

Water Quality Index

Methodology



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Background

Northland Regional Council (NRC) undertakes State of Environment (SoE) monitoring at 52 rivers around Northland on a monthly basis. The results of the SoE monitoring are compared to national guidelines such as the National Policy Statement for Freshwater (NPS-FW). These national guidelines provide a useful framework however can sometimes misrepresent the natural environment for Northland. For this reason, the Northland Regional Council developed this Water Quality Index to provide a more regional context, assessing results of key attributes against 'natural state' Northland reference sites.

Water Quality Index

The Water Quality Index (WQI) is based on six key river water quality attributes measured in SoE monitoring. The current WQI is developed from an approach described in the NRC 2019 SOE Water Quality report (Nicholson and Perquin, August 2019¹). The six attributes are as follows:

- Ammoniacal-N for toxicity or NH₄-N (g/m³)
- Nitrate-N for toxicity NO₃-N (g/m³)
- Visual clarity (Black disk distance in m) - as surrogate of suspended fine sediment
- *Escherichia coli* or *E.coli* (MPN/100 mL)
- Dissolved reactive phosphorous or DRP (g/m³)
- Dissolved inorganic nitrogen or DIN (g/m³)

The basic concept for calculating WQI involves assessment of the long-term (5 hydro years – i.e., July to June) median values for each of the above attributes. It compares these median values against their Northland Objective Values (NRC Objective Value). NRC Objective values are 92nd (for nutrients and *E.coli*) or 8th percentile values (for Visual clarity and DO minima) using the long-term water quality results from NRC water quality reference monitoring sites. In other words, NRC Objective values represent some of the poorest water quality results observed at the most pristine sites in the monitoring network. There are seven reference sites in the NRC river network, listed in table 1.

Table 1: Reference Sites for deriving Northland Objective values.

Site ID	Site Name	Freshwater Management Unit (FMU)
LOC.306641	Peria at Honeymoon Valley Road*	Doubtless Bay
LOC.101751	Waipapa at Forest Ranger	Hokianga
LOC.313165	Tapapa at SH1	
LOC.103304	Waipoua at SH12	Waipoua
LOC.313168	Wairau at SH12	
LOC.313171	Punaruksu at Russell Road	Whananaki Coast
LOC.312177	Pukenui at Kanehiana Drive	Whangārei

* Water quality data collected from the new site Peria at Atkinson is merged with the data from a previous Honeymoon Valley site.

¹ Nicholson, C; Perquin, J-C, 2019. River water quality and ecology in Northland – State and trends 2012–2016

The assessment for estimating WQI score uses the same data range for both the calculation of Northland Objective Values and the long-term median. An example of NRC objective values for the six key attributes between July 2016 and June 2021 (five-year hydrological period) are shown in Table 2.

Table 2: Northland Objective values for six key attributes for the hydrological period between July 2016 and June 2021.

Water quality attribute	NRC Objective value
NH ₄ -N g/m ³ (92 nd percentile)	0.01
NO ₃ -N g/m ³ (92 nd percentile)	0.10
Visual Clarity m (8 th percentile)	0.87
<i>E.coli</i> MPN/100mL (92 nd percentile)	703
DRP g/m ³ (92 nd percentile)	0.051
DIN g/m ³ (92 nd percentile)	0.10

Scoring

The water quality Index score is a percentage calculated from the number of attributes that “pass” assessed against their NRC Objective Values. The equation is explained below:

$$WQI = n/N \times 100$$

Where, **n** = number of NPS-FM attributes within NRC Objective values, and
N = total number of NPS-FM attributes assessed (i.e., six attributes)

Sites are then assigned one of four grades based on these WQI scores. Grades are as follows:

Excellent: WQI \geq 90 i.e., at least 90% of the NPS-FM attributes are within NRC Objective values.

Good: WQI \geq 80 i.e., at least 80% of the NPS-FM attributes are within NRC Objective values.

Fair: WQI \geq 50 i.e., at least half of the NPS-FM attributes are within NRC Objective values.

Poor: WQI $<$ 50 i.e., less than 50% of the NPS-FM attributes are within NRC Objective values.

This modified approach of estimating WQI grade based on percentage of attributes rather than actual number of attributes meeting the NRC Objective values (as originally followed by the NRC 2018 SOE report) has been adopted to accommodate further NPS-FM attributes in future as more data becomes available.

NH ₄ -N	NO ₃ -N	Visual Clarity (Black disk)	<i>E.coli</i>	DRP	DIN	WQI = % NPS-FM attributes within NRC Objective values	WQI grade for KPI
fail	fail	pass	pass	pass	fail	50	Fair

In the example above only three NPS-FM attributes (Visual clarity, *E.coli*, and DRP) are within their NRC Objective values and therefore the site has a WQI score of 50 representing an overall WQI grade of “Fair” water quality.

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