Public Works
Manly Hydraulics Laboratory

NSW ESTUARY AND RIVER WATER LEVELS ANNUAL SUMMARY 2015–2016

Report MHL2474
November 2016

prepared for
NSW Office of Environment and Heritage

Office of Environment & Heritage

This page intentionally blank

NSW ESTUARY AND RIVER WATER LEVELS ANNUAL SUMMARY 2015–2016

Report MHL2474
November 2016

Peter Leszczynski
110b King Street
Manly Vale NSW 2093
T: 02 9949 0200
E: peter.leszczynski@mhl.nsw.gov.au
W: www.mhl.nsw.gov.au

Cover photograph: Coraki photo from the web camera, Richmond River

Document control

Issue/ Revision	Author	Reviewer	Approved for issue	
			Name	Date
Draft 21/10/2016	B Tse, MHL	S Dakin, MHL	A Joyner	26/10/2016
Final 04/11/2016		M Fitzhenry, OEH	A Joyner	04/11/2016

Report No. MHL2474
ISSN: 2205-5525 (Print)
ISSN: 2205-5533 (Online)
First published November 2016

Manly Hydraulics Laboratory is Quality System Certified to AS/NZS ISO 9001:2008.

Foreword

Manly Hydraulics Laboratory (MHL) is a business group within the Department of Finance, Services and Innovation. The NSW water level database has been developed by MHL to support a number of programs associated with coastal, floodplain and estuary management for the NSW Office of Environment and Heritage. The monitoring service is available to local government and other organisations, both in Australia and overseas.

This annual summary presents water level measurements captured by automatic water level recording stations along the coastal estuaries and rivers of NSW from 1 July 2015 to 30 June 2016. MHL maintains the automatic recording stations and catalogues the data collected.

This summary provides information on how to access the data and additional data output types that are available on request.

The standards adopted for the program are those that were specified by the Australian Water Resources Council established in 1962 and the NSW Surface Water Working Group.

Requests for further information should be directed to:

Manager Environmental Data
Manly Hydraulics Laboratory
110B King Street
MANLY VALE NSW 2093

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

Other annual summaries in this series include:

- NSW Ocean and River Entrance Tidal Levels
  Annual Summary 2015–2016
  Manly Hydraulics Laboratory
  Report No. MHL2475
  ISSN: 2205-5541 (Print)
  ISSN: 2205-555X (Online)
- NSW Coastal Rainfall
  Annual Summary 2015–2016
  Manly Hydraulics Laboratory
  Report No. MHL2476
  ISSN: 2205-5568 (Print)
  ISSN: 2205-5576 (Online)
- NSW Wave Climate and Coastal Air Pressure
  Annual Summary 2015–2016
  Manly Hydraulics Laboratory
  Report No. MHL2477
  ISSN: 2205-5584 (Print)
  ISSN: 2205-5592 (Online)
- NSW Estuary and River Water Quality
  Annual Summary 2015–2016
  Manly Hydraulics Laboratory
  Report No. MHL2478
  ISSN: 2205-5606 (Print)
  ISSN: 2205-5614 (Online)

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

Summary

This report contains:

- a brief description of the estuary and river water level measurement program
- guidelines of how to use this report
- information on how to access the database
- a description of significant developments which occurred in 2015–2016
- a list of all stations for which MHL collected water level data in 2015–2016 (Table 4)
- maps of station locations and the annual data summaries for each site
- Appendix A which details the water level data available online
- Appendix B which outlines some of the data analysis suites and presentation formats available
- Appendix C, a glossary of terms
- Appendix D, a list of other publications which may be of interest.

Contents

1. Water level monitoring program

This report presents the thirty-first year of water level data collected by MHL. The network of automatic recorders and the associated analysis routines enable efficient delivery of water level data. As well as near-real time water level information at over 220 stations in NSW, extracts from the historical database of water levels can be made available on request (refer to Appendix A).

The present program is based on a network of automatic water level recording stations installed at various coastal sites (see Section 5 Station Location Maps). This network consists of over 220 permanent stations funded by the NSW Office of Environment and Heritage (OEH), and over 100 short-term client-based project sites featuring site-specific systems of water level and water quality sensing and logging. The network features four distinctive systems of data capture: gas purge pressure system, solid state Floatwell, submersible pressure transducer and ultrasonic/radar distance measuring units. The logging systems consist of Campbell Scientific data loggers which mostly record water levels every 15 minutes, while some stations record at a 1-minute logging interval. Each system functions as follows:

- Gas purge pressure system: the water level is determined by a pressurised constant flow of nitrogen gas through a line to a fixed point in the water column known as the orifice. The pressure in the line builds up to the same pressure as the water at that depth. This pressure is measured by the pressure sensor and converted into a water level by the data logger. The system relies on the principle that water depth is proportional to pressure. The system is shown in Figure 1.
- Solid state Floatwell: the water level is sensed by a float connected to a shaft encoder. The system is shown in Figure 2.
- Submersible water level transducer: the water level is determined by a vented pressure sensor and converted into a water level by the data logger. The system is shown in Figure 3.
- Ultrasonic/radar distance measuring units: pulses are transmitted from the transducer towards the water and are reflected by the water back to the transducer. The elapsed time from emission to reception of the signals is dependent on the distance and hence the water level can then be determined. The system is shown in Figure 4.

Data is transferred to the NSW Data Collection Warehouse, Data Centre 1 and to MHL's data server using a variety of telemetry techniques including internet protocol (IP), landline telephone, cellular networks and Event-reporting Radio Telemetry System (ERTS). The incoming raw data is then available to external users to view online in tables or plots, as schematised in Figure 5.

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

Data is backed up daily and archived to magnetic tape as a security measure at regular intervals. A backup database is also kept at Data Centre 1.

2. How to use this report

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

The NSW coastal zone has been divided into geographic regions based on river systems. Location maps display the station locations and the annual plots confirm the availability and suitability of data for the particular period of interest. Click on the links below to access the maps and plots for the region of interest:

- Tweed
- Coffs
- Hunter
- Metro
- South Coast.

A list of water level data collected and stored is included in Appendix A. Continuous level data stored online is tabulated in Table A1, whilst historical level data (mainly from staff gauges) is tabulated in Table A2.

Once a choice has been made of the period for which information is required, data and services can be obtained in a variety of formats, according to their intended use.

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

- graphical plots (see Figures B1, B3 and B4)
- time series data (see Figure B2)
- tidal analyses (see Figures B5, B6, B7)
- frequency analysis (see Figures B8, B9)
- catchment rainfall and level comparisons (see Figure B10)
- consulting services (see Figure B11)
- sample water quality plots (see Figure B12).

3. How to access the data

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

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

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

4. Significant events and developments 2015–2016

4.1 Significant events

The financial year 2015–2016 saw a similar number of flood warnings issued by the Bureau of Meteorology (BoM) compared with the previous year due to the June 2016 East Coast Low event.

In August 2015, a moderate flood warning was issued for the Shoalhaven River. In January 2016, a minor flood warning was issued for the Karuah River and minor to major warning issued for the Hunter River. In June 2016, minor flood warnings were issued for the Bellinger, Nambucca, Hastings, Wyong, Nepean/Hawkesbury and Moruya rivers; moderate flood warnings were also issued for the Tweed and Shoalhaven rivers; a minor to moderate was issued for the Richmond River; a minor to major was issued for the Georges River and a moderate to major flood warning was issued for the Brunswick River.

During 2015–2016 flood warnings, as described by the NSW State Emergency Service's NSW flood classification scale, were issued as listed below in Table 1.

Table 1 2015–2016 floods

River/estuary system	Date	NSW SES classification
Tweed River	June 2016	Moderate
Brunswick River	June 2016	Moderate to Major
Richmond River	June 2016	Minor to Moderate
Bellinger River	June 2016	Minor
Nambucca River	June 2016	Minor
Hastings River	June 2016	Minor
Karuah River	January 2016	Minor
Hunter River	January 2016	Minor to Major
Wyong River	June 2016	Minor
Nepean/Hawkesbury River	June 2016	Minor
Georges River	June 2016	Minor to Major
Shoalhaven River	August 2015	Moderate
	June 2016	Moderate
Moruya River	June 2016	Minor

The NSW State Emergency Service defines the level of flooding as follows:

Minor flooding: Causes inconvenience. Low-lying areas next to watercourses are inundated, which may require the removal of stock and equipment. Minor roads may be closed and low-level bridges submerged.

Moderate flooding: In addition to the above, the evacuation of some houses may be required. Main traffic routes may be covered. The area of inundation is substantial in rural areas, requiring the removal of stock.

Major flooding: In addition to the above, extensive rural areas and/or urban areas are inundated. Properties and towns are likely to be isolated and major traffic routes likely to be closed. Evacuation of people from flood-affected areas may be required.

4.2 Station upgrades

A number of water level gauging stations had significant infrastructure upgrade works undertaken across the network. Some of these upgrades were the result of a network-wide audit to improve data reliability, safety of field operators and performance of stations during flood events. Details of these upgrades are shown in Table 2. Stations are listed based on locality from north to south. This aligns with Table 4 Index of figures in Section 5.

Table 2 2015–2016 station upgrades

Station name	Date	Issue		Comments
		Data quality	WHS	
Woodburn	Nov-2015	✓	✓	New backup station installed due to access issues with existing site.
Evans River Fishing Co-op	Jun-2016	✓		Temporarily decommissioned due to refurbishment of the jetty; a secondary standalone station was installed on the bank whilst construction works are taking place.
East Gundurimba	Mar-2016		✓	New ladder installed.
Bungawalbin Creek	Aug 2015	✓		New station installed to provide greater understanding of flood dynamics in the lower Richmond Valley.
Belmore Bridge	Nov-2015	✓		New gauge post and plates installed, 0–12 m.
Bolwarra Upstream	Nov-2015	✓		Extended orifice line.
Dunmore	Jun-2016	✓		Upgrade of logging and sensing equipment.
Gostwyck	Nov-2015	✓		Replaced flood damaged gauge plates.
Tuncurry	Jun-2016		✓	Station relocated nearby to a downstream jetty to improve safe access and remove the need to access through private land.
Koolewong	Mar-2016		✓	Station relocated to the bank to improve safe access.
Fullers Bridge	Apr-2016	✓		New station installed to provide monitoring of the Lane Cove River system.
Canterbury Road Bridge	Nov-2015	✓	✓	Station relocated to a temporary radar location during bridge works.
Hewitts Creek Entrance	Dec-2015	✓		New gauge post and plates installed, 1–2 m.
Lake Illawarra Entrance	Jun-2016	✓		New gauge post and plates installed, 1–2 m.

Station name	Date	Issue		Comments
		Data quality	WHS	
Island Point	Sep-2015	✓		Relocated sensor to a temporary site and replaced all equipment after August 2015 flood event.
Lake Conjola	Jun-2016		✓	Station relocated to the bank to improve safe access to the station.
Across network			✓	Submerged object signs installed at relevant sites to alert swimmers.

4.3 Data provision

Water level data is provided to the public on behalf of OEH, through the following methods:

- the public webpages of MHL, OEH and BoM, providing near real-time access to a limited sample of data
- email correspondence and file transfer protocol (FTP)
- a web-based data request system where electronic requests can be submitted via MHL's homepage at http://mhl.nsw.gov.au under the Data Request menu.

Water level data is provided to OEH and the NSW State Emergency Service (SES) through the following methods:

- OEH and NSW SES officer access to a customised MHL web portal, providing near-real time environmental data and our 'quality assured' historical database
- NSW SES officers also receive automated notifications for flood warning systems in NSW
- data access also continues to assist the BoM, local government authorities, SES, NSW Police, Sydney Catchment Authority, NSW Surf Life Saving Association, universities, the NSW court system, private consultancies, NSW Roads and Maritime Services and the Natural Resources Commission.

Please note all water level data is available in Australian Height Datum via the OEH Wiski web data portal and the MHL public web page, with the exception of local water resource datum stations.

During 2015–2016:

- in excess of 181,000 public and customer webpage hits per month were served by MHL
- MHL had approximately 106,000 visits per month to its website
- in excess of 2 million individual webpage hits have been recorded in 2015–2016.

Access to this data is supported by the following:

- Wiski Web continues to be developed as a web portal for OEH to access MHL's 'quality assured' data
- a web-based self-serve portal has been developed to allow specific users to download data or access a web services application for automated data self-service. Contact MHL to obtain a user name and password: https://new.mhl.nsw.gov.au/services/mhladas/

5. Water level monitoring summary

5.1 Data capture performance

Water level data presented by MHL is collected, analysed and subjected to a strict quality assurance process in accordance with MHL's internal standards and work instructions to manage and represent the uncertainty in recorded water level data. This process results in a quality code which is assigned to all water level data, as described in Table 3 below. Access to site- and time-specific station records and quality codes should be undertaken in accordance with procedures in Section 3.

During 2015–2016 overall data capture across the network, for data with a quality code of 150 or better, was 98.9%. Table 4 Index of figures provides data capture percentages for each river/estuary network. Missing or poor quality data can result in gaps in the data record. This can be caused by a range of reasons, such as sensor or equipment damage or failure, power failure, or site specific environmental issues such as siltation or collapse of waterway banks at gauging stations.

Automatic recorded water level data is typically recorded to a resolution that is higher than the actual level of certainty. A sensor may record data to three decimal places (measured in metres). However, due to systematic and random uncertainties involved in the collection of the data and the environment, data values may only be accurate to two decimal places. These uncertainties are accounted for through MHL's quality control and quality assurance processes.

Table 3 MHL data quality code descriptions

Quality code		Water level*
55	Records processed to	±20 mm
100	Data from previous MHL database, processed to	±20 mm
105	Records processed to	±50 mm
150	Uncoded – data not yet quality controlled	Raw data from the instrument with only preliminary quality checks performed
208	Records processed to greater than	±50 mm
161, 204, 205, 206, 207	Data loss	

* A quality code is assigned under the conditions that at least 95% of the data meets the quality code requirements, based on single point calibration

5.2 Interpretation of data

There are various factors which can influence water level data in the extensive network of OEH automated water level recorders, operated and maintained by MHL. Differences between sites can be attributed to the characteristics of the overall water body being analysed, and also characteristics specific to the station locality and design.

Report MHL2100 *Water Level Frequency Distribution Analysis* (March 2014) provides a statistical analysis and frequency distribution analysis of available water level information for the majority of water level stations, in addition to a station classification into one of three station types: ocean tide stations ('O', dominated by a semi-diurnal tide), estuary stations ('E', particularly ICOLLs, generally having a reduced tidal influence, and may experience both flood conditions and static water levels, governed by entrance morphology), and flood stations ('F', upstream of tidal influence or behind weirs, and dominated by dramatic water level fluctuations during low frequency flood events). Review by the reader of MHL2100 concurrently with this publication, and familiarity with environmental factors in interpretation of the presented data, is recommended to assist interpretation for the station of interest.

Refer to Report MHL2475 *Ocean and River Entrance Tidal Levels Annual Summary 2015–2016*, for annual water level data at ocean tide classified sites.

5.3 Water level monitoring summary

This section documents locality maps and quality assured water level monitoring summaries for each station. Tables 4 and 6 provide indexes to the figures presented.

Table 4 Index of figures

	Figure
Typical gas purge station	1
Typical solid state Floatwell station	2
Typical submersible water level station	3
Typical ultrasonic station	4
Data transfer schematic	5

River/estuary system	Station name	Station no	MGA zone	Easting	Northing	Datum	Data capture % ^	Figure
Station Locality Map	Tweed River Region						99.73	6
Broadwater	Cobaki	201448	56	549344	6883128	TRHD		7
Terranora Inlet	Dry Dock	201428	56	550715	6881235	TRHD		8
Tweed River	Terranora	201447	56	548955	6880384	TRHD		9
Tweed River	Tweed Entrance South	201472	56	554109	6883772			*
Tweed River	Letitia 2A	201429	56	554309	6882407	TRHD		10
Tweed River	Barneys Point	201426	56	554110	6877710	TRHD		11
Tweed River	Tumbulgum	201432	56	545172	6871999	TRHD		12
Tweed River	North Murwillumbah	201420	56	539329	6866467	TRHD		13
Tweed River	Bray Park Weir	201455	56	536209	6864484	TRHD		14
Tweed River	Murwillumbah Bridge	201465	56	539219	6866353	TRHD		15
Rous River	Kynnumboon	201422	56	538179	6867895	TRHD		16
Cudgen Lake	Bogangar	202416	56	554698	6866441	BRFMD		17
Cudgen Lake	Kingscliff Upstream	202434	56	557030	6873280	BRFMD		18

River/estuary system	Station name	Station no	MGA zone	Easting	Northing	Datum	Data capture % ^	Figure
Station Locality Map	Brunswick River Region						100.00	19
Marshalls Creek	Orana Bridge	202475	56	553611	6845534	BRFMD		20
Marshalls Creek	Billinudgel	202400	56	551554	6847116	BRFMD		21
Brunswick River	Brunswick Heads	202403	56	554078	6843182			*
Brunswick River	Mullumbimby	202402	56	548580	6841766	BRFMD		22
Station Locality Map	Richmond River Region						95.62	23
Lennox Head	Lake Ainsworth	203455	56	557863	6816160	AHD		24
Richmond River	Ballina Breakwall	203425	56	556992	6805681			*
Richmond River	Missingham Bridge	203465	56	556161	6806420	RRVD		25
Richmond River	Byrnes Point	203461	56	551362	6805886	RRVD		26
Richmond River	Wardell	203468	56	545282	6797087	RRVD		27
Richmond River	Woodburn	203412	56	533496	6784089	RRVD		28
Evans River	Evans River Fishing Co-op	203462	56	542250	6778375	RRVD		29
Evans River	Iron Gates	203475	56	539700	6778241	RRVD		30
Tucombil Canal	Tucombil Highway Bridge	203480	56	532949	6782596	RRVD		31
Rocky Mouth Creek	Rocky Mouth Creek	203432	56	531748	6781331	RRVD		32
Richmond River	Bungawalbin	203450	56	527031	6788276	RRVD		33
Bungawalbin Creek	Bungawalbin Creek	2034133	56	516561	6776508	RRVD		34
Richmond River	Coraki	203403	56	527981	6793775	RRVD		35
Wilsons River	East Gundurimba	203427	56	526034	6809079	RRVD		36
Leycester Creek	Tuncester	203443	56	523441	6814619	RRVD		37
Wilsons River	Woodlawn College	203402	56	529528	6815751	RRVD		38
Station Locality Map	Clarence River Region						99.15	39
Clarence River	Yamba	204454	56	535118	6744433			*
Tasman Sea	Norfolk Island	240401	58	787557	6781940			*
Tasman Sea	Lord Howe Island	240402	57	505521	6512362			*
Clarence River	Oyster Channel	204451	56	530468	6744254	AHD		40
Clarence River	Maclean	204410	56	518999	6741473	AHD		41
Clarence River	Lawrence	204453	56	510259	6736948	AHD		42

River/estuary system	Station name	Station no	MGA zone	Easting	Northing	Datum	Data capture % ^	Figure
Clarence River	Tyndale	204465	56	512580	6729227	AHD		43
Clarence River	The Avenue Upstream	204475	56	507150	6714123	AHD		44
Clarence River	The Avenue Downstream	204476	56	507174	6714140	AHD		45
Clarence River	Brushgrove	204406	56	507508	6729089	AHD		46
Clarence River	Ulmarra	204480	56	502596	6722105	AHD		47
Clarence River	Grafton	204400	56	493388	6715141	AHD		48
Clarence River	Rogans Bridge	204414	56	488813	6723401	AHD		49
Palmers Channel	Palmers Island Bridge	204426	56	525780	6744108	AHD		50
Lake Wooloweyah	Lake Wooloweyah	204485	56	533141	6739053	AHD		51
Station Locality Map	Woolgoolga Region						100.00	52
Wooli River	Wooli Entrance	205462	56	525680	6693338	AHD		53
Wooli River	Wooli Caravan Park	205463	56	524551	6697797	AHD		54
Corindi Creek	Red Rock	205450	56	521919	6683065	AHD		55
Woolgoolga Lake	Woolgoolga Lake	205455	56	519091	6669486	AHD		56
Woolgoolga Creek	Woolgoolga	205441	56	515783	6668247	CTF		57
Moonee Creek	Moonee Creek	205435	56	514953	6658959	AHD		58
Station Locality Map	Coffs Harbour Region						99.63	59
Tasman Sea	Coffs Harbour	205470	56	514052	6647645			*
Coffs Creek	Coffs Creek Highway Bridge	205439	56	511160	6648716	AHD		60
Newports Creek	Newports Creek	205460	56	510016	6645652	AHD		61
Boambee Creek	Boambee	205438	56	507834	6643805	AHD		62
Boambee Creek	Boambee Entrance	205475	56	509896	6642068	AHD		63
Station Locality Map	Bellinger River Region						100.00	64
Bonville Creek	Bonville	205480	56	503975	6640378	AHD		65
Bellinger River	Repton	205403	56	502358	6632218	AHD		66
Bellinger River	Bellingen Bridge	205442	56	490336	6631224	AHD		67
Kalang River	Urunga	205407	56	501233	6626813	AHD		68
Kalang River	Upstream Newry Island	205458	56	497966	6625223	AHD		69
Kalang River	Kooroowi	205440	56	482967	6629647	AD		70

River/estuary system	Station name	Station no	MGA zone	Easting	Northing	Datum	Data capture % ^	Figure
Station Locality Map	Nambucca River Region						100.00	71
Deep Creek	Deep Creek	205485	56	500253	6613431	AHD		72
Nambucca River	Stuarts Island Downstream	205466	56	499519	6608564	AHD		73
Nambucca River	Macksville	205416	56	492382	6602967	AHD		74
Taylors Arm	Utungun	205414	56	485800	6600344	AHD		75
Nambucca River	Bowraville Downstream	205425	56	486768	6608695	AHD		76
Warrell Creek	Warrell Creek	205490	56	491986	6600076	AHD		77
Station Locality Map	Macleay River Region						92.33	78
Borirgala Creek	Borirgala Creek	206450	56	496445	6586064	AHD		79
Macleay River	South West Rocks	206456	56	501638	6582579	AHD		80
Korogoro Creek	Hat Head	206465	56	505462	6563993	AHD		81
Saltwater Lagoon	Saltwater Lagoon	206460	56	506119	6582610	AHD		82
Macleay River	Smithtown	206406	56	494960	6568643	AHD		83
Macleay River	Kempsey	206402	56	485137	6561355	AHD		84
Macleay River	Aldavilla Downstream	206459	56	479318	6561231	AHD		85
Killick Creek	Crescent Head	207452	56	497704	6549628	AHD		86
Station Locality Map	Hastings River Region						99.72	87
Maria River	Green Valley	207406	56	486416	6540068	AHD		88
Wilson River	Telegraph Point	207415	56	481082	6534512	AHD		89
Port Macquarie	Port Macquarie	207420	56	491554	6523090			*
Hastings River	Settlement Point	207418	56	490636	6525312	AHD		90
Hastings River	Dennis Bridge Downstream	207444	56	482995	6525235	AHD		91
Hastings River	Wauchope Railway Bridge	207401	56	474995	6520192	AHD		92
Station Locality Map	Camden Haven Region						99.79	93
Lake Cathie	Lake Cathie	207441	56	486162	6509679	AHD		94
Camden Haven River	North Haven	207423	56	483134	6499413	AHD		95
Stingray Creek	West Haven	207437	56	480664	6499768	AHD		96
Camden Haven River	Laurieton	207425	56	480923	6497744	AHD		97
Camden Haven River	Logans Crossing	207428	56	470913	6502295	LWRD		98
Queens Lake	Lakewood	207475	56	477455	6500578	AHD		99
Watson Taylors Lake	Watson Taylors Lake	207480	56	475578	6491082	AHD		100

River/estuary system	Station name	Station no	MGA zone	Easting	Northing	Datum	Data capture % ^	Figure
Station Locality Map	Manning River Region						99.52	101
Tasman Sea	Crowdy Head Boat Harbour	208471	56	476348	6477414			*
Manning River	Harrington	208425	56	470255	6473391	AHD		102
Manning River	Croki	208404	56	461589	6473115	AHD		103
Manning River	Dumaresq Island	208430	56	454329	6470475	AHD		104
Manning River	Taree	208410	56	448687	6468633	AHD		105
Manning River	Wingham	208400	56	440559	6473212	AHD		106
Manning River	Mount George	208440	56	419229	6472262	LWRD		107
Dingo Creek	Ashlea Bridge Downstream	208436	56	433875	6476673	AD		108
Manning River	Farquhar Inlet	208415	56	461745	6466021	AHD		109
Station Locality Map	Great Lakes Region						99.87	110
Wallis Lake Entrance	Forster	209402	56	453635	6440173			*
Wallamba River	Tuncurry	209401	56	450568	6442279	AHD		111
Wallamba River	Tuncurry Wetlands	209451	56	447501	6442917	AD		112
Wallamba River	Nabiac	209404	56	436831	6446432	AHD		113
Wallis Lake	Pacific Palms Wharf	209406	56	455401	6422551	AHD		114
Smiths Lake	Tarbuck Bay	209465	56	451548	6417906	AHD		115
Myall River	Bulahdelah	209460	56	425442	6413407	AHD		116
Myall River	Bombah Point	209475	56	434682	6403309	AHD		117
Station Locality Map	Port Stephens Region						100.00	118
Myall River	Tea Gardens	209480	56	421723	6385111	AHD		119
Karuah River	Karuah	209485	56	403411	6386503	AHD		120
Karuah River	Mallabula Point	209461	56	407770	6379228	PSHD		121
Port Stephens	Shoal Bay	209474	56	422749	6379489			*
Station Locality Map	Hunter River Region						99.89	122
Hunter River	Stockton Bridge	210456	56	386238	6360819	AHD		123
Hunter River	Hexham Bridge	210448	56	376568	6368156	AHD		124
Williams River	Raymond Terrace	210452	56	382357	6375355	AHD		125
Williams River	Seaham	210462	56	381105	6385316	AHD		126
Hunter River	Green Rocks	210432	56	377459	6378142	AHD		127
Hunter River	Morpeth	210430	56	371590	6378484	AHD		128
Hunter River	McKimms Corner	210455	56	368191	6378929	AHD		129
Hunter River	Belmore Bridge	210458	56	364492	6377780	AHD		130

River/estuary system	Station name	Station no	MGA zone	Easting	Northing	Datum	Data capture % ^	Figure
Hunter River	Bolwarra Downstream	210451	56	365591	6380224	AHD		131
Hunter River	Bolwarra Upstream	210459	56	365828	6381130	AHD		132
Hunter River	Oakhampton Railway Bridge	210475	56	365866	6381600	AHD		133
Station Locality Map	Paterson River Region						99.17	134
Paterson River	Hinton Bridge	210410	56	373306	6379619	AHD		135
Paterson River	Dunmore	210409	56	369277	6383252	AHD		136
Paterson River	Paterson Railway Bridge	210406	56	370303	6392399	AHD		137
Paterson River	Gostwyck #	210402	56	369088	6396074	AHD		138
Station Locality Map	Wallis Creek Region						99.92	139
Wallis Creek	Wallis Creek Upstream	210428	56	366420	6376950	AHD		140
Wallis Creek	Wallis Creek Downstream	210457	56	366440	6376997	AHD		141
Wallis Creek	Louth Park	210453	56	363251	6373693	AHD		142
Station Locality Map	Lake Macquarie Region						99.07	143
Lake Macquarie	Marmong Point	211460	56	370992	6350370	AHD		144
Cockle Creek	Cockle Railway Station	211455	56	371189	6354213	AHD		145
Cockle Creek	Barnsley Vale	211450	56	369036	6354808	AHD		146
Lake Macquarie	Belmont	211461	56	374287	6343446	AHD		147
Lake Macquarie	Swansea Channel	211462	56	373155	6338270	AHD		148
Dora Creek	Kalang Road	211475	56	358900	6338978	AHD		149
Dora Creek	Cooranbong	211470	56	355446	6339055	AHD		150
Stockton Creek	Morisset	211480	56	357710	6336566	AHD		151
Station Locality Map	Tuggerah Lakes Region						100.00	152
Wallarah Creek	Wallarah Creek Bridge	211420	56	360913	6323587	AHD		153
Tuggerah Lake	Toukley	211401	56	362599	6318531	AHD		154
Wyong River	Wyong Weir Upstream	211417	56	351596	6316778	AHD		155
Ourimbah Creek	Lees Bridge	211425	56	353684	6311538	AHD		156
Tuggerah Lake	Long Jetty	211418	56	358757	6308079	AHD		157
Tumbi Umbi Creek	Tumbi Umbi	211419	56	355321	6307480	AHD		158

River/estuary system	Station name	Station no	MGA zone	Easting	Northing	Datum	Data capture % ^	Figure
Station Locality Map	Brisbane Water Region						99.76	159
Narara Creek	Manns Road	211435	56	345890	6302955	AHD		160
Wamberal Lagoon	Wamberal Lagoon	212450	56	355526	6300283	AHD		161
Terrigal Lagoon	Terrigal Bridge	212455	56	355079	6298683	AHD		162
Avoca Lagoon	Avoca Lagoon	212452	56	354079	6296162	AHD		163
Cockrone Lake	Cockrone Lake	212453	56	353841	6292959	AHD		164
Worthing Ave Creek	Erina	212436	56	350150	6299610	AHD		165
Erina Creek	Punt Bridge	212433	56	347514	6298928	AHD		166
Brisbane Water	Ettalong	212423	56	346015	6290156	AHD		167
Brisbane Water	Koolewong	212422	56	344273	6295029	AHD		168
Station Locality Map	Hawkesbury River Region						97.27	169
Hawkesbury River	Patonga	212440	56	339822	6286295			*
Hawkesbury River	Spencer	212431	56	327772	6296497	AHD		170
Hawkesbury River	Gunderman Caravan Park	212429	56	319440	6298151	AHD		171
Hawkesbury River	Webbs Creek	212408	56	312331	6303939	AHD		172
Hawkesbury River	Colo Junction	212407	56	303223	6298183	AHD		173
Hawkesbury River	Sackville	212406	56	303203	6292012	AHD		174
Hawkesbury River	Ebenezer	212427	56	304388	6286030	AHD		175
Hawkesbury River	Windsor	212426	56	297588	6279514	AHD		176
Hawkesbury River	Freemans Reach	212410	56	294009	6283328	AHD		177
Nepean River	Castlereagh	212404	56	284495	6275964	AHD		178
Station Locality Map	Sydney North Region						98.35	179
Narrabeen Lagoon	Narrabeen Caravan Park	213408	56	342666	6269525	AHD		180
Narrabeen Lagoon	Narrabeen Bridge	213422	56	342174	6268454	AHD		181
Dee Why Lagoon	Dee Why	213424	56	342725	6264718	AHD		182
Curl Curl Lagoon	Curl Curl	213426	56	342098	6262458	AHD		183
Manly Lagoon	Riverview Parade	213413	56	340504	6260456	AHD		184
Manly Lagoon	Queenscliff Bridge	213414	56	340963	6260561	AHD		185

River/estuary system	Station name	Station no	MGA zone	Easting	Northing	Datum	Data capture % ^	Figure
Lane Cove River	Fullers Bridge	213476	56	329370	6259278	AHD		186
Port Jackson	Sydney	213470	56	338842	6255833			*
Station Locality Map	Parramatta River and Cooks River Region						98.94	187
Parramatta River	Silverwater Bridge	213435	56	319683	6255592	ZFD		188
Cooks River	Canterbury Road	213411	56	325944	6245849	AHD		189
Cooks River	Illawarra Road Bridge	213420	56	328303	6244862	AHD		190
Cooks River	Tempe Bridge	213415	56	329694	6244231	AHD		191
Station Locality Map	Georges River Region						97.31	192
Georges River	Picnic Point Downstream	213410 D	56	315269	6237999	AHD		193
Georges River	Como Bridge	213425	56	321829	6236499	AHD		194
Georges River	Milperra	213405	56	313222	6244042	AHD		195
Prospect Creek	Lansdowne Bridge	213402	56	312039	6248143	AHD		196
Georges River	Lansvale	213401	56	311150	6247099	AHD		197
Cabramatta Creek	Irelands Bridge	213407	56	309832	6246486	AHD		198
Georges River	Scrivener Street	213404	56	309137	6244541	AHD		199
Georges River	Liverpool Weir	213400	56	308514	6244022	WC		200
Port Hacking	Bundeena	214452	56	329394	6227133			*
Station Locality Map	Wollongong Region						99.48	201
Hewitts Creek	Hewitts Creek Upstream	214410	56	308179	6200428	AHD		202
Hewitts Creek	Hewitts Creek Downstream	214411	56	308179	6200428	AHD		203
Hewitts Creek	Hewitts Creek Entrance	214408	56	308991	6199982	AHD		204
Cabbage Tree Creek	Balgownie Road #	214409	56	305367	6192700	AHD		205
Bellambi	Bellambi	214488	56	308722	6194180	AHD		206
Towradgi Creek	Towradgi Creek Upstream	214477	56	307608	6193627	AHD		207
Towradgi Creek	Towradgi Creek Downstream	214475	56	307608	6193627	AHD		208
Cabbage Tree Creek	Cabbage Tree Creek Upstream #	214405	56	306275	6191832	AHD		209
Cabbage Tree Creek	Cabbage Tree Creek Downstream #	214406	56	306275	6191832	AHD		210
Fairy Creek	Fairy Creek Upstream	214403	56	306351	6189967	AHD		211
Fairy Creek	Fairy Creek Downstream	214404	56	306351	6189967	AHD		212

River/estuary system	Station name	Station no	MGA zone	Easting	Northing	Datum	Data capture % ^	Figure
Byarong Creek	Byarong Creek #	214420	56	303773	6186987	AHD		213
Byarong Creek	Koloona Avenue Upstream #	214425	56	302909	6189424	CB		214
Byarong Creek	Koloona Avenue Downstream #	214426	56	302909	6189424	CB		215
American Creek	Blackmans Parade Upstream #	214430	56	301043	6185312	CB		216
American Creek	Blackmans Parade Downstream #	214431	56	301043	6185312	CB		217
Station Locality Map	Lake Illawarra Region						97.33	218
Mullet Creek	Mullet Creek	214400	56	298397	6182420	AHD		219
Lake Illawarra	Koonawarra Bay	214440	56	300464	6179788	AHD		220
Lake Illawarra	Cudgeree Bay	214416	56	303934	6177233	AHD		221
Lake Illawarra	Lake Illawarra Entrance	214417	56	304579	6176195	AHD		222
Macquarie Rivulet	Princes Highway	214402	56	296808	6174979	AHD		223
Little Lake	Little Lake Entrance	214467	56	304250	6173571	AHD		224
Station Locality Map	Kiama Region						99.83	225
Minnamurra River	Minnamurra	214442	56	303031	6167146	AHD		226
Werri Lagoon	Werri Lagoon	214445	56	301816	6155035	AHD		227
Crooked River	Gerroa	215410	56	299419	6150158	AHD		228
Station Locality Map	Shoalhaven River Region						99.90	229
Shoalhaven River	Shoalhaven Heads	215470	56	293877	6140761	AHD		230
Shoalhaven River	Hay Street	215415	56	292468	6140163	AHD		231
Shoalhaven River	Terara	215420	56	283258	6139535	AHD		232
Shoalhaven River	Nowra Bridge	215411	56	280834	6139287	AHD		233
Shoalhaven River	Grady's Caravan Park	215430	56	268094	6138339	AHD		234
Crookhaven River	Crookhaven Heads	215408	56	295288	6135156			*
Shoalhaven River	Greenwell Point	215417	56	293199	6134901	AHD		235
Wollumboola Lake	Wollumboola	215454	56	295853	6131507	AHD		236

River/estuary system	Station name	Station no	MGA zone	Easting	Northing	Datum	Data capture % ^	Figure
Station Locality Map	Jervis Bay Region						100.00	237
Currarong Creek	Currarong Creek	216405	56	301142	6122850	AHD		238
Jervis Bay	Jervis Bay	216470	56	291092	6111027			*
St Georges Basin	Island Point	216415	56	280748	6113511	AHD		239
Sussex Inlet	Sussex Inlet	216412	56	280903	6105512	AHD		240
Swan Lake	Swan Lake	216425	56	277905	6102577	AHD		241
Station Locality Map	Ulladulla Region						100.00	242
Lake Conjola	Lake Conjola	216420	56	272446	6094316	AHD		243
Narrawallee Inlet	Narrawallee	216430	56	269839	6090673	AHD		244
Tasman Sea	Ulladulla Boat Harbour	216471	56	270710	6084368			*
Burrill Lake	Burrill Lake Bridge	216435	56	267949	6080931	AHD		245
Lake Tabourie	Lake Tabourie	216440	56	264310	6074957	AHD		246
Station Locality Map	Batemans Bay Region						98.91	247
Durras Lake	Durras Lake	216445	56	255304	6052185	AHD		248
Clyde River	Nelligen	216453	56	241369	6050944	AHD		249
Clyde River	Princess Jetty	216410	56	244664	6045231			*
Station Locality Map	Moruya Region						100.00	250
Tomaga River	George Bass Drive	216455	56	245110	6031671	AHD		251
Moruya River	Moruya Bridge	217410	56	236703	6022317	AHD		252
Moruya River	Moruya Hospital	217402	56	235673	6022790	AHD		253
Station Locality Map	Coila and Tuross Lakes						96.61	254
Tuross River	Coila Lake	218405	56	242279	6006865	AHD		255
Tuross River	Tuross Head	218410	56	240898	6005120	AHD		256
Station Locality Map	Wagonga Inlet and Wallaga Lake						92.30	257
Wagonga Inlet	Barlows Bay	218415	56	239464	5988955	AHD		258
Wallaga Lake	Regatta Point	219405	56	236881	5971060	AHD		259
Station Locality Map	Bermagui and Bega River Region						100.00	260
Bermagui Harbour	Bermagui	219470	56	237453	5964777			*
Bega River	Bega River	219410	55	766022	5933969	AHD		261

River/estuary system	Station name	Station no	MGA zone	Easting	Northing	Datum	Data capture % ^	Figure
Station Locality Map	Eden Region						99.99	262
Back Lagoon	Back Lagoon	219415	55	759851	5914073	AHD		263
Merimbula Lake	Merimbula Wharf	220410	55	759296	5913048	AHD		264
Merimbula Lake	Merimbula Lake	220405	55	756507	5913260	AHD		265
Pambula Lake	Pambula Lake	220415	55	756744	5905022	AHD		266
Tasman Sea	Eden Boat Harbour	220470	55	758557	5893267			*
Lake Curalo	Lake Curalo	220420	55	758414	5895364	AHD		267
Wonboyn Lake	Agnew Wharf	220425	55	759146	5873220	AHD		268

* See Report MHL2475 Ocean and River Entrance Tidal Levels Annual Summary 2015–2016
^ Data capture percentages do not include ocean tide stations
# Data capture percentages excluded from river/estuary network average, due to being a flood station ('F') with sensor situated above base flow water levels

TRHD	Tweed River Hydro Datum
BRFMD	Brunswick River Flood Mitigation Datum
AHD	Australian Height Datum
RRVD	Richmond River Valley Datum
CTF	Cease to Flow of Control Structure
AD	Assumed Datum
LWRD	Local Water Resources Datum
PSHD	Port Stephens Hydro Datum
ZFD	Zero Fort Denison
WC	Weir Crest
CB	Culvert Bed

Water level readings for all the estuaries are available in AHD with the exception of Logans Crossing and Mount George, which are in the local water resources datum (LWRD). There are a number of estuary level gauges that still maintain level data in the local port datum as presented in this report. The local port datum generally equates to Indian springs low water (ISLW). An indicative adjustment of each station datum level to the local AHD is shown in Table 5. These adjustments were calculated circa 1990 for MHL by NSW Public Works Survey, using tidal harmonic analysis over a tidal epoch. These values should be used with caution, as AHD levels are revised from time to time and improvements to GPS surveying techniques may provide additional refinement.

Table 5 Summary of adjustment to AHD

River/estuary	Station	Station datum	Adjustment to AHD
Cobaki Broadwater	Cobaki	TRHD	-0.863
Terranora Creek	Dry Dock	TRHD	-0.875
Terranora Broadwater	Terranora	TRHD	-0.853
Tweed River	Letitia 2A	TRHD	-0.886
Tweed River	Barneys Point	TRHD	-0.883
Tweed River	Tumbulgum	TRHD	-0.893
Tweed River	North Murwillumbah	TRHD	-0.909

River/estuary	Station	Station datum	Adjustment to AHD
Tweed River	Bray Park Weir	TRHD	-0.934
Tweed River	Murwillumbah Bridge	TRHD	-0.909
Rous River	Kynnumboon	TRHD	-0.926
Cudgen Lake	Bogangar	BRFMD	-0.051
Cudgen Lake	Kingscliff Upstream	BRFMD	-0.066
Marshalls Creek	Orana Bridge	BRFMD	-0.024
Marshalls Creek	Billinudgel	BRFMD	-0.019
Brunswick River	Mullumbimby	BRFMD	-0.010
Richmond River	Missingham Bridge	RRVD	-0.860
Richmond River	Byrnes Point	RRVD	-0.857
Richmond River	Wardell	RRVD	-0.824
Richmond River	Woodburn	RRVD	-0.815
Evans River	Evans River Fishing Co-op	RRVD	-0.809
Evans River	Iron Gates	RRVD	-0.819
Tucombil Canal	Tucombil Highway Bridge	RRVD	-0.815
Tucombil Canal	Tucombil Floodgate	RRVD	-0.815
Rocky Mouth Creek	Rocky Mouth Creek	RRVD	-0.815
Richmond River	Bungawalbin	RRVD	-0.809
Richmond River	Bungawalbin Creek	RRVD	-0.809
Richmond River	Coraki	RRVD	-0.815
Wilsons River	East Gundurimba	RRVD	-0.831
Leycester Creek	Tuncester	RRVD	-0.855
Wilsons River	Woodlawn College	RRVD	-0.826
Port Stephens	Mallabula Point	PSHD	-0.959
Parramatta River	Silverwater Bridge	ZFD	-0.925

Table 6 Index of Appendix B figures

Sample water level data outputs	Figure
Standard Water Level Plot	B1
Standard Water Level Printout	B2
Predicted Versus Actual Water Level	B3
Typical Flood Hydrograph	B4
Flood Level Statistics	B5
Tidal Plane Analysis: Harmonic Constituents	B6
Typical Tidal Plane Analysis	B7
Frequency Distribution Analysis	B8
Typical Frequency Distribution Plots	B9
Rainfall-Water Level Correlation	B10
Lake Conjola Entrance Decision Support System	B11
Sample Water Quality Plots	B12

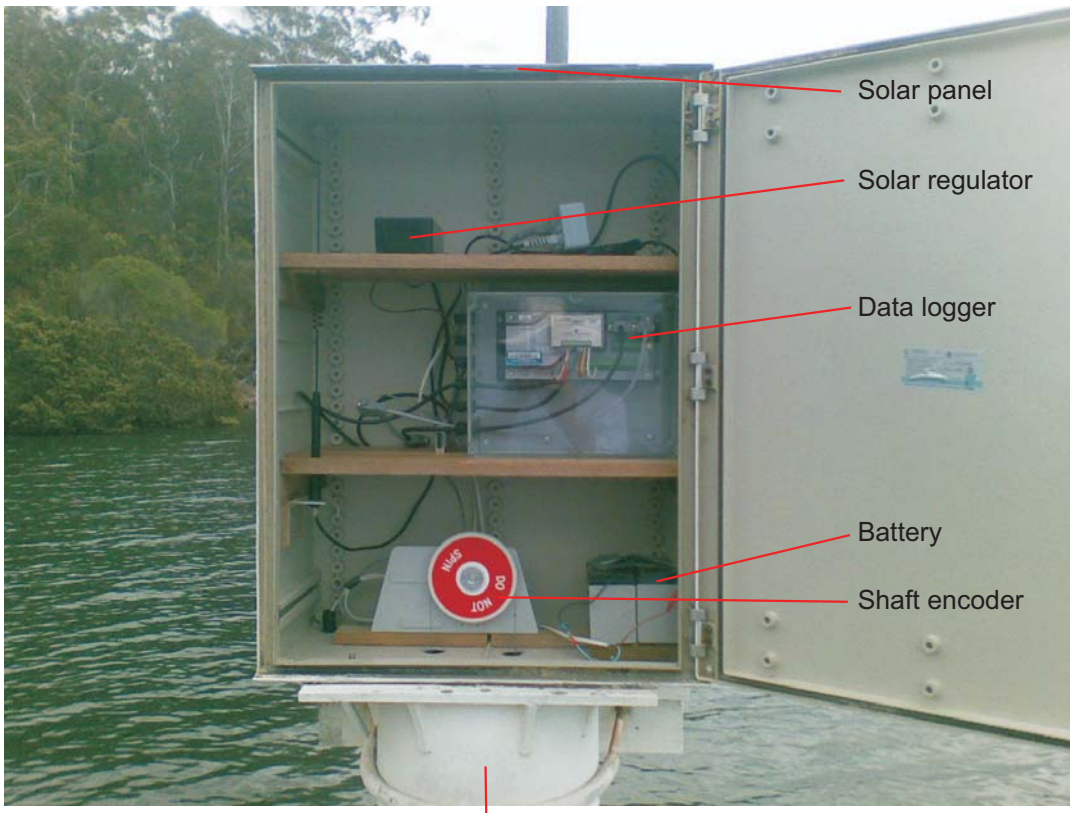
Public Works
Manly Hydraulics Laboratory

TYPICAL GAS PURGE STATION

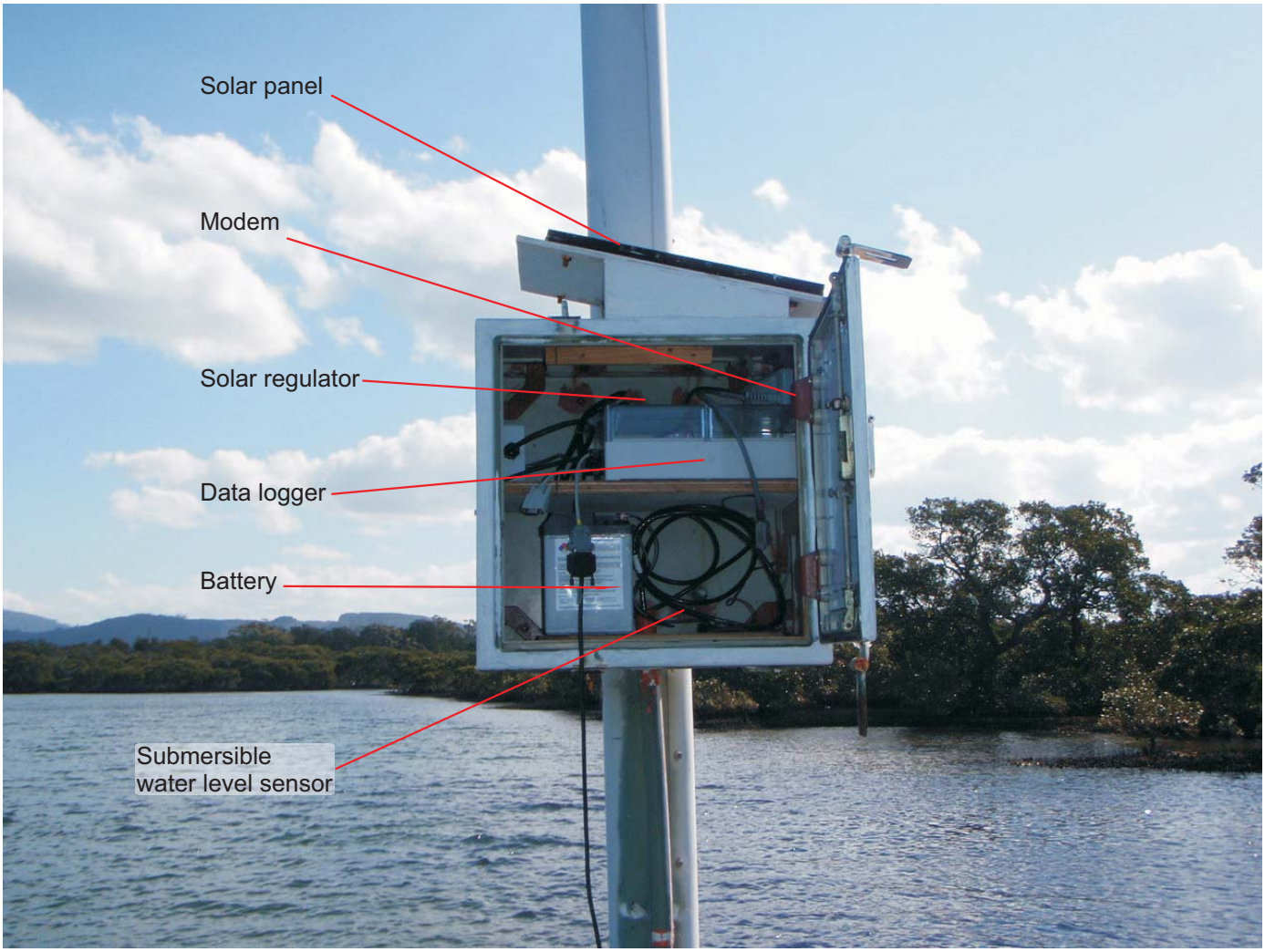
MHL Report 2474

Figure 1

DRAWING 2474-01.cdr



300mm diameter PVC stilling well - inside is a float
(150mm diameter) and a counterweight (200g)



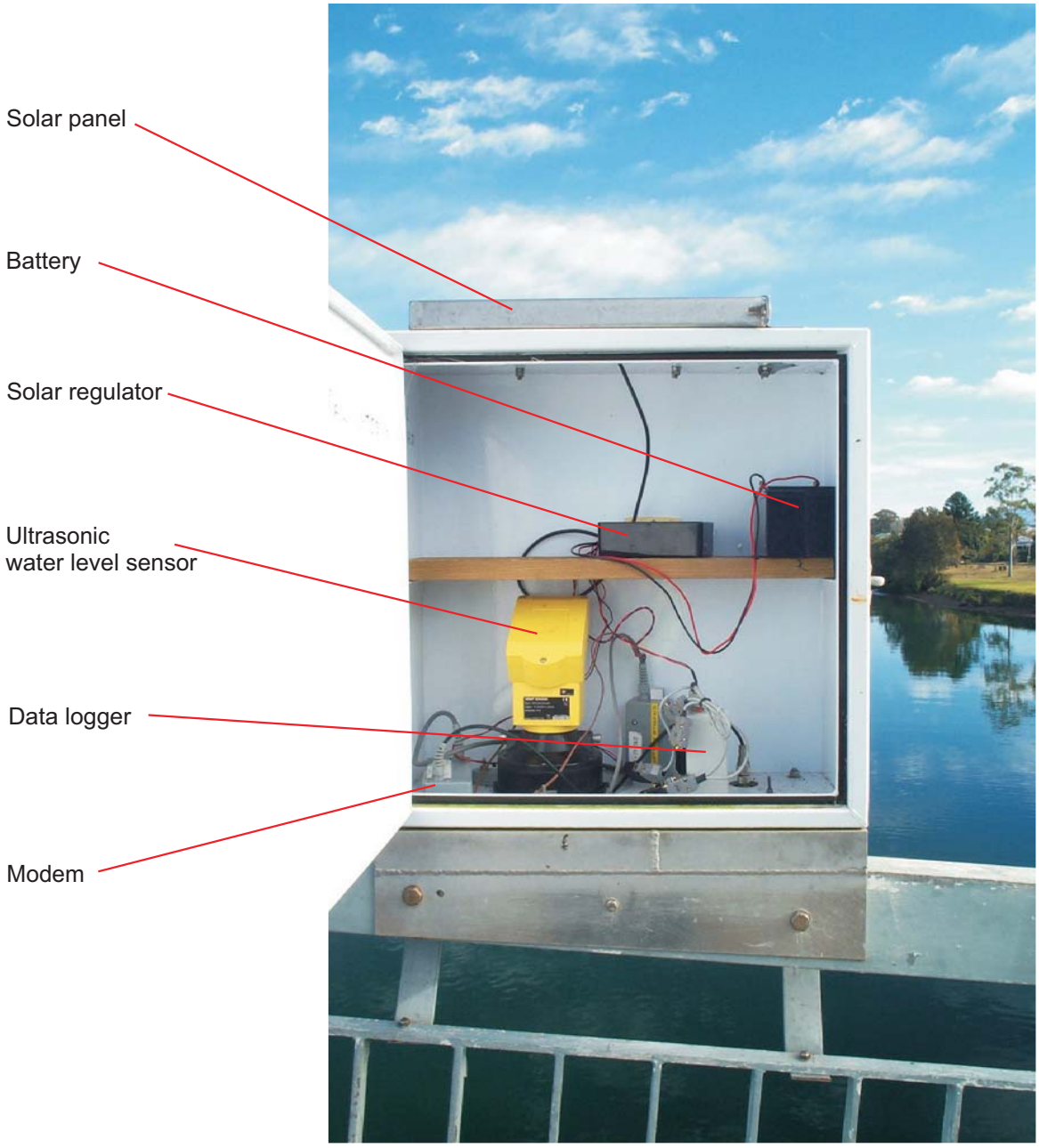
NSW GOVERNMENT
Public Works
Manly Hydraulics Laboratory

TYPICAL SUBMERSIBLE WATER LEVEL STATION

MHL
Report 2474

Figure
3

DRAWING 2474-01.cdr



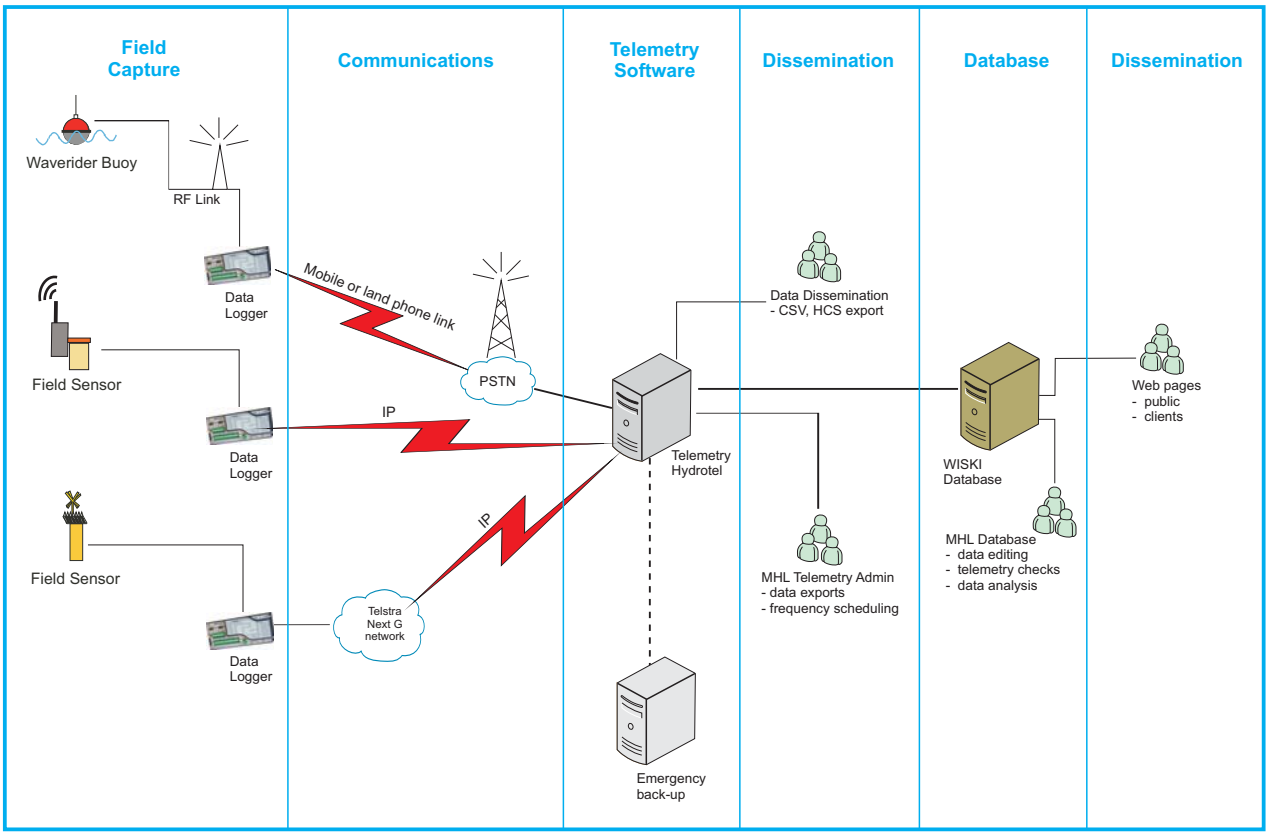
NSW GOVERNMENT
Public Works
Manly Hydraulics Laboratory

TYPICAL ULTRASONIC STATION

MHL
Report 2474

Figure
4

DRAWING 2474-01.cdr


Field Capture
Communications
Telemetry Software
Dissemination
Database
Dissemination
Waverider Buoy
RF Link
Data Logger
Mobile or land phone link
PSTN
Field Sensor
IP
Data Logger
Telemetry Hydrotel
Data Dissemination
- CSV, HCS export
Web pages
- public
- clients
WISKI Database
Field Sensor
IP
Telstra Next G network
Data Logger
MHL Telemetry Admin
- data exports
- frequency scheduling
MHL Database
- data editing
- telemetry checks
- data analysis
Emergency back-up

Appendix A

Station data online

Table A1 Station data online

Coastal region	River/creek	Location	Period of data
Tweed	Broadwater	Cobaki	Dec 1987–ongoing
Tweed	Terranora Inlet	Dry Dock	Dec 1987–ongoing
Tweed	Broadwater	Terranora	Dec 1987–ongoing
Tweed	Tweed River	Letitia 2A	Nov 1987–ongoing
Tweed	Tweed River	Letitia 2B	Nov 1987–June 2008
Tweed	Tweed River	Barneys Point	Mar 1987–ongoing
Tweed	Bartletts Creek	Bartletts Creek	Nov 1994–Mar 1996
Tweed	Leddays Creek	Leddays Creek	Dec 1994–June 1996
Tweed	McLeods Drain	McLeods Drain	Mar 1996–Apr 1996
Tweed	Tweed River	Tumbulgum	Jul 1985–ongoing
Tweed	Tweed River	North Murwillumbah	Jan 1987–ongoing
Tweed	Tweed River	Bray Park Weir	Nov 2002–ongoing
Tweed	Tweed River	Murwillumbah Bridge	Nov 2002–ongoing
Tweed	Rous River	Kynnumboon	Aug 1990–ongoing
Brunswick	Cudgen Creek	Kingscliff	May 1985–ongoing
Brunswick	Cudgen Creek	Kingscliff Upstream	May 2014–ongoing
Brunswick	Cudgen Creek	Cudgen Creek	May 1985–Nov 2009
Brunswick	Cudgen Lake	Cudgen Lake	Nov 1993–Dec 1993
Brunswick	Belongil Creek	Belongil	Dec 1994–Dec 1996
Brunswick	Cudgen Lake	Bogangar	Dec 1985–ongoing
Brunswick	Marshalls Creek	Orana Bridge	Nov 2002–ongoing
Brunswick	Marshalls Creek	Capricornia Canal	Mar 1997–Mar 1998
Brunswick	Marshalls Creek	New Brighton	Mar 1997–Apr 1998
Brunswick	Marshalls Creek	Billinudgel	Jan 1986–ongoing
Brunswick	Brunswick River	Mullumbimby	Jul 1984–ongoing
Brunswick	Simpsons Creek	Simpsons Creek	Apr 1998–Mar 1999
Richmond	Lennox Head	Lake Ainsworth	Oct 1994–ongoing
Richmond	Richmond River	Missingham Bridge	Nov 2003–ongoing
Richmond	Richmond River	Byrnes Point	Apr 1990–ongoing
Richmond	Richmond River	Wardell	Oct 2002–ongoing
Richmond	Richmond River	Woodburn	Sep 1985–ongoing
Richmond	Tucombil Canal	Tucombil at Highway	Dec 1989–ongoing
Richmond	Tucombil Canal	Tucombil Floodgate	Oct 1990–Aug 2015
Richmond	Tuckean Broadwater	Tuckean	Oct 1995–Oct 1996
Richmond	Evans River	Iron Gates	Dec 1992–May 1993
Richmond	Evans River	Iron Gates	Apr 1997–ongoing
Richmond	Evans River	Fishing Co-op	Mar 1997–ongoing
Richmond	Evans River	Evans Head	Nov 1981–Aug 1984
Richmond	Richmond River	Rocky Mouth Creek	Sep 1994–ongoing
Richmond	Richmond River	Bungawalbin	Sep 2002–ongoing
Richmond	Richmond River	Bungawalbin Creek	Aug 2015–ongoing
Richmond	Richmond River	Coraki	Dec 1987–ongoing
Richmond	Wilsons River	East Gundurimba	Apr 1980–ongoing
Richmond	Leycester Creek	Tuncester	Mar 1980–ongoing
Richmond	Wilsons River	Woodlawn College	Mar 1980–ongoing
Richmond	Wilsons Creek	Federal	Nov 1988–Sep 1995
Clarence	Clarence River	Oyster Channel	Nov 2002–ongoing
Clarence	Clarence River	Maclean	Jan 1990–ongoing
Clarence	Clarence River	Lawrence	Nov 2002–ongoing
Clarence	Clarence River	Tyndale	Nov 2002–ongoing
Clarence	Clarence River	The Avenue upstream	Nov 2002–ongoing
Clarence	Clarence River	The Avenue downstream	Nov 2002–ongoing
Clarence	Empire Vale Creek	Empire Vale Creek	May 1998–Oct 1999

Coastal region	River/creek	Location	Period of data
Clarence	Clarence River	Roberts Creek	May 1994–May 1996
Clarence	Clarence River	Brushgrove	Sep 1989–ongoing
Clarence	Clarence River	Ulmarra	Sep 2002–ongoing
Clarence	Clarence River	Grafton	Jul 1987–ongoing
Clarence	Clarence River	Rogans Bridge	Jul 1993–ongoing
Clarence	Clarence River	Tarrent Bridge	Mar 1999–Apr 2000
Clarence	Palmers Channel	Palmers Island	Aug 1990–Sep 2009
Clarence	Palmers Channel	Palmers Island Bridge	Dec 2001–ongoing
Clarence	Lake Wooloweyah	Lake Wooloweyah	June 2009–ongoing
Bellinger	Wooli River	Wooli Entrance	Jul 1991–ongoing
Bellinger	Wooli River	Wooli Caravan Park	Jul 1991–ongoing
Bellinger	Corindi Creek	Red Rock	Feb 2004–ongoing
Bellinger	Woolgoolga Creek	Woolgoolga Lake	May 2007–ongoing
Bellinger	Woolgoolga Creek	Woolgoolga	Mar 1990–ongoing
Bellinger	Moonee Creek	Moonee Creek	Aug 2002–ongoing
Bellinger	Coffs Creek	Coffs Creek at Highway	Dec 1980–ongoing
Bellinger	Newports Creek	Newports Creek	Nov 1990–ongoing
Bellinger	Boambee Creek	Boambee Downstream	Apr 1991–Sept 2006
Bellinger	Boambee Creek	Boambee	Jan 1980–ongoing
Bellinger	Boambee Creek	Boambee Entrance	Mar 2005–ongoing
Bellinger	Bonville Creek	Bonville	Aug 2009–ongoing
Bellinger	Never Never Creek	Gleniffer	Nov 1996–Nov 2003
Bellinger	Bellinger River	Repton	Jun 1988–ongoing
Bellinger	Bellinger River	Bellingen Downstream	Jul 1984–Mar 2001
Bellinger	Bellinger River	Bellingen Bridge	July1996–ongoing
Bellinger	Bellinger River	Thora	Nov 2010–ongoing
Bellinger	Kalang River	Urunga	Sep 1993–ongoing
Bellinger	Kalang River	Newry Island	Sep 1989–ongoing
Bellinger	Kalang River	Kooroowi	May 1985–ongoing
Bellinger	Deep Creek	Deep Creek	Apr 2002–ongoing
Bellinger	Nambucca River	Stuarts Island	Mar 1993–Dec 2012
Bellinger	Nambucca River	Stuarts Island Downstream	Nov 2008–ongoing
Bellinger	Nambucca River	Macksville	May 1983–ongoing
Bellinger	Taylors Arm	Utungun	Oct 1991–ongoing
Bellinger	Nambucca River	Bowraville	Dec 2008–ongoing
Bellinger	Warrell Creek	Warrell Creek	Feb 2010–ongoing
Macleay	Yarrahapinni Wetland	Borirgala	Jul 2008–ongoing
Macleay	Macleay River	South West Rocks	Apr 1988–ongoing
Macleay	Korogoro Creek	Hat Head	Feb 2004–ongoing
Macleay	Saltwater Lagoon	Saltwater Lagoon	Aug 2004–ongoing
Macleay	Andersons Inlet	Middle Island	Mar 1996–Dec 2006
Macleay	Macleay River	Smithtown	Feb 1986–ongoing
Macleay	Macleay River	Kempsey	Jul 1983–ongoing
Macleay	Macleay River	Euroka Upstream	Jul 1990–June 2011
Macleay	Macleay River	Aldavilla Downstream	Dec 2011–ongoing
Macleay	Ryanda Creek	Guyra	Dec 1987–Oct 1991
Hastings	Maria River	Connection Creek	Sep 1994–Oct 1995
Hastings	Maria River	Green Valley	Dec 1992–ongoing
Hastings	Wilsons River	Telegraph Point	Sep 1989–ongoing
Hastings	Hastings River	Settlement Point	Feb 1986–ongoing
Hastings	Killick Creek	Crescent Head	Apr 2001–ongoing
Hastings	Hastings River	Dennis Bridge Downstream	May 1994–ongoing
Hastings	Hastings River	Dennis Bridge Upstream	Mar 1994–Dec 2007
Hastings	Hastings River	Wauchope Railway Bridge	Oct 1985–ongoing
Hastings	Kooloonbung Creek	Kooloonbung	Dec 1985–Jan 1987

Coastal region	River/creek	Location	Period of data
Hastings	Hastings River	Lake Innes	Aug 1993–Sep 1994
Hastings	Hastings River	Lake Cathie	Aug 1992–ongoing
Camden Haven	Camden Haven River	North Haven	Oct 1986–ongoing
Camden Haven	Stingray Creek	West Haven	Oct 1986–ongoing
Camden Haven	Camden Haven River	Laurieton	Aug 1990–ongoing
Camden Haven	Camden Haven River	Logans Crossing	Sep 1989–ongoing
Camden Haven	Lakewood	Lakewood	Dec 2001–ongoing
Camden Haven	Watson Taylors Lake	Watson Taylors Lake	Dec 2001–ongoing
Manning	Dingo Creek	Ashlea Bridge Downstream	Apr 2011–ongoing
Manning	Manning River	Harrington	Jul 1987–ongoing
Manning	Manning River	Croki	Jan 1992–ongoing
Manning	Manning River	Dumaresq Island	Aug 2001–ongoing
Manning	Manning River	Taree	Sep 1985–ongoing
Manning	Manning River	Wingham	Jul 1989–ongoing
Manning	Manning River	Killawarra	Aug 1991–Dec 1999
Manning	Manning River	Mount George	Jul 1992–ongoing
Manning	Scotts Creek	Scotts Creek	Oct 1998–Oct 1999
Manning	Dingo Creek	Munyaree Flat	May 1991–Oct 2009
Manning	Manning River	Farquhar Inlet	Aug 1987–ongoing
Karuah	Wallamba River	Tuncurry	Aug 1985–ongoing
Karuah	Wallamba River	Tuncurry Wetlands	Mar 2001–ongoing
Karuah	Wallamba River	Wallamba Broadwater	Aug 1997–Aug 1998
Karuah	Coolongolook River	Peach Tree Point	Jul 1997–Mar 1999
Karuah	Wallamba River	Nabiac	Nov 1983–ongoing
Karuah	Wallis Lake	Darawakh Swamp	Jul 2008–Oct 2009
Karuah	Wallis Lake	Booti Island	Jul 1997–Aug 1998
Karuah	Wallis Lake	Tiona	Aug 1985–Jul 2015
Karuah	Wallis Lake	Pacific Palms Wharf	Oct 2013–ongoing
Karuah	Smith Lake	Tarbuck Bay	May 1996–ongoing
Karuah	Smith Lake	Pacific Palms	May 1995–May 1996
Karuah	Myall River	Markwell	Nov 2003–ongoing
Karuah	Myall River	Bulahdelah	Nov 1984–ongoing
Karuah	Myall Lake	Mayers Point	Jul 1996–Mar 1998
Karuah	Myall Lake	Bombah Broadwater	Jul 1996–Mar 1998
Karuah	Myall Lake	Bombah Point	Jul 2001–ongoing
Karuah	Myall River	Monkey Jacket	Jul 1996–Mar 1998
Karuah	Myall River	Tea Gardens upstream	Mar 1995–May 1995
Karuah	Myall River	Tea Gardens	Dec 2008–ongoing
Karuah	Karuah River	Karuah	Dec 2009–ongoing
Karuah	Port Stephens	Mallabula Point	July 1992–ongoing
Hunter	Hunter River	Stockton Bridge	Dec 1984–ongoing
Hunter	Iron Bark Creek	Upstream of Flood Gate	May 1998–Oct 2004
Hunter	Iron Bark Creek	Pacific Highway Bridge	Mar 1997–Mar 1999
Hunter	Hunter River	Hexham Bridge	Jun 1980–ongoing
Hunter	Williams River	Raymond Terrace	Apr 1980–ongoing
Hunter	Williams River	Seaham	Dec 1995–ongoing
Hunter	Hunter River	Green Rocks	Aug 1979–ongoing
Hunter	Paterson River	Hinton Bridge	Aug 1979–ongoing
Hunter	Paterson River	Dunmore	Jul 1979–ongoing
Hunter	Paterson River	Railway Bridge	Sep 1983–ongoing
Hunter	Paterson River	Gostwyck	Oct 1988–ongoing
Hunter	Hunter River	Morpeth	Apr 1985–ongoing
Hunter	Hunter River	McKimms Corner	May 1986–ongoing
Hunter	Wallis Creek	Wallis Creek Downstream	Aug 1979–ongoing
Hunter	Wallis Creek	Wallis Creek Upstream	Apr 1990–ongoing

Coastal region	River/creek	Location	Period of data
Hunter	Wallis Creek	Wallis Creek	Sep 1997–Oct 1998
Hunter	Wallis Creek	Louth Park	Dec 1984–ongoing
Hunter	Hunter River	Belmore Bridge	Jun 1992–ongoing
Hunter	Hunter River	Bolwarra Downstream	Mar 1986–ongoing
Hunter	Hunter River	Bolwarra Upstream	Apr 1992–ongoing
Hunter	Hunter River	Shortland Wetland Centre	Mar 1999–Jul 2000
Hunter	Hunter River	Oakhampton Railway Br	Dec 1995–ongoing
Macquarie-Tuggerah Lakes	Lake Macquarie	Marmong Point	Jun 1986–ongoing
Macquarie-Tuggerah Lakes	Cockle Creek	Cockle Railway Station	Feb 1985–ongoing
Macquarie-Tuggerah Lakes	Cockle Creek	Barnsley Vale	Feb 1986–ongoing
Macquarie-Tuggerah Lakes	Lake Macquarie	Belmont	May 1986–ongoing
Macquarie-Tuggerah Lakes	Lake Macquarie	Swansea Channel	Mar 1996–ongoing
Macquarie-Tuggerah Lakes	Dora Creek	Kalang Road	Sep 1993–ongoing
Macquarie-Tuggerah Lakes	Dora Creek	Cooranbong	Jun 1990–ongoing
Macquarie-Tuggerah Lakes	Stockton Creek	Morisset	Dec 1984–ongoing
Macquarie-Tuggerah Lakes	Wallarah Creek	Wallarah Creek Bridge	May 1994–ongoing
Macquarie-Tuggerah Lakes	Tuggerah Lake	Toukley	Feb 1985–ongoing
Macquarie-Tuggerah Lakes	Wyong River	Wyong Weir Upstream	Jul 1990–ongoing
Macquarie-Tuggerah Lakes	Berkeley Creek	Berkeley Vale	Jul 1989–Feb 1994
Macquarie-Tuggerah Lakes	Tuggerah Lake	Killarney Vale	Feb 1985–Sep 1991
Macquarie-Tuggerah Lakes	Chittaway Creek	Old Chittaway Road	Sep 1994–Apr 1996
Macquarie-Tuggerah Lakes	Chittaway Creek	Turpentine	Jul 1990–May 1993
Macquarie-Tuggerah Lakes	Ourimbah Creek	Lees Bridge	May 1993–ongoing
Macquarie-Tuggerah Lakes	Tuggerah Lake	Long Jetty	Sep 1991–ongoing
Macquarie-Tuggerah Lakes	Tumbi Umbi Creek	Tumbi Umbi	Apr 1994–ongoing
Hawkesbury	Narara Creek	Manns Road	Mar 1996–ongoing
Hawkesbury	Wamberal Lagoon	Wamberal Lagoon	Jul 1993–ongoing
Hawkesbury	Terrigal Lagoon	Terrigal Bridge	Jun 1993–ongoing
Hawkesbury	Avoca Lake	Avoca Lake	Jun 1993–ongoing
Hawkesbury	McMasters Beach	Cockrone Lake	Jun 1993–ongoing
Hawkesbury	Worthing Ave Creek	Erina Bridge	Feb 1996–Aug 2007
Hawkesbury	Worthing Ave Creek	Erina	Aug 2007–ongoing
Hawkesbury	Erina Creek	Punt Bridge	Mar 1994–ongoing
Hawkesbury	Narara Creek	Narara A/C	Jul 1988–Mar 1995
Hawkesbury	Brisbane Water	Wharf Street	Aug 1985–May 1995
Hawkesbury	Brisbane Water	Ettalong	Apr 1986–ongoing
Hawkesbury	Brisbane Water	Koolewong	Aug 1985–ongoing
Hawkesbury	Hawkesbury River	Little Patonga	Jun 1986–Dec 1992
Hawkesbury	Hawkesbury River	Patonga	Jun 1992–ongoing
Hawkesbury	Hawkesbury River	Gentlemans Halt	Oct 1986–Mar 1996
Hawkesbury	Hawkesbury River	Gunderman	Oct 1986–Jan 1992
Hawkesbury	Hawkesbury River	Spencer	Apr 1992–ongoing
Hawkesbury	Hawkesbury River	Gunderman Caravan Park	Apr 1992–ongoing
Hawkesbury	Hawkesbury River	Webbs Creek	Jun 1981–ongoing
Hawkesbury	Hawkesbury River	Lower Portland	Feb 1988–Dec 1997
Hawkesbury	Hawkesbury River	Colo Junction	May 1998–ongoing
Hawkesbury	Hawkesbury River	Sackville Upstream	July 1991–Aug 2011
Hawkesbury	Hawkesbury River	Sackville	May1980–ongoing
Hawkesbury	Hawkesbury River	Sackville Downstream	July 1991–Nov 2010
Hawkesbury	Hawkesbury River	Ebenezer	Sep 1989–ongoing
Hawkesbury	Hawkesbury River	Windsor	Sep 1987–ongoing
Hawkesbury	Hawkesbury River	Freemans Reach	Apr 1980–ongoing
Hawkesbury	Nepean River	Castlereagh	Nov 1981–ongoing
Hawkesbury	Berowra Creek	Berowra Point	May 1995–Sep 1995
Hawkesbury	Berowra Creek	Oaky Point	May 1995–Sep 1995

Coastal region	River/creek	Location	Period of data
Hawkesbury	Berowra Creek	Berowra Waters Ferry	May 1995–Sep 1995
Hawkesbury	Berowra Creek	Berowra Marina	May 1995–Sep 1995
Hawkesbury	Berowra Creek	Crosslands Reserve	May 1995–Sep 1995
Sydney Coastal	Narrabeen Lagoon	Pittwater Road Bridge	Aug 1994–ongoing
Sydney Coastal	Narrabeen Lagoon	Middle Creek	May 1992–Jan 1994
Sydney Coastal	Narrabeen Lagoon	Narrabeen Lake	Aug 1986–ongoing
Sydney Coastal	Narrabeen Lagoon	Middle Creek Bridge	Apr 1995–ongoing
Sydney Coastal	Narrabeen Lagoon	Narrabeen Creek	May 1998–ongoing
Sydney Coastal	Dee Why Lagoon	Dee Why	Mar 1996–ongoing
Sydney Coastal	Curl Curl Lagoon	Curl Curl	Aug 1991–ongoing
Sydney Coastal	Manly Creek	Queenscliff Bridge	Sep 1990–ongoing
Sydney Coastal	Manly Creek	Riverview Parade	Mar 1990–ongoing
Sydney Coastal	Manly Creek	Manly Dam	Jun 1990–ongoing
Sydney Coastal	Haslams Creek	Haslams Creek	Jan 1992–Oct 1995
Sydney Coastal	Penrith	Penrith Lakes	May 1992–Jun 1996
Sydney Coastal	Lane Cove River	Fullers Bridge	Apr 2016–ongoing
Sydney Coastal	Parramatta River	Silverwater Bridge	Apr 2012–ongoing
Sydney Coastal	Cooks River	Canterbury Road	Sep 1991–ongoing
Sydney Coastal	Cooks River	Tempe Bridge	Aug 1991–ongoing
Sydney Coastal	Cooks River	Illawarra Road Bridge	Jul 2001–ongoing
Sydney Coastal	Georges River	Como Bridge	Feb 2001–ongoing
Sydney Coastal	Georges River	Picnic Point Downstream	May 1989–ongoing
Sydney Coastal	Georges River	Milperra	Oct 1980–ongoing
Sydney Coastal	Georges River	Kelso Creek Downstream	Sep 1996–ongoing
Sydney Coastal	Georges River	Kelso Creek Upstream	Sep 1996–ongoing
Sydney Coastal	Prospect Creek	Lansdowne Bridge	Nov 1987–ongoing
Sydney Coastal	Georges River	Lansvale	Aug 1980–ongoing
Sydney Coastal	Cabramatta Creek	Irelands Bridge	Mar 1988–ongoing
Sydney Coastal	Georges River	Scrivener Street	Oct 1980–ongoing
Sydney Coastal	Georges River	Liverpool Weir	Jul 1980–ongoing
Sydney Coastal	Woronora River	Woronora Bridge	Apr 1998–ongoing
Wollongong Coastal	Towradgi Creek	Towradgi Creek	Apr 1992–ongoing
Wollongong Coastal	Hewitts Creek	Hewitts Creek	Oct 2001–ongoing
Wollongong Coastal	Hewitts Creek	Hewitts Creek Entrance	May 2005–ongoing
Wollongong Coastal	Cabbage Tree Creek	Balgownie Road	Nov 2002–ongoing
Wollongong Coastal	Cabbage Tree Creek	Cabbage Tree Creek	Apr 1985–ongoing
Wollongong Coastal	Fairy Creek	Fairy Creek	Jul 2007–ongoing
Wollongong Coastal	Byarong Creek	Byarong Creek	Jul 1993–ongoing
Wollongong Coastal	Byarong Creek	Koloona Avenue	Jul 2001–ongoing
Wollongong Coastal	American Creek	Blackmans Parade	Nov 2001–ongoing
Wollongong Coastal	Mullet Creek	Mullet Creek	Apr 1985–ongoing
Wollongong Coastal	Lake Illawarra	Koonawarra Bay	Jul 1994–ongoing
Wollongong Coastal	Lake Illawarra	Cudgeree Bay	Dec 1987–ongoing
Wollongong Coastal	Lake Illawarra	Entrance	Jul 1991–ongoing
Wollongong Coastal	Macquarie Rivulet	Princes Highway	Dec 1984–ongoing
Wollongong Coastal	Minnamurra River	Minnamurra	Mar 2002–ongoing
Wollongong Coastal	Lake Illawarra	Buroo Point	Dec 1987–May 1990
Wollongong Coastal	Lake Illawarra	Kanahooka Bay	Dec 1987–Jan 1990
Wollongong Coastal	Little Lake	Little Lake	May 1992–Oct 2014
Wollongong Coastal	Little Lake	Little Lake Entrance	May 2014–ongoing
Wollongong Coastal	Werri Lagoon	Werri Lagoon	Aug 2002–ongoing
Shoalhaven	Shoalhaven River	Shoalhaven Heads	Feb 1991–ongoing
Shoalhaven	Shoalhaven	Wharf Road	Jan 1990–Mar 2002
Shoalhaven	Shoalhaven	Hay Street	Jan 2002–ongoing
Shoalhaven	Shoalhaven	Nowra Bridge	Aug 1990–ongoing

Coastal region	River/creek	Location	Period of data
Shoalhaven	Shoalhaven	Grady's	Feb 2006–Jan 2010
Shoalhaven	Shoalhaven	Grady's Caravan Park	Oct 2010–ongoing
Shoalhaven	Shoalhaven	Crookhaven Heads	Jan 1991–ongoing
Shoalhaven	Shoalhaven	Greenwell Point	Dec1989–ongoing
Shoalhaven	Shoalhaven	Terara	Aug 2001–ongoing
Shoalhaven	Lake Wollumboola	Lake Wollumboola	Jul 1991–ongoing
Shoalhaven	Crooked River	Gerroa	Feb 1999–ongoing
Clyde River-Jervis Bay	Currarong Creek	Currarong Creek	Oct 1995–ongoing
Clyde River-Jervis Bay	St. Georges Basin	Sussex Inlet	Nov 2000–ongoing
Clyde River-Jervis Bay	St. Georges Basin	Island Point	Jul 1991–ongoing
Clyde River-Jervis Bay	Lake Conjola	Conjola Lake	Sep 1992–ongoing
Clyde River-Jervis Bay	Narrawallee Inlet	Narrawallee Inlet	Aug 1993–ongoing
Clyde River-Jervis Bay	Swan Lake	Swan Lake	Jan 2000–ongoing
Clyde River-Jervis Bay	Burrill Lake	Burrill Lake Bridge	Nov 1991–ongoing
Clyde River-Jervis Bay	Tabourie Lake	Tabourie Lake	Sep 1992–ongoing
Clyde River-Jervis Bay	Durras Lake	Durras Lake	Nov 2000–ongoing
Clyde River-Jervis Bay	Clyde River	Princess Jetty, Batemans Bay	Dec 1985–ongoing
Clyde River-Jervis Bay	Clyde River	Nelligen	Apr 1994–ongoing
Clyde River-Jervis Bay	Tomaga River	George Bass Drive	Aug 1996–ongoing
Moruya	Moruya River	Quarry Wharf	May 1989–Aug 1995
Moruya	Moruya River	Moruya Bridge	May 1997–ongoing
Moruya	Moruya River	Moruya Hospital	Oct 1990–ongoing
Tuross	Tuross River	Coila Lake	Jan 1996–ongoing
Tuross	Trunketabella Creek	Trunketabella Bridge	May 1994–Mar 1998
Tuross	Tuross River	Tuross Head	May 1994–ongoing
Tuross	Wagonga River	Narooma Public Wharf	Aug 1996–Aug 2008
Tuross	Wagonga River	Barlows Bay	Sep 1996–ongoing
Bega	Wallaga Lake	Wallaga Lake	Aug 1993–Jul 2007
Bega	Wallaga Lake	Meads Bay	Feb 1999–Feb 2000
Bega	Wallaga Lake	Regatta Point	Oct 1993–ongoing
Bega	Bega River	Hancock Bridge	Nov 2000–ongoing
Bega	Bega River	Bega	Nov 2000–ongoing
Towamba	Back Lagoon	Back Lagoon	Feb 2009–ongoing
Towamba	Merimbula Wharf	Merimbula Wharf	Mar 1991–ongoing
Towamba	Merimbula Lake	Merimbula Lake	Mar 1991–ongoing
Towamba	Curalo Lagoon	Curalo Lagoon	Mar 1996–Mar 1998
Towamba	Lake Curalo	Lake Curalo	Jul 2007–ongoing
Towamba	Wonboyn River	Wonboyn River	Aug 1999–Sep 1999
Towamba	Pambula Lake	Pambula Lake	Mar 1991–ongoing
Towamba	Wonboyn Lake	Agnew Wharf	Aug 1997–ongoing

Table A2 Historical data

River region name	River/creek	Station	Data start	Data finish	AWRC *
Bellinger	Bellinger North Arm	Backwater Creek	07-Apr-1962	11-Apr-1962	205409
Bellinger	Backwater Creek	Backwater Creek	10-Jul-1962	11-Jul-1962	N/A
Bellinger	Bellinger River	Bellingen Bridge	21-Jan-1959	20-Feb-1985	205400
Bellinger	Bellinger River	Backwater Raleigh	07-Feb-1981	25-Jan-1989	205412
Bellinger	Nambucca River	Bowraville	01-Jan-1890	01-May-1977	205006
Bellinger	Coffs Creek	Coffs Harbour	19-Jan-1982	19-Dec-1988	205439
Bellinger	Bellinger River	Coffs Harbour	08-Apr-1962	10-May-1980	205439
Bellinger	Bellinger River	Congarinni Bridge	08-Jan-1974	06-Feb-1989	205415
Bellinger	Coffs Creek	Coffs Harbour	19-Jan-1982	20-Dec-1988	205439
Bellinger	Bellinger River	Dairy Factory Raleigh	18-Feb-1959	24-Jan-1989	205402
Bellinger	Bellinger River	Fernmount PO	08-Apr-1962	24-Jan-1989	205401
Bellinger	Nambucca River	Franks Wharf	08-May-1980	29-Jan-1989	205414
Bellinger	Bellinger South Arm	Gauge 9	08-Apr-1962	12-Jul-1962	N/A
Bellinger	Nambucca River	Golf Club Nambucca Heads	01-Jan-1890	01-May-1977	N/A
Bellinger	Gumma Gumma Creek	Gumma Road	10-Jul-1985	09-Apr-1988	205431
Bellinger	Nambucca River	Gumma Gumma Ck Jn, 0.7km U\S	01-Jan-1890	01-May-1977	N/A
Bellinger	Nambucca River	Hacienda Motor Inn	09-May-1980	21-Feb-1989	205433
Bellinger	Taylors Arm	Kings Point	09-May-1980	12-Apr-1988	205436
Bellinger	Nambucca River	Lanes Bridge 5.2km D\S	01-Jan-1890	01-May-1977	N/A
Bellinger	Nambucca River	Lower Nambucca, Gauge 10	09-May-1980	23-May-1981	N/A
Bellinger	Nambucca River	Macksville	01-Mar-1894	21-Dec-1988	205416
Bellinger	Stewarts River	Midindi	10-Jul-1985	10-Jul-1985	N/A
Bellinger	Bellinger	North Arm Mylestom	07-Apr-1962	19-Dec-1988	205405
Bellinger	Nambucca River	Nambucca	10-May-1980	11-Oct-1982	N/A
Bellinger	Nambucca River	Nambucca Marine	09-Jul-1985	10-Jul-1985	205432
Bellinger	Nambucca River	Nth of Hacienda Motor Inn	01-Jan-1890	01-May-1977	N/A
Bellinger	Bellinger River	Paxton Raleigh	09-May-1980	03-Apr-1981	N/A
Bellinger	Nambucca River	Pacific Highway at Watt Ck	01-Jan-1890	01-May-1977	N/A
Bellinger	Bellinger North Arm	Repton Railway Bridge	17-Feb-1959	26-Jan-1986	205403
Bellinger	Bellinger North Arm	Repton	08-Apr-1962	27-Jan-1986	205404
Bellinger	Nambucca River	Showground	12-Sep-1979	10-Jul-1985	205434
Bellinger	Nambucca River	Teagues Creek	10-Apr-1985	10-Jul-1985	205418
Bellinger	Nambucca River	Tewinga School, 1.8km D/S	01-Jun-1950	01-Mar-1974	N/A
Bellinger	Nambucca River	Upper Tewinga	09-May-1980	05-Apr-1988	205419

River basin name	River/creek	Station	Data start	Data finish	AWRC
Bellinger	Kalang River	Urunga Bridge	10-Jul-1962	25-Jan-1989	205407
Bellinger	Nambucca River	Usshers Fruit Stall	03-May-1985	10-Jul-1985	205417
Bellinger	Taylors Arm	Utungun	01-Jan-1890	01-May-1977	N/A
Bellinger	Kalang River	Urunga Boatshed	17-Apr-1962	27-Oct-1985	205406
Bellinger	Nambucca River	Watt Creek	09-May-1980	23-May-1981	205430
Bellinger	Woolgoolga Creek	Lakeside Caravan Park	15-Jul-1982	31-Jul-1988	205441
Bellinger	Backwater	Yellow Rock	10-Jul-1962	12-Jul-1962	N/A
Bellinger	Bellinger North Arm	Yellow Rock	18-Feb-1959	10-Jul-1962	205410
Clarence	Clarence River	Baryulgil	21-Feb-1954	21-Feb-1954	204900
Clarence	Clarence River	Briner Bridge	21-Jul-1965	21-Jan-1967	204407
Clarence	Clarence River	Bultitude	21-Jul-1965	12-May-1980	204407
Clarence	Clarence River	Brushgrove	01-Jan-1890	09-May-1980	204406
Clarence	Clarence River	Buccarumbi	15-Jun-1950	21-Feb-1954	204005
Clarence	Clarence River	Chaseling	21-Jul-1965	21-Mar-1967	204423
Clarence	Clarence River	Chatsworth	17-Feb-1957	11-Apr-1962	204411
Clarence	Clarence River	Copmanhurst	04-Feb-1890	20-Feb-1956	204903
Clarence	Orara River	Coutts Crossing	01-Mar-1946	31-Aug-1959	N/A
Clarence	Orara River	Coramba	01-Jan-1954	01-Jan-1954	N/A
Clarence	Orara River	Glenreagh	22-Jul-1950	21-Feb-1954	204906
Clarence	Clarence River	Grafton (North Street)	19-Feb-1956	10-May-1980	204401
Clarence	Coldstream River	Coldstream	24-Jan-1959	27-Jan-1959	204429
Clarence	Clarence River	Grafton (Prince Street)	01-Jan-1841	15-Jan-1968	204400
Clarence	Backwater	Great Marlow	01-Jan-1946	31-Jan-1967	204432
Clarence	Clarence River	Iluka	01-Jan-1945	29-Jun-1956	N/A
Clarence	Clarence River	Jackadgery	15-Jun-1950	27-Jun-1950	204004
Clarence	Clarence River	Lawrence	01-Jan-1946	02-Apr-1959	204409
Clarence	Clarence River	Maclean	08-Mar-1890	11-May-1980	204410
Clarence	Clarence River	Newbold	01-Mar-1948	30-Jun-1950	204007
Clarence	Clarence River	Nymboida	18-Jun-1950	10-Feb-1956	204001
Clarence	Clarence River	Palmers Island	14-Feb-1957	13-May-1980	204412
Clarence	Clarence River	Palmers Channel	14-Feb-1957	11-Apr-1962	204426
Clarence	Clarence River	Quarry	22-Jan-1959	17-Nov-1959	N/A
Clarence	Clarence River	Shark Creek Bridge	21-Jul-1965	13-May-1980	204425
Clarence	Clarence River	South Grafton	23-Mar-1953	14-Apr-1962	204402

River basin name	River/creek	Station	Data start	Data finish	AWRC
Clarence	Clarence River	Sheathers	21-Jul-1965	21-Mar-1967	204413
Clarence	Clarence River	South Arm	22-Jan-1959	21-Feb-1959	204407
Clarence	Sportsmans Creek	No. 17	22-Jan-1959	16-Nov-1959	204408
Clarence	Clarence River	South Grafton Railway Bridge	23-Mar-1953	14-Apr-1962	204402
Clarence	Clarence River	South Grafton Common	08-Apr-1962	11-May-1980	204000
Clarence	Shark Creek	Swamp	04-Feb-1890	10-Feb-1956	204425
Clarence	Clarence River	Tabulam	04-Feb-1890	10-Feb-1956	204002
Clarence	Clarence River	Towgan Grange	09-Feb-1956	10-Feb-1956	204432
Clarence	Coldstream River	Tucabia	22-Feb-1953	14-Apr-1962	204403
Clarence	Clarence River	Ulmarra	15-Jun-1948	15-Nov-1959	204427
Clarence	Clarence River	Yamba	12-Jun-1945	01-Mar-1946	204454
Hunter	Hunter River	Belmore Bridge	08-Mar-1893	05-Jun-1974	210047
Hunter	Wollombi Creek	Bulga	13-Feb-1955	20-May-1962	210028
Hunter	Hunter River	Cummins Dam D/S	19-Feb-1962	14-Jun-1964	210400
Hunter	Hunter River	Cummins Dam U/S	11-Jun-1964	21-Mar-1978	210425
Hunter	Williams River	Dungog	02-Dec-1961	11-Jun-1964	N/A
Hunter	Paterson River	Dunmore Bridge	10-Dec-1920	20-Jan-1978	210409
Hunter	Hunter River	Duckenfield	19-Feb-1962	04-Feb-1971	210412
Hunter	Hunter River	East Maitland No. 1	26-Feb-1955	03-Mar-1955	N/A
Hunter	Hunter River	Goulbourne Grove	14-Jan-1961	29-Mar-1963	210405
Hunter	Hunter River	Green Rocks	01-Sep-1914	14-Jun-1964	210432
Hunter	Paterson River	Gostwyck	01-Jan-1990	01-Jan-1991	N/A
Hunter	Wollombi Creek	Hanging Rock	29-Oct-1959	31-May-1962	210051
Hunter	Tarro	Hexham Swamps	12-Sep-1960	29-Jun-1962	N/A
Hunter	Paterson River	Hinton Bridge	01-Sep-1914	15-Jan-1974	210410
Hunter	Allyn	Halton	01-Feb-1951	31-Jul-1965	N/A
Hunter	Hunter River	Hinton Hill	09-Mar-1967	10-Mar-1967	N/A
Hunter	Fishery Creek	Kurri Kurri	01-Nov-1959	31-May-1962	210053
Hunter	Hunter River	Liddesdale	07-Aug-1967	14-Jan-1968	N/A
Hunter	Paterson River	Lostock	08-Feb-1951	12-Apr-1962	N/A
Hunter	Hunter River	Louth Park	27-Jun-1949	05-Jun-1962	210454
Hunter	Hunter River	Macreas Hollow	27-Aug-1949	27-Oct-1955	N/A
Hunter	Hunter River	Millers Forest	25-Jan-1955	21-Mar-1978	210415
Hunter	Wallis Creek	Mulbring	01-Feb-1955	30-Apr-1960	N/A

River basin name	River/creek	Station	Data start	Data finish	AWRC
Hunter	Hunter River	Morpeth	19-Jun-1840	23-Jan-1974	210430
Hunter	Paterson River	Mount River	01-Apr-1962	30-Jun-1964	N/A
Hunter	Hunter River	Oakhampton Power Station	25-Jan-1972	26-Jan-1972	210426
Hunter	Hunter River	Oakhampton Wards	06-Aug-1967	08-Nov-1984	210427
Hunter	Paterson River	Paterson	22-Jul-1965	07-Sep-1967	210406
Hunter	Wollombi Creek	Porters Hollow	19-Feb-1962	17-May-1962	210404
Hunter	Wollombi Creek	Payne's Crossing	29-Oct-1959	30-Apr-1960	210048
Hunter	Hunter River	Raymond Terrace	17-Jun-1930	30-Sep-1987	210419
Hunter	Wallis Creek	Richmond Vale	01-May-1962	31-May-1962	N/A
Hunter	Paterson River	Scotts Dam	01-Mar-1956	18-Oct-1985	210439
Hunter	Hunter River	Sandgate	20-Jun-1950	02-Mar-1956	210423
Hunter	Williams River	Seaham	19-Mar-1963	24-May-1981	210418
Hunter	Hunter River	Singleton	12-Feb-1913	15-Apr-1957	210001
Hunter	Paterson River	Stradbroke	09-Mar-1967	12-Dec-1982	210408
Hunter	Williams River	Tilligra	01-Apr-1931	31-May-1963	N/A
Hunter	Hunter River	Tomago	08-Jun-1950	18-Jan-1968	210422
Hunter	Wallis Creek	Trappaud Bridge	29-Aug-1952	30-May-1962	210444
Hunter	Wallis Creek	Victoria Bridge	27-Jun-1949	26-Jan-1972	210443
Hunter	Hunter River	Walka Pumping Station	03-Jan-1950	14-Jun-1964	210401
Hunter	Hunter River	West Maitland Railway Station	13-Aug-1952	20-Aug-1952	N/A
Hunter	Louth Park	West Maitland Railway Station	14-Aug-1952	20-Aug-1952	N/A
Hunter	Hunter River	Wallis Creek	08-Dec-1950	21-Feb-1962	N/A
Hunter	Paterson River	Woodville	01-Jan-1971	17-Feb-1972	N/A
Hunter	Wollombi Creek	Warkworth	05-Aug-1952	30-Apr-1960	210004
Hunter	Hunter River	Wyburns	01-Mar-1955	16-May-1962	210403
Hastings	Hastings River	Bains Bridge	12-Jan-1968	07-Oct-1988	207400
Hastings	Hastings River	Blackmans Point North	09-May-1950	08-Apr-1988	207406
Hastings	Maria River	D/S Pipers Creek Junction	08-May-1980	09-Apr-1988	207414
Hastings	Camden Haven River	Dunbogan	10-May-1980	05-May-1985	N/A
Hastings	Hastings River	Ellenborough	99-Mar-1946	99-May-1980	207004
Hastings	Hastings River	Fernbank Creek	14-Jun-1967	08-Apr-1988	207411
Hastings	Camden Haven River	Forest Oaks	04-Apr-1988	08-Apr-1988	N/A
Hastings	Maria River	Hacks Ferry	13-Jan-1968	11-May-1980	207413
Hastings	Maria River	Green Valley	11-Jun-1967	17-Mar-1979	207413

River basin name	River/creek	Station	Data start	Data finish	AWRC
Hastings	Camden Haven River	Herons Creek	08-May-1980	11-Jul-1985	N/A
Hastings	Camden Haven River	Highway Herons Creek	08-May-1980	17-Apr-1988	N/A
Hastings	Camden Haven River	Kendall Road Bridge	01-Oct-1982	27-Mar-1989	N/A
Hastings	Hastings River	Kings Creek Mouth	13-Jan-1968	07-Apr-1988	207402
Hastings	Hastings River	Kings Creek	13-Jan-1968	17-Jan-1986	207409
Hastings	Backwater	Kings Creek	08-Nov-1966	04-May-1985	207410
Hastings	Camden Haven River	Laurieton Wharf	10-May-1980	11-Dec-1982	N/A
Hastings	Hastings River	Narrowgut	13-Jun-1967	12-Apr-1988	207403
Hastings	Camden Haven River	North Haven	10-May-1980	11-Oct-1982	N/A
Hastings	Hastings River	Port Macquarie	09-May-1980	11-Jul-1985	207420
Hastings	Camden Haven River	Queens Lake	09-May-1980	18-Sep-1986	N/A
Hastings	Hastings River	Railway Bridge	12-Jan-1968	06-Jul-1988	207401
Hastings	Hastings River	Rawdon Island	14-Jun-1967	06-Jul-1988	207407
Hastings	Hastings River	Rawdon Is Bridge	10-Jul-1985	10-Jul-1985	207408
Hastings	Hastings River	Sancrox Bridge	13-Jan-1968	11-Oct-1982	207404
Hastings	Hastings River	Settlement Point	09-May-1980	11-Jul-1985	207418
Hastings	Camden Haven River	Stewarts	09-May-1980	21-Feb-1985	N/A
Hastings	Wilson River	Telegraph Point	13-Jan-1968	30-Jan-1989	207415
Hastings	Backwater	Telegraph Point	04-May-1985	11-Jul-1985	207416
Hastings	Hastings River	Tuffins Lane	13-Jan-1968	10-Jul-1985	207412
Hastings	Hastings River	U/S Dennis Highway Bridge	13-Jan-1968	07-Nov-1984	207405
Hawkesbury	Eastern Creek	Blacktown Road	11-Jun-1964	13-Jun-1964	212036
Hawkesbury	Hawkesbury River	Bushels Lagoon	11-Jun-1964	17-Nov-1969	N/A
Hawkesbury	Grose River	Burralow	01-Apr-1950	10-Mar-1976	212291
Hawkesbury	South Creek	Clarkes	11-Jun-1964	15-Jun-1964	212033
Hawkesbury	Hawkesbury River	Cliftonville Lodge	06-Aug-1986	23-Apr-1990	212418
Hawkesbury	Bakers Lagoon	Cornwallis	30-Aug-1963	07-Mar-1971	212411
Hawkesbury	Hawkesbury River	Cornwallis	31-Jan-1958	07-Mar-1971	212401
Hawkesbury	Erina Creek	Worthing Road	20-Mar-1983	18-Dec-1992	212412
Hawkesbury	Erina Creek	Freemans Reach	01-Jan-1900	31-Dec-1999	212410
Hawkesbury	Erina Creek	Lingi Street	28-Apr-1985	02-Apr-1989	212424
Hawkesbury	Hawkesbury River	Lower Portland (Dagyle)	19-Nov-1961	12-Feb-1992	212417
Hawkesbury	Hawkesbury River	Lower Hawkesbury	28-Jul-1984	22-Apr-1990	212419
Hawkesbury	Erina Creek	Merit Farm	22-Mar-1983	06-Aug-1990	212416

River basin name	River/creek	Station	Data start	Data finish	AWRC
Hawkesbury	Hawkesbury River	Narara	01-Mar-1979	30-Jul-1984	212411
Hawkesbury	Hawkesbury River	North Richmond Bridge	18-Feb-1959	01-Sep-1963	212902
Hawkesbury	Hawkesbury River	North Richmond	10-Jun-1964	09-Mar-1976	212200
Hawkesbury	Nepean River	Penrith	15-Jun-1952	13-Jun-1964	212201
Hawkesbury	Hawkesbury River	Pitt Town Bottoms	19-Feb-1959	02-May-1963	212405
Hawkesbury	Hawkesbury River	Port Erringhi	21-Mar-1983	16-Apr-1989	212414
Hawkesbury	Hawkesbury River	Punt Road, Pitt Town	27-Apr-1989	05-Aug-1990	212409
Hawkesbury	Hawkesbury River	Sackville Ferry	19-Nov-1961	19-Nov-1969	212406
Hawkesbury	Colo River	Upper Colo	17-Jan-1951	09-Mar-1976	212290
Hawkesbury	Nepean River	Wallacia	05-Jun-1952	13-Jun-1964	212202
Hawkesbury	Hawkesbury River	Wisemans Ferry	12-Jun-1964	13-Jun-1964	212425
Hawkesbury	Hawkesbury River	Windsor Bridge	17-Jun-1949	25-Jan-1976	212403
Hawkesbury	Erina Creek	Winani Road	30-Apr-1988	07-Feb-1990	212425
Hawkesbury	Hawkesbury River	Yarramundi	28-Apr-1963	19-May-1963	212400
Macquarie-Tuggerah Lakes	Ourimbah Creek	Chittaway Pt.	26-Oct-1985	07-May-1988	211407
Macquarie-Tuggerah Lakes	Jilliby Creek	Jilliby	01-Jun-1985	15-Aug-1989	211403
Macquarie-Tuggerah Lakes	Ourimbah Creek	Palmgrove	26-Oct-1985	24-Dec-1985	211406
Macquarie-Tuggerah Lakes	Wyong River	Tacoma	06-Aug-1986	06-Aug-1990	211405
Macquarie-Tuggerah Lakes	Wyong River	U/S Yarramalong	04-May-1985	26-Feb-1992	211408
Macleay	Macleay River	Austral Eden	10-May-1980	13-Jul-1985	206439
Macleay	Macleay River	Belgrave	08-May-1963	11-May-1963	206415
Macleay	Belmore River	Belmore Swamp	11-May-1980	16-Jul-1985	206452
Macleay	Macleay River	Cooks Lane Kempsey	31-Jan-1984	11-Jul-1985	206447
Macleay	Macleay River	Clybucca Creek	22-Feb-1954	12-Jul-1985	206411
Macleay	Macleay River	Cootbobongatti	11-May-1980	12-May-1980	206438
Macleay	Macleay River	Crescent Head	09-Feb-1956	21-Nov-1959	206410
Macleay	Macleay River	Eastern Creek	09-May-1980	12-May-1980	206416
Macleay	Macleay River	Euroka Creek	03-Apr-1981	31-Jan-1989	206431
Macleay	Macleay River	Frogmore Swamp	08-May-1980	01-Aug-1987	206449
Macleay	Macleay River	Frederickton	12-Oct-1952	12-May-1963	206403
Macleay	Macleay River	Glenrock	05-May-1963	13-Jul-1985	206413
Macleay	Belmore River	Gladstone Bridge	22-Feb-1953	12-Jul-1985	206405
Macleay	Macleay River	Glenrock	22-Feb-1953	12-Jul-1985	206454
Macleay	Macleay River	Greenhills	08-Aug-1952	18-Nov-1959	206400

River basin name	River/creek	Station	Data start	Data finish	AWRC
Macleay	Macleay River	Hat Head Road	23-Feb-1954	21-Nov-1959	206445
Macleay	Macleay River	Jerseyville	22-Feb-1953	12-Jul-1985	206408
Macleay	Macleay River	Kempsey Bridge	01-May-1983	29-Jul-1984	206443
Macleay	Macleay River	Kinchela	12-Oct-1952	12-Jul-1985	206426
Macleay	Macleay River	Longreach Island	11-Oct-1982	11-Jul-1985	206422
Macleay	Macleay River	Low Land East Kempsey	09-May-1980	18-Jun-1986	206428
Macleay	Macleay River	New Entrance	13-Oct-1952	01-Jan-1984	206409
Macleay	Macleay River	Seven Oaks	05-Feb-1956	27-Jan-1959	206412
Macleay	Macleay River	Short St Kempsey	08-Aug-1952	17-Nov-1959	206401
Macleay	Macleay River	Sillito Swamp	23-Feb-1953	14-Jul-1985	206444
Macleay	Macleay River	Smithtown	12-Oct-1952	11-Jul-1985	206406
Macleay	Macleay River	Seven Oaks Bend	09-May-1980	11-Jul-1985	206430
Macleay	Macleay River	Spencers Creek	23-Feb-1981	11-Jul-1985	206436
Macleay	Macleay River	Stuarts Point	11-Oct-1982	03-May-1985	206425
Macleay	Macleay River	Summer Island	22-Jan-1959	11-Jul-1985	206407
Macleay	Macleay River	Seven Oaks Smithtown	31-Jan-1984	28-Mar-1989	206429
Macleay	Macleay River	Swan Pool	09-May-1980	15-Jul-1985	206433
Macleay	Macleay River	Top Frogmore	31-May-1983	28-Feb-1989	206419
Macleay	Macleay River	Traffic Bridge Kempsey	22-Feb-1953	14-May-1963	206402
Macleay	Macleay River	Upper Belmore River	23-Feb-1953	09-May-1980	206404
Macleay	Belmore River	Upper Belmore	10-May-1980	17-Jul-1985	206424
Macleay	Macleay River	Upper Kinchela Creek	09-May-1980	15-Jul-1985	206420
Manning	Manning River	Bohnock Road Bridge	07-Nov-1984	05-Feb-1990	208414
Manning	Cattai Creek	Cattai Creek Bridge	06-Oct-1982	04-Feb-1990	208405
Manning	Lansdowne River	Coopernook	12-Nov-1959	06-Feb-1990	208418
Manning	Manning River	Croki	20-Mar-1978	05-Feb-1990	208404
Manning	Manning River	Cundle Flat P.O.	07-Aug-1952	01-Mar-1956	208900
Manning	Dawson River	Dawson River	04-Feb-1990	04-Feb-1990	208422
Manning	Dickensons Creek	Dickensons Creek	11-Oct-1982	06-Feb-1990	208416
Manning	Manning River	Downstream Dumaresq Island	10-May-1980	04-Feb-1990	208403
Manning	Manning River	Cundletown	03-Apr-1981	07-Feb-1990	208412
Manning	Manning River	Farquhar Inlet	31-Jan-1984	31-Jan-1984	208415
Manning	Ghinni Creek	Ghinni Creek	08-Apr-1962	06-Feb-1990	208421
Manning	Gloucester River	Gloucester Pol.	14-Aug-1952	24-Feb-1955	208020

River basin name	River/creek	station	Data start	Data finish	AWRC
Manning	Manning River	Harrington	01-Feb-1929	30-Jun-1930	N/A
Manning	Nowendoc River	Knorrit Flat No. 8	01-Feb-1954	02-Mar-1956	N/A
Manning	Manning River	Manning Point	12-Oct-1982	05-Feb-1990	208406
Manning	Manning River	Macquarie Street, Taree	30-Jan-1984	05-Feb-1990	208409
Manning	Manning River	Mount George	01-Feb-1929	02-Mar-1956	208901
Manning	Manning River	Pampoolah	10-May-1980	06-Feb-1990	208413
Manning	Pipeclay Canal	Pipeclay Canal	04-Feb-1900	04-Feb-1990	208420
Manning	Manning River	Pulteney Street, Taree	01-Feb-1929	02-Mar-1956	208407
Manning	Scotts Creek	Scotts Creek	11-May-1980	04-Feb-1990	208423
Manning	Cattai Creek	Tappin Creek Junction	10-May-1980	06-Feb-1990	208419
Manning	Manning River	Tinonee	10-May-1980	05-Feb-1990	208411
Manning	Manning River	Taree Estate	10-May-1980	04-Feb-1990	208401
Manning	Lansdowne River	Upper Lansdowne	10-May-1959	05-Feb-1990	208417
Manning	Manning River	Wingham Bight Bridge	01-Feb-1929	05-Feb-1990	208400
Richmond	Richmond River	Apps	07-Mar-1987	04-Apr-1989	203424
Richmond	Richmond River	Ballina	25-Jan-1951	01-Mar-1957	203421
Richmond	Richmond River	Backwater Gauge	01-Mar-1955	31-Jun-1967	203438
Richmond	Richmond River	Behind Power Station	10-Mar-1870	11-May-1980	N/A
Richmond	Richmond River	Bagotville	23-Jan-1955	27-Apr-1989	203414
Richmond	Rocky Mouth Creek	Bridge	12-Jul-1954	02-Nov-1972	203433
Richmond	Richmond River	Buckendoon Lane	19-Jun-1972	29-Oct-1972	N/A
Richmond	Richmond River	Bently	10-Jul-1962	11-Jul-1962	N/A
Richmond	Richmond River	Bangalow	21-Feb-1954	10-Jul-1962	N/A
Richmond	Bungawalbin Creek	Bungawalbin Junction	01-Jul-1921	04-Nov-1972	203409
Richmond	Bungawalbin Creek	Boggy Creek	03-Jun-1945	09-Feb-1956	203405
Richmond	Richmond River	Broadwater	01-Feb-1921	27-Apr-1989	203414
Richmond	Bungawalbin Creek	Bungawalbin Flat	21-Jul-1965	05-Nov-1972	N/A
Richmond	Richmond River	Casino (Pump Station)	01-Nov-1917	20-Feb-1971	203451
Richmond	Richmond River	Cliffords Gauge	27-Jan-1974	29-Jan-1974	N/A
Richmond	Richmond River	Coraki	10-Mar-1870	11-May-1980	203403
Richmond	Richmond River	Cannon Point	02-Mar-1975	07-Mar-1975	N/A
Richmond	Richmond River	Codrington	01-Jan-1887	06-Jun-1974	203431
Richmond	Richmond River	Casino (Bridge)	20-Feb-1954	23-Jul-1965	203452
Richmond	Emigrant Creek	Cumbalum	10-Mar-1870	11-May-1980	203442

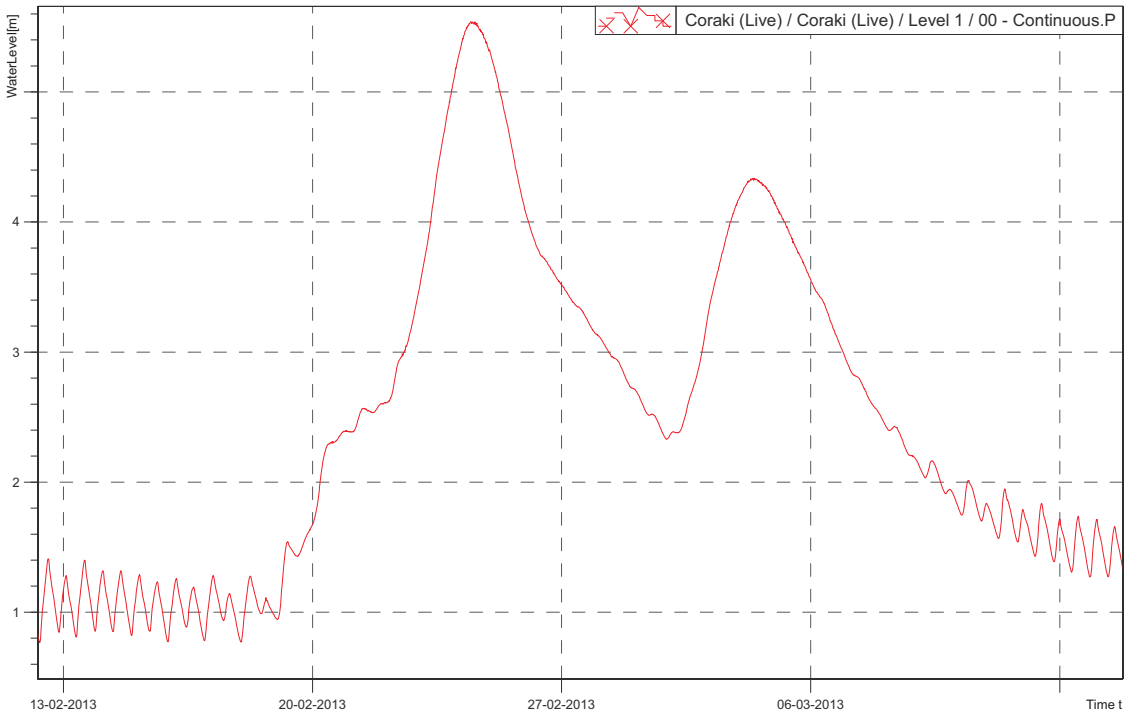
River basin name	River/creek	station	Data start	Data finish	AWRC
Richmond	Richmond North Arm	Dolbys	11-Feb-1954	10-Mar-1956	203448
Richmond	Richmond River	Dungarubba	29-Mar-1955	04-Nov-1972	203410
Richmond	Richmond River	Eltham	10-Jul-1962	11-Jul-1962	N/A
Richmond	Richmond River	Empire Vale Creek	13-Dec-1955	21-Jul-1959	203418
Richmond	Backwater	Empire Vale Ck.	19-Jul-1965	22-Jul-1965	N/A
Richmond	Richmond River	Evans Head	09-Apr-1988	09-Apr-1988	N/A
Richmond	Richmond River	Fabridam	13-Feb-1972	30-Oct-1972	N/A
Richmond	Bora Creek	Flood	24-Jan-1953	06-Jul-1967	203408
Richmond	Richmond River	Green Ridge	11-Feb-1954	18-Jan-1962	203430
Richmond	Richmond River	Gundurimba	01-Jan-1887	03-Feb-1990	203427
Richmond	Rocky Mouth Creek	Hillview	20-Feb-1954	17-Feb-1972	203432
Richmond	Evans River	Irongate Downstream	20-Feb-1954	25-Jan-1959	203400
Richmond	Richmond River	Irvington	01-Nov-1917	01-Feb-1956	N/A
Richmond	Evans River	Irongate Upstream	20-Feb-1954	25-Jan-1959	203400
Richmond	Richmond River	Woodburn	01-Jan-1887	28-Apr-1989	203412
Richmond	Richmond River	Kilgin School	13-Feb-1972	30-Jan-1974	N/A
Richmond	Richmond River	Kyogle	20-Feb-1954	22-Jul-1965	N/A
Richmond	Wilsons River	Lismore	01-Jan-1887	03-Feb-1990	203904
Richmond	Chiliots Creek	Lower Teven	10-Mar-1870	11-May-1980	N/A
Richmond	Richmond River	Marom Creek	02-Mar-1975	02-Apr-1989	N/A
Richmond	Richmond River	Meerschaum Vale	06-Mar-1987	02-Apr-1989	N/A
Richmond	Bungawalbin Creek	Moonum Hill	24-Jan-1953	04-Apr-1989	203404
Richmond	Richmond River	Nashua	10-Jul-1962	11-Jul-1962	N/A
Richmond	Leycester Creek	Nimbin Road	20-Feb-1954	11-Jul-1962	203401
Richmond	Sandy Creek	No. 2	20-Feb-1953	09-Aug-1958	203407
Richmond	North Creek	Bridge	13-Feb-1972	03-Nov-1972	N/A
Richmond	Richmond River	Pimlico Drainage	11-Feb-1972	11-May-1980	N/A
Richmond	Wilsons River	Lismore Powerhouse	28-Oct-1972	23-Jan-1979	203440
Richmond	Richmond River	Power Station Lismore	28-Oct-1972	25-Jan-1979	N/A
Richmond	Backwater Gauge	Richmond	18-Mar-1967	31-Jun-1967	N/A
Richmond	Richmond River	Riley's Hill	19-Jun-1950	05-Apr-1989	203413
Richmond	Wilsons River	Ruthven	11-Feb-1976	06-Mar-1976	N/A
Richmond	Pelican Creek	Ruthven	02-Mar-1975	06-Mar-1976	N/A
Richmond	Richmond River	Sandy Creek	24-Jan-1953	09-Jul-1967	203424

River basin name	River/creek	Station	Data start	Data finish	AWRC
Richmond	Richmond River	Seelim Drain	20-Feb-1953	12-Aug-1958	203423
Richmond	Sandy Creek	Sandy Creek	28-Mar-1955	10-Mar-1956	203406
Richmond	Richmond River	South Ruthven	26-Jan-1974	06-Mar-1975	N/A
Richmond	Boundary Creek	Spencers Backwater	13-Dec-1955	31-Oct-1972	203439
Richmond	Wilsons River	South Ruthven	11-Feb-1976	06-Mar-1976	N/A
Richmond	Richmond River	Tatham	01-Nov-1917	31-Oct-1972	203435
Richmond	Richmond River	Tuckarumba	27-Aug-1957	31-Oct-1972	203429
Richmond	Leycester Creek	Tuncester	10-May-1980	06-Apr-1990	203443
Richmond	Richmond River	Teven Creek	16-Jan-1972	15-Mar-1974	203436
Richmond	Tucombil Canal	Mouth (Sharpes)	01-Jun-1953	29-Feb-1956	203433
Richmond	Tucombil Canal	Tucombil Floodgate Mouth	12-Feb-1954	29-Apr-1989	203434
Richmond	Tucombil Canal	Tucombil Highway Bridge	01-Mar-1937	10-Nov-1972	203411
Richmond	Richmond River	Wardell	01-Jan-1887	04-Nov-1972	203416
Richmond	Wilsons Creek	Woodlawn College	22-Jan-1955	03-Feb-1990	203402
Richmond	Wilsons River	Wyrallah	01-Jan-1887	06-Apr-1990	203428
Tweed	Tweed River	Bakers Byangum	14-Jun-1952	26-Apr-1989	201404
Tweed	Tweed River	Blackwater Environ	22-Feb-1953	22-Feb-1956	201414
Tweed	North Arm Tweed River	Commercial Road	14-Jun-1952	14-Jul-1954	201410
Tweed	Tweed River	Eungella	19-Feb-1954	28-Mar-1955	201001
Tweed	Tweed River	Kynn Bridge No. 3	14-Jun-1952	18-Mar-1967	201406
Tweed	Tweed River	Murwillumbah	30-Apr-1955	02-May-1956	201420
Tweed	North Arm Tweed River	Murwillumbah Lavender Ck	20-Feb-1953	14-Jul-1954	201411
Tweed	Tweed River	Norco Factory	22-Feb-1953	14-Jul-1954	201419
Tweed	Tweed River	No. 5	22-Feb-1953	14-Jul-1954	N/A
Tweed	Tweed River	North Wharf	20-Feb-1953	24-Mar-1953	201418
Tweed	Tweed River	Power Station	19-Jan-1938	11-Jun-1945	N/A
Tweed	Tweed River	Salmons Farm	30-Apr-1955	03-May-1956	201415
Tweed	Tweed River	South Murwillumbah	20-Feb-1953	14-Jul-1954	N/A
Tweed	North Arm Tweed River	Tygalgah (Smiths)	14-Jun-1952	15-Jun-1952	201409
Tweed	Tweed River	The Bluff	20-Feb-1953	14-Jul-1954	201417
Tweed	North Arm Tweed River	Tygalgah (Browns)	14-Jun-1952	11-Jun-1966	201408

* AWRC station numbers are assigned following conventions established by the Australian Water Resources Commission.

Appendix B

Sample outputs



NSW GOVERNMENT

Public Works
Manly Hydraulics Laboratory

STANDARD WATER LEVEL PLOT

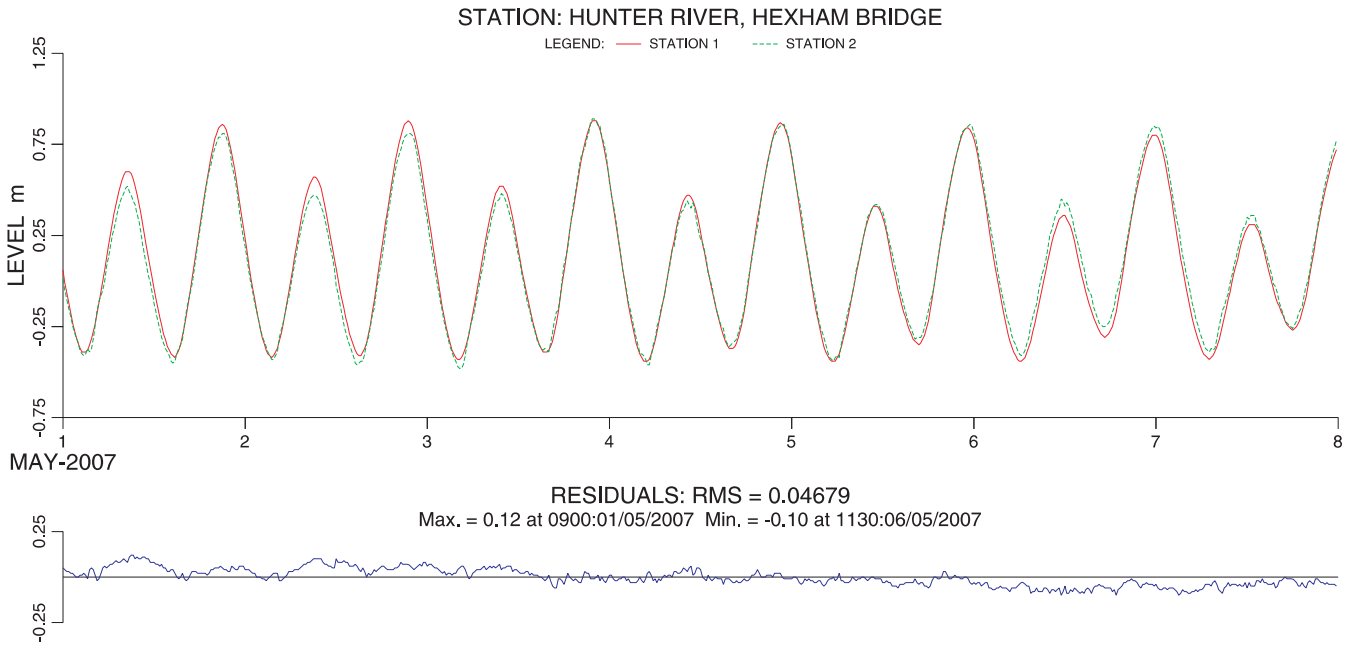
MHL Report 2474

Figure B1

DRAWING 2474-B1.cdr

Station Name	Bogangar (Live)
Station Number	202416
MGA Easting (m zone 56)	554672.28
MGA Northing (m zone 56)	6866410.41
Datum	Brunswick River Flood Mitigation Datum (BFMD)

Date	Time	Value [m]	State of value
13/03/2013	0:00:00	1.279	55 (Fair)
13/03/2013	0:15:00	1.278	55 (Fair)
13/03/2013	0:30:00	1.276	55 (Fair)
13/03/2013	0:45:00	1.277	55 (Fair)
13/03/2013	1:00:00	1.279	55 (Fair)
13/03/2013	1:15:00	1.277	55 (Fair)
13/03/2013	1:30:00	1.277	55 (Fair)
13/03/2013	1:45:00	1.275	55 (Fair)
13/03/2013	2:00:00	1.274	55 (Fair)
13/03/2013	2:15:00	1.274	55 (Fair)
13/03/2013	2:30:00	1.274	55 (Fair)
13/03/2013	2:45:00	1.274	55 (Fair)
13/03/2013	3:00:00	1.273	55 (Fair)
13/03/2013	3:15:00	1.273	55 (Fair)
13/03/2013	3:30:00	1.271	55 (Fair)
13/03/2013	3:45:00	1.271	55 (Fair)
13/03/2013	4:00:00	1.271	55 (Fair)
13/03/2013	4:15:00	1.269	55 (Fair)
13/03/2013	4:30:00	1.269	55 (Fair)
13/03/2013	4:45:00	1.268	55 (Fair)
13/03/2013	5:00:00	1.267	55 (Fair)
13/03/2013	5:15:00	1.267	55 (Fair)
13/03/2013	5:30:00	1.266	55 (Fair)
13/03/2013	5:45:00	1.264	55 (Fair)
13/03/2013	6:00:00	1.265	55 (Fair)
13/03/2013	6:15:00	1.263	55 (Fair)
13/03/2013	6:30:00	1.262	55 (Fair)
13/03/2013	6:45:00	1.261	55 (Fair)
13/03/2013	7:00:00	1.26	55 (Fair)
13/03/2013	7:15:00	1.259	55 (Fair)
13/03/2013	7:30:00	1.259	55 (Fair)
13/03/2013	7:45:00	1.258	55 (Fair)
13/03/2013	8:00:00	1.257	55 (Fair)
13/03/2013	8:15:00	1.256	55 (Fair)
13/03/2013	8:30:00	1.254	55 (Fair)
13/03/2013	8:45:00	1.254	55 (Fair)
13/03/2013	9:00:00	1.253	55 (Fair)



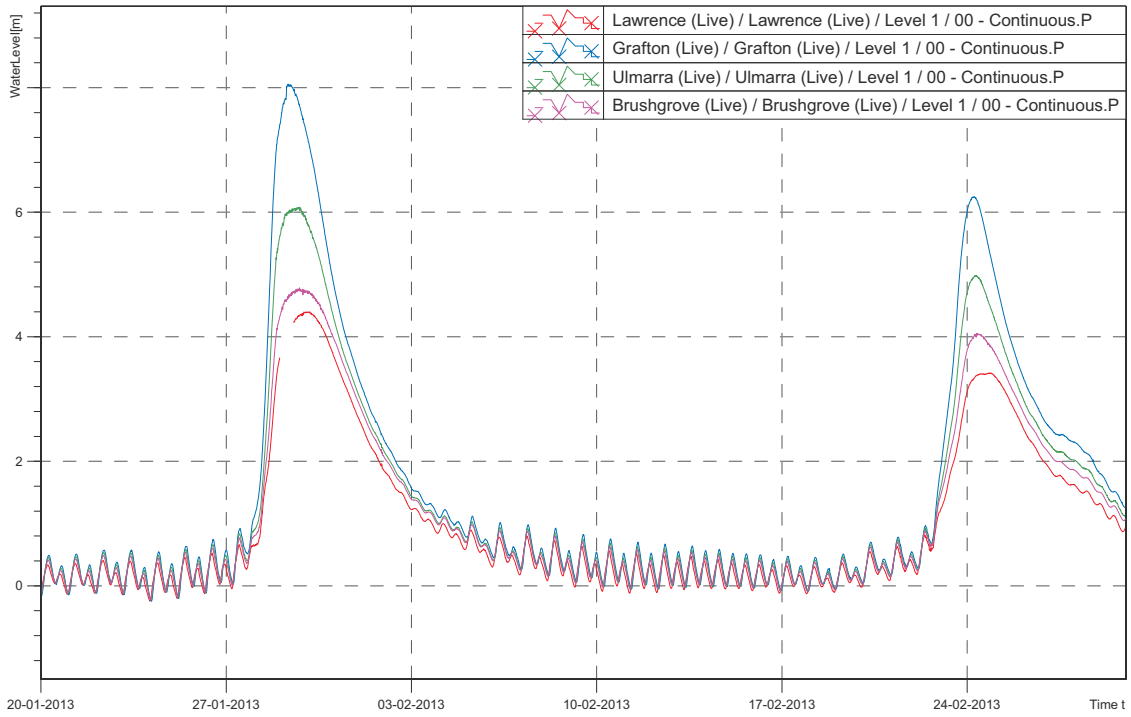
Public Works
Manly Hydraulics Laboratory

SAMPLE PREDICTED VERSUS ACTUAL WATER LEVEL

MHL Report 2474

Figure B3

DRAWING 2474-B1.cdr



Public Works
Manly Hydraulics Laboratory

TYPICAL FLOOD HYDROGRAPH

MHL Report 2474

Figure B4

DRAWING 2474-B1.cdr

STATION NAME	: Bellingen Bridge (Live)
RECORDER TYPE	: MHL Station
A.W.R.C. No.	: 205442
DATA START	: 01.01.1997
DATA FINISH	: 01.07.2013
DATA TOTAL	: 16 years 6 months 1 days
DATABASE TIME INTERVAL (second)	: 0
THRESHOLD LEVEL (m)	: 4.000
DATUM	: Australian Height Datum
DATE OF ISSUE	: 14:14 17.07.2013
ANALYSIS PERFORMED BY	: darvils3

COMMENTS : Bellingen Bridge (Live) Level 1 00 - Continuous.P event ranking for period 01.01.1997 to 01.07.2013

RANK	PEAK (m)	DATE TIME	START	DURATION (hr)	MAX RISE (m/hr)
1	8.810	31.03.2009 18:15	31.03.2009	59.5	1.200
2	8.770	09.03.2001 19:45	08.03.2001	98.3	0.680
3	8.470	22.05.2009 15:30	21.05.2009	85.3	0.520
4	8.270	17.02.2009 10:00	16.02.2009	33.0	1.240
5	7.910	01.02.2001 21:30	31.01.2001	80.0	0.480
6	7.890	20.10.2004 13:30	20.10.2004	15.8	5.200
7	7.740	14.06.2011 15:45	14.06.2011	40.8	0.600
8	7.590	03.03.2006 12:30	02.03.2006	42.8	0.800
9	7.270	06.11.2009 23:00	06.11.2009	15.0	1.320
10	6.390	15.07.1999 05:30	14.07.1999	35.3	0.400
11	6.330	05.09.2008 19:45	05.09.2008	13.3	0.760
12	6.070	11.01.2011 06:45	10.01.2011	41.0	0.400
13	6.000	27.10.2009 01:45	26.10.2009	19.3	0.880
14	5.720	05.02.2008 01:30	04.02.2008	11.3	1.160
15	5.520	21.08.2007 03:15	20.08.2007	11.3	0.600
16	5.330	05.01.2008 19:45	04.01.2008	38.0	0.600
17	4.800	04.10.2010 20:00	04.10.2010	14.3	0.480
18	4.410	06.11.2009 11:45	06.11.2009	2.5	0.480
19	4.390	20.10.2004 23:00	20.10.2004	1.5	0.320
20	4.300	03.03.1999 01:45	03.03.1999	3.3	0.280
21	4.290	29.01.2001 04:00	29.01.2001	2.8	0.400
22	4.259	03.03.2013 10:15	03.03.2013	17.3	0.276
23	4.250	06.03.1997 21:15	06.03.1997	11.5	0.120
24	4.210	16.06.2011 08:15	16.06.2011	12.0	0.160
25	4.160	06.03.2004 12:30	06.03.2004	1.8	0.320

ANALYSIS OF TIDAL OBSERVATIONS

STATION NAME: SYDNEY TIDE GAUGE
RECORDER TYPE: DATATAKER
DATUM: ZERO CAMP COVE
ANALYSIS OF HOURLY TIDAL HEIGHTS FROM 0000:01/07/2006 TO 2300:02/07/2007
NO. OF OBSERVATIONS = 8808 NO. OF POINTS ANALYSED = 8808
MID POINT 1100:31/12/2006 SEPARATION = 1.00
TIME ZONE : EST LATITUDE -33 DEG 51 MIN LONGITUDE 151 DEG 14 MIN

LIST OF HARMONIC CONSTITUENTS (none inferred)

NO	NAME	FREQUENCY (cyc/hr)	PERIOD (day,hr)	MEAN AMPLITUDE (metres)	G-PHASE (deg)	LOCAL AMPLITUDE (metres)	LOCAL PHASE (deg)
1	Z0			0.9442544		0.9442544	
2	SA	0.0001141	365d,06h	0.0687380	134.44	0.0687380	137.76
3	SSA	0.0002282	182d,15h	0.0253974	94.37	0.0253974	254.89
4	MSM	0.0013098	31d,19h	0.0127537	218.02	0.0127537	352.77
5	MM	0.0015122	27d,13h	0.0045407	231.96	0.0045407	183.42
6	MSF	0.0028219	14d,18h	0.0063242	203.81	0.0063242	290.01
7	MF	0.0030501	13d,16h	0.0197710	0.04	0.0197710	246.77
8	ALP1	0.0343966	29.07h	0.0010548	340.23	0.0012517	63.36
9	2Q1	0.0357063	28.01h	0.0042532	12.51	0.0049768	230.94
10	SIG1	0.0359087	27.85h	0.0034849	358.80	0.0040822	32.95
11	Q1	0.0372185	26.87h	0.0235868	62.04	0.0276398	231.35
12	RHO1	0.0374209	26.72h	0.0039826	47.55	0.0045466	33.57
13	O1	0.0387307	25.82h	0.0964938	79.47	0.1132471	199.69
14	TAU1	0.0389588	25.67h	0.0048251	39.02	0.0038170	140.68
15	BET1	0.0400404	24.97h	0.0009819	119.70	0.0012014	194.88
16	NO1	0.0402686	24.83h	0.0064338	97.09	0.0101144	331.97
17	CHI1	0.0404710	24.71h	0.0013989	109.61	0.0016622	158.00
18	PI1	0.0414385	24.13h	0.0024470	110.75	0.0024282	312.08
19	P1	0.0415526	24.07h	0.0438246	113.24	0.0433163	317.91
20	S1	0.0416667	24.00h	0.0085778	350.80	0.0057799	159.80
21	K1	0.0417807	23.93h	0.1482257	119.04	0.1648004	302.91
22	PSI1	0.0418948	23.87h	0.0009772	38.01	0.0009954	226.40
23	PHI1	0.0420089	23.80h	0.0013041	170.86	0.0012738	157.71
24	THE1	0.0430905	23.21h	0.0011649	133.17	0.0013896	91.59
25	J1	0.0432929	23.10h	0.0098439	143.92	0.0110957	277.22
26	SO1	0.0446027	22.42h	0.0011343	179.38	0.0013342	89.17
27	OO1	0.0448308	22.31h	0.0055142	179.16	0.0106868	247.15
28	UPS1	0.0463430	21.58h	0.0013787	191.35	0.0025018	209.65
29	OQ2	0.0759749	13.16h	0.0019358	185.88	0.0018419	283.90
30	EPS2	0.0761773	13.13h	0.0064635	190.10	0.0061639	99.91
31	2N2	0.0774871	12.91h	0.0188741	193.07	0.0178317	240.20
32	MU2	0.0776895	12.87h	0.0202965	207.12	0.0194891	65.35
33	N2	0.0789993	12.66h	0.1102693	219.37	0.1059412	211.22
34	NU2	0.0792016	12.63h	0.0222446	227.84	0.0214290	36.16
35	H1	0.0803973	12.44h	0.0032975	75.82	0.0032149	198.67
36	M2	0.0805114	12.42h	0.4972989	236.40	0.4796013	179.67
37	H2	0.0806255	12.40h	0.0018385	116.32	0.0017993	63.20
38	MKS2	0.0807396	12.39h	0.0027644	357.01	0.0035091	97.68
39	LDA2	0.0818212	12.22h	0.0062575	239.25	0.0059819	137.31
40	L2	0.0820236	12.19h	0.0255340	205.15	0.0160559	291.53
41	T2	0.0832193	12.02h	0.0075370	284.31	0.0075370	310.99
42	S2	0.0833333	12.00h	0.1230184	259.96	0.1232939	289.97
43	R2	0.0834474	11.98h	0.0009521	234.34	0.0011622	82.81
44	K2	0.0835615	11.97h	0.0372762	250.14	0.0489554	77.56
45	MSN2	0.0848455	11.79h	0.0016331	140.10	0.0015165	121.53
46	ETA2	0.0850736	11.75h	0.0021299	262.67	0.0030466	33.34
47	MO3	0.1192421	8.39h	0.0002076	257.42	0.0002349	320.91
48	M3	0.1207671	8.28h	0.0022126	329.64	0.0020900	64.72
49	SO3	0.1220640	8.19h	0.0002182	312.04	0.0002566	102.27
50	MK3	0.1222921	8.18h	0.0004813	256.17	0.0005161	23.31
51	SK3	0.1251141	7.99h	0.0014364	115.62	0.0016006	329.50
52	MN4	0.1595106	6.27h	0.0014571	86.07	0.0013501	21.20
53	M4	0.1610228	6.21h	0.0036473	100.36	0.0033923	346.90
54	SN4	0.1623326	6.16h	0.0001853	59.21	0.0001784	81.08
55	MS4	0.1638447	6.10h	0.0013697	162.81	0.0013239	136.09
56	MK4	0.1640729	6.09h	0.0003293	221.19	0.0004171	351.87
57	S4	0.1666667	6.00h	0.0005941	317.28	0.0005968	17.31
58	SK4	0.1668948	5.99h	0.0002646	110.72	0.0003482	328.16
59	2MK5	0.2028036	4.93h	0.0001315	223.15	0.0001360	293.56
60	2SK5	0.2084474	4.80h	0.0000989	182.53	0.0001105	66.43
61	2MN6	0.2400220	4.17h	0.0005808	12.83	0.0005190	251.22
62	M6	0.2415342	4.14h	0.0017160	49.46	0.0015393	239.26
63	2MS6	0.2443561	4.09h	0.0023009	120.07	0.0021448	36.61
64	2MK6	0.2445843	4.09h	0.0004861	120.42	0.0005937	194.37
65	2SM6	0.2471781	4.05h	0.0002108	133.96	0.0002043	137.26
66	MSK6	0.2474062	4.04h	0.0002752	145.25	0.0003493	305.95
67	3MK7	0.2833149	3.53h	0.0001989	344.69	0.0001984	358.36
68	M8	0.3220456	3.11h	0.0001635	15.87	0.0001415	148.93
69	M10	0.4025570	2.48h	0.0003138	209.37	0.0002618	285.70

RMS (RESIDUAL ERROR) = 0.07972

ANALYSIS OF TIDAL OBSERVATIONS

TIME OF ANALYSIS	:	1745:03/10/2007
ANALYSIS PERFORMED BY	:	LB using INTERACTIVE program MTIDE1X V1.0A
STATION LOCATION	:	SYDNEY, N.S.W., AUSTRALIA
STATION NAME	:	MIDDLE HEAD, COBBLERS BAY
STATION LATITUDE	:	033 DEG 51 MIN SOUTH
STATION LONGITUDE	:	151 DEG 14 MIN EAST
DATUM	:	ZERO CAMP COVE
ANALYSIS PERIOD START TIME	:	0000:01/07/2006
ANALYSIS PERIOD FINISH TIME	:	2300:30/06/2007
MID POINT TIME	:	1100:30/12/2006
PERIOD OF ANALYSIS	:	365 DAYS 00 HRS
LOCAL TIME ZONE NAME	:	EASTERN STANDARD TIME
LOCAL TIME FACTOR	:	GMT +10.00 HRS
TIME MERIDIAN	:	-10.08 HRS

TIDAL PLANES IN METRES ABOVE ZERO OF LOCAL GAUGE VALUES

High High Water (Solstices Springs)	H.H.W.(S.S.)	:	1.907
Mean High Water Springs	M.H.W.S.	:	1.564
Mean High Water	M.H.W.	:	1.441
Mean High Water Neaps	M.H.W.N.	:	1.318
Mean Sea Level	M.S.L.	:	0.943
Mean Low Water Neaps	M.L.W.N.	:	0.569
Mean Low Water	M.L.W.	:	0.446
Mean Low water Springs	M.L.W.S.	:	0.323
Indian Spring Low Water	I.S.L.W.	:	0.078

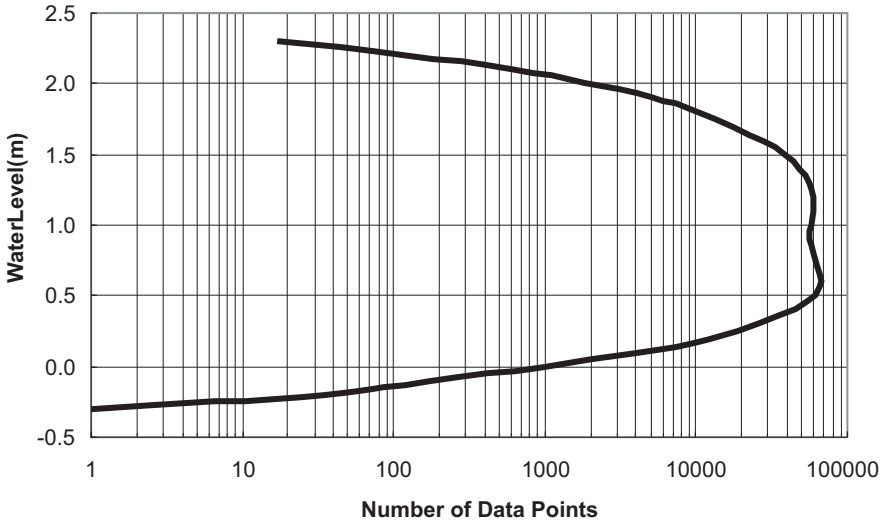
TIDAL RANGES IN METRES

Mean Spring Range	(M.H.W.S. - M.L.W.S.)	:	1.241
Mean Neap Range	(M.H.W.N. - M.L.W.N.)	:	0.749
Mean Range	(M.H.W. - M.L.W.)	:	0.995
Range	(H.H.W.(S.S.) - I.S.L.W.)	:	1.829

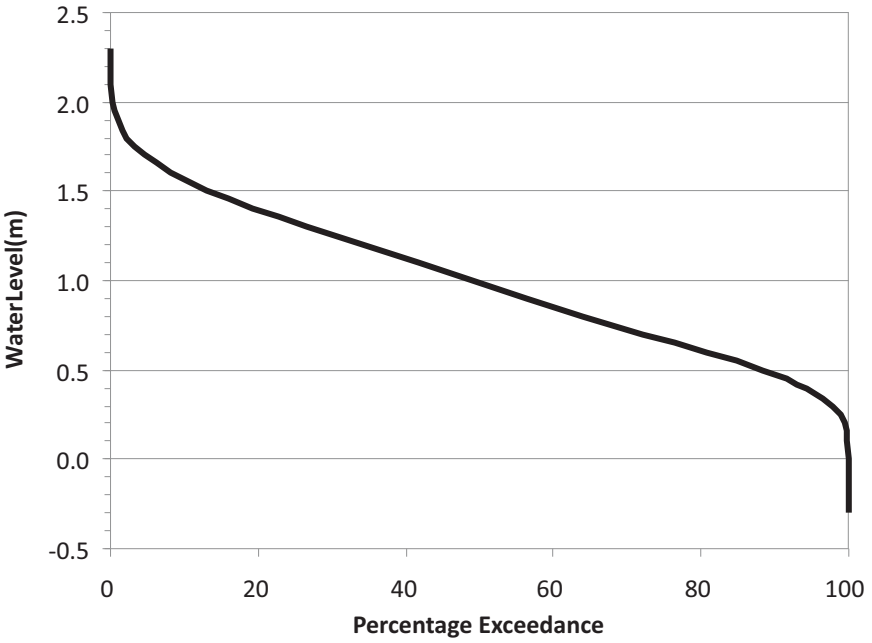
Port Jackson at Sydney
Frequency Distribution Analysis

Water Level (m)	Normalised Frequency	Cumulative Frequency	Number of Observations in Class Interval	Cumulative Observations	Percent Exceedance
2.3	0.00002	0.00002	17	17	0.0022
2.2	0.00015	0.00017	117	134	0.0172
2.1	0.00077	0.00094	601	735	0.0945
2.0	0.00240	0.00335	1870	2605	0.3348
1.9	0.00649	0.00983	5048	7653	0.9835
1.8	0.01276	0.02259	9928	17581	2.2593
1.7	0.02298	0.04557	17880	35461	4.5569
1.6	0.03606	0.08163	28058	63519	8.1625
1.5	0.04940	0.13103	38442	101961	13.1025
1.4	0.06235	0.19338	48519	150480	19.3375
1.3	0.07150	0.26487	55638	206118	26.4873
1.2	0.07666	0.34153	59655	265773	34.1533
1.1	0.07640	0.41793	59453	325226	41.7933
1.0	0.07364	0.49157	57305	382531	49.1573
0.9	0.07172	0.56329	55811	438342	56.3293
0.8	0.07595	0.63924	59101	497443	63.9241
0.7	0.08219	0.72143	63959	561402	72.1432
0.6	0.08521	0.80664	66308	627710	80.6642
0.5	0.07805	0.88469	60735	688445	88.4689
0.4	0.05891	0.94360	45845	734290	94.3603
0.3	0.03415	0.97775	26572	760862	97.7749
0.2	0.01566	0.99341	12190	773052	99.3414
0.1	0.00506	0.99847	3934	776986	99.8469
0.0	0.00126	0.99973	984	777970	99.9734
-0.1	0.00022	0.99996	172	778142	99.9955
-0.2	0.00004	1.00000	34	778176	99.9999
-0.3	0.00000	1.00000	1	778177	100.0000
TOTAL	**1.00000**		**778177**		

Station Information	
River/Estuary System	Port Jackson
AWRC No.	213470
Station name	Sydney
Datum	Zero Camp Cove*
MGAZone	56
Easting	338842
Northing	6255836



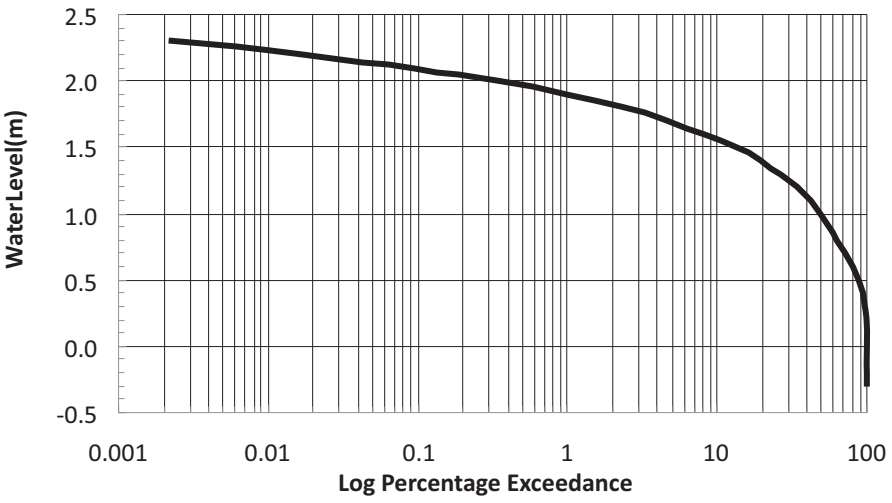
Summary Statistics	
Time Interval (mins)	15
Record start date	24/09/1987
Highest water level recorded (m)	2.32
Daterecorded	27/04/1990
Lowest water level recorded (m)	-0.28
Date recorded	28/02/2010
Tidal plane annual average record	1990-2010
MHW(m)	1.45
MSL(m)	0.95
MLW (m)	0.44



Notes:

Refer toAppendix B for frequency distribution analysis table.

*The information supplied has been collected for use by the Office of Environment & Heritage, and the water levels only approximately relate toAustralian Height Datum (AHD) or other specified datum. Other users should independently verify the suitability of this data for their particular use.



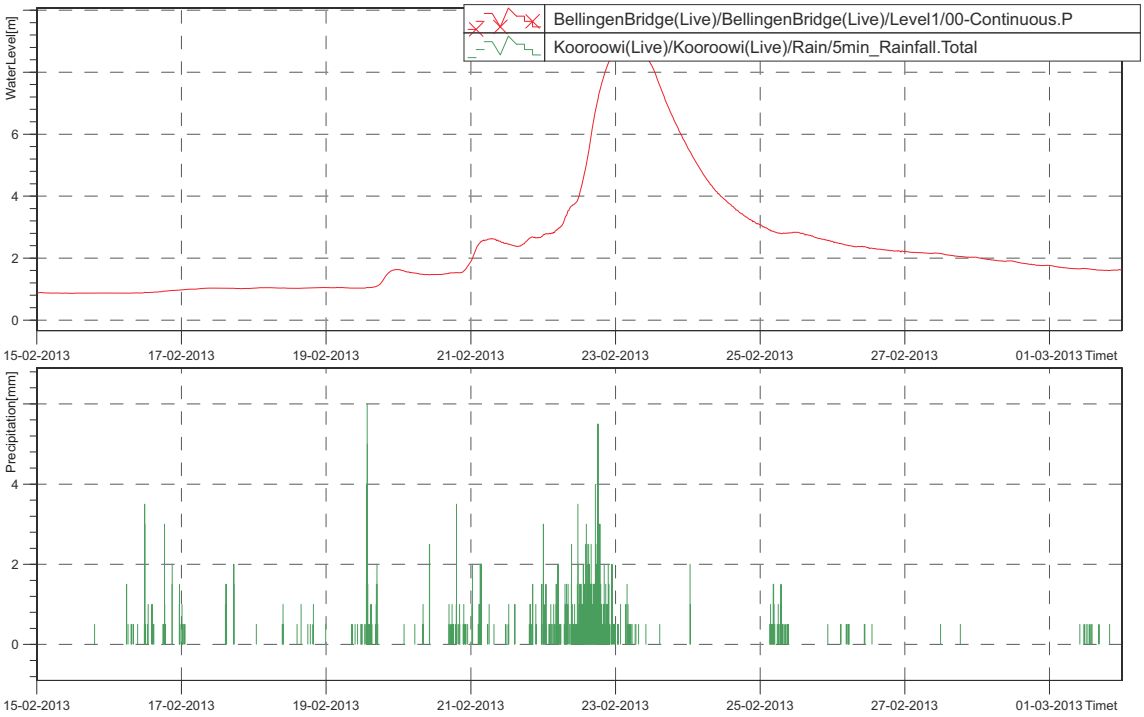
NSW GOVERNMENT
Public Works
Manly Hydraulics Laboratory

TYPICAL FREQUENCY DISTRIBUTION PLOTS

MHL Report 2474

Figure B9

DRAWING 2474-B1.cdr



NSW GOVERNMENT

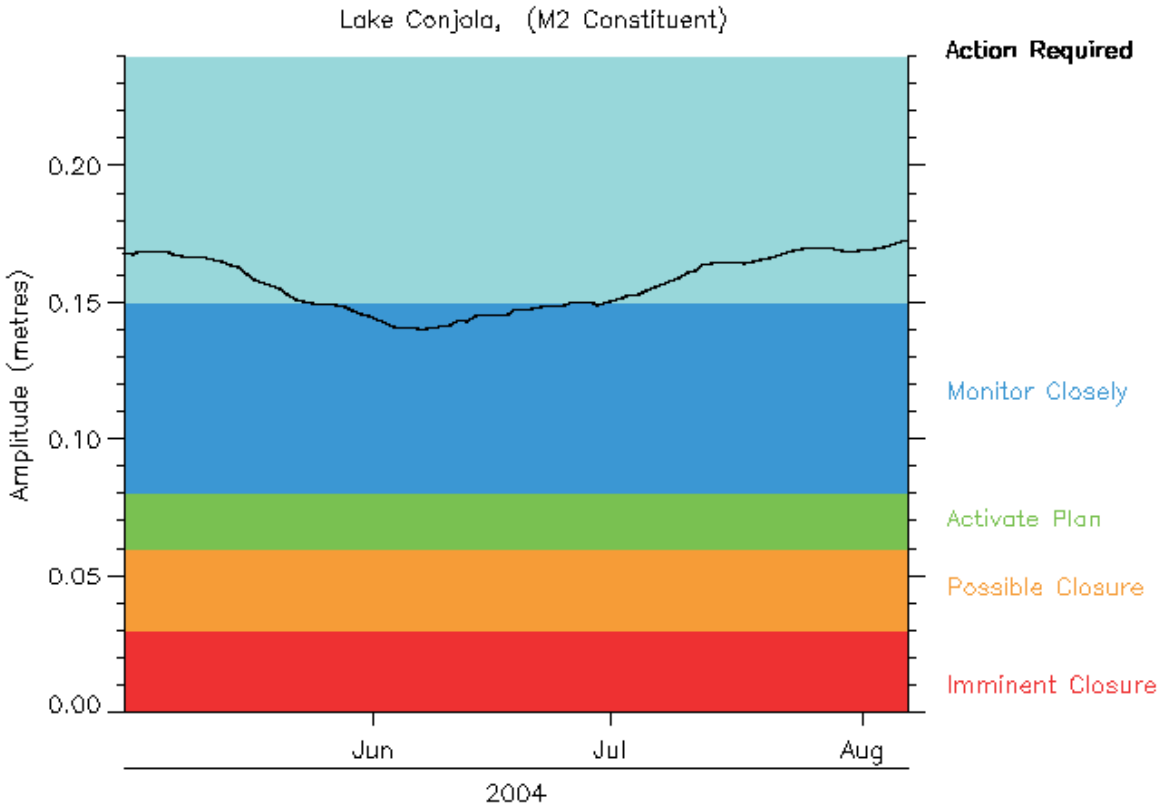
Public Works
Manly Hydraulics Laboratory

SAMPLE RAINFALL-WATER LEVEL CORRELATION

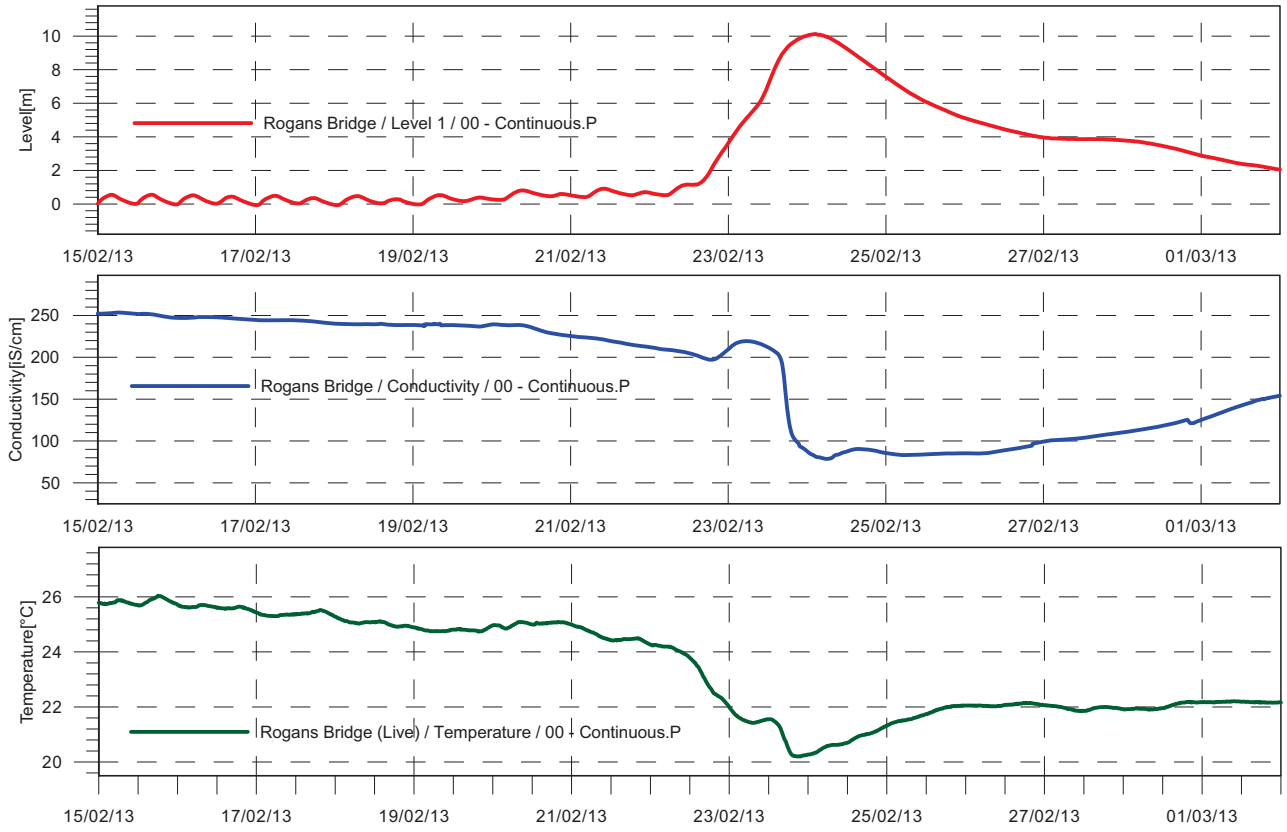
MHL Report 2474

Figure B10

DRAWING 2474-B1.cdr



NSW GOVERNMENT Public Works Manly Hydraulics Laboratory	SAMPLE ENTRANCE DECISION SUPPORT SYSTEM	MHL Report 2474 Figure B11 DRAWING 2474-B1.cdr



NSW GOVERNMENT
Public Works
Manly Hydraulics Laboratory

SAMPLE WATER QUALITY PLOTS

MHL Report 2474

Figure B12

DRAWING 2474-B1.cdr

Appendix C

Glossary of terms

Appendix C Glossary of terms

The following glossary of terms defines common terms used across MHL publications referenced in Appendix D.

Amplitude (H)	One-half the range of a constituent tide. By analogy, it may be applied also to the maximum speed of a constituent current.
Automatic Tide Gauge	An instrument that automatically registers the rise and fall of the tide. In some instruments, the registration is accomplished by recording the heights at regular time intervals in digital format.
Benchmark (BM)	A fixed physical object or mark used as reference for a vertical datum. A tidal benchmark is one near a tide station to which the tide staff and tidal datums are referred. A primary benchmark is the principal (or only) mark of a group of tidal benchmarks to which the tide staff and tidal datums are referred.
Chart Datum	The datum to which soundings on a chart are referred. It is usually taken to correspond to a low-water elevation, and its depression below mean sea level is represented by the symbol Z.
Coastal Boundary	The Mean High Water Line (MHWL) or Mean Higher High Water Line (MHHWL) when tidal lines are used as the coastal boundary. Also, lines used as boundaries inland of and measured from (or points thereon) the MHWL or MHHWL.
Constituent	One of the harmonic elements in a mathematical expression for the tide-producing force and in corresponding formulas for the tide or tidal current. Each constituent represents a periodic change or variation in the relative positions of the earth, moon and sun. A single constituent is usually written in the form y = A cos (at + á), in which y is a function of time as expressed by the symbol t and is reckoned from a specific origin. The coefficient A is called the amplitude of the constituent and is a measure of its relative importance. The angle (at + á) changes uniformly and its value at any time is called the phase of the constituent. The speed of the constituent is the rate of change in its phase and is represented by the symbol a in the formula. The quantity a is the phase of the constituent at the initial instant from which the time is reckoned. The period of the constituent is the time required for the phase to change through 360° and is the cycle of the astronomical condition represented by the constituent.
Digital Recorder (or logger)	An electronic recorder system which stores the information in accessible form, for example, on tape or solid state memory.
Digitise	To translate analog information into digital form i.e. a series of numeric data readable by, and stored within, a digital computer.

Diurnal	Having a period or cycle of approximately one tidal day. Thus, the tide is said to be diurnal when only one high water and one low water occur during a tidal day, and the tidal current is said to be diurnal when there is a single flood and a single ebb period of a reversing current in the tidal day. A rotary current is diurnal if it changes its direction through all points of the compass once each tidal day. A diurnal constituent is one which has a single period in the constituent day. The symbol for such a constituent is the subscript 1.
Encoder	A device that translates tidal movement into computer readable data.
Estuary	An embayment of the coast in which fresh river water entering at its head mixes with the relatively saline ocean water. When tidal action is the dominant mixing agent it is usually termed a tidal estuary. Also, the lower reaches and mouth of a river emptying directly into the sea where tidal mixing takes place. The latter is sometimes called a river estuary.
Extreme High Water	The highest elevation reached by the sea as recorded by a tide gauge during a given period.
Extreme Low Water	The lowest elevation reached by the sea as recorded by a tide gauge during a given period.
Floatwell	A stilling well in which the float of a float-actuated gauge operates.
Gas Purged Pressure Gauge	A type of analog tide gauge in which gas, usually nitrogen, is emitted from a submerged tube at a constant rate. Fluctuations in hydrostatic pressure due to changes in tidal height modify the emission rate for recording.
Harmonic Analysis	Process of measuring or calculating the relative amplitudes and frequencies of all the significant harmonic components present in a given wave form.
Harmonic Prediction	Method of predicting tides by combining the harmonic constituents into a single tidal curve. The work is usually performed by electronic digital computer.
Head	The difference in water level at either end of a strait, channel, inlet, etc.
High Water (HW)	The maximum height reached by a rising tide. The high water is due to the periodic tidal forces and the effects of meteorological, hydrologic, and/or oceanographic conditions. For tidal datum computational purposes, the maximum height is not considered a high water unless it contains a tidal high water.
High Water Mark	A line or mark left upon tide flats, beach, or alongshore objects indicating the elevation of the intrusion of high water. The mark may be a line of oil or scum on alongshore objects, or a more or less continuous deposit of fine shell or debris on the foreshore or berm. This mark is physical evidence of the general height reached by wave runup at recent high waters. It should not be confused with the Mean High Water Line or Mean Higher High Water Line.
Higher High Water (HHW)	The highest of the high waters (or single high water) of any specified tidal day due to the declination A_l effects of the moon and sun.
Higher Low Water (HLW)	The highest of the low waters of any specified tidal day due to the declination A_l effects of the moon and sun.

Highest Astronomical Tide (HAT)	The highest level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions; this level will not be reached every year. HAT is not the extreme level which can be reached as storm surges may cause considerably higher levels to occur.
Hydrographic Datum	A datum used for referencing depths of water and the heights of predicted tides or water level observations. Same as Chart Datum. See Datum.
Indian Spring Low Water	A datum originated by Professor G. H. Darwin when investigating the tides of India. It is an elevation depressed below mean sea level by an amount equal to the sum of the amplitudes of the harmonic constituents M_2, S_2, K_1, and O_1.
Inverse Barometer Effect	The inverse response of sea level to changes in atmospheric pressure. A static reduction of 1.005 mb in atmospheric pressure will cause a stationary rise of 1 cm in sea level.
K_1	Lunisolar diurnal constituent. This constituent, with O_1, expresses the effect of the moon's declination. They account for diurnal inequality and, at extremes, diurnal tides. With P_1, it expresses the effect of the sun's declination. Speed = T + h = 15.041,068,6° per solar hour.
Lambda	Smaller lunar evectional constituent. This constituent, with V_2, U_2, and (S_2), modulates the amplitude and frequency of M_2 for the effects of variation in solar attraction of the moon. This attraction results in a slight pear-shaped lunar ellipse and a difference in lunar orbital speed between motion toward and away from the sun. Although (S_2) has the same speed as S_2, its amplitude is extremely small. Speed = 2T - s + p = 29.455,625,3° per solar hour.
Low Water (LW)	The minimum height reached by a falling tide. The low water is due to the periodic tidal forces and the effects of meteorological, hydrologic, and/or oceanographic conditions. For tidal datum computational purposes, the minimum height is not considered a low water unless it contains a tidal low water.
Lower High Water (LHW)	The lowest of the high waters of any specified tidal day due to the declination A_l effects of the moon and sun.
Lower Low Water (LLW)	The lowest of the low waters (or single low water) of any specified tidal day due to the declination A_l effects of the moon and sun.
Lowest Astronomical Tide (LAT)	The lowest level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions; this level will not be reached every year. LAT is not the extreme level which can be reached as storm surges may cause considerably lower levels to occur.
Lunar tide	That part of the tide on the earth due solely to the moon as distinguished from that part due to the sun.
Magnetic Tape	Recording tape on which (numeric) data may be stored.
M_2	Principal lunar semi-diurnal constituent. This constituent represents the rotation of the Earth with respect to the Moon. Speed = 2T - 2s + 2h = 28.984,104,2° per solar hour.
Mean High Water (MHW)	A tidal datum. The average of Mean High Water Spring and Mean High Water Neap.

Mean High Water Springs (MHWS), Mean Low Water Springs (MLWS)	The height of MHWS is the average, throughout a year when the average maximum declination of the moon is 23.5°, of the heights of two successive high waters during those periods of 24 hours (approximately once a fortnight) when the range of the tide is the greatest. The height of MLWS is the average height obtained by the two successive low waters during the same periods.
Mean High Water Neaps (MHWN), Mean Low Water Neaps (MLWN)	The height of MHWN is the average, throughout a year, as defined above, of two successive high waters during those periods of 24 hours (approximately once a fortnight) when the range of the tide is least. The height of MLWN is the average height obtained by the two successive low waters during the same periods.
Mean Range of Tide (Mn)	The difference in height between Mean High Water and Mean Low Water.
Modem	A device allowing a computer to be accessed over a telephone line.
Neap Tides	Tides of decreased range or tidal currents of decreased speed occurring semi-monthly as the result of the moon being in quadrature. The neap range (Np) of the tide is the average range occurring at the time of neap tides and is most conveniently computed from the harmonic constants. It is smaller than the mean range where the type of tide is either semi-diurnal or mixed and is of no practical significance where the type of tide is predominantly diurnal. The average height of the high waters of the neap tide is called Neap High Water or High Water Neaps (MHWN) and the average height of the corresponding low waters is called Neap Low Water or Low Water Neaps (MLWN).
O_1	Lunar diurnal constituent. See K_1. Speed = T - 2s + h = 13.943,035,6° per solar hour.
Phase	1. Any recurring aspect of a periodic phenomenon, such as new moon, high water, flood strength, etc. 2. A particular instant of a periodic function expressed in angular measure and reckoned from the time of its maximum value, the entire period of the function being taken as 360°. The maximum and minimum of a harmonic constituent have phase values of 0° and 180°, respectively.
Pressure Sensor	A pressure transducer sensing device for water level measurement. A relative transducer is vented to the atmosphere and pressure readings are made relative to atmospheric pressure. An absolute transducer measures the pressure at its location. The readings are then corrected for barometric pressure taken at the surface.
Range of Tide	The difference in height between consecutive high and low waters. The mean range is the difference in height between mean high water and mean low water. The great diurnal range or diurnal range is the difference in height between mean higher high water and mean lower low water.
Relative Mean Sea Level Change	A local change in mean sea level relative to a network of benchmarks established in the most stable and permanent material available (bedrock, if possible) on the land adjacent to the tide station location. A change in relative mean sea level may be composed of both an absolute mean sea level change component and a vertical land movement change component, together.

S_2	Principal solar semi-diurnal constituent. This constituent represents the rotation of the Earth with respect to the Sun. Speed = 2T = 30.000,000,0° per solar hour.
Seiche	A stationary wave usually caused by strong winds and/or changes in barometric pressure. It is found in lakes, semi-enclosed bodies of water, and in areas of the open ocean. The period of a seiche in an enclosed rectangular body of water is usually represented by the formula: Period (T) = 2L / square root (gd) in which L is the length, d the average depth of the body of water, and g the acceleration of gravity.
Semi-Diurnal	Having a period or cycle of approximately one-half of a tidal day. The predominant type of tide throughout the world is semi-diurnal, with two high waters and two low waters each tidal day. The tidal current is said to be semi-diurnal when there are two flood and two ebb periods each day. A semi-diurnal constituent has two maxima and two minima each constituent day, and its symbol is the subscript 2.
Shallow Water Constituent	A short-period harmonic term introduced into the formula of tidal (or tidal current) constituents to take account of the change in the form of a tide wave resulting from shallow water conditions. Shallow water constituents include the overtides and compound tides.
Slack Water (Slack)	The state of a tidal current when its speed is near zero, especially the moment when a reversing current changes direction and its speed is zero. The term also is applied to the entire period of low speed near the time of turning of the current when it is too weak to be of any practical importance in navigation. The relation of the time of slack water to the tidal phases varies in different localities. For a perfect standing tidal wave, slack water occurs at the time of high and of low water, while for a perfect progressive tidal wave, slack occurs midway between high and low water.
Solar Tide	1. The part of the tide that is due to the tide-producing force of the sun. 2. The observed tide in areas where the solar tide is dominant. This condition provides for phase repetition at about the same time each solar day.
Solid State	An electronic device composed of components with no moving parts – in this instance, using the electronic properties of solids, as in transistors, semi-conductors and integrated circuits.
Spring High Water	Same as Mean High Water Springs (MHWS). See Spring Tides.
Spring Low Water	Same as Mean Low Water Springs (MLWS). See Spring Tides and Mean Low Water Springs.
Spring Tides	Tides of increased range or tidal currents of increased speed occurring semi-monthly as the result of the moon being new or full. The spring range (Sg) of tide is the average range occurring at the time of spring tides and is most conveniently computed from the harmonic constants. It is larger than the mean range where the type of tide is either semi-diurnal or mixed, and is of no practical significance where the type of tide is predominantly diurnal. The average height of the high waters of the spring tides is called Spring High Water or Mean High Water Springs (MHWS) and the average height of the corresponding low waters is called Spring Low Water or Mean Low Water Springs (MLWS).

Storm Surge	The local change in the elevation of the ocean along a shore due to a storm. The storm surge is measured by subtracting the astronomic tidal elevation from the total elevation. It typically has a duration of a few hours. Since wind generated waves ride on top of the storm surge (and are not included in the definition), the total instantaneous elevation may greatly exceed the predicted storm surge plus astronomic tide. It is potentially catastrophic, especially on low-lying coasts with gently sloping offshore topography.
Telemeter	Transmit data to a distant receiving station via a telephone line or by telegraphic means.
Tidal Characteristics	Principally, those features relating to the time, range, and type of tide.
Tidal Constants	Tidal relations that remain practically constant for any particular locality. Tidal constants are classified as harmonic and non-harmonic. The harmonic constants consist of the amplitudes and epochs of the harmonic constituents, and the non-harmonic constants include the ranges and intervals derived directly from the high and low water observations.
Tidal Current	A horizontal movement of the water caused by gravitational interactions between the Sun, Moon and Earth. The horizontal component of the particulate motion of a tidal wave. Part of the same general movement of the sea that is manifested in the vertical rise and fall called tide.
Tide	The periodic rise and fall of the water resulting from gravitational interactions between Sun, Moon and Earth. The vertical component of the particulate motion of a tidal wave. Although the accompanying horizontal movement of the water is part of the same phenomenon, it is preferable to designate this motion as tidal current.
Tide Curve	A graphic representation of the rise and fall of the tide in which time is usually represented by the abscissa and height by the ordinate. For a semi-diurnal tide with little diurnal inequality, the graphic representation approximates a cosine curve.
Tide (Water Level) Gauge	An instrument for measuring the rise and fall of the tide (Water Level).
Tide Tables	Tables which give daily predictions of the times and heights of high and low waters. These predictions are usually supplemented by tidal differences and constants through which predictions can be obtained for numerous other locations.
Tsunami	A shallow water progressive wave, potentially catastrophic, caused by an underwater earthquake or volcano.
Universal Time (UTC)	Same as Greenwich Mean Time (GMT).
Z_0	Symbol recommended by the International Hydrographic Organisation to represent the elevation of mean sea level above chart datum.

Appendix D

Other publications of interest

Appendix D Other Publications of Interest

Data reports

MHL Annual Estuary and River Water Levels Summaries available:

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

MHL Annual Ocean Tide Levels Summaries available:

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

MHL Annual Coastal Rainfall Summaries available:

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

MHL Annual Wave Climate and Coastal Air Pressure Summaries available:

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

Frequency distribution analysis

Manly Hydraulics Laboratory 2014, *OEH NSW Water Level Frequency Distribution Analysis*, MHL Report 2100, March 2014.

Network reports

Manly Hydraulics Laboratory 2005, *Review of Automatic Water Level Recorder Network,* MHL Report 1419, October 2005.

Flood reports

Manly Hydraulics Laboratory 2013, *NSW North Coast Flood Summary January–March 2013,* MHL Report 2202, May 2013.

Manly Hydraulics Laboratory 2015, *NSW Hunter and Central Coast Flood Summary April–May 2015,* MHL Report 2364, June 2015.

Manly Hydraulics Laboratory 2016, *NSW South Coast Flood Summary August 2015,* MHL Report 2367, September 2016.

Harmonic Analysis and Tidal Planes

Manly Hydraulics Laboratory 1994, *The Harmonic Analysis of NSW Tide Gauge Network, Volumes 1 and 2,* Report No. MHL604.

Department of Public Works and Services 2003, *DLWC NSW Tidal Planes Data Compilation 2001 – Volume 1 Tidal Plane Analyses*, Manly Hydraulics Laboratory, Report No. 1098.

Department of Public Works and Services 2002, *DLWC NSW Tidal Planes Data Compilation 2001 – Volume 2 Tidal Phase Analyses*, Manly Hydraulics Laboratory, Report No. 1098.

Manly Hydraulics Laboratory 2005, *Investigation into Tidal Planes Compilation – NSW Tidal Planes Data Compilation Stage 3*, MHL Report 1269, November 2005.

Manly Hydraulics Laboratory 2012, *OEH NSW Tidal Planes*, MHL Report 2053, October 2012.

Mean Sea Level

Intergovernmental Oceanographic Commission of UNESCO 1985, *Manual on Sea Level Measurement and Interpretation*, IOC Manuals and Guides, No. 14.

Intergovernmental Oceanographic Commission of UNESCO 1986, *Global Sea-level Observing System (GLOSS) Implementation Plan* 1985–1990, IOC/INF-663.

NSW Committee on Tides and Mean Sea Level 1990, *The Role of the NSW Committee on Tides and Mean Sea Level*.

National Mapping Council, Permanent Committee on Tides and Mean Sea Level (PCTMSL), *Tide Gauge Survey Information.*

Anomalies and Storm Surge Analysis

Manly Hydraulics Laboratory 1991, *Storm Surges Monitored Along the NSW Coast March–April 1990,* Report No. MHL591.

Manly Hydraulics Laboratory 2008, *South Coast NSW Tide-Storm Surge Analysis,* MHL Report 1618, December 2008.

Manly Hydraulics Laboratory 2011, *NSW Ocean Water Levels,* MHL Report 1881, March 2011.

University of Queensland, 2010, Tropical Cyclone 'Roger' Storm Surge Assessment, Research Report CE162, J. Stewart, D. Callaghan and P. Nielsen, July 2010.

Public Works
Manly Hydraulics Laboratory

110B King Street
Manly Vale NSW 2093
T 02 9949 0200
F 02 9948 6185
TTY 1300 301 181
www.mhl.nsw.gov.au