



# NSW ESTUARY AND RIVER WATER QUALITY ANNUAL SUMMARY 2016–2017

Report MHL2577  
October 2017

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NSW Office of Environment and Heritage

Cover Photograph: Bombah Point station, Myall Lakes

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# Foreword

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Manly Hydraulics Laboratory (MHL) is a business group within the Department of Finance, Services and Innovation. The NSW water quality database has been developed by MHL to support a number of programs associated with coastal, floodplain and estuary management for NSW Office of Environment and Heritage (OEH), WaterNSW<sup>1</sup> and Wollongong City Council (WCC).

This summary presents an overview of water quality measurements captured by the automatic recording stations along the coastal estuaries and rivers of New South Wales, from 1 July 2016 to 30 June 2017. MHL maintains the automatic recording stations and catalogues the data collected. During the 2016–2017 monitoring period the overall data recovery rate was 98.6%.

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

Requests for further information should be directed to:

Manager Environmental Data	Email	:	<a href="mailto:data-request@mhl.nsw.gov.au">data-request@mhl.nsw.gov.au</a>
Manly Hydraulics Laboratory	WWW	:	<a href="http://mhl.nsw.gov.au/">http://mhl.nsw.gov.au/</a>
110B King Street	Telephone	:	(02) 9949 0200
Manly Vale NSW 2093			

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- NSW Estuary and River Water Levels Annual Summary 2016–2017  
Manly Hydraulics Laboratory  
Report No. MHL 2573  
ISSN: 2205-5525 (Print)  
ISSN: 2205-5533 (Online)
- NSW Coastal Rainfall Annual Summary 2016–2017  
Manly Hydraulics Laboratory  
Report No. MHL 2575  
ISSN: 2205-5568 (Print)  
ISSN: 2205-5576 (online)
- NSW Ocean and River Entrance Tidal Levels Annual Summary 2016–2017  
Manly Hydraulics Laboratory  
Report No. MHL 2574  
ISSN: 2205-5541 (Print)  
ISSN: 2205-555X (Online)
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Manly Hydraulics Laboratory  
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ISSN: 2205-5584 (Print)  
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Electronic copies of the reports in this series can be downloaded at <http://www.mhl.nsw.gov.au/> under the 'Publications' link.

<sup>1</sup> Formerly for the Department of Primary Industries Water (DPI Water).

# Executive summary

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This report contains:

- a brief description of the water quality programs
- guidelines on how to use this report
- information on how to access the database
- significant developments which occurred in 2016–2017
- the data summaries and station location maps for each station
- [Appendix A](#), detailing the data available online
- [Appendix B](#), showing data output formats available at MHL
- [Appendix C](#), a list of other publications which may be of interest.

# Contents

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<b>FOREWORD</b>	<b>I</b>
<b>EXECUTIVE SUMMARY</b>	<b>II</b>
<b>1. WATER QUALITY MONITORING PROGRAM</b>	<b>1</b>
<b>2. HOW TO USE THIS REPORT</b>	<b>3</b>
<b>3. HOW TO ACCESS THE DATA</b>	<b>4</b>
<b>4. SIGNIFICANT EVENTS AND DEVELOPMENTS</b>	<b>5</b>
4.1 Flood events	5
4.2 Cross-sectional profiling	5
4.3 Station development	6
4.4 Station issues	6
<b>5. WATER QUALITY MONITORING SUMMARY</b>	<b>7</b>
<b>APPENDICES</b>	
Appendix A Data on-line	A1
Appendix B Sample outputs	B1
Appendix C Other publications of interest	C1
<b>TABLES</b>	
Table 1 Station list	1
Table 2 NSW flood classifications 2016–2017	5
Table 3 Index of figures	7

# 1. Water quality monitoring program

This report presents a summary of the water quality data currently collected by Manly Hydraulics Laboratory (MHL). The network of automatic recorders and the associated analysis routines enable efficient delivery of water quality data. As well as near real time water quality information at 20 stations in NSW, extracts from the historical database of water quality data can be provided on request (refer to [Appendix A](#)).

The present program is based on a network of automatic recording stations installed at various estuaries (see [Station Location Maps](#) in Section 5). This network consists of 20 permanent stations funded by NSW Office of Environment and Heritage (OEH), WaterNSW<sup>1</sup> and Wollongong City Council (WCC) (see [Table 1](#)). The logging systems consist of data loggers which record water quality information every 15 minutes. Data is transmitted via telemetry to the database every six hours.

**Table 1 Station list**

River/ estuary system	Station name	Station no.	MGA	Easting	Northing	Station owner	Data start	Overall data capture rate 2016–2017
Richmond	Coraki	203403	56	527976	6793772	OEH/WaterNSW	21-Oct-09	97.5%
Richmond	Oakland Road	203470	56	526684	6791185	WaterNSW	06-Mar-12	97.2%
Clarence	Rogans Bridge	204413	56	488813	6723401	OEH/WaterNSW	03-Dec-09	87.4%
Clarence	Grafton	204400	56	493398	6715149	OEH/WaterNSW	04-Dec-09	99.8%
Macleay	Kempsey	206402	56	485099	6561395	OEH/WaterNSW	09-Feb-10	99.8%
Manning	Wingham	208400	56	440523	6473219	OEH/WaterNSW	08-Dec-09	97.4%
Manning	Taree West	208420	56	447161	6469672	WaterNSW	30-Apr-10	100.0%
Myall Lakes	Bombah Point	209475	56	434680	6403299	OEH	13-Jul-09	100.0%
Myall River	Tea Gardens	209480	56	421723	6385111	OEH	20-Oct-09	100.0%
Paterson	Dunmore	210409	56	369238	6383269	OEH/WaterNSW	15-Oct-09	99.4%
Paterson	Hinton Bridge	210410	56	373245	6379624	OEH/WaterNSW	15-Oct-09	100.0%
Hunter	McKimms Corner	210455	56	368162	6378933	OEH/WaterNSW	08-Oct-09	100.0%
Hunter	Hexham	210448	56	376768	6367608	OEH/WaterNSW	13-Apr-11	96.5%
Hunter	Green Rocks	210432	56	377459	6378142	OEH/WaterNSW	15-Oct-09	97.3%
Williams	Raymond Terrace	210452	56	382352	6375361	OEH/WaterNSW	15-Oct-09	100.0%
Hawkesbury	Sackville	212406	56	303238	6292029	OEH/WaterNSW	30-Oct-09	99.7%
Hawkesbury	Leets Vale	212461	56	309195	6299263	WaterNSW	22-Jun-10	100.0%
Lake Illawarra	Koonawarra Bay	214440	56	300064	6179621	WCC	15-Jun-93	100.0%
Lake Illawarra	Cudgerie Bay	214416	56	303885	6177264	WCC	09-Feb-93	100.0%
Shoalhaven	Grady's Caravan Park	215430	56	268024	6138282	OEH/WaterNSW	06-Oct-10	99.1%
<b>Overall</b>								<b>98.6%</b>

<sup>1</sup> Formerly for the Department of Primary Industries Water (DPI Water).

The network features three distinctive water quality probe types for obtaining temperature and conductivity readings:

1. EC1500: designed for long-term deployment at unattended monitoring stations. The sensor head is epoxy encapsulated and has a large toroid to allow the flow of water through it. The sensor is nominated to measure conductivity from zero to full scale with the probe resolution of electrical conductivity (EC)  $\pm 1\%$  at full scale and temperature  $\pm 0.2^\circ\text{C}$
2. AquiStar CT2X: a submersible sensor with built-in data logging. The CT2X incorporates 4-pole electrode cell measurement technology with a probe resolution of EC  $\pm 1$  microsiemen/cm and temperature  $\pm 0.01^\circ\text{C}$
3. YSI Sonde 600XL: a multi-parameter probe with a probe resolution of EC  $\pm 1$  microsiemen/cm and temperature  $\pm 0.01^\circ\text{C}$ .

In 2010, logger programs at all sites were modified to output salinity (Practical Salinity Units (psu)) and specific conductivity at  $25^\circ\text{C}$  (microseimens/cm) in addition to the standard outputs of water level, temperature and conductivity. This update is intended to make the near real-time data more usable by the diverse range of end users.

Temperature and conductivity values are obtained directly from the instrumentation. Specific conductivity at  $25^\circ\text{C}$  is calculated using the equation:

$$\text{Specific Conductivity } [\mu\text{s/cm}] = C / (1 + 0.0198933 * (T - 25))$$

where C = uncompensated EC, T = temperature

Salinity is calculated using the UNESCO formula (seawater salinity calculation) and the full equation can be found in:

UNESCO Technical Papers in Marine Science, #36 (1981a) 'The Practical Salinity Scale 1978 and the International Equation of State of Seawater 1980', *UNESCO Division of Marine Sciences* (Paris), pp. 25.

Water quality data is transferred to MHL's databases, located in NSW Government Data Centres (GovDC), using a variety of telemetry techniques including internet protocols, landline telephone and cellular networks. The incoming raw data is then made available in near real time to external users to view via the web.

The data is stored in a database and subject to a quality assurance process which involves several control steps to ensure data quality is maintained. 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 and copies are stored off site.

## 2. How to use this report

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

The NSW coastline has been divided into geographic regions based on river systems. Location maps display the station locations and the annual plots confirm the availability and suitability of data for the particular period of interest. Extracts from the historical database of water quality data can be made available on request (refer to [Appendix A](#)).

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](#) outlines sample data output types.

There are various factors which can influence the water quality data presented in this report. The reader should be familiar with these factors and data recording limitations when interpreting it. These factors include:

- In coastal streams or estuaries, salt water often mixes with fresh water. The addition of salt water greatly increases conductivity, with the ocean typically recording an approximate level of 36 psu compared with fresh water which is almost zero.
- In inland locations, freshwater inflows associated with rainfall events may lower conductivity. The auto scaling of the conductivity plots can visually over-emphasise these changes. Conversely, during low flow conditions the dissolved solids are more concentrated and therefore conductivity levels are higher. Caution should be exercised when interpreting the conductivity and derived salinity plots in this report recognising different scaling and the proximity of water quality station locations to the ocean.
- At monitoring stations impacted by tides, conductivity will be influenced by natural flows, as well as saltwater intrusion brought upstream with rising tides. The salinity value for any particular monitoring station can vary significantly between high and low tides. For example, during the 2016–2017 monitoring period, the salinity values at Tea Gardens varied by approximately 25 psu between high and low tides, and at Taree West variations of approximately 14 psu were observed. This measured variation should not be misread as noisy trace fluctuations (due to instrument limitations or malfunction), but rather it typically represents measured responses to the surrounding environment.

### 3. How to access the data

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

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

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

## 4. Significant events and developments

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### 4.1 Flood events

This section outlines events and developments which have influenced water quality monitoring during this reporting period. Floods introduce significant freshwater inflows which impact on electrical conductivity and temperature, as shown in the data summaries. [Table 2](#) lists the flood events that occurred during the 2016–2017 reporting period. The flood events are classified according to the NSW State Emergency Service’s classification scale.

**Table 2 NSW flood classifications 2016–2017**

River basin	Date	Flood classification
Richmond River	August 2016	Minor
	March 2017	Major
Clarence River	March 2017	Minor
Macleay River	March 2017	Minor
Manning River	March 2017	Minor
Hunter River	March 2017	Minor
Hawkesbury River	March 2017	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 Cross-sectional profiling

A cross-sectional profile is taken at more than four points across the channel at the surface and at 0.3 m intervals below the surface. The profile information provides a cross-check as to whether the in situ sensor is providing data that is representative of the complete river cross-section.

In May, June and July 2017, cross-sectional water quality profiling was undertaken on the Richmond, Clarence, Macleay, Manning, Paterson, Hunter, Hawkesbury and Shoalhaven rivers, as part of WaterNSW’s water sharing plans monitoring program.

### 4.3 Station development

The following station developments and upgrades occurred during the 2016–2017 reporting period:

- The Rogans Bridge station (Clarence River) was upgraded with a more powerful solar panel, and the height of the solar panel on an extension pole was also raised to improve solar input in April 2017.
- The Grady's Caravan Park station (Shoalhaven River) was installed with a new YSI water quality sensor and a 91 metre custom-made cable on 29 May 2017 which increases the quality of the data and reliability of the data capture of the site.

### 4.4 Station issues

The Oakland Road station (Richmond River) experienced a catastrophic power surge (lightning strike) on 25 November 2016 which caused damage to the logger, modem and all sensors. New components were installed and data communications re-established on 13 January 2017. The water quality sensor and cable were damaged during the flood in March 2017. New components were installed on 2 May 2017. There were two periods of water temperature and salinity missing data, from 25 November 2016 to 13 January 2017, and from 31 March 2017 to 2 May 2017, which were backfilled with data from the downstream station at Bungawalbin following discussions with WaterNSW.

The Rogans Bridge station (Clarence River) experienced a cable failure on 20 January 2017. A new cable was installed on 9 March 2017.

The Grafton station's (Clarence River) water quality housing collapsed during the flood in March 2017, causing the water quality sensor to be sitting in mud and impacting water quality readings. New pipework and support brackets were installed on 30 May 2017. Salinity data was fitted from 20 March 2017 to 20 May 2017 according to actual in-field status measurement on 12 April 2017, 11 May 2017 and 30 May 2017.

In May 2017, a representative of WaterNSW identified the Leets Vale station (Hawkesbury River) as a potential hazardous site, with submerged navigational hazards in the channel close to shore. The Wisemans Ferry Wharf was recommended as an alternative station. The future of the Leets Vale station on the water sharing plans monitoring program is to be confirmed during the 2017–2018 fiscal year.

## 5. Water quality monitoring summary

This section documents locality maps and quality assured water quality monitoring summaries for each station. [Table 3](#) provides an index to the figures presented. Daily rainfall data from the nearest available OEH rain gauge is added to the figure to show the influence of rainfall events. Rain gauges associated with the water quality results are indicative only and are not necessarily representative of the rainfall influence on water quality readings at the location of the water quality probes. Note that all parameters with the exception of total daily rainfall are presented at 3-hourly intervals for annual plot resolution purposes, which explains the apparent truncated low tides seen on some water level plots.

**Table 3 Index of figures**

River/estuary system	Station name	Station no.	Comparative OEH rainfall station name	Figure
Station Locality Map	Richmond River Region			<a href="#">1</a>
Richmond River	Coraki	203403	Lake Ainsworth	2
Richmond River	Oakland Road	203470	Lake Ainsworth	3
Station Locality Map	Clarence River Region			<a href="#">4</a>
Clarence River	Rogans Bridge	204413	Wooli Caravan Park	5
Clarence River	Grafton	204400	Wooli Caravan Park	6
Station Locality Map	Macleay River Region			<a href="#">7</a>
Macleay River	Kempsey	206468	Aldavilla Downstream	8
Station Locality Map	Manning River Region			<a href="#">9</a>
Manning River	Wingham	208400	Nabiac	10
Manning River	Taree West	208420	Nabiac	11
Station Locality Map	Great Lakes Region			<a href="#">12</a>
Myall Lakes	Bombah Point	209475	Bulahdelah	13
Station Locality Map	Port Stephens Region			<a href="#">14</a>
Myall River	Tea Gardens	209480	Bulahdelah	15
Station Locality Map	Paterson River Region			<a href="#">16</a>
Paterson River	Dunmore	210409	Belmore Bridge	17
Paterson River	Hinton Bridge	210410	Belmore Bridge	18
Station Locality Map	Hunter River Region			<a href="#">19</a>
Hunter River	McKimms Corner	210455	Belmore Bridge	20
Hunter River	Green Rocks	210432	Hexham	21
Williams River	Raymond Terrace	210452	Hexham	22
Hunter River	Hexham	210448	Hexham	23
Station Locality Map	Hawkesbury River Region			<a href="#">24</a>
Hawkesbury River	Sackville	212406	Sackville DS	25
Hawkesbury River	Leets Vale	212461	Colo Junction	26
Station Locality Map	Lake Illawarra Region			<a href="#">27</a>
Lake Illawarra	Koonawarra Bay	214440	Darkes Road	28
Lake Illawarra	Cudgeree Bay	214416	Darkes Road	29
Station Locality Map	Shoalhaven River Region			<a href="#">30</a>
Shoalhaven River	Grady's Caravan Park	215430	Yellow Rock Road	31



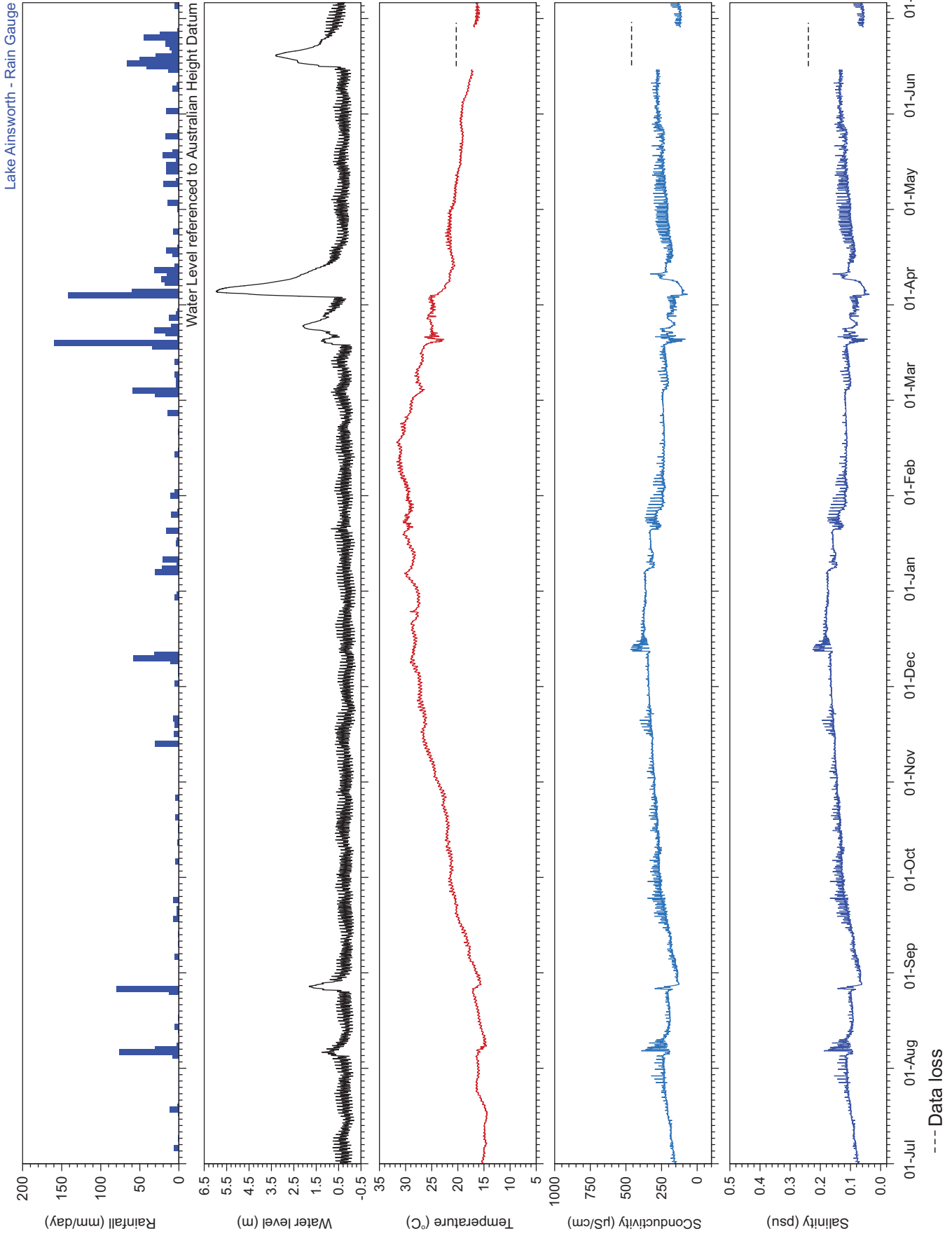
**Manly  
Hydraulics  
Laboratory**

**STATION LOCATIONS  
RICHMOND RIVER REGION**

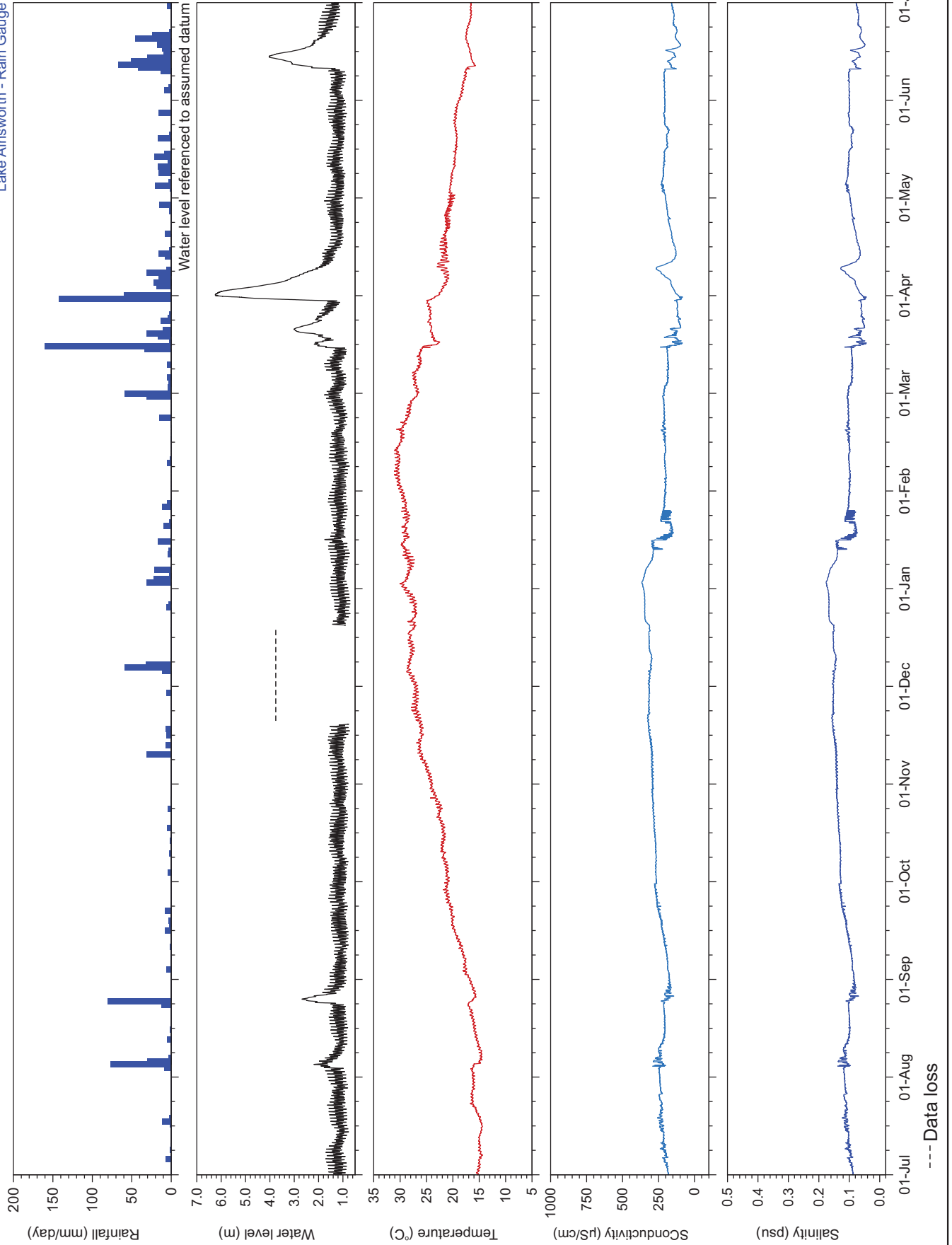
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Report 2577

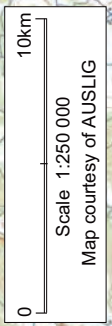
Figure  
1

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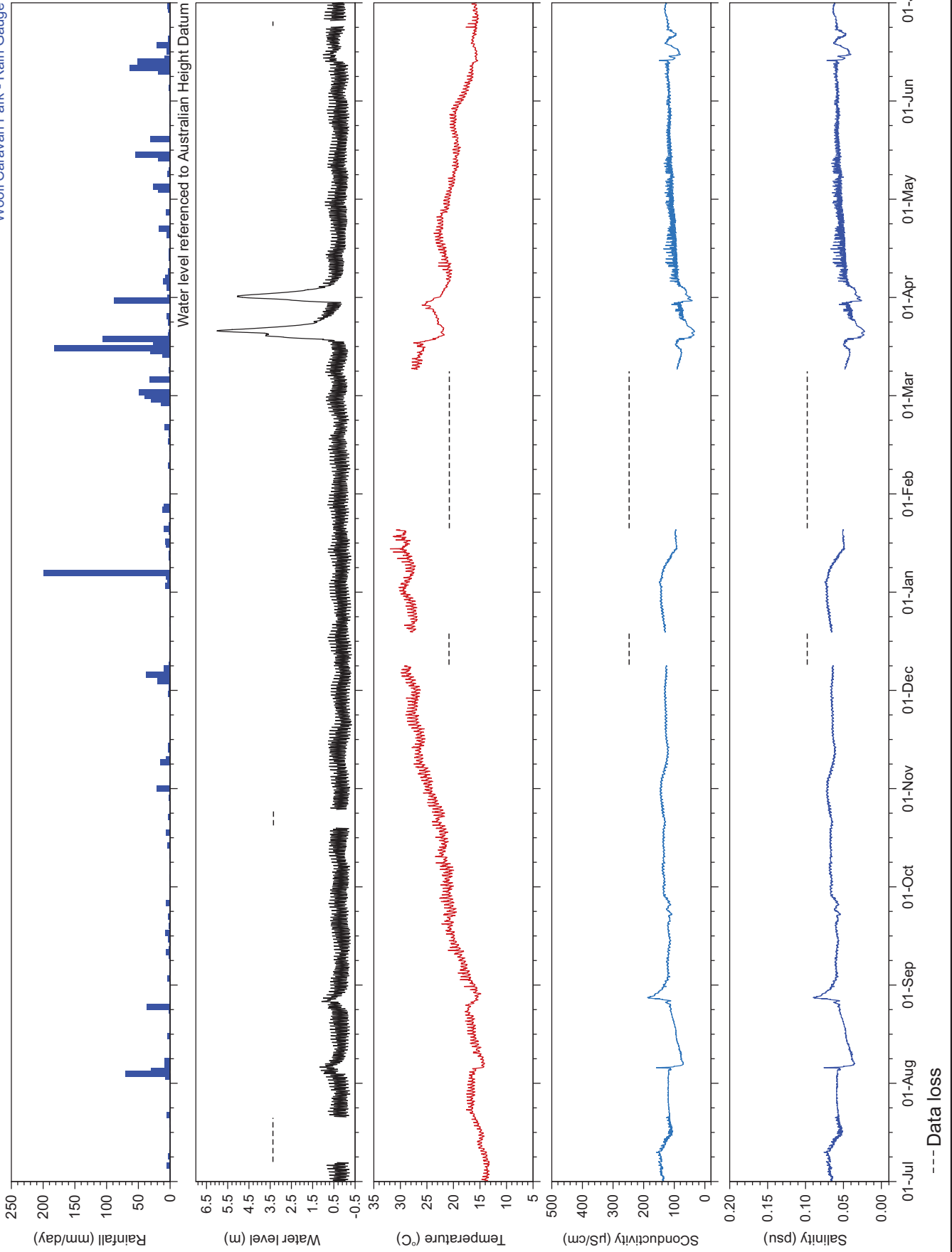


Lake Ainsworth - Rain Gauge

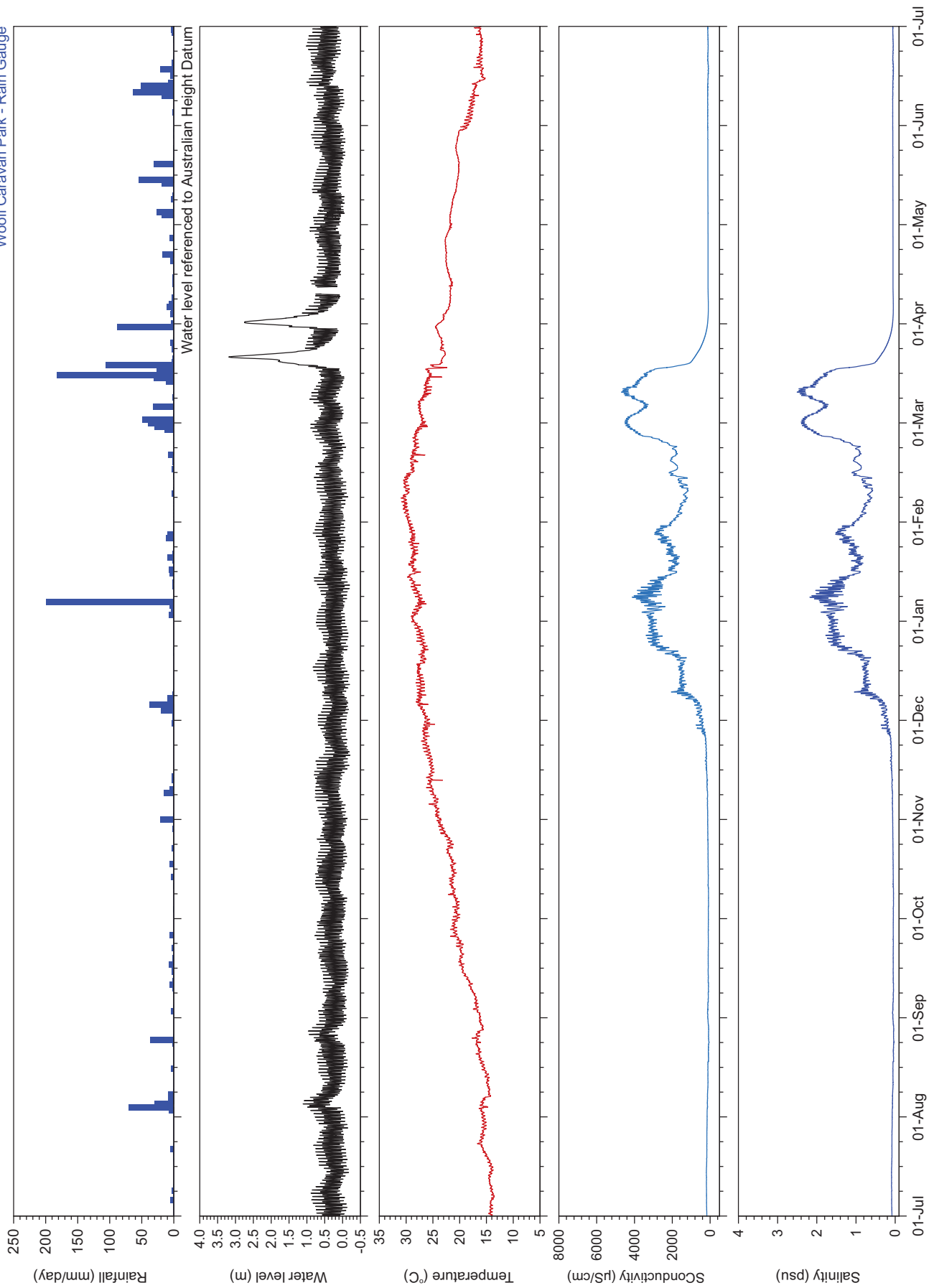


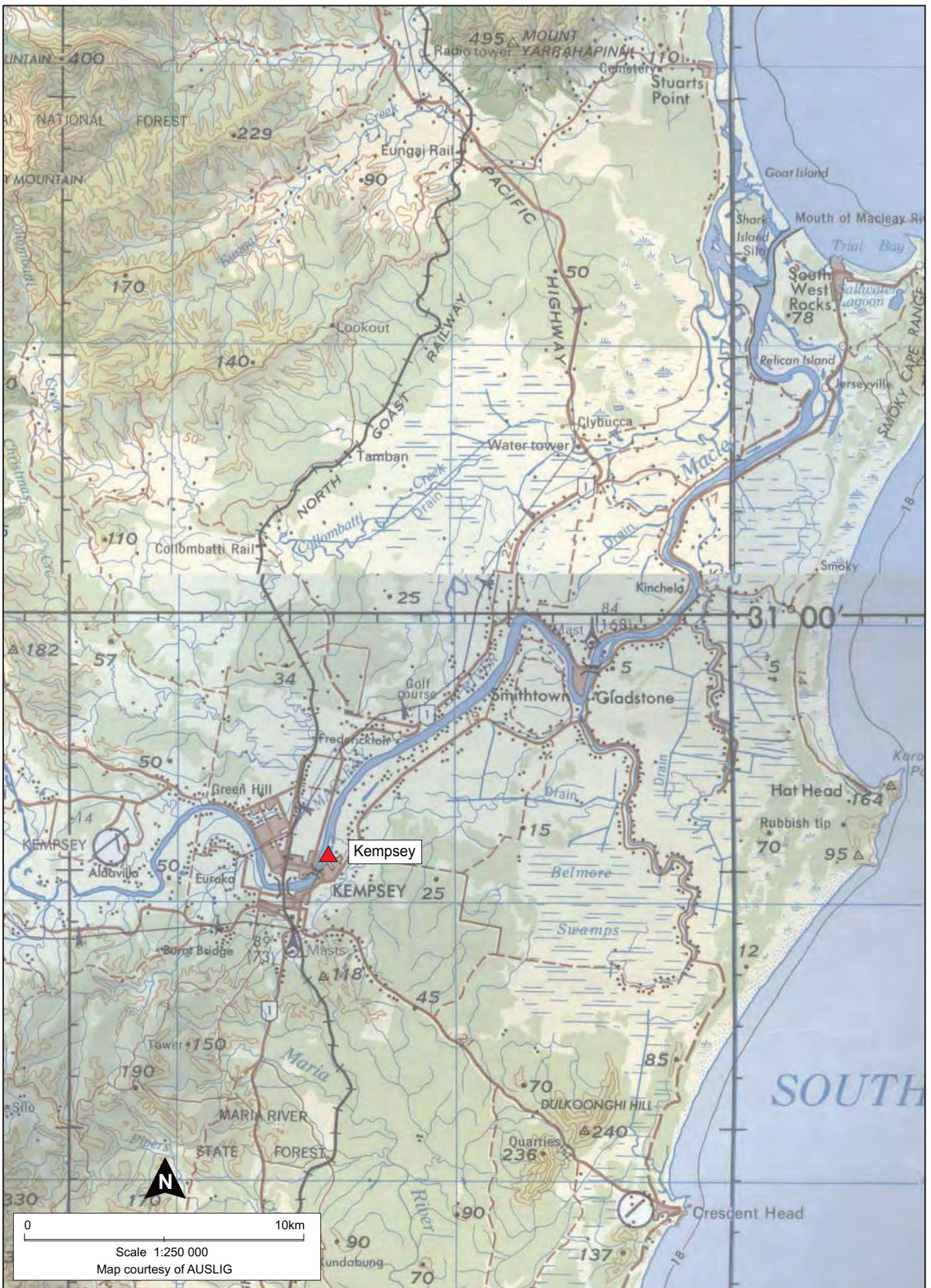


Wooli Caravan Park - Rain Gauge



Wooli Caravan Park - Rain Gauge





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Laboratory**

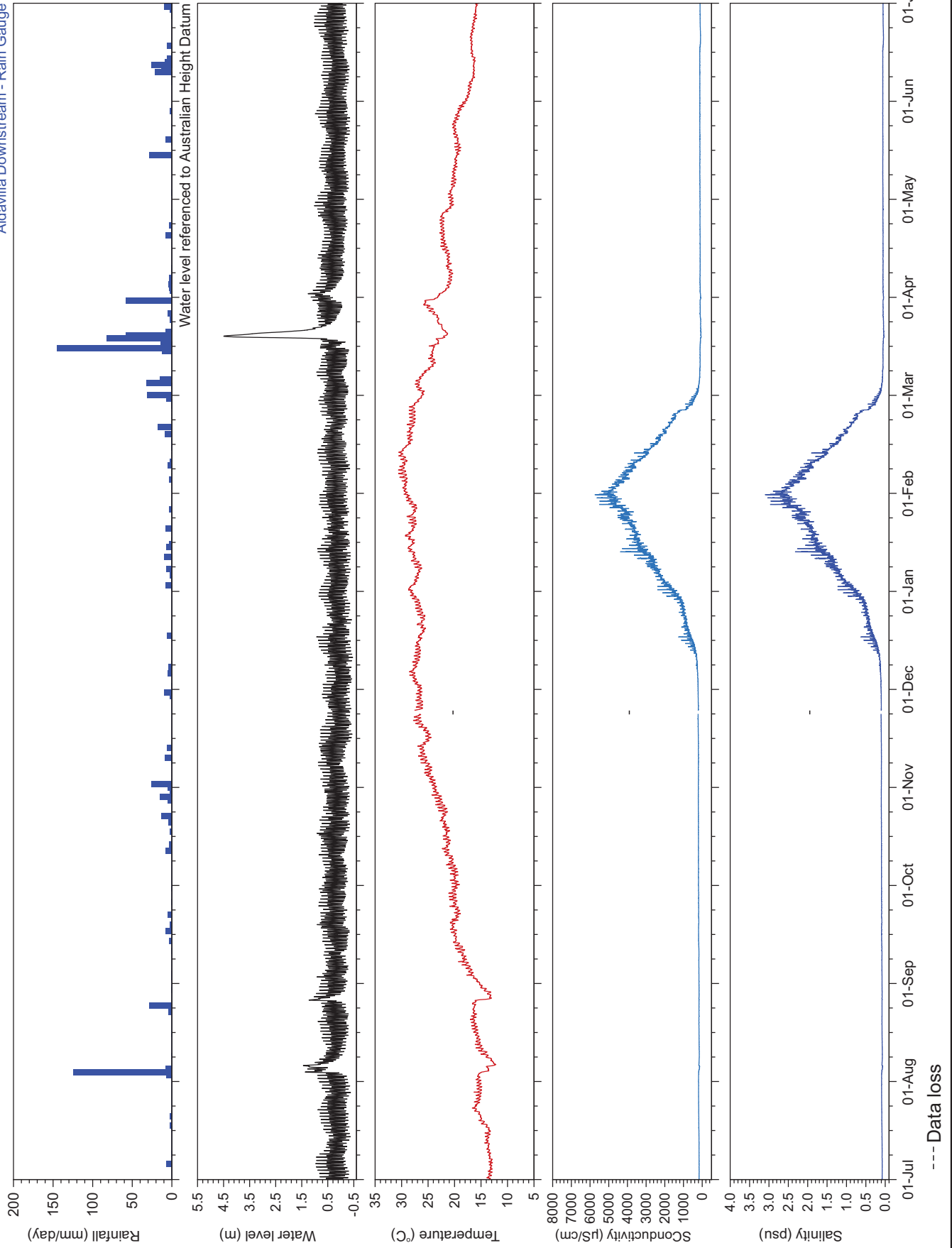
**STATION LOCATIONS  
MACLEAY RIVER REGION**

MHL  
Report 2577

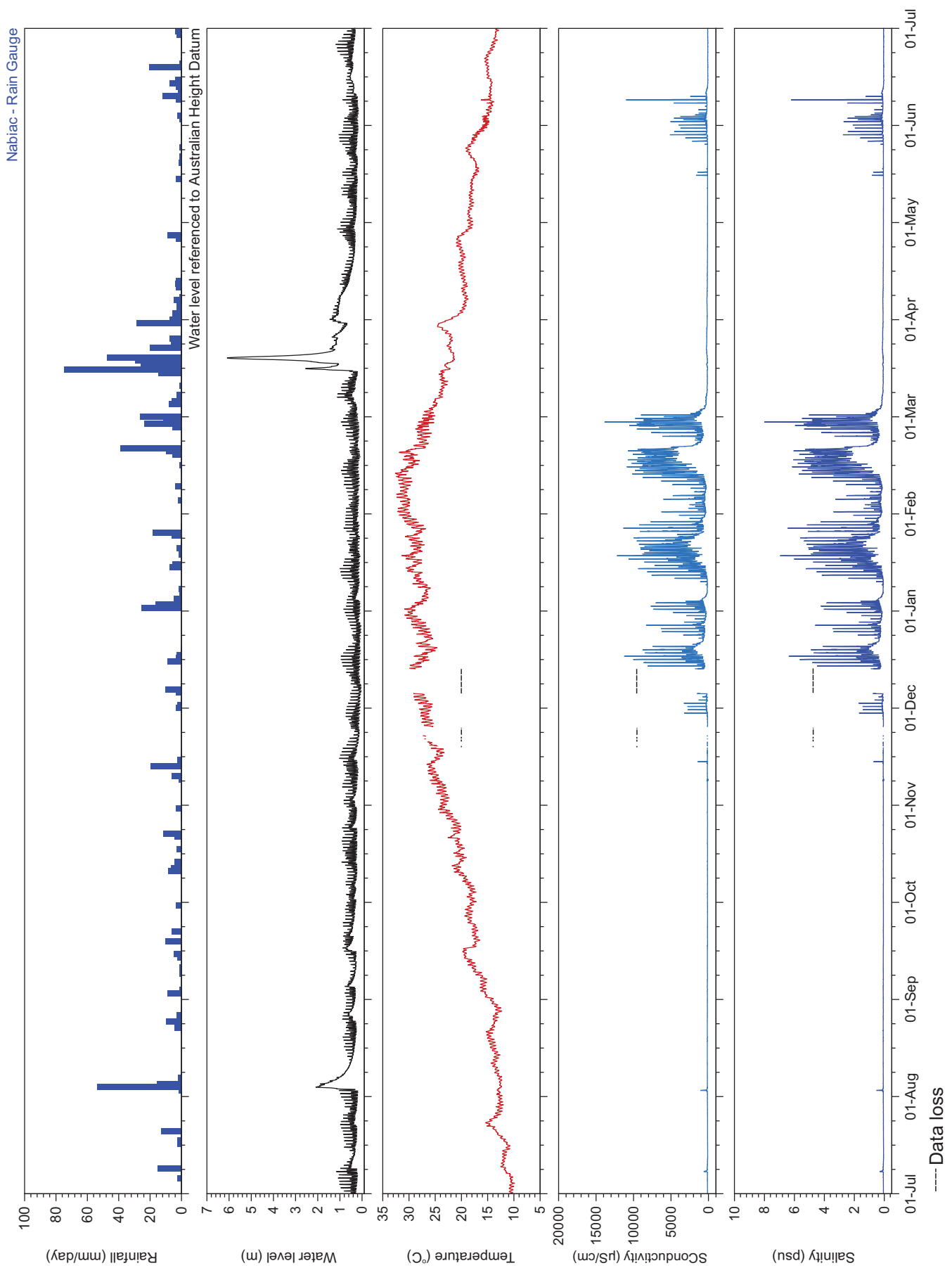
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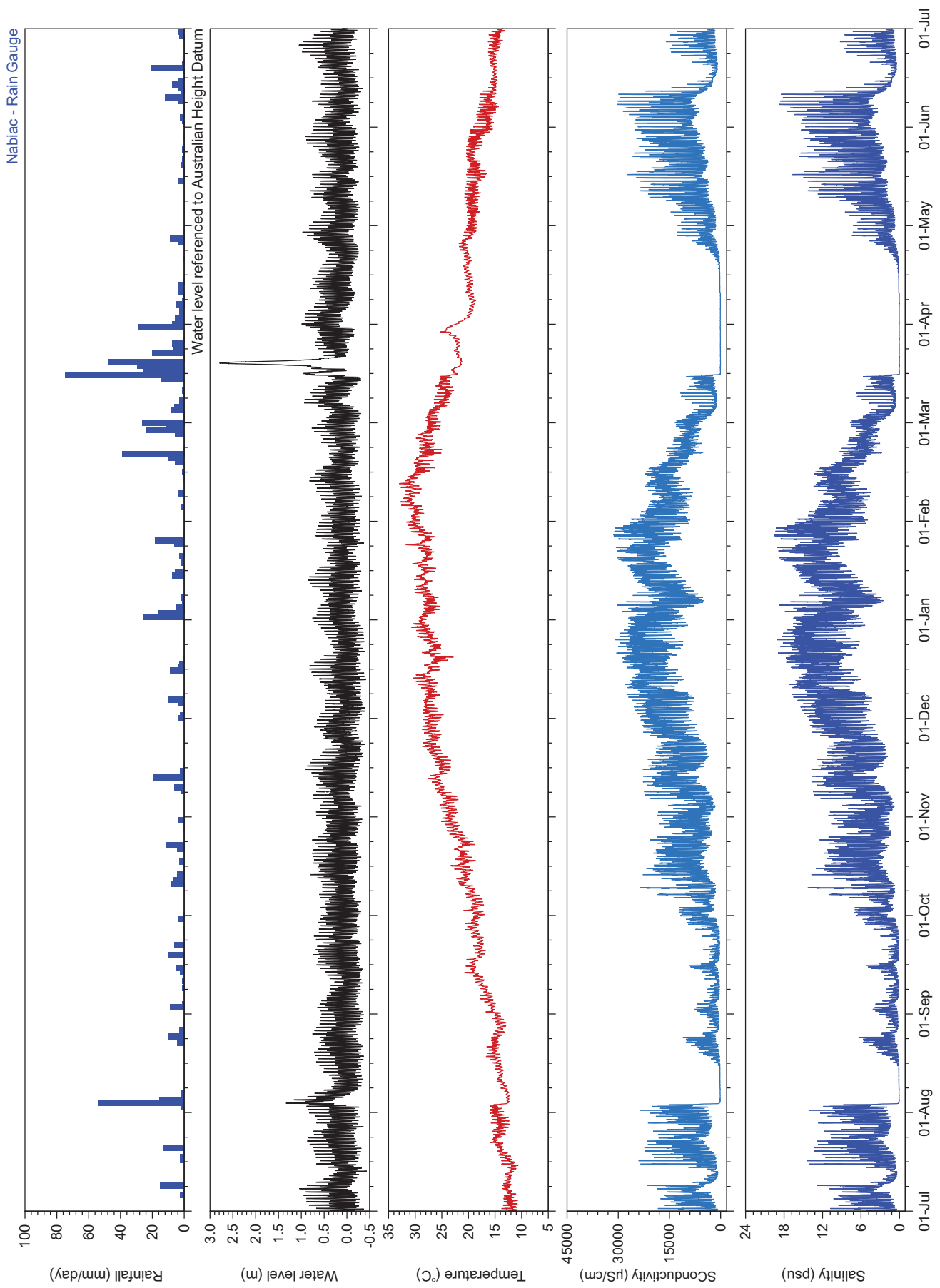
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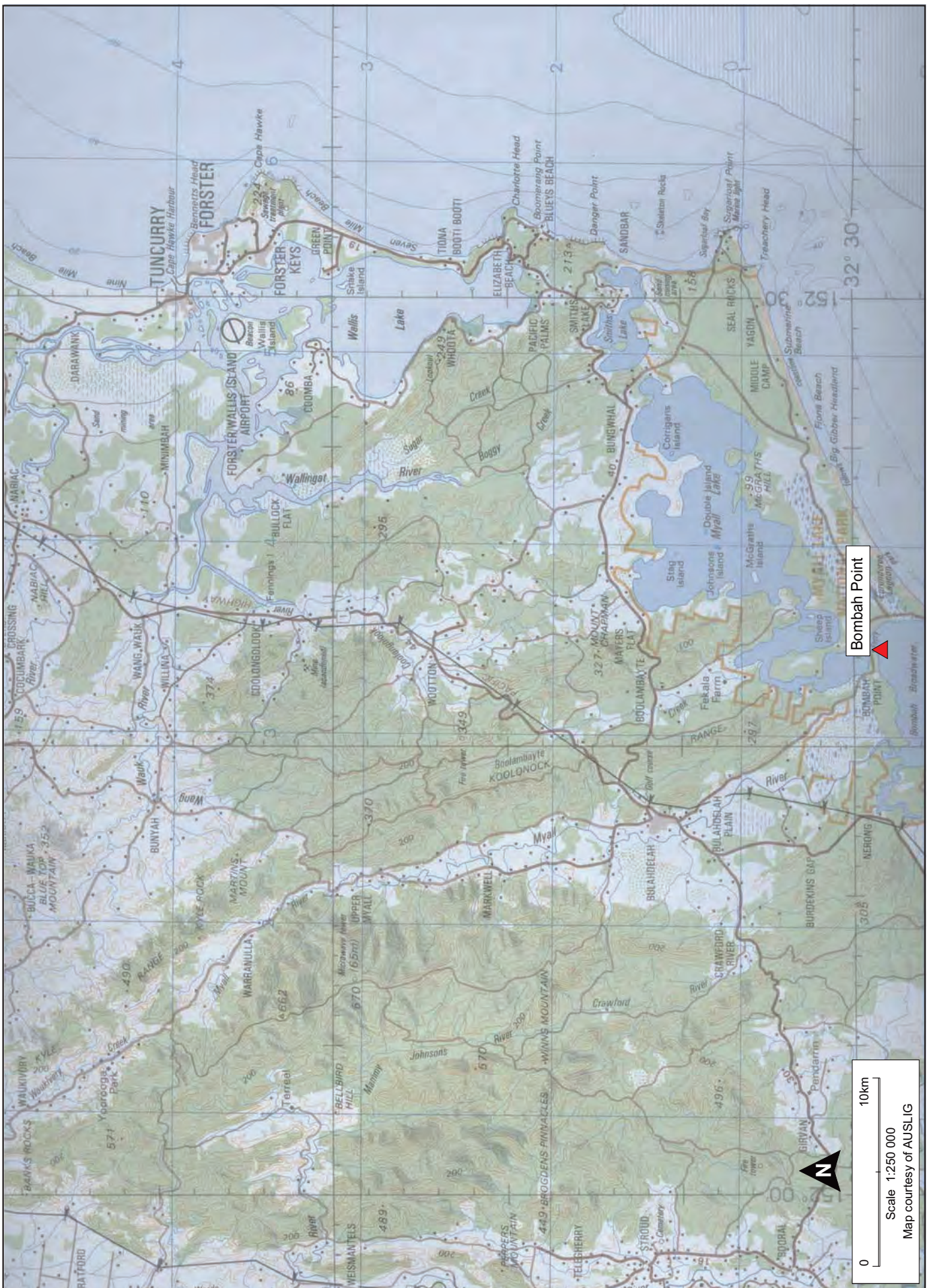
Aldavilla Downstream - Rain Gauge







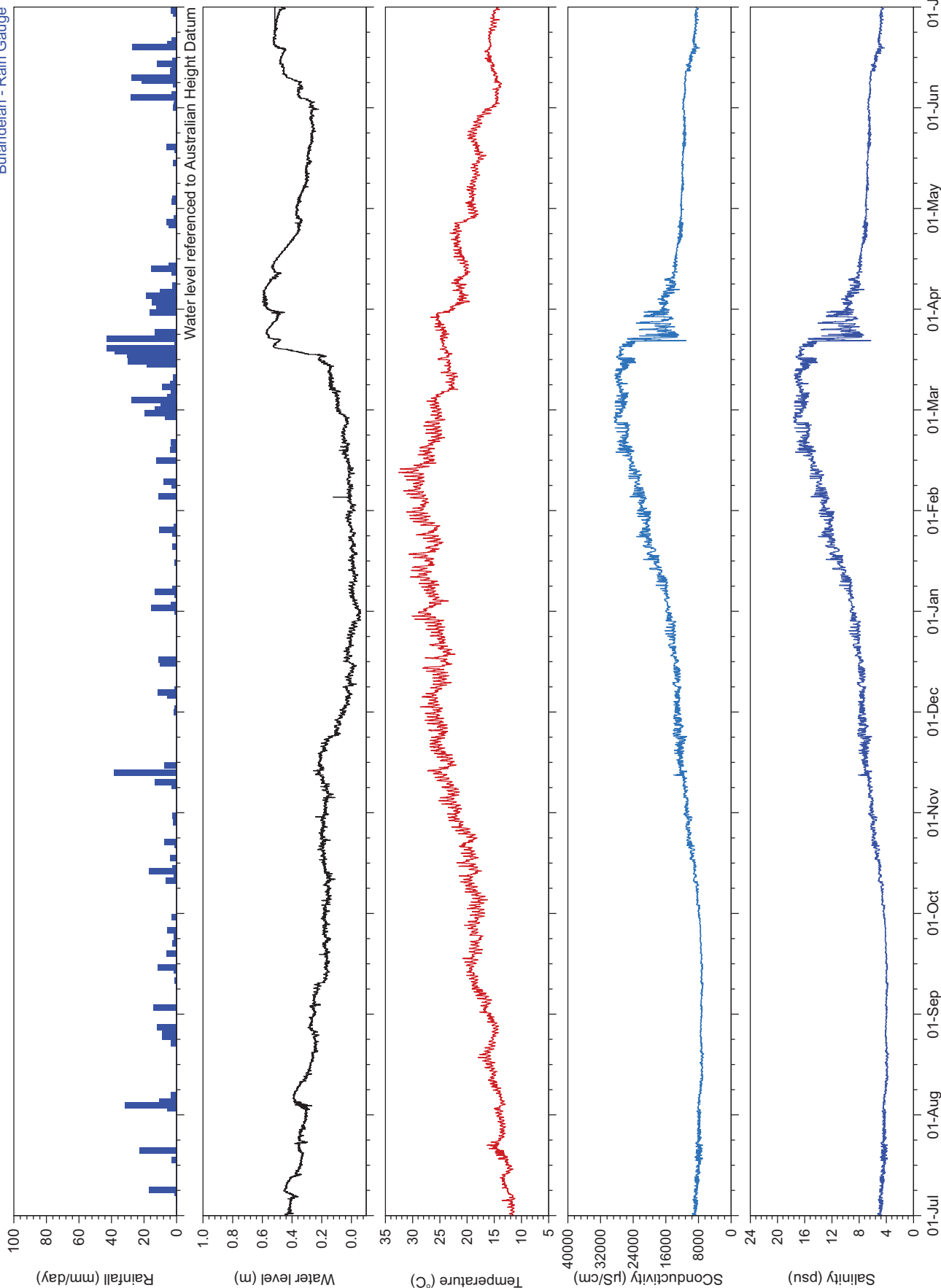




Bombah Point

10km  
Scale 1:250 000  
Map courtesy of AUSLIG

Bulahdelah - Rain Gauge



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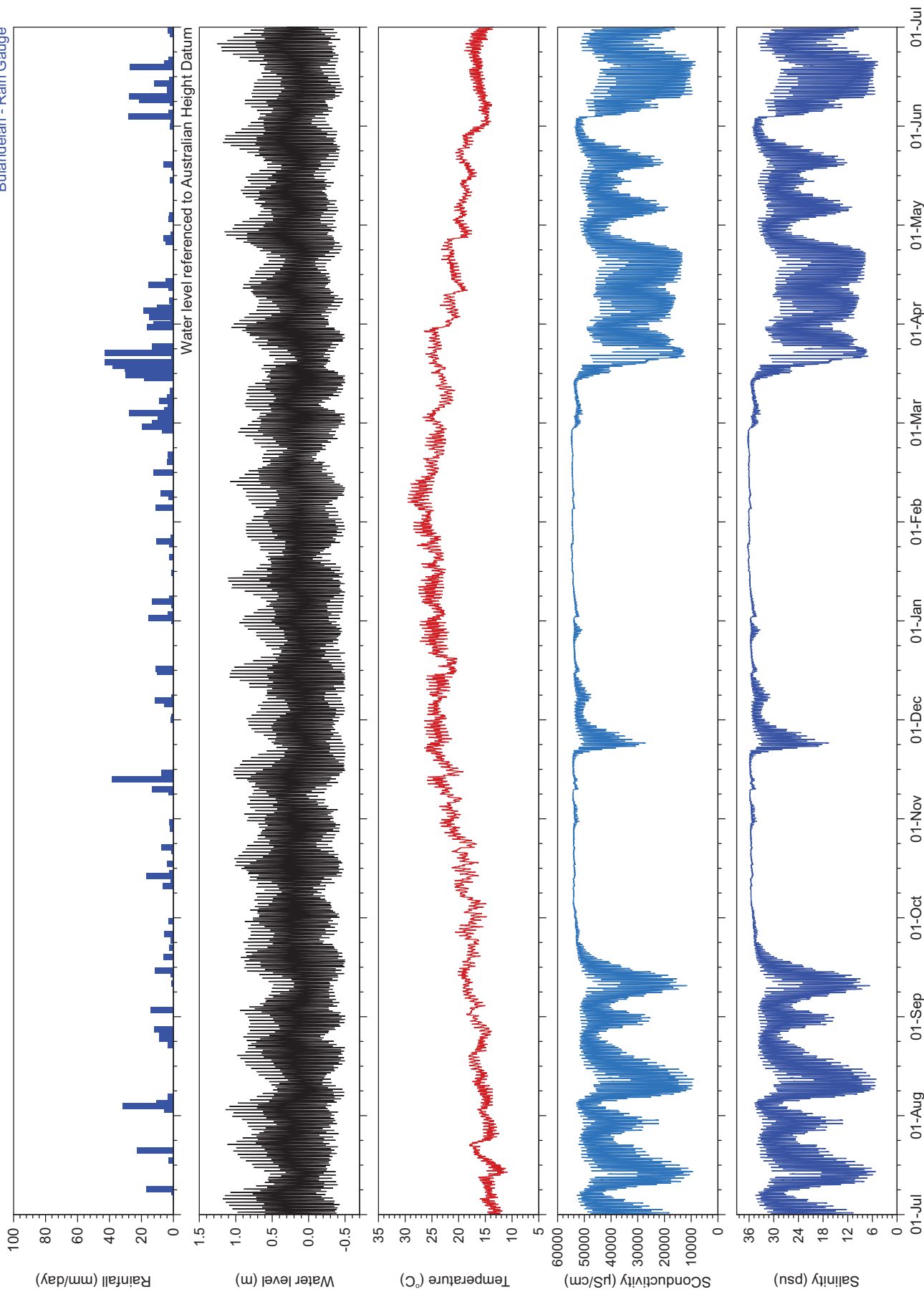
WATER LEVEL AND WATER QUALITY DATA  
2016–2017  
BOMBAH POINT

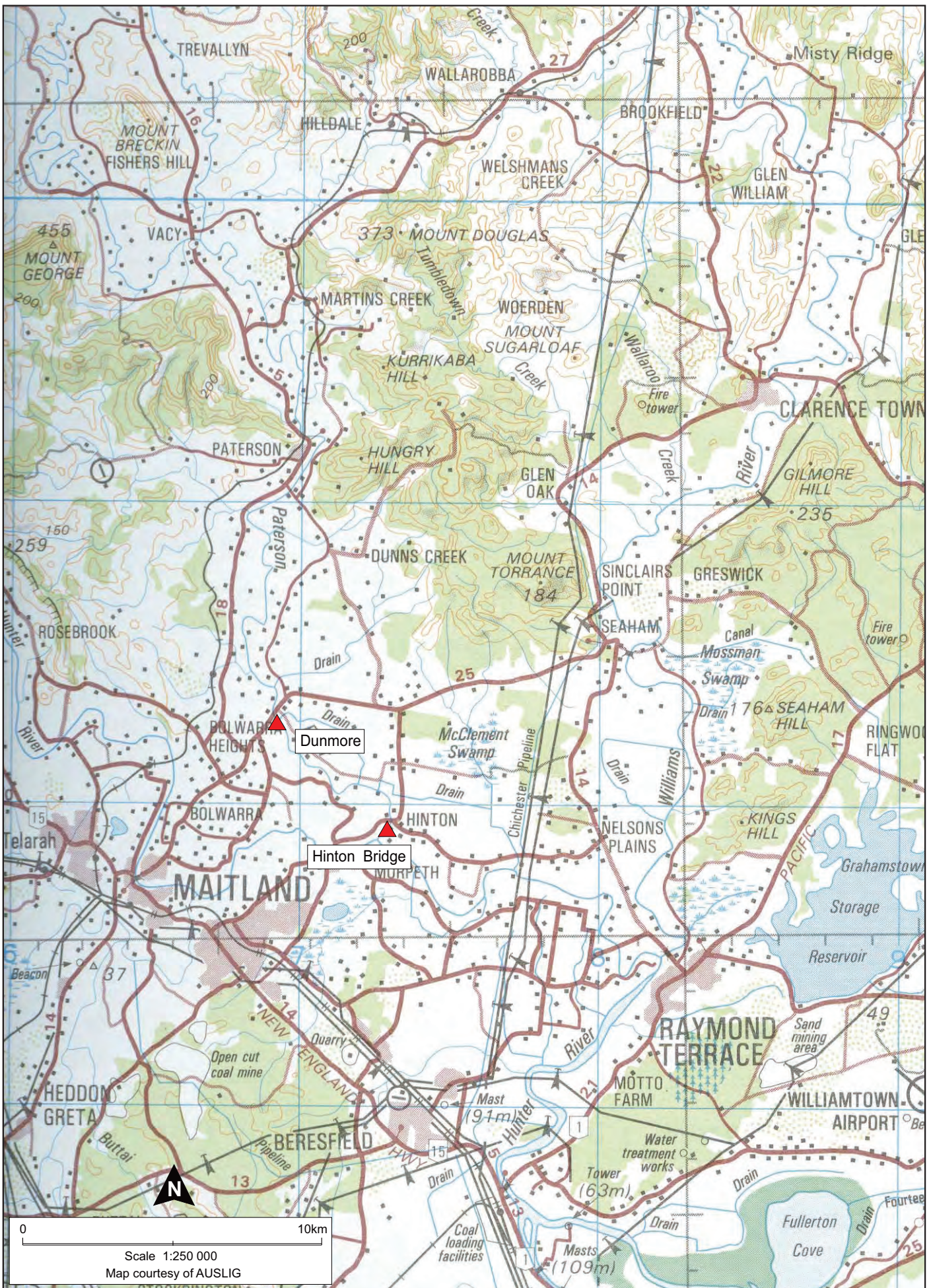
MHL  
Report 2577

Figure  
13

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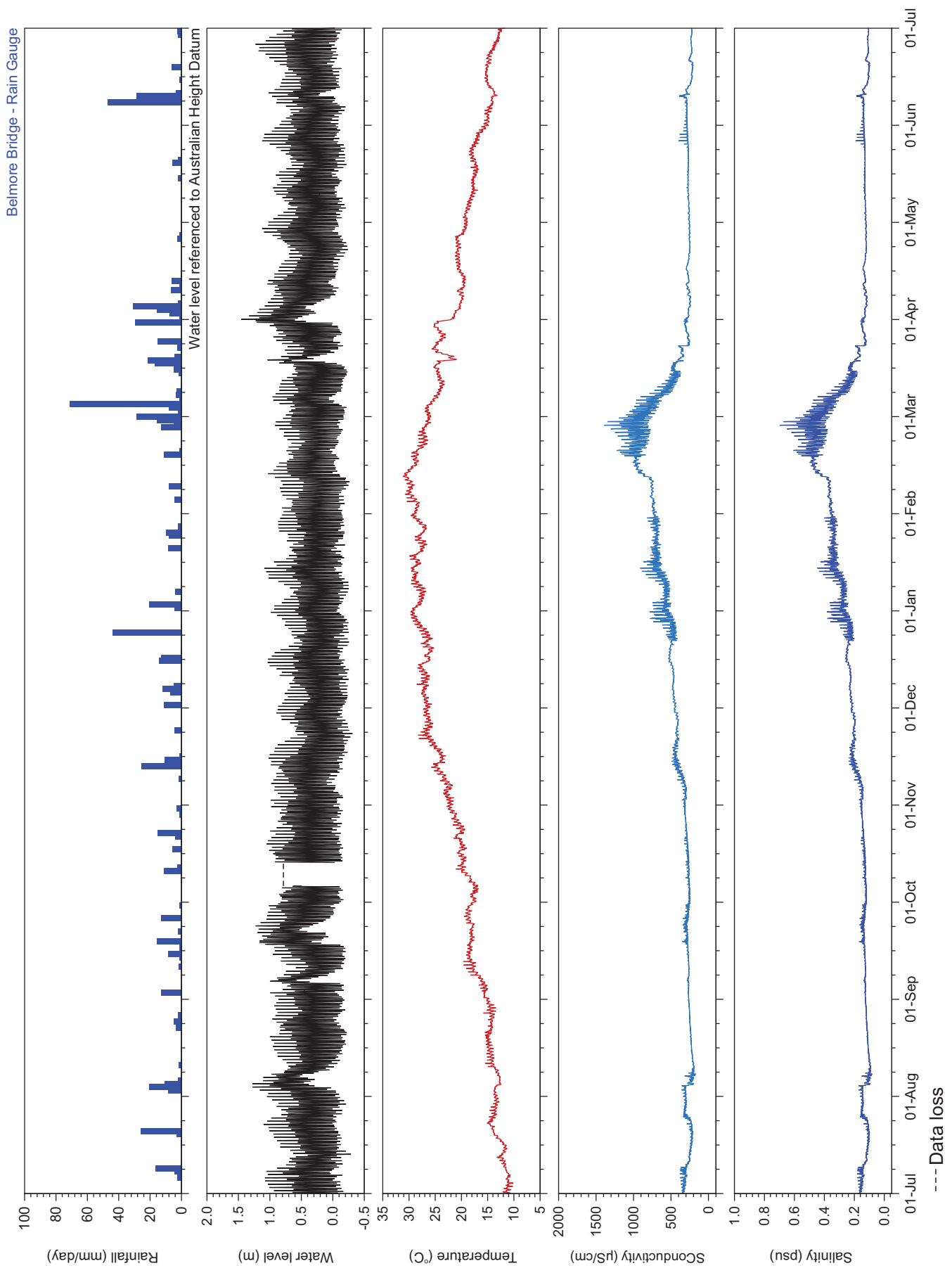
**Manly  
Hydraulics  
Laboratory**

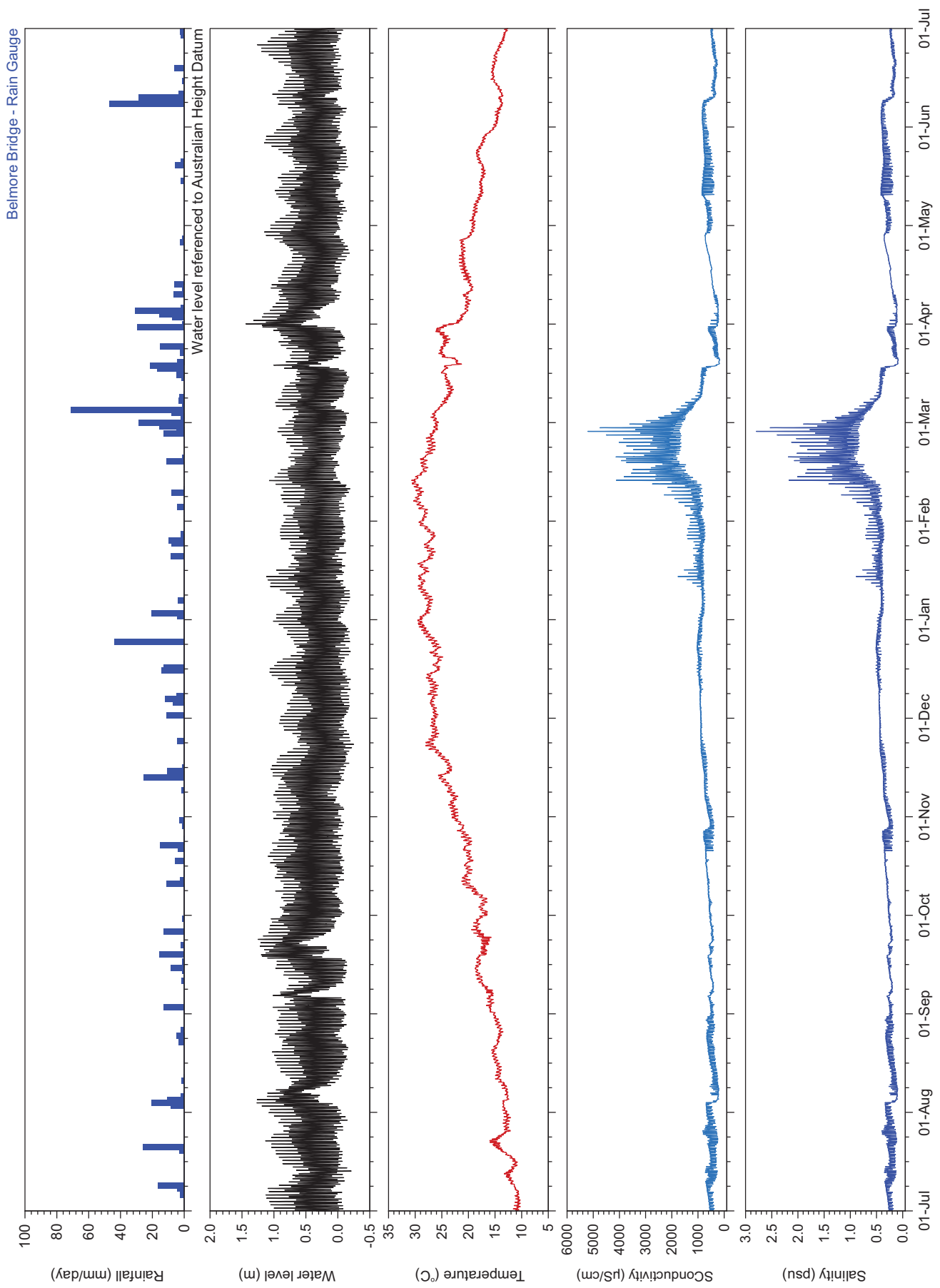
**STATION LOCATIONS  
PATERSON RIVER REGION**

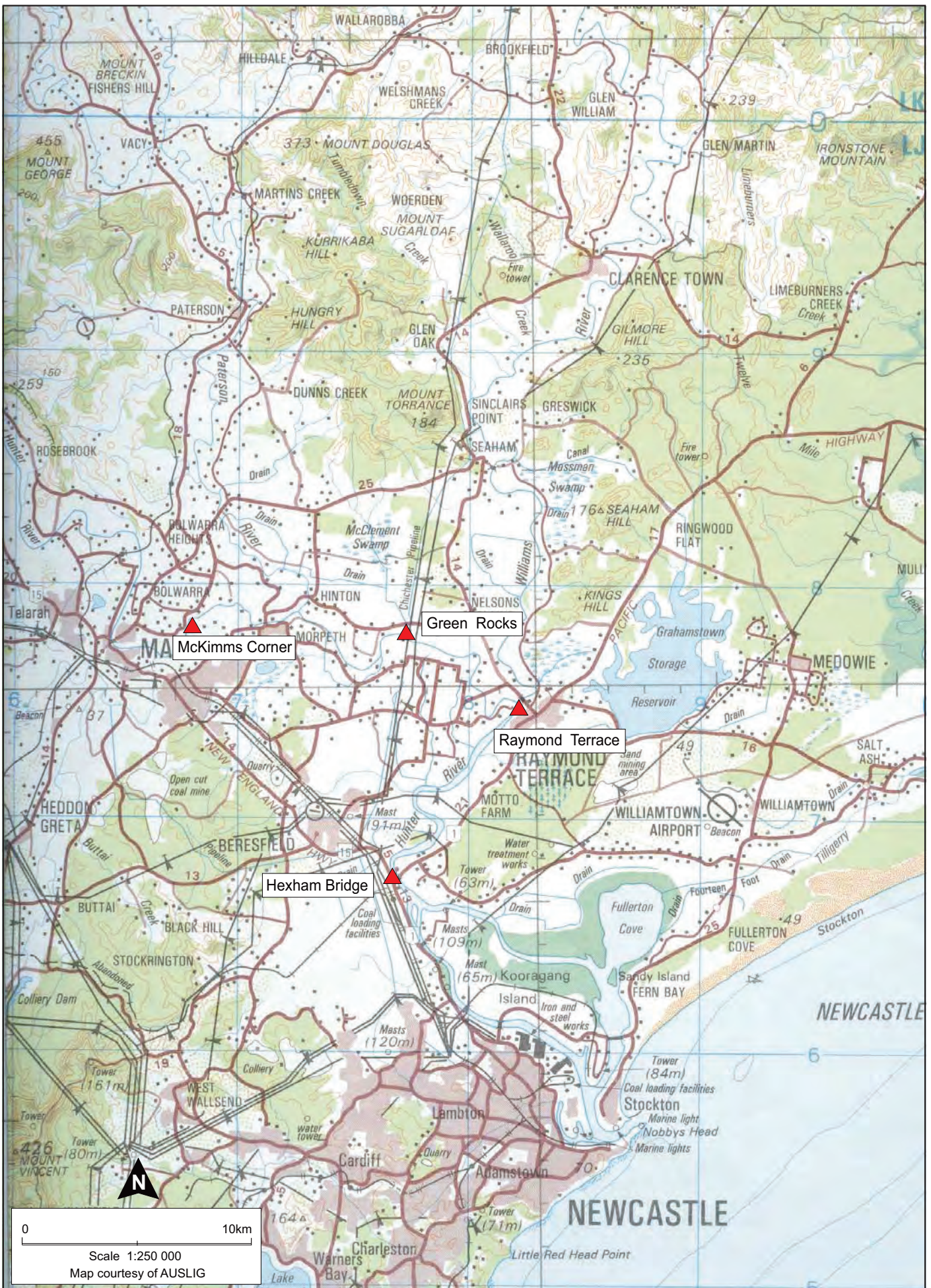
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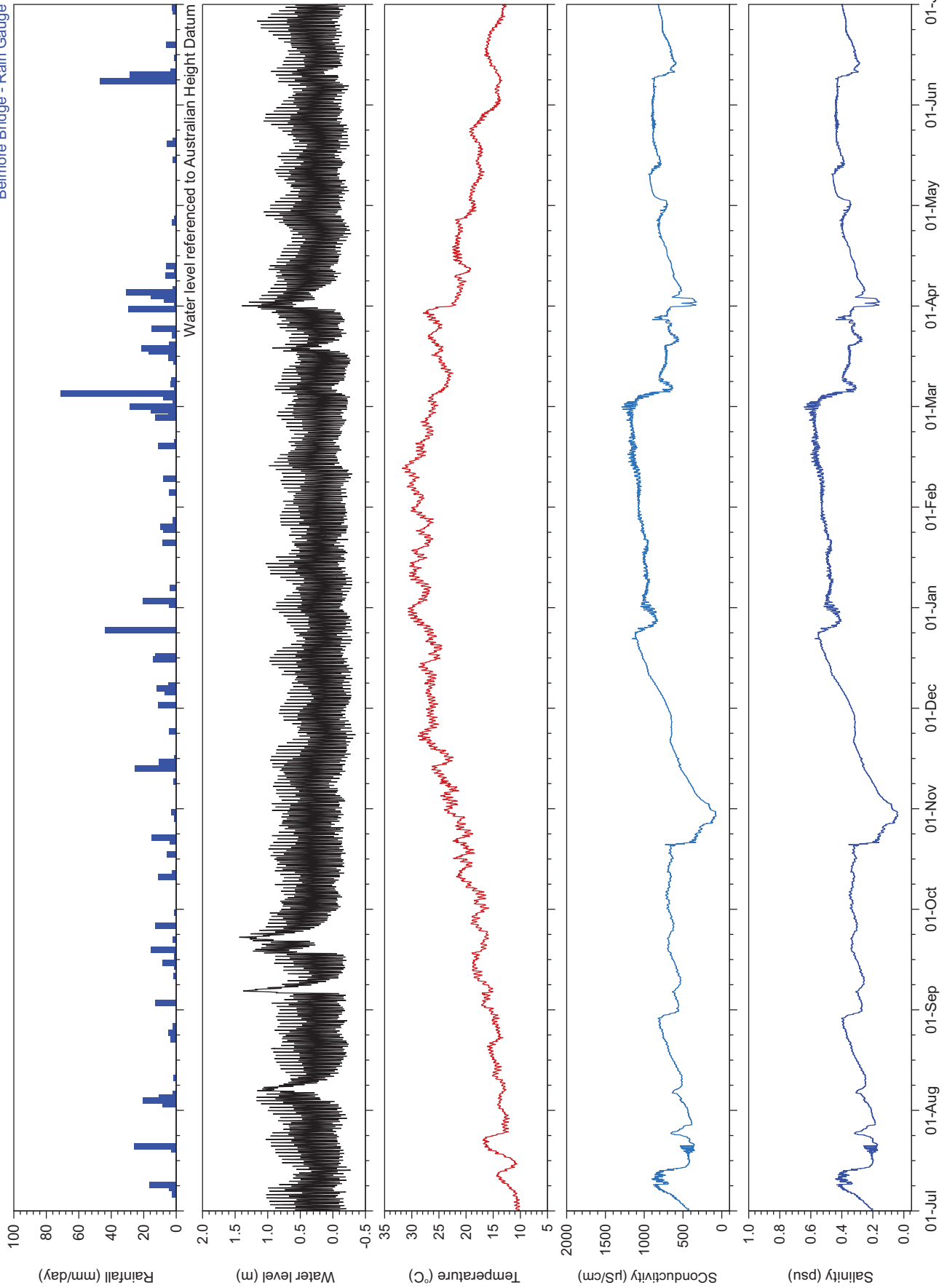
**STATION LOCATIONS  
HUNTER RIVER REGION**

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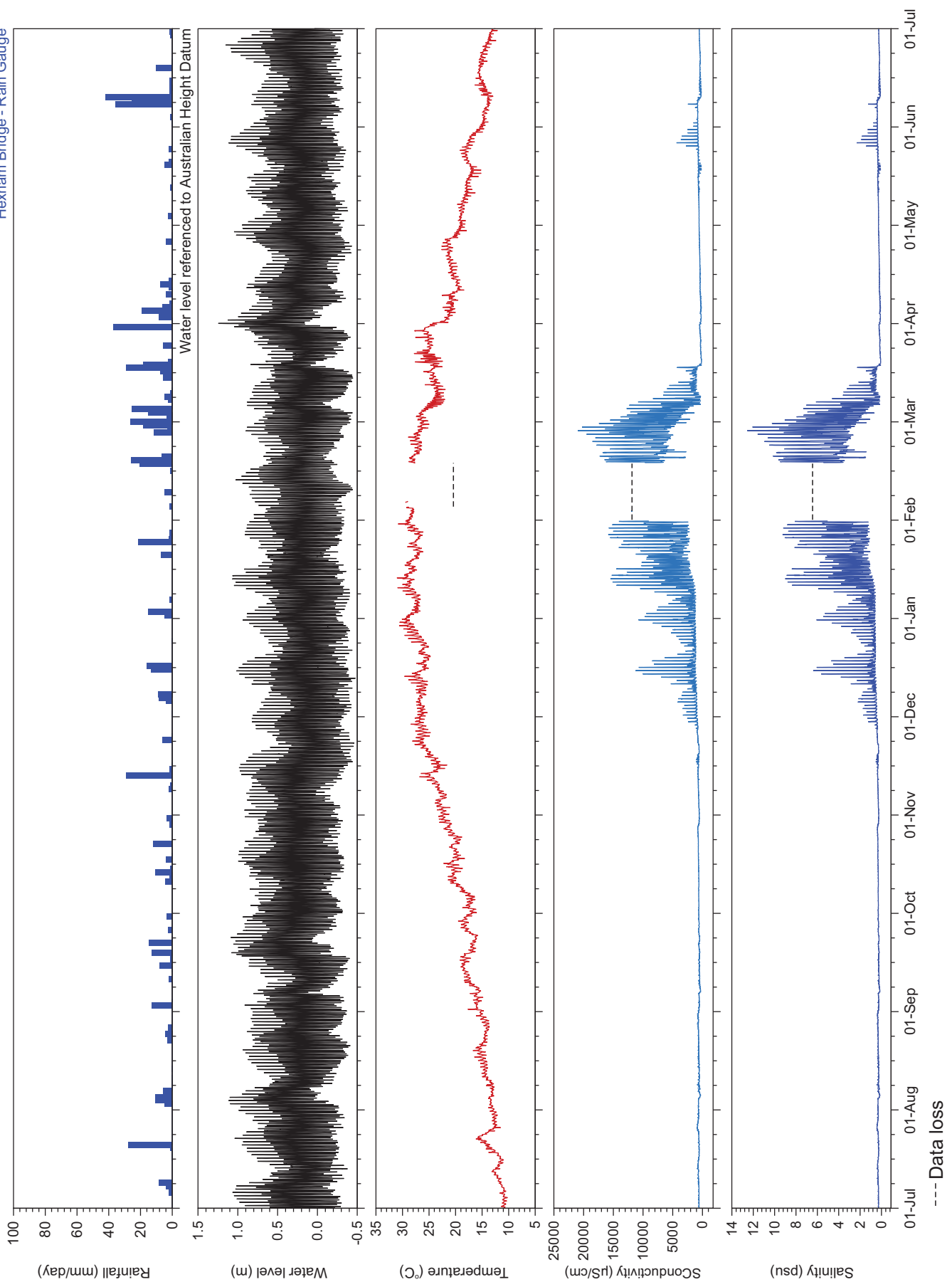
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19

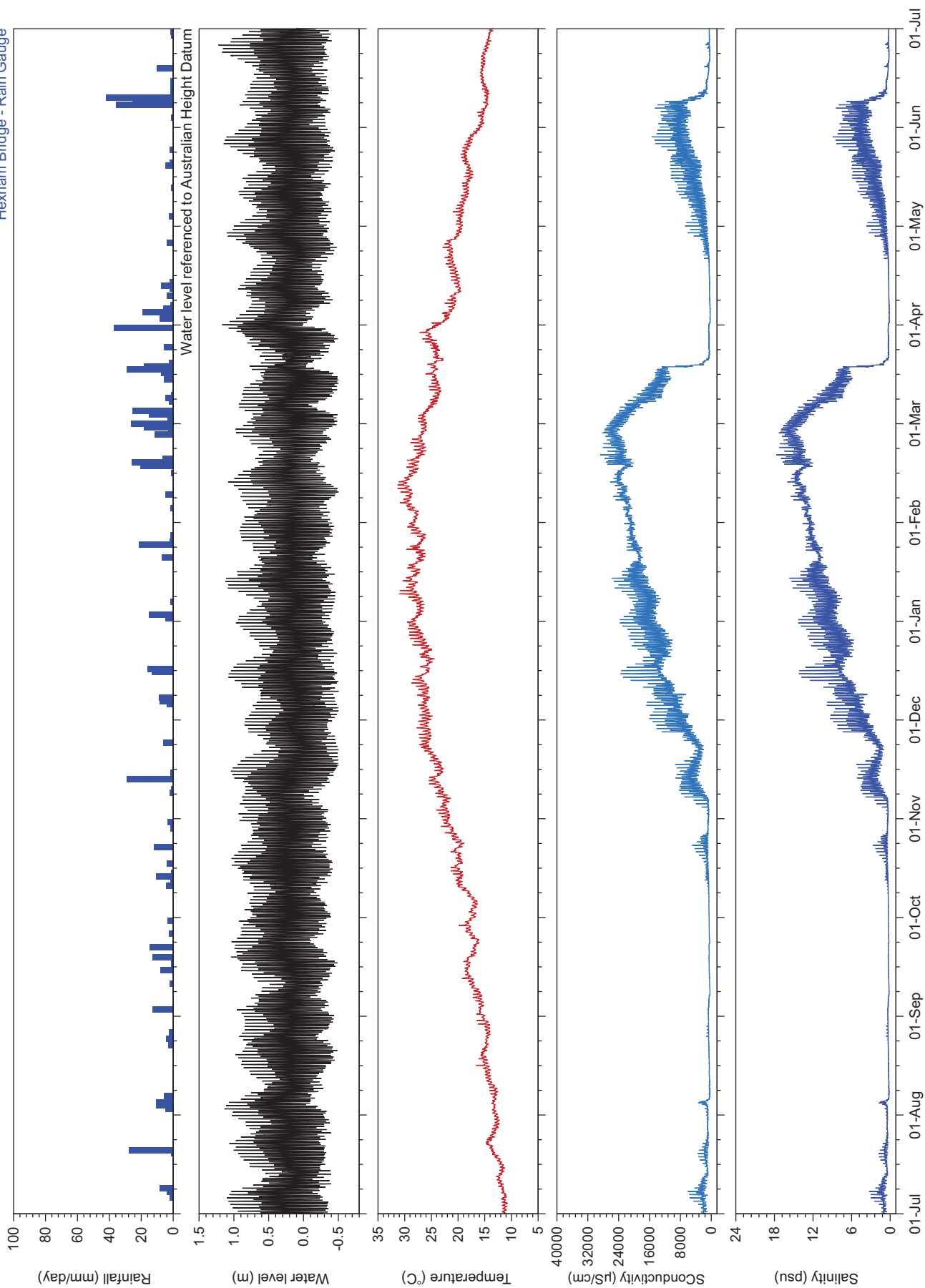
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Belmore Bridge - Rain Gauge

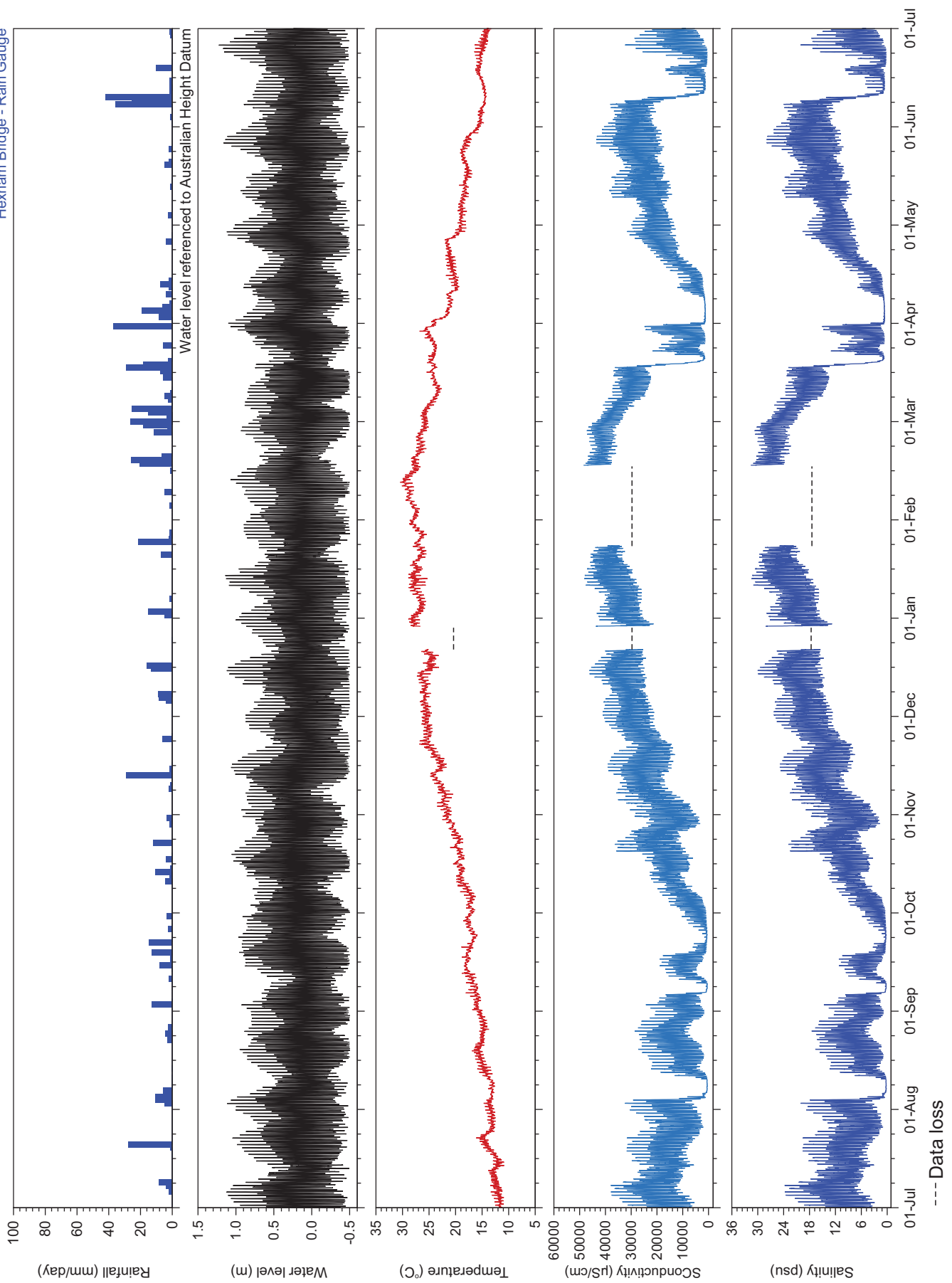


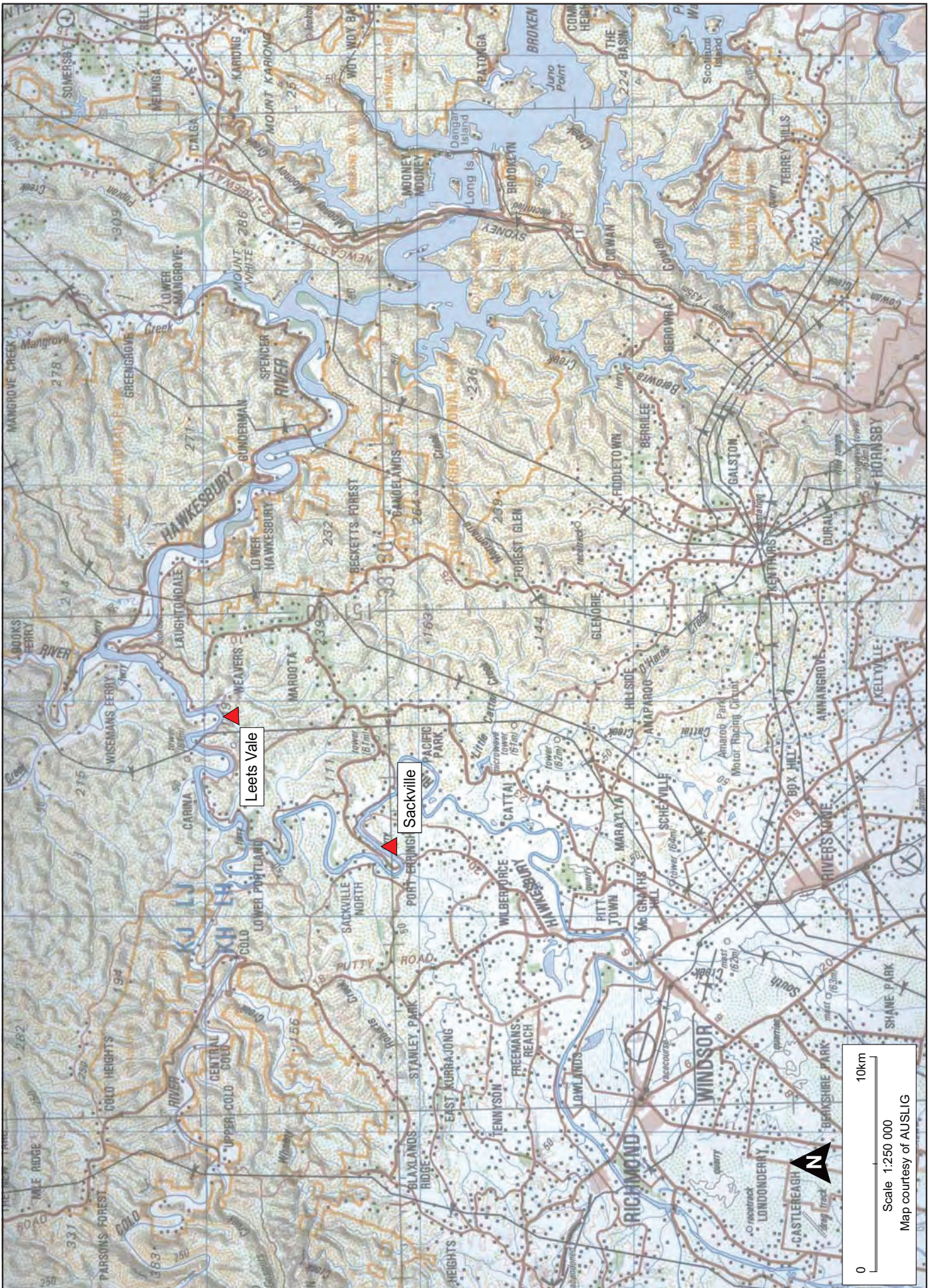
Hexham Bridge - Rain Gauge



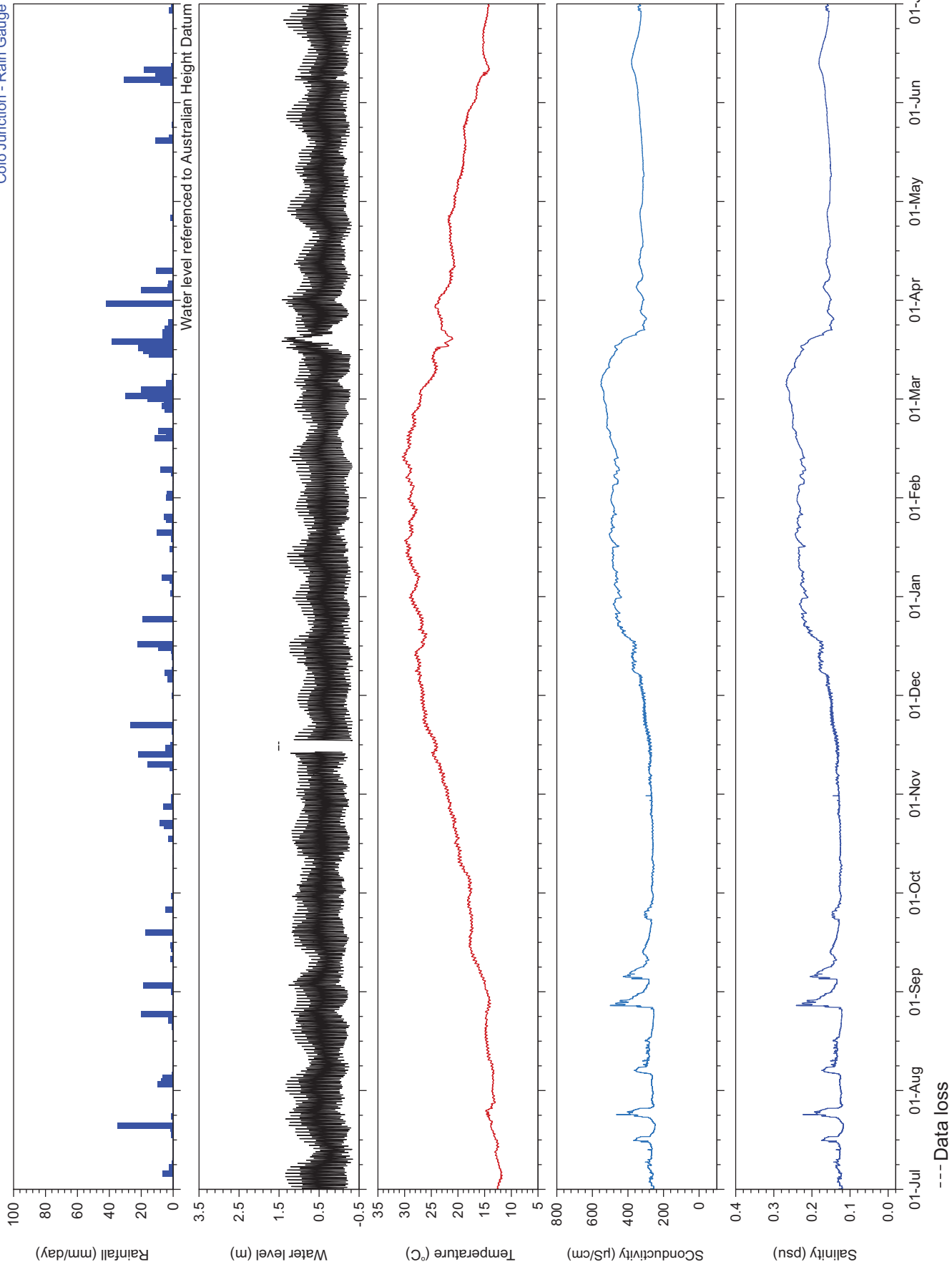


Hexham Bridge - Rain Gauge

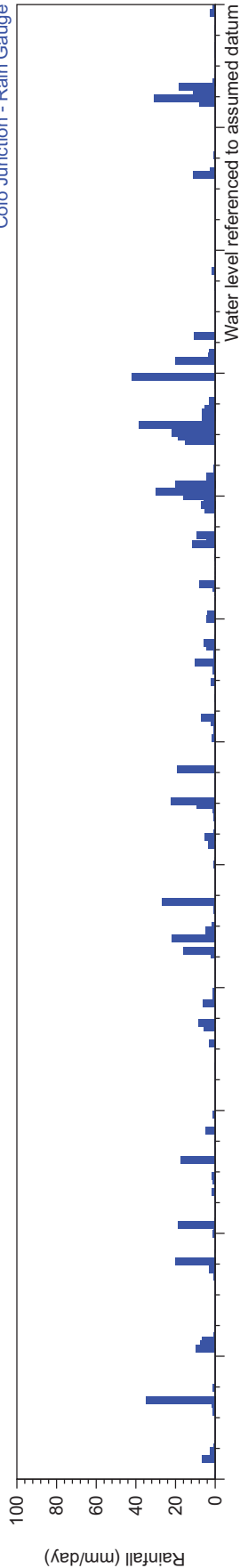




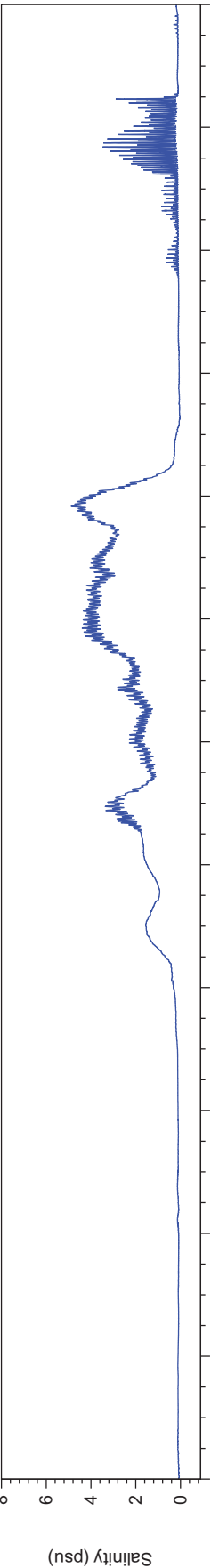
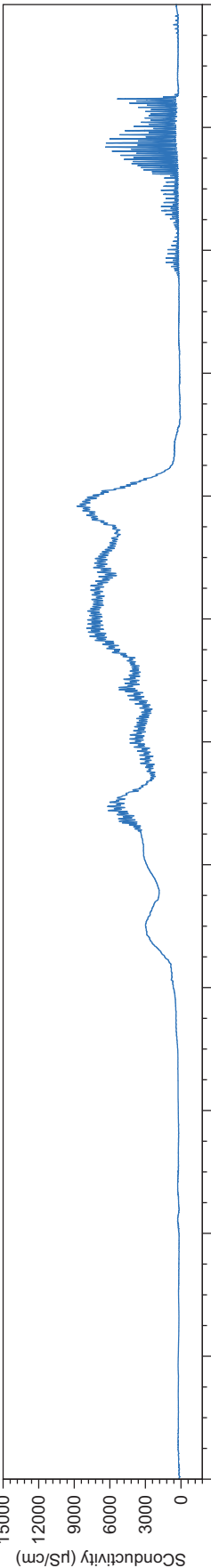
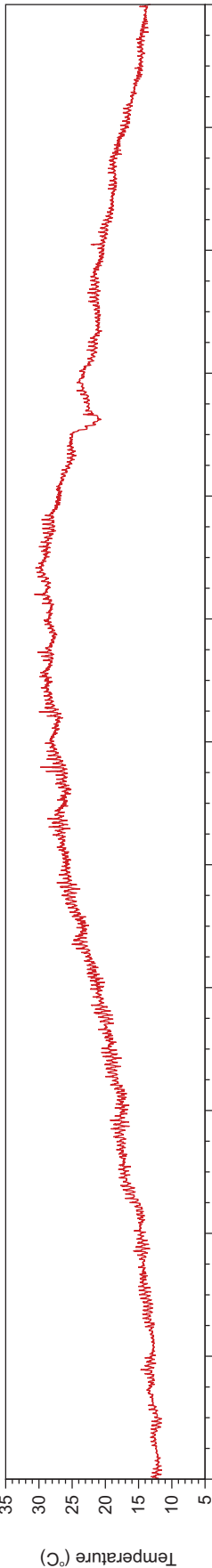
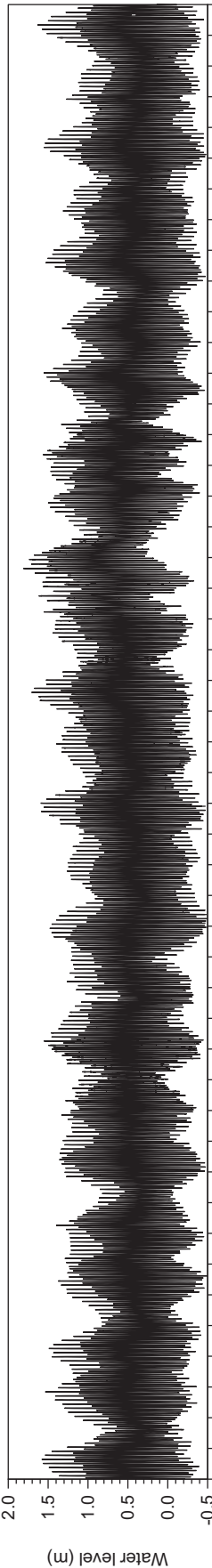
Colo Junction - Rain Gauge

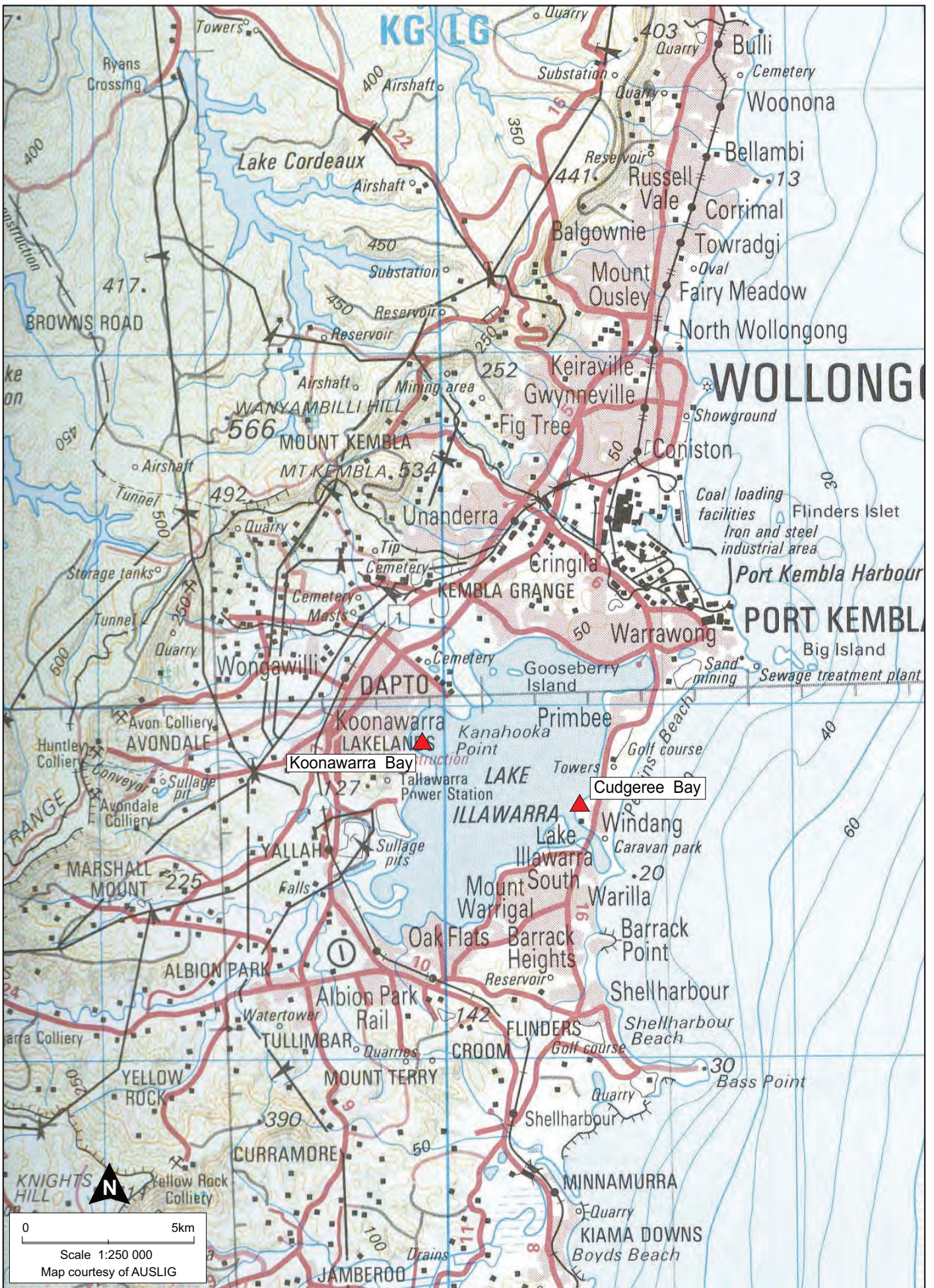


Colo Junction - Rain Gauge



Water level referenced to assumed datum





0 5km  
 Scale 1:250 000  
 Map courtesy of AUSLIG



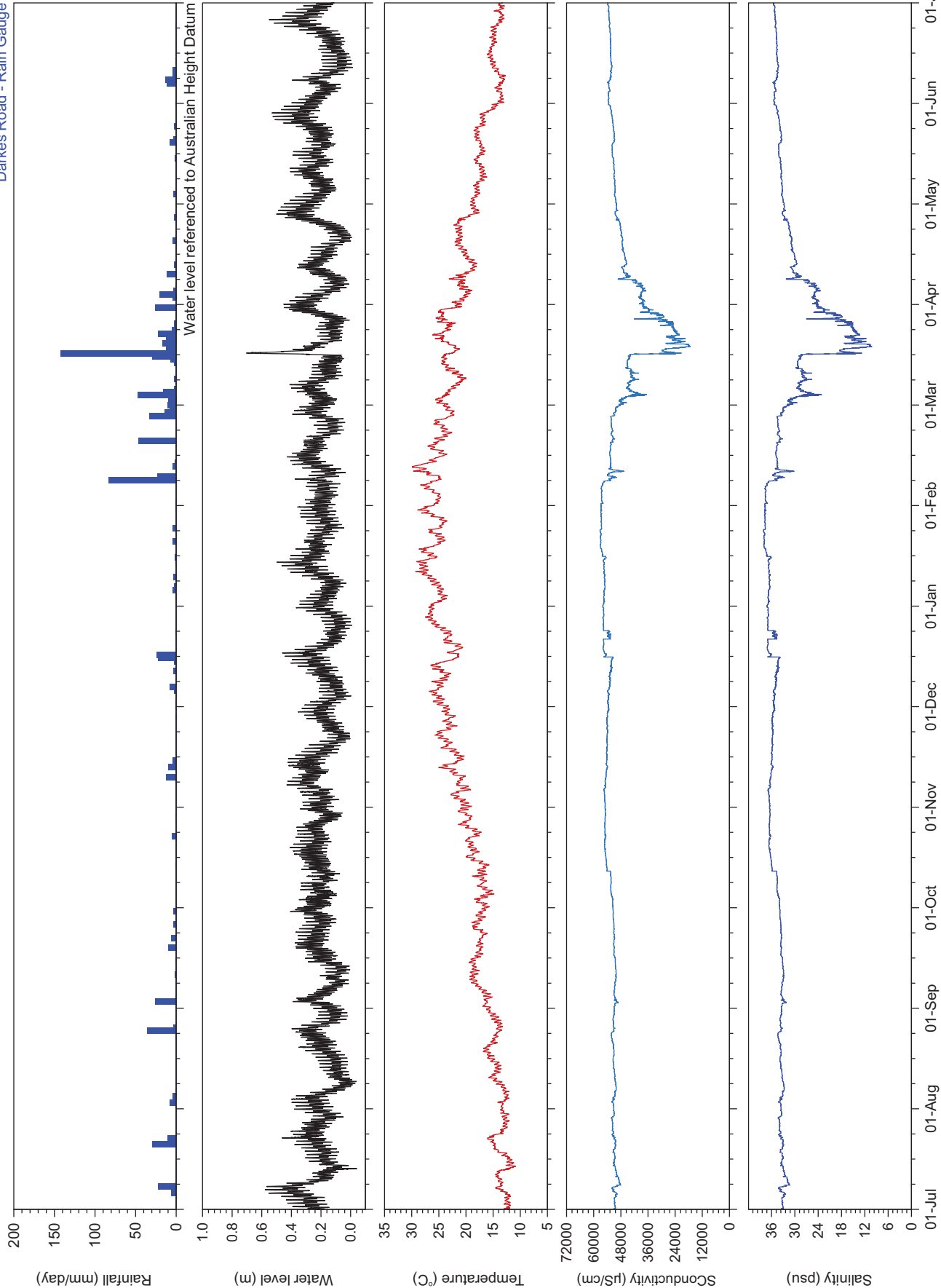
**Manly  
 Hydraulics  
 Laboratory**

**STATION LOCATIONS  
 LAKE ILLAWARRA REGION**

MHL  
 Report 2577  
 Figure  
 27

DRAWING 2577-27.cdr

Darkes Road - Rain Gauge



Manly  
Hydraulics  
Laboratory

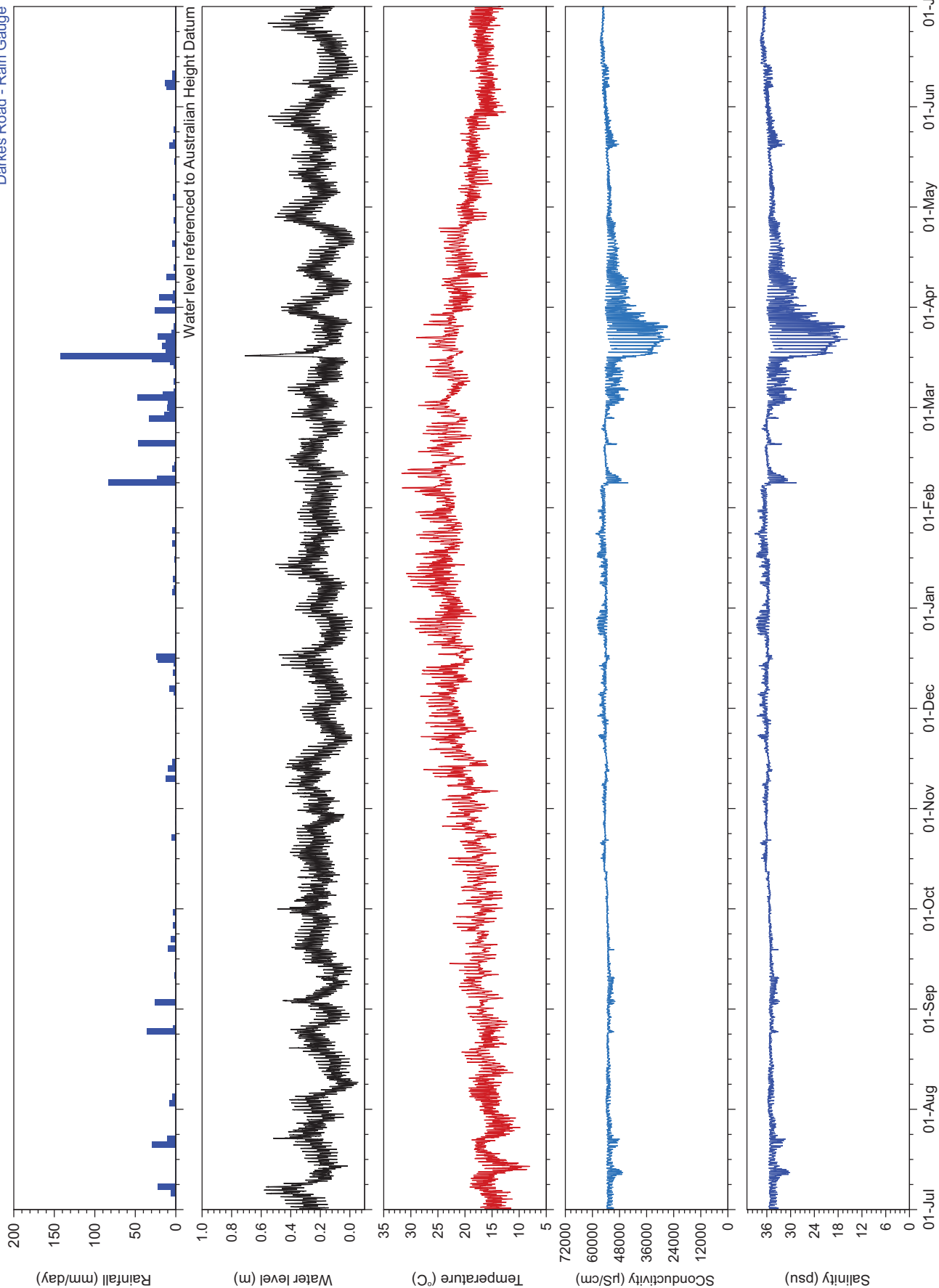
WATER LEVEL AND WATER QUALITY DATA  
2016–2017  
KOONAWARRA BAY

MHL  
Report 2577

Figure  
28

DRAWING 2577-28.cdr

Darkes Road - Rain Gauge



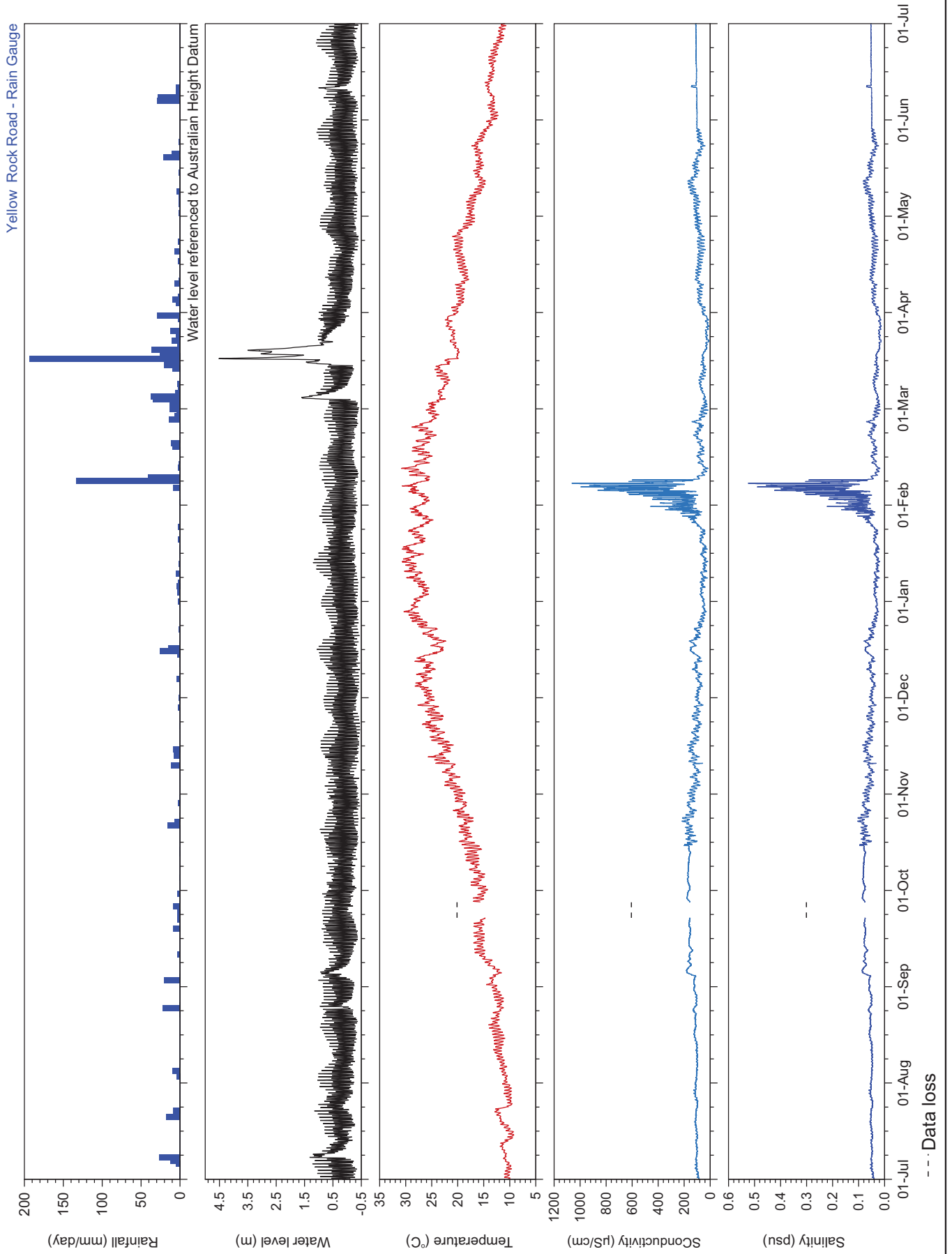


STATION LOCATIONS  
SHOALHAVEN RIVER REGION

MHL  
Report 2577  
Figure  
30



Manly  
Hydraulics  
Laboratory



## Appendix A Data on-line

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Please note that water quality data might not be continuous for the period specified.

**Data on-line**

<b>Station long name</b>	<b>Station name</b>	<b>Station number</b>	<b>Start date</b>	<b>End date</b>	<b>Additional MHL report number reference</b>
Brunswick River at Mullumbimby	Mullumbimby	202402	08-Apr-98	18-Mar-99	1000
Richmond River at Coraki	Coraki	203403	20-Sep-94	ongoing	749
Richmond River at Oakland Road	Oakland Road	203470	06-Mar-12	ongoing	
Tuombil Canal at Tuombil Highway Bridge	Tuombil Highway Bridge	203411	21-Aug-97	29-Aug-98	961
Rocky Mouth Creek at Rocky Mouth Creek	Rocky Mouth Creek	203432	06-Sep-94	21-Aug-96	794
Tuombil Canal at Tuombil Floodgate	Tuombil Floodgate	203434	09-Sep-94	29-Sep-95	961
Richmond River at Bungawalbin	Bungawalbin	203450	09-Sep-94	28-Aug-13	
Lennox Head at Lake Ainsworth	Lake Ainsworth	203455	15-Nov-95	30-Nov-96	851
Clarence River at Grafton	Grafton	204400	02-Mar-99	ongoing	1065
Clarence River at Rogans Bridge	Rogans Bridge	204413	09-Mar-99	ongoing	1065
Clarence River at Mylneford	Mylneford	204460	21-May-10	29-Jan-13	
Nambucca River at Macksville	Macksville	205416	17-Feb-99	22-Feb-00	1050
Coffs Creek at Coffs Creek Highway Bridge	Coffs Creek Highway Bridge	205439	14-Dec-92	23-Nov-96	
Bonville Creek at Bonville	Bonville	205480	08-Aug-97	15-Feb-99	985
Borirgala Creek at Borirgala Creek	Borirgala Creek	206450	06-Apr-01	26-Sep-01	1151
Macleay River at South West Rocks	South West Rocks	206456	01-Mar-96	01-Mar-99	986
Macleay River at Euroka Upstream	Euroka Upstream	206458	07-Dec-09	17-Jun-11	
Macleay River at Kempsey	Kempsey	206402	09-Feb-10	ongoing	
Maria River at Green Valley	Green Valley	207406	30-Sep-94	01-Nov-95	760
Lake Cathie at Lake Cathie	Lake Cathie	207441	18-Aug-93	07-Sep-94	
Manning River at Wingham	Wingham	208400	08-Dec-09	ongoing	
Manning River at Taree	Taree	208410	16-Feb-10	30-Oct-13	
Manning River at Taree West	Taree West	208420	30-Apr-10	ongoing	
Myall River at Bombah Point	Bombah Point	209475	09-Jul-96	ongoing	906
Myall River at Tea Gardens	Tea Gardens	209480	20-Oct-09	ongoing	
Paterson River at Dunmore	Dunmore	210409	15-Oct-09	ongoing	
Paterson River at Hinton Bridge	Hinton Bridge	210410	03-Dec-93	ongoing	750
Wallis Creek at Wallis Creek Downstream	Wallis Creek Downstream	210428	21-Sep-95	01-Oct-98	965
Hunter River at Green Rocks	Green Rocks	210432	03-Dec-93	ongoing	750
Hunter River at Hexham Bridge	Hexham Bridge	210448	17-Dec-93	ongoing	750

Station long name	Station name	Station number	Start date	End date	Additional MHL report number reference
Hunter River at Fullerton Cove Salinity Buoy	Fullerton Cove Salinity Buoy	210149	21-Jun-13	01-Jul-16	
Williams River at Raymond Terrace	Raymond Terrace	210452	15-Oct-09	ongoing	
Hunter River at McKimms Corner	McKimms Corner	210455	08-Oct-09	ongoing	
Hunter River at Belmore Bridge	Belmore Bridge	210458	01-Dec-93	ongoing	750
Nepean River at Castlereagh	Castlereagh	212404	01-Jul-94	01-Jul-98	
Hawkesbury River at Sackville	Sackville	212406	01-Jul-94	ongoing	
Hawkesbury River at Colo Junction	Colo Junction	212407	07-Nov-09	05-Jul-13	
Hawkesbury River at Ebenezer	Ebenezer	212427	01-Jul-94	01-Jul-98	
Hawkesbury at Wisemans Ferry Wharf	Wisemans Ferry Wharf	212460	10-Jun-10	19-Jul-13	
Hawkesbury at Leets Vale	Leets Vale	212461	22-Jun-10	ongoing	
Lake Illawarra at Cudgeree Bay	Cudgeree Bay	214416	09-Feb-93	ongoing	994
Lake Illawarra at Koonawarra Bay	Koonawarra Bay	214440	15-Jun-93	ongoing	994
Shoalhaven at Grady's Caravan Park	Grady's Caravan Park	215430	06-Oct-10	ongoing	
Wollumboola Lake at Wollumboola	Wollumboola	215454	01-Feb-99	06-Jan-11	1145
Crookhaven River at Crookhaven Heads	Crookhaven Heads	215471	06-Mar-95	07-Apr-95	
Currarong Creek at Currarong Creek	Currarong Creek	216405	04-Mar-96	04-Mar-97	858
Swan Lake at Swan Lake	Swan Lake	216425	02-Feb-99	02-Feb-00	
Clyde River at Nelligen	Nelligen	216453	17-Sep-96	17-Sep-97	889
Tomaga at George Bass Drive	George Bass Drive	216455	28-Aug-96	28-Aug-97	890
Tuross River at Coila Lake	Coila Lake	218405	08-Mar-96	21-Nov-96	848
Wagonga River at Barlows Bay	Barlows Bay	218415	30-Aug-96	30-Aug-97	888
Wallaga Lake at Regatta Point	Regatta Point	219405	06-Mar-95	07-Apr-95	
Bega River at Bega	Bega	219410	24-Feb-10	21-May-13	
Back Lagoon at Back Lagoon	Back Lagoon	219415	25-Sep-97	25-Sep-98	963
Lake Curalo at Lake Curalo	Lake Curalo	220420	09-Mar-96	09-Mar-98	920
Wonboyn River at Agnew Wharf	Agnew Wharf	220425	20-Aug-97	20-Aug-98	964

Station long name	Station name	Station number	Start date	End date	Additional MHL report number reference
Bartletts Creek at Bartletts Creek	Bartletts Creek	Station number not assigned	06-Jun-95	19-Mar-96	780
Leddays Creek at Leddays Creek	Leddays Creek	Station number not assigned	02-Jun-95	31-Jul-96	780
Officer Drain at Officer Drain (near Ritchies Creek)	Officer Drain	Station number not assigned	02-Jun-95	21-Mar-96	780
McLeods Drain at McLeods Drain (near Stotts Creek)	McLeods Drain	Station number not assigned	21-Mar-96	31-Jul-96	780
McLeods Drain Offshoot at McLeods Drain Offshoot	McLeods Drain Offshoot	Station number not assigned	21-Mar-96	31-Sep-96	780
Cudgen Lake at Cudgen Lake	Cudgen Lake	Station number not assigned	14-Dec-92	05-Nov-93	674
Cudgen Creek at Cudgen Lake West	Cudgen Lake West	Station number not assigned	08-Oct-93	05-Nov-93	674
Cudgen Creek at Cudgen Creek	Cudgen Creek	Station number not assigned	15-Dec-92	05-Nov-93	674
Simpsons Creek at Belongil	Belongil	Station number not assigned	06-Dec-94	17-Dec-96	
Richmond River at Shaws Bay	Shaws Bay	Station number not assigned	11-Mar-99	12-Apr-00	755, 849
Marshalls Creek at Capricornia Canal	Capricornia Canal	Station number not assigned	24-Mar-97	31-Mar-11	1051
Marshalls Creek at New Brighton	New Brighton	Station number not assigned	17-Mar-97	24-Apr-98	1000
Brunswick River at Pacific Highway Bridge	Pacific Highway Bridge	Station number not assigned	18-Mar-97	18-Mar-99	1000
Simpsons Creek at Simpsons Creek	Simpsons Creek	Station number not assigned	03-Apr-98	18-Mar-99	1000
Tuckean Broadwater at Tuckean	Tuckean	Station number not assigned	30-Oct-95	29-Oct-96	850
Richmond River at Empire Vale Creek	Empire Vale Creek	Station number not assigned	08-May-98	12-Oct-99	1032
Roberts Creek at Roberts Creek	Roberts Creek	Station number not assigned	20-May-94	24-May-96	784

Station long name	Station name	Station number	Start date	End date	Additional MHL report number reference
Clarence River at Tarrent Bridge	Tarrent Bridge	Station number not assigned	04-Mar-99	11-Apr-00	1065
Andersons Inlet at Middle Island MM1	Middle Island MM1	Station number not assigned	06-Apr-01	15-Dec-06	986
Andersons Inlet at Middle Island MM2	Middle Island MM2	Station number not assigned	19-Mar-96	03-Feb-99	986
Andersons Inlet at Double Island	Double Island	Station number not assigned	19-Mar-96	03-Feb-99	986
Macleay River at Andersons Inlet	Andersons Inlet	Station number not assigned	06-Apr-01	27-Sep-01	1151
Maria River at Connection Creek	Connection Creek	Station number not assigned	22-Sep-94	26-Oct-95	760
Hastings River at Lake Innes	Lake Innes	Station number not assigned	19-Aug-93	07-Sep-94	760
Scotts Creek at Scotts Creek	Scotts Creek	Station number not assigned	20-Oct-98	22-Oct-99	1029
Wallis Lake at Peach Tree Point	Peach Tree Point	Station number not assigned	30-Jul-97	09-Mar-99	987
Wallis Lake at Wallamba	Wallamba	Station number not assigned	30-Jul-97	25-Aug-98	987
Wallis Lake at Booti Island	Booti Island	Station number not assigned	31-Jul-97	25-Aug-98	987
Wallis Lake at Darawakh Creek	Darawakh Creek	Station number not assigned	26-Aug-98	08-Mar-99	987
Smiths Lake at Smiths Lake	Smiths Lake	Station number not assigned	04-May-95	16-May-96	771
Myall Lake at Mayers Point	Mayers Point	Station number not assigned	10-Jul-96	04-Mar-98	906
Myall River at Monkey Jacket	Monkey Jacket	Station number not assigned	09-Jul-96	04-Mar-98	906
Lake Wollumboola at Lake Wollumboola	Lake Wollumboola Floating	Station number not assigned	07-Dec-00	19-Jun-01	1145
Tuross Lake at Trunketabella	Trunketabella	Station number not assigned	04-May-94	11-Mar-98	921

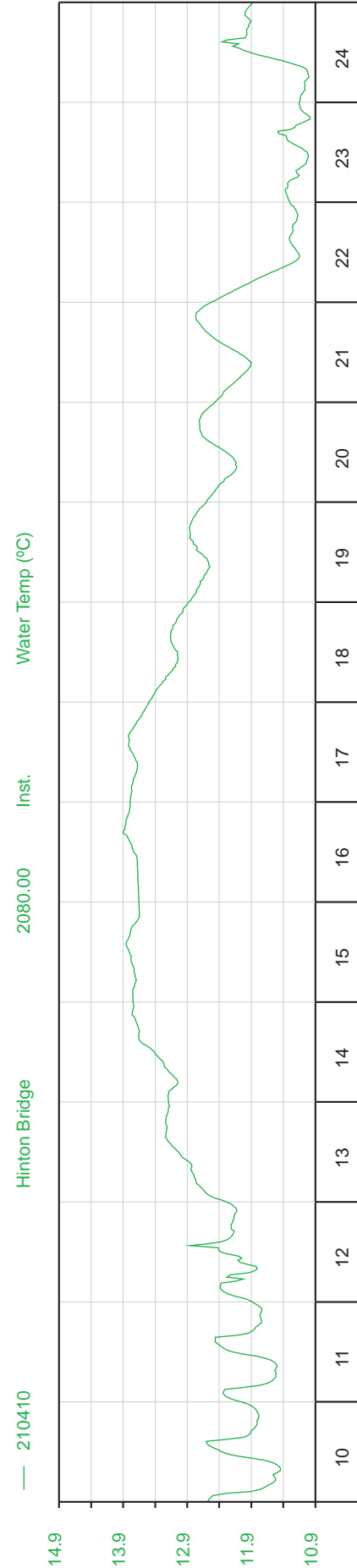
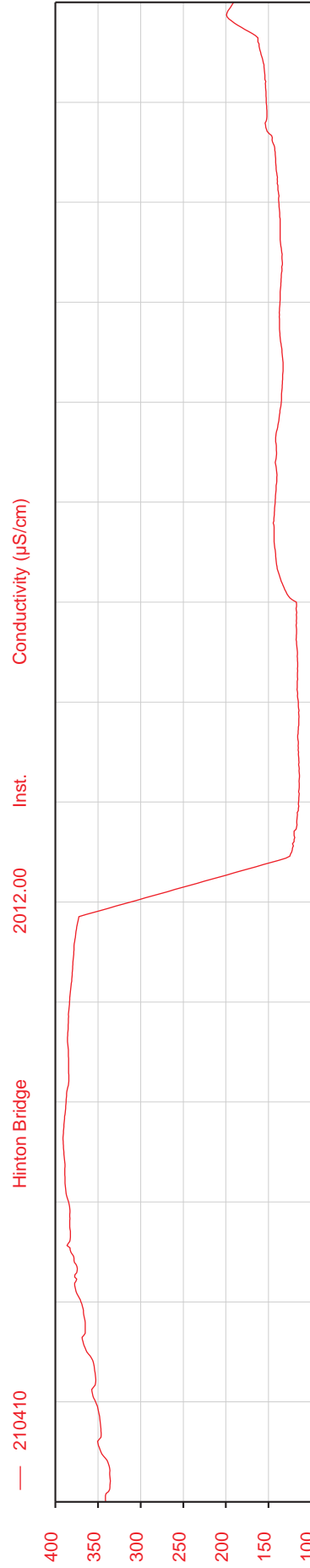
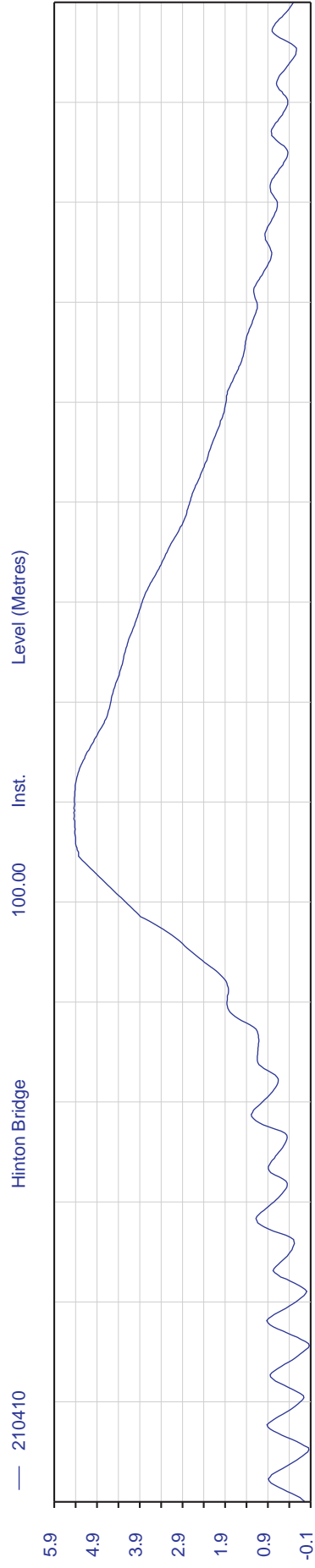
Station long name	Station name	Station number	Start date	End date	Additional MHL report number reference
Wallaga Lake at Meads Bay	Meads Bay	Station number not assigned	03-Feb-99	10-Feb-00	1048
Hexham Swamp at Ironbark Creek Downstream	Ironbark Creek Downstream	Station number not assigned	08-Aug-02	30-Jun-09	
Hexham Swamp at Ironbark Creek Upstream	Ironbark Creek Upstream	Station number not assigned	09-Aug-02	27-Oct-04	
Hexham Swamp at Morris Jetty	Morris Jetty	Station number not assigned	07-Aug-02	30-Jun-09	
Hunter River at Fishery Creek	Fishery Creek	Station number not assigned	08-Aug-02	07-Mar-03	
Hunter River at Fishery Creek 2	Fishery Creek	Station number not assigned	11-Jun-03	29-Aug-03	
Hexham Swamp at Shortland Wetland Centre	Shortland Wetland Centre	Station number not assigned	10-Mar-99	04-Jul-00	1058
Hexham Swamp at SWC Canoe Trail	SWC Canoe Trail	Station number not assigned	07-Aug-02	09-Jan-03	1221
Lake Macquarie at Swansea Channel Site 4	Swansea Channel Site 4	Station number not assigned	28-Mar-96	14-Jun-96	770
Lake Macquarie at Swansea Channel Site 5	Swansea Channel Site 5	Station number not assigned	15-Apr-96	10-May-96	770
Orphan site at Berowra Water Quality	Berowra Creek Water Quality	Station number not assigned	26-May-95	29-Nov-95	745
Berowra Creek at Berowra Waters Marina	Berowra Waters Marina	Station number not assigned	22-Aug-01	23-Nov-01	
Narrabeen Lagoon at Pittwater Road Bridge	Pittwater Road Bridge	Station number not assigned	23-Feb-96	15-Nov-05	
Manly Lagoon at Riverview Parade	Riverview Parade	Station number not assigned	02-Feb-96	05-Jan-07	
Manly Lagoon at Manly Dam	Manly Dam	Station number not assigned	29-Jan-96	22-Aug-01	
Shoalhaven River at Wharf Road	Wharf Road	Station number not assigned	06-Mar-95	07-Apr-95	
Shoalhaven River at DPI Waterra Bridge	DPI Waterra Point	Station number not assigned	07-Mar-95	07-Apr-95	

<b>Station long name</b>	<b>Station name</b>	<b>Station number</b>	<b>Start date</b>	<b>End date</b>	<b>Additional MHL report number reference</b>
Clyde River at Clyde Site 7	Clyde River Site 7	Station number not assigned	25-Sep-96	08-Oct-96	792
Clyde River at Clyde Site 16	Clyde River Site 16	Station number not assigned	25-Sep-96	08-Oct-96	
Wonboyn River Upstream of Wonboyn Lake	Wonboyn River	Station number not assigned	21-Aug-97	06-Sep-98	

# Appendix B Sample outputs

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Period 15 Day Plot Start 00:00\_10/06/2011  
 Interval 30 Minute Plot End 00:00\_25/06/2011



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Latitude,+152:10:56.06,,  
Longitude,-32:42:53.57,,  
Datum,PSHD,,

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5/07/2011,0:30:00,1.47403,6 (Good)  
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5/07/2011,1:00:00,1.3186,6 (Good)  
5/07/2011,1:15:00,1.22369,6 (Good)  
5/07/2011,1:30:00,1.10246,6 (Good)  
5/07/2011,1:45:00,1.03073,6 (Good)  
5/07/2011,2:00:00,0.949726,6 (Good)  
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5/07/2011,2:30:00,0.756913,6 (Good)  
5/07/2011,2:45:00,0.658031,6 (Good)  
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## Appendix C Other publications of interest

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### 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), 2474 (15–16).

MHL Annual Ocean Tide Levels Summaries available:

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

MHL Annual Coastal Rainfall Summaries available:

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

MHL Annual Wave Climate and Coastal Air Pressure Summaries available:

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

MHL Estuary and River Water Quality Summaries available:

MHL Report Nos. 2161 (11–12), 2222 (12–13), 2295 (13–14), 2387 (14–15), 2478 (15–16).

### Salinity profiling

NSW Public Works 2010, *Bellinger and Kalang Rivers Data Collection July 2008–September 2009*, Manly Hydraulics Laboratory, Report No. 1951.

NSW Public Works 2012, *NSW Estuaries Salinity Data Compilation*, Manly Hydraulics Laboratory, Report No. 1812.



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