Ōhau Channel Diversion Wall Monitoring Report

2018-2024

Internal Report for Resource Consent RM16-0527-BC (Conditions 10.2, 10.3, & 10.4)

Prepared by Justine Randell, Lakes Operations Officer, BOPRC

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Contents

1 Introduction

1.1 Ōhau Wall

The 1250m long Ōhau Wall was constructed in 2008 for the purpose of diverting the poorer quality water from Lake Rotorua and the Ōhau Channel down the Okere Arm of Lake Rotoiti towards the Kaituna River. The wall would subsequently improve the water quality of Lake Rotoiti by substantially reducing the amount of water from Lake Rotorua mixing with Lake Rotoiti.

Figure 1.1: Location of the Ōhau Diversion Wall in Lake Rotoiti (image from Becca 2016)

1.2 Consent Compliance Monitoring

Bay of Plenty Regional Council (BOPRC) holds a resource consent, RM16-0527-BC, for placing and using the diversion wall at the end of Ōhau Channel that connects Lake Rotorua to Lake Rotoiti. The consent was granted in December 2016 and replaced previous consent 63209 that was granted in November 2006. The resource consent requires water quality monitoring at a range of sites located in Lakes Rotorua and Rotoiti, the Ōhau Channel, Kaituna River and Maketū Estuary. Most of the water quality monitoring sites have been established prior to the installation of the wall as part of long-term monitoring programmes, however certain analyses were specifically initiated to comply with the consent conditions.

Under the current consent the monitoring results have been reported annually for 2015, 2016 and 2017 calendar years. This report will include monitoring for calendar years from 2018 – 2024 (and graphs will recap data back to 2015).

The consent requires a range of water quality monitoring to be undertaken as follows:

1.2.1 Nutrients and Chlorophyll (Condition 6.1)

The following nutrients, including chlorophyll, are to be monitored monthly:

- Dissolved Reactive Phosphorus (DRP)
- Total Phosphorus (TP)
- Ammoniacal Nitrogen (NH_4-N)
- Nitrate-Nitrogen (NOx)
- Total Nitrogen (TN)
- Chlorophyll-*a* (Chl-*a*)

Samples are taken at the following sites shown in Table 1.1 which also shows the Monitoring Site Location ID where monitoring data is obtained. Sites are also shown in Appendix A.

Table 1.1: Consent Monitoring Sites and Monitoring Sampling Site Location ID

Consent Monitoring Site	Monitoring Sampling Site Location ID
Ōhau Channel	Ōhau Channel at SH33
Okere Arm	Kaituna at Rotoiti Outlet
Western Basin of Lake Rotoiti	Lake Rotoiti Site 3 (Integrated Sample)
Eastern Basin of Lake Rotoiti	Lake Rotoiti Site 4 (Integrated Sample)
Lake Rotorua	Lake Rotorua Site 2 (Integrated Sample)
	Lake Rotorua Site 5 (Integrated Sample)
Kaituna River (Paengaroa)	Kaituna at Maungarangi Road
Kaituna River (AFFCO)	Kaituna at AFFCO Intake Ponds (up to July 2018) then 67 Malcom Rd from May 2019
Kaituna River (Waitangi)	Kaituna at Te Matai
Kaituna River (Troutpools)	Kaituna at Clarkes (d/s of Waiari Stream Confluence)
Kaituna (Te Tumu)	Kaituna at Te Tumu
Maketū Estuary	Maketū Estuary at boat ramp

1.2.2 Blue-Green Algae (Condition 6.2)

Monitoring of blue-green algal numbers is undertaken weekly, generally between November to March each year at the following sites. In some instances, monitoring may begin earlier in October and finish in the winter months the following year.

- Ōhau Channel
- Okere Arm
- Okawa Bay
- Te Weta Bay
- Western Basin of Lake Rotoiti
- Eastern Basin of Lake Rotoiti
- Kaituna River at Waitangi
- Kaituna River at Te Tumu
- Kaituna River at Trout Pools
- Maketū Estuary

1.2.3 Suspended Sediment (Condition 6.3)

Monthly monitoring of suspended solids is to be undertaken at the following sites.

- Ōhau Channel (including at Waipuna)
- Okere Arm (at the end of the diversion wall)
- Okere Arm (at the Okere Gates)
- Te Tumu
- Maketū Estuary

2 Water Quality Monitoring Results

The following section reports on water quality results as required by Consent condition 6.1 and 10.2. As noted in Table 1.1, the name of some monitoring sites differs from those in the consent conditions, however these monitoring locations are located at the required consent locations as listed in Table 1.1 and results at these sites go back many years, with some sites monitored before the wall was constructed.

Both lake and stream samples are collected monthly by BOPRC's Environmental Information Services team in conjunction with BOPRC's Laboratory Services team who analyse the majority of the samples in their IANZ accredited laboratory. This compliance monitoring is incorporated with long term monitoring for other programmes so a variety of analysis that is undertaken is not included in this report.

In addition, for Lake Rotorua and Rotoiti, permanent monitoring stations in the form of buoys are installed where water quality information can be accessed 24/7 on the BOPRC website, environmental data portal. The portal provides data in the form of graphs that indicates stratification events, habitat stressors, and weather information. See link: Data - Bay of Plenty Regional Council WebPortal. A variety of other water quality information is also found on the website.

2.1 Lake Rotorua and Lake Rotoiti

Lake water quality samples are collected monthly at Site 2, south of Mokoia Island, and Site 5, north of Mokoia Island for Lake Rotorua. Lake Rotoiti samples are taken in the Western basin of the lake at Site 4, and the Eastern basin of the lake at the 'Narrows' at Site 3.

Refer to Appendix A for a map of monitoring sites.

Samples are collected at various depths including 1m from the bottom of the lake, at the hypolimnion, and an integrated sample that includes the top few metres of the lake. For this report, the integrated samples are used.

2.1.1 Phosphorus

As can be seen in the below graphs, TP has been below or close to the 0.02 g/m3 upper control target set for TP for Lake Rotorua up to 2019. This can be attributed to ongoing actions within the catchment to improve the water quality of the lake, such as alum dosing. Stratification events, usually during summer, causes low oxygen in bottom waters resulting in the release of phosphorus from the lake bottom sediments making nutrients, including nitrogen, available to promote algal growth, sometimes causing blue-green algal blooms.

For the reporting period 2018-2024, Lake Rotorua TP and DRP show peaks in May 2019, June 2020, March 2021, May 2022 and April 2024 (lines between the graph markers have been included to show these peaks more clearly). Typically, these peaks are attributed to when the lake mixes after stratification events during the summer months where phosphorus is released into the water column but does not reach the surface until the lake mixes again during autumn. The peaks of TP and DRP in 2021 and 2022 are likely to be attributed to a pause in alum dosing at the Puarenga Alum dosing plant from August 2018 to October 2021 due to alum tank replacement, and a cease in dosing at the Utuhina alum dosing plant during Covid lock-down. With the operation of both plants from April 2021, the phosphorus peaks have reduced.

For Lake Rotoiti, TP and DRP show strong seasonal fluctuations, with DRP concentrations within Lake Rotoiti much higher than Lake Rotorua. TP peaks in Lake Rotoiti are of similar concentration to the peaks in Lake Rotorua in 2021 and 2022.

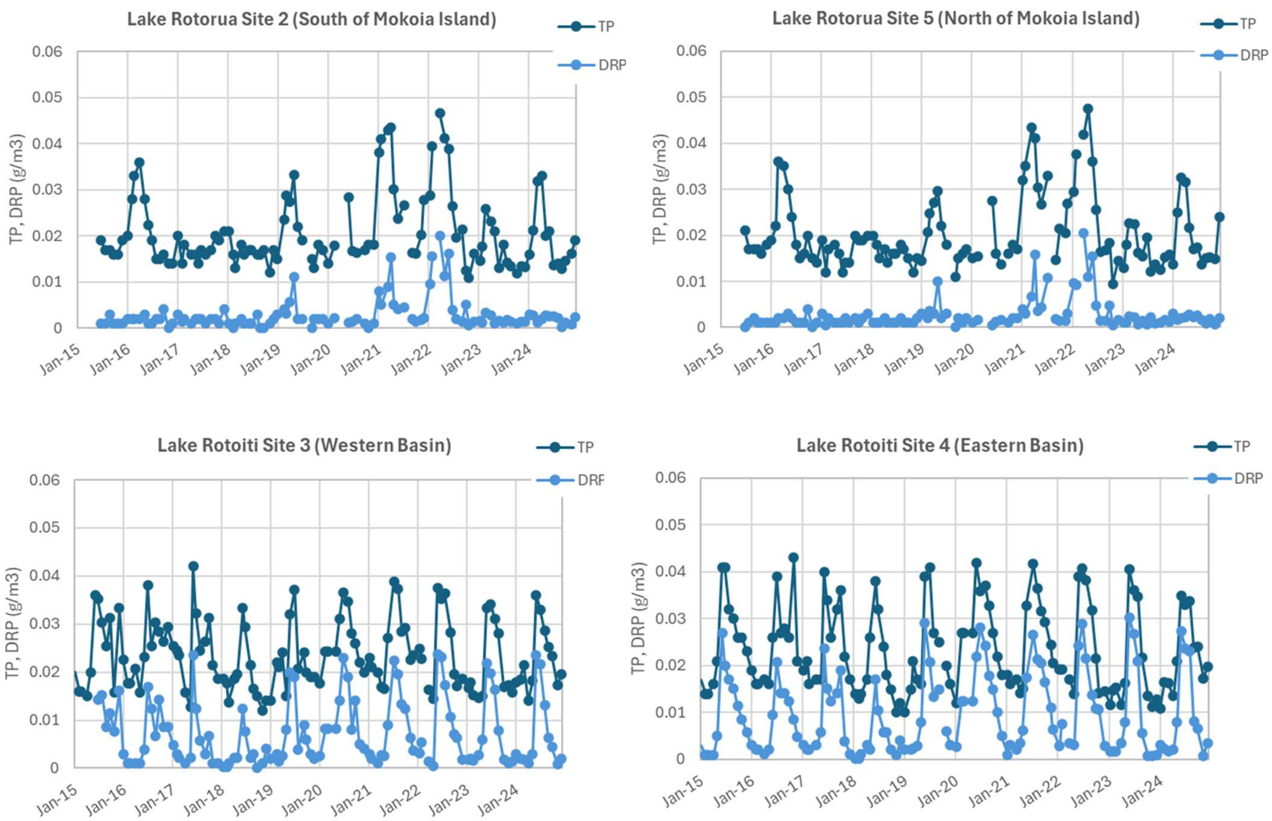

Figure 2.1: Total phosphorus and dissolved reactive phosphorus in Lake Rotorua and Lake Rotoiti.

2.1.2 Nitrogen

For Lake Rotorua, nitrogen peaks generally correlate to heavy rainfall events. The peaks correspond closely to the rainfall depth data received at Relph Road, Ngongotaha. The peaks are notable around the winter months as can be seen in the graphs below in figure 2.2. For Rotorua and Rotoiti, there appears to be only a slight increase in total nitrogen over the reporting period, and peaks of Nitrate-Nitrogen and Ammoniacal nitrogen tend to follow the TN peaks. Note the two different scales for the TN on the graph that show Lake Rotorua TN is around twice that of Lake Rotoiti TN concentrations.

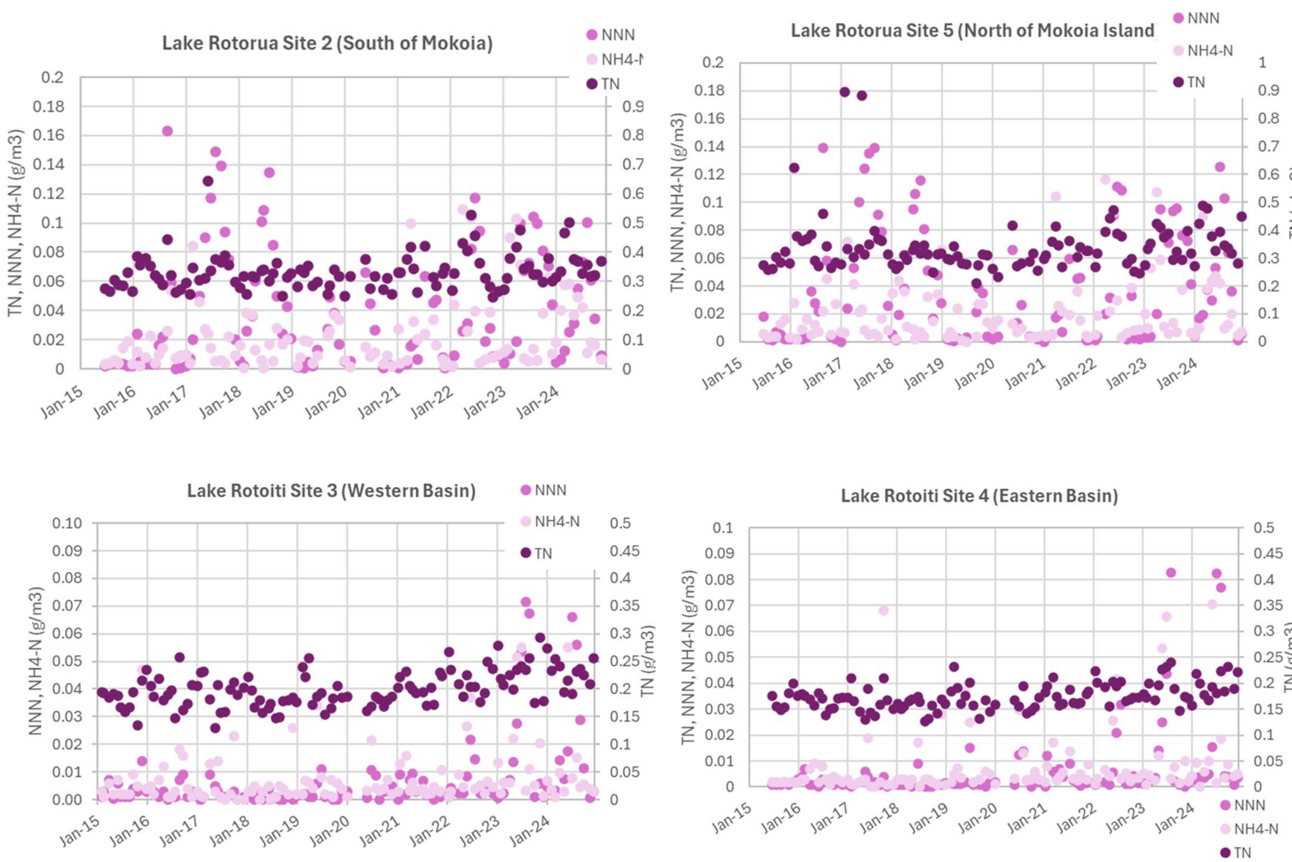

Figure 2.2: Total nitrogen, Nitrate-nitrogen, and Ammoniacal nitrogen in Lake Rotorua and Lake Rotoiti.

2.1.3 Chlorophyll~*a*

When looking at the graphs below in Figure 2.3, Chlorophyll~*a* concentrations in Lake Rotorua are generally twice that of levels in Lake Rotoiti. While Chlorophyll~*a* levels in Lake Rotorua appear to have shown no increase during the reporting period, levels in Lake Rotoiti have appeared to decrease.

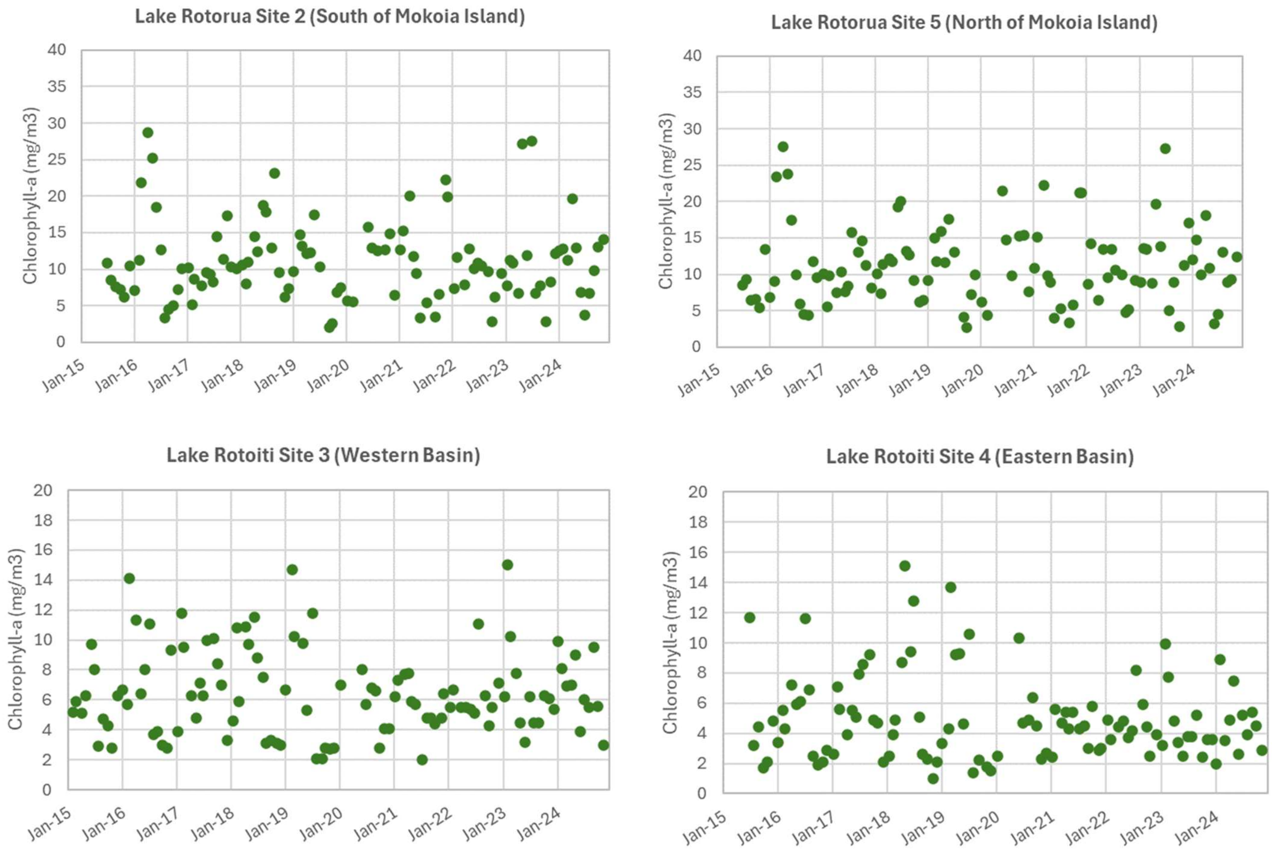

Figure 2.3: Chlorophyll~*a* in Lake Rotorua and Lake Rotoiti.

2.2 Ōhau Channel and Okere Arm

Ōhau Channel samples are collected at SH33 where it crosses the Ōhau Channel. Okere Arm samples are collected at Rotoiti Outlet located at the start of the Kaituna River at the jetty platform adjacent to Okere Fall Store. See Appendix A for sampling locations.

2.2.1 Phosphorus

During the reporting period, Ōhau Channel showed slightly higher concentrations of TP than Okere Arm. However, DRP concentrations are very similar for both sites with small DRP peaks at both sites that appear to match peaks (however at a lower concentration range) shown in Lake Rotorua in mid- 2022 when high rainfall was received in the area over many months.

Levels of TP in the Ōhau Channel were generally marginally higher than Lake Rotoiti, contrastingly, DRP concentrations were lower in the channel and Okere Arm when compared with DRP concentrations in Lake Rotoiti. See Figure 2.4 below.

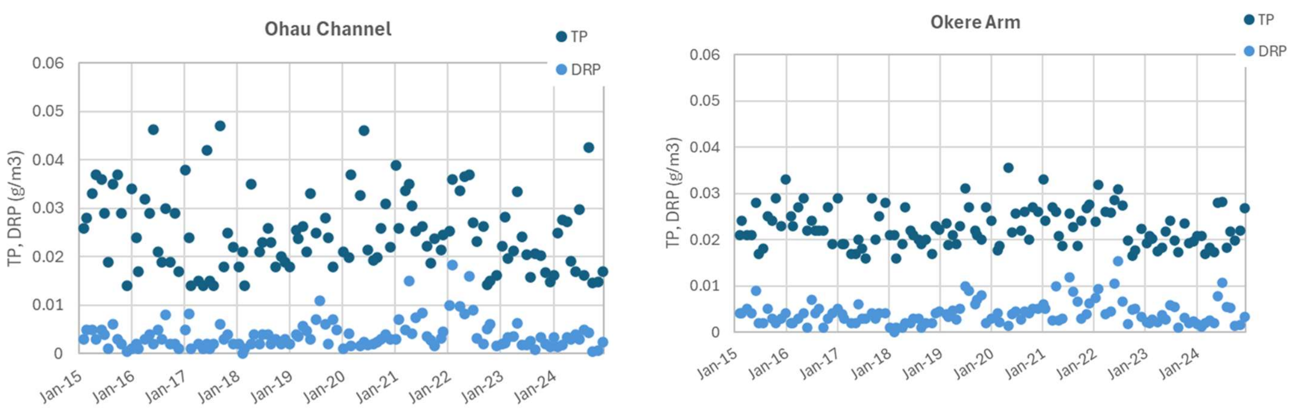

Figure 2.4: Total phosphorus and dissolved reactive phosphorus in Ohau Channel and Okere Arm

2.2.2 Nitrogen

Total Nitrogen levels in both the Ōhau Channel and Okere Arm have remained fairly stable since 2018, with levels in the channel being slightly higher than TN levels in Okere Arm. TN levels at both sites are slightly lower than TN levels in Lake Rotoiti, and similar to those in Lake Rotorua. Refer to Figure 2.5 below.

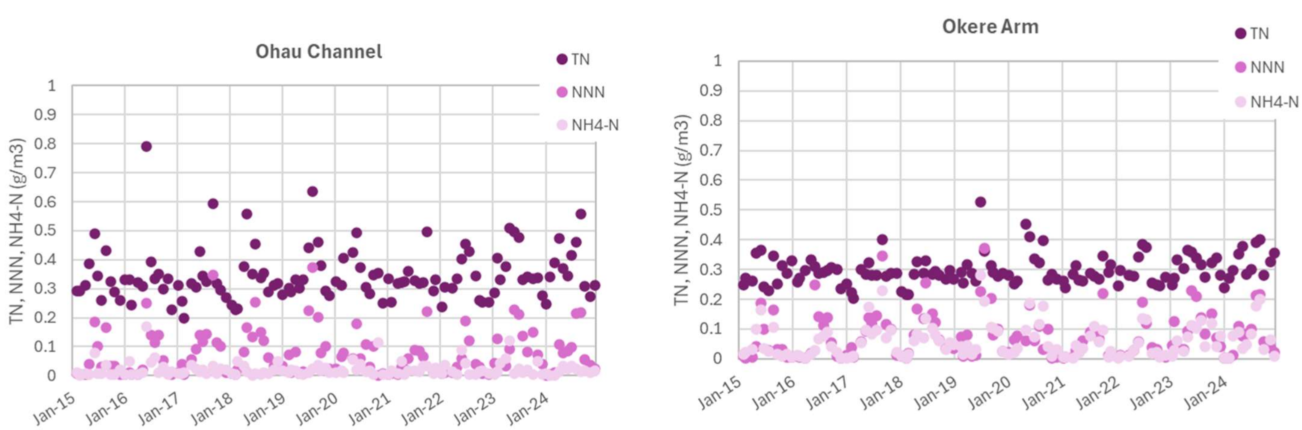

Figure 2.5: Total nitrogen, Nitrate-nitrogen, and Ammoniacal nitrogen in Ohau Channel and Okere Arm

2.2.3 Chlorophyll~*a*

Concentrations of Chlorophyll~*a* in the Ōhau Channel and Okere Arm are similar to Lake Rotoiti concentrations, and lower than Lake Rotorua sites. Peaks of chlorophyll in the Channel in May 18, Nov 21, May/Jul 23 and Feb/Apr 24 also appear at Okere Arm, however at lower concentrations, apart from Apr 16 where the peak was higher in Okere Arm. During the reporting period it appears Chlorophyll-*a* has not increased over time. It was noted in previous reports that the concentration of chlorophyll~*a* in the Ōhau Channel has reduced since the Ōhau wall was commissioned in 2008 (Hamill 2017, Becca 2016, McIntosh 2015) where concentrations of Chlorophyll~*a* were around 20-30 mg/m3 at times. Refer to Figure 2.6 below.

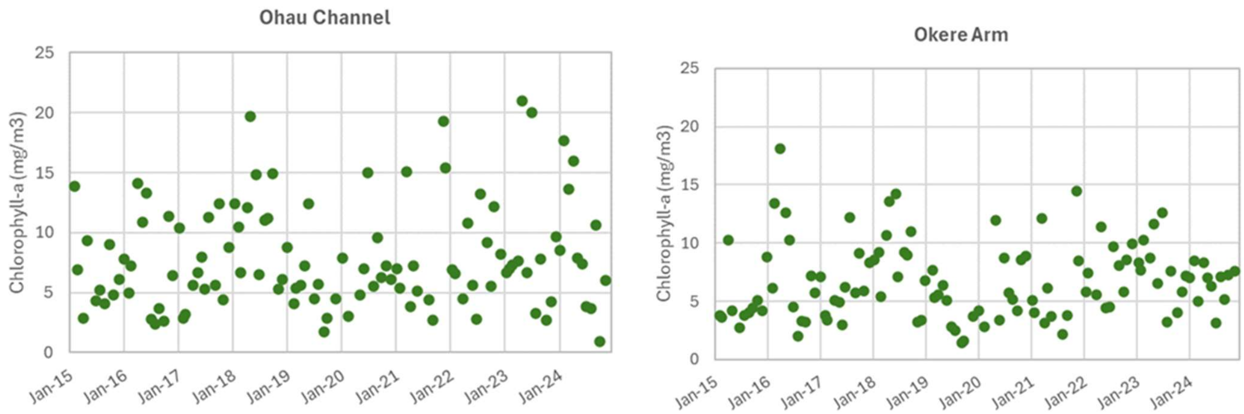

Figure 2.6: Chlorophyll~*a* in Ōhau Channel and Okere Arm

2.3 Kaituna River and Maketu Estuary

Four sites along the Kaituna River are monitored, with a site near the river mouth at Te Tumu, and Maketū Estuary, totalling six sites in this monitoring group. The site at Te Tumu has a period of data missing from August 2018 until October 2019. It is unclear why this has occurred. For Kaituna (AFFCO) site, data was collected at the AFFCO Intake Pontoon site until July 2018, and in May 2019 samples were collected at the 67 Malcolm Road site. Again, data is missing for this time period during the change-over and it is also unclear why this has occurred.

2.3.1 Phosphorus

Although Concentrations of TP increases at sampling locations down the Kaituna River, TP has reduced at all sites over the reporting period. DRP shows a similar pattern, increasing in concentration downstream, however at Maketū Estuary, DRP has reduced concentrations compared with the upper Kaituna River sites. See Figure 2.7.

2.3.2 Nitrogen

Nitrogen tells a similar story to phosphorus where concentrations of TN increase down the Kaituna. See Figure 2.8. Overall TN levels at each site show similar concentrations over the reporting period, with the exception of Maketū Estuary where TN has notably increased in concentration.

Ammoniacal Nitrogen (NH4-N) levels appear to drop considerably from Okere Arm concentrations at the first downstream locations at Paengaroa and AFFCO, however from these sites NH4-N increases downstream with the highest concentrations at Maketū Estuary. As Hamill (2018) suggests, these downstream nutrient inputs are not related to the Ōhau wall.

Nitrate Nitrogen (NNN) is elevated at Paengaroa compared with Okere Arm and NNN levels increase in concentration as sampling sites progress down the Kaituna, with the exception of Maketū Estuary where NNN levels drop considerably. NNN has remained relatively stable in the Kaituna sites, perhaps with a slight increase over the reporting period, however, Maketū Estuary appears to show a marked increase in concentrations from around mid-2022 which may be related to the high rainfall levels received at this time.

2.3.3 Chlorophyll~*a*

Chlorophyll~*a* concentrations gradually decrease in concentration downstream from Okere Arm. Peaks seen in April 2016 and August 2022 are evident in all downstream sites, despite the reducing concentrations overall. Maketū Estuary has a marked decrease in chlorophyll-*a* levels, most likely due dilution from the influence of seawater. Refer to Figure 2.9.

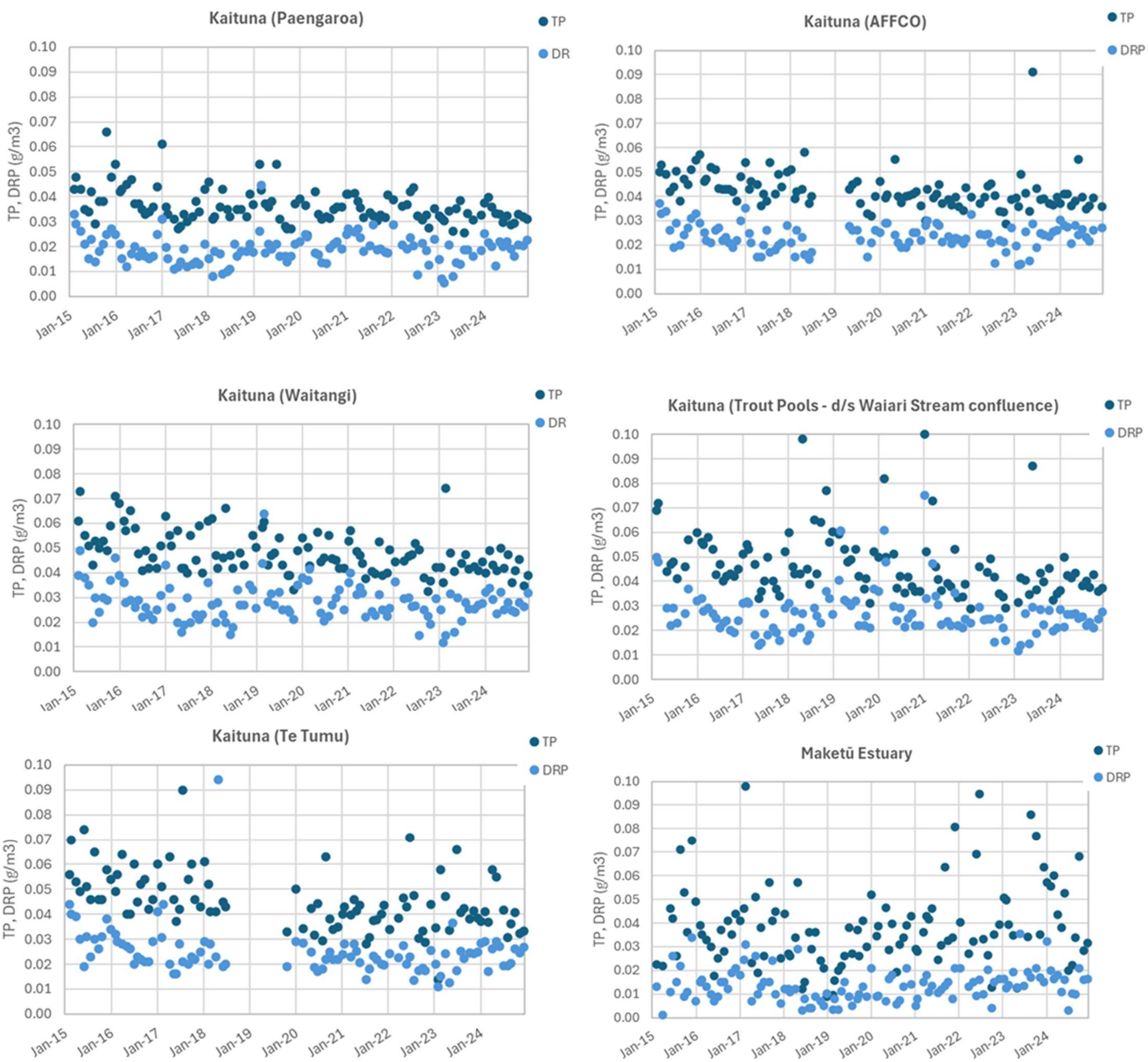

Figure 2.7: Total phosphorus and dissolved reactive phosphorus in Kaituna River and Maketū Estuary

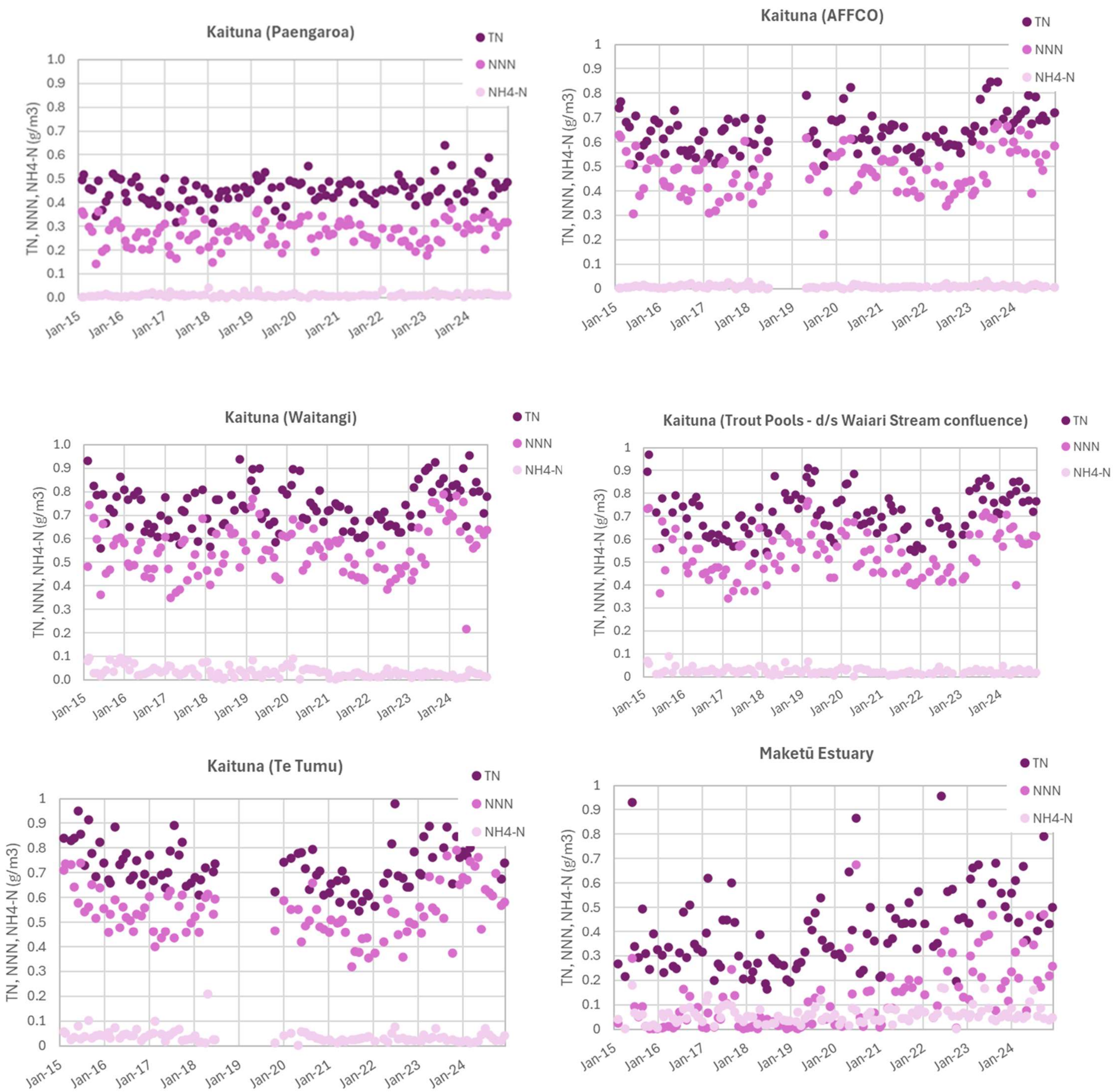

Figure 2.8: Total nitrogen, Nitrate-nitrogen, and Ammoniacal nitrogen in Kaituna River and Maketū Estuary

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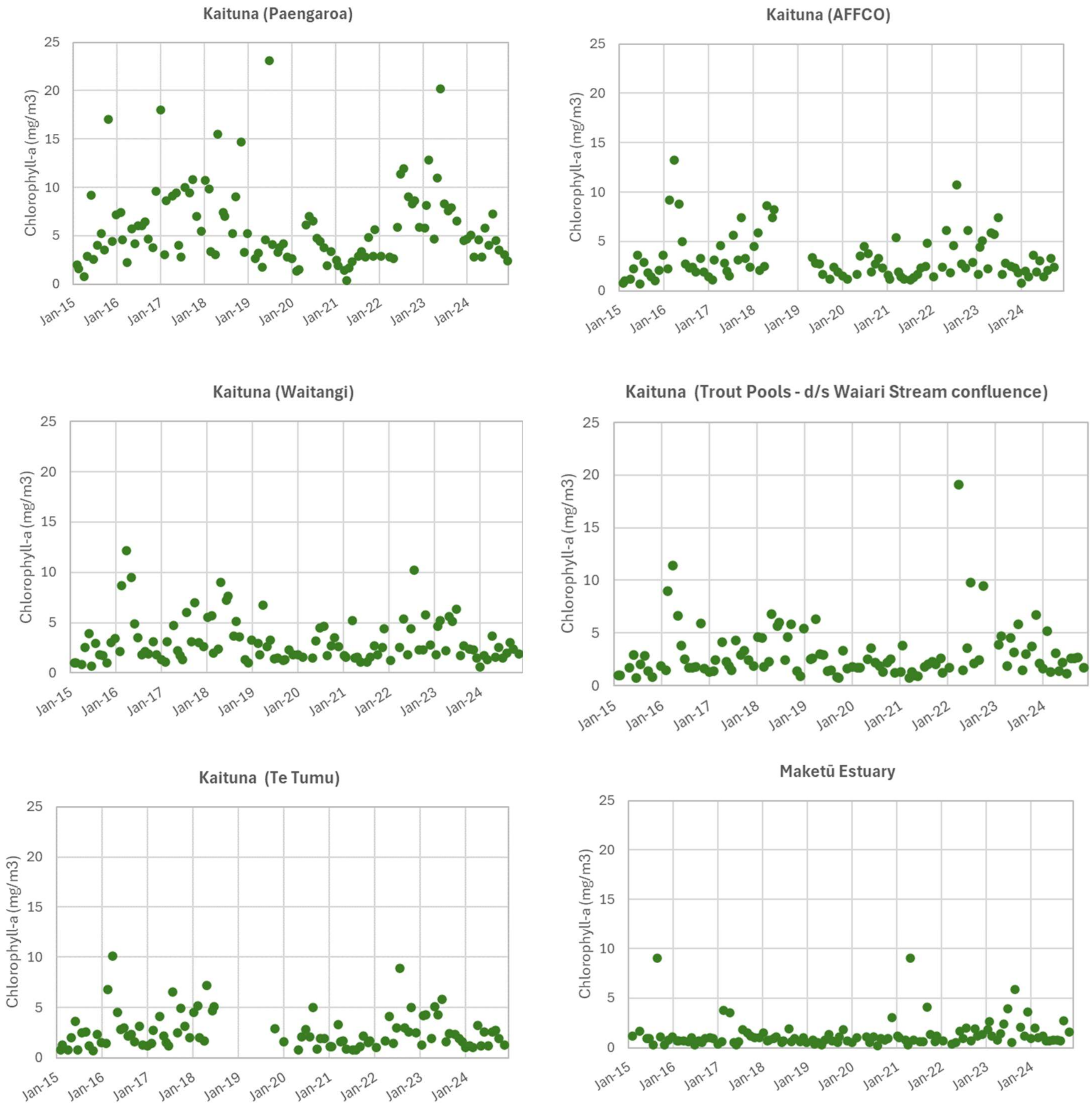

Figure 2.9: Chlorophyll~*a* in the Kaituna River and Maketū Estuary

3 Blue-Green Algae Monitoring

Blue-Green algal blooms (cyanobacteria) are an important indicator of the overall environmental quality of a water body. Cyanobacteria are naturally occurring and live in a range of waterways; however some can produce toxins that are harmful to animals and humans. Toxic algae can become a problem when they increase to high concentrations forming blooms. Generally toxic algae are in low numbers and do not present much danger, however in the summer months when weather is warmer, rainfall is low, and conditions are calm, stratification events in lakes can occur causing the release of nutrients that algae thrive on. Not all blooms are toxic, and levels of toxicity can only be determined by laboratory testing. (https://www.lawa.org.nz/learn/factsheets/can-i-swim-here/toxic-algae)

The *New Zealand Guidelines for Cyanobacteria in Recreational Fresh Waters – Interim Guidelines* 2009 sets a green, amber or red alert level for assessing the health risk of cyanobacteria. See table 3.1. Green is safe, amber is 'alert mode' and red is 'action mode' and a public health notification of potential health risk is required for the water body affected. NB: New MfE and MoH guidelines as of 29 January 2025 are now in place - *'Aotearoa New Zealand Guidelines for Cyanobacteria in Recreational Freshwaters,* however the majority of data in this report was collected under the interim guidelines.

Table 3.1: The Ministry for the Environment and Ministry of Health New Zealand Guidelines for Cyanobacteria in Recreational Fresh Waters

Alert level	Actions (See section 2.4 for the recommended framework for roles and responsibilities relating to actions, and the text box at the beginning of Section 3 for advice on interpreting the guidance in this table.)
Surveillance (green mode) *Situation 1:* The cell concentration of total cyanobacteria does not exceed 500 cells/mL.[a] *Situation 2:* The biovolume equivalent for the combined total of all cyanobacteria does not exceed 0.5 mm^3/L.	• Undertake weekly or fortnightly visual inspection[b] and sampling of water bodies where cyanobacteria are known to proliferate between spring and autumn.
Alert (amber mode) *Situation 1:* Biovolume equivalent of 0.5 to < 1.8 mm^3/L of potentially toxic cyanobacteria (see Tables 1 and 2); **or** *Situation 2[c]:* 0.5 to < 10 mm^3/L total biovolume of all cyanobacterial material.	• Increase sampling frequency to at least weekly.[d] • Notify the public health unit. • Multiple sites should be inspected and sampled.
Action (red mode) *Situation 1:* ≥ 12 µg/L total microcystins; **or** biovolume equivalent of ≥ 1.8 mm^3/L of potentially toxic cyanobacteria (see Tables 1 and 2); **or** *Situation 2[c]:* ≥ 10 mm^3/L total biovolume of all cyanobacterial material; **or** *Situation 3[e]:* cyanobacterial scums consistently present.	• Continue monitoring as for alert (amber mode).[d] • If potentially toxic taxa are present (see Table 1), then consider testing samples for cyanotoxins.[f] • Notify the public of a potential risk to health.

(/https://environment.govt.nz/assets/Publications/Files/nz-guidelines-cyanobacteria-recreational-fresh-waters.pdf)

Condition 6.2 of the consent requires weekly monitoring of blue-green algae, or cyanobacteria, from 15 November to 30 March. This monitoring may sometimes commence earlier, or finish later if monitoring sites, in addition to those required by this consent, are showing elevated levels causing health alerts. Monitoring occurs at popular recreational and swimming sites around the region.

Since 2012, sites in the Kaituna River downstream of Trout Pool Road have only been sampled for cyanobacteria if the Trout Pool samples have a red health alert result. If the water leaving Lake Rotoiti has low cyanobacteria, then higher levels downstream cannot be attributed to the wall.

3.1 Cyanobacteria monitoring results

As can be seen in Table 3.2 below, from the beginning of the 2017/2018 monitoring season to the beginning of the 2020/2021 monitoring season, only one red alert occurred on the 22 October 2020 at the Ōhau Channel site. Until November 2021, monitoring sites over the seasons 2017/2018, 2018/2019 and 2019/2020 were green with few instances of amber alerts, which occurred mainly at Okawa Bay, Lake Rotoiti.

In the 2021/2022 monitoring season, the incidence of amber alerts increased, in predominately all of the Lake Rotoiti sites between May 2021 and December 2021, with far less alerts in the Lake Rotorua sites for the same period. Te Weta Bay and, in particular, Okawa Bay are both enclosed, shallow bays and it would seem that the incidence of algal blooms may have been localised to these areas based on the site conditions at that time (stratification).

The number of amber alerts, including red alerts have increased since December 2022 and for the remainder of this reporting period, with red alerts occurring at Lake Rotorua and Lake Rotoiti sites. A red alert in the Kaituna River at the Trout Pools site in March 2022 triggered sampling downstream in the Kaituna at Waitangi (Te Matai site).

Table 3.2: Cyanobacteria (Total Biovolume mm^3/L) monitoring results 2017/2018 to 2023/2024 monitoring seasons:

	LAKE ROTORUA				LAKE ROTOITI					KAITUNA	
	Holdens Bay	Ngongotaha	Ohau Channel	Hamurana	Otaramarae	Te Weta	Okere Arm	Okawa Bay	Hinehopu	Trout Pool	Waitangi (Te Matai)
31/12/2024	0.8894	2.3334	0.8251	0.9114	0.7486	1.6363	4.4776	10.5067	0.5500	2.7658	
23/12/2024	7.9698	1.0558	3.7657	0.1670	0.2725	1.6119	4.0097	11.9812	0.2246	2.7316	
17/12/2024	10.0631	0.3328	6.6814	4.1261	0.1498	0.7550	3.8032	6.9494	0.1227	1.9403	
09/12/2024	7.4884	0.3581	13.6844	3.4498	0.1260	0.9892	4.6271	0.9321	0.2924	4.5393	
02/12/2024	1.8554	4.3257	2.5186	0.1056	0.0364	0.3911	2.1642	0.4966	0.2031	1.7179	
27/11/2024	3.4746		6.3422		0.0446	0.0014	0.0068			0.0021	
27/05/2024	0.0098	0.0008	0.0085	0.0010	0.0399	0.2640	0.0410	0.0060	0.0188	0.2936	
20/05/2024	0.0076	0.1096	4.7257	0.0143	0.2202	0.5885	0.8125	0.0230	0.0203	0.0483	
13/05/2024	0.4899	0.1497	22.7663	0.0757	0.3335	0.2687	0.4587	0.0043	0.0512	0.0908	
06/05/2024	0.5191	1.9368	87.1219	0.0726	0.1491	0.2800	1.5506	0.0418	0.0594	0.6193	
29/04/2024	0.1152	9.9753	31.6007	0.1370	0.1028	1.7451	2.5274	0.0789	0.0474	1.0687	
22/04/2024	0.1853	0.0834	0.5881	0.3554	0.0191	0.2028	0.7023	0.1459	0.0275	0.9867	
15/04/2024	0.4821	1.1604	1.5876	0.7361	0.0214	0.2171	1.4664	0.2641	0.0313	0.5644	
08/04/2024	31.5019	8.6782	1.7398	1.3815	0.0297	0.6149	5.6046	0.5300	0.0852	1.1664	
02/04/2024	3.5732	15.3971	24.3905	8.8056	0.1243	0.7688	8.2797	0.3248	0.0106	0.1648	
25/03/2024	3.6047	2.5244	0.8974	0.7777	0.1059	0.6204	1.3619	0.3118	0.0182	0.3091	
18/03/2024	0.0868	1.1473	0.0295	0.1934	0.0815	0.4532	1.1222	0.2532	0.0233	0.7137	
11/03/2024	1.3987	0.9421	4.2981	0.6373	0.2647	0.6846	2.2887	0.4726	0.0760	1.2459	
04/03/2024	0.1982	0.0020	21.8203	0.2238	0.1430	0.4496	2.0568	0.6891	0.2304	2.9432	
26/02/2024	28.6935	23.1410	25.0575	0.3137	0.1066	0.4606	2.6170	0.5818	0.0612	1.8047	
19/02/2024	4.1219	6.1137	6.2021	1.3758	0.0861	0.7579	2.0192	1.1800	0.1764	1.1777	
12/02/2024	0.3511	4.3323	0.9871	6.9523	0.2353	0.2372	1.6956	0.7280	0.0074	0.6189	
05/02/2024	1.8509	1.4041	8.2118	0.0652	0.0855	0.4901	1.8234	1.3355	0.2382	1.3873	
30/01/2024	1.6412	0.1616	3.3953	1.0403	0.1273	0.8386	2.4372	1.8763	0.0934	1.7780	
22/01/2024	6.4564	1.7528	1.7852	1.4197	0.3124	4.8717	3.2029	0.4128	0.0443	1.2152	
15/01/2024	2.2536	0.5080	3.1858	1.1872	0.1462	1.7738	1.9746	14.5593	0.0391	0.9604	
08/01/2024	5.2237	4.8725	1.6012	0.2975	0.1143	0.5325	1.5307	33.8855	0.0337	0.4284	
18/12/2023	0.0588	0.7712	2.2965	0.0052	0.0026	0.4956	0.0803	0.0482	0.0957	0.0579	
11/12/2023	0.5071	0.1606	0.2985	0.0099	0.0054	0.0216	0.1257	0.1514	0.1338	0.1891	
05/12/2023	0.3394	0.0381	0.0785	0.0157	0.0233	0.0048	0.1213	0.0986	0.0040	0.0272	
27/11/2023	0.0999	0.2502	0.2120	0.1412	0.0245	0.1219	0.4193	0.1006	0.0304	0.2994	
20/11/2023	0.2250	1.1998	0.0933	0.0555	0.2173	0.0106	0.0177	0.2508	0.0044	0.1133	
13/11/2023	1.2882	0.4960	0.2988	0.1619	0.0386	0.1728	0.4539	0.0508	0.0724	0.3546	
06/11/2023	0.2995	0.1816	0.2371	0.1230	0.0055	0.0681	0.2294	0.0314	0.0487	0.2146	
31/10/2023	0.0077	0.6797	0.1043	0.1268	0.1084	0.0168	0.2163	0.1263	0.0090	0.3830	

Table 3.2 continued

	LAKE ROTORUA				LAKE ROTOITI					KAITUNA	
	Holdens Bay	Ngongotaha	Ohau Channel	Hamurana	Otaramarae	Te Weta	Okere Arm	Okawa Bay	Hinehopu	Trout Pool	Waitangi (Te Matai)
29/05/2023	0.0185	0.0425	0.2302	0.0134	0.2750	0.4581	0.1204	0.0365	0.2233	0.2045	
22/05/2023	0.0006	1.0047	0.0106	0.0041	0.6130	0.6515	0.1161	0.2268	0.1480	0.0968	
15/05/2023	0.1334	0.0158	0.0368	0.0188	0.2242	0.6602	0.7060	0.2229	0.3134	0.2758	
08/05/2023	0.0091	0.0011	0.0217	0.0000	0.1363	1.8453	0.0985	0.9637	0.2813	0.0205	
02/05/2023	0.0036	0.0050	0.0193	0.0128	0.2411	1.3008	1.4072	0.8129	1.0740	0.0538	0.0250
25/04/2023	1.3664	2.5743	4.7185	2.0567	0.4774	0.7324	2.9150	1.2758	0.6528	3.7745	0.3079
18/04/2023	3.9893	0.0079	2.8450	0.4706	0.9251	1.1704	1.8446	0.5250	0.8175	1.4896	0.6939
11/04/2023	3.1325	1.5820	9.3098	1.7764	0.3609	6.0134	5.0009	0.6471	0.5843	3.2863	1.6267
03/04/2023	15.0484	1.6247	49.9151	10.3590	0.2567	5.1558	28.2288	1.9143	0.4390	11.7290	8.1402
27/03/2023	113.7264	4.9748	294.4834	44.9143	0.6092	2.6390	75.7438	1.6859	0.4603	38.9994	21.6614
21/03/2023	49.9027	17.1910	38.6500	4.4068	0.7887	1.2464	21.6077	3.2158	0.3722	11.7733	6.0143
13/03/2023	0.3171	2.8059	33.7122	9.8105	0.4284	1.3916	12.4290	0.7403	0.3315	11.4649	6.7689
06/03/2023	6.0518	58.0320	18.5645	8.6465	0.0514	2.4058	16.0294	0.0643	0.1789	14.8328	4.6407
27/02/2023	8.7366	20.7051	8.0395	2.6526	0.0927	0.3734	1.9030	0.0391	0.0714	2.9871	0.7828
20/02/2023	20.5479	12.8599	2.7570	2.1814	0.0646	0.2051	10.7589	0.6893	0.2029	7.6184	
15/02/2023	0.9567	2.4909	0.2744	0.1755	0.3873	0.2506	0.1796	0.2567	0.0894	0.5124	
07/02/2023	3.0366	0.0515	0.9326	0.0267	0.0470	0.0292	1.3656	0.2331	0.0087	0.5655	
31/01/2023	0.0487	0.0029	0.0637	0.0068	0.0723	0.0620	0.9275	0.0231	0.1208	0.3829	
23/01/2023	0.0358	0.2493	0.0674	0.0220	0.1497	0.2463	0.8469	0.7972	0.1482	0.4150	
17/01/2023	1.2030	2.1621	1.2628	0.0291	0.3059	0.0404	1.5014	0.9855	0.1700	0.2757	
09/01/2023	0.6724	0.0051	0.1804	0.5303	0.2634	0.4047	0.0221	0.9546	0.3459	0.4871	
19/12/2022	2.4337	0.0236	0.0248	0.0017	1.7128	15.2861	3.5665	181.9379	0.1715	5.1491	
12/12/2022	0.3401	0.0052	0.0529	0.0004	0.0719	3.3055	0.1196	20.8317	0.7068	0.0862	
05/12/2022	0.0022	0.0065	0.0017	0.0453	0.0589	0.8593	0.0189	23.2660	0.0236	0.8949	
28/11/2022	0.3749	0.2705	0.0842	0.0481	0.2226	0.2964	0.0762	1.1009	0.3015	0.1026	
14/11/2022	0.0120	0.0002	0.0026	0.0004	0.0046	0.0068	0.1036	0.1991	0.1810	0.0104	
10/10/2022			0.0140				0.0460				
03/10/2022			0.0013				0.0143				
27/09/2022			1.5700				0.7531				
20/09/2022			6.2409				2.8363				
13/09/2022			5.3177				2.1565				
07/09/2022			2.6293				1.0480				
02/09/2022			9.2772				5.5493				
16/05/2022	0.0013	0.0085	0.0093	0.0029	0.5972	1.1436	0.5211	0.0011	1.8909	0.0350	
09/05/2022	0.3766	0.0101	0.0777	0.0045	0.5221	1.0567	0.0343	0.0037	1.2084	0.0500	
02/05/2022	0.0440	0.0400	0.0132	0.0674	1.3153	2.0938	1.0573	0.0479	2.2209	0.0331	
25/04/2022	0.0041	0.0084	0.0669	0.0159	1.8818	1.4131	1.6500	0.1005	0.0689	0.0498	
18/04/2022	0.0221	0.0011	0.0111	0.0033	1.1561	0.0384	0.9787	0.0789	0.9830	0.6905	
11/04/2022	0.0150	0.0065	0.0425	0.0750	0.7654	1.1184	0.8237	0.0073	0.0399	0.0472	
04/04/2022	0.0223	0.0084	0.0269	0.0206	0.6322	0.8197	0.0396	0.2516	0.1025	0.4802	
28/03/2022	0.0006	0.0002	0.0001	0.0002	0.6735	1.2163	0.0493	0.0170	6.7480	2.1788	
21/03/2022	0.0168	0.0073	0.0010	0.0108	0.0855	0.6291	0.7053	0.2199	3.0957	0.0717	
14/03/2022	0.0004	0.1491	0.1293	0.0093	0.6943	1.8598	0.0390	1.0126	1.9233	1.2345	
07/03/2022	6.3882	4.6760	1.7300	1.0493	0.7054	1.3134	0.6933	0.7184	5.1627	1.2902	
28/02/2022	0.8628	0.0316	1.8687	0.1056	1.1340	1.2847	1.7081	3.9787	2.9952	0.0719	
21/02/2022	0.1472	0.0090	0.0022	0.0045	1.1048	1.8293	1.1797	4.2503	1.3469	0.0868	
14/02/2022	0.0123	0.0016	0.0010	0.0017	2.2342	0.8251	0.0606	5.2307	3.0323	0.0394	
07/02/2022	0.0065	0.0182	0.0004	0.0049	1.5214	2.2252	0.4809	3.9688	2.8363	0.2749	
31/01/2022	0.0826	0.0005	0.0011	0.0005	0.9667	1.3137	1.2645	4.6496	1.3187	0.0344	
24/01/2022	0.0190	0.0185	0.0023	0.0004	0.9649	0.6836	0.6293	1.9332	0.9216	0.5855	
17/01/2022	0.0027	0.0008	0.0032	0.0032	1.8403	0.8396	0.5198	1.0873	0.6224	0.2898	
10/01/2022	0.3351	0.0006	0.0007	0.0005	0.4504	0.4705	0.1473	1.1685	1.2185	0.0152	
20/12/2021	0.0368	0.0547	0.0068	0.0008	0.6419	0.5208	0.2284	2.0818	0.7770	0.0177	
13/12/2021	0.0190	0.1212	0.0109	0.0003	0.3223	0.6762	0.8312	0.0671	0.3438	0.0934	
07/12/2021	0.0003	0.0004	0.0040	0.0070	0.1200	1.3356	0.0295	0.1632	0.0811	0.0027	
29/11/2021	0.0025	0.0007	0.0018	0.0008	0.0246	0.0097	0.1162	0.0098	0.0131	0.0017	
22/11/2021	0.1018	2.2453	1.3344	0.0245	0.1702	0.0123	0.0239	0.5540	0.0640	1.1027	
16/11/2021	0.4333	0.0135	1.8226	0.3590	0.0014	0.4836	0.0489	0.0106	0.0506	0.0378	
08/11/2021	0.3895	0.3858	0.0864	0.0246	0.0039	0.0103	0.0772	0.0007	0.0050	0.0434	
01/11/2021	0.1076	0.0024	0.0342	0.2781	0.0000	0.0897	0.0410	0.0000	0.0274	0.3801	

Table 3.2 continued

	LAKE ROTORUA				LAKE ROTOITI					KAITUNA	
	Holdens Bay	Ngongotaha	Ohau Channel	Hamurana	Otaramarae	Te Weta	Okere Arm	Okawa Bay	Hinehopu	Trout Pool	Waitangi (Te Matai)
11/10/2021	0.1721	0.0003	0.0061	0.0001	0.0035	0.0087	0.0065	0.0000	0.0132	0.0217	
13/09/2021	0.2064	0.0004	0.0111	0.0000	0.0001	0.0645	0.0122	0.0100	0.0080	0.1284	
09/08/2021	0.0002	0.0009	0.0149	0.0064	0.0111	0.0189	0.0024	0.1291	0.0266	0.0055	
12/07/2021	0.0000	0.0002	0.0325	0.0004	0.0331	0.0121	0.0083	0.0184	0.0113	0.0200	
28/06/2021	0.0058	0.0001	0.0074	0.0000	0.0604	0.0340	0.0026	0.0020	0.0536	0.0237	
14/06/2021	0.0007	0.0001	0.0007	0.0001	0.0333	0.0241	0.0022	0.0290	0.0604	0.0182	
24/05/2021	0.0014	0.0005	0.0034	0.0013	0.0055	0.0040	0.0102	0.0004	0.0248	0.0051	
17/05/2021	0.0098	0.0331	0.0252	0.0049	0.0170	0.0148	0.0077	0.0014	0.0130	0.0183	
10/05/2021	0.0268	0.0045	0.4037	0.0000	0.0377	0.0315	0.0181	0.0024	0.0069	0.2595	
04/05/2021	0.2508	0.0132	0.0364	0.0572	0.0080	0.0125	0.0117	0.0034	0.0146	0.0099	
26/04/2021	0.0029	0.0008	0.0080	0.0040	0.1884	0.0182	0.0037	0.0085	0.0247	0.0061	
19/04/2021	0.0007	0.0001	0.0012	0.0001	0.0001	0.0121	0.0078	0.0051	0.4970	0.0070	
12/04/2021	0.0032	0.0079	0.0044	0.0002	0.0378	0.0223	0.0029	0.1739	0.0675	0.0038	
05/04/2021	0.0006	0.0103	0.0009	0.0365	0.1043	0.0169	0.1175	0.0082	0.0268	0.0009	
30/03/2021	0.0221	0.0002	0.0014	0.0002	0.0057	0.1248	0.0011	0.0047	0.2078	0.0095	
22/03/2021	0.0012	0.0005	0.0015	0.0122	0.1648	0.1888	0.0031	0.0057	0.0456	0.0881	
15/03/2021	0.0025	0.0365	0.0007	0.0099	0.0040	0.1709	0.2652	0.0131	0.0228	0.0059	
08/03/2021	0.0329	0.0092	0.1361	0.0055	0.0213	0.1922	0.1275	0.0072	0.2099	0.1466	
01/03/2021	0.0049	0.0901	0.0021	0.0025	0.0886	0.3778	0.0053	0.0171	0.2690	0.0083	
22/02/2021	0.3082	0.0052	0.0024	0.0001	0.0826	0.2595	0.0135	0.1859	0.0181	0.0514	
16/02/2021	0.0101	0.0000	0.0009	0.0413	0.1417	0.0174	0.0895	0.0031	0.0107	0.0018	
08/02/2021	0.1424	0.0166	0.0070	0.1052	0.0143	0.2767	0.0275	0.0625	0.0127	0.0893	
01/02/2021	0.0106	0.0241	0.0185	0.0005	0.0266	0.2772	0.0370	0.0050	0.0092	0.0001	
25/01/2021	0.0003	0.0003	0.0041	0.0001	0.0004	0.1541	0.0817	0.0296	0.0018	0.0022	
18/01/2021	0.1526	0.0059	0.0102	0.1927	0.0036	0.0184	0.0041	0.0213	0.1109	0.0001	
11/01/2021	0.0167	0.0000	0.0379	0.0012	0.0153	1.4533	0.0089	0.0160	0.0741	0.0228	
04/01/2021	0.0077	0.0154	0.0001	0.0048	0.1194	0.0346	0.1547	0.0207	0.4611	0.0148	
21/12/2020	0.1299	0.0694	0.0134	0.0067	0.0191	0.0040	0.0416	0.0509	0.2001	0.0585	
14/12/2020	0.0011	0.0050	0.0035	0.0003	0.0178	0.0771	0.0151	0.3430	0.0202	0.0010	
07/12/2020	0.0007	0.0044	0.0187	0.0000	0.0128	0.0574	0.0059	0.0472	0.0037	0.0115	
30/11/2020	0.0178	0.0016	0.0528	0.0035	0.1834	0.0313	0.0307	0.0305	0.0567	0.0196	
23/11/2020	0.0217	0.0141	0.8910	0.0414	0.0133	0.0180	0.8949	0.0386	0.0163	1.2527	
12/11/2020	0.0205	0.0128	0.0386	0.0269	0.0817	0.0333	0.0488	0.0527	0.0201	0.0400	
22/10/2020	0.5595	0.0079	100.2603					0.1569			
17/08/2020			1.4303				0.1150				
18/06/2020	0.0054	0.0022	0.0008	0.0073	0.0415	0.3391	0.1326	0.0237	0.0298	0.0774	
10/06/2020	0.0046	0.0134	0.8317	0.0428	0.0409	0.0365	0.0978	0.0147	0.0105	0.0870	
03/06/2020	0.0018	0.0018	0.0421	0.0003	0.3258	0.0300	0.0277	0.1104	0.0425	0.3964	
25/05/2020	0.0985	0.0383	0.0592	0.0206	1.2288	0.1695	0.1039	0.0417	0.0358	0.0711	
18/05/2020	0.0008	0.0004	0.0003	0.0027	0.1365	0.1173	0.0470	0.1255	0.0135	0.0347	
12/05/2020	0.0936	0.0545	0.3476	0.1010	0.3019	0.4666	0.6966	0.0348	0.0058	1.3169	
05/05/2020	0.0186	0.0001	0.0416	0.0000	0.0101	0.2997	0.0966	0.0821	0.1096	0.0720	
28/04/2020	0.0090	0.0002	2.0526	0.0006	0.1513	0.0308	0.1989	0.1009	0.0412	0.1032	
20/04/2020	0.0784	0.0000	0.0272	0.0000	0.0326	0.3598	0.0105	1.1586	0.4359	0.0431	
09/04/2020	0.0511	0.0163	0.0421	0.0494	0.2994	0.0542	0.0676	0.9214	0.0439	0.0151	
02/04/2020	0.0160	0.0370	0.0129	0.1198	0.0175	0.0968	0.0228	0.3044	0.0282	0.0144	
26/03/2020	0.0207	0.0291	0.0475	0.1230	0.0046	0.0149	0.0292	1.0975	0.0165	0.0612	
19/03/2020	0.0270	0.0190	0.0220	0.0153	0.0507	0.0392	0.0637	0.6396	0.1215	0.0189	
09/03/2020	0.0670	0.0201	0.0935	0.0033	0.0149	0.2584	0.0132	0.1255	0.0179	0.0256	
27/02/2020	0.0141	0.0040	0.0037	0.0040	0.0160	0.0361	0.0041	0.0653	0.0128	0.0294	
19/02/2020	0.0106	0.0034	0.0468	0.0014	0.0024	0.2117	0.0262	1.0510	0.0106	0.0306	
11/02/2020	0.0021	0.0067	0.0019	0.0001	0.0006	0.1739	0.0112	0.0149	0.0089	0.0007	
29/01/2020	0.2819	0.3701	0.1579	0.0292	0.0190	0.0639	0.1759	0.0518	0.0095	0.0377	
15/01/2020	0.0111	0.0080	0.0070	0.0025	0.4387	1.1123	0.0864	0.0201	0.0238	0.0398	
07/01/2020	0.0005	0.0072	0.0154	0.0081	0.1161	0.1030	0.0320	0.2198	0.0294	0.0332	
10/12/2019	0.0070	0.1699	0.0019	0.0016	0.0347	0.0508	0.0121	0.3325	0.0204	0.0173	
26/11/2019	0.0100	0.0020	0.0090	0.0007	0.1159	0.0569	0.0146	0.0853	0.0008	0.0261	
20/11/2019	0.0010	0.0247	0.2877	0.0000	0.1050	0.0048	0.0018	0.1596	0.0031	0.1853	
12/11/2019	0.0190	0.0009	0.0005	0.0046	0.0118	0.0133	0.0048	0.0132	0.0014	0.0050	

Table 3.2 continued

	LAKE ROTORUA				LAKE ROTOITI					KAITUNA	
	Holdens Bay	Ngongotaha	Ohau Channel	Hamurana	Otaramarae	Te Weta	Okere Arm	Okawa Bay	Hinehopu	Trout Pool	Waitangi (Te Matai)
08/07/2019								0.0581			
21/06/2019								0.2368			
06/06/2019								1.9981			
23/05/2019	0.0033		0.0035	0.0017	0.0036	0.0002	0.0010	2.0755		0.0014	
16/05/2019		0.0000						0.2537	0.0045		
10/05/2019	0.0088	0.0000	0.0010	0.0002	0.0023	0.0003	0.0031	0.8552	0.0031	0.0065	
02/05/2019	0.0013	0.0000	0.0024	0.0010	0.0022	0.0002	0.0074	0.5375	0.0039		
26/04/2019	0.0010	0.0000	0.0013	0.0013	0.0002	0.0017	0.0003	0.1016	0.0009	0.0008	
18/04/2019	0.0017	0.0000	0.0020	0.0011	0.0006	0.0012	0.0008	0.2515	0.0013	0.0006	
11/04/2019	0.0000	0.0035	0.0014	0.0030	0.0075	0.0026	0.0075	0.2963	0.0029	0.0021	
04/04/2019	0.0018	0.0007	0.0007	0.0015	0.0007	0.0017	0.0007	0.0203	0.0033	0.0005	
29/03/2019	0.0014	0.0004	0.0046	0.0014	0.0008	0.0050	0.0014	0.1051	0.0098	0.0075	
21/03/2019	0.0023	0.0000	0.0020	0.0006	0.0149	0.0030	0.0024	0.0106	0.0066	0.0006	
15/03/2019	0.0018	0.0040	0.0013	0.0040	0.0019	0.0014	0.0019	0.0176		0.0017	
07/03/2019	0.0014	0.0024	0.0038	0.0026	0.0020	0.0013	0.0019	0.1774	0.0259	0.0008	
28/02/2019	0.0011	0.0019	0.0020	0.0000	0.0053	0.0058	0.0020	0.1666	0.0142	0.0012	
21/02/2019	0.0019	0.0015	0.0018	0.0038	0.0009	0.0022	0.0027	0.0112	0.0077	0.0022	
14/02/2019	0.0087	0.0006	0.0027	0.0102	0.0036	0.0026	0.0004	0.0234	0.0033	0.0007	
05/02/2019	0.0228	0.0176	0.0435	0.0005	0.0000	0.0028	0.0004	0.0045	0.0061	0.0053	
30/01/2019	0.0006	0.0016	0.0046	0.0001	0.0022	0.0100	0.0015	0.0021	0.0000	0.0014	
23/01/2019	0.0065	0.0014	0.0178	0.0005	0.0069	0.0028	0.0025	0.0037	0.0128	0.0046	
14/01/2019	0.0000	0.0010	0.0216	0.3455	0.0088	0.0567	0.0074	0.0009	0.1046	0.0011	
07/01/2019	0.0011	0.0000	0.0061	0.0000	0.0029	0.0352	0.0028	0.0239	0.0059	0.0037	
19/12/2018	0.0237	0.0052	0.0015	0.0006	0.0244	0.0276	0.0235	0.1216	0.0500	0.0060	
13/12/2018	0.0125	0.0000	0.0068	0.0006	0.0290	0.0355	0.0159	0.0269	0.0209	0.0103	
05/12/2018	0.0037	0.0019	0.0050	0.0000	0.0054	0.0056	0.0053	0.0265	0.0126	0.0040	
29/11/2018	0.0049	0.0008	0.0035	0.0010	0.0116	0.0022	0.0024	0.0139	0.0031	0.0029	
21/11/2018	0.0012	0.0078	0.0000	0.0003	0.0000	0.0049	0.0022	0.0122	0.0034	0.0052	
31/05/2018	0.0008		0.0010		0.1085	0.0008	0.0018	0.5806			
24/05/2018		0.0017	0.0048	0.0016				0.7031	0.3022		
18/05/2018	0.0042		0.0008		0.0050	0.0014		0.2640		0.0161	
10/05/2018		0.0018	0.0060	0.0009			0.0037	0.0013	0.0042		
04/05/2018	0.0041		0.0035		0.0027	0.0028		0.0801		0.0018	
26/04/2018		0.0011	0.0048	0.0001			0.0012	0.1462	0.0106		
20/04/2018	0.0067		0.0130		0.0151	0.0067		0.1881		0.0065	
13/04/2018		0.0261	0.0038	0.0170			0.0045	0.0265	0.0145		
05/04/2018	0.0012		0.0074		0.0045	0.0174		0.0163		0.0187	
29/03/2018	0.0144	0.0023	0.1646	0.0067	0.0069	0.0084	0.0232	0.0089	0.0284	0.0128	
22/03/2018	0.0204	0.0033	0.0011	0.0000	0.0133	0.4166	0.0128	0.9474	0.0371	0.0819	
16/03/2018	0.0001	0.0000	0.0060	0.0004	0.0245	0.1543	0.0270	0.5076	0.1406	0.0090	
08/03/2018	0.0115	0.0017	0.0003	0.0000	0.0082	0.2407	0.0077	0.5749	0.0154	0.0035	
01/03/2018	0.0003	0.0070	0.0002	0.0002	0.0094	0.3279	0.0042	0.6299	0.0084	0.0045	
22/02/2018	0.0643	0.0008	0.0013	0.0025	0.0081	0.0128	0.0100	0.2022	0.0312	0.0011	
15/02/2018	0.0000	0.0032	0.0000	0.0059	0.0027	0.0126	0.0045	0.2518	0.0048	0.0036	
09/02/2018	0.0010	0.0020	0.0005	0.1367	0.0046	0.0260	0.0017	0.4302	0.0007	0.0052	
25/01/2018	0.0014	0.0032	0.0008	0.0038	0.0030	0.0105	0.0002	0.3256	0.0015	0.0026	
18/01/2018	0.0042	0.0083	0.0044	0.0000	0.0000	0.0051	0.0029	0.0136	0.0008	0.0110	
11/01/2018	0.0012	0.0000	0.0037	0.0010	0.0000	0.0067	0.0047	0.5905	0.0002	0.0036	
07/01/2018	0.0163	0.0015	0.0000	0.0006	0.0006	0.0027	0.0000	0.1188	0.0000	0.0000	
28/12/2017	0.3546	0.0008	0.0035	0.0576	0.0231	0.0175	0.0189	0.0590	0.0105	0.0131	
21/12/2017	0.0081	0.0026	0.0057	0.0890	0.0174	0.0175	0.0106	0.0143	0.0333	0.0004	
15/12/2017	0.0009	0.0000	0.0000	0.0095	0.0196	0.0187	0.0073	0.0099	0.0174	0.0105	
08/12/2017	0.0181	0.0036	0.0036	0.0045		0.0224	0.0033	0.0332	0.0000	0.0075	
01/12/2017	0.2842	0.0401	0.0482	0.0025		0.0417	0.0376	0.1294	0.0056	0.0273	
23/11/2017	0.3800								0.0741		
15/05/2017		0.0000	0.0042				0.0046	0.0031	0.0000	0.0020	
08/05/2017	0.0000		0.0091	0.0000	0.0017	0.0022	0.0000	0.0078		0.0000	
01/05/2017		0.0000	0.0065				0.0018	0.0000	0.0078	0.0080	
24/04/2017	0.0113		0.0076	0.0019	0.0000	0.0051	0.0069	0.0165		0.0194	
18/04/2017		0.0083	0.0104				0.0026	0.0499	0.0002	0.0024	
10/04/2017	0.0000	0.5231	0.0345	0.2278	0.0019	0.0000	0.1685	0.6407		0.0376	
02/04/2017			0.2092				0.0201	0.3359	0.2515	0.0207	
27/03/2017	0.0081	0.0000	0.0075	0.0000	0.0083	0.2279	0.0082	0.3372		0.0036	
20/03/2017			0.0128				0.0015	0.1260	0.0105	0.0033	
14/03/2017	0.0000	0.0000	0.0019	0.0000	0.1298	0.1660	0.0096	1.1793		0.0204	
06/03/2017			0.0000				0.0036	4.1403	0.0025	0.0006	
26/02/2017	0.0013	0.0114	0.0000	0.0000	0.0006	0.3912	0.4765	5.0615		0.0026	
19/02/2017		6.3574	0.1906				0.0013	1.6478	0.0000	0.0002	
12/02/2017	0.0484		0.0222	0.0270	0.0145	0.0961	0.0027	0.5045		0.0017	
06/02/2017		0.0687	2.3756	2.4409	0.6757	1.3111	0.1501	0.8115	0.0084	0.1266	
30/01/2017	0.0028		0.0001				0.0028	0.4447		0.0667	
23/01/2017	0.8743	0.0113	0.0091	0.0722	0.1997	0.1415	0.0567	0.3000	0.0412	0.0733	
16/01/2017			0.3981				0.3041	0.1633		0.3766	
09/01/2017	0.2663	0.0540	0.0952	0.0515	0.0426	0.1232	0.4285	0.1670	0.0303	0.2897	
19/12/2016	0.0922		0.0372				0.1163	0.0062		0.1106	
12/12/2016	0.6936	0.0022	0.3966	0.0410	0.0322	0.0340	0.0811	0.2565	0.2155	0.0756	
28/11/2016	0.4965	0.0405	0.0418	0.0335	0.0352	0.0584	0.0623	0.6143		0.3010	
22/11/2016	0.0333	0.0321	0.0438	0.0083		0.3065	0.0751	0.3048	0.0778	0.1311	

4 Suspended Sediment Monitoring

Monthly suspended solid monitoring is to be undertaken at Ōhau Channel, Okere Arm at the end of the diversion wall, Okere Arm at the Okere Gates, Kaituna River at Te Tumu, and Maketū Estuary. This work is for Condition 6.3 of the consent.

Sampling has not been undertaken at Okere Arm at the end of the diversion wall. This site was an additional site to the original consent, presumably to indicate any potential erosion or resuspension of sediment that might occur in the Ōhau Channel itself. Further investigation into sampling at this site will be undertaken.

4.1 Total Suspended Solids results

As can be seen in the graphs below in figure 4.1, total suspended solid (TSS) concentrations at Okere Arm (Rotoiti Outlet) have remained steady over the reporting period and show little variation. Ōhau Channel shows slightly higher concentrations than the outlet. It was noted by Hamill (2018) that for the lake area sites, phytoplankton blooms are the major cause of TSS in the lakes, while for the Kaituna River, concentrations at Te Tumu are affected by rain events causing elevated suspended solids, particularly during winter. Contrastingly, fluctuations in suspended concentrations (note that TSS graph scale is double the other three sites) at Maketū Estuary reflects the tidal environment where potential resuspension of sediment occurs from wind and wave action.

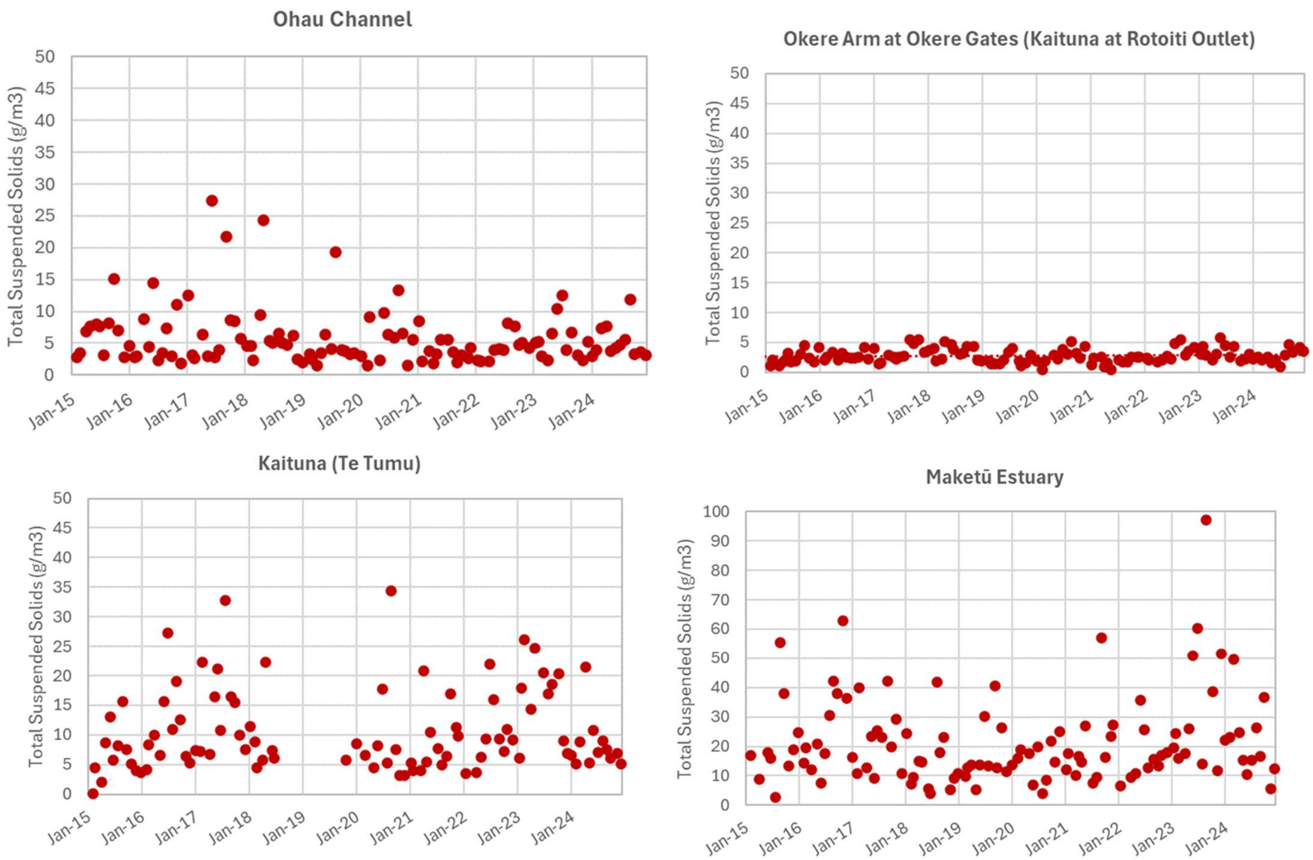

Figure 4.1: Total Suspended Solids in Ōhau Channel, Okere Arm (at Okere Gates), Kaituna River at Te Tumu, and Maketū Estuary.

5 Conclusion

An increase in total biovolume (mm^3/L) of cyanobacteria bacteria within both lakes is apparent since the 2022/2023 monitoring season. Prior to that, in the 2021/2022 monitoring season, Lake Rotoiti showed a significant increase in amber alerts for most of the season, while Lake Rotorua suffered only a handful of amber alerts in comparison. This indicates that the elevated concentrations may have originated within Lake Rotoiti. In the 2022/2023 monitoring season, from February 2023 to April 2023, it appears that the Ōhau diversion wall prevented the red alerts from reaching the main body of the lake, with the same red alerts passing through Okere Arm, and on to Trout Pools and down the Kaituna River. This pattern can also be seen in the 2023/2024 monitoring season. Overall, although over this reporting period it appears Okawa Bay and Te Weta Bay have periodically elevated levels of blue-green Algae independent of the main body of Lake Rotoiti, the Ōhau diversion wall appears to be preventing elevated levels in the main body of Lake Rotoiti.

The Ohau Diversion Wall 7-year review undertaken in March 2024 as part of Condition 10.1 of the consent presents an evaluation of the impact of the Ōhau Channel Diversion Wall on the water quality of Lake Rotoiti, including its fisheries. The report aimed to assess the effectiveness of the wall in improving water quality in Lake Rotoiti and its influence on achieving water quality targets, including its impact on the water quality of the Kaituna River. The report also looks at the potential consequences of removing the diversion wall. While improvements in Lake Rotorua have occurred as a result of interventions such as alum dosing and wastewater reticulation, the question is, would removing the wall cause a decline in Lake Rotoiti's water quality. The report suggests that there is evidence that the diversion wall has led to enhanced water quality in Lake Rotoiti independent of water quality improvement in Lake Rotorua and that a stepped change in improved water quality occurred when the wall was constructed 2008. However, the report notes that there is no evidence showing that the water quality in Lake Rotoiti is still improving. Evidence of this is perhaps shown in this annual (2018-2024) monitoring report for Lake Rotoiti phosphorus and nitrogen concentrations and increased incidences of blue-green algae amber and red alerts over recent years in this reporting period.

Also noted in the 7-year review report is that there appears to be no evidence to suggest that the diversion wall has had an impact on the water quality in the Kaituna River.

Previous annual water quality monitoring reports (McIntosh 2015, 2016) note that the diversion wall has not resulted in adverse effects on Lake Rotoiti or Kaituna River water quality.

The next Ōhau Diversion Wall monitoring report is due in June 2026 and will include monitoring results from the 2025 calendar year.

6 References

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7 Appendices

Appendix A

Lake Rotorua, Lake Rotoiti, Ōhau Channel, Okere Arm sample sites

Kaituna River and Maketū Estuary sample sites