Department of Climate Change, Energy, the Environment and Water

Water quality index methodology

River condition index

June 2025

NSW GOVERNMENT

Acknowledgement of Country

Department of Climate Change, Energy, the Environment and Water acknowledges the traditional custodians of the land and pays respect to Elders past, present and future.

We recognise Australian Aboriginal and Torres Strait Islander peoples' unique cultural and spiritual relationships to place and their rich contribution to society.

Artist and designer Nikita Ridgeway from Aboriginal design agency – Boss Lady Creative Designs, created the People and Community symbol.

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Contents

1 Introduction

The NSW Water Quality Index summarises water quality conditions in NSW rivers at a sub-catchment scale. The index was developed as a component of the updated NSW River Condition Index, completed in 2023. This document describes the data sources and methods used to calculate the water quality index and the process used to extrapolate data from an individual monitoring site into a sub catchment score for spatial representation.

The initial NSW River Condition Index, published in 2012, arose from a project funded by the National Water Commission to develop a framework for aligning water sharing plans with catchment action plans (Healey et al. 2012). The National Water Commission *Framework for Assessing River and Wetland Health* (FARWH) (Norris et al. 2007a) was adopted to combine different indicators of river condition into a single condition score, at a state wide scale (Muschal et al. 2010).

The FARWH framework recommends the inclusion of 6 key components (or indices) for the assessment of river and wetland health, all of which are considered representative of ecological integrity. The initial (2012) NSW River Condition Index included 5 categories:

- Riparian vegetation cover
- Hydrologic stress
- River biodiversity condition
- River styles geomorphic condition
- Catchment disturbance.

The FARWH (Norris et al. 2007a) recognises the importance of including a water quality index to report on river conditions and ecosystem health. The drivers for water quality are numerous and varied, including land use, soil type, geology, altitude, climatic conditions, vegetation type and cover, diffuse and point source pollution sources and river regulation. In addition, chemical and biological processes at a site affect its quality. Water quality can change from week to week. A water quality index considers long-term changes in water quality characteristics on biota, such as changes in suspended sediment and nutrient concentrations or loads, and the effects of changes in salinity or toxicant levels (Norris et al. 2007a).

The most recent edition of the River Condition Index (2023) included a water quality index to bring the total number of categories assessed to 6. The River Condition Index sub-indices, which represent each FARWH category, are shown in Figure 1.

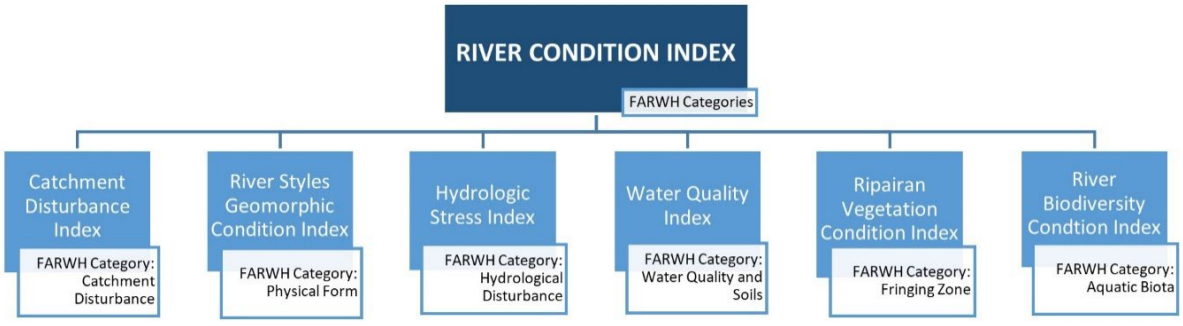

Figure 1: Indices used in the assessment of the River Condition Index, with reference to the FARWH indices

2 Water quality index method

A water quality index is a tool to communicate complex and technical water quality data in a simple and consistent way. It is useful for presenting water quality results with different units (mg/L and percent saturation) or characteristics (turbidity in a montane river versus a lowland river) on a common scale. It can also be used as a reporting tool to evaluate changes in water quality over the life of a water quality management or water sharing plan.

There is extensive literature and a wide range of methods for calculating water quality indices. A number of individual water quality index methods, as well as key text and review papers, were reviewed to determine an appropriate index for NSW that was robust and met requirements.

The key questions considered when evaluating the various methods included:

- Has it been tested and accepted in peer review literature?
- How widely is it used?
- Can it be used without requiring calibration to biogeographically distinct regions? Is it appropriate for a range of river types?
- Is it flexible? Can it be used with continuous water quality data or toxicants if required?
- Can it be easily presented and understood for reporting?

A method based on a modified Canadian Council of Ministers of the Environment water quality index (Lumb et al. 2006) was selected that incorporated both the frequency and exceedance of water quality targets. The method scales data from multiple sampling occasions, and combines multiple parameter results to provide an overall single score for a monitoring site, with higher scores representing better overall water quality. The approach can include multiple parameters such as nitrogen, phosphorus, turbidity, dissolved oxygen, pH and electrical conductivity results.

The water quality index score is based on the *Frequency* and the *Amplitude* of exceedance of regional water quality targets. The index is calculated as:

$$\mathbf{WaQI} = \mathbf{100} - \left(\frac{\sqrt{\mathbf{F1^2} + \mathbf{F2^2}}}{\mathbf{1.41421}}\right)$$

Where WaQI = Water Quality Index score

Note: The highest possible WaQI score is 141.421 (i.e. $\sqrt{(100^2+100^2)}$ = 141.421). Dividing by a factor of 1.41421 scales the score back to a maximum of 100.

Where F1 (*Frequency*) is the number of failed results per total number of tests as a percentage:

$$\mathbf{F1} = \left(\frac{\mathbf{Number\ of\ failed\ tests}}{\mathbf{Total\ number\ of\ tests}}\right) \boldsymbol{X}\ \mathbf{100}$$

And where F2 (*Amplitude*) is the amount a water quality result exceeds the target by. To calculate F2 requires three steps. Firstly, the number of times an individual result is greater than (or less than) the target, or *Excursion.*

Where the test value should not exceed the target or test objective (turbidity, nitrogen, phosphorus, electrical conductivity and upper limits for pH and dissolved oxygen), use:

$$\mathbf{Excursion} = \left(\frac{\mathbf{Failed\ test\ value\ i}}{\mathbf{Test\ objective}}\right) - \mathbf{1}$$

OR, when the test value should not fall below the targets (lower limit for pH and dissolved oxygen), use:

$$\textbf{Excursion} = \left(\frac{\textbf{Test objective}}{\textbf{Failed test value i}}\right) - \textbf{1}$$

The total amount the result does not comply with the target is calculated by summing the *Excursions* and dividing by the number of tests to give the *nse* (normalised sum of excursions):

$$\textbf{nse} = \left(\frac{\sum_{\textbf{i=1}}^{\textbf{n}} \textbf{excursion i}}{\textbf{number of tests}}\right)$$

The *nse* is then scaled to yield an F2 value between 0 and 100:

$$\textbf{F2} = (\textbf{nse} \div [\textbf{0.01nse} + \textbf{0.01}])$$

The water quality index output was divided by 100 to yield a number between 0 and 1.0, where a score of 1.0 represents a site in reference condition. This value can be categorised to indicate the general water quality at a monitoring site. The assignment of water quality index values to different categories is a subjective process that incorporates expert opinion and the public's expectations of water quality. Rather than an even split in categories, as used in other layers for the River Condition Index (i.e. 0.0-2.0, 2.0-4.0, 4.0-6.0, 6.0-8.0 and 8.0-1.0), the water quality index category score range has been adjusted to be consistent with the high proportion of modified or disturbed catchments in NSW with a larger proportion of scores in the poor to very poor categories than good to very good (Table 1).

The indices representing the various measures of water quality should be equivalent (Norris et al. 2007a). For example, salinity could be an issue in one catchment and nutrients in another. For this reason, there has been no weighting of parameters.

Table 1: Categories used for the derivation of the Water Quality index layer

Water Quality Index Score	Water quality rating
0.0 - 0.29	Very Poor
0.3 - 0.59	Poor
0.6 - 0.79	Moderate
0.8 - 0.94	Good
0.95 - 1.0	Very Good

3 Water quality targets method

To include a water quality layer in an updated NSW River Condition Index, the NSW Department of Climate Change, Energy, the Environment and Water (the department) required regionally specific targets to assess changes in water quality over time. The National Water Quality Management Strategy identifies the key principles to consider when managing water quality. Regionally specific water quality targets, matched to regional conditions, have been developed for NSW inland and

coastal catchments (DCCEEW Water 2025). This was undertaken using the reference condition approach described in the National Water Quality Management Strategy (ANZG 2018). These regional targets have been used to assess the water quality results and calculate the water quality index score.

Management targets are long term objectives used to assess whether an environmental value is being achieved or maintained. Monitoring progress towards achieving the targets will identify trends and inform long term actions that address the causes of water quality decline. This information can be used to inform planning and management practices required to contribute to improved water quality. They are not a guideline value that, if exceeded, indicates that some form of investigative or compliance action should commence.

Water quality targets can be developed at varying spatial resolutions. A local or site-specific target could focus on a single monitoring point, a wetland, lake, or river reach, to identify if a particular contaminant of concern exceeds an appropriate level. These targets provide a high degree of confidence and can account for unique local drivers for water quality. They can be used by industry, regulators or catchment managers to assess if an action (such as a new mining development, a licenced discharge, or a change in land use) impacts the water quality at a specific site or area of interest.

Regionally specific targets apply across a larger spatial scale, such as a drainage basin or climatic zone. These targets are more generic in nature and are suitable for application at any monitoring location within a defined area. Discrete regions can be defined as areas with similar drivers for water quality (land use, geology, topography, rainfall), similar water quality conditions, and biological or ecological features.

3.1 Considerations for unique water quality zones

Many landscape characteristics influence the spatial variability in water quality, such as sediment type, nutrient, and salt concentrations in rivers and streams, and the interactions between them (Lintern et al. 2017). The strength of the relationships can be influenced by the distance and spatial arrangement of constituent sources within the catchment and cross correlations between landscape characteristics and seasonality.

Preliminary research undertaken by Ryan et al. (2011) towards developing regionally appropriate water quality guidelines aimed at establishing a statistical framework for determining discrete regions of similar water quality conditions across NSW. The relevant predictor variables differed for each water quality indicator, but there were also a number of shared predictors. For instance, percentage cover of agricultural land use, altitude and stream order were key predictors in most cases, as was the distance from each station to the centroid (average position) of volcanic geology within the drainage area. The cluster analysis pattern of stations provided a helpful and intuitive framework for understanding how water quality changes across the state. The strong geographic aspect to these patterns suggested that large-scale factors such as altitude, northing and easting may be the most important predictors of water quality at a state-wide scale rather than smaller scale factors.

Based on the previous target setting approaches adopted by the Murray Darling Basin Authority and other Basin States, it was proposed that zones be defined based on broad characteristics.

To develop water quality targets for the water quality index, altitude boundaries were proposed that align with the zone boundaries identified in the Sustainable Rivers Audit (Davies et al. 2008) and selected for the Basin Plan application zones (Tiller and Newall 2010). Altitude was used as a surrogate for other water quality drivers. The highest annual rainfall is recorded in the upper catchments, with figures declining with increasing distance west from the Great Dividing Range. Land use in the steeper upper catchment is predominantly livestock grazing, changing to mixed farming (grazing and cropping) as the land slope decreases. Areas with an altitude less than 200 m are predominantly floodplains.

The altitude boundaries used to develop the targets were:

- Montane - greater than 700 m
- Uplands - between 200 and 700 m and
- Lowlands - less than 200 m for inland NSW and less than 150 m on the NSW coast.

Large storages disrupt the regular drivers and processes that determine the variability in water quality in the catchment, such as runoff, discharge, sediment transport and bank wetting. Releases from the bottom of a large storage further exacerbates changes. To account for this, the regulated rivers were assigned to separate zones to the unregulated waterways. This will also account for the different wetting and drying cycles between a more permanent regulated river and a temporary or intermittently flowing unregulated tributary.

Catchments known to contain unique drivers for water quality were also identified, such as high nutrient loads and turbidity from the Liverpool Plains, high nutrient loads from basalt derived soils in the upper Macintyre River catchment, temporary waters in the Pilliga Forest and the highly regulated Kolety/Edward-Wakool River system and Yanco, Colombo and Billabong creeks. Catchments with very good quality water, such as the Goodradigbee and Goobarragandra rivers in the Murrumbidgee catchment, were also identified to ensure they remain protected.

A total of 49 water quality target zones were proposed for inland NSW and 29 for coastal NSW (Figure 2). Zone descriptions can be found in Appendix 1.

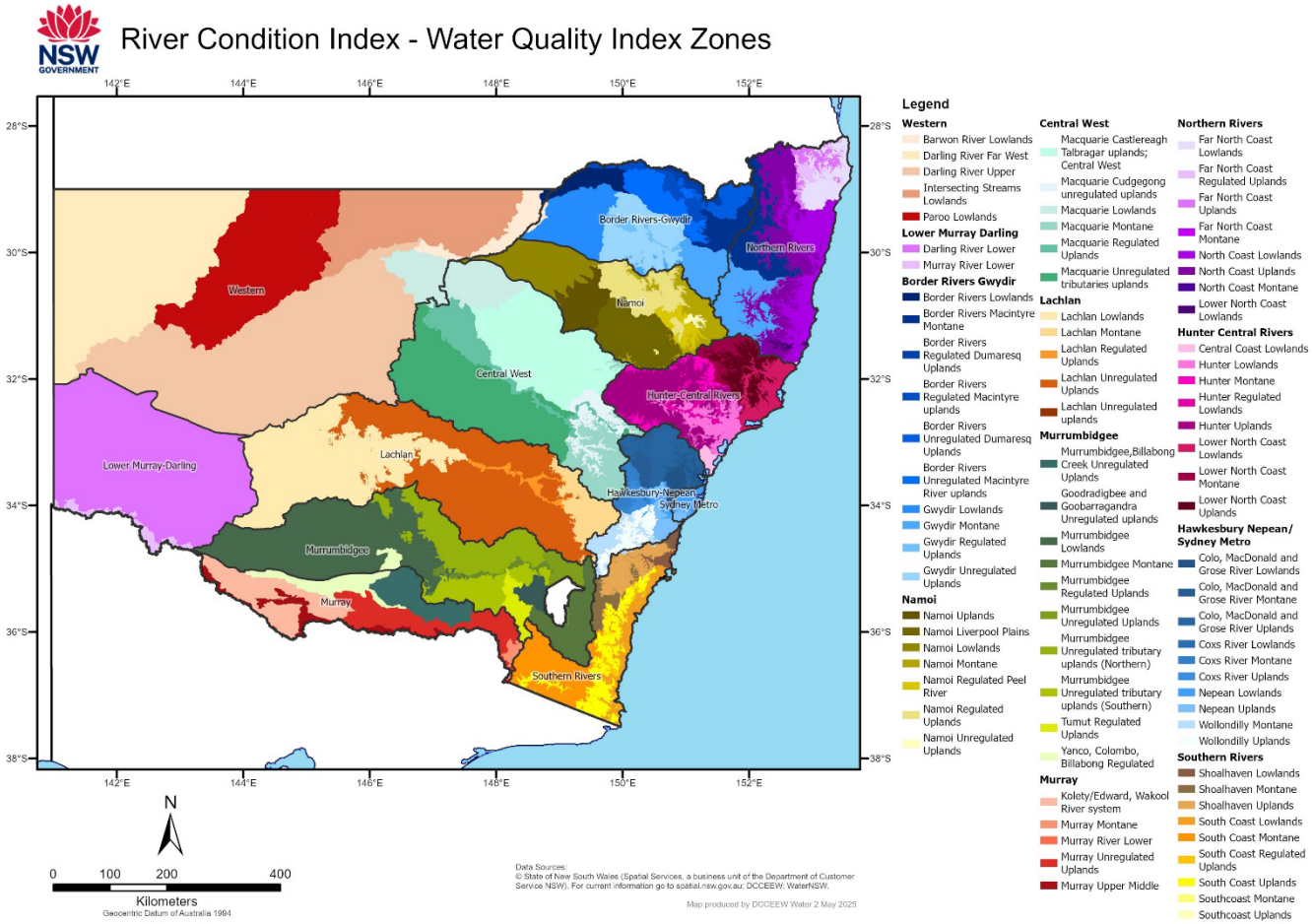

Figure 2: Water quality target zones for NSW

3.2 Calculating water quality targets for NSW

Ideally, targets would be derived from data collected before significant human disturbance, or from reference, or sites with the least disturbed conditions to quantify the natural water quality. Water quality data from a reference site are used to provide a suitable baseline or benchmark for comparison against data from an assessment site in a similar aquatic ecosystem or geographic unit. This benchmark is a value for a contaminant that, if not exceeded, indicates a low risk that the water quality and associated aquatic ecosystems will be unacceptably impacted (van Dam et al. 2019). Targets based on reference sites also recognise that the aquatic ecosystem has evolved in the presence of any naturally elevated concentrations of contaminants.

For modified ecosystems (like the majority of rivers of NSW), the 'best available' reference site will be the only option. In Australia and New Zealand, the 80th percentile (and 20th percentile for lower limits of variables such as dissolved oxygen and pH) of the reference data is recommended for slightly to moderately disturbed systems (ANZG 2018). Available data from a more disturbed site, which is likely to have a broader range of contaminant concentrations than a site in reference condition, can be used to calculate the targets. This can be achieved by adjusting the percentiles used to derive the target, such as using the 25th and 75th percentiles.

As none of the existing monitoring sites were identified as being in reference condition, the 25th and 75th percentiles of the data from the least disturbed site in each zone were calculated. Adopting the

75th percentile to derive targets excludes some of the more extreme results and brings the target value down to be more in line with a site in a less disturbed or reference condition. For inland catchments, targets were calculated for 6 commonly measured water quality parameters: total nitrogen, total phosphorus, turbidity, dissolved oxygen, pH and electrical conductivity. Oxidised nitrogen and filterable reactive phosphorus were included in this list for coastal sites.

The water quality targets for each of the water quality zones used to develop the water quality index layer are listed in Appendix 2. These targets were used to calculate the water quality index score for each site. To account for temporal variability in water quality, a 5-year data set (July 2016 to June 2021) was used to calculate the index scores. A more comprehensive description of how regionally specific water quality targets were developed for NSW inland and coastal catchments is described in DCCEEW-Water (2025).

4 Converting point data to a sub-catchment score

Outside of the Sydney metropolitan catchments, water quality is monitored monthly at 140 sites. Of these, 113 sites are located in inland catchments and 27 in coastal catchments. This sparse distribution of sites means that most smaller catchments do not include a water quality monitoring site. To enable the extrapolation of data from a water quality monitoring site to the broader catchment in order to align with the other layers included in the River Condition Index, the method adopted for the Sustainable River Audit (Davies et al. 2008) macroinvertebrate scores were used.

To convert data from a monitoring point to a River Condition Index sub-catchment score, the site water quality index score was extrapolated upstream and downstream of the monitoring site until reaching a water quality zone boundary, a regulated river, major storage or another monitoring site.

Water quality data was reported using altitudinal zones within a given valley. Where there was only one monitoring site in an entire water quality zone, the water quality index score was applied to all reaches in the zone. Where there were multiple monitoring sites in a zone, an average of the site Water Quality Index scores were applied to all reaches in that zone that did not have a monitoring site.

In many cases, there were two water quality index zones covering the one River Condition Index sub-catchment. To calculate a single value for the sub-catchment, the river length in each water quality index zone in the sub-catchment was measured. The portion of river length in each water quality zone was calculated as a percentage of the total river length in the whole sub-catchment. Each of the water quality index scores was multiplied by the percentage of river length in each zone, and the products were added to get a single overall score for the River Condition Index sub-catchment.

Rules developed for the extrapolation of point data to a catchment score are:

1. Site area of influence extends upstream and/or downstream until reaching a water quality zone boundary, a regulated river, major storage or another monitoring site – whichever comes first.
2. The site's area of influence extends up the main trunk of the river, as well as all the upstream tributaries unless there is another site on a tributary. In that case, the tributary's site has an area of influence that extends downstream until it reaches the junction with the main river and

upstream along the main trunk of the tributary as well as its upstream tributaries. For regulated rivers, the area of influence does not extend up into unregulated tributaries, only to the storage.

3. Where there are no sites on a tributary, the average water quality index score of all other monitoring sites in that water quality zone is applied.
4. Where a River Condition Index sub-catchment extends across water quality zone boundaries, the water quality index score from the two zones will be weighted using the percentage of river length in each zone.

A length weighted average of the river reach water quality scores is then applied to generate a Water Quality Index score between 0 and 1 for each sub-catchment:

$$\mathbf{WQI_b} = \frac{(\mathbf{WQI_{r1}} * \mathbf{L_{r1}}) + (\mathbf{WQI_{r2}} * \mathbf{L_{r2}}) \ldots}{\sum \mathbf{L_{r1}} + \mathbf{L_{r2}} \ldots}$$

(where WQI_b = water quality index, WQI_{r1} = water quality index for reach 1 within the basin, L_{r1} = length of reach 1)

This results in an overall condition score ranging between 0 and 1, with higher scores representing better condition. The state-wide water quality condition index is shown in Figure 3. Areas where there was insufficient data to calculate a score (Pilliga Scrub, Bland River catchment and far western NSW) are shown in grey.

There are a limited number of routine water quality monitoring sites across NSW. Continued monitoring of water quality across more locations would lead to a more detailed analysis and would improve the accuracy of the index.

The NSW River Condition Index (2023) is available via the SEED open data portal and as an interactive map. The method for calculation of the River Condition Index components is also available (DPE 2023).

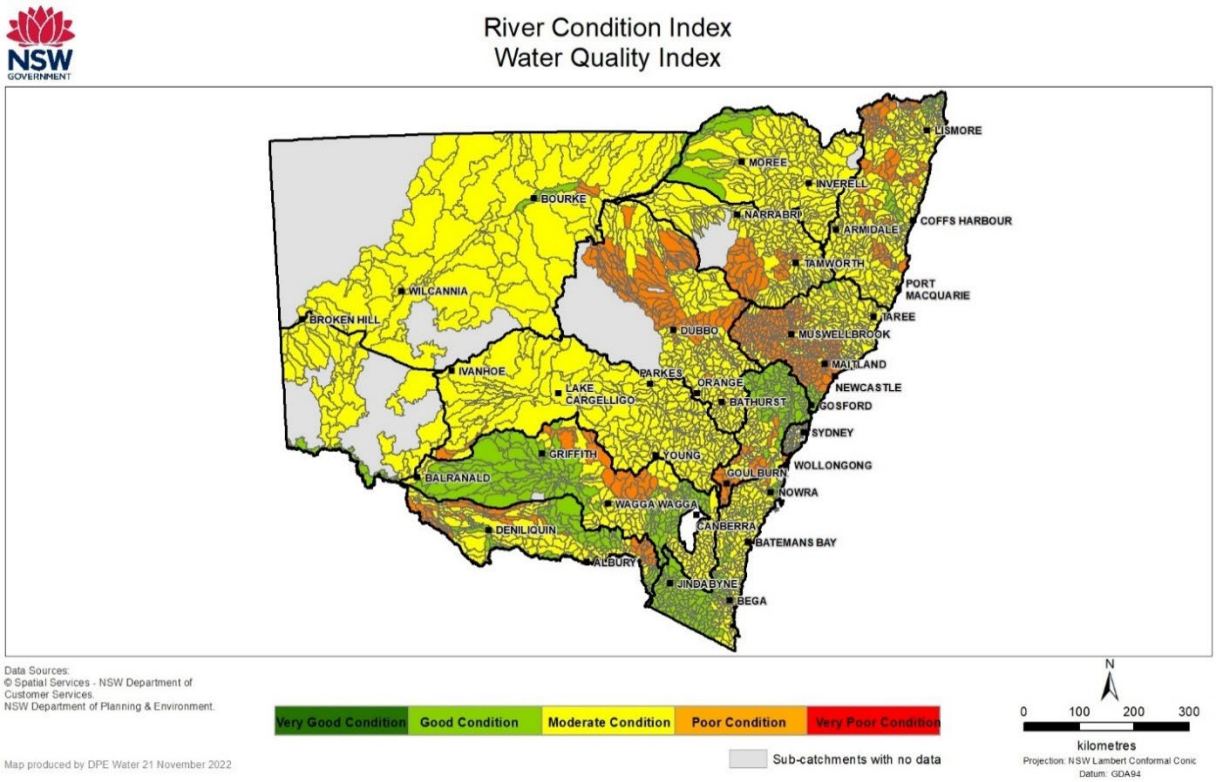

Figure 3: Water quality index layer for the NSW River Condition Index

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6 Appendix

6.1 Appendix 1 – Description of unique water quality target zones

Table 2: Descriptions of unique water quality target zones for inland NSW

Valley - Zone	Description
NSW Border Rivers - Dumaresq montane	Tenterfield, Mole, Beardy catchments above 700 m altitude. Less fertile soils and lower salinity hazard than the neighbouring Macintyre catchment
NSW Border Rivers - Macintyre montane	Macintyre catchments above 700 m altitude and the Severn River to Pindari Dam. Fertile soils and areas of high salinity hazard
NSW Border Rivers - Unregulated Dumaresq uplands	Unregulated rivers and creeks (Tenterfield, Mole, Beardy) with altitude between 200 and 700 m. Less fertile soils and low salinity hazard
NSW Border Rivers - Regulated Dumaresq uplands	Regulated Dumaresq River from the junction with Pike Creek (downstream of Glenlyon Dam) to the junction with the Macintyre River upstream of Boggabilla
NSW Border Rivers - Unregulated Macintyre River	Unregulated Macintyre River from an altitude of 700 m to the Macintyre River/Severn River junction. All other waterways in the Macintyre/Severn catchment including Ottleys and Croppa Creeks with altitude between 200 and 700 m or until they reach a regulated river. Fertile soils and areas of high salinity hazard
NSW Border Rivers - Regulated Severn Macintyre uplands	Regulated Severn River downstream of Pindari Dam and Macintyre River from the Macintyre River/Severn River junction to an altitude of 200 m
NSW Border Rivers - Lowlands	All rivers and creeks with an altitude less than 200 m until they reach the Barwon River. Includes Whalan Creek and Boomi River
Gwydir - Montane	All rivers and creeks in the catchment area of Copeton Dam or above 700 m altitude. Fertile soils in the upper catchment
Gwydir - Unregulated uplands	Unregulated rivers and creeks (Horton, Myall, Halls, Warialda, Tycannah) with altitude between 200 and 700 m or until they flow into the regulated Gwydir River. Nutrient sources and high salinity hazard
Gwydir - Regulated uplands	Regulated Gwydir River from Copeton Dam to an altitude of 200 m
Gwydir - Lowlands	All rivers and creeks with altitude less than 200 m to the junction with the Barwon River. Includes Gil Gil, Mehi, Moomin, Thalaba, Carole and Gwydir systems
Namoi - Montane	All rivers and creeks above 700 m altitude. Fertile soils in the headwaters along the Great Dividing Range
Namoi - Unregulated uplands	Unregulated rivers and creeks (Macdonald, Namoi, Manilla, Cockburn, Halls, Peel) with altitude between 200 and 700 m or until they flow into a large storage or a regulated river
Namoi - Regulated uplands	Regulated Manilla River from Split Rock Dam to the junction with the Namoi River at Manilla and the Namoi River from Manilla to an altitude of 200 m
Namoi - Regulated Peel River	Regulated Peel River from Chaffey Dam to the junction with the Namoi River downstream of Keepit Dam. Higher salinity than the Manilla/Namoi regulated system
Namoi - Liverpool Plains	Unregulated Mooki River and Coxs Creek catchments from an altitude of 700 m to the junction with the Namoi River. High nutrient, sediment and salt loads and high pH
Namoi - Pilliga Forest	All waterways flowing out of the Pilliga Forest until they reach the regulated Namoi River. Forested, low fertility soils and highly ephemeral waterways
Namoi - Lowlands	All rivers and creeks with an altitude less than 200 m to the junction with the Barwon River at Walgett. Includes Pian Creek
Wambuul/Macquarie, Castlereagh, Bogan - Montane	All rivers and creeks above 700 m altitude
Wambuul/Macquarie, Castlereagh, Bogan - Castlereagh Talbragar uplands	Rivers and creeks in the Castlereagh catchment with an altitude between 200 and 700 m and the Talbragar River from 700 m until it reaches the regulated Wambuul/Macquarie River. Fertile soils and high salinity hazard
Wambuul/Macquarie, Castlereagh, Bogan - Unregulated Wambuul/Macquarie Cudgegong uplands	Unregulated rivers and creeks in the Cudgegong and Wambuul/Macquarie catchments from an altitude of 700m until they reach Windamere or Burrendong Dams or the regulated Cudgegong River. Areas of less fertile soils and low salinity hazard

Valley - Zone	Description
Wambuul/Macquarie, Castlereagh, Bogan - Unregulated uplands	Unregulated rivers and creeks (Little, Bells, Bogan) with altitude between 200 and 700 m or until they reach the regulated Wambuul/Macquarie River. High salinity hazard
Wambuul/Macquarie, Castlereagh, Bogan - Regulated uplands	Regulated Cudgegong River from Windamere Dam to Burrendong Dam and Wambuul/Macquarie River from Burrendong Dam to an altitude of 200 m
Wambuul/Macquarie, Castlereagh, Bogan - Lowlands	All rivers and creeks with an altitude less than 200 m to the junction with the Barwon River. Includes lowlands in Bogan and Castlereagh River catchments and all the distributary streams
Lachlan - Montane	Abercrombie River and all rivers and creeks above 700 m altitude
Lachlan - Unregulated uplands	Unregulated rivers and creeks (Lachlan, Boorowa, Belubula, Bland) with an altitude between 200 and 700 m or until they reach Carcoar or Wyangala dams or the regulated Lachlan and Belubula Rivers. High salinity hazard in the mid Lachlan subcatchments and small parts of the Belubula catchment
Lachlan - Regulated uplands	Regulated Belubula River from Carcoar Dam to the Lachlan River junction and Lachlan River from Wyangala Dam to an altitude of 200 m
Lachlan - Lowlands	All rivers and creeks with an altitude less than 200 m. Includes Lachlan River to the end of system and Willandra Creek
Murrumbidgee - Montane	All rivers and creeks above 700 m altitude
Murrumbidgee - Unregulated Murrumbidgee uplands	Unregulated rivers and creeks (Murrumbidgee, Yass) with an altitude from 700 m until they reach Burrinjuck Dam
Murrumbidgee - Goodradigbee, Goobarragandra unregulated uplands	Unregulated rivers and creeks (Goodradigbee, Goobarragandra, Tumut) with an altitude from 700 m until they reach Burrinjuck or Blowering dams or the regulated Tumut River. Large areas of undisturbed catchment leading to good water quality
Murrumbidgee - Unregulated tributary uplands (Northern)	Unregulated rivers and creeks to the north of the Murrumbidgee River (Jugiong, Muttama) with an altitude between 200 and 700 m or until they reach the regulated Murrumbidgee River. High salinity hazard and high nutrient inputs from some catchments
Murrumbidgee - Unregulated tributary uplands (Southern)	Unregulated rivers and creeks to the south of the Murrumbidgee River (Adelong, Tarcutta, Hillas) with an altitude between 200 and 700 m or until they reach the regulated Murrumbidgee River. Lower salinity hazard than the northern catchments. High nutrient inputs from some catchments
Murrumbidgee - Regulated Tumut uplands	Regulated Tumut River from Blowering Dam to the Murrumbidgee River junction. Good water quality
Murrumbidgee - Regulated Murrumbidgee uplands	Regulated Murrumbidgee River from Burrinjuck Dam to an altitude of 200 m
Murrumbidgee - Lowlands	Regulated Murrumbidgee River from an altitude of 200 m to the junction with the Murray River. All rivers, creeks and distributary channels with an altitude less than 200 m until they join the regulated Murrumbidgee River
Murrumbidgee - Unregulated Billabong Creek	Unregulated Billabong Creek to the junction with Colombo Creek. High salinity hazard
Murrumbidgee -Regulated Yanco, Colombo Billabong creeks	Includes Yanco and Colombo Creeks from the Murrumbidgee River offtake to the junction with Billabong Creek. The regulated Billabong Creek from Colombo Creek to the junction with the Kolety/Edward River
Murray - Montane	All rivers and creeks above 700 m altitude
Murray - Unregulated uplands	The Murray River from 700 m until it flows into Lake Hume. Unregulated rivers and creeks with an altitude between 200 and 700 m or until they flow into Lake Hume or the regulated Murray River
Central Murray River - Upper	Murray River from Lake Hume to Murrumbidgee River/Murray River junction
Central Murray River - Kolety/Edward-Wakool River system	The Kolety/Edward, Wakool, Niemur rivers, Merran Creek and distributary channels from the Lake Mulwala offtake to the junction with the Murray River
Central Murray River - Middle	Murray River from Murrumbidgee River/Murray River junction to Darling River/Murray River junction at Lock 10
Lower Murray River - Lowlands	Murray River from Lock 10 (Wentworth) to the NSW/South Australia border
Intersecting Streams - Lowlands	Moonie, Narran, Bokhara, Birrie, Culgoa and Warrego Rivers from NSW/Queensland border to their junction with the Barwon or Darling Rivers
Intersecting Streams - Paroo River	Paroo River from NSW/Queensland border to the junction with the Darling River. No licenced extraction
Barwon River - Lowlands	Barwon River from Mungindi to the Barwon River/Culgoa River junction
Darling River - Upper	Darling River from the Barwon River/Culgoa River junction to inflow into Lake Wetherell
Darling River - Lower	Darling River from Menindee Lakes to the Darling River/Murray River junction at Lock 10

Table 3: Descriptions of unique water quality target zones for coastal NSW catchments

Valley - Zone	Description
Far North Coast - Montane	All rivers and creeks above 700 m altitude
Far North Coast - Uplands	All rivers and creeks with an altitude between 150 and 700 m
Far North Coast - Regulated uplands	Regulated Iron Pot and Eden creeks and Richmond River downstream of Toonumbar Dam
Far North Coast - Lowlands	All rivers and creeks with an altitude less than 150 m to the upper tidal limit
North Coast - Montane	All rivers and creeks above 700 m altitude
North Coast - Uplands	All rivers and creeks with an altitude between 150 and 700 m
North Coast - Lowlands	All rivers and creeks with an altitude less than 150 m to the upper tidal limit
Lower North Coast - Montane	All rivers and creeks above 700 m altitude
Lower North Coast - Uplands	All rivers and creeks with an altitude between 150 and 700 m
Lower North Coast - Lowlands	All rivers and creeks with an altitude less than 150 m to the upper tidal limit
Hunter - Montane	All rivers and creeks above 700 m altitude
Hunter - Uplands	All rivers and creeks with an altitude between 150 and 700 m or until flow into a dam or regulated river
Hunter - Regulated lowlands	Hunter and Patterson rivers and Glennies Creek downstream of Glenbawn, Lostock and Glennies Creek dams
Hunter - Unregulated lowlands	All unregulated rivers and creeks with an altitude less than 150 m to a regulated river or the upper tidal limit
Hunter - Central Coast	All rivers in the Central Coast catchment area
Sydney Metropolitan - Coxs River montane	All rivers and creeks in Coxs River catchment above 700 m altitude
Sydney Metropolitan - Coxs River uplands	All rivers and creeks in Coxs River catchment with an altitude between 150 and 700 m or until flowing into Warragamba Dam
Sydney Metropolitan - Wollondilly montane	All rivers and creeks in Wollondilly River catchment above 700 m altitude
Sydney Metropolitan - Wollondilly uplands	All rivers and creeks in Wollondilly River catchment with an altitude between 150 and 700 m or until flowing into Warragamba Dam
Sydney Metropolitan - Nepean uplands	All rivers and creeks in Nepean River catchment with an altitude above 150 m
Sydney Metropolitan - Nepean lowlands	All rivers and creeks with an altitude less than 150 m to the upper tidal limit
Sydney Metropolitan - Colo, McDonald, and Grose River uplands	All rivers and creeks with an altitude greater than 150 m to the top of the catchment
Sydney Metropolitan - Colo, McDonald, and Grose River lowlands	All rivers and creeks with an altitude less than 150 m to the junction with the Nepean or Hawkesbury Rivers
Sydney Metropolitan - Shoalhaven montane	All rivers and creeks above 700 m altitude
Sydney Metropolitan - Shoalhaven uplands	All rivers and creeks with an altitude between 150 and 700 m or until flowing into Tallowa Dam
Sydney Metropolitan - Shoalhaven lowlands	Shoalhaven River downstream of Tallowa Dam
South Coast - Montane	All rivers and creeks above 700 m altitude
South Coast - Uplands	All rivers and creeks with an altitude between 150 and 700 m or until flowing into Brogo Dam
South Coast - Regulated uplands	Regulated river downstream of Brogo Dam
South Coast - Lowlands	All rivers and creeks with an altitude less than 150 m to the upper tidal limit

6.2 Appendix 2 – Water quality targets used to derive the Water Quality Index for the River Condition Index

Table 4: Water quality zone targets for inland NSW using 25th and 75th percentile results for least disturbed monitoring site in each zone

Zone	Total N (µg/L) 75%ile	Total P (µg/L) 75%ile	Turbidity (NTU) 75%ile	DO (%saturation)	pH 25%ile and 75%ile	EC (µS/cm) 75%ile
Border Rivers Dumaresq montane	650	35	5	90-110	6.6-7.5	185
Border Rivers Macintyre montane	980	170	20	90-110	7.6-8.5	380
Border Rivers Dumaresq unregulated uplands	570	70	15	80-110	7.0-8.0	200
Border Rivers regulated Dumaresq uplands	700	60	15	80-110	7.3-8.2	250
Border Rivers Macintyre unregulated uplands	950	180	30	80-110	7.5-8.5	700
Border Rivers Macintyre regulated uplands	800	130	30	80-110	7.5-8.5	350
Border Rivers lowlands	1,000	140	130	65-110	7.3-8.3	300
Gwydir montane	850	60	10	90-110	7.5-8.5	450
Gwydir unregulated uplands	350	55	25	80-110	7.5-8.5	760
Gwydir regulated uplands	700	70	40	80-110	7.5-8.5	570
Gwydir lowlands	1,100	200	270	65-110	7.1-8.1	530
Namoi montane	860	100	15	90-110	7.1-8.0	200
Namoi unregulated uplands	670	50	15	80-110	7.5-8.5	430
Namoi regulated uplands	950	150	40	80-110	7.5-8.5	600
Regulated Peel	600	55	15	80-110	7.5-8.5	480
Liverpool Plains	1,600	400	50	80-110	8.0-9.0	1,200
Pilliga Forest	-	-	-	-	-	-
Namoi lowlands	1,100	200	120	65-110	7.5-8.5	520
Macquarie montane	600	35	10	90-110	7.1-8.0	100
Castlereagh Talbragar uplands	700	100	20	80-110	7.2-8.2	1,500
Macquarie Cudgegong unregulated uplands	270	25	5	80-110	7.5-8.5	570
Macquarie unregulated uplands	650	50	10	80-110	7.1-8.0	870
Macquarie regulated upland	850	40	10	80-110	7.1-8.0	350
Macquarie Castlereagh lowlands	1,400	130	80	65-110	7.2-8.2	660
Lachlan montane	760	50	25	90-110	7.1-8.0	320
Lachlan unregulated uplands	760	50	30	80-110	7.2-8.1	770
Lachlan regulated uplands	820	90	25	80-110	7.5-8.5	860
Lachlan lowlands	700	70	65	65-110	7.2-8.2	480
Murrumbidgee montane	290	30	10	90-110	6.9-7.9	80
Murrumbidgee unregulated uplands	430	40	20	80-110	7.3-8.2	160
Goodradigbee, Goobarragandra unregulated uplands	140	20	10	80-110	7.2-8.1	110
Murrumbidgee unregulated tributaries uplands (Northern)	720	55	15	80-110	7.6-8.6	1,585
Murrumbidgee unregulated tributaries uplands (Southern)	820	70	40	80-110	7.2-8.1	175
Murrumbidgee regulated uplands	550	40	20	80-110	7.0-8.0	175
Tumut regulated uplands	210	30	5	80-110	6.5-7.5	40
Murrumbidgee lowlands	500	50	40	65-110	7.0-8.0	200
Billabong Creek unregulated	1,300	110	60	80-110	7.2-8.1	2,275
Regulated Yanco, Colombo, Billabong creeks	510	60	60	65-110	7.0-8.0	200
Murray montane	150	15	5	90-110	6.8-7.7	30
Murray uplands	200	30	10	80-110	6.7-7.6	50
Kolety/Edward, Wakool	460	55	40	80-110	6.7-7.6	65
Murray River: upper, middle	450	30	15	80-110	6.9-7.8	60

Zone	Total N (µg/L) 75%ile	Total P (µg/L) 75%ile	Turbidity (NTU) 75%ile	DO (%saturation)	pH 25%ile and 75%ile	EC (µS/cm) 75%ile
Murray River: lower	600	55	40	80-110	7.1-8.1	170
Barwon River	1,000	150	230	65-110	7.1-8.0	310
Intersecting Streams	1,300	320	550	60-110	7.1-8.0	270
Paroo River	1,400	320	650	60-110	7.0-7.9	130
Darling River: upper	1,100	230	230	60-110	7.4-8.3	1,000
Darling River: lower	1,600	360	230	60-110	7.8-8.9	900
Lower Murray River	570	60	40	80-110	7.2-8.1	170

Table 5: Water quality zone targets for coastal NSW using 25th and 75th percentile results for least disturbed monitoring site in each zone

Zone	Total N (µg/L) 75%ile	NOX (µg/L) 75%ile	Total P (µg/L) 75%ile	FRP (µg/L) 75%ile	Turb (NTU) 75%ile	DO (%sat)	pH 25%ile and 75%ile	EC (µS/cm) 75%ile
Far North Coast uplands (Southeast QLD targets)	250	40	30	15	25	90-110	6.5-8.2	580
Far North Coast unregulated lowlands	340	60	60	35	10	85-110	7.0–8.0	200
Far North Coast regulated (Richmond River)	530	110	150	100	15	85-110	7.5-8.5	360
North Coast montane (Gwydir montane targets)	850	N/A	60	N/A	10	90-110	7.5-8.5	450
North Coast uplands	260	110	20	10	5	90-110	6.7-7.7	60
North Coast lowlands	150	60	20	10	5	85-110	6.5-7.5	80
Lower North Coast montane (Namoi montane targets)	860	N/A	100	N/A	15	90-110	7.0-8.0	200
Lower North Coast uplands	460	50	35	15	10	90-115	7.3-8.2	200
Lower North Coast lowlands	320	80	20	10	5	85-110	6.8-7.8	150
Hunter montane (Namoi montane targets)	860	N/A	100	N/A	15	90-110	7.0-8.0	200
Hunter uplands	390	30	60	30	10	90-110	7.5-8.5	250
Hunter unregulated lowlands	600	60	20	10	20	85-110	6.8-7.8	1,000
Hunter regulated (Hunter, Patterson River)	650	160	80	20	35	85-110	7.4-8.4	820
Central Coast	600	350	50	20	15	85-110	6.1-7.1	270
Coxs River montane	460	50	50	15	5	90-110	7.5-8.5	1,050
Coxs River uplands	300	30	20	5	5	90-110	7.3-8.3	320
Wollondilly montane	700	20	50	10	5	90-110	6.9-7.9	600
Wollondilly uplands	660	60	25	5	5	90-110	7.3-8.3	620
Nepean uplands	70	10	10	5	5	90-110	6.5-7.5	130
Nepean lowlands	340	180	10	5	5	85-110	6.8-7.8	150
Colo, McDonald, and Grose River uplands	250	90	10	5	5	85-110	6.7-7.6	160
Colo, McDonald, and Grose River lowlands	250	90	10	5	5	85-110	6.7-7.6	160
Shoalhaven montane	190	20	20	10	5	90-110	6.8-7.8	60
Shoalhaven uplands	310	20	25	5	10	90-110	7.1-8.1	130
Shoalhaven lowlands	420	140	25	5	10	85-110	6.8-7.8	120
South Coast montane	370	60	30	10	10	90-110	6.4-7.4	100
South Coast uplands	330	160	20	10	5	90-110	6.8-7.7	100
South Coast unregulated lowlands	160	30	15	10	5	85-110	6.6-7.6	140
South Coast regulated lowlands (Brogo River)	320	100	30	10	5	85-110	6.6-7.6	160