Don’t landfill! Pond sediments may be beneficially use as soils and soil amendments

Managing stormwater pond sediments

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water NEW ZEALAND
The New Zealand Water & Wastes Association Waiora Aotearoa

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Stormwater 2024
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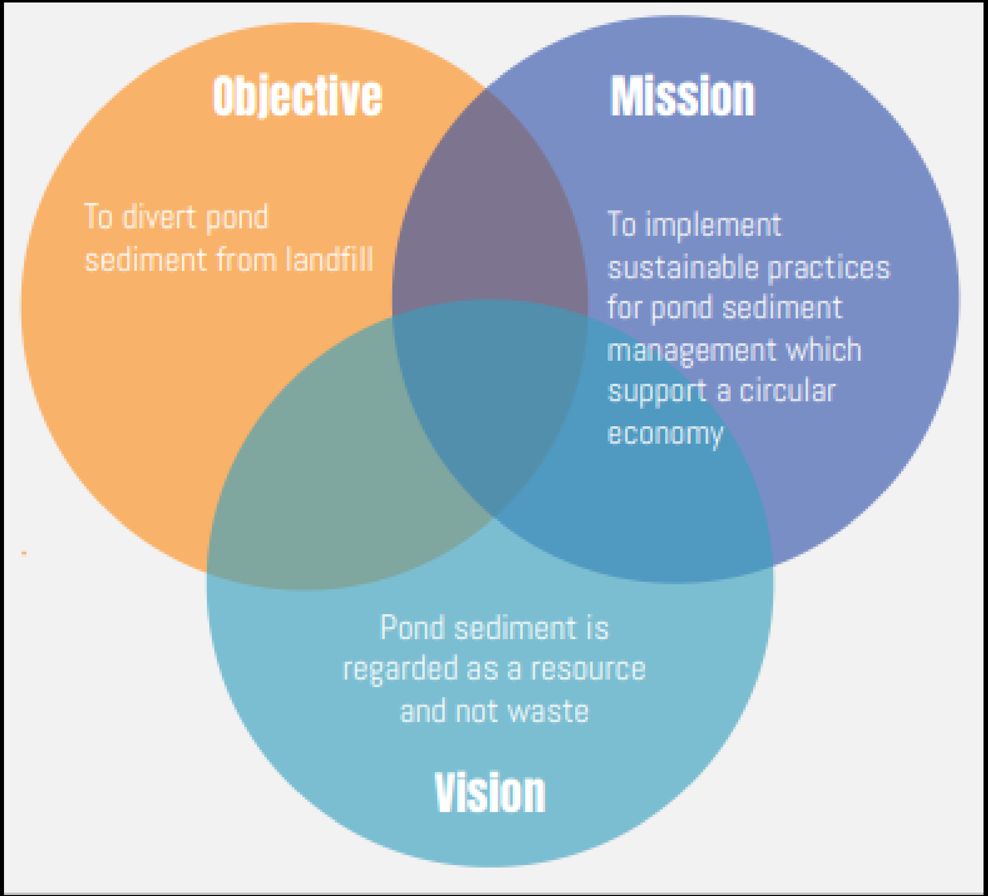
Background

- Auckland's 650 stormwater ponds require periodic desilting
- The desilting programme could remove 20,000-30,000 T p.a.
- Most sediment is currently landfilled

- One-off projects have re-used pond sediment
- Drivers for Diversion
    - reduce disposal $
    - reduce GHG emissions
    - use a (new) resource
    - support circular economy
- Auckland Council requested a study of beneficial reuse



Defining beneficial reuse

Not all uses are equally beneficial. Some are nearly waste disposal, e.g.

- landfill surfacing
- fill/contouring material confined within dewatered geobags

But fill/contouring can deliver landfill & transport related carbon savings

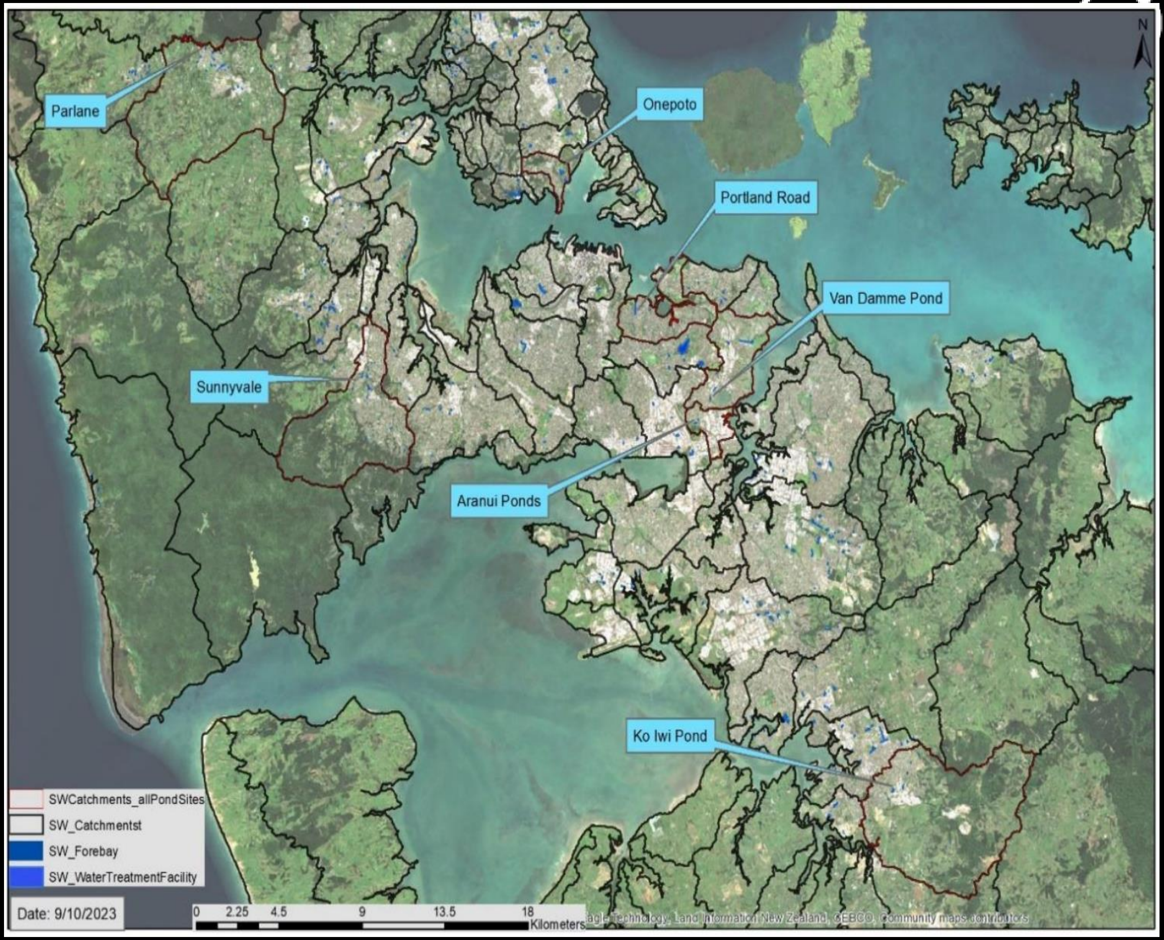
Beneficial uses

- Topsoil substitute – with or without amendment
- Soil amendment
- Soil amendment after processing / composting
- Subsoil substitute / capping & contouring material
- Aggregate (per AC 2024 COP)

Auckland Motorways 2010 Road Derived Sediments (RDS) and Vegetative Material Reuse Feasibility Study (nzta.govt.nz
(led by P Mitchel – consultants A Mason C Depree R Simcock)

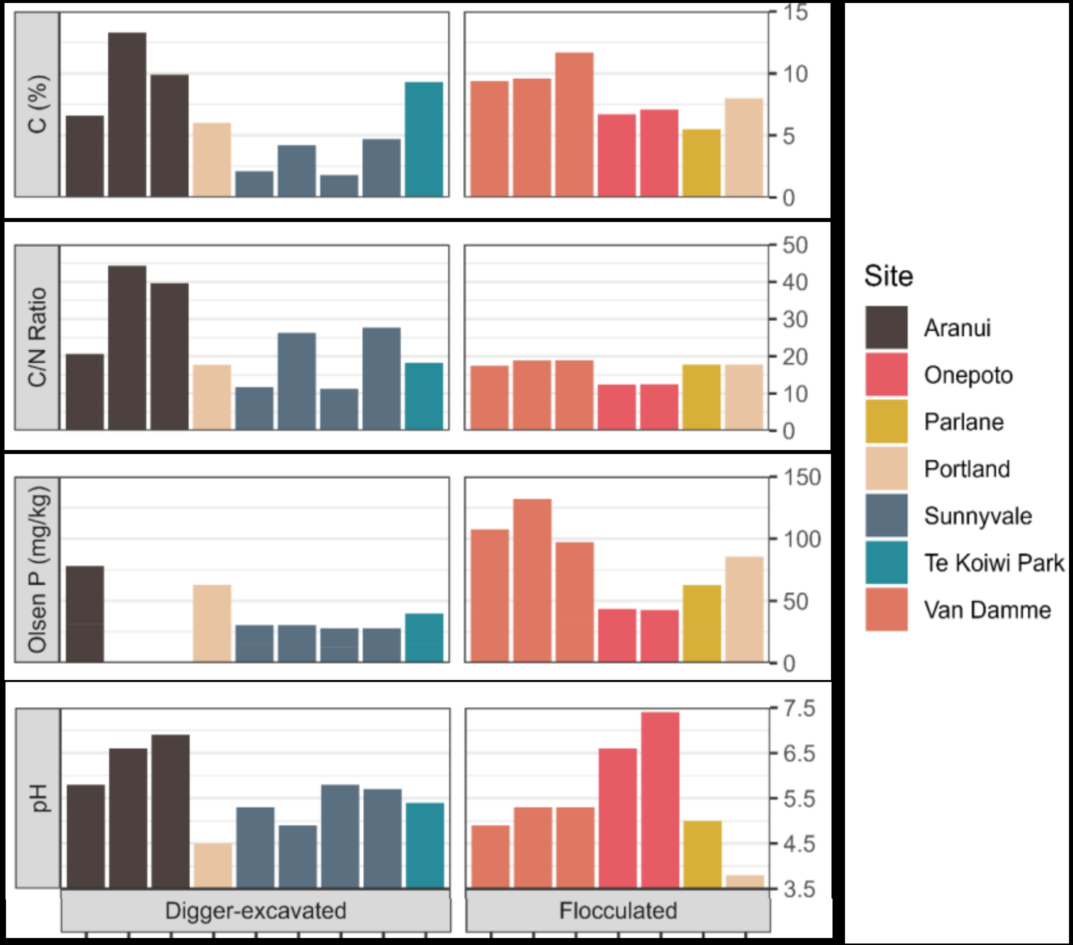
Methods

- Literature review
- Assess sediments from 6 ponds before and after processing
- Field growth trial
- Workshops



Is sediment OK for plants?
Will plants grow in it?

- Extraction method matters
- Properties influenced by amount/type of plant material (live/sawdust)
- Contaminants concentrations vary with catchment & 'upstream' treatment
- Flocculants can influence pH

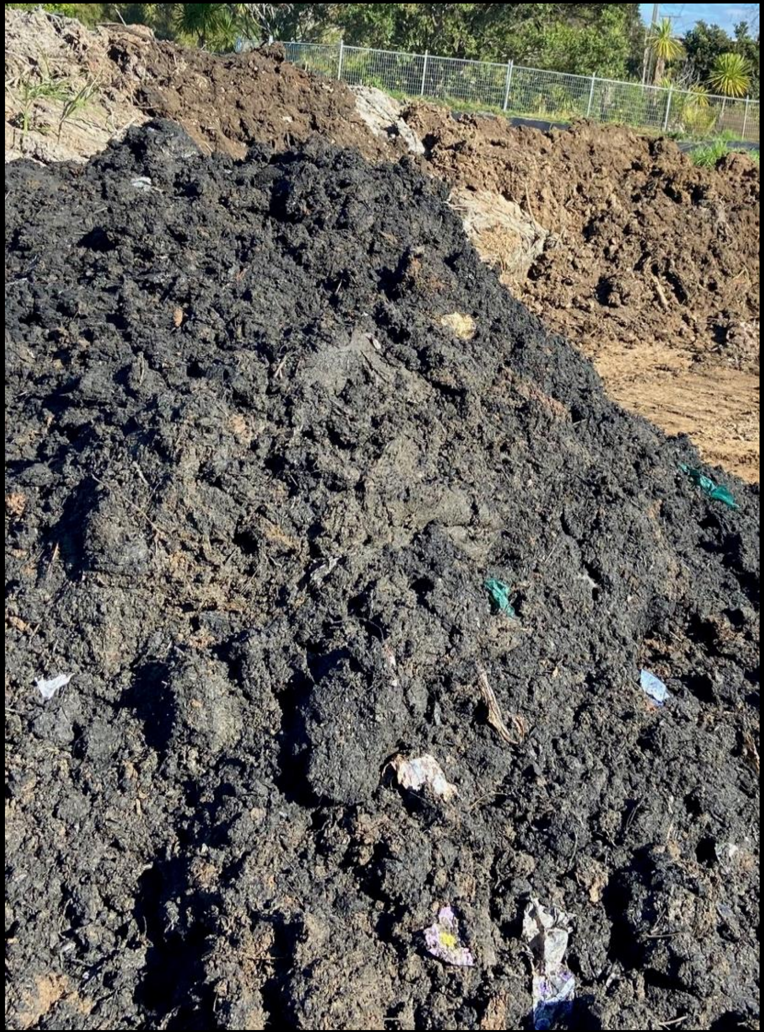


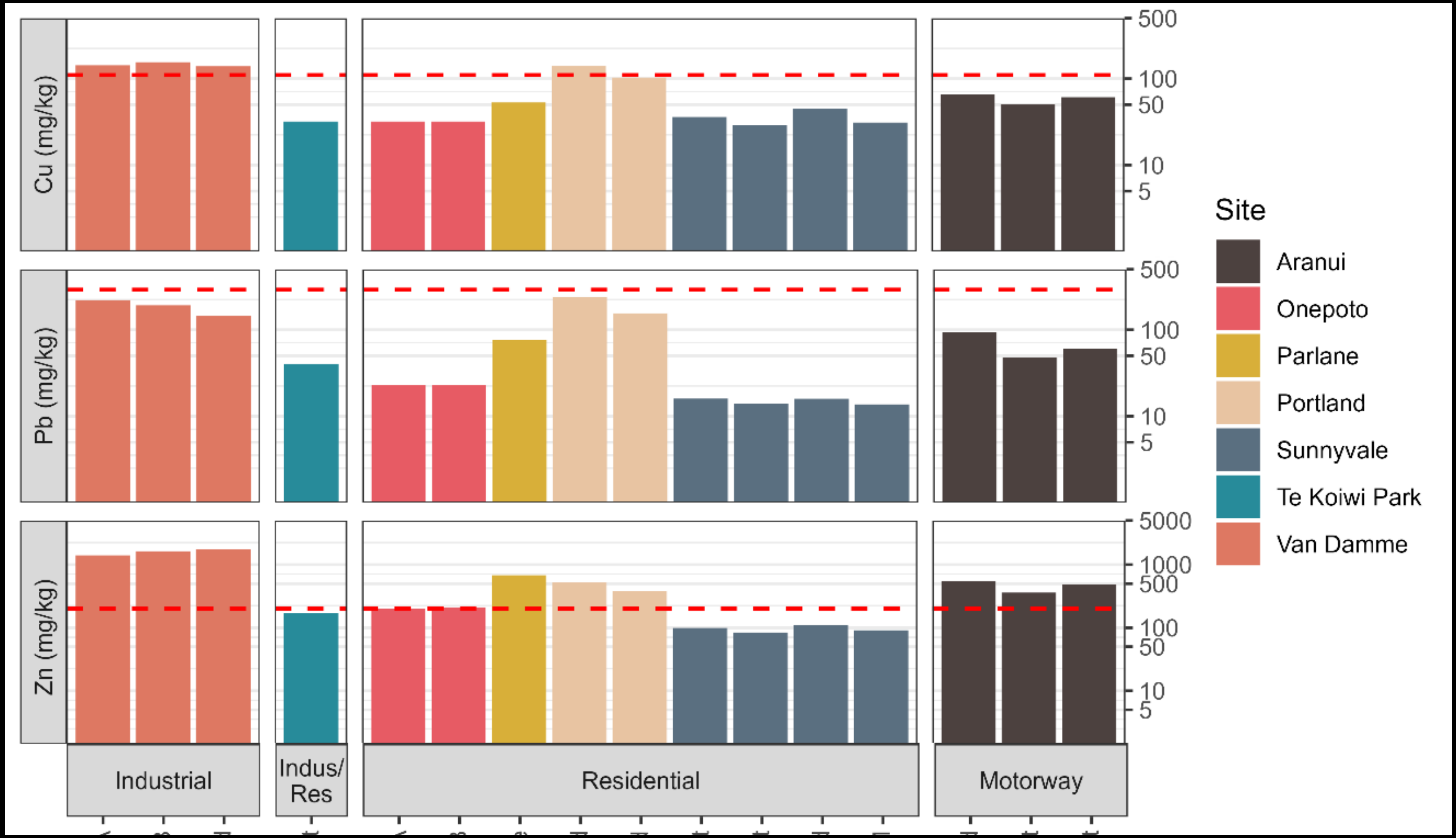
Sediments change after extraction

- Ripening = aeration and activation of organic matter by microbes, plant roots
- Cracking / physical mixing activates further biological actions
- Settlement occurs as sediments oxidise, compact or are compacted
- Leaching can occur (e.g., Zn pH<5.5)

How contaminated is it?

- Gross-pollutants: plastics, plants
- Main micro-contaminants
    - metals (As, Cu, Zn)
    - hydrocarbons
- Contaminant load influenced by
    - land-use in surrounding catchment,
    - pond age/time since last 'cleaning',
    - u/s GPT or bioretention
    - marine /acid-sulphate influence





---- Eco-SGV Cavanagh Harmsworth 2023 [LandCare Report (envirolink.govt.nz)]

Regulatory vs risk approaches

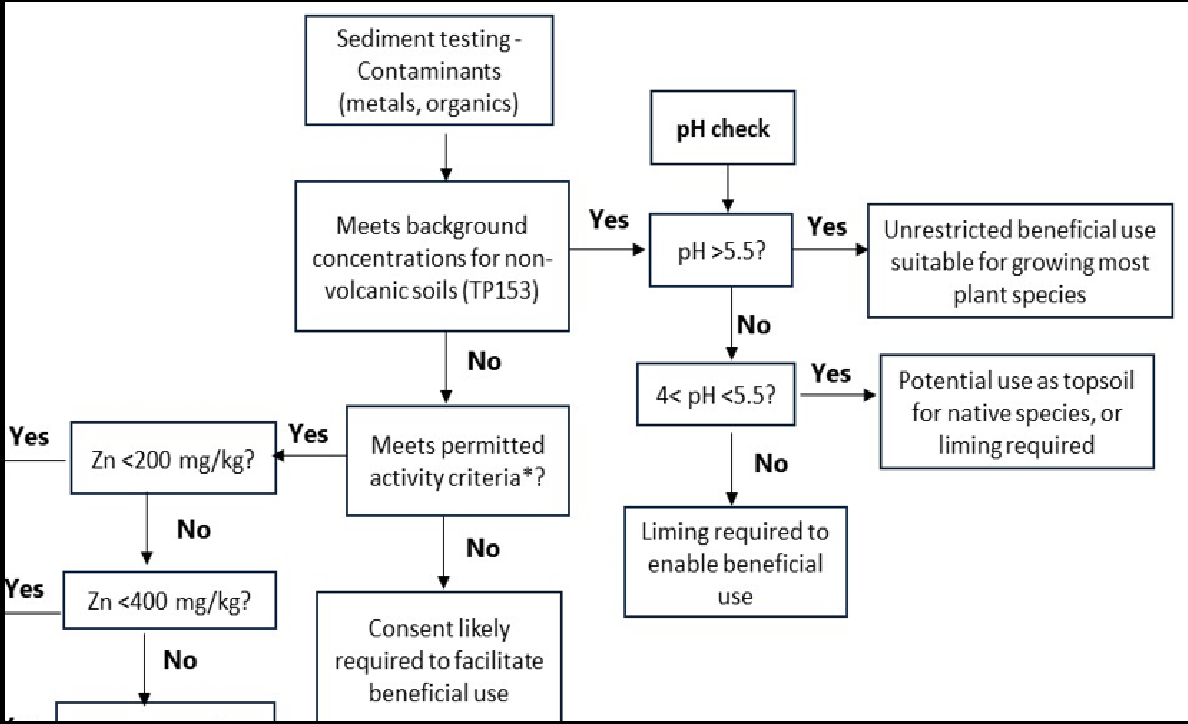
- Beneficial use needs to meet regulatory requirements
  - E30 – contaminated land
  - E13 – clean fills, managed fills and landfills
  - Soil contaminant standards (SCS)
  - [Ecological guideline values] (Eco-SGV)
- ‘Background’ (clean fill) concentration vs permitted activity criteria (E30) vs regulatory ‘effect’ concentrations (SCS, Eco-SGV) vs landfill disposal criteria
- Volcanic soil vs non-volcanic soils

Different parts of council have different drivers/regulatory obligations

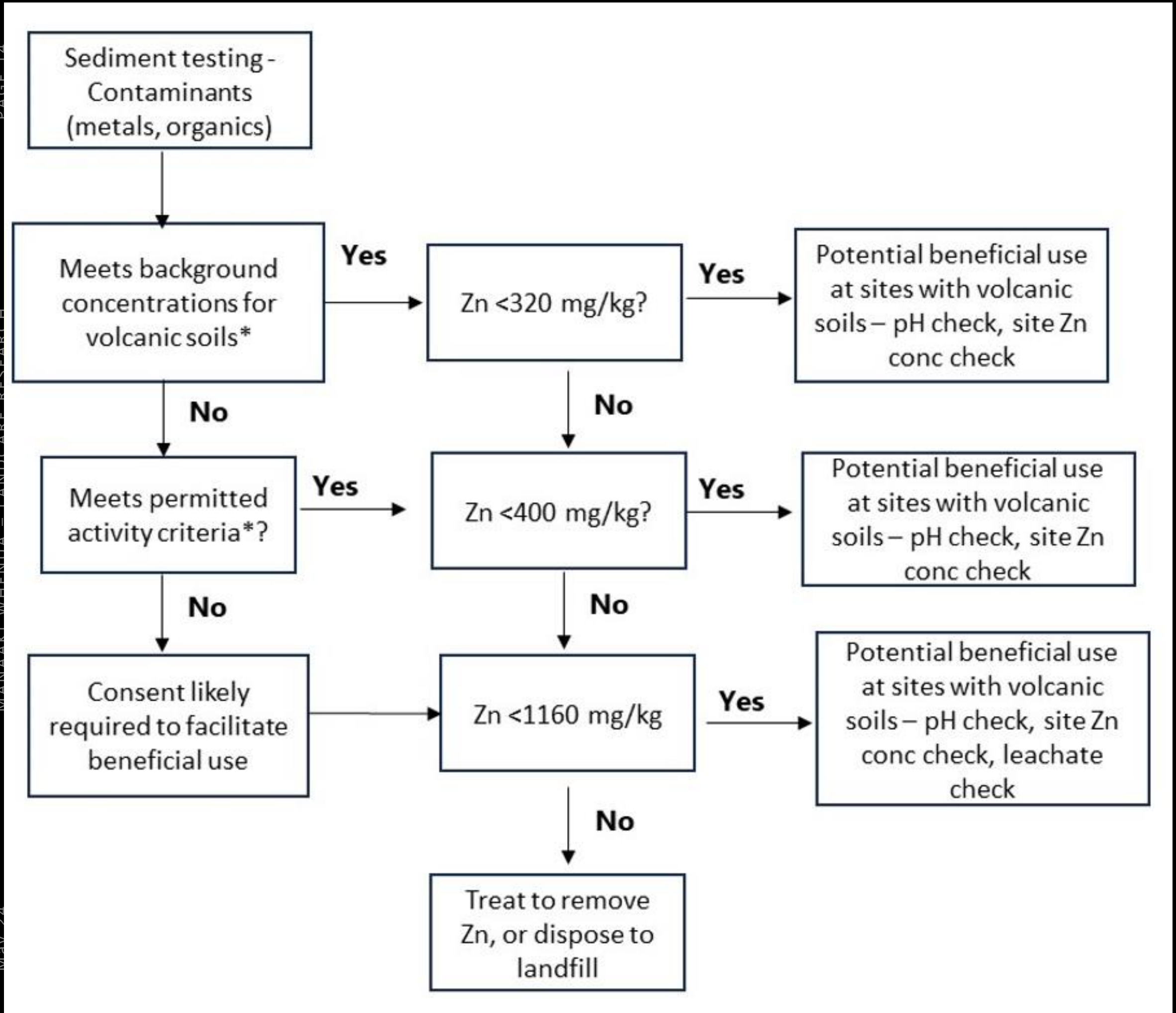
Analyte	HDSFB	HPSMP	HSBB	HSAB	Portland Rd Test 01	DD S1 Portland	DD S2 Portland	DD S3 Portland	DD S4 Portland	BB 2S2 Portland	BB 3S3 Portland	Waitaramoa Reserve 1	Waitaramoa Reserve 2	Waitaramoa Reserve 3	Waitaramoa Reserve 4	**Auckland Unitary Plan: Operative in Part Permitted activity criteria[1] (mg/kg)**	**NES Human Health SCS Recreational[2] (mg/kg)**	**Cleanfill Disposal Criteria (Volcanic soils)[3] (mg/kg)**
Heavy metals, screen As, Cd, Cr, Cu, Hg, Ni, Pb, Zn																		
Total Recoverable Arsenic	6.8	20	25	17	24	23	22	19	20	22	21	**30**	15	3	6	**80[1,2]**	**80**	12
Total Recoverable Cadmium	0.10	0.27	0.22	0.32	0.52	0.11	0.35	0.18	0.19	0.34	0.3	0.66	0.13	<0.10	0.19	**7.5[1,2]**	**400**	0.65
Total Recoverable Chromium[4]	37	36	66	57	40	24	22	25	17	25	21	50	36	52	46	**400**	**2,700**	125
Total Recoverable Copper	74	190	150	**210**	**210**	91	63	48	33	53	53	56	32	31	37	**325**	**>10,000**	90
Total Recoverable Lead	50	84	170	120	**210**	110	160	120	75	150	110	72	64	12.9	65	**250[1,2]**	**880**	65
Total Recoverable Mercury	0.04	0.11	0.17	0.11	0.23	0.2	0.17	0.24	0.094	0.13	0.13	<0.10	<0.10	<0.10	<0.10	**0.75**	**1,800**	0.45
Total Recoverable Nickel	63	20	38	36	36	8.3	16	13	14	17	17	92	61	89	71	**320**	**>10,000**	320
Total Recoverable Zinc	200	530	450	650	670	150	300	140	150	240	220	185	73	73	100	**1,160**	**>10,000**	1,160
Organochlorine Pesticides Screening in Soil (OCPs)																		
Total DDT Isomers	<LOR	<LOR	—	—	—	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	—	—	—	—	**12**	**240**	LOR
Polycyclic Aromatic Hydrocarbons Screening in Soil (PAHs)																		
Benzo(a)Pyrene equivalent[5]	0.33	0.16	—	—	—	0.44	1.0	1.3	0.56	**0.95**	0.82	—	—	—	—	**20**	**40**	LOR

Suggested approach - contaminants

- Zinc is key contaminant for screening
- consider concentrations at recipient site
- pH matters
- mitigate erosion risk near streams / ponds



Flow chart for **Non-volcanic soils** at recipient site

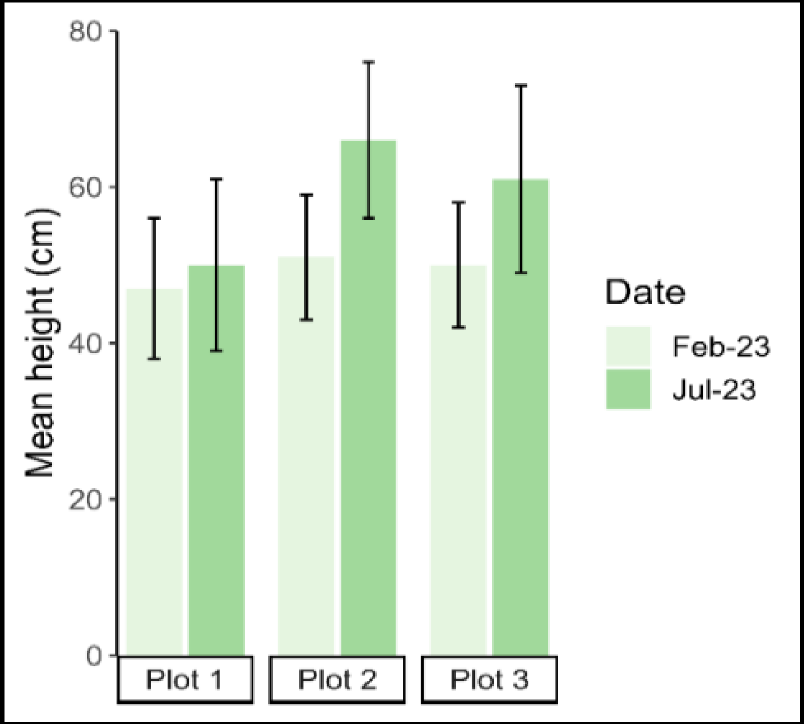


Volcanic soils at *recipient* site

- More cautious with higher zinc concentrations
- Greater potential effect on soil organisms & aquatic systems

Plant growth trial, Portland Rd

- Digger-dug sediment the best *unamended* growth medium.
- Both sediments more fertile than local soil. Double Carbon, N, P; similar C:N (15-20)
- Higher plant available water 120 cf. 60 mm in 300 mm depth provides ~20 days summer demand
- pH <4 killed plants in flocculated sediments, prevented seeds
- Marine influence?



Flocculated **Soil** **Digger-dug**

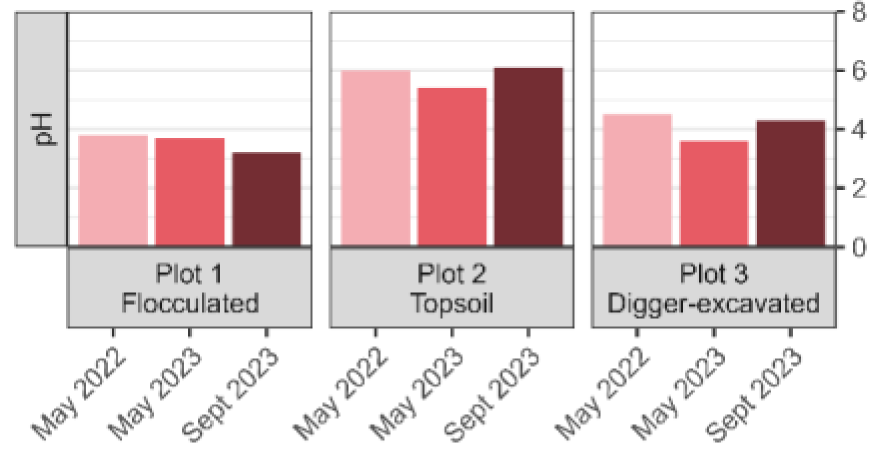
Plant growth trial, Portland Rd

- Extraction method impacted organics size, homogeneity and pH
- Digger dug sediment had few weeds -> lower competition with planted native seedlings, native seeds established ("goldilocks pH"?)
- Digger dug had larger pieces of gross Pollutants

Case study flocculated sediment

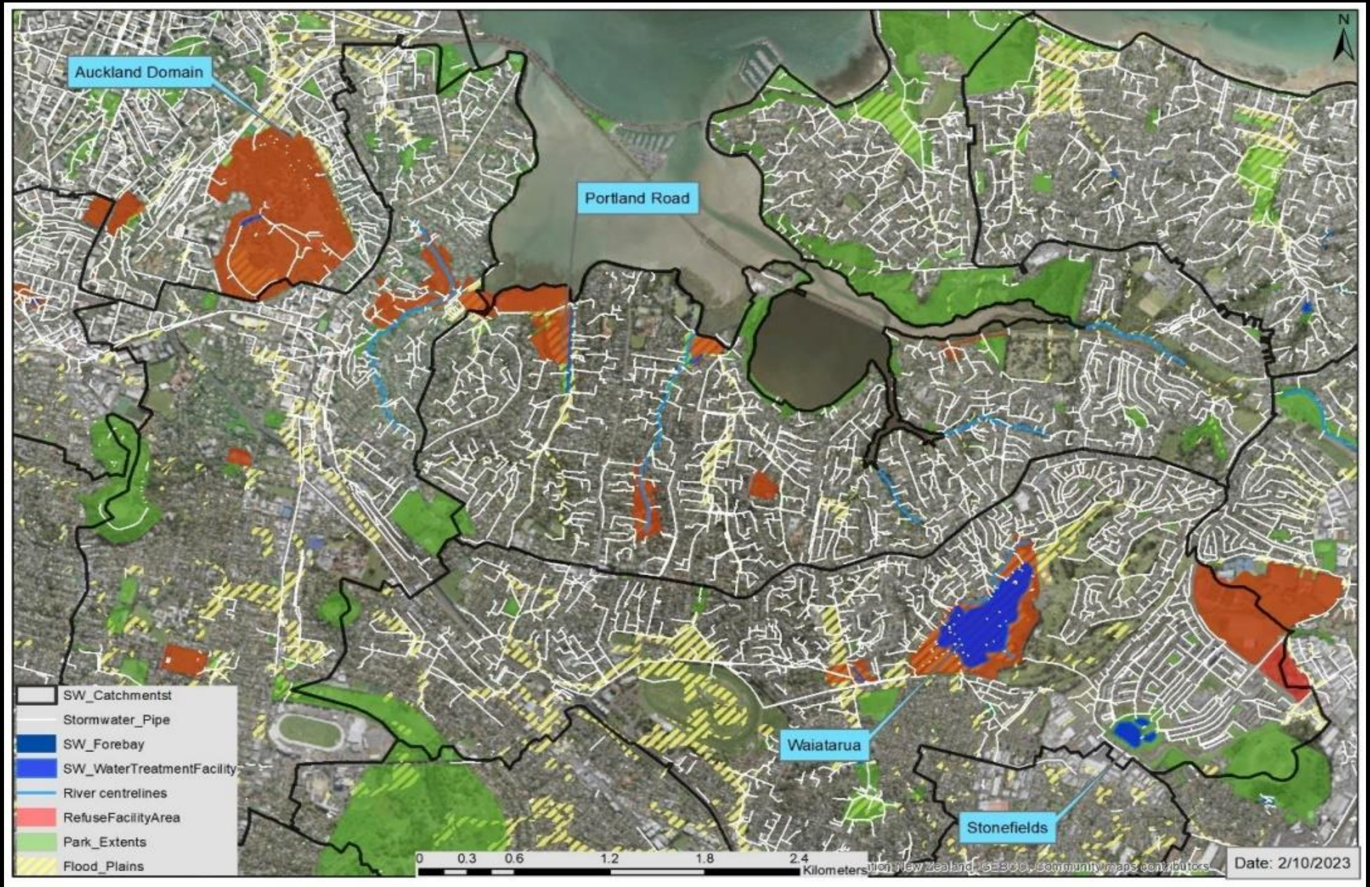
- Flocculation is effective
- pH <4.5 may have promoted subsequent leaching of Zn from sediment in first 12 months
- Recommend: amend sediment to raise pH>5.5 when cultivating (accelerating ripening); and/or use non-acidifying flocculants for acid/acid sulphate sediments

Total Zn	**6-7**	**to**	**<0.005 Mg/L**
Total Cu	**1-2**	**to**	**<0.002**
Total Pb	**3-4**	**to**	**<0.004**



General issues to consider when assessing sediment reuse options

Opportunities for reuse: parks and closed landfills



Recommendation:
Find the best receiving sites

- Space to dewater (grass)
- Capacity above flood volume requirements
- Receiving soil characteristics
- Area needing uplift (closed landfill, low quality mown area)
- Adequate lead in time for Council, community /board consultation, consenting.
- Costs and opportunities highly variable from site to site

Recommendation: Potential uses

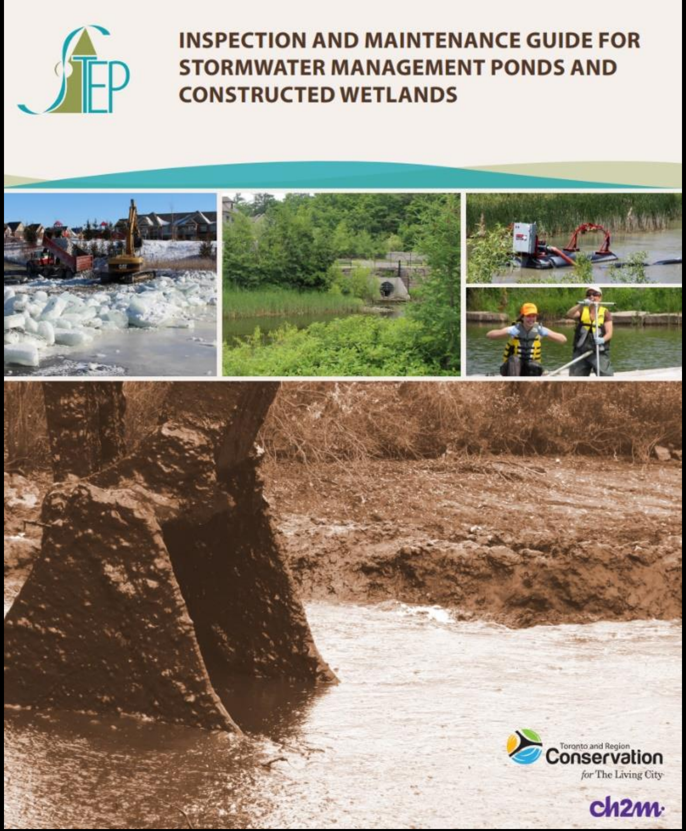
- land contouring: bunds, platforms and embankments
- flood protection (in geobags)
- topsoil /subsoil substitute
- deeper capping on old landfills allows taller plants
- amendment to increase resilience of local soils to drought and nutrient loss
- improved drainage / load-bearing areas (for coarser sediments with lower organic content)

Design ponds to optimise sediment quality

- Retrofit forebays where absent
- Ensure access to allow frequent maintenance (lower Zn accumulation)
- Add upstream GPT

Alignment with overseas guidance

- Canada TRCA (2018) directly relevant
- Costs are specific to specific ponds and disposal options
- Management strongly based on regulatory requirements on contaminant concentrations
- Requires testing of receiving topsoils to show benefit



Most pond sediments are a resource

Use requires:

- testing contaminants, plant nutrients (pH), texture
- dewatering and 'ripening' sediments
- managing gross pollutants
- assessing receiving site soils and contours
- compliance with AUP E30 (contaminated land)

https://www.knowledgeauckland.org.nz/publications/considerations-for-the-beneficial-use-of-sediments-from-stormwater-ponds-across-auckland/

Many thanks to Glasgow Contractors

Thank you!
Questions? Patai?