

EA WATER 12
QUALITY BOX



ENVIRONMENT AGENCY

**Designs that prevent water
pollution – nature's way.**



**A guide to surface water best
management practices, the
effective and economical answer
to non-point source pollution.**



The problem of non-point source pollution

Point-source pollution – from sewage and industrial effluents, for example, is easily regulated. However pollution from diffuse sources like surface water run-off from farmland or urban areas is not. The US EPA say that diffuse pollution, from silt and solids in particular, is the most significant pollution they face today. And thinking in the UK is heading the same way.

In the countryside farming activities have led to organic matter, nutrients, phosphates, pesticides, nitrates and silt running directly off exposed topsoil or through field drains. Some of these pollutants have contaminated groundwater. Many have reached water courses, damaging plant and animal life, upsetting the natural balance of the food chain and affecting public drinking water supplies.

In urban areas surface water can be contaminated by oil, silt, leaves, dog mess etc. – a mixture of pollutants from the air, roads, industrial yards and other hard surfaces, such as drives and pavements. Discharges from surface water outfalls have been found with average concentrations of suspended solids in excess of 200 mg/l – **almost the same as raw sewage**. Discharges have also been found to be contaminated with sewage debris and very high levels of dangerous bacteria.



There are five main causes:

- Contaminants deposited on drained surfaces – oil, rubber, chemicals, pesticides, mud, etc.
- Wrong connections of foul water to surface water drains, either by accident or ignorance.
- Public ignorance of where drains ultimately lead to.
- Spillages and deliberate disposal, particularly of oil, flushed into surface water drainage systems.
- Sudden flushing of contaminated water into drains, which leads to flooding and subsequent groundwater pollution.

Heavy rainfall accelerates runoff, scouring and concentrating a dangerous cocktail of pollutants which flushes rapidly into drains, thence to rivers, causing immediate contamination and flooding. Because the natural settling-out process is bypassed, the common result is widespread contamination of natural watercourses and the public water supply.



Fortunately, the introduction of Best Management Practices (BMPs) means that non-point source pollution and flooding – urban and agricultural, can be effectively and economically prevented and/or controlled.

Best Management Practices – the natural solution

Best Management Practices are ways of minimising diffuse pollution. Broadly two sorts of techniques have been developed – procedural and structural. They aim to:

- Slow the speed of runoff to allow settlement, filtering and infiltration;
- Reduce the quantity of runoff collected;
- Provide natural ways of treating collected surface water before it is either discharged to a water-course or infiltrated into land.

There is a wide range of BMP options from which designers, developers, planners, drainage specialists and civil engineers may choose. It is worth bearing in mind that BMPs are almost always cheaper than conventional systems – usually between 10% and 50% lower in cost.

BMP options include:

- grass swales and filter strips
- infiltration basins, trenches or other infiltration devices
- detention ponds
- extended detention ponds
- retention ponds
- wetlands
- porous surfaces
- procedural BMPs, which are part of the technical advice and working practices available to minimise pollution, especially in agricultural areas, and which include conservation ploughing techniques and new pesticide handling methods, for example.

SWALES

Grass swales can utilise the common green space alongside roads and highways or any other open space. A swale is basically a much-improved "ditch" with a very broad bottom and very gently sloping sides. It gives a low sheet flow, slowing the water and giving pollutants in the flow a chance to settle out.

Swales are primarily used at the headwaters of the catchment at the edge of the property or highway. They can also form a network, draining to storage ponds or wetlands.

Swales avoid the need for expensive roadside kerbs and gulleys. Maintenance costs are much lower and drainage of the road surface is guaranteed.



PONDS

Detention ponds are designed to collect storm run-off, holding it for a few hours to let the sediment settle out. Outside of storm periods, most ponds will be



dry. Their main function is to remove solids and removal rates of +80% are possible. The rates achieved for nutrient and trace metal removal are, however, more modest; a retention pond or wet-land will improve this performance.



Retention ponds retain a significant volume of water all the time. The design can allow for substantial variation in the retained water level and

the pond can become an attractive local amenity – as well as an effective filter for nutrients, trace metals, bacteria and organic matter.

Stormwater wetlands are basically enhanced wet ponds with shallow areas incorporating a variety of marsh and wetland plants



covered in about 6-12 inches of water. The algae and plant material filter and remove nutrients to a much greater degree than ponds alone. Stormwater wetlands must



always be purpose-built; leading surface water into an existing, natural wetland can harm aquatic life and is not an acceptable practice.

POROUS PAVEMENTS

An alternative to conventional paving, porous pavements allow water to permeate through, rather than run off, the paving. Rainwater can filter directly into the subsoil or can drain into a reservoir (about one metre deep) before soaking slowing away, discharging to the water-course or even being stored for landscape watering.

Porous surfaces are particularly appropriate where run-off is lightly contaminated and close to source. They have been shown to remove up to 80% of sediment, 60% of phosphorus, 80% of nitrogen and substantial levels of trace metals and organic matter.



INFILTRATION TRENCHES



These are shallow, excavated trenches, backfilled with stone to create an underground reservoir. From this the water filters into the

subsoil, and can help to replenish groundwater resources, where this is desirable.

Providing a gully, sump pit or grassed filter strip to remove excessive solids can increase both the life and effectiveness of the trench which, even on its own, is a highly successful pollution prevention technique.

FILTER STRIPS

Just as grass swales reduce sediment in urban areas, grass filter strips alongside fields can effectively remove sediment and some nutrients in the runoff from ploughed land. The strips can be wide enough to form buffer zones between the water course and the farmland.



INFILTRATION BASINS

These are “dips” in the ground, far shallower than ponds, where storm-water runoff is stored to soak gradually away through the soil of the basin floor. They are suitable for larger catchment areas than infiltration trenches – around 10 hectares. Properly constructed, they can remove a large proportion of non-soluble pollutants.

FRENCH DRAINS

These are below-ground systems comprising a trench filled with gravel wrapped in a geotextile membrane. Runoff water is led to them either directly from the surface or through a system of pipes. French drains are less costly than kerbs and gulleys and are especially useful where there are only small watercourses available to receive runoff water.

Questions and Answers

Despite the outstanding success of BMPs in many different countries, they are still not in widespread use in the UK.

There are several common questions about the use of structural BMPs in particular which still cause concern:

1) SAFETY RISKS

- (a) **Children** – Stormwater ponds can be designed to be very safe by adjusting the geometry. The slopes to the pond should be very gentle. This minimises the risk that a child might fall into the pond. A flat bench on the edge of the shoreline, plus a shallow shelf filled with emergent plants on the inside of the shoreline, together provide an effective barrier to children. In most cases, fencing isn't required.
- (b) **Trapped pollutants in sediment** – Research studies from many sites in the USA show that pollutants can be considered to be neither hazardous nor toxic material. In most cases, sediments can be safely spread on land or used for landscaping around the site.

2) MAINTENANCE COSTS

Maintenance requirements for BMPs are generally less than those for conventional drainage systems, e.g. de-silting storm drains and inlets. This is because BMPs trap many pollutants at one point, sparing you from having to clean out many small structures. Grass swales, for example, must be mown, yet compared with cleaning gulleys and clearing blockages from conventional drainage systems, the cost is minimal.

3) APPEARANCE

Detention ponds may hold turbid water for a few hours after rain and a deposit of sediment may remain during dry weather. With sensitive planting and landscaping, however, BMPs like swales, ponds and wetlands can be attractive features, as can porous surfaces for car parks and pedestrian areas.

Benefits



Stormwater wetlands can be attractive features.

1 Increase in property values

With well designed stormwater ponds and wetlands, developers have been selling adjacent lots at a substantial premium to those further away, both here and abroad.

2 Increased wildlife and conservation value

It isn't uncommon for herons, ducks and other waterfowl to inhabit storm-water ponds and wetlands. Their presence increases the amenity value of the pond to the residents. As people stop to watch the birds and to talk with neighbours, a whole social life can develop around such wetlands.

3 Sustainable development

BMPs represent a more sustainable way of managing surface water runoff.

4 ...and a cleaner water environment!

Examples of BMP sites In the UK

STORMWATER RETENTION POND

Lexmark, Rosyth

Developed to balance the flow from an industrial site.



PERMEABLE CAR PARK

Ostrich Kingdom, Freuchie

This car park is designed to be permeable with stone chipping laid down.



DETENTION POND

Eastfield, Glenrothes

A flood prevention area consisting of marsh with surface outfalls discharging into the area.



INFILTRATION TRENCH

A1 Road, East Lothian

Attenuates road runoff



POROUS CAR PARK

Nottingham Trent University

Solid blocks with a porous infill in a car park



(picture by Prof. Chris Pratt, Coventry University)

FLOOD PREVENTION POND

Stenton Pond, Glenrothes

Controls surface water produced by both industrial and housing developments.



INFILTRATION TRENCH

Shire Hall, Reading

Storm water runoff intercepted by permeable strips in this car park.



(picture by Prof Chris Pratt, Coventry University)

GRASS SWALE

Freepoint Leisure, West Calder

Storm water produced from this 165 acre site is drained with the use of swales and ponds.



STORMWATER POND

Motorola, West Lothian

Runoff balanced and treated by ponds



ACTION NOW!

It is vital that developers, planning authorities, local communities, farmers and industry work together with the environment agencies to tackle diffuse pollution. Doing this "nature's way" is unquestionably the most sensible and cost-effective option.

"NATURE'S WAY" VIDEO

If "seeing is believing" then watching this informative and compelling ½ hour video will certainly bring the benefits of Best Management Practices to life for you, your colleagues and all opinion-formers and decision-makers in your area or business.

The video produced by International Association on Water Quality (IAWQ) is available for £9.50 from; IAWQ, Duchess House, 20 Mason's Yard, Duke Street, London SW1Y 6BH. Tel: 0171 839 8390. Fax: 0171 839 8299.

REFERENCES AND FOR FURTHER DETAILS ABOUT BMPs



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0345 73 72 71

*24-hours a day, 7 days a week, all calls
are charged at local rates.*

MANAGEMENT AND CONTACTS:

The Environment Agency delivers a service to its customers, with the emphasis on authority and accountability at the most local level possible. It aims to be cost-effective and efficient and to offer the best service and value for money.

Head Office is responsible for overall policy and relationships with national bodies including Government.

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For general enquiries please call your local Environment Agency office. If you are unsure who to contact, or which is your local office, please call our general enquiry line.

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

**ENVIRONMENT AGENCY
GENERAL ENQUIRY LINE**

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