

Dec 13th, 1:30 PM - 3:10 PM

Cost Effective Modelling to Improve the Functionality of the Broken Creek Rice's Weir and Kennedy's Weir Vertical Slot Fishways

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Presenter Information

Steven Slarke, Jarrah Muller, Ivor Stuart, Justin O'Connor, Matthew Jones, and Mark Turner



**Fish Passage 2018 - International
Conference on River Connectivity
Albury - Australia, 10-14 Dec 2018**

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By: Steven Slarke (Jacobs), Justin O'Connor (Arthur Rylah Institute) and Ivor Stuart (Arthur Rylah Institute)

13 Dec 2018



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Aims of this Presentation

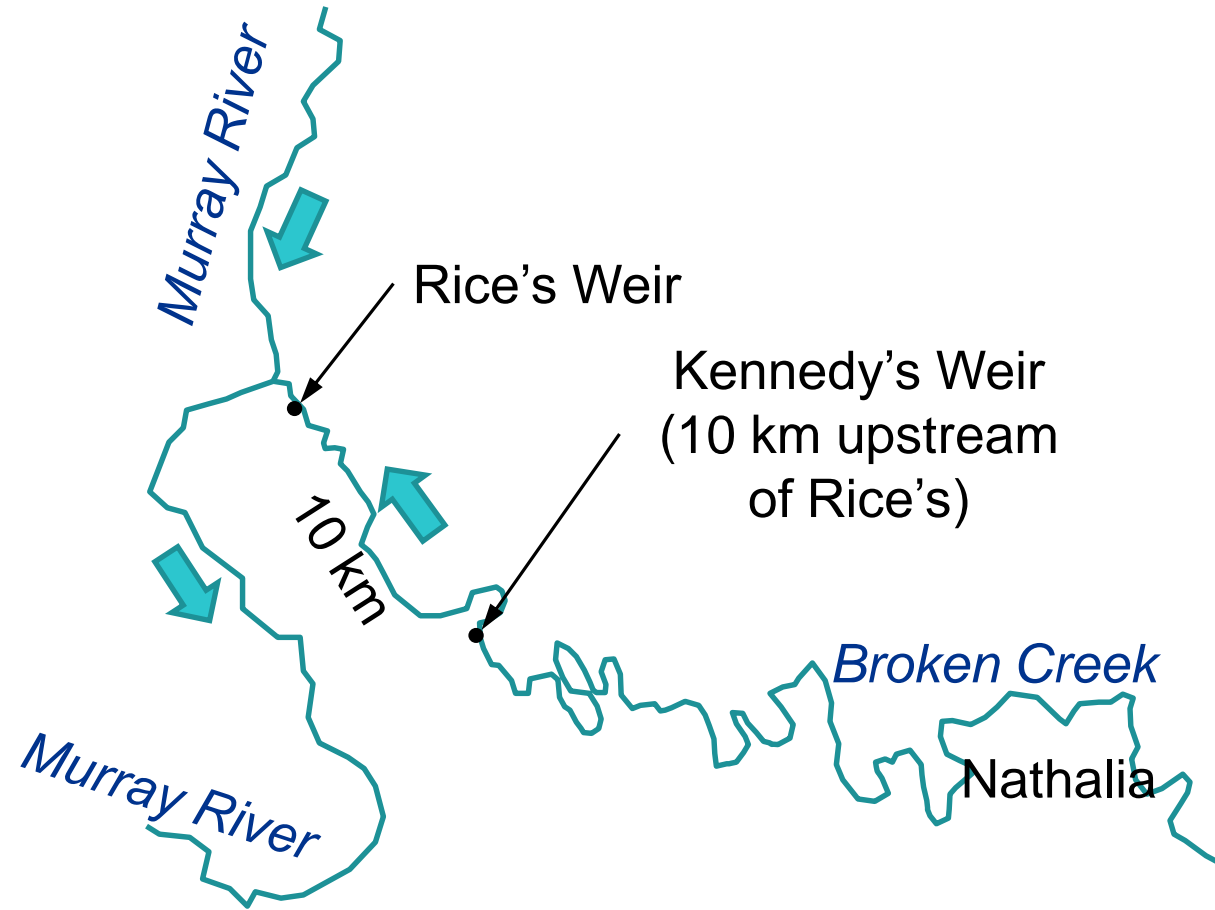
- Overview of Broken Creek.
- Kennedy's Weir (and Rice's Weir) VS Fishways – current biological limitations.
- Water levels analysis.
- Hydraulic and biological modelling – existing scenario – poor functionality.
- Conceptual level 'key-holed slots'.
- Hydraulic and biological modelling – modified scenario – improved functionality.

Broken Creek



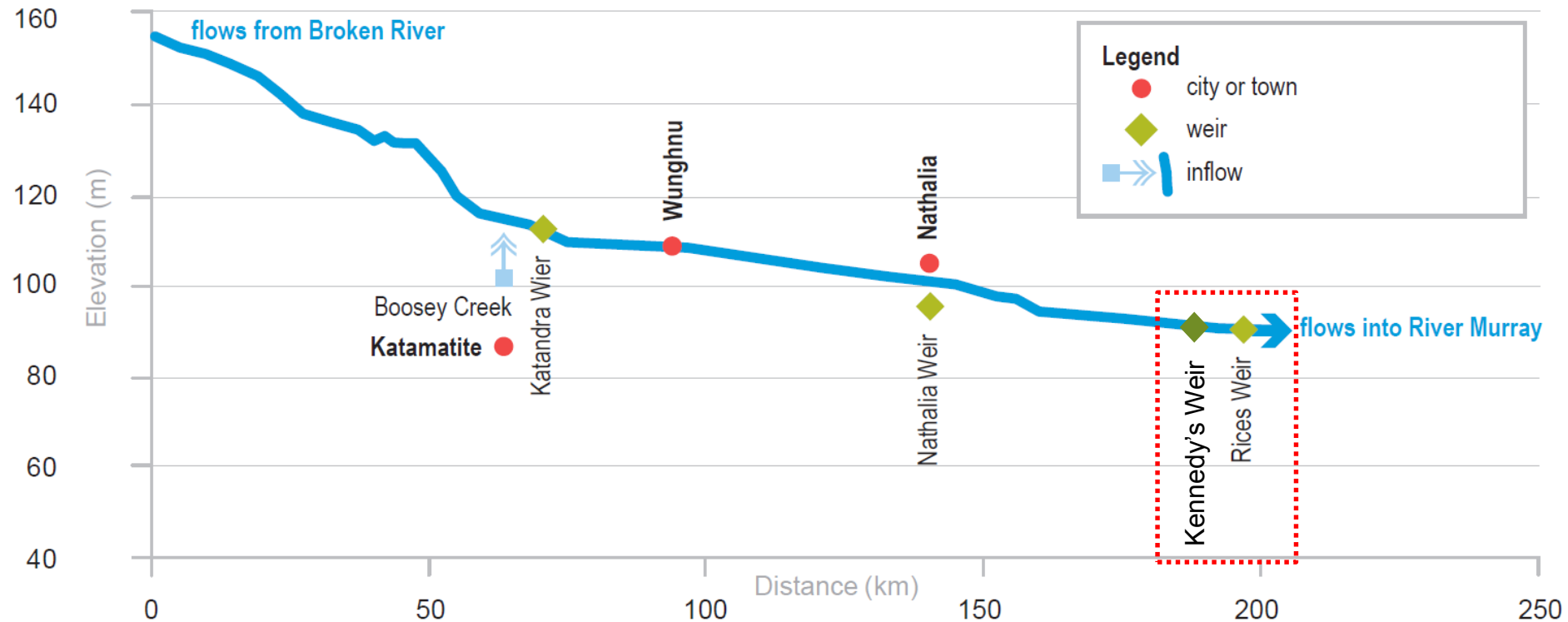
Source: Google Maps

Broken Creek



Broken Creek Longitudinal Profile

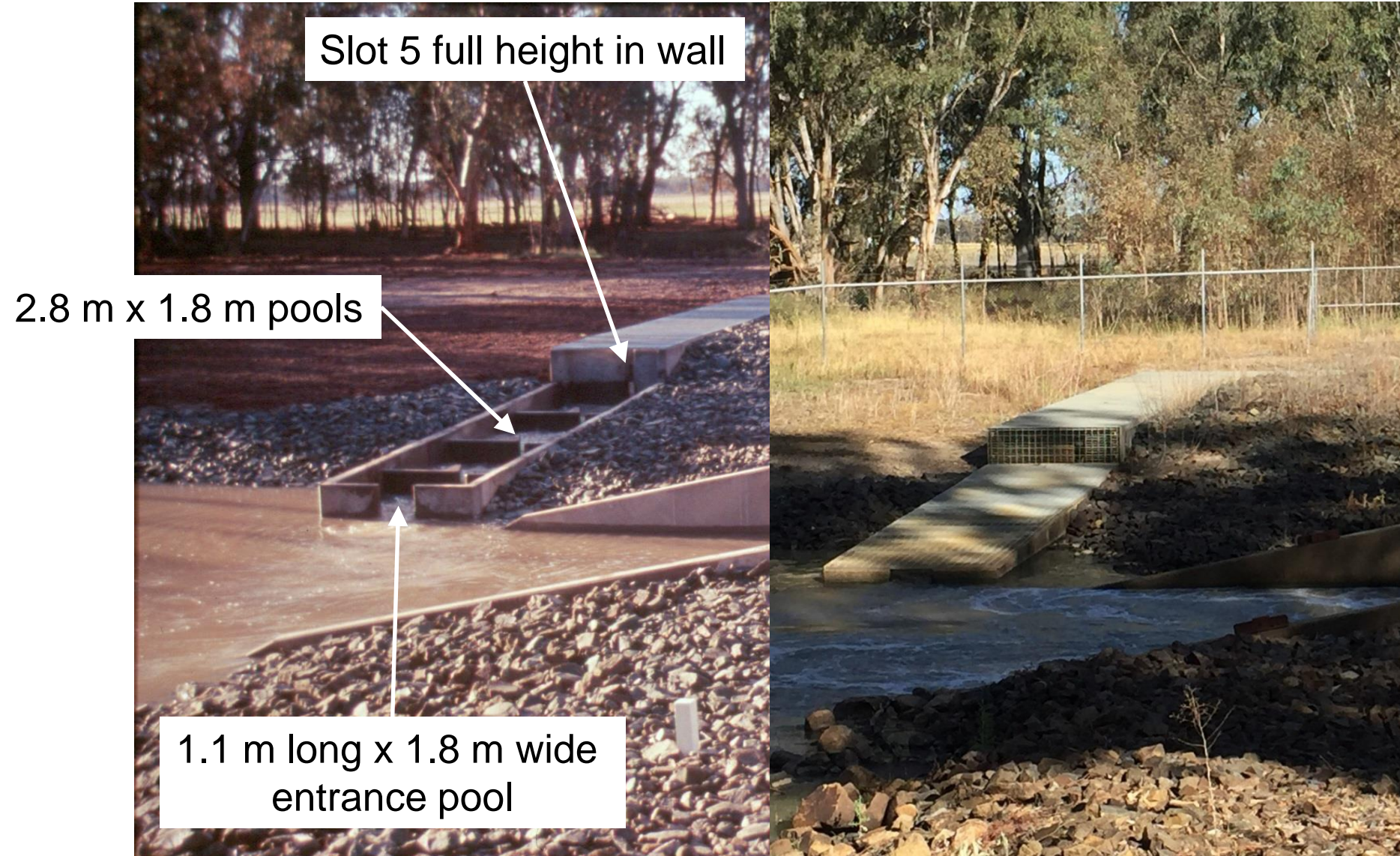
ARI aim to improve hydraulics at 6 other fishways downstream of Nathalia



Source: MDBA

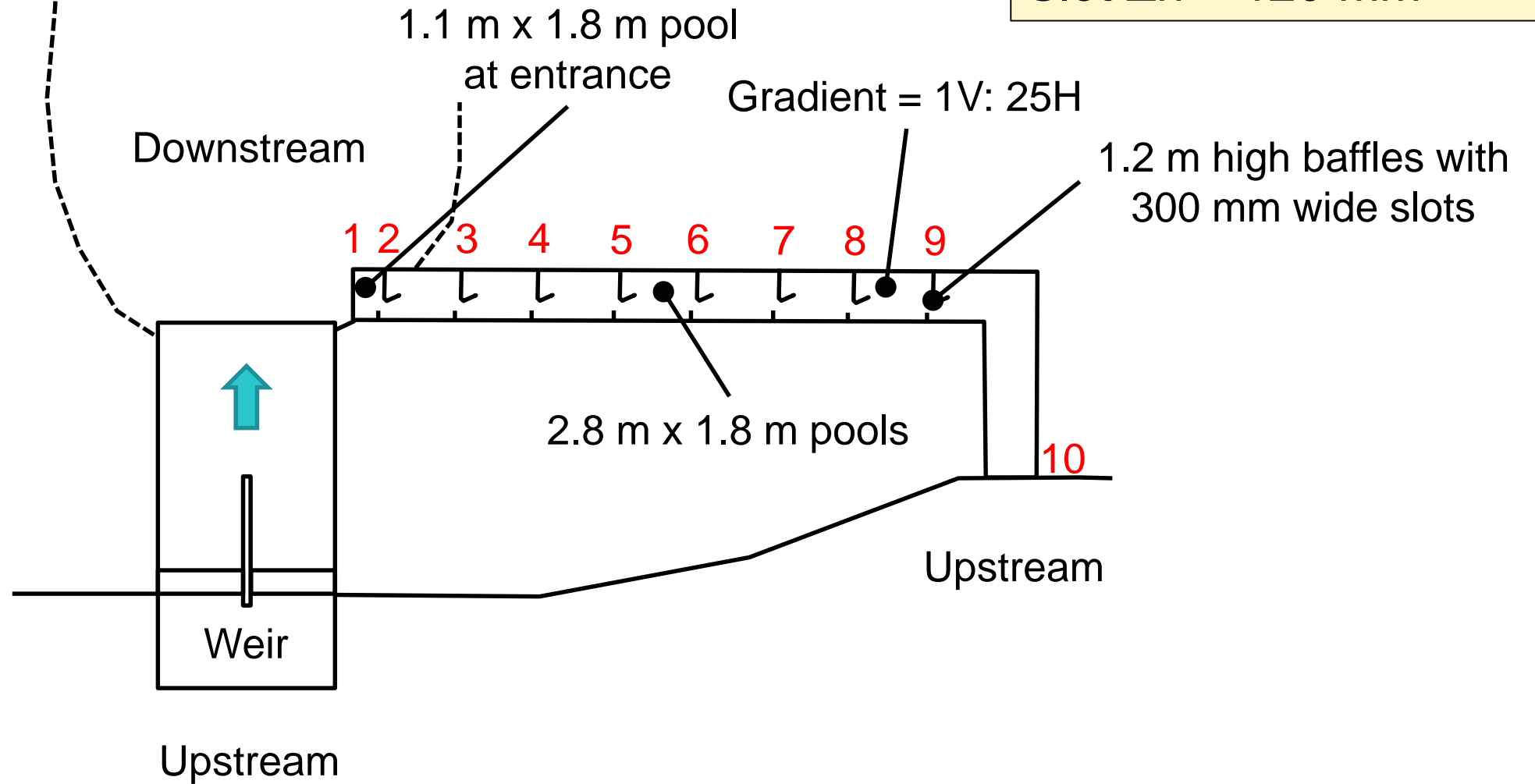


Kennedy's Weir and VS Fishway



Kennedy's Weir and VS Fishway

Total $\Delta H = 1.1 \text{ m (max)}$
Slot $\Delta h = 120 \text{ mm}$

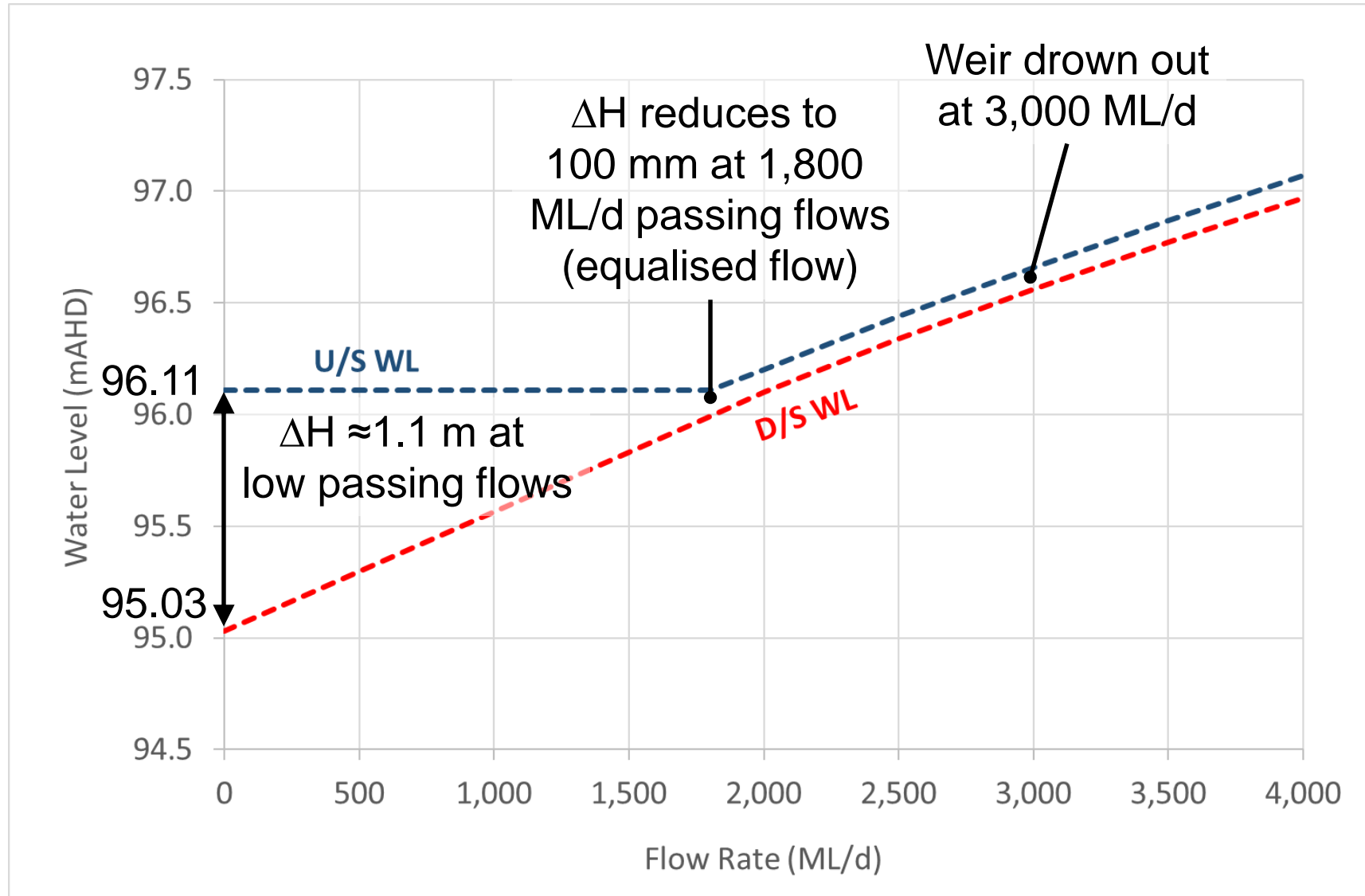


Issue and Requirement

- Issue:
 - The fishways are turbulent, and prevent the upstream passage of all but the largest and hardiest fish.
- Requirement:
 - Conceptual design and modelling of ‘key-hole’ slots to improve the biological functionality for small, medium and large-sized native fish.



Kennedy's Flow Rating Curve



Jacobs Hydraulic and Biological Functionality Model

- Jacobs developed MS Excel based model for vertical slot fishways.
- Model Inputs:
 - Structure geometry (levels, slot sizes, pool dimensions, slot discharge coefficients etc.)
 - Biological criteria for small, medium and large-sized native fish:
 - Maximum pool turbulence (W/m^3)
 - Minimum pool water depth (m)
 - Maximum slot velocity (m/sec)



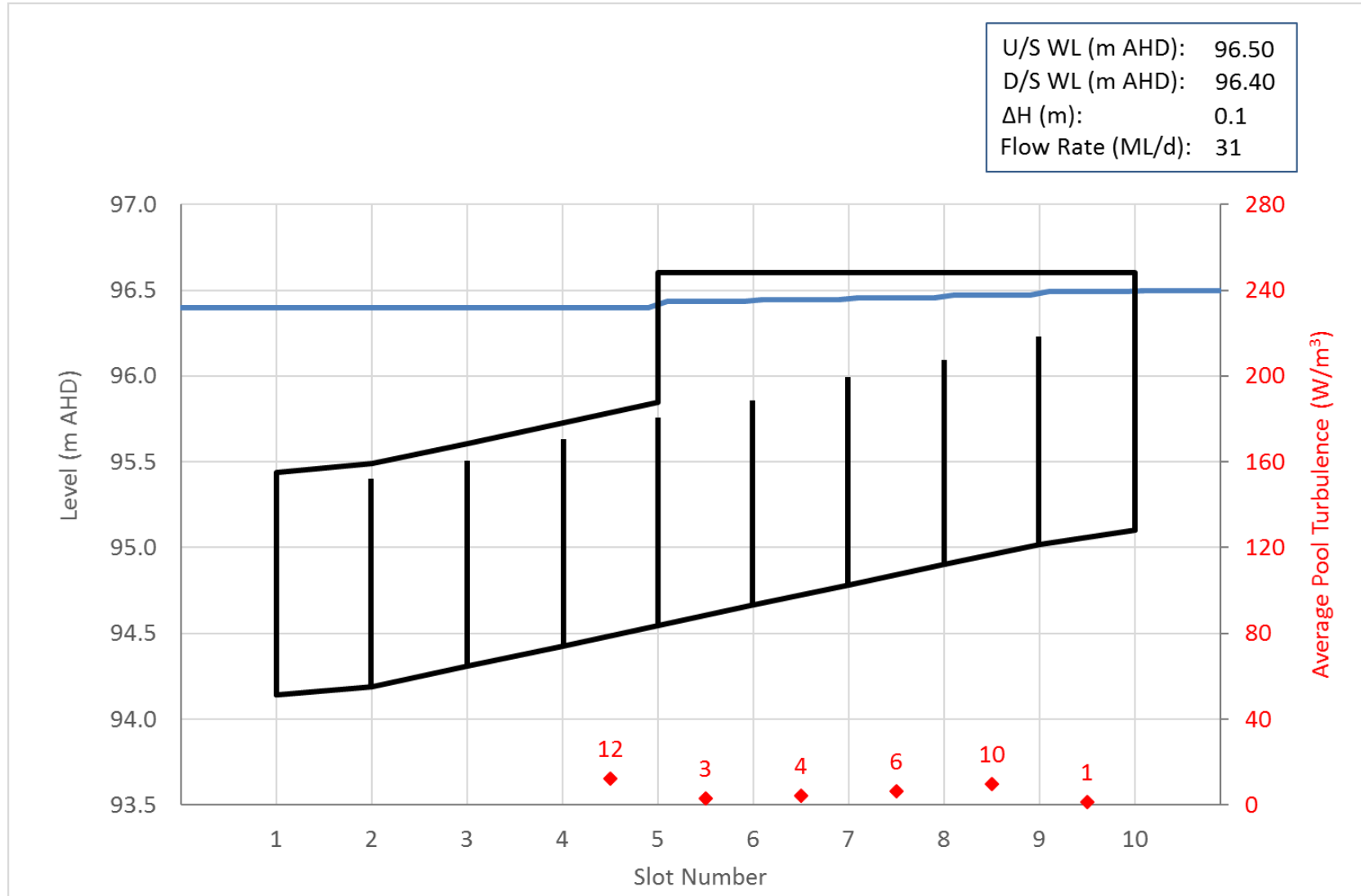
Biological Functionality Criteria

Fish Category	Size Range	Pool Turbulence	Pool Water Depth	Slot Water Velocity
		Desirable maximum	Desirable minimum	Desirable maximum
		W/m ³	mm	m/sec
Small-sized fish	20 to 100 mm	30	500	1.0
Medium-sized fish	100 to 650 mm	60	1000	1.2
Large-sized fish	650 to 1400 mm	90	1500	1.4

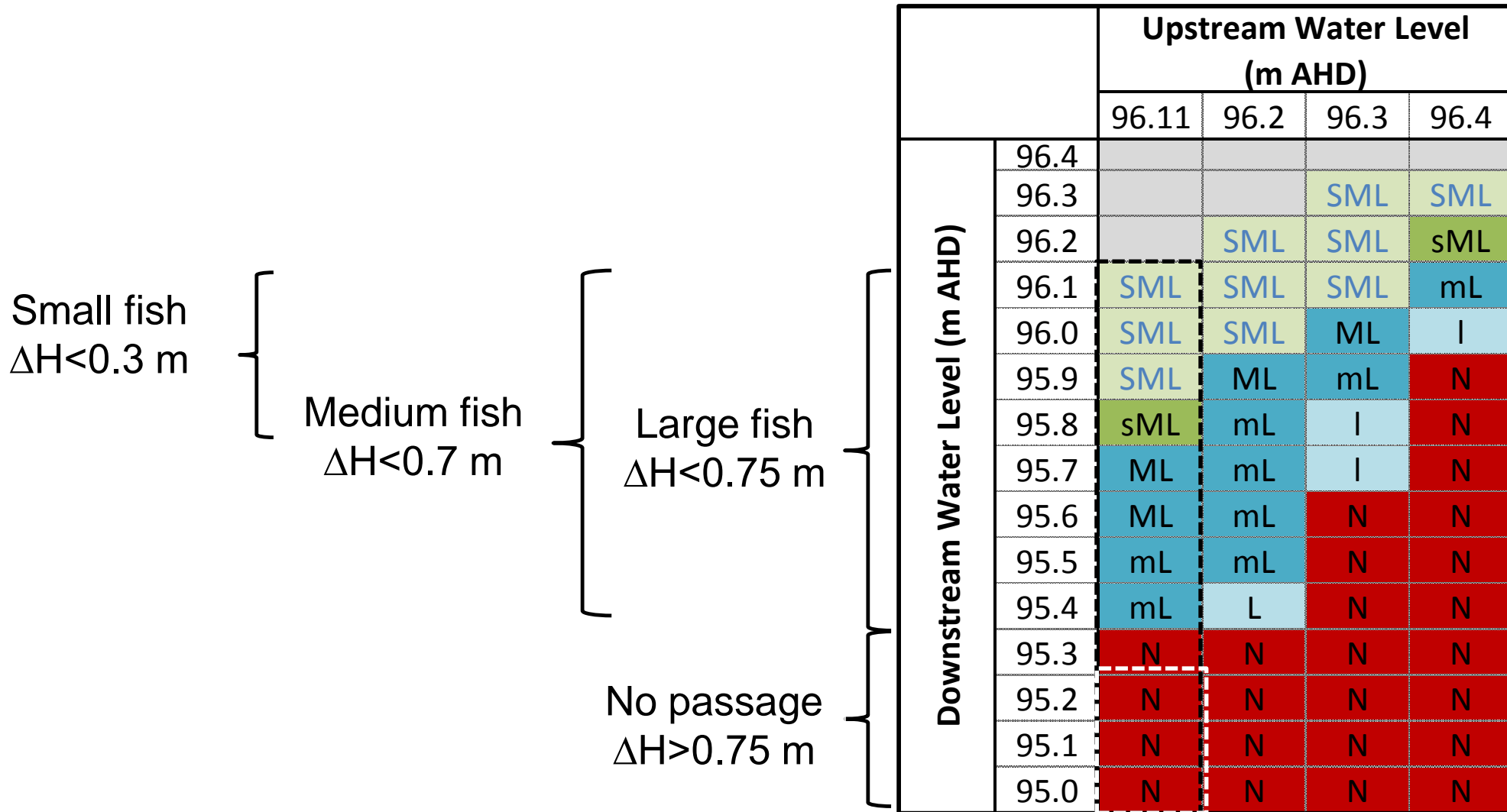
Jacobs Hydraulic and Biological Functionality Model

- How the model works:
 - considers incremental combinations of water levels to solve the water surface profile and flow through the fishway.
- Graphical Outputs
 - Hydraulic functionality:
 - flow, turbulence, depth, velocity
 - Biological functionality:
 - The ability of the fishway to pass the target small, medium and large-sized native fish species – comparing the biological requirements against the modelled hydraulic outputs.

Kennedy's VS Fishway: Existing Scenario



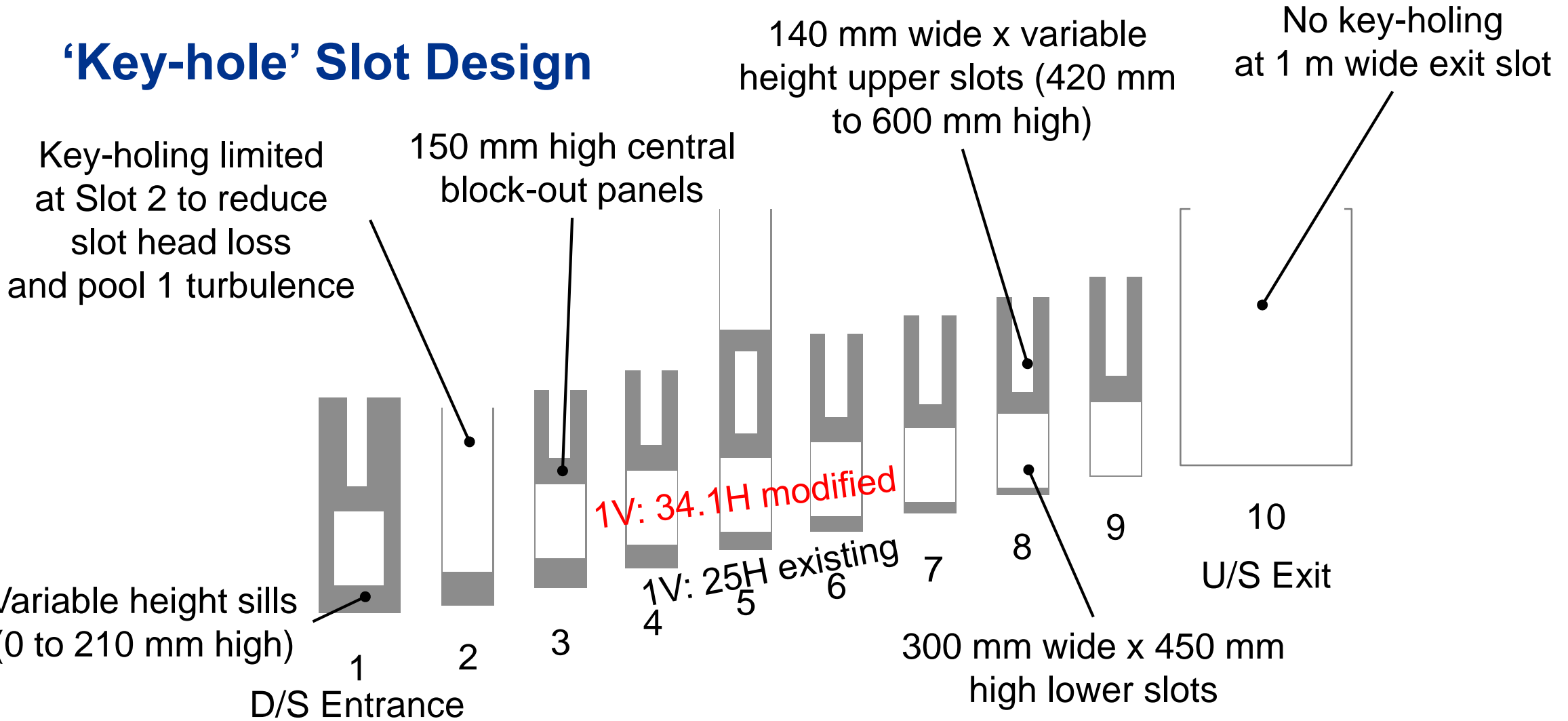
Biological Functionality – Existing Scenario



80% of the time, D/S water level between 95.04 (10th %ile) and RL 95.22 (90th %ile). Average RL 95.14



'Key-hole' Slot Design

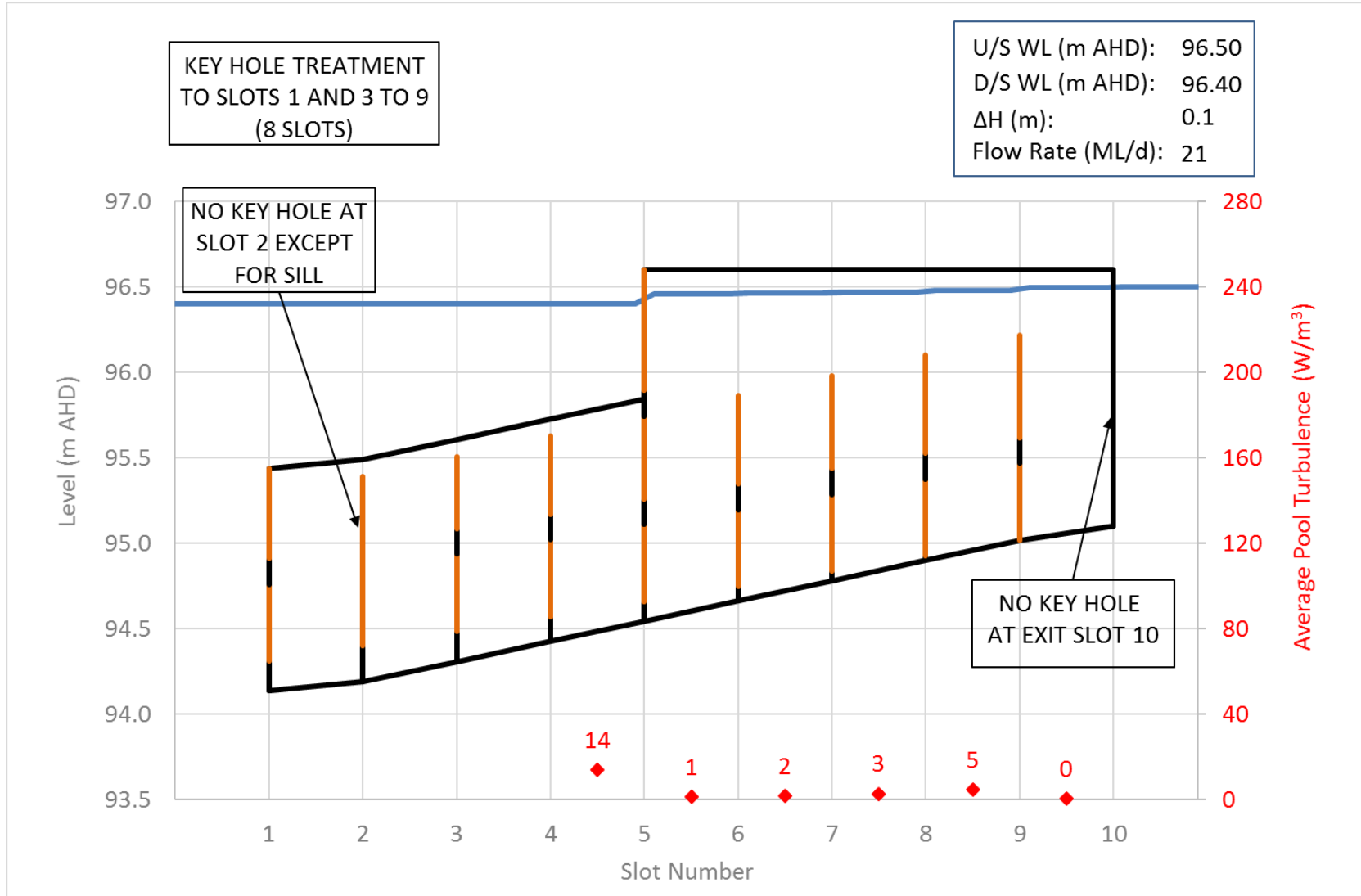


Aims – Improve biological functionality for the passage of small, medium and large-sized native fish by:

- Flattening the fishway gradient from 1V: 25H to 1V: 34.1H by the introduction of sill plates, and
- Reducing the slot area, flow and pool turbulence by the introduction of 'key hole' slotted plates.

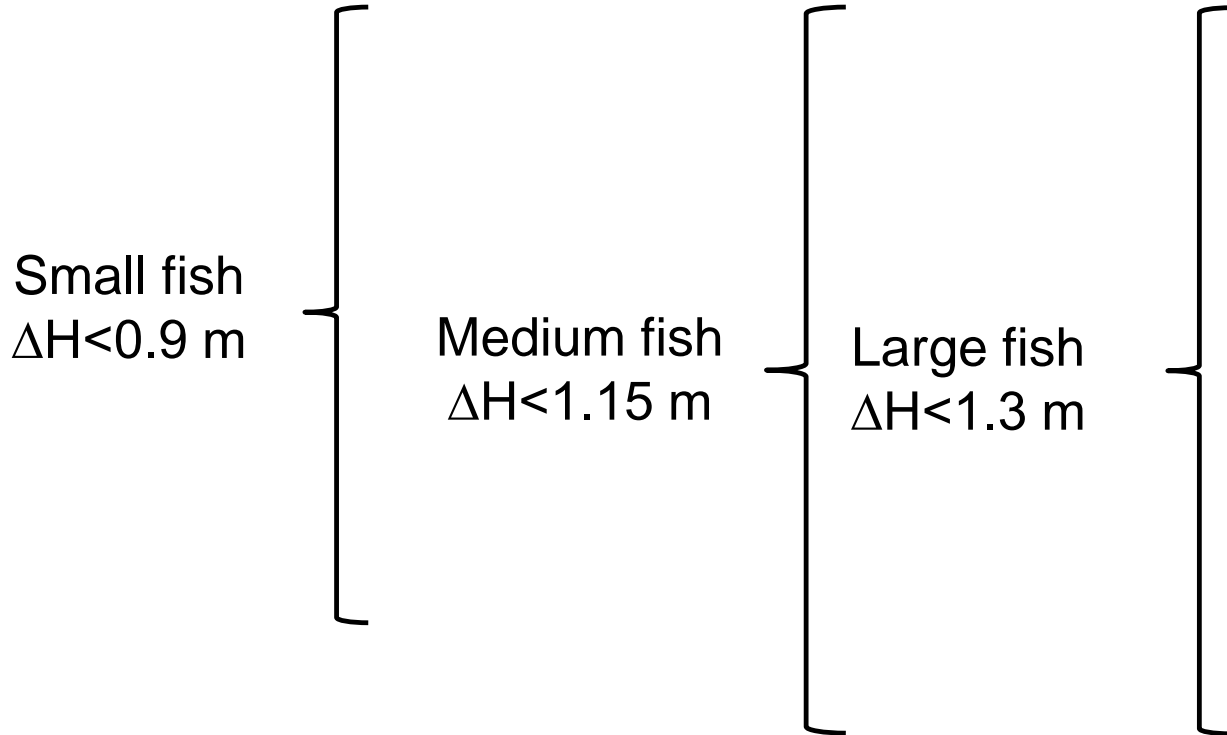
Kennedy's VS Fishway: Modified Scenario

'key-holed' vertical slots



Biological Functionality – Modified Scenario

Potential operational change? Artificially raise D/S WL by 150 mm or pass higher flows to facilitate passage for small-sized native fish for more of the time.

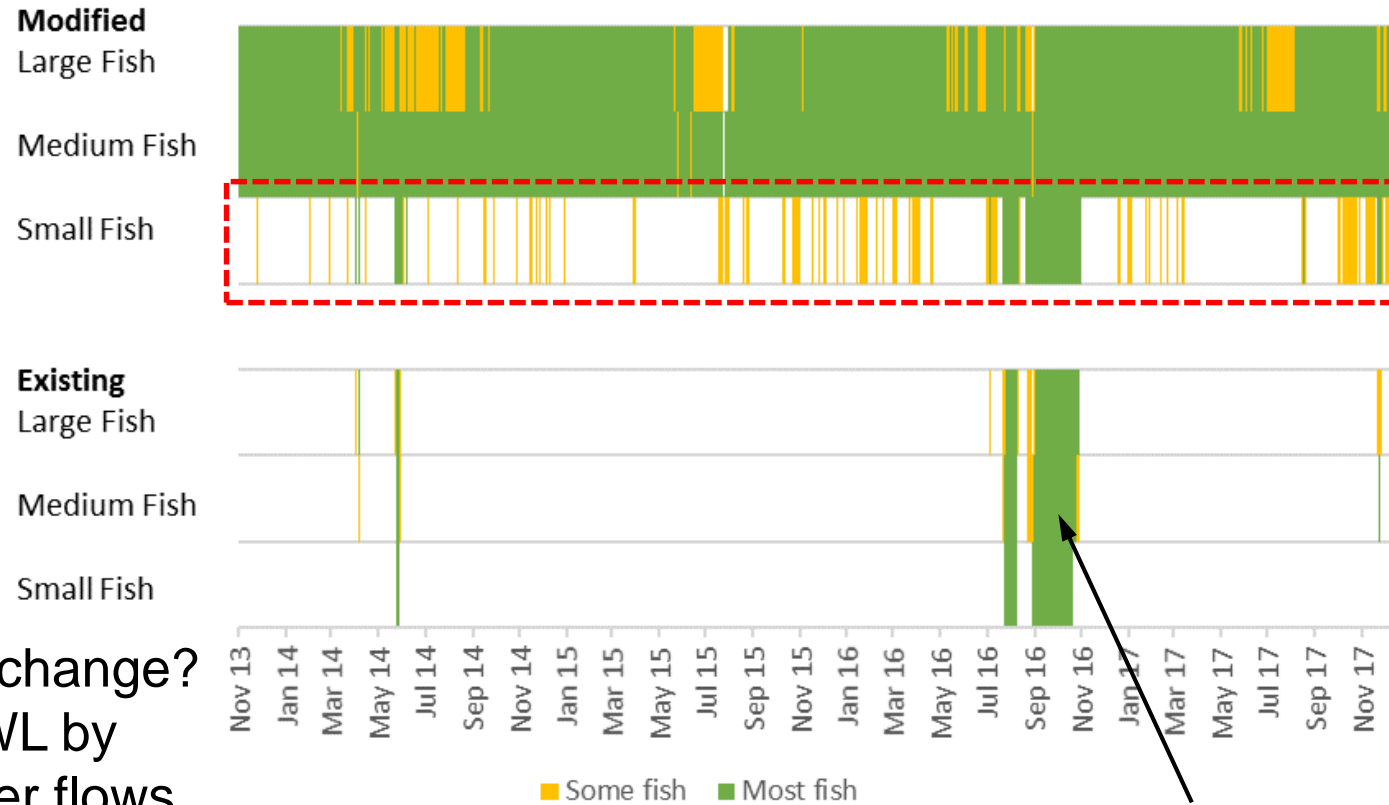


		Upstream Water Level (m AHD)			
		96.11	96.2	96.3	96.4
Downstream Water Level (m AHD)	96.4				
	96.3			SML	SML
	96.2		SML	SML	sML
	96.1	SML	SML	SML	mL
	96.0	SML	SML	ML	I
	95.9	SML	SML	mL	N
	95.8	SML	SML	I	N
	95.7	SML	sML	N	N
	95.6	SML	ML	N	N
	95.5	SML	ML	N	N
	95.4	SML	ML	N	N
	95.3	SML	ML	N	N
	95.2	sML	ML	N	N
	95.1	ML	mL	N	N
95.0	ml	ml	N	N	



80% of the time, D/S water level between 95.04 (10th %ile) and RL 95.22 (90th %ile). Average RL 95.14

Biological Functionality – Kennedy’s VS Fishway



Potential operational change?
Artificially raise D/S WL by
150 mm or pass higher flows
to facilitate passage for
small-sized native fish for
more of the time.

2016 flooding event

Summary

- Jacobs used a low-cost MS Excel based '*VS fishway hydraulic and biological modelling tool*' to model the functionalities of the Kennedy's Weir and Rice's Weir fishways.
- Conceptual level 'key-hole' retrofitted slotted plates were designed and modelled to demonstrate potential improvements to the fishways for the passage of small, medium and large-sized native fish.
- ARI and Jacobs are now working with Goulburn-Murray Water to fabricate and retrofit the key-hole baffle plates.

Thank you

Acknowledgements:

- Arthur Rylah Institute
- Goulburn-Murray Water
- The Jacobs team

