NSW Border Rivers valley annual surface water quality report: 2023–2024

Key Points

- Flow from July 2023 to June 2024 was primarily characterised by low flow conditions across much of the catchment. There were higher flows in the regulated Dumaresq and Macintyre rivers from September to February due to releases from the two major storages, Glenlyon and Pindari Dams.
- Heavy rainfall in Southern Queensland from ex-tropical Cyclone Megan resulted in moderate flooding in the lower Macintyre River in April 2024. There were no reports of fish deaths in the Border Rivers catchment.
- The water quality index indicated that of the 15 routine monitoring sites in the catchment, 14 were rated as moderate and one as poor. Seven sites returned a lower water quality index score in 2023–2024 compared to 2022–2023.
- All sites were below the Basin Plan agriculture and irrigation salinity target of 957 µS/cm (microSiemens per centimetre). The median and 80th percentile at Mungindi were both above the End-of Valley targets of 281 µS/cm and 380 µS/cm, respectively. Due to lower flows during 2023–2024, the annual salt load was less than the End-of-Valley target.
- Pindari Dam had a red alert warning for blue-green algae from October 2023 through until January 2024. A red alert warning for recreational use was also issued for Lake Inverell on the Macintyre River from February to May 2024.

The water quality data used in this report is compiled from 15 routine water quality monitoring sites. The data is collected monthly for 2 monitoring programs, with 10 sites collected under the Border Rivers Water Quality Monitoring Program on behalf of the Dumaresq-Barwon Rivers Commission and 5 sites for the State Water Quality Assessment and Monitoring Program. These programs are responsible for collecting, analysing and reporting the ambient water quality condition of rivers in NSW. This annual report summarises the surface water quality data collected in the Border Rivers Valley from July 2023 to June 2024. The location of monitoring sites is shown in Figure 1.

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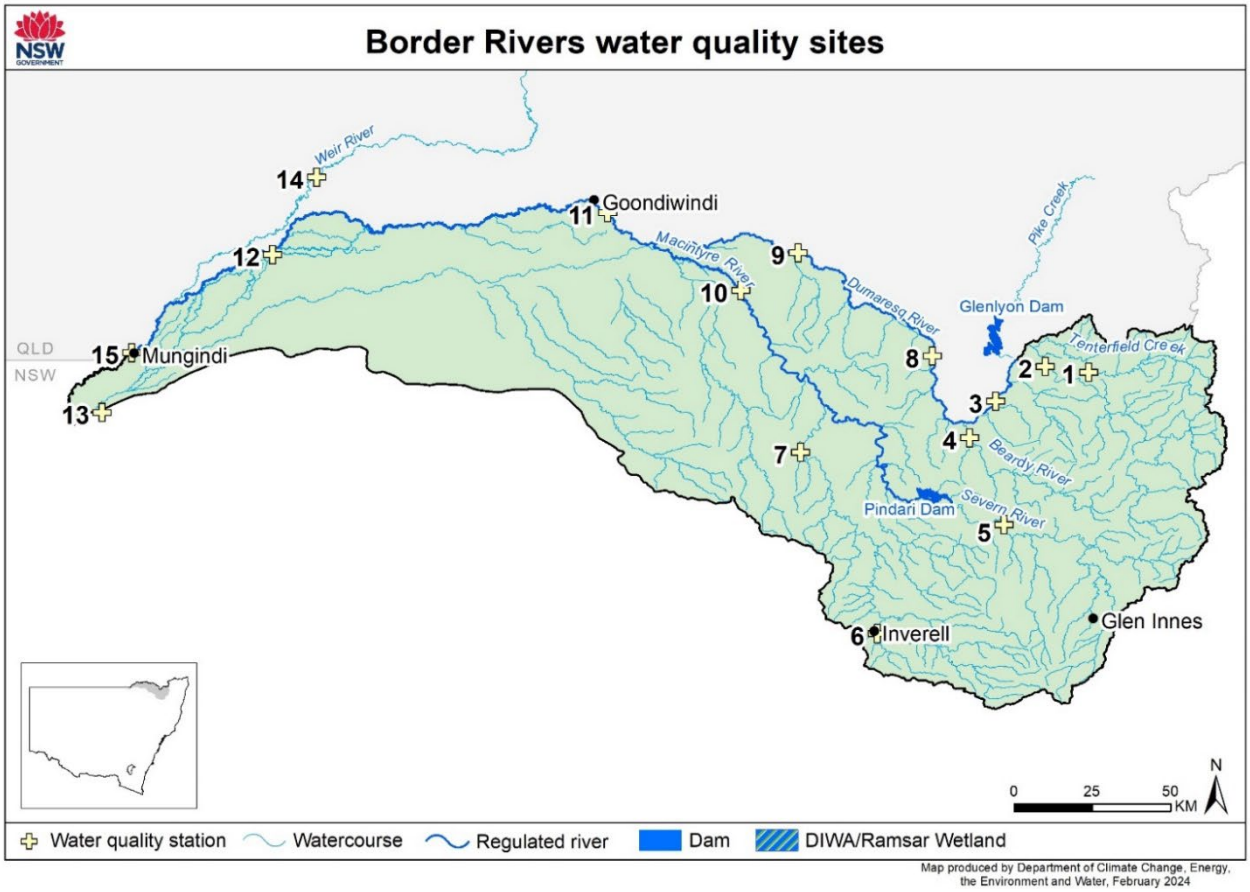

Figure 1: Location of routine water quality monitoring sites in the Border Rivers valley

Table 1: Site information for each monitoring site in the Border Rivers catchment. Refer to Figure 1 and the site numbers for the location of each site

Site number	Site name	Water Quality Zone	Station number
1	Tenterfield Creek at Clifton	Unregulated Dumaresq uplands	416003
2	Mole River at Donaldson	Unregulated Dumaresq uplands	416032
3	Dumaresq River at Roseneath	Regulated Dumaresq uplands	416011
4	Beardy River at Haystack	Unregulated Dumaresq uplands	416008
5	Severn River at Strathbogie Road Bridge	Macintyre Montane	416039
6	Macintyre River at Inverell	Unregulated Macintyre River uplands	416016
7	Macintyre River at Wallangra	Unregulated Macintyre River uplands	416010
8	Dumaresq River at Bonshaw Weir	Regulated Dumaresq uplands	416007
9	Dumaresq River at Glenarbon Weir	Regulated Dumaresq uplands	416040
10	Macintyre River at Holdfast Crossing	Regulated Macintyre uplands	416012
11	Macintyre River at Salisbury Bridge	Regulated Macintyre uplands	41610044
12	Macintyre River at Kanowna	Border Rivers lowlands	416048
13	Gil Gil Creek at Collarenebri Road Bridge	Border Rivers lowlands	41610152
14	Weir River at Tallwood	Border Rivers lowlands	416202A
15	Barwon River at Mungindi	Border Rivers lowlands	416001

Catchment description

The Border Rivers Catchment is located on the NSW/Queensland border, with an area of 24,000 km^2. The NSW portion of the Border Rivers rises in the hilly and rugged granite and basalt areas of the New England Tablelands to an elevation of 1,300 m above sea level. The catchment is bounded by the Gwydir Catchment to the south, the Great Dividing Range to the east, and the Queensland border to the north.

The Border Rivers catchment consists of several major upland tributaries and flows westward onto a flat plain with numerous channels. In the north-east, the Macintyre River rises in the Waterloo Range and is 300 km in length. The Severn River (NSW) is a major tributary of the Macintyre River and flows into Pindari Dam. Immediately to the north and flowing into the Macintyre River is the Dumaresq River. The Dumaresq River is 214 km in length and is formed by the joining of the Severn River, that rises in Queensland, and Tenterfield Creek, which rises in the New England Tablelands west of Tenterfield. Other tributaries are Pike Creek (Queensland), which flows into Glenlyon Dam, Mole River and Beardy River. Pindari Dam (NSW) and Glenlyon Dam (QLD) are the 2 major water storages influencing flow in the catchment.

Land use in the NSW Border Rivers catchment is largely grazing in the upper catchment, with increased cultivation in the mid and lower sections. Irrigated agriculture is mostly located adjacent to the Macintyre River downstream from Boggabilla.

Catchment conditions during 2023–2024

Flow from 2023 to 2024 was characterised by low rainfall from July to October which resulted in low flows in most creeks and rivers across the catchment (Figure 2A). Increased rainfall from November to January combined with releases from Pindari and Glenlyon Dams maintained higher flows over the summer. Releases saw Glenlyon Dam drop from 95% capacity to 60% and Pindari Drop from 84% to 50% in early 2024 (Figure 2B). Figure 2C highlights that there was no widespread flooding across the Border Rivers catchment in 2023–2024. Heavy rainfall in Southern Queensland from ex-tropical Cyclone Megan resulted in moderate flooding in the lower Macintyre River in April 2024. Discharge in the Barwon River at Mungindi peaked at 12,997 ML/day on 20 April 2024 and then quickly receded (Figure 2C).

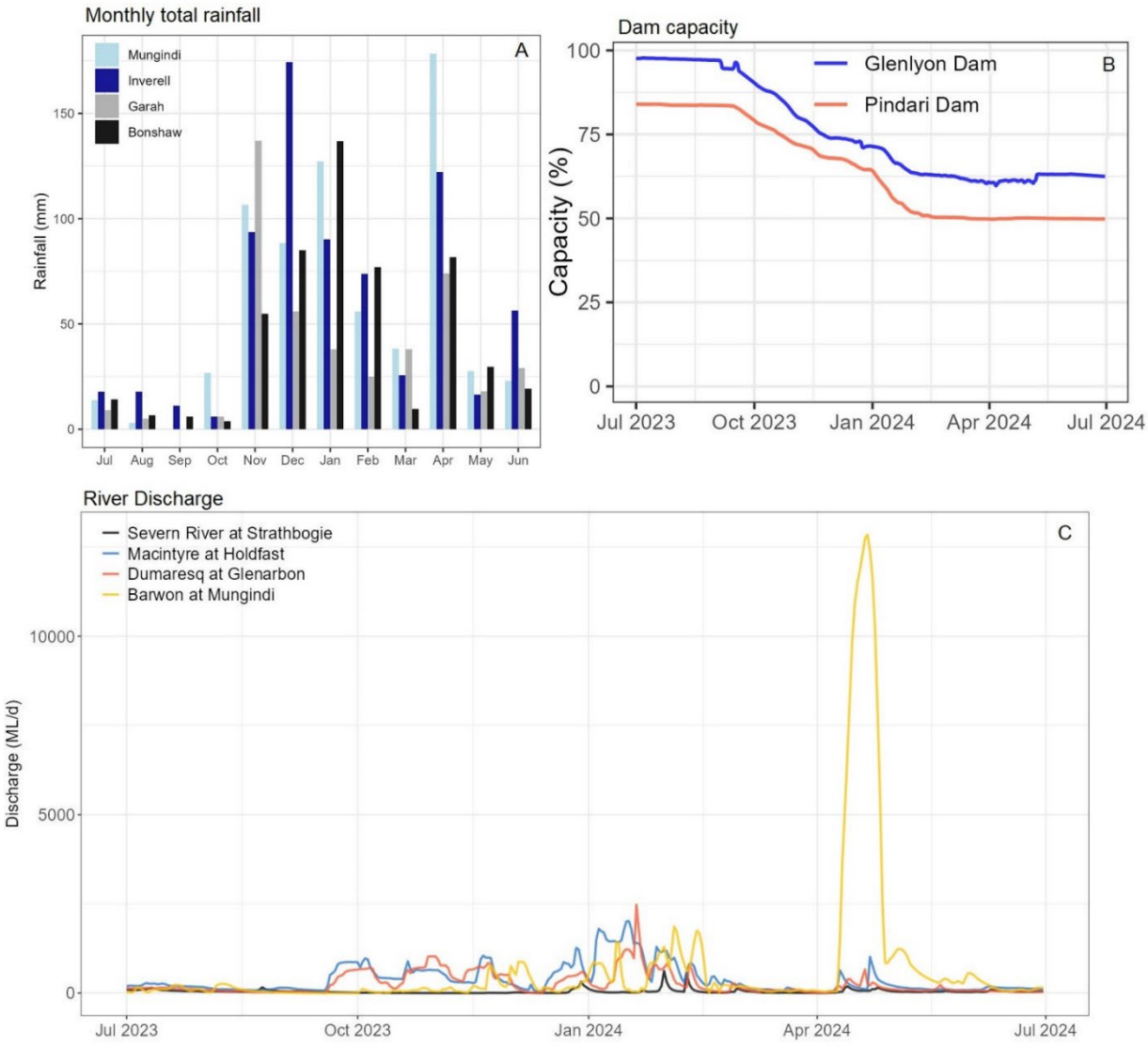

Figure 2: Catchment conditions for selected stations in the Border Rivers catchments from July 2023 to June 2024 for A: Monthly total rainfall (mm), B: Dam capacity (%) and C: River discharge (ML/day).

Water quality for water dependent ecosystems

NSW uses a Water Quality Index (WaQI) to communicate complex and technical water quality data simply and consistently. The WaQI score is calculated for each monitoring site using total nitrogen, total phosphorus, turbidity, pH, dissolved oxygen and electrical conductivity. The index compares the monthly water quality results against predetermined water quality targets to calculate a score between one and 100. A score of 100 represents a site in pristine condition, while a score of one is a highly degraded site. This value can then be categorised to rate the general water quality at a monitoring site. The results from the WaQI are summarised in Figure 3. Sites with a change of less than 5 points in WaQI score have been identified with horizontal arrows. Arrows pointing up or down indicate the score has increased/decreased by more than 5 points.

Compared to the 2022–2023 results, the water quality index category ratings in the Border Rivers remained the same in 2023–2024 for 14 of the 15 sites. One site (Barwon River at Mungindi) had a decline in rating from good to moderate.

The Weir River at Tallwood was the only site in the Border Rivers catchment rated as poor. The index score in the Weir River was low due to high readings for turbidity, total nitrogen and total phosphorus concentrations. All other Border Rivers sites were rated as moderate.

The index score at 5 of the 15 sites showed minimal change. Three sites (Macintyre River at Holdfast Crossing, Beardy River at Haystack and Severn River at Strathbogie Road Bridge) returned a better index score than in 2022–2023, largely in response to lower turbidity and nutrient concentrations.

The remaining 7 sites returned a lower index score than in 2022–2023. There was a general trend of higher electrical conductivity in unregulated upland catchments in response to lower rainfall and flows compared to the previous year.

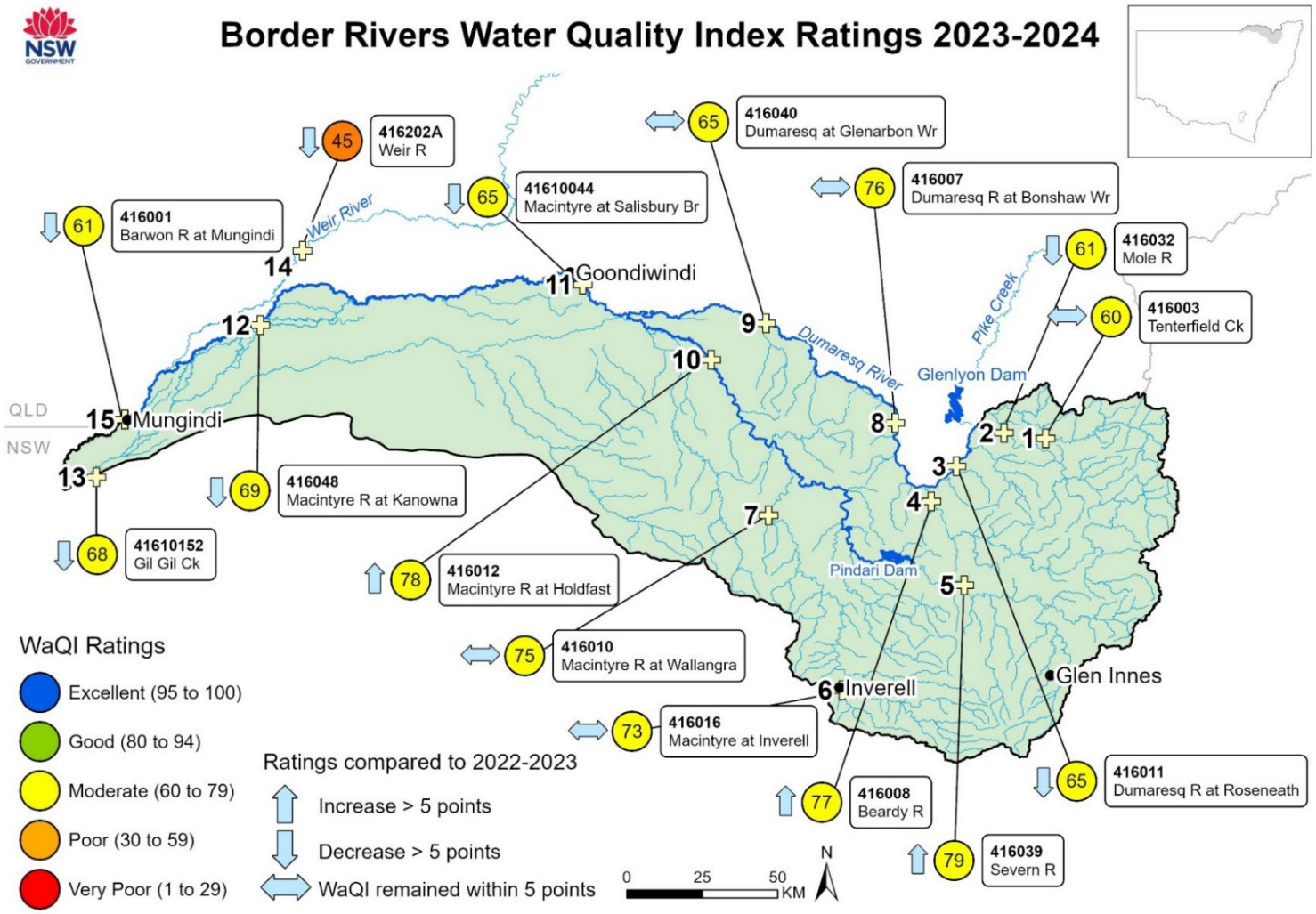

Figure 3: Water quality index scores and ratings for the NSW Border Rivers valley

The median pH in the Border Rivers was above 7.0 at all sites and suitable for aquatic ecosystem health or agricultural enterprises.

There was a gradual increase in turbidity and total suspended solids with distance down the catchment until Salisbury Bridge (near Goondiwindi), with a larger increase at sites in the lower valley. This reflects the cumulative effects of land use, soil disturbance and human activity on water quality. The highest turbidity results were in the Weir River, followed by Gil Gil Creek at Collarenebri Road Bridge, Macintyre River at Kanowna and the Barwon River at Mungindi.

The highest phosphorus concentrations in the upland areas of the Border Rivers were in the Macintyre catchment at Inverell and Wallangra and the Severn River, while the lower results were in the unregulated tributaries such as the Mole and Beardy rivers and the regulated Dumaresq River (Roseneath, Bonshaw and Glenarbon). Most of the uplands area has low soil nutrient concentrations, though there is an area of basalt-derived soils along the Great Dividing Range near Glen Innes and Inverell with higher soil nitrogen and phosphorus, which contributes to the high nutrient concentrations found in the Macintyre and Severn rivers. Soil erosion and nutrient transport can be exacerbated by the historical conversion of forested land to grazing, particularly clearing in the riparian zone.

The fertile soils associated with cropping and irrigation in the lowland area of the Border Rivers are a source of excess nutrients in Gil Gil Creek, Weir River and Barwon River at Mungindi. Previous years, flooding would have mobilised large volumes of sediment and attached nutrients across the Border Rivers catchment. These sediments and nutrients will continue to be slowly transported down the river systems over the coming years.

Dissolved oxygen levels were relatively consistent at all sites except the Weir River, with good flow conditions maintaining levels in the safe range for fish health. The lowest dissolved oxygen readings are usually in the lower catchment, where high turbidity reduces light penetration, reducing aquatic plant growth, and higher water temperature reduces the solubility of oxygen in the water column.

The 2 sites in the upper Macintyre catchment (Inverell and Wallangra) had the highest median electrical conductivity. There is a large salt store in the geology and soils in parts of the upper Macintyre catchments. These salts would have been mobilised following the heavy rainfall in 2022 and the recharge of shallow groundwater. Less saline water from the Severn River provides dilution flows in the Macintyre River, resulting in a drop in electrical conductivity between the Wallangra and Holdfast Crossing monitoring sites. Due to the regular rainfall and high flows, electrical conductivity results were generally low in the regulated system, with no risk to agriculture production or soil structure decline.

Summary statistics for the key water quality parameters at each monitoring site in the Border Rivers catchment have been displayed as box plots (Figure 4). The box plots show the annual 25th, 50th and 75th percentile values, with error bars indicating the 10th and 90th percentile values for each site.

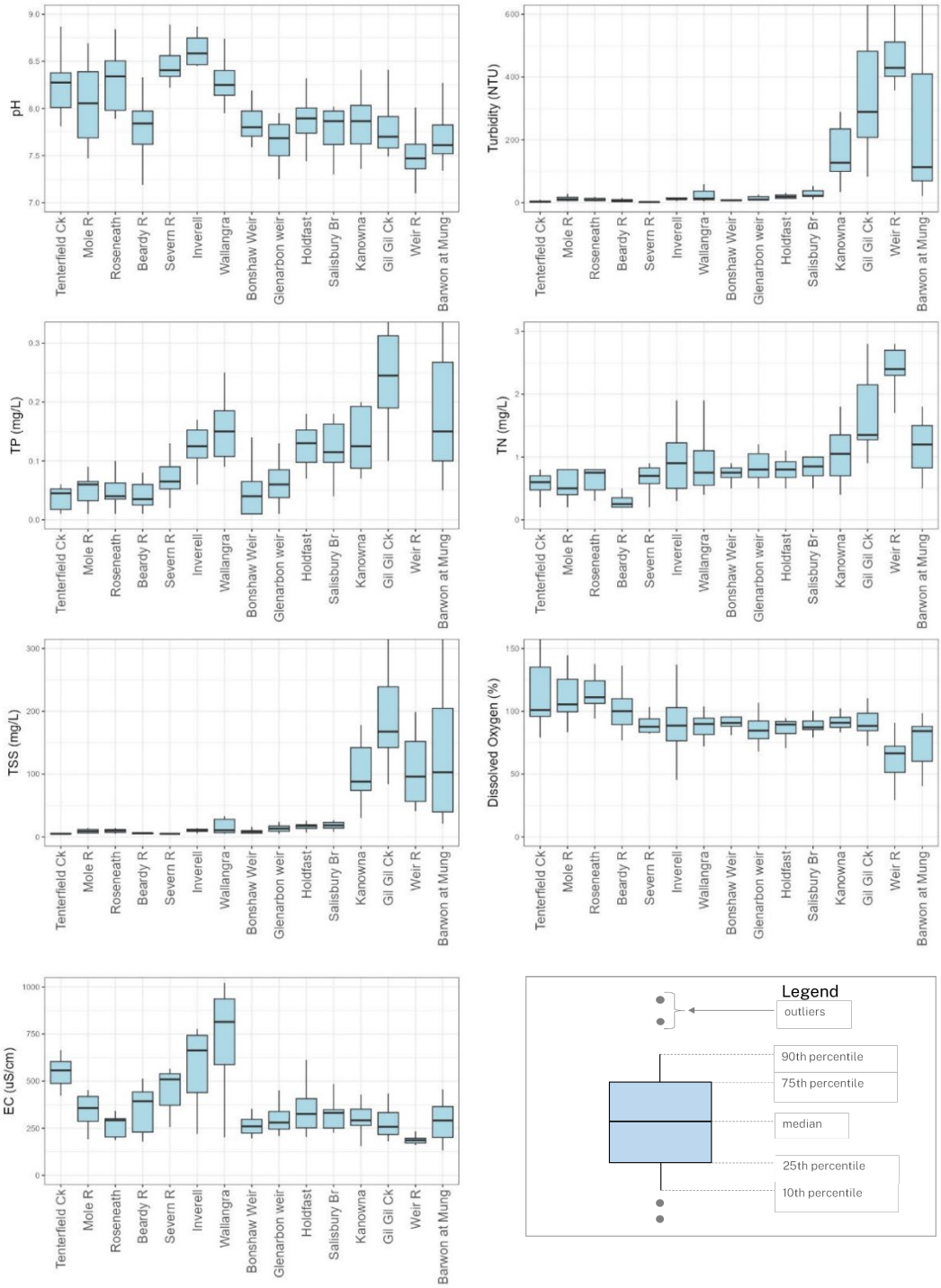

Figure 4: Water quality data by site, moving upstream to downstream from left to right. The water quality parameters shown are pH, Turbidity, Total phosphorus (TP), Total nitrogen (TN), Total suspended solids (TSS), Dissolved oxygen, and electrical conductivity (EC) *Note: extreme results were not plotted to maintain emphasis on the core data*

Irrigation and salinity

There are 4 continuous electrical conductivity monitoring sites in the Border Rivers catchment (Macintyre River at Inverell, Holdfast Crossing and Mungindi and Dumaresq River at Glenarbon

Weir). Figure 5 shows electrical conductivity was highest in the Macintyre River at Inverell. The other 3 monitoring sites are on regulated rivers, and the release of low conductivity water from the major storages over summer diluted the salts in the river system. All sites were below the Basin Plan agriculture and irrigation salinity target of 957 µS/cm for 2023 to 2024.

The Basin Salinity Management Strategy End-of-Valley salinity targets for the Barwon River at Mungindi are:

- the median percentile electrical conductivity does not exceed 250 µS/cm
- the 80th percentile electrical conductivity does not exceed 330 µS/cm and
- the annual salt load does not exceed 50,000 t/year.

The median of 310 µS/cm and the 80th percentile of 392 µS/cm were both above the End-of-Valley target values. Due to lower flows during 2023–2024, the annual salt load of 26,401 t/year was less than the End-of-Valley target.

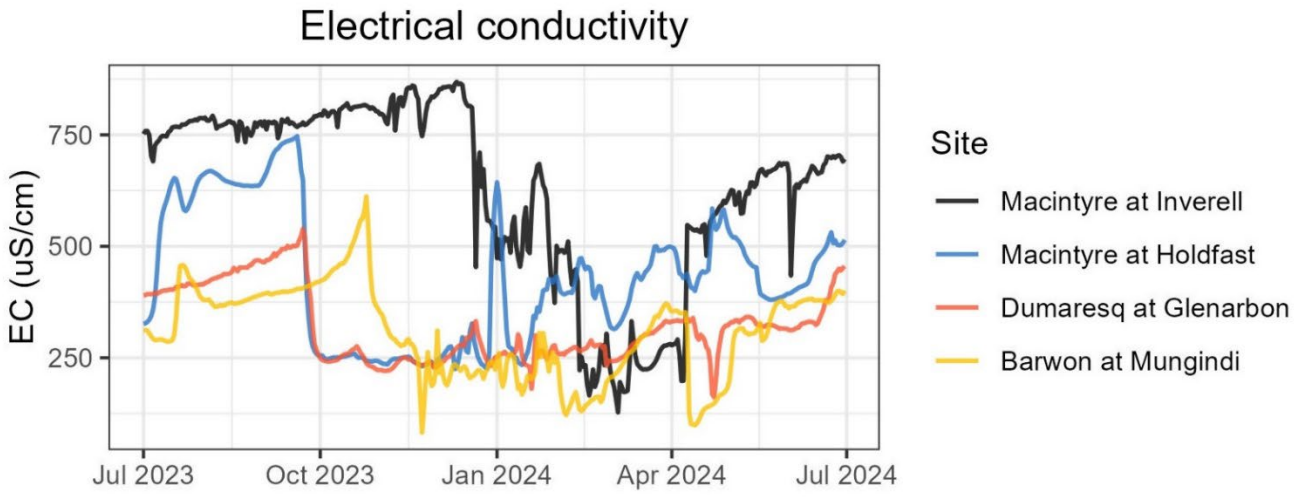

Figure 5: Electrical conductivity (µS/cm) in the Border Rivers valley

Recreation

Exposure to blue-green algae (cyanobacteria) through ingestion, inhalation or contact during recreational water use can impact human health. A colour alert scale is used with a green alert warning indicating low numbers of blue-green algae but requiring monitoring, an amber alert warning being a heightened level of alert with increased sampling and surveillance, and a red alert warning being a state of action where waters are unsuitable for recreational use. For more information about blue-green algae and algal alerts, see the WaterNSW algae web page (Algae - WaterNSW).

Table 2 indicates the distribution of red alert warnings for blue green algal blooms from July 2023 to June 2024. Pindari Dam is known to have regular algal blooms, especially in summer, that can persist for months. Pindari Dam was on red alert for recreational use for 4 months from October 2023 to January 2024 and again in April. Inflow from the heavy rainfall events over previous years would have flushed nutrients such as nitrogen and phosphorus into the dam, which encouraged

algal growth. Pindari Dam has a multi-level offtake installed. During algal blooms, the offtake is set at a lower depth to minimise the release of blue-green algae from the water surface of the storage into the Severn River downstream. This provides safer water for the village of Ashford and downstream water users.

Warm air temperatures and lower flow conditions provided ideal conditions for algal growth in Lake Inverell, resulting in red alert warnings for recreational use issued from February to May. The algae in Lake Inverell also seeded the Macintyre River downstream at Inverell.

Table 2: Distribution of red alert warnings for blue green algae in the NSW Border Rivers valley - July 2023 to June 2024

	Jul				Aug				Sep					Oct				Nov				Dec					Jan				Feb				Mar					Apr				May					Jun			
Pindari Dam Station 1 (Dam Wall)	3	*	*	*	*	*	3	3	3	*	*	*	*	*	3	3	3	3	3	3	3	3	3	3	3	3	3	3	*	*	*	*	*	*	*	*	*	*	*	*	*	3	3	*	*	*	*	*	*	*	*	*
Pindari Dam Station 2/3	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3	3	3	3	3	3	3	3	3	3	3	3	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Pindari Dam Station Boat Ramp	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3	3	3	3	3	3	3	3	3	3	3	3	3	*	*	*	*	*	*	*	*	*	*	*	*	3	3	*	*	*	*	*	*	*	*	*	*
Macintyre River at Inverell (Middle Creek)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3	3	3	3	*	3	3	3	3	3	3	3	3	3	3	3	3	3	*	*	*	*
416065 - Macintyre River at Boggabilla Weir	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3	3	3	3	3	*	3	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
41610161 - Macintyre River at Lake Inverell	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3	3	3	3	*	3	3	3	3	3	3	3	3	3	3	3	3	3	*	*	*	*

Key: * = no red alert; 3 = red alert

Extreme water quality events

Rainfall leading into the 2023–2024 summer was above average (Figure 6 - BoM, 2024), which maintained flows in most creeks and rivers across the catchment. Heavy rainfall from ex-tropical Cyclone Megan resulted in moderate flooding in the Macintyre River at Mungindi and high flows in Gil Gil Creek. No fish deaths were reported in the NSW Border Rivers.

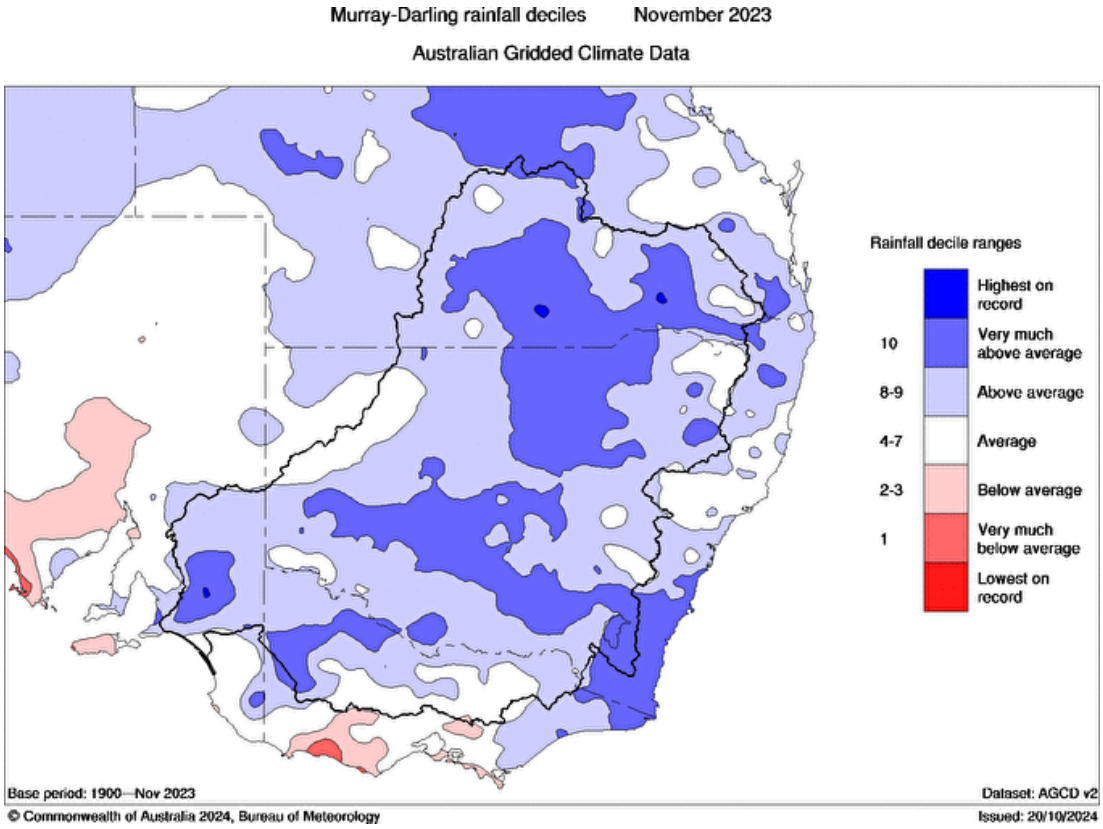

Figure 6: Murray Darling rainfall deciles for November 2023 (Source: BoM).

Long-term water quality trends

Analysis of WaQI scores from 2013–2014 to 2023–2024 shows the Weir River has consistently low scores with a median below 50, which is a rating of poor (Figure 7). Tenterfield Creek has the next lowest median score over the period. All other sites have a long term median WaQI rating of good or moderate, with sites lower down the Macintyre River at Salisbury Bridge, Kanowna and Mungindi having the highest long-term ratings. The range of WaQI scores varies across sites. Some sites have a large spread of results, some more consistent, while others have outliers in response to droughts, floods or other significant disturbance events occurring in the catchment area.

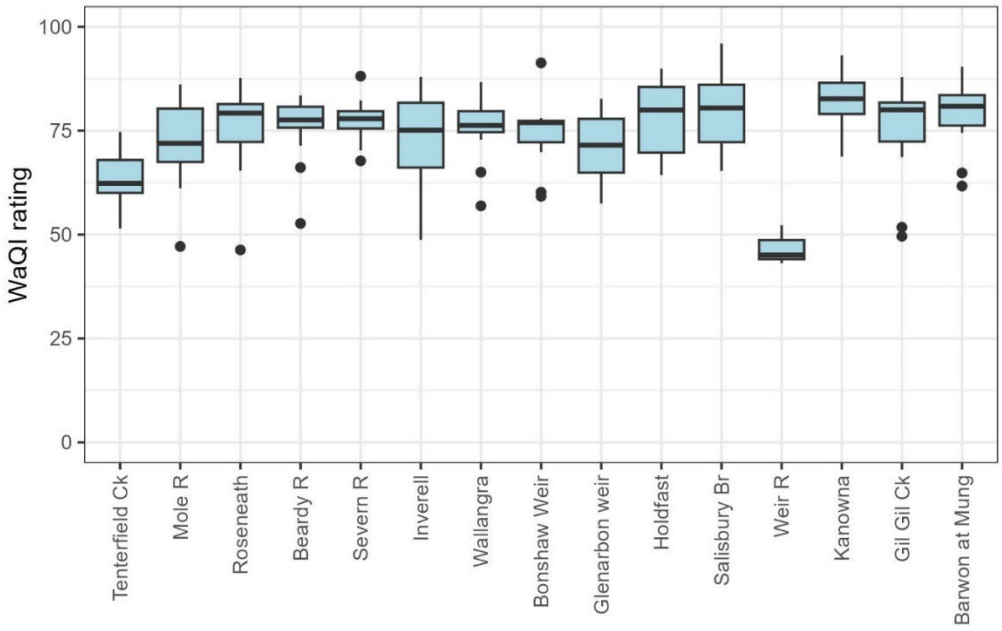

Figure 7: Boxplots showing long-term (2013-2014 to 2023-2024) WaQI ratings for every site in the NSW Border Rivers

The number of sites with ratings of good, moderate and poor fluctuated yearly depending on the impacts of both droughts and floods (Figure 8). The number of sites with a good rating has declined from 9 sites in 2014–2015 and 2016–2017 down to one site in 2023–2024. Moderate ratings have increased in recent years, peaking at 13 sites in 2023–2024 as the water quality at good sites declined. The number of poor sites has fluctuated between zero and 2 most years, apart from 2019–2020, which included a combination of both drought and flooding conditions and saw an increase to 8 sites.

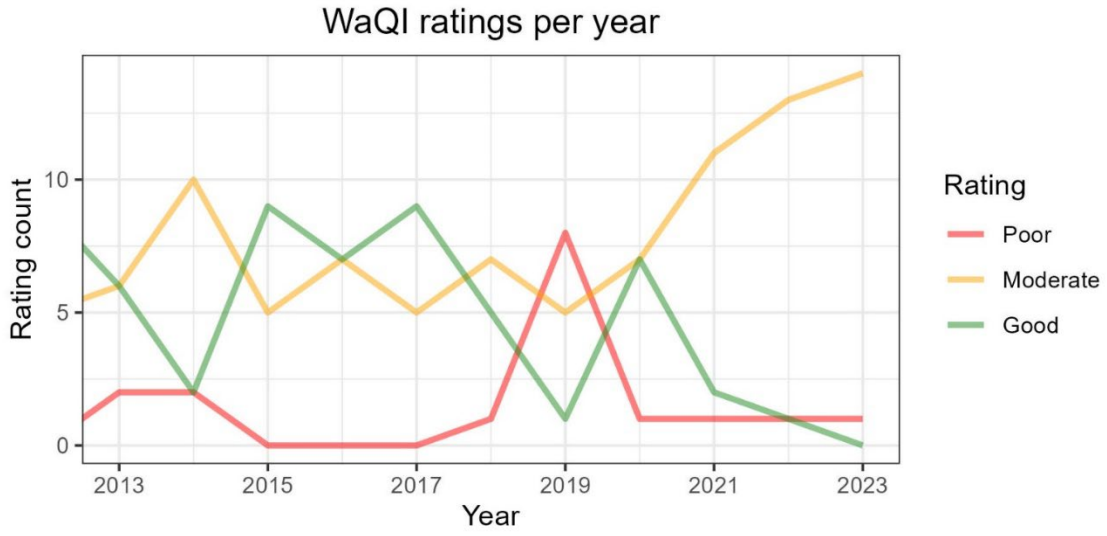

Figure 8: Graph summarising long-term water quality index ratings (2012–2013 to 2023-2024) for 15 sites in the NSW Border Rivers

Summary

The quality of the water in a river or stream reflects the underlying climate and geology and the multiple activities and land uses occurring in a catchment area. Numerous factors can contribute to the observed results.

Lower flows in 2023–2024 compared to the previous year resulted in a general trend of lower turbidity and nutrient concentrations, while electrical conductivity was higher. Of the 15 water quality monitoring sites, 14 were rated as moderate, with one as poor. There was a decline in water quality index scores at 7 sites.

High rainfall in previous years would have recharged shallow saline groundwater and mobilised salts from naturally saline soils and geology across the landscape. The mobilisation of these salts and lower flows resulted in higher electrical conductivity, particularly in unregulated upland catchments. Electrical conductivity in the regulated system was less than the irrigation targets.

No fish deaths were reported in the NSW Border Rivers. The flushing of nutrients into Pindari Dam and Lake Inverell by high flows over the previous years may have contributed to red alert warnings for blue-green algae in these two areas.

For more detailed information about water quality issues in the Border catchment, see the Border surface water quality technical report (https://www.industry.nsw.gov.au/__data/assets/pdf_file/0007/305755/Water-quality-technical-report-for-the-Border-Rivers-surface-water-resource-plan-area-SW16.pdf).

References and further information

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Bureau of Meteorology, (BoM). Recent and historical rainfall maps: http://www.bom.gov.au/climate/maps/rainfall/?variable=rainfall&map=decile&period=month&region=md&year=2023&month=11&day=30

Fish kills in NSW: https://www.dpi.nsw.gov.au/fishing/habitat/threats/fish-kills

NSW DPE water for the environment: https://www.environment.nsw.gov.au/topics/water/water-for-the-environment/other-regions/border-rivers-annual-environmental-water-priorities

MDBA water management: https://www.mdba.gov.au/water-management/catchments/border-rivers