

## Bridges

Bridges are the preferred structure for crossing streams as they cause the least disturbance to the waterway both hydraulically and to the environment.

### Potential Waterway Impacts

The impacts of bridges can include:

- Alteration to the stream's natural flow pattern.
- Removal of riparian and in-stream vegetation.
- Reduction in wildlife and aquatic fauna habitat in the immediate vicinity of the crossing.
- Reduction in hydraulic capacity of the stream.
- Increased extent of flooding upstream.
- Increased nutrient loads where crossings are used for regular stock movement on dairy farms.
- Sediment input during construction.
- Toxicant inputs from highly trafficked bitumen roads via bridge drains.
- Sediment inputs from unsealed roads via bridge drains.

### Assessment Criteria

#### **Purpose**

The purpose of the bridge affects the potential impacts to the stream and standards of construction. A bridge on a public road will have different requirements than one for internal farm access.

#### **Structural Design**

Where the bridge is open to public usage or heavy vehicles, the applicant should submit design drawings which have been certified by an experienced and qualified engineer as satisfying all relevant Australian Standards or Bridge Design Codes.

Alternative bridge structures are acceptable for light duty farm access purposes.

#### **Bridge Level**

The height of the bridge relative to flood levels and natural surface is needed to assess the potential impact on flows.

For significant bridge structures used for public access, the underside of the bridge beams should preferably be above the maximum recorded flood level or the 1% AEP flood level. A freeboard clearance of up to 300mm above design flood level is desirable to avoid damage from floating flood debris.

On minor bridges such as for internal farm access, submergence during floods would be acceptable provided the bridge is securely attached to the foundations.

### **Waterway**

Where the underside of the deck is above or at the top of bank and in-stream piers/piles occupy less than 5% of the cross-sectional area, there would be no significant change to the available waterway. In these cases, the proposed bridge would be acceptable subject to correct alignment of the piers/piles to mitigate debris problems.

Where the underside of the deck is below the top of bank on bridges, there is potential for a significant reduction in the available waterway area and a hydraulic assessment is necessary.

### **Road / Track Approaches**

Potential increases in flood levels due to obstruction by road or track approaches to bridges need to be considered.

Where the road or track approaches are at natural surface level or floodplain level, the structure would not obstruct flood flows.

Where the road or track approaches are above natural surface level or floodplain level, an assessment of the flows across the floodplain is needed. Detailed hydraulic modelling would be a pre-requisite for approval in such cases. This would normally be associated with significant public works and the applicant should submit a report on the effects of the works. In assessing the hydraulic report, consideration must be given to multiple waterway openings across the floodplain to provide a balanced flow distribution. This avoids excessive flow concentration and bed erosion in the main stream in the longer term.

### **Number of Spans**

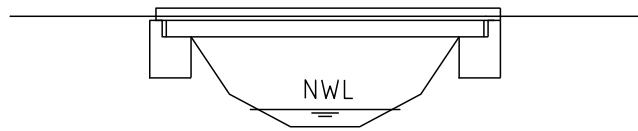
Bridges can be either single or multi-span as shown in **Figure 1**.

Single span bridges are preferred to:

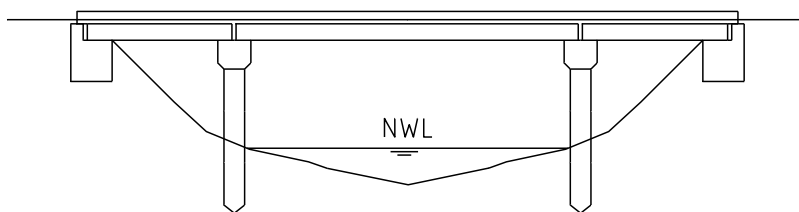
- Avoid disturbance to the stream bed and in-stream biota, and
- Minimise flood debris being caught on the piers which may threaten the stability of the bridge or increase flooding upstream.

**Figure 1: Bridge Arrangements**

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**Single Span Bridge**



**Three Span Bridge**

NWL = Normal water level

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Multiple span bridges are acceptable on wide streams. Acceptable arrangements include:

- Piers located outside the normal low flow stream width. In this regard, a three span bridge would be preferable to a two span bridge. The spans do not need to be of equal length.
- Piers aligned parallel to the direction of flow
- Riprap provided around the piers to mitigate local scouring.

### **Bridge Abutments**

The abutments should be located so that they do not significantly encroach into the waterway thereby reducing the available waterway area, and obstructing the movement of terrestrial fauna along the riparian zone.

### **Batter Protection**

Rock beaching is generally used on the batters to protect against abutment scour, as this area will generally not revegetate due to inadequate light and lack of rainfall. Beaching should extend typically 3 metres upstream and downstream of the bridge abutments.

The batter is to be excavated to the depth of the beaching to maintain the waterway area. The slope of the batters should be in the range of 1(v):1(h) to 1(v):2(h). In general, the beaching should extend at least 600 mm below the toe of the bank to mitigate undermining.

Where the stream banks are stable, rock beaching may not be required.

### **Fish Passage**

To ensure adequate light under bridges for fish, it is suggested that the underside of the bridge beams should be at least 1.0 metre above the base flow water level in the stream.

### **Local Drainage**

Local drainage from the site and access roads should be directed to sedimentation basins or grassed filter zones to trap sediments, rather than discharging directly to the stream. Where outfall directly to the waterway cannot be avoided, piped or rock chute outfalls may be needed. (See Works on Waterways Notes – Rock Chutes)

The bridge deck should be graded to sedimentation basins or grassed filter zones to trap sediments at each end of the bridge, with the return flow either overland or by pipe to the stream.

On dairy farms, the bridge deck and tracks are to be graded away from the waterway to a drainage recycling system to prevent animal wastes directly discharging to the waterway. There should be no direct connection of any dairy track to a stream or connected drain.

### **Fencing and Bridge Railing**

Bridge railing or fencing is normally necessary on access crossings for the safety of users. The type of railing depends on the purpose of the crossing and risks associated with flooding. For bridges used for public access, the guard railing must comply with VicRoads standards.

Where the crossing is set above the highest recorded flood level or the 1% AEP flood level, the railing should have low potential to catch flood debris. Build-up of flood debris can reduce the hydraulic capacity and ultimately threaten the stability of the structure.

For stock crossings, a pipe rail or three plain wire fence would be suitable. These fences are easily repaired or replaced after floods. Mesh type fencing (e.g. ringlock) should not be used as it will catch debris and restrict flood flows.

Similarly, fencing across the stream close to the crossing is to be avoided. Cross fencing should be located at least 20 metres upstream or downstream of the bridge. Again, a simple plain wire fence with as few wires as is practical, or temporary electric fence, is preferred to avoid catching debris and creating obstructions to the movement of aquatic fauna.