Murrumbidgee valley annual surface water quality report: 2022–2023

Key Points

- Flow during July 2022 to June 2023 was characterised by heavy rain falling across much of the catchment. This rain resulted in regular large flow events throughout the catchment.
- The heavy rains kept water storage levels high throughout the year.
- Flooding was the main driver of water quality in the Murrumbidgee catchment. The water quality index indicated of the 26 sites in the catchment, 2 were rated as good, 18 as moderate and 6 as poor. As a result of the flooding, 10 sites returned a lower water quality index score while 13 sites showed minimal change in 2022–2023 compared to 2021–2022.
- All sites were below the Basin Plan agriculture and irrigation salinity target of 833 µS/cm (microSiemens per centimetre). Electrical conductivity in the Murrumbidgee River downstream of Balranald weir was very close to the End-of-Valley 80th percentile salinity target of 258 µS/cm. It exceeded the median value of 162 µS/cm.
- Red alerts for blue-green algae occurred at Burrinjuck Dam from April to June. No other sites received red alerts for 2022–2023.

The water quality data used in this report is collected on a monthly frequency at 26 sites in the Murrumbidgee valley for the State Water Quality Assessment and Monitoring Program. The program is 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 Murrumbidgee Valley from July 2022 to June 2023. The location of monitoring sites is shown in Figure 1.

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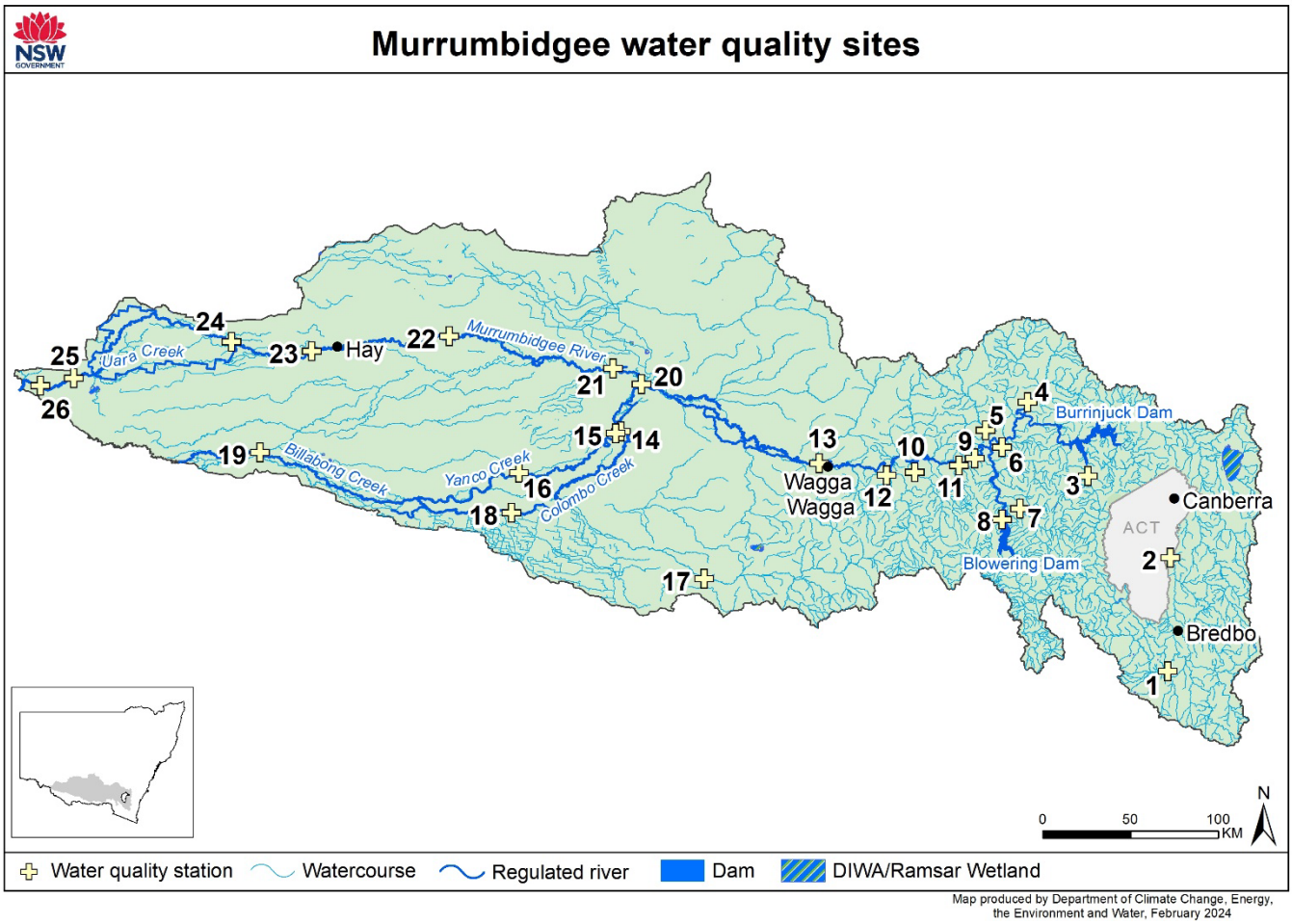

Figure 1: Location of routine water quality monitoring sites in the Murrumbidgee valley

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

Site number	Site name	Water Quality Zone	Station number
1	Murrumbidgee River at Mittagang Crossing	Murrumbidgee Montane	410033
2	Murrumbidgee River at Angle Crossing	Murrumbidgee unregulated uplands	410213
3	Goodradigbee River at Wee Jasper	Goodradigbee/Goobarragandra unregulated uplands	410024
4	Jugiong Creek at Jugiong	Unregulated tributary uplands (Northern)	410025
5	Muttama Creek at Coolac	Unregulated tributary uplands (Northern)	410044
6	Adjungbilly Creek at Darbalara	Unregulated tributary uplands (Southern)	410038
7	Goobarragandra River at Little River Road	Goodradigbee/Goobarragandra unregulated uplands	41010924
8	Tumut River at Oddys Bridge	Tumut regulated uplands	410073
9	Murrumbidgee River at Gundagai	Murrumbidgee regulated uplands	410004
10	Hillas Creek at Mundarlo Road Bridge	Unregulated tributary uplands (Southern)	41010809
11	Adelong Creek at Bereena	Unregulated tributary uplands (Southern)	41010890
12	Tarcutta Creek at Old Borambola	Unregulated tributary uplands (Southern)	410047

Site number	Site name	Water Quality Zone	Station number
13	Murrumbidgee River downstream Wagga at Roach Road	Murrumbidgee regulated uplands	41010395
14	Colombo Creek at Morundah	Regulated Yanco, Colombo Billabong creeks	410014
15	Yanco Creek at Morundah	Regulated Yanco, Colombo Billabong creeks	410015
16	Yanco Creek at Yanco Bridge	Regulated Yanco, Colombo Billabong creeks	410169
17	Billabong Creek at Walbundrie	Billabong Creek unregulated uplands	410091
18	Billabong Creek at Jerilderie	Regulated Yanco, Colombo Billabong creeks	410016
19	Billabong Creek at Darlot	Regulated Yanco, Colombo Billabong creeks	410134
20	Murrumbidgee River downstream Yanco Weir	Murrumbidgee lowlands	410036
21	Murrumbidgee River downstream Gogeldrie weir	Murrumbidgee lowlands	410082
22	Murrumbidgee River at Carathool	Murrumbidgee lowlands	410078
23	Murrumbidgee River downstream Hay weir	Murrumbidgee lowlands	410136
24	Murrumbidgee River downstream Maude weir	Murrumbidgee lowlands	410040
25	Murrumbidgee River downstream Balranald weir	Murrumbidgee lowlands	41010901
26	Murrumbidgee River at Waldaira	Murrumbidgee lowlands	41010143

Catchment description

The Murrumbidgee valley is bounded by Cooma in the east, Balranald in the west, Temora to the north and Henty to the south. The catchment covers an area of approximately 84,000 km^2. The Murrumbidgee River starts in the alpine regions of Kosciuszko National Park, winds through the Monaro High Plains and then the Australian Capital Territory. Once the river reaches the south-west slopes of New South Wales, it flows 1,600 km westward to its confluence with the Murray River near Balranald. It has average annual flows of around 4.4 million megalitres and is the third largest river in the Murray–Darling Basin. Major streams in the Murrumbidgee Catchment include: the Bredbo River, Numeralla River, Goodradigbee River, Cotter River, Goobarragandra River, Tumut River and Yass River in the upper catchment; Tarcutta Creek and Jugiong Creek in the mid catchment; and Old Man Creek, Mirrool Creek, Billabong Creek, Yanco Creek and Colombo Creek in the lower catchment.

West of Gundagai, the Murrumbidgee River meanders across the floodplain where numerous floodplain wetlands rely on periodic connectivity to the river. The Murrumbidgee River encounters a number of regulatory structures in its headwaters and on the lowland floodplain.

The Murrumbidgee River is a heavily regulated system and has 14 dams and 8 large weirs. The largest dams are Burrinjuck Dam near Yass, with a capacity of 1.026 million megalitres, and Blowering Dam near Tumut, holding 1.628 million megalitres. More than 10,000 km of irrigation channels supplied by the two storages provide water to the irrigation areas.

The Murrumbidgee Irrigation Area, located on the northern side of the Murrumbidgee River downstream of Narrandera, is privately owned and operated by Murrumbidgee Irrigation. The area is

fed by two canals. The Main Canal receives water diverted at Berembed Weir to serve the Yanco, Leeton and Griffith areas while the Sturt Canal receives water diverted at Gogeldrie Weir to supply the Whitton and Benerembah areas. Located to the south of the Murrumbidgee River, the Coleambally Irrigation area is privately owned and managed by Coleambally Irrigation Corporation. Water is diverted at Gogeldrie Weir into the Coleambally Canal. The Hay Private Irrigation District diverts water from HayWeir and Maude Weir regulates flow into the Lower Murrumbidgee's Nimmie-Caira system.

The Murrumbidgee catchment contains many significant wetland habitats such as the extensive Lowbidgee wetlands, and Tuckerbill and Fivebough Swamps, listed under the Ramsar Convention for international ecological importance. Extensive areas of riparian river red gum forest along the middle and lower reaches of the river provide valuable riparian habitat for waterbirds and a variety of threatened fauna species.

The upper Murrumbidgee catchment is largely used for grazing with large areas of native vegetation. The mid-catchment from Gundagai to Leeton is extensively cropped with large areas of irrigated agriculture downstream of Narrandera (DoIW 2018).

Catchment conditions during 2022–2023

Flow during 2022–2023 was characterised by heavy rain falling across much of the catchment (Figure 2A). On 1 July 2022, both Burrinjuck and Blowering dams were above at 80% capacity (Figure 2B). Ongoing rainfall and air space releases from Burrinjuck Dam maintained flow in the Murrumbidgee River at Gundagai around 10,000 ML/day for most of 2022–2023, peaking at over 150,000 ML/day in November 2022 (Figure 2C). These high flows inundated large areas of the lower Murrumbidgee floodplain and resulted in several flow events over 10,000 ML/day downstream of Maude Weir.

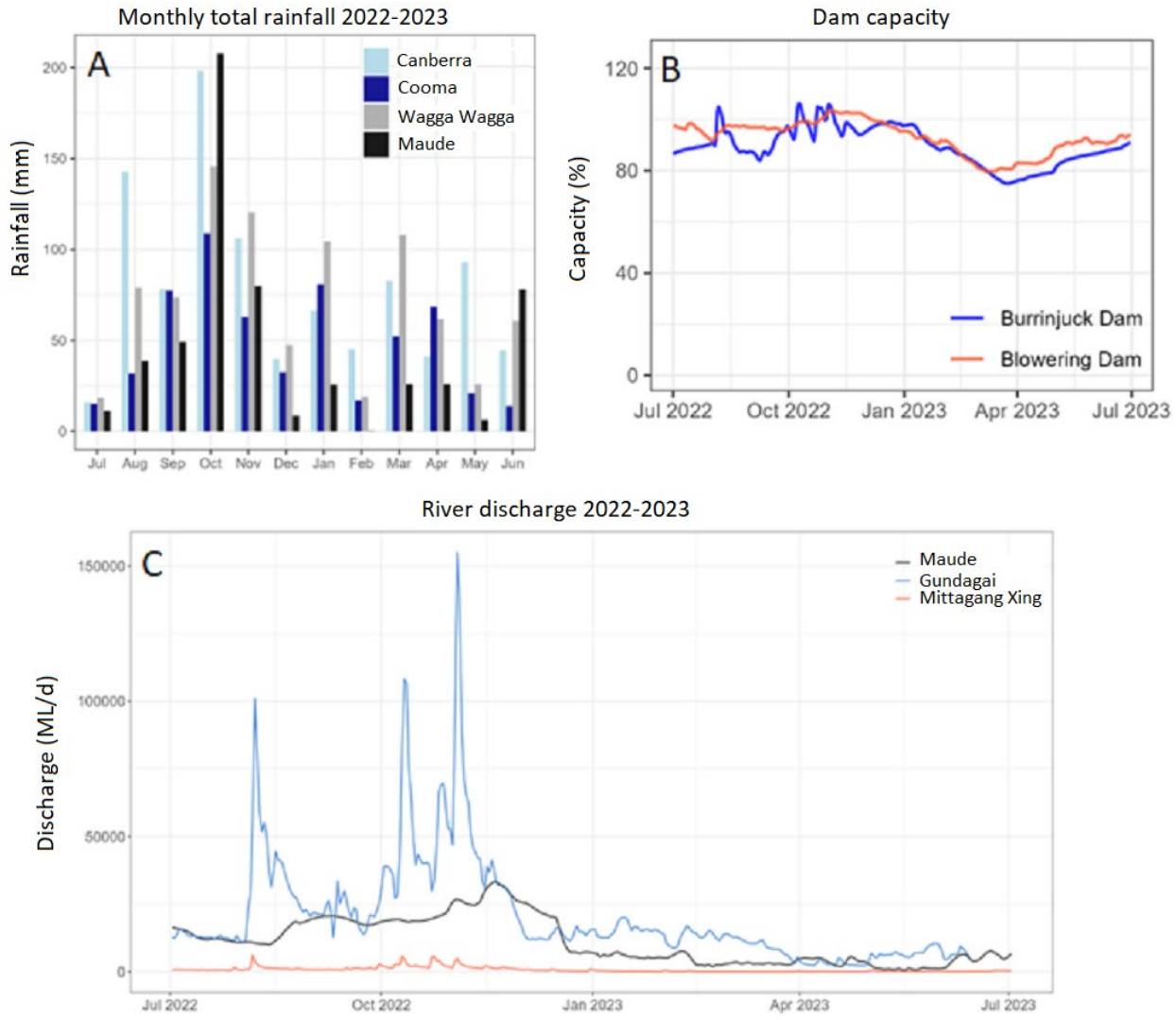

Figure 2: Catchment conditions for selected stations in the Murrumbidgee catchment from July 2022 to June 2023 for A: Monthly total rainfall (mm) B: Dam capacity (%) and C: River discharge (ML/day)

Water quality for water dependent ecosystems

NSW uses a Water Quality Index (WaQI) as a tool to communicate complex and technical water quality data in a simple and consistent way. The WaQI score was 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 a set of predetermined water quality targets to calculate a score between 1 and 100. A score of 100 represents a site in pristine condition, while a score of one is a very 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 and Figure 4. Sites where there has been 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.

The water quality index category ratings in the upper Murrumbidgee catchment improved in 2022–2023 for one of the 13 sites, while 4 sites declined compared to 2021–2022.

- Adjungbilly Creek at Darbalara improved from moderate to good.
- Murrumbidgee River at Angle Crossing and Gundagai, Goodradigbee River at Wee Jasper, and Goobarragandra River at Little River Road declined from good to moderate.

In the lower catchment, only one site (Yanco Creek at Yanco Bridge) declined from moderate to poor. There was no change in the ratings for the remaining sites, compared to 2021–2022.

Overall, 6 sites in the Murrumbidgee catchment were rated as poor in 2022–2023. Muttama Creek had high turbidity and nutrient concentrations. Hillas and Tarcutta creeks had high turbidity, total phosphorus and electrical conductivity. Yanco Creek at Yanco Bridge had high nutrients. Billabong Creek at Jerilderie had high turbidity, nutrient concentrations and electrical conductivity. Billabong Creek at Darlot had high nutrient concentrations and electrical conductivity.

Compared to the 2021–2022 results, the water quality index score improved for 3 sites.

- Adjungbilly Creek at Darbalara
- Billabong Creek at Walbundrie
- Murrumbidgee River downstream Hay weir

Of the 26 monitoring sites, 13 sites showed minimal change while 10 sites returned a lower index score than in 2021 to 2022.

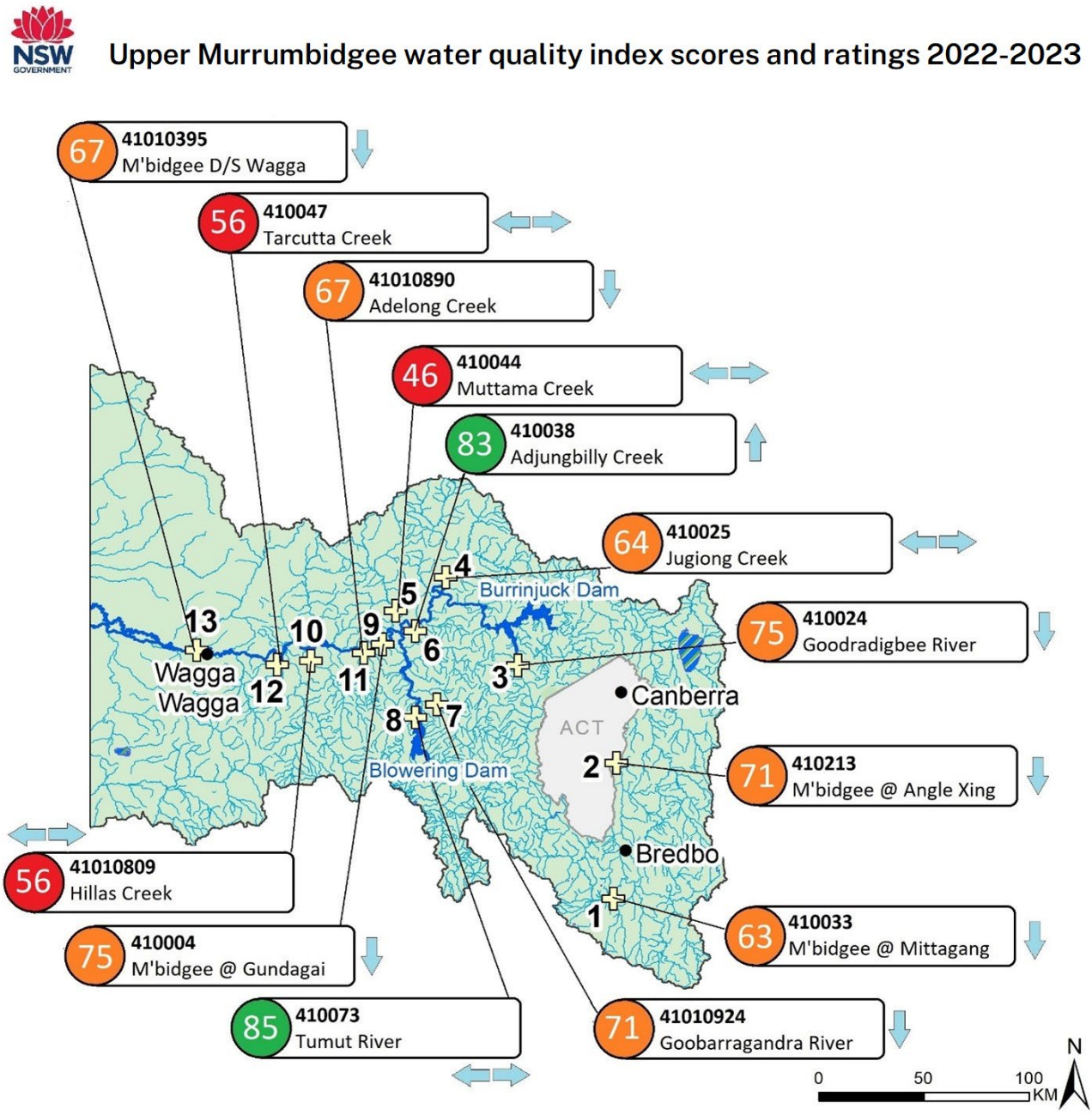

Figure 3: Water quality index (WaQI) scores and ratings for the upper Murrumbidgee River 2022–2023

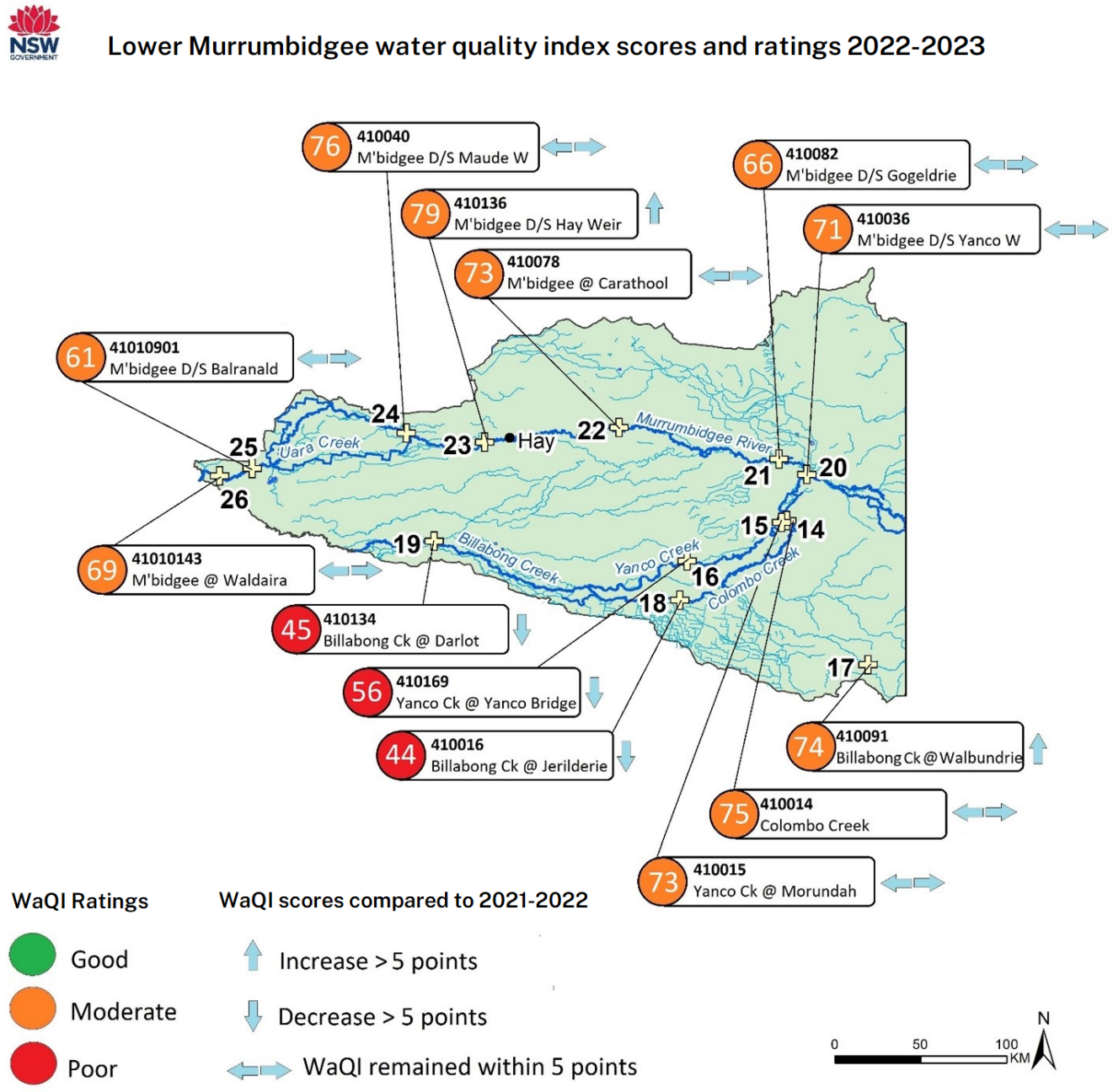

Figure 4: Water quality index (WaQI) scores and ratings for the lower Murrumbidgee River 2022–2023

Upper Murrumbidgee

The numerous unregulated catchments downstream of Burrinjuck Dam (Jugiong, Muttama, Adjungbilly, Hillas, Adelong and Tarcutta creeks) had the highest turbidity, total nitrogen and total phosphorus results. This is consistent with research indicating that most of the suspended sediment delivery in the mid-Murrumbidgee catchment originates from the unregulated tributaries adjacent to the Murrumbidgee River.

The Goodradigbee, Goobarragandra and Tumut rivers had the lowest turbidity and nutrient concentrations. The Goodradigbee and Goobarragandra catchments both contain large areas of undisturbed National Parks and reserves. Tumut River at Oddy's Bridge is located downstream of Blowering Dam which can act as a sediment trap, allowing soil particles and attached nutrients to settle in the dam, and releasing better quality into the river downstream.

There was a large range of dissolved oxygen results in Muttama Creek. Muttama Creek also had the highest median electrical conductivity followed by Jugiong Creek. These two catchments are adjacent to each other, with similar geology and large sources of salt stored in the landscape. There is limited opportunity for irrigation from both Muttama and Jugiong creeks, making the risk to agriculture production and soil structure, low. Electrical conductivity is low and stable across the other monitoring sites in the upper catchment and would not pose a threat to water uses.

Lower Murrumbidgee

The median pH was relatively consistent throughout the lower Murrumbidgee (between 7 and 7.5) and suitable for aquatic ecosystems or agricultural enterprises. Median dissolved oxygen in the lower Murrumbidgee was generally suitable to maintain aquatic ecosystems throughout 2022 to 2023, though dissolved oxygen levels did drop at some sites in response to widespread flooding of the floodplain, which led to deoxygenated water being generated on the floodplain and then returning back to the river.

Billabong Creek at Walbundrie is the only monitoring site on an unregulated waterway in the lower Murrumbidgee catchment. Heavy rainfall and runoff resulted in high turbidity, total nitrogen and total phosphorus concentrations at this site. Electrical conductivity is also high at Walbundrie due to a large quantity of salt stored in the soils and geology of the landscape.

In most rivers, nutrient concentrations and turbidity tend to increase with distance down the catchment, reflecting the cumulative impacts of land use, soil disturbance and human activity on water quality. Yanco Creek followed this trend with higher total nitrogen, total phosphorus and turbidity at Yanco Bridge than at Morundah. In Billabong Creek median turbidity was higher at downstream sites, but the high nutrient concentrations and electrical conductivity detected at Walbundrie were diluted by the regulated flows from Yanco Creek.

In the regulated Murrumbidgee River from downstream of Yanco Weir to Waldaira at the bottom of the catchment, there is very little change in turbidity or nutrient concentration with progression downstream.

Summary statistics for the key water quality parameters at each monitoring site in the Murrumbidgee valley have been displayed as box plots. Due to the high number of monitoring sites,

the box plots have been divided into upper (Figure 5) and lower (Figure 6) catchments. 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.

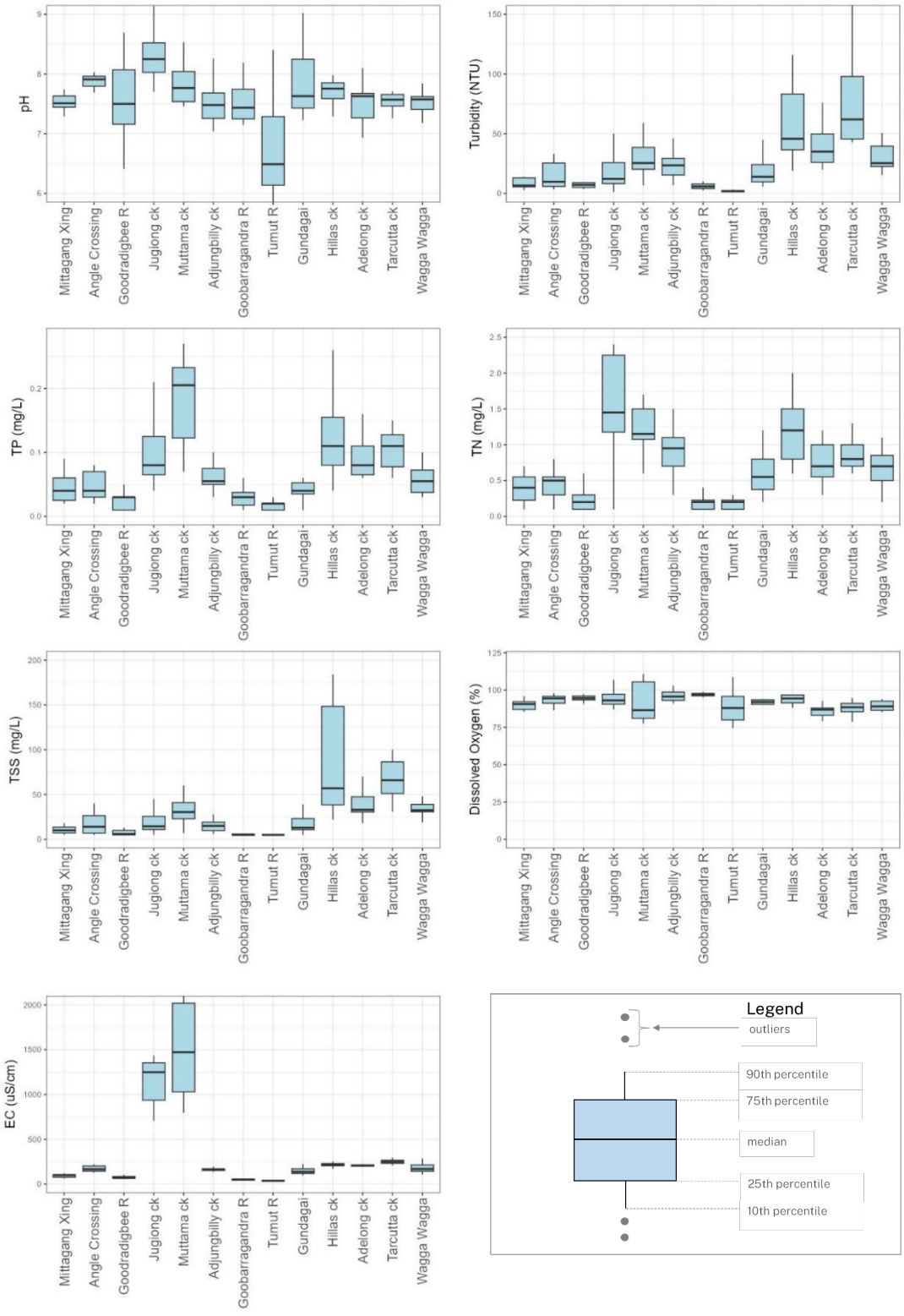

Figure 5: The upper Murrumbidgee catchment. Water quality data by site, moving upstream to downstream from left to right. The water quality parameters shown are pH, Turbidity, Total phosphorus (TP), Total nitrogen (TN), Total suspended solids (TSS), Dissolved oxygen, and electrical conductivity (EC).

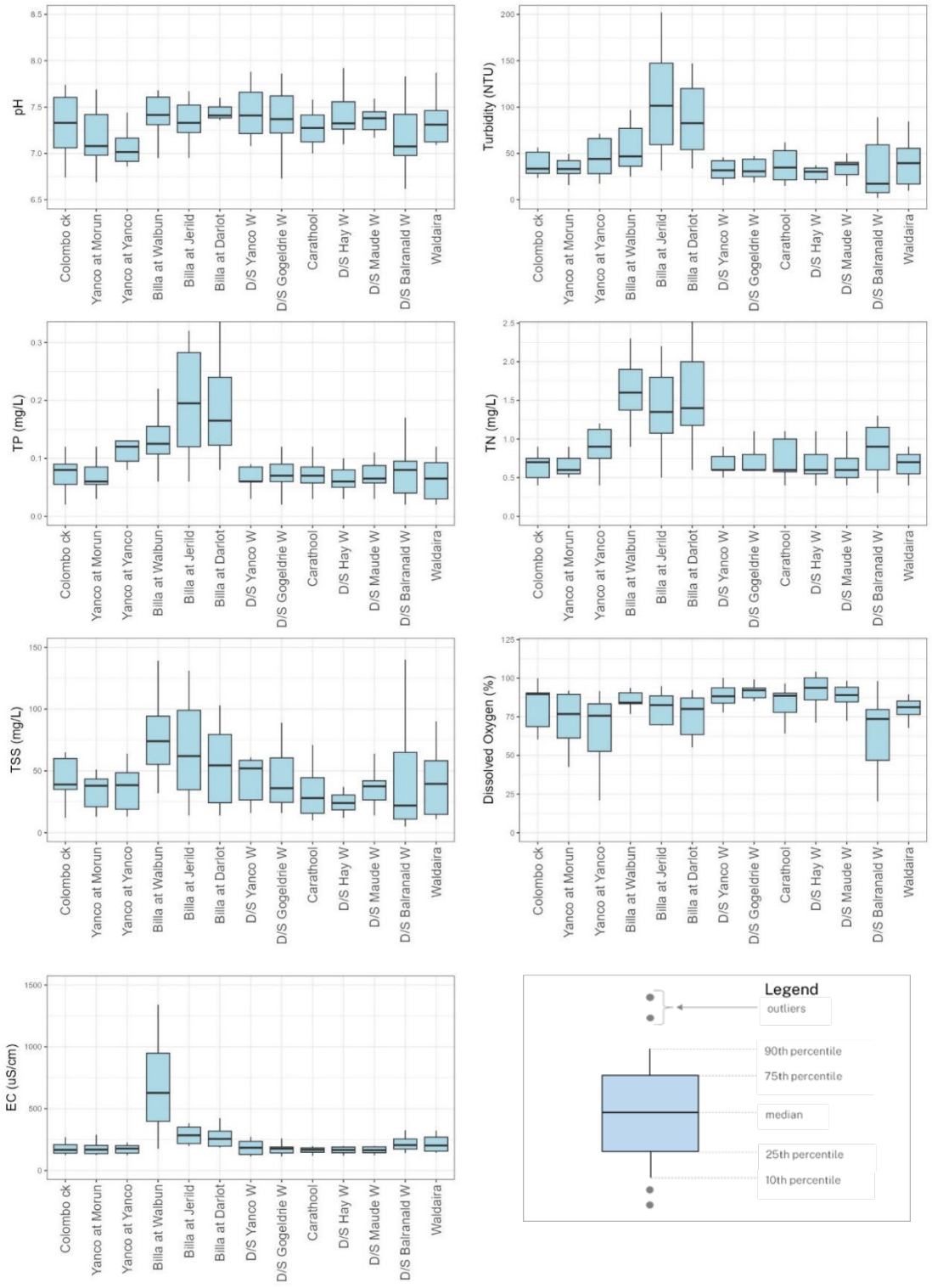

Figure 6: The lower Murrumbidgee catchment. Water quality data by site, moving upstream to downstream from left to right. The water quality parameters shown are pH, Turbidity, Total phosphorus (TP), Total nitrogen (TN), Total suspended solids (TSS), Dissolved oxygen, and electrical conductivity (EC).

Irrigation and salinity

There are 42 continuous electrical conductivity monitoring sites in the Murrumbidgee valley with many located in smaller unregulated tributaries. Figure 7 plots selected sites and highlights that with continuing high flows, electrical conductivity remained low across the Murrumbidgee catchment.

There are 3 Irrigation Infrastructure Operators in the Murrumbidgee River valley.

- Murrumbidgee Irrigation Limited
- Coleambally Irrigation Cooperative Limited
- Hay Irrigation District

The closest monitoring stations to the offtakes for these areas are Murrumbidgee River at Wagga Wagga and Murrumbidgee River downstream of Balranald Weir. Both sites had a 95th percentile electrical conductivity lower than the Basin Plan agriculture and irrigation salinity target of 833 µS/cm for 2022 to 2023.

The Basin Salinity Management Strategy End-of-Valley salinity targets for the Murrumbidgee River downstream Balranald Weir are:

- the median electrical conductivity does not exceed 162 µS/cm
- the 80th percentile electrical conductivity does not exceed 258 µS/cm and;
- the annual salt load does not exceed 169,600 t/year.

The 80th percentile (257 µS/cm) was very close to the End-of-Valley target, while the median electrical conductivity (210 µS/cm) and annual salt load of 602,637 t/year exceeded the target value.

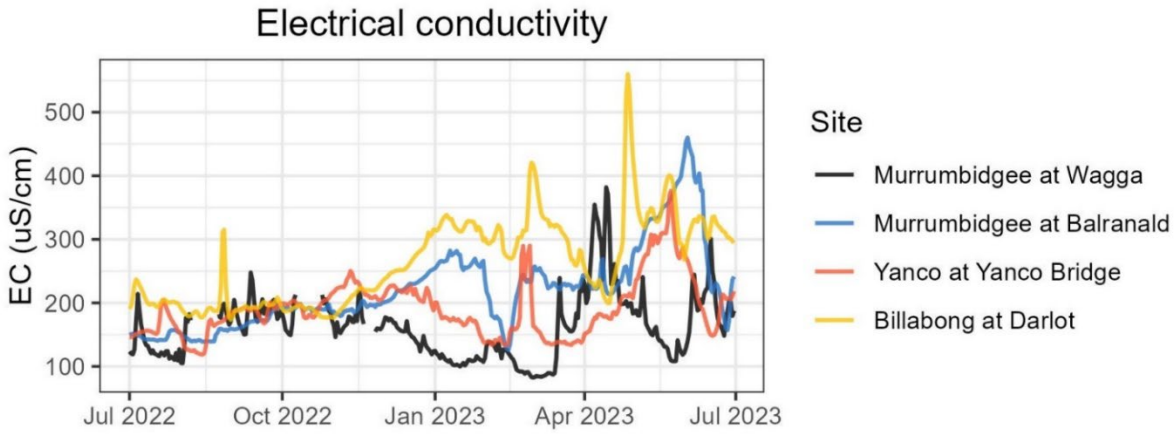

Figure 7: Electrical conductivity (µS/cm) at selected sites in the Murrumbidgee valley

Recreation

Exposure to blue-green algae (cyanobacteria) through ingestion, inhalation or contact during recreational use of water 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).

Burrinjuck Dam is located in a cooler part of the state and algal blooms are usually less frequent. Inflow from the heavy rainfall events would have flushed nutrients such as nitrogen and phosphorus into the dam, encouraging algal growth. Table 1 indicates the distribution of algal alerts during July 2022 to June 2023. Red alerts for recreational use were issued for Burrinjuck Dam during April to June 2023. Water is released from Burrinjuck Dam via a multi-level offtake. The rivers downstream are not seeded by the release of algae from within the storage. There were no red alerts for recreational use downstream of Burrinjuck Dam or for the Murrumbidgee River in 2022–2023.

Table 2: Distribution of algal alert levels in the Murrumbidgee Valley July 2022 to June 2023

	Jul					Aug					Sep					Oct					Nov					Dec					Jan					Feb					Mar					Apr					May					Jun				
Blowering Dam	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1	1	1	1	*	*	*	*	*	1	1	*	*	*	1	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Blowering Downstream	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1	1	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Burrinjuck Dam	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1	*	*	*	*	*	2	2	2	2	2	1	2	2	2	2	2	2	3	3	3	2	2	1	3	3	3	1	1	*	*	*	*	*
Burrinjuck Downstream	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	*	*	*	1	1	1	1	*	*	*	*	*	*	*	*	*
Murrumbidgee River at Gogeldrie	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Murrumbidgee River at Hay weir	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*
Murrumbidgee River at Redbank	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*
Murrumbidgee River at Maude weir	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Murrumbidgee River at Balranald	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	1	1	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	1	*
Yanga Lake at Regatta Beach	*	*	*	*	*	*	*	*	*	*	2	2	2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Key : * = Nil/Low alert 1 = green alert 2 = amber alert 3 = red alert

Extreme water quality events

Spring 2022 was the wettest spring on record (since 1900) for New South Wales. In October, heavy rainfall led to widespread flooding in the Murray–Darling Basin, impacting many towns in inland New South Wales (Figure 8 - BoM, 2023). The heavy rains led to substantial increases in water storage levels, with many storages spilling. Floodwaters from the Murrumbidgee and the Lachlan Rivers merged to form an “inland sea” on the Hay Plains (Figure 9). With flooding on this scale came an increased risk of hypoxic blackwater events.

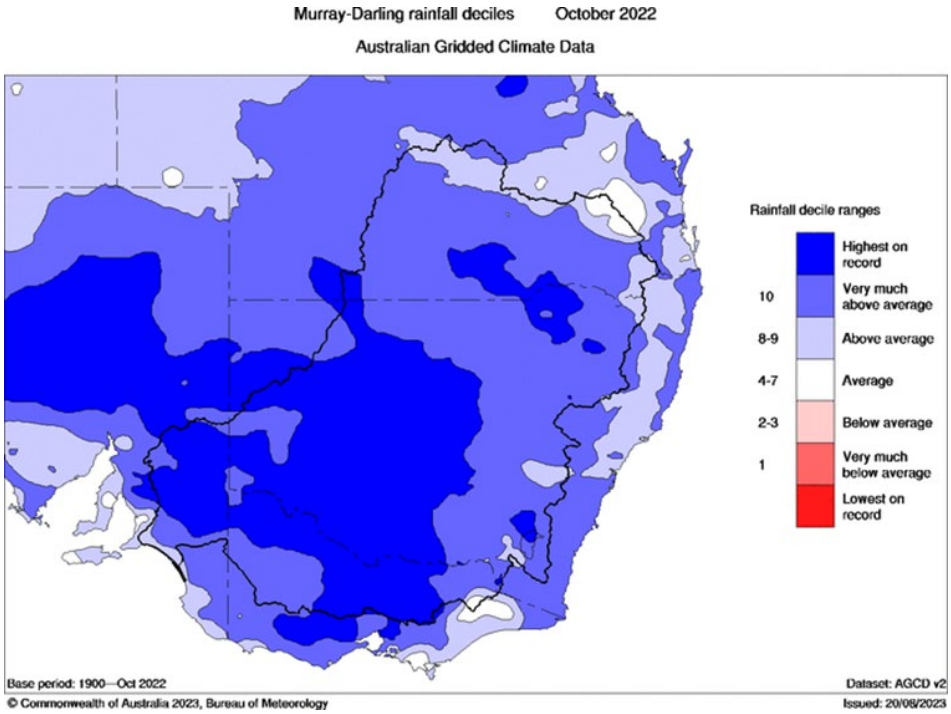

Figure 8: Murray Darling rainfall deciles for October 2022. (Source: BoM)

Figure 9: Floodwater from the Lachlan and Murrumbidgee rivers inundates vast sections of Hay Plains. (Picture: Ali McLean – ABC News)

Continued flooding of the lower Murrumbidgee floodplain and increasing water temperatures resulted in declining dissolved oxygen levels downstream of Maude, Redbank and Balranald weirs. Dissolved oxygen downstream of Balranald Weir briefly dropped below the critical level for fish health of 2 mg/L. As a measure to prevent fish deaths, a base flow of 4,000 to 5,000 ML/day was maintained at Maude Weir to provide a flow to dilute low dissolved oxygen floodwater returning to the main channel from the floodplain upstream of Balranald.

NSW Fisheries investigated a report of up to 10 dead fish in the Murrumbidgee River near Wagga Wagga in November 2022. Species affected included Golden Perch and Murray Cod. The suspected cause was attributed to critically low dissolved oxygen generated by high rainfall, washing organic material into the waterways. High amounts of decaying organic material, combined with high summer temperatures, reduced dissolved oxygen levels below the threshold needed for native fish to breathe and survive.

Fish kills in NSW are listed on Department of Primary Industries website.

Summary

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

In 2022 to 2023, flooding was the key driver of water quality. The water quality index indicated that of the 26 monitoring sites in the catchment, 2 were rated as good, 18 as moderate and 6 as poor. As a result of the flooding, 10 sites returned a lower water quality index score in 2022–2023 compared to 2021–2022.

The management of inflows into the rivers, and their release, was a careful balancing act, which was continually monitored and adjusted as needed. Agencies and scientific experts worked together to monitor the dissolved oxygen levels throughout the river system and advise the best operational measures to minimise the risk to aquatic life.

Due low dissolved oxygen caused by flood events, up to 10 dead fish were reported in the Murrumbidgee River near Wagga Wagga in November 2022.

Although hypoxic blackwater events may result in the loss of fish and other aquatic life, the impacts of these events on the environment are usually short-term, as the river water re-oxygenates again as the flooding subsides. Naturally occurring events such as these underpin the broad health of rivers. They provide nutrients to drive the overall production of our river and wetland systems. In the

longer term, native fish, water birds and other organisms benefit from the increased production in the river, boosting food supplies and supporting breeding cycles.

For more detailed information about water quality degradation issues in the Murrumbidgee catchment see the Murrumbidgee surface water quality technical report (https://www.industry.nsw.gov.au/__data/assets/pdf_file/0004/305743/Water-quality-technical-report-for-the-Murrumbidgee-surface-water-resource-plan-area-SW9.pdf).

Long-term water quality trends

Upper

Analysis of WaQI scores from 2012–2013 to 2022–2023 shows most sites have a long term median WaQI rating of moderate (Figure 10). Muttama Creek had the lowest median and a rating of poor. Muttama Creek has a history of being affected by stormwater drainage issues that creates water quality problems (Reroc, n.d).

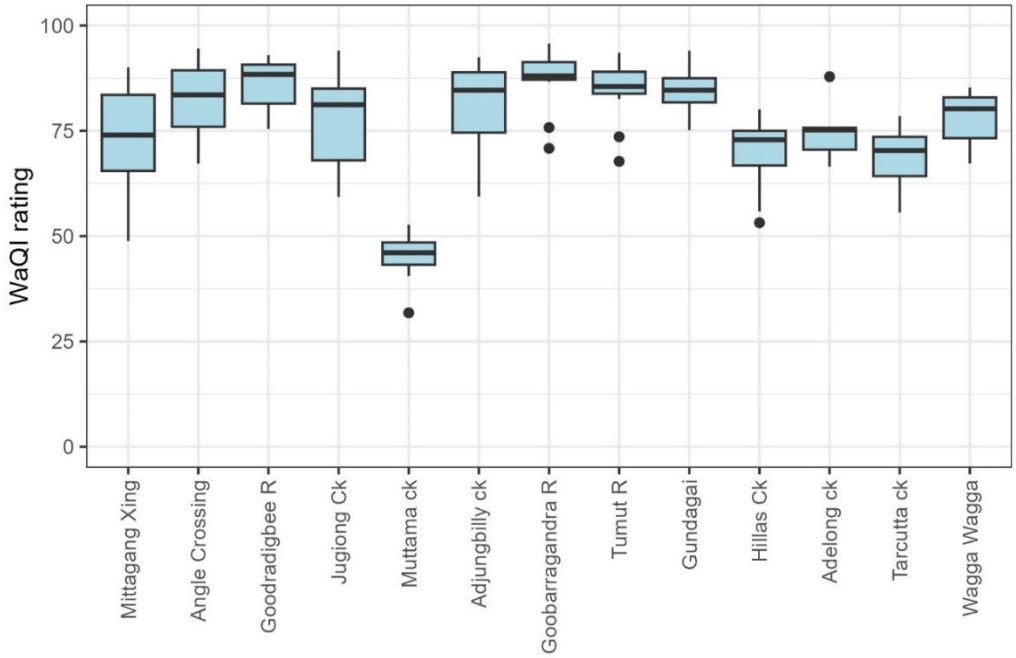

Figure 10: Boxplots showing long-term (2012–2013 to 2022–2023) WaQI scores for sites in the upper Murrumbidgee valley

The number of sites with a good rating has declined from a peak of 10 in 2014–2015 down to 2 in 2022–2023 (Figure 11). Over the same period, the number sites with a moderate rating increased from one to 8. There was an increase in the number of poor sites from one in 2012–2013 up to 3 in

2022–2023. The decline in water quality over this time coincides with extensive areas burnt by bushfires followed by heavy rain and flooding.

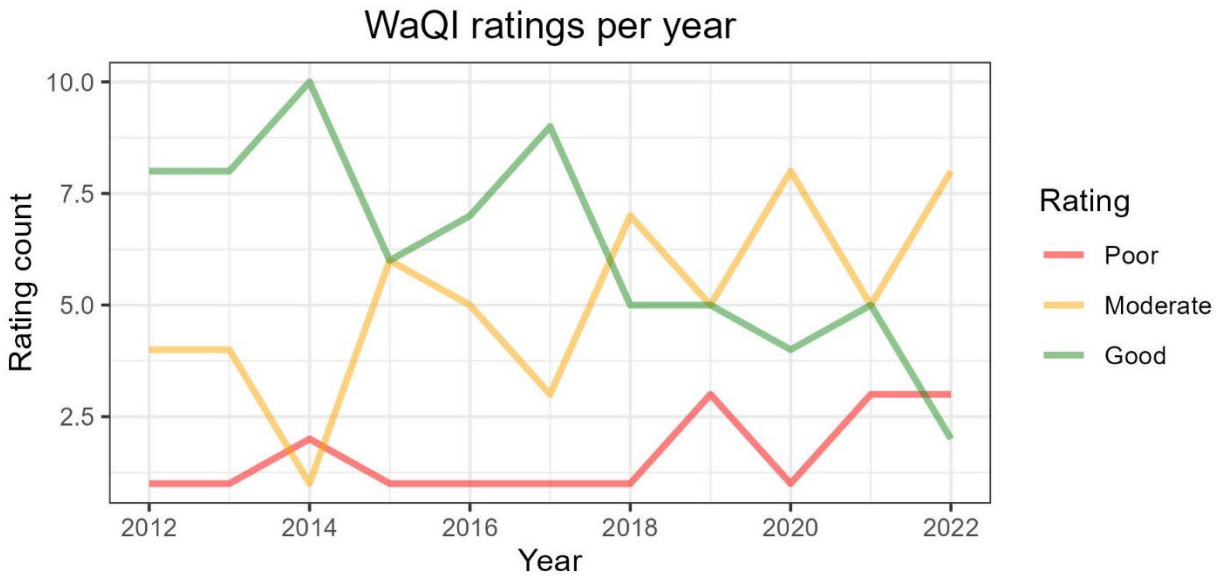

Figure 11: Graph summarising long-term water quality index ratings (2012–2013 to 2022–2023) for sites in the upper Murrumbidgee Valley by year

Lower

Analysis of WaQI scores from 2012–2013 to 2022–2023 shows most sites have a long term median WaQI rating of moderate (Figure 12). Billabong Creek at Darlot had the lowest median and a rating of poor.

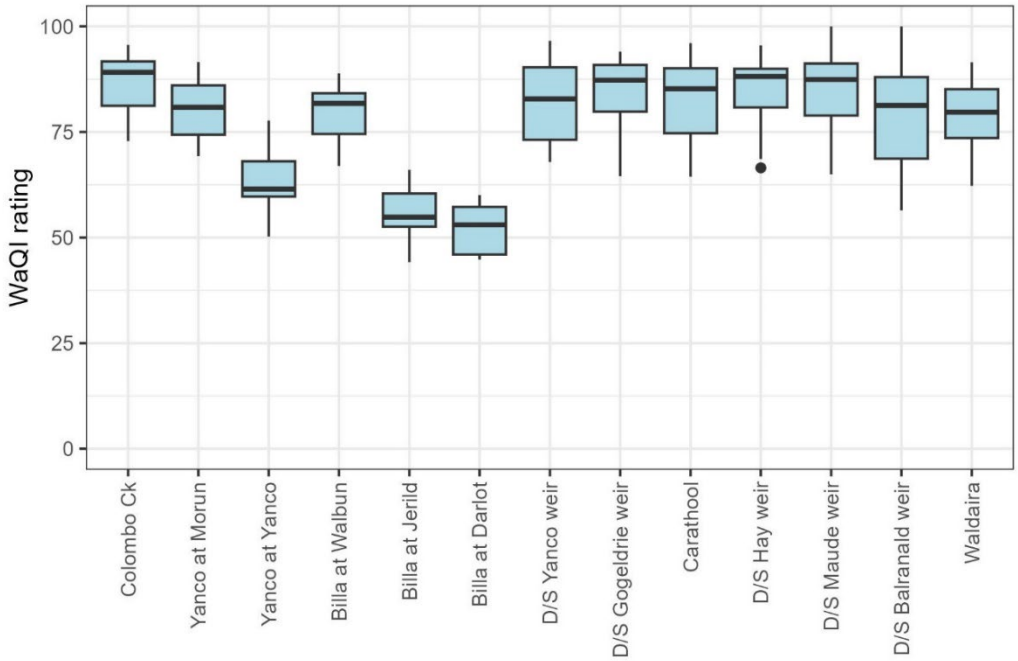

Figure 12: Boxplots showing long-term (2012–2013 to 2022–2023) WaQI scores for sites in the lower Murrumbidgee valley

The number of sites with a good rating has declined from a peak of 10 in 2014–2015 down to zero in 2022–2023 (Figure 13). Over the same period, the number sites with a moderate rating increased from one to 10. The number of poor sites peaked at 4 in 2016–2017. The decline in water quality over this time coincides with extensive areas burnt by bushfires followed by heavy rain and flooding.

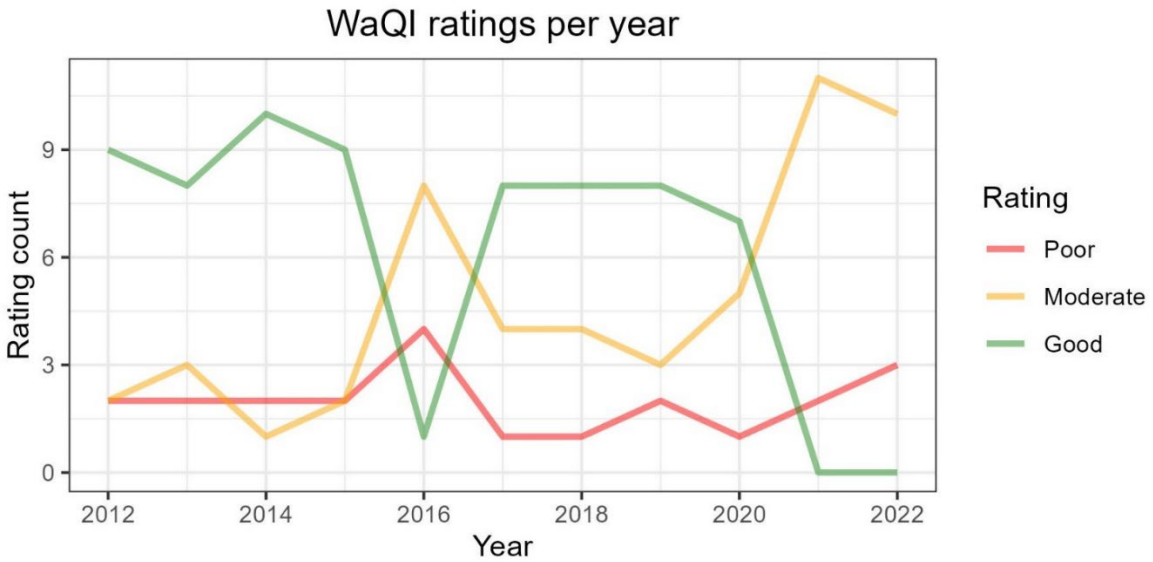

Figure 13: Graph summarising long-term water quality index ratings (2012–2013 to 2022–2023) for sites in the lower Murrumbidgee Valley by year

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