DESIGN AND OPERATION OF TRASH SCREENS
CASE STUDY

MONK'S PARK LABYRINTH

1.0 SCREEN REQUIREMENT

1.1 The Site

The site is situated on the River Brent near Wembley, just north of the road junction where the A404 (Harrow Rd) crosses the North Circular Road, near Stonebridge Park Railway Station.

Figure 1.1 View of the site from the adjacent public park looking towards the North Circular

Immediately upstream of the site is the Tockington flood storage area, and some 3km upstream of this is the Welsh Harp reservoir. The catchment area is mostly urban and particularly flashy in nature.

1.2 Reason for Installation

In the late 1970's there were extensive improvements to the watercourses in this area of London, together with general development in the area. As part of an improvement scheme to the Brent the downstream under-bridge culvert was found to be under capacity during design storm flows. (*Manual, Section2.1 discusses site history and its influence in determining whether to screen or not).*

Reconstruction of the culvert underneath the North Circular Road was felt to be excessively expensive whilst physical model tests demonstrated that the design flows could be accommodated if the soffit of the culvert was made smooth. The existing culvert was a reinforced concrete roof slab supported on sidewalls by concrete beams. The scheme entailed bolting GRP panels to sit flush between the underside of the beams.

The screen was designed to protect the GRP panels from damage by large debris carried during high flows. (*Manual, Section 2.2 details the approach to risk assessment. Evaluation under key factor C in this case gives a high probability and high consequence).*

1.3 Decision Process

The size of the main culvert (8.5m x 1.9m) meant that it was extremely unlikely that the culvert would block from debris accumulation. Historical records showed that no previous blockages of the culvert had been recorded, although regular de-shoaling was required to sustain the full depth of available culvert area.

The likelihood of damage to the GRP panels was assessed. Maintenance crews reported regular occurrences of oil drums and tree trunks in high flows. There was deemed to be a significant risk of damage to multiple GRP culvert linings resulting in, should it occur, a sudden drop in capacity of the culvert and thereby an almost immediate threat of spillage from the channel upstream. Flood water would have quickly covered the North Circular trunk road followed by more general inundation of office blocks, factories, shops and houses. Repairs would be costly and leave the culvert at risk whilst new panel linings were fabricated.

Figure 1.3 View downstream of the screen showing the culvert entry under the North Circular

1.4 Consultation

Consultation was a vital aspect of the project. There was no equivalent structure in the Greater London Area or, as far as it was known, elsewhere in the UK. Discussions were held with maintenance staff to determine the access requirements for future cleaning. Details of plant loadings and storage requirements were compiled.

The aesthetic considerations were obtained from Brent Council planners. The main objective was to keep the large steel structure below the top of the general ground level so as not to be generally visible from the trunk road and adjacent park.

2.0 DESIGN

2.1 Designer

The screen was designed by engineers of Greater London Council (G.L.C.).

2.2 Design Parameters

The primary function of the screen was to prevent large debris from entering the downstream culvert and damaging the GRP soffit and reducing flood flow capacity. The size of debris was therefore judged, to be the vital parameter in the screen design. Large debris was to be excluded from the culvert.

Figure 2.2 View looking downstream showing the labyrinth structure under moderate flow conditions

There was substantial data available regarding the catchment and its hydrology, modelling work having been previously undertaken. The likely flood flows had been estimated and could therefore be used in the design of the screen.

The catchment area was known to the designers and consequently there was some knowledge of the type of debris likely to be collected at a screen placed in this location. *(Manual, Section3.2 discusses data requirements and the importance of having suitable data to use in the design of a screen. In this case the designer had good data arising from the improvement works on the watercourse).*

2.3 Screen Area

The screen was designed to collect the expected amount of debris from the upstream catchment lengths, without the need for cleaning during an event.

In order to pass the design flow it was estimated that 90% of the screen would be blinded. Should the available flow area reduce further, the screen was configured to act as a labyrinth weir. The length of weir and depth between top of bank and weir being sufficient to pass the design flood. *(Manual, Section3.3.3 details calculation of screen size. However in this case there were specific factors that gave rise to the unique design which are outside most normal situations).*

2.4 Features

The installation consists of a vertical, steel fence arrangement across the watercourse. The watercourse at this location is canalised with reinforced concrete walls and bed.

The length of the “fence” is increased by arranging it zigzag fashion across the 12m wide bed, the total length of fence being about 46m. The fence is 2m high, while the side walls of the channel are 2.5m high. The panels are 7m in length.

There is a silt trap in the channel bed immediately upstream of the screen. This is approximately 0.6m deep.
Adjacent to the structure on the downstream side a bridge is installed to carry a public footpath; it is about 3m wide and was designed to carry maintenance plant such as the grab lorry used to clean the screen.

Figure 2.4.1 View looking upstream clearly showing the local channel widening at the silt trap, under moderate flow conditions.

Figure 2.4.2 View upstream, under normal flow conditions. There can be a significant build up of transported river bed material collected in the silt trap.

A fenced compound with lockable access gate is provided on the left bank, in which trash removed from the screen may be stored temporarily to drain before being carted on the public highway to tip.

Tockington Park (immediately upstream of the screen) acts as a flood storage area. Downstream of the screen the canalisation continues for about 200m until the two parallel, 1.9m high culverts, 8.5m and 3.5m wide, are entered.

There is no emergency bypass channel, as the facility to pass the design flood is provided over the top of the screen.

There is no telemetry or dedicated lighting at the site, as it is not intended that the screen is cleaned out of hours or during an event. *(Manual, Section 3.4 appraises screen arrangement).*

2.5 Access arrangements

Access from the North Circular Road, (100m away), is facilitated by the provision of a lay-by (doubling as a bus-stop) with fold –down lockable bollards leading off to a metalled road to the footbridge. Hardstandings from which to operate the grab lorry are provided on either side of the river adjacent to the screen.

At the upstream end of the compound is a concrete lined ramp providing plant access to the river bed. The concrete canalisation ends here and upstream the banks are sloping and vegetated. (*Manual, Section 3.4.1 details screen access requirement. In this case the ramp down to the channel ensures good access for operatives and vehicles, although the slope is perhaps too steep).*

2.6 Modifications

Since installation there have been no modifications to the screen structure.

Figure 2.6 The park area to the left of the fence is designed to be used as a flood starage area.

3.0 OPERATION

3.1 Operational Development

During periods of low flow there is very little trash accumulation and the operator visits only on a fortnightly basis. However, during times of spate material of all descriptions (with a large majority of artificial matter) is washed down and is caught against the screen. The blockage impedes the flow more and more causing a considerable difference of head over the structure. Eventually the water cascades over the top and although floating material already there tends to remain in position, entrapped by the pressure of the current, subsequent floating trash is swept over and on downstream.

Figure 3.1.1 Debris collecting on the screen prior to the event reaching its peak. The weir effect of the structure is clearly visible.

Figure 3.1.2 Debris collected on the screen during a significant event. The type of debris oil drums and pallets have the potential to damage the

Figure 3.1.3 Large items of debris are removed by mechanical grab once the event has subsided.

There is no clearance of debris undertaken during flood conditions. The operations team will clear accumulated debris once the flood waters have subsided and it is safe too enter the channel.

Figure 3.1.4 A significant event can bring a large amount of debris downstream.

Clearing of the screen is carried out by grab-lorry, which removes the bulk of the material. Final clearance is then undertaken by operatives working in the channel bed. *(Manual, Section 3.4.2 details alternative approaches to screen clearance. The approach adopted here presents low risk to operatives provided procedures are adhered to).*

The present clearance gang consists of one foreman/grab-lorry driver and two cleaners. Debris is lifted by grab out of the labyrinth and directly into the lorry. The clearance between the turn-back panels is sufficient for the positioning of the grab into the corners of the screen.

When full, the lorry moves to the adjacent compound and tips the load there to allow it to drain while it returns to remove further debris from the concrete bed.

Manual clearance uses hand tools including rakes, forks, brooms and the like. The labourers wear thigh-boots and gloves.

The work can only be carried out during periods of low flow, such as will allow the labourers to safely wade about on the concrete bed of the channel. Cleaning would not be practical at other times as it would be unsafe for the labourers and the grab bucket cannot be controlled in strong currents.

3.2 Equipment on Site

There is no cleaning equipment on site, neither is there shelter, toilets or other welfare provision.

3.3 Access for Clearance

No clearance is undertaken during flood flows. At all other times access is gained to the site as detailed above. It was originally intended to operate the grab lorry from the bridge, however for reasons of public safety this is not done, (the bridge carries a public footpath).

Entry to the channel bed for operatives can be from a vertical ladder adjacent to the bridge or via the channel access ramp. Access is safe when there is dry weather flow, although care must be taken not to step into the silt trap (about 0.6m deeper) immediately upstream of the screen.

The hardstanding areas in the compound are composed of “grasscrete” blockwork. On the right-bank the crossfall (about 1 in 10) is a little too steep to easily control the movement of the lorry, which tends to side-slip during manoeuvring.

Figure 3.3 Entry to the channel can be from the ladder as shown in the photograph or by vehicle ramp. However the silt trap poses an additional safety risk as it is between the ramp and the structure. The step down is clearly visible in the photograph.

During clearance the grab-driver is situated on the near-side of the centreline of the lorry, at the front, and his view of the stream bed is restricted when operating on the left bank, the lorry of necessity pointing downstream. This situation presents safety problems, as the driver cannot be certain where operatives are in the channel. If material should fall from the grab there is a serious risk of injury if operatives are in the vicinity.

3.4 Reporting and Response Procedures

No log book is kept at the site, nor are there any formal reporting procedures in place.

Present contractual arrangements between the Client and Contractor arms of the Environment Agency are such that the screen is only cleaned at fortnightly intervals, unless specially instructed. There is no emergency call-out procedure, principally because nothing can be done to clear the screen during high flows.

4.0 MAINTENANCE

4.1 Inspection Cycles

It is assumed that the design life of the installation was originally 50 years, however there is no maintenance manual available from which to judge the designers original intentions. The structure is robust in nature and currently there is very little evidence of a need for substantial maintenance. The structure would benefit from repainting.

There is no evidence available to demonstrate that maintenance inspections have been undertaken.

4.2 Written Procedures

Written procedures are not available although they are believed to exist.

4.3 New Technology and Legislation

The CDM regulations have an impact on the way in which the screen is operated. At the present time a safe system of work does not appear to be in place. The fact that there are no written operational or maintenance procedures available indicates that if there are agreed systems then they are only informal. There is no audit trail in the event of an accident or emergency at the installation.

The present arrangement for clearing debris with mobile plant is generally satisfactory, there may be opportunities to enhance clearance efficiency through the use of improved mechanical plant. The manual clearance of debris should be questioned. If the screen is designed only to collect large debris why clear away material that will be removed during normal flows.

5.0 PERFORMANCE

Since commissioning there have been no reported incidents of damage to the soffit of the under bridge culvert. It is concluded therefore that the screen is performing its primary function satisfactorily.