Namoi Valley annual surface water quality report: 2022–2023

Key Points

- Flow during the 2022–2023 period was characterised by heavy rain falling across much of the catchment from September through to November 2022. Flooding occurred in all catchments across the Namoi valley.
- NSW Fisheries investigated 2 fish death reports. The first report was the Namoi River, near Gunnedah on 31 January 2023. Tens of dead and injured fish were reported. A second event was investigated at Split Rock Dam, near Manila on 7 February 2023. Ten dead Murray cod were reported.
- Flooding was the main driver of water quality in the Namoi Valley. The Water Quality Index showed that of the 11 monitoring sites, 4 were rated as good, 5 as moderate and 2 were poor. One site had an improved water quality index rating compared to the 2021–2022 results.
- Sites on the Mooki River, Coxs Creek and Namoi River at Gunnedah exceeded the Basin Plan agriculture and irrigation salinity target of 957 µS/cm (microSiemens per centimetre). The median and 80th percentile in the Namoi River at Goangra were both less than their respective End-of-Valley salinity targets of 475 µS/cm and 715 µS/cm.
- Chaffey Dam, Split Rock Dam and the Peel River downstream of Chaffey Dam all recorded red alert warnings for blue-green algae during November and December 2022. Quipolly Dam also had a red alert warning for recreational use during March until June 2023.

The water quality data used in this report is collected on a monthly frequency at 11 sites in the Namoi 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 Namoi Valley from July 2022 to June 2023. The location of monitoring sites is shown in Figure 1.

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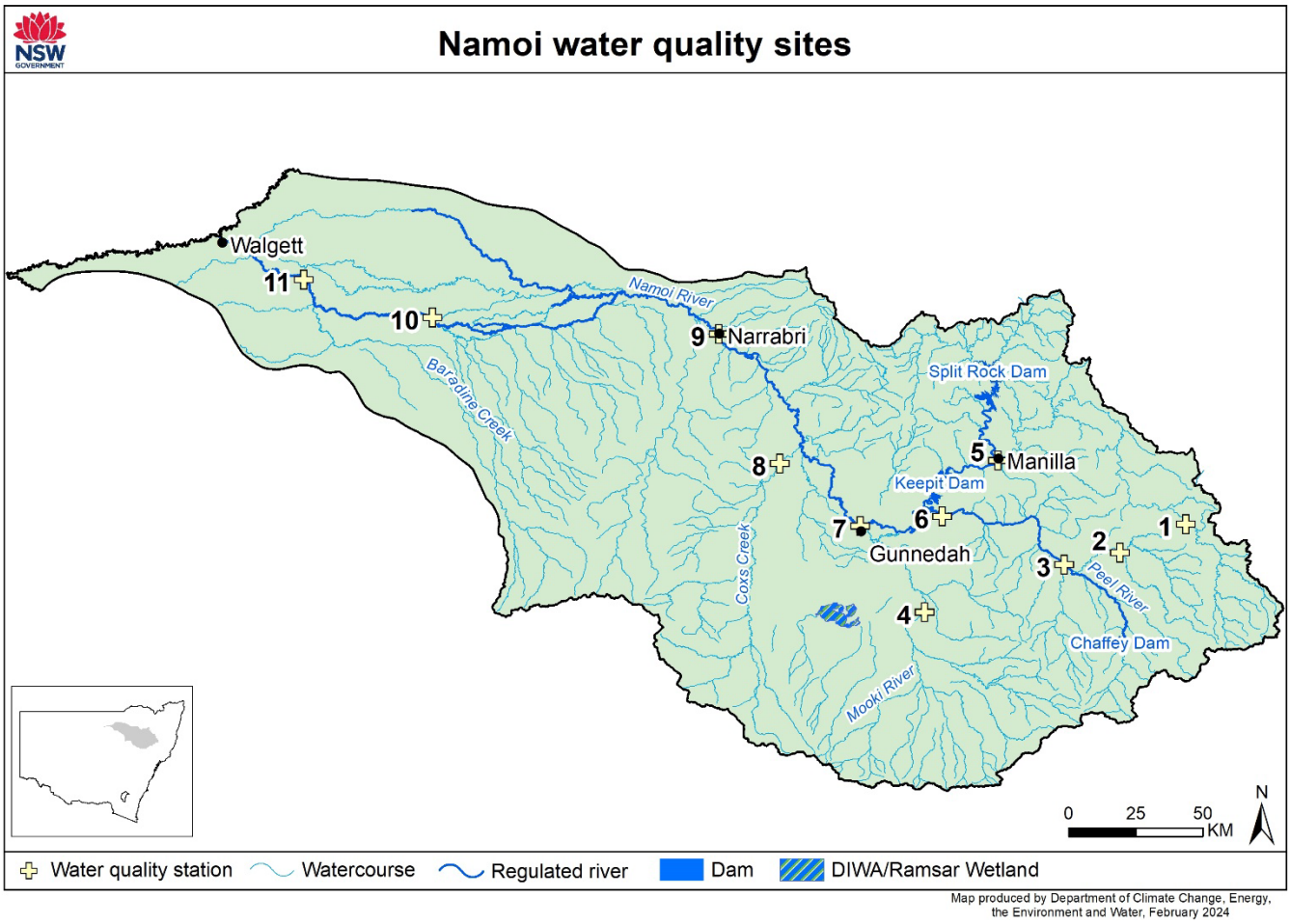

Figure 1: Location of routine water quality monitoring sites in the Namoi valley

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

Site number	Site name	Water Quality Zone	Station number
1	Macdonald River at Woolbrook	Namoi Montane	419010
2	Cockburn River at Mulla Crossing	Namoi Unregulated Uplands	419016
3	Peel River upstream Paradise Weir	Namoi Regulated Peel River	419024
4	Mooki River at Breeza	Namoi Liverpool Plains	419027
5	Namoi River at Manilla	Namoi Regulated uplands	419022
6	Peel River at Carrol Gap	Namoi Regulated Peel River	419006
7	Namoi River at Gunnedah	Namoi Regulated uplands	419001
8	Coxs Creek at Boggabri	Namoi Liverpool Plains	419032
9	Narrabri Creek at Narrabri	Namoi Regulated uplands	419003
10	Namoi River at Bugilbone	Namoi Lowlands	419021
11	Namoi River at Goangra	Namoi Lowlands	419026

Catchment description

The Namoi River catchment is in north-west New South Wales and covers approximately 42,000 km^2. The Namoi River is around 700 km in length and rises in the rugged terrain of the Great Dividing Range, meandering westward onto the riverine plain to join the Barwon River at Walgett.

Several major tributaries flow into the Namoi River. The Macdonald and Peel Rivers are in the eastern catchment area. The Mooki River and Coxs Creek join the Namoi River mid-catchment at Gunnedah and Boggabri respectively. Smaller tributaries, anabranches and effluent channels characterise the lower catchment.

Flows in the Namoi River are regulated by large dams and several in-stream regulatory structures. Chaffey Dam is in the upper sections of the Peel River. The Manilla River lies in the north-east of the catchment and flows into Split Rock Dam. Keepit Dam is the largest storage in the region and is located on the Namoi River upstream of the junction with the Peel River. There are three weirs situated on the Namoi River downstream of Narrabri. Mollee Weir is designed to hold and re-regulate flows to improve the precision with which water can be supplied to the lower valley. Gunidgera Weir is located at Wee Waa and assists with re-regulation. Its main function is to pass regulated flows into Gunidgera and Pian Creeks.

Land use is largely grazing in the upper catchment with increased cultivation for dryland farming on the Liverpool Plans and the lower catchment. Irrigated agriculture is mostly located adjacent to the Peel River near Tamworth, Mooki River and Coxs Creek on the Liverpool Plains and on the Namoi floodplain downstream of Gunnedah.

Catchment conditions during 2022–2023

Flow during 2022–2023 was influenced by heavy rain falling across the Namoi catchment from August to November 2022, and heavy falls in the mid and upper catchment in March 2023 (Figure 2A). This resulted in large flood events on the Namoi River with discharge at Gunnedah peaking at 134,000 megalitres per day (ML/day) on 24 October 2022, with contributions from the upper Namoi (over 176,000 ML/day) and Peel rivers (over 25,500 ML/day) (Figure 2C). The October flow event extended to the lower Namoi with discharge at Goangra peaking at over 90,000 ML/day in November 2022.

In July 2022 both Chaffey and Keepit dams were at 100% capacity while Split Rock Dam was at 73% (Figure 2B). Following continued rainfall, Split Rock had filled to capacity by October and remained near that level until the end of June 2023. Releases from Keepit Dam in March saw the volume decrease, but it had fill back up to almost 96% capacity by the end of June 2023 (Figure 2B).

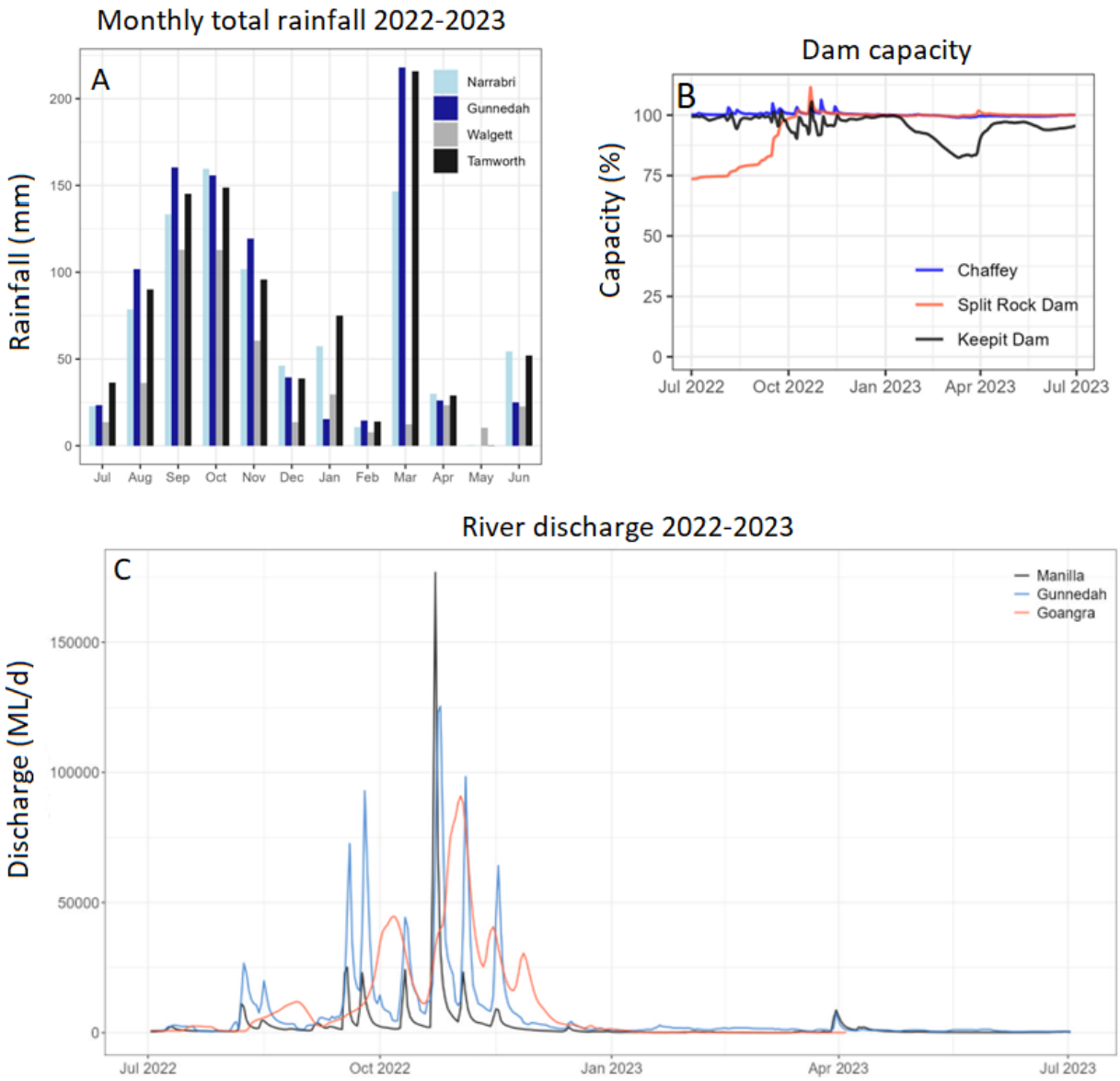

Figure 2: Catchment conditions for selected stations in the Namoi Valley from July 2022 to June 2023 for A: Monthly total rainfall (mm) B: Dam capacity (%) and C: River discharge (ML/day)

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.

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 Namoi Valley improved in 2022–2023 for one of the 11 sites. The ratings remained the same for the other 10 sites.

- Coxs Creek at Boggabri improved from poor to good.
- The Cockburn River at Mulla Crossing, Mooki River at Breeza, and the Namoi River at Manilla remained good.
- Macdonald River at Woolbrook, Peel River upstream Paradise Weir, Namoi River at Gunnedah, Bugilbone, and at Goangra remained moderate.
- The Peel River at Carrol Gap and Narrabri Creek at Narrabri remained poor.

The Peel River at Carroll Gap and Narrabri Creek at Narrabri rated as poor, largely due to high turbidity, total nitrogen and total phosphorus results following major flooding across the catchment. The improvement at Coxs Creek at Boggabri from poor to good was due to lower nutrient levels, higher dissolved oxygen and pH levels remaining within water quality guidelines. Coxs Creek is ephemeral and regularly ceased to flow in 2021–2022. Samples collected from isolated pools of deteriorating water quality during this period returned a poor rating. Increased flows in 2022–2023 prevented pools from stagnating, leading to an improved water quality index score.

Compared to the 2021–2022 results, there was minimal change in the water quality index scores for 7 of the 11 sites.

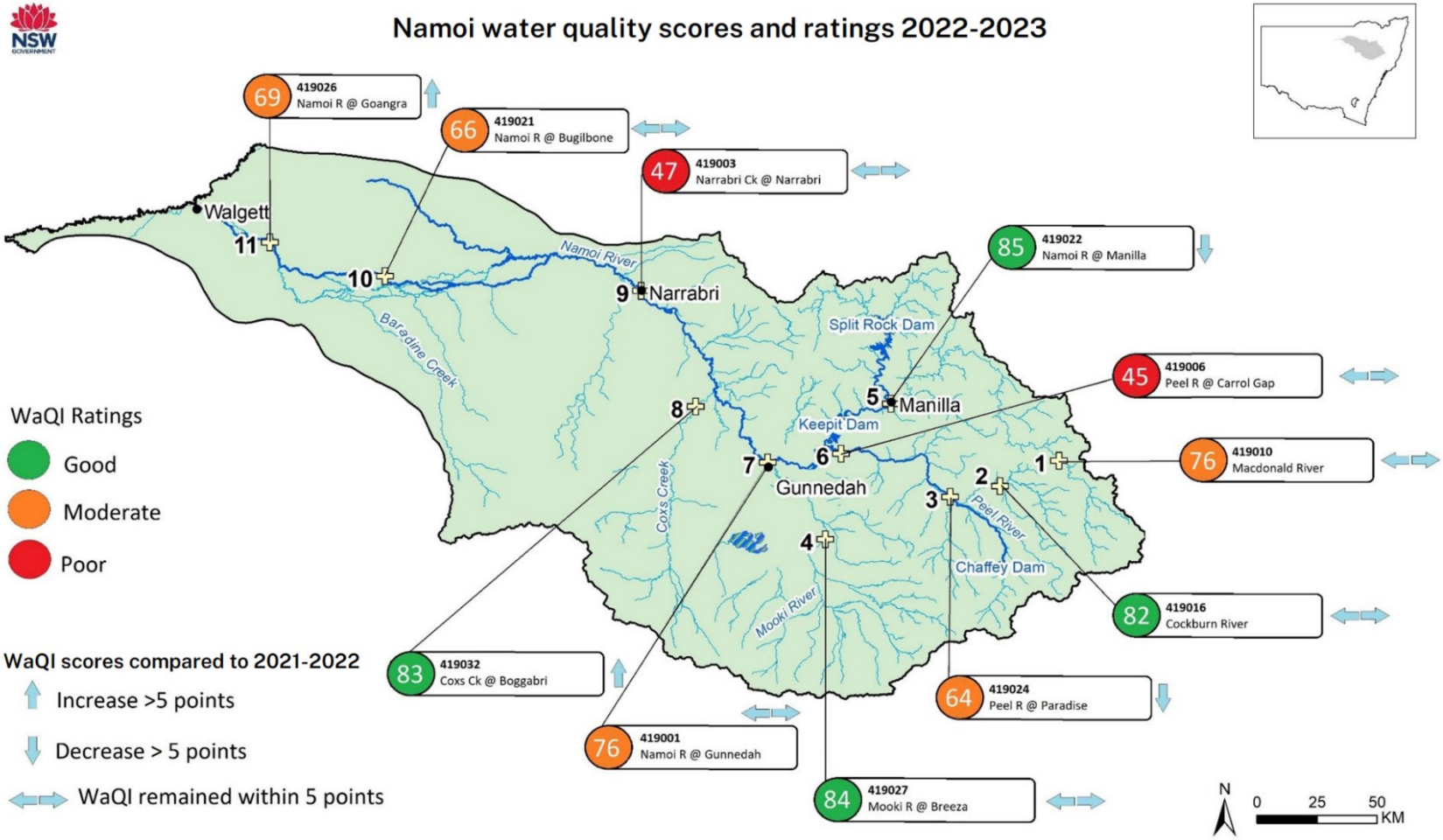

Figure 3: Water quality index scores and ratings for the Namoi valley

The pH fluctuated markedly between catchments. The soils in the Mooki River and Coxs Creek catchments are naturally alkaline which causes elevated pH at these two sites.

Turbidity increased with distance down the catchment, reflecting the impact of the cumulative effects of high flows, land use, soil disturbance and human activity on water quality. There were particularly high turbidity results in the lower catchment at Narrabri Creek and Namoi River at Bugilbone and Goangra as increased flow velocity during floods transported high loads of sediment.

The fertile alluvial clay soils in the Liverpool Plains catchment are naturally high in phosphorus. As these soils are eroded into the Mooki River and Coxs Creek by floods and runoff events, the associated nutrients are transported downstream. The high flows resulted in high nitrogen concentrations in the Mooki River and Coxs Creek and the Namoi River downstream.

Dissolved oxygen levels were above critical levels for aquatic ecosystems. The lowest dissolved oxygen readings were 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. In addition, major flooding resulted in the flushing of organic matter off the lowland floodplains and into waterways. The rapid breakdown of this material by bacteria can cause dissolved oxygen levels to decline.

The Mooki River at Breeza and Coxs Creek at Boggabri had the highest median electrical conductivity in the Namoi valley, followed by the Peel River at Carroll Gap. These sites have historically had high electrical conductivity caused by rainfall and runoff mobilising salts stored in the soil and geology of the landscape and inputs from shallow saline groundwater.

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

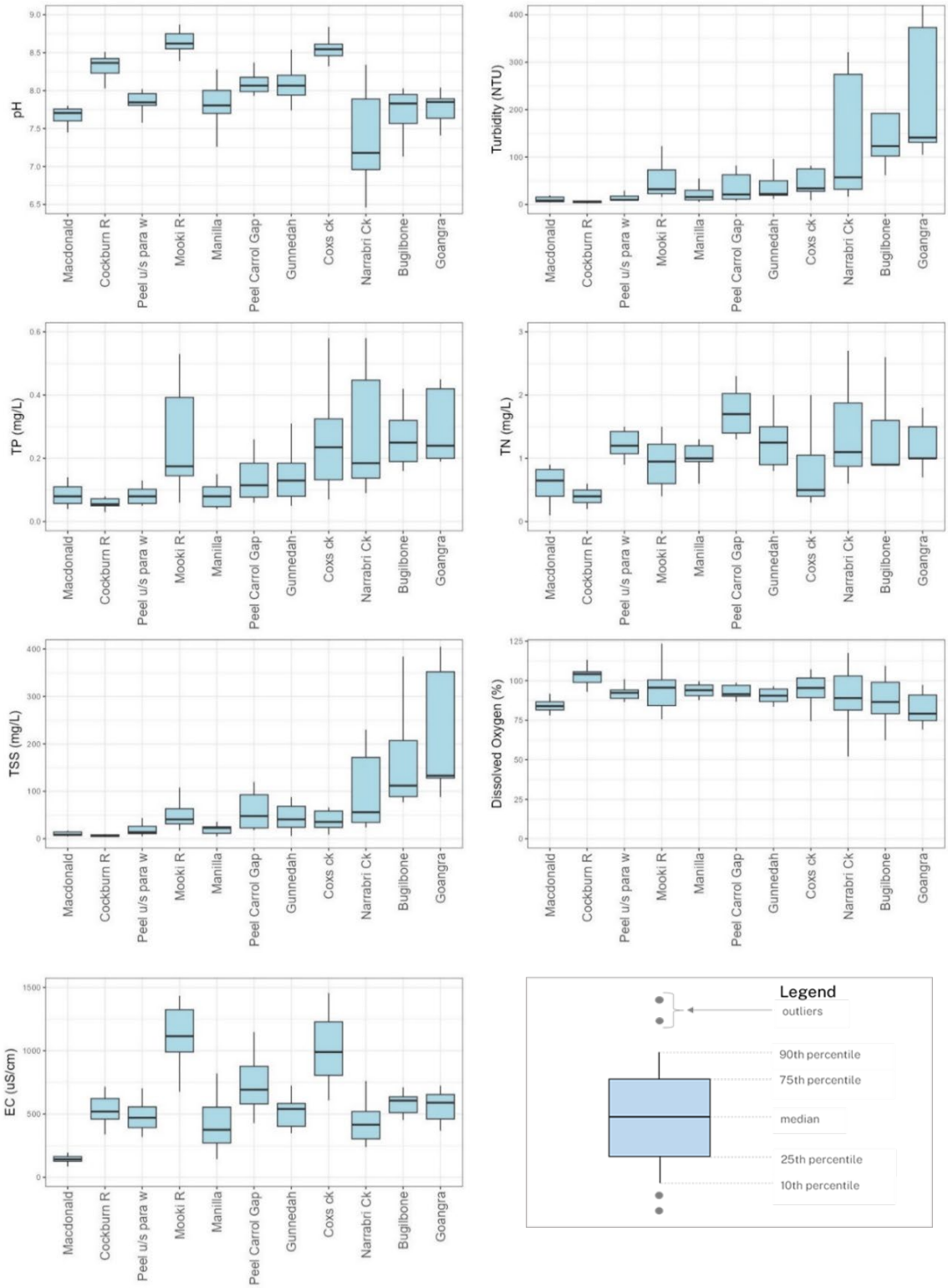

Figure 4: Water quality data by site, moving upstream to downstream from left to right. The water quality parameters shown are pH, Turbidity, Total phosphorus (TP), Total nitrogen (TN), Total suspended solids (TSS), Dissolved oxygen, and electrical conductivity (EC).

Irrigation and salinity

There are 8 continuous electrical conductivity monitoring sites in the Namoi valley. Figure 5 plots selected sites and shows electrical conductivity fluctuated throughout the year in response to flooding events.

Monitoring showed that sites on the Mooki River, Coxs Creek and Namoi River at Gunnedah had a 95th percentile electrical conductivity above the Basin Plan agriculture and irrigation salinity target of 957 µS/cm for 2022 to 2023. Rainfall and extensive flooding in late 2022 would have recharged shallow aquifers. Dryer conditions and lower flows in 2023 would have allowed the shallow saline groundwater to drain back into the river channels, increasing the electrical conductivity.

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

- the median electrical conductivity does not exceed 475 µS/cm
- the 80th percentile electrical conductivity does not exceed 715 µS/cm and
- the annual salt load does not exceed 127,600 t/year.

The median (466 µS/cm) and 80th percentile (570 µS/cm) were both less than the End-of Valley targets. Due to the high flows, the annual salt load of 366,354 t/year exceeded the End-of-Valley target value.

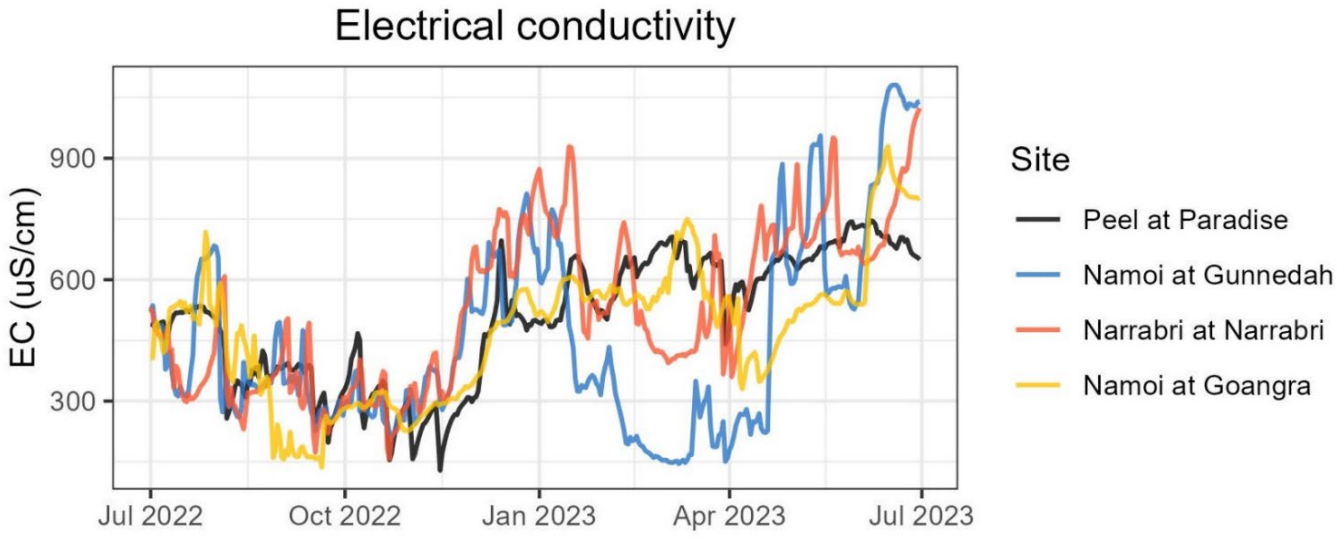

Figure 5: Electrical conductivity (EC) in the Namoi valley

Recreation

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

Blue-green algae have historically been a major issue in Chaffey and Quipolly dams due to stratification and warm water temperatures. Less frequent blooms usually occur in Keepit and Split Rock dams. Blooms during low flows can occur in the Namoi River at Walgett due to high nutrient inputs. Table 2 indicates the distribution of algal alerts from July 2022 to June 2023. The majority of red alert warnings for recreational use occurred over the summer months for Chaffey Dam and the Peel River downstream of Chaffey Dam. Quipolly Dam was red alert for blue-green algal blooms from March until June 2023.

Table 2: Distribution of algal alert levels in Namoi Valley Dams July 2022 to June 2023

	Jul					Aug					Sep					Oct					Nov					Dec					Jan					Feb					Mar					Apr					May					Jun				
Chaffey Dam	2	2	2	2	1	2	2	1	*	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	3	3
Peel River (downstream of Chaffey Dam)	2	2	2	2	*	2	2	*	*	1	1	2	2	1	1	1	1	1	1	1	3	3	3	3	3	3	3	3	3	3	3	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	*	*	1	1	*	*	*	1
Split Rock Area	1	1	1	*	*	*	*	*	*	1	1	1	1	1	1	1	2	2	2	3	3	3	3	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
Keepit Dam	*	*	*	1	1	1	1	1	1	1	1	1	*	*	*	*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	*	*	*	*	*	*	*	*	*	*	*	*	*
Namoi River (downstream of Keepit Dam)	1	1	1	1	1	1	1	1	1	1	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	2	2	1	1	*	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*
Quipolly Dam	2	2	2	2	2	2	2	2	2	2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Namoi River at Walgett	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	*	*	*	*	*	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 6 - BoM, 2023 and Figure 7). The Namoi River reached major flood levels above 100,000 ML/day at Gunnedah in September, peaking again near the end of October above 136,000 ML/day.

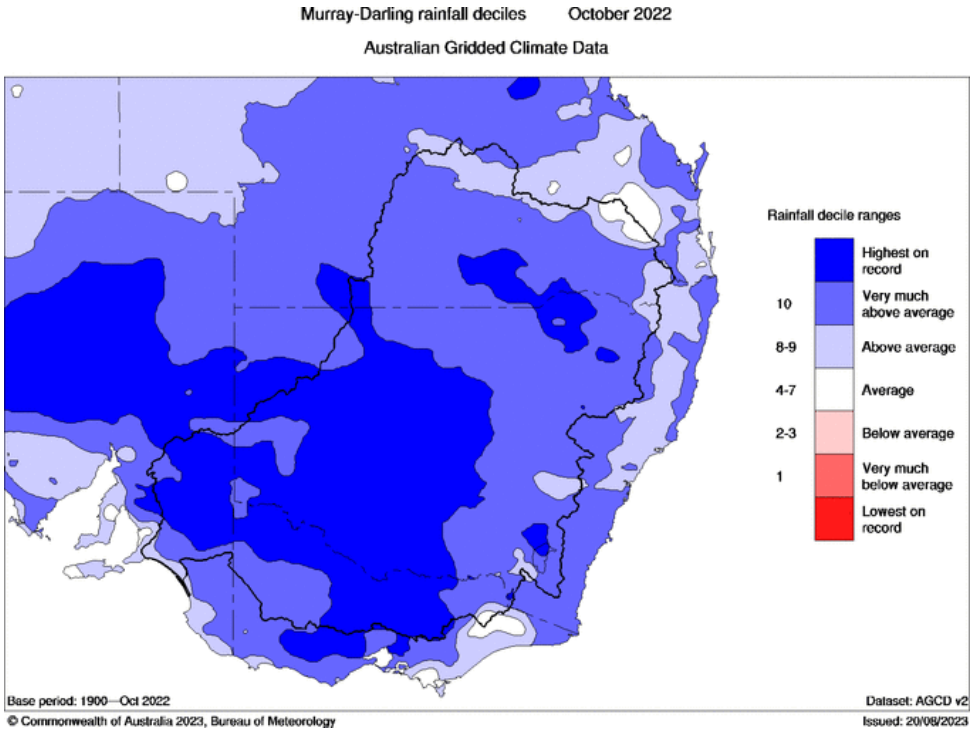

Figure 6: Murray Darling rainfall deciles for October 2022. (Source: BoM)

Figure 7: The Namoi River near Gunnedah 24th September 2022. (Source: Planet Explorer)

The heavy rain maintained water storage levels at near 100% capacity, with many storages spilling. With flooding on this scale came an increased risk of hypoxic blackwater events and a high risk of significant fish deaths.

NSW Fisheries investigated 2 fish death reports in the Namoi Valley in 2023. The first report was the Namoi River, near Gunnedah on 31 January. Tens of dead and injured fish were reported. Species affected included Murray Cod, Golden Perch, Bony Herring, and carp. NSW Fisheries determined the cause was attributed to an outbreak of Red Spot disease. Changes in water quality conditions because of the floods may have contributed to the disease occurring.

The second fish death report occurred at Split Rock Dam, near Manila on 7 February 2023. Ten dead Murray cod were reported. The cause could not be determined.

Summary

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

In 2022 to 2023, major flooding across the catchment was the key driver of water quality. Increased runoff carried high volumes of sediment and nutrients into waterways resulting in 6 of 11 water quality monitoring sites being rated as moderate or poor. In addition, the recharge of shallow aquifers led to saline discharge and increased electrical conductivity at some sites in 2023.

The flood flows resulted in a hypoxic blackwater event in the lower Namoi catchment which contributed to low oxygen levels in the Barwon and Darling rivers. Hypoxic, or low oxygen blackwater is a feature of Australian lowland river systems and occurs when organic material, such as sticks, leaves, bark and grass is broken down in the floodwater or washed off the floodplain into the river. The breakdown of this material by bacteria can rapidly use up all the oxygen in the water. The dark appearance of the water is due to the release of tannins as the organic matter decays. NSW Fisheries investigated 2 fish death reports in the Namoi Valley.

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.

The flushing of nutrients from catchment areas into Chaffey, Split Rock and Quipolly dams by floodwaters may have contributed to the high potentially harmful blue-green algal numbers, with Chaffey Dam being on either amber or red alert warnings for most of 2022 to 2023.

For more detailed information about water quality issues in the Namoi catchment see the Namoi surface water quality technical report (https://www.industry.nsw.gov.au/__data/assets/pdf_file/0003/305742/Water-quality-technical-report-for-the-Namoi-surface-water-resource-plan-area-SW14.pdf).

Long-term water quality trends

Analysis of WaQI scores from 2012–2013 to 2022–2023 shows the majority of sites have a long term median WaQI rating of good or moderate (Figure 8). The Peel River at Carrol Gap had the lowest median and a rating of poor. This site is at the lower end of the Peel River catchment and is impacted by a naturally high salt store in the soils and geology. Coxs Creek also returned lower WaQI scores. Coxs Creek ceases to flow regularly resulting in samples being collected from isolated pools of deteriorating water quality. Significant droughts and floods resulted in outlier results at some sites.

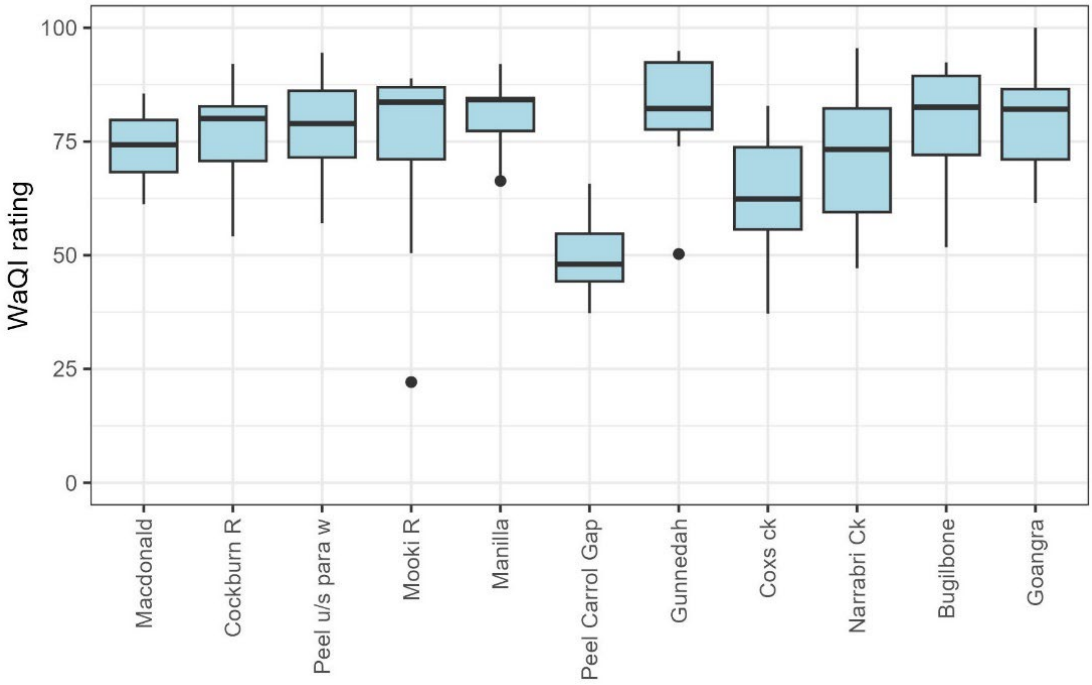

Figure 8: Boxplots showing long-term (2012–2013 to 2022–2023) WaQI scores for every site in the Namoi valley

The number of sites with a good rating declined from 2012–2013 until 2019–2020, coinciding with the breaking of extended drought in 2020 (Figure 9). At the same time there was an increase in the number of poor ratings, peaking with 7 sites in 2019–2020. The number of sites with a moderate rating has been gradually increasing over the past 10 years after years of severe drought and floods.

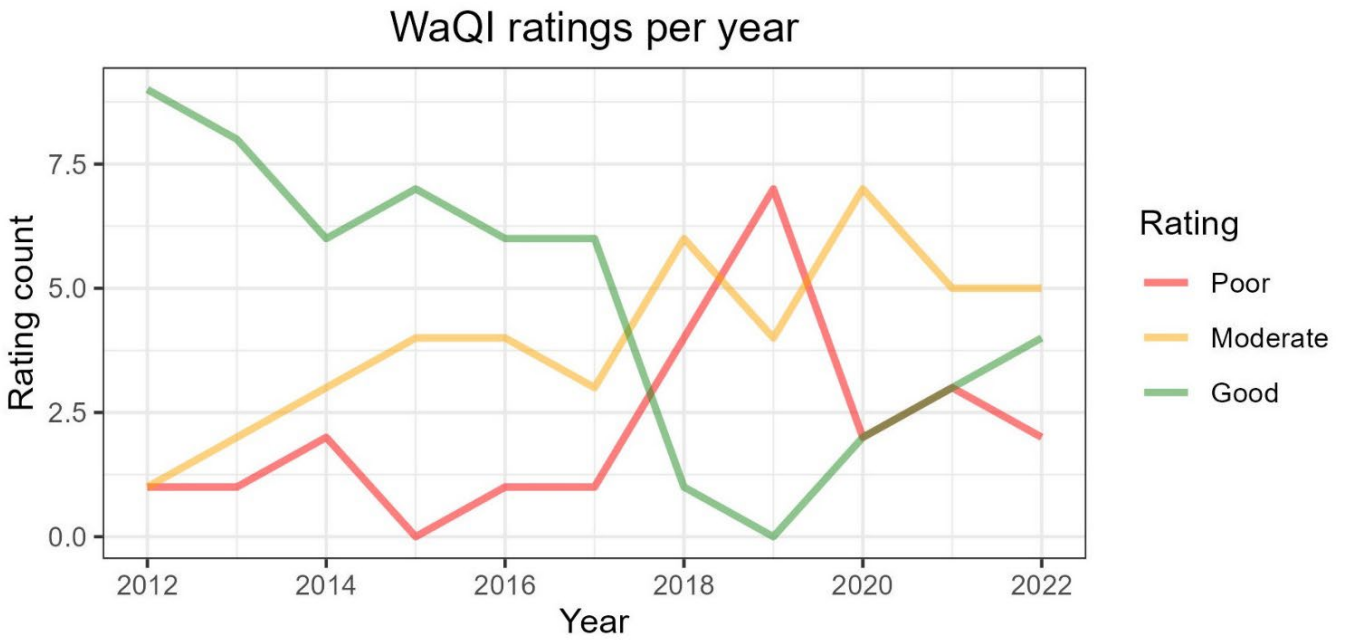

Figure 9: Graph summarising long-term water quality index ratings (2012–2013 to 2022–2023) for every site in the Namoi Valley by year

References and further information

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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/namoi-annual-environmental-water-priorities

Red spot disease: https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/aquatic-industries/wildfish-shellfish/red-spot