

You have asked me to comment on whether water quality in Lake Tarawera has remained unchanged over the last 30 years. This question concerns a document that Rowan Wells has produced in which he claims this might be the case. I outline my detailed response to the question below, but in brief terms: Many key water quality attributes in Lake Tarawera have deteriorated over the last 34 years based on the long-term records that NIWA has collected and a formal trend analysis of that data.

As Chris McBride has outlined to you in one of his earlier emails, several datasets could be considered to assess the long-term water quality trends in Lake Tarawera, including the regular Bay of Plenty Regional Council monitoring data (collected within the lake), and the NIWA water quality data from their National River Water Quality Network (collected at the outflow of the lake). The regional council data is intermittent before 2005, which precludes a robust assessment of long-term changes beyond that year. The NIWA data dates to 1989 and represents the most consistent dataset available.

Because I have not found a formal long-term trend analysis of the NIWA datasets in any of the documents that have already been circulated, I have carried out a formal trend analysis on that dataset myself. I have used the same trend analysis method that the Ministry for the Environment and regional councils use for their State of the Environment reporting. This method uses a Kendall tau trend method for detecting and quantifying two aspects of the behaviour of water quality over time: the direction and rate of change of the variable over the period of interest (in this case, 34 years of data collected by NIWA).

The results of this analysis are presented in the table below and in the figures for visual reference and interpretation (Chris McBride has kindly supplied the figures). Based on the analysis, I conclude that the key attributes total phosphorus, total nitrogen, and black disk (a measure of water clarity used in rivers and streams) show worsening (or, in other words, deteriorating) trends over the last 34 years (with very high confidence). Results for dissolved reactive phosphorus show a similar pattern. Results for nitrate (and ammonium, results not shown) are indeterminate, i.e., there is little to no confidence in the trend direction. The 'percent annual change' provides you with an 'average' annual change of the respective attribute. Although the values appear low, small changes every year over prolonged periods can add up to some fairly drastic changes over time.

See Table

The graphic representation of the trends (see below) also shows an appreciable inter-annual variation of water quality in the lake, which suggests to me that other factors (e.g., weather, broad scale climatic patterns, in-lake dynamics) contribute to that variation, but I have not assessed that formally.

I have only presented trend analysis for the entire data record (34 years), but the analysis could be done for 20 or 10 years, which would provide a little bit more insight into how and when things have changed in the lake. This would require a bit more time, though. I have also not formally analysed the regional council data at this stage. The correction of the lab methodology error that resulted in values that are higher than they should be requires a bit more thought on how to approach the trend analysis.

See Graphs