NSW GOVERNMENT

Manly Hydraulics Laboratory

NSW ESTUARY AND RIVER WATER QUALITY ANNUAL SUMMARY 2023–24

Report MHL3068
June 2025

Prepared for:

NSW Department of Climate Change, Energy, the Environment and Water – Conservation Programs, Heritage, and Regulation

Cover photograph: Tea Gardens, Myall River

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

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110B King Street
Manly Vale NSW 2093
T 02 9949 0200
ABN 27 578 976 844 www.mhl.nsw.gov.au

Foreword

The NSW Department of Climate Change, Energy, the Environment and Water - Conservation Programs, Heritage, and Regulation (DCCEEW CPHR) and WaterNSW commissioned NSW government's specialist advisor, Manly Hydraulics Laboratory (MHL), to develop the NSW water quality database which supports a number of programs associated with coastal, floodplain and estuary management. MHL maintains the automatic recording stations and catalogues the collected data.

This annual summary presents water quality measurements captured by the automatic recording stations along the coastal estuaries and rivers of New South Wales, from 1 July 2023 to 30 June 2024. The overall data recovery rate was 98.3%.

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

Direct requests for further information to:

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

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- NSW Estuary and River Water Levels Annual Summary 2023–24
  Manly Hydraulics Laboratory
  Report No. MHL 3064
  ISSN: 2205-5533 (Online)
- NSW Ocean and River Entrance Tidal Levels and Coastal Air Pressure Annual Summary 2023–24
  Manly Hydraulics Laboratory
  Report No. MHL 3065
  ISSN: 2205-555X (Online)
- NSW Coastal Rainfall Annual Summary 2023–24
  Manly Hydraulics Laboratory
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Executive summary

The *NSW Estuary and River Water Quality Annual Summary 2023-24* presents the water quality measurements captured by the automatic recording stations along the coastal estuaries and rivers of New South Wales from 1 July 2023 to 30 June 2024. The overall data recovery rate was 98.3%. The target recovery rate of 95% or more is achieved for the 2023–24 reporting period.

This report contains:

- a brief description of the water quality measurement program
- guidelines on how to use this report
- information on how to access the database
- significant developments which occurred in 2023–24
- the data summaries and station location maps for each station
- **Digitised continuous** data, detailing the data available online
- **Other publications** of interest, a list of other publications which may be of interest.

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1 Water quality monitoring program

This report presents a summary of the water quality data currently collected by Manly Hydraulics Laboratory (MHL) at 21 monitoring stations in NSW. The network of automatic recorders and the associated analysis routines enable efficient delivery of water quality data. Readers can also request specific water quality data extracts from the historical database (refer to **Digitised continuous** data).

The present program is based on a network of automatic recording stations installed at various estuaries (see **Water quality monitoring** summary in Section 5). This network consists of 21 permanent stations funded by the Department of Climate Change, Energy, the Environment and Water - Conservation Programs, Heritage, and Regulation (DCCEEW CPHR) and WaterNSW (see **Table 1-1**). The logging systems consist of data loggers which record water quality information every 15 minutes.

Table 1-1 Station list

River/ estuary region	Station name	Station no.	MGA zone	Easting	Northing	Station owner	Data start	Overall data capture rate 2023–24
Richmond	Lake Ainsworth	203455	56	557863	6816160	DCCEEW CPHR	10-Apr-18	100.0%
Richmond	Coraki	203403	56	527976	6793772	DCCEEW CPHR /WaterNSW	21-Oct-09	100.0%
Richmond	Oakland Road	203470	56	526684	6791185	WaterNSW	06-Mar-12	100.0%
Clarence	Rogans Bridge	204413	56	488813	6723401	DCCEEW CPHR /WaterNSW	03-Dec-09	99.5%
Clarence	Grafton	204400	56	493398	6715149	DCCEEW CPHR /WaterNSW	04-Dec-09	94.9%
Macleay	Kempsey	206402	56	485099	6561395	DCCEEW CPHR /WaterNSW	09-Feb-10	99.9%
Lake Cathie	Lake Cathie	207441	56	486162	6509679	DCCEEW CPHR	18-Jun-20	96.6%
Manning	Wingham	208400	56	440523	6473219	DCCEEW CPHR /WaterNSW	08-Dec-09	100.0%
Manning	Taree West	208420	56	447161	6469672	WaterNSW	30-Apr-10	90.3%
Myall Lakes	Bombah Point	209475	56	434680	6403299	DCCEEW CPHR	13-Jul-09	100.0%
Myall River	Tea Gardens	209480	56	421723	6385111	DCCEEW CPHR	20-Oct-09	100.0%
Paterson	Dunmore	210409	56	369238	6383269	DCCEEW CPHR /WaterNSW	15-Oct-09	99.8%
Paterson	Hinton Bridge	210410	56	373245	6379624	DCCEEW CPHR /WaterNSW	15-Oct-09	98.5%
Hunter	McKimms Corner	210455	56	368162	6378933	DCCEEW CPHR /WaterNSW	08-Oct-09	98.5%
Hunter	Hexham	210448	56	376768	6367608	DCCEEW CPHR /WaterNSW	13-Apr-11	100.0%
Hunter	Green Rocks	210432	56	377459	6378142	DCCEEW CPHR /WaterNSW	15-Oct-09	98.5%
Williams	Raymond Terrace	210452	56	382352	6375361	DCCEEW CPHR /WaterNSW	15-Oct-09	98.8%
Hawkesbury	Sackville	212406	56	303238	6292029	DCCEEW CPHR /WaterNSW	30-Oct-09	97.7%
Hawkesbury	Leets Vale	212461	56	309195	6299263	WaterNSW	22-Jun-10	98.3%

River/ estuary region	Station name	Station no.	MGA zone	Easting	Northing	Station owner	Data start	Overall data capture rate 2023–24
Shoalhaven	Grady's Caravan Park	215430	56	268024	6138282	DCCEEW CPHR /WaterNSW	06-Oct-10	99.1%
Wonboyn Lake	Wonboyn Lake	220452	55	758839	5873472	DCCEEW CPHR	25-Oct-18	93.7%
Overall								**98.3%**

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

1. 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 ± 0.1 microsiemen/cm and temperature ± 0.01°C.
2. YSI Sonde 600XL: a multi-parameter probe with a probe resolution of EC ± 1-100 microsiemen/cm (range dependent) and temperature ± 0.01°C.
3. YSI EXO3 Sonde: a multi-parameter probe with a probe resolution of EC ± 0.1-10 microsiemen/cm (range dependent) and temperature ± 0.001°C.

Logger programs at all stations output water level, temperature, conductivity and specific conductivity, as well as salinity in practical salinity units (psu). This allows more usable near real-time data for the diverse range of end users.

Temperature and conductivity values are obtained directly from the instrumentation. Specific conductivity compensated to 25°C is calculated using the equation:

$$\textit{specific conductivity [µs/cm]} = C / (1+0.0198933 * (T-25))$$

where C = *uncompensated conductivity,* T = *temperature*

Salinity (psu) is calculated using the UNESCO formula for seawater salinity. The full equation is found at:

> 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 collection, processing and storage system hosted on cloud computing platforms using telemetry techniques based on common Internet protocols and data connections over cellular telephone networks. External users can view the near real time raw data via the web.

The raw data is also transferred in a separate process to an MHL database hosted in NSW government data centres (GovDC) where it is subject to a quality assurance process involving several control steps to maintain data quality.

Data is backed up daily and archived to long-term storage at regular intervals.

2 How to use this report

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

The NSW coastline is divided into geographic regions based on river systems to present water monitoring information. 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 **Digitised continuous** data).

All data presented in this report are recorded in Australian Eastern Standard Time (EST). Allowance for daylight saving time needs to be made by the user of the data if required.

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.

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 for salinity compared with almost zero for fresh water.
- 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 2023–24 monitoring period, the salinity values at Lake Cathie varied by approximately 26 psu between high and low tides, and at Hexham Bridge variations of approximately 19 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 through the tidal cycle.

3 How to access the data

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

Typically, the last seven days of raw 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** .

Order quality controlled data via the MHL web page (http://www.mhl.nsw.gov.au) by emailing data-request@mhl.nsw.gov.au. Regular users can request development of customised decision support tools for supply of data using the same email address.

4 Significant events and developments

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 4-1** lists the 2023–24 flood warnings as described by the NSW State Emergency Service's (SES) classification scale.

Table 4-1 NSW flood classifications 2023–24

River basin	Date	Flood classification
Hawkesbury River	April 2024	Minor to Moderate
	June 2024	Minor to Moderate
Shoalhaven	June 2024	Minor

The SES determines flood warning classifications based on the following definitions:

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 Highest recorded salinity readings

Peak salinity levels at each station are reviewed for the 2023–24 monitoring period. No stations showed peak salinity levels higher than previous years' measurements.

4.3 Cross-sectional profiling

Cross-sectional profiles at monitoring stations are used to indicate how representative in situ sensor readings are of the complete river cross-section for the conditions at the time of profiling. A cross-sectional profile is undertaken within 10 metres upstream or downstream of the in situ sensor to the opposite bank. The cross-section is divided into a minimum of five equidistant sections and electrical conductivity readings are taken from the surface to the bed at 0.3 metre intervals.

In February, March, April and May 2024, cross-sectional water quality profiling was undertaken on the Richmond, Clarence, Macleay, Manning, Paterson, Hunter, Hawkesbury

and Shoalhaven rivers, as part of the monitoring program. Refer to *Monitoring of Estuaries for Water Sharing Plans Annual Summary 2023–24* (Report MHL3081) for more detail on the cross-sectional profiling results.

4.4 Station development

The following station developments and upgrades occurred during the 2023–24 reporting period:

- McKimms Corner (Hunter River) station was upgraded with a new EXO3 water quality sensor and a 100m cable and instrument slide on 27 May 2024 to increase the quality and reliability of the data capture at the site.
- Wonboyn Lake (Wonboyn Lake) station was upgraded with a new CR1000X logger on 3 April 2024 to increase the reliability of the data capture at the site.

4.5 Station issues

Lake Cathie (Cathie Creek) station's conductivity sensor experienced shell growth during May and June 2024. A new water quality sensor was installed on 25 June 2024.

Grafton (Clarance River) station's water quality sensor poly pipe and cable was damaged due to civil works being undertaken to lay a concrete footing for a new light post in September 2023. A temporary standalone water quality sensor[1] was deployed on 13 October 2023 to maintain data capture.

Taree West (Manning River) station's water level gas line, water quality sensor and cable were damaged following a significant bank collapse during the flood on 6 July 2022. Temporary standalone water level[2] and water quality sensors[1] were deployed on 11 August 2022 to maintain data capture.

McKimms Corner (Hunter River) station water quality sensor was damaged by lightning on 19 February 2024. A new water quality sensor was installed on 27 February 2024.

Green Rocks (Hunter River) station water quality sensor was damaged by lightning on 19 February 2024. A new water quality sensor was installed on 27 February 2024.

Leets Vale (Hawkesbury River) station equipment was damaged when the station was inundated during the March 2022 flood, even after the equipment housing was raised by 0.5 m in November 2021. A standalone water level and water quality sensors were deployed on 25 May 2022 to maximise data capture until the station was reinstated on 5 June 2024.

Wonboyn Lake (Wonboyn Lake) station logger program was malfunctioning from 22 March 2024. A new logger program was installed on 3 April 2024. The station's conductivity sensor experienced shell growth during April and May 2024. A new water quality sensor was

[1] Temporary deployment arrangement using a 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 ± 0.1 microsiemens/cm and temperature ± 0.01°C.

[2] Temporary deployment arrangement using a Solinst Levelogger 5: an unvented pressure transducer that requires compensation with barometric data. The Levelogger 5 measures absolute pressure using a Hastelloy pressure sensor with a resolution of 0.1 mm and manufacturer stated accuracy of 25 mm.

installed on 15 May 2024.

Readers should exercise caution when using standalone water quality information as the temporary deployment location can be different to the parent station.

5 Water quality monitoring summary

This section documents locality maps and quality assured water quality monitoring summaries for each station. **Table 5-1** provides an index to the figures presented. Daily rainfall data from the nearest available DCCEEW CPHR or Bureau of Meteorology (BoM) rain gauge is added to the figure to recognise 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 observed on some water level plots. DCCEEW CPHR rainfall stations and BoM rainfall stations are presented as 9am daily rainfall totals.

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River/estuary region	Station name	Station no.	Comparative DCCEEW CPHR or BoM rainfall station name	Figure
Station Locality Map	Richmond River Region			Figure 5-1
Richmond River	Lake Ainsworth	203455	Lake Ainsworth	Figure 5-2
Richmond River	Coraki	203403	New Italy (Vineyard Haven)^	Figure 5-3
Richmond River	Oakland Road	203470	New Italy (Vineyard Haven)^	Figure 5-4
Station Locality Map	Clarence River Region			Figure 5-5
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Clarence River	Grafton	204400	Grafton Research^	Figure 5-7
Station Locality Map	Macleay River Region			Figure 5-8
Macleay River	Kempsey	206468	Aldavilla Downstream	Figure 5-9
Station Locality Map	Lake Cathie			Figure 5-10
Lake Cathie	Lake Cathie	207441	Port Macquarie Airport AWS^	Figure 5-11
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Manning River	Wingham	208400	Wingham (Lanark Close)^	Figure 5-13
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Station Locality Map	Port Stephens Region			Figure 5-17
Myall River	Tea Gardens	209480	Bulahdelah	Figure 5-18
Station Locality Map	Paterson River Region			Figure 5-19
Paterson River	Dunmore	210409	Belmore Bridge	Figure 5-20
Paterson River	Hinton Bridge	210410	Belmore Bridge	Figure 5-21
Station Locality Map	Hunter River Region			Figure 5-22
Hunter River	McKimms Corner	210455	Belmore Bridge	Figure 5-23
Hunter River	Green Rocks	210432	Hexham Bridge	Figure 5-24
Williams River	Raymond Terrace	210452	Hexham Bridge	Figure 5-25
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Station Locality Map	Hawkesbury River Region			Figure 5-27
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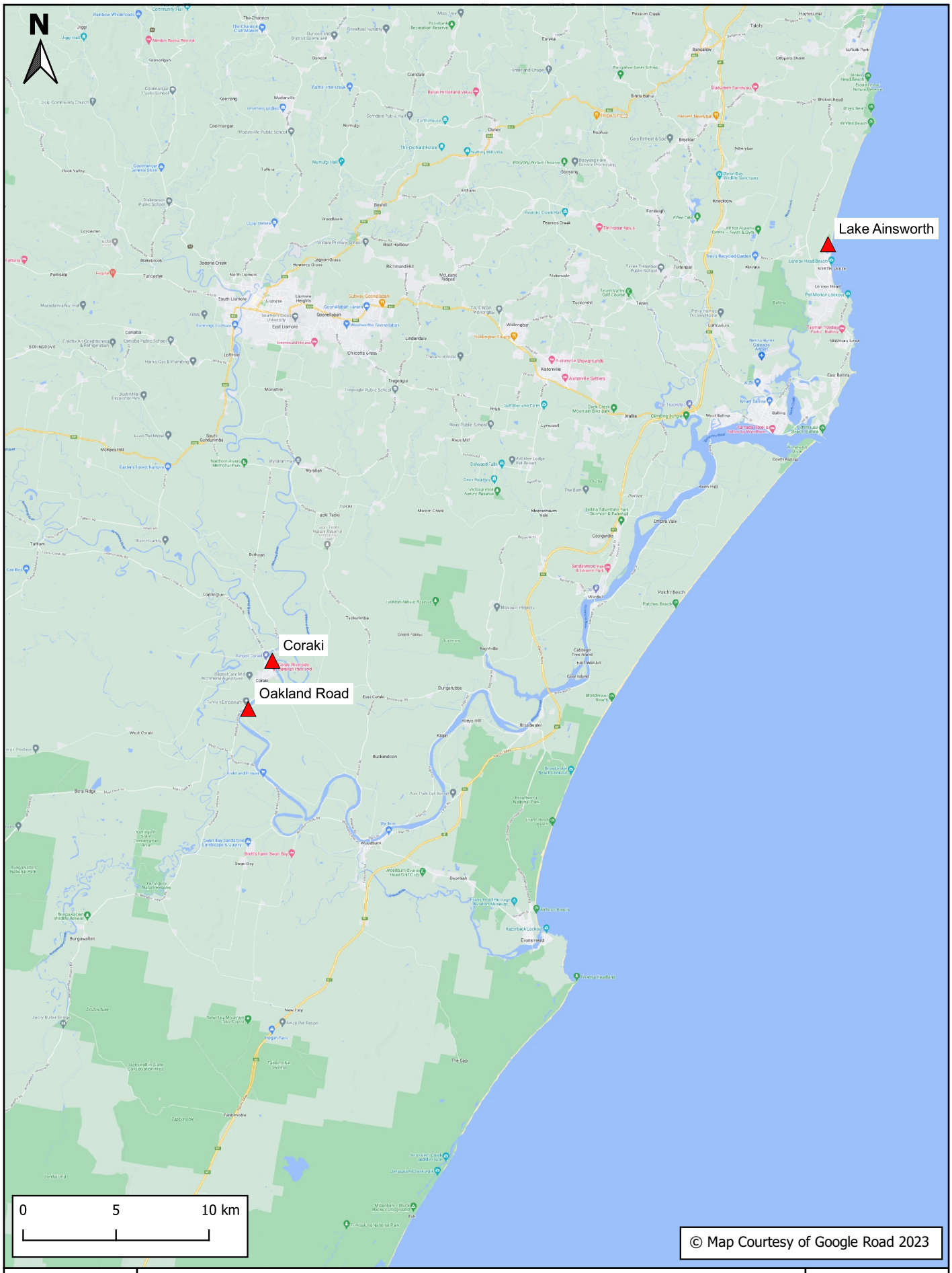
Station Locality Map	Wonboyn Lake			Figure 5-32
Wonboyn Lake	Wonboyn Lake	220452	Green Cape Lighthouse^	Figure 5-33

^ Daily rainfall totals downloaded from the BoM's Climate Data Online website have not been quality controlled by MHL.



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WATER QUALITY STATION LOCATIONS
RICHMOND RIVER REGION

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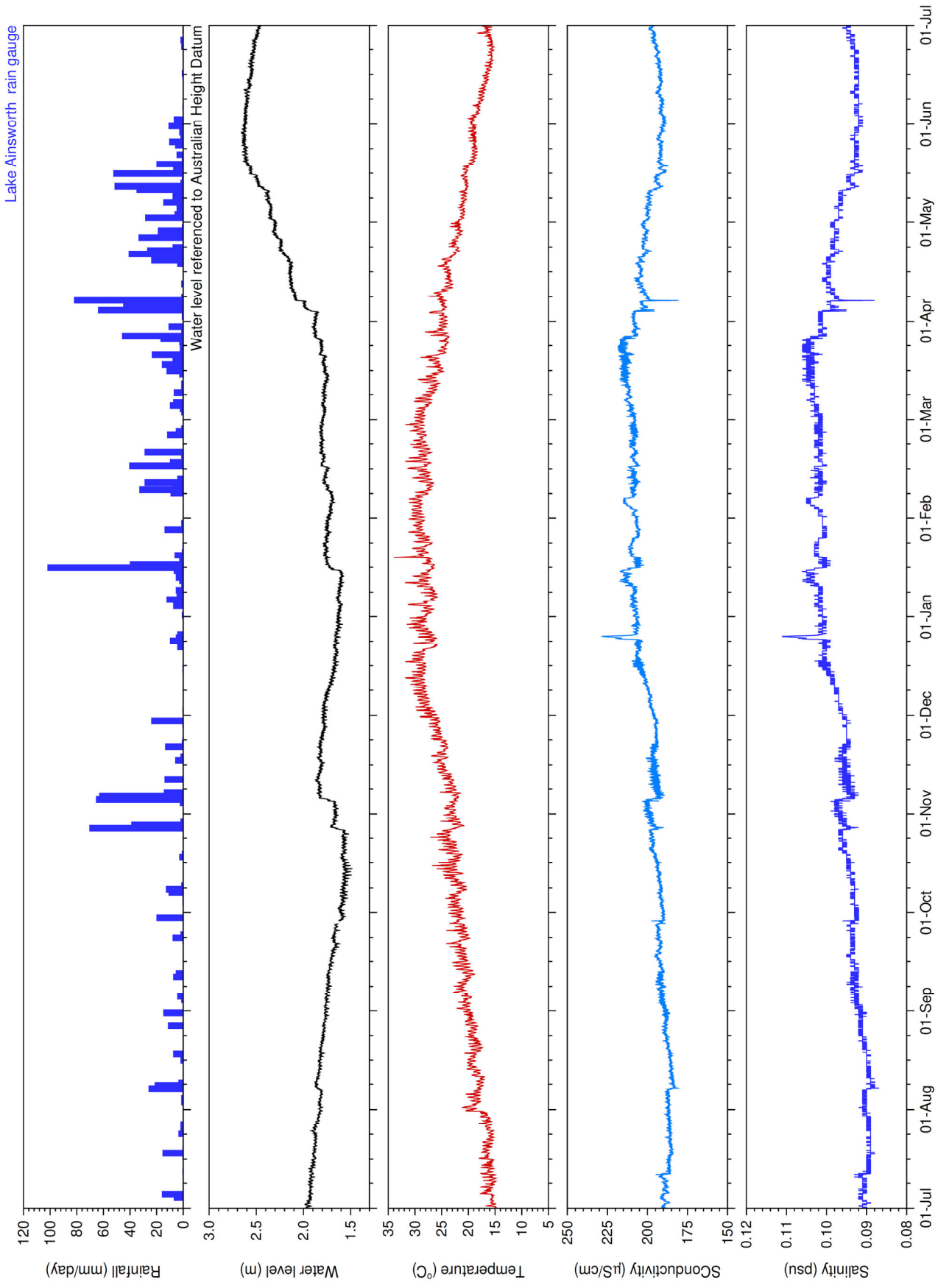
Report MHL3068
Figure
5-1



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WATER LEVEL AND WATER QUALITY DATA
2023-24
LAKE AINSWORTH

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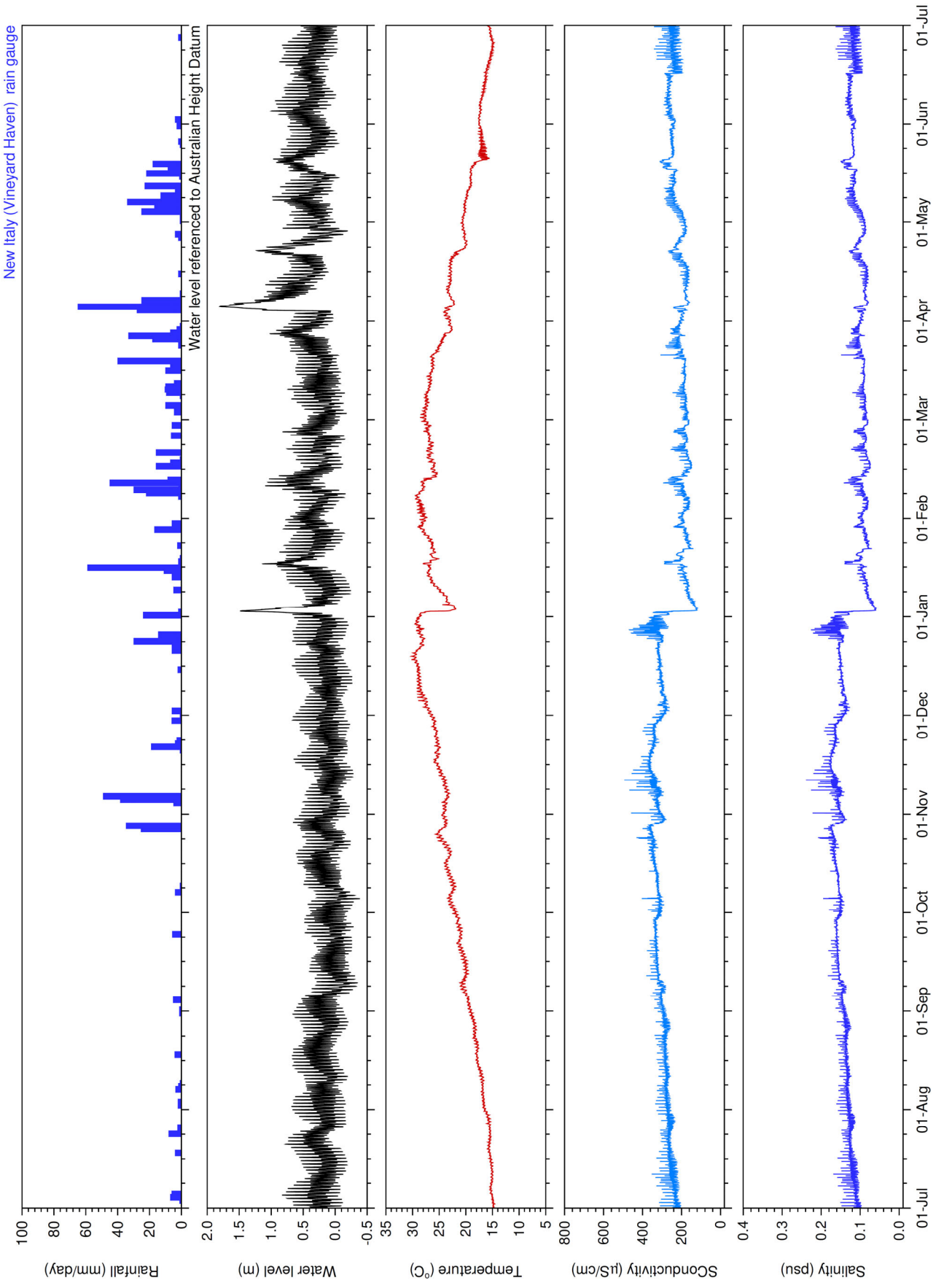
Figure
5-2



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WATER LEVEL AND WATER QUALITY DATA
2023-24
CORAKI

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Figure
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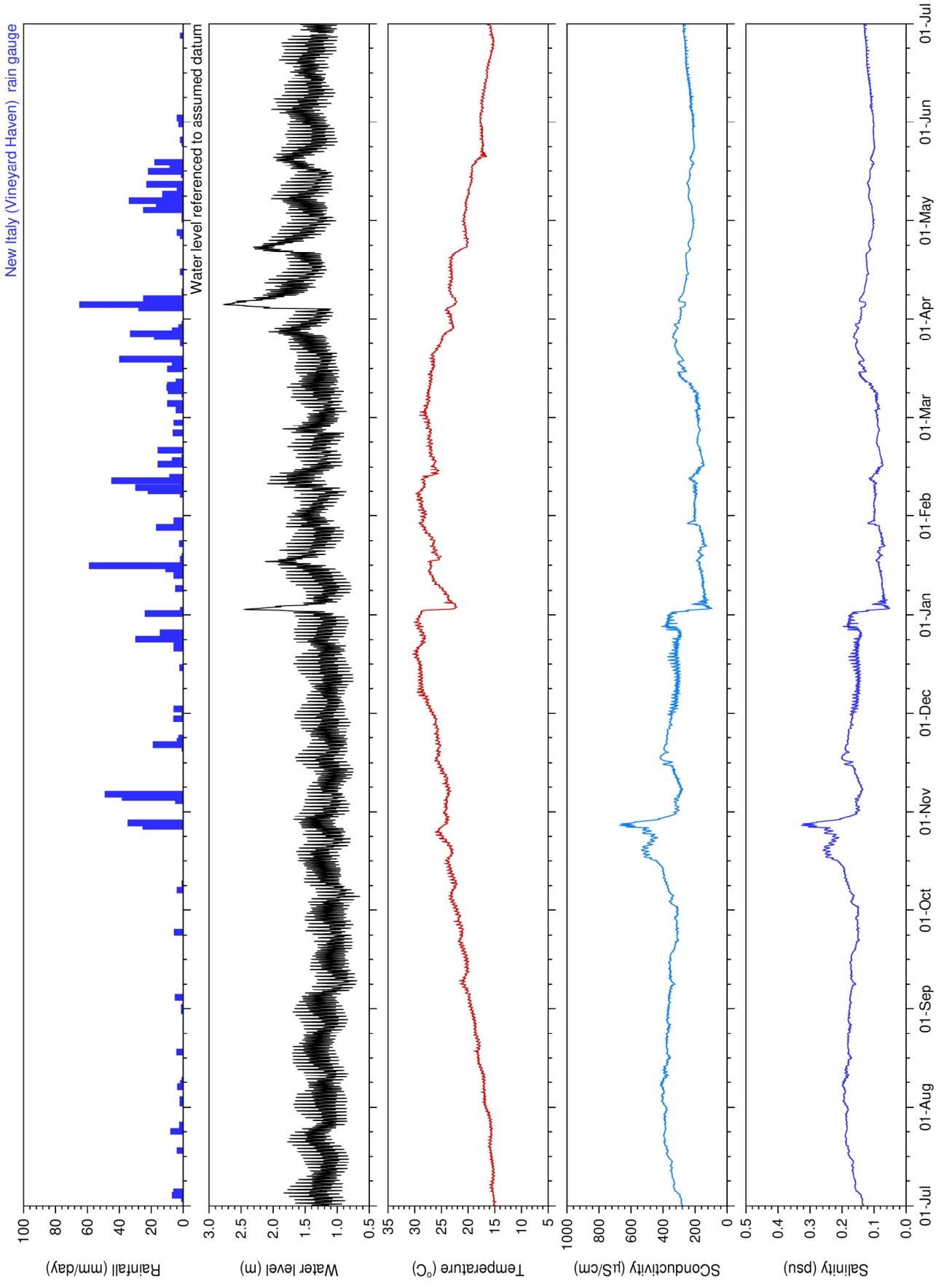

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WATER LEVEL AND WATER QUALITY DATA
2023-24
OAKLAND ROAD

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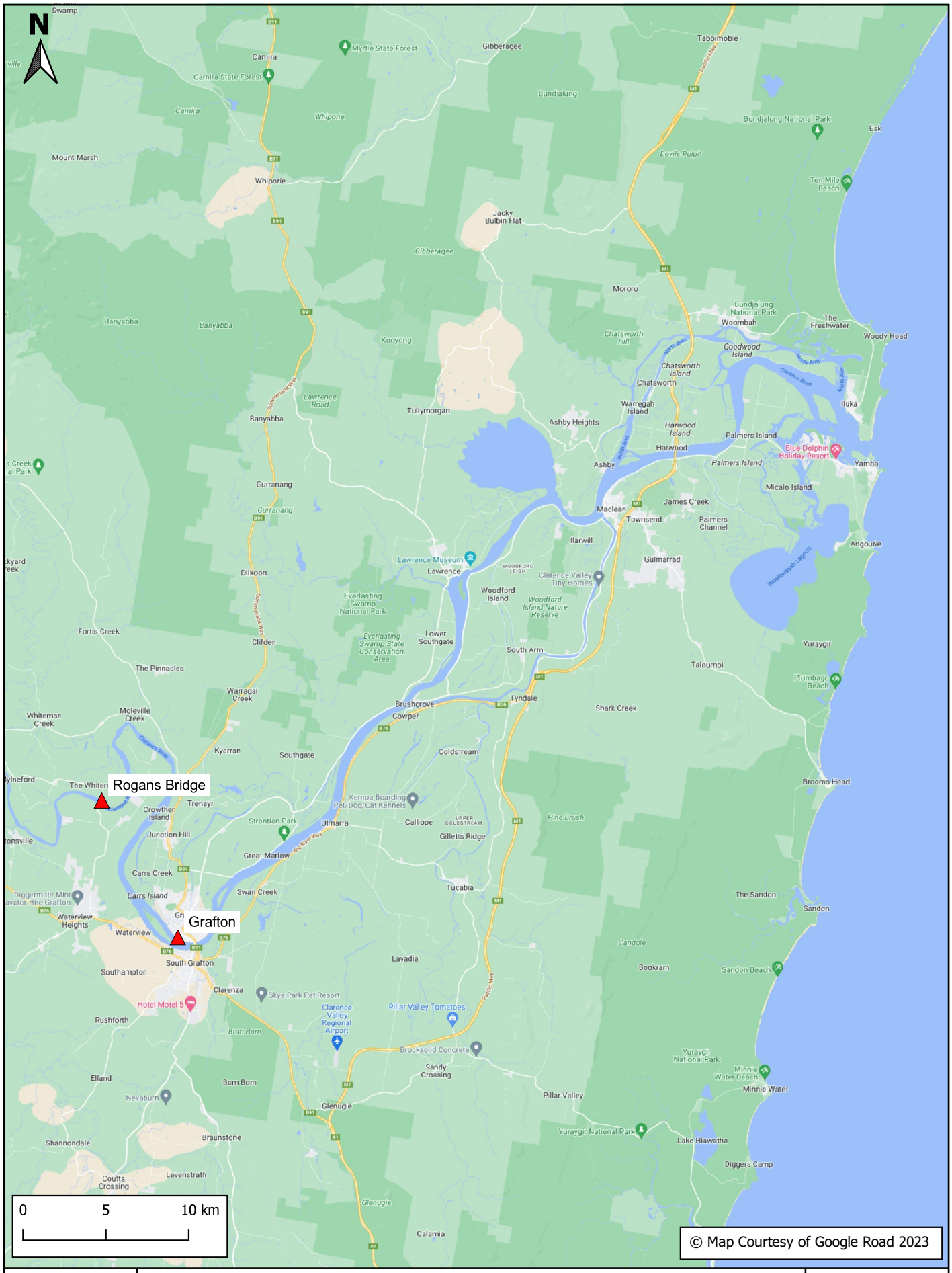
Figure
5-4



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WATER QUALITY STATION LOCATIONS
CLARENCE RIVER REGION

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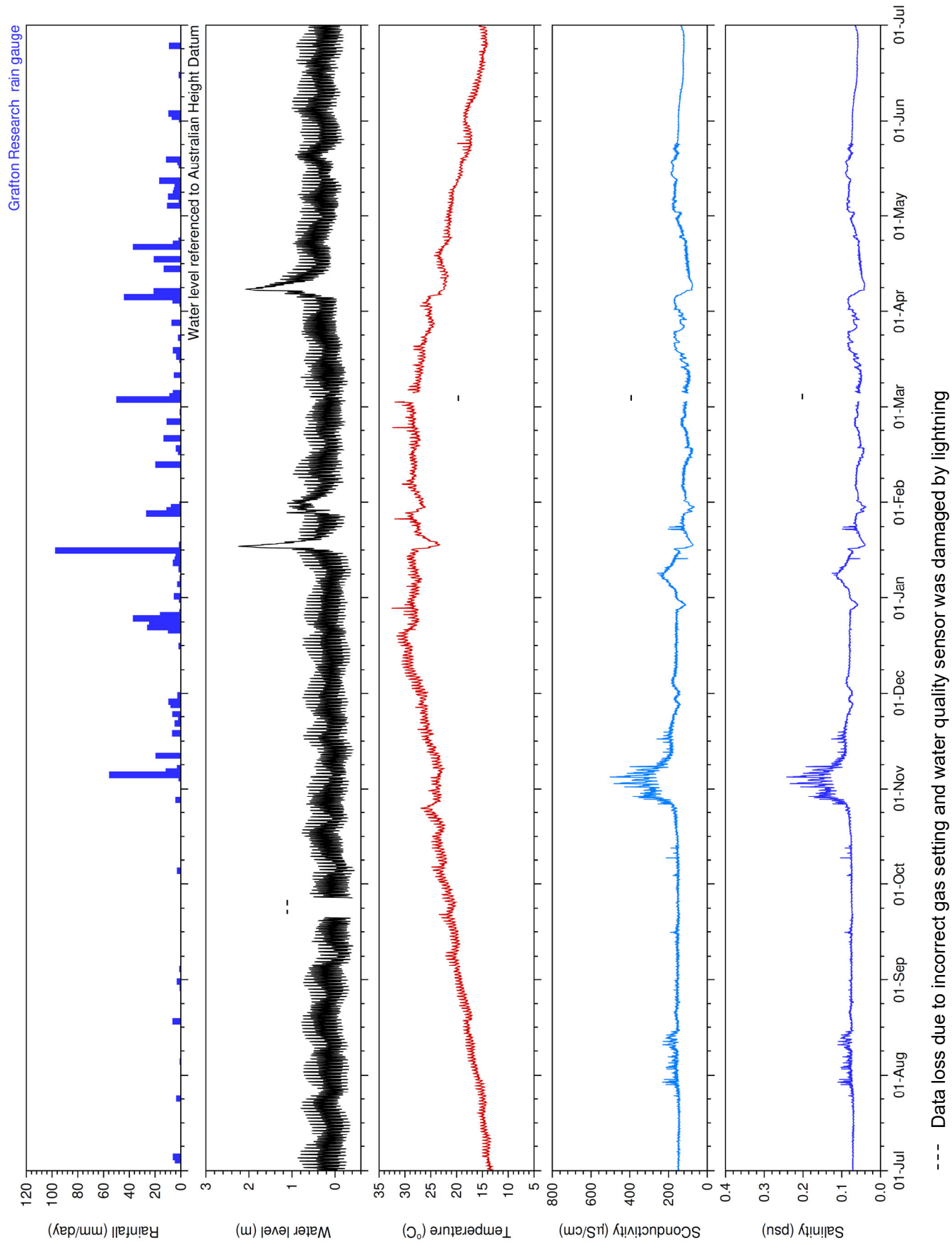
Figure
5-5



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WATER LEVEL AND WATER QUALITY DATA
2023-24
ROGANS BRIDGE

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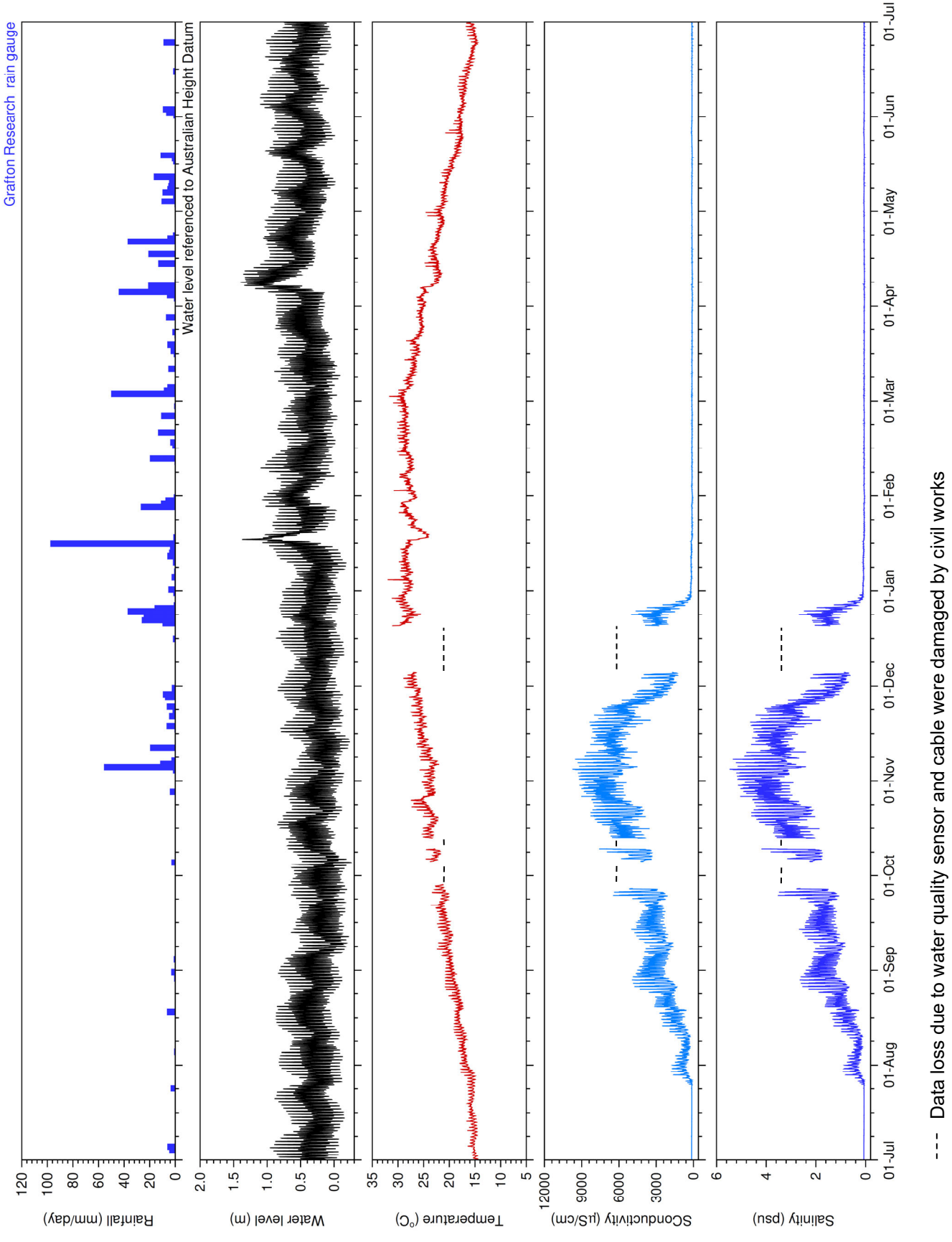
Figure
5-6



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WATER LEVEL AND WATER QUALITY DATA
2023-24
GRAFTON

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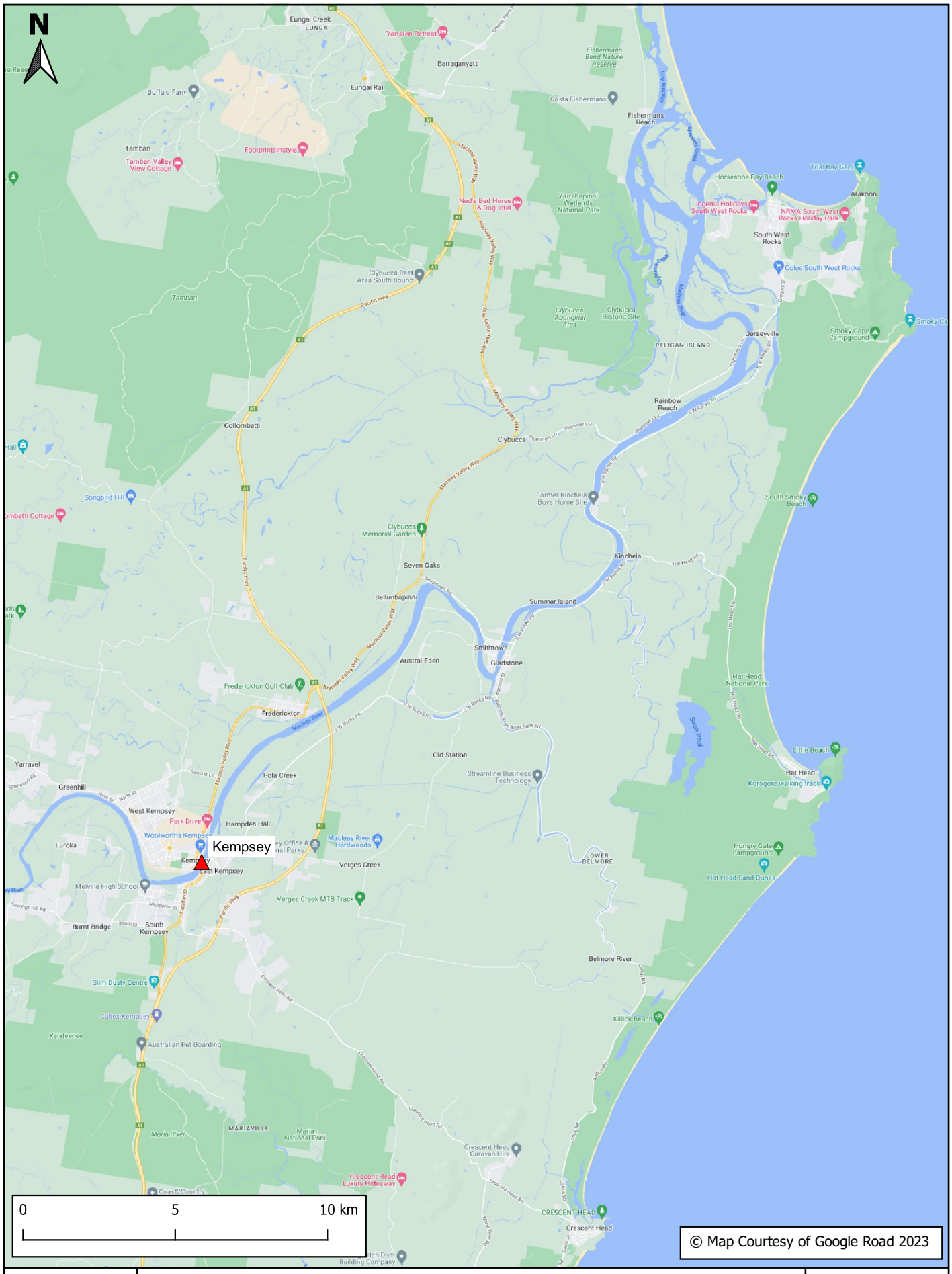
Figure
5-7



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WATER QUALITY STATION LOCATIONS
MACLEAY RIVER REGION

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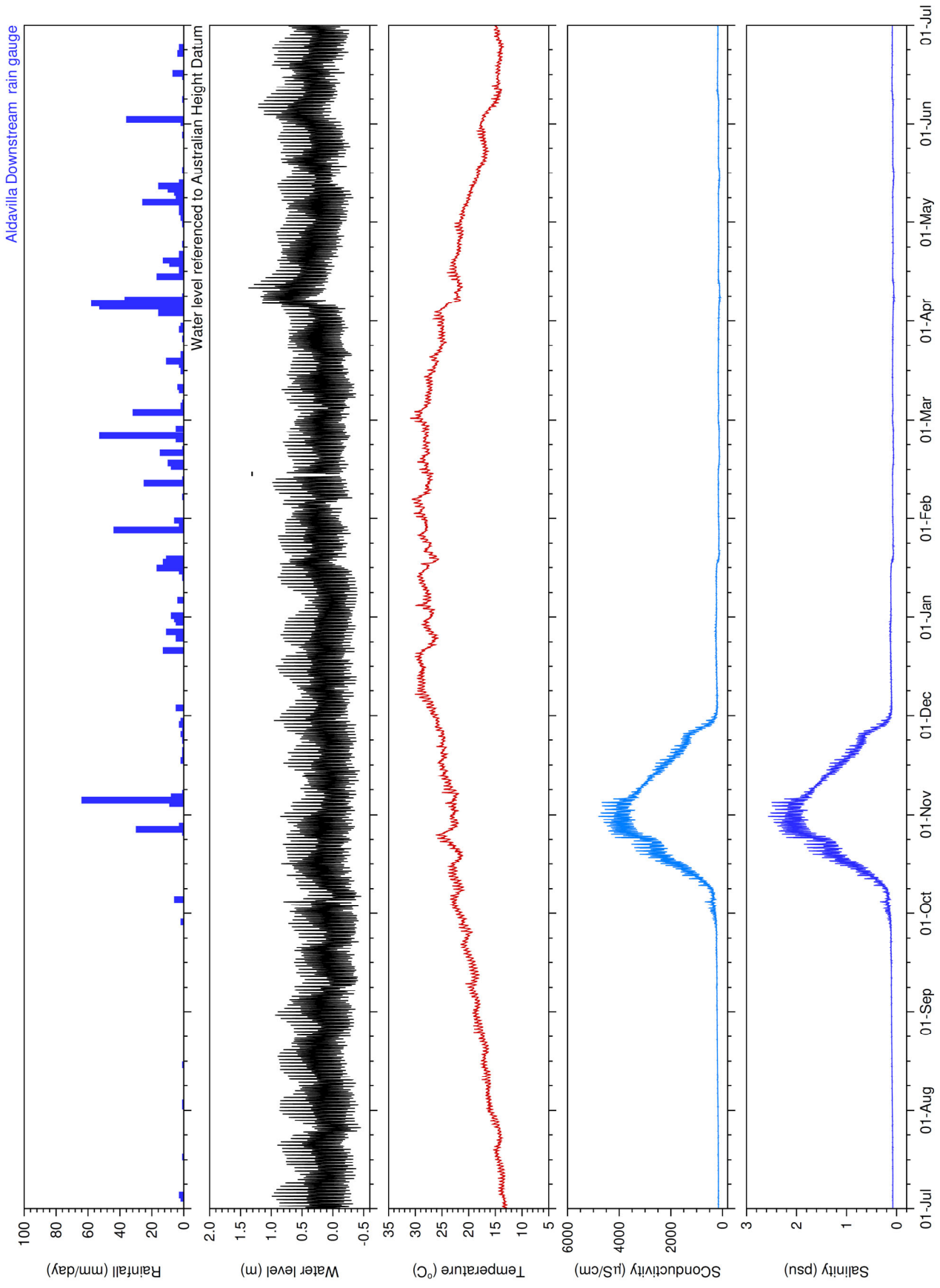
Figure
5-8



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WATER LEVEL AND WATER QUALITY DATA
2023-24
KEMPSEY

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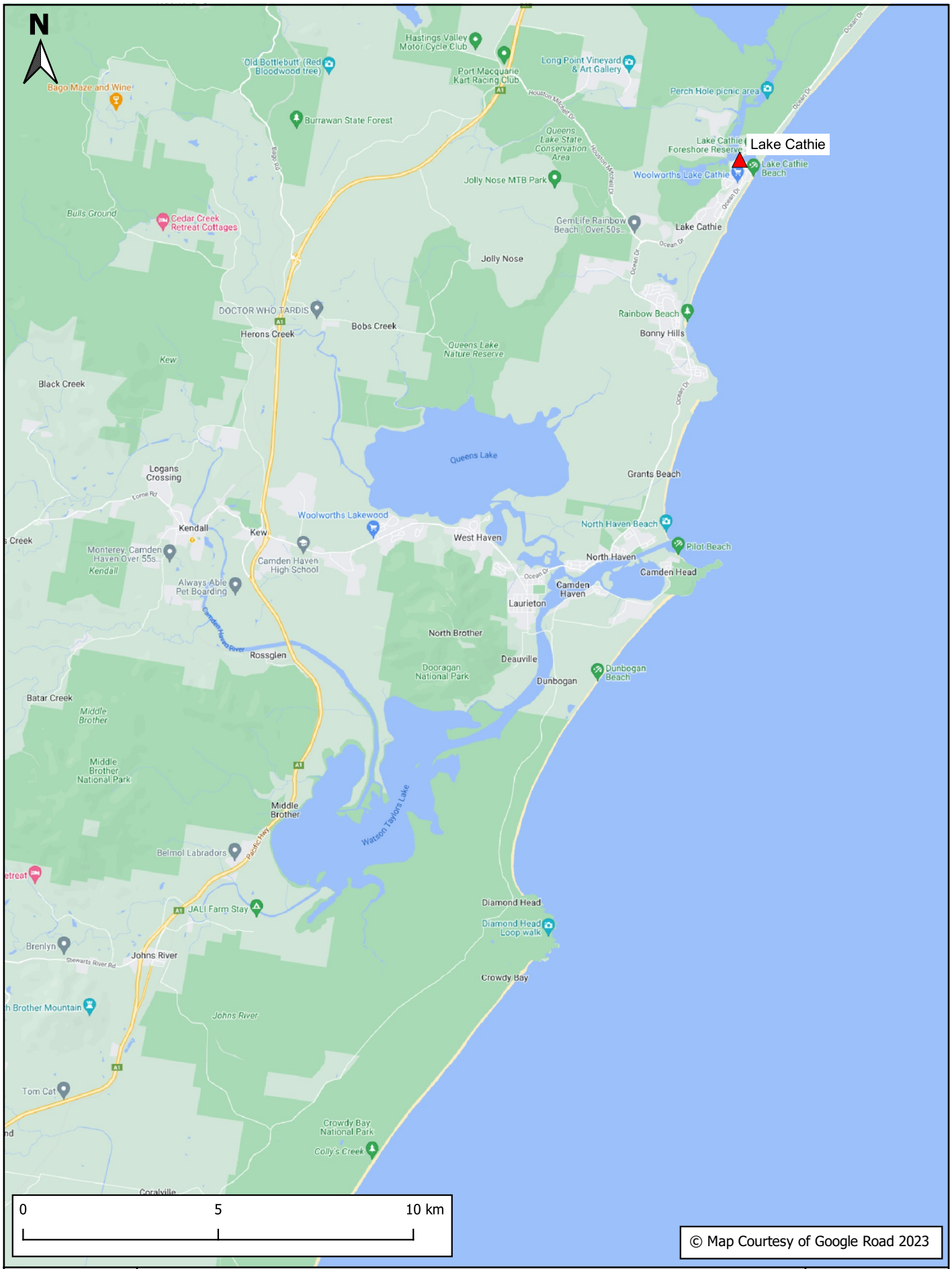
Figure
5-9



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WATER QUALITY STATION LOCATIONS
LAKE CATHIE

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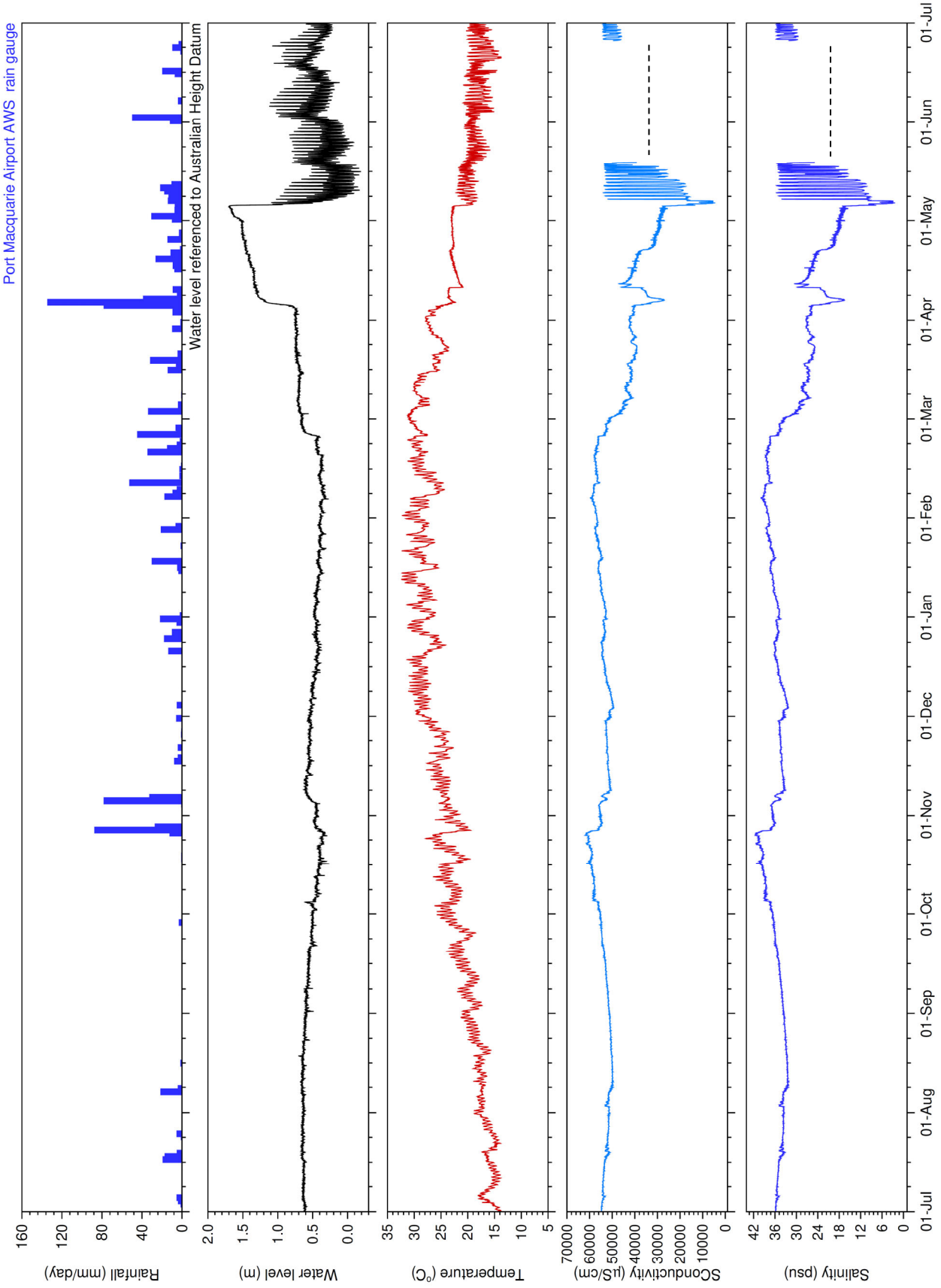
Figure
5-10



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WATER LEVEL AND WATER QUALITY DATA
2023-24
LAKE CATHIE

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Figure
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WATER QUALITY STATION LOCATIONS
MANNING RIVER REGION

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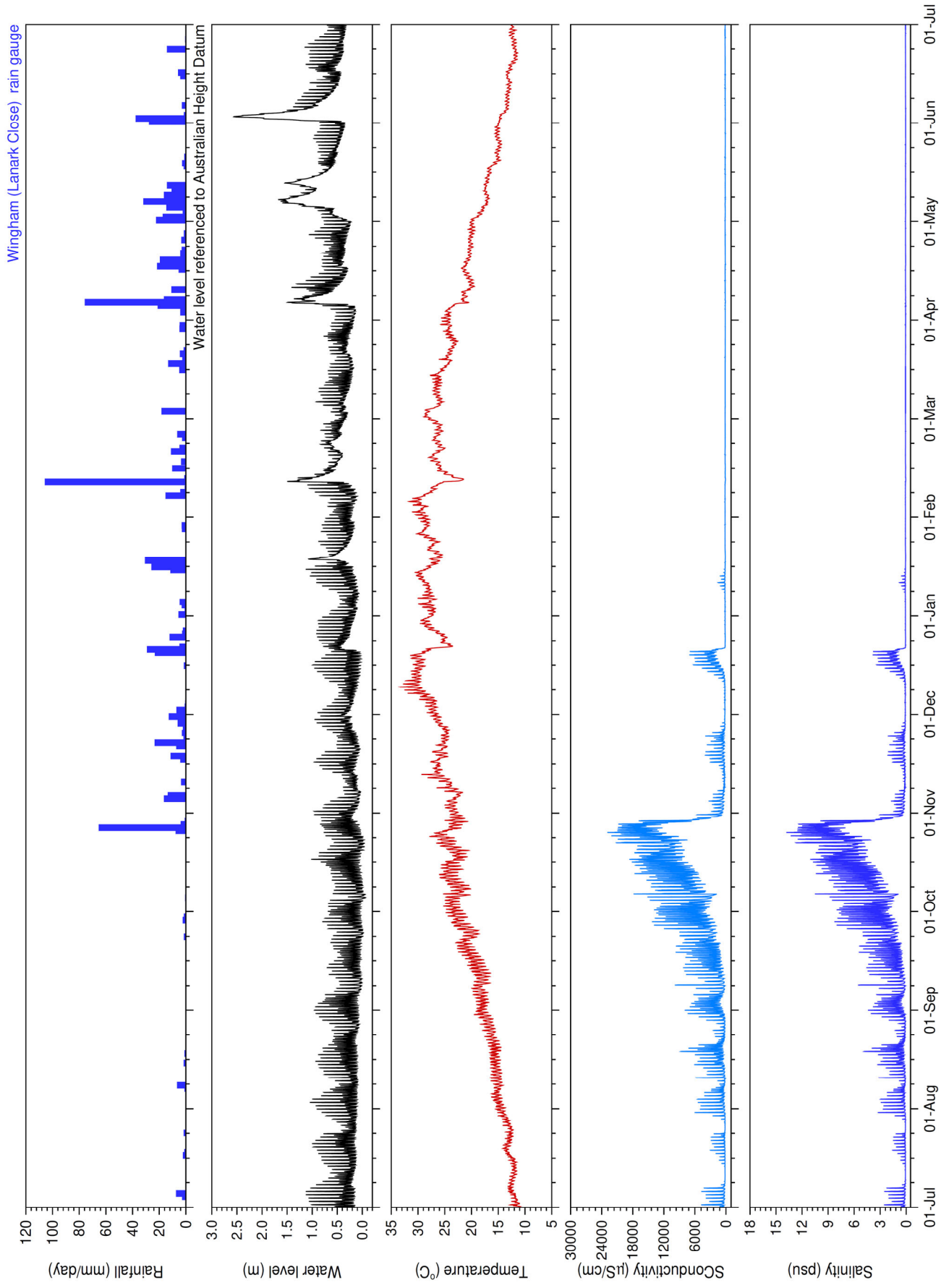
Figure
5-12



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WATER LEVEL AND WATER QUALITY DATA
2023-24
WINGHAM

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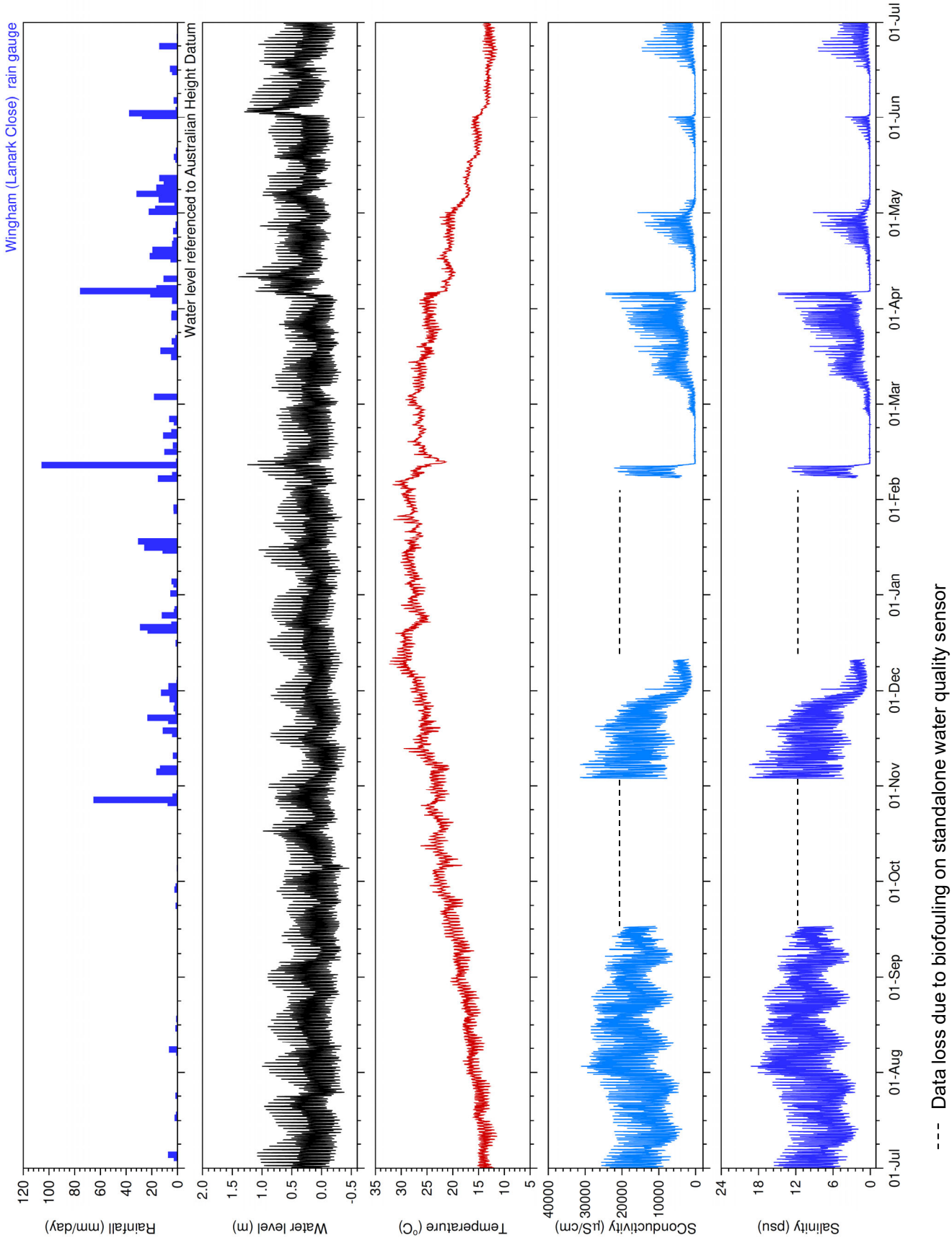
Figure
5-13



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WATER LEVEL AND WATER QUALITY DATA
2023-24
TAREE WEST

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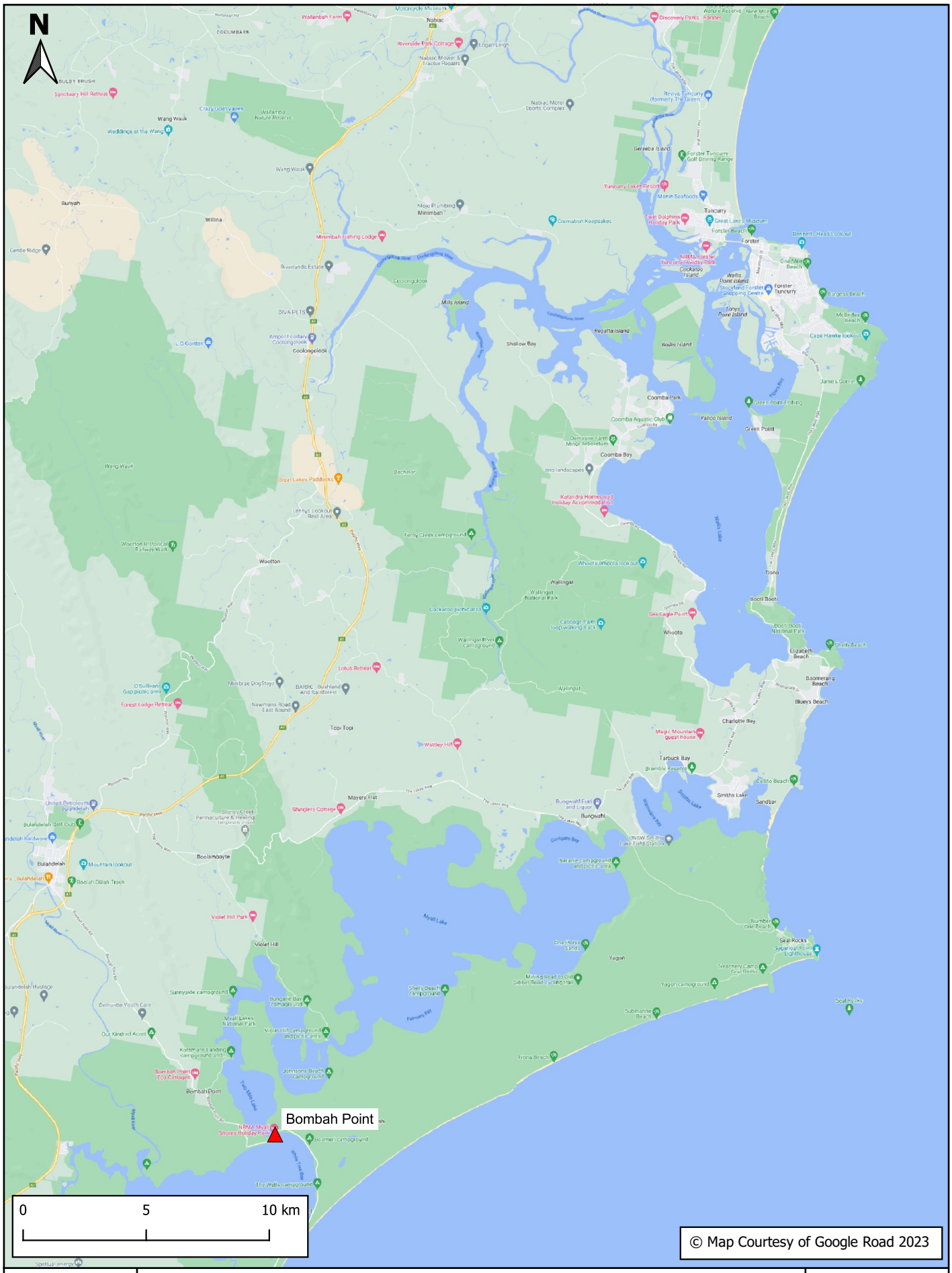
Figure
5-14

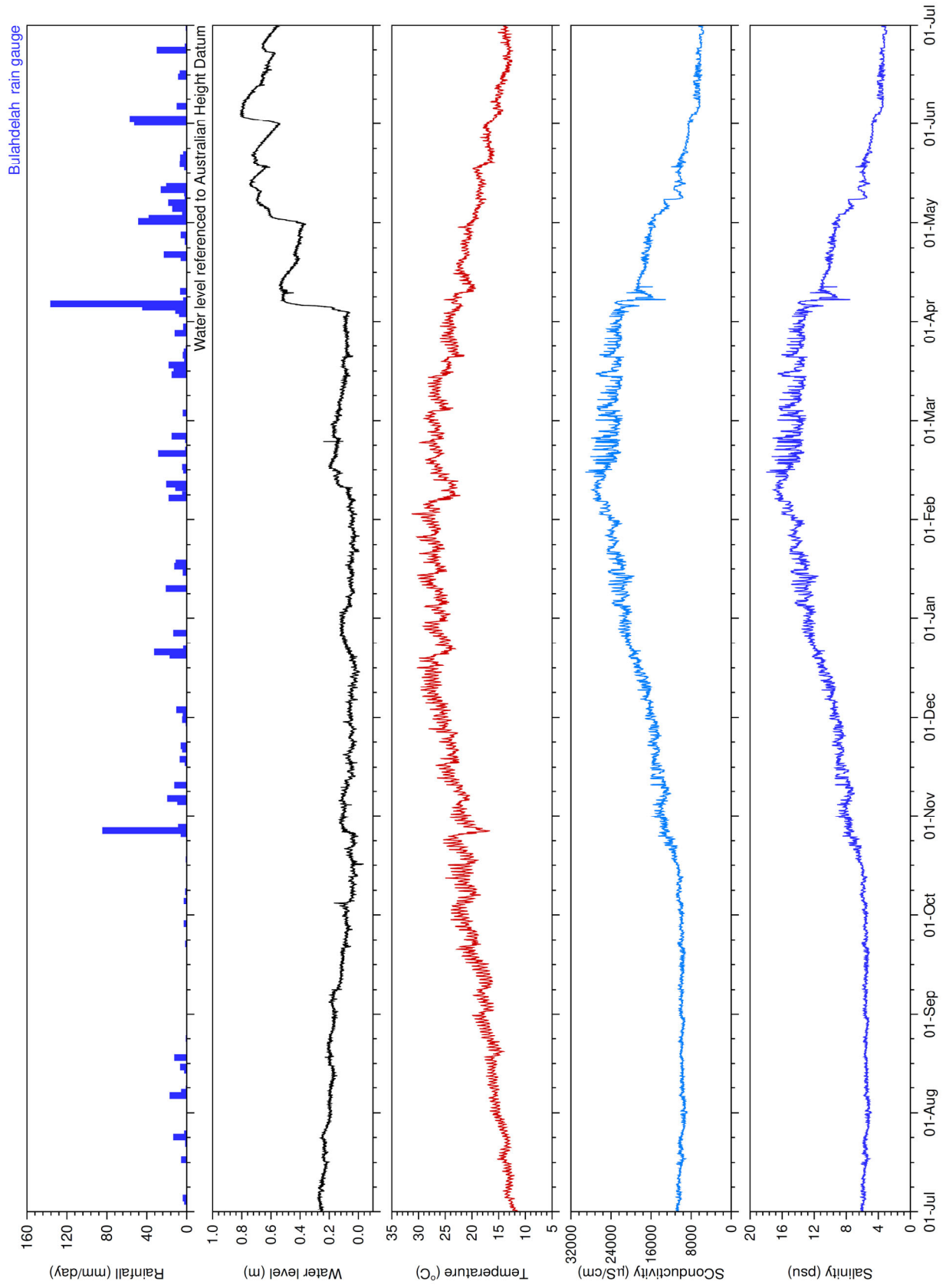


NSW GOVERNMENT

WATER QUALITY STATION LOCATIONS
GREAT LAKES REGION

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-15

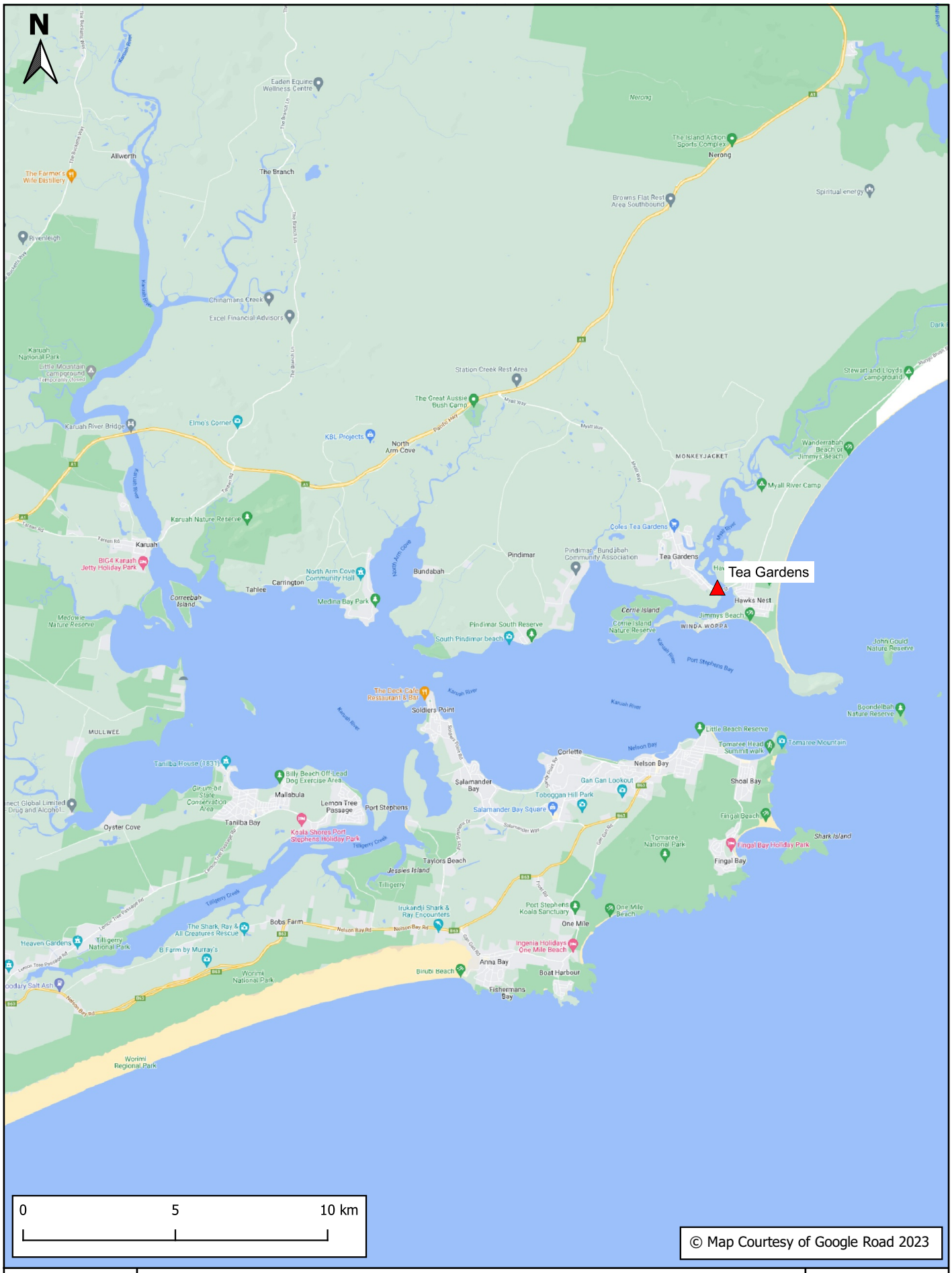


NSW GOVERNMENT

WATER LEVEL AND WATER QUALITY DATA
2023-24
BOMBAH POINT

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-16

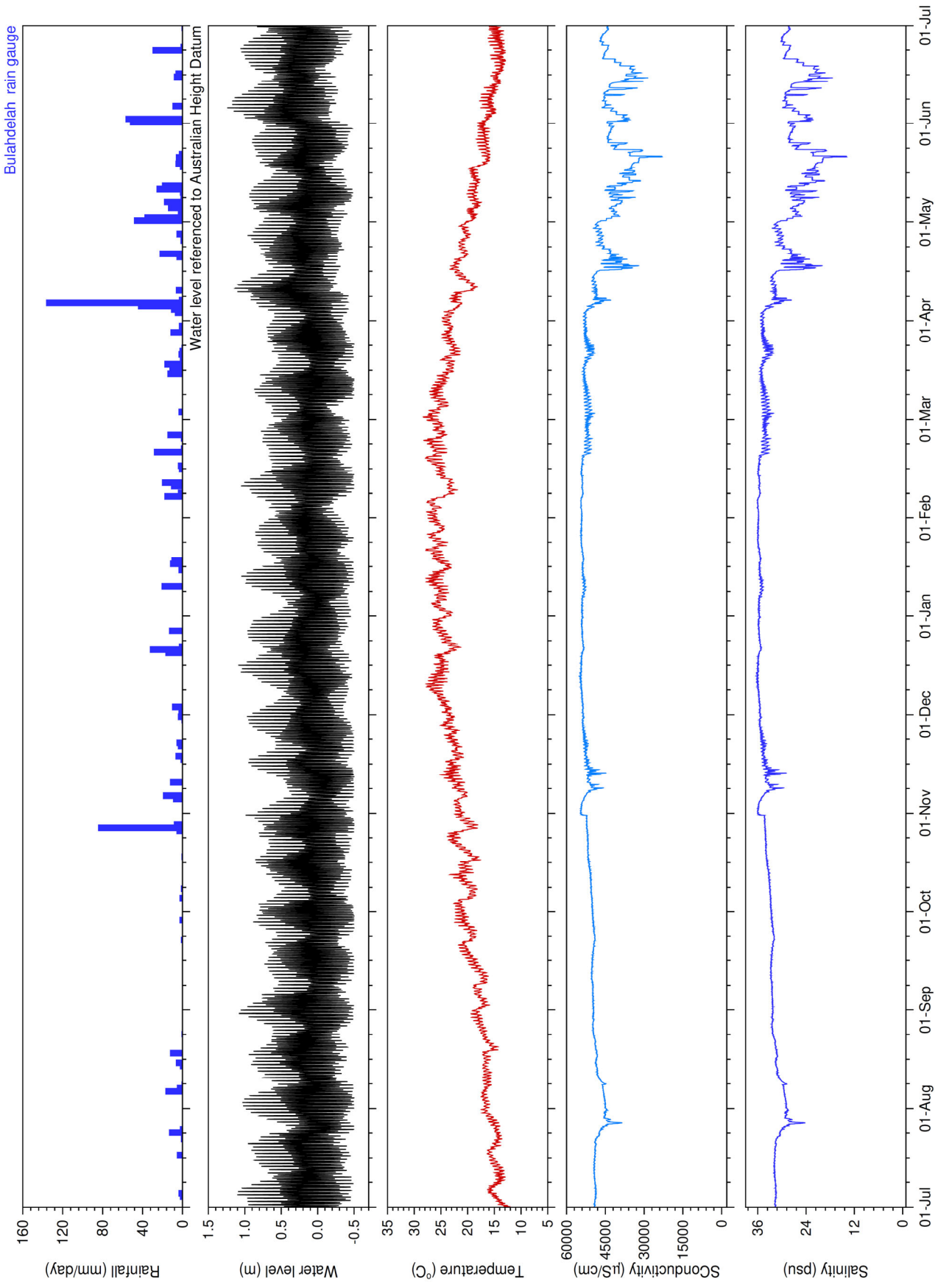


NSW GOVERNMENT

WATER QUALITY STATION LOCATIONS
PORT STEPHENS REGION

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-17



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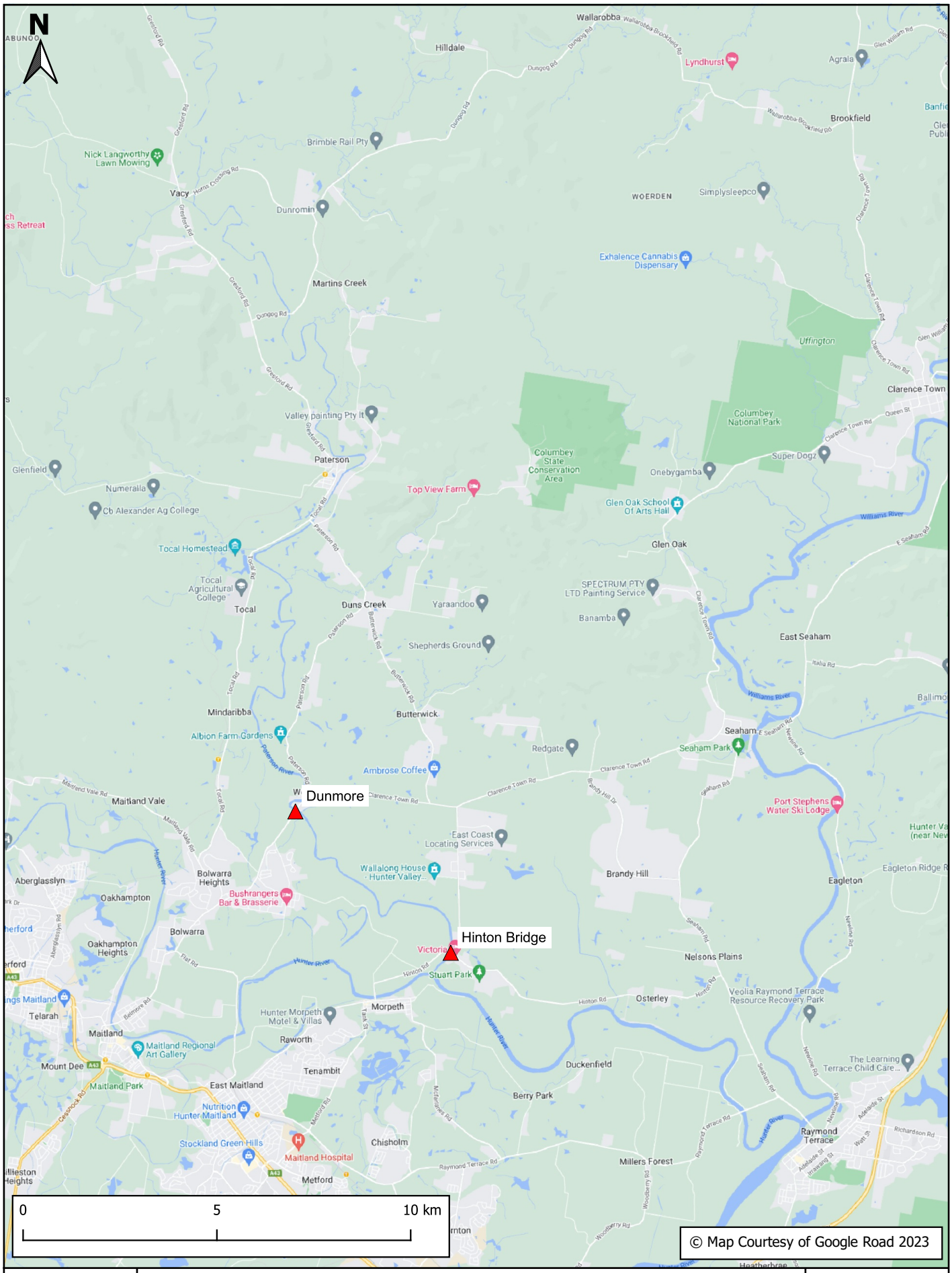
WATER LEVEL AND WATER QUALITY DATA
2023-24
TEA GARDENS

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-18

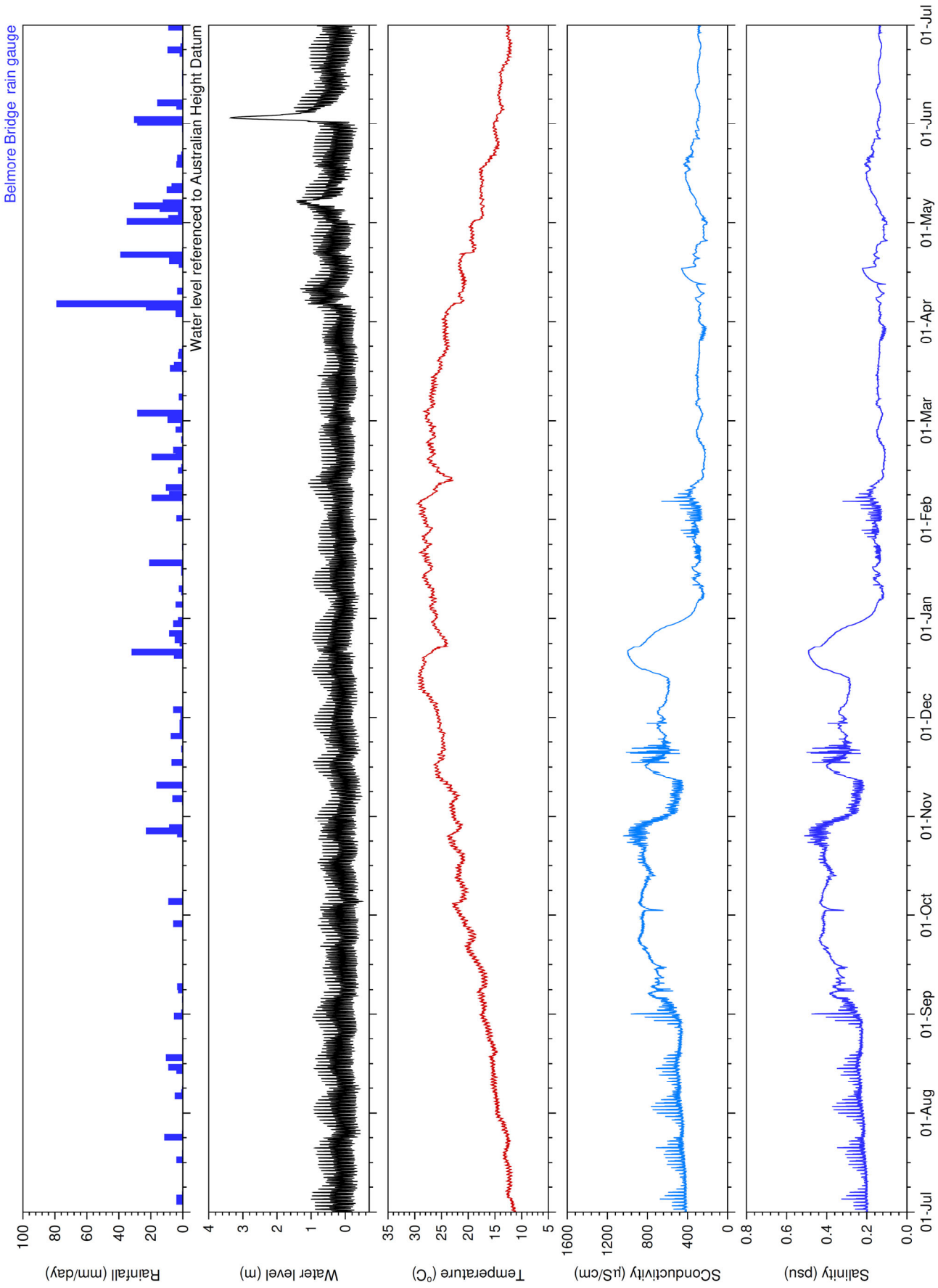


NSW GOVERNMENT

WATER QUALITY STATION LOCATIONS
PATERSON RIVER REGION

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-19



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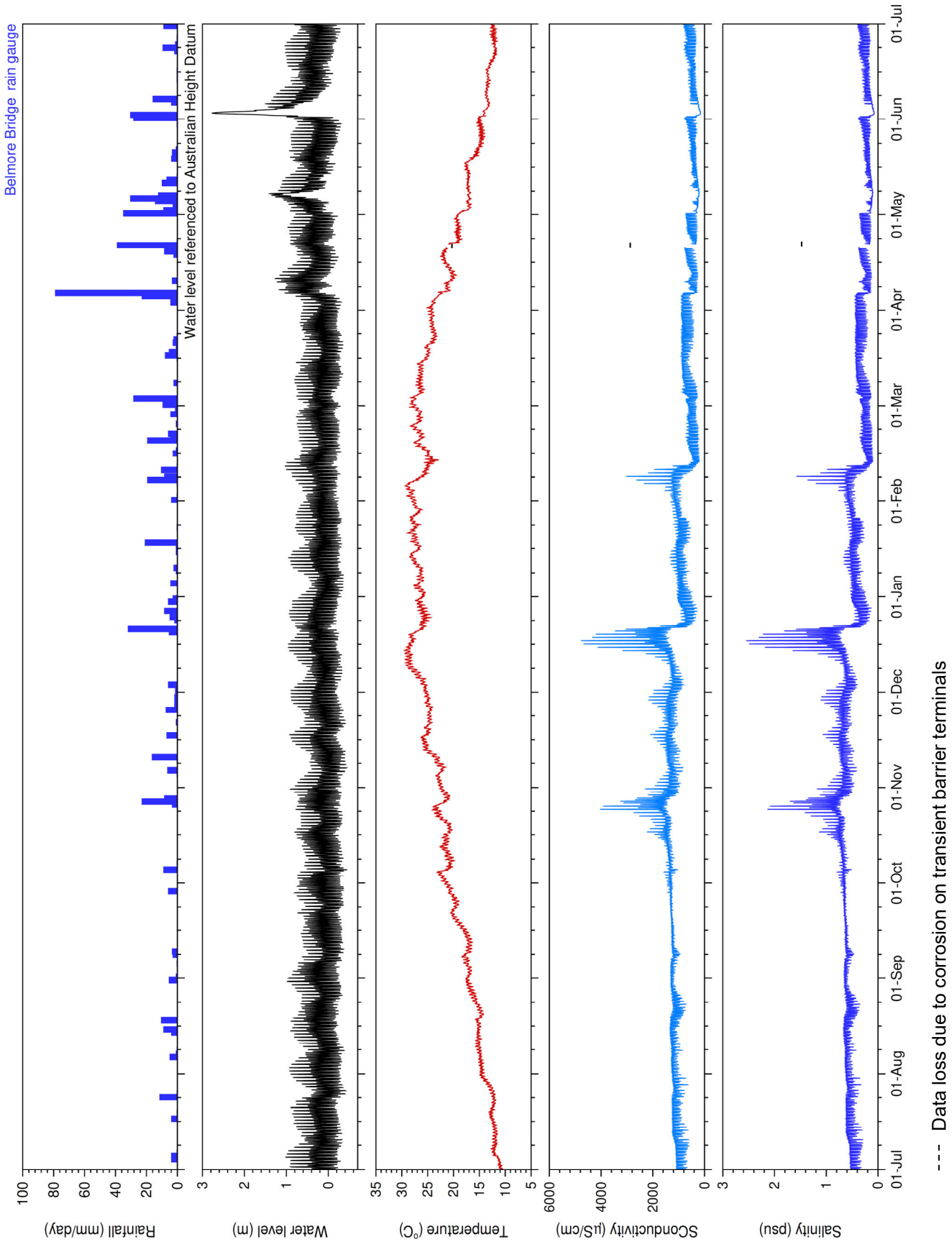
WATER LEVEL AND WATER QUALITY DATA
2023-24
DUNMORE

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-20



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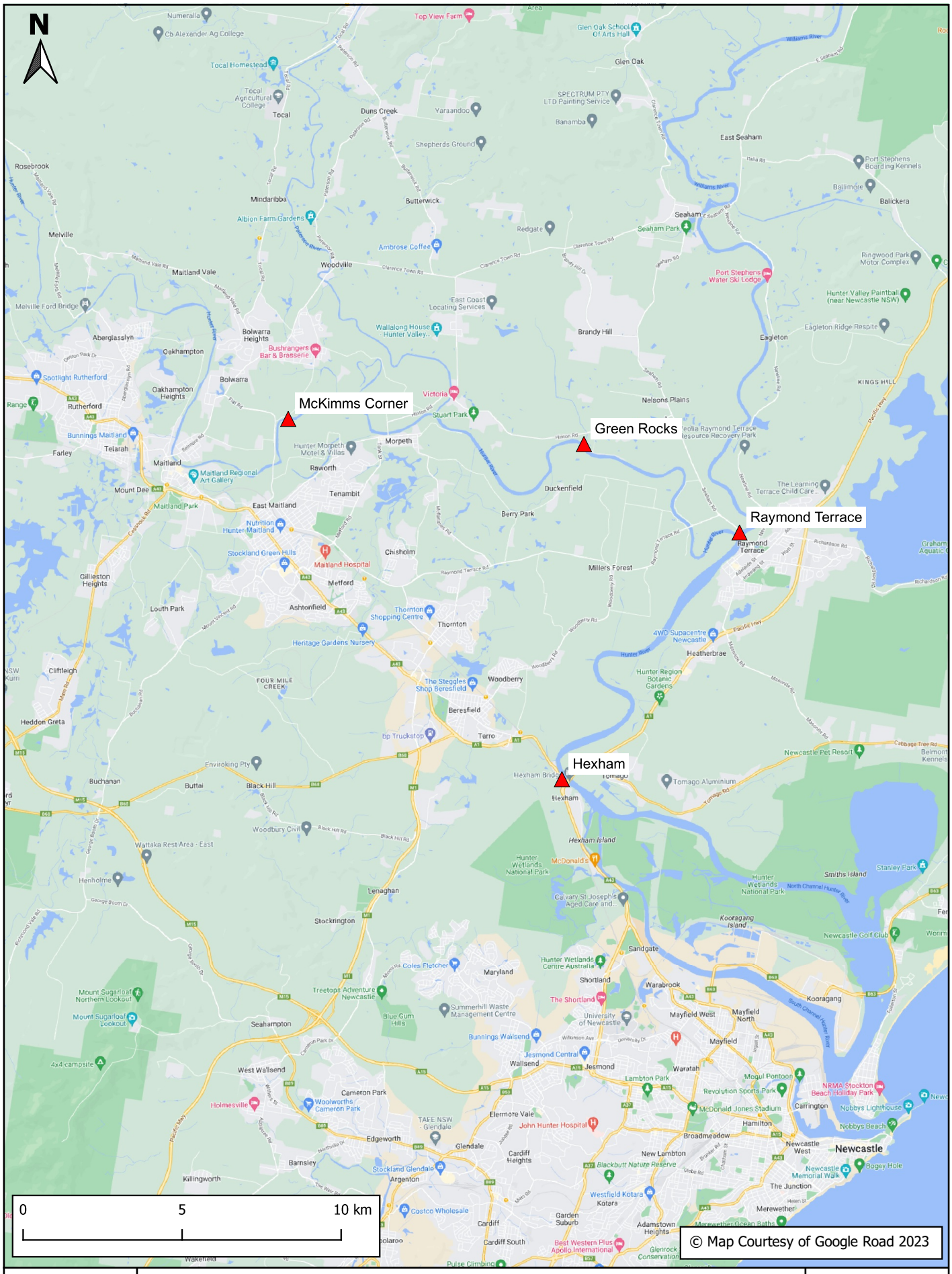
WATER LEVEL AND WATER QUALITY DATA
2023-24
HINTON BRIDGE

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-21

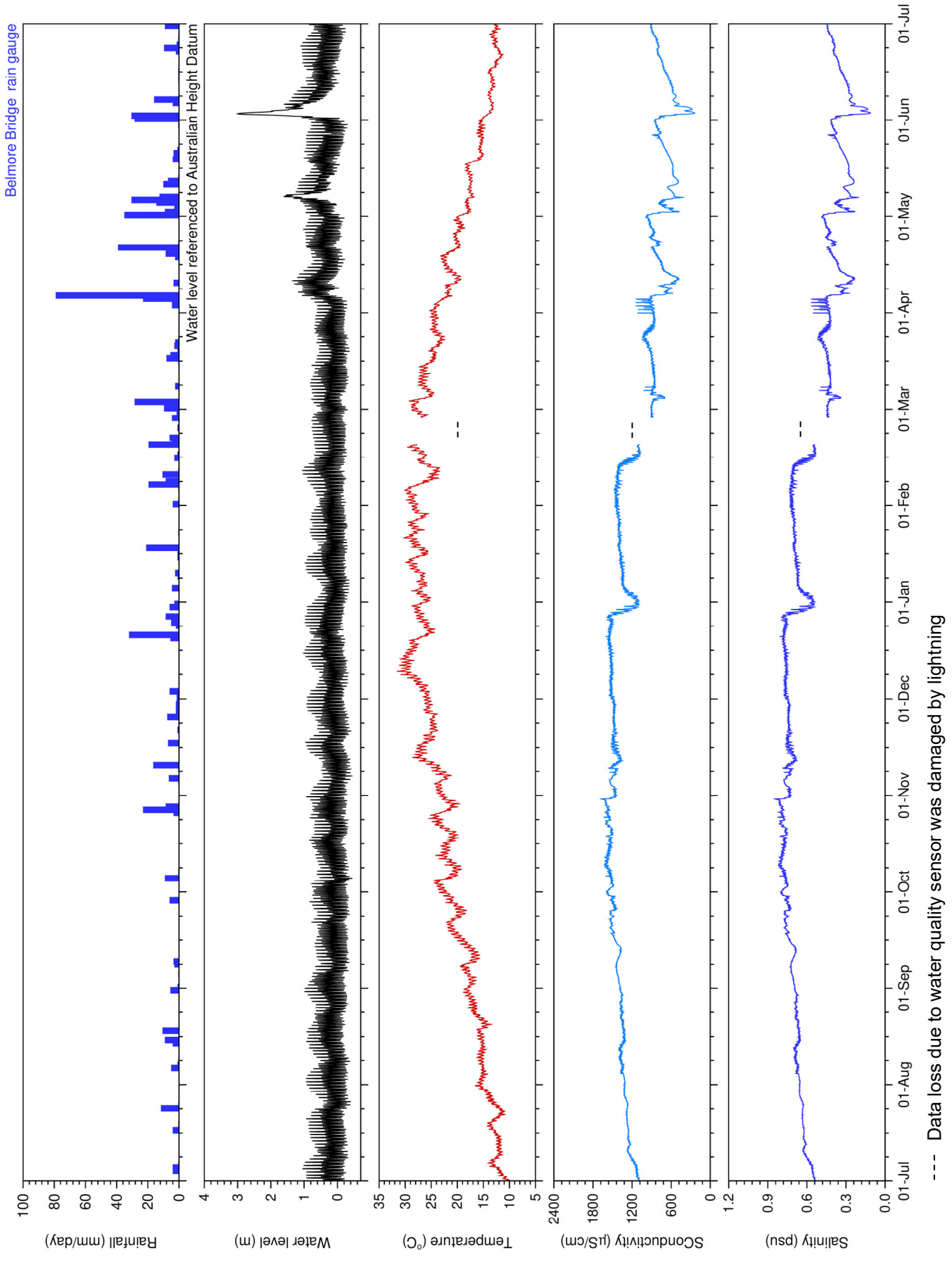


NSW GOVERNMENT

WATER QUALITY STATION LOCATIONS
HUNTER RIVER REGION

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-22

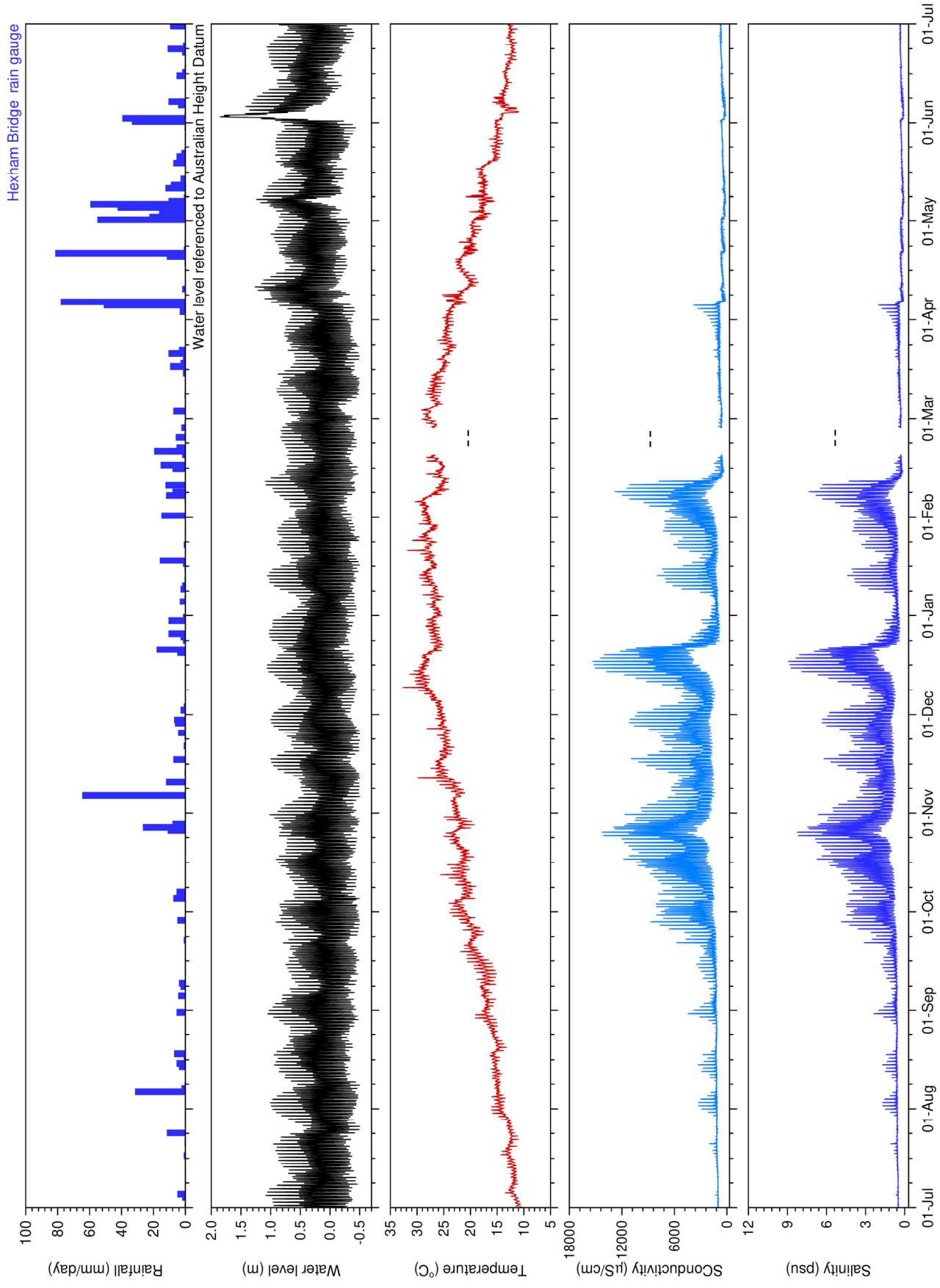


NSW GOVERNMENT

WATER LEVEL AND WATER QUALITY DATA
2023-24
McKIMMS CORNER

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-23



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WATER LEVEL AND WATER QUALITY DATA
2023-24
GREEN ROCKS

Manly Hydraulics Laboratory

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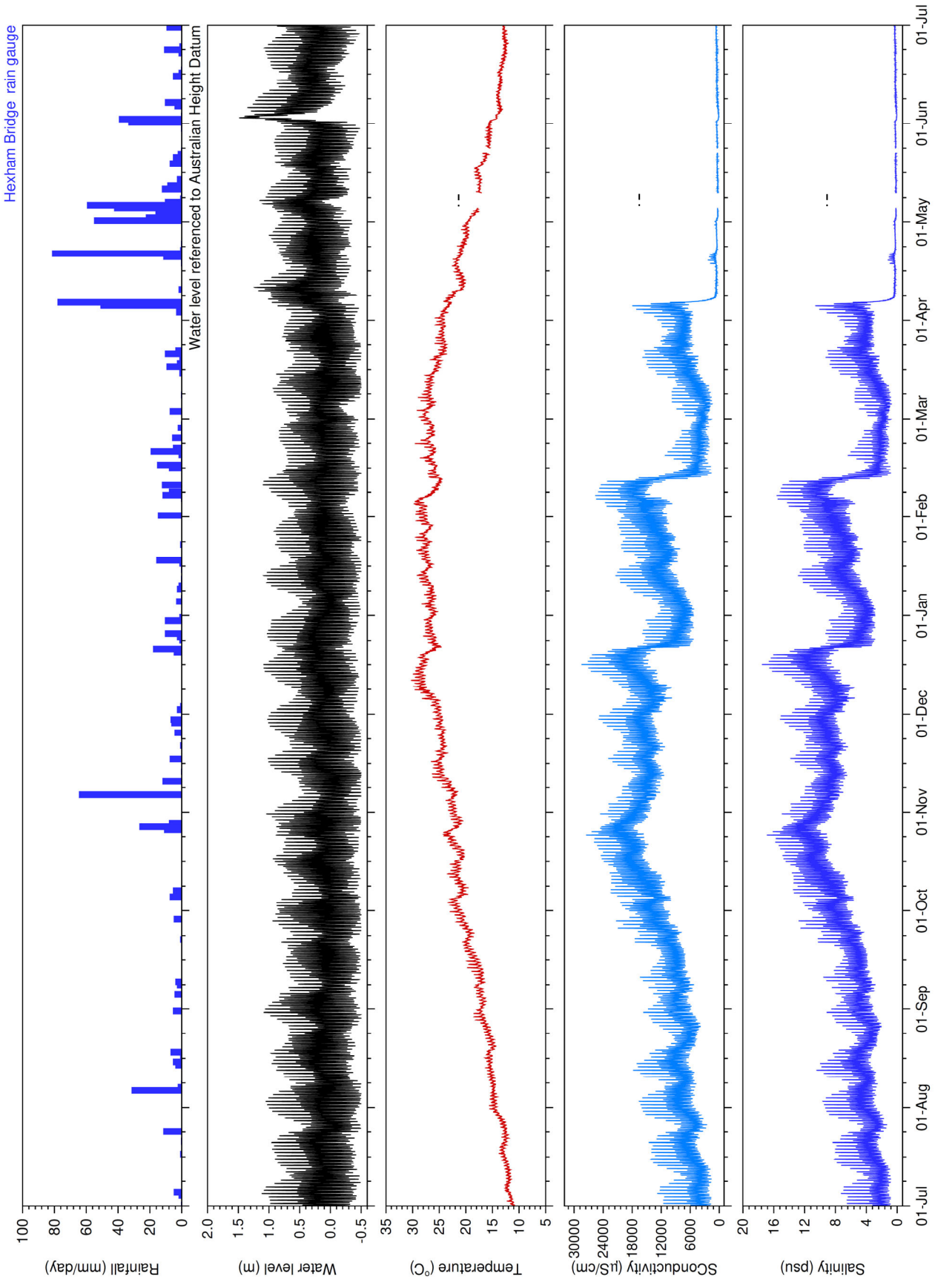
Figure
5-24



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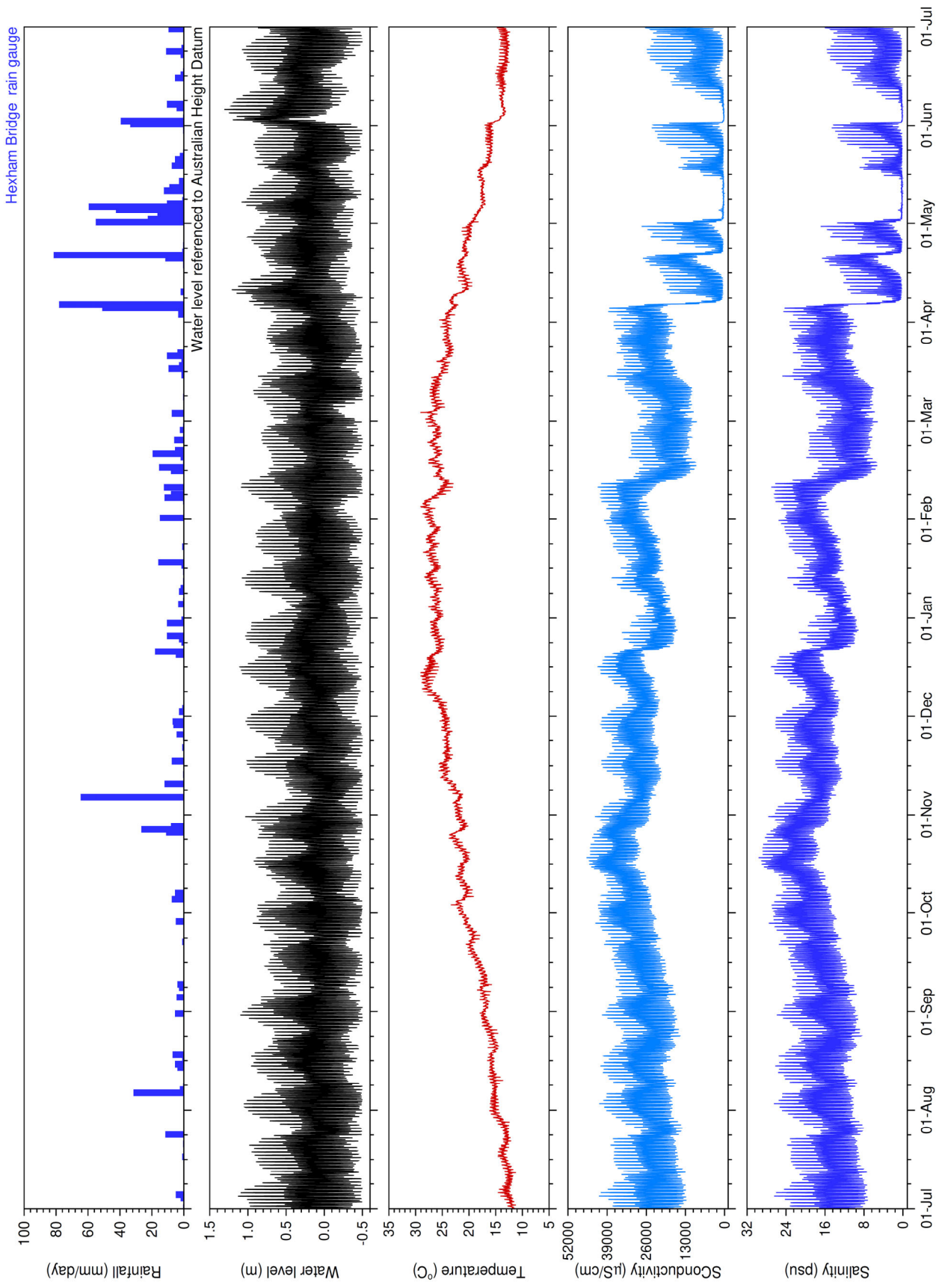
WATER LEVEL AND WATER QUALITY DATA
2023-24
RAYMOND TERRACE

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-25



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WATER LEVEL AND WATER QUALITY DATA
2023-24
HEXHAM BRIDGE

Manly Hydraulics Laboratory

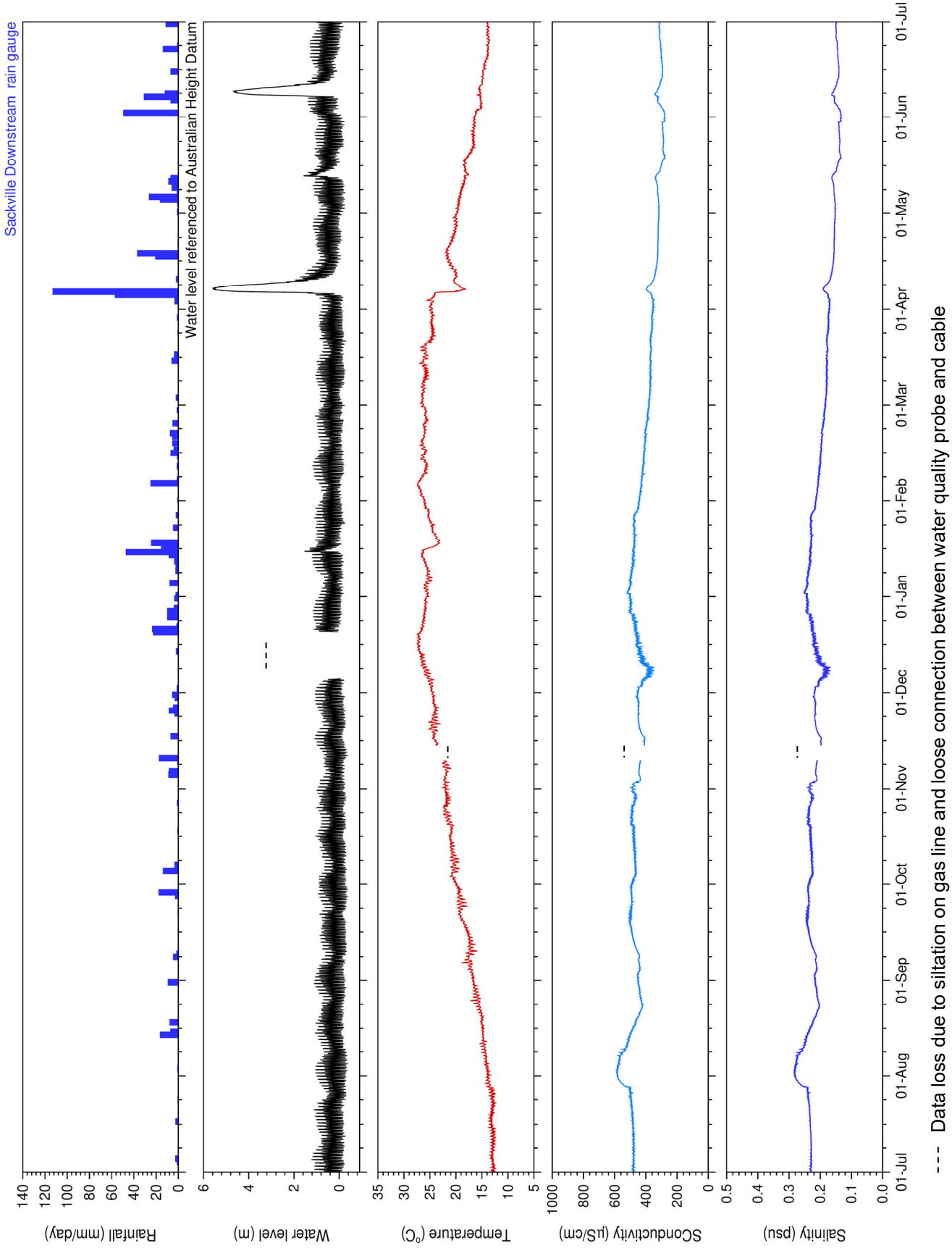
Report MHL3068
Figure
5-26

NSW GOVERNMENT

WATER QUALITY STATION LOCATIONS
HAWKESBURY RIVER REGION

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-27



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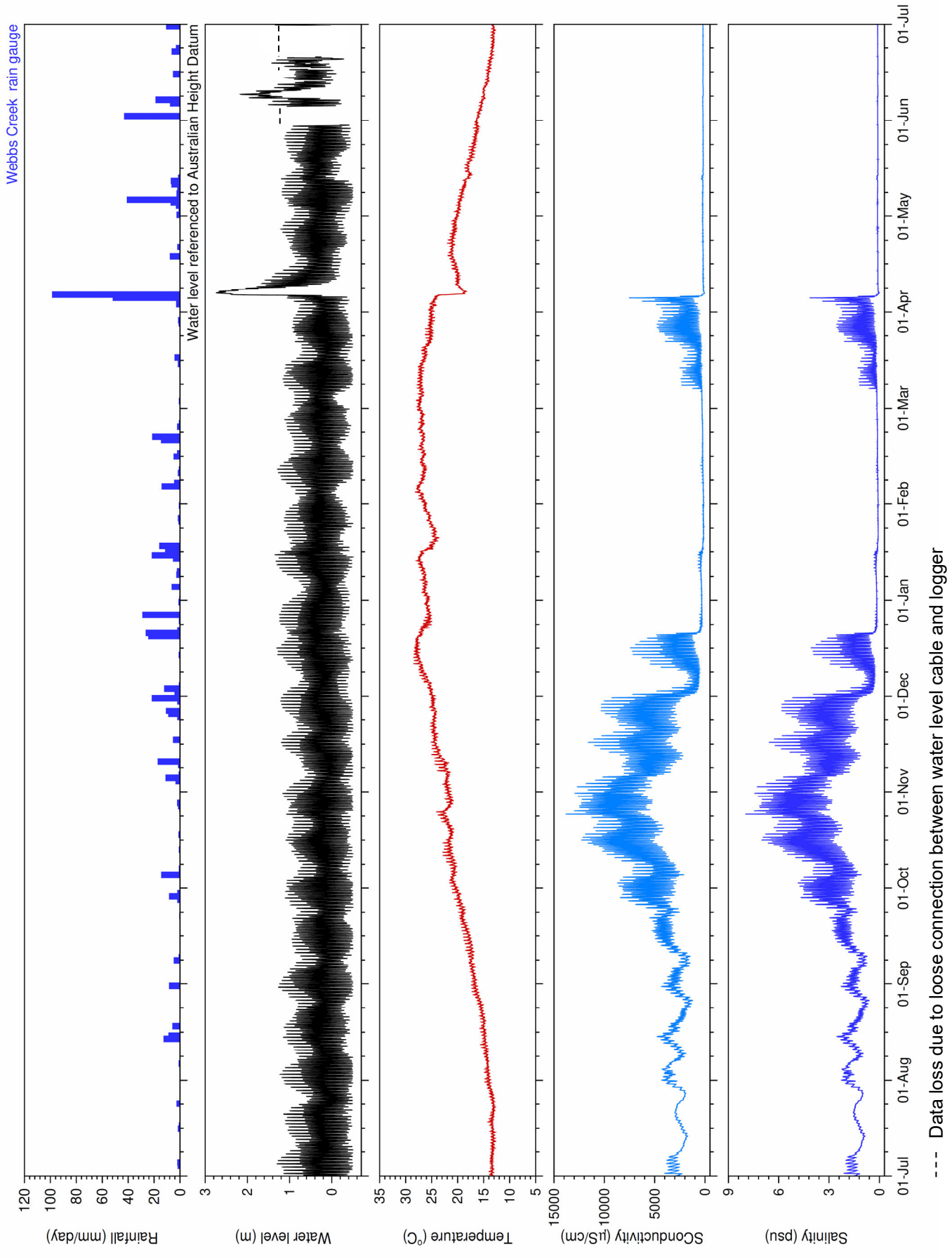
WATER LEVEL AND WATER QUALITY DATA
2023-24
SACKVILLE

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-28



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WATER LEVEL AND WATER QUALITY DATA
2023-24
LEETS VALE

Manly Hydraulics Laboratory

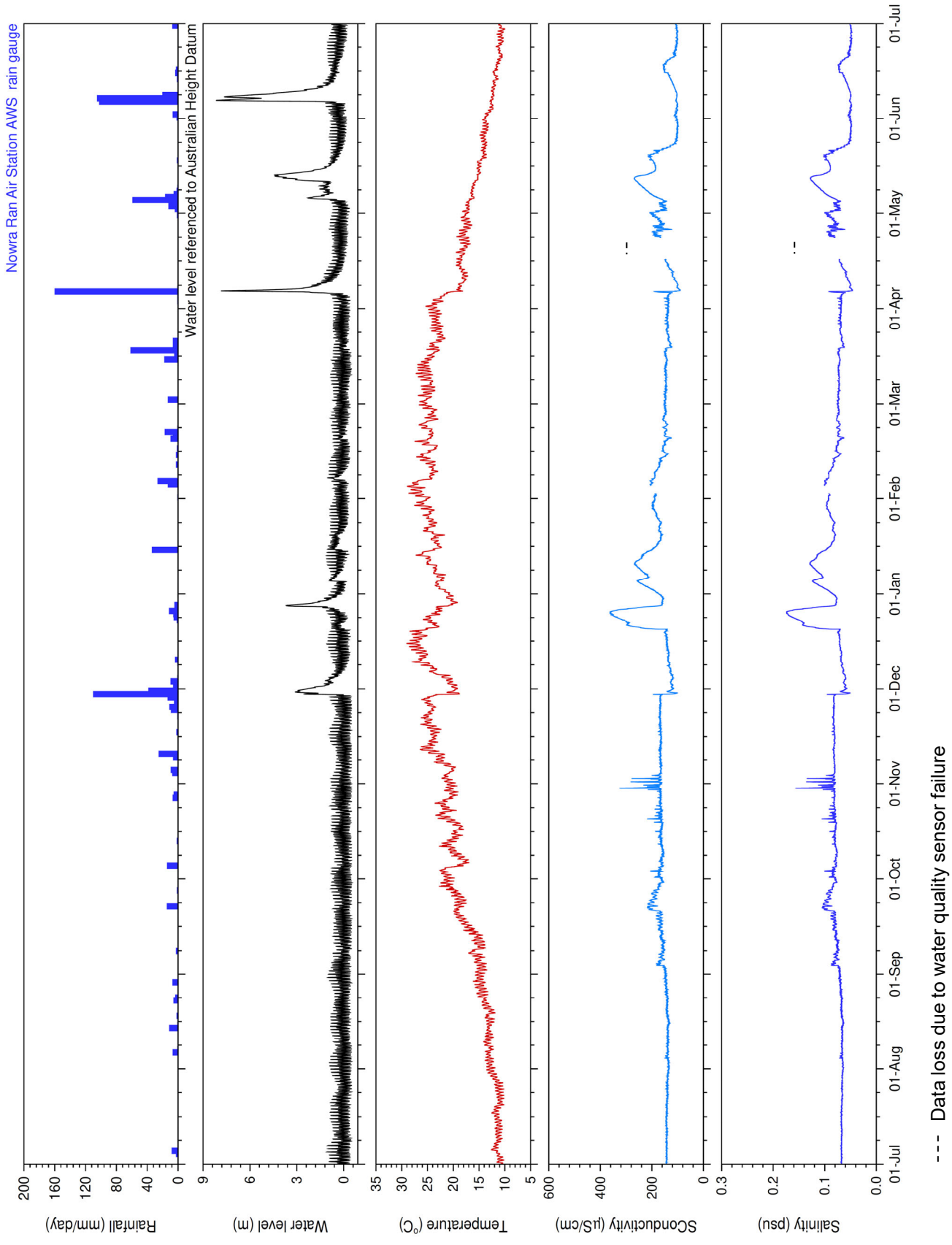
Report MHL3068
Figure
5-29

NSW GOVERNMENT

WATER QUALITY STATION LOCATIONS
SHOALHAVEN RIVER REGION

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-30

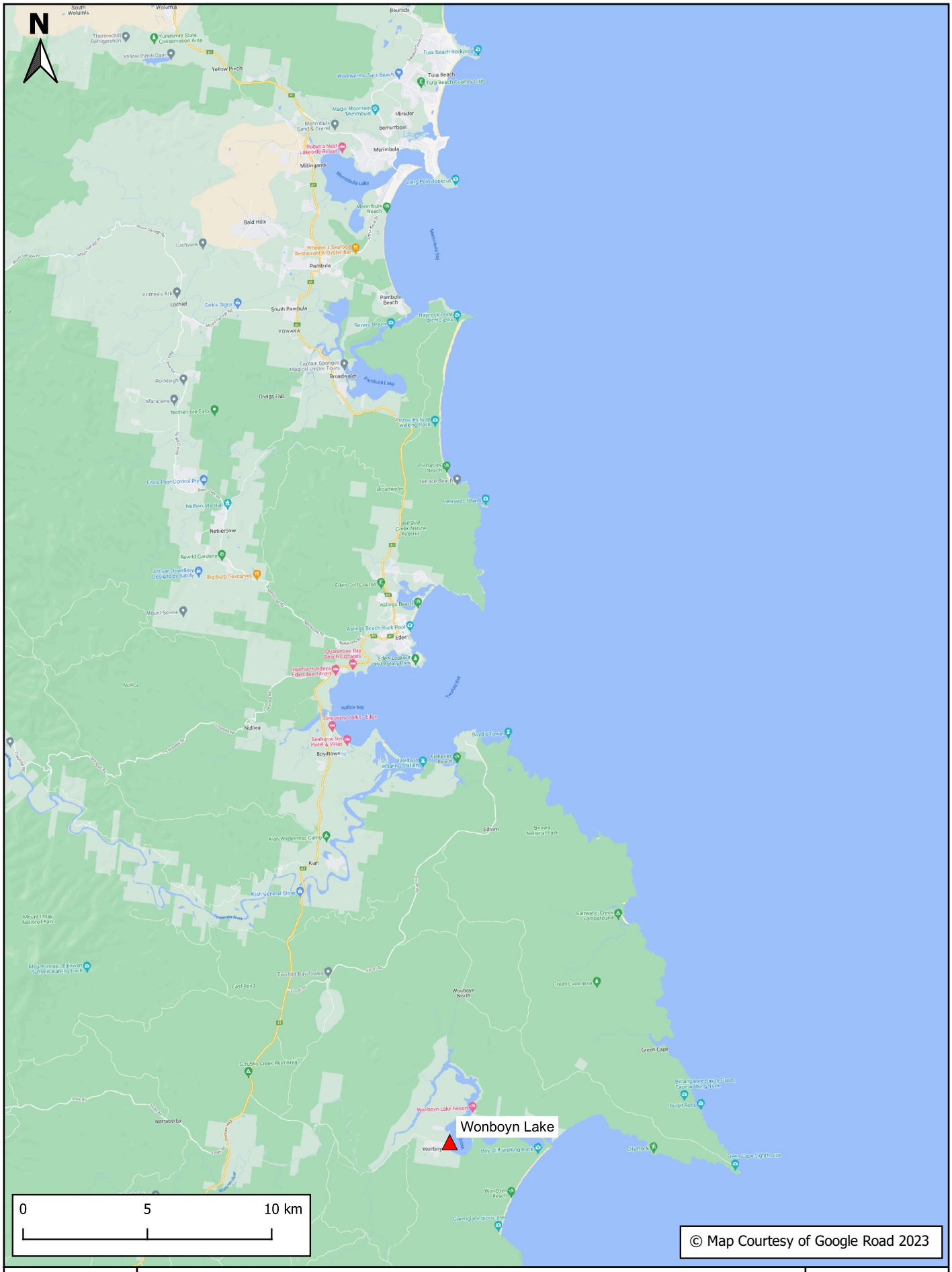


NSW GOVERNMENT

WATER LEVEL AND WATER QUALITY DATA
2023-24
GRADY'S CARAVAN PARK

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-31



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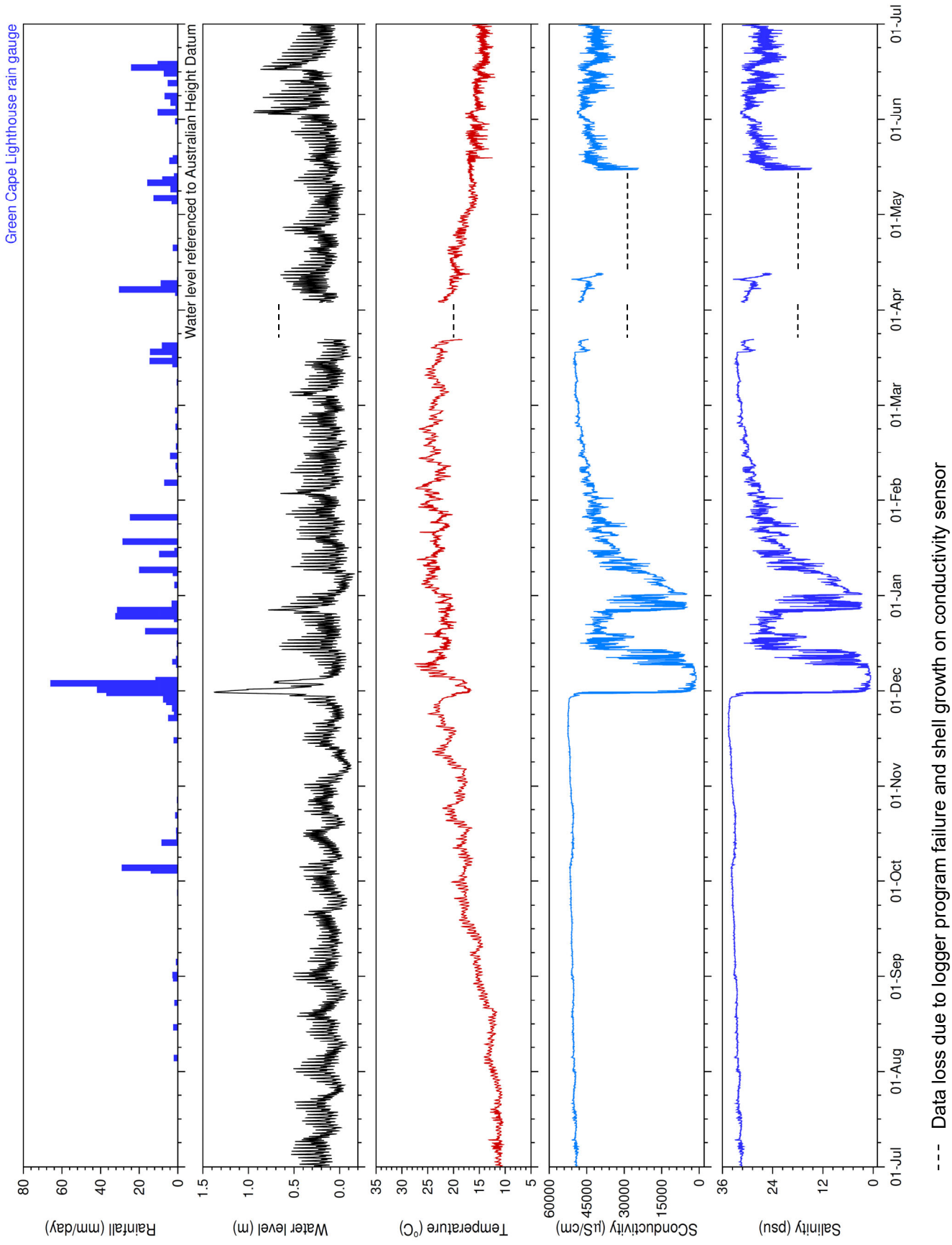
WATER QUALITY STATION LOCATIONS
WONBOYN LAKE

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-32



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WATER LEVEL AND WATER QUALITY DATA
2023-24
WONBOYN LAKE

Manly Hydraulics Laboratory

Report MHL3068
Figure
5-33

Appendix A Digitised continuous data

Please note that water quality data might not be continuous between a station's tabled start and end dates.

Table A1 Data on line

Station long name	Station name	Station number	Start date	End date	Water quality data collected	Additional MHL report number reference
Tweed River at Tumbulgum	Tumbulgum	201432	07-Nov-23	ongoing	COND, DO, fDOM, pH, SAL, TA, TEMP, TUR	
Brunswick River at Mullumbimby	Mullumbimby	202402	08-Apr-98	18-Mar-99	COND, DO, pH, SAL, TEMP, TUR	1000
Richmond River at Coraki	Coraki	203403	20-Sep-94	ongoing	COND, DO, pH, SAL, TEMP, TUR	749
Richmond River at Oakland Road	Oakland Road	203470	06-Mar-12	ongoing	COND, SAL, TEMP	
Tucombil Canal at Tucombil Highway Bridge	Tucombil Highway Bridge	203411	21-Aug-97	29-Aug-98	COND, DO, pH, SAL, TEMP	961
Rocky Mouth Creek at Rocky Mouth Creek	Rocky Mouth Creek	203432	06-Sep-94	21-Aug-96	COND, DO, pH, SAL, TEMP, TUR	794
Tucombil Canal at Tucombil Floodgate	Tucombil Floodgate	203434	09-Sep-94	29-Sep-95	COND, DO, ORP, pH, SAL, TEMP	961
Richmond River at Bungawalbin	Bungawalbin	203450	09-Sep-94	28-Aug-13	COND, DO, ORP, pH, SAL, TEMP	
Lennox Head at Lake Ainsworth	Lake Ainsworth	203455	15-Nov-95	ongoing	COND, DO, pH, SAL, TEMP	851
Clarence River at Maclean	Maclean	204410	07-Nov-23	ongoing	COND, DO, fDOM, pH, SAL, TA, TEMP, TUR	
Clarence River at Grafton	Grafton	204400	02-Mar-99	ongoing	COND, DO, pH, SAL, TEMP, TUR	1065
Clarence River at Rogans Bridge	Rogans Bridge	204413	09-Mar-99	ongoing	COND, DO, pH, SAL, TEMP, TUR	1065
Clarence River at Mylneford	Mylneford	204460	21-May-10	29-Jan-13	COND, SAL, TEMP	
Nambucca River at Macksville	Macksville	205416	17-Feb-99	22-Feb-00	COND, DO, pH, SAL, TEMP, TUR	1050
Coffs Creek at Coffs Creek Highway Bridge	Coffs Creek Highway Bridge	205439	14-Dec-92	23-Nov-96	TEMP	
Bonville Creek at Bonville	Bonville	205480	08-Aug-97	15-Feb-99	COND, DO, pH, SAL, TEMP, TUR	985

Station long name	Station name	Station number	Start date	End date	Water quality data collected	Additional MHL report number reference
Borirgala Creek at Borirgala Creek	Borirgala Creek	206450	06-Apr-01	26-Sep-01	COND, DO, pH, SAL, TEMP, TUR	1151
Macleay River at South West Rocks	South West Rocks	206456	01-Mar-96	01-Mar-99	pH	986
Macleay River at Euroka Upstream	Euroka Upstream	206458	07-Dec-09	17-Jun-11	COND, SAL, TEMP	
Macleay River at Kempsey	Kempsey	206402	09-Feb-10	ongoing	COND, SAL, TEMP	
Maria River at Green Valley	Green Valley	207406	30-Sep-94	01-Nov-95	COND, DO, ORP, pH, SAL, TEMP	760
Lake Cathie at Lake Cathie	Lake Cathie	207441	18-Aug-93	ongoing	COND, DO, ORP, pH, SAL, TEMP	
Manning River at Wingham	Wingham	208400	08-Dec-09	ongoing	COND, SAL, TEMP	
Manning River at Taree	Taree	208410	16-Feb-10	30-Oct-13	COND, SAL, TEMP	
Manning River at Taree West	Taree West	208420	30-Apr-10	ongoing	COND, SAL, TEMP	
Myall River at Bombah Point	Bombah Point	209475	09-Jul-96	ongoing	COND, SAL, TEMP	906
Myall River at Tea Gardens	Tea Gardens	209480	20-Oct-09	ongoing	COND, SAL, TEMP	
Paterson River at Dunmore	Dunmore	210409	15-Oct-09	ongoing	COND, SAL, TEMP	
Paterson River at Hinton Bridge	Hinton Bridge	210410	03-Dec-93	ongoing	COND, SAL, TEMP	750
Wallis Creek at Wallis Creek Upstream	Wallis Creek Upstream	210428	21-Sep-95	01-Oct-98	COND, DO, pH, SAL, TEMP	965
Hunter River at Green Rocks	Green Rocks	210432	03-Dec-93	ongoing	COND, SAL, TEMP	750
Hunter River at Hexham Bridge	Hexham Bridge	210448	17-Dec-93	ongoing	COND, SAL, TEMP	750
Hunter River at Fullerton Cove Salinity Buoy	Fullerton Cove Salinity Buoy	210149	21-Jun-13	01-Jul-16	COND, SAL, TEMP	
Williams River at Raymond Terrace	Raymond Terrace	210452	15-Oct-09	ongoing	COND, SAL, TEMP	
Hunter River at McKimms Corner	McKimms Corner	210455	08-Oct-09	ongoing	COND, SAL, TEMP	
Hunter River at Belmore Bridge	Belmore Bridge	210458	01-Dec-93	02-Jun-95	COND, TEMP	750

Station long name	Station name	Station number	Start date	End date	Water quality data collected	Additional MHL report number reference
Nepean River at Castlereagh	Castlereagh	212404	21-Feb-95	01-Jul-98	COND, DO, pH, SAL, TEMP, TUR	
Hawkesbury River at Sackville	Sackville	212406	01-Jul-94	ongoing	COND, DO, pH, SAL, TEMP, TUR	
Hawkesbury River at Colo Junction	Colo Junction	212407	07-Nov-09	05-Jul-13	COND, SAL, TEMP	
Hawkesbury River at Ebenezer	Ebenezer	212427	01-Jul-94	01-Jul-98	COND, DO, pH, SAL, TEMP, TUR	
Hawkesbury at Wisemans Ferry Wharf	Wisemans Ferry Wharf	212460	10-Jun-10	19-Jul-13	COND, SAL, TEMP	
Hawkesbury at Leets Vale	Leets Vale	212461	22-Jun-10	ongoing	COND, SAL, TEMP	
Shoalhaven at Grady's Caravan Park	Grady's Caravan Park	215430	06-Oct-10	ongoing	COND, SAL, TEMP	
Wollumboola Lake at Wollumboola	Wollumboola	215454	01-Feb-99	19-Jun-01	COND, DO, pH, SAL, TEMP, TUR	1145
Crookhaven River at Crookhaven Heads	Crookhaven Heads	215408	06-Mar-95	07-Apr-95	COND, DO, pH, SAL, TEMP	
Currarong Creek at Currarong Creek	Currarong Creek	216405	04-Mar-96	02-Mar-97	COND, DO, pH, SAL, TEMP	858
Swan Lake at Swan Lake	Swan Lake	216425	02-Feb-99	02-Feb-00	COND, DO, pH, SAL, TEMP, TUR	
Clyde River at Nelligen	Nelligen	216453	17-Sep-96	17-Sep-97	COND, DO, pH, SAL, TEMP	889
Tomaga at George Bass Drive	George Bass Drive	216455	28-Aug-96	27-Aug-97	COND, DO, pH, SAL, TEMP	890
Tuross River at Coila Lake	Coila Lake	218405	06-Oct-94	12-Nov-96	COND, DO, pH, SAL, TEMP	848
Wagonga River at Barlows Bay	Barlows Bay	218415	02-Sep-96	27-Aug-97	COND, DO, pH, SAL, TEMP, TUR	888
Wallaga Lake at Regatta Point	Regatta Point	219405	06-Mar-95	07-Apr-95	COND, DO, pH, SAL, TEMP	
Bega River at Bega	Bega	219410	24-Feb-10	21-May-13	COND, SAL, TEMP	
Back Lagoon at Back Lagoon	Back Lagoon	219415	25-Sep-97	24-Sep-98	COND, DO, pH, SAL, TEMP, TUR	963
Lake Curalo at Lake Curalo	Lake Curalo	220420	09-Mar-96	09-Mar-98	COND, DO, pH, SAL, TEMP, TUR	920
Wonboyn River at Agnew Wharf	Agnew Wharf	220425	20-Aug-97	20-Aug-98	COND, DO, pH, SAL, TEMP, TUR	964

Station long name	Station name	Station number	Start date	End date	Water quality data collected	Additional MHL report number reference
Wonboyn Lake at Hemingway Creek	Wonboyn Lake	220452	25-Oct-18	ongoing	COND, SAL, TEMP	
Bartletts Creek at Bartletts Creek	Bartletts Creek	201454	06-Jun-95	19-Mar-96	COND, DO, pH, SAL, TEMP	780
Leddays Creek at Leddays Creek	Leddays Creek	201452	02-Jun-95	31-Jul-96	COND, DO, pH, SAL, TEMP	780
Officer Drain at Officer Drain (near Ritchies Creek)	Officer Drain	201453	02-Jun-95	21-Mar-96	COND, DO, pH, SAL, TEMP	780
McLeods Drain at McLeods Drain (near Stotts Creek)	McLeods Drain	201436	21-Mar-96	31-Jul-96	COND, DO, pH, SAL, TEMP	780
McLeods Drain Offshoot at McLeods Drain Offshoot	McLeods Drain Offshoot	201436U	21-Mar-96	31-Sep-96	COND, DO, pH, SAL, TEMP	780
Cudgen Lake Site A	Cudgen Lake	202479	13-Oct-93	15-Oct-93	COND, SAL, TEMP	674
Cudgen Creek at Cudgen Lake West	Cudgen Lake West	202416W	08-Oct-93	05-Nov-93	COND, DO, ORP, pH, SAL, TEMP	674
Cudgen Creek at Cudgen Creek	Cudgen Creek	202419	15-Dec-92	05-Nov-93	COND, DO, ORP, pH, SAL, TEMP	674
Simpsons Creek at Belongil Creek	Belongil Creek	202423	06-Dec-94	17-Dec-96	COND, DO, ORP, pH, SAL, TEMP, TUR	
Richmond River at Shaws Bay	Shaws Bay	203490	11-Mar-99	12-Apr-00	COND, DO, pH, SAL, TEMP, TUR	755, 849
Marshalls Creek at Capricornia Canal	Capricornia Canal	202420	24-Mar-97	31-Mar-98	COND, DO, pH, SAL, TEMP, TUR	1051
Marshalls Creek at New Brighton	New Brighton	202421	17-Mar-97	01-Apr-98	COND, DO, pH, SAL, TEMP, TUR	1000
Brunswick River at Pacific Highway Bridge	Pacific Highway Bridge	202422	18-Mar-97	18-Mar-99	COND, DO, pH, SAL, TEMP, TUR	1000
Simpsons Creek at Simpsons Creek	Simpsons Creek	202424	03-Apr-98	18-Mar-99	COND, DO, pH, SAL, TEMP, TUR	1000
Tuckean Broadwater at Tuckean	Tuckean	203477	30-Oct-95	29-Oct-96	COND, DO, pH, SAL, TEMP, TUR	850
Richmond River at Empire Vale Creek	Empire Vale Creek	203489	08-May-98	12-Oct-99	COND, DO, pH, SAL, TEMP, TUR	1032

Station long name	Station name	Station number	Start date	End date	Water quality data collected	Additional MHL report number reference
Roberts Creek at Roberts Creek	Roberts Creek	204491	20-May-94	24-May-96	COND, DO, pH, SAL, TEMP, TUR	784
Clarence River at Tarrent Bridge	Tarrent Bridge	204415	04-Mar-99	11-Apr-00	COND, DO, pH, SAL, TEMP, TUR	1065
Andersons Inlet at Middle Island MM1	Middle Island MM1	206471	06-Apr-01	15-Dec-06	COND, DO, pH, SAL, TEMP, TUR	986
Andersons Inlet at Middle Island MM2	Middle Island MM2	206471	19-Mar-96	03-Feb-99	COND, DO, ORP, pH, SAL, TEMP	986
Andersons Inlet at Double Island	Double Island	206473	19-Mar-96	03-Feb-99	COND, DO, ORP, pH, SAL, TEMP	986
Macleay River at Andersons Inlet	Andersons Inlet	206470	06-Apr-01	27-Sep-01	COND, DO, pH, SAL, TEMP, TUR	1151
Maria River at Connection Creek	Connection Creek	207429	22-Sep-94	26-Oct-95	COND, DO, ORP, pH, SAL, TEMP	760
Hastings River at Lake Innes	Lake Innes	207442	19-Aug-93	07-Sep-94	COND, DO, ORP, pH, SAL, TEMP	760
Scotts Creek at Scotts Creek	Scotts Creek	208423	20-Oct-98	22-Oct-99	COND, DO, pH, SAL, TEMP, TUR	1029
Wallis Lake at Peach Tree Point	Peach Tree Point	209448	30-Jul-97	09-Mar-99	COND, DO, pH, SAL, TEMP, TUR	987
Wallis Lake at Wallamba Broadwater	Wallamba Broadwater	209449	30-Jul-97	25-Aug-98	COND, DO, pH, SAL, TEMP, TUR	987
Wallis Lake at Booti Island	Booti Island	209447	31-Jul-97	25-Aug-98	COND, DO, pH, SAL, TEMP, TUR	987
Wallis Lake at Darawakh Swamp	Darawakh Swamp	209405	26-Aug-98	08-Mar-99	COND, DO, pH, SAL, TEMP, TUR	987
Smiths Lake at Pacific Palms	Pacific Palms	209466	04-May-95	16-May-96	COND, DO, ORP, pH, SAL, TEMP	771
Myall Lake at Mayers Point	Mayers Point	209445	10-Jul-96	04-Mar-98	COND, DO, pH, SAL, TEMP	906
Myall River at Monkey Jacket	Monkey Jacket	209446	09-Jul-96	04-Mar-98	COND, DO, pH, SAL, TEMP	906
Lake Wollumboola at Wollumboola	Wollumboola	215454	01-Feb-99	19-Jun-01	COND, DO, pH, SAL, TEMP, TUR	1145
Tuross Lake at Trunketabella Bridge	Trunketabella Bridge	218412	04-May-94	11-Mar-98	COND, DO, ORP, pH, SAL, TEMP	921
Wallaga Lake at Meads Bay	Meads Bay	219407	03-Feb-99	10-Feb-00	COND, DO, pH, SAL, TEMP, TUR	1048
Hexham Swamp at Ironbark Creek Downstream	Ironbark Creek Downstream	210437D	01-May-98	15-Nov-16	COND, DO, pH, SAL, TEMP, TUR	

Station long name	Station name	Station number	Start date	End date	Water quality data collected	Additional MHL report number reference
Hexham Swamp at Ironbark Creek Upstream	Ironbark Creek Upstream	210437U	09-Aug-02	27-Oct-04	COND, DO, pH, SAL, TEMP, TUR	
Hexham Swamp at Morris Jetty	Morris Jetty	210484	07-Aug-02	30-Jun-09	COND, DO, pH, SAL, TEMP, TUR	
Hunter River at Fishery Creek	Fishery Creek	210485	08-Aug-02	07-Mar-03	COND, DO, pH, SAL, TEMP, TUR	
Hunter River at Fishery Creek 2	Fishery Creek 2	210485D	11-Jun-03	29-Aug-03	COND, DO, pH, SAL, TEMP, TUR	
Hexham Swamp at Shortland Wetland Centre	Shortland Wetland Centre	210483	10-Mar-99	04-Jul-00	COND, DO, pH, SAL, TEMP, TUR	1058
Lake Macquarie at Swansea Channel Site 4	Swansea Channel Site 4	211482	15-Apr-96	10-May-96	COND, DO, pH, SAL, TEMP	770
Lake Macquarie at Swansea Channel Site 5	Swansea Channel Site 5	211487	15-Apr-96	10-May-96	COND, DO, pH, SAL, TEMP	770
Berowra Creek at Oaky Point Site 2	Oaky Point Site 2	2124121	26-May-95	29-Nov-95	COND, DO, pH, SAL, TEMP	745
Narrabeen Lagoon at Narrabeen Bridge	Narrabeen Bridge	213422	23-Feb-96	15-Nov-05	COND, DO, pH, SAL, TEMP, TUR	
Shoalhaven River at Wharf Road	Wharf Road	215425	06-Mar-95	07-Apr-95	COND, DO, pH, SAL, TEMP	
Clyde River at Mays Wharf WQ (Site 9)	Mays Wharf WQ (Site 9)	216478	25-Sep-96	08-Oct-96	COND, pH, SAL, TEMP	792
Clyde River at Currowan Site 16A	Currowan Site 16A	216481	24-Sep-96	27-Sep-96	COND, SAL, TEMP	
Clyde River at Currowan Site 16B	Currowan Site 16B	216494	24-Sep-96	27-Sep-96	COND, SAL, TEMP	
Clyde River at Currowan Site 16C	Currowan Site 16C	216495	24-Sep-96	27-Sep-96	COND, SAL, TEMP	
Wonboyn River of Wonboyn Lake	Wonboyn River	220480	21-Aug-97	06-Sep-98	COND, DO, pH, SAL, TEMP, TUR	

Key:
COND = Conductivity
DO = Dissolved oxygen
fDOM = Fluorescent Dissolved Oxygen Matter
ORP = Oxidation-reduction potential
pH = Potential of Hydrogen
SAL = Salinity
TA = Total Algae
TEMP = Temperature
TUR = Turbidity

Appendix B 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), 2474 (15-16), 2573 (16-17), 2617 (17-18), 2692 (18–19), 2769 (19–20), 2855 (20-21), 2906 (21–22), 2994 (22-23), 3064 (23-24).

MHL annual ocean tide levels and coastal air pressure summaries available:

MHL Report Nos. 515 (86–87), 544 (87–88), 563 (88–89), 585 (89–90), 602 (90–91), 628 (91–92), 658 (92–93), 697 (93–94), 732 (94–95), 777 (95–96), 876 (96–97), 947 (97–98), 1013 (98–99), 1069 (99–00, 1129 (00–01), 1205 (01–02), 1277 (02–03), 1347 (03–04), 1423 (04–05), 1512 (05–06), 1764 (06–07), 1848 (07–08), 1933 (08–09), 2010 (09–10), 2089 (10–11), 2158 (11–12), 2219 (12–13), 2292 (13–14), 2384 (14–15), 2475 (15-16), 2574 (16-17), 2618 (17-18), 2693 (18–19), 2770 (19–20), 2856 (20-21), 2907 (21–22), 2995 (22-23), 3065 (23-24).

MHL annual coastal rainfall summaries available:

MHL Report Nos. 610 (90–91), .624 (91–92), 660 (92–93), 699 (93–94), 730 (94–95), 776 (95–96), 874 (96–97), 946 (97–98), 1015 (98–99), 1071 (99–00), 1131 (00–01), 1207 (01–02), 1278 (02–03), 1348 (03–04), 1424 (04–05), 1513 (05–06), 1765 (06–07), 1849 (07–08), 1934 (08–09), 2011 (09–10), 2090 (10–11), 2159 (11–12), 2220 (12–13), 2293 (13–14), 2385 (14–15), 2476 (15-16), 2575 (16-17), 2619 (17-18), 2694 (18–19), 2771 (19–20), 2857 (20-21), 2908 (21–22), 2996 (2022-23), 3066 (23-24).

MHL annual wave climate and coastal air pressure summaries available:

MHL Report Nos. 547 (87–88), 560 (88–89), 581 (89–90), 600 (90–91), 627 (91–92), 655 (92–93), 695 (93–94), 733 (94–95), 779 (95–96), 877 (96–97), 948 (97–98), 1016 (98–99), 1072 (99–00), 1132 (00–01), 1208 (01–02), 1279 (02–03), 1349 (03–04), 1425 (04–05), 1514 (05–06),1766 (06–07), 1850 (07–08), 1935 (08–09), 2012 (09–10), 2091 (10–11), 2160 (11–12), 2221 (12–13), 2294 (13–14), 2386 (14–15), 2477 (15-16), 2576 (16-17), 2620 (17-18), 2695 (18–19), 2772 (19–20), 2858 (20-21), 2909 (21–22), 2997 (22-23), 3067 (23-24).

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), 2577 (16-17), 2621 (17-18), 2696 (18–19), 2773 (19–20), 2859 (20-21), 2910 (21–22), 3001 (22-23), 3068 (23-24).

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.

110B King Street

Manly Vale NSW 2093