

Managing farm run-off with constructed wetlands

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Thomson's Creek Wetland, Otago, Central Otago

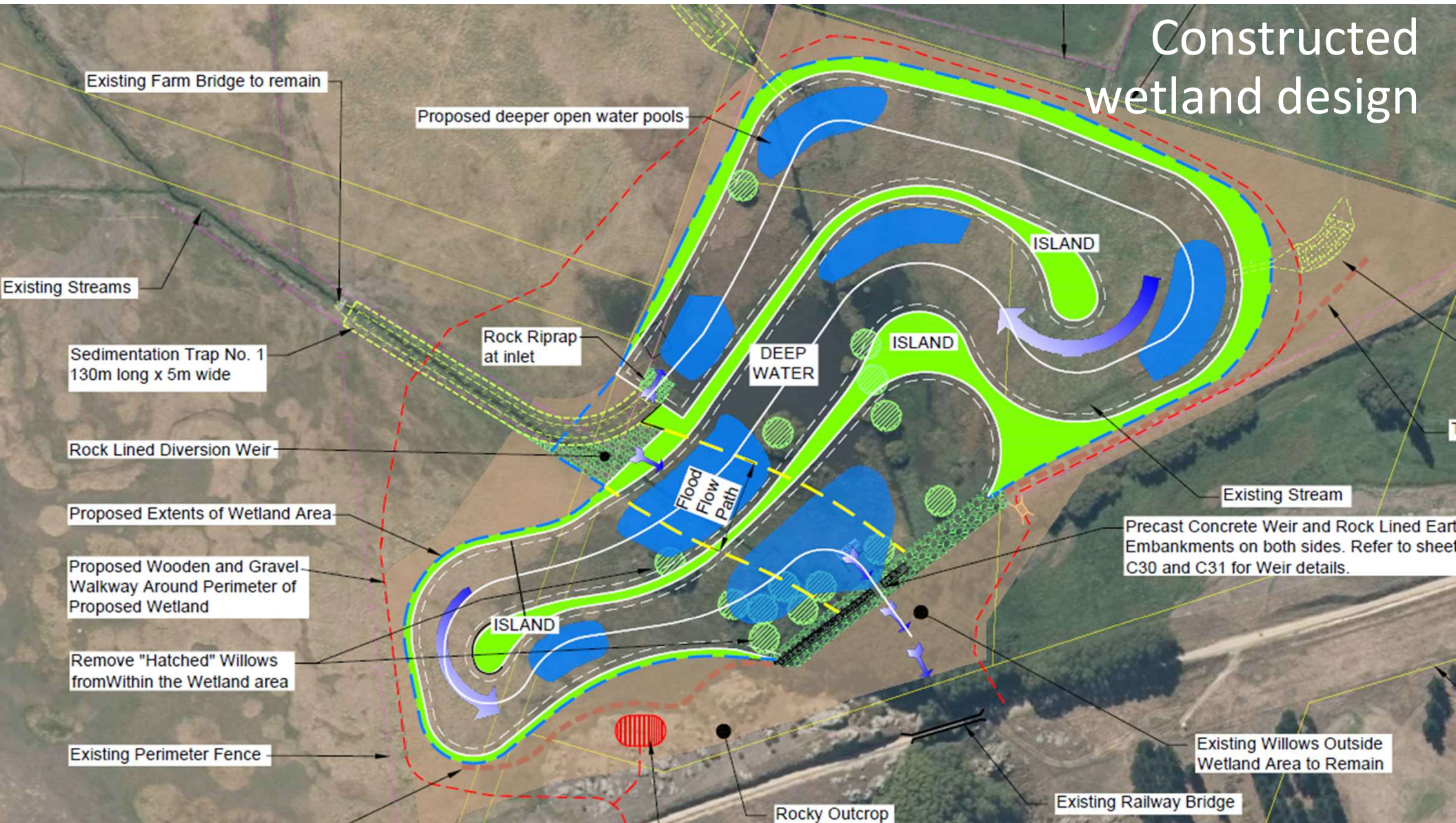
Thomson Project / Otago Catchment Community

September 2023





Thomsons Creek Wetland- Starting point

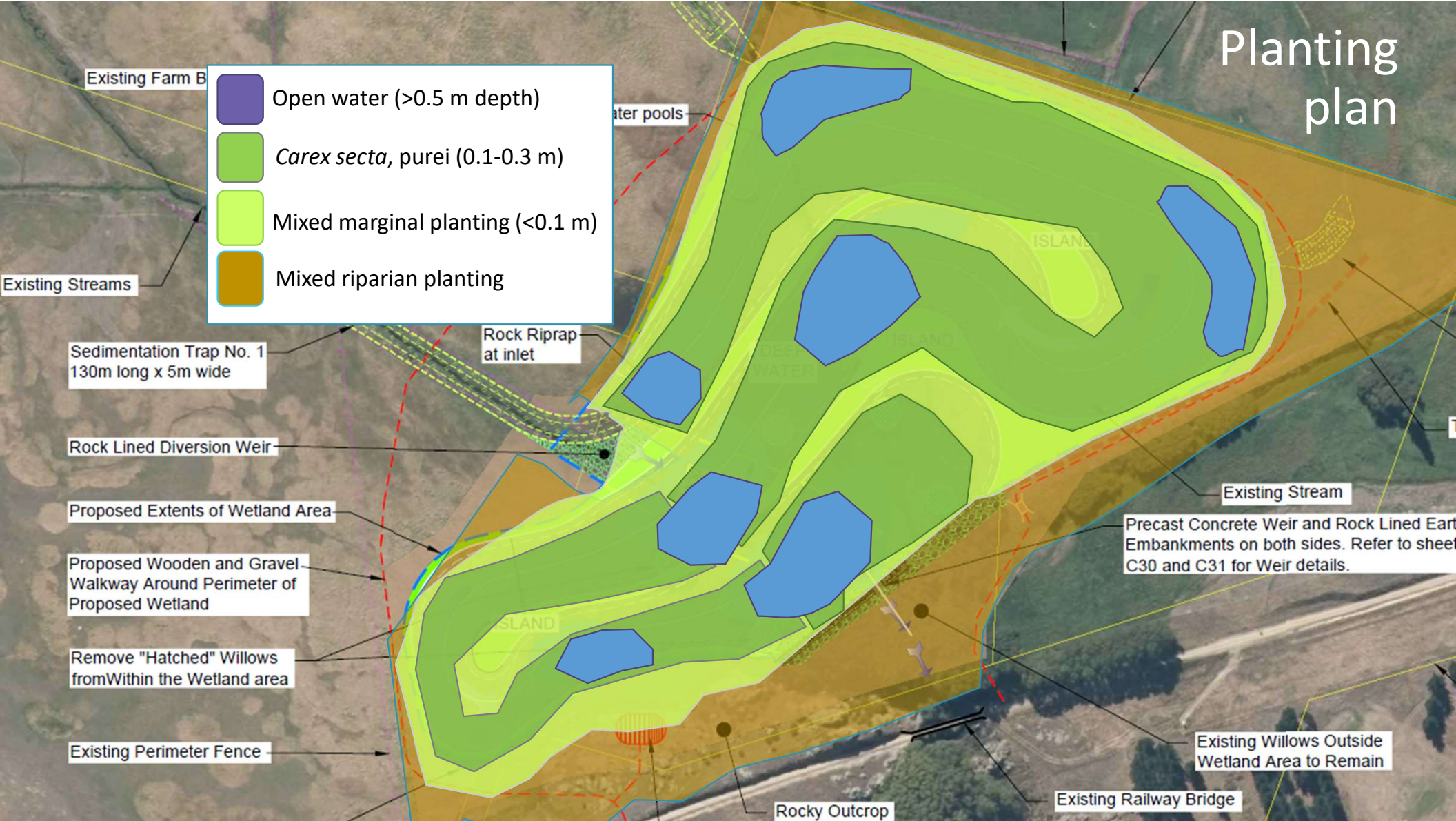


Constructed wetland design



Planting plan

-  Open water (>0.5 m depth)
-  *Carex secta, purei* (0.1-0.3 m)
-  Mixed marginal planting (<0.1 m)
-  Mixed riparian planting



Existing Farm B

Water pools

Existing Streams

Sedimentation Trap No. 1
130m long x 5m wide

Rock Riprap
at inlet

Rock Lined Diversion Weir

Proposed Extents of Wetland Area

Proposed Wooden and Gravel
Walkway Around Perimeter of
Proposed Wetland

Remove "Hatched" Willows
from Within the Wetland area

Existing Perimeter Fence

Rocky Outcrop

Existing Stream

Precast Concrete Weir and Rock Lined Earth
Embankments on both sides. Refer to sheets
C30 and C31 for Weir details.

Existing Willows Outside
Wetland Area to Remain

Existing Railway Bridge



Late Feb 2023



Late March 2023



Late June 2023

How it should look when plants established



l team
mmunity



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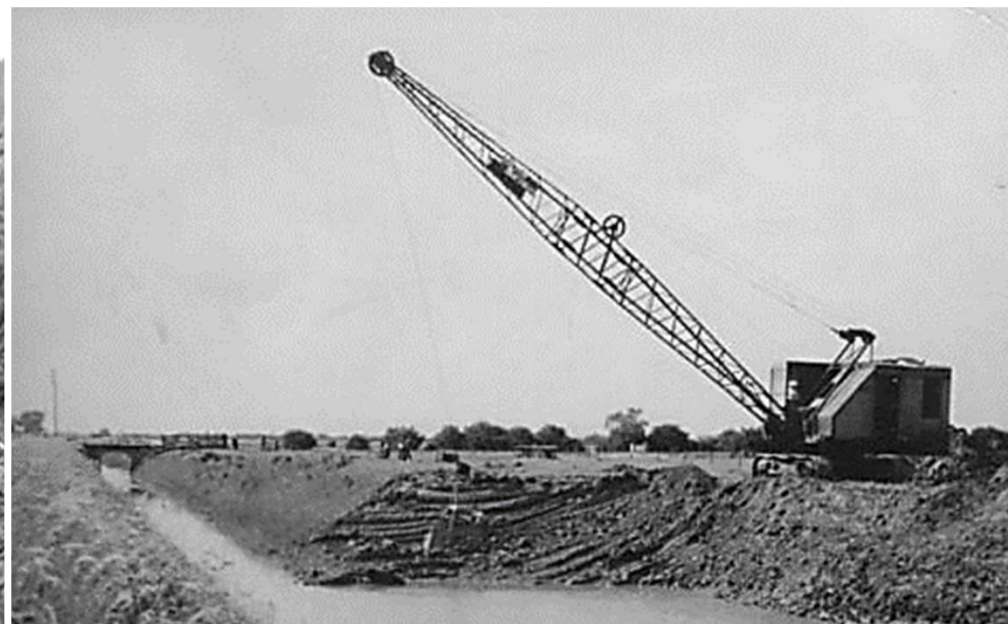


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An aerial photograph showing a constructed wetland in a rural landscape. The wetland is a long, narrow strip of land with a variety of vegetation, including tall grasses, reeds, and small trees. It is situated between two green fields. The sky is overcast with grey clouds.

Outline:

- Wetlands treated as wastelands
- Wetlands treated as assets
- Constructed wetlands
 - Why
 - How they work
- New guidelines
 - What and how
 - Contaminant removal
- How wetlands can work for farmers







Habitat & biodiversity



Recreation & mahinga kai

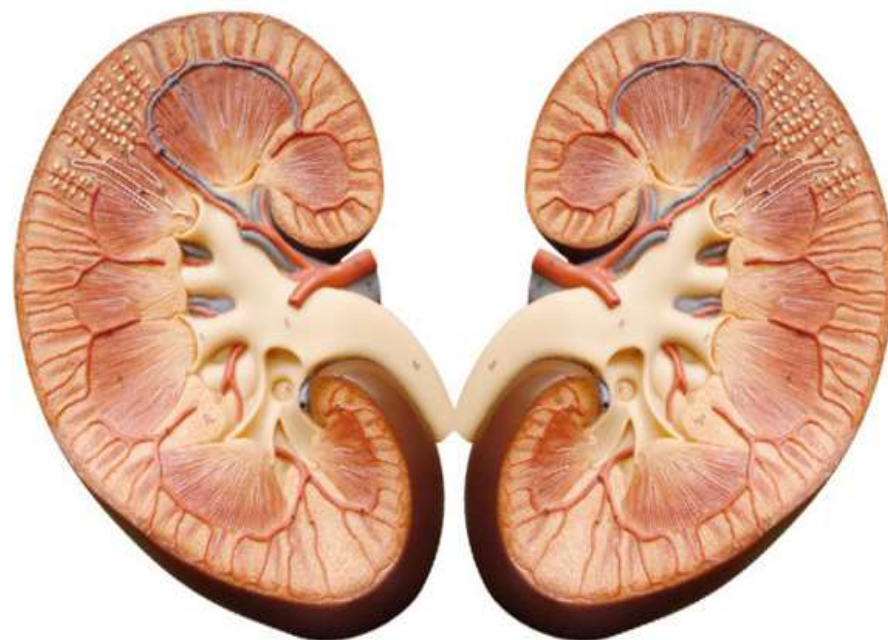


Cultural resources



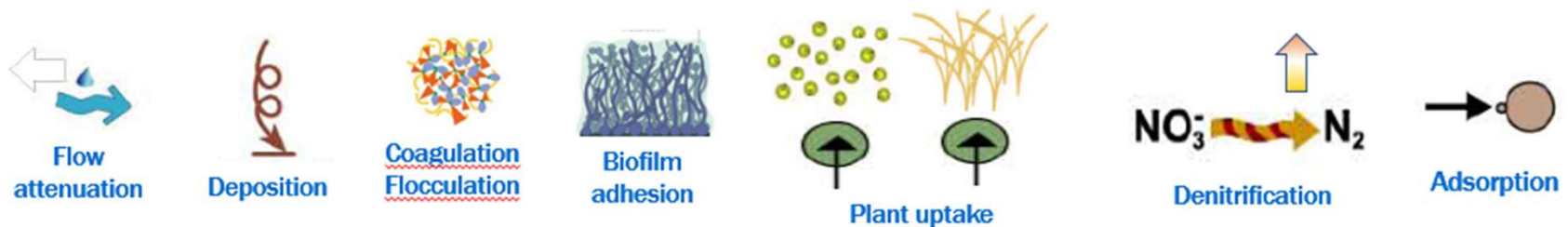
WETLANDS- Kidneys of the landscape

- Interface between land & water
- Buffer storm-flows
- Sustain base-flows
- Filter out
 - Suspended sediment
 - Nutrients
 - other contaminants



Why construct wetlands?

- Relatively simple nature-based option
- Replicate water “filtration” processes of natural wetlands
- Can remove sediment, nutrients and bugs from farm run-off
- Can often be sited on lower productivity areas of farm
- Enhance on-farm biodiversity, mahinga kai and aesthetics
- Can store carbon and reduce net greenhouse gas emissions





Shane Birchall,
Lake Okaro,
Bay of Plenty



David Hopkins,
Waitotara, South
Taranaki



White family, Tukipo, Hawkes Bay



Gray & Marilyn Baldwin,
Putaruru, Waikato



Raewyn & Tony van Gool,
Waituna, Southland



Owl Farm, Waikato



Kaiwairai Dairies, Wairarapa



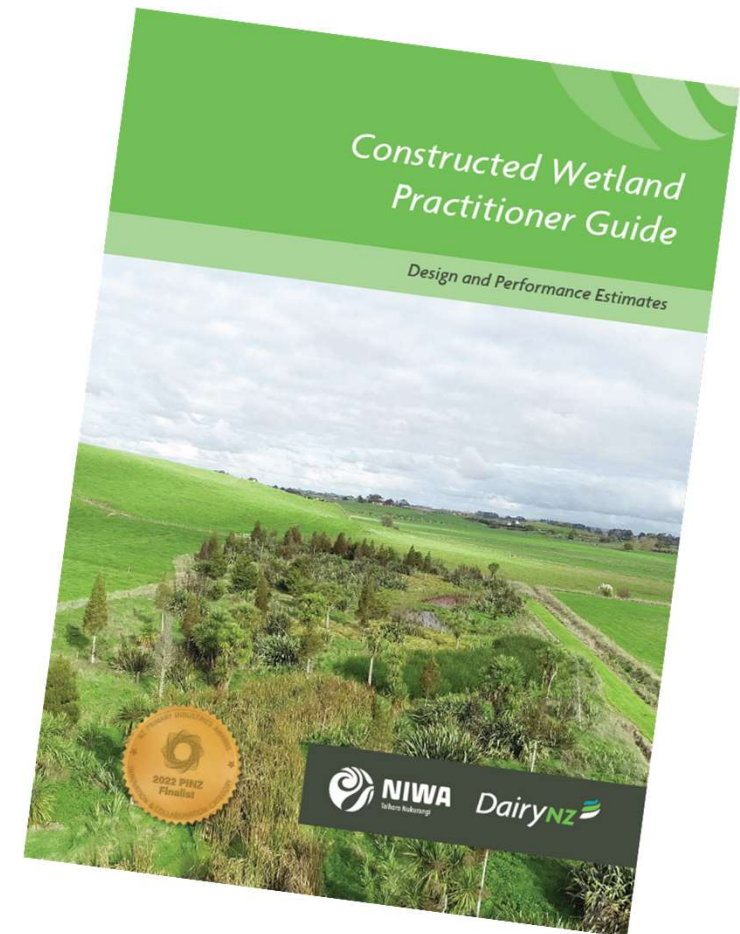
Whangamaire,
Waikato



Donna & Phil Cram, Taranaki

NEW Constructed Wetland Guide

- NIWA teamed up with DairyNZ to assess performance and develop new guidance to help incentivise uptake
- Robust development process
 - Practitioner Technical Group to inform development and endorse suitability of guidelines
 - Endorsed by most councils, WRA, F&GNZ
- Freely available to download on NIWA and DairyNZ websites



www.niwa.co.nz

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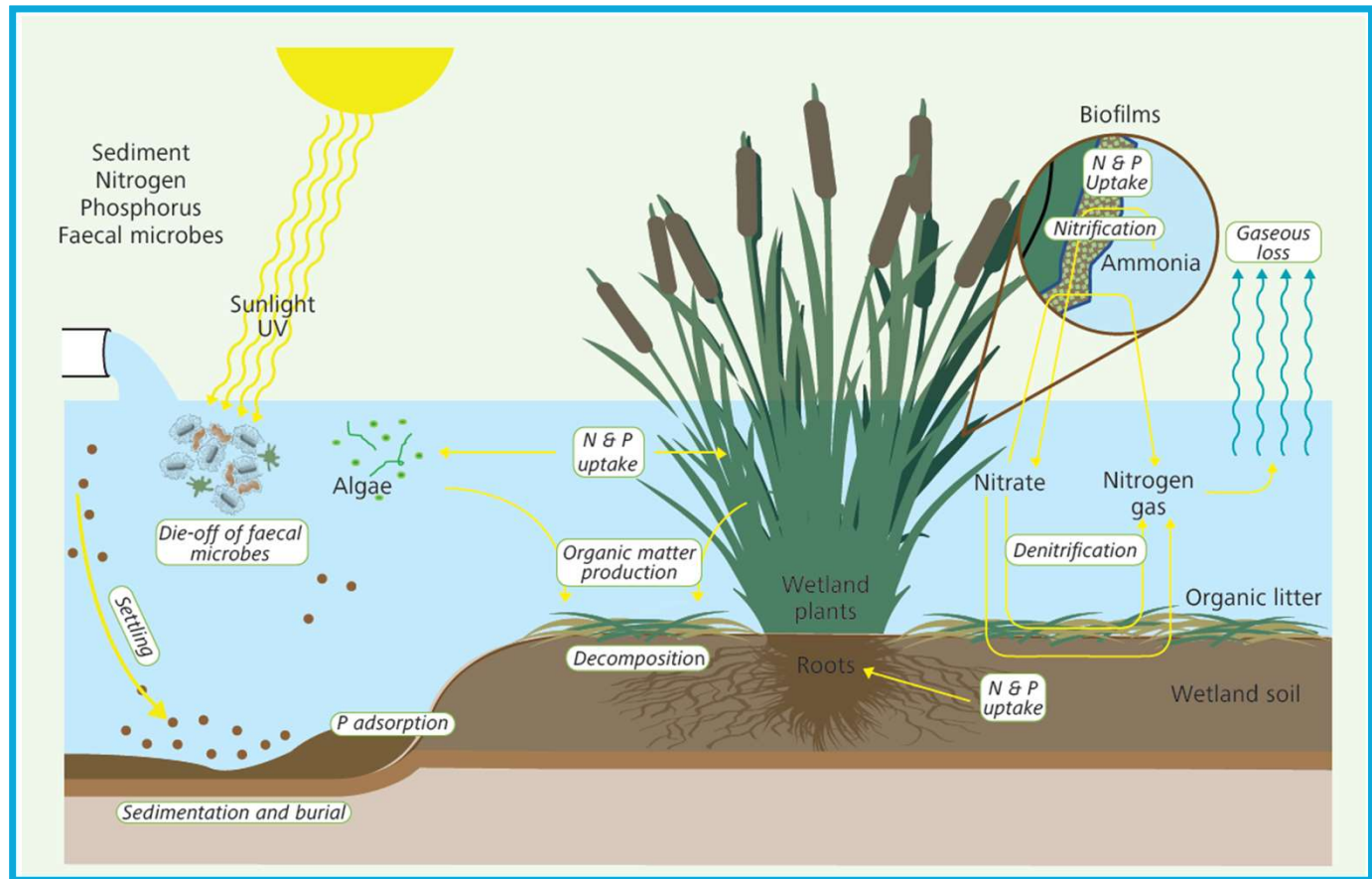
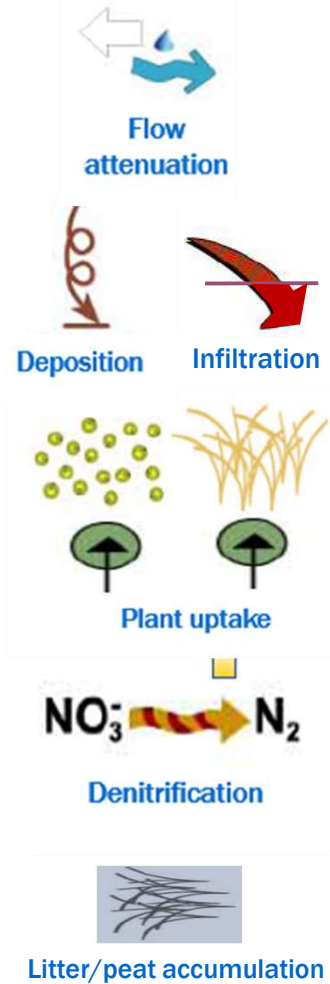
www.dairynz.co.nz

DairyNZ

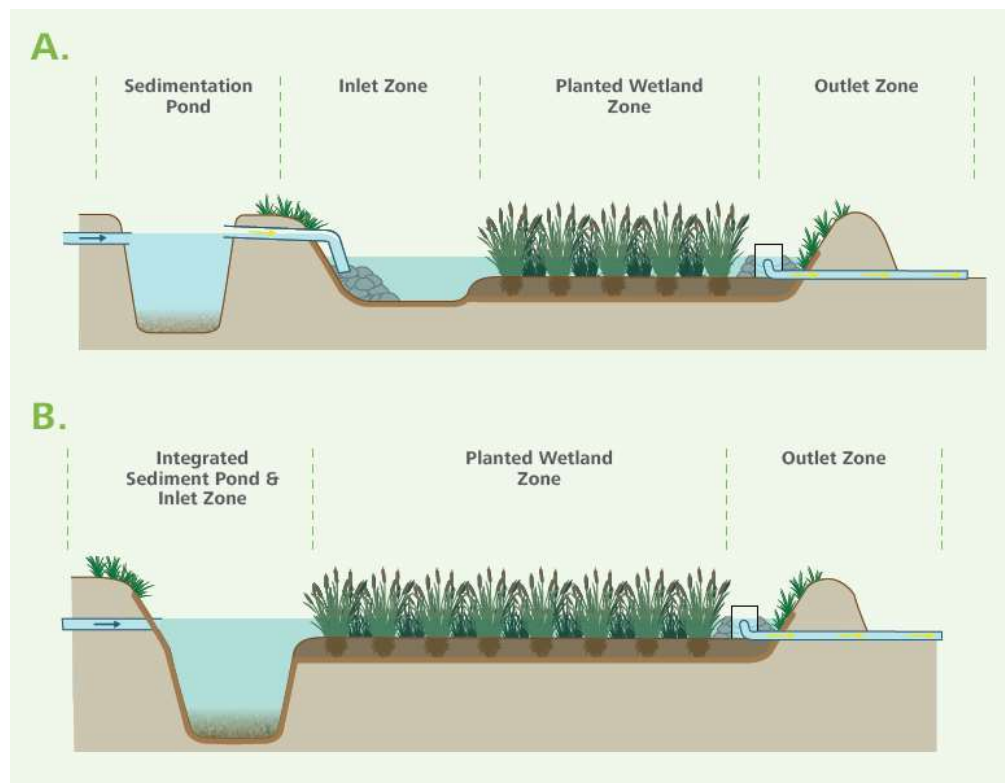
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SURFACE-FLOW CONSTRUCTED WETLANDS

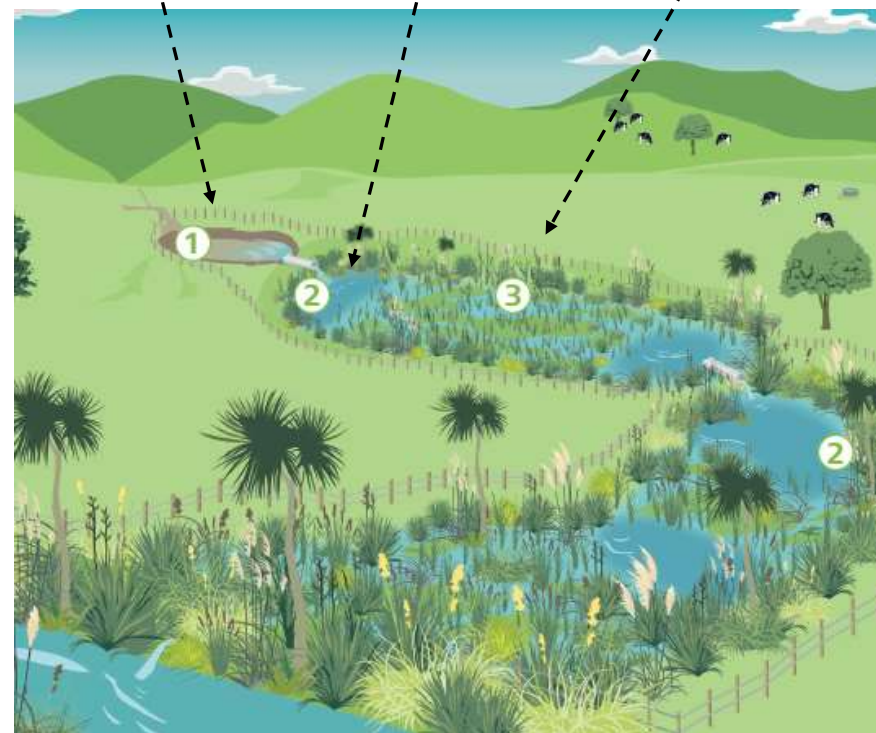
Key contaminant removal processes



Wetland design

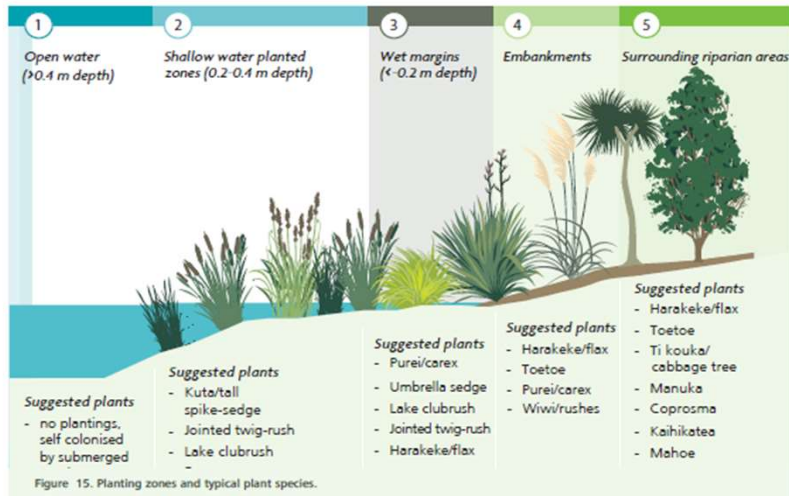


1. Initial sedimentation pond
2. Open water zones to disperse flow
3. 70% shallow vegetated zones



Vegetation

- Plant selection
- Planting and weed management



Typha orientalis

raupo, bulrush
(planting depth 0-40cm)



Machaerina articulata

mokuautoto, jointed
twig-bush, baumea
(planting depth 0-40cm)



Eleocharis sphacelata

kuta, tall spike-rush, spike-sedge
(planting depth 20-60cm)



Schoenoplectus tabernaemontani

kapungawha, Lake club-rush
planting depth 0-40cm



Bolboschoenus fluviatilis and
B. medianus, purua grass,
kukuraho, ririwaka, river



Carex secta, purei, makura



C. germinata, *C. lesssoniana* and
C. virgata, rautahi, carex



Austroderia richardii, *A. fulvida*,
A. toetoe, toetoe



Cordyline australis, ti kouka,
cabbage tree



Cyperus ustulatus, toetoe
upokotangata, giant umbrella
sedge



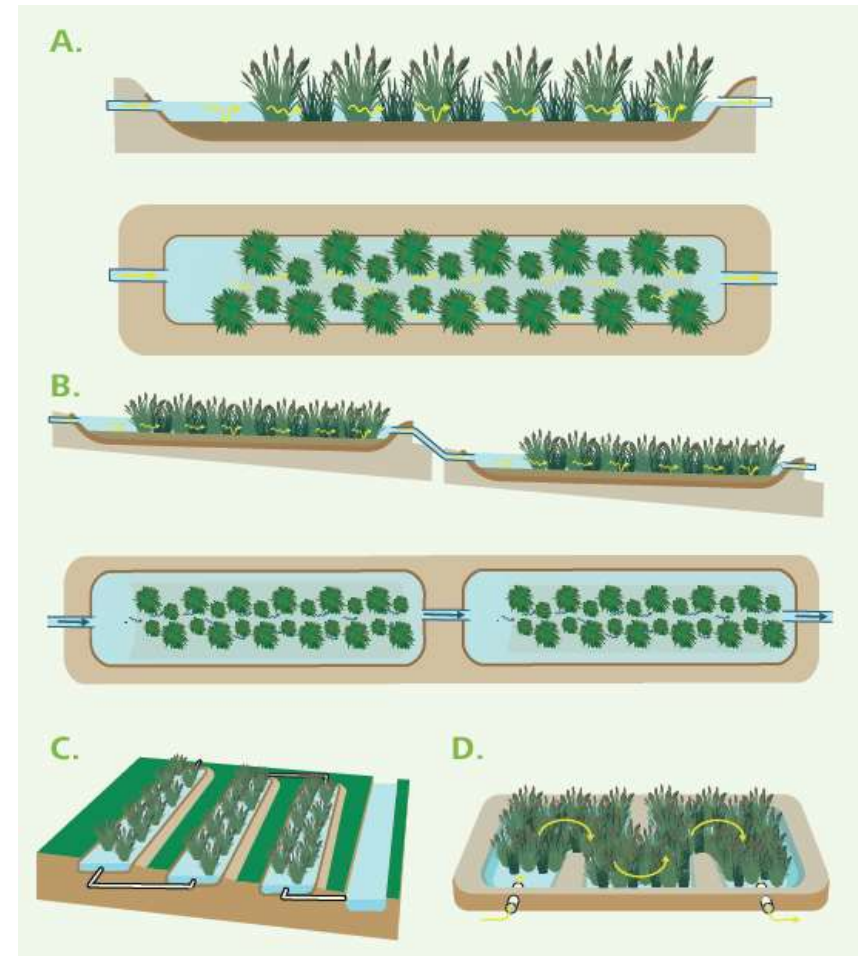
Phormium tenax, harakeke,
New Zealand flax



Avoid invasive introduced
species such as *Glyceria
maxima*, reed sweetgrass

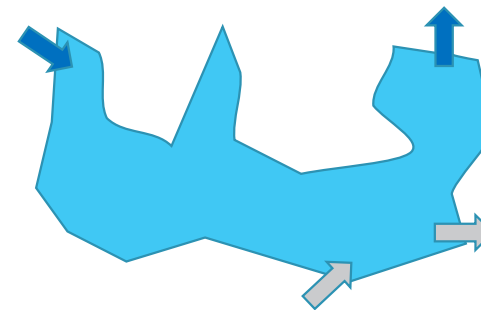
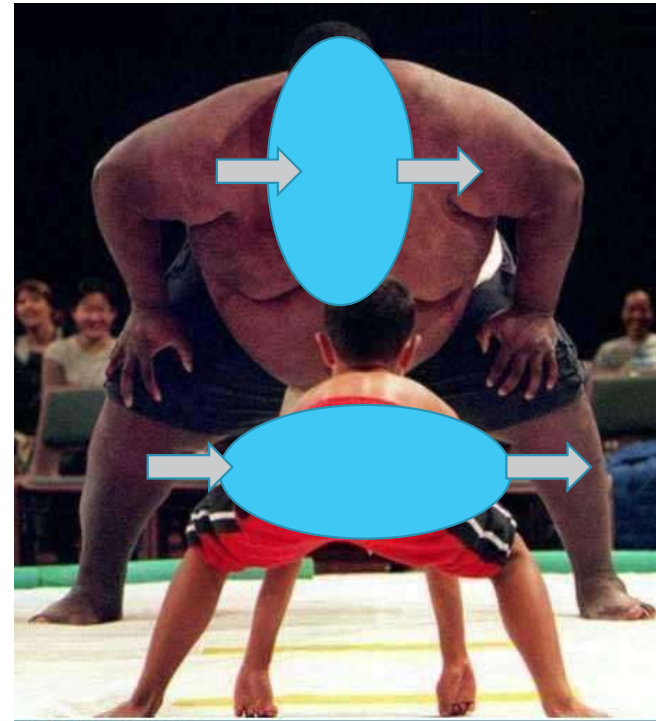
Guidance

- Size
- Flow paths intercepted
- Shape and arrangement
- Sediment pond
- In-let/out-let structure
- Embankments
- Maintenance
- Costings
- Case-studies

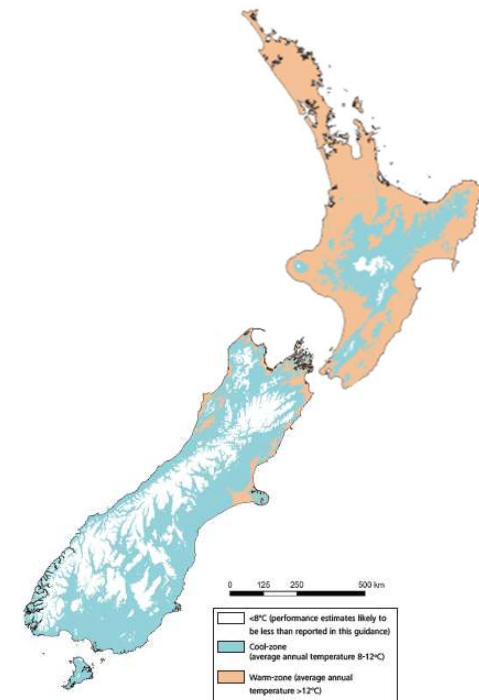
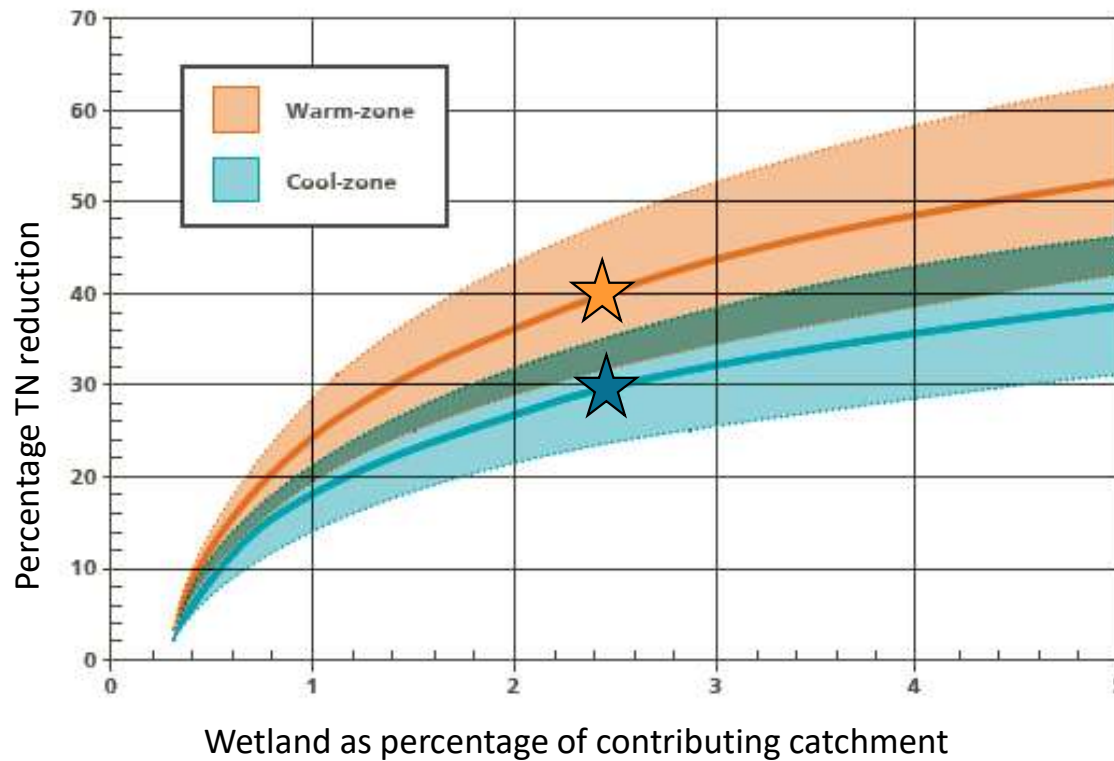


Size matters !

- ◉ Wetland WQ performance related to size
- ◉ Also location and design
 - ◉ Proportion of flow intercepted
 - ◉ Flow variability
 - ◉ Shape / Hydraulic efficiency
 - ◉ Plant cover
 - ◉ Temperature

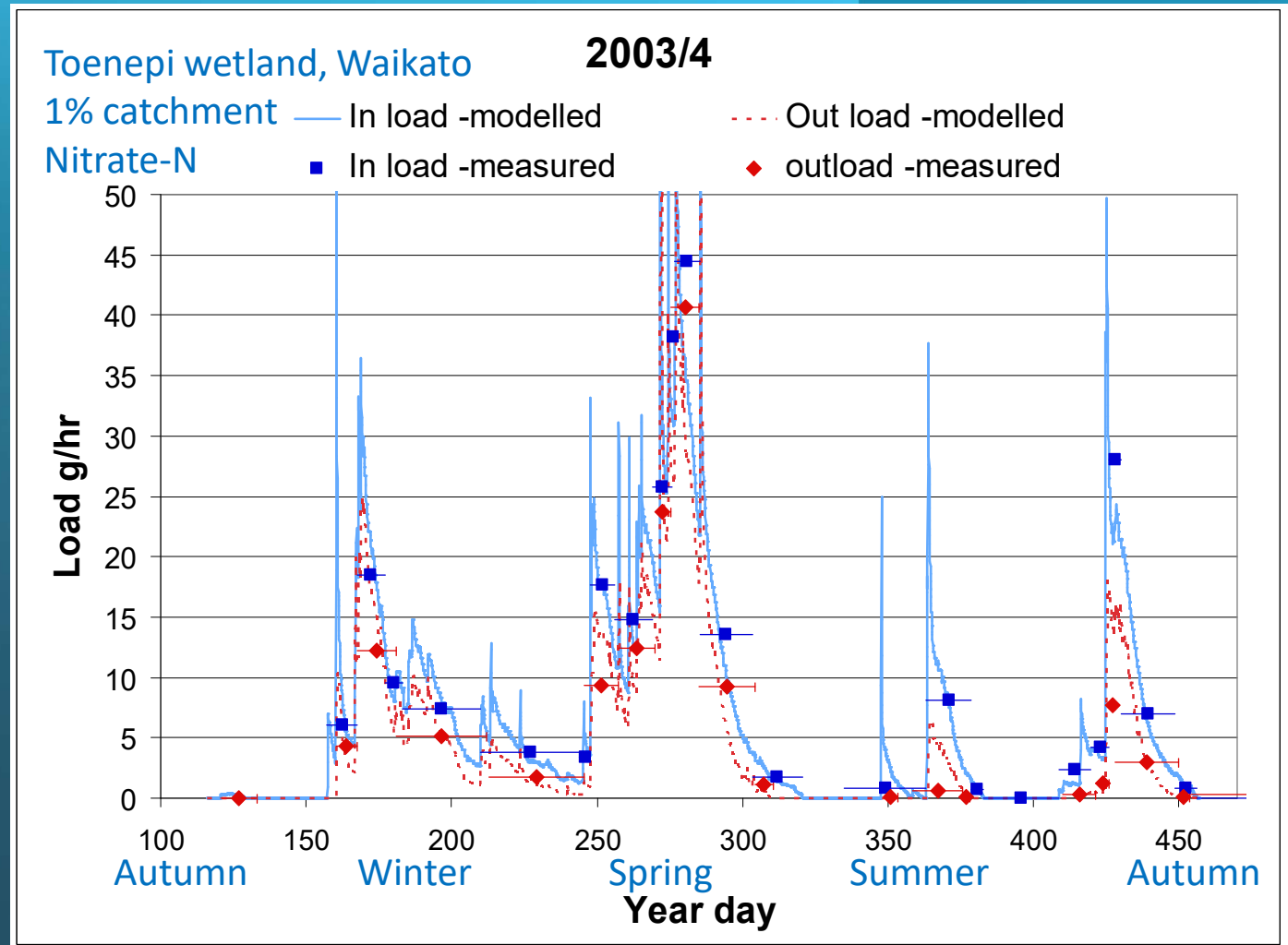


Performance estimates - Nitrogen



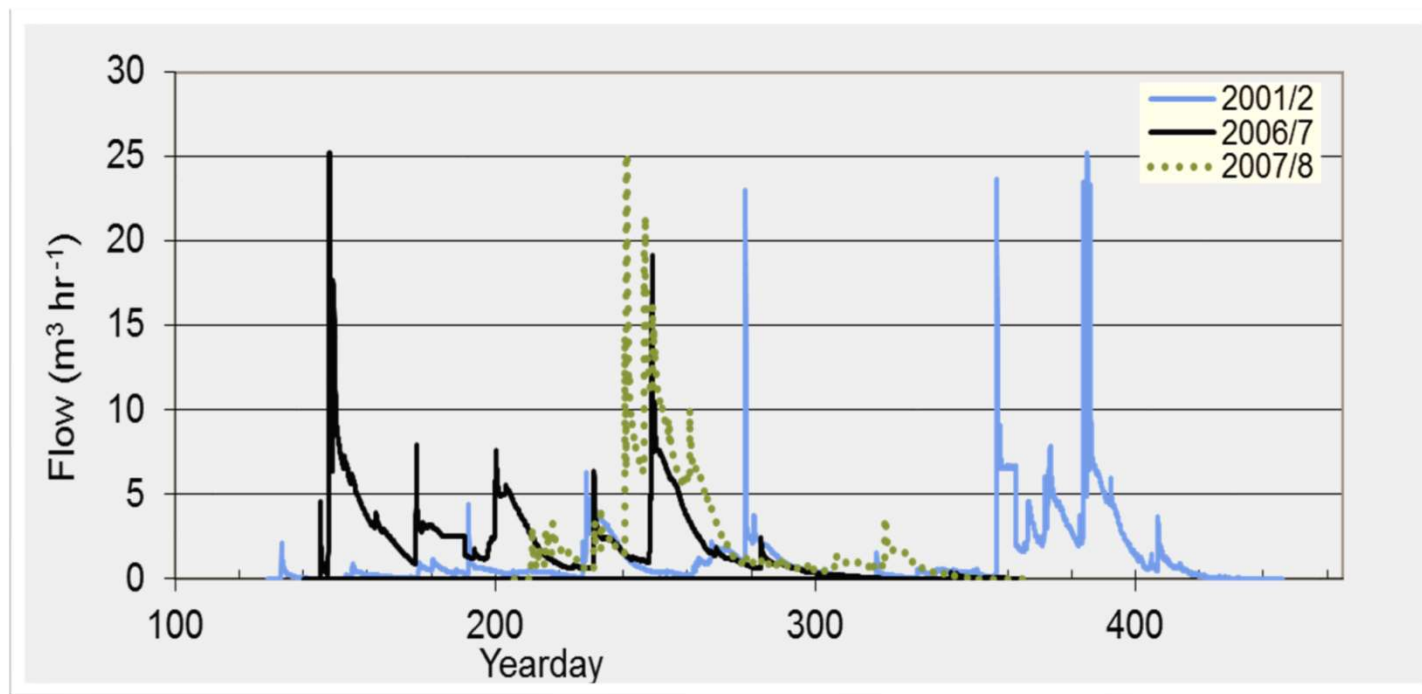
Assume normal NZ pastoral farming practices, climate conditions and flat to rolling landscapes

- Treatment varies with changing inflows & concentrations (=load)
- Performance will vary each year

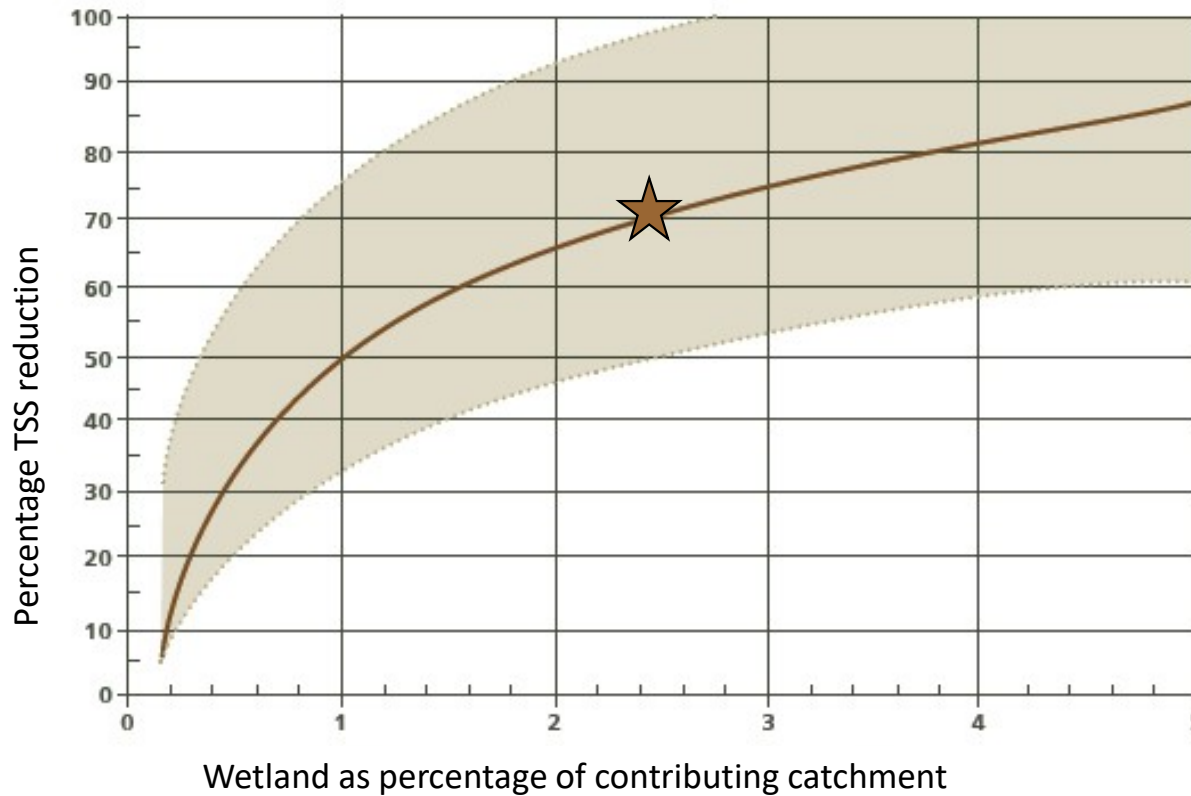


Tanner & Kadlec (2013). *Ecological Engineering* 56: 79-88

Farm run-off and drainage varies markedly from year to year
- Wetland performance will vary with it

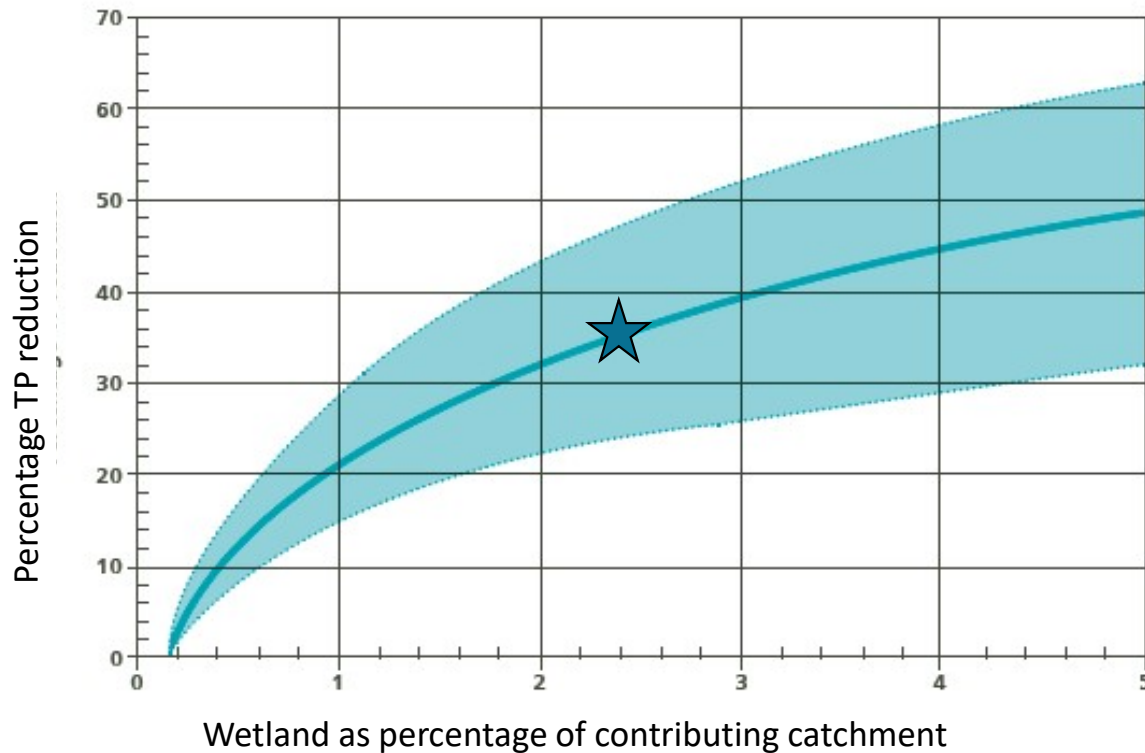


Performance estimates – Suspended sediment



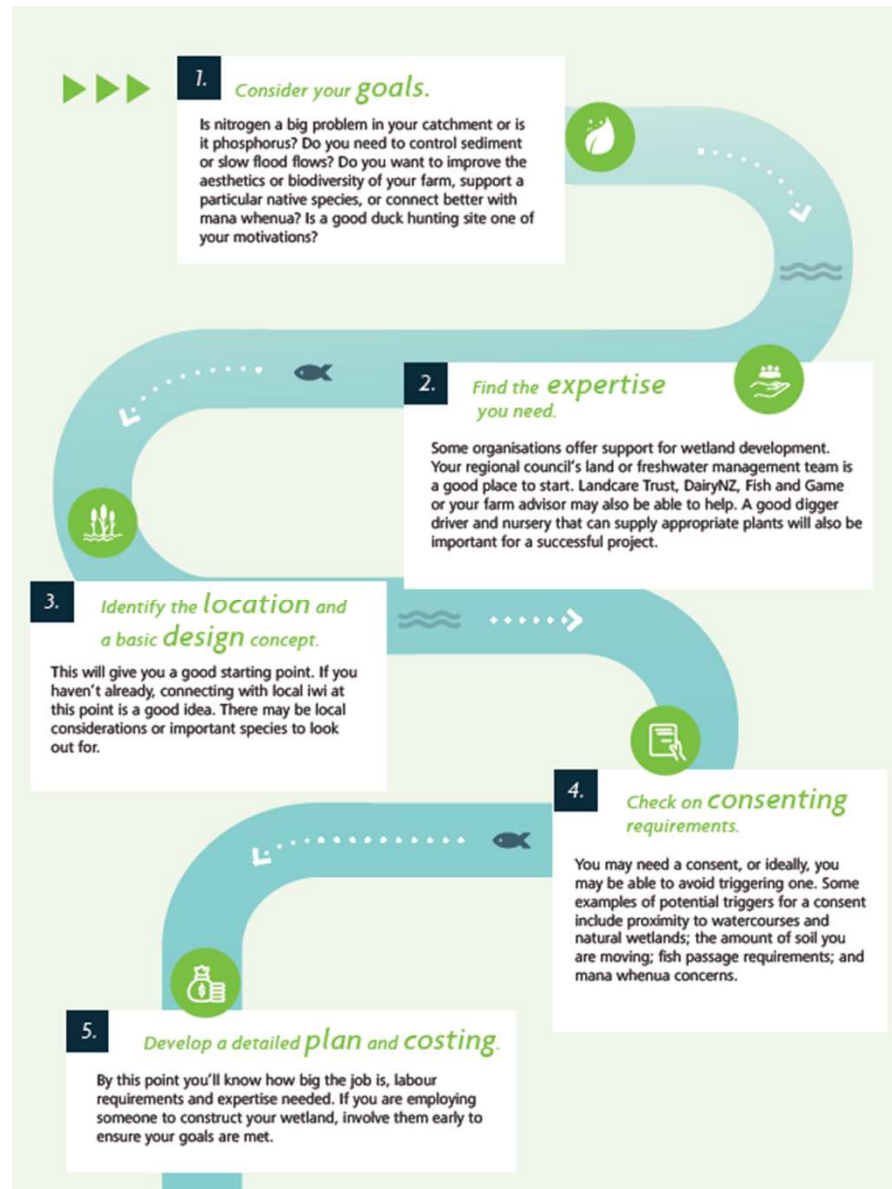
Estimates limited to catchments with soils <35% clay

Performance estimates – Phosphorus



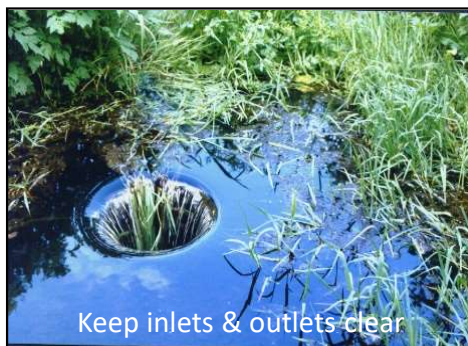
- *Estimates limited to wetlands receiving mainly particulate-associated P with soil clay content <35%*
- *Work continuing to identify ways to enhance retention of dissolved P*

Steps to develop a constructed wetland






Maintenance needs

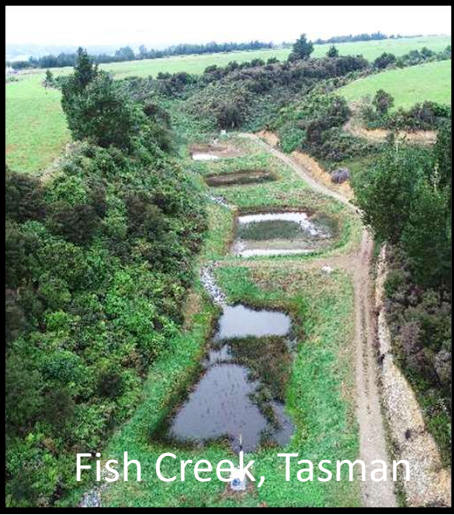
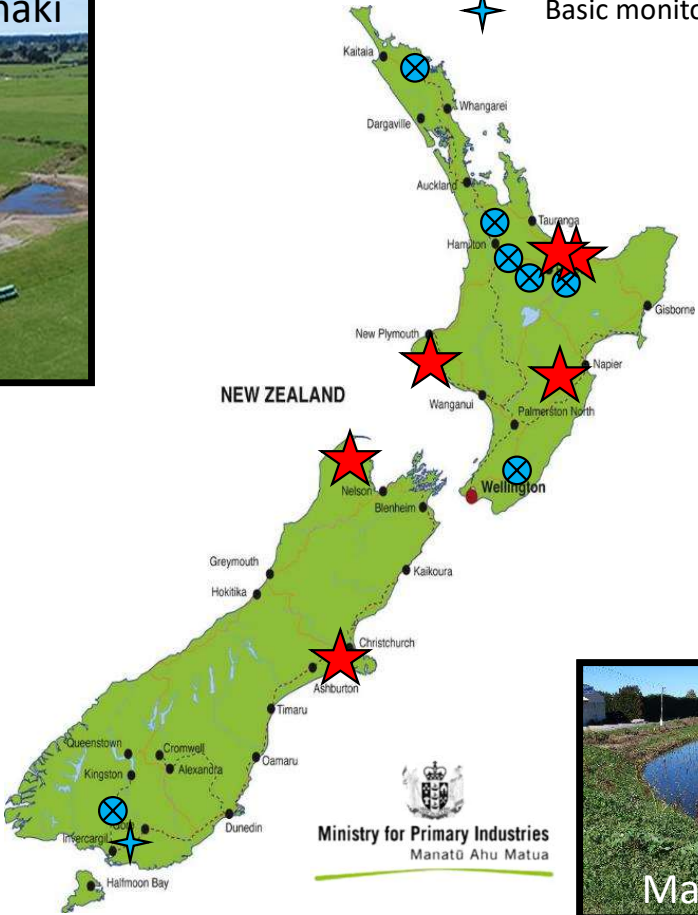
Constructed wetland:



CONSTRUCTED WETLAND MONITORING & DEMONSTRATION NETWORK

Building the evidence base

-  NEW monitoring sites
-  Previously monitored
-  Basic monitoring

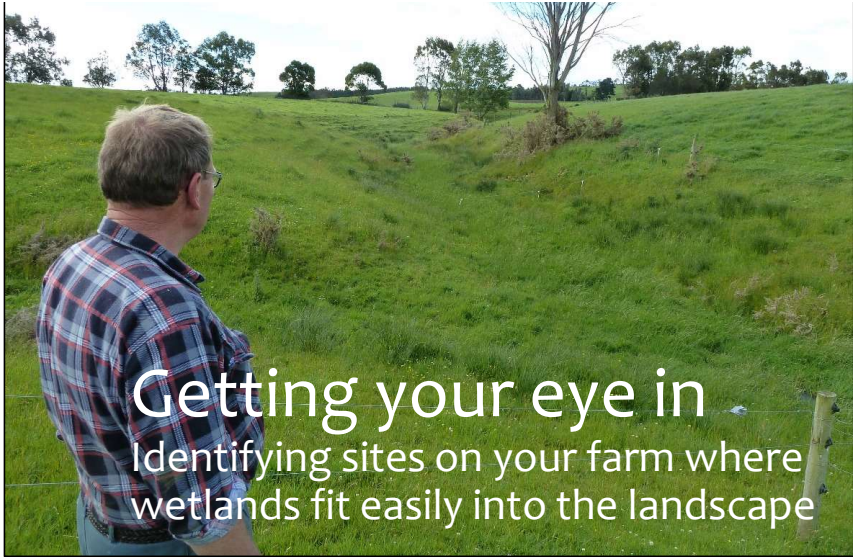


Small wetlands work too



Ann & Ben Gillespie



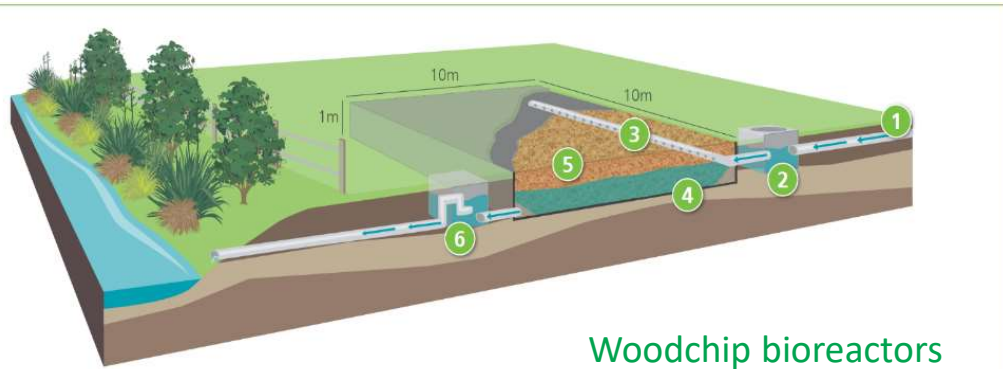
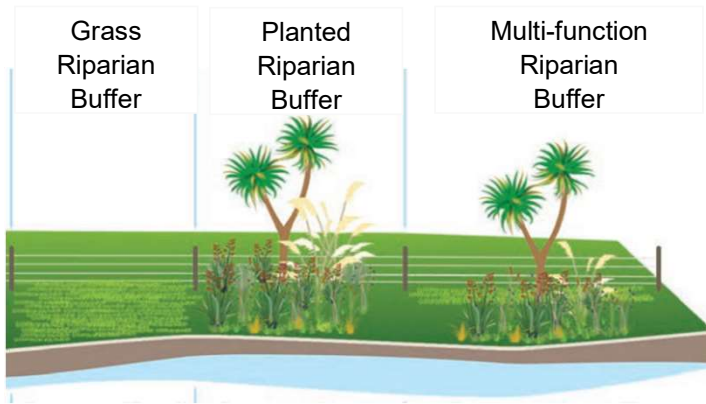


Getting your eye in
Identifying sites on your farm where
wetlands fit easily into the landscape



Other edge-of-field and waterway mitigation options to consider

Riparian buffers



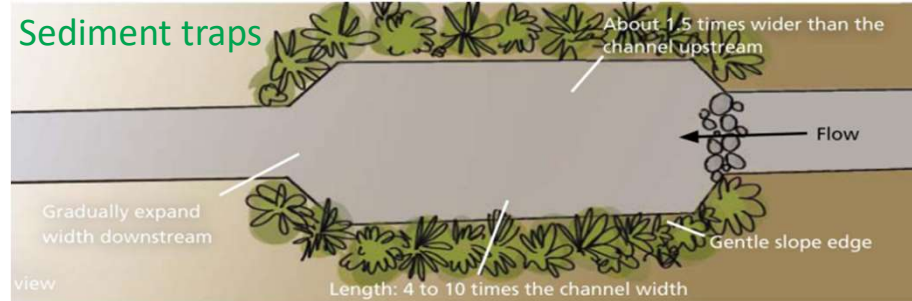
Woodchip bioreactors

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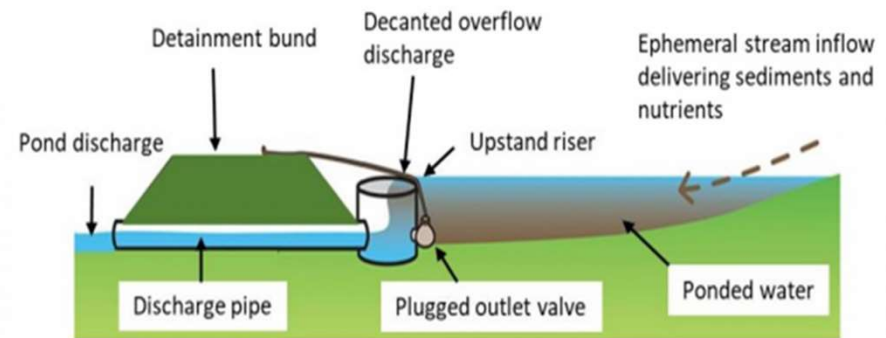
FANS



Filamentous algal nutrient scrubbers



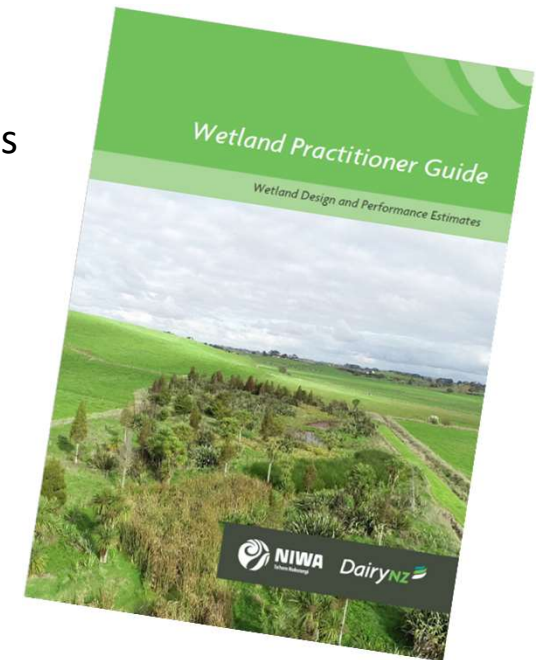
Detainment bunds



Conclusions: Wetlands as mitigation assets

- New nutrient management tool for farmers
 - Performance estimates can be used for nutrient budgeting and farm plans
- Strengths
 - Multiple contaminants and flow paths, robust, low maintenance
 - Biodiversity and aesthetics
- #1 On-farm management of soils, nutrients & grazing
- #2 protect and rehabilitate existing wetlands
- #3 construct wetlands (or apply other mitigations)
 - 1-5% of catchment area in wetlands
 - Focus on key contaminant flow paths
 - Maximise performance through good design & implementation

Check out the
guidelines!



www.niwa.co.nz
www.dairynz.co.nz

Thanks to:

- Thompson's Project and Otago Catchments Community; Manuherikia CG
- MfE for funding the Thompsons Creek Wetland as an exemplar demonstration project
- Pete, the farmer who provided the land
- Nicola McGrouther for co-ordination and project management
- Matt Hickey and ORC for providing flow estimates and WQ data for the catchment
- Brendan Sheehan for engineering design, and supervision
- Contractors for making it happen in very challenging conditions
- Jo Wakelin for supervising plant supply and planting
- Many others and the amazing local community that has got behind the project

- More broadly for supporting work on constructed wetlands for management of agricultural run-off
 - Farmers who have provided support and access to their land
 - LMOs and many other partners for assistance with field trials & monitoring
 - Funding from MBIE, the dairy industry, regional councils, WRA and MPI
 - DairyNZ who have assisted with funding and development of the practical guidelines
 - Practitioner Technical Advisory Group



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