Policy and Planning Committee

Tuesday 11 June 2019
10.30am
Taranaki Regional Council, Stratford

Agenda for the meeting of the Policy and Planning Committee to be held in the Taranaki Regional Council chambers, 47 Cloten Road, Stratford, on Tuesday 11 June 2019 commencing at 10.30am.

Members	Councillor N W Walker	(Committee Chairperson)
	Councillor M P Joyce	
	Councillor C L Littlewood	(via Zoom)
	Councillor D H McIntyre	
	Councillor B K Raine	
	Councillor C S Williamson	(via Zoom)
	Councillor D L Lean	(ex officio)
Representative Members	Ms E Bailey	(Iwi Representative)
	Councillor G Boyde	(Stratford District Council)
	Mr J Hooker	(Iwi Representative)
	Councillor R Jordan	(New Plymouth District Council)
	Mr P Muir	(Taranaki Federated Farmers)
	Councillor C Coxhead	(South Taranaki District Council)
	Mr M Ritai	(Iwi Representative)
Apologies	Councillor D N MacLeod	(ex officio)
	Councillor P Nixon	(South Taranaki District Council)

Notification of Late Items

Closing Karakia and Karakia for kai

Agenda Memorandum

Date 11 June 2019

Memorandum to
Chairperson and Members
Policy and Planning Committee

Subject: Confirmation of Minutes – 30 April 2019

Approved by: A D McLay, Director-Resource Management

B G Chamberlain, Chief Executive

Document: 2269835

Resolve

That the Policy and Planning Committee of the Taranaki Regional Council:

a) takes as read and confirms the minutes of the Policy and Planning Committee meeting of the Taranaki Regional Council held in the Taranaki Regional Council chambers, 47 Cloten Road, Stratford, on Tuesday 30 April 2019 at 10.30am

b) notes the recommendations therein were adopted by the Taranaki Regional Council on 21 May 2019.

Matters arising

Appendices

Document #2244757 – Minutes Policy and Planning Committee

Minutes of the Policy and Planning Committee Meeting of the Taranaki Regional Council, held in the Taranaki Regional Council Chambers, 47 Cloten Road, Stratford, on Tuesday 30 April 2019 at 10.30am.

Members	Councillors	N W Walker	(Committee Chairperson)
		C L Littlewood	
		D H McIntyre	
		B K Raine	
		C S Williamson	
		D N MacLeod	(ex officio)
		D L Lean	(ex officio)
Representative Members	Councillors	R Jordan	(New Plymouth District Council)
	Messrs	J Hooker	(Iwi Representative)
		M Ritai	(Iwi Representative)
		P B Muir	(Federated Farmers Taranaki)
	Ms	E Bailey	(Iwi Representative)
Attending	Messrs	B G Chamberlain	(Chief Executive)
		A D McLay	(Director-Resource Management)
		G K Bedford	(Director-Environment Quality)
		S J Hall	(Director-Operations)
		C L Spurdle	(Planning Manager)
		R Phipps	(Science Manager)
		B E Pope	(Compliance Manager)
		S Tamarapa	(Iwi Communications Officer)
		R Ritchie	(Communications Manager)
		P Ledingham	(Communications Adviser)
		A Parr	(Harbourmaster)
	Ms	J Mack	(Committee Administrator)
	Mrs	V McKay	(Science Manager)
	Mrs	H Gerrard	(Science Manager)
	Mr	J Clough	(Wrightson Consulting)
	Ms	P Fourie	(Fonterra)
	Mr	B Cheer	(Fonterra)

Apologies The apologies from Councillor M P Joyce and Mr G Boyde (Stratford District Council) were received and sustained.

Notification of Late Items

There were no late items of business. – Mr Hooker – requested further information on potential volcanic events associated with the Maunga.

1. Confirmation of Minutes – 19 March 2019

Resolved

THAT the Policy and Planning Committee of the Taranaki Regional Council

1. takes as read and confirms the minutes and confidential minutes of the Policy and Planning Committee meeting of the Taranaki Regional Council held in the Taranaki Regional Council chambers, 47 Cloten Road, Stratford, on Tuesday 19 March 2019 at 10.35am
2. notes that the recommendations therein were adopted by the Taranaki Regional Council on 9 April 2019.

Littlewood/Raine

Matters Arising

There were no matters arising.

2. Update on the Coastal Plan Review

2.1 Mr C Spurdle, Planning Manager, spoke to the memorandum presenting an update on the Coastal Plan review process and explained upcoming actions required under the Schedule 1 process of the *Resource Management Act 1991.*

Recommended

That the Taranaki Regional Council:

1. receives this memorandum entitled *Update on the Coastal Plan review*;
2. requests that officers prepare a report on the Proposed Plan, including submissions, under Section 42A of the RMA;
3. approves a hearing; and
4. approves the use of an independent hearing commissioner in the hearing.

Muir/Littlewood

3. Review and approval of Port Safety Management System and navigation update

3.1 Mr A D McLay, Director – Resource Management, spoke to the memorandum informing Members of the review and approval by Maritime New Zealand of the council's *Port and Harbour Safety Management System Manual for Port Taranaki and its*

Approaches and introduced Mr A Parr, Harbourmaster who gave a presentation on the Port Safety Management System Manual and 2018/19 navigation/safety programme.

Recommended

That the Taranaki Regional Council:

1. receives this memorandum;
2. notes the Port and Harbour Safety Management System Manual was developed by the Council and Port Taranaki Ltd;
3. notes the Port and Harbour Safety Management System Manual has been approved by Maritime New Zealand with three relatively minor areas for improvement recommended.

MacLeod/Muir

4. Latest report from the Parliamentary Commissioner for the Environment on climate change targets and policies

4.1 Mr C L Spurdle, Planning Manager, spoke to the memorandum introducing the latest report from the Parliamentary Commissioner for the Environment entitled "*Farms, forests and fossil fuels: The next great landscape transformation*" and to discuss its findings and recommendations.

Recommended

That the Taranaki Regional Council:

1. receives the memorandum *Latest report from the Parliamentary Commissioner for the Environment on climate change targets and policies*

Littlewood/Williamson

5. Irrigation NZ News magazine: Articles of interest

5.1 Mr A D McLay, Director-Resource Management, spoke to the memorandum introducing several articles from the latest Irrigation NZ News magazine that will be of interest to the Committee and provide some useful national context.

Recommended

That the Taranaki Regional Council:

1. receives this memorandum *Irrigation NZ News magazine: Articles of interest*

Raine/MacLeod

6. Riparian management programme update

6.1 Mr S J Hall, Director-Operations, spoke to the memorandum updating Members on progress with the Council's riparian management programme. Members noted good progress was being made but implementation needed to increase to meet the 2020 target for completion.

Recommended

That the Taranaki Regional Council:

1. receives this memorandum *Riparian management programme update*; and
2. notes the progress with the riparian programme and development of auditing process.

Muir/Littlewood

7. Farm environment plans and good management practices

7.1 Mr A D McLay, Director-Resource Management, spoke to the memorandum introducing the potential role of farm environmental plans in resource management. The plans address environmental management on farms. A powerpoint presentation from Mrs P Fourie and Mr B Cheer (Fonterra) was made to introduce Fonterra's farm environment programme.

Recommended

That the Taranaki Regional Council:

1. receives this memorandum;
2. notes the Fonterra farm environment plans are an example of a sector led non regulatory resource management initiative;
3. notes the Ministry for the Environment are considering farm environmental plans as part of its freshwater management reform package to be released mid-2019; and
4. notes the Council has commenced a project to develop online advice for Taranaki farmers to promote the uptake of good farming management practices and aid the preparation of property-specific farm environment plans in the region.

Walker/Raine

8. State of the Environment Monitoring of Lake Rotorangi water quality and biological programme Annual Reports 2016-2018

8.1 Mr G K Bedford, Director-Environment Quality spoke to the memorandum to present a report prepared by staff, on the ecological and physico-chemical state of Lake Rotorangi as determined in the 2016-2018 programme monitoring the state of the lake, and trends in that quality since monitoring first began in 1984.

8.2 Monitoring planned at other lakes in the region was discussed.

Recommended

That the Taranaki Regional Council:

1. receives this memorandum noting the preparation of a report into the state of the water quality and biological programme of Lake Rotorangi as determined in monitoring during 2016-2018;
2. notes the findings of the SEM programme; and
3. adopts the specific recommendation therein.

Williamson/MacLeod

Closing Karakia Mr M Ritai (Iwi Representative) gave the closing Karakia to the Policy and Planning Committee and Karakia for kai (lunch).

There being no further business, the Committee Chairperson Councillor N W Walker, declared the meeting of the Policy and Planning Committee meeting closed at 12.45pm.

Confirmed

Chairperson ______________________________

N W Walker

Date **11 June 2019**

Agenda Memorandum

Date 11 June 2019

Memorandum to
Chairperson and Members
Policy and Planning Committee

Subject: 2019 Central Government Budget Initiatives

Approved by: A D McLay, Director - Resource Management

BG Chamberlain, Chief Executive

Document: 2269129

Purpose

1. The purpose of this memorandum is to inform members of budget announcements relating to the Government's *Productive and Sustainable Land Use* package.

Recommendations

That the Taranaki Regional Council:

a) receives this memorandum entitled *2019 Central Government Budget Impacts*;

b) notes there is little detail to determine the impacts of the package on Council programmes.

Budget Initiatives

2. On 30 May 2019, the Government delivered its annual budget. Included in the budget was a $229 million Productive and Sustainable Land Use package. The focus of this package is to:
   - help farmers with the climate change challenge by investing in research;
   - encourage sustainable land use; and
   - improve freshwater quality in at risk catchments.

3. Set out below is a brief overview of the key elements of the Government's Productive and Sustainable Land Use package

Accelerating a Local Government Reform Programme to Enhance Community Wellbeing and Strengthen Local Governance

4. Led by the Minister of Local Government, this $10 million initiative over three years aims to help to enhance community wellbeing and strengthen local governance. This will be done by funding additional staff to work with local government to make

improvements to water services, develop strategies to manage natural hazards and climate change and improve local government financial sustainability.

5. Budget breakdown to 2023:

Vote	2018/19	2019/20	2020/21	2021/22	2022/23	*Capital*
Internal Affairs	-	3.333	3.333	3.334	-	-

<u>Productive and Sustainable Land Use: Climate Change Commission and Government Response</u>

6. Led by the Minister for Climate Change, this $43 million initiative aims to support New Zealand's transition to more sustainable land use and a low emissions and climate resilient economy. This will be done by providing funding to: establish key institutions and regulations through implementation of the *Climate Change Response (Zero Carbon) Amendment Act* and an Emissions Trading Scheme auctioning platform, and ensure the Government has the resources to deliver on its obligations and commitments.

7. Budget breakdown to 2023:

Vote	2018/19	2019/20	2020/21	2021/22	2022/23	*Capital*
Environment	-	7.110	11.202	12.202	12.201	*0.449*

<u>Productive and Sustainable Land Use: Enabling the Transition in Agriculture</u>

8. Led by the Minister of Agriculture with the Minister for the Environment and the Minister for Climate Change, this $122 million initiative is part of the Productive and Sustainable Land Use package of initiatives.

9. This initiative aims to support more sustainable land use practice in the agriculture sector. This will be done through providing funding for:
   - on-the-ground advice to farmers;
   - supporting Māori agribusiness;
   - information, tools and advice to support farmers making change to more environmentally sustainable and higher value production, including organics;
   - improving on-farm emissions data and upgrading decision and regulatory tools; and
   - protecting high-value food exports and updating our official assurances system.

10. Budget breakdown to 2023:

Vote	2018/19	2019/20	2020/21	2021/22	2022/23	*Capital*
Agriculture, Biosecurity, Fisheries and Food Safety	-	15.851	33.221	37.591	35.578	-

Productive and Sustainable Land Use: Freshwater and Transition to a Sustainable and Low Emissions Economy

11. Led by the Minister for the Environment with the Minister for Agriculture and the Minister for Climate Change, this $64.3 million initiative aims to provide funding to establish key institutions and regulations through:
    - implementation of the *Climate Change Response (Zero Carbon) Amendment Act* and an Emissions Trading Scheme auctioning platform;
    - developing good management practice standards and guidance across farm systems;
    - addressing freshwater over-allocation and Māori rights and interests in freshwater; and
    - providing funding to invest in at-risk catchments and wetlands restoration, and supporting councils, businesses and regions.

12. Budget breakdown to 2023:

Vote	2018/19	2019/20	2020/21	2021/22	2022/23	*Capital*
Environment	-	11.900	17.291	17.295	17.799	-

Protecting Lakes, Rivers and Lands from Invasive Pests and Weeds

13. Led by the Minister for Land Information, this $7.5 million initiative aims to minimise the high risk of major pest and weed outbreaks in many iconic lakes, rivers and lands stewarded by the Crown. This will be done by providing for the acceleration and enhancement of existing biosecurity programmes, and prioritisation of key sites.

Budget breakdown to 2023:Vote	2018/19	2019/20	2020/21	2021/22	2022/23	*Capital*
Lands	-	1.875	1.875	1.875	1.875	-

Strengthening the Integrity of the Environmental Management System

14. Led by the Minister for Biosecurity, this 34.4 million initiative aims to build greater resilience and more effective risk management in the biosecurity system. This will be done through providing funding for:
    - fit-for-purpose workforce planning and management systems to ensure New Zealand's border service workforce is efficiently deployed and managed across New Zealand;
    - improving diagnostic and surveillance capability to respond to growing volumes and diversifying the Ministry for Primary Industry's (MPI's) scientific expertise;
    - Tiaki, a programme that will provide MPI with a better IT system to manage biosecurity responses; and
    - building MPI's capability to better manage marine and freshwater biosecurity risks.

15. The budget website also notes that the initiative will enable New Zealand to better manage economic and urban growth within environmental limits. This will be done through providing funding for comprehensive reform of the resource management system and the improvement of implementation, compliance and enforcement of National Direction (how resources are managed under the RMA).

16. Budget breakdown to 2023:

Vote	2018/19	2019/20	2020/21	2021/22	2022/23	*Capital*
Environment	-	6.480	10.004	7.500	6.500	*3.948*

Essential Freshwater Work Programme

17. In October 2018, the Government launched an *Essential Freshwater Work Programme* to stop further degradation and loss, reverse past damage and address water allocation issues. These will be achieved through a new *National Policy Statement for Freshwater Management* and a new *National Environmental Standard for Freshwater Management*, among other things. This is a non-spending initiative.

Reforms to the Resource Management Act

18. The Government is undertaking a two stage process to reform the resource management system. A Bill will shortly be introduced to Parliament addressing immediate issues with the Resource Management Act (RMA). The second stage will be a comprehensive review of the resource management system, focused on the RMA. This is a non-spending initiative.

Implications for Council

19. To date little detail has been provided regarding how the Government will address the aforementioned initiatives. Accordingly, at this point of time it is not possible to anticipate how these Government initiatives may impact or contribute to the Council's programmes. As always, the devil will be in the detail. However, the Council will endeavour to gain the maximum advantage of the programmes for the region and minimise the cost impact of the package, given the Council has just completed its financial planning for 2019/20.

Decision-making considerations

20. Part 6 (Planning, decision-making and accountability) of the *Local Government Act 2002* has been considered and documented in the preparation of this agenda item. The recommendations made in this item comply with the decision-making obligations of the *Act*.

Financial considerations—LTP/Annual Plan

21. This memorandum and the associated recommendations are consistent with the Council's adopted Long-Term Plan and estimates. Any financial information included in this memorandum has been prepared in accordance with generally accepted accounting practice.

Policy considerations

22. This memorandum and the associated recommendations are consistent with the policy documents and positions adopted by this Council under various legislative frameworks including, but not restricted to, the *Local Government Act 2002*, the *Resource Management Act 1991* and the *Local Government Official Information and Meetings Act 1987*.

Iwi considerations

23. This memorandum and the associated recommendations are consistent with the Council's policy for the development of Māori capacity to contribute to decision-making processes (schedule 10 of the *Local Government Act 2002*) as outlined in the adopted long-term plan and/or annual plan. Similarly, iwi involvement in adopted work programmes has been recognised in the preparation of this memorandum.

Legal considerations

24. This memorandum and the associated recommendations comply with the appropriate statutory requirements imposed upon the Council.

Agenda Memorandum

Date 11 June 2019

Memorandum to
Chairperson and Members
Policy and Planning Committee

Subject: Submission on Climate Change Response (Zero Carbon) Amendment Bill

Approved by: AD McLay, Director – Resource Management

BG Chamberlain, Chief Executive

Document: 2262913

Purpose

1. The purpose of this memorandum is to introduce a draft submission on the Climate Change Response (Zero Carbon) Bill (the Bill) and to recommend it be adopted by the Council.

2. The draft submission is attached to this memorandum.

Executive summary

3. On 8 May 2019, the Government introduced the Climate Change Response (Zero Carbon) Amendment Bill to Parliament. It was subsequently referred to the Environment Select Committee who have called for submissions by 16 July 2019.

4. The intention of the Bill is to provide a framework by which New Zealand can develop and implement clear and stable climate change policies that contribute to global efforts under the Paris Agreement to limit the global average temperature increase to 1.5 degrees Celsius above pre-industrial levels. It sets up a Climate Change Commission to provide independent and expert advice to the Government on climate change. It also sets new greenhouse gas reduction targets, establishes a series of emissions budgets and sets out a range of climate change adaptation measures.

5. In July 2018, the Council made a submission on proposals for a Zero Carbon Bill. Many of the provisions in the Bill as introduced are consistent with the Council's earlier submission and therefore the draft submission is largely supportive of the Bill.

6. One area where the Council is seeking change is in relation to the specific target for biogenic methane. This requires gross emissions of biogenic methane (largely from agriculture and waste sources) to be reduced by 10% by 2030 and by at least 24% to 47% by 2050.

7. The draft submission notes that the 10% reduction in gross biogenic methane by 2030 is a worthwhile aspiration and one that could be achievable given advances in technology and further reductions in animal numbers. The 2050 target for gross emissions of biogenic methane is however, likely to be challenging for New Zealand's agricultural sector to meet, with potentially significant economic and social costs for New Zealand and its communities and regions.

8. The draft submission calls for the 2050 target contained in the Bill for gross biogenic methane to be reviewed in light of the findings of the yet to be released report of the Interim Climate Change Committee. It also recommends the findings of the recently released report of the Parliamentary Commissioner for the Environment regarding agriculture and the use of forest sinks as offsets be considered.

9. The draft submission also comments on provisions in the Bill relating to the Treaty of Waitangi, the impacts on regions of advice or decisions taken under the Bill, how emissions budgets are to be meet (and in particular, the use of offshore mitigation), and the power to request information on climate change adaptation. Also raised for consideration is a report prepared for regional councils and Local Government New Zealand that recommends central government return to the role it previously had of supporting regional government in flood risk management.

Recommendations

That the Taranaki Regional Council:

a) receives the memorandum *'Submission on Climate Change Response (Zero Carbon) Amendment Bill'*;

b) adopts the submission with any changes recommended by the Committee.

Background

10. On 8 May 2019, the Government introduced the Climate Change Response (Zero Carbon) Amendment Bill to Parliament. The Bill can be viewed at http://www.legislation.govt.nz/bill/government/2019/0136/latest/LMS183736.html?src=qs

11. The timing of introduction of the Bill was later than expected, mainly because of the extensive work behind the scenes required to get a high level of cross-party consensus on it. The Bill has subsequently been referred to the Environment Select Committee who has called for submissions by 16 July 2019. The Government expects the amended Act to come into force in late 2019.

12. Members will recall that the Council made a submission on proposals for a Zero Carbon Bill back in July 2018 in response to a discussion document released by the Ministry for the Environment entitled *'Our Climate, Your Say!'*

13. Many of the provisions in the Bill are in line with the Council's submission, which supported the inclusion of an emissions reduction target in legislation, the preparation of emissions budgets and an emissions reduction plan and the establishment of a Climate Change Commission (the Commission). Also included as part of the Bill (which the Council also supported), was a national climate change risk assessment and a national

adaptation plan to provide direction to bodies such as councils, on how to respond to climate change that is already happening.

14. The intention of the Bill is to provide a framework by which New Zealand can develop and implement clear and stable climate change policies that contribute to global efforts under the Paris Agreement to limit the global average temperature increase to 1.5 degrees Celsius above pre-industrial levels.

15. The Bill seeks to strike a balance between flexibility and prescription in dealing with what will be a long-term transition to a low emissions economy.

16. In light of the above, the draft submission is largely supportive of the Bill as introduced, apart from the specific target to reduce gross emissions of biogenic methane by set amounts by certain dates. The Council's draft submission also seeks a small number of other changes to the Bill.

The Bill

17. The Bill is in the form of an amendment to the Climate Change Response Act 2002 rather than as a stand-alone Bill as originally planned. This is intended to ensure climate change legislation is consistent and integrated.

18. As noted above, the main features of the Bill are:

- the establishment of a new independent Climate Change Commission to provide independent expert advice and monitoring that will help keep successive government's on track to meeting its long-term mitigation and adaptation goals (proposed new sections 5A to 5N);
- a new greenhouse gas emissions reduction target to –
  - reduce gross emissions of biogenic methane by at least 24% to 47% below 2017 levels by 2050, with an interim requirement to reduce emissions to 10% below 2017 levels by 2030;
  - reduce net emissions of all other greenhouse gases to zero by 2050 (proposed new sections 5O to 5R);
- the establishment of a series of emissions budgets to act as 'stepping stones' towards the 2050 target (proposed new sections 5S to 5ZI);
- the establishment of a range of climate change adaptation measures to make sure New Zealand understands the risks it faces and has plans to address them (proposed new sections 5ZM to 5ZW).

19. The Bill sets out details of the Climate Change Commission's functions in relation to the overall emissions target, emissions budgets, emissions reduction plans and adaptation plans. The Bill also provides for the Minister for Climate Change to request other advice from the Commission, including advice on the New Zealand Emissions Trading Scheme.

20. The inclusion of a greenhouse gas emissions reduction target in legislation is to provide a clear signal on New Zealand's' long-term emissions reduction goal. However, as noted in the Council's draft submission, the precise metrics on this need to reflect what is realistically achievable otherwise there is a risk of raising expectations that cannot be achieved (or alternatively of under delivering).

21. The Bill allows the target to be revised, but only in very limited and specific circumstances. If the Commission recommends amending the target, this would involve a new amendment Bill being introduced to Parliament, following policy development work and public consultation. This underscores the importance of getting the target right to begin with.

22. A system of emissions budgets over the short to medium term provide interim targets towards achieving the emissions reduction target. The Commission will also track progress and determine whether New Zealand is on track to meet the emissions reduction target established under the Bill. This is intended to create accountability across successive governments.

23. Emissions budgets are supported by an emissions reduction plan that includes strategies and policies to achieve the reductions required. The idea behind this is that the emissions budgets and plan will operate as a market signal, providing households, businesses and industries with greater predictability, which will drive investment towards low emissions technology and investment.

24. The Bill also provides for an improved framework for action on adaptation. This consists of a national climate risk assessment, a national adaptation plan, regular progress reporting on the implementation of the national adaptation plan and an adaptation-information gathering power. The Commission has been given functions to regularly monitor and report on the implementation and effectiveness of the national adaptation plan.

25. Interestingly, no provision has been made in the Bill for penalties or legal remedies if the 2050 target and emissions budgets are not met. The Bill makes it clear that the 2050 target and emissions budgets are not enforceable in a court of law, except that a court may make a declaration if the Government fails to meet the targets. The Government must then respond to the failure by reporting to the House of Representatives (see proposed new section 5ZJ). This probably reflects the fact that non-compliance may be due to factors or events outside of the Government's control and the legal drafters have considered it appropriate that failure to meet targets or budgets and the response, is best left to elected representatives.

26. The effect of plans, such as the emission reduction plan and adaptation plan, on statutory decision-making, for example by councils, is also addressed in the Bill (see proposed new section 5ZK). This makes it clear that the 2050 target and emissions budgets can be taken into account *'in the exercise or performance of a public function..'* but the failure to take the target or emissions budget into account does not invalidate the decision. In other words, the targets and budgets are permissive considerations, which may be taken into account, but failure to do so does not invalidate a decision.

The draft submission

27. As previously mentioned the draft submission is largely supportive of the Bill and lists areas of the Bill that the Council had previously supported in its earlier submission.

28. One area where the Council is seeking change is in relation to the target for biogenic methane. The Council's previous submission made in July 2018 accepted a target of net zero long-lived gases with stabilised short-lived gases by 2050. This was one of three

options put out for consultation; the other options were reducing net carbon dioxide emissions to net zero by 2050 and net zero emissions across all greenhouse gases by 2050.

29. However, in October 2018, the Intergovernmental Panel on Climate Change (IPCC) released its latest report, which recommended global emissions of agricultural methane be reduced by 24% to 47% from 2010 levels by 2050 to stay within the 1.5 degrees Celsius warming, as set out under the Paris Agreement. This target has been picked up in the Bill, together with an interim target of a 10% reduction in gross emissions of biogenic methane by 2030.

30. The draft submission notes that the 10% reduction in gross biogenic methane by 2030 is a worthwhile aspiration and one that could be achievable given advances in technology and further reductions in animal numbers. The 2050 target for gross emissions of biogenic methane is however, likely to be challenging for New Zealand's agricultural sector to meet.

31. The agricultural sector currently has very limited options at the farm scale to significantly reduce greenhouse gas emissions below existing levels other than by substantial reductions in stock numbers or production. The Minister has stated on numerous occasions that the transition to a low-emissions economy must *'be planned, gradual and carefully phased in'* and that it must minimise negative social and economic impacts of change *'so it is just and fair for people, communities and regions'*. At the 'Just Transitions Summit' held in New Plymouth in May 2019, much was also made of the need not to leave anyone behind in the transition.

32. There is potential for significant impacts on communities and regions from a target to reduce gross emissions of biogenic methane and these need to be carefully and thoroughly considered.

33. The draft submission notes that a report prepared by the Interim Climate Change Committee (ICCC) on how agriculture is to be dealt with in the New Zealand Emissions Trading Scheme is currently with the Government. The Council suggests that the 2050 target contained in the Bill for gross biogenic methane be reviewed in light of the findings of the ICCC.

34. Further work also needs to be done on net verses gross biogenic methane in the context of the Parliamentary Commissioner for the Environment's recent report recommending the use of forests to offset greenhouse gas emissions be limited to agriculture (see report to the Policy and Planning Committee of 30 April 2019).

35. The draft submission also comments on provisions in the Bill relating to the Treaty of Waitangi, the impacts on regions of advice or decisions taken under the Bill, how emissions budgets are to be meet (and in particular, the use of offshore mitigation), and the power to request information on climate change adaptation.

36. In relation to climate change adaptation, the draft submission draws to the Select Committee's attention, recent work done on behalf of the regional sector looking into central government co-investment in river management for flood protection. Flooding is New Zealand's most common natural hazard and one that is already responding to climate change impacts. The Council urges the select Committee to consider

recommendations that central government return to the role it previously had of supporting regional government in flood risk management.

Decision-making considerations

37. Part 6 (Planning, decision-making and accountability) of the *Local Government Act 2002* has been considered and documented in the preparation of this agenda item. The recommendations made in this item comply with the decision-making obligations of the *Act*.

Financial considerations—LTP/Annual Plan

38. This memorandum and the associated recommendations are consistent with the Council's adopted Long-Term Plan and estimates. Any financial information included in this memorandum has been prepared in accordance with generally accepted accounting practice.

Policy considerations

39. This memorandum and the associated recommendations are consistent with the policy documents and positions adopted by this Council under various legislative frameworks including, but not restricted to, the *Local Government Act 2002*, the *Resource Management Act 1991* and the *Local Government Official Information and Meetings Act 1987*.

Iwi considerations

40. This memorandum and the associated recommendations are consistent with the Council's policy for the development of Māori capacity to contribute to decision-making processes (schedule 10 of the *Local Government Act 2002*) as outlined in the adopted long-term plan and/or annual plan. Similarly, iwi involvement in adopted work programmes has been recognised in the preparation of this memorandum.

Legal considerations

41. This memorandum and the associated recommendations comply with the appropriate statutory requirements imposed upon the Council.

Attachment

42. Document 2259841: Submission on Climate Change Response (Zero Carbon) Amendment Bill

11 June 2019
Document: 2259841

Environment Committee
Select Committee Services
Parliament Buildings
Wellington 6160

Submission on Climate Change Response (Zero Carbon) Amendment Bill

Introduction

1. The Taranaki Regional Council (the Council) thanks the Environment Committee for the opportunity to make a submission on the Climate Change Response (Zero Carbon) Amendment Bill (the Bill).

2. The Council makes this submission in recognition of the purpose of local government set out in the Local Government Act 2002, and the role, status, powers and principles under that Act relating to local authorities. In particular, the Council's comments are made in recognition of its:

   - functions and responsibilities under the Local Government Act 2002 and the Resource Management Act 1991 (RMA); and
   - its regional advocacy responsibilities whereby the Council represents the Taranaki region on matters of regional significance or concern.

3. The Council has also been guided by its Mission Statement *'To work for a thriving and prosperous Taranaki'* across all of its various functions, roles and responsibilities, in making this submission.

General support for the Bill

4. The Council generally supports the Bill as introduced with one major exception relating to the target for biogenic emissions, which is outlined later in this submission.

5. The Council considers it is crucial for New Zealand that the legislation for addressing climate change offers maximum certainty and predictability and a stable and clear policy environment within which all sectors of society can plan for climate change. A high degree of flexibility will also be required as knowledge of climate change improves and technology and social attitudes

change over time. The Council considers that the Bill provides a broad legislative framework that by and large balances these needs and will enable New Zealand to make progress in meeting its commitments under the Paris Agreement. Much detail is still required however, on precisely how New Zealand is to meet its targets, how quickly this will occur and what the social, economic and environmental impacts will be so that, as Hon James Shaw, Minister for Climate Change has said, the transition *'is just and fair for people, communities and regions'*[1].

6. At the recent 'Just Transitions Summit' held in New Plymouth on the 9 and 10 May 2019 and attended by the Prime Minister and a number of senior Cabinet Ministers, much was made of the call that we 'leave no one behind' in moving to a low emissions economy. The Council fully acknowledges and supports this call and urges the Committee and all members of Parliament to keep this at the forefront of their deliberations on the Bill.

7. Of course, there will also be opportunities for New Zealand that arise from responding to the challenges of climate change and these must also be considered.

8. In July 2018, the Council made a submission on proposals for the Zero Carbon Bill as outlined in the Ministry for the Environment's discussion document *'Our Climate Your Say!'*[2] A number of the major proposals contained in that document which the Council supported or offered qualified support for, are reflected in the Bill. These include:

   - establishing a new independent Climate Change Commission to provide expert advice, monitoring and reporting to the Government on its long-term mitigation and adaptation goals (new sections 5A to 5N) ;
   - setting a greenhouse gas emissions reduction target (new section 5O) and providing a process to review the target (new sections 5P to 5R);
   - establishing a series of emissions budgets to act as 'stepping stones' towards the 2050 target, and how, in broad terms those budgets are to be met (new sections 5S to 5Y);
   - the inclusion of matters to be considered in advising on and setting budgets (new section 5Z);
   - allowing for emissions budgets to be revised having regard to certain matters (new section 5ZB);
   - requiring the Minister to prepare and publish emissions reduction plans within certain timeframes to achieve the emissions budgets (new sections 5ZD to 5ZF) ;
   - requiring national climate change risk assessments to be carried out (new section 5ZM 5ZP);
   - requiring a national adaptation plan to be prepared (new section 5ZQ to 5ZR);

[1] Ministry for the Environment, 2018. *Our Climate, Your Say!: Consultation on the Zero Carbon Bill,* page 8.
[2] Ministry for the Environment, 2018. *Our Climate, Your Say!: Consultation on the Zero Carbon Bill.*

- the inclusion of an adaptation information-gathering power (new sections 5ZV);
- obligations on the Minister to have regard to or take into account the Treaty of Waitangi when carrying out functions under the Act (new section 3A(a)).

9. However, there are some matters which the Council considers need further consideration.

Emission reduction target for 2050

10. The target for emissions reductions is set out in proposed new section 5O. It requires that net emissions of greenhouse gases are zero by 2050 (which will require offsets such as forestry), **except** biogenic methane (agriculture and waste emissions) which are required to reduce their gross emissions by 10% by 2030 and to be further reduced by at least 24% to 47% by 2050.

11. The Council fully supports a target that distinguishes between long-lived gases such as carbon dioxide, and short-lived gases such as methane. This recognises their different lifespans in the atmosphere, their potency as greenhouse gases and therefore their warming effects.

12. The Council also supports a target for biogenic emissions being included in the Bill in some form as this will provide an ongoing incentive for further work to be done on mitigation options that will be needed if New Zealand is to meet its international obligations.

13. However, the Council has reservations with the target set out in the Bill for gross biogenic emissions reductions by 2050 and believes the target to be overly optimistic as to what can be achieved at the current time.

14. Of the three options put forward in last year's discussion document *'Our Climate, Your Say'*, the Council offered qualified support for a target of net zero long-lived gases by 2050 and stabilised short-lived gases such as methane from agricultural sources, also by 2050. The Council submitted at the time that this option offered the best mix of credible science, practical abatement interventions and lowest transition costs.

15. However, since this time, the Intergovernmental Panel on Climate Change (IPCC) has released its latest report which has recommended global emissions of agricultural methane be reduced by 24% to 47% from 2010 levels by 2050 to stay within the 1.5 degrees Celsius warming, as set out in the Paris Agreement. This target has been picked up in the Bill, together with an interim target of a 10% reduction in gross emissions of biogenic methane by 2030.

16. The Council considers that the interim target of a 10% reduction in gross biogenic methane by 2030 is a worthwhile aspiration and one that could be achievable given advances in technology and further reductions in animal numbers. The 2050 target for reductions of gross emissions of biogenic methane from 2017 levels is, however, likely to be challenging for New Zealand's agricultural sector to meet.

17. Given that agriculture is a significant earner of export income for New Zealand, and is sensitive to movements in international markets, the Council maintains that we would need to be certain of the efficacy of mitigation options and that these were also being applied by our trade competitors.

18. Currently, the agricultural sector has very limited options at the farm scale to significantly reduce greenhouse gas emissions below existing levels other than by substantial reductions in stock numbers or production.[3] Furthermore, there are challenges to be overcome in accurately measuring agricultural emissions at the farm or sector scale.

19. The requirement to reduce gross biogenic methane emissions by between 24% and 47% by 2050 could have significant social and economic consequences for New Zealand, and for many communities and regions, including Taranaki, where agriculture makes a significant contribution to economic and social wellbeing.[4]

20. The Minister for Climate Change has stated on numerous occasions that the transition to a low-emissions economy must *'be planned, gradual and carefully phased in'* and that it must minimise negative social and economic impacts of change *'so it is just and fair for people, communities and regions'*. At the 'Just Transitions Summit' held in New Plymouth in May 2019, much was also made of the need not to leave anyone behind in the transition.

21. We also note that the target for carbon emitters is a net target which will be able to be offset by forest planting. Emissions of biogenic methane will not. This is contrary to the recent report of the Parliamentary Commissioner for the Environment[5] that recommended forest sinks be allowed only for biological emissions such as methane from agriculture. The Parliamentary Commissioner maintains that this approach more closely aligns the duration of the warming impact of biological emissions with the duration of forest sinks (also part of biological cycles) that could offset those emissions.

22. The Parliamentary Commissioner also proposes that a landscape approach be employed to deal with biological emissions. This would integrate climate change policy with other environmental and social objectives such as improved water quality, reduced soil erosion and enhanced biodiversity, as well as more resilient rural communities at the local level. These are matters that fall squarely within the current statutory functions of regional councils and are also of national interest.

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[3] Indeed, optimising emissions reductions on a global scale, by providing for New Zealand farmers to optimise production while poor land overseas is switched from intensive agriculture, cropping or grazing, to forestry, has greater integrity and better global environmental outcomes than imposing constraints and costs on New Zealand farmers and their productivity.

[4] This comes on top of the decision to end offshore oil and gas exploration in Taranaki which will also have a negative effect on the region.

[5] Parliamentary Commissioner for the Environment, 2019. *Farms, forests and fossil fuels: The next great landscape transformation.*

23. While the Council acknowledges that the target to reduce net emissions to zero by 2050 presents an opportunity for farmers to diversify their farming operations by planting trees, this could on the other hand, result in a reduction in land use diversity if large swathes of existing farmland are converted to forestry. This could potentially have significant impacts on local communities. It will also do little to encourage carbon emissions reductions at source. Transitional arrangements could be considered for those sectors lacking low carbon technology options, through for example continuing free allocations, access to international units or even some forestry offsets.

24. The Council considers that the approach recommended by the Parliamentary Commissioner for the Environment should be given serious consideration by the Select Committee.

25. The Council also notes that the Government announced on 17 May 2019, its second stage reforms to the ETS designed to ensure that it can deliver on the net-zero target in the Zero Carbon Amendment Bill. However, as part of these announcements the Government deferred decisions on how agriculture would fully enter the ETS.

26. The Council is aware that the Interim Climate Change Committee (ICCC) delivered its report on agriculture and its admission to the ETS on 30 April 2019. The Government has said it will release the report once it has had the opportunity to consider it and prepare a response. The ICCC has said that their report will deliver evidence and analysis on ways of delivering efficient emissions reductions in the agricultural sector that are consistent with the Government's objective for a 'just transition' and will consider the full suite of options that could deliver those reductions. They have indicated that the ETS will be part of, but not the sole, focus of the report.

27. The Council submits that the 2050 target for gross biogenic methane reductions be reviewed in light of the findings of the ICCC and recommendations of the Parliamentary Commissioner for the Environment.

Decision sought

28. That the Committee:

- Retains the distinction in the Bill between biogenic methane and other greenhouse gases;
- Reviews the 2050 target for reductions in gross biogenic methane in light of the findings of the Interim Climate Change Committee;
- Considers the recommendations of the Parliamentary Commissioner for the Environment that forest sinks only be available for biological emissions and that a landscape approach to biological emissions be developed.

Other matters

Treaty of Waitangi

29. In its submission on the discussion document *'Our Climate, Your Say!'* the Council called for obligations under the Treaty of Waitangi to be included in the list of considerations when advising on and setting emissions budgets.

30. The Council is pleased to see proposed new sections to be included in the Climate Change Response Act that specifically deal with obligations under the Treaty of Waitangi in relation to the Bill. This includes membership of the Climate Change Commission which must have members who among other things, have technical and professional skills, experience and expertise in, and an understanding of innovative approaches relevant to te Tiriti o Waitangi, and te ao Māori (including tikanga Māori, te reo Māori, mātauranga Māori and Māori economic activity)(proposed new section 5H).

31. There is a requirement to include in emissions reduction plans, strategies to mitigate the impacts on iwi and Māori (section 5ZD). In relation to the national adaptation plan there is also reference to taking into account effects on iwi and Māori (section 5ZQ).

32. In other clauses in the Bill there are more general references to social, cultural, environmental and ecological considerations, (proposed new section 5L), distributional impacts (proposed new section 5Q), impacts on communities (proposed new section 5Z), and the cultural effects of climate change (proposed new section 5ZN).

33. In relation to the national adaptation plan (proposed new section 5ZQ) we note that effects on iwi and Māori are included in the matters that must take into account but such effects are not included in the matters to be taken into account in preparing the national climate change risk assessment (proposed new section 5ZN), which is a necessary precursor to the national adaptation plan.

Decision sought

34. That the Committee:

    - Consider whether more specific references to the Treaty of Waitangi or to effects on iwi and Māori should be made throughout the Bill;
    - Include reference to iwi and Māori in proposed new section 5ZN(2)(a) (Preparation of national climate change risk assessment).

Consideration of impacts on regions

35. In its submission on *'Our Climate, Your Say!'* the Council sought consideration of the impacts of climate change on regions. New Zealand's regions are highly diverse and the impacts of climate mitigation and adaptation will be equally diverse requiring the Commission or the Minister to have particular regard to these differences in carrying out their functions under the Act.

36. The Council is pleased to see reference to regions in a number of places in the Bill and recommends that they be retained.

37. There are a number of areas however, where references to distributional impacts could be made more specific by making reference to the impacts on regions. These are in proposed new section 5Q(2) (Recommendations to amend 2050 target) and in proposed new section 5ZN(2) (Preparation of national climate change risk assessment) and proposed new section 5ZQ(4) (National adaptation plan).

38. In these (and other relevant cases) the more general wording could be replaced by the wording (or similar) in proposed new section 5Z(2)(b)(vii), namely:

> '*(vii) the distribution of those impacts across the regions and communities of New Zealand, and from generation to generation*'.

Decision sought

39. That the Committee:

- Consider including specific reference to the impacts on regions in relevant sections of the Bill (including those noted above), using the wording in proposed new section 5Z(2)(b)(vii) or similar.

How emissions budgets are to be met

40. Proposed new section 5W(1) states that emissions budgets must be met, as far as possible, through domestic emissions reductions and domestic removals. There is no mention of using emissions reductions from overseas.

41. This is in contrast to proposed new section 5X where, in its role in advising the Minister, the Commission must give an indication of the proportion of the emissions budget that will be met by offshore mitigation, in addition to greenhouse gas reductions and removals. Furthermore, the Commission must advise the Minister of the appropriate limit on the amount of offshore mitigation that will be used to meet the emissions budget.

42. The Council supports the intent that lies behind proposed new section 5W(1), that is , that as far as possible emissions budgets should be met through domestic reductions and removal. The reality is however, that offshore mitigation will be important for New Zealand, especially in the transition, when there will be considerable uncertainty over long time periods, and questions over when new technologies will become available and at what cost.

43. Using overseas mitigation options, even as a stop-gap measure, could mean we could meet our targets at lower cost than if we relied only on domestic reduction and removals and could therefore ease the transition to a low-emissions economy for the many people who will be affected by rising costs and other effects of the transition. It also means that New Zealand is not solely reliant on forest planting as a means of mitigation, given that planting forests are generally short term mitigation options, carry their own risks and the available space for planting is not inexhaustible.

44. In its current form, proposed new section 5W(1) could be seen as giving an absolute priority to domestic reductions and removals, ahead of overseas mitigation.

Decision sought

45. That the Committee:

- Amend proposed section 5W(1) to specifically allow for consideration of overseas mitigation as an option for meeting emissions budgets. A possible wording could be (addition in italics):

> 'Emissions budgets must be met as far as possible, through domestic emissions reductions and domestic removals *and where this is not considered realistic after considering the matters in section 5Z(2), an emissions budget can be met in part, by offshore mitigation.'*

Adaptation to climate change

46. The Council fully supports the inclusion of adaptation to climate change being included in the Bill. The Council considers that mitigation and adaptation are part of the same climate change challenge for New Zealand and it makes sense for both to be addressed in an integrated and comprehensive way in legislation.

47. The Council believes adapting to climate change that is already with us is perhaps New Zealand's most pressing climate change challenge over the short to medium term. This is because New Zealand society in general will be faced with enormous costs in adjusting to a changing climate with local councils in particular, having to grapple with rising sea levels, risks to vital infrastructure, flooding of vulnerable urban areas as well as threats to community services and facilities and our productive and most intensively used land.

48. There is a very strong case to be made now for central government co-investment in climate change adaptation plans and strategies to ease the burden on already pressured councils.

49. For example, a recent report prepared for regional councils and Local Government New Zealand[6] concluded that improving flood protection is a critical first action in adaptation to climate change to achieve a more resilient New Zealand.

50. Flooding is the most common natural hazard we face in New Zealand and in many areas New Zealanders have been protected from the full force of flood events by river management and flood protection schemes. These provide safety and security to around 1.5 million hectares of our most productive land and to over 100 towns and cities. In total these schemes currently provide an estimated

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[6] Hutchings, J; Williams, J; Lawson, L; Chamberlain; B; and regional authority river managers, 2018. Central Government Co-Investment in River Management for Flood Protection. Critical Adaptation to Climate Change for a More Resilient New Zealand.

annual benefit of over $11 billion each year. Annual maintenance and capital costs total close to $200 million.

51. Regional authorities estimate the annual capital cost of meeting climate change and other objectives for their river management and flood protection schemes to be at least $150 million above the current $200 million per year. However, present funding arrangements are neither equitable nor sustainable for addressing present and emerging needs.

52. Prior to the 1990s the capital cost of substantial river management and flood protection schemes was commonly supported at levels of 50% to 70% by central government with maintenance and operating costs at rates of around 25%. In the decades since then, Crown and related assets have received flood protection at a cost to regional and local ratepayers, with no contribution from the Crown. These assets include rail and road infrastructure, airports, education facilities, Crown land and health facilities, along with the general efficient functioning of communities and the wider economy.

53. The co-investment in river management report concluded that there is a strong case for central government to reconsider the role it plays in flood risk management as New Zealand’s primary natural hazard and one that is already showing the effects of climate change.

54. Regional government is ready now to partner with central government and directly-affected property owners to co-invest in fit-for-the-future flood risk management.

Decision sought

55. That the Committee:

- Retain Part 1C Adaptation, of the Bill, as an essential and core part of the Zero Carbon Amendment Bill;

- In its report to Parliament, include discussion, along with recommendations, regarding the priority and urgency of central government co-investing with regional councils in river management and flood protection schemes, in recognition of the immediate climate change adaptation and other benefits of such investments to New Zealand society and economy.

Power to request information

56. Proposed new section 5ZV establishes powers for the Minister to request ‘reporting organisations’ (which include local government) to provide information on climate change adaptation.

57. The Council supports the introduction of an adaptation reporting power. This will provide a clearer picture of actions being undertaken and gaps that remain to be addressed.

58. In its submission on *‘Our Climate, Your Say!’* the Council raised concerns regarding the open nature of the reporting power and opportunities that would

be provided to reporting organisations to have input into what information was requested, reporting timeframes and costs etc.

59. The Council notes that the Bill provides for regulations to be made relating to requiring provision of information (proposed new section 5ZW). Regulations can be made for different sectors, classes of activity or geographical areas. In preparing the regulations the Minister must consider such things as the size and capability of the reporting organisation and must consult with the reporting organisations.

60. There is the remaining question of the cost of preparing reports. This could be covered by a specific reference to costs in proposed section 5ZW.

Decision sought

61. That the Committee:

- Consider amending proposed new section 5ZW(2)(a) as follows (addition in italics):

  'In preparing the regulations, the Minister must consider –

  (a) the ability to tailor a request to reflect the size and capability of the reporting organisation *and the costs of providing the information'*;

Conclusion

62. The Taranaki Regional Council again thanks the Environment Committee for the opportunity to make a submission on the Climate Change Response (Zero Carbon) Amendment Bill.

63. Overall, the Council supports the Bill and considers it provides a framework which will enable New Zealand to make progress on its obligations under the Paris Agreement.

64. However, the Council has significant reservations regarding the 2050 target for biogenic methane and suggests that the target be reviewed in light of the findings of the Interim Climate Change Committee and recent recommendations of the Parliamentary Commissioner for the Environment.

65. The Council notes that actually achieving the targets in relation to climate change will require a lot of effort outside of the Bill in areas of operational, institutional and policy support. It will also be important that the Government ensures New Zealand's trading partners are doing their bit for climate change otherwise New Zealand will face added costs in international markets.

66. In terms of adaptation to climate change, the Council supports retaining the adaptation provisions of the Bill as it sees adaptation as an essential part of the climate change challenge for New Zealand. The Council submits that regional councils are ready and willing to partner with central government on a co-investment strategy for river management and flood control works.

67. The Council also reminds the Committee of the Government's stated objective that New Zealand's transition to a low carbon economy must be gradual and carefully phased in and must be just and fair for people, communities and regions.

68. The Council wishes to be heard in support of its submission.

Yours faithfully

B G Chamberlain
Chief Executive

Agenda Memorandum

Date 11 June 2019

Memorandum to
Chairperson and Members
Policy and Planning Committee

Subject: National Planning Standards

Approved by: AD McLay, Director – Resource Management

BG Chamberlain, Chief Executive

Document: 2256281

Purpose

1. The purpose of this memorandum is to inform members of the new National Planning Standards and the proposed approach for their implementation.

Executive summary

2. The *National Planning Standards* were introduced on 4 April 2019.

3. The Council has three years to fully comply with the Standards for the Regional Policy Statement and ten years for its Resource Management Act 1991 (RMA) plans. Council intends to ensure all plans meet the requirements as they are reviewed.

4. The standards require that RMA policy statement and plans are available online in a prescribed interactive format (ePlanning). The Council is implementing ISOVIST software in collaboration with other regional councils.

Recommendations

That the Taranaki Regional Council:

a) receives this memorandum *National Planning Standards;*

b) notes the National Environmental Standards will be applied as Council plans are reviewed.

Background

5. As part of the 2017 amendments to the RMA, new national planning standards were to be introduced. The purpose of the national planning standards (planning standards) is to improve consistency in plan and policy statement structure, format and content. The planning standards also support implementation of other national direction, such as national policy statements, and aim to assist users to comply with the procedural principles of the RMA.

6. In the absence of central government guidance, councils have generally developed their plans and policy statements independently of each other. The Ministry for the Environment stated that because of this they are inconsistent and hard to understand, compare and comply with. It is their view that the wide variation in the structure and format of plans has meant that national direction, such as national policy statements, are often interpreted and implemented differently and it was felt that this reduced the effectiveness of these instruments.

7. The Rules Reduction Taskforce found in its September 2015 report that plans and policy statements are complex to the extent that people at all levels need specialist knowledge and experience to understand their provisions. Therefore, the planning standards are an attempt to standardise the basic elements of RMA plans and policy statements. The Government hopes that this will eventually enable councils and plan users to focus their resources on the matters that directly influence resource management outcomes.

The national planning standards

8. On 5 April 2019, the Minister for the Environment issued the first set of national planning standards which can be found by following this link https://www.mfe.govt.nz/node/24894/.

9. The purpose of the national planning standards "… is to *improve the efficiency and effectiveness of the planning system*". They provides mandatory directions for regional policy statements, regional plans, district plans and combined plans under the RMA in relation to their:
   - structure
   - format
   - definitions
   - noise and vibration metrics
   - electronic functionality and accessibility.

10. Of note, national planning standards do not apply to national policy statements or environmental standards prepared under the RMA. The rationale for this decision is interesting given the drive for consistency and efficient integration of national and regional planning instruments.

11. The Council must meet some basic electronic accessibility and functionality requirements by 5 April 2020. The standards must be implemented in their entirety within three years for the Regional Policy Statement and ten years for RMA plans. For practicality purposes, Council officers intend to develop the freshwater, land and air plans in the planning standard's structure and format as they are reviewed. Relevant definitions will also be incorporated where appropriate.

12. The structure and format of Proposed Coastal Plan will also be 'retrofitted' after its adoption due to its advanced stage in development. Definitions where appropriate are already reflected into revised versions of the Proposed Plan.

ePlanning

13. As part of the national planning standards, ePlanning has become a requirement. This involves the requirement for plans and policy statements prepared under the RMA to be available online in a prescribed interative format.

14. The regional sector Policy Managers' Special Interest Group (SIG) has identified a software solution to ePlanning is an important next step over the coming years. Several councils around New Zealand are already using various forms of ePlanning including Environment Canterbury, Marlborough District Council and New Plymouth District Council.

15. ePlans must include the following:

    a. a GIS viewer which:
       i. includes all spatial layers of the policy statement or plan maps
       ii. enables users to search for a specific property
       iii. enables users to select which spatial layers are displayed on the viewer.
    b. the ability for users to query the ePlan to display the plan provisions that apply to:
       i. a specific property by entering an address and by selecting the property in the GIS viewer
       ii. one or more specific activities managed by rules in the plan. Electronic Accessibility and Functionality Standard 67
    c. the ability to display the policy statement or plan version as at any date from when the policy statement or plan is in the ePlan, to the present (excluding interactive maps).
    d. the ability to download and print a copy of any part of the policy statement or plan (excluding interactive maps).
    e. the ability to link between provisions, including definitions of terms when viewing the term in the ePlan.
    f. the electronic seal of the local authority and an electronic signature verifying its authenticity in the ePlan, and in any downloaded or printed copy of the policy statement or plan.

16. Regional councils have worked collaboratively to procure a uniform ePlanning solution – ISOVIST.

17. The Council is implementing ISOVIST's ePlanning solutions. ISOVIST is the preferred ePlanning platform around the country and has been adopted locally by the New Plymouth District Council. ISOVIST have the specialist expertise and experience required to deliver a fit-for-purpose ePlan solution for Taranaki. It is expected that the ISOVIST eplanning solution will be ready for use in 2020 when Council officers are intending to notify the next round of RMA plans.

Decision-making considerations

18. Part 6 (Planning, decision-making and accountability) of the *Local Government Act 2002* has been considered and documented in the preparation of this agenda item. The recommendations made in this item comply with the decision-making obligations of the *Act*.

Financial considerations—LTP/Annual Plan

19. This memorandum and the associated recommendations are consistent with the Council's adopted Long-Term Plan and estimates. Any financial information included in this memorandum has been prepared in accordance with generally accepted accounting practice.

Policy considerations

20. This memorandum and the associated recommendations are consistent with the policy documents and positions adopted by this Council under various legislative frameworks including, but not restricted to, the *Local Government Act 2002*, the *Resource Management Act 1991* and the *Local Government Official Information and Meetings Act 1987*.

Iwi considerations

21. This memorandum and the associated recommendations are consistent with the Council's policy for the development of Māori capacity to contribute to decision-making processes (schedule 10 of the *Local Government Act 2002*) as outlined in the adopted long-term plan and/or annual plan. Similarly, iwi involvement in adopted work programmes has been recognised in the preparation of this memorandum.

Legal considerations

22. This memorandum and the associated recommendations comply with the appropriate statutory requirements imposed upon the Council.

Appendices/Attachments

23. Document 2241114: National Planning Standards.

Ministry for the Environment
Manatu Mo Te Taiao

National Planning Standards

New Zealand Government

This document may be cited as: Ministry for the Environment. 2019. *National Planning Standards*. Wellington: Ministry for the Environment.

Published in April 2019 by the
Ministry for the Environment
Manatū Mō Te Taiao
PO Box 10362, Wellington 6143, New Zealand

ISBN: 978-1-98-852598-3 (online)

Publication number: ME 1394

This document is available on the Ministry for the Environment website: www.mfe.govt.nz.

Contents

Tables

1. Foundation Standard

Purpose

The purpose of the first set of national planning standards (the planning standards) is to improve the efficiency and effectiveness of the planning system by providing nationally consistent:

- structure
- format
- definitions
- noise and vibration metrics
- electronic functionality and accessibility

for regional policy statements, regional plans, district plans and combined plans under the Resource Management Act 1991 ("RMA").

The planning standards do not alter the effect or outcomes of policy statements or plans.

Interpretation of terms in the planning standards

1. 'Policy statement or plan' includes: a regional policy statement, a proposed regional policy statement, a proposed plan, a plan, a variation or a change.
2. 'Combined plan' means a plan that meets the RMA requirements of two or more of the following: a regional policy statement, a regional plan (including a regional coastal plan) or a district plan.
3. 'ePlan' means an online interactive policy statement or plan.
4. 'Provisions' means all content in a policy statement or plan, including but not limited to background content, issues, objectives, policies, methods, rules, and anticipated environmental results.
5. 'Part [#]' is a title only, which groups together one or more chapters, appendices or maps. It is shown in the planning standards as all-caps white text on navy blue background. Parts have no provisions separate from their underlying chapters, appendices or maps.
6. 'Heading' is a title only, which groups together one or more chapters under a common theme for the plan users' ease of reference. It is shown in the planning standards as all-caps blue text. Headings have no provisions separate from their underlying chapters.
7. 'Chapter' is the main grouping of provisions in a policy statement or plan. It is shown in the planning standards as text to the right of a 'Chapters:' identifier.
8. 'Section' is a sub-grouping of provisions within a chapter. It is shown in the planning standards as text below or to the right of a 'Sections:' identifier.
9. '[square brackets]' means the local authority must enter its own applicable title or content. '(Round brackets)' have their standard grammatical meaning.

Mandatory directions

1. Every policy statement or plan must comply with the *1. Foundation* Standard.
2. Except for the mandatory directions in *16.A Electronic accessibility and functionality*, if a proposed policy statement or proposed plan complies with all the relevant planning standards, the operative policy statement or operative plan that will be replaced by the proposed policy statement or proposed plan does not have to comply with the planning standards.

3. The planning standards must be used in conjunction with each other where relevant. Table 1 sets out which planning standards are relevant to each type of policy statement or plan.
4. An appropriate term must be used wherever tangata whenua/mana whenua is shown in the planning standards. The appropriate term must be determined through engagement with affected groups, and may vary depending on the context. If agreement on an appropriate term cannot be reached through engagement, local authorities must use the term 'tangata whenua'.
5. Tangata whenua/mana whenua content must be integrated throughout the policy statement or plan where the local authority determines it appropriate.
6. The local authority seal and date the policy statement or plan was made operative must be included, below the title of the policy statement or plan in accordance with RMA Schedule 1 clause 17(3).
7. Unless otherwise directed in these planning standards, local authorities may use cross-references and links within the policy statement or plan. Any references or links to external material not incorporated by reference under RMA Schedule 1 Part 3 must be identified as not having legal effect beyond the scope provided for in the policy statement or plan.

Table 1: National Planning Standards relevant to each type of policy statement or plan

	Structure standards	Chapter standards	Form standards	Other standards
Regional policy statements	*2. Regional policy statement structure*	*6. Introduction and general provisions*	*10. Format* *11. Regional spatial layers* *13. Mapping* *16. Electronic accessibility and functionality*	*14. Definitions* *17. Implementation*
Regional plans	*3. Regional plan structure*	*6. Introduction and general provisions*	*10. Format* *11. Regional spatial layers* *13. Mapping* *16. Electronic accessibility and functionality*	*14. Definitions* *15. Noise and vibration metrics* *17. Implementation*
District plans	*4. District plan structure*	*6. Introduction and general provisions* *7. District-wide matters* *8. Zone framework* *9. Designations*	*10. Format* *12. District spatial layers* *13. Mapping* *16. Electronic accessibility and functionality*	*14. Definitions* *15. Noise and vibration metrics* *17. Implementation*
Combined regional policy statement, regional plan and district plan	*5. Combined plan structure*	*6. Introduction and general provisions* *7. District-wide matters: excluding the Strategic direction and Coastal environment directions, and replacing General district-wide matters heading with General matters heading* *8. Zone framework* *9. Designations*	*10. Format* *11. Regional spatial layers* *12. District spatial layers* *13. Mapping* *16. Electronic accessibility and functionality*	*14. Definitions* *15. Noise and vibration metrics* *17. Implementation*

	Structure standards	Chapter standards	Form standards	Other standards
Combined regional policy statement and regional plan	*5. Combined plan structure*	*6. Introduction and general provisions*	*10. Format* *11. Regional spatial layers* *13. Mapping* *16. Electronic accessibility and functionality*	*14. Definitions* *15. Noise and vibration metrics* *17. Implementation*
Combined plan – all others	*5. Combined plan structure*	*6. Introduction and general provisions* *7. District-wide matters* *8. Zone framework* *9. Designations*	*10. Format* *11. Regional spatial layers* *12. District spatial layers* *13. Mapping* *16. Electronic accessibility and functionality*	*14. Definitions* *15. Noise and vibration metrics* *17. Implementation*

2. Regional Policy Statement Structure Standard

Mandatory directions

Directions for all parts

1. All parts and their titles in table 2 must be included, in the order shown. Additional parts must not be included.
2. Chapters and sections that are black in table 2 must be included, in the order shown.
3. Unless otherwise specified, chapters and sections that are grey in table 2 must be included if relevant to the regional policy statement, in the order shown.
4. If a chapter in table 2 is included, its associated heading must also be included.
5. Local authorities must add sections and subsections within chapters where appropriate to organise related provisions.

Directions for Parts 2 and 3

6. The *Coastal environment* chapter must set out the approach to managing the coastal environment and giving effect to the New Zealand Coastal Policy Statement.
7. Any specific provisions relating to the coastal environment which are located in other topic chapters must be cross-referenced in the *Coastal environment* chapter.
8. Excluding the provisions in Part 2, provisions that apply to the coastal marine area must be located in the *Coastal marine area* section.
9. Provisions (excluding the provisions in Part 2) that:
   a. apply predominantly to only one topic must be located in the relevant chapter under the *Topics* heading
   b. apply to more than one topic must be located in the relevant chapters under the *Domains* heading.
10. Any other matter addressed by the regional policy statement not covered by the structure in table 2 must be included as a new chapter, inserted alphabetically under the *Topics* heading in Part 3. Additional chapters must not be synonyms or subsets of the chapters in table 2.
11. If overlays are used, their provisions must be located in the relevant *Domain* and *Topic* chapters and sections.

Directions for Part 5

12. Part 5 must be titled Appendices and Maps, or Appendices, or Maps depending on whether it contains appendices (including schedules and appendices not located within the relevant chapter) or static maps (in addition to or instead of a GIS viewer) or both.

Table 2: Regional policy statement structure

PART 1 – INTRODUCTION AND GENERAL PROVISIONS		
INTRODUCTION		
Chapters:	Foreword or mihi	
	Contents	
	Purpose	
	Description of the region	
HOW THE POLICY STATEMENT WORKS		
Chapters:	Statutory context	
	General approach	
	Cross boundary matters	
INTERPRETATION		
Chapters:	**Definitions**	
	Abbreviations	
	Glossary	
NATIONAL DIRECTION INSTRUMENTS		
Chapters:	**National policy statements and New Zealand Coastal Policy Statement**	
	National environmental standards	
	Regulations	
	Water conservation orders	
[TANGATA WHENUA/MANA WHENUA]		
Chapter:	**[Tangata whenua/mana whenua]**	
PART 2 – RESOURCE MANAGEMENT OVERVIEW		
Chapters:	**Significant resource management issues for the region**	
	Resource management issues of significance to iwi authorities in the region	
	Integrated management	
PART 3 – DOMAINS AND TOPICS		
DOMAINS		
Chapters:	Air	
	Coastal environment	Section: Coastal marine area
	Geothermal	
	Land and freshwater	
TOPICS		
Chapters:	Ecosystems and indigenous biodiversity	
	Energy, infrastructure and transport	
	Hazards and risks	
	Historical and cultural values	

	Natural character
	Natural features and landscapes
	Urban form and development
PART 4 – EVALUATION AND MONITORING	
Chapters:	**Monitoring the efficiency and effectiveness of the policy statement**
PART 5 – [APPENDICES AND MAPS]	
Chapters:	Appendices
	Maps

3. Regional Plan Structure Standard

Mandatory directions

Directions for all parts

1. All parts and their titles in table 3 must be included, in the order shown. Additional parts must not be included.
2. Chapters and sections that are black in table 3 must be included, in the order shown.
3. Unless otherwise specified, chapters and sections that are grey in table 3 must be included if relevant to the regional plan, in the order shown.
4. If a chapter in table 3 is included, its associated heading must also be included.
5. Local authorities must add sections and subsections within chapters where appropriate to organise related provisions.

Directions for Part 2

6. Objectives addressing the integrated management of resources or providing strategic direction on resource management, must be located in the *Integrated objectives* chapter.
7. Policies addressing the integrated management of resources or providing strategic direction on resource management, must be located in the *integrated policies* chapter.
8. The *Coastal environment* chapter must set out the approach to managing the coastal environment and giving effect to the New Zealand Coastal Policy Statement.
9. Any specific provisions relating to the coastal environment which are located in other topic chapters must be cross-referenced in the *Coastal environment* chapter.
10. The *Coastal marine area* section must be included unless a separate regional coastal plan or proposed regional coastal plan exists for the region.
11. If a regional plan does not include the *Coastal environment* chapter but includes the *Coastal marine area* section, that section becomes a chapter.
12. The *Coastal marine area* section must contain all coastal marine provisions, except for any coastal marine provisions under the *integrated management* heading, in the *Coastal zones* chapter or in the *Coastal precincts (multi-zone)* chapter.
13. Provisions that apply to the coastal marine area as a whole must be located in the *Coastal marine area* section and not in a zone.
14. Provisions (excluding the provisions under the *Integrated management* heading) that:
    a. apply only to a freshwater management unit, catchment, identified area, coastal zone or coastal precinct must be located in the relevant chapter under the *Area-specific matters* heading
    b. apply predominantly to only one topic (but not only to a freshwater management unit, catchment, identified area, coastal zone or coastal precinct) must be located in the relevant chapter under the *Topics* heading
    c. apply to more than one topic must be located in the relevant chapter under the *Domains* heading.
15. Any other matter addressed by the regional plan not covered by the structure in table 3 must be included as a new chapter, inserted alphabetically under the *Topics* heading in Part 2. Additional chapters must not be synonyms or subsets of the chapters in table 3.

16. Each catchment, freshwater management unit, identified area, coastal zone and multi-zone precinct under the *Area-specific matters* heading must have its own chapter.

17. If overlays are used, their provisions must be located in the relevant *Domain, Topic, Freshwater management unit, Catchment*, and *Area* chapters and sections.

Directions for Part 3

18. Part 3 must be titled Appendices and Maps, or Appendices, or Maps, depending on whether it contains appendices (including schedules and appendices not located within the relevant chapter) or static maps (in addition to or instead of a GIS viewer) or both.

Table 3: Regional plan structure

PART 1 – INTRODUCTION AND GENERAL PROVISIONS	
INTRODUCTION	
Chapters:	Foreword or mihi
	Contents
	Purpose
	Description of the region
HOW THE PLAN WORKS	
Chapters:	Statutory context
	General approach
	Cross boundary matters
	Relationships between spatial layers
INTERPRETATION	
Chapters:	**Definitions**
	Abbreviations
	Glossary
NATIONAL DIRECTION INSTRUMENTS	
Chapters:	**National policy statements and New Zealand Coastal Policy Statement**
	National environmental standards
	Regulations
	Water conservation orders
[TANGATA WHENUA/MANA WHENUA]	
Chapter:	**[Tangata whenua/mana whenua]**
PART 2 – MANAGEMENT OF RESOURCES	
INTEGRATED MANAGEMENT	
Chapters:	Integrated objectives
	Integrated policies
DOMAINS	
Chapters:	Air

	Coastal environment	**Section: Coastal marine area**[1]
	Geothermal	
	Land and freshwater	
TOPICS		
Chapters:	Ecosystems and indigenous biodiversity	
	Energy and infrastructure	
	Historic heritage	
	Natural character	
	Natural features and landscapes	
	Natural hazards	
	Sites and areas of significance to Māori	
AREA-SPECIFIC MATTERS		
Chapters:	[Insert name of freshwater management unit] freshwater management unit	
	[Insert name of catchment] catchment	
	[Insert name of area] area	
	Coastal zones	Section: [Insert name of coastal zone] zone
	Coastal precincts (multi-zone)	Section: [Insert name of coastal multi-zone precinct] precinct
PART 3 – [APPENDICES AND MAPS]		
Chapters:	Appendices	
	Maps	

[1] Refer to direction 10 in this standard.

4. District Plan Structure Standard

Mandatory directions

Directions for all parts

1. All parts and their titles in table 4 must be included, in the order shown. Additional parts must not be included.
2. Chapters and sections that are black in table 4 must be included, in the order shown.
3. Unless otherwise specified, chapters and sections that are grey in table 4 must be included if relevant to the district plan, in the order shown.
4. If a chapter in table 4 is included, its associated heading must also be included.
5. Local authorities must add sections and subsections within chapters where appropriate to organise related provisions.

Directions for Part 3

6. The zones chosen in Part 3 must be included, in the order shown in table 4.
7. If only one zone is chosen within a chapter, the zone name becomes the name of the chapter.
8. If used, the *Settlement zone* must be placed in either the *Rural*, *Residential* or the *Commercial and mixed use* zones chapters.
9. If used, the *Natural open space zone* must be placed in either the *Rural* zones or the *Open space and recreation* zones chapters.
10. If used, precincts that apply to only one zone must be located within the relevant zone chapter or section.
11. If used, precincts that apply to multiple zones, must use the *Precincts (multi-zone)* heading and each precinct must be a separate chapter.
12. If development areas are used, the *Development areas* heading must be included and each development area must be a separate chapter.
13. If overlays are used, their provisions must be located in the relevant *District-wide matters* chapters and sections.

Directions for Part 4

14. Part 4 must be titled Appendices and Maps, or Appendices, or Maps, depending on whether it contains appendices (including schedules and appendices not located within the relevant chapter) or static maps (in addition to or instead of a GIS viewer) or both.

Table 4: District plan structure

PART 1 – INTRODUCTION AND GENERAL PROVISIONS	
INTRODUCTION	
Chapters:	Foreword or mihi
	Contents
	Purpose
	Description of the district
HOW THE PLAN WORKS	
Chapters:	Statutory context
	General approach
	Cross boundary matters
	Relationships between spatial layers
INTERPRETATION	
Chapters:	**Definitions**
	Abbreviations
	Glossary
NATIONAL DIRECTION INSTRUMENTS	
Chapters:	**National policy statements and New Zealand Coastal Policy Statement**
	National environmental standards
	Regulations
	Water conservation orders
TANGATA WHENUA/MANA WHENUA	
Chapter:	[**Tangata whenua/mana whenua**]
PART 2 – DISTRICT-WIDE MATTERS	
STRATEGIC DIRECTION	
Chapters:	[Insert name of strategic direction matter]
	Urban form and development
ENERGY, INFRASTRUCTURE, AND TRANSPORT	
Chapters:	**[Insert name of chapter]**
HAZARDS AND RISKS	
Chapters:	Contaminated land
	Natural hazards
HISTORICAL AND CULTURAL VALUES	
Chapters:	Historical heritage
	Notable trees
	Sites and areas of significance to Māori
NATURAL ENVIRONMENT VALUES	
Chapters:	Ecosystems and indigenous biodiversity

	Natural character	
	Natural features and landscapes	
	Public access	
SUBDIVISION		
Chapters:	**[Insert name of chapter]**	
GENERAL DISTRICT-WIDE MATTERS		
Chapters:	Activities on the surface of water	
	Coastal environment	
	Earthworks	
	Light	
	Noise	
	Signs	
	Temporary activities	
PART 3 – AREA-SPECIFIC MATTERS		
ZONES		
Chapters:		**Sections:**
	Residential zones	Large lot residential zone
		Low density residential zone
		General residential zone
		Medium density residential zone
		High density residential zone
	Rural zones	General rural zone
		Rural production zone
		Rural lifestyle zone
		Settlement zone
	Commercial and mixed use zones	Neighbourhood centre zone
		Local centre zone
		Commercial zone
		Large format retail zone
		Mixed use zone
		Town centre zone
		Metropolitan centre zone
		City centre zone
	Industrial zones	Light industrial zone
		General industrial zone
		Heavy industrial zone
	Open space and recreation zones	Natural open space zone
		Open space zone

		Sport and active recreation zone
	Special purpose zones	Airport zone
		Corrections zone
		Future urban zone
		Hospital zone
		Māori purpose zone
		Port zone
		Stadium zone
		Tertiary education zone
		[Additional Special Purpose] zone
PRECINCTS (MULTI-ZONE)		
Chapters:	[Insert name of multi-zone precinct] precinct	
DEVELOPMENT AREAS		
Chapters:	[Insert name of development area] development area	
DESIGNATIONS		
Chapter:	**[Insert name of requiring authority]**	
PART 4 – [APPENDICES AND MAPS]		
Chapters:	Appendices	
	Maps	

5. Combined Plan Structure Standard

Mandatory directions

All combined plans

Directions for all parts

1. A combined plan that joins together:
   a. a regional policy statement, a regional plan and a district plan must use the structure in table 5
   b. a regional policy statement and a regional plan must use the structure in table 6
   c. a regional policy statement and a district plan must:
      i. include Part 1 – *Introduction and General Provisions* and the [Appendices and Maps] part as directed in *4. District Plan Structure* Standard, except that the 'Description of the district' chapter must be titled 'Description of the region and district(s)'
      ii. in between Part 1 – *Introduction and General Provisions* and the [Appendices and Maps] part, attach Parts 2–4 as directed in *2. Regional Policy Statement Structure* Standard, followed by Parts 2–3 as directed in *4. District Plan Structure* Standard
   d. a regional plan and a district plan must:
      i. include Part 1 – *Introduction and General Provisions* and the [Appendices and Maps] part as directed in *3. Regional Plan Structure* Standard
      ii. in between Part 1 – *Introduction and General Provisions* and the [Appendices and Maps] part, attach Part 2 as directed in *3. Regional Plan Structure* Standard, followed by Parts 2–3 as directed in *4. District Plan Structure* Standard.
2. All parts and their titles in tables 5 and 6 must be included, in the order shown. Additional parts must not be included.
3. Chapters and sections that are black in tables 5 and 6 must be included, in the order shown.
4. Unless otherwise specified, chapters and sections that are grey in tables 5 and 6 must be included if relevant to the plan, in the order shown.
5. If a chapter in tables 5 and 6 is included, its associated heading must also be included.
6. Local authorities must add sections and subsections within chapters where appropriate to organise related provisions.

Combined plan – regional policy statement, regional plan and district plan

Directions for Part 2

7. Provisions in Part 2 must be regional policy statement provisions.
8. Provisions that address the integrated management of resources across topics and domains must be located in the *Integrated management* chapter.

Directions for Parts 3 and 4

9. The *Coastal environment* chapter must set out the approach to managing the coastal environment and giving effect to the New Zealand Coastal Policy Statement.

10. Any specific provisions relating to the coastal environment which are located in other topic chapters must be cross-referenced in the *Coastal environment* chapter.
11. The *Coastal marine area* section must be included unless a separate regional coastal plan or proposed regional coastal plan exists for the region.
12. If the combined plan does not include the *Coastal environment* chapter but includes the *Coastal marine area* section, that section becomes a chapter.
13. The *Coastal marine area* section must contain all coastal marine provisions, except for any coastal marine provisions in Part 2, in the *Coastal zones* chapter or in the *Coastal precincts* chapter.
14. Provisions that apply to the coastal marine area as a whole must be located in the *Coastal marine area* section and not in a zone.
15. If a zone occurs both landward and seaward of mean high water springs, it must be located as a section within the most appropriate zone chapter.
16. Any other matter addressed by the plan not covered by the structure in table 5 must be included as a new chapter, inserted alphabetically under the relevant *Topic* heading in Part 3. Additional chapters must not be synonyms or subsets of the chapters in table 5.
17. Any regional policy statement issues not significant for the region or to iwi authorities must be located in Parts 3 and 4, as significant issues for the region or to iwi authorities must be located in Part 2.
18. Provisions (excluding the provisions in Part 2) that:
    a. apply only to a freshwater management unit, catchment, identified area or zone must be located in the relevant chapter or section of Part 4
    b. apply predominantly to only one topic (but not only to a freshwater management unit, catchment, identified area or zone) must be located in the relevant topic chapter of Part 3
    c. apply to more than one topic must be located in the relevant chapters under the *Domains* heading.
19. If overlays are used, their provisions must be located in the relevant *Domain*, *Topic*, *Freshwater Management Unit, Catchment* and *Area* chapters and sections*.*

Directions for Part 4

20. The zones chosen in Part 4 must be included, in the order shown in table 5.
21. If only one zone is chosen within a chapter, the zone name becomes the name of the chapter.
22. If used, the *Settlement zone* must be placed in either the *Rural*, *Residential* or the *Commercial and mixed use* zone chapters.
23. If used, the *Natural open space zone* must be placed in either the *Rural* zones or the *Open space and recreation* zones chapters.
24. If used, zones entirely in the coastal marine area must be separate sections within the *Coastal zones* chapter.
25. If used, zones that are both seaward and landward of mean high water springs must be placed in the most appropriate chapter of Part 4 in table 5.
26. If used, precincts (whether on land or in the coastal marine area) that apply to only one zone must be located within the relevant zone chapter or section.
27. If used, precincts landward of mean high water springs that apply to multiple zones, must use the *Precincts (multi-zone)* heading and each precinct must be a separate chapter.

28. If used, precincts seaward of mean high water springs and precincts on both sides of mean high water springs that apply to multiple zones, must use the *Coastal Precincts (multi-zone)* chapter and each precinct must be a separate section.
29. If development areas are used, the *Development areas* heading must be included and each development area must be a separate chapter.

Directions for Part 6

30. Part 6 must be titled Appendices and Maps, or Appendices, or Maps, depending on whether it contains appendices (including schedules and appendices not located within the relevant chapter) or static maps (in addition to or instead of a GIS viewer) or both.

Table 5: Plan structure for combined regional policy statement, regional plan and district plan

PART 1 – INTRODUCTION AND GENERAL PROVISIONS	
INTRODUCTION	
Chapters:	Foreword or mihi
	Contents
	Purpose
	Description of the region
HOW THE PLAN WORKS	
Chapters:	Statutory context
	General approach
	Cross boundary matters
	Relationship between spatial layers
INTERPRETATION	
Chapters:	**Definitions**
	Abbreviations
	Glossary
NATIONAL DIRECTION INSTRUMENTS	
Chapters:	**National policy statements and New Zealand Coastal Policy Statement**
	National environmental standards
	Regulations
	Water conservation orders
[TANGATA WHENUA/MANA WHENUA]	
Chapter:	**[Tangata whenua/mana whenua]**
PART 2 – RESOURCE MANAGEMENT OVERVIEW	
Chapters:	**Significant resource management issues for the region**
	Resource management issues of significance to iwi authorities
	Integrated management
PART 3 – DOMAINS AND TOPICS	

DOMAINS		
Chapters:	Air	
	Coastal environment	**Section: Coastal marine area**[2]
	Geothermal	
	Land and freshwater	
ENERGY, INFRASTRUCTURE AND TRANSPORT		
Chapters:	**[Insert name of chapter]**	
HAZARDS AND RISKS		
Chapters:	Contaminated land	
	Natural hazards	
HISTORICAL AND CULTURAL VALUES		
Chapters:	Historic heritage	
	Notable trees	
	Sites and areas of significance to Māori	
NATURAL ENVIRONMENT VALUES		
Chapters:	Ecosystems and indigenous biodiversity	
	Natural character	
	Natural features and landscapes	
	Public access	
SUBDIVISION		
Chapters:	**[Insert name of chapter]**	
URBAN FORM AND DEVELOPMENT		
Chapters:	**Urban form and development**	
GENERAL MATTERS		
Chapters:	Activities on the surface of water	
	Earthworks	
	Light	
	Noise	
	Signs	
	Temporary activities	
PART 4 – AREA-SPECIFIC MATTERS		
CATCHMENTS AND AREAS		
Chapters:	[Insert name of freshwater management unit] freshwater management unit	
	[Insert name of catchment] catchment	
	[Insert name of area] area	

[2] Refer to direction 11 in this standard.

ZONES		
Chapters:		**Sections:**
	Residential zones	Large lot residential zone
		Low density residential zone
		General residential zone
		Medium density residential zone
		High density residential zone
	Rural zones	General rural zone
		Rural production zone
		Rural lifestyle zone
		Settlement zone
	Commercial and mixed use zones	Neighbourhood centre zone
		Local centre zone
		Commercial zone
		Large format retail zone
		Mixed use zone
		Town centre zone
		Metropolitan centre zone
		City centre zone
	Industrial zones	Light industrial zone
		General industrial zone
		Heavy industrial zone
	Open space and recreation zones	Natural open zone
		Open space zone
		Sport and active recreation zone
	Coastal zones	[Insert name of coastal zone] zone
	Special purpose zones	Airport zone
		Corrections zone
		Future urban zone
		Hospital zone
		Māori purpose zone
		Port zone
		Stadium zone
		Tertiary education zone
		[Additional special purpose zone]

PRECINCTS (MULTI-ZONE)	
Chapters:	[Insert name of multi-zone precinct] precinct

	Coastal precincts	Section: [Insert name of coastal multi-zone precinct] precinct
DEVELOPMENT AREAS		
Chapters:	[Insert name of development area] development area	
DESIGNATIONS		
Chapters:	**[Insert name of requiring authority]**	
PART 5 – EVALUATION AND MONITORING		
Chapters:	**Monitoring the efficiency and effectiveness of regional policy statement provisions**	
PART 6 – [APPENDICES AND MAPS]		
Chapters:	Appendices	
	Maps	

Combined plan – regional policy statement and regional plan

Directions for Parts 2 and 3

31. If overlays are used, their provisions must be located in the relevant *Domain, Topic, Freshwater Management Unit, Catchment* and *Area* chapters and sections.

Directions for Part 2

32. Provisions in Part 2 must only be regional policy statement provisions.

33. Any other regional policy statement matter addressed by the plan not covered by Part 2 in table 6 must be included as a new chapter, inserted alphabetically under the *Topics* heading in Part 2. Additional matters must not be synonyms or subsets of the chapters in table 6.

34. Regional policy statement provisions addressing the integrated management of resources across topics and domains must be located in the *Integrated management* chapter.

35. The *Coastal environment* chapter in Part 2 must set out the regional policy statement approach to managing the coastal environment and giving effect to the New Zealand Coastal Policy Statement.

36. Any specific regional policy statement provisions relating to the coastal environment which are located within other topic chapters must be cross-referenced in the *Coastal environment* chapter in Part 2.

37. If the plan contains regional policy statement provisions that apply to the coastal marine area, these must be located in the *Coastal marine area* section in Part 2.

38. If provisions in the *Sites and areas of significance to Māori* chapter are also relevant to other domain or topic chapters in Part 2 – *Regional Policy Statement*, the other domain or topic chapters must contain a cross-reference to the relevant provisions in this chapter.

Directions for Part 3

39. Provisions in Part 3 must only be regional plan provisions.

40. Regional plan objectives addressing the integrated management of resources, or which provide strategic direction on resource management, must be located in the *Integrated objectives* chapter.

41. Regional plan policies addressing the integrated management of resources, or which provide strategic direction on resource management, must be located in the *Integrated policies* chapter.

42. The *Coastal environment* chapter must set out the regional plan approach to managing the coastal environment and giving effect to the New Zealand Coastal Policy Statement.

43. Any specific regional plan provisions relating to the coastal environment which are located in other topic chapters must be cross-referenced to the *Coastal environment* chapter.

44. The *Coastal marine area* section in Part 3 must be included unless a separate regional coastal plan or proposed regional coastal plan exists for the region.

45. If Part 3 does not include the *Coastal environment* chapter but includes the *Coastal marine area* section, that section becomes a chapter.

46. The *Coastal marine area* section must contain all regional plan coastal marine provisions, except for any coastal marine provisions under the *Integrated management* heading, in the *Coastal zones* chapter or in the *Coastal precincts (multi-zone)* chapter.

47. Regional plan provisions that apply to the coastal marine area as a whole must be located in the *Coastal marine area* section and not in a zone.

48. Regional plan provisions (excluding the provisions in Part 2) that:

    a. apply only to a freshwater management unit, catchment, identified area or zone must be located in the relevant chapter or section under the *Area-specific matters* heading.

    b. apply predominantly to only one topic (but not only to a freshwater management unit, catchment, identified area or zone) must be located in the relevant chapter and section under the *Topics* heading.

    c. apply to more than one topic must be located in the relevant chapters under the *Domains* heading.

49. Any other regional plan matter addressed by the plan not covered by Part 3 in table 6 must be included as a new chapter, inserted alphabetically in Part 3. Additional chapters must not be synonyms or subsets of the chapters in table 6.

50. If provisions in the *Sites and areas of significance to Māori* chapter are also relevant to other domain or topic chapters, the other domain or topic chapters must contain a cross-reference to the relevant provisions in this chapter.

51. Each catchment, freshwater management unit, geographic area or coastal zone under the *Area-specific matters* heading must have its own chapter.

Directions for Part 5

52. Part 5 must be titled Appendices and Maps, or Appendices, or Maps, depending on whether it contains appendices (including schedules and appendices not located within the relevant chapter) or static maps (in addition to or instead of a GIS viewer) or both.

Table 6: Plan structure for a combined regional policy statement and regional plan

PART 1 – INTRODUCTION AND GENERAL PROVISIONS	
INTRODUCTION	
Chapters:	Foreword or mihi
	Contents
	Purpose
	Description of the region
HOW THE PLAN WORKS	
Chapters:	Statutory context
	General approach

	Cross boundary matters	
	Relationship between spatial layers	
INTERPRETATION		
Chapters:	**Definitions**	
	Abbreviations	
	Glossary	
NATIONAL DIRECTIONS INSTRUMENTS		
Chapters:	**National policy statements and New Zealand Coastal Policy Statement**	
	National environmental standards	
	Regulations	
	Water conservation orders	
TANGATA WHENUA/MANA WHENUA		
Chapter:	**[Tangata whenua/mana whenua]**	
PART 2 – REGIONAL POLICY STATEMENT		
RESOURCE MANAGEMENT OVERVIEW		
Chapters:	**Significant resource management issues for the region**	
	Resource management issues of significance to iwi authorities	
	Integrated management	
DOMAINS		
Chapters:	Air	
	Coastal environment	Section: Coastal marine area
	Geothermal	
	Land and freshwater	
TOPICS		
Chapters:	Ecosystems and indigenous biodiversity	
	Energy, infrastructure and transport	
	Hazards and risks	
	Historical and cultural values	
	Natural character	
	Natural features and landscapes	
	Urban form and development	
PART 3 – REGIONAL PLAN		
INTEGRATED MANAGEMENT		
Chapters:	Integrated objectives	
	Integrated policies	
DOMAINS		
Chapters:	Air	

	Coastal environment	**Section: Coastal marine area**[3]
	Geothermal	
	Land and freshwater	
TOPICS		
Chapters:	Ecosystems and indigenous biodiversity	
	Energy and infrastructure	
	Historic heritage	
	Natural character	
	Natural features and landscapes	
	Natural hazards	
	Sites and areas of significance to Māori	
AREA-SPECIFIC MATTERS		
Chapters:	[Insert name of freshwater management unit] freshwater management unit	
	[Insert name of catchment] catchment	
	[Insert name of area] area	
	Coastal zones	Section: [Insert name of coastal zone] zone
	Coastal precincts (multi-zone)	Section: [Insert name of coastal multi-zone precinct] precinct
PART 4 – EVALUATION AND MONITORING		
Chapters:	**Monitoring the efficiency and effectiveness of regional policy statement provisions**	
PART 5 – [APPENDICES AND MAPS]		
Chapters:	Appendices	
	Maps	

[3] Refer to direction 45 in this standard.

6. Introduction and General Provisions Standard

Mandatory directions

Introduction

1. In paper or PDF versions of a policy statement or plan, a contents page detailing all parts, chapters, sections and any subsections must be included in the *Contents* chapter.
2. ePlans must include a form of navigation.
3. If the statutory purpose of the policy statement or plan is included, it must be located in the *Purpose* chapter.
4. If key information (including issues) about the region or district relevant from a resource management perspective is included in the policy statement or plan, it must be located *in Description of the region, or Description of the district* chapter.

How the policy statement or plan works

5. If the following matters are addressed, they must be located in the *Statutory context* chapter:
    a. a list of all RMA planning documents relevant to the region or district, and how they relate to each other and to the policy statement or plan
    b. how Māori and Treaty of Waitangi matters in Part 2 of the RMA including but not limited to sections 6(e), 6(f), 6(g), 7(a) and 8, are addressed
    c. information or a reference and link to information, required by any existing or pending Treaty of Waitangi settlement legislation or related statutory documents
    d. a list of other plans that are relevant to the context or content of the policy statement or plan under sections 61(2) and (2A), 66(2) and (2A) and 74(2) and (2A) of the RMA.
    e. other legislation that directs changes to an RMA policy statement or plan.
6. If the following matters are addressed, they must be located in the *General approach* chapter:
    a. an explanation of the approach to integrated management, including (where relevant) hapū or iwi management values or practices
    b. the steps plan users should take to determine if an activity is provided for by the policy statement or plan
    c. how resource consent applications subject to multiple zones or chapters are treated
    d. an outline of administrative or other provisions of the RMA that apply
    e. information to be submitted with a resource consent application
    f. how controlled and restricted discretionary activities will be assessed in addition to the specific requirements in individual rules
    g. any other matter that assists with the use of the policy statement or plan.
7. If the following matters are addressed, they must be located in the *Cross boundary matters* chapter:
    a. processes and other provisions for dealing with issues that cross jurisdictional boundaries
    b. processes and other provisions for dealing with issues between local authorities.

8. The *relationships between spatial layers* chapter must include an explanation of how spatial layers relate to one another (further detail may be included in specific chapters).

Interpretation

9. Definitions must be located in the *Definitions* chapter in accordance with *14. Definitions* Standard.
10. Definitions must be included in a single list, which includes both terms required by the planning standards, and additional terms the local authority chooses to define.
11. The *10. Format* Standard and *14. Definitions* Standard provide the structure, form and content for this chapter.
12. Abbreviations must be located in the *Abbreviations* chapter, using table 7.

Table 7: Abbreviations

Abbreviations	Full terms
NES	National environmental standard
NPS	National policy statement
NZCPS	New Zealand Coastal Policy Statement
[Abbreviation]	[Insert full term]

13. Abbreviations must be listed numerically and then alphabetically.
14. If a glossary is provided, it must be located in the *Glossary* chapter, using Table 8.

Table 8: Glossary

Term	Explanation
[Term]	[Explanation, and reference to any relevant legislation]

15. Terms must be listed numerically and then alphabetically.

National direction instruments

16. A national policy statement and New Zealand Coastal Policy Statement table must be provided in the form in table 9 in the *National policy statements and New Zealand Coastal Policy Statement* chapter.
17. Table 9 must be in accordance with the following directions:
    a. Policy statements or plans must provide a link to the document listed in the first column.
    b. The 'Hauraki Gulf Marine Park Act 2000' must be included in the first column when relevant to the region or district.
    c. For each national policy statement or New Zealand Coastal Policy Statement insert one of the following options in the second column:
        iii. The ['policy statement' or 'plan'] has been reviewed [insert any relevant review dates and references to relevant changes]
        iv. This national policy statement does not apply to the ['policy statement' or 'plan']
        v. The ['policy statement' or 'plan'] has not yet been reviewed

Table 9: National policy statements and New Zealand Coastal Policy Statement

National policy statements and New Zealand Coastal Policy Statement
National policy statements (NPSs) and the New Zealand Coastal Policy Statement (NZCPS) form part of the Resource Management Act's policy framework and are prepared by central government. NPSs and the NZCPS contain objectives,

National policy statements and New Zealand Coastal Policy Statement	
polices and methods that must be given effect to by policy statements and plans. NPSs and the NZCPS must also be given regard to by consent authorities when making decisions on resource consent applications, alongside other considerations. The following table provides an overview of whether any relevant review/s of the [insert name of policy statement or plan] has been undertaken in relation to NPSs and the NZCPS.	
National Policy Statement on Freshwater Management 2014 (amended in August 2017)	[insert the relevant option from instruction 17c]
National Policy Statement on Urban Development Capacity 2016	[insert the relevant option from instruction 17c]
National Policy Statement on Renewable Electricity Generation 2011	[insert the relevant option from instruction 17c]
New Zealand Coastal Policy Statement 2010	[insert the relevant option from instruction 17c]
National Policy Statement on Electricity Transmission 2008	[insert the relevant option from instruction 17c]
[Hauraki Gulf Marine Park Act 2000 (sections 7 and 8)]	[insert the relevant option from instruction 17c]

18. A national environmental standards table must be provided in the form in table 10 in the *National environmental standards* chapter.

19. Plans must provide a link to the national environment standards listed in table 10 [or when a new national environmental standard is promulgated].

Table 10: National environmental standards

National environmental standards
National environmental standards (NESs) are prepared by central government and can prescribe technical standards, methods (including rules) and/or other requirements for environmental matters throughout the whole country or specific areas. If an activity doesn't comply with an NES, it is likely to require a resource consent. NESs must be observed and enforced by local authorities. The following NESs are currently in force: • Resource Management (National Environmental Standard on Plantation Forestry) Regulations 2017 • Resource Management (National Environmental Standards for Telecommunication Facilities) Regulations 2016 • Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 • Resource Management (National Environmental Standards for Electricity Transmission Activities) Regulations 2009 • Resource Management (National Environmental Standard for Sources of Drinking Water) Regulations 2007 • Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (amended 2011)

20. A regulations table must be provided in the form in table 11 in the *Regulations* chapter.

21. Policy statements or plans must provide a link to the regulations listed in table 11 or when a new regulation is promulgated.

Table 11: Regulations

Regulations
The regulations included in this chapter come under the Resource Management Act 1991 (excluding the national environmental standards listed above). These regulations are: • Resource Management (Discount on Administrative Charges) Regulations 2010 • Resource Management (Exemption) Regulations 1996 • Resource Management (Exemption) Regulations 2017 • Resource Management (Forms, Fees, and Procedure) Regulations 2003 • Resource Management (Infringement Offences) Regulations 1999 • Resource Management (Marine Pollution) Regulations 1998 • Resource Management (Measurement and Reporting of Water Takes) Regulations 2010

Regulations
• Resource Management (Network Utility Operations) Regulations 2016
• Resource Management (Transitional, Fees, Rents, and Royalties) Regulations 1991

22. A water conservation order table must be provided in the form of table 12 in the *Water conservation orders* chapter, if one or more water conservation orders are located in the region or district.

23. Table 12 must be in accordance with the following directions:

    a. Policy statements or plans must provide a link to the water conservation order when it is included.

    b. For each water conservation order insert one of the following options in the second column:

        i. The [‘policy statement’ or ‘plan’] has been reviewed. [insert any relevant review dates and references to relevant changes]

        ii. The [‘policy statement’ or ’plan’] has not yet been reviewed.

Table 12: Water conservation orders

Water conservation orders	
Regional policy statements, regional plans and district plans cannot be inconsistent with the provisions of a water conservation order. A water conservation order can prohibit or restrict a regional council issuing new water and discharge permits, although it cannot affect existing permits. The following table provides an overview of whether any relevant review/s of the [insert name of policy statement or plan] have been undertaken in relation to relevant water conservation orders.	
[Insert name of water conservation order]	[insert relevant option from 23b]

24. Local authorities must consider whether to include additional content in the *National direction instruments* chapters, including within tables 9-12. This content can address the implementation of national direction in the local setting.

Tangata whenua/mana whenua

25. The provisions under the [*Tangata whenua/Mana whenua*] heading must only include context and process-related provisions. Other tangata whenua/mana whenua provisions must be integrated throughout the policy statement or plan where the local authority determines it is appropriate.

26. Local authorities must consider the matters in direction 28, and may include provisions relating to these matters. These decisions must be made after engaging with tangata whenua/mana whenua. Provisions may include links to material outside the policy statement or plan.

27. Chapters and sections under this heading may be structured as appropriate, but must comply with *10. Format* Standard*.*

28. Matters to consider for provisions under the [*Tangata whenua/Mana whenua*] heading:

    a. Recognition of hapū and iwi

        i. a history of the hapū or iwi within the rohe

        ii. the relationship of hapū or iwi with their rohe

        iii. environmental management perspectives and values of hapū or iwi

        iv. a description of resources of significance to tangata whenua/mana whenua

        v. where agreed with the iwi authorities, a list of relevant iwi authorities. Where possible this should include links to iwi authority websites

        vi. where agreed with iwi authorities, a description of the relationship of hapū or iwi with ancestral lands, water, sites, wāhi tapu, and other taonga, and interests in resource management

vii. an explanation of how hapū or iwi values have been considered when preparing the policy statement or plan, or are reflected in the policy statement or plan

viii. an overview of resource management arrangements from any Treaty settlement and post-treaty settlement agreements

ix. a list of any statutory acknowledgements for the district and region, and a brief explanation of how they affect the policy statement or plan and are reflected in policy statement or plan provisions. Where possible this should include a link to the relevant statutory acknowledgement legislation

x. if a statutory acknowledgement requires a specific resource management processes, identification of that process.

b. Tangata whenua/mana whenua – local authority relationships

i. a list of formal relationships agreements between tangata whenua/mana whenua and the local authority as they relate to resource management functions. These may include memoranda of understanding, mana whakahono a rohe or iwi participation arrangements, co-management agreements, joint management agreements, or transfer of powers under RMA section 33. Where agreed with tangata whenua/mana whenua this list should include links to these relationship agreement documents.

c. Hapū and iwi planning documents

i. a list of hapū or iwi planning documents lodged with the local authority. Where agreed with tangata whenua/mana whenua this should include links to the planning documents

ii. a description of how the local authority has taken the hapū or iwi planning documents into account in the policy statement or plan

iii. an explanation of how hapū or iwi planning documents are used

iv. if relevant and agreed, parts of the hapū or iwi planning documents.

d. Involvement and participation with tangata whenua/mana whenua

i. any specific involvement and participation or RMA consultation processes with tangata whenua/mana whenua: required by the RMA, in relationship agreements, or in hapū or iwi planning documents

ii. a description of best practice involvement, participation or RMA consultation processes with hapū or iwi, as agreed with specific hapū or iwi. This may include a link or reference to external best practice processes documents

iii. an explanation of the purpose of any involvement, participation or RMA consultation processes

iv. how the involvement, participation or RMA consultation processes are given effect to.

7. District-wide Matters Standard

Mandatory directions

Strategic direction

1. If the following matters are addressed, they must be located under the *Strategic direction* heading:
    a. an outline of the key strategic or significant resource management matters for the district
    b. issues, if any, and objectives that address key strategic or significant matters for the district and guide decision making at a strategic level
    c. policies that address these matters, unless those policies are better located in other more specific chapters
    d. how resource management issues of significance to iwi authorities are addressed in the plan.
2. Rules must not be included under the *Strategic direction* heading.
3. An *Urban form and development* chapter must be included under the *Strategic direction* heading.
4. Each strategic direction matter must be its own chapter and be included alphabetically under the *Strategic direction* heading.

Energy, infrastructure and transport

5. Provisions relating to energy, infrastructure and transport that are not specific to the *Special purpose zones* chapter or sections must be located in one or more chapters under the *Energy, infrastructure and transport* heading. These provisions may include:
    a. statement about the status of transport corridors eg, the adjoining zoning applies to the centre line of mapped roads
    b. noise-related metrics and noise measurement methods relating to energy, infrastructure and transport, which must be consistent with the *15. Noise and vibration metrics* Standard
    c. the management of reverse sensitivity effects between infrastructure and other activities.
6. The chapters under the *Energy, infrastructure and transport* heading must include cross-references to any energy, infrastructure and transport provisions in a *Special purpose zones* chapter or sections.
7. Zone chapters must include cross-references to relevant provisions under the *Energy, infrastructure and transport* heading.
8. All chapters must be included alphabetically.

Hazards and risks

9. If provisions to manage contaminated land are addressed, they must be located in the *Contaminated land* chapter.
10. If provisions relating to natural hazards are addressed (except coastal hazards), they must be located in the *Natural hazards* chapter.
11. The *Natural hazards* chapter must include cross-references to any coastal hazards provisions in the *Coastal environment* chapter.
12. If provisions relating to hazardous substances are addressed, they must be located in a chapter titled *Hazardous substances* under the *Hazards and risks* heading.
13. If the following matters are addressed, they must be located in a *Hazardous substances* chapter:

a. any provision required to manage the land use aspects of hazardous substances

b. provisions relating to the use, storage and disposal of hazardous substances on land that presents a specific risk to human or ecological health, safety and property

c. provisions required to manage land use in close proximity to major hazard facilities to manage risk and reverse sensitivity issues.

14. Any additional chapters to address other hazards and risks must be included alphabetically under the *Hazards and risks* heading.

Historical and cultural values

15. If the following matters are addressed, they must be located in the *Historic heritage* chapter:

a. identification of historic heritage

b. provisions to protect and manage historic heritage

c. heritage orders

d. schedule(s) of identified historic heritage and heritage orders. This may cross-reference an appendix.

16. If the following matters are addressed, they must be located in the *Notable trees* chapter:

a. identification of individual trees or groups of trees

b. provisions to manage trees or groups of trees

c. a schedule(s) of individual trees and groups of trees. This schedule must include a description of the tree(s) including the species of the tree(s). This may cross-reference an appendix.

17. If the following matters are addressed, they must be located in the *Sites and areas of significance to Māori* chapter:

a. descriptions of the sites and areas (eg, wāhi tapu, wāhi tūpuna, statutory acknowledgement, customary rights, historic site, cultural landscapes, taonga and other culturally important sites and areas) when there is agreement by Māori to include this information

b. provisions to manage sites and areas of significance to Māori

c. a description of agreed process of identification of sites and areas including an explanation of how tangata whenua or mana whenua are engaged

d. a schedule(s) that lists the specific or general location of sites and areas of significance to Māori when this information is provided. This may cross-reference an appendix

e. a description of any regulatory processes for identification.

18. Any additional chapters to address other historical and cultural values on a district-wide basis must be included alphabetically under the *Historical and cultural values* heading.

Natural environment values

19. If the following matters are addressed, they must be located in the *Ecosystems and indigenous biodiversity* chapter:

a. identification and management of significant natural areas, including under s6(c) of the RMA

b. maintenance of biological diversity

c. intrinsic values of ecosystems and indigenous biodiversity.

20. If provisions to protect the natural character of wetlands, lakes and rivers and their margins are addressed, they must be located in the *Natural character* chapter.

21. If the following matters are addressed, they must be located in the *Natural features and landscapes* chapter:
    a. identification of features and landscapes that are outstanding, significant or otherwise valued
    b. provisions to protect and manage outstanding natural features and landscapes including from inappropriate subdivision, use and development
    c. provisions to manage other valued features and landscapes.
22. If provisions to maintain and enhance public access to and along the coastal marine area, lakes, and rivers are addressed they must be located in the *Public access* chapter.
23. Any additional chapters to address other natural environment values on a district-wide basis must be included alphabetically under the *Natural environment values* heading.

Subdivision

24. Subdivision provisions must be located in one or more chapters under the *Subdivision* heading. These provisions may include:
    a. any technical subdivision requirements from Part 10 of the RMA
    b. material incorporated by reference, such as Codes of Practice, under Part 3 of Schedule 1 of the RMA.
25. The chapters under the *Subdivision* heading must include cross-references to any relevant provisions under the *Energy, infrastructure and transport* heading.
26. All chapters must be included alphabetically.

General district-wide matters

27. If provisions for managing activities on the surface of water are addressed, they must be located in the *Activities on the surface of water* chapter.
28. If the district has a coastline, a *Coastal environment* chapter must be provided that:
    a. sets out the approach to managing the coastal environment and giving effect to the NZCPS
    b. sets out provisions for implementing the local authorities functions and duties in relation to the coastal environment, including coastal hazards
    c. provides cross-references to any other specific coastal provisions that may be located within other chapters.
29. If provisions for managing earthworks are addressed, they must be located in the *Earthworks* chapter. This chapter may also include:
    a. provisions for quarries and gravel extraction where managed on a district-wide basis
    b. provisions for mining where they are managed on a district-wide basis.
30. The *Earthworks* chapter must include cross-references to any relevant earthworks provisions under the *Energy, infrastructure, and transport* heading.
31. The *Earthworks* chapter must include cross-references to any provisions for mining, quarries and or gravel extraction in a Special purpose zone or zone chapter or section.
32. If provisions for managing light are addressed, they must be located in the *Light* chapter. These provisions may include:
    a. provisions for light spill and glare (including light spill limits) for different zones, receiving environments or other spatially defined area
    b. specific requirements for common significant light generating activities.

33. If provisions for managing noise are addressed, they must be located in the *Noise* chapter. These provisions may include:

    a. noise provisions (including noise limits) for zones, receiving environments or other spatially defined area

    b. requirements for common significant noise generating activities

    c. sound insulation requirements for sensitive activities and limits to the location of those activities relative to noise generating activities.

34. Any noise-related metrics and noise measurement methods must be consistent with the *15. Noise and vibrations metrics* Standard.

35. The *Noise* chapter must include cross-references to any relevant noise provisions under the *Energy, infrastructure, and transpo*rt heading.

36. If provisions for managing signs are addressed, they must be located in the *Signs* chapter.

37. If provisions to manage temporary activities, buildings and events are addressed, they must be located in the *Temporary activities* chapter.

38. Any additional chapters to address other matters on a district-wide basis must be included alphabetically under the *General district-wide matters* heading.

8. Zone Framework Standard

Mandatory directions

1. A district plan, and a combined plan with a district plan component (for areas landward of mean high water springs), must only contain the zones listed in table 13 consistent with the description of those zones, except for:
    a. a special purpose zone when direction 3 is followed, or
    b. in the case of a combined plan that includes a regional plan and district plan, a zone that is both seaward and landward of mean high water springs.
2. If an existing zone in a plan is consistent with the description of a zone in table 13, that existing zone must use that zone name in table 13, and the associated zone colour in *13. Mapping* Standard table 19.
3. An additional special purpose zone must only be created when the proposed land use activities or anticipated outcomes of the additional zone meet all of the following criteria:
    a. are significant to the district, region or country
    b. are impractical to be managed through another zone
    c. are impractical to be managed through a combination of spatial layers.
4. Provisions developed for each zone must manage the use, development, and protection of natural and physical resources in it, in accordance with Part 2 of the RMA.

Discretionary direction

5. Except for zones that are renamed through mandatory direction 2, a local authority must choose at least one of the zones in table 13 to use in its plan.

Table 13: Zone names and descriptions

Zone name	Description
Large lot residential zone	Areas used predominantly for residential activities and buildings such as detached houses on lots larger than those of the Low density residential and General residential zones, and where there are particular landscape characteristics, physical limitations or other constraints to more intensive development.
Low density residential zone	Areas used predominantly for residential activities and buildings consistent with a suburban scale and subdivision pattern, such as one to two storey houses with yards and landscaping, and other compatible activities.
General residential zone	Areas used predominantly for residential activities with a mix of building types, and other compatible activities.
Medium density residential zone	Areas used predominantly for residential activities with moderate concentration and bulk of buildings, such as detached, semi-detached and terraced housing, low-rise apartments, and other compatible activities.
High density residential zone	Areas used predominantly for residential activities with high concentration and bulk of buildings, such as apartments, and other compatible activities.
General rural zone	Areas used predominantly for primary production activities, including intensive indoor primary production. The zone may also be used for a range of activities that support primary production activities, including associated rural industry, and other activities that require a rural location.

Zone name	Description
Rural production zone	Areas used predominantly for primary production activities that rely on the productive nature of the land and intensive indoor primary production. The zone may also be used for a range of activities that support primary production activities, including associated rural industry, and other activities that require a rural location.
Rural lifestyle zone	Areas used predominantly for a residential lifestyle within a rural environment on lots smaller than those of the General rural and Rural production zones, while still enabling primary production to occur.
Settlement zone	Areas used predominantly for a cluster of residential, commercial, light industrial and/or community activities that are located in rural areas or coastal environments.
Neighbourhood centre zone	Areas used predominantly for small-scale commercial and community activities that service the needs of the immediate residential neighbourhood.
Local centre zone	Areas used predominantly for a range of commercial and community activities that service the needs of the residential catchment.
Commercial zone	Areas used predominantly for a range of commercial and community activities.
Large format retail zone	Areas used predominantly for commercial activities which require large floor or yard areas.
Mixed use zone	Areas used predominantly for a compatible mixture of residential, commercial, light industrial, recreational and/or community activities.
Town centre zone	Areas used predominantly for: • in smaller urban areas, a range of commercial, community, recreational and residential activities. • in larger urban areas, a range of commercial, community, recreational and residential activities that service the needs of the immediate and neighbouring suburbs.
Metropolitan centre zone	Areas used predominantly for a broad range of commercial, community, recreational and residential activities. The zone is a focal point for sub-regional urban catchments.
City centre zone	Areas used predominantly for a broad range of commercial, community, recreational and residential activities. The zone is the main centre for the district or region.
Light industrial zone	Areas used predominantly for a range of industrial activities, and associated activities, with adverse effects (such as noise, odour, dust, fumes and smoke) that are reasonable to residential activities sensitive to these effects.
General industrial zone	Areas used predominantly for a range of industrial activities. The zone may also be used for activities that are compatible with the adverse effects generated from industrial activities.
Heavy industrial zone	Areas used predominantly for industrial activities that generate potentially significant adverse effects. The zone may also be used for associated activities that are compatible with the potentially significant adverse effects generated from industrial activities.
Natural open space zone	Areas where the natural environment is retained and activities, buildings and other structures are compatible with the characteristics of the zone.
Open space zone	Areas used predominantly for a range of passive and active recreational activities, along with limited associated facilities and structures.
Sport and active recreation zone	Areas used predominantly for a range of indoor and outdoor sport and active recreational activities and associated facilities and structures.
Special purpose zones	

Zone name	Description
Airport zone	Areas used predominantly for the operation and development of airports and other aerodromes as well as operational areas and facilities, administrative, commercial and industrial activities associated with airports and other aerodromes.
Corrections zone	Areas used predominantly for the efficient operation and development of prisons and associated facilities and activities and the security requirements of prisons. The zone may also be used for new and changing approaches to prisoner reintegration and rehabilitation.
Future urban zone	Areas suitable for urbanisation in the future and for activities that are compatible with and do not compromise potential future urban use.
Hospital zone	Areas used predominantly for the operation and development of locally or regionally important medical, surgical or psychiatric care facilities, as well as health care services and facilities, administrative and commercial activities associated with these facilities.
Māori purpose zone	Areas used predominantly for a range of activities that specifically meet Māori cultural needs including but not limited to residential and commercial activities.
Port zone	Areas used predominantly for the operation and development of ports as well as operational areas and facilities, administrative, commercial and industrial activities associated with ports.
Stadium zone	Areas used predominantly for the operation and development of large-scale sports and recreation facilities, buildings and structures. It may accommodate a range of large-scale sports, leisure, entertainment, art, recreation, and/or event and cultural activities.
Tertiary education zone	Areas used predominantly for the operation and development of tertiary education facilities and associated activities.

9. Designations Standard

Mandatory directions

1. Each relevant requiring authority name must be a chapter under the *Designations* heading. Chapters must be included alphabetically.
2. Designation tables must be included numerically based on the number in the designation unique identifier.

Table 14: Designations

[Name of designation]	
Designation unique identifier	
Designation purpose	
Site identifier	
Lapse date	
Designation hierarchy under section 177 of the Resource Management Act	[insert 'Primary', 'Secondary' or 'Varies']
Conditions	[insert 'Yes' and a link to schedule or external document if not included below table or 'No']
Additional information	[insert additional information or 'n/a']

3. A separate designation table in the form provided in table 14 must be used for each designation in a chapter.
4. Designation unique identifiers required in the right-hand column of table 14 must use the applicable requiring authority unique identifier in table 15 followed by a sequential number for each designation. All other requiring authority unique identifiers must be created in accordance with the *10. Format* Standard.
5. Information included in the right-hand column of the site identifier row in table 14 must be one or more of the following:
    a. a legal description
    b. a physical address
    c. a site name
    d. a site description.
6. Information in the right-hand column of the lapse date row in table 14 may be:
    a. the lapse date
    b. identification that designation has been given effect.
7. Designation conditions must be included in the plan or referenced through one of the following means:
    a. free form text below the relevant table
    b. an appendix to the designations chapter
    c. a link to an external document.

Table 15: Requiring authority unique identifiers

Requiring authority unique identifiers	
ACNZ	Airways Corporation of New Zealand Ltd
CNZ	Chorus NZ Ltd
KRH	KiwiRail Holdings Ltd
KL	Kordia Ltd
MSNZ	Meteorological Service of New Zealand
MCHI	Minister for Children
MCOR	Minister of Corrections
MCOU	Minister for Courts
MDEF	Minister of Defence
MEDU	Minister of Education
MPOL	Minister of Police / NZ Police
MJUS	Minister of Justice
MCON	Minister of Conservation
MLAN	Minister for Land Information
NZTA	New Zealand Transport Agency
SPK	Spark New Zealand Trading Ltd
NZME	NZME (in respect of the radio networks)
TPR	Transpower New Zealand Ltd

10. Format Standard

Mandatory directions

Order and grouping of provision types

1. Unless otherwise stated, if a type of provision listed below is used, the title must be used, in the order shown and the provisions must be located beneath the title:

   Regional policy statements

   Issues

   Objectives

   Policies

   Methods

   Principal reasons

   Anticipated environmental results

   Regional plans/district plans

   Issues (if stated)

   Objectives

   Policies

   Rules (if any)

   Methods other than rules (if stated)

   Principal reasons (if stated)

   Anticipated environmental results (if stated).

2. Unless otherwise stated, all of the provisions listed above included in a chapter, section or sub-section must be grouped according to provision type.

Matters associated with rules

3. Any rules must be ordered in the following way: permitted, controlled, restricted discretionary, discretionary, non-complying, prohibited. Where a single rule contains more than one activity status, this order must be used within the single rule.
4. Activity status and relevant matters of control or discretion must be located with the specific rule they apply to.
5. If a activity status is abbreviated the following abbreviations must be used: 'PER' for permitted, 'CON' for controlled, 'RDIS' for restricted discretionary, 'DIS' for discretionary, 'NC' for non-complying and 'PR' for prohibited.

Differentiating provisions subject to change, variation or appeal

6. A means (eg, side-bar annotation or similar) to differentiate the status of policy statement or plan provisions must be included that indicates:
   a. provisions that are subject to plan change or variation
   b. provisions that are subject to appeal.

Differentiating the status of rules in proposed plans

7. In accordance with s86E of the RMA, proposed plans must include a means (eg, side-bar annotation or similar) to differentiate any rule that has legal effect from a date other than the date on which the decision on submissions relating to the rule is made and publicly notified under clause 10(4) of Schedule 1 to the RMA.

Differentiating provisions in combined plans

8. Combined plans must identify the type of provisions using the following abbreviations, placed next to each provision:
   a. RPS – for regional policy statement provisions
   b. RP – for regional plan excluding regional coastal plan provisions
   c. RCP – for regional coastal plan provisions
   d. DP – for district plan provisions.
9. The abbreviation in direction 8 must be placed next to the part, chapter, section or sub-section titles instead of next to specific provisions if all the provisions in the part, chapter, section or sub-section are provisions of one particular type.

Changes to policy statement or plan text

10. Where text in an ePlan is changed as a result of a change or variation, policy statements or plans must show the date and name of the relevant change or variation by a side bar annotation or similar means.

Differentiating defined terms

11. Unless the context otherwise requires, terms defined in a policy statement or plan must be differentiated (eg, by text highlighting, italicising or similar). This includes where that term is within another definition.
12. ePlans must include a means to view a definition (eg, a pop-up box, link to the *Definitions* chapter or similar) when the defined term is selected. For policy statements or plans otherwise displayed online, a link to the definition of the term in the *Definitions* chapter must be provided.
13. If a definition copies a definition from legislation or national direction the definition must be differentiated (eg, by text highlighting, italicising or similar) and must include the title and version of the source document.

Matters associated with schedules

14. Each schedule must include the following information for each site or item identified:
   a. unique identifier (created by the local authority)
   b. site identifier (eg, legal description, physical address, site name or description)
   c. site type (including description of values)
   d. map reference or link.
15. Local authorities must consider whether to include additional relevant information in schedules.

Identification of chapters, sections and sub-sections

Mandatory directions	Examples
16. All chapters and sections must use the titles provided in table 16.	
17. Local authorities must identify all chapters, sections and sub-sections in the *Introduction and general provisions, Evaluation and monitoring,* and *Appendices and maps* parts.	Part 1 – Introduction and general provisions Introduction (heading) 1.1 Mihi 1.2 Purpose 1.3 Description of the region (when a local authority chooses to apply this numbering sequence to the introduction heading in Part 1)
18. Additional chapters, excluding chapters in the *Introduction and general provisions*, *Evaluation and monitoring*, and *Appendices and maps* parts, must be identified with a unique identifier consisting of the key two to five letters of the chapter title in capital letters, a space, an en-dash, a space, and the chapter title.	'MIN – Mining' when a chapter on mining is included
19. Additional sections, excluding sections in the *Introduction and general provisions, Evaluation and monitoring*, and *Appendices and maps* parts, must be identified with a unique identifier consisting of the key two to five letters of the chapter title in capital letters, a space, an en-dash, a space, then the key two to five letters of the section title in capital letters, a en-dash, a space, and the section title.	'CE – PA – Public access' (when a section on *public access* is included in a *coastal environment* chapter of a regional plan)
20. Additional sub-sections must include a sub-section title.	'Walkways' (when a sub-section on walkways in a *public access* section is included)
21. If a local authority inserts an additional chapter or section, the key two to five letters must be unique and not duplicate any unique identifier specified in table 16.	

Identification of freshwater management units, catchments, areas, precincts and development areas chapters

Mandatory directions	Examples
22. Freshwater management units must be identified with 'FMU', followed by a sequential number, a space, an en-dash, a space, the freshwater management unit's unique name, a space, and 'freshwater management unit'.	FMU18 – Selwyn Te Waihora freshwater management unit
23. Catchments must be identified with 'CAT', followed by a sequential number, a space, an en-dash, a space, the catchment's unique name, a space, and 'catchment'.	CAT3 – Hutt River catchment
24. Areas must be identified with 'AREA', followed by a sequential number, a space, an en-dash, a space, and the area's unique name, a space, and 'area'.	AREA6 – Tutukaka area
25. Precincts must be identified with 'PREC', followed by a sequential number, a space, an en-dash, a space, the precinct's unique name, a space, and 'precinct'.	PREC1 – Arrowtown character precinct

Mandatory directions	Examples
26. Development areas must be identified with 'DEV', followed by a sequential number, a space, an en-dash, a space, the development area's unique name, a space, and 'development area'.	DEV21 – One Tree Point development area

Identification of requiring authorities and designations

Mandatory directions	Examples
27. The requiring authority unique identifier in table 15 of 9. Designations Standard must be used if applicable.	
28. The requiring authority unique identifier of all additional requiring authorities relevant to a plan, must consist of the key two to five letters of the requiring authority name in capital letters.	
29. Designations chapters must be identified with the requiring authority unique identifier, a space, an en-dash, a space and the name of the requiring authority.	CRLL – City Rail Link Limited
30. The designation unique identifier in table 15 of 9. Designations Standard must include the requiring authority unique identifier, a hyphen, and a sequential number.	MEDU-21

Identification of appendices and schedules

Mandatory directions	Examples
31. Appendices must be identified with 'APP', followed by a sequential number, a space, an en-dash, a space, and the appendix title.	APP1 – Vehicle turning circle
32. Schedules must be identified with 'SCHED', followed by a sequential number, a space, an en-dash, a space, and the schedule title.	SCHED1 – Heritage buildings
33. When schedules are located in chapters, sections, or sub-sections, they must be identified with the chapter and/or section with a unique identifier, a hyphen, then 'SCHED', followed by a sequential number, a space, an en-dash, a space, and the schedule title.	HH-SCHED28 – Scheduled buildings
34. Where schedules are grouped as appendices in the *Appendices and maps* part, each schedule grouping must include a descriptive title.	
35. Appendices must be grouped according to the content they address.	

Identification of tables, diagrams or figures

Mandatory direction	Examples
36. Each table, diagram or figure must be identified starting with 'Table', 'Diagram' or 'Figure', a space, followed by a sequential number (starting at the beginning of the policy statement or plan), a space, an en-dash, a space, and the table, diagram or figure title.	Table 1 – Contents table Diagram 25 – Vehicle turning circle A

Numbering of issues, objectives, policies, rules, methods, principal reasons and anticipated environmental results

Mandatory directions	Examples
37. When used in chapters and zone sections, issues, objectives, policies, rules, methods, principal reasons and anticipated environmental results must be numbered using the relevant chapter or zone section unique identifier, a hyphen, then the first letter(s) of the provision type, and then a sequential number.	RMIA-I1 (Issue in the Resource management issues of significance to iwi authorities chapter) FMU18-O1 (Objective in a Freshwater Management Unit chapter) TEMP-P1 (Policy in the Temporary activities chapter) RLZ-R1 (Rule in the Rural lifestyle zone chapter) GA-R1 (General or catch-all rule in the General approach chapter) LF-M1 (Method in the Land and Freshwater chapter) AIR-PR1 (Principal reason in the Air chapter)
38. When used in sections, issues, objectives, policies, rules, methods, principal reasons and anticipated environmental results must be numbered using the relevant chapter unique identifier, a hyphen, then a unique identifier consisting of the key 2-5 letters of the section title in capital letters, a hyphen, then the first letter(s) of the provision type, and then a sequential number.	
39. When used in sub-sections, issues, objectives, policies, rules, methods, principal reasons and anticipated environmental results must be numbered following the directions in 38 above. No additional abbreviations must be added to the numbering sequence.	
40. Local authorities must use the following first letters(s) of each provision type: 'I' for issues, 'O' for objective, 'P' for policy, 'R' for rule, 'M' for method, (other than rule) 'PR' for principal reasons, and 'AER' for anticipated environmental results when numbering these provisions.	
41. Provision types included in each chapter must be sequentially numbered from the beginning of the chapter. Section and sub-section headings must not restart the chapter numbering sequence.	

Numbering of subset issues, objectives, policies, rules, methods, principal reasons and anticipated environmental results

Mandatory directions	Examples
42. For provision subset numbering, the first three tiers which are: number, letter, lower-case non-capitalised Roman numeral.	O1(1)(a)(i) (brackets are optional when the numbering is distributed across policy statement or plan text).
43. Additional sub-provisions must be uniquely identifiable.	

Numbering of additional issues, objectives, policies, rules, methods, principal reasons and anticipated environmental results in a policy statement or plan

Mandatory direction	Examples
44. If an additional provision is added, the next sequential number must be used.	CE-M1, CE-M2, CE-M5 (new provision), CE-M3, CE-M4

Numbering when issues, objectives, policies, rules, methods, principal reasons and anticipated environmental results in a policy statement or plan are deleted

Mandatory direction	Examples
45. If an existing provision is deleted, adjacent provision numbers unaffected by the deletion must retain their existing numbers.	

Table 16: Unique identifier table for chapters, sections and zone framework

Chapters, sections and zone framework	Unique identifier
Chapters and sections	AIR – Air AREA – Areas ASW – Activities on the surface of water CAT – Catchments CE – Coastal environment CL – Contaminated land CMA – Coastal marine area DEV – Development areas ECO – Ecosystems and indigenous biodiversity EI – Energy and infrastructure EIT – Energy, infrastructure and transport EW – Earthworks GEO – Geothermal HAZ – Hazards and risks HCV – Historical and cultural values HH – Historic heritage IM – Integrated management IO – Integrated objectives IP – Integrated policies LF – Land and freshwater LIGHT – Light NC – Natural character NFL – Natural features and landscapes NH – Natural hazards NOISE – Noise PA – Public access PREC – Precincts RMIA – Resource management issues of significance to iwi authorities SIGN – Signs SRMR – Significant resource management issues for the region SASM – Sites and areas of significance to Maori SUB – Subdivision TEMP – Temporary activities TREE – Notable trees UFD – Urban form and development
Zone framework	RESZ – Residential zones LLRZ – Large lot residential zone LRZ – Low density residential zone GRZ – General residential zone MRZ – Medium density residential zone HRZ – High density residential zone RURZ – Rural zones GRUZ – General rural zone RPROZ – Rural production zone RLZ – Rural lifestyle zone SETZ – Settlement zone CMUZ – Commercial and mixed use zones NCZ – Neighbourhood centre zone LCZ – Local centre zone

Chapters, sections and zone framework	Unique identifier
	COMZ – Commercial zone LFRZ – Large format retail zone MUZ – Mixed use zone TCZ – Town centre zone MCZ – Metropolitan centre zone CCZ – City centre zone INZ – Industrial zones LIZ – Light industrial zone GIZ – General industrial zone HIZ – Heavy industrial zone OSRZ – Open space and recreation zones NOSZ – Natural open space zone OSZ – Open space zone SARZ – Sport and active recreation zone SPZ – Special purpose zones AIRPZ – Airport zone PORTZ – Port zone HOSZ – Hospital zone TEDZ – Tertiary education zone STADZ – Stadium zone FUZ – Future urban zone MPZ – Māori purpose zone CORZ – Corrections zone

Example

Format standard applied to a coastal environment chapter, with public access and reclamation sections and a walkways sub-section

Chapter

CE – Coastal environment (for the chapter heading)

CE-O1 and CE-O2 (for objectives)

CE-P1 to CE-P3 (for policies)

CE-R1 to CE-R26(1)(a)(i) with associated activity status and matters of control or discretion listed as they apply (for rules with sub-set numbering)

Sections and sub-section

CE-PA – Public access (for the section heading)

CE-PA-O3 to CE-PA-O5 (for objectives)

CE-PA-P4 to CE-PA-P6 (for policies)

CE-PA-R27 to CE-PA-R29(1)(a)(i) with associated activity status and matters of control or discretion listed as they apply (for rules with sub-set numbering)

Walkways (for the sub-section heading)

CE-PA-O6 to CE-PA-O7 (for objectives)

CE-PA-P7 to CE-PA-P8 (for policies)

CE-PA-R30 to CE-PA-R32(1)(a)(i) with associated activity status and matters of control or discretion listed as they apply (for rules with sub-set numbering)

CE – Reclamation (for the section heading)

CE-RC-O8 to CE-RC-O10 (for objectives)

CE-RC-P9 to CE-RC-P10 (for policies)

CE-RC-R33 to CE-RC-R35(1)(a)(i) with associated activity status and matters of control or discretion listed as they apply (for rules with sub-set numbering)

11. Regional Spatial Layers Standard

Mandatory directions

1. Where a regional policy statement, a regional plan or a regional component of a combined plan uses a spatial layer that has the functions described in table 17:
   a. the policy statement or plan must use the name of the relevant spatial layer
   b. provisions introduced by the spatial layer must be located in the location identified.
2. In addition to the spatial layers in table 17, other spatial layers may be used within regional policy statements, regional plans and regional components of combined plans (provided they do not overlap with the spatial layers specified in this standard).

Table 17: Spatial layers for regional policy statements, regional plans and regional components of combined plans table

Spatial layer name	Function	Location of spatial layer provisions
Zone	A zone spatially identifies and manages an area with common environmental characteristics or where environmental outcomes are sought, by bundling compatible activities or effects together, and controlling those that are incompatible. In regional plans, zones can only be applied to the coastal marine area. In combined plans with district plan and regional plan components, a zone can be both seaward and landward of mean high water springs.	Zone chapters or sections
Overlay	An overlay spatially identifies distinctive values, risks or other factors that require management.	Domain and topic chapters, and freshwater management unit, catchment and area chapters
Precinct	A precinct spatially identifies and manages an area where additional place-based provisions apply to modify or refine aspects of the policy approach or outcomes anticipated in the underlying zone(s). In combined plans with district plan and regional plan components, a precinct can be both seaward and landward of mean high water springs.	If apply to only one zone, use in the associated zone chapter or section If apply to multiple zones, use in the sections of the Coastal precincts chapter
Specific control	A specific control spatially identifies where a site or area has provisions that are different from other spatial layers or region-wide provisions that apply to that site or area.	Relevant chapters or sections
Freshwater management unit	A freshwater management unit's function and requirements are set in the National Policy Statement for Freshwater Management 2014 (amended 2017).	Freshwater management unit chapters
Airshed	An airshed spatially identifies where the Minister for the Environment has specified an airshed under the Resource Management (National Environmental Standards for Air Quality) Regulations 2004.	Air chapter
Area	An area spatially identifies an area, which is not a zone, overlay, specific control, freshwater management unit or airshed, where activities or classes of activities are managed in a certain way.	Area chapters

12. District Spatial Layers Standard

Mandatory directions

1. Where a district plan or a district plan component of a combined plan uses a spatial layer that has the functions described in table 18:
   a. the plan must use the name of the relevant spatial layer
   b. provisions introduced by the spatial layer must be located in the location identified.
2. Other than the spatial layers identified in table 18, no other spatial layers may be created.

Table 18: Spatial layers for district plans and district plan components of combined plans table

Spatial layer name	Function	Location of spatial layer provisions
Zones	A zone spatially identifies and manages an area with common environmental characteristics or where environmental outcomes are sought, by bundling compatible activities or effects together, and controlling those that are incompatible.	Zone chapters or sections
Overlays	An overlay spatially identifies distinctive values, risks or other factors which require management in a different manner from underlying zone provisions.	District-wide matters chapters for district plans Domain and topic chapters for combined plans with a district component
Precincts	A precinct spatially identifies and manages an area where additional place-based provisions apply to modify or refine aspects of the policy approach or outcomes anticipated in the underlying zone(s).	If apply to only one zone, in the associated zone chapter or section If apply to multiple zones, in the multi-zone precincts chapters
Specific controls	A specific control spatially identifies where a site or area has provisions that are different from other spatial layers or district-wide provisions that apply to that site or area (for example where verandah requirements apply, or where a different maximum height on a particular site applies).	Relevant chapters or sections
Development areas	A development area spatially identifies and manages areas where plans such as concept plans, structure plans, outline development plans, master plans or growth area plans apply to determine future land use or development. When the associated development is complete, the development areas spatial layer is generally removed from the plan either through a trigger in the development area provisions or at a later plan change.	Development area chapters
Designations	Spatially identifies where a designation is included in a plan under section 168 or section 168A or clause 4 of Schedule 1 of the RMA.	Designations chapters
Heritage orders	Spatially identifies heritage orders enabled under section 189 of the RMA.	*Historic heritage* chapter

13. Mapping Standard

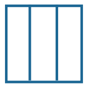
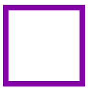
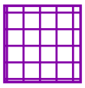
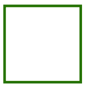
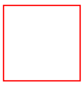
Mandatory directions

1. District plan maps, and maps of combined plans with a district plan component, must use the corresponding colour from table 19 to map all zones applied from table 13 of *8. Zone framework* Standard and, if required, zones may be labelled on maps.
2. A policy statement or plan must use the symbols in table 20 wherever maps display the features listed in that table and, if required:
   a. an alternative vector type may be used to support data capture, but still represented in accordance with table 20 (eg, a polygon may be used for data capture associated with a line or point symbol).
   b. symbols may be labelled on maps.

Table 19: Zone colour palette

Zone name	Colour	Description
Large lot residential zone		RGB: 242, 235, 204
Low density residential zone		RGB 255, 255, 190
General residential zone		RGB: 245, 245, 122
Medium density residential zone		RGB: 254, 219, 125
High density residential zone		RGB: 255, 181, 97
General rural zone		RGB: 181, 187, 125
Rural production zone		RGB: 168, 181, 122
Rural lifestyle zone		RGB: 227, 203, 154
Settlement zone		RGB: 217, 222, 18
Neighbourhood centre zone		RGB: 255, 181, 199
Local centre zone		RGB: 245, 143, 148
Commercial zone		RGB: 227, 97, 117
Large format retail zone		RGB: 255, 115, 223
Mixed use zone		RGB: 230, 0, 169
Town centre zone		RGB: 199, 4, 111
Metropolitan centre zone		RGB: 255, 181, 255; RGB: 168, 0, 132 Angle: 45.00 Separation: 10
City centre zone		RGB: 137, 68, 101
Light industrial zone		RGB: 207, 171, 245
General industrial zone		RGB: 176, 115, 255
Heavy industrial zone		RGB: 132, 0, 168
Natural open space zone		RGB: 56, 173, 0
Open space zone		RGB: 187, 240, 156
Sport and active recreation zone		RGB: 137, 205, 102
Special purpose zones		RGB: 204, 204,204

Table 20: Symbol representation

Symbol name	Symbol	Description	
Coastal environment overlay		Polygon Angle: 90.00 Line width: 1 pts	Line separation: 80 pts RGB 28, 103, 148 Outline width: 2 pts
Designation		Polygon Fill: None RGB 20, 177, 231	Outline width: 1.5 pts Designation identifier
Heritage area overlay		Polygon Fill: None RGB: 132, 0, 168 Outline width: 2 pts	
Heritage item overlay		Point RGB: 132, 0, 168	
Heritage item overlay extent		Polygon Angle 1: 0, Angle 2: 90 Line width 1 pts	Line separation: 5pts RGB 132, 0, 168 Outline width: 1 pts
Marae overlay		Point RGB: 201, 53, 42	
National grid line		Line RGB: 52, 52, 52 Line width: 2 pts	
National grid underground cable		Line RGB: 52, 52, 52 RGB: 255, 255, 255 Line width: 3 pts	
Noise control boundary overlay		Polygon Angle: 45.00 Line width: 1 pts	Line separation: 5 pts RGB 245, 130, 33 Outline width: 2 pts
Notable tree group overlay		Polygon Fill: None RGB: 38, 115, 0 Outline width: 1 pts	
Notable tree overlay		Point RGB: 38, 115, 0	
Statutory acknowledgement areas		Polygon Fill: RGB 255, 255,255 with default transparency of 70% Outline width: 0.5 pts Outline RGB: 255, 0, 0	

14. Definitions Standard

Mandatory directions

1. Where terms defined in the *Definitions List* are used in a policy statement or plan, and the term is used in the same context as the definition, local authorities must use the definition as defined in the *Definitions List*. However if required, they may define:
    a. terms that are a subcategory of, or have a narrower application than, a defined term in the *Definitions List.* Any such definitions must be consistent with the higher level definition in the *Definitions List*.
    b. additional terms that do not have the same or equivalent meaning as a term defined in the *Definitions List*.
2. Te reo Māori terms used in rules must be defined or translated in English in the *Definitions* chapter.
3. When a definition in the *Definitions List* is used*,* consequential amendments may be required to the policy statement or plan to ensure that the application of the definition does not alter the effect or outcomes of policy statements or plans.
4. Where the *Definitions List* incorporates a definition from legislation, the definition applied is the version included in the legislation on the date of gazettal of this standard.
5. Local authorities must consider whether to:
    a. include, or cross reference to, diagrams to illustrate definitions
    b. include instructions on how definitions relate to one another (eg, nesting tables or Venn diagrams).
6. If a term is used in more than one context (eg, ‘bed’ may relate to the bottom of a river or a place to sleep), local authorities must, in their *Definitions* chapter, add the context in which the term is defined in brackets after the term name eg, bed (in relation to lakes, rivers and the sea).
7. Definitions of terms, whether from the *Definitions List* or other sources, must be listed numerically and then alphabetically as one list.

Definitions List

Term	Definition
abrasive blasting	means the cleaning, smoothing, roughening, cutting or removal of part of the surface of any article by the use, as an abrasive, of a jet of sand, metal, shot or grit or other material propelled by a blast of compressed air or steam or **water** or by a wheel.
accessory building	means a detached **building**, the use of which is ancillary to the use of any **building, buildings** or activity that is or could be lawfully established on the same **site**, but does not include any **minor residential unit**.
allotment	has the same meaning as in section 218 of the RMA (as set out in the box below) means— a. any parcel of land under the Land Transfer Act 1952 that is a continuous area and whose boundaries are shown separately on a survey plan, whether or not— i. the subdivision shown on the survey plan has been allowed, or subdivision approval has been granted, under another Act; or ii. a subdivision consent for the subdivision shown on the survey plan has been granted under this Act; or b. any parcel of land or building or part of a building that is shown or identified separately— i. on a survey plan; or ii. on a licence within the meaning of Part 7A of the Land Transfer Act 1952; or c. any unit on a unit plan; or d. any parcel of land not subject to the Land Transfer Act 1952.
amenity values	has the same meaning as in section 2 of the RMA (as set out in the box below) means those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.
ancillary activity	means an activity that supports and is subsidiary to a primary activity.
aquifer	means a permeable geological formation, group of formations, or part of a formation, beneath the ground, capable of receiving, storing, transmitting and yielding **water**.
bed	has the same meaning as in section 2 of the RMA (as set out in the box below) means— a. in relation to any river— i. for the purposes of esplanade reserves, esplanade strips, and subdivision, the space of land which the waters of the river cover at its annual fullest flow without overtopping its banks: ii. in all other cases, the space of land which the waters of the river cover at its fullest flow without overtopping its banks; and b. in relation to any lake, except a lake controlled by artificial means,— i. for the purposes of esplanade reserves, esplanade strips, and subdivision, the space of land which the waters of the lake cover at its annual highest level without exceeding its margin: ii. in all other cases, the space of land which the waters of the lake cover at its highest level without exceeding its margin; and c. in relation to any lake controlled by artificial means, the space of land which the waters of the lake cover at its maximum permitted operating level; and d. in relation to the sea, the submarine areas covered by the internal waters and the territorial sea.

best practicable option	has the same meaning as in section 2 of the RMA (as set out in the box below) in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to— a. the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and b. the financial implications, and the effects on the environment, of that option when compared with other options; and c. the current state of technical knowledge and the likelihood that the option can be successfully applied.
bore	means any hole drilled or constructed in the ground that is used to— i. investigate or monitor conditions below the ground surface; or ii. abstract gaseous or liquid substances from the ground; or iii. **discharge** gaseous or liquid substances into the ground; but it excludes test pits, trenches, soak holes and soakage pits.
boundary adjustment	means a **subdivision** that alters the existing boundaries between adjoining **allotments**, without altering the number of **allotments**.
building	means a temporary or permanent movable or immovable physical construction that is: a. partially or fully roofed, and b. is fixed or located on or in **land**, but c. excludes any motorised vehicle or other mode of transport that could be moved under its own power.
building coverage	means the percentage of the **net site area** covered by the **building footprint**.
building footprint	means, in relation to **building coverage**, the total area of **buildings** at ground floor level together with the area of any section of any of those **buildings** that extends out beyond the ground floor level limits of the **building** and overhangs the ground.
cleanfill area	means an area used exclusively for the disposal of cleanfill material.
cleanfill material	means virgin excavated natural materials including clay, gravel, sand, soil and rock that are free of: a. combustible, putrescible, degradable or leachable components; b. **hazardous substances** and materials; c. products and materials derived from hazardous waste treatment, stabilisation or disposal practices; d. medical and veterinary wastes, asbestos, and radioactive substances; e. contaminated soil and other contaminated materials; and f. liquid wastes.
coastal water	has the same meaning as in section 2 of the RMA (as set out in the box below) means seawater within the outer limits of the territorial sea and includes— a. seawater with a substantial fresh water component; and b. seawater in estuaries, fiords, inlets, harbours, or embayments.
commercial activity	means any activity trading in goods, equipment or services. It includes any **ancillary activity** to the commercial activity (for example administrative or head offices).
community corrections activity	means the use of **land** and **buildings** for non-custodial services for safety, welfare and community purposes, including probation, rehabilitation and reintegration services, assessments, reporting, workshops and programmes, administration, and a meeting point for community works groups.

community facility	means **land** and **buildings** used by members of the community for recreational, sporting, cultural, safety, health, welfare, or worship purposes. It includes provision for any **ancillary activity** that assists with the operation of the community facility.
contaminant	has the same meaning as in section 2 of the RMA (as set out in the box below) includes any substance (including gases, odorous compounds, liquids, solids, and micro-organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar, or other substances, energy, or heat— a. when discharged into water, changes or is likely to change the physical, chemical, or biological condition of water; or b. when discharged onto or into land or into air, changes or is likely to change the physical, chemical, or biological condition of the land or air onto or into which it is discharged.
contaminated land	has the same meaning as in section 2 of the RMA (as set out in the box below) means land that has a hazardous substance in or on it that— a. has significant adverse effects on the environment; or b. is reasonably likely to have significant adverse effects on the environment.
cultivation	means the alteration or disturbance of **land** (or any matter constituting the **land** including soil, clay, sand and rock), for the purpose of sowing, growing or harvesting of pasture or crops.
discharge	has the same meaning as in section 2 of the RMA (as set out in the box below) includes emit, deposit, and allow to escape.
drain	means any artificial watercourse, designed, constructed, or used for the drainage of surface or subsurface **water**, but excludes artificial watercourses used for the conveyance of **water** for electricity generation, irrigation, or water supply purposes.
drinking water	means **water** intended to be used for human consumption; and includes **water** intended to be used for food preparation, utensil washing, and oral or other personal hygiene.
dry abrasive blasting	means **abrasive blasting** using materials to which no **water** has been added.
dust	means all non-combusted solid particulate matter that is suspended in the air, or has settled after being airborne. Dust may be derived from materials including rock, sand, cement, **fertiliser**, coal, soil, paint, animal products and wood.
earthworks	means the alteration or disturbance of **land**, including by moving, removing, placing, blading, cutting, contouring, filling or excavation of earth (or any matter constituting the **land** including soil, clay, sand and rock); but excludes gardening, cultivation, and disturbance of **land** for the installation of fence posts.
educational facility	means **land** or **buildings** used for teaching or training by child care services, schools, and tertiary education services, including any **ancillary activities**.
effect	has the same meaning as in section 3 of the RMA (as set out in the box below) includes— a. any positive or adverse effect; and b. any temporary or permanent effect; and c. any past, present, or future effect; and d. any cumulative effect which arises over time or in combination with other effects— regardless of the scale, intensity, duration, or frequency of the effect, and also includes— e. any potential effect of high probability; and f. any potential effect of low probability which has a high potential impact.

environment	has the same meaning as in section 2 of the RMA (as set out in the box below) includes— a. ecosystems and their constituent parts, including people and communities; and b. all natural and physical resources; and c. amenity values; and d. the social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) or which are affected by those matters.
esplanade reserve	has the same meaning as in section 2 of the RMA (as set out in the box below) means a reserve within the meaning of the Reserves Act 1977— a. which is either— i. a local purpose reserve within the meaning of section 23 of that Act, if vested in the territorial authority under section 239; or ii. a reserve vested in the Crown or a regional council under section 237D; and b. which is vested in the territorial authority, regional council, or the Crown for a purpose or purposes set out in section 229.
esplanade strip	has the same meaning as in section 2 of the RMA (as set out in the box below) means a strip of land created by the registration of an instrument in accordance with section 232 for a purpose or purposes set out in section 229.
fertiliser	means a substance or biological compound or mix of substances or biological compounds in solid or liquid form, that is described as, or held out to be suitable for, sustaining or increasing the growth, productivity or quality of soils, plants or, indirectly, animals through the application to plants or soil of any of the following: a. nitrogen, phosphorus, potassium, sulphur, magnesium, calcium, chlorine, and sodium as major nutrients; or b. manganese, iron, zinc, copper, boron, cobalt, molybdenum, iodine, and selenium as minor nutrients; or c. fertiliser additives to facilitate the uptake and use of nutrients; or d. non-nutrient attributes of the materials used in fertiliser. It does not include livestock effluent, human effluent, substances containing pathogens, or substances that are plant growth regulators that modify the physiological functions of plants.
fresh water	has the same meaning as in section 2 of the RMA (as set out in the box below) means all water except coastal water and geothermal water.
functional need	means the need for a proposal or activity to traverse, locate or operate in a particular **environment** because the activity can only occur in that **environment**.
green infrastructure	means a natural or semi-natural area, feature or process, including engineered systems that mimic natural processes, which are planned or managed to: a. provide for aspects of ecosystem health or resilience, such as maintaining or improving the quality of **water**, air or soil, and habitats to promote biodiversity; and b. provide services to people and communities, such as storm water or flood management or climate change adaptation.
greywater	means liquid waste from domestic sources including sinks, basins, baths, showers and similar fixtures, but does not include **sewage**, or **industrial and trade waste**.

gross floor area	means the sum of the total area of all floors of a **building** or **buildings** (including any void area in each of those floors, such as service shafts, liftwells or stairwells), i. where there are exterior walls, measured from the exterior faces of those exterior walls ii. where there are walls separating two **buildings**, measured from the centre lines of the walls separating the two **buildings** iii. where a wall or walls are lacking (for example, a mezzanine floor) and the edge of the floor is discernible, measured from the edge of the floor.
ground level (for the purposes of district plans and the district plan component of combined plans)	means— a. the actual finished surface level of the ground after the most recent **subdivision** that created at least one additional **allotment** was completed (when the record of title is created) b. if the ground level cannot be identified under paragraph (a), the existing surface level of the ground c. if, in any case under paragraph (a) or (b), a retaining wall or retaining **structure** is located on the **boundary**, the level on the exterior surface of the retaining wall or retaining **structure** where it intersects the **boundary**.
groundwater	means **water** occupying openings, cavities, or spaces in soils or rocks beneath the surface of the ground.
habitable room	means any room used for the purposes of teaching or used as a living room, dining room, sitting room, bedroom, office or other room specified in the Plan to be a similarly occupied room.
hazardous substance	has the same meaning as in section 2 of the RMA (as set out in the box below) includes, but is not limited to, any substance defined in section 2 of the Hazardous Substances and New Organisms Act 1996 as a hazardous substance. The Hazardous Substances and New Organisms Act 1996 defines hazardous substances as meaning, unless expressly provided otherwise by regulations or an EPA notice, any substance— a. with 1 or more of the following intrinsic properties: i. explosiveness: ii. flammability: iii. a capacity to oxidise: iv. corrosiveness: v. toxicity (including chronic toxicity): vi. ecotoxicity, with or without bioaccumulation; or b. which on contact with air or water (other than air or water where the temperature or pressure has been artificially increased or decreased) generates a substance with any 1 or more of the properties specified in paragraph (a).
height	means the vertical distance between a specified reference point and the highest part of any feature, **structure** or **building** above that point.
height in relation to boundary	means the **height** of a **structure**, **building** or feature, relative to its distance from either the boundary of a: a. **site**, or b. other specified reference point.

historic heritage	has the same meaning as in section 2 of the RMA (as set out in the box below) a. means those natural and physical resources that contribute to an understanding and appreciation of New Zealand's history and cultures, deriving from any of the following qualities: i. archaeological: ii. architectural: iii. cultural: iv. historic: v. scientific: vi. technological; and b. includes— vii. historic sites, structures, places, and areas; and viii. archaeological sites; and ix. sites of significance to Māori, including wāhi tapu; and x. surroundings associated with the natural and physical resources.
home business	means a **commercial activity** that is: a. undertaken or operated by at least one resident of the **site**; and b. is incidental to the use of the **site** for a **residential activity.**
industrial activity	means an activity that manufactures, fabricates, processes, packages, distributes, repairs, stores, or disposes of materials (including raw, processed, or partly processed materials) or goods. It includes any **ancillary activity** to the industrial activity.
industrial and trade waste	means liquid waste, with or without matter in suspension, from the receipt, manufacture or processing of materials as part of a commercial, industrial or trade process, but excludes **sewage** and **greywater**.
intensive indoor primary production	means **primary production** activities that principally occur within buildings and involve growing fungi, or keeping or rearing livestock (excluding calf-rearing for a specified time period) or poultry.
L_{A90}	has the same meaning as the 'Background sound level' in New Zealand Standard 6801:2008 Acoustics – Measurement of Environmental Sound.
L_{Aeq}	has the same meaning as 'time-average A-weighted sound pressure level' in New Zealand Standard 6801:2008 Acoustics -Measurement of Environmental Sound.
$L_{AF(max)}$	has the same meaning as the 'maximum A-frequency weighted, F-time weighted sound pressure level' in New Zealand Standard 6801:2008 Acoustics – Measurement Of Environmental Sound.
lake	has the same meaning as in section 2 of the RMA (as set out in the box below) means a body of fresh water which is entirely or nearly surrounded by land.
land	has the same meaning as in section 2 of the RMA (as set out in the box below) a. includes land covered by water and the airspace above land; and b. in a national environmental standard dealing with a regional council function under section 30 or a regional rule, does not include the bed of a lake or river; and c. in a national environmental standard dealing with a territorial authority function under section 31 or a district rule, includes the surface of water in a lake or river.
land disturbance	means alteration or disturbance of **land**, (or any matter constituting the **land** including, soil, clay, sand and rock), that does not permanently alter the profile, contour or **height** of the **land**.

landfill	means an area used for, or previously used for, the disposal of solid waste. It excludes **cleanfill** areas.
L_{dn}	has the same meaning as the 'Day night level, or day-night average sound level' in New Zealand Standard 6801:2008 Acoustics – Measurement of Environmental Sound.
L_{peak}	has the same meaning as 'Peak sound pressure level' in New Zealand Standard 6801:2008 Acoustics – Measurement of Environmental Sound.
minor residential unit	means a self-contained **residential unit** that is ancillary to the principal **residential unit**, and is held in common ownership with the principal **residential unit** on the same **site**.
natural and physical resources	has the same meaning as in section 2 of the RMA (as set out in the box below) Includes land, water, air, soil, minerals, and energy, all forms of plants and animals (whether native to New Zealand or introduced), and all structures.
natural hazard	has the same meaning as in section 2 of the RMA (as set out in the box below) means any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.
net floor area	a. means the sum of any **gross floor area**; and b. includes— i. both freehold and leased areas; and ii. any stock storage or preparation areas; but c. excludes— i. void areas such as liftwells and stair wells, including landing areas; ii. shared corridors and mall common spaces; iii. entrances, lobbies and plant areas within a **building**; iv. open or roofed outdoor areas, and external balconies, decks, porches and terraces; v. off street loading areas; vi. **building** service rooms; vii. parking areas and basement areas used for parking, manoeuvring and access; and viii. non-habitable floor spaces in rooftop **structures**.
net site area	means the total area of the **site**, but excludes: a. any part of the **site** that provides legal access to another **site**; b. any part of a rear **site** that provides legal access to that **site**; c. any part of the **site** used for access to the **site**; d. any part of the **site** subject to a designation that may be taken or acquired under the Public Works Act 1981.
network utility operator	has the same meaning as in s166 of the RMA (as set out in the box below) means a person who— a. undertakes or proposes to undertake the distribution or transmission by pipeline of b. operates or proposes to operate a network for the purpose of— i. telecommunication as defined in section 5 of the Telecommunications Act 2001; or ii. radio communication as defined in section 2(1) of the Radio Communications Act 1989; or c. is an electricity operator or electricity distributor as defined in section 2 of the Electricity Act 1992 for the purpose of line function services as defined in that section; or d. undertakes or proposes to undertake the distribution of water for supply (including irrigation); or

	e. undertakes or proposes to undertake a drainage or sewerage system; or f. constructs, operates, or proposes to construct or operate, a road or railway line; or g. is an airport authority as defined by the Airport Authorities Act 1966 for the purposes of operating an airport as defined by that Act; or h. is a provider of any approach control service within the meaning of the Civil Aviation Act 1990; or i. undertakes or proposes to undertake a project or work prescribed as a network utility operation for the purposes of this definition by regulations made under this Act,— and the words network utility operation have a corresponding meaning.
noise	has the same meaning as in section 2 of the RMA (as set out in the box below) includes vibration.
noise rating level	means a derived **noise** level used for comparison with a **noise** limit.
notional boundary	means a line 20 metres from any side of a **residential unit** or other **building** used for a noise sensitive activity, or the legal **boundary** where this is closer to such a **building**.
official sign	means all **signs** required or provided for under any statute or regulation, or are otherwise related to aspects of public safety.
operational need	means the need for a proposal or activity to traverse, locate or operate in a particular environment because of technical, logistical or operational characteristics or constraints.
outdoor living space	means an area of open space for the use of the occupants of the **residential unit** or units to which the space is allocated.
peak particle velocity	means, to the extent used for the assessment of the risk of structural damage to a fixed **structure**, the instantaneous maximum velocity reached by a vibrating surface as it oscillates about its normal position.
primary production	means: a. any aquaculture, agricultural, pastoral, horticultural, mining, **quarrying** or forestry activities; and b. includes initial processing, as an **ancillary activity**, of commodities that result from the listed activities in a); c. includes any **land** and **buildings** used for the production of the commodities from a) and used for the initial processing of the commodities in b); but d. excludes further processing of those commodities into a different product.
quarry	means a location or area used for the permanent removal and extraction of aggregates (clay, silt, rock or sand). It includes the area of aggregate resource and surrounding **land** associated with the operation of a quarry and which is used for **quarrying activities**.
quarrying activities	means the extraction, processing (including crushing, screening, washing, and blending), transport, storage, sale and recycling of aggregates (clay, silt, rock, sand), the deposition of overburden material, rehabilitation, landscaping and cleanfilling of the **quarry**, and the use of **land** and **accessory buildings** for offices, workshops and car parking areas associated with the operation of the **quarry**.
raft	has the same meaning as in section 2 of the RMA (as set out in the box below) means any moored floating platform which is not self-propelled; and includes platforms that provide buoyancy support for the surfaces on which fish or marine vegetation are cultivated or for any cage or other device used to contain or restrain fish or marine vegetation; but does not include booms situated on lakes subject to artificial control which have been installed to ensure the safe operation of electricity generating facilities.
reclamation	means the manmade formation of permanent dry **land** by the positioning of material into or onto any part of a **waterbody**, **bed** of a **lake** or **river** or the coastal marine area, and a. includes the construction of any causeway, but

	b. excludes the construction of **natural hazard** protection **structures** such as seawalls, breakwaters or groynes except where the purpose of those **structures** is to form dry **land**.
residential activity	means the use of **land** and **building(s)** for people's living accommodation.
residential unit	means a **building(s)** or part of a **building** that is used for a **residential activity** exclusively by one household, and must include sleeping, cooking, bathing and toilet facilities.
retirement village	means a managed comprehensive residential complex or facilities used to provide residential accommodation for people who are retired and any spouses or partners of such people. It may also include any of the following for residents within the complex: recreation, leisure, supported residential care, welfare and medical facilities (inclusive of hospital care) and other non-residential activities.
river	has the same meaning as in section 2 of the RMA (as set out in the box below) means a continually or intermittently flowing body of fresh water; and includes a stream and modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal).
road	has the same meaning as in section 2 of the RMA (as set out in the box below) has the same meaning as in section 315 of the Local Government Act 1974; and includes a motorway as defined in section 2(1) of the Government Roading Powers Act 1989 Section 315 of the Local Government Act 1974 road definition: road means the whole of any land which is within a district, and which— a. immediately before the commencement of this Part was a road or street or public highway; or b. immediately before the inclusion of any area in the district was a public highway within that area; or c. is laid out by the council as a road or street after the commencement of this Part; or d. is vested in the council for the purpose of a road as shown on a deposited survey plan; or e. is vested in the council as a road or street pursuant to any other enactment;— f. and includes— g. except where elsewhere provided in this Part, any access way or service lane which before the commencement of this Part was under the control of any council or is laid out or constructed by or vested in any council as an access way or service lane or is declared by the Minister of Works and Development as an access way or service lane after the commencement of this Part or is declared by the Minister of Lands as an access way or service lane on or after 1 April 1988: h. every square or place intended for use of the public generally, and every bridge, culvert, drain, ford, gate, building, or other thing belonging thereto or lying upon the line or within the limits thereof;— but, except as provided in the Public Works Act 1981 or in any regulations under that Act, does not include a motorway within the meaning of that Act or the Government Roading Powers Act 1989 Section 2(1) of the Government Roading Powers Act 1989 motorway definition motorway— a. means a motorway declared as such by the Governor-General in Council under section 138 of the Public Works Act 1981 or under section 71 of this Act; and b. includes all bridges, drains, culverts, or other structures or works forming part of any motorway so declared; but c. does not include any local road, access way, or service lane (or the supports of any such road, way, or lane) that crosses over or under a motorway on a different level

rural industry	means an industry or business undertaken in a rural environment that directly supports, services, or is dependent on **primary production**.
sewage	means human excrement and urine.
sign	means any device, character, graphic or electronic display, whether temporary or permanent; which a. is for the purposes of— i. identification of or provision of information about any activity, property or **structure** or an aspect of public safety; ii. providing directions; or iii. promoting goods, services or events; and b. is projected onto, or fixed or attached to, any, **structure** or natural object; and c. includes the frame, supporting device and any ancillary equipment whose function is to support the message or notice.
site (for district plans and the district plan component of combined plans)	means: a. an area of **land** comprised in a single record of title as per Land Transfer Act 2017; or b. an area of **land** which comprises two or more adjoining legally defined **allotments** in such a way that the **allotments** cannot be dealt with separately without the prior consent of the council; or c. the **land** comprised in a single **allotment** or balance area on an approved survey plan of **subdivision** for which a separate record of title as per Land Transfer Act 2017 could be issued without further consent of the Council; or d. except that in relation to each of sub clauses (a) to (c), in the case of **land** subdivided under the Unit Title Act 1972 or 2010 or a cross lease system, a site is the whole of the **land** subject to the unit development or cross lease.
special audible characteristic	has the same meaning as 'special audible characteristic' in section 6.3 of New Zealand Standard 6802:2008 Acoustics – Environmental Noise.
stormwater	means run-off that has been intercepted, channelled, diverted, intensified or accelerated by human modification of a land surface, or run-off from the surface of any **structure**, as a result of precipitation and includes any contaminants contained within.
structure	has the same meaning as in section 2 of the RMA (as set out in the box below) means any building, equipment, device, or other facility, made by people and which is fixed to land; and includes any raft.

subdivision	has the same meaning as "subdivision of land" in section 218 of the RMA (as set out in the box below) means— a. the division of an allotment— i. by an application to the Registrar-General of Land for the issue of a separate certificate of title for any part of the allotment; or ii. by the disposition by way of sale or offer for sale of the fee simple to part of the allotment; or iii. by a lease of part of the allotment which, including renewals, is or could be for a term of more than 35 years; or iv. by the grant of a company lease or cross lease in respect of any part of the allotment; or v. by the deposit of a unit plan, or an application to the Registrar-General of Land for the issue of a separate certificate of title for any part of a unit on a unit plan; or b. an application to the Registrar-General of Land for the issue of a separate certificate of title in circumstances where the issue of that certificate of title is prohibited by section 226.
sustainable management	has the same meaning as in section 5 of the RMA (as set out in the box below) means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while— a. sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and b. safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and c. avoiding, remedying, or mitigating any adverse effects of activities on the environment.
temporary military training activity	means a temporary activity undertaken for the training of any component of the New Zealand Defence Force (including with allied forces) for any defence purpose. Defence purposes are those purposes for which a defence force may be raised and maintained under section 5 of the Defence Act 1990 which are: a. the defence of New Zealand, and of any area for the defence of which New Zealand is responsible under any Act: b. the protection of the interests of New Zealand, whether in New Zealand or elsewhere: c. the contribution of forces under collective security treaties, agreements, or arrangements: d. the contribution of forces to, or for any of the purposes of, the United Nations, or in association with other organisations or States and in accordance with the principles of the Charter of the United Nations: e. the provision of assistance to the civil power either in New Zealand or elsewhere in time of emergency: f. the provision of any public service.
territorial authority	has the same meaning as in section 5 of the Local Government Act 2002 (as set out in the box below) means a city council or a district council named in Part 2 of Schedule 2.
visitor accommodation	means **land** and/or **buildings** used for accommodating visitors, subject to a tariff being paid, and includes any **ancillary activities**.
wastewater	means any combination of two or more the following wastes: **sewage**, **greywater** or industrial and trade waste.

water	has the same meaning as in section 2 of the RMA (as set out in the box below) a. means water in all its physical forms whether flowing or not and whether over or under the ground: b. includes fresh water, coastal water, and geothermal water: c. does not include water in any form while in any pipe, tank, or cistern.
waterbody	has the same meaning as in section 2 of the RMA (as set out in the box below) means fresh water or geothermal water in a river, lake, stream, pond, wetland, or aquifer, or any part thereof, that is not located within the coastal marine area.
wet abrasive blasting	means **abrasive blasting** using material to which **water** has been added.
wetland	has the same meaning as in section 2 of the RMA (as set out in the box below) includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions.

15. Noise and Vibration Metrics Standard

Mandatory directions

1. Any plan rule to manage noise emissions must be in accordance with the mandatory noise measurement methods and symbols in the applicable New Zealand Standards incorporated by reference into the planning standards and listed below:

    New Zealand Standard 6801:2008 Acoustics – Measurement of environmental sound

    New Zealand Standard 6802:2008 Acoustics – Environmental noise

    New Zealand Standard 6803:1999 Acoustics – Construction noise

    New Zealand Standard 6805:1992 Airport noise management and land use planning – measurement only

    New Zealand Standard 6806:2010 Acoustics – Road-traffic noise – New and altered roads

    New Zealand Standard 6807:1994 – Noise Management and Land Use Planning for Helicopter Landing Areas- excluding 4.3 Averaging

    New Zealand Standard 6808:2010 Acoustics – Wind farm noise

    New Zealand Standard 6809:1999 Acoustics – Port noise management and land use planning

2. Any plan rule to manage noise emissions must be consistent with the mandatory assessment methods in section 6 Rating Level and section 7 LMAX of New Zealand Standard 6802:2008 Acoustics – Environmental Noise (incorporated by reference into the planning standards), provided the type of noise emitted is within the scope of New Zealand Standard 6802:2008.

3. Any plan rule to manage damage to structures from construction vibration must be consistent with the metrics for peak particle velocity (ppv) in ISO-4866:2010 – Mechanical vibration and shock, incorporated by reference into the planning standards.

16. Electronic Accessibility and Functionality Standard

Mandatory directions

A. Electronic accessibility and functionality

1. Local authorities must ensure their policy statements and plans comply with the requirements of direction 2 within the timeframes specified in *17. Implementation* Standard.
2. Electronic accessibility and functionality requirements:
    a. Accessibility
        i. Policy statements or plans must be hosted on a local authority webpage no more than three clicks (three pages or pop-ups) from the local authority's home page.
        ii. Up-to-date webpage addresses for policy statements and plans must be provided to the Ministry for the Environment.
    b. Functionality
        i. Policy statement and plans must have keyword search functionality.
    c. Data standards
        i. Publicly accessible digital datasets used in the preparation of a policy statement or plan, available under Creative Commons attribution CC BY 4.0 licensing, must be listed or uploaded to data.govt.nz in machine readable, non-proprietary format.
        ii. Any amended planning map digital dataset must be uploaded to, or listed on, data.govt.nz in machine readable non-proprietary format, once they become operative or treated as operative.
        iii. Datums and projections must be compliant with the New Zealand Geodetic Datum (NZGD2000) and New Zealand Transverse Mercator 2000 (NZTM2000).
        iv. New policy statement or plan information incorporated through a policy statement or plan review, change or variation using a vertical datum must be compliant with New Zealand Vertical Datum 2016 (NZVD2016).

B. Online interactive policy statement or plan

1. Policy statements and plans must be in an online interactive format (ePlan) within the timeframes specified in *17. Implementation* Standard.
2. The ePlan must include:
    a. a GIS viewer which:
        i. includes all spatial layers of the policy statement or plan maps
        ii. enables users to search for a specific property
        iii. enables users to select which spatial layers are displayed on the viewer.
    b. the ability for users to query the ePlan to display the plan provisions that apply to:
        i. a specific property by entering an address and by selecting the property in the GIS viewer
        ii. one or more specific activities managed by rules in the plan.

c. the ability to display the policy statement or plan version as at any date from when the policy statement or plan is in the ePlan, to the present (excluding interactive maps).

d. the ability to download and print a copy of any part of the policy statement or plan (excluding interactive maps).

e. the ability to link between provisions, including definitions of terms when viewing the term in the ePlan.

f. the electronic seal of the local authority and an electronic signature verifying its authenticity in the ePlan, and in any downloaded or printed copy of the policy statement or plan.

3. The ePlan must be accessible from the local authority's website (in accordance with requirement 16.A.2(a)(i)), however an ePlan may be shared by two or more local authorities.

4. Local authorities must provide an opportunity to submit on a policy statement or plan online, either through the ePlan or through an online submission tool that is linked to the ePlan.

5. Directions 1-4 above for online interactive plans do not apply to the Chatham Islands Council and to the Minister of Local Government and Minister of Conservation in their roles as local authority for offshore and subantartic islands.

17. Implementation Standard

Mandatory directions

For every policy statement or plan

1. Subject to the timeframes in *17. Implementation* Standard and *1. Foundation* Standard direction 2, a policy statement or plan must be compliant with the relevant planning standards.

Regional policy statements

2. Regional councils, and unitary authorities with separate regional policy statements, must comply with the following planning standards: *1. Foundation, 2. Regional policy statement structure, 6. Introduction and general provisions, 10. Format, 11. Regional spatial layers, 13. Mapping, 14. Definitions* through either a) or b) whichever is sooner:
    a. Amendments to the regional policy statement made by three years from when the planning standards come into effect.
    b. Notification of a proposed regional policy statement for submissions under clause 5, Schedule 1 RMA after the planning standards come into effect.

Regional plans

3. Regional councils, and unitary authorities with separate regional plans, must comply with the following planning standards: 1. Foundation 3. Regional plan structure, 6. Introduction and general provisions, 10. Format, 11. Regional spatial layers, 13. Mapping, 14. Definitions, 15. Noise and vibration metrics through either a) or b) whichever is sooner:
    a. Amendments to the regional plan(s) made by 10 years from when the planning standards come into effect.
    b. Notification of a proposed regional plan (but not a proposed change or variation) for submissions under clause 5, Schedule 1 RMA after the planning standards come into effect.

District plans

4. Territorial authorities not listed in direction 5, and unitary authorities with separate district plans, must comply with the following planning standards: *1. Foundation, 4. District plan structure, 6. Introduction and general provisions, 7. District-wide matters, 8. Zone framework, 9. Designations, 10. Format, 12. District spatial layers, 13. Mapping, 15. Noise and vibration metrics*, through either a) or b) whichever is sooner:
    a. Amendments to the district plan made by five years from when the planning standards come into effect.
    b. Notification of a proposed district plan (but not a proposed change or variation) for submissions under clause 5, Schedule 1 RMA after the planning standards come into effect.
5. Territorial authorities listed below must comply with the following planning standards: 1. Foundation, 4. District plan structure, 6. Introduction and general provisions, 7. District-wide matters, 8. Zone framework, 9. Designations, 10. Format, 12. District spatial layers, 13. Mapping, 15. Noise and vibration metrics, through either a) or b) whichever is sooner:
    a. Amendments to the district plan made by seven years from when the planning standards come into effect.
    b. Notification of a proposed district plan (but not a proposed change or variation) for submissions under clause 5, Schedule 1 RMA after the planning standards come into effect.

- Christchurch City Council
- Dunedin City Council
- Hurunui District Council
- Invercargill City Council
- Kāpiti Coast District Council
- Opotiki District Council
- Queenstown-Lakes District Council
- South Taranaki District Council
- Thames-Coromandel District Council
- Any territorial authorities committed to a combined district plan (through a council resolution, MOU or similar statutory obligation) under section 80 (3) of the RMA.

6. Territorial authorities, and unitary authorities with separate district plans, must comply with *14. Definitions* Standard through either a), b) or c) whichever is sooner:

   a. Amendments to the district plan of a territorial authority in direction 4 above or of a unitary authority made by seven years from when the planning standards come into effect.

   b. Amendments to the district plan of a territorial authority in direction 5 above made by nine years from when the planning standards come into effect.

   c. Notification of a proposed district plan (but not a proposed change or variation) for submissions under clause 5, Schedule 1 RMA after the planning standards come into effect.

Implementation – Combined plan (regional policy statement, regional plan and district plan) by a unitary authority

7. Unitary authorities that have or produce a combined plan (regional policy statement–regional plan–district plan) must comply with the following planning standards: *1. Foundation, 5. Combined plan structure, 6. Introduction and general provisions, 7. District-wide matters (excluding the Strategic direction and Coastal environment directions, and replacing General district-wide matters heading with General matters heading), 8. Zone framework, 9. Designations, 10. Format, 11. Regional spatial layers, 12. District spatial layers, 13. Mapping, 14. Definitions, 15. Noise and vibration metrics*, through either a) or b) whichever is sooner:

   a. Amendments to the combined plan made by 10 years from when the planning standards come into effect.

   b. Notification of a proposed combined plan (but not a proposed change or variation) for submissions under clause 5, Schedule 1 RMA after the planning standards come into effect.

Combined plan (regional policy statement and regional plan)

8. Regional councils that have or produce a combined plan (regional policy statement–regional plan) must comply with the following planning standards*: 5. Combined plan structure, 6. Introduction and general provisions, 10. Format, 11. Regional spatial layers, 13. Mapping, 14. Definitions, 15. Noise and vibration metrics*, through either a), b), or c) whichever is sooner:

   a. Amendments to the regional policy statement components of the combined plan made by three years from when the planning standards come into effect.

   b. Amendments to the regional plan components of the combined plan made by 10 years from when the planning standards come into effect.

c. Notification of a proposed combined plan (but not a proposed change or variation) for submissions under clause 5, Schedule 1 RMA after the planning standards come into effect.

Other combined plans

9. Local authorities that produce a combined plan (regional policy statement–district plan, regional plan–district plan, or regional policy statement–regional plan–district plan by a non-unitary authority) must comply with the following planning standards (as relevant): *5. Combined plan structure, 6. Introduction and general provisions, 7. District-wide matters, 8. Zone framework, 9. Designations, 10. Format, 11. Regional spatial layers, 12. District spatial layers, 13. Mapping, 14. Definitions, 15. Noise and vibration metrics*, when the proposed combined plan is notified for submissions under clause 5, Schedule 1 RMA after the planning standards come into effect.
10. Until the proposed combined plan is notified for submissions under clause 5, Schedule 1 RMA, the local authorities' precursor policy statement or plan must comply with *17. Implementation S*tandard directions 1–8.

Electronic accessibility and functionality and online interactive plans

11. Local authorities must comply with the mandatory directions of *16.A: Electronic accessibility and functionality* by one year from when the planning standards come into effect.
12. Directions 1-4 in *16.B: Online interactive policy statement or plan* do not apply to the Chatham Islands Council, or to the Minister of Local Government and Minister of Conservation in their roles as local authority for offshore and subantartic islands.
13. Local authorities not listed in directions 14 and 15 must comply with the mandatory directions of *16.B: Online interactive policy statement or plan* by five years from when the planning standards come into effect.
14. Territorial authorities listed below must comply with the mandatory directions of *16.B: Online interactive policy statement or plan* by seven years from when the planning standards come into effect.
    - Christchurch City Council
    - Dunedin City Council
    - Invercargill City Council
    - Kāpiti Coast District Council
    - Queenstown-Lakes District Council
    - Thames-Coromandel District Council
    - Any territorial authorities committed to a combined plan or a combined district plan (through a council resolution, MOU or similar statutory obligation) under section 80(3) of the RMA, excluding unitary authorities and those territorial authorities listed in direction 15.
15. Territorial authorities listed below, and all regional councils and unitary authorities, must comply with the mandatory directions of *16.B: Online interactive policy statement or plan* by 10 years from when the planning standards come into effect.
    - Central Hawke's Bay District Council
    - Central Otago District Council
    - Clutha District Council
    - Gore District Council
    - Hauraki District Council

- Hurunui District Council
- Kaikoura District Council
- Kawerau District Council
- Mackenzie District Council
- Manawatu District Council
- Matamata-Piako District Council
- Opotiki District Council
- Otorohanga District Council
- Rangitikei District Council
- Ruapehu District Council
- South Taranaki District Council
- South Waikato District Council
- Stratford District Council
- Tararua District Council
- Waimate District Council
- Wairoa District Council
- Waitaki District Council
- Waitomo District Council

Agenda Memorandum

Date 11 June 2019

Memorandum to
Chairperson and Members
Policy and Planning Committee

Subject: Section 42A report and track changes version of the Proposed Coastal Plan for Taranaki

Approved by: A D Mc Lay, Director – Resource Management

BG Chamberlain, Chief Executive

Document: 2261602

Purpose

1. The purpose of this memorandum is to present Members with the Section 42A report and the Track changes version of the *Proposed Coastal Plan for Taranaki* (the Proposed Plan) in preparation for the hearing of submissions in accordance with the Schedule 1 process of the *Resource Management Act 1991* (the RMA).

2. A copy of the Section 42A report for the hearing and the track changes version of the Plan showing recommended amendments are attached separate to the Agenda.

3. Members should note that the Council is not formally adopting the Report or its recommendations or the Proposed Plan. The Report and Plan have been prepared as part of the requirements of the Plan review process of the RMA and has involved additional engagement with submitters prior to the formal hearing of submissions. Formal decisions on submissions will be made and any changes to the Proposed Plan will be considered following receipt of the hearing panel's recommendations.

Executive summary

4. Pursuant to the RMA, the Taranaki Regional Council (the Council) has commenced the formal review process involving the release of the Proposed Plan.

5. The Proposed Plan was publicly notified for submissions on 24 February 2018. The deadline for submissions was 27 April 2018.

6. Sixty-one submissions on the Proposed Plan were received and summarised in the Summary of decisions requested document, which was publicly notified on 21 July 2018 along with public notice calling for further submissions in support or opposition to the initial submissions. Twenty-five further submissions were subsequently received.

7. The main issues/themes raised in submissions are: integrated management; coastal management areas and the coastal environment boundary; use and development; recognition of regionally important infrastructure; the identification of tangata whenua principles, values and sites of significance; the protection of surf breaks: and the protection of indigenous species; and rules permitting, controlling and prohibiting activities in the coastal management area.

8. In October 2018, the draft versions of the track changes version of the Proposed Plan and the Officers report on decisions were made available to submitters. These documents were released and gave submitters an indication of officers' preliminary recommendations in response to their submissions.

9. The aforementioned documents informed pre-hearing discussions with interested submitters and provided an opportunity for both parties to further discuss and resolve issues prior to holding a formal hearing.

10. At the time of writing this memorandum 42 submitters had indicated they wished to appear at a hearing.

11. It is proposed that a hearing on submissions takes place in the second half of July, subject to the availability of hearing committee members. Member's will recall that at the Policy and Planning Committee meeting of the 30th of April, it was agreed to appoint two accredited elected members on the panel plus appoint a suitability accredited and qualified independent hearing commissioned with expertise in tikanga Maori.

Recommendations

That the Taranaki Regional Council:

a) receives this memorandum entitled *Section 42 A report and track changes version of the Proposed Coastal Plan for Taranaki*; and

b) agrees to release the *Track changes of the Proposed Coastal Plan for Taranaki hearing version* and the *Proposed Coastal Plan for Taranaki Section 42 A report for the hearing* prior to a formal hearing of submissions;

c) notes the hearing committee established by the Council will hear the submissions;

d) notes the Council will receive the hearing committee decision for consideration and adoption before being formally released and potentially open to any appeals.

Background

12. Members have been kept up to date with progress on the review of the current *Regional Coastal Plan for Taranaki*.

13. To briefly recap, pursuant to the RMA the Council) is responsible for promoting the sustainable management of the coastal marine area of the Taranaki region and is required to review the existing regional Coastal Plan. The coastal marine area refers to the 'wet bit' of the coast. Its landward boundary is the mean high water mark and it extends seaward to 12 nautical miles (22 km). Beyond this is the Exclusive Economic Zone, which is managed by the Environmental Protection Authority (EPA), based in Wellington.

14. As Members are aware, following significant pre-notification consultation including consultation on a draft Proposed Plan, the Proposed Coastal Plan was publicly notified for submissions on 24 February 2018. The deadline for submissions was 27 April 2018.

15. Sixty-one submissions on the Proposed Plan were received. The Council was then required to summarise the submissions received, publicly notify the availability of this summary and call for further submissions in support or opposition to the initial submissions received. A total of 25 further supporting or opposing submissions were received by the closing date of 4 August 2018.

16. In October 2018, this Committee received an Officer's report on submissions. The report presented all the submission points made in the 61 initial submissions, noted all further submissions who had supported or opposed each submission point, and set out officers' recommendation and rationale to either grant or decline the relief sought in submissions.

17. The Committee agreed that the Officer's report be distributed to all submitters as a basis for pre-hearing consultation with submitters. The intention of this pre-hearing stage of the process was to determine whether submitters were satisfied with the officer's recommendations or wished to engage in further discussions with a view to reaching agreement on where further changes might be made, thereby reducing the number of submitters and length of time required to hear submissions at a formal Hearing. This process has been very successfully applied by the Council in the past and has been welcomed by submitters as a positive and constructive step in the process.

18. Council officers met or engaged with 28 submitters in meetings, via videoconference, phone or email.

Report and track change version of the Proposed Plan

19. Council officers have prepared two documents required for the hearing of the Proposed Coastal Plan, the *Proposed Coastal Plan for Taranaki track changes hearing version* and the *Proposed Coastal Plan for Taranaki Section 42A report for the hearing* (both attached separate to this Agenda).

20. The Council is not formally adopting the Plan or recommendations in the Section 42A Report at this stage and will receive recommendations from the hearing panel following the hearing before making final decisions regarding the adoption of any Plan amendments.

21. The Track changes version identifies all changes that are recommended to the notified version of the Plan. Changes that are the result of submissions made on the proposed plan are identified in red with an accompanying number identifying the submitter(s) responsible for the amendment. Some changes are minor, with slight amendments to words only while others represent significant changes to the plan with a number of additional provisions and a number of deletions. All additions are <u>underlined</u> while deletions are ~~strikethrough~~.

22. Officers have also sought to further align the Plan for consistency and readability; this has resulted in a number of minor and inconsequential amendments that do not change the provision intent. These changes have been identified in blue.

23. The submission point(s) responsible for the change or amendment in the revised track change version of the Proposed Plan can be determined by identifying the submitter and finding the corresponding submission point listed within the relevant provisions in the Section 42A report.

24. The Section 42A report identifies all points raised in submissions and also whether these submission points were supported or opposed by other submitters in further submissions. Officers have considered all of the submission points and provided recommendations that will be considered by the hearing panel. Officers have responded by recommending that the hearing panel 'accept', 'accept in part', 'grant in kind', 'decline' or 'no relief necessary' the submission points. Officers have also provided a commentary that discusses the submitters request, including evidence or reasoning provided and, in some instances, additional details identified in pre-hearing engagement. The commentary also explains the officers recommendations including any changes recommended to the amendment sought.

25. Officers note that some submitters are still working with Council officers in identifying sites of significance to Māori to be included under Schedule 5B and identified on the online Planning Maps. This work is nearing completion, however, is likely to result in consequential amendments to Schedule 7A [Significant surf breaks and Significant Surfing Area] where the Schedule will now identify traditional names associated with surf breaks alongside the commonly used surf break name. The traditional names have been identified through Schedule 5B where the location of a sites of significance and a surf break are contiguous. This work will be completed shortly and the relevant areas of the Plan updated prior to being made publicly available for submitters on the Council website.

26. In accordance with the RMA, the Council is required to provide submitters with the Section 42A report prior to the hearing. If the Council requires submitters to provide briefs of evidence then the Section 42A report must be provided to all submitters who wish to be heard at a hearing at least 15 working days prior to the hearing.

Hearing of submissions

27. Council officers are currently preparing for a hearing.

28. At this stage it is uncertain how long the Hearing might take – this depends entirely on how many submitters wish to attend and how long they need to present their submissions. It is possible that in the order of 35 submitters may wish to attend the hearing.

29. If required, oral submissions and evidence will be heard over 3 days with an additional day set aside for deliberations and decision making by the hearing panel. At the hearing, submitters will be able to speak to their submission and provide expert witnesses in support of their submission. The hearing panel will also have the opportunity to ask any questions and seek clarification on the relief being sought. Those speaking must ensure that their presentation is within the scope of their written submission as they are not allowed to raise new issues.

30. In preparation of the hearing, council officers are working to establish a hearing panel. The Council currently has two councillors who are accredited under the 'Making Good

Decisions' programme and are qualified to sit on a hearing panel. These are M Joyce and N Walker whom the Council intends to appoint to the panel. Officers have sought the views of iwi authorities on their views on the appointment of an additional accredited hearing commissioner with tikanga Māori expertise as required under s 34A of the RMA.

31. In the past, Council plan hearing panels have been constructed entirely by councillors acting as commissioners, this is the first time that this Council has utilized an independent hearing commissioner in a Plan change hearing. Appointing councillors to the hearing panel is recommended to ensure RMA decision making is an accurate reflection of the local context and values. However, utilizing independent hearing commissioners allows the Council to appoint commissioners with specific, relevant expertise that will add value and fresh insights to the hearing and decision making process. Officers consider that the inclusion of an additional hearing commissioner with tikanga Māori expertise is consistent with the approach adopted by the Council to ensure that the Māori world view is considered alongside all other values during the decision making process. This practice is also used by other councils in New Zealand.

32. Council officers have sought the views from iwi authorities on this approach. At this point of time, the Council has received three responses. There is general support for the appointment of an independent hearing commissioner with tikanga Māori expertise. However, two iwi raised broader issues relating to the make-up of the hearing panel and requested greater Māori representation on the panel. However, as noted in our memorandum of 30 April 2019, a three person panel that includes two accredited councillors and one independent hearing commissioner is considered appropriate in the circumstances and recognising the training accredited hearing panel members receive to objectively consider all matters. Officers further invited recommendations for the hearing commissioner, however, at the time of writing this agenda, no recommendations have been received.

33. Council officers will be updating submitters on details relating to the hearing in due course prior to releasing the documents publicly on the Council website.

34. Once the hearing has been completed and the hearing panel has made its decisions, Officers will compile a 'Decisions' document for consideration and likely adoption by the Council. The Council is required to give reasons for its decisions.

35. Submitters have 30 working days from receipt of the Council's decision to appeal to the Environment Court against the Council's decision.

36. The Council approves the Proposed Plan once amendments have been made following appeals (if any). The Council may however approve part of the Proposed Plan if all submissions or appeals relating to that part have been disposed of. If there are no appeals it is likely that the Coastal Plan for Taranaki would be made operative late this year or early next year.

Decision-making considerations

37. Part 6 (Planning, decision-making and accountability) of the *Local Government Act 2002* has been considered and documented in the preparation of this agenda item. The recommendations made in this item comply with the decision-making obligations of the *Act*.

Financial considerations—LTP/Annual Plan

38. This memorandum and the associated recommendations are consistent with the Council's adopted Long-Term Plan and estimates. Any financial information included in this memorandum has been prepared in accordance with generally accepted accounting practice.

Policy considerations

39. This memorandum and the associated recommendations are consistent with the policy documents and positions adopted by this Council under various legislative frameworks including, but not restricted to, the *Local Government Act 2002*, the *Resource Management Act 1991* and the *Local Government Official Information and Meetings Act 1987*.

Iwi considerations

40. This memorandum and the associated recommendations are consistent with the Council's policy for the development of Māori capacity to contribute to decision-making processes (schedule 10 of the *Local Government Act 2002*) as outlined in the adopted long-term plan and/or annual plan. Similarly, iwi involvement in adopted work programmes has been recognised in the preparation of this memorandum.

Legal considerations

41. This memorandum and the associated recommendations comply with the appropriate statutory requirements imposed upon the Council.

Appendices/Attachments

2143144: Proposed Coastal Plan for Taranaki Section 42A report for the hearing
2133439: Track changes of the Proposed Coastal Plan for Taranaki hearing version
2133440: Track changes of the Proposed Coastal Plan for Taranaki hearing version (Schedules)

Agenda Memorandum

Date 11 June 2019

Memorandum to
Chairperson and Members
Policy and Planning Committee

Subject: SEM Freshwater physico-chemical monitoring programme 2017-2018 report

Approved by: G K Bedford, Director-Environment Quality

B G Chamberlain, Chief Executive

Document: 2259308

Purpose

1. The purpose of this memorandum is present an update to the Committee on the latest results of the Council's annual state of the environment monitoring programme for fresh water quality (physicochemical measures). Current and long-term trends are also set out for Members' information.

2. The full physicochemical report (*Freshwater Physicochemical Programme State of the Environment Monitoring Annual Report 2017-2018, Technical Report 2018-103*) is available upon request. It provides details of the Council's monitoring of the SEM freshwater physicochemical sites in the 2017-2018 year, including analysis of trends in this data since 1995. The Executive summaries and recommendations of the reports are attached to this memorandum.

3. A presentation of the report will be made to Members.

Executive summary

4. In order to ascertain the successful adoption and application or otherwise of the Council's policies and methods of implementation, the Council conducts 'state of the environment' (SEM) monitoring to obtain and report up to date robust information for parameters that characterise the region's environment and resources. The results and findings of each annual SEM programme for the region's freshwater systems can be interrogated to determine trends and changes in trends in the quality of freshwater's physicochemical parameters, alongside the information on the current 'state' of the region's freshwater resources that SEM generates. With SEM established in 1995, the database is extensive enough to allow regular robust trend analysis, conducted according to nationally recognised methodologies, for such reviews.

5. Further, with the establishment of national standards for water quality by the Government through the National Policy Statement for Freshwater- National Objectives Framework, and the requirement that representative monitoring be established for each

of the region's Freshwater Management Units, the Council and regional community can determine how good Taranaki's surface water is according to nationally recognised criteria.

6. The latest results and findings describing the state of and long-term trends in the state of physicochemical data from the report are summarised and presented herein for Members' information. This report also includes a separate section on trend analysis for the most recent 7-year period (2011-2018), which has been provided so the Committee and public can review both the long-term and the most recent trends. Recent trend data reflects the effects of the Council's methods of water management through the provisions of the current Regional Fresh Water Plan and its implementation. Results that are statistically and environmentally significant are identified.

7. Further, this memorandum also assesses the state of the region's waterways in the light of the attribute values (standards) established within the National Objectives Framework (NOF) that is part of the National Policy Statement for Freshwater Management 2014 (NPS-FW). This gives the Council and community guidance as to whether the surface waters in Taranaki are 'good' or 'bad', according to nationally promulgated criteria.

8. **Flows:** flows in 2017-2018 were characterised by much higher median flows in all rivers and streams sampled by the programme, with several floods or freshes and few low flows being sampled.

9. **Aesthetic, physical and chemical measures**: Not surprisingly given the high flow regimes, in general water quality was comparatively poorer in clarity, in bacteria numbers, and in nutrient levels, than was typical in the past. Narrower temperature ranges, mainly due to higher minimum temperatures, and similar median water temperatures, were measured in the 2017-2018 period compared with ranges and medians measured during the first 22 years of the SEM programme. The 2017-2018 median turbidity was higher at ten sites, and median bacteria numbers were higher at all sites. Median dissolved reactive and/or total phosphorus levels were higher at five sites. Median nitrate and/or total nitrogen species' levels were higher at two sites and lower at two sites, while median ammonia nitrogen levels were higher at five sites. These generally poorer water quality results during the year have consequently affected short-term and long-term trends in quality. The 2017-2018 median levels of dissolved oxygen saturation and pH were both similar to long term medians. Biochemical oxygen demand (a measure of putrescible organic material) increased (deteriorated) at two sites but was otherwise typical.

10. **Sites:** Several measures in the Stony River showed continuing deterioration, following a natural erosion event in February 2017 (a year after another similar event). The Maketawa site showed a number of deteriorations in median results across a number of parameters, in 2017-2018. All sites monitored had at least five parameters showing different from usual quality, which may be related to the greater proportion of higher flows sampled.

11. **The state of our waterways:** Comparing the 2015-2018 results against the nutrient criteria set out in the compulsory National Objectives Framework (NOF), there are 60 results which can be categorised, across 4 parameters. 75 % of all results lie in their respective 'A' band, and 23% in the 'B' band**- a total of 98 % of all results for water quality in**

Taranaki being either ('A' Excellent) or 'B '(Good) . No results fall below the national bottom lines ('C' Fair).

12. In terms of the NOF criteria for swimmability, there are 75 possible gradings (4 parameters plus the overall assigned grade, for each site). Two sites (13%) and 23% of all results met at least the 'C' grading. Sites higher in catchments had better gradings than those lower down.

13. It is important to note that most of the SEM sites in the programme are not considered contact recreational sites; the streams are too shallow, cold and/or small for recreational bathing activities. Nevertheless, the Government requires that for a regional perspective, swimmability is measured at these sites.

14. Long term (23-year) physicochemical trends have shown some significant deterioration in some aspects of water quality (particularly **phosphorus**) in many of the sites regardless of their position in a catchment. The lower Waingongoro River site is the notable exception, showing significant reductions in both forms of phosphorus. On the other hand, there has been a significant long term improvement in **total nitrogen** at three of the eleven sites monitored, against one site showing deterioration. **Nitrate** is showing deterioration at only 3 of the 11 sites monitored, and **ammonia** is likewise generally stable at other than 3 sites. Long term trends for **faecal coliforms and enterococci bacteria** showed no clear regional pattern, with deteriorations in both groups in the Mangaoraka and Waiwhakaiho and in enterococci in the lower Punehu and Maketawa, and improvement in coliforms in the upper Punehu Stream. Significant deteriorations in black disc clarity were recorded at two sites, one of which reflected historical erosion events in the headwaters (Stony River). Almost all sites are reducing in temperature, although not at a rate that is considered ecologically meaningful. This result could be the effect of the regional riparian management programme.

15. The greatest improvement in long term water quality has been illustrated in the Waingongoro River at SH 45, with significantly improving trends in DRP and total phosphorus, and with reduction in nitrate and total nitrogen by slightly less than the rate defined as significant. This improvement has been coincident with land-irrigation of a major industrial (meatworks) discharge and the diversion of Eltham's WWTP discharge out of the river in recent years. The upper Patea and Punehu Streams also show improving long-term trends. Most long term deterioration in aspects of water quality, with five parameters showing significant deterioration, has been found in the lower reaches of the Mangaoraka Stream (both phosphorus species, both bacteriological species and black disc), the mid-reaches of the Waiwhakaiho River, (dissolved phosphorus, nitrate, ammonia and both bacteriological species), and the mid-reaches of the Maketawa Stream (three nutrient species, enterococci and BOD_5). More recent data for these sites indicate the deterioration has largely been stopped in the Mangaoraka Stream, and virtually eliminated in the Punehu Stream.

16. Analysis of recent trends indicates a positive direction of trends in water quality, although the latest seven-year trends do not show the same wide-spread improvements that had been evident in this analysis in-recent years. This correlates strongly with prevailing weather patterns, with 4 of the last 5 and 5 of the last 7 years being markedly wetter than typical in terms of flows during sampling runs. Over the last 6 years, the annually updated record of the number of parameters showing either maintenance or

improvement in the most recent 7 year period, has fallen from 99% to 80% of all measures annually reported. Nevertheless, the rolling seven-year trends remain more positive than the long-term trends, with fewer sites and measures showing significant deterioration, particularly in nutrient concentrations; and further, the percentage of measures showing either maintenance or improvement in the long term has continued to climb steadily even though short-term changes are not currently as numerous as they have been in the past. Other measures (bacteria, organics, aesthetics) show no regional pattern of change in either direction.

17. Thus, there continues to be a clear pattern of trends in water quality parameters becoming more positive as time passes, notwithstanding that on a year-by-year basis there will be natural fluctuations.

18. The report makes recommendations to continue the freshwater physicochemical component of the SEM programme in a similar format (with minor changes to sampling) and to update the trend analysis reports following analysis at the end of the 2018-2019 year.

19. The value of this monitoring and analytical work lies in the advantage of up-to-date feedback to the Council and regional community on the consequences of land use and water quality management initiatives adopted in the region. The monitoring shows that the Council and community are giving effect to the *Regional Fresh Water Plan for Taranaki,* and informs the considerations and decision-making processes for the Council and community as the next *Regional Land and Water Plan* is drafted. In addition, the report helps give a regional perspective to national-level reviews of water quality and water quality management that are released from time to time.

20. In 2015-2016 the Council also ran an extended monitoring programme that incorporated a number of additional sites. The purpose in doing so was to examine the representativeness of the existing network, utilising actual monitoring results. This examination is included in the report being presented today. In summary, for all physicochemical parameters, the range of values across the regular SEM sites encompassed the range found across the additional "comparative" sites. That is, under base flow conditions monitored seasonally over the full course of a year, the existing SEM sites were found to already represent the full range of baseline water quality in the Taranaki region. No site in either the existing network (11 catchments) or the 5 additional catchments gave anomalous results.

21. The ecological health of the region's streams is shown by the macroinvertebrate communities and periphyton assemblages. The 2017-18 state of the environment reports for these parameters, and recreational water quality over the last bathing season, are being prepared.

Recommendations

That the Taranaki Regional Council:

a) receives this memorandum noting the preparation of a report on the state of and trends in regional physicochemical water quality data for Taranaki, for 2017-2018 and over the periods 1995-2018 and 2011-2018 respectively, together with information on compliance with the NOF and regional guidelines;

b) receives the report *Freshwater Physicochemical Programme State of the Environment Monitoring Annual Report 2017-2018 Technical Report 2018-103*

c) notes the findings of the trend analyses of data from the SEM physicochemical programme;

d) notes the findings of the analysis of water quality state data from the SEM physicochemical programme;

e) notes the findings of examination of the representativeness of the existing monitoring network; and

f) adopts the specific recommendations therein.

Background

22. This Committee has been regularly informed of the findings that emerge from the Council's various fresh water 'state of the environment' monitoring programmes. These programmes are important as indicators of the effectiveness of the Council's and community's interventions and resource management initiatives addressing fresh water quality in the region. Members will be aware that there is a high level of interest nationally in the state and management of the country's fresh water resources.

23. The *Regional Fresh Water Plan for Taranaki* contains objectives to manage the state of the region's surface freshwater. Objective 6.2.1 requires the Council and region 'to maintain and enhance the quality of the surface water resources of Taranaki by avoiding, remedying or mitigating the adverse effects of contaminants discharged to land and water from point sources', while Objective 6.3.1 is an equivalent objective for diffuse sources of contaminants.

24. In Section 10.3 of the Plan, the Council commits to continued monitoring, research and investigations related to fresh water quality, to provide information on the state of fresh water in the region and the effectiveness of the Plan.

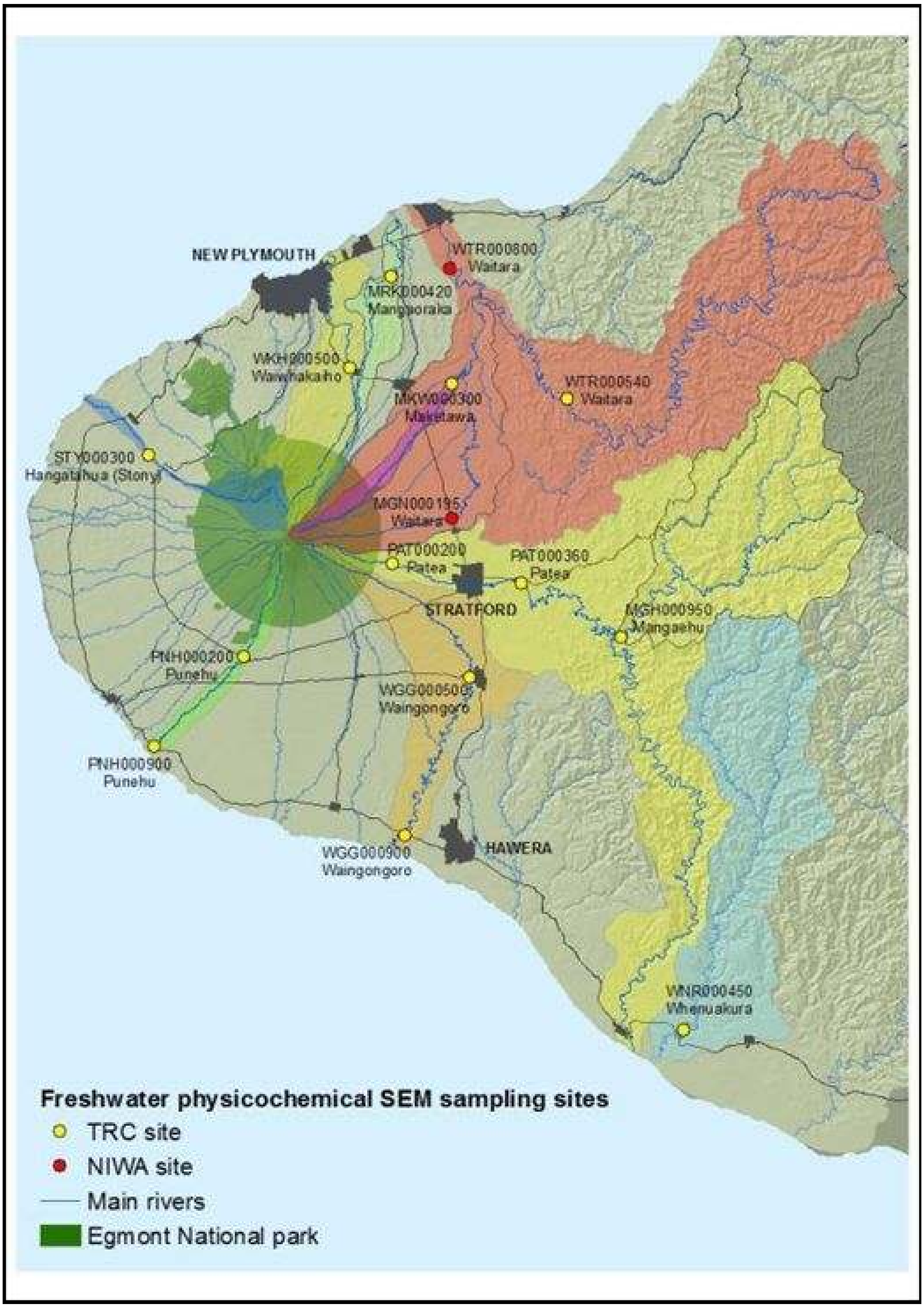
25. Section 4 of the RFWP recognises that iwi seek the recognition of the values of water and protection of the mana, mauri, and wairua of waterways against contamination; maintenance of the quality of water for its ability to provide mahinga kai; and respect for wāhi tapu and other areas or resources that have special significance.

26. The Council's 2018-2028 LTP has, under the 'Levels of service' specified for resource management, a commitment to '*maintain and enhance overall water quality in our rivers and lakes, groundwater and coastal waters*'. The measure for this activity is: '*parameters that characterise the physical, bacteriological, biological and chemical quality of surface water*', and the target is '*improvements in nutrient levels… appearance... organic contamination... bacterial levels... temperature and algal cover, against a baseline of 1995 water quality, as applicable, at 10 representative sites*.'

27. Staff have, and have been trained in, the software and methodology used by NIWA for trend analysis of freshwater systems, to ensure that data and analysis provided to the

Council and the public of Taranaki is robust, defensible, and consistent with analyses delivered at a national level. In this way timely and reliable feedback on the quality and health of the region's streams and the effectiveness of water quality management in the region can be generated and utilised.

28. Companion reports on the latest results of the Council's SEM programmes monitoring the state of the ecological health of the region's streams as shown by macroinvertebrate communities and periphyton assemblages, and recreational water quality over the last bathing season, are in preparation.



Discussion

State of the region's waterways

29. The Council monitors 13 sites on its own account, and also makes use of data from two further sites monitored by NIWA (for a smaller range of parameters). In years gone by, one Council site was also monitored independently by NIWA (lower Waingongoro River site). This duplicated sampling regime provided a quality control and independent audit function for both agencies. However, NIWA have now reduced its national water quality monitoring programme and have abandoned this site. This memorandum includes data from the two remaining water quality sites being maintained by NIWA as part of its 30-year old National Rivers Water Quality Monitoring Network. NIWA analyse for a much narrower range of parameters than does this Council.

30. The programme network was expanded by the Council for the 2015-2016 year in response to the obligation signalled by the government through the 2014 National Policy Statement for Freshwater Management, that all surface waters in every region must be incorporated into Freshwater Management Units and every FMU must have representative monitoring established. A mid-Waitara River site (Tarata) and lower Whenuakura River site were accordingly added to the suite of sites monitored within this programme.

31. Each sampling run by the Council measures up to 22 physical and chemical water quality parameters at thirteen sites that represent six selected ring plain catchments, two catchments with sub-catchments covering both the ring plain and eastern hill country, and one eastern hill-country catchment.

32. The data includes parameters for organic contamination (BOD), bacteriological quality (enterococci and faecal coliforms), appearance (suspended solids and clarity), and the nutrient species phosphorus (total and dissolved reactive) and nitrogen (ammonia, nitrate, and total nitrogen), as well as general measures of water quality (conductivity, pH and temperature). In the year under review, surveys were performed regularly in the second week of every month from July 2017 to June 2018, as is standard for this programme.

33. In the 2017-2018 year, variability in site water quality occurred in response to flow conditions and with season. Generally there was some spatial deterioration in most aspects of water quality in a downstream direction. This was illustrated by poorer water clarity (increased turbidity), increased bacteriological counts and nutrient levels, and wider water temperature and pH ranges at downstream sites. The eastern hill country sites typically have elevated suspended solids and turbidity.

2017-2018 results

34. Hydrology and meteorology have a significant effect on water quality on a year by year basis. Unlike 2015-2016, which was overall considerably drier than usual, but similar to the 2016-2017 year, which was wetter than has been the median over the duration of records across almost all sites, the 2017-2018 year was wetter than the median at all sites. This consequently adversely affected both state and trends.

35. **Flows**: By contrast with flows during the 2015-2016 period, when median flows at times of sampling were universally lower than typical of those during the previous 23 year period, and in common with the 2016-2017 year, which was characterised by much higher median flows in almost all rivers and streams, median sampled flows in the 2017-2018 year were all high, by between 26% and 283%.

36. **Aesthetic and physical measures**: the 2017-2018 median results for turbidity and clarity were either similar to or (mostly) poorer than the medians for the previous long term period. The Stony River was markedly worse than usual across all aesthetic measures, due to natural erosion events. This site has a record of such events.

37. Median temperatures were similar at all sites, although remaining in a narrower range (ie marked by neither low flow nor flood events).

38. **Nutrients:** A majority of sites' median nutrient levels remained similar in the 2017-2018 period to those over the longer period. A few improvements in median nutrient species (nitrate N at one site and total phosphorus at two sites) were recorded across individual sites. On the other hand, deterioration was frequently or occasionally found in median ammonia N (at five of eleven sites, at four by more than 50%), nitrate N (at three sites), total nitrogen (at two sites), dissolved reactive phosphorus (at five sites) and total phosphorus (at six sites). On an overall view, ammonia and nitrate nitrogen and dissolved reactive and total phosphorus levels showed more increases, with no clear pattern for total nitrogen.

39. **Bacteria:** Overall, there was a deterioration in bacteriological water quality, with the number of worse than typical sites exceeding markedly the number of sites showing better results, particularly for both faecal coliforms and enterococci.

40. **Other measures:** The 2017-2018 median levels of dissolved oxygen saturation, pH, and biochemical oxygen demand (a measure of putrescible organic material) were all similar to long term medians, although median BODs increased at 4 sites, all on the ring plain.

41. Overall, during the 2017-2018 period, water quality parameters' medians differed by more than 20% from 22-year medians for 49% of comparisons (47% deterioration; 2% improvement), and by more than 50% from historical medians for 35% of comparisons (35% deterioration, 0% improvement). This was coincident with higher median flows (26 to 283%) sampled at all of the eleven sites over the 2017-2018 period.

42. **Sites:** On a site specific basis comparing the 2017-2018 period with the previous 22-year historical record, there was much greater variability in water quality in the recent period, with individual sites recording five to nine of the fifteen parameters as having lower quality, with few instances of any improved quality. Differences in comparative water quality were related to the greater proportion of higher flows sampled, with deterioration in visual clarity, turbidity, suspended solids, BOD, bacterial species, ammoniacal nitrogen and phosphorus species. The higher flows sampled may relate to an improvement in nitrate or total nitrogen recorded for three sites, due to dilution. The greatest and smallest variabilities in water quality were exhibited in the Punehu catchment, where the upper site had the most (nine parameters) and the lower site the least (five parameters), indicating the effect of timing when multiple flood events were sampled.

Water quality and national criteria

43. The above discussion reviews whether the state of the quality at each site is changing on a year by year and a longer-term basis. This is a separate question from whether the water is suitable for use and whether it meets the Government's expectations. The Government's National Policy Statement for Freshwater Management 2014 includes compulsory attributes (parameters) with accompanying criteria for water quality. For each attribute there are four bands or grades, with the bottom band ('D') being deemed to represent unacceptable water quality ('Below the National Bottom Line'). The Government has recently changed the criteria for 'swimmability' where there are now 4 separate criteria just for this consideration, with 5 gradings for each criterion, with the overall categorisation being based on the worst of the four criteria. There is no assigned 'bottom line' for the swimmability criteria, but a general assumption that at least a 'C' is required to meet public expectations.

44. Gradings for all parameters are generally to be made on the basis of the last three years' worth of data. Therefore data from 15 sites can be utilised for this evaluation.

45. Comparing the 2015-2018 results against the nutrient criteria set out in the compulsory National Objectives Framework, there are 60 results which can be categorised, across 4 parameters. It is found that 75% of all results lie in their respective 'A' band, and 23% in the 'B' band- a total of 98% of all results for water quality in Taranaki being either 'A' or 'B'. There is a single 'C' grade result; and no result in the 'D' grade- that is, there is no nutrient result in Taranaki that lies below a national 'bottom line'. Seven of the 15 sites have straight 'A' grades for nutrients.

46. Sites with 100% of 'A' grade parameters for nutrients include the Waitara River (both mid and lower sites), Stony River, upper Punehu Stream, upper Patea River, the Maketawa, Manganui, Whenuakura, and the Mangaehu River. The parameter that most often causes a site to receive a 'B' rather than 'A' is that of occasional peak ammonia concentrations (strictly, the 95th%ile value) failing to lie below the threshold. The only sites with more than 1 'B' grading for nutrients are the lower Punehu, both sites in the Waingongoro, and the mid Patea River site.

47. In terms of swimmability, there are 75 possible gradings (4 parameters plus the overall assigned grade, for each site). Two sites (13%) and 23% of all results met at least the 'C' grading. Sites higher in catchments had better gradings than those lower down. Across all sites, the most common cause of failure was non-compliance with the 95th%ile limit- a criterion limiting the maximum value allowed during rare peak events.

48. It is important to note that most of the SEM sites in the programme are not considered contact recreational sites; the streams are too shallow, cold and/or small for recreational bathing activities. Nevertheless, the Government requires that on a regional basis, swimmability is measured at these sites.

Long-term trends (23 years)

49. Section 7(f) of the Resource Management Act 1991 requires the Council to have particular regard to the '*maintenance and enhancement of the quality of the environment*'.

50. Long term (23-year) physicochemical trends have shown some significant deterioration in some aspects of water quality (particularly **phosphorus**) in many of the sites regardless of their position in a catchment. The lower Waingongoro River site is the notable exception, showing significant reductions in both forms of phosphorus. On the other hand, there has been a significant long term improvement in **total nitrogen** at three of the eleven sites monitored, with only the lower Punehu showing deterioration. Nitrate is showing deterioration at only 2 of the 11 sites monitored, and ammonia is likewise generally stable at other than 3 sites. Long term trends for **faecal coliforms and enterococci bacteria** showed no clear regional pattern, with deteriorations in the Mangaoraka and Waiwhakaiho and for enterococci in the lower Punehu and the Maketawa, and improvement in the upper Punehu Stream. Significant deteriorations in black disc clarity were recorded at two sites, one of which reflected historical erosion events in the headwaters (Stony River). Traditional indicators of pollution, organic matter (BOD), suspended solids, clarity (black disc), conductivity (dissolved matter) generally show no apparent trends at most sites over the 23 year period, other than for deterioration in clarity and suspended solids in the Stony River and in BOD in the lower Waingongoro and the Maketawa. Almost all sites are reducing in temperature, although not at a rate that is considered ecologically meaningful. This could be associated with the increasing implementation of the regional riparian planting programme.

51. Sites which show little change or which show overall improvement over the full 23 year record include the upper Patea River, upper/mid Punehu Stream, the mid Patea River, the lower Waingongoro River, and the Mangaehu River. The sites showing the greatest number of deteriorating parameters are the Mangaoraka Stream, Waiwhakaiho River, and the Maketawa Stream. Overall, 78% of measures are either showing improvement or no clear trend. This measure indicates the degree to which the Council and regional community are giving effect to the obligation within the Resource Management Act and the *Regional Fresh Water Plan for Taranaki* to maintain and enhance the quality of the environment.

52. Because recent trends are more positive than long-term trends (see next section), there has been a progressive lift in the number of water quality parameters that over the long term have shown improvement eg for the full record to the end of the 2012 year, 75% of all parameters were showing either maintenance or improvement in quality; whereas for the full record to 2018, 78% of all parameters are showing either maintenance or improvement.

Recent trends

53. Over the last seven years, 80% of all parameters have either shown no trend ('maintenance') or improvement ('enhancement'). That is, there is an overall shift towards improving rather than the continuation of deteriorating trends in the region as time passes. However, the percentage of parameters showing maintenance or improvement in recent trends is lower than the percentages reported to the Council in the past few years, reflecting the preponderance of wetter than usual sampling conditions in the last few years, which in turn has meant reductions in water quality. Four of the last 5 and 5 of the last 7 years have been markedly wetter than typical in terms of flows during sampling runs. Over the same period, the annually updated record of the number of parameters showing either maintenance or improvement in the most recent 7 year period, has fallen from 99% to 80% of all measures annually reported.

Nevertheless, the number of parameters showing a recent deteriorating trend is still reduced, from 25% in earlier 7-year trend analysis, to 20% within the most recent seven years- a reduction of 12% in the number of measurements showing degradation.

54. Further, the rolling seven-year trends still remain more positive than the long-term trends, with fewer sites and measures showing significant deterioration, particularly in nutrient concentrations; and further, the percentage of measures showing either maintenance or improvement in the long term has continued to climb steadily as each new year passes even though short-term changes are not currently as numerous as they have been in the past.

55. Total nitrogen and nitrate are showing no pattern on a regional scale over this more recent period of time, but the Mangaoraka Stream is one individual site where there is site-specific deterioration in both parameters, and the Stony River and Maketawa Stream in total nitrogen. The upper Stony River and lower Punehu Stream sites and again the Maketawa Stream are the three sites showing deterioration in both phosphate measures in recent years. The Maketawa is the only site showing deterioration in bacterial parameters. Six of the eleven Council sites show either no or only a single deteriorating trend in any parameter over the last seven years. Of the two NIWA sites, the lower Waitara River site is likewise showing no trends in recent yearsand the Manganui River site (upper catchment) some degree of deterioration in phosphate measures.

56. Over the last eleven years, the seven-year (recent) trends in total nitrogen and nitrate have been predominantly positive (ie concentrations have been and are reducing). In each of the previous four years, the annual calculation of seven-year trends in these two nutrients have found no deteriorating trends at any site. However, as noted above, elevated river flows in the year under review correlated with poorer water quality, and on a regional scale this has meant that trends have not continued. Likewise, trends in recent concentrations of phosphate species were strongly positive (reducing) up to a few years ago, but co-incident with wetter conditions during sampling since then, these improvements have now stabilised on a regional perspective.

57. In terms of recent trends, the Maketawa Stream is performing the most poorly. Most mid to lower catchment sites are showing little or no deterioration in any parameter over recent years.

58. In further comparing the long-term and the seven-year trends, there is a noticeable change in trend patterns for the better for the Mangaoraka Stream, the Waingongoro River (both sites) and lower Punehu River. The Mangaoraka Stream is one that has been the focus of ongoing inspections and surveillance by Council officers because of previous poor quality. The Manganui River and the Maketawa Stream are the two sites showing an increase in the number of deteriorating measures, when long-term and recent trends are compared.

Examination of representativeness of regional sites in the physico-chemical fresh water quality monitoring network (2015-2016 programme)

59. The original selection of the existing surface freshwater physicochemical SEM sites in Taranaki in 1995 was undertaken with great care specifically to cover a wide range of situations, based upon knowledge gained from the extensive Taranaki Ring Plain Water

Resources Survey of 1980-1982, various water quality surveys for major development projects, and resource consent compliance monitoring throughout the region over more than a decade. The sites in the existing network are considered representative of the water bodies in the region (this having been subsequently demonstrated by both internal review and external audit), while also being chosen as sites located in the parts of the region subject to the greatest pressures on water quality, thus enabling the Council to give effect to Section 35 (1) and (2)(a)-(2)(d) of the Resource Management Act 1991. An analysis of the proportional distribution of the site locations against the distribution of all reaches of the region's rivers when both were classed according to the national River Environment Classification, found that the sites' distribution reflects the regional distribution of land cover classes extremely closely (within a percentage point or so). Further, an audit of the Council's physico-chemical SEM network by NIWA in 2010 on behalf of the Auditor-General's Office found the network to be satisfactory for its purpose.

60. Nonetheless, more recently it was decided by Council officers to further examine the representative nature of the site network, to engender further confidence in the integrity and strength of the monitoring network and the value of its results for informing the regional community on the state of and trends in the quality of Taranaki's freshwater systems, for feedback on policy and intervention effectiveness, and as a basis for informing further policy development. The NPS-FM requires the Council to ensure it undertakes representative sampling for every Freshwater Management Unit in the region, thus ensuring monitoring that reflects all freshwater quality.

61. Therefore, an evaluation of the representativeness of the existing SEM physicochemical sites as descriptors of baseline water quality in the Taranaki region was carried out during the 2015-2016 monitoring year. Ten 'equivalent' sites within the region were matched by landscape and hydrological characteristics with existing SEM sites, for comparative assessment of respective water quality. Four seasonal surveys were conducted at or near base flows within one day of the regular monthly SEM sampling, at about the same time of day for 'paired sites'.

62. The surveys were carried out in July and October 2015 and January and April 2016. Stream flows generally were above annual median in July, at about median in October and April, and below median in January. Neither flood nor drought occurred at the times of sampling. All samples were analysed for physical parameters, dissolved oxygen, nutrients and faecal indicator bacteria.

63. In summary, for all physicochemical parameters, the range of values across the regular SEM sites encompassed the range found across the "comparative" sites. That is, under base flow conditions monitored seasonally over the full course of a year, the existing SEM sites were found to already represent the full range of baseline water quality in the Taranaki region. No site in either the existing network (11 catchments) nor the 5 additional catchments gave anomalous results.

Conclusion

64. A wetter than usual year in 2017-2018 meant some noticeable changes in overall water quality during the year when compared with the long-term record, with some physical parameters elevated above usual levels. While this has impacted in the current results

upon the number of measures showing improvement in recent years, it should be noted that this reflects a temporary rather than long-term shift.

65. Water quality in the region is 'fit for purpose' by almost all measures at most sites most of the time, and more so when the compulsory national criteria are considered. The exception is 'swimmability' when measured by NPS criteria.

66. There continues to be a clear pattern of trends in water quality parameters becoming more positive as time passes, notwithstanding that on a year by year basis there will be natural fluctuations.

67. An extended network of sites was monitoring during 2015-2016, and the assessment of results is described again above. This showed that the existing SEM sites meaningfully represent the full range of baseline water quality in the Taranaki region.

68. These results, together with other past results presented to the Council (eg in-stream ecological health monitoring and research findings) validate the investment by the Council and the regional community in the continuing policy and plan measures to improve the region's surface water quality.

Decision-making considerations

69. Part 6 (Planning, decision-making and accountability) of the *Local Government Act 2002* has been considered and documented in the preparation of this agenda item. The recommendations made in this item comply with the decision-making obligations of the *Act*.

Financial considerations—LTP/Annual Plan

70. This memorandum and the associated recommendations are consistent with the Council's adopted Long-Term Plan and estimates. Any financial information included in this memorandum has been prepared in accordance with generally accepted accounting practice.

Policy considerations

71. This memorandum and the associated recommendations are consistent with the policy documents and positions adopted by this Council under various legislative frameworks including, but not restricted to, the *Local Government Act 2002*, the *Resource Management Act 1991* and the *Local Government Official Information and Meetings Act 1987*.

Iwi considerations

72. This memorandum and the associated recommendations are consistent with the Council's policy for the development of Māori capacity to contribute to decision-making processes (schedule 10 of the *Local Government Act 2002*) as outlined in the adopted long-term plan and/or annual plan. Similarly, iwi involvement in adopted work programmes has been recognised in the preparation of this memorandum.

Legal considerations

73. This memorandum and the associated recommendations comply with the appropriate statutory requirements imposed upon the Council.

Appendices/Attachments

74. Document 2268449: *Freshwater Physicochemical Programme State of the Environment Monitoring Annual Report 2017-2018, Technical Report 2018-103 (*Executive summary and recommendations).

Freshwater Physicochemical Programme State of the Environment Monitoring Annual Report 2017-2018, Technical Report 2018-103.

Executive summary and recommendations

Section 35 of the Resource Management Act requires local authorities to undertake monitoring of the region's environment, including land, air, and fresh and marine water quality. As set out in the Regional Policy Statement for Taranaki (2010), the quality of the region's fresh water resources is of primary importance for the region's communities, including iwi, economic sectors, and social and cultural sectors. To inform the community of the state of, pressures upon, and trends in water quality in the region, a number of monitoring programmes have been put in place. The freshwater physicochemical component of the State of Environment Monitoring (SEM) programme for Taranaki was initiated by the Taranaki Regional Council in the 1995-96 monitoring year and subsequently has been continued in each year. Data from this programme were used as the basis for the first five-year SEM report published in 2003, for trending purposes over the ten year period 1995 to 2005, and the thirteen year period 1995 to 2008 as presented in the third SEM report published in 2009, and the nineteen year period 1995-2014 as presented in the fourth SEM report (TRC, 2015a)

In the year under review, surveys continued to be performed regularly in the second week of every month from July 2017 to June 2018, under a wider range of flow conditions than typical, ranging through high floods to low early summer flows. This year was characterised by much higher median flows sampled by the programme in all rivers and streams. Each sampling run measured up to 22 physical and chemical water quality parameters at thirteen sites representing eight selected ring plain catchments and three eastern hill-country catchments. Two of the sites were established two years before, to increase representation of the eastern hill-country, in anticipation of the government's requirement that the Council must establish Freshwater Management Units and have representative monitoring across the entire region.

The twelve months of water quality data are presented for each of the Council's thirteen sites, together with a statistical summary for both the year and accumulated data to date. Results are discussed on a site-by-site basis and, more briefly, on a comparative parameters' basis. Data from the two Taranaki sites included in the NIWA national network monitoring programme are also presented and discussed.

Variability in site water quality occurred in response to flow conditions and with season. Generally there was some spatial deterioration in most aspects of water quality in a downstream direction. This was illustrated by poorer water clarity (increased turbidity), increased bacteriological counts and nutrient levels, and wider water temperature and pH ranges at downstream sites. This was usually coincident with increases in substrate algal cover during summer-autumn low flow conditions, a feature of Taranaki ring plain streams (and surface waters elsewhere in New Zealand); a response to elevated nutrient runoff, and warmer more open conditions in lower reaches of developed and farmland catchments. Higher turbidity and suspended solids levels (and therefore poorer visual clarity) characterised the eastern hill country Mangaehu, Whenuakura and Waitara Rivers sites in these rivers' lower reaches.

Over the 2017-2018 monitoring year, flows at times of sampling were much higher than usual, with several floods or freshes and few low flows sampled. In general terms, for the eleven sites monitored for more than 10 years, water quality was comparatively poorer in clarity, suspended solids concentrations, organics, bacteria numbers and nutrient levels, to past quality. Narrower temperature ranges, mainly due to higher minimum temperatures, and similar median water temperatures, were measured in the 2017-2018 period compared with ranges and medians measured during the first 23 years of the SEM programme. The 2017-2018 median turbidity was higher at ten sites, and median bacteria numbers were higher at all sites. Median dissolved reactive and/or total phosphorus levels were higher at five sites. Median nitrate and/or total nitrogen species' levels were higher at two sites and lower at two sites, while median ammoniacal nitrogen levels were higher at five sites. The report also provides an assessment of each site's statistical water quality in terms of appropriate guidelines and standards for various usages based upon a summary of the record for the complete 1995-2018 period.

For the fourth time, results are also compared with the compulsory national water quality criteria set out in the *National Objectives Framework* (NOF) that is part of the *National Policy Statement for Freshwater Management 2014 (NPS-FW*). The NOF assigns grades ('attribute states') for indicators ('attributes'), from A (best) to D (worst), with a National Bottom Line of acceptability being a C state. During the 2017-2018 year, the Ministry for the Environment amended the NOF grading system so that the 4 grades, with the bottom grade being unacceptable, were removed from the NOF in respect of *E coli*. Instead, there is now a matrix of categorisation, with 4 separate criteria to each be considered and the overall grading being the worst of the four. There are now five grades, and no bottom line, for *E coli*. The Government has stated that as a whole, 80% of the country's waterways should be within the top 3 categories by 2030, and 90% by 2040. It should be noted that these percentages do not necessarily apply at the regional level. For the purpose of comparisons, this report uses the five-step categories, with rivers in either of the bottom two categories being deemed unacceptable for recreational purposes.

The RMA requires that particular regard be given to the *'maintenance and enhancement of the quality of the environment'*. Therefore a key determinant for the Council is to identify where trends in water quality show no change ('*maintenance*') and/or improvement ('*enhancement*'), in either case aligning with the objective of the RMA, or alternatively show decline. With the availability of a suitable period (minimum of ten years) of robust data and access to appropriate statistical software, temporal trend analyses were performed for state of the environment reporting purposes and reported elsewhere during 2006. Regular updates of these temporal trends subsequently have been prepared at appropriate intervals and reported separately, and data for the period 1995 to 2018 are summarised and presented for all thirteen Council sites briefly in the current Annual Report. In addition, this report presents trend analysis for the two NIWA sites in Taranaki.

Also, for the fourth time, trends over the most recent period (the last seven years) have been incorporated into this report. Previously, they were calculated and presented separately; for the sake of convenience and completeness of reference they have now been included herein. These data help identify and evaluate the current state of flux in water quality, rather than those trends that are more historical in nature.

Long term (23-year) physicochemical trends have shown some significant deterioration in some aspects of water quality (particularly phosphorus) in many of the middle and lower catchments (e.g. the Mangaoraka Stream at Corbett Road, Punehu Stream at SH 45, Waiwhakaiho River at SH3 and Maketawa Stream at Tarata Road). On the other hand, there has been a significant long term improvement in total nitrogen at three of the eleven sites monitored, with only one site that is showing deterioration in this measure. Long term trends for faecal coliforms and enterococci bacteria showed statistically significant changes over the 23-year period for one or other species at five sites, out of eleven, with improvement at one site (Punehu Stream at Wiremu Road) and deterioration at four sites in mid and lower catchments. Significant deteriorations in black disc clarity were recorded at two sites, one of which reflected historical erosion events in the headwaters.

The most improvement in long term water quality has been illustrated in the Waingongoro River at SH 45, with significantly improving trends in DRP and total phosphorus, and with reduction in nitrate and total nitrogen by slightly less than the rate defined as significant. This improvement has been coincident with land-irrigation of a major industrial (meatworks) discharge since 2001 and the diversion of Eltham’s WWTP discharge out of the river since 2010. Most long term deterioration in aspects of water quality, where five parameters have significantly deteriorated, has been found in the mid-reaches of the Maketawa Stream (both phosphorus species, ammonia nitrogen, enterococci and $BOD_{5)}$) and Waiwhakaiho River (dissolved phosphorus, nitrate and ammonia nitrogen, and both bacteriological species), and in lower reaches of the Mangaoraka Stream (both phosphorus species, both bacteriological species and black disc), with no parameters showing significant long term improvement. More recent data for these sites indicate the deterioration has reduced in the Waiwhakaiho River and Mangaoraka Stream.

Analysis of recent trends indicates a better direction in water quality, although the latest seven-year trends do not show the same wide-spread improvements that had been evident in recent years. The latest rolling seven-year trend is more positive than the long-term trend, with fewer sites and measures showing significant deterioration, particularly in nutrient concentrations. Other measures (bacteria, organics, aesthetics) show no regional pattern of change in either direction.

This report on the results of the 2017-2018 monitoring period also includes recommendations for the 2018-2019 period and the results of internal and external laboratory quality control exercises, which, with relatively few exceptions, resulted in good inter and intra-laboratory precision.

Recommendations provide for the continuation of this programme.

Recommendations

1. THAT the existing freshwater physicochemical component of the SEM programme continue in a similar format for the 2018-2019 monitoring year.
2. THAT an additional (split) sample be collected on at least one occasion during the monitoring year, in conjunction with the intra-laboratory quality control programme, for analysis by an external, accredited laboratory.
3. THAT the appropriate trend analysis reported on the datasets for all Taranaki sites over the 1995-2018 period (provided in the current report), be updated for the 1995-2019 period at the conclusion of the 2018-2019 year.

Freshwater Physicochemical Programme
State of the Environment Monitoring
Annual Report
2017-2018

Technical Report 2018-103

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Taranaki Regional Council
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STRATFORD

ISSN: 1178-1467 (Online)
Document: 2244008 (Word)
Document: 2268449 (Pdf)

June 2019

Executive summary

Section 35 of the *Resource Management Act* (RMA) requires local authorities to undertake monitoring of the region's environment, including land, air, and fresh and marine water quality. As set out in the *Regional Policy Statement for Taranaki (2010)*, the quality of the region's fresh water resources is of primary importance for the region's communities, including iwi, economic sectors, and social and cultural sectors. To inform the community of the state of, pressures upon, and trends in water quality in the region, a number of monitoring programmes have been put in place. The freshwater physicochemical component of the State of Environment Monitoring (SEM) programme for Taranaki was initiated by the Taranaki Regional Council in the 1995-1996 monitoring year and subsequently has been continued in each year. Data from this programme were used as the basis for the first five-year SEM report published in 2003, for trending purposes over the ten year period 1995 to 2005, and the thirteen year period 1995 to 2008 as presented in the third SEM report published in 2009, and the nineteen year period 1995-2014 as presented in the fourth SEM report (TRC, 2015a).

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The twelve months of water quality data are presented for each of the Council's thirteen sites, together with a statistical summary for both the year and accumulated data to date. Results are discussed on a site-by-site basis and, more briefly, on a comparative parameters' basis. Data from the two Taranaki sites included in the NIWA national network monitoring programme are also presented and discussed.

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Over the 2017-2018 monitoring year, flows at times of sampling were much higher than usual, with several floods or freshes and few low flows sampled. In general terms, for the eleven sites monitored for more than 10 years, water quality was comparatively poorer in clarity, suspended solids concentrations, organics, bacteria numbers and nutrient levels, to past quality. Narrower temperature ranges, mainly due to higher minimum temperatures, and similar median water temperatures, were measured in the 2017-2018 period compared with ranges and medians measured during the first 22 years of the SEM programme. The 2017-2018 median turbidity was higher at ten sites, and median bacteria numbers were higher at all sites. Median dissolved reactive and/or total phosphorus levels were higher at five sites. Median nitrate and/or total nitrogen species' levels were higher at two sites and lower at two sites, while median ammoniacal nitrogen levels were higher at five sites.

The report also provides an assessment of each site's statistical water quality in terms of appropriate guidelines and standards for various usages based upon a summary of the record for the complete 1995-2018 period.

For the fourth time, results are also compared with the compulsory national water quality criteria set out in the *National Objectives Framework* (NOF) that is part of the *National Policy Statement for Freshwater Management 2014 (NPS-FW)*. The NOF assigns grades ('attribute states') for indicators ('attributes'), from A (best) to D (worst), with a National Bottom Line of acceptability being a C state. During the 2017-2018 year, the Ministry for the Environment amended the NOF grading system so that the 4 grades, with the bottom grade being unacceptable, were removed from the NOF in respect of *E coli*. Instead, there is now a matrix of categorisation, with 4 separate criteria to each be considered and the overall grading being the worst of the four. There are now five grades, and no bottom line, for *E coli*. The Government has stated that as a whole, 80% of the country's waterways should be within the top 3 categories by 2030, and 90% by 2040. It should be noted that these percentages do not necessarily apply at the regional level. For the purpose of comparisons, this report uses the five-step categories, with rivers in either of the bottom two categories being deemed unacceptable for recreational purposes.

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Analysis of recent trends indicates a better direction in water quality, although the latest seven-year trends do not show the same wide-spread improvements that had been evident in recent years. The latest rolling seven-year trend is more positive than the long-term trend, with fewer sites and measures showing significant deterioration, particularly in nutrient concentrations. Other measures (bacteria, organics, aesthetics) show no regional pattern of change in either direction.

This report on the results of the 2017-2018 monitoring period also includes recommendations for the 2018-2019 period and the results of internal and external laboratory quality control exercises, which, with relatively few exceptions, resulted in good inter and intra-laboratory precision.

Recommendations provide for the continuation of this programme.

Table of contents

List of tables

List of figures

1 Introduction

The Resource Management Act 1991 (RMA) established new requirements for local authorities to undertake environmental monitoring. Section 35 of the RMA requires local authorities to monitor, among other things, the state of the environment of their region or district, to the extent that is appropriate to enable them to effectively carry out their functions under the Act.

To this effect, the Taranaki Regional Council (the Council) established a state of the environment monitoring (SEM) programme for the region. This programme is outlined in the Council's *State of the Environment Monitoring Procedures Document*, which was prepared in 1997. The monitoring programme is based on the significant resource management issues that were identified in the Council's *Regional Policy Statement for Taranaki* (1994). The relevant issues are presented in Appendix II.

The SEM programme comprises a number of individual monitoring activities, many of which are undertaken and managed on an annual basis (from 1 July to 30 June). For some of these annual monitoring activities, summary reports are produced following the end of each monitoring year. Where possible, individual consent monitoring programmes have been integrated with the SEM programme to save duplication of effort and minimise costs. The purpose of annual SEM reports is to summarise monitoring activity results for the year and provide a brief interpretation of these results.

Annual SEM reports act as 'building blocks' towards the preparation of the regional state of the environment report every five years. The Council's first, or baseline, state of the environment report was prepared in 1996 (TRC, 1996b), summarising the region's progress in improving environmental quality in Taranaki over the past two decades. The second report (for the period 1995-2000) was published in 2003 (TRC, 2003). Data spanning the ten year period 1995 to 2005 have been used in the preparation of a trend report (TRC, 2006). The third State of the Environment report (for the period 1995 to 2007) was published (TRC, 2009a) and included trend reporting, and the fourth report (for the 1995 to 2014 period) has been published (TRC, 2015a). The provision of appropriate computer software statistical procedures allows regular reporting on trends in the environmental quality over time, in relation to Council's ongoing monitoring activities, now that there has been an accumulation of a comprehensive dataset of sufficient duration to permit a meaningful analysis of trends (i.e. minimum of 10 years).

This report summarises the results for the sites surveyed in the freshwater physicochemical SEM programme over the 2017-2018 monitoring year, the twenty-third year of the programme. Previous years' results have been presented in the TRC Technical Reports listed in the References section.

A network of nine freshwater sites was established in mid-1995 for physicochemical monitoring on a long-term basis to provide information on trends in the state of Taranaki's regional surface water quality and this network was maintained with the addition (for various purposes) of one site during the 1998-99 period, another site in the 2003-2004 period, and two more sites in the 2015-2016 period. The latter change was brought about because of the direction within the Government's *National Policy Statement for Freshwater Management 2014*, that all freshwater within each region must be included within a 'Freshwater Management Unit' (FMU), for each of which the regional council is obliged to set objectives and limits (bottom lines for quality measures that are related to community values for that water body), and to undertake representative monitoring that demonstrates progress towards the objectives for that FMU. The NPS objectives and limits are to be set by 31 December 2025, or if particular circumstances apply, by 31 December 2030. The Taranaki Regional Council is seeking to establish objectives and limits as appropriate for the Taranaki region through the current review of the Regional Fresh Water Plan for Taranaki.

The Taranaki Regional Council's SEM programme also includes a freshwater biological component encompassing the same thirteen sites plus forty-six additional sites, which is reported separately (see TRC, 2018b).

The physicochemical programme has been designed to provide a general picture of water quality for nine different catchments in the region affected by a range of different land uses and industries, and recognising cumulative impacts. This monitoring is undertaken in addition to consent compliance monitoring and will enable the Council to report on trends in water quality over time for the Taranaki region. The monitoring programme covers nine of the sixty-nine catchments in the Taranaki region and 44% of the total area of the region (Figures 1 and 2). Given that a number of the largest catchments in the region are included in the network, it provides a relatively representative indication of the state of surface water in the region.

The sites were specifically selected to be representative of major/significant waterways and positioned in the upper, middle, and lower reaches of catchments. Both ringplain and eastern hill country catchments were represented with a mixture of land uses including waterways under industrial discharge pressures.

Notwithstanding the wide coverage of the region through the existing representative sites, in 2015-2016 the Council undertook an extended survey programme that involved regular sampling across a large number of additional catchments, to confirm (or otherwise) the degree of representation afforded by the current programme. An analysis of the alignment between the additional surveys and the ongoing programme is set out in this report.

The existing programme also meshes with a national programme, which has been operated by the National Institute of Water and Atmospheric Research (NIWA) since January 1989. This National Rivers Water Quality Network (NRWQN) was designed to monitor changes in water quality by sampling physical and chemical parameters monthly at 77 river sites around New Zealand (Smith, et al, 1989). Until December 2015, the programme included three sites in Taranaki (Figure 1); one upper/mid catchment site (Manganui River at State Highway 3, incorporating some farm land area) and two lower catchment sites (Waitara River at Bertrand Road and Waingongoro River at SH45). Data from these sites are presented within this report (sections 4.2.2 and 4.4) and previous reports.

However, it should be noted that as of December 2015 NIWA has withdrawn from water quality sampling and analysis at the Waingongoro River site on SH45, following a rationalisation of the monitoring network nation-wide. NIWA has noted that part of the rationale for ceasing monitoring at this site was that the Council data are seen by them as robust and reliable, and hence NIWA's work could be viewed as unnecessary duplication from the perspective of national water quality reporting. From this Council's perspective, it meant the loss of a quality control measure, although a large number of other QA/QC measures remain in place.

The design of the TRC SEM programme was deliberately chosen to follow the design of the NIWA national programme, although the actual sampling days in each monthly survey do not coincide for the two programmes. However, the two programmes are complementary and each is designed for robust trend detection purposes using similar methodologies.

Physicochemical water quality monitoring is performed to obtain an understanding of the physical and chemical characteristics of water by means of statistical sampling (Ward & McBride, 1986). It requires repetitive measurements of such characteristics through time. The complex variations of those characteristics in the natural, and more especially the modified environment, make it difficult to obtain accurate understandings, and therefore the monitoring systems employed must be designed to supply the required information at the necessary sensitivity, accuracy and precision (Ward & McBride, 1986).

2 Sites

The Council has chosen sites which are within the existing hydrological flow monitoring network where possible. Hydrological information is vital to the interpretation of physicochemical data. Generally, sites have been positioned strategically within representative catchments in the region, with industrial and/or intensive farming land uses, and including both the higher and lower quality waterways of the region (Figure 1).

The sites selected and maintained for the monitoring of physicochemical water quality by Taranaki Regional Council are listed in Table 1, with comments relating to selection criteria following the table.

Table 1 Sample sites for TRC network programme

Stream	Location	Site code
Maketawa Stream	at Tarata Road	MKW000300
Mangaoraka Stream	at Corbett Road	MRK000420
Waiwhakaiho River	at SH3	WKH000500
Stony River	at Mangatete Road	STY000300
Punehu Stream	at Wiremu Road	PNH000200
Punehu Stream	at SH45	PNH000900
Waingongoro River	at Eltham Road	WGG000500
Waingongoro River	at SH45	WGG000900
Patea River	at Barclay Road	PAT000200
Patea River	at Skinner Road	PAT000360
Mangaehu River	at Raupuha Road	MGH000950
Whenuakura River	at Nicholson Road	WNR000450
Waitara River	at Autawa Road	WTR000540

All sites are described in detail and referenced with location maps, photographs, GPS and map references on the internal electronic TRC site reference system (ESAM) which is integrated into the existing LAB water quality computer and Taradise GIS databases.

A brief description of all sites in the Taranaki Regional Council and NIWA programmes follows.

Site Maketawa Stream at Tarata Road

The site in the lower reaches of a developed farmland catchment is representative of a sub-catchment of the Manganui and Waitara Rivers catchments, with valued trout and native fish habitat. The stream drains into the Manganui River below the principal abstractions for the Motukawa HEP scheme. This site requires flow gauging on each sampling occasion for rating purposes.

Site Mangaoraka Stream at Corbett Road

This site is representative of a northern Taranaki ringplain stream, (but with its source outside the National Park), draining an intensive agricultural catchment. The site is also a hydrological recording station. It is located toward the lower catchment and is the principal tributary of the lower Waiongana Stream. The Mangaoraka Stream is a trout fishery of local importance.

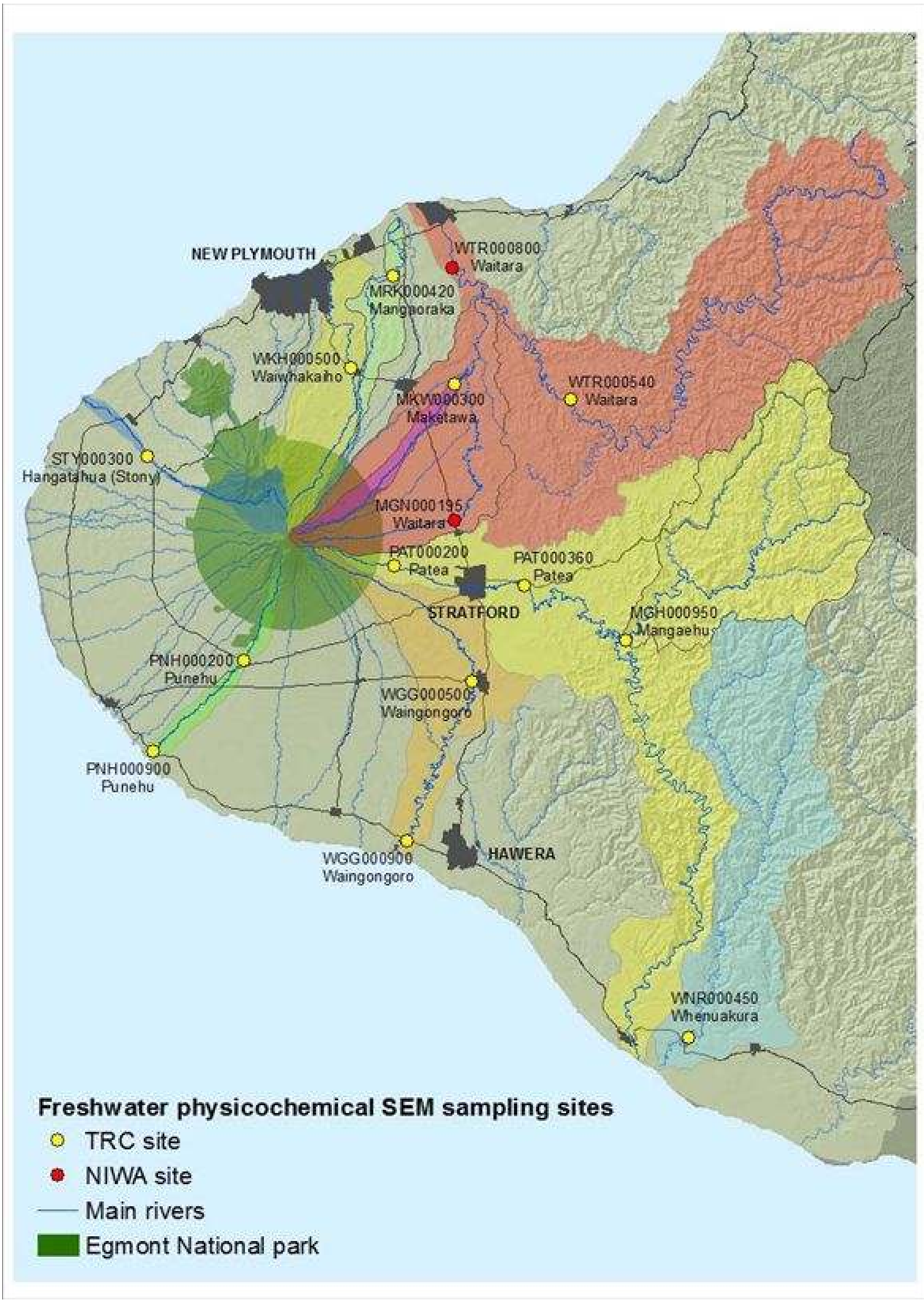

Figure 1 Freshwater physicochemical SEM sampling sites

Site Waiwhakaiho River at SH3

This site is an existing hydrological recording station and was included in the Taranaki ring plain survey (TRC 1984). It is representative of the mid catchment of a National Park-sourced river draining developed farmland and is immediately upstream of the major diversion site for the New Plymouth water supply and the Mangorei HEP scheme. This site has also been integrated into compliance monitoring programmes related to the diversion consent. The lower river is markedly influenced by HEP generation releases and industrial impacts and is further monitored by way of a site specific monitoring programme. Occasional natural headwater erosion events may affect water quality from time to time (including iron-oxide release from tributary streams).

Site Hangatahua (Stony) River at Mangatete Road

This river is protected in its natural state by way of a Local Conservation Order. This site is as close to the National Park Boundary (within 7 km) as realistically possible, given the need for regular access. The site was used during the ring plain survey (TRC, 1984). This river is notoriously difficult to rate (hydrologically) and regular flow gauging is necessary although, more recently, a hydrological recording station has been established. The river has also been affected by significant natural erosion events in the headwaters from time-to-time. Several of these events have occurred since the SEM programme commenced particularly in the latter part of 2006, during mid-2008 and mid-2009, and early 2014, mid-2016 and early/mid-2017.

Sites Punehu Stream at Wiremu Road (1) and at SH45 (2)

This stream is representative of a south-western Taranaki catchment subjected primarily to intensive agricultural land use with water quality potentially affected by diffuse source run-off and point source discharges from dairy shed treatment pond systems in the lower reaches of the catchment and Mangatawa Stream sub-catchment in particular. No industrial discharges in the catchment are known to occur. Both sites were included in the Taranaki ring plain survey and the lower site near the coast remained a NIWA hydrological recording station for a national representative basin from 1970 until 2011, when the station was closed. The upstream site (located approximately 2 km from the National Park boundary) is representative of relatively unimpacted stream water quality although this reach is in open farmland, and requires regular flow rating. Flow gaugings at this site are therefore necessary on each sampling occasion, and flow gaugings were implemented at the lower reach site in 2011 after hydro station closure by NIWA.

Sites Waingongoro River at Eltham Road (1) and at SH45 (2)

Both sites were Taranaki ring plain survey sites and are existing hydrological recording stations. Site 1 is representative of agricultural impacts in the upper catchment and provides a control site for monitoring the impacts of major industrial/municipal discharges which have occurred in the vicinity of Eltham. The site is therefore also included in a consent compliance monitoring programme.

Site 2 is representative of the combined impacts of industrial/municipal and agricultural point source discharges plus diffuse run-off, in the lower reaches of a principal Taranaki trout fishery river and the longest river confined to the ring plain. One of the major industrial (meatworks) point-source discharges to the mid reaches of the river has been partially re-directed to land irrigation during summer-autumn low flow periods since January 2001 and the Eltham WWTP discharge was diverted out of the catchment (by pipeline to the Hawera WWTP) from June 2010.

This site was part of the NIWA (NZ rivers) survey network from January 1989 to November 2015, and has been monitored by the Council since July 1998.

Sites Patea River catchment: Patea River at Barclay Road and at Skinner Road, and Mangaehu River at Raupuha Road bridge

The Barclay Road site is representative of the upper catchment adjacent to the National Park above agricultural impacts and requires flow ratings to be established. The Skinner Road site, which is integrated with consent compliance monitoring programmes, was a ring plain survey site, and is representative of developed farmland drainage and is downstream of Stratford (urban run-off, closed landfill and up-graded (in 2009) oxidation pond discharges and the gas-fired power station discharge). It is also an established hydrological recorder station. The Mangaehu River site, in the lower reaches of one of the largest hill country catchments, represents the principal eastern hill country tributary flowing into the Patea River and has an established hydrological recorder station.

Sites Waitara River at Autawa Road (1) and at Bertrand Road (2, NIWA)

The Autawa Road site, in the mid reaches of the eastern hill country part of the Waitara catchment, is representative of a combination of upland agricultural development and native forest. It is 6.1 km above the hydrological recording station that was established in 1970 at Tarata for a national representative basin, with the discharge from the Motukawa power station in between, and has been monitored by the Council for physicochemical water quality since July 2015.

The Bertrand Road site is currently part of the NIWA (NZ rivers) survey network and is an existing hydrological recording station. It was also a Taranaki ring plain survey site, and is representative of the lower reaches of the largest Taranaki catchment (draining both ring plain and eastern hill country catchments) but upstream of any tidal influence. NIWA data are utilised for this site.

Site Manganui River at SH3

This site was a Taranaki ring plain survey site and is currently one of the two Taranaki sites in the NIWA (NZ rivers) survey network in conjunction with the hydrological recording station that was established for a national representative basin in 1971. The site is representative of the upper/mid reaches (approximately 7 km from the National Park boundary) of a high quality river receiving limited agricultural run-off. NIWA data are utilised for this site.

Site Whenuakura River at Nicholson Road

This site is in the lower reaches of an eastern hill county catchment in the southern part of the region that has largely been developed for agriculture, with some production forestry and native forest. It is an established hydrological recording station 10.7 km from the coast in the upper section of tidal river, above the saline influence, and has been monitored by the Council for physicochemical water quality since July 2015.

3 Sampling procedure and analytical parameters

Sampling has been performed monthly on the second Wednesday of each calendar month, to allow for typical variations in relation to fluctuating flows and seasonal trends. This is consistent with the scientifically established sampling frequency that is required for long-term trend analysis. It has been performed by trained Council Technical Officers under the supervision of the designated Environmental Scientist and according to standard TRC field methodology outlined in an appropriate manual (TRC 2004a) which was last revised in 2012.

Analyses have been performed in the TRC IANZ-registered chemistry laboratory using standard methods. The parameters analysed and site of measurements are listed in Table 2.

Table 2 SEM physicochemical parameters and site of measurement

Parameter	Unit	Location
Time	NZST	On site
Temperature	˚C	On site
Flow	m^3/s	On site recorder or rated SG or gauging
Dissolved oxygen	g/m^3	On site
BOD_5 (total)	g/m^3	Laboratory
pH	-	Laboratory
Conductivity @ 20°C	mS/m	Laboratory
Black disc clarity	m	On site
Turbidity	NTU	Laboratory
Absorbance @ 770, 440, 340 nm	/cm	Laboratory (membrane filtration)
Ammonia-N	g/m^3N	Laboratory
Nitrate-N	g/m^3N	Laboratory
Total-N	g/m^3N	Laboratory
Dissolved reactive phosphorus	g/m^3P	Laboratory
Total phosphorus	g/m^3P	Laboratory
Alkalinity	g/m^3CaCO_3	Laboratory
Suspended solids	g/m^3	Laboratory
Faecal coliform and *E. coli* bacteria (mTEC)	cfu/100 mL	Laboratory
Enterococci bacteria	cfu/100 mL	Laboratory

The instrument used for turbidity measurement was changed in January 2016, from a Hach 2100A to a WTW Cyberscan turbidimeter. All the water samples collected monthly since June 2006, a period of almost ten years, had been tested with both instruments, providing data for comparative analysis on performance of the two meters, and for turbidity trend analysis using the replacement meter.

The precision of the laboratory analyses has been checked regularly by the collection of split samples from one randomly chosen site on selected sampling runs (generally every three months). These samples were unidentified for laboratory processing purposes and included with the other samples in the normal manner for laboratory analysis. Comparative results have been stored in the appropriate database and a separate internal report prepared for quality control purposes (see Appendix III).

Stream flow gaugings have been performed at the five sites where no permanent hydrological stations exist and/or the rating is unstable, in conjunction with each monthly sampling survey run.

All samples were logged into the TRC computer database following receipt by the laboratory with subsequent analytical results and audited flow data stored in this database.

4 Water quality results

Water quality data accumulated for the period July 2017 to June 2018 are presented for each of the thirteen sites. Statistical summaries of these data and the cumulative data for nine sites (July 1995 to June 2018), one site in the lower Waingongoro River (July 1998 to June 2018), one site in the lower Maketawa Stream (July 2003 to June 2018), and one site each in the lower Whenuakura River and mid Waitara River (July 2015 to June 2018) are also presented on a site-by-site basis, together with a general discussion of water quality at each site. A comparison of water quality through the region is provided following the individual sites' discussions (Section 4.2).

4.1 Sites' water quality

Maketawa Stream at Tarata Road (site: MKW000300)

Analytical data from the monthly samples are presented in Table 3.

Table 3 Analytical results from monthly samples: Maketawa Stream at Tariki Road

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20 °C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^3P	cfu/100mL	cfu/100mL
12 Jul 2017	0800	0.021	0.006	0.001	28	2.10	0.6	8.6	11.2	98	0.034	190	84
09 Aug 2017	0805	0.078	0.019	0.001	5	0.09	3.8	1.8	11.0	102	0.064	2000	3300
13 Sep 2017	0810	0.016	0.003	0.000	26	3.72	<0.5	9.0	11.4	100	0.031	130	23
11 Oct 2017	0715	0.023	0.005	0.001	24	1.73	0.7	7.1	10.7	101	0.037	1100	2300
08 Nov 2017	0700	0.070	0.016	0.001	12	0.20	5.4	5.8	10.4	101	0.108	62000	12000
13 Dec 2017	0710	0.015	0.003	0.000	33	3.65	<0.5	8.9	9.4	99	0.038	1100	160
10 Jan 2018	0705	0.020	0.005	0.000	27	3.88	<0.5	8.1	8.6	95	0.037	630	560
14 Feb 2018	0710	0.032	0.008	0.000	26	3.15	0.6	8.5	9.1	99	0.045	490	660
14 Mar 2018	0700	0.014	0.003	0.000	32	3.88	<0.5	9.9	9.9	98	0.027	230	440
11 Apr 2018	0800	0.072	0.017	0.002	9	0.90	1.5	6.5	11.0	100	0.033	4610	4450
09 May 2018	0800	0.016	0.004	0.000	30	3.42	<0.5	9.6	10.8	98	0.037	240	130
13 Jun 2018	0815	0.013	0.003	0.000	27	2.25	0.8	8.0	10.8	100	0.035	670	120

Date	Time NZST	FC	Flow	NH_4	NO_2	NO_3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m^3/s	g/m^3N	g/m^3N	g/m^3N	pH	g/m^3	°C	g/m^3N	g/m^3N	g/m^3P	NTU
12 Jul 2017	0800	190	2.503	0.010	0.002	0.52	7.6	<2	8.5	0.02	0.54	0.037	1.5
09 Aug 2017	0805	2000	101.989	0.042	0.003	0.07	6.8	130	11.0	2.00	2.07	0.774	75
13 Sep 2017	0810	130	2.476	0.023	0.003	0.48	7.6	<2	9.0	<0.01	0.47	0.031	0.9
11 Oct 2017	0715	1300	6.022	0.112	0.001	0.28	7.5	3	11.5	0.11	0.39	0.047	2.1
08 Nov 2017	0700	62000	32.465	0.252	0.007	0.27	7.3	58	12.7	1.64	1.92	0.425	40
13 Dec 2017	0710	1200	1.092	0.004	0.003	0.05	7.8	<2	16.8	0.02	0.07	0.046	0.7
10 Jan 2018	0705	720	1.267	0.005	0.002	0.01	7.5	<2	19.1	0.14	0.15	0.106	0.6
14 Feb 2018	0710	490	1.958	0.011	0.004	0.33	7.6	<2	18.5	<0.07	0.40	0.053	0.9
14 Mar 2018	0700	250	1.969	0.011	0.002	0.40	7.6	<2	14.0	<0.01	0.41	0.032	0.4
11 Apr 2018	0800	4670	13.711	0.100	0.004	0.33	7.1	42	9.6	0.36	0.69	0.128	14
09 May 2018	0800	240	1.428	0.005	0.002	0.27	7.6	<2	10.8	0.03	0.30	0.046	1.4
13 Jun 2018	0815	730	2.975	0.011	0.001	0.17	7.5	6	10.7	0.09	0.26	0.053	1.8

The statistical summary of these data is presented in Table 4.

Table 4 Statistical summary of data from July 2017 to June 2018: Maketawa Stream at Tarata Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.013	0.078	0.020	12	0.025
A440F	Absorbance @ 440nm filtered	/cm	0.003	0.019	0.005	12	0.005
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.002	0.000	12	0.001
ALKT	Alkalinity total	g/m^3 $CaCO_3$	5	33	26	12	9
BLACK DISC	Black disc transparency	m	0.09	3.88	2.70	12	1.42
BOD_5	Biochemical oxygen demand 5 day	g/m^3	<0.5	5.4	0.6	12	1.6
CONDY	Conductivity @ 20°C	mS/m	1.8	9.9	8.3	12	2.2
DO	Dissolved oxygen	g/m^3	8.6	11.4	10.8	12	0.9
PERSAT	Dissolved oxygen saturation	%	95	102	100	12	2
DRP	Dissolved reactive phosphorus	g/m^3P	0.027	0.108	0.037	12	0.022
ECOL	E. coli bacteria	cfu/100 mL	130	62000	650	12	17643
ENT	Enterococci bacteria	cfu/100 mL	23	12000	500	12	3465
FC	Faecal coliform bacteria	cfu/100 mL	130	62000	725	12	17630
FLOW	Flow	m^3/s	1.092	101.989	2.490	12	29.092
NH_4	Ammoniacal nitrogen	g/m^3N	0.004	0.252	0.011	12	0.074
NO_2	Nitrite nitrogen	g/m^3N	0.001	0.007	0.002	12	0.002
NO_3	Nitrate nitrogen	g/m^3N	0.008	0.518	0.276	12	0.164
pH	pH		6.8	7.8	7.6	12	0.3
SS	Suspended solids	g/m^3	<2	130	<2	12	39
TEMP	Temperature	°C	8.5	19.1	11.2	12	3.6
TKN	Total kjeldahl nitrogen	g/m^3N	<0.01	2.00	0.09	12	0.71
TN	Total nitrogen	g/m^3N	0.07	2.07	0.40	12	0.66
TP	Total phosphorus	g/m^3P	0.031	0.774	0.050	12	0.225
TURBY	Turbidity	NTU	0.4	75	1.4	12	22.99

A statistical summary of the fifteen years' data collected since 1 July 2003 is presented in Table 5.

Table 5 Statistical summary of data from July 2003 to June 2018: Maketawa Stream at Tarata Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.002	0.141	0.017	180	0.022
A440F	Absorbance @ 440nm filtered	/cm	0.001	0.031	0.004	180	0.005
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.002	0.000	180	0.000
ALKT	Alkalinity total	g/m^3 $CaCO_3$	5	34	28	180	6
BLACK DISC	Black disc transparency	m	0.09	5.23	2.55	180	1.15
BOD_5	Biochemical oxygen demand 5 day	g/m^3	<0.5	5.4	<0.5	180	0.5
CONDY	Conductivity @ 20°C	mS/m	1.8	12.6	8.6	180	1.3
DO	Dissolved oxygen	g/m^3	8.6	12.5	10.6	180	0.8
PERSAT	Dissolved oxygen saturation	%	90	103	98	180	2
DRP	Dissolved reactive phosphorus	g/m^3P	0.004	0.108	0.025	180	0.011
ECOL	E. coli bacteria	cfu/100 mL	50	62000	335	180	5185
ENT	Enterococci bacteria	cfu/100 mL	6	12000	180	180	1789
FC	Faecal coliform bacteria	cfu/100 mL	50	62000	335	180	5189
FLOW	Flow	m^3/s	0.838	101.989	2.006	180	8.11
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.252	0.010	180	0.025
NO_2	Nitrite nitrogen	g/m^3N	<0.001	0.012	0.002	180	0.002
NO_3	Nitrate nitrogen	g/m^3N	0.008	0.918	0.268	180	0.206
pH	pH		6.8	7.9	7.6	180	0.2
SS	Suspended solids	g/m^3	<2	130	<2	180	7
TEMP	Temperature	°C	4.8	19.1	11.5	180	3.1
TKN	Total kjeldahl nitrogen	g/m^3N	-0.01	2.00	0.07	179	0.12
TN	Total nitrogen	g/m^3N	<0.05	2.07	0.40	180	0.28
TP	Total phosphorus	g/m^3P	0.018	0.774	0.035	180	0.066
TURB	Turbidity (Hach 2100A)	NTU	0.5	14	0.9	150	1.8
TURBY	Turbidity (Cyberscan WTW)	NTU	0.4	75	1.2	157	7.6

Discussion

2017-2018 period

Good aesthetic water quality was indicated by a median black disc clarity of 2.70 metres, in the lower reaches of this ring-plain stream near to its confluence with the Manganui River. The maximum clarity (black disc value of 3.88 m) was recorded in mid-summer under low flow conditions (1.27 m^3/s). Flood conditions were sampled on three occasions, including the highest recorded sampled flow (102 m^3/s) in late winter 2017, and the second and sixth highest sampled flows in late spring 2017 and mid-autumn 2018, respectively. Record high turbidity (75 NTU) and suspended solids concentration (130 g/m^3) and low black disc visibility (0.09 m) occurred during the first, August 2017 flood. Poorest water quality conditions were recorded at the time of the spring flood, in terms of bacterial number (62,000 faecal coliforms/100mL), BOD_5 (5.4 g/m^3) and some dissolved nutrients (ammonia 0.242 g/m^3N and DRP 0.108 g/m^3P).

pH was relatively stable (6.8 to 7.8), although it would be expected that pH would have reached a higher maximum later in the day than at the usual times of sampling (i.e. prior to 0820 NZST), particularly during summer low flow conditions.

Good water quality was indicated by high dissolved oxygen concentrations (minimum of 95% saturation) and low BOD_5 levels (median: 0.6 g/m^3). Bacteriological quality was typical of the lower reaches of developed ring plain catchments subject to agricultural impacts, for the frequent fresh flow conditions, with median faecal coliform and enterococci numbers of 650 and 500 (per 100 mL) respectively. Water temperature varied over a moderate range of 10.6°C with a maximum mid-summer (early morning) river temperature of 19.1°C recorded in January 2018.

Brief comparison with the previous 2003-2017 (fourteen year) period

The flow range sampled at this site during 2017-2018 was the widest recorded, while the median sampled flow was higher than that for the previous fourteen-year period (by 514 L/s, or 26%). Generally, stream water quality was slightly better in appearance/clarity (higher median black disc clarity [by 0.15 m], with no difference in median suspended solids level, though median turbidity was slightly higher [by 0.2 NTU]). Bacterial water quality was poorer, with significantly higher median faecal coliform and enterococci numbers, by 315 and 320 cfu/100 mL, respectively. Median water temperature was slightly lower [by 0.2°C], while the maximum water temperature was higher [by 1.2°C] than the maximum previously recorded. Other physicochemical aspects of water quality were very similar for the two periods, in terms of median values. Wide ranges for parameters such as suspended solids, conductivity, turbidity, pH and total phosphorus reflected the large flood events sampled. Median pH values were identical, and the maximum pH value was 0.1 unit lower than that of the past fourteen-year record. For nutrients, nitrogen species all had similar median values, and total and dissolved phosphorus were higher (by 43 and 54%, respectively) during the monitoring year in comparison with the medians of the previous fourteen year record.

Mangaoraka Stream at Corbett Road (site: MRK000420)

Analytical data from the monthly samples are presented in Table 6 and the stream flow record is illustrated in Figure 3.

Table 6 Analytical results from monthly samples: Mangaoraka Stream at Corbett Road

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20 °C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^3P	cfu/100mL	cfu/100mL
12 Jul 2017	0835	0.024	0.004	0.000	32	0.92	0.6	12.9	10.7	98	0.017	610	640
09 Aug 2017	0835	0.065	0.014	0.001	12	0.10	3.7	4.1	10.3	98	0.031	8300	32000
13 Sep 2017	0845	0.020	0.004	0.000	34	2.42	<0.5	12.8	10.8	101	0.012	400	180
11 Oct 2017	0745	0.035	0.008	0.001	33	0.76	1.3	12.0	10.3	100	0.028	8400	2700
08 Nov 2017	0730	0.036	0.008	0.001	48	0.23	7.2	16.0	9.8	96	0.041	56000	130000
13 Dec 2017	0745	0.034	0.007	0.000	87	2.05	0.9	25.1	9.2	98	0.011	2200	640
10 Jan 2018	0745	0.032	0.006	0.000	64	2.30	0.9	19.2	8.2	90	0.021	2200	1600
14 Feb 2018	0740	0.039	0.010	0.001	52	2.30	0.8	16.5	8.6	95	0.048	1800	1300
14 Mar 2018	0730	0.019	0.004	0.000	45	2.92	0.6	15.6	9.6	96	0.013	930	1500
11 Apr 2018	0835	0.057	0.013	0.001	32	0.37	4.3	13.4	10.6	97	0.074	39700	38300
09 May 2018	0830	0.024	0.005	0.000	51	2.28	0.5	17.0	10.4	99	0.021	620	280
13 Jun 2018	0855	0.021	0.004	0.000	50	2.20	0.5	17.2	10.3	98	0.014	730	160

Date	Time NZST	FC	Flow	NH_4	NO_2	NO_3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m^3/s	g/m^3N	g/m^3N	g/m^3N	pH	g/m^3	°C	g/m^3N	g/m^3N	g/m^3P	NTU
12 Jul 2017	0835	780	3.316	0.043	0.005	1.27	7.4	8	10.6	0.27	1.54	0.070	7.4
09 Aug 2017	0835	8500	70.423	0.085	0.005	0.30	7.0	150	12.8	1.97	2.27	0.607	81
13 Sep 2017	0845	400	2.607	0.030	0.005	1.12	7.6	2	11.6	0.24	1.36	0.022	2.4
11 Oct 2017	0745	8600	3.132	0.097	0.011	1.00	7.5	10	13.4	0.48	1.49	0.088	6.6
08 Nov 2017	0730	57000	11.14	0.072	0.007	0.86	7.6	130	14.2	2.61	3.48	0.450	49
13 Dec 2017	0745	2200	0.217	0.007	0.007	0.39	7.9	<2	18.4	0.12	0.52	0.022	1.7
10 Jan 2018	0745	3100	0.343	0.029	0.008	0.56	7.6	<2	19.7	0.15	0.72	0.029	1.8
14 Feb 2018	0740	1800	0.526	0.024	0.008	0.81	7.7	<2	20.0	0.20	1.02	0.063	1.4
14 Mar 2018	0730	970	0.998	0.022	0.003	0.83	7.7	<2	15.2	<0.01	0.84	0.023	0.9
11 Apr 2018	0835	50000	3.09	0.154	0.016	0.86	7.5	25	11.1	0.79	1.67	0.219	14
09 May 2018	0830	660	0.829	0.008	0.003	0.83	7.8	2	13.3	0.04	0.87	0.035	1.4
13 Jun 2018	0855	730	0.836	0.016	0.003	0.98	7.6	<2	12.3	0.06	1.04	0.020	1.0

The statistical summary of these data is presented in Table 7.

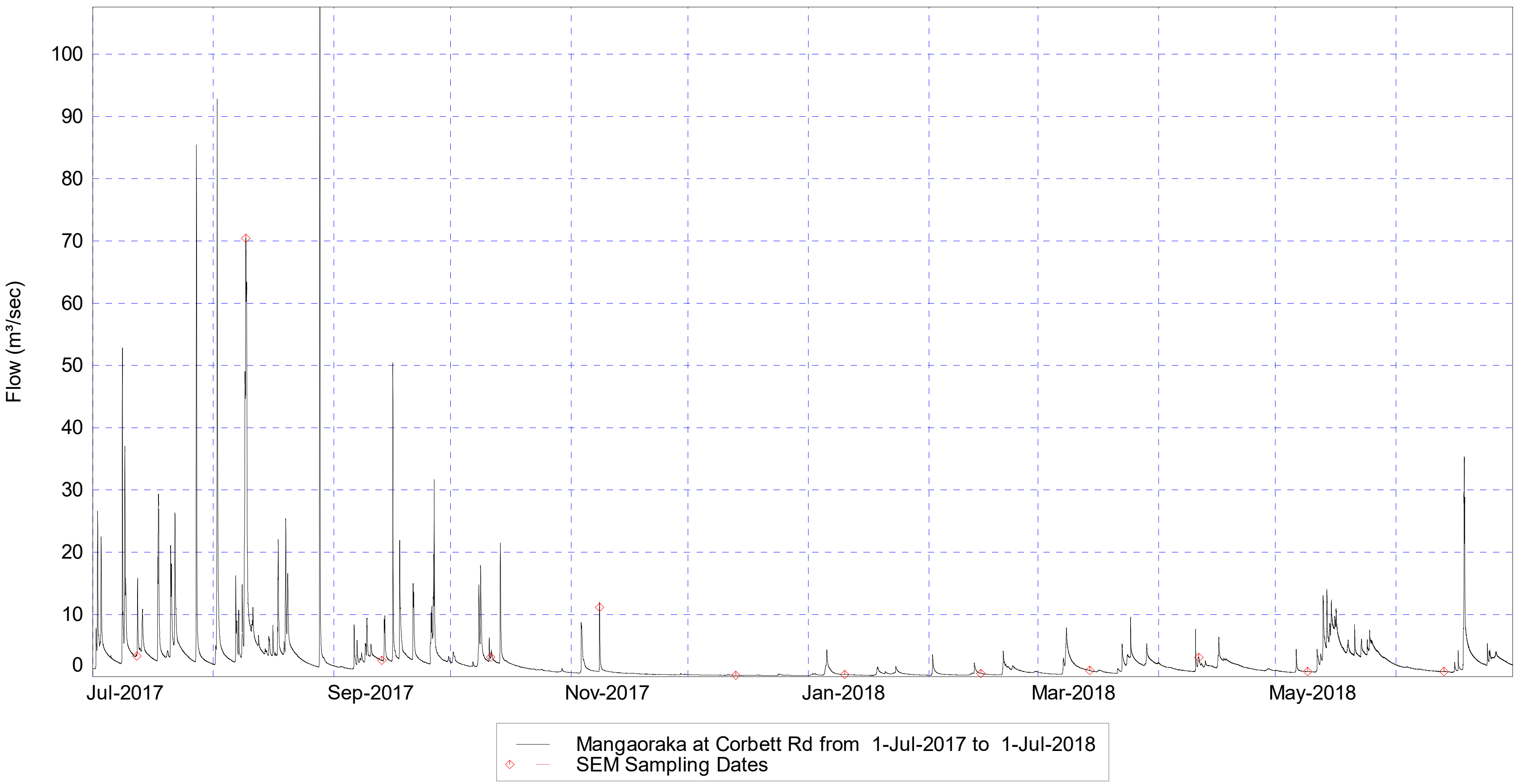

Figure 2 Flow record for the Mangaoraka Stream at Corbett Road

Table 7 Statistical summary of data from July 2017 to June 2018: Mangaoraka Stream at Corbett Road

Parameter		Units	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.019	0.065	0.033	12	0.015
A440F	Absorbance @ 440nm filtered	/cm	0.004	0.014	0.006	12	0.004
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.001	0.000	12	0.000
ALKT	Alkalinity total	g/m^3 $CaCO^3$	12	87	46	12	15
BLACKDISC	Black disc transparency	m	0.10	2.92	2.12	12	1.01
BOD_5	Biochemical oxygen demand 5 day	g/m^3	<0.5	7.2	0.8	12	0.6
CONDY	Conductivity @ 20°C	mS/m@20C	4.1	25.1	15.8	12	14.4
DO	Dissolved oxygen	g/m^3	8.2	10.8	10.3	12	0.8
PERSAT	Dissolved oxygen saturation	%	90	101	98	12	3
DRP	Dissolved reactive phosphorus	g/m^3 P	0.011	0.074	0.021	12	0.019
ECOL	E. coli bacteria	cfu/100mL	400	56000	2000	12	18163
ENT	Enterococci bacteria	cfu/100mL	160	130000	1400	12	37845
FC	Faecal coliform bacteria	cfu/100mL	400	57000	2000	12	20006
FLOW	Flow	m^3/s	0.217	70.423	1.802	12	1.479
NH_4	Ammoniacal nitrogen	g/m^3 N	0.007	0.154	0.030	12	0.045
NO_2	Nitrite nitrogen	g/m^3 N	0.003	0.016	0.006	12	0.004
NO_3	Nitrate nitrogen	g/m^3 N	0.295	1.265	0.845	12	0.281
PH	pH	pH	7.0	7.9	7.6	12	0.2
SS	Suspended solids	g/m^3	<2	150	2	12	53
TEMP	Temperature	˚C	10.6	20.0	13.4	12	3.3
TKN	Total kjeldahl nitrogen	g/m^3 N	<0.01	2.61	0.22	12	0.84
TN	Total nitrogen	g/m^3 N	0.52	3.48	1.20	12	0.81
TP	Total phosphorus	g/m^3 P	0.020	0.607	0.049	12	0.194
TURBY	Turbidity	NTU	0.9	81	2.1	12	25

A statistical summary of the 23 years' data collected since 1 July 1995 is presented in Table 8.

Table 8 Statistical summary of data from July 1995 to June 2018: Mangaoraka Stream at Corbett Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.014	0.074	0.025	276	0.011
A440F	Absorbance @ 440nm filtered	/cm	0.001	0.019	0.006	276	0.003
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.004	0	276	0.001
ALKT	Alkalinity total	g/m^3 $CaCO_3$	12	108	41	276	18
BLACK DISC	Black disc transparency	m	0.055	4.73	1.83	276	0.888
BOD_5	Biochemical oxygen demand 5 day	g/m^3	<0.5	14	0.6	276	1.4
CONDY	Conductivity @ 20°C	mS/m	4.1	28.7	14.5	276	3.8
DO	Dissolved oxygen	g/m^3	7.8	11.8	10.1	275	0.8
PERSAT	Dissolved oxygen saturation	%	83	107	97	275	4
DRP	Dissolved reactive phosphorus	g/m^3P	<0.003	0.074	0.009	276	0.010
ECOL	E. coli bacteria	cfu/100 mL	80	60000	800	252	7841
ENT	Enterococci bacteria	cfu/100 mL	31	180000	430	276	15292
FC	Faecal coliform bacteria	cfu/100 mL	84	60000	800	276	8501
FLOW	Flow	m^3/s	0.16	70.243	1.186	276	5.051
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.308	0.021	276	0.047
NO_2	Nitrite nitrogen	g/m^3N	0.001	0.039	0.005	276	0.005
NO_3	Nitrate nitrogen	g/m^3N	0.05	1.73	0.84	276	0.305
pH	pH		6.9	8.1	7.6	276	0.2
SS	Suspended solids	g/m^3	<2	310	2	276	27
TEMP	Temperature	°C	5.8	20.5	13.2	276	2.9
TKN	Total kjeldahl nitrogen	g/m^3N	<0.01	4.46	0.20	276	0.46
TN	Total nitrogen	g/m^3N	0.27	5.18	1.10	276	0.53
TP	Total phosphorus	g/m^3P	0.007	0.860	0.023	276	0.097
TURB	Turbidity (Hach 2100A)	NTU	0.8	100	1.6	245	8.6
TURBY	Turbidity (Cyberscan WTW)	NTU	0.6	81	2.1	157	9.8

These are provided for reference and comparative purposes and are discussed in Section 4.2 in association with appropriate graphical ('box and whisker' plots) presented in Appendix I.

Discussion

2017-2018 period

Black disc clarity and turbidity results continued to indicate a reasonable standard of aesthetic water quality for the lower reaches of a developed, agricultural catchment although it is noted that turbidity levels were slightly higher (median: 2.1 NTU) than might be expected given the concentration of suspended solids (median: 2 g/m^3). This was due to the very fine, colloidal nature of suspended material in the stream at this site, partly as a consequence of the headwaters being situated below the National Park. The moderate maximum black disc value of 2.92 m coincided with early autumn, moderate flow conditions, while the poorest turbidity conditions (81 NTU and 0.10 m black disc) were recorded during a large flood in winter 2017, with a large increase in suspended sediment. Poorest water quality, as indicated by high BOD_5 (up to 7.2 g/m^3), faecal bacteria number and nutrient species, both nitrogen and phosphorus, was recorded for this flood and two freshes sampled in spring and autumn.

The relative absence of freshes near the sampling occasions from late spring to early autumn contributed to the slightly elevated pH values (up to 7.9), though these levels were similar to those recorded previously. It should be noted all levels were recorded prior to mid-morning and were not representative of higher pH levels that might be expected later in the day when algal photosynthetic activity would be likely to raise pH more significantly.

Generally, high dissolved oxygen concentrations, high percentage saturation, and low BOD_5 levels (<1.4 g/m^3) during moderate and lower flows were indicative of relatively good physicochemical water quality, but the very high median bacterial numbers (1,400 enterococci and 2,000 faecal coliforms cfu/100 mL) were much higher than typical of the lower reaches of a stream draining an intensively developed catchment, although the Mangaoraka Stream is essentially a lowland catchment as its headwaters do not extend as far towards the upper slopes of Mt Taranaki as most ring plain rivers and streams. [Investigative work in the lower catchment has identified stock access to streams as a probable primary contributor to these elevated numbers, although the cumulative impacts of consented dairy pond discharges also contribute, particularly under lower flow conditions]. Water temperatures varied over a moderate range of 9.4°C with a maximum (mid-morning) temperature of 20.0°C in February 2018 during a period of moderate flow conditions. Dissolved oxygen saturation did not fall below 90% during the period, with this minimum recorded during a period of low flow conditions (Figure 2).

Brief comparison with the previous 1995-2017 period

Aesthetic stream water quality at this site during the 2017-2018 period was similar [median black disc clarity higher by 0.29 m, median suspended solids level and median turbidity the same]. Bacterial water quality deteriorated as reflected in higher median faecal coliform number by 1,200 cfu/100 mL and median enterococci number by 970 cfu/100 mL. Median water temperature was 0.2°C higher in the 2017-2018 period although the maximum water temperature (20.0°C) was 0.5°C lower than the previous maximum recorded. Median conductivity was higher. The median flow sampled during 2017-2018 (1.802 m^3/s) was significantly higher (by 616 L/s) than the median of flows sampled over the previous 22-year period. Wide ranges for parameters such as suspended solids, turbidity, pH, and BOD_5 reflected the high floods and peaks of smaller freshes sampled on occasions during the 2017-2018 period (Figure 2). Median pH value was the same and maximum pH was 0.2 unit lower than the past record. Most nitrogen nutrient species had similar median values during the monitoring year in comparison with the previous 22-year record, though ammonia was higher (by 43%), while phosphorus nutrient species had higher median values (by 113 to 133%) over the 2017-2018 period.

Waiwhakaiho River at SH 3 (site: WKH000500)

Analytical data from the monthly samples are presented in Table 9 and the river flow record is illustrated in Figure 4.

Table 9 Analytical results from monthly samples: Waiwhakaiho River at SH3

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20 °C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^3P	cfu/100mL	cfu/100mL
12 Jul 2017	0905	0.015	0.003	0.000	43	1.10	<0.5	11.0	11.4	99	0.030	230	54
09 Aug 2017	0900	0.054	0.012	0.000	5	0.12	2.1	1.8	10.8	100	0.019	5100	4200
13 Sep 2017	0915	0.02	0.005	0.000	23	3.80	<0.5	7.0	11.7	102	0.020	190	100
11 Oct 2017	0820	0.053	0.014	0.001	23	0.80	1.0	6.1	11.0	102	0.017	8600	930
08 Nov 2017	0750	0.079	0.018	0.001	9	0.30	2.2	4.2	10.6	101	0.046	57000	40000
13 Dec 2017	0810	0.011	0.002	0.000	67	3.24	<0.5	15.9	10.0	103	0.050	350	130
10 Jan 2018	0800	0.016	0.004	0.000	57	3.76	<0.5	14.0	9.5	99	0.026	8000	18000
14 Feb 2018	0810	0.026	0.007	0.001	43	3.00	<0.5	11.5	9.8	104	0.028	800	220
14 Mar 2018	0800	0.011	0.003	0.000	62	3.39	<0.5	15.1	10.4	101	0.034	260	100
11 Apr 2018	0915	0.045	0.01	0.001	13	1.15	0.8	2.4	11.0	101	0.014	1500	1430
09 May 2018	0900	0.013	0.003	0.000	58	3.08	<0.5	14.8	11.2	104	0.036	100	15
13 Jun 2018	0925	0.02	0.005	0.000	47	1.27	<0.5	11.7	11.2	103	0.028	160	53
Date	Time NZST	FC	Flow	NH_4	NO_2	NO_3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m^3/s	g/m^3N	g/m^3N	g/m^3N	pH	g/m^3	°C	g/m^3N	g/m^3N	g/m^3P	NTU
12 Jul 2017	0905	230	7.889	0.007	<0.001	0.21	7.8	3	7.9	0.02	0.23	0.042	3.2
09 Aug 2017	0900	5200	180	0.018	0.001	0.05	6.8	280	11.0	0.91	0.96	0.357	41
13 Sep 2017	0915	190	11.462	0.007	0.001	0.11	7.7	<2	8.2	0.03	0.14	0.020	1.0
11 Oct 2017	0820	9100	19.981	0.053	<0.001	0.10	7.4	4	10.9	0.23	0.33	0.057	2.8
08 Nov 2017	0750	58000	37.734	0.157	0.004	0.10	7.3	20	11.7	0.9	1.00	0.143	14
13 Dec 2017	0810	350	2.066	<0.003	0.003	0.01	8.2	<2	15.7	0.02	0.05	0.056	0.8
10 Jan 2018	0800	8000	2.600	0.005	0.002	0.06	7.9	<2	17.8	0.04	0.10	0.032	1.6
14 Feb 2018	0810	900	4.032	0.012	0.003	0.08	8.1	<2	17.3	0.07	0.15	0.033	0.7
14 Mar 2018	0800	260	2.625	0.006	0.002	0.13	8.0	<2	13.1	0.04	0.17	0.041	0.7
11 Apr 2018	0915	1630	23.291	0.024	0.003	0.16	7.3	9	9.8	0.07	0.23	0.028	2.2
09 May 2018	0900	100	2.651	0.003	0.002	0.12	8.1	<2	11.5	0.02	0.14	0.038	0.6
13 Jun 2018	0925	160	4.981	0.010	0.002	0.07	7.9	4	10.0	0.05	0.12	0.034	1.4

The statistical summary of these data is presented in Table 10.

Table 10 Statistical summary of data from July 2017 to June 2018

Paramete		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm Filtered	/cm	0.011	0.079	0.020	12	0.022
A440F	Absorbance @ 440nm Filtered	/cm	0.002	0.018	0.005	12	0.005
A770F	Absorbance @ 770nm Filtered	/cm	0.000	0.001	0.000	12	0.000
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	5	67	43	12	22
BDISC	Black disc transparency	m	0.12	3.80	2.14	12	1.41
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	2.2	<0.5	12	0.8
CONDY	Conductivity @ 20'C	mS/m	1.8	15.9	11.2	12	9.6
DO	Dissolved Oxygen	g/m^3	9.5	11.7	10.9	12	0.7
PERSAT	Dissolved Oxygen Saturation %	%	99	104	102	12	2
DRP	Dissolved reactive phosphorus	g/m^3P	0.014	0.050	0.028	12	0.011
ECOL	E.coli bacteria	cfu/100 mL	100	57000	575	12	16102
ENT	Enterococci bacteria	cfu/100 mL	15	40000	175	12	12023
FC	Faecal Coliforms	cfu/100 mL	100	58000	625	12	16382
FLOW	Flow	m^3/s	2.066	180	6.435	12	50.054
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.157	0.008	12	0.044
NO_2	Nitrite nitrogen	g/m^3N	<0.001	0.004	0.002	12	0.001
NO_3	Nitrate nitrogen	g/m^3N	0.01	0.21	0.10	12	0.05
PH	pH	pH	6.8	8.2	7.8	12	0.4
SS	Suspended solids	g/m^3	<2	280	2	12	80
TEMP	Temperature	°C	7.9	17.8	11.2	12	3.3
TKN	Total Kjeldahl nitrogen	g/m^3N	0.02	0.91	0.04	12	0.33
TN	Total nitrogen	g/m^3N	<0.05	1.00	0.16	12	0.32
TP	Total phosphorus	g/m^3P	0.020	0.36	0.040	12	0.073
TURBY	Turbidity	NTU	0.6	41	1.8	12	12

A statistical summary of the 23 years' data collected since 1 July 1995 is presented in Table 11.

Table 11 Statistical summary of data from July 1995 to June 2018: Waiwhakaiho River at SH3

Paramete		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm Filtered	/cm	0.005	0.095	0.015	276	0.018
A440F	Absorbance @ 440nm Filtered	/cm	0.000	0.022	0.003	276	0.004
A770F	Absorbance @ 770nm Filtered	/cm	0.000	0.007	0.000	276	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	5	76	48	276	17
BDISC	Black disc transparency	m	0.12	8.05	3.06	276	1.42
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	5.0	<0.5	276	0.6
CONDY	Conductivity @ 20'C	mS/m	1.8	17.4	12.2	276	3.4
DO	Dissolved Oxygen	g/m^3	9.1	12.8	10.8	276	0.7
PERSAT	Dissolved Oxygen Saturation %	%	91	110	101	276	3
DRP	Dissolved reactive phosphorus	g/m^3P	<0.004	0.108	0.025	276	0.011
ECOL	E.coli bacteria	cfu/100 mL	23	57000	210	252	5619
ENT	Enterococci bacteria	cfu/100 mL	1	40000	100	276	3742
FC	Faecal Coliforms	cfu/100 mL	23	83000	225	276	7694
FLOW	Flow	m^3/s	1.705	180	3.818	276	14.282
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.157	0.008	276	0.022
NO_2	Nitrite nitrogen	g/m^3N	<0.001	0.010	0.002	276	0.001
NO_3	Nitrate nitrogen	g/m^3N	0.01	0.47	0.11	276	0.10
PH	pH	pH	6.8	8.5	7.9	276	0.3
SS	Suspended solids	g/m^3	<2	280	<2	276	19
TEMP	Temperature	°C	4.8	18.3	11.2	276	2.9
TKN	Total Kjeldahl nitrogen	g/m^3N	<0.01	1.95	0.07	276	0.21
TN	Total nitrogen	g/m^3N	<0.05	2.10	0.20	276	0.26
TP	Total phosphorus	g/m^3P	0.014	0.437	0.035	276	0.047
TURB	Turbidity (Hach 2100A)	NTU	0.4	26	0.7	245	2.8
TURBY	Turbidity (Cyberscan WTW)	NTU	0.3	41	0.7	157	4.9

These are provided for reference and comparative purposes and are discussed in Section 4.2 in association with appropriate graphical ('box and whisker' plots) presented in Appendix I.

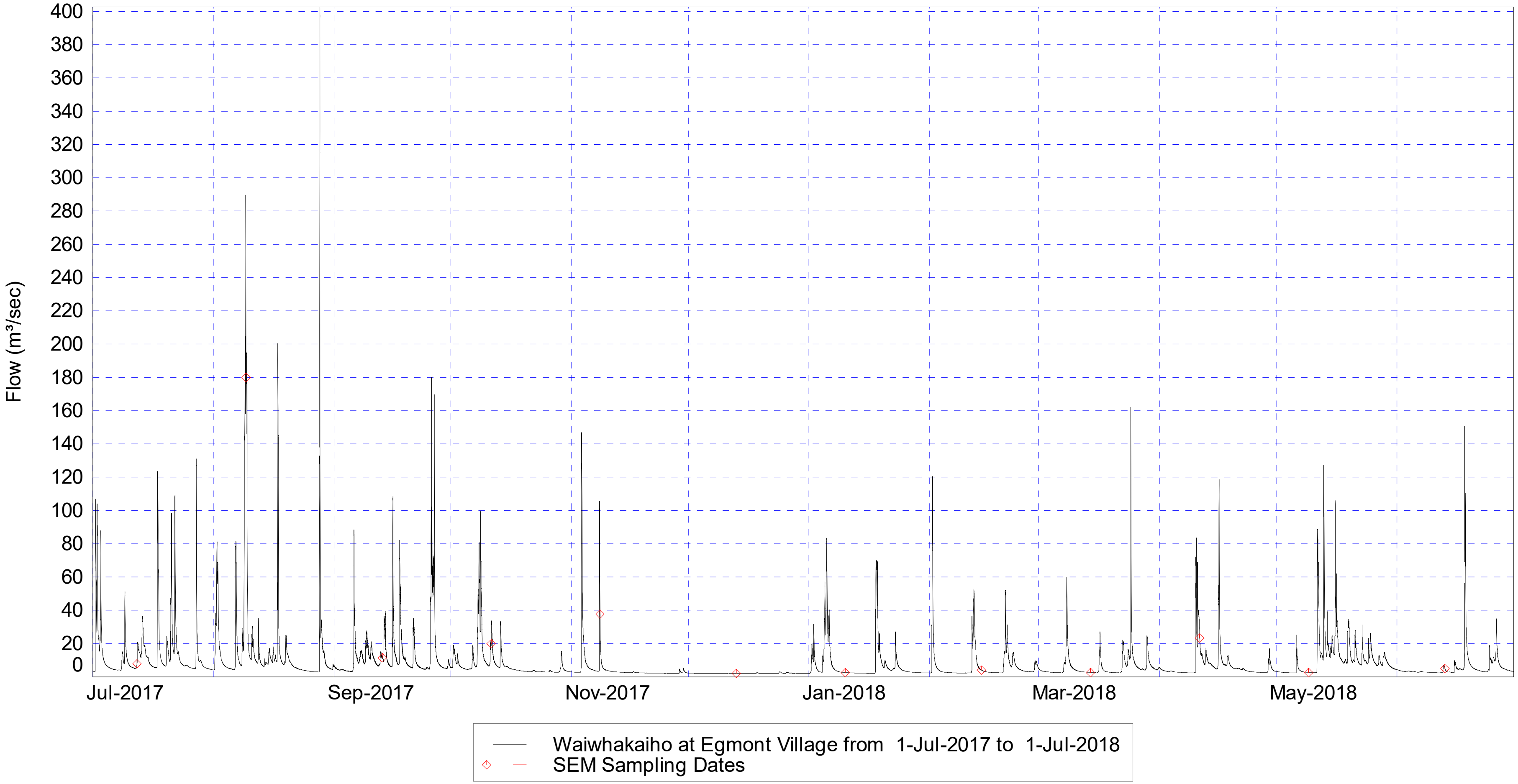

Figure 3 Flow record for the Waiwhakaiho River at SH3 Egmont Village

Discussion

2017-2018 period

During the 2017-2018 period there was no re-occurrence of the severe orange discolouration of the river which occurred in November 2013 when an iron-oxide laden seepage discharge from the Kokowai Stream entered the main river within the National Park. Discolouration had extended downstream beyond the mid reaches, but the river cleared within a few days of this event (TRC, 2014.) [Note: Similar events had occurred in the past (e.g. 1975) but none had been recorded since the inception of the SEM programme in mid-1995].

During the 2017-2018 period, black disc clarity and turbidity results indicated relatively good water quality in terms of appearance, particularly for the mid reaches of a developed ringplain agricultural catchment, considering the large proportion of fresh events that was sampled. This was emphasised by median black disc and turbidity values of 2.14 m and 1.8 NTU respectively. The maximum black disc value (3.80 m) was recorded in early spring fresh flow conditions (11.46 m^3/sec) (Figure 3) with the worst conditions (black disc clarity of 0.12 m) during a high in August 2017 when the turbidity increased markedly (41 NTU) with high suspended solids concentration (180 g/m^3). Generally, poorer water quality was recorded at the time of this fresh flow when elevated faecal coliform bacterial numbers (57,000 cfu/100 mL) and increased colour (absorbances @ 340 nm and 440 nm), together with decreased clarity and conductivity, were recorded.

A maximum pH value of 8.2 was recorded under low flow conditions in early summer, with values of ≥7.7 units on eight occasions throughout 2017-2018. pH values could be expected to have risen further later in the day, as all sampling at this site was undertaken no later than 0925 hrs.

Very good water quality was indicated by high dissolved oxygen concentrations (median saturation of 102%) and low BOD_5 levels (median of < 0.5 g/m^3). Bacteriological quality was moderate, with median faecal coliform and enterococci numbers (625 and 175 per 100 mL, respectively) typically reflecting agricultural catchment influences in the relative frequency of large and small freshes during, or immediately prior to, sampling surveys during 2017-2018. The anomalously high bacterial numbers recorded for the January 2018 sampling during low flow may relate to birds roosting immediately upstream.

River water temperatures recorded a moderate range of 9.9°C during the period with a maximum mid-morning water temperature of 17.8°C recorded in January 2018 during a period of low flow conditions.

Brief comparison with the previous 1995-2017 period

River water quality measured by the 2017-2018 survey in many aspects was generally poorer than that recorded over the previous 22-year period. Median black disc clarity was lower (by 0.92 m) with median turbidity higher by 1.1 NTU, and median suspended solids levels were slightly higher. Bacteriological water quality deteriorated as reflected in increases in median faecal coliform number of 400 cfu/100 mL and in enterococci number by 75 cfu/100 mL. Median water temperature was identical between the periods, while the maximum temperature was 0.5°C lower in the recent period than that recorded during the previous twenty-two years.

Median sampled flow over the 2017-2018 period was significantly higher (by 2,653 L/s, or 70%) than for the flows sampled in the previous 22-year period, coincident with an increase in fresh events sampled. This was reflected in the lower median conductivity level found for the 2017-2018 period.

Median concentrations for nitrogen nutrient species showed a decrease or were similar in the recent sampling period. The recent median phosphorus nutrient species concentrations showed a slight increase, compared to those of the longer period.

No differences were recorded in terms of the medians of BOD_5 and percentage dissolved oxygen between the two periods.

Stony River at Mangatete Road (site: STY000300)

Analytical data from the monthly samples are presented in Table 12.

Table 12 Analytical results from monthly samples: Stony River at Mangatete Road

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20 °C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^3P	cfu/100mL	cfu/100mL
12 Jul 2017	1005	0.025	0.006	0.000	28	0.24	<0.5	6.9	11.8	100	0.030	120	32
09 Aug 2017	1015	0.065	0.019	0.002	5	0.01	<0.5	1.7	11.2	102	0.021	140	110
13 Sep 2017	1020	0.018	0.005	0.000	14	0.48	<0.5	5.1	11.6	100	0.012	9	<1
11 Oct 2017	0915	0.033	0.009	0.002	23	0.92	<0.5	5.3	11.1	101	0.011	34	8
08 Nov 2017	0910	0.063	0.015	0.001	9	0.25	0.6	3.6	10.8	100	0.013	180	20
13 Dec 2017	0920	0.005	0.001	0.000	53	5.10	<0.5	12.3	10.1	102	0.021	12	9
10 Jan 2018	0910	0.008	0.002	0.000	44	4.40	<0.5	10.6	9.6	98	0.020	20	25
14 Feb 2018	0915	0.015	0.004	0.000	36	4.72	<0.5	9.4	9.7	101	0.021	9	28
14 Mar 2018	0920	0.005	0.001	0.000	50	5.80	<0.5	12.3	10.4	101	0.021	9	15
11 Apr 2018	1015	0.029	0.008	0.001	13	0.19	<0.5	6.9	11.0	100	0.016	51	48
09 May 2018	1030	0.007	0.002	0.000	45	2.27	<0.5	11.5	10.7	102	0.028	7	6
13 Jun 2018	1035	0.026	0.008	0.001	34	0.14	<0.5	8.7	11.1	101	0.033	54	5

Date	Time NZST	FC	Flow	NH_4	NO_2	NO_3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m^3/s	g/m^3N	g/m^3N	g/m^3N	pH	g/m^3	°C	g/m^3N	g/m^3N	g/m^3P	NTU
12 Jul 2017	1005	120	5.521	0.009	<0.001	0.04	7.7	49	7.1	0.08	0.12	0.125	26
09 Aug 2017	1015	160	80.237	0.007	0.002	0.02	7.0	1900	9.9	0.36	0.38	2.900	610
13 Sep 2017	1020	9	9.044	0.004	<0.001	0.02	7.5	24	8.2	<0.01	<0.05	0.041	11.0
11 Oct 2017	0915	34	10.221	<0.003	0.008	0.00	7.5	19	10.1	0.02	<0.05	0.049	7.6
08 Nov 2017	0910	180	17.858	<0.003	0.001	0.00	7.4	67	11.5	0.16	0.17	0.154	33
13 Dec 2017	0920	13	2.563	<0.003	0.002	0.00	8.2	<2	14.8	0.02	<0.05	0.024	0.6
10 Jan 2018	0910	20	3.06	<0.003	0.001	0.04	7.8	<2	15.6	<0.01	<0.05	0.020	0.8
14 Feb 2018	0915	12	3.483	0.010	<0.001	0.02	8.0	<2	16.4	<0.04	0.06	0.021	0.9
14 Mar 2018	0920	9	2.47	<0.003	<0.001	0.01	8.0	<2	13.1	0.02	<0.05	0.022	0.4
11 Apr 2018	1015	51	9.973	0.006	0.001	0.04	7.3	105	9.4	0.02	0.06	0.175	58
09 May 2018	1030	7	2.954	<0.003	<0.001	0.04	8.0	2	12.5	<0.01	0.05	0.029	2.1
13 Jun 2018	1035	54	4.702	0.008	0.001	0.04	7.8	180	10.1	0.06	0.10	0.245	100

The statistical summary of these data is presented in Table 13.

Table 13 Statistical summary of data from July 2017 to July 2018 Stony River at Mangatete Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.005	0.065	0.022	12	0.021
A440F	Absorbance @ 440nm filtered	/cm	0.001	0.019	0.006	12	0.006
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.002	0.000	12	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	5	53	31	12	17
BDISC	Black disc transparency	m	<0.01	5.80	0.70	12	3.12
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	0.6	<0.5	12	0.
CONDY	Conductivity @ 20°C	mS/m	1.7	12.3	7.8	12	3.5
DO	Dissolved oxygen	g/m^3	9.6	11.8	10.9	12	0.7
PERSAT	Dissolved oxygen saturation %	%	98	102	101	12	1
DRP	Dissolved reactive phosphorus	g/m^3P	0.011	0.033	0.021	12	0.007
ECOL	E.coli bacteria	cfu/100 mL	7	180	27	12	60
ENT	Enterococci bacteria	cfu/100 mL	<1	110	18	12	30
FC	Faecal coliforms	cfu/100 mL	7	180	27	12	62
FLOW	Flow	m^3/s	2.470	80.237	5.112	12	21.764
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.010	0.003	12	0.003
NO_2	Nitrite nitrogen	g/m^3N	<0.001	0.008	0.001	12	0.002
NO_3	Nitrate nitrogen	g/m^3N	<0.01	0.04	0.02	12	0.023
pH	pH		7.0	8.2	7.8	12	0.4
SS	Suspended solids	g/m^3	<2	1900	22	12	539
TEMP	Temperature	°C	7.1	16.4	10.8	12	3.0
TKN	Total kjeldahl nitrogen	g/m^3N	<0.01	0.36	0.02	12	0.07
TN	Total nitrogen	g/m^3N	<0.05	0.38	0.06	12	0.10
TP	Total phosphorus	g/m^3P	0.020	2.9	0.045	12	0.817
TURBY	Turbidity	NTU	0.4	610	9.3	12	172

A statistical summary of the 23 years' data collected since 1 July 1995 is presented in Table 14.

Table 14 Statistical summary of data from July 1995 to June 2018: Stony River at Mangatete Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.000	0.077	0.009	276	0.014
A440F	Absorbance @ 440nm filtered	/cm	0.000	0.028	0.002	276	0.004
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.007	0.000	276	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	5	57	38	276	12
BDISC	Black disc transparency	m	<0.01	13.12	3.12	276	2.71
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	1.8	<0.5	276	0.1
CONDY	Conductivity @ 20°C	mS/m	1.7	13.3	9.6	276	2.4
DO	Dissolved oxygen	g/m^3	9.4	12.3	10.7	276	0.6
PERSAT	Dissolved oxygen saturation %	%	87	106	99	278	2
DRP	Dissolved reactive phosphorus	g/m^3P	0.004	0.210	0.018	276	0.013
ECOL	E.coli bacteria	cfu/100 mL	<1	18000	8	252	1136
ENT	Enterococci bacteria	cfu/100 mL	<1	1900	5	276	133
FC	Faecal coliforms	cfu/100 mL	<1	18000	8	276	1086
FLOW	Flow	m^3/s	1.988	80.237	3.609	276	8.583
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.021	<0.003	276	0.003
NO_2	Nitrite nitrogen	g/m^3N	<0.001	0.008	<0.001	276	0.001
NO_3	Nitrate nitrogen	g/m^3N	<0.01	0.11	0.02	276	0.02
pH	pH		7.0	8.2	7.8	276	0.2
SS	Suspended solids	g/m^3	<2	2500	<2	276	313
TEMP	Temperature	°C	5.7	16.6	10.8	276	2.5
TKN	Total kjeldahl nitrogen	g/m^3N	<0.01	1.78	0.04	276	0.16
TN	Total nitrogen	g/m^3N	<0.05	1.82	0.06	276	0.16
TP	Total phosphorus	g/m^3P	0.008	3.38	0.025	276	0.332
TURB	Turbidity (Hach 2100A)	NTU	0.2	700	0.8	245	66
TURBY	Turbidity (Cyberscan WTW)	NTU	0.2	1400	1.6	157	164

These are provided for reference and comparative purposes and are discussed in Section 4.2 in association with appropriate graphical ('box and whisker' plots) presented in Appendix I.

Discussion

2017-2018

Black disc clarity and turbidity results, which more often in the past have indicated generally good river water quality in terms of appearance for the mid-reaches of a Taranaki ring plain river, have also showed significant deterioration in aesthetic quality from time to time as a result of severe erosion in the headwaters of this river during winter and spring floods in 1998-1999, and again following an intensive, prolonged wet period in February 2004. Some improvement occurred in 2004-2005 and continued through most of the 2005-2006 period, but conditions deteriorated markedly following the very wet spring conditions in 2006, near mid-winter 2008, and in mid-winter 2009. No significant headwater erosion events were identified over the 2009-2010 period, but headwater erosion was recorded again in late May-early June 2011. Further erosion events in the headwaters were recorded during a dry period in February 2014 (see Photo 3, TRC 2014). Some headwater erosion was indicated after flood events in mid-February 2016, and early February 2017. Measured clarity improved from December 2017. The minimum black disc value (<0.01 m) and maximum turbidity (610 NTU) and suspended solids (1900 g/m^3) values were recorded during a high flood (80.2 m^3/sec) in August 2017. Generally, wet weather and fresh flow conditions did not result in changes in nutrient or bacterial levels to the extent found in other monitored ringplain streams, with the exception of total phosphorus, which increased to a greater degree in particulate form (maximum of 2.90 g/m^3P). The maximum black disc clarity of 5.80 m was measured in early autumn under low flow conditions, coincident with the very low suspended solids and turbidity (0.4 NTU) levels.

Maximum mid-morning pH (8.2) occurred under autumn relatively low flow conditions, while the median pH (7.8) was equivalent with the median of past years' results. Dissolved oxygen concentrations were consistently high with a minimum saturation of 98%, and BOD_5 levels were below the detectable limit on all but one occasion (0.6 g/m^3); a further indication of high water quality when not influenced by severe erosion events.

Bacteriological water quality was high, with median faecal coliform and enterococci numbers (27 and 18 cfu/100 mL, respectively) indicative of minimal impact of upstream developed farmland at this site near mid-catchment, although there were six instances of elevated counts under fresh flow conditions.

River water temperatures varied over a moderate range of 9.3°C during the period, with a maximum mid-morning temperature of 16.4°C recorded in late summer (February 2018) under moderate flow conditions.

Nutrient levels were generally very low in terms of median ammoniacal nitrogen, nitrate-nitrogen, and dissolved reactive phosphorus concentrations. Total nitrogen concentration was also relatively low throughout the year. Total phosphorus concentration varied markedly, coincident with suspended solids concentration, ranging from 0.020 to 2.9 g/m^3.

Brief comparison with the previous 1995-2017 period

Water quality measured during the 2017-2018 survey period, in comparison with the previous 22 years' survey results, was poorer aesthetically in terms of median black disc clarity (which was lower by 2.42 m), median turbidity (higher by 7.7 NTU), and suspended solids level which was higher (by >20 g/m^3) than the historical median.

Median bacteriological water quality was poorer in the latest period, although both periods had high quality with all median faecal coliform and enterococci counts <30 cfu/100 mL.

Water temperature range was slightly narrower (by 0.6°C) in the 2017-2018 period than that in the earlier 22-year period, with identical median values over the two periods. For nutrient species, median nitrate and total nitrogen were identical for the two periods, being low at 0.02 and 0.06 g/m^3, respectively; and DRP and TP were higher in the more recent period (by 17 and 80%, respectively).

Median sampled flow during the 2017-2018 period was higher (by 1.50 m^3/s, or 42%) than the median of flows sampled over the previous 22-year period, with six fresh and flood events and two relatively low flow periods sampled in 2017-2018. This was reflected in the much lower median conductivity value (by 1.8 mS/m at 20°C) recorded in 2017-2018.

Punehu Stream at Wiremu Road (site: PNH000200)

Analytical data are presented in Table 15 from the monthly samples.

Table 15 Analytical results from the monthly samples: Punehu Stream at Wiremu Road

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20 °C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^3P	cfu/100mL	cfu/100mL
12 Jul 2017	1035	0.088	0.02	0.001	10	0.12	6.0	5.9	12.0	100	0.025	5000	3000
09 Aug 2017	1050	0.103	0.023	0.001	8	0.31	0.9	3.8	11.0	100	0.013	930	220
13 Sep 2017	1100	0.045	0.01	0.001	12	1.80	<0.5	6.2	11.2	102	0.018	11	12
11 Oct 2017	0955	0.092	0.022	0.002	13	0.42	0.8	4.9	10.9	102	0.013	1000	180
08 Nov 2017	0940	0.095	0.021	0.001	8	0.45	1.2	4.2	10.6	100	0.016	2400	430
13 Dec 2017	0955	0.018	0.003	0.000	25	2.27	<0.5	8.3	9.3	102	0.039	270	88
10 Jan 2018	0955	0.028	0.006	0.000	17	2.67	<0.5	9.2	9.0	98	0.020	140	170
14 Feb 2018	0935	0.032	0.008	0.001	22	4.50	<0.5	8.0	9.4	103	0.035	80	220
14 Mar 2018	0955	0.024	0.006	0.000	16	2.68	<0.5	11.0	9.9	100	0.022	84	100
11 Apr 2018	1045	0.066	0.014	0.001	6	1.03	0.6	10.3	10.7	100	0.009	394	576
09 May 2018	1100	0.023	0.005	0.000	21	1.25	<0.5	10.6	10.5	103	0.030	150	3
13 Jun 2018	1115	0.062	0.014	0.001	8	0.64	0.6	7.6	10.9	101	0.013	320	70

Date	Time NZST	FC	Flow	NH4	NO2	NO3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m3/s	g/m3N	g/m3N	g/m3N	pH	g/m3	°C	g/m3N	g/m3N	g/m3P	NTU
12 Jul 2017	1035	5400	4.075	0.149	0.004	0.14	7.2	170	6.0	1.84	1.98	0.639	130
09 Aug 2017	1050	930	5.535	0.050	0.001	0.03	7.1	29	9.6	0.30	0.33	0.088	14
13 Sep 2017	1100	11	1.195	0.015	0.001	0.04	7.3	<2	9.5	<0.02	0.06	0.020	2.4
11 Oct 2017	0955	1000	3.382	0.024	0.001	0.02	7.1	12	10.5	0.25	0.27	0.073	9.6
08 Nov 2017	0940	2500	2.142	0.003	0.002	0.02	7.2	19	11.3	0.31	0.33	0.072	12
13 Dec 2017	0955	270	0.341	0.003	0.002	0.01	7.9	<2	17.9	0.02	<0.05	0.046	1.4
10 Jan 2018	0955	150	0.35	0.007	0.002	0.11	7.4	<2	18.2	0.03	0.14	0.022	2.1
14 Feb 2018	0935	96	0.243	0.007	0.001	0.01	7.8	<2	18.2	0.02	<0.05	0.035	0.9
14 Mar 2018	0955	84	0.384	0.027	0.001	0.24	7.5	<2	14.4	0.02	0.26	0.030	2.3
11 Apr 2018	1045	424	3.024	0.042	0.003	0.41	6.8	8	10.4	0.18	0.59	0.034	4.9
09 May 2018	1100	180	0.39	0.007	0.001	0.08	7.6	<2	13.3	0.06	0.14	0.032	3.2
13 Jun 2018	1115	320	3.056	0.033	0.002	0.09	7.1	9	10.1	0.17	0.26	0.041	7.4

The statistical summary of these data is presented in Table 16.

Table 16 Statistical summary of data from July 2017 to June 2018 Punehu Stream at Wiremu Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.018	0.103	0.054	12	0.032
A440F	Absorbance @ 440nm filtered	/cm	0.003	0.023	0.012	12	0.007
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.002	0.001	12	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	6	25	12	12	22
BDISC	Black disc transparency	m	0.12	4.50	1.14	12	1.32
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	6.0	<0.5	12	1.6
CONDY	Conductivity @ 20°C	mS/m	3.8	11.0	7.8	12	8.6
DO	Dissolved oxygen	g/m^3	9.0	12.0	10.6	12	0.9
PERSAT	Dissolved oxygen saturation %	%	98	103	100	12	2
DRP	Dissolved reactive phosphorus	g/m^3P	0.009	0.039	0.019	12	0.009
ECOL	E.coli bacteria	cfu/100 mL	11	5000	295	12	1456
ENT	Enterococci bacteria	cfu/100 mL	3	3000	175	12	829
FC	Faecal coliforms	cfu/100 mL	11	5400	295	12	1565
FLOW	Flow	m^3/s	0.243	5.535	1.668	12	1.792
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.149	0.020	12	0.040
NO_2	Nitrite nitrogen	g/m^3N	0.001	0.004	0.002	12	0.001
NO_3	Nitrate nitrogen	g/m^3N	0.008	0.407	0.059	12	0.039
pH	pH		6.8	7.9	7.2	12	0.3
SS	Suspended solids	g/m^3	<2	170	5	12	48
TEMP	Temperature	°C	6.0	18.2	10.9	12	4.0
TKN	Total kjeldahl nitrogen	g/m^3N	<0.05	1.98	0.26	12	0.53
TN	Total nitrogen	g/m^3N	<0.05	1.98	0.26	12	0.37
TP	Total phosphorus	g/m^3P	0.020	0.639	0.038	12	0.173
TURBY	Turbidity	NTU	0.9	130	4.0	12	36

A statistical summary of the 23 years' data collected since 1 July 1995, is presented in Table 17.

Table 17 Statistical summary of data from July 1995 to July 2018: Punehu Stream at Wiremu Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.015	0.144	0.032	276	0.023
A440F	Absorbance @ 440nm filtered	/cm	0.001	0.032	0.007	276	0.005
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.005	0.000	276	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	6	27	22	276	5
BDISC	Black disc transparency	m	0.08	4.53	1.77	276	0.88
BOD5	Biochemical oxygen demand 5day	g/m3	<0.5	6.0	<0.5	276	0.4
CONDY	Conductivity @ 20°C	mS/m	3.8	11.0	8.6	276	1.2
DO	Dissolved oxygen	g/m3	8.9	12.5	10.5	275	0.8
PERSAT	Dissolved oxygen saturation %	%	87	106	100	275	3
DRP	Dissolved reactive phosphorus	g/m3P	0.007	0.389	0.022	276	0.024
ECOL	E.coli bacteria	cfu/100 mL	3	6100	105	252	839
ENT	Enterococci bacteria	cfu/100 mL	<1	3000	36	276	236
FC	Faecal coliforms	cfu/100 mL	3	6100	120	276	860
FLOW	Flow	m3/s	0.18	12.38	0.436	276	1.139
NH4	Ammoniacal nitrogen	g/m3N	0.002	0.149	0.007	276	0.013
NO2	Nitrite nitrogen	g/m3N	<0.001	0.014	0.001	276	0.001
NO3	Nitrate nitrogen	g/m3N	<0.01	0.41	0.029	276	0.05
pH	pH		6.8	8.3	7.6	276	0.2
SS	Suspended solids	g/m3	<2	170	<2	276	15
TEMP	Temperature	°C	5.0	19.2	11.8	276	3.3
TKN	Total kjeldahl nitrogen	g/m3N	0.01	1.98	0.15	276	0.17
TN	Total nitrogen	g/m3N	<0.05	0.87	0.15	276	0.172
TP	Total phosphorus	g/m3P	0.015	0.639	0.034	276	0.052
TURB	Turbidity (Hach 2100A)	NTU	0.45	29	1.7	245	3.1
TURBY	Turbidity (Cyberscan WTW)	NTU	0.46	28	2.4	157	10.8

These are provided for reference and comparative purposes and are discussed in Section 4.2 in association with appropriate graphical ('box and whisker' plots) presented in Appendix I.

Discussion

2017-2018

Past black disc clarity and turbidity results have been indicative of relatively good water quality in terms of aesthetic appearance, although these values have been poorer than might be anticipated for the upper reaches of a ring plain stream. This was related to the open nature of the reaches of both the stream and the upstream tributary draining developed farmland catchment immediately downstream of the National Park through the 2 km reach upstream of this site. This area had also been subject to stock access in the past (see photos in TRC 2000 and 2011) although in recent years the banks have been fenced and planted in the immediate vicinity of the site. Reduced aesthetic quality was recorded for 2017-2018, with sample medians of 1.14 m (black disc) and 4.0 NTU (turbidity), owing to the large proportion of fresh events that was sampled.

Minimum black disc clarity (0.12 m) was recorded during a fresh in July 2017, coincidental with a large increase in suspended solids concentration (170 g/m^3) and in turbidity (130 NTU). The highest recorded ammonia concentration (0.149 g/m^{3}N) occurred during this event. A maximum black disc value of 4.50 m was measured under very low flow conditions in late summer (February 2018). This was the second highest visual clarity measurement on the overall record.

The maximum pH (7.9) was recorded (in mid-morning) in early summer, under low flow conditions (341 L/s).

Dissolved oxygen concentrations were consistently high (98 to 103% saturation for the period), and median BOD_5 level was less than 0.5 g/m^3; a further indication of generally high water quality, though a high BOD_5 value (of 6.0 g/m^3) was recorded for a fresh event sampled in July 2017.

A moderate median faecal coliform bacterial count for the upper reaches of a ring plain stream (295 cfu/100 mL) indicated some impacts of upstream farmland run-off (and possible stock access) on stream water quality at this site, and represented some deterioration below the National Park boundary in this aspect of water quality. Surface runoff from surrounding farmland has been a common feature in the past in this reach of the stream and several freshes were sampled during the 2017-2018 period, similar to many previous periods, resulting in a relatively typical median for the latest period.

Water temperatures varied over a relatively wide range (12.2°C) for the upper reaches of a ring plain stream, reflecting the bouldery, open nature of the reach below the National Park. A maximum mid-morning water temperature of 18.2°C was recorded in January 2016, relatively high for the upper reaches of a ring plain stream at this time of the day (0955 hrs).

Brief comparison with the previous 1995-2017 period

Stream water quality measured during the 2017-2018 period was significantly poorer in terms of median turbidity (which was higher by 1.6 NTU, or 54%) and median black disc clarity (which was lower by 0.63 m, or 36%) than the previous overall record. Median suspended solids concentration (5 g/m^3) in the recent year was increased by the relatively large proportion of freshes sampled, raising the level above the median (<2 g/m^3) of the previous 22-year period. Median dissolved oxygen percentage saturation levels were identical for the two periods.

Bacteriological water quality was poorer over the most recent period in terms of median faecal coliform number (by 175 cfu/100 mL) and median number of enterococci (by 139 cfu/100 mL). The relative median nitrogen species concentrations varied between the periods, recent ammoniacal, nitrate and total nitrogen values being higher. Total and dissolved phosphorus median values in the recent year were similar to those for the long-term record.

The water temperature range was narrower (by 2.0°C) compared with surveys prior to the latest twelve-month period; with the median flow sampled greatly higher, by 1,232 L/s, or 283%, in the 2017-2018 period.

Median pH value was lower during the recent sampling period (by 0.4 units). The minimum pH measured in the recent period was the lowest of the overall record, at 6.8 in April 2018 but the maximum pH was 0.4 unit lower than the maximum recorded in the previous 22-year period.

Punehu Stream at SH45 (site: PNH000900)

Analytical data are presented in Table 18 from the monthly samples. The flow data in Table 18 present actual flows gauged at the site at the time of sampling. Previously, data from a NIWA flow recording station elsewhere in the catchment were used by the Council to provide a synthesized flow rate at this site, but the station in this stream is no longer operated by NIWA.

Table 18 Analytical results from monthly samples: Punehu Stream at SH45

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20°C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^3P	cfu/100mL	cfu/100mL
12 Jul 2017	1100	0.04	0.008	0.000	36	0.14	3.1	17.7	11.3	99	0.054	7000	6000
09 Aug 2017	1115	0.044	0.011	0.001	26	0.10	1.6	11.8	10.6	100	0.032	2200	2900
13 Sep 2017	1130	0.023	0.008	0.001	28	1.45	0.6	15.0	11.1	101	0.036	310	69
11 Oct 2017	1025	0.054	0.013	0.003	34	0.40	2.3	14.8	10.7	101	0.051	6100	800
08 Nov 2017	1005	0.088	0.024	0.002	25	0.06	11.0	12.1	10.2	99	0.042	34000	17000
13 Dec 2017	1025	0.043	0.008	0.000	43	2.10	0.8	16.6	9.4	104	0.053	1100	440
10 Jan 2018	1030	0.039	0.007	0.000	30	2.71	<0.5	14.5	8.8	98	0.064	1300	1000
14 Feb 2018	1030	0.056	0.012	0.001	33	2.98	0.6	12.2	9.1	101	0.045	800	3600
14 Mar 2018	1030	0.029	0.006	0.000	26	3.06	0.5	17.0	9.8	99	0.034	780	1500
11 Apr 2018	1115	0.06	0.012	0.001	10	0.45	1.7	16.6	10.8	100	0.042	3450	7670
09 May 2018	1130	0.027	0.005	0.000	31	1.40	<0.5	17.4	10.5	102	0.030	370	110
13 Jun 2018	1145	0.058	0.012	0.000	12	0.62	0.9	11.3	11	101	0.023	930	400

Date	Time	FC	Flow	NH_4	NO_2	NO_3	pH	SS	Temp	TKN	TN	TP	Turb
	NZST	cfu/ 100mL	m^3/s	g/m^3N	g/m^3N	g/m^3N	pH	g/m^3	°C	g/m^3N	g/m^3N	g/m^3P	NTU
12 Jul 2017	1100	7000	2.249	0.116	0.014	2.11	7.5	35	9.1	0.86	2.98	0.286	35
09 Aug 2017	1115	2400	5.346	0.075	0.010	1.01	7.5	61	12.2	0.52	1.54	0.186	26
13 Sep 2017	1130	320	3.191	0.057	0.010	1.90	7.6	4	11.1	0.22	2.13	0.053	3.2
11 Oct 2017	1025	6500	3.855	0.119	0.027	1.26	7.5	23	12.7	0.7	1.99	0.205	15
08 Nov 2017	1005	36000	3.960	0.087	0.011	0.49	7.4	170	13.7	1.82	2.32	0.755	160
13 Dec 2017	1025	1200	0.303	0.011	0.008	0.66	7.9	2	20.0	0.05	0.72	0.068	2.3
10 Jan 2018	1030	1400	0.468	0.024	0.006	0.49	7.5	<2	20.6	0.10	0.60	0.076	0.9
14 Feb 2018	1030	1100	0.326	0.017	0.002	0.16	7.7	<2	20.7	<0.13	0.29	0.058	1.3
14 Mar 2018	1030	800	0.584	0.025	0.003	0.92	7.6	<2	15.8	0.04	0.96	0.043	1.0
11 Apr 2018	1115	4300	5.306	0.068	0.008	2.57	7.1	21	11.4	0.29	2.87	0.107	12
09 May 2018	1130	370	0.625	0.015	0.003	0.92	7.6	<2	14.3	<0.06	0.98	0.038	1.4
13 Jun 2018	1145	1000	4.279	0.023	0.004	1.02	7.2	10	11.1	0.24	1.26	0.052	6.1

The statistical summary of these data is presented in Table 19.

Table 19 Statistical summary of data from July 2017 to June 2018 Punehu Stream at SH45

Parameter		Unit	Min	Max	Median	N	Std Dev.
A340F	Absorbance @ 340nm Filtered	/cm	0.023	0.088	0.044	12	0.018
A440F	Absorbance @ 440nm Filtered	/cm	0.005	0.024	0.010	12	0.005
A770F	Absorbance @ 770nm Filtered	/cm	0.000	0.003	0.000	12	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	10	43	29	12	9
BDISC	Black disc transparency	m	0.06	3.06	1.01	12	1.16
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	11	0.8	12	3.0
CONDY	Conductivity @ 20'C	mS/m	11.3	17.7	14.9	12	2.4
DO	Dissolved Oxygen	g/m^3	8.8	11.3	10.6	12	0.8
PERSAT	Dissolved Oxygen Saturation %	%	98	104	100	12	2
DRP	Dissolved reactive phosphorus	g/m^3P	0.023	0.064	0.042	12	0.012
ECOL	E.coli bacteria	cfu/100 mL	310	34000	1200	12	9442
ENT	Enterococci bacteria	cfu/100 mL	69	17000	1250	12	4918
FC	Faecal Coliforms	cfu/100 mL	320	36000	1300	12	9971
FLOW	Flow	m^3/s	0.303	5.346	2.720	12	2.011
NH_4	Ammoniacal nitrogen	g/m^3N	0.011	0.119	0.041	12	0.040
NO_2	Nitrite nitrogen	g/m^3N	0.002	0.027	0.008	12	0.007
NO_3	Nitrate nitrogen	g/m^3N	0.158	2.572	1.125	12	0.722
PH	pH		7.1	7.9	7.5	12	0.2
SS	Suspended solids	g/m^3	<2	170	7	12	48
TEMP	Temperature	°C	9.1	20.7	13.2	12	4.0
TKN	Total Kjeldahl nitrogen	g/m^3N	0.04	1.82	0.23	12	0.52
TN	Total nitrogen	g/m^3N	0.29	2.98	1.40	12	0.90
TP	Total phosphorus	g/m^3P	0.038	0.755	0.072	12	0.203
TURBY	Turbidity	NTU	0.9	160	4.6	12	45

A statistical summary of the 23 years' data collected since 1 July 1995, is presented in Table 20.

Table 20 Statistical summary of data from July 1995 to June 2018 Punehu Stream at SH45

Parameter		Unit	Min	Max	Median	N	Std Dev.
A340F	Absorbance @ 340nm Filtered	/cm	0.015	0.115	0.039	276	0.015
A440F	Absorbance @ 440nm Filtered	/cm	0.002	0.027	0.008	276	0.004
A770F	Absorbance @ 770nm Filtered	/cm	0.000	0.006	0.000	276	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	10	46	33	276	7
BDISC	Black disc transparency	m	0.055	3.65	1.50	276	0.713
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	11.0	0.9	276	1.0
CONDY	Conductivity @ 20'C	mS/m	5.8	22.9	16.1	276	2.5
DO	Dissolved Oxygen	g/m^3	8.6	12.8	10.4	276	0.8
PERSAT	Dissolved Oxygen Saturation %	%	90	114	99	276	3
DRP	Dissolved reactive phosphorus	g/m^3P	0.013	0.212	0.044	276	0.026
ECOL	E.coli bacteria	cfu/100 mL	48	34000	510	250	3201
ENT	Enterococci bacteria	cfu/100 mL	15	17000	320	275	1851
FC	Faecal Coliforms	cfu/100 mL	51	36000	560	276	3401
FLOW	Flow	m^3/s	0.242	12.3	0.820	276	1.538
NH_4	Ammoniacal nitrogen	g/m^3N	0.004	0.376	0.040	276	0.058
NO_2	Nitrite nitrogen	g/m^3N	0.001	0.110	0.014	276	0.014
NO_3	Nitrate nitrogen	g/m^3N	0.07	3.79	0.96	276	0.74
PH	pH		7.1	8.6	7.7	276	0.2
SS	Suspended solids	g/m^3	<2	220	3	276	22
TEMP	Temperature	°C	5.0	21.0	13.4	276	3.5
TKN	Total Kjeldahl nitrogen	g/m^3N	0.03	1.99	0.32	276	0.28
TN	Total nitrogen	g/m^3N	0.21	4.30	1.40	276	0.83
TP	Total phosphorus	g/m^3P	0.026	0.755	0.079	276	0.072
TURB	Turbidity (Hach 2100A)	NTU	0.8	50	1.9	245	4.9
TURB	Turbidity (Cyberscan WTW)	NTU	0.8	160	2.3	157	14.1

These are provided for reference and comparative purposes and are discussed in Section 4.2 in association with appropriate graphical ('box and whisker' plots) presented in Appendix I.

Discussion

2017-2018 period

Moderate aesthetic water quality was indicated by a median black disc clarity of 1.01 m, this clarity being typical of the lower reaches of developed ringplain catchments, though lower than normal owing to the large proportion of fresh events that was sampled. A median suspended solids concentration of 7 g/m^3 and turbidity of 4.6 NTU was also more typical of the lower reaches of a ring plain catchment, for the relatively high flows sampled. Minimum clarity (black disc value of 0.06 and turbidity of 160 NTU, and suspended solids concentration of 170 g/m^3) was recorded during the peak of a large fresh, after a four-week dry period, in November 2017. Deterioration in other water quality parameters during this event was shown by elevations to highest recorded levels in bacterial numbers, total phosphorus concentration, and an increase in BOD_5.

pH range was moderate, with the maximum value of 7.9 recorded in December under low flow conditions, but this value was recorded in late morning and would be expected to have reached a higher level later in the day. This value was 0.7 unit lower than the maximum recorded previously at a similar time of the day.

Although dissolved oxygen concentrations remained consistently high (minimum of 98% saturation), BOD_5 concentrations often indicated low levels of organic enrichment (ie $\geq$1 g/m^3).

The high median bacteriological numbers (1250 enterococci and 1300 faecal coliform cfu/100 mL) were further indication of the impacts of developed farmland run-off and point source discharges on the water quality of the lower reaches of a ring plain catchment. The wide range of faecal coliform numbers (370 to 1,400 cfu/100 mL) found during summer to autumn lower flow conditions was indicative of point source discharges of pond system treated dairy sheds' wastes and/or stock access (see TRC, 2011). Relatively high median nutrient levels were consistent with such impacts.

Water temperature varied over a moderate range of 11.6˚C with a maximum summer (late morning) temperature of 20.7˚C recorded in February 2018 and the lowest temperature (9.1˚C) recorded in July 2017; the former 0.3˚C below the previous maximum temperature and the latter 4.1˚C above the previous minimum temperature.

Brief comparison of upper and lower Punehu Stream sites during the 2017-2018 period

Downstream deterioration in certain aspects of water quality in the lower stream reaches was emphasised by a very significant increase in median bacteriological numbers (1005 faecal coliforms cfu/100 mL and 1075 enterococci cfu/100 mL), and median nutrient concentrations (particularly nitrogen species), with nitrate and total nitrogen, and total phosphorus increasing by factors of about 15, 4.4 and 1.9 times, respectively. These downstream spatial trends may be compared with median 22-year historical data which indicate bacterial increases of 440 cfu/100 mL (faecal coliforms) and 284 cfu/100 mL (enterococci) and increases in nitrate and total nitrogen, and total phosphorus of 32, 8.3, and 1.3 times respectively. Relatively similar median (2017-2018) turbidity levels and suspended solids concentrations were found, with a small decrease in median black disc clarity (12% reduction) between sites, compared with the historical median turbidity decrease of only 0.1 NTU and decrease in median black disc clarity of 0.27 m. Some of these changes are more apparent when mass loadings are calculated, taking into account the increased flow at the lower site (e.g. median flow increased by 63% in the lower reaches of the stream). The downstream water temperature range decreased by 0.6˚C while the median increased by 2.3˚C. The median pH increased by only 0.1 unit in the lower reaches.

The differences between upper and lower stream clarity (black disc), turbidity, pH and temperature ranges may have been greater but for the impact of the open, developed farmland on the reach between the National Park and the upper site at Wiremu Road.

Brief comparison with the previous 1995-2017 period

Poorer aesthetic water quality was indicated with a significant increase in median turbidity (of 2.3 NTU, or 100%) recorded during the more recent twelve-month survey period, decrease in median black disc clarity (of 0.4 m), and an increase in median suspended solids concentration (of 4 g/m^3).

In the more recent survey period, a large deterioration was recorded in median faecal coliform bacterial number (of 780 cfu/100 mL) and increase in median enterococci bacteria number (by 930 cfu/100 mL). Almost identical median nitrogen nutrient species concentrations were recorded for the recent and long term periods. There was a slight improvement in phosphorus levels, with lower levels of both the dissolved reactive form (by 4%) and total phosphorus (by 9%).

Median dissolved oxygen saturation levels were within 1%, while median BOD_5 level was lower, by 8%, for the most recent period.

Median pH for 2017-2018 was lower by 0.2 unit, a reflection of the large number of freshes sampled, and the maximum pH was 0.7 unit lower in comparison with the previous 22-year period.

Water temperature range was narrower (by 4.4˚C); this decrease due to both higher minimum and lower maximum water temperatures (by 4.1 and 0.3˚C) over the recent survey period, with the 2017-2018 median water temperature 0.2˚C lower than the median 22-year temperature.

Median sampled flow over the 2017-2018 period was significantly higher than the median sampled (by 2100 L/s, or 256%) flow for the previous 22-year period.

Waingongoro River at Eltham Road (site: WGG000500)

Analytical data are presented in Table 21 from the monthly sampling programme. The river flow recorded at this site for the twelve-month period is presented in Figure 5.

Table 21 Analytical results from monthly samples: Waingongoro River at Eltham Road

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20°C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^3P	cfu/100mL	cfu/100mL
12 Jul 2017	1225	0.044	0.01	0.000	24	0.14	6.7	8.5	11.5	100	0.069	13000	10000
09 Aug 2017	1240	0.073	0.017	0.001	9	0.20	3.8	4.1	10.8	100	0.070	4600	1600
13 Sep 2017	1300	0.009	0.003	0.000	25	1.75	<0.5	10.0	10.7	102	0.028	62	11
11 Oct 2017	1135	0.014	0.004	0.000	24	0.66	1.1	9.5	10.5	102	0.031	1900	180
08 Nov 2017	1135	0.086	0.019	0.001	11	0.19	4.0	5.6	10.2	99	0.051	19000	3500
13 Dec 2017	1150	0.023	0.005	0.000	41	2.63	0.7	12.4	9.9	110	0.030	270	42
10 Jan 2018	1200	0.023	0.005	0.000	31	3.18	0.5	10.0	9.4	103	0.032	680	230
14 Feb 2018	1145	0.037	0.009	0.001	27	2.03	0.6	8.7	9.4	104	0.029	510	790
14 Mar 2018	1210	0.014	0.003	0.000	28	1.96	0.5	11.6	10.0	102	0.025	350	370
11 Apr 2018	1255	0.059	0.013	0.001	17	0.84	2.7	8.7	10.8	100	0.072	5330	15300
09 May 2018	1310	0.017	0.004	0.001	32	2.26	0.5	12.1	10.9	106	0.030	280	28
13 Jun 2018	1315	0.029	0.006	0.000	16	1.07	0.9	8.2	10.9	101	0.022	270	65
Date	Time NZST	FC	Flow	NH_4	NO_2	NO_3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m^3/s	g/m^3N	g/m^3N	g/m^3N	pH	g/m^3	°C	g/m^3N	g/m^3N	g/m^3P	NTU
12 Jul 2017	1225	13000	12.417	0.195	0.008	1.31	7.4	140	8.1	2.78	4.10	0.811	83
09 Aug 2017	1240	4700	46.451	0.117	0.006	0.48	7.1	95	10.6	1.15	1.64	0.370	39
13 Sep 2017	1300	62	4.406	0.026	0.007	1.51	7.6	4	11.7	0.28	1.80	0.038	2.0
11 Oct 2017	1135	2000	6.261	0.039	0.009	1.35	7.5	15	12.6	0.38	1.74	0.116	10
08 Nov 2017	1135	19000	6.956	0.107	0.007	0.56	7.4	41	12.9	1.27	1.84	0.250	24
13 Dec 2017	1150	270	0.448	0.013	0.007	0.69	8.2	4	19.4	0.07	0.77	0.050	1.6
10 Jan 2018	1200	700	0.919	0.014	0.005	0.77	7.8	<2	19.1	0.03	0.80	0.036	1.4
14 Feb 2018	1145	510	1.012	0.019	0.002	0.44	8.0	<2	19.6	<0.10	0.54	0.039	1.0
14 Mar 2018	1210	360	2.424	0.014	0.005	1.67	7.7	3	15.4	0.02	1.69	0.043	1.3
11 Apr 2018	1255	5330	5.356	0.293	0.010	0.77	7.3	13	10.3	0.63	1.41	0.137	6.0
09 May 2018	1310	280	1.382	0.010	0.007	1.65	7.9	<2	13.6	<0.06	1.72	0.041	1.7
13 Jun 2018	1315	280	3.821	0.015	0.005	1.03	7.4	8	10.8	0.11	1.14	0.055	3.9

The statistical summary of these data is presented in Table 22.

Table 22 Statistical summary of data from July 2017 to June 2018: Waingongoro River at Eltham Rd

Parameter		Unit	Min	Max	Median	N	Std Dev.
A340F	Absorbance @ 340nm Filtered	/cm	0.009	0.086	0.026	12	0.025
A440F	Absorbance @ 440nm Filtered	/cm	0.003	0.019	0.006	12	0.006
A770F	Absorbance @ 770nm Filtered	/cm	0.000	0.001	0.000	12	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	9	41	24	12	9
BDISC	Black disc transparency	m	0.14	3.18	1.41	12	1.03
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	6.7	0.8	12	2.0
CONDY	Conductivity @ 20'C	mS/m	4.1	12.4	9.1	12	2.5
DO	Dissolved Oxygen	g/m^3	9.4	11.5	10.6	12	0.6
PERSAT	Dissolved Oxygen Saturation %	%	99	110	102	12	3
DRP	Dissolved reactive phosphorus	g/m^3P	0.022	0.072	0.030	12	0.019
ECOL	E.coli bacteria	cfu/100 mL	62	19000	595	12	36075
ENT	Enterococci bacteria	cfu/100 mL	11	15300	300	12	4897
FC	Faecal coliforms	cfu/100 mL	62	19000	605	12	6071
FLOW	Flow	m^3/s	0.448	46.451	4.114	12	12.681
NH_4	Ammoniacal nitrogen	g/m^3N	0.010	0.293	0.022	12	0.091
NO_2	Nitrite nitrogen	g/m^3N	0.002	0.010	0.007	12	0.002
NO_3	Nitrate nitrogen	g/m^3N	0.438	1.66	1.02	12	0.463
PH	pH		7.1	8.2	7.6	12	0.3
SS	Suspended solids	g/m^3	<2	140	6	12	45
TEMP	Temperature	°C	8.1	19.6	12.8	12	3.9
TKN	Total Kjeldahl nitrogen	g/m^3N	0.02	2.78	0.20	12	0.82
TN	Total nitrogen	g/m^3N	0.54	4.10	1.66	12	0.91
TP	Total phosphorus	g/m^3P	0.036	0.811	0.052	12	0.228
TURBY	Turbidity	NTU	1.0	83	3.0	12	24

A statistical summary of the 23 years' data collected since 1 July 1995, is presented in Table 23.

Table 23 Statistical summary of data from July 1995 to June 2018: Waingongoro River at Eltham Rd

Parameter		Unit	Min	Max	Median	N	Std Dev.
A340F	Absorbance @ 340nm Filtered	/cm	0.009	0.100	0.021	276	0.014
A440F	Absorbance @ 440nm Filtered	/cm	0.000	0.024	0.005	276	0.003
A770F	Absorbance @ 770nm Filtered	/cm	0.000	0.003	0.000	276	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	9	49	30	276	7
BDISC	Black disc transparency	m	0.10	4.39	1.685	276	0.799
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	7.3	0.7	276	0.9
CONDY	Conductivity @ 20'C	mS/m	4.1	14.7	11.2	276	1.6
DO	Dissolved Oxygen	g/m^3	9.2	13.0	10.6	277	0.7
PERSAT	Dissolved Oxygen Saturation %	%	92	121	103	276	5
DRP	Dissolved reactive phosphorus	g/m^3P	0.003	0.146	0.020	276	0.015
ECOL	E.coli bacteria	cfu/100 mL	6	59000	190	252	4118
ENT	Enterococci bacteria	cfu/100 mL	3	15300	100	276	1466
FC	Faecal coliforms	cfu/100 mL	6	100000	200	276	7222
FLOW	Flow	m^3/s	0.326	46.451	1.667	276	4.165
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	1.72	0.017	276	0.11
NO_2	Nitrite nitrogen	g/m^3N	<0.001	0.033	0.007	276	0.005
NO_3	Nitrate nitrogen	g/m^3N	0.13	2.31	1.13	276	0.49
PH	pH		7.1	8.6	7.8	276	0.3
SS	Suspended solids	g/m^3	<2	180	3	276	19
TEMP	Temperature	°C	5.6	21.5	12.6	276	3.2
TKN	Total Kjeldahl nitrogen	g/m^3N	0.00	2.78	0.19	276	0.33
TN	Total nitrogen	g/m^3N	0.21	4.10	1.44	276	0.55
TP	Total phosphorus	g/m^3P	0.013	0.829	0.040	276	0.088
TURB	Turbidity (Hach 2100A)	NTU	0.70	36	1.5	245	3.8
TURB	Turbidity (Cyberscan WTW)	NTU	0.62	18	2.0	157	7.8

These are provided for reference and comparative purposes and are discussed in Section 4.2 in association with appropriate graphical ('box and whisker' plots) presented in Appendix I.

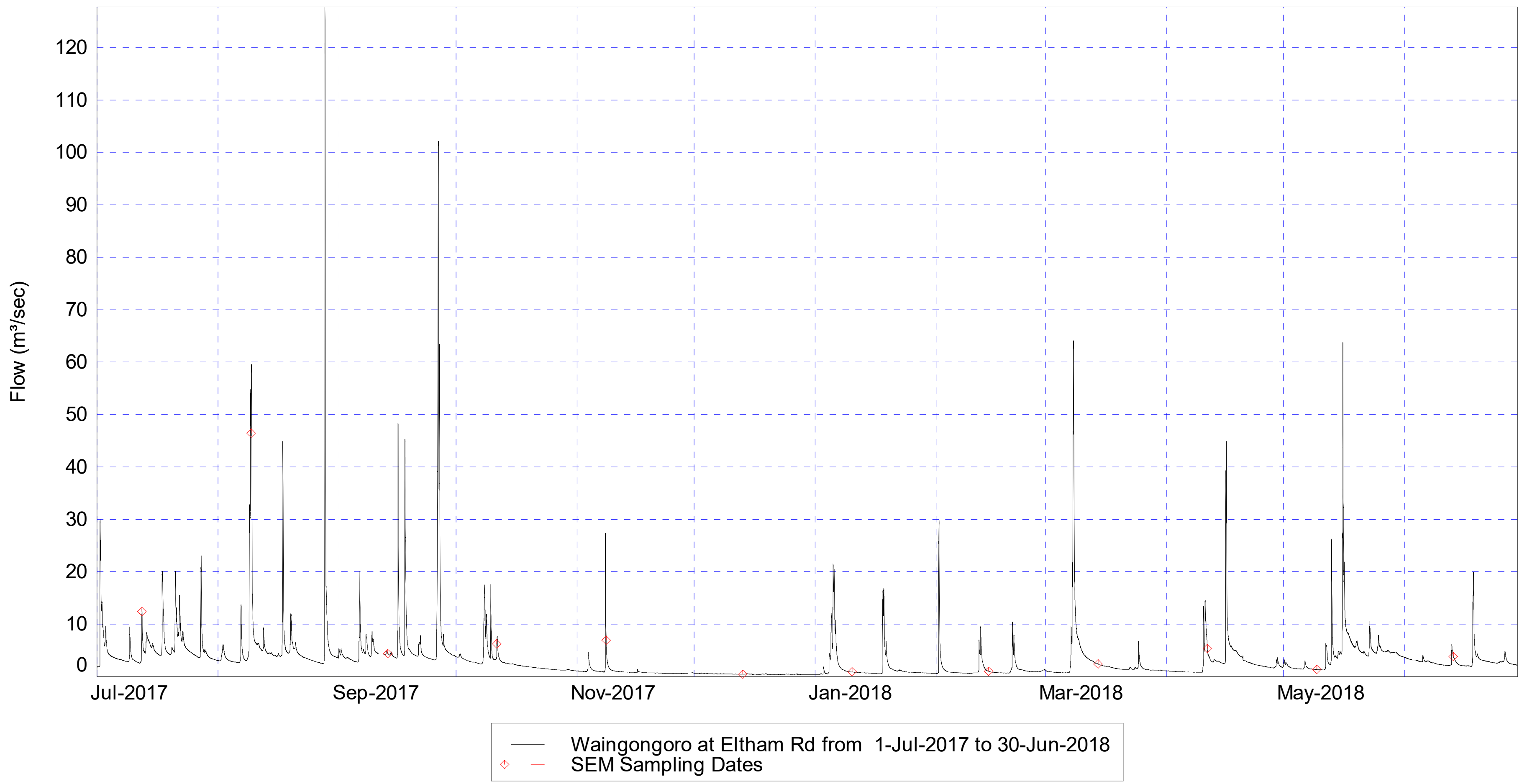

Figure 4 Flow record for the Waingongoro River at Eltham Road

Discussion

2017-2018

Moderate aesthetic water quality (more similar to lower ringplain reaches' aesthetic quality) was indicated by a median black disc clarity of 1.41 m and median turbidity of 3.0 NTU, in the mid-reaches of the longest ring-plain river in Taranaki but recognising that this site (altitude: 200 m asl) is 23 km from the National Park boundary. The maximum clarity (black disc of 3.18 m), 1.21 m lower than the historical maximum, was recorded in mid-summer during a period of low flow conditions (0.92 m^3/s), while worst black disc clarity (0.14 m) occurred near the peak of a large fresh coincident with turbidity of 83 NTU and suspended solids concentration of 140 g/m^3 sampled in July 2017 (Figure 4). Generally, the poorer water quality conditions monitored during freshes (elevated bacterial numbers, some elevated nutrients, discolouration, and decreased clarity) were apparent on more occasions than usual during the 2017-2018 period.

pH reached a maximum of 8.2 in early-summer coincident with supersaturation (110%) of dissolved oxygen, although it would be expected that pH would have risen further later in the day, particularly in mid to late summer, than the value measured at the time of sampling (near midday).

Good water quality was indicated by high dissolved oxygen concentrations (minimum of 99% saturation recorded in spring) and low BOD_5 levels (median: 0.8 g/m^3). Bacteriological quality was more typical of the mid reaches of developed ring plain catchments, subject to agricultural impacts, though relatively poor owing to the high flows sampled, with median faecal coliform and enterococci numbers of 605 and 300 cfu/100 mL, respectively. Water temperature varied over a moderate range of 11.5˚C with the maximum summer (late morning) river temperature of 19.6˚C recorded in February 2017 under low flow conditions (Figure 4).

Brief comparison with previous 1995-2017 period

The latest twelve-month period sampled a wider range of flow conditions with median sampled flow much higher (by 2,478 L/s. or 152%) than the median of flows sampled over the previous 22-year period. Aesthetic river water quality was lower in terms of median black disc clarity (which was lower by 0.27 m), and median turbidity level (which was higher by 1.0 NTU), with median suspended solids level higher (by 3 g/m^3), during the 2017-2018 period.

In general, some deterioration in faecal coliform bacteriological water quality was recorded in the 2017-2018 period with a higher median number (by 425 cfu/100 mL) and in median enterococci number (by 200 cfu/100 mL). Some increases were indicated in median nutrient species' concentrations over the 2017-2018 period, particularly ammoniacal and total nitrogen, and dissolved and total phosphorus, which rose by 29%, 15%, 50% and 33%, respectively. Median nitrate nitrogen value fell by 22%.

The range in water temperature was narrower (by 4.4˚C) over the 2017-2018 period due to both warmer (by 2.5˚C) minimum and cooler maximum (by 1.9°C) water temperatures.

Median pH value was lower (by 0.2 unit), and the maximum pH previously recorded (over 22 years) was 0.4 unit higher than that measured in the 2017-2018 period.

Waingongoro River at SH45 (site: WGG000900)

Analytical data are presented in Table 24 from the monthly sampling programme. The river flow recorded at this site for the twelve-month period at this SH45 site is presented in Figure 6.

Table 24 Analytical results from monthly samples: Waingongoro River at SH45

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20°C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^3P	cfu/100mL	cfu/100mL
12 Jul 2017	1155	0.03	0.006	0.000	36	0.24	2.2	16.2	10.8	96	0.047	2000	870
09 Aug 2017	1200	0.076	0.018	0.001	17	0.22	4.8	7.8	10.6	98	0.048	2100	2100
13 Sep 2017	1215	0.036	0.005	0.000	35	0.89	0.9	16.3	10.9	101	0.043	150	6
11 Oct 2017	1115	0.045	0.013	0.003	36	0.49	2.4	15.7	10.2	100	0.050	4000	950
08 Nov 2017	1050	0.035	0.008	0.001	47	0.24	3.5	19.0	9.7	97	0.042	3600	2300
13 Dec 2017	1100	0.034	0.006	0.000	56	1.87	0.7	20.8	9.5	106	0.060	540	95
10 Jan 2018	1130	0.033	0.006	0.000	41	1.96	0.7	15.3	9.1	102	0.056	470	310
14 Feb 2018	1100	0.064	0.016	0.001	33	1.65	0.9	11.9	9.0	102	0.064	540	690
14 Mar 2018	1115	0.021	0.004	0.000	34	2.10	0.6	14.5	9.8	101	0.042	320	630
11 Apr 2018	1200	0.078	0.018	0.001	26	0.25	5.6	12.8	10.5	97	0.098	12700	14700
09 May 2018	1220	0.028	0.006	0.000	39	1.52	0.6	16.8	11.0	107	0.047	200	43
13 Jun 2018	1240	0.026	0.005	0.000	37	0.63	2.2	17.8	10.5	99	0.069	230	72

Date	Time NZST	FC	Flow	NH_4	NO_2	NO_3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m^3/s	g/m^3N	g/m^3N	g/m^3N	pH	g/m^3	°C	g/m^3N	g/m^3N	g/m^3P	NTU
12 Jul 2017	1155	2000	12.146	0.056	0.011	2.47	7.6	39	9.6	0.82	3.30	0.174	22
09 Aug 2017	1200	2100	54.817	0.066	0.022	1.07	7.3	170	11.5	1.37	2.46	0.553	58
13 Sep 2017	1215	150	14.399	0.052	0.016	2.71	7.7	12	11.9	0.53	3.26	0.070	8.1
11 Oct 2017	1115	4000	12.616	0.091	0.023	2.29	7.6	17	13.8	0.75	3.06	0.177	16
08 Nov 2017	1050	3700	19.081	0.028	0.013	2.42	7.8	75	15.1	1.35	3.78	0.380	31
13 Dec 2017	1100	540	1.842	0.019	0.017	1.79	8.1	2	20.6	0.31	2.12	0.080	2.2
10 Jan 2018	1130	500	3.173	0.015	0.010	1.31	7.9	<2	21.3	0.22	1.54	0.064	1.8
14 Feb 2018	1100	600	2.83	0.026	0.008	0.92	7.8	2	21.5	0.26	1.19	0.084	2.3
14 Mar 2018	1115	320	6.875	0.048	0.007	0.91	7.8	4	16.7	1.08	2.00	0.059	1.4
11 Apr 2018	1200	13300	23.52	0.389	0.020	1.28	7.4	77	11.2	1.44	2.74	0.319	25
09 May 2018	1220	200	4.909	0.012	0.012	2.12	8.1	3	14.3	0.09	2.22	0.069	3.1
13 Jun 2018	1240	230	14.748	0.056	0.110	3.11	7.7	17	12.2	0.27	3.49	0.139	7.2

The statistical summary of these data is presented in Table 25.

Table 25 Statistical summary of data from July 2017 to June 2018: Waingongoro River at SH45

Parameter		Unit	Min	Max	Median	N	Std Dev.
A340F	Absorbance @ 340nm Filtered	/cm	0.021	0.078	0.0234	12	0.020
A440F	Absorbance @ 440nm Filtered	/cm	0.004	0.018	0.006	12	0.005
A770F	Absorbance @ 770nm Filtered	/cm	0.000	0.003	0.001	12	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	17	56	36	12	10
BDISC	Black disc transparency	m	0.22	2.10	0.76	12	0.76
BOD_5	Biochemical oxygen demand 5day	g/m3	0.6	5.6	1.6	12	1.7
CONDY	Conductivity @ 20'C	mS/m	7.8	20.8	16	12	3.4
DO	Dissolved Oxygen	g/m3	9.0	11.0	10.4	12	0.7
PERSAT	Dissolved Oxygen Saturation %	%	96	107	100	12	3
DRP	Dissolved reactive phosphorus	g/m3P	0.042	0.098	0.049	12	0.016
ECOL	E.coli bacteria	cfu/100 mL	150	12700	540	12	3562
ENT	Enterococci bacteria	cfu/100 mL	6	14700	660	12	4104
FC	Faecal Coliforms	cfu/100 mL	150	13300	570	12	3723
FLOW	Flow	m3/s	1.842	52.817	12.381	12	14.495
NH_4	Ammoniacal nitrogen	g/m3N	0.012	0.389	0.050	12	0.103
NO_2	Nitrite nitrogen	g/m3N	0.007	0.110	0.014	12	0.028
NO_3	Nitrate nitrogen	g/m3N	0.91	3.11	1.96	12	0.76
PH	pH		7.3	8.1	7.8	12	0.2
SS	Suspended solids	g/m3	<2	170	14	12	50
TEMP	Temperature	°C	9.6	21.5	14.0	12	4.2
TKN	Total Kjeldahl nitrogen	g/m3N	0.09	1.44	0.64	12	0.81
TN	Total nitrogen	g/m3N	1.19	3.78	2.60	12	0.81
TP	Total phosphorus	g/m3P	0.059	0.553	0.112	12	0.157
TURBY	Turbidity	NTU	1.4	58	7.6	12	17

This was the twentieth year of state of the environment data collection by the Taranaki Regional Council for this site, and these data are provided in Table 26 for reference or comparative purposes.

Table 26 Statistical summary of data from July 1998 to June 2018: Waingongoro River at SH45

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.009	0.078	0.032	240	0.012
A440F	Absorbance @ 440nm filtered	/cm	0.002	0.019	0.007	240	0.003
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.004	0.000	240	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	17	62	39	240	9
BDISC	Black disc transparency	m	0.12	4.34	1.185	240	0.596
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	6.7	1.0	240	0.9
CONDY	Conductivity @ 20˚C	mS/m	7.8	23.2	16.4	240	2.3
DO	Dissolved oxygen	g/m^3	8.4	12.9	10.5	240	0.8
PERSAT	Dissolved oxygen saturation %	%	89	141	102	240	6
DRP	Dissolved reactive phosphorus	g/m^{3}P	0.015	0.223	0.053	240	0.033
ECOL	E.coli bacteria	cfu/100 mL	3	41000	220	239	3177
ENT	Enterococci bacteria	cfu/100 mL	6	14700	150	240	1170
FC	Faecal coliforms	cfu/100 mL	3	41000	225	240	3181
FLOW	Flow	m^3/s	0.997	54.817	5.007	240	7.378
NH_4	Ammoniacal nitrogen	g/m^{3}N	<0.003	0.389	0.034	240	0.045
NO_2	Nitrite nitrogen	g/m^{3}N	0.003	0.132	0.020	240	0.019
NO_3	Nitrate nitrogen	g/m^{3}N	0.48	3.11	1.87	240	0.56
pH	pH		7.2	9.1	7.8	240	0.3
SS	Suspended solids	g/m^3	<2	170	5	240	17
TEMP	Temperature	°C	5.4	22.0	13.8	240	3.8
TKN	Total kjeldahl nitrogen	g/m^{3}N	0.00	1.51	0.38	240	0.27
TN	Total nitrogen	g/m^{3}N	0.55	3.78	2.40	240	0.62
TP	Total phosphorus	g/m^{3}P	0.042	0.553	0.094	240	0.061
TURB	Turbidity (Hach 2100A)	NTU	1.0	36	2.3	209	4.0
TURBY	Turbidity (Cyberscan WTW)	NTU	0.8	58	3.2	157	7.7

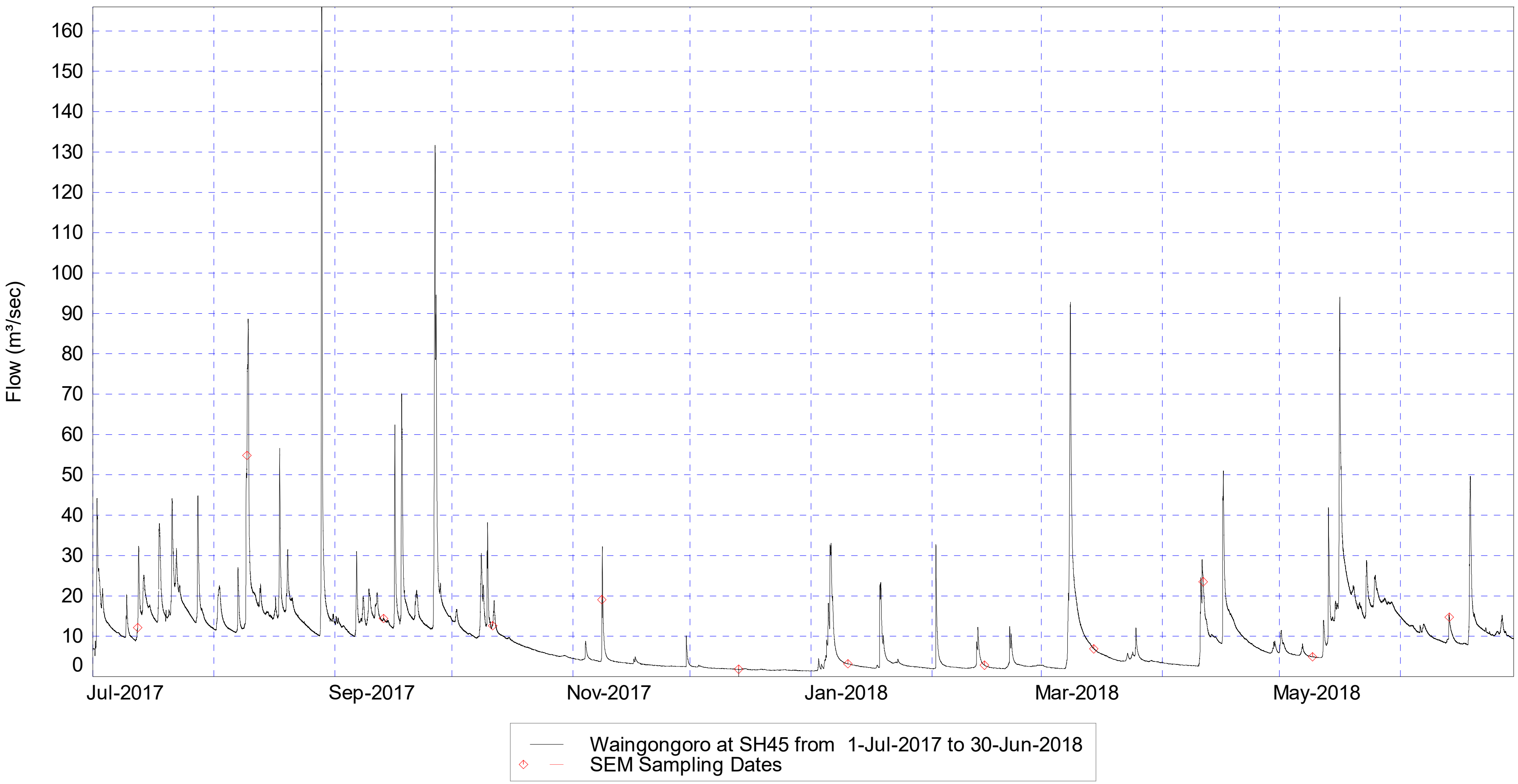

Figure 5 Flow record for the Waingongoro River at SH45

Discussion

2017-2018 period

Relatively poor aesthetic water quality was indicated by a median black disc clarity of 0.76 m and median turbidity of 7.6 NTU, in the lower reaches of the longest ringplain-confined river or stream in Taranaki. The moderately low maximum clarity (black disc value of 2.10 m) was recorded in mid-autumn in recession flow conditions (6.88 m^3/s), six days after a flood. The minimum clarity of 0.21 m was recorded during the highest sampled flow recorded for the site, in August 2017 (54.8 m^3/s, Figure 5). Poorest water quality conditions were apparent at times of fresh flows, when elevated bacterial numbers, nutrients, and/or discolouration, and decreased clarity were typical.

pH reached 8.1 in early summer under low flow conditions coincidental with highest dissolved oxygen saturation level (106%), although it would be expected that pH would have risen further during summer/autumn later in the day (i.e. after 1130 NZST) than values recorded at the earlier sampling times.

Good water quality was indicated by high dissolved oxygen concentrations (minimum of 96% saturation) and moderate BOD_5 levels (median: 1.6 g/m^3). Bacteriological quality was relatively poor at this site, with numbers typical for the lower reaches of developed ring plain catchments, subject to agricultural impacts, with median faecal coliform and enterococci numbers of 570 and 660 (cfu/100 mL) respectively. These numbers reflected, to some degree, the frequent preceding river freshes on sampling survey occasions during the period. Median nutrient levels were relatively high and typical of the lower reaches of ring plain rivers receiving agricultural and industrial point-source discharges. Water temperatures varied over a moderate range of 11.9˚C with a maximum mid-summer (late morning) river temperature of 21.5˚C recorded in February 2018.

Brief comparison of upper and lower Waingongoro River sites during the 2017-2018 period

Downstream deterioration in aspects of water quality over the 40 km length between the mid reaches and the lower reaches of the river was emphasised by more turbid conditions (lower median black disc clarity by 0.65 m (46% decrease), increased median turbidity level (by 4.6 NTU), and an increase in median suspended solids concentration of 8 g/m^3). Bacteriological quality, in terms of the median faecal coliform count, remained poor (lower by 35 cfu/100 mL) at the lower river site whereas the median enterococci count deteriorated by360 cfu/100 mL (compared with historical median deteriorations of 40 cfu/100 mL for faecal coliforms and 50 cfu/100 mL for enterococci). The lower river site's pH range was narrower (by 0.3 unit) over the 2017-2018 period, but the median pH level was higher (by 0.2 unit) at the downstream site. Maximum pH recorded was 0.1 unit lower at the downstream site, which was atypical of downstream increases in pH in ringplain streams.

Median BOD_5 was higher by 0.8 g/m^3 at the SH45 site where all median nutrient species' concentrations also showed significant increases (by 57% to 127%) compared with upstream concentrations. Historical (1998-2017) median data also indicate from 58% to 170% increases in nutrient species concentrations in a downstream direction.

Water temperature range was slightly larger (by 0.4˚C) at the lower site and median water temperature was 1.2˚C warmer at this site in the lower reach of the river in comparison with the mid reach site. Historical median temperatures have increased downstream by 1.0˚C and ranges have been wider by 0.7˚C. Median flow increased by 201% at the lower reach site in the 2017-2018 period compared with 203% over the previous nineteen-year period.

Brief comparison with the previous 1998-2017 period

The most recent twelve-month period sampled a wider range of flow conditions and the median sampled flow was higher by 7,541 L/s, or 156%, than that sampled over the previous nineteen-year period. This was due in part to several freshes.

Water clarity at the time of sampling was poorer, with the medians for suspended solids higher by 9 g/m^3, turbidity higher by 4.6 NTU, and black disc clarity lower by 0.65 m in the 2017-2018 period.

Median faecal coliform bacterial number showed a large deterioration, by 350 cfu/100 mL, with a similar increase in enterococci, by 350 cfu/100 mL. While pH median values were the same, a much narrower range (by 1.1 unit) was recorded in the recent twelve-month period due to the absence of very elevated summer pH values which had been recorded at times in the previous nineteen-year period. Dissolved oxygen saturation median value was slightly lower in the recent period. Dissolved phosphorus nutrient levels reduced slightly (by 9%) while total phosphorus increased (by 19%) in the recent one year period, and all of the median nitrogen nutrient species' levels were higher, by 4 to 56%.

The 2017-2018 range in water temperatures was narrower (by 4.7˚C) due to a higher minimum temperature (by 4.2˚C) and lower maximum temperature (by 0.5˚C) while the median was 0.2˚C higher in the 2017-2018 sampling period than that recorded over the previous nineteen-year period.

Patea River at Barclay Road (site: PAT000200)

Analytical data are presented in Table 27 from the monthly sampling programme.

Table 27 Analytical results from monthly samples: Patea River at Barclay Road

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD$_5$	Cond @ 20 °C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^{3}P	cfu/100mL	cfu/100mL
12 Jul 2017	1300	0.077	0.016	0.001	9	0.44	0.6	3.7	11.9	101	0.019	44	13
09 Aug 2017	1315	0.099	0.021	0.001	2	0.34	0.8	1.7	10.1	102	0.007	50	50
13 Sep 2017	1340	0.017	0.005	0.000	13	7.00	<0.5	4.6	11.4	101	0.015	4	8
11 Oct 2017	1225	0.082	0.017	0.000	6	1.66	<0.5	2.8	11.1	102	0.008	28	3
08 Nov 2017	1210	0.100	0.020	0.001	6	1.78	0.8	2.9	10.6	100	0.013	65	28
13 Dec 2017	1230	0.016	0.004	0.000	30	4.06	<0.5	7.6	9.8	100	0.035	8	6
10 Jan 2018	1240	0.018	0.004	0.000	23	4.38	<0.5	6.3	9.6	98	0.022	200	70
14 Feb 2018	1220	0.030	0.007	0.001	16	3.40	<0.5	5.6	9.6	100	0.020	76	150
14 Mar 2018	1300	0.015	0.003	0.000	23	4.39	0.5	6.6	10.1	100	0.023	130	130
11 Apr 2018	1315	0.054	0.011	0.001	6	2.48	2.4	4.5	10.8	100	0.008	114	71
09 May 2018	1345	0.014	0.003	0.000	24	4.14	<0.5	6.8	10.8	100	0.024	14	8
13 Jun 2018	1345	0.040	0.008	0.000	8	1.90	<0.5	4.7	10.9	101	0.013	36	6

Date	Time NZST	FC	Flow	NH4	NO2	NO3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m3/s	g/m3N	g/m3N	g/m3N	pH	g/m3	°C	g/m3N	g/m3N	g/m3P	NTU
12 Jul 2017	1300	50	2.110	0.007	0.001	0.01	7.2	7	5.6	0.16	0.17	0.028	3.9
09 Aug 2017	1315	50	10.300	0.004	0.001	<0.01	6.7	21	10.7	0.20	0.20	0.048	9.3
13 Sep 2017	1340	4	0.415	<0.003	<0.001	0.02	7.4	<2	7.7	<0.01	<0.05	0.015	0.5
11 Oct 2017	1225	28	2.372	<0.003	<0.001	<0.01	7.0	2	8.9	0.02	<0.05	0.018	0.9
08 Nov 2017	1210	65	1.239	<0.003	0.002	<0.01	7.2	2	10.7	0.18	0.18	0.025	1.4
13 Dec 2017	1230	8	0.111	<0.003	0.002	<0.01	7.8	<2	13.4	0.02	<0.05	0.037	0.6
10 Jan 2018	1240	200	0.139	0.009	0.002	0.02	7.4	<2	13.8	<0.01	<0.05	0.028	0.5
14 Feb 2018	1220	84	0.232	0.006	<0.001	0.02	7.5	<2	14.7	<0.03	0.05	0.022	0.6
14 Mar 2018	1300	130	0.199	0.027	<0.001	0.03	7.6	<2	12.2	<0.01	<0.05	0.025	0.4
11 Apr 2018	1315	114	1.335	<0.003	0.001	0.02	7.0	3	8.7	0.04	0.06	0.016	1.0
09 May 2018	1345	14	0.195	0.004	<0.001	0.04	7.5	<2	10.2	0.02	0.06	0.027	0.6
13 Jun 2018	1345	36	0.935	0.004	<0.001	0.02	7.2	<2	8.7	0.05	0.07	0.015	0.7

The statistical summary of these data is presented in Table 28.

Table 28 Statistical summary of data from July 2017 to June 2018: Patea River at Barclay Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.014	0.100	0.035	12	0.034
A440F	Absorbance @ 440nm filtered	/cm	0.003	0.021	0.008	12	0.007
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.001	0.000	12	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	2	30	11	12	9
BDISC	Black disc transparency	m	0.34	7.00	2.94	12	1.93
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	2.4	<0.5	12	0.5
CONDY	Conductivity @ 20˚C	mS/m	1.7	7.6	4.6	12	1.8
DO	Dissolved oxygen	g/m^3	9.6	11.9	10.7	12	0.7
PERSAT	Dissolved oxygen saturation %	%	98	102	100	12	1
DRP	Dissolved reactive phosphorus	g/m^3P	0.007	0.035	0.017	12	0.008
ECOL	E.coli bacteria	cfu/100 mL	4	200	47	12	58
ENT	Enterococci bacteria	cfu/100 mL	3	150	20	12	51
FC	Faecal coliforms	cfu/100 mL	4	200	50	12	58
FLOW	Flow	m^3/s	0.111	10.3	0.675	12	2.840
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.027	0.004	12	0.007
NO_2	Nitrite nitrogen	g/m^3N	<0.001	0.002	0.001	12	0.000
NO_3	Nitrate nitrogen	g/m^3N	<0.01	0.04	0.02	12	0.012
pH	pH		6.7	7.8	7.3	12	0.3
SS	Suspended solids	g/m^3	<2	21	<2	12	<2
TEMP	Temperature	°C	5.6	14.7	10.4	12	2.7
TKN	Total kjeldahl nitrogen	g/m^3N	<0.01	0.20	0.06	12	0.07
TN	Total nitrogen	g/m^3N	<0.05	0.20	0.06	12	0.06
TP	Total phosphorus	g/m^3P	0.015	0.048	0.025	12	0.010
TURBY	Turbidity	NTU	0.4	9.3	0.6	12	2.6

A statistical summary of the 23 years' data collected since 1 July 1995, is presented in Table 29.

Table 29 Statistical summary of data from July 1995 to June 2018: Patea River at Barclay Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.006	0.112	0.016	276	0.022
A440F	Absorbance @ 440nm filtered	/cm	0.000	0.024	0.004	276	0.005
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.004	0.000	276	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	2	34	21	275	7.2
BDISC	Black disc transparency	m	0.09	10.14	4.33	275	1.828
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	3.7	<0.5	276	0.3
CONDY	Conductivity @ 20˚C	mS/m	1.7	8.2	6.1	276	1.4
DO	Dissolved oxygen	g/m^3	9.1	12.4	10.6	276	0.7
PERSAT	Dissolved oxygen saturation %	%	90	103	99	276	2
DRP	Dissolved reactive phosphorus	g/m^3P	0.004	0.042	0.018	276	0.008
ECOL	E.coli bacteria	cfu/100 mL	<1	10000	22	252	698
ENT	Enterococci bacteria	cfu/100 mL	<1	2200	8	276	188
FC	Faecal coliforms	cfu/100 mL	<1	10000	23	276	671
FLOW	Flow	m^3/s	0.084	18.000	0.218	276	1.556
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.057	<0.003	276	0.006
NO_2	Nitrite nitrogen	g/m^3N	<0.001	<0.003	<0.001	276	<0.000
NO_3	Nitrate nitrogen	g/m^3N	<0.01	0.14	0.02	276	0.017
pH	pH		6.5	8.0	7.5	276	0.2
SS	Suspended solids	g/m^3	<2	160	<2	276	11
TEMP	Temperature	°C	3.7	14.9	9.4	276	2.5
TKN	Total kjeldahl nitrogen	g/m^3N	0.00	2.70	0.05	276	0.19
TN	Total nitrogen	g/m^3N	<0.05	2.72	0.07	276	0.19
TP	Total phosphorus	g/m^3P	0.008	0.281	0.025	276	0.021
TURB	Turbidity (Hach 2100A)	NTU	0.3	31	0.6	245	2.2
TURBY	Turbidity (Cyberscan WTW)	NTU	0.2	9.3	0.6	156	0.9

These are provided for reference and comparative purposes and are discussed in Section 4.2 in association with appropriate graphical ('box and whisker' plots) presented in Appendix I.

Discussion

2017-2018 period

Aesthetic water quality was high, as emphasised by median black disc and turbidity values of 2.9 m and 0.6 NTU respectively. The lowest black disc clarity (0.34 m) and highest turbidity were recorded in August 2017, coincident with a high flood (10.3 m^3/s) and increase in suspended solids, but minimal increases in BOD_5 and bacterial levels.

Maximum pH (7.8) at this shaded site was measured under very low flow conditions in early summer. pH range, which is typically narrow, although measurements have been confined to around midday, was relatively wide (varying by 1.1 unit) over the period, as a result of a very low minimum pH value (6.7) measured for the August 2017 flood.

Dissolved oxygen concentrations were consistently high with a minimum saturation of 98% recorded. The high water quality was also emphasised by very low BOD_5 levels (≤0.5 g/m^3 for the majority of the period) and generally low nutrient concentrations under normal flow conditions. Dissolved reactive phosphorus levels were typical of National Park sourced rivers.

Bacterial water quality was relatively high (median faecal coliform and enterococci numbers of 50 and 20 cfu/100 mL respectively). There was some evidence of the slightly elevated counts found in past years in summer-autumn during periods of stable flow conditions, which may have been due to stock access upstream of the site noted previously in this short reach of the river below the National Park boundary.

River water temperatures varied over a moderate range (9.1˚C) at this relatively shaded site during the period. A maximum mid-day temperature of 14.7˚C was recorded under low flow conditions in February 2018.

Brief comparison with the previous 1995-2017 period

A wider range and a much higher median of river flows was sampled during the 2017-2018 period, with six significant freshes sampled, in comparison with the previous 22-year period. Median flow for the 2017-2018 sampling occasions was 459 L/s, or 212%, higher than the median of sampled flows over the previous 22-year period. Aesthetic river water quality was significantly lower in terms of median black disc clarity, but not median turbidity, during the 2017-2018 period. Median suspended solids concentrations were very low (below 2 g/m^3) in both periods.

Median nutrient species levels were comparatively similar between the two periods, although there was an increase in median ammoniacal-nitrogen at low level over the latest twelve-month sampling period. Total nitrogen reduced at low level, possibly related to the higher flows.

Median faecal coliform bacterial number decreased (by 29 cfu/100 mL) and median enterococci number increased (by 12 cfu/100 mL) over the recent sampling period. Median pH value was lower by 0.2 unit, while the maximum pH value was 0.2 unit lower, in the 2017-2018 period.

Median water temperature over the past twelve-month period was 1.0˚C higher than the median for the previous 22-year period; the maximum temperature was 0.2˚C lower, and the minimum temperature was 1.9˚C higher in the latest period. Therefore, a narrower range of temperatures (by 2.1°C) was recorded in the 2017-2018 period.

Patea River at Skinner Road (site: PAT000360)

Analytical data are presented in Table 30 from the monthly sampling programme and the flow illustrated in Figure 7.

Table 30 Analytical results from monthly samples: Patea River at Skinner Road

Date	Time NZST	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20 °C	DO	DO Sat	DRP	E.coli	ENT
		/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^{3}P	cfu/100mL	cfu/100mL
12 Jul 2017	1345	0.055	0.013	0.001	15	0.13	0.6	5.7	11.7	101	0.049	7200	4000
09 Aug 2017	1345	0.069	0.019	0.003	10	0.21	2.8	3.6	10.6	100	0.039	3600	1500
13 Sep 2017	1415	0.016	0.004	0.000	24	2.39	<0.5	9.0	10.9	102	0.028	200	62
11 Oct 2017	1310	0.025	0.006	0.000	24	0.54	1.0	7.6	10.4	101	0.026	2100	270
08 Nov 2017	1310	0.089	0.020	0.001	11	0.28	4.0	5.4	9.9	100	0.051	35000	12000
13 Dec 2017	1320	0.034	0.007	0.000	38	2.11	1.0	12.2	10.2	110	0.087	120	58
10 Jan 2018	1345	0.028	0.006	0.000	30	1.88	1.0	10.4	9.6	109	0.082	270	400
14 Feb 2018	1315	0.036	0.009	0.001	28	2.27	0.7	9.8	9.3	104	0.050	580	1100
14 Mar 2018	1340	0.015	0.003	0.000	28	2.32	0.6	10.3	10.0	103	0.020	270	370
11 Apr 2018	1405	0.044	0.009	0.001	17	0.78	2.3	8.9	10.6	100	0.046	4180	3120
09 May 2018	1430	0.019	0.004	0.000	29	2.11	0.8	10.6	10.9	104	0.040	250	74
13 Jun 2018	1425	0.029	0.006	0.000	23	1.14	1.2	8.9	10.8	102	0.026	1300	34

Date	Time NZST	FC	Flow	NH_4	NO_2	NO_3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m^3/s	g/m^{3}N	g/m^{3}N	g/m^{3}N	pH	g/m^3	°C	g/m^{3}N	g/m^{3}N	g/m^{3}P	NTU
12 Jul 2017	1345	7400	21.476	0.122	0.007	0.52	7.3	59	7.4	1.54	2.07	0.420	45
09 Aug 2017	1345	3800	74.302	0.102	0.005	0.32	7.0	72	11.1	0.96	1.28	0.326	34
13 Sep 2017	1415	210	6.532	0.068	0.008	1.09	7.6	3	11.2	0.07	1.17	0.032	1.6
11 Oct 2017	1310	2200	11.106	0.064	0.006	0.77	7.5	11	12.6	0.29	1.07	0.098	7.3
08 Nov 2017	1310	44000	8.234	0.207	0.012	0.48	7.3	22	14.2	1.20	1.69	0.202	19
13 Dec 2017	1320	120	0.669	0.016	0.031	0.95	8.2	<2	20.3	0.10	1.08	0.110	1.6
10 Jan 2018	1345	300	1.524	0.017	0.024	0.78	8.1	<2	20.5	0.04	0.84	0.095	1.4
14 Feb 2018	1315	580	3.044	0.032	0.016	0.62	8.0	<2	19.5	0.12	0.76	0.064	1.9
14 Mar 2018	1340	280	4.31	0.030	0.007	1.07	7.8	<2	15.7	0.08	1.16	0.033	0.9
11 Apr 2018	1405	4330	13.778	0.225	0.010	0.87	7.2	18	11.2	0.59	1.47	0.102	7.2
09 May 2018	1430	260	2.266	0.049	0.021	0.96	7.7	<2	12.7	0.06	1.04	0.052	1.6
13 Jun 2018	1425	1300	4.888	0.047	0.011	0.80	7.6	4	11.4	0.18	0.99	0.043	2.3

The statistical summary of these data is presented in Table 31.

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Table 31 Statistical summary of data from July 2017 to June 2018: Patea River at Skinner Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.015	0.089	0.032	12	0.023
A440F	Absorbance @ 440nm filtered	/cm	0.003	0.020	0.006	12	0.006
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.003	0.000	12	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	10	38	24	12	8
BDISC	Black disc transparency	m	0.13	2.39	1.51	12	0.92
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	4.0	1.0	12	1.1
CONDY	Conductivity @ 20˚C	mS/m	3.6	12.2	9.0	12	2.5
DO	Dissolved oxygen	g/m^3	9.3	11.7	10.5	12	0.7
PERSAT	Dissolved oxygen saturation %	%	100	110	102	12	3
DRP	Dissolved reactive phosphorus	g/m^3P	0.020	0.087	0.043	12	0.021
ECOL	E.coli bacteria	cfu/100 mL	120	35000	940	12	9822
ENT	Enterococci bacteria	cfu/100 mL	34	12000	385	12	1916
FC	Faecal coliforms	cfu/100 mL	120	44000	940	12	12343
FLOW	Flow	m^3/s	0.669	74.302	5.710	12	20.308
NH_4	Ammoniacal nitrogen	g/m^3N	0.016	0.225	0.056	12	0.071
NO_2	Nitrite nitrogen	g/m^3N	0.005	0.031	0.010	12	0.008
NO_3	Nitrate nitrogen	g/m^3N	0.315	1.092	0.788	12	0.243
pH	pH		7..0	8.2	7.6	12	0.4
SS	Suspended solids	g/m^3	<2	72	4	12	24
TEMP	Temperature	°C	7.4	20.5	12.6	12	4.2
TKN	Total kjeldahl nitrogen	g/m^3N	0.04	1.54	0.15	12	0.52
TN	Total nitrogen	g/m^3N	0.76	2.07	1.12	12	0.37
TP	Total phosphorus	g/m^3P	0.032	0.420	0.096	12	0.124
TURB	Turbidity	NTU	0.91	45	2.1	12	14.7

A statistical summary of the 23 years' data collected since 1 July 1995 is presented in Table 32.

Table 32 Statistical summary of data from July 1995 to June 2018: Patea River at Skinner Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.009	0.095	0.024	276	0.015
A440F	Absorbance @ 440nm filtered	/cm	0.001	0.023	0.005	276	0.004
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.004	0.000	276	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	10	57	28	276	6
BDISC	Black disc transparency	m	0.05	4.68	1.82	276	0.83
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	16	1.0	276	1.4
CONDY	Conductivity @ 20˚C	mS/m	3.6	14.3	9.9	276	1.5
DO	Dissolved oxygen	g/m^3	8.9	12.9	10.6	276	0.7
PERSAT	Dissolved oxygen saturation %	%	87	121	103	276	6
DRP	Dissolved reactive phosphorus	g/m^3P	0.010	0.160	0.038	276	0.030
ECOL	E.coli bacteria	cfu/100 mL	2	35000	210	252	3871
ENT	Enterococci bacteria	cfu/100 mL	4	19000	110	276	1804
FC	Faecal coliforms	cfu/100 mL	2	63000	230	276	5574
FLOW	Flow	m^3/s	0.650	77.53	3.048	276	8.378
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.329	0.052	276	0.051
NO_2	Nitrite nitrogen	g/m^3N	<0.001	0.051	0.016	276	0.008
NO_3	Nitrate nitrogen	g/m^3N	0.21	1.54	0.91	276	0.22
pH	pH		6.9	8.8	7.8	276	0.4
SS	Suspended solids	g/m^3	<2	360	<2	276	27
TEMP	Temperature	°C	5.3	22.3	12.9	276	3.4
TKN	Total kjeldahl nitrogen	g/m^3N	0.01	4.07	0.23	276	0.36
TN	Total nitrogen	g/m^3N	0.41	4.50	1.22	276	0.34
TP	Total phosphorus	g/m^3P	0.022	1.390	0.066	276	0.108
TURB	Turbidity (Hach 2100A)	NTU	0.2	80	1.5	245	6.9
TURBY	Turbidity (Cyberscan WTW)	NTU	0.9	45	1.7	157	5.2

These are provided for reference and comparative purposes and are discussed in Section 4.2 in association with appropriate graphical ('box and whisker' plots) presented in Appendix I.

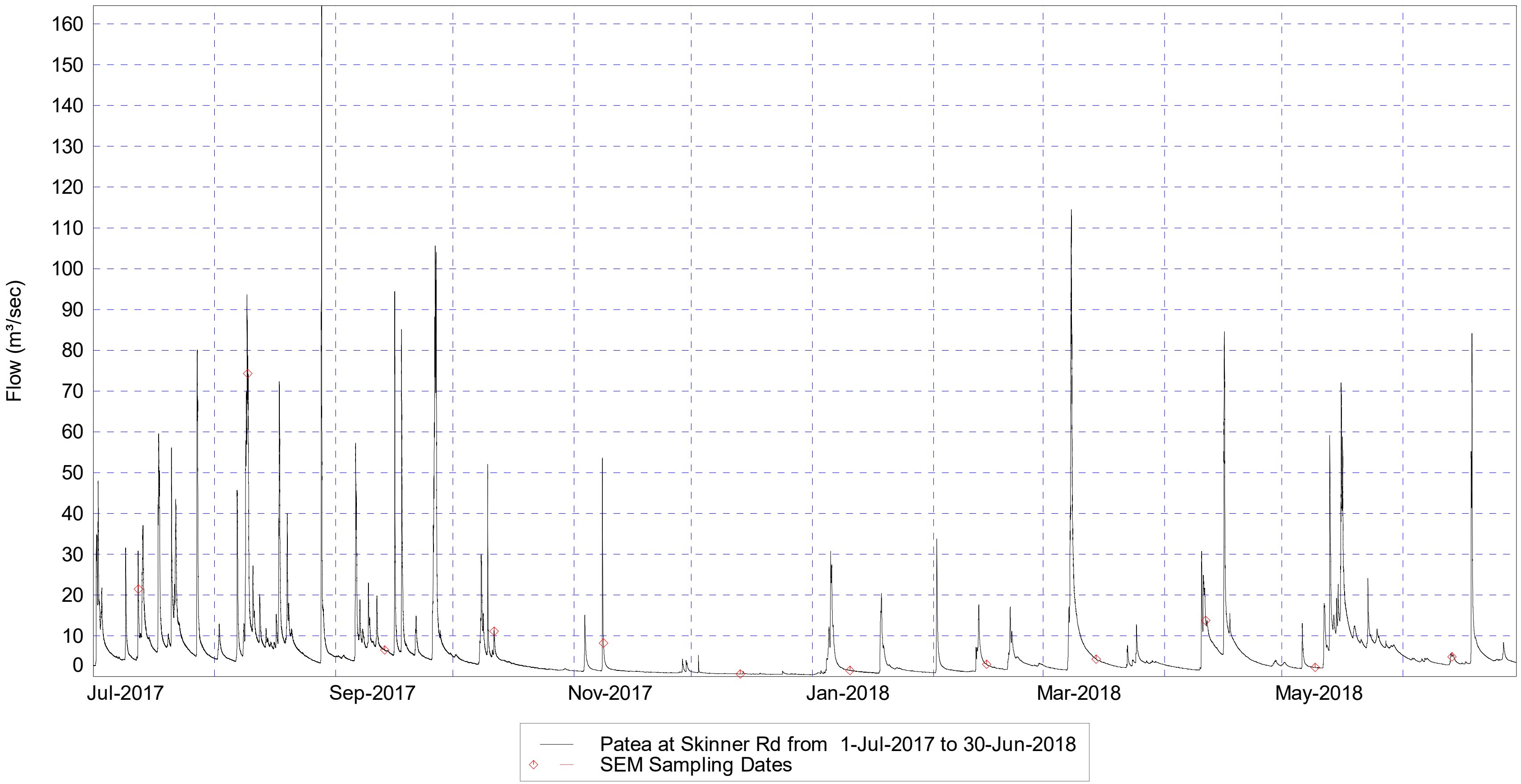


Figure 6 Flow record for the Patea River at Skinner Road

Discussion

2017-2018 period

Moderate median black disc clarity (1.51 m) was slightly lower and median turbidity (2.1 NTU) was slightly higher than typical of the mid reaches of a ring plain river draining a developed catchment and receiving various point source discharges. Overall, this clarity and a low median suspended solids concentration (3.5 g/m^3), were indicative of moderate aesthetic water quality at this site. Minimum clarity (black disc of 0.13 m and turbidity of 45 NTU) and an increase in suspended solids concentrations (59 g/m^3) were recorded shortly after the peak of a large fresh sampled in July 2017 (Figure 6). Deterioration in water quality during this event was also illustrated by high bacterial numbers and elevated BOD_5 and total phosphorus concentration. Similar flow events occurred in August and November 2017 and April 2018.

Early afternoon pH levels reached a maximum of 8.2 units in early summer, coincident with dissolved oxygen saturation peaking at 110%. Dissolved oxygen levels were consistently high (100% or higher saturation) with supersaturation recorded particularly during summer low flow conditions coincident with more extensive algal cover and elevated pH levels (≥ 8.0 units). BOD_5 concentrations under normal to low recession flow conditions were generally indicative of moderately low organic contamination (i.e. up to 1.2 g/m^3), with higher oxygen demand during freshes (i.e. up to 4.0 g/m^3).

The poor median bacteriological numbers (940 faecal coliforms and 385 enterococci cfu/100 mL) may be attributed to the high proportion of developed catchment, urban runoff, proximity of the municipal oxidation ponds system discharge to this site, dairy farm waste disposal in the upper catchment, and particularly the high proportion of freshes sampled in the 2017-2018 period. The moderate range of faecal coliform numbers recorded under lower river flow conditions probably reflected some seasonal variability in the municipal oxidation pond performance due to the relative proximity of this discharge, together with other point source and non-point source discharges.

Water temperatures varied over a moderately wide range of 13.1°C with a maximum (early afternoon) summer temperature of 20.5˚C recorded in January 2018 (coincident with a pH of 8.1 and 109% dissolved oxygen saturation).

Brief comparison of upper and mid Patea River catchment sites during the 2017-2018 period

Some deterioration from the high upstream water quality conditions measured at the Barclay Road site was apparent at the Skinner Road site nearly 19 km (river distance) below the National Park boundary. This was emphasised particularly by elevated median bacterial species' numbers (18-fold increases) and increases in median nutrient species concentrations (2.5 to 44-fold) compared with historical (22-year) downstream increase in median bacterial numbers (10 to 14-fold) and nutrient species concentrations (2 to 47 fold). The pH range increased by 0.1 unit at the Skinner Road site with a maximum pH 0.4 unit higher than at the upstream site. A moderate increase in median turbidity levels (1.5 NTU) was measured in mid catchment, almost identical to the historical median increase. Median BOD_5 increased by about >0.9 g/m^3 although maximum BOD_5 was 1.6 g/m^3 higher downstream. A deterioration in black disc clarity (median clarity decreased significantly by 1.43 m and maximum clarity to a larger degree by 4.61 m) was recorded, as a result of increased turbidity from run-off and point source discharges within the developed catchment of the river between the two sites. This may be compared with a 22-year median black disc deterioration of 2.52 m and maximum clarity deterioration of 5.46 m.

Water temperature range increased (by 4.0˚C) at the Skinner Road site, where median water temperature was higher (by 2.2˚C) and maximum water temperature was higher (by 5.8˚C) than at the Barclay Road site. In comparison, the historical 22-year median and maximum water temperatures have shown downstream increases of 3.8˚C and 7.4˚C respectively.

Brief comparison with the previous 1995-2017 period

The median of sampled flows in the recent twelve-month period was 2,770 L/s, or 94%, higher than the median of flows sampled over the 1995-2017 period, due largely to more, mostly large freshes sampled in the 2017-2018 year. Aesthetic water quality was lower than historical conditions, with median black disc clarity lower by 0.32 m, and increase in the median suspended solids concentrations (by 2 g/m^3) and turbidities (0.4 NTU) between periods.

There was a narrower pH range (by 0.7 pH unit) and lower maximum pH (by 0.6 unit) during the 2017-2018 period. Median dissolved oxygen percentage saturation was the same (at 103%) for the two periods.

Bacterial water quality deteriorated significantly for both faecal coliform and enterococci bacteria during the more recent sampling period, with the median numbers increasing by 720 and 265 cfu/100 mL, respectively. Variability in municipal oxidation ponds' system performance and dairy shed wastes disposal would have been expected to have contributed to any differences in bacterial quality between periods, together with more sampling during or after freshes, when contamination from pasture run-off may occur, in the recent period.

Water temperature range was narrower (by 3.9˚C) during the more recent sampling period although the median water temperature was 1.3˚C higher than the longer term median. The maximum water temperature was 1.8°C lower than previously recorded and the minimum water temperature was higher (by 2.1˚C) in the latest twelve-month period.

Median BOD_5 was higher during the more recent period (by 0.5 g/m^3), with median nitrogen nutrient species concentrations being similar (range of-8 to +14%). There was a decrease in median dissolved reactive and total phosphorus species during the more recent twelve-month period (by 16 and 46%).

Mangaehu River at Raupuha Road (site: MGH000950)

Analytical data are presented in Table 33 from the monthly sampling programme. The flow record for the period is illustrated in Figure 8.

Table 33 Analytical results from monthly samples: Mangaehu River at Raupuha Road

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20°C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^3P	cfu/100mL	cfu/100mL
12 Jul 2017	1415	0.049	0.010	0.000	36	0.14	3.9	9.5	11.4	100	0.013	330	340
09 Aug 2017	1420	0.085	0.023	0.005	20	0.09	1.2	5.6	10.4	97	0.006	2200	3900
13 Sep 2017	1450	0.034	0.007	0.000	27	0.51	<0.5	7.4	11.0	100	0.007	130	26
11 Oct 2017	1340	0.053	0.013	0.003	38	0.34	0.5	9.7	10.0	101	0.006	1000	340
08 Nov 2017	1345	0.060	0.012	0000	43	0.37	0.8	10.8	9.8	102	0.009	2600	400
13 Dec 2017	1355	0.054	0.011	0.000	58	1.57	0.6	13.2	9.2	109	<0.003	240	185
10 Jan 2018	1405	0.063	0.012	0.000	26	1.40	0.5	9.4	8.8	101	0.011	470	160
14 Feb 2018	1345	0.089	0.021	0.002	38	1.04	0.8	10.4	8.9	104	0.008	540	440
14 Mar 2018	1415	0.047	0.010	0.000	37	0.77	<0.5	10.1	9.5	99	0.005	300	80
11 Apr 2018	1450	0.085	0.017	0.001	15	0.07	1.2	7.2	9.7	93	0.008	10300	5330
09 May 2018	1500	0.064	0.013	0.001	35	0.85	0.6	10.0	10.7	101	0.005	500	63
13 Jun 2018	1500	0.039	0.007	0.000	40	1.24	<0.5	10.7	10.8	100	0.008	180	33

Date	Time NZST	FC	Flow	NH_4	NO_2	NO_3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m^3/s	g/m^3N	g/m^3N	g/m^3N	pH	g/m^3	°C	g/m^3N	g/m^3N	g/m^3P	NTU
12 Jul 2017	1415	340	12.747	0.021	0.002	0.18	7.6	42	8.8	0.24	0.42	0.092	23
09 Aug 2017	1420	2400	100.423	0.023	0.004	0.16	7.2	740	11.1	1.1	1.26	0.642	260
13 Sep 2017	1450	150	16.552	0.015	0.001	0.26	7.5	19	10.4	0.10	0.36	0.033	13
11 Oct 2017	1340	1100	9.857	0.012	<0.001	0.12	7.7	24	15.0	0.11	0.23	0.059	22
08 Nov 2017	1345	2800	12.578	0.008	0.002	0.06	7.9	16	16.5	0.19	0.25	0.031	21
13 Dec 2017	1355	300	2.681	<0.003	0.004	0.02	8.2	3	22.8	0.06	0.08	0.015	3.4
10 Jan 2018	1405	500	3.459	0.012	0.003	0.07	7.6	<2	22.0	0.13	0.20	0.019	3.3
14 Feb 2018	1345	570	3.801	0.025	0.002	0.05	7.9	5	22.1	0.06	0.11	0.020	6.4
14 Mar 2018	1415	300	7.317	0.027	0.002	0.20	7.7	9	17.2	0.12	0.32	0.020	6.3
11 Apr 2018	1450	10700	86.715	0.025	0.004	0.21	7.1	320	12.5	0.94	1.15	0.323	230
09 May 2018	1500	510	6.124	0.019	0.002	0.14	7.6	9	12.6	0.15	0.29	0.032	11
13 Jun 2018	1500	180	11.068	0.025	0.003	0.18	7.7	6	10.8	0.15	0.33	0.018	4.1

The statistical summary of these data is presented in Table 34.

Table 34 Statistical summary of data from July 2017 to June 2018: Mangaehu River at Raupuha Rd

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.034	0.089	0.057	12	0.018
A440F	Absorbance @ 440nm filtered	/cm	0.007	0.023	0.012	12	0.005
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.005	0.000	12	0.002
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	15	58	36	12	11
BDISC	Black disc transparency	m	0.07	1.57	0.64	12	0.53
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	3.9	0.6	12	1.0
CONDY	Conductivity @ 20°C	mS/m	5.6	13.2	9.8	12	2.0
DO	Dissolved oxygen	g/m^3	8.8	11.4	9.9	12	0.8
PERSAT	Dissolved oxygen saturation %	%	93	109	100	12	3.8
DRP	Dissolved reactive phosphorus	g/m^3P	<0.003	0.013	0.008	12	0.003
ECOL	E.coli bacteria	cfu/100 mL	130	10300	485	12	2866
ENT	Enterococci bacteria	cfu/100 mL	26	5330	260	12	1749
FC	Faecal coliforms	cfu/100 mL	150	10700	5055	12	2979
FLOW	Flow	m^3/s	2.681	100.423	10.462	12	33.463
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.027	0.020	12	0.008
NO_2	Nitrite nitrogen	g/m^3N	0.001	0.004	0.002	12	0.001
NO_3	Nitrate nitrogen	g/m^3N	0.02	0.26	0.15	12	0.074
pH	pH		7.1	8.2	7.6	12	0.3
SS	Suspended solids	g/m^3	<2	740	12	12	220
TEMP	Temperature	°C	8.8	22.8	13.8	12	5.0
TKN	Total kjeldahl nitrogen	g/m^3N	0.06	1.10	0.14	12	0.35
TN	Total nitrogen	g/m^3N	0.08	1.26	0.30	12	0.38
TP	Total phosphorus	g/m^3P	0.015	0.642	0.032	12	0.189
TURBY	Turbidity	NTU	3.3	260	12	12	92

A statistical summary of the 23 years' data collected since 1 July 1995 is presented in Table 35.

Table 35 Statistical summary of data from July 1995 to June 2018: Mangaehu River at Raupuha Road

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.027	0.181	0.054	276	0.018
A440F	Absorbance @ 440nm filtered	/cm	0.001	0.056	0.011	276	0.006
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.025	0.000	276	0.002
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	9	79	38	276	13
BDISC	Black disc transparency	m	<0.01	4.04	0.84	276	0.732
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	5.6	0.6	276	0.6
CONDY	Conductivity @ 20°C	mS/m	4.3	16.1	9.9	276	2.3
DO	Dissolved oxygen	g/m^3	7.7	12.9	10.0	276	0.9
PERSAT	Dissolved oxygen saturation %	%	83	118	100	276	5.4
DRP	Dissolved reactive phosphorus	g/m^3P	<0.003	0.026	0.006	276	0.003
ECOL	E.coli bacteria	cfu/100 mL	6	16000	230	252	1896
ENT	Enterococci bacteria	cfu/100 mL	1	7200	72	276	896
FC	Faecal coliforms	cfu/100 mL	6	16000	245	276	2012
FLOW	Flow	m^3/s	1.658	111.870	7.141	276	16.607
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.081	0.012	276	0.011
NO_2	Nitrite nitrogen	g/m^3N	<0.001	0.016	0.002	276	0.001
NO_3	Nitrate nitrogen	g/m^3N	<0.01	0.43	0.10	276	0.09
pH	pH		6.8	8.4	7.7	276	0.3
SS	Suspended solids	g/m^3	<2	1300	4	276	123
TEMP	Temperature	°C	4.3	24.9	13.9	276	4.4
TKN	Total kjeldahl nitrogen	g/m^3N	0.02	2.47	0.16	276	0.29
TN	Total nitrogen	g/m^3N	<0.05	2.72	0.295	276	0.32
TP	Total phosphorus	g/m^3P	<0.003	0.786	0.020	276	0.106
TURB	Turbidity (Hach 2100A)	NTU	1.4	850	3.5	245	63
TURBY	Turbidity (Cyberscan WTW)	NTU	0.8	390	4.4	157	51

These are provided for reference and comparative purposes and are discussed in Section 4.2 in association with appropriate graphical ('box and whisker' plots) presented in Appendix I.

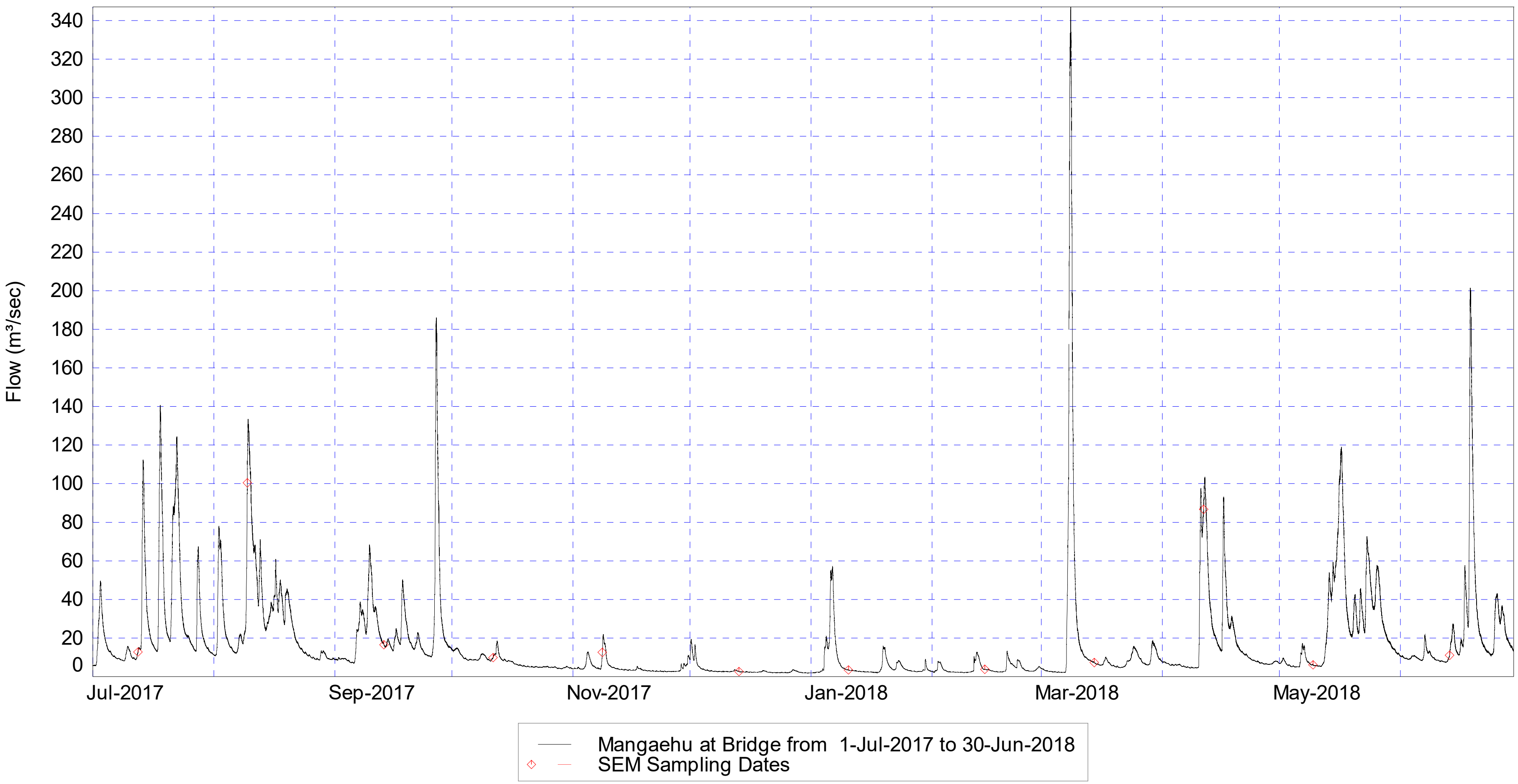


Figure 7 Flow record for the Mangaehu River at Raupuha Road

Discussion

2017-2018 period

The relatively poor visual appearance which characterises the mid and lower reaches of this eastern hill-country catchment river was emphasised by a low median black disc clarity of 0.64 metres with a maximum of 1.57 metres measured during a 11-day receding flow period in December 2017. Clarity was infrequently more than 1.5 metres (on one occasion) due to the presence of very fine, colloidal, suspended particles. The median suspended solids concentration was 12 g/m^3 which was higher than previously measured for this river. Absorbances (at 340 and 440 nm) were also relatively high (in excess of 0.033/cm and 0.006/cm respectively) at all times, indicative of slight dissolved colour in the river water (e.g. yellow-brown appearance) at this site in the lower reaches of the river. Minimum clarities (0.09 and 0.07 m black disc values) were coincident with turbidity levels of 260 and 230 NTU and suspended solids concentrations of 740 and 320 g/m^3, during flood flows of 100 and 87 m^3/s recorded in August 2017 and April 2018, respectively. Fresh flows (in excess of 10 m^3/s) were usually coincident with a general deterioration in water quality as emphasised by elevated turbidity, suspended solids, some nutrient species' (particularly total phosphorus) levels and bacterial counts (e.g. in July, August, September, October and November 2017 and April and June 2018, Figure 7).

Maximum mid-afternoon pH values in the summer period (7.6 to 8.2 units) were moderate for the lower reaches of a Taranaki river in early afternoon, an indication of the limited influence of algal photosynthetic activity on water quality (despite significant algal substrate cover) in this reach of the river system where more turbid conditions and silt deposition on the substrate have been typical of the site. A minimum pH (7.1 units) was found under flood conditions in April 2018.

Dissolved oxygen concentrations were consistently high (median of 9.9 g/m^3) with a median saturation level of 101%. On the majority of occasions BOD_5 concentrations were indicative of relatively low organic content (i.e. less than 1.0 g/m^3). The median bacteriological numbers (262 enterococci and 505 faecal coliforms cfu/100 mL) were more reflective of the impacts of developed farmland run-off and possibly stock access to the lower reaches of this eastern hill country river.

Water temperatures varied over a wide range of 14.0˚C with a maximum (early afternoon) summer temperature of 22.8˚C recorded in December 2017 under low flow conditions, at which time dissolved oxygen saturation was 109% and pH was 8.2 units.

Brief comparison with the previous 1995-2017 period

The range of flows sampled during the 2017-2018 period was relatively wide but narrower than the range sampled over the previous 22-year period. The median sampled flow in the 2017-2018 period was significantly higher (by 3,400 L/s, or 48%) than that sampled over the longer term. Median black disc clarity was lower (by 0.21 m) and median turbidity was higher (by 7.5 NTU) in the most recent period, while the median suspended solids concentrations was higher by 8 g/m^3.

For nitrogen nutrient species, median concentrations of nitrate and ammoniacal nitrogen were higher (by 53 and 67%, respectively), while total nitrogen was similar in the latest period, Dissolved reactive and total phosphorus were significantly higher (by 33 and 60%, respectively) compared to the medians for the previous 22-year period. Median bacterial numbers increased markedly for enterococci (by 193 cfu/100 mL) and faecal coliforms (by 275 cfu/100 mL) in the 2017-2018 period.

Median dissolved oxygen saturation level was identical in the 2017-2018 period while median pH level was 0.1 unit lower in the recent period. Maximum pH was 0.2 unit lower than the maximum previously recorded while minimum pH was 0.3 unit higher than the minimum recorded.

The range of water temperatures was narrower (by 6.6°C) in the latest twelve-month period than over the previous 22-year period due to a lower maximum temperature (by 2.1˚C) and higher minimum temperature (by 4.5˚C) in the 2017-2018 sampling year, while median water temperature was 0.1˚C lower during 2017-2018.

Whenuakura River at Nicholson Road (site: WNR000450)

Analytical data are presented in Table 36 from the monthly sampling programme. The flow record for the period is illustrated in Figure 8.

Table 36 Analytical results from monthly samples: Whenuakura River at Nicholson Road

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20°C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^3P	cfu/100mL	cfu/100mL
13 Jul 2017	0930	0.129	0.027	0.001	38	0.09	1.2	14.1	11.5	97	0.016	870	300
10 Aug 2017	1100	0.104	0.023	0.002	29	0.07	0.8	9.5	10.5	96	0.012	430	230
14 Sep 2017	1000	0.061	0.014	0.001	40	0.12	0.6	14.7	10.7	98	0.020	340	77
12 Oct 2017	0855	0.151	0.036	0.004	36	0.04	2.0	12.5	9.4	89	0.022	3700	730
09 Nov 2017	0900	0.057	0.011	0.001	58	0.08	1.6	17.1	9.6	95	0.010	2500	530
14 Dec 2017	0900	0.051	0.010	0.000	84	0.60	1.0	23.8	9.0	100	0.012	200	84
11 Jan 2018	0915	0.087	0.017	0.001	54	0.42	0.8	18.1	8.1	92	0.022	450	220
15 Feb 2018	0915	0.092	0.020	0.001	70	0.32	1.1	21.8	8.3	92	0.026	560	930
15 Mar 2018	0945	0.063	0.013	0.001	57	0.26	0.6	19.2	8.8	92	0.019	200	280
12 Apr 2018	1000	0.122	0.025	0.002	17	0.07	1.2	10.6	10.1	92	0.017	4200	767
10 May 2018	1025	0.077	0.016	0.001	60	0.22	0.7	19.1	10.2	95	0.022	630	92
14 Jun 2018	1030	0.079	0.017	0.001	47	0.14	0.8	17.3	10.7	97	0.022	600	63

Date	Time NZST	FC	Flow	NH_4	NO_2	NO_3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m^3/s	g/m^3N	g/m^3N	g/m^3N	pH	g/m^3	°C	g/m^3N	g/m^3N	g/m^3P	NTU
13 Jul 2017	0930	900	23.226	0.030	0.003	0.21	7.6	500	7.5	0.99	1.20	1.080	270.0
10 Aug 2017	1100	430	35.186	0.013	0.002	0.12	7.6	500	10.6	0.62	0.74	0.596	260.0
14 Sep 2017	1000	340	13.493	0.030	0.006	0.40	7.4	88	11.2	0.33	0.74	0.298	64.0
12 Oct 2017	0855	3700	29.332	0.037	0.008	0.21	7.3	1100	12.9	0.92	1.14	0.850	110.0
09 Nov 2017	0900	2600	10.292	0.013	0.002	0.30	7.7	300	15.3	0.30	0.60	0.149	140.0
14 Dec 2017	0900	200	2.854	<0.003	0.003	0.57	7.9	17	20.4	0.1	0.67	0.052	12.0
11 Jan 2018	0915	450	3.267	0.017	0.004	0.52	7.4	32	21.2	0.19	0.71	0.056	35.0
15 Feb 2018	0915	620	2.993	0.042	0.008	0.67	7.6	31	21.0	<0.09	0.77	0.090	29.0
15 Mar 2018	0945	200	4.248	0.027	0.004	0.44	7.5	73	17.6	18.96	19.4	0.105	34.0
12 Apr 2018	1000	4200	63.169	0.051	0.004	0.13	7.1	930	10.9	0.93	1.06	0.524	430.0
10 May 2018	1025	670	3.833	0.024	0.004	0.52	7.8	34	12.9	0.16	0.68	0.088	35.0
14 Jun 2018	1030	610	15.936	0.021	0.005	0.23	7.8	190	10.9	0.35	0.58	0.143	110.0

The statistical summary of these data is presented in Table 37.

Table 37 Statistical summary of data from July 2017 to June 2018: Whenuakura River at Nicholson Rd

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.051	0.151	0.089	12	0.032
A440F	Absorbance @ 440nm filtered	/cm	0.010	0.036	0.017	12	0.008
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.004	0.001	12	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	17	84	50	12	18
BDISC	Black disc transparency	m	0.04	0.60	0.13	12	0.17
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	2.0	0.9	12	0.4
CONDY	Conductivity @ 20˚C	mS/m	9.5	23.8	17.2	12	4.3
DO	Dissolved oxygen	g/m^3	8.1	11.5	9.8	12	1.1
PERSAT	Dissolved oxygen saturation %	%	89	100	95	12	3
DRP	Dissolved reactive phosphorus	g/m^3P	0.010	0.026	0.018	12	0.005
ECOL	E.coli bacteria	nos/100 mL	200	4200	580	12	1415
ENT	Enterococci bacteria	nos/100 mL	63	930	255	12	304
FC	Faecal coliforms	nos/100 mL	200	4200	615	12	1419
FLOW	Flow	m^3/s	2.854	63.169	11.892	12	18.169
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.051	0.026	12	0.014
NO_2	Nitrite nitrogen	g/m^3N	0.002	0.008	0.004	12	0.002
NO_3	Nitrate nitrogen	g/m^3N	0.118	0.672	0.351	12	0.185
pH	pH	pH	7.1	7.9	7.6	12	0.2
SS	Suspended solids	g/m^3	17	1100	139	12	371
TEMP	Temperature	°C	7.5	21.2	12.9	12	4.7
TKN	Total kjeldahl nitrogen	g/m^3N	<0.09	18.96	0.34	12	5.35
TN	Total nitrogen	g/m^3N	0.58	19.40	0.74	12	5.37
TP	Total phosphorus	g/m^3P	0.052	1.08	0.146	12	0.348
TURBY	Turbidity	NTU	12	430	87	12	129

A statistical summary of the three years' data collected since 1 July 2015 is presented in Table 38.

Table 38 Statistical summary of data from July 2015 to June 2018: Whenuakura River at Nicholson Rd

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.048	0.151	0.062	36	0.027
A440F	Absorbance @ 440nm filtered	/cm	0.009	0.036	0.013	36	0.007
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.006	0.001	36	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	17	94	58	36	18
BDISC	Black disc transparency	m	0.04	0.96	0.26	28	0.20
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	2.0	0.8	36	0.4
CONDY	Conductivity @ 20˚C	mS/m	9.5	24.6	18.4	36	3.8
DO	Dissolved oxygen	g/m^3	7.8	12.1	9.5	36	1.1
PERSAT	Dissolved oxygen saturation %	%	88	100	95	36	3
DRP	Dissolved reactive phosphorus	g/m^3P	0.009	0.039	0.017	36	0.006
ECOL	E.coli bacteria	nos/100 mL	23	4200	490	36	935
ENT	Enterococci bacteria	nos/100 mL	17	1400	210	36	352
FC	Faecal coliforms	nos/100 mL	23	4200	520	36	944
FLOW	Flow	m^3/s	1.929	63.169	6.204	36	12.136
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.055	0.025	36	0.012
NO_2	Nitrite nitrogen	g/m^3N	0.001	0.008	0.004	36	0.002
NO_3	Nitrate nitrogen	g/m^3N	0.087	0.672	0.364	36	0.151
pH	pH	pH	7.1	7.9	7.6	36	0.2
SS	Suspended solids	g/m^3	4	1100	46	36	286
TEMP	Temperature	°C	6.1	21.9	13.6	36	4.5
TKN	Total kjeldahl nitrogen	g/m^3N	0.01	18.96	0.25	36	3.12
TN	Total nitrogen	g/m^3N	0.32	19.40	0.68	36	3.13
TP	Total phosphorus	g/m^3P	0.022	1.08	0.089	36	0.249
TURBY	Turbidity	NTU	4.9	760	36	36	151

Discussion

2017-2018 period

The relatively poor visual appearance which characterises the mid and lower reaches of this eastern hill-country catchment river was indicated in the low black disc clarity with a range of 0.04 to 0.60 metres, due to the presence of very fine, colloidal, suspended particles. The median suspended solids concentration over this third year of monitoring was high, at 139 g/m^3, with a maximum recorded value of 1100 g/m^3 in April 2018, four values ≥500 g/m^3, and a minimum value of 17 g/m^3. Median turbidity level was correspondingly high, at 87 NTU with a range from 12 to 430 NTU. Absorbances (at 340 and 440 nm) were also relatively high (medians of 0.083/cm and 0.017/cm respectively), indicative of slight dissolved colour in the river water (e.g. brown appearance) at this site in the lower reaches of the river. Fresh flows (in excess of 4 m^3/s) were usually coincident with a general deterioration in water quality as emphasised by elevated turbidity, suspended solids, some nutrient species' (particularly total phosphorus) levels and bacterial counts.

Maximum early/mid-morning pH value, in the early summer (7.9 units), was moderate for the lower reaches of a Taranaki river, an indication of the limited influence of algal photosynthetic activity on water quality in this reach of the river system where more turbid conditions and silt deposition on the substrate have been typical of the site. A minimum pH (7.1 units) was found under flood conditions in April 2018.

Dissolved oxygen concentrations (median 9.8 g/m^3) were consistently slightly below saturation level (range 89 to 95%). On the majority of occasions BOD_5 concentrations were indicative of relatively low organic content (i.e. less than 1.0 g/m^3), with values of up to 2.0 g/m^3 recorded. The median bacteriological numbers (615 faecal coliforms and 255 enterococci cfu/100 mL) were more reflective of the impacts of developed farmland run-off and possibly stock access to the lower reaches of this eastern hill country river. The frequent high faecal coliform number indicated a continuous or continual source upstream.

Water temperatures varied over a wide range of 14.7˚C with a maximum (early/mid- morning) summer temperature of 21.2˚C recorded in January 2018 under low flow conditions.

Brief comparison with the previous 2015-2017 period

The median of sampled flows in the recent twelve-month period was significantly higher (by 6,011 L/s, or 102%) than flows sampled over the previous two years, due to a large number of freshes being sampled in the 2017-2018 year. The range of river flows sampled was wider, due to a high maximum flow (of 63.2 m^3/s), though the minimum flow sampled (at 2,854 L/s) was higher.

Median black disc clarity was significantly lower (by 0.17 m, or 57%) and median turbidity was higher (by 56 NTU, or 181%) in the more recent period, while the median suspended solids concentrations was higher by 100 g/m^3, or 256%.

For nitrogen nutrient species, median concentrations of nitrate was slightly lower (by 3%), while ammoniacal and total nitrogen were slightly higher (by 8%) in the later period, Dissolved reactive phosphorus was identical, while total phosphorus was significantly higher (by 4 and 23%) compared to the medians for the previous two-year period. Median bacterial numbers increased markedly for enterococci (by 105 cfu/100 mL) and faecal colif6orms (by 130 cfu/100 mL) in the 2017-2018 period.

Median dissolved oxygen saturation level was relatively similar (1% higher) in the 2017-2018 period while median pH level was the same during the two periods. Maximum pH and minimum pH were both identical with the respective previously recorded values.

The range of water temperatures was narrower (by 2.1°C) in the later twelve-month period than over the previous two-year period due to a lower maximum temperature (by 0.7˚C) and lower minimum temperature (by 1.4˚C) in the 2017-2018 sampling year, while median water temperature was 1.6˚C lower during 2017-2018.

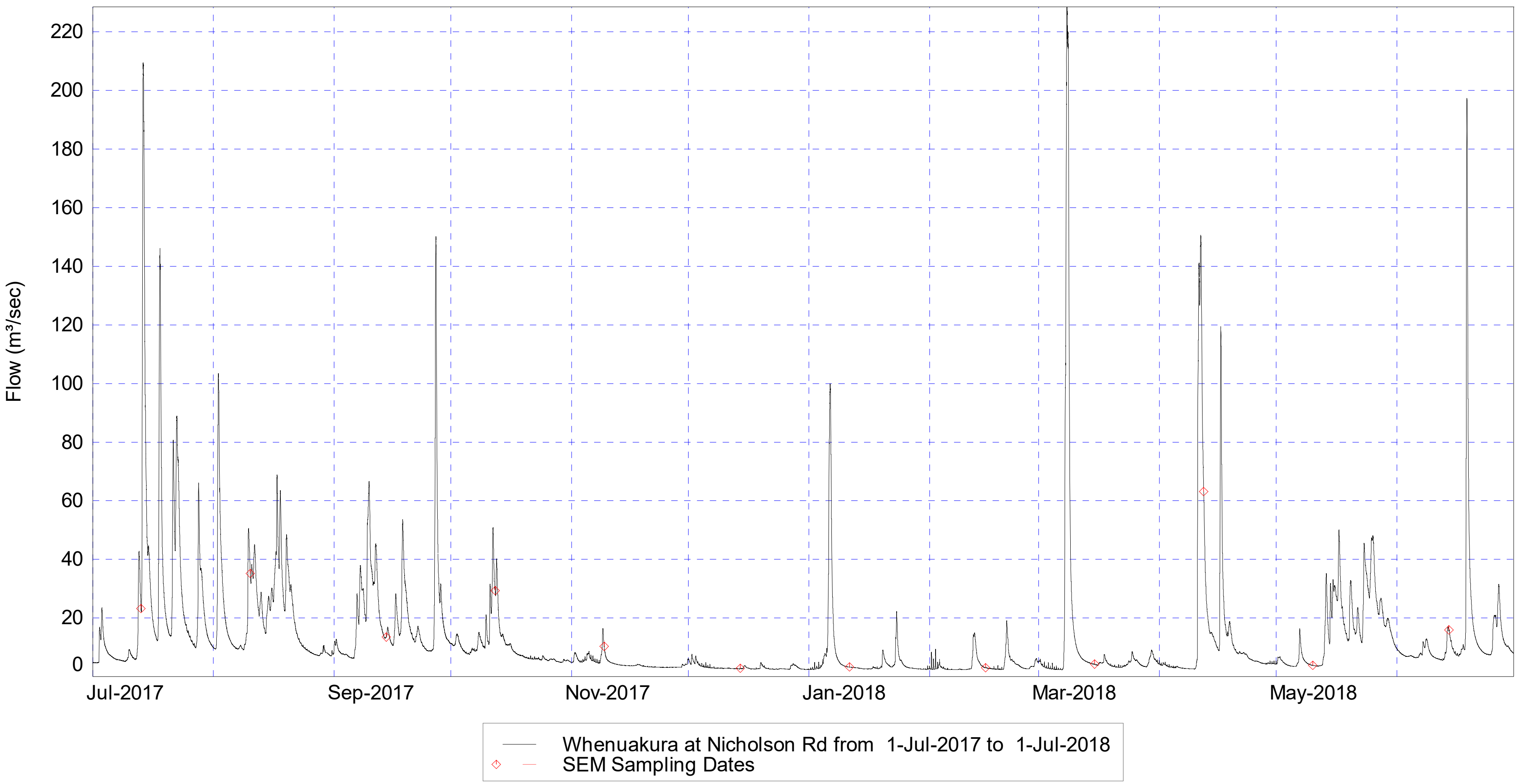


Figure 8 Flow record for the Whenuakura River at Nicholson Road

Waitara River at Tarata

Analytical data are presented in Table 39 from the monthly sampling programme. The flow record for the period is illustrated in Figure 9.

Table 39 Analytical results from monthly samples: Waitara River at Tarata

Date	Time	A340F	A440F	A770F	ALKT	Black disc	BOD_5	Cond @ 20°C	DO	DO Sat	DRP	E.coli	ENT
	NZST	/cm	/cm	/cm	g/m^3 $CaCO_3$	m	g/m^3	mS/m	g/m^3	%	g/m^3P	cfu/100mL	cfu/100mL
13 Jul 2017	1325	0.049	0.010	0.000	22	0.18	0.8	7.3	11.6	99	0.009	2100	450
10 Aug 2017	1345	0.066	0.015	0.001	11	0.03	0.8	4.3	10.1	96	0.009	500	400
14 Sep 2017	1340	0.028	0.006	0.000	22	0.16	0.6	6.8	10.7	98	0.011	730	69
12 Oct 2017	1210	0.059	0.013	0.001	27	0.12	0.6	7.6	9.8	97	0.010	330	100
09 Nov 2017	1245	0.122	0.032	0.004	20	0.04	2.2	5.9	9.3	93	0.115	13000	2300
14 Dec 2017	1215	0.038	0.007	0.000	35	0.94	1.2	12.2	8.4	98	<0.003	115	88
11 Jan 2018	1230	0.073	0.016	0.001	29	0.28	0.6	9.8	7.9	91	0.008	230	170
15 Feb 2018	1225	0.108	0.023	0.001	25	0.12	1.0	10.0	8.1	92	0.004	280	78
15 Mar 2018	1215	0.038	0.008	0.000	29	0.75	<0.5	9.4	9.2	96	0.008	120	60
12 Apr 2018	1315	0.062	0.013	0.001	14	0.14	0.7	8.6	10.0	94	0.010	2970	1330
10 May 2018	1315	0.070	0.015	0.001	33	0.22	0.6	10.8	10.2	97	0.011	310	23
14 Jun 2018	1330	0.061	0.014	0.001	31	0.22	0.5	9.3	10.8	97	0.013	610	47

Date	Time NZST	FC	Flow	NH_4	NO_2	NO_3	pH	SS	Temp	TKN	TN	TP	Turb
		cfu/ 100mL	m^3/s	g/m^3N	g/m^3N	g/m^3N	pH	g/m^3	°C	g/m^3N	g/m^3N	g/m^3P	NTU
13 Jul 2017	1325	2200	48.102	0.026	0.003	0.24	7.4	93	7.7	0.47	0.71	0.180	61
10 Aug 2017	1345	500	271.437	0.031	0.002	0.26	7.1	1100	11.7	0.82	1.08	1.520	580
14 Sep 2017	1340	730	42.695	0.017	0.002	0.37	7.3	53	11.3	0.19	0.56	0.143	46
12 Oct 2017	1210	330	40.603	0.017	0.003	0.17	7.4	94	14.7	0.21	0.38	0.169	89
09 Nov 2017	1245	14000	57.032	0.073	0.004	0.15	7.2	1200	15.0	0.48	0.63	0.794	900
14 Dec 2017	1215	115	4.608	<0.003	<0.001	0.04	7.8	10	23.1	0.15	0.19	0.021	7.3
11 Jan 2018	1230	230	7.965	0.031	0.003	0.22	7.4	17	22.1	0.23	0.45	0.056	25
15 Feb 2018	1225	300	27.228	0.028	0.003	0.14	7.3	5	21.4	0.15	0.29	0.127	59
15 Mar 2018	1215	120	12.268	0.021	0.003	0.39	7.4	8	17.6	9.81	10.20	0.029	6.9
12 Apr 2018	1315	3000	104.491	0.032	0.003	0.24	7.0	150	12.0	0.42	0.66	0.334	230
10 May 2018	1315	310	9.400	0.025	0.003	0.24	7.5	25	17.9	0.20	0.44	0.080	35
14 Jun 2018	1330	640	16.882	0.047	0.004	0.22	7.6	110	10.3	0.23	0.45	0.097	59

A statistical summary of these data is presented in Table 40.

Table 40 Statistical summary of data from July 2017 to June 2018: Waitara River at Tarata

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.028	0.122	0.062	12	0.028
A440F	Absorbance @ 440nm filtered	/cm	0.006	0.032	0.014	12	0.007
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.004	0.001	12	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	11	35	26	12	7
BDISC	Black disc transparency	m	0.03	0.94	0.17	12	0.28
BOD_5	Biochemical oxygen demand 5day	g/m^3	0.5	2.2	0.6	12	0.5
CONDY	Conductivity @ 20˚C	mS/m	4.3	12.2	9.0	12	2.2
DO	Dissolved oxygen	g/m^3	7.9	11.6	9.9	12	1.1
PERSAT	Dissolved oxygen saturation %	%	91	99	96	12	3
DRP	Dissolved reactive phosphorus	g/m^3P	<0.003	0.115	0.010	12	0.031
ECOL	E.coli bacteria	nos/100 mL	115	13000	415	12	3923
ENT	Enterococci bacteria	nos/100 mL	23	2300	94	12	694
FC	Faecal coliforms	nos/100 mL	115	14000	415	12	3923
FLOW	Flow	m^3/s	4.608	271.437	33.916	12	74.199
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.073	0.027	12	0.017
NO_2	Nitrite nitrogen	g/m^3N	<0.001	0.004	0.003	12	0.001
NO_3	Nitrate nitrogen	g/m^3N	0.040	0.387	0.227	12	0.095
pH	pH		7.0	7.8	7.4	12	0.2
SS	Suspended solids	g/m^3	5	1200	73	12	429
TEMP	Temperature	°C	7.7	23.1	14.8	12	5.0
TKN	Total kjeldahl nitrogen	g/m^3N	0.15	9.81	0.23	12	2.75
TN	Total nitrogen	g/m^3N	0.19	10.2	0.50	12	2.80
TP	Total phosphorus	g/m^3P	0.021	1.52	0.135	12	0.439
TURBY	Turbidity	NTU	6.9	900	59	12	278

A statistical summary of the three years' data collected since 1 July 2015 is presented in Table 41.

Table 41 Statistical summary of data from July 2015 to June 2018: Waitara River at Tarata

Parameter		Unit	Min	Max	Median	N	Std Dev
A340F	Absorbance @ 340nm filtered	/cm	0.026	0.122	0.056	36	0.022
A440F	Absorbance @ 440nm filtered	/cm	0.006	0.032	0.012	36	0.006
A770F	Absorbance @ 770nm filtered	/cm	0.000	0.004	0.001	36	0.001
ALKT	Alkalinity Total	g/m^3 $CaCO_3$	11	51	29	36	9
BDISC	Black disc transparency	m	0.03	1.28	0.32	36	0.39
BOD_5	Biochemical oxygen demand 5day	g/m^3	<0.5	2.2	0.6	36	0.4
CONDY	Conductivity @ 20˚C	mS/m	4.3	12.5	8.8	36	1.8
DO	Dissolved oxygen	g/m^3	7.9	11.8	9.6	36	1.1
PERSAT	Dissolved oxygen saturation %	%	91	103	97	36	3
DRP	Dissolved reactive phosphorus	g/m^3P	<0.003	0.115	0.008	36	0.018
ECOL	E.coli bacteria	nos/100 mL	43	13000	365	36	2313
ENT	Enterococci bacteria	nos/100 mL	6	2300	83	36	312
FC	Faecal coliforms	nos/100 mL	43	14000	370	36	2474
FLOW	Flow	m^3/s	4.608	271.437	25.587	33	48.287
NH_4	Ammoniacal nitrogen	g/m^3N	<0.003	0.073	0.018	36	0.013
NO_2	Nitrite nitrogen	g/m^3N	<0.001	0.005	0.002	36	0.001
NO_3	Nitrate nitrogen	g/m^3N	0.009	0.488	0.172	36	0.119
pH	pH		7.0	7.9	7.4	36	0.2
SS	Suspended solids	g/m^3	2	1200	20	36	314
TEMP	Temperature	°C	7.5	24.5	15.2	36	4.9
TKN	Total kjeldahl nitrogen	g/m^3N	0.04	9.81	0.21	35	1.63
TN	Total nitrogen	g/m^3N	0.09	10.2	0.44	36	1.64
TP	Total phosphorus	g/m^3P	0.019	1.52	0.051	36	0.278
TURBY	Turbidity	NTU	3.7	900	22	36	206

Discussion

2017-2018 period

The relatively poor visual appearance which characterises the mid-reaches of this eastern hill-country catchment river was emphasised by a low median black disc clarity of 0.17 metres with a maximum of 0.94 metres measured during a long low flow period in December 2017. Clarity was infrequently more than 0.3 metres (on two occasions) due to the presence of very fine, colloidal, suspended particles. The median suspended solids concentration was 73 g/m^3. Absorbances (at 340 and 440 nm) were also relatively high (medians of 0.062/cm and 0.014/cm respectively) at all times, indicative of slight dissolved colour in the river water (e.g. yellow-brown appearance) at this site in the mid reaches of the river. Minimum clarities (0.03 and 0.04m black disc value) were coincident with turbidity levels of 580 and 900 NTU and suspended solids concentration of 1100 and 1200 g/m^3, during flood flows of 127 and 57m^3/s recorded in August and November 2017, respectively. Fresh flows (in excess of 20 m^3/s) were usually coincident with a general deterioration in water quality as emphasised by elevated turbidity, suspended solids, and bacterial counts (e.g. in July, September, October and November 2016, and February and April 2018, Figure 9).

Maximum mid-afternoon pH values in early summer (7.8 units) was moderate for the mid reaches of a Taranaki river in early afternoon, an indication of the limited influence of algal photosynthetic activity on water quality. A minimum pH (7.1 units) was found under flood conditions in August 2017.

Dissolved oxygen concentrations, were consistently high (median of 7.9 g/m^3) and slightly below saturation with a median saturation level of 95%. On the majority of occasions BOD_5 concentrations were indicative of relatively low organic content (i.e. less than 1.0 g/m^3). High median bacteriological numbers (415 faecal coliforms and 94 enterococci cfu/100 mL) indicated some impacts of developed farmland run-off and possibly stock access to the lower reaches of this eastern hill country river. Nutrient species concentrations, both nitrogen and phosphorus, were relatively low, over narrow ranges.

Water temperatures varied over a wide range of 15.4˚C with a maximum (early afternoon) summer temperature of 23.1˚C recorded in December 2017 under low flow conditions, at which time dissolved oxygen saturation was 98% and pH was 7.8 units.

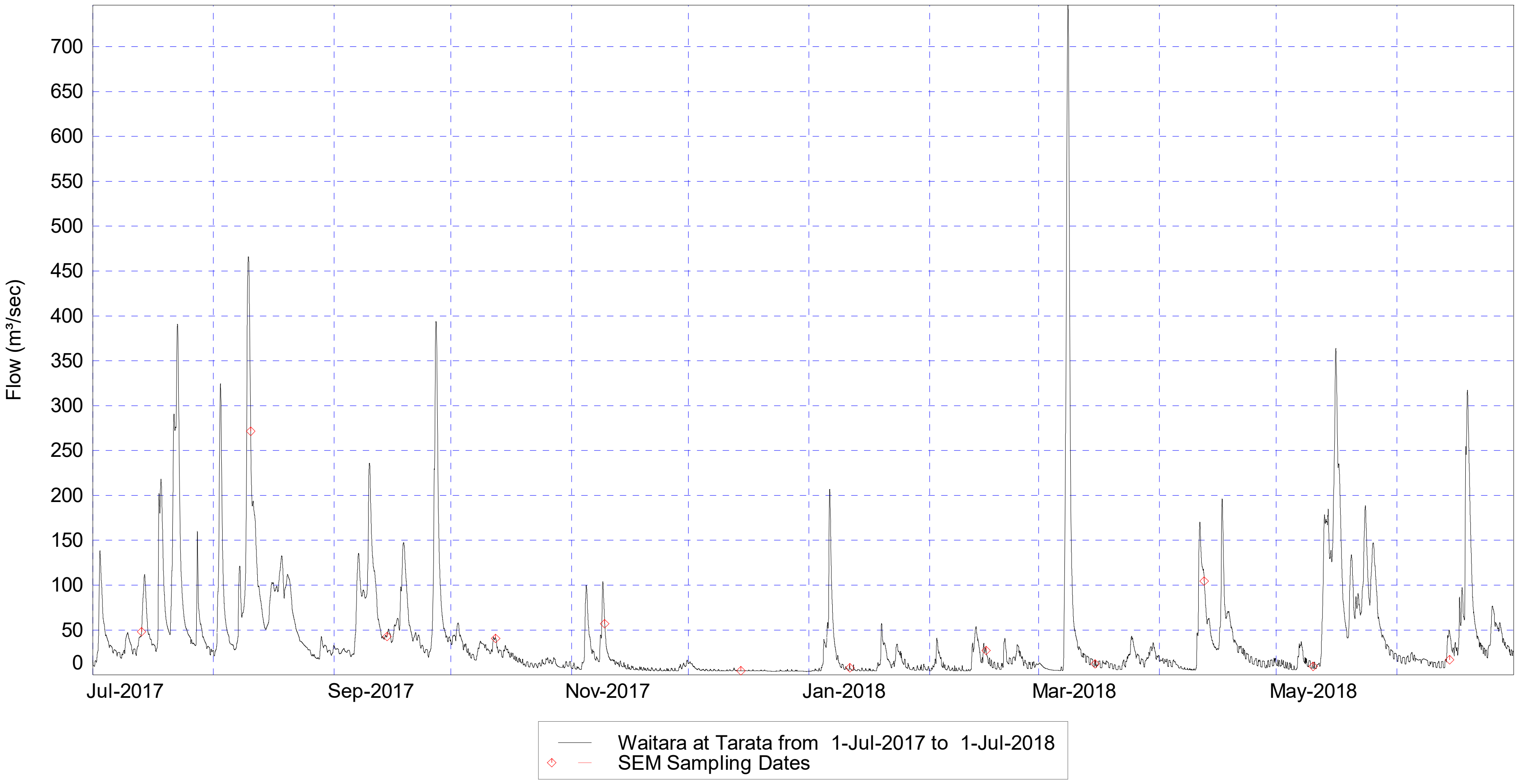


Figure 9 Flow record for the Waitara River at Tarata

Brief comparison with the previous 2015-2017 period

The median of sampled flows in the recent twelve-month period was significantly higher (by 11,877 L/s, or 54%) than flows sampled over the previous two years, due to a large number of freshes being sampled in the 2017-2018 year. The range of river flows sampled was wider in 2017-2018, due to both the highest maximum (271 m^3/s) and the lowest minimum (4.61 m^3/s) flows yet recorded. The relatively high number of fresh flows sampled were usually coincident with a general deterioration in water quality, as emphasised by elevated turbidity, suspended solids, all nutrient species (particularly total phosphorus) and bacterial counts.

Median black disc clarity was significantly lower (by 0.23 m, or 58%) and median turbidity was higher (by 43 NTU, or 258%) in the more recent period, while the median suspended solids concentrations was higher by 56 g/m^3, or 329%.

For nitrogen nutrient species, median concentrations of ammoniacal, nitrate and total nitrogen were higher (by 59, 50 and 32%) in the later period, while dissolved reactive phosphorus and total phosphorus were higher (by 43 and 238%) compared to the medians for the previous two-year period. Median bacterial numbers increased for enterococci (by 35 cfu/100 mL) while faecal coliforms increased (by 50 cfu/100 mL) in the 2017-2018 period.

Median dissolved oxygen saturation level was relatively similar (2% lower) in the 2017-2018 period while median pH level was the same for the two periods. Maximum pH was 0.2 unit lower and minimum pH was 0.1 unit lower than the respective previously recorded values.

The range of water temperatures was narrower (by 1.6°C) in the later twelve-month period due to a lower maximum temperature (by 1.4˚C) and higher minimum temperature (by 0.2˚C) in the 2017-2018 sampling year, while median water temperature was 0.7˚C lower during 2017-2018.

4.2 Comparative water quality for the twenty three-year (1995-2018) period

4.2.1 TRC data

In addition to the site descriptions of water quality measured during the 2017-2018 monthly sampling programme, a general comparison between the thirteen sites of the Council's programme and also including the two NIWA sites may be made for the 23-year sampling period to date (1995-2018) using statistical (tabular and graphical) data summaries. These have been provided for each individual site in Tables 5, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38 and 41. Comparative statistics for selected parameters are provided in Table 42 and in the form of the 'box and whisker' plots of Appendix II.

These site comparisons for the summary data over the 23 year record are discussed within groupings of parameters, as follows.

Appearance (turbidity, black disc clarity, suspended solids, absorbance)

The water quality at all but four of the sites has been clean and clear with very low median suspended solids concentrations (3 g/m^3 or lower) and low median turbidity levels (less than 2.5 NTU) except during flood flow conditions. The exceptions have been the three sites in the mid and lower reaches of eastern hill-country rivers and the lower reaches of the Waingongoro River. The eastern hill-country catchment rivers were typically slightly cloudy due to fine colloidal solids and yellow-brown in appearance under most flow conditions. An elevated median suspended solids concentration (46 g/m^3) has been recorded for the Whenuakura River, which was affected by widespread soil erosion after a major flood the month before the monitoring site was established in July 2015; median turbidity level (36 NTU, over three years) is significantly higher for this river than at any other site. The site in the lower reaches of the longest ring plain river (Waingongoro) also has elevated median suspended solids concentration (5 g/m^3) and turbidity (3.2 NTU). The site in the mid-reaches of the Stony River has shown marked variability, with erosion events in the headwaters the major contributing factor.

Generally, upper, catchment sites have exhibited higher aesthetic quality with a gradual deterioration toward the mid to lower reaches of the streams and rivers sampled.

Black disc clarity has shown greater variation between sites although similar trends of decreasing clarity down catchments occurred. Highest clarity was found in the upper reaches of the Patea River and the mid reaches of the Stony River (when not impacted by upper catchment erosion events) and the Waiwhakaiho River, with these sites' median clarities greater than 3.0 metres and maxima in excess of 8 metres at times. All but four other sites have achieved a median black disc clarity in excess of 1.5 metres. Due to the elevated turbidity of the eastern hill country rivers, the median clarities in the mid and lower reaches of the rivers were all less than 0.9 metres, while the site in the lower reaches of the Waingongoro River also had a relatively low median black disc value of 1.2 metres. Greatest variability was found at the Stony River site which has been the subject of several severe upper catchment erosion events at irregular intervals during the 23 year period.

Table 42 Some comparative water quality data for the thirteen TRC SEM sites for the twenty three-year period July 1995 to June 2018 (n = 36 to 276 samples)

Site	Black disc		BOD_5	Conductivity @ 20°C	Faecal coliform bacteria		Nutrients: Ammonia	Nutrients: Nitrate	Nutrients: Total N	Nutrients: DRP	Nutrients: Total P	pH		Dissolved oxygen saturation			Suspended solids	Temperature			Turbidity
Unit	m		g/m^3	mS/m	cfu/100mL		g/m^3N	g/m^3N	g/m^3N	g/m^3P	g/m^3P			%			g/m^3	°C			NTU
	Maximum	Median	Median	Median	Minimum	Median	Median	Median	Median	Median	Median	Maximum	Median	Min	Med	Range	Median	Maximum	Median	Range	Median
Maketawa Stream at Tarata Road*	5.23	2.55	<0.5	8.6	50	335	0.010	0.27	0.40	0.025	0.035	7.9	7.6	90	98	13	<2	19.1	11.5	14.3	1.2
Mangaoraka Stream at Corbett Road	4.73	1.80	0.6	14.5	84	800	0.021	0.84	1.10	0.009	0.023	8.1	7.6	83	97	24	2	20.5	13.2	14.7	2.1
Waiwhakaiho River at SH3	8.05	3.06	<0.5	12.2	23	210	0.008	0.11	0.20	0.025	0.035	8.5	7.9	91	101	19	<2	18.3	11.2	13.5	0.7
Stony River at Mangatete Road	13.12	3.12	<0.5	9.6	<1	8	<0.003	0.02	0.06	0.018	0.025	8.2	7.8	87	99	19	<2	16.6	10.8	10.9	1.6
Punehu Stream at Wiremu Road	4.53	1.77	<0.5	8.6	3	105	0.007	0.05	0.15	0.022	0.034	8.3	7.6	87	100	19	<2	19.2	11.8	14.2	2.4
Punehu Stream at SH45	3.65	1.50	0.9	16.1	51	560	0.040	0.96	1.40	0.044	0.079	8.6	7.7	90	99	24	3	21.0	13.4	16.0	2.3
Waingongoro River at Eltham Road	4.39	1.68	0.7	11.2	6	200	0.017	1.13	1.46	0.020	0.040	8.6	7.8	92	103	29	3	21.5	12.6	15.9	2.0
Waingongoro River at SH45 **	4.34	1.18	1.0	16.4	3	225	0.034	1.87	2.40	0.053	0.094	9.1	7.8	89	102	52	5	22.0	13.8	16.6	3.2
Patea River at Barclay Road	10.14	4.33	<0.5	6.2	<1	21	<0.003	0.02	0.07	0.018	0.025	8.0	7.5	90	99	13	<2	14.9	9.4	11.2	0.6
Patea River at Skinner Road	4.68	1.82	1.0	9.9	2	230	0.052	0.91	1.22	0.038	0.066	8.8	7.8	87	103	34	<2	22.3	12.9	17.0	1.7
Mangaehu River at Raupuha Road	4.04	0.84	0.6	9.9	6	245	0.012	0.10	0.30	0.006	0.020	8.4	7.7	83	100	35	4	24.9	13.9	20.6	4.4
Whenuakura River at Nicholson Road***	0.96	0.26	0.8	18.4	23	490	0.025	0.36	0.68	0.017	0.089	7.9	7.6	88	95	12	46	21.9	13.6	15.8	36
Waitara River at Tarata***	1.28	0.32	0.6	8.8	43	370	0.018	0.17	0.44	0.008	0.051	7.9	7.4	91	97	12	20	24.5	15.2	17.0	22

[Notes: * for the period July 2003 to June 2018 (n = 180 samples);
** for the period July 1998 to June 2018 (n = 240 samples);
*** for the period July 2015 to June 2018 (n = 36 samples)]

Turbidity is for the period June 2005 to June 2018.

64

Absorbances (at 340 nm) have been generally relatively low. They are indicative of slight dissolved colour, particularly at the eastern hill country sites, and also at both the upper and lower Punehu Stream sites, and to a slightly lesser extent at the site in the lower Waingongoro River. Absorbances at 770 nm were very low, indicating that any apparent dissolved colour was seldom due to the scattering effects of small colloidal particles.

Water temperature, pH, and conductivity

Coldest median water temperature (9.4˚C) has been measured at the upper site on the Patea River (altitude: 500 m asl) with increased median water temperatures in a downstream direction as might be expected. Highest maximum water temperatures have been recorded in the lower reaches of the Mangaehu River (24.9˚C), the Whenuakura River (24.5°C), the Waingongoro River (22.0˚C), and the smaller Punehu Stream (21.0˚C), and in the mid reaches of the Waitara River (24.5°C) and Patea River (22.3˚C); these six sites also exhibiting five of the six highest medians (13.9˚C, 13.6°C, 13.8˚C, 13.4˚C, 15.2°C and 12.9˚C, respectively) and widest ranges (20.6˚C, 15.8°C, 16.6˚C, 16.0˚C, 17.0°C and 17.0˚C, respectively) of water temperatures. Atypically, relatively high median (11.8˚C), maximum (19.2˚C) and a wide range (14.2˚C) of water temperatures have been recorded in the upper reach of the Punehu Stream at Wiremu Road, probably due to the open, bouldery nature of the 2 km reach between the National Park and the sampling site (altitude: 270 m asl).

Highest pH values (8.5 to 9.1) have been recorded at the mid and lower ring plain river and stream sites due to algal photosynthetic effects coincidental with more extensive substrate algal cover under warmer, mid to late summer, low flow conditions. pH values at all sites were slightly alkaline i.e., medians ranging from 7.5 to 7.9 in the ring plain rivers and streams, and from 7.4 to 7.7 in eastern hill-country rivers. (Note: diurnal temperature and pH variability is limited by the sampling regime for each site – see below).

Conductivity, a measure of the degree of mineralisation of the water, increased with distance downstream but median values were all indicative of relatively low total ionic content (i.e. <16.5 mS/m at 20°C, except the new site in the lower reaches of the Whenuakura River, at 18.4 mS/m at 20°C). Greatest variability was generally recorded in the mid to lower reaches of the larger rivers and streams which were subject to wider ranges of flow.

Dissolved oxygen and biochemical oxygen demand

Very high median dissolved oxygen concentrations characterised all ten ring plain sites and the three eastern hill country sites. Ranges were relatively narrow at most sites (<30% at ten sites) and median values were 95% saturation or higher at all sites. Summer-autumn lower flow conditions, coincident with more extensive algal substrate cover, resulted in supersaturation on occasions at various sites in the mid to lower reaches of streams and rivers. The narrowest saturation ranges (≤13%) were found in the upper reaches of the Patea River, mid reaches of the Maketawa Stream and Waitara River, and lower reaches of the Whenuakura River, with wider saturation ranges (≥19%) recorded at mid and lower catchment sites, and the widest (52%) in the lower reaches of the longest ring plain river where substrate periphyton cover often has been more extensive. (Note: wider ranges may occur at all sites, but particularly lower reach sites, as the nature of the sampling regime does not provide for diurnal variability; rather sampling is confined to a narrow fixed time window for each site).

Biochemical oxygen demand (BOD_5), a measure of the amount of biodegradable matter present, was generally less than 1 g/m^3 (i.e. no medians greater than 1.0 g/m^3), indicative of low organic enrichment at all sites. Median values were highest in the lower reaches of the Waingongoro River (1.0 g/m^3), Punehu Stream (0.9 g/m^3) and Whenuakura River (0.8 g/m^3), and the mid reaches of the Mangaoraka Stream and Waingongoro and Patea Rivers, all sites downstream of point and non-point source discharges. Elevated BOD_5 levels (>2 g/m^3) have been measured from time to time at most sites during fresh and flood flow conditions, reflecting the influence of non-point source farmland and stormwater run-off, and have reached

2.4 g/m^3 under summer low flow conditions downstream of Stratford in the Patea River at the Skinner Road site.

Nutrients (nitrogen and phosphorus)

Nutrients such as nitrate, ammoniacal nitrogen and dissolved reactive phosphorus may readily be taken up by the flora of rivers and streams. An abundance of these nutrient forms may result in prolific and objectionable growths of attached filamentous algae (periphyton), particularly when in combination with low river flows, increased temperatures, and a plentiful supply of energy in the form of light (autotrophic growths) and/or organic matter (heterotrophic growths). Highest nutrient concentrations were recorded at the lower sites in the ring plain rivers and streams sampled, consistent with increased non-point source run-off and point source discharges through each ring plain catchment e.g., increases of 830% and 130% in median total nitrogen and total phosphorus respectively over the length of the Punehu Stream; 1600% and 160% respectively from the upper to the mid reaches of the Patea River; and 58% and 140% respectively through the mid to lower reaches of the Waingongoro River. Elevated nitrate concentrations often reflect high groundwater inputs, particularly after very wet weather (winter-spring) conditions when groundwater levels are higher and therefore contribute more proportionately to river/stream base flows. Highest median concentrations of dissolved reactive phosphorus (DRP), total phosphorus, ammoniacal, nitrate and total nitrogen were generally found at the lower Punehu Stream site, mid Patea River (Skinner Road) site, mid and lower Waingongoro River sites, and to a slightly lesser degree at the site in the Mangaoraka Stream. However, relatively low dissolved reactive phosphorus concentrations (median of <0.01 g/m^{3}P) in the Mangaoraka Stream reflect the source of this ring plain stream which rises outside of the National Park, compared with the documented natural sources of dissolved phosphorus from within the Park found in ring plain rivers and streams (TCC, 1984 and TRC, 2010). Relatively low dissolved reactive phosphorus (median of <0.01 g/m^{3}P) measured at the sites in the mid reaches of the Waitara River and lower reaches of the Mangaehu River reflect the rivers' eastern hill country catchment source. The high total phosphorus concentrations, largely in particulate form, measured for the lower reaches of the Whenuakura site (median of 0.089 g/m^{3}P) relate to the high sediment loads carried during the first three years of monitoring.

Bacteria

Poor bacteriological water quality (median faecal coliform numbers from 225 to 800 per 100 mL) has been recorded at the sites in the lower reaches of the Maketawa Stream, Punehu Stream, Waingongoro River, Mangaehu River, Whenuakura River and particularly the Mangaoraka Stream. Relatively poor bacteriological quality (medians from 200 to 370 per 100 mL) in the mid reaches of the Waiwhakaiho, Waingongoro, Patea and Waitara Rivers, also reflect non-point source run-off and point source discharges (and possibly stock access) to these developed farmland river and streams. The cumulative impacts of several dairy pond treatment systems' discharges to the Mangatawa Stream have impacted upon Punehu Stream quality (TRC, 2011). One of the sites' (Mangaoraka Stream) counts have continuously exceeded 80 faecal coliforms cfu/100 mL, indicative of consistently poor bacteriological quality.

The sites in the mid reaches of the Waiwhakaiho, Waingongoro, Patea and Waitara Rivers have had comparatively good bacteriological water quality on occasions.

The sites in the Patea River's upper reaches (at Barclay Road) and the Stony River in mid-reach (at Mangatete Road) generally recorded very high bacteriological water quality, with median faecal coliform numbers of 21 and 8 cfu/100 mL respectively.

The upper site in the Punehu Stream (at Wiremu Road), however, has had an unexpectedly high median faecal coliform count of 105 cfu/100 mL, probably reflecting stock access to this stream and farm seepage and surface run-off over the 2 km reach between the National Park and Wiremu Road.

Enterococci numbers reflected the trends outlined above for faecal coliform bacteria, with the highest median counts generally recorded at the sites in the lower reaches of the Mangaoraka Stream and the Punehu Stream and lowest median counts in the Stony River and in the upper reaches of the Patea River.

4.2.2 NIWA data

A summary of the comparable 23 years of data for the two Taranaki region sites included in the NIWA national network (see Figure 1) is presented in Table 43. (A third site, Waingongoro River at SH45, was monitored until November 2015. Refer to TRC 2015 for a summary of comparative data from this site). The Manganui River system draining from Mt Taranaki is a sub-catchment of the Waitara River basin, and thus provides an 'upstream' comparison with the Bertrand Rd site on the lower Waitara River. The Waitara River itself flows from the highly erodible eastern hill country.

Table 43 Some comparative water quality data for the two NIWA SEM sites for the 23-year period July 1995 to June 2018 (n = 275 samples)

Site Unit	Black disc (m)		BOD_5 (g/m^3)	Conductivity @ 20°C (mS/m)	Nutrients: Amm-N (g/m^3N)	Nitrate (g/m^3N)	Total N (g/m^3N)	DRP (g/m^3P)	TP (g/m^3P)	pH		Dissolved oxygen saturation %	Temperature (°C)			Turbidity (NTU)	Flow (m^3/sec)
	Maximum	Median	Median	Median	Median	Median	Median	Median	Median	Maximum	Median	Median	Maximum	Median	Range	Median	Median
Waitara River at Bertrand Road	3.2	0.42	0.7	8.8	0.012	0.31	0.57	0.006	0.037	8.6	7.7	102	24.8	13.9	18.3	8.6	30.3
Manganui River at SH3	7.7	3.9	<0.5	6.3	0.006	0.09	0.18	0.009	0.015	8.0	7.5	100	18.7	10.7	14.1	1.0	0.92

These data indicate more turbid (cloudier) appearance in the lower reach of the Waitara River (median black disc clarity of 0.42 metres and turbidity of 8.6 NTU) with very clear conditions toward the upper reach of the Manganui River. Lower Waitara River median clarity was the third to worst of all fifteen sites monitored in the region, reflecting the significant impact of the eastern hill country component of this large river's catchment. (Lower clarities are noted in the Mangaehu and Whenuakura Rivers (Table 42), which drain entirely from the eastern hill country). Median water temperatures were typical of those found at comparable sites elsewhere in the region (Table 42 and Table 43), while median pH, conductivity, dissolved oxygen and BOD_5 levels were also typical. Median nutrient concentrations were within the range of medians found at other regional sites monitored by TRC and were comparable with similarly located sites (in terms of position in the river reach).

4.2.3 Comparative water quality for the twenty three-year (1995-2018) period

The 23 years of state of the environment monitoring (SEM) data may be summarised and compared with various published guidelines and standards for different water usages (TRC, 2006a and TRC, 2009). As the monitoring programme samples all weather conditions on a systematically random basis there will always be data which fail to meet standards on some occasions. Therefore, the median statistic has been used to assess compliance with guidelines and standards in Table 44.

Table 44 Comparison of 1995-2018 SEM (TRC and NIWA) sites' median water quality with guideline values for various usages

Usage	Aesthetics		Contact recreation		Prevention of undesirable growths			Stock water		Aquatic ecosystems					Irrigation	Drinking water	
Parameter	Black disc	BOD_5	E.coli	BOD_5	DRP	TP	TN	Faecal coliforms	Faecal coliforms	Black disc	DO Saturation	NO_3	NH_4	Temp	TN	TP	NO_3
Guideline	>1.6 m	<3g/m^3	<550/ 100mLs	<3g/m^3	<0.03 g/m^3P	<0.03 g/m^3P •	<0.6 g/m^3 N•	<1000/ 100mL	Median <100/100 mL	>0.8m	>80%	<0.4 g/m^3N	<0.9 g/m^3N	<25 °C	<25 g/m^3N	<0.8 g/m^3 P	<11.3 g/m^3N
Reference	1,2	2,3	2,3	2	1,2	1	1	1,2	1			1,2	1	2	1	1	1,2
Site																	
Maketawa Stream at Tarata Road	✓	✓	✓	✓	✓	x	✓	✓	x	✓	✓✓*	✓	✓✓	✓✓	✓✓	✓✓	✓✓
Mangaoraka Stream at Corbett Road	✓	✓	x	✓	✓	✓	x	✓	x	✓	✓✓*	x	✓✓	✓✓	✓✓	✓	✓✓
Waiwhakaiho River at SH3	✓	✓	✓	✓	✓	x	✓	✓	x	✓	✓✓*	✓	✓✓	✓✓	✓✓	✓✓	✓✓
Stony River at Mangatete Road	✓	✓	✓	✓✓	✓	✓	✓	✓	✓	✓	✓✓*	✓	✓✓	✓✓	✓✓	✓	✓✓
Punehu Stream at Wiremu Road	✓	✓	✓	✓	✓	x	✓	✓	x	✓	✓✓*	✓	✓✓	✓✓	✓✓	✓✓	✓✓
Punehu Stream at SH45	x	✓	✓	✓	x	x	x	✓	x	✓	✓✓*	x	✓✓	✓✓	✓✓	✓✓	✓✓
Waingongoro River at Eltham Road	✓	✓	✓	✓	✓	x	x	✓	x	✓	✓✓*	x	✓	✓✓	✓✓	✓	✓✓
Waingongoro River at SH45	x	✓	✓	✓	x	x	x	✓	x	✓	✓✓*	x	✓✓	✓✓	✓✓	✓✓	✓✓
Patea River at Barclay Road	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓✓*	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Patea River at Skinner Road	✓	✓	✓	✓	x	x	x	✓	x	✓	✓✓*	x	✓✓	✓✓	✓✓	✓	✓✓
Mangaehu River at Raupuha Road	x	✓	✓	✓	✓✓	✓	✓	✓	x	✓	✓✓*	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Whenuakura River at Nicholson Road°	x	✓✓	✓	✓✓	✓	x	x	✓	x	x	✓✓*	✓	✓✓	✓✓	✓✓	✓	✓✓
Waitara River at Autawa Road°	x	✓✓	✓	✓✓	✓	x	✓	✓	x	x	✓✓*	✓	✓✓	✓✓	✓✓	✓	✓✓
Manganui River at SH 3	✓	✓✓	✓	✓✓	✓	✓	✓	✓	✓	✓	✓✓*	✓	✓✓	✓✓	✓✓	✓✓	✓✓
Waitara River at Bertrand Road	x	✓✓	✓	✓✓	✓	x	✓	✓	x	x	✓✓*	✓	✓✓	✓✓	✓✓	✓	✓✓
Summary of sites (15) in compliance	9	15	14	15	12	5	9	15	3	12	15	10	14	15	15	15	15

Key:
- ✓✓ = maximum (*minimum) value also meets usage guideline
- ✓ = median value, meets usage guideline
- x = median value, does not meet usage guideline
- • = 80% of values to meet usage guidelines

References:
1 = ANZECC, 2000
2 = TRC, 2003 & TRC, 2009
3 = MfE, 2003

Note: ° Whenuakura River at Nicholson Road and Waitara River at Autawa Road data are for the period July 2015 to June 2018 (n = 36 samples).

4.2.3.1 Aesthetics

Most sites met the aesthetic quality guidelines, although the six sites which did not achieve the black disc clarity are all situated in the mid or lower reaches of catchments, three of which (Mangaehu, Waitara and Whenuakura Rivers) are eastern hill country catchments.

4.2.3.2 Contact recreation

The Council's and NIWA's programmes do not necessarily collect samples representative of water quality typical of conditions at times when contact recreation is likely, as is stipulated in the MfE guidelines for monitoring recreational bathing, and therefore care should be taken when comparing results against the guidelines. It should also be noted that most of the SEM sites in the programme are not contact recreational sites; the streams are too shallow, cold and/or small at these locations. A specific recreational water quality SEM programme is structured around the requirements of the MfE guidelines and reported separately (TRC, 2017), and on the Council's website (www.trc.govt.nz). However, the sites' data presented in Table 44 are indicative of bacteriological conditions likely to exist at contact recreational sites in the vicinity of the reaches of the streams/rivers monitored, from a year-round, all-flows perspective. The Government's NOF standards apply to data gathered all year round, and are applied to the SEM data further in section 4.2.4.2 below.

One site (in the lower reaches of the Mangaoraka Stream) consistently failed to meet the guideline, while most of the other sites have failed to meet instantaneous guidelines ('Alert' and 'Action' modes (TRC, 2018) occasionally under spring-summer low flow conditions (refer to individual tables of 2017-2018 data) and under flood flow conditions (when contact recreation suitability is not an issue).

4.2.3.3 Undesirable growths

Algal growth smothers habitat and food sources for aquatic life and looks unattractive. Exceedance of guideline values at some sites is therefore of concern. However, exceedances of the guidelines for the prevention of undesirable nuisance growths will not necessarily result in nuisance growths occurring in the region's streams. Rather, excessive algal growths are most likely to occur in mid to late summer-autumn under conditions of warm, low flows, absence of recent rain events to scour the growths, and strong sunlight.

In the lower reaches of most Taranaki catchments, elevated nutrient levels are high enough to promote algal growth under low flow conditions. Most lower-river/stream sites illustrated exceedances of nutrient guideline values (Table 44). This is true particularly of total nitrogen and total phosphorus species which generally increased in concentration downstream. Dissolved reactive phosphorus levels were more variable with levels decreasing or remaining relatively stable downstream of the National Park boundary (where dissolved reactive phosphorus is present from natural sources).

The Council has a separate SEM programme that focuses specifically on nuisance growths at various freshwater indicator locations in the region (TRC, 2006b, TRC, 2014a, TRC, 2016b, and TRC, 2018b). In general, periphyton growths are more likely and more prolific in drier summers, when flows decrease and there is less scouring and disturbance of stream beds, more sunlight, higher temperatures, less grazing by macroinvertebrates, and less dilution of discharges containing nutrients. The lower reaches of ring plain streams in southern and western Taranaki particularly can experience nuisance growths, particularly in the mid-summer-early autumn period.

4.2.3.4 Stock water

The bacteriological guideline for stock water was previously 1000 faecal coliforms cfu/100 mL. All median values at all sites comfortably met this guideline. Given that higher faecal coliform levels in streams generally occur under conditions of heavy rainfall, when stream water is less likely to be utilized, individual results above this guideline generally do not indicate a need for concern.

The ANZECC (2000) water quality guideline stipulates a limit of 100 thermo-tolerant coliforms (which includes faecal coliforms) cfu/100 mL, for median values. As noted above, with many Council samples gathered at times when stock would not need water, the guideline is not necessarily appropriate as a basis for evaluating the regional water quality data. It may be noted that at three of the nine sites shown in Table 44 as otherwise exceeding the bacteriological guidelines, the 25th percentile result (see Appendix I) satisfies the criterion. All sites complied with the nitrate-N guideline.

4.2.3.5 Aquatic ecosystems

While all sites complied with the ammoniacal nitrogen and temperature guidelines, five sites (in the middle to lower reaches of catchments) had median values above the guideline for nitrate-N and two sites under the visibility guideline. The Council has a separate SEM programme that focuses specifically on the macroinvertebrate fauna of 59 sites in the region (including all of the thirteen sites in the physicochemical programme and the two NIWA sites) and none of these communities where monitoring has taken place for the more than 10 years has illustrated significant deterioration, while seven (one upper, three middle and three lower reach) of the 11 sites in the physicochemical programmes have shown significant improvements in stream 'health' trends over the 23 years (1995 to 2018) to date (TRC, 2006c, Stark and Fowles, 2006 and TRC, 2018b).

4.2.3.6 Irrigation

All sites met the relevant nutrient guidelines for irrigation water.

4.2.3.7 Drinking water

The drinking water nitrate standard was complied with at all sites, although all sites would require treatment to achieve bacteriological drinking water standards.

4.2.4 National Objectives Framework

In 2014, Ministry for the Environment released a 'National Policy Statement for Freshwater Management (NPS-FM)' which sets out objectives and policies that direct local government to manage water in an integrated and sustainable way, while providing for economic growth within set water quantity and quality limits. The national policy statement is a first step to improve freshwater management at a national level.

This national policy statement provides a National Objectives Framework (NOF) that specifies nationally applicable standards for particular water quality parameters, to assist regional councils and communities to more consistently and transparently plan for freshwater objectives. The national policy statement acknowledges iwi and community values by recognising the range of iwi and community interests in fresh water, including environmental, social, economic and cultural values.

The national policy statement sets national bottom lines for two compulsory values – ecosystem health and human health for recreation – and minimum acceptable states for other national values.

Overall freshwater quality within a region must be maintained or improved. The national policy statement allows some variability in terms of freshwater quality, within each Freshwater Management Unit, as long as the overall freshwater quality is still maintained within that FMU.

In September 2015, Ministry for the Environment published a reference document on reporting and calculation of NOF values called 'A Draft Guide to Attributes – in Appendix 2 of the NPS-FM, 2014. The purpose of the Guideline is to provide Council staff with guidance on the role and use of attributes involved in the implementation of the NPS-FM.

The NPS-FM identifies 13 national values and uses for freshwater. Two of these are compulsory values that apply to all water bodies: ecosystem health and human health for recreation. For ecosystem health, the NPS-FM specifies attributes to manage long-term exposure to two toxicants, nitrate (NO_3N) and ammoniacal nitrogen (NH_4N). *E. coli* is the attribute used for specifying human health for recreational objectives for freshwater, because it is moderately well correlated with *Campylobacter* bacteria and numeric health risk levels can be calculated (MfE, 2015).

For nitrate and ammoniacal nitrogen attributes, the recommended number of samples to determine the sample statistic for assessing progress towards freshwater objectives is at least 30 samples collected on a monthly basis over three years. Fewer samples can be used, but confidence in sample statistics will be lower. More samples will improve the confidence in estimates of sample statistics, however, the marginal improvements in confidence diminish beyond about 20-40 samples (McBride, 2014).

In March 2018, MfE published an updated document: 'A Draft Guide to Attributes in Appendix 2 of the NPS-FM 2014 (as amended 2017)' focussing on new attribute state recommendations for *E. coli* and planktonic cyanobacteria. A background document for the proposed new changes to *E. coli* was produced earlier (December 2017), titled 'A Draft Guide to Swimming, E. coli and National Targets under the NPS-FM 2014 (as amended 2017)', which provided an overview of 'primary contact' objectives, policies, approach to monitoring and reporting for regional councils to follow.

A major change for *E. coli* was presented, with five attribute states A, B, C, D and E (previously four: A, B, C and D) and four criteria or 'statistical tests' to satisfy each attribute state. The overall grading to be assigned to a river is to be the worst of the four. The rigorous criteria were developed to determine the infection risk profiles relating to *E. coli* levels and the proportion of population at risk of *Campylobacter* infection for activities likely to involve full immersion such as swimming or white water rafting (McBride, 2014; Ministry for the Environment and Ministry of Health, 2003). Additionally, the attribute state for *E. coli* is determined by using a minimum of 60 samples over a maximum of five years, collected on a regular basis regardless of weather and flow condition.

Thus, there are now five grades, but no 'bottom line', for *E coli*. The Government has stated that, as a whole, 80% of the country's waterways should be within the top 3 categories by 2030, and 90% by 2040. It should be noted that these percentages do not necessarily apply at the regional level. For the purpose of comparisons, this report uses the five-step categories, with rivers in either of the bottom two categories being deemed unacceptable for recreational purposes.

The following sections present the results of the NOF analysis at 13 sites monitored as part of the Taranaki physico-chemical programme. This includes Whenuakura River at Nicholson Road and Waitara River at Autawa Road, that were added to the programme in July 2015 (36 samples were collected and used for the analysis). Two of NIWA's national monitoring sites were also included in the analysis, i.e., Waitara River and Bertrand Road and Manganui River at State Highway 3.

4.2.4.1 Ecosystem health

The national policy statement specifies attributes to manage long term exposure for two toxicants, nitrate and ammoniacal nitrogen. These toxicants can cause both lethal and sub-lethal (e.g. reducing growth rates or reproductive success) effects to aquatic species. It is recommended for councils to set freshwater objectives in the A or B attribute states when sensitive species are present that may be at risk of lethal effects.

All sites met the NOF standard set for toxicants nitrate and ammoniacal nitrogen (Figure 10, Table 45). Almost three-quarters of the sites (73%) achieved 'A' grade for both attributes in terms of their annual medians.

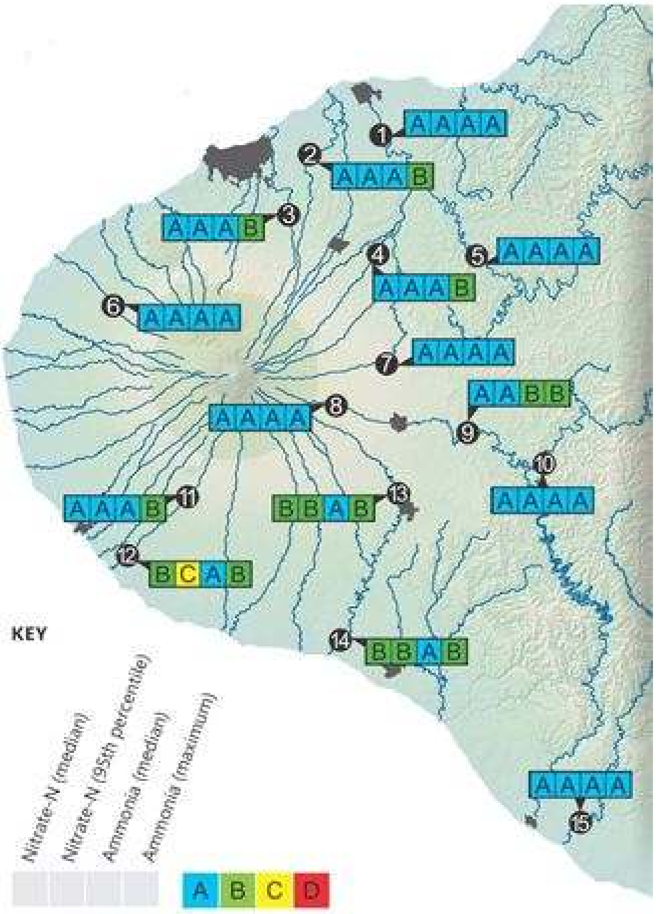


Figure 10 NOF results for ecosystem health at 13 SEM sites and two NIWA sites in Taranaki

Table 45 Summary result for water quality data from 2015-2018 for ecosystem health (n=36 samples).

Site No	Value	Ecosystem health			
		Nitrate-N (g/m^{3})		Ammoniacal-N	
	Attribute	Annual median	Annual 95th percentile	Annual median	Annual maximum
1	Waitara River at Bertrand Rd	A	A	A	A
2	Mangaoraka Stream at Corbett Rd	A	A	A	B
3	Waiwhakaiho River at SH3	A	A	A	B
4	Maketawa Stream at Tarata Rd	A	A	A	B
5	Waitara River at Autawa Rd	A	A	A	A
6	Stony River at Mangatete Rd	A	A	A	A
7	Manganui River at SH3	A	A	A	A
8	Patea River at Barclay Rd	A	A	A	A
9	Patea River at Skinner Rd	A	A	B	B
10	Mangaehu River at Raupuha Rd	A	A	A	A
11	Punehu Stream at Wiremu Rd	A	A	A	B
12	Punehu Stream at SH45	B	C	A	B
13	Waingongoro River at Eltham Rd	B	B	A	B
14	Waingongoro River at SH45	B	B	A	B
15	Whenuakura River at Nicholson Rd	A	A	A	A

4.2.4.2 Human health

The definition of primary contact sites in the Freshwater NPS is:

a. Any part of specified river or lake that a regional council considers is used, or would be used but for existing freshwater quality, for primary contact; and
b. Any other site in any other river or lake that regional council has determined should be managed for primary contact.

According to the updated Draft Guide to Attributes (as amended 2017), the *E. coli* attribute describes different statistical measures of the distribution of *E. coli* concentrations, and the associated risk of *Campylobacter* infection through ingestion of water during recreation activities (McBride, 2012; Ministry for the Environment and Ministry of Health, 2003). The four individual statistical measures are:

- Percentage of exceedances greater than 540 cfu/100 mL: this measure indicates how often the level of *E.* coli exceeds the acceptable threshold for swimming
- Percentage of exceedances greater than 260 cfu/100 mL: This measure indicates how often the level of *E. coli* exceeds the point where additional monitoring is required
- Median: the mid-point of E. coli levels
- 95^{th} percentile: an indication of the top range of *E. coli* levels within the distribution.

All four criteria are necessary to establish an attribute state. If one or more criteria can't be satisfied, a lower attribute state must apply. Higher attribute states provide lower levels of infection risk for each activity type.

Overall, two sites (13%) met all four of the new NOF standards set for *E. coli* (11, Table 46), if compliance is assumed to require at least a 'C' grade. The sites located in the upper river catchments showed better results compared to the sites in the middle and lower catchments, i.e. Patea River at Barclay Road (grade A), and Stony River at Mangatete Road (grade B).

The majority of the sites (80%) received 'D' grade for the 95^{th} percentile criterion, and hence fail to satisfy the Government's target.

Four sites met the requirement of acceptable threshold for swimming (less than 20% of the time recording exceedances greater than 540 cfu/100 mL), the national threshold applied within the summer recreational bathing survey. However, it is important to note that most of the SEM sites in the programme are not considered contact recreational sites; the streams are too shallow, cold and/or small for recreational bathing activities.

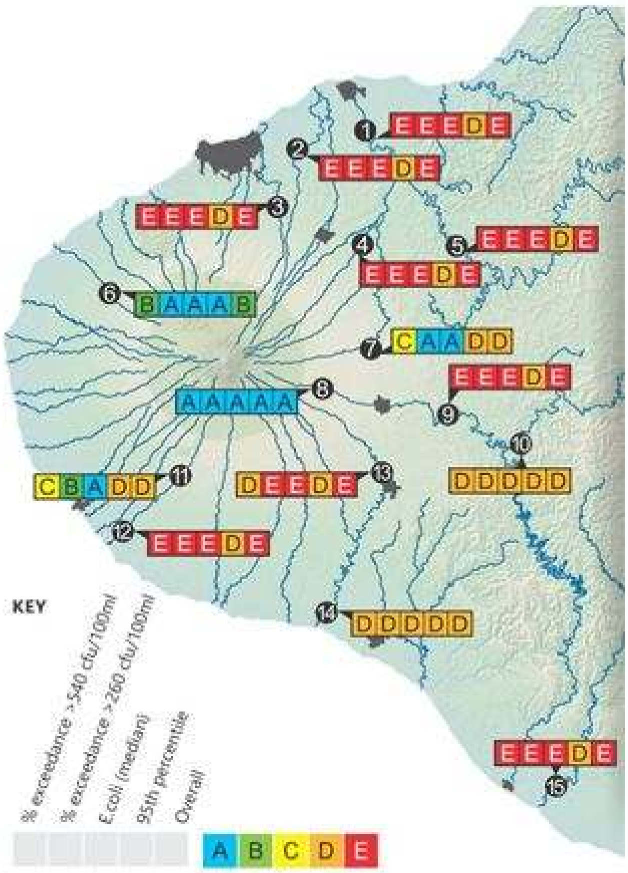


Figure 11 NOF results for human health for recreation at 13 SEM sites and two NIWA sites in Taranaki

Table 46 Results for NOF attribute states for 13 SEM sites in Taranaki

Site No	Value	Human health for recreation				
		Escherichia coli (*E.coli*/100mL)				
	Attribute	% exceed-ances over 540 cfu/100 mL	% exceed-ances over 260 cfu/100 mL	Median concentra-tion cfu/100 mL	95th percentile of *E. coli*/100 mL	Overall
1	Waitara River at Bertrand Rd	E	E	E	D	E
2	Mangaoraka Stream at Corbett Rd	E	E	E	D	E
3	Waiwhakaiho River at SH3	E	E	E	D	E
4	Maketawa Stream at Tarata Rd	E	E	E	D	E
5	Waitara River at Autawa Rd	E	E	E	D	E
6	Stony River at Mangatete Rd	B	A	A	A	B
7	Manganui River at SH3	C	A	A	D	D
8	Patea River at Barclay Rd	A	A	A	A	A
9	Patea River at Skinner Rd	E	E	E	D	E
10	Mangaehu River at Raupuha Rd	D	D	D	D	D
11	Punehu Stream at Wiremu Rd	C	B	A	D	D
12	Punehu Stream at SH45	E	E	E	D	E
13	Waingongoro River at Eltham Rd	D	E	E	D	E
14	Waingongoro River at SH45	D	D	D	D	D
15	Whenuakura River at Nicholson Rd	E	E	E	D	E

4.3 Trends in physicochemical water quality data from 1995 to 2018

4.3.1 Introduction

Twenty three years of physicochemical water quality data have been collected up to 30 June 2018. These data have been analysed for trends each year since 10 years of data became available. Previous trend analysis has been reported in TRC (2006, 2009, 2009a, 2010, 2011, 2012, 2013, 2014, 2015, 2015a, 2016 and 2017).

An update of the trends including data from the 2017-2018 monitoring year is provided. It does not include a detailed interpretation of the results. This will be provided at least prior to each five-yearly State of the Environment Report, if not before.

4.3.2 Trend analysis methods

The trend analysis involves a flow adjustment of the raw data for each variable at each site, followed by trend analysis accounting for any seasonal pattern. This analysis has been adopted throughout New Zealand for water quality trend analysis (following Scarsbrook and McBride, 2007).

Flow adjustment is necessary because most water quality variables are subject to either dilution (decreasing concentration with increasing flow) or land run-off (increasing concentration with increasing flow). Flow adjustment was performed using LOWESS (LOcally WEighted Scatterplot Smoothing), within the Time Trends software[1], with a 30% span. Every data-point in the record was then adjusted depending on the

[1] Trend analysis prior to 2009 has been conducted with Datadesk software. A comparison of the Time trends and Datadesk software was undertaken during the 2009 trend analysis to ensure that the different software packages produced similar results. Refer to Hope (2009) for details of this analysis.

value of flow (adjusted value = raw value – smoothed value + median value (where the smoothed value is that predicted from the flow using LOWESS)).

The non-parametric trend analysis was then applied to the whole data set for each parameter at each site, which takes into account the seasonal variability in the data.

This analysis is based on two key measures:

- The seasonal Kendall slope estimator (SKSE) which measures the magnitude of the trend, and
- The associated seasonal Kendall trend test which determines whether the trend is significant.

Statistically significant trends were determined using a p-value <0.05 or <0.01. If a p-value is less than 0.05 (or 0.01), then there is a less than 5% (or 1%) chance of finding a trend when there is not one. In the data presented below, p-values are expressed as a percentage and highlighted if the percentage is less than 5% (statistically significant) or less than 1% (very statistically significant).

The slope of the trend (SKSE) is expressed in units of change per year, and can also be expressed in terms of relative change (RSKSE) which is the percent of change per year. A positive SKSE or RSKSE indicates a positive (increasing) trend, and a negative SKSE or RSKSE indicates a negative or decreasing trend. The RSKSE allows comparisons in the slope between parameters and sites and is used in the tables below.

It is recognised that the statistical significance of a trend does not necessarily imply a 'meaningful' trend i.e., one that is likely to be relevant in a management sense. Ballantine and Davies-Colley (2009) have determined a 'meaningful' trend as one for which the RSKSE is statistically significant and has an absolute magnitude >1 percent per year. This approach has also been adopted below.

4.3.3 Results of long term trend analysis

Table 47 summarises the significant trends recorded for each water quality parameter at the 11 sites monitored in the physicochemical state of the environment monitoring programme where there are sufficient data. Trend analysis will be performed on the two sites that were established in 2015-2016, on the Whenuakura River at Nicholson Road and the Waitara River at Tarata, when 10 years of data have been gathered.

Of the nutrients, DRP, and to a lesser extent total phosphorus, have shown a significantly deteriorating trend (ie concentrations are increasing) at a number of sites in the middle and lower catchments, which would be more subject to anthropogenic pressures. Five and three out of eleven sites have shown a significant deterioration in DRP and total phosphorus, respectively; another two sites come close to the significant trend definition for deterioration in dissolved phosphorus, and three for total phosphorus. On the other hand, the lower Waingongoro River site shows significant reductions in both forms of phosphorus.

Total nitrogen improved significantly at three of the eleven sites monitored, deteriorated significantly at one site, and otherwise generally showed no significant trend. The improvements are in the upper (Patea River at Barclay Road and Punehu Stream at Wiremu Road), and middle (Stony River at Mangatete Road) catchment, and the deterioration in the lower (Punehu at SH45) catchment. Nitrate showed significant deteriorating trends at only two of the eleven sites, in middle (Waiwhakaiho at SH3) and lower (Punehu Stream at SH45) catchments where more land use intensification occurs. While ammoniacal nitrogen showed generally stable trends throughout all catchment levels, with the exception of the Punehu Stream at Wiremu Road (upper catchment), Maketawa Stream at Tarata Road, and Waiwhakaiho River at SH3 (both mid catchment), where significant trends of deterioration are apparent.

Generally, mid catchment and lower catchment sites appear to be showing the most deterioration in nutrients. There is notable improvement in the Waingongoro River at SH45 (for DRP and total phosphorus). This is a positive aspect as the lower catchment would be under the most pressure from land use intensification and upstream influences. The Punehu Stream at SH45, Waiwhakaiho River at SH3 and Maketawa at Tarata Road have the greatest number of deteriorating trends in relation to nutrients (three of five nutrients). All other sites had 2 or less of 5 nutrients increasing (Table 47).

The Waingongoro River at SH45 is showing a very significant improving trend in dissolved reactive phosphorus and total phosphorus (Figure 12), with two other parameters, nitrate and total nitrogen, improving at slightly less than the rate defined as a significant trend. It is probable that this is due to the reduction in meatworks' discharges to the river at Eltham (between 2001 and 2008) and the elimination of all Eltham WWTP municipal discharges in the catchment (since mid-2010). However, a significant increasing trend was detected for BOD at this site.

Faecal coliforms and enterococci bacteria generally showed little statistically significant change over the 23 year period, although Mangaoraka Stream at Corbett Rd indicated a very significant deteriorating trend in faecal coliforms and enterococci. There is also a very significant increase in faecal coliforms at Waiwhakaiho River at SH3 (and a significant increase for enterococci), and in enterococci at Maketawa at Tarata Road and Punehu Stream at SH45 (but not for faecal coliforms). One site showed significant improvement in faecal coliforms: Punehu Stream at Wiremu Road, an upper catchment site.

Traditional indicators of pollution, organic matter (BOD), suspended solids, clarity (black disc), conductivity (dissolved matter) generally show no apparent trends at most sites over the 23 year period. However, the Stony River shows deterioration in clarity and suspended solids as a result of the significant erosion events that have occurred in the headwaters of this catchment in recent years and the LOWESS curve indicates periods of erosion and recovery over time. Deterioration in clarity has also been significant at the Mangaoraka Stream (Corbett Road), where steady declines throughout the period are apparent (Figure 12), with Waiwhakaiho River (SH3) just outside the defined significantly changing definition. There was a significant improvement in suspended solids at Punehu Stream SH 45. There has been a continued deterioration trend in BOD at Waingongoro SH45 since the 2014 year, and at Maketawa Stream at Tarata Road since the 2016 year. Mangaoraka Stream at Corbett Road showed no significant long-term deterioration in BOD when the latest year is included in the analysis, being slightly less than the 1% per year criterion. Some significant trends in water temperature and pH have been noted (Table 48), all being negative, however, the rates of change per year in all of these cases are less than 1% and are not 'meaningful' changes.

Figure 12 shows the trends graphically for a selected number of sites and parameters where significant trends were recorded.

Table 47 'Meaningful' trends in surface water quality at 11 State of the Environment Monitoring sites in Taranaki- 1995-2018 (p<5% and RSKSE (%change/yr) >1%)

		Water Quality Variable															
															Total no. sites		
Catchment Level	Location	Dissolved Reactive P	Total Phosphorus	Nitrate	Ammoniacal-N	Total Nitrogen	Faecal coliforms	Enterococci	Conductivity	Black Disc	Suspended Solids	Temp°C	Biochemical O_2	pH	Improvement	No change	deterioration
Upper	Patea River Barclay Rd	⚪	⚪	🟢	⚪	🟢	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	2	11	0
Upper/ Middle	Punehu Stream Wiremu Rd	⚪	⚪	🟠	🔴	🟢	🟢	⚪	⚪	⚪	⚪	⚪	⚪	⚪	2	9	2
Middle	Stony River Mangatete Rd	⚪	⚪	⚪	⚪	🟢	⚪	⚪	⚪	🔴	🔴	⚪	⚪	⚪	1	10	2
Middle	Maketawa Stream Tarata Rd*	🔴	🔴	⚪	🔴	⚪	⚪	🔴	⚪	⚪	⚪	⚪	🟠	⚪	0	8	5
Middle	Patea River Skinner Rd	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	0	13	0
Middle	Waiwhakaiho R. SH3	🔴	⚪	🔴	🔴	⚪	🔴	🟠	⚪	⚪	⚪	⚪	⚪	⚪	0	8	5
Middle	Waingongoro R. Eltham Rd	🔴	🔴	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	0	11	2
Lower	Mangaoraka Stream Corbett Rd	🔴	🔴	⚪	⚪	⚪	🔴	🔴	⚪	🔴	⚪	⚪	⚪	⚪	0	8	5
Lower	Waingongoro R. SH45**	🟢	🟩	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	🔴	⚪	2	10	1
Lower	Punehu Stream SH45	🔴	⚪	🔴	⚪	🔴	⚪	🔴	⚪	⚪	🟩	⚪	⚪	⚪	1	9	4
Lower	Mangaehu River Raupuha Rd	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪	0	13	0
Total no. sites:	Improvement	1	1	1	0	3	1	0	0	0	1	0	0	0			
	No change	5	7	7	8	7	8	7	11	9	9	11	9	11			
	Deterioration	5	3	3	3	1	2	4	0	2	1	0	2	0			

Key:

*Maketawa Tarata Road: Data for this site only for the past 15 years: 2003-2018

**Waingongoro SH45: Data for this site only for the past 20 years: 1998 – 2018

- 🟢 statistically very significant **improvement** P<0.01 (1%)
- 🟩 statistically significant **improvement** P<0.05 (5%)
- ⚪ no statistically significant change
- 🟠 statistically significant **deterioration** P<0.05 (5%)
- 🔴 statistically very significant **deterioration** P<0.01 (less than 1% probability that the trend is due to natural variability and doesn't represent an actual change)

Upper catchment site **Mid-catchment site** **Lower catchment site**

Table 48 p-values (%) and trend slopes (% change per year) for flow and seasonally adjusted water quality variables at 11 Taranaki sites. Significant deteriorations are shown in orange (p<5%) and red (p<1%) and significant improvements are shown in light green (p<5%) and dark green (p<1%). 'Real' trends (i.e., the change is ecologically significant) are highlighted (>1% change per year).

Catchment Level	Location	Water Quality Variable													
		Dissolved Reactive P		Total Phosphorus		Nitrate		Ammonia-N		Total Nitrogen		Faecal coliforms		Enterococci	
		p-value (%)	% change per yr	*p*-value (%)	% change per yr	*p*-value (%)	% change per yr	*p*-value (%)	% change per yr	*p*-value (%)	% change per yr	*p*-value (%)	% change per yr	*p*-value (%)	% change per yr
Upper	Patea River Barclay Rd	0.01	0.88	73.15	0.08	0.00	-1.94	34.44	0.31	0.00	-3.86	49.26	0.60	6.61	1.84
Upper/ Middle	Punehu Stream Wiremu Rd	26.56	0.21	77.79	-0.09	1.14	1.28	0.00	3.07	0.00	-1.71	0.59	-1.85	47.83	-0.53
Middle	Stony River Mangatete Road	0.00	0.96	0.39	0.94	33.67	0.34	80.13	-0.02	0.00	-2.67	62.02	0.35	9.49	1.16
Middle	Maketawa Stream Tarata Road	0.00	3.08	0.01	2.05	83.03	0.19	0.16	2.70	35.31	-0.36	6.13	2.56	0.19	4.29
Middle	Patea River Skinner Rd	8.63	-0.51	0.62	-0.79	65.28	0.12	99.39	0.00	16.30	-0.21	52.69	-0.50	68.62	0.63
Middle	Waiwhakaiho SH3	0.00	1.32	0.00	0.88	0.19	1.73	0.03	2.65	7.57	-0.62	0.00	2.88	2.76	1.95
Middle	Waingongoro Eltham Rd	0.00	3.83	0.00	2.09	6.18	0.43	46.89	0.43	36.43	0.21	95.74	0.09	63.10	-0.36
Lower	Mangaoraka Stream Corbett Rd	0.00	2.91	0.01	1.63	62.02	-0.09	33.29	0.63	11.45	-0.29	0.02	2.46	0.00	5.09
Lower	Waingongoro SH45*	0.00	-2.41	0.00	-2.02	0.00	-0.91	21.29	0.69	0.01	-0.81	81.49	0.12	41.52	0.78
Lower	Punehu Stream SH45	0.00	1.77	4.33	0.83	0.00	1.91	9.50	-0.87	0.09	1.03	60.95	0.33	0.00	4.26
Lower	Mangaehu River Raupuha Rd	69.74	0.19	38.06	0.37	53.69	0.29	98.78	0.00	0.12	-0.92	26.24	-0.77	23.43	0.95
Total no. sites: Improvement		1		2		1		0		3		1		0	
No change		5		6		7		8		7		8		7	
Deterioration		5		3		3		3		1		2		4	

Table 48 (cont) *p*-values (%) and trend slopes (% change per year) for flow and seasonally adjusted water quality variables at 11 Taranaki sites. Significant deteriorations are shown in orange (*p*<5%) and red (*p*<1%) and significant improvements are shown in light green (p<5%) and dark green (p<1%). 'Real' trends (i.e., the change is ecologically significant) are highlighted (>1% change per year).

Catchment Level	Location	Water Quality Variable											
		Conductivity		Black Disc		Suspended Solids		Temp °C		Biochemical O_2		pH	
		p-value (%)	% change per yr	*p*-value (%)	% change per yr	*p*-value (%)	% change per yr	*p*-value (%)	% change per yr	*p*-value (%)	% change per yr	*p*-value (%)	% change per yr
Upper	Patea River Barclay Rd	1.53	-0.14	12.35	-0.41	34.42	0.00	86.08	-0.02	25.02	0.00	9.20	-0.03
Upper/ Middle	Punehu Stream Wiremu Rd	0.00	0.29	28.93	-0.27	42.11	0.00	60.41	-0.07	1.08	0.00	0.00	-0.08
Middle	Stony River Mangatete Road	64.19	0.04	0.00	-3.04	0.09	1.50	82.50	0.03	40.47	0.00	11.81	-0.02
Middle	Maketawa Stream Tarata Road	4.40	0.21	94.31	0.10	97.69	0.00	4.71	0.56	2.40	1.93	48.39	0.01
Middle	Patea River Skinner Rd	100.00	0.00	30.34	-0.42	23.10	-0.19	57.78	0.07	43.23	0.25	33.29	-0.02
Middle	Waiwhakaiho SH3	47.83	-0.05	0.12	-0.90	70.85	0.00	38.06	-0.14	93.26	0.00	0.27	-0.06
Middle	Waingongoro Eltham Rd	55.72	-0.04	14.53	-0.39	97.57	0.00	73.15	-0.05	19.23	0.54	1.44	-0.05
Lower	Mangaoraka Stream Corbett Rd	0.10	0.19	0.00	-1.63	28.89	0.28	84.88	0.03	2.55	0.84	4.92	-0.02
Lower	Waingongoro SH45*	50.61	0.07	2.64	0.79	23.79	-0.52	78.59	0.04	0.06	2.19	0.00	-0.09
Lower	Punehu Stream SH45	1.16	0.26	98.18	0.01	2.70	-1.33	68.62	-0.06	51.20	-0.28	0.00	-0.10
Lower	Mangaehu River Raupuha Rd	88.48	0.02	5.76	-0.73	94.53	0.00	58.83	-0.06	5.37	-0.54	38.90	0.02
Total no. sites: Improvement		0		0		1		0		0		0	
No change		11		9		9		11		9		11	
Deterioration		0		2		1		0		2		0	

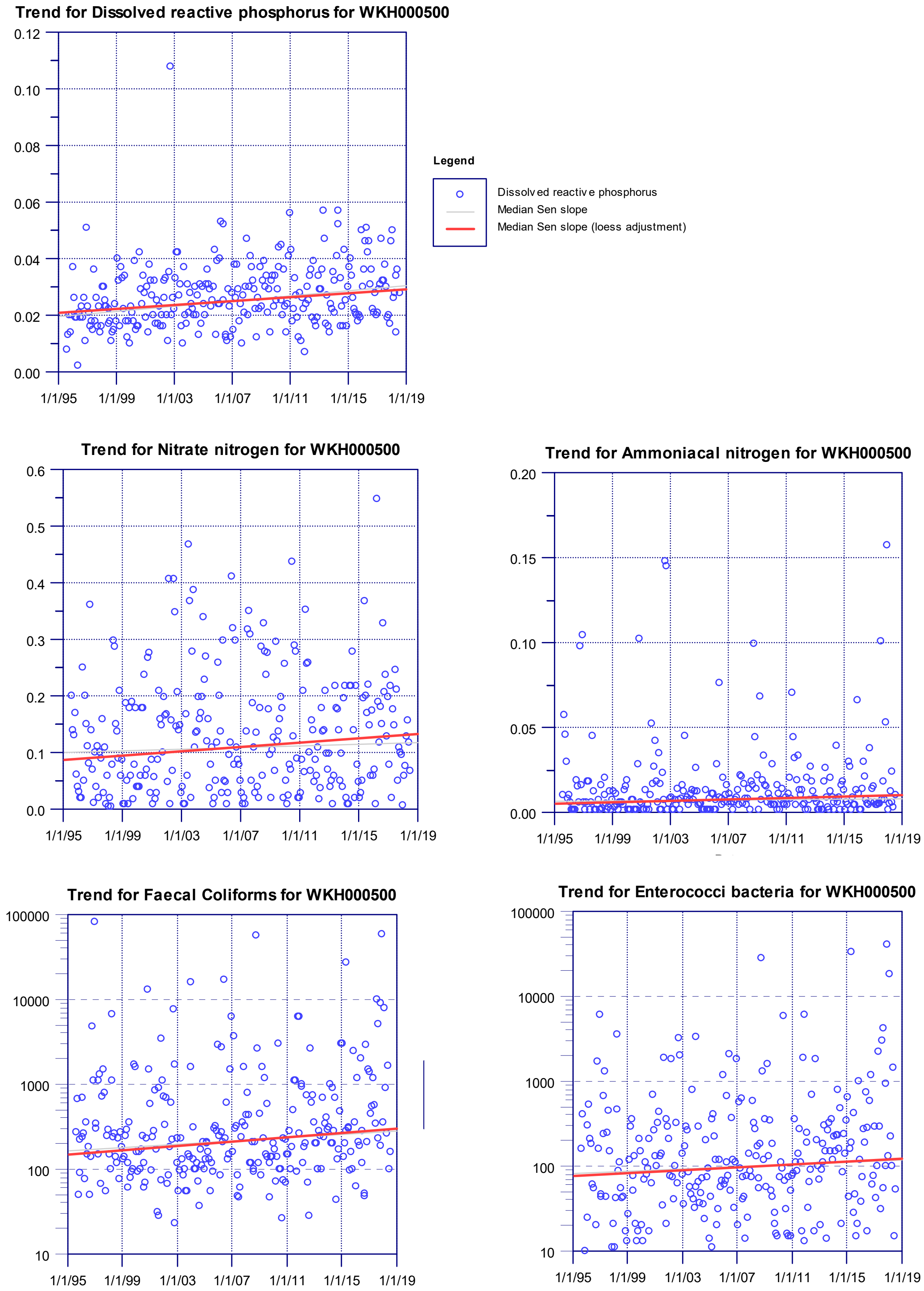


Figure 12 Scatterplots of selected parameters for selected sites where significant trends have been reported (flow adjusted data and LOWESS trend line (span 30%))

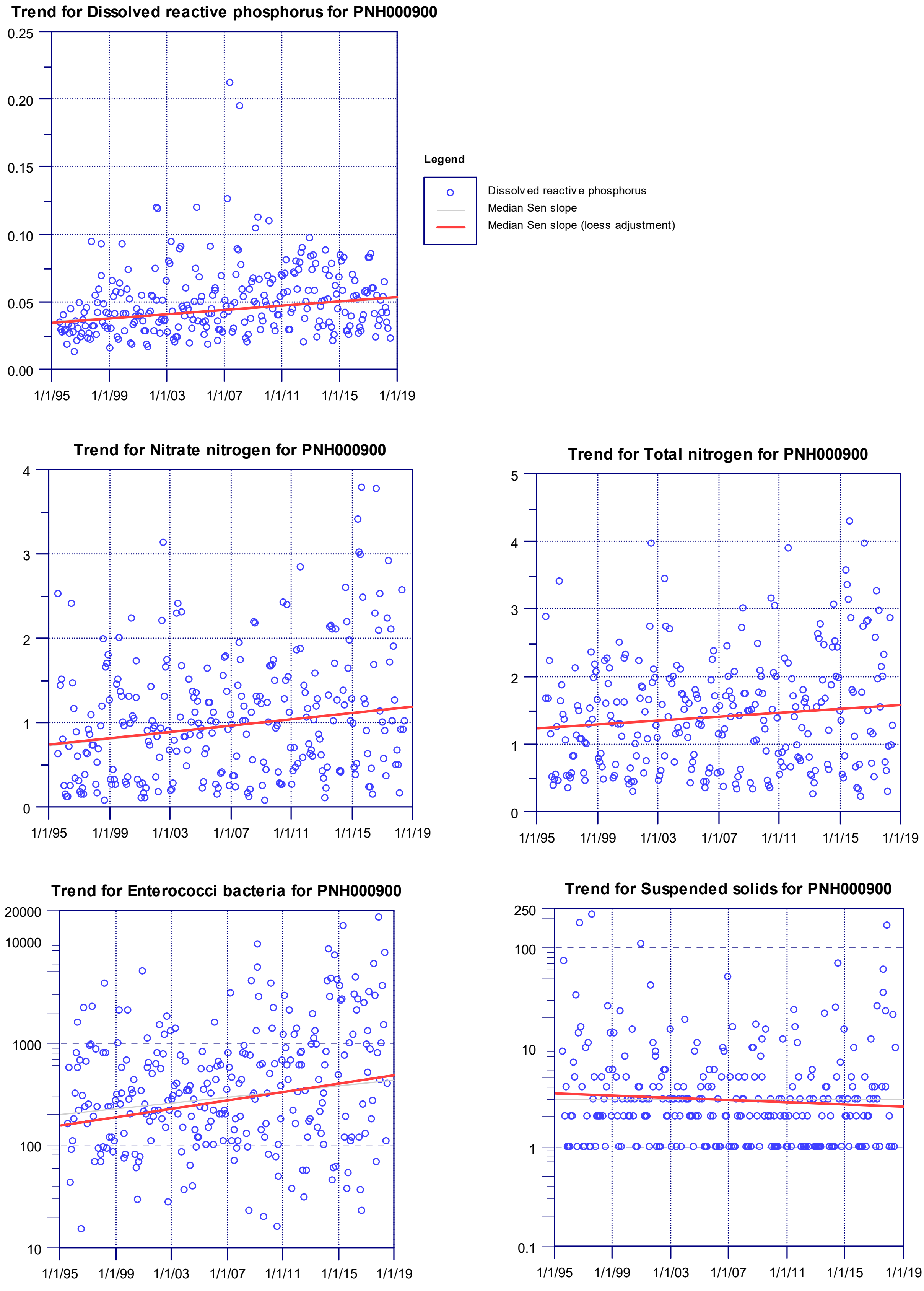


Figure 12 (cont) Scatterplots of selected parameters for selected sites where significant trends have been reported (flow adjusted data and LOWESS trend line (span 30%))

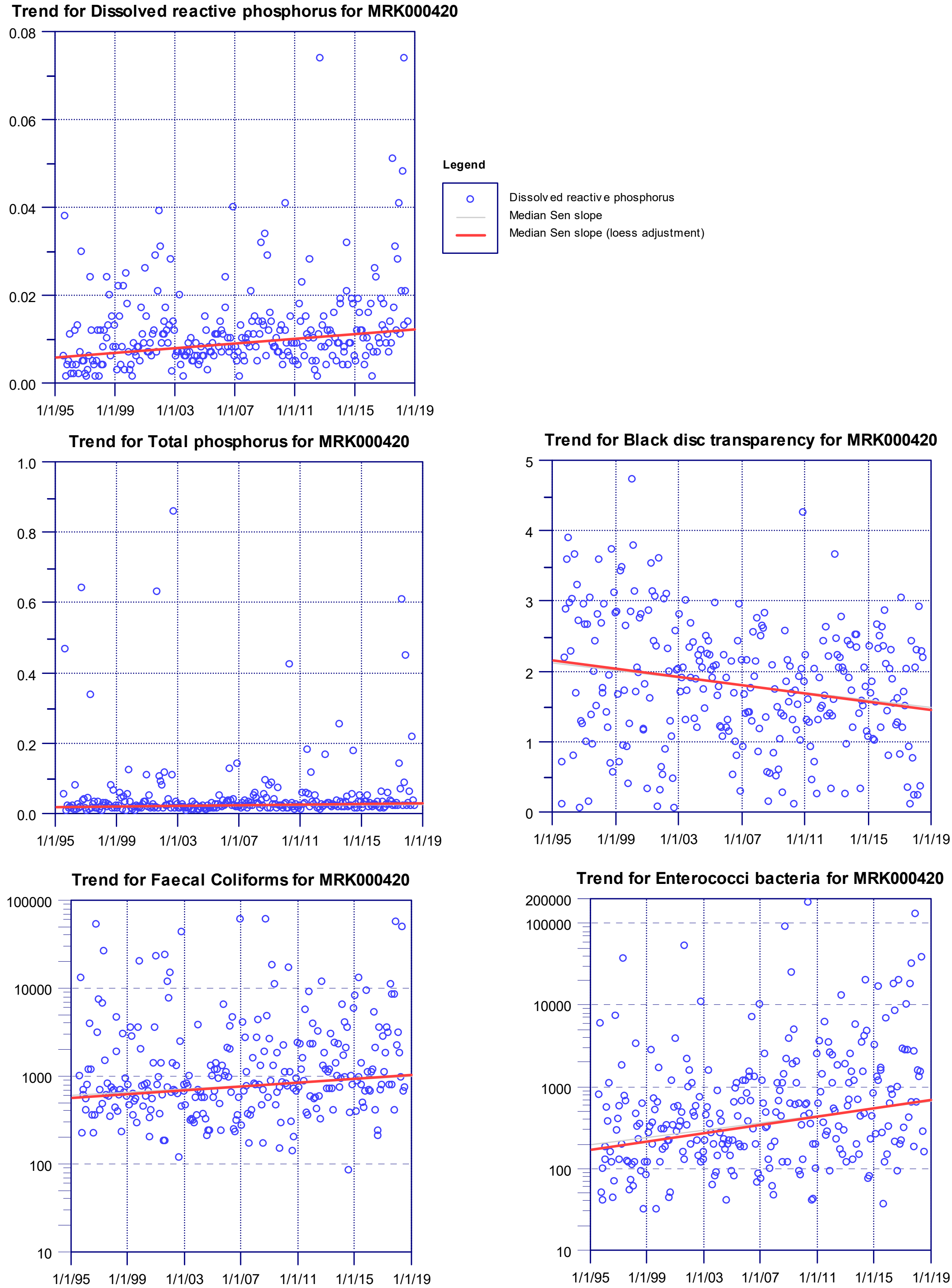


Figure 12 (cont) Scatterplots of selected parameters for selected sites where significant trends have been reported (flow adjusted data and LOWESS trend line (span 30%))

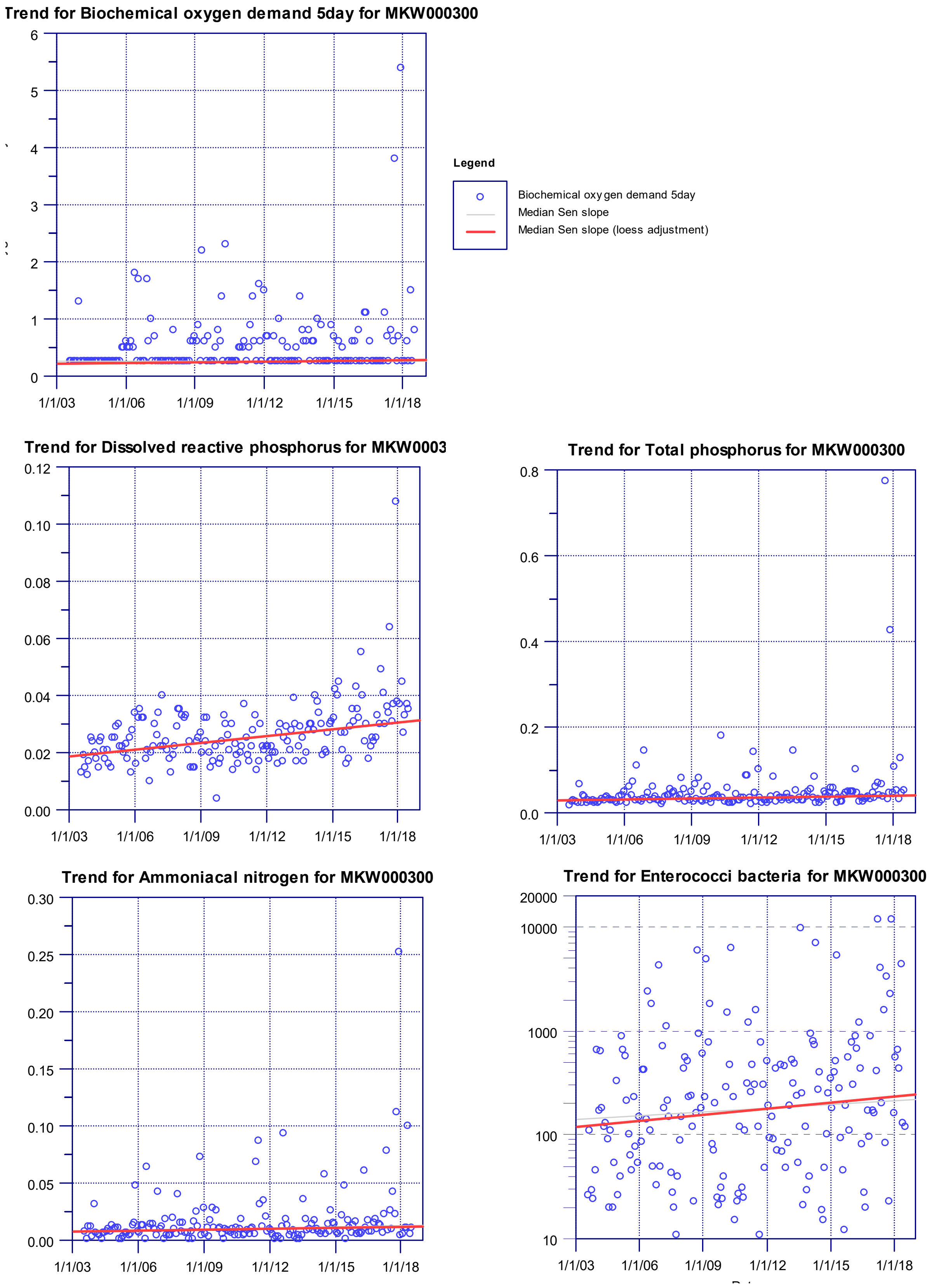


Figure 12 (cont) Scatterplots of selected parameters for selected sites where significant trends have been reported (flow adjusted data and LOWESS trend line (span 30%))

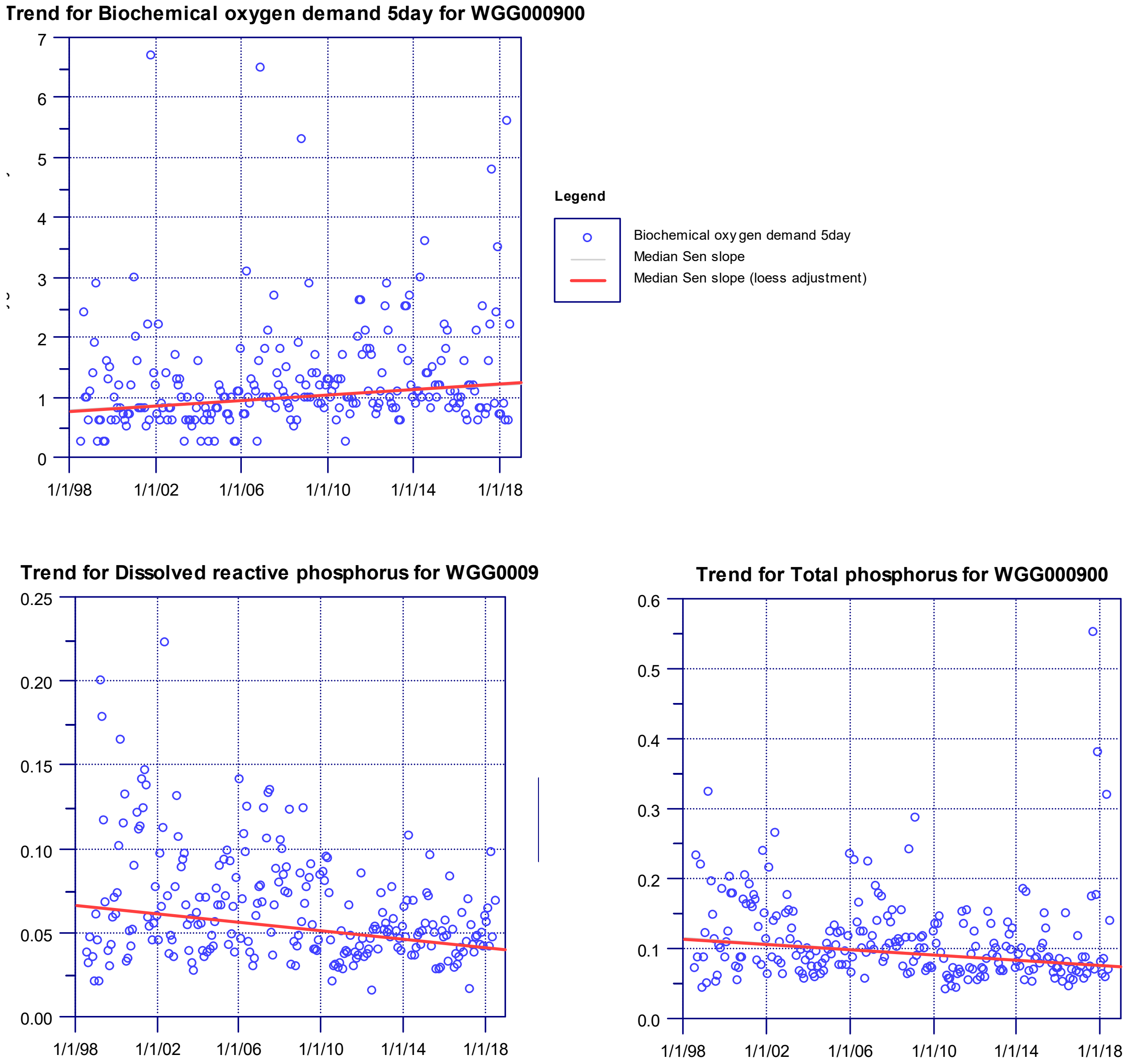


Figure 12 (cont) Scatterplots of selected parameters for selected sites where significant trends have been reported (flow adjusted data and LOWESS trend line (span 30%))

4.4 Trends in physicochemical water quality data from 2011 to 2018

4.4.1 Introduction

Data from State of the Environment physicochemical water quality monitoring programme (11 sites) for the most recent 7-year period (July 2011- June 2018) were trended using the same methodology as for the full record (1995-2018, section 4.3.2) to observe if there were any changes in trends in recent years. The latter is the more meaningful feedback for effectiveness of current policies and interventions.

Physicochemical data from two NIWA sites were also assessed over a 7-year (July 2011-June 2018) and the full record (January 1989-June 2018). Starting from December 2015, Waingongoro site at SH45 is no longer monitored for water quality by NIWA. This is part of a NIWA plan to disestablish many of the pre-existing NRWQN sites and eventually replace with a lesser number of 'benchmark' sites that will include newly created sites and some selected NRWQN sites. Hence, there will be no further trending of NIWA information at this site and comparison with TRC data will not be discussed. (For previous analysis, refer to TRC, 2015)

Only significant 'real' trends are shown i.e., those significant trends where there was greater than 1% change per year for physicochemical parameters were considered 'real' trends with a change of a magnitude which could be ecologically significant as well.

An overall summary for the physicochemical water quality monitoring programme comparing the long term and short term trend is provided, together with a summary for each catchment.

4.4.2 Results of trend analysis

Overall, there were some differences between the long term and short term record, in the relative number of measures showing improvement, no significant change or deterioration (Table 49). There are more measures showing no significant trend in the short term record compared to the long term record. This is the result of fewer measures showing either improving or deteriorating trends in nutrients, organics and aesthetics, indicating wider stability in the recent trends.

Table 49 Summary of physicochemical trends between 23 years and 7 years of data

Statistical level	Total number of trends	
	23 years	7 years
Improvement ($p<0.01$)	7	0
Improvement ($p<0.05$)	1	3
Being maintained	76	85
Deterioration ($p<0.05$)	3	12
Deterioration ($p<0.01$)	23	10
Total	110	110

Comparison of long term trends 1995-2018 (23 years) and 2011-2018 (7 years) analysis.

Nutrients

- 40 of 55 measures of the nutrients (73%) showed maintenance (62%) or improvement (11%) in the long term trend.
- 41 of 55 measures of the nutrients (74%) showed maintenance (71%) or improvement (4%) in the recent 7 year trend.

Bacteria

- 16 of 22 measures of bacterial levels (73%) showed maintenance (71%) or improvement (4%) in the long term trend.
- 20 of the 22 measures of the bacterial levels (91%) showed maintenance in the recent 7 year trend.

Organics

- 9 of 11 measures (82%) of organics contamination showed maintenance in the long term trend.
- 21 of 22 measures of organics (95%) showed maintenance and one measure showed improvement (5%) in the recent 7 year trend.

Aesthetics

- 19 of 22 measures (86%) of aesthetics showed maintenance (81%) or improvement (5%) in the long-term trend.
- 20 of 22 measures of the aesthetics (91%) showed maintenance in the recent 7 year trends.

Specific changes in trends for nutrients, bacteria, organics and aesthetics are shown in Figure 13.

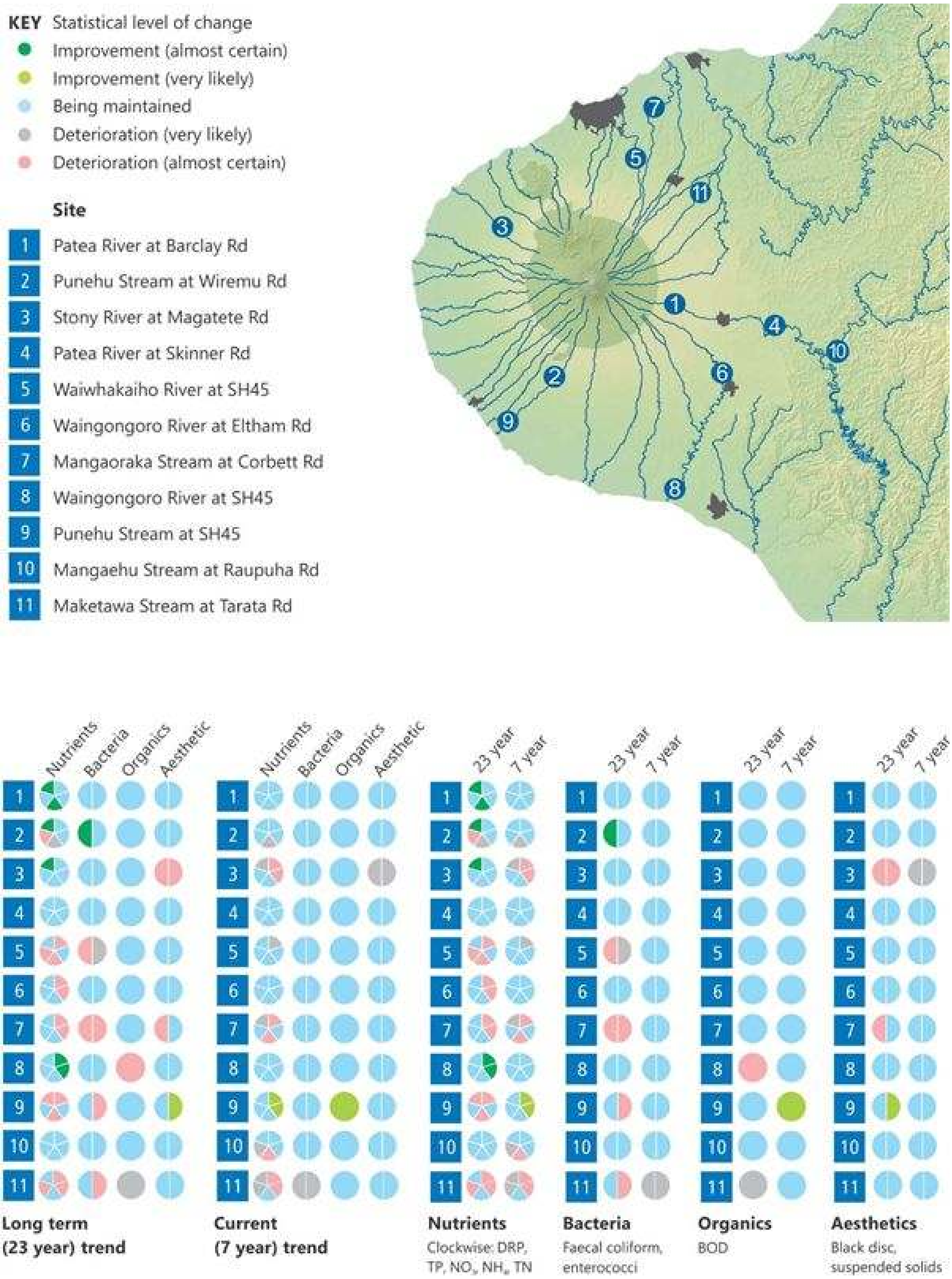
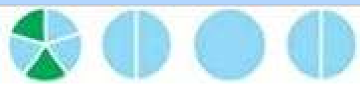
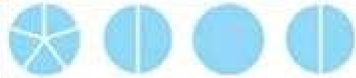
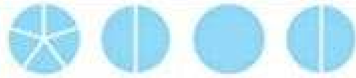
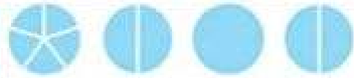
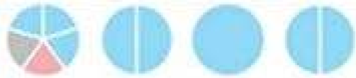


Figure 13 Specific changes in trend for nutrients, bacteria, organics and aesthetic parameters in the long term (23 years) and current (7 years) trend

4.4.2.1 Patea River catchment

- At the upper site Barclay Road, significant long term deterioration in NO_3 and continued in the 7 year trend. Other parameters are not changing significantly.
- At the middle site Skinner Road, long term and recent trends are not changing significantly for all parameters measured.
- The Mangaehu River has shown deterioration over the short term for NO_3 and NH_4.

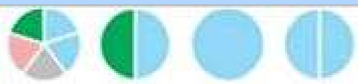
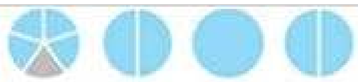
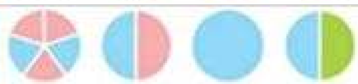
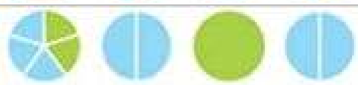
Sites	Records	Nutrients Bacteria Organics Aesthetic	
Patea River at Barclay Road (upper catchment)	23 year trend	1	
	7 year trend	1	
Patea River at Skinner Road (middle catchment)	23 year trend	4	
	7 year trend	4	
Mangaehu River at Raupuha Road (lower catchment)	23 year trend	10	
	7 year trend	10	

Key: Nutrients: Clockwise: DRP, TP, NO_3, NH_4, TN
Bacteria: Faecal coliform, enterococci
Organics: Biological oxygen demand
Aesthetics: Black disc, suspended solids

4.4.2.2 Punehu Stream catchment

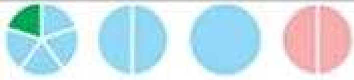
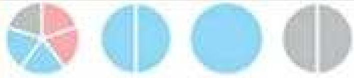
- At the upper site Wiremu Road, significant long term improvement in TN and faecal coliforms did not continue in the short term trend. Significant deterioration in NH_4 recorded in the long term trend did not continue in the 7 year trend. Other parameters are not changing significantly.

At the lower site SH45, the long term deteriorating trends in DRP, NO_3, TN and enterococci are not present in the 7 year trend, with DRP reversing to show improvement. Long term improvement in suspended solids was not recorded in the short term. BOD and TP have improved in the short term.

• Sites	Records	Nutrients Bacteria Organics Aesthetic	
Punehu Stream at Wiremu Road (upper catchment)	23 year trend	2	
	7 year trend	2	
Punehu Stream at SH 45 (lower catchment)	23 year trend	9	
	7 year trend	9	

4.4.2.3 Stony River catchment

- Significant improvement recorded in the long term trend for TN had reversed in the recent 7 year period, with significant deterioration recorded. However, significant deterioration in clarity and suspended solids ~~was~~ recorded in the long term trend have reduced in the recent trend.
- DRP and TP show significant deterioration in the recent 7 year trend.

Sites	Records	Nutrients Bacteria Organics Aesthetic
Stony River at Mangatete Road (middle catchment)	23 year trend	3 
	7 year trend	3 

Key: Nutrients: Clockwise: DRP, TP, NO_3, NH_4, TN
Bacteria: Faecal coliform, enterococci
Organics: Biological oxygen demand
Aesthetics: Black disc, suspended solids

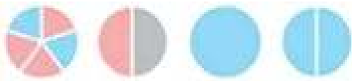
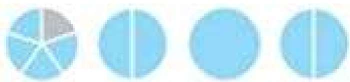
4.4.2.4 Maketawa River catchment

- Significant long term deterioration in DRP, TP and NH_4 continued in the 7 year trend. However, deterioration in organics has tapered off in the 7 year trend.
- The 7-year trend showed deterioration for all nutrient species except NO_3 and both bacteria.

Sites	Records	Nutrients Bacteria Organics Aesthetic
Maketawa River at Tarata Road (middle catchment)	23 year trend	11 
	7 year trend	11 

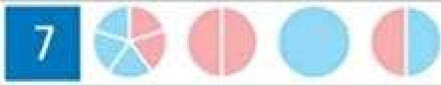
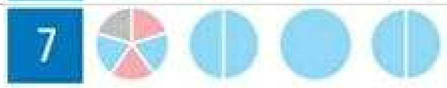
4.4.2.5 Waiwhakaiho River

- Significant long term deterioration was recorded for DRP, NO3, NH_4 and faecal coliforms at this mid catchment site, with enterococci also deteriorating.
- These trends had tapered off in the 7 year trend, except for deterioration of DRP. Other parameters are not changing significantly.

Sites	Records	Nutrients Bacteria Organics Aesthetic
Waiwhakaiho River at SH45 (middle catchment)	23 year trend	5 
	7 year trend	5 

4.4.2.6 Mangaoraka Stream (Waiongana Stream catchment)

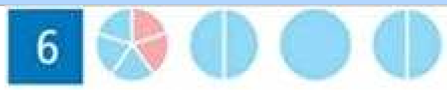
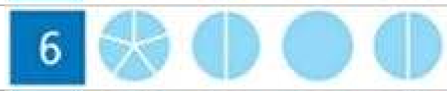
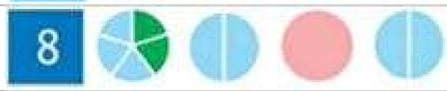
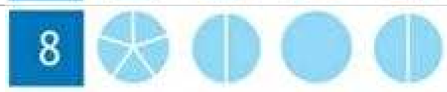
- Significant long term deteriorations were recorded for DRP, TP, faecal coliforms, enterococci and black disc. These trends had tapered off in the 7 year trend, except for DRP.
- The 7 year trend showed deteriorating trend in DRP, NO_3 and TN, while other parameters are not changing significantly.

Sites	Records	Nutrients Bacteria Organics Aesthetic
Mangaoraka Stream at Corbett Road	23 year trend	
	7 year trend	

Key: Nutrients: Clockwise: DRP, TP, NO_3, NH_4, TN
Bacteria: Faecal coliform, enterococci
Organics: Biological oxygen demand
Aesthetics: Black disc, suspended solids

4.4.2.7 Waingongoro River catchment

- At the upper site Eltham Road, significant long term deterioration in DRP and TP tapered off in the 7 year trend. Other parameters are not changing significantly.
- At the lower site SH45, significant improvements in DRP and TP were recorded in the long-term trend. BOD showed significant deterioration in the long-term trend. These trends tapered off in the recent 7 year trend. Other parameters are not changing significantly.

Sites	Records	Nutrients Bacteria Organics Aesthetic
Waingongoro River at River Road	23 year trend	
	7 year trend	
Waingongoro River at SH45	23 year trend	
	7 year trend	

4.4.3 NIWA State of the Environment sites

Physicochemical data from two NIWA sites in the Taranaki region were also assessed over a 7 year (July 2011-June 2018) and the full record spanning from January 1989 to June 2018 (Table 50). In order to accurately compare the TRC and NIWA data, a 23-year trend has been compiled (TRC data spans from 1995).

Summary of trend results for NIWA sites is as follows:

- In the Waitara River, long term deterioration for the nutrients, (DRP, NO_3, and TN) have tapered off and appear to be stable in the last 7 years.
- In the Manganui River, recent significant deterioration for TP and deterioration for DRP were recorded in the 7 year trend.
- Note that suspended solids and BOD are not recorded by NIWA, and bacteria had been recorded only since 2005; as such these parameters are not included in the tables below.

Table 50 Meaningful' trends in surface water quality at NIWA's monitoring sites in Taranaki

Site	Record (years)	Dissolved Reactive P	Total Phosphorus	Nitrate	Ammoniacal-N	Total Nitrogen	Conductivity	Black Disc	Temp˚C	pH	Total no sites:	Improvement	No change	Deterioration
Waitara River at Bertrand Rd Bridge	29	● (pink)	● (pink)	● (pink)	● (blue)	● (pink)	● (blue)	● (blue)	● (blue)	● (blue)		0	5	4
	23	● (blue)	● (blue)	● (pink)	● (pink)	● (pink)	● (blue)	● (blue)	● (blue)	● (blue)		0	6	3
	7	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)		0	9	0
Manganui River at SH3	29	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)		0	9	0
	23	● (blue)	● (blue)	● (blue)	● (pink)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)		0	8	1
	7	● (grey)	● (pink)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)		0	7	2

Key
- ● statistically significant **improvement** P<0.01
- ● statistically significant improvement P<0.05
- ● no statistically significant change
- ● statistically significant **deterioration** P<0.05
- ● statistically significant **deterioration** P<0.01

4.5 Addition of new water quality sites for NPS-FW monitoring purposes

The RMA requires [Section 35 (2)(a)] the Council to:

'*monitor the state of* ***the whole or any part of*** *the environment of its region.... .****to the extent that is appropriate*** *to enable the local authority to effectively carry out its functions under this Act;...'*.

The Council has had SEM of fresh water in place since 1995, through a number of specific programmes. These have been audited by the Office of the Auditor-General, as well as by other independent experts, and found each time to be fit for purpose. The programmes have targeted areas with the greatest pressures upon or changes in the water resources of the region, to determine how and why water quality might be changing and the effectiveness of the Council's interventions.

However, the NPS-FW now requires, in addition, that the Council *'identifies a site or sites at which monitoring will be undertaken that are* ***representative for each freshwater management unit'*** [Policy CB1 (b)]. All freshwater in every region must be incorporated into a Freshwater Management Unit (FMU) as defined within the NPS.

This Council has identified four FMUs for the Taranaki region: water bodies of outstanding value; the ring plain; the northern and southern coastal terraces; and the eastern hill country. In terms of the distribution of the current SEM sites for monitoring fresh water, Council staff determined that two more sites within the eastern hill country were needed for the purpose of representativeness of FMUs. Accordingly, since July 2015 Council staff have been undertaking sampling for water quality monitoring purposes at two new sites: Waitara River near Tarata in the northern hill country, and the Whenuakura River at SH 3, on the southern borders of the hill country. Results from these sites are reported for the third time herein.

5 Conclusions

The physicochemical component of the SEM programme which commenced in July 1995, with monthly sampling performed at nine river and stream sites, in seven selected catchments, continued from July 2017 through to June 2018. From mid-1998 an additional site in the lower reaches of the Waingongoro River was included, and a site in the lower reaches of the Maketawa Stream was added in mid-2003. Sites in the mid-reaches of the Waitara River and lower reaches of the Whenuakura River were added in July 2015, and thus 2017-2018 was the third full year of sampling. Sampling in the year under review coincided randomly with a wide range of flow conditions in the 2017-2018 period (in comparison with the previous 22 year period), ranging from high floods through to relatively low flow conditions but was characterised by more fresh events than typical during previous years. This report provides monthly data for up to 22 parameters and a statistical summary of the twelve months' data for each of the sites, and compares this period's water quality with the previous 22 years' data. It also provides an up-to-date statistical summary of the 23 years' data to date for all sites and discusses, in brief, comparative water quality at these sites.

River and stream waters were generally of moderate to good quality, particularly at sites in the upper reaches of ring plain catchments, with some deterioration in a downstream direction coincident with increased run-off, possible stock access, and point source discharges. This was illustrated particularly by decreased clarity and increased nutrient levels and bacteriological numbers, and wider water temperature and pH ranges in a downstream direction. Aesthetic quality deterioration was also coincident with increased flows following, or during, the freshes. However, dissolved oxygen levels remained high and there was little evidence of significant organic contamination (i.e. BOD_5 concentrations were generally less than 1.0 g/m^3 except during freshes).

The eastern hill country river sites in the mid and lower reaches were characterised by some dissolved colour, relatively high turbidity, poorer clarity, and slightly to moderately elevated suspended sediment concentrations.

Although the upper site in the Punehu Stream was located within 3 km of the National Park boundary, influence of the open developed farmland section of the relatively short reach below the National Park boundary on aspects of water quality has been documented. This was illustrated by poorer clarity, and higher temperature and bacteriological numbers than might be expected for a ring plain stream sampled in the reach near the National Park boundary. The relatively open nature of the reach between the National Park and the sampling site contributed to these aspects of the water quality measured, although more recently riparian planting has been performed in this reach.

Flows in 2017-2018

During the 2017-2018 period, median flows sampled were all higher than typical of those sampled during the previous 22-year period. For the eleven sites monitored over at least 10 years, median flows were higher over the latest period (by 26 to 283%), compared with the long-term median of sampled flow records (Table 51).

Table 51 Comparison of 2017-2018 water quality with previous long-term (1995-2017) data (using median values) for each SEM site

Parameter Site	Black disc	Conductivity @ 20°C	BOD_5	Faecal coliform bacteria	Enterococci bacteria	Nutrients					pH	Dissolved oxygen saturation	Suspended solids	Temperature	Turbidity	Flow (L/s)	Flow (%)
						Ammonia-N	Nitrate-N	Total N	DRP	Total P							
Maketawa Stream at Tarata Road	=	=	XX	XX	XX	=	=	=	XX	X	=	=	=	=	X	508	26↑
Mangaoraka Stream at Corbett Road	=	=	X	XX	XX	X	=	=	XX	XX	=	=	=	=	=	616	52↑
Waiwhakaiho River at SH3	X	=	=	XX	XX	=	=	✓	X	=	=	=	XX	=	XX	2,653	70↑
Stony River at Mangatete Road	XX	=	=	XX	XX	=	XX	XX	=	XX	=	=	XX	=	XX	1510	42↑
Punehu Stream at Wiremu Road	X	=	XX	XX	XX	XX	XX	XX	=	=	=	=	XX	=	XX	1,232	283↑
Punehu Stream at SH45	X	=	=	XX	XX	=	=	=	=	=	=	=	XX	=	XX	1,291	234↑
Waingongoro River at Eltham Road	=	=	=	XX	XX	X	✓	=	XX	X	=	=	XX	=	X	2,478	152↑
Waingongoro River at SH45	X	=	XX	XX	XX	XX	=	=	=	=	=	=	XX	=	XX	7,532	156↑
Patea River at Barclay Road	X	=	=	XX	XX	XX	=	✓	=	=	=	=	=	=	X	458	212↑
Patea River at Skinner Road	=	=	=	XX	XX	=	=	=	=	X	=	=	XX	=	X	2770	94↑
Mangaehu River at Raupuha Road	X	=	=	XX	XX	XX	XX	=	X	XX	=	=	XX	=	XX	3,400	48↑
Whenuakura River at Nicholson Road	XX	=	=	X	XX	=	=	X	X	XX	=	=	XX	=	XX	6,011	102↑
Waitara River at Autawa Road	XX	=	=	=	XX	XX	XX	X	X	XX	=	=	XX	=	XX	11,877	54↑

[KEY: Improvement by ≥50% (✓✓); 21-49% (✓): no significant change (=): deterioration by 21 to 49% (X); ≥ 50% (XX)]

[Notes: Whenuakura River and Waitara River data collection commenced in mid 2015; Maketawa Stream data collection commenced in mid 2003; Waingongoro River at SH45 data collection commenced in mid 1998]

Aesthetic and physical parameters in 2017-2018

Generally, for the sites monitored at least 10 years, water quality in the 2017-2018 period (Table 51) showed similar to much poorer **black disc clarity, suspended solids and turbidity** levels, compared with the long-term monitoring record. Eight of the eleven sites deteriorated in all three measures, and ten sites showed increased turbidity. Median water **temperatures** were similar in the year under review, and narrower temperature ranges were measured, mainly due to higher minimum temperatures (in comparison with the longer period).

Median **dissolved oxygen saturation and pH** showed no significant differences in the latest period (Table 51). **BOD_5 concentration** increased at one upper (Punehu), two mid (Maketawa and Waiwhakaiho) and one lower (Waingongoro) catchment site and was similar for the other sites, between the two periods.

Nutrients in 2017-2018

A majority of sites' median nutrient levels remained similar in the 2017-2018 period to those over the longer period. A few improvements in median nutrient species (nitrate nitrogen at one site and total nitrogen at two sites) were recorded. Deterioration was found in median nitrate nitrogen (at two of eleven sites, by more than 50%), ammoniacal nitrogen (at four sites), total nitrogen (at two sites), dissolved reactive phosphorus (at five sites) and total phosphorus (at six sites) (Table 51). On an overall view, ammoniacal nitrogen and dissolved and total phosphorus levels showed more increases and no decreases, with nitrate and total nitrogen showing a few increases and decreases. This is consistent with the high proportion of fresh events sampled.

Bacteria in 2016-2017

Overall, there was a deterioration in bacteriological water quality, with all sites worsening. Bacteria numbers increased by more than 50% at all sites in terms of median enterococci numbers during the 2017-2018 period. This general trend of deterioration in bacteriological water quality during 2017-2018 almost certainly was a consequence of the increased proportional frequency of sampling of freshes during the 2017-2018 period compared with that over the longer period.

Trends

This TRC programme is complemented by the two sites surveyed by NIWA as a component of the New Zealand surface water quality network (Smith et al, 1989). These sites' data have been made available for TRC usage and a brief summary and discussion have been provided in this report. Other aspects (e.g. trends) will be reported upon elsewhere by NIWA.

A trend assessment has been performed upon eleven TRC sites over the 1995-2018 period (including one site for the 1998-2018 period and one site for the 2003-2018 period) and summarised in this Annual Report. Trend analysis has also been performed on the two NIWA sites. This complements earlier trend analyses.

In conclusion, long term (23-year) physicochemical trends have indicated significant deterioration for some parameters at some sites, especially for nutrients mainly in the middle and lower catchments, alongside stability in most measures and some improvements. Overall, between 55% and 91% (depending on the parameter) of results show either maintenance or improvement in water quality.

A significant improvement in aspects of temporal water quality (mainly nutrients) has been found at the site in the lower Waingongoro River, coincident with the reductions between 2001 and 2010 in waste loadings discharged by industry and the township to the river in mid catchment at Eltham (TRC, 2015a). Dissolved reactive phosphorus and total phosphorus have been the main nutrients showing significant deterioration in the Waingongoro River at Eltham Road, and Punehu Stream at SH 45 where nitrate has also deteriorated. The Waiwhakaiho River site at SH3 has also recorded a significant deterioration in DRP and nitrate and ammoniacal nitrogen. The trends for these three sites have indicated that phosphorus level is increasing at a steady but slow rate. All three sites are situated in catchments with intensive agricultural land use. However there has been a significant improvement in total nitrogen at three of the eleven sites monitored, with the lower Punehu being the only site showing any degree of deterioration in total nitrogen over the long term (a trend which has disappeared in recent years).

One mid-reach site, the Maketawa Stream at Tarata Road, and one lower reach site, the Waingongoro River at SH45, have shown significant long term deterioration in BOD_5 although concentrations have remained consistently below the recognised criterion of $2g/m^3$ at these sites.

Faecal coliforms and enterococci trends generally have not altered significantly over the 23-year period at the majority of sites. However, two sites of the eleven have shown significant deterioration, one in each of the lower or mid reaches, and one site, in an upper reach, has shown improvement.

Fluctuating trends for black disc clarity and suspended solids reflect the historical erosion events in the headwaters of the Stony River. Significant deteriorations in black disc clarity were also recorded for the Mangaoraka Stream at Corbett Road. All sites have had insignificant trends for conductivity, temperature, and pH.

Over the long term, the Waiwhakaiho River (mid catchment) and Mangaoraka Stream (lower catchment) show the greatest degree of deterioration; both sites show much less or no deterioration at all in recent years.

On a site specific basis comparing the 2017-2018 period with the previous 22-year historical record, there was much greater variability in water quality in the recent period, with individual sites recording five to nine of the fifteen parameters as having lower quality, with few instances of any improved quality. Differences in comparative water quality were related to the greater proportion of higher flows sampled, with deterioration in visual clarity, turbidity, suspended solids, BOD, bacterial species, ammoniacal nitrogen and phosphorus species. The higher flows sampled may relate to an improvement in nitrate or total nitrogen recorded for three sites, due to dilution. The greatest and smallest variabilities in water quality were exhibited in the Punehu catchment, where the upper site had the most and the lower site the least, indicating the effect of timing when multiple flood events were sampled.

Overall, during the 2017-2018 period water quality parameters' medians differed by more than 20% from 22-year medians for 49% of comparisons (47% deterioration; 2% improvement), and by more than 50% from historical medians for 35% of comparisons (35% deterioration, 0% improvement). This was coincident with higher median flows (26 to 283%) sampled at all of the eleven sites over the 2017-2018 period.

6 Recommendations

1. THAT the existing freshwater physicochemical component of the SEM programme continue in a similar format for the 2018-2019 monitoring year.
2. THAT an additional (split) sample be collected on at least one occasion during the monitoring year, in conjunction with the intra-laboratory quality control programme, for analysis by an external, accredited laboratory.
3. THAT the appropriate trend analysis reported on the datasets for all Taranaki sites over the 1995-2018 period (provided in the current report), be updated for the 1995-2019 period at the conclusion of the 2018-2019 year.

7 Acknowledgements

This programme's Job Manager was James Kitto (Science Advisor) who was the principal author of the Annual Report. Statistical analyses were provided by Fiza Hafiz (Scientific Officers) with the majority of the field sample collection performed by Ray Harris, Rae West and Rachel McDonnell (Technical Officers). Hydrological data were provided by Fiona Jansma (Scientific Officer) with field gaugings performed by Warrick Johnston, Craig Pickford and Regan Diggelmann (Hydrology Officers). Graham Bryers and Mike Crump (NIWA) assisted with the provision of National network data for two Taranaki sites and with the inter-laboratory comparison exercise. All water quality analytical work was performed by the Taranaki Regional Council ISO-9000 accredited laboratory under the supervision of John Williams.

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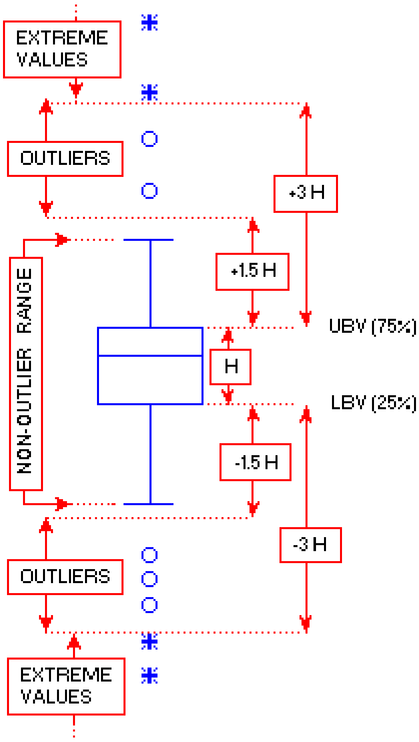
Appendix I

Statistical 'Box & Whisker' Plots of 1995-2018 Water Quality Parameters for all SEM sites

Interpretation of Box and Whisker Plots (produced using STATISTICA)

Box and whisker plots are a useful method of summarising data in a graphical form that allows rapid comparisons of data groups. The data is represented as a box with a whisker from each end.



The median (middle value of the sorted data; half of the data is either side of the median) is represented by a single horizontal line (or ◊ point).

The top and bottom of the box represent the upper (UBV) and lower (LBV) hinges respectively. The median splits the ordered group of data in half and the hinges split the remaining halves in half again. This means that 50% of the data lies within the box.

Hspread, comparable to the interquartile (25% and 75%) range is the difference between the values of the two hinges, i.e., Upper hinge – Lower hinge = Hspread. The inner fences (within whiskers) are defined as follows:

Lower fence = lower hinge – (1.5 x Hspread)
Upper fence = upper hinge + (1.5 x Hspread)

The outer fences (outside whiskers) are defined as follows:

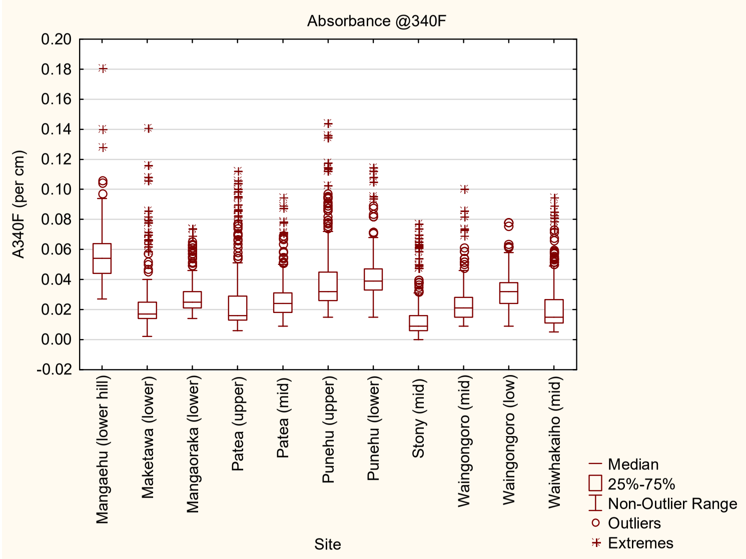
Lower fence = lower hinge – (3 x Hspread)
Upper fence = upper hinge + (3 x Hspread)

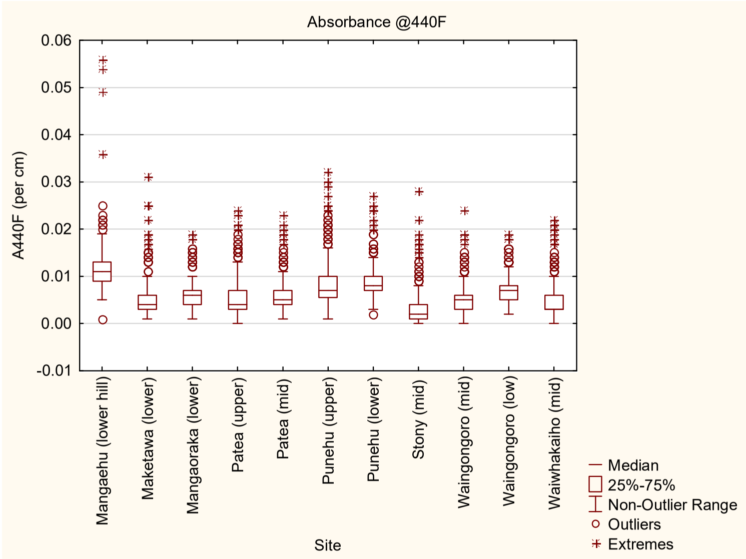
The whiskers show the range of values that lie within the inner fences. Values outside the inner fence are plotted as open circles (o). Values outside the outer fence are plotted as asterisks (*).

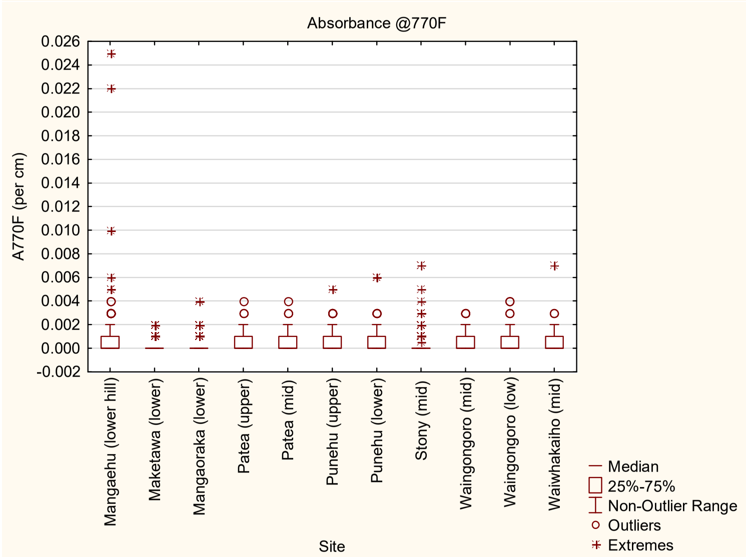
Site locations

Stream	Location
Maketawa Stream	at Tarata Road
Mangaehu River	at Raupuha Road
Mangaoraka Stream	at Corbett Road
Patea River	at Barclay Road
Patea River	at Skinner Road
Punehu Stream	at Wiremu Road
Punehu Stream	at SH45
Stony River	at Mangatete Road
Waingongoro River	at Eltham Road
Waingongoro River	at SH45
Waitara River	at Tarata
Waiwhakaiho River	at SH3
Whenuakura River	at Nicholson Road

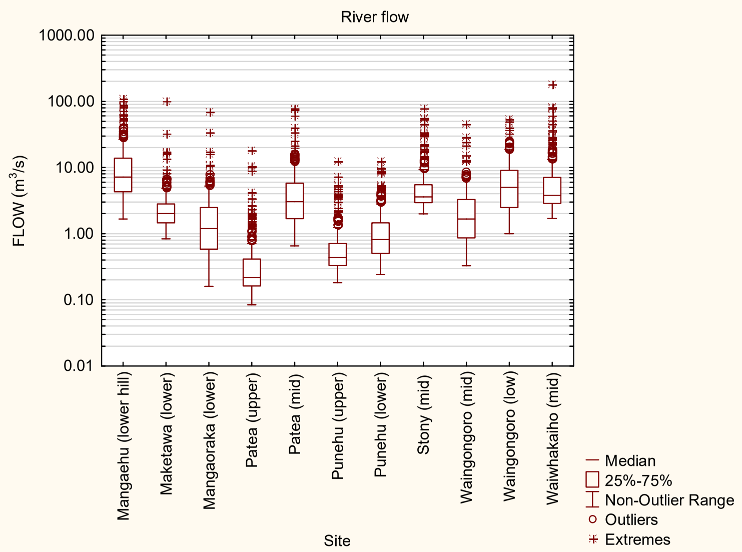
Absorbance (1cm)

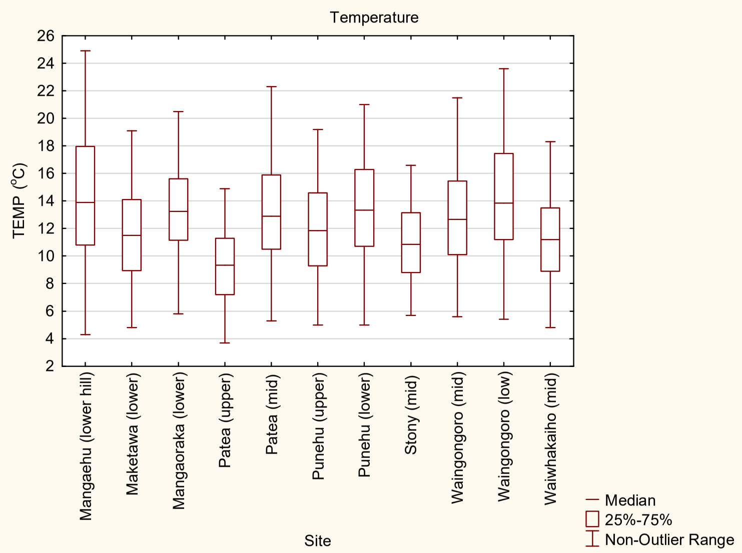


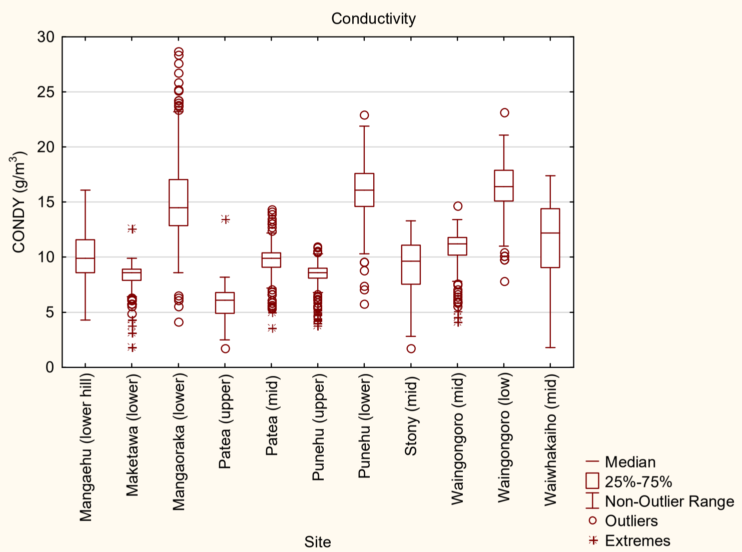


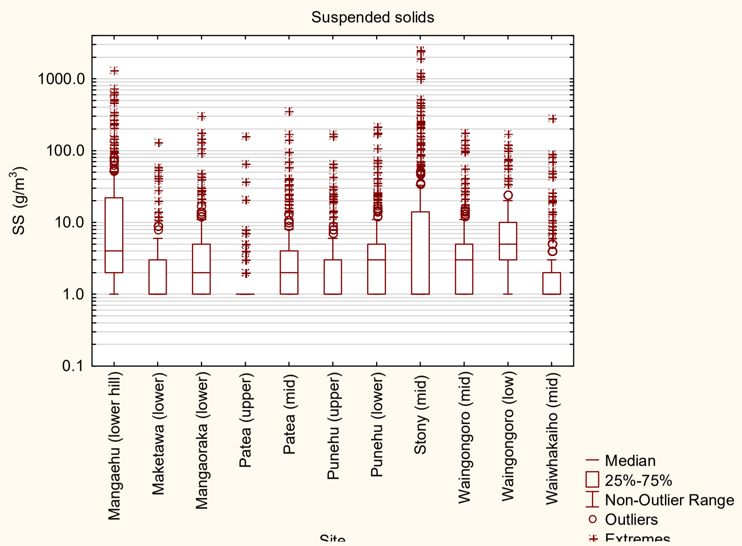


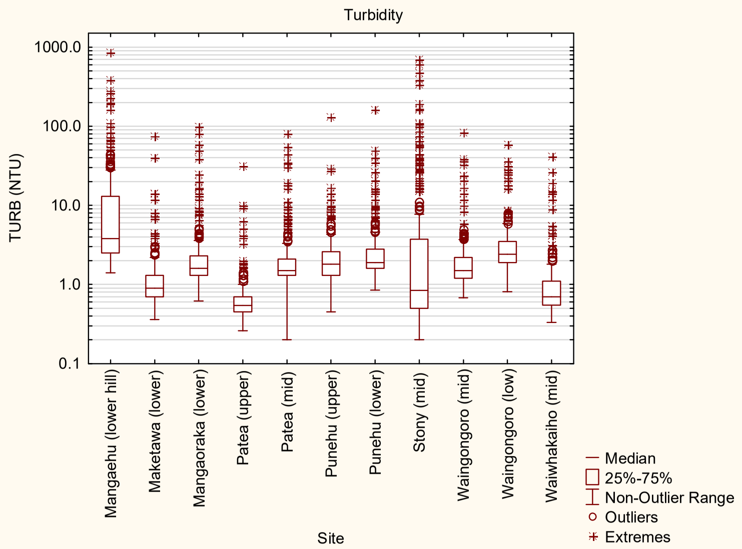
Physical Quality

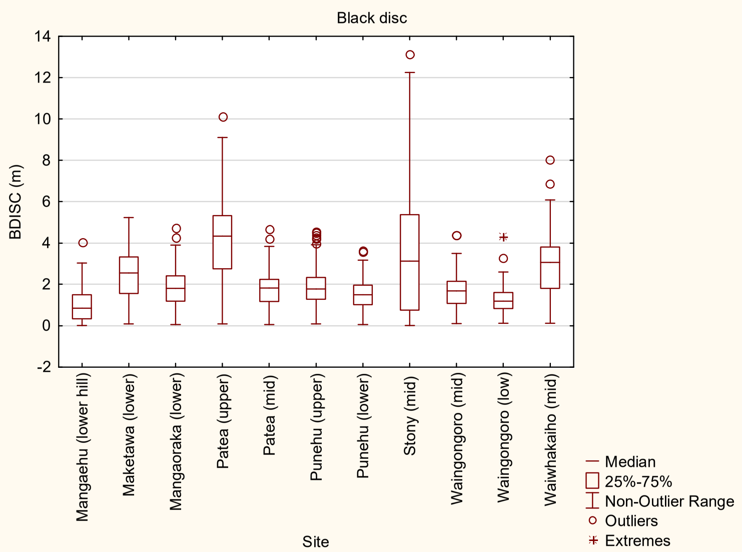


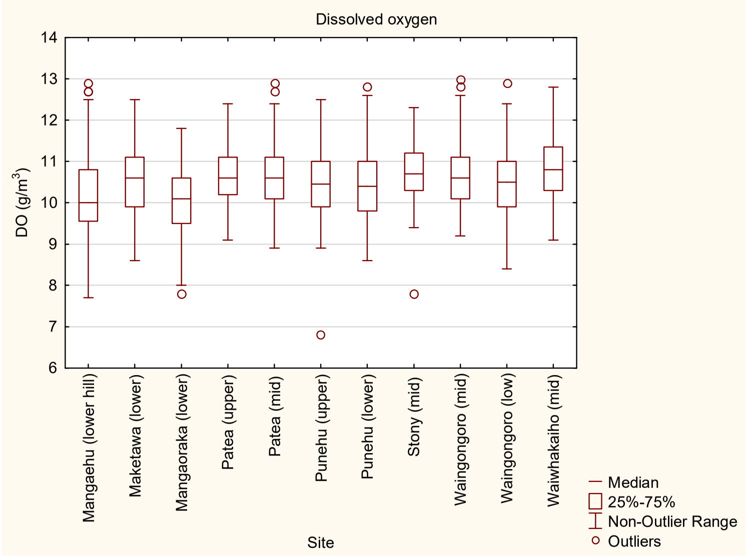


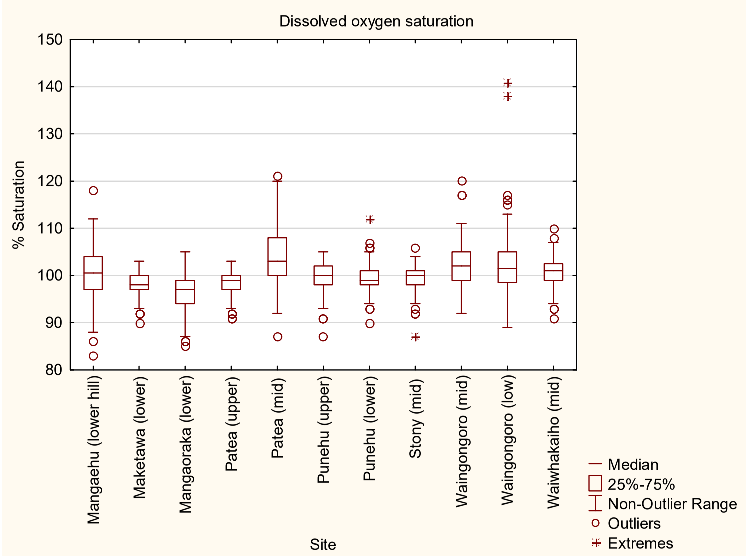


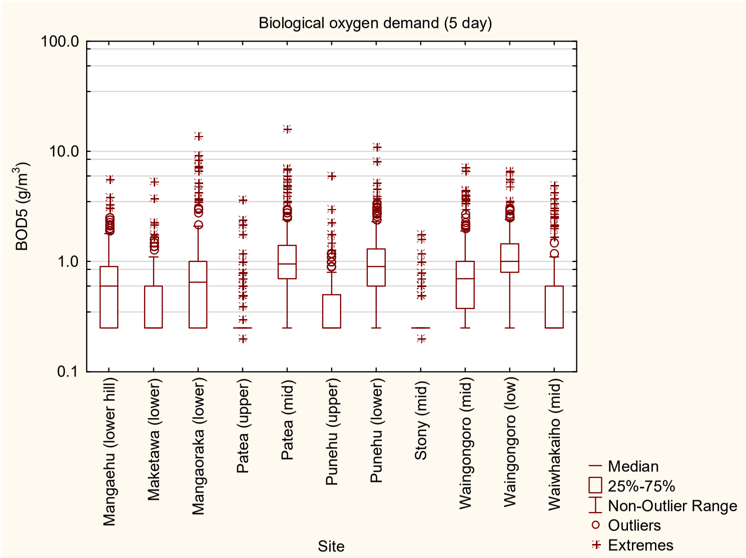

Suspended solids
SS (g/m3)
0.1
1.0
10.0
100.0
1000.0
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Median
25%-75%
Non-Outlier Range
Outliers

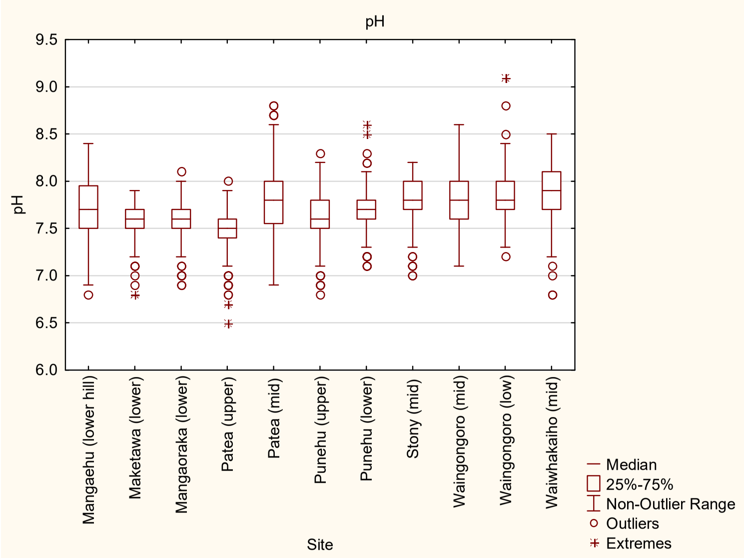

Turbidity
TURB (NTU)
0.1
1.0
10.0
100.0
1000.0
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

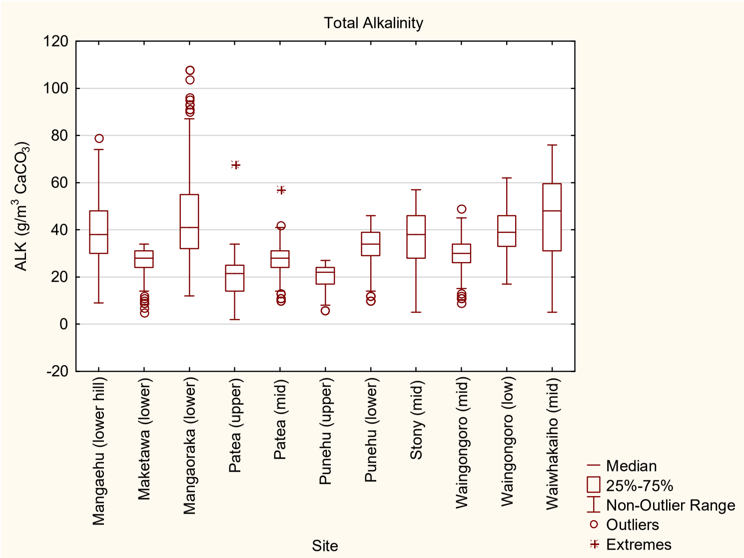

Black disc
BDISC (m)
-2
0
2
4
6
8
10
12
14
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes


Dissolved oxygen
DO (g/m3)
14
13
12
11
10
9
8
7
6
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers

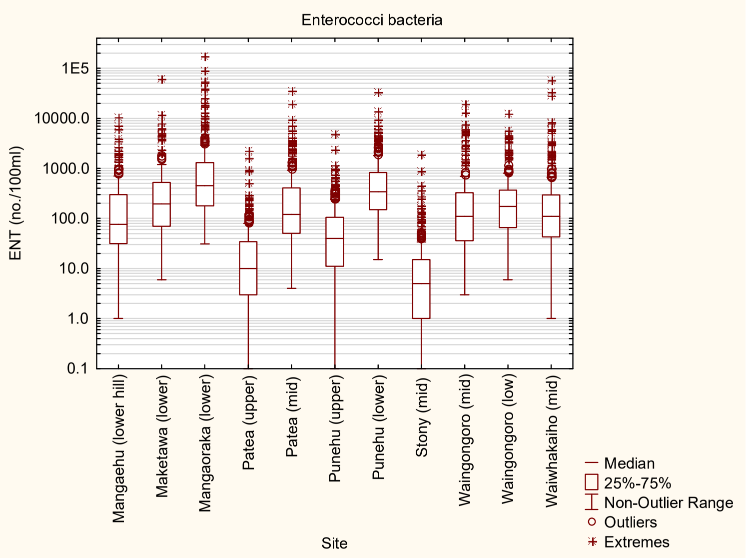

Dissolved oxygen saturation
% Saturation
150
140
130
120
110
100
90
80
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes


Biological oxygen demand (5 day)
BOD5 (g/m3)
100.0
10.0
1.0
0.1
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

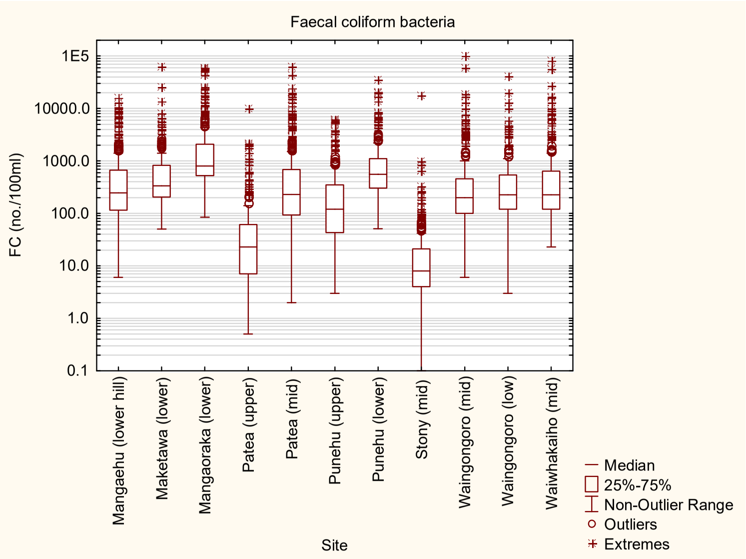

pH
pH
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes


Total Alkalinity
ALK (g/m3 CaCO3)
120
100
80
60
40
20
0
-20
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

Bacteria

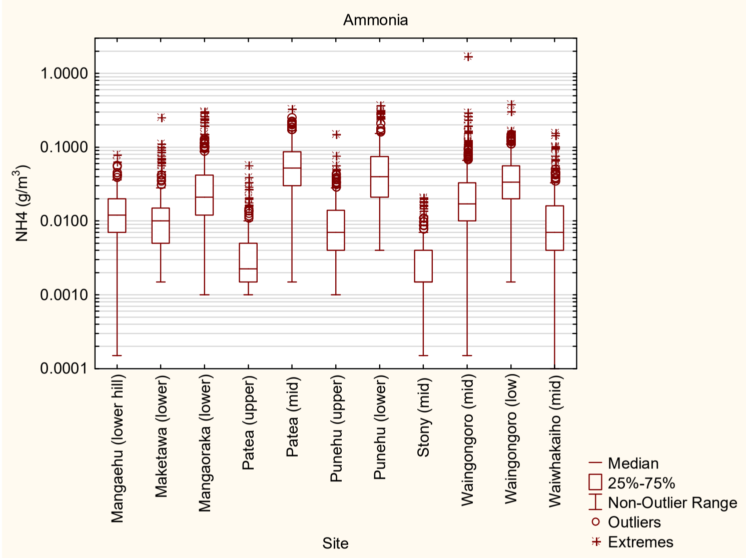


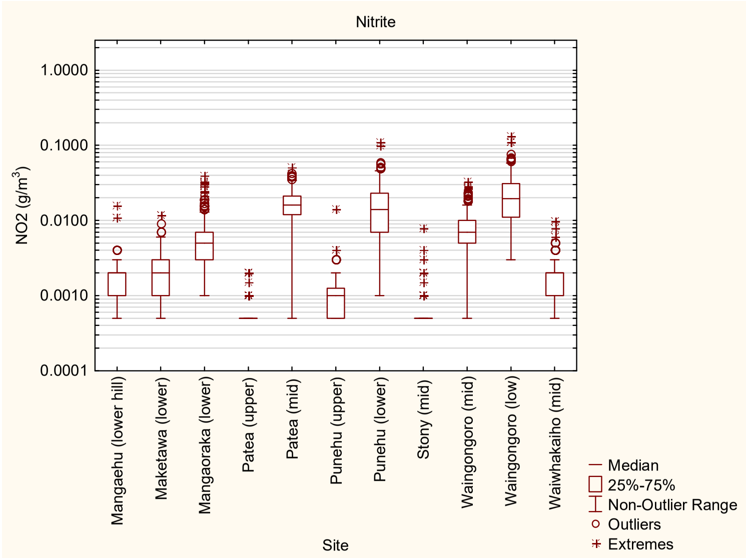
Enterococci bacteria
ENT (no./100ml)
1E5
10000.0
1000.0
100.0
10.0
1.0
0.1
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

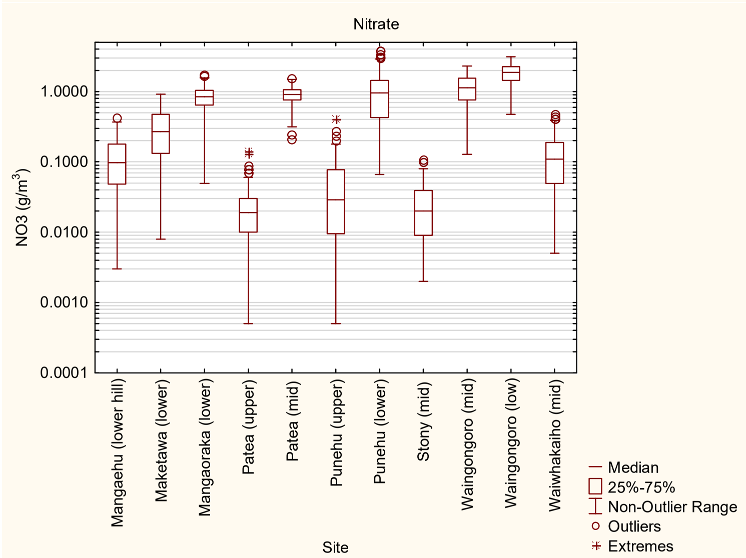


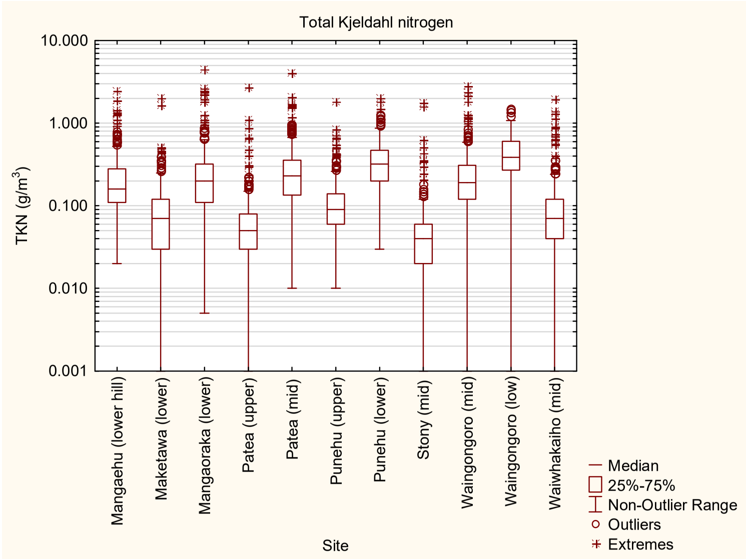
Faecal coliform bacteria
FC (no./100ml)
1E5
10000.0
1000.0
100.0
10.0
1.0
0.1
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

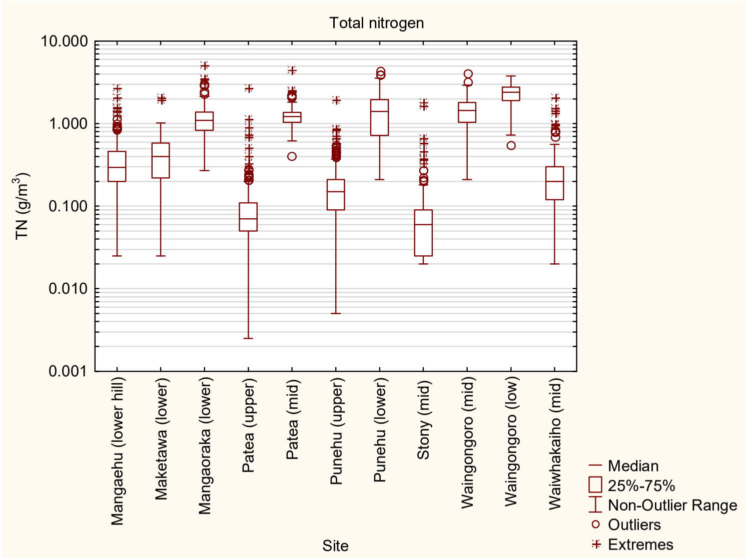
Nutrients

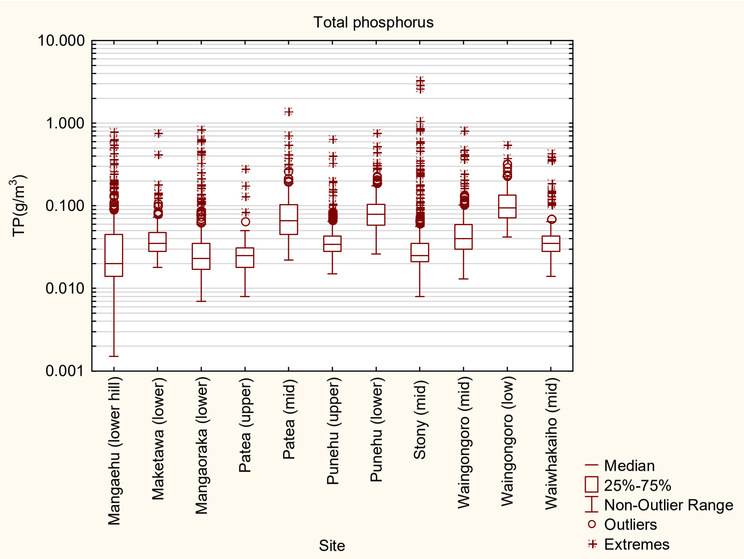

Ammonia
NH4 (g/m3)
1.0000
0.1000
0.0100
0.0010
0.0001
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes


Nitrite
NO2 (g/m3)
1.0000
0.1000
0.0100
0.0010
0.0001
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

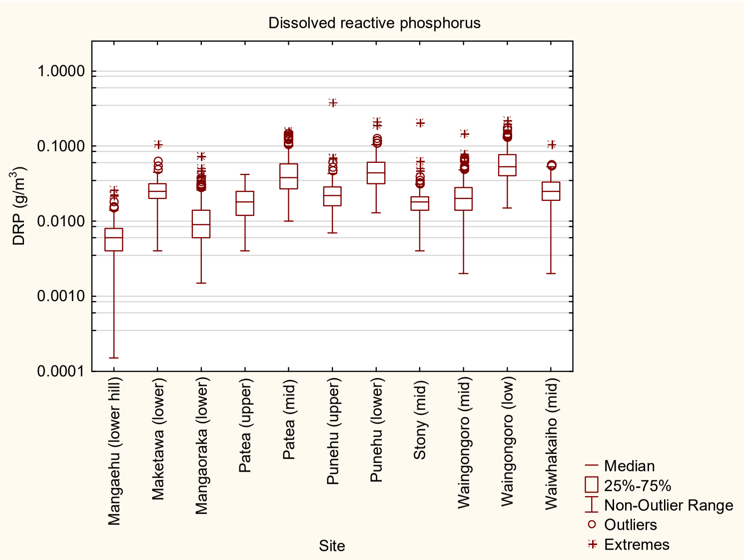

Nitrate
NO3 (g/m3)
1.0000
0.1000
0.0100
0.0010
0.0001
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes


Total Kjeldahl nitrogen
TKN (g/m³)
10.000
1.000
0.100
0.010
0.001
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes


Total nitrogen
TN (g/m³)
10.000
1.000
0.100
0.010
0.001
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes



Total phosphorus
TP(g/m^3)
10.000
1.000
0.100
0.010
0.001
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes



Dissolved reactive phosphorus
DRP (g/m^3)
1.0000
0.1000
0.0100
0.0010
0.0001
Mangaehu (lower hill)
Maketawa (lower)
Mangaoraka (lower)
Patea (upper)
Patea (mid)
Punehu (upper)
Punehu (lower)
Stony (mid)
Waingongoro (mid)
Waingongoro (low)
Waiwhakaiho (mid)
Site
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

Appendix II

Section 6.2 of the Regional Policy Statement for Taranaki 2010

Maintaining and enhancing the quality of water in our rivers, streams, lakes, and wetlands

Background to the issue

Water use is important to economic growth and sustainability in the region. Use of water is a fundamental requirement of most rural based industry and agricultural activities and is appropriate where effects on water quality can be avoided, remedied or mitigated. Water quality refers to the physical, chemical and biological characteristics of water that affect its ability to sustain environmental values and uses. Good surface water quality is important, not only in terms of maintaining healthy rivers and streams but also in terms of water supply purposes, meeting the consumptive demands of Taranaki's agricultural and industrial sectors and protecting the natural character and amenity values associated with particular surface water bodies.

Taranaki's water bodies have generally good to excellent water quality on most physical, chemical and biological measures and comparisons. However, surface water quality is lost or reduced through land or water use activities resulting in point or diffuse source discharges of contaminants to surface water or onto land in circumstances where the discharge may enter water.

Point source discharges (ie: waste discharges from a pipe) commonly occur from a wide range of activities such as industries, urban wastewater treatment systems and farming operations etc. Most are treated and discharged in a manner that ensures that adverse effects on water quality are not significant or are no more than minor. However, multiple point source discharges to the same water body can have a cumulative adverse effect on water quality and point source discharges can contribute to the decline in water quality that occurs down the length of ring plain catchments.The Taranaki Regional Council closely monitors point source discharges and this will need to continue.

The cumulative effects of diffuse (widespread) or non-point source discharges to water, such as runoff from land of leachate of agricultural wastes, nutrients or sediments, are the principal cause of reduced water quality in most catchments in the region. Diffuse source contamination is often attributable to poor land use practices such as the excessive use of fertilisers and agrichemicals to land, grazing of river and stream margins, the direct entry of stock to water, and inappropriate land use on erosion prone land. The effects of diffuse source contamination are also exacerbated by the loss or modification of riparian vegetation along the banks of waterways. The adverse effects of point source discharges are not always significant and some are no more than minor.

The significant issues in relation to maintaining or enhancing surface water quality are:

WQU ISS 1	**Managing adverse effects on water quality arising from point source discharges to water bodies.**
WQU ISS 2	**Managing adverse effects on water quality arising from diffuse source discharges to water bodies.**
WQU ISS 3	**Managing the cumulative adverse effects on water quality arising from both multiple point source discharges and diffuse source discharges to water bodies.**

OBJECTIVE

WQU OBJECTIVE 1

To maintain and enhance surface water quality in Taranaki's rivers, streams, lakes and wetlands by avoiding, remedying or mitigating any adverse effects of point source and diffuse source discharges to water.

POLICIES

Sustainable land management practices

WQU POLICY 1

Sustainable land management practices and techniques that avoid, remedy or mitigate adverse effects on surface water quality will be encouraged, including:

(a) the retention and restoration of effective riparian buffer zones;

(b) the careful application of the correct types and quantity of fertiliser and agrichemicals;

(c) the careful application of the appropriate quantities of farm dairy effluent having regard to topography, land area, weather and soil conditions;

(d) the development, recontouring and restoration of disturbed land to reduce diffuse source discharges of contaminants to water;

(e) farm management practices that avoid, remedy or mitigate the effects of stock entry to rivers and streams, trampling and pugging by stock, overgrazing, and accelerated erosion from inappropriate land use on erosion prone land; and

(f) other land management practices, including the discharge of contaminants to land and the diversion of stormwater runoff to land, which avoid or reduce contamination of surface water.

Riparian management

WQU POLICY 2

The retirement and planting of riparian margins throughout the Taranaki region will be promoted, with a particular focus on ring plain catchments.

Protection of water quality in areas of high natural character

WQU POLICY 3

The water quality of the Stony (Hangatahua) River catchment and other rivers, streams, lakes and wetlands with high natural character, ecological and amenity values such as the Maketawa Stream catchment and parts of the Manganui River catchment will be maintained and enhanced as far as practicable.

Domestic and community water supplies

WQU POLICY 4

The importance of maintaining or enhancing water quality in catchments which are used for domestic and community water supplies will be recognised.

Point source discharges to surface water

WQU POLICY 5

Waste reduction and waste treatment and disposal practices, which avoid, remedy or mitigate the adverse environmental effects of the point source discharge of contaminants into water or onto or into land will be required. This includes the cumulative adverse effects of multiple point source discharges to the same waterbody.

In considering policies in regional plans or resource consent proposals to discharge contaminants or water to land or water, matters to be considered by the Taranaki Regional Council will include:

(a) the actual or potential effects of the discharge on the natural character, ecological and amenity values of the water body, including

indigenous biodiversity values, fishery values and the habitat of trout;

(b) the relationship of tangata whenua with the water body;

(c) the use of water for domestic and community water supply purposes;

(d) the actual or potential risks to human and animal health from the discharge;

(e) the significance of any historic heritage values associated with the waterbody;

(f) the degree to which the needs of other resource users might be compromised;

(g) the allowance for reasonable mixing zones and sufficient dilution (determined in accordance with (a) to (o) of this Policy);

(h) the potential for cumulative effects;

(i) measures to reduce the volume and toxicity of the contaminant;

(j) off set mitigation of the effects of the contaminants;

(k) measures to reduce the risk of unintended discharges of contaminants;

(l) the necessity of the discharge and the use of the best practicable option for the treatment and disposal of contaminants;

(m) the availability and effectiveness of alternative means of disposing of the contaminant;

(n) relevant national guidelines and national environmental standards on catchment management; and

(o) the sensitivity of the receiving environment.

Restoration of water quality

WQU POLICY 6

Where the life-supporting capacity of rivers, streams, lakes or wetlands is under pressure as a result of point or diffuse discharges to surface water, improvements in the biological health and quality of water will be promoted.

For the purposes of this policy, in determining the desired life supporting capacity, the matters to be considered will include:

(a) the existing status of water quality according to a selection of chemical parameters and its consequences for life-supporting capacity;

(b) the existing habitat quality, including the need to maintain and enhance aquatic ecosystems and species;

(c) the degree to which cultural and spiritual values of or customary uses by tangata whenua are affected by existing water quality; and

(d) the natural character, ecological and amenity values of the water body, including indigenous biodiversity values, fishery values and the habitat of trout and the potential for enhancement of those values.

Explanation of the policies

Policy 1 outlines management practices to be encouraged that will contribute to maintaining and enhancing water quality by reducing diffuse source discharges of contaminants.

Policy 2 recognises the significant water quality benefits that can be achieved by maintaining and enhancing existing riparian vegetation and promoting the restoration of riparian margins. Riparian margins help mitigate adverse effects of diffuse source discharges of contaminants by providing buffering capacity and preventing direct entry of stock into waterways. Policy 2 applies throughout Taranaki. However, the focus will be on ring plain catchments, which includes Taranaki's most intensively farmed land and where pressures associated with diffuse source contamination are most significant.

Policy 3 recognises that some rivers, streams, lakes and wetlands are highly valued for their natural character, and ecological and amenity values. Through this policy, the Council seeks to maintain or enhance the quality of water in systems recognised as having high natural character and in-stream values (refer Appendix I).

Policy 4 recognises the importance to people and communities and their health and safety, of maintaining or enhancing water quality in catchments used for domestic or community water supplies. However, nutrients or other contaminants will always be present in water, either from natural sources or from the effects of land use or discharging activities, even if these activities are managed to best practice standards. Investment in appropriate water treatment systems and processes will therefore also be required to ensure the community has suitable potable water.

Policy *5* recognises that there are existing discharges to surface water and that discharges to surface water will be necessary in future. Policy 5 sets out a framework to assess proposals or policy on point source discharges to surface water. It requires waste reduction or treatment practices that avoid, remedy or mitigate adverse environmental effects arising from the discharge of contaminants to land or water from point sources. The policy also states the matters that will be considered by the Taranaki Regional Council including catchment specific values and uses, the degree to which other resource users (both consumptive and non-consumptive) may be affected, the adoption of measures to avoid, remedy or mitigate adverse effects, including off set mitigation measures such as riparian plantings, and any national guidelines.

Where multiple point source discharges occur to the same water body there may be cumulative adverse effects on water quality. These effects are also to be avoided, remedied or mitigated under Policy 5.

Policy *6* relating to life supporting capacity is to establish an overall policy intention to generally upgrade the receiving water environment in those waters in which the life supporting capacity is under pressure. Parameters that may be used to measure life supporting capacity include biological oxygen demand, suspended sediment, dissolved reactive phosphate, nitrate and ammonia levels, pH, temperature, macro-invertebrate community index, the presence of pathogenic micro-organisms, and nuisance algae. The necessity of the discharge itself will be considered under Policy 5.

Related policies

All policies relating to **Section 5.1** [Soil erosion]; Policy 1 of **Section 5.2** [Soil health], **Section 6.1** [Sustainable water allocation], **Section 6.2** [Surface water quality], **Section 6.4** [Wetlands], **Section 6.5** [Land drainage and other associated diversions], and **Section 6.6** [Use of river and lake beds]; Policy 1 of **Section 8.1** [Preservation of the natural character of the coastal environment]; all policies relating to **Section 9** [Indigenous biodiversity], **Section 10.1** [Outstanding natural features and landscapes]; **Section 10.3** [Amenity values]; and **Section 13** [Minerals]; Policy 1 of **Section 15.2** [Regionally significant infrastructure]; and all policies relating to **Section 16** [Issues of significance to iwi].

METHODS OF IMPLEMENTATION

The Taranaki Regional Council will:

WQU METH 1

Maintain a **regional plan or plans** with objectives, policies and methods of implementation to ensure that any adverse effects of point and diffuse source discharges to land and water are avoided, remedied, or mitigated, and that water quality is maintained and enhanced, particularly in water bodies that have high natural character, ecological and amenity values and in those that have relatively poor water quality.

WQU METH 2

Apply regional rules to allow, regulate, and in some instances prohibit the following point source discharges to land and water:

(a) point source discharges of water;

(b) point source discharges of stormwater;

(c) point source discharges from closed landfills;

(d) point source discharges from industrial and trade premises;

(e) point source agricultural discharges;

(f) point source discharges from hydrocarbon exploration; and

(g) other point source discharges.

WQU METH 3

Participate and support the dairy farming industry in the preparation and implementation of a regional action plan under the **Dairying and Clean Streams Accord** and include in that Plan targets for excluding stock from water bodies, farm dairy effluent discharge compliance with resource consents, the protection of regionally significant wetlands, and nutrient management.

WQU METH 4 Implement the **Sustainable Land Management Programme** to promote sustainable land use practices that will avoid, remedy or mitigate the adverse effects of diffuse source discharges.

WQU METH 5 Implement the **Riparian Management Programme** to promote the retirement and planting of riparian margins by:

(a) liaising and consulting with interested land users;

(b) preparing property plans in conjunction with landowners containing property-specific advice on riparian management actions and programmes; and

(c) providing on-going technical advice, information and other assistance to plan holders, promoting riparian management.

WQU METH 6 Consider the use of **financial incentives**, such as the provision of plant material at low cost to landowners, for riparian management purposes.

WQU METH 7 Provide **advice and information** including guidelines**,** to landowners, resource users and the public:

(a) to generally promote awareness of water quality issues;

(b) to encourage the adoption of riparian management principles and practices that avoid, remedy or mitigate adverse effects of diffuse source discharges on water quality; and

(c) on systems, siting, design, installation, operation and maintenance procedures for industrial and agricultural waste treatment and disposal systems.

(d) promote where appropriate the adoption of waste disposal systems that reduce the potential for cumulative adverse effects on water quality.

WQU METH 8 **Advocate**, as appropriate:

(a) to manufacturers and suppliers of agrichemicals, fertilisers and other agricultural compounds, the strengthening of the education and information provision role they play with a view to minimising the likelihood and potential effects of agrichemical and fertiliser application on water quality;

(b) to industrial and agricultural users to adopt waste minimisation or reduction practices and cleaner production technologies to reduce the quantity of contaminants being discharged to the environment;

(c) to industry to prepare and adopt codes of practice and guidelines aimed at reducing the effects of point and diffuse source discharges;

(d) to territorial authorities to construct and upgrade stormwater reticulation systems and wastewater treatment systems where urban developments make such an upgrade desirable; and

(e) to territorial authorities, the Department of Conservation, and other appropriate organisations such as the Queen Elizabeth II National Trust and the Taranaki Tree Trust, that they protect or retire riparian margins.

WQU METH 9	Promote the application and use of relevant **industry codes of practice.**
WQU METH 10	**Liaise or consult** as appropriate with territorial authorities regarding resource consent applications upstream of community water supply abstraction points.
WQU METH 11	Participate in the development and implementation of any **national environmental standards or national policy statements** on water quality or human drinking water standards.
WQU METH 12	**Support**, as and when appropriate, actions by the dairy industry under the Dairy Industry Strategy for Sustainable Environmental Management.
WQU METH 13	**Require** the preparation of **contingency plans** to reduce the risk of a spill that may have significant adverse effects on water quality.
WQU METH 14	**Monitor and gather information** on the state of water quality, pressures on water quality, and responses to management.
WQU METH 15	**Support**, as and when appropriate, **research and investigations** into water quality management including waste treatment options and the cumulative effects of point source discharges on water quality.

Territorial authorities may wish to consider the following methods:

WQU METH 16	Include in **district plans**, policies, rules, guidelines or other information to avoid, remedy or mitigate the adverse effects of land use activities and management practices on water quality.
WQU METH 17	Include in **district plans** and **resource consents,** provisions or conditions for fencing and the retention or planting of riparian vegetation, including rules for the creation of esplanade reserves and esplanade strips when land is subdivided.
WQU METH 18	Consider the use of **financial incentives** such as land purchase or compensation, fencing grants, providing plants, rates relief and other funds.
WQU METH 19	**Plant**, where appropriate, riparian margins on land owned by the territorial authority.

Principal reasons for adopting the objective, policies and methods

The objective, policies and methods of implementation establish a policy framework for water quality issues in the Taranaki region. Their aim is to maintain Taranaki's generally high to excellent water quality and to enhance that water quality by addressing the effects of water contamination from diffuse and point sources.

The objective sets a broad direction for water quality management that seeks to maintain and enhance overall surface water quality in Taranaki's rivers, streams, lakes and wetlands. The objective states that this is to be done by avoiding, remedying or mitigating the adverse effects of point and diffuse source discharges to water through the policies and methods set out. The terms. 'maintain' and 'enhance' as used in the objective are not mutually exclusive terms that require both to be given effect to in all cases. The objective has been adopted to establish a broad region-wide goal but the extent to which surface water quality is maintained and enhanced will be determined on a case by case basis by reference to the policies and methods in the RPS. In some situations it will be appropriate that water quality be maintained and enhanced. In other situations for example where a new or increased discharge to water is proposed, it may not always be practicable to enhance water quality, but a range of matters and considerations have been set out in the Regional Policy Statement by which any adverse effects can be avoided, remedied or mitigated.

In respect of point source discharges of contaminants, the policies and methods focus on regulatory methods (complemented by a mix of non-regulatory methods). Regulation is a simple, efficient and effective method of controlling the adverse effects of these discharges, including their cumulative adverse effects on water quality.

Through rules and other provisions in a regional plan, appropriate levels of control are applied that address point source discharges to fresh water and which also protect water quality in rivers and streams that have high natural character, ecological and amenity values.

In respect of diffuse source discharges – the most significant source of contaminants entering waterways – non-regulatory methods such as advice and information and, in particular, the implementation of the Riparian Management Programme and the Sustainable Land Management Programme are considered appropriate. These programmes have proven to be successful to date in terms of public acceptance, the adoption of sustainable land management practices and the achievement of desired environmental outcomes. Other non-regulatory methods also contribute towards achieving the desired environmental outcomes. Financial incentives will aid in landowner acceptance and co-operation with regard to retiring land, particularly where these incentives support a voluntary approach to land use and management. The approaches for point and diffuse source discharges are considered appropriate having regard to their efficiency and effectiveness and their benefits and costs.

Environmental results anticipated

WQU ER 1

All significant point source discharges to surface water consented and monitored.

WQU ER 2

Any adverse environmental effects of point source discharges to surface water are avoided, remedied or mitigated.

WQU ER 3

Increased planting and fencing along the margins of rivers, streams lakes and wetlands with:

- *90% of dairy farms having riparian management plans by 2016; and*
- *90% of riparian management plans implemented by 2016.*

WQU ER 4

Maintain or enhance surface water quality and the life-supporting capacity of freshwater against a range of physical, chemical and biological measures.

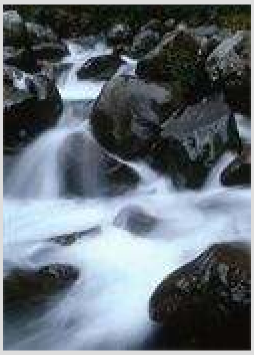
The resource consents process and compliance monitoring

The Taranaki Regional Council's regulatory activities, particularly in the area of resource consent processing and administration and compliance monitoring, is one of the core activities of Council. The level of activity in this area fluctuates from year-to-year depending on the level of economic activity and other factors, but the Council anticipates it will process some 3,000 applications for resource consents (covering coastal, discharge, land use or water permits) over the next ten years.

In relation to water quality, all significant point source discharges to fresh water have a resource consent. Through the resource consents process, discharge activities that may have significant adverse effects on water quality are considered and only allowed subject to compliance with certain conditions (activities that have little or no adverse effects are permitted through rules in the *Regional Fresh Water Plan for Taranaki* – subject to compliance with conditions).

As at 1 April 2009, there were 1,479 discharge consents to surface water in the Taranaki region – 1,046 (or 71%) of which are agricultural discharges. Every discharge activity authorised by resource consent is monitored to ensure that the consent holder is complying with the conditions of that consent. The frequency and extent of that monitoring depends upon the size, scale and nature of discharge activity being monitored as well as the potential environmental impacts of the activity.

Over the last decade, there has been significant investment made by agriculture and industry in waste treatment and disposal systems and the overall level of compliance with consent conditions is high (generally around 95%). As a result, Taranaki rivers and streams show good to excellent water quality against most measures.



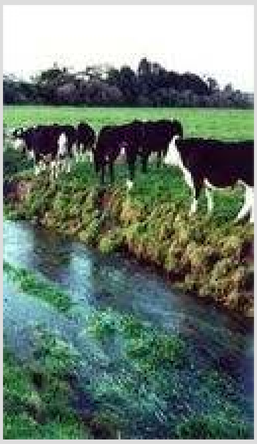
Riparian Management Programme

A major focus of the Taranaki Regional Council's land management work over the next ten years will be to continue to promote the retirement and planting of riparian margins along Taranaki rivers, streams, lakes and wetlands through the Riparian Management Programme.

The Riparian Management Programme, targets dairying land use on the ring plain, and includes the provision of a property planning service to land occupiers involving the preparation of riparian management plans and associated supply of low cost, high quality riparian plants.

Riparian management plans set out recommendations for the retirement or re-vegetation of land along the banks of rivers and streams. The retirement or revegetation of riparian margins forms an interface between the stream and land, preventing stock access, and decreases the amount of diffuse contaminants (in the form of animal excreta, sediment and fertiliser run-off) entering the stream and reducing water quality. Not only does this have major benefits for fresh water quality, it also has benefits for coastal waters into which rivers and streams ultimately flow.

As at 30 June 2009, the Taranaki Regional Council had prepared 2,255 riparian management plans, covering 12,212 kilometres of streambank. Some 93% of Taranaki dairy farms now have a riparian plan for their property. The programme has grown exponentially over time particularly since the implementation of the *Dairying and Clean Streams Accord – Regional Action Plan for Taranaki* has begun to be implemented. There continues to be strong demand for the property planning service and most plan recommendations are being implemented progressively. The Council's target as set out in the Regional Action Plan is to have 90% of dairy farms covered by riparian plans by 2010 and to have 90% implemented by 2015.



Appendix III

SEM Physicochemical Programme TRC Intra-lab Quality Control Report 2017-2018

Background

The Resource Management Act 1991 (RMA) established a requirement for local authorities to undertake environmental monitoring. Section 35 of the RMA requires, among other things, that the state of the environment in the region be monitored to an extent which enables local authorities to effectively carry out the functions under the RMA. In 1995, the Taranaki Regional Council (the Council) established a state of the environment monitoring (SEM) programme for the region. This programme is outlined in the Council's State of the *Environment Monitoring Procedures Document,* 1997.

A network of nine freshwater sites was developed in mid-1995 for physiochemical monitoring on a long-term basis to provide information on trends in the state of surface water quality in the Taranaki region. This network was extended to ten sites in the 1998-1899 period and eleven sites in the 2003-2004 period and thirteen sites in the 2016-2017 period. Sampling is carried out on the second Wednesday of each month for the entire year at the first 11 sites, and on the next day for last two sites. The programme also meshes with a similar national programme operated by the National Institute of Water and Atmospheric Research (NIWA) since 1989, which included three sites in Taranaki until December 2015 and two sites thereafter.

As a quality control measure of the TRC laboratory precision for this programme, and as part of general quality assurance practices at the Council, a sample is collected from one of the eleven monitoring sites (chosen randomly) every three to four months and split on site for duplicate analyses. For quality control purposes, this sample is unidentified and is analysed in exactly the same way and at the same time as other samples, and recorded on the Council's database. In conjunction with the sampling undertaken by NIWA, a sample from one of the three (now two) network sites is split in the field from time to time as a quality control procedure for TRC laboratory analytical accuracy assessment. These comparisons between Council and NIWA results are reported in Appendix IV. The results of the internal Taranaki Regional Council quality control sampling for the 2016-2017 period are presented and discussed in this Appendix (III) to the report.

Introduction

Quality assurance (for precision and accuracy) is an essential aspect of any laboratory and monitoring programme. Quality control is an essential tool in this assurance, and is carried out by the Council for the SEM programme at up to four times per year, and annually for NIWA monitoring.

This report presents the results from the QC sample and precision results for the routine sample from which it was split, and compares the difference of each result from the mean of the two results. The difference is presented as a percentage of the mean and levels of these differences are expressed as follows:

Difference from mean (%)	Symbol/Comment
<10%	✓
10-20%	*
21-50%	**
>50%	***

The acceptability of the precision of pairs of analyses varies from parameter to parameter and the symbols defined above are only a guideline. For instance a 20% difference is acceptable for bacteriological samples, as there can be considerable variation in bacteriological counts, whereas pH measurements should not vary by more than 0.2 unit between subsamples.

There are various reasons why sub-sample results may differ, including discrepancies in laboratory equipment and/or techniques and general within sample variation. Sampling variation should be minimal as only a single sample has been collected for splitting into duplicate sub-samples prior to analyses. The amount of variation in results can differ from one type of analysis to another, and this report identifies those techniques that are more prone to variation. Once these methods are identified, it is possible to determine whether differences in results are significant and if so, whether these are due to laboratory discrepancies. Attempts to eliminate these problems can then be made wherever possible.

Results

Comparisons of split samples are presented in chronological order for the annual sampling period between July 2017 and June 2018.

First QC exercise

These split samples were collected from the Punehu Stream site at Wiremu Road on 9 August 2017 under high flood conditions (5.54 m^3/s) and heavy rainfall. Results are presented in Table 1.

Table 1 Results of SEM QC sampling on 9 August 2017

Site: PNH000200					
Date: 9 August 2017				Difference from mean (%)	Comments
Parameter	Units	Routine Sample	QC Sample		
A340F	/cm	0.103	0.105	1	✓
A440F	/cm	0.023	0.023	0	✓
A770F	/cm	0.001	0.001	0	✓
ALKT	g/m^3 $CaCO_3$	8	7	7	✓
BOD5	g/m^3	0.9	1.6	28	**
CONDY	mS/m @ 20°C	3.8	3.9	1	✓
DRP	g/m^3-P	0.013	0.013	0	✓
ENT	/100mL	220	570	44	**
ECOL	/100mL	930	2400	43	**
FC	/100mL	930	2400	43	**
NH4	g/m^3-N	0.050	0.050	0	✓
NO2	g/m^3-N	0.001	0.002	33	**
NO3	g/m^3-N	0.03	0.03	0	✓
pH	pH	7.1	7.1	0	✓
SS	g/m^3	29	36	11	*
TKN	g/m^3-N	0.30	0.32	3	✓
TN	g/m^3-N	0.33	0.35	3	✓
TP	g/m^3-P	0.088	0.084	2	✓
TURBY	NTU	14	15	3	✓

Comments

The differences between pairs of enterococci and faecal coliform counts were outside acceptable tolerance levels (20%) for bacteriological samples.

The 28% difference on BOD_5 and 11% difference on suspended solids may relate to heterogeneity of a sample collected in flood conditions. The difference in nitrite results (of 0.001 g/m^3) was relatively insignificant at the very low concentrations (<0.01 g/m^3). None of these results was an outlier in terms of the site's historical record.

Overall, results showed relatively good laboratory analytical precision performance, with 13 of 19 pairs of results being within the 10% guideline.

Second QC exercise

These split samples were collected from the Punehu Stream site at SH45 on 8 November 2017 under highly turbid, recession flow (3.96 m^3/sec) and fine, partially cloudy weather conditions. Results are presented in Table 2.

Table 2 Results of SEM QC sampling on 8 November 2017

Site: MRK000420					
Date: 8 November 2017				Difference from mean (%)	Comments
Parameter	Units	Routine Sample	QC Sample		
A340F	/cm	0.088	0.080	5	✓
A440F	/cm	0.024	0.021	7	✓
A770F	/cm	0.002	0.002	0	✓
ALKT	g/m^3 $CaCO_3$	25	25	0	✓
BOD5	g/m^3	11	11	0	✓
CONDY	mS/m @ 20°C	12.1	12.1	0	✓
DRP	g/m^3-P	0.042	0.037	6	✓
ENT	/100mL	17000	25000	19	*
ECOL	/100 mL	34000	55000	24	**
FC	/100mL	36000	55000	21	**
NH4	g/m^3-N	0.087	0.087	0	✓
NO2	g/m^3-N	0.011	<0.001	>50	***
NO3	g/m^3-N	0.49	0.50	1	✓
pH	pH	7.4	7.4	0	✓
SS	g/m^3	170	180	3	✓
TKN	g/m^3-N	1.82	1.83	<1	✓
TN	g/m^3-N	2.32	2.33	<1	✓
TP	g/m^3-P	0.755	0.725	2	✓
TURBY	NTU	160	160	0	✓

Comments

The difference between the pair of enterococci counts was within the acceptable tolerance level (20%), whereas the differences in *E. coli* and faecal coliform counts were just outside this level for bacteriological samples.

The difference in nitrite results was relatively insignificant at the low concentration, though this was the first time in 89 exercises that the difference was >50%.

Otherwise, overall laboratory analytical precision performance was good, with 15 of the 19 pairs of results recorded within the 10% guideline.

Third QC exercise

These split samples were collected from the site in the Punehu Stream at Wiremu Road on 14 February 2018 under clear, steady low flow (0.24 m^3/sec) and fine, partially cloudy weather conditions. Results are presented in Table 3.

Table 3 Results of SEM QC sampling on 14 February 2018

Site: STY000300					
Date: 14 February 2018				Difference from mean (%)	Comments
Parameter	Units	Routine Sample	QC Sample		
A340F	/cm	0.032	0.029	5	✓
A440F	/cm	0.008	0.009	7	✓
A770F	/cm	0.001	0.002	33	**
ALKT	g/m^3 $CaCO_3$	22	22	0	✓
BOD5	g/m^3	<0.5	<0.5	0	✓
CONDY	mS/m @ 20°C	8.0	8.0	0	✓
DRP	g/m^3-P	0.035	0.035	0	✓
ENT	/100mL	220	260	8	✓
ECOL	/100mL	80	92	7	✓
FC	/100mL	96	92	2	✓
NH4	g/m^3-N	0.007	0.008	7	✓
NO2	g/m^3-N	<0.001	<0.001	0	✓
NO3	g/m^3-N	0.01	<0.01	>33	**
PH	pH	7.8	7.8	0	✓
SS	g/m^3	<2	<2	0	✓
TKN	g/m^3-N	0.02	0.02	0	✓
TN	g/m^3-N	<0.05	<0.05	0	✓
TP	g/m^3-P	0.035	0.0364	1	✓
TURBY	NTU	0.86	0.73	8	✓

Comments

The difference of 0.001 units in filtered absorbance readings at 770 nm was not significant as it was within acceptable equipment performance tolerance.

Otherwise 18 pairs of parameters analysed were well within acceptable agreement, representing excellent laboratory analytical precision for these samples.

Fourth QC exercise

These split samples were collected from the site in the Waingongoro River at SH45 on 9 May 2018 under clear, recession flow conditions (4.91 m^3/sec), and fine, partly cloudy weather. The results are presented in Table 4.

Table 4 Results of SEM QC sampling on 9 May 2018

Site: MKW000300					
Date: 9 May 2018				Difference from mean (%)	Comments
Parameter	Units	Routine Sample	QC Sample		
A340F	/cm	0.028	0.028	0	✓
A440F	/cm	0.006	0.006	0	✓
A770F	/cm	0.000	0.000	0	✓
ALKT	g/m^3 $CaCO_3$	39	40	1	✓
BOD5	g/m^3	0.6	0.6	0	✓
CONDY	mS/m @ 20°C	16.8	16.8	0	✓
DRP	g/m^3-P	0.047	0.045	2	✓
ENT	/100mL	43	20	37	**
ECOL	/100mL	200	200	0	✓
FC	/100mL	200	200	0	✓
NH4	g/m^3-N	0.012	0.014	8	✓
NO2	g/m^3-N	0.012	0.012	0	✓
NO3	g/m^3-N	2.12	2.13	0	✓
PH	pH	8.1	8.0	1	✓
SS	g/m^3	3	3	0	✓
TKN	g/m^3-N	0.09	0.30	54	***
TN	g/m^3-N	2.22	2.44	5	✓
TP	g/m^3-P	0.069	0.067	1	✓
TURBY	NTU	3.1	2.7	7	✓

Comments

The differences between enterococci counts for the paired samples was outside acceptable tolerance levels for bacteriological samples (20%), whereas there was no difference between paired *E.*coli and faecal coliform counts.

The TKN paired results were significantly different but at low concentration and as a result of the small difference in total nitrogen results from which they were calculated (not analysed). None of these results were outliers in terms of the historical record for this site

Otherwise, 17 of the 19 parameters' pairs of results were within the 10% guideline representing good laboratory analytical precision.

Summary

Four split samples were collected and analysed during this one-year (2017-2018) period for the assessment of internal laboratory analytical precision. The following table summarises the number of times each category of differences from the mean occurred for all analyses commonly performed on SEM samples.

	Difference from mean of pairs of split samples							
Parameter ID	<10%		10-20%		21-50%		>50%	
A340F	4	(93)	-	(7)	-	(0)	-	(0)
A440F	4	(75)	-	(18)	-	(5)	-	(2)
A770F	3	(78)	-	(0)	1	(9)	-	(13)
ALKT	4	(100)	-	(0)	-	(0)	-	(0)
BOD5	3	(86)	-	(11)	-	(2)	-	(1)
CONDY	4	(100)	-	(0)	-	(0)	-	(0)
DO*	-	(100)	-	(0)	-	(0)	-	(0)
DRP	4	(93)	-	(6)	-	(0)	-	(1)
ENT	1	(42)	1	(24)	2	(27)	-	(7)
ECOL	2	(49)	-	(31)	2	(19)	-	(1)
FC	2	(49)	-	(31)	2	(18)	-	(2)
NH4	4	(78)	-	(13)	-	(5)	-	(3)
NO2	2	(92)	-	(3)	1	(3)	1	(1)
NO3	3	(86)	-	(4)	1	(9)	-	(1)
pH	4	(100)	-	(0)	-	(0)	-	(0)
SS	3	(87)	1	(10)	-	(3)	-	(0)
TKN	3	(50)	-	(19)	-	(22)	1	(9)
TN	4	(84)	-	(10)	-	(7)	-	(0)
TP	4	(87)	-	(7)	-	(4)	-	(2)
TURB	4	(98)	-	(1)	-	(1)	-	(0)

(NB: () = % of QC samples for 1995 to 2018 period; * Winkler method to 2012)

This summary for the 2017-2018 period indicated:

- results from pairs of all three bacteriological species' samples varied in precision with two sets of results falling outside the acceptable variability (20%). This follows the historical trend for paired bacteriological analyses which have found at least 42% of the period's quality control samples within the 10% difference of the mean (for all three species), and from 66% to 80% of samples within 20% of the mean for paired samples in all species.
- TKN analytical variability greater than 20% was recorded on one occasion, due to reliance on calculations from another nitrogen species which, however, was within acceptable precision tolerance. TKN duplicates have traditionally shown this variability with only 50% and 69% to date within 10% and 20% of the mean respectively.
- Nitrite analytical variability of between 33 and >50% was recorded on two occasions, at low to very low concentrations and the differences were considered insignificant at these levels.

- BOD_5 variability of 28% (0.7 g/m^3) was recorded on one occasion, with a corresponding suspended solids difference of 11%, possibly as the result of sample heterogeneity under the flood conditions monitored.
- variability in split samples agreement for filtered absorbances at 340 nm, 440 nm, and 770 nm which had occurred occasionally, but almost entirely within equipment performance tolerance values, was only once recorded (at 770 nm) over the 2017-2018 period.

In general, laboratory analytical performance has been acceptable, with very good precision of results shown for the majority of parameters following the continuation of split-sampling field methodology to remove any sampling bias in the quality control programme. Some exceptions in analytical precision have been identified and these are being addressed by the laboratory. Additional inter-laboratory analyses are recommended as part of this process. No results from this exercise were statistical outliers in the context of the 23-year historical database for all sites in the programme. The dissolved oxygen measurement was undertaken by field meter during the year and therefore has been removed from the intra-laboratory programme.

Appendix IV

SEM Physicochemical Programme Inter-lab Quality Control Report 2017-2018

Introduction

A network of nine freshwater sites was developed in mid-1995 for physiochemical monitoring on a long-term basis to provide information on trends in the state of surface water quality in the Taranaki region. One further site was added to this network in the 1998-99 period, another in the 2003-2004 period and two more in the 2015-2016 period (see Introduction). Sampling is carried out on the second Wednesday of each month for the entire year. The programme also meshes with a similar national programme operated by the National Institute of Water and Atmospheric Research (NIWA) since 1989, which included three sites in Taranaki and is performed on the third Tuesday of each month throughout the year although part way through the 2013-2014 period NIWA adjusted the Waingongoro River site sampling to coincide with the timing of the TRC sampling protocol.

As a quality control measure for this programme, and as part of general quality assurance practices at the Council, a sample is collected randomly from one of the thirteen monitoring sites every three to four months and split for duplicate analyses (see Appendix III). The additional sample is analysed in exactly the same way and at exactly the same time as other samples, and recorded on the Council's database. In conjunction with the sampling undertaken by NIWA, the Council also shares a duplicate sub-sample from time to time as a quality control procedure to assess accuracy of laboratory analytical performance. Normally a single sample is collected from one of the three (now two) sites and then split for sub-samples' analyses by each of the laboratories. A sample was collected from one of the three (now two) sites, on one occasion in the 2017-2018 year for the inter-laboratory comparison exercise.

Quality assurance is an essential aspect of any laboratory and monitoring programme. Quality control is an essential tool in this assurance, and is carried out by the Council from time-to-time with NIWA monitoring.

This report presents the results from NIWA and TRC samples and compares the difference of each result from the mean of the two results. The difference is presented as a percentage of the mean, and levels of these differences are expressed as follows:

Difference from mean (%)	Symbol/Comment
<10%	✓
10-20%	*
21-50%	**
>50%	***

The acceptability of the precision of pairs of analyses varies from parameter to parameter and the symbols defined above are only a guideline. These differences may also be related to the precision of various methods, which can vary between laboratories.

There are various reasons why sample results may differ, including discrepancies in laboratory equipment and/or techniques and general sample variation. Sampling variation should be minimal as samples are normally collected and split into subsamples by both parties. The amount of variation in results can differ from one type of analysis to another, and this report identifies those techniques that are more prone to variation. Once these methods are identified, it is possible to determine whether differences in results are significant and, if so, whether these are due to sample variability or laboratory discrepancies. Attempts to eliminate these problems can then be made wherever possible.

One quality control sampling run was performed with NIWA field staff during the 2017-2018 period, on 20 March 2018. Sampling was performed at the Waitara River site at Bertrand Road during a steady recession flow (15.6 m^3/s), 12 days after a large flood in fine, cloudless weather. The water appeared clear and light green-brown.

Results

2017-2018 exercise

Comparisons of the individual samples' analytical results for the Manganui River (at SH3) site are presented in Table 1.

Table 1 Results of SEM QC sampling by TRC & NIWA on 20 March 2018

MGN000195					
		Time:1030 (NZST)		Difference from mean (%)	Comments
Parameter	Units	TRC	NIWA		
A340F	/cm	0.029	0.0278	2	✓
A440F	/cm	0.006	0.0058	<1	✓
BDISC	m	3.10	3.188	1	✓
CONDY	mS/m @ 20⁰C	10.1	10.58	2	✓
DO	g/m^3	10.4	10.1	1	✓
DRP	g/m^3-P	0.008	0.0036	38	**
ECOL	cfu/100 mL	34	-	-	-
NH4	g/m^3-N	0.008	0.006	14	*
NO3	g/m^3-N	0.35	0.033	3	✓
pH	pH	8.1	8.13	<1	✓
TEMP	°C	18.5	18.0	14	*
TN	g/m^3-N	0.45	0.475	3	✓
TP	g/m^3-P	0.017	0.015	6	✓
TURBY	NTU	1.8	2.4	14	*

[Note: N/A = not available; N/R = not reported]

Comments

A significant difference in paired measurements between the two laboratories was recorded for dissolved reactive phosphorus, ammoniacal nitrogen, temperature and turbidity, of which dissolved phosphorus showed the most significant difference. Otherwise good analytical agreement was recorded for all other parameters.

Good operator field agreement was indicated by the similarity in the pair of black disc measurements, though there was a difference recorded (0.5°) on temperature.

	Difference from mean of pairs of split samples							
Parameter ID	<10%		10-20%		20-50%		>50%	
A340F	1	(93)	-	(4)	-	(4)	-	(0)
A440F	1	(59)	-	(37)	-	(0)	-	(4)
CONDY	1	(93)	-	(4)	-	(0)	-	(3)
DO	1	(100)	-	(0)	-	(0)	-	(0)
DRP	-	(43)	-	(25)	1	(29)	-	(4)
ECOL	-	(25)	-	(33)	-	(33)	-	(0)
NH4	-	(38)	1	(24)	-	(17)	-	(21)
NO3	1	(90)	-	(7)	-	(3)	-	(0)
pH	1	(100)	-	(0)	-	(0)	-	(0)
TEMP	-	(97)	1	(3)	-	(0)	-	(0)
TN	1	(85)	1	(7)	-	(7)	-	(0)
TP	1	(59)	-	(26)	1	(15)	-	(0)
TURB	-	(34)	1	(48)	-	(17)	-	(0)

(NB: () - % of QC samples over the 1995 to 2018 period)

This summary indicates:

- generally good inter-laboratory analytical performance for most parameters while taking into account variations in laboratory methods and equipment performance tolerances.
- ammoniacal nitrogen and dissolved reactive phosphorus nutrient analyses and turbidity measurements have showed greatest variability between laboratories, while *E.coli* bacteriological counts have tended to vary more widely with lower counts more often recorded by the NIWA laboratory.

Acceptable inter-laboratory agreement has been apparent for most of the parameters analysed. An exception has been identified from time to time for DRP and further comparisons will be performed during future SEM programmes. Good field agreement was recorded for black disc and dissolved oxygen measurements as normally recorded in the past, though there was a difference on temperature measurement, for the first time in 30 comparisons.

Discussions with NIWA, Hamilton staff have determined that annual inter-laboratory comparisons will continue to be performed on <u>one</u> sample collected at one of the two NIWA sites (by TRC personnel) and <u>split on site for analysis</u> by each of the two laboratories, alongside the sample collected in the routine manner by NIWA field party staff.

Appendix V

An evaluation of the representativeness of existing SEM physicochemical sites as descriptors of baseline water quality in the Taranaki region

Executive summary

The Taranaki Regional Council maintains a network of surface freshwater physicochemical monitoring sites as a component of the State of Environment Monitoring (SEM) programme for Taranaki. In July 2015, the network was enlarged by the establishment of sites in the Whenuakura and Waitara catchments, to increase representation of the waterways within the eastern hill country. This brought the total number of sites monitored to thirteen in eight selected ring-plain catchments and three eastern hill-country catchments that together comprise 44% of the total area of the region.

These sites are considered representative of the water bodies in the region (shown by both internal review and external audit), while also being chosen as sites located in the parts of the region subject to the greatest pressures on water quality, thus enabling the Council to give effect to Section 35 (1) and (2)(a)-(2)(d) of the Resource Management Act 1991. An analysis of the proportional distribution of the sites against the distribution of all reaches of the region's rivers when both were classed according to the national River Environment Classification, found that the sites' distribution reflects the regional distribution of land cover classes extremely closely. Further, an audit of the Council's physico-chemical SEM network by NIWA in 2010 on behalf of the Auditor-General's Office found the network to be satisfactory for its purpose. However, more recently it was decided by Council officers to further examine the representative nature of the site network, to engender further confidence in the integrity and strength of the monitoring network and the value of its results for informing the regional community on the state of and trends in the quality of Taranaki's freshwater systems, for feedback on policy and intervention effectiveness, and as a basis for informing further policy development.

Therefore, an evaluation of the representativeness of the existing SEM physicochemical sites as descriptors of baseline water quality in the Taranaki region has been carried out during the 2015-2016 monitoring year. Ten "equivalent" sites within the region were selected to match by landscape and hydrological characteristics with existing SEM sites, for comparative assessment of respective water quality. Four, seasonal surveys were conducted at or near base flows within one day of the regular monthly SEM sampling, at about the same time of day for "paired sites".

The equivalent sites were selected on the basis of factors such as commonality of mountain, ring-plain or hill country source, size of and position within the catchment, land cover and use, and types of discharge to the waters. Adjacent catchments were chosen where practicable. Some sites were within catchments already monitored. The additional catchments (Huatoki, Kapoaiaia, Kaupokonui, Kapuni and Waiongana) increased the proportion of the regional area covered to 48%. All sites except one had a hydrometric station within the catchment.

The surveys were carried out in July and October 2015 and January and April 2016. Stream flows generally were above annual median in July, at about median in October and April, and below median in January. Neither flood nor drought occurred at the times of sampling. All samples were analysed for physical parameters, dissolved oxygen, nutrients and faecal indicator bacteria.

This report presents the water quality data in tables. Box plots are included which allow visual assessment of variation within each site, between matched pairs of sites, and across all sites, for each parameter measured.

In summary, for all physicochemical parameters, the range of values across the regular SEM sites encompassed the range found across the "comparative" sites. That is, under base flow conditions monitored seasonally over the full course of a year, the existing SEM sites were found to already represent the full range of baseline water quality in the Taranaki region.

Table of contents

List of tables

List of figures

1 Introduction

1.1 State of environment monitoring for freshwater physicochemistry

The Resource Management Act 1991 (RMA) established new requirements for local authorities to undertake environmental monitoring. Section 35 of the RMA requires local authorities to monitor, among other things, the state of the environment of their region or district, to the extent that is appropriate to enable them to effectively carry out their functions under the Act.

To this effect, the Taranaki Regional Council ('the Council') has established a state of the environment monitoring (SEM) programme for the region. This programme is outlined in the Council's 'State of the Environment Monitoring Procedures Document', which was prepared in 1997. The monitoring programme is based on the significant resource management issues that were identified in the Council's Regional Policy Statement for Taranaki (1994).

A network of nine freshwater sites was established in mid-1995 for physicochemical monitoring on a long-term basis to provide information on trends in the state of Taranaki's regional surface water quality and this network was maintained with the addition (for various purposes) of one site during the 1998-99 period, another site in the 2003-2004 period, and two more sites in the 2015-2016 period (Table 1). The latter two were added as a consequence of the *National Policy Statement for Freshwater Management 2014*. This NPS stipulated that all fresh water in each region must be included in a Freshwater Management Unit (FMU), and that councils must establish and undertake monitoring at one or more representative sites in every FMU. While 3 of the 4 FMUs proposed for the Taranaki region (*Regional Land and Water Plan*, in development) were covered by the existing monitoring network, it was considered that an additional site located on one of the coastal plains of the region, and a second site within the hill country alongside an existing site in that FMU, would strengthen the informative value of the surface freshwater monitoring network. Table 1 and Figure 1 give further information on the network as of 2018.

Table 1 Sample sites for TRC network programme and NIWA national programme*

Stream	Location	Site code
Maketawa Stream	at Tarata Road	MKW000300
Mangaoraka Stream	at Corbett Road	MRK000420
Waiwhakaiho River	at SH3	WKH000500
Stony River	at Mangatete Road	STY000300
Punehu Stream	at Wiremu Road	PNH000200
Punehu Stream	at SH45	PNH000900
Waingongoro River	at Eltham Road	WGG000500
Waingongoro River	at SH45	WGG000900
Patea River	at Barclay Road	PAT000200
Patea River	at Skinner Road	PAT000360
Mangaehu River	at Raupuha Road	MGH000950
Whenuakura River	at Nicholson Road	WHN000450
Waitara River	at Autawa Road	WTR000540
*Waitara River	at Bertrand Road	WTR000800
*Manganui River	at SH3	MGN000195

The Taranaki Regional Council's SEM programme also includes a freshwater biological component encompassing the same thirteen sites plus forty-six additional sites, which is reported separately (see TRC, 2012a).

The physicochemical programme has been designed to provide a general picture of water quality for nine different catchments in the region affected by a range of different land uses and industries, and recognising cumulative impacts. This monitoring is undertaken in addition to consent compliance monitoring and enables the Council to report on trends in water quality over time for the Taranaki region. The monitoring programme covers eight of the sixty-nine catchments in the Taranaki region and 44% of the total area of the region (Figure 1). Given that a number of the largest catchments in the region are included in the network, it provides a relatively representative indication of the state of surface water in the region.

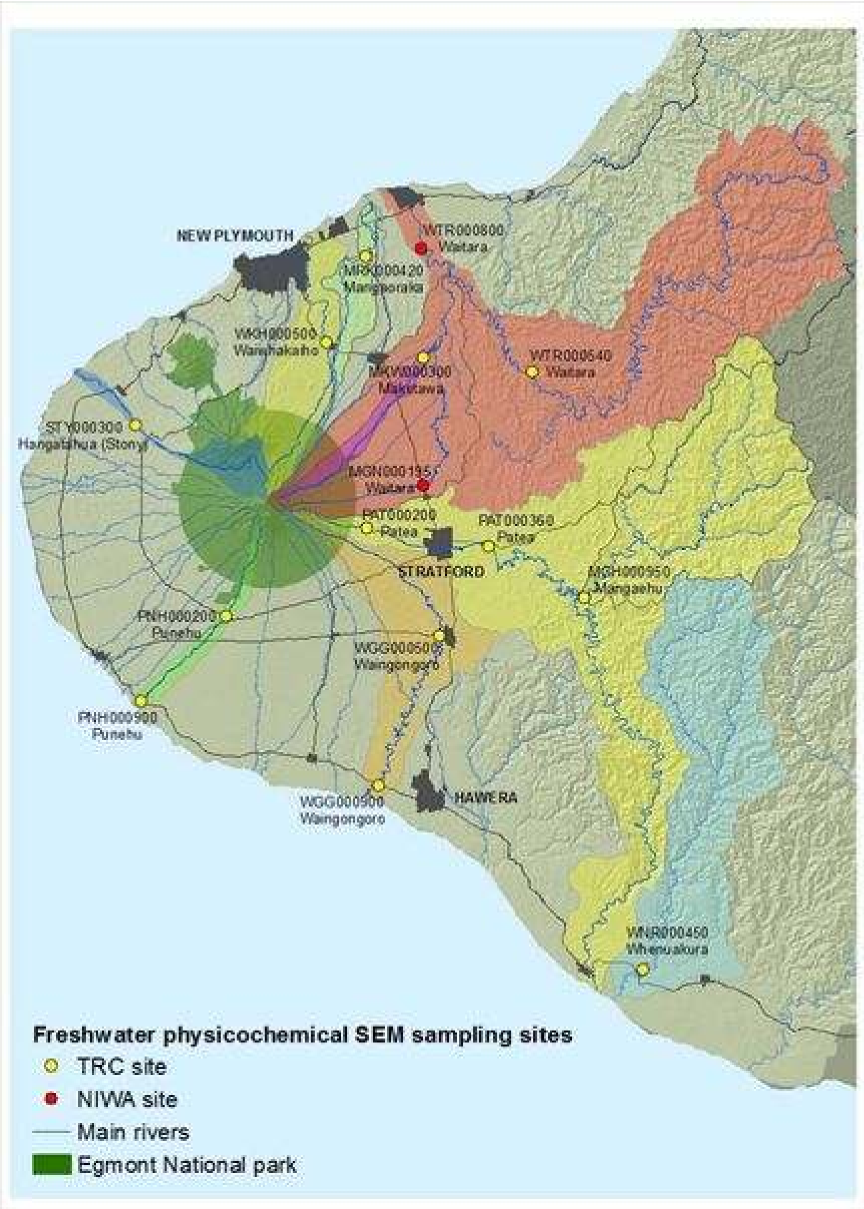


Figure 1 Freshwater physicochemical SEM sampling sites and catchments aerial map

The sites were specifically selected to be representative of major/significant waterways and positioned in the upper, middle, and lower reaches of catchments (Figure 1). Both ring-plain and eastern hill country catchments were represented with a mixture of land uses including waterways under industrial discharge pressures.

The existing programme also meshes with the national programme, which has been operated by the National Institute of Water and Atmospheric Research (NIWA) since January 1989. The National Rivers Water Quality Network (NRWQN) was designed to monitor changes in water quality by sampling physical and chemical parameters monthly at 77 river sites around New Zealand. The programme includes two sites in Taranaki (Figure 1): one upper/mid catchment site (Manganui River at State Highway 3, incorporating some farm land area) and one lower catchment site (Waitara River at Bertrand Road, incorporating both ring-plain and hill country). Another lower catchment site (Waingongoro River at State Highway 45), which is also a Council monitoring site, was dropped by NIWA from their NRWQN programme in December 2015, but is still maintained by the Council. The Waiokura Stream site is also a NIWA national best-farming practices catchment monitoring site sampled monthly (more recently by the Council) at Manaia Golf Course.

The design of the TRC SEM programme was deliberately chosen to follow the design of the NIWA national programme, although the actual sampling days in each monthly survey do not coincide for the two programmes. However, the two programmes are complementary and each is designed for robust trend detection purposes using similar methodologies.

The existing sites are considered representative of the various types and characteristics of water bodies in the region, while also being chosen as sites located in the parts of the region subject to the greatest pressures on water quality, thus enabling the Council to give effect to Section 35 (1) and (2)(a)-(2)(d) of the Resource Management Act 1991. An analysis of the proportional distribution of the sites against the distribution of all reaches of the region's rivers when both were classed according to the national River Environment Classification, found that the sites match the regional distribution of land cover classes extremely closely. [1]

Council SEM sites vs REC land cover classes for Taranaki rivers

REC Land cover class	B	EF	IF	P	S	U	
Taranaki rivers (km)	68	115	3448	8605	632	129	12,559
% of rivers in class	0.5	0.9	26	66	5	1	
% of SEM sites in class	0	0	27	64	9	0	

Further, an audit of the Council's physico-chemical SEM network by NIWA in 2010 on behalf of the Auditor-General's Office found the network to be adequate for its purpose of having sufficient statistical power and coverage to detect large scale patterns (ie within each REC class) in surface water quality state and trends in the Taranaki region.[2]

Nonetheless, the Council has decided to further test the representative nature of its network of sites, to engender further confidence in the integrity and strength of the monitoring network and the value of its

[1] *Trends in the quality of the surface water of Taranaki,* Taranaki Regional Council February 2006, FRODO 95735

[2] *Freshwater quality monitoring by Environment Southland, Taranaki Regional Council, Horizons Regional Council and Environment Waikato,* NIWA Report CHC2010-141

results for informing the regional community on the state of and trends in the quality of Taranaki's freshwater systems, for feedback on policy and intervention effectiveness, and as a basis for informing further policy development.

2 Objectives of the survey

An evaluation of the representativeness of the existing SEM physicochemical sites as descriptors of baseline water quality in the Taranaki region was carried out during the 2015-2016 monitoring year. The survey was designed:

- To include sites of equivalent characteristics located elsewhere in the region which may be matched with existing SEM sites for comparative assessment
- To undertake sampling within one or two days of the regular monthly SEM sampling survey at approximately the same time of day as sampled at each equivalent SEM site
- To cover seasonal variation by sampling once in all four seasons under base flow conditions
- To be sufficiently robust in site selection and sampling protocols to allow meaningful comparisons of data across sites.

2.1 Sites

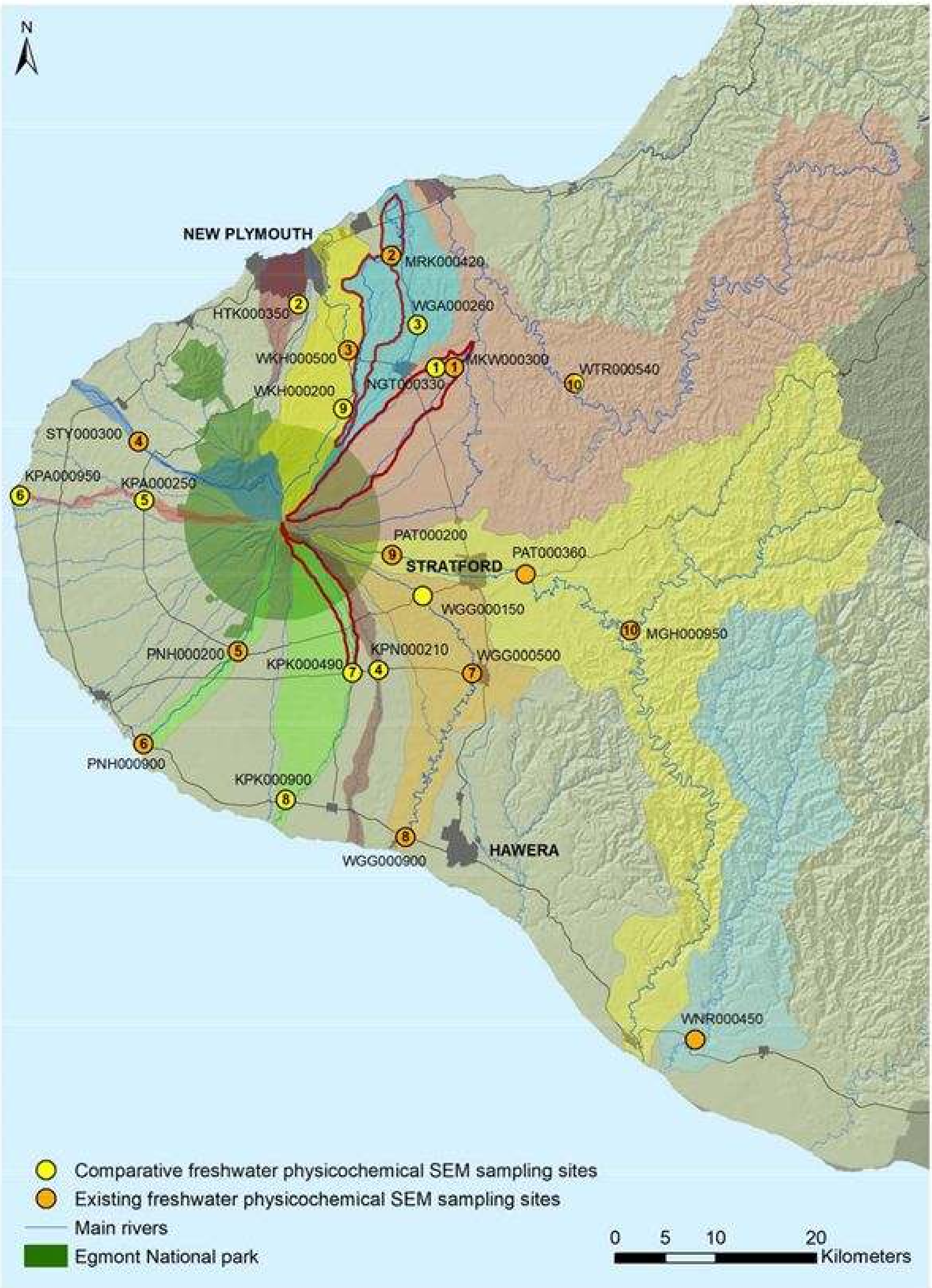
The set of ten sites chosen for comparative sampling in the extended programme is described in Table 2 and depicted in Figure 2. One of the two new long-term SEM sites (Waitara River at Autawa Rd, Tarata) was matched to an existing site (Mangaehu River at Raupuha Road).

Table 2 Additional physicochemical sites for comparison with SEM programme sites

SEM sites			Additional sites			
Stream	**Location**	**Site code**	**Stream**	**Location**	**Site code**	**Timing**
Maketawa S.	Tarata Rd	MKW000300	Ngatoro S.	Tarata Rd	NGT000330	0730-0900
Mangaoraka S.	Corbett Rd	MRK000420	Huatoki S	Hadley Drive	HTK000350	0800-0930
Waiwhakaiho R.	SH3	WKH000500	Waiongana S.	SH3A	WGA000260	0830-1000
Stony R.	Mangatete Rd	STY000300	Kapuni S.	Eltham Rd	KPN000210	0930-1100
Punehu S.	Wiremu Rd	PNH000200	Kapoaiaia S.	Wiremu Rd	KPA000250	1000-1130
Punehu S.	SH45	PNH000900	Kapoaiaia S.	Near coast	KPA000950	1030-1200
Waingongoro R.	Eltham Rd	WGG000500	Kaupokonui S.	Kaponga	KPK000490	1130-1245
Waingongoro R.	SH45	WGG000900	Kaupokonui S.	SH45	KPK000900	1145-1315
Patea R.	Barclay Rd	PAT000200	Waiwhakaiho R.	Peters Rd.	WKH000200	1200-1345
Patea R.	Skinner Rd	PAT000360	-	-	-	1300-1500
Mangaehu R.	Raupuha Rd	MGH000950	*Waitara R.*	*Autawa Rd*	*WTR000540*	1330-1530
Whenuakura R. (new)	Nicholson Rd	WNR000450	-	-	-	0930-1100
Waitara R. (new)	Autawa Rd	WTR000540				1300-1430
Waitara R. (NIWA)	Bertrand Rd	WTR000800	-		-	0900-0930
Manganui R. (NIWA)	SH3	MGN000195	Waingongoro R.	Opunake Rd	WGG000150	1000-1030

The pairs of sites were selected largely from adjacent or near catchments, with similar elevation and land uses.

Figure 2 Freshwater physicochemical SEM sampling sites and catchments aerial map, with additional sites surveyed for comparison



A brief description of the "paired sites" selected for the comparative sampling follows. The existing SEM site is listed first.

Sites Maketawa and Ngatoro Streams at Tarata Road

These sites are in adjacent sub-catchments of the Manganui River, a tributary of the Waitara River. They are representative of the lower reaches of developed farmland, mainly dairy, with valued trout and native fish habitat. The streams join before draining into the Manganui River below the principal abstractions for the Motukawa HEP scheme. The Maketawa Stream is flow gauged on each sampling; there is a hydrometric station on the Ngatoro Stream about 4.3 km upstream, below the abstraction for Inglewood water supply and above its confluences with the Ngatoro-nui and Ngatoro-iti Streams.

Sites Mangaoraka Stream at Corbett Road and Huatoki Stream at Handley Road

These sites are representative of the lower reaches of northern Taranaki ring-plain streams arising outside of the National Park, draining intensive agricultural catchments. Both streams are regionally significant for angling. The Mangaoraka site is a hydrometric station.

Sites Waiwhakaiho River at SH3 and Waiongana Stream at SH3A

These sites in adjacent catchments are representative of the mid-reaches of streams draining developed farmland that arise within the National Park on the northern side. The Waiwhakaiho catchment has a larger proportion within the Park than the Waiongana catchment; both sites are existing hydrometric stations.

Sites Hangatahua (Stony) River at Mangatete Road and Kapuni Stream at Eltham Road

These sites are representative of the mid-reaches of narrow catchments that have a relatively large proportion within the National Park. The Stony River is protected in its natural state by a Local Conservation Order. It has been affected by significant natural erosion events in its headwaters from time to time. The Kapuni Stream site is representative of agricultural impacts in the upper catchment. The Stony River is flow-gauged on each sampling; there is a hydrometric station on the Kapuni Stream, 15.2 km downstream of the monitoring site.

Sites Punehu and Kapoaiaia Streams at Wiremu Road (1) and SH45 (2)

These sites are representative of south-western and western Taranaki catchments, respectively, which are subjected primarily to intensive agricultural land use. Both catchments are narrow, the Kapoaiaia unusually so, and have sources high within the National Park. The upstream sites, both about 5 km from the Park boundary, are representative of relatively un-impacted stream water quality, though the reaches sampled are in open farmland. The lower sites are both within 1.5 km of the coast. The Punehu Stream is flow gauged at both sites on each sampling; there is a hydrometric station on the Kapoaiaia Stream near the lower site.

Sites Waingongoro River and Kaupokonui Stream at Eltham Road (1) and SH45 (2)

These sites are representative of relatively broad catchments on the southern Taranaki ring-plain. Sites 1 in the mid reaches are representative of agricultural impacts in the upper catchment. Sites 2 in the lower reaches are representative both of agricultural point source discharges and diffuse run-off, and of industrial/municipal discharges which occur around Eltham (Waingongoro) and Kaponga (Kaupokonui). Both streams are important trout fisheries. The Waingongoro River sites are existing hydrometric stations; there is a hydrometric station near the lower sampling site on the Kaupokonui Stream.

Sites Patea River at Barclay Road and Waiwhakaiho River at Peters Road

These sites are representative of upper catchments adjacent to the National Park that are largely above agricultural impacts. The Patea River is flow gauged on each sampling occasion; there is a hydrometric station on the Waiwhakaiho River about 8.0 km downstream.

Sites Mangaehu River at Raupuha Road and Waitara River at Autawa Road

These sites in adjacent catchments are representative of rivers draining Taranaki eastern hill country in the central (Mangaehu) and northern (Waitara) parts of the region. At about 100 metres altitude, both sites are above confluences with the mountain-sourced Patea and Manganui Rivers, respectively. They are representative of a combination of upland agriculture and native forest, the Waitara having the greater proportion of forest. The Mangaehu site is an established hydrometric station; the Waitara site is 6.1 km above the hydrometric station at Tarata, with the discharge from Motukawa power station in between.

Two existing SEM sites were not “paired”, and another site was monitored for possible comparison with a NIWA site:

Site Whenuakura River at Nicholson Road

This site is representative of the lower reaches of an eastern hill country catchment in the southern part of the region that has largely been developed for agriculture, with some exotic and native forest. Together with the Waitara River at Autawa Road site, it was established in July 2015 to increase representation of the eastern hill country, and may be compared to the Waitara and Mangaehu River sites (above). It is an established hydrometric station, on the marine terrace 10.7 km from the coast in the upper section of tidal river, above the saline influence.

Site Patea River at Skinner Road

This site is representative of developed farmland drainage and is downstream of Stratford (urban run-off, closed landfill, municipal oxidation pond and thermal power station discharges). It is an established hydrometric station and dissolved oxygen monitoring site. No directly comparable site was surveyed, though the site in the adjacent Waingongoro catchment at Eltham would be similar in terms of farmland drainage from a relatively wide ring-plain catchment.

Site Waingongoro River at Opunake Road

This site was surveyed for comparison with the NIWA site on the Manganui River at SH3, which is representative of the upper/mid reaches of a high quality river on the eastern ring-plain receiving limited agricultural run-off. Direct comparison between these sites was not carried out, as the respective sampling dates were too far apart (5 days) for the weather/flow conditions encountered. However, comparison may be drawn with two nearby sites that are representative of south-eastern ring plain streams, at similar distance from the National Park though at lower altitude: Kapuni and Kaupokonui Streams at Eltham Road. There is a hydrometric station 23 km downstream.

2.2 Sampling procedure and analytical parameters

The additional sites were all sampled on the same day [the day following the normal SEM run] on four occasions:

9 July 2015

15 October 2015

14 January 2016

14 April 2016

The two new permanent SEM sites, Whenuakura River at Nicholson Road and Waitara River at Autawa Road, where monthly monitoring commenced in July 2015, were sampled on the same days as the additional sites.

No flow measurements were undertaken with the additional sampling, but indicative data were obtained from hydrometric stations in the same catchment except the Huatoki.

Analyses were performed in the TRC IANZ-registered chemistry laboratory using standard methods. The parameters analysed and site of measurements are listed in Table 2.

Table 3 SEM physicochemical parameters and site of measurement

Parameter	Unit	Location
Time	NZST	On site
Flow	m^3/s	On site recorder or rated SG or gauging
Temperature	˚C	On site
Dissolved oxygen	g/m^3	On site
BOD_5 (total)	g/m^3	Laboratory
Suspended solids	g/m^3	Laboratory
Turbidity	NTU	Laboratory
Conductivity @ 20°C	mS/m	Laboratory
pH	pH	Laboratory
Alkalinity	$g/m^3 CaCO_3$	Laboratory
Ammonia-N	$g/m^3 N$	Laboratory
Nitrate-N	$g/m^3 N$	Laboratory
Total-N	$g/m^3 N$	Laboratory
Dissolved reactive phosphorus	$g/m^3 P$	Laboratory
Total phosphorus	$g/m^3 P$	Laboratory
Faecal coliform and *E. coli* bacteria (mTEC)	cfu/100 mL	Laboratory

3 Results

Water quality data from the four, seasonal two-day surveys of the ten pairs of sites and three unpaired sites are presented in Appendix I of this report. Some dissolved oxygen data are missing, for seven of the "comparative" sites, due to a field instrument fault on 14 January 2016.

Flow data are included for the sites that are hydrometric stations, or where manual gauging was done. As well as volumetric rate, percentage of median flow is given to allow direct comparison between sites. For those comparative (eight) sites where there was no flow measurement, percentage of median flow at a hydrometric site in the same catchment is reported for the time of sampling, except for the Huatoki which was without flow monitoring.

"Box and whisker" plots are presented in Appendix II, which allow visual assessment of variation within each site, between matched pairs of sites, and across all sites, for each parameter measured. (The plots, which normally require a minimum of five data, have been modified by replicating the datasets, so the whiskers represent the data range, and the box ends and inner line are the averages of adjacent quartile values).

On each of the four surveys, there was little or no rainfall between the two sampling days throughout the Taranaki region, except some showers in and near the National Park on 8/9 July 2015. On three of the surveys, in winter and spring 2015 and autumn 2016, some rainfall did occur shortly before the first day of sampling, the most on 12/13 April 2016 - this resulted in fresh flows that had reduced to about median levels on the second day of sampling. The rainfall had (relatively) greater impact at the regular SEM sites, which were sampled on the first day of the surveys, than at the "matched" sites, which were sampled on the second day.

Maketawa and Ngatoro Streams at Tarata Road

These sites were well matched for landscape and hydrological characteristics, being in adjacent catchments similar in size, shape and elevation, and both were on streams receiving several discharges from farm dairy effluent treatment systems. Overall, similar results were produced. The Maketawa had slightly higher conductivity, and higher BOD.

Mangaoraka Stream at Corbett Road and Huatoki Stream at Handley Road

While both sites are at 60 m elevation on the northern ring plain, the Mangaoraka catchment upstream is larger, and proportionally wider in the lower reaches, with a higher intensity of dairy farming. The results reflect this. Temperature, electro-conductivity (EC), pH and alkalinity were higher in the Mangaoraka, while turbidity and suspended solids were similar. BOD, and faecal coliform and ammonia concentrations, which may be related to farm dairy discharges, were higher in the Mangaoraka, while other nutrients (nitrate and phosphorus species) were similar to the Huatoki values.

Waiwhakaiho River at SH3 and Waiongana Stream at SH3A

These sites in adjacent catchments differ in distance from the Park boundary, 10.6 km for the Waiwhakaiho, (175 m altitude) versus 16.1 km for the Waiongana, (140 m), almost entirely through pastoral land. The median flow in the Waiwhakaiho, at 3.92 m^3/s, is more than double that in the Waiongana, at 1.46 m^3/s. Rainfall preceding the October 2015 survey affected the Waiwhakaiho results the more. Overall, temperature and pH/alkalinity values were similar, with higher conductivity in the Waiongana, BOD and ammonia values were similar, whereas oxidised nitrogen and total nitrogen were higher in the Waiongana. Phosphorus species were similar. These results are consistent with two catchments both receiving some farm dairy discharges, one over a longer distance (ie a greater cumulative increase) than the other.

Hangatahua (Stony) River at Mangatete Road and Kapuni Stream at Eltham Road

Despite the Stony River site being at higher altitude (260 m versus 168 m) and closer to the Park boundary (7.2 km versus 10.6 km), the temperatures were similar or lower in the Kapuni Stream, perhaps as a result of the narrower channel and more riparian shading of the Kapuni. EC was similar, and pH slightly higher in the Stony. The natural erosion events that occur occasionally in the Stony were manifest in the winter and autumn surveys, with comparatively very high suspended solids, turbidity and total phosphorus values. BOD was very low and dissolved oxygen consistently near saturation level at both sites. Nitrogen species and faecal bacteria were present at comparatively higher levels in the Kapuni Stream, consistent with farming activities in the upper catchment, which are absent in the Stony catchment under the Conservation Order.

Punehu and Kapoaiaia Streams at Wiremu Road (1) and SH45 (2)

Overall, the results for the two upper catchment sites on the western ring plain were very similar and showed good water quality. The upper Kapoaiaia had higher pH/alkalinity. The upper Punehu had higher suspended solids and turbidity. Total ammonia concentrations were higher in the upper Punehu. DRP concentrations were higher in the upper Kapoaiaia, probably from natural sources in the Park, while total phosphorus concentrations were similar. BOD and faecal bacteria level were low at both sites.

Differences in water quality between the catchments developed with distance downstream (16.6 km between the SEM Punehu sites and 19.6 km between the matching Kapoaiaia sites). This is consistent with the higher proportion of pastoral activities in the broader, but still narrow, Punehu catchment, and the extreme narrowness of the Kapoaiaia catchment. Temperature range was wider in the lower Punehu. EC was significantly higher in the lower Punehu, a function of a larger proportion of the catchment being near to the saline influence of the coast. The pH of the lower Kapoaiaia was significantly higher, though alkalinity was similar, the result of algal photosynthesis. Turbidity and suspended solids were noticeably higher in the lower Punehu, and BOD, faecal bacteria and all nutrient species were also higher.

Waingongoro River and Kaupokonui Stream at Eltham Road (1) and SH45 (2)

While the upstream sites both represent the mid reaches of southern ring plain waters flowing through intensive pastoral farming lands, the mid Waingongoro site is considerably further (22.8 km) from the Park boundary compared to the mid Kaupokonui site (9.1 km), although it is also much further from the sea (44.0 km versus 22.3 km). This is reflected in the monitoring results. The temperature at the mid-Waingongoro site was higher, consistent with its lower altitude (200 m versus 270 m). EC was much higher in the mid-Waingongoro, and the pH, alkalinity, suspended solids and turbidity were all higher than in the mid-Kaupokonui. BOD was higher, and faecal bacteria and all nutrient species were much higher in the mid-Waingongoro as a result of accumulation along a longer, broader catchment.

The comparative results for the two lower catchment sites, which represent the largest (Waingongoro) and second-largest (Kaupokonui) catchments on the southern ring plain, are similar to those for the mid-catchment sites, with increased effects from agriculture as a greater proportion of the catchments above the lower sites is in agriculture. At the two lower sites, both at 20 m altitude, temperatures were similar, and EC slightly higher in the Waingongoro. The pH was higher in the Kaupokonui, and alkalinity was similar, suggesting more algal influence. Turbidity and suspended solids were similar. BOD was notably higher in the Waingongoro and faecal bacteria levels were similar. Nutrient levels were all higher in the Waingongoro.

Patea River at Barclay Road and Waiwhakaiho River at Peters Road

While these sites are both near the National Park on the eastern side, they are at different altitudes (500 m for the SEM upper Patea site, and 330 m for the matched upper Waiwhakaiho site), and drain catchments of differing lithology. This was reflected in the lower temperatures at the upper Patea site, and the higher conductivity, pH and alkalinity at the upper Waiwhakaiho site. Turbidity and suspended solids levels, BOD, faecal bacteria and nutrients were all low at both sites, as might be expected near to the Park, with the exception of dissolved phosphorus at the upper Waiwhakaiho site, which is known to leach naturally from the rock in that catchment.

Mangaehu River at Raupuha Road and Waitara River at Autawa Road

These sites, representing large eastern hill country catchments, produced similar results for temperature and conductivity, Suspended solids and turbidity, both high as a result of land erosion, were also similar. The range of pH and dissolved oxygen was wider at the Mangaehu site, suggesting a greater influence of algal photosynthesis. Dissolved oxygen was slightly below saturation on some occasions, more at the Waitara site. BOD was significantly higher at the Mangaehu site. Faecal bacterial levels were similar, the Mangaehu tending to be higher. Nitrogen species levels were similar, with a large proportion in organic form and a wider range of total nitrogen at the Mangaehu site. Total phosphorus concentration range was very wide at the Mangaehu site, with much higher levels than at the Waitara site. Conversely, dissolved phosphorus levels, while low, were the lower at the Mangaehu site.

4 Discussion

The original selection of the existing surface freshwater physicochemical SEM sites in Taranaki was undertaken with great care specifically to cover a wide range of situations, based upon knowledge gained from the extensive Taranaki Ring Plain Water Resources Survey of 1980-1982, various water quality surveys for major development projects, and resource consent compliance monitoring throughout the region over more than a decade. Flow measurement is required at every sampling, to enable accurate assessment of temporal trends in water quality, which has taken considerable effort, particularly for those sites which must be gauged manually each month.

Two sites were added in July 2015 to represent better the eastern hill country, one of which is situated in a marine terrace landform not included previously.

The 13 physicochemical monitoring sites serve as base sites for the freshwater biological (benthic macroinvertebrate) SEM programme, which covers a much greater number of locations (59) in the region.

The ten sites chosen in 2015-2016 for comparative assessment comprise two in upper reaches (Waiwhakaiho and Kapoaiaia), five in mid-reaches (Ngatoro, Waiongana, Huatoki, Kaupokonui and Kapuni), and three in lower reaches (Kapoaiaia, Kaupokonui and Waitara), giving a spread of location within catchments. The matches between “paired” sites were the best practicable, on the basis of ease of access and availability of flow data. Some matching of features was particularly good, for example, the Maketawa and Ngatoro sites in adjacent catchments; others less so, for example, the mid Waingongoro and mid-Kaupokonui sites with different catchment areas.

Flow conditions at sampling were reasonably steady, considering the seasonal and spatial variables involved in a region with frequent rainfall. Some rainfall did occur on the day before three of the four surveys commenced, but no or negligible amount between the two days of sampling. This potentially affected the regular SEM sites more than the comparative sites, as only SEM sites were sampled on the first day of each survey. No very high or low (extreme) flow conditions were encountered.

The water quality monitoring results for the regular SEM sites were all within the normal ranges for the near-base flow conditions surveyed. The results for the ”matched” additional sites were collectively all within the respective ranges of values found for the regular SEM sites. No result was returned that could not be explained in terms of site location, generic land use, geological and hydrological characterisation, and season.

This one-off investigation added another 5 catchments to the 11 already included in the regular monitoring network. When results for each parameter were reviewed across all types of catchment, it was found that no additional site gave results that lay outside the usual range of results from within the existing network. That is, amongst the additional catchments staff found no waterways that would give results that lie outside the range of results reported to the Council and public each year. Conversely, the survey showed that the existing sites can be properly considered representative and informative of the range of catchment types found in the region.

Now it has been demonstrated that the existing surface physicochemical SEM sites comprehensively represent freshwater quality in the Taranaki region, it is suggested that further information about the nature of the region’s waterways can be usefully gained through some additional monitoring and data review, to assess whether subtle changes are occurring in the water chemistry. This relates to examining the ionic composition of the water, and parameters such as silica, which currently are not monitored, but should be periodically, for example, over twelve months every five years at each site.

5 Recommendations

It is recommended that the Council:

1. notes that the existing freshwater physicochemical SEM sites have been further demonstrated to be representative as descriptors of baseline water quality in the Taranaki region and as a network to satisfy the Freshwater Management Unit monitoring requirements of the National Policy Statement on Freshwater Management 2014
2. notes that additional monitoring and analysis in the form of ionic balances be carried out periodically to enable assessment of more subtle changes in water quality

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Appendix I

Seasonal data tables of 2015-2016 Water Quality Parameters for SEM and comparative sites

SEM site: MKW000300 (Maketawa Stream at Tarata Road)

Date	Time NZST	ALKT g/m^3 $CaCO_3$	BOD_5 g/m^3	Cond @ 20 °C mS/m	DO g/m^3	DO Sat %	DRP g/m^3P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m^3/s	Flow* % median
08-Jul-2015	0805	24	<0.5	8.0	10.5	100	0.027	200	200	2.470	
14-Oct-2015	0700	28	0.6	8.3	10.9	100	0.029	3400	3400	2.157	
13-Jan-2016	0705	29	0.8	8.1	9.9	100	0.043	320	330	1.411	
13-Apr-2016	0815	20	1.1	6.9	10.0	100	0.055	1100	1200	2.788	

Date	Time NZST	NH_4 g/m^3N	NO_2 g/m^3N	NO_3 g/m^3N	pH pH	SS g/m^3	Temp °C	TKN g/m^3N	TN g/m^3N	TP g/m^3P	Turb NTU
08-Jul-2015	0805	0.017	0.002	0.408	7.5	3	7.9	0.09	0.50	0.036	1.6
14-Oct-2015	0700	0.013	0.003	0.217	7.7	<2	10.9	0.12	0.34	0.042	1.3
13-Jan-2016	0705	0.007	<0.001	0.139	7.7	<2	15.2	0.03	0.17	0.048	0.5
13-Apr-2016	0815	0.061	0.012	0.478	7.6	4	13.8	0.25	0.74	0.1	2.4

Matched site: NGT000330 (Ngatoro Stream at Tarata Road)

Date	Time NZST	ALKT g/m^3 $CaCO_3$	BOD_5 g/m^3	Cond @ 20 °C mS/m	DO g/m^3	DO Sat %	DRP g/m^3P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m^3/s	Flow* % median
09-Jul-2015	0830	27	<0.5	9.1	12.3	101	0.028	120	120		141
15-Oct-2015	0800	32	0.6	9.3	11.0	99	0.031	500	510		88
14-Jan-2016	0745	33	<0.5	9.0			0.047	360	360		74
14-Apr-2016	0835	30	0.5	9.0	10.6	100	0.066	300	300		93

Date	Time NZST	NH_4 g/m^3N	NO_2 g/m^3N	NO_3 g/m^3N	pH pH	SS g/m^3	Temp °C	TKN g/m^3N	TN g/m^3N	TP g/m^3P	Turb NTU
09-Jul-2015	0830	<0.003	0.003	0.52	7.5	<2	6.2	0.09	0.61	0.028	0.9
15-Oct-2015	0800	0.014	0.006	0.33	7.3	<2	10.5	0.08	0.42	0.048	1.1
14-Jan-2016	0745	<0.003	0.001	0.18	7.9	<2	16.1	0.00	0.18	0.054	0.6
14-Apr-2016	0835	0.010	0.005	0.46	7.5	2	11.6	0.21	0.68	0.077	1.1

*Flow at SH3, 4.3 km upstream: median, 0.580 m^3/s; MALF, 0.273 m^3/s.

SEM site: MRK000420 (Mangaoraka Stream at Corbett Road)

Date	Time NZST	ALKT g/m^3 $CaCO_3$	BOD_5 g/m^3	Cond @ 20 °C mS/m	DO g/m^3	DO Sat %	DRP g/m^3P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m^3/s	Flow % median
08-Jul-2015	0845	35	<0.5	13.7	11.1	99	0.010	500	500	1.931	157
14-Oct-2015	0735	53	1.6	17.1	10.5	99	0.010	9200	9200	0.969	79
13-Jan-2016	0740	62	0.7	17.7	9.6	101	0.018	670	670	0.287	23
13-Apr-2016	0845	47	1.2	15.6	9.7	100	0.026	5300	5300	1.082	88

Date	Time NZST	NH_4 g/m^3N	NO_2 g/m^3N	NO_3 g/m^3N	pH pH	SS g/m^3	Temp °C	TKN g/m^3N	TN g/m^3N	TP g/m^3P	Turb NTU
08-Jul-2015	0845	0.026	0.004	1.12	7.5	5	9.6	0.34	1.46	0.028	2.7
14-Oct-2015	0735	0.049	0.008	0.84	7.8	<2	12.9	0.25	1.10	0.024	2.8
13-Jan-2016	0740	0.017	0.003	0.44	7.9	<2	17.3	0.02	0.46	0.031	0.8
13-Apr-2016	0845	0.019	0.009	0.87	7.8	5	15.6	0.28	1.16	0.060	4.5

Median flow 1.228 m^3/s; MALF 0.246 m^3/s.

Matched site: HTK000350 (Huatoki Stream at Handley Road)

Date	Time NZST	ALKT g/m^3 $CaCO_3$	BOD_5 g/m^3	Cond @ 20 °C mS/m	DO g/m^3	DO Sat %	DRP g/m^3P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m^3/s	Flow % median
09-Jul-2015	0745	23	<0.5	10.0	11.7	100	0.011	150	290		
15-Oct-2015	0710	28	0.5	10.8	10.7	97	0.007	410	410		
14-Jan-2016	0710	35	0.6	11.1			0.007	420	420		
14-Apr-2016	0800	29	<0.5	10.8	10.6	99	0.011	460	460		

Date	Time NZST	NH_4 g/m^3N	NO_2 g/m^3N	NO_3 g/m^3N	pH pH	SS g/m^3	Temp °C	TKN g/m^3N	TN g/m^3N	TP g/m^3P	Turb NTU
09-Jul-2015	0745	<0.003	0.001	0.83	7.3	3	8.1	0.15	0.98	0.015	1.9
15-Oct-2015	0710	0.009	<0.001	0.54	7.6	<2	11.1	0.03	0.58	0.019	1.7
14-Jan-2016	0710	0.008	<0.001	0.27	7.7	2	16.1	0.03	0.30	0.019	2.0
14-Apr-2016	0800	0.006	0.002	0.62	7.4	8	11.7	0.22	0.84	0.019	1.8

SEM site: WKH000500 (Waiwhakaiho River at SH3)

Date	Time NZST	ALKT g/m^3 $CaCO_3$	BOD_5 g/m^3	Cond @ 20 °C mS/m	DO g/m^3	DO Sat %	DRP g/m^3P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m^3/s	Flow % median
08-Jul-2015	0915	32	<0.5	9.2	11.8	101	0.020	96	96	6.178	158
14-Oct-2015	0805	28	0.8	7.7	11.4	103	0.019	2500	2500	5.630	144
13-Jan-2016	0810	59	<0.5	13.5	10.5	105	0.036	1200	1200	2.599	66
13-Apr-2016	0920	39	0.7	10.4	10.4	104	0.042	1900	2000	5.454	139
Date	**Time NZST**	**NH_4 g/m^3N**	**NO_2 g/m^3N**	**NO_3 g/m^3N**	**pH pH**	**SS g/m^3**	**Temp °C**	**TKN g/m^3N**	**TN g/m^3N**	**TP g/m^3P**	**Turb NTU**
08-Jul-2015	0915	0.009	0.001	0.17	7.6	4	7.7	0.03	0.20	0.027	0.5
14-Oct-2015	0805	0.013	0.002	0.06	7.8	3	10.0	0.19	0.25	0.037	1.7
13-Jan-2016	0810	<0.003	<0.001	0.07	8.2	<2	14.5	0.01	0.08	0.040	0.4
13-Apr-2016	0920	0.030	0.010	0.19	7.6	<2	13.6	0.07	0.27	0.058	1.0

Median flow 3.922 m³/s; MALF 2.036 m³/s.

Matched site: WGA000260 (Waiongana River at SH3A)

Date	Time NZST	ALKT g/m^3 $CaCO_3$	BOD_5 g/m^3	Cond @ 20 °C mS/m	DO g/m^3	DO Sat %	DRP g/m^3P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m^3/s	Flow % median
09-Jul-2015	0900	32	<0.5	11.3	11.9	100	0.019	780	800	2.103	144
15-Oct-2015	0820	47	1.0	14.7	11.0	99	0.022	2000	2100	0.819	56
14-Jan-2016	0810	57	<0.5	16.4			0.038	370	370	0.590	40
14-Apr-2016	0900	45	0.6	14.1	10.5	100	0.039	1400	1400	1.213	83
Date	**Time NZST**	**NH_4 g/m^3N**	**NO_2 g/m^3N**	**NO_3 g/m^3N**	**pH pH**	**SS g/m^3**	**Temp °C**	**TKN g/m^3N**	**TN g/m^3N**	**TP g/m^3P**	**Turb NTU**
09-Jul-2015	0900	0.018	0.004	0.54	7.5	2	7.2	0.30	0.84	0.034	3.5
15-Oct-2015	0820	0.020	0.013	0.68	7.9	<2	10.4	0.10	0.79	0.046	1.4
14-Jan-2016	0810	<0.003	0.002	0.28	8.1	<2	15.9	0.00	0.28	0.047	0.7
14-Apr-2016	0900	0.012	0.009	0.61	7.7	<2	11.9	0.22	0.84	0.055	1.2

Median flow 1.463 m³/s; MALF 0.407 m³/s.

SEM site: STY000300 (Stony River at Mangatete Road)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow % median
08-Jul-2015	1015	28	<0.5	7.9	11.9	101	0.018	12	12	5.740	
14-Oct-2015	0905	26	<0.5	7.0	11.4	102	0.014	9	9	6.569	
13-Jan-2016	0915	49	<0.5	10.8	10.5	106	0.024	4	4	2.939	
13-Apr-2016	1020	32	<0.5	8.3	10.3	101	0.028	12	12	4.181	
Date	**Time NZST**	**NH_4 g/m³N**	**NO_2 g/m³N**	**NO_3 g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
08-Jul-2015	1015	0.004	<0.001	0.05	7.6	24	7.3	0.	0.05	0.029	11
14-Oct-2015	0905	0.003	<0.001	0.01	7.7	2	9.7	0.06	0.07	0.018	2.0
13-Jan-2016	0915	<0.003	<0.001	0.03	8.0	<2	14.4	0.02	0.05	0.024	0.4
13-Apr-2016	1020	<0.003	0.001	0.02	7.8	250	12.8	0.04	0.06	0.277	76

Matched site: KPN000210 (Kapuni Stream at Eltham Road)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	*Flow % median
09-Jul-2015	1045	24	<0.5	8.9	12.3	101	0.017	160	160		150
15-Oct-2015	0940	27	<0.5	8.8	11.1	102	0.010	92	100		95
14-Jan-2016	0935	28	<0.5	8.0	9.9	101	0.018	170	180		31
14-Apr-2016	1110	28	0.5	9.0	11.1	101	0.030	300	310		44
Date	**Time NZST**	**NH_4 g/m³N**	**NO_2 g/m³N**	**NO_3 g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
09-Jul-2015	1045	0.017	0.002	1.00	7.3	<2	6.1	0.15	1.15	0.021	1.5
15-Oct-2015	0940	0.015	0.003	0.85	7.7	<2	10.5	0.01	0.86	0.016	0.9
14-Jan-2016	0935	0.006	0.003	0.47	7.8	<2	15.3	0.	0.38	0.021	0.6
14-Apr-2016	1110	0.055	0.006	0.71	7.5	5	10.1	0.24	0.96	0.045	0.6

*Flow at Normanby Road, 15.2 km downstream. Median 1.304 m³/s; MALF 0.348 m³/s

SEM site: PNU000200 (Punehu Stream at Wiremu Road)

Date	Time NZST	ALKT g/m³ CaCO₃	BOD₅ g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow* % median
08-Jul-2015	1050	15	<0.5	8.7	11.8	101	0.014	90	90	0.940	(276)
14-Oct-2015	0950	16	<0.5	7.3	11.0	102	0.018	88	88	0.540	(158)
13-Jan-2016	0955	26	<0.5	8.4	9.6	102	0.032	70	76	0.228	(45)
13-Apr-2016	1055	10	<0.5	9.7	9.9	100	0.014	130	130	1.042	(225)
Date	**Time NZST**	**NH₄ g/m³N**	**NO₂ g/m³N**	**NO₃ g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
08-Jul-2015	1050	0.034	0.002	0.11	7.3	4	7.2	0.17	0.28	0.032	4.3
14-Oct-2015	0950	0.004	<0.001	0.01	7.6	<2	10.7	0.11	0.12	0.021	1.9
13-Jan-2016	0955	0.006	<0.001	0.01	7.8	<2	16.8	0.06	0.07	0.045	1.2
13-Apr-2016	1055	0.028	0.004	0.28	7.3	2	13.7	0.09	0.37	0.035	2.4

*Percentage of median flow is based on record for Pihama hydrometric station, 15.6 km downstream

Matched site: KPA000250 (Kapoaiaia Stream at Wiremu Road)

Date	Time NZST	ALKT g/m³ CaCO₃	BOD₅ g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow* % median
09-Jul-2015	1020	25	<0.5	9.2	12.3	102	0.026	48	51		196
15-Oct-2015	0930	31	<0.5	9.2	10.8	100	0.027	100	100		101
14-Jan-2016	0920	37	<0.5	9.7			0.036	100	110		50
14-Apr-2016	1020	26	<0.5	8.9	10.6	101	0.025	220	220		120
Date	**Time NZST**	**NH₄ g/m³N**	**NO₂ g/m³N**	**NO₃ g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
09-Jul-2015	1020	<0.003	0.001	0.37	7.4	<2	6.1	0.03	0.40	0.028	1.0
15-Oct-2015	0930	0.012	<0.001	0.10	7.8	<2	11.2	0.09	0.19	0.035	1.3
14-Jan-2016	0920	0.006	<0.001	0.02	7.9	<2	15.6	0.05	0.07	0.041	0.7
14-Apr-2016	1020	0.005	0.002	0.33	7.4	<2	11.5	0.09	0.42	0.031	1.3

*Flow relates to site near coast, 19.7 km downstream. Median 0.674 m³/s; MALF 0.270 m³/s

SEM site: PNH000900 (Punehu Stream at SH45)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow* % median
08-Jul-2015	1115	28	1.1	20.0	11.5	100	0.028	340	340	2.573	(276)
14-Oct-2015	1015	29	2.0	14.8	10.9	102	0.039	610	610	1.245	(158)
13-Jan-2016	1025	39	0.9	14.8	9.4	99	0.065	700	720	0.342	(45)
13-Apr-2016	1135	14	0.8	11.3	9.9	100	0.026	760	760	1.550	(225)
Date	**Time NZST**	**NH_4 g/m³N**	**NO_2 g/m³N**	**NO_3 g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
08-Jul-2015	1115	0.078	0.016	3.00	7.4	10	9.0	0.13	3.13	0.054	4.8
14-Oct-2015	1015	0.102	0.044	1.28	7.6	3	12.4	0.47	1.79	0.072	4.7
13-Jan-2016	1025	0.032	0.011	0.62	7.8	2	17.8	0.03	0.66	0.088	1.4
13-Apr-2016	1135	0.032	0.005	0.46	7.3	5	14.7	0.22	0.68	0.059	3.8

*Flow at Pihama, 1.0 km upstream, above Mangatawa confl.. Median 0.689 m³/s, MALF 0.270 m³/s

Matched site: KPA000950 (Kapoaiaia Stream 900m from coast)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow % median
09-Jul-2015	1100	25	<0.5	12.1	12.4	103	0.024	140	140	1.323	196
15-Oct-2015	1020	29	0.7	10.4	10.7	103	0.017	84	84	0.684	101
14-Jan-2016	0955	40	0.7	11.6			0.029	250	250	0.339	50
14-Apr-2016	1045	24	<0.5	10.2	10.7	102	0.030	610	610	0.806	120
Date	**Time NZST**	**NH_4 g/m³N**	**NO_2 g/m³N**	**NO_3 g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
09-Jul-2015	1100	0.007	0.002	0.75	7.5	<2	7.3	0.23	0.98	0.024	1.2
15-Oct-2015	1020	0.008	0.002	0.24	7.9	<2	13.9	0.15	0.39	0.029	1.0
14-Jan-2016	0955	0.003	0.001	0.04	8.4	3	19.7	0.12	0.16	0.046	1.6
14-Apr-2016	1045	0.007	0.004	0.66	7.4	<2	12.9	0.3	0.96	0.043	1.1

Flow median 0.674 m³/s; MALF 0.270 m³/s

SEM site: WGG000500 (Waingongoro River at Eltham Road)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow % median
08-Jul-2015	1240	29	0.5	11.4	11.5	102	0.019	140	140	2.277	130
14-Oct-2015	1135	33	0.6	11.7	11.5	111	0.020	68	68	1.309	75
13-Jan-2016	1150	37	0.7	10.5	10.2	108	0.037	230	230	0.431	25
13-Apr-2016	1250	29	1.1	10.2	10.1	102	0.064	930	1000	1.119	64

Date	Time NZST	NH_4 g/m³N	NO_2 g/m³N	NO_3 g/m³N	pH pH	SS g/m³	Temp °C	TKN g/m³N	TN g/m³N	TP g/m³P	Turb NTU
08-Jul-2015	1240	0.011	0.005	1.68	7.6	3	8.9	0.30	1.98	0.040	2.1
14-Oct-2015	1135	0.016	0.012	1.38	8.3	<2	12.7	0.13	1.45	0.035	1.4
13-Jan-2016	1150	0.012	0.003	0.38	8.1	<2	18.7	0.03	0.41	0.051	1.2
13-Apr-2016	1250	0.103	0.022	0.83	7.7	<2	14.0	0.37	1.22	0.105	2.0

Flow median 1.751 m³/s; MALF 0.443 m³/s; 5-year low 0.346 m³/s.

Matched site: KPK000490 (Kaupokonui Stream at Eltham Road)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow* % median
09-Jul-2015	1200	26	<0.5	7.8	12.4	102	0.013	14	14		180
15-Oct-2015	1120	29	<0.5	8.1	10.7	101	0.008	64	64		83
14-Jan-2016	1045	34	0.6	8.2			0.013	40	40		35
14-Apr-2016	1140	26	0.7	7.5	10.8	102	0.016	72	80		81

Date	Time NZST	NH_4 g/m³N	NO_2 g/m³N	NO_3 g/m³N	pH pH	SS g/m³	Temp °C	TKN g/m³N	TN g/m³N	TP g/m³P	Turb NTU
09-Jul-2015	1200	<0.003	0.001	0.40	7.6	<2	5.8	0.00	0.40	0.013	0.7
15-Oct-2015	1120	0.014	0.002	0.26	8.0	<2	11.9	0.03	0.29	0.011	0.8
14-Jan-2016	1045	0.008	<0.001	0.08	8.1	<2	17.4	0.05	0.13	0.022	1.2
14-Apr-2016	1140	0.012	0.002	0.23	7.5	<2	11.1	0.06	0.29	0.019	0.7

*Flow at Glenn Road, 18.0 km downstream, above Mangawhero confluence. Median 2.023 m³/s; MALF 0.746 m³/s

SEM site: WGG000900 (Waingongoro River at SH45)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow % median
08-Jul-2015	1200	36	2.1	18.2	11.2	100	0.050	280	280	9.470	188
14-Oct-2015	1100	44	0.9	18.9	10.9	105	0.029	220	220	5.128	102
13-Jan-2016	1110	50	1.0	17.7	9.8	108	0.057	120	130	1.201	22
13-Apr-2016	1220	38	1.6	15.2	9.7	100	0.083	1200	1200	4.279	79
Date	**Time NZST**	**NH_4 g/m³N**	**NO_2 g/m³N**	**NO_3 g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
08-Jul-2015	1200	0.104	0.054	2.58	7.6	8	10.1	0.99	3.62	0.086	4.5
14-Oct-2015	1100	0.034	0.014	2.44	7.9	3	13.7	0.21	2.66	0.056	3.1
13-Jan-2016	1110	0.028	0.010	1.11	8.0	<2	19.6	0.22	1.34	0.084	1.3
13-Apr-2016	1220	0.022	0.015	1.22	7.8	7	15.8	0.67	1.90	0.15	5.4

Flow median 5.042 m³/s; MALF 1.344 m³/s; 5-year LF 1.083 m³/s

Matched site: KPK000900 (Kaupokonui Stream at SH45)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow % median
09-Jul-2015	1230	35	0.6	17.1	12.2	103	0.022	68	68		180
15-Oct-2015	1200	43	0.7	17.7	10.6	102	0.019	220	240		83
14-Jan-2016	1140	55	0.9	16.6			0.024	130	130		35
14-Apr-2016	1215	31	0.7	11.5	10.5	101	0.048	480	510		81
Date	**Time NZST**	**NH_4 g/m³N**	**NO_2 g/m³N**	**NO_3 g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
09-Jul-2015	1230	0.003	0.005	1.94	7.6	5	7.7	0.63	2.58	0.041	2.8
15-Oct-2015	1200	0.016	0.010	1.74	8.2	2	13.8	0.25	2.00	0.040	2.3
14-Jan-2016	1140	0.009	0.006	0.70	8.4	<2	20.0	0.0	0.68	0.041	1.6
14-Apr-2016	1215	0.027	0.008	0.86	7.7	2	13.1	0.21	1.08	0.062	1.6

*Flow at Glenn Road, 0.7 km upstream, above Mangawhero confluence. Median 2.023 m³/s; MALF 0.746 m³/s

SEM site: PAT000200 (Patea River at Barclay Road)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow % median
08-Jul-2015	1315	18	<0.5	5.9	11.7	101	0.018	11	11	0.267	(117)
14-Oct-2015	1230	25	<0.5	6.9	11.1	102	0.024	120	120	0.154	(61)
13-Jan-2016	1220	28	<0.5	6.8	10.2	99	0.027	25	25	0.178	(39)
13-Apr-2016	1320	18	<0.5	5.5	10.2	100	0.023	54	54	0.208	(89)
Date	**Time NZST**	**NH_4 g/m³N**	**NO_2 g/m³N**	**NO_3 g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
08-Jul-2015	1315	<0.003	<0.001	0.04	7.4	<2	6.0	0.01	0.05	0.027	0.5
14-Oct-2015	1230	0.005	<0.001	0.01	7.6	<2	9.4	0.11	0.12	0.027	1.0
13-Jan-2016	1220	0.006	<0.001	0.01	7.6	<2	11.8	0.04	0.05	0.029	0.5
13-Apr-2016	1320	<0.003	0.001	0.01	7.1	<2	11	0.04	0.05	0.027	0.4

*Flow at Skinner Road, 17.5 km downstream. Median 3.169 m³/s; MALF 0.765 m³/s

Matched site: WKH000200 (Waiwhakaiho River at Peters Road)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow* % median
09-Jul-2015	1205	34	<0.5	9.0	12.1	102	0.046	11	11		158
15-Oct-2015	1105	41	<0.5	9.5	10.9	102	0.053	20	20		144
14-Jan-2016	1110	44	<0.5	9.9	10.0	102	0.003	78	78		66
14-Apr-2016	1220	38	<0.5	9.6	10.5	102	0.043	220	220		139
Date	**Time NZST**	**NH_4 g/m³N**	**NO_2 g/m³N**	**NO_3 g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
09-Jul-2015	1205	0.016	0.001	0.11	7.6	<2	6.5	0.04	0.15	0.046	0.8
15-Oct-2015	1105	0.007	<0.001	0.02	8.0	<2	11.0	0.03	0.05	0.055	0.8
14-Jan-2016	1110	<0.003	<0.001	0.02	8.0	<2	14.4	0.03	0.05	0.061	0.7
14-Apr-2016	1220	0.011	0.001	0.12	7.7	<2	12.7	0.12	0.24	0.043	0.9

*Flow at SH3, Egmont Village, 8.0 km downstream: Median 3.922 m³/s; MALF 2.036 m³/s

SEM site: MGH000950 (Mangaehu River at Raupuha Road)

Date	Time NZST	ALKT g/m^3 $CaCO_3$	BOD_5 g/m^3	Cond @ 20 °C mS/m	DO g/m^3	DO Sat %	DRP g/m^3P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m^3/s	Flow % median
08-Jul-2015	1445	23	1.4	7.6	10.8	97	0.008	1700	1700	21.704	312
14-Oct-2015	1330	46	<0.5	11.3	10.4	103	0.005	240	240	8.202	118
13-Jan-2016	1355	47	0.5	11.0	9.3	105	0.005	84	84	3.335	48
13-Apr-2016	1440	39	1.9	10.4	9.1	94	0.007	5400	5400	16.400	236
Date	**Time NZST**	**NH_4 g/m^3N**	**NO_2 g/m^3N**	**NO_3 g/m^3N**	**pH pH**	**SS g/m^3**	**Temp °C**	**TKN g/m^3N**	**TN g/m^3N**	**TP g/m^3P**	**Turb NTU**
08-Jul-2015	1445	0.021	0.004	0.16	7.3	460	9.7	1.27	1.43	0.441	390
14-Oct-2015	1330	0.017	0.002	0.11	7.9	10	14.5	0.14	0.25	0.023	13
13-Jan-2016	1355	0.010	0.002	0.03	8.0	5	20.8	0.14	0.17	0.018	4.3
13-Apr-2016	1440	0.019	0.004	0.07	7.4	210	15.6	0.83	0.90	0.373	160

Flow median 6.952 m³/s, MALF 2.342 m³/s

Matched (new SEM) site: WTR000540 (Waitara River at Autawa Road)

Date	Time NZST	ALKT g/m^3 $CaCO_3$	BOD_5 g/m^3	Cond @ 20 °C mS/m	DO g/m^3	DO Sat %	DRP g/m^3P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow* m^3/s	Flow* % median
09-Jul-2015	1335	15	0.7	7.0	11.0	96	0.01	930	930	38.519	210
15-Oct-2015	1250	30	0.6	9.0	10.1	100	0.007	63	63	20.901	114
14-Jan-2016	1230	31	0.5	8.9	8.6	96	0.008	120	120	9.985	55
14-Apr-2016	1330	32	<0.5	10.2	9.4	94	0.008	540	560	21.389	117
Date	**Time NZST**	**NH_4 g/m^3N**	**NO_2 g/m^3N**	**NO_3 g/m^3N**	**pH pH**	**SS g/m^3**	**Temp °C**	**TKN g/m^3N**	**TN g/m^3N**	**TP g/m^3P**	**Turb NTU**
09-Jul-2015	1335	0.027	0.003	0.21	7.3	320	8.6	0.43	0.64	0.021	300
15-Oct-2015	1250	0.008	0.002	0.13	7.6	6	14.8	0.15	0.28	0.021	8.6
14-Jan-2016	1230	0.018	0.002	0.10	7.5	7	20.7	0.16	0.26	0.029	8.3
14-Apr-2016	1330	0.017	0.003	0.11	7.4	19	15.6	0.44	0.55	0.043	18

*Flow at Tarata, 6.1 km downstream, below Motukawa HEP station outflow. Median 18.312 m³/s; MALF 3.187 m³/s

SEM site (new): WNR000450 (Whenuakura River at Nicholson Road)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow* m³/s	Flow* % median
09-Jul-2015	1015	36	1.3	14.5	11.2	94	0.019	830	830	14.157	267
15-Oct-2015	0855	68	0.8	19.7	10.1	96	0.012	280	280	6.819	129
14-Jan-2016	0855	64	1.2	19.4	8.4	90	0.019	490	520	2.742	52
14-Apr-2016	0915	32	1.9	11.8	9.3	88	0.018	2200	2300	6.299	119
Date	**Time NZST**	**NH_4 g/m³N**	**NO_2 g/m³N**	**NO_3 g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
09-Jul-2015	1015	0.021	0.007	0.34	7.3	980	7.9	1.27	1.62	0.709	760
15-Oct-2015	0855	0.016	0.004	0.34	7.7	26	13.5	0.21	0.55	0.065	24
14-Jan-2016	0855	0.035	0.005	0.42	7.6	32	18.6	0.2	0.63	0.100	40
14-Apr-2016	0915	0.052	0.006	0.27	7.2	400	13.8	0.92	1.20	0.042	340

*Flow median 5.293 m³/s; MALF 1.939 m³/s

SEM site (unmatched): PAT000360 (Patea River at Skinner Road)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow* m³/s	Flow* % median
08-Jul-2015	1405	26	0.5	9.6	11.6	103	0.026	100	100	3.696	117
14-Oct-2015	1300	30	0.9	9.9	11.8	116	0.036	92	92	1.948	61
13-Jan-2016	1315	32	1.0	10.1	9.9	106	0.073	370	370	1.235	39
13-Apr-2016	1410	28	1.3	9.9	10.1	104	0.057	600	600	2.834	89
Date	**Time NZST**	**NH_4 g/m³N**	**NO_2 g/m³N**	**NO_3 g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
08-Jul-2015	1405	0.072	0.011	0.93	7.6	<2	8.7	0.50	1.44	0.043	1.7
14-Oct-2015	1300	0.028	0.016	0.89	8.6	<2	13.6	0.10	1.01	0.054	1.7
13-Jan-2016	1315	0.047	0.018	0.63	8.0	<2	17.1	0.02	0.67	0.096	1.3
13-Apr-2016	1410	0.044	0.021	0.86	7.6	3	14.9	0.39	1.27	0.096	2.5

*Flow median 3.169 m³/s, MALF 0.765 m³/s.

Additional site: WGG000150 (Waingongoro River at Opunake Road)

Date	Time NZST	ALKT g/m³ $CaCO_3$	BOD_5 g/m³	Cond @ 20 °C mS/m	DO g/m³	DO Sat %	DRP g/m³P	E.coli cfu/ 100mL	FC cfu/ 100mL	Flow m³/s	Flow % median
09-Jul-2015	1000	22	<0.5	7.0	12.4	101	0.020	23	23		130
15-Oct-2015	0900	27	<0.5	7.7	11.2	102	0.017	28	28		75
14-Jan-2016	0900	27	<0.5	7.2	9.9	100	0.023	100	100		25
14-Apr-2016	1040	24	<0.5	6.9	10.8	100	0.020	40	40		64
Date	**Time NZST**	**NH_4 g/m³N**	**NO_2 g/m³N**	**NO_3 g/m³N**	**pH pH**	**SS g/m³**	**Temp °C**	**TKN g/m³N**	**TN g/m³N**	**TP g/m³P**	**Turb NTU**
09-Jul-2015	1000	<0.003	<0.001	0.48	7.3	<2	5.1	0.07	0.55	0.020	0.6
15-Oct-2015	0900	0.005	<0.001	0.41	7.7	<2	9.7	0.02	0.43	0.018	0.4
14-Jan-2016	0900	<0.003	<0.001	0.16	7.8	<2	14.4	0.0	0.16	0.026	0.5
14-Apr-2016	1040	0.007	<0.001	0.36	7.4	<2	10.2	0.1	0.46	0.022	0.2

Flow at Eltham Road, 23 km downstream: median 1.751 m³/s; MALF 0.443 m³/s; 5-year low 0.346 m³/s.

Appendix II

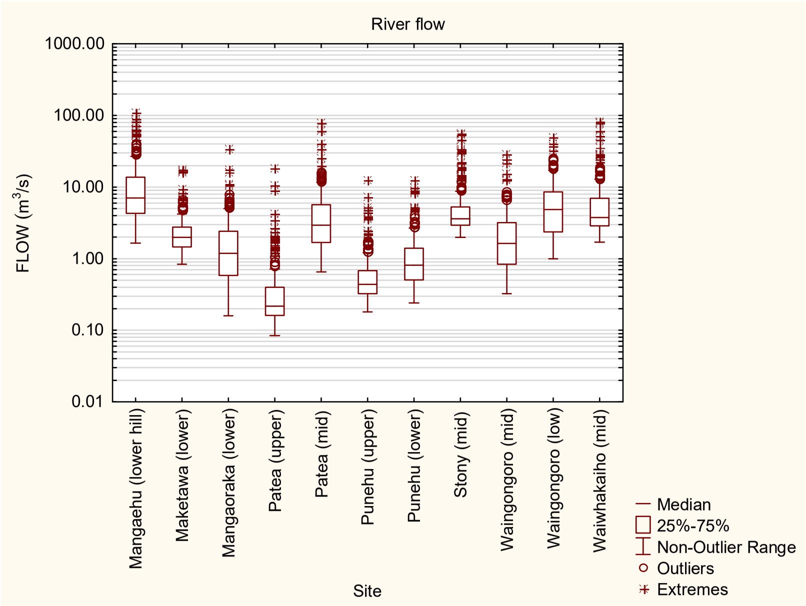
Seasonal ‘Box & Whisker’ Plots of 2015-2016 Water Quality Parameters for SEM and comparative sites

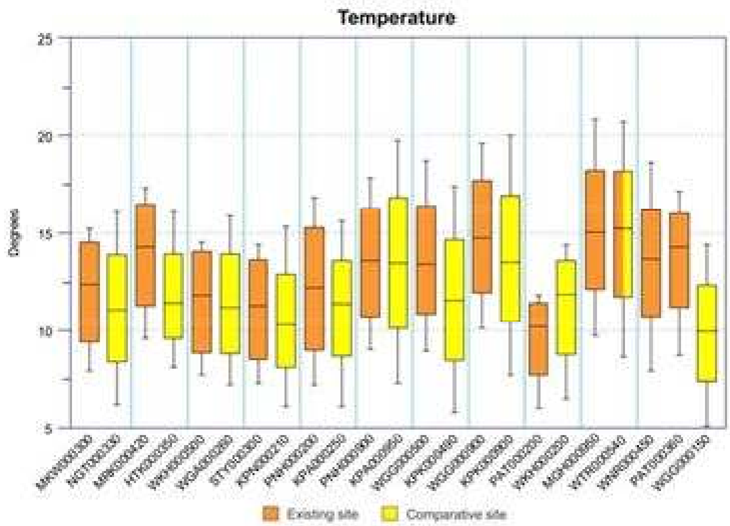
Site locations

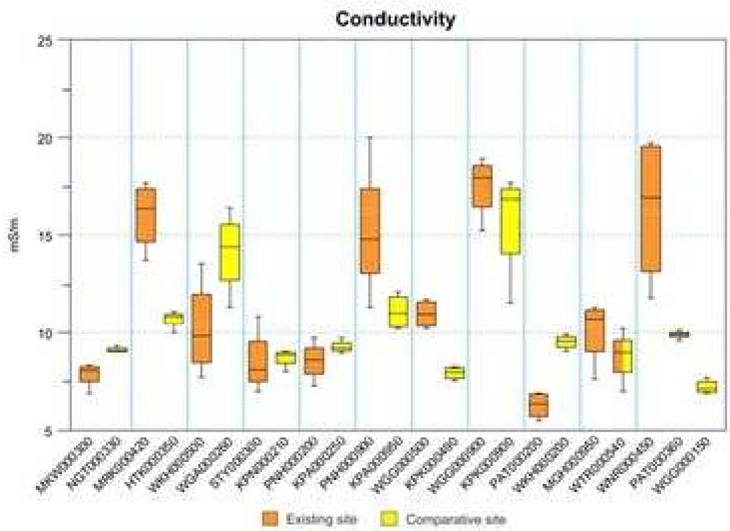
Stream*	Location	Site code
Maketawa Stream Ngatoro Stream	at Tarata Road at Tarata Road	MKW000300 NGT000330
Mangaoraka Stream Huatoki Stream	at Corbett Road at Handley Road	MRK000420 HTK000350
Waiwhakaiho River Waiongana Stream	at SH3 at SH3A	WKH000500 WGA000260
Stony River Kapuni Stream	at Mangatete Road at Eltham Road	STY000300 KPN000210
Punehu Stream Kapoaiaia Stream	at Wiremu Road at Wiremu Road	PNH000200 KPA000250
Punehu Stream Kapoaiaia Stream	at SH45 at SH45	PNH000900 KPA000950
Waingongoro River Kaupokonui Stream	at Eltham Road at Eltham Road	WGG000500 KPK000490
Waingongoro River Kaupokonui River	at SH45 at SH45	WGG000900 KPK000900
Patea River Waiwhakaiho River	at Barclay Road at Peters Road	PAT000200 WKH000200
Mangaehu River Waitara River	at Raupuha Road at Tarata	MGH000950 WTR000540
Whenuakura River	at Nicholson Road	WNR000450
Patea River	at Skinner Road	PAT000360
Waingongoro River	at Opunake Road	WGG000150

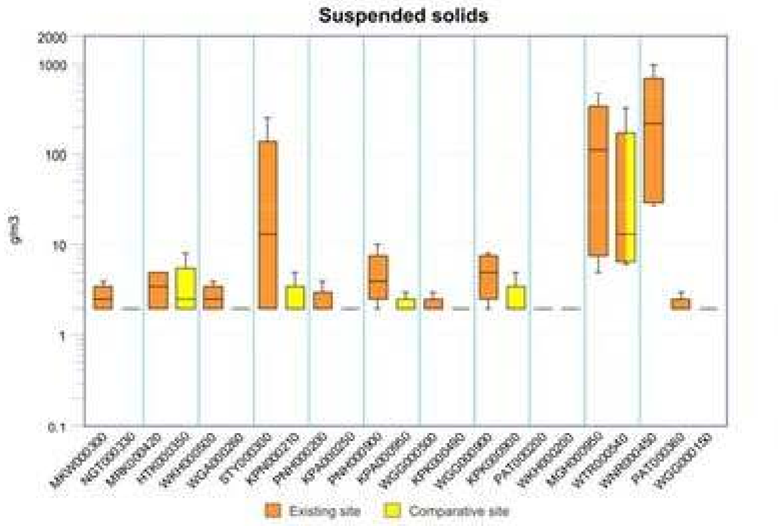
- The long-term SEM site, followed by the paired site monitored in this comparative survey. The Whenuakura River site may be compared with the Mangaehu and Waitara Rivers sites, all representing eastern hill country catchments. The Patea River at Skinner Road and Waingongoro River at Opunake Road are unmatched with another site on the graphs.

Physical Quality








Suspended solids
g/m3
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1000
100
10
1
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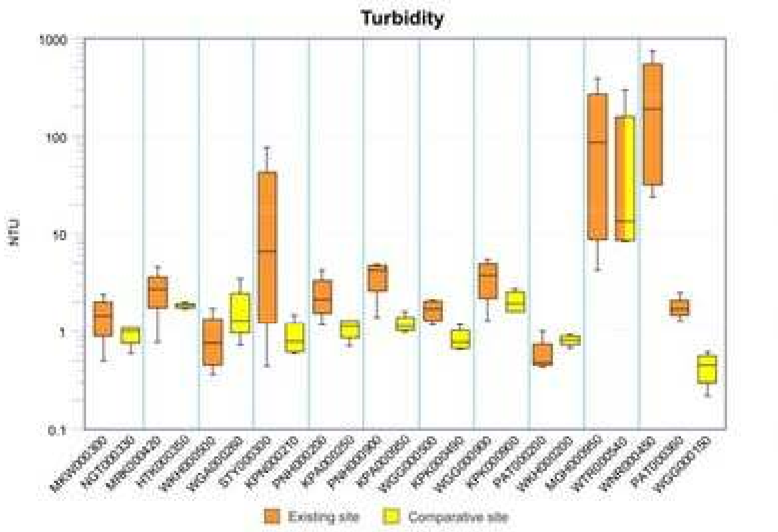
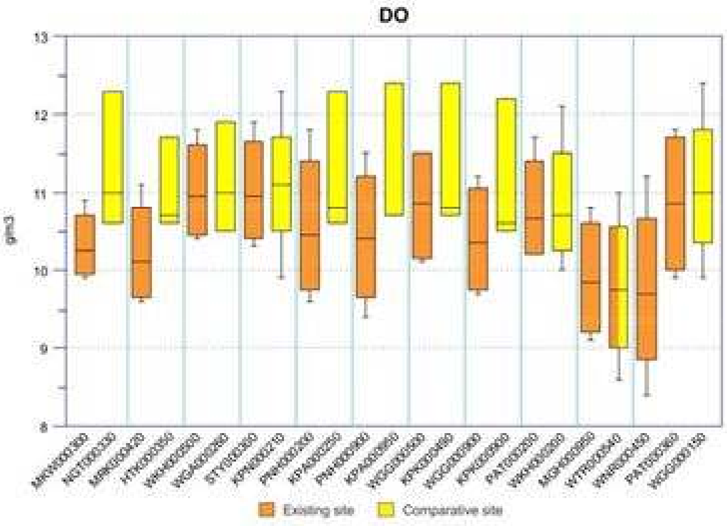
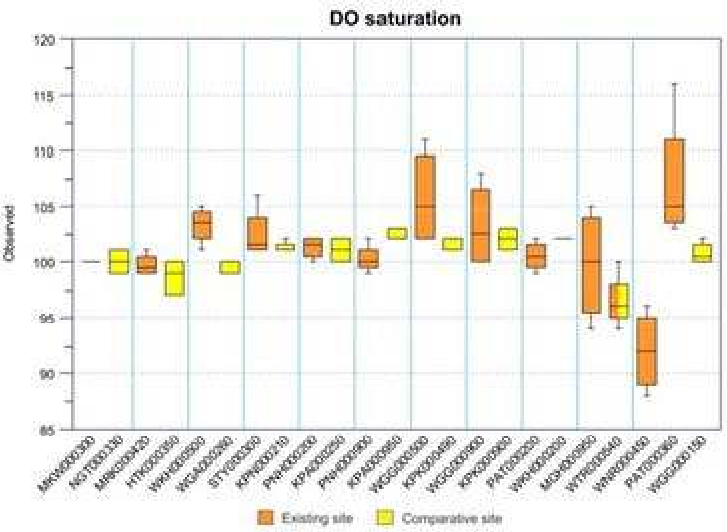
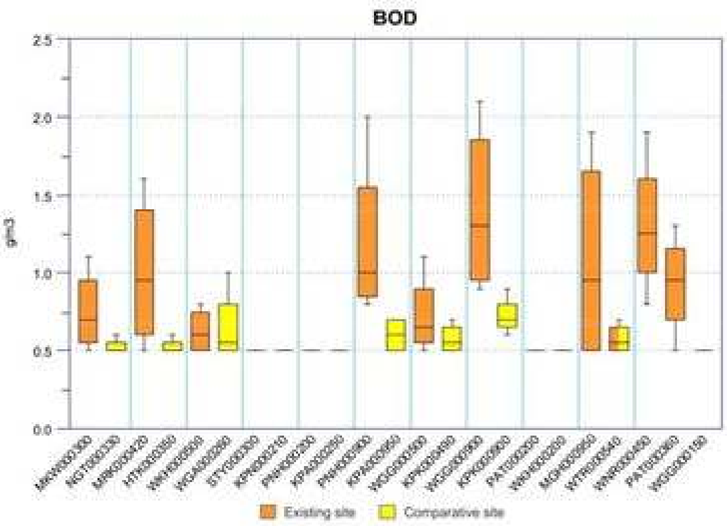
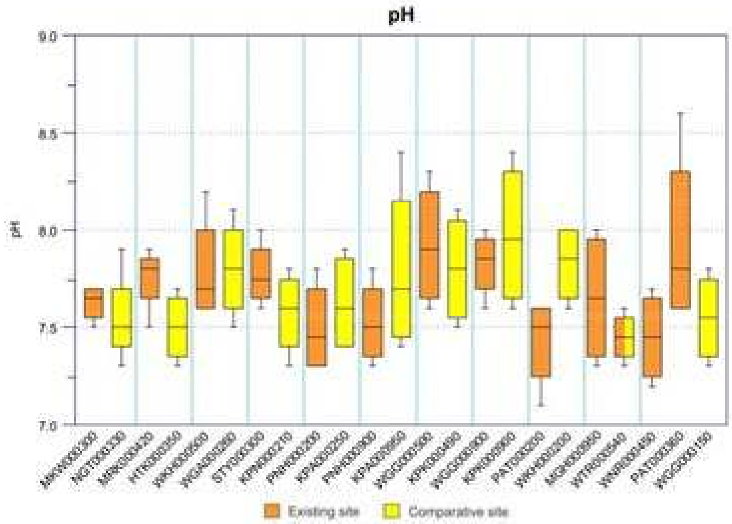
Existing site
Comparative site


Turbidity
NTU
1000
100
10
1
0.1
Existing site
Comparative site


DO
g/m3
Existing site
Comparative site


DO saturation
Observed
Existing site
Comparative site


BOD
g/m3
Existing site
Comparative site


pH
pH
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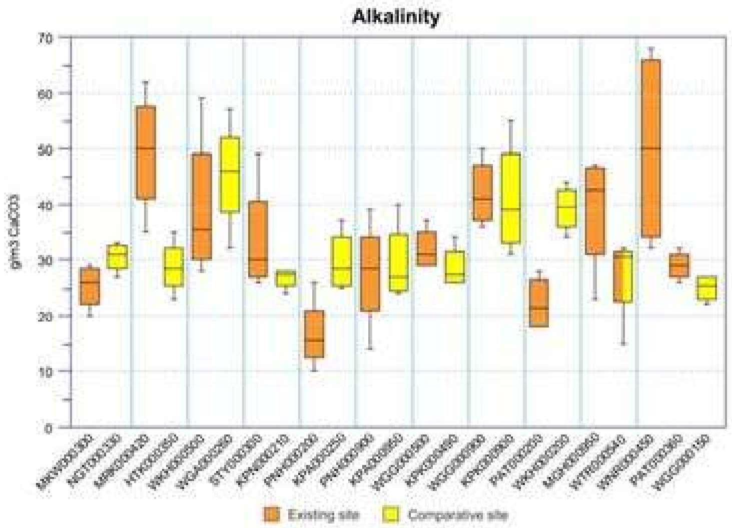
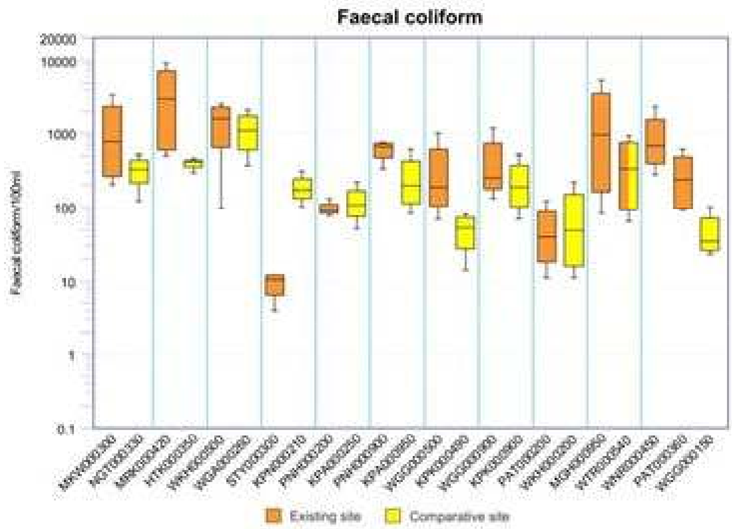
8.5
8.0
7.5
7.0
Existing site
Comparative site


Alkalinity
g/m3 CaCO3
70
60
50
40
30
20
10
0
Existing site
Comparative site

Bacteria


Faecal coliform
Faecal coliform/100ml
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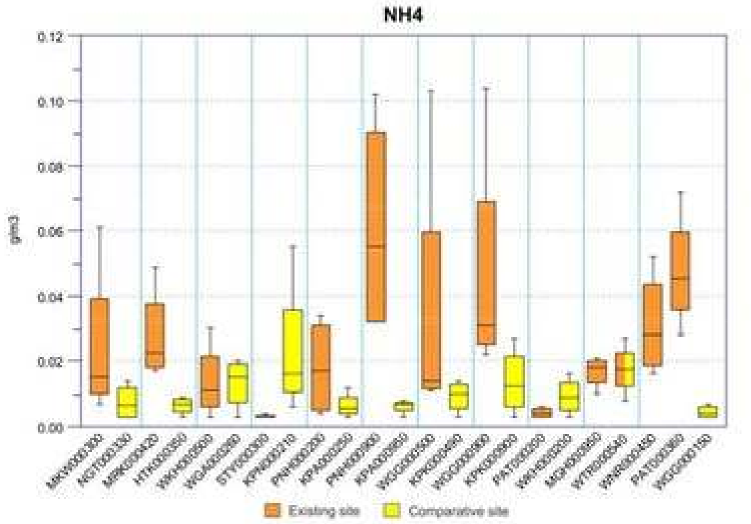
10000
1000
100
10
1
0.1
Existing site
Comparative site

Nutrients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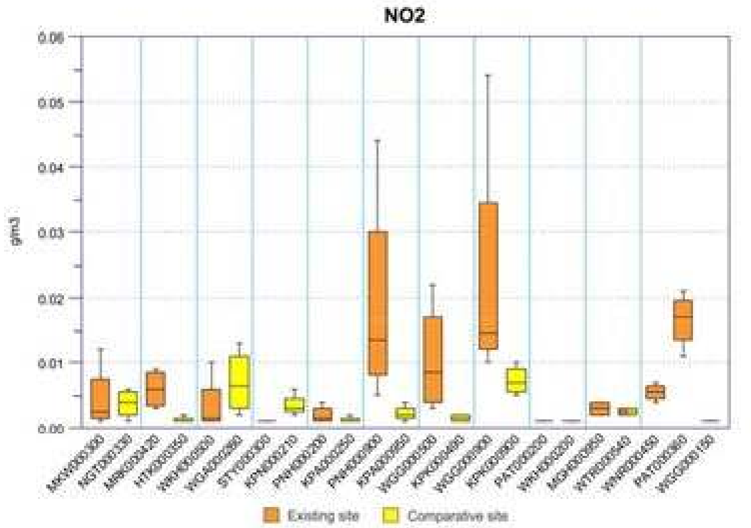
0.04
0.02
0.00
g/m3
Existing site
Comparative site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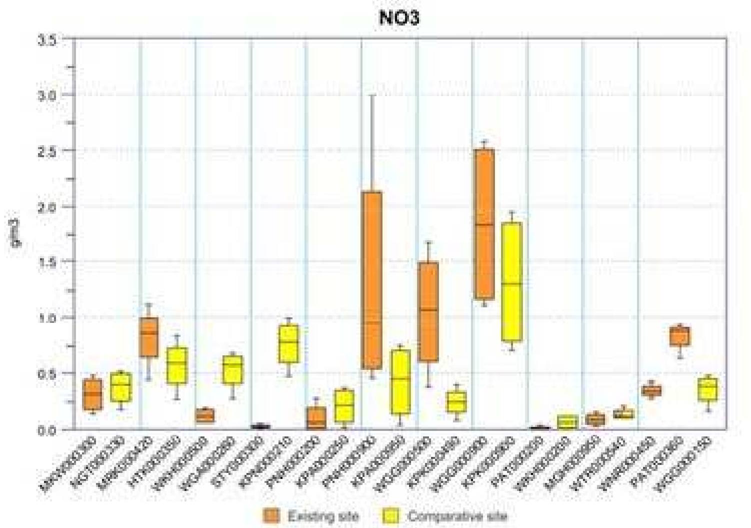
0.04
0.03
0.02
0.01
0.00
g/m3
Existing site
Comparative site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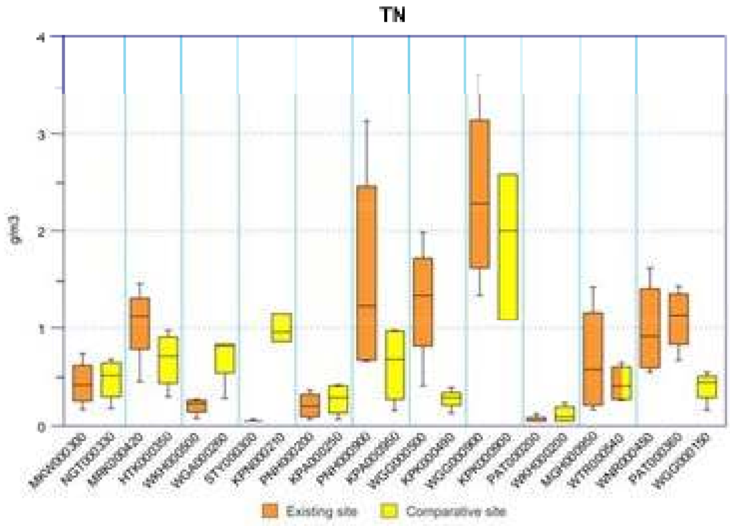
1.5
1.0
0.5
0.0
g/m3
Existing site
Comparative site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g/m3
4
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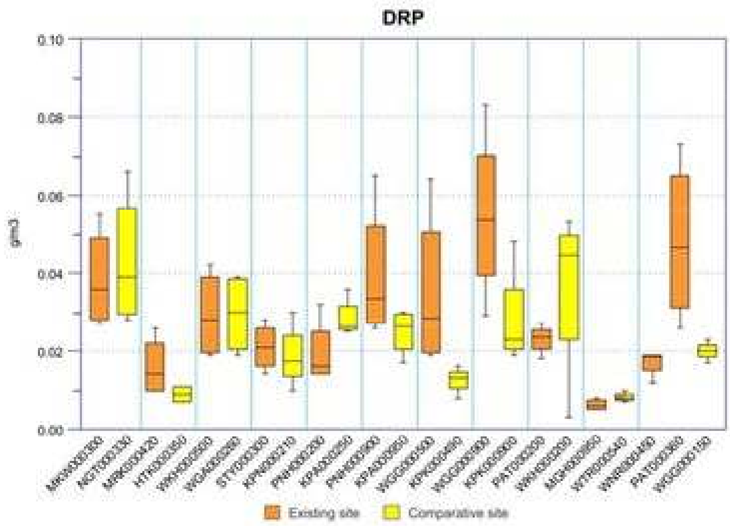
0
Existing site
Comparative site


DRP
g/m3
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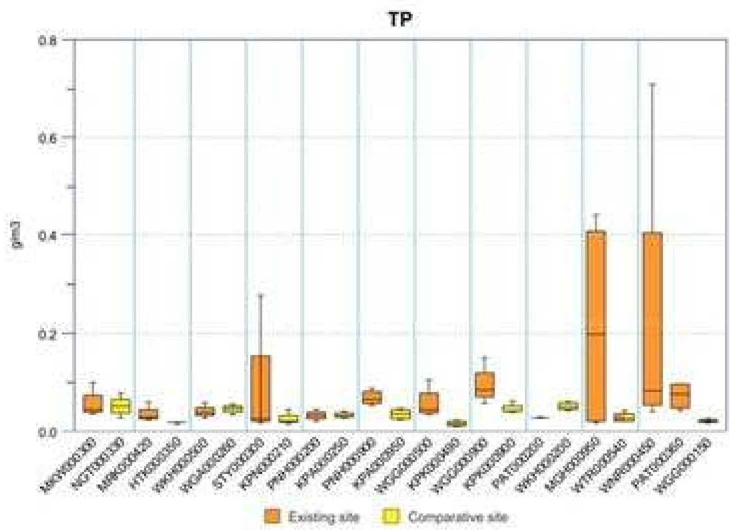
0.08
0.06
0.04
0.02
0.00
Existing site
Comparative site


TP
g/m3
0.8
0.6
0.4
0.2
0.0
Existing site
Comparative site

Agenda Memorandum

Date 11 June 2019

Memorandum to
Chairperson and Members
Policy and Planning Committee

Subject: **MfE and Stats NZ report – *'Environment Aotearoa 2019'***

Approved by: AD McLay – Director, Resource Management

BG Chamberlain, Chief Executive

Document: 2268160

Purpose

1. The purpose of this memorandum is to introduce and briefly discuss the latest national synthesis report prepared by the Ministry for the Environment (MfE) and Stats New Zealand (Stats NZ) on the state of New Zealand's environment, entitled *'Environment Aotearoa 2019'*.

2. The full report and a summary document can be found at https://www.mfe.govt.nz/publications/environmental-reporting/environment-aotearoa-2019 while a media release on the report can be found at https://www.mfe.govt.nz/news-events/new-report-signals-nine-top-environmental-issues-facing-new-zealand .

Executive summary

3. This is the second synthesis report prepared by MfE and Stats NZ on the state of New Zealand's environment. It was released on 18 April 2019. It follows the first synthesis report released in October 2015 just after the Environmental Reporting Act 2015 was passed.

4. Information used in the 2019 report is drawn from the most recent domain reports – *Our marine environment 2016*, *Our freshwater 2017*, *Our atmosphere and climate 2017*, *Our land 2018* and *Our air 2018*. Information is sourced from a variety of agencies such as regional councils, government departments and ministries, consultants, Crown Research Institutes and scientific papers and reports.

5. Following recommendations from the Parliamentary Commissioner for the Environment in 2015, the report is structured around 'issues'. Nine issues have been identified under five themes: our ecosystems and biodiversity; how we use our land; pollution from our activities; how we use our freshwater and marine resources; and our changing climate.

6. As with the 2015 report, *Environment Aotearoa 2019* does not discuss responses to the issues identified which tends to leave a negative view of what is happening to New Zealand's environment. For example, the report does not discuss the work that regional councils are doing in response to the issues raised. However, the Ministry for the Environment notes that they cannot consider this aspect as it falls outside the scope of the legislation.

7. The report concludes with a section on improving our understanding of the environment and strengthening reporting systems.

8. MfE and Stats NZ are undertaking work on the next domain reports in the series, *Our marine environment 2019*, and *Our fresh water 2020*.

Recommendation

THAT the Taranaki Regional Council:

a) receives the memorandum *'MfE and Stats NZ report – Environment Aotearoa 2019'.*

Background

9. The *'Environment Aotearoa 2019'* report, prepared under the Environmental Reporting Act 2015, was released on 18 April 2019.

10. The Environmental Reporting Act 2015 requires the Secretary for the Environment and Government Statistician to produce a series of domain reports every six months and a synthesis report every three years. The purpose of the synthesise report is to describe the state of New Zealand's environment, the pressures on the environment and the impacts that the state and changes to the environment are having on such things as ecological integrity, the economy, public health and te ao Māori.

11. The first synthesis report was prepared in October 2015 (just after the Act was passed) and was reported to the Committee at its meeting on 26 November 2015. The Committee has been provided previously with reports on individual domain reports, which are the building blocks for the synthesis report.

12. Information used in the 2019 report is drawn from the most recent domain reports – *Our marine environment 2016*, *Our freshwater 2017*, *Our atmosphere and climate 2017*, *Our land 2018* and *Our air 2018*. Information is sourced from a variety of agencies such as regional councils, government departments and ministries, consultants, Crown Research Institutes and scientific papers and reports.

13. When reviewing *Environment Aotearoa 2015*, the Parliamentary Commissioner for the Environment suggested structuring future synthesis reports around issues, which are defined '*...as a change in the state of the environment that is (partly) caused by human activities (pressures) and has consequences (impacts)'*.

14. The *Environment Aotearoa 2019* report consequently focuses on nine issues (see below). The issues have been narrowed down from the findings of the each of the domain reports noted above and were reviewed, ranked and prioritised according to set criteria. The issues reported on (under various themes) are:

Theme 1: Our ecosystems and biodiversity

- Issue 1: Our native plants, animals and ecosystems are under threat

Theme 2: How we use our land

- Issue 2: Changes to the vegetation on our land are degrading the soil and water
- Issue 3: Urban growth is reducing versatile land and native biodiversity

Theme 3: Pollution from our activities

- Issue 4: Our waterways are polluted in farming areas
- Issue 5: Our environment is polluted in urban areas

Theme 4: How we use our freshwater and marine resources

- Issue 6: Taking water changes flows which affects our freshwater ecosystems
- The way we fish is affecting the health of our ocean environment

Theme 5: Our changing climate

- Issue 8: New Zealand has high greenhouse gas emissions per person
- Issue 9: Climate change is already affecting Aotearoa New Zealand.

Discussion

15. The first thing that Members should note is that the model of environmental reporting that has been retained in this report is that of pressure-state-impact. The logic of this framework is that pressures cause changes to the state of the environment, and these changes have impacts on ecological integrity, public health, the economy, te ao Māori etc. The report makes the point that our environment is inextricably connected with these and other aspects of our community life.

16. However, as we have previously noted, the report does not cover how agencies such as regional councils are responding to environmental issues, or how we are implementing resource management more broadly. Therefore, the question of 'what are we doing about it?' is unfortunately, left unanswered. The response from the Ministry for the Environment is that they cannot consider responses as this aspect is outside the scope of the legislation.

17. While this is acknowledged it does tend to promote a rather negative view of what is happening and that very little is being done about it. For example, Issue 4 states that 'Our waterways are polluted in farming areas', which is a very broad statement that does not accurately reflect the work that is being done both nationally and in Taranaki to improve water quality. Furthermore, some of the actions being taken now will take decades to show improvements.

18. Our riparian and sustainable land management programmes and our focus on land disposal of dairy effluent to land rather than to water, combined with our ongoing resource consenting, compliance monitoring and enforcement programmes are reflected in excellent results being achieved in our own state of the environment monitoring programmes. For example, our latest ecological monitoring shows that the ecological health of our rivers and streams are the best they have ever been with improvements made every year over the past several years.

19. In terms of physicochemical state (see item elsewhere in this agenda), when comparing the 2015-2018 results against the nutrient criteria set out in the compulsory National Objectives Framework (NOF), there are 60 results which can be categorised, across 4

parameters. Seventy-five percent of all results lie in their respective 'A' band, and 23% in the 'B' band- a total of 98.3% of all results for water quality in Taranaki being either 'A' (excellent) or 'B' (good). No results fall below the national bottom lines ('C' (fair)).

20. These reflects the considerable investment made by the Taranaki community to improving water quality.

21. We made these points in our submissions to the Environmental Reporting Bill but the current reporting model was retained.

22. The report largely presents data at an aggregated or national level (as is its purpose) with less discussion of what is happening at a regional or local level despite many new or updated environmental indicators having been used in the 2019 report, a number of which have come from regional councils. MfE has stated that while the report tells a national story, it acknowledgers important regional variations where possible but better information is needed about what is happening at the regional level.

23. Another note-worthy absence in the report are comparisons with national guidelines and overseas standards. This makes it harder for the reader to get a sense of how good or bad our environment is relative to accepted national or overseas standards.

24. Some of the issues highlighted in the report include:

- Our native biodiversity is under significant pressure from introduced species, pollution, physical changes to our landscape, harvesting of wild species and other factors. Almost 4,000 native species are currently threatened with or at risk of extinction.
- Logging native forests, draining wetlands and clearing land have degraded a range of benefits provided by native vegetation, accelerated our naturally high rates of soils loss and affected our waterways.
- Growth of urban centres has led to land fragmentation and threatens the limited supply of versatile land near Auckland and other regional centres.
- Waterways in farming areas are polluted by excess nutrients, pathogens, and sediment. This threatens our freshwater ecosystems and cultural values, and may make our water unsafe for drinking and recreation.
- Some of our cities and towns have polluted air, land and water that comes from home heating, vehicle use, and disposal of waste, wastewater and stormwater.
- Using freshwater for hydroelectric power generation, irrigation, domestic and other purposes changes water flows in rivers and aquifers. This affects freshwater ecosystems and the ways we relate to and use our waterways.
- Harvesting marine species affects the health of the marine environment and its social, cultural and economic value to us. Fishing could change the relationship that future generations have with the sea and how they use its resources.
- Our per-person rate of greenhouse gas emissions is one of the highest for an industrialised country. Most of our emissions in 2016 came from livestock and road transport. Changes to our climate are already being felt and we can expect further wide-ranging consequences for our culture, economy, infrastructure, coasts and native species.

25. As previously noted, there is an emphasis in the issues identified on the negative impacts of use and development of resources with little acknowledgement of the socioeconomic benefits.

26. The report concludes with a section on improving our understanding of the environment and strengthening reporting systems so that future decisions about the environment 'are effective as they can be'. Part of the problem here is that there is no overarching requirement to collect environmental information at the national level for national environmental reporting purposes. MfE and Stats NZ have to reuse and re-analyse data from many different sources and incorporate it into the reporting framework as best they can. This is reflected in the patchy nature of the final report where gaps appear in a number of the issues, including missing or incomplete data and limited knowledge.

27. Regional councils have made it clear to the Ministry on many occasions that the regional data that we collect is to meet our own statutory duties to monitor the state of the environment within the region. It is not collected for national state of the environment monitoring purposes and therefore it might not have the required coverage. For example, monitoring sites are often selected to reflect specific resource management issues particular to the Taranaki context.

28. The Council has indicated that it would be prepared to consider carrying out monitoring or data collection specifically for national environmental reporting purposes if central government provided the resources necessary to do this.

29. We do note, however, that good progress is being made on National Monitoring Standards with regional council input and that this project will be beneficial for future national state of the environment reports.

30. MfE and Stats NZ are undertaking work on the next domain reports in the series, *Our marine environment 2019*, and *Our fresh water 2020*.

Decision-making considerations

31. Part 6 (Planning, decision-making and accountability) of the *Local Government Act 2002* has been considered and documented in the preparation of this agenda item. The recommendations made in this item comply with the decision-making obligations of the *Act*.

Financial considerations—LTP/Annual Plan

32. This memorandum and the associated recommendations are consistent with the Council's adopted Long-Term Plan and estimates. Any financial information included in this memorandum has been prepared in accordance with generally accepted accounting practice.

Policy considerations

33. This memorandum and the associated recommendations are consistent with the policy documents and positions adopted by this Council under various legislative frameworks including, but not restricted to, the *Local Government Act 2002*, the *Resource Management Act 1991* and the *Local Government Official Information and Meetings Act 1987*.

Iwi considerations

34. This memorandum and the associated recommendations are consistent with the Council's policy for the development of Māori capacity to contribute to decision-making processes (schedule 10 of the *Local Government Act 2002*) as outlined in the adopted long-term plan and/or annual plan. Similarly, iwi involvement in adopted work programmes has been recognised in the preparation of this memorandum.

Legal considerations

35. This memorandum and the associated recommendations comply with the appropriate statutory requirements imposed upon the Council.

Agenda Memorandum

Date 11 June 2019

Memorandum to
Chairperson and Members
Policy and Planning Committee

Subject: Key Native Ecosystems programme update

Approved by: S R Hall, Director - Operations

B G Chamberlain, Chief Executive

Document: 2253940

Purpose

1. The purpose of this memorandum is to present for Members' information an update on the identification of seventeen new Key Native Ecosystem (KNE) sites.

Executive summary

2. The *Biodiversity Strategy for the Taranaki Regional Council* ('the Biodiversity Strategy') sets out four strategic priorities for the Taranaki Regional Council (the Council), one of which relates to protection of KNEs on privately owned land.

3. KNEs refer to terrestrial (land) areas identified by the Council as having regionally significant ecological values and which are targeted for ongoing protection.

4. Officers work with interested landowners, including iwi, and community groups to promote the voluntary protection and enhancement of ecological values associated with the sites.

5. All landowners can seek an assessment of their particular site for potential involvement in the KNE programme. When opportunities arise, new sites are assessed in relation to their regional significance, and/or existing information and databases updated.

6. Protection of KNEs is part of the Council's **non-regulatory** work and involves working with interested landowners and others through the preparation and implementation of biodiversity plans, the provision of environmental enhancement grant funding, and/or assisting with pest and weed control.

7. The ongoing identification and assessment of sites with potentially regionally significant indigenous biodiversity values has resulted in 17 new sites being identified as KNEs covering a total area of 739.08 ha.

8. This financial year, Council officers have identified a total of 28 new KNE sites in the region, covering an area of 907 ha.

9. With the addition of the new sites, the Council has so far identified 293 KNEs covering approximately 123,396 hectares in the region.

10. 240 of the KNE sites are partially or completely privately owned. Together, they cover approximately 13,650 hectares or 20% of the total area of indigenous vegetation in Taranaki in private ownership.

11. KNE sites target the most vulnerable and at risk types of indigenous vegetation and do not cover all indigenous vegetation types.

Recommendations

That the Taranaki Regional Council:

a) receives this memorandum and the attached inventory sheets for Honeyfield's Bush, O'Sullivan Brothers, Lucien's Lot, McDonalds Glen, Te Kapua Park Bush, Hooper's Bush, Vertical Horizons, Tapuinikau Pa, Tataraimaka Pa, Eco Blue Nature Reserve, Coplestone's Bush, Banga's Bush, Jones Bush, Brough QEII, Log Jam, Abplanalp Kaupokonui Bush, Brookwood; and

b) notes that the aforementioned sites have indigenous biodiversity values of regional significance and should be identified as Key Native Ecosystems.

Background

12. To assist it in giving effect to its statutory functions for indigenous biodiversity under the *Resource Management Act 1991*, the Taranaki Regional Council (the Council) has recently reviewed and adopted the *Biodiversity Strategy for the Taranaki Regional Council* ('the Biodiversity Strategy'). The Biodiversity Strategy sets out four strategic priorities, one of which relates to the Council focusing on protecting KNEs on privately owned land.

13. The Council's management approach is to work with interested landowners, community groups and other interested parties to promote the voluntary protection and enhancement of ecological values associated with KNE sites on privately owned land. It involves the provision of a property planning service and other assistance, including the preparation and implementation of biodiversity plans, the provision of environmental enhancement grant funding, and/or assisting with pest and weed control.

14. The identification of KNEs is ongoing by Council. All landowners can seek an assessment of their particular site for potential involvement in the KNE programme. When opportunities arise, new sites are assessed in relation to their regional significance, and/or existing information and databases updated.

KNE site inventory process

15. Council officers have recently investigated and consulted with landowners to identify a further seventeen sites totalling 739.08 hectares and recommend they be adopted as a KNE. The candidate sites are:

- Honeyfield's Bush
- O'Sullivan Brothers
- Lucien's Lot
- McDonalds Glen
- Te Kapua Park Bush
- Hooper's KNE
- Vertical Horizons
- Tapuinikau Pa
- Tataraimaka Pa
- Eco Blue Nature Reserve
- Coplestone's Bush
- Banga's Bush
- Jones Bush
- Brough QEII
- Log Jam
- Abplanalp Kaupokonui Bush
- Brookwood.

16. All the sites have been assessed by officers as significant in accordance with criteria set out in Bio Policy 4 of the *Regional Policy Statement for Taranaki* (2010), i.e. rarity and distinctiveness, representativeness or ecological context. Copies of the inventory sheets for the new sites are attached to this item.

17. With the addition of the new sites, the Council has so far identified 293 KNEs (covering approximately 123,396 hectares), which includes public conservation land. Of the 289,000 hectares of indigenous vegetation in the region, approximately 64,000 hectares is in private ownership.

18. A total of 240 of the KNE sites, covering approximately 13,650 hectares, are partially or completely privately owned. This represents around 20% of the privately owned indigenous vegetation in the region. However, of note KNE sites do not cover all indigenous vegetation in the region but rather the most vulnerable and at risk types of indigenous vegetation.

19. Identification of a site as a KNE does not have any extra bearing on the rules or controls that already apply to such sites in regional or district council plans. Identification of sites is undertaken by the Council to focus its **non-regulatory** efforts to work with and support landowners to protect biodiversity values on their land. As previously noted, protection is implemented through the preparation and implementation of biodiversity plans, the provision of environmental enhancement grant funding, and/or assisting land occupiers and/or care groups with pest and weed control.

20. The *2018–2028 Long Term Plan* includes, amongst other things, a target to maintain and regularly update the Council's Inventory of KNEs. The identification of the additional

KNEs gives effect to that commitment. This financial year, Council officers have identified a total of 28 new KNE sites in the region, covering an area of 907 ha.

Decision-making considerations

21. Part 6 (Planning, decision-making, and accountability) of the *Local Government Act 2002* has been considered and documented in the preparation of this agenda item. The recommendations made in this item comply with the decision-making obligations of the Act.

Financial considerations—LTP/Annual Plan

22. This memorandum and the associated recommendations are consistent with the Council's adopted Long-Term Plan and estimates. Any financial information included in this memorandum has been prepared in accordance with generally accepted accounting practice.

Policy considerations

23. This memorandum and the associated recommendations are consistent with the policy documents and positions adopted by this Council under various legislative frameworks including, but not restricted to, the *Local Government Act 2002*, the *Resource Management Act 1991,* the *Local Government Official Information and Meetings Act 1987*, and the *Biosecurity Act 1993*.

Iwi considerations

24. This memorandum and the associated recommendations are consistent with the Council's policy for the development of Māori capacity to contribute to decision-making processes (schedule 10 of the *Local Government Act 2002*) as outlined in the adopted long-term plan and/or annual plan. Similarly, iwi involvement in adopted work programmes has been recognised in the preparation of this memorandum.

Legal considerations

25. This memorandum and the associated recommendations comply with the appropriate statutory requirements imposed upon the Council.

Appendices/Attachments

26. Document No. 2198548, 2198539, 2229835, 2164059, 2248678, 2231697, 2231678, 2231680, 2231643, 2200270, 2238779, 2238777, 2238839, 2238869, 2254029, 2249570, 2253967.

Honeyfield's Bush

At a glance

TRC Reference: BD/9636

Ecological District: Egmont

Land Tenure: Private

Area(ha): 9.4

GPS: 1676850X & 5654509Y

Habitat: Forest Remnant

Bioclimatic Zone: Lowland

Ecosystem Type: MF7.3: Tawa, pukatea, podocarp forest
VS5.2, Northern rata, kamahi forest
WF8: Kahikatea, pukatea forest

LENZ: H1.3a Acutely threatened
F5.2b Acutely threatened

National: Priority 1 – Threatened Land Environment
Priority 4 – Threatened Species

Regional: Key Native Ecosystem

Regional Ecosystem Loss: Acutely Threatened <10% left
At risk 20-30% left

Catchment: Matanehunehu (379)
Waiweranui (378)

General Description

The Honeyfield's Bush forest remnants are located approximately 6.3kms south east of Okato on the western Mount Taranaki ring plain. The area consists of two lowland forest remnants totalling around 9.4 hectares on mainly flat ground. They lie in the Egmont Ecological District and are within the Waiweranui and Matanehunehu stream catchments. These sites are remnants of native forest classified as 'Acutely Threatened' land environments and 'At Risk' and 'Acutely Threatened' ecosystem types (MF7.3: Tawa, pukatea, podocarp forest, VS5-2: Northern rata, kamahi forest, WF8: Kahikatea, pukatea forest). They also provide greater connectivity to other habitats, KNE's and priority ecosystems in this vicinity with very good additional riparian links along stream margins on this property.

Ecological Features

Flora

The forest remnant canopies are dominated by kahikatea and pukatea with occasional tawa, miro, rimu and rewarewa present in the south remnant. The understory and ground cover is intact and is a mix of pigeonwood, mahoe, coprosma, tree ferns and ground ferns. Climbers and epiphytes are fairly common. Three species of threatened rata and the threatened poroporo are present and are notable for the site.

Fauna

Native birds at the site include kereru, tui, grey warbler, kingfisher and morepork will likely be present. There is very good habitat for a range of other notable native species including reptiles, invertebrates and native fish.

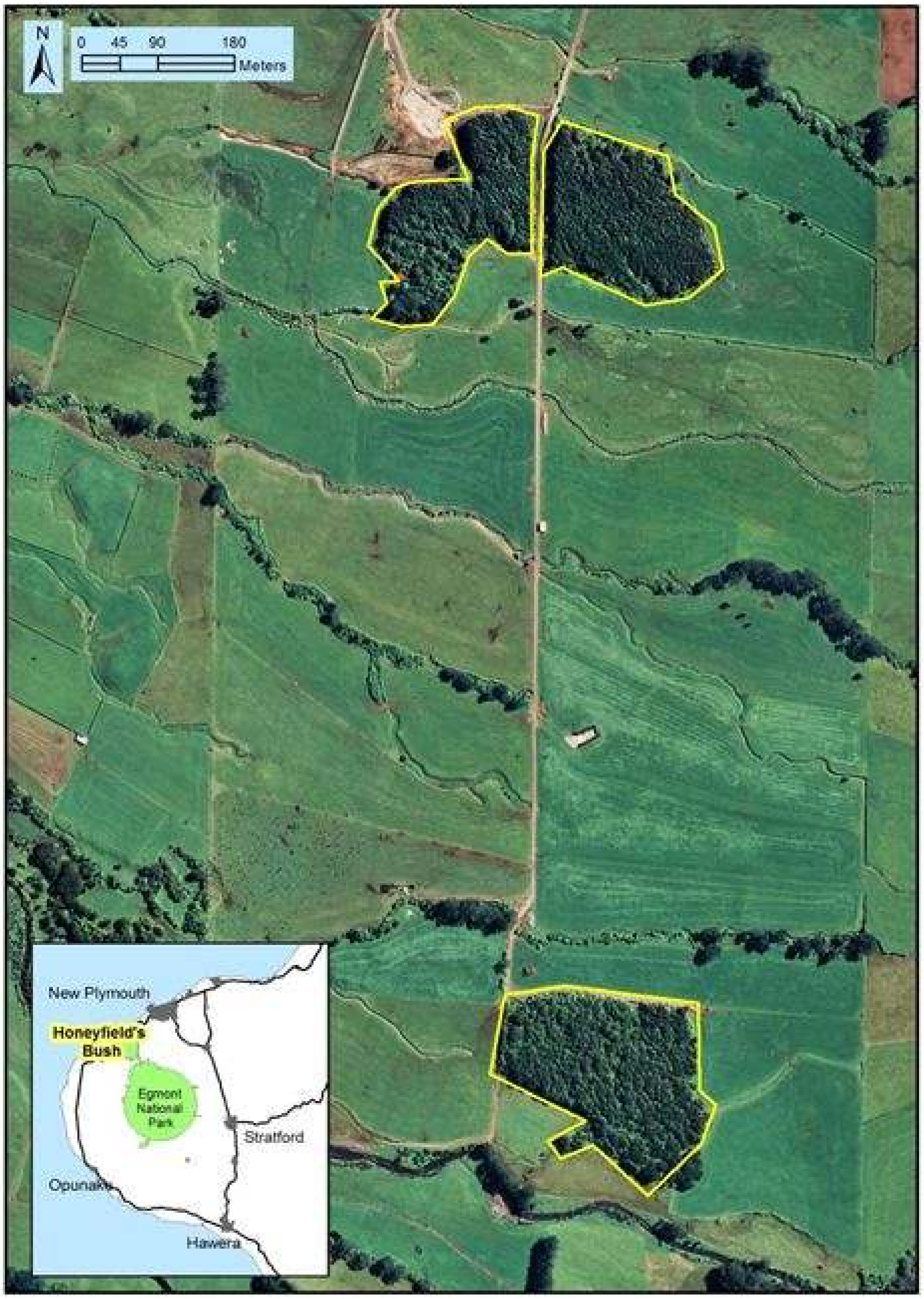
Ecological Values

Ecological Context - Medium	Provides connectivity to other habitats, KNE's and priority ecosystems in this vicinity with additional very good riparian links along stream margins on this property.
Rarity and Distinctiveness - Medium	Contains three species of 'Threatened' rata and the 'Threatened' poroporo. Provides habitat for and likely to contain other notable species including reptiles, invertebrates and native fish.
Representativeness - High	Are remnants of native forest classified as a 'Acutely Threatened' land environments and 'At Risk' and 'Acutely Threatened' ecosystem types (MF7.3: Tawa, pukatea, podocarp forest, VS5-2: Northern rata, kamahi forest, WF8: Kahikatea, pukatea forest).

Sustainability - Positive	Key ecological processes still influence the site and with appropriate management, it can remain resilient to existing or potential threats.

Other Management Issues

Habitat Modification - Low	Historic modification from drainage in this area.
Herbivores - High	Potential high risk from browsing although currently securely fenced and in good condition.
Possum Self-help	The property is within the possum self-help area and receives sustained possum control.
Predators - Medium	Predators including rodents, mustelids, possums, feral cats and hedgehogs will be having an impact on native species at the site.
Weeds - Medium	Potential weed threat is medium to high although currently low with weeds confined to the margins and receive control.



O'Sullivan Brothers

At a glance

TRC Reference:	BD/9640	LENZ:	F1.1b Not threatened F7.2a At risk
Ecological District:	North Taranaki	National:	Priority 2 – Sand Dunes and Wetlands Priority 4 – Threatened Species
Land Tenure:	Private	Regional:	Key Native Ecosystem Close proximity to a representative ecosystem site
Area(ha):	300	Regional Ecosystem Loss:	At risk 20-30% left Less reduced >50% left
GPS:	1750009X & 5691894Y	Protection Status:	QEII Covenant
Habitat:	Forest Remnant	Catchment:	Tongaporutu (403)
Bioclimatic Zone:	Lowland		
Ecosystem Type:	MF7.2: Rata, tawa, kamahi, podocarp forest MF7.3: Tawa, pukatea, podocarp forest		

General Description

The O'Sullivan Brothers site is located on private land 10kms south east of Ahititi in North Taranaki within the North Taranaki Ecological District and Tongaporutu River catchment. The area is large (300 ha) and consists of a range of habitats including primary forest, cutover primary forest, areas of regenerating native scrub and a unique tableland open water wetland well above the main valley floor. The site is also connected to existing native habitats in the area including priority ecosystems. The site provides good connectivity to other Key Native Ecosystems and habitats in this area including the Moki/Makino Conservation Area and the Tongaporutu Grazing Co Bush.

Ecological Features

Flora

The cutover area and existing primary old forest contains tawa, pukatea, rimu, rewarewa, miro, black maire, hinau and totara. A thin ridge of beech (probably hard beech) is also present at one site in the block. The understory and canopy of regenerating areas contains manuka, mahoe, pigeonwood, lancewood, tree daisy, tree ferns and nikau. Groundcover ferns are reasonably diverse in some areas.

Fauna

Notable fauna within the area includes the 'Threatened, Nationally Critical' long-tailed bat and 'At Risk' bush falcon, long-tailed cuckoo, North Island fernbird, North Island rifleman, North Island robin, Western North Island brown kiwi and whitehead. A number of other threatened or at risk fauna species are also likely to be present including native fish, reptiles and invertebrates. The area also contains populations of other forest birds including the New Zealand pigeon, grey warbler, tomtit, fantail, tui, bellbird and morepork.

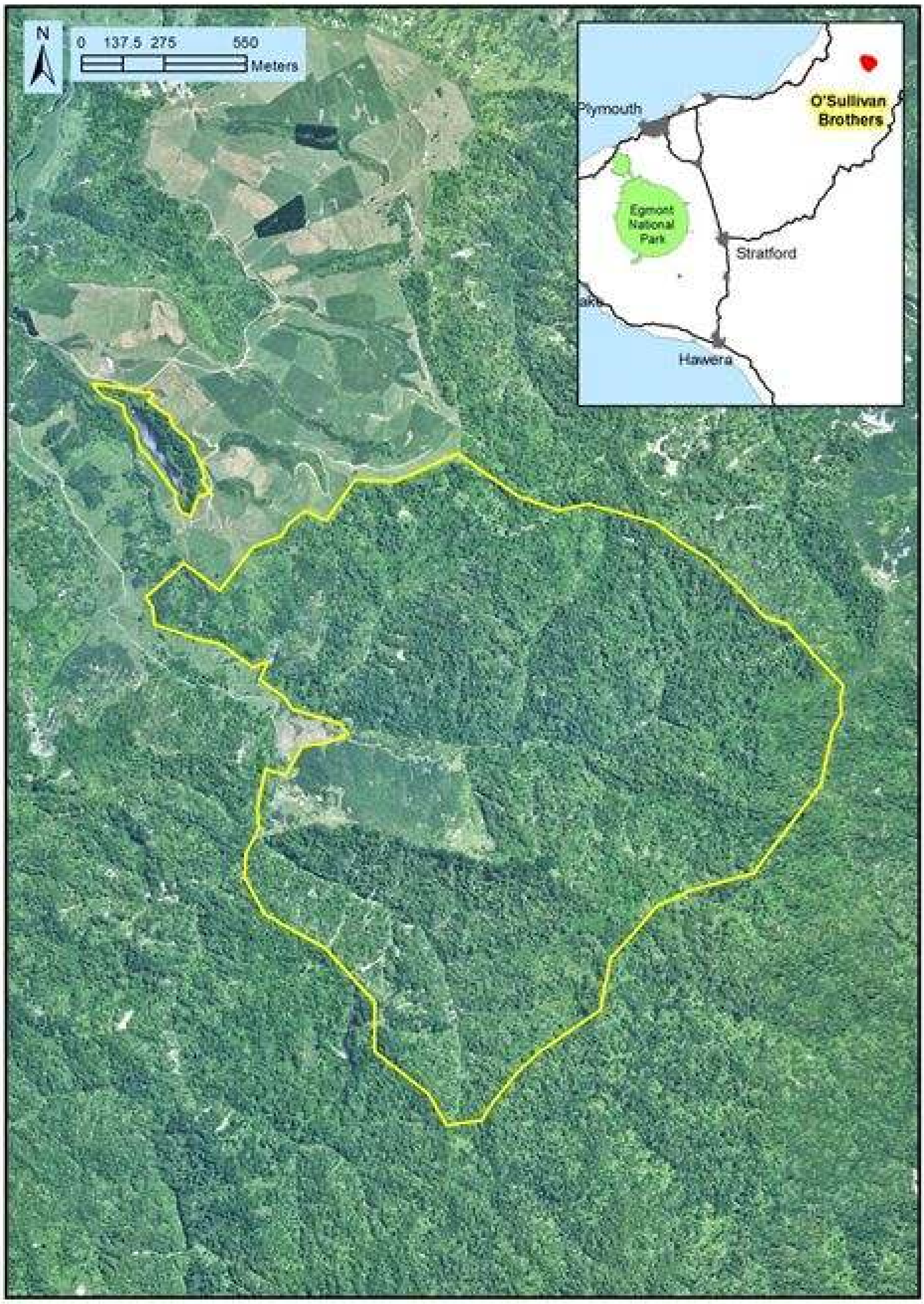
Ecological Values

Ecological context - High	Provides additional habitat and greater connectivity with priority ecosystems and KNE's in this area.
Rarity and Distinctiveness - High	Contains threatened and at risk species such as the 'Threatened' long-tailed bat and four species of threatened rata, 'At Risk' species include bush falcon, long-tailed cuckoo, North Island Fernbird, North Island rifleman, North Island robin, Western North Island brown kiwi and whitehead. Also likely to contain other notable species such as freshwater fish and reptiles.

Representativeness - Medium	Contains a large area of an 'At Risk' ecosystem type (MF7-3 tawa, pukatea, podocarp forest). Also contains a small area of indigenous vegetation classified as an 'At Risk' (F7.2a) LENZ environment.
Sustainability - Positive	Key ecological processes still influence the site and with appropriate management, it can remain resilient to existing or potential threats.

Other Management Issues

Habitat Modification - Low	Stock currently have minor access in the valley end although will be excluded once protected and fenced.
Herbivores - High	Possums and goats.
Predators - Medium	Predators including rodents, mustelids, possums, feral cats and hedgehogs will be having an impact on native species at the site.
Weeds - Low	Occasional African clubmoss, foxglove and burdock.



Lucien's Lot

At a glance

TRC Reference:	BD/9647	LENZ:	F5.3b Not threatened
Ecological District:	Egmont	National:	Priority 4 – Threatened Species
Land Tenure:	Private	Regional:	Close proximity to a representative ecosystem site Key Native Ecosystem
Area(ha):	2.3	Regional Ecosystem Loss:	Less reduced >50% left
GPS:	1683084X & 5658753Y	Protection Status:	QEII Covenant Local Government
Habitat:	Forest Remnant	Catchment:	Katikara (382)
Bioclimatic Zone:	Lowland		
Ecosystem Type:	MF7.2: Rata, tawa, kamahi, podocarp forest		

General Description

The Lucien's Lot covenant is located on private land approximately 7.8km south-east of Okato. The remnant consists of a mix of existing cutover lowland tawa/kamahi forest and some small previously cleared regenerating scrub/forest in the Katikara stream catchment. The remnant is connected to other KNEs in the area including Katikara Bush and Egmont National Park and close to other KNEs such as Carrington Road B.

Ecological Features

Flora

This remnant is a good example of existing and regenerating lowland native forest, with a canopy consisting predominantly of tawa, hinau, rimu, miro and kamahi. The understory and ground cover is intact and climbers and epiphytes are occasional. Recent myrtle rust threats have elevated potentially vulnerable native flora species to 'Threatened' or 'At risk' status. Five of these newly listed species are present at this site including three species of rata, kanuka and manuka. The 'Threatened' poroporo is also present on the forest margin.

Fauna

Native birdlife recorded in and around the covenanted area include the grey warbler, fantail, tui, bellbird, New Zealand pigeon, tomtit and morepork. The 'At risk' long-tailed cuckoo occasionally visits this site and is notable for the area. The Katikara Stream catchment contains regionally distinctive and threatened freshwater fish which are likely to be present at this site. Notable reptiles and invertebrates are also likely to be present.

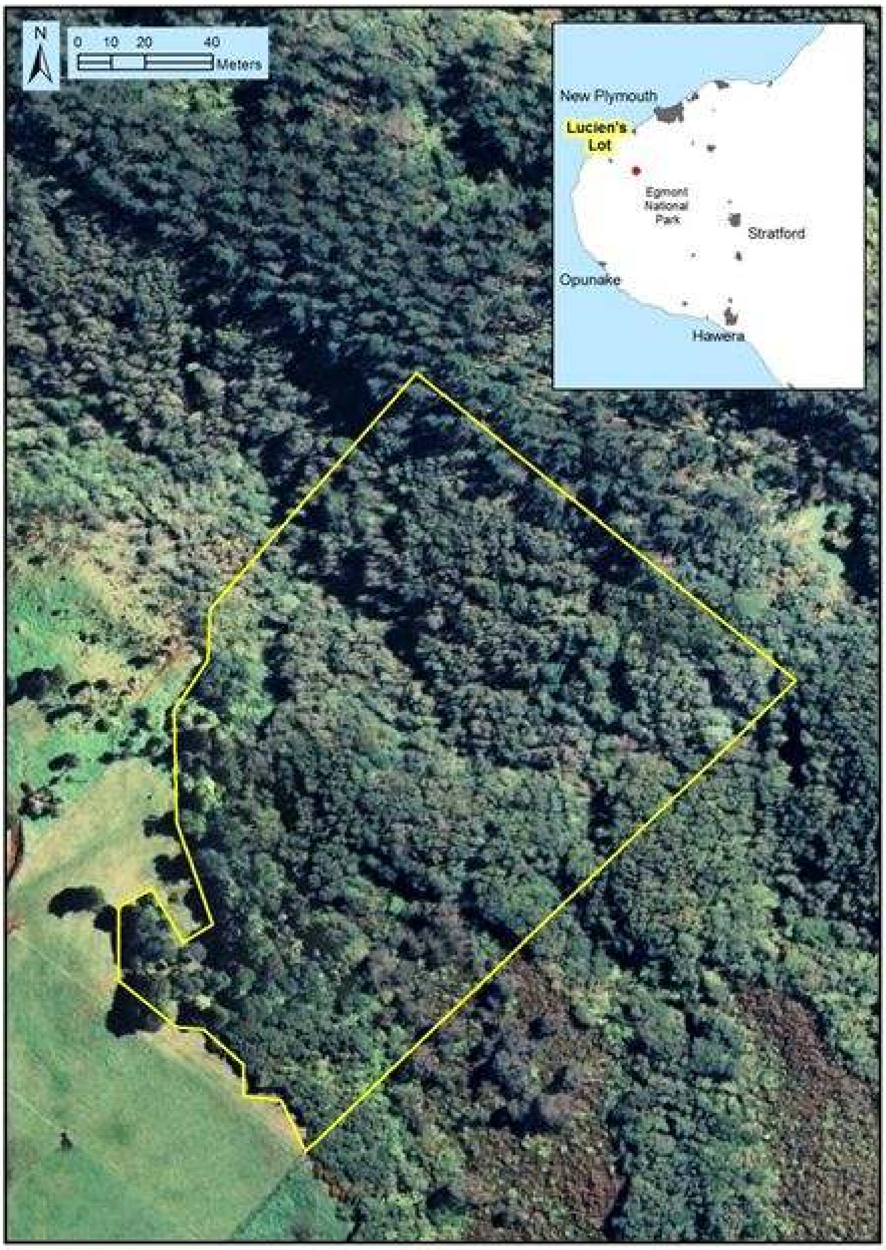
Ecological Values

Ecological context - High	Provides additional habitat and greater connectivity with other KNE in this area such as Katikara Bush and Egmont National Park.
Rarity and Distinctiveness - High	Contains the 'Threatened' poroporo and five newly listed 'Threatened' and 'At Risk' flora species due to potential vulnerability to myrtle rust including three species of rata, kanuka and manuka. Provides habitat for and likely to contain notable fauna species such as freshwater fish, reptiles and invertebrates.
Representativeness - Low	Contains indigenous vegetation classified as a 'Less reduced and better protected' (F5.3b) LENZ environment.
Sustainability - Positive	Key ecological processes still influence the site and with appropriate management, it can remain resilient to existing or

	potential threats. The site has the additional benefit of being formally protected.

Other Management Issues

Habitat Modification - Low	Protected from stock and the remnant is formally protected by a QEII Covenant.
Herbivores - High	Potential high risk from browsing although currently secure and in good condition.
Possum Self-help	The property is within the possum self-help area and receives possum control by the landowner.
Predators - Medium	Predators including rodents, mustelids, possums, feral cats and hedgehogs will be having an impact on native species at the site.
Weeds - Medium	Gorse is present but is acting as a nursery crop for native seedlings.



McDonalds Glen

At a glance

TRC Reference: BD/9637

Ecological District: Egmont

Land Tenure: Private

Area(ha): 1.2

GPS: 1701360X & 5632713Y

Habitat: Forest Remnant

Bioclimatic Zone: Lowland

Ecosystem Type: MF7.3: Tawa, pukatea, podocarp forest

LENZ: F5.2a Acutely threatened

National: Priority 1 – Threatened Land Environment
Priority 4 – Threatened Species

Regional: Key Native Ecosystem

Regional Ecosystem Loss: At risk 20-30% left

Catchment: Kapuni (352)

General Description

The McDonalds Glen forest remnant is a small (1.2ha) privately owned lowland forest remnant located approximately 3kms south east of Kaponga and is situated on the true left bank of the Kapuni Stream. The bush remnant lies in the Egmont Ecological District and provides some connectivity to other habitats in the vicinity with good riparian links along the stream margin. Forest remnants such as this are now very rare in this area. The remnant also contains vegetation associated with an 'Acutely Threatened' (F5.2a) LENZ environment.

Ecological Features

Flora

The forest remnant canopy is dominated by tawa with occasional rewarewa, pukatea, titoki and one very large kahikatea. The understory and ground cover is intact and is a of mix mahoe, kawakawa, tree ferns and ground ferns. Native climbers are particularly common especially jasmine and muehlenbeckia. Two species of threatened rata and the threatened poroporo are present and are notable for the site.

Fauna

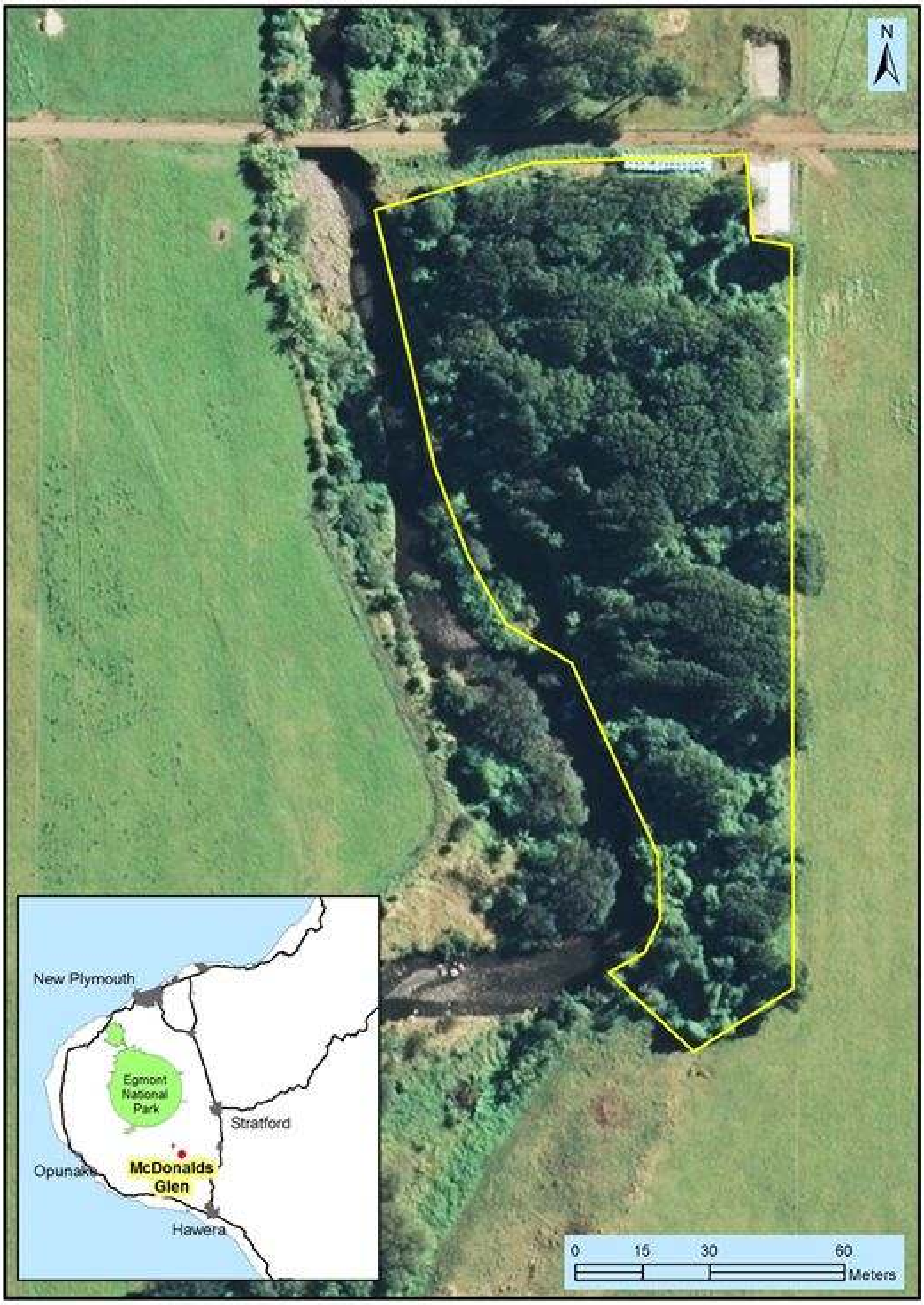
Native birds confirmed present include kereru and fantail. Other native birds are likely to be present or use this area such as grey warbler, tui, kingfisher and morepork. The Kapuni stream on the west forest margin contains notable species such as koaro and longfin eel and freshwater crayfish will be present. There is good habitat for a range of other notable native species including reptiles and invertebrates.

Ecological Values

Ecological Context - Medium	Provides some connectivity to other habitats in the vicinity with good riparian links along the stream margin.
Rarity and Distinctiveness - Medium	Contains two species of 'Threatened' rata and the 'Threatened' poroporo. Provides habitat for and likely to contain other notable species including reptiles and invertebrates.
Representativeness - High	Is a remnant of native forest classified as an 'Acutely Threatened' land environment and an 'At Risk' ecosystem type (MF7.3: Tawa, pukatea, podocarp forest).
Sustainability - Positive	In relatively good vegetative condition and likely to continue to improve.

Other Management Issues

Habitat Modification - Medium	At risk from modification although no immediate threats.
Herbivores - High	Potential high risk from stock browse if the fences were ever breached.
Possum Self-help	The remnant is within the possum self-help program area and receives occasional possum control by the landowner.
Predators - Medium	Predators including rodents, mustelids, possums, feral cats and hedgehogs will be having an impact on native species at the site.
Weeds - High	A variety of environmental weed species are present including wandering willy, boxthorn and blackberry.



Te Kapua Park Bush

At a glance

TRC Reference:	BD/9648	LENZ:	F5.2a Acutely threatened
Ecological District:	Egmont	National:	Priority 1 – Threatened Land Environment Priority 4 – Threatened Species
Land Tenure:	Private	Regional:	Key Native Ecosystem
Area(ha):	5.0	Regional Ecosystem Loss:	Less reduced >50% left
GPS:	1710843X & 5646159Y	Protection Status:	Local Government
Habitat:	Forest Remnant	Catchment:	Patea (343)
Bioclimatic Zone:	Lowland		
Ecosystem Type:	MF7.2: Rata, tawa, kamahi, podocarp forest		

General Description

Te Kapua Park Bush is located on the northeast side of the Stratford township in central Taranaki and lies in the Egmont Ecological District and Patea River catchment. The remnant is comprised of a 5 hectare cutover lowland forest remnant on the western edge of the Stratford Racing Club property. The forest canopy for the northern two thirds of the remnant is dominated by tawa with a good understory and ground cover. The southern third of the remnant is younger regenerating native forest with occasional old forest species present. The remnant provides good connectivity to other priority habitats in the area such as the King Edward Park and Carrington Walkway KNE and Kahouri Bush to the east. The forest area is the second largest remnant in the Stratford township and is classified as an 'Acutely Threatened' land environment (F5.2a) and a 'Less Reduced' ecosystem type (MF7.2: Rata, tawa, kamahi, podocarp forest).

Ecological Features

Flora

The forest canopy for the northern two thirds of the remnant is dominated by tawa with a good understory and ground cover. The southern third of the remnant is younger regenerating native forest with occasional old forest canopy trees present. Planted well established non local native specimen trees are also present in places along the road such as tanekaha, beech and kauri. Notable threatened species include poroporo, ramarama, rohutu, northern rata and two species of white rata.

Fauna

Native birds confirmed present include kereru, kingfisher and fantail. Other native birds are likely to be present or use this area such as grey warbler, tui, silvereye and morepork etc. There is good habitat for a range of other notable native species including reptiles and invertebrates. There is very limited freshwater habitat present which is confined to very small stream/seep areas with limited fish access.

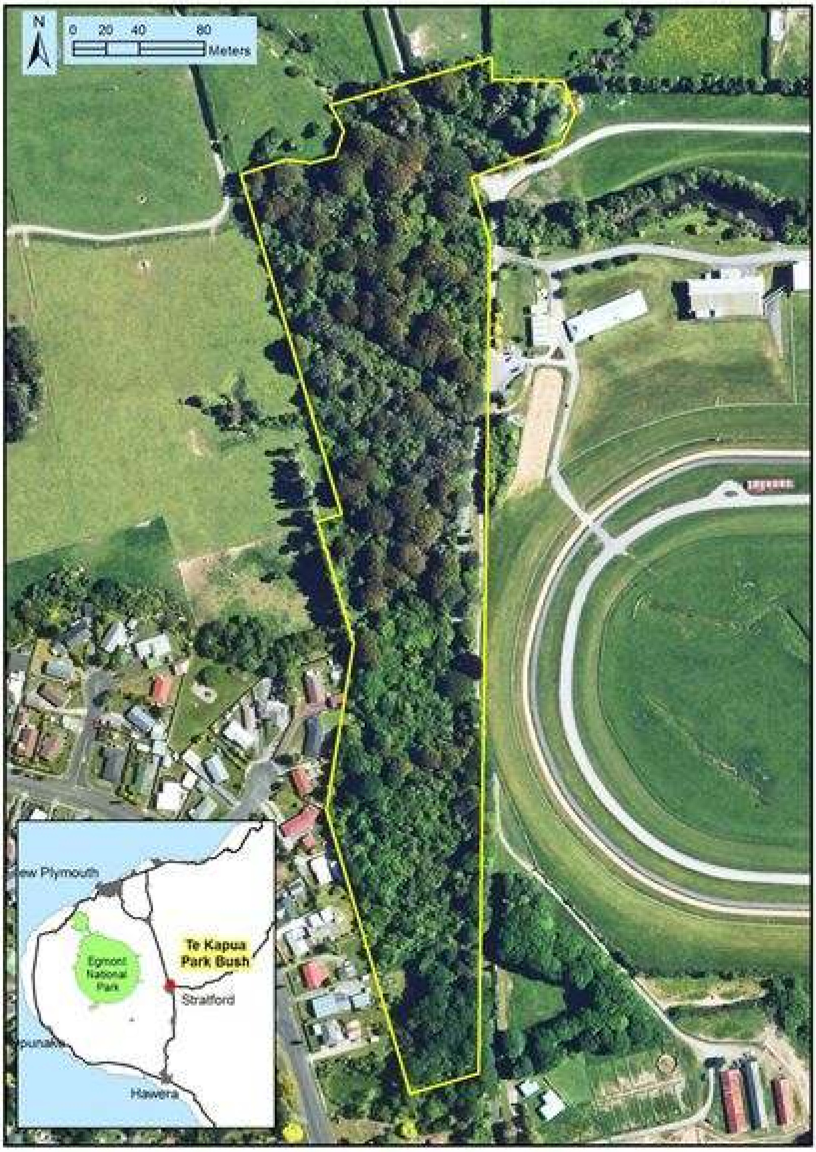
Ecological Values

Ecological context - High	Provides connectivity to other habitats, KNE's and priority ecosystems in this vicinity.
Rarity and Distinctiveness - Medium	Contains 'Threatened' species such as poroporo and five newly listed 'Threatened' flora species due to potential vulnerability to myrtle rust (three species of rata, ramarama and rohutu). Provides habitat for and also likely to contain other notable fauna species including reptiles and invertebrates.

Representativeness - High	Is a remnant of native forest classified as an 'Acutely Threatened' land environment and a 'Less Reduced' ecosystem type (MF7.2: Rata, tawa, kamahi, podocarp forest).
Sustainability - Positive	Key ecological processes still influence the site and with appropriate management, it can remain resilient to existing or potential threats.

Other Management Issues

Habitat Modification - Low	Historic modification and localised damage in areas close to housing.
Herbivores - High	Potential high risk from browsing on the northern end bordering the farmland. Other margins border the road or urban housing.
Weeds - High	Significant weed threats are present including old man's beard, exotic jasmine, cherry, holly, sycamore, strawberry dogwood and wandering willy.
Predators - Medium	Predators including rodents, mustelids, possums, cats and hedgehogs will be having an impact on native species at the site.
Possum Self-help	The property is within the possum self-help area and receives sustained possum control.



Hoopers KNE

At a glance

TRC Reference: BD/9625

Ecological District: Egmont

Land Tenure: Private

Area(ha): 8.2

GPS: 1706121X & 5672618Y

Habitat: Forest Remnant

Bioclimatic Zone: Semi-Coastal

Ecosystem Type: WF13: Tawa, kohekohe, rewarewa, hinau, podocarp forest

LENZ: F5.2a Acutely threatened

National: Priority 1 – Threatened Land Environment

Priority 4 – Threatened Species

Regional: Key Native Ecosystem

Regional Ecosystem Loss: Chronically threatened 10-20% left

Protection Status: QEII Covenant

Catchment: Waiongana (394)

General Description

The Hoopers KNE is located on private land 3.5km south east of Lepperton in North Taranaki within the Egmont Ecological District. This 8.2 hectare native forest remnant provides habitat for a range of native terrestrial species and is linked to other existing native and exotic habitats in the area. The site is situated over a hill and valley landform in the Waiongana catchment. The site provides good connectivity to other KNE and QEII remnants in the area.

Ecological Features

Flora

The main canopy of the site is dominated by tawa, with other canopy trees including pukatea, kahikatea and kohekohe. A number of other plant species are also present in the canopy and sub-canopy. These include kawakawa, pigeonwood, supplejack, swamp maire, karaka, puka, ponga, nikau and mapou.

Fauna

Native birdlife recorded in and around the KNE include the New Zealand pigeon, tui, wax eye and fantail. Future surveys will reveal what freshwater fish species are present in the creeks and pond. Good habitat exists for notable reptiles and invertebrates.

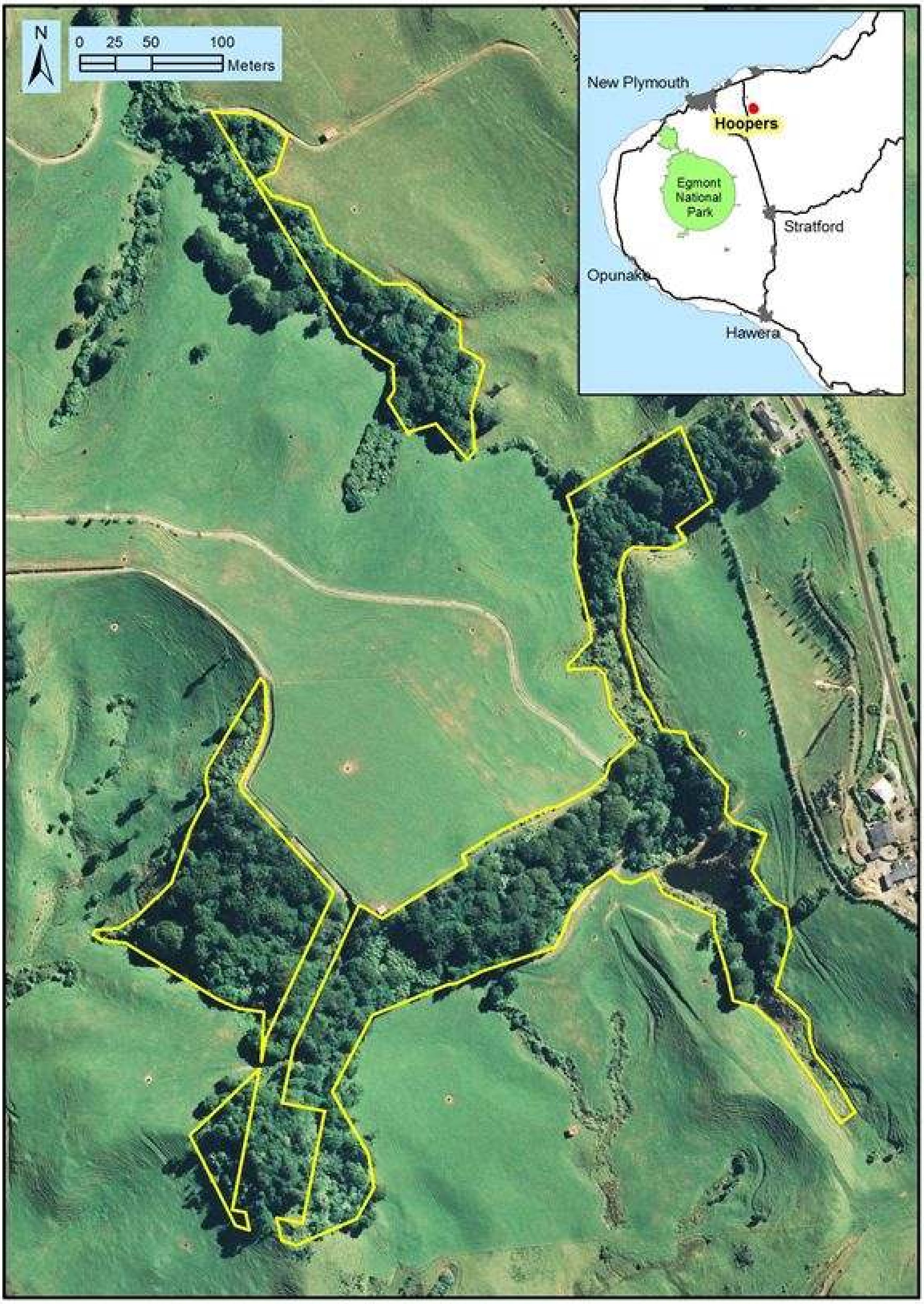
Ecological Values

Sustainability - Positive	Small area so edge effects have an impact but key ecological processes still influence the site. Under appropriate management, it can remain resilient to existing or potential threats.
Ecological Context - Medium	Connected to other small remnants in the area by native vegetation on riparian margins and provides connectivity to other KNEs and QEIIs
Representativeness - High	Contains indigenous vegetation on F5.2a – an 'Acutely Threatened' LENZ environment
Rarity and Distinctiveness - Medium	Contains Swamp maire. Listed as "Threatened, Nationally Critical"

Other Management Issues

Habitat Modification - Medium	Currently fenced and stock are excluded from the area.
Herbivores - Low	Potential high risk from browsing although currently secure and in good condition.

Possum Self-help	Bush remnants are within the Possum self-help area.
Predators - High	Mustelids, possums, feral cats, hedgehogs and rodents will be having an impact on native biodiversity at this site.
Weeds - Low	Occasional woolly nightshade present, no vine weeds found.



Tapuinikau Pa

At a glance

TRC Reference: BD/9650

Ecological District: Egmont

Land Tenure: Private

Area(ha): 3.5

GPS: 1672269X & 5655144Y

Habitat: Forest Remnant

Bioclimatic Zone: Semi-Coastal

Ecosystem Type: VS5.2, Northern rata, kamahi forest

WF13: Tawa, kohekohe, rewarewa, hinau, podocarp forest

LENZ:	H1.3a Acutely threatened F5.2b Acutely threatened
National:	Priority 1 – Threatened Land Environment
Regional:	Key Native Ecosystem Representative ecosystem type
Regional Ecosystem Loss:	At risk 20-30% left Chronically threatened 10-20% left
Protection Status:	DOC Covenant
Catchment:	Teikaparua (Warea) (377)

General Description

The Tapuinikau Pa forest remnant is located on the true right of the Warea River, 7 km south west of Okato town. The site provides key habitat and connectivity with other forest remnants in the area and along the Warea river leading to Egmont National Park. The canopy is dominated by rewarewea, karaka and kohekohe, with a varied understory including nikau, hangehange and coprosma species.

Ecological Features

Flora

Rewarewa, kohekohe and karaka are the dominant canopy species at this site with large tree ferns often emerging through the canopy. Cabbage trees and rata are common in canopy gaps, with a large variety of understory species including karamu, mapou, nikau and hangehange. Epiphytes including Astelia species are common and supplejack vines are thick in areas.

Fauna

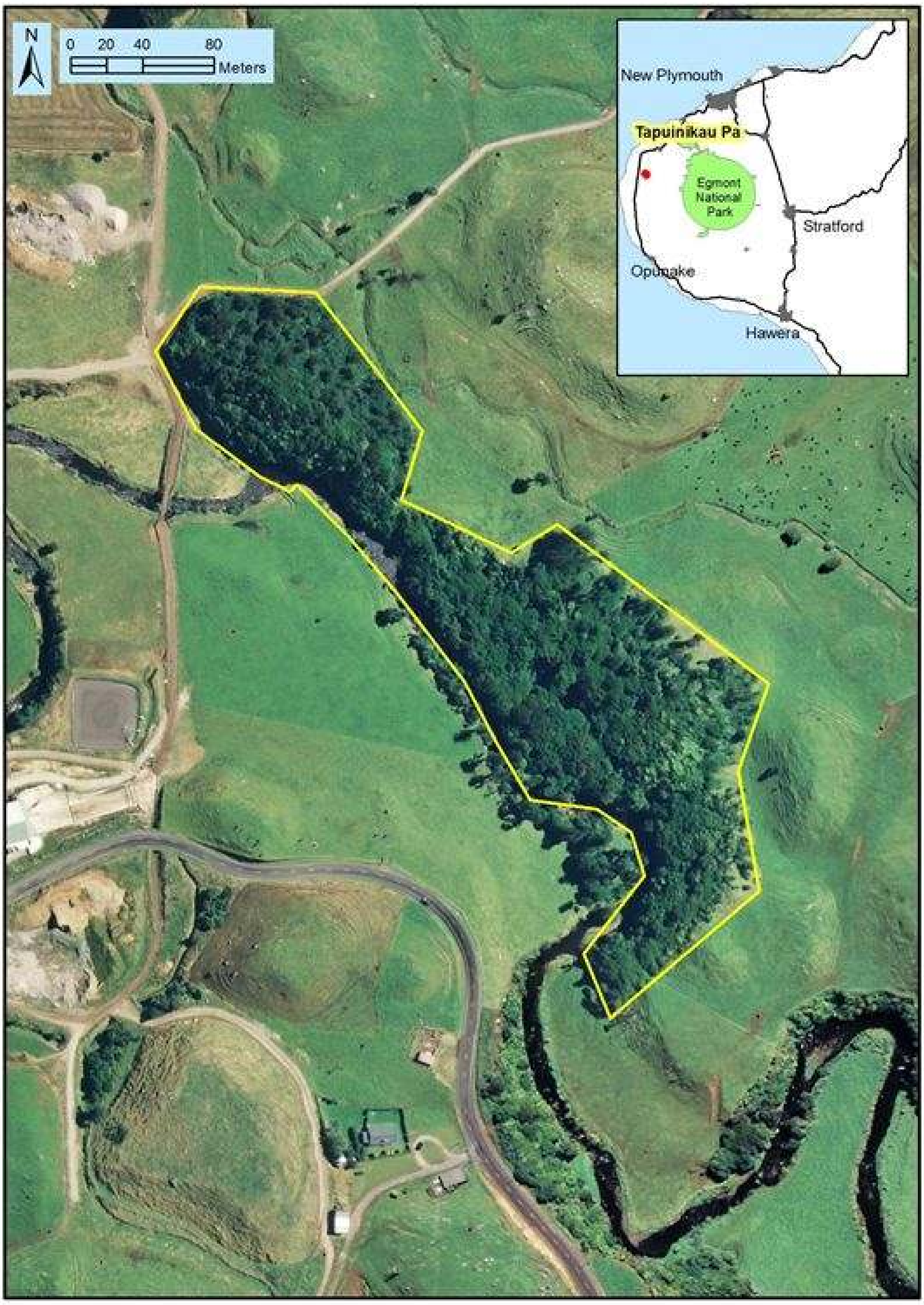
Native birdlife present at Tapuinikau Pa include fantail, wax eye, tui and kereru. The western boundary of the forest remnant forms part of the true left of the Warea river which provides habitat for native and introduced fish and invertebrates. Notable reptiles and invertebrates are also likely to be present.

Ecological Values

Ecological Context - Medium	Provides habitat along the Warea river and is close proximity to other Key Native Ecosystems in the area including Donald's Bush and NRGE Farms Limited Bush Block and Wetlands.
Rarity and Distinctiveness - Medium	Contains the 'Nationally Vulnerable' white rata (Metrosideros perforata) and other notable species will be present.
Representativeness - High	Contains indigenous vegetation on F5.2b - an 'Acutely Threatened' LENZ environment and is a regenerating remnant of a forest type now rare in Taranaki. This remnant is identified as a representative priority ecosystem.
Sustainability - Positive	Key ecological processes still influence the site and with appropriate management, it can remain resilient to existing or potential threats.

Other Management Issues

Habitat Modification - Medium	Historical Pa site and naturally revegetating areas on the boundary are the only visible human impacts.
Herbivores - Medium	A damaged section of fencing on the northern end of the remnant is allowing a small amount of stock intrusion.
Possum Self-help	Within Possum Self Help area.
Predators - Medium	Mustelids, possums, feral cats, hedgehogs and rodents will be having an impact on native biodiversity at this site.
Weeds - Low	A small amount of woolly nightshade on the boundary has been sprayed.



Tataraimaka Pa

At a glance

TRC Reference:	BD/9656	LENZ:	F5.2b Acutely threatened
Ecological District:	Egmont	National:	Priority 1 – Threatened Land Environment
Land Tenure:	Private	Regional:	Key Native Ecosystem
Area(ha):	0.79	Regional Ecosystem Loss:	Chronically threatened 10-20% left
GPS:	1676949X & 45668061Y	Protection Status:	DOC Covenant
Habitat:	Coastal/Forest Remnant	Catchment:	Waiaua 1 (Waiaua) (894)
Bioclimatic Zone:	Coastal		
Ecosystem Type:	WF13: Tawa, kohekohe, rewarewa, hinau, podocarp forest		

General Description

The Tataraimaka Pa forest remnant is located at the coast end of Pitone Road, five kilometres south west of Oakura. Although small in size this remnant provides habitat for native flora and fauna on an 'Acutely Threratened' F5.2b LENZ environment. Pohutakawa and karaka dominate the canopy with an understory comprised mostly of kawakawa and hangehange. Coastal cliffs form the northern most area of this site, providing potential habitat for seabirds.

Ecological Features

Flora

The original vegetation at this site is highly modified and is dominated by mature pohutakawa and karaka. Karo and puka are common in the understory with cabbage tree, kawakawa, hangehange and wharangi is also present. Bracken, flax and several coprosma species make up the majority of the understory.

Fauna

Birdlife present at Tataramaika Pa includes fantail, tui and kereru. Notable reptiles and invertebrates are also likely to be present.

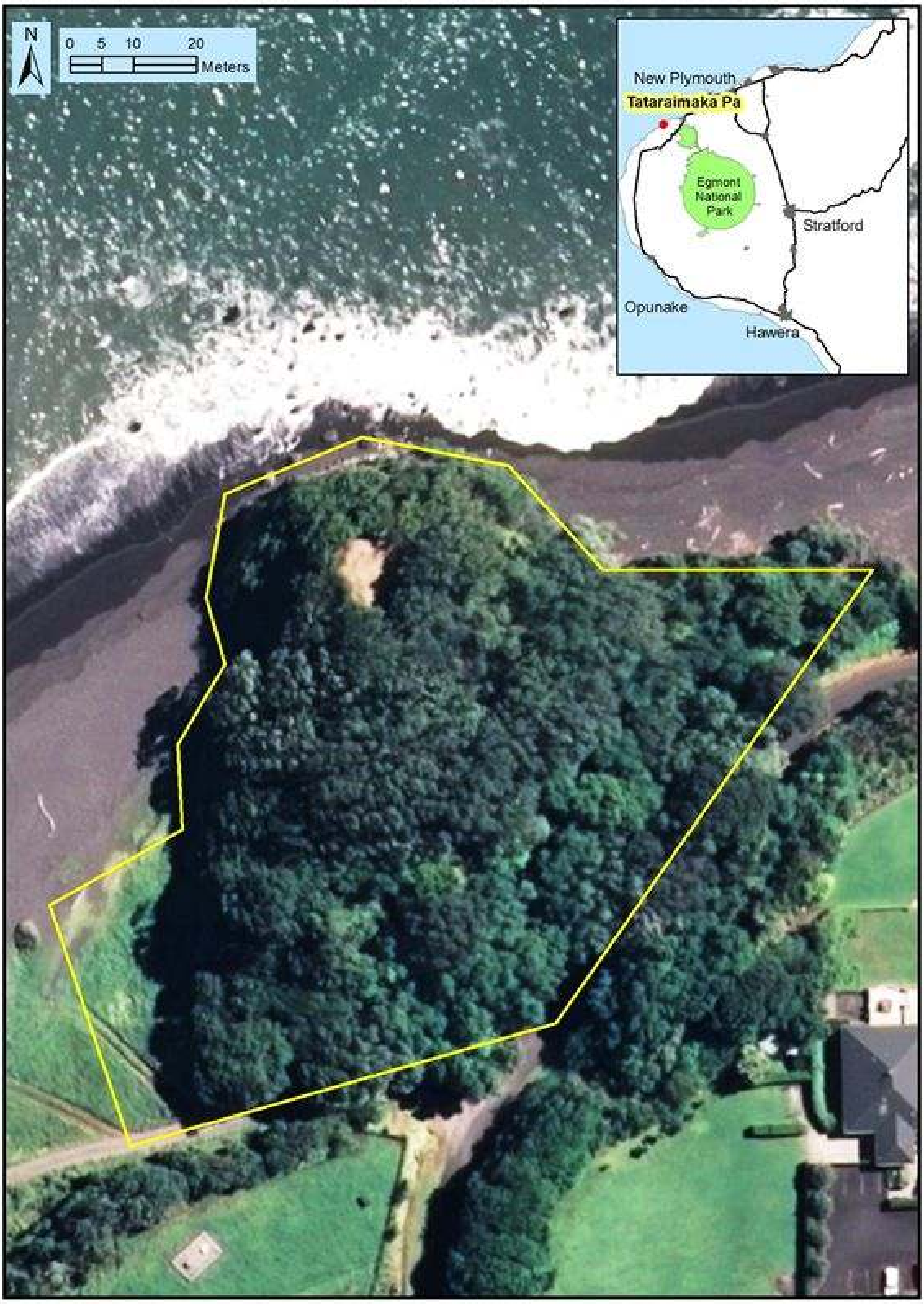
Ecological Values

Representativeness - High	Very small example of indigenous vegetation on F5.2b – an 'Acutely Threatened' LENZ environment
Sustainability - Positive	In fair to good vegetative condition. Key ecological processes still influence the site. Under appropriate management, it can remain resilient to existing or potential threats
Rarity and Distinctiveness - Medium	The vegetation at this site is highly modified but is representative of Pa in coastal Taranaki.
Ecological Context - Medium	Although highly modified, coastal forest vegetation is rare on this part of the Taranaki Coast. This vegetation provides important links with other KNEs in the area such as the Maitahi Scenic Reserve.

Other Management Issues

Habitat Modification - High	The vegetation at this site is highly modified and is a mix of mature native species that would not have naturally occurred here. It is

	however typical of coastal Pa in Taranaki. A walking track is present along with a clearing at the top of the site.
Herbivores - Low	Stock are excluded from the site, possums present in low numbers based on level of sign seen
Predators - Medium	Mustelids, possums, feral cats, hedgehogs and rodents will be having an impact on native biodiversity at this site.
Weeds - Low	Small amount of gorse in top clearing, tradescantia and montbretia present in patches in lower parts of remnant.



Eco Blue Nature Reserve

At a glance

TRC Reference: BD/9642

Ecological District: Matemateaonga

Land Tenure: Private

Area(ha): 4.9

GPS: 1734661X & 5653805Y

Habitat: Forest Remnant

Bioclimatic Zone: Lowland

Ecosystem Type: MF7.3: Tawa, pukatea, podocarp forest

LENZ: F7.2a At risk

National: Priority 4 – Threatened Species

Regional: Key Native Ecosystem

Regional Ecosystem Loss: At risk 20-30% left

Protection Status: QEII Covenant

Catchment: Patea (343)

General Description

The Eco Blue Nature Reserve forest remnant is located on privately owned land approximately 1km west of Huiakama in East Taranaki. The 4.9ha forest remnant lies in the Matemateaonga Ecological District and Patea River catchment. The forest canopy is dominated by tawa and kahikatea with occasional, miro, rimu and rewarewa. The forest is close to Huiakama and Putere wetlands, and also provides good connectivity to other forest remnants, such as the Lowe KNE’s.

Ecological Features

Flora

The forest canopy is dominated by tawa and kahikatea, with occasional, miro, rimu and rewarewa. The understory and ground cover is mainly sparse although climbers and epiphytes are fairly common. Recent myrtle rust threats have elevated potentially vulnerable native flora species to ‘Threatened’ status. Notably, four of these new threatened species are present at this site including two species of rata, ramarama and manuka.

Fauna

Notable native birds present include the 'At Risk" North island Robin, as well as tomtit, kereru, tui, bellbird, silvereye, grey warbler, fantail, kingfisher and harrier. Morepork will also be present. Also notable is the likely presence of the 'Threatened' long-tailed bat. There is very good habitat for a range of other notable native species including reptiles and invertebrates.

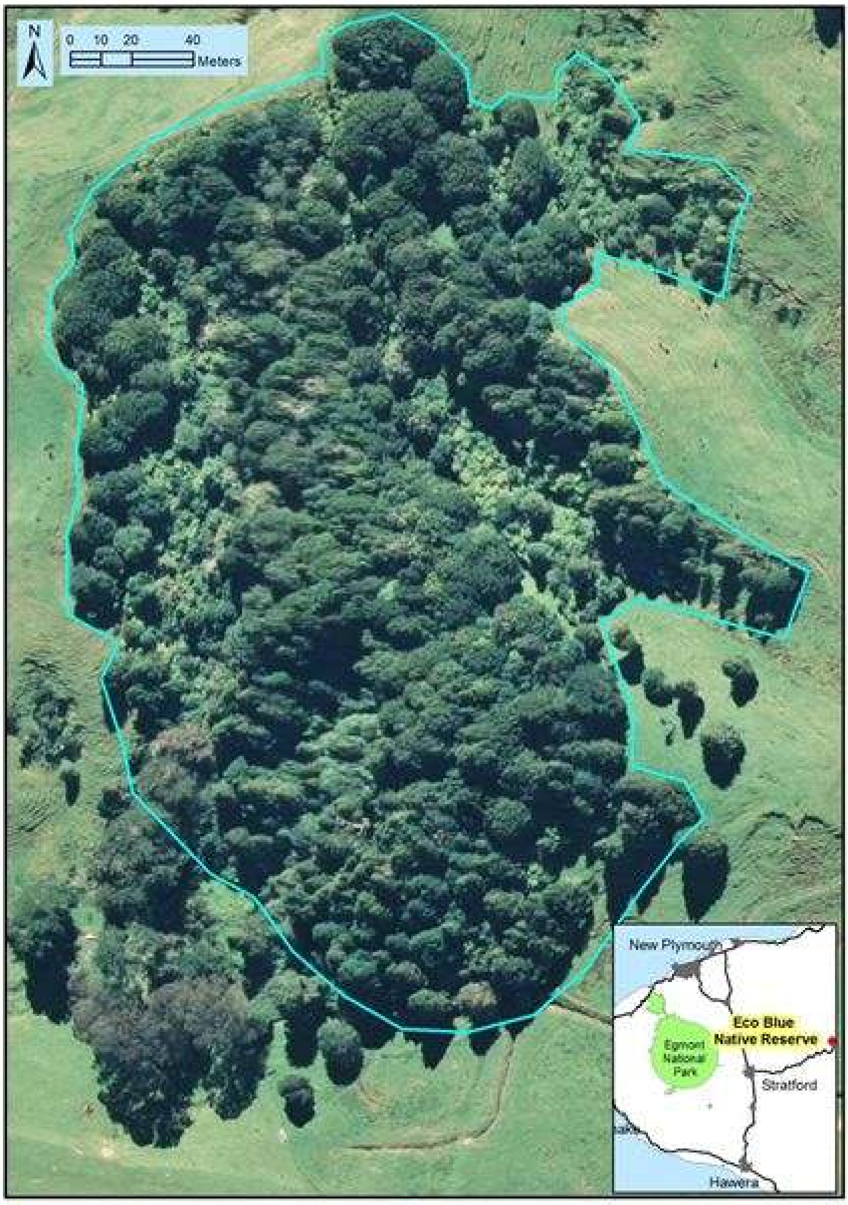
Ecological Values

Ecological Context - Medium	Enhances connectivity between fragmented indigenous habitats in this area including Putere Wetland on this property, and nearby KNE's including Lowe's and Te Wera wetlands.
Rarity and Distinctiveness - High	Likely to contain notable fauna species such as the 'Threatened' long-tailed bat. Provides habitat for and also likely to contain other notable fauna species including reptiles and invertebrates. Also contains four newly listed 'Threatened' and 'At Risk' flora species due to potential vulnerability to myrtle rust including two species of rata, ramarama and manuka.
Representativeness - Medium	Similar to and close to a remnant of a native forest ecosystem (MF7.2: Rata, tawa, kamahi, podocarp forest) that has been identified as a priority representative area for management in Taranaki (Top 30% Priority Representative Ecosystems).

Sustainability - Positive	In good vegetative condition although unfenced sections would improve dramatically if stock were fully excluded from the remainder of the site

Other Management Issues

Habitat Modification - Low	Localised removal of exotic tree species on the forest edge, with wetland development proposed in its place. Although the habitat is vulnerable to modification there are no immediate threats.
Herbivores - High	Stock have had an impact on small accessible areas of the forest remnant although fenced and steep areas are intact.
Possum Self-help	The site is outside the current possum self-help program boundary although receives occasional possum control by the landowners. High possum numbers have the potential to impact on forest health.
Predators - Medium	Predators including rodents, mustelids, possums, feral cats and hedgehogs will be having an impact on native species at the site.
Weeds - Low	Currently a low threat at this site with occasional shrub weed species.



Coplestone's Bush

At a glance

TRC Reference:	BD/9632	**LENZ:**	F7.2a At risk
Ecological District:	Matemateaonga	**National:**	Priority 4 – Threatened Species
Land Tenure:	Private	**Regional:**	Key Native Ecosystem
Area(ha):	2.5	**Regional Ecosystem Loss:**	At risk 20-30% left
GPS:	1720480X & 5640629Y	**Protection Status:**	QEII Covenant (pending)
Habitat:	Forest Remnant	**Catchment:**	Patea (343)
Bioclimatic Zone:	Lowland		
Ecosystem Type:	MF7.3: Tawa, pukatea, podocarp forest		

General Description

The Coplestone forest remnant is on privately owned land near Pukengahu approximately 9.5kms South East of Stratford. The 2.5ha forest remnant lies in the Matemateonga Ecological District and Patea River catchment. The forest consists of a forest gully head of an unnamed tributary of the Katatuna Stream, and an eastern facing hill slope. The forest canopy is dominated by tawa, with occasional pukatea and rewarewa.

Ecological Features

Flora

The forest canopy is dominated by tawa with occasional, rewarewa, pukatea and titoki. The understory is dominated by a mix of pate, mahoe, pigeonwood, and tree ferns. Ground cover is present through most of the remnant dominated by a mix of ferns. Three species of "Nationally Vulnerable" rata are present, as well as the "Declining" manuka.

Fauna

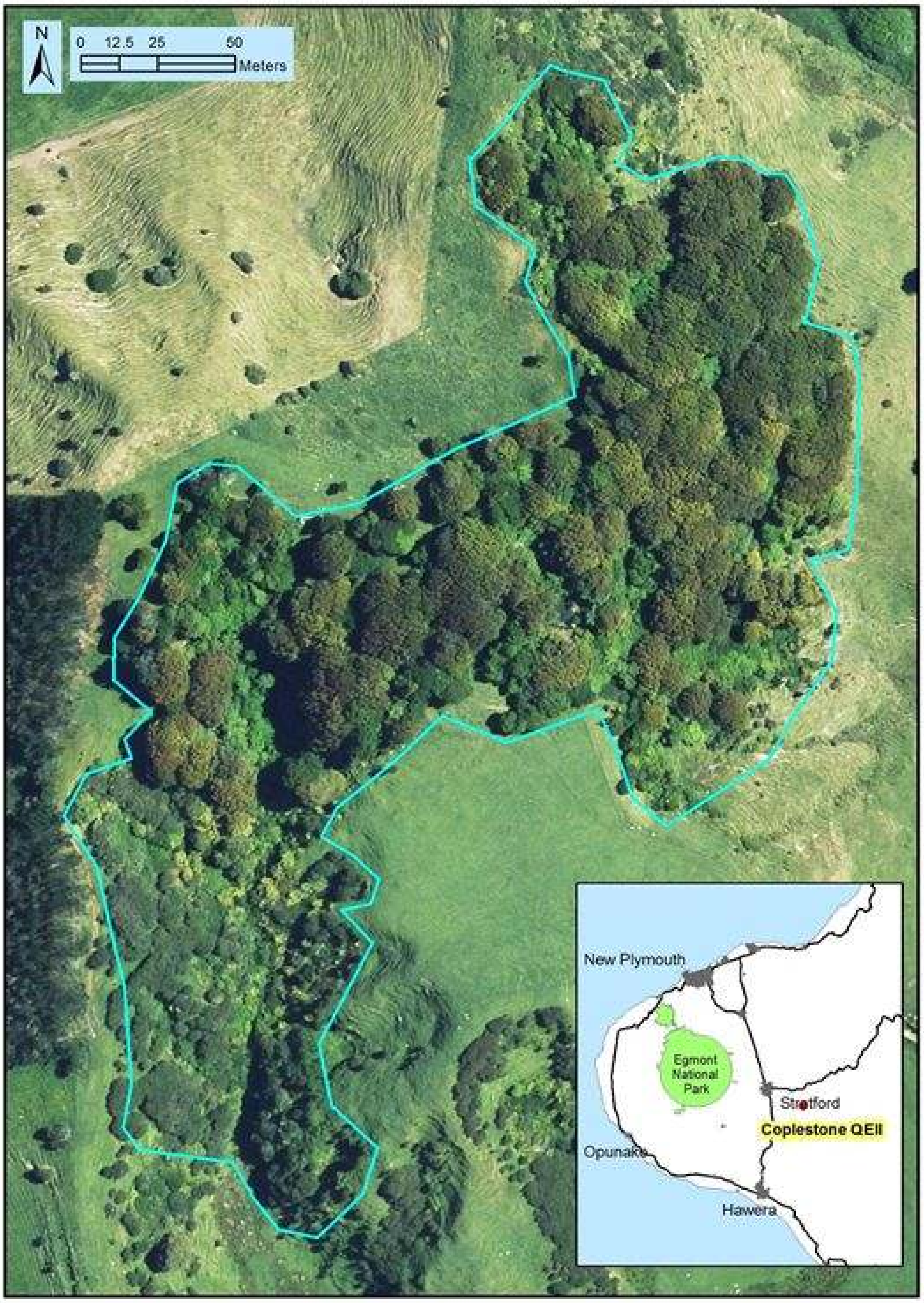
Native birds present include kereru, tui, bellbird, silvereye, shining cuckoo, grey warbler, fantail and kingfisher. Morepork are likely to be present. A small stream in the valley floor and adjoining wetlands are likely to contain notable freshwater fish. There is also very good habitat for a range of other notable native species including reptiles which have been recorded nearby, and invertebrates.

Ecological Values

Sustainability - Positive	In moderate vegetative condition although would improve dramatically if fully fenced and goats were eradicated.
Rarity and Distinctiveness - Medium	Provides habitat for and also likely to contain other notable fauna species including reptiles and invertebrates. Also contains four newly listed 'Threatened' and 'At Risk' flora species due to potential vulnerability to myrtle rust including three species of rata and manuka.
Representativeness - Medium	Contains vegetation on an 'At Risk' land environment (F7.2a) and is a remnant of an ecosystem that is considered 'At Risk' (MF7.3: Tawa, pukatea, podocarp forest) in Taranaki.
Ecological Context - Low	The Sextus Family Reserve, Ngaere Swamp Forests and Rahui KNEs lie within a 3.5km radius of this site.

Other Management Issues

Weeds - Low	Currently a low threat at the site.
Predators - Medium	Predators including rodents, mustelids, possums, feral cats and hedgehogs will be having an impact on native species at the site.
Possum Self-help	This site falls within the Possum Self-Help area.
Herbivores - High	Cattle and sheep and goats have had an impact on accessible areas of the forest remnant, although fenced and steeper areas are relatively intact.
Habitat Modification - Low	There are no immediate risks to the habitat and the landowner is looking into formal protection through QEII.



Banga's Bush

At a glance

TRC Reference: BD/9646

Ecological District: Egmont

Land Tenure: Private

Area(ha): 1

GPS: 1674193X & 5653026Y

Habitat: Forest Remnant/Wetland

Bioclimatic Zone: Semi-Coastal

Ecosystem Type: WF13: Tawa, kohekohe, rewarewa, hinau, podocarp forest

WF8: Kahikatea, pukatea forest

LENZ:	F5.2b Acutely threatened
	C1.3a Acutely threatened
National:	Priority 1 – Threatened Land Environment
	Priority 4 – Threatened Species
	Priority 2 – Sand Dunes and Wetlands
Regional:	Key Native Ecosystem
	Close proximity to a representative ecosystem site
Regional Ecosystem Loss:	Chronically threatened 10-20% left
	Acutely Threatened <10% left
Protection Status:	QEII Covenant
Catchment:	Kapoaiaia (375)

General Description

Banga's Bush forest remnant is located on privately owned land approximately 4.5km north east of Pungaraehu, in Coastal Taranaki. The 1ha remnant lies in the Egmont Ecological District and Kapoaiaia River catchment. The forest canopy is dominated by swamp maire and pukatea. The forest provides good connectivity to NRGE KNE and a Private QEII as well as other nearby priority ecosystems.

Ecological Features

Flora

The forest canopy is dominated by swamp maire and pukatea, with occasional pigeonwood and hinau. The understory and ground cover is mainly kawakawa, New Zealand fuchsia and ferns. Recent myrtle rust threats have elevated potentially vulnerable native flora species to 'Threatened' status. Notably, four of these new threatened species are present at this site including swamp maire and two species of rata.

Fauna

Native birds present include the kereru, tui, silvereye, grey warbler, fantail, kingfisher and harrier. Morepork will also be present. There is very good habitat for a range of other notable native species including freshwater fish, reptiles and invertebrates.

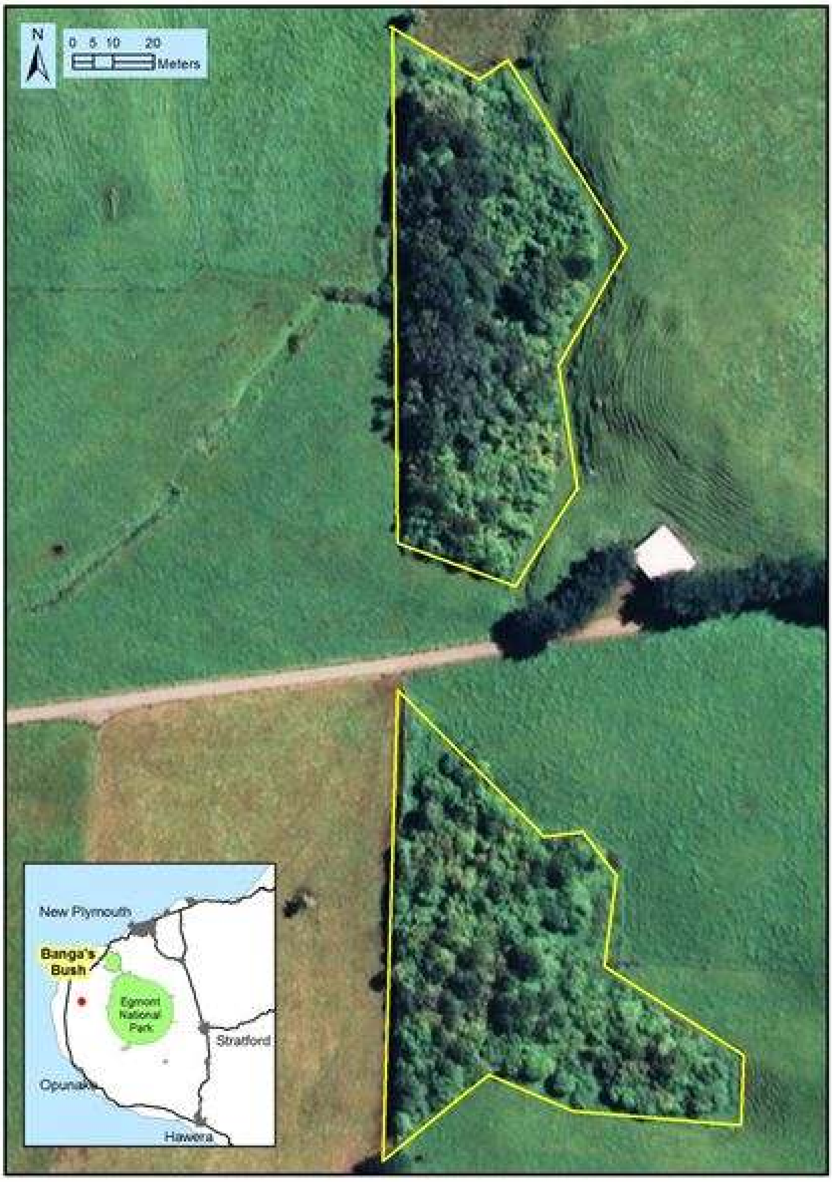
Ecological Values

Sustainability - Positive	In good vegetative condition although fencing requires maintenance.
Representativeness - High	Contains vegetation on C1.3a and F5.2b 'Acutely Threatened' land environments and is representative of ecosystems now considered very rare in the Taranaki landscape. The forest remnant lies in close proximity (250m) to habitat that has been identified as a priority representative area for management in Taranaki (Top 30% Priority Representative Ecosystems).
Rarity and Distinctiveness - Medium	Likely to contain notable fauna species such as the 'At Risk' Brown Mudfish. Provides habitat for and also likely to contain other notable fauna species including reptiles and invertebrates. Also contains three newly listed 'Threatened' flora species due to

	potential vulnerability to myrtle rust including two species of rata and swamp maire.
Ecological Context - Medium	Enhances connectivity between fragmented indigenous habitats in this area including priority ecosystem types and nearby KNE's including NRGE and a Private QEII (Brophy's).

Other Management Issues

Weeds - Low	Currently a low threat to the site with only a few edge weeds.
Predators - Medium	Predators including rodents, mustelids, possums, feral cats and hedgehogs will be having an impact on native species at the site.
Possum Self-help	The site is inside the current possum self-help program boundary and receives regular possum control by the farm manager by way of poisoning and shooting.
Herbivores - High	Stock have had recent access to a small area through a broken section of fence.
Habitat Modification - Low	Although the habitat is vulnerable to modification there are no immediate threats to the site.



Jones' Bush

At a glance

TRC Reference:	BD/9651	LENZ:	F5.2b Acutely threatened
Ecological District:	Egmont	National:	Priority 1 – Threatened Land Environment Priority 2 – Sand Dunes and Wetlands Priority 4 – Threatened Species
Land Tenure:	Private		
Area(ha):	2.27		
GPS:	1674028X & 5653764Y		
Habitat:	Forest Remnant/Wetland	Regional:	Close proximity to a representative ecosystem site Key Native Ecosystem
Bioclimatic Zone:	Semi-Coastal		
Ecosystem Type:	WF13: Tawa, kohekohe, rewarewa, hinau, podocarp forest	Regional Ecosystem Loss:	Chronically threatened 10-20% left
		Protection Status:	QEII Covenant (Pending)
		Catchment:	Teikaparua (Warea) (377)

General Description

Peter Jones' forest remnant is located on privately owned land approximately 4.5km northeast of Pungarehu in Coastal Taranaki. The 2.2ha forest remnant lies in the Egmont Ecological District and Teikaparua (Warea) River catchment. The forest canopy is dominated by kohekohe and tawa, with occasional, rewarewa and swamp maire. The forest provides good connectivity to NRGE KNE and two new potential KNE. It is also close to a priority ecosystem.

Ecological Features

Flora

The forest canopy is dominated by kohekohe and tawa, with occasional, swamp maire and rewarewa. The understory and ground cover is mainly sparse although climbers and epiphytes are fairly common. Recent myrtle rust threats have elevated potentially vulnerable native flora species to 'Threatened' status. Notably, three of these new threatened species are present at this site including three species of rata and swamp maire.

Fauna

Kereru, tui, silvereye, grey warbler, fantail, kingfisher, morepork and harrier are present at the site and regularly seen by the landowner and harrier are present at the site. There is very good habitat for a range of other notable native species including freshwater fish, reptiles and invertebrates.

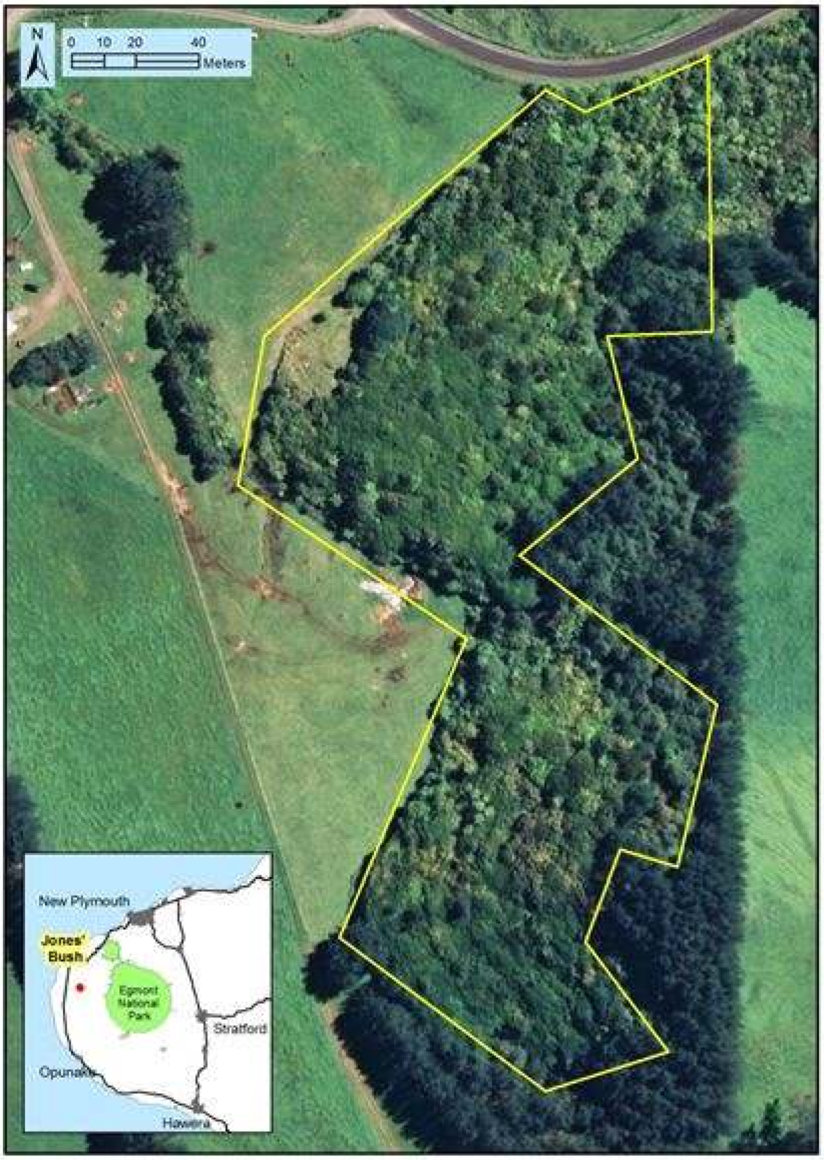
Ecological Values

Sustainability - Positive	In good vegetative condition where stock access is prohibited. Unfenced sections would improve dramatically if stock were fully excluded.
Representativeness - High	F5.2b 'Acutely Threatened" Land Environment. In close proximity to an area which has been identified as a priority representative area for management in Taranaki (Top 30% Priority Representative Ecosystems).
Rarity and Distinctiveness - High	Provides habitat for and also likely to contain other notable fauna species including reptiles, invertebrates and freshwater fish. Also contains three newly listed 'Threatened' flora species due to potential vulnerability to myrtle rust including three species of rata and swamp maire.

Ecological Context - Medium	Enhances connectivity between fragmented indigenous habitats in this area including NRGE KNE, and two potential new KNE sites on the neighbouring properties.

Other Management Issues

Weeds - Low	Low levels of weeds are present at the site, but include isolated patches of blackberry, gorse, Japanese honeysuckle and acacia.
Predators - Medium	Predators including rodents, mustelids, possums, feral cats and hedgehogs will be having an impact on native species at the site.
Possum Self-help	The site is within the current possum self-help program and receives occasional possum control by the landowners. High possum numbers have the potential to impact on forest health.
Herbivores - High	The site is not fully fenced. Stock damage is evident in localized areas of the remnant. Fencing of the site would be beneficial.
Habitat Modification - Medium	Future removal of pine and macrocarpa on the eastern and southern boundaries of the remnant will create some disturbance to the forest edge. Although the habitat is vulnerable to modification there are no additional immediate threats.



Brough Covenant

At a glance

TRC Reference: BD/7018

Ecological District: Egmont

Land Tenure:

Area(ha): 1.7

GPS: 1694617X & 5674450Y

Habitat: Forest Remnant

Bioclimatic Zone: Semi-Coastal

Ecosystem Type: WF13: Tawa, kohekohe, rewarewa, hinau, podocarp forest

LENZ: F5.2b Acutely threatened

National: Priority 1 – Threatened Land Environment

Priority 4 – Threatened Species

Regional: Key Native Ecosystem

Regional Ecosystem Loss: Chronically threatened 10-20% left

Protection Status: QEII Covenant

Catchment: Te Henui (391)

General Description

Brough Covenant lies within New Plymouth city opposite the Te Henui Walkway and runs alongside the adjacent Te Henui Stream. The bush lies in the Egmont Ecological District. The site is a small 1.7ha semi coastal forest remnant on private land. The majority of the bush lies on a well-drained steep north facing gully slope immediately adjacent to the Te Henui Stream. While the bush is small, it forms an important part of a larger habitat fragment matrix. This site is directly adjacent to the Welbourn Scenic Reserve KNE and across river from the Welbourn School Bush KNE. The bush is also less than 500m from Pukekura Park KNE.

Ecological Features

Flora

The site is dominated by kohekohe, which has a very limited distribution nationally due to clearance and its high vulnerability to possum browse. Other canopy species present include tawa, pukatea, and rewarewa.
Kanano, kawakawa, mahoe and pigeonwood are present make up the understory, with a number of seedlings and a mix of ferns (including the 'At Risk' King Fern) making up the ground cover. Epiphytes and vines are also common at the site, including 3 species of 'Threatened' rata. Recent myrtle rust threats have elevated potentially vulnerable native flora species to threatened status, including the rata species mentioned, along with Pohutukawa and Manuka, both also present at the site.

Fauna

The site provides habitat for kereru, tui, grey warbler, fantail, shining cuckoo, kingfisher and morepork. Welbourn School Bush also provides protection to the habitat of threatened native fish within the adjacent Te Henui Stream. Notable native fish including giant kokopu, shortjaw kokopu and longfinned eel and lamprey have been recorded in the Te Henui stream. Gold-stripe gecko, a species which is largely restricted to Taranaki has been recorded across the river in the Welbourn School Bush KNE and may be present at this site.

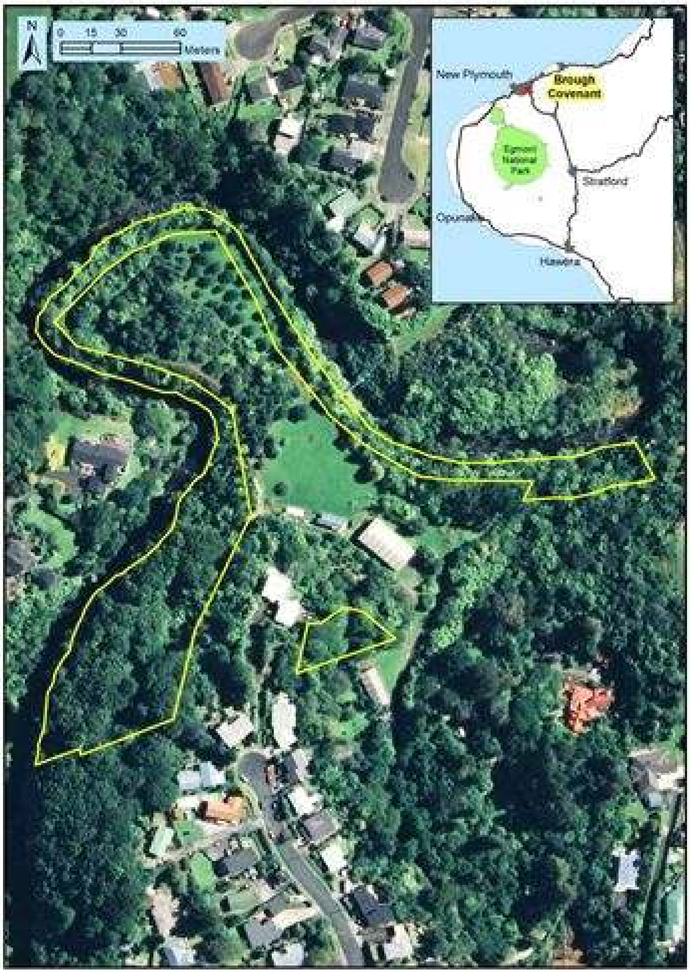
Ecological Values

Ecological Context - Medium	Is close to and interconnected with other indigenous forest remnants that provide seed sources and corridors for dispersal of fauna and flora.

Rarity and Distinctiveness - Medium	Regionally distinctive in that it contains the 'Declining' King fern and three species of 'Nationally Vulnerable' Rata. Other notable species are also known in the area, including 'At Risk' Goldstripe Gecko and a rare orchid - *Nemtoceras rivularis aff. Te Henui* – which is restricted to the Te Henui.
Representativeness - Medium	Contains a small area (1.7ha) of indigenous vegetation on F5.2b - an "Acutely Threatened" LENZ environment. Is also an example of an ecosystem type that is now very rare in Taranaki (<20% remaining).
Sustainability - Positive	The site is in good vegetative condition.

Other Management Issues

Weeds - Medium	There are many weeds impinging on the values of this site including climbing asparagus, wandering willy, wild ginger, Japanese honeysuckle, African clubmoss, brush wattle and wild cherry.
Predators - Medium	Predators such as rats, mustelids, possums, hedgehogs and feral cats will be having an impact on the site.
Possum Self-help	The site falls outside the rural Possum Self Help area but the landowners undertake their own possum control, including occasional trapping. Residents are encouraged to control possums within New Plymouth city as part of the Towards Predator Free Taranaki initiative.
Habitat Modification - Medium	A walking track and steps have been built in sections of the bush. Gardens bordering the boundaries of the site have altered the forest edge.



Log Jam

At a glance

TRC Reference: BD/9658		**LENZ:**	F1.1b Not threatened
Ecological District: North Taranaki			F7.2a At risk
Land Tenure: Private		**Local:**	Likely Significant Natural Area
Area(ha): 372.18		**National:**	Priority 1 – Threatened Land Environment
GPS: 1722750X & 5672442Y			Priority 4 – Threatened Species
Habitat: Forest Remnant		**Regional:**	Key Native Ecosystem
Bioclimatic Zone:	Lowland		Representative ecosystem type
Ecosystem Type:	WF13, tawa, kohekohe, rewarewa, hinau, podocarp forest	**Regional Ecosystem Loss:**	Chronically threatened 10-20% left
		Protection Status:	QEII Covenant pending
		Catchment:	Onaero (398)

General Description

The Log Jam KNE is located on privately owned land near Urenui in northern Taranaki. The site is within the North Taranaki Ecological District.

The KNE covers 372.18 ha and is a mix of original and cut over lowland forest with small areas of modified regenerating native forest in places. The forest is typical of original and regenerating forest found in the North Taranaki area. The KNE is surrounded by adjacent native forest including a 4.8km boundary with the Taramoukou Conservation Area. Other nearby protected areas includes the Pouiatoa Conservation area, Pukehou Scenic Reserve and Toro Rd QEII. The site is located within the Onaero River catchment.

Ecological Features

Flora

Log Jam site is completely forested and large in area (372.18 ha). The site also has the benefit of being connected to very large contiguous native forest including the Taramoukou Conservation Area (DOC estate) and other native forest on private land. The large old forest areas within the block contain some very impressive emergent canopy forest trees such as matai, rimu, northern rata and pukatea etc. The main canopy varies from areas of kamahi, hinau, rewarewa, miro, tawa etc to lower stature pigeonwood, broadleaf, mapou and tree ferns now typical for this inland Taranaki area. The northern edge of the block contains some areas of regenerating native scrub in relatively good condition. The old forest area contains good areas of epiphytes from ground level to well into the canopy. Notable species including Tawhirikaro (Pittosporum cornifolium) were observed perching in the canopy.

Fauna

Notable bird species include North Island brown kiwi, bush flacon, long-tailed cuckoo, and North Island robin. Other bird species present include grey warbler, silvereye, tomtit, tui, bellbird, fantail and shining cuckoo. Other notable native fauna will be present including bats, reptiles, freshwater fish and invertebrates.

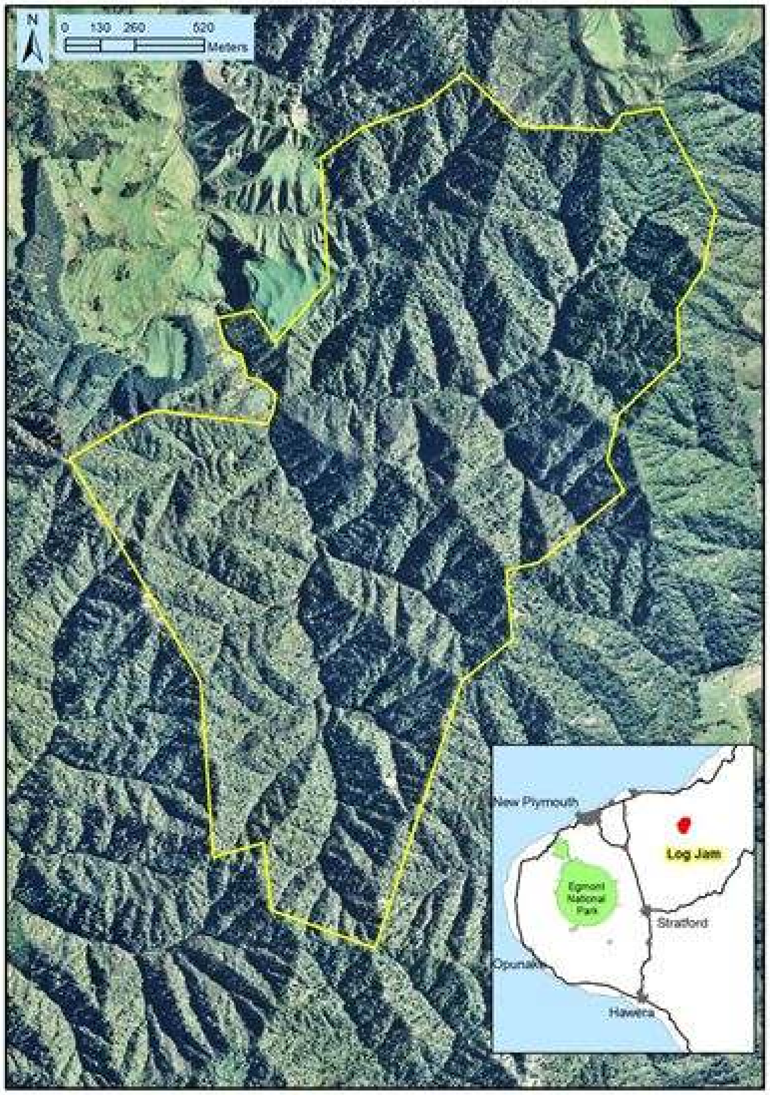
Ecological Values

Sustainability - Positive	In good vegetative condition and large in area. Key ecological processes still influence the site. Under appropriate management, it can remain resilient to existing or potential threats.
Ecological context - High	Close to and provides connectivity to Taramoukou Scenic Reserve. Also provides core habitat for notable priority species New

	Zealand falcon, long tailed bat, long tailed cuckoo, North Island brown kiwi and tawhirikaro.
Representativeness - Medium	Contains indigenous vegetation on F1.1b. The ecosystem type (WF13, tawa, kohekohe, rewarewa, hinau, podocarp forest) 'Chronically Threatened'. Priority ecosystem type top 30%.
Rarity and Distinctiveness - High	Contains a host of 'Threatened' 'At Risk' and 'Regionally Distinctive' species including New Zealand falcon, North Island brown kiwi, long-tailed bat, long-tailed cuckoo, North Island rifleman, North Island robin and Tawhirikaro (Pittosporum cornifolium). Likely to contain other notable native species including priority fish, reptiles and invertebrates.

Other Management Issues

Weeds - Low	From current observations low.
Predators - High	Cats, stoats, feral pigs, ferrets and rats are present.
Herbivores - High	Goats and possums are present and both understorey and canopy browse is evident.
Habitat Modification - Low	Ongoing pressure from goats and possums will continue to alter the long-term dynamics of the forest.



Abplanalp Kaupokonui Bush

At a glance

TRC Reference:	BD/9661	National:	Priority 4 – Threatened Species
Ecological District:	Egmont	Regional:	Key Native Ecosystem Representative ecosystem type
Land Tenure:	Private		
Area(ha):	7.0	Regional Ecosystem Loss:	Less reduced >50% left
GPS:	1697080X & 5641686Y	Protection Status:	Local Government
Habitat:	Forest Remnant	Catchment:	Kaupokonui (355)
Bioclimatic Zone:	Lower Montane		
Ecosystem Type:	MF8.2: Rimu, rata, kamahi forest		

General Description

The Abplanalp Kaupokonui Bush adjoins the southern margin of the Egmont National Park at an altitude of 490 metres above sea level. The 7.1 hectare remnant is semi-compact and roughly triangular in shape, and is situated on rocky ground between the Kaupokonui River and a small tributary. The underlying landform is of LUC class 4s1, with Uia sandy loam soils. The site is located in the Egmont Ecological district, and the ecosystem type for this area has been mapped as MF8-2, Rimu, rata, kāmahi forest (Singers 2016), less reduced or intact, with 68% remaining (Leathwick, 2017). The structure of the vegetation at the site, as surveyed in the field, is dominated by a canopy of established regenerating kamahi, with tawa, rimu, miro and kahikatea becoming apparent in the canopy.

Ecological Features

Flora

The forest canopy is dominated by established regenerating kamahi, with a range of successional canopy and emergent species becoming evident, including tawa, rimu, miro and kahikatea. There is a diversity shrubs, vines and ferns in the understory and forest floor, with epiphytes becoming more apparent as the forest matures. Vegetation at the site presents a range of terrestrial habitat niches, including regenerating forest, understorey and groundcover vegetation, deep litter and logs on the forest floor, seepages and dark humid stream banks, and well lit disturbance areas induced by regular stream bank erosion and deposition events.

Fauna

Native birds confirmed to be present include fantail, grey warbler and paradise shelduck. A number of other species have been anecdotally listed as likely to be present, or use the forest remnant as part of their wider habitat, including tui, kereru, Australasian harrier hawk, bellbird, white-eye and morepork. There is good habitat for native lizards, including dense canopy vegetation, epiphytes and vines, along with litter and logs on the forest floor. The site will contain a diverse range of terrestrial invertebrates which may include notable species such as peripatus. During initial site assessment no observations were made of freshwater species, although future surveys may detect koura, eel and galaxid fish species. It is likely that the longfin eel (Anguilla dieffenbachii, 'At Risk, Declining') will be present in the stream system.

Ecological Values

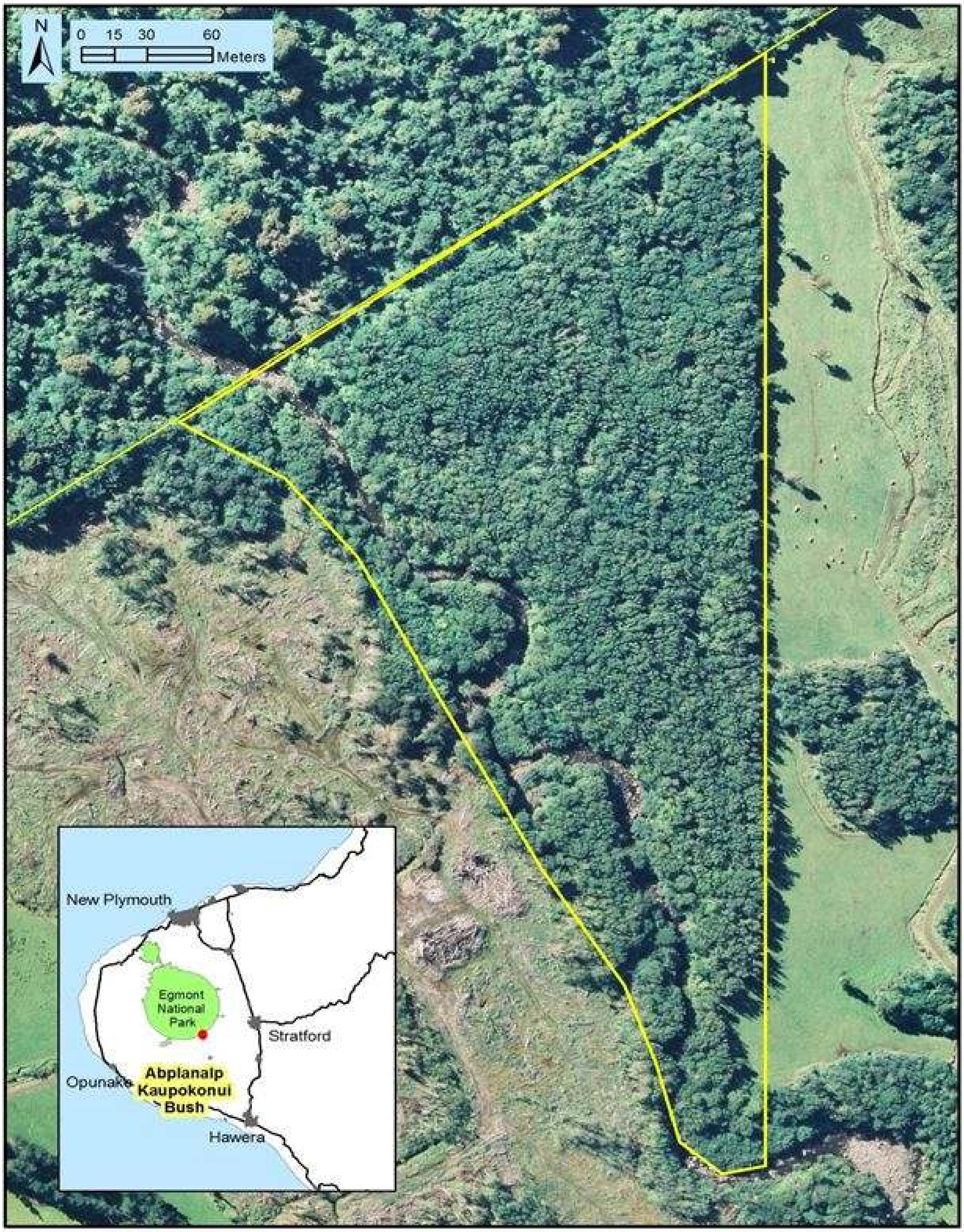
Ecological context - High	Provides connectivity to other habitats, KNE's and priority ecosystems in the area. Adjoins Egmont National Park.
Rarity and Distinctiveness - Medium	Notable species include a number of rata vines (crimson and scarlet rata), now classified as having conservation status 'Nationally Vulnerable', owing to the recent incursion of Myrtle Rust into NZ.

	Also present is Fuchsia procumbens, classified as being 'At Risk' (Naturally Uncommon).
Representativeness - High	While the ecosystem type has been classified as being MF8-2, Rimu, rata, kamahi forest, less reduced or intact, with 68% remaining (Singers 2016), the site has also been identified to be a regional priority for management (Leathwick, 2017).
Sustainability - Positive	Key ecological processes still influence the site and with appropriate management, it can remain resilient to existing or potential threats. While the site is presently in a state of mid-stage regeneration following historic disturbance, owing to the site adjoining the Egmont National Park it is expected that recovery of the ecosystem will ultimately be optimised.

Other Management Issues

Habitat Modification - Low	Historic modification; Livestock excluded for many years; Landowners considering conservation covenant with the QEII National Trust.
Herbivores - Medium	Extensive possum habitat in the vicinity. Situated on edge of Egmont National Park which receives regular periodic possum control and situated within the Taranaki Regional Council Possum Self Help area. Goats are in extremely low numbers in the ENP.
Weeds - Low	Current incidence of ecological pest plants is very low. The site is situated adjacent post-harvest exotic forest land, which could give rise to increased risk of weed incursion.
Predators - High	Predators including mustelids, possums, feral cats, rodents and hedgehogs will be having an impact on native species at the site.

[Location Map Overleaf]


N
0 15 30 60
Meters
New Plymouth
Egmont
National
Park
Stratford
Opunake
Abplanalp
Kaupokonui
Bush
Hawera

Brookwood

At a glance

TRC Reference: BD/9659

Ecological District: Egmont

Land Tenure: Private

Area(ha): 4.31

GPS: 1686664X & 5671058Y

Habitat: Forest Remnant/Wetland

Bioclimatic Zone: Semi-Coastal

Ecosystem Type: WF13: Tawa, kohekohe, rewarewa, hinau, podocarp forest

WF8: Kahikatea, pukatea forest

LENZ: F5.2b Acutely threatened

National: Priority 1 – Threatened Land Environment

Regional: Key Native Ecosystem

Regional Ecosystem Loss: Acutely Threatened <10% left

Chronically threatened 10-20% left

Protection Status: Local Government

QEII Covenant

Catchment: Tapuae (386)

General Description

Brookwood is located on private land approximately 3km south west of New Plymouth in North Taranaki. Brookwood consists of two semi coastal forest /wetlands which are approx. 4.31ha and are connected to Woodside KNE. Brookwood lies in a small gully system of the Tapuae Stream catchment. The sites are undergoing formal protection and are potential new KNE sites. These sites are also close to and provide connectivity with other Key Native Ecosystems nearby such as Woodside, Donalds QEII, McNeils and Pukiekie.

Ecological Features

Flora

The main canopy at both sites consists of tawa, pukatea, kahikatea, rewarewa, pigeonwood, titoki, mahoe, kamahi, puriri and kohekohe. The undergrowth is dominated by kiekie, mapou, coprosma with pukatea and kohekohe seedlings. The ground cover is dominated by an array of ferns. Also present is 'Regionally Distinctive' jointed fern and 'Threatened' swamp maire. The wetlands are in very good condition and are dominated by harakeke, ti kouka & raupo.

Fauna

Native birdlife recorded in and around Brookwood include the New Zealand pigeon/kereru, grey warbler/riroriro, fantail/piwakawaka, tui and morepork/ruru. Notable freshwater species are present in the small tributary of the Tapuae Stream within the forest including 'At Risk' species such as longfin eel. Native freshwater crayfish/koura are also present. The site is likely to contain other notable species such as the banded kokopu and notable native reptiles and invertebrates.

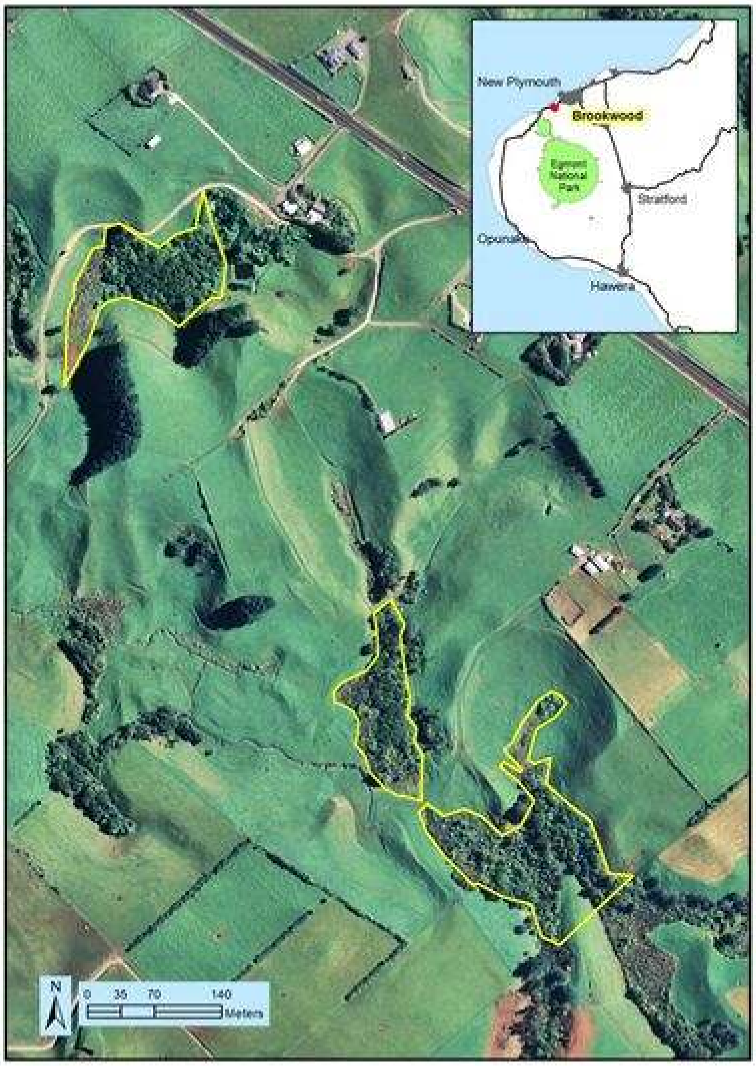
Ecological Values

Sustainability - Positive	Key ecological processes still influence the site and with appropriate management, it can remain resilient to existing or potential threats and will mature over time to provide increased biodiversity and ecological function.
Ecological context - High	This site provides additional habitat and greater connectivity within the local landscape generally and with several other Key Native Ecosystems in the area such as Woodside, Donald's QEII, Twin Bush and Pukiekie.
Representativeness - High	Contains vegetation on an 'Acutely Threatened' land environment (F5.2b Land Environment of New Zealand) and has remnants of

	regionally threatened ecosystems (WF8 kahikatea, pukatea forest and WF13 Tawa, kohekohe, rewarewa, hinau, podocarp forest. Singers and Lawrence 2016).
Rarity and Distinctiveness - High	Contains good habitat for the 'At Risk' longfin eel and banded kokopu. 'Regionally Distinctive' jointed fern and 'Threatened' swamp maire are also present.

Other Management Issues

Weeds - High	High risk although currently under a successful long running weed control programme. Small localised areas of holly, blackberry and African clubmoss.
Predators - High	Predators such as rats, mustelids, possums, feral cats and hedgehogs are present at the site.
Possum Self-help	The site is within the possum self-help area. Possum control is carried out on annual basis.
Herbivores - Medium	Currently fenced and stock proof although vulnerable to stock browsing if fences were breached. Currently under good possum control although vulnerable if possum numbers were high.
Habitat Modification - Low	Site 2 SNA. Site 1 undergoing QEII covenant.



Vertical Horizon

At a glance

TRC Reference: BD/9657

Ecological District: Egmont

Land Tenure: Private

Area(ha): 3.52

GPS: 1710879X & 5670209Y

Habitat: Forest Remnant

Bioclimatic Zone: Lowland

Ecosystem Type: WF13: Tawa, kohekohe, rewarewa, hinau, podocarp forest

LENZ: F5.2a Acutely threatened

National: Priority 1 – Threatened Land Environment

Regional: Key Native Ecosystem

Close proximity to a representative ecosystem site

Regional Ecosystem Loss: Chronically threatened 10-20% left

Protection Status: QEII Covenant

Catchment: Waitara (395)

General Description

The Vertical Horizon forest remnant is located 7.5 km north east of Inglewood, across the road from Everett Park Reserve. Measuring 3.52 ha the remnant is part of the Vertical Horizon Camp with a walkway in place, some educational signage regarding plant species and contains both naturally regenerating native plant species and native plantings.

Ecological Features

Flora

The remnant is made up of young regenerating forest with tree ferns being the dominant emergent in the canopy. Mahoe, karamu, lemonwood and rimu are all established with kawakawa and hangehange crowding the understory. NZ passionfruit is common in the remnant as is rangiora, supplejack and ferns such as hen and chicken.

Fauna

Many native bird species present in Vertical Horizon share their home range with nearby Everett Park and include New Zealand pigeon, bellbird, shinning cuckoo, fantail, kingfisher, tomtit, tui, and grey warbler. Good habitat exists for koura and native fish species in the stream and pools that flow through the middle of the forest. Notable reptiles and invertebrates are also likely to be present.

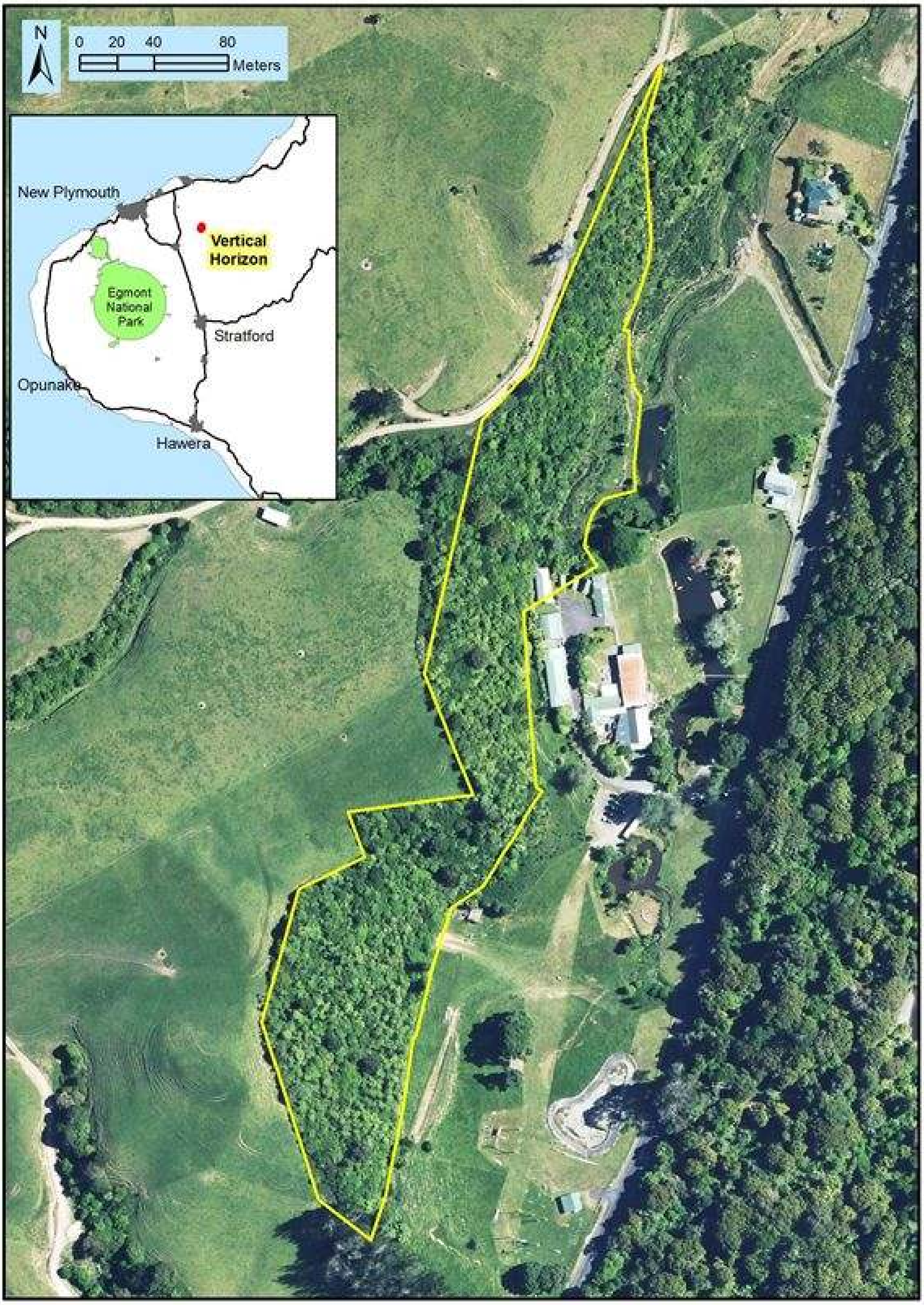
Ecological Values

Ecological Context - Medium	Provides additional habitat and greater connectivity with other covenants and KNE in this area such as the nearby Everett Park
Sustainability - Positive	A small area with high connectivity to larger areas and vegetation corridors. In good vegetative condition. Key ecological processes still influence the site. Under appropriate management, it can remain resilient to existing or potential threats
Rarity and Distinctiveness - Low	Not known to contain any 'Threatened' species or species uncommon in Taranaki
Representativeness - High	Contains indigenous vegetation on F5.2a - an 'Acutely Threatened' LENZ environment

Other Management Issues

Habitat Modification - Low	Walking tracks are present

Herbivores - Low	Stock are excluded from the forest
Possum Self-help	Within Possum Self Help area
Predators - Medium	Mustelids, possums, feral cats, hedgehogs and rodents will be having an impact on native biodiversity at this site.
Weeds - Medium	Boundary weeds present in some areas



Whakataka te hau

Karakia to open and close meetings

Whakataka te hau ki te uru	Cease the winds from the west
Whakataka te hau ki tonga	Cease the winds from the south
Kia mākinakina ki uta	Let the breeze blow over the land
Kia mātaratara ki tai	Let the breeze blow over the ocean
Kia hī ake ana te atakura	Let the red-tipped dawn come with a sharpened air
He tio, he huka, he hauhu	A touch of frost, a promise of glorious day
Tūturu o whiti whakamaua kia tina.	Let there be certainty
Tina!	Secure it!
Hui ē! Tāiki ē!	Draw together! Affirm!

Nau mai e ngā hua

Karakia for kai

Nau mai e ngā hua	Welcome the gifts of food
o te wao	from the sacred forests
o te ngakina	from the cultivated gardens
o te wai tai	from the sea
o te wai Māori	from the fresh waters
Nā Tāne	The food of Tāne
Nā Rongo	of Rongo
Nā Tangaroa	of Tangaroa
Nā Maru	of Maru
Ko Ranginui e tū iho nei	I acknowledge Ranginui above and
Ko Papatūānuku e takoto ake nei	Papatūānuku below
Tūturu o whti whakamaua kia	Let there be certainty
tina	Secure it!
Tina! Hui e! Taiki e!	Draw together! Affirm!