Fish superhighways: ensuring free passage between freshwater and estuarine habitats

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Abstract

Commercial, recreational and indigenous fisheries target many fish species that undertake small to large scale migrations in order to complete their lifecycle, access breeding or spawning grounds, seek refuge or gain access to other habitats and resources. In addition to these economically and culturally valuable species, many other native fish species undertake migrations during their life cycle.

The human population in Queensland coastal areas has increased exponentially over time and so has development. Pressures on coastal waterways from both agricultural and urban development have resulted in the construction of numerous barriers, including dams, weirs, sewerage infrastructure and flood gates, culverts, causeways and bridge crossings.

These barriers can prevent or reduce fish passage in both upstream and downstream directions. This infrastructure is termed 'waterway barrier works' under Queensland legislation. Focus of current research is to gain an understanding of their impacts on fish populations in both estuarine and freshwater habitats and how best to reduce these impacts.

Fisheries Queensland, a service of the Department of Employment, Economic Development and Innovation, is responsible for administering the *Fisheries Act 1994* and issuing development approvals for waterway barrier works under the *Fisheries Act 1994* and the *Sustainable Planning Act 2009*. Through this legislation and development assessment process Fisheries Queensland seeks to minimise impacts on fish passage from waterway barrier works through design modification or the inclusion of a fishway. The importance of fish passage and connectivity on fisheries productivity, and options for mitigation of impacts from development in coastal Queensland waterways will be highlighted.

Introduction

The intensification of population growth along the Queensland coastline is resulting in an increase in development pressure on our coastal waterways. While developments are required to minimise impacts on the waterways, often it is difficult for proponents to understand the indirect impact their proposed development can have on fish habitats within a natural waterway and the ability of native fish to move uninhibited between estuarine and freshwater environments (O'Hanley and Tomberlin 2005).

Many native fish species undertake some form of migration between freshwater and marine environments. Dams, weirs, bridges and culvert crossings are just some of the barriers that can restrict migration and affect the fish assemblages found within waterways (Rolls 2010). Some structures inherently need to be located over or within waterways, however the incorporation of certain design characteristics can provide for fish passage or reduce the impacts from development on native fish assemblages within the waterway (Cotterell 1998).

Fisheries Queensland, a service of the Department of Employment, Economic Development and Innovation, administers the *Fisheries Act 1994* (FA) and issues development approvals under the FA and *Sustainable Planning Act 2009* (SPA) for operational works that is the building or raising of waterway barrier works. Waterway barrier works are those works that have the potential to limit fish passage and native fish assemblages (Peterken *et al.* 2009). Blocking or limiting fish passage through waterways can restrict fish from accessing breeding, spawning and feeding grounds and in some cases prevent the completion of an individual's lifecycle (Lawson *et al* 2010, Rolls 2010).

When a proponent submits a development application to Fisheries Queensland for an operational works approval for the building or raising of waterway barrier works, the proponent must demonstrate that the development provides for fish passage. If not, it is up to the proponent to demonstrate why fish passage through the site of works is not necessary or desirable. Only then will a development approval for the proposal be issued.

Case Study 1 – Schulz Canal bridge crossing

The Schulz Canal is located on the northside of Brisbane and is a highly developed waterway. Some downstream sections of the waterway have previously been channelized, and in recent years extensive widening and deepening works have been undertaken for flood mitigation. However, the banks of the waterway are colonised with relatively healthy and mature mangroves, and adjacent saltmarsh areas are extensive and comparatively healthy. A bikeway runs along the northern bank of Schulz Canal and recreational fisherman use this path to access the waterway. Considering the development pressure on the waterway and works that have been undertaken in recent times, the waterway provides important fish habitat and connectivity between freshwater creeks and downstream Moreton Bay.

In 2010, a major bikeway and pedestrian bridge crossing of Schulz Canal was proposed (Figure 1). The bikeway crossing was a nine span bridge design to achieve the required flood immunity with one bridge pier located in the bed of Schulz Canal. While the bridge design itself did not constitute waterway barrier works, construction of the bridge was inherently going to require a structure to be placed into the waterway.

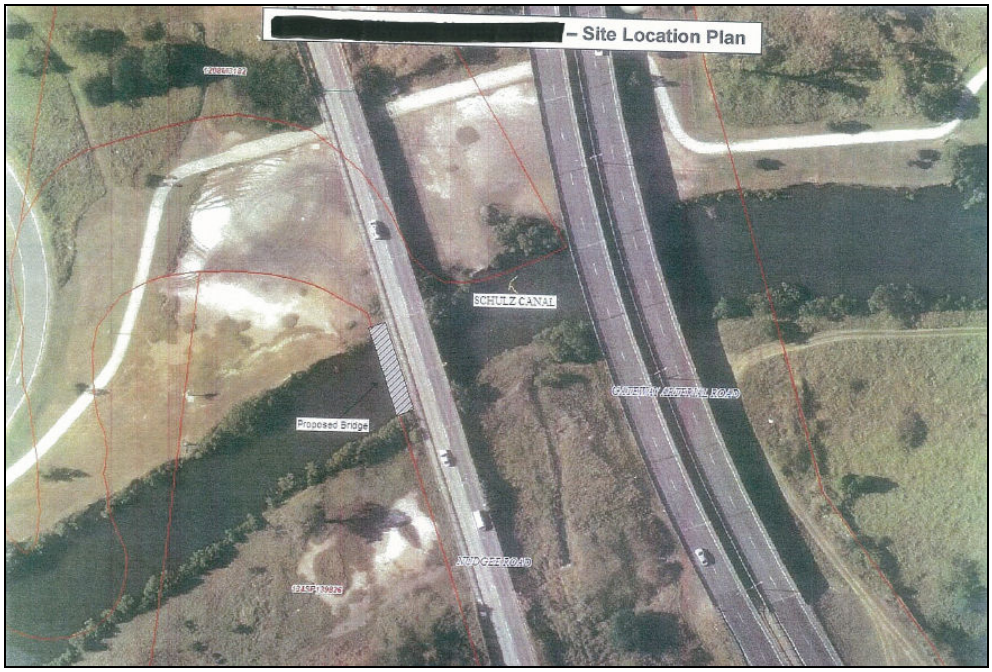

Figure 1 – Site Location Plan

The proponent considered a number of options for construction, including:

- a rock fill construction platform incorporating culverts to convey flows
- platform constructed from sand-filled geotextile bags incorporating culverts to convey flows
- staged construction of platforms partially across the waterway
- construction of a piled platform

A platform providing access to both sides of the waterway would have required a significant amount of material to be placed into the waterway, and while inclusion of a culvert would have allowed for the conveyance of flows, the cross-sectional area of the waterway was significantly reduced and therefore flow velocities through a culvert arrangement would have posed a physical barrier to fish passage under most circumstances.

Significant pre-lodgement consultation between Fisheries Queensland and the proponent during the preliminary design stage allowed for negotiation of the construction methodology and design of the temporary platform. The footprint and dimensions of the platform, extension of the platform into Schulz Canal and any increase in natural water velocities that would preclude fish passage were issues of discussion. While the impacts to fish passage would have been temporary, there were feasible alternative designs that would have minimised these impacts during construction.

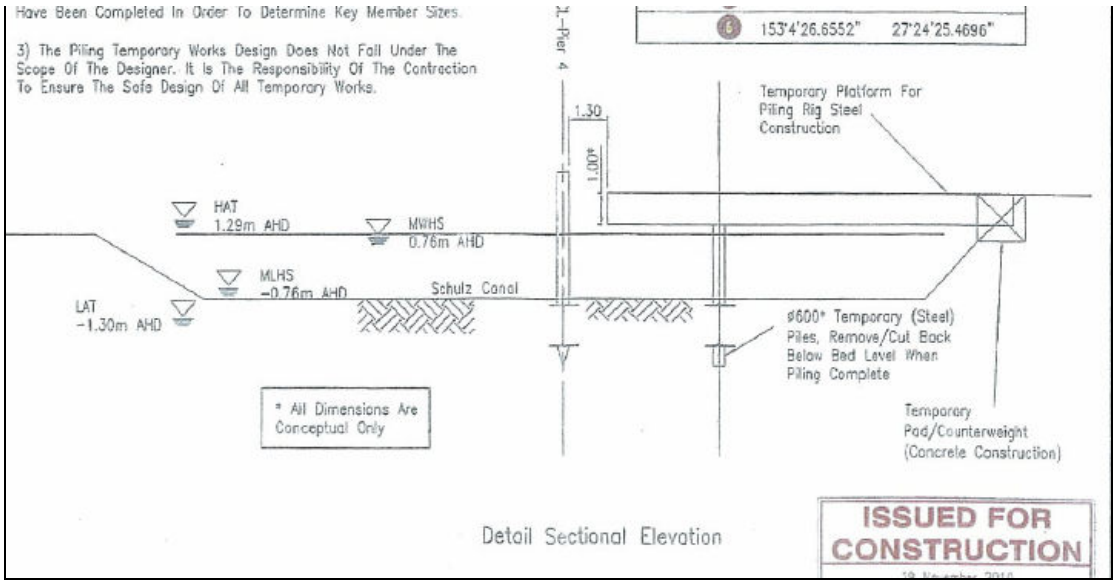

Figure 2 – Approved temporary platform design

Following a number of discussions, it was determined that the most appropriate option was a piled temporary platform (Figure 2). A piled platform did not require the placement of any fill into the waterway, did not reduce the cross-sectional area of the waterway and would have little to no impact on fish passage through this section of Schulz Canal. The platform was designed to accommodate the load requirements for pile drivers and construction machinery, and as the structure provided for fish passage upstream and downstream of the site, the application for both the bridge and temporary construction platform were approved.

Case Study 2 – Nerang River bank stabilisation

The Nerang River is a major waterway in south-east Queensland with its headwaters located near the Queensland – New South Wales border, flowing through to the Gold Coast into the Southport Broadwater. It is highly developed in urbanised sections with extensive canal systems existing in the downstream reaches of the waterway and the majority of properties adjacent to the river have private river access.

Boat wash had caused significant bank erosion and undercutting on the southern bank of the river and was posing a public safety risk. The section of the bank of concern was located behind a sports stadium and consisted of steep, almost vertical slopes more than four (4) metres high in some sections with mangroves growing on the intertidal zone.

The original proposal to address the erosion included a number of possible options including:

- installation of rock fillets and rock revetment of the eroding bank
- installation of a rock reef
- placement of fill material to raise the levels to increase wave dissipation
- plantings and stabilisation of the bank.

The original design of the rock revetments along the bank would have effectively operated as a fish trap. On high tides, water would spill behind the revetment and on the falling tide any fish behind the revetment would be trapped. In addition, the

extension of the rock revetment into the waterway had the potential to impact on fish passage through this section of the Nerang River.

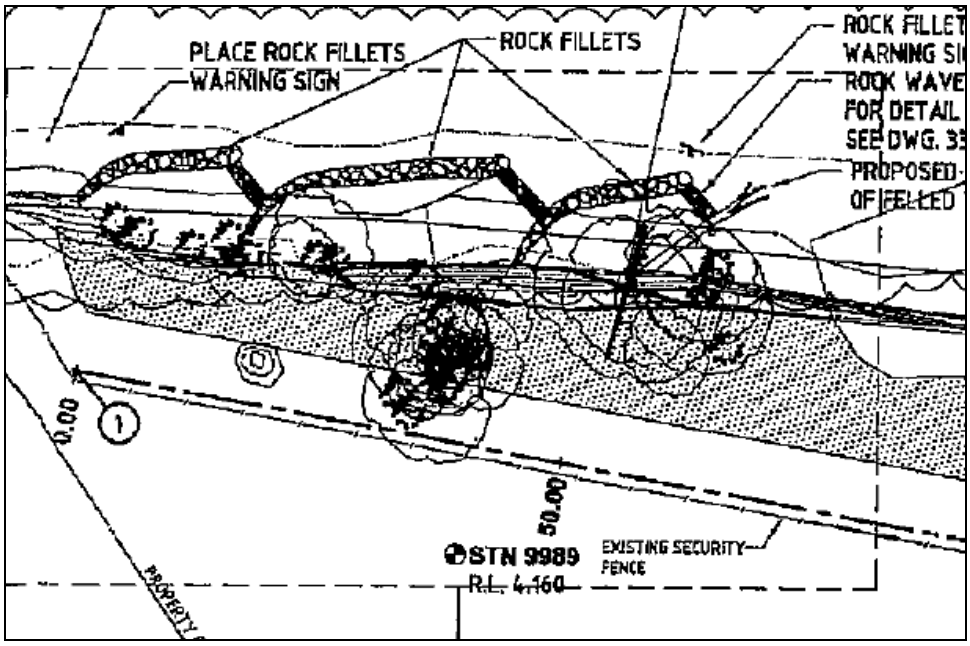

Figure 3 – Approved rock fillet design for erosion protection

The ultimate design of erosion protection works consisted of a combination of the proposed options depending on the severity of erosion and undercutting. The design of the rock revetment included lowering the height of the revetment to bed level to provide for fish passage, moving it further into the waterway and creating an opening on the upstream or downstream end to allow fish to escape on a falling tide (Figure 3). In some sections, coir logs were placed on the bank to dissipate wave energy and provide an area for sediment deposition and colonisation by vegetation, and in other areas planting of reeds, rushes and mangrove seedlings were undertaken to accelerate colonisation. Due to the severity of bank erosion, some sections required backfilling and compaction to regularise the bank

Conclusions

Development within waterways can reduce the ability of migratory fish to move between estuarine and freshwater environments (Rolls 2010). Even development that is for the rehabilitation and restoration of a waterway and of intended benefit to fisheries productivity can restrict fish passage. It is also important to understand that while permanent structures may have minimal impact, temporary structures built to facilitate construction or maintenance works can have unnecessary permanent and temporary impacts on fish passage and waterway habitats.

Take Home Messages

- Many fish species need to move between estuarine and freshwater environments
- Development within waterways can pose barriers to upstream and downstream fish passage
- Works within waterways constitute waterway barrier works under the *Fisheries Act 1994* and require development approval

- Fisheries Queensland aims to ensure proponents reduce, minimise and mitigate temporary and permanent impacts on fish passage and waterway habitats
- Considerations and amendments to design can significantly reduce the impacts of development on fish passage and fisheries productivity

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