PALMERSTON NORTH NATURE CALLS

Collecting water samples from the Manawatū River for testing of contaminants

Wastewater Contaminants

Contaminants are substances that change the condition of the wastewater receiving environment - the river water, ocean water or land. Solvents, cleaners, chemicals, fats and oils, and human and food waste are carried in wastewater to the treatment plant where they are removed before the treated wastewater is re-introduced into the environment. Palmerston North's treatment plant at Totara Road uses a range of processes to remove contaminants so that wastewater meets safe levels for discharge to the environment.

Whichever option is selected as the Best Practicable Option (BPO), the Totara treatment plant will continue removing contaminants for the next 50 years. Understanding the types and quantities of contaminants present in our wastewater helps us predict future demands on the treatment plant. Improvements to accommodate increased wastewater flows and changing contaminant loads will be a key part of the capital investment and work programme resulting from the BPO.

Contaminants enter our wastewater from residential, commercial and tradewaste sources. Although 20% of wastewater volume comes from tradewaste, it contributes a much lower percentage of total contaminant loads. Tradewaste discharges are managed with permits, and in many cases the low concentrations of contaminants are due to pre-treatment onsite before wastewater joins the wider system. By comparison, residential and commercial sources make up 80% of wastewater volume and 80% to 98% of contaminant loads.

Contaminant concentrations in wastewater vary, depending on wastewater volumes and the quantity of contaminants. To measure contaminants we consider both wastewater flows and contaminant loads.

Flow Flow is the measure of the rate of wastewater entering the treatment plant. We measure flow in litres per second for a "snapshot" rate, and in cubic metres per day to compare variations over time. At the Totara treatment plant, flow measurements are taken every two minutes by meters within the primary sedimentation tank, the bypass channels and the UV channel outlet. A meter upstream of the plant measures flow every five minutes.

Wet and dry weather affect wastewater flows – peak wet weather flow can be eight times the volume of dry weather flow. The BPO team have used daily and 90 day rolling average flow measurements to investigate daily and seasonal variations and trends

Load Load is the amount of contaminants in the wastewater when it arrives at the treatment plant, measured in grams per second and kilograms per day. Loads are measured at two and five minute intervals using a UV spectrometer. They are also measured by testing samples as part of routine contaminant monitoring and by analysing data provided to Council by tradewaste dischargers.

Each method of collecting data has limitations, so having several meters allows us to clarify and validate the readings from each source.

We've completed investigations to determine the types and levels of contaminants currently present in our wastewater and where they come from. We've identified trends and gathered data on emerging contaminants to help predict contaminant loads and treatment requirements for the duration of the new resource consents and beyond. This factsheet will summarise the findings of these investigations and discuss what they mean for the wastewater BPO process and for our shortlist options.

Contaminants

Wastewater treatment focusses on four major groups of contaminants:

Suspended solids

These are undissolved organic materials that are suspended in wastewater. They are currently removed at the Totara treatment plant by sedimentation followed by biological treatment and filtration.

Dissolved contaminants or nutrients

Phosphates from cleaning products, fertilisers and detergents; nitrates from protein waste matter; ammonia in urine all can contribute to algal blooms in oceans and rivers which overwhelm other plant and animal inhabitants in these environments. Phosphorus is currently removed from wastewater by biological treatment and chemical dosing. Nitrogen compounds are removed by biological nutrient removal.

Organic strength

Organic strength is measured by the Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of the organic matter in the untreated wastewater. A large proportion of BOD and COD are removed by biological treatment processes so that the treated wastewater will not deplete oxygen in the receiving water, ensuring levels of oxygen remain sufficient to sustain fish and other animals.

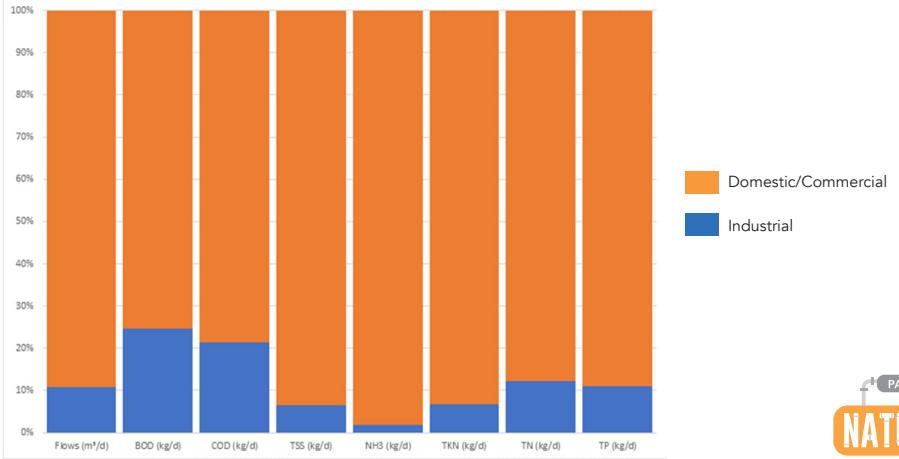
Micro-organisms

This group includes pathogenic viruses and bacteria. We measure faecal coliforms as an indicator of the presence of human or animal wastes in the water. While most micro-organisms are harmless, some can cause diseases, such as hepatitis B, gastroenteritis or typhoid. Micro-organisms are removed at the treatment plant by biological treatment and UV light disinfection.

Table 1: Table of contaminants

Types	What are they	Impacts
Emerging organic contaminants (EOCs)	Nine different classes: Flame retardants Parabens Insect repellents Antimicrobials Industrial alkylphenols Pharmaceuticals Musk fragrances Plasticisers Steroid hormones See the following page for more information about EOCs.	These chemicals have potential to accumulate in the environment over time and there is growing concern about possible adverse effects to human and ecosystem health. Although typically not regulated under current environmental laws, it is good practice to test for and monitor EOCs.
Phosphorus	Dissolved Reactive Phosphorus (DRP) makes up 80 – 90% of the Total Phosphorus (TP) in domestic wastewater.	These nutrients are needed by organisms for growth and reproduction. Increased nitrogen and/or phosphorus can create algal blooms.
Nitrogen	Includes ammonia, nitrates and nitrites, Soluble Inorganic Nitrogen (SIN) and Total Nitrogen (TN). TKN measures combined organic nitrogen and ammonia.	
Suspended Solids (TSS)	Undissolved organic material, including sediment, silt, plant and animal matter.	High concentrations can make waterways septic, killing flora and fauna in the receiving environment.
Fats, Oils, Grease (FOG)	Fats and oils tipped down household drains. Tradewaste oils from garages and manufacturing.	Anerobic bacteria decompose fats and oils, using up oxygen and releasing toxic gases that have potential to harm organisms.
Chemical Oxygen Demand (COD)	A measure of the organic strength of the waste when it is measured chemically.	COD is a chemical measure of the potential polluting impact of wastewater based on its organic strength.
Biochemical Oxygen Demand (BOD)	A measure of how much oxygen will be used by aerobic bacteria in wastewater to convert organic material.	High BOD indicates a loss of oxygen available to the ecosystem and life within it.
Bacteria and viruses	Pathogens including Enterococci and Escherichia Coli. Faecal Coliforms are monitored as an indicator for the presence of these and other pathogens.	These and other pathogens can cause disease to humans and animals.

Figure 1: Percentage contribution to wastewater flows and contaminant loads from domestic/commercial and industrial sources:



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Tradewaste

Businesses who wish to discharge wastewater into the system can apply for a discharge permit. There are currently 518 consented tradewaste discharges served by the Totara Wastewater Treatment Plant. Tradewaste discharges are priced based on the volume of wastewater and the contaminant loads in the wastewater. Permit holders with large discharge volumes are often required to carry out pre-treatment of their wastewater on-site before it enters the system.

EOCs

EOCs are synthetic or naturally occurring chemicals that accumulate in the environment with potential to cause adverse ecological and/or human health effects. This is an area of ongoing research. Effects of the accumulation of EOCs in the environment are only starting to be understood as detection methods have just recently become available. New EOCs arise from development of new chemicals and changes in the use and disposal of existing chemicals.

Testing and monitoring of our wastewater and the Manawatū River indicates EOCs are present in levels consistent with the rest of New Zealand, which are many orders of magnitude below international PNEC (predicted no-effect concentration) guidelines. However some EOCs are significantly higher in Palmerston North wastewater - notably ibuprofen and paracetamol which are likely to be coming from a combination of industrial and domestic sources. Low concentrations of paracetamol in treated wastewater indicate effective treatment and tracing to source will enable onsite pre-treatment for ibuprofen where necessary.

Tradewaste Surveys

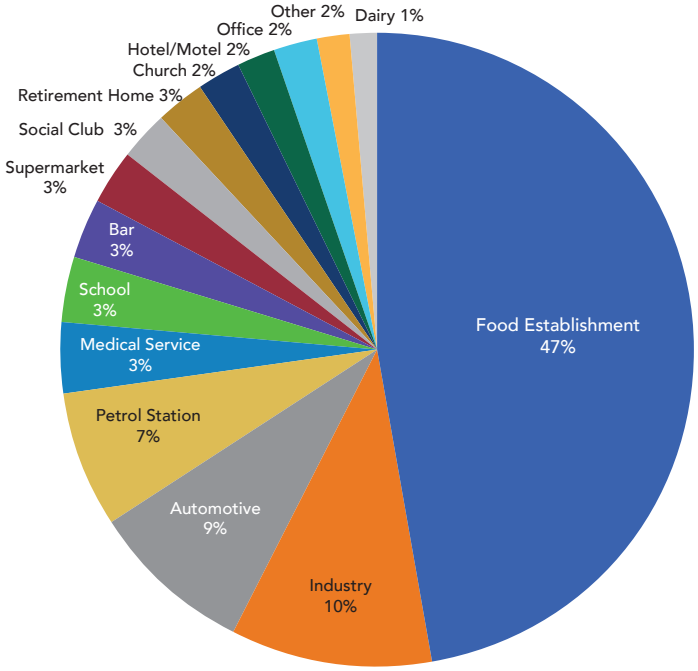
In 2019, Council invited tradewaste dischargers to participate in an online survey to identify current and future tradewaste discharges, provide information about their onsite pre-treatment practices and collect other information about wastewater discharges. While the level of response was low, important information was provided by significant tradewaste dischargers. Feedback indicates a good level of pre-treatment is already being practised and significant dischargers have well-established standard operating procedures and an appreciation of the need for onsite management of tradewaste discharges.

The survey respondents were broken down into six industry groups. The percentage contributions of wastewater flow and contaminant loads for each industry group are shown as percentages of the total for each contaminant in Table 2 below.

Table 2: Percentage flows and loads of survey respondents grouped by industry

Subtotals (%)	Flow	BOD	COD	DRP	TP	TSS	FOG	Amm-N	Nitrate	Nitrite	TKN	TN
Milk/Dairy	51%	61%	59%	88%	69%	51%	72%	38%	99%	99%	50%	74%
Laundries	22%	9%	11%	1%	7%	13%	0%	1%	0%	0%	6%	3%
Food processors	7%	10%	10%	3%	6%	14%	23%	2%	1%	0%	15%	8%
Research facility	10%	4%	5%	8%	8%	19%	2%	25%	0%	0%	10%	6%
Pharmaceuticals	9%	15%	13%	5%	5%	2%	3%	18%	0%	0%	15%	8%
Waste management	1%	1%	0%	1%	4%	1%	1%	17%	0%	0%	4%	0%

Figure 2: Industry groupings for all 518 tradewaste permit holders. Nearly half of permit holders are food establishments.



Estimated future loads

To establish the future requirements of the wastewater treatment system, we predicted the future daily contaminant load in grams per person for domestic wastewater, based on our current population and the combined contaminant loads from domestic, commercial and tradewaste sources. We took progressive 10-yearly population growth estimates for 50 years, to cover the duration of the new consents. We put these together to calculate projections of our mass contaminant loads into the future. Projections were generated for a low growth scenario and a high growth scenario.

Wastewater Flows	Now	2073
Average dry weather flow to plant	250 litres per second	340 - 350 litres per second
Average wet weather peak flow	2,070 litres per second	No change expected
Peak instantaneous flow	2,200 litres per second	No change expected
Industrial contribution by volume	Around 8%	Around 8%

Contaminant Loads	Now (kg per day)	2073 (kg per day)
BOD	6,600	10,526 - 10,544
TSS	7,300	9,983 - 10,027
Nitrogen	1,200	1,632
Phosphorus	196	302
Ammonia	740	1,085

Dry weather wastewater flows are predicted to be 40% greater in 50 years than current dry weather flows. The industrial and domestic contributions to wastewater are likely to remain the same in percentage terms. The North East Industrial Zone is likely to contribute about 10 litres per second to wastewater flow, not enough to influence the flow predictions to the treatment plant.

Wet weather peak flows are also anticipated to remain the same, however these predictions have not accounted for a likely increase in rainfall resulting from climate change. Peak instantaneous flows are likely to increase in frequency with climate change effects but the quantity is expected to stay the same. Improvements from Council's Inflow and Infiltration (I & I) work programme, expected to reduce the infiltration of stormwater, seawater and groundwater into the wastewater system, have not been accounted for in these predictions.

How do predictions help the BPO process?

Predictions enable the BPO system to define capacity, process, technology and infrastructure requirements for the Totara treatment plant under the selected BPO option. Resource consents for the new wastewater system will have conditions around ongoing monitoring of contaminant levels and environmental impacts, and specifications around particular contaminants. The future flow and load estimates also assist the BPO to:

- Estimate how will the system handle peak flows and instantaneous peak flows.
- Design appropriately sized and fit for purpose components for new wastewater infrastructure.
- Predict environmental effects over the life of the consent.
- Identify possible social and cultural effects.
- Identify areas where good practice or regulations for tradewaste pre-treatment might be appropriate in the context of the selected option.
- Understand wastewater requirements for particular industries.
- Develop indicative future pricing for tradewaste.

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What are the implications for the shortlist options?

Table 3 shows the importance of each contaminant type based on expected infrastructure requirements and operating costs for each of the shortlist options. The table provides these ratings by industry group.

The importance level is color-coded:

Red (high importance). The parameter has high infrastructure and/or operating costs to meet water quality requirements for that receiving environment.

Blue (medium importance). The parameter has some infrastructure and/or operating costs to meet water quality requirements for that receiving environment.

Green (low importance). The parameter has a low effect on infrastructure and/or operating costs to meet water quality requirements for that receiving environment.

*Table 3: Comparative importance of tradewaste quantity/quality for different shortlisted options receiving environments**

Receiving Environment / Industry Group	River and connected Ground water																Land (Local Fluvial and Coastal Sand)								Ocean						
	Daily Volume			TSS			BOD/COD			TP/DRP			Amm-N			TN			Daily Volume	TSS	BOD/COD	TP/DRP	Amm-N		TN		Daily Vol	TSS	BOD/COD	TP/DRP	Amm-N	TN
	R2B + GW2	R2B + GW2 - No RO	Dual R+L	R2B + GW2	R2B + GW2 - No RO	Dual R+L	R2B + GW2	R2B + GW2 - No RO	Dual R+L	R2B + GW2	R2B + GW2 - No RO	Dual R+L	R2B + GW2	R2B + GW2 - No RO	Dual R+L	R2B + GW2		Dual R+L					Local Fluvial	Coastal	Local Fluvial	Coastal						
Milk/Dairy																															
Laundries (Commercial)																															
Food Processors																															
Research Facilities																															
Pharmaceuticals																															
Waste Management																															

**Note that the GW2 option (discharge to groundwater) has been removed from the shortlist due to high cost and complexity issues.*

The shortlist options that discharge to into the Manawatū River are expected to have higher treatment infrastructure requirements and operating costs to achieve river water quality standards.

Coastal land options have medium requirements and importance compared with inland (fluvial) land options which have lower requirements and importance.

The ocean environment has the lowest level of treatment requirements.

The five shortlist options are:

Option 1

River discharge at the existing point (2 variants)

Option 2

River discharge at two points (2 variants)

Option 3

Land discharge, 97% and river discharge, 3% (2 variants)

Option 4

Land discharge, 45-55% and river discharge, 45-55% (4 variants)

Option 6

Ocean discharge, 97% and land or river, 3% (2 variants)

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Key outcomes for the Best Practicable Option (BPO).

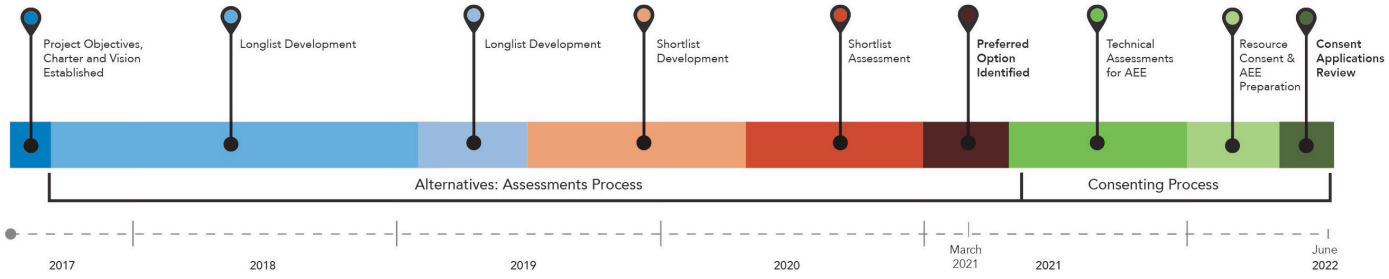
The preferred shortlist option will:

- Protect public health and minimise public health risks.
- Minimise environmental effects on air, land and water, minimise whole-of-life carbon emissions and optimise resource recovery.
- Contribute to improving the health and mauri of the Manawatū River.
- Be developed with the active engagement of the community and key stakeholders.
- Be affordable and cost effective.
- Be innovative and evidence based.
- Be sustainable, enduring, and resilient. Take an integrated approach to the management and cumulative effects on the Manawatū River catchment.
- Facilitate long term growth and economic development.
- Enhance people's use and enjoyment of the Manawatū River.

About this project

The Nature Calls project takes a fresh look at how we manage wastewater in Palmerston North and what we need to achieve before 2022 to future-proof our wastewater management and infrastructure. The process involves engagement with iwi, the community and stakeholders as well as technical investigations, including this one. The timeline below shows expected project progress through to June 2022 when the consent applications for the preferred option will be lodged.

Project timeline



For more information, contact us.

For more information about wastewater, the Nature Calls project and the shortlist options:

Visit www.pncc.govt.nz/naturecalls

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