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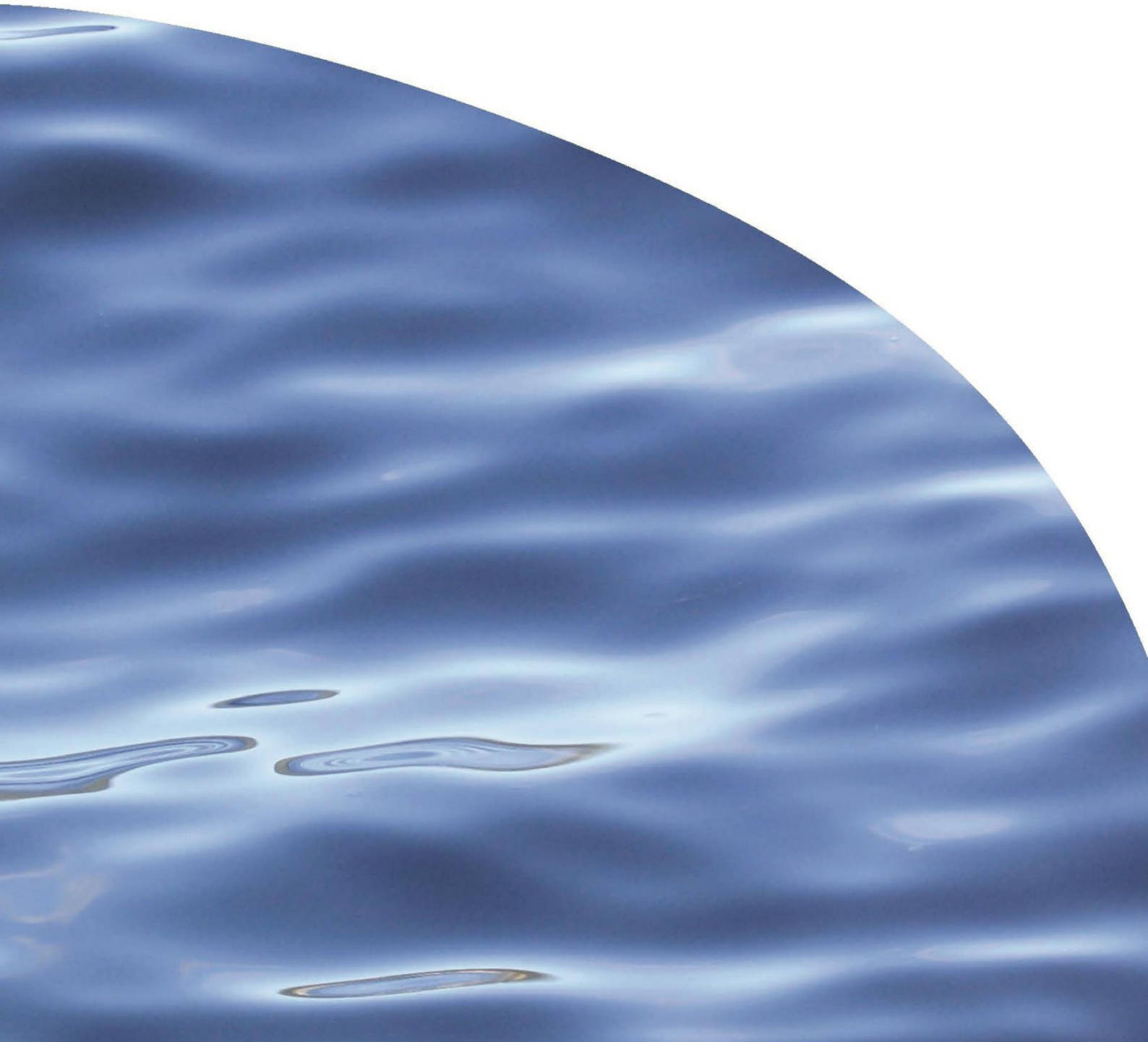
ADVICE FOR THE NCC WHAKAMAHERE WHAKATU NELSON PLAN: WATER QUALITY



ADVICE FOR THE NCC WHAKAMAHERE WHAKATU NELSON PLAN: WATER QUALITY

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EXECUTIVE SUMMARY

Nelson City Council (NCC) is reviewing the operative Nelson Resource Management Plan (NRMP), and preparing its successor, the Whakamahere Whakatu Nelson Plan. The consent status of activities in the Coastal Marine Area (CMA) is defined in part by the activities' ability (or otherwise) to comply with the relevant standards and limits of this plan. However, this is not the only purpose for standards; they 'provide a framework for managing water quality and water resources…[and] classification also provides an indication of general water quality objectives' (Forrest et al. 1994). The current standards were reviewed to determine whether they remain fit for purpose. Consideration was given to requirements of the New Zealand Coastal Policy Statement (NZCPS, DoC 2010), approaches taken by other councils, national guidance, and the availability of local water quality information.

Development of comprehensive regionally-appropriate standards for a range of parameters is not achievable given the limited state of the environment information available in the region. Moreover, where other councils have identified guidance on acceptable values for a range of parameters, they are employed for definition of water quality categories or as target quality standards, rather than as obligatory standards.

The standards in the extant NRMP are largely suitable for inclusion in the new Whakamahere Nelson Plan, however minor changes are recommended to:

- align faecal indicator bacteria standards with current Ministry of Health/Ministry for the Environment guidelines
- allow for assessment of the Shellfish Gathering standard in shellfish flesh (as well as water samples)
- extend the Shellfish Gathering class across the whole CMA
- extend the Contact Recreation class to include the Horoirangi Marine Reserve
- remove reference to 'shellfish gathering season' and 'bathing season'.

The present criteria governing the determination of mixing zones and discharge criteria appear to be generally appropriate. We suggest a minor amendment to incorporate risks of cumulative and/or persistent effects.

NZCPS requirements regarding water quality include managing the effects of activities on land, but do not necessarily require monitoring the impact of these activities on the state of the marine receiving environment. Furthermore, NZCPS requirements cannot be met solely by the setting of consent conditions, but require other monitoring or management (independent of consented activities) from council. Accordingly, acceptance of our recommendations is insufficient to fulfil all the requirements of the NZCPS regarding marine water quality.

Instituting a marine monitoring programme may also be required to move towards fulfilment of some NZCPS obligations. Monitoring should also consider opportunities for maximising value from existing data collection in the NCC area and adjacent CMAs, and the opportunities emerging as a result of technology advances such as satellite imagery and high-frequency data-collection with moored instrumentation.

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GLOSSARY

CMA	Coastal Marine Area
CR	Contact Recreation
DO	Dissolved Oxygen
FIB	Faecal Indicator Bacteria
MfE/MoH	Ministry for the Environment/Ministry of Health
NCC	Nelson City Council
NPS-FM	National Policy Statement for Freshwater Management
NRMP	Nelson Resource Management Plan
NZCPS	New Zealand Coastal Policy Statement
RMA	Resource Management Act
SG	Shellfish Gathering

1. BACKGROUND AND SCOPE

Nelson City Council (NCC) is reviewing the operative Nelson Resource Management Plan (NRMP), and preparing its successor, the Whakamahere Whakatu Nelson Plan.

The NRMP includes regional coastal planning provisions. Since the NRMP was made operative, the New Zealand Coastal Policy Statement 2010 (NZCPS) has been adopted. The regional coastal plan provisions of the NRMP need to be reviewed to account for the direction set by the NZCPS, and to reflect new information about the state of the coastal environment.

Marine Water Quality Standard classifications are currently set out in objectives and policies in the NRMP together with parameters for discharges, mixing zones, assessment criteria and specific discharges, along with a schedule to the Plan, which establishes standards for each parameter in the water quality class. The areas to which the classes relate are mapped in the NRMP. Consented activities in the Coastal Marine Area (CMA) can be assessed in terms of their ability (or otherwise) to comply with the relevant standards and limits as defined in water quality classes. However, this is not the only purpose for classification and standards; 'classification also provides an indication of general water quality objectives' (Forrest et al. 1994).

The NRMP classifications were developed following an independent report on water classification options (Forrest et al. 1994) and public input through the NRMP development process. The current standards need to be reviewed to determine whether they remain fit for their management purpose. This report presents the results of this review.

Section 2 begins with an overview of the relevant requirements of the NZCPS in relation to water-quality classification and standards and then compares these with the current classifications and standards in the NRMP. This is followed by a comparative review of classifications and standards in coastal plans from other regions and with other relevant policies and criteria, including national freshwater management initiatives. Section 2.4 compares the current standards with water-quality monitoring data to assess (to the extent that the data allow) the feasibility of compliance. Current standards are then reviewed and recommendations made for their retention or revision. Section 3 assesses how current criteria for mixing zones and discharges in the NRMP meet the requirements of the NZCPS and compares them with the criteria in other coastal plans. The final section of this report summarises our conclusions and recommendations.

2. WATER QUALITY CLASSIFICATIONS AND STANDARDS

2.1. New Zealand Coastal Policy Statement requirements

The New Zealand Coastal Policy Statement (NZCPS, Department of Conservation 2010) provides policies to achieve the purpose of the Resource Management Act 1991 (RMA) in relation to the coastal environment. Regional policy statements and plans must give effect to the NZCPS. Here we consider the three NZCPS policies relevant to water quality, policies 21–23 (see Appendix 2). Minor reference is made to Policy 14, Restoration of natural character. Guidance documents are available for some policies of the NZCPS, but the only available guidance relevant to the three key policies considered here concerns discharge of untreated human sewage. No reference to standards or water quality classes are made in the NZCPS, but the RMA includes water quality classes (RMA Schedule 3), which some councils employ in their regional plans. Schedule 3 water quality classes can be adapted by councils, as has occurred in the case of NCC.

Tangata whenua engagement is required by several policies, including those directly considered here. For example, if water quality is restricting cultural activities, Policy 21 requires that tāngata whenua are engaged to identify areas of interest to them (Policy 21 (e)). Policy 23 (3) requires early and meaningful consultation with tangata whenua in production of plans allowing for the discharge of treated human sewage. An assessment of the state, nature or process of engagement is outside the scope of this report.

2.1.1. Environmental information requirements

A number of NZCPS policies relevant to marine water quality require measurement of water quality, but several do not. For example, actions are required independent of the state of water quality in Policy 22 [2 - 4]: Sediments, and Policy 23 [2 - 5]: Managing discharge of human sewage and stormwater, and from marine facilities). These policies do not require water quality to be assessed, or that standards are developed. However, in cases where sediments on land may be disturbed, the NZCPS requires that actions are taken to, for example ‘Reduce sediment loadings in runoff and in stormwater systems through controls on land use activities’ (Policy 22 (4)). Policy 22 also requires assessment and monitoring of ‘sediment levels and impacts on the coastal environment’. This requirement similarly does not relate to or require the setting of water quality standards, but is a requirement of councils that is currently not met by NCC[1]. Policy 14, Restoration of natural character, requires that discharges (including leaching) are reduced or eliminated if they have degraded natural character.

[1] We note that NCC plans to introduce monitoring of sediment deposition rates in estuaries. We are not aware of plans to monitor sediment levels in the coastal environment.

Other parts of the NZCPS require that the actual state of water quality is known. Considering the amount and type of data that is available from council and other sources, it is apparent that giving effect to the NZCPS will require more data than are currently available in the Nelson CMA. This is particularly the case with respect to Policy 21, Enhancement of water quality. This policy directs councils to undertake certain actions where 'the quality of water in the coastal environment has deteriorated so that it is having a significant adverse effect on ecosystems, natural habitats, or water-based recreational activities, or is restricting existing uses, such as aquaculture, shellfish gathering, and cultural activities'. Some aspects of environmental health relevant to this policy are well understood (such as levels of faecal contamination), but others less so. For example, the effects of suspended sediment on ecosystems is complex. Suspended sediment dynamics in Tasman Bay are affected by both resuspension of fine sediments, and input of new sediments (Cornelisen et al. 2011; Gillespie & Rhodes 2006; Newcombe et al. 2015). Resuspended sediments are likely to be an important limiting factor in the recovery of shellfish beds (Handley & Brown 2012) and are also likely to affect the health and extent of sponge gardens and seaweed communities. Little information exists on the present day extent and health of these biogenic habitats, and it is likely that no information exists regarding historical extent of some habitats[2]. Moreover, the degree of suspended sediment loading in the water column, and likely effects of those sediments on natural habitats, is similarly unknown. Under Policy 21, if 'water quality has deteriorated so that it is having a significant adverse effect on ecosystems', council must 'give priority to improving that quality' by 'including provisions in plans to address improving water quality in the areas identified (above)' (Policy 21, 1 (b)). Assessment of the degree of effect of suspended sediment on ecosystems, and of subsequent measures to improve water quality would require monitoring of sediment levels in the coastal environment, rather than reliance on sediment input data. Insufficient data exist to set robust standards for recovery of shellfish beds, and effects on other habitats. Moreover, the effects of factors other than water quality on these habitats should be recognised. Disturbance, and indirect effects of fisheries are likely to act cumulatively with suspended sediments to degrade biogenic habitats.

Accordingly, uncertainty regarding the effects of water quality on marine communities, and the interactions of multiple stressors on those communities mean that direct actions or standards appropriate to Policy 21 are not immediately identifiable. It does seem clear, however, that monitoring in the marine environment is required to better understand the dynamics of the ecosystem, and allow Council to move towards meeting the requirements of such policies[3].

[2] Iwi and other members of the community may hold useful historical knowledge about some of these habitats, particularly shallow seaweed communities.

[3] Monitoring is also implicitly required to give effect to Policy 14 Restoration of natural character: 'Promote restoration or rehabilitation of the natural character of the coastal environment, including by…identifying areas and opportunities for restoration or rehabilitation'.

Policy 22 (2) also requires an understanding of sediment levels (presumably sediment input) in the CMA, so that 'subdivision, use, or development' can be shown to fulfil the requirement that they 'will not result in a significant increase in sedimentation'. Similarly, Policy 23 requires knowledge of the nature of the receiving environment, including 'the sensitivity of the receiving environment' (1a) 'capacity…to assimilate contaminants' (1c). Clause (5b) considers contaminated seabed material, and requires that 'dumping or storage of dredged material does not result in significant adverse effects on water quality or the seabed, substratum, ecosystems or habitats'. Assessment of adverse effects can generally be addressed with appropriate monitoring (including baseline surveys) of a given consented activity, but the parameters defined in scheduled water quality standards are unlikely to be sufficiently informative to make this assessment, and other parameters may need to be measured.

In the case of contamination by faecal material, however, we can interpret the Policy 21 requirements more immediately. This is largely because of the higher degree of certainty regarding acceptable levels of contamination with regard to human health (compared to the complexity and uncertainty associated with assessment of ecological impacts). This is considered in Section 2.5 below, with regard to the assessment of the Shellfish Gathering class.

2.2. Existing Nelson Resource Management Plan

Under the NRMP, coastal marine waters are managed for:

- fisheries, fish spawning, aquatic ecosystem, and aesthetic purposes: Class FEA
- contact recreation purposes: Class CR
- shell fish gathering purposes: Class SG
- cultural purposes: Class C.

The scheduled water quality classes, and map of classified areas, are reproduced in Appendix 3. The classes were defined on the basis of recommendations from Forrest et al. (1994), and are substantially based on those laid out in the RMA's Schedule 3 (Appendix 1). Class FEA applies to the entire CMA. Class CR applies out to 200 m seaward of mean high water spring tide in areas identified in the NRMP, including the Monaco Peninsula, Tahunanui Beach and the Back Beach, the Haven around the Cut, Glenduan, Cable Bay and the mouth of the Whangamoa River. Class SG applies to a zone extending from the 10–40 m depth contour in Tasman Bay, and Class C to Delaware Inlet.

The scheduled water classes are referred to in a number of coastal marine rules in the NRMP, and may be referred to along with additional requirements; for example:

> **CMr.39.3**
> Discharges of contaminants, other than those permitted by other rules in this Plan, to coastal water are discretionary activities if:
>
> a) after reasonable mixing the classification standards (contained in Schedule CMs) for the receiving water are complied with, and
>
> b) after reasonable mixing the discharge (either by itself or in combination with other discharges) does not have significant adverse effects on habitats, feeding grounds or ecosystems.

> **CMr.48.3**
> The discharge of agrichemicals (including herbicides and pesticides) into the Coastal Marine Area is a discretionary activity if:
>
> a) after reasonable mixing the classification standards (contained in the Coastal Marine water quality standards Schedule CMs) for the receiving water are complied with and there is no reduction in water quality.

In the latter case the reference to the standards may be unnecessary, as the requirement that 'there is no reduction in water quality' could be applied to any aspect of water quality and is more stringent than scheduled water quality standards.

2.3. Information from non-NCC sources

2.3.1. Coastal plans

No consistent approach to water quality classifications is apparent in the plans of other councils. Most have like NCC adopted a subset of, or variations on, the classes listed in Schedule 3 of the RMA. In general, councils make extensive use of the narrative standards set out in the RMA, including those in Schedule 3 requiring avoidance of adverse effects due to the discharge of contaminants and those in Section 107 relating to effects of discharges. The numerical standards for temperature and Dissolved Oxygen (DO) in Schedule 3 are also commonly included in coastal plans, such as those of Auckland, Bay of Plenty, Canterbury, Hawke's Bay, Marlborough and Northland.

Use of numerical standards for variables, other than temperature and DO, is most common with respect to Faecal Indicator Bacteria (FIB) measures in relation to shellfish gathering and contact recreation. Use of numerical standards for other parameters (such as water clarity, nutrients and chlorophyll-*a*) is used in some cases as a means of classifying water quality (Waikato) or in target setting (Manawatu-Whanganui).

Waikato's coastal plan manages the coastal marine area on the basis of three water quality classifications: ecological health, contact recreation, and shellfish gathering. Coastal waters are classified for contact recreation, based on bacteriological (faecal indicator) counts. Estuarine waters are managed for all three classifications, with two bacteriological variables for shellfish gathering and seven numerical water-quality variables for ecological health (DO, pH, turbidity, ammonia, nitrate, phosphorus and chlorophyll-*a*) [4]. Twenty-five beaches and seven estuaries are currently monitored for water quality. Numerical values are assigned to each variable and categorised as 'excellent', 'satisfactory' or 'unsatisfactory' by comparison with ranges of values for each category (e.g., < 28, 28–280 and > 280 enterococci/100 ml for excellent, satisfactory and unsatisfactory, respectively). Bacteriological guideline values are derived from the national *Microbiological water quality guidelines for marine and freshwater recreational areas* (Ministry for the Environment/Ministry of Health 2003). Scores across the different variables are combined into an overall assessment of estuarine health (excellent, etc.) based on the proportion of samples in each category for each variable.

Manawatu-Whanganui's coastal plan is perhaps the most different to other plans and is described here in more detail. The Manawatu-Wanganui Regional Coastal Plan was made operative in April 2014 as part of *One Plan* (Horizons Regional Council 2014). For the management of water quality, coastal waters are divided into:

1. one Seawater Management Zone (SMZ) which comprises the entire CMA other than the Estuary Water Management Sub-zones, and
2. thirteen Estuary Water Management Sub-zones associated with specified estuarine waters.

Four groups of values, with corresponding management objectives, are applied to the Seawater Management Zone:

- Ecosystem values:
    - inanga spawning
    - whitebait migration
- Recreational and cultural values:
    - contact recreation
    - amenity
    - mauri
    - shellfish gathering
- Water use:
    - industrial abstraction

[4] This information is not included in the Coastal Plan but is provided on the Council's website. Available at http://www.waikatoregion.govt.nz/Environment/Environmental-information/Environmental-indicators/Coasts/Coastal-water-quality/Estuarine-water-quality-techinfo/ , accessed September 2016.

- Social and economic values
    - capacity to assimilate pollution
    - existing infrastructure.

Various sub-sets of these values (with the exception of shellfish gathering, which only applies to the SMZ) are applied to each estuary sub-zone. Several additional values are applied to sub-zones, namely the ecosystem values of 'life-supporting capacity', 'sites of significance - aquatic' and 'sites of significance – riparian', and the cultural value 'sites of significance – cultural'. In the case of riparian sites of significance, the plan identifies specific values to be protected (gravel and sand habitats of dotterel, mud and silt habitat and estuarine roosts of wading birds, shortjaw kokopu and redfin bully habitat). Several of the values apply to all zones and sub-zones: contact recreation, amenity, mauri, industrial abstraction, capacity to assimilate pollution, and existing infrastructure.

Water quality *targets* (not obligatory standards) are then applied to each water management zone and subzone in Schedule I of *One Plan*. Water quality targets for the seawater management zone (Table 1) are designed to reduce the risk of undesirable biological growths and adverse effects on aquatic organisms by managing nutrient concentrations, toxicity and oxygen depletion. The targets also protect visual clarity and bacteriological quality for contact recreation. The targets for the estuary water management subzones (Table 2) are similar, but less strict in terms of DO concentration, algal biomass and bacteriological quality, all of which are likely to be more variable in estuaries than on the open coast. The toxicity target also reflects a lower level of protection in estuaries than for the coast, presumably reflecting the presence of stressors from the surrounding catchment.

Table 1. Water quality targets in the seawater management zone (Horizons Regional Council 2014: p 1-25).

DO (%SAT)	Algal biomass	TP (g/m³)	TN (g/m³)	Ammoniacal nitrogen (g/m³)	Toxicity	Visual clarity (m)		Enterococci (number/100 ml)		Faecal Coliforms (number/100 ml)	
>	Chl *a* (mg/m3)	<	<	<	%[1]	>	%Δ	1 Nov - 30 Apr	1 May - 31 Oct	<	90th %ile
90	3	0.01	0.06	0.06	99	1.6	20	140	280	14	43

[1] refers to ANZECC (2000) guidelines for protection of specified percentage of species.

In terms of giving effect to the NZCPS, none of the coastal plans examined presented significantly different approaches to that currently used by NCC. Manawatu-

Whanganui and Waikato include a wider range of numerical criteria and, in the case of estuaries, apply these to particular estuaries. Waikato's estuarine health criteria currently are apparently only applied to those estuaries that are monitored (in this situation, although compliance is only tested in those estuaries that are presently being monitored, there is the possibility of assessing other estuaries in the future).

Table 2. Water quality targets for estuary water management subzones in Manawatu-Whanganui (Horizons Regional Council 2014: p 1-23).

Water Management Zone	Estuary sub-zone	Temp (°C)	DO (%SAT)	Algal biomass	Macroalgae	DRP (g/m^3)	SIN[1] (g/m^3)	Ammoniacal nitrogen (g/m^3)	Toxicity	E.coli/100 ml		Euphotic Depth	Visual clarity (m)	Visual clarity (m)
		<	>	Chl *a* (mg/m^3)	% cover	<	<	<	%[2]	<50th %ile	<20th %ile	%Δ	>	%Δ
Coastal Manawatu	Manawatu Estuary	24	70	4	5	0.015	0.444	0.4	95	260	550	10	1.2	20
Coastal Rangitikei	Rangitikei Estuary	24	70	4	5	0.015	0.167	0.4	95	260	550	10	1.2	20
Lower Whanganui	Whanganui Estuary	24	70	4	5	0.015	0.167	0.4	95	260	550	10	1.2	20
Coastal Whangaehu	Whangaehu Estuary	22	70	4	5	0.015	0.167	0.4	95	260	550	10	1.2	20
Turakina	Turakina Estuary	22	70	4	5	0.015	0.167	0.4	95	260	550	10	1.2	20
Ohau	Ohau Estuary	22	70	4	5	0.01	0.11	0.4	95	260	550	10	1.2	20
Lake Horowhenua	Hokio Estuary	24	70	4	5	0.015	0.167	0.4	95	260	550	10	1.2	20
Owahanga	Owahanga Estuary	22	70	4	5	0.015	0.167	0.4	95	260	550	10	1.2	20
East Coast	Wainui Estuary	22	70	4	5	0.015	0.167	0.4	95	260	550	10	1.2	20
Akitio	Akitio Estuary	22	70	4	5	0.015	0.167	0.4	95	260	550	10	1.2	20
Kai Iwi	Kai Iwi Estuary	22	70	4	5	0.015	0.167	0.4	95	260	550	10	1.2	20
Mowhanau	Mowhanau Estuary	24	70	4	5	0.015	0.167	0.4	95	260	550	10	1.2	20
Waikawa	Waikawa Estuary	22	70	4	5	0.01	0.167	0.4	95	260	550	10	1.2	20

[1] Soluble Inorganic Nitrogen (SIN) concentration is measured as the sum of nitrate nitrogen, nitrite nitrogen and ammoniacal nitrogen or the sum of total oxidised nitrogen and ammoniacal nitrogen.

[2] refers to ANZECC (2000) guidelines for protection of specified percentage of species.

2.3.2. The National Policy Statement for Freshwater Management (NPS-FM)

The recent National Policy Statement for Freshwater Management (NPS-FM: MfE 2014) stipulates that freshwaters need to be managed sustainably so that human values are provided for, while also providing for economic growth. In other words, the NPS-FM calls for values-based freshwater management.

A number of different values are identified, and the national value Te Hauora o te Wai (ecosystem health) is compulsory. This value is described as follows (Appendix 1 of the NPS-FM):

Te Hauora o te Wai (ecosystem health)

- 'In a healthy freshwater ecosystem ecological processes are maintained, there is a range and diversity of indigenous flora and fauna, and there is resilience to change.'
- 'Matters to take into account for a healthy freshwater ecosystem include the management of adverse effects on flora and fauna of contaminants, changes in freshwater chemistry, excessive nutrients, algal blooms, high sediment levels, high temperatures, low oxygen, invasive species, and changes in flow regime. Other matters to take into account include the essential habitat needs of flora and fauna and the connections between water bodies.'
- 'The health of flora and fauna may be indicated by measures of macroinvertebrates.'

The NPS-FM sets out objectives and policies to direct local government and provides a National Objectives Framework (NOF) to assist regional councils and communities to plan for 'freshwater objectives' (desired environmental outcomes).

The NOF defines three acceptable states (A, B, C) and a national bottom line, below which (State D) management action for improvement is required. Attributes of these states are defined numerically and descriptively. Currently classes have been defined for four attributes for Te Hauora o te Wai. These are periphyton biomass (trophic state), nitrate and ammonia (toxicity), and DO. Further attributes are under development. An example of a NOF attribute table (from Appendix 2 of the NPS-FM 2014) is given below (Table 3). This shows that classes are defined with median and 95th percentile numerical limits, and even in the descriptive (narrative) definition, numerical limits to the number of species affected by this attribute are defined.

Table 3. Example of attribute data (for nitrate toxicity) from the National Policy Statement for Freshwater Management

Value	Ecosystem health		
Freshwater Body Type	Rivers		
Attribute	Nitrate (Toxicity)		
Attribute Unit	mg NO_3-N/L (milligrams nitrate-nitrogen per litre)		
Attribute State	**Numeric Attribute State**		**Narrative Attribute State**
	Annual Median	**Annual 95th Percentile**	
A	≤ 1.0	≤ 1.5	High conservation value system. Unlikely to be effects even on sensitive species
B	> 1.0 and ≤ 2.4	>1.5 and ≤ 3.5	Some growth effect on up to 5% of species.
C	> 2.4 and ≤ 6.9	>3.5 and ≤ 9.8	Growth effects on up to 20% of species (mainly sensitive species such as fish). No acute effects.
National Bottom Line	6.9	9.8	
D	> 6.9	>9.8	Impacts on growth of multiple species, and starts approaching acute impact level (i.e. risk of death) for sensitive species at higher concentrations (>20 mg/L)

While it is undoubtedly desirable to have robust standards for the marine receiving environment, the understanding of marine ecology and stressor effects is less well-developed in the marine environment than in fresh water. No similarly comprehensive national guidance exists for the marine environment. Identification of limits such as those presented in the NPS-FW presently is beyond the capability of any council, and would be unrealistic in the absence of a robust historical data set.

2.3.3. Estuarine limit-setting

Two key bodies of work in the estuarine space may be relevant to standard setting in future. Recent work undertaken in an MBIE-funded project developed guidelines for estuarine susceptibility to eutrophication (Robertson et al. 2016). Nitrogen thresholds are given for estuaries across a range of flushing and dilution potentials. The authors acknowledged that the thresholds supplied are based on limited data, and site-specific studies are required to correctly determine nutrient load thresholds for a given estuary. Accordingly, the information presented therein would not appropriately feed in to standard-setting for planning purposes.

The requirements for limit-setting upstream of estuarine environments is the subject of a Ministry for the Environment funded project 'Managing Upstream: Estuaries State and Values' which is expected to begin this year. Future development of both these projects will provide greater guidance for councils on suitable limits for managing estuaries. At present, however, information is insufficiently robust for inclusion in planning documents. Extrapolation from preliminary data, or premature adoption of un-tested standards would be unlikely to contribute to effective environmental management over the life of the new plan.

There are four significant estuaries within the Nelson jurisdiction; Eastern Waimea, Nelson Haven, Delaware, and Kokorua. State of the Environment monitoring has been undertaken for all estuaries (Table 4), as well as various consent monitoring reports for Waimea and Nelson Haven. These have some value in provision of background information on environmental health, although data specific to water quality is limited, and that which exists predates the original assessment by Forrest et al. (1994), and therefore the original recommendations from which the current NRMP standards were derived.

Table 4. Estuarine surveys in Nelson's CMA.

Location	Survey type	Date	Source
Waimea	Preliminary survey	2002	Robertson et al. (2002)
	Habitat map	1999	Robertson et al. (2002)
		2006	Clark et al. (2008)
		2014	Stevens & Robertson (2014)
	Fine scale survey	2001	Robertson et al. (2002)
		2006	Gillespie et al. (2006)
		2013/14	Robertson & Robertson (2014)
	Historical map	2003	Tuckey & Robertson (2003)
Nelson Haven	Preliminary survey	2008	Gillespie (2009a)
	Habitat map	2009	Gillespie et al. (2011a)
	Fine scale survey	2012	Gillespie et al. (2012)
Delaware	Preliminary survey	2009	Gillespie (2009b)
	Habitat map	2009	Gillespie et al. (2011b)
	Fine scale survey	2009	Gillespie et al. (2009)
Whangamoa/	Preliminary survey	2013	Gillespie (2013)
Kokorua	Habitat map	2015	Stevens & Robertson (2015)
	Fine scale survey	2014/2015	Robertson & Stevens (2015)

2.4. Water quality data and the determination of standards

2.4.1. Freshwater quality data, and relevance to marine standard-setting

Freshwater data are collected and summarised on the website of Land Air Water Aotearoa (LAWA, www.lawa.org.nz). On LAWA each stream (or sampled site) is compared for streams across the whole of New Zealand, and placed in quartiles. Trends are identified where possible. Selected data from NCC streams, from the sampling point nearest the coast in each stream, are presented in Appendix 4. General findings are reported here, and we assess the importance of this data to marine water quality in the context of standard-setting.

Escherichia coli is the FIB most commonly reported from freshwater, and in many streams an improvement was identified. No degradation was identified in the NCC streams.

Measures related to water clarity (black disc measurements and turbidity) either displayed no trend or showed improvement. The two measures of nutrients presented here (ammoniacal nitrogen N and dissolved reactive phosphorus DRP) either displayed no trends (ammoniacal N) or showed equal occurrence of stream health improvement and degradation (DRP).

Assessment of how freshwater quality translates into marine water quality would require information on flow volumes (loading calculations) and modelling of the fate of freshwater-borne contaminants (sediments, nutrients, etc.) in the marine environment. Given that the parameters measured in freshwater monitoring are not measured with any frequency in the marine environment, the value of translating freshwater quality into assessments of marine health is limited at this stage.

The key relevance of freshwater data to marine standard-setting, is that noticeable degradation has not been identified over recent years. Had substantial degradation been identified since the past water quality standards were defined, this may have had some implications for the review of standards. For example, this may have been relevant to identification of appropriate standards over the lifetime of the new plan. More importantly, changes in freshwater inputs would possibly need to be considered in the design and analysis of a marine monitoring programme, which would ultimately lead to development of marine standards.

2.4.2. Marine water quality data

Other than datasets of FIB levels, we are not aware of any ongoing data collection of water quality parameters in or near the Nelson CMA that would inform a reassessment of water quality standards. The TASCAM buoy (www.cawthron.org.nz/tascam) records parameters such as temperature, salinity, turbidity, chl-*a*, and pH in Tasman Bay, but this is within the Motueka River plume on

the western side of Tasman Bay. While relevant to environmental conditions in the Nelson CMA, TASCAM data in itself is insufficient for standard-setting locally.
Three main sources of data were available to assess the suitability of existing water quality standards for FIB:

- Council recreational water quality monitoring. This tests FIB (enterococci) levels in single water samples taken from the shallows (knee-deep water) at four beaches in the Nelson CMA. Testing takes place up to 20 times over the summer period.
- Bell Island–Nelson Regional Sewerage Business Unit (NRSBU) monitoring of water quality at both outlets of Waimea estuary (the eastern outlet is partly in the Nelson CMA). This has tested a range of FIB classes in winter and summer since 2008 (only the summer survey occurred in 2009). Surface waters are tested at sites where water depths are between ~4 and 10 m. Mussels are also deployed at the same sites for several days in cages ~2 m below the surface, and FIB levels in mussel flesh are then measured.
- At the Nelson North Wastewater Treatment (Wakapuaka) discharge locations water samples were taken on six occasions before, and eight occasions after, a 2008 plant upgrade. Samples were taken from surface waters at or along-current from the diffuser, which sits in approximately 11 m of water.

These data sources are discussed with respect to the relevant water quality classes below.

2.5. Existing standards and their suitability

2.5.1. Faecal indicator bacteria

Contact recreation standard

Existing NCC (NMRP 2012) standards for FIB for the CR: Contact Recreation class are:

- The median of samples taken over the bathing season shall not exceed 35 enterococci/100 ml, and
- No sample, in the following areas, shall exceed the following limits.

Area	Use Category	Enterococci limit/100 ml
Tahunanui (main beach)	Designated bathing beach	104
Port opposite Cut	Moderate	153
Haven (at Atawhai)	Moderate	153
Tahunanui (back beach)	Light	275
Monaco	Light	275
The Glen Beach	Light	275
Cable Bay	Light	275

While people are more likely to engage in contact recreation in the warmer months, people continue to swim, dive and undertake other forms of contact recreation in cooler months. While monitoring may focus on high-use seasons, there is no clear reason to retain reference to 'bathing season' in the standard. **We recommend removal of reference to bathing season.** The substitution of another time frame (e.g., 'calendar year' in place of 'bathing season') would not be appropriate as the most suitable timeframe for assessment of impact is dependent on the monitoring purpose. For state of the environment monitoring, a sampling programme may span the whole year, or the bathing season, dependent on Council aims. In the case of consent monitoring, the expected duration of impact would dictate the appropriate timeframe.

The Council recreational water quality data set shows that in general FIB levels are below the existing NCC minimum standard for recreational water quality for single samples. However, the lowest limit for FIB concentrations (104 enterococci/100 ml) has been exceeded on at least one occasion per summer at all sites (Appendix 5, Figure A-1). This includes Tahunanui, the beach at which this standard is currently applied. Maximum NCC standards for single samples (275 enterococci/100 ml) are often exceeded at all sites.

The median standard for all areas designated for Contact Recreation has not been exceeded in the past 17 summers at Tahunanui or Cable Bay. It was exceeded at Atawhai in the summer of 2001/02, and at Monaco in 1999/2000. On both occasions numbers of samples were low (5 or 6). Results are therefore less reliably representative of water quality across the bathing season than when greater numbers (~20) of samples are collected across the season. However, another breach of standards occurred in the summer of 2013/14 at Monaco, on the basis of a 22-sample dataset. Median concentrations of enterococci were also elevated at Tahunanui and Atawhai that summer, although concentrations were still below the 35/100 mL median standard.

The Bell Island and Nelson North data show that FIB concentrations in water samples taken from slightly further off shore are generally undetectable, or are very low. Only a single sample from Bell Island monitoring showed substantially elevated concentrations of faecal coliforms (July 2015, Appendix 5: Figure A-2), and enterococci (the FIB used in standard-setting) concentrations were not elevated on that sampling occasion. After commissioning of the Nelson North plant upgrade, FIB were not detectable (i.e., were below the analytical detection limit) 1000 m from the discharge on any of the eight sampling occasions.

If existing standards in the Nelson Plan are used for setting of consent-associated limits, it should be recognised that background FIB concentrations may exceed those limits on occasion. For this reason, the inclusion of appropriate controls in survey design is important. Also, the use of sufficient replication in monitoring survey designs

is necessary to ensure that the potentially high background variability in FIB concentrations is accounted for.

Existing NRMP contact recreation standards are those provided by the Department of Health (1992) provisional guidelines, although no areas were classified by NCC for infrequent use (which requires that single samples cannot exceed 500 enterococci per 100 ml). The concentrations of enterococci used to define limits for single samples in the 1992 guidelines are similar to those in the more recent MfE/MoH (2003) classes: DoH: ≤ 104 (bathing beach), ≤ 153 (moderate use), ≤ 275 (light use); MfE/MoH ≤ 140 ≤ 280 (all per 100 ml). Many other council plans use the MfE/MoH guidelines for surveillance, alert, and action levels for marine waters (Box 1, Section D, MfE 2003), as does NCC in its recreational water quality reporting[5]. Therefore it may be appropriate to employ these standards for water-quality classes. Waikato Regional Council consider waters with < 280 enterococci as of 'satisfactory' quality, while the Hawke's Bay Regional Council CR standard is '280 enterococci bacteria/100 ml in marine waters in a single sample'. Given the particularly high use of Tahunanui Beach and the Port/Haven areas relative to other areas, and given the historical approach to Contact Recreation in NCC, it is reasonable to set a more stringent standard at high-use areas**.**

Accordingly we recommend the MfE/MoH guideline of ≤140 enterococci/100 ml for Tahunanui, the Port opposite the Cut, and the Haven (at Atawhai), and the higher standard of ≤ 280 enterococci/100 ml in all other areas designated for contact recreation. Our maintenance of a higher limit at low-use sites is consistent with the historical approach of NCC, however a more stringent standard could equally be applied at all CR sites. The application of the ≤140 enterococci/100 ml standard at all sites could be considered, however this would be substantially more stringent than that employed by many other councils.

High bacterial contamination can be detected in single samples, while nearby samples have very low or undetectable concentrations of bacteria (Cawthron unpublished data, Appendix 4). Moreover, faecal contamination can come from a range of sources, including natural sources such as seabird populations[6]. Accordingly, monitoring surveys based on the standards may use the single sample maximum value as a trigger for additional, more intensive, sampling. We note that Council will continue to calculate integrated statistics from water quality monitoring data for State of the Environment reporting purposes.

[5] http://nelson.govt.nz/assets/Environment/Downloads/scorecards/2014/Recreational-Bathing-Water-Quality-Scorecard-2014-15.pdf.

[6] Microbial source tracking (MST) is a molecular (genetic) technique that can be used to identify the source of contamination.

Shellfish gathering standard

Existing NCC (NRMP 2012) standards for FIB for the SG: Shellfish Gathering class are:

- aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants, and
- the median faecal coliform content of water samples taken over a shellfish gathering season shall not exceed 14 MPN/100 ml and not more than 10% of samples should exceed 43 MPN/100 ml.

The latter clause is the same as the guidance provided by MfE/MoH (2003).

There is a range of shellfish in the Nelson CMA that could be harvested (including cockles, mussels, oysters, scallops). It is not clear which months or seasons would constitute the 'shellfish gathering season', and this component of the standard is therefore not useful. **We recommend removal of reference to shellfish gathering season.** As for the suggested removal of the reference to 'bathing season' in the Contact Recreation standard, the substitution of another time frame in place of 'shellfish gathering season' would not be appropriate. The most suitable time frame for assessment of impact is dependent on the monitoring purpose.

In both the NCC and MoH (1995) standards faecal coliforms are the FIB used to determine suitability of shellfish for consumption, although this is the FIB class least-frequently measured in monitoring in the region. In the Bell Island data set, faecal coliforms were measured on fewer occasions than enterococci (7 vs. 16, Appendix 5 Figure A-2), however they were at concentrations considered unacceptable for human consumption on two of seven occasions at the eastern outlet of the Waimea estuary (in one of two samples on each occasion).

Faecal coliforms were above detection limit in six of the 28 water quality samples. This was insufficient to establish a local relationship[7] between faecal coliforms and the more commonly-measured enterococci. However, a very approximate conversion can be made between enterococci and faecal coliform concentrations[8]. This estimates 43 faecal coliforms/100 mL as equivalent to ten enterococci/100 mL. A concentration of ten enterococci/100 mL is at the current laboratory detection limit. Accordingly, if enterococci concentrations in seawater are used to estimate suitability of shellfish for human consumption, the MfE/MoH/NCC standard for single samples is exceeded if more than 10% of samples contain detectable enterococci. In the case of assessment of the median value, the relatively high detection limit is more problematic. Due to the standard being very near detection limit, the assessment of whether the median exceeded 14 faecal coliforms/100mL would not be calculable with current methods.

[7] The resulting power function was $y = 2.7748x^{0.7676}$ with an R^2 of 0.2407, indicating that the regression line did not explain the relationship well.

[8] http://www.mfe.govt.nz/publications/international-environmental-agreements/microbiological-water-quality-guidelines-marine#notehv.

When faecal coliforms are measured, however, the detection limit is lower, at 2 MPN/100 ml (most probably number) faecal coliform (using the standard APHA method). Accordingly, direct measurement of faecal coliforms is important in water sampling.

Suitability of shellfish for human consumption can be tested in the water (as per the above standard), or in mussel flesh. In sampling undertaken as part of the Bell Island monitoring, bacterial contamination was often detected in mussel flesh when not detected in water column samples. Concentrations of faecal coliforms at or below 230/100 g wet weight of shellfish flesh are considered acceptable for human consumption, values up to 330/100 g are considered marginally acceptable, and beyond 330/100 g are considered unacceptable for human consumption (MoH 1995).

Shellfish offer a means of integrating FIB concentrations over several days, and are apparently more likely to show a signal of bacterial contamination than single point in time water samples. For that reason they are perhaps a more reliable indicator of relative contamination. However, nationally, councils tend to use direct water sampling to test for faecal contamination. This has the advantages of simplicity (cost-effectiveness) and ease of comparison with national water quality guidelines. **Accordingly, we recommend that a standard is available for testing for faecal contamination in both water samples and in shellfish flesh.**

To allow for shellfish flesh measurements to be used in assessing SG standards, clause 1 ('Aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants') could be assessed with the MoH (1995) standards. The standard could therefore be re-phrased thus:

> 1) Aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants, and
>
> 2) Faecal contamination may be assessed either in water samples or in shellfish flesh, with the corresponding standards of:
>
> > i) Water: The median faecal coliform content of samples shall not exceed 14 MPN/100 ml and not more than 10% of samples should exceed 43 MPN/100 ml.
> >
> > ii) Shellfish flesh: The 80th percentile faecal coliform content of samples shall not exceed 230 faecal coliforms/100 g and no samples should exceed 330 faecal coliforms/100 g shellfish flesh.

The decision of which standard (and sampling method) to employ will again be dependent on the monitoring purpose. We suggest that the default should be measurement of both parameters. However, on some occasions collection of shellfish flesh measurements will not be feasible. If no natural populations exist (or are not accessible without incurring unreasonable cost), the deployment of caged mussels may be appropriate (such as employed in water quality monitoring for the Bell Island

sewage treatment plant). Deployment of caged mussels may, however, not be feasible under certain conditions, for example, in areas with high vessel traffic, or very strong currents.

2.5.2. Other parameters

Standards other than those pertaining to FIB are largely the descriptive (often referred to as 'narrative') standards defined in the RMA. Minor changes to these standards were recommended by Forrest et al. (1994), and insufficient data exists to re-assess these recommendations on the basis of empirical data. Forrest et al. recognised the utility of overseas data (such as the ANZECC guidelines) in providing guidance for assessing the descriptive standards. These include numerical guidelines and trigger levels[9].

The two non-bacterial parameters with numerical standards are temperature and DO. The temperature standard (FEA classification, 'The natural temperature of the water shall: a] not be changed by more than 2°C, and b] not exceed 25°C') was recommended by Forrest et al. on the basis of guidelines including ANZECC (1992). ANZECC 2000 (table 3.3.1) does not provide default values for temperature. It recognises that the preferred method for obtaining trigger values for temperature, DO, and a number of other parameters, is through reference data. The specified method for deriving default upper and lower trigger values is to take the 80th and 20th percentiles from monitoring data. Under ANZECC guidelines for naturally occurring stressors (such as temperature), two years of monthly sampling is required to establish suitable reference data. ANZECC (2000) does, however recommend that the maximum change in temperature should not exceed 2°C over one hour for the protection of aquaculture species (table 4.4.2). This NCC standard of > 2°C change has been in place in NCC for many years, and as stated by Forrest et al. (1994): 'The temperature standard of ±3°C may not be protective of larval stages or highly sensitive species'. Insufficient cause is apparent to recommend a change of the standard from 2°C to 3.0°C. Similarly, no reason is apparent to require revision of the temperature maximum of 25°C.

The DO standard (FEA classification, 'The concentration of dissolved oxygen shall exceed the higher of 6 mg/L or 80% saturation') was recommended by Forrest et al. on the basis that the RMA standards were similar to other guidelines, including ANZECC 1992. ANZECC 2000 standards for aquatic ecosystems of south-east Australia[10] give 80% DO saturation as the trigger values for estuarine systems, and 90% DO saturation for marine waters. The NCC inclusion of a 6 mg/L minimum DO adds a degree of conservatism to the RMA standard, by limiting the permissible DO reduction under low absolute DO concentrations. Accordingly, while adoption of a

[9] ANZECC provide guidelines or trigger values, rather than standards, and recommend that further investigation be the response to measurements exceeding guideline/trigger values.

[10] These are the most appropriate standards for New Zealand waters, although they should still be used with caution, as New Zealand waters are more productive than Australian waters.

90% DO saturation standard would not be unreasonable for marine waters, the maintenance of the existing standard is also defensible.

2.5.3. Classification zones

Shellfish gathering

The current NRMP recognises that 'some people gather shellfish within estuaries and other intertidal areas in the district and that there is a general expectation that such areas should be available for shellfish gathering without risk to public health' (CM 6.2.v). Forrest et al. (1994) state that 'virtually all of our coastal waters have some value in terms of shellfish resources', however due to lack of data and likelihood of frequent breaches of the SG standards, they proposed a compromise where 'class SG be applied to all areas where achieving compliance is a realistic target'. Accordingly they recommended (for the whole of Tasman and Golden bays) that the SG class be assigned to areas between 10 and 40 m water depth, where shellfish aquaculture had been conditionally approved at the time. This approach is perhaps more relevant to the Tasman District Council CMA, where large aquaculture management areas are in place. They also recommended data collection and subsequent plan review on the basis of resultant data. While the data collected in the interim are informative of frequency of breaches in some areas, we are not aware of data that allow for assessment of SG standards in many nearshore and estuarine environments. Nonetheless, Policy 21 of the NZCPS requires that where coastal water quality has deteriorated to the extent that it is restricting existing uses (including shellfish gathering), councils should 'give priority to improving that quality by…including provisions in plans to address improving water quality…[and] where practicable, restoring water quality to at least a state that can support such activities' (see full text in Appendix 2). We interpret this to mean that any limitation on shellfish gathering (or suitability of shellfish for human consumption) occurring as a result of poor water quality should be considered in the plan. This is a very different approach to the rationale used by Forrest et al. (1994), as it requires improvement of water quality where it is restricting activities, rather than designation of areas based on the achievability of limits.

There is no reason why waters between 10 m and 40 m deep should be considered more appropriate for shellfish gathering than those < 10 m and > 40 m, and a number of sources indicate that inclusion of all waters is a better approach. For example:

- The compromise suggested by Forrest et al. (1994) was not proposed as a permanent solution
- Council (in the NRMP) and Forrest et al., recognise the importance of all waters for shellfish gathering
- If water quality is too poor for shellfish gathering, then improvement of water quality, rather than avoidance of harvesting, is required by the NZCPS.

Moreover, if the SG class is not applied nearshore, it may be permissible to allow a substantial reduction in shellfish under a rule such as the existing Coastal Marine Rule 39.311 (but see RMA Section 69 (c)12). Under the NZCPS, extension of the SG class to all waters is appropriate, and a plan to ensure that the standards are not exceeded is apparently required. We recognise that other councils have SG standards applied to areas where these standards are likely to be exceeded.

Identification of the most appropriate actions to improve water quality may require more data. While we have access to data that shows that shellfish gathering standards are frequently exceeded (Appendix 5 Figure A-1.), the NZCPS clause 21:1(d) requirement that 'stock are excluded from the coastal marine area, adjoining intertidal areas and other water bodies and riparian margins in the coastal environment, within a prescribed time frame' may not improve conditions, if the contamination is coming from further upstream, or if it stems from a non-bovine source. In the latter case, microbial source tracking could be used to identify the organisms causing contamination[13].

Contact recreation

The Horoirangi Marine Reserve has been gazetted since the NRMP was made operative. The reserve is popular with divers, and it therefore seems appropriate to extend the contact recreation standard to cover the reserve area.

Overlap of Contact Recreation and Shellfish Gathering zones

The question of whether it is useful to have both Contact Recreation and Shellfish Gathering classes (and standards) applied in the same area requires consideration. Should our recommendations be accepted, all CR areas would also be covered by the SG class. Both classes include standards for FIB. While this may make the CR standard regarding faecal contamination unnecessary, there is value in maintaining both standards. It is likely that in the short term the SG class will be aspirational as far as the state of the marine environment is concerned, and substantial achievement of background SG standards will require that broad-scale measures are taken to reduce faecal contamination. It is also likely that activity would be required to integrate management with neighbouring councils[14], in particular with Tasman District Council regarding the Waimea Inlet.

[11] CMr.39.3: Discharges of contaminants, other than those permitted by other rules in this Plan, to coastal water are discretionary activities if: a) after reasonable mixing the classification standards (contained in Schedule CMs) for the receiving water are complied with, and b) after reasonable mixing the discharge (either by itself or in combination with other discharges) does not have significant adverse effects on habitats, feeding grounds or ecosystems.

[12] Subject to the need to allow for reasonable mixing of a discharged contaminant or water, a regional council shall not set standards in a plan which result, or may result, in a reduction of the quality of the water in any waters at the time of the public notification of the proposed plan unless it is consistent with the purpose of this Act to do so.

[13] In the case of the Motueka river plume, bovine sources have been identified as the key source of contamination in off-shore aquaculture areas, Cornelisen et al. (2011).

[14] Integration across local authority boundaries is a requirement of the NZCPS, Policy 4a(ii).

In terms of consent-associated monitoring, the monitoring programme associated with any consented activity in the 'SG + CR' areas would need to define the most appropriate survey design. When considering consent conditions for overlapping SG and CR classes, the approach taken should be that outlined in Section 2.5.1: Shellfish gathering standard (above). Both shellfish flesh and water column measurements should be taken, but to directly assess the CR standard, measurement of enterococci in the water column sample should be included[15]. The default monitoring plan should be to assess FIB in both shellfish flesh and water samples. Any deviation from this default would be considered in light of the particular conditions relevant to a given consent.

The alternative option to overlapping SG and CR classes—that of removing the CR class on the basis that the SG standards are more stringent—is problematic. This is because the relationship between the different faecal indicator bacteria is not well-defined. Moreover, the parameters relevant to established recreational water quality monitoring programmes are those in the CR class, which provides an important historical context within which to assess future measurements of enterococci. Maintenance of the CR class provides for explicit assessment of the most established standard relevant to the specific CR use in the sub-set of relevant areas.

A key benefit in maintaining the two standards is for monitoring purposes. The two standards use different types of indicator bacteria (on the basis of national guidelines), and the data presented in the appendices show that these do not necessarily correlate. As discussed above, assessment of the SG class with shellfish flesh contamination measurements should be permitted by the standards. While the SG standard is overall more stringent regarding acceptable levels of faecal contamination, on any given occasion it is conceivable that SG standards are met while CR standards are exceeded.

2.6. Recommended classifications and standards

The standards as defined in the NRMP are generally fit for purpose, and in line with the approach taken by many councils. Insufficient information exists for the development of standards for many parameters, and best available national or international guidance (such as ANZECC 2000), or development of reference data sets, should be used as required for management of coastal waters.

As discussed above, we suggest minor changes in bacterial contamination standards to reflect changes in guidance, and to allow for measurements of contamination in shellfish flesh. **We recommend extension of the CR class to the Horoirangi**

[15] In the case of assessment of the SG standard alone, it would only be necessary to measure faecal coliform concentration. However, it is good and common practice to measure all common classes of FIB, that is, *E. coli*, faecal coliforms, and enterococci.

Marine Reserve, and of the SG class to all waters, the latter in recognition of the requirements of the NZCPS. These changes have been integrated into the Schedule below (Table 5).

Table 5. Revised standards (italics indicate revisions).

Classification: Management Purpose	**Standards to apply, after reasonable mixing**
FEA: Fishing, fish spawning, aquatic ecosystem, aesthetic purposes. (Applies over whole of Coastal Marine Area.)	1) The natural temperature of the water shall: a) not be changed by more than 2°C, and b) not exceed 25°C, and 2) The concentration of dissolved oxygen shall exceed the higher of 6 mg/l or 80% saturation, and 3) There shall be no significant adverse effects on aquatic life arising from the discharge of a contaminant into water, a pH change, the deposition of matter on the foreshore or seabed, or any other cause, and 4) There shall be no: a) production of any conspicuous oil or grease films, scums or foams or floatable or suspended material, and b) conspicuous change in the colour or visual clarity, and c) emission of objectionable odour in the receiving water.
CR: Contact recreation	1) The visual clarity of the water shall not be so low as to be unsuitable for bathing, and 2) The water shall not be rendered unsuitable for bathing by the presence of contaminants, and 3) There shall be no undesirable biological growths as a result of any discharge of a contaminant into water, and 4) The median of samples shall not exceed 35 enterococci/100 ml, and *5) No sample shall exceed the following limits.* *140 enterococci/100 ml at Tahunanui main beach, the port opposite the Cut, and the Haven (at Atawhai)* *280 enterococci/100 ml at Tahunanui back beach, Cable Bay, Monaco, The Glen Beach, and Horoirangi Marine Reserve.*
SG: Shellfish gathering *(Applies over whole of Coastal Marine Area.)*	1) Aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants, and 2) *Faecal contamination may be assessed with either water samples or in shellfish flesh, with the corresponding standards of*: i) Water column: The median faecal coliform content of samples shall not exceed 14 MPN/100 ml and not more than 10% of samples should exceed 43 MPN/100 ml. *ii) Shellfish flesh: The 80th percentile faecal coliform content of samples shall not exceed 230 faecal coliforms/100 g and no samples should exceed 330 faecal coliforms/100 g shellfish flesh.*
C: Cultural values (Delaware Inlet)	1) The quality of the water shall not be altered in those characteristics which have a direct bearing on: a) the availability of seafood, and b) the quality of seafood, and c) the spiritual values of the water, and 2) Aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants, and 3[16]) The median faecal coliform content of samples taken over a shellfish gathering season shall not exceed 14 MPN/100 ml and not more than 10% of samples should exceed 43 MPN/100 ml.

[16] It may be appropriate to remove the temporal limitation ('shellfish gathering season') and add the shellfish flesh standard in line with the recommended changes to the Shellfish Gathering class. However, we have not consulted with iwi on the appropriateness of these changes.

3. MIXING ZONES AND DISCHARGE CRITERIA

3.1. NRMP Policies CM 6.4 Mixing zones and 6.5 Assessment criteria

Policies CM 6.4 Mixing zones and 6.5 Assessment criteria of the NRMP (Appendix 6) specify the parameters that govern the determination of an appropriate mixing zone and the assessment of applications to discharge in the CMA. Forrest et al. (1994) described the two broad approaches to defining mixing zones: (1) in terms of the physical mixing process and (2) in terms of the effects of the discharge. The parameters set out in the NRMP relate to the effects-based approach. This approach sets the size of the mixing zone on the basis of the values of the receiving environment and requires a judgement of whether a value needs to be protected or how much a value can be compromised.

3.2. Consistency with the NZCPS 2010

Policy 23 of the NZCPS specifies matters that should receive particular regard in managing discharges to the marine environment. Clause (1) of this policy relates to the sensitivity and capacity of the receiving environment and the nature of the discharge. It requires that significant adverse effects on ecosystems and habitats (after reasonable mixing) be avoided and that mixing zones should be as small as necessary to achieve the required water quality in the receiving environment, and to minimise adverse effects on the life-supporting capacity of water within the mixing zone. The matters in Policy 23 (1) of the NZCPS are addressed in policies CM 6.4 and 6.5 of the NRMP.

Clauses (2) and (3) of Policy 23 relate to discharge of raw and treated human sewage, respectively, and are addressed in policies CM 6.6 and 6.7 of the NRMP. Management of stormwater discharges (clause (4) of Policy 23) is addressed in the NRMP by the requirement to minimise contaminants in the discharge by using the best practical option (Policy CM 6.8), which is consistent with the approach adopted in clause (4). Clause (5) of Policy 23, listing matters to be considered with regard to discharges from ports and other marine facilities, is addressed in Policy CM 6.10 of the NRMP.

3.3. Guidance for setting mixing zones in the Nelson CMA (Forrest et al. 1994)

Forrest et al (1994) provided a set of criteria to be considered when setting mixing zones using the effects-based approach. These are listed below and compared with the parameters in Policy CM 6.4 to assess whether there is any basis for modification of the latter.

3. What are the uses and values of the receiving environment?
    - Consider potential uses and values, as well as existing ones.
    - How common or widespread are the values of concern? E.g., do they include rare species or habitats, prime recreation areas?
    - Are the receiving waters classified or covered by other policy or rules?
4. Are the uses and values likely to be affected by the discharge?
    - Is one of the uses or values so susceptible to change that it will clearly set the strictest requirements for the size or shape of the mixing zone?
    - Are any of the likely effects within the mixing zone so serious that no mixing zone should be tolerated?
    - How much of the total 'pool' of a value will be affected by the discharge?
    - Are there cumulative or interactive effects of this activity with that of other activities?
    - Will the effects be short term, long term, or permanent?
    - What is the degree of uncertainty in the assessment of effects, and are the uncertainties important?
5. Is there going to be any environmental benefit which partly or wholly offsets the adverse effects of the discharge within the mixing zone?
6. Has the best option been chosen (in terms of minimising environmental effects)?
    - Is it practical to improve the quality of the effluent to provide greater environmental protection?
    - Could the timing of the discharge be altered to reduce environmental effects?
    - Is it practical to increase the dilution of the effluent (e.g., by addition of a diffuser) to provide greater environmental protection?
    - Could another discharge location be chosen to reduce environmental effects?
    - What are the costs and other trade-offs associated with the options? (If environmental effects could be readily reduced, then a small or nil mixing zone may be appropriate).

The first of Forrest et al.'s criteria is broadly addressed in clauses (a) and (b) of Policy CM 6.4 and clauses (a) and (e–g) of Policy CM 6.5, expressed in terms of the coastal water classification applied to the receiving environment, its values and sensitivity. Potential, rather than actual, uses and values of the receiving environment are considered in Policy CM 6.5 (Assessment criteria). Potential uses would be compromised if the effects of the proposed activity are long term or permanent. Persistence of effect is addressed by Forrest et al.'s second criterion but not explicitly by policies CM 6.4 or 6.5. In the context of the Nelson CMA, although proximity to areas valued for shellfish gathering or commercial fishing are to be taken into consideration in Policy CM 6.4 (b) and 6.5 (f), aquaculture is not mentioned but could

become a value in the future. Aquaculture is particularly vulnerable to decreases in water quality.
The second of Forrest et al.'s criteria is addressed in part by policies CM 6.4 (b–c) and 6.5 (c–h). The issues of cumulative persistence of effects (other than bioaccumulation of contaminants) and uncertainty associated with the assessment of effects are not explicitly addressed.

The third criterion is not addressed by Policies CM 6.4 or 6.5. Criterion 4 is addressed by Policies CM 6.4 (d), (e) and (g).

3.4. Comparison with other regional coastal plans

NCC's policies for mixing zones and discharges of contaminants were compared with those of the following councils:

- Auckland Council
- Bay of Plenty Regional Council
- Canterbury Regional Council
- Hawke's Bay Regional Council
- Manawatu-Manganui Regional Council
- Northland Regional Council
- Otago Regional Council
- Southland Regional Council
- Waikato Regional Council
- West Coast Regional Council.

In general, the policies relating to mixing zones and discharges in the NRMP (policies CM 6.4 and 6.5) encompass those included in the plans of other councils. There are, however, three sets of issues addressed in this context in other plans that are not explicitly addressed in the mixing zone or discharge assessment criteria of the NRMP:

- adverse effects on habitats of threatened species
- avoidance of effects listed in section 107 of the RMA:
    - production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials
    - any conspicuous changes in colour or clarity
    - emission of objectionable odour
    - any significant adverse effects on aquatic life, aesthetics and amenity value
- opportunities to enhance existing water quality.

The first of these is indirectly addressed by the requirement to take account of the proximity of the mixing zone to areas valued for ecological reasons (Policy CM 6.4.b) and the water-quality classification of the receiving environment (Policy CM 6.5.a). The water-quality classification FEA applies to the whole of the CMA of the Nelson region and requires that there shall be no significant adverse effects on aquatic life from the discharge. In addition, Policy CM 7.2.i requires that a discharge of contaminants within the CMA shall not (either by itself or with other discharges) give rise to any significant adverse effects on habitats, feeding grounds or ecosystems.

The second set of issues is also addressed by NRMP Policy CM 6.2, in which these criteria are included as standards in the FEA coastal marine water-quality class.

Objectives and policies in several coastal plans require that discharges to the CMA shall not compromise the maintenance and/or enhancement of existing water quality or of the physical characteristics of receiving waters that contribute to their life-supporting capacity. Policy CM 1.6 of the NRMP requires that opportunities to restore or enhance the life-supporting capacity of the CMA 'should be identified and, where practicable, acted upon'. Policy CM 6.1 states that coastal marine water quality standards should be maintained or enhanced to 'reflect community aspirations and tangata whenua values for: (a) management for fisheries, fish spawning, aquatic ecosystem, and aesthetic purposes over the whole Coastal Marine Area, and (b) contact recreation, shell fish gathering, or cultural purposes, in specified parts of the Coastal Marine Area'.

3.5. Conclusions – mixing zones and discharge criteria

In general, the present set of criteria that the Council considers should govern the determination of an appropriate mixing zone and the assessment of applications to discharge appear to be appropriate. The fact that aquaculture is not specifically mentioned as a potential use of the affected water body is not of concern because it should be considered under Policy CM 6.5.e.

Risks of cumulative and/or persistent effects could be incorporated by amending Policy CM 6.5 d to 'the assimilative capacity (including available dilution and dispersal*, and the potential for cumulative or persistent effects*) of the water and the existing water quality'.

4. CONCLUSIONS

The standards in the extant NRMP are largely suitable for inclusion in the new Whakamahere Nelson Plan. Development of comprehensive regionally-appropriate standards for a range of parameters (e.g., specific nutrient standards, measures of water clarity) is not achievable given the limited state of the environment information available. Moreover, where other councils have identified values for a range of parameters, they are employed for categorisation or as water quality targets, rather than as obligatory standards.

We recommend minor changes to:

- align faecal indicator bacteria standards with current MoH/MfE guidelines
- allow for assessment of the SG standard in shellfish flesh (as well as water samples)
- extend the SG class across the whole CMA
- extend the CR class to include the Horoirangi Marine Reserve
- remove reference to ‘shellfish gathering season’ and ‘bathing season’.

The assessment of the suitability of standards for cultural monitoring should be assessed in partnership with iwi. From a scientific perspective, there is no reason to reassess these cultural standards, except that it may be appropriate to allow for assessment of the faecal contamination standard with both water column and shellfish flesh measurements, as recommended for the SG class.

The present criteria governing the determination of mixing zones and discharge criteria appear to be generally appropriate. We suggest a minor amendment to incorporate risks of cumulative and/or persistent effects.

NZCPS requirements regarding water quality include managing the effects of activities on land, but do not necessarily require monitoring the impact of these activities on the state of the marine receiving environment. NZCPS requirements cannot be met solely by the setting of consent conditions, but require further monitoring or management from council. Accordingly, acceptance of our recommendations is insufficient to fulfil all the requirements of the NZCPS regarding marine water quality.

Institution of a marine monitoring programme may also be required to move towards fulfilment of some NZCPS obligations. Assessment of marine monitoring requirements would require consideration of:

- environmental quality
    - water column
    - seabed
    - habitat integrity and use

- relative importance, including cumulative impacts, of different stressors
    - nutrients and primary productivity
    - sediment input and dynamics
    - fisheries-associated impacts
    - aquaculture in adjacent CMAs (and possibly future aquaculture in the Nelson CMA).

Monitoring should also consider opportunities for maximising value from existing data collection in the NCC and adjacent CMAs, and the opportunities emerging as a result of technology advances such as satellite imagery and high-frequency data-collection with moored instrumentation.

5. ACKNOWLEDGEMENTS

Annika Wagenhoff (Cawthron) provided material on the NPS-FM. Garreth Gabb (NCC) approved use of Bells Island and Nelson North wastewater monitoring data. Paul Fisher (NCC) provided recreational water quality monitoring data.

6. REFERENCES

ANZECC 1992. Australian and New Zealand guidelines for fresh and marine waters. National Water Quality Management Strategy Paper No 4, Australian and New Zealand Environment and Conservation Council, Canberra.

ANZECC 2000. Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy Paper 4. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra. 103 pp.

Clark K, Gillespie P, Forrest R, Asher R 2008. State of the environment monitoring of Waimea Inlet: broad scale habitat mapping November 2006. Prepared for Tasman District Council and Nelson City Council. Cawthron Report No. 1473. 24 p.

Cornelisen C, Gillespie P, Kirs M, Young R, Forrest R, Barter P, Knight B, Harwood V 2011. Motueka River plume facilitates transport of ruminant faecal contaminants into shellfish growing waters, Tasman Bay, New Zealand. New Zealand Journal of Marine and Freshwater Research 45: 477–495.

DoC/New Zealand Department of Conservation 2010 New Zealand Coastal Policy Statement 2010. Publishing Team, Department of Conservation, Wellington, New Zealand. 29 p.

DoH/Department of Health 1992 Provisional microbiological guidelines for recreational and shellfish-gathering waters in New Zealand. Department of Health, Wellington, New Zealand. 17 p.

Forrest B, Roberts R, Crutchley H 1994 Coastal water quality assessment and classification: a briefing report for the Regional Coastal Plan Prepared for Tasman District Council and Nelson City Council. Cawthron Report No. 275. 74 pp plus appendices.

Gillespie P 2009a. Preliminary assessment of the environmental status of the Nelson Haven. Prepared for Nelson City Council. Cawthron Report No. 1545. 17 p.

Gillespie P 2009b. Preliminary assessment of the environmental status of Delaware Inlet. Prepared for Nelson City Council. Cawthron Report No. 1549. 21 p. plus appendices.

Gillespie P 2013. Preliminary assessment of the environmental status of the Whangamoa Inlet, Nelson. Prepared for the Nelson City Council. Cawthron Report No. 2446. 18 p. plus appendix.

Gillespie P, Clark K, Conwell C 2006. Waimea Estuary state of environment monitoring: fine-scale benthic assessment, April 2006. Prepared for Tasman District Council. Cawthron Report No. 1315. 27 p.

Gillespie P, Clement D, Asher R 2009. Delaware Inlet fine-scale benthic baseline 2009. Prepared for Nelson City Council. Cawthron Report No. 1594. 28 p.

Gillespie P, Clement D, Asher R 2011a. Nelson Haven state of environment monitoring: broad-scale habitat mapping, January 2009. Prepared for Nelson City Council. Cawthron Report No. 1978. 46 p.

Gillespie P, Clement D, Asher R 2011b. State of the environment monitoring of Delaware Inlet: broad-scale habitat mapping January 2009. Prepared for Nelson City Council. Cawthron Report No. 1903. 33 p.

Gillespie P, Clement D, Clark DE, Asher R 2012. Nelson Haven fine-scale benthic baseline 2012. Prepared for Nelson City Council. Cawthron Report No. 2209. 22 p. plus appendices.

Gillespie P, Rhodes L 2006. The quantity and quality of suspended particulate material of near-bottom waters in the Motueka River outwelling plume, Tasman Bay. Prepared for Stakeholders of the Motueka Integrated Catchment Management Programme. Cawthron Report No. 1114. 27 p.

Handley S, Brown S 2012. Feasibility of restoring Tasman Bay mussel beds. NIWA client report NEL2012-013. Prepared for Nelson City Council. 31 p.

Horizons Regional Council 2014. One Plan. http://www.horizons.govt.nz/data/one-plan accessed October 2016.

MfE/MoH 2003. Ministry for the Environment, Ministry of Health. Microbiological water quality guidelines for marine and freshwater recreational areas. Publication Reference No 474. Ministry for the Environment, Wellington. 89 p plus appendices.

MfE 2014. National Policy Statement for Freshwater Management 2014. Wellington: Ministry for the Environment. 34 p.

MoH 1995. Ministry of Health microbiological reference criteria for food. Ministry of Health. October 1995. 25 p.

Newcombe E, Clark D, Gillespie P, Morrisey D, MacKenzie L 2015. Assessing the state of the marine environment in Tasman Bay and Golden Bay. Prepared for Nelson City Council and Tasman District Council. Cawthron Report No. 2716. 70 p. plus appendix.

Nelson Regional Management Plan (NMRP 2012). http://nelson.govt.nz/environment/nelson-resource-management-plan/nelson-resource-management-plan-2/view-the-nrmp/download-the-nrmp-2/ accessed September 2016

Robertson B, Robertson B 2014. Waimea Inlet fine-scale monitoring 2013 / 2014. Wriggle Coastal Management report prepared for Tasman District Council. 19 p. plus appendices.

Robertson B, Gillespie P, Asher R, Frisk S, Keeley N, Hopkins G, Thompson S and Tuckey B 2002. Estuarine environmental assessment and monitoring: a national protocol. Part A. Development, Part B. Appendices, and Part C. Application. Prepared for supporting Councils and the Ministry for the Environment, Sustainable Management Fund Contract No. 5096. Part A. 93 p. Part B. 159 p. Part C. 40 p plus field sheets.

Robertson BM, Stevens L, Robertson B, Zeldis J, Green M, Madarasz-Smith A, Plew D, Storey R, Hume T, Oliver M 2016. New Zealand Estuary Trophic Index Screening Tool 1. Determining eutrophication susceptibility using physical and nutrient load data. Prepared for Envirolink Tools Project: Estuarine Trophic Index, MBIE/NIWA Contract No: C01X1420. 47p.

Robertson B, Stevens L 2015. Kokorua Inlet fine scale monitoring 2014/15. Wriggle Coastal Management Report. Prepared for Nelson City Council. 23 pp plus appendices.

Stevens L, Robertson B 2015. Kokorua Inlet 2015 broad scale habitat mapping. Wriggle Coastal Management Report. Prepared for Nelson City Council.18 pp plus appendices.

Stevens L, Robertson B 2014. Waimea Inlet 2014 broad scale habitat mapping. Wriggle Coastal Management Report. Prepared for Tasman District Council. 33 pp plus appendices.

Tuckey B, Robertson B 2003. Broad scale mapping of Waimea and Ruataniwha Estuaries using historical aerial photographs. Prepared for Tasman District Council. Cawthron Report No. 828. 28 p.

APPENDICES

Appendix 1. Resource Management Act Schedule 3

Schedule 3 Water quality classes

Note: The standards listed for each class apply after reasonable mixing of any contaminant or water with the receiving water and disregard the effect of any natural perturbations that may affect the water body.

1 Class AE Water (being water managed for aquatic ecosystem purposes)

(1) The natural temperature of the water shall not be changed by more than 3° Celsius.

(2) The following shall not be allowed if they have an adverse effect on aquatic life:

(a) any pH change:

(b) any increase in the deposition of matter on the bed of the water body or coastal water:

(c) any discharge of a contaminant into the water.

(3) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(4) There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

2 Class F Water (being water managed for fishery purposes)

(1) The natural temperature of the water—

(a) shall not be changed by more than 3° Celsius; and

(b) shall not exceed 25° Celsius.

(2) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(3) Fish shall not be rendered unsuitable for human consumption by the presence of contaminants.

3 Class FS Water (being water managed for fish spawning purposes)

(1) The natural temperature of the water shall not be changed by more than 3° Celsius. The temperature of the water shall not adversely affect the spawning of the specified fish species during the spawning season.

(2) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(3) There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

4 Class SG Water (being water managed for the gathering or cultivating of shellfish for human consumption)

(1) The natural temperature of the water shall not be changed by more than 3° Celsius.

(2) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.
(3) Aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants.

5 Class CR Water (being water managed for contact recreation purposes)
(1) The visual clarity of the water shall not be so low as to be unsuitable for bathing.
(2) The water shall not be rendered unsuitable for bathing by the presence of contaminants.
(3) There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

6 Class WS Water (being water managed for water supply purposes)
(1) The pH of surface waters shall be within the range 6.0–9.0 units.
(2) The concentration of dissolved oxygen in surface waters shall exceed 5 grams per cubic metre.
(3) The water shall not be rendered unsuitable for treatment (equivalent to coagulation, filtration, and disinfection) for human consumption by the presence of contaminants.
(4) The water shall not be tainted or contaminated so as to make it unpalatable or unsuitable for consumption by humans after treatment (equivalent to coagulation, filtration, and disinfection), or unsuitable for irrigation.
(5) There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

7 Class I Water (being water managed for irrigation purposes)
(1) The water shall not be tainted or contaminated so as to make it unsuitable for the irrigation of crops growing or likely to be grown in the area to be irrigated.
(2) There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

8 Class IA Water (being water managed for industrial abstraction)
(1) The quality of the water shall not be altered in those characteristics which have a direct bearing upon its suitability for the specified industrial abstraction.
(2) There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

9 Class NS Water (being water managed in its natural state)
The natural quality of the water shall not be altered.

10 Class A Water (being water managed for aesthetic purposes)
The quality of the water shall not be altered in those characteristics which have a direct bearing upon the specified aesthetic values.

11 Class C Water (being water managed for cultural purposes)

The quality of the water shall not be altered in those characteristics which have a direct bearing upon the specified cultural or spiritual values.

Appendix 2. New Zealand Coastal Policy Statement.

Note that guidance is in development[17] for all three policies listed below, although some guidance is available for the discharge of untreated human sewage[18].

Policy 21: Enhancement of water quality

1. Where the quality of water in the coastal environment has deteriorated so that it is having a significant adverse effect on ecosystems, natural habitats, or water-based recreational activities, or is restricting existing uses, such as aquaculture, shellfish gathering, and cultural activities, give priority to improving that quality by:
    a) identifying such areas of coastal water and water bodies and including them in plans;
    b) including provisions in plans to address improving water quality in the areas identified above;
    c) where practicable, restoring water quality to at least a state that can support such activities and ecosystems and natural habitats;
    d) requiring that stock are excluded from the coastal marine area, adjoining intertidal areas and other water bodies and riparian margins in the coastal environment, within a prescribed time frame; and
    e) engaging with tangata whenua to identify areas of coastal waters where they have particular interest, for example in cultural sites, wāhi tapu, other taonga, and values such as mauri, and remedying, or, where remediation is not practicable, mitigating adverse effects on these areas and values.

Policy 22: Sedimentation

1. Assess and monitor sedimentation levels and impacts on the coastal environment.
2. Require that subdivision, use, or development will not result in a significant increase in sedimentation in the coastal marine area, or other coastal water.
3. Control the impacts of vegetation removal on sedimentation including the impacts of harvesting plantation forestry.
4. Reduce sediment loadings in runoff and in stormwater systems through controls on land use activities

Policy 23: Discharge of contaminants

1. In managing discharges to water in the coastal environment, have particular regard to:
    a) the sensitivity of the receiving environment;

[17] http://www.doc.govt.nz/about-us/science-publications/conservation-publications/marine-and-coastal/new-zealand-coastal-policy-statement/policy-statement-and-guidance/
[18] http://www.doc.govt.nz/about-us/science-publications/conservation-publications/marine-and-coastal/new-zealand-coastal-policy-statement/policy-statement-and-guidance/sewage-discharges/

b) the nature of the contaminants to be discharged, the particular concentration of contaminants needed to achieve the required water quality in the receiving environment, and the risks if that concentration of contaminants is exceeded; and
c) the capacity of the receiving environment to assimilate the contaminants; and:
d) avoid significant adverse effects on ecosystems and habitats after reasonable mixing;
e) use the smallest mixing zone necessary to achieve the required water quality in the receiving environment; and
f) minimise adverse effects on the life-supporting capacity of water within a mixing zone.

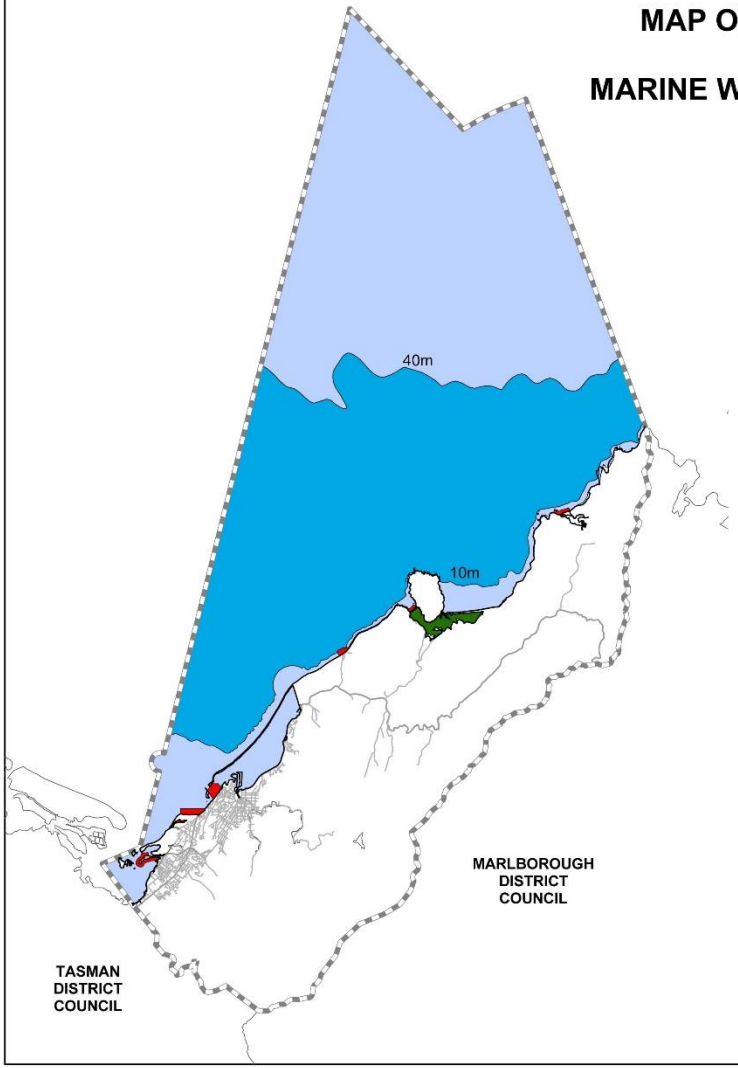
2. In managing discharge of human sewage, do not allow:
   a) discharge of human sewage directly to water in the coastal environment without treatment; and
   b) the discharge of treated human sewage to water in the coastal environment, unless:
      i. there has been adequate consideration of alternative methods, sites and routes for undertaking the discharge; and
      ii. informed by an understanding of tangata whenua values and the effects on them.
3. Objectives, policies and rules in plans which provide for the discharge of treated human sewage into waters of the coastal environment must have been subject to early and meaningful consultation with tangata whenua.
4. In managing discharges of stormwater take steps to avoid adverse effects of stormwater discharge to water in the coastal environment, on a catchment by catchment basis, by:
   a) avoiding where practicable and otherwise remedying cross contamination of sewage and stormwater systems;
   b) reducing contaminant and sediment loadings in stormwater at source, through contaminant treatment and by controls on land use activities;
   c) promoting integrated management of catchments and stormwater networks; and
   d) promoting design options that reduce flows to stormwater reticulation systems at source.
5. In managing discharges from ports and other marine facilities:
   a) require operators of ports and other marine facilities to take all practicable steps to avoid contamination of coastal waters, substrate, ecosystems and habitats that is more than minor;
   b) require that the disturbance or relocation of contaminated seabed material, other than by the movement of vessels, and the dumping or storage of dredged material does not result in significant adverse effects on water quality or the seabed, substrate, ecosystems or habitats;

c) require operators of ports, marinas and other relevant marine facilities to provide for the collection of sewage and waste from vessels, and for residues from vessel maintenance to be safely contained and disposed of; and
d) consider the need for facilities for the collection of sewage and other wastes for recreational and commercial boating.

Appendix 3. NRMP coastal marine water quality standards schedule and map.

<table>
<tr><th>Classification: Management Purpose</th><th>Standards to apply, after reasonable mixing</th></tr>
<tr><td>FEA: Fishing, fish spawning, aquatic ecosystem, aesthetic purposes.
(Applies over whole of Coastal Marine Area.)</td><td>1) The natural temperature of the water shall:
a) not be changed by more than 2°C, and
b) not exceed 25°C, and
2) The concentration of dissolved oxygen shall exceed the higher of 6mg/l or 80% saturation, and
3) There shall be no significant adverse effects on aquatic life arising from the discharge of a contaminant into water, a pH change, the deposition of matter on the foreshore or seabed, or any other cause, and
4) There shall be no
a) production of any conspicuous oil or grease films, scums or foams or floatable or suspended material, and
b) conspicuous change in the colour or visual clarity, and
c) emission of objectionable odour in the receiving water.</td></tr>
<tr><td>CR: Contact recreation</td><td>1) The visual clarity of the water shall not be so low as to be unsuitable for bathing, and
2) The water shall not be rendered unsuitable for bathing by the presence of contaminants, and
3) There shall be no undesirable biological growths as a result of any discharge of a contaminant into water, and
4) The median of samples taken over the bathing season shall not exceed 35 enterococci/100ml, and
5) No sample, in the following areas, shall exceed the following limits.
<table>
<tr><th>Area</th><th>Use Category</th><th>Enterococci limit/100ml</th></tr>
<tr><td>Tahunanui (main beach)</td><td>Designated bathing beach</td><td>104</td></tr>
<tr><td>Port opposite Cut</td><td>Moderate</td><td>153</td></tr>
<tr><td>Haven (at Atawhai)</td><td>Moderate</td><td>153</td></tr>
<tr><td>Tahunanui (back beach)</td><td>Light</td><td>275</td></tr>
<tr><td>Cable Bay</td><td>Light</td><td>275</td></tr>
<tr><td>Monaco</td><td>Light</td><td>275</td></tr>
<tr><td>The Glen Beach</td><td>Light</td><td>275</td></tr>
</table></td></tr>
<tr><td>SG: Shellfish gathering (offshore areas in Tasman Bay between 10-40m depth contour)</td><td>1) Aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants, and
2) The median faecal coliform content of samples taken over a shellfish gathering season shall not exceed 14 MPN per 100ml and not more than 10% of samples should exceed 43 MPN per 100ml.</td></tr>
<tr><td>C: Cultural values (Delaware Inlet)</td><td>1) The quality of the water shall not be altered in those characteristics which have a direct bearing on:
a) the availability of seafood, and
b) the quality of seafood, and
c) the spiritual values of the water, and
2) Aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants, and
3) The median faecal coliform content of samples taken over a shellfish gathering season shall not exceed 14 MPN per 100ml and not more than 10% of samples should exceed 43 MPN per 100ml.</td></tr>
</table>

MAP OF NELSON CITY DISTRICT and MARINE WATER QUALITY STANDARDS

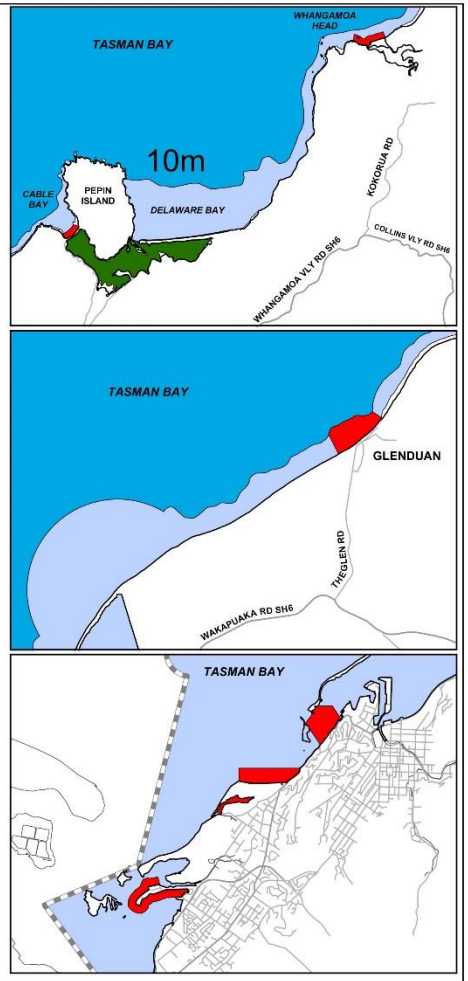


Legend

Marine Water Quality Standards

- FEA (Over the Whole Coastal Marine Area)
- FEA & Contact Recreation Overlay
- FEA & Cultural Overlay
- FEA & Shellfish Gathering Overlay
- **District Boundary**

FEA means 'Management for Fisheries, Fish Spawning, Aquatic Ecosystems and Aesthetic Purposes.'



The Territorial Sea and EEZ Boundaries are Derived from the Definitive Limits Depicted on Charts held in the Territorial Limits Chart Folio held by the RNZN Hydrographic Office in Accordance with Section 31 of the Territorial Seas and EEZ Act, 1987.

Bathymetry Reproduced from RNZN Surveys by Permission of the Hydrographer RNZN.

NELSON CITY COUNCIL

OPERATIVE IN PART (EXCLUDING REGIONAL COASTAL PLAN)
1 SEPTEMBER 2004

NELSON RESOURCE MANAGEMENT PLAN

N

1:275,000

MAP A1.1

Appendix 4. Data from freshwater monitoring sites in Nelson

The site closest to the coast in each catchment was selected from the Land and Water Aotearoa (LAWA) website (www.lawa.org.nz). On LAWA each site is compared to the range of sites across the whole of New Zealand, and placed in quartiles. Q1 = best quality, Q4 = worst quality. *E. coli* is the FIB most commonly reported from freshwater. Trends are either improvement (imp.) or degradation (deg.) where not specified, no trend was identified.

Table A-1. Freshwater data from Land Air Water Aotearoa

Site	Type	*E. coli*	Black disc	Turbidity	Ammoniacal N	Phosphorous (DRP)
Saxton Creek	rural	Q4 (imp.)	Q3	Q4	Q4	Q3
Orphanage Stream	rural	Q3 (imp.)	Q2 (imp.)	Q2	Q3	Q3 (imp.)
Poorman Stream	urban	Q2	Q1 (imp.)	Q1 (imp.)	Q1	Q3
York Stream	urban	Q4	Q2	Q3	Q3	Q3
Jenkins Creek	urban	Q3 (imp.)	Q1 (imp.)	Q3	Q3	Q3
Maitai	urban	Q2[19]	Q1 (imp.)	Q1 (imp.)	Q1	Q2
Todds Valley Stream	rural	Q3 (imp.)	Q2 (imp.)	Q2 (imp.)	Q3	Q3 (imp.)
Wakapuaka	rural	Q2[20]	Q1 (imp.)	Q1 (imp.)	Q1	Q2 (deg.)
Whangamoa	rural	Q1 (imp.)	Q1	Q1	Q1	Q2 (deg.)

[19] At the Collingwood St Bridge frequent breaches of recreational bathing limits were recorded
[20] At Paremata Flats frequent breaches of recreational bathing limits were recorded

Appendix 5. Faecal indicator bacteria in coastal waters.

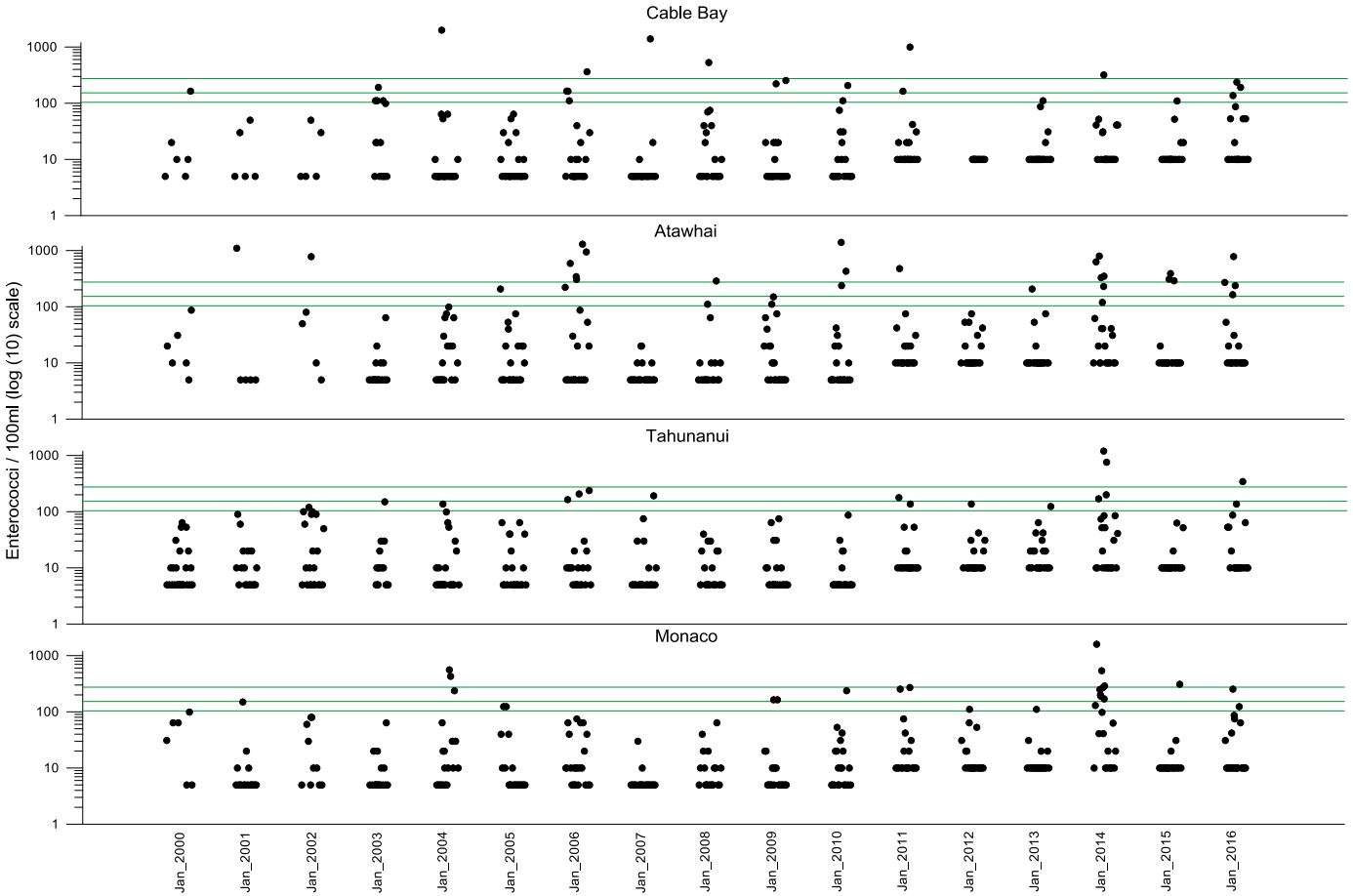


Figure A-1. Enterococci concentrations in shallow coastal waters at four sites. Council data 1999-2016. Green lines represent limits corresponding to use categories: Designated bathing beach, 104 enterococci/100ml; Moderate use, 153 enterococci/100ml; Light use 275 enterococci/100ml. Note log-scale on y-axis. Maximum possible value (due to laboratory techniques) is 1200 enterococci/100ml.

Table A-2. Median enterococci /100 mL in shallow coastal waters at four sites, and number of samples taken over the summer season. Council data 1999-2016. Figures in bold indicate those exceeding current NCC standards.

	Summer beginning:	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cable Bay	Median	10	5	5	7.5	5	5	7.5	5	5	5	5	10	10	10	10	10	10
	# samples	6	5	5	18	21	21	22	21	20	22	21	21	13	22	21	20	21
Atawhai	Median	15	5	**50**	5	7.5	5	5	5	5	7.5	5	10	10	10	25.5	10	10
	# samples	6	5	5	18	20	21	23	21	19	22	21	21	21	22	22	20	21
Tahunanui	Median	5	10	10	10	5	7.5	10	5	5	5	5	10	10	10	25.5	10	10
	# samples	29	20	24	22	24	24	23	21	20	22	21	21	21	22	22	20	21
Monaco	Median	**47.5**	5	10	5	10	5	10	5	5	5	10	10	10	10	**52**	10	10
	# samples	6	17	10	18	20	21	23	21	20	22	21	21	21	22	22	20	21

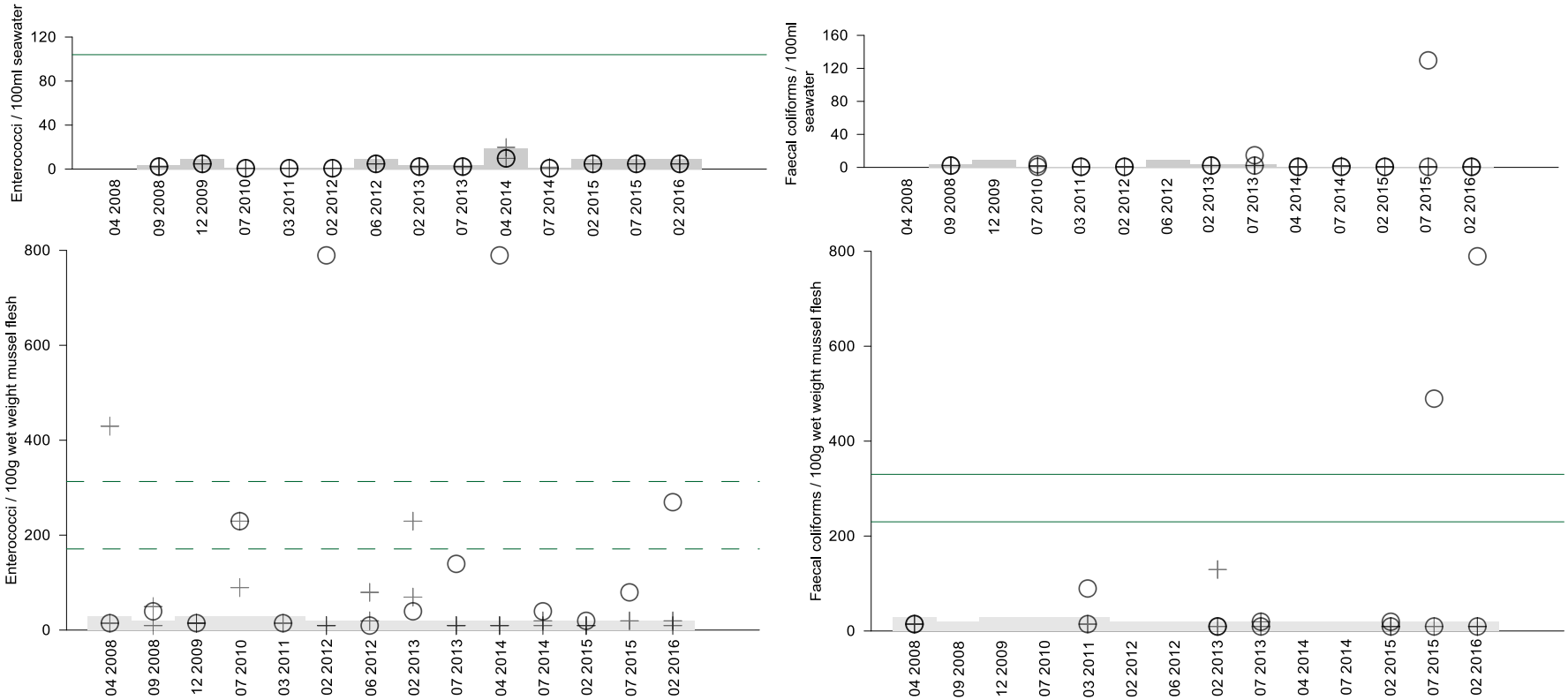


Figure A-2. Faecal indicator bacteria (FIB) from NRSBU monitoring data. Enterococci (left) and fecal coliforms (right) are monitored in both seawater (top) and mussels (bottom). **Circles** indicate data from sampling stations at the eastern outlet of the Waimea estuary, and crosses indicate sampling stations at the western outlet. Light grey samples indicate a single sample, while dark grey symbols indicate two samples. **Grey bars** indicate approximate analytical detection limits. Samples with FIB concentrations below analytical detection limits were assigned the value of half the detection limit for the purposes of plotting data. **Green lines** on the plot of enterococci in seawater (top left) indicate the lowest NCC limit for recreational water quality. **Green lines** on the plot of FIB in mussel flesh (bottom plots) indicate Ministry of Health guidelines for the marginal suitability (>230 faecal coliforms / 100g) and unacceptability (>330 faecal coliforms / 100g) of shellfish for human consumption. The **dashed lines** on the enterococci plot (left) are an estimate of enterococci concentrations that correspond to Ministry of Health guideline concentrations for faecal coliforms.

Table A-3. Receiving water bacteriological indicator monitoring results 2006 – 2010, before and after commissioning of an upgrade to the Nelson North Wastewater Treatment plant. MPN or CFU/100 ml. Samples were taken at the outlet diffuser site (Boil), and to the north-east (NE) on ebb tides, and to the south-west (SW) on flood tides.

Transect/Date		Boil 0m	250m	500m	1000m	Control
Pre-Commission						
25/11/2006	Enterococci	<5	<5	<5	<5	<5
NE	Faecal coliforms	<5	5	5	<5	<5
23/02/2007	Enterococci	10	5	<5	<5	<5
SW	Faecal coliforms	860	160	25	35	<5
23/05/2007	Enterococci	70	15	5	<5	<5
NE	Faecal coliforms	360	90	70	<5	<5
6/09/2007	Enterococci	70	5	<5	<5	<5
NE	Faecal coliforms	1200	23	13	<5	<5
29/11/2007	Enterococci	<5	<5	<5	<5	<5
NE	Faecal coliforms	<5	<5	<5	<5	<5
29/02/2008	Enterococci	<5	<5	<5	<5	<5
SW	Faecal coliforms	<5	<5	<5	<5	<5
Post-commission						
26/05/2008	Enterococci	5	<5	<5	<5	<5
NE	Faecal coliforms	30	5	5	<5	<5
11/09/2008	Enterococci	<5	<5	<5	<5	<5
SW	Faecal coliforms	<5	<5	<5	<5	<5
10/12/2008	Enterococci	<5	5	<5	<5	<5
SW	Faecal coliforms	5	<5	<5	<5	<5
24/02/2009	Enterococci	<5	<5	<5	<5	<5
NE	Faecal coliforms	<5	<5	<5	<5	<5
4/06/2009	Enterococci	<5	<5	<5	<5	<5
SW	Faecal coliforms	<5	<5	<5	<5	<5
23/10/2009	Enterococci	42	31	<10	<10	<10
SW	Faecal coliforms	10	<10	<10	<10	<10
21/12/2009	Enterococci	<5	<5	<5	<5	<5
NE	Faecal coliforms	<5	<5	<5	<5	<5
23/04/2010	Enterococci	70	10	10	<5	<5
SW	Faecal coliforms	30	15	<5	<5	<5

Appendix 6. NRMP Mixing zones and assessment criteria

Policy CM 6.4 Mixing zones

In considering what constitutes a 'reasonable mixing zone', in any particular situation, account will be taken of:

a) the purposes for which the water is managed, and
b) the sensitivity of the receiving environment (i.e. available dilution and dispersal and the proximity of areas valued for ecological, recreational, cultural, shellfish gathering or commercial fishing reasons), and
c) the nature of the discharge including contaminant type, concentration and volume, and
d) the location and design of the proposed outfall and the potential for improving the same, and
e) the proposed method of treatment and the potential for improving that method, and
f) the need to confine any significant adverse effects to the mixing zone, and
g) the desirability of keeping the size of the mixing zone as small as possible, and of keeping it away from the inter tidal area.

Explanation and Reasons

CM6.4.i The policy provides an indication of the parameters which the Council considers should govern the determination of an appropriate mixing zone and hence provides some guidance to prospective applicants for a coastal discharge permit.

Policy CM 6.5 Assessment criteria

When considering new proposals or applications to discharge contaminants directly to water, or reviewing existing discharges, matters to be taken into account include:

a) the water quality classification for the receiving environment, and
b) the total contaminant load (composition/concentration/flow rate) of the discharge, and
c) the presence or absence of toxic constituents, and the potential for bioaccumulative or synergistic effects, and
d) the assimilative capacity (including available dilution and dispersal) of the water and the existing water quality, and
e) actual or potential uses of the water body and the degree to which the needs of other water users are, or may be, compromised, and
f) scenic, aesthetic, amenity, recreational and commercial fisheries values, and
g) the cultural and spiritual values of tangata whenua, and
h) the actual or potential risk to human health from the discharge.

Explanation and Reasons

CM6.5.i The policy sets out the matters or values which the Council considers to be most relevant to determination of a coastal discharge permit application. This policy

should be taken into account by applicants when preparing environmental effects assessments.