MEMORANDUM

Bay of Plenty REGIONAL COUNCIL

To: Rotorua Te Arawa Lakes Work-streams Leaders Group

From: Andy Bruere **Date:** 24 January 2013

Lakes Operations Manager

File Ref: 2.00034

Subject: **Actions in the proposed Lake Ōkataina Action Plan**

1 Purpose

This memo provides information to the Te Arawa Lakes work-stream leaders for discussion and endorsement on the proposed actions in the Lake Ōkataina Action Plan.

2 Recommendations

That the Rotorua Te Arawa Lakes work-stream leaders:

1. Receive this memo, *"Actions in the draft Lake Ōkataina Action Plan".*

2. Agree and confirm respective budget could be budgeted within their delegated authority. Respectively:

Land use change incentive	– Managers Land Resources (Rotorua)
Research and information distribution	– Lakes Operations Manager
Overall budget allocation	– Rotorua Lakes Business Manager
General policy direction	– Programme leader – Water Policy.

3. Endorse the proposed Lake Ōkataina Action Plan and recommend the proposed actions to the respective funding agencies.

3 Proposed actions

3.1 Proposed action 1: Provide targeted support for 17.2 ha of pasture to forest conversion in the Lake Ōkataina catchment

This action is a targeted one-off support for 17.2 ha land use change for reducing 189 kg of nitrogen input (estimate) of to Lake Ōkataina catchment. We propose:

Action lead: Lakes Programme Team, Bay of Plenty Regional Council.

Budget: An estimate $45,000 from existing programme budget (within programme variations), no additional budget is required.

Timeframe: Within 1-5 years (2013 – 2018), estimated completion date June 2018.

Communications lead by: Land Resources Manager.

We expect this action will covert 17.2 ha of farmland to either forestry or native bush. Location selection is upon negotiation between the landowners and Land Resource Manager of an area/s suitable for keeping nutrients on land.

The land use change targeted approach is consistent with and implements Policy 21, Policy 22, Policy 31, Policy 32 and particularly Policy 33 and Method 43 of the Bay of Plenty Regional Water and Land Plan (see Appendix 1).

3.2 Proposed action 2: Investigate the role of the bush and forestry catchment in contributing to the phosphorus load reaching Lake Ōkataina

This action covers three areas of research specifically for Lake Ōkataina. This research action is to help us to better understand the phosphorus input from bush and forestry area in this catchment. The three areas of investigation covers:

1. Define and compare the phosphorus run-off characteristics of the Lake Ōkataina catchment

2. Examine and quantify the phosphorus run-off from pest-damaged and undamaged native bush within the catchment

3. Identify and quantify the phosphorus run-of impacted by the harvest cycle of the commercial forest areas in the catchment.

We propose:

Action lead: Chair in Lakes Management and Restoration, University of Waikato

Budget: An estimate of $25,000 over three-year period from existing Bay of Plenty Regional Council budget. Alternatively, possible funding could be achieved through contestable research fund.

Timeframe: Within 5 years, completion date: November 2018.

Communications lead by: Lakes Operation Manager.

We expect this action will provide scientific proof of whether restoring the native bush in the Ōkataina catchment could help us reaching the phosphorus reduction target. We also expect the outcomes of this action to be developed into a lake model for Lake Ōkataina. The model could simulate possible changes in water quality caused by various factors in the catchment.

The research option is consistent with the approach of Method 68 and Method 72 of the Bay of Plenty Regional Water and Land Plan (see Appendix 1).

3.3 Proposed action 3: Consider opportunities on case by case basis and methods to further support 200 ha land use change in the Lake Ōkataina catchment

This action aims to further reduce phosphorus in the Lake Ōkataina catchment by providing conditional assistance to keen landowners for changing their land use. We propose:

Action lead: Lakes Programme Team, Bay of Plenty Regional Council.

Budget: An estimate of $550k investment to be allocated in the next 10 year plan process, and the proposals will be assessed by Land Resource Manager on case-by-case basis. Detail of the method is yet to be investigated.

Timeframe: Within 3 - 10 years (2015 – 2023), depending on landowner uptake.

Communications lead by: Land Resources Manager.

The reach of this action is depending on the landowners and Council uptake. For the areas in the catchment that is suitable for pasture to forestry conversion, it is possible this option could achieve 30% of the phosphorus reduction target given the current landowner interests.

The land use change responsive approach is consistent with and implements Policy 21, Policy 22, Policy 31, Policy 32 and particularly Policy 33 and Method 43 of the Bay of Plenty Regional Water and Land Plan (see Appendix 1).

3.4 Proposed action 4: Update community on Lake Ōkataina's water quality trends, including Lake Ōkataina Scenic Reserve Board and Ngāti Tarāwhai Iwi Trust

This action aims to inform Lake Ōkataina respective iwi authority the access of new lake water quality related information. This action can be carried out by all agencies working on the Lake Programme by providing a copy of relevant reports or publications (as they become available) to the Lake Ōkataina Scenic Reserve Board and Ngāti Tarāwhai Iwi Trust.

Action lead: University of Waikato, Bay of Plenty Regional Council, Te Arawa Lakes Trust, Rotorua District Council

Budget: Programmed staff-time, no additional budget is required

Timeframe: On-going

Communications lead: Lakes Operation Manager.

We expect this action will ensure the Lake Ōkataina Scenic Reserve Board and Ngāti Tarāwhai Iwi Trust to be informed about research reports related to the water quality of Lake Ōkataina.

The information provision option is consistent with Policy 25, Policy 26 and Method 28 of the Bay of Plenty Regional Water and Land Plan (see Appendix 1).

3.5 Regulatory interventions

The review of regulatory interventions for all Rotorua Te Arawa lake catchments will be looked into in a separate working programme, as noted in the *stocktake of actions* (Section 6.2) of the background information document.

4 Response to public feedback

Two of the proposed actions (proposed action 2 and 4) were proposed in the publicly consulted draft Lake Ōkataina Action Plan. A total of five written submissions received, one supported one of the proposed actions (action 2) and no one opposed the proposed actions.

Overall, submitters agreed that Lake Ōkataina is highly valued and its situation is unique. Most agree there is a need to reduce the targeted amount of nutrients going into Lake Ōkataina, while one asked about the influence of natural water quality fluctuation.

The public feedback also identified priorities for maintaining or improving water quality including:

- Tight control on Hornwort in Lake Ōkataina
- Including a timeframe of the research on native bush leaching, and control (herbivore pest) actions if the research shows that will reduce phosphorus leaching into Lake Ōkataina
- Strong iwi ownership is supported
- Encourage land use change as it is currently the only approved way to reduce nutrient into Lake Ōkataina.

Given the priority identified by feedback received, we now propose two additional actions (action 1 and 3) to be incorporated into the Lake Ōkataina Action Plan.

Detailed response to each comment point is attached as Appendix 2.

4.1 Background

Lake Ōkataina has good water quality but is not meeting the agreed target because the nutrient levels in the lake are too high.

The draft Lake Ōkataina Action Plan estimates that we need to reduce 860 kg of nitrogen and 380 kg of phosphorus going into the lake per year to meet its target trophic level.

The draft also sought public feedback in October and November 2012 to help us identify priorities and new ideas.

Two of five feedback received suggested achieving the nutrient reduction target through changing some pasture land to a different use which exports less nutrients.

We estimate the nitrogen target can be achieved by further converting 17.2 ha dry stock farming to forestry land use (see proposed action 1).

However, the phosphorus target is more difficult to achieve. If all the farming land use within the catchment was converted to forestry, then there would still be a shortfall in the phosphorus reduction target of about 50kg/yr. It is unlikely that all the farming land use will be converted to forestry.

There are few other opportunities to reduce phosphorus in the catchment. Consequently we believe it is necessary to investigate the role of the bush and forestry catchment in contributing to the phosphorus load reaching the lake (see proposed action 2), while encouraging sustainable land use change (see proposed action 3) and informing interested iwi representatives of the status of the lake (see proposed action 4).

Appendix 1

Relevant Policies and Methods in the Operative Bay of Plenty Regional Water and Land Plan.

Policy 21 To manage land and water resources in the Bay of Plenty within an integrated catchment management framework to:

(a) Maintain or enhance water quality in individual lakes to meet their Trophic Level Index ('TLI') and Water Quality Classification.

(b) Require the management of nitrogen or phosphorus in individual Rotorua lake catchments.

(c) Reduce cyanobacterial algal blooms on the Rotorua Lakes by managing nutrient inputs in the lake catchment.

(d) Maintain or improve water quality in streams and rivers to meet their Water Quality Classification.

(e) Have full regard to the water quality classifications for coastal waters (including harbours and estuaries), and policies relevant to the coastal environment in the Bay of Plenty Regional Coastal Environment Plan.

(f) Recognise and provide for heritage values in resource management decisions.

(g) Maintain existing high quality groundwater, where the following have been identified:

  (i) Potable water, including aquifers used for municipal water supply.

  (ii) Natural water quality that has not been adversely affected by land use or point source discharges.

  (iii) Recharge areas of aquifers related to areas specified in (i) and (ii). and

  (iv) In the groundwater catchments of the Rotorua lakes, Ohiwa and Tauranga harbours.

(h) Avoid, remedy or mitigate adverse effects on groundwater quality in other areas not otherwise addressed by (g).

(i) Ensure the levels of bacteria in those rivers and streams that have been identified as important swimming sites and in lakes in Schedule 10 meet the Ministry of Health/Ministry for the Environment Recreational Water Quality Guidelines (1999) as a minimum.

(j) Understand the effects of changing land cover and land use practices on water flows and levels in rivers, streams, lakes.

(k) Promote and encourage the adoption of sustainable land management practices that are appropriate to the environmental characteristics and limitations of the site to:

(i) Protect the soil and avoid, remedy or mitigate the adverse effects of erosion.

  (ii) Maintain the health of the region's soil resources for future generations.

  (iii) Achieve the appropriate management of riparian areas, including the retirement and planting of riparian areas of streams, rivers, lakes, wetlands and estuaries.

  (iv) Avoid, remedy or mitigate adverse effects on water quality in the receiving environment.

  (v) Take into account the assimilative capacity of the soil.

  (vi) Recognise and provide for heritage values of the site.

  (vii) Maintain or improve the protective function of coastal sand dunes.

  (viii) Control sediment entering estuaries and harbours from use and development activities.

(l) Manage land and water resources according to realistic management goals that are appropriate to the existing environmental quality and heritage values (including ecosystem values) of the location.

Policy 22 To research and monitor the effects of land use practices on surface and groundwater quality, and take appropriate action within the framework of this regional plan (including future plan changes) where such investigations indicate land use has significant adverse effects on water quality, or there is a high risk that future development would adversely affect water quality. This is particularly relevant to lakes, and groundwater used for municipal water supply.

Policy 25 To encourage and provide for community involvement in the management of water, and land resources.

Policy 26 To continue to raise community awareness about water quality and integrated management issues.

Policy 31 To promote the adoption of the stewardship of soil and water resources, ecosystems, and cultural, amenity, natural character and landscape values.

Policy 32 To allow resource use and development where there are beneficial effects on the social, cultural and economic wellbeing of people and communities; and adverse effects on the environment are avoided, remedied or mitigated.

Policy 33 To promote and support land use change and/or land management practices in the catchments of the Rotorua Lakes that will achieve lake water quality improvement.

Cross-Reference Also refer to policies in sections 15.3.1, 16.3.1 and 16.3.2 of the Bay of Plenty Regional Policy Statement in relation to heritage values.

Method 28 Provide information to the community on:

(a) The natural influences on water quality, including geothermal inputs, and the subsequent limitations on the use of that water.
(b) The water quality of rivers and lakes where this information is available.

Method 43 Support land use changes, and changes to land use rules, that:

(a) Achieve lake management objectives identified in lake Action Plans developed in accordance with Method 41.
(b) Integrate land use planning and rules in Environment Bay of Plenty's resource management plans and Rotorua District Council's District Plan for lake catchments.
(c) Recognise that land use change and land management practices are an important part of lake management.
(d) Actively promote and support low nutrient loss land uses and land management practices in the catchments of the Rotorua Lakes.

Method 68 Continue to investigate and clarify the nutrient exports of different land uses, and best nutrient management practices.

Method 72 Undertake research where monitoring indicates an environmental problem that is not currently understood or explained, and research is necessary, appropriate and practicable. Research may be in conjunction with the city council, district councils, other resource management agencies, tangata whenua, industry organisations and other organisations as appropriate.

Appendix 2

Detailed responses (proposed) to comment points.

Comments are kindly provided by:

- Rotorua Lakes Community Board (RLCB)
- David Hamilton of Waikato University (DH)
- Bruce Parks (BP)
- Terry Beckett (TB)
- Lake Ōkataina Scenic Reserve Board (LŌSRB)
- Lakes Water Quality Society (LWQS).

RLCB comment point 1: Lake Ōkataina is somewhat of a special case – support.
Response: Noted.

LWQS comment point 1: Lake Ōkataina is a special lake and deserves an Action Plan that will deliver the required improvements to lake water quality.
Response: Noted.

RLCB comment point 3: Pasture land should be included as a cause of water quality decline.
Response: As noted in the background document, we have limited information supporting that any change to the pasture land area since 1994 that has caused water quality decline in Lake Ōkataina.

RLCB comment point 4: Agreed with the nutrients reduction target (860kgN/year and 380kgP/year) for Lake Ōkataina.
Response: Noted.

RLCB comment points 9 and 10: The nutrient loss from indigenous forest in Lake Ōkataina is similar to native forest in other North Island catchments.
Response: Noted.

RLCB comment point 11: Considers that no significant nutrient reduction can be yielded from native forest.
Response: Noted.

RLCB comment point 14: Agreed with evidence based adaptive approach.
Response: Noted.

DH comment point 4: Mention is made of "how much algae the lake has". This would be better termed as the concentration of algae in the lake.
Response: (Section 1.1) Change from"*how much algae the lake has"* to *"how concentrated algae biomass in the lake".*

DH comment point 1: In general I found the presentation of some figures to be poor and to detract from the quality of the text. The cover photo was very dark (lighten?) and Figures 2 and 6 looks like they are poor-resolution scans.
Response: (Section 1.2 & 1.6) Make sure that final version of the Action Plan includes good quality pictures. The water quality trend graph will be replaced with an updated and high resolution version.

DH comment point 2: The following statement had potential to be ambiguous as it was not clear whether it referred to the whole catchment (which I am aware it does) or specifically to the non-Iwi land: "Outside this reserve area, about 10 percent of the catchment is pasture, eight percent is in exotic forest and the remainder is wetland, buildings and bare ground."
Response: Change *"outside this reserve area" to "other than the reserve area" to provide clarification.*

DH comment point 3: Instances of spelling of phosphorous should be changed to be phosphorus.
Response: Change spelling from *"phosphorous" to "phosphorus".*

DH comment point 5: "Local iwi playing a main role in looking after the lake and land" could be changed to: Local iwi playing a primary role in looking after the lake and land.
Response: (Section 1.3) Checking with Ngāti Tarāwhai Iwi Trust representatives and the Lake Ōkataina Scenic Reserve Board about change *"main role"* to *"primary role".*

DH comment point 6: I found the following statement: "The hornwort infestation discovered in the lake several years ago continues to be managed" to be a little vague and I consider that the Action Plan plays down the potential effect of the hornwort infestation. Carbon generated from this macrophyte and other invasive species (e.g., *Lagarosiphon*) could contribute significantly to the oxygen depletion in bottom waters and may be playing a role in the deterioration of water quality evidenced from the TLI.
Response: (Section 1.4) Adding text to clarify how the Hornwort has been managed in the catchment. Recommending the text reads *"The hornwort infestation discovered in the lake several years ago has been controlled. To date the control programme has had good results. The Regional Council undertook a three year programme (2010 – 2012) aiming to eradicate Hornwort from Lake Ōkataina. The hornwort program in Lake Ōkataina involves monitoring and weed control over at least the next five years".*

DH comment point 7: I think that the statement: "There have not been any obvious changes in the catchment which would have led to higher nutrient levels." Is a little presumptuous. We actually have very little information about the catchment and there currently appears to be very high levels of exotic herbivorous grazers that may be playing a role – perhaps an increasing role – in denudation of the forest understory, potentially having an impact on water quality.
Response: (Section 1.5) Delete sentence.

DH comment point 8: I am not sure how to suggest a rectification to a problem in Table 1 where stormwater is assigned an area of 0% and yet contributes 0.3% of the nitrogen. It may be necessary to include more numbers after the decimal point.
Response: (Section 1.5 Box 1) Change to "*0%"* to *"<0.1%*".

RLCB comment point 2: Summarised draft Action Plan as four factors causing the drop in water quality.
Response: (Section 1.5) Amend the text to provide more clarity and clear misunderstanding *Page 7 – Add new paragraph "The combination of these factors leaves us uncertain about what has caused the water quality to drop."*

RLCB comment points 6 and 7: The current format – not including nutrient budget and export efficiency of nutrient, is not supported.
Response: (Section 1.5, linking to new Appendix) Append the nutrient budget report to be appended to the supporting Lake Ōkataina Water Quality Background document. Add land use map and estimated nutrient sources as an appendix to Box 1, 1.5

DH comment point 9: E. coli should be in italics. Also for Esherischia coli in the footnote.
Response: (Section 1.6 and footnote) Change spelling "E. coli" to "*E. coli*" (in italic) and "Esherischia coli" to "*Escherichia coli"*.

DH comment point 10: As per comment 7, I think it is presumptuous to say that "If no action was taken, it is likely that Lake Ōkataina's water quality would remain steady (because of little change is expected in the catchment). As has been seen over the past seven years, the nutrient levels would vary with the amount of rainfall and the lake level." No evidence is presented to support the latter statement. Also, if no action meant not controlling invasive weed infestations (primarily hornwort) then I believe that there is a significant risk to lake water quality. I don't think that any lake in the Rotorua catchment can continue to be "unmanaged" without a significant risk (either from invasive species, pests in the Lake Catchment or changes in land use intensity).

Response: (Section 1.7) Amend the sentence *"If current actions continue and the environment (for example, the climate or the land use) stays the same, Lake Ōkataina's water quality may remain steady. Current actions are listed as "ongoing" actions in Table 1 and 2."*

DH comment point 11: "Once oxygen levels drop to a certain point, nutrients would start to be released from the bottom of the lake" could be changed to: Once oxygen levels drop to a certain point, nutrients would increasingly be released from the bottom of the lake.

Response: (Section 1.7) Amend the sentence to provide scientific accuracy *"Once oxygen levels drop to a certain point, nutrients would increasingly be released from the bottom of the lake.*

RLCB comment point 12: Considers Addressing nutrient loss from pastoral land remains the only viable way to attain the nutrient reduction target for Lake Ōkataina.

Response: (Section 1.9, Table 1) Priority noted.

RLCB comment point 15: Asks Council to take action to reduce nutrients from pastoral land for achieving the water quality target in Lake Ōkataina.

Response: (Section 1.9, Table 1) Request for action noted. Consulting on a new action supports managing and changing land use for meeting the Lake Ōkataina nitrogen reduction target in the near-term in principle.

DH comment point 12: The following statement was not clear: "However, this can only happen with the support of favourable market conditions."

Response: (Section 1.9, Table 1) Change the sentence *"However, this would ~~can~~ only happen if the landowners see a financial benefit in doing so. ~~With the support of favourable market conditions.~~"*

RLCB comment point 13: Disturbed that only action on pastoral land is a voluntary change and limited to favourable market condition.

Response: (Section 1.9, Table 1) Priority noted. Amend text to provide clarification: *Page 11 - "We are reasonably confident of ~~achieving~~ that the nitrogen target could be achieved by voluntary land use change from agriculture to forestry. However, this would ~~can~~ only happen if the landowners see a financial benefit in doing so. ~~With the support of favourable market conditions.~~"*
Page 12 – "Led by: Landowners, if they see a financial benefit in doing so."

DH comment point 13: The following could be re-worded for clarity: "A recent voluntary change has estimated to meet 78 % (671 kg per year) of the nitrogen, and nearly 10 % (37 kg per year) of the phosphorus reduction target."

Response: (Section 1.9, Table 1) *Amend the sentence "A recent voluntary land use change is estimated to have achieved 78% (671 kg out of 860 kg per year) of the nitrogen reduction target, and nearly 10% (37 kg out of 380 kg per year) of the phosphorus reduction target. Further changes could remove 2,009 kg of nitrogen and 11 kg of phosphorus per year."*

LWQS comment point 2: The Draft Action Plan Table 1 identifies phosphorus levels being leached into the lake at 0.28kg/ha. This is high in comparison to phosphorus leaching in the Lake Rotorua catchment of 0.1kg/ha. We understand that this is likely to be the result of

the steep sided nature of the catchment and the high numbers of pests destroying the under-story of the bush. The plan calls for further investigation to be undertaken by the Waikato University but provides no time frames in which this is to be achieved. We urge Council to have this work done quickly.

Response: (Section 1.9, Table 1) Priority noted. Including timeframe as indicated in the Work-streams leaders' memo.

RLCB comment point 5: The Council suggested control animal pest would lead to significant nutrient reduction.

Response: (Section 1.9, page 11) Amend the text to provide more clarity and clear understanding *"This would provide us new evidence about ~~This involves considering~~ whether animal pest control will significantly reduce the nutrient input."*

RLCB comment point 8: Concerns about the funding and new evidence will result any action to investigate how the water quality is affected by the state of native bush.

Response: Seeking clarification from submitter about what the concern is and what results the submitter would like to see.

LWQS comment point 3: Assuming this [research] work confirms the lake phosphorus levels are being dramatically increased because of the destruction of the under-story then the action point is needed to provide pest control as soon as practicable and with an agreed time line. There is no doubt in our minds that the significant population of wallabies in the catchment is a principal cause of soil erosion.

Response: (Section 1.9, page 11) Priority noted, as described in draft Action Plan *"As new evidence becomes available, we will take an adaptive approach – that is to act (and consult) on the most effective, efficient and appropriate options available for improving water quality in Lake Ōkataina."*

BP comment point: Jetty and boat ramp need mending.

Response: This feedback was forward to Robert Atkinson (Rotorua District Council Parks Asset and Planning Manager responded) for response: *"The issues that the high lake levels are causing are wide and varied and not just restricted to boat ramps and jetties. It is affecting lake side BBQ's, lighting, car parking and public toilets. In terms of boat ramps and jetties Council has made the decision that it will try and get one boat launching site operational in each of the affected lakes. As you can imagine there are quite a few of them and we have had to prioritise these works.*

The jetty at Lake Ōkataina is on the list of those that need to be attended to but Council is currently completing works at other locations. If you like I can keep you informed as to when the work will start on the jetty at Lake Ōkataina but cannot give you a definite date."

LWQS comment point 4: Another concern is at the southern end of the lake where there is significant reversion associated with the land use on the Ōkataina 10 Trust land. There is no action in the plan to control the gorse in the catchment. With gorse leaching levels comparable to dairy farming remedial land management actions needs to be taken.

Response: Concern noted. Research on gorse management options has being carried out as explained in the Section 3.9 (page 28) of background information document. The Council adopt an adaptive approach when new evidence becomes available, as outlined in Section 1.9 (page 11) of the draft Action Plan.

TB comment point: The monitoring does not reflect the natural fluctuations (submission from Terry Beckett)

Response: Scientific enquiry – no response yet.

LŌSRB enquiry point 1: Motorboat impact on lake water quality (enquiry from Lake Ōkataina Scenic Reserve Board)

Response: With regards to impacts of motorboats on lakes, an excellent reference is from a NIWA review for the West Coast regional Council, 2007: entitled "Potential impacts of emissions from outboard motors on the aquatic environment: a literature review". The review concludes that normal levels of motorised recreational boating activity do not have a significant impact on water quality which respect to toxicity.
The Waikato University has recently test out if motorboats had negative impacts on Lake Tikitapu (through water disturbance) has recently been tested in Lake Tikitapu. "Velocity metres" were deployed in the bottom of the Lake during the height of the water ski season to assess the impact motorboats may have on the sediments of the lake. No disturbance was registered from motorboat activity.

LŌSRB enquiry point 2: Monitoring on lake water colour

Response: The Regional Council measures the lake water clarity as a part of its Trophic Level Index value assessment. Clarity is measured using a Secchi disc (SD) attached to a tape measure. The depth at which the disc disappears from sight is recorded by the tape measure (in meters). That record is in page 19 of the Rotorua Lakes report (http://www.boprc.govt.nz/media/140219/environmentalpublication2011_17201011rotorualakestliupdate_final.pdf, see "SD (m)" the deeper it reaches the clearer the water). Water colour, however, is not measured.

Lake Okataina

1992 to 2011 Site 1 (1 Jul 1992 - 30 Jun 2011)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	(0.01)	(0.03)	0.19	(-0.70)	(-0.32)			
Average Over Period	(2.25)	(10.32)	9.43	(128.40)	(28.45)			
Percent Annual Change (%/Year)	**0.00**	**0.00**	**2.25**	**0.00**	**0.00**	**0.45**	**0.45**	**0.37**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TLI av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1992 - Jun 1993	1.92	11.10	9.92	139.44	2.94	2.47	3.13	2.84	2.85	0.14			
Jul 1993 - Jun 1994	1.56	9.57	5.58	117.91	2.71	2.70	2.39	2.63	2.61	0.07			
Jul 1994 - Jun 1995	1.23	11.37	6.00	124.00	2.44	2.44	2.49	2.69	2.52	0.06			
Jul 1995 - Jun 1996	1.71	10.44	5.00	112.17	2.81	2.57	2.26	2.58	2.55	0.11			
Jul 1996 - Jun 1997													
Jul 1997 - Jun 1998													
Jul 1998 - Jun 1999													
Jul 1999 - Jun 2000	2.16	11.21	5.14	121.50	3.07	2.46	2.29	2.68	2.62	0.17			
Jul 2000 - Jun 2001													
Jul 2001 - Jun 2002	3.34	8.11	8.40	143.62	3.55	2.94	2.57	2.88	2.99	0.20			
Jul 2002 - Jun 2003	3.11	8.20	8.12	111.28	3.47	2.93	2.87	2.55	2.95	0.19			
Jul 2003 - Jun 2004	2.76	11.08	10.70	142.13	3.34	2.48	3.22	2.87	2.98	0.19			
Jul 2004 - Jun 2005	2.12	10.47	6.70	144.95	3.05	2.57	2.96	2.90	2.87	0.11			
Jul 2005 - Jun 2006	1.89	11.53	9.16	150.48	2.92	2.42	3.03	2.94	2.83	0.14			
Jul 2006 - Jun 2007	1.66	11.42	7.00	134.53	2.77	2.43	2.89	2.80	2.67	0.08			
Jul 2007 - Jun 2008	2.26	10.20	9.75	163.00	3.16	2.60	2.97	3.06	2.95	0.12			
Jul 2008 - Jun 2009	2.46	10.84	8.81	119.77	3.21	2.51	2.98	2.65	2.84	0.16			
Jul 2009 - Jun 2010	2.22	10.44	8.66	90.28	3.10	2.57	2.94	2.28	2.72	0.19			
Jul 2010 - Jun 2011	2.09	10.17	12.25	92.80	3.00	2.81	3.40	2.31	2.88	0.24			
Averages	**2.17**	**10.41**	**8.00**	**127.25**	**3.04**	**2.58**	**2.91**	**2.71**	**2.78**	**0.04**	**0.01**	**0.01**	**0.0773**

LŌSRB enquiry point 3: Wheko wetland lagoon – is its water quality checked?

Response: The landowner of that wetland property needs to have a monitoring agreement (as a part of a wetland management agreement) with the Regional Council for the Council to enter the property assess the wetland conditions (Method 261 of Bay of Plenty Water and Land Plan).

LŌSRB enquiry point 4: Information about groundwater and water table influences.

Response: Currently there are some groundwater bore investigations being carried out. A three phase investigative drilling program has been carried out to improve our understanding of the flow direction, hydraulic properties, quality and age of groundwater within the 'greater' Lake Tarawera groundwater catchment. This catchment includes water inputs from Lakes Rerewhakaaitu, Rotomahana, Rotokakahi, Tikitapu, Ōkāreka and Ōkataina.
The focus of the Phase 3 drilling program was on groundwater near Lakes Rotokakahi, Tikitapu and Ōkāreka. The drilling identified several high flowing aquifer layers, but only at Lake Rotokakahi was an aquifer identified that showed elevated nitrate levels indicating the effects of land use activity. The remaining

aquifers had low nitrate concentrations consistent with pristine oxidised groundwater systems. Groundwater age was moderate to high (50 to 150 years) in most of the aquifers sampled.

The drilling program has now been largely completed. The next phase is to construct a conceptual geological model for the greater Lake Tarawera groundwater catchment. The model will be used to develop groundwater flow and nutrient models for the area. This work will support the development of Action Plans to manage the water quality of the lakes within this catchment.