Liam Allan (Pattle Delamore Partners Ltd)

Treating Leachate-Impacted Stormwater with a Nitrifying Trickling Filter: Not a Load of Rubbish

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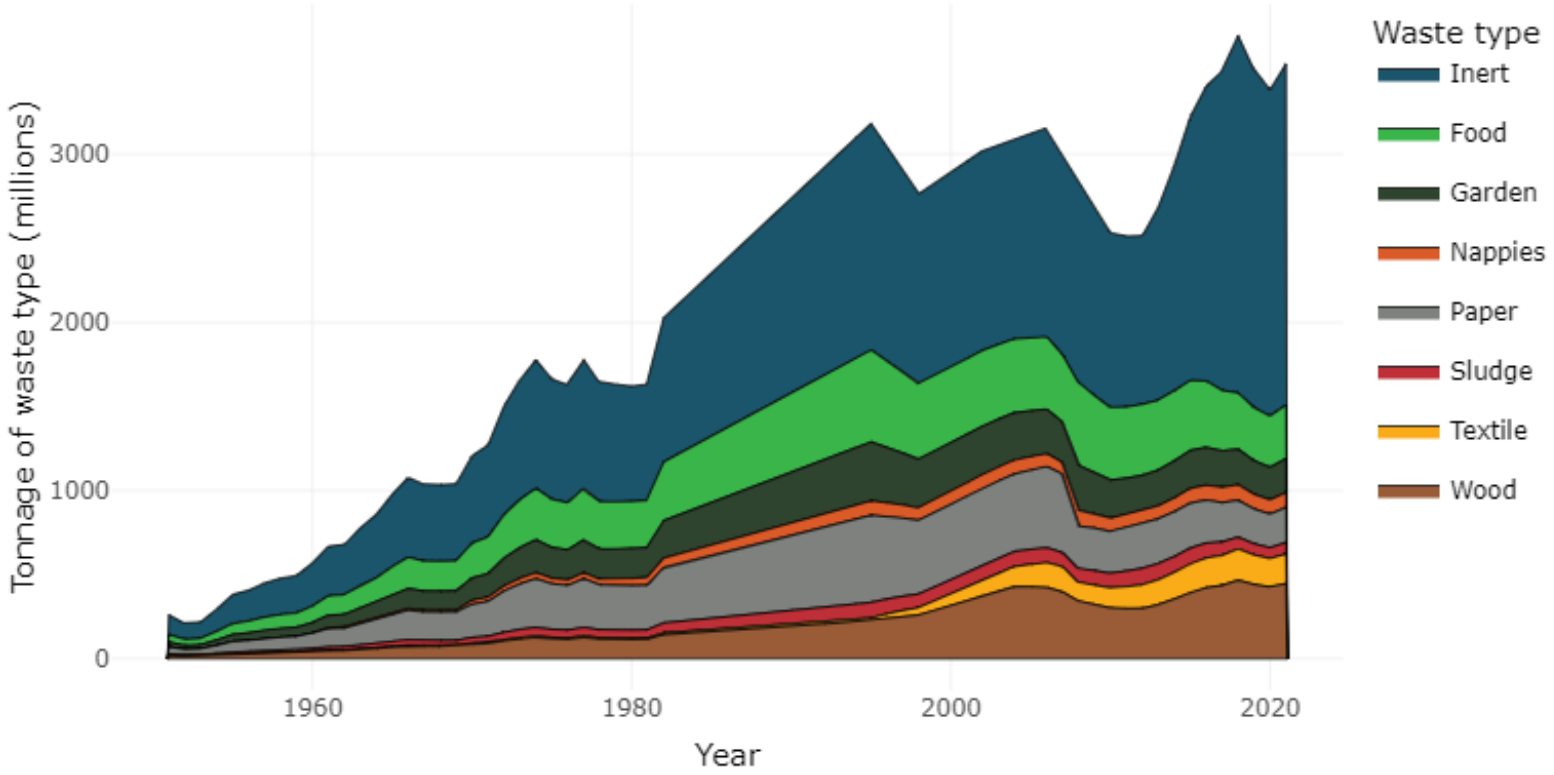
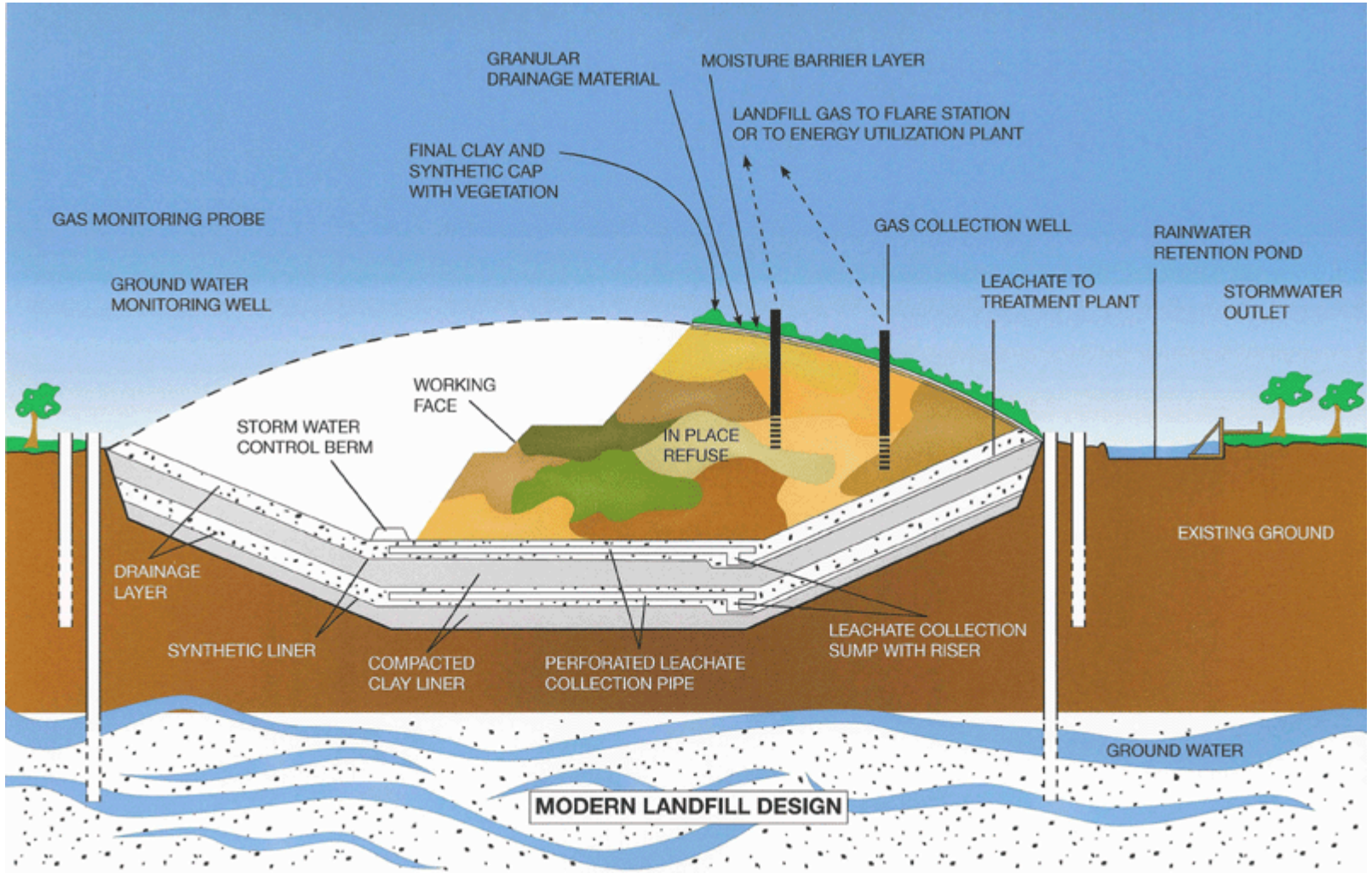
Introduction

- 700 kg of waste per person in 2022-2023 period in NZ
- Where does it go?
- Most landfills until 1980s were unlined "tips"
- Dealing with legacy environmental impacts



Source: MfE Waste Generation and Disposal Data (2023)

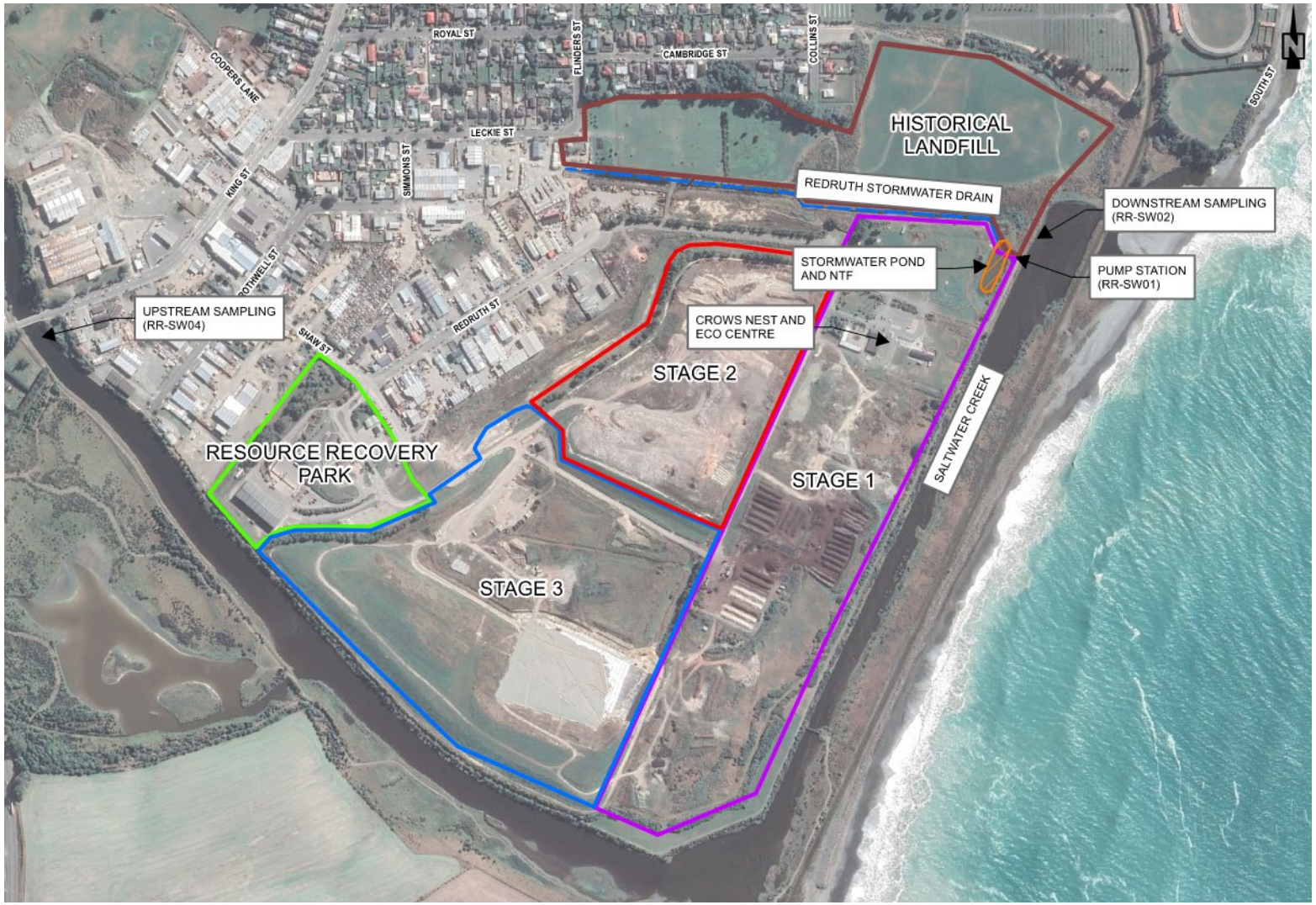
Leachate and Landfills: A Re-Cap



Source: CSIR Guidelines for Human Settlement Planning and Design Volume 2 (2000)

- Leachate results from water percolating through a landfill and picking up contaminants
- Organic nitrogen is converted to ammoniacal-nitrogen, harmful to aquatic life
- Modern landfills manage leachate using capping, liners, and collection systems

The Site



- Redruth Landfill, South Timaru
- Landfilling since 1940s (Stage 1)
- Ongoing improvement work and landfilling activities
- Public access
  - Walkway
  - Eco Centre
  - Crows Nest
- Stormwater drain to pump station

Issues

- Historical landfill cells with minimal capping and liners
  - More leachate generated
  - Leachate seeps to site stormwater network
- Leachate-impacted stormwater enters Saltwater Creek via SW01 pump station
- Elevated ammoniacal nitrogen at SW01
- Waterway concentration increases

	Ammoniacal-N (2004-2020)		
	RR-SW04 (Ōtipua-Saltwater Creek – Upstream)	RR-SW01 (Pump Station)	RR-SW02 (Ōtipua-Saltwater Creek – Downstream)
Trigger Value (g/m³)	**0.7**		
Sample Size	30	41	43
Lower Quartile (g/m³)	0.03	13.8	0.30
Median (g/m³)	0.12	22	0.54
Upper Quartile (g/m³)	0.27	32	2.00
Max (g/m³)	3.20	66	7.00

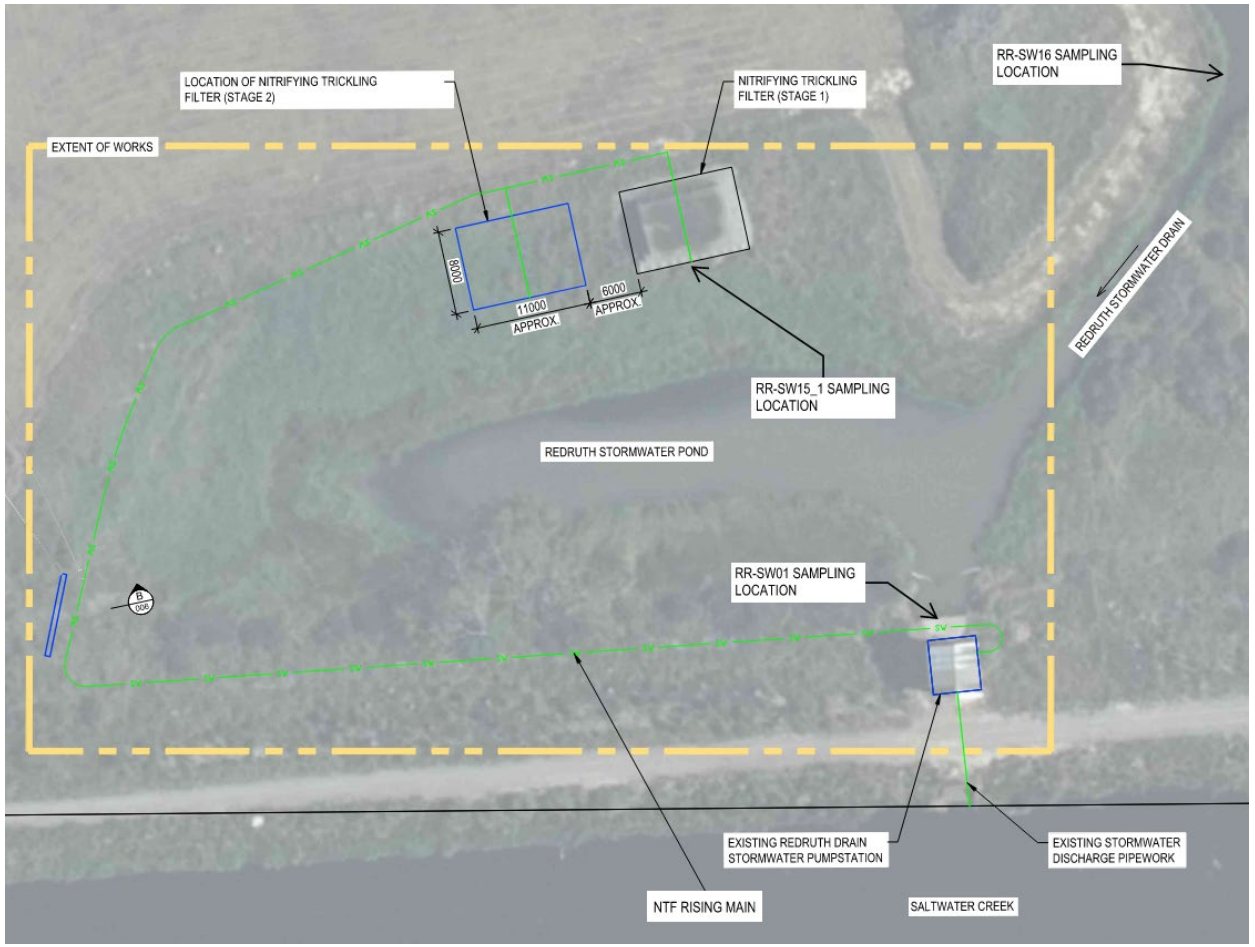
Objectives

- Mitigate the ecotoxic effect of ammoniacal nitrogen on Saltwater Creek
- Visually-appealing design due to proximity to walkways
- Easy to maintain and operate with no specialist skills
- Minimal capital and operational costs
- Incorporate community education

Design

- Nitrifying Trickling Filter (NTF) with gabion basket construction
- Cost efficient
- Blends-in to surrounding environment
- Flexible material

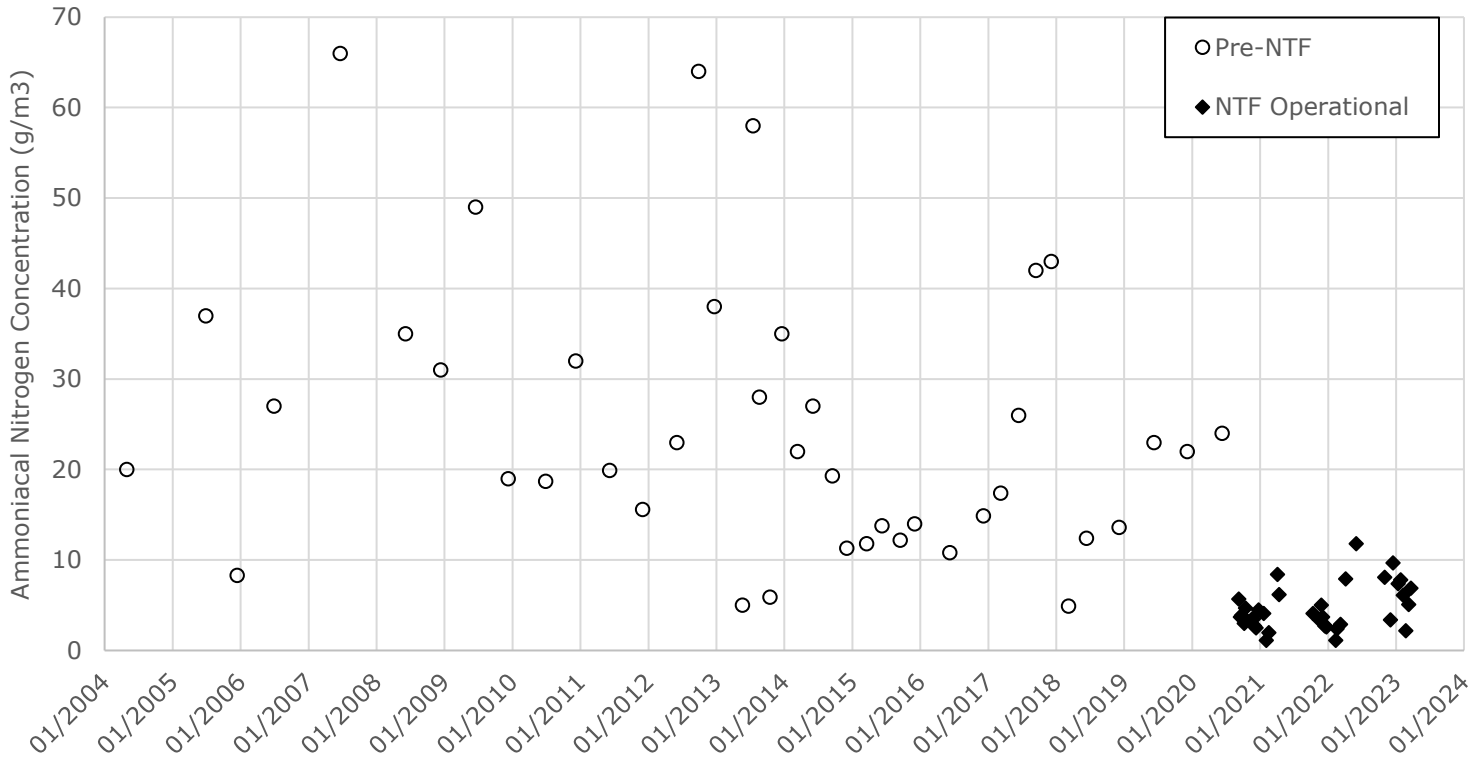
Operation and Monitoring



- Utilises existing pump housing and power supply
- Sprinklers provide ammoniacal nitrogen to nitrifying bacteria on rock surfaces
- Pump controller is intuitive
- Three monitoring locations – 36 samples since September 2020

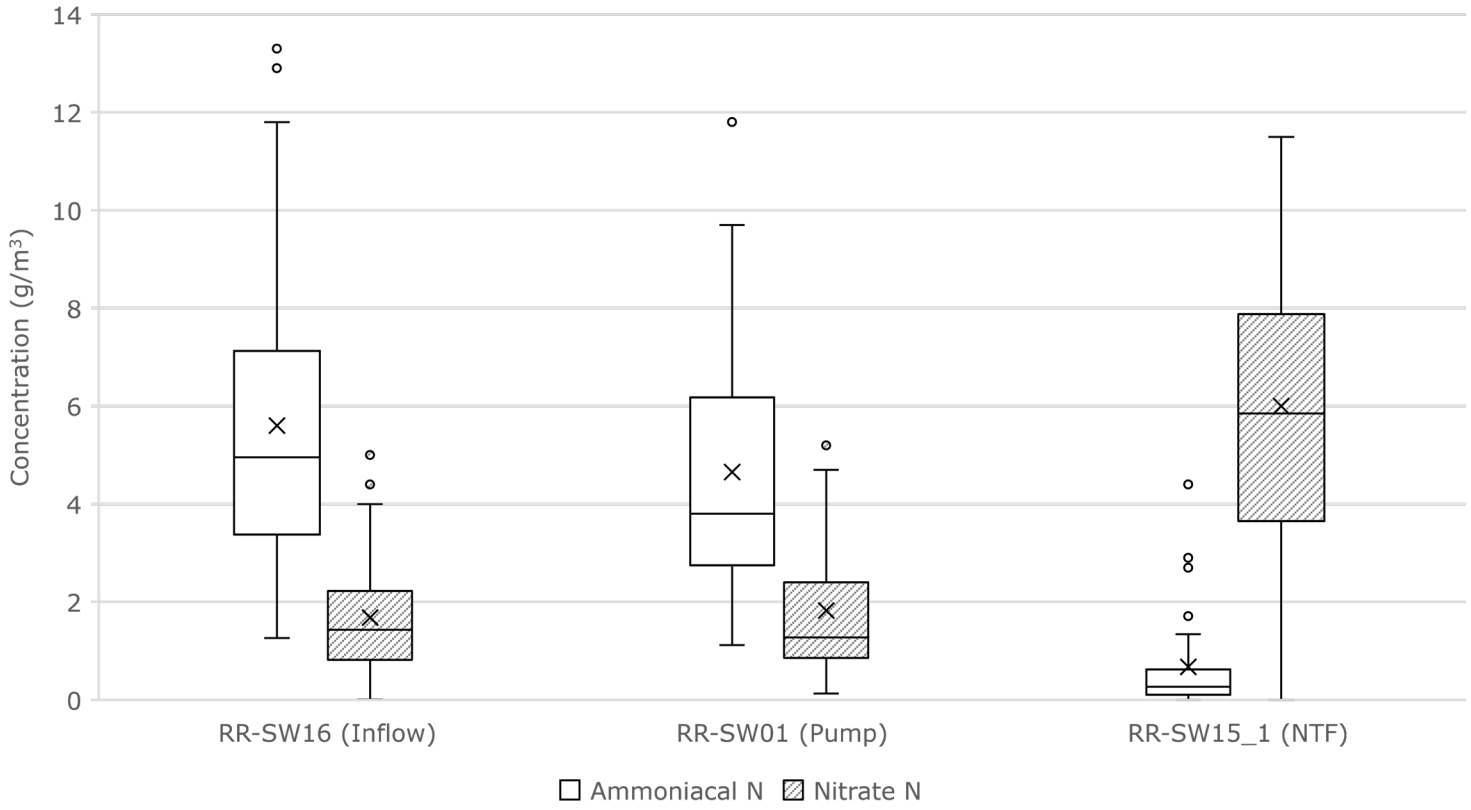
Long-Term Water Quality

- Consistently lower concentrations after commissioning
- Decreasing trend since 2010
- Visible improvements of pond clarity noted

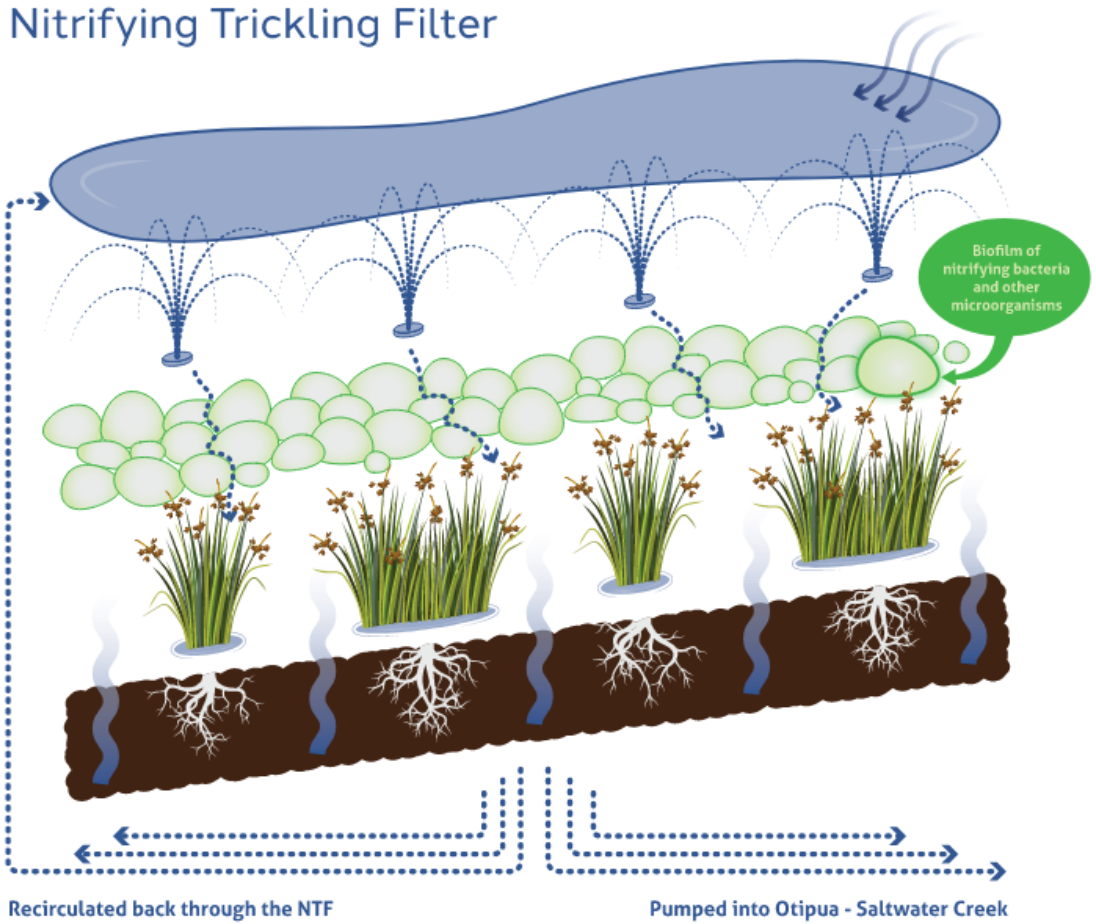


Nitrification

- Conversion of ammoniacal-nitrogen to nitrate-nitrogen
- Treatment efficiency typically >90%
- Nitrate increase
- Concentration is still elevated – more can be done



Next Steps



1
Stormwater from the surrounding catchment flows into the pond.

2
Stormwater from the pond is pumped to sprinklers at the top of the NTF.

3
The water trickles through the NTF rocks. The rocks are coated in a slime layer of 'nitrifying bacteria'.

4
The bacteria convert ammonia to nitrate which is then taken up by plantings at the base of the NTF.

5
Plant roots convert nitrates into nitrogen gas which is returned to the atmosphere (denitrification).

6
Treated stormwater is recirculated back through the NTF or pumped into Otipua - Saltwater Creek.

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- Display board to be installed soon
- Eco Centre has presented to school groups on the NTF
- Second NTF monitoring
- Nitrate treatment needed

Summary

- The objectives of the design have all been achieved
- High treatment efficiency typically >90%
- Highly replicable, simple design

Acknowledgements

- Co-authors Dr Mark Ellis (PDP) and Dr Sachin Narkhede (Timaru District Council)
- Nils Buchan (PDP) – NTF Stage 2 designer
- Trinity White (PDP) – Community display board designer
- Timaru District Council
- South Canterbury Eco Centre

Questions?

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