The New Zealand National Fish Passage Guidelines:

Rising To The Challenge Of Reconnecting Our Waterways

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Rationale

Provide access to information needed to design for fish passage

Set minimum design standards

Enable more consistent fish passage management across NZ

Basis for shifting expectations

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Scope

Structures ≤4 m high

Design of new structures

Remediation of existing structures

Creation of built barriers

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Objectives

Good fish passage design will achieve:

- Efficient and safe upstream and downstream passage of all aquatic organisms and life stages with minimal delay or injury
- The structure provides no greater impediment to fish movements than adjacent stream reaches
- A diversity of physical and hydraulic conditions leading to a high diversity of passage opportunities
- Continuity of geomorphic processes such as the movement of sediment and debris
- Structures have minimal maintenance requirements and are durable

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Principles of good fish passage design

The principles of good fish passage design include:

- Maintaining continuity of instream habitat
- Minimising alterations to stream alignment
- Minimising alterations to stream gradient
- Maintaining water velocities within a range equivalent to adjacent stream reaches
- Maintaining water depths within a range equivalent to adjacent stream reaches
- Minimising constraints on bankfull channel capacity

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Introducing NZ's freshwater fish - Whitebait

Giant kōkopu *(Galaxias argenteus)*

Banded kōkopu *(Galaxias fasciatus)*

Shortjaw kōkopu
(Galaxias postvectis)

Kōaro *(Galaxias brevipinnis)*

Inanga *(Galaxias maculatus)*

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Images: NIWA, Te Ara, Terranature

Introducing NZ's freshwater fish – OTHER SPECIES

Bluegill bully
(*Gobiomorphus hubbsi*)

Pouched lamprey
(*Geotria australis*)

Common smelt
(*Retropinna retropinna*)

Longfin eel (*Anguilla dieffenbachii*)

Shortfin eel
(*Anguilla australis*)

Redfin bully
(*Gobiomorphus huttoni*)

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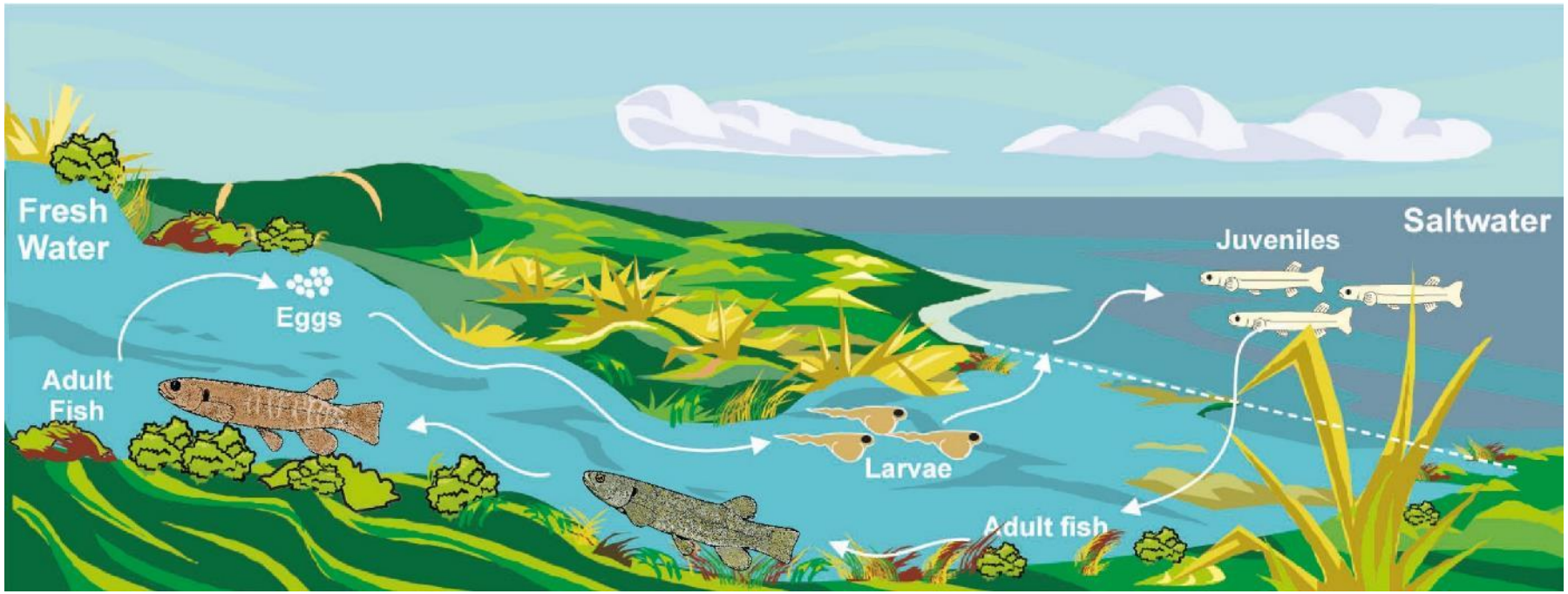
Why is connectivity important?



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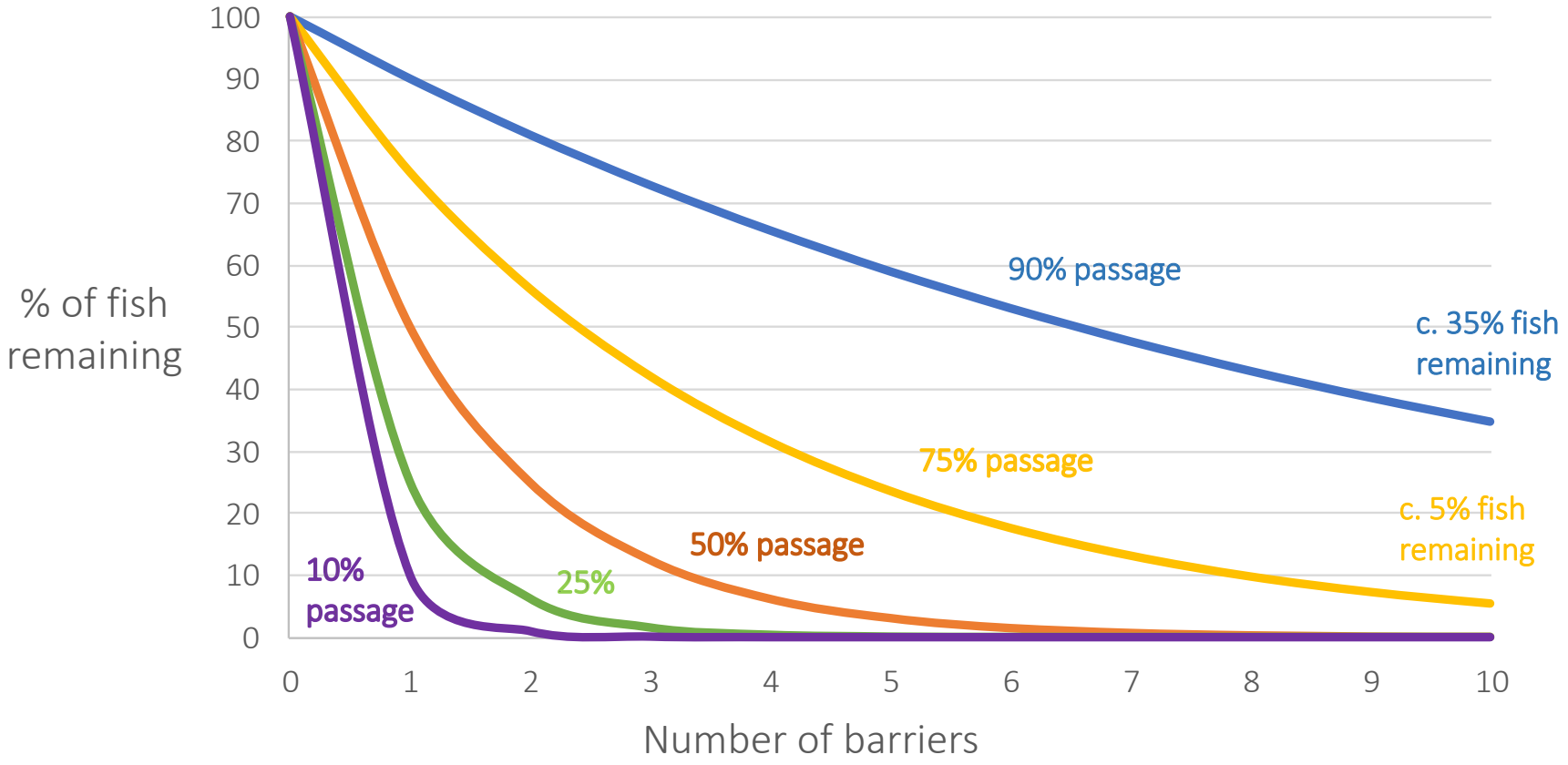
Why is connectivity important? – Cont'd



➔ Population decline

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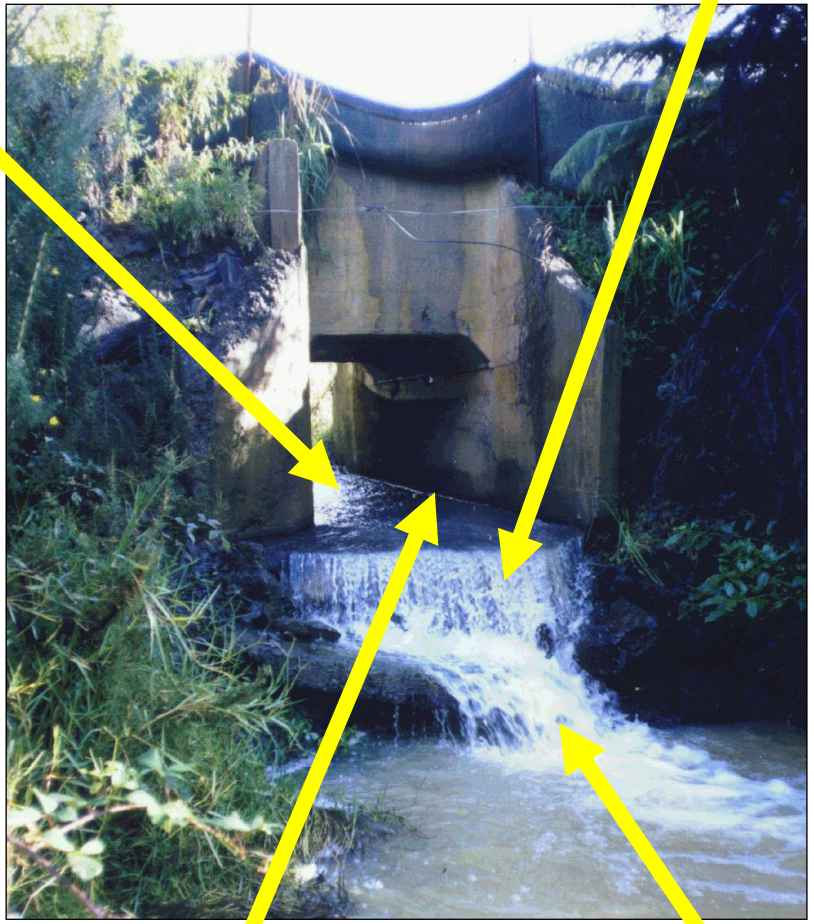
What makes a fish migration barrier?



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Fish passage management in NZ

CONSERVATON ACT 1987

Reprint as at 19 May 2016

hwater Fisheries Regulations

(SR 1983/277)

David Beattie, Governor-General

Order in Council

vernment House at Wellington this 19th day of Dece

Present:
His Excellency the Governor-General in Council

"No culvert or ford should impede fish passage"

Department of Conservation
Te Papa Atawhai

"… that any dam or diversion structure has a fish facility included & set conditions on their design & performance"

Resource Management Act 1991

https://en.wikipedia.org/wiki/File:Coat_of_arms_of_New_Zealand.svg

s.13: *"avoiding damaging, destroying, disturbing, or removing the habitats of animals in, on, or under the bed of a lake or river implemented in regional & district plan policies & rules"*

NPS, NES

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New structures

Don’t build new barriers!

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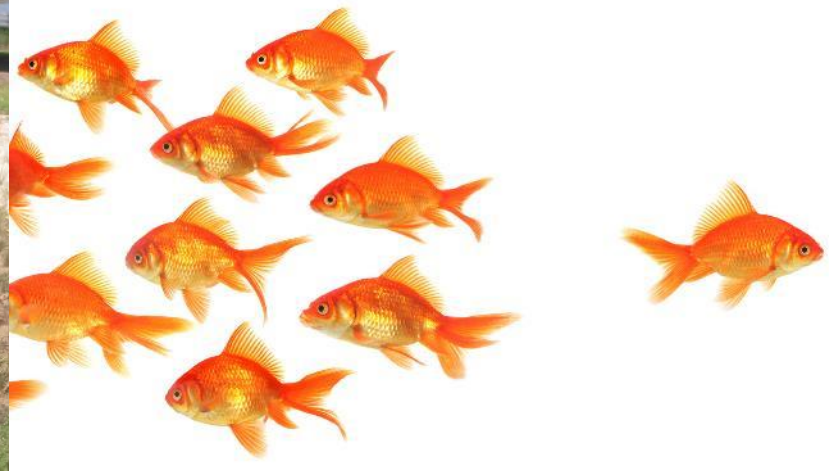
New Structures – General principles



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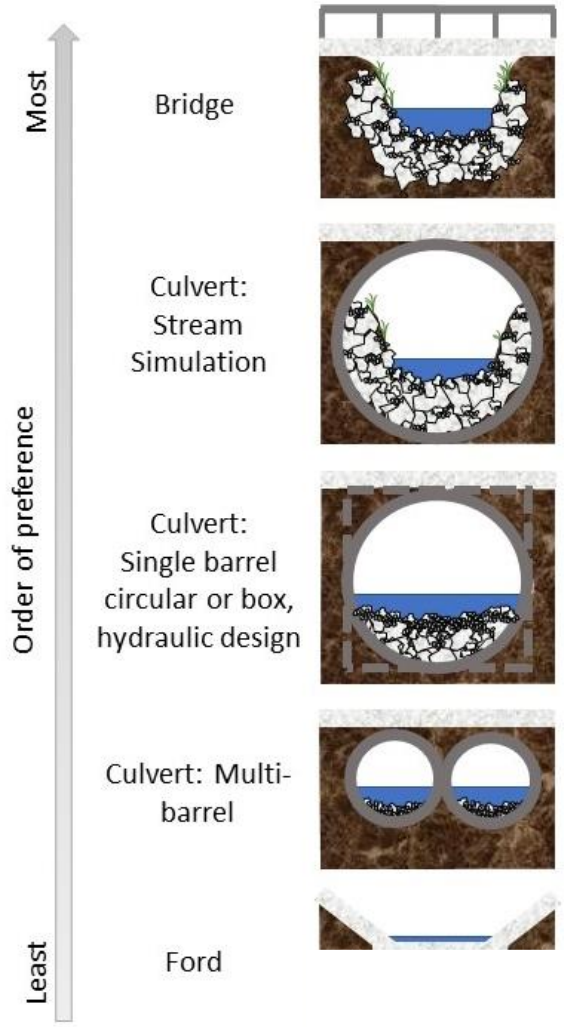
Road crossings – Order of preference



Bridge:

- Natural bed and banks
- Natural water depths and velocities
- Natural substrate
- Preserves stream gradient and alignment
- Minimal construction disturbance

…

Ford:

- Artificial bed and banks
- Reduced depth and increased velocity
- Often creates a vertical barrier on the downstream face

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Minimum standards vs best practice

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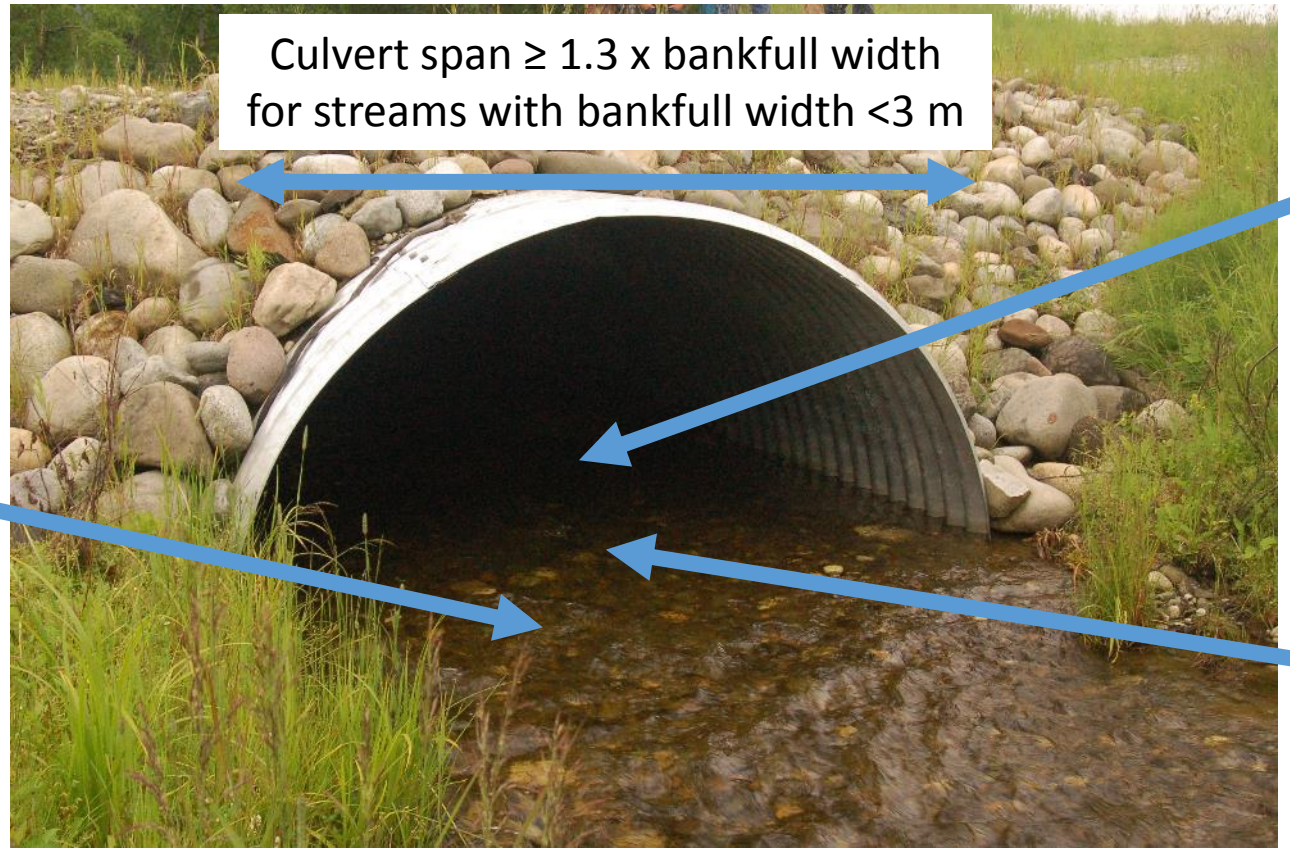
Hydraulic design of culverts



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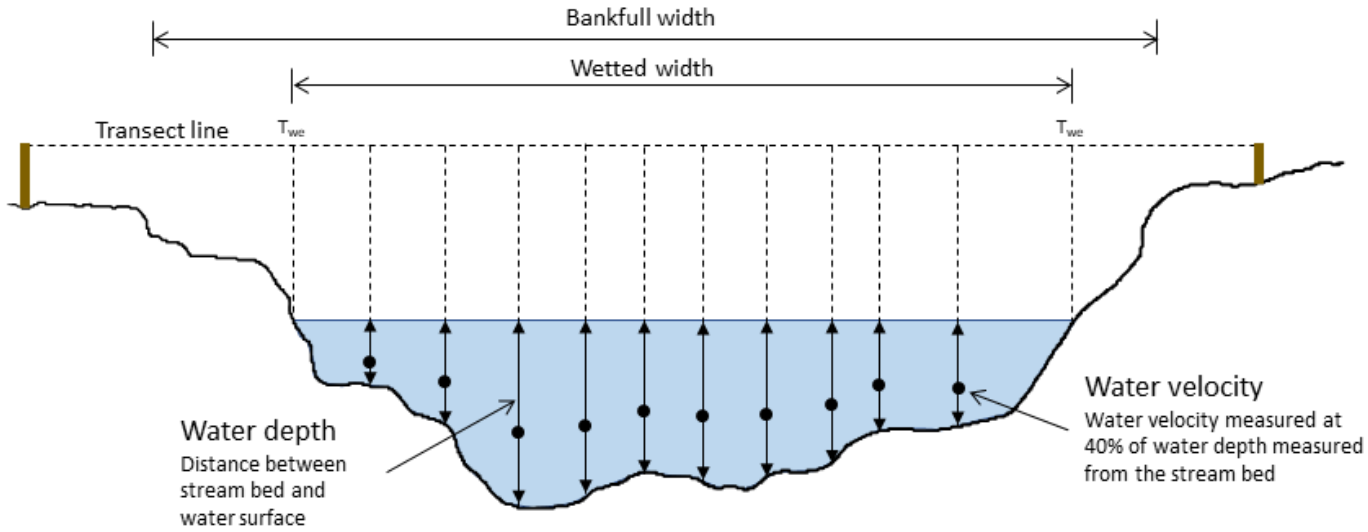

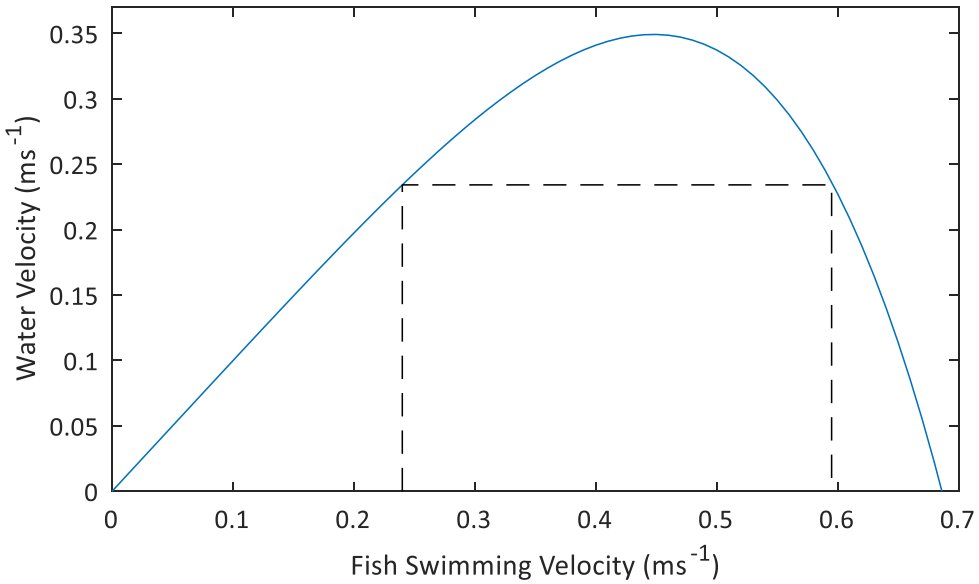

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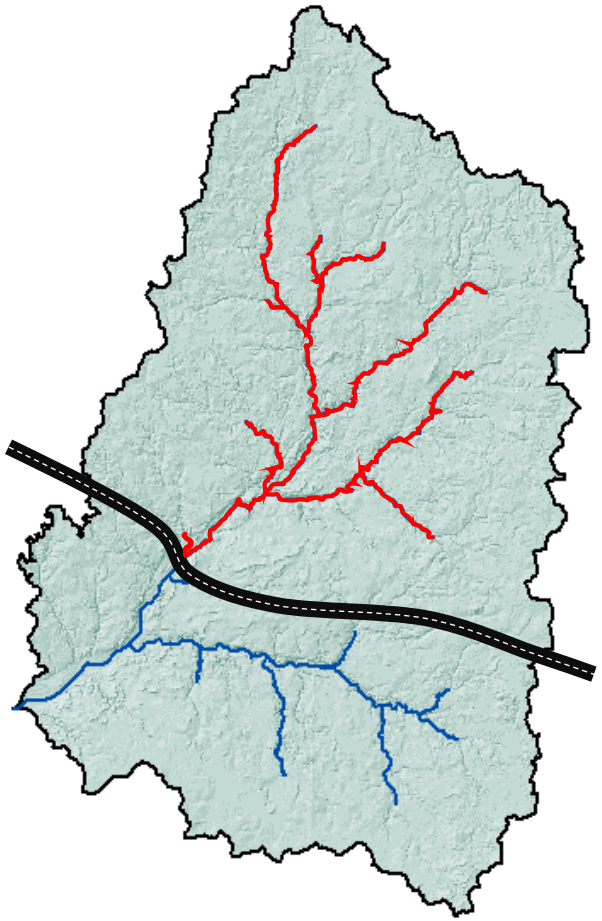
Best practice

Best practice culvert design – when where and how?

High value:

- Habitat
- Species



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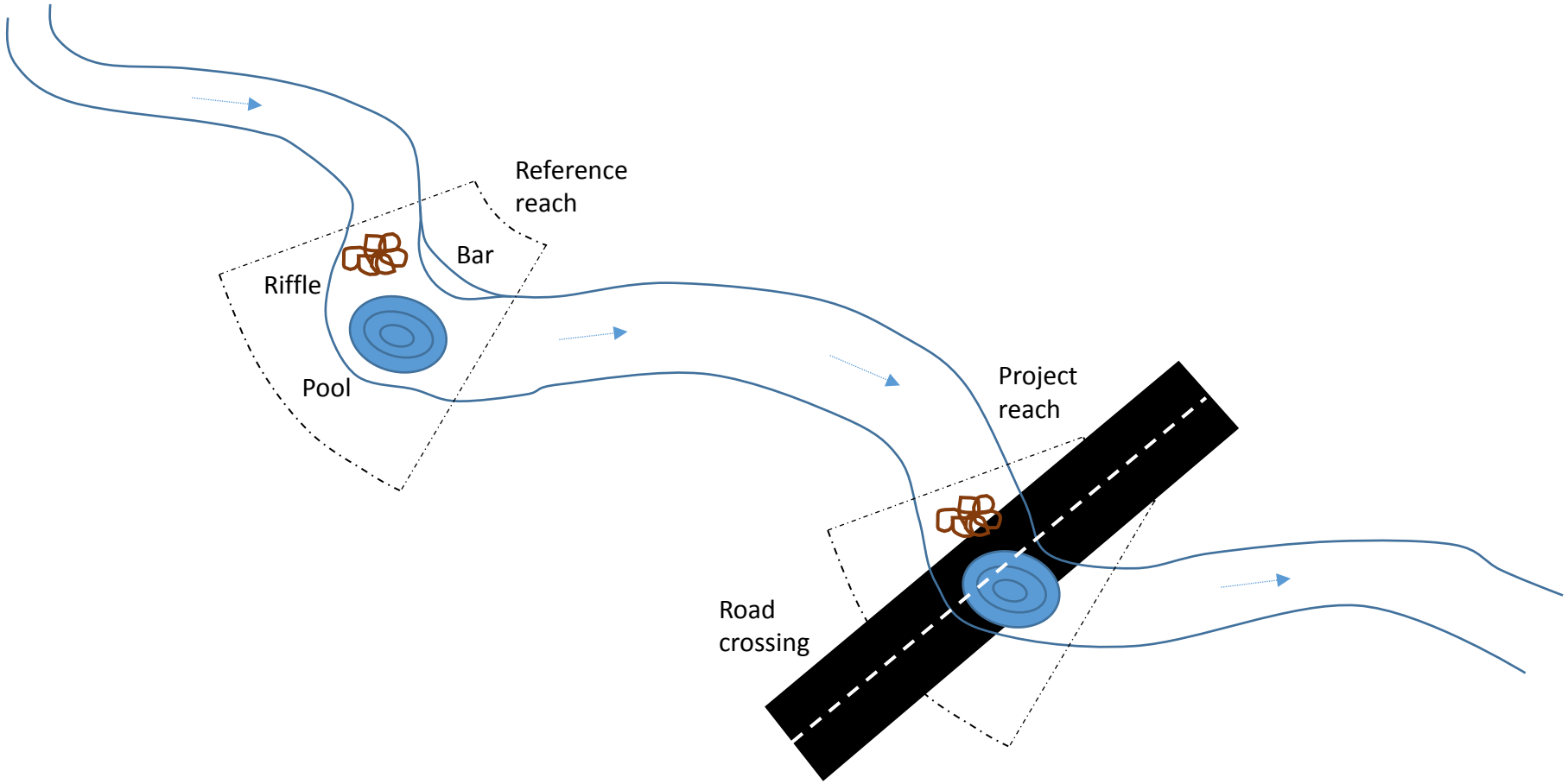
Stream simulation design of culverts



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Rock ramps

Rock-ramp weir design

V-shaped lateral profile

Gentle slope (1:30)

Low velocity wetted margins

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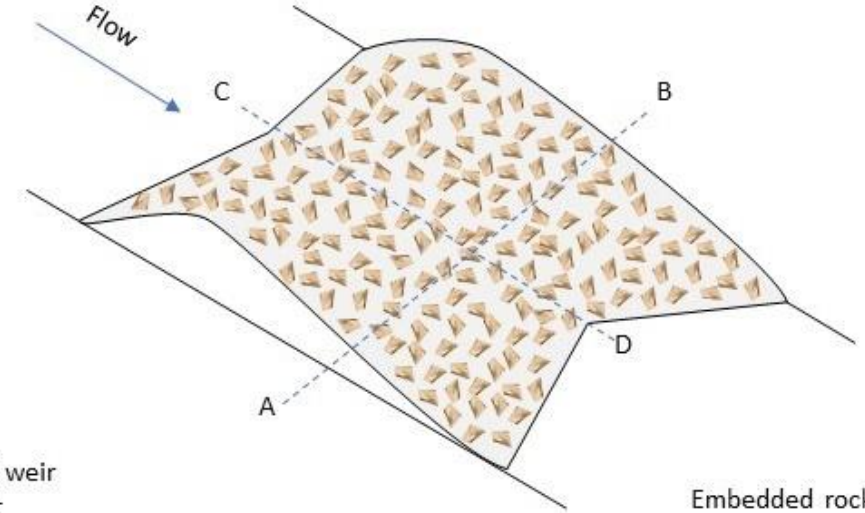
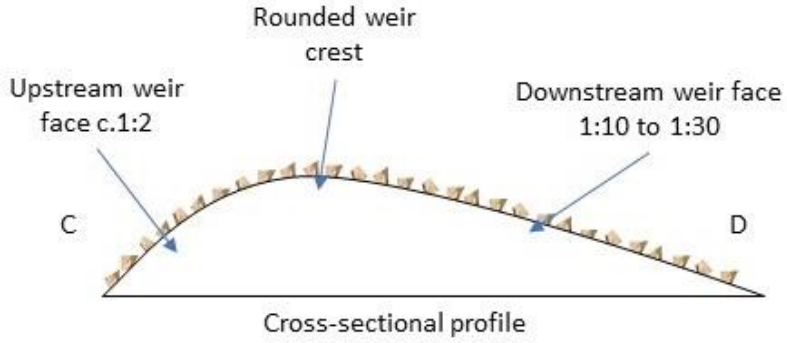
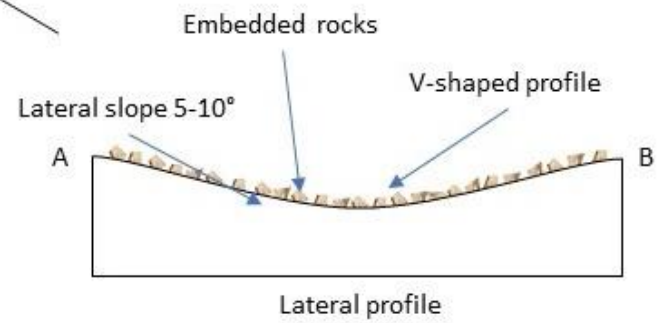
Conventional weir design







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Remediation of existing structures

Many existing structures do not allow effective fish passage

Not close to knowing full extent of problem

c.6400 small structures assessed

- 45% considered barriers

That's a lot of barriers to fix!

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Options

Removal should be first option & will ALWAYS have best result

Replacement with fish friendlier design

Retrofit existing structure to improve connectivity

- Ensure fit for purpose!

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Options

Common problems	Possible fixes							
	Removal	Replacement	Backwatering	Ramp fishway	Baffles	Mussel spat ropes	Bypass structure	Fish friendly flap gate
Excessive fall height	✓	✓	✓	✓		?	✓	
High water velocities	✓	✓	✓		✓	✓	?	
Insufficient water depth	✓	✓	✓		✓		?	
Physical blockage	✓	✓		✓			✓	✓

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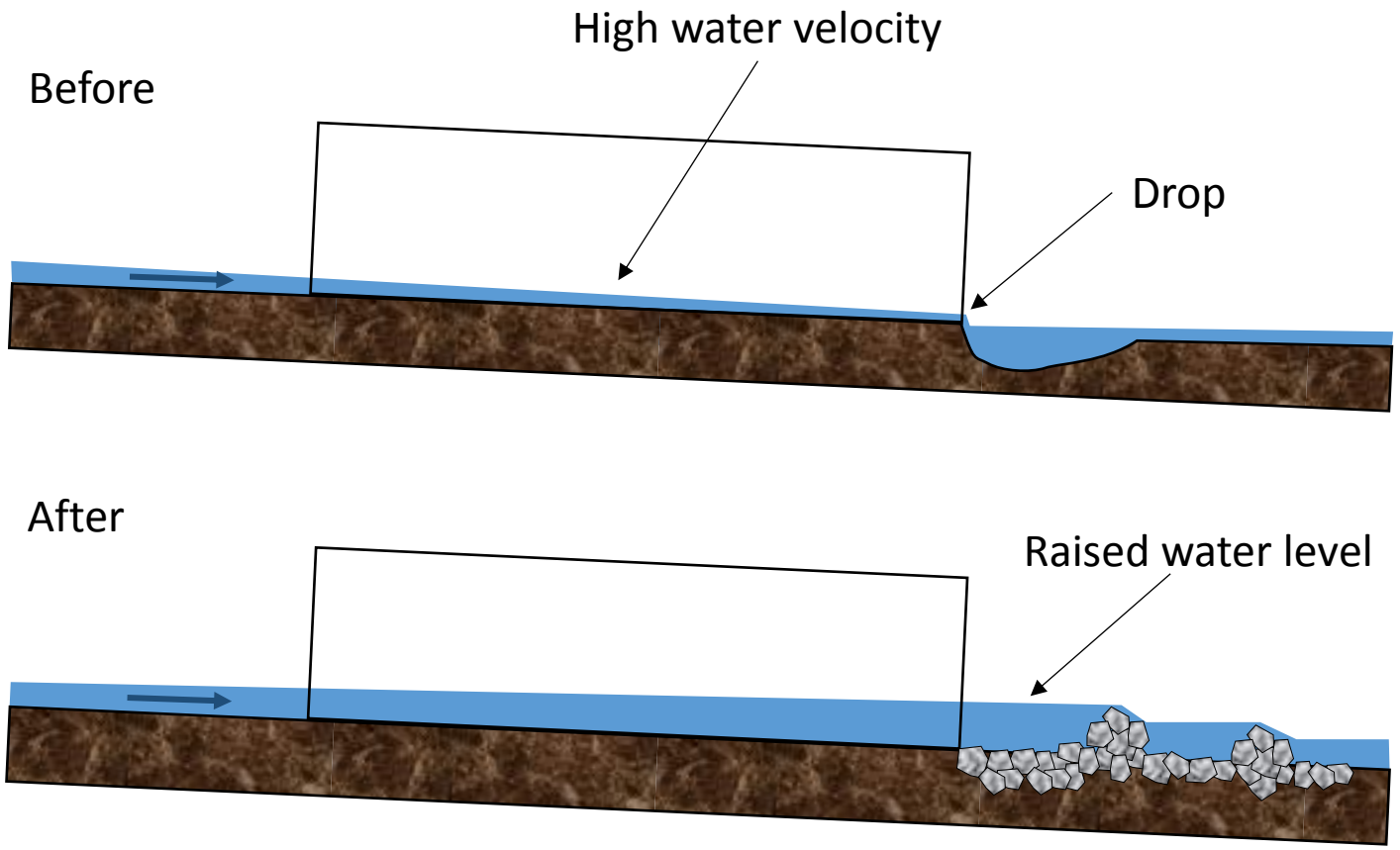
Backwater



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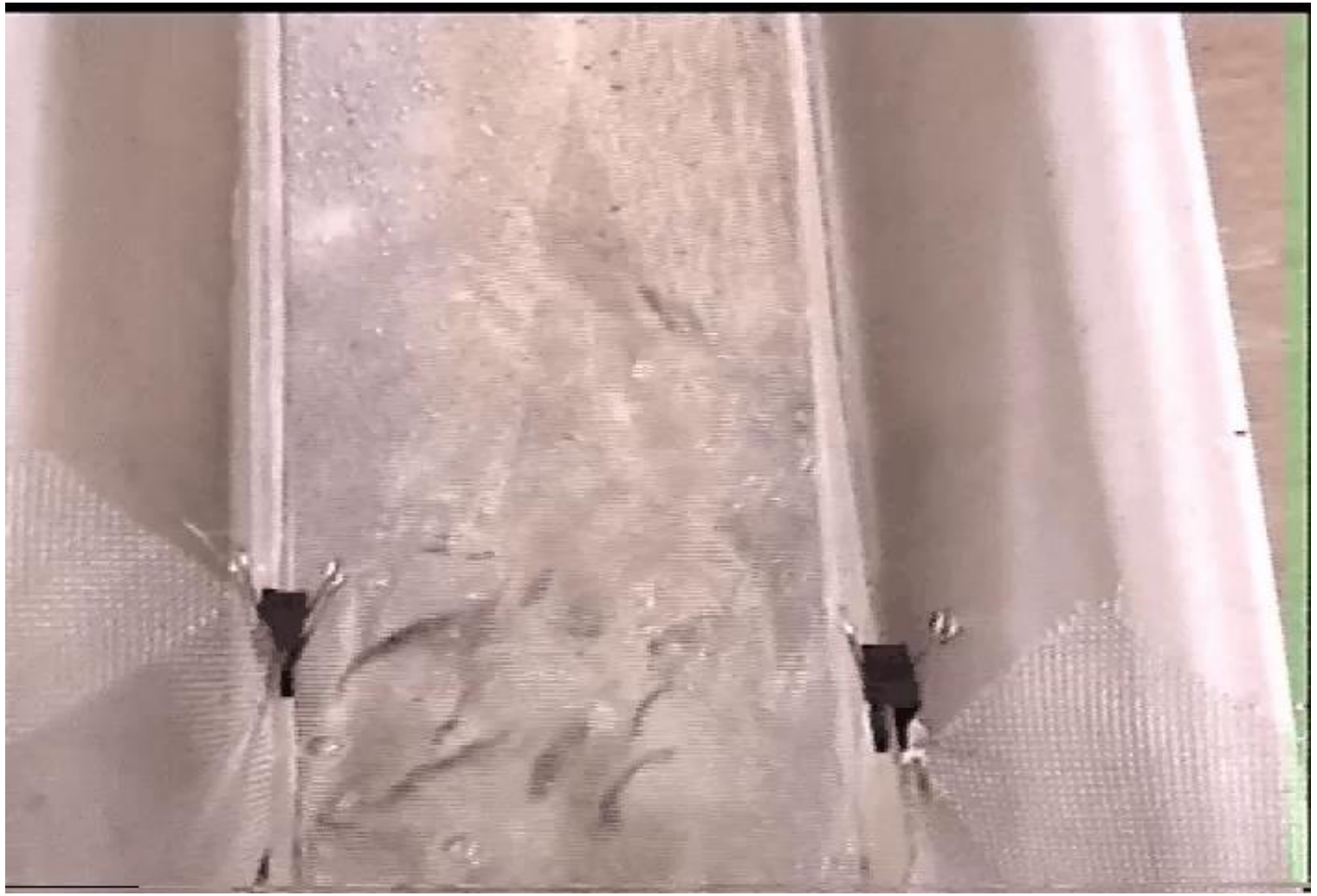
Sand

Ramps



Juvenile inanga (*Galaxias maculatus*) 15^{o} ramp

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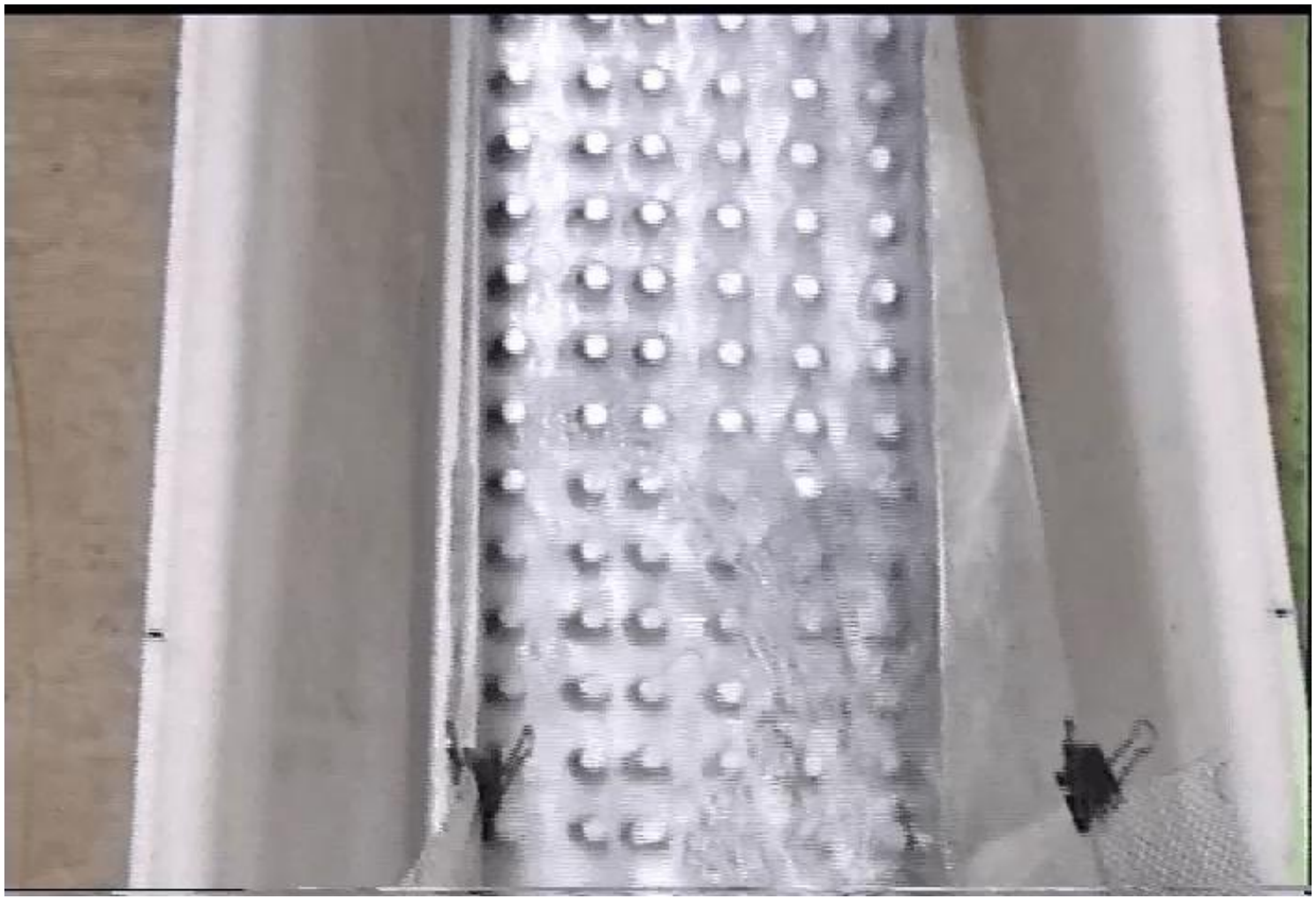
Miradrain®

Ramps



Juvenile inanga (*Galaxias maculatus*) 15^{o} ramp

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Ramps

Best practice to use rock-ramp fishways

‘Nature-like’ design

Low slope (≤1:30)

V-shaped cross-section

Pools >2 m long

Drop between pools <75 mm

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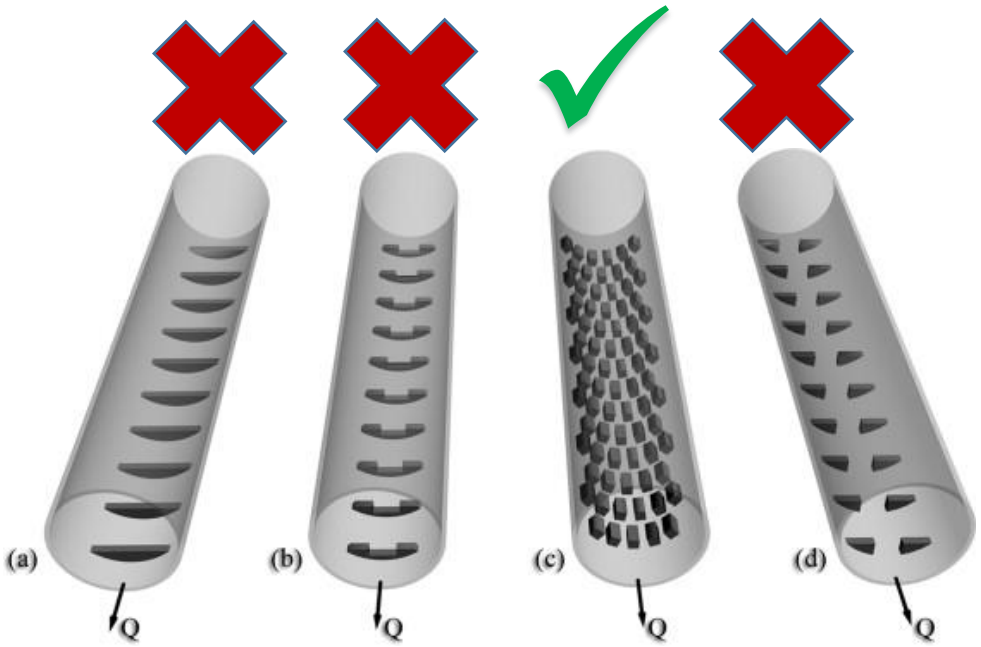
Baffles

Baffles can be effective where high water velocities limit fish passage

Variety of designs proposed

Spoiler baffle designs recommended option for culverts

Weir type baffles not currently recommended



Some examples of possible culvert baffle installations that have been proposed to facilitate fish passage. (a) weir baffle; (b) Alberta fish weir; (c) spoiler baffle; (d) slotted weir baffle. Source: Feurich et al. (2012).

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Baffles

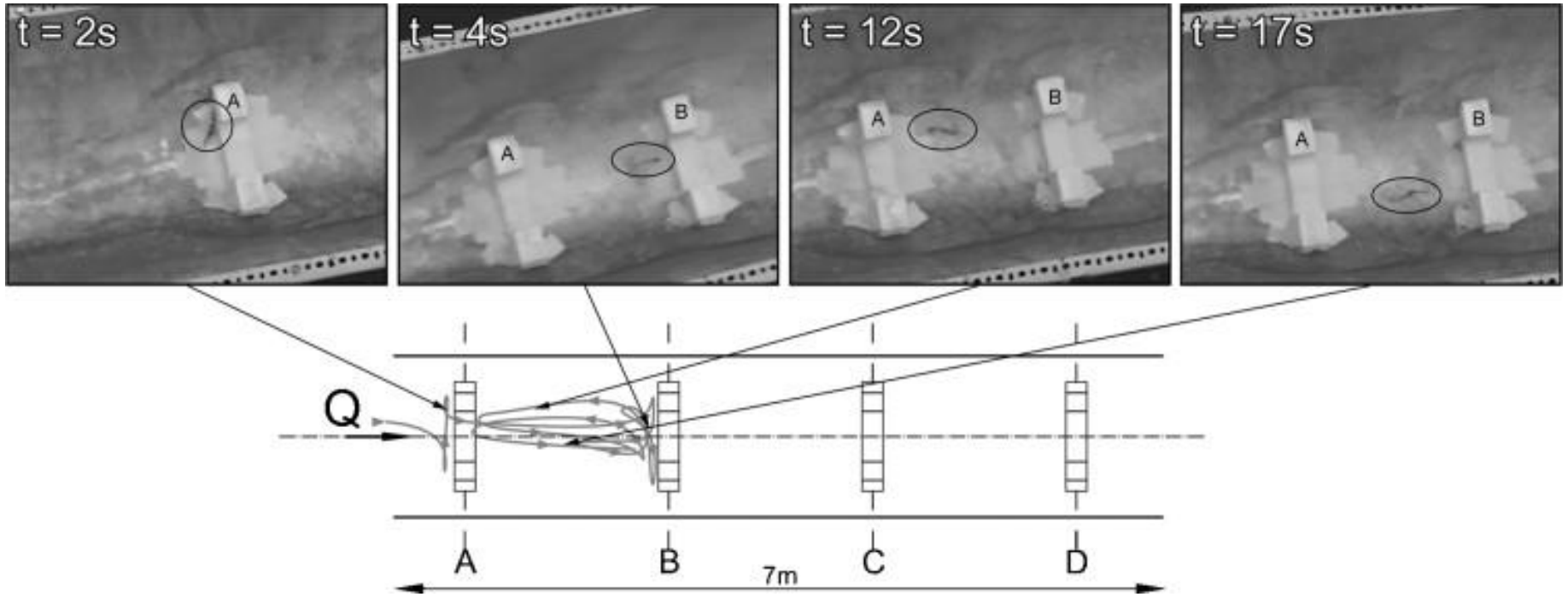

Fig. 3. Example of overhead images taken of a fish attempting to negotiate a circular culvert fitted with Alberta fish weir. A plan view of the experimental set up showing a typical path taken by fish during the test is also shown. Source: Feurich et al (2012)

Feurich et al (2012) Improvement of fish pas
Ecological Engineering 47: 1-8

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Baffles

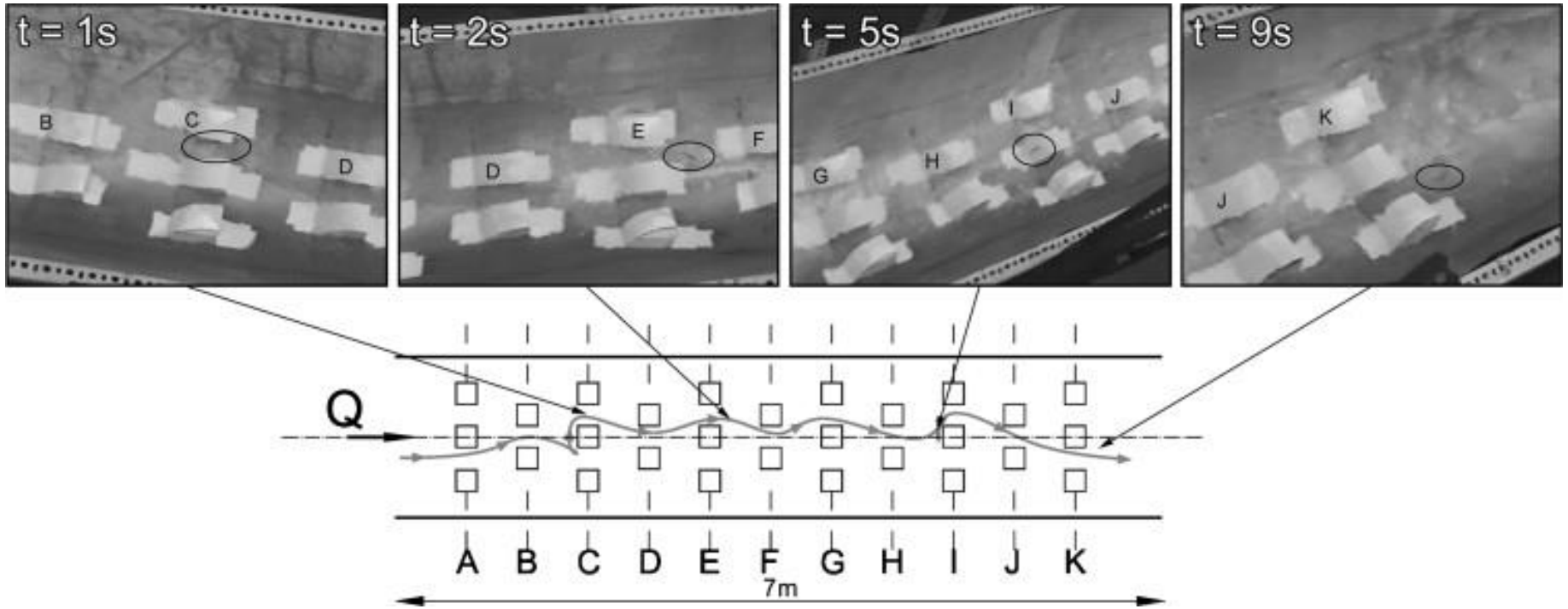

Fig. 4. Example of overhead images taken of a fish negotiating a circular culvert fitted with spoiler baffles. A plan view of the experimental set up showing a typical path taken by fish during the test is also shown. Source: Feurich et al (2012)

Feurich et al (2012) Improvement of fish pas
Ecological Engineering 47: 1-8

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Baffles

For culverts up to 2% slope:

- Rectangular baffles (0.25 x 0.12 x 0.12 m)
- Spacing of 0.20 m between rows & 0.12 m between blocks within rows
- Baffles to cover c.1/3 of culvert base

Correct installation important for durability

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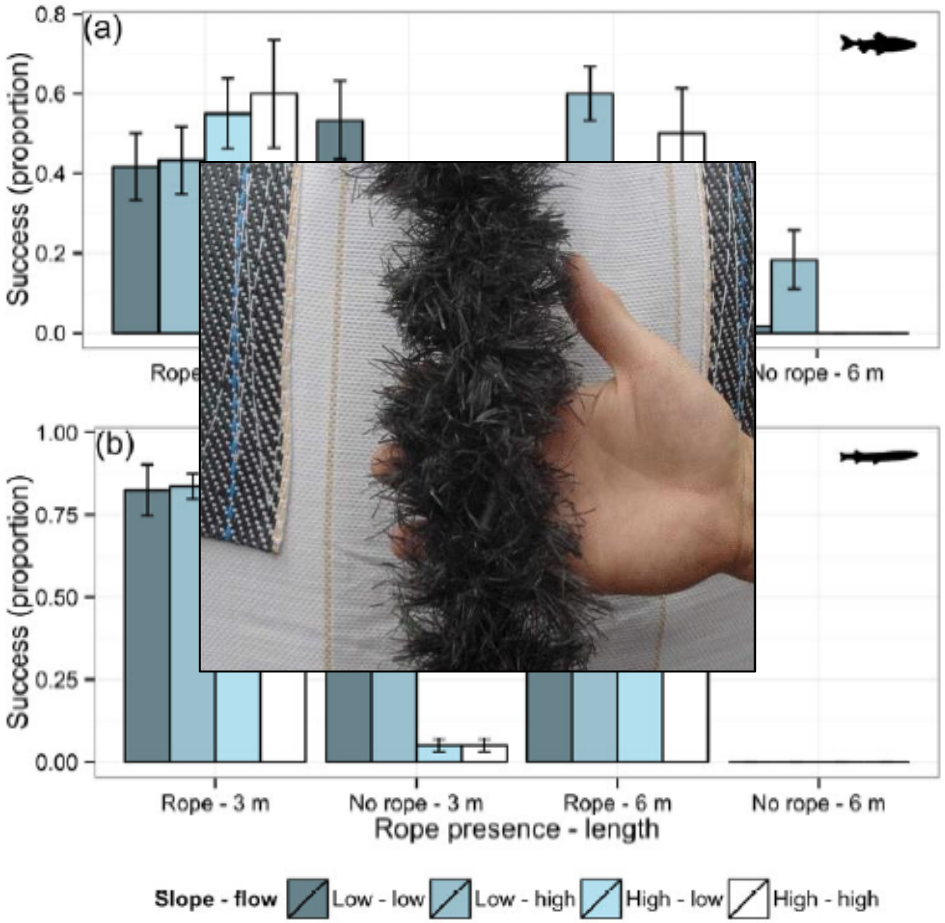
Mussel spat ropes

Mussel spat ropes tested as novel solution

Can help good climbers at vertical drops

Effective at enhancing passage in small culverts

Widely misused!



David et al (2014) Learning the ropes: improve fish & shrimp passage throug
Applied Ecology, 51: 214-223

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Mussel spat ropes

Mussel spat ropes can be cost-effective fix for culverts <1.2 m Ø IF installed correctly

- Number of ropes scaled to culvert size
- Ropes tight and flush with culvert base
- Ropes full length of culvert
- ‘Swimming lanes’ between ropes for fish

- Too few ropes
- Ropes not in water!
- Ropes loose
- Ropes not full length of culvert
- Ropes old and worn

David et al (2014) Appropriate use of mu
facilitate passage for stream organisms.
Council Technical Report 2014/29

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Bypass structures

Bypass structures

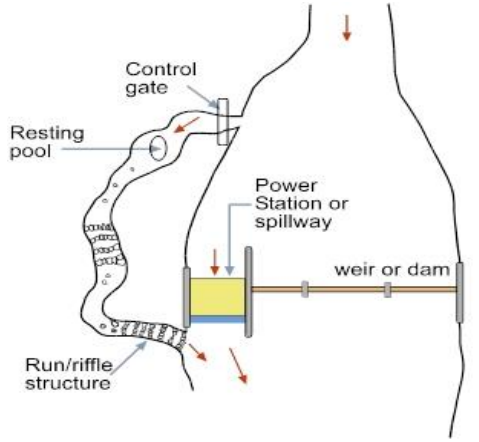
Nature-like fishways

- Mimic natural stream characteristics

Technical fishways

- Hard engineered designs
- Vertical slot, denil, pool & weir

Relatively few examples in NZ



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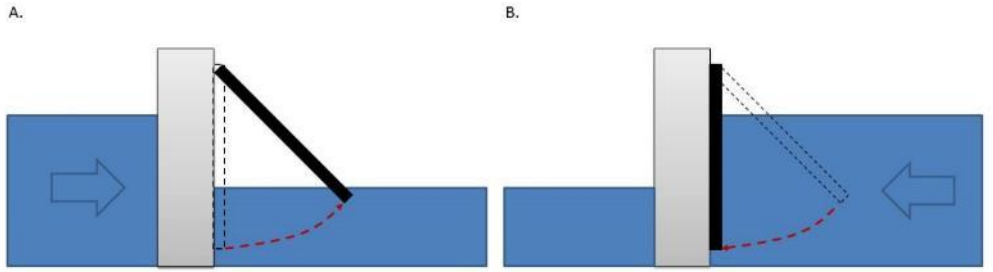
Other structures

Tide gates obstruct the movement of fish

Gates close on incoming tide when most fish move upstream

‘Fish friendly’ self-regulating gates can be used to hold gates open for longer



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Built barriers – a special case for protecting native biodiversity

Chapter outline:

- When must selective fish passage be considered
- Which native fish will benefit
- Setting objectives
- Biological factors to consider
- Best practice design criteria and installation

Out of scope:

- Non-physical intentional barriers

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The importance of monitoring

There are a range of innovative and cost-effective solutions being developed

Need to ensure designs meet best practice or minimum standards

Require monitoring to ensure effectiveness before widespread application

Remember that one size does not fit all

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Why fish friendly?

Economic vs ecological costs

Immediate vs lifetime costs

Resilience of structures

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Questions and Acknowledgements

New Zealand Fish Passage Advisory Group

Trust Power
Waikato Regional Council
pdp
NZ Transport Agency Waka Kotahi
Christchurch City Council
tasman lifestyle district council
Tonkin+Taylor
Auckland Council
CAWTHRON INSTITUTE
Ministry for the Environment
Manatū Mō Te Taiao
Fish & Game New Zealand
Te Rūnanga o NGĀI TAHU
DairyNZ
Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha
ATS Environmental
Department of Conservation
Te Papa Atawhai
NIWA Taihoro Nukurangi

https://www.niwa.co.nz/freshwater-and-estuaries/research-projects/new-zealand-fish-passage-guidelines

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