Retrofitting Surface Water Management Measures

Digman, C.J.[1], Balmforth, D.J.[2], Ashley, R.M.[3], Stovin, V.[3], Glerum, J.[4] and Shaffer, P.[4]

[1] MWH, 1 Red Hall Avenue, Paragon Business Village, Wakefield, WF1 2UL, UK

[2] MWH, Terriers House, 201 Amersham Road, High Wycombe, Bucks, HP13 5AJ

[3]. University of Sheffield, Sir Frederick Mappin Building, Mappin St, Sheffield,S1 3JD

[4] CIRIA, Classic House, 174 – 180 Old Street, London, EC1 9BP

ABSTRACT

In recent years, CSO discharges and urban drainage flooding has been the target of major improvements. The approach has been to build larger assets to convey or store the flow. As standards become increasingly tighter and the risk of flooding increases, there is growing recognition that we need to change how we manage surface water. Continuing in our current state is unsustainable as well as leaving assets with limited adaptability for (unknown) future requirements.

The best way to achieve better surface water management (SWM) is often to control water at its source and keep it on the surface. This is a step change from our existing approach of getting water underground as quickly as possible. CIRIA has recognised the need for this change and is developing guidance to support practitioners to retrofit surface water management measures into urban areas.

WHY SHOULD WE CHANGE HOW WE MANAGE SURFACE WATER?

Our current approach to managing rainfall in urban areas is to move the water from the surface to below ground infrastructure as soon as possible (e.g. Sewers for Adoption (WRc, 2006)). When rainfall cannot be managed in this way it can be viewed by some as a 'system failure'. The capacity of below ground systems is very limited. Increasing this capacity is expensive. The Foresight Report (Evans et al. 2004) identified that the costs to increase capacity and storage in the light of future climate change projections are substantial. When the system is increased in size, greater quantities of flow are treated and often spilt from CSOs causing pollution from combined sewers. Even where we have separate systems (that are not cross connected) surface pollutants are washed off. This pollution is now starting to be more recognised as a problem that needs to be addressed.

The EU Water Framework Directive (2000/60/ EC) is placing greater emphasis on managing water quality impacts from CSOs and surface water systems. The revised Bathing Water Directive (2006/7/EC) and Shellfish Waters Directive (2006/113/EEC) are also creating major investment in AMP5 to reduce the impact of CSO discharges. Flooding is also being addressed in a major way through the AMP5 DG5 programme and the new Act. Yet many of the solutions will increase the operational costs through increased treatment volumes, and in the future many assets may have to be made bigger; with carbon burdens increasing (Severn Trent Water, 2010).

The alternative is to keep the water on the surface, manage flows at source to reduce runoff, return it to the ground and enable treatment of pollution at source or as close to source as possible. New development is being driven towards this approach already, however, to make a significant impact on flood risk and water quality demands will require measures to be **retrofitted** into our existing urban areas. The new Flood and Water Management Act (2010) may start to facilitate this. However, secondary legislation and a change in funding processes will be required to make this a success. In addition, greater working across professions is needed to enable these measures to be implemented into the urban area and to ensure that the measures add value by improving amenity and bio-diversity.

A NEW APPROACH TO RETROFIT SURFACE WATER MANAGEMENT MEASURES

Recently, CIRIA recognised the need to address the challenges and opportunities that retrofitting offer and is developing guidance with MWH and the University of Sheffield. The guidance is being developed to support practitioners' retrofit SWM measures and will be

published in 2011. The guidance will take into account a wide number of drivers for retrofitting. These include:

- managing flood risk
- reducing surface water sewer discharges
- improving bio-diversity
- enhancing the amenity value
- enhancing urban drainage adaptation capacity
- reducing CSO discharges
- improving water quality
- improving urban planning
- delivering green infrastructure
- managing extreme events

A key part of the guidance is to provide a structured process for retrofitting. It is recognised that many of the measures will need more than just an 'engineering' approach to successfully retrofit. Therefore the guidance is aimed at a wide number of professions who need to work together. This joined up approach will be critical not only to recognise the wide number of benefits but also to achieve retrofitting within the context of the current legislative and regulatory regimes.

There are many key new terms in the guidance, two of which are defined below:

- *Retrofitting – includes measures installed in existing areas from a single plot to area wide. Also includes measures used in the regeneration of an existing area*
- *Measures – primarily physical in nature, both on public and private owned land across a range of scales.*

Fundamental to the guidance is a process that will assist practitioners to retrofit measures into urban areas. Once the drivers to be addressed are known and some critical factors within the catchment are established, the process will help to determine the types of generic measures that can be used. The next step focuses on what specific measures are suitable in different land use types. For example, resolving water quality issues from CSO discharges will require very different measures to manage exceedance flows. Understanding the types of measures suitable will be critical to swiftly assess a catchment, as measures used in a Victorian terraced area will be very different to a large industrial site, for example.

The process is being designed to be used by a variety of practitioners including engineers, planners, urban designers and landscape architects. It is intended to be a vital tool in supporting the implementation of surface water management measures, whether used to understand that retrofit is possible during a high level planning exercise within a Local Authority or to aid practical implementation by a responsible stakeholder.

EXAMPLES OF SUCCESSFUL RETROFITTING

Throughout the world there are many examples of measures that have been retrofitted to manage surface water. Particularly well established programmes of implementation can be found in the USA, in Europe (e.g. Netherlands, Germany, Sweden), Japan and Australia. Many of the drivers for retrofitting in these countries have been water quality, with further benefits seen through better flood risk management. Many of the designs have also positively contributed to the urban area.

In Augustenborg, Malmö, Sweden, a socially deprived area was regenerated (10ICUD, 2005). Part of this saw it change from being a combined sewer system to a separate system where above ground pathways were used (Figure 1) such as canals, ditches, ponds and wetlands before discharging to traditional storm water systems. In addition to this, various forms of source control were used including green roofs. To achieve this, the local community was engaged with the design and hence felt empowered throughout the process.

Figure 1 Temporary detention pond in urban environment (right). and green roof on a building (left)

In Portland, Oregon, a major disconnection programme is still on

going where to date 42,000 properties have been disconnected with rain water from roofs discharging directly to the ground (Portland Environmental Sevices, 2010) or through more attractive means such as planters (Figure 2) or to bio retention areas. Rain gardens have been retrofitted within many school grounds (Figure 2) and over 500 green streets have been installed since the first one in 2003 (Elkin 2008).

Figure 2 (left) An example of an infiltration planter collecting water directly from the roof (courtesy Timber Press, Dunnett & Clayden 2007). Figure 3 Portland Oregon: Mt. Tabor Middle School Rain Garden (Photo Credit: Mt. Tabor Middle School)

Examples within the UK are more limited. Most likely locations to find retrofit SWM measures are in areas being re-developed or regenerated although there are many measures dealing with flooding especially in the aftermath of the 2007 events. Pure retrofit schemes in existing areas are less common place, with only a small number of schemes being identified during this project to date, of which a couple are described below.

In Keighley, Yorkshire a number of measures have been implemented to help manage surface water runoff and prevent flooding. These schemes were investigated, designed and implemented for a number of reasons, including strong local champions within Bradford Metropolitan District Council and a proportion of funding available through European and UK research projects. This has resulted in an under drained swale and a stepped swale (Figure 4) amongst other measures being installed to manage flood risk.

Figure 4 Stepped swale in Keighley

In Bristol, the Dings housing estate was retrofitted as a result of regeneration to address major traffic and parking problems. The subsequent design recognised the wider benefits possible through regeneration and used measures to reduce the flood risk locally.

SUCCESS FACTORS

In investigating cases studies either as retrofits in existing areas or as regeneration, a number of key success factors have emerged. These are briefly summarised in the *Table 1*.

Table 1 Summary of the success factors identified from case studies investigated

Success factor	Summary
Strong driver	Without this, implementation is unrealistic, as funding likely to be attached to the driver
Local champions	These people see or communicate a vision of what is trying to be achieved. They are essential enablers to help overcome some of the barriers that are put in place.
Funding	Often linked to the driver. Having capital and operational funding vital if scheme is to be implemented (whether with the stakeholder building or adopting the measure).
Legislation and regulation	Often cited as a barrier. Current legislation will help new build and redevelopment. Dialogue between responsible stakeholders required to overcome potential issues.
Local policy	This can provide an enabling context and a strong reason to retrofit
Cost	When good financial benefits are demonstrated, this can significantly help to overcome other barriers.
Multiple benefits	Recognising multiple benefits may be critical to implementing a scheme. This may be through the water quality benefits seen when resolving a flood risk problem.

THE BENEFITS OF CHANGING OUR APPROACH

The time frame to see the benefits of changing our approach will vary depending upon how aggressively we can tackle SWM in urban areas. This will require us to provide solutions at the source-pathway-receptor (SPR) level. Various different drivers are present, particularly for the Water Industry, including improving water quality and managing flood risk. A programme to

retrofit surface water management measures could reap major benefits, if the measures can be implemented. The benefits associated with reducing the volume and rate of water entering the sewers include:

- Reduce flood risk by lowering the water level and reducing the need for large below ground storage tanks
- Reduce point source pollution from CSOs or surface water outfalls
- Treat the runoff at or as close to source so improving the water quality when it goes to ground or reaches a receiving water
- Reduce energy costs by not treating extra flow from new below ground solutions as well as slowly reducing the flow that is already treated
- Be more adaptive to managing water in extreme events
- Provide capacity in the system to take new foul flows
- Provide the opportunity to improve the urban landscape by creating functional SWM measures that integrate into their surroundings

CONCLUSIONS

The CIRIA project is developing guidance that will support practitioners to retrofit measures into existing urban areas. There is the opportunity to achieve this if the Flood and Water Management Act (2010) is followed for areas being regenerated. Ownership, regulatory and legislative issues are still a potential challenge when retrofitting into existing areas. However, the wider benefits that can be realised means that SWM measures offer new opportunities for alternative approaches to building larger assets below ground.

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