Contaminants Present in Organic Waste: Phase 1 Synthesis Report

Prepared for Ministry for the Environment

DRAFT

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Report for Ministry for the Environment

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1.0 Audience and the Purpose of the Report

1.1 Introduction

The Ministry for the Environment (MfE) commissioned Eunomia Research & Consulting, Whetū Consulting Group, and Massey University, to examine issues of contaminants in organic waste. The project aims to understand and address the challenges posed by contaminants in our organic waste material streams in order to mitigate risks to soil, human and animal health and expand end markets for processed organic waste. The project outputs will build on existing knowledge and standards and provide clear action recommendations for addressing the contaminants challenge.

The report is one of a series in the project's three phases:

Phase 1: Review of Regulations and Guidelines

- Establish framework
- Review of NZ standards regulations and guidelines
- Review of international practice
- Gap analysis and synthesis report (this report)

Phase 2: Engagement and End Markets

- Develop stakeholder engagement plan
- Tangata Whenua engagement
- Industry engagement
- Analysis and reporting

Phase 3: Recommendations

- Draft recommendations
- Review by Tangata Whenua and industry
- Final recommendations.

1.2 Synthesis

This report draws together the high-level findings of the phase 1 work, including providing an analysis of key gaps identified. It should be read alongside the other phase 1 reports. Addressing of the key gaps is likely to be important to creating a set of

solutions that will meet the objectives of the New Zealand Waste Strategy[1]. Central to the waste strategy is the concept of the circular economy enriched by Te OAo Māori.

2.0 Harmonising with Te Ao Māori

The partnership between Tangata Whenua and Crown partners plays a pivotal role in establishing and supporting practices that manage organic contaminants in a culturally appropriate manner for Māori and in accordance with the principles of the Treaty of Waitangi. This partnership is not merely a legal or political obligation, but a critical element in the successful and sustainable management of environmental challenges.

Te Ao Māori provides unique insights into environmental stewardship, emphasising the interconnectedness of all things and the importance of maintaining the mauri of the environment. However, the implementation of these insights requires a respectful and inclusive engagement process with Māori and iwi. This process must acknowledge the unique context and challenges faced by iwi, including resource limitations and time constraints.

Furthermore, the engagement process should be high quality, ensuring that the proposed solutions are practical, market-tested, and respectful of Māori values and practices. This necessitates the development of contact protocols that ensure a consistent and professional approach, including briefing stakeholders about the project's purposes, managing engagement, and accurately recording information.

Through this partnership, there must be recognition of power dynamics. These must be considered and proactively balanced to allowing for the establishment and support of practices that not only manage organic contaminants but also respect and uphold the Māori relationship with the environment. This approach ensures that the management of organic contaminants aligns with the principles of the Treaty of Waitangi, fostering a more sustainable and harmonious relationship between humans and the natural world.

3.0 Overview of New Zealand Legislation, Standards, and Guidelines

This section provides a summary of the key findings from the analysis of New Zealand legislation, standards, and guidelines, in relation to contamination in organic waste. For detail on the documents covered please refer to the full report.

[1] Ministry for the Environment. 2023. *Te rautaki para | Waste strategy.* Wellington: Ministry for the Environment.

1. There are a range of standards, and guidelines which intersect in some way with the issue of manage contamination in organic waste streams and have been serving to provide the current framework for management.
2. These have been developed independently of each other over time, and while there is some broad alignment, they do not form a comprehensive approach.
3. There are some inconsistencies – for example there is no standard definition of contamination, the range of contaminants covered, and the nominated contaminant thresholds vary – often considerably – between the standards and guidelines.
4. In terms of the controls that have been developed in New Zealand, the focus has been on product and application controls.
5. There has recently been some development in terms of input controls specifically in relation to organics with kerbside standardisation with guidance on food organics and FOGO (food organics/garden organics) collections specifically excluding specific materials.[2] Other non-organic specific input controls include restrictions on single use packaging.
6. There are some notable gaps: There are no standards or controls for AD digestate (although one is under development by the bioenergy association), and there are no standards for vermicast/vermicomposting, there are also no standards for use of manures.
7. There is no clear framework or process for updating and integrating new contaminants or processes when they arise. This can be seen most clearly with recent issues such as microplastics and PFAS. It is up to the industry organisations overseeing the various guidelines and standards to identify an issue, determine thresholds, and formulate a response. Ideally, we would have an understood and accepted process that is regularly reviewing the issues, and all standards and guidelines can reference a commonly held list.
8. In existing standards and regulation, there is limited reference to te tiriti or mātauranga Māori, and how what level/type of contamination is considered acceptable needs to take into account cultural, environmental, and human and animal health concerns.

[2] the Standard Materials for Kerbside Collections Notice 2023 (Notice No. 1) - 2023-go4222 - New Zealand Gazette exclsudes paper and cardboard; compostable packaging; tea bags; sawdust from treated timber; animal waste; and ash.

4.0 Comparison of International and NZ Contamination Limits

The contaminant limits set out in the various NZ standards and guidelines, were compared to a select group of international standards (refer Appendix A.1.0 for detail). Specific contaminants considered in this analysis include inorganic trace elements, specific organic chemical compounds, and pathogens.

In general, the same trace elements were covered by the various standards. The exceptions were NZ standards and guidelines include arsenic and boron, and the European standards cover thallium.

Amongst the standards examined there is notable variation. Key points include the following:

- Limits are set according to different criteria – some limits are specified for products or product grades (such as compost), some for feedstock type (e.g products made from biosolids), some are set based on application rates, while other limits are set according to the receiving environment (e.g. rural vs urban soils). This makes like for like comparisons more difficult.
- Cadmium limits for the NZ biogro standard, NES for rural soils, and MPI guidelines and are very similar to the European standards, but are markedly higher in NZ for things like industrial and recreational land
- Chromium limits in NZ are notably higher
- With the exception the Biogro standards, lead limits are generally higher in NZ
- Nickel limits are broadly comparable
- Mercury limits, again with the exception of Biogro standards are higher in NZ
- Zinc limits are broadly comparable
- Copper limits, again with the exception of Biogro standards are higher in NZ
- PCB limits are only covered by a small number of the standards but the NZS4454 has slightly lower limits than the European standards.
- Pathogen limits are only noted in the European biosolids and sludge standards, and these are higher than the relevant NZ standards.

Of the different limits considered, the NZ Biogro standards are most similar to other international standards. For example, in terms of lead concentration the Biogro standard stipulates 45 -250 mg/per kg of dry weight in soils depending on the application. This compares with the various European guidelines that range from 45 mg to 200mg depending on the application, and other NZ guidelines which range from 160 to 3,300 (with most around 200-300).

5.0 Gap Analysis

5.1 Introduction

A gap analysis was undertaken to identify what measures New Zealand has in place and what might be required to enable a system to be developed that facilitates a circular bioeconomy. The gap analysis builds on the research into current New Zealand legislation regulation, guidelines and practices, and the international practices identified in the previous reports

The gap analysis is split into two tables:

The first table looks at gaps in standards and guidelines across organic soil amendment product types. The soil amendment product types chosen for the purposes of the analysis were:

- Compost
- Digestate
- Vermicast
- Biosolids and biosolid-derived products
- Mulches and other soil amendments.

These broad classifications were chosen as they represent the primary types of soil amendment products derived from organic wastes.

The first table focuses specifically on standards, guidelines contaminants covered and contaminant levels. These are considered across process inputs, process controls, output controls, and application controls.

The second table covers other 'wider value chain' aspects related to organic waste contamination that apply across all processing and product types such as control of system inputs through international treaties or legislation, monitoring, data, enforcement, education, market development etc. These gaps are also examined across the value chain covering control of system inputs, process inputs, process controls, output quality, and application/end use controls.

Gaps are assessed based on 'traffic light' grading system as follows:

Green notates no significant gaps.
Yellow indicates that there are some measures in place, but room for improvement.
Orange indicates significant gaps.

Each box in the matrix is annotated with simple notes outlining the reason for the assessment.

The gap analysis notes two aspects - what is currently in place and what is missing.

Standards and Guidelines Gaps

			Process Inputs	Process Controls	Output Quality	Application/End Use Controls
Composts	**Standards**	What we have	NZS 4454, advises on feedstock selection. NZS 4454 advises on control of invasive plants BioGro, restricts feedstocks Assure Quality, feedstocks should not pose contaminant risks Reference to international standards for compostable plastics (e.g. ASTM D6954-18, BS 8472, EN 13432)	NZS 4454, establishes process standards NZS 4454 advises on control of invasive plants BioGro,does not specify production protocols Assure Quality, proposes some process controls (e.g. temperature)	NZS 4454, specifies quality requirements for composts, soil conditioners, and mulches NZS 4454 advises on testing for plant propagules BioGro, specifies heavy metal limits Assure Quality, specifies heavy metal limits	National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health BioGro, specifies pesticide residue limits Assure Quality, specifies pesticide residue limits
		What is missing	No NZS4454 certification. Inconsistency in contaminants considered and limits across standards (and with guidelines) in terms of contaminants covered and contaminant limits No mandatory standards Emerging contaminants such as microplastics and PFAS not covered			Inconsistency in contaminants considered and limits. No mandatory standards. Emerging contaminants such as microplastics and PFAS not covered The NES is not triggered by use of soil amendment products (only during a consent to change land use), so NES is effectively not used in this context.
	Guidelines	What we have	Guidelines for beneficial use of organics It's Complicated: A Guide to Biodegradable Compostable Plastic Products and Packaging (WMINZ)		No guidelines specifically on output quality (but output quality is covered in standards)	Guidelines for beneficial use of organics Technical guidelines for disposal to land MPI - Working towards New Zealand risk-based soil guideline values for the management of cadmium accumulation on productive land
		What is missing	In absence of adequate standards that cover emerging contaminants, there should be guidelines covering emerging contaminants			
	Classes of contaminants covered by standards and guidelines	What we have	Heavy metals Chemicals residues Microorganisms Physical contaminants		Heavy metals Chemicals residues (NZS:4454) Microorganisms (NZS:4454) Physical contaminants (NZS:4454)	Heavy metals Chemicals residues Microorganisms
		What is missing	Plastics Emerging contaminants Consistent clear coverage	Plastics/microplastics Emerging contaminants Consistent clear coverage		Emerging Physical contaminants Plastics/microplastics Emerging contaminants Consistent clear coverage
	Contaminant levels covered by standards and guidelines	What we have	Specified in standards and guidance but varies between documents		Specified in standards and guidance but varies between documents	
		What is missing	Consistent approach to determining contaminant levels			

			Process Inputs	Process Controls	Output Quality	Application/End Use Controls
Digestate	**Standards**	What we have	Voluntary standard in development by Bioenergy Association			National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health Protect Human Health BioGro, specifies pesticide residue limits Assure Quality, specifies pesticide residue limits
		What is missing	No current standard			Inconsistency in contaminants considered and limits No mandatory standards
	Guidelines	What we have	Technical Guide 08: The production and use of digestate Guidelines for beneficial use of organics It's Complicated: A Guide to Biodegradable Compostable Plastic Products and Packaging	Technical Guide 08: The production and use of digestate It's Complicated: A Guide to Biodegradable Compostable Plastic Products and Packaging	Technical Guide 08: The production and use of digestate	Guidelines for beneficial use of organics Technical guidelines for disposal to land
		What is missing	In absence of adequate standards that cover emerging contaminants, there should be guidelines covering emerging contaminants			Inconsistency in contaminants considered and limits. No mandatory standards. The NES is not triggered by use of soil amendment products (only during a consent to change land use), so NES is effectively not used in this context.
	Classes of contaminants covered by standards and guidelines	What we have	Heavy metals Chemicals residues Microorganisms Physical contaminants		Heavy metals Emerging contaminants Microorganisms Physical contaminants	Heavy metals Chemicals residues Microorganisms
		What is missing	Plastics Emerging contaminants Consistent clear coverage	Plastics/microplastics Emerging contaminants Consistent clear coverage	Chemicals residues Plastics/microplastics (discussed in TG8) Consistent clear coverage	Emerging Physical contaminants Plastics/microplastics Emerging contaminants Consistent clear coverage
	Contaminant levels covered by standards and guidelines	What we have	Specified in standards and guidance but varies between documents		Specified in standards and guidance but varies between documents	
		What is missing	Consistent approach to determining contaminant levels			

			Process Inputs	Process Controls	Output Quality	Application/End Use Controls
Vermi-composting	**Standards**	What we have	NZS 4454, advises on feedstock selection BioGro, restricts feedstocks Assure Quality, feedstocks should not pose contaminant risks Reference to international standards for compostable plastics (e.g. ASTM D6954-18, BS 8472, EN 13432)	NZS 4454, requires pasturasation of vermicast or input material BioGro,does not specify production protocols	No specifc controls for vermicast	National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health Protect Human Health BioGro, specifies pesticide residue limits Assure Quality, specifies pesticide residue limits
		What is missing	No NZS4454 certification. Inconsistency in contaminants considered and limits No mandatory standards		Specifc controls for vermicast	Inconsistency in contaminants considered and limits. No mandatory standards. The NES is not triggered by use of soil amendment products (only during a consent to change land use), so NES is effectively not used in this context.
	Guidelines	What we have	Guidelines for beneficial use of organics It's Complicated: A Guide to Biodegradable Compostable Plastic Products and Packaging	Internal document compiled by Revital Fertilisers, September 2017 describing the procedures involved in vermiculture and greenwaste processing	No specifc controls for vermicast	Guidelines for beneficial use of organics Technical guidelines for disposal to land
		What is missing	In absence of adequate standards that cover emerging contaminants, there should be guidelines covering emerging contaminants	Specific controls for vermicomposting	Specifc controls for vermicast	In absence of adequate standards that cover emerging contaminants, there should be guidelines covering emerging contaminants
	Classes of contaminants covered by standards and guidelines	What we have	Heavy metals Chemicals residues Microorganisms Physical contaminants		No specific contaminants for vermicast	Heavy metals Chemicals residues Microorganisms
		What is missing	Plastics Emerging contaminants Consistent clear coverage		Specific contaminant controls for vermicast	Emerging Physical contaminants Plastics/microplastics Emerging contaminants Consistent clear coverage
	Contaminant levels covered by standards and guidelines	What we have	Specified in standards and guidance but varies between documents		No specific contaminants for vermicast	
		What is missing	Consistent approach to determining contaminant levels			

			Process Inputs	Process Controls	Output Quality	Application/End Use Controls
Biosolids & biosolid derived products	**Standards**	What we have	Trade waste bylaws	No specific controls for processing of biosolids or biosolid derived products (e.g. dried solids)	No specifc controls for WWTP soil amendment outputs	National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health Protect Human Health BioGro, specifies pesticide residue limits Assure Quality, specifies pesticide residue limits
		What is missing	Consistent approach	Specific controls	Specifc controls for WWTP soil amendment outputs	Inconsistency in contaminants considered and limits No mandatory standards
	Guidelines	What we have	Guidelines for beneficial use of organics It's Complicated: A Guide to Biodegradable Compostable Plastic Products and Packaging	Guidelines for beneficial use of organics		Guidelines for beneficial use of organics Technical guidelines for disposal to land
		What is missing	In absence of adequate standards that cover emerging contaminants, there should be guidelines covering emerging contaminants	Require updating to take into account emerging contaminants		Inconsistency in contaminants considered and limits. No mandatory standards. The NES is not triggered by use of soil amendment products (only during a consent to change land use), so NES is effectively not used in this context.
	Classes of contaminants covered by standards and guidelines	What we have	Heavy metals Chemicals residues Microorganisms Physical contaminants	Heavy metals Chemicals residues Microorganisms		
		What is missing	Plastics Emerging contaminants Consistent clear coverage	Plastics/microplastics Physical contaminantsEmerging contaminants Consistent clear coverage		Emerging Physical contaminants Plastics/microplastics Emerging contaminants Consistent clear coverage
	Contaminant levels covered by standards and guidelines	What we have	Specified in standards and guidance but varies between documents			Specified in standards and guidance but varies between documents
		What is missing	Consistent approach to determining contaminant levels			Consistent approach to determining contaminant levels

			Process Inputs	Process Controls	Output Quality	Application/End Use Controls
Mulches and other soil amendments	**Standards**	What we have	NZS 4454, advises on feedstock selection BioGro, restricts feedstocks Assure Quality, feedstocks should not pose contaminant risks Reference to international standards for compostable plastics (e.g. ASTM D6954-18, BS 8472, EN 13432)	NZS 4454, establishes process standards BioGro,does not specify production protocols Assure Quality, does not cover mulches and othe soil amendments	NZS 4454, specifies quality requirements for composts, soil conditioners, and mulches BioGro, specifies heavy metal limits Assure Quality, specifies heavy metal limits	National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health Protect Human Health BioGro, specifies pesticide residue limits Assure Quality, specifies pesticide residue limits
		What is missing	No NZS4454 certification. Inconsistency in contaminants considered and limits No mandatory standards There is no consistent defintion for what constitutes soil amendements, and no process for how these should be idenfitied and included in standards or guidelines.			Inconsistency in contaminants considered and limits. No mandatory standards. There is no consistent defintion for what constitutes soil amendements, and no process for how these should be idenfitied and included in standards or guidelines. The NES is not triggered by use of soil amendment products (only during a consent to change land use), so NES is effectively not used in this context.
	Guidelines	What we have	Guidelines for beneficial use of organics It's Complicated: A Guide to Biodegradable Compostable Plastic Products and Packaging			Guidelines for beneficial use of organics Technical guidelines for disposal to land
		What is missing	There is no consistent defintion for what constitutes soil amendements, and no process for how these should be idenfitied and included in standards or guidelines. In absence of adequate standards that cover emerging contaminants, there should be guidelines covering emerging contaminants Soil amendments such as biochar, bark, recycled gypsum, fish byproducts, manures, etc are only peripherally considered			
	Classes of contaminants covered by standards and guidelines	What we have	Heavy metals Chemicals residues Microorganisms Physical contaminants		Heavy metals Chemicals residues (NZS:4454) Microorganisms (NZS:4454) Physical contaminants (NZS:4454)	Heavy metals Chemicals residues Microorganisms
		What is missing	Plastics Emerging contaminants Consistent clear coverage	Plastics/microplastics Emerging contaminants Consistent clear coverage		Emerging Physical contaminants Plastics/microplastics Emerging contaminants Consistent clear coverage
	Contaminant levels covered by standards and guidelines	What we have	Specified in standards and guidance but varies between documents		Specified in standards and guidance but varies between documents	
		What is missing	Consistent approach to determining contaminant levels			

Wider Value Chain Gaps

		Control of System Inputs	Process Inputs	Process Controls	Output Quality	Application/End Use Controls
Global treaties	What we have	Basel Convention (hazrdous waste incl waste plastic) Stockholm Convention (Persistant Organic Pollutants) Rotterdam Convention (Hazardous chemicals) Minamata Convention (Mercury) UN Plastics treaty mandate (plastics and microplastics)				
	What is missing	Not clear the level of ambition that will be adopted in the UN plastics treaty. The conventions help control the worst outcomes but are not proactive in enabling progress towards a circular economy.				
Te Ao Maori	What we have	Manaaki Whenua Landcare Research - Oneone Ora Tangata Ora producing Integrated Framework Hua Parakore Framework	Limited small-scale kaitiaki driven soil assessments			
	What is missing	Adoption of Māori frameworks into legislation/policy; regulatory and/or compliance controls. Lack of support for existing education and behaviour programmes such as Hua Parakore. Iwi Post-Settlement Agreements & JMAs in place; however organic contaminants may be too niche to be a focus point regardless.	No widespread guidance on Māori cultural contaminants. No standardised approach to manage significant cultural contaminants No Māori collective responsible for standardising Māori agricultural place-based knowledge and practices - (potentially Manaaki Whenua Landcare Research)			Missing a form of Māori "Halal" certification for end-use product to be identified as processed in culturally appropriate manner. Two-way communication channels to Māori horticultural sector & Māori community - Māori agency perhaps.

		Control of System Inputs	Process Inputs	Process Controls	Output Quality	Application/End Use Controls
	What we have	• Animal Products Act 1999 • Animal Products Amendment Act 2012 • Food Act 2014 • Hazardous Substances and New Organisms Act 1996 • Agricultural Compounds and Veterinary Medicines Act 1997 • Agricultural Compounds and Veterinary Medicines (Exemptions and Prohibited Substances) Regulations 2011 • Biosecurity Act 1993 and regulations • Regulations under the Waste Minimisation act banning microbeads, selected single use plastic products (straws fruit stickers, tablewate and cutlery, plastic shopping bags, and produce bags)	• Animal Products Act 1999 • Animal Products Amendment Act 2012 • Food Act 2014 • Agricultural Compounds and Veterinary Medicines Act 1997 • Agricultural Compounds and Veterinary Medicines (Exemptions and Prohibited Substances) Regulations 2011 • Biosecurity Act 1993 and regulations • Regulations and Gazette notices under the Waste Miminsation Act restricting materials that can be put in kerbside food and garden waste collections			• Animal Products Act 1999 • Animal Products Amendment Act 2012 • Biosecurity Act 1993 and regulations • National Cadmium Management Strategy • Food Act 2014 • NES for Assessing and Managing Contaminants to Soil 2012 • National Planning Framework (under development)
NZ Legislation/regulation	What is missing	Controls on PFAS, plastics	Controls on PFAS, plastics, risks from GMOs			No framework for testing and controlling soil limits
	What we have		Council information on what can be put into colletction bins Information to the public at organic dropoff sites Private collector information to customers		Council information on what can be put into colletction bins Information to the public at organic dropoff sites Private collector information to customers	
Consumer information	What is missing		Standardised information for consumers/suppliers of material in order to help reduce this source of contaminants.		Standardised information for consumers/suppliers of material in order to help reduce this source of contaminants.	

		Control of System Inputs	Process Inputs	Process Controls	Output Quality	Application/End Use Controls
Monitoring & enforcement, and data	What we have		Operator visual inspection of collected material	Operator visual inspection and screening of input material	Operator visual inspection of collected material Voluntary testing of output quality	Voluntary testing of output quality
	What is missing	New Zealand does not have its own standards for compostable products	Centrallised collation of data. Limited visability of what is actually happening		Centrallised collation of data. Improved visibility of what is actually happening	Centrallised collation of data. Improved visibility of what is actually happening Sector wide programme of ongoing testing and dissemination of results to inform good practice
Education and knowledge transfer, and engagement/feedback	What we have		Guidelines available. Industry/community organisations (e.g. organic waste sector group)			
	What is missing		No formal plan or industry wide approach			
Administration/ policy/ planning structures/ investment/funding	What we have		Industry/community organisations. MfE oversight of policy. Much of the sector oversight in terms of standards and guidance relies on sector organisations and voluntary contributions.			
	What is missing		No agency with responsibility across the sector Coherent national policy approach with structures that can align knowledge with practical guidance and implementation			
Research and innovation - new knowledge input, including identifying and classifying emerging contaminants	What we have		Industry/community organisations, research centres			
	What is missing		Transparent and inclusive development of a robust R&D plan, with commensurate funding, to guide the collaboration and knowledge generation necessary for a safe, efficient, sustainable, culturally appropriate circular bio-economy and a clear pathway for disseminating new knowledge to the participating industry/community sectors			
Market development	What we have				Sector groups and private businesses responsible for market development	Industry/community organisations, research centres
	What is missing				Sector wide body to promote standards, product certification and markets to create and end to end system that give confidence to consumers	

5.2 Gap Analysis Commentary

Key points to arise out the above gap analysis include the following:

While there are a range of legislative measures, standards, and guidelines in place, these do not provide a comprehensive regime that covers all processes, contaminant types, or application scenarios. The only area that was considered well-covered are guidelines for the application of biosolids, and even here they currently require updating to reflect emerging contaminants.

Key gaps identified included:

- Standards and guidelines are all voluntary
- Controls on contaminants in compost, digestate, vermicomposting and mulch and other products that will be used as soil amendments
- Standards for anaerobic digestion and digestate quality
- Standards for biosolids processing and output quality
- Adoption of Māori frameworks into legislation/policy; regulatory and/or compliance controls.
- Lack of support for existing education and behaviour programmes such as Hua Parakore.[3]
- No widespread guidance on Māori cultural contaminants.
- No standardised approach to manage significant cultural contaminants.
- No Māori collective responsible for standardising Māori agricultural place-based knowledge and practices
- Missing a form of Māori certification for end-use product to be identified as processed in culturally appropriate manner.
- No centralised systems for monitoring, enforcement and data gathering on what is happening in the sector in particular process inputs, output controls, and end use applications.
- Sector wide programme of ongoing testing and dissemination of results to inform good practice.
- No agency with responsibility across the sector to direct policy, planning, delivery structures, and investment
- No coherent national policy approach with structures that can align knowledge with practical guidance and implementation. No identified adequate resourcing to enable functions to be carried out effectively.
- A lack of a transparent and inclusive development of a robust plan, covering research & development, policy, funding, education and information dissemination, and delivery structures, with commensurate funding, to guide the

[3] Hua parakore is a kaupapa Māori (Indigenous) system and framework for growing kai (product and food)) developed by Te Waka Kai Ora (National Maori Organics Authority). In addition to being a food growing system, hua parakore is also, an Indigenous validation and verification scheme that is run by Te Waka Kai Ora and supported by a network of hua parakore growers in Aotearoa (NZ). Homepage | Hua Parakore (teachable.com)

collaboration and knowledge generation necessary for a safe, efficient, sustainable, culturally appropriate circular bioeconomy and a clear pathway for disseminating new knowledge to the participating industry/community sectors.
- A lack of a sector-wide body to promote standards, product certification and markets to create an end-to-end system that give confidence to consumers.

6.0 Discussion

One of the overarching observations to emerge from the work so far is that Aotearoa New Zealand's approach to managing organic contaminants has been largely ad-hoc and reactive. The sector relies heavily on a range of industry and community bodies to identify issues and determine appropriate action – such as the development and application of guidelines, standards, education, or advocacy. These bodies are often reliant on volunteer input. While there may be communication between the different bodies there is no formal way for them to coordinate or collaborate.

There is no cohesive regime of controls or structures for addressing issues as they arise and ensuring that solutions that are put in place align with wider strategic objectives and cultural considerations. Internationally, other jurisdictions, notably Europe, have more comprehensive and cohesive systems in place. While they have similarly developed in response to issues that have arisen, they are also further advanced in terms of organic waste diversion and developing solutions to address issues of potential contamination.

The issue of contaminants in organic waste is a longstanding one, however a number of things have changed in recent years to mean that current systems and solutions in Aotearoa New Zealand are generally speaking, no longer adequate. These include:

- There is an increasing emphasis on recovering organic waste streams. This is driven not only by the intent to reduce waste to disposal and maximise the value of recovered materials but also by the recognition that recovering organics has important benefits in reducing greenhouse gas emissions, and reducing use of fossil fuel based synthetic fertilisers, and potentially improving soil health and water quality.
- There is an awareness of the need for society to operate in a circular economy in order to stay within planetary boundaries. This encompasses the concept of a circular bioeconomy, where organic wastes are cycled back into natural systems, ideally with the outcome of enhancing and regenerating those systems and achieving the highest value use of the waste materials. To achieve a circular bioeconomy requires that 'natural' and 'technical' systems do not cross-contaminate one another.
- This has led to a greater focus on attempting to recover materials from sources that may be at higher risk of contamination, such as household food waste, wastewater treatment plant effluent, and sludges.
- The impending Natural and Built Environment Act (NBEA) provides a framework for on controls on soil limits. The National Planning Framework will develop limits

around nutrient levels and concentrations of key contaminants and requires the monitoring and reporting of environmental limits and targets.

- There is a growing awareness of 'emerging' contaminants – substances such as microplastics and nanoplastics, and PFAS and PFOS. Not only are these substances more ubiquitous but knowledge of their potential negative impacts is still not fully understood.
- In Aotearoa, there is a need to develop an approach that is grounded not only in western science but in mātauranga Māori and that integrates with te ao Māori. The solutions we develop need to harmonise with nature and be based on robust evidence and systematic understanding and application of Aotearoa's community values.
- There are a large number of pieces of legislation, guidelines, standards, positions statements and workstreams that all intersect with, and potentially impact on, the issue of how contaminants in organic waste are managed. There is therefore a growing need to align these efforts and ensure consistency (for example in definitions and contaminant levels), and harmony of intent.
- Organic waste diversion activity takes place at a range of scales and in different contexts from households to community scale, to marae, and municipal level activities. Each of these present different risks and different challenges for introducing controls. Any controls therefore will have to be appropriate to the context in which they may be applied.

The above means there is a need to strike a balance between maximizing the recovery of organics, and thus avoiding the negative impacts of sending organics to disposal such as greenhouse gas emissions and loss of nutrients and avoiding negative consequences from the increase in contaminants in soil, water and their uptake by plants, animals, and people. In other words, there is risk in both higher and lower levels of control of contaminants that are already in organic waste streams.

What is required is a system that not just enables contaminants to be identified and appropriately controlled, but that ultimately facilitates the optimisation of the recovery of organic wastes to their highest value use, while ensuring that people, and the mauri of the land are protected and enhanced.

There needs to be consideration of how to most effectively take account of the different risks posed by different feedstocks, the degree to which those risks can be managed and mitigated through education, collection and processing approaches and the further risks associated with how the various products may be used in the different receiving environments.

This system needs to be responsive to new contaminants such that culturally and environmentally appropriate guidelines and standards can be defined and integrated with waste management. Such a system would require leadership, management, governance and funding to effectively operate.

Appendices

A.1.0 Comparison of Contamination Limits

New Zealand								Austria				Germany		Italy		
Contaminant	NZS4454: 2005	BioGro	AsureQuality	NES Standard[1] (soil concentrations)	2017 Guidelines – Organics on Productive Land	Technical Guide 08[2]	MPI Technical Paper No: 2012/06	Class A + Organic	Class A Agriculture	Class B Reclaim (limit)	Class B Reclaim (guide)3	Application rate: 20 tonnes dm / 3 years	Application rate: 30 tonnes dm / 3 years	Green Compost	Biowaste compost	Sludge Compost
Chemical (mg/kg dry weight)																
Cadmium (Cd)	3	2 (soil) 1 (compost excl. HW)[3] 0.7 (compost incl. HW)	3	0.8 (rural soil) 3 (residential soil) 230 (HDR soil)[4] 400 (recreation soil) 1,300 (industrial soil)	10	10	1 (soil limit)1 (minii	0.7	1	3	-	1.5	1	1.5	1.5	1.5
Chromium (Cr)	600	150 (total) 1 (VI)	400	>10,000 (III) VI: 290 (rural soil) 460 (residential soil) 1,500 (HDR soil) 2,700 (recreation soil) 6,300 (industrial soil)	1500	1500	-	70	70	250	-	100	70	0.5	0.5	0.5
Arsenic (As)	20	20	20	17 (rural soil) 20 (residential soil) 45 (HDR soil) 80 (recreation soil) 70 (industrial soil)	30	30	-									
Boron (B)	-	-	-	>10,000	-	-	-									
Lead (Pb)	250	100 (soil) 250 (excl. HW) 45 (incl. HW)	200	160 (rural) 210 (residential) 500 (HDR) 880 (recreation) 3,300 (industrial)	300	300	-	45	120	200	-	150	100	140	140	140
Nickel (Ni)	60	35 (soil) 60 (excl. HW) 25 (incl. HW)	60	-	135	135	-	25	60	100	-	50	35	100	100	100
Mercury (Hg)	2	1 0.4 (incl. HW)	1	200 (rural) 310 (residential) 1000 (HDR) 1,800 (recreation) 4,200 (industrial)	7.5	7.5	-	0.4	0.7	3	-	1	0.7	1.5	1.5	1.5
Zinc (Zn)	600	300 200 (incl. HW)	575	-	1500	1500	-	200	500	1800	1200	400	300	500	500	500
Copper (Cu)	300	60 70 (incl. HW)	270	>10,000	1250	1250	-	70	150	500	400	100	70	230	230	230
Thalium (Tl)								-	-	-	-	-	-	2	2	2
Organic (mg/kg dry weight)																
DDT/DDD/DDE	0.5	0.2	5.0 (meat) 1.25 (milk fat) 0.5 (eggs)	45 (rural) 70 (residential) 240 (HDR) 400 (recreation) 1,000 (industrial)	-	-	-									
Lindane (Hexachlorocyclohexane)	0.02	2	2	-	-	-	-									
Aldrin	0.02	-	-	-	-	-	-									
Dieldrin	0.05	-	-	1.1 (rural) 2.6 (residential) 45 (HDR) 70 (recreation) 60 (industrial)	-	-	-									
Chlordane	0.05	-	-	-	-	-	-									
PCP	-	-	-	55 (rural) 55 (residential) 110 (HDR) 150 (recreation) 360 (industrial)	-	-	-									
BaP	-	-	-	6 (rural) 10 (residential) 24 (HDR) 40 (recreation) 35 (industrial)	-	-	-									
Heptachlor and Heptachlor epoxide	0.02	-	-	-	-	-	-									
Hexachlorobenzene (HCB)	0.02	-	-	-	-	-	-									
Dioxin																
Total PCBs	0.5	-	-	-	-	-	-	-	-	1	1	-	-	-	-	0.8
Dioxin-like PCBs (ug/kg dry weight)	-	-	-	0.09 (rural) 0.12 (residential) 0.33 (HDR) 0.52 (recreation) 1.2 (industrial)	-	-	-									
TCDD (ug/kg dry weight)	-	-	-	0.12 (rural) 0.15 (residential) 0.35 (HDR) 0.6 (recreation) 1.4 (industrial)	-	-	-									
Emerging Organic Contaminants (EOCs) (mg/kg dry weight)																
Nonyl phenol and ethoxylates (NP/NPE)	-	-	-	-	50	50	-									
Phthalate (DEHP)	-	-	-	-	100	100	-									
Linear alkydbenzene sulphonates (LAS)	-	-	-	-	2600	2600	-									
Musks – Tonalide	-	-	-	-	15	15	-									
Musks – Galaxolid	-	-	-	-	50	50	-									
Pathogens (count)																
E. coli or Faecal coliforms	<100 MPN/g	-	-	-	<100 MPN/g	<100 MPN/g	--	-	-	-	-	-	-	1000	1000	1000
Campylobacter	-	-	-	-	<1/25 g	<1/25 g	-									
Salmonella	-	-	-	-	<2 MPN/g	<100 MPN/g	-	-	-	-	-	Absent in 50g	Absent in 50g	Absent in 25g	Absent in 25g	Absent in 25g
Human adenovirus	-	-	-	-	<1 PFU/0.25g	<1 PFU/0.25g	-									
Helminth ova	-	-	-	-	< 1/4g	< 1/4g	-									