River Weirs – Good Practice Guide

Guide - Section B1

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2. SECTION B – DETAILED GUIDANCE

2.1 Safety

2.1.1 Introduction

In the UK, 438 people lost their lives through drowning in the year 2000. Of these, 199 were in rivers and streams, and 44 in canals. Indeed, in June 2002, whilst this guide was being drafted, the weir featured on the front cover (Pulteney Weir in Bath) was implicated in the death of a 37-year old man who fell into the river. According to the local press this was "just the latest incident in which people have been killed or injured after jumping into the river around the weir".

Figure 2.1 Headline from the Bath Chronicle, June 2002

BODY RECOVERED: river level dropped to help search

By Simon Davies

Missing man found in weir

THE body of a man who disappeared after falling into the river in Bath was finally recovered from Pulteney Weir yesterday.

The body, found by police divers, has been confirmed as that of 37-year-old Welshman Gary Aston, who vanished early on Sunday morning.

The Avon and Somerset Police underwater search unit had spent three days diving around Pulteney Weir in the latest attempt to find him after his fall into the River Avon.

Mr Aston, of Penygraig, Rhondda, had visited Bath Races with friends on Saturday before enjoying a night out in the city when tragedy struck.

Police said Mr Aston had been "larking about" with a friend at the back of the Waitrose store in The Podium when they were seen by security guards.

The pair ran off and jumped over a chain fence leading to the riverbank.

Mr Aston fell in the water and the other hid in bushes for a while, unaware of the tragedy.

DANGER SPOT: Pulteney Weir with the water level lowered in the hunt for the missing man

Work and leisure activities in or adjacent to water inevitably carry the risk of drowning. In this guide we have attempted to raise awareness of the risks in relation to weirs.

As a result of the death of a teenager at a sluice in Somerset, the South West region of the Environment Agency set up OPUS – Operation Public Safety. This is now a national initiative aimed at reducing the risks to members of the public.

2.1.2 The Construction (Design and Management) Regulations 1994 (CDM)

In response to the poor health and safety record in construction the CDM Regulations were introduced in 1994 to ensure that safety is considered at all stages of the design and construction process. These regulations apply to works on weirs as they do to all other forms of construction.

The CDM Regulations place duties on clients, planning supervisors, designers and contractors to plan, co-ordinate and manage health and safety throughout all stages of a project. It should be emphasised that these regulations do not simply refer to the actual process of building the works, nor just to the construction personnel working on the site – they apply to the whole process from early planning, through design, construction, and onto subsequent operation and maintenance.

Construction works that will be completed in less than 30 days, or that will take less than 500 man-days to construct, are excluded from the Regulations unless there will be five or more people on site at any time. **However, CDM applies to all design work no matter how long the work lasts or how many workers are involved. Furthermore, CDM applies to all demolition work, regardless of the length of time or the number of workers.**

The following section provides guidance on safety issues under a number of relevant headings. In order to emphasise the importance of **considering how the weir will be used** once constructed, the guidance starts with recreation, amenity and navigation issues, then moves on to operation and maintenance, and only then addresses construction.

An important part of the planning of any weir scheme will be the establishment of a Risk Register. In this all potential risks are identified, with the aim of eliminating, mitigating or reducing them as the development of the project continues. Any residual risks will remain on the register, which will from part of the Health and Safety file for the project.

2.1.3 Recreation, amenity and navigation

(i) General

Rivers offer a wide range of leisure and recreational activities, from walking along the riverbank to angling, canoeing and boating. Weirs provide a focal point for such activities, attracting people and thereby exposing them to risks, including:

- Canoeists and other water users getting trapped in a reverse roller downstream of the weir
- Risk of injury to canoeists or swimmers from submerged sharp objects (rocks, corroding sheet piles, damaged gabion cages, etc)
- Swimmers not appreciating the depth and relatively low temperature of the water
- Walkers attempting to use the weir crest as a crossing point and falling into the river
- Exposure to contaminated water

It should be noted that owners or operators of river structures have a duty of care to anyone using the river, whether such use is authorised or encouraged or not. It is

therefore necessary to consider all possible uses of the river when planning and designing weirs and related structures.

Appropriate design of the weir and associated works can ensure that the risks associated with recreational and leisure activities are minimised. In particular, users of the river need to be warned about the presence of the weir and the risks that it may pose. The installation of warning signs and protective booms may be appropriate for all rivers used for recreational navigation, to minimise the risk of boats being trapped on the weir crest, or carried over it.

Protective booms have proven to be very successful in reducing the risk of boating accidents at weirs. However, there is at least one case of a protective boom being implicated in an accident when it was struck by at boat at night. The boat capsized and lives were lost. Nevertheless, the risks posed by a boom are likely to be significantly less than the risks associated with navigators being unaware of the presence of a weir. Clearly, detailed design of safety systems at weirs needs to be founded on a full understanding of the risks, and must be carried out in full consultation with the navigation authority. This will include consideration of the types of activity on the river and, for example, the ability of craft to be manoeuvred into safety when the risk becomes apparent to a boater (for example, narrow boats with small engines cannot be steered out of danger quickly).

Figure 2.2 Safety boom upstream of a weir

The boom is designed to prevent accidental navigation over the weir. Note that the boom also acts to trap debris, which is difficult to clear.

Warning signs provide an inexpensive means of risk reduction. They should be located both upstream and downstream of weirs, so that navigators approaching from either direction have advance warning of the risks. High visibility is the most important requirement, with a simple message "DANGER – WEIR". The provision of a visual

image depicting the risk should also be considered to convey the warning to non-English speakers. In situations where there is a chance that a warning may be missed, such as when the approach to the weir is on a bend, more than one sign should be provided.

Figure 2.3 Warning sign

Warning signs need to be highly visible and secure against vandalism (NB And life jackets need to be fastened if they are to be effective!). In some circumstances it will be important to provide lighting at a structure, particularly if it is likely to be used (for example by canoeists) in conditions of poor natural light.

Side weirs for flood control can pose a particular risk to the public. Often these weirs are formed from lowered sections of flood embankments, which double as footpaths or even vehicular tracks (the spill weir at Willen Lake, Anglian region, is a cycle track). Whilst safe in normal flow conditions, these weirs can be extremely dangerous in floods. Carefully worded warning signs will be required to alert people of the risks of trying to traverse the weir when it is spilling. Guidance on signage on navigable rivers can be obtained from the Association of Inland Navigation Authorities (AINA); a code of practice is currently (November 2002) being prepared.

Perhaps one of the most difficult decisions with regard to public safety is whether to provide fencing or hand railing to restrict or discourage access to potentially dangerous areas. This decision should be made after a thorough assessment of the risks, which should then be weighed against the benefits of not fencing.

Figure 2.4 Security fencing

In situations where it is essential to discourage access or minimise vandalism, fencing like this may be necessary. Fortunately, most weirs do not require such a level of protection.

(ii) Safe access

In implementing works in rivers, those responsible should consider the provision of safe access for members of the public. In particular, where appropriate, access should be considered for walkers, ramblers, canoeists, anglers, swimmers, families with young children, and disabled persons.

In particular, at weir structures used by canoeists, provision should be made for safe and easy egress from the river both upstream and downstream of the weir. Shallow sloping banks (instead of vertical walls) are one of the simplest ways of achieving this.

Consideration of access for the disabled is perhaps most relevant when a new weir or a refurbished weir creates a public crossing point over the river. Early consultation with local interest groups will identify whether it is appropriate to make special provision for disabled persons. Clearly, where there is an identified need (or a justifiable desire) to provide access for the disabled, every effort should be made to incorporate such provision into the design (comprehensive guidance in this respect can be found in the Countryside Agency's "Increasing access to the wider countryside for disabled people"). Such provision may include car parks close to an amenity.

With respect to the specific requirements of established footpaths, guidance may be obtained from the County Council Rights of Way Officer.

Figure 2.5 Stepping stones

This imaginative way of providing access at a weir via stepping-stones needs careful consideration. Its simplicity and attractive appearance must be weighed against the risks of pedestrians slipping or falling into deep water.

2.1.4 Risks in operation and maintenance

In general weirs require limited attention for their operation and maintenance. They are normally robust structures and can be expected to last for years without much intervention. Maintenance activities include clearing debris from the crest, removing silt from upstream of the weir, providing safety booms, and carrying out repairs to the structure. Movable or gated weirs require routine maintenance to mechanical and electrical plant. The most fundamental consideration with respect to all such activities is the provision of safe access. Pedestrian access to the weir crest itself should not be encouraged, for obvious reasons (slippery surface, flowing water, risk of fall into deep/turbulent water). A footbridge is likely to provide the safest means of access, but this is not always possible. An alternative for maintenance personnel is the provision of eyebolts in the abutments, to which a safety harness can be attached.

The removal of large floating debris from the weir (for example, tree trunks) can be a difficult operation. Where it is not practicable to make specific provision in the design to make this activity less hazardous, consideration should be given to how operatives can adopt safe working practices. For example, the option of providing space at the weir abutments for lifting equipment may be appropriate for larger weirs, and is unlikely to add significantly to the cost.

Future maintenance of the river reaches upstream and downstream of the weir should also be considered in the planning and design stages. Activities such as clearing vegetation, cutting back overhanging trees, removal of silt and repairs to erosion protection may form part of the channel maintenance regime in the vicinity of the weir. These activities may be carried out from the adjacent land, or from the river itself, using floating plant and equipment. In both cases it is necessary to consider how the operations can be carried out safely.

British Waterways staff are frequently faced with maintenance problems that require access to the crest of the weir. A case in point is the need to replace lost or damaged dam boards (these are commonly provided on the crest of a weir, spanning between vertical steel H-columns, to allow seasonal adjustments to canal water levels). BW have found that, if the weir upstream face is vertical, they can manoeuvre a maintenance vessel right up alongside the crest in low flow conditions, moor it in place, and thereby gain safe access to replace a missing dam board.

Weirs that incorporate a fish pass, regulating gates, and/or flow/level monitoring equipment are likely to require more maintenance than a simple weir structure. The specific requirements of any particular installation must be considered in the design process, and the design tailored to facilitate safe maintenance activities.

For any activities that require operatives to venture in or near the water, it is important that the all those concerned are aware of the risks and take suitable precautions. Reference should be made to relevant Health & Safety guidance before venturing on site.

In terms of planning the construction of a new weir, it should be noted that this might have implications for channel maintenance if this activity has previously been carried out by floating plant, because the weir will form a barrier to such plant.

Another factor to consider in the design of new or rehabilitation works, is the incorporation of the means of isolating parts of the structure, and/or temporarily lowering water levels, to facilitate inspection and maintenance. The provision of a penstock in or adjacent to a weir could, for example, allow the water level to be lowered in times of low flow, to allow inspection and maintenance of the weir crest, glacis and stilling basin. Similarly, provision for stoplogs on a fish pass or sluice could allow dewatering for inspection and maintenance activities (see Case Study N).

2.1.5 Risks in construction and rehabilitation

This guide is not the appropriate place for a treatise on construction risks. Excellent guidance can be found in “Construction risk in river and estuary engineering” (Morris

and Simm, 2000). Specific risks relating to the construction and rehabilitation of weirs include:

- Rapidly increasing flow in the river
- Slippery and uneven surfaces
- Pockets of deep water where the river bed has been scoured out
- Dangerous hydraulic conditions immediately downstream of the weir
- Exposure to water-borne diseases.

2.1.6 Risk reduction measures

In the design of new or rehabilitated structures, consideration should be given to:

- Avoiding dangerous hydraulic conditions downstream of the weir
- Providing life belts and/or throwing lines on both banks (NB these tend to be a focus for vandalism, and should not be relied upon as a sole solution to a risk of drowning)
- Providing a boom across the channel upstream of the weir to warn boaters and help prevent accidental navigation over the weir
- Providing warning signs in prominent positions, both upstream and downstream
- Providing hand-railing along weir abutments (although that it should be noted that hand-railing can also restrict access for operations and maintenance staff)
- Avoiding vertical wing-walls and abutments where possible, to make it easier for people to get out of the water if they find themselves in difficulty (or to make their rescue easier)
- Avoiding leaving submerged hazards in the river that will pose a risk to swimmers or canoeists. This is often a problem when an old weir is rehabilitated, especially if the new works are constructed upstream, leaving corroding steel piles or frayed gabion baskets in the bed of the river at the old weir.

It is important to note that provision alone of the safety features listed above is not in itself sufficient to guarantee a high degree of safety. It is essential that a documented inspection regime, with appropriate inspection intervals, is established to ensure that the measures remain effective.

In the particular case of booms, these are largely intended to prevent leisure boats in inexperienced hands from being navigated over the weir. For canoeists who wish to shoot the weir, the boom may itself create a hazard, since negotiating it can require release of the paddle. For weirs used by canoeists, the boom should therefore be located well upstream of the weir if possible. Similarly, where booms are provided downstream of a weir, to prevent boaters from approaching the turbulent waters, they should be located some distance downstream, to avoid risk to canoeists for whom they can present a serious hazard.

Figure 2.6 Dangerous side weir?

This side weir regulates the water level in the navigation waterway. There are clearly risks associated with people gaining access to the structure, with a steep drop on one side and deep water on the other. Basic risk reduction measures have been provided in the form of fencing and safety equipment, but more could be done. However, it will never be possible to restrict all access or provide comprehensive safety equipment – it is a question of balance.

2.2 Legal and planning issues

This document is not the appropriate place to go into detail on the legal and planning issues that are of relevance to works on weirs. Early consultation with the planning authority and statutory consultees will ensure that such issues are raised and taken into account. However, it is worth noting the following:

The Land Drainage Act 1991 requires that the consent of the drainage authority is sought before the construction of, or alteration to, any mill dam, weir or similar obstruction on a watercourse. In the case of an ordinary watercourse, the drainage authority is likely to be the local council, but may be an internal drainage board. In the case of a main river, the consent of the Environment Agency is required for any works on the bed and banks of the river.

An ***impoundment licence*** may be required for the construction or modification of any weir. If the purpose of a weir is to allow removal of water from the stream, an ***abstraction licence*** will be required. It follows that, if an existing weir has been constructed for the purpose of water abstraction, then consultation with all parties concerned will be required before the weir is removed or altered in any way that would affect the abstraction of water. If abstracted water is returned to the river after use (including passing through a lake) ***discharge consent*** may be required**.** ***Navigation consent*** will be required for any works in a navigable river.

The Wildlife and Countryside Act (1981, as amended by the CROW Act, 2000), which is reviewed every five years, provides protection to certain listed species. It should be noted that it is an offence to take, damage or destroy the nest of any wild bird whilst that nest is in use or being built. The Act affords protection to flora and

fauna under specific schedules. Schedule 1 of the Act lists protected bird species, of which there are about 85.

The Salmon and Fresh Water Fisheries Act (SAFFA) provides power for the Environment Agency to require fish passes for migratory salmonids and, as a result of the Environment Act, such fish passes must be approved in form and dimension by the Agency. Other Acts permit the Agency to require fish passes for other species, including coarse fish, eels and elvers. This is an area of technical specialism that requires consultation with experts.

The European Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) emphasises actions to conserve habitats and to restore populations of plants and animals to a favourable conservation status. As well as requiring the establishment of Special Areas of Conservation, the Directive requires wider countryside conservation measures. Annex I of the Directive provides details of specific types of protected habitats that may be relevant to weirs and Annex II lists protected species. The environmental assessment should aim to establish the presence or absence of any of these habitats and species.

Riparian owners (i.e. the proprietors of land adjacent to a river or stream) have certain rights and also certain duties. It therefore is essential that ownership of a weir, and the adjacent land, is investigated from the outset, and the consent of any riparian owner is sought before any proposals are finalised. A specific case of this is the question of mill rights, which needs to be fully explored before works are undertaken at mills. It is also important to appreciate that works on a weir may have impacts well beyond the immediate environment, and landowners both upstream and downstream could be affected (see Case Study E).

Other legislation that will be of general relevance includes:

- The Construction (Design and Management) Regulations (1994) – see Section 2.1.2 herein
- The Environment Act (1995)
- The Water Act
- The Land Drainage Act
- The Wildlife and Countryside Act (as amended by the CROW Act, 2000)
- The European Habitats Directive
- In the particular case of access to weir structures, it may be appropriate to consult the Disability Discrimination Act (1996).