Outcomes and lessons: Trading cost for complexity

Freshwater Management Tool

Healthy Waters
Paradigm Morphum

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Outcomes & Lessons

Freshwater Management Tool

Stormwater is costly & challenging

Management tools

- Simple question – how to improve
- Challenge – least cost & to target
- Modelling solution – process-based, continuous & optimisable

Waterway Action & Investment Strategies needed

1. Water Reform = affordable
2. RMA Reform = compliance
3. Water & RMA Reform = outcomes

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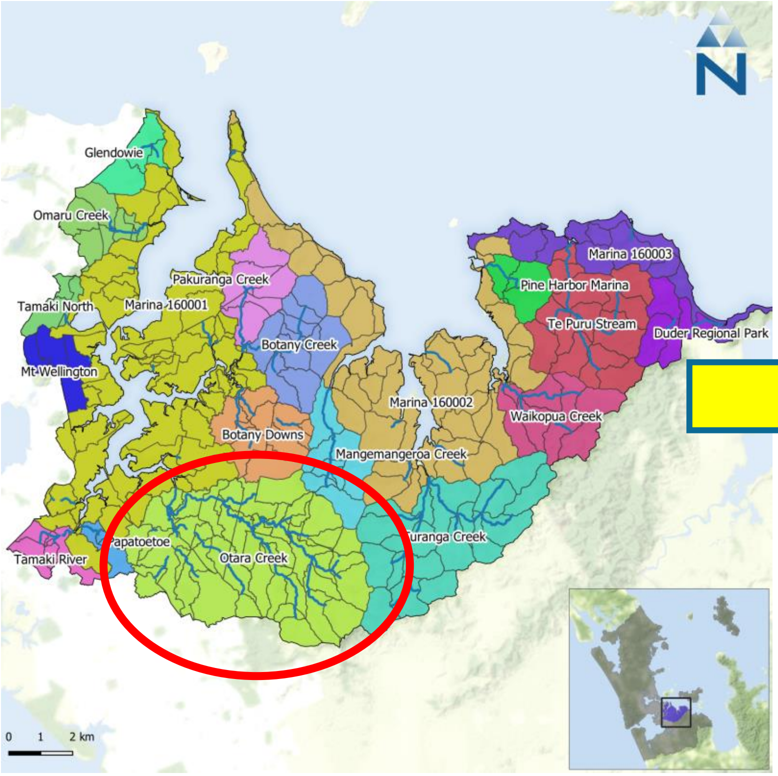
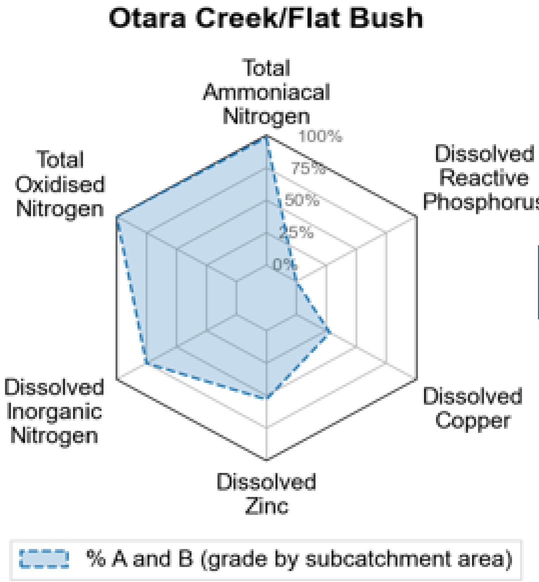
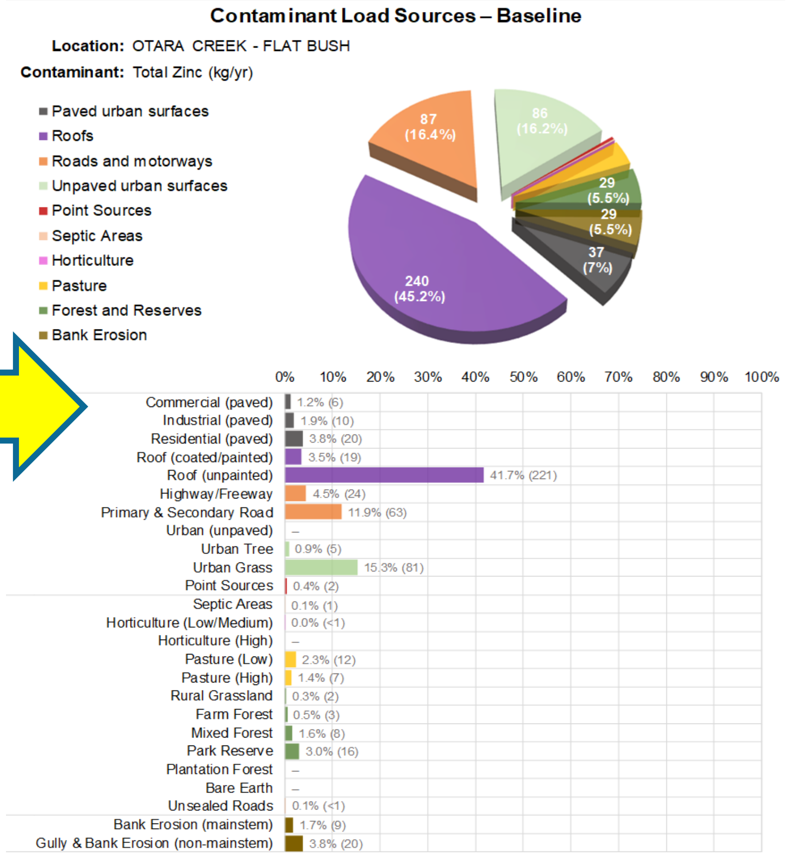
Choice matters – save ~75% of cost for urban water quality with “source controls”







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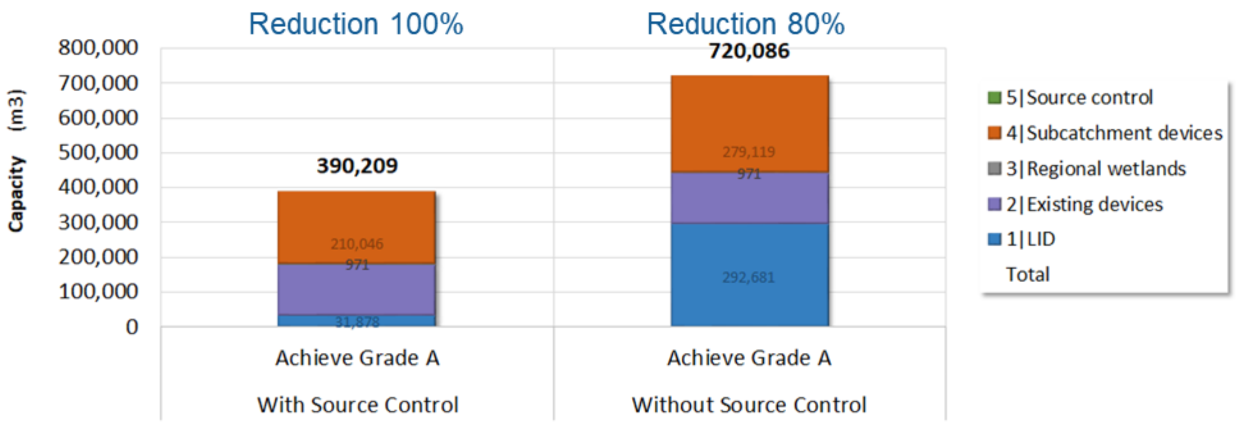
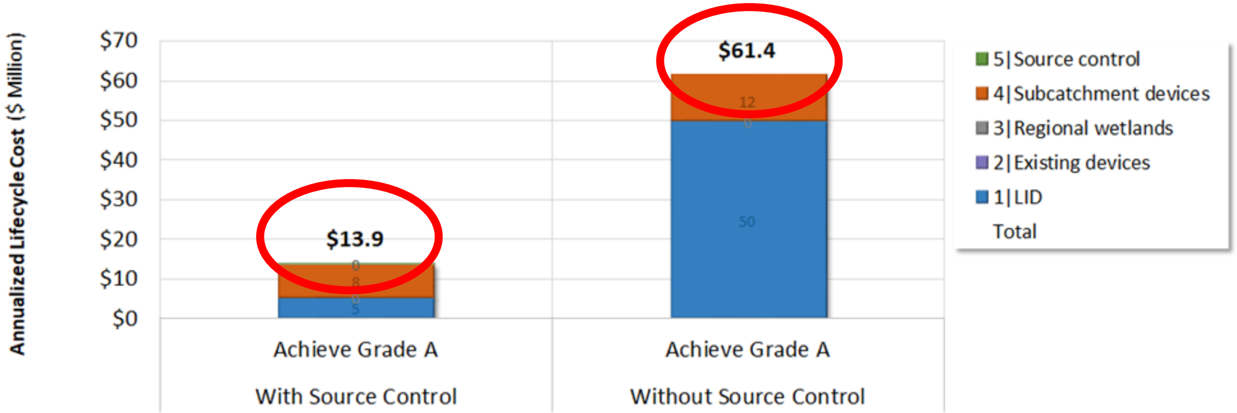
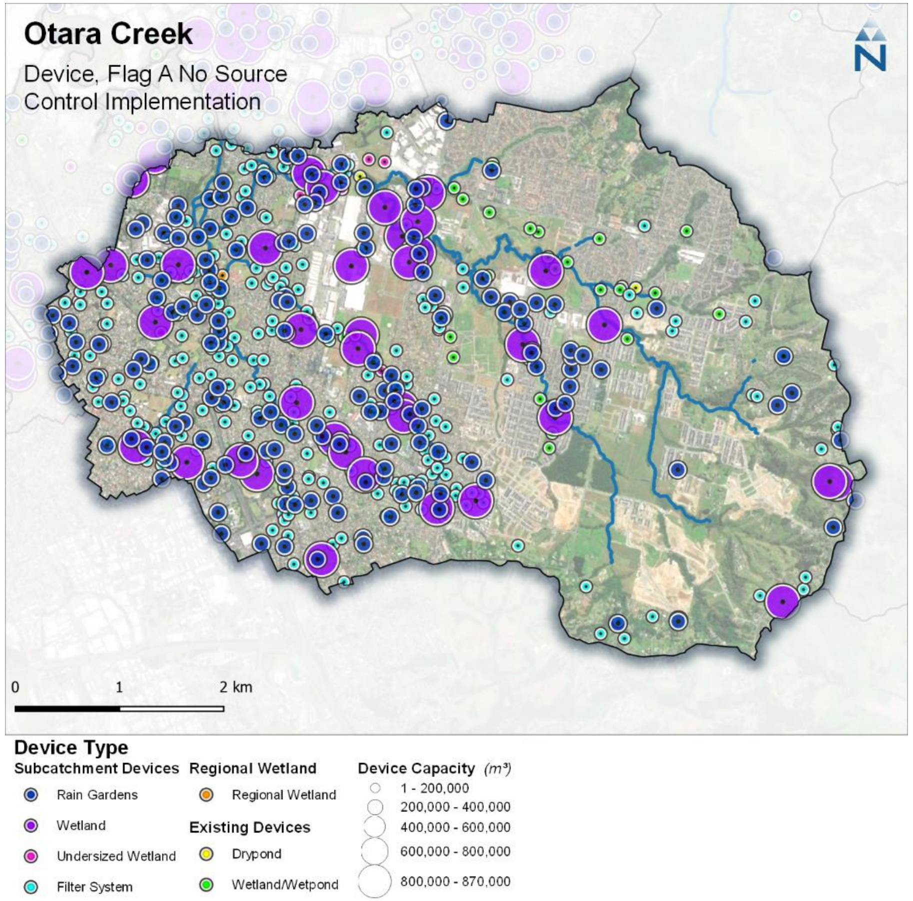
Choice matters – save ~75% of cost, be more targeted







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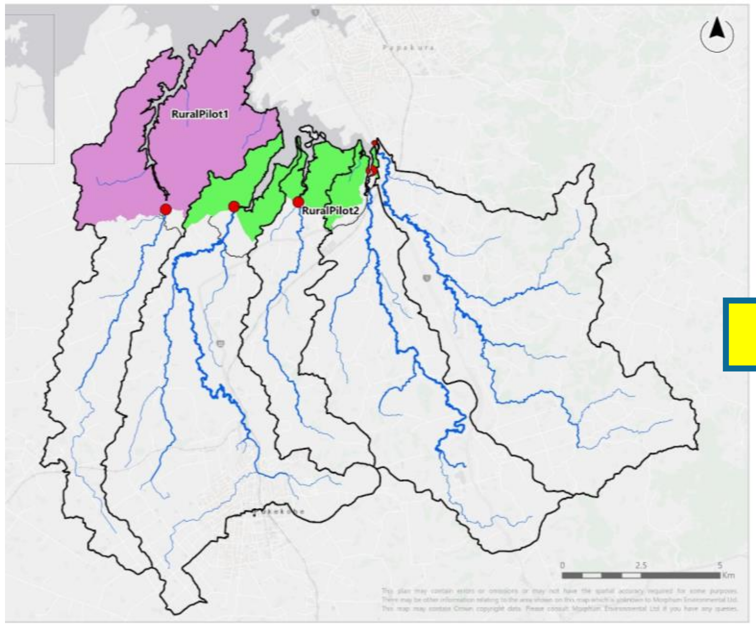
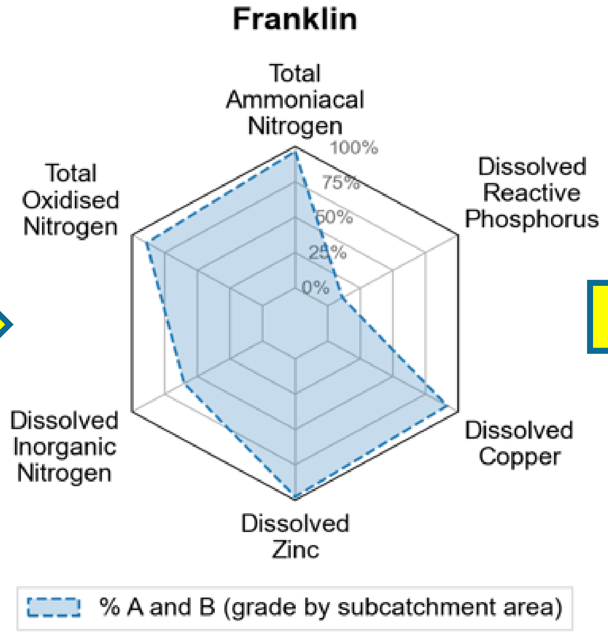
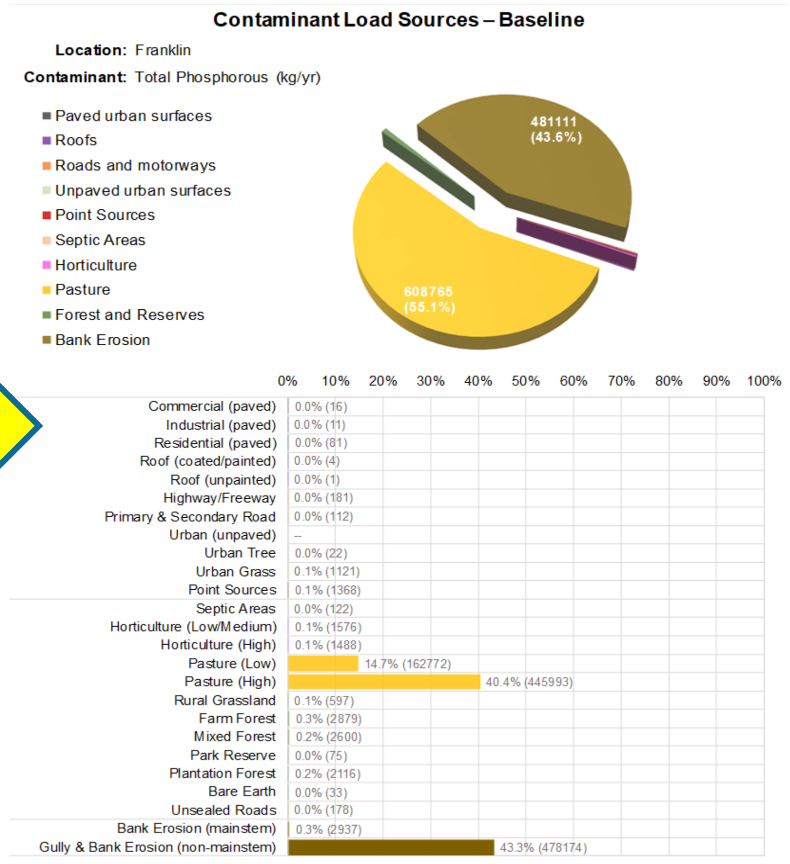
Freshwater Management Tool

Targeting matters – save ~90% of cost for rural water quality







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Freshwater Management Tool

Targeting matters – save ~90% of cost for rural water quality

Constituent		High Impact – Dairy (>10 SU/Ha)
Modelled Treatment	TSS	-15%
	TN	-61%
	TP	-93%
	TCu	-
	TZn	-
	E.Coli	-62%
	Mitigation Bundle	Enacting M3 measures on more than 10SU/ha Dairy pasture
	BMP Description	HRU swap
	Opportunity to locate BMP	Implicitly limited by HRU
	Available to Swap	100%
	Annualised Life Cycle Cost /m²	$0.0361

Mitigation Bundle 3 (M3) on Pasture

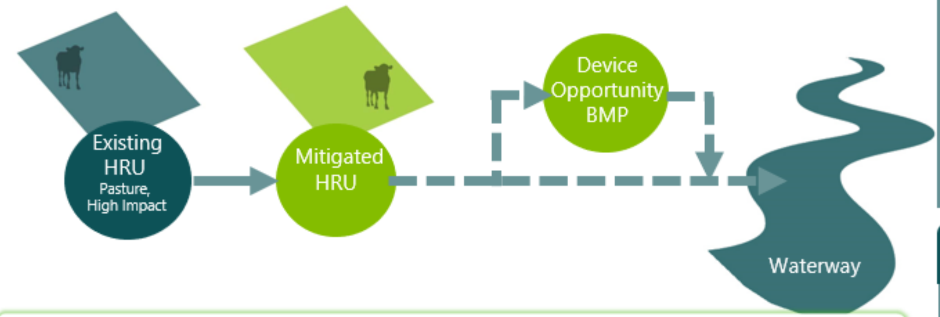
(High Impact – Dairy ≥10 SU/Ha)

Good practices adopted for farm management and/or farm systems

Practices applied as suitable to farms in studies – generalised for FWMT purposes. Not all actions are feasible on same HRU, but generalised effect and costs are expected to be shared.

Intensity **More than 10 SU/ha (dairy, Flat or Steep HRUs)**	1	Full Stock exclusion from streams using single-wire fencing
	2	Soil Olsen phosphorus levels reduced from 38 to 32
	3	Effluent areas enlarged appropriate to effluent potassium loading rates
	4	Additional one month's effluent pond storage
	5	Low effluent application depth
	6	N mitigation: Based essentially on reducing N inputs (feed and fertiliser) and stocking rates: 1. Stocking rate reduction from 3.1 cows/effective hectare to 2.8 2. N fertiliser use reduction from 116 kg N/effective hectare to 29 3. Bought feed (as % of total offered) reduction from 17% to 15%
	7	P mitigation: based on reducing P inputs as per OVERSEER, fertiliser, effluent and cropping and adjusting stocking rates as needed

FWMT model design



Optimisation considers effects with or without further downstream treatment by devices such as wetlands and riparian devices

Water Quality Purpose	
Contaminant interception	✗
Contaminant generation reduction	✓
Instream processes	✗
Habitat	✗

Flow Purpose
None

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Reference: Auckland Council (2021). Freshwater Management Tool: report 8. Lifecycle Costs and benefits for rural mitigations in the freshwater management tool. Available on Knowledge Auckland.

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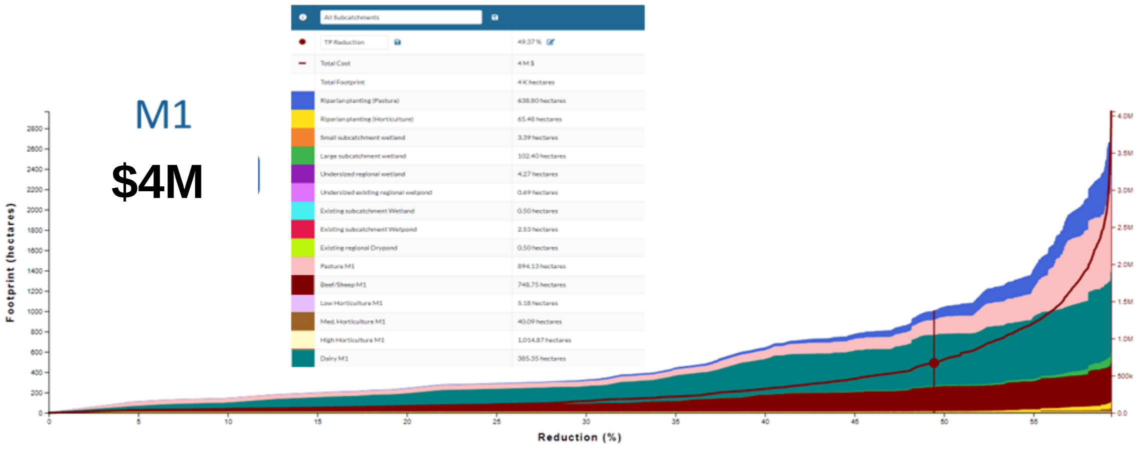
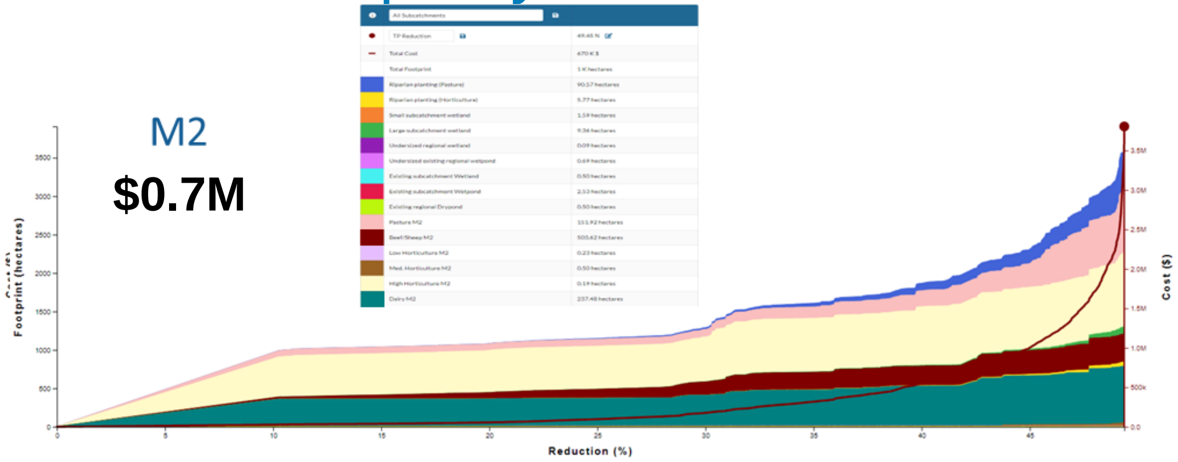
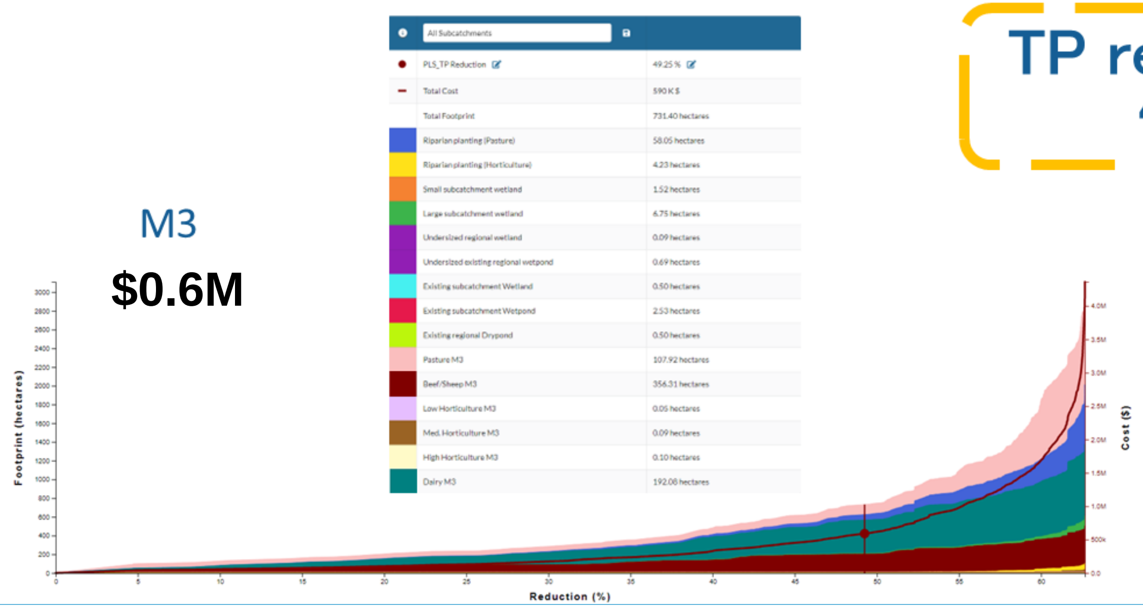
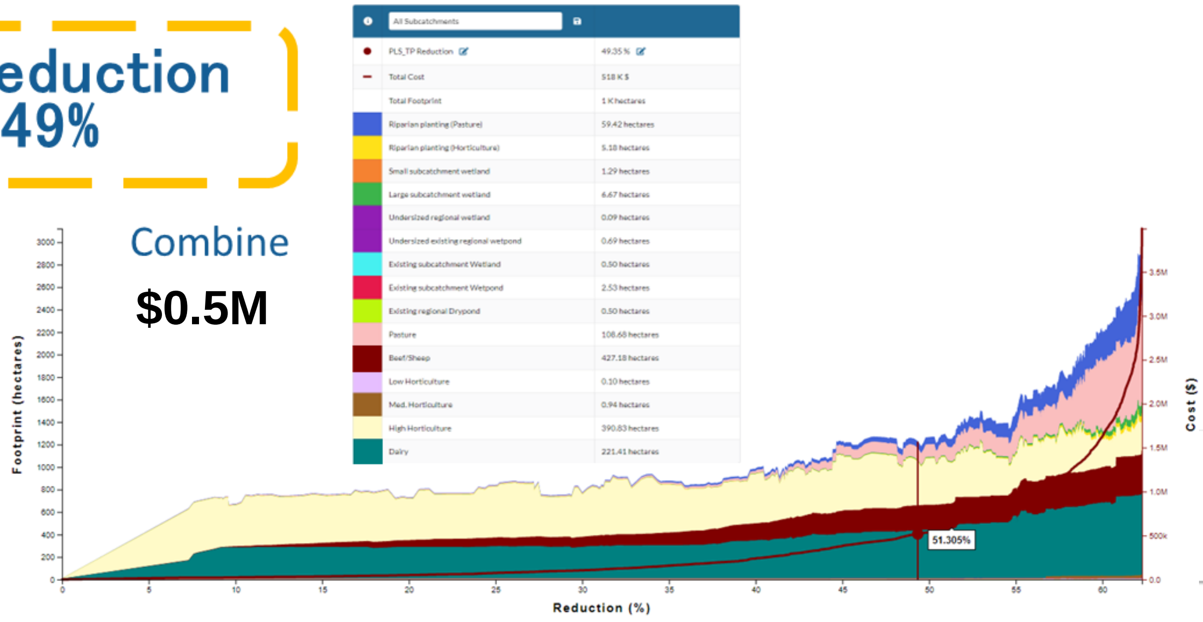




TP reduction 49%





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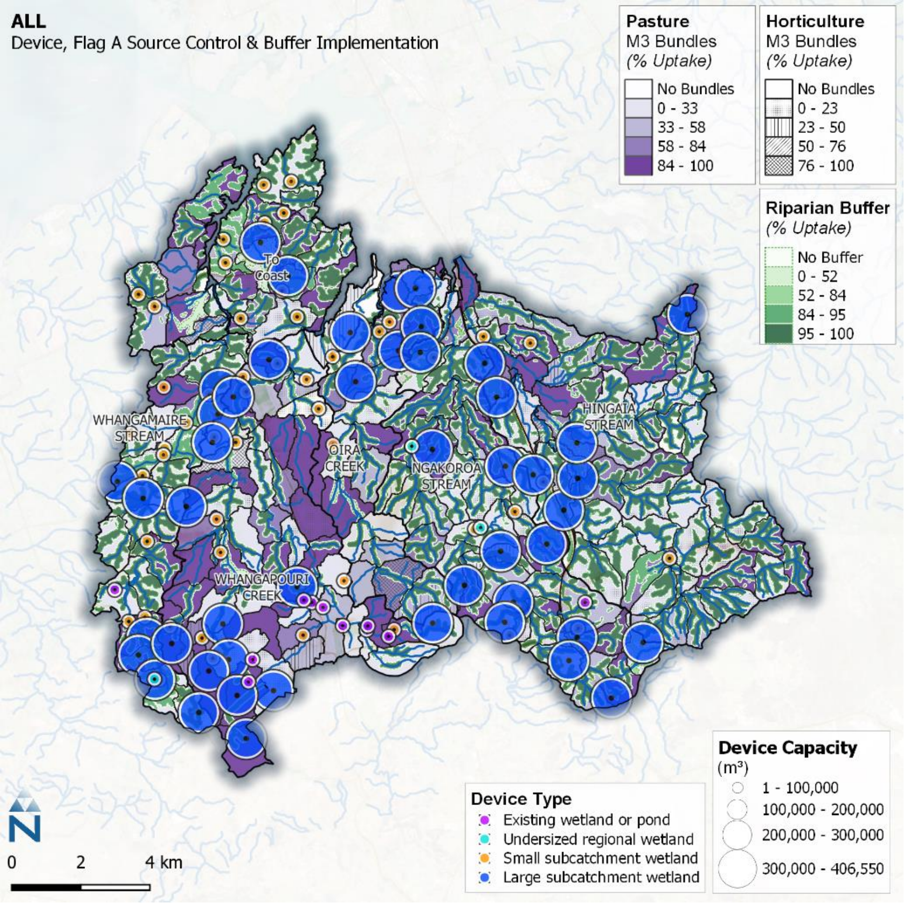

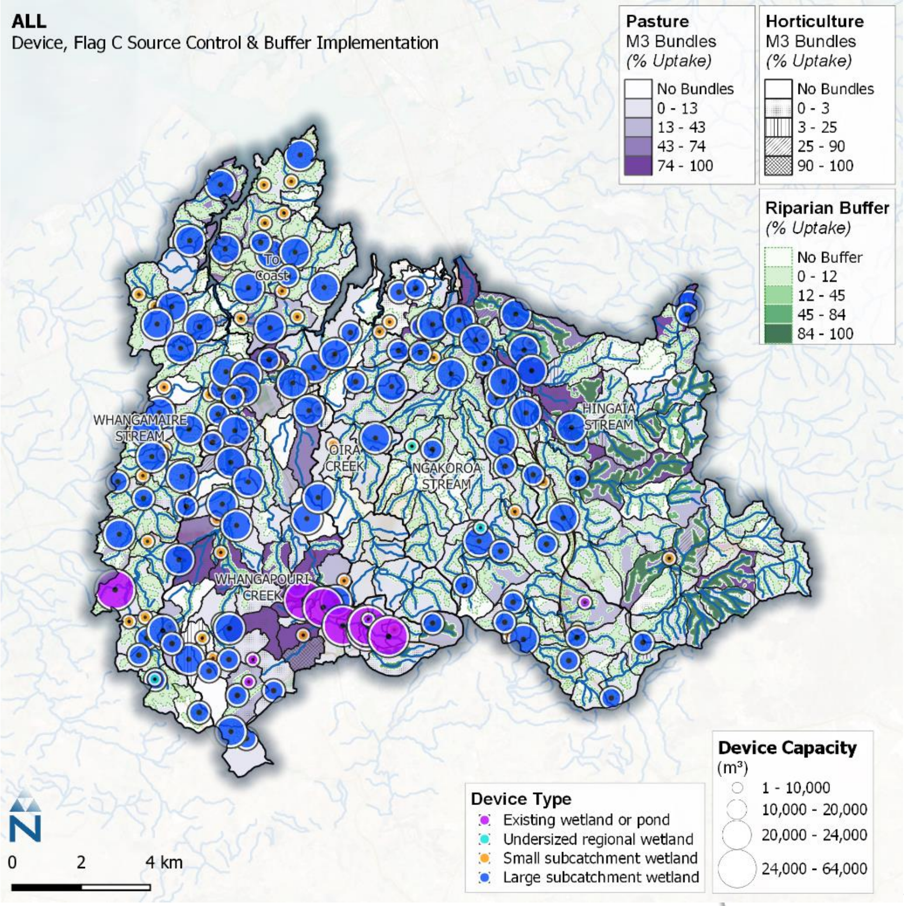

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Optimisation

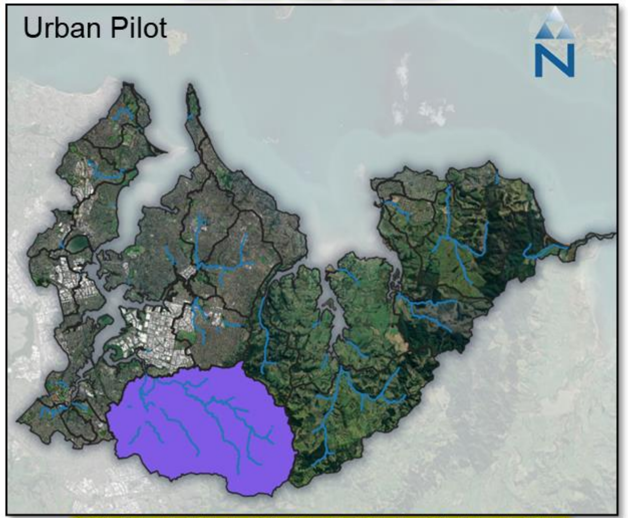
Complex inputs & approach – purpose governs design, design governs use

Otara Creek

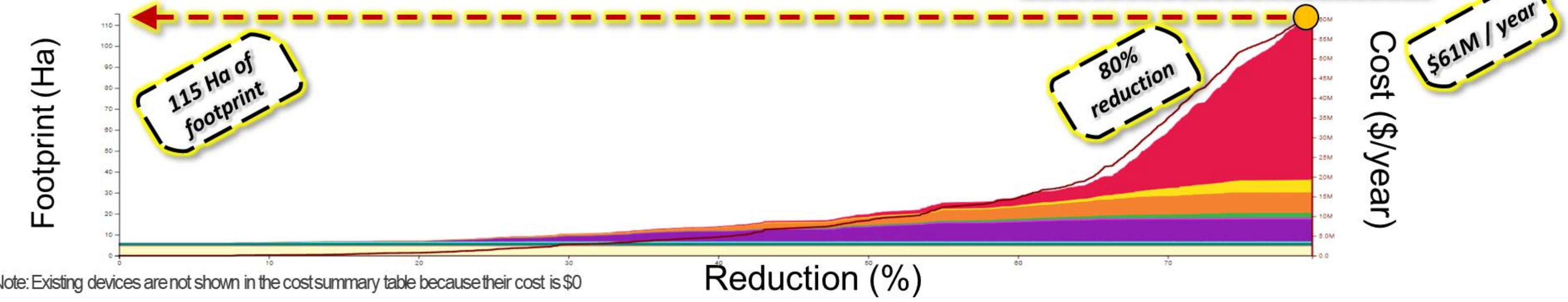
Optimisation Objective: Achieve A Grade for Zinc

Without Source Control

Mitigation Type	Footprint (ha)	Cost ($/yr)	Capacity (m^3)
Total	115.44	$61M	720,085.88
Permeable pavement	79.05	$27M	211,443.24
Rain tanks	2.36	$6M	50,964.97
Rain garden	6.18	$17M	30,119.78
Filter system	0.01	$32K	153.40
Subcatchment rain garden	9.96	$6M	64,217.97
Subcatchment wetland	10.53	$4M	194,928.57
Undersized subcatchment Wetland	0.59	$115K	10,962.01
Subcatchment Filter system	0.71	$2M	9,010.94
Regional Wetlands	0.05	$10K	970.77
Existing regional Drypond	0.04	- -	833.47
Existing regional Wetpond	1.2	- -	29,887.00
Existing regional Wetland	0.06	- -	1,124.65
Existing subcatchment Wetland	0.3	- -	5,581.62
Existing subcatchment Wetpond	4.37	- -	109,174.71
Existing subcatchment Drypond	0.04	- -	712.78



Strategy to achieve A grade



Note: Existing devices are not shown in the cost summary table because their cost is $0

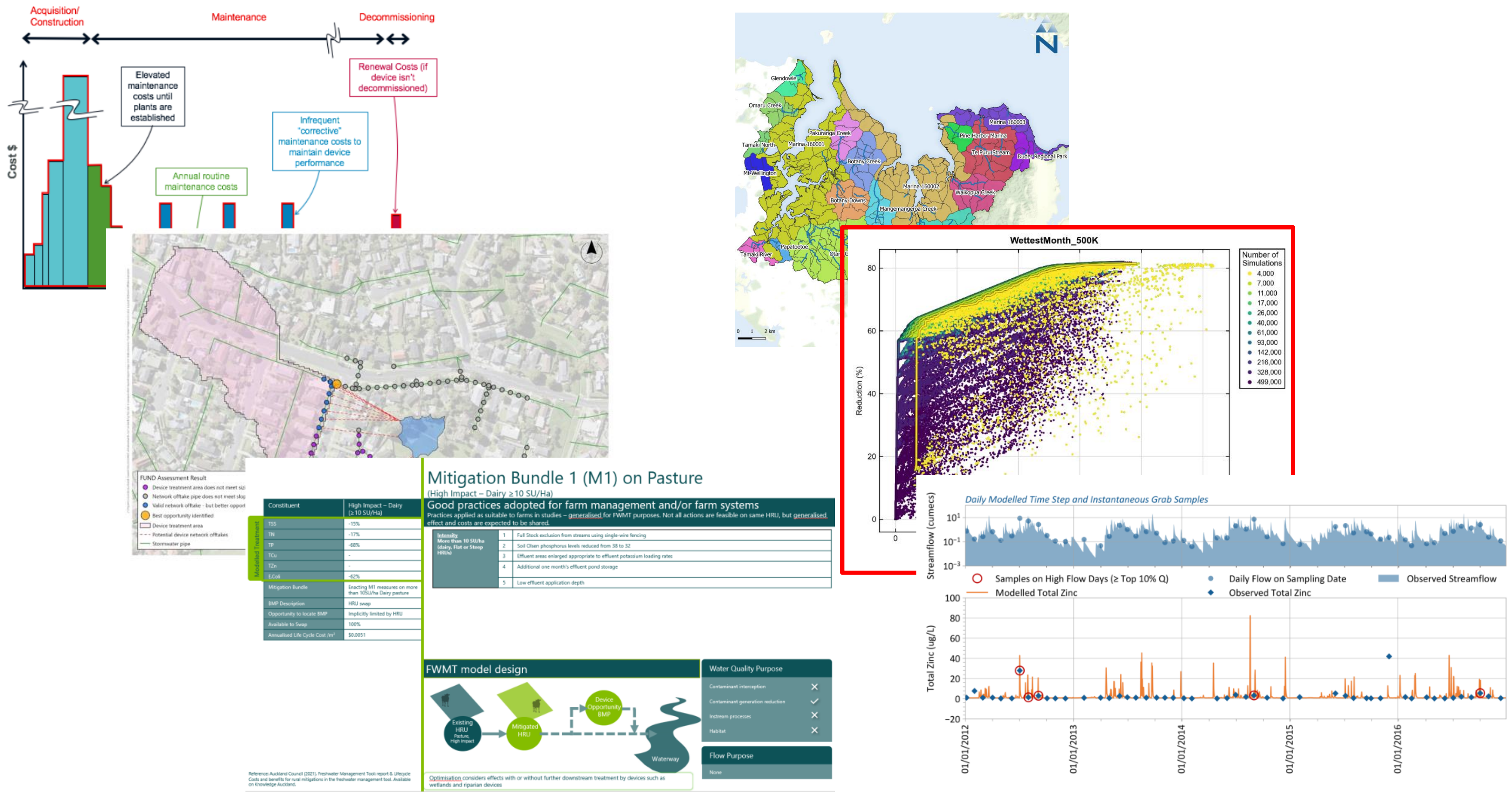
Optimisation

Input complexity – opportunity mapping

Offtake Criteria	Justification	Data Source(s)
Pipe <100m from edge of potential device	Diversion pipelines greater than this length require multiple manholes and unlikely to be installed by directional drilling, therefore deemed too disruptive and expensive to construct.	SW Pipe Network (Auckland Council, 2019)
If network offtake within 2m of permanent stream or intersects an existing treatment facility, then remove opportunity	Treatment device opportunities unlikely to utilise offtakes crossing permanent streams or from existing treatment devices.	Permanent Streams Layer (Auckland Council, 2018) swWaterTreatmentFacility (Auckland Council, 2019)
Grade between pipe and device location >1.0%	Selected as minimum grade to allow adequate conveyance of stormwater to device. 1.0% recognizes that pipe invert is often inferred using pipe ground level as a proxy, incorporating error margin. Auckland design manual states 0.1% minimum grade for stormwater pipes	AC SW Pipe Network swPipe (Auckland Council, 2019) DEM (AC, 2016)
Assumed excavation depth of device footprint 1.5m	Assumed earthworks required to prepare device site location for constructed treatment opportunity. Earthworks that require excavation depth > 1.5m likely prohibited by costs/disruption and less likely to drain back into the network.	NA
Assumed pipe invert depth of 1.5m if no attribution exists	Pipe invert level was calculated using stormwater network invert levels where available (either from the pipe itself or any adjoining infrastructure such as manholes). 1.5m represents the typical balance between minimized earthworks/ safe trenching depth and minimum network covers.	NA
Treatment area exceeds 2500 m^2	Based on min device area / treatment area ratios including viability of public device treating multiple private properties.	NA
Preferential network offtake	Estimated device type is assigned based on device footprint to device catchment ratio. Device	NA

Optimisation

Complex inputs & approach – purpose governs design, design governs use



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Optimisation

Approach complexity (Tier 1) – Best solutions

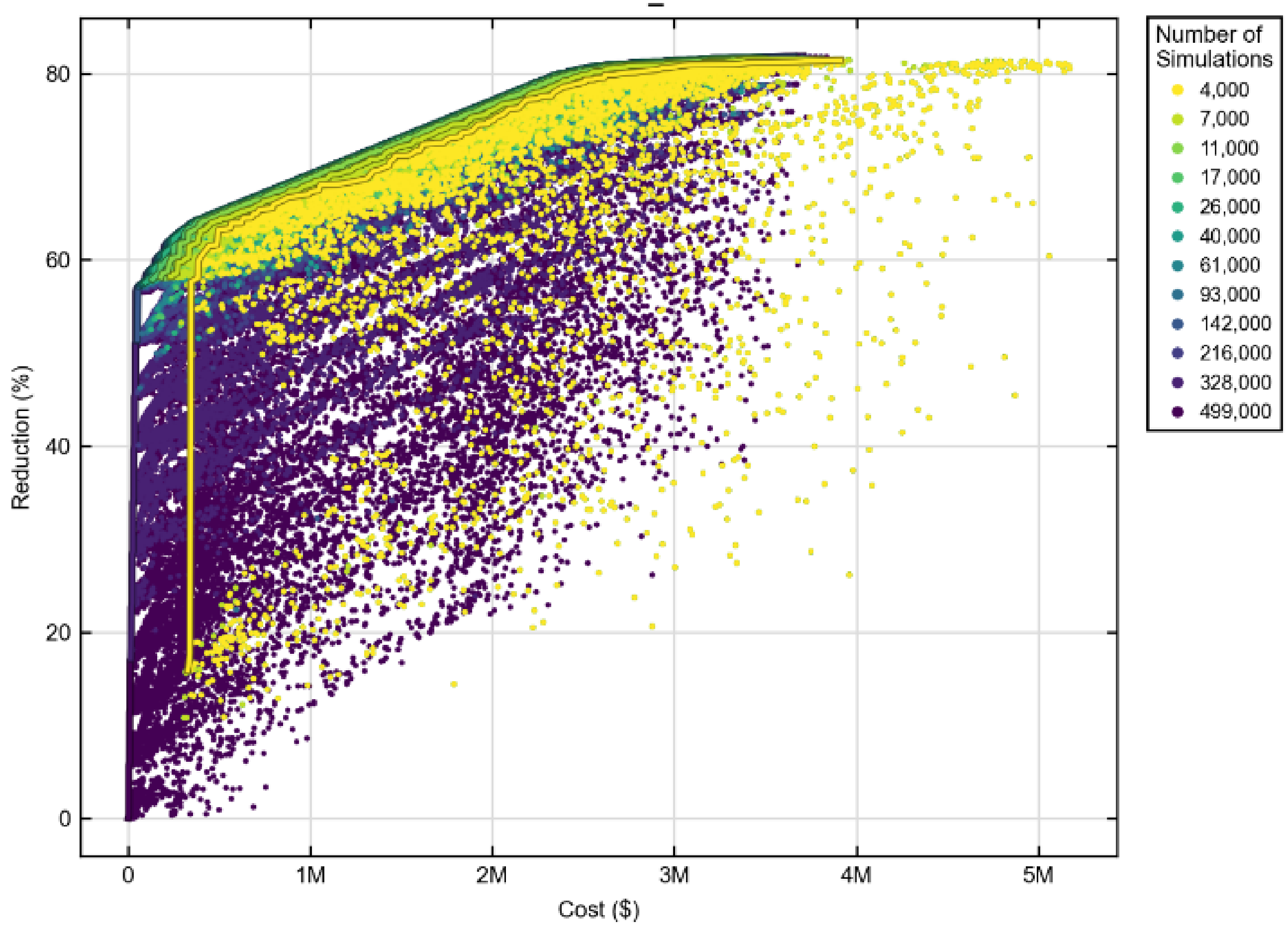
Optimisation begins in sub-catchment ("Tier 1") in three steps

A. Design limiting contaminant – N, P, CU, Zn, E.coli…
B. Best solutions (3M → 100) – "limiting" load
C. Production run (100) – "critical" load

Best solutions choices

- Limiting contaminant
- Boundary climate 3M Short-period (average year*, 25-75mm design storm**, wettest month*)
- Convergence

*Real, **Synthetic



Lessons learned

Management tools trade cost for complexity… necessary complexity

"Deliver outcome, save cost & ensure compliance"

Challenging & complex – stormwater is costly & diverse

- **Least-cost** – 50-year lifecycle (optimised)
- **Action-based** – x111 diverse interventions on x106 activities, across x5,465 sub-catchments (for infrastructure and practices)
- **Targeted** – designed around critical times, sources and treatment needed
- **Integrated** – regionwide mountains to sea
- **Strategic** – action, scale, cost & outcome (by sub-catchment)

Are management tools essential to Entity services?
(…in Healthy Waters for AMP, LTP, NDC, WQTR)

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