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Proof of concept for an innovative pump fishway design to move fish upstream over dams

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Pump Fishway Project: Proof of Concept

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Funded by NSW Recreational Fishing Trusts

The problem:

- ~50,000 high dams globally – 500 in Australia
- Migration blocked to major habitat areas upstream
- Very few high fishways exist, <3% in Australia
- Very few mitigate barrier effects adequately
- High fishway costs impede mitigation
- Design innovation is an urgent priority

Commercial Fish Pump in Operation

Tassal Salmon Farm, Bruny Island, Tasmania

- Airlift pump relocating & grading Atlantic salmon
- 10,000 fish, 2–4kg moved without injury through 200mm pipe in 3 hours
- 2–4 kg Atlantic salmon passing through pipe



Pump Fishway Project Goals & Objectives

- Design a better, cheaper upstream fishway
- Combine methods from fishways & aquaculture
- Attract and trap fish in chamber that can be pressurized for piped passage
- Use reservoir's hydraulic head to provide flow & energy
- Provide experimental proof of concept using models
- Refine and test full-scale prototype in the laboratory and the field
- Optimize all passage stages – attraction, entry, passage, refuge
- Full range of migrating species and sizes

Initial vertical-cylinder model



Horizontal-cylinder model



Research conclusions

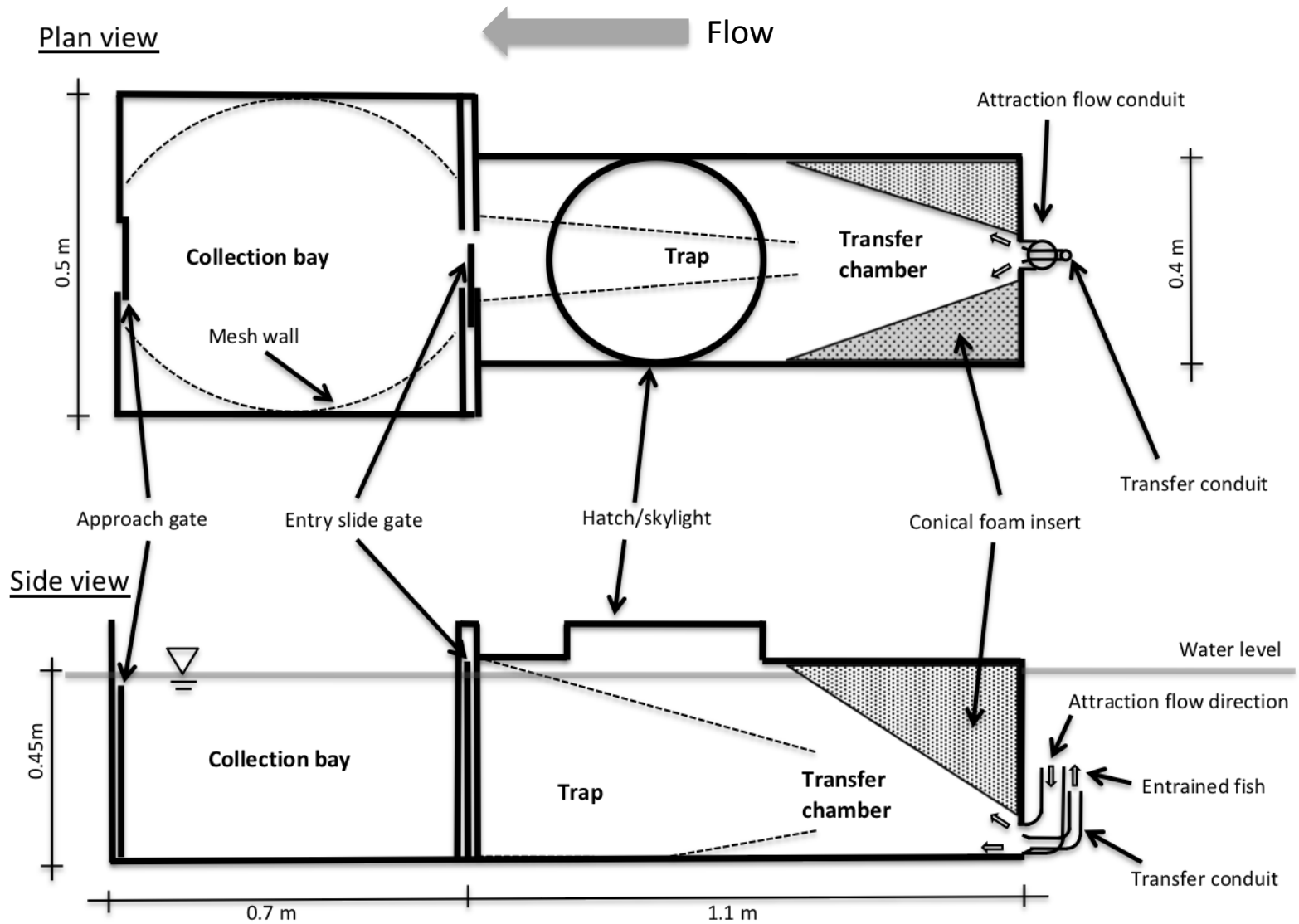
- Disturbed fish seek refuge at depth
- Escape reactions stimulate swimming into flows
- Curved structures reduce delays



Design responses

- Horizontal design allows fish to remain at bottom
- Input attraction flows at upstream limits
- Eliminate sharp corners

HORIZONTAL-CYLINDER FISHWAY MODEL HC3

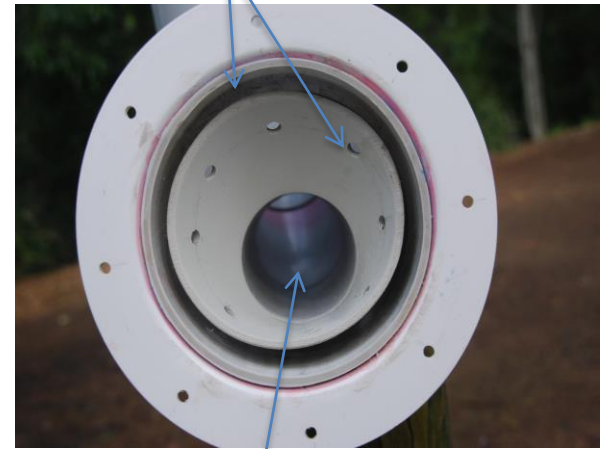


Modified Pump Fishway model HC3

Transfer chamber

Collection bay

Attraction flow inlets



Transfer conduit entrance

Transfer conduit

Transfer conduit integrated within attraction flow conduit

Attraction flow conduit



Performance summary: Horizontal cylinder models

Model	No. trials	Fish length (mm)	Percent fish through gate (min.)	Percent fish transferred (< 30 min.)	Model average transfer (%)
Original	4	83	100 (5.8)	80 (18.8)	
Original	4	64.2	90 (13.4)	10 (30)	
Original	4	60.3	100 (8.8)	15 (30)	35
Modified 1	5	54.4	88 (15)	72 (26)	72
Modified 2	9	50.3	100 (6.6)	98 (17.9)	98



Pump Fishway Features

- Combines four technologies:
 - Fish passage, aquaculture transfer, hydro energy, novel hydraulic pumping
- Compact, light-weight, modular construction
 - Floating → independent of tailwater variation?
 - Barge-mounted & re-positioned → optimal attraction?
 - Removable before floods?
- Constant operation, short cycling period
- Energy-independent
- Simple → reliability, low maintenance
- Proof-of-concept established



Expected Pump Fishway Benefits

- Less limited by fish size, physiology & behaviour
- Versatile, adaptable to sites $>\sim 2\text{m}$
- Low capital and operating costs
- Energy independent
- All critical fishway functions effective:
 - attraction, entry, passage, refuge

