Fish Friendly Waterway Rehabilitation

WATERWAY MANAGEMENT PRACTICES

Photo 1 – Rock chute/ramp fishway near Tamworth, NSW

Photo 2 – Rehabilitation of an old concrete stormwater drain, Brisbane, QLD

1. Introduction

The retention and/or rehabilitation of suitable fish habitat and passage conditions is just one of the issues that needs to be considered when designing waterway modifications. Other design issues may include aesthetics, conservation of fauna and flora, terrestrial habitats, connectivity of terrestrial wildlife corridors, human movement corridors, flooding and drainage requirements, maintenance access, and safety issues.

Aquatic wildlife plays an important role in maintaining balanced ecosystems within our urban environments. Failure to achieve a suitable balance can result in adverse consequences such as increased mosquito and vermin populations, reduced recreational experiences, reduced recreational and commercial fishing, and a diminished return on the childhood experience of 'exploring your local neighbourhood'.

2. Supplementing existing fish habitats

The provision of suitable fish habitat and passage conditions does not mean simply building fish habitats. It is noted that enhancing fish habitats beyond their natural conditions could result in the unnatural dominance of certain fish species, or the proliferation of non-native species.

The construction of lakes and wetlands may initially appear to be an enhancement of aquatic habitat; however, in many cases these waterway features can represent significant barriers to fish passage. The primary cause of the problem is the grade control structures (usually weirs) that often appear at the upstream and/or downstream boundaries of these water bodies.

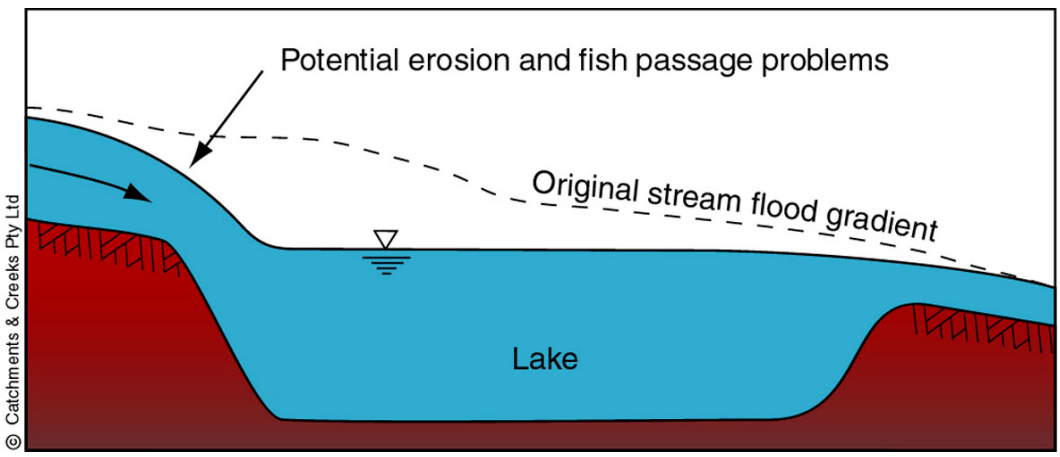

Figure 1 – Typical water surface gradient of an on-stream constructed lake

By their very nature, lakes and wetlands have a very flat water-surface; however, creeks have a sloping water surface, especially during flood flows. The construction of a large on-stream lake or wetland within a creek usually results in the amplification of the water surface gradient at the upstream and/or downstream ends of the water body as shown in Figure 1.

3. Erosion control

Optimum fish friendly erosion control measures are generally best achieved through the use of natural materials, such as rock and vegetation. Synthetic materials should be used sparingly, and only when natural-based, soft engineering options fail to achieve the required outcomes.

If rock protection is required, then the extent of rock placement should be limited to the minimum necessary so that the watercourse can maintain the maximum extent of naturally vegetated surfaces. Maintaining open voids between rocks may be suitable for those rocks located below the water line (to enhance aquatic habitat, Photo 3) but above the normal water line the voids should be filled with soil and small rocks and pocket planted (Photo 4).

Figure 3 – Rock placement in marine waters

Photo 4 – Early stages of revegetation of a rock stabilised stream bank

4. Bed stabilisation structures

A sudden fall in bed level is a common problem within incised waterways. These bed conditions can result from a number of contributing factor including urbanisation, sewer pipe crossings, causeways, and the exposure of bedrock. The resulting 'waterfall' conditions usually represent a barrier to fish passage, especially during periods of low flow.

Fish friendly treatment options include rock chutes (ridge rock placement and random placement, Photo 1), pool-riffle systems, (Photo 5) rock weirs (single rock height, Photo 6) and graded channels.

Table 1 provides a guide to the use of various fish-friendly grade control structures. This table should be used only as a guide. The suitability of any design will ultimately depend on the site conditions and the detailed hydraulic design.

Photo 5 – Constructed pool-riffle system

Photo 6 – Ridge rock fishway

Table 1 – Guidance of the selection of grade control structure [a]

	Rock ramp (ridge rock)	Rock chute	Pool-riffle system	Rock weirs (low structures)	Graded channel
Channel grade (over full length of structure including dissipation pool):					
1 in 20 to 1 in 30 (energy dissipation pool required at base)	✓				
1 in 30 to 1 in 40 (energy dissipation pool required at base)		✓			
1 in 50 to 1 in 80 (flatter grades can be achieved)			✓		
near-vertical fall (single) or 1 in 100 to 1 in 200 (series)				✓	
1 in 200 to 1 in 2000 (depends on geometry & roughness)					✓
Maximum fall at any given structure:					
100mm (maximum water fall at single step/weir)	✓			✓	
500mm (200 to 400mm preferred for pool/riffles)		✓	✓		
no limit (fish resting areas required along ramp/channel)	[b]				✓
Dominant bed material upstream of the structure:					
clay (fixed-bed channel)	✓	✓	✓	✓	✓
sand (moving-bed channel)		✓	[c]		✓
gravel (moving-bed alluvial channel)		✓	✓		✓
solid bedrock exposed at the structure	✓			✓	[d]
Flow depth during critical fish passage (ranking: 1 = best, 4 = worst):					
< 200mm	2	3	3	2	1
200 to 500mm	3	2	2	2	1
greater than 500mm (usually requires a low bed gradient)	4	2	3	2	1
Typical size of fish (ranking: 1 = best, 3 = worst):					
small freshwater fish, < 6cm	3	2	2	3	1
medium freshwater fish, 6 to 15cm	2	2	2	2	1
large freshwater fish, > 15cm	2	3	3	2	1
Suitability for downstream movement (ranking: 1 = best, 5 = worst):					
passage during water depth < 300mm	2	2	2	2	1
passage during water depth of 300 to 500mm	4	3	3	2	1
passage during water depth > 500mm	5	4	3	2	1

[a] Information is provided as a guide only (assumes typical channel conditions for given structure).

[b] High falls can be achieved, but can become a fish passage barrier during high flows.

[c] Riffles may be unstable if placed on sand. Sand can fill voids within the riffles or even fully bury the riffles. Sand can also fill the pools if energy levels within the upstream riffle are reduced.

[d] If the exposed bedrock has a steep gradient, then fish passage conditions can be reduced. This may required the inclusion of grouted rock weirs or rock ramp to achieve suitable fish passage conditions.