Cofferdams

INSTREAM PRACTICES

Flow Control	✓	No Channel Flow	✓	Dry Channels	✓
Erosion Control		Low Channel Flows	✓	Shallow Water	✓
Sediment Control		High Channel Flows		Deep Water	✓

Symbol

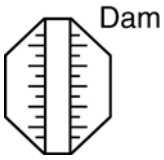

Photo 1 – Upstream sandbag cofferdam located within a concrete channel during channel maintenance

Photo 2 – Downstream sandbag and compacted fill cofferdam located within a storm drain during drain maintenance

Key Principles

1. The critical design parameter is normally the disturbing force associated with overtopping flows.
2. The critical design parameter for the associated low-flow bypass system is normally the dry weather flow rate of the stream (i.e. seasonal base flow).
3. Government waterway licensing requirements, including fish passage requirements, can dominate over the cofferdam design, and the timing and duration of use.
4. Appropriate consideration must be given to the expected damage to the channel bed and banks during the construction and removal of the cofferdams.

Design Information

The design of cofferdams usually relies on the outcomes of key hydraulic and geotechnical investigations.

Cofferdams can vary from minor, low-risk structures to major engineering structures. The design and approval of instream barriers such as cofferdams may need to incorporate advice from a range of experts, including those listed in Table 1. Large cofferdams may be considered formal 'engineering structures' that, in some States, must only be designed by specific personnel.

The height of the cofferdam will depend on a number of factors. As a minimum, the height should be 300mm above the expected dry-weather water level. The upstream dry-weather water level will depend on the hydraulic capacity of the flow bypass system.

The width of the crest of the cofferdam (in the direction of channel flow) depends on the required structural stability of the cofferdam during overtopping flows, and whether or not the crest of the dam is required to be accessible to construction machinery.

Free standing earth fill cofferdam should have side slopes no steeper than 2:1 (H:V). Any earth fill used in the formation of an earth cofferdam must be free of organic debris. The clay content should be non-dispersive (e.g. Emerson's Aggregate Test Class 6, 7 or 8).

Table 1 – Possible expert advice required in the design and operation of cofferdams

Professional	Areas of interest
Structural engineer	• Structural integrity of engineered structures • Structural integrity of cofferdam in association with possible impact from floating debris
Geotechnical	• Structural integrity of foundations of some vertical-faced structures • Stability of earth embankments
Hydraulic engineer	• Hydraulic assessment of overtopping flows • Potential impacts on local flood levels
Waterway officer	• Potential impacts of channel erosion caused by overtopping flows
Fisheries officer	• Fish passage requirements • Allowable timing and duration of works within the calender year • Design of flow bypass system

The are two main low-flow bypass systems: gravity lines (Figure 1) and pumped bypass flow (Figure 2).

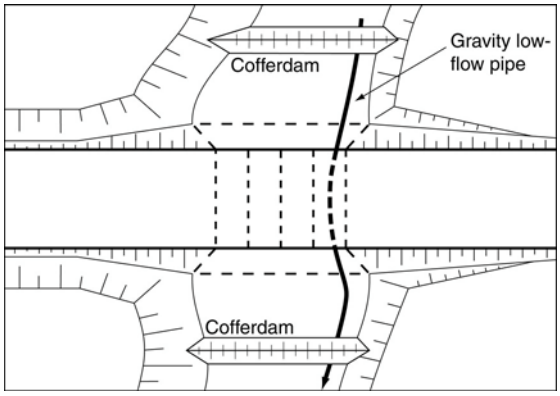

Figure 1 – Cofferdam with gravity bypass pipe

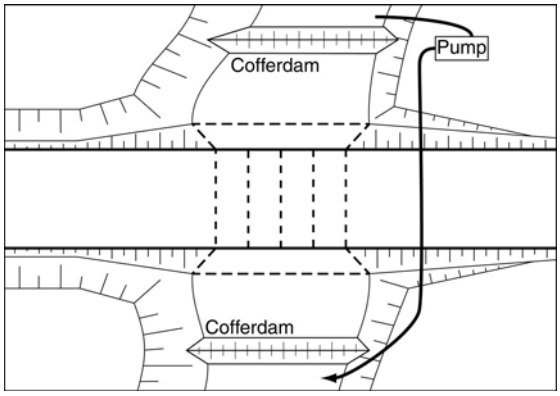

Figure 2 – Cofferdam with pumped bypass flow

In tidal waters, tide gates may be required to allow storm/flood flows to discharge through the downstream cofferdam (Photos 3 & 4).

Photo 3 – Flood bypass pipes with attached tide gates prior to their installation shown right

Photo 4 – Installation of downstream cofferdam with flood bypass pipes (left) within a tidal waterway

Description

Cofferdams are usually small earth and/or sandbag watertight dams constructed across the bed of a channel or stream; however they can also be large engineered structures.

Construction options include compacted earth, sandbag, sheet piling and prefabricated rubber dams.

A cofferdam should not be confused with an 'isolation barrier', which may or may not be watertight, and is usually installed to isolate only a part of the channel width.

Purpose

Cofferdams are used to:

- isolated full sections of a channel so that construction can occur within a dry channel; and/or
- assist in the bypassing of channel flows around an instream disturbance.

Dry weather channel flows are either gravitated through, or pumped around, the work area.

Cofferdams are used during both instream construction and maintenance activities.

Limitations

Generally of greatest value during periods of low stream flow. During periods of medium to high stream flow the use of an isolation barrier may be preferable.

Not suitable for use during periods of fish migration.

Advantages

During favourable weather conditions, this flow control technique can significantly reduce the contamination of stream flows.

Maintaining a 'dry' channel bed can help reduce overall channel disturbance and sediment generation.

Disadvantages

Significant damage to the channel's bed and banks may occur during the installation and removal of the cofferdams.

Damage to cofferdams may occur during wet weather.

Can be costly and may require regular maintenance.

Can be subject to vandalism.

The flow bypassing system can experience debris blockage problems.

Can cause significant interference to fish migration.

Special Requirements

Care must be taken to obtain all necessary licences with respect to working within waterways and forming a temporary waterway and/or fish passage barrier.

A downstream sediment control system is normally required while the barrier is being installed and removed.

Cofferdams should not be allowed to cause upstream flooding problems.

Cofferdams need to be appropriately designed for possible over-topping flows.

Site Inspection

Daily inspection for debris blockage or vandalism.

Check the cofferdam for leaks.

Materials

- Earth fill: non-dispersive earth free of organic debris. Emerson's Aggregate Class 6, 7 or 8.
- Geotextile fabric: heavy-duty, needle-punched, non-woven filter cloth (minimum 'bidim' A34 or equivalent).

Installation

1. Prior to commencing any works, obtain all necessary approvals and permits required to conduct the necessary works including permits for the disturbance of riparian and aquatic vegetation, and the construction of all permanent or temporary instream barriers and instream sediment control measures.
2. Refer to approved plans for location, extent, and construction details. If there are questions or problems with the location, extent, or method of installation contact the engineer or responsible on-site officer for assistance.

3. If there is flow within the watercourse or drainage channel at the time of installation of the cofferdam, then install appropriate downstream sediment control devices and/or flow diversion systems prior to installation of the dam. Such measures should only be installed if considered appropriate for the local conditions, and only if their installation is judged to provide a net overall environmental benefit.
4. To the maximum degree practical, construction activities and equipment must not operate within open flowing waters.
5. Ensure clearing and excavation of access paths and the banks and bed of the watercourse are limited to the minimum practicable.
6. If dispersive, highly unstable, or highly erosive soils are exposed, then priority must be given to the prompt stabilisation of all such areas.
7. Remove any cleared organic matter or debris from the channel and dispose of it properly. Do not use organic matter or debris to build the cofferdam.
8. To assist in the eventual removal of all materials used in the construction of a temporary cofferdam, a protective layer of geotextile filter cloth (preferably in the form of a single sheet) should be placed over the channel prior to installation of the cofferdam. If more than one sheet of fabric is required, overlap the fabric by at least 600mm.
9. If the cofferdam is to be constructed of free-standing compacted fill, the sides of the cofferdam must be no steeper than 2:1 (H:V).
10. Stabilise all disturbed areas subject to flowing water, including flow bypass and overflow areas, with rock or other suitable materials if expected flow velocities exceeds that allowable for the in-situ material. The minimum rock size placed within the main channel shall be 200mm.

Maintenance

1. While construction works continue on the site, inspect the cofferdam prior to forecast rainfall, daily during extended periods of rainfall, after runoff producing rainfall, or otherwise on a weekly basis.
2. Ensure that cofferdam is stable and undamaged.
3. Dispose of excessive accumulations of sediment or debris in a manner that will not create an erosion or pollution hazard.
4. Repair any places in the cofferdam that have weakened or that have been subjected to damage from stream flows or overtopping water.
5. If a bypass floodway exists, check that the floodway is stable and capable of operating at its design capacity.

Removal

1. Cofferdams should be removed as soon as possible after they are no longer needed.
2. If excessive sediment or debris has collected upstream of the cofferdam, remove such material before the dam is removed and dispose of such material properly.
3. If there is flow within the watercourse or drainage channel at the time of removal of the cofferdam, then install appropriate downstream sediment control devices and/or flow diversion systems prior to removal of the dam. Such measures should only installed if considered appropriate for the local conditions, and only if their installation is judged to provide a net overall environmental benefit.
4. Ensure any channel water contained within the enclosed channel area is suitably treated before either the water is discharged from the enclosure or the cofferdams are removed.
5. Ensure the release of sediment and the damage to the channel's bed and banks is minimised during removal of the cofferdams.
6. Remove all construction materials, sediment deposits and debris and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
7. Restore the watercourse channel to its original cross-section, and smooth and appropriately stabilise and/or revegetate all disturbed areas.