TOOLS FOR NPS-FM IMPLEMENTATION IN URBAN CATCHMENTS

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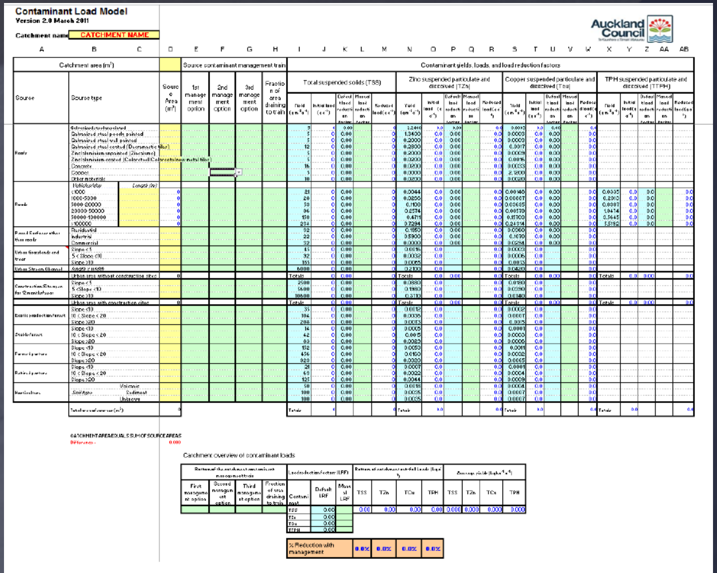
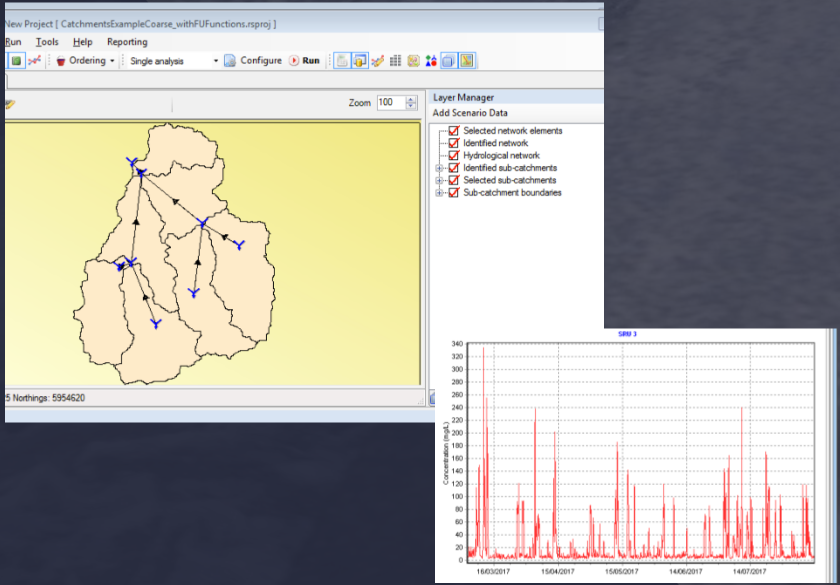
CONTAMINANT LIMIT SETTING

YIELD-BASED CATCHMENT CONTAMINANT LOAD MODELS



COUPLED CATCHMENT LOAD AND STREAM HYDROLOGICAL MODELS



OBJECTIVE

Explore methods for assessment against in-stream concentration-based attributes in urban catchments with minimal data:

1. INCORPORATION OF UNCERTAINTY
2. ESTIMATION OF IN-STREAM CONCENTRATIONS

1. INCORPORATING UNCERTAINTY INTO LOAD MODELS

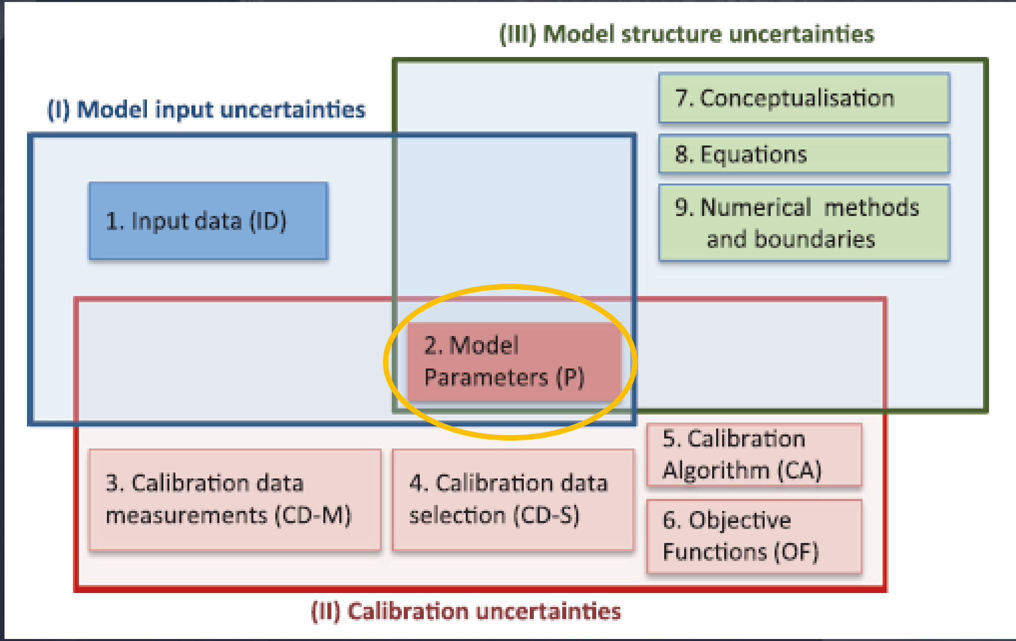
MOTIVATION

Catchment zinc load = 50 kg/year

	Mitigation A	Mitigation B
Cost	$200 K	$250 K
Load reduction	40% (35-50%)	60% (20-70%)
Zinc load after mitigation	28-32 kg/year	15–40 kg/year

YIELD-BASED LOAD MODELS

- Divide catchment into source types
- Each source type has contaminant yield
- Treatment incorporated by load reduction factor
- Load from catchment = Σ source area x source yield x load reduction factor



From Deletic et al. (2012). Physics & Chemistry of the Earth 42:3-10.

ASSIGNING DISTRIBUTIONS

SOURCE YIELDS

Assume yields are uniformly distributed between “low”, “best” and “high” CLM values

Seek to refine where possible, exploring alternative methods to define distributions

E.g. roof source yields

LOAD REDUCTION FACTORS

Assume LRFs are uniformly distributed between the range of values suggested by a review of literature

Range of values very broad for many of the treatment devices

Represents a first-cut approach

EXAMPLE

- 1 ha source area
- unpainted galvanised steel roof
- treatment through raingardens

A. Baseline CLM

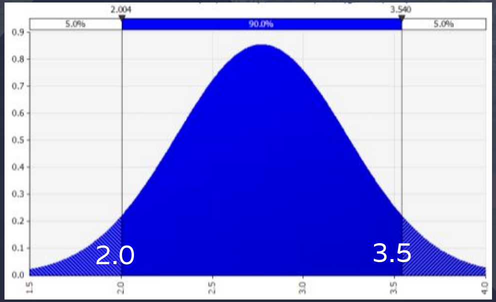
2.8 g/m²/yr x 60% removal

source yield *load reduction factor*

= 9.0 kg/year

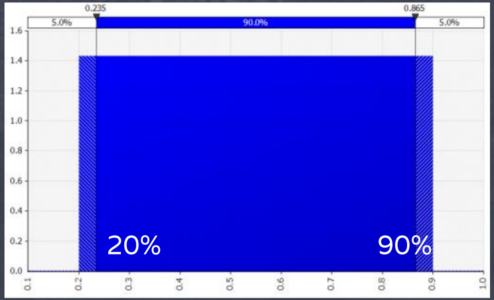
average annual load

B. CLM with uncertainty



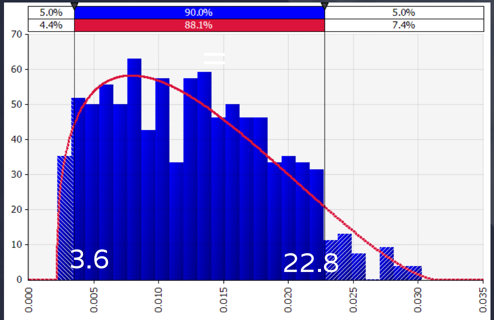
source yield

x



load reduction factor

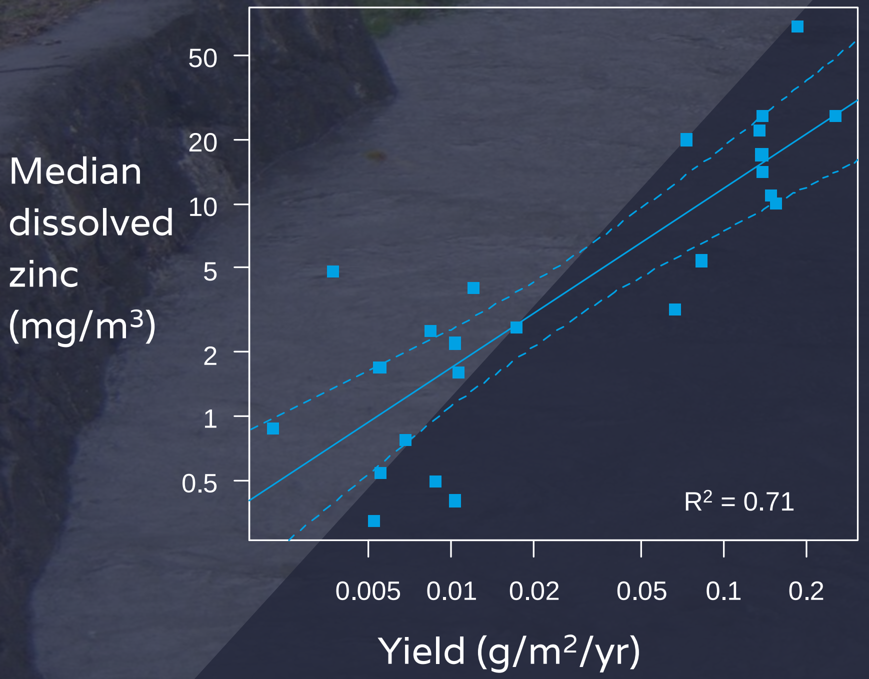
=

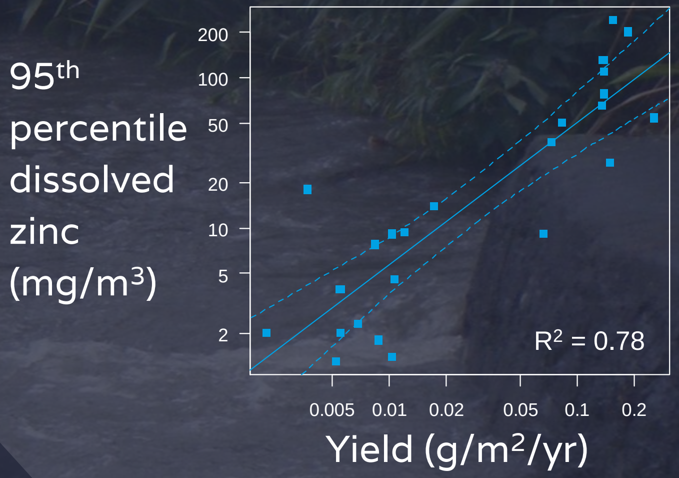


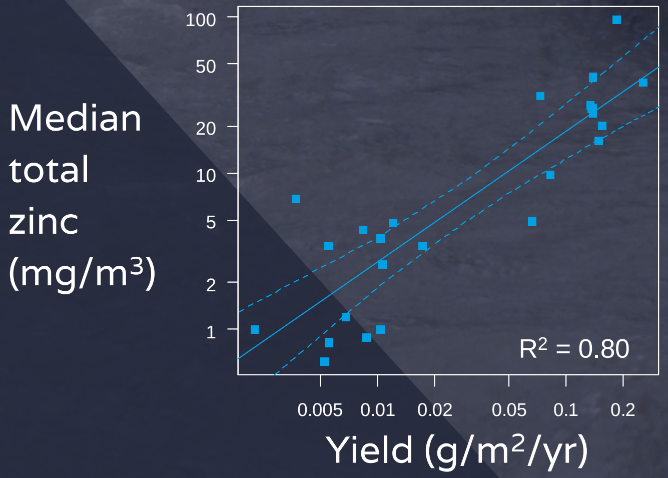
distribution of annual loads

2.
ESTIMATING IN-STREAM CONCENTRATIONS FROM LOADS

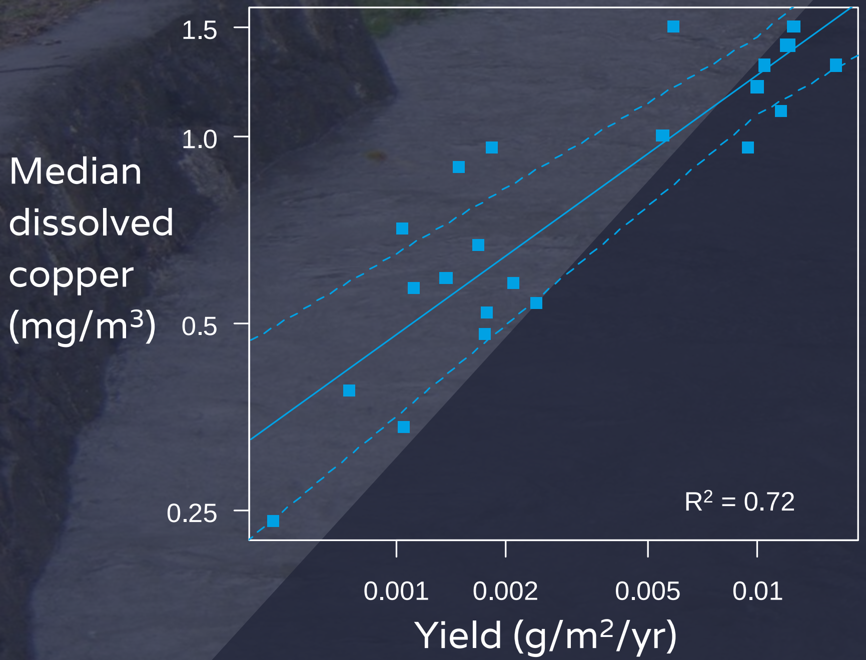
ZINC YIELDS VS IN-STREAM ZINC CONCENTRATIONS

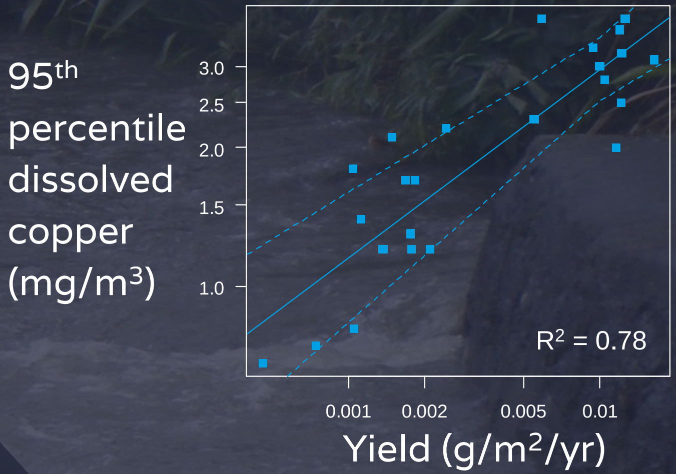


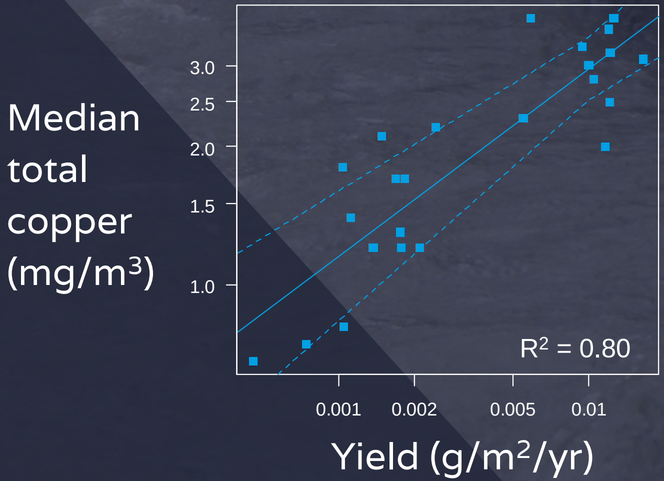




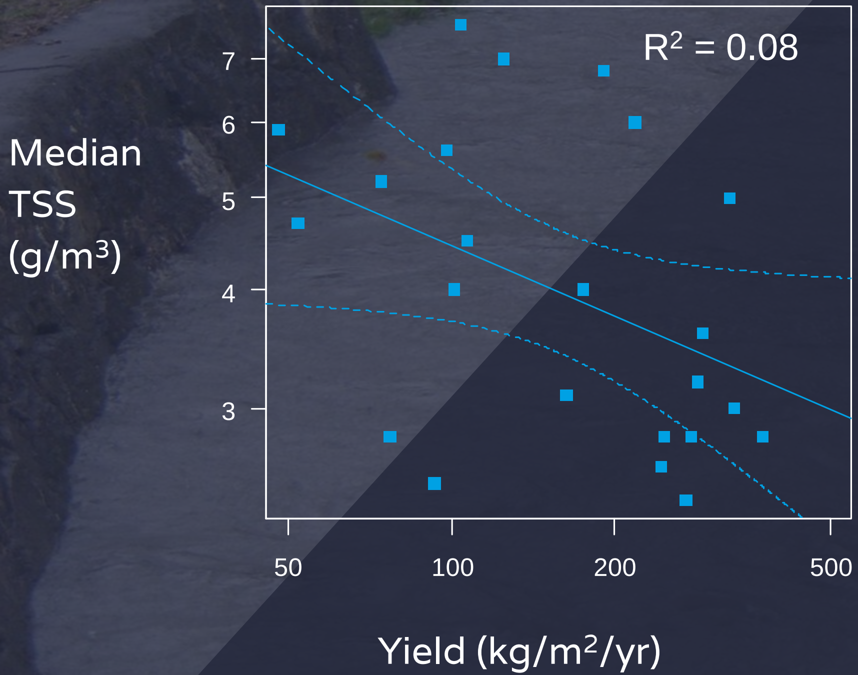
COPPER YIELDS VS IN-STREAM COPPER CONCENTRATIONS

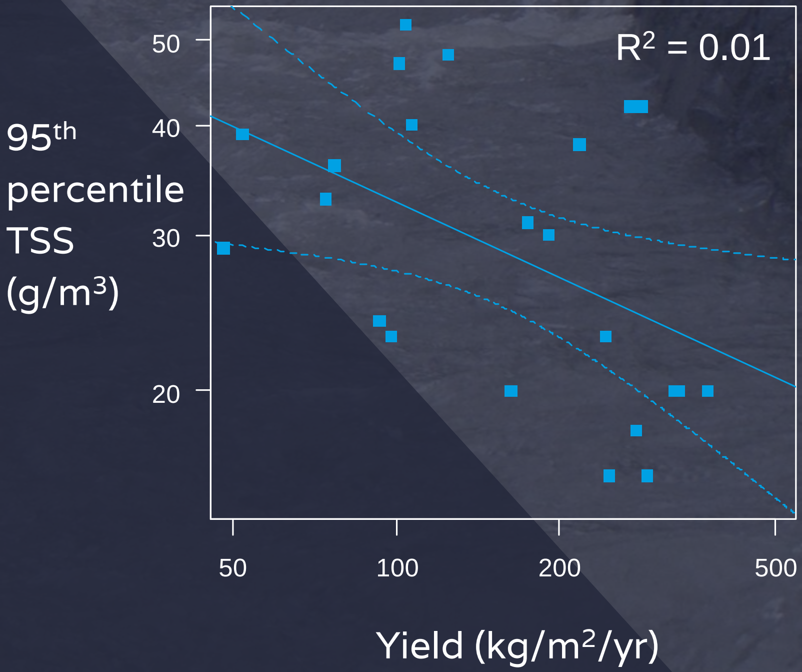






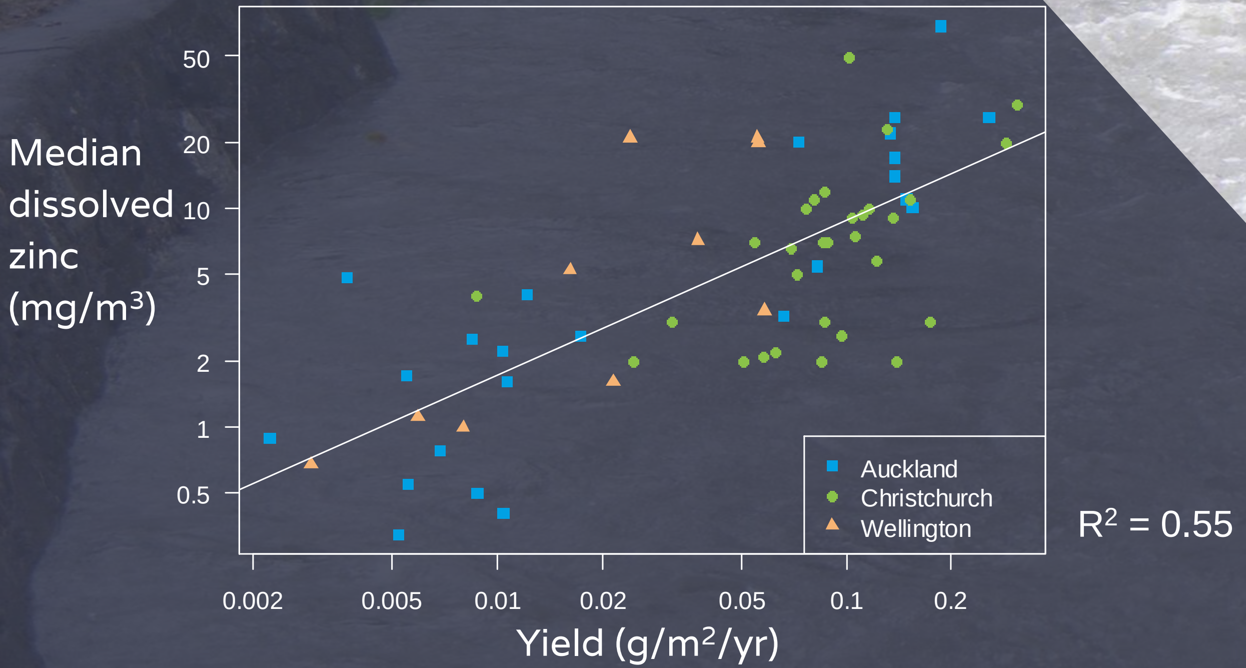
SEDIMENT YIELDS VS IN-STREAM TSS CONCENTRATIONS






Does it only work
for Auckland?

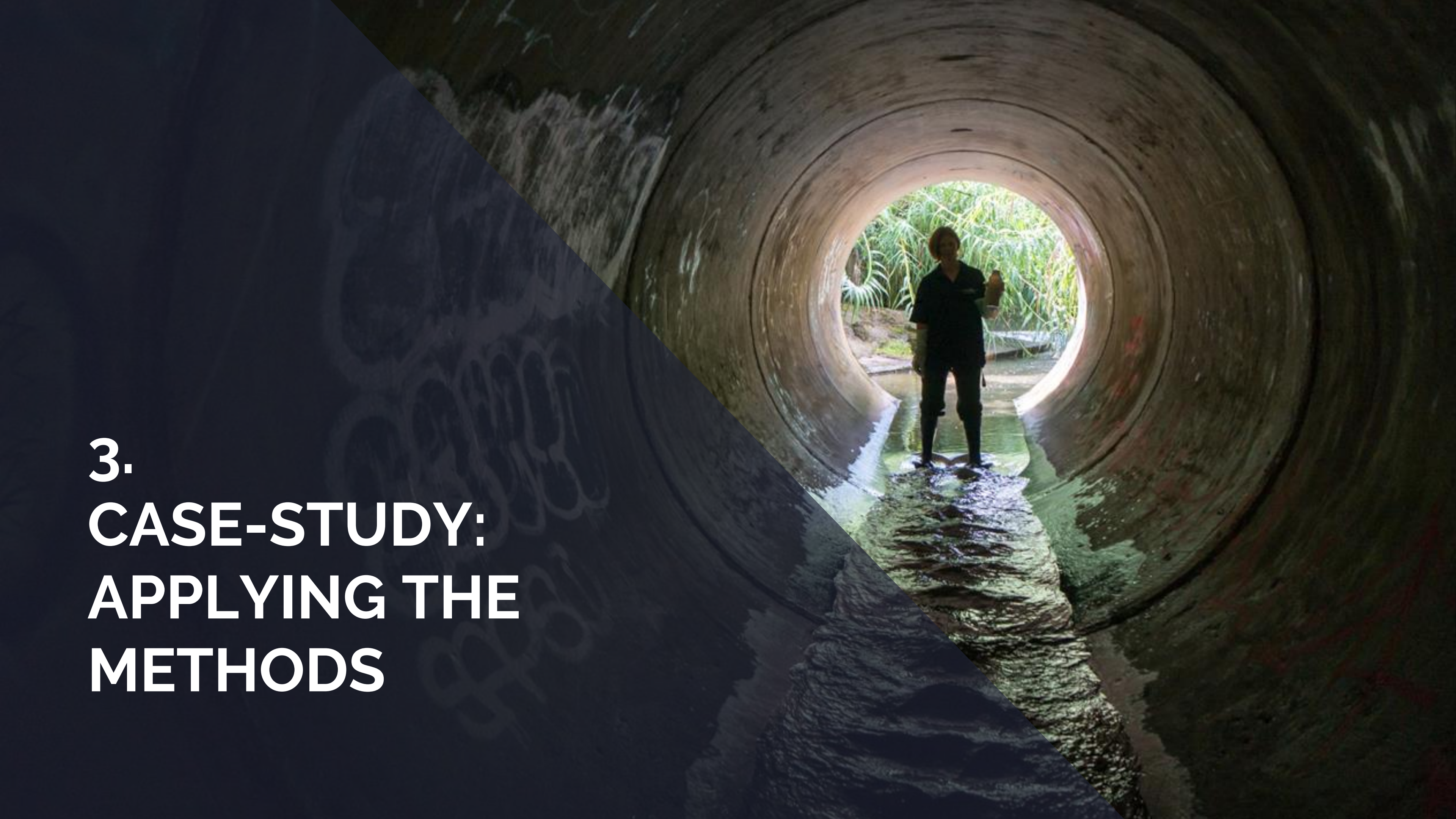
ZINC – INCLUDING WELLINGTON AND CHRISTCHURCH



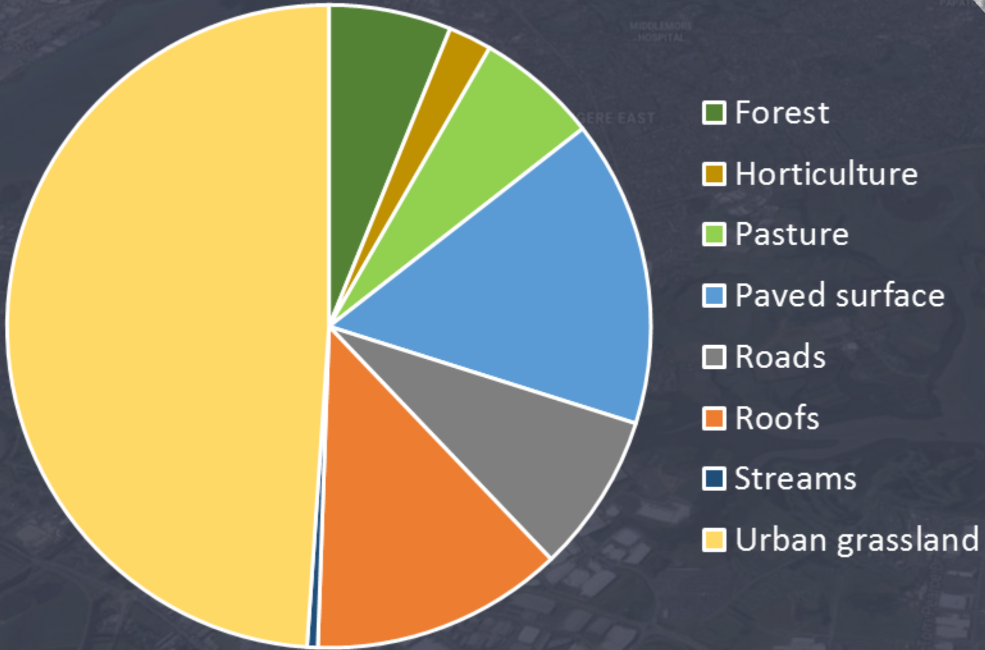
POTENTIAL APPLICATIONS

- Estimate current in-stream Cu & Zn in unmonitored streams
- Predict future Cu & Zn in monitored or unmonitored streams
- Estimate maximum allowable loads to achieve desired in-stream concentration
- Identify streams with additional Cu & Zn sources

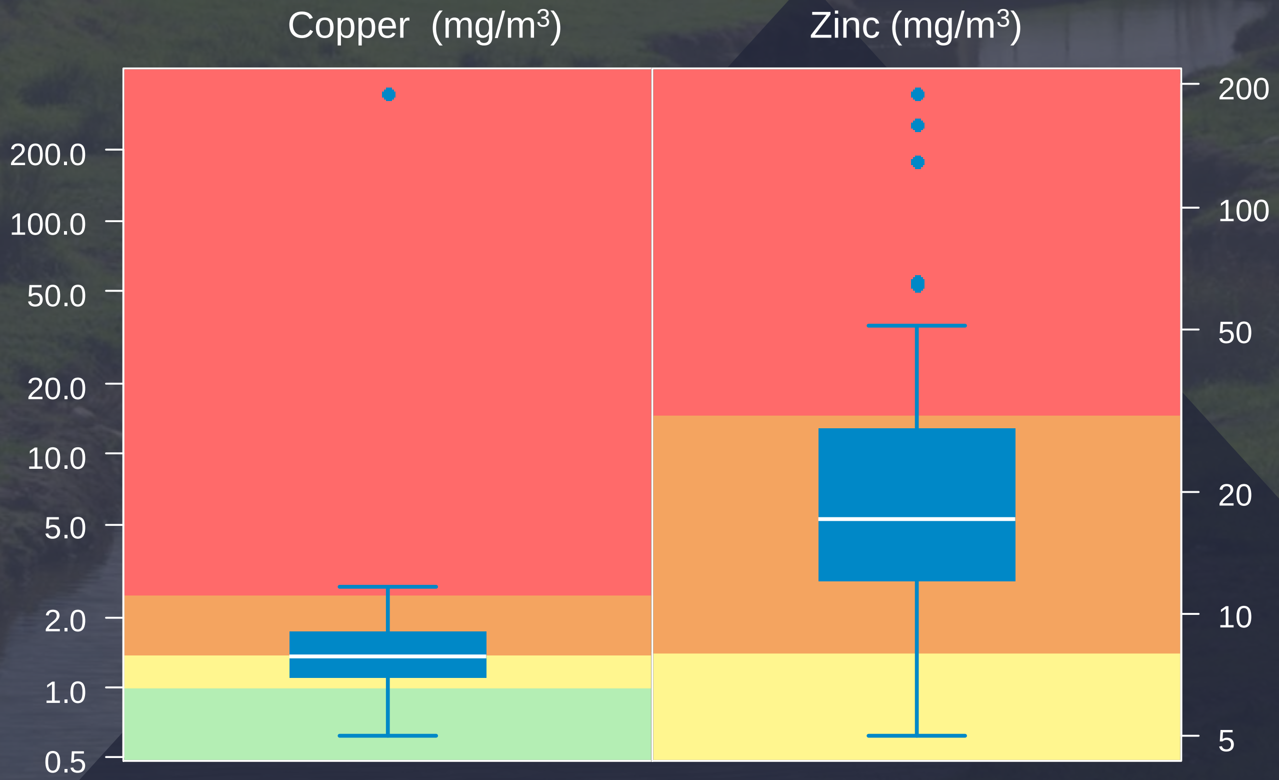
3.
CASE-STUDY: APPLYING THE METHODS



PUHINUI STREAM CATCHMENT CURRENT LANDUSE



CURRENT STREAM CONCENTRATIONS

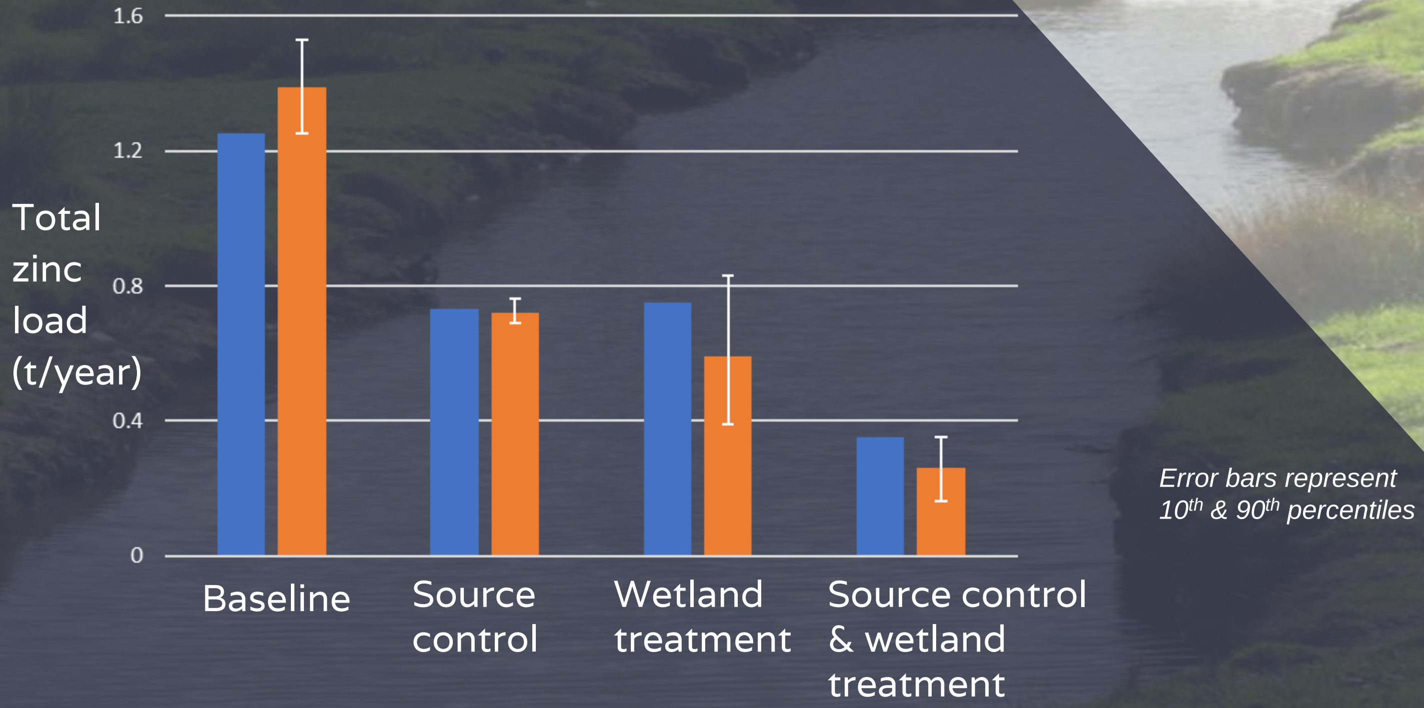


Coloured bands relate to protection levels from ANZECC (2000) guidelines

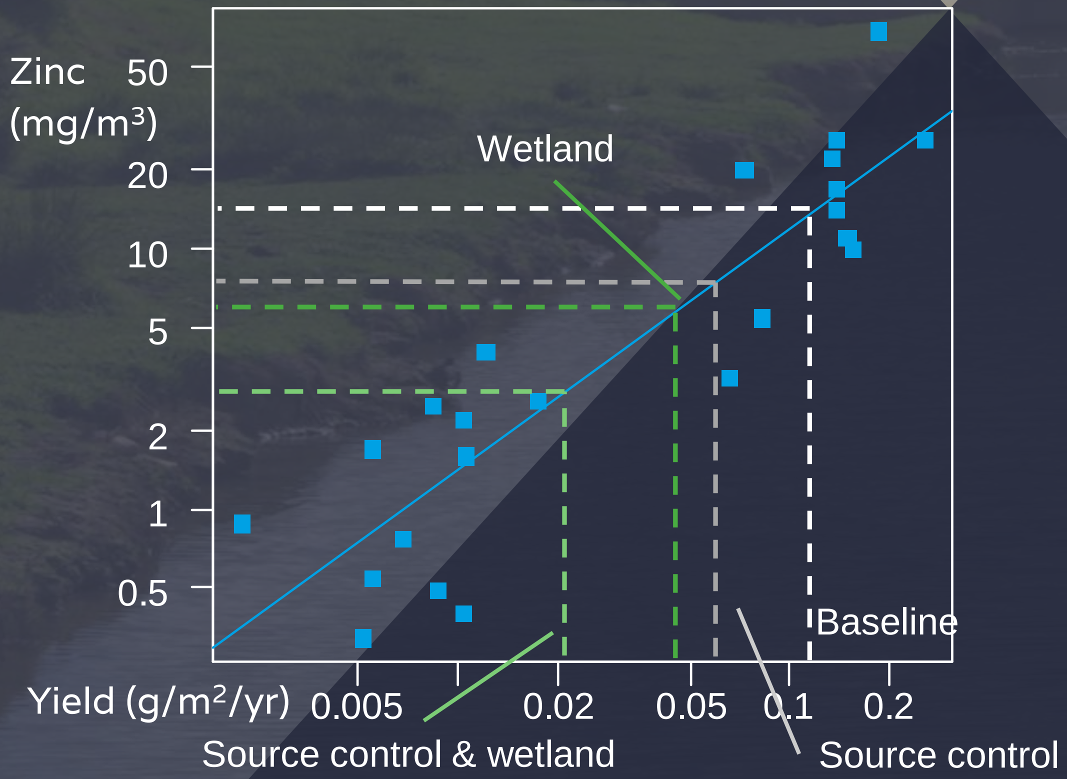
POSSIBLE SCENARIOS TO REDUCE ZINC LOADS AND CONCENTRATIONS

- Source control – replace galvanised iron roofs with low-zinc materials
- Wetland treatment throughout the catchment
- Source control and wetland treatment

PUHINUI STREAM CATCHMENT ESTIMATED ZINC LOADS



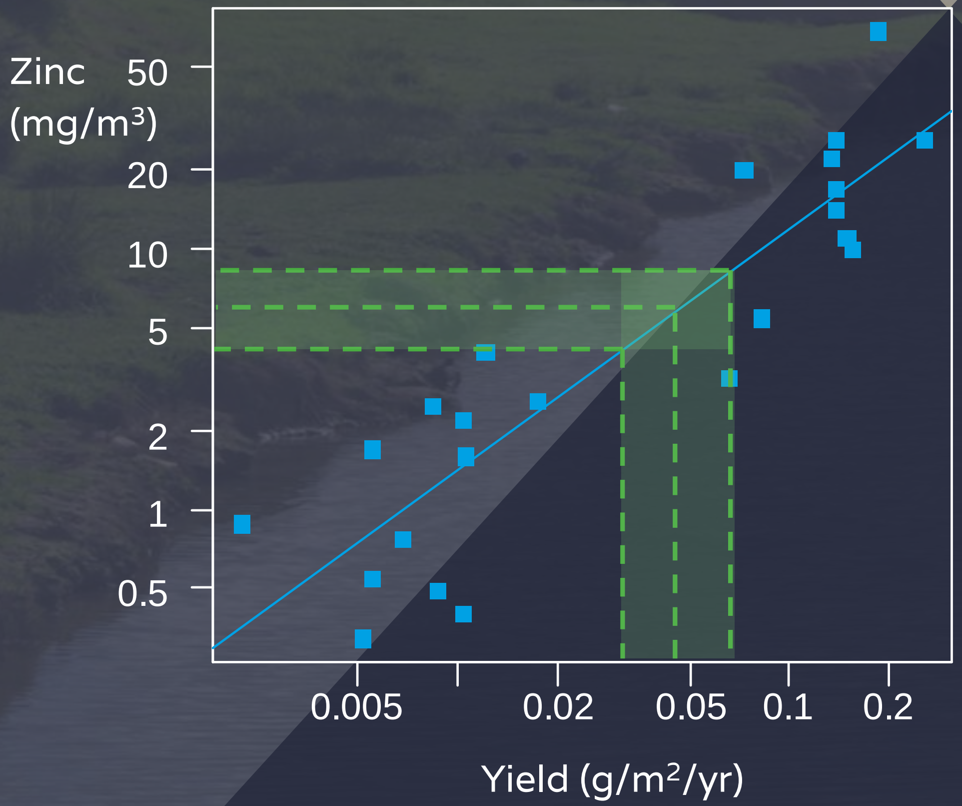
MEDIAN DISSOLVED ZINC PREDICTED FROM YIELDS



	Median zinc conc. (mg/m³)	Attribute state *
Baseline	13	C
Source control	7.1	B
Wetland	5.9	B
Source control & wetland	2.7	B

* Indicative only, based on ANZECC (2000) guidelines, see paper for details

RANGE IN ZINC PREDICTIONS WITH WETLAND TREATMENT



Load estimate	Yield	Median zinc conc. (mg/m^3)	Attribute state *
Mean	0.047	5.9	B
10^{th} percentile	0.031	4.0	B
90^{th} percentile	0.066	8.1	C

* Indicative only, based on ANZECC (2000) guidelines, see paper for details

SUMMARY

LOADS WITH UNCERTAINTY

- It is important to quantify uncertainty in model predictions
- Uncertainty can be quantified through modelling or literature review
- Proof-of-concept will be expanded and refined

ESTIMATING IN-STREAM CONCS

- Need to model in-stream concentrations
- Simple empirical relationships can provide screening estimates
- Refinement of data and relationships needed

Catchment load estimates with uncertainty, linked to estimates of in-stream concentrations

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