Catchment management
managing water – managing land

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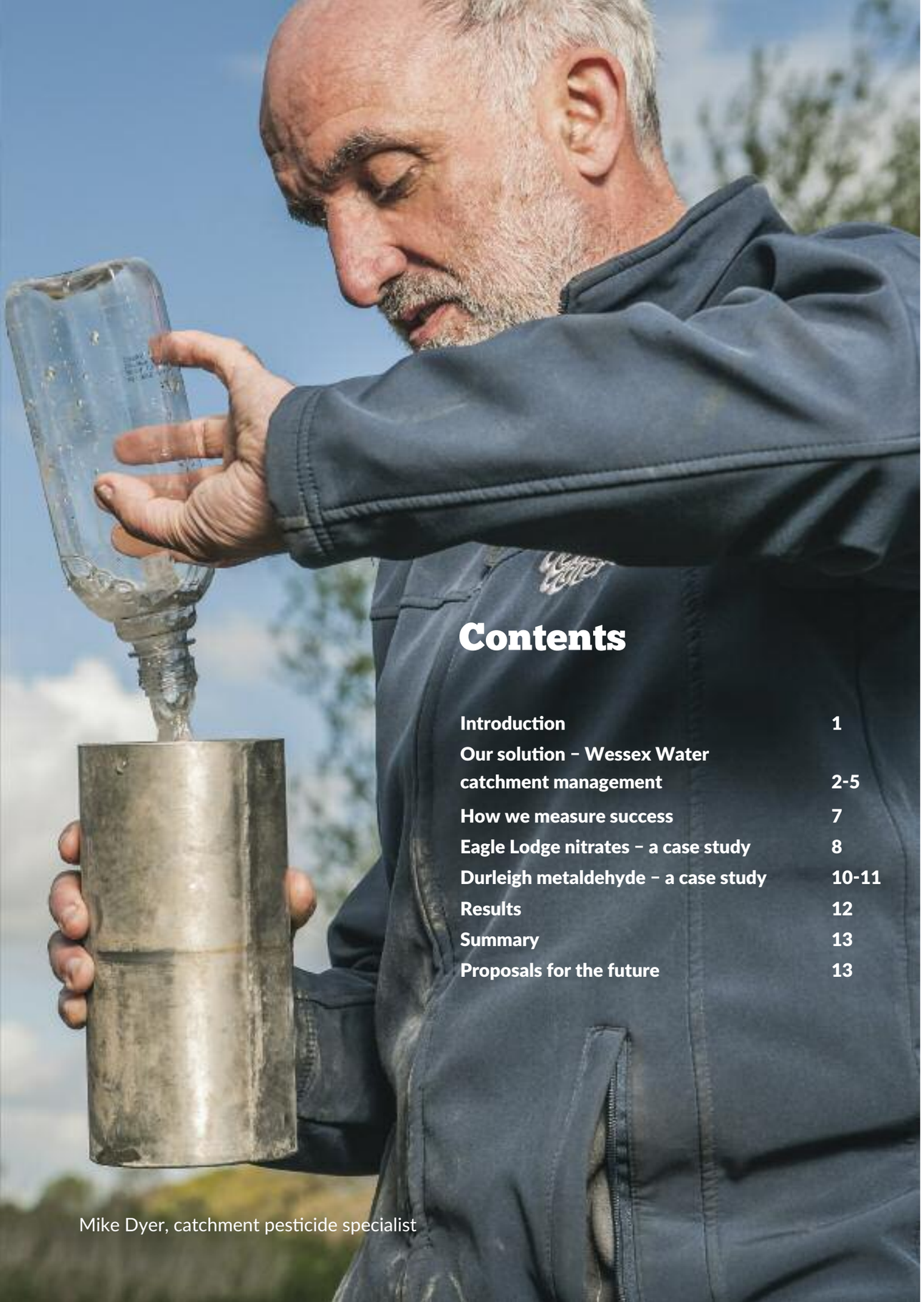

Mike Dyer, catchment pesticide specialist

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Introduction

the problem of poor water quality

Wessex Water supplies drinking water to 1.3 million people in the south west of England.

About 80% of the water we supply comes from groundwater sources in Wiltshire and Dorset. These natural underground reservoirs, known as aquifers, are formed when rainwater infiltrates rocks such as chalk, limestone and sandstone.

Groundwater is usually free of the impurities found in other water sources like surface reservoirs or rivers so it needs less treatment. However, the level of treatment required to maintain and further improve water quality is affected by rising levels of nitrates and pesticides that the water has picked up from the soil.

The remaining 20% of the water we supply comes from surface reservoirs filled by rainfall and runoff from the surrounding catchment. Water quality in these reservoirs is directly affected by the activities taking place on this land. If routine operations such as pesticide and/or nutrient use are poorly timed or managed they can put additional pressure on treatment works or restrict use of the sources.

The traditional approach to dealing with poor quality water has been to construct large treatment plants. But they are expensive to build and operate, have a large carbon footprint and provide no benefit to the wider environment.

Fertilisers (nutrients) and pesticides are key components for agricultural production and land management. Nitrogen fertiliser increases crop yields and pesticides are used to control insects, molluscs, weeds and diseases.

Excess nitrates that are not taken up by crops and pesticide residues that have not broken down are at risk of being washed into rivers and aquifers. These will pollute the environment and the water sources used for public water supply.

Currently more than 20 of our water supply sources are affected by elevated nitrate concentrations. We have already built four treatment plants to remove nitrate and 11 sites now have carbon filters to remove pesticides.

Building more treatment plants does not benefit the environment or our customers. Instead we have developed an approach that is more sustainable, lower in cost, has wider benefits for the environment and involves working with the local community.

Our aim is to prevent the deterioration of water quality at source. By working with those who manage the land, we can effectively manage water. We are achieving improved raw water quality through our catchment management programme.

Our solution

Wessex Water catchment management

Background

Wessex Water catchment management began in 2005 and involves working with local farmers and landowners within the catchment areas of public water supply boreholes and reservoirs in order to safeguard the quality of ground and surface waters.

Our catchment management objective is to stabilise and then reduce the levels of contaminant at each source so no additional treatment is required. We work in partnership with local farmers and landowners because they, not Wessex Water, own the land that makes up the water supply catchments.

This allows us to influence and implement changes in agricultural land use and practice to reduce the levels of nitrate and pesticide entering the ground and surface water environments.

We believe clean water and food production should complement each other and that by working together the water and farming industry can achieve our goals while protecting the environment.

Many farmers appreciate working with us in catchment management and recognise the service our catchment advisers provide to the partnership. And it's not only individual farmers who appreciate working with us.

We have liaised closely with various organisations including the National Farmers' Union (NFU) and Natural England's Catchment Sensitive Farming (CSF) on catchment management initiatives.

Paul Stanfield, catchment delivery manager

"We value the work undertaken by Wessex Water catchment management and over the years we have established a close working relationship."
Charlotte Woodsford, CSF officer, Natural England

Our solution

Wessex Water catchment management

Our team

We employ a team of well-qualified and experienced catchment advisers and scientists. The advisers are trained to offer agronomic advice to farmers.

Over the next five years the catchment team will cover 21 at risk catchments across our region comprising 15 groundwater sources at risk from nitrate, one groundwater source threatened by pesticides and five reservoirs at risk from a combination of pesticides (including metaldehyde) and nutrients which encourage excessive algal growth. Algal growth in reservoirs leads to taste and odour issues associated with their metabolism by-products (MIB and geosmin).

In addition, we will be using catchment management to address high nitrogen concentrations entering Poole Harbour and causing environmental problems linked to increased algal biomass in certain parts of the harbour.

Working with farmers

Catchment advisers are responsible for a group of catchments which have been prioritised according to their present and predicted nitrate or pesticide level and the impact that the loss of the source would have on our water supply operations.

The advisers make direct and personal contact with all the landowners and farmers within their catchments and discuss the issues and raise awareness of the problem (nitrate or pesticide). This is often the first time farmers realise that a local drinking water supply source is threatened with water quality problems as a result of their activity.

Our experience shows that in by far the majority of cases, local farmers and landowners are concerned by the impact they might have and are keen to work with our advisers to reduce the pollution.

Surface water and groundwater catchments and the issues affecting them differ, but they both involve monitoring to define and understand them.

The catchment management team collects large quantities of data from the farms and the catchment ranging from information provided by the farmer such as current and historical farm records, to direct hydrometric and soil data measured on the farm and within the catchment.

This local, targeted monitoring is a key component of our catchment management and the results are collated, analysed and then fed back to the farmers through our advisers. They then assist with agronomic advice and in the development of agricultural management plans (for soil, manure, fertiliser and crop protection) which optimise the nutrient and pesticide efficiency and reduce losses through leaching.

Good farming practice is generally not a threat to good water supplies and our catchment management seeks to identify activities that represent the greatest risk to water supplies; poor practice needs to be identified and changes made.

This requires intensive fieldwork in cooperation with the farmers and in many cases we are discovering that what has been loosely described as “diffuse pollution” is actually a number of “point source pollutions”.

Examples of issues we have found in close proximity to our groundwater sources include:

- bare soils over the winter period
- over application, uneven application and poorly timed application of inorganic nitrogen fertiliser
- miss-timed slurry or manure spreading on stubble fields
- defective manure and slurry storage, sometimes in unlined chalk pits
- insufficient storage capacity for livestock manures
- over winter grazing
- outdoor pig rearing
- storage, mixing and application of pesticides on heavily fissured limestone or poorly timed applications within sensitive surface water catchments.

Thorough investigation and cooperation with farmers enables these issues or risks to be addressed.

Solutions include assisting farmers into agri-environment schemes (Countryside Stewardship), advice on amounts and timing of applications, fertiliser spreader and pesticide sprayer calibration and provision of locally derived data to improve management plans and agricultural practice.

Where the farmer needs specific assistance (financial or otherwise), for example to prime a change in practice, we will look at this on a case by case basis.

We have contributed financially and with advice to support trials into farming methods that have the potential to reduce nitrate leaching and crop efficacy. For instance, precision farming and the use and varieties of cover crops, and we make this data available to farmers we work with.

The immediate impact of these improvements on the land within our catchments will be to reduce nitrate leaching from the soil into the underlying rocks and aquifers.

Timescales involved

Improvements in land use can have a rapid impact on surface water quality, while it may take longer to influence all the groundwater because of the travel time of water through the rocks.

To investigate this we have carried out detailed modelling work to calculate the degree and timescale by which the reduction in leaching will lower source nitrate levels. The modelling indicates that drinking water exceedances can be avoided by our catchment management approach.

The time lag in groundwater means that historic nitrate applications contribute to the nitrate concentrations observed today. However, nitrate trends vary seasonally and it is often the peaks that threaten to exceed permissible concentrations. These peaks probably result from more recent activity which can be addressed by catchment management today. **Reducing the peaks will allow time for the average trend to stabilise and decline.**

“We have been working with Wessex Water for a number of years on catchment management and found the process thought provoking and the results informative. I hope that we can continue to work together to ensure a safe water supply from the catchment as well as continue to farm effectively and efficiently.”
Philip Simmonds, farm manager, Salisbury

Adrian Moore, catchment adviser

How we measure success

A key part of catchment management is to measure the effectiveness of our work with farmers.

The impact of catchment management is monitored through a toolbox of performance indicators which include:

- the nitrate/pesticide trends measured at our sources
- the degree to which catchment farmers engage with the project
- progress towards the reduction or elimination of risks to water quality associated with high risk farming activities
- the modelling or numerical assessment of nitrate leaching reduction at field or farm level and empirical field measurement.

The monitoring system underpinning our catchment management work is designed to measure changes in contaminant concentrations as they move from field application to our water sources.

Initially we expect to see adjustments to farming practice leading to reductions in surplus residues in soils, resulting in less leaching to the aquifer beneath or run-off into surface waters. These changes are picked up in farm records and in the case of nitrates are monitored by soil mineral nitrogen (SMN) sampling, porous pots (which sample water draining from the soil zone) and surface water sampling. Changes in pesticide concentration are monitored through surface water sampling.

Reductions in contaminants leaching from the soil will lead to lower levels of contaminant in groundwater and surface water in the source catchments and ultimately in the sources themselves. These changes are picked up by groundwater sampling from boreholes and wells and surface water in the catchment.

We measure reductions at our sources through our regular supply sampling and online nitrate monitors. The monitoring is extensive and in a typical year we take approximately 9,000 water samples and almost 1,500 soil samples across all of our catchments for analysis and feedback to farmers.

This data plays an important role in understanding the movement and fate of pollutants. It provides information for farmers to update their fertiliser plans and demonstrates the impact of the catchment management on water quality of both drinking water supplies and the wider environment.

Farm data also plays a significant role in helping to demonstrate catchment management’s effectiveness. Analysis of data such as fertiliser application records and crop yields can uncover trends and identify practices that lead to greater nutrient use efficiencies benefiting farm productivity, water quality and the environment. These records can also demonstrate the extent to which advice has been adopted by farmers and how issues have been resolved.

Tim Stephens, catchment adviser

Eagle Lodge nitrates – a case study

Eagle Lodge is a groundwater source supplying the Dorchester area.

The water from the boreholes failed the nitrate standard several times between 1999 and 2001 and we are required by the Drinking Water Inspectorate (DWI) to ensure and maintain compliance with regard to nitrate.

A nitrate removal plant was planned and designed for Eagle Lodge in 2004 but the high construction and running costs of such a plant, and the need for additional land to build it on, led us to look at a catchment management option for the source.

Our catchment management started in 2005 and followed a series of dry winters when nitrate peaks regionally had been lower than in previous years. The objective was to optimise nitrate inputs in the catchment to the extent that under high groundwater situations nitrate peaks remained below the nitrate standard.

Our catchment adviser made contact with the catchment farmers, explained the nitrate problem to them, obtained farm records, identified specific issues and developed a good working relationship.

This allowed the adviser to suggest changes in farming practice including:

- improved nutrient and manure management
- calibration of fertiliser spreaders
- altered drilling dates of autumn sown crops
- use of winter cover crops and the adoption of resource protection measures under environmental stewardship.

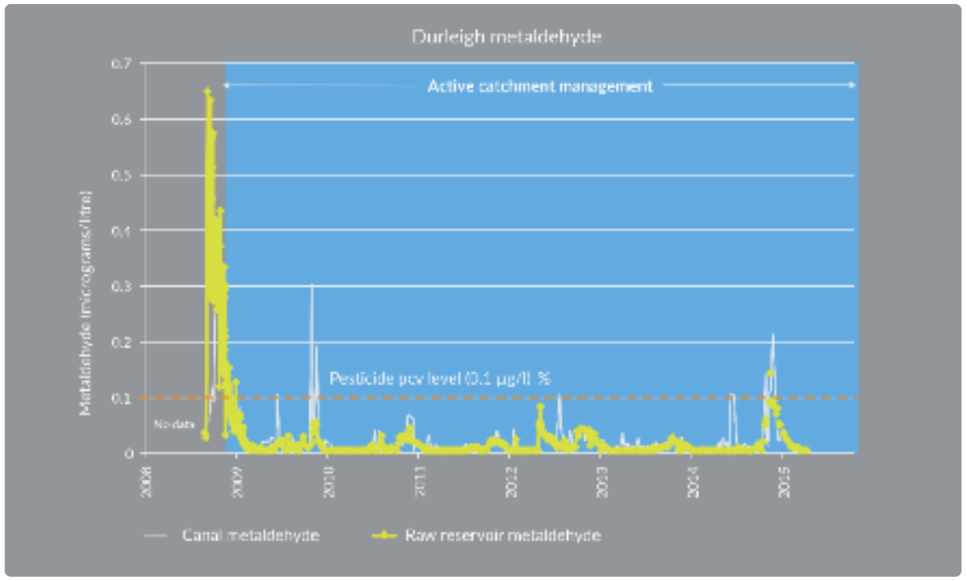
Many farmers took up these options assisted, between 2005 and 2008, by a jointly funded European project, the Water Resources Management in Cooperation with Agriculture (WAgriCo).

Since 2006, with a return of some wetter winters, there have been some nitrate peaks, but below the drinking water standard limit and well below the levels seen before catchment management began.

Wessex Water takes a very proactive approach by working with farmers to improve water quality. By helping to measure soil indices, soil mineral nitrogen, muck testing and so on farmers are better able to manage inputs for both economic and environmental advantage."
Joe Foot, farmer, Weymouth

Louise Moderski-Rush, catchment adviser

Durleigh metaldehyde – a case study



Durleigh is a surface reservoir in the western area of our supply region which supplies water to Bridgwater and the surrounding area. The treatment works for the reservoir includes granular activated carbon (GAC) which is effective in removing most of the pesticides that enter the reservoir from the farmland in the catchment.

However, the plant is not effective in removing metaldehyde, a widely used molluscicide which passes through GAC, so the source had to be shut down in 2008 when a large spike of metaldehyde entered the reservoir, resulting in concentrations well above the permitted concentration or value (PCV) limit of 0.1 ug/l.

It remained switched off for four months between September and December 2008 and the only way to remove the metaldehyde was to drain the reservoir and allow it to refill naturally with cleaner water from the catchment.

Treatment options were investigated but given the difficulty of removing metaldehyde we decided to tackle it using catchment management – active catchment management began at Durleigh in October 2008.

We sent a letter to all the catchment farmers explaining the situation and requesting their cooperation with our catchment adviser and followed this with joint visits to the catchment together with the Environment Agency (EA).

Catchment water samples were taken and the results shown to the farmers. Their response was exemplary to the extent that one farmer, whose fields had been shown to be contributing significantly to the 2008 incident, voluntarily switched to a different, more expensive molluscicide.

In recognition of the goodwill and effectiveness of this action, we agreed to contribute financially to all catchment farmers who made the switch to non-metaldehyde based slug treatments.

Catchment management continues at Durleigh through a mixture of catchment sampling, farm visits and a regular newsletter sent out jointly from the EA and ourselves.

In addition to natural inflows from the catchment, we can also pump water into the reservoir, from the River Tone via the Bridgwater and Taunton Canal, to top it up up during autumn.

The use of the canal at this time is a balance between the need to refill the reservoir and avoiding the transfer of any contaminant into it from the very large River Tone catchment where no catchment management takes place.

Since the start of active catchment management there has been only one incident of metaldehyde exceedance in the reservoir and this occurred in October 2014 when significantly elevated metaldehyde levels occurred in the River Tone as the canal was being pumped. The volume of water pumped before sample analysis confirmed the metaldehyde contamination was enough to push the raw reservoir water over the limit.

Fortunately, the success of catchment management in minimising metaldehyde within the natural reservoir catchment meant that once the canal pump was switched off, the natural catchment inflows were able to dilute the raw reservoir to the extent that there was no interruption to supply.

Although unfortunate, this event provided further indication of the difference that our active catchment management makes.

As a result of this peak the entire River Tone has been designated as a Safeguard Zone and a joint letter from the EA, CSF and Wessex Water has been sent to every farmer in the River Tone catchment advising them of this problem. In addition, tighter controls have been imposed on the use of canal pumping to ensure this event is not repeated.

Results

Our catchment management has shown some very good results and we have not had to install treatment at any of the sites where we started it – nor do we have any plans to do so.

Where strong partnerships have formed with local farmers everyone is gaining from the programme with action benefiting water quality, farming and the local environment.

The initiative represents a low cost solution to dealing with the problem of nitrates and pesticides with the actual cost benefit ratio varying from site to site. On average, when using catchment management we are solving water quality problems for approximately one sixth the cost of the treatment alternative. This is a clear benefit to our customers with additional benefits for the wider environment.

Furthermore, catchment management has a significantly lower carbon footprint than building and operating treatment plants. Generally a catchment approach is more suited to small catchments or sub-catchments than large ones.

Our modelling shows catchment management will have an impact on both average and peak nitrate levels at our sources within acceptable timescales. Reduced nitrate and pesticide use or greater efficiency in use has wider benefits for the local environment. In particular, in many of the catchments where we are working, Natural England is looking for a significant reduction in the nitrate level in rivers to safeguard biodiversity and our work is contributing to that.

In Poole Harbour algal blooms which affect marine life and birds result from nutrient enrichment with nitrates and phosphates entering the harbour from the catchments of the Frome and Piddle rivers. Nitrate comes from a variety of sources including sewage treatment works discharges. Our investment in the last 10 years has reduced this loading significantly and agriculture now remains the largest source. Our experience in catchment management will be used to help to reduce this agricultural loading over the next five years and beyond.

Jez Graham and Esa-pekka Tuominen, catchment science team

Summary

Our region is predominately rural with the majority of land in agricultural production. So we rely on local farmers and landowners to manage their land in a way which safeguards water quality while also recognising their need to sustain viable farming businesses.

Our catchment management work seeks to support local farmers in achieving the common objectives of good land management, food production and high quality ground and surface waters.

Since catchment management began in 2005 there have been no nitrate exceedances in treated water at any of the at risk catchments. There has also been a step change in pesticide prone catchments with no exceedances of targeted pesticides.

The Drinking Water Inspectorate has recognised the positive impact of catchment management at the high nitrate sites where we first started our work by releasing us from an undertaking to install further treatment facilities at these sites.

Furthermore, due to the success of catchment management we no longer require additional treatment for pesticides and metaldehyde removal at one groundwater site and two surface reservoirs.

These are real, measurable outcomes that not only provide cost savings for us and our customers, but also for catchment farmers in terms of optimised and reduced use of nutrients and pesticides.

Management of the problem in the catchment, working in partnership between those who know how to manage water resources and those who know how to manage the land, is more sustainable and cost effective than installing a treatment plant which is expensive to construct and operate.

It also deals with the issue rather than leaving it in the environment where it could have wider impacts on biodiversity

Together with farmers we can manage the water and manage the land.

Proposals for the future

We believe that catchment management – not treatment – should be the primary tool for managing raw water quality. To achieve this we believe that the following are required.

- The Environment Agency (EA) needs to ensure that its Drinking Water Protected Area safeguard zone action plans have clear actions and that outcomes are adhered to by all parties, with the need for water protection zones clearly spelt out if the voluntary measures being trialled over the next few years are not successful.
- Continued recognition by the EA that the pollution of waters with pesticides or nitrates is a major issue which can result in public water supply sources becoming unavailable.
- Improvements in the incentives for farmers to avoid causing pollution. The opportunities for implementation of leaching reduction measures under the reformed common agricultural policy should be explored and realised. Incentives are best channelled through agri-environment schemes and the importance of the protection of water used for water supplies still needs to be recognised. This might be in the form of additional land management requirements and matching payments to farms that are in a water supply safeguard zone. These additional requirements would be focused on ensuring that water supplies are protected from contamination.
- A key regulatory issue is that catchment management is never going to give you the same certainty of outcome as operating a treatment plant. There remains a risk of occasional, and usually minor, exceedances of the drinking water standards, at least in the short term. These should only result in a change of plan to a treatment approach if they are sustained or represent a risk to public health.

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