Appendix 5

The Hearing Panel has requested further evidence on the potential environmental benefits of the implementation of proposed Rule 13-1 in target Water Management Zones. In response, this appendix contains information regarding the current state of coastal lakes (without Rule 13-1 scenario) with regard to cyanobacterial blooms; it also contains general predictions for nutrient reduction resulting from the implementation of proposed Rule 13-1. There are three parts to this appendix:

1. Evidence of the number of cyanobacterial alerts (MfE/MoH, 2009) based on cell-counts from recreational lakes monitoring collected weekly from 1 November to 30 April between 2003 and 2009;

2. Anecdotal evidence on the occurrence of algal blooms in some coastal lakes and wetlands from annual summer observations by Wellington Fish & Game officers between 1981 and 2008; and

3. General predictions relating the information above to catchment nutrient loads resulting from the implementation of proposed Rule 13-1.

Frequency of cyanobacterial bloom alerts from Horizons' monitoring data

Horizons has monitored four coastal lakes to determine recreational risk to users from potentially toxic cyanobacterial blooms over varying timeframes since 2003. Cyanobacterial cell counts have been determined from samples collected either fortnightly or weekly during the summer bathing season (1 November-30 April) and were compared to the alert levels contained in the Interim New Zealand Guidelines for Cyanobacteria in Recreational Fresh Waters (MfE & MoH, 2009).

For clarity it should be noted that:

1. The MfE and MoH (2009) Interim Guidelines were released in December 2009. They have been compared to historical data in this evaluation, but management of health risk at the time was carried out on a different basis;
2. Sampling at Lakes Dudding, Pauri and Wiritoa has been done routinely on a weekly basis and provides a reasonably unbiased estimate for the summer period;

3. Lake Horowhenua has the longest period of records and sampling has sometimes been targeted toward algal bloom events, so it may therefore overestimate bloom frequency.

The MfE & MoH (2009) alert levels recommend the following responses:

- **Green:** weekly to fortnightly surveillance showing low cell counts/biovolumes and low numbers of cyanobacterial cells.
- **Amber:** weekly sampling recommended, multiple sites should be sampled, public health unit to be notified. Samples have moderate cell counts/biovolumes with moderate numbers of potentially toxic cyanobacterial cells.
- **Red:** continue monitoring as for amber alert, test for cyanotoxins, and notify the public of potential health risk (i.e. via signage).

The figures below show the proportional differences in alert levels between lakes and between years. There is substantial variation between years and between lakes. This variation is largely driven by year to year environmental variation that is attributable to weather patterns affecting each lake. The most variable lake from year to year is Lake Horowhenua, followed by lakes Dudding, Wiritoa and Pauri in decreasing order of variation in alert level.

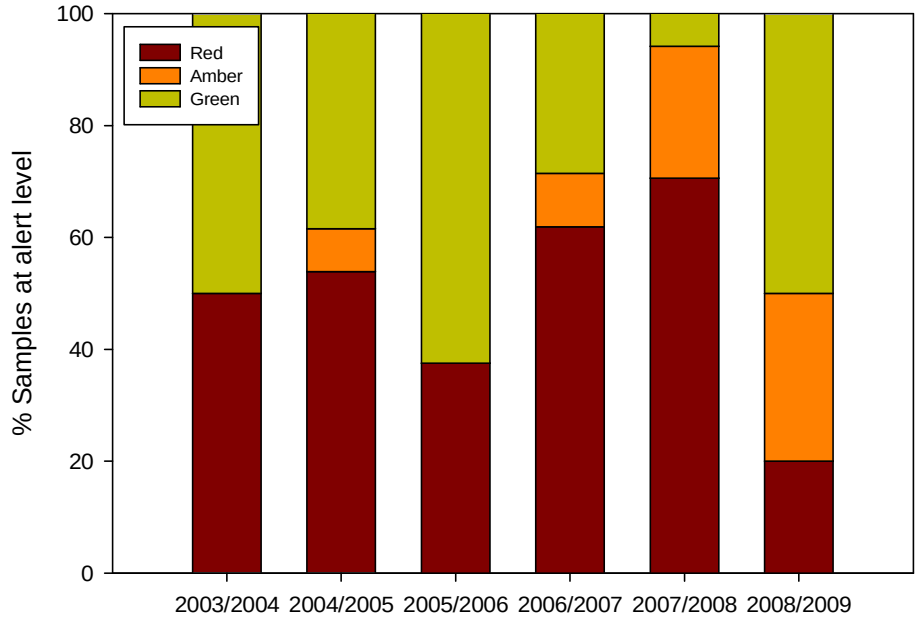

Figure 1: Lake Horowhenua – Percent of algal cell counts within three cyanobacterial alert classes (MfE & MoH, 2009) for each year of monitoring collected during the summer (1 Nov - 30 April).

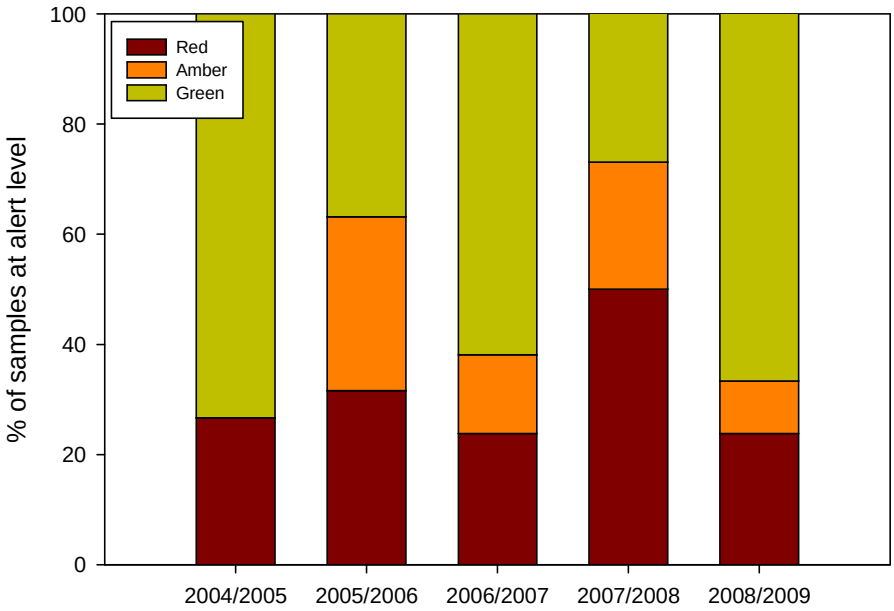

Figure 2: Lake Dudding – Percent of algal cell counts within three cyanobacterial alert classes (MfE & MoH, 2009) for each year of monitoring collected during the summer (1 Nov-30 April).

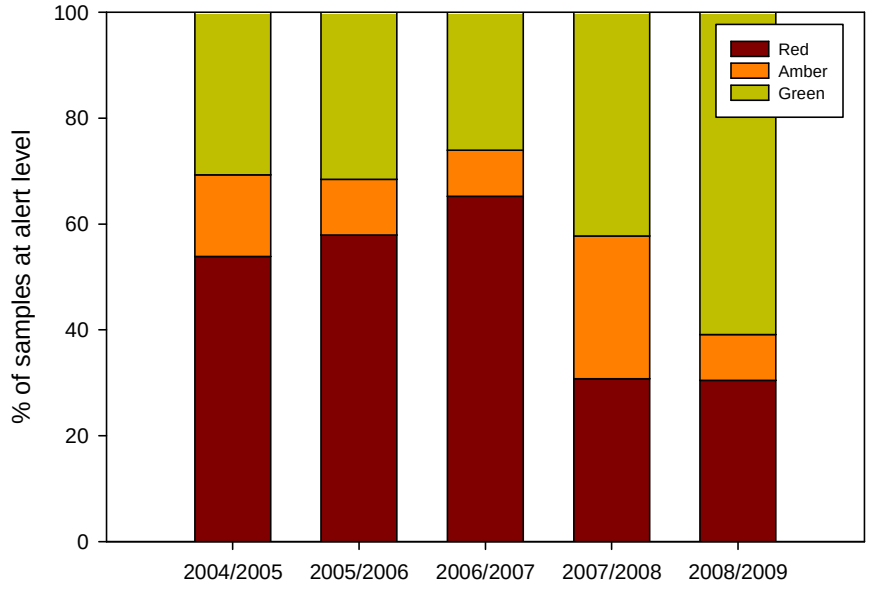

Figure 3: Lake Wiritoa – Percent of algal cell counts within three cyanobacterial alert classes (MfE & MoH, 2009) for each year of monitoring collected during the summer (1 Nov-30 April).

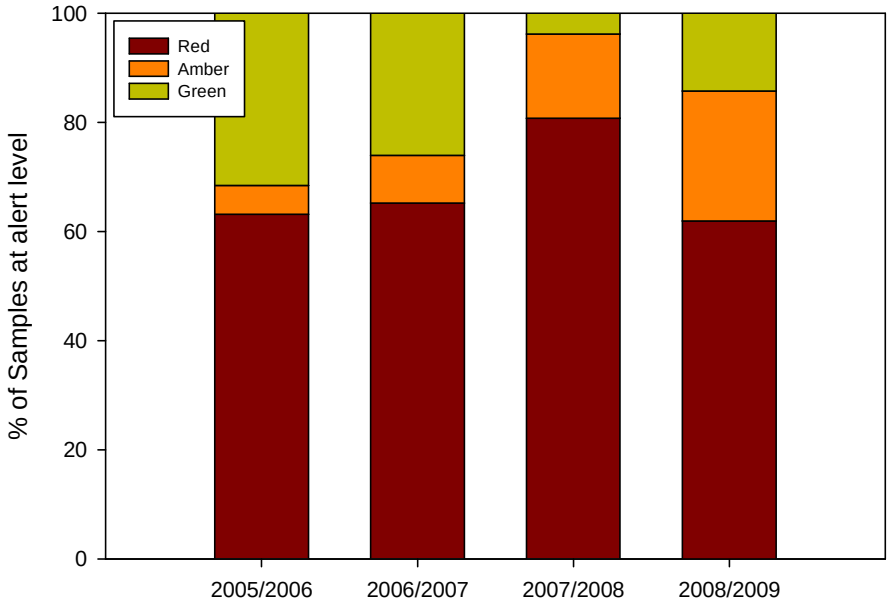

Figure 4: Lake Pauri – Percent of algal cell counts within three cyanobacterial alert classes (MfE & MoH, 2009) for each year of monitoring collected during the summer (1 Nov-30 April).

Despite year to year and lake to lake variation, all lakes in all years had between 20% and 81% of samples within the red alert category for cyanobacterial cells, requiring public notification of potential health risk for between 5 and 21 weeks each summer period (which is 26 weeks long) according to the guidelines. Lake Pauri had the highest proportion of samples in the red alert class (Figure 4), with lakes Horowhenua (Figure 1), Wiritoa (Figure 3) and Dudding (Figure 2) following in decreasing order.

Anecdotal observations of the occurrence of cyanobacterial blooms

Wellington Fish & Game officers survey many of the coastal lakes and wetlands within Water Management Zones subject to proposed Rule 13-1, for the purposes of determining game-bird populations annually during the summer. Observations of algal blooms were made during these surveys, although these were not formally documented.

Table 1 below documents the frequency of anecdotal algal bloom observations. The subjective scale used was as follows: Always = algal blooms in all years surveyed; Often = algal blooms in most years surveyed; Occasionally = algal blooms in some years surveyed; Never = algal blooms never observed during surveys.

Although these anecdotal surveys do not provide quantitative observational data, they do provide a qualitative baseline of the current and recent state of eutrophication and cyanobacterial risk for many of the Region's coastal lakes and wetlands. These qualitative observations are confirmed by the quantitative monitoring data from the four lakes which have had regular monitoring of algal cell-count, as displayed in the proportion of cyanobacteria alerts above.

Quantitative results in Figures 1 to 4 above are in general agreement with the anecdotal observations contained in Table 1 below for those lakes which have been monitored.

Table 1: Anecdotal summer observations of algal and cyanobacterial blooms in coastal lakes and wetlands by Wellington Fish & Game officers between 1981 and 2008. The column entitled Monitoring data collected refers to data collected by Horizons under the summer recreation monitoring programme since 2003.

Lake / Wetland	Water Management Zone	Algal bloom frequency	Years of observation	Monitoring data collected
Lake Kohata	West_4	Often	23 (1985 – 2008)	No
Lake Wiritoa	West_4	Occasionally	23 (1985 – 2008)	Yes
Lake Pauri	West_4	Occasionally	23 (1985 – 2008)	Yes
Kaitoke Lake	West_4	Often	23 (1985 – 2008)	No
Lake Dudding	West_5	Often	27 (1981 – 2008)	Yes
Lake Heaton	West_5	Always	27 (1981 – 2008)	No
Lake Bernard	West_5	Never	27 (1981 – 2008)	No
Lake William	West_5	Often	27 (1981 – 2008)	No
Lake Alice	West_5	Occasionally	27 (1981 – 2008)	No
Lake Herbert	West_5	Always	27 (1981 – 2008)	No
Lake Koitiata	West_5	Often	27 (1981 – 2008)	No
Pukepuke Lagoon	West_6	Often	27 (1981 – 2008)	No
Omanuka Lake	West_6	Often	27 (1981 – 2008)	No
Lake Kaikokopu	West_6	Often	27 (1981 – 2008)	No
Lake Koputara	West_6	Often	27 (1981 – 2008)	No
Foxton Lake #4	West_6	Often	27 (1981 – 2008)	No
Foxton Lake #3	West_6	Often	27 (1981 – 2008)	No
Lake Horowhenua	Hoki_1	Always	27 (1981 – 2008)	Yes
Lake Papaitonga	West_8	Often	27 (1981 – 2008)	No

Conclusions

The current frequency of cyanobacterial blooms in coastal lakes within the target management zones is high, with bloom density frequently exceeding the "red" alert level described in the Interim Guidelines 2009 prepared by MfE & MOH. This indicates significant current negative effects on values such as Contact Recreation, Amenity and Stockwater. Additionally, negative effects on Life Supporting Capacity can be inferred as a result of the fluctuations in water quality (physico-chemical state) within the lakes that results from the 'boom and bust' cycles of cyanobacterial blooms and the organic material added to the lake system as a result of algal die-off. This effect on Life Supporting Capacity is illustrated by the low diversity of native fish in the Region's coastal lakes (McArthur *et al.* 2007).

Direct modelling of the expected changes in cyanobacterial bloom frequency and duration as a result of the implementation of proposed Rule 13-1 in the target Water Management Zones cannot be undertaken with the existing monitoring information. However, given the likelihood of reductions in nutrient load for the target catchments, the frequency and duration of cyanobacterial blooms is also assumed to decrease over time with the effect of reducing the negative effects on values such as Life Supporting Capacity, improving lake water clarity and slowing the eutrophication of lakes, particularly those with no outflows.

Mr Max Gibbs has recommended (s42A report, key points box page 42) implementing stock-exclusion and refurbishment of riparian buffer zones to further realise environmental benefits in coastal dune lakes. In addition to environmental benefits conferred from nutrient load reductions, benefits from stock exclusion detailed within Horizons' FARM strategy would also apply to these target catchments.

The key factor which confounds the calculation of environmental benefits associated with the implementation of proposed Rule 13-1 is the complex hydrological interaction between ground and surface water in the lake target catchments. This means that the timeframe and degree of water quality benefits (resulting from Rule 13-1) cannot readily be established. However, the monitoring of current state indicates that change in a positive direction is required and that water quality may yet get worse before it improves, as a result of the lag between contamination from land use reaching lake waters and the time required for riparian buffers to become established within stock-excluded areas.

Photo 1: Degrading algal bloom on Lake Horowhenua (2008).

References

McArthur, K.J., Clark, M. and McGehan, J. 2007. Sites of Significance for Aquatic Biodiversity in the Manawatu-Wanganui Region: Technical report to support policy development. *Horizons Regional Council Report No: 2007/EXT/794.*

Ministry for the Environment and Ministry of Health. 2009: New Zealand Guidelines for Cyanobacteria in Recreational Fresh Waters - Interim Guidelines. Prepared for the Ministry for the Environment and Ministry of Health by S.A. Wood, D.P. Hamilton, W.J. Paul, K.A. Safi and W.M. Williamson. Wellington: Ministry for the Environment.

NB: Interim Guidelines available on the Ministry for the Environment website at: http://www.mfe.govt.nz/publications/water/guidelines-for-cyanobacteria/nz-guidelines-cyanobacteria-recreational-fresh-waters.pdf