DESIGN AND OPERATION OF TRASH SCREENS
CASE STUDY

LUSTRUM BECK

1. SCREEN REQUIREMENT

1.1 The Site

The site of the installation is located at the upstream face of a 3.0m diameter Armco culvert that carries the Lustrum Beck beneath the A126, Durham Road by-pass. The Lustrum Beck runs through the semi-urban area of Stockton-on-Tees. The Armco extends into a Victorian, brick arch culvert, which supports a railway,

The area immediately upstream is open playing fields/playground and this area is used by the local children for recreation. A housing area backs onto the open area and a number of allotments abut the watercourse.

Figure 1.1 View of the area prior to construction of the screen but after the installation of the culvert.

1.2 Reasons for Installation

In 1991 the railway embankment was effectively extended by Cleveland County Council to enable the A126 to be constructed along side it. The existing Victorian brick arch was extended by the placement of an 3.5m diameter Armco culvert.

At this location on the beck, there had been no record of blockage of the Victorian culvert. In fact, there were no particular records of any flooding or other problems on the watercourse immediately upstream of the culvert. There was however a history of flooding of the Lustrum Beck due to lack of channel capacity some 1 km upstream of the culvert. Also, prior to the construction of the highway the general area had been much less open to the public than it is now. The highway scheme included the implementation of a riverside walk as general improvements to the area. This had the effect of making the site more attractive to the local residents, especially children.

It was known at the time of culvert construction that there was a continuing maintenance problem at the downstream end of the watercourse, at a tidal flap and screens known as the

Lustrum Screens. This involved excessive debris amounts partially blocking the screens protecting the tidal flaps where the watercourse outfalls into the River Tees.

The Armco culvert being of 3.5m diameter and the debris being, apparently, generally small in both type and quantity would lead to assess that the risk of culvert blockage as being very low. However, should there be a blockage, then the consequence of such would be extensive flooding to the upstream areas. This would occur as the A126 runs on a high level embankment at this location and would at as a dam.

At the culvert design stage, the Local Authority applied to the NRA for land drainage consent to install a trash screen at the culvert entry. They had recognised the risk of the new culvert becoming attractive to children. Land drainage consent was initially refused on the grounds that the flood risk in the area would be significantly increased, particularly in the area 1 km upstream of the screen.

There was an incident in June 1993 when a child drowned in the watercourse during high flows; he had been playing in the culvert. As a consequence of the difficult access conditions at the downstream end of the culvert, the emergency services took almost two hours to find and recover the child.

After this incident, the Cleveland County Council installed a high security fence around the culvert entrance. However, these measures were not sufficient to prevent a further incident in the culvert where a child became trapped in a side culvert on a rising flow. It took the emergency services some time to afford the rescue.

Figure 1.2 View on the new armco culvert, note the concrete haunching allowing access into the culvert. The fence was installed after the fatal accident. However, it did not deter children from entering he culvert.

1.3 Decision Process

After this further incident, the NRA commissioned a report to assess the NRA's refusal to consent, in connection with the construction of the culvert and the need to place a trash screen at the culvert entrance. An independent assessment was made which resulted in a recommendation that a suitable screen could be justified at this location. This was principally based on exclusion of unauthorised persons, although the prevention of debris reaching the downstream, problematical tidal screen did provide significant benefit to the NRA. *(Manual, Section 2.2 discusses risk assessment and in particular the consequences of unauthorised access into the culvert).*

It should be noted that the decision to place a screen simply to exclude unauthorised entry can be a highly emotive issue and needs careful consideration. *(From the risk assessment provided in the Manual the probability of unauthorised entry is high and the consequence of such is high).*

1.4 Consultation

Before installation and final design a great deal of consultation was undertaken with the NRA, (particularly their workforce who had knowledge of the area) the local authority and the local residents.

Figure 1.4 View showing the public footpath running adjacent to the new culvert and the inadequacy of the fencing.

2 DESIGN

2.1 Designer

The National Rivers Authority as the Client for the scheme sought tenders from suitably qualified consultants to undertake the design and supervise the construction of the installation. An Engineer's Report was produced in October 1994. This investigated options for preventing unauthorised access to the culvert over a 60 year period.

The report concluded that it was economically justified to construct a trash screen at the culvert entry.

2.2 Design Parameters

Although the primary reason for screen installation was the prevention of unauthorised entry to the culvert, the size of screen still had to be determined with a view to the amount of material likely to be screened. The catchment above the culvert entry was examined to ascertain the type of debris and likely amount. The catchment is rural with the immediate downstream area running through an urban area. The overall split is approximately 75% rural, 25% urban. The average gradient of the main stream length is 1 in 250.

Figure 2.2 View of the Lustrum Beck immediately upstream of the trash screen site. To the right are allotments gardens and to the left is the new public park and play area.

The debris type was not analysed in great detail, however it was known that the majority of debris is general stream bank vegetation (including a significant proportion from the adjacent allotments) with some domestic refuse and fly tipping. There was no record of the amount of debris reaching this point in the watercourse during a year. There was a walk over survey of the watercourse. This investigated the type and amount of debris that was available within the bankfull range of water levels. This range is regarded as the appropriate indicator for a non-routine event, i.e. the level of event for which the screen should be designed. *(Manual, Section 3.2 advises on design data requirements).*

The contributing length of watercourse was 4km, with 20**%** woodland/urban, 60**%** suburban/open public areas, and 20**%** open non-public areas.

The interim guidance note was used to effect the design.

2.3 Screen Area

The screen area is 69.5 m^2, this being from three stages of raking screen each with a rake length of 1.8m and three working platform areas, each 1.8m wide. *(Manual, Section 3.3.4 details methods of determining screen area).*

The screen area was derived directly from the interim guidance note (large amounts of debris), which advises a screen area of 9 times the culvert area in this case, 63.6m^2 for this site.

Figure 2.3 General view of the screen clearly showing the three stages and the heavy duty construction materials.

2.4 Features

The three inclined screen areas are set at 45 % to the horizontal and have 30mm diameter bars set at 150 centres. The maximum reach for raking is 1.8 m.

The horizontal working platforms are of a steel, open mesh, proprietary, flooring construction.

The screen is situated within a fenced, although not secure, compound which provides sufficient area for the temporary storage of debris. It would not be possible to provide a totally secure area in this location due to the high level of crime and vandalism that occur here.

The screen superstructure is situated within a reinforced concrete substructure, with the sidewalls finishing at a level 500mm above the screen levels. The channel bed is from reinforced concrete which runs from the culvert entry to 0.5 m upstream of the first screen stage.

There is water level telemetry upstream and downstream of the screen, this provides the operators control room with an indication of level differential across the screen and hence an indication of screen blinding.

2.5 Access Arrangements

The installation compound is accessed from the public highway by a private roadway, which is of a suitable construction to allow vehicle access in all weather conditions. The site compound is gated and there is sufficient hard standing area to allow vehicles to turn round. The roadway ends with a hammerhead for turning purposes. This is directly adjacent to the compound gate. *(Manual, Section 3.4.1 provides guidance on access arrangements).*

Part of the compound area surfacing is reinforced concrete, this allows for the debris storage and transfer to disposal vehicles. This surface is graded to provide a fall to the watercourse area, allowing drainage of collected debris prior to final removal.

Figure 2.5 The screen site includes a concrete hard standing and areas for turning vehicles. The access road is dedicated to the screen.

There are no welfare facilities on site for operatives. This is as a consequence of the area suffering from a high rate of vandalism and the likelihood that facilities of this nature would be destroyed as a matter of course. There is a secure steel cabinet for the telemetry equipment.

Operator access to the screens working platforms are by step irons from the hardstanding area (through gates in the fence) and from the normal ground level on the opposite bank. There is sufficient working space on the working platforms to allow temporary storage of debris and safe working for the operators.

The removal of debris from the working platforms to the hardstanding area can only be achieved by using the rake to physically lift debris up to the platform. There is a high risk of back injury from this operation. In practice, however material can be removed bit by bit to a wheelbarrow for removal to the hardstanding and eventual collection.

3.0 OPERATION

3.1 Operational Development

At the design stage the operational requirements of the screen, i. e. its routine and non-routine clearance were appraised. Allowance was made for the screen to be visited on a weekly basis as part of the NRA's existing operational commitments.

3.2 Equipment on Site

No equipment is kept on site due to the vulnerable nature of the area to vandalism and general crime, although there are level sensors within the watercourse for the telemetry. There is a secure steel cabinet on site for housing the telemetry processing and signalling equipment. All operational and maintenance equipment is brought to site as required. *(Manual, Sections 3.4.3 and 3.4.4 provide guidance on screen security and operational constraints).*

3.3 Access Arrangements

Operators can access the site from a concrete roadway directly from the public highway. The access is for the screen only and is locked at all times. The Environment Agency is the screen operator and they use a varying authority system of padlocks for all their installations.

The roadway is accessible in all but the severest conditions, e.g. a major flood event. The installation has a dedicated compound, and although this is not secure it is appropriate to the locality.

The compound is safe to work in, with no tripping hazards and non-slip surfaces. Lighting however has not been installed. It was felt that there was sufficient background lighting from adjacent street lights and that special floodlighting would be susceptible to vandalism. The route to the screen from the compound is free from tripping hazards and straightforward. During non-routine events, access to the screens can be gained by step irons, however access would in all cases be available without the need to use the step irons.

Figure 3.3 View on top screen, the angle of rake and construction details are clearly visible.

There are three levels of working platform, from which each level of screen can be cleared. Each platform is of non-slip, open mesh steel-decking construction, secured with specialist counter sunk locking bolts to the steel frame of the super structure. This secure locking was a modification to the original system after it was found that children had started to dismantle the decking.

Debris can be temporarily stored safely on the working platform, before being transferred to the main compound for eventual disposal off site.

The screen is routinely visited for inspection and clearance on a weekly basis; any debris collected is removed to a licensed tip at that time. No debris is left uncollected on site.

There is a call out system in place for ensuring clearance is undertaken during a non-routine event.

3.4 Reporting and Response Procedures

Operational records are kept detailing times, dates of inspection and actions taken. This is in the form of site logs that are held by the Environment Agency. There is no formal system in place at this time to ensure that action requirements highlighted in the logs are undertaken. This formalised reporting and implementation system is being developed at the present time. There is particular concern that the results of vandalism at the site could result in public liability claims against the Environment Agency. There has been recognition that formalised systems of reporting and actioning, with clear line of communication and responsibility are required to assist in avoiding these types of claim. *(Recommendations for procedural requirements are set out in Section 5.0 of the Manual).*

4.0 MAINTENANCE

4.1 Procedures

The various elements of the installation have design lives thus;

- Concrete substructure, 60 years
- Steelwork superstructure, 20 years

- Telemetry, 10 years.

Consequently there will be refurbishment work required at those intervals. There are suitable written procedures for the undertaking of this work in the future.

5.0 PERFORMANCE

The screen has generally performed as expected since its construction in 1994 with no flooding arising as a consequence of screen blockage.

The installation has, however been prone to constant vandalism with a number of consequences such as;

- The fixing of the decking has required revision as the original bolting system could be undone and the panels dismantled. A new system using countersunk bolt heads was installed.
- It has been found that the gap between screen bar and wall was slightly in excess of the 150mm recommended in the IGN and that a small child could and did squeeze between the gap.

Modification of these elements has been successful in preventing further access to the culvert. However, the installation remains an attractive play area for local children and the operator remains vigilant. It is particularly important that reporting systems are in place to ensure the operator is fully aware of ongoing condition of the installation, *(Manual, Section 5.5 provides guidance on this matter).*