Discharge of Metals to Water

Advice on Proposed Standards

Taumata Arowai

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1. Introduction

1.1 Purpose of this report

The purpose of this report is to provide technical advice to support The Water Services Authority - Taumata Arowai (Taumata Arowai) in the development of Tranche 2 of the Wastewater Environmental Performance Standards (WEPS) for discharges of metals in municipal treated wastewater discharges to water. The report reviews the available evidence on the occurrence, sources, treatment and environmental effects of metals in treated wastewater discharges. It also examines the regulatory approaches in Aotearoa New Zealand and internationally together with exploring options for managing metals in accordance with the 2025 WEPS framework.

This report evaluates the need for a national approach to managing metals. Part of this is to develop and assess potential frameworks, test assumptions using available evidence and the technical knowledge of the consultant team and provide recommendations to assess the risk posed by metals in the discharge itself. It also considers, risks to the receiving environment, and recommend appropriate control frameworks commensurate with the scale of the risks identified. The final recommendations seek to provide an approach that is protective of environmental and human health whilst being practicable, consistent and proportional to the level of risk posed by metals in the treated wastewater discharges.

This report is not intended to be directly used as public facing material as part of the Taumata Arowai consultation process for Tranche 2 of the Wastewater Environmental Performance Standards but rather a technical document to inform the consultation materials. The language and presentation style of this document is therefore aligned with this purpose.

1.2 Scope of Work

This report provides technical advice to support the development of potential treated wastewater environmental performance standards for metals in treated municipal wastewater discharged to water. It follows a staged process that defines the issues concerning metals in discharges from wastewater treatment plants (WWTP), reviews of current regulatory approaches, reviews available evidence such as available monitoring data, and assesses whether a national metals standard is warranted.

Potential regulatory and technical approaches are then developed and tested through a risk-based framework, including feasibility testing against available wastewater treatment plant data and receiving environment information. The outcomes of this assessment were used to develop the recommended metals standard for stakeholder consultation by Taumata Arowai.

The scope is limited to discharges of treated municipal wastewater to surface water and the management of associated metal-related environmental and public health risks.

A synopsis of the report is shown in Table 1. The report contains abbreviations and acronyms which are defined in Section 9.

Table 1 Report Outline

Report section	Purpose in this report
Section 1. Introduction	Defines the purpose, scope, assumptions, exclusions and limitations of technical advice.
Section 2. Issues	Describes why metals are a potential concern, including their sources, environmental effects, treatment, and current management.
Section 3. Information Review	Reviews the international and New Zealand information on metals regulation, monitoring, wastewater consents, and receiving environment effects, providing the evidence base for this report.
Section 4. Case for Metals Standard	Evaluates the opportunities, constraints and risks associated with implementing a national metals standard.

Report section	Purpose in this report
Section 5. Possible Approaches	Identifies and assesses available management tools, risk assessment methods and options for deriving numeric standards.
Section 6. Proposed Standard for Feasibility Testing	Develops an initial risk-based framework and proposed control measures for testing.
Section 7. Feasibility Testing of Standard	Tests the proposed framework against practical, operational and environmental considerations and refines the approach.
Section 8. Revised Standard for Consultation	Presents the recommended risk-based framework and proposed controls for stakeholder consultation and feedback.
Sections 9–11. Supporting Information	Provides abbreviations, glossary terms used throughout the report.
Appendices	Contains detailed technical reviews, consent analyses, receiving environment assessments and supporting evaluation material.

1.3 Exclusions

Matters specifically excluded from the scope include:

– Biosolids management and land application
– Discharges of treated wastewater to land
– Industrial wastewater discharges and industrial treatment systems
– Protection from corrosion of wastewater networks, treatment plant assets, or operational processes except where relevant to metal discharges to water
– Broader management of trade waste outside its role in influencing metal inputs to municipal wastewater systems

1.4 Limitations

This report: has been prepared by GHD and its subconsultants, Beca and Stantec, for Taumata Arowai and may only be used and relied on by Taumata Arowai for the purpose agreed between GHD and Taumata Arowai as set out in section 1.1 of this report.

GHD and its subconsultants otherwise disclaim responsibility to any person other than Taumata Arowai arising in connection with this report. GHD and its subconsultants also exclude implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD and subconsultants in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD and its subconsultants have no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD and its subconsultants, as described in this report (refer section 1.5 of this report) and specific subsections of this report. GHD and its subconsultants disclaim liability arising from any of the assumptions being incorrect.

GHD and it subconsultants have not been involved in the preparation of the Taumata Arowai material which will be used for consultation and have had no direct contribution to the Taumata Arowai consultation materials or process other than in the development of this report for the purpose as stated in Section 1.1. GHD and its subconsultants exclude and disclaim all liability for all claims, expenses, losses, damages and costs, including indirect, incidental or consequential loss, arising directly or indirectly in connection with the Taumata Arowai consultation materials and process.

GHD and its subconsultants have prepared this report on the basis of information provided by Taumata Arowai and others who provided information to GHD and its' subconsultants (including Government authorities), which GHD and its subconsultants have not independently verified or checked beyond the agreed scope of work. GHD and its subconsultants do not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.5 Assumptions

This report has been prepared on the basis of the following general assumptions:

– The information contained in the National Consents Database of wastewater consents, developed by Taumata Arowai, is a reflection of the number, location, type and discharge point of publicly operated wastewater treatment plants in New Zealand. This database has been updated by Taumata Arowai with the best available information, as part of Tranche 1 and to support Tranche 2 of the WEPS, to inform the recommendations provided within this report. However, it requires verification and validation as some information is known to be inaccurate. Information, values and analysis contained in this report which has leveraged the database is therefore subject to change following verification and validation of the database.

– GHD and its subconsultants have assumed that the intent of the discharge Standards is also to protect against a variety of potential effects in the receiving water body, to adequately protect public health and to enable the maintenance or improvement of receiving water quality.

– The proposed approaches presented in this report have been tested against a very small set of available metals data derived from consent related monitoring associated with only eight wastewater treatment plants. This paucity of data introduces uncertainty into a number of the quantitative assessments carried out to support the development of numeric limits. It is expected that further data will be gathered to enable further analysis and future refinement of the proposed standards that achieves appropriate balance of environmental and public health protection, limits of treatment technology and affordability.

– The Proposed Metals Standard will not directly address potential effects from metals other than those presented in the numerical limits. However, compliance with the Proposed Standard will reduce the risks of other related effects as a result of co-regulation of the other metals along with those for which standards have been defined. However, specific investigation of risks for other metals not addressed is recommended.

– The 2025 WEPS do not propose numerical limits for the blended discharge from treatment plants with separate municipal and industrial treated wastewater streams, blended prior to discharge. The municipal wastewater stream is controlled by the 2025 WEPS with the industrial stream being separately controlled. We have assumed this continues for these metals WEPS.

More specific assumptions related to each task outlined in the Consultancy Services Order (CSO) and associated RFP Response document are provided in the respective sections.

1.6 Precautionary Approach

As for the Tranche 1, the 2025 WEPS, a precautionary approach has been applied to this technical work and the development of the numerical standards proposed in this document, addressing both environmental and public health aspects.

The precautionary approach applied recognises that, instead of treatment limits being set on a plant-specific basis as is currently the case, under the Proposed Standards treatment limits for some parameters will be set for multiple plants that fall within a category or class. For example, all plants that discharge to a particular receiving environment and dilution category will be subject to the same numerical limits.

The intention being that the treatment limits that apply to all the plants in that class are set at a level that protects public health and the environment for all the plants in that class, notwithstanding there will be variation between plants in areas like the sensitivity of the receiving environment, or human contact in or near the receiving environment.

We note that due to these local variations, the precautionary approach is applied “overall” and is not intended to achieve the most precautionary outcome for every factor and situation.

2. Issues

2.1 Effects of Metals

The primary effects from metals that may be present in the discharge from a WWTP include:

– Toxicity[1], resulting from direct exposure to metals of organisms in the receiving environment. While several metals are essential nutrients at low concentrations, they become toxic at sufficiently elevated and prolonged exposure levels. Metal toxicity can affect a range of physiological and biochemical processes within an exposed organism, resulting in impaired growth, reproduction, development, and possible reduced survival rates. The toxicity of metals is highly variable between metals and between various potential conditions in the receiving environment.
– Accumulation in sediments. Metals that are sorbed into particles can settle out of the wastewater and accumulate onto the floor of the receiving environment. This process is dependent upon the conditions in the water body and the form of the metal. A change in the environmental conditions such as the change from freshwater to salt water can change the form of the metal, such that metal comes out of solution and is deposited in these transition areas (e.g. estuaries, discharges into salt water).
– Bioaccumulation in food web. Following discharge, metals present in treated wastewater can enter aquatic food webs and subsequently be transferred into food sources. Certain metals are known to bioaccumulate through the food web, particularly at the higher trophic levels. This can result in these organisms (including humans, in the case of shellfish consumption) being exposed to higher loads of metals through their concentration in their food sources.

The relevant transport pathways associated with the discharge of metals within treated wastewater to surface water include:

– Direct uptake from water (across gills or other respiratory surfaces in aquatic organisms)
– Ingestion (of contaminated water, sediment, or food, including bioaccumulation)
– Absorption (through skin or external tissues)
– Sediment exposure following adsorption of metals to suspended solids and deposition in sediments, with subsequent uptake by benthic organisms

2.2 Sources of Metals

The key sources of metals that can be found in the discharges from wastewater treatment plants include:

– Wastewater from domestic, commercial and light industrial premises: Treated potable water is supplied to residential, commercial and industrial premises via the reticulated water supply network. Subsequent use generates wastewater, which is discharged into the sewer network and conveyed to the WWTP. Metals may be introduced through a range of sources during this process, including corrosion and leaching from water supply and wastewater infrastructure (e.g. copper and lead pipework, fittings and sealants), as well as from products, materials and activities used within homes, businesses and light industrial premises. The types and concentrations of metals present are influenced by the quality of the supplied water, the characteristics and condition of the water and wastewater networks, and the nature of activities occurring within the serviced catchment.
– Trade Waste is defined by the Model General Bylaws: Part 23 – Trade Waste[2] as "any liquid, with or without matter in suspension or solution, that is or may be discharged from a Trade Premises to the WWA's Sewerage System ...". This includes commercial, industrial premises, leachate from landfills, and tankered

[1] Toxicity is discussed in this report as acute toxicity, or chronic toxicity. Acute toxicity refers to *'a lethal or adverse sub-lethal effect that occurs as a result of a short (relative to the organism's life span) exposure to a chemical'*. Chronic toxicity refers to '*a lethal or sub-lethal adverse effect that occurs as the result of exposure to a chemical for a period that is a substantial portion of the organism's life span or an adverse sub-lethal effect on a sensitive early life stage'*., as defined in Warne et al., 2025 in **Method for deriving Australian and New Zealand water quality guideline values for protecting aquatic ecosystems from toxicants - update of 2018 version.**
[2] NZS 9201:Part 23:2004).

waste which may be received directly at the WWTP. Dependent on the nature of the premises and the activity undertaken therein, this discharge can contain various metals at varying concentrations.

– Many of the sewerage networks in New Zealand receive stormwater, either from infiltration from groundwater, or inflow from the direct connection of stormwater into the sewer. This can be either by design on combined sewers, or inadvertent connection to the wrong pipe.

  The contribution of metals from the groundwater would generally be minimal, inflow of stormwater can contain significant metal loads, particularly copper (Cu) and Zinc (Zn). In addition, some first flush stormwater systems on industrial premises divert to sewer, which may also contribute to stormwater metal loads.

– Metals can be used in the network to manage septicity and odour at the WWTP as part of the treatment process, particularly the reduction of phosphorus. This can result in residual concentrations of the metals in the discharge, particularly aluminium (Al) and Iron (Fe).

– Whilst likely a minor source, the use of the metals in the treatment process at Water Treatment Plants may result in a residual concentration in the Supplied Water Treatment where these are connected to the municipal sewerage system. This particularly applies to Aluminium (Al) and Iron (Fe).

2.3 Treatment of Metals in WWTP

Municipal WWTPs are generally not designed specifically to reduce metals. Reductions in metals in municipal WWTPs are incidental to the processes that reduce organic load, nutrients and pathogens and include:

– Solids reduction (sedimentation or filtration) reduces metals in particulates and some colloidal forms

– Biological treatment can also reduce metals associated with the solids formed

– Removal of dissolved metals requires targeted processes typically performed for industrial sites

Therefore, whilst some reduction in metals will currently be being achieved in most WWTPs, typically this is not a design or operational performance parameter for the WWTP.

2.4 Current Status of Controls in Consents

A review of the extent and manner in which metals are mentioned in current consents was undertaken for this project and is presented in Section 3.4 and summarised here. Of the 192 discharges to water consents identified, 42 of these had conditions relating to metals in the treated wastewater.

Metal monitoring requirements, where included in consents, appear to show a relationship with both the size of the treatment plant and the sensitivity of the receiving environment. Across the dataset, smaller and medium-sized plants (particularly those discharging to rivers and streams) are predominantly subject to monitoring only conditions.

As plant size increases, the required monitoring becomes more structured. Large plants, especially those discharging to estuaries, low-energy coastal environments, or the open ocean, are more likely to have numerical limits for metals alongside specified monitoring frequencies. In these cases, monitoring is typically undertaken on a monthly to annual basis, with monthly or quarterly (3–6 monthly) sampling being most common. Consents with numerical limits incorporate a range of statistical measures such as maximum concentrations, percentiles (e.g. 90th or 95th), or rolling medians.

For a large number of WWTPs throughout New Zealand, there is no information on the concentration or load of metals which are present in the discharge., This is particularly the case for smaller discharges and those to freshwater.

2.5 Which Metals to Address

There are a wide range of metals or surrogates that could be monitored and controlled. The most appropriate suite of the metals can vary depending upon the nature of the catchment, WWTP and the receiving environment. Potential tiered or tailored ways of monitoring for metals include:

– Total suspended solids as a surrogate. The main method for reduction of metals is through incorporation with solids that are removed from the liquid stream prior to discharge.

Therefore, the removal of suspended solids and residual concentrations in the discharge can be an indicator for the potential concentration of particulate metals associated with the discharge. This is workable for metals that do associate with the particulates but is not a useful surrogate for dissolved metals.

- Copper and zinc are the primary metals present in domestic sewage and stormwater.
- Arsenic, copper, chromium, lead, nickel, mercury, zinc. This is the standard suite of metals that has been monitored for in consents and other investigations in New Zealand.
- Other metals in the Biosolids Guideline 2025 or Drinking Water Quality Assurance Rules 2022[3]: cadmium, iron, boron, manganese, antimony, barium, magnesium, sodium, potassium. This recognises the wider range of metals that may be present in supplied drinking water and hence sewage.
- Aluminium or ferric iron may be present at higher concentrations, if used for treatment of Water Supply, dosing within the network or for phosphorus (P) removal at WWTP's.
- Suite of metals, selected on specific risk basis based on influent. There may be other metals which could be present from a specific source in the network. Further, based on a risk assessment of the potential sources, the range of metals could be reduced to only those expected to be present at environmentally significant concentrations.

Analysis for metals can be undertaken for a range of forms:

- Dissolved- represents the immediately bioavailable fraction of metals in the sewage. This is the most relevant to direct toxicity effects.
- Acid Soluble -The solubility of metals can be significantly impacted by the pH of the solution with more metals dissolving in acidic conditions (low pH). The acid soluble form, includes dissolved metals and some of the colloidal and particulate fractions that can be dissolved by hot dilute mineral acid, reflecting the conditions in the mammalian gut.
- Total recoverable - This includes the full digestion of all metals that can be removed from the solid form.

Costs for monitoring of treated wastewater are expected to be the analytical costs only, as samples will already being collected for the Tranche 1 standards. The cost of analysis depends upon the suite of metals being tested for, with standard suites available from laboratories. Therefore, the cost of analysis is not directly related to the number of metals for analysis. However, analysis for non-standard metals will increase the cost. Table 2 provides an estimate of the costs of analysis for two standard suites of metals currently used in consents for the range of potential frequencies of required analysis.

Table 2 Annual Costs of Analysis for a single WWTP for metals (as at mid 2026).

Note that this assumes that sampling of treated wastewater is already being undertaken as required by 2025 WEPS and hence not accounted for in this table.

Suite of metal	Annual Cost for Fortnightly Analysis	Annual Analysis
Dissolved Copper and zinc	$1,080	$40
Dissolved Arsenic, copper, chromium, lead, nickel, mercury, zinc	$1,850	$70

However, the cost of sampling in the receiving environment for water quality, sediment and/or shellfish flesh can be considerable depending on the extent and complexity of sample collection. Significant costs can be incurred due to the logistics involved, including health and safety requirements (i.e. sampling from streams, estuaries and coastal zones).

[3]: **https://www.taumataarowai.govt.nz/assets/Drinking-Water-Supplier/Drinking-Water-Quality-Assurance-Rules-2022-Revised-2024.pdf**

3. Information Review

A desktop literature review was undertaken to support the development of WEPS for metals in treated municipal wastewater discharges. The review aimed to identify and evaluate regulatory approaches, guideline values, monitoring requirements, and management practices currently used internationally and within New Zealand to control metals in wastewater and protect receiving environments.

The review considered relevant New Zealand Guidelines and a range of international regulatory frameworks and guidance documents, including those from Australia, the United States, Canada, the European Union, and the United Kingdom.

Particular attention was given to end-of-pipe discharge standards, treatment requirements, management controls, metals subject to regulation, monitoring requirements, and the rationale underpinning regulatory controls.

The New Zealand Model Trade Waste Bylaw was also reviewed to provide context on existing source-control approaches within New Zealand.

To support the development of options for metals management, the review further examined New Zealand wastewater discharge consents to identify current consented limits, monitoring requirements, and regulatory practices for metals.

A review of information available on the status of metals in receiving environments was undertaken to enable an understanding of the scale of the current issue. This included State of the Environment (SoE) monitoring undertaken by Regional Councils to indicate the wider context, and any receiving environment monitoring for sediment and shellfish flesh that has been undertaken as required by wastewater consents. This review aimed to understand the specific effects currently identified by wastewater consent monitoring.

Relevant information gleaned from the international literature review is provided in Appendix A, with the National Consent Database review in Appendix B, and receiving environment monitoring review in Appendix C.

3.1 Relevant New Zealand Guidelines

There are no New Zealand standards for the discharge of metals in treated wastewater. However, there are relevant guidelines that apply to the quality of the receiving water, sediment and shellfish flesh. These have been used in various ways through this report and include:

- Australian and New Zealand guidelines for fresh and marine water quality [4]. This is the primary source for receiving water guidelines which addresses metals, including:
  - Default Guideline Values for all metals considered to protect against **chronic** toxicity for a range of protection levels, 80%, 90%, 95% and 99%. This provides a comprehensive set of guidelines for all metals considered on a consistent basis.
  - DRAFT Default Guideline Values for copper and zinc in freshwater to protect against **chronic** toxicity for a range of protection levels, 80%, 90%, 95% and 99%[5]. Whilst that these DGVs are not formally approved, the DRAFT DGV represents the most up to date toxicological information available and uses the same methodology as the approved DGVs.
  - Default Guideline Values for copper and zinc to protect against **acute** toxicity for a range of protection levels, 80%, 90%, 95% and 99%.
  - **Sediment** quality guidelines for all metals considered as DGV and GV - High.[6]

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[4] **https://www.waterquality.gov.au/guidelines/anz-fresh-marine**[4]

[5] **https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/draft-dgvs#draft-default-guideline-values**

[6] **https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants**

- Food Standards Australia New Zealand (FSANZ) 2024. Australia New Zealand Food Standards Code – Schedule 19: Maximum Levels of Contaminants and Natural Toxicants[7]. This provides maximum concentrations limits for flesh from mollusca for arsenic (inorganic), cadmium, lead, and mercury.
- Drinking Water Quality Assurance Rules 2022[8]. These rules set the regulatory framework that controls the delivery of supplied water in New Zealand. The drinking water standards are relevant to freshwater environments where raw water is sourced for water supply.
- Water Services (Drinking Water Standards for New Zealand) Regulations 2022[9]. These set the maximum acceptable value (MAV) for various contaminants in supplied water, including metals.

The chronic DGVs for copper and zinc are currently under review[10], and Freshwater Receiving Environment limits[11] (DGV) that have recently been released that have been developed to protect against acute toxicity effects. Table 3 presents the recently published Acute toxicity DGVs, the current chronic toxicity DGVs, and the DRAFT chronic toxicity DGVs. The colour coding represents the differences between the DGVs within each metal, with the red shading being the lowest DGV and green shading being the highest. Points of note are:

- For copper, the acute DGVs are less than the current chronic DGVs, which is inconsistent but reflects the newer toxicology data that has been included into the newer acute DGVs. The DRAFT chronic DGVs are more stringent than the current chronic DGVs and consistent with the acute DGVs.
- For Zinc, the acute and chronic relationship is as expected, but the DRAFT chronic DGVs are more stringent than the current chronic DGVs.
- The DRAFT chronic DGVs represent the current state of the toxicology data but have not been accepted as formal DGVs as they are in Consultation Draft stage and may change before becoming the final DGVs.

Table 3 Default Guideline Values in Freshwater from various Guidance documents

Parameter	Species protection level	ANZG Acute DGV	Current ANZG Chronic DGV	DRAFT ANZG Chronic DGV
Unit	**%**	**mg/L**	**mg/L**	**mg/L**
Copper	99	0.0007	0.001	0.0002
	95	0.0013	0.0014	0.00047
	90	0.0017	0.0018	0.00073
	80	0.0029	0.0025	0.0013
Zinc	99	0.011	0.0024	0.0015
	95	0.024	0.008	0.0041
	90	0.036	0.015	0.0068
	80	0.059	0.031	0.012

The range of conditions that the acute guidelines are considered appropriate for use in, given in the guidance documents, is provided in Table 4. Typically, the concentrations in New Zealand waters are within these ranges, and hence the acute DGVs are considered appropriate for use for these metals WEPS.

[7] **https://www.legislation.gov.au/F2015L00454/latest/text**

[8] **https://www.taumataarowai.govt.nz/assets/Drinking-Water-Supplier/Drinking-Water-Quality-Assurance-Rules-2022-Revised-2024.pdf**

[9] **https://www.legislation.govt.nz/secondary-legislation/pco-drafted/2022/168/en/latest/#LMS698023**

[10] DRAFT Default Guideline values to protect against chronic toxicity for:
- copper at dissolved organic carbon receiving environment concentrations < 0.5 mg/l from the DRAFT Toxicant default guideline values for aquatic ecosystem protection Dissolved copper in freshwater technical brief September 2023 and
- zinc at the index condition (pH 7.5, hardness 30 mg/L CaCO3 and 0.5 mg/L DOC) from the DRAFT Toxicant default guideline values for aquatic ecosystem protection Zinc in freshwater technical brief May 2024

[11] Gadd J.B., Hickey, C.W., Snelder, A.H. (2024) Acute copper and zinc water quality guideline values for Aotearoa. **https://environment.govt.nz/assets/publications/Freshwater/accute-copper-and-zinc-water-quality-guideline-values.pdf**

Table 4 Applicable range in water chemistry for using the acute GVs

Metal	pH	Hardness	Dissolved organic carbon
Unit	**pH units**	**mg $CaCO_3$/L**	**mg/L**
Copper	5.0 – 8.8	3.9 – 989	0.1 – 30
Zinc	5.4 – 8.5	14 - 411	0.1 – 20

3.2 International Regulations

3.2.1 Nature of Regulations

A desktop review of available regulations included the following:

- Review of International Regulations (Australia, USA, Canada, European Commission, Germany, England & Wales, Scotland, Northern Ireland, NZ)
- Summary of monitoring and reporting requirements
- Summary of numerical limits from regulations for trade waste, end of pipe (EOP) and receiving environment (RE)

It was found that there are few EOP standards internationally, some examples that do have numerical limits are:

- British Columbia Municipal Wastewater Regulation (2012)
- Limits are not universal, numerical metal limits are site specific and risk based.
- Germany – Abwasserverordnung (AbwV)
- Sector based industrial discharge standard
- EU – Commission Implementing Decision (EU) 2016/902
- Offer a range of guidance concentrations for specific metals in industrial wastewater. These are used to set enforceable permit-specific limits, where wastewater must be within the Best Available Techniques – Associated Emission Levels (BAT AEL).

There is little consistency over how metals are managed and the degree of monitoring undertaken. Often management is sector specific for particular waste streams (e.g. mining), with bylaws enforcing metal pretreatment control (Canada, Germany, EU). Regulation can be subject to self-monitoring and reporting (USA, Canada) or management of metals on a site-specific basis (England, Aus).

3.2.2 International regulation numeric limits

Numeric limits across international regulations for arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), zinc (Zn) and aluminium (Al) are summarised in Table 5. These limits apply mostly to industrial or site-specific discharges. Metal limits internationally appear to be on a case-by-case basis, receiving environment driven or controlled by limits regulating what enters a WWTP (such as trade waste controls or pre-treatment specifications) rather than EOP limits, and hence are generally not directly useful for the derivation of the limits for this Standard.

Table 5 Summary of numerical international end of pipe limits

Country	Regulation	Nature of the statistic (e.g. median, 90%ile)	State	As mg/L	Cd mg/L	Cr mg/L	Cu mg/L	Pb mg/L	Hg mg/L	Ni mg/L	Zn mg/L	Al mg/L
Canada	Canada – Metal and Diamond Mining Effluent Regulations (SOR/2002-222), Schedule 4 Table 1	Maximum authorised monthly mean effluent concentration	Total	0.1			0.1	0.08		0.25	0.4	
		Maximum authorised monthly mean effluent concentration (transitional)	Total	0.3			0.3	0.1		0.5	0.5	
EU	EU – Commission Implementing Decision (EU) 2016/902 (IED BAT Conclusions), Table 3	BAT AEL - Yearly average for direct emissions to water - LOWER LIMIT	Expressed as metal			0.005	0.005			0.005	0.02	
		BAT – AEL - Yearly average for direct emissions to water - UPPER LIMIT	Expressed as metal			0.025	0.05			0.05	0.3	
Germany	Germany – Abwasserverordnung (AbwV), Annex 39 (Non-ferrous metal production)	Before mixing. Maximum concentration (qualified sample or 2-hour composite) LOWER LIMIT	Total	0.1	0.05	0.2	0.1	0.2		0.1	0.4	3
		Before mixing. Maximum concentration (qualified sample or 2-hour composite) UPPER LIMIT	Total	0.3	0.1	0.5	0.5	0.5	0.02	2	1	6
Scotland	Scotland – CAR Licence (example conditions, e.g. **landfill)	Max. allowable effluent conc. (spot or composite sample)	Total	0.1	0.005	0.1	0.05	0.1	0.001	0.2	0.5	
UK	UK (all) – *Waste Inc	Max. conc. (effluent) (instant or short-term sample)	Total	0.15	0.05			0.20	0.03	0.50	1.5	

3.3 Trade Waste Bylaws

3.3.1 Model TW Bylaw NZS 9201:Part 23:2004

The New Zealand Model Trade Waste Bylaw (NZS 9201:Part 23:2004) provides a framework for territorial authorities to regulate industrial and commercial discharges to municipal wastewater systems. It establishes a consent-based regime, sets contaminant limits to protect wastewater infrastructure and treatment processes, requires pre-treatment and monitoring, and enables cost recovery and enforcement. While based on a national template, councils adapt the bylaw to local conditions and treatment plant capabilities.

The Model TW Bylaw provides recommended numerical limits for metals, as shown in Table 6. Mass limits may also be applied. These limits apply to the discharge from the individual premises which will be diluted, typically in the sewer, by all the other sources of influent received at the WWTP. As such, these limits are relatively high, especially when compared to receiving environment limits.

Table 6 NZ Model Trade Waste Bylaw heavy metal limits

Metal (total)	Maximum concentration (mg/L)	Metal (total)	Maximum concentration (mg/L)
Antimony	10	Manganese	20
Arsenic	5	Mercury	0.05
Barium	10	Molybdenum	10
Beryllium	0.005	Nickel	10
Cadmium	0.5	Selenium	10
Chromium	5	Silver	2
Cobalt	10	Thallium	10
Copper	10	Tin	20
Lead	10	Zinc	10

Other metals such as dissolved aluminium, dissolved iron and boron and are also included in the Model TW Bylaw, with limits shown in Table 7.

Table 7 Other metals in NZ Model Bylaw

Metal	Maximum concentration (mg/L)
Dissolved aluminium	100
Dissolved Iron	100
Boron	25

The Model TW Bylaw also provides examples of the types of discharges that would be considered ‘permitted” discharges that do not require a trade waste consent and “Conditional” Trade Waste which would require a consent to discharge to the sewer network and hence the WWTP. This table is reproduced below.

Table G2 – Examples of dischargers/processes producing trade waste

Permitted Trade Waste (some of these industries may require a Consent as Conditional Trade Waste)	Conditional Trade Waste
Bakeries Vehicle wash facilities Churches (with catering facilities) Clothing manufacturers Doctors' surgeries (excluding day care surgical facilities) Hotels and motels (with catering facilities) Laundries Marae Mechanical workshops/service stations Medical laboratories Restaurants – small, medium (excluding those with commercial macerators) Wholesalers/retailers including butchers, greengrocers and fishmongers (excluding those with commercial macerators) Schools, polytechnics, universities (with laboratories) Take away Premises Veterinary surgeries	Approved Stormwater discharged to Sewer Beverage manufacturers (including wineries) Concrete batching plants Dairy processing plants Dentists Dry Cleaners Electroplaters Fellmongers Food processors including canneries Foundries Fruit and vegetable processors including canneries Galvanizers Hospitals (including day care surgical facilities) Landfills (leachate discharge) Manufacturers of chemicals, and of chemical, petroleum, coal, rubber and plastic products Manufacturers of clay, glass, plaster, masonry, and mineral products Manufacturers of fabricated metal products, machinery and equipment Manufacturers of fertilizer Manufacturers of paper and paper products Metal finishers Mortuaries Medical laboratories Photo processors Premises with commercial macerators Printers Restaurants – large Scientific and other laboratories Spray painting facilities Stock sale yards Tankered Wastes Tanneries and leather finishings (including fellmongery) Textile fibre and textile processors Truck wash facilities Vaccine manufacturers Waste management processors Woolscourers

Figure 1 ***Examples of Trade Wastes and their category under the Model TW Bylaw. Excerpt from Model TW Bylaw NZS 9201:Part 23:2004***

3.3.2 Trade Waste Bylaw by Councils

Trade waste bylaws (TW bylaw) in New Zealand play a critical role in the management of metals in wastewater discharges by controlling what comes into the WWTP, thus providing the primary mechanism for territorial authorities to control metals entering the public wastewater network.

Through the TW bylaw framework, councils establish site-specific permitting systems that impose contaminant limits, including metal thresholds, on industrial and commercial discharges. These permits typically require pre-treatment (e.g. sedimentation, pH adjustment, or chemical precipitation), regular monitoring, and reporting to ensure that metal concentrations do not adversely affect biological treatment processes, inhibit microbial activity, or accumulate in sludge to levels that restrict disposal or reuse.

While there is no universal statutory requirement for all councils to have a TW bylaw, legislation provides clear authority for their use and anticipates their development where needed. Overall, although not mandatory in all cases, trade waste bylaws are widely implemented in New Zealand as a practical and effective mechanism for managing trade waste risks and ensuring sustainable wastewater system operation.

A summary of a range of council implemented trade waste bylaws is included in Appendix A.

3.4 New Zealand Consents

A summary of New Zealand consents with metal related consent limits is provided in Table 8 and Table 9. A review of WWTP consents that include sediment and/or shellfish monitoring for metals in their conditions was also undertaken; see Section 3.5.2 for a summary of these results and Appendix C for more detailed information.

Table 8 NZ consents with metal related consent limits

Description	Count of consents	Percentage of total discharge to water consents
Total no. of discharge to water consents	192	
Total no. with **no** heavy metal controls (or unknown)	145	76 %
Total no. with heavy metal controls	42	22 %
Total no. with monitoring conditions only (no limits)	23	12 %
Total no. with numerical metal limits	19	10 %
Notes: *Controls* refers to any consent condition relating monitoring, reporting, investigation requirements, or numerical concentration limits. *Limits* refers specifically to enforceable numerical limits applied to metal concentrations in the treated wastewater discharge. Consents classified as having monitoring conditions only include metal-related monitoring and/or reporting requirements but do not contain numerical compliance limits for metals.		

Overall, open ocean discharge consents have the strongest focus on metals, with 17 out of 22 consents containing conditions relating to metals, with most including specific numeric limits. Metal-related conditions were less common for river/stream, estuary, low-energy coastal, and land and water discharges, although they were still present across all of these receiving environments. For medium-sized WWTPs, river/stream discharges contained the greatest number of consents with metal conditions, reflecting the large number of river discharge consents overall, while open ocean discharges again showed the highest proportional occurrence of metal-related conditions. Estuary, low-energy coastal, land and water, and lake discharges generally had fewer consents with metal monitoring or limits. For small WWTPs, metal-related conditions were rare and were largely confined to river/stream discharges, with only a single low-energy coastal consent containing metal monitoring.

As highlighted in Section 1.5 (assumptions), the National Consents Database has not been verified for the purpose of this report. As with Tranche 1, information provided to inform the database was assumed to be correct at the time it was supplied. Therefore, the intent of the tables below is to provide a relative indication of the WWTP consents relating to metals across the country.

Table 9 Summary of discharge to water consents with conditions relating to metals

Plant size / Receiving environment	No. of consents with metal monitoring (no numerical limits)	No. of consents with specific limits	Total with conditions relating to metals	Total number of WWTPs in category
Large*	7	13	20	28
Medium*	12	6	18	87
Small*	4	-	4	75
LARGE				
Open ocean	3	9	12	15
River/stream	2	1	3	5

Plant size / Receiving environment	No. of consents with metal monitoring (no numerical limits)	No. of consents with specific limits	Total with conditions relating to metals	Total number of WWTPs in category
Low energy coastal	-	2	2	3
Estuary	1	1	2	3
Land and water	1	-	1	2
MEDIUM				
Open ocean	3	2	5	7
River/stream	5	1	6	59
Low energy coastal	2	1	3	9
Estuary	1	1	2	6
Land and water	1	1	2	5
Lake	-	-	-	1
SMALL				
Open ocean	-	-	-	1
River/stream	3	-	3	59
Low energy coastal	1	-	1	2
Estuary	-	-	-	6
Land and water	-	-	-	7
Notes: *WWTP size is based on population size serviced: Large = > 20,000 Medium = 1,001 to 20,000 Small = < 1,000				

3.4.1 Numeric Limits in New Zealand consents

Using existing consultant team knowledge in addition to the National Consents Database, 19 WWTP were identified as having numerical consent compliance limits for metals in treated wastewater. Summary statistics of these limits are provided in Table 10 below, with detail provided in Appendix B.

As shown, numeric limits in NZ WWTP discharge consents show a wide range of values with little consistency. This indicates that the limits are likely highly site specific in current consenting.

Table 10 Summary statistics from treated wastewater consent limit values in New Zealand consents

Nature of statistic	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Min	5	0.01	0.000014	0.00002	0.000003	0.01	0.000001	0.0002	0.0000 23
Median	7	0.56	0.075	0.44	0.13	0.24	0.007	0.69	0.875
Mean	14	2.8298	0.220	1.746	0.225	0.383	0.011	1.515	1.966
95th percentile	28	11.1	0.698	6.1	0.61	1.29	0.031	5.3	5.55
Max	30	16	0.8	16	1.6	1.6	0.04	7	16

3.4.2 Monitoring and Reporting Requirements in Current New Zealand Consents

The National Consent Database review (Appendix B) indicates that New Zealand wastewater discharge consents typically manage heavy metals through monitoring programmes and environmental effects monitoring rather than through strict EOP discharge limits. Of the 192 discharges to water consents in the database, 23 of these were confirmed to have conditions requiring monitoring of metals in treated wastewater. Of these consents, the majority of them discharge into rivers or streams (10 consents) or open ocean (6 consents).

Across the reviewed consents, zinc, copper, chromium, cadmium, lead and nickel are the most consistently monitored metals across all receiving environments. Arsenic is also very common, with mercury monitored less consistently. Iron and aluminium are only monitored at a small number of river discharge plants, and in dissolved form, whereas where specified, the other metals are frequently monitoring as their total form. Monitoring frequency varies considerably across the consents with annual or six-monthly monitoring appearing most common.

Overall, the review indicates that metal monitoring of treated wastewater is relatively uncommon compared with other more routine wastewater parameters and is generally undertaken at frequencies of annually or six-monthly intervals. Where metals are monitored, there is focus on the standard trace metals suite of arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc, with zinc and copper appearing most consistently across sites. Monitoring of iron, aluminium and cobalt is rare, suggesting these metals are generally only included where there is a specific receiving environment concern or site-specific risk.

3.5 Receiving Environment Monitoring

A review of information available on the status of metals in receiving environments was undertaken to enable an understanding of the scale of the current issue. This included:

- State of the Environment (SoE) monitoring undertaken by Regional Councils to indicate the wider context and;
- Receiving environment monitoring for sediment and shellfish flesh that has been undertaken as required by consents to understand the specific effects currently identified by wastewater consent monitoring.

3.5.1 State of the Environment

Regional Councils/Unitary Authorities undertake a range of monitoring programmes designed to assess the ‘State of the Environment’ (SoE) across a range of receiving environment domains (land, air, water). For the freshwater domain, a subset of SoE networks includes some metal analyses. Similarly, for some coastal SoE programmes, some councils analyse a subset of near shore sites, commonly estuaries, for metal accumulation in subtidal benthic sediments to, in part, assess state of estuarine receiving environments.

Tatauranga Aotearoa Statistics New Zealand report the collated results for both freshwater quality sampling and coastal (estuarine) sediment sampling SoE programmes that have included analyses of metals. Results across freshwater and estuarine sampling suggest in general, catchment wide sources of metals, particularly those associated with stormwater runoff and legacy sources (i.e. copper, zinc and lead) represent key sources of metals in downstream receiving environments. Some metals are reported at concentrations approaching or exceeding ANZG sediment/water guideline values in some regions. Exceedances are most commonly associated with highly urbanised catchments, ports, industrial areas and locations affected by historical contamination.

In general, the available information suggests that treated municipal wastewater discharges are generally a relatively minor contributor to metal accumulation (in sediments) or long-term catchment water quality issues compared with diffuse urban runoff and legacy contamination sources. While treated wastewater discharges may contribute metals locally, particularly where trade waste, landfill leachate or metal-based treatment chemicals are present, catchment-derived stormwater and legacy sources are typically the dominant drivers of elevated sediment metal concentrations within estuaries and harbours.

Coastal sediments

Coastal sediment monitoring demonstrates that estuaries function as long-term sinks for contaminants transported from throughout the catchment. Metals derived from stormwater runoff, transport network, roofing materials, industrial activities and legacy contaminated sites accumulate in depositional environments over time where they can persist for decades. Consequently, elevated sediment metal concentrations often reflect the cumulative effects of multiple catchment sources rather than any single discharge.

Statistics New Zealand[12] summarise results of key sediment metals in coastal monitoring sites in New Zealand, Figure 2 shows examples for the three commonly reported metals, copper, zinc and lead, with results highlighted showing sediment concentrations exceeding the ANZG DGV thresholds. In the four years of data summarised (from 2015 to 2018), most monitored sites in 13 regions had concentrations of lead, cadmium, copper, and zinc below default guideline values (DGV) for metals in sediment:

- 96% sites (295 of 307) were below the DGV for lead, no site exceeded the upper guideline value (GV-high).
- 100% of sites were below the DGV for cadmium.
- 99.7% of sites (305 of 306) were below the DGV for copper, no site exceeded the GV-high guideline.
- 97.1% of sites (298 of 307) were below the DGV for zinc, no site exceeded the GV-high guideline.

In general, where sediment results exceed DGVs, this is attributed to a combination of wider catchment runoff (e.g. stormwater sources), as well as legacy contamination issues (such as those reported for Ports environments, or discharges from legacy activities such as gaswork sites in urban areas).

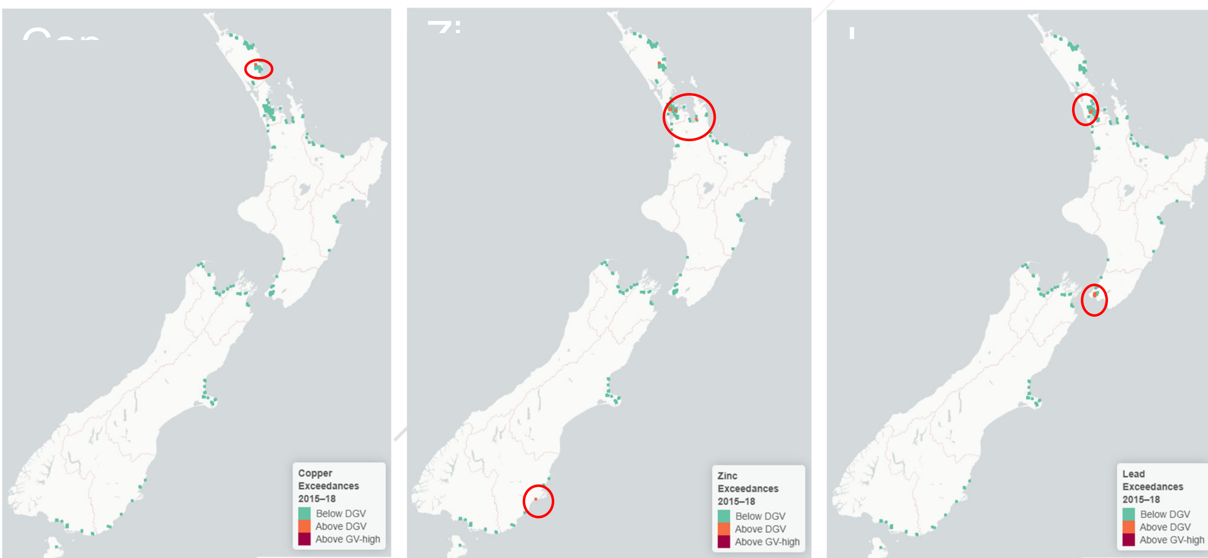

Figure 2 ***Location of copper, zinc and lead exceedance of ANZG DGV in estuarine sediments reported for State of the Environment sampling in New Zealand (Source Statistics New Zealand)***

Freshwater quality

Freshwater SoE monitoring for metals has primarily focused on dissolved copper and zinc, particularly in urban streams and lower river reaches. Monitoring results show that exceedances of ANZG guideline values occur most frequently in urban catchments and are closely associated with the effects of urbanisation and stormwater runoff. Auckland, Wellington, Canterbury and Otago all report sites where dissolved copper and zinc concentrations periodically exceed guideline values for aquatic ecosystem protection as shown in Table 11.

The observed spatial patterns indicate that metal contamination in freshwater environments is primarily driven by diffuse catchment sources, including road runoff which captures metals from brake and tyre wear, roofing materials, industrial and commercial activities, and other urban land-use pressures. These sources are mobilised during rainfall events and transported through stormwater networks into receiving waters.

[12] **Heavy metal load in coastal and estuarine sediment | Stats NZ**

At a catchment load scale, treated municipal wastewater discharges are generally considered to contribute a smaller proportion of total metal loads than diffuse stormwater sources. However, treated wastewater discharges may present a localised issue if the WWTP receives substantial trade waste inputs, landfill leachate contributions, uses chemicals in treatment systems, or has a combined sewer systems in the catchment.

Overall, the available freshwater monitoring data suggest that urban stormwater runoff is typically the dominant source of copper and zinc in freshwater receiving environments, with treated wastewater point source discharges representing a secondary source in most catchments.

Table 11 Summary of freshwater SoE monitoring for dissolved copper and zinc reported on Statistics New Zealand

(Source: **StatsNZ: River water quality – heavy metals: Data to 2022 | Stats NZ**)

Aspect	Copper (dissolved)	Zinc (dissolved)
Met ANZG 95% DGV for at least 95% of monitoring events	28 / 100 sites	43 / 84 sites
95% DGV exceeded more than 5% of monitoring events:		
Auckland	24 / 34 sites	11 / 34 sites
Wellington	6 / 10 sites	5 / 10 sites
Canterbury	36 / 50 sites	25 / 40 sites
Otago	5 / 6 sites	n/a

3.5.2 WWTP receiving environment monitoring

A review of NZ WWTP consents that include receiving environment monitoring for sediment and shellfish flesh was undertaken to give further context around whether there appears to be a problem with metals in the environment as a result of treated wastewater discharges. Overall, it was found that the majority of monitoring results (excluding some maximum values) for metal parameters in both sediment and shellfish were below applicable guidelines, as shown in Table 12 and Table 13 below. Results from the sediment and shellfish review are summarised in the sections below and detailed in Appendix C.

From the monitoring reports acquired for sediment and shellfish review, any relevant treated wastewater monitoring results were also analysed. A summary table of the treated wastewater monitoring results[13] against derived limits is provided as Table 23 in Section 5.4.11.

The sediment / shellfish monitoring review was completed using WWTPs, identified through existing consultant team knowledge and the National Consents Database, that had sediment and shellfish monitoring as a condition of their consents. A selection of monitoring reports, laboratory reports and additional information was provided by Taumata Arowai. Compliance outcomes and numeric results related to metals in sediment and shellfish monitoring are summarised in this section and detailed in Appendix C.

Summary from monitoring reports:

– Across most WWTPs, sediment metal concentrations are generally below guideline values (except for several maximum recorded values > DGV, but not >95th percentile), with limited or no evidence of discharge-related accumulation.
– Sediment metals' concentrations are generally variable, but downstream/outfall samples are not consistently the highest. For example, Blenheim inside-plume sediment results are very similar to outside-plume results for most metals, with only small differences in chromium, copper, nickel, zinc and mercury inside the plume.
– Where paired upstream/downstream data are available, the pattern is mixed. At Westport, the 100 m downstream sediment sample is higher than the immediately upstream sample for arsenic, chromium, copper, lead, nickel and zinc, but cadmium is slightly lower and mercury is similar. In contrast, at Reefton, the 50 m downstream sediment results are generally lower than the immediately upstream result for most metals, indicating that there are other possible sources or historical contamination present at this site.

[13] Note that only treated wastewater results from the monitoring reports acquired for the sediment / shellfish review were included in this analysis

– Marine outfall/transect datasets do not show a strong distance-based gradient. At Christchurch, Tauranga/Omanu, Awatoto/Napier and Mangere, concentrations vary between stations, but there is no clear pattern of metals being highest at the outfall and decreasing with distance. Some elevated values occur away from the discharge alignment, suggesting local sediment characteristics, depositional areas, natural background, or other catchment/harbour sources may be influencing results.
– Shellfish results also do not show a consistent discharge-related increase. At Blenheim, inside-plume and outside-plume shellfish concentrations are broadly similar. At Omanu, the outfall-alignment shellfish sample is not consistently the highest across metals; for example, zinc and copper are higher at some north/south stations than at the outfall alignment.
  - Temporal trends are also mixed. Bell Island shellfish results show higher concentrations for some metals in 2011 compared with 2006 and 2016, while 2016 values are generally lower for several parameters. This suggests variability over time rather than a simple increasing trend attributable to discharge.
– Where exceedances occur, they are typically attributed to natural background or catchment inputs, rather than treated wastewater discharges.
– Nickel and arsenic are the most commonly elevated parameters, but these are frequently explained by geological or environmental baseline conditions.
– Shellfish results show occasional exceedances (esp. arsenic and cadmium), though these are often linked to non-WWTP sources or speciation issues (e.g. total vs inorganic arsenic).

Table 12 and Table 13 show the summary statistics calculated from sediment and shellfish monitoring results in the receiving environment of various WWTP (details in Appendix C). Sediment results indicate that metal concentrations are generally below respective guidelines values, except for rare occasions where the maximum may be exceeded (as shown in **bold** or *italicised* text in the tables below). The same is seen for the shellfish results, with all statistics shown being below the food standard guidelines with the exception of arsenic.

From text in the relevant monitoring reports, it is indicated that when elevated concentrations occurred, they were frequently present at reference locations or upgradient sites as well as downgradient from the discharge, suggesting influence from catchment geology, historical contamination, sediment type, or other environmental factors rather than treated wastewater discharge.

Table 12 Statistics derived from sediment monitoring undertaken by a portion of WWTP's

Sediment (mg/kg)	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Min	-	2	0.005	2.6	0.4	1.2	2.1	14.7	0.01
Median	-	5.3	0.02	17.8	5.4	6.8	14	38	0.03
Mean	-	5.9	0.05	26.3	7.5	8.7	*31.9*	51	0.047
95th %ile	-	8.3	0.22	60.9	12.1	16	*82.1*	90.5	0.081
Max	-	**33**	0.5	*95*	*83*	*70*	*102.3*	*649*	**0.6**
ANZG DGV[14]	**-**	**20**	**1.5**	**80**	**65**	**50**	**21**	**200**	**0.15**
ANZG GV-High	-	*70*	*10*	*370*	*270*	*220*	*52*	*410*	*1.0*

Notes:
– To calculate the statistics, half of the detection limit was used in events where the value was under the laboratory detection limit.
– **Bold** or *italic* text indicates where a value has exceeded the guideline value.

[14] ANZG Interim Sediment Quality Guideline values: **https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants** as updated from the ISQG by Simpson, SL, Batley, GE & Chariton, AA 2013a, **Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines,** CSIRO Land and Water Report 8/07, CSIRO Land and Water.

Table 13 Statistics derived from shellfish monitoring undertaken by a portion of WWTP's

Shellfish (mg/kg)	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Min	7.4	**1.01**	0.005	0.1	0.37	0.01	0.005	4.7	0.005
Median	12.1	**2**	0.048	0.3	0.97	0.045	1.2	9.8	0.017
Mean	12.5	**3.1**	0.063	0.5	1.04	0.06	1.1	10.4	0.015
95th %ile	17.80	**7.9**	0.211	1.42	1.74	0.17	2.54	15	0.024
Max	19.2	**9.2**	0.23	2	2.2	0.18	3.1	17	0.025
Food Standards – FSANZ Schedule 19[15]		**1**	**2**			**0.5**			**1**

Notes:

– To calculate the statistics, half of the detection limit was used in events where the value was under the laboratory detection limit.

– **Bold** text indicates where a value has exceeded the guideline value.

3.6 Summary of Information

There are no New Zealand standards for the discharge of metals in treated wastewater. However, there are relevant guidelines that apply to the quality of the receiving water, sediment and shellfish flesh.

The review of international approaches to managing metals in treated wastewater indicates that there is no consistent international framework of EOP standards that can be directly adopted or adapted. While some jurisdictions apply numerical limits, these are typically site-specific, sector-based, or driven by receiving environment requirements, and therefore are not directly transferable to a national municipal wastewater standard.

Within the New Zealand context, aluminium (Al) and iron (Fe) are important considerations due to their use in water and wastewater treatment processes (e.g. coagulation and phosphorus removal). These metals may be present in discharges as residuals from treatment. International EU standards may include guideline limits for metals used in pre-treatment processes, however, EOP metal concentrations are likely controlled by site-specific discharge permits so are generally not applicable to the development of this standard.

Trade Waste bylaws play a critical role in managing metals in New Zealand by regulating industrial and commercial discharges into the wastewater network. They provide an effective influent control mechanism, including requirements for pre-treatment and monitoring. However, the numerical limits within TW bylaws are high and not suitable for direct application as EOP discharge standards.

The analysis of New Zealand wastewater consents shows that metals are not widely regulated. A large proportion of consents lack any metal-related conditions, and where controls exist, they are more commonly monitoring-only rather than numerical limits. Only a small number of treatment plants, primarily larger facilities, have specific limits, highlighting a limited and inconsistent regulatory baseline.

State of the Environment and receiving environment monitoring indicates that metal concentrations are generally low and within guideline values. Where exceedances do occur, they are typically attributed to urban stormwater runoff, wider catchment inputs, or legacy contamination, rather than treated wastewater discharges.

[15] Food Standards Australia New Zealand (FSANZ) 2024. Australia New Zealand Food Standards Code – Schedule 19: Maximum Levels of Contaminants and Natural Toxicants. Federal Register of Legislation. **https://www.legislation.gov.au/F2015L00454/latest/text**

The review of shellfish and sediment monitoring indicates that municipal WWTP discharges generally have little detectable influence on metal concentrations in receiving environment sediments or shellfish tissues, particularly where discharges occur to coastal marine environments with moderate to high dilution and dispersion capacity. Across the sites reviewed, sediment and shellfish metal concentrations were typically below relevant guideline values, showed no consistent spatial gradient away from outfalls, and were often similar to concentrations measured at reference or control sites, and hence may be representative of natural sources.

4. Case for Metal Standard

4.1 Opportunity

Currently, the 2025 WEPS includes controls on the effects of specific contaminants, but not for metals. Therefore, applications for consents could be required to include a site-specific assessment of the effects of metals.

As highlighted in previous sections, some information on metals is available for larger WWTPs, particularly those that discharge to coastal waters. However, there is minimal or no information available across the country on the concentrations and effects of metals discharged from WWTPs, particularly for smaller WWTPs and those discharging into freshwater.

Based on the information review, metals in treated wastewater discharges do not generally appear to be a significant environmental issue. However, for larger urban plants or those receiving high proportions of trade waste or other specific sources of metals input, there is a risk that localised impacts on ecosystems may occur. Currently, there is a lack of data available to determine if this is the case and thus taking a consistent risk-based approach to the management of these risks appears prudent.

This metals related WEPS can establish specific regulations to provide national consistency for the management of metals in treated wastewater. This project provides an opportunity to impose controls of metals in WWTP discharges, where such discharges pose a risk and also the ability to require the gathering of information across the country on metal loads from WWTPs. This could close the current information gap on the significance of treated wastewater as a source of metals to the environment.

4.2 Constraints

Under the Resource Management Act Section 104(2D) the following applies:

(2D) When considering a resource consent application that relates to a wastewater network, as defined in section 5 of the Water Services Act 2021,—

- (a) a consent authority must not grant the consent contrary to—
  - (i) a wastewater environmental performance standard made under section 138 of that Act; or
  - (ii) an infrastructure design solution; and
- (b) a consent authority must include, as a condition of granting the consent, requirements that are no more or less restrictive than is necessary to give effect to—
  - (i) the wastewater environmental performance standard; or
  - (ii) the infrastructure design solution.

(2DA) However, subsection (2D)—

- (a) does not apply if an exception under a wastewater environmental performance standard or an infrastructure design solution applies; and
- (b) except as expressly otherwise provided in this Act, does not prevent a consent authority from including, as a condition of granting a resource consent, a requirement that relates to any activity, effect, or other matter that a wastewater environmental standard or an infrastructure design solution does not regulate or manage.

As for Tranche 1, we have taken an approach which is protective of the environment and public health whilst balancing cost implications for wastewater asset owners.

4.3 Implementation Risks

4.3.1 Having a Metals Standard

The primary risks of having a metals standard include:

– An interpretation of the limited amount of available information could be that there is apparent lack of adverse effects indicated by current receiving environment monitoring.

Further, limited numbers of wastewater consents have requirements associated with metals which could also be interpreted to mean that metals in treated wastewater discharges are not considered to represent a significant risk of effects of metals in the environment. A standard may impose additional cost on the wastewater industry and hence rate payers that is not supported by the potential for effects to occur. These additional costs could include additional capital costs if an upgrade is required to meet any imposed metal limits and operational costs in monitoring and reporting.

– If the metals standard is developed as a separate regulation to the Tranche 1 2025 WEPS, this could create complexity and confusion in implementation. This could be addressed by incorporating the metals standards into the 2025 WEPS regulation.
– If developed on an insufficiently precautionary basis, the standard could allow the discharge of increased concentrations and loads of metals into the environment. This could reduce the incentive for reducing metals at source, and other metals management which is currently undertaken.

4.3.2 Not having a Metals Standard

The primary risks of not having a metals standard include:

– The risk associated with the current lack of information on metals in treated wastewater would continue. This could hamper future efforts to understand the sources of metals *in* and the potential for adverse impacts *on* the environment and hence the appropriate targeting of control measures.
– If no specific metals standard is developed, this could continue the general lack of focus on metals in wastewater consent applications, which could allow the unregulated and unassessed discharge of metals into the environment. This could be resulting in currently unknown costs to the community and environment through pollution effects.
– A decision to not impose a metal standard could reduce the incentive for reducing metals at source through trade waste controls, pollution prevention programmes, pre-treatment requirements, and other management which is currently undertaken.
– In the absence of a national metals' standard, the management of metals in wastewater may rely more heavily on existing mechanisms such as trade waste bylaws, source control programmes, consent conditions and site-specific assessments. Implementation may vary between regions and network operators, potentially resulting in inconsistent approaches to controlling metals at source.
– The effects of metals are highly dependent upon site specific conditions in the receiving environment, particularly pH and temperature. A national approach may not allow for these site-specific conditions to be allowed for.
– The presence and associated risks of metals in treated wastewater varies between regions and WWTPs. Catchments with little or no trade waste input, limited industrial and commercial activity, and low levels of stormwater ingress may have relatively low concentrations of metals. A national EOP standard may therefore impose monitoring and compliance requirements, and associated costs, on systems where metals are not a significant risk.
– The 2025 WEPS allows Regional Councils to require site specific assessment for metals. This means that the anticipated benefits of "stream-lining" applications from Tranche 1 may not occur and has created uncertainty as to the nature of the assessments that are required to apply for consents.
– There is no relevant international guidance available for the development of an EOP standard. Therefore, learnings from other countries are not available.

4.4 Conclusion

The information review has indicated that generally the effects of metals in treated wastewater discharges are minimal. However, currently, there is a lack of information available, particularly for smaller WWTPs and discharges into freshwater environments to confidently make the above assertion.

Therefore, there is a strong case for developing a metals standard which will focus on:

– Developing a framework and, where appropriate, setting limits based on the risk of causing adverse environmental impacts from wastewater discharges
– Setting trigger levels for assessment of the monitoring results to indicate where further site-specific investigations are warranted on the basis of risk.
– Application of limits, with associated compliance monitoring and reporting, where potential risks of effects from metals are present due to the nature of the wastewater network catchment, WWTP treatment process or the receiving environment.
– Developing the knowledge base through monitoring and reporting requirements, where this can be achieved with a low level of sampling effort and cost.

5. Possible Approaches

5.1 Tools Available

A range of regulatory, operational and monitoring tools are available to manage metals in treated wastewater discharges. These tools can be applied individually or in combination, depending on the level of risk posed by the discharge and the sensitivity of the receiving environment.

Source control measures—focus on reducing metals entering the wastewater system and include:

– Trade waste bylaws and permitting requirements to manage industrial and commercial inputs
– Management of drinking water treatment and distribution systems where aluminium or iron-based treatment chemicals are used
– Inflow and infiltration reduction programmes, which can reduce the entry of stormwater-derived metals into wastewater networks

Discharge management / End-of Pipe tools—focus on controlling metals at the wastewater treatment plant and include:

– Monitoring of metals in treated wastewater
– Use of total suspended solids (TSS) as a surrogate indicator for particulate-bound metals
– End-of-pipe toxicity-based numerical limits derived from well established receiving environment guideline values and dilution assumptions (e.g. international limits, where available)
– Selection of appropriate analytical methods, including dissolved, acid-soluble or total metal analyses
– Compliance monitoring and reporting requirements

Risk-based assessment tools—can be used to tailor requirements to site-specific circumstances and may consider:

– Wastewater treatment plant size (small, medium, large) and characteristics
– Trade waste, landfill leachate and stormwater inputs
– Receiving environment type and dilution capacity
– Existing background metal concentrations
– The presence of depositional environments, sensitive ecosystems, or species potentially affected by metal bioaccumulation

The development of controls should also recognise that metal toxicity is influenced by both the concentration and bioavailability of metals in the receiving environment. Key considerations include:

– Use of guideline-value based approaches rather than site-specific toxicity testing
– The role of mixing and dilution in managing acute (closer to the point of discharge) and chronic effects (at the zone of reasonable mixing)
– The influence of water chemistry factors / toxicity modifiers such as pH, hardness and dissolved organic carbon etc on metal toxicity

Consideration is also required regarding the most appropriate form of analysis (e.g. dissolved, acid-soluble or total metals), the limited availability and inherent variability of receiving environment data, and whether site-specific adjustments or exclusions may be warranted for sensitive ecological values.

In addition, while whole-effluent toxicity testing is generally not appropriate for assessing metals due to the dominant influence of other contaminants such as ammonia, emerging toxicity assessment methods may provide future opportunities to refine metal controls and should be considered as scientific understanding evolves.

5.2 Tranche 1 Standards

5.2.1 Relevant Current Regulations

The 2025 WEPS include the definition of various discharge environments, and the documents that informed the development of the standards included the associated minimum dilutions as follows:

- Freshwater:
  - High dilution means that the dilution ratio of freshwater to wastewater at the point of discharge is 250:1 or greater
  - Moderate dilution means that the dilution ratio is less than 250:1 but greater than or equal to 50:1
  - Low dilution means that the dilution ratio is less than 50:1 but greater than or equal to 10:1
  - Very low dilution means that the dilution ratio is less than 10:1
- Lakes, Full dilution ratio >50:1, At 100m from diffusers in slack water 20:1
- Coastal:
  - Estuary, Full dilution ratio >50:1. At 100m from diffusers in slack water 20:1
  - Low-energy coastal water, Full dilution ratio >100:1. At 100m from diffusers in slack water 20:1
  - High-energy coastal water, Full dilution ratio >200:1. At 100m from diffusers in slack water 20:1, or
  - Open ocean, Full dilution ratio >1,000:1. At 100m from diffusers in slack water 100:1

The 2025 WEPS also include a number of specific arrangements that have been made to address issues that were identified during its development. These provide a framework that can be used to address the issues that have been raised for this metals standard.

Specific elements in the 2025 WEPS that are useful to the potential metals standards include:

- Small WWTPs were defined as having an incoming daily average $cBOD_5$ load of less than 85 kg/day, which equates to an equivalent population of less than 1,000 people. These WWTPs were considered to be relatively low risk in terms of catchment scale issues, such as nitrogen and phosphorus, and hence the limits for these parameters do not apply to these WWTPs. However, effects that would occur close to the discharge, such as toxicity effects from ammonia, would still apply and be the same as for bigger WWTPs. This sets a useful precedent for toxicity effects from metals.
- A number of requirements for risk assessments of varying levels of specificity in terms of the method of the assessment and the outcomes that could result. These provide useful frameworks for any risk assessment to be used for this metals standard, as follows:
  - The Discharge to Land 2025 WEPS include a specified risk assessment which includes the definition of levels of risk and defined numeric limits that apply for the level of risk identified through the risk assessment. (cf DtL Reg 90)
  - The Discharge to Water 2025 WEPS include the requirement to assess the risk of excess periphyton growth (Periphyton Risk Assessment, PRA) if the receiving environment includes hard bottomed areas. The 2025 WEPS identify areas to be assessed but does not specify how the levels of risk within those areas are determined. Rigour is ensured by the requirement for suitably qualified and experienced practitioners (SQEP) to undertake the assessment. Specific numeric limits for each of the risk levels, which are low through to very high. (cf DtW Hard bottom Reg 66)
  - For discharges within 4km of a Shellfish Gathering Area, a Quantitative Microbial Risk Assessment (QMRA) is required. The 2025 WEPS identify the steps required for the QMRA and specified the acceptable level of risk as the mean individual illness risk being less than 1%. The potential outcome of the QMRA is unspecified and open to results of the assessment. The consent authority is allowed to "*include a condition requiring the consent holder to avoid, remedy, or mitigate the effect of any pathogen identified in the quantitative microbial risk assessment*". (DtW QMRA Reg 64).
- Following the precedent set by the 2025 WEPS, the outcome of a risk assessment for metals can be any of the following options, either singly or in combination:
  - Open based on the result of assessment

- Require imposing a numeric limit on the discharge, with compliance monitoring and reporting for either a standard suite or specific metals as identified through process
- Require monitoring of receiving environment as well as the discharge, such as sediment or shellfish flesh
- Require monitoring and reporting of the discharge only with trigger levels for further investigation.
- Require monitoring and reporting of the discharge only
- No metal specific actions required as risk is addressed through Tranche 1 controls (i.e. for Total suspended solids, TSS)
- Exclusion from WEPS, if the risk posed by the metals in the discharge are too high

The Tranche 1 2025 WEPS also specify:

– Monitoring and reporting requirements. The frequency of sampling depends upon the size of the WWTP
– Regulations to check whether small WWTP status still applies (cf and allows 3 years for the WWTP to be upgraded meet the relevant control for larger WWTPs (cf DtW Reg 83). This could be a useful framework for the management of a shift in the risk status of a WWTP with respect to metals.
– Timeframes for achieving compliance with the standards (cf DtW Reg 84 allows 5 years from consent issue), if they are not complied with from the start of the consent. This may be needed for any limits which are imposed on metals.
– Notification requirements if a WWTP does not comply with the limits, and that a consent may specify conditions to apply, if the discharge exceeds concentration limit (DtW Reg 81).

5.2.2 Possible Adaptations for Metals Standard

The following options have been identified for the metals standard which would use the existing 2025 WEPS as a template:

– Graduated controls based on risk assessment, including mitigations (similar to DtL & WRMP):
    - Small, low risk, domestic catchments = TSS as a surrogate or Cu, Zn monitoring only
    - Medium risk: require controls: Trade Waste Bylaw, I&I reduction programme, monitoring of full range of metals
    - Large WWTP with significant metal inputs: numerical EOP limits, compliance monitoring etc
– Naturally elevated concentrations in Receiving Environment (cf T1 exception)
– Soft bottom reaches, deposition zones (cf Hard bottom in T1)
– Particularly sensitive/important ecology (cf pristine exclusion in T1)
– Bioaccumulation in food web – (cf QMRA in T1)

5.2.3 Inclusions and Exceptions from WEPS

Regulation 40 and 41 of the 2025 WEPS specifies:

“40 Application of this Part

(1) This Part prescribes standards that apply only to—

(a) the discharge of treated wastewater into water from a publicly owned wastewater treatment plant that is part of a publicly owned wastewater network:

(b) the effects of the contaminants in that discharge on the environment and public health.

(2) However, the standards set out in this Part do not apply—

(a) to the discharge of treated wastewater if the wastewater is sourced only from producers of industrial and trade waste; or

(b) if 1 or more of the exceptions set out in regulations 43 and 44 apply.

41 Purposes of this Part

The purposes of this Part are to manage—

(a) the effects of contaminants specified in regulation 49(2); and

(b) in relation to a wastewater treatment plant to which the shellfish gathering standards specified in regulations 63 to 65 apply, the effects of a pathogen in the wastewater.”

The definition of the WWTPs to which the WEPS would apply do not require changes to allow for the inclusion of a metals standard.

The purposes of the Part 3 would need to be extended to ensure that the effects of metals are included in the scope of the regulation.

The exceptions in the 2025 WEPS are relevant to the metals standard without modifications include:

– All parts of WEPS
  - Claims settlements relating to Whanganui River and Whangaehu River (Regs 6 and 7)
– Specific DtW (Reg 43)
  - Discharge to an aquifer, a cave or karst system, or geothermal water
  - Discharges near registered drinking water abstraction point
  - Discharges to a wetland that is not used in the treatment process, with a wetland being a natural wetland as defined in Section 2(1) of the Resource Management Act 1991 (RMA).

Exclusions which are relevant to metals <u>*but could require modification*</u> are:

– Discharges to "pristine water", which is defined as “*a water body that—*

  i. *meets the attributes of band A in each table in Appendix 2A of the NPS-FM; or*

  ii. *meets the attributes referred to in subparagraph (i) except for any that the water body does not meet as a result of a naturally occurring process*:

  However, metals are not included in the parameters defined in App 2A of the NPS-FM. However, the parameters included do define “pristine” for a wide range of other parameters which collectively identify “pristine” waters. Therefore, modification is probably not required.

– Limits relating to nitrogen and/or phosphorus do not apply to discharges that discharge to water bodies with naturally elevated nitrogen and/or phosphorus (Reg 44). An additional clause could be added to this regulation that addresses naturally elevated metals such as arsenic in waters affected by volcanic activity. Suggested wording could be:

– Possible new part (c) *“the discharge concentration limits for specific metals (see regulations XX) do not apply to discharging treated wastewater into a water body that, due to naturally occurring processes, contains sufficient concentrations of that metal for the discharge not to cause any adverse effects.”*

5.3 Assessment of Approaches

As indicated in Section 5.1, a range of potential tools are available to manage metals in wastewater, ranging from source control measures, monitoring requirements, risk-based controls, and EOP limits. Taking into account the Tranche 1 framework (Section 5.2) and existing monitoring / reporting requirements in place, Table 14 lists a range of ‘Pros’ and ‘Cons’ for a proposed subset of control tools considered for the general approach to managing discharge / environment risks. These are developed further in Section 7 under the approach to feasibility testing.

Table 14 Examples of potential tools, including pros and cons of tool, to assess risk of metals discharging to the receiving environment from WWTPS

Potential Management Tool	Pros	Cons
Use TSS as a surrogate	Minimal cost impact	Assumes minimal risk from metals as a result of the treatment to reduce TS Does not reflect risk for dissolved metals which is the bioavailable form
Monitoring of metals: “domestic” metals: copper, zinc standard six metals or wider range of metals, identified by risk assessment	Metals for analysis can be tailorable to site risk potential	Will have notable cost implications for WWTPs with no current monitoring or at reduced range Provides information but does not encourage reduction in concentrations in isolation from other tools
Type of analysis (e.g. dissolved, total etc)	Analysis for both Total and Dissolved provide good indication of risks to water column and sediment	Increases costs for multiple forms Total metal alone: may over represent risks, particularly for EOP limits derived for toxicity Dissolved meta alone: may not fully represent risks, especially for accumulation
Compliance monitoring	Large data set required to inform risk assessments	Will have large cost implications for all WWTPs Will incentivise behaviours to manage metals concentrations
Require Trade Waste Bylaw	Nationally consistent framework for Businesses Improve control of influent	May impose costs that are not currently operationally required to administer the bylaw
Require Inflow Management Program	Reduce the number of direct connections of stormwater to the sewer network	May require significant effort and cost, with minimal long term improvement
Require Influent Management Plan	Covers all potential sources Provides solid information to inform risk assessment process Balances risks of sources Can be required by consent and reference existing tools like TW Bylaw	New concept Additional reporting requirement placed on consent holder
Numeric EOP Limits Based on Dilution Factor from Tranche 1 and 95% DGV	Clear and consistent Would be scaled by Dilution factor and possibly through small WWTP exclusion Protective of Environment	May result in significant compliance costs May require upgrades if applied at all sites Effort may be disproportionate to level of risk
Risk Assessment process to assign appropriate tools: Size, catchment, dilution, Aspects of receiving environment	Allows scaling of approach	Requires information to undertake assessment Need to define approach and scope of risk assessment in regulations similar to DtL
Soft Bottom or deposition area assessment	Tailoring of controls to specific risk of effects of accumulation	Requires collection of information to undertake assessment this would require receiving environment monitoring as basis for assessment Need to define approach to risk assessment
Sensitive, important or bioaccumulative ecology assessment or exclusion	Tailors controls to risks for specific types of ecology if present	Need to be able to identify ecology and specific nature of risk. This would require tailored ecological survey and assessment.

Potential Management Tool	Pros	Cons
Use of 99% DGV as discussed in Section 3.1 for bioaccumulative metals for EOP numeric limits	Tailors level of protection to risk from type of metal and DFs	May be overly precautionary if applied at all sites May require upgrades if applied at all sites

5.4 Derivation of Numeric Standards

5.4.1 Approach

The derived EOP treated wastewater limits were calculated by back-calculating from the relevant ANZG aquatic ecosystem guideline values for metals. In this context, "back-calculating" means starting with the target concentration in the receiving environment and then working backwards to determine the concentration that could be present in the treated wastewater at the point of discharge while still meeting that target in the receiving environment after dilution and mixing and, for the initial considerations, allowing for background concentrations.

This approach was adopted because the environmental objective for metals is defined in the receiving environment rather than at the point of discharge. ANZG guideline values (DGVs) as discussed in Section 3.1 are intended to protect aquatic ecosystems by specifying concentrations that should not be exceeded within the receiving water to achieve a selected level of species protection. As a result, deriving end-of-pipe treated wastewater limits by back-calculating from these receiving environment targets provides a direct and transparent means of translating ecological protection goals into treated wastewater discharge concentrations that can be applied within a regulatory or operational framework.

The method also allows key environmental factors that influence the potential effects of a discharge to be considered. By incorporating assumptions regarding background metal concentrations and/or available dilution, the approach recognises that receiving environments differ in their existing water quality and capacity to assimilate contaminants. Whilst higher background concentrations would reduce the remaining capacity before guideline values are reached and result in more stringent treated wastewater discharge limits, greater dilution allows for higher treated wastewater concentrations to achieve the same receiving environment outcome.

A balance between the robustness and trade-offs between these approaches was considered, with the overall intent of linking derived discharge limits to the environmental conditions under which they are expected to operate, helping ensure that metal concentrations following mixing remain consistent with the selected ANZG level of ecosystem protection. Considerations about the approaches adopting background concentrations versus available dilutions are discussed further in Section 5.4.4.

5.4.2 Methodology

The approach assumes that, following discharge and mixing with the receiving environment, metal concentrations at the defined dilution do not exceed the selected ANZG species protection level (e.g. 95% species protection, which is typically used in assessment of environmental effects used in support of resource consent applications for treated wastewater discharges to water). Background concentrations were initially considered and were estimated as a percentage of the applicable ANZG guideline value (for example, 50% of the 95% species protection value) to account for the existing background contribution of metals in the receiving environment prior to discharge. This consideration of background adjustment versus a straight mixing-based approach (without background adjustment) is further explained in Section 5.4.3.

The allowable treated wastewater concentration was then derived using the assumed dilution factor for the receiving environment (e.g., 10:1, 50:1, 100:1, 250:1, or 1000:1), according to the following equation:

Treated Wastewater Limit = (Guideline Value x Dilution Factor)

For initial comparison against background adjustment, the derived limit was also adjusted to allow for the nominal background concentration value for the metal.

Multiple scenarios were assessed using different receiving water dilution categories and background concentration assumptions to illustrate the range of potential end-of-pipe limits under varying environmental conditions.

Higher assumed dilution factors result in less stringent end-of-pipe limits, while higher background concentrations reduce the available assimilation capacity and therefore produce more stringent limits.

A comparison of the general derivation approach against international approaches and trade waste bylaws is shown in Table 15.

Table 15 Derived Limits vs International & TW Bylaw Limits

Aspect	Derived Limits (this scope)	International Limits	NZ Trade Waste Bylaw
Purpose	Environmental protection	Mixed (sector / RE-specific)	Network / WWTP protection
Application	Risk-based (ANZG 95% DGV + dilution in RE)	Site / industry specific	Influent control only
Consistent Basis	High (ANZG DGV based)	Low–moderate	Unclear, number of drivers
Typical Cu	Low (site dependent)	0.005–0.5 mg/L	10 mg/L
Typical Zn	Low (site dependent)	0.02–1.5 mg/L	10 mg/L
Typical Cd	Low	~0.005–0.1 mg/L	0.5 mg/L
Relative Stringency	Moderate–high	Moderate	Very low
Order of Magnitude	—	—	10–1,000× higher than derived EOP limits
Link to Receiving Environment	Direct	Often indirect	None (asset protection focus)

5.4.3 Available Dilutions

The derivation of the 2025 WEPS was based on a range of dilution ratios that were assumed or required to be achieved following mixing. Most of these dilution ratios were not documented into the 2025 WEPS regulations themselves, but are recorded in the supporting technical documents. Table 16 summarises the various dilution ratio scenarios which have been considered in the derivation of the numeric standards for metals. For the freshwater very low dilution category, a dilution factor of 5 has been applied. NR indicates that the dilution scenario is not relevant for that receiving environment category.

Table 16 Dilution Ratio scenarios considered in the derivation of the numeric limits

Receiving Environment Category	Full Dilution	Near field Dilution	50% of Full Dilution	20% of Full Dilution
Freshwater				
High	250:1	NR	125:1	50:1
Moderate	50:1	NR	25:1	10:1
Low	10:1	NR	5:1	2:1
Very Low	5:1	NR	2.5:1	1:1
Lakes	50:1	20:1	25:1	10:1
Coastal				
Estuaries / Harbours	50:1	20:1	NR	NR
Low Energy Coastal	100:1	20:1	NR	NR
Nearshore Coastal	200:1	20:1	NR	NR
Open Ocean	1000:1	100:1	NR	NR

5.4.4 Addressing Background Factors

Unlike the parameters addressed in the 2025 WEPS, our approach to metals has been somewhat more precautionary because some metals can accumulate through a water body and can increase in toxicity by transferring between being dissolved, particulate or incorporated into organic matter. There are minimal natural mechanisms for the removal of metals from the water system. The available information discussed in Section 3.5.1 indicates metal concentrations in the environment are typically low but present.

5.4.4.1 Background concentration considerations

Consideration of the background concentrations as part of the derivation of the numeric limits was initially considered as this would recognise that metals are naturally present in receiving environments and are generally persistent once discharged. As opposed to the wastewater contaminants considered in the 2025 WEPS that are subject to degradation or conversion, such as ammonia. Whilst the background-based approach provides a clear link to receiving environment assimilative capacity for the given metal, it also requires various assumptions about existing background concentrations to be defined.

Further, background concentrations were not numerically included in the assessment of the limits undertaken for the 2025 WEPS, given the method for deriving most of the limits (i.e. not based on back-calculation from DGVs), the non-conservative nature of the contaminants considered, and the significant variation in concentrations of the parameters considered across water bodies in New Zealand.

For the development of the numerical standards for metals, an initial assessment incorporating background concentration was assessed alongside a mixing-based approach (that did not include background concentration). A background concentration of 50% of the 95% chronic DGV (ANZG) was assumed (except for bioaccumulating metals detailed in Section 5.4.10, where the background concentration used is zero).

Qualitative assessment against the mixing based numerical limits was undertaken and resulted in broadly similar derived limits across most receiving environment categories.

Given this, the mixing approach was adopted because it provides for a simpler and more nationally consistent framework that aligns with the existing 2025 WEPS , whilst producing broadly similar derived limits to the background-based approach.

5.4.4.2 Mixing based approach

The mixing based approach applies a proportion of the available dilution as a proxy for a range of factors that might affect assimilative capacity. Mixing threshold scenarios were selected as follows:

- 50% of the available dilution of the 95th chronic toxicity freshwater DGV (ANZG)
- 50% of the available dilution of the 95th draft chronic toxicity (copper and zinc) freshwater DGV (ANZG)
- 20% of the available dilution of the 95th acute toxicity (copper and zinc) freshwater DGV (ANZG)
- Full dilution of the 99th acute toxicity to protect against bioaccumulation for cadmium, lead and mercury for freshwater and marine DGV (ANZG)
- Near field dilution of the 95th chronic marine DGV (ANZG)
- Full dilution of the 95th chronic marine DGV (ANZG)

For near field dilution/mixing, this is typically assessed as the initial dilution immediately following discharge. It can be assessed using CORMIX modelling, or similar modelling tools. For the calculations undertaken for the derivation of the metal limits using the mixing-based scenarios no background concentrations were included. This approach therefore acts as a proxy for the combined effect of mixing, dilution and remaining assimilative capacity, rather than directly representing existing metal concentrations in the receiving environment.

5.4.5 Chronic Toxicity 95% DGV

Table 17 shows the derived treated wastewater limits for freshwater and marine environments to achieve 95% species protection (ANZG), assuming receiving environment dilution ratios. For chronic freshwater derived limits, available mixing of 50% has been applied to receiving environment dilution ratios, this includes lakes. Table 17 lists the final dilution factor applied, taking into account the category, and 50% available mixing for freshwater. Limits highlighted in shaded cells are the limits that have been presented as the recommended limits in Table 33

Table 17 Derived numeric limits to achieve 95% protection (ANZG) against chronic toxicity effects

Dilution category	Dilution ratio applied in derivation	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Freshwater (50% dilution)										
High	50% of 250:1	**6.875**	**1.625**	0.025	**0.125**	0.175	0.425	0.075	**1.375**	1
Moderate	50% of 50:1	**1.375**	**0.325**	0.005	**0.025**	0.035	0.085	0.015	**0.275**	0.2
Low	50% of 10:1	**0.275**	**0.065**	0.001	**0.005**	0.007	0.017	0.003	**0.055**	0.04
Very low	50% of 5:1	**0.1375**	**0.0325**	0.0005	**0.0025**	0.0035	0.0085	0.0015	**0.0275**	0.02
Lakes	50% of 50:1	1.375	0.325	0.005	0.025	0.035	0.085	0.015	0.275	0.2
Marine (full dilution)										
Estuaries / Harbours	50:1	1.85	-	0.275	0.22	**0.03**	0.22	0.02	0.295	**0.4**
Low Energy Coastal	100:1	3.7	-	0.55	0.44	**0.06**	0.44	0.04	0.59	**0.8**
Nearshore Coastal	200:1	7.4	-	1.1	0.88	**0.12**	0.88	0.08	1.18	**1.6**
Open Ocean	1000:1	37	-	5.5	4.4	**0.6**	4.4	0.4	5.9	**8**

Figure 3 (freshwater) and Figure 4 (coastal / marine) show the comparison between the derived limits across different dilutions, and the consent limit concentrations in current WWTP consents (grey boxes). The limits provided in the NZ Model Trade Waste Bylaw have been included in the graph for comparison only (noting these limits relate to influent, not treated wastewater).

Figure 3 and Figure 4 show that the derived limits are distributed throughout the range of concentrations represented by the few existing WWTP consent limits (typically upper percentile limits, rather than medians), with their position varying by metal and dilution category. For freshwater assessments, the derived limits were generally within the interquartile range for some metals (e.g. arsenic, mercury and nickel) but below for others. Whilst for coastal/marine assessments, the derived limits were largely within the interquartile range. The model Trade Waste Bylaw limits are located at or above the highest derived limit for each metal assessed and, for most metals, occur towards the upper end of or above the range of concentrations represented by existing consent limits.

In summary, noting the small number of WWTP with existing consent limits for metals and that these limits generally apply to total metals rather than dissolved metals, the freshwater and coastal/marine assessments suggest the derived limits are not inconsistent with these existing consent limits. In contrast, as expected, the Trade Waste Bylaw limits are higher than the derived limits for all metals assessed, as the Bylaw limits apply to influent, rather than treated wastewater. It is also of note that the consent limits generally apply to total metals, whereas the derived limits apply to dissolved metals.

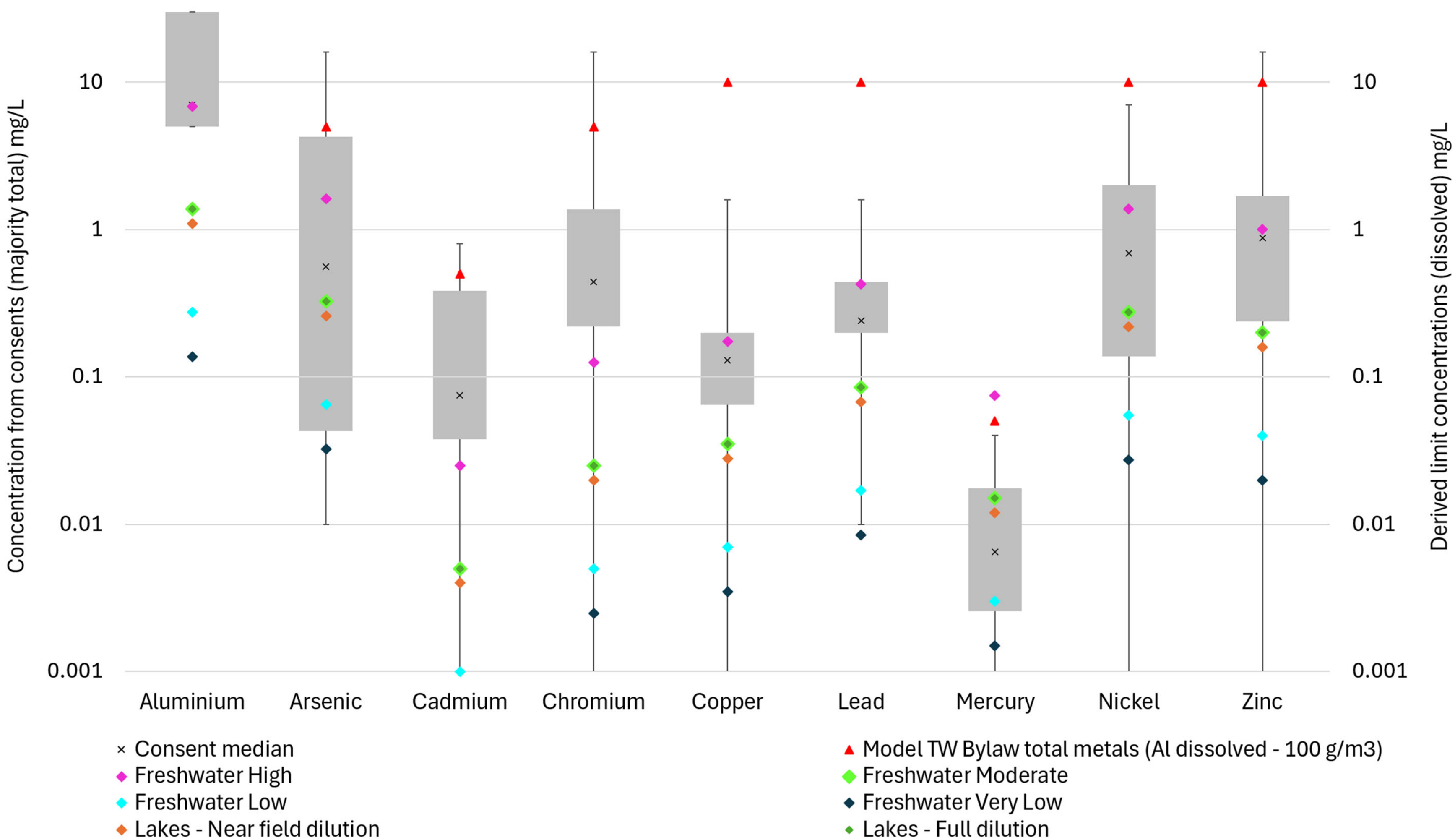

Figure 3 ***Comparison of freshwater derived limits against existing resource consent limits and Trade Waste Bylaw (influent limits)***

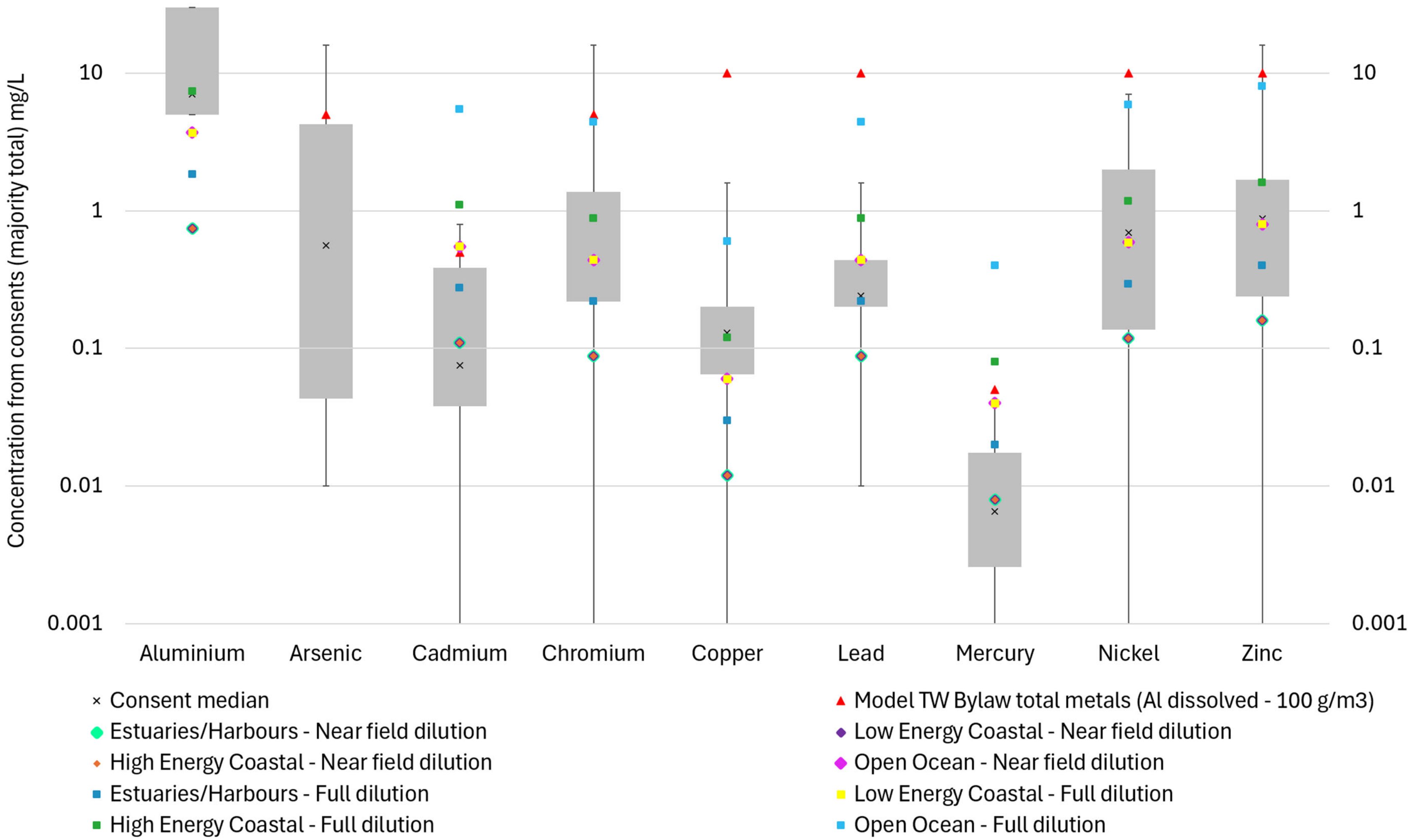

Figure 4 ***Comparison of coastal derived limits against existing resource consents limits and Trade Waste Bylaw (influent limits)***

5.4.6 DRAFT Chronic toxicity 95% DGV (Cu and Zn in Freshwater)

Table 18 shows the derived treated wastewater limits for copper and zinc in freshwater based on the DRAFT chronic toxicity DGVs as discussed in Section 3.1. The derived limits are based on the DGVs required to achieve 95% species protection (ANZG) assuming an available 50% dilution in the receiving environment. Limits highlighted in shaded cells are the limits that have been presented as the recommended limits in Table 33

Table 18 Derived numeric limits to achieve 95% protection (DRAFT ANZG) against chronic toxicity effects with available 50% mixing

Dilution category	Dilution ratio applied in derivation	Copper	Zinc
		mg/L	mg/L
High	50% of 250:1	**0.0588**	**0.5125**
Moderate	50% of 50:1	**0.0118**	**0.1025**
Low	50% of 10:1	0.0024	0.0205
Very low	50% of 5:1	0.0012	0.0103
Lakes	50% of 50:1	**0.0118**	**0.1025**

5.4.7 Acute toxicity 95% DGV (Cu and Zn in Freshwater)

Table 19 shows the derived treated wastewater limits for copper and zinc in freshwater based on the acute toxicity DGVs as discussed in Section 3.1. The derived limits are based on the DGVs required to achieve 95% species protection in accordance with the acute guideline values for copper and zinc, while comparing values using 20% of the available dilution. Limits highlighted in shaded cells are the limits that have been presented as the recommended limits in Table 33

Table 19 Derived numeric limits to achieve 95% protection using acute freshwater guideline values (acute GV) using 20% of the available dilution

Dilution category	Dilution ratio applied in derivation	Copper	Zinc
		mg/L	mg/L
Using 20% of the available dilution			
High	20% of 250:1	0.065	1.2
Moderate	20% of 50:1	0.013	0.24
Low	20% of 10:1	0.0026	0.048
Very low	20% of 5:1	0.0013	0.024
Lakes (full dilution)	20% of 50:1	0.013	0.24

5.4.8 Marine Near-Field Dilution vs Full Mixing

Table 20 shows the derived treated wastewater limits for marine environments to achieve 95% species protection (ANZG), assuming the dilution ratios for each category in the receiving environment. The limits show a comparison between using the overall (full) dilution factor or near-field dilution factor for each receiving environment category. Limits highlighted in shaded cells are the limits that have been presented as the recommended limits in Table 33

Table 20 Comparison of marine (and lakes) overall and near-field dilution derived numeric limits to achieve 95% protection (ANZG)

Dilution	Dilution ratio applied in derivation	Aluminium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Overall (Full) dilution									
Lakes	50% of 50:1	1.375	0.005	0.025	0.035	0.085	0.015	0.275	0.2
Estuaries /Harbours	50:1	1.85	0.275	0.22	**0.03**	0.22	0.02	0.295	**0.4**
Low Energy Coastal	100:1	3.7	0.55	0.44	**0.06**	0.44	0.04	0.59	**0.8**
Nearshore Coastal	200:1	7.4	1.1	0.88	**0.12**	0.88	0.08	1.18	**1.6**
Open Ocean	1000:1	37	5.5	4.4	**0.6**	4.4	0.4	5.9	**8**
Near Field dilution									
Lakes	20:1	**1.1**	0.004	**0.02**	0.028	0.068	0.012	**0.22**	0.16
Estuaries/ Harbours, Low Energy Coastal, & High Energy Coastal (Nearshore)	20:1	**0.74**	0.11	**0.088**	0.012	**0.088**	**0.008**	**0.118**	0.16
Open Ocean	100:1	**3.7**	**0.55**	**0.44**	0.06	**0.44**	**0.04**	**0.59**	0.8

– Limit to achieve 95% protection limit (ANZG)
– Note that lakes calculation uses the freshwater ANZG limits, not marine and is based on 50% of full dilution

5.4.9 Limits specific to Chemical Dosing for Phosphorus Control

The UK has developed specific limits that apply where either iron (as ferric) or aluminium is being used to reduce total phosphorus (TP) concentrations in treated wastewater. The latest set of permits are being implemented through the PR24 Water Industry National Environment Programme[16]. These permits are derived to reduce nutrient loading into waterbodies.

The metal coagulant primarily used in chemical dosing is Ferric sulphate, as Ferric chloride is more corrosive. The iron (Fe) limits may vary with water quality constraints, but the following limits are generally applied at the end of pipe:

– 95%ile limit of 4 mg/L and;
– 8 mg/L as an Upper tier.

Alum is less frequently used for chemical dosing to control phosphorus concentrations, except it is starting to be used more as disinfection is being increasingly required, as ferric can pose issues with UV disinfection. Depending

[16] PR24 Water Industry National Environment Programme - National Data Library This contains all the actions that are currently identified for all WWTPs throughout England and Wales (WINEP).

on the stringency of the TP limits, enhanced solids removal is included in the WWTPs to achieve the phosphorus limits and also to ensure achievement of the desired metal permit.

The aluminium limit is defined on a case-by-case basis. There are restrictions on the use of aluminium upstream of conservation designations. Where the use of aluminium is proposed upstream of a nature conservation site, justification will be required, and if accepted, the “River needs” aluminium limit will be calculated. The discharge limit varies depending upon pH and hardness conditions in the receiving water body and is given in Table 21.

Table 21 Aluminium standards from UK for Chemical dosing[17]

Determinand	Receiving water quality Conditions		
	pH > 6 (5%ile)	pH <6 (5%ile) CaCO3 < 20mg/l	pH <6 (5 %ile) CaCO3 > 20mg/l
Total aluminium	1 mg/l as maximum	0.5 mg/l Emission standard	1 mg/l Emission standard
Dissolved aluminium		0.075 mg/l as 95%ile	0.5 mg/l as 95%ile
Dissolved aluminium		0.1 mg/l as maximum	1 mg/l as maximum

Note: Standards apply for pH <6 where derogation of the pH standard to reflect ‘natural’ acidification is acceptable.

These limits are similar to those derived and as described in previous sections and as can be seen from Figure 6. Therefore, specific limits that only apply when chemical dosing for phosphorus reduction is undertaken do not need to be included in this framework. However, the use of metal-based coagulants for phosphorus reduction may contribute to elevated concentrations of the dosed metal in treated wastewater.

A precautionary approach could be that for all WWTP that undertake chemical dosing to achieve the phosphorus limit, the proposed WEPS would impose numeric limit and associated monitoring. However, a blanket requirement is not considered appropriate, particularly given that the WWTPs that are the most likely to have chemical dosing to achieve the phosphorus limit are also those on which the most restrictive metal control measures are likely to fall in the proposed WEPS risk framework.

5.4.10 Bioaccumulation

Table 22 shows the derived limits for bioaccumulating metals. The limits were calculated to achieve 99% species protection under the ANZG guidelines, which is considered conservative but reflects the risk of bioaccumulation.. Limits highlighted in shaded cells are the limits that have been presented as the recommended limits in Table 33

Table 22 Derived numeric limits for bioaccumulating metals to achieve 99% protection (ANZG)

Dilution	Dilution ratio applied in derivation	Cadmium	Lead	Mercury
		mg/L	mg/L	mg/L
Freshwater				
High	250:1	**0.015**	**0.25**	**0.015**
Moderate	50:1	**0.003**	**0.05**	**0.003**
Low	10:1	**0.0006**	**0.01**	**0.0006**
Very Low	5:1	**0.0003**	**0.005**	**0.0003**
Lakes	50:1	**0.003**	**0.05**	**0.003**
Marine				
Estuaries / Harbours	50:1	**0.035**	0.11	**0.005**
Low Energy Coastal	100:1	**0.07**	0.22	0.01

[17] PR24 WINEP driver guidance – Urban Waste Water Treatment Regulations. Version 0.3

Dilution	Dilution ratio applied in derivation	Cadmium	Lead	Mercury
		mg/L	mg/L	mg/L
Nearshore Coastal / High Energy Coastal	200:1	0.14	0.44	0.02
Open Ocean	1000:1	0.7	2.2	0.1
Marine (Near-field dilution)				
Estuaries/Harbours, Low Energy Coastal, & Nearshore (High Energy Coastal)	20:1	0.014	0.044	0.002
Open Ocean	100:1	0.07	0.22	0.01

Limit to achieve 99% protection limit (ANZG)
Assuming background concentration of 0%
Near field dilutions provided for comparison but were not appropriate for use in recommended limits

5.4.11 Comparison against Available Wastewater Consent Monitoring

As discussed in Section 3.5.2, a review was undertaken of wastewater discharge consents requiring reporting for sediment and shellfish monitoring for metals (detailed in Appendix C). As part of this review, reported treated wastewater concentrations was also assessed. The available end of pipe monitoring data represents a small fraction of all the WWTPs throughout NZ and only represents some of the discharge environments defined in the 2025 WEPS. It is also noted that most of the available data provides results in the form of total metals whilst the derived limits are all based on the proportion of that which is in dissolved form. Nevertheless, this data provides a preliminary indication of how the derived numeric standards compare to recorded treated wastewater concentrations and hence whether they could be expected to be typically complied with.

Figure 5 to Figure 8 show the 90th percentile of the collected treated wastewater data for copper, aluminium, zinc and lead (as red line) and the median value (dotted line) against the various derived limits (shown as circles). Noting the paucity of the available data for treated wastewater concentrations available for this assessment (about 50 samples only from across the country), the treated wastewater concentrations could generally comply with the derived limits shown in Figure 5 to Figure 8. Exceptions to this include, for copper the low and very low dilution and lake environments and for zinc all freshwater receiving environments, all marine for near field dilutions and estuary/harbour for full dilution. Copper, zinc, aluminium and lead show all derived limits being higher than the recorded 90th percentile concentration by a considerable margin in the high dilution environments.

Table 23 shows the statistics calculated from the empirical treated wastewater monitoring results of various WWTP against the derived limits. The derived treated wastewater limits used in this comparison were the most stringent derived limit for each receiving environment, and, for coastal waters, the limit based on full dilution as well. In the table, the **<u>bold and underlined</u>** text indicates where the pooled treated wastewater results is at or exceeds the most stringent of the derived limits (i.e. limit for very low dilution freshwater) whilst the **bold** or *italicised* text indicates when a recorded treated wastewater concentration has exceeded the relevant derived limit for an individual receiving environment.

Noting the paucity of data and that the data that is available is predominantly for total rather than dissolved metals, the results from the analysis of the available data treated wastewater concentrations indicate that for most metals the WWTPs assessed may comply with the derived limits with some exceptions. The exceptions to this are copper, zinc, chromium and potentially cadmium, particularly in low and very low dilution and lake freshwater environments and for zinc, potentially also other freshwater environments and the near field derived limit in estuaries.

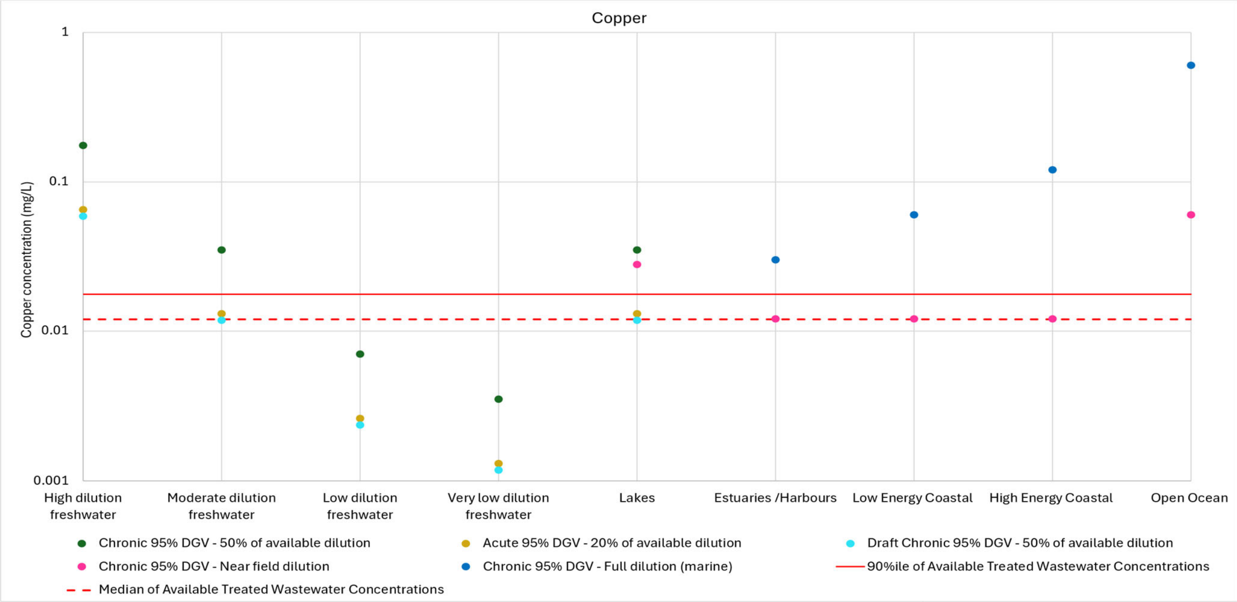

Figure 5 ***Comparison of derived limits, and median and 90th percentile treated wastewater concentration for copper***

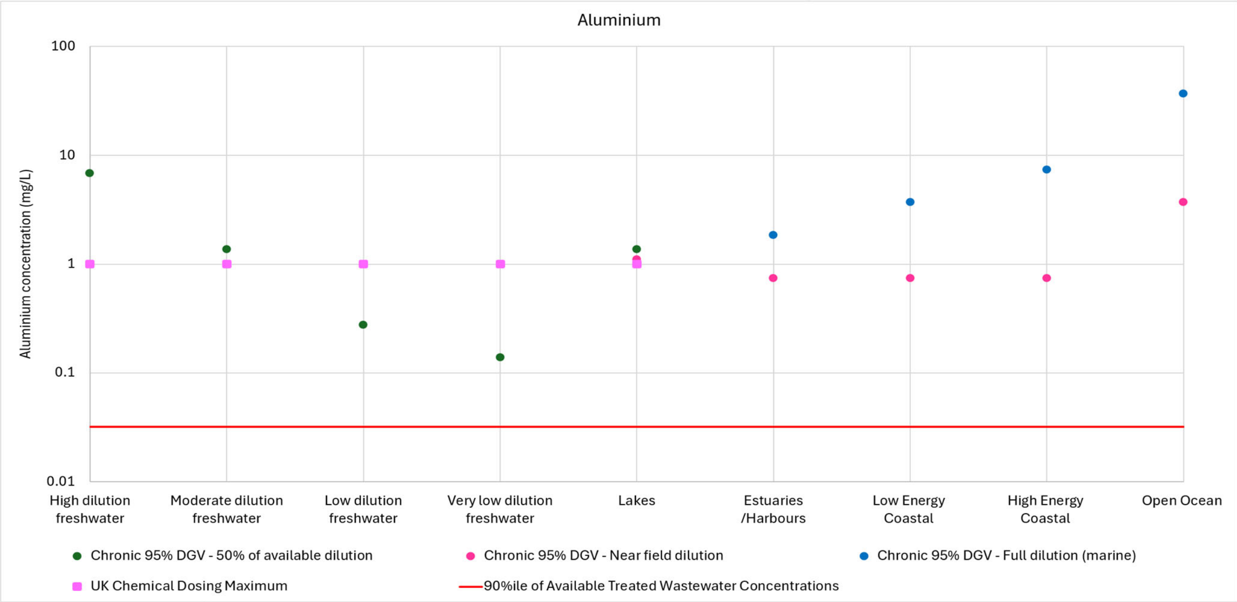

Figure 6 ***Comparison of derived limits and 90th percentile treated wastewater concentration for aluminium. Note that the median treated wastewater concentration is the same as the 90th percentile due to limited available data for aluminium.***

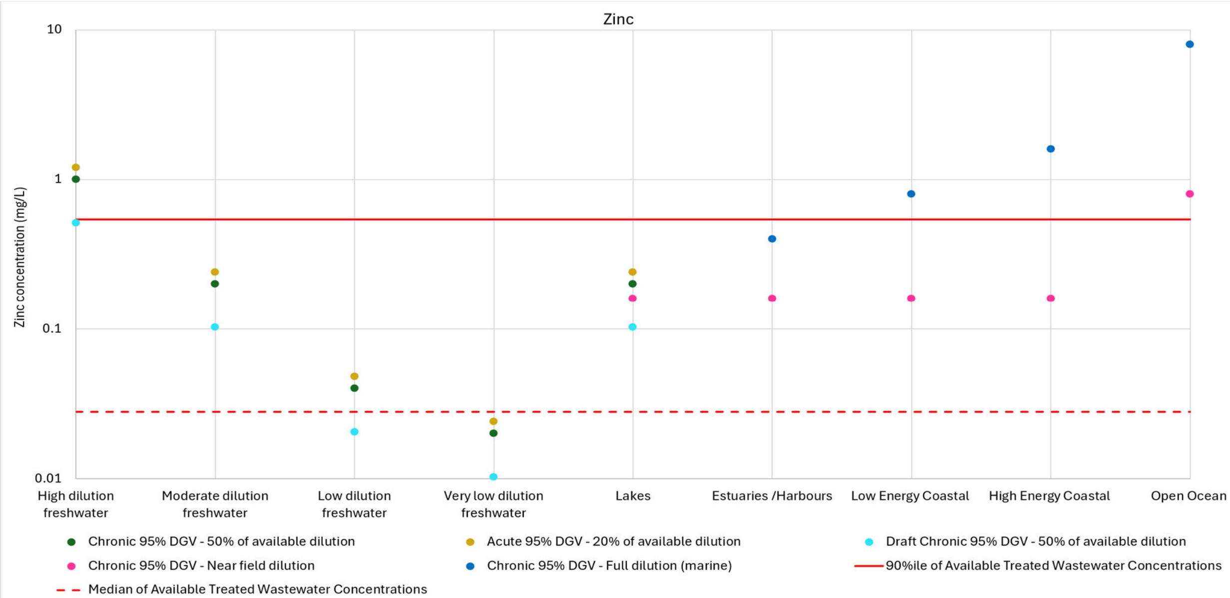

Figure 7 ***Comparison of derived limits, and median and 90th percentile treated wastewater concentration for zinc***

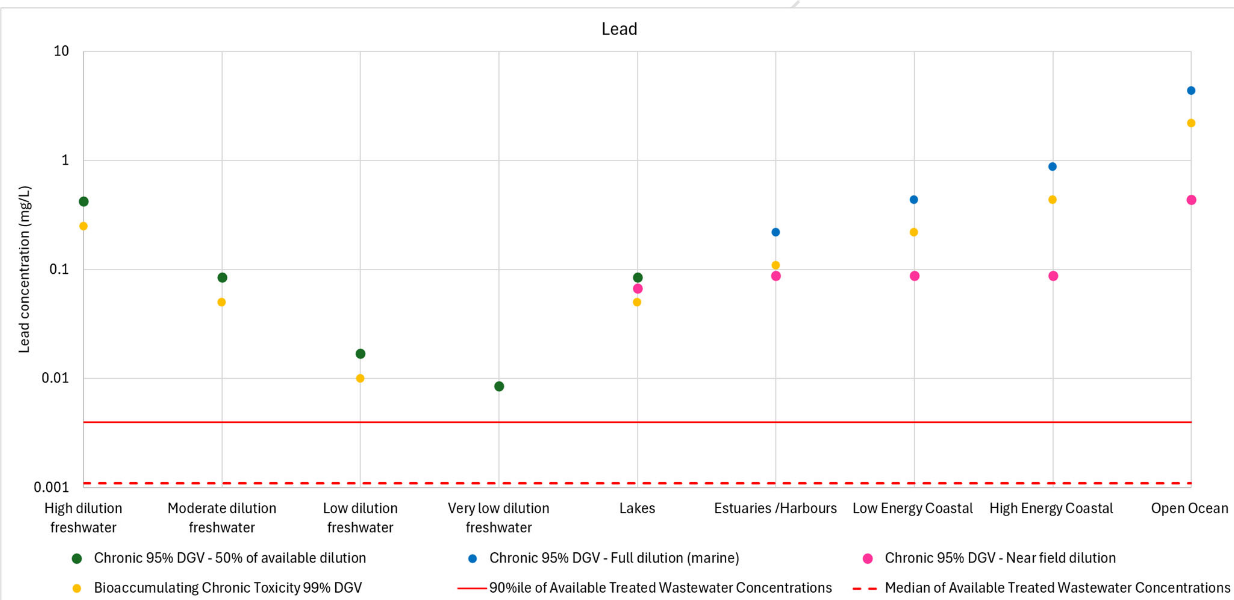

Figure 8 ***Comparison of derived limits, and median and 90th percentile treated wastewater concentration for lead***

Table 23 Statistics derived from treated wastewater results from a small number of WWTPs whose consents require metals sampling, compared against the derived limits

	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Unit	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Median of all treated wastewater results	0.032	0.004	0.00012	**0.0057**	**0.012**	0.001	**0.0027**	**0.028**	0.0001
90th %ile of all treated wastewater results	0.032	0.011	**0.00055**	**0.0255**	**0.018**	0.004	**0.0055**	**0.54**	0.0002
Estuary	No. of WWTP: 3								
Result count	1	23	23	23	23	23	23	23	16
Min	0.032	0.001	0.000025	0.00001	0.001	0.0001	0.0005	0.0024	0.00003
Median	0.0320	0.0050	0.00003	0.0040	0.0032	0.0010	0.0025	0.0090	0.0001
Mean	0.0320	0.0052	0.0002	0.0046	0.0044	0.0012	0.0035	0.0132	0.0001
90th %ile	0.0320	0.0060	0.00045	0.0090	0.0081	0.0024	0.0076	0.0268	0.0001
95th %ile	0.0320	0.0101	0.0005	0.0097	***0.0125***	0.0039	0.0089	0.0451	0.0002
Max	0.032	0.025	0.0015	0.01	***0.013***	0.006	0.01	0.05	0.0005
Most conservative derivation	**0.7400**	**No limit**	**0.035**	**0.0880**	**0.0120**	**0.0880**	**0.1180**	**0.1600**	**0.0080**
Full dilution derived limit	*1.8500*	*No limit*	*0.2750*	*0.2200*	*0.0300*	*0.2200*	*0.2950*	*0.4000*	*0.0200*
Open ocean	No. of WWTP: 3								
Result count	0	22	22	22	22	22	22	22	2
Min		0.0026	0.0001	0.0020	0.0051	0.0005	0.0020	0.0105	0.00003
Median		0.0044	0.0001	0.0151	0.0136	0.0031	0.0026	0.1780	0.00003
Mean		0.0059	0.0003	0.0158	0.0133	0.0027	0.0036	0.2981	0.00003
90th %ile		0.0105	0.0006	0.0279	0.0167	0.0041	0.0055	0.6270	0.00003
95th %ile		0.0105	0.0006	0.0290	0.0178	0.0044	0.0055	0.6490	0.00003
Max		0.0105	0.0006	0.0300	0.0210	0.0056	0.0110	***0.9200***	0.00003
Most conservative derivation	**3.7000**		**0.5500**	**0.4400**	**0.0600**	**0.4400**	**0.5900**	**0.8000**	**0.0400**
Full dilution derived limit	*37.0000*		*5.5000*	*4.4000*	*0.6000*	*4.4000*	*5.9000*	*8.0000*	*0.4000*
Low dilution freshwater	No. of WWTP: 1								
Result count	0	0	0	0	7	7	7	7	0

	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Unit	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Min					***0.0120***	0.0007	0.0016	***0.0640***	
Median					***0.0181***	0.0010	0.0050	***0.0893***	
Mean					***0.0203***	0.0024	0.0045	***0.1142***	
90^{th} %ile					***0.0290***	0.0047	0.0050	***0.1740***	
95^{th} %ile					***0.0290***	0.0060	0.0050	***0.2070***	
Max					***0.0290***	0.0072	0.0050	***0.2400***	
Low dilution derived limit	**0.2750**	**0.0650**	**0.0006**	**0.0050**	**0.0024**	**0.010**	**0.0550**	**0.0205**	**0.0006**
High dilution freshwater	No. of WWTP: 1								
Single Result	0.032	0.001	0.0005	0.0005	0.005	0.0005	0.0005	0.049	0.0005
High dilution derived limit	**6.8750**	**1.6250**	**0.015**	**0.1250**	**0.0588**	**0.250**	**1.3750**	**0.5125**	**0.015**

– Values in bold and underline exceed the derived numeric limit for at least one of the receiving environments.
– Note that only one set of results was available for the high dilution freshwater environment.
– To calculate the statistics, half of the detection limit was used in events where the value was under the laboratory detection limit.
– Results are for total metals; derived limits are for dissolved metals.

5.5 Conclusion - Derived Standards

The derived end-of-pipe wastewater limits were calculated by back-calculating from the relevant ANZG aquatic ecosystem default guideline values (DGVs) for metals. The approach assumes that, following discharge and mixing with the receiving environment, metal concentrations at the defined dilution do not exceed the selected ANZG species protection level. The mixing based approach was applied to represent a proportion of the available dilution as a proxy for a range of factors that might affect assimilative capacity in the receiving environment. This was undertaken for both chronic and acute toxicity DGVs and bioaccumulative DGVs.

The derived limits have been compared against:

– the limits that have been included in NZ consents
– the treated wastewater concentrations reported as required the monitoring undertaken under these consents and
– limits in the Trade Waste Bylaw for discharges to the sewer network and hence the WWTP after dilution from other sewage sources from the WWTP catchment

Actual monitoring data collected from WWTPs represents a very small fraction of all the WWTPs throughout NZ (only 8 WWTPs) and only represents some of the discharge environments defined in the 2025 WEPS. However, noting this limitation, this data has been used to provide a preliminary evaluation of how the derived numeric standards compare to recorded treated wastewater concentrations and hence whether they would be expected to be typically complied with.

When compared to the consent limits (typically upper percentile) which are currently included as treated wastewater limits in consents for discharge into both the freshwater and coastal/marine environments, the derived limits ranged from generally within to below the interquartile range of the consent limits, depending on the metal and assessment scenario. Noting the small dataset available, this suggests the derived limits are not inconsistent with existing consent limits. It is also of note that the consent limits generally apply to total metals, whereas the derived limits are proposed to apply to dissolved metals, being representative of the bioavailable fraction which primarily is responsible for any toxicity effect. Consideration of limits for total metals against limits that are only considering the dissolved fraction, will be conservative. Control of the particulate portion of the metals in the discharge will be through the suspended solids limits in the 2025 WEPS.

In contrast, the Trade Waste Bylaw limits were generally higher than the derived limits for all metals assessed. This is to be expected given that these limits apply to individual trade waste discharges **into** the sewer network.

The UK limits that apply for chemical dosing for phosphorus reduction are similar to those derived for this project. Therefore, specific limits that only apply when chemical dosing for phosphorus reduction is undertaken need not be included in this framework, however, the use of metals for P reduction is a risk factor that could indicate the presence of elevated aluminium or iron dependent on which metal is used in the treatment process to reduce phosphorus.

There is a paucity of data on NZ treated wastewater concentrations available and data that is available is predominantly for total rather than dissolved metals. However, except for low and very low dilution and lake freshwater environments and for estuaries, the treated wastewater concentrations reviewed would generally comply with the limits, with some derived limits being higher than the recorded concentrations by a considerable margin in the high dilution environments.

Results from this analysis show that treated wastewater concentrations for most metals may comply with the derived limits, with the exception of copper, zinc, chromium and potentially cadmium, particularly in low and very low dilution and lake freshwater receiving environments, potentially also in other freshwater environments and estuary/harbour environments.

Given the available information and on a precautionary basis, the most stringent of the derived limits described in this Section were taken into the feasibility testing phase of this work.

These derived limits may exceed actual treated wastewater concentrations by a considerable margin for the higher dilution environments and may require additional controls on treated wastewater concentrations than is currently undertaken for the low and very low dilution and lake environments. We recommend that further information on treated wastewater concentrations from WWTPs are sought through the consultation phase.

As previously noted, there is minimal information available on the actual treated wastewater concentrations throughout New Zealand, and none on some of the receiving environment categories considered. In particular, most analysis has been conducted for the total form of the metal, rather than the dissolved form which is the recommended form against which the derived limits will be assessed. Further as demonstrated by the change in the DGVs between the current and DRAFT DGVs as discussed in Section 3.1, the toxicology on which the receiving environment guidelines are based can change rapidly, particularly for metals of interest.

In view of this paucity of data on treated wastewater and the potentially rapidly changes in toxicology information, it is recommended that the numerical limits included into the metals WEPS be reviewed at five to ten year intervals.

6. Feasibility Testing of the Framework

6.1 Premise of Framework

The following is a summary of the overall premise of the Standard that has been established for testing.

– Influent Management Controls available to Asset Owner
    - Influent management includes trade waste bylaws and water chemistry adjustments to reduce contamination risks at the point where flows enter the WWTP
– Tiered Risk-Based Monitoring
    - Monitoring is tiered by risk, from TSS (as a surrogate) for low risk to targeted metals (e.g. copper, zinc, other) for moderate to very high-risk discharges
    - Ability to add additional metals and site-specific controls (e.g. numerical limits & monitoring requirements)
– Numeric Limits and Guidelines
    - Numeric limits are applied as required based on risk categorization
    - Based on recognised guideline values (refer to Section 3.1) and dilution ratios
    - Need to consider dissolved vs total metals for compliance and monitoring
– Statistical Compliance Assessment
    - Compliance relies on statistical metrics assessing long-term trends rather than single sample variability (subject to framework testing)

6.2 Risk Assessment Approach

A risk-based approach is identified as the appropriate process to set out a decision-based framework and to test the feasibility of the framework. The following principles are considered in the decision points identified:

– Consideration of a precautionary risk-based approach with the intent of balancing costs with environmental and public health outcomes
– Consideration of what features of a WWTP contribute to potential discharge risk of metals
– Consideration of what features of the receiving environment of a WWTP contribute to potential receiving environment risk of metals
– Consideration of available controls / tools to manage both discharge risk and receiving environment risk

The proposed framework therefore considers two separate but related components:

– **Discharge Risk**—the likelihood that a wastewater treatment plant will discharge elevated concentrations of metals, considering factors such as trade waste inputs, landfill leachate, stormwater inflow and the use of metal-based treatment chemicals
– **Receiving Environment Risk**—the likelihood that metals discharged from a wastewater treatment plant could result in adverse environmental effects, taking into account receiving environment dilution, potential for sediment accumulation and the sensitivity of ecological receptors

Figure 9 shows the initial iteration of the proposed decision framework incorporating the approaches set out in Section 5.3. Yellow highlighted items represent the additions to the framework taken through the feasibility testing of the Standard.

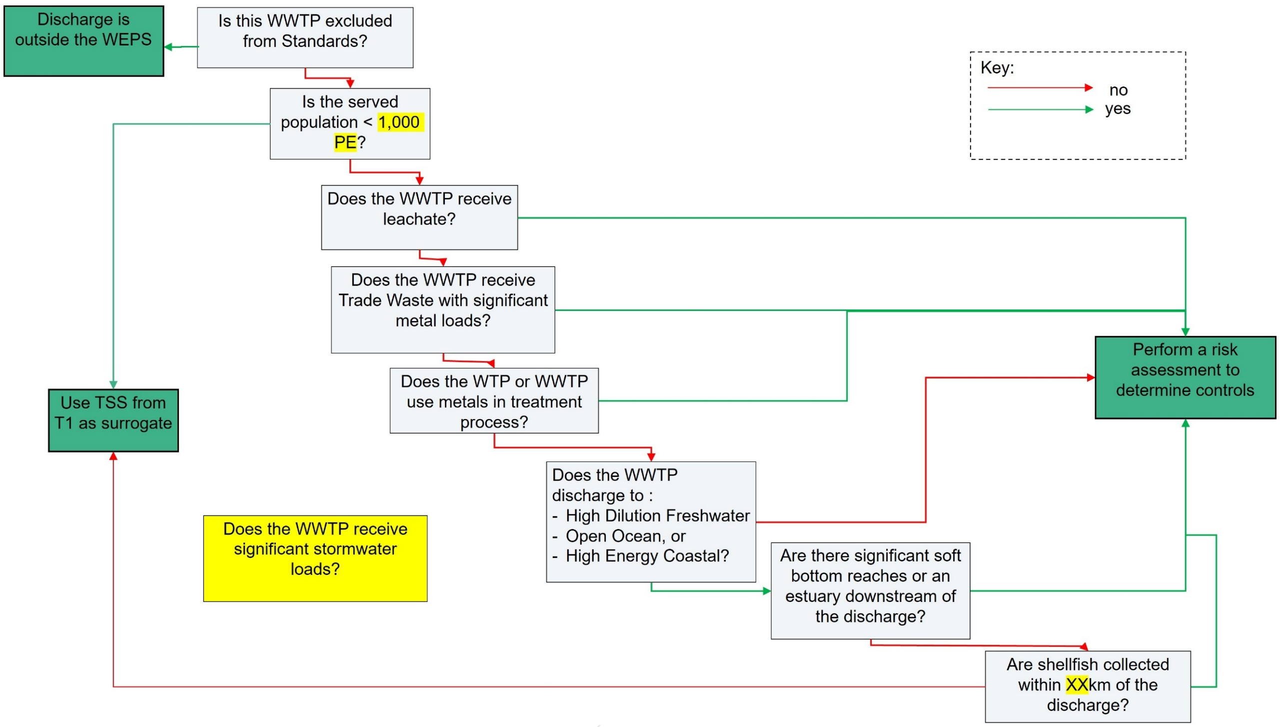

Figure 9 Proposed framework for metal feasibility testing

6.2.1 Discharge Risk and Receiving Environment Risk

Factoring in the above decision points shown in Figure 9 Table 24 and Table 25 set out the proposed approaches for assessing the Discharge Risk Category and Receiving Environment Risk Category for this stage of feasibility testing, respectively.

The 4-point approach for assigning a discharge risk (low, medium, high or very high) takes into account the size of the WWTP, trade waste inputs (as a proportion of total flow and probable metal load), contribution of stormwater inflow (recognising this represents catchment loads of key stormwater metals), and whether metal-based chemicals are used in any water treatment process (i.e. alum or ferric dosing). It is noted in the table below, the specific metrics for trade waste input as a proportion of flow, or the stormwater ratios were not specifically defined, rather are represented conceptually as ‘X’.

Table 24 Proposed approach for assessment of discharge risk for feasibility testing

Discharge Risk Category	Size of Discharge	Trade Waste Inputs	Stormwater Inflow[18]	Chemical Use in Water or Wastewater TP
1 - Low	Small (<1, 000 PE)	Domestic and Service trade wastes only	PWWF:ADF <X	None
2 - Medium	Medium (1,000 < 10,000 PE)	Leachate from landfill and/or trade waste with "high" metals: TW Flow < X% of WWTP median ADF	PWWF:ADF X<X	Aggressive Water supply

[18] PWWF is typically the Instantaneous Peak Wet Weather Flow received at the WWTP observed over a day, with polling of data at 15 minute or less intervals. ADF is the average daily flow. These are the typical metrics used to assess the variability of influent flow to a WWTP.

Discharge Risk Category	Size of Discharge	Trade Waste Inputs	Stormwater Inflow[18]	Chemical Use in Water or Wastewater TP
3 - High	Large (10,000 > 100,000 PE)	Leachate from landfill and/or trade waste with "high" metals: TW Flow X% > X% of WWTP median ADF	PWWF:ADF X<X	Al or Fe for water treatment or P reduction in WW treatment or odour control
4 – Very High	City (> 100,000 PE)	Leachate from landfill and/or trade waste with "high" metals: TW Flow > X% of WWTP median ADF	PWWF:ADF >X	

The 3-point approach for assigning the receiving environment risk (low, medium or high) takes into account the dilution ratio of the immediate receiving environment (as per the definition in Tranche 1 and under 2025 WEPS) the potential for sediment accumulation in depositional zones, and whether there is a risk of metal bioaccumulation in biota.

Table 25 Proposed approach for assessment of receiving environment risk

Environment Risk Category	Dilution Ratio	Sediment Accumulation	Bioaccumulation
1 - Low	Freshwater: High DR > 250 Coastal: Open Ocean High Energy Coastal	Low	Low
2 - Medium	Freshwater: Moderate 50 < DR > 250 Lakes Coastal: Low Energy Coastal	Limited	Limited
3 - High	Freshwater: Low and Very Low DR < 50 Coastal: Estuary	Depositional zones (e.g. Estuaries)	Shellfish collected within 4km

6.2.2 Approach to Risk Based Control Framework

Table 26 sets out the proposed series of controls for feasibility testing (initially described in Section 5.1) to manage the discharge and receiving environment risk (Section 6.2.1). The intent of the proposed control framework was to recognise that TSS is strongly correlated with total metal loads (total fraction). The assessment of total metal loads (rather than dissolved fractions) is also recognised as a conservative approach when assessing potential for chronic effects. Thus, if TSS is adequately managed, total metal loads, by default, will also be effectively managed. This approach was identified as being cost effective, given that WWTP are usually required (under the current sampling requirements) to monitor for TSS in the routine discharge. Depending on the level of risk assigned to the discharge or receiving environment, different monitoring and reporting requirements are imposed to manage risks.

Table 26 Proposed Control Framework for management of discharge and receiving environment risks for feasibility testing

Discharge Risk / Environmental Risk	Environment Risk - Low	Environment Risk - Medium	Environment Risk - High
Discharge Risk - Low	TSS as surrogate	TSS as surrogate	TSS as surrogate Information monitoring
Discharge Risk – Medium	TSS as surrogate	TSS as surrogate Information monitoring	Surveillance metal monitoring: Monitor for Al, Cu, Zn and specific metals in trade waste 10 yr review of effect
Discharge Risk – High	TSS as surrogate Information monitoring	Surveillance monitoring: Monitor for Al, Cu, Zn and specific metals in trade waste 10 yr review of effect	Numeric Limits: Compliance monitoring
Discharge Risk – Very High	Surveillance Monitoring: Monitor for Al, Cu, Zn and specific metals in trade waste 10 yr review of effect	Numeric Limits: Compliance monitoring	Numeric Limits: EOP Compliance monitoring Sediment monitoring against guideline values as trigger for review

7. Feasibility Testing of Standard

7.1 Feasibility Testing Approach

Each decision element of the proposed decision framework in Figure 4, and as described in Section 6, was assessed using a SWOT (Strength, Weakness Opportunity, Threat) analysis. This sets out the following:

– **Strengths**—things expected to work well
– **Weaknesses**—constraints around the issue/element that will limit its application
– **Opportunities**—things that the element of the framework allows Taumata Arowai to provide additional benefit / improvements
– **Threats**—risks that the element will not work as intended or will impose unnecessary restrictions or effort

As the SWOT assessment was progressed, experienced technical practitioners discussed specific WWTP examples and issues associated with these to assess the criteria of the SWOT analysis – this was also aimed at including a range of different WWTP that were assumed to cover various risk categories.

Following the SWOT analyses a revised framework was developed that took into account the recommendations from each decision element.

7.1.1 SWOT Assessment

Each decision element presented in Figure 4 was assessed against the SWOT criteria. Details of the SWOT analyses for each decision criteria are listed in Appendix D. Key recommendations for each decision criteria and a brief rationale are listed in Table 27. Based on the outcomes of the SWOT analysis, recommendations for the consolidated framework are listed in Table 28.

Table 27 Summary of key recommendations and rationale for decision framework elements assessed in the SWOT analysis

Decision Framework Element	Key Recommendation	Rationale
WWTP excluded from Standards?	Retain exclusion, but make it metal-specific rather than excluding the whole WWTP. Clearly define "naturally elevated metals" criteria.	Helps address geologically elevated metals (e.g., arsenic) while avoiding blanket exclusions and inconsistent regional application.
Population <1,000 PE?	Do not use population size as an exclusion criterion for metals. Use input/risk-based triggers instead.	Population is a poor proxy for metals risk; small plants can still receive high-risk industrial or tankered wastes.
Receives leachate?	Combine leachate with trade waste as a single risk factor and use it as a monitoring trigger rather than a compliance trigger.	Leachate composition is highly variable and difficult to quantify, but it remains a useful indicator of potential metals loading.
Receives trade waste with significant metal loads?	Retain as a key risk trigger. Define trade waste broadly to include tankered waste and leachate.	Trade waste is one of the strongest indicators of metals risk and aligns with existing management systems.
Receives significant stormwater loads?	Retain as a risk factor using a flow-ratio approach (e.g., Peak Wet Weather Flow: Average Dry Weather Flow), with thresholds developed through consultation.	Stormwater may increase metals loading, but improved data and clear definitions are needed. Presence/absence of combined sewer or engineered discharge point from stormwater to sewer is a possible proxy for stormwater loads rather than a flow or ratio-based measure.
WWTP uses metals in treatment process?	Treat as a key risk factor. Initially focus on monitoring (particularly Al and Fe) rather than limits where feasibility is uncertain. Consider alternative standards where dosing is required for phosphorus removal.	Aluminium and iron use is expected to increase under nutrient removal controls; strict limits may conflict with phosphorus treatment objectives.
Discharge to high-dilution freshwater, open ocean, or high-energy coastal environment?	Avoid over-simplification by excluding these high-dilution environments. Separate freshwater and marine pathways and further evaluate dilution assumptions and derived limits.	High dilution may reduce risk but can still allow localised near-field (acute) effects.
Significant soft bottom reaches or estuary downstream?	Do not use as a specific trigger for additional controls. Rely instead on broader toxicity and surrogate TSS/sediment management frameworks unless evidence demonstrates WWTP derived metals are accumulating in downstream depositional RE.	Current evidence does not strongly support wastewater metals accumulation as a widespread issue in these environments.
Shellfish collected within *XX* km of discharge? (number yet to be determined)	Remove as a decision criterion. Retain only as a contextual or ecosystem indicator where appropriate.	Relationship between WWTP discharge and shellfish metal concentrations is uncertain and highly assumption dependent.

Table 28 Consolidated approach from framework testing

Theme	Framework Recommendation
Framework basis	Move from size-based screening to risk-based screening.
Key discharge risk drivers	Focus on trade waste, leachate, tankered discharges, stormwater inflow, and chemical treatment/dosing (e.g. Aluminium / Iron).
Environmental risk drivers	Focus on low-dilution freshwater and estuarine receiving environments.
Monitoring approach	Preference is for monitoring / evidence gathering before imposing widespread numeric limits.
Criteria proposed for removal from framework	Population threshold, shellfish criterion, and soft bottom / estuary trigger as standalone decision points.

Theme	Framework Recommendation
Criteria proposed for retention/modification	Exclusions, all forms of trade waste, stormwater inflow, treatment chemical use, and low dilution receiving environments.

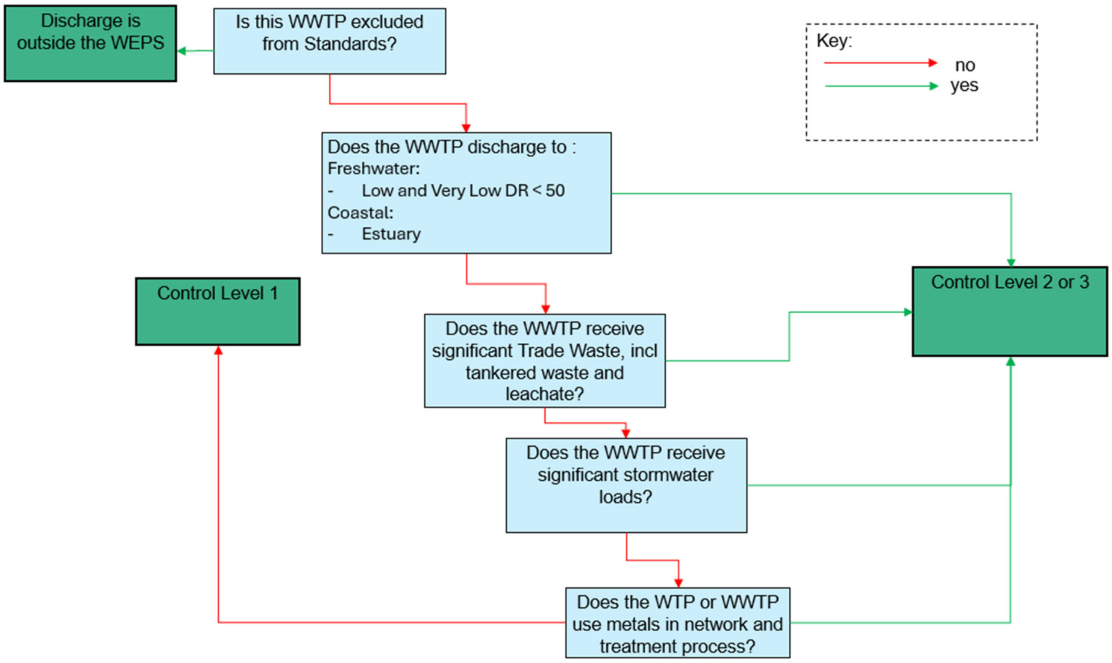

Figure 10 Consolidated Decision Framework

7.1.2 WWTP process ability to achieve the limits

A review was undertaken of the ability of WWTPs to comply with the proposed limits which were initially derived on the basis of a percentage of background DGV. On this basis, a total of 192 WWTP that discharged to water were included in the assessment. Appendix E details this review which found that:

Current NZ WWTPs rely on a combination of sedimentation, biological treatment and filtration processes (activated sludge, trickling filter, ponds) and in some cases tertiary treatment processes to produce treated wastewater to meet their current resource consent limits. These processes have not been designed specifically to reduce metals concentrations, but metals removal is incidental as a result of the physical, biochemical and sometimes chemical processes occurring as part of the wastewater treatment process.

Metal removal mechanisms associated with WWTP processes include:

– Dissolved/particulate fractions reduced via precipitation, adsorption to biosolids, solids sedimentation
– Chemical conditions which determine metal dissolved/particulate fractions (Partition coefficient K_d)
– Solids separation determines effluent TSS and removes associated metals from the liquid treated effluent stream and this impacts overall removal efficiency

Removal efficiencies:

– Vary depending on influent concentration, treatment conditions, effluent suspended solids (TSS)
– Activated sludge systems[19]: removal rates typically achieved are Pb, Cr (>90%), As, Zn (75 – 90%), Cu, Cd (55 – 95%), Ni (15 – 50%)
– Trickling filter systems[20]: Generally lower removal rates and inconsistent

[19] Santos A, Judd S. 2010. The fate pf metals in wastewater treated by the activated sludge process and membrane bioreactors: A brief Review. Environmental Monitoring.2010, 12, 110 - 118
[20] Ziolka D. et al. 2009. The effectiveness of conventional trickling filter treatment plants at reducing concentrations of copper in wastewaters, Science of the Total Environment, vol 407, December 2009.

– Waste stabilisation ponds[21]: Zn (80 – 90%), Cu (85 – 95%), Pb (50 – 70%), Cd, Ni, Cr (>90%)

Ability to achieve proposed limits

(Note: based on limits derived to achieve the 95%ile DGV after full mixing assuming that the background concentration was 50% of the 95% DGV).

WWTP removal efficiencies should generally be sufficient to achieve most of the proposed limits provided influent trade waste controls are strong and optimal TSS removal is maintained. However, for most sensitive receiving environments in the low and very low dilution and lake categories for freshwater it is uncertain whether all plants in the high risk category would be able to consistently meet the most stringent derived limits specifically for copper, zinc, chromium and potentially cadmium. For zinc, the derived limits may potentially also be difficult to achieve in other freshwater environments and estuary/harbour receiving environments. The paucity of available data means that this cannot be robustly tested at this point in time using real treated wastewater end of pipe monitoring data.

There could be site specific situations where additional controls are required, such as a small community where the treatment system is a “lower tech” single oxidation pond discharging to a minor stream and there is a predominant trade waste discharge of heavy metals (e.g.an electroplater).

The proposed standards are based on dissolved metals because this form is generally more bioavailable and is therefore used as a basis for the ANZG environmental guidelines from which the proposed limits are derived.

Where a WWTP is not able to consistently meet an imposed limit, despite robust trade waste controls, then to operationally control an existing WWTP process to meet a dissolved metal limit in an end of pipe discharge will be very challenging. There are many physical and chemical factors and highly variable conditions affecting the particulate/dissolved metals partitioning. Whilst there are technologies available to reduce dissolved metals, including membrane processes such as nanofiltration (NF) and reverse osmosis (RO), chemical precipitation and ion-exchange, the more stringent of the derived limits are very low and so would be particularly challenging to reliably achieve with current technology. Retrofitting a treatment process to specifically reduce metals would also bring additional operational complexity as well as high capital and operational cost.

On balance, it is considered that there is unlikely to be a simple, inexpensive or operationally efficient process that can be readily incorporated into existing biological treatment plants to further reduce the dissolved metal concentration in the treated wastewater. The proposed limits for copper and zinc in low and very low dilution and lake freshwater receiving environments and for low dilution marine environments would be set on or close to the limit of technology for treatment plants. As a much smaller dataset was available for chromium and cadmium, the proposed limits for these metals should be reviewed when further data is available to better understand limit of technology.

On this basis and considering the paucity of actual treated wastewater data with which to robustly test the proposed limits, it was considered the proposed numeric limits for low and very low dilution and lake freshwater receiving environments (copper, chromium and potentially cadmium) and all freshwater receiving environments plus estuaries/harbours (zinc), that are allocated to the high risk category in the controls framework, may not be met by a number of WWTPs. There is also no clear and cost effective way to improve discharge quality if trade waste controls are already robust.

This led to review of the risk and controls framework and the proposed numeric limits. A number of further options for implementation were explored. These are outlined in Section 7.3.

[21] Toumi A, Nejmeddine A. 2000. Heavy metal removal in waste stabilisation ponds and high rate ponds, Water Science & Technology, 42(10), 17- 21.

7.2 Consolidated Risk Assessment

7.2.1 Discharge and Environment Risk Level Identification

The amended approaches to the Discharge Risk Category and Environment Risk Category are listed in Table 29 and Table 30, respectively.

For the Discharge Risk Category, a category of ‘High’ is assigned if the WWTP receives trade waste and/or landfill leachate; if the WWTP uses metal (aluminium or ferric) for the wastewater treatment or odour treatment process; or if the WWTP receives a significant stormwater load[22].

The Discharge Risk is assigned independently of the WWTP size – recognising that small WWTP may also receive trade waste /leachate, or use chemical treatment, or receive proportionally significant stormwater loads. It is also noted here, each risk factor acts independently of other risk factors, thus any single factor can result in an overall ‘High’ risk level.

Table 29 Amended discharge risk assessment

Discharge Risk Category	Trade Waste Inputs	Chemical Use in Water or Wastewater Treatment Plant	Significant Stormwater Load
Discharge Risk - High	Leachate from landfill, tankered waste and/or trade waste with potentially "high" metals. Identified through the Presence of “Conditional Trade Waste[23]” within the WWTP catchment	Al or Fe for water treatment and the ‘sludge’ is discharged to sewer, or P reduction in WW treatment or odour control	Presence/Absence of combined sewer and/or engineered connections designed to allow overflow of stormwater into sewer network.

[1] Discharge Risk Category not assessed as ‘High’ = ‘Other than High’ (i.e. low, medium risk)

Table 30 Amended receiving environmental risk assessment

Environment Risk Category[1]	**Dilution Ratio**
Environment Risk - High	Freshwater: – Low and Very Low DR < 50 Coastal: – Estuary

[1] Environmental Risk Category not assessed as ‘High’ = ‘Other than High’ (i.e. low, medium risk)

7.2.2 Amended Risk Based Control Framework

As set out in Section 6.1.2 a series of proposed risk-based controls were identified for the management of both discharge and environment risks. Following the SWOT analysis and revised approach to the discharge and environment risk frameworks, the consolidated recommended risk-based control tools are listed in Table 31. This lists three levels of control, combining surrogate and surveillance monitoring for ‘Other than High’ (i.e. low to moderate risk thresholds), escalating to the incorporation of 10-year reviews and End of Pipe / receiving environment monitoring for High Risks combination.

Table 31 Consolidated discharge and environmental risk based control framework for feasibility testing

Discharge Risk / Environmental Risk	Environment Risk – Other than High	Environment Risk – High
Discharge Risk: Other than High	**Level 1 Control:** TSS and TP[1] as a surrogate Information monitoring of treated wastewater	**Level 2 Control:** TSS and TP[1] as surrogate Surveillance monitoring of treated wastewater

[22] Assessed on the basis of Presence/Absence of engineered controls and/or combined sewer/stormwater networks. The imposition of requirement to assess the contribution of network inflow and infiltration was considered but discontinued as this is too onerous for the purpose of this risk assessment method.
[23] As defined by Model TW Bylaw as given in **Error! Reference source not found.** of this report.

Discharge Risk / Environmental Risk	Environment Risk – Other than High	Environment Risk – High
		10 yr review with numeric limits as trigger values for investigation[2]
Discharge Risk: High	**Level 2 Control:** TSS and TP[1] as surrogate Surveillance Monitoring of treated wastewater 10 yr review with numeric limits as trigger values for investigation	**Level 3 Control:** Numeric Limits: Compliance monitoring of treated wastewater If required by the Regional Council, Receiving Water and/or Sediment monitoring against ANZG Default Guidelines as trigger(s) for review[3]

[1] The use of TP as a surrogate only applies to WWTP not defined as a small WWTP as per 2025 WEPS Regulation 58, and noting Regulation 59(a) that does not require TN or TP discharge concentrations to be met. The treatment process required to achieve the TSS limits will also reduce the particulate form of metals. The TP limits, especially the limits for low dilution situations, require a greater level of treatment than the TSS limit. This higher level of treatment will further reduce the metals that required just to achieve the TSS limit.

[2] Exceedance of a Level 2 trigger value may initiate investigation of potential contaminant sources and associated risks. The 10-year review is intended as a periodic framework review and does not prevent earlier intervention by the consent authority where monitoring results indicate elevated risk or adverse environmental effects.

[3] These surveys can be required by the Regional Council as conditions of the consent. The need for them would be identified as part of the processing of the application.

7.3 Review of Options for Implementation of Risk Framework and Limits

Given the paucity of existing data regarding metals concentrations in treated wastewater, any numeric standard proposed would benefit from addressing this data gap to enable robust consideration of the sector's ability to meet them. There are several ways this could be achieved, including:

– Request data from asset owners, including voluntary data, either during or as part of consultation
– Rely on gradual buildup of data over the course of the implementation of the metal WEPS, as consents are granted and monitoring is required, rely on "bow wave" of new consents to provide range of information over initial period of implementation
– Require through the metal WEPS that **all** WWTPs undertake collection of at least 2 samples per year from enactment of the regulations and supply these to Taumata Arowai

Given that the copper and zinc limits for low and very low dilution and lake freshwater environments are considered very challenging for the sector to meet with current technology and at reasonable cost a number of alternatives to setting numeric limits for compliance were considered and these are outlined below:

1. Do not set numeric limits at this point, collect data to fill the gap and then set appropriate limits in the future This approach could apply to all plants, all metals and all receiving environments.
2. Do not set numeric limits for low and very low dilution and lake freshwater, not for the sensitive estuarine receiving environments. This approach would only apply to low, very low dilution and lake freshwater environments and estuaries and only for copper and zinc. It could be coupled with site specific limit setting.
3. Progress with site-specific determination of limits for low and very low dilution and lake freshwater and estuary receiving environments. This approach would only apply to low, very low dilution and lake freshwater and estuaries and for copper and zinc. Regional council would then be required to set consent limits for these metals based on the site-specific assessment.
4. Use numeric trigger values where exceedance results in required actions which escalate based on severity. This approach could apply to medium and high-risk plants, all receiving environments and all metals.
5. Use trigger values or numeric limits which also enable site specific assessments to demonstrate that site specific risk is less than that assumed by the numeric value and enables movement between risk

categories. Moderating factors may include background metal concentrations, pH, water hardness etc. This approach could be applied to medium and high risk plants, all metals and all receiving environments.

6. Numeric limits could be proposed as presented in Table 33 with data collection during consultation and beyond which enable refinement of the limits in the future. This approach could apply to medium and high-risk plants, all receiving environments and all metals.

It was determined that option six be progressed forward to consultation on the basis that it is generally consistent with the Tranche 1 approach and presents the simplest set of limits, risk and control framework for implementation.

These limits must provide a set of robust evidence and science based numeric limits that are sufficiently protective of the receiving environments so as to effectively manage the risk of more than minor adverse environmental impacts and that appropriately balances access to suitable technologies and cost efficiency. Achieving this balance requires specific consideration of limits set for copper and zinc in low and very low dilution and lake freshwater environments and estuaries.

The final set of proposed limits to inform the consultation process is set out in Table 33.

7.4 Worked examples

Table 32 shows a series of worked examples demonstrating where particular WWTP are likely to end up in the proposed framework. It is noted here that these examples have not been explicitly tested against the 2025 WEPS dilution criteria, rather assumptions about the direct receiving environment dilution capability have been applied.

- Large municipal WWTPs are generally associated with larger towns, cities, or regional urban centres, such as Christchurch, Palmerston North, Whangārei, Nelson, Napier, Blenheim, Timaru and Auckland, that typically service larger populations and more complex catchments. These plants likely include trade waste, stormwater inputs, or coastal/estuarine receiving environments. As a result, these examples tend to sit within the higher nominal contaminant control levels, generally Level 2 or Level 3.
- Medium-sized WWTPs are commonly associated with smaller towns or district centres, such as Huntly, Ngāruawāhia, Morrinsville, Gore, Reefton and Westport. These examples show more variation, reflecting differences in local catchment characteristics, receiving environments and the likely presence of trade waste or stormwater inputs. Medium-sized schemes therefore do not fall into a single control category but generally sit between the larger urban examples and the smaller rural schemes.
- Small WWTPs are mostly associated with rural settlements, small townships, and coastal communities, including places such as Browns, Otane, Duvauchelle, Piopio, Opononi, Seddon and Waihou. Many of these communities appear to have less complex wastewater catchments, with trade waste, stormwater inputs and chemical phosphorus treatment generally identified as unlikely. These examples are commonly assigned lower nominal contaminant control levels, particularly Level 1.
- The table also shows that small coastal or rural communities are not always treated the same. Some small schemes have higher control levels where the receiving environment is more sensitive, has lower dilution, or where trade waste or stormwater inputs are likely. The local context still influences the final control level.

Table 32 Worked examples of WWTP

WWTP	Size	At risk receiving environment?	Trade waste (includes leachate / tankering)	Stormwater (Y/N)	Use of chemicals to treat TP	Nominal Level of Control*
Bell Island, Tasman	Large	Yes	Yes			3
Blenheim, Marlborough	Large	Yes	Likely	Likely		3
Whangarei, Northland	Large	Yes	Likely	Likely		3
Cambridge, Waikato	Large	No	Likely	Likely	Yes	2
Pukekohe, Waikato	Large	Yes	Yes	Likely	Yes	3
Mangere, Auckland	Large	Yes	Yes	Yes		3
Totara Rd Palmerston Nth, Manawatū-Whanganui	Large	No	Yes	Yes		2
Awatoto (Napier)	Large	No	Likely			2
Timaru, Canterbury	Large	No				2
Christchurch, Canterbury	Large	No	Likely	Yes		2
Te Maunga, Bay of Plenty	Large	No				2
Nelson North, Nelson	Large	No	Yes			2
Waipukurau, Hakes Bay	Medium	No			Yes	2
Waipawa, Hawkes Bay	Medium	No			Yes	2
Westport, West Coast	Medium	Yes				2
Gore, Southland	Medium	No	Likely			2
Reefton, West Coast	Medium	No				1
Huntly, Waikato	Medium	No		Yes		2
Ngaruawahia, Waikato	Medium	No		Yes		2
Featherston, Wellington	Medium	Yes		Yes		3
Western Treatment Plant, Wellington	Medium	No	Likely			2
Green Island, Otago	Medium	No	Yes			2
Morrinsville, Waikato	Medium	Yes	Yes			3
Collingwood, Tasman	Small	Yes				2
Browns, Southland	Small	Yes				2
Otane, Hawkes Bay	Small	Yes				2

WWTP	Size	At risk receiving environment?	Trade waste (includes leachate / tankering)	Stormwater (Y/N)	Use of chemicals to treat TP	Nominal Level of Control*
Duvauchelle, Cantebury	Small	No				1
Havelock, Marlborough	Small	Yes	Likely	Likely		3
Norsewood, Manawatu-Whanganui	Small	No	Unlikely	Unlikely	Unlikely	1
Piopio, Waikato	Small	No	Unlikely	Unlikely	Unlikely	1
Pongaroa, Manawatu-Whanganui	Small	No	Unlikely	Unlikely	Unlikely	1
Tokanui, Southland	Small	No	Unlikely	Unlikely	Unlikely	1
Seddon, Marlborough	Small	No	Unlikely	Unlikely	Unlikely	1
Waiotira, Northland	Small	No	Unlikely	Unlikely	Unlikely	1

8. Recommended Standard for Consultation

8.1 Introduction

This section provides a summary of the proposed metals standard that is recommended for consultation with stakeholders. This is the result of the process as described in this report, that was undertaken to develop the standard and the various decisions that have been made to address the issues raised throughout the process.

The main text in the following sections describes the standard as proposed. The yellow boxes at the end of each section identify the section(s) where this aspect of the standard was discussed and a brief suggestion for consultation with stakeholders to gather feedback on the decisions that have been made in developing the proposed standard.

8.2 Case for the Metals Standard

Metals in wastewater are derived from a number of sources including trade waste, stormwater and chemical treatment processes. Treatment plants are not specifically designed to remove these metals but these influent concentrations are reduced as a positive co-benefit of the solids removal processes undertaken at WWTPs. Whilst only a very small number of WWTPs in New Zealand monitor for metals concentrations in treated wastewater and even fewer operate to meet specific resource consent compliance limits, some metals are highly toxic and/or bioaccumulate in aquatic ecosystems, at very low levels, especially in dissolved form.

On the basis of this risk, there is a valid case for developing a metals standard which will be protective of receiving environments through the effective management of metals in wastewater discharges. Acknowledging the current paucity of treated wastewater data upon which to derive a standard, the proposed approach will involve the following elements;

- Site specific risk assessment and controls framework to determine the risk posed by a particular treated wastewater discharge and controls that are appropriate to the level of risk determined
- Setting trigger levels for assessment of the monitoring results for some risk categories to indicate where further site-specific investigations are needed

– Application of limits to the high-risk category, with associated compliance monitoring and reporting, where potential risks of effects from metals are present due to the nature of the catchment or the receiving environment
– Expanding the knowledge base through monitoring and data reporting requirements, which can be achieved with a low level of sampling effort and cost
– Periodic review of the Standard to enable new data, toxicology information/ guidelines and potentially new technology, to be considered

Consultation topic:
Section 4: Do you agree that this is a strong case for developing a metals standard?

8.3 Scope of Metals Standard

The proposed Framework builds on the structure provided by 2025 WEPS, therefore regulations with respect to metals should be included as additional regulations in Part 3 of the 2025 WEPS, rather than a separate regulation.

Previous discussions have referred to this standard as being for “heavy metals”, which is an ill-defined term and does not cover all the metals of concern. In particular, a metal of concern for a number of reasons is Aluminium, which is not a heavy metal.

Therefore, we recommend that the standard is developed to address “metals” rather than “heavy metals”. This should be included into Regulation 41 to widen the purpose of the 2025 WEPS to include metals.

The Exceptions included in the 2025 WEPS in Regulation 6 and 7 for whole Standard and Regulations 43 and 44 for Discharges to Water are generally appropriate for the metals standard. An addition should be made to Regulation 44 to include naturally elevated metals as follows:

Possible new part (c) “*the discharge concentration limits for specific metals (see regulations XX) do not apply to discharging treated wastewater into a water body that, due to naturally occurring processes, contains sufficient concentrations of that metal for the discharge not to cause any adverse effects.*”
This is considered appropriate because where naturally occurring elevated levels are evident then the ecosystems will have naturally adjusted to these conditions and will be more tolerant of metals in the receiving environment. It is however noted that it may also be possible that some organisms may be near the limit of their stress threshold and will not be resilient to the addition of more metals. Hence, where naturally elevated metals concentrations are observed, a site specific assessment will be undertaken under current RMA processes or those that will replace it.

Consultation topic:
Section 5.2.3: Are there any other exceptions that should be allowed for in the Standard?

8.4 Framework for Metals Standards

8.4.1 Risk Based Framework

The recommended standard will use a risk basis for identifying the appropriate levels of controls that would apply to a WWTP discharge. The elements that will be assessed include:

– Discharge Risk Categories. Risk is considered High if any of the following cases are present:
  - Trade Waste Inputs: Presence of any “Conditional Trade Waste” as defined by the Model Trade Waste Bylaw within the WWTP catchment. This should include waste received by sewer or by tanker and is listed in Figure 1
  - Leachate from landfill, tankered waste
  - Chemical Use in Wastewater Treatment Plant or wastewater network.
  - Significant Stormwater Load: defined as any network which includes combined sewers or engineered connections designed to allow overflow of stormwater into sewer network.

– Environment Risk Category. Risk is considered High if the discharge is into any of the following low dilution scenarios:

- Freshwater: Low and Very Low DR < 50
- Coastal: Estuary

It is also noted that, each risk category acts independently of other risk categories, thus any single category can result in an overall ‘High’ risk level. If these conditions are not present, then the risk for that category is considered “other than high” (i.e. moderate or low risk).

Consultation topics on Section 7.1.1: Aspects of the risk framework:

- Assessment of risk based purely on size (i.e. small WWTP as used in Tranche 1 for nutrients) has not been included in the framework as size is a poor indicator of potential presence of metals.
- Risk from Trade Waste is based on the presence of any “Conditional Trade Waste” discharging to the network. The definition of a flow-based threshold is not proposed owing to expected difficulties in sourcing the relevant flow data during implementation. Therefore, the test in the risk framework is a simple presence/absence test for trade waste on the “Controlled Activities” list in the Model Trade Waste Bylaw as given in Table 6 of this report.
- We have assumed that the Drinking Water Quality Assurance Rules (DWQAR) adequately address risks of metals in supplied water, particularly if the metals are used in chemical dosing as part of the water treatment process, and it provides sufficient control over the chemical composition of the supplied water with respect to mobilising metals in the catchment into the influent to the WWTP. Therefore, no additional controls on supplied water as part of the WEPS are proposed
- The shellfish gathering area and the soft bottom / estuary trigger for risk assessment has not been included as a decision point in the risk framework. Whilst there is considerable evidence that sedimentation and nutrient accumulation is an issue in these environments, there is minimal evidence that build-up of metals from wastewater discharges is occurring and leading to adverse impacts.
- After considering a tiered risk structure, we decided that the simple approach of “high risk versus other than high risk” for each element adequately reflects the differential in risk, and the resultant control methods applied.
- Given the simplicity of the proposed risk framework, we have recommended that a Suitably Qualified and Experienced Practitioner (SQEP) is NOT required to perform the assessment. The independent review performed by the Regional Council in processing the consent application is sufficient.

8.4.2 Summary of Controls Imposed

The controls that could be imposed resulting from the risk assessment have been identified as levels of control as follows:

– Level 1 Control:
  - If discharge risk **and** environmental risk are both **“Other than high”**
  - TSS and TP, except for small WWTPs, as a surrogate[24]
  - Information monitoring of discharge

– Level 2 Control:
  - If discharge risk **or** environmental risk are **“High”**
  - TSS and TP, except for small WWTPs, as surrogate
  - Surveillance monitoring of discharge
  - 10 yr review with numeric limits used as trigger level values which initiate investigation of contributing sources

[24] The treatment process required to achieve the TP limits especially at low limits require a greater level of treatment than the TSS limit. This higher level of treatment will also reduce the metals, especially the particulate form.

– Level 3 Control:
  - If discharge risk **and** environmental risk are **"High"**
  - Numeric Limits
  - Compliance monitoring of discharge
  - Receiving Water and Sediment monitoring, as required by regional council, against ANZG Default Guidelines as trigger(s) for review

8.4.3 Proposed Numeric Limits

Based on the feasibility testing carried out, the proposed numeric limits have been set as follows:

– Freshwater receiving environments (rivers): using a proportional mixing assumption associated with low end of each of the receiving environment dilution values and derived from current or draft (copper and zinc only) chronic ANZG DGVs for the 95% species protection level.

– Freshwater receiving environments (lakes): generally use a proportional mixing assumption for the receiving environment and derived from current or draft (copper and zinc) chronic ANZG DGVs for the 95% species protection level

– Marine water receiving environments: using a near-field dilution assumption associated with each receiving environment and derived from current chronic ANZG DGVs for the 95% species protection level. Except for copper and zinc which will apply the overall (full) dilution assumption.

– Limits for cadmium, lead and mercury were based on the bioaccumulative derivation (full dilution and current chronic DGV at 99% species protection level) where it was the most stringent limit

Data on the existing performance of WWTPs with regard to metal reduction and discharge quality is sparse leading to high levels of uncertainty about what discharge quality treatment plants are currently achieving and what they are doing to manage key risk factors such as trade waste inputs, stormwater inflows and chemical treatment methods.

Initial approaches and testing of numerical limits highlighted that the derived limits for dissolved copper, zinc, chromium and potentially cadmium and nickel in low and very low dilution and lake freshwater receiving environments and for dissolved zinc in other freshwater environments and estuary/harbour receiving environments would be very challenging to achieve with a low potential for additional treatment technology to be successfully and cost effectively retrofitted to existing plants to reduce dissolved metals concentrations further.

Thus, the numeric limits for copper and zinc for low and very low dilution and lake freshwater receiving environments has been proposed at the same level as that for a moderate dilution receiving environment. It is noted that there remains a potential issue of compliance for zinc in freshwater and estuary/harbour receiving environments as well as for chromium and potentially cadmium in low and very low dilution and lake freshwater. The numeric limits for all metals should be reviewed once further data is available.

Whilst between 10 and 15% of plants (approximately 50) would fall into the sensitive low and very low freshwater and estuary/harbour categories, only a portion of these will also have high-risk discharge factors. Higher dilution freshwater categories and marine waters, excluding estuaries/harbour, are less likely to result in high-risk discharge factors. For those that are determined to be in the high-risk category, there is potential that under certain physico-chemical conditions dissolved copper and zinc concentrations in the receiving waters may mean that the 95 % species protection may not be achieved for these metals. This potential risk is considered to apply to a small number of plants and is thought to be mitigated in part by the following:

– Gathering and analysis of metals data from a wide range of New Zealand WWTPs which will enable the proposed limits to be further tested and reviewed in the context of what is being and can be achieved.

– TSS and Phosphorus limits were set in Tranche 1 and are considered protective of sensitive receiving environments. The methods required to achieve these Tranche 1 limits will help moderate and control metals concentrations in discharges to meaningful degree.

– ANZG DGVs are derived based on modelling and toxicity testing of representative species. They tend to be conservative and are specifically intended to be used to trigger site specific investigations and assessments that can take into account location specific factors such as background, pH, water hardness and organic compounds all of which can affect the prevalence of dissolved metal species.

On balance, given the level of uncertainty with respect to actual WWTP discharge quality and assuming that trade waste and other discharge risk factors are managed, the proposed copper and zinc limits for high-risk sites are considered to represent an appropriate balance of environmental risk, effectiveness of available retrofit technologies/approaches and cost efficiency.

Table 33 shows the proposed treated wastewater limits for freshwater and marine environments. For each metal (except copper and zinc), the most stringent of the derived limit for respective dilution categories has been applied. For copper and zinc, given the concerns expressed above for freshwater low and very low dilution and lake categories, the derived limit for freshwater moderate category is applied. For similar reasons, full dilution derived limits have been applied for copper and zinc in the marine receiving environments. All marine limits for other metals have been proposed at the most stringent derived limit.

For all derived limits, refer to Section 5.4 for full descriptions across each type. The numeric limits would apply as the annual 90th percentile for most WWTPs, except small WWTPs for which the limit will be measured as an annual 75th percentile, as stated in Regulation 59.

Table 33 Proposed numeric limits to apply to metals WEPS standard in mg/L

Receiving Environment Category	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Unit	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Freshwater[3]									
High	6.875	1.6250	0.015	0.1250	0.0588	0.25	0.015	1.3750	0.5125
Moderate	1.375	0.3250	0.003	0.0250	0.0118	0.05	0.003	0.2750	0.1025
Low	0.275	0.0650	0.0006	0.0050	0.0118[4]	0.01	0.0006	0.0550	0.1025[4]
Very Low	0.1375	0.0325	0.0003	0.0025	0.0118[4]	0.005	0.0003	0.0275	0.1025[4]
Lakes	1.100	0.2600	0.003	0.0200	0.0118	0.05	0.003	0.2200	0.1025
Marine[5]									
Estuaries / Harbours	0.740	-	0.035	0.0880	0.03	0.0880	0.005	0.1180	0.4
Low Energy Coastal	0.740	-	0.07	0.0880	0.06	0.0880	0.0080	0.1180	0.8
High Energy Coastal	0.740	-	0.1100	0.0880	0.12	0.0880	0.0080	0.1180	1.6
Open Ocean	3.700	-	0.5500	0.4400	0.6	0.4400	0.0400	0.5900	8

[1] Limit to apply as annual 90%ile of monitored data set for medium and large plants. Limit to apply as annual 75%ile of monitored data set for small plants.

[2] Applies to dissolved fraction of all metals

[3] Freshwater: current or draft (copper and zinc only) chronic ANZG DGC for 95% species protection level, assuming 50% mixing in rivers. In Lakes, near field dilution for Aluminium,,Chromium and Nickel and 50% of full dilution for copper and zinc.

[4] Copper & Zinc – DRAFT chronic ANZG DGV for 95% species protection level for moderate receiving environment category

[5] Marine: current chronic ANZG DGC for 95% species protection level, assuming full dilution for copper and zinc only, all other metals have assumed near field dilution mixing

[6] Cadmium, lead and mercury limits for receiving environments are based on the bioaccumulative derived limit where it is the most stringent.

Consultation topics:

- Section 3.4.1 presents the information on metal limits that are applied to existing consents. Section 5.4.11 and 7.1.2 discuss the information that is available on the concentrations of metals in treated wastewater, which is minimal particularly as discharged to freshwater. The information that has been reviewed indicates that the proposed limits are not inconsistent with those currently applied in consents and will generally be achievable for most WWTPs, potentially with the exception of copper, zinc, chromium and cadmium in more sensitive receiving environments. Hence, further information on whether WWTPs will be able to achieve the numeric limits would be usefully sought. Especially on whether additional management of the influent or a treatment upgrade would be required. It is expected that where elevated levels are observed they will initiate an investigation into potential upstream/ trade waste contributions and may lead to additional upstream controls on the relevant businesses where appropriate. This would encourage contaminant reduction at the source, with costs allocated to the contributors, rather than necessitating costly treatment plant upgrades. If upgrades or additional controls are required to comply, an indication of the expected cost of undertaking this would be useful in determining the cost to benefit ratio of imposing the metals standard. Noting that there are limits to current treatment technology.
- Section 7.2.1: Use of limits and monitoring required by the 2025 WEPS for TSS and TP, except for small WWTPs, as a surrogate for presence of metals. The treatment process required to achieve the TSS limits will also reduce the particulate form of metals. The TP limits, especially the limits for low dilution situations, require a greater level of treatment than the TSS limit. This higher level of treatment will further reduce the metals from that required just to achieve the TSS limit.
- Section 5.4: On a precautionary basis, the most constraining derived limit has been proposed for each metal and receiving environment category, except for copper and zinc as described above. However, this may exceed actual treated wastewater concentrations by a considerable margin for the higher dilution environments and may require additional control than is currently undertaken for the low dilution environments.
- There is minimal information available on the actual treated wastewater concentrations throughout New Zealand, and none on some of the receiving environment categories considered. Most analysis has been conducted for the total form of the metal, rather than the dissolved form which is the recommended form against which the derived limits will be assessed. Further as demonstrated by the change in the DGVs between the current and DRAFT DGVs as discussed in Section 3.1, the toxicology on which the receiving environment guidelines are based can change rapidly, particularly for metals of interest. In view of this paucity of data on treated wastewater and the potentially rapidly changes in toxicology information, it is recommended that the numerical limits included into the metals WEPS be reviewed at five to ten year intervals.
- The ability to treat the wastewater to achieve the phosphorus standards in the 2025 WEPS is important to ensure risks of nutrient pollution and eutrophication in the receiving environment are appropriately managed. The derived limits were similar to the UK limits for aluminium or iron where chemical dosing for phosphorus reduction as described in Section 5.4.9. However, the adoption of the derived metals limits could limit the ability of WWTPs to achieve the phosphorus limits in the 2025 WEPS.
- The use of metals (aluminium or iron) to reduce TP can also reduce the pH which can solubilise metals and hence buffering may be required before discharge. We anticipate that this will not impose significant operational issues.

8.4.4 Monitoring and Reporting

The sampling frequency for each level of control would be:

– Information monitoring: quarterly of treated wastewater
– Surveillance and Compliance Monitoring:
– Small plants: quarterly (i.e. 3 monthly) of treated wastewater
– Medium plants: monthly of treated wastewater (noting this is reduced from Tranche 1)
– Large plants: fortnightly of treated wastewater (noting this is reduced from Tranche 1)
– Receiving Water and/or Sediment monitoring: These surveys can be required by the Regional Council as conditions of the consent. The need for them would be identified as part of the processing of the application

- It is anticipated a SQEP would advise the applicant on the scope and extent commensurate with the risk identified, giving greater certainty to applicants. Field surveys, if required, would be required once every five years

Analysis to include analysis for Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel and Zinc and any specific other metals identified as potentially present through risk assessment process. Analysis to be undertaken of the dissolved fraction of metals.

Reporting will be as currently required in Regulation 82.

Consultation topics:

- Monitoring is proposed for all WWTPs, with the scope and frequency dependent upon the level of risk. The frequency of sampling is adjusted to reflect the risk. Additional costs for the treated wastewater sampling are expected to be the analytical costs only, as samples will already being collected for the Tranche 1 standards. The frequency of sampling for metals is reduced from that required in the 2025 WEPS.
- However, for the highest risk level, monitoring of receiving water, sediment and/or shellfish flesh may be required at the discretion of the Regional Council. Receiving environmental sampling costs would include staff, logistics, equipment hire which could include boats and divers, development of sampling programme, data analysis and reporting. The cost of this additional sampling will be considerable in the order of $20,000 to over $200,000 depending upon the complexity of sample collection as described in Section 2.5.
- This approach to monitoring has been proposed to address the current information gaps, with the reduced frequency and scope for low risk discharges to address cost concerns.

8.4.5 Potential Staging of Compliance

The Tranche 1 2025 WEPS allow for the following staging for bringing WWTPs into compliance with any applied limits, which would also apply to the metals standards:

- Regulations to check whether small WWTP status still applies (cf and allows 3 years for the WWTP to be upgraded meet the relevant control for larger WWTPs (cf DtW Reg 83). This could be a useful framework for the management of a shift in the risk status of a WWTP with respect to metals.
- Timeframes for achieving compliance with the standards (cf DtW Reg 84 allows 5 years from consent issue), if they are not complied with from the start of the consent. This may be needed for any limits which are imposed on metals.
- Notification requirements if a WWTP does not comply with the limits, and that a consent may specify conditions to apply if the discharge exceeds concentration limit (DtW Reg 81).

9. Abbreviations and acronyms

Table 34 Abbreviations and Acronyms

Term	Definition
ADF	Average Daily Flow
Al	Aluminium
Amm-N	Ammoniacal Nitrogen
ANZG	Australia and New Zealand Guidelines
As	Arsenic
$cBOD_5$	Carbonaceous Biological Oxygen Demand (5-day test)
Cd	Cadmium
CMA	Coastal Marine Area
Cu	Copper
Cr	Chromium (Hexavalent chromium (Cr(VI))
CSO	Consultancy Service Order
DtL	Discharge to Land
DtW	Discharge to Water
DR	Dilution Ratio
EBPR	Extended biological phosphorus reduction
EOP	End of Pipe
Fe	Iron
Hg	Mercury
I&I	Inflow and Infiltration
ILOS	Increased Level of Service
IUVA	International UV Association
LOS	Level of Service
LOT	Limits of Technology
LRV	Log10 Reduction Values
MBR	Membrane Bioreactor
MLD	Megalitres per day
7-day MALF	7-day Mean Annual Low Flow
Ni	Nickel
NPS-FM	National Policy Statement for Freshwater Management
ORP	Oxidation Reduction Potential
Pb	Lead
PE	Population Equivalent
QMRA	Quantitative Microbial Risk Assessment
RE	Receiving Environment
RMA	New Zealand Resource Management Act 1991
SQEP	Suitably Qualified and Experienced Practitioner
T1	Tranche 1

Term	Definition
TP	Total Phosphorus
TSS	Total Suspended Solids
TW	Trade Waste
UVT	Ultraviolet Transmissivity
WEPS	Wastewater Environmental Performance Standards
WWTP	Wastewater Treatment Plant
Zn	Zinc

10. Glossary

Table 35 Glossary

Term	Definition	Source
7-day Mean Annual Low Flow	Flows calculated by averaging the lowest seven-day rolling mean flow for each year on record. It is calculated based on full hydrological years (June to July) to avoid splitting a single drought event across years.	**LAWA Glossary**
Acute Toxicity	A lethal or adverse sub-lethal effect that occurs as the result of a short exposure period to a chemical relative to the organism's life span.	**ANZ Guidelines for Fresh & Marine Water Quality Glossary**
Assimilative Capacity	The maximum loading rate of a particular pollutant that can be tolerated or processed by the receiving environment without causing significant degradation to the quality of the ecosystem and hence the community values it supports.	**ANZ Guidelines for Fresh & Marine Water Quality Glossary**
Ammoniacal Nitrogen	Covers two forms of nitrogen: ammonia and ammonium.	**LAWA Glossary**
Bioaccumulation	The accumulation overtime of a substance or contaminant (e.g. heavy metal) in a living organism.	**LAWA Glossary**
Chronic Toxicity	A lethal or sub-lethal adverse effect that occurs as the result of exposure to a chemical for a period that is a substantial portion of the organism's life span or an adverse sub-lethal effect on a sensitive early life stage'	Method for deriving Australian and New Zealand water quality guideline values for protecting aquatic ecosystems from toxicants - update of 2018 version.
Coastal Marine Area	Refers to the foreshore, seabed, and coastal water, and the air space above the water – of which the seaward boundary is the outer limits of the territorial sea. of which the landward boundary is the line of mean high water springs, except that where that line crosses a river, the landward boundary at that point shall be whichever is the lesser of 1 kilometre upstream from the mouth of the river; or the point upstream that is calculated by multiplying the width of the river mouth by 5.	**New Zealand Resource Management Act 1991**
Controlled Activity	Activities described by section 87A(2) of the RMA which require a resource consent from the Regional Council.	**New Zealand Resource Management Act 1991**
Heavy Metal	High atomic weight metals, including copper, lead, zinc, chromium, cadmium, mercury. Toxic to biota at high concentrations.	**New Zealand Municipal Wastewater Monitoring Guidelines**
Dissolved Metal	Metals in a water sample that pass a 0.45 micron filter. Often used as a measure of the portion of total metals that are bioavailable (and hence toxic to biota).	**New Zealand Municipal Wastewater Monitoring Guidelines**
Dissolved Oxygen	Oxygen gas that is freely available in water to sustain the lives of fish and other aquatic organisms.	**New Zealand Municipal Wastewater Monitoring Guidelines**
Discharge	Volume of treated wastewater that is released from a wastewater treatment plant into the receiving environment.	**Technical Advice on Discharge to Water Standards**

Term	Definition	Source
Dilution Ratio	Ratio of receiving environment flowrate/volume to wastewater discharge flowrate/volume. A measure of extent of dilution that takes place within the receiving environment.	**Technical Advice on Discharge to Water Standards**
Metal	Metals are naturally occurring elemental contaminants that may occur in dissolved, particulate, or complexed forms in water and sediment. In receiving environment assessments, metals typically include both metallic and metalloid elements (e.g., copper, zinc, lead, nickel, chromium, arsenic).	Adapted from **ANZ Guidelines for Fresh & Marine Water Quality Glossary**
Mixing zone	Zone in which mixing of the treated wastewater discharge takes place in the receiving environment.	**New Zealand Municipal Wastewater Monitoring Guidelines**
Near-field Mixing	Mixing and dispersion of the discharge with the water of the receiving environment that occurs immediately in the vicinity of discharge point. Occurs due to the buoyancy and momentum of the discharge plume as it discharges from the diffuser.	**Technical Advice on Discharge to Water Standards**
Receiving Environment	Any waterbody receiving discharge from a wastewater treatment plant.	**Adapted from NPSFM**
Total Metal	The concentration of a metal in an unfiltered sample that is digested in strong nitric acid.	**ANZ Guidelines for Fresh & Marine Water Quality Glossary**
Total Phosphorus	A measure of all forms of phosphorus in the water, including dissolved and particulate, organic and inorganic. Reflects the potential for the discharge to cause nutrient effects.	**LAWA Glossary**
Total Suspended Solids	The entire amount of organic and inorganic particles dispersed in water.	**US EPA**
Toxicity	The inherent potential or capacity of a material to cause adverse effects in living organisms.	**ANZ Guidelines for Fresh & Marine Water Quality Glossary**
Trade Waste	Any liquid, with or without matter in suspension or solution, that is or may be discharged from a Trade Premises to the WWA's Sewerage System	NZ Model Trade Waste Bylaw NZS 9201:Part 23:2004
Ultraviolet Transmissivity	An indication of the ability of a liquid to transmit UV light at the specified wavelength.	**Technical Advice on Discharge to Water Standards**

Appendices

Appendix A

Literature review and NZ Trade Waste Bylaw

Wastewater Standards – Discharges to Water: Metals

Literature Review

This literature review was undertaken to support the development of wastewater environmental performance standards for metals by examining international approaches to the regulation, management, treatment, and monitoring of heavy metals in wastewater discharges. Consistent with the project scope, the review focused on regulatory frameworks, guidance documents, environmental quality standards, permitting approaches, and best practice management measures from Australia, the United States, Canada, the European Union, and the United Kingdom. The review sought to identify how different jurisdictions control metals in municipal wastewater, the metals commonly regulated, the rationale for regulating these contaminants, and the monitoring requirements used to demonstrate compliance.

A high level summary of the international regulations is shown in Table 1 below. A more detailed outline of the sources identified from the international literature review is provided in Table 2, with numerical limits outlined in Table 3.

The review found that there is no single internationally adopted approach to regulating heavy metals in wastewater discharges. Instead, most jurisdictions use a combination of receiving-environment objectives, environmental quality standards, discharge permitting, source control, trade waste management, and treatment requirements to manage risks associated with metals. Controls are generally intended to protect aquatic ecosystems, human health, sediment quality, and food resources, reflecting concerns around toxicity, persistence, bioaccumulation, and impacts on wastewater treatment processes. Commonly regulated metals include arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc, aluminium, and manganese, although the specific metals and control mechanisms vary considerably between regions.

A key finding of the review is that few jurisdictions apply universal end-of-pipe metal limits specifically for municipal wastewater treatment plants. Instead, metals are most commonly regulated through risk-based permitting frameworks and environmental quality objectives, with discharge limits determined on a site-specific basis according to receiving environment sensitivity and local environmental risks. Receiving water quality criteria and environmental quality standards play a key role in many regulatory systems, particularly in Australia, the United States, the European Union, and the United Kingdom, where permit conditions are often derived from ambient water quality objectives rather than nationally prescribed effluent standards.

The review also identified source control and trade waste management as important regulatory tools for controlling metals entering wastewater systems. Several countries, including New Zealand, the United States, Canada, and Australia, rely on pretreatment programmes, trade waste bylaws, and industrial discharge controls to reduce metal loads entering municipal wastewater networks. In parallel, treatment technologies such as chemical precipitation and enhanced solids removal were commonly identified as effective methods for removing heavy metals from wastewater streams, particularly where industrial contributions are significant. A set of examples for numerical limits in Trade Waste Bylaws in NZ is provided in Table 4, with additional information in Table 5.

Table 1 Summary of international regulations

Country	Regulation	Which metals analysed for	State of metals analysed for (i.e. dissolved, acid soluble, total etc.)	Frequency of analysis	What is sampled (i.e. influent, interstage or EOP)
Australia					
Australia / NZ	Australian & New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)	As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn, Al, Mn	Dissolved (toxicant DGVs are dissolved concentrations)	No mandatory monitoring – applied via receiving-water assessment and risk-based regulation	Receiving waters (not wastewater)
Australia (Victoria)	State Environment Protection Policy (Waters) 2019 (SEPP); EPA Publication 1733	Metals covered via ANZG DGVs (same as above)	Dissolved (via ANZG framework)	Not prescribed – monitoring only required where licences/permissions require demonstration of compliance	Receiving waters; wastewater monitoring only if required under EPA permission
Australia	EPA Victoria – Guidance for environmental and human health risk assessment of wastewater discharges	Metals considered as chemical hazards (not explicitly listed)	Not specified	Case-by-case, based on risk assessment outcomes	Effluent (EOP) where required by approval
Australia (municipal wastewater)	Australian Guidelines for Sewerage Systems – Effluent Management (1997)	Cd, Cr, Cu, Pb, Hg, Ni, Zn	Not specified	Not prescribed – monitoring implied where industrial inputs present	Effluent (EOP); source control (trade waste)
Australia	Australian Guidelines for Water Recycling / ADWG-based potable reuse schemes	As, Cd, Cr(III), Cr(VI), total Cr, Cu, Pb, Hg (inorganic & methyl), Mo, Ni, U, V, Zn	Typically total (aligned with drinking-water guidelines)	Regular monitoring required under scheme approvals (scheme-specific)	Treated effluent at multiple reuse barriers
USA					
USA (federal)	NPDES permits (general framework)	Permit-specific (e.g. Cu, Pb, Zn, Ni, Cr, Hg where relevant)	Typically total recoverable, unless dissolved is specified	Typically monthly or quarterly (permit-specific)	Effluent (EOP)
USA (federal & state)	NPDES permits (general framework)	Permit-specific (e.g. Cu, Pb, Zn, Ni, Cr, Hg where relevant)	Typically total recoverable, unless dissolved is specified	Typically monthly or quarterly (permit-specific)	Effluent (EOP)
USA (indirect dischargers)	National Pretreatment Program (40 CFR Part 403)	Commonly Cu, Pb, Cr, Ni, Zn (industry-specific)	Typically total	Self-monitoring – frequency varies (often monthly–quarterly)	Industrial influent to sewer
USA (California)	40 CFR §131.38 – California Toxics Rule	Antimony, As, Be, Cd, Cr(III), Cr(VI), Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn	Dissolved	Monitoring required via NPDES permits where criteria are controlling	Effluent and/or receiving waters

Country	Regulation	Which metals analysed for	State of metals analysed for (i.e. dissolved, acid soluble, total etc.)	Frequency of analysis	What is sampled (i.e. influent, interstage or EOP)
USA (Washington State)	WAC 173-201A – Water Quality Standards	Same suite as above	Dissolved	Permit-driven (typically monthly)	Effluent and receiving waters
Canada					
Canada (federal)	Wastewater Systems Effluent Regulations (WSER)	Not specified (no metals)	N/A	N/A	N/A
Canada- provincial - (BC)	Municipal Wastewater Regulation (BC), Part 6	Al, As, Cd, Cr, Cu, Fe, Pb, Hg, Ni, Ag, Zn	Typically total	Permit-specified; where Part 6 applies	Effluent (EOP)
Canada (industrial sector)	Metal and Diamond Mining Effluent Regulations (MDMER)	As, Cu, Pb, Ni, Zn	Total (unfiltered)	Weekly to monthly, with formal reporting	Final effluent
Canada (municipal pretreatment)	Toronto Sewer Use Bylaw (Chapter 681)	Extensive list incl. Al, As, Cd, Cr (total & VI), Cu, Pb, Hg, Ni, Zn, etc.	Total	Industrial user self-monitoring (frequency specified in approvals)	Industrial discharge to sewer
Europe					
European Union	Water Framework Directive / EQS Directive (2008/105/EC)	Cd, Pb, Hg, Ni (priority metals)	Dissolved (0.45 µm)	Environmental monitoring programmes (member-state defined)	Receiving waters
EU (industrial wastewater)	IED BAT Conclusions (e.g. 2016/902 chemical sector)	Cr, Cu, Ni, Zn	Usually total (as metal)	Regular monitoring, commonly monthly or continuous	Final effluent
UK					
Germany	Abwasserverordnung (AbwV) – sector annexes	Cd, Cr, Cu, Pb, Hg, Ni, Zn (sector-dependent)	Total	Mandatory monitoring; frequency defined in annexes	Effluent (EOP)
United Kingdom	Environmental Permitting Regulations (EPR) / CAR (Scotland)	Typically Cd, Cr, Cu, Pb, Hg, Ni, Zn (site-specific)	Total, unless EQS requires dissolved	Permit-specific (often monthly)	Effluent (EOP)
UK (ambient standards)	UK Water Framework Directive Regulations	Cd, Pb, Hg, Ni	Dissolved (EQS basis)	Environmental monitoring programmes	Receiving waters
NZ					
NZ	NZ Model Trade Waste Bylaw	Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Hg, Mo, Ni, Se, Ag, Tl, Sn, Zn	Total	N/A	Influent/trade waste entering public wastewater system. Specific limits determined by each Council

Table 2 *Source results from literature review*

Country	Source	Method of control	Metals identified for control	Basis / reason for the control	Comment
Australia					
Australia	**Environment Protection Authority Victoria (EPA)** Guidance for environmental and human health risk assessment of wastewater discharges to surface waters Year: 2025 **https://www.epa.vic.gov.au/sites/default/files/2025-05/Guidance-for-risk-assessment-of-wastewater-discharges-to-surface-waters.pdf**	Risk-based control through environmental and human health risk assessment to inform permission conditions and discharge limits; comparison against guideline values (e.g. ANZG) as part of risk analysis.	Metals are identified as chemical hazards; no specific metals listed.	Metals are controlled due to their potential for direct toxicity to aquatic ecosystems and human health, including risks of bioaccumulation and impacts on environmental values.	No numeric heavy metal discharge limits. It provides a framework for assessing risks from metals and determining risk-based discharge limits on a case-by-case basis, typically by reference to ANZG guideline values.
Australia	**Environment Protection Authority Victoria** VicEPA State Environment Protection Policy (SEPP Water) Year: 2019 **https://www.vgls.vic.gov.au/client/en_AU/search/asset/1302334/0**	Whole-of-environment regulatory control via environmental quality objectives under SEPP (Waters), applied to all activities that may impact surface water, groundwater, estuarine and marine waters	Aluminium; Arsenic; Cadmium; Chromium (III and VI); Copper; Lead; Mercury; Nickel; Zinc	SEPP (Waters) establishes legally binding environmental quality indicators and objectives for water protection; these adopt or give effect to ANZG Guidelines toxicant default guideline values (DGVs) to protect aquatic ecosystems and beneficial uses	Not wastewater-specific. Controls apply indirectly to wastewater discharges through the obligation that all activities must meet SEPP water quality objectives; EPA Publication 1733 provides scientific justification and derivation of objectives rather than operational discharge limits.
Australia	**Agriculture and Resource Management Council of Australia and New Zealand** Australian Guidelines for Sewerage Systems – Effluent Management. 1997	Control through effluent management based on environmental values, application of technology-based guidelines, trade waste controls, and discharge licensing; toxicants	Cadmium; Chromium; Copper; Lead; Mercury; Nickel; Zinc	Heavy metals are controlled due to acute and chronic toxicity, persistence, and potential for bioaccumulation, with risks to aquatic ecosystems, sediments, biota, crops and human health.	Where large volumes of industrial wastes may contribute toxicants, the toxicants must be controlled at the source. The *Guidelines for Sewerage Systems Acceptance of Trade Waste (Industrial Waste)* should be consulted.

Country	Source	Method of control	Metals identified for control	Basis / reason for the control	Comment
	Year: 1997 **https://www.waterquality.gov.au/sites/default/files/documents/effluent-management.pdf**	to be controlled at source where industrial inputs occur. Toxicants are removed from wastewater through biodegradation or are retained in the sludge.			This document does not set numeric heavy-metal concentration limits. It establishes a framework requiring protection of environmental values, with acceptable levels referenced to external guidelines and enforced via licences.
Australia / NZ	**Australian government and New Zealand government** Australian and New Zealand guidelines for fresh and marine water quality Year: 2018 **https://www.waterquality.gov.au/guidelines/anz-fresh-marine**	Framework-based control using environmental values, water quality objectives, indicators and guideline values; application of weight-of-evidence and risk assessment to assess whether guideline values for toxicants are met Each of the following has toxicant default guideline values (DGVs) for aquatic ecosystem protection in freshwater and/or marine waters under the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG):	Aluminium (Al); Arsenic (As); Cadmium (Cd); Chromium (Cr); Copper (Cu); Lead (Pb); Manganese (Mn); Mercury (Hg); Nickel (Ni); Selenium (Se); Zinc (Zn)	Metals are controlled to protect aquatic ecosystems and human water uses, recognising risks of toxicity, persistence and bioaccumulation; guideline values are used as benchmarks to assess risk to environmental values	This source provides a management framework, not discharge standards. It supports setting objectives and assessing compliance against toxicant guideline values rather than prescribing effluent concentration limits
Australia / NZ	**Australian government and New Zealand government** Chromium (III) in freshwater – ANZG toxicant technical brief Year: 2026 **https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/toxicants/chromium-iii-fresh-2026**	Control through application of Default Guideline Values (DGVs) for aquatic ecosystems, implemented via the ANZG Water Quality Management Framework and used to assess compliance with environmental values	Chromium (III)	Chromium (III) is controlled due to its toxicity to aquatic organisms, with risks dependent on concentration and bioavailability; guideline values are derived to protect specified proportions of aquatic species from adverse effects	This technical brief provides updated numeric guideline values under the ANZG framework. It applies to assessment of receiving waters and does not set wastewater discharge limits; published as a final post-2018 update
Australia	**Sydney Water** Wastewater Treatment Planning Guidelines Year: 2021 **https://www.sydneywater.com.au/content/dam/sydneywater/documents/provider-information/standards-specifications/wastewater-treatment-planning-guidelines.pdf**	Indirect control through wastewater treatment planning and compliance with Environmental Protection Licenses (EPLs), including specification of treatment processes, configuration, monitoring, and performance reporting for discharge effluent	Not specified.	The guidelines provide a planning framework for wastewater treatment assets to ensure treated effluent meets EPL-defined discharge quality and load limits, which may include metals where required by site-specific licences	This document does not set metals limits or guideline values. Any metals control occurs via EPL conditions and downstream regulatory instruments, not through the guidelines themselves
Australia	**Water Services Australia** WSA 300 Aust Wastewater Quality Management Guidelines Year: 2022 **https://wsaa.asn.au/Web/Web/Resources/Reports-and-resources.aspx?hkey=b217bc36-1b4a-4baf-a5df-c90f28ef6b8e**	The guidelines are a non-mandatory framework for effectively managing wastewater to a wastewater system from its source, through its collection, transfer, and treatment, to its disposal or reuse.	Not specified.	The guidelines provide a non-mandatory national framework for managing wastewater quality from source through to treatment, discharge, or reuse, with the objective of protecting public health, assets, treatment processes, and receiving environments	WSA 300 does not set numeric limits or identify specific metals. Any metals control occurs via trade waste agreements, EPA licences, or jurisdiction-specific standards implemented alongside this framework
Australia	**USEPA** Australian Potable water reuse specifications Year: 2006, 2008 & 2009 **https://www.epa.gov/waterreuse/summary-australias-water-reuse-guideline-or-regulation-potable-water-reuse**	The specifications presented in the table include some parameters to be monitored for treated municipal wastewater with intention of using as potable recycled water in Australia. The NWQMS federal guidelines provide detailed information about these parameters (NWQMS, 2006; 2008; 2009).	Arsenic; Cadmium; Chromium (III); Chromium (VI); Chromium (total); Cobalt; Copper; Lead; Methylmercury; Mercury (inorganic); Molybdenum; Nickel; Uranium; Vanadium; Zinc	The framework is designed to manage public health (drinking water) and environmental risks associated with potable reuse of treated municipal wastewater and stormwater, using multiple-barrier treatment, risk management, and regulatory oversight	This page is an informational summary, not a regulatory instrument. It does not set contaminant limits or specify metals; any metals control is addressed through drinking water guidelines and jurisdiction-specific approvals supporting potable reuse schemes
Australia - Tasmania	**Department Of Primary Industries, Water & Environment** Emission limit guidelines for sewage treatment plants that discharge pollutants into fresh and marine waters Year: 2001	Regulatory authorities should ensure that emission limits set for the point source discharge of pollutants to surface waters from new or existing sewage treatment plants are set in accordance with these guidelines unless the regulator considers that site-specific circumstances preclude their use.	Not specified.	The Emission Limits Guidelines: Table 1: Emission limits – Accepted Modern Technology (Applicable to New and Upgraded Plants) These provide suggested parameters and values for nutrients, oil & grease, pH, coliforms and BOD.	"Emission Limit Guidelines – Sewage Treatment Plants" (June 2001) is a regulatory guideline published under Tasmania's State Policy on Water Quality Management 1997. It sets numeric emission (effluent) limits for point-source discharges from sewage treatment plants to surface waters in Tasmania.

Country	Source	Method of control	Metals identified for control	Basis / reason for the control	Comment
	https://epa.tas.gov.au/Documents/Emission_Limit_Guidelines_June_2001.pdf				Heavy metal limits are not specified however, mentions that 'additional parameters will be monitored (i.e. metals, pesticides) where plants accept trade wastes.'
USA					
USA	**National Archives and Records Administration** Clean Water Act – Part 133 Year: 2022 **https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-133**	In Part 133, EPA published secondary treatment standards based on an evaluation of performance data for WWTPs practicing a combination of physical and biological treatment to remove biodegradable organics and suspended solids. The regulation applies to all WWTPs and identifies the technology-based performance standards achievable based on secondary treatment for 5-day biochemical oxygen demand (BOD5), total suspended solids (TSS), and pH. e.g., activated sludge, trickling filters, and rotating biological contactors	Not specified.	Established under the Clean Water Act to set minimum, uniform secondary treatment standards to control conventional pollutants in municipal wastewater discharges and protect receiving waters	Part 133 regulates BOD_5, TSS, pH, and percent removal only. It does not establish metals limits; metals are controlled through NPDES permit conditions and water-quality-based effluent limits developed under other CWA provisions
USA	**National Archives and Records Administration** Clean Water Act – Numeric limits for priority pollutants for State of California Year: 1983 **https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-131/subpart-D/section-131.38**	Federally promulgated numeric water quality criteria, applied as water-quality-based standards for inland surface waters, enclosed bays, and estuaries	Antimony; Arsenic; Beryllium; Cadmium; Chromium (III); Chromium (VI); Copper; Lead; Mercury; Nickel; Selenium; Silver; Thallium; Zinc	Criteria were established to protect human health and aquatic life where California lacked EPA-approved numeric criteria for priority toxic pollutants under the Clean Water Act	This regulation is state-specific (California only). The numeric metals criteria are applied through NPDES permitting and water quality standards implementation, not as direct effluent limits
USA	**USEPA** Water Quality Standards for Surface Waters of the State of Washington, Chapter 173-201A WAC . Numeric limits for WAC 173-201A-240(5)(b), Table 240: Aquatic Life Criteria Year: 2024 **https://www.epa.gov/system/files/documents/2025-03/wa_wqs_0011_122024.pdf**	Numeric water quality criteria, applied as water-quality-based standards to protect human health, implemented through NPDES permits and other Clean Water Act mechanisms	Antimony; Arsenic; Beryllium; Cadmium; Chromium (III); Chromium (VI); Copper; Lead; Mercury; Nickel; Selenium; Silver; Thallium; Zinc	Criteria are established to protect human health, including people who consume fish and shellfish, based on toxicological risk and fish consumption exposure assumptions	These are state water quality standards, not effluent limits. Metals criteria are applied indirectly via permitting (WQBELs). EPA approved 145 human health criteria for 75 pollutants in December 2024; aquatic life criteria approval was deferred separately
USA	**USEPA** National Recommended Water Quality Criteria - Organoleptic Effects. EPA Quality Criteria for Water, 1986 Year: 1986 **https://www.epa.gov/wqc/national-recommended-water-quality-criteria-organoleptic-effects**	Non-regulatory, advisory water quality criteria providing recommended ambient concentrations to avoid objectionable taste and odour	Iron; Copper; Zinc	These criteria are based on organoleptic (taste and odour) effects	EPA states organoleptic data have limitations and no demonstrated relationship to adverse human health effects. Criteria are guidance only, used by states as reference material when developing water quality standards or permit conditions; not enforceable under the Clean Water Act
USA	**USEPA** National Pollutant Discharge Elimination System (NPDES) Permit Year: Not stated **https://www.epa.gov/npdes/npdes-permit-limits** **https://www.epa.gov/npdes/npdes-permit-basics**	Every water treatment plant that puts water into rivers or lakes needs an NPDES permit. **https://www.epa.gov/npdes/permit-limits-tbels-and-wqbels** Technology-based Effluent Limitations (TBELs) Water Quality-based Effluent Limitations (WQBELs)	Common sampling parameters: Flow rate and pH, recorded at the interval stated on your permit (could be daily, monthly, etc.) Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS) daily and monthly averages USA E. Coli or Faecal Coliform Phosphorus, Total Nitrogen, Fats/Oils/Grease (FOG), Ammonia and Turbidity	NPDES permits translate Clean Water Act requirements into facility-specific limits, using both technology-based effluent limits (TBELs) and water-quality-based effluent limits (WQBELs) to ensure receiving waters meet applicable water quality standards	NPDES permits are the primary enforcement mechanism in the US. Metals limits are not blanket national limits but are derived case-by-case based on applicable effluent guidelines, receiving water quality standards, and reasonable potential analyses. Permits also include monitoring and reporting requirements

Country	Source	Method of control	Metals identified for control	Basis / reason for the control	Comment
USA	**USEPA** NPDES State Program authority Year: ranges from state to state **https://www.epa.gov/npdes/npdes-state-program-authority**	Delegated regulatory authority: EPA authorises states, territories, and tribes to administer and enforce NPDES permits	Indirect – metals regulated through state-issued NPDES permits	Clean Water Act allows EPA to delegate NPDES permitting authority to states and territories that meet federal requirements, enabling local administration of permit limits (including metals)	Most states are authorised to run NPDES programmes, but EPA retains oversight and may continue issuing permits in specific circumstances (e.g. tribal lands, certain federal facilities, or where a state lacks authorisation). Permit content must remain consistent with federal Clean Water Act requirements
USA	**USEPA** NPDES for small Publicly Owned treatment works (POTWs) Year: 2021 **https://www.epa.gov/system/files/documents/2022-09/PresentationSlides_POTWPermitting_6.16.22.pdf**	Implementation and permit-writing guidance for NPDES permits issued to Publicly Owned Treatment Works (POTWs)	Metals addressed where required in permits (e.g., Copper; Lead; Zinc) via WQBELs or pretreatment controls	Guidance explains how POTW permits incorporate technology-based limits (secondary treatment standards) and water-quality-based effluent limits where necessary to meet receiving-water standards	Slides clarify that municipal secondary treatment standards (40 CFR Part 133) do not set metals limits; metals are controlled through WQBELs, pretreatment programmes, and site-specific permit conditions. The presentation is explanatory and not itself regulatory [epa.gov]
USA	**USEPA** National Pretreatment Program Year: 2011 **https://www.epa.gov/sites/default/files/2015-10/documents/pretreatment_program_intro_2011.pdf**	Under the National Pretreatment Program (40 CFR Part 403), industries discharging POTWs must reduce metals before entering the sewer system using on-site treatment or process controls	Copper; Lead; Chromium; Nickel; Zinc	Prevents pollutants that cannot be adequately treated by POTWs from passing through to receiving waters, interfering with treatment processes, or contaminating sewage sludge	Pretreatment requirements are implemented through federal categorical pretreatment standards (40 CFR Parts 405–471) and local limits set by POTWs. These controls are enforced via industrial user permits, sewer use ordinances, and POTW NPDES permits. The programme is regulatory and applies nationally, but limits are industry- and facility-specific
USA	**USEPA** best practice Wastewater Technology Fact Sheet Chemical Precipitation, 2000 Year: 2000 **https://nepis.epa.gov/Exe/ZyPDF.cgi/P1001QTR.PDF?Dockey=P1001QTR.PDF**	Regulatory programme framework establishing pretreatment controls on industrial discharges to POTWs. Chemical precipitation as a method of removing metals from wastewater	Cadmium; Chromium; Copper; Lead; Mercury; Nickel; Silver; Zinc	Document explains the need to control pollutants that POTWs are not designed to remove, including toxic metals that may cause pass-through, interference with treatment, or sludge contamination	This is an early EPA programme description (superseded by later guidance but still authoritative on intent). It underpins 40 CFR Part 403, categorical pretreatment standards, and POTW local limits. Does not set numeric limits itself; it explains programme objectives and structure
USA	Membrane WW treatment Year: Not stated	Treatment technology review describing membrane processes (MF, UF, NF, RO) used in industrial wastewater treatment	Not specified.	EPA review assesses membrane treatment capabilities to inform effluent guidelines, industry studies, and rulemaking, including the ability of nanofiltration (NF) and reverse osmosis (RO) to remove dissolved contaminants	The document is technology-focused, not pollutant-specific. It identifies NF and RO as capable of removing “heavy metals” but does not name individual metals or set regulatory requirements. It is informational and does not establish control obligations
Canada					
Canada	**Government of Canada** Wastewater Systems Effluent Regulations (SOR/2012-139) Year: 2012 **https://laws-lois.justice.gc.ca/eng/regulations/SOR-2012-139/FullText.html**	The WSER is made under section 36(5) of the Fisheries Act and establishes national minimum effluent quality standards for municipal wastewater systems. The regulated parameters are limited to: Carbonaceous biochemical oxygen demand ($CBOD_5$) Total suspended solids (TSS) Unionised ammonia Chlorine	Not specified.	Regulations prohibit the deposit of deleterious substances into waters frequented by fish, and require effluent to meet secondary-treatment standards and pass acute lethality testing on rainbow trout	WSER establish enforceable limits for carbonaceous biochemical oxygen demand (CBOD), total suspended solids (TSS), unionised ammonia, and acute lethality, but do not prescribe numeric limits for metals or name individual metals. Metals are regulated indirectly where they contribute to effluent toxicity or fish harm under the Fisheries Act
Canada	**Environmental Management Act** British Columbia municipal wastewater regulation 2012 Year: 2012 **https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/87_2012#part6**	Receiving-environment-based effluent standards, including maximum concentration limits for specified substances	Aluminium; Arsenic; Cadmium; Chromium; Copper; Iron; Lead; Mercury; Nickel; Silver; Zinc	Part 6 applies where standard secondary-treatment performance is insufficient. It establishes site-specific standards to protect aquatic life in the receiving environment, including explicit limits for toxic substances	Unlike federal WSER, the BC regulation explicitly names and regulates metals by concentration where required. Part 6 standards are applied case-by-case, based on receiving-water sensitivity and environmental risk, and are enforceable under provincial authorisations
Canada	**Government of Canada** Metal and Diamond Mining Effluent Regulations (SOR/2002-222) – Fisheries Act Year: 2002 **https://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/**	Effluent limits (national, sector-specific)	Arsenic; Copper; Lead; Nickel; Zinc	Protection of fish and fish habitat from deleterious substances under s.36 of the Fisheries Act	Applies only to metal and diamond mines; national regulation; not applicable to municipal or non-mining industrial wastewater

Country	Source	Method of control	Metals identified for control	Basis / reason for the control	Comment
Canada	**Government of Ontario** Effluent Monitoring and Effluent Limits – Metal Mining Sector (O. Reg. 234/07, amending O. Reg. 560/94) Year: 2007 **https://www.ontario.ca/laws/regulation/r07234**	Effluent limits (sector-specific regulation)	Not specified.	Provincial industrial pollution control under the Environmental Protection Act	Mining-sector regulation focuses on monitoring, toxicity and general parameters; metal limits historically addressed via federal MDMER or permits
Canada	**City of Toronto** City of Toronto Municipal Code, Chapter 681 – Sewers By-law Year: 2023 **\nhttps://www.toronto.ca/legdocs/municode/1184_681.pdf**	Pretreatment / sewer-use limits (numeric concentration limits)	Aluminium; Antimony; Arsenic; Cadmium; Chromium (total and hexavalent); Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Silver; Tin; Titanium; Zinc	Protection of sewer infrastructure, treatment plant performance, sludge quality and receiving waters	Indirect control (applies to discharges to sewers, not directly to the environment); authoritative example of explicit metal listing in Canada
Europe					
European Union	**EUR-Lex** European Commission (2000) Water Framework Directive Year: 2000 **https://eur-lex.europa.eu/resource.html?uri=cellar:5c835afb-2ec6-4577-bdf8-756d3d694eeb.0004.02/DOC_1&format=PDF**	Minimum treatment requirements (secondary and, where required, more stringent treatment) for urban wastewater discharges	Not specified.	Directive aims to protect the environment from adverse effects of urban wastewater by requiring collection and treatment standards, including secondary treatment and additional treatment in sensitive areas	The Directive sets requirements for treatment levels and performance parameters (e.g. BOD, COD, TSS) but does not identify or regulate individual metals. Metals are addressed indirectly through other EU instruments (e.g. Water Framework Directive, Industrial Emissions Directive) and through Member State permit conditions, not via this Directive itself
European Union	**EUR-Lex** Environmental quality standards Year: 2008/2013 **https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02008L0105-20130913**	Environmental quality standards (EQS) for surface waters, requiring compliance through discharge controls and permits	Cadmium; Lead; Mercury; Nickel	Establishes EU-wide EQS for priority substances to protect aquatic ecosystems and human health, under the Water Framework Directive	Ambient EQS for cadmium, lead, mercury and nickel are used to assess surface-water compliance. For these metals, assessment may account for dissolved or bioavailable concentration, natural background concentrations and water-quality parameters affecting bioavailability.
European Union	EUR-Lex Urban wastewater treatment directive Year: 1991; revised 2024 **https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31991L0271** Revised: **https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202403019**	EU legislation does not prescribe specific unit processes for metals removal; however, the Urban Wastewater Treatment Directive (EU) 2024/3019 requires additional treatment where necessary to achieve compliance with Water Framework Directive environmental quality standards, including for metals. EU technical assessments recognise that metals in urban wastewater are largely particle-bound and are therefore reduced through enhanced solids removal associated with advanced treatment processes	Not specified.	Protects the environment from adverse effects of insufficiently treated urban wastewater by requiring collection systems and secondary (and where applicable, more stringent) treatment	The Directive sets treatment performance requirements (e.g. BOD, COD, TSS, nutrients) but does not identify or regulate individual metals. Metals are addressed through other EU instruments (e.g. Water Framework Directive, EQS Directive) and Member State permits, not directly here
European Union	**EUR-Lex** Commission Implementing Decision (EU) 2016/902 – BAT Conclusions for common wastewater and waste-gas treatment in the chemical sector Year: 2016 **\nhttps://eur-lex.europa.eu/eli/dec_impl/2016/902/oj**	Permit-based BAT-associated emission levels (BAT-AELs)	Chromium; Copper; Nickel; Zinc	Industrial Emissions Directive (2010/75/EU): prevention and reduction of industrial pollution using best available techniques	Binding through permits for covered chemical installations; limits expressed as BAT-AEL ranges, not uniform legal limits
European Union	Commission Implementing Decision (EU) 2024/2974 – BAT Conclusions for smitheries and foundries Year: 2024 **\nhttps://eur-lex.europa.eu/eli/dec_impl/2024/2974/oj**	Permit-based BAT requirements (monitoring and treatment of wastewater)	Arsenic; Chromium; Copper; Nickel; Zinc	IED pollution prevention for metal processing industries	Applies only to smitheries and foundries; metals appear in monitoring definitions and wastewater treatment BAT
Germany	**Federal Ministry of Justice and Consumer Protection**	National effluent limits (sector-specific annexes)	Cadmium; Chromium; Copper; Lead; Mercury; Nickel; Zinc	Protection of surface waters via technology-based minimum requirements	Metals are listed only in relevant annexes; requirements differ by industrial sector and discharge type

Country	Source	Method of control	Metals identified for control	Basis / reason for the control	Comment
	Ordinance on Requirements for the Discharge of Wastewater into Bodies of Water *Abwasserverordnung (AbwV) – Verordnung über Anforderungen an das Einleiten von Abwasser in Gewässer* (as amended 2024) Year: 2024 **https://www.gesetze-im-internet.de/abwv/**				
United Kingdom					
England & Wales	**UK Government** The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 Year: 2017 **\nhttps://www.legislation.gov.uk/uksi/2017/407/contents**	Receiving-water environmental quality standards (EQS)	Cadmium; Lead; Mercury; Nickel	Protection of ecological and chemical status of surface waters	Ambient standards, not discharge limits; used to derive permit conditions
Scotland	**UK Government** Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) (as amended) Year: 2011 **https://www.legislation.gov.uk/ssi/2011/209/contents**	Permit-based controls linked to EQS	Cadmium; Chromium; Copper; Iron; Lead; Nickel; Zinc	Prevention of deterioration and achievement of water-quality objectives	Metals enforced through licence conditions rather than uniform national limits
England	**UK Environment Agency** Standard Rules Permits under Environmental Permitting Regulations (e.g. SR rules for sewage discharges) Year: 2014 (revised 2026) **https://www.gov.uk/government/collections/standard-rules-environmental-permitting**	Permit-based, generic conditions	Not specified.	General pollution prevention and protection of receiving waters	Metals controlled indirectly; explicit metal limits only appear in bespoke permits, not standard rules
England & Wales	**UK Government** Environmental Permitting (England & Wales) Regulations 2016 (Schedule 22 – Groundwater) Year: 2016 **https://www.legislation.gov.uk/uksi/2016/1154/schedule/22**	Framework regulation (groundwater hazard control)	Cadmium; Mercury; Arsenic (metals flagged as hazardous substances)	Defines hazardous substances for groundwater as those toxic, persistent, and liable to bio-accumulate specifically enumerating heavy metals (e.g. “metals (in particular cadmium and mercury) and their compounds; arsenic and its compounds”). Preventive control: inputs of these metals into groundwater must be prevented or limited to avoid any pollution. No numeric limits are set directly in the regulation – instead permits must aim for no discharge of these hazardous metals to groundwater.	Scope: Applicable to all discharges to groundwater in England & Wales under the EPR 2016 regime (transposing EU Groundwater Directive). Heavy-metal discharges to groundwater are only authorised after rigorous demonstration that no pollution will result.
Northern Ireland	**UK Government** The Water Framework Directive (Classification, Priority Substances and Shellfish Waters) Regulations (Northern Ireland) 2015 Year: 2015 **https://www.legislation.gov.uk/nisr/2015/351/contents/made**	Receiving-water EQS	Cadmium; Lead; Mercury; Nickel	Transposes EU EQS Directive into NI law, establishing strict surface water quality standards for named metals (e.g., Cadmium AA-EQS 0.08–0.25 µg/L by hardness; Nickel AA-EQS 4 µg/L; Lead AA-EQS 1.2 µg/L; Mercury MAC-EQS 0.07 µg/L). These serve as legally binding ambient limits, requiring regulatory measures to reduce metal pollution in rivers, lakes, and coastal waters.	Scope: Applies in Northern Ireland; similar standards apply across the UK due to retained EU law or parallel legislation (ensuring consistency post-EU exit). These values influence conditions in discharge consents and permits (e.g., industrial and municipal effluents) to protect water quality and meet “good chemical status” objectives.
Scotland	Environment Agency Standard Permit (Bespoke) – Example (e.g., landfill leachate discharge to water) Year: 2025 **The Environmental Authorisations (Scotland) Amendment Regulations 2025**	Permit-based (site-specific effluent limits)	Arsenic; Cadmium; Chromium; Copper; Lead; Mercury; Nickel; Zinc	Under the Environmental Permitting regime, the EA issues *bespoke permits* with site-specific metal limits where necessary. For example, a landfill leachate discharge permit may list maximum concentrations for heavy metals (e.g., As ≤0.1 mg/L; Cd ≤0.005 mg/L; Cr ≤0.1 mg/L; Cu ≤0.05 mg/L; Pb ≤0.1 mg/L; Hg ≤0.001 mg/L; Ni ≤0.2 mg/L; Zn ≤0.5 mg/L) Exceeding these limits in the effluent is a breach of permit.	Scope: Site-specific and sector-specific in England (analogous approaches in Wales, Scotland via respective agencies). These numeric heavy metal limits are not set by a single regulation but derive from permit conditions to meet local water quality needs. They may be influenced by national guidelines or BAT standards, ensuring consistent protection across similar facilities (e.g., incinerators, leachate plants)
NZ additional info					

Country	Source	Method of control	Metals identified for control	Basis / reason for the control	Comment
NZ	**Jacobs: Parliamentary Commissioner for the Environment** Chemical contaminants in Aotearoa State of knowledge, management and risks (2021) Year: 2021 **https://pce.parliament.nz/media/4tzdtzeh/jacobs-chemical-contaminants-in-aotearoa.pdf**		Copper; Lead; Zinc; Chromium; Arsenic; Nickel; Cadmium; Mercury		This report provides a national-level summary of the chemical contaminants that Regional Councils/Unitary Authorities include in consent-based monitoring requirements and routine State of the Environment (SoE) monitoring programmes. Only includes records that specified the targeted metal/metalloid and organic chemical contaminants (CCs).

Specific monitoring and reporting requirements summary from international regulations

– **Australia:** National guidelines (e.g., ANZG 2018) recommend heavy metal water quality criteria but do *not impose mandatory monitoring** at WWTPs; regulatory oversight of heavy metals is typically handled case-by-case through environmental licences as needed (e.g., if industrial inputs are significant). Some state EPAs require monitoring heavy metals where site-specific risk assessments indicate potential impacts.

– **USA**: NPDES permits (federally and state-administered) contain monitoring and reporting requirements for any regulated pollutant in a given discharge. If heavy metals are present or regulated via water quality standards or technology-based limits, permittees must monitor and report at specified intervals, often monthly or quarterly. Industrial indirect dischargers (under the EPA's National Pretreatment Program) are subject to self-monitoring for heavy metals if covered by relevant categorical standards (e.g., metal finishing) and must report results to the local WWTP and regulatory agencies.

– **Canada:** The national municipal WWTP regulation (WSER) does not list heavy metals as regulated parameters, so there are no universal heavy-metal monitoring mandates for municipal effluents nationwide. However, sector-specific federal regulations (e.g., for mining) and provincial/municipal frameworks impose heavy-metal monitoring where relevant. Mining effluent regulations require weekly sampling for specific metals with periodic reporting to the regulator and allow reduced or increased frequencies based on concentration thresholds. Municipal sewer-use bylaws often enforce heavy metal pretreatment controls with monitoring obligations for industrial dischargers (self-monitoring and reporting, subject to verification by authorities).

– **European Union (EU):** Wastewater discharges from large industrial facilities are regulated through permits containing BAT (Best Available Technique) requirements. EU BAT Conclusions explicitly require heavy metal monitoring in effluents from certain sectors. For example, chemical industry BAT standards mandate regular monitoring (often monthly or continuous, where feasible) of total Cr, Cu, Ni, Zn in the effluent, with results reported to authorities as part of permit compliance. The Urban Waste Water Treatment Directive (1991) and its 2024 recast focus on conventional pollutants; heavy metal monitoring is not universally required for municipal WWTPs unless needed to meet local environmental quality standards.

– **Europe** (Member States): Germany sets uniform effluent heavy metal limits per industry in its Waste Water Ordinance (AbwV), and dischargers are mandated to monitor those metals using prescribed methods and frequencies – often continuous or frequent sampling for large flows. Compliance is ensured via periodic submission of results and immediate notifications if limits are exceeded (e.g., similar to MDMER, immediate reporting obligations).

– **United Kingdom:** Post-Brexit, UK regulations incorporate EU water quality standards for metals (for environmental monitoring), but WWTP permits (under the Environmental Permitting Regulations) handle heavy metals on a site-specific basis. If a WWTP's discharge could affect compliance with surface water EQS for metals (e.g., cadmium, lead, mercury, nickel), the Environment Agency or devolved regulators will include appropriate permit limits and monitoring requirements. For standard small WWTP permits, heavy metals are generally not explicitly listed for routine monitoring, but any that need to be controlled are addressed through bespoke permit conditions or trade effluent consents for industrial sources.

– **New Zealand Trade Waste Bylaws:** The Model Trade Waste Bylaw refers to a standardised framework developed to help councils regulate trade waste discharges into public wastewater networks. It is not itself law, but a template that territorial authorities adapt and formally adopt as their own bylaw. Controls inputs to the wastewater network (industrial/commercial discharges to sewer).

International regulation numerical limits

Table 3 International regulation numerical limits

Country	Regulation	Nature of the statistic (e.g. median, 90%ile)	State of metals analysed for (ie. Dissolved, acid soluble, total etc.	Arsenic (As) mg/L	Cadmium (cd) mg/L	Chromium (Cr) mg/L	Copper (Cu) mg/L	Lead (Pb) mg/L	Mercury (Hg) mg/L	Nickel (Ni) mg/L	Selenium (Se) mg/L	Zinc (Zn) mg/L	Aluminium (Al) mg/L	Manganese (Mn) mg/L	Comment
Canada	Canada - WSER (SOR/2012-139)	Averages + max + pass/fail	Not specified (no metal limits)	-	-	-	-	-	-	-	-	-	-	-	No metal-specific limits; metals only indirectly controlled via toxicity + “deleterious substances” framework.
USA	USA — 40 CFR 133.102	30-day average	N/A (no metal limits)	-	-	-	-	-	-	-	-	-	-	-	Municipal secondary treatment baseline; metals regulated elsewhere (WQBELs/pretreatment).
USA	USA — 40 CFR 133.102	7-day average	N/A (no metal limits)	-	-	-	-	-	-	-	-	-	-	-	
USA	USA — 40 CFR 133.102	Range (pH)	N/A (no metal limits)	-	-	-	-	-	-	-	-	-	-	-	

Country	Regulation	Nature of the statistic (e.g. median, 90%ile)	State of metals analysed for (ie. Dissolved, acid soluble, total etc.	Arsenic (As) mg/L	Cadmium (cd) mg/L	Chromium (Cr) mg/L	Copper (Cu) mg/L	Lead (Pb) mg/L	Mercury (Hg) mg/L	Nickel (Ni) mg/L	Selenium (Se) mg/L	Zinc (Zn) mg/L	Aluminium (Al) mg/L	Manganese (Mn) mg/L	Comment
EU	EU — Directive 91/271/EEC Annex I Table 1	Concentration limits + minimum % reduction	Not specified (no metal limits)	-	-	-	-	-	-	-	-	-	-	-	Conventional/nutrient performance & monitoring methods; no metal-specific limits in this directive
EU	EU — EQS Directive 2008/105/EC Annex I	AA-EQS (annual average) (not inland Surface waters Pb & Ni)	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	0.0002	-	-	0.0013	0.0007	0.0086	-	-	-	-	Ambient standards (not effluent limits); implemented via permits/measures to achieve EQS Cd varies by 5 hardness classes; Pb & Ni subject to bioavailability-based compliance.
EU	EU — EQS Directive 2008/105/EC Annex I	AA-EQS (annual average) (inland Surface waters Pb & Ni)	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	-	-	-	0.0012	0.0007	0.004	-	-	-	-	Ambient standards (not effluent limits); implemented via permits/measures to achieve EQS Cd varies by 5 hardness classes; Pb & Ni subject to bioavailability-based compliance.
EU	EU — EQS Directive 2008/105/EC Annex I	AA-EQS (annual average) Inland surface waters Cd CLASS 1	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	0.00008	-	-	-	-	-	-	-	-	-	
EU	EU — EQS Directive 2008/105/EC Annex I	AA-EQS (annual average) Inland surface waters Cd CLASS 2	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	0.00008	-	-	-	-	-	-	-	-	-	
EU	EU — EQS Directive 2008/105/EC Annex I	AA-EQS (annual average) Inland surface waters Cd CLASS 3	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	0.00009	-	-	-	-	-	-	-	-	-	
EU	EU — EQS Directive 2008/105/EC Annex I	AA-EQS (annual average) Inland surface waters Cd CLASS 4	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	0.00015	-	-	-	-	-	-	-	-	-	
EU	EU — EQS Directive 2008/105/EC Annex I	AA-EQS (annual average) Inland surface waters Cd CLASS 5	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	0.00025	-	-	-	-	-	-	-	-	-	
EU	EU — EQS Directive 2008/105/EC Annex I	MAC-EQS (max allowable conc.)	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	-	-	-	0.014	0.0007	0.034	-	-	-	-	
EU	EU — EQS Directive 2008/105/EC Annex I	MAC-EQS (max allowable conc.) Cd CLASS 1	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	0.00045	-	-	0.014	0.0007	0.034	-	-	-	-	Ambient standards (not effluent limits); implemented via permits/measures to achieve EQS. MAC-EQS not set for some substances where AA-EQS is considered protective. Cd varies by 5 hardness classes; Pb & Ni subject to bioavailability-based compliance.

Country	Regulation	Nature of the statistic (e.g. median, 90%ile)	State of metals analysed for (ie. Dissolved, acid soluble, total etc.	Arsenic (As) mg/L	Cadmium (cd) mg/L	Chromium (Cr) mg/L	Copper (Cu) mg/L	Lead (Pb) mg/L	Mercury (Hg) mg/L	Nickel (Ni) mg/L	Selenium (Se) mg/L	Zinc (Zn) mg/L	Aluminium (Al) mg/L	Manganese (Mn) mg/L	Comment
EU	EU — EQS Directive 2008/105/EC Annex I	MAC-EQS (max allowable conc.) Cd CLASS 2	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	0.00045	-	-	-	-	-	-	-	-	-	
EU	EU — EQS Directive 2008/105/EC Annex I	MAC-EQS (max allowable conc.) Cd CLASS 3	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	0.0006	-	-	-	-	-	-	-	-	-	
EU	EU — EQS Directive 2008/105/EC Annex I	MAC-EQS (max allowable conc.) Cd CLASS 4	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	0.0009	-	-	-	-	-	-	-	-	-	
EU	EU — EQS Directive 2008/105/EC Annex I	MAC-EQS (max allowable conc.) Cd CLASS 5	Dissolved for Cd/Pb/Hg/Ni (0.45 µm filtration)	-	0.0015	-	-	-	-	-	-	-	-	-	
EU	EU Directive 2008/105/EC (as amended 2013)	Biota EQS (supplementary)	Biota (wet weight)	-	-	-	-	-	-	-	-	-	-	-	Applies specifically to mercury for food-web protection.
USA	USA (Washington) — WAC 173-201A-240 Table 240	Marine aquatic life Acute (numeric where not equation-based)	Dissolved (per Table 240 notes)	0.069	0.033	1.1	0.0048	0.21	0.0018	0.074	0.29	0.09	-	-	Freshwater metal criteria for many metals are equation-based (hardness/DOC) and not reproduced in this numeric-only table.
USA	USA (Washington) — WAC 173-201A-240 Table 240	Marine aquatic life Chronic (numeric where not equation-based)	Dissolved (per Table 240 notes)	0.036	0.0079	0.05	0.0031	0.0081	0.000025	0.0082	0.071	0.081	-	-	Freshwater metal criteria for many metals are equation-based (hardness/DOC) and not reproduced in this numeric-only table.
USA	USA (Washington) — WAC 173-201A-240 Table 240	Human health (water & organisms)	Human health metals criteria: total metals unless noted	0.000018	-	-	-	-	-	-	0.06	1	-	-	Human health criteria are risk-based; table contains many other non-metals too.
USA	USA (Washington) — WAC 173-201A-240 Table 240	Human health (organisms only)	Human health metals criteria: total metals unless noted	0.00014	-	-	-	-	-	-	0.2	1	-	-	
Aus / NZ	Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)	Default guideline value (DGV)	Dissolved	0.013	0.0002	0.001	0.0014	0.0034	0.00007	0.011	0.005	0.008	0.055	-	Values correspond to ANZG 95% species protection freshwater DGVs; Cr listed as hexavalent chromium.
Aus	Australian Guidelines for Water Recycling (NWQMS 2006; 2008; 2009) and Australian Drinking Water Guidelines (ADWG 2022)	Chemical concentration target	Not specified (drinking-water guideline basis) (Cr VI)	0.007	0.002	0.05	2	0.01	0.001	0.02	0.01		0.2	0.5	Values sourced from Australian Drinking Water Guidelines and applied to potable recycled water under the Australian Guidelines for Water Recycling; Cr(III), total Cr, Zn, and methyl-Hg are not specified.
USA	United States — California Toxics Rule (40 CFR §131.38)- Marine aquatic life – Acute		Dissolved	0.069	0.042	1.1	0.0048	0.21	0.0018	0.074	0.29	0.09	-	-	Explicit numeric marine CCC values

Country	Regulation	Nature of the statistic (e.g. median, 90%ile)	State of metals analysed for (ie. Dissolved, acid soluble, total etc.	Arsenic (As) mg/L	Cadmium (cd) mg/L	Chromium (Cr) mg/L	Copper (Cu) mg/L	Lead (Pb) mg/L	Mercury (Hg) mg/L	Nickel (Ni) mg/L	Selenium (Se) mg/L	Zinc (Zn) mg/L	Aluminium (Al) mg/L	Manganese (Mn) mg/L	Comment
USA	United States — California Toxics Rule (40 CFR §131.38)- Marine aquatic life – chronic		Dissolved	0.036	0.0093	0.05	0.0031	0.0081	0.000025	0.0082	0.071	0.081	-	-	Explicit numeric marine CCC values
USA	EPA National Recommended Organoleptic Criteria	Organoleptic criterion (taste/odour/colour effects)	Ambient water (state not specified)	-	-	-	1	-	-	-	-	5	-	-	Numeric values are based on aesthetic effects only (taste, colour, staining), not toxicity or human health.
USA	EPA National Recommended Water Quality Criteria - Human Health Criteria Table	Human Health	-	0.000018	-	-	1.3	-	-	0.61	0.17	7.4	-	0.05	These human health criteria are developed by the EPA under Section 304(a) of the Clean Water Act.
Canada	Canada – Metal and Diamond Mining Effluent Regulations (SOR/2002-222), Schedule 4 Table 1	Maximum authorised monthly mean effluent concentration	Total (unfiltered)	0.1	-	-	0.1	0.08	-	0.25	-	0.4	-	-	Federal effluent limits for metal/diamond mines; Schedule 4, Table 1
Canada	Canada – Metal and Diamond Mining Effluent Regulations (SOR/2002-222), Schedule 4 Table 2	Maximum authorised monthly mean effluent concentration (transitional)	Total (unfiltered)	0.3	-	-	0.3	0.1	-	0.5	-	0.5	-	-	Transitional limits; Schedule 4, Table 2
Canada	Canada – City of Toronto Municipal Code, Chapter 681 (Sewer Use By-law)	Maximum allowable sewer discharge concentration	Total (unfiltered)	0.02	0.008	0.08	0.04	0.12	0.0004	0.08	0.02	0.04	-	0.05	Indirect control to sewer; sanitary/combined sewer limits (Table of limits)
EU	EU – Commission Implementing Decision (EU) 2016/902 (IED BAT Conclusions), Table 3	BAT-AEL (yearly average) for direct emissions to water - LOWER LIMIT	Expressed as metal	-	-	0.005	0.005	-	-	0.005	-	0.02	-	-	BAT-associated emission levels for chemical sector wastewater
EU	EU – Commission Implementing Decision (EU) 2016/902 (IED BAT Conclusions), Table 3	BAT-AEL (yearly average) for direct emissions to water - UPPER LIMIT	Expressed as metal	-	-	0.025	0.05	-	-	0.05	-	0.3	-	-	BAT-associated emission levels for chemical sector wastewater
Germany	Germany – Abwasserverordnung (AbwV), Annex 39 (Non-ferrous metal production)	Before mixing. Maximum concentration (qualified sample or 2-hour composite) LOWER LIMIT	Total (unfiltered)	0.1	0.05	0.2	0.1	0.2	-	0.1	-	0.4	3	-	Sector-specific effluent limits; Annex 39 tables
Germany	Germany – Abwasserverordnung (AbwV), Annex 39 (Non-ferrous metal production)	Before mixing. Maximum concentration (qualified sample or 2-hour composite) UPPER LIMIT	Total (unfiltered)	0.3	0.1	0.5	0.5	0.5	0.02	2	-	1	6	-	Sector-specific effluent limits; Annex 39 tables
UK	UK – Water Framework Directive (Standards and Classification) Directions (E&W) / retained EQS (Dir. 2013/39/EU)	AA-EQS (annual average) for inland surface waters	Dissolved (filtered)	-	-	-	-	0.0072	0.00005	0.02	-	-	-	-	Receiving-water EQS used to derive permit conditions (priority substances)

Country	Regulation	Nature of the statistic (e.g. median, 90%ile)	State of metals analysed for (ie. Dissolved, acid soluble, total etc.	Arsenic (As) mg/L	Cadmium (cd) mg/L	Chromium (Cr) mg/L	Copper (Cu) mg/L	Lead (Pb) mg/L	Mercury (Hg) mg/L	Nickel (Ni) mg/L	Selenium (Se) mg/L	Zinc (Zn) mg/L	Aluminium (Al) mg/L	Manganese (Mn) mg/L	Comment
UK	UK – Water Framework Directive (Standards and Classification) Directions (E&W) / retained EQS (Dir. 2013/39/EU)	AA-EQS (annual average) for inland surface waters - Cd CLASS 1	Dissolved (filtered)	-	0.00008	-	-	-	-	-	-	-	-	-	Receiving-water EQS used to derive permit conditions (priority substances)
UK	UK – Water Framework Directive (Standards and Classification) Directions (E&W) / retained EQS (Dir. 2013/39/EU)	AA-EQS (annual average) for inland surface waters - Cd CLASS 2	Dissolved (filtered)	-	0.00008	-	-	-	-	-	-	-	-	-	Receiving-water EQS used to derive permit conditions (priority substances)
UK	UK – Water Framework Directive (Standards and Classification) Directions (E&W) / retained EQS (Dir. 2013/39/EU)	AA-EQS (annual average) for inland surface waters - Cd CLASS 3	Dissolved (filtered)	-	0.00009	-	-	-	-	-	-	-	-	-	Receiving-water EQS used to derive permit conditions (priority substances)
UK	UK – Water Framework Directive (Standards and Classification) Directions (E&W) / retained EQS (Dir. 2013/39/EU)	AA-EQS (annual average) for inland surface waters - Cd CLASS 4	Dissolved (filtered)	-	0.00015	-	-	-	-	-	-	-	-	-	Receiving-water EQS used to derive permit conditions (priority substances)
UK	UK – Water Framework Directive (Standards and Classification) Directions (E&W) / retained EQS (Dir. 2013/39/EU)	AA-EQS (annual average) for inland surface waters - Cd CLASS 5	Dissolved (filtered)	-	0.00025	-	-	-	-	-	-	-	-	-	Receiving-water EQS used to derive permit conditions (priority substances)
UK	Scotland – CAR Licence (example conditions, e.g. **landfill	Max. allowable effluent conc. (spot or composite sample)	Total (unfiltered)	0.1	0.005	0.1	0.05	0.1	0.001	0.2	-	0.5	-	-	Illustrative SEPA permit limits for an industrial leachate discharge (site-specific example) . Actual values vary per permit and receiving water sensitivity. "–" = not limited in this permit.
UK	UK (all) – *Waste Inc	Max. conc. (effluent) (instant or short-term sample)	Total (unfiltered)	0.15	0.05	-	-	0.20	0.03	0.50	-	1.5	-	-	Legally required emission limit values for heavy metals in incinerator scrubber wastewater (identical across UK via Industrial Emissions rules). These limits are measured at the effluent discharge point of dedicated treatment plants for flue-gas cleaning liquors.

NZ Trade Waste Bylaw examples

Table 4 NZ Trade Waste Bylaw examples

Regulation	Total Arsenic (As) mg/L	Total Cadmium (cd) mg/L	Total Chromium (Cr) mg/L	Total Copper (Cu) mg/L	Total Lead (Pb) mg/L	Total Mercury (Hg) mg/L	Total Nickel (Ni) mg/L	Total Selenium (Se) mg/L	Total Zinc (Zn) mg/L	Dissolved Aluminium (Al) mg/L	Total Manganese (Mn) mg/L	Other
Kaikōura District Trade Waste Bylaw 2022	5	0.5	2	0.2	0.2	0.004	10	10	2	100	20	Antimony (10 g/m³), Barium (10 g/m³), Beryllium (0.005 g/m³), Cobalt (10 g/m³), Copper (0.2 g/m³), Molybdenum (10 g/m³), Silver (2 g/m³), Thallium (10 g/m³), Tin (20 g/m³)
Startford District Council Trade Waste Bylaw 2020						0.05	10	10	10		20	Molybdenum (10 g/m³), Silver (2 g/m³), Thallium (10 g/m³), Tin (20 g/m³)
New Plymouth District Council Trade Waste Bylaw 2025	5	0.05	5	10	10	0.01	10	10	10		20	Antimony (Sb) – 10 g/m³, Barium (Ba) – 10 g/m³, Beryllium (Be) – 0.005 g/m³, Cobalt (Co) – 10 g/m³, Molybdenum (Mo) – 10 g/m³, Silver (Ag) – 2 g/m³, Thallium (Th) – 10 g/m³, Tin (Sn) – 20 g/m³.
South Taranaki District Council Trade Waste Bylaw 2024	5	0.05	5	10	10	0.05	10	10	10		20	Antimony – 10 g/m³, Barium – 15 g/m³, Beryllium – 0.005 g/m³, Cobalt – 10 g/m³, Molybdenum – 10 g/m³, Silver – 2 g/m³, Thallium – 10 g/m³, Tin – 20 g/m³.
Whanganui District Council Trade Waste Bylaw 2025. Whanganui Trade Waste Discharge Standards 2025	5	0.5	5	10	10	0.05	10	10	10		20	Antimony – 10 g/m³, Barium – 10 g/m³, Beryllium – 0.005 g/m³, Cobalt – 10 g/m³, Molybdenum – 10 g/m³, Silver – 2 g/m³, Thallium – 10 g/m³, Tin – 20 g/m³.
Palmerston North Trade Waste Bylaw 2022 Trade Waste administration manual 2022	5	0.5	5	10	10	0.05	10	10	10		20	Antimony – 10 g/m³, Barium – 10 g/m³, Beryllium – 0.005 g/m³, Cobalt – 10 g/m³, Molybdenum – 10 g/m³, Silver – 2 g/m³, Thallium – 10 g/m³, Tin – 20 g/m³.
Manawatu District Council Trade Waste Bylaw 2022	5	0.5	5	10	10	0.05	10	10	10		20	Antimony – 10 g/m³, Barium – 10 g/m³, Beryllium – 0.005 g/m³, Cobalt – 10 g/m³, Molybdenum – 10 g/m³, Silver – 2 g/m³, Thallium – 10 g/m³, Tin – 20 g/m³.
Tararua District Council Trade Waste Bylaw 2025	5	0.5	5	10	10	0.05	10	10	10		20	Antimony – 10 g/m³, Barium – 10 g/m³, Beryllium – 0.005 g/m³, Cobalt – 10 g/m³, Molybdenum – 10 g/m³, Silver – 2 g/m³, Thallium – 10 g/m³, Tin – 20 g/m³.
Hamilton City Council Trade Waste Bylaw 2016 (amended 2023)	5	0.5	5	5	5	0.005	5	5	5		5	Antimony – 5 g/m³, Barium – 5 g/m³, Beryllium – 0.005 g/m³, Cobalt – 5 g/m³, Molybdenum – 5 g/m³, Silver – 2 g/m³, Thallium – 5 g/m³, Tin – 5 g/m³.
Napier City Council Integrated trade waste & wastewater Bylaw 2022 Integrated trade waste & wastewater Bylaw Administration Manual 2022	5	0.5	5	10	10	0.05	10	10	10		10	Includes mass limits (mg/kg) and max. conc. (g/m3) Antimony – 10 g/m³, 0.025 kg/day, Barium – 10 g/m³, 0.025 kg/day, Beryllium – 0.005 g/m³, 0.0001 kg/day, Cobalt – 10 g/m³, 0.025 kg/day, Molybdenum – 10 g/m³, 0.025 kg/day, Silver – 2 g/m³, 0.010 kg/day, Thallium – 10 g/m³, 0.025 kg/day, Tin – 10 g/m³, 0.025 kg/day.
Gore District Council Trade Waste Bylaw 2016	5	0.5	5	10	10	0.05	10	10	10		20	Antimony – 10 g/m³, Barium – 10 g/m³, Beryllium – 0.005 g/m³, Cobalt – 10 g/m³, Molybdenum – 10 g/m³, Silver – 2 g/m³, Thallium – 10 g/m³, Tin – 20 g/m³
Waitaki District Council Trade Waste Bylaw 2021	5	0.05	5	10	10	0.05	10	10	10		20	Antimony – 10 g/m³, Barium – 10 g/m³, Beryllium – 0.005 g/m³, Cobalt – 10 g/m³, Molybdenum – 10 g/m³, Silver – 2 g/m³, Thallium – 10 g/m³, Tin – 20 g/m³.

Regulation	Total Arsenic (As) mg/L	Total Cadmium (cd) mg/L	Total Chromium (Cr) mg/L	Total Copper (Cu) mg/L	Total Lead (Pb) mg/L	Total Mercury (Hg) mg/L	Total Nickel (Ni) mg/L	Total Selenium (Se) mg/L	Total Zinc (Zn) mg/L	Dissolved Aluminium (Al) mg/L	Total Manganese (Mn) mg/L	Other
Grey District Council Trade Waste Bylaw 2018	5	0.5	5	5	5	0.005	5	5	5		5	Antimony – 5 g/m³, Barium – 5 g/m³, Beryllium – 0.005 g/m³, Cobalt – 5 g/m³, Molybdenum – 5 g/m³, Silver – 2 g/m³, Thallium – 5 g/m³, Tin – 5 g/m³
Matamata-Piako District Council Trade Waste Bylaw 2020	5	0.5	5	10	10	0.05	10	10	10	100	20	Antimony – 10 g/m³, Barium – 10 g/m³, Beryllium – 0.005 g/m³, Cobalt – 10 g/m³, Molybdenum – 10 g/m³, Silver – 2 g/m³, Thallium – 10 g/m³, Tin – 20 g/m³ Dissolved: Iron – 100 g/m³, Boron – 25 g/m³.
Dunedin City Council Trade Waste Bylaw 2020	5	0.5	5	10	10	0.05	10	10	10	100	20	Antimony – 10 g/m³, Barium – 10 g/m³, Beryllium – 0.005 g/m³, Boron – 25 g/m³, Cobalt – 10 g/m³, Iron (dissolved) – 100 g/m³, Molybdenum – 10 g/m³, Silver – 2 g/m³, Thallium – 10 g/m³, Tin – 20 g/m³.
Whangarei District Council Trade Waste Control 2023	5	0.5	5	10	10	0.05	10	10	10	100	20	Antimony – 10 g/m³, Barium – 10 g/m³, Beryllium – 0.005 g/m³, Boron – 25 g/m³, Cobalt – 10 g/m³, Iron (dissolved) – 100 g/m³, Molybdenum – 10 g/m³, Silver – 2 g/m³, Thallium – 10 g/m³, Tin – 20 g/m³.

Table 5 NZ Trade Waste Bylaw additional information

Regulation	Link to bylaw	Volume of discharge	Permitted trade waste comment	Controlled trade waste comment	Conditional trade waste comment	Prohibited trade waste comment	Comment (relating to the bylaw or metals specifically)
Kaikōura District Trade Waste Bylaw 2022	Trade Waste Bylaw 2022	Permitted: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s	Trade waste discharge that has been approved by, or is acceptable to, the Council, if it has the physical and chemical characteristics which comply with the requirements of the Council standard as defined in Schedule 1A of this bylaw.	Not mentioned	Trade waste discharge that does not comply with all the physical and chemical characteristics set out in Schedule 1A, but which may be approved for discharge to Council's system subject to conditions.	Trade waste that has prohibited characteristics as defined in Schedule 1B and that does not meet the conditions of Schedule 1A.	Note: The concentration for chromium includes all valent forms of the element. Chromium (VI) is more toxic than chromium (III), and for a discharge where chromium (III) makes up a large proportion of the characteristic, higher concentration limits may be imposed.
Startford District Council Trade Waste Bylaw 2020	Microsoft Word - Bylaws - Revised Trade Waste Bylaw - OCTOBER 2020	Permitted: 24 hr flow vol. < 6 m3 (car wash exception) Max. inst. Flow rate < 2 L/s	Any Trade Waste discharged to the Council system shall comply at all times with schedule 1, except where the nature and levels of such characteristics are varied by the Council as part of an approval to discharge a Trade Waste.	Not mentioned	Conditional trade waste means: a. Trade waste derived from a trade activity and/or process of such complexity or size, or employing such chemicals, raw materials, or feed stock, that the risk and/or consequences of it exceeding acceptable discharge characteristics (listed in Schedule 1) are considered significant by Council to the extent that specific conditions are placed upon the consent holder by Council; or b. Any trade waste discharged from trade premises where the discharge exceeds 6 cubic metres per day (excluding car washing facilities), or has an instantaneous flow rate of 2 litres per second or greater.	Trade waste that has, or is likely to have, any of the prohibited characteristics set out in schedule 2.	Has specific limits for metals in organic compounds in Table 1.3
New Plymouth District Council Trade Waste Bylaw 2025	trade-waste-bylaw-2025-adopted-24-june-2025.pdf	Permitted: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s	If the wastewater characteristic is not covered under the Acceptable Discharge Characteristics, then it is determined to be not permitted unless the authorised officer approves the discharge in writing. Permitted trade waste means trade waste derived from a trade activity	Controlled - A trade waste discharge, including tankered trade waste discharges, will require a controlled trade waste consent. The discharge will be subject to the general conditions in clause 9 of this bylaw, and any other	Conditional – A trade waste discharge will require a conditional trade waste consent if it is a significant discharge. The discharge will be subject to the general condition in clause 9 of this bylaw, and any other specific	Prohibited – An authorised officer will not grant a trade waste consent where the discharge is classified as prohibited as detailed in Schedule 1B of this bylaw.	Discharge is prohibited if it contains Mercury, Cadmium, Tin or Chromium as an organic compound

Regulation	Link to bylaw	Volume of discharge	Permitted trade waste comment	Controlled trade waste comment	Conditional trade waste comment	Prohibited trade waste comment	Comment (relating to the bylaw or metals specifically)
			and/or process that has been assessed to have a low risk to the wastewater system. The customer is permitted to discharge trade waste without holding a trade waste consent. Permitted - A trade waste discharge may be registered as a permitted trade waste discharge subject to the customer complying with all relevant general conditions in clause 9 of this bylaw. Permitted discharges do not have an expiry date. However should the discharge breach any relevant condition in clause 9 of this bylaw then the Council will review the permitted discharge status and may reclassify the discharge as a controlled discharge.	specific conditions as determined by an authorised officer.	conditions as determined by an authorised officer.		
South Taranaki District Council Trade Waste Bylaw 2024	https://www.southtaranaki.com/repository/libraries/id:27mlbegko1cxbyf94es5/hierarchy/Documents/Bylaws/Trade%20Waste%20Bylaw%20%282024%29%202024-06-24.pdf	> 5 m3 (24 hr flow)will be controlled. >20 (24 hr flow) is conditional	Permitted trade waste must also meet the controlled substances standards and may not have any of the prohibited characteristics in Schedule 4. 2) A discharge from any trade premises, including the types of premises listed below, consisting of a 24 hour flow volume greater than 5 cubic metres, is a discharge of controlled trade waste.	1) Controlled trade waste must also meet the controlled substances standards, unless otherwise approved by the Council in a trade waste consent or a trade waste agreement. 2) Controlled trade waste must not have any of the prohibited characteristics in Schedule 4. 3) A discharge of trade waste from any trade premises, including those listed below, consisting of a 24 hour flow volume of greater than 20 cubic metres is a discharge of conditional trade waste.	1) Conditional trade waste must also meet the controlled substances standards, unless otherwise approved by the Council in a trade waste consent or a trade waste agreement. 2) Conditional trade waste must not have any of the prohibited characteristics in Schedule 4.	Prohibited characteristics are present if their concentration exceeds background levels.	Discharge is prohibited if it contains Mercury, Cadmium, Tin or Chromium as an organic compound
Whanganui District Council Trade Waste Bylaw 2025 Whanganui Trade Waste Discharge Standards 2025	https://www.whanganui.govt.nz/files/assets/public/v/2/bylaws/trade-waste-bylaw-2025.pdf	Permitted: 24 hr flow vol. < 10 m3 Max. inst. Flow rate < 2 L/s	The nature and levels of the Characteristics of any Trade Waste discharged to the Sewerage System must comply at all times with the following requirements, except where the nature and levels of such Characteristics are varied by the Council as part of a Conditional Trade Discharge Permit.	Not mentioned	Lists industries that will be regarded as conditional trade waste		Discharge is prohibited if it contains Tin as tributyl or organic compound
Palmerston North Trade Waste Bylaw 2022 Trade Waste administration manual 2022	Palmerston North Trade Waste Bylaw 2022	Permitted: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s Controlled: 24 hr flow rate > 5 m3	Means a trade waste discharge that meets the physical and chemical standards as defined in appendix 1 of the Administration Manual.	Trade waste discharge that meets the physical and chemical characteristics defined in appendix 1 of the Administration Manual but where the volume of discharge exceeds 5m3 per day.	Means a trade waste discharge that complies with consent conditions approved by the Council.	Means a trade waste that has prohibited characteristics as defined in appendix 2 of the Administration Manual and is not permitted to be discharged to the wastewater system.	Discharge is prohibited if it contains Tin as tributyl or organic compound
Manawatu District Council Trade Waste Bylaw 2022	Trade-Waste-Bylaw-2022-Final.pdf	Permitted: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s Controlled: 24 hr flow rate > 5 m3	Acceptable Discharge means a Permitted Trade Waste Discharge into the Public Wastewater Network. Permitted Trade Wastes must comply with all of the requirements for Characteristics in Schedule 1.	Trade Waste that complies with the physical and chemical Characteristics of a Permitted Trade Waste in accordance with Schedule 1 of this Bylaw, but where the volume exceeds 5m3 per day, for which conditions have been placed upon the Permit by the Council.	Trade Waste which is not a Permitted Trade Waste, Controlled Trade Waste or a Prohibited Trade Waste for which conditions have been placed upon the Permit by Council.		

Regulation	Link to bylaw	Volume of discharge	Permitted trade waste comment	Controlled trade waste comment	Conditional trade waste comment	Prohibited trade waste comment	Comment (relating to the bylaw or metals specifically)
			Failure to comply with one or more of these characteristics will mean that a Permit is required for a Controlled or Conditional Trade Waste.				
Tararua District Council Trade Waste Bylaw 2025	Trade-Waste-Bylaw-2025.pdf	Permitted: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s	Trade waste discharge that has been approved by, or is acceptable to Council and as long as it has the physical and chemical characteristics which comply with the requirements of the Council standard as defined in Schedule 1A of this Bylaw.	Not mentioned	Trade waste for which conditions have been placed upon the consent by Council.	Rade waste that contains, or is likely to contain, prohibited characteristics as defined in Schedule 1B to this Bylaw and does not meet the conditions of Schedule 1A. The waste is not acceptable for discharge into Council's wastewater network.	Discharge is prohibited if it contains Tin as tributyl or organic compound
Hamilton City Council Trade Waste Bylaw 2016 (amended 2023)	Hamilton-Trade-Waste-and-Wastewater-Bylaw-2016-Amended-2023.pdf	Permitted: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s Conditional: 24 hr flow rate > 5 m3	Trade Waste discharge that complies with the physical and chemical Characteristics defined in Schedule 1A of this bylaw. Approval Notice must be obtained	Not mentioned	Trade Waste discharge which exceeds the physical and chemical Characteristics defined in Schedule 1A of this bylaw, and which is not a Prohibited Trade Waste. Conditional Consent must be obtained, or a Trade Waste Agreement be entered into	Trade Waste discharge that has any of the prohibited Characteristics as defined in Schedule 1B of this bylaw.	Schedule 2 of this bylaw has pre-treatment requirements for a list of business types
Napier City Council Integrated trade waste & wastewater Bylaw 2022 Integrated trade waste & wastewater Bylaw Administration Manual 2022	NCC-Trade-Waste-and-Wastewater-Bylaw-2022.pdf	Permitted & Controlled: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s Conditional: can have 24 hr flow rate > 5 m3	Characteristics of any Trade Waste and Wastewater Discharged to the Council's Public Wastewater Network System must comply at all times to permitted characteristics in Schedule A of admin manual	Trade Waste that, after Pre-treatment, complies with all of the physical and chemical Characteristics in Schedule A of the Administration Manual, and has a Discharge volume of less than 5 m3/day and a flow of less than 2 L/s. All Operators discharging Trade Waste into the Public Wastewater Network which are classified as Controlled or Conditional must obtain a Trade Waste Consent.	Tankered Waste, Trade Waste discharged from Mobile Facility and Vendor Operations, and any Trade Waste that, after Pre treatment, complies with all of the physical and chemical Characteristics set out in Schedule A of the Administration Manual unless otherwise specified in a Trade Waste Consent, and may have a discharge volume of more than 5 m3/day and/or a flow of more than 2 L/s	Trade Waste that has, or is likely to have, any of the physical and chemical characteristics as set out in Schedule B of this Administration Manual.	Administration manual has pre-treatment requirements for a list of business types **Note on heavy metals from bylaw:** Heavy metals have the potential to: • Impair the treatment process; • Impact on the receiving environment; and • Limit their use of Wastewater sludge and effluent. Where any of these factors are critical it is important that local acceptance limits should be developed. The concentration of chromium includes all valent forms of the element. Chromium (VI) is considered to be more toxic than chromium (III), and for a Discharge where chromium (III) makes up a large proportion of the characteristic, higher concentration limits may be acceptable. Specialist advice should be sought. Metals will be tested as total, not dissolved. If sludge is used as a biosolid then metal concentration/ mass are important such that the biosolids Guidelines are met
Gore District Council Trade Waste Bylaw 2016	https://www.goredc.govt.nz/repository/libraries/id:2buwl3j7c17q9srz9ase/hierarchy/Your%20Council/Documents/Plans%2C%20policies%20and%20bylaws/Bylaws/Trade%20Waste%20Bylaw%20-%202016.pdf	Permitted: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s	Trade waste discharge that has been approved by, or is acceptable to, the Council and as long as it has the physical and chemical characteristics which comply with the requirements of the Council standard as defined in schedule 1A	Not mentioned	Trade waste discharge that does not comply with all the physical and chemical characteristics set out in Schedule 1A but which may be approved for discharge by the Council subject to conditions.	Trade waste that has prohibited characteristics as defined in schedule 1B and does not meet the conditions of schedule 1A. The waste is not acceptable for discharge into the Council's system unless specifically approved by them as a conditional trade waste.	Note: The concentration for chromium includes all valent forms of the element. Chromium (VI) is considered to be more toxic than chromium (III), and for a discharge where chromium (III) makes up a large proportion of the characteristic, higher

Regulation	Link to bylaw	Volume of discharge	Permitted trade waste comment	Controlled trade waste comment	Conditional trade waste comment	Prohibited trade waste comment	Comment (relating to the bylaw or metals specifically)
			of this Bylaw.				concentration limits may be imposed.
Waitaki District Council Trade Waste Bylaw 2021	trade-waste-bylaw-2021.pdf	Permitted: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s Conditional: 24 hr flow rate > 5 m3 Max. inst. Flow rate > 2 L/s	Trade waste having physical and chemical characteristics that comply with the all the standards in Schedule 3A of this bylaw, or a discharge the Council certifies in writing to be a permitted discharge.	Not mentioned	Trade waste that has, or is likely to have, characteristics which exceed any of the characteristics listed in schedule 3A, but which does not have any prohibited characteristics listed in schedule 3C	Trade waste that has any characteristic listed in schedule 3C	
Grey District Council Trade Waste Bylaw 2018	Microsoft Word - Trade Waste Bylaw.docx	Permitted: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s	Trade Waste discharge that is permitted by this Bylaw, so long as it continues to comply with the physical and chemical characteristics defined in Schedule 1A of this Bylaw. Except where the nature and levels of such characteristics are varied by GDC as part of a consent to discharge Trade Waste.	Not mentioned	Trade Waste discharge which exceeds the physical and chemical characteristics defined in Schedule 1A of this Bylaw, and which is not a Prohibited Trade Waste.	Trade Waste discharge that has any of the prohibited characteristics as defined in Schedule 1B.	Also has mass limit concentrations of metals (kg/day) Note on heavy metals from bylaw: Note: Heavy metals have the potential to: • Impair the treatment process; • Impact on the receiving environment; and • Limit their use of Wastewater sludge and effluent. Where any of these factors are critical it is important that local acceptance limits should be developed. The concentration of Chromium includes all valent forms of the element. Chromium (VI) is considered to be more toxic than chromium (III), and for a Discharge where chromium (III) makes up a large proportion of the characteristic, higher concentration limits may be acceptable. Specialist advice should be sought. Metals will be tested as total, not dissolved. If sludge is used as a biosolid then metal concentration/mass are important such that the biosolids Guidelines are met.
Matamata-Piako District Council Trade Waste Bylaw 2020	Final_Trade_Waste_Bylaw_2020.pdf	Permitted: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s	Trade Waste discharge that has been Approved by, or is acceptable to the Council and as long as it has the physical and chemical Characteristics comply with the requirements as defined in schedule 1 of this Bylaw.	Not mentioned	Trade Waste which has or is likely to have Characteristics which exceed any of the acceptable physical and chemical Characteristics as defined in schedule 1 of this Bylaw, but which does not have any prohibited Characteristics.	Trade Waste that has prohibited Characteristics as defined in schedule 2 and does not meet the conditions of schedule 1. The waste is not acceptable for discharge into the Council's system unless specifically Approved by the Council as a Conditional Trade Waste (this Trade Waste is likely to be subject to Pre-Treatment).	
Dunedin City Council Trade Waste Bylaw 2020	Trade-Waste-Bylaw.pdf	Permitted: 24 hr flow vol. < 5 m3 Max. inst. Flow rate < 2 L/s	A trade waste discharge is classified as permitted where the discharge: (a) Does not exceed a 24-hour flow volume of 5 m3 and a flow rate of 2.0 L/s at any time, at the point of discharge; (b) Complies with the characteristics specified in Schedule A; and (c) Is not tankered waste.	Not mentioned	Trade waste discharge is classified as conditional where the discharge is not classified as permitted or prohibited.		

Appendix B

National Consents Database review

National Consents Database review

A high level review of existing New Zealand wastewater discharge consents was undertaken to understand current regulatory practice and identify how metals are presently managed through resource consents.

Table 1 below shows the WWTP identified as having specific numeric limits for treated wastewater and how they are monitored within the wastewater discharge consents.

The review provides an overview of current consenting approaches used throughout New Zealand and identifies the extent to which heavy metals are regulated within municipal wastewater discharges. Analysis of the consent database enables comparison of the metals most frequently controlled, the range of consent limits applied, and the monitoring frameworks used by consent authorities. This information helps to identify common regulatory practices, areas of consistency, and variability in the management of heavy metals across the sector.

The review found that out of the 192 WWTP discharge to water consents in the review, the majority of consents do not include any monitoring related to metals, and of those that do, even fewer have numerical limits. 19 WWTP were identified as having numerical limits, and 23 WWTP were identified as having monitoring-only requirements for metals in wastewater.

Of the WWTP consents that have numerical limits, there is little consistency with the limits themselves and the frequency of monitoring.

Limitations

The information contained in the National Consents Database of wastewater consents, developed by Taumata Arowai, is a reflection of the number, location, type and discharge point of publicly operated wastewater treatment plants in New Zealand. This database has been updated by Taumata Arowai with the best available information to inform the recommendations provided within this report. However, it requires verification and validation. Information, values and analysis contained in this report which has leveraged the database is therefore subject to change following verification and validation of the database.

Table 1 Numerical Limits from NZ WWTP consents

Name of WWTP	Region	Size	Receiving environment	Frequency	Type of sample	Form of metal	Nature of statistic	Aluminium (g/m^3)	Arsenic (g/m^3)	Cadmium (g/m^3)	Chromium (g/m^3)	Copper (g/m^3)	Lead (g/m^3)	Mercury (g/m^3)	Nickel (g/m^3)	Zinc (g/m^3)
Seaview	Wellington	Large	Low energy coastal	Monthly	24hr composite sample	Dissolved	95th percentile	-	0.115	0.035	0.22	0.065	0.22	0.005	0.35	0.75
Bell Island	Tasman	Large	Estuary	Annually	Representative sample'	Total	Max concentration	-	1.98	0.039	0.24	0.072	0.24	0.006	0.39	0.83
Porirua	Wellington	Large	Low energy coastal	Monthly	24hr composite sample	Total	Max concentration	-	0.023	0.055	0.044	0.013	0.044	0.001	0.07	0.08
Tahuna (Otepoti)	Otago	Large	Open ocean	Fortnightly	24hr composite sample	Unspecified	Rolling 12-month 95th percentile	5	-	0.05	0.3	0.07	0.3	0.005	0.2	0.35
Timaru	Canterbury	Large	Open ocean	Monthly	24hr composite sample	Unspecified	90th percentile	-	-	0.33	0.264		0.264	0.024	4.2	0.9
Whanganui	Manawatu-Whanganui	Large	Open ocean	Monthly (after 24 months compliance can switch to 4-monthly)	24hr composite sample	Total Chromium, unspecified for others	At least 95% of the time and for no more than 2 consecutive days	-	-	-	5	0.5	0.5	0.01	1.5	5
Gisborne	Gisborne	Large	Open ocean	6 monthly	24hr composite sample	Unspecified	Max concentration	-	-	0.8	2	0.2	0.2	0.004	-	2
Awatoto (Napier)	Hawke's Bay	Large	Open ocean	Quarterly	24hr composite sample	Unspecified	Max concentration	-	-	0.55	0.44	0.13	0.44	0.04	7	1.5
East Clive	Hawke's Bay	Large	Open ocean	Quarterly	24hr composite sample	Unspecified	Max concentration	-	-	0.07	0.44	0.13	0.44	0.01	0.7	1.5
Nelson North	Nelson	Large	Open ocean	Annually	Unspecified	Unspecified	Max concentration	-	-	0.275	1.37	0.065	0.22	0.02	3.5	0.75

Name of WWTP	Region	Size	Receiving environment	Frequency	Type of sample	Form of metal	Nature of statistic	Aluminium (g/m^3)	Arsenic (g/m^3)	Cadmium (g/m^3)	Chromium (g/m^3)	Copper (g/m^3)	Lead (g/m^3)	Mercury (g/m^3)	Nickel (g/m^3)	Zinc (g/m^3)
New Plymouth	Taranaki	Large	Open ocean	Unspecified	Unspecified	Unspecified	Max concentration	-	-	0.04	0.15	0.1	0.1	0.002	0.15	0.2
Moa Point	Wellington	Large	Open ocean	3 months	Unspecified	Total	Max concentration	-	0.26	0.08	0.48	0.14	0.48	0.01	0.77	1.65
Paraparaumu	Wellington	Large	River (very low dilution)	Monthly	24hr composite sample	Unspecified	Max concentration	-	0.01	0.004	0.01	0.01	0.01	0.0002	0.1	0.1
Picton	Marlborough	Medium	Low energy coastal	Quarterly	24hr composite sample	Unspecified	Rolling median of the last 8 samples	-	-	-	-	0.065	0.22	0.02	-	0.15
Westport	West Coast	Medium	Estuary	9 times per year	24hr composite sample	Total acid soluble	Max concentration	30	16	0.63	16	1.6	1.6	0.03	5	16
Oamaru	Otago	Medium	Land and water	Annually	Unspecified	Total	Max concentration	-	0.05	0.01	0.5	0.2	0.1	0.01	0.1	1
Green Island	Otago	Medium	Open ocean	Monthly	24hr composite sample	Total arsenic & Cadmium. Unspecified for others	6-month median value	-	0.86	0.17	0.34	0.17	0.23	0.0021	0.68	0.85
							95th percentile	-	5	0.68	1.37	0.34	1.26	0.0042	1.36	1.7
Katikati	Bay of Plenty	Medium	Open ocean	Annually	24hr composite sample	Total	Max concentration	-		0.000014	0.00002	0.000003	-	0.0000007	0.0002	0.000023
Reefton	West Coast	Medium	River (high dilution)	9 times per year	24hr composite sample	Total acid soluble	Max concentration	7	4	0.15	4	0.4	0.4	0.007	1.2	4
Summary statistics																
							Median	7	0.56	0.075	0.44	0.13	0.24	0.007	0.69	0.875
							Mean	14	2.8298	0.220	1.746	0.225	0.383	0.011	1.515	1.966
							95th percentile	28	11.1	0.698	6.1	0.61	1.29	0.031	5.3	5.55
							Max	30	16	0.8	16	1.6	1.6	0.04	7	16

Table 2 Summary of WWTP identified as having monitoring-only requirements for metals in wastewater

Site	Region	Population served	Size	Receiving environment	Iron	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Unit	Type	Monitoring Frequency
Clifton	Southland	53814	Large	Estuary	-	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	-	Monitoring only	Monitoring only	Unspecified	Total	3 months
Blenheim	Marlborough	29590	Large	Land and water	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Unspecified	Unspecified	Annually
Army Bay	Auckland	62990	Large	Open ocean	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	g/m^3	Total and dissolved	6 monthly
Christchurch	Canterbury	349662	Large	Open ocean	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	mg/m^3	Total	6 monthly
Eastern Districts Sewerage Scheme	Canterbury	39180	Large	Open ocean	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	g/m^3	Total	6 monthly

Site	Region	Population served	Size	Receiving environment	Iron	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Unit	Type	Monitoring Frequency
Totara Road (Palmerston North)	Manawatu-Whanganui	82817	Large	River/stream	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	g/m^3	Unspecified	Monthly
Pukete	Waikato	141401	Large	River/stream	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	mg/L	Total	Annually
Helensville	Auckland	3830	Medium	Estuary	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	g/m^3	Total	Annually
Feilding	Manawatu-Whanganui	16067	Medium	Land and water	-	Monitoring only	-	-	-	-	-	-	-	-	Unspecified	Dissolved	Monthly
Clarks Beach	Auckland	2500	Medium	Low energy coastal	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	-	Monitoring only	Monitoring only	mg/L	Total	6 monthly
Akaroa	Canterbury	1450	Medium	Low energy coastal	-	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	-	-	Monitoring only	Unspecified	Unspecified	Annually (in January)
Snells/Algies	Auckland	4000	Medium	Open ocean	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	-	Monitoring only	Monitoring only	g/m^3	Total and dissolved	6 monthly
Ohope	Bay of Plenty	2850	Medium	Open ocean	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	-	Monitoring only	Monitoring only	Monitoring only	Unspecified	Trace metal	5 yearly
Bluff	Southland	2000	Medium	Open ocean	-	-	Monitoring only	Monitoring only	-	Monitoring only	Monitoring only	-	Monitoring only	Monitoring only	Unspecified	Total	3 monthly
Warkworth	Auckland	3500	Medium	River/stream	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	-	Monitoring only	Monitoring only	g/m^3	Total and dissolved	6 monthly
Waipawa	Hawke's Bay	2028	Medium	River/stream	Monitoring only	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	g/m^3	Total and dissolved iron, unspecified for others	2 yearly
Waipukurau	Hawke's Bay	4269	Medium	River/stream	-	Monitoring only	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	g/m^3	Total and dissolved Aluminium, unspecified for others	2 yearly
Morrinsville	Waikato	6485	Medium	River/stream	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	-	Monitoring only	Monitoring only	Unspecified	Total	Annually
Te Aroha	Waikato	4287	Medium	River/stream	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	-	Monitoring only	Monitoring only	Unspecified	Total	Annually
Duvauchelle	Canterbury	250	Small	Low energy coastal	-	-	Monitoring only	-	Monitoring only	Monitoring only	-	-	Monitoring only	Monitoring only	Unspecified	Unspecified	Annually (in January)
Otane	Hawke's Bay	640	Small	River/stream	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	-	Total and dissolved Aluminium, unspecified for others	2 yearly
Norsewood	Manawatu-Whanganui	312	Small	River/stream	-	-	Monitoring only	Monitoring only	Monitoring only	Monitoring only	Monitoring only	-	-	Monitoring only	Unspecified	Total	6 monthly
Browns	Southland	145	Small	River/stream	-	-	-	-	-	Monitoring only	Monitoring only	-	Monitoring only	Monitoring only	Unspecified	Total	3 times per year

Appendix C

Receiving environment monitoring review

Receiving environment monitoring review

Review of wastewater treatment plants with consent conditions considering monitoring of metals in sediments and shellfish

To gather contextual information about metals in receiving environments around New Zealand, a high level review of compliance reporting and any other recent monitoring reports from WWTP that have been identified as having conditions in their consents for monitoring metals in sediment and/or shellfish was undertaken. Reports were provided by Taumata Arowai and the relevant consent conditions (if available) and monitoring reports where relevant have been summarized in the sections below.

1. Sediment and shellfish consents and monitoring reports

1.1 Awatoto (Hawke's Bay)

Site	Awatoto
Consent number	CD090514W or AUTH-118503-02
Consent type	Coastal permit
Sediment testing requirement summary	Sediment is tested at 4 locations, located 300 m and 500 m north and south of the outfall diffuser midpoint. Testing is required twice yearly. Samples are analysed for zinc, arsenic, cadmium, chromium, copper, tin, nickel, lead and mercury. The consent specifies analytical detection limits for each analyte, but no sediment quality trigger or compliance criterion was identified. **Detection limits for sediment analytes:** zinc 0.001 mg/kg, arsenic 0.001 mg/kg, cadmium 0.00005 mg/kg, chromium 0.0005 mg/kg, copper 0.0005 mg/kg, tin 0.0005 mg/kg, nickel 0.0005 mg/kg, lead 0.0001 mg/kg, and mercury 0.00008 mg/kg.
Shellfish testing requirement summary	No shellfish metals testing is required. Instead, wastewater toxicity is tested against reference water.

1.2 Bell Island (Tasman)

Site	Bell Island
Consent number	RM171238
Consent type	Coastal permit
Sediment testing requirement summary	Sediment testing is undertaken at 10 locations (shown in Figure A of the consent document), at varying distances from the outfall. Monitoring is required at five-yearly intervals. Sediment samples are analysed for total mercury, arsenic, cadmium, chromium, copper, lead, nickel and zinc. No explicit sediment quality trigger or compliance criterion was identified in the consent. Results are to be compared to relevant national or regional guidelines in monitoring reports prepared in the 6th, 12th, and 18th anniversaries of the commencement of the consent.
Shellfish testing requirement summary	Shellfish testing is undertaken at the same sediment sampling locations where cockles are present, at five-yearly intervals. Shellfish samples are analysed for arsenic, cadmium, chromium, copper, lead, nickel and zinc. No explicit shellfish metal compliance criterion was identified in the consent. Results are to be compared to relevant national or regional guidelines in monitoring reports prepared in the 6th, 12th, and 18th anniversaries of the commencement of the consent.

1.2.1 Bell Island WWTP 2017 Monitoring report

Site	Bell Island Wastewater Treatment Plant
Report title	Bell Island Wastewater Treatment Plant Consent Renewal: Assessment of Environmental Effects
Date	November 2017
Associated consent	NN000539
Additional reports	This report contains another report in the appendix published by Cawthorne industries October 2017. The results relevant for this assessment are within this report appendix and referenced to in the larger general report.
Sediment monitoring summary	**Sediment metals results summary** Sediment trace metal monitoring in 2006, 2011 and 2016 found elevated nickel and chromium concentrations at both potential impact and reference sites, indicating these concentrations were most likely attributable to natural catchment inputs rather than the wastewater discharge. Across the monitored sites, sediment metal concentrations were generally below ANZECC (2000) ISQG-high values, but nickel commonly exceeded the ISQG-low value of 21 mg/kg and chromium approached or, in some locations, remained below the ISQG-low value of 80 mg/kg. The report concludes that there was no spatial pattern indicating accumulation of metals due to the Bell Island discharge.
Shellfish monitoring summary	**Shellfish metals results summary** Shellfish metals monitoring of cockle tissue found elevated arsenic concentrations at all monitored sites in 2006, 2011 and 2016, with concentrations above the FSANZ guideline value for arsenic, although the report notes this criterion applies to inorganic arsenic rather than total arsenic. Chromium and nickel were also elevated at some sites, but comparisons between potential impact and reference sites indicated these concentrations were attributable to natural catchment inputs rather than the wastewater discharge. Cadmium, copper, lead, zinc and mercury were low and generally below relevant food standards or international guideline values.

1.3 Blenheim (Marlborough)

Site	Blenheim
Consent number	U071181.G(c)
Consent type	Coastal permit
Sediment testing requirement summary	**Conditions 64-65 (Benthic survey summary)** Sediment testing is undertaken at 12 stations, comprising six pairs located inside and outside the wastewater plume at set distances downstream of the discharge. Monitoring is required within two years of commissioning the new outfall pipeline, again within four years, and then at five-yearly intervals. Sediment samples are analysed for arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc. While no explicit sediment quality criterion is stated in the consent condition itself, compliance reporting has assessed results against ANZECC (2000) ISQG-low guidelines.
Shellfish testing requirement summary	**Condition 66 (Benthic survey summary)** Where pipi *(Paphies australis)* are present, shellfish testing is undertaken during the same monitoring events as sediment testing. At each event, 15 to 20 pipi are collected and analysed as composite tissue samples for faecal coliforms and arsenic, cadmium, chromium, copper, mercury, lead, nickel and zinc. While no explicit shellfish metal criterion is stated in the consent condition itself, compliance reporting has assessed shellfish metals against ANZFSC (2015).

1.3.1 Blenheim STP 2024 Monitoring report

Site	Blenheim sewage treatment plant
Report title	Blenheim Sewage Treatment Plant receiving environment monitoring 2024 (Cawthron Report 4041)
Date	6 June 2024

Associated consent	U071181
Additional reports	An appendix (F) of the Blenheim monitoring report for this period
Consent type	Discharge permits and coastal permits
Sediment monitoring summary	**Sediment results summary** Sediment trace metals were below ANZG (2018) default guideline values at all stations except nickel, which exceeded the lower sediment trigger value (DGV, indicating possible biological effects) at all sites but remained below the upper trigger value (GV-High, indicating more likely biological effects) and showed no plume-related pattern. The report notes the elevated nickel is likely due to naturally elevated background concentrations in the Wairau catchment rather than the wastewater discharge.
Shellfish monitoring summary	**Shellfish results summary** Shellfish trace metal concentrations showed no clear spatial pattern between plume and non-plume stations and were generally consistent with previous survey years. Except for arsenic, all measured metals were below FSANZ maximum permissible levels for human consumption. Total arsenic exceeded the FSANZ value at all stations, but the report notes the standard applies to inorganic arsenic only and the analysis did not distinguish between inorganic and organic arsenic species.

1.4 Browns (Southland)

Site	Browns
Consent number	301154
Consent type	Discharge to land and water
Sediment testing requirement summary	**Condition 7(c) and Condition 14 summary** Sediment is tested at one downstream stream bed location agreed with Environment Southland. Sampling is required twice yearly for the first two years, then every five years. Samples are analysed for copper, lead, nickel and zinc, against sediment limits of 65, 50, 21 and 200 mg/kg respectively (ANZECC 2000). If any limit is exceeded, additional upstream and downstream sediment sampling is required.
Shellfish testing requirement summary	No shellfish monitoring requirements were identified.

1.4.1 Browns lab reports

Sediment monitoring summary	Across the 2013–2022 sediment samples, concentrations of copper, lead, nickel and zinc were consistently below the ANZECC (2000) guideline values (65, 50, 21 and 200 mg/kg respectively). Overall, the results indicate no exceedances of sediment quality guidelines over the monitoring period, and therefore no trigger for additional sampling based on these thresholds.
Shellfish monitoring summary	Not included

1.5 Christchurch (Canterbury)

Site	Christchurch
Consent number	CRC051724
Consent type	Coastal permit
Sediment testing requirement summary	**Condition 23 summary** Sediment testing is undertaken at 18 locations, including 16 sites around the diffuser and 2 control sites south of the Waimakariri River. Sampling is required before commissioning, one year after commissioning, and then every five years in February or March. Samples are analysed for arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc. Trigger values are 20 mg/kg arsenic, 1.5 mg/kg cadmium, 80 mg/kg chromium, 65 mg/kg copper, 50 mg/kg lead, 0.15 mg/kg mercury, 21 mg/kg nickel and 200 mg/kg zinc, consistent with ANZECC (2000) – although not referenced in the consent directly. If any trigger is exceeded, notification and a risk and mitigation report are required.

Shellfish testing requirement summary	**Condition 27 summary** No shellfish metals testing is required under this consent. Instead, the consent requires biological testing of tuatua.

1.5.1 Christchurch compliance monitoring report

Site	Christchurch Wastewater Treatment Plant Oxidation Ponds, Cuthberts Road
Report title	Compliance Monitoring Report. Christchurch - West Melton Water Management Zone
Date	22 May 2023
Associated consent	CRC051724
Additional reports	Christchurch City Council Ocean Outfall: 2022 Benthic Biological Survey Ocean Outfall Christchurch Wastewater Treatment Plant
Consent type	Discharge permits and coastal permits
Sediment monitoring summary	**Sediment results summary** Sediment quality suggests that the control sites are different from the outfall sites, while benthic community structure was inconclusive with one control site not statistically separated from a large proportion of the outfall sites. The northern sites contained high abundances of the polychaete worm Heteromastus which is generally indicative of a disturbed environment. The lack of significant differences amongst the other sites, and the inconclusive control sites suggest factors other than the outfall and discharge have a strong influence on the benthic community.
Shellfish monitoring summary	**Shellfish results summary** The benthic fauna sampling was conducted in 2022. The benthic community was similar to the 2018 survey, but statistically different to the 2012 and 2007 surveys. Some of this difference could be attributed to some degree by variations in the level of resolution for some taxonomic groups, which provided some limitations in the detail of benthic community structure. Analysis of the benthic communities as a whole showed that only one control site was significantly different from the outfall sites and that two other sites (N2500 and N200) were significantly different from the other outfall sites. Based on the results from the 2022 survey, the discharge is not having a significant effect on the benthic community.

1.6 Eastern districts (Canterbury)

Site	Eastern Districts Sewerage Scheme
Consent number	*CRC041162.2*
Consent type	Coastal permit
Sediment testing requirement summary	**Conditions 19–23 summary** Sediment is tested at 9 fixed plume locations: one adjacent to the diffuser, four to the north and four to the south. Sampling is required in February or March, at three and five years after commissioning, and then every five years. Samples are analysed for arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc. No explicit sediment quality criterion or trigger was identified in the consent. Compliance appears to relate to meeting the monitoring and reporting requirements, with results reviewed over time for trends and possible adverse effects.
Shellfish testing requirement summary	No analytical testing for metals. Benthic infauna (not specific to shellfish) is collected for a count.

1.6.1 Eastern Districts compliance monitoring report

Site	Eastern District Sewer Scheme (EDSS)
Report title	Eastern Districts Sewer Scheme – Annual Compliance Monitoring Report 2021 - 2022
Date	August 2022
Associated consent	CRC041162.2
Additional reports	Appendix B – Waimakariri District Council outfall: sixth post construction survey

Consent type	Discharge permits and coastal permits
Sediment monitoring summary	**Sediment results summary** The survey found no significant effects from the outfall, based on sampling and analysis of sediment physicochemical properties and seabed fauna assemblages. The most notable differences in sediment physicochemical characteristics from previous years is the overall increase in levels at station S1000. Arsenic (Ar), cadmium (Cd), total organic carbon (TOC), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), phosphorus (P), and zinc (Zn) were all recorded at higher levels than those recorded in 2017. However, all these increases are smaller than the values recorded for the same chemical compounds in 2007. All levels recorded are below the ISQG-low trigger values for marine water (Table 3-5) (ANZECC 2000, ANZECC 2022).
Shellfish monitoring summary	**Shellfish results summary** No significant patterns of change attributable to the outfall discharge were evident from the analyses of the spatial and temporal distribution of animals living at the seabed. Significant differences in the similarities of infauna at varying distances from the outfall diffuser, and among successive surveys, were found; however, there was no distinct pattern in relation to the distance of sample stations away from the diffuser. Consequently, effects to the seabed faunal community caused by the outfall that are detectable by the sampling methods employed) are likely to be minor, and not distinguishable from natural marine processes in the area

1.7 Opotiki (Bay of Plenty)

Site	Opotiki
Consent number	63179
Consent type	Discharge to land
Sediment testing requirement summary	Sediment testing is only required if groundwater heavy metals exceed the freshwater trigger levels in Table 1. If triggered, sediment samples are collected from the estuary and analysed for arsenic, chromium, copper, lead, mercury and zinc. Sediment trigger levels are arsenic 70 mg/kg, chromium 370 mg/kg, copper 270 mg/kg, lead 220 mg/kg, mercury 1 mg/kg and zinc 410 mg/kg, based on ANZECC ISQG-High. If sediment trigger levels are exceeded, additional sediment sampling and shellfish monitoring are required.
Shellfish testing requirement summary	Shellfish testing is only required if sediment concentrations exceed the trigger levels in Table 1, or when otherwise directed by the Regional Council. Shellfish are analysed for the heavy metals in Table 1. Shellfish criteria are arsenic 1 mg/kg, lead 2 mg/kg and mercury 0.5 mg/kg, based on the Australia and New Zealand Food Standards Code.

1.7.1 Opotiki WWTP groundwater contaminant review

Site	Opotiki WWTP
Report title	Opotiki WWTP groundwater contaminant review
Date	17 January 2022
Sediment monitoring summary	Opotiki WWTP groundwater contaminant review report does not provide numerical reported values for heavy metals other than copper. Numerical copper results are provided for groundwater and estuary sediment only. Groundwater copper was compared with the ANZECC 80% marine trigger value of 0.008 mg/L, with the report noting that two samples from P4 and one sample from P10 exceeded this trigger. Estuary sediment copper results were all below the ISQG-low guideline of 65 mg/kg, with reported values ranging up to 15.2 mg/kg.

1.8 Timaru (Canterbury)

Site	*Timaru - Domestic and industrial*
Consent number	CRC242247
Consent type	Coastal permit

Sediment testing requirement summary	Sediment testing is undertaken at 16 stations around the outfall. Monitoring is required within two years of commissioning the Domestic Wastewater Treatment Plant upgrade, again within five years, and then every five years. Samples are analysed for arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc. No explicit sediment trigger values are stated in the consent for these samples. The consent requires a five-yearly survey report comparing results with previous monitoring periods and assessing effects on the receiving environment. Other environmental media have specific references to ANZECC guidelines.
Shellfish testing requirement summary	No shellfish metals testing requirements were identified in the consent.

1.8.1 Timaru WWTP compliance monitoring report

Site	Timaru WWTP
Report title	Compliance Monitoring Report – Seaforth Timaru
Date	16 May 2025
Associated consent	CRC242247
Additional reports	Monitoring survey of seabed ecology, sediments and water quality at the Timaru Wastewater Treatment Plant ocean outfall: 2025
Consent type	Discharge permits and coastal permits
Sediment monitoring summary	**Sediment results summary** Sediment metal concentrations in 2025 were consistently low, within the ranges typical for un-impacted sandy coastal sediments and well below the ANZG (2018) default guideline values (DGV) for ecological effects. No spatial patterns suggestive of outfall effects were identified. Metal concentrations in 2025 were generally lower than those recorded in 2020 and comparable to results from 2017 and 2007. Mercury levels were below the ADL (200 mg/kg) in 2025 and 2020, but since the ADL was lower for 2017 samples (100 mg/kg) it is difficult to make comparisons with this year. Concentrations of all metals were all much lower than those recorded during the 1996 survey (CH2M Beca 2002), which were still generally below DGVs. As discussed in previous studies (Clark 2017; CH2M Beca 2002), metal input from the Timaru WWTP outfall is either at a very low level and / or the high energy nature of coastal waters in this area dilutes any soluble heavy metals in the discharge and rapidly disperses any heavy metals adsorbed onto particulates derived from the outfall discharge.
Shellfish monitoring summary	**Shellfish results summary** While no consistent patterns suggestive of an outfall effect were observed in the community indices in 2025, one notable exception was the 50N-Iso station, which exhibited significantly lower evenness and diversity compared to all other stations.

1.9 Westport (West Coast)

Site	Westport
Consent number	AUTH-RC00408-1
Consent type	Discharge to water
Sediment testing requirement summary	Sediment is tested at two locations in the Buller River, one upstream and one downstream of the discharge. Sampling is required once per year. Samples are analysed for arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc using an acid soluble metal screen. Trigger values are arsenic 20 mg/kg, cadmium 1.5 mg/kg, chromium 80 mg/kg, copper 65 mg/kg, mercury 0.15 mg/kg, nickel 21 mg/kg, lead 50 mg/kg and zinc 200 mg/kg (these are not referenced as ANZECC guidelines in the consent but align with the ANZECC DGVs). If any trigger is exceeded, effluent metals monitoring is required on five occasions over the following year, and ongoing monitoring continues until compliance is achieved.
Shellfish testing requirement summary	No shellfish testing requirements were identified in the consent.

1.10 Tauranga (Bay of Plenty)

Site	Tauranga - Chapel St WWTP
Consent number	62878-AP
Consent type	Coastal permit
Sediment testing requirement summary	**Conditions 12.1–12.3 and 13.0 summary** Sediment monitoring is required as part of a broad spatial ecological survey of benthic biota and sediments in the vicinity of the outfall, comparable to the survey undertaken by Cawthron Institute in 2003. The consent requires this survey to be undertaken in 2014 and 2024, with results provided to the Regional Council within three months of each survey. The consent does not specify sediment analytes, sampling locations, or sediment quality trigger values in the condition itself, but implies to use the same guidelines as used in the Cawthorne study referenced.
Shellfish testing requirement summary	**Conditions 12.1–12.3 summary** Shellfish monitoring is required annually in February. Intertidal tuatua soft tissue is collected from five stations adjacent to the outfall, with five replicate samples collected per station and analysed for arsenic, cadmium, chromium, copper, mercury, lead, nickel and zinc. The consent also requires three replicate mussel samples to be collected from the outfall diffuser each February and analysed for the same analytes to provide a worst-case measure of trace metal accumulation. The consent criteria require no replicate to exceed the following trace metal concentration limits: inorganic arsenic 2 mg/kg, copper 30 mg/kg, lead 2 mg/kg, mercury 0.5 mg/kg, nickel 80 mg/kg and zinc 50 mg/kg. If any sample exceeds these limits, the consent holder must notify the Regional Council and Pacific Health immediately and investigate the likely cause.

1.11 Reefton (West Coast)

Site	Reefton
Consent number	RC00395/1
Consent type	Discharge to water
Sediment testing requirement summary	Sediment is tested at two locations in Cemetery Creek, one upstream and one downstream of the discharge. Sampling is required once per year. Samples are analysed for arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc. Trigger values are arsenic 20 mg/kg, cadmium 1.5 mg/kg, chromium 80 mg/kg, copper 65 mg/kg, mercury 0.15 mg/kg, nickel 21 mg/kg, lead 50 mg/kg and zinc 200 mg/kg. If any trigger is exceeded, effluent metals monitoring is required on five occasions over the following year, and ongoing monitoring continues until compliance is achieved.
Shellfish testing requirement summary	No shellfish testing requirements were identified in the consent.

1.11.1 Reefton WWTP Monitoring report 2024 – 2025

Site	Reefton Wastewater Treatment Plant
Report title	Environmental Monitoring Report for Reefton Wastewater Treatment Plant July 2024 – June 2025
Date	15 July 2025
Associated consent	RC00395
Additional reports	No additional metals-specific reports were identified in the uploaded annual monitoring report.
Consent type	Discharge to water
Sediment monitoring summary	**Sediment metals results summary** One sediment sampling event was undertaken on 17 September 2024 at Site 8 (immediately upstream of the discharge point in Cemetery Creek) and Site 10 (50 m downstream of the discharge point). Several trigger values were exceeded at the upstream site (Site 8), with arsenic at 33 mg/kg, copper at 83 mg/kg, mercury at 0.3 mg/kg, lead at 70 mg/kg and zinc at 649 mg/kg. Downstream sediment concentrations at Site 10 were lower and below the trigger values reported in the consent summary,

	with arsenic 2.22 mg/kg, cadmium 0.03 mg/kg, chromium 8.6 mg/kg, copper 7.2 mg/kg, mercury <0.1 mg/kg, nickel 9.5 mg/kg, lead 13 mg/kg and zinc 74 mg/kg. The report notes that Site 8 is upstream of the discharge and therefore less likely to reflect effects from treated effluent, although overflows may still influence sediment quality.
Shellfish monitoring summary	No shellfish metals monitoring results were reported.

1.12 Westport (West Coast)

Site	Westport
Consent number	RC00408
Consent type	Discharge permit
Sediment testing requirement summary	Sediment is tested at two locations in the Buller River, one immediately upstream and one 100 m downstream of the treated sewage effluent discharge. Sampling is required once per year. Samples are analysed using an acid soluble metal screen for arsenic, cadmium, chromium, copper, mercury, nickel, lead, zinc and poly aromatic hydrocarbons. Trigger values are arsenic 20 mg/kg, cadmium 1.5 mg/kg, chromium 80 mg/kg, copper 65 mg/kg, mercury 0.15 mg/kg, nickel 21 mg/kg, lead 50 mg/kg, zinc 200 mg/kg and poly aromatic hydrocarbons 4000 µg/kg (dry weight). If any trigger is exceeded, effluent metals monitoring is required on five occasions over the following year, and ongoing monitoring continues until compliance is achieved.
Shellfish testing requirement summary	No shellfish testing requirements were identified in the consent.

1.12.1 Westport WWTP Monitoring report 2024 - 2025

Site	Westport Wastewater Treatment Plant
Report title	Environmental Monitoring Report for Westport Wastewater Treatment Plant July 2024 – June 2025
Date	15 July 2025
Associated consent	RC00408
Additional reports	No additional metals-specific reports were identified in the uploaded annual monitoring report.
Consent type	Discharge permits
Sediment monitoring summary	**Sediment metals results summary** One sediment sampling event was undertaken on 3 March 2025 at Site 14 (immediately upstream of the bridge) and Site 15 (100 m downstream of the bridge). Sediment metals concentrations at both sites were below the consent trigger values for arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc, so no follow-up effluent metals sampling was required. Reported concentrations were: arsenic 4.91 mg/kg upstream and 10.5 mg/kg downstream; cadmium 0.05 and 0.04 mg/kg; chromium 10.3 and 14 mg/kg; copper 8.3 and 11 mg/kg; mercury <0.1 mg/kg at both sites; nickel 10.5 and 13.2 mg/kg; lead 5.9 and 9.6 mg/kg; and zinc 40 and 45 mg/kg. Overall, the results indicate compliance with the sediment metals trigger values and no metals-related trigger for additional monitoring.
Shellfish monitoring summary	No shellfish metals monitoring results were reported.

1.13 Other environmental monitoring reports and plans

Army Bay (Auckland)

Site	Army Bay WWTP / Whangaparāoa Passage
Report/s title	Army Bay WWTP Receiving Environment Monitoring (2025); Bioresearches (2025) – Environmental Monitoring of the Benthos (Autumn 2025)
Consent number	DIS60331146
Consent type	Discharge consent with Receiving Environment Monitoring Plan (REMP)
Sediment testing / monitoring requirement summary	Sediment metals monitoring is undertaken for As, Cd, Cr, Cu, Pb, Ni and Zn (total recoverable and bioavailable fractions) at 100 m, 250 m and 1000 m from the outfall. 2025 results: - As: 4.2–8.0 mg/kg - Cr: 17–38 mg/kg - Cu: 5.3–10 mg/kg - Pb: 8.6–17 mg/kg - Ni: 6.7–13 mg/kg - Zn: 37–75 mg/kg - Cd: <0.1 mg/kg (below detection) All concentrations were below ANZG/NOAA guideline thresholds. Slightly elevated concentrations were observed at 100–250 m (particularly south and west of the outfall), however no consistent spatial trend was identified and variability is attributed to sediment characteristics (mud content) rather than WWTP discharge. No adverse effects attributable to the discharge were identified.
Shellfish testing / monitoring requirement summary	Shellfish metals monitoring is undertaken for As, inorganic As, Cd, Pb and Hg. Historical monitoring (2020–2024) identified cadmium exceedances at multiple sites, while lead and mercury concentrations were generally low. Effluent cadmium concentrations were consistently below detection (<0.00005 mg/L), indicating that elevated shellfish cadmium concentrations are not attributable to the WWTP discharge and are more likely associated with catchment-derived sources (e.g. stormwater or agricultural inputs).

Bay of plenty monitoring program

Site	Bay of Plenty Regional Council contaminant monitoring programme (regional estuary, river, water and shellfish monitoring)
Report title	Bay of Plenty Comprehensive Contaminant Report 2020
Consent number	Not consent-specific / regional state of environment monitoring report
Consent type	Regional contaminant monitoring report / state of environment monitoring
Sediment testing / monitoring requirement summary	This report provides regional estuary and river sediment monitoring data that have been included as broader comparison / context information only. The estuary sediment results are useful receiving-environment context, but they are from a regional state of environment monitoring programme rather than site-specific WWTP outfall monitoring. The river sediment results are more appropriately treated as background or catchment-context values from a separate regional snapshot survey. Representative numerical values from this report are summarised in Table 6, separate from the explicit WWTP outfall / affected-environment results in Table 5.
Shellfish testing / monitoring requirement summary	Shellfish were analysed for heavy metals at selected Tauranga Harbour sites. These data are useful regional context and comparison information, but they are not site-specific WWTP outfall monitoring results. Representative values are summarised in Table 6.

Watercare Mangere Harbour (Auckland) Environmental Monitoring Plan

Site	Watercare Mangere Wastewater Treatment Plant – Harbour Environmental Monitoring Programme (HEMP)
Report title	Watercare Mangere Harbour Environmental Monitoring Programme 2024–2025
Consent number	Resource consent 30083
Consent type	Discharge consent / coastal receiving environment monitoring programme

Sediment testing / monitoring requirement summary	The HEMP requires sediment quality monitoring at 13 sites, with total concentrations of cadmium, copper, lead, mercury and zinc measured at all sites. Monitoring is undertaken on a two-yearly basis for sites 1 to 6 and the pond sites, and four-yearly for sites 7 to 11. The 2024–25 HEMP report states that sediment data are compared with ANZG (2018) and MacDonald et al. (1996), *Development and evaluation of sediment quality guidelines for Florida coastal waters*, sediment quality guidelines. In 2024, no sediment metal concentrations exceeded sediment quality guidelines at any monitored site. o
Shellfish testing / monitoring requirement summary	No shellfish metals testing is required under the HEMP monitoring programme; shellfish monitoring is four-yearly at two sites for DDT and dieldrin in Pacific oysters.

Hastings Wastewater Environmental Monitoring Report

Site	Hastings East Clive Wastewater Treatment Plant
Report title	Final 9-Year Review Report and Appendices
Consent number	CD130214W or AUTH-120712-01
Consent type	Discharge of final combined wastewater into Hawke Bay via an offshore outfall
Sediment testing / monitoring requirement summary	This report summarises receiving environment monitoring undertaken over the nine-year review period from 25 June 2014 to 24 June 2023. Sediment quality was assessed against the ANZECC/ARMCANZ (2000) ISQG-low values referenced in the consent, with the report also noting that the currently applicable sediment criteria are the ANZG (2018) default guideline values and high guideline values. Across the review period, mercury was reported to be slightly elevated in sediment on three isolated occasions, but no evidence of long-term accumulation of contaminants in sediment was identified, and no discernible adverse benthic sediment effects were reported outside the consented mixing zones. The review report does not provide year-by-year sediment metals results or numerical sediment metals concentrations.
Shellfish testing / monitoring requirement summary	The discharge consent does not require metals testing for shellfish. Shellfish were considered and tested for other non-metals analytes.

Clarks Beach (Auckland) Receiving Environment Monitoring Programme

Site	Watercare Clarks Beach (Southwest Wastewater Scheme)
Report title	Watercare Services Southwest Manukau Water Quality and Benthic Ecology Baseline Monitoring 2024–2025; and Clark's Wastewater Treatment Plant Upgrade: Pre-construction Shellfish Monitoring 2024/2025
Consent number	CST60082600 and CST60082302
Consent type	Baseline receiving environment monitoring required under Condition 27 of the new Clarks Beach outfall discharge consents
Sediment testing / monitoring requirement summary	Sediment metals analysis is not identified as part of the sediment monitoring programme.
Shellfish testing / monitoring requirement summary	Based on the dedicated pre-construction shellfish monitoring report, shellfish metals monitoring forms part of the two-year baseline Receiving Environment Monitoring Programme required before discharge from the new Clarks Beach outfall begins. Farmed Pacific oysters are monitored at five Waiuku Estuary sites and analysed for arsenic, copper, zinc and lead. The report includes the following criteria: inorganic arsenic 1 mg/kg wet weight, copper Generally Expected Level (GEL) 30 mg/kg wet weight, zinc GEL 290 mg/kg wet weight, and lead food standard limit 2 mg/kg wet weight. The currently available reporting covers the pre-discharge baseline period only. The purpose of this monitoring is to establish reference conditions against which future shellfish metals results can be assessed once the new outfall is operational. Continued monitoring is intended to support detection and evaluation of any future changes following commencement of discharge.

2. Sediment and shellfish numeric monitoring results from supplied reports

The numerical results for sediment and shellfish monitoring are shown below in Table 1 and Table 2. Statistics were calculated from these and provided in the main body of the report.

Table 1 Sediment monitoring results (all results in mg/kg)

Source	WWTP	Location	Marine / Freshwater	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury	Year	
Bell Island Wastewater Treatment Plant Consent Renewal: Assessment of Environmental Effects (AEE)	Bell Island	Waimea Inlet	Marine		4.1	0.03	0.58	0.55	< 0.09	1.6	7.9	0.012	2006	Mean values
						<0.01	51	12	8.3	72	38	<0.05	2006	
						<0.01	56.7	9.8	6.1	102.3	37.3	<0.05	2006	
						<0.01	44.7	9	6.4	76.7	34	<0.05	2006	
						<0.01	26.3	4.8	3.8	47.7	21.3	<0.05	2006	
						<0.01	23	4	3.2	42.7	19.3	<0.05	2006	
						0.1	69	10	4.2	65	44		2006	
						0.1	45	9	6.3	72	38		2006	
						0.4	61	7	7.7	58	34		2006	
						0.5	95	12	11.3	94	50		2006	
						<0.01	20	3.1	2.6	31	18	<0.05	2006	
						<0.01	60.7	11	10	75.7	41.7	<0.05	2006	
						<0.01	31.3	5.9	4.5	77	25	<0.05	2006	
						<0.01	51	10.6	9.2	87	40	<0.05	2006	
						<0.01	37.3	6	6.5	71.3	29	<0.05	2006	
					5	<0.09	42	7.2	5.9	55	29	<0.05	2011	
					6	<0.08	72	9	5.7	82	38	<0.05	2011	
					7	<0.09	54	10	7	79	37	<0.05	2011	
					<5	<0.09	44	6.7	5.2	65	29	<0.05	2011	
					<4	<0.08	25	3.7	3	41	19	<0.05	2011	
					6	<0.09	55	9.3	7.9	70	39	<0.05	2011	
					5	<0.10	49	8.9	6.3	64	33	<0.05	2011	
					4	<0.09	54	5.7	5.8	80	26	<0.05	2011	
					7	<0.10	56	12	10	77	44	<0.05	2011	
					7	<0.09	48	7.9	8.1	76	35	<0.05	2011	
					4	0.02	52	9.9	6.7	68	35	0.03	2016	
					5	0.02	57	10	5.6	80	38	0.03	2016	
					5	0.02	59	11.5	7	86	41	0.04	2016	
					4	0.02	31	5.5	4.3	48	22	0.02	2016	
					4.4	0.01	36	5	3.3	49	22	0.01	2016	
					5	0.03	61	11	7.2	78	40	0.03	2016	
					4.5	0.02	56	10.4	6.8	73	37	0.03	2016	
					4	0.02	43	6.6	5.8	72	28	0.01	2016	
					6	0.02	53	10.9	9.2	77	40	0.03	2016	
					7.4	0.02	59	12.1	9.8	83	43	0.03	2016	
Blenheim Sewage Treatment Plant receiving environment monitoring 2024	Blenheim	Wairau Estuary	Marine		5.556		17.778	9.778	15.333	28.8	72.222	0.049	2024	Outside plume, estimated values from graph
					5.278		17.778	9.778	15.333	28.2	69.444	0.078	2024	
					5.556		18.889	8.889	16	26.4	69.444	0.104	2024	
					6.111		20	9.778	16	25.2	72.222	0.049	2024	

Source	WWTP	Location	Marine / Freshwater	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury	Year	
					6.944		16.667	10.667	16.667	21.6	72.222	0.049	2024	
					6.389		21.111	9.778	16	23.4	69.444	0.058	2024	
					5.556		21.111	10.667	16.667	30.6	80.556	0.049	2024	Inside plume, estimated values from graph
					5.833		20	9.778	16	25.8	77.778	0.049	2024	
					5.556		18.889	10.667	16.667	25.2	69.444	0.062	2024	
					5.278		17.778	10.667	14.667	28.2	69.444	0.042	2024	
					5.556		18.889	8.889	14.667	25.2	69.444	0.042	2024	
					7.222		26.667	10.667	16.667	27.6	75	0.062	2024	
Compliance lab reports for Browns WWTP	Browns	Unnamed tributary of Tussock Creek at Limeworks Road	Freshwater					12	11	14	92		2013	Sep
								14.7	14	20.5	101		2013	Sep
								7.5	6.2	4.9	97		2014	March
								18	14	15	70		2014	Sep
								9.1	9.7	11	68		2015	March
								10	16	12	130		2015	Sep
								8.7	12	12	65		2020	Sep
								8.8	10	11	65		2021	March
								12	12	14	91		2022	March
								10	11	11	83		2022	Sep
2025 Compliance monitoring report	Awatoto/Napier	Hawke Bay	Marine		3.2	0.2	10.3	3.4	5.6	7.3	33	0.04	2024	500 m S
					3.5	0.19	10.5	4.2	6.3	7.3	36	0.05	2024	300 m S
					3.2	0.17	9.7	3.1	5.2	6.6	32	0.04	2024	500 m N
					5.3	0.38	14.4	8.1	11.2	10.7	53	0.07	2024	300 m N
					3.3	0.19	9.3	3.5	5.6	6.9	32	0.04	2025	500 m S
					3.6	0.17	9.6	3.8	6	7.3	33	0.04	2025	300 m S
					4.3	0.22	11.4	6.3	7.4	8.1	37	0.05	2025	500 m N
					3.1	0.16	8.6	2.8	4.7	6.3	29	0.04	2025	300 m N
Environmental Monitoring Report for Reefton Wastewater Treatment Plant July 2024 - June 2025	Reefton	Cemetery Creek	Freshwater		25	0.24	21	79	53	14	270	0.2	2021	50m d/s
					3.32	<0.1	2.6	16	15.2	3.5	82	<1	2022	50m d/s
					4.18	0.08	3.5	14	13.3	5.3	86	0.6	2023	50m d/s
					2.22	0.03	8.6	7.2	13	9.5	74	<0.1	2024	50m d/s
					33	0.31	9.9	83	70	19	649	0.3	2024	immediately u/s
Environmental Monitoring Report for Westport Wastewater Treatment Plant July 2024 - June 2026	Westport	Buller River	Freshwater		4.91	0.05	10.3	8.3	5.9	10.5	40	<0.1	2025	immediately u/s
					10.5	0.04	14	11	9.6	13.2	45	<0.1	2025	100m d/s
2024 Benthic Ecology and Sediment Assessment. Omanu Ocean Outfall. For TCC	Taurangua - Chapel St & Te Maunga	Omanu Beach	Marine		3.7	<0.01	4.7	0.5	1.5	2.1	17.1			2000N-12
					4.4	<0.01	5.3	0.5	1.6	2.4	17.6			1000N-12
					4.6	<0.01	5.3	0.5	1.5	2.5	17			100N-12
					4	<0.01	4.9	0.7	1.6	2.5	17.6			20N-12
					4.3	<0.01	5.1	0.5	1.6	2.3	15.7			Outfall-12
					10.5	0.011	9.6	0.7	2.3	5.6	23			Outfall-20

Source	WWTP	Location	Marine / Freshwater	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury	Year	
					5.2	<0.01	5.7	0.5	1.6	2.6	17.6			20S-12
					4.7	<0.01	5.1	0.6	1.5	2.5	15.9			100S-12
					5.5	<0.01	5.3	0.4	1.2	2.5	14.7			1000S-12
					4.2	<0.01	6.5	0.5	1.4	3.8	34			2000S-12
Christchurch City Council Ocean Outfall: 2022 Benthic Biological Survey	Christchurch City Council	Pegasus Bay	Marine		6.4	0.01	11.6	3	10.3	9.8	38.3	0.05	2022	North
					6.5	0.02	13	4.3	11.7	10.8	43.7	0.05	2022	North
					6.2	0.01	11.2	2.8	10	9.3	36.7	0.05	2022	North
					6.4	0.01	12.4	3.4	11.4	10	39	0.05	2022	North
					5.8	0.01	11.3	2.5	9.6	9.1	34.3	0.04	2022	North
					5.9	0.01	11.5	2.5	9.8	8.9	34	0.04	2022	South
					6.3	0.01	11.8	2.8	10.6	9.2	35	0.04	2022	South
					6.1	0.01	11.6	2.7	10.3	9.1	34.7	0.04	2022	South
					6.1	0.02	13.2	3.3	10.3	10.2	37.3	0.05	2022	South
					6	0.01	12.5	2.9	10	9.4	35.7	0.04	2022	South
					5.1	0.01	10.9	2.4	8.6	8.7	33	0.04	2022	West
					5.1	0.01	10.8	2.5	8.6	8.6	32.7	0.04	2022	West
					5.1	0.01	10.9	2.5	8.7	8.7	34	0.04	2022	West
					6.1	0.01	12.8	3.1	10.1	9.9	36.7	0.04	2022	East
					6.5	0.02	13.6	3.6	11.2	10.3	39.3	0.05	2022	East
					6.4	0.02	13.5	3.8	11.3	10.9	41.3	0.05	2022	East
		Waimakari ri River	Fresh (control for marine)		3.8	0.02	11.1	4.3	8.9	9.8	37	0.05	2022	Control
					4	0.02	11.1	4.2	9	9.8	37	0.05	2022	Control
MANGERE WASTEWATER TREATMENT PLANT HARBOUR MONITORING 2024–25	Mangere	Auckland	Marine			0.014		3.1	4.3		40	<0.02	2024	Metals 2
						0.014		3.7	4.4		43	<0.02	2024	Metals 2
						0.014		3.6	4.4		43	<0.02	2024	Metals 2
						0.028		4.7	6.1		51	<0.02	2024	Metals 3
						0.031		5.7	7.2		58	0.02	2024	Metals 3
						0.029		5.1	6.1		53	<0.02	2024	Metals 3
						0.017		3.1	4.1		36	<0.02	2024	Metals 4
						0.016		2.9	4.2		36	<0.02	2024	Metals 4
						0.018		3.2	4.3		38	<0.02	2024	Metals 4
						0.016		3	3.7		36	<0.02	2024	Metals 5
						0.014		2.9	3.7		36	<0.02	2024	Metals 5
						0.014		2.9	3.9		36	<0.02	2024	Metals 5
						0.023		3.1	4.2		38	<0.02	2024	Outfall

Source	WWTP	Location	Marine / Freshwater	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury	Year	
						0.024		3.5	4.4		38	<0.02	2024	Outfall
						0.018		3.3	4		35	<0.02	2024	Outfall
						0.023		3.4	4.6		42	<0.02	2024	Purakau Upper
						0.022		3.3	4.6		41	<0.02	2024	Purakau Upper
						0.024		3.4	4.7		41	<0.02	2024	Purakau Upper
						0.049		4.3	5.6		52	<0.02	2024	Pond 14
						0.052		5.1	6.3		54	<0.02	2024	Pond 14
						0.048		4.8	6.2		54	<0.02	2024	Pond 14
						0.06		5.3	6.4		54	0.02	2024	Pond 16
						0.063		5.4	6.2		54	<0.02	2024	Pond 16
						0.059		5.3	6.4		54	0.02	2024	Pond 16

Table 2 Shellfish monitoring results (all results in mg/kg)

Source	WWTP	Location	Marine / Freshwater	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury	Year	Notes
Bell Island Wastewater Treatment Plant Consent Renewal: Assessment of Environmental Effects (AEE)	Bell Island	Waimea Inlet	Marine		1.8	< 0.01	0.66	0.37	< 0.08	1.5	4.7	< 0.01	2006	
					1.9	< 0.01	0.46	0.44	< 0.09	2.4	6.7	< 0.01	2006	
					2.2	< 0.02	0.63	0.63	< 0.09	1.7	8.1	< 0.01	2006	
					2.1	< 0.01	1	0.38	< 0.08	1.6	5.1	< 0.01	2006	
					9.2	0.09	1.1	1.6	< 0.1	1.5	15		2011	
					6.5	0.06	2	1.3	< 0.1	2.1	15		2011	
					7.3	0.07	1.9	2.2	< 0.1	2.5	14		2011	
					6.3	0.06	0.76	1.3	< 0.09	1.3	14		2011	
					5.7	0.07	0.65	1.1	< 0.1	1.2	15		2011	
					7	0.08	0.75	1.5	< 0.09	1.6	15		2011	
					8.8	0.08	0.76	1.6	< 0.1	1.6	17		2011	
					3.9	0.02	0.68	0.77	0.06	2.4	9.5		2016	
					1.9	0.02	0.31	0.67	0.03	1.9	7.8		2016	
					2.1	0.01	0.28	0.84	0.04	1.8	8.9		2016	
					3.5	0.02	1.1	0.8	0.16	3.1	8.4		2016	
					2.8	0.02	0.53	0.69	0.07	2.6	7.5		2016	
Blenheim Sewage Treatment Plant receiving environment monitoring 2024	Blenheim	Wairau Estuary	Marine		1.01	0.03	0.1	0.94	0.029	0.16	9.5	0.022	2024	Outside plume, estimated values from graph
					1.07	0.047	0.1	0.78	0.024	0.13	8.6	0.019	2024	
					1.48	0.06	0.28	1.22	0.18	0.4	11.6	0.025	2024	
					1.36	0.05	0.1	0.97	0.124	0.26	10.5	0.024	2024	
					1.56	0.043	0.3	1.09	0.173	0.37	10.8	0.022	2024	
					1.17	0.048	0.1	1.23	0.1	0.23	11.1	0.017	2024	Inside plume, estimated values from graph
					1.46	0.054	0.3	1.22	0.164	0.32	10.2	0.019	2024	

Source	WWTP	Location	Marine / Freshwater	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury	Year	Notes
					1.13	0.038	0.1	1.12	0.029	0.18	12	0.022	2024	
					1.6	0.052	0.1	1.06	0.107	0.23	11.1	0.013	2024	
					1.11	0.046	0.1	0.97	0.058	0.2	9.8	0.019	2024	
					1.01	0.028	0.1	0.91	0.029	0.15	9.6	0.021	2024	
2024 Benthic Ecology and Sediment Assessment. Omanu Ocean Outfall. For TCC	Taurangua - Chapel St & Te Maunga	Omanu Beach	Marine	12.1	1.91	0.23	<0.20	1.2	<0.02	<0.010	9.8	0.016	2024	2000N
			Marine	7.4	2.2	0.199	<0.2	1.65	<0.02	<0.010	11.2	0.018	2024	800N
			Marine	19.2	1.64	0.105	<0.19	0.85	<0.019	<0.10	7.8	<0.010	2024	Outfall Alignment
			Marine	12.2	2	0.23	<0.20	1.87	<0.02	<0.010	9.8	0.016	2024	800S
			Marine	11.8	2.1	0.173	<0.20	0.81	<0.02	<0.010	9.5	0.012	2024	2000S

3. Treated wastewater monitoring results from supplied reports

From the reports identified through the sediment and shellfish monitoring review; any results found for metals in treated wastewater were also analysed. The numerical results are shown below in Table 3. Statistics were calculated from these and provided in the main body of the report.

Table 3 Treated wastewater monitoring results (all results are for total metals in g/m³)

Source	WWTP	Discharges to	Dilution category	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury	Year
Bell Island Wastewater Treatment Plant and Rabbit Island Biosolids Application. Combined Annual Compliance Report 2023/2024	Bell Island	Waimea Inlet	Estuary		<0.01	<0.0005	0.009	0.003	<0.003	0.009	<0.01	<0.0002	2004/05
					<0.05	<0.003	0.009	<0.005	<0.002	0.01	0.05	<0.0002	2005/06
					<0.01	<0.0005	0.006	0.005	0.006	0.0031	0.013	<0.0002	2006/07
					<0.01	<0.00005	0.01	0.003	<0.003	0.0025	<0.005	<0.0002	2007/08
					<0.01	<0.00005	0.006	0.002	0.004	0.0019	0.006	<0.0002	2008/09
					<0.01	<0.0005	0.004	0.013	<0.003	0.0022	0.011	<0.0002	2009/10
					<0.01	<0.0005	0.005	0.002	<0.003	0.0059	0.009	<0.0002	2010/11
					0.006	<0.0003	0.008	<0.003	0.001	0.004	0.01	<0.0003	2011/12
					0.0033	<0.00005	0.0053	0.0049	0.00021	0.0035	0.013	<0.00005	2012/13
					0.0024	<0.00005	0.0031	0.0084	0.00032	0.0036	0.017	<0.00005	2013/14
					0.0033	<0.00005	0.0098	0.0027	0.00022	0.0031	0.0077	<0.00005	2014/15
					0.0039	<0.00005	0.0027	0.0032	0.0026	0.0032	0.017	<0.00005	2015/16
					0.0031	<0.00005	0.0058	0.006	0.00024	0.0022	0.022	<0.00005	2021/22
					0.0057	<0.00005	0.0028	0.0067	0.00027	0.0025	0.028	<0.00005	2022/23
					0.0033	<0.00005	0.002	0.0023	0.0016	0.0023	0.0074	<0.00005	2023/24
Blenheim Sewage Treatment Plant Annual Monitoring Report - July 2024 - June 2025	Blenheim	Wairau Estuary	Estuary		0.004	0.00005	0.003	0.0049	0.00057	0.002	0.007		9/01/2020
					0.006	0.00005	0.003	0.0024	0.0004	0.002	0.005		6/01/2021
					<0.021	<0.0011	<0.011	<0.011	<0.0021	<0.011	<0.021		6/01/2022
					0.005	<0.000053	0.0026	0.0034	0.00019	0.00175	0.0041		4/01/2023
					0.003	<0.000053	0.0019	0.0026	0.0002	0.00172	0.0037		3/01/2024
					0.003	<0.000053	0.002	0.0033	0.0001	0.00153	0.0045		4/12/2025
					0.001	0.00006	0.00001	0.001	0.001	0.008	0.0024		
Compliance lab reports	Browns	Tributary to Tussock Creek	Low dilution freshwater					0.012	<0.002	<0.01	0.082		24/03/2014
								0.025	0.0072	<0.01	0.24		8/09/2014
								0.012	<0.002	<0.01	0.064		10/09/2020
								0.029	0.0031	<0.01	0.13		10/03/2021
								0.029	0.0026	<0.01	0.11		10/03/2022
								0.017	<0.002	<0.01	0.084		24/09/2013
								0.0181	0.000674	0.00163	0.0893		24/09/2013
Annual compliance report 2025	Napier	Hawke Bay	Open ocean		0.0044	0.00014	0.03	0.0135	0.0044	0.0027	0.65		6/08/2024
					0.0038	0.00014	0.028	0.0135	0.0039	0.0026	0.63		7/08/2024
					0.0044	0.00015	0.0196	0.0137	0.0038	0.0025	0.53		8/08/2024
					0.0038	0.00015	0.024	0.0132	0.0035	0.0028	0.6		9/08/2024
					0.0043	0.00012	0.0162	0.0121	0.0034	0.0021	0.54		10/08/2024
					0.0047	0.0001	0.0132	0.0124	0.0031	0.002	0.47		11/08/2024
					0.0048	0.00013	0.0161	0.015	0.0041	0.0022	0.57		12/08/2024
					0.0054	0.0001	0.0085	0.0155	0.0038	0.0024	0.28		13/05/2025
					0.0046	0.0001	0.0119	0.0168	0.0033	0.0025	0.196		14/05/2025
					0.0042	0.00008	0.025	0.0129	0.0026	0.0021	0.16		15/05/2025
					0.0042	0.00011	0.027	0.0143	0.0031	0.0024	0.153		16/05/2025

Source	WWTP	Discharges to	Dilution category	Aluminium	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury	Year
					0.0043	0.00009	0.026	0.0149	0.003	0.0021	0.153		17/05/2025
					0.0035	0.0001	0.029	0.0179	0.0037	0.0026	0.54		18/05/2025
					0.0042	0.00012	0.025	0.021	0.0056	0.0032	0.92		19/05/2025
Environmental Monitoring Report for Reefton Wastewater Treatment Plant July 2024 – June 2025	Reefton	Cemetery creek	High dilution freshwater	0.032	<0.002	<0.001	<0.001	0.005	<0.001	<0.001	0.049	<0.001	17/10/2024
Environmental Monitoring Report for Westport Wastewater Treatment Plant July 2024 – June 2025	Westport	Buller River	Estuary	0.032	<0.002	<0.001	<0.001	0.013	<0.001	<0.001	0.047	<0.001	10/03/2024
Compliance lab reports	Timaru domestic	Pacific Ocean	Open ocean		<0.021	<0.0011	<0.011	<0.011	<0.0021	<0.011	<0.021		5/12/2024
					<0.021	<0.0011	<0.011	<0.011	<0.0021	<0.011	<0.021		5/02/2025
					<0.021	<0.0011	<0.011	0.012	<0.0021	<0.011	<0.021		9/01/2025
					<0.021	<0.0011	<0.011	<0.011	<0.0021	<0.011	<0.021		7/11/2024
					<0.021	<0.0011	<0.011	0.015	<0.0021	<0.011	0.028		9/10/2024
					<0.021	<0.0011	<0.011	0.015	<0.0021	<0.011	<0.021		4/09/2024
Compliance lab reports	Christchurch	Pegasus Bay	Open ocean		0.0035	<0.0010	0.014	0.012	0.0018	0.011	0.054	<0.00005	20/01/2022
					0.0026	<0.0010	0.002	0.016	<0.0010	0.002	0.031	<0.00005	5/07/2022

Appendix D

SWOT analysis

Is this WWTP excluded from Standards?

Strengths:

- Already set out and established within existing framework.
- Accepted and understood by regulators/practitioners.
- Removes pristine / Attribute A waters where assumptions differ (95% vs 99% protection).

Weaknesses:

- Pristine definitions are based on NPS-FM which does not include metals.
- Not future-proof if NPS-FM changes.
- Lack of consistent national background data/information.
- Difficulty aligning metals with existing nutrient-based frameworks.

Opportunities:

- Introduce “naturally elevated metals” exclusions (e.g., arsenic).
- Make exclusions parameter-specific rather than blanket.
- Better align framework with real-world geochemical conditions.

Threats/Risks:

- How is naturally elevated defined – can be multiple interpretations
- Difficult to define and demonstrate natural vs anthropogenic sources.
- Different situations can be either conservative or not conservative enough
- Risk of over-excluding systems (especially arsenic-prone areas).
- Potential inconsistent application across regions.
- Could be overly conservative or insufficiently protective.
- Unforseen: Arsenic in WTP slurry – then goes to WWTP

Examples:

- Queenstown / Shotover – pristine receiving environment (Attribute A)
- Rotorua / Waikato – geothermal arsenic/naturally elevated.
- Auckland volcanic areas – potential elevated metals.

Recommendation:

- Retain exclusion but only apply to specific metals, not whole WWTP.
- Clearly define criteria for “naturally elevated” and exclusion to avoid misunderstanding.

Is the served population < 1,000 PE?

Strengths:

- Already embedded in framework and easy to apply.
- Reduces burden and cost on small WWTPs.
- Reflects generally lower overall discharge volumes.

Weaknesses:

- Logic for TN and TP in Tranche 1 does not apply to metals
- Population is not a good proxy for metals risk.
- Metals behave differently (toxicity-based, not cumulative nutrient effect).
- Data availability for small WWTPs is limited.
- Assumption that small plants are low risk may not be accurate.

Opportunities:

- Shift to input-based triggers instead (trade waste, leachate).
- Better align framework with actual risk drivers (mass load, toxicity) as opposed to size.

Threats/Risks:

- Small WWTPs may still have high-risk inputs (industrial, tankered waste).
- Could miss significant localised impacts (small changes can cause toxicity regarding metals).
- Potential inconsistency with other contaminants.

Examples:

- Most small WWTP will likely not have trade waste with significant metals: most Southland WWTPs
- [TBC - Which small WWTPs do have industrial inputs]
- Small WWTPs that currently have metals monitoring:

- Duvauchelle, Canterbury
- Otane, Hawkes Bay
- Norsewood, Manawatu-Whanganui
- Browns, Southland

Recommendation:

- Do not use population as an exclusion for metals?
- Use trade waste / input-based assessment instead?

Does the WWTP receive leachate?

Strengths:

- Leachate typically identifiable via bylaws or operator knowledge.
- Useful indicator of potential elevated contaminant inputs.
- Highlights systems that may need further assessment.

Weaknesses:

- Flow is not a good indicator for metals risk – mass load more important.
- Leachate flows often not measured.
- Heterogeneous composition (wide range of concentrations).
- Difficult to quantify proportion and impact.

Opportunities:

- Introduce monitoring for a while and then revisit – get info but not 35 yr of cost.
- Combine leachate with trade waste in a single risk factor.
- Use time-bound monitoring then reassess.
- Improve understanding of inputs without long-term cost burden.

Threats/Risks:

- Could discourage sending leachate to WWTP where it is best option/outcome.
- Could create cost or disposal issues.
- Complexity with old (& closed) vs new landfill systems.
- Volume vs concentration mismatches.

Examples:

- Eves Valley & York Valley landfills in Nelson go to WWTP
- Pumping intercepted GW from closed landfills – Waitakere landfills to WWTP and Green Island landfill to GIWWTP
- Morrinsville closed landfill pumps to WWTP

Recommendation:

- Bundle leachate with trade waste.
- Use as monitoring trigger rather than direct compliance trigger [TBC]

Does the WWTP receive Trade Waste with significant metal loads?

Strengths:

- National basis removes trigger for industry to move.
- Trade waste is a strong indicator of metal inputs.
- Aligns with existing management systems.

Weaknesses:

- Definition of “significant”
- Mass-based risk rather than flow-based.
- Lack of data across sites.
- Not all councils have consistent systems.

Opportunities:

- WWRMP – could identify large TW sources
- Expand to include all non-domestic inputs (leachate, tankered waste) to better understand risk.

Threats/Risks:

- High-strength slug loads (tankered waste), especially into small plants.
- Perverse outcomes if waste diverted.
- Data gaps.
- Operational risks to plant.

Examples:

- Small WWTPs with large TW?
- Large WWTPs with trade waste systems (& TW bylaws).
- Small councils rely more on operator knowledge than bylaws to know inputs e.g. Chathams
- Tankered waste to larger plants (e.g. Māngere).

Recommendation:

- Keep as a risk trigger
- Define trade waste broadly.
- Use % flow as surrogate with acknowledged uncertainty.
- Include tankered inputs and leachate.

Does the WWTP receive significant stormwater loads?

Strengths:

- Reflects risk of primary contaminants in small WWTP (thus will likely be in Control Level 2)

Weaknesses:

- We don't know how StW affects metal conc in WW, other than overall load
- How to determine loads of StW (need flow & conc for StW data which is often absent)
- Assuming load in is proportional/relative to load out, but this is not the case
- Captures groundwater infiltration which is less likely to include metals
- No definition of DWF to differentiate with wet weather flow

Opportunities:

- Information gathering
- Possibly requirement to record total daily flow

Threats/Risks:

- Using a different metric to what is normally used – may not be interpreted as intended
- Risk of getting the ratio incorrect – probably small but to be improved with data

Examples:

- Featherston WWTP ADF 2000, Peak DF 12000, some metal data available
- TBC: Huntly / Ngaruawahia

Recommendation:

- Ratio of Annual Median Daily Flow: Peak Daily Flow

[Note this requires data to assess which is currently not available]

- Not recommending to record instantaneous flow
- Consultation to determine the ratio calculation is required

Does the WTP or WWTP use metals in treatment process?

Strengths:

- If included in the process we would generate information where there is currently limited, particularly around aluminium entering or being used within treatment systems.
- Captures a live and increasingly relevant issue because more plants may need chemical dosing for phosphorus removal.
- Monitoring/consideration of aluminium addresses a metal that is often not included in the traditional heavy metals suite.

Weaknesses:

- A risk-based limit may fail in low-dilution environments where plants need aluminium or ferric dosing to achieve phosphorus standards.
- Aluminium behaviour is highly site-specific because toxicity, solubility and bioavailability vary with pH and other receiving-environment conditions.

Opportunities:

- EU standards for Al /Fe to remove P [TBC pending update]
- An interim approach of monitoring aluminium without immediately imposing limits could build an evidence base before setting enforceable thresholds.

Threats/Risks:

- If limits are too strict, plants may be unable to comply both with metals limits and phosphorus removal requirements.
- Making discharge to sewer/WWTP too difficult could redirect wastes or treatment residuals to other disposal routes that are less acceptable environmentally.
- Risk of unintended consequences for effects on P
- Al: changeable toxicity with pH in receiving environment

Examples:

- Use of Al or Fe to get rid of P in WTP
- Hamilton / Cambridge/ other Waikato examples
- Pukekohe
- MoU in place TP 1 mg/L / TN 4mg/L
- Check against exclusions for Waikato River
- Central Hawke's Bay plants (Waipawa/Waipukurau)and Palmerston North noted as phosphorus-targeted examples.

Recommendation:

- Live issue – more places may start using chemical dosing as WEPS gets enforced, esp in low diln environments.
- If derived limit is too low (esp. in low diln rivers), may not apply, use EU standard instead
- Consider monitoring only for aluminium rather than a limit
- Consider a differentiated approach where aluminium used for phosphorus removal is monitored first, and limits are only applied once feasibility is better understood.

Does the WWTP discharge to: High Dilution Freshwater, Open Ocean, or High Energy Coastal?

Strengths:

- Using existing definitions in Tranche 1

Weaknesses:

- A lot of large WWTP in this category – possibly unacceptable from TA end
- Currently assuming far field dilution, compared with near field.
- Need to consider acute (near field) v chronic (farfield)
- Mixes freshwater and marine criteria

Opportunities:

- Reduce constraints around discharge to open ocean

Threats/Risks:

- Excluding or down-weighting metals in these environments could miss localised acute toxicity effects within the (nearfield) mixing zone.
- Captures many existing consents and many of the larger discharges, so a simplistic screening rule could affect a large share of the sector.
- High-dilution assumptions may not be precautionary enough, especially if 1000:1 far-field dilution is used where consideration of nearer-field conditions are important.

Examples:

- [TBC pending update]

Recommendation:

- Not necessarily recommending just monitoring at this stage
- Refine the framework by splitting high-dilution freshwater from marine categories.
- Review and compare CORMIX vs far-field derived limits and obtain operational feedback on feasibility before finalising the approach.

Are there significant soft bottom reaches or an estuary downstream of the discharge?

Strengths:

- Considers risk of sedimentation
- TSS as a surrogate is likely to be effective
- TP also could act as a surrogate due to solids removal requirements, though TSS is a more direct correlation, noting TP not as good for dissolved fractions.

Weaknesses:

- Definitions are broad/unclear: "significant soft bottom reaches" or "estuary downstream" could capture a very large proportion of discharges, possibly >50% .
- Ambiguity in how substrate categories are interpreted and applied in practice.
- Soft-bottom conditions may reflect historical sediment deposition or changing stream condition, making the trigger unstable over time.

Opportunities:

- Considers highly sensitive RE of estuaries
- Could prompt clearer future definitions (e.g., depth, significance thresholds, depositional versus transport zones) if retained in some form.

Threats/Risks:

- If used as a trigger, it may unintentionally pull in a large proportion of the industry without strong evidence that wastewater metals are accumulating to problematic levels.
- Risk the framework overemphasises metals in estuarine/soft-bottom settings when background material suggests sedimentation, organic loading and nutrients are the dominant estuary pressures.

Examples:

- Southland streams noted as examples of waterways now classed as soft-bottom due to sediment deposition, despite likely historical hard-bottom conditions.
- Whangerei discharge to estuarine Hatea River has sediment monitoring which shows minimal impact other than SW influences

Recommendation:

- Not included as a trigger for needing to include extra steps /monitoring
- Rely instead on the broader toxicity/TSS/sediment-management framework unless stronger evidence emerges that wastewater metals are accumulating in downstream depositional environments.
- Expand surrogate monitoring approach (TSS + TP) for low and very low risk discharges.
- Reduce need for direct metals monitoring in low-risk environments.

Are shellfish collected within XXkm of the discharge?

Strengths:

- Could capture bioaccumulation pathway relevant to human health.

Weaknesses:

- Overly precautionary
- Too many assumptions
- Weak correlation between discharge and shellfish contamination at distance.
- Highly assumption-driven (transport, uptake, bioavailability).
- Not consistent with metals behaviour compared to pathogens.

Opportunities:

- Use shellfish as an ecosystem indicator rather than compliance criterion.

Threats/Risks:

- Loss of local shellfish beds due to monitoring
- Potential to unnecessarily restrict shellfish harvesting.

Examples:

- [TBC]

Recommendation:

- Possibly remove as a decision criterion; retain only as contextual/ecosystem indicator if required.

Appendix E

WWTP process ability

Heavy metal removal by municipal wastewater treatment processes

Municipal wastewater treatment processes are targeted primarily at the reduction of solids (TSS), organic constituents (COD, BOD) and nitrogen and phosphorus compounds in sewage to enable treated effluent to be discharged to the receiving environments within prescribed and acceptable impact limits. Specific treatment processes for the removal of heavy metals are generally not implemented in municipal treatment plants and the observed removal is incidental to the main objectives of the treatment.

While biological wastewater treatment processes may require the presence of trace metals for microbial growth (Co, Mo, Zn, Fe etc.), heavy metals present in the influent wastewater are generally not directly removed through biological pathways. but through the physical/chemical characteristics of wastewater quality and surface characteristics of particulates and organic solids (biomass).

The fractionation of heavy metals in the wastewater treatment process, i.e. the partition between dissolved and particulate species, is important for the potential removal of heavy metals during treatment. Heavy metal speciation is affected by element chemistry, wastewater water quality (hardness, alkalinity, pH and redox potential etc.).

Physical solids removal by mechanical treatment processes (screening, sedimentation and filtration and adsorption onto organic biomass in biological treatment are the primary mechanism for the reduction of the particulate metal fraction. The dissolved fraction of heavy metals passes through the treatment process to the effluent with minimal attenuation.

Removal efficiency varies by metal due to differences in partitioning coefficients (K_d). Each metal has a characteristic distribution between dissolved and particulate phases. Metals with higher particulate fractions are removed more effectively during treatment sedimentation.

Metal	Typical Partitioning	Removal Mechanism	Sensitivity to TSS
Pb, Cr(III), Cu	High (K_d)	Strong biosorption	High
Zn, Ni	Moderate (K_d)	Mixed dissolved/particulate	Moderate
Cd, Cr(VI)	Low ((K_d)	Mostly dissolved	Low

The most common wastewater treatment systems include both solids separation with biological treatment by activated sludge. Activated sludge reliably removes metals that strongly bind to biomass. Studies of activated sludge systems show that heavy metals partition into sludge via adsorption, complexation with extracellular polymers, and incorporation into flocs. Metals with strong affinity for biomass exhibit high removal efficiencies.

Literature investigations of removal of metals by full activated sludge wastewater treatment with primary sedimentation, biological aeration and secondary sedimentation show a wide variation of performance, depending on the influent metal concentrations and the solids capture efficiency of final clarification. A comprehensive study of a Polish activated sludge plant measured heavy metal removal over period 2017 – 2020. (Mlynska, A et al, 2025)

	Element						
	Zn	Pb	Cd	Cu	Cr	Ni	Mn
% removal	81	75	82	76	87	64	41

A removal comparison of activated sludge process (ASP) with secondary clarifier versus membrane bioreactor (MBR) showed higher heavy metal removal with improved effluent solids capture performance. (Santos A. et al, 2009).

	Element						
% removal	Cd	Cr	Cu	Pb	Hg	Ni	Zn
ASP	62	69	68	74	87	46	68
MBR	74	83	83	73	92	64	75

Waste Stabilisation Ponds (WSP), otherwise known commonly in NZ as oxidation ponds, are the most common wastewater treatment system for small communities with about 200 facilities across the country. WSP rely primarily on natural biological and physical/chemical process like oxidation, adsorption, precipitation and sedimentation. Because of New Zealand's relatively sunny climate and widespread use of lagoons, ponds successfully remove some metals (e.g., zinc, copper, and lead) by trapping them in algal biomass or settling them into bottom sludge.

Unlike activated sludge systems where pH values remain in the 7 – 8 range, high levels of sunlight promote algal photosynthesis, which raises the pond's pH (often above pH > 8). This elevated alkalinity causes dissolved heavy metal ions (like cadmium, copper, and nickel) to form insoluble precipitates that settle to the pond floor. However, because of the changing chemical conditions, the heavy metal removal rates in WSPs are more variable. A study in Morocco of metal removal in WSP versus high-rate algal ponds (HRAP) found Zn, Cu, Pb removal in WSP of 91%, 92% and 71% respectively whereas the HRAP removal was 1.3x, 10x and 2x more effective for the respective metals. The high sunlight and ambient temperature in the geographic location and observed elevated pH during the day was considered a factor in the very high removal rates due to increased precipitation. (Toumi A, et al, 2000). Such high removal rates may not be sustained in the New Zealand conditions.

Overall treatment performance

Heavy metal removal in the different treatment processes is dominated by the same physical/chemical mechanisms of adsorption and precipitation into the biomass solids and the efficiency of solids removal from the effluent stream. The treatment processes with lower effluent suspended solids tend to exhibit higher metal removal rates. Effluent dissolved metal removals tend to be similar across all processes.

Activated sludge systems offer the most consistent metal removal performance as they usually incorporate multiple treatment steps; primary sedimentation, biological processes, secondary sedimentation (or membrane filtration). The treatment train maximises potential metal precipitation and adsorption due to stable operating conditions. Final solids sedimentation or filtration produces a low effluent suspended solids, minimising the release of adsorbed particulate metals.

Waste stabilization pond-based systems are varied in configuration, with combinations of multiple ponds in series with or without aeration. Biological processes can incorporate anaerobic and aerobic ponds. Generally, pond systems rely on sedimentation of solids within the pond volume rather than a specific solids removal step. The effluent suspended solid capture is therefore more variable. Chemical conditions, especially pH, can vary diurnally and seasonally, leading to more variable metal precipitation conditions. Overall metal removal is similar to activated sludge but with less consistency.

All the conventional treatment systems ultimately incorporate a significant proportion of the heavy metals removed into the process solids retained in the treatment system. Recovery and disposal of these solids which contain removed heavy metals is a separate consideration.

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