



The Feasibility of a Nitrogen PES Scheme in the Poole Harbour Catchment

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Summary

Background

This study has examined the feasibility of a 'nitrogen trading' Payments for Ecosystem Services (PES) scheme around Poole Harbour. Managed by the RSPB, it is one of three studies commissioned by Defra in February 2012 to test the feasibility of PES schemes in novel markets and specific parts of England. These studies follow government commitments in the recent Natural Environment White Paper (Defra, 2011a) and England Biodiversity Strategy (Defra, 2011b) to expand markets in ecosystem services.

There is considerable potential for a nitrogen trading market in the Poole Harbour catchment, created by the legal imperative to protect Poole Harbour Special Protected Area (SPA) from further damage due to nitrate pollution. Wildlife in Poole Harbour is suffering considerably from nitrogen-driven eutrophication, and under the Conservation of Species and Habitats Regulations 2010, this means that any new sources of nitrate from developments, industry or consented agricultural activity in the 800km² catchment feeding the harbour must be mitigated by reducing the loading reaching the harbour from existing nitrogen discharges.

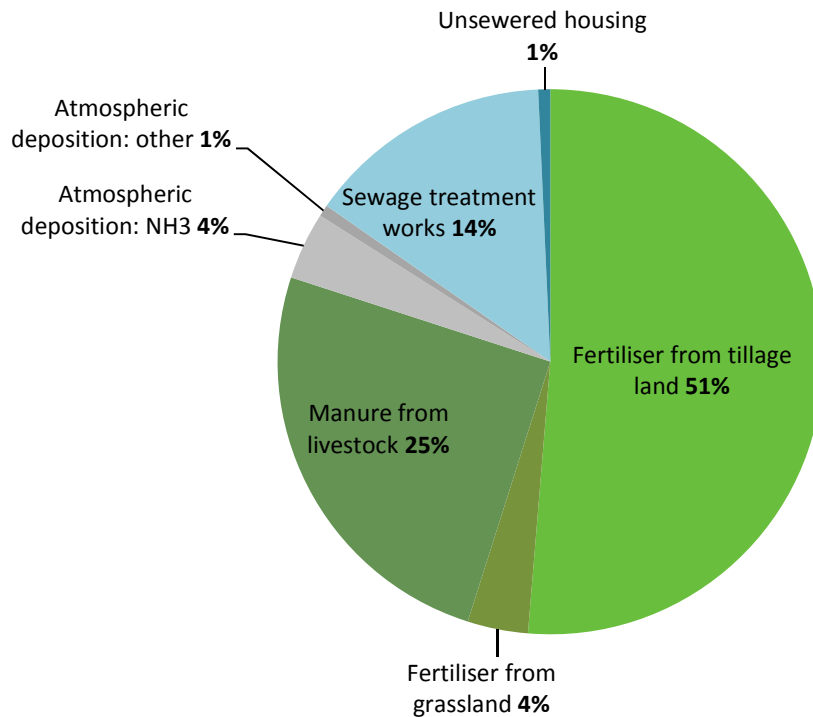
Research by the Environment Agency and Natural England (EA/NE, 2013) show that the majority of these existing discharges are agricultural (see Figure 1), and that the most cost-effective means of reducing nitrogen inputs to Poole Harbour would come from reducing agricultural pollution; nitrogen mitigation through this route could potentially cost £4.9M less than any alternative.

This study set out to investigate the feasibility of a PES scheme in which reductions in existing (and largely agricultural) nitrogen discharges were paid for by those seeking planning permission for new development that would inevitably increase nitrogen loading through the sewerage system.

Nutrient mitigation PES schemes could be applicable in many other parts of Britain, especially as there are several other Natura 2000 sites where nutrient pollution is at damaging levels (EA, 2013).



Figure 1: Estimated contributions of nitrogen sources to annual native load on Poole Harbour (EA/NE, 2013)



This study included technical and legal research into the feasibility of such a scheme, and discussion with potential buyers, sellers, intermediaries, stakeholders and statutory regulators for such a scheme, in particular:

- Farmers, landowners and their trade unions
- Local authorities
- Wessex Water, as the water and wastewater supplier
- Environmental organisations
- The Environment Agency and Natural England as regulators

Following the decision of local authorities to take responsibility for co-ordinating nitrogen mitigation for new development, this study has worked closely with them rather than with developers, who were originally considered the scheme beneficiaries and potential funding source.



Key findings

Although there are no technical barriers to a nitrogen mitigation PES, and elements of such a system are now appearing in the catchment, this study has found substantial barriers to a scheme paying farmers for ongoing land management changes. Key among them are that:

- Two of the three local authorities have firm objections to paying farmers for reductions in agricultural nitrogen pollution, with the third still undecided. The reasons cited are essentially that any use of developers' funds to address agricultural pollution is unfair and politically unacceptable given that new development is expected to comprise <2% of total nitrogen load from the catchment while agriculture contributes 85%, and that councils face demands from the electorate and central government for more affordable housing.
- Farmers and landowners are unwilling to accept long-term contracts for PES measures. This matters because mitigation needs to be in place for the lifetime of any new development – upward of 50 years – while land management agreements are typically signed for five or ten year periods. There is some willingness to accept longer-term contracts for measures such as woodland planting or wetland construction, as this is seen as a complete land-use change and more suitable for long-term contracts. However, farmers in discussion have asked for 30-year contracts that are more expensive than outright land purchase at a fair market value.

Beyond these two substantial barriers, there are also several lesser problems and decisions outstanding:

- Monitoring of any PES measures is likely to be difficult. While several organisations have expressed an interest in providing advice to farmers before a PES contract is agreed, none are keen to monitor or enforce them. This problem may be solved by the Environment Agency and Natural England's Nitrogen Management Strategy, which will need to monitor and enforce its progress.
- A systematic review by the Centre for Ecology and Hydrology reveals that, although functional wetlands generally contribute to an overall decline in nutrient concentrations, not all wetland types can be assumed to function in the same way. This appears to be largely a consequence of the early stage of research in this area, with data available only for a relatively small subset of wetlands for which important information (location, age, *etc.*) was often missing; further experience may overcome this problem. Uncertainties for



nitrogen removal were found to be particularly high. Whilst wetlands designed, situated and managed optimally can be assumed to reduce nutrients in run-off from agricultural land, details of design lie beyond the scope of this research project. In the absence of this fine-tuning of wetland to working landscape, uncertainties about the nitrate control benefits of wetland types raise questions about their general contribution to nitrate mitigation.

There are, however, PES-like agreements appearing in the catchment. In particular, the Borough of Poole Council have converted farmland to parkland at Upton Country Park. The reduced nitrogen pollution due to this change is being used to mitigate nitrogen discharges from new development in Poole, with developers purchasing 'mitigation credits' through the Community Infrastructure Levy. To date this has seen £102,000 of credits purchased.

There is also still potential for West Dorset Council to decide to purchase land management change from farmers, and we will continue to investigate this. West Dorset Council have not finally estimated their mitigation needs – once this has been done and should the Council be interested we will arrange a meeting between Council staff and interested farmers, to discuss PES measures and see whether the problem of long-term contracts or covenants could be ironed out once a specific contract was on offer.



Background to this study

This study is one of three commissioned by Defra in February 2012, to test the feasibility of Payments for Ecosystem Services (PES) schemes in both novel markets and specific parts of England. These studies follow government commitments in the recent Natural Environment White Paper (Defra, 2011a) and England Biodiversity Strategy (Defra, 2011b) to expand markets in ecosystem services.

Managed by the RSPB, this study has examined the feasibility of a 'nitrogen trading' PES scheme around Poole Harbour. The potential for a market in nitrate reduction is created by the legal imperative to protect Poole Harbour Special Protected Area (SPA) from further damage due to nitrate pollution. In effect this means that any new sources of nitrate from developments, industry or consented agricultural activity in the 800km² catchment feeding the harbour must be mitigated by reducing the loading reaching the harbour from existing sources.

Traditionally such challenges have been met by investment in end-of-pipe treatment by water companies, often at significant cost both financial and in terms of greenhouse gas emissions (Defra, 2008).

The scheme explored in this paper would see investment in land management and habitat creation to increase the ability of the catchment to *regulate* nitrogen levels and/or increase the *provision* of unpolluted water so as to reduce overall loads from land management. Box 1 sets out the relevant concepts of mitigation and ecosystem services.

The direct beneficiaries of such a scheme would be new developers and others seeking consent for activities (industrial or agricultural) that could lead to emissions of nitrogen compounds. The most likely providers would be land managers or water companies, going beyond regulatory requirements to reduce the diffuse inputs of nitrogen compounds from their land or operations. These reductions could be sold as 'mitigation credits' to potential developers, allowing their projects to proceed at a lower cost than if they had to prevent or mitigate discharges themselves.



Box 1: Mitigation, offsetting and the role of PES

Many projects have the potential to damage the features of protected sites, or wildlife in a broader sense. Mitigation and offsetting are the two routes for allowing such projects to take place without overall damage to wildlife.

Mitigation is action that prevents damage from occurring, while *offsetting* is action 'designed to deliver biodiversity benefits in compensation for losses.' (Defra, 2011a).

Ecosystem services are the benefits that people receive from the rest of the living world, and are often divided into four broad categories (MA, 2005):

- *provisioning* services provide particular products
- *regulating* services buffer pollution and potentially damaging natural processes such as flooding
- *cultural* services are the inspiration and comfort of mind that we gain from wildlife
- *supporting* services are those that underpin other services

Payments for Ecosystem Services (PES) cover any 'payments to compensate for actions undertaken to increase the levels of desired ecosystem services' (Dunn, 2011).

Mitigation and offsetting actions can be seen as preventing overall reductions in ecosystem services, and payments for ecosystem services as one method of delivering the actions.

This study investigates whether a PES scheme could bolster the *regulating* services that protect Poole Harbour against nitrogen pollution as *mitigation* for new nitrogen discharges, and in part through *provision* of clean water to the Harbour.

Poole Harbour

Poole Harbour is Britain's largest natural harbour, with an area of 36km² and an 800km² catchment. The Harbour is a much-used recreational and navigational harbour (including both cross-channel ferries and one of the country's busiest lifeboat stations), holds shell- and shallow-water fisheries, and fronts the large town of Poole. It is also a wetland habitat of international importance, hosting critical summer wader and over-wintering wildfowl populations. For this, it has been designated under the Ramsar convention and as a Special Protection Area (SPA) under the European Birds Directive. The map below shows the full extent of the Poole Harbour catchment.



The Poole Harbour Catchment



The Ecological Impacts of Nitrogen Enrichment

Poole Harbour is extremely shallow – with a mean depth of only 48cm – and due to this and its narrow entrance and complicated shoreline it takes a long time to ‘flush’; it takes a mean of 17 days for water to move from the western side of the Harbour to the English Channel. It also has a large (at 800km²) predominantly chalk catchment dominated by agriculture. For England, it has a warm and sunny climate. Each of these is a risk factor for eutrophication. Eutrophication driven by nitrogen species has become a substantial problem in Poole Harbour since the 1980s, causing its designated sites to fail their objectives under international (SPA) commitments (EA/NE, 2013). Over the past 30 years, the shores of the Harbour have been increasingly covered by macroalgal growth, smothering the feeding grounds of designated bird species. Meeting conservation objectives requires a substantial reduction in the amount of available nitrogen added to the Harbour (*ibid.*).

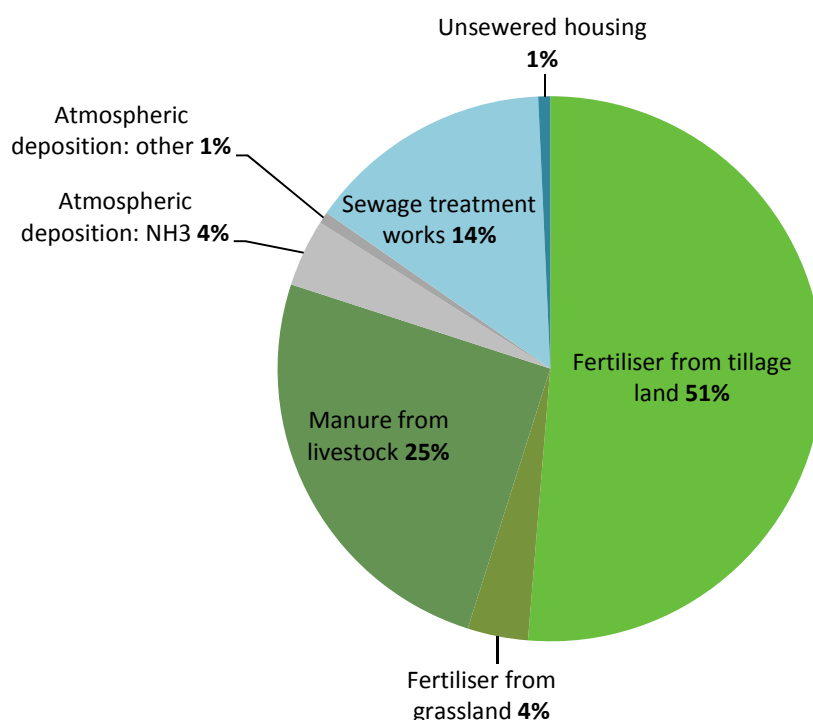
Any activity adding to available nitrogen loads in the Harbour is referred to as a ‘nitrogen discharge’ in this report.

Native nitrogen discharges to the Harbour (those from the hydrological and sewage catchments) make up 81% of gross inputs, and arise from agriculture, sewage outflows and atmospheric discharges (EA/NE, *ibid.*). The remaining 19% of gross inputs arrive from the English Channel following discharge from other catchments, although water entering from the Channel has a lower nitrogen concentration than the water returned on the outgoing tide. Inputs from the Channel cannot be reduced with any degree of accuracy by local action, and so measures to address them have not been investigated by this study.

Following large investments in sewage treatment, agriculture accounts for the large majority of native nitrogen discharges, as shown in Figure 1.



Figure 1: Estimated contributions of nitrogen sources to annual native load on Poole Harbour (EA/NE, 2013)



The majority of nitrogen discharges to Poole Harbour come from the rivers Frome and Piddle, which between them drain the majority of the catchments and deliver 66% of the nitrogen inputs (EA/NE, *ibid.*). Lesser inputs arrive from the English Channel (19%) are discharged directly to the Harbour (8%), or come down the smaller Sherford and Corfe rivers (7%).

Legal Drivers for Nitrogen Control

In Poole Harbour the failure of the SPA to meet its conservation objectives due to nitrogen pollution has the potential to constrain new development in Poole, Dorchester and large areas of rural west Dorset unless any additional loads can be mitigated.

Under the Conservation of Habitats and Species Regulations 2010 (hereafter the Habitats Regulations), competent authorities may not issue Consents for discharges or planning



permission for developments unless they are satisfied there would be no adverse impacts on sites such as Poole Harbour SPA that have been designated under the Habitats Regulations.

Any new homes and or businesses will result in more waste water, including nitrogen, entering sewerage networks. While treatment works have some capacity to treat nitrogen even if the quality of final effluent remains constant the load (concentration x volume) will inevitably increase, risking a further adverse impact on the site.

By contrast the use of nitrates in agricultural fertilisers is not subject to consenting or other forms of prior authorisation. As a result they are not captured by Habitats Regulations. That said, the Nitrate Pollution Prevention Regulations 2008 impose certain restrictions on agricultural activities in areas designated as Nitrate Vulnerable Zones (NVZs) with the aim of preventing agricultural sources of nitrogen causing pollution of drinking water and/or eutrophication. The Poole Harbour catchment is designated as an NVZ in recognition of the sensitivity to eutrophication and its importance as a drinking water source. However, the uniform restrictions placed on all NVZs, designed to address the majority of nitrate pollution problems across England, are not sufficient to tackle the environmental impacts of nitrates on Poole Harbour.

Sewage treatment discharges from towns are regulated under the EU Urban Wastewater Treatment Regulations 1994 (as amended). Such discharges must be treated sufficiently to allow receiving waters to meet their EU-level standards and objectives, in this case including ecological impacts from eutrophication.



Box 2: Phosphate management

Nitrogen discharges are not the catchment's only nutrient problem. The rivers of the Poole Harbour catchment – the Frome, Piddle, Corfe and Sherford – are each suffering environmental damage from phosphate discharges (EA, 2009). Phosphate concentrations are too high in each river for any to meet Good Ecological Status under the Water Framework Directive, and too high for the River Frome Site of Special Scientific Interest (SSSI) to be in Favourable condition.

Unmitigated additional development would add phosphate to the rivers, exacerbating their environmental problems.

However, this study has concentrated on nitrate and not phosphate discharges. The legislative and regulatory requirements for phosphate control do not have the absolute requirement on mitigation that exists for nitrate, and so a PES mitigation scheme would be much less feasible. Specifically, planning decisions surrounding phosphate damage to a SSSI are covered by section 28G(2) of the Wildlife and Countryside Act 1981. This requires the planning authority:

'to take reasonable steps, consistent with the proper exercise of the authority's functions, to further the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which the site is of special scientific interest.'

Beyond that, the Water Framework Directive is not directly binding on planning authorities, who under regulation 17 of the Water Environment Regulations 2003 must only:

in exercising their functions so far as affecting a river basin district, have regard to –

(a) the river basin management plan for that district... and

(b) any supplementary plan.

For these rivers, neither the river basin management plan nor any supplementary plan stipulates phosphate mitigation for new development.

Legislation is not the only potential driver for a PES scheme, but in this case there is no potential 'buyer' for phosphate reductions. Although damaging to natural features, phosphate levels are not so high as to damage economic interests that are able to fund phosphate reduction.



The Role of a Nutrient PES Scheme

This study set out to explore the technical, legal and practical feasibility of delivering a PES scheme to mitigate nitrogen discharges from new development. To be viable such a scheme must deliver mitigation at a lower cost than if each developer needed to prevent their own discharge.

The ecosystem service being provided is the enhanced capacity of Poole Harbour and its catchment to regulate additional nutrient discharges, allowed by the provision of less-polluted water from farmland (see Box 1).

To the public, landowner, local authority or developer the finer points of ecosystem service terminology are probably unhelpful. Rather it might be said that this study set out to explore whether a scheme concentrating on creating and selling land-management nitrogen mitigation credits would be feasible.

Such a nutrient trading scheme in the Poole Harbour catchment could have considerable economic benefits. Lessons learned may have generic applicability to similar schemes and benefits elsewhere in the country. Both local and national benefits are explored here.

Also important is the interaction of this study with the Nitrogen Management Strategy for Poole Harbour. This seeks to address as a whole the current eutrophication of Poole Harbour, and as such has a broader scope than this study. Box 3 sets out the role of the Strategy, and the links between the Strategy and this study.



Box 3: The Nitrogen Management Strategy for Poole Harbour

This feasibility study, and any eventual PES scheme, is framed by the Nitrogen Management Strategy for Poole Harbour. This Strategy, led by the Environment Agency and Natural England, will address as a whole the current eutrophication of the Harbour. It has been developed primarily to fulfil the Environment Agency's duty (under the Water Environment Regulations) to ensure that the water-related standards and objectives of the Poole Harbour SPA are met by December 2015.

As such, the Nitrogen Management Strategy (NMS) has a wider scope and ambition than this PES project; encompassing all existing nitrogen inputs, as well as the marginal discharges from new development. Its key planks are:

1. Nitrogen loads to the harbour must be reduced to the 1730t/yr level that existed in the early 1980s, immediately prior to eutrophication becoming damaging to the designated features of the SPA,
2. All new development in the catchment must be 'nitrogen neutral'; adding, on balance, no additional nitrogen to the harbour.

The second of these reinforces the legal basis for a PES scheme, and PES measures could be an integral element of the Strategy's delivery.

The overall target is ambitious, reducing long-term nitrogen inputs to the Harbour from the current 2300 tonnes/yr to the 1730 tonnes/yr target. This 570 tonne/yr reduction represents a 25% cut in nitrogen inputs, a reduction that is 13 times larger than the expected marginal nitrogen load from new development.

The NMS concentrates on agricultural nitrogen discharges which cumulatively contribute 85% of Poole Harbour's nitrogen input, while the input from sewage has been substantially reduced by significant water company investment. It is thus likely to have a substantial impact on farming in the Poole Harbour catchment. The Strategy aims to reduce agricultural pollution voluntarily, but will be backed where necessary by the Agency's relevant regulatory powers, including the power to limit polluting discharges under the Environmental Permitting Regulations 2010.

There are potential conflicts between PES mitigation of nitrogen and the aims of the NMS. The Strategy sets voluntary targets for total agricultural nitrogen reductions. As these are voluntary, they could potentially be met through PES-funded measures, and as PES measures would be balanced by new nitrogen discharges elsewhere they could fund farmers to meet their targets without any overall reduction in nitrogen discharges to the Harbour.



Development and associated Nitrogen pressures around Poole Harbour

Nitrogen mitigation requirements for new development in the Poole Harbour catchment are likely to be between 21 and 40 tonnes of nitrogen *per annum* by 2035 (EA/NE, 2013). This is based on the projections of population growth found in the Local Plans and Core Strategies of the relevant planning authorities, Purbeck and West Dorset District Councils, and Poole Borough Council – which are expected to contribute 21 tonnes *p.a.* – and Wessex Water’s projections that increased commercial activity will add 19 tonnes *p.a.* (Wessex Water, 2010).

Broadly, the options for mitigating nitrogen inputs from new development are:

1. Improved nitrogen removal at sewage treatment works
2. ‘Land use options’: change from intensive farming to a less intensive land use
3. ‘Land management options’: changes in farming practice while maintaining the same broad land use
4. Creation of functional habitat

Within each of these broad categories are a number of specific measures, which are listed within Table 1. Wessex Water have calculated the cost-effectiveness of nitrogen removal at each of their six sewage treatment works discharging to the catchment (Wessex Water, 2010), and the three least expensive (per tonne of nitrogen removed) are presented below.

Land use changes would involve the reversion of either arable land or managed grassland. Reversion is the cessation of fertiliser application and a shift to rough grazing or habitat.

There are a large number of changes to farming practice that can reduce nitrogen discharges while maintaining the same land use. ADAS identified 84 different measures in their recent inventory (ADAS, 2011). This study has concentrated on a sub-set of these 84; those identified as relevant by the EA/NE Nitrogen Management Strategy for Poole Harbour, and those suggested by farmers and agronomists in discussions at and following a workshop held in May 2012 as part of this study.

Any change to land use or land management that reduces yield has the potential to displace nitrate discharges elsewhere, as more food is grown in another part of the world to compensate. However, this may not happen given international tariffs and subsidies, and would likely be in an area less vulnerable to nitrates than Poole Harbour. As these measures can be supported by agri-environment funds, there is also an opportunity cost in diverting these funds from other priorities to control nitrates in this catchment.



Potential for PES

Table 1: Estimates of total cost over 50 years for nitrogen mitigation options (RPA, 2011; Wessex Water 2010)

Measure	Total potential reduction	Cost Effectiveness of Options (£/Tonne, 50-yr cost)
Application of CSF across whole catchment (15% nitrate leaching reduction from arable and 5% from grassland)	206tN	£23.6k
Establishment of cover crops following winter wheat production across 9323 ha of land wheat is grown on)	321tN	£47.5k
Baling and removal of Oilseed Rape straw (assuming 1664 ha grown)	52tN	£66.4k
Moving from Oilseed Rape to spring beans	104tN	£74.5k
Move from Oilseed Rape to winter oats	84.61tN	£92.3k
Use of clover in place of nitrogen fertiliser on all managed grassland	158tN	£136.9k
Intensification of existing nitrogen stripping at Poole sewage treatment works	52tN	£163k
No tillage and reduction in livestock numbers to achieve 100% target reduction across arable and grassland	550tN	£174.9k
10% reduction in fertiliser applied to oilseed rape (winter wheat already below RB209 recommendations)	206tN	£197.4k
Reduced 20% application of nitrogen to managed grassland	126tN	£207.0k



Measure	Total potential reduction	Cost Effectiveness of Options (£/Tonne, 50-yr cost)
Introduction of nitrogen stripping at Dorchester sewage treatment works	81tN	£242k
Allow field drainage systems to deteriorate, with reduced stocking density (assumed 25% reduction in managed grassland leaching)	198.25tN	£404.2k
Purchase and reversion (ceasing fertiliser use) of arable land	>500tN	£526.6k
Purchase and reversion (ceasing fertiliser use) of managed grassland	>500tN	£556.9k
Introduction of nitrogen stripping at Wareham sewage treatment works	20tN	£1.1M

Table 1 shows land management options to be the most cost-effective means of reducing nitrogen discharges. The economic benefits of any PES scheme that could unlock these measures would be considerable; for 40 tonnes *per annum* of nitrogen, over 50 years, there is a £4.6M benefit to mitigating through cover crops following winter wheat (£1.9M) compared to the least expensive other option of nitrogen stripping at Poole sewage treatment works (£6.5M).



Applicability elsewhere in the UK

Nutrient trading PES schemes could be applied elsewhere in the United Kingdom, wherever nutrient discharges are captured by regulation. Under the current regulatory system, this would apply to two key areas:

- **European protected areas** where the adverse impacts of new plans and projects must be mitigated under the Habitats Regulations. The 2009 River Basin Management Plans identified 64 Natura 2000 sites in England and Wales, failing to meet objectives as a result of diffuse nutrient pollution. Nutrient trading schemes may allow new development to proceed cost-effectively around such sites, and indeed one is now in place for the phosphate-stressed River Mease SAC, where developer contributions go toward phosphate reduction measures.
- **Water Framework Directive (WFD) objectives** for 'no deterioration' in status. Both the Environment Agency and Secretary of State must act to prevent deterioration due to nutrient discharges, preventing any new development likely to cause deterioration. However, planning authorities do not have the same duties, and this may undermine such decisions. A nutrient trading scheme may be able to solve 'no deterioration' impasses at lower cost. This situation may become increasingly common should phosphate standards be tightened (as is currently proposed by the UK Technical Advisory Group for the Water Framework Directive; UKTAG, 2012) and as new river basin management plans are made.

In both of these cases, mitigation must be secured for the lifetime of the new development or discharge and so any PES contracts will be long-term. Generally, long-term PES *schemes* are favourable to 'sellers' as it gives them some security of income and confidence that measures implemented will not have a short life and that contracts can be renewed. However, as explored below, long-term PES *contracts* may raise serious challenges for on-farm measures.

There is longer-term potential to expand a nutrient trading scheme to include all nitrogen discharges in the catchment, although this is beyond the scope of this study. The Environment Agency (EA) have mooted a permitting regime covering all nitrogen discharges, in which case a cap-and-trade system would usefully reduce the costs of compliance. The Agency can require such permits under regulation 12 of the Environmental Permitting Regulations 2010, which stipulates that polluting water and groundwater discharges require an environmental permit.



In other countries, nutrient trading schemes have been expanded to cap agricultural discharges as well as point sources, most famously to address nitrogen levels in the Chesapeake Bay, as discussed in Box 4. This is not currently relevant in England and Wales, as regulations on agriculture cover activities through blanket regulations (e.g. NVZs or on-label pesticide use) rather than impacts, and obligations are not tradable. However, there is scope for both of these. In particular:

- **European protected areas** that are failing to achieve their standards and objectives. The Water Framework Directive requires Member States to ensure that these are met¹, and in England this responsibility lies primarily on the Environment Agency and Secretary of State. The Environment Agency hold powers under the Environmental Permitting Regulations to limit or prevent polluting nutrient discharges, and this could be implemented as a tradeable system that allows a cap-and-trade market.
- **The Nitrates Directive** requires member states to protect drinking water and address eutrophication due to agricultural nitrates. To date this has been implemented through a consistent action programme in England albeit targeted in Nitrate Vulnerable Zones. Any future tightening of restrictions might open the possibility of a cap-and-trade scheme to meet obligations.

Such cap-and-trade schemes open the possibility for shorter-term PES contracts, as participants in the market would be able to purchase mitigation for short-term as well as long-term needs. Cap-and-trade schemes are discussed in Box 4.

¹ The date for compliance depends on interpretation of the Directive – and is either December 2027 or December 2015.



Box 4: Cap-and-Trade

Cap-and-trade markets depend on a legal limit (the 'cap') being set on the total amount of a pollutant that can be emitted. This total limit is then allocated or auctioned to those seeking to pollute, who may then trade their permission to pollute. This model can be extremely economically efficient, as in a well-designed market the ability to pollute should be purchased for the most valuable activities.

The Chesapeake Bay Program is the most well-known cap on nutrient discharges. At 11,600km² the Bay is far larger than Poole Harbour, but faces many of the same problems; it is a shallow bay, draining a large and heavily-used catchment. It too faces eutrophication, damaging both its wildlife and valuable fisheries. To address this, the US Environmental Protection Agency has capped nitrogen, phosphorous and sediment inputs to the Bay from each contributing sector and major catchment. The federal and state governments must ensure that these caps are met, through a combination of measures of their choice.

Several states have allowed nutrient trading between sectors, including trading of reductions in diffuse agricultural nitrogen discharges (Branosky *et al.* 2011); this has the potential to reduce the overall cost of meeting the Bay's nutrient targets by just over one-third (Chesapeake Bay Commission, 2012), although the Program is too recent for its costs to be fully known and there is still controversy about its overall efficacy and social impact (Center for Progressive Reform, 2012).



Changes to the original PES feasibility study design

This original plan for this research study changed substantially as the study progressed. In particular:

- Functional wetlands have not been a central part of the study, as originally planned. A literature review conducted for this study by the Centre for Ecology and Hydrology (CEH) – attached here as Annex 1 and discussed below – found that although functional wetlands have benefits for nutrient control including nitrogen control, they could not guarantee a specific nitrogen discharge reduction. This uncertainty prevents them from being used to mitigate nitrate impacts on Natura 2000 sites until our knowledge of their design and use improves. The review suggests that functional wetlands can still be used to control nitrogen species, including their use to address impacts on Natura 2000 sites.
- The catchment's local planning authorities decided at the start of our project to take responsibility for co-ordinating nitrogen mitigation for new development, and so this study has involved work with them rather than with developers, who were originally considered the scheme beneficiaries.
- This study has spent more time and effort than expected linking our work with other organisations' work. There have been a number of these in the catchment – most notably the EA/NE Nitrogen Management Strategy and regular meetings between local authorities and the regulators to arrange mitigation, as well as the Frome and Piddle Initiative (a Defra WFD catchment pilot hosted by Wessex Water).
- The project has been delayed by several months – by the area's heavy and repeated flooding throughout 2012 which became a heavy draw on EA and landowner resource. There was also a need to fit in with the other processes taking place in the catchment, most notably the NMS. so as to avoid confusion and fatigue amongst stakeholders.



Work undertaken

This project ran from February 2012 to March 2013. As with many PES schemes, it has involved several strands of work: discussions with potential buyers, sellers and broader stakeholders, and also work on practicalities such as quantifying the benefits of measures and understanding the legal background. This section summarises the work carried out on each of these fronts.

Stakeholder work

Existing PES schemes have shown the importance of keeping all stakeholders involved and up to date throughout development. The Poole Harbour catchment has a large number of active stakeholders, including:

- Farmers, landowners and their representatives: notably the NFU and CLA
- The water and wastewater supplier: Wessex Water
- Regulators: the Environment Agency and Natural England, including the Catchment Sensitive Farming scheme
- Conservation charities and advisors: the Dorset Wildlife Trust, Westcountry Rivers Trust, FWAG SW, GWCT and the Frome, Piddle and West Dorset Fisheries Association
- Local authorities: the councils for each of West Dorset, Purbeck and Poole, as well as Dorset County Council
- Prospective developers: including both large firms and individual households.

An introductory workshop was held on the 29th of May 2012. The event was independently facilitated by RK Partnership, and included representatives from each of these stakeholders², as a first exploration of whether a market in nitrogen reduction measures could be useful around Poole Harbour. The workshop gathered opinions on key aspects of PES: what its benefits and drawbacks could be, what measures could be useful and what barriers there might be to a scheme. This followed preliminary discussions, to make sure that stakeholders had had some time to consider the idea. A summary report of this workshop is attached as Appendix 2.

This study continued to work with stakeholders as a whole, through two stakeholder processes in the catchment: the Frome and Piddle Initiative and the Nitrogen Management Strategy.

² Save for small developers (those building only one or a few houses)



Poole Harbour PES Feasibility Study

The Frome and Piddle Initiative, hosted by Wessex Water, is a group of stakeholders interested in the Water Framework Directive targets for the rivers and Poole Harbour, and tasked with forming an initial plan to meet them. It is one of 15 catchment pilots funded by the government but hosted by an outside organisation. This has been an extremely useful forum for discussing a PES scheme, and we have attended the roughly bimonthly steering groups since February 2012 and taken part in its task and finish groups for nutrient levels.

As outlined above, the Nitrogen Management Strategy (NMS) aims to address the eutrophication of Poole Harbour from existing as well as new sources. The Strategy and its impact on this feasibility study are discussed in more detail in Box 3, and we have worked with the NMS team to ensure that overlaps between our projects are identified and discussed with stakeholders, and do not lead to confusion.

Seller-side work

Farmers and landowners are the most likely ‘sellers’ of PES measures – as action at a farm level is the most economic means of reducing nitrogen discharges to Poole Harbour – and there is also considerable potential for Wessex Water to deliver reductions in their nitrogen discharges as mitigation for new development. We have held discussions with a number of farmers, landowners, each of their unions and Wessex Water to explore these options.

Work with these potential PES ‘sellers’ has been both crucial and time-consuming: the farming and landowning community tend to be more heterogeneous than ‘buyers’, less clear about the need for measures, and greater in number.

Discussions with farmers, landowners and unions

Over an 800km² catchment, it is difficult to involve all farmers and landowners, or even a representative sample. We have tackled this problem by holding discussions through a number of channels:

- The stakeholder workshop held on the 29th of May 2012 included farmers and landowners invited through the NFU and CLA, as well as representatives from these unions.
- We arranged a series of meetings with the NFU, CLA, Wessex Water and the Nitrogen Management Strategy team – as well as interested farmers. These have covered both the



PES scheme and broader NMS; one meeting every two months from July 2012 to March 2013.

- Following these meetings, we worked closely with the NFU and CLA to canvass opinions across the catchment. They contacted members to check interest, and have helped put us in contact with potentially interested farmers and landowners.
- FWAG SW were commissioned to discuss PES in general and particular measures in detail with ten representative farmers – chosen to cover all types of cropping, tenure and farm size across the catchment – FWAG SW's report is Annex 3 of this document.

Collectively, this work has provided a sound overview of farmers' and landowners' positions on PES measures, and the barriers and opportunities on the seller side. The only major barrier thrown up is a reluctance to agree to long-term contracts. The reasons for this are discussed below.

Buyer-side work

This study was originally expected to work closely with particular developers, as they would be the most likely 'buyers' in a PES scheme. This changed after early meetings with the local planning authorities when it became clear they had taken a decision to co-ordinate the mitigation of new development in the catchment. Planning authorities took this step on the basis that many developers would be looking to build only a small number of houses, and that there would be economies of scale were councils to arrange single deals and levy rather than each developer needing to grapple with nitrogen mitigation.

The planning authorities – in this case the Borough of Poole, West Dorset District and Purbeck District Councils – are (or will soon be) able to levy developers in general through the Community Infrastructure Levy³, or otherwise levy specific developments through 'section 106' agreements⁴. They can then act as 'buyers' for mitigation measures. Dorset County Council have been helping the district/borough councils to co-ordinate measures across the catchment.

Beyond those seeking new development or discharge Consents, there are no potential buyers for nitrogen-related PES measures. This is because without limits on new agricultural nitrogen

³ A general levy that can be raised on all development to provide for infrastructure needs, under the Community Infrastructure Levy Regulations 2010 (as amended)

⁴ A charge for works required for planning condition, specific to a particular development and raised under s106 of the Town and Country Planning Act 1990



discharges, purchasers of PES measures cannot guarantee their purchase would lead to a reduction in total nitrogen levels in Poole Harbour, while government bodies are already required to ensure such a reduction happens to meet legislative obligations (see Box 3). As such, none of the stakeholders directly affected by eutrophication of the Harbour have an incentive to purchase PES measures.

There is funding available from the government for the environmental benefits of some measures – through Stewardship payments or the English Woodland Grant Scheme – but none of the measures have the substantial environmental or amenity benefits that would be needed to attract additional funding from conservation charities. Indeed much of the conservation activity of groups such as RSPB and The Wildlife Trusts tend to be underpinned by Stewardship and/or Woodland grants albeit with added value from expertise in design, implementation and monitoring of schemes.

It is notable that the authorities' preferred solution – of creating parkland – has been chosen despite its higher cost partly because of the broader public benefits that it provides.

As such, discussions around purchasing PES measures were concentrated on the catchment's planning authorities. This has involved five meetings between January 2012 and March 2013 – with the councils, Natural England and the Environment Agency – with a number of one-to-one discussions and background research to answer queries in between these meetings.

Buyer-side discussions have been more difficult than those with potential sellers. Calculation of mitigation needs has been complicated and delayed by changes to the Nitrogen Management Strategy, by the need for Local Plans to be put in place and by the ultimate uncertainty within these Plans – as well as by broader resource constraints in the Councils.

As discussed below, there are considerable barriers thrown up at the buyer side to any PES measure, in particular a political reluctance to 'pay the polluter' by funding reductions in agricultural nitrogen discharges.

Statutory Regulators

Close working with regulators has been crucial to this study, especially given the concurrent development of the Nitrogen Management Strategy for Poole Harbour, and that Catchment Sensitive Farming is active in the catchment.

As such we have linked our work with both farmers and local authorities to the Strategy, and shared time and resources.

Beyond that, we have also worked with regulators to ensure that suggested PES measures are sufficient to meet mitigation needs and to examine the impact of any PES scheme on the Strategy's broader goals.

Potential Intermediaries

The intermediary role for any PES scheme in Poole Harbour would be somewhat different from most existing PES schemes. There are already a number of organisations providing agricultural advice and grants in the catchment – more so than in most parts of the country – and limited wider environmental benefits of the sort that would encourage NGOs to take on the role of intermediary.

An internal RSPB meeting was held to examine the benefits and costs of the RSPB taking this role in PES schemes, and it was decided that there were too few benefits for our priority species from the mitigation measures for us to take on a long-term intermediary role.

As such, following initial discussions with potential intermediaries and farmers, our work has explored dividing the intermediary role between existing advisors and new advisors likely to appear following AMP⁶ or the implementation of the NMS.

This has involved discussions with both Catchment Sensitive Farming and Wessex Water, and also with the staff leading the Nitrogen Management Strategy – although notably not the local authorities, who do not hold the staff or expertise for this work.

Natural England as an intermediary

The Catchment Sensitive Farming (CSF) scheme provides advice and grants for nutrient and sediment control. It is administered by Natural England, and run on the ground by catchment officers who are in close contact with farmers. These officers have many of the skills, contacts and discussions relevant to nutrient trading. CSF grants are available for some but by no means all of the on-farm actions that may reduce nitrogen discharges; grants are available as part-

⁵ AMP6 is the next (and 6th) water company Asset Management Plan. These are five-year investment plans, signed off by the government-appointed regulator Ofwat, setting out what water companies plan to do over the following five years, and how much they can charge customers. AMP6 runs from 2015 to 2020.



funding for capital works including fencing, drainage reconfiguration, building of hard tracks and roofing for slurry and silage stores⁶. Those who receive grants for works must maintain them for the following five years, but are free to remove them afterwards. CSF operates in only a small proportion of England, but this deliberately includes many nutrient-stressed areas. The scheme is currently due to run through to 2014. The CSF programme is active in the Frome and Piddle catchments, but has only one staff member covering 750km² and so concentrates on limited areas. CSF staff monitor the performance of their granted schemes, but will have limited capacity to monitor other non-CSF schemes, and their role is separated from that of regulatory enforcement.

Environmental Stewardship payments are also administered by Natural England, although through its land management advisors rather than CSF catchment officers. These are ongoing payments for land management changes rather than capital expenditure. Again, these are short-term agreements, made for ten years with an option to leave the agreement after five years. No new agreements are expected to be made for the next two financial years due to delays agreeing the EU budget. Environmental Stewardship is currently under review, and it is likely that a redesigned scheme with more incentives for nutrient management will be available from August 2015, after this moratorium.

Around Poole Harbour, these Natural England schemes could also act as intermediaries in a nitrogen mitigation PES scheme. This is particularly true of CSF, which already discusses and funds nutrient-control measures with farmers and other landowners. The CSF programme in this catchment is over-subscribed, relies on match-funding and cannot stretch to larger projects, so there is a good opportunity for PES payments to complement the CSF programme.

Links to the Environmental Stewardship programme are also possible. As with CSF, any measures identified by advisors that would reduce nitrogen discharges, but cannot be funded from the Environmental Stewardship budget, could be put forward for PES funding. It is also possible that some measures could be double-funded: receiving funding through an Environmental Stewardship scheme, and also from a PES buyer.

⁶ A full list can be found in the CSF Capital Grant Scheme Farmer Handbook (CSF3; Natural England, 2013)



Wessex Water

Wessex Water have a team of agronomists providing nitrogen management advice above their boreholes (which have been threatened by rising nitrogen levels). The company propose to expand this team substantially to cover the entire catchment. The proposal is being made as part of the Periodic Review process, which means that Wessex Water would be able to reclaim the cost of the team through water bills as an alternative to introducing expensive nitrogen-stripping at the Dorchester sewage treatment works. This team could act as intermediaries in any PES scheme, as a functioning mitigation scheme would reduce the pressure for additional treatment in Dorchester. During this study, Wessex Water have indicated potential interest in providing nitrogen management advice to farmers and making them aware of PES contracts, but would not take on any contract enforcement role.

Summary

The initial intermediary role – of raising awareness of PES measures and funding, and signposting farmers toward potential buyers – could be performed by several organisations. Both CSF and Wessex Water have expressed willingness to advise farmers of funding for measures that would mitigate new nitrogen discharges, provided that this is not excessively complex – with a preference for a simple flat rate of payment for nitrogen savings, rather than a negotiated or auctioned scheme as these would require more administration.

For a PES scheme to be viable agreements must be monitored, verified and, where necessary enforcement action taken to ensure delivery or recoup costs. We have not been able to identify any body willing to take on this role. One may appear, given that implementation of the Nitrogen Management Strategy will require the monitoring and potentially enforcement of nitrogen leaching targets in the catchment, which could be combined with the monitoring of PES measures. Otherwise, contractors would need to be hired to monitor PES measures.

Research

Several pieces of background research have been needed to establish the technical feasibility of a PES scheme, running alongside and supporting discussions with stakeholders. This has been vital to the project, in establishing the foundations for a PES scheme and also in working with stakeholders.

The research carried out has concentrated on two areas: establishing the benefits of PES measures, and the legal basis for a PES scheme.



Review of Functional Wetlands

The Centre for Ecology and Hydrology were commissioned to quantify the impact of various types of wetland on nutrient discharges, and to check their reliability. This was done through a systematic literature review of published studies: the full report is attached as Annex 1, and the key results presented in Table 2 below.

The report first looked at wetlands as a whole, and then examined whether the review's sample showed any significant difference between the performances of different types of wetland, including both natural habitats and constructed functional wetlands.

The review showed that overall, wetlands provide clear nutrient control benefits: reductions in phosphate species were seen at 91% of wetlands, in nitrogen species at 83%, and in nitrates (the most important nitrogen species in this catchment) at 67%.

However, the review also shows that at a substantial minority of sites there is an increase in nitrate and nitrogen species as a result of the wetland, and that this was true of wetlands specifically constructed for nutrient control as well as for natural wetlands.

In summary, although there is clear and well-documented evidence that adding wetlands to a catchment should decrease nitrogen discharges, the impact on nitrogen of any given wetland is uncertain. So while wetlands are a useful tool for addressing high nutrient levels in a catchment, and indeed for existing high nutrient levels affecting Natura 2000 sites, they do not provide the certainty of effect required for mitigation by the Habitats Regulations; that the construction of a new wetland will entirely mitigate the nitrogen released by new development. This prevents the use of functional wetlands without further research into how to ensure reductions from a given wetland.

Following this, we have concentrated on other land-management measures – although we have also investigated landowners' willingness to construct functional wetlands, for use if further research works out how benefits can be guaranteed or if the far more certain phosphate benefits are ever required.



Table 2: Impact of functional wetlands on nutrient discharges

Analyte	Number of sites	% of sites showing a reduction	% of sites showing an increase	Mean % reduction (n ³ , sd)
All P-species	35	91	14	73 (26, 34)
All N-species	70	83	20	24 (52, 146)
Reactive P-species	26	92	12	80 (20, 30)
Less-reactive P-species	9	89	22	51 (7, 36)
Ammonium	31	90	10	81 (23, 28)
Nitrate	27	67	37	-67 (20, 205)
Nitrite	5	100	0	82 (5, 12)
Total and organic N	7	86	14	75 (4, 17)
Suspended solids	7	100	0	38 (2, 18)

Legal Analysis

A number of untested legal questions had to be answered before a PES scheme. The RSPB in-house lawyer has provided ongoing support throughout this project. Key questions have been:

- *How can a PES contract be legally agreed?* Such contracts would need to be secured for the life of any development or discharge, and so would be much longer-term than most land management agreements. With covenants difficult to secure in the UK for environmental measures, legal work was needed to be clear on what could be agreed. The conclusion here was that covenanting was also possible, as the covenant was of financial benefit to another parcel of land (the land to be developed). Long-term contracts lasting for the expected lifetime of the new development would also be possible, although they would rely on continuity of ownership, with clauses requiring covenanting on sale or new owners to sign similar contracts.
- *How do the requirements of a PES scheme fit into other regulations and the Nitrogen Management Strategy?* It is clear that PES measures must go beyond existing regulatory requirements. The Nitrogen Management Strategy sets *voluntary* nitrogen discharge standards that are also beyond existing regulatory requirements, and which may become regulatory requirements if not met by voluntary means. Environment Agency and Natural England staff working on the Nitrogen Management Strategy were of the opinion that any PES measures should thus go beyond the voluntary standards set by the Strategy. However, as there is no legal requirement to meet voluntary measures,



these are not binding on PES contractees and so PES measures must only go beyond existing regulatory requirements.

- *Under what conditions can a planning authority mitigate for the nitrogen discharges of new development?* The catchment's planning authorities are not directly responsible for new nitrogen discharges, but they are keen to act as the buyer for mitigation measures, and have both a responsibility for issuing planning permission and the ability to levy charges on developers. The authorities requested that we examine whether they are able to take on the role of providing nitrogen mitigation for all development; the work confirmed that they could.

Support for Tool Development

Both this study and the Nitrogen Management Strategy have needed accurate estimates of the impact of on-farm measures on nitrogen discharges. The NMS team has taken the lead on developing a tool to estimate these, based on the best available science. We have supported them in this; inputting to the design of the tool and helping to arrange its piloting.

The tool employs the Neap-N methodology developed by ADAS to estimate nitrate leaching at the field scale using data on land use, management (fertiliser and manure applications; mitigation options employed etc.), soil type, rainfall and other climatic variables. The tool can report at either the whole catchment or at field scale, giving a robust estimate of both current nitrogen discharges and the reduction in discharges from any given measure; these findings are accepted as evidence of nitrogen discharge control by the Environment Agency and Natural England.

The tool is currently GIS-based, but will be modified to allow farmers to use a simpler spreadsheet interface. It is not yet available on-line but is expected to be freely available once modified.

Public Engagement

This has been a technical project, and one to ensure no environmental change rather than any improvement, so there has been limited scope for general public engagement.

To gauge the public acceptability of a PES scheme, this study conducted three focus groups across the catchment to look at public attitudes to nutrient pollution, concentrating on the broad roles and responsibilities participants believe each party should take. To avoid biasing



responses, participants were not made aware until after the focus group that the groups had been commissioned by the RSPB. The groups were led by the market research company Creative Research.

Awareness of the problem

Although some focus group members, particularly those resident in Poole itself, have seen the visible signs of eutrophication ('smelly green slime') they had not linked this to diffuse pollution. One or two had connected the presence of the 'green slime' to changes in river biodiversity (e.g. one had a partner who used to fish one of the local rivers but had stopped doing so when the fish disappeared) but overall there is little awareness of how diffuse pollution impacts on water.

Emotional engagement in eutrophication was limited, although there was general agreement that it was a problem and that 'something should be done'.

Roles and responsibilities

In general, participants expected the main players to be taking the following roles.

Defra, the EA and NE: seen to be responsible for all aspects of nutrient pollution:

- developing policy
- setting the rules
- monitoring and enforcement
- reducing levels of pollution
- researching solutions
- supporting farmers financially and through education
- educating and informing the public

Local Authorities: seen as playing a similar but more hands-on role:

- setting rules
- monitoring and enforcement
- cleaning up
- using planning restrictions
- reducing levels of pollution e.g. by installing buffer zones
- advising farmers
- educating and informing the public



NGOs: not always suggested as having a role, unless prompted, but seen as independent and trusted. Suggested roles were:

- monitoring
- lobbying
- raising public awareness
- advising farmers

Water companies: no real understanding of what role they might play:

- some assume they have knowledge/expertise they could share
- educate the public and advise farmers
- some feel they are too profit driven and will do the minimum they need to, or may even feel they use 'water quality issues' as an excuse for higher prices

Farmers: if they are a major cause of the problem, they should be responsible for tackling the causes – although this should be limited to what is financially viable:

- must first be educated in risks and ways to avoid pollution
- regulation should then be increased and cross-compliance enforced
- lastly, payments could follow for adopting appropriate measures (possibly means-tested)

The Food Industry: interestingly, raised spontaneously and seen as the 'villains of the piece', with deep pockets and the ability to act:

- should encourage good practice
- could educate both farmers and public
- should put less pressure on farmers to produce 'perfect' produce at low prices

General Public: recognised as also being 'part of the problem', but generally powerless:

- should behave in an 'environmentally friendlier' way
- need educating in relation to ethically and environmentally sound practices
- many participants bridled at any associated increase in food prices



How feasible is a PES scheme in the Poole Harbour Catchment?

Elements of a PES scheme are already appearing in the catchment, and there are no technical barriers to a nitrogen mitigation PES. However, this study has found substantial barriers to a scheme paying farmers for land management changes.

What is possible?

Emerging PES and PES-like schemes

Two agreements with PES elements have been struck in the catchment:

1. A 268-dwelling planned development in the centre of Poole has recently agreed to purchase £102,000 of nitrogen mitigation from the Borough of Poole Council. The Borough is converting land on its Upton Country Park farm from agricultural use to public parkland – a change which will prevent nitrogen discharges equivalent to the discharges from 2,500 houses, and also mitigate heathland damage by providing alternative places for dog-walking. The new development has purchased 268 houses' worth of this mitigation. This agreement has been explored and struck following our and Natural England's early discussions with Poole Borough Council, and the subsequent decision of the councils to arrange mitigation on behalf of developers.
2. Poundbury, on the edge of Dorchester, is the site of a large urban development managed by the Duchy of Cornwall. Phases 3 and 4 of Poundbury were granted planning permission over the course of this year, and include 1200 dwellings, a 2,500m³ commercial development and a primary school for 450 children. The Duchy of Cornwall is a major landowner in the catchment, and the nitrogen discharges from this development have been mitigated by permanent and contractually binding changes to the management of the Duchy estate. Similar measures are likely for further Duchy development in the catchment.

This agreement, struck before the start of this study, falls short of a full PES scheme in that the Duchy of Cornwall has mitigated its own development; no money has changed hands. It is a demonstration, though, that land management changes can be a cost-effective means of mitigating new development without making it unviable.

These two between them suggest that PES agreements have a key role to play in permitting development in the catchment. The Upton Country Park route – of a council purchasing and



entirely reverting land – remains the councils' favoured mitigation option for future development.

There is also the potential for the local authorities to fund increased nitrogen stripping at the Poole sewage treatment works, should this not be funded through the Periodic Review process.

Barriers to an on-farm PES scheme

A number of barriers to a PES scheme involving payments for land management changes have been identified during this study. Many of these have been ironed out, but several remain problematic and appear extremely difficult to resolve.

On the buyers' side, ethical objections to 'paying polluters' are the critical barrier to a PES scheme based on changes to farm management. The elected members – and many staff – of Purbeck District Council and the Borough of Poole Council have strong objections to levying development to fund on-farm changes to land management. Given that all new development to 2035 is expected to comprise <2% of total nitrogen load from the catchment, while agriculture contributes 85%, and with demands from the electorate and central government for more affordable housing, the councils decided that any use of developers' funds to address agricultural pollution is unfair and politically unacceptable. This is true even if this leads to increased costs on development. It is also true even though payments would only be made where farmers go beyond their legal obligations; the feedback we have had from the two Councils is that this would still be seen as rewarding polluters, as they consider the legal obligations on farmers to be too lax. This is a contrast to the position of Wessex Water, who work closely with farmers to improve on the regulatory baseline where it benefits public water supply.

The situation at West Dorset Council is less clear, as West Dorset District is likely to have larger short-term mitigation needs than the other councils. With a more rural district and more councillors from a farming background, the council may also take a different position on on-farm land management change. As of May 2013, the mitigation needs for the District are still being calculated, and it is possible that once they are known the Council will decide to mitigate through on-farm PES measures.

It is possible that the position of Poole and Purbeck Councils might change over time. Decisions on how to mitigate new development will need to be made regularly until nitrogen levels in Poole Harbour fall to environmentally safe levels, which the Nitrogen Management Strategy

expects to take most of this century. The lower cost of on-farm mitigation, changes to regulation on agriculture and even changes to the make-up of the councils could all change this decision.

On the sellers' side, longevity of PES contracts is, at present, also very problematic. Farmers and landowners are extremely chary of any contract longer than 10 years, which is the standard length for other land management agreements. But mitigation needs to be in place for the lifetime of any new development, which Natural England treat as being between 50 and 80 years depending on the project.

Detailed discussion with farmers and farm advisors has shown that there may be willingness to accept longer-term contracts for measures such as woodland planting or wetland construction, as this is seen as a complete land-use change and more suitable for long-term contracts than ongoing management activities such as planting cover crops each winter. However, these land-use changes are less cost-effective than ongoing activities, and they are even less financially viable; farmers in discussion have asked for 30-year contracts that are more expensive than outright land purchase.

Breaking down this barrier would require either more research to see whether a small number of farmers would accept such long-term contracts, or for another party to take on the liability for negotiating new contracts at the end of each 10-year period – over which prices may rise or fall substantially. Such an approach would require a guarantee that funding to ensure sufficient mitigation was always to meet the obligations of the Habitats Regulations. There is no party currently willing to take this liability on, and it is unlikely that any would without government intervention to create a Trust system or give such a role to an existing public body.

Monitoring of PES measures depends on the outcome of the Nitrogen Management Strategy. There is currently no organisation willing to monitor and enforce the implementation of PES measures. The NMS will require monitoring of agricultural practice across the catchment, to ensure that targets (either voluntary or regulatory) are met – and whichever organisation does this would be the best-placed to monitor PES measures as well. At the moment, this has not been decided, so it is likely to be a barrier for some time. There is potential for Natural England to be given this role – through the CSF scheme – or another public body such as the Rural Payments Authority, but this would require changes to their remits.

Functional wetlands also appear to have substantial uncertainty for this particular use. As noted above, CEH's review of functional wetlands showed that while they can be effective in reducing nitrogen their benefits were uncertain. This uncertainty prevents wetlands from



meeting the strict tests established by the Habitats Regulations and settled case law, but this might be expected to change as the science of design and deployment develops.

Other Problems and Complications

There are a number of lesser problems and barriers to a nutrient trading PES scheme. None of these are show-stoppers, but they are still problematic.

Expertise and time in competent authorities is limited – the local authorities have neither existing staff expertise and time nor the budget to acquire it, so favour simple but expensive mitigation measures (such as wholesale purchase and reversion of land) over more complex but less expensive PES measures. However, PES measures have been approved by both Natural England and the Environment Agency and are simple enough that they should not require additional expertise on the part of the local authorities – this barrier should be surmountable.

Farmers' Willingness-to-Accept for measures is relatively, although not unreasonably, high. The economic analysis conducted for the NMS and based on income foregone shows that on-farm measures are considerably more economic than other mitigation options. However, farmers' WTA is higher than the income foregone, narrowing the gap and making some measures less financially viable than land purchase.

Interactions with the Nitrogen Management Strategy are complex and could cause problems. Any new regulatory targets for agricultural nitrogen discharge will change farmers' ability to sell nitrogen mitigation. Many will already be reducing nitrogen discharges to meet these new targets, and may not be willing or able to go yet further as part of a PES agreement. However, PES agreements could also provide a useful source of funding for non-PES nitrogen reductions; PES profits could be put toward meeting regulatory requirements, and PES measures could fund part of a broader farm restructuring.

Any new voluntary targets for agricultural discharge will make a nitrogen trading scheme more attractive to farmers, as a PES scheme could fully fund work to meet voluntary targets. This is not legally problematic, as the targets would be merely voluntary. However, the scheme would then interfere with the goals of the NMS; nitrogen reductions would be double-counted against both the 'nitrogen neutrality' target and the voluntary target. The voluntary targets would, as a result, need to be tightened or would be inadequate to secure Environment Agency duties toward the Poole Harbour SPA.



Depth of groundwater is also a complication. Percolation through chalk to groundwater happens at an average rate of 1m/yr. Ground level in the chalk areas of the catchment is a mean 30m above groundwater, and in some areas is 80m above groundwater. These higher areas are much less suitable for mitigation; mitigation measures need to reduce nitrogen load to Poole Harbour as soon as new development starts to discharge nitrogen, so in areas high above groundwater, measures will need to be in place decades before they can be used as mitigation. This represents a considerable cost to either buyer or seller. These higher chalk areas are generally arable, and thus measures to reduce nitrogen leaching would otherwise be less expensive than in lower, clay, dairy areas. This is not an insuperable barrier, but it does cut down the number of farms which could in practice provide mitigation.

Lessons Learned

Beyond the particular barriers and requirements of a nitrogen mitigation PES, several features of this project could be relevant to future PES schemes:

Collaboration has been important, but has also caused delays. As with most PES studies, this has been a cross-sector project and so has needed a lot of collaboration. This has been with government bodies, stakeholders and specific businesses rather than the general public. The necessity of working with a broad range of stakeholders is itself a key lesson. It has also required considerable time and effort, with parts of this study delayed to fit into the schedules of other organisations and processes, most notably the agreement of the Nitrogen Management Strategy.

Clarity on regulation has also been important. Statute plays a key part in nitrogen discharges, and it has been important to have statutory bodies taking a clear line on what is and is not required of each party.

The role of local authorities has been greater than expected. They decided quite early in the process to take on an intermediary role between developers and potential sellers. This is something that local authorities could do in many cases, allowing a useful consolidation of the buyer role, especially as the Community Infrastructure Levy comes into use across England. Local authority staff have relatively little expertise in PES schemes, and training and support from central government on how to identify and engage with schemes would be worthwhile.

Early discussion with farming unions has also been important. Both the NFU and CLA have large memberships in the catchment, and so have been important partners to discussions. They



have been keenly engaged with this study, and helpful in contacting farmers and landowners in the area. The NFU have expressed an interest in helping farmers to negotiate any eventual PES contracts; a role which would help farmers in a monopsonistic market, but risks creating a cartel.

Technical research into wetlands had an enormous impact on this study, and shows the importance of early research into proposed measures, the size and certainty of their benefits.

Further legacy of this study

There are two substantial barriers to a land management PES scheme: the need for long-term agreements, and the unwillingness of two of the local authorities to fund agricultural measures. More expensive PES agreements involving land purchase and land use change by the planning authorities are already appearing, with developers paying for this through the Community Infrastructure Levy.

Short of central government intervention, there are still three potential routes to an on-farm PES scheme appearing:

1. There is still potential for West Dorset Council to decide to purchase land management change from farmers, and we will continue to investigate this. West Dorset Council have not finally estimated their mitigation needs – once this has been done and should the Council be interested we will arrange a meeting between Council staff and interested farmers, to discuss PES measures and see whether the problem of long-term contracts or covenants could be ironed out once a specific contract was on offer.
2. Similarly, there is the potential for exceptionally large housing or commercial developments in Purbeck and Poole (those which would require a bespoke section 106 agreement rather than the Community Infrastructure Levy) to mitigate their own nitrogen discharges. In these cases, the developer may mitigation through land management PES measures. Several such schemes may appear over the next few years, in which cases the work done by this project could be used to put a PES agreement in place – and we would put developers in contact with those farmers who have shown an interest in PES agreements.
3. Should the Nitrogen Management Strategy decide to regulate agricultural nitrogen discharges, there will be scope for and considerable benefit from a short-term nitrogen market between farmers in the catchment – this would in effect be a cap-and-trade



scheme building on the work done for this project. We take part in discussions for any such scheme, and help to apply the results of this feasibility study.

Contributions by developers to local authority-led mitigation schemes appear a likely PES-like means of achieving nitrogen mitigation. The £102,000 purchase of nutrient mitigation from Borough of Poole Council should be the first in a number of similar agreements.

There is scope for central government to intervene and support land management PES schemes. Indeed Government intervention in terms of guidance to Ofwat and water companies proved crucial in stimulating growth of PES type catchment schemes in the water industry.

In the context of Poole Harbour such intervention is likely to create economic benefits, although with greater cost and risk exposure to the public purse. Government could remove some of the transaction costs of PES schemes by giving Catchment Sensitive Farming officers, Natural England land management advisors and the Rural Payments Agency a remit to advise landowners on PES options, and to monitor their implementation. It could also guarantee – itself or through a trust – to rearrange 10-year PES contracts as they lapse, bearing the long-term risk of PES agreements.

Perhaps more importantly, this study has shown that regulation is crucial to the legitimacy and therefore feasibility of PES schemes; local government has been unwilling to make payments to farmers because they consider regulation on farmers to be unfairly inadequate. This may be addressed for Poole Harbour by the Nitrogen Management Strategy, but is likely to remain a problem elsewhere in the country. There appears to be a role for central government in setting a clear and widely-accepted regulatory baseline on which PES agreements can build.



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