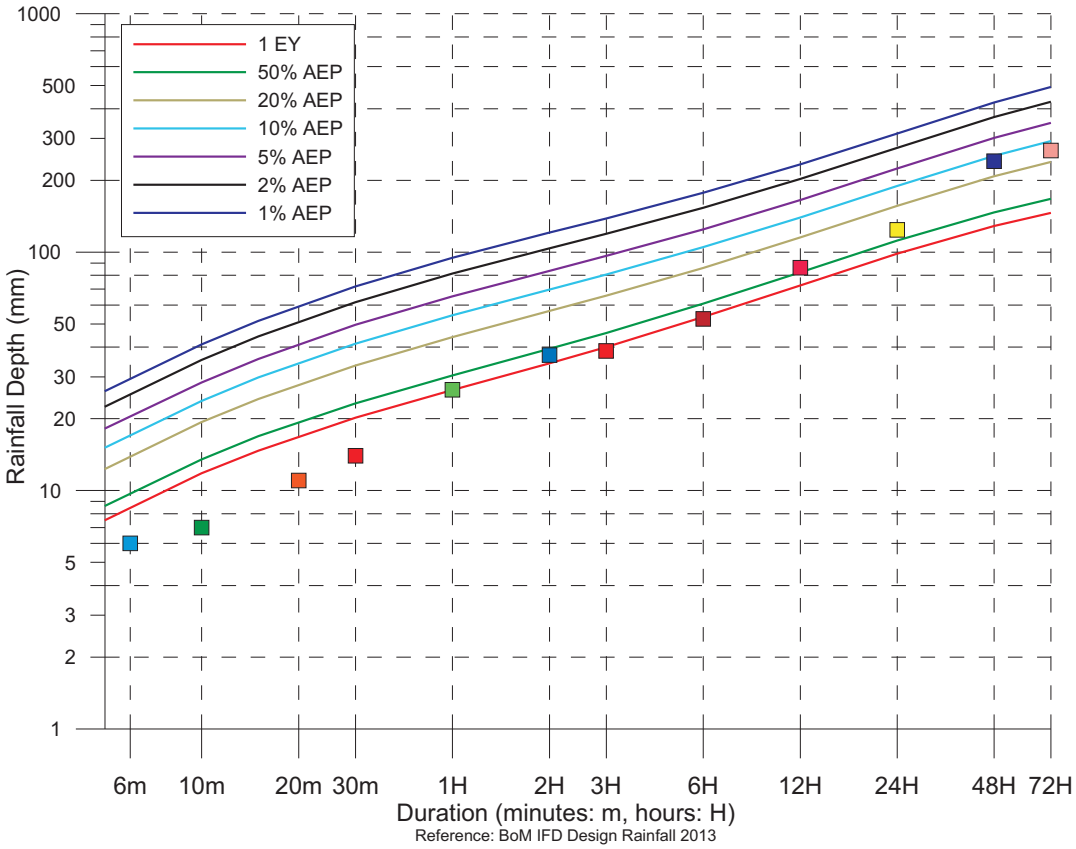
MHL Report 2364
Figure C63
DRAWING 2364-C63

Site owner: MHL Latitude: -33.3782 Longitude: 151.3377

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Strickland Forest Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	6.0	19:28_20/04/2015
	10m	7.0	19:28_20/04/2015
	20m	11.0	05:32_22/04/2015
	30m	14.0	05:26_22/04/2015
	1H	26.5	04:48_22/04/2015
	2H	37.0	04:48_22/04/2015
	3H	38.5	04:48_22/04/2015
	6H	52.5	19:24_20/04/2015
	12H	86.0	18:18_21/04/2015
	24H	124.0	10:54_21/04/2015
	48H	240.5	08:12_20/04/2015
	72H	266.5	04:24_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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STRICKLAND FOREST
INTENSITY-FREQUENCY-DURATION
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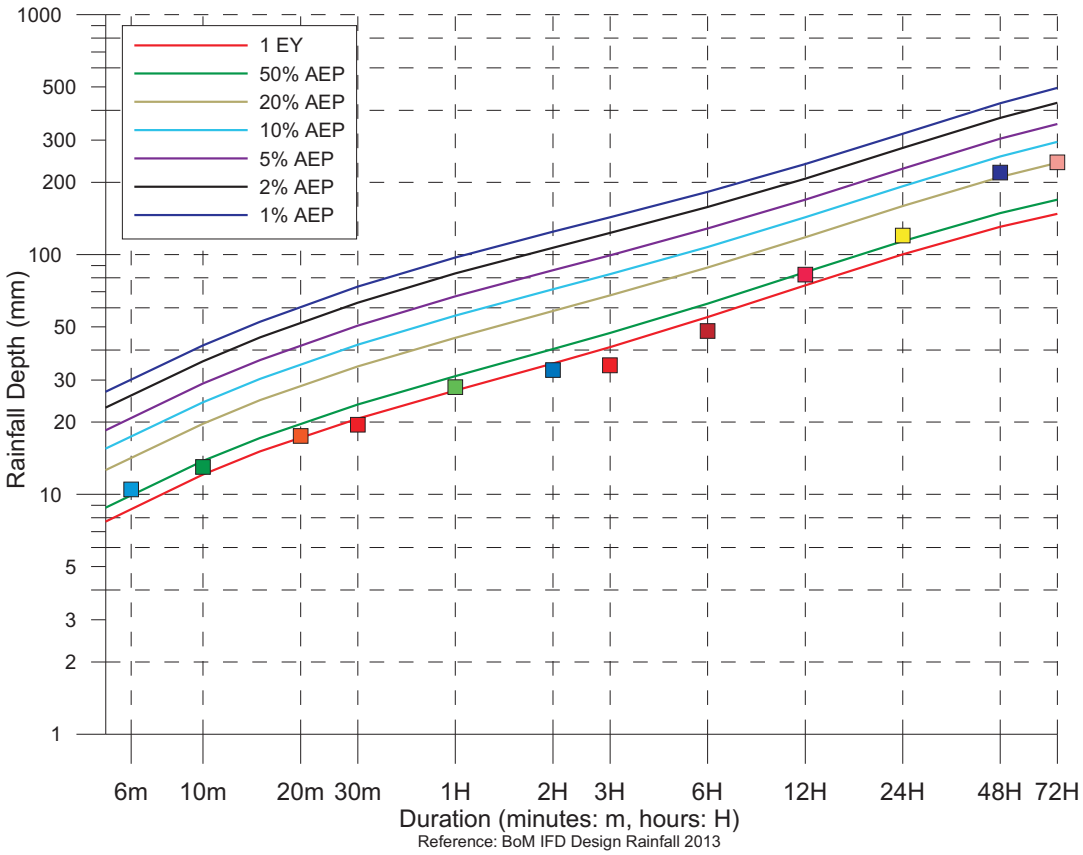
MHL Report 2364
Figure C64
DRAWING 2364-C64

Site owner: MHL Latitude: -33.3814 Longitude: 151.3759

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Lisarow Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	10.5	04:44_22/04/2015
10m	13.0	04:44_22/04/2015
20m	17.5	04:44_22/04/2015
30m	19.5	04:44_22/04/2015
1H	28.0	04:44_22/04/2015
2H	33.0	04:44_22/04/2015
3H	34.5	04:44_22/04/2015
6H	48.0	18:12_21/04/2015
12H	82.5	18:08_21/04/2015
24H	120.0	08:26_21/04/2015
48H	219.5	08:06_20/04/2015
72H	242.5	23:36_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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LISAROW
INTENSITY-FREQUENCY-DURATION
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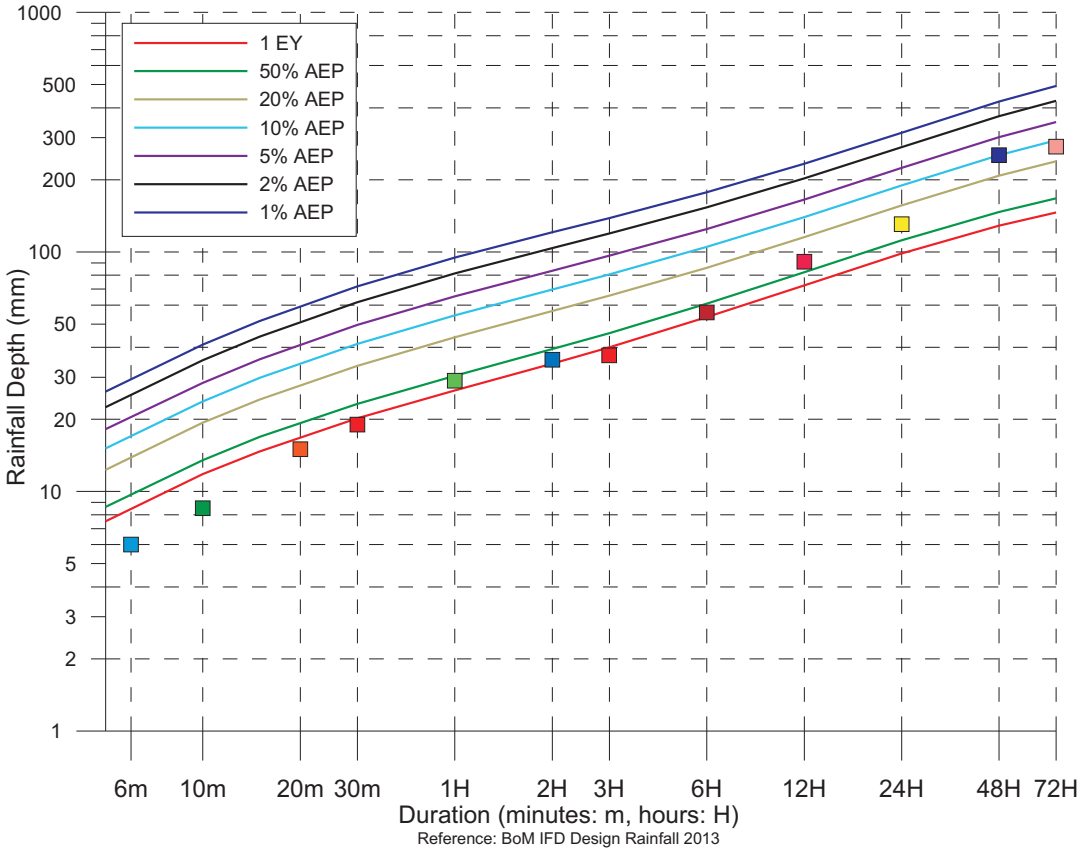
MHL Report 2364
Figure C65
DRAWING 2364-C65

Site owner: MHL Latitude: -33.3926 Longitude: 151.3284

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Narara Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	6.0	06:04_22/04/2015
10m	8.5	05:30_22/04/2015
20m	15.0	05:30_22/04/2015
30m	19.0	05:30_22/04/2015
1H	29.0	05:14_22/04/2015
2H	35.5	04:52_22/04/2015
3H	37.0	04:52_22/04/2015
6H	56.0	19:16_20/04/2015
12H	91.0	16:42_20/04/2015
24H	130.5	16:38_20/04/2015
48H	253.5	08:12_20/04/2015
72H	275.5	02:46_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
- The term Annual Exceedance Probability (AEP) will be used for design events (rainfalls and floods) including and rarer (less frequent) than those with a 10% AEP.
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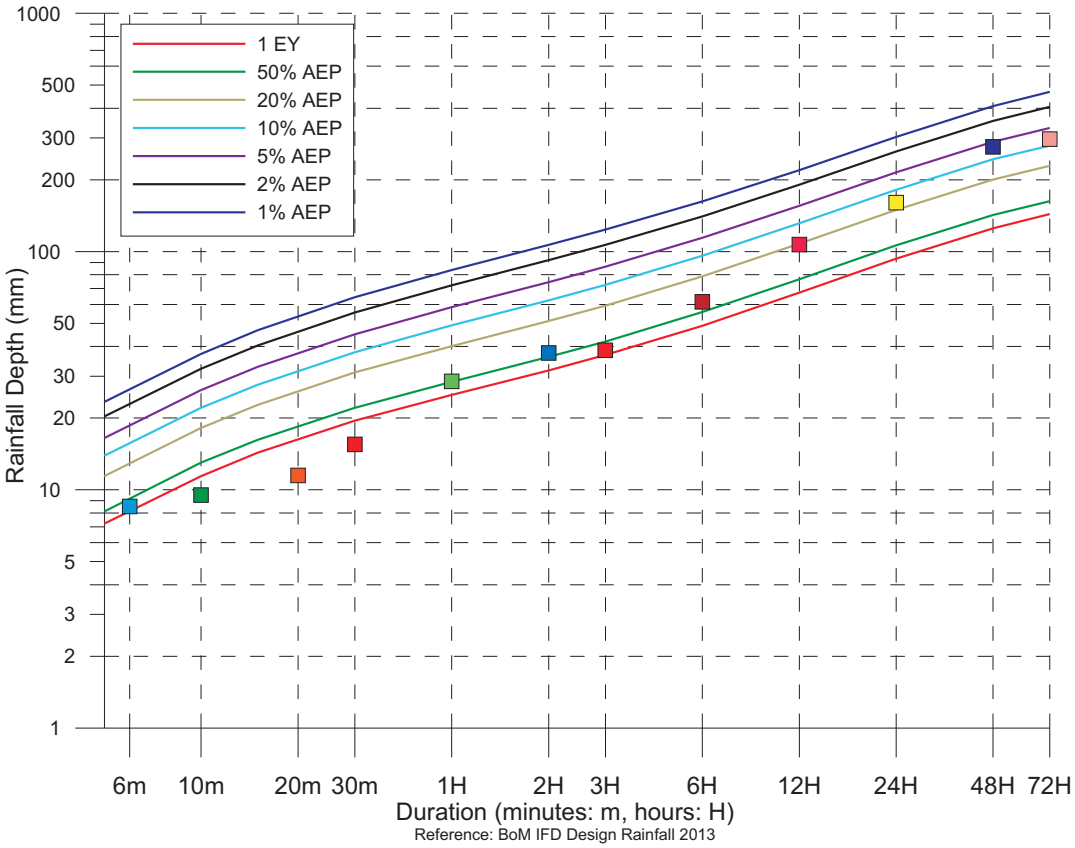
Site owner: MHL Latitude: -33.2325 Longitude: 151.2162

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Kulnura Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	8.5	16:52_25/04/2015
	10m	9.5	16:52_25/04/2015
	20m	11.5	17:02_02/05/2015
	30m	15.5	05:02_22/04/2015
	1H	28.5	05:02_22/04/2015
	2H	37.5	04:44_22/04/2015
	3H	38.5	03:38_22/04/2015
	6H	61.5	19:46_20/04/2015
	12H	107.0	14:40_20/04/2015
	24H	160.5	15:14_20/04/2015
	48H	275.0	07:52_20/04/2015
	72H	296.0	22:46_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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KULNURA
INTENSITY-FREQUENCY-DURATION
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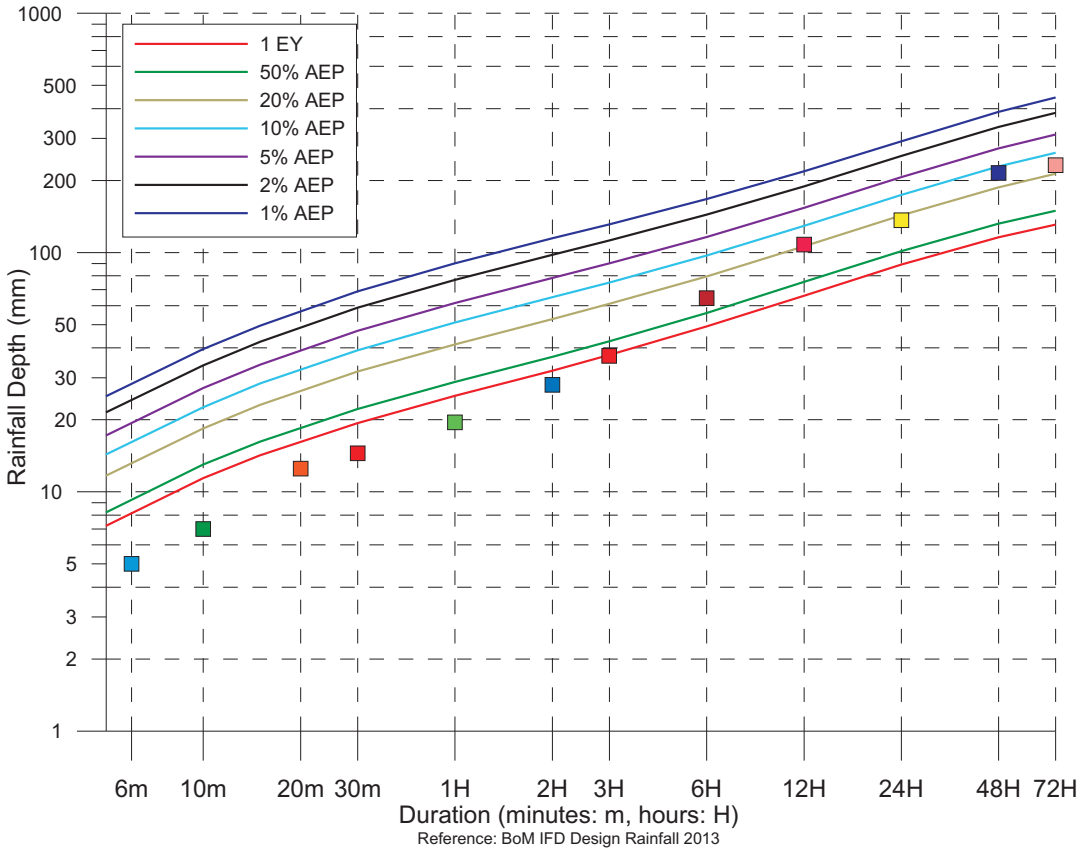
MHL Report 2364
Figure C67
DRAWING 2364-C67

Site owner: MHL Latitude: -33.2035 Longitude: 151.3227

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Whitemans Ridge Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	5.0	16:56_02/05/2015
	10m	7.0	04:54_22/04/2015
	20m	12.5	16:42_02/05/2015
	30m	14.5	16:40_02/05/2015
	1H	19.5	03:34_04/04/2015
	2H	28.0	03:18_04/04/2015
	3H	37.0	03:52_04/04/2015
	6H	64.5	03:30_04/04/2015
	12H	108.0	03:30_04/04/2015
	24H	136.5	21:04_03/04/2015
	48H	215.0	06:30_20/04/2015
	72H	231.5	23:12_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

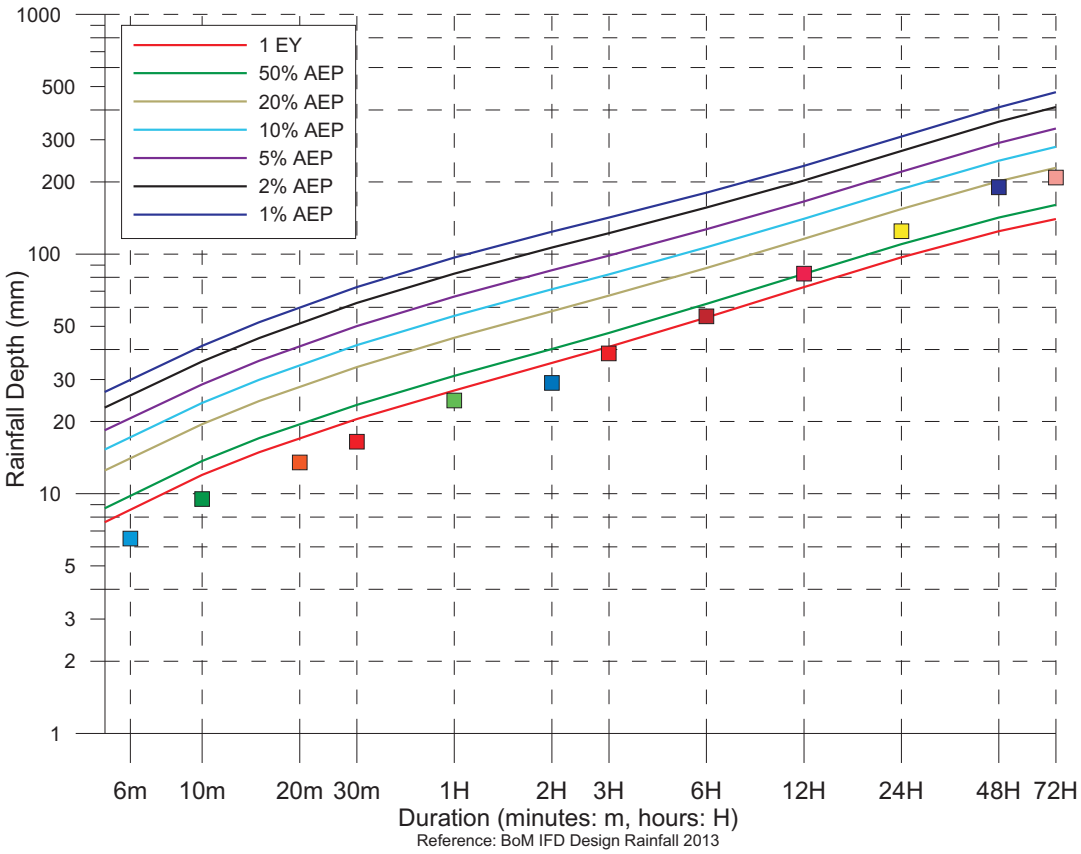
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

WHITEMANS RIDGE
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C68
DRAWING 2364-C68

Site owner: MHL Latitude: -33.3333 Longitude: 151.3900

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Kangy Angy Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		**Rainfall Depth (mm)**	**Time/Date**
	6m	6.5	14:24_06/04/2015
	10m	9.5	14:26_06/04/2015
	20m	13.5	04:38_22/04/2015
	30m	16.5	04:38_22/04/2015
	1H	24.5	04:38_22/04/2015
	2H	29.0	21:18_21/04/2015
	3H	38.5	21:18_21/04/2015
	6H	55.0	18:14_21/04/2015
	12H	83.0	18:08_21/04/2015
	24H	124.5	06:00_21/04/2015
	48H	190.0	06:46_20/04/2015
	72H	208.5	00:22_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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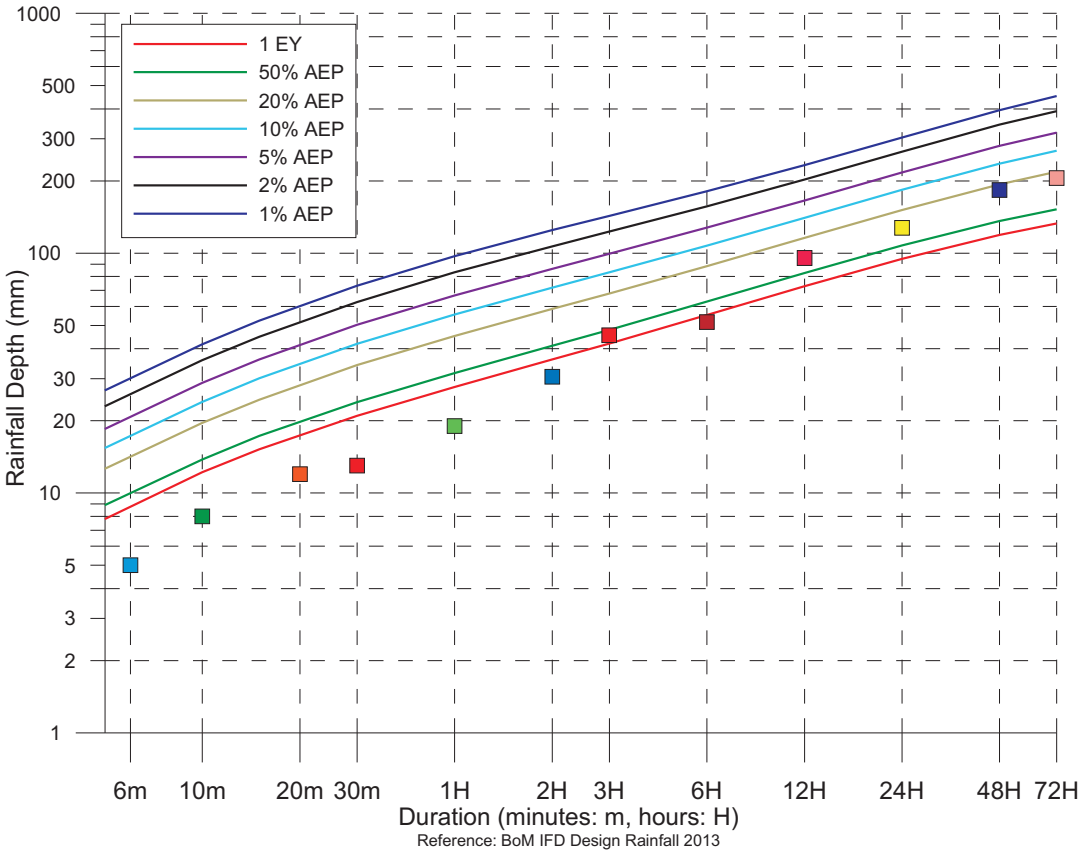
Site owner: MHL Latitude: -33.2509 Longitude: 151.4692

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Hamlyn Terrace Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	5.0	17:22_22/04/2015
	10m	8.0	17:18_22/04/2015
	20m	12.0	17:12_22/04/2015
	30m	13.0	22:36_21/04/2015
	1H	19.0	20:46_21/04/2015
	2H	30.5	21:08_21/04/2015
	3H	45.5	20:08_21/04/2015
	6H	46.5	20:08_21/04/2015
	12H	51.5	18:30_21/04/2015
	24H	95.5	02:44_04/04/2015
	48H	117.0	23:48_03/04/2015
	72H	127.5	23:06_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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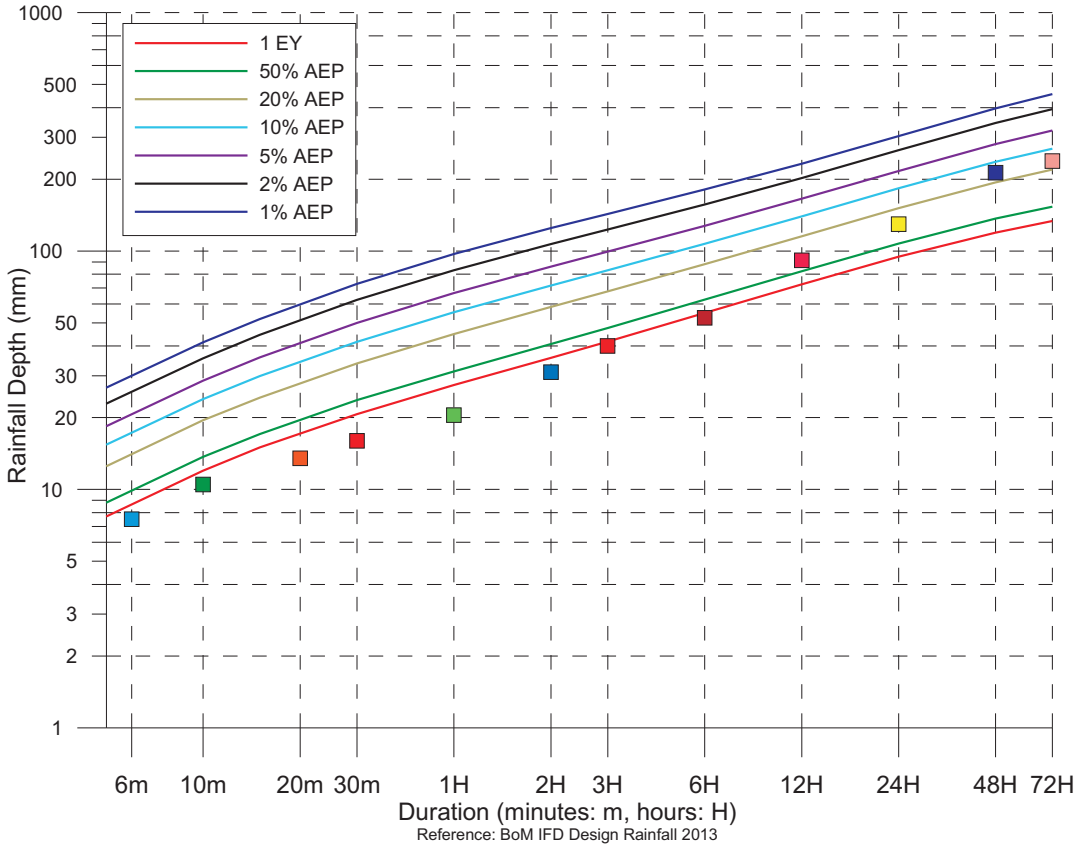
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

HAMLYN TERRACE
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C70
DRAWING 2364-C70

Site owner: MHL Latitude: -33.2978 Longitude: 151.4001

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Mardi Dam Rainfall Depth 01 April 2015 – 05 May 2015			
	Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
	6m	7.5	04:28_22/04/2015
	10m	10.5	04:28_22/04/2015
	20m	13.5	04:24_22/04/2015
	30m	16.0	04:26_22/04/2015
	1H	20.5	04:24_22/04/2015
	2H	31.0	21:06_21/04/2015
	3H	40.0	20:40_21/04/2015
	6H	52.5	18:02_21/04/2015
	12H	91.5	02:36_04/04/2015
	24H	129.5	23:06_20/04/2015
	48H	213.0	06:34_20/04/2015
	72H	238.5	04:08_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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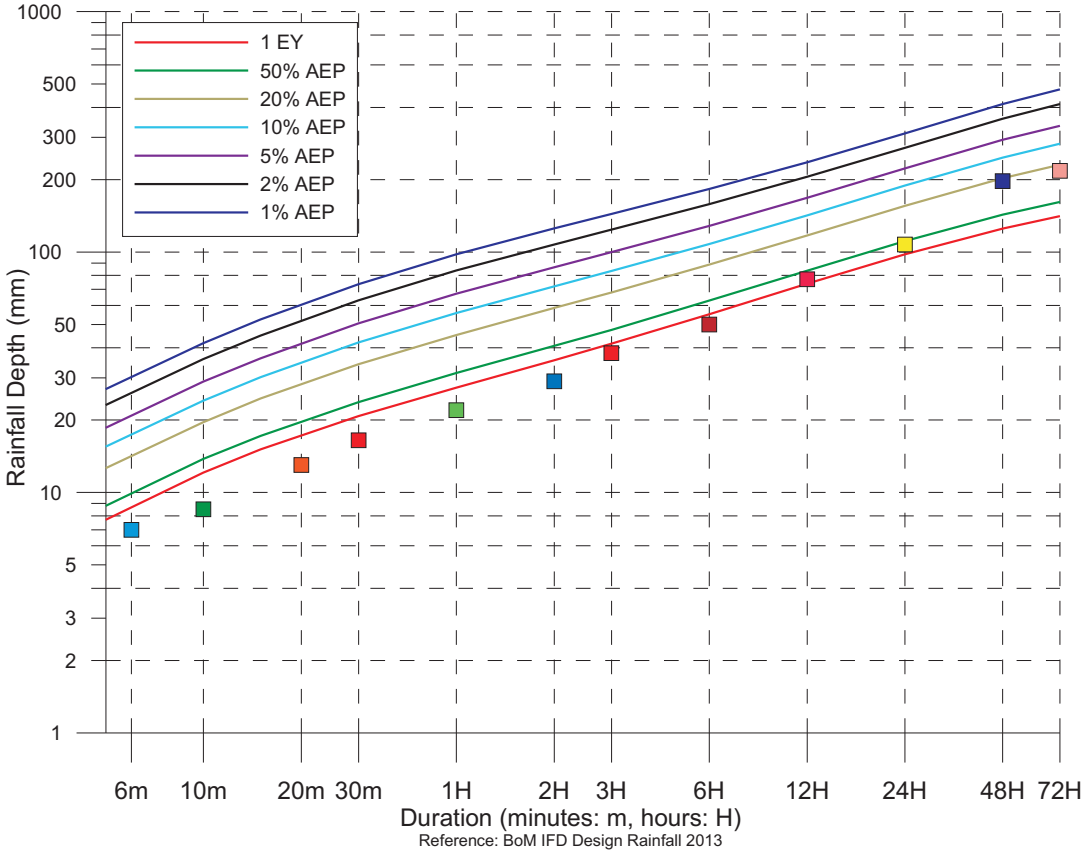
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

MARDI DAM
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C71
DRAWING 2364-C71

Site owner: MHL Latitude: -33.3448 Longitude: 151.4223

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Berkeley Vale Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	7.0	23:32_01/05/2015
10m	8.5	04:38_22/04/2015
20m	13.0	04:38_22/04/2015
30m	16.5	04:34_22/04/2015
1H	22.0	04:32_22/04/2015
2H	29.0	21:10_21/04/2015
3H	38.0	20:46_21/04/2015
6H	50.0	18:08_21/04/2015
12H	77.0	00:44_04/04/2015
24H	107.5	00:00_21/04/2015
48H	197.0	06:40_20/04/2015
72H	217.5	02:42_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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For further information on the relationship between EY, AEP, ARI, and uses in engineering design, please refer to BoM Frequently Asked Questions under New AR&R probability terminology: http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml

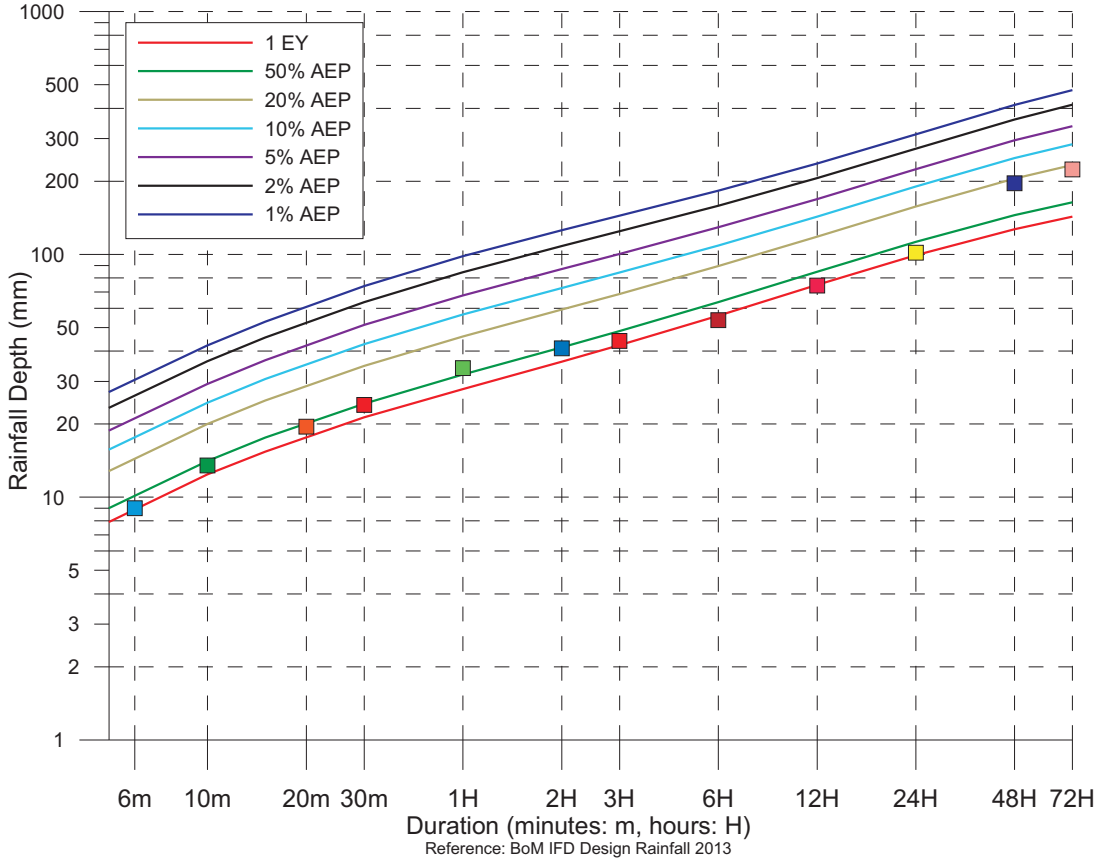
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

BERKELEY VALE
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C72
DRAWING 2364-C72

Site owner: MHL Latitude: -33.3790 Longitude: 151.4745

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Bateau Bay Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	9.0	04:30_22/04/2015
10m	13.5	08:12_20/04/2015
20m	19.5	17:12_02/05/2015
30m	24.0	17:08_02/05/2015
1H	34.0	16:58_02/05/2015
2H	41.0	16:34_02/05/2015
3H	44.0	16:22_02/05/2015
6H	53.5	16:22_02/05/2015
12H	74.5	02:16_04/04/2015
24H	101.5	20:28_03/04/2015
48H	196.0	05:46_20/04/2015
72H	224.0	23:38_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*

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NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

BATEAU BAY
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

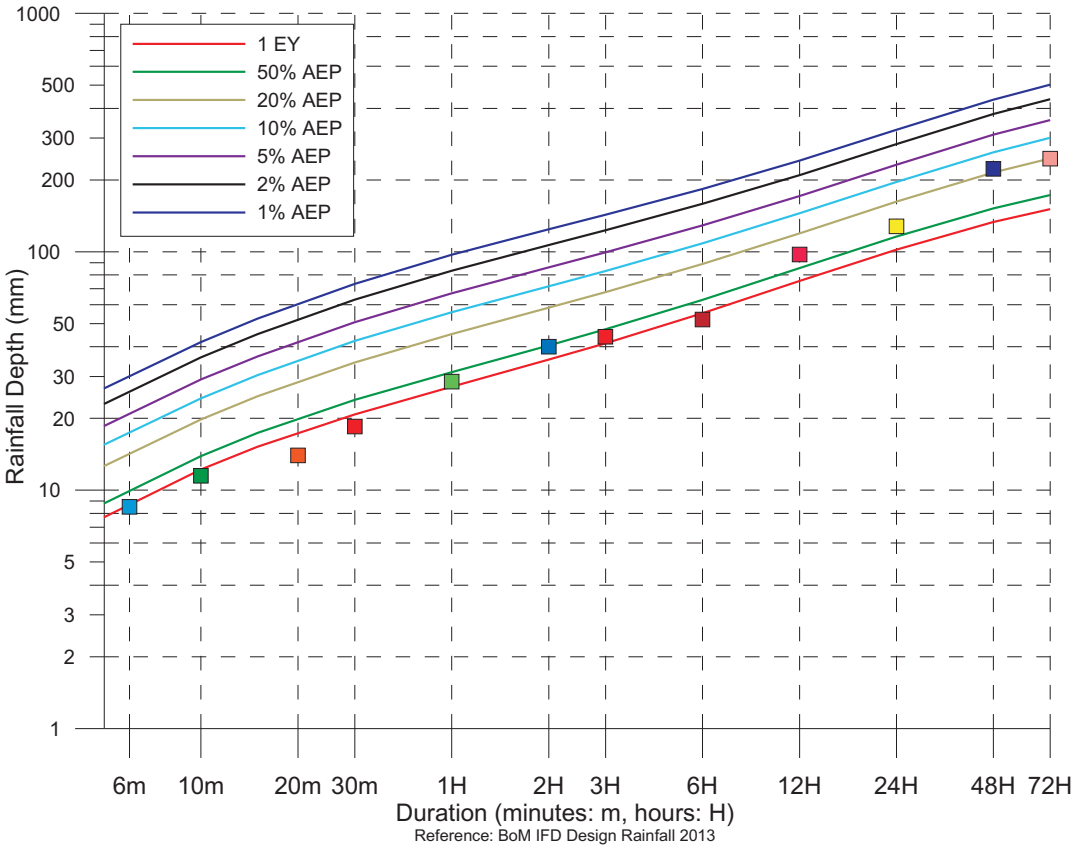
MHL Report 2364

Figure C73

DRAWING 2364-C73

Site owner: MHL Latitude: -33.4026 Longitude: 151.3939

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Mount Elliot Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	8.5	04:42_22/04/2015
10m	11.5	04:42_22/04/2015
20m	14.0	04:42_22/04/2015
30m	18.5	17:14_02/05/2015
1H	28.5	16:50_02/05/2015
2H	40.0	16:46_02/05/2015
3H	44.0	16:36_02/05/2015
6H	52.0	16:36_02/05/2015
12H	97.5	02:52_04/04/2015
24H	128.0	22:06_03/04/2015
48H	222.5	08:00_20/04/2015
72H	246.0	22:24_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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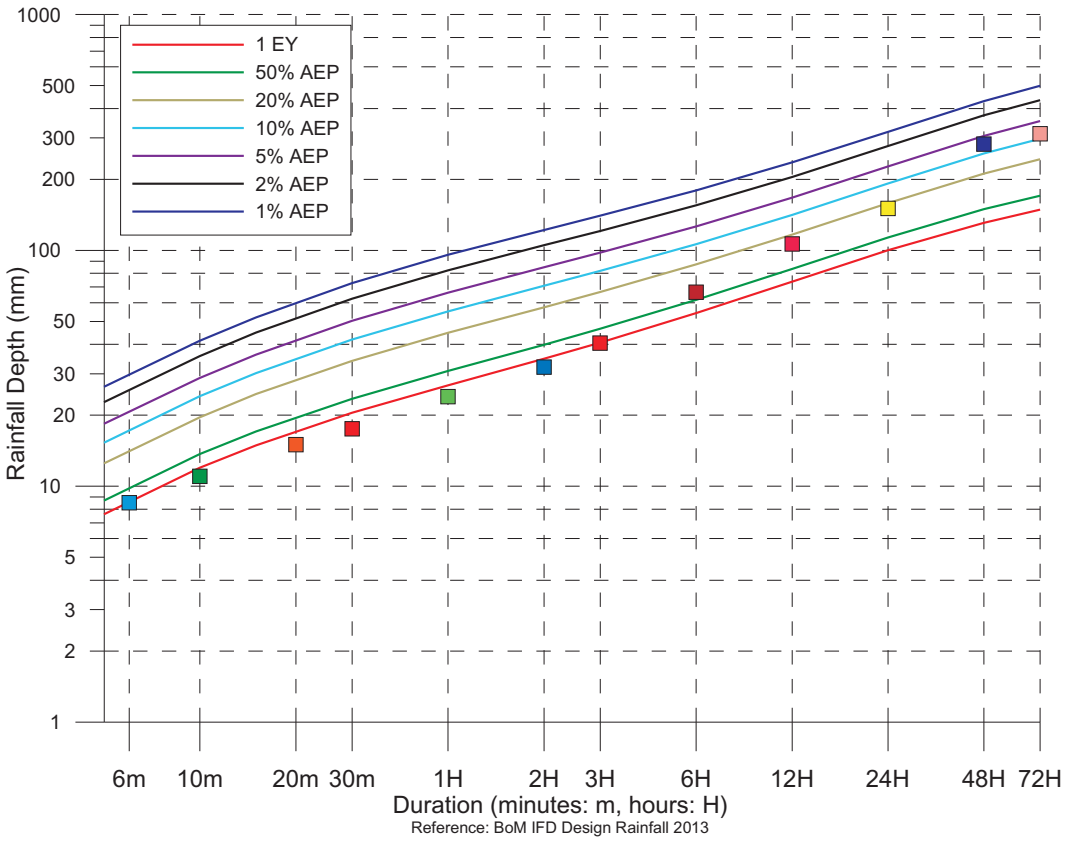
NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

MOUNT ELLIOT
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

MHL Report 2364
Figure C74
DRAWING 2364-C74

Site owner: MHL Latitude: -33.4179 Longitude: 151.3595

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Wyoming Rainfall Depth 01 April 2015 – 05 May 2015		
Duration (minutes: m) (hours: H)	**Rainfall Depth (mm)**	**Time/Date**
6m	8.5	19:22_20/04/2015
10m	11.0	19:20_20/04/2015
20m	15.0	19:18_20/04/2015
30m	17.5	05:34_22/04/2015
1H	24.0	05:10_22/04/2015
2H	32.0	22:08_21/04/2015
3H	40.5	21:20_21/04/2015
6H	66.5	17:30_20/04/2015
12H	106.5	17:30_20/04/2015
24H	150.5	17:30_20/04/2015
48H	282.5	08:04_20/04/2015
72H	312.5	02:42_20/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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NSW GOVERNMENT Public Works
Manly Hydraulics Laboratory

WYOMING
INTENSITY-FREQUENCY-DURATION
01 APRIL - 05 MAY 2015

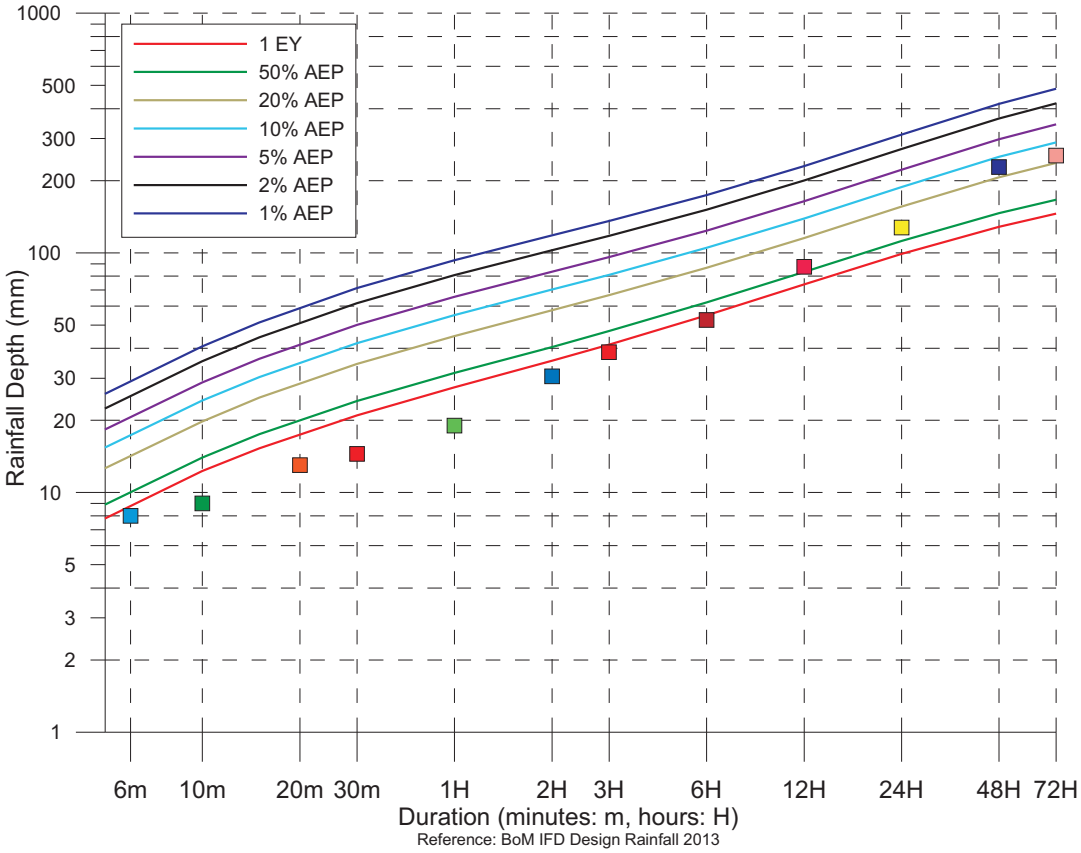
MHL Report 2364

Figure C75

DRAWING 2364-C75

Site owner: BoM Latitude: -33.4788 Longitude: 151.3898

AEP= Annual Exceedance Probability
EY = Exceedance per Year



Reference: BoM IFD Design Rainfall 2013

Kincumber Rainfall Depth 01 April 2015 – 05 May 2015			
Duration (minutes: m) (hours: H)		Rainfall Depth (mm)	Time/Date
	6m	8.0	19:12_20/04/2015
	10m	9.0	05:28_22/04/2015
	20m	13.0	05:28_22/04/2015
	30m	14.5	05:26_22/04/2015
	1H	19.0	18:52_20/04/2015
	2H	30.5	17:48_20/04/2015
	3H	38.5	21:10_21/04/2015
	6H	52.5	17:46_20/04/2015
	12H	87.5	16:26_20/04/2015
	24H	127.5	16:24_20/04/2015
	48H	228.0	06:06_20/04/2015
	72H	255.0	23:12_19/04/2015

The Bureau of Meteorology (with reference to the Australian Rainfall and Runoff, Institute of Engineers 2013) states: AEP is defined as *The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.*
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Appendix D

Office of Water
Water Level Stations Local Datum to AHD Conversion Table

#STATION	STATION NAME	LATITUDE	LONGITUDE	GAUGE ZERO	DATUM
210001	HUNTER RIVER AT SINGLETON	-32.5605	151.1714	27.63	AHD
210002	HUNTER RIVER AT MUSWELLBROOK BRIDGE	-32.2565	150.8893	136.251	AHD
210004	WOLLOMBI BROOK AT WARKWORTH	-32.5684	151.0331	47.755	AHD
210010	WILLIAMS RIVER AT GLEN MARTIN (MILL DAM FALLS)	-32.5586	151.8043	0.825	AHD
210011	WILLIAMS RIVER AT TILLEGRA	-32.3187	151.6873	85.243	AHD
210017	MOONAN BROOK AT MOONAN BROOK	-31.9423	151.2809	454.983	AHD
210021	PATERSON RIVER AT D/S LOSTOCK DAM	-32.3360	151.4668	116.038	AHD
210022	ALLYN RIVER AT HALTON	-32.3063	151.5129	111.82	AHD
210028	WOLLOMBI BROOK AT BULGA	-32.6508	151.0201	56.499	AHD
210031	GOULBURN RIVER AT SANDY HOLLOW	-32.3452	150.5743	113.448	AHD
210039	HUNTER RIVER AT BELLTREES	-32.0018	151.1104	285.422	AHD
210044	GLENNIES CREEK AT MIDDLE FALBROOK(FAL DAM SITE)	-32.4503	151.1495	69.92	AHD
210055	HUNTER RIVER AT DENMAN	-32.3809	150.7114	101.997	AHD
210056	HUNTER RIVER AT ABERDEEN	-32.1650	150.8835	158.505	AHD
210061	PAGES RIVER AT BLANDFORD (BICKHAM)	-31.8098	150.9252	392.515	AHD
210064	HUNTER RIVER AT GRETA	-32.6635	151.4037	9.648	AHD
210066	MERRIWA RIVER AT UPSTREAM VALLANCES CREEK	-32.2963	150.3343	183.235	AHD
210076	ANTIENE CREEK AT LIDDELL	-32.3366	150.9824	132.034	AHD
210080	WEST BROOK AT U/S GLENDON BROOK	-32.4716	151.2837	68.529	AHD
210083	HUNTER RIVER AT LIDDELL	-32.4892	150.9236	60.951	AHD
210084	GLENNIES CREEK AT THE ROCKS NO.2	-32.3637	151.2400	126.05	AHD
210089	BLACK CREEK AT ROTHBURY	-32.7166	151.3259	31.128	AHD
210091	MERRIWA RIVER AT MERRIWA	-32.1343	150.3530	238.955	AHD
210114	CARROW BROOK AT CARROWBROOK	-32.2620	151.3122	229.967	AHD
210124	DART BROOK AT YARRANDI BRIDGE	-32.0113	150.7846	215.564	AHD
210125	HUNTER RIVER AT UPSTREAM BAYSWATER CREEK	-32.4864	151.0216	50.331	AHD
210126	HUNTER RIVER AT UPSTREAM FOY BROOK	-32.4849	151.0491	49.352	AHD
210127	HUNTER RIVER UPSTREAM GLENNIES CREEK	-32.4994	151.0620	46.84	AHD
210129	HUNTER RIVER UPSTREAM SINGLETON	-32.5684	151.1595	29.543	AHD
210130	FOY BROOK AT DOWNSTREAM BOWMANS CK. BRIDGE	-32.4702	151.0586	56.943	AHD
210134	HUNTER RIVER AT LONG POINT	-32.5595	151.1375	34.912	AHD
210135	WOLLOMBI BROOK AT D/S BRICKMANS BRIDGE	-32.8404	151.0649	77.346	AHD
210136	CHICHESTER RIVER AT CHICHESTER	-32.2012	151.6331	167.515	AHD
210137	WANGAT RIVER AT WANGAT	-32.2088	151.6642	163.286	AHD
210142	PAGES RIVER U/S KEWELL CREEK	-31.9670	151.0079	246.295	AHD
210143	ALLYN RIVER AT FLYING FOX LANE	-32.5166	151.5838	8.159	AHD
210144	WILLIAMS RIVER AT UNDERBANK	-32.2455	151.6056	161.6	AHD
210146	HALLS CREEK AT UPSTREAM GIANTS CREEK	-32.3307	150.5324	130.43	AHD
210147	WYBONG CREEK AT MANOBALAI	-32.1826	150.6609	172.045	AHD
210150	CHICHESTER RIVER AT CIPOLLETTI WEIR	-32.2391	151.6955	117.685	AHD
210903	WILLIAMS RIVER AT DUNGOG (FACTORY MILL RACE)	-32.3946	151.7606	41.231	AHD
211008	JIGADEE CREEK AT AVONDALE	-33.0720	151.4702	2.047	AHD
211009	WYONG RIVER AT GRACEMERE	-33.2692	151.3614	4.495	AHD
211010	JILLIBY CREEK AT U/S WYONG RIVER (DURREN LANE)	-33.2442	151.3921	6.558	AHD
211013	OURIMBAH CREEK AT U/S WEIR	-33.3482	151.3440	11.859	AHD
211014	WYONG RIVER AT YARRAMALONG	-33.2169	151.2761	18.953	AHD
211015	OURIMBAH CREEK D/S BANGALOW CREEK	-33.3259	151.3915	2.778	AHD
211017	WYONG RIVER AT WYONG FISHWAY	-33.2778	151.4065	-0.061	AHD