Hunter 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 several large flow events and flooding in July 2022.
- The heavy rains led to substantial increases in water storage levels.
- Flooding was the main driver of water quality in the Hunter catchment. The water quality index indicated that of the 7 sites in the catchment, 3 rated as moderate and 4 as poor. Of the 7 monitoring sites, one site had poorer water quality in 2022–2023 than in 2021–2022.
- Electrical conductivity in the Hunter River at Singleton exceeded 900 µS/cm (microSiemens per centimetre) during periods of low flow between January and June 2023. The Hunter River at Muswellbrook also exceeded 600 µS/cm during 2023.
- Monitoring in the Hunter and Paterson tidal pools showed higher electrical conductivity at Raymond Terrace in May and June 2023. Heavy rainfall and flooding during 2022 brought freshwater inflows to the tidal pools which kept electrical conductivity low.
- Glennies Creek Dam and Glennies Creek recreation area was on red alert for blue-green algal blooms for recreational use in October until November 2022. There were no red alerts for the rest of the Hunter valley.

The water quality data used in this report is collected on a monthly frequency at 8 sites in the Hunter 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 Hunter Valley from July 2022 to June 2023. The location of monitoring sites is shown in Figure 1.

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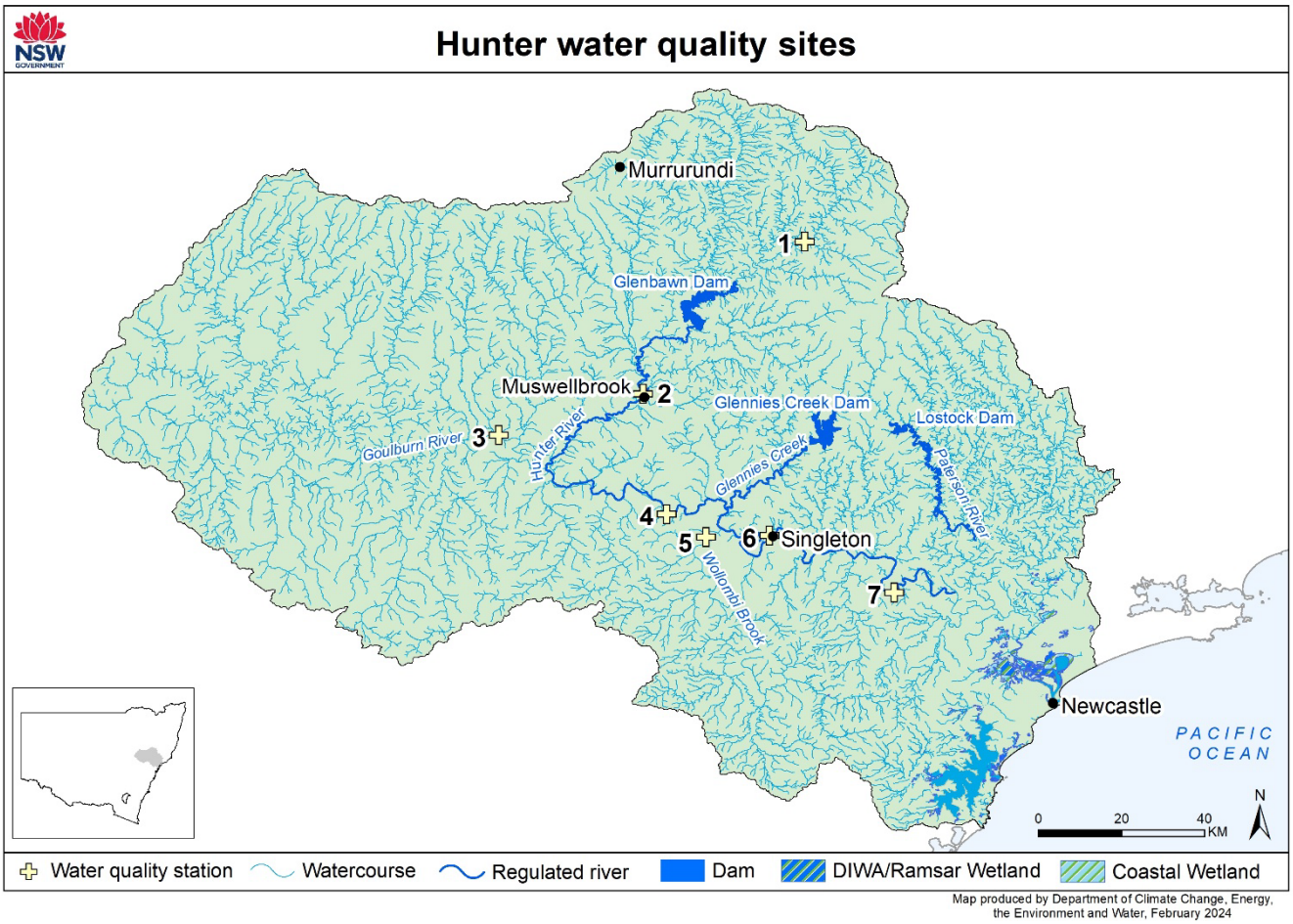

Figure 1: Location of routine water quality monitoring sites in the Hunter valley

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

Site number	Site name	Water Quality Zone	Station number
1	Hunter River at Moonan Flat	Hunter unregulated uplands	210005
2	Hunter River at Muswellbrook	Hunter regulated lowlands	210002
3	Goulburn River at Sandy Hollow	Hunter unregulated lowlands	210031
4	Hunter River at Moses Crossing	Hunter regulated lowlands	21010092
5	Wollombi Brook at Warkworth	Hunter unregulated lowlands	210004
6	Hunter River at Singleton	Hunter regulated lowlands	210001
7	Hunter River at Luskintyre	Hunter regulated lowlands	210009

Catchment description

The Hunter catchment covers an area of approximately 21,500 km^2, rising in the Mount Royal Range north-east of Scone and flowing through the Hunter Valley before reaching the Tasman Sea at Newcastle. The Hunter is recognised for its unique ecology, with tropical and temperate climate zones spanning a range of landscapes including World Heritage-listed National Parks, mountain ranges, floodplains and the Hunter Estuary wetlands.

The largest tributary of the Hunter River is the Goulburn River which begins at Ulan near Mudgee and flows east to join the Hunter River near Denman. Several other tributaries join the Hunter River including the Pages, Williams and Paterson Rivers, and Moonan, Stewart and Wollombi Brooks. The Paterson and Williams Rivers rise in the Barrington Tops and drain the higher rainfall area with both rivers flowing south into the Hunter estuary. The southern side of the Hunter is drained by a number of streams, the largest being the Wollombi Brook.

Several large population centres are present in the Hunter Catchment including Newcastle, Maitland, Raymond Terrace, Cessnock, Singleton and Muswellbrook. Major local industries include coal mining, viticulture, electricity production, dairy farming and cattle grazing. The Hunter is regulated by two major headwater storages, Glenbawn and Glennies Creek Dams, as well as a number of smaller dams. Large volumes of water are also extracted for power station use in Lake Liddell.

Catchment conditions during 2022–2023

Flow during 2022–2023 was characterised by heavy rain falling across much of the catchment from July 2022 through to May 2023 (Figure 2A). Glenbawn Dam, Glennies Creek Dam and Lostock Dam generally maintained full capacity throughout the year (Figure 2B). Figure 2C shows large flow events occurred throughout the Hunter catchment, including at Greta where discharge peaked around 200,000 megalitres per day (ML/day) on 8 July 2022. Several large flow events (over 48,000 ML/day) also occurred at Greta and Sandy Hollow in October 2022. Discharge at Belltrees upstream of Glenbawn Dam was typically much lower than at Greta and Sandy Hollow throughout the year.

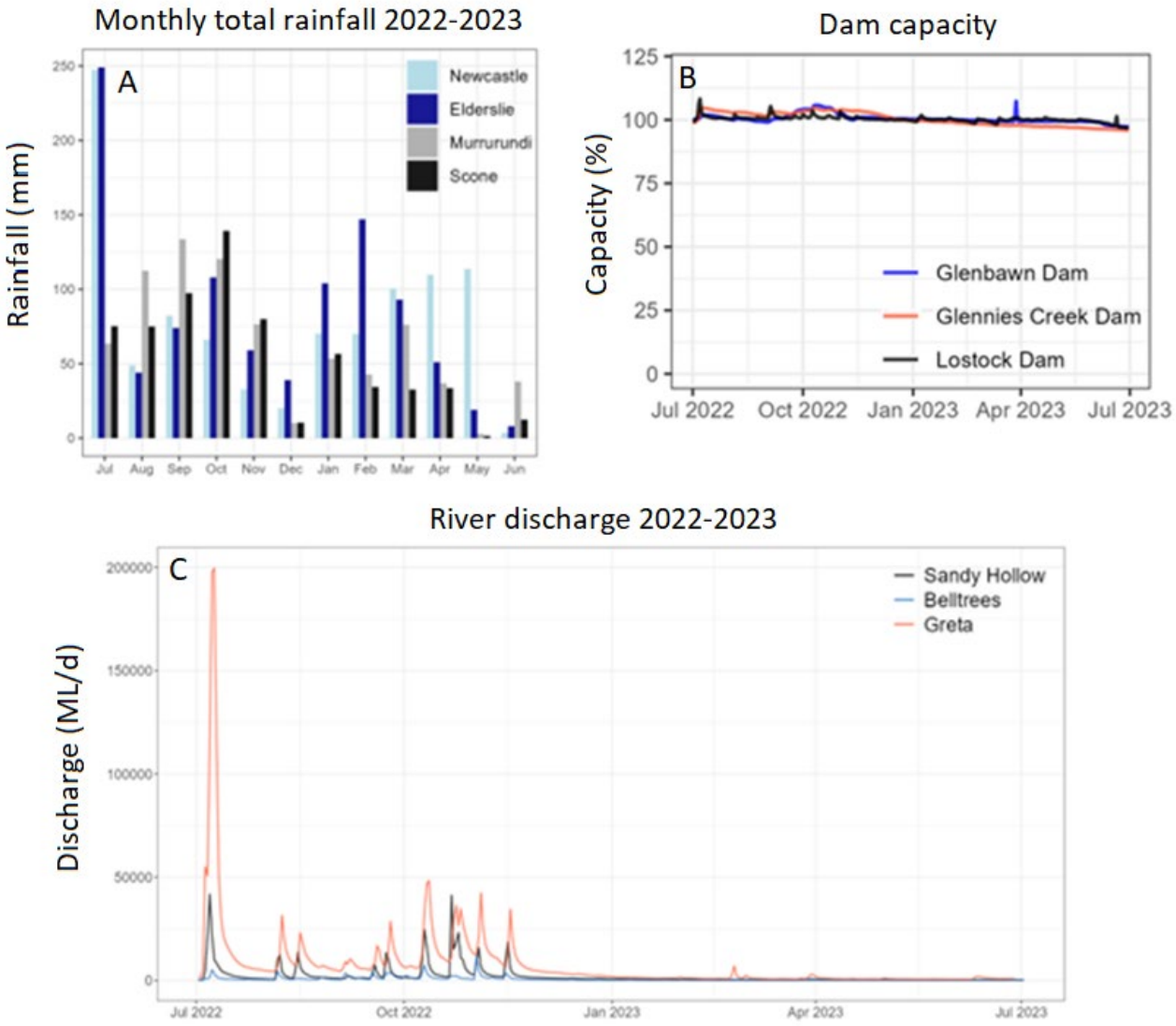

Figure 2: Catchment conditions for selected stations in the Hunter catchment from July 2022 to June 2023for A: Monthly total rainfall (mm) B: Dam capacity (%) and C: River discharge (ML/day)

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 Hunter Valley declined in 2022–2023 for one of the 7 sites compared to 2021–2022.

- Hunter River at Singleton declined from moderate to poor.
- Hunter River at Moonan Flat, Muswellbrook Bridge, and Wollombi Brook at Warkworth remained moderate.
- Hunter River at Moses Crossing, Luskintyre, and the Goulburn River at Sandy Hollow remained poor.

The Hunter River at Muswellbrook had a higher index score in 2022–2023 compared to 2021–2022 due to better dissolved oxygen levels however the rating remained moderate. The Hunter River at Singleton had the lowest index score due to higher turbidity and nutrient concentrations following flooding.

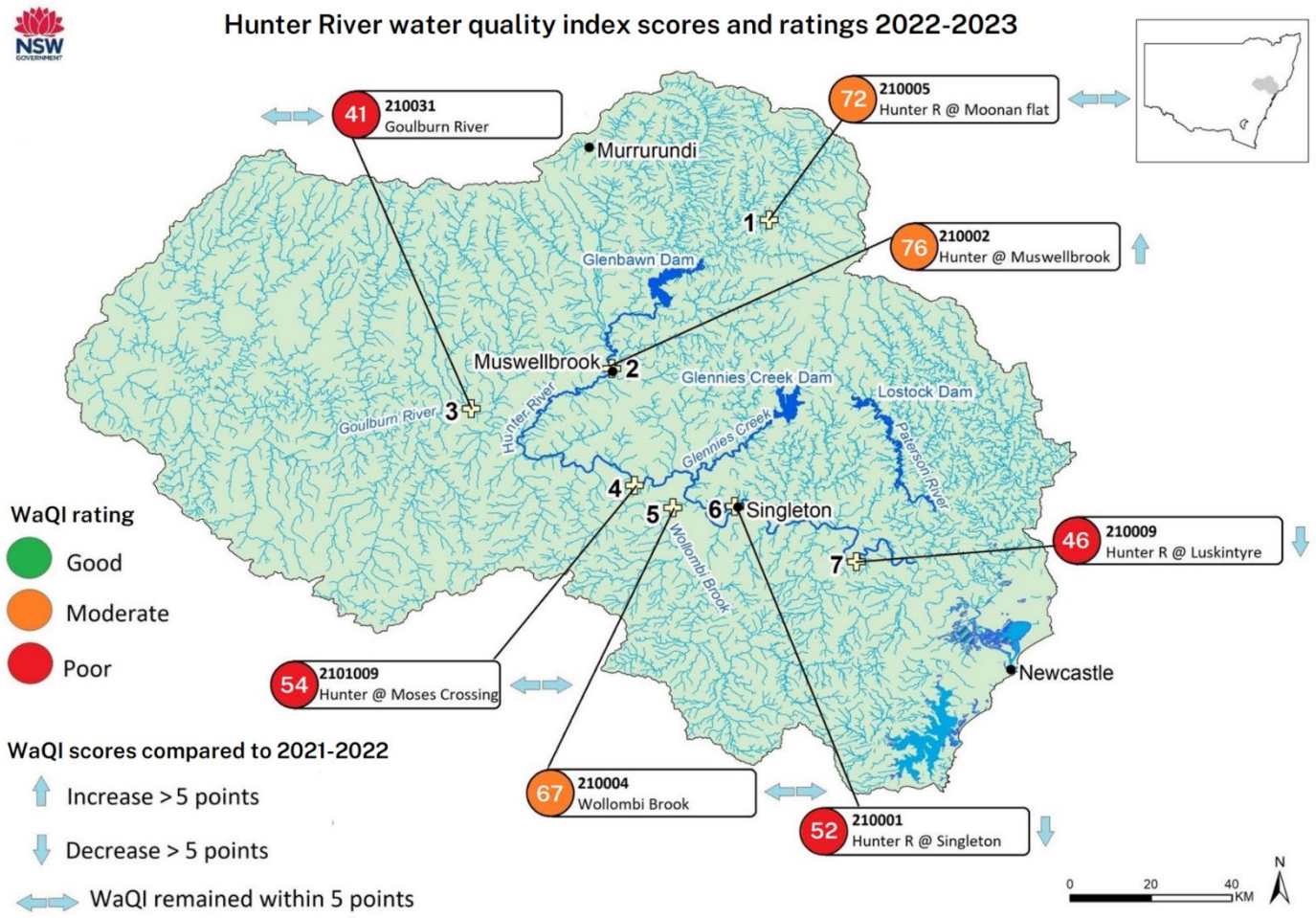

Figure 3: Water quality index scores and ratings for the Hunter valley

The median pH in the Hunter Valley was above 7.0 at all sites, though slightly lower in Wollombi Brook.

There is a general trend of increasing turbidity and nutrient concentrations with distance down the Hunter catchment, reflecting the impact of the cumulative effects of land use, soil disturbance and human activity on water quality. The Hunter River at Luskintyre had the highest median turbidity, total suspended solids, and total nitrogen results. Sandy and less fertile soils in the Wollombi Brook catchment resulted in lower turbidity, total nitrogen and total phosphorus results than at the surrounding monitoring sites in the Hunter River.

Dissolved oxygen levels can fluctuate between sites in response to local drivers, but during 2022–2023 were generally consistent down the catchment. Results were slightly lower in Wollombi Brook, but there would have been no impact on the health of aquatic ecosystems.

Electrical conductivity results show the Hunter River at Moonan Flat, located in the upper reaches, remained near or below 500 µS/cm during 2022 and 2023. The remaining sites in the middle and lower sections of the catchment had median levels below 1,000 µS/cm which is safe for irrigation and water-dependent ecosystems.

Summary statistics for the key water quality parameters at each monitoring site in the Hunter valley 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.

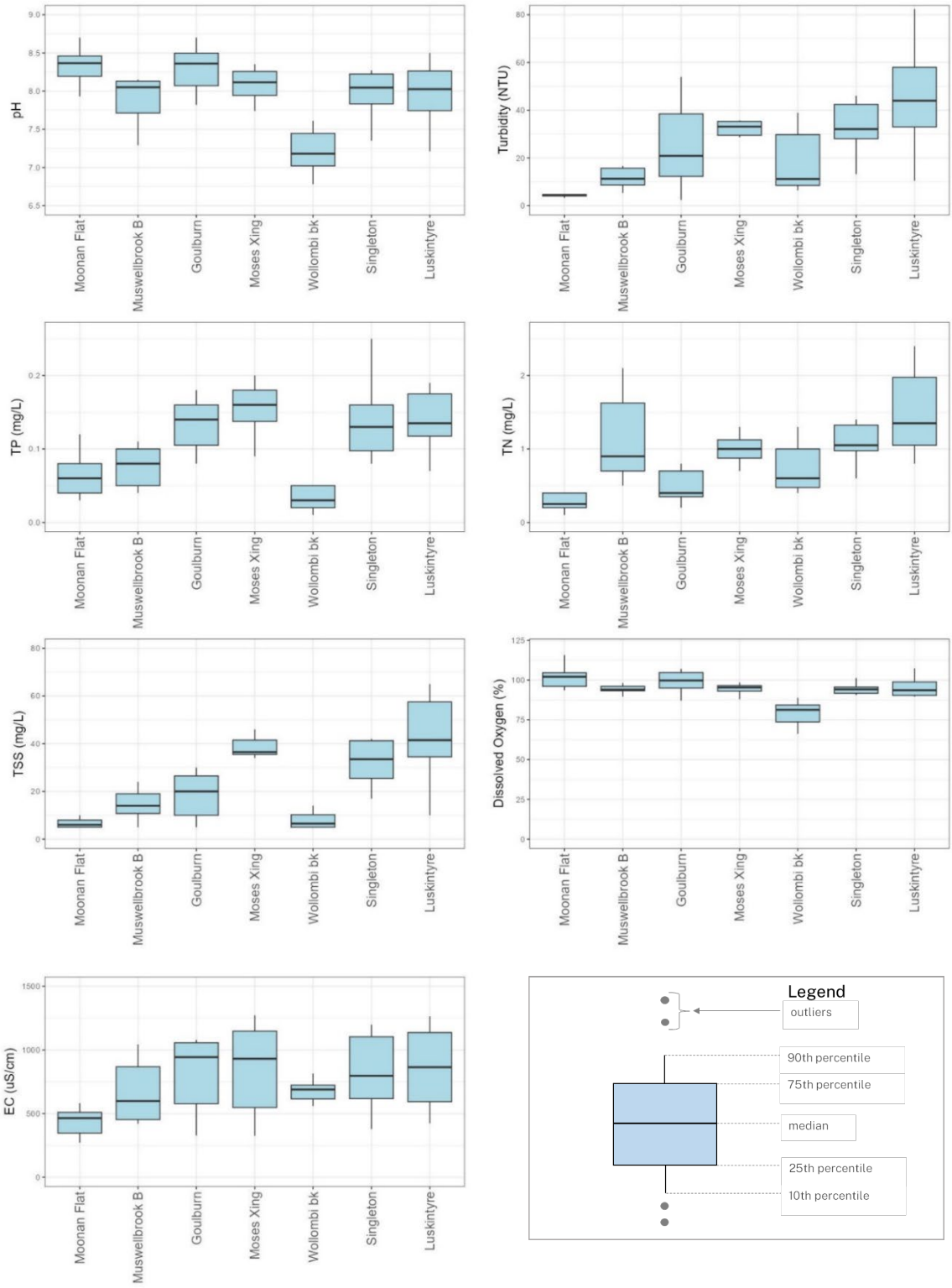

Figure 4: Water quality data by site, moving upstream to downstream from left to right. The water quality parameters shown are pH, Turbidity, Total phosphorus (TP), Total nitrogen (TN), Total suspended solids (TSS), Dissolved oxygen, and electrical conductivity (EC).

Irrigation and salinity

The Hunter River valley is generally considered to be saline due to the marine origin of some of its Permian sediments. The Hunter River valley also has a variety of potential sources of salinity including rainfall, atmospheric deposition, and a range of anthropogenic sources including mining, power generation and agriculture (OEH, 2013).

The Hunter River Salinity Trading Scheme operates to minimise the impact of saline water discharges from industry on the Hunter River. This is done by allowing saline water to be discharged only at times of high flow or flood when it is diluted by the Hunter River. When the river is in low flow, no discharges are allowed.

River salinity targets are established for the upper, middle and lower sections of the river. The total allowable discharge is calculated so that:

- salt concentrations do not exceed 600 µS/cm in the upper section (Glenbawn Dam to Denman) or
- salt concentrations do not exceed 900 µS/cm in the middle and lower sections (downstream of Denman).

When the river is in flood, unlimited discharges are allowed as long as the salt concentrations do not exceed 900 µS/cm (OEH, 2013).

There are 32 continuous electrical conductivity monitoring sites in the Hunter valley. Figure 5 shows the electrical conductivity at 4 selected sites on the Hunter River. Between July and December, electrical conductivity remained low due to continuing rain and high flows in the Hunter River diluting salts. Once the flooding had subsided, discharge from saline shallow saline groundwater and inflows from saline tributaries resulted in increased electrical conductivity through early 2023.

Downstream of Aberdeen there is a marked increase in electrical conductivity from January through to May 2023, with both Muswellbrook and Denman exceeding the 600 µS/cm target. Electrical conductivity at Singleton exceeded the 900 µS/cm target.

The drop in electrical conductivity across all Hunter River sites in June coincides with a release peaking at over 2,000 ML/day from Glenbawn Dam. Electrical conductivity increased again once the release from Glenbawn Dam was completed.

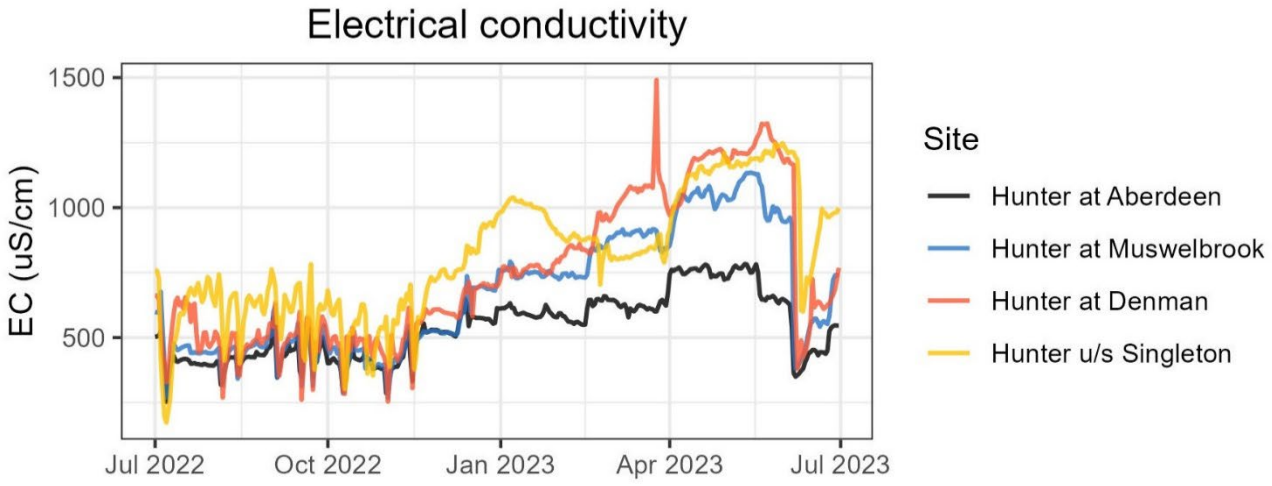

Figure 5: Mean daily electrical conductivity (µS/cm) at selected sites in the Hunter River

During periods of low flow in the Hunter and Paterson rivers, salt water from the sea can push further up the Hunter estuary, particularly at high tides. Monitoring in the Hunter and Paterson tidal pools (Figure 6) shows heavy rainfall and flooding during 2022 brought freshwater inflows to the tidal pools which kept electrical conductivity low. Electrical conductivity at Raymond Terrace increased in 2023 during lower inflows from the Hunter River, with the highest results in May and June 2023.

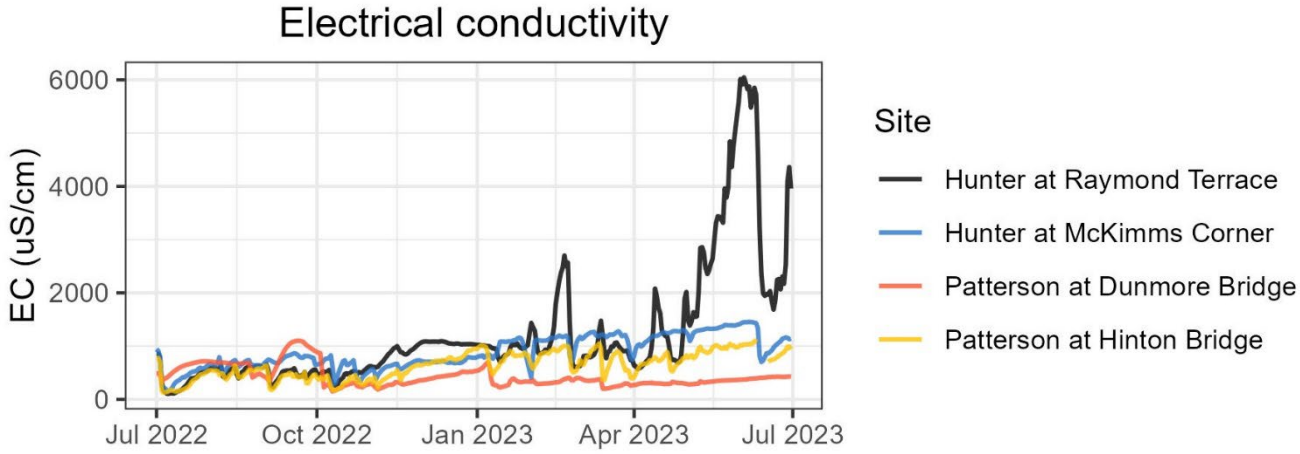

Figure 6: Electrical conductivity (µS/cm) in the Hunter and Paterson rivers tidal pools

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 algal blooms have historically been an issue in the Hunter region during the summer months due to warmer temperatures, low rainfall and lack of inflows. Table 2 indicates the distribution of algal alerts for selected sites during July 2022 to June 2023. Glennies Creek Dam and recreation area was briefly on red alert for recreational use during October and November 2022. Higher inflows would have helped reduce algal blooms.

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

	Jul					Aug					Sep					Oct					Nov					Dec					Jan					Feb					Mar					Apr					May					Jun				
Hunter River (upstream Glenbawn Dam)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1	*	*	*	*	*	2	2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Glenbawn Dam	2	1	1	1	1	1	1	*	*	*	*	*	1	1	1	1	*	*	*	*	*	*	*	*	*	2	2	2	*	1	1	1	1	1	1	1	*	*	*	*	*	*	*	*	1	1	1	1	1	*	*	*	*	*	*	*	*
Glennies Creek Dam	*	*	*	*	*	*	*	*	*	*	*	*	*	2	2	3	3	3	3	3	2	2	2	1	*	*	*	*	*	1	1	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Glennies Creek Recreation Area	1	*	*	*	*	*	*	*	*	*	*	*	*	2	2	2	3	3	3	3	2	2	1	*	*	2	2	2	2	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	1	1
Lostock Dam	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Williams River (Boag's Hill)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	1	2	1	*	1	1	1	1	1	1	*	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Grahamstown Dam	*	*	*	*	*	*	*	*	*	*	*	*	1	*	*	*	1	*	*	*	1	1	*	*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*	1	1	*	*	1	*	*	*	*	1	*	*	*	*	*	*	*
Lake Liddell	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	2	2	2	1	1	1	1	1	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. For the east coast of New South Wales, several days of very heavy rain in July resulted in major flooding of the Hawkesbury–Nepean River and extended along the New South Wales coast. A natural disaster was declared for New South Wales following the flooding from heavy rainfall. Numerous locations set new daily July rainfall records, including the Hunter Valley (Figure 7 - BoM, 2023 and Figure 8). Further flooding occurred in the Northern Rivers with increased rainfall over September 2022.

With flooding on this scale came an increased risk of poor water quality events and a high risk of significant fish deaths. Despite widespread flooding, no fish kills were reported in the Hunter Valley for 2022–2023. Fish kills in NSW are listed on Department of Primary Industries website.

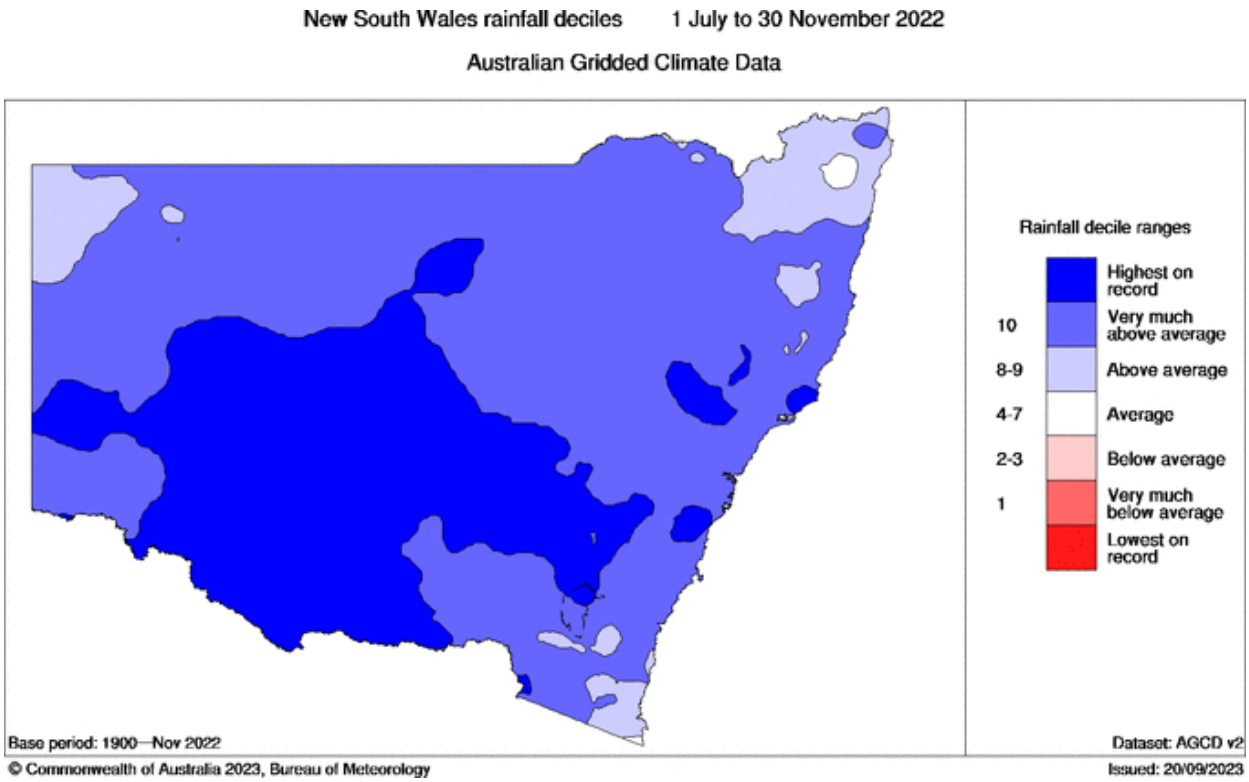

Figure 7: NSW rainfall deciles from July to November 2022. (Source: BoM).

Figure 8: Floodwaters in the Hunter Valley near Singleton, 7 July 2022 (Source: Planet Explorer).

Summary

The quality of the water in a river or stream is a reflection of 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 main water quality driver. Increased runoff carries high volumes of sediment and attached nutrients into waterways resulting in 3 of the 7 water quality monitoring sites being rated as moderate, and the remaining 4 sites as poor. One site returned a higher water quality index score in 2022–2023 than in 2021–2022.

Electrical conductivity levels in the Hunter River were safe for irrigation and water-dependent ecosystems during 2022 but increased above target values in 2023. There was an increase in electrical conductivity in the Hunter tidal pool at Raymond Terrace during lower inflows from the Hunter River in May and June.

There were no reports of fish deaths in the Hunter Valley.

Major flooding can result in the loss of fish and other aquatic life, though 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.

Long-term water quality trends

Analysis of WaQI scores from 2012–2013 to 2022–2023 shows most sites have a long term median WaQI ratings of moderate or good (Figure 9). The highest score was in Wollombi Brook at Warkworth. There is a decreasing trend in scores with distance down the Hunter River. The Goulburn River at Sandy Hollow had the lowest median score for the 10-year period and a poor rating.

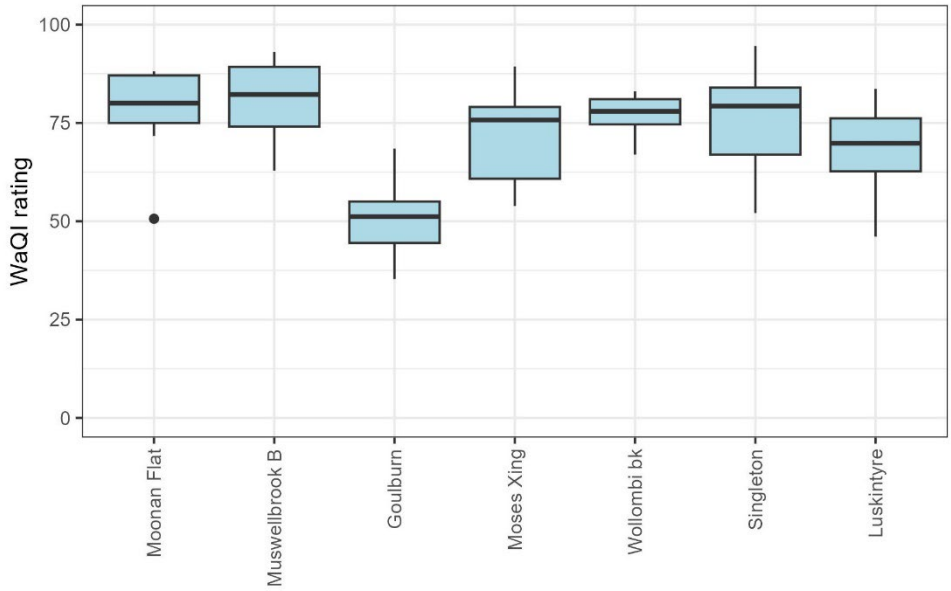

Figure 9: Boxplots showing long-term (2012–2013 to 2022–2023) WaQI scores for every site in the Hunter valley

The number of sites with a good rating declined from 2012–2013 to 2016–2017 before improving back up to 4 sites in 2017–2018 (Figure 10). Since then, the number of sites rated as good has continued to decline with zero good sites for the past two years. Over the same time there has been an increase in the number of poor sites from one in 2012–2013 to 4 in 2022–2023. The highest number of poor sites in 2022–2023 coincides with continued rainfall and extensive flooding in 2022.

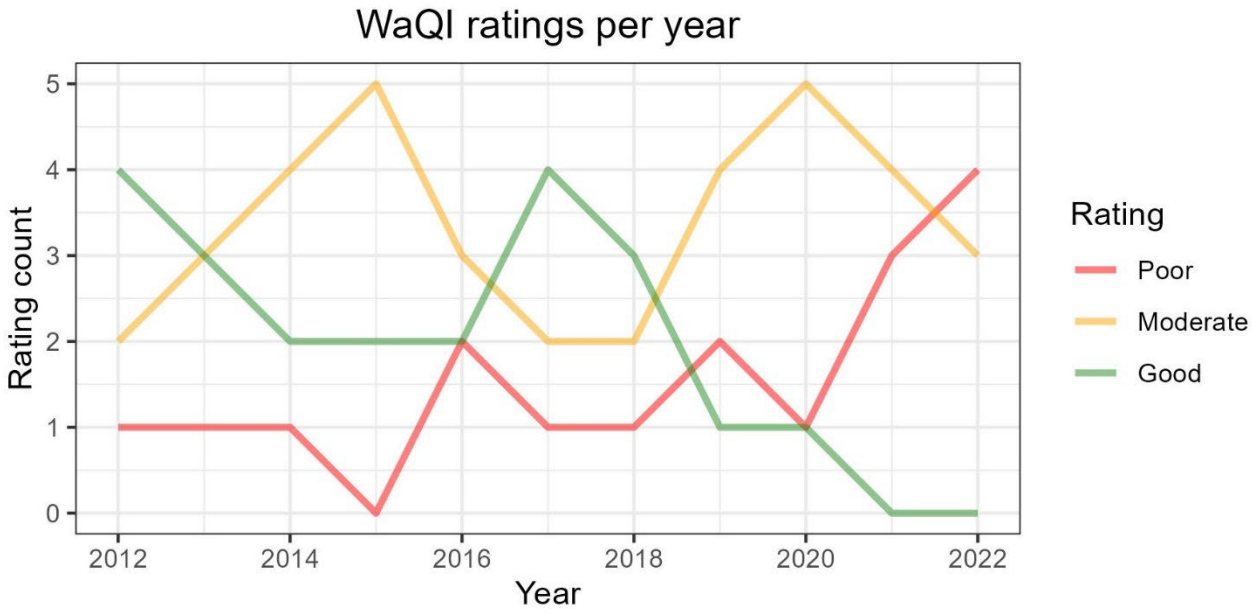

Figure 10: Graph summarising long-term water quality index ratings (2012–2013 to 2022–2023) for every site in the Hunter Valley by year

References and further information

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