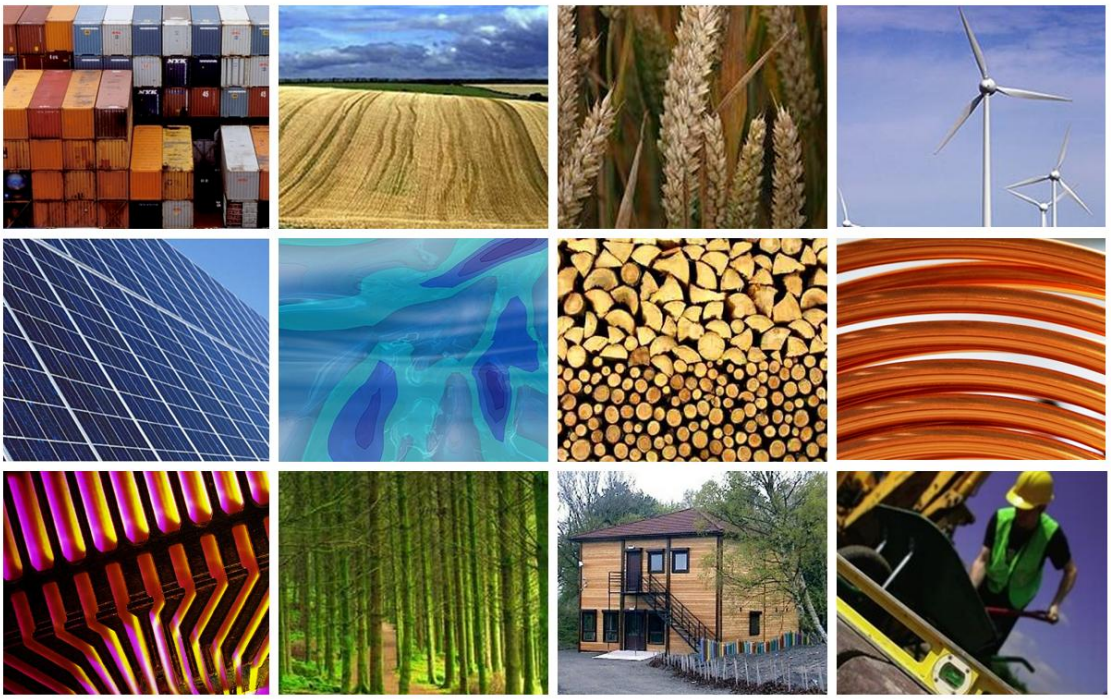
Final Report to Defra

Payment for Ecosystem Services (PES) Pilot on Flood Regulation in Hull

May 2013



the Land Trust

Hull City Council

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Executive Summary

Context

This report has been prepared by the Land Trust and Ursus Consulting Ltd on behalf of Defra and summarises the outcomes of a pilot Payment for Ecosystem Services (PES) study in Kingston upon Hull. Two PES pilot schemes have been designed for the Orchard Park and Greenwood ward in the North West of the city. This corner of the city is one of the most densely populated in England with a population of 11,400. Land and property are vulnerable to surface water flooding: during the heavy rains of June 2007 high volumes of surface water and high tides combined to cause drains, becks, streams and ditches to overflow and flood large areas and some 900 properties (16% of the total). The area is characterised by council and socially rented terraced housing and demolished and void tower blocks. Much of the land and three quarters or all properties are owned by Hull City Council. Orchard Park was amongst the worst off 1% of wards nationally in 2007, with residents suffering from both multiple deprivation and a poor quality environment, with extensive areas of low quality amenity grassland devoid of biodiversity or recreational interest. An estimated 1,644 households in the area are still at flood risk from a 1 in 100 year rainfall event: the estimated damage costs of such an event would exceed £44 million but the vast majority of residents do not have property insurance. The PES pilot has focused on addressing this risk.

What has been achieved through the pilot?

Despite the changing policy and institutional context during the life of the pilot project the research aims have been achieved, including:

- *Identifying how green and blue space in this dense urban area currently delivers ESs to its residents, drawing on the UK National Ecosystems Assessment (UKNEA) characterisation or urban ecosystems.*
- *Identifying opportunities and community preferences for enhanced ES delivery including: regulation (flood risk management, climate regulation, water and air quality); provisioning (food and biomass); cultural (recreation, landscape and health benefits); and supporting services (biodiversity).*
- *Designing mechanisms for providers to deliver flood risk management measures and for beneficiaries to pay them, building on lessons learnt from the Defra funded 'Best practice guide for PES payments (URS et al, 2013); and*
- *Securing commitments from partners to take the proposed PES schemes forward in tandem with locally important processes and funding opportunities.*

Methodology

The pilot was carried out in three phases:

- ***Phase 1** involved setting up a Local Task Group to steer the pilot, provide institutional, policy, land holding, flood risk and technical knowledge and desk review of the economic benefits and opportunities for ES enhancement through Green Infrastructure (GI) and Sustainable Drainage Systems (SuDs). Stakeholder mapping of potential beneficiaries, buyers, sellers, and intermediaries and mapping of key PES characteristics was carried out.*
- ***Phase 2** focused on development of materials and a deliberative dialogue built around a workshop ('Hull 6, Whatever the Weather') which brought together local stakeholders to explain ESA and develop a mix of SuDS and GI options that could deliver flood prevention and other priority ESs at different scales. Participants developed initial designs for a mix of SuDs treatments and the framework for PES approaches that could deliver them.*

- ***Phase 3*** *involved more detailed design of two PES pilot propositions defining: roles, mechanisms, costs, payment vehicles, additional financial needs and next steps. The resulting pilot PES schemes are summarised below.*

1) A Country Park scale PES

Dane Park pilot PES scheme would create a Country Park in the study area and across the boundary with East Riding of Yorkshire. The primary objectives is to address surface water flood risks for the 1,600 properties at risk in the North West of the Hull through a mix of different SuDS treatments including swales, bunds, ponds, replacement of permeable road and car park surfaces and conversion of amenity grassland to semi natural grasslands and more varied woodlands. This high quality green infrastructure would also deliver water quality, recreation opportunities (through 'floodable' sports pitches, a pavilion, fishing ponds, circular walking and cycling routes), landscape and amenity and climate regulation (Urban Heat Island effect and carbon sequestration) ESs benefits and underpin green growth led regeneration. During the establishment phase the Dane Park PES would be a 'many to one' scheme. Many of the sites earmarked for the scheme – including amenity grassland, schools grounds, sports pitches, roads and verges and council house gardens are currently owned or leased by Hull City Council. Sites currently have a low opportunity cost but in some cases high maintenance costs (up to £1000/ha pa for closely mown amenity grassland). Some of the proposed SuDS treatments would have initial capital costs but would lower ongoing maintenance costs relative to current uses. Thus Hull City Council Parks Department would be the principle provider of ESs but also a major beneficiary – on behalf of its tenants and residents – along with local environmental and recreation groups. The local water company, Yorkshire Water Services (YWS), will also benefit.

The PES scheme will initially involve a piggy-backing approach. A single ES – reduction in surface water runoff to the sewer system – will be offered to YWS on the basis that SuDS in the form of swales, retention ponds and aqua greens will reduce runoff during extreme rainfall events and reduce investment needs to upgrade combined sewers and pumping capacity across the Hull and Haltemprice catchment. Flood regulation will be an umbrella for the other ESs which will simultaneously be provided to local and city wide beneficiaries. Other organisations and the local community will be expected to contribute towards the set up costs of the Park through participation in design, volunteer works and bringing in grant funding, wherever possible. Formal recreation such as use of sports pitches and golf facilities will be paid for directly by the users and will be set at levels designed to cover ongoing maintenance costs.
In order to become a PES buyer YWS will need to make a business case to Ofwat under the PR14 process. Whether or not this is successful Hull City Council intends to draw down external and research funding using a mix of potential sources which might include: Defra pathfinder, EU Wild Cities, Interreg, Environment Agency partnership funding, DCLG growth funds and the Green City Initiative. In the longer term – as the economic benefits of ESs can be clearly demonstrated - the scheme would become layered so that different stakeholders could buy ESs of interest on their own behalf (e.g. as an alternative to flood risk insurance or as biodiversity offsets for businesses) or on behalf of environmental or recreational organisation members.

The scheme would involve several local and regional voluntary sector intermediaries (such as the Land Trust, Groundwork, Wildlife and Woodland Trusts) to develop economic opportunities such as jobs, training in food and biomass production and running small enterprises for long term management of woodlands, grassland, ponds and recreational facilities.

2) Street Level PES scheme

A second pilot has been designed on a smaller scale applicable to an average residential terraced street in North Hull. Typically houses are slightly set back from the street with a 5m by 4m front garden, the

majority of which have been covered over with impermeable concrete as off-street parking. Roofs drain to downpipes, while front gardens and pavements drain to the road: all drains are connected to Yorkshire Water Services' (YWS) combined sewers which are at capacity for extreme rainfall events. Streets lack street trees, grass verges or planting to intercept storm waters and reduce runoff.

The pilot PES scheme aims to encourage householders (owners and council tenants) to manage their front yards to reduce waste water runoff to combined drains, so reducing flood risks. A palette of different treatments – ranging from the very low cost (disconnecting downpipes, water butts, creating rainwater gardens and square metre 'mini allotments') to the more expensive (replacing permeable surfaces and carports with green roofs) – would be available to meet individual pockets and interests. An initial investment of £100k would buy basic downpipe disconnections for all 4,930 suitable terraced and semi detached houses in the Orchard Park and Greenwood area.

In the event of a successful bid to Ofwat under the PR14 process, Yorkshire Water Services (YWS) would be the main buyer on behalf of customers across the Hull and Haltemprice catchment. The scheme would be similar to free water conservation appliances provided to water customers or energy retrofitting grants financed by energy suppliers. Grants offered to home owners or tenants groups would be justified as an alternative to investment in sewage capacity and through savings in treatment costs at water treatment plant. Under the umbrella of the flood risk management benefits, the PES would also provide wider ES benefits (visual, biodiversity, health, and water quality and climate regulation) as well as local employment opportunities for private contractors and social enterprises. Hull City Council would play a key role as an intermediary in identifying priority streets and properties, disbursing funds and supervising the quality of work undertaken.

Learning points from the pilot

The pilots have proved the concept of PES schemes for flood risk management in urban areas but have not yet reached the implementation stage. Key learning points that have emerged include:

- ***The necessity of taking an adaptive management approach**. During the course of the pilot the funding and policy context has changed considerably but, with the benefit of a local steering group whose expertise, enthusiasm and commitment have informed the shape of the pilot, it has been possible to take an adaptive approach and pursue alternatives as new data and potential buyers – such as the water company through the PR14 process – arise. The pilot has also highlighted the substantial time required to develop a complex PES scheme from scratch.*

- ***PES and ES concepts were relatively easy to communicate** to potential beneficiaries and providers with very limited ES knowledge by using a combination of pictures, icons and 'wider benefits of greenspace' vocabulary. Economic valuation of UK NEA urban ecosystems categories and the services they provide proved very challenging in the urban context: we therefore developed a 'palette or treatments' approach which focused on the **costs of delivery** (per hectare or unit) and **qualitative descriptions of ES benefits** for each treatment as the basis for mixing and matching SuDS treatments.*

- ***Deliberative dialogue, taking the form of a design charette, successfully brought together stakeholders** including both technical experts and local community experts to discuss ES concepts, identify local priorities and opportunities for PES at different scales. The success of the workshop hinged on: involvement of a well connected NGO with ES awareness; a visionary and inspiring facilitator; group visits to key sites; and carefully prepared background materials.*

- ***Engaging with potential PES buyers is challenging in the current economic climate***. *Potential ES 'sellers' in urban areas – particularly Local Authority departments, Defra agencies and other LNP partners – are relatively easy to engage as they recognise the benefits in breaking down funding silos and maximising the ES benefits delivered by any intervention. In contrast engaging potential private sector buyers – particularly local businesses and economically deprived households - has proved very challenging and at this stage proxy buyers are needed on their behalf.*

- ***Ensuring the greatest possible ES benefits are being delivered by policies and funding streams*** *such as PR14, Regional Growth Funds, Community Infrastructure Levy and S106 agreements, biodiversity offsetting and Lottery Funding.*

What is the legacy of the project?

- ***Locally*** *the two pilot PES schemes are tailored to local opportunities and needs: Dane Park PES provides opportunities for a multi-agency public and voluntary sector approach to maximising wider benefits of green infrastructure across administrative boundaries, akin to total environment pilots; the street level PES would be applicable to many streets and housing estates in other flood-prone areas of Hull. Both PES pilots will inform future SuDS work across Hull and will also provide a vehicle for mainstreaming ES and SuDS concepts across other single purpose funding streams (regeneration, growth funds and CIL and S106). Both pilots have also been designed to maximise green growth benefits – such as volunteering, skills training, jobs and supply chain opportunities - and strengthened community capacity for neighbourhood management in addition to ES benefits.*

- ***Sub-regionally*** *the street level approach, if successful, could be applied by YWS to other towns and neighbourhoods facing future flood risks /limited sewer capacity across Yorkshire. The concepts are being shared with the two local LNPs.*

- ***Nationally*** *the pilot learnings have been shared with the Green Economy Council, the Ecosystems Knowledge Network and the Defra PES Best Practice Guide. The research findings also resonate with those of the Ecosystems Market Task Force which highlighted flood risk management and waste water catchment management as national priorities and highlighted the need for a strong clear policy framework providing clarity and assurance for water and sewage companies involved in PES. This work also highlights the long term nature and challenges of working with multiple beneficiaries in this setting.*

1. INTRODUCTION

1.1 OVERVIEW

This report summarises the outcomes of the Defra funded Payment for Ecosystem Services (PES) pilot in Hull. The pilot has focused on developing a pilot PES scheme focused on flood alleviation and green infrastructure development in Northern Hull.

1.1.1 Ecosystem services

This study uses an Ecosystems Services Approach (ESA) for categorising Ecosystem Services (ES) based on the UN Millennium Ecosystem Assessment framework approach which describes ESs according to the four categories of Provisioning, Cultural, Regulation and Supporting. This ESA approach has been widely applied to natural and agricultural areas but has so far been little used for describing the benefits derived from urban habitats (as opposed to green infrastructure). The first comprehensive application to urban areas is the UK NEA (2011) which describes – mainly in qualitative terms - the ESs provided by 11 categories of urban sub-habitats. The sub-habitats are closely related to a CABE inventory (2010) of 16,000+ individual greenspaces and water features across the country and also correspond to PPG17 definitions. The status and likely contribution that each sub-habitat makes to delivering urban ecosystem services is discussed in Section 2. The relevance of each sub-habitat in the study area is discussed in Section 3.

1.1.2 Payment for Ecosystem Services

The underlying concept behind Payments for Ecosystem Services (PES) schemes is that those who provide ecosystem services - like any service – should be compensated for doing so. A PES has been defined as involving a **voluntary** transaction where a **well-defined ecosystem service** (or a land-use likely to secure that service) is being 'bought' by a (minimum of one) **ecosystem service buyer** from a (minimum of one) **ecosystem service provider** if, and only if, the ecosystem service provider secures ecosystem service provision (**conditionality**) (Wunder,2005). In addition a PES should provide **additionality,** that is payments should only be made for actions that are additional to those usually expected of landholders for actions that society considers over and above their responsibility, rather than those required to meet legal requirements.

Over the last 10-15 years there has been a growing body of experience in designing PES and by 2010 OECD estimated that more than 300 PES (or PES-like) programmes were in place. URS et al (2012, unpublished) identify two broad types of PES scheme:

- **Public payment schemes** for private land owners to maintain or enhance ecosystem services (government-financed PES); and
- **Self-organised private deals** in which individual beneficiaries of ecosystem services contract directly with service providers (user-financed PES).

PES can be developed at a variety of spatial scales including:

- **International**, e.g. international forestry offsets (REDD+) and the Green Development Mechanism (GDM); Agri-Environment schemes;

- **National**, e.g. Environmental Stewardship and national park entrance fees (which tend to be administered by government agencies);
- **Water Catchment or wider area**, e.g. downstream water users paying for watershed management on upstream land (which tend to be user-financed through water utilities); and
- **Local/neighbourhood**, e.g. residents collectively funding an NGO or management company to manage local green space for biodiversity or recreational amenity.

Building on the emerging lesson from the Defra funded best practice guide for PES payments (URS et al, 2012, still 'in press' at the time of the review) the intention of this pilot was to explore the opportunities for a water catchment or local scale PES in an urban area based on either a public payment or self-organised private deal.

1.1.3 The pilot study area

This pilot PES scheme has focused on a small area of Hull. Hull City is a densely populated area covering 71.5 sq km (7150 ha), with a population of 250,000 making it one of the densest urban areas in England. According to the Hull City Council's Strategic Flood Risk Assessment (SFRA, 2009) almost 95% of the city lies within the flood plains of the River Hull and/or River Humber. The main watercourses within the city boundary are the River Hull, the Beverley and Barmston Drain (draining the Wolds to the west) and the Holderness Drain (draining Holderness Plain to the East).

During the heavy rains of June 2007 high volumes of surface water and high tides combined to cause the drain and becks, streams and ditches flowing into the Beverly and Barmston drain to overflow and flood large areas of North West Hull. A report by Hull City Council (Oct 2007) showed that nearly 900 properties were flooded in the Northern area in Orchard Park and Greenwood ward (equivalent to 16% of all properties). This has been selected as the core study area for the pilot. The ward has a population of 11,400 which simultaneously suffers from extreme multiple deprivation (amongst the worst off 10% of wards nationally), poor quality environment and greenspace and high future surface water flood risks. The adjoining wards of University and Beverly, also within the Northern Area, suffer from some aspects of income and greenspace deprivation, but are not threatened by the same flood risks as Orchard Park. Adjacent areas to east (North Carr) and south (Derringham) are also badly affected by flooding but are not included in the study area but could be beneficiaries of flood related PES schemes.

The institutional arrangements for flood risk management within this area are shared by government – Hull City Council and the Environment Agency – and Yorkshire Water Services (YWS). ESs could be enhanced to provide better flood regulation services to households and businesses by actions by any of these organisations but also by households themselves, schools, voluntary sector organisations and other land owners and managers. All of these actors would potentially benefit from enhanced flood regulation. Thus the area offers scope for a number of different configurations of buyers or sellers for the delivery of wider area or localised public or private PES schemes.

1.2 AIMS OF THE PILOT

This pilot PES project aims to enable better delivery of a mix of ecosystem services – but with a particular focus on flood alleviation – through better management of green and blue urban sub-habitats in the North Hull area. The project has been led by the Land Trust (drawing upon the

resources of retained agents 'URSUS Consulting' and with 'Groundwork in Hull') working in close partnership with Hull City Council (HCC). The project has drawn together existing research on ESs and modelling of flood risks in North Hull and undertaken research on institutional arrangements, community engagement and the potential for Sustainable Drainage Systems (SuDS) to demonstrate how a practical scheme could be developed for this densely populated, flood prone urban area. The specific aims of the project are shown in Box 1.1.

Box 1.1 Specific Pilot PES Aims

The specific aims of the research were to:

- Identify how areas of green and blue space in North Hull and its fringes (within the East Riding of Yorkshire – ERY) including drains, secondary school sites, amenity greenspace and sports facilities provide ES benefits to communities in North Hull, and how such benefits could be enhanced in the future.
- Identify community and local business' preferences for enhanced ESs delivery in the future through improvement works and long term management of existing urban greenspace and water courses. Potential new ESs were expected to include regulation (flood alleviation, climate, air quality and water), provisioning (food, fuel and firewood), cultural (recreation, landscape and health benefits) and supporting (biodiversity) services.
- Design a sustainable mechanism – a PES - for beneficiaries of flood alleviation to pay those that manage land on their behalf. The proposed mechanism was expected to involve Hull City Council and Groundwork in its delivery and the Land Trust as an intermediary to coordinate land management and collect payments on a long term basis.

Research outcomes are expected to have policy relevance at several levels:

- **Locally**: feeding into decision making and funding processes within Hull City including Building Schools for the Future (BSF), the Hull greenspace strategy and flood risk management initiatives. Wider benefits could include volunteering, skills, and green job opportunities and strengthened community capacity for neighbourhood management.
- **Sub-regionally**: aligning with the HCC/East Riding Yorkshire Council and Environment Agency's flood risk management proposals. The pilot could help identify a scaleable model for financially sustainable management of larger flood alleviation areas and furnish lessons about engaging communities in ESs planning.
- **Nationally**: contributing lessons on whether PES schemes are workable as a mechanism for flood prone urban communities by paying land managers to manage multi-functional urban and urban fringe green and blue space on their behalf. The research has also explored how an intermediary, such as the Land Trust, can help to reduce risks and costs and guarantee that benefits will be delivered in the long term.

1.3 METHODOLOGY

1.3.1 Phase 1

Phase 1 mainly involved desk research and included drawing on the body of existing local evidence in Hull and Yorkshire and Humber and a wider literature review covering:

- collating GIS and modelling data for the study area on flood risks, socio economic characteristics based on ONS neighbourhood statistics and Hull City Council's database;
- literature review of the contribution and value of ecosystem services from urban ecosystems;

- an assessment of the institutional, policy, socio and economic context for the study and the opportunities for a PES that these create.

A full list of references is shown at Annex D. Early in Phase 1 a Project Working group with key stakeholders in Hull was also established (see Section 1.3.4) and individual discussions were held with stakeholders within Hull City Council, the Environment Agency and the third sector. By the end of the first phase: boundaries of the study area had been defined; urban sub-habitats and the ESs they currently provide in the study area had been defined; and aims, objectives and potential characteristics of a pilot PES had been identified.

1.3.2 Phase 2

During Phase 2 the main activities involved the preparation for, running and analysis of the outcomes of a PES design workshop involving a range of stakeholders. The aim of the workshop was to design a palette of treatments which together would make up a compelling proposition for enhancing existing, and developing new, green and blue space to deliver multiple ecosystem service benefits to the local community in Orchard Park and elsewhere in Hull. In order to allow a 'hands on' approach the workshop was designed for a maximum of 20 carefully selected participants (shown in Annex B) who would together provide local knowledge of issues and opportunities, and the necessary technical landscape design and engineering skills.

The participants were proposed by Groundwork and Steering Group members and personalised invitations were sent to individuals. Councillor approval was required for both the invitation and participant list and this required more time than initially envisaged. The full day workshop event was held in September at the Orchard Centre, a local meeting venue run by a local social enterprise.

The workshop was designed by the core team, the task group chair and an independent facilitator, an adviser to the Hull's Building Schools for the Future programme, who brought both local knowledge and skills in innovative urban landscape design. The team provided an initial introductory briefing on the flood risk and ecosystem services concepts and local social economic issues. Additional local background was provided by representatives of local NGOs. This was followed by a morning of field visits to four sites:

- Bainton road – a road of typical two bed terraced housing with front gardens concreted over for offstreet parking and a tarmac road surface with street trees or vegetation except for a neglected greenspace earmarked for future development.
- Amenity greenspace within a 1930s terraced council estate. The site is fenced to prevent dogs entering and has no amenities or play equipment and is very little used.
- Amenity grassland around terraced social housing in 'the Danes' area adjoining the administrative boundary with East Riding. Much of the space has been created as a result of demolition of tower blocks and a thinning out of terraced housing in the past. The greenspace currently has limited aesthetic, recreational or flood regulation value and is costly to maintain.
- Greenspace around the Orchard Centre and shops, the centre of Orchard Park, characterised by small isolated patches of grassland and planting which are a focus for anti-social behaviour and litter, providing very limited wider benefits.

During an intense afternoon session participants worked in groups to identify a palette of potential treatments for a PES at a landscape level and at a street level.

At the neighbourhood scale this involved developing and mapping different Sustainable Drainage System (SuDS) approaches such as permeable surfaces, swales/bunds/filter strips and retention/balancing ponds, tree planting, floodable sports pitches and recreational facilities, green roofs and allotments etc which together could help to manage flood risk in the Orchard Park area.

At the street level this involved identifying actions at three levels:

- Improvements to house and front garden rain water drainage to reduce run off to sewers including disconnecting downpipes, replacing impermeable pavements, introducing rain water and vegetable gardens and green roofs;
- Improvements to street surface and design to replace permeable surfaces with SuDS treatments;
- 'Meanwhile uses' for a vacant temporary greenspace of rough grassland with some biodiversity interest and low maintenance costs but which could provide greater recreational and visual interest for the street.

Materials for the workshop included background materials on different treatments and costs developed by URSUS Consulting including pictures, descriptions, potential cost implications and wider benefits. The terminology reflected that used in the URS best practice guide but with relied on the language of 'wider benefits' and icons rather than more scientific ecosystem services terminology. Base maps and flood related materials (focusing on the impacts of 2007 floods) were provided by Hull City Council and other materials were contributed by participants such as Arup. A workshop report was circulated to participants and Defra at the end of Phase 2.

1.3.3 Phase 3

During Phase 3 the work focused on developing the ideas emerging from the design workshop into proposals for pilot PES schemes. During this phase the work has been delayed for a month in order to dovetail with the outcomes of YWS's modelling of the Hull and Haltemprice water catchment. This work which was initially expected to be completed during mid 2012, but was delayed until late December, but has now reported and informed initial discussions between Hull City Council, YWS and its engineers. Subject to approval of its plans by Ofwat, these discussions suggest promising scope for the water company to become the primary buyer of a street level pilot PES scheme and a key player in a larger scale PES to deliver SuDS based recreational Country Park at Dane Park on the edge of Hull.

1.3.4 Involving stakeholders

A task group was established at project inception and has brought together a number of different departments in Hull City Council and local organisations with a real enthusiasm for applying the PES concept to environmental management and regeneration in the city. The group included the following members: Hull City Council officers responsible for Flood Risk Protection and Management (Steve Wragg, task group chair), Parks and Open space (Andrew Wilson), Building Schools for the Future programme in North Hull (Nikola Idle), North and North Carr area team director (John Bracewell or alternate), Regeneration and European Funding officer (Daphne Robins), and

Environment and Climate Change coordinator (Martin Budd). The group also included Hull and East Riding Local Nature Park (LNP) coordinator (Nadine Senior), the Operations Director and Community Development Officer at Groundwork in Hull (Libby Goodacre and Karen Tozer) and the Environment Agency Humber Strategy Team (Andrew Ward-Campbell).

The group has steered the PES pilot and added real value in helping define the initial scope, identify challenges and opportunities, provide data and information, test concepts and language and shape the proposed PES schemes. The group met at the beginning of Phases 1 and 2 and a number of the members attended the PES design workshop during Phase 2. The group has reviewed and approved interim and final reports.

1.3.5 Information sharing and dissemination

Knowledge sharing and dissemination activities have included:

- Attending the Ecosystem Services Knowledge Network (EKN) inaugural meeting in Birmingham, liaison with coordinators, providing a project description for the website and a case study description after completion of the pilot and contribution to a workshop planned for May 2013;
- Meeting with the URS team responsible for drafting Defra's Best Practice Guide for Payments for Ecosystem Services including: one to one meetings with the project manager and Environment Agency adviser; attending the 'Payment for Ecosystem Services Good Practice Guide Workshop' in London on 1st May; providing comments to the URS team on the outline, early draft and consultation copies and discussion on how the best practice guide could be used in the Hull PES pilot;
- Sharing of early findings and lessons with Local Nature Partnerships (LNPs) at regional coordination workshops organised by URSUS Consulting and Tavistock Institute in the North East, South East and South West as part of the Defra-funded Formative Evaluation of LNPs; and
- Discussions with the TUC member of the Green Economy Council on the emerging findings and lessons from the pilot.

1.4 LAYOUT OF THE REMAINDER OF THIS REPORT

- **Chapter 2**: Provides an overview of urban sub-habitats, the ecosystem services the provide and estimates of their value;
- **Chapter 3**: Describes the context of North Hull and its sub habitats, the ecosystem services they currently provide and opportunities for enhancing ES delivery through a PES scheme;
- **Chapter 4**: Describes two pilot PES schemes – at a large Country Park scale and a street scale for North Hull; and
- **Chapter 5**: Summarises the outcomes of the study and the key lessons learnt.

Supporting materials are shown in a series of Annexes including: a more detailed description of the socio economic context in the study area (A), participation in the Phase 2 workshop (B), descriptions of the palette of different SuDS treatments applicable which may help deliver the PES schemes in the project area (C) and relevant web resources and a reference list (D).

2. ECOSYSTEM SERVICES IN URBAN AREAS AND DESIGNING A PES

2.1 INTRODUCTION

During Phases 1 and 2 of the pilot a literature review focused on characterising urban ecosystems and the value of the services they provide as a basis for designing an urban PES for North Hull. The review:

- Identified 11 sub-habitats based on UK NEA categories (reflecting PPG 17 categories further broken down where necessary to identify elements such as street trees and water bodies) which provide different ecosystem services as summarised in Table 2.1 below;
- Identified the types of ecosystem services being provided by these sub-habitats in urban areas;
- Identified any transferable monetary or other quantitative values for areas of sub-habitat or ecosystem services which could be applicable to the project area.

Table 2.1 summarises 11 urban sub-habitats identified by UK NEA which contribute to an urban area's green and blue infrastructure, each providing a combination of ecosystem services as described in Section 2.3.

There are a number of well known techniques, summarised in Defra documents (Defra, 2007) and UK NEA Chapter 22 (UK NEA, 2011) for placing a monetary value on different types of environmental goods and services. Those particularly relevant to this pilot are summarised in Table 2.2 which shows that market based methods have been widely used for valuing provisioning services (food, biomass, wildlife related recreation, fishing etc), while travel cost methods, hedonic pricing and contingent valuation have been used for valuing cultural services (informal recreation, aesthetic values of landscapes, trees and proximity to greenspace). The main approach to valuing regulating services such as water, air quality, erosion and flood regulation have been damage costs avoided methods. The approaches are generally based on estimating the marginal value of ecosystem-related goods and the benefits generated from alternative strategies for change rather than the total value of existing stocks of ESs.

A description of the current ESs provided by existing urban ecosystems and their value is provided below and this characterisation is used for identifying existing services and opportunities in North Hull (section 3). A fuller review of the literature was included in the interim report.

Section 2.3 presents some of the emerging lessons in developing PES schemes and their implications for designing a PES pilot in an urban area.

Table 2.1 Characterisation of urban sub-habitats

Urban Sub-Habitat	Description
Natural and semi natural greenspace	Includes woodlands, urban forestry, scrub, grasslands (e.g. downlands, commons and meadows), (*wetlands, open and running water*), wasteland, derelict land and rock areas
Public parks and formal gardens	Including urban parks, country parks and formal gardens.
Amenity greenspace and Domestic gardens	Most commonly, but not only in housing areas—including informal recreation spaces, green spaces in and around housing, domestic gardens and village greens.
Outdoor sports facilities, recreational areas and amenity greenspace	Includes natural or artificial surfaces & publicly or privately owned tennis courts, bowling greens, sports pitches, golf courses, athletics tracks, school and other playing fields and other outdoor sports areas. And space for children and teenagers—play areas, skateboard parks, basketball hoops, informal areas (e.g. 'hanging out' areas, teenage shelters).
Allotments, community gardens and urban farms	Includes allotments and community gardens and arable farmland and orchards in urban areas.
Street trees	Single trees and small areas with scattered trees, often surrounded by paved ground
Cemeteries,	And including churchyards and burial grounds
Water	Includes natural and artificial water (rivers, streams, groundwater, lakes, wetlands, ponds, ditches, canals, reservoirs (PPG 17 includes in *natural and semi natural urban greenspace)*
Green corridors	Verges and hedges, river and canal banks, cycle ways, and rights of way. Generally poor data available on extent.
Previously developed land (Brownfield)	Derelict, contaminated and vacant land (not included in PPG 17)

Table 2.2 Valuation methods and literature for valuing ecosystem services

Valuation Method	Overview of method	Ecosystem services commonly applied to	Example studies
Adjusted market prices	Market prices adjusted for distortions (e.g. subsidies and taxes)	Food, fibre, biomass, forest products, hunting/fishing	Godoy et al (1993) Bateman et al (2003)
Production function methods	Estimate production functions to identify the effect of ecosystem services as inputs to the production process	Maintenance of arable land and agricultural productivity, prevention of damage from erosion, groundwater recharge, drainage and natural irrigation, storm protection, flood mitigation	Ellis and Fisher (1987) Barbier (2007) VEEsSIE (2011)
Damage cost avoided	Calculates the costs which are avoided by not allowing ecosystems to degrade	Drainage and natural irrigation, storm protection, flood mitigation, carbon sequestration by woodland, reedbeds and wetlands and in floodplain soils Health/mortality impacts from heat waves	Kim & Dixon (1986) Badola & Hussain (2005) SWIMMER (2007); Kayranli *et al*. (2010); Zehetner *et al*. (2009). (Haines *et al*., 2006; Kovats, 2008; World Health Organisation 2004).
Averting behaviour	Estimates the expenditures that are made to avoid damage	Environmental impacts on human health e.g. pollution control; flood resistance and resilience measures	Rosado et al (2000) Eftec EA flood (2011)
Revealed Preference methods	Examines the expenditures that individuals make in order to benefit from goods + services e.g. travel costs (including time) for recreation; hedonic price (price premiums) for property	Recreation; Price premiums for proximity to green areas, views of trees, peace and quiet.	Bockstael & McConnel (2006), Willis and Garrod (1990,91 etc) for travel cost methods; Day et al (2007) for hedonic pricing Forestry commission (2010)

Stated Preference Methods	Uses surveys to ask individuals to make choices between different levels of environmental goods at different prices to reveal Willingness to Pay for ES	Recreation, water quality, species conservation and biodiversity, flood prevention, air quality, peace and quiet	Carson et al (2003) Contingent Valuation, Adamowicz et al (1994) discrete choice experiment Garrod and Willis (1991) CVM water based recreation

Source: based on Bateman *et al* (2011) and UK NEA (2011, chapter 22, Economic Values)

2.2 THE VALUE OF ECOSYSTEM SERVICES IN URBAN AREAS

The environmental, economic and social benefits of diverse urban sub habitats are summarised in Table 2.3 and discussed in the following paragraphs.

2.2.1 Provisioning services

Food and biomass

For urban ecosystems in general provisioning services – production of crops, livestock, food and fibre for sale – are limited but allotments, domestic gardens and community orchards all play a valuable role in the production of food and awareness raising about healthy living issues. There are an estimated quarter of a million allotments in the UK with 100,000 people are on waiting lists.

Urban sub-habitats can also play a role in waste management using natural biological systems for waste, such as mulching with locally produced woodchip and compost. A number of local authorities – such as Rotherham - are also now using biomass harvested from urban park and street tree prunings as renewable energy fuel for biomass boilers in schools, public buildings and housing.

Table 2.3 Types of urban sub habitats and the value of ESs they provide

	Contribution to ecosystem services
Natural and semi natural greenspace **Public parks and formal gardens**	Urban greenspace and access to waterways have positive impacts on health through increasing physical activity (so reducing the costs of inactivity) and increasing wellbeing (by reducing the side effects of stress high population density, stress, anxiety, aggression and noise). Surveys (CABE 2004) show that 91% of people believe that parks and open spaces improve quality of life and 74% believe they are important for health & mental well-being. UK NEA suggests these areas can provide a mix of biodiversity, recreational, aesthetic and regulatory services and that these are correlated and tend to increase with the size of the area and proximity to residential areas
Amenity greenspace and Domestic gardens	Domestic gardens can be important for richness and abundance of species but this depends on size, management, housing density and type and relation to wider greenspaces. As gardens generally are not under LA control UK NEA found limited information on their condition across England but surveys suggest a diverse patchwork of sub-habitats, potentially with features good for biodiversity (ponds, large trees, flowering plants, bees and pollination services) but often containing a large number of non-native species. BTO Garden Bird Watch and Garden Nesting surveys (BT 2010) help quantify avian biodiversity (but no data for the study area). UK wide trend has been for non permeable paving of front gardens (more than 75% in many urban areas) which increases the rate of run-off and risks of flash flooding.
Outdoor sports facilities, recreational areas and amenity greenspace	Across the UK a significant proportion of LA greenspace is classified as outdoor sports facilities of variable quality and access. Current ESs mainly cultural – recreation, amenity and health. Six Acre Standard requires playing pitches to be provided within 1.2 km of urban dwellings, other outdoor sport facilities within a 20–30 min drive, and children's playing spaces within 100–1,000 m walking distance from home (FIT & NPFA 2008). Limited biodiversity benefit in most cases but can provide water regulation benefits (where surface allows infiltration) and water quality benefits, depending on the level of chemicals

	applied in managing greenspace.
Allotments, community gardens and urban farms	UK NEA record a general decline in allotments across England (1,350 ha cf to 55,000 ha in 1940s). ES benefits are mainly food production. The National Society for Allotments and Leisure Gardens estimate a standard plot (250m2) can feed a family of 4 for a year.
Street trees	Trees in urban areas provide sources of timber and other by-products such as wood chip for biomass and compost. They are also important in providing regulating services including: clean air, carbon sequestration, urban cooling, water regulation (slowing run off rates) erosion protection, and noise reduction. Street trees improve air quality (intercepting traffic related particulates) due to proximity to high intensity traffic (e.g. have reduced PM10 by 0.4-0.7% in Chicago and Philadelphia). They can diversify habitats and enrich biodiversity. Urban trees are found mainly on private land (nationally 66% occur in gardens, schools, churchyards and allotments). A further 20% grow in public parks and open spaces, and 12% are street trees.
Water	Water bodies can be important recreation and biodiversity resources. However urban water bodies often receive polluted inputs from roads, domestic misconnections and overloads from foul to storm sewers and so often dominated by pollution tolerant fauna and flora. Straightened and modified banks and channels mean that physical habitat variability is often low, flow is reduced and a range of other negative ecological impacts occur. Reinstating urban brooks, becks and drains to a more natural state enhances flood attenuation and flood storage capacity and can be a cost effective alternative to traditional engineering, while also increasing recreation and biodiversity ESs.
Green corridors	Have intrinsic wildlife value and important as public pathways joining different habitats across wider areas and providing valuable cultural ES benefits to local people and visitors. Hedges are natural features of green corridors that can provide a route for dispersing wildlife; as such, they are recognised for their habitat importance
Previously developed land (Brownfield)	Can have important biodiversity benefits if sites have been disused and undisturbed.

Source: Based on UK NEA, (2011, Chapter 10, Urban Ecosystems and various economic studies).

2.2.2 Cultural Services

Urban ecosystems provide opportunities for many cultural services including recreation, mental and physical health benefits, spiritual and aesthetic enjoyment, education and opportunities to strengthen community cohesion (or social capital). Cultural services from urban greenspace are particularly important in densely populated areas and are particularly associated with high quality and accessible parks and woodland, waterscapes, local nature reserves and playing fields and playgrounds.

Health benefits

Urban green space and woodlands can provide restorative benefits of exercise, calm and remoteness, and escape from stress. A considerable body of evidence shows how proximity and extent of greenspace can have discernible benefits for psychological well-being and in encouraging people to take active exercise, with commensurate health cost savings.

For instance an English Nature report (Seymour, 2003) on nature found evidence that aspects of urban living environments - such as high population density, stress, anxiety, aggression, noise and information / stimulus overload - have negative impacts on mental well-being. Recent research using health records for 0.3 million people in the Netherlands found a strong negative correlation between city dwellers living near green areas and the incidence of depression. The positive effects of green surroundings were greatest for people with low levels of income and education. It was found that in urban zones where 90 per cent of the area was green space, the incidence of anxiety was 18

people per 1,000 which rose to 25 per 1,000 in areas with only 10 per cent greenery. The evidence on the link between mental health and richness of biodiversity is not quite so clear, but a study by Fuller et al (2007) shows that species richness of urban parks can increase psychological benefits. Pretty et al have also found a strong correlation between recovery rates from surgery and access to, or even sight of, 'natural' scenery.

The UK NEA provides an overview of the growing body of evidence demonstrating a positive relationship between green infrastructure and physical activity such as walking, cycling or running. For instance studies by Humpel *et al.* (2002), Owen *et al.* (2004) and Lee & Maheswaran (2010) establish links between the quality of a landscape, convenience of facilities such as footpaths and accessibility of places to walk to - such as parks and nature reserves – in increasing the likelihood of people taking active exercise. Bird (for RSPB, 2004) estimated the potential savings to the local economy and NHS from those investing in new circular footpaths (3 km) or parks (20ha). The study shows that 16-20% of residents within a 1km radius of new facilities are likely to start taking more daily exercise: the economic savings are greatest in high density urban areas ranging from £0.1-1.0 million a year. Research by Coombes *et al.* (2010) shows that people living within 500m of accessible green space are 24% more likely to meet recommended levels of physical activity. A Sustrans (2009) study also shows that good quality open space encourages people to make more short journeys on foot or bike.

UK NEA cites assessments of health changes arising from a variety of contacts with nature provided, ranging from around £10/person a year for a marginal increase in woodland within 1 km of a person's home to around £300/person a year for views of greenspace from the person's home (UK NEA, 2011).

Tourism and Recreation

Across the UK a significant proportion of LA greenspace is classified as outdoor sports facilities of variable quality and access. In addition to providing recreational ESs, recreational greenspace can provide flood regulation benefits (where green surfaces allow infiltration) and water filtration benefits, depending on the level of chemicals applied in managing greenspace. In most cases recreational greenspace offers limited biodiversity benefit. Improvements in the quality and connectivity of playing fields, amenity greenspace and waterways can significantly improve recreational facilities and opportunities for the local community within urban areas. The EA's Mayesbrook Park study in East London and Ladywell Fields Park and a literature review by O'Gorman et al (2010) for urban waterside recreation for British Waterways shows a wide range of values for tourism based on inland water and other natural features.

Rich wildlife attracts visitors and there are numerous studies on the economic benefits that wildlife tourism brings to areas. UK NEA reported that the economic valuation of nature recreation sites with similar physical characteristics can generate very different values according to their proximity to large population areas: they estimate a range of £1,000 p.a. at the lower end to £65,000 p.a. in the most attractive locations – such as coastal areas - and according to the type of wildlife present. Bird watching can generate significant spending (according to RSPB studies), with conservative estimates of £4 per person per day and £2,750/ha a year for wetlands which attract the greatest number of wildlife visitors (Eftec Handbook, 2005).

Visual, Spiritual and aesthetic

The character of urban landscapes, or specific features and buildings can give inspiration and a feeling of spiritual wellbeing or cultural identification to both residents and visitors. Even objectively low quality landscapes with few obvious charms can provide a sense of community or permanence to local residents. Improvements to urban sub-habitats can enhance the views from people's homes and positively affect property values. Improved management of greenspace and waterways can provide significant benefits in terms of visual amenity. There is a growing literature on the economic benefits of trees and well planned and managed parks, gardens and squares on values of nearby properties ranging from increased values up to 34%, with a typical increase of 5% (CABE, 2005). Improvements to sub-habitats can also add to people's enjoyment on journeys to and through local areas.

Community cohesion

Urban ecosystems are also important for social cohesion, providing opportunities for volunteering and development of community and 'friends' groups that help build social capacity. Research has shown that community open space and natural settings can help build a sense of community and promote social capital in disadvantaged communities (Dines et al, 2006) while Kuo and Sullivan (2001) found that greenspace can enhance feelings of social safety in a neighbourhood and help to reduce aggression and crime. The value of volunteer time is often used as a proxy for the value of social capital created by managing greenspace. A study by BTCV (2008) also found that seven out of ten volunteers in their conservation projects also increased the amount of waste they recycled and gave advice to others about environment friendly behaviour.

Education

Urban greenspace – particularly woodlands, wetland areas and nature reserves – can also provide education opportunities. Evidence from Woodland for Life (2011) shows that forest schools providing education opportunities can give children the tools to develop healthy lifestyles, whilst providing a unique learning experience and skills which in the long run will benefit themselves and society.

2.2.3 Regulating Services

Regulating services provided by urban sub-habitats may be even more vital to urban areas than rural ones. All types of sub-habitat can provide purification services (cleaning water, air and soil) and help to regulate climate hazards and reduce noise.

Water Quality

More natural hydrology and better connection with flood plains generally enhances water purification and reduces treatment costs or defers the need for investment in the sewerage system. Improved habitat management, particularly in the uplands can lead to water quality improvements and so to reductions in the costs of potable water supply. This has been the basis of the majority of UK PES schemes to date. Commercial confidentiality means that the scale of benefits is unclear. UKNEA estimates water quality benefits of inland wetlands at £290/ha p.a and OFWAT accepts that likely benefits from the South West Water 'Upstream Thinking' programme is 65:1 compared to conventional treatment of more contaminated raw water.

Flood regulation

The management of urban sub-habitats can also play a major role in flood control. Traditional combined sewer systems work by conveyance taking waste water and storm water away from where it arises to treatment plants as fast as possible. However, in many areas combined sewers are at capacity and unable to cope with more than 1 in 30 year rainfall events. Where capacity is exceeded sewers can back up and lead to surface water flooding – including foul flooding - around sewers and in downstream areas. UK NEA estimates the average annual cost of flooding (including coastal) in the UK at some £1,400 million, although this can rise as high as £3,200 million in extreme years such as 2007. Two thirds of these costs are borne directly by householders and businesses. Climate change is likely to increase the frequency and intensity of flooding events, with annual costs rising to more than £20,000 million (in 2010 prices) by 2060 under extreme scenarios. The indirect mental and physical impacts of severe flooding are also significant and long lasting.

There is limited data on the impacts of urban ecosystems and hydrology and their relation to flooding by reducing rates of run-off and reducing risk of 1:100 or 1:200 flood events. Most evidence is based on upland habitat and management regime changes or inland or coastal wetlands. However, evidence is starting to emerge on how urban greenspace designed specifically for SuDS can encourage infiltration and slow surface water runoff rates and flash flooding. Trees and vegetation can also intercept rainfall and slow the rate of run-off, while parks and gardens serve as sustainable soakaways.

Climate Regulation

Urban green space can help to address climate regulation in two ways: through regulating micro-climates; and reducing CO_2 emissions.

Temperatures in cities are higher than in rural areas with consequences for human well-being and the environment – the so called Urban Heat Island (UHI) effect. The process of urbanisation and development alters the natural energy balance, mainly due to the loss of cooling from vegetated surfaces when they are replaced by impervious materials used in the construction of buildings and roads. Living vegetation helps in countering UHI. In summer, the cooler air of a shady street or park is noticeably more comfortable. Average UK temperatures are predicted to rise by as much as 4°C this century as a result of climate change but research by the University of Manchester shows that a 10 per cent increase in urban tree canopy cover can help to cancel out this increase.

Urban woodlands, trees, vegetation and woodland can also sequester carbon and help to mitigate climate change. The role of urban soils in climate regulation remains unclear: greenhouse gases are emitted from soils but better management of greenspace, rewetting of some areas, tree planting, and development of green roofs and conversion of hard standing areas to permeable ones are all likely to contribute to reducing carbon losses or sequestering carbon. The extent of carbon sequestered will depend on the area, type of vegetation and the long term management regime. There is now an established methodology for valuing the benefits of carbon sequestration based on the value of damage costs avoided for each tonne or CO_2 equivalent emissions abated. Defra (2008a) has published full revised guidance on how to value greenhouse gas emissions in government appraisals based on the concept of a shadow price of £25/tonne CO_2 equivalent to assess the value of greenhouse gas abatement in the UK.

Attempts to value the climate change benefits of improvements to urban green and blue space have been made for Mayesbrook Park in East London where impacts were quantified for: increased

vegetation cover's contribution to reducing UHI-related mortality and ill health impacts from heat waves for the population living up to half kilometre of the park's boundary; and the carbon sequestration benefits of newly planted trees, reedbeds and wetland habitat and flood plain soils.

Green space can also help to reduce natural hazards associated with other extreme events (wind, snow, cold snaps etc) but this often goes hand in hand with flood protection and regulating ESs are seldom quantified to avoid double-counting. However, it should be noted that tree planting can increase risks from wind blow (i.e. negative benefits), and it is therefore important that new planting is with appropriate native species and that trees are regularly maintained.

Air regulation

Plants act as natural filters, trapping dust and harmful chemicals, cleaning the air and helping to make towns and cities healthier and less polluted. Roadside trees can trap up to 90 per cent of traffic-related air-borne dust particles. UK NEA found that across the UK urban air quality has generally improved (with a more than 95% fall in sulphur dioxide and black smoke emissions) but in many areas nitrogen oxides, fine particles (PM10 and PM2.5) and background ozone have increased as a result of rising car ownership.

Improved urban sub-habitats generally enhance settlement of general particulates and SO, NOx and Ozone. In theory these impacts can be quantified and valued based on the impacts of health costs avoided from manmade particulate pollution for populations close to areas of significant woodland planting. However, urban parks such as Mayesbrook in London have identified these impacts as significant, but not worth the effort of valuing.

Noise Reduction

Improved urban sub-habitats can help also help regulate noise. A major factor is ground characteristics with soft lawns or grass likely to reduce ambient noise levels by up to 3dBA compared to concrete paving. Increasing greenspace and street trees can have benefits in reducing traffic noise but the impacts are complex to quantify and value.

2.2.4 Supporting Services

This category of services is treated separately in the Millennium ESA since ecosystems provide crucial services which are integral to their overall functioning and resilience and underpin the delivery of more easily quantifiable ESs. However, supporting services such as soil formation, nutrient cycling, water cycling and photosynthesis are complex to quantify and there is always a risk of double counting if valuation is attempted. Habitats and wildlife are also sometimes treated separately as a supporting service based on their intrinsic value, rather than their recreational value.

Wildlife and genetic diversity

Wildlife and genetic diversity have an intrinsic value of their own as supporting ESs but also provide ESs for direct human use which can be quantified. For instance, urban water courses can provide habitats for a variety of flora and fauna both in-channel and within associated corridors and can be important habitats for birds which attract tourists. Studies of urban canals by British Waterways have shown sightings of herons, mallards, swans, geese, coots, moorhens, toads and dragon flies and rarer species such as water voles, bats, grass snakes, kingfishers, terrapins, otters and osprey on urban canals.

Nationwide wildlife surveys by the RSPB and others confirm that urban green infrastructure is now critical for biodiversity, with species such as hedgehogs, frogs, songbirds and butterflies thriving in the leafier parts of towns and cities. A number of studies have explored the relationship between species assemblage structure in different urban sub-habitats[1]. These show that species diversity depends on the type and size of sub-habitats, their isolation and surrounding land cover and uses. UK NEA found that patch sizes have tended to fall with urbanisation. Overall, the species that have tended to disappear with urbanisation include habitat specialists, more area-demanding species and those associated with more complex vegetation structures such as forests. The species that tend to remain or increase in richness in urban areas are more likely to be habitat generalists, less area-demanding species and edge specialists. Increasing the size and quality of urban greenspaces of all types offers opportunities to improve species diversity and resilience in the face of climate change.

Soil

Many of the supporting and regulating functions that urban soil could provide have been reduced and restricted, mainly through widespread sealing and degradation causing urban soils to lose their functions and resilience. UK NEA found that up to 75% of front gardens and driveways in UK cities have been paved over. This has increased the rate of surface water run-off and contributed to major hazards such as flooding. However, change to land cover and particularly new woodland planting and denser and more diverse grass cover can have positive impacts in slowing erosion and promoting soil formation.

2.2.5 Wider economic and regeneration benefits of green space

Although not included in the UN Millennium framework or UK NEA ecosystem services approaches, urban sub-habitats also provide other wider economic benefits. A green, healthy environment often goes hand in hand with commercial and economic success. As noted above high-quality green spaces increase residential property values over identical properties in the same area. There are also green space related job opportunities. These include jobs delivering capital works and maintenance of parks and public open spaces and include management of allotments, street scene, park rangers, sports facility managers and those involved in landscape gardening, harvesting and market gardening. In addition Sustainable urban drainage systems require bio-engineering skills (for designing wetlands, bunds and swales) and construction skills for replacement of impermeable surfaces and installation of green roofs etc.

2.3 EMERGING LESSONS ON DEVELOPING A PES

The following sections summarise some of the key components which need to be considered in designing a PES scheme. These include the actors involved, how they are configured, the mode of payment and how multiple ESs can be packaged. This structure and the emerging lessons from the

[1] As quoted in UK NEA and including: allotments (Luniak 1980); brownfield sites (Davis & Glick 1978; Dickman 1987); cemeteries (Lussenhop 1977; Biadun 1994); ponds (Parris 2006); remnant habitat patches (Crooks *et al*. 2004); roundabouts and traffic islands (Whitmore *et al*. 2002; Helden & Leather 2004); and woodland/forest patches (Tilghman 1987; Hobbs 1988; Miyashita *et al*. 1998; Park & Lee 2000, Niemelä *et al.* 2002; Magura *et al*. 2004; Lehvävirta *et al*. 2006; Morimoto *et al*. 2006; Platt & Lill 2006; Sadler *et al*. 2006).

PES best practice have been used as the basis for designing a PES tailored to the specific situation in the study area, the characteristics of which are summarised in chapter 3.

2.3.1 Actors involved

Each PES scheme involves a range of actors including:

- **Buyers** who can be broken down into three groups: primary buyers – individuals or businesses buying on their own behalf; secondary buyers purchasing on behalf of sections of the public such as water utilities, insurance companies and NGOs; and tertiary buyers who purchase improved ES provision on behalf of the wider public, i.e. the government.
- **Sellers** - resource managers whose actions can potentially secure production of the beneficial service and can include individual or institutional land owners or managers, NGOs or Local Authorities as managers of greenspace;
- **Intermediaries** – successful PES schemes often have intermediaries or 'honest brokers' who can assist with scheme development and implementation and collect and distribute payments on behalf of multiple sellers or buyers and ensure that ESs are provided in perpetuity; and
- **Knowledge providers –** who can include a wide array of specialists whose responsibilities and expertise can facilitate scheme development. These can include resource management experts, valuation specialists, land use planners, landscape architects, regulators and legal advisors.

A number of different configurations of buyers and sellers are possible including:

- **'One-to-one'** where a single buyer (e.g. a water company) enters into a contract with a single provider (e.g. a major land-owner such as the National Trust). The United Utilities SCaMP project in the North West is the best known example of this model.
- **'One-to-many'** where a single buyer (e.g. a water company) makes arrangements, via a broker, to pay many ES providers (e.g. farm businesses or land owners for water-sensitive management practices). There are a growing number of catchment management scale examples of this model in the UK including pilots run by the Environment Agency, South West Water, West Country River Trust etc).
- **'Many-to-one'** where multiple buyers (e.g. a water company, government agencies and NGOs) together pay a single ES provider (e.g. a Local Authority or NGO) to develop and maintain a habitat or landscape. There is so far limited experience of this model.
- **'Many-to-many'** where government (on behalf of society) or multiple buyers (as above) compensate many sellers (e.g. farmers) for sympathetic land management practices which will deliver enhanced ESs. Agri-environment schemes fit this model. This could also apply to a group of NGOs or smaller landowners working together to improve natural areas to improve water quality, flood risks and other benefits for which there are a number of distinct benefits. This approach is being investigated by River Trusts in the south east but there are no other known examples yet.

2.3.2 Payment approaches

The mode of payment is one of the key variables in a PES design. URS et al distinguish between two broad approaches:

- **Output based payments** – based on a valuation of the ecosystem services provided. This requires detailed quantification and monetary valuation of each ES being provided (e.g. carbon sequestration, water purification, recreation, flood risk alleviation and biodiversity) as the basis for negotiating the level of PES payment. Although this is perhaps the purest form of PES approach, the best practice review suggests the scientific information to quantify benefits and valuation techniques have seldom been available to apply this approach. Our literature review suggests that it is unlikely to be a practical approach for urban sub-habitats and ESs.

- **Effort based payments** – based on contracting for a prescribed level of management practice or area of habitat creation, based on the assumption that the agreed practice or area of habitat will yield a desired level of change in ES provision (which is not itself specified). This approach has so far been more widely used, even in cases such as rural water catchments where only a single, relatively well understood and valued ES is being provided.

2.3.3 Packaging of multiple ES benefits

Where more than one ES is being offered to buyer(s) these can be packaged in several ways which have been characterised by the OECD as follows:

- **Bundling**. A package of services from the same land/habitat area is sold to the same buyers in a bundle for a single price (e.g. wildlife and water quality conservation);
- **Layering.** A bundle of services from the same land area is sold to different buyers (e.g. an NGO buys wildlife benefits on behalf of its members, while a water company buys water quality benefits on behalf of its customers). Over time additional ESs and buyers can be added according to their interests e.g. businesses may buy carbon sequestration to offset their own carbon emissions or businesses or households (or a local authority on their behalf) could buy flood risk management benefits for downstream communities.
- **Piggy-backing**. A single ecosystem service is provided as an umbrella service to a buyer (e.g. water quality to a water company) but with other beneficiaries contributing to the costs of delivering other correlated services (such as biodiversity, carbon sequestration and flood risk) in cash or kind. In most cases the correlated ESs would not be bought on an ongoing basis by beneficiaries, who would instead contribute to start-up or capital costs.

2.3.4 Potential sellers and buyers for habitats and ES types

Table 2.4 is based on the URS best practice guide and summarises some of the key habitat types likely to be found in urban areas. Based on our literature review and the URS guide, the key ESs provided by urban sub habitats have been reduced to a manageable handful and denoted with icons. These include: recreation (very important); water quality, flood regulation, habitat for wildlife and landscape quality/amenity (medium importance); and climate regulation which is very important for some sub habitats such as woodlands.

Table 2.4 Matrix summarising importance of habitats for the delivery of urban Ecosystem Services

Habitat type		Urban	Woodlands	Semi-natural grassland	Freshwaters (open water, Wetlands & floodplains)	Enclosed farmland
Ecosystem Service	**Typical ownership**	Multiple small scale: local authorities, residential, commercial	Public – FC & LAs, voluntary sector (Woodland Trusts), private owners	Common land, farmers, landowners, LAs, voluntary sector	Mixed - estates, agri-business, individual farmers, tenant farmers	Estates, individual farmers, Local authorities
	Typical buyers					
Water Quality 	Water supply and treatment companies, on behalf of customers	**MEDIUM**	**MEDIUM**	**MEDIUM**	**HIGH**	**HIGH**
Flood regulation 	Environment Agency, insurance companies, local authorities	**MEDIUM**	**MEDIUM**	**LOW**	**HIGH**	**HIGH**
Climate Regulation 	Private sector e.g. retail and organisations on behalf of individuals; Government	**LOW**	**HIGH**	**LOW**	**MEDIUM**	**LOW**
Habitat for Wildlife 	Conservation NGOs on behalf of members e.g. Woodland Trust, RSPB	**MEDIUM**	**HIGH**	**HIGH**	**MEDIUM**	**HIGH**
Recreation 	Individuals - tourists, activities, house buyers. Tourism and leisure industry	**MEDIUM**	**HIGH**	**MEDIUM**	**MEDIUM**	**MEDIUM**
Landscape and amenity 	Individuals - tourists, activities, house buyers. Tourism and leisure industry	**MEDIUM**	**HIGH**	**MEDIUM**	**MEDIUM**	**MEDIUM**

Source: Based on URS et al Draft PES Best Practice Guide, 2012

2.4 SUMMARY OF KEY FINDINGS AND THEIR RELEVANCE TO THE PILOT PES DESIGN

The literature review has highlighted the importance of urban sub-habitats in providing multiple ESs. In most urban areas deterioration in sub habitats opens up many opportunities for increasing ESs delivery through better management, better connectivity and increased areas of green and blue space. The PES best practice guide suggests that the greatest opportunities are in providing recreation and landscape amenity, water quality, flood regulation, climate regulation and habitat for wildlife which will often be provided as a bundle by each hectare of improved habitat. This

manageable handful of ESs has been used as the basis for identifying existing ES provision and future opportunities in North Hull; although in practice any improvements would also have wider cultural, provisioning and regulating ESs bundled with the primary ESs.

Compared to rural areas and lessons from established PESs - many of which focus on water quality improvements - there is so far limited evidence on the quantitative relationship between sub-habitat management and ESs delivered. There is even less valuation data which could be used as the basis for an output-based (valuation of services delivered) PES approach. Flooding regulation is the exception. There is plentiful data on the economic benefits of flood risk reduction in the literature (based on damage costs avoided techniques) and also information on the efficacy and costs of delivering sustainable drainage treatments from practical implementation in the UK, Netherlands and the US. This data can provide the basis for designing PES schemes based on effort-based modes of payment.

Given the complexity of land tenure in urban areas, PES schemes are likely to involve many providers including Local Authorities, individual land owners (peri-urban farmers, businesses, and schools, those with gardens or allotments, churches etc) in delivering a package of ESs. It is less likely that a primary buyer will be found to purchase ESs on its own account or on behalf of beneficiaries than for rural water catchment PES schemes. Instead there may be a number of potential secondary buyers such as water utilities, insurance companies or NGOs who are willing to buy specific ESs such as water quality, flood regulation, biodiversity or angling on behalf of their clients or members.

While ideally multiple ESs in urban areas would be layered and sold according to their incremental benefits or the Willingness to Pay of different beneficiaries, in practice the complexity is likely to mean that it will be easier for a tertiary buyer – such as Local Government – to buy a key ES such as recreation or flood regulation on behalf of residents, with other beneficiaries such as community groups, businesses, and government agencies piggy-backing on this arrangement and contributing to the delivery of the project in whatever ways prove practical.

3. THE STUDY AREA

3.1 OVERVIEW

The following sections describe existing urban sub-habitats, current levels of ecosystem service delivery and opportunities for improvements in the Hull PES pilot study area.

Collating and analysing this information has been the first step in exploring whether there are opportunities to improve the extent, quality and management of green and blue space in North Hull and the surrounding peri-urban areas of East Riding of Yorkshire to deliver ecosystem benefits to local communities to increase their resilience to flood risks, while simultaneously improving wider benefits (Ecosystem Services) from greenspace, including food and biomass production, recreation, health, landscape amenity and biodiversity.

3.1.1 Characteristics of the study area

The Orchard Park and Greenwood ward of North Hull forms the core of the study area. The ward is characterised as the 23rd most deprived ward nationally (2007, ONS) with its position having deteriorated from 28th in 2004. The area has 5,800 properties, of which nearly three quarters are rented from the council and registered social landlords: the percentage of owner occupiers is well below city averages (at less than 20%). Housing is largely small terraces (62%) and low value (with 98% of properties falling in Council Tax Band A). Large areas of housing stock would benefit from improvement but large scale renewal is unlikely to proceed in the next few years.

Benefit dependency is very high and unemployment levels amongst adults and young people are amongst the highest in Hull City, with low educational attainment and adult skill levels. There are very few businesses in this corner of Hull and the public sector (Hull City and the Health Service) are the major sources of employment. In the immediate future employment and skills training opportunities are most likely to come from initiatives by the voluntary sector and social enterprises.

The area has a relatively high percentage of greenspace, but much of it is low quality amenity grassland which is poorly maintained and configured, of low visual quality and as a result providing limited benefits to the local population. The visual character of Orchard Park has largely been defined by its tower blocks, which have recently been demolished or are now awaiting demolition. A full description of the socio economic characteristics of North Hull is shown at Annex A.

3.1.2 Processes creating opportunities for a PES pilot in the study area

Despite the deprivation of the study area a number of strategic planning and decision making processes identified prior to and during the pilot project appeared to offer immediate or long term opportunities for the development of a PES pilot.

Building Schools for the Future (BSF). School building is one of the few ongoing areas of construction and development activity in the City. BSF is due to complete works at the new Thomas Ferens Academy in the East of Orchard Park and needs to provide greenspace with community access to compensate for land take of playing grounds in the flood zone. A school on the outskirts of

the area – Sir Henry Cooper – will be demolished leaving a large area of potential greenspace. As late as early 2012 a substantial budget had been allocated for greenspace investment and a green corridor along the Beverly and Barmston (B+B) drain to Sir Henry Cooper School within East Riding. This would have offered an opportunity for a layered 'One to many' PES focused on recreation and biodiversity ESs delivered by Hull City Council and community groups. Unfortunately this budget was significantly cut during 2012 and the opportunity is no longer available.

A cross boundary flood alleviation project between Environment Agency, Hull City Council and East Riding of Yorkshire Council. During 2011 and 2012 a large scale modelling exercise was identifying best approaches to flood alleviation around Cottingham and North Hull. This initially identified the opportunity for large scale water retention areas on the greenspace around the project area and was expected to result in a £16 mn project which could have created the basis for a 'one to many' bundled PES scheme. However, the latest modelling in mid 2012 demonstrated that engineering works higher in the catchment could address some of the flood risk issues and investment in green space in Northern Hull has not been included in the project design.

Yorkshire Water Services (YWS) modelling of the Hull and Haltemprice catchment to identify the causes of sewer flooding during 2007 and whether investment in different forms of flood regulation are required to address the root causes. This modelling has reported later than initially expected but the results in late December are promising for the development of SuDS based PES schemes in Orchard Park and possibly also other parts of the city.

Housing renewal. Orchard Park Regeneration Team secured substantial private finance initiative (PFI) funding for housing renewal projects to help transform Orchard Park through the Northern Area Improvement Plan, developed in consultation with residents, identified regeneration priorities including the demolition of 7 tower blocks and redevelopment of the resulting space. The project was halted by CLG in November 2010 and opportunities for private funding through Homes and Community Agency have not yet been successful, but demolition of the remaining blocks will go ahead by 2014.

Kingswood private housing development adjacent to Orchard Park is expected to be the first area to take off when the economy and housing market in Hull revive. This area is mainly of upmarket private housing with opportunities to increase greenspace provision through SuDS treatments in the future. In the longer term this may offer opportunities for a local PES scheme, but since it falls in a different administrative area it is unlikely that S106 payments or Community Infrastructure Levy could contribute to an Orchard Park PES.

Other businesses that could potentially have been interested in a PES in Orchard Park, include:

- businesses downstream in the catchment benefitting from reduced flood risk and potentially lower insurance premiums;
- insurance companies able to generate additional business by offering affordable flood insurance cover to currently uninsured households or to HCC for social housing;
- businesses along the Humber estuary, who might be required to offset any biodiversity losses from expansion activities and would be prepared to pay for sub-habitat creation at receptor sites in the project area as a form of biodiversity offsetting.

In the context of the continuing economic recession none of these business groups is currently in a position to become involved.

3.2 EXISTING SUB-HABITATS IN THE STUDY AREA

Map 3.1 and Table 3.1 show the make-up of existing urban sub-habitats in North Hull according to the categories described in Section 2. Orchard Park has only 25% greenspace compared to an average of 35% across the city. Orchard Park land use is dominated by domestic buildings, impermeable roads and pathways and domestic gardens (35%). Table 3.2 shows that Orchard Park and the adjoining areas of East Riding which wrap around the west and north of Hull city boundaries together comprise 165 ha of greenspace made up of the following sub-habitats:

- **Domestic gardens** (52%) –much of it linked to private and social rented housing;
- **Outdoor sports facilities/recreational areas** (17.5%) – which falls administratively within East Riding but is currently owned or on long lease to Hull City Council;
- **Amenity greenspace** (10.4%) –mostly around housing, road and path verges owned, and maintained to standard mowing regimes, by Hull City Council. Some of this space has been created by the demolition of tower blocks;
- **Schools grounds** (10.2%) – particularly around Henry Cooper school on the East Riding boundary and the new Thomas Ferens Academy by the Beverly and Barmston drain;
- **Green corridor** (2.9%) principally pathways bordering the Beverly and Barmston Drain with EA access rights; and
- **Natural and semi natural space** (6.2%) – At Oppy Woods within East Riding an area of undermanaged and utilised woodland.

The area has few of the sub-habitat types likely to provide the greatest ESs benefits and in particular has no public parks and formal gardens, cemeteries and churchyards and very limited water, other than a stretch of the Beverly and Barmston drain.

Hull City Council is the major land owner and land manager in the study area. The Parks service is responsible for management of parks, gardens, cycle routes and rights of way and for delivering street scene management through a Direct Labour Organisation on behalf of the Northern Area committee. The Parks service also manages the city's allotment sites with some 1,800 allotment plots of varying sizes and a huge waiting list of about 1,000 individuals across the city, but with no allotment sites within Orchard Park and Greenwood ward. The Park's service has carried out a greenspace audit (2011) which will feed into a Greenspace strategy which has not yet been completed. A Play Space strategy (2010) identified opportunities for additional sports facilities which have been reflected in the BSF programme for sports provision in schools.

Table 3.1 Land use within Orchard Park and Greenwood ward

Ha by ward	Orchard Park and Greenwood	University	Beverly	Hull City
Total Area	24.14	24.50	25.40	719.6
Domestic Buildings	2.73	2.23	2.27	61.6
Non Domestic Buildings	0.40	1.25	1.07	46.2
Road	4.17	3.00	2.84	93.7
Path	0.76	0.20	0.12	11.8
Domestic gardens	8.46	7.04	6.36	148.1
Greenspace	6.27	8.32	9.49	247.6
Water	0.07	0.11	0.73	17.8
Other (incl rail)	1.27	2.35	2.52	92.8
Population density/Km2	5819	3885	3661	3409

Source: ONS Neighbourhood statistics, Land Use database 2005

Quality of Greenspace

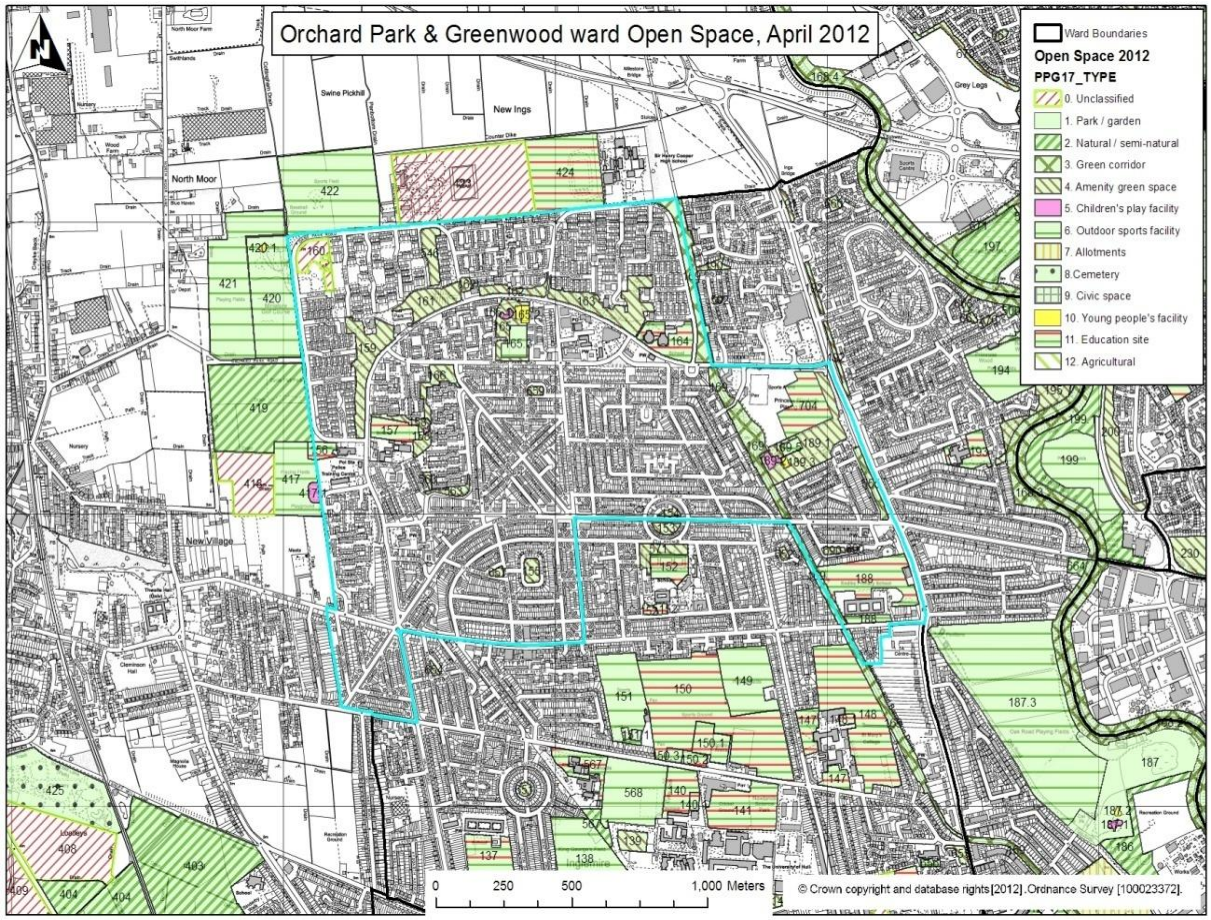
While Orchard Park and Greenwood ward itself is poorly provided for, the surrounding area of East Riding which wraps around Orchard Park does have natural and semi natural areas at Oppy Wood, and extensive outdoor sports facilities to the West (golf course pitch and putt) and 8 football pitches (with space for 16) to the North. However, these facilities are currently characterised as poor quality and under-used and they offer a real opportunity for capital investment and more intensive management to provide multiple ESs. Most of the greenspace within Orchard Park itself is amenity grassland running along Hall road and between housing areas or around school buildings. Figure 3.2 illustrates that these spaces are of generally poor quality. The types of ESs currently provided are described in section 3.3.

3.3 CURRENT ECOSYSTEM SERVICES AND FUTURE OPPORTUNITIES

3.3.1 Water Quality

There is currently very limited water in the Orchard Park area which is limited to Beverly and Barmston drain, managed by the Environment Agency, but not used for drinking water. Water quality may be polluted by farming activities upstream and by misconnections. There may be opportunities for improving water quality for wildlife and recreational opportunities such as fishing. The Local Nature Partnership is keen to explore alternative approaches to water management to help improve water quality and supply. Environment Agency and engineers involved in designing flood regulation schemes have identified opportunities to create new wetlands and retention ponds as part of SuDS schemes.

Figure 3.1 *Extent* of existing greenspace in the study area based on PPG 17 categories (2012)



Source: Hull City Council 2012

Table 3.2 Existing extent of greenspace in the study area based on PPG 17 categories, 2012

Greenspace (based on UK NEA and PPG 17)	Greenspace (ha) in Orchard Park and Greenwood		
Natural and semi natural greenspace	10.3	Site 419, Oppy Wood, (Outside/adjacent to boundary)	No biodiversity action plan or survey data. Opportunities to enhance management for Biodiversity, recreation and amenity, water regulation and water and air quality benefits.
Public parks and formal gardens	0	No sites in/adjacent to ward Site 187, Oak Road, 8.4 ha, approx 1km SE of ward	Extensive areas of domestic gardens but no survey data on existing ESs. However, observation and GIS mapping suggest many front drives have been paved/concreted and there is potential to improve water regulation by removing impermeable surfaces.
Domestic gardens	85.6	using Ordnance Survey Land use data	
Green corridor	4.9	Site 169, Beverley and Barmston Drain within ward boundary	Limited area along Beverly and Barmston drain – currently limited diversity and prone to fly tipping. EA study on River Hull may provide options for increasing biodiversity and recreation benefits.
Outdoor sports facilities, recreational	*Within Hull boundary*		Large area of outdoor sports facilities in the Study area in East Riding but limited provision within Orchard Park or any type of sports or play facilities. Biodiversity ESs may be higher in the pitch and put area since it is not very actively
	0.86	Site 165.3, grass, Shaw Park	
	0.29	Site 189.5, bowling greens	

areas		Princess Elizabeth playing fields	managed (grass cutting regime, chemicals). Other facilities (e.g. next to Henry Cooper school) are large mown grass areas with limited ESs but capacity to provide far greater flood regulation and maybe water quality benefits.
	Outside ward/city boundary		
	3.66	Site 417, Courtland Rd Park	
	6.43	Site 420, Dane Park Mini Golf	
	8.17	Site 421, Dane Park PF (W)	
	9.42	Site 422, Dane Park PF (E)	
Amenity greenspace	17.17	15 sites	Pockets of closely mown amenity grassland are found throughout the area, especially around housing estates, road and paths. Limited biodiversity, recreation or aesthetic ESs. No data from BTO bird surveys on the study.
Allotments, community gardens and urban farms	0	No allotments currently in the study area	Across Hull there is a current waiting list >1000 and demand in new housing sites (such as Kingswood). Schools and community groups previously allocated sites on HCC plots now having to find their own sites on school grounds. National Society for Allotments and Leisure Gardens estimate a standard plot (250m2) can feed a family of 4 for a year.
School grounds	0.55	Site 156, Holy Name Primary	Hull LBAP identifies opportunities to considerably enhance little used areas of grassland around the edges or in awkward corners of playing fields and school grounds for wildlife.
	1.17	Site 157, The Parks Primary	
	1.64	Site 164, Thorpepark Primary	
	4.16	Site 188, Endike Primary	
	2.73	Site 704, Ferens Academy (opens 9/12)	
	6.54	Site 424, Henry Cooper 6.54ha (ERY- closes 9/12)	
Cemeteries & church grounds	0	None in study area	
Water	0.7	Based on Ordnance Survey	Beverly and Barmston drain. Water quality may be polluted by misconnections. Physical habitat variability appears low and offers opportunities for improving water quality and alignment for wildlife and recreation (fishing). Opportunities to create new wetlands as part of SuDS schemes.
Previously developed (brownfield) land	0.06	6 sites (2010 NLUD database)	Very small areas in the study area around Hull Tech and a demolished school in the Danes which is unmanaged but with naturally colonizing vegetation and woodland offers opportunities for enhancement including SuDS retention pond, visual, habitat for wildlife and informal recreation ESs.
Total	164.35		
Street trees (no.)	1,669	Within ward boundary	Several thousand trees within Orchard Park and Oppy Woods. Diversity of habitat and biodiversity currently limited but could be enhanced by more active management and enriching planting.
	74	Sir Henry Cooper School site	

Source: Hull City Council, Greenspace strategy draft 2012, Ordnance Survey Land Use Data and NLUD

Figure 3.2 Quality of Existing Greenspace and water features in the Study Area

Beverly and Barmston (B+B) Drain

Fly tipping, B+B drain

Semi natural area

Footpath by B+B drain

B+B drain

Woodland, semi natural areas

Amenity Greenspace

Amenity Greenspace

Impermeable hard standing

Horticultural area Hull TEC

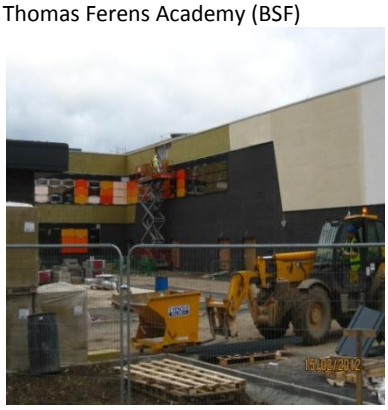
Recreation facilities

Pitch and Putt course

Amenity greenspace around housing

Orchard Park Centre

Thomas Ferens Academy (BSF)



High rise housing, Hall Road

Terraced Housing flooded in 2007

Housing by B+B green corridor

3.3.2 Flood Regulation

Figure 3.3 shows the extent of flooding in North Hull during the extreme rainfall in 2007. Hull is in a unique position in relation to flood risk as the Hull and Haltemprice catchment drains seven valleys and seven distinct watersheds into rivers and drains flowing through Hull and into the River Humber. The Hull area is mainly low and with seasonally wet deep clay. Ninety five percent of the City is within Flood Zone 3 of the Environment Agency's flood map. Table 3.3 shows that during the severe 2007 floods some 2000 properties in the Northern and North Carr areas of Hull experienced flooding (Hull CC, 2007) of which 885 were within Orchard Park and Greenwood ward which is the core of the study area. Of the 15% of households in the study area affected almost 65% had no household

or contents insurance and over half were considered vulnerable, while 55% were council or social tenants. Table 3.4 shows that about 1,644 households in this area are still at flood risk from a 1 in 100 year event and that the estimated damage costs would exceed £44 mn.

Figure 3.3 Areas of Hull inundated during 2007 Floods

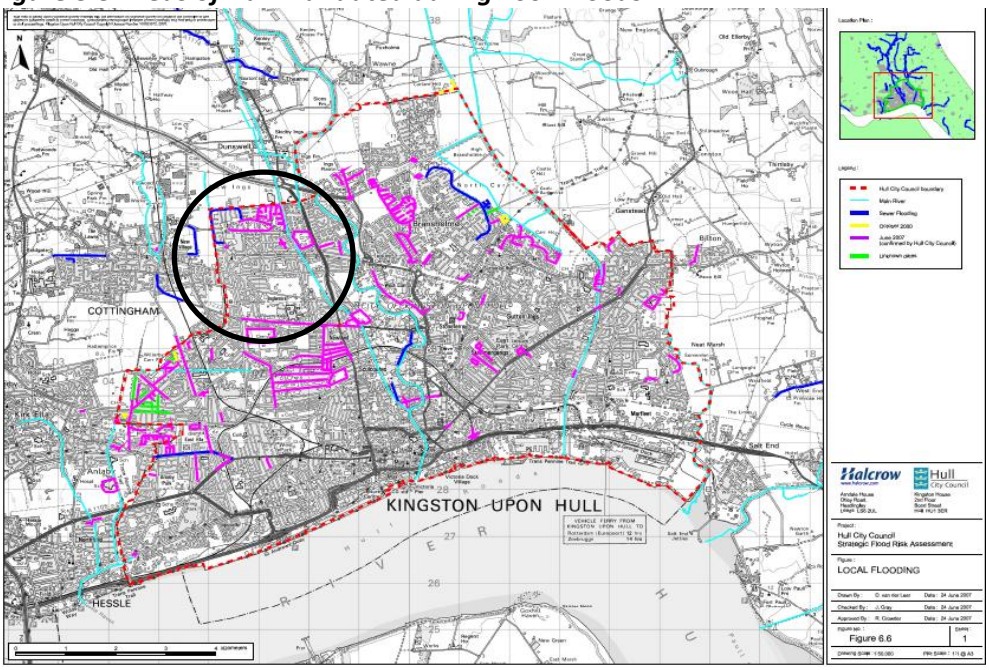


Table 3.3. Extent of Flooding in the North Hull During 2007 floods

Area	Tenure	'Gold'[1] households left most vulnerable by flooding	'Silver'[1] households without contents and/or buildings insurance	'Bronze' households with insurance
Study Area: Northern Area – Orchard Park	Council Rented	281	142	57
	Housing Association	40	7	1
	Own Home	125	17	173
	Private Rented	21	10	11
Orchard Park total		467	176	242
North Carr – to the east of the study area	Council Rented	265	66	50
	Housing Association	2		5
	Not Known	1	1	7
	Own Home	255	40	459
	Private Rented	16	13	17
North Carr Total		539	120	538

Source: Hull City Council, unpublished report, 11/10/07

1'Gold' and 'Silver' package support includes £250 per household cash payments and discounts to council tax.

2 Including those with a disability, the elderly, or people on their own with young children under 5

Table 3.4. Flood Depths, properties and approximate damages for flooded areas for 1% annual probability (1 in 100 years) Surface Water Flood Event

Area	Properties with low (0.15m-0.3m) depth of flooding	Damage costs at approx median depth £ mn	Properties within medium (0.3-0.6m) depth of flooding	Damage costs at approx median depth £ mn	Properties within high (>0.6m) depth of flooding	Damage costs at approx median depth £ mn	Total estimated damage costs
Study area: Orchard Park	1200	31.2	390	11.31	54	1.67	44.18
Adjoining areas: Derringham	1180	30.68	359	10.41	49	1.52	42.61
Bransholme	510	13.26	125	3.62	21	0.65	17.53
All Hull	4490		1378		181		104.32

Source: Hull Surface Water Management Plan, 2007

Responsibilities for managing floods risks and water quality in the study area are shared between the Environment Agency, Hull City Council, East Riding of Yorkshire Council and Yorkshire Water Services. Any of these four organisations could be either potential sellers or buyers of a flood related PES scheme. Following the 2007 flooding the four organisations formed a multi-agency group which evolved into a Flood Alliance between chief executives and Regional Directors with responsibilities for addressing flood risks.

Environment Agency

Environment Agency is responsible for management of rivers and open drains including the Beverly and Barmston (B+B) and its banks running through the study area. Flood Risk Management Strategies have been prepared for the Rivers Hull and Humber. During 2012 a River Hull Flood Risk Mapping Study has been produced with more detailed flood risk levels and depths for the B+B drain. This is currently at full capacity and while it did not overtop during the 2007 floods it has the capacity to do so. EA has identified the opportunity for further improvements to the environmental quality and alignment of the B+B drains in order to provide flood regulation, habitat for wildlife, recreational and landscape ESs.

Hull City Council

Hull City Council is responsible for maintenance of ditches and dykes and for flood alleviation to protect council owned housing in flood risk areas. Following the floods of 2007 it commissioned a Strategic Flood Risk Assessment (SFRA) covering surface, groundwater, river and pluvial flood risks from the River Hull, Humber Estuary, drains, groundwater and rainfall to the city. The Council incurred significant costs during the 2007 floods for emergency evacuation services, house clearance and drying out, reinstating damaged houses and providing support for the most vulnerable who lost possessions or were uninsured. However, no full cost assessment of damage costs to the Council, insurance companies, households or businesses has been carried out. In order to address future flood risks the council commissioned a Surface Water Management Plan (Dec 2009) which modelled the causes of past flooding and identified that some 6,400 properties are at risk of future flooding across the city. The most vulnerable wards are Orchard Park in the study area and Derringham directly to the south. The main cause of surface water flooding in Derringham and Orchard Park is rural runoff from the west of the city when water escapes from flooded fields and grasslands. The Council has identified opportunities for 'sacrifice areas', a study by Halcrow (Jan 2011) highlighted

flood storage options at Springhead Park Golf Course in Derringham and regarding of Creyke and Mill Becks north of Cottingham (East Riding Yorkshire district) wrapping around the study area. The schemes are centred around flood management further upstream and are currently being delivered with East Riding of Yorkshire Council.

Across the city the large area of impermeable hard surface is also an issue. Planning conditionality now requires that significant new areas of hard standing in the City use permeable surfaces to reduce flows into the Hull and Haltemprice drainage systems. Hull City Council has identified opportunities for using large and small scale sustainable drainage (SuDS) schemes in North Hull and other flood prone areas to deliver flood regulation ESs.

A Flood Mitigation Investment Plan (FMIP) in 2012 used conceptual modelling to show how street level SuDS treatments such as water butts, soak away gardens and green roofs on council housing could help to reduce surface water to the combined sewer system.

East Riding of Yorkshire Council

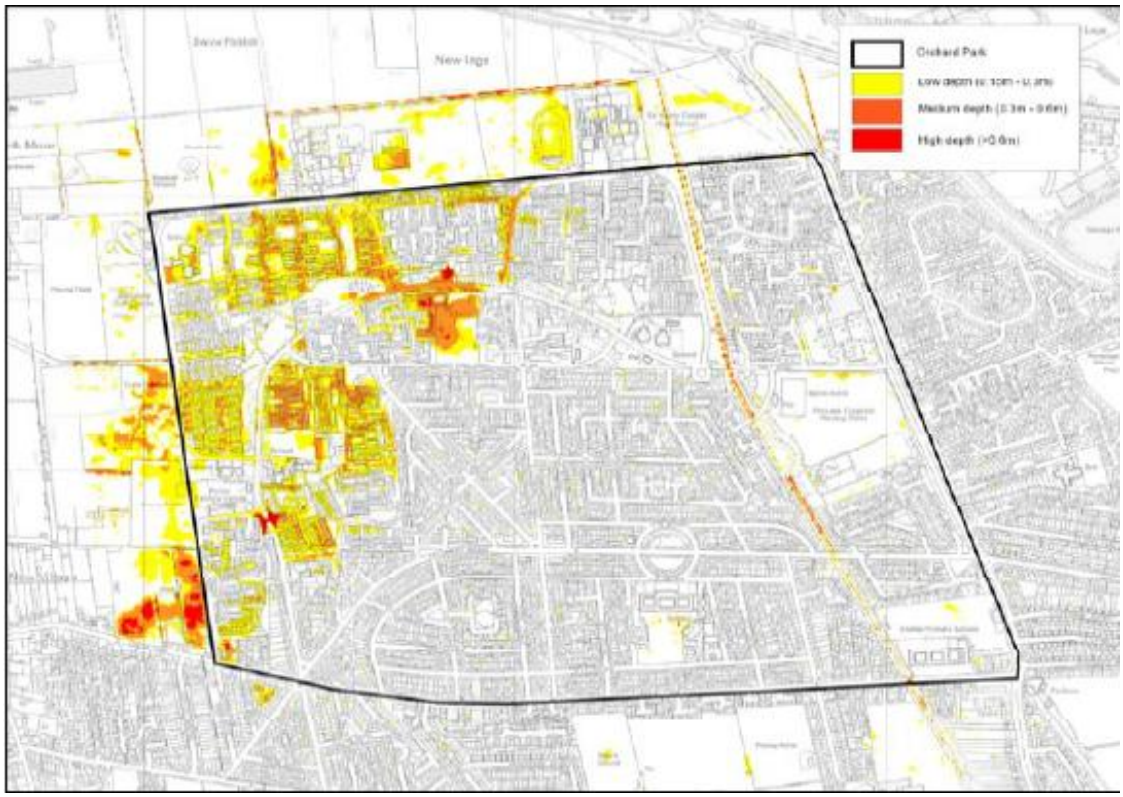
Surface water flood alleviation feasibility studies carried out on behalf of Hull and East Riding Councils and the Environment Agency were expected to identify opportunities to create flood attenuation greenspace – so called aqua greens – around Orchard Park as part of a wider engineering project expected to cost some £16 million between 2013 and 2015. This could have offered a significant opportunity to develop a successful large scale PES scheme for the area. However, the study results were delayed until late 2012 and eventually showed that tiered storage at Eppleworth Road in East Riding (i.e. an engineering only solution) would reduce sufficient surface water flow in times of extreme rainfall to obviate the need for a very large flood plain scheme.

Yorkshire Water Services

Yorkshire Water Services (YWS) owns and manages the drinking water and the drainage network for the city and operates pumping stations and sewage treatment facilities. An analysis of the causes of the 2007 flooding in the study area showed that the system was overwhelmed due to the intensity of the storm event (pumping capacity in the system has been improved since 2007) and sewers backed up and flooded properties in Orchard Park and Derringham.

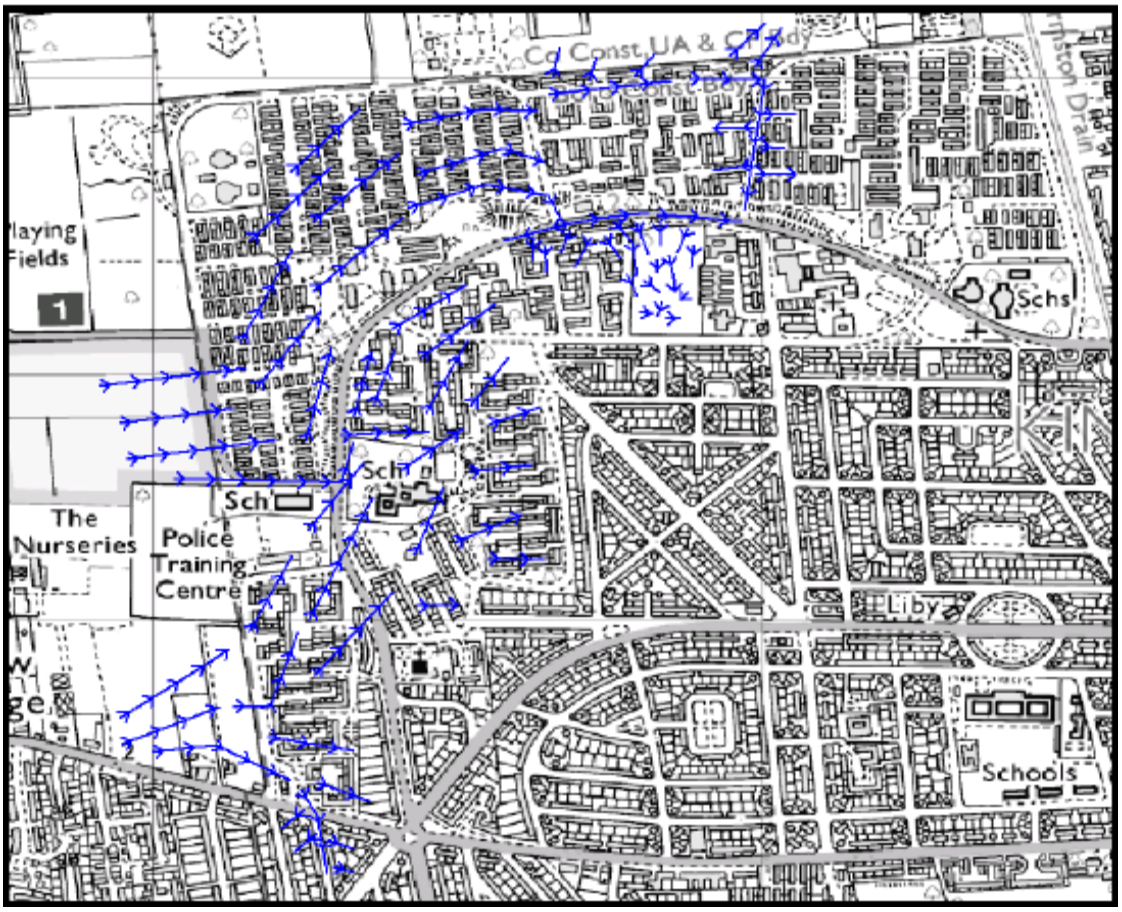
YWS has now completed a city wide model of all of pumped sewerage infrastructure. This model has allowed YWS and the council to work with consultancy partners Arup to develop an understanding of the areas of the city where interventions are needed to reduce the future impacts of 'pluvial' flooding. This is predicated on YWS supporting the idea of a 'unique situation' in Hull where the connectivity of the surface water drainage network to the pumped sewerage network leads to a need to provide a level of service beyond that which is seen as the industry norm (effective conveyance of the 1 in 30 year storm). YWS are using the outputs of the modelling work to develop their business case for the next 5 year asset management period which runs from 2015. Proposals have been included for an increased level of service in Hull through a wide range of approaches including management of water at source through SuDS and greenspace management. There is a precedent for this approach as Yorkshire Water has invested in SuDS approaches for solving flood issues on a small scale in Harrogate (Spinney Hill) and is now looking at a larger trial in Bridlington to use SuDS measures to address bathing water quality issues.

Figure 3.4 Flood extents within Orchard Park, 1% probability



Source: Hull City Surface Water Management Plan, 2009

Figure 3.5 Flood Flow routes within Orchard Park, 1% probability



Source: Hull City Surface Water Management Plan, 2009

The YWS modelling process has been a major driver for the design of the PES pilot, but the modelling and analysis was delayed until late December 2012 and has only recently reported.

3.3.3 Climate Regulation

Hull City Environmental and Climate Change Strategy (2010) set the objective of reducing CO2 emissions across the city by 34% by 2020 from a 2005 base and identified the need to adapt to climate change. As a densely populated urban area, Orchard Park is likely to experience the Urban Heat Island effect. Heat wave plans are in place.

Land use data, GIS mapping and observation suggest that the study area has a high percentage of impermeable area and while there are quite extensive areas of grass there are few street trees, woodland or areas of more intensive vegetation. Nearly 12% of the total area is covered by roads and pathways with extensive paving of front paths and gardens with impermeable paving and concrete to create hard standing for off street car parking. Hull Planning policies now require that any sizeable areas of new hard standing are permeable to prevent an increase in run-off risks, but there is no requirement to replace existing impermeable surface. There is therefore considerable scope for removing hard paving in front gardens and replacing other hard standing areas (car parks, paths, road sides, school yards etc) with permeable paving or SuDS which would combat future UHI effects and also sequester carbon.

3.3.4 Habitats for Wildlife

Little biodiversity data is available for Orchard Park which contains no Local Nature Reserves, SSSIs or known areas rich in biodiversity. No surveys have been carried out for the area likely to have the richest habitat and wildlife diversity, i.e. the small area of water and green corridor running along the Beverly and Barmston drain or a small brownfield site created by the demolition of a primary school in the Danes. Biodiversity related recreation is currently limited, although there may be opportunities to increase bird watching or angling from improvements to the B+B drain or creation of new ponds in the future.

A potential provider or buyer for habitat for wildlife ESs is the newly set up Hull and East Riding Local Nature Partnership (2012) which has identified the need to take an ES approach to setting its priorities and to value and promote the ESs that the natural environment provides in the Hull and East Riding area. In the longer term the LNP intends to develop a robust evidence base to support this objective. The LNP is identifying opportunities to take a landscape scale approach.

3.3.5 Recreation

Greenspace in the study area provides opportunities for formal recreation – mainly pitch and putt in the West and football adjacent to Sir Henry Cooper School. Football pitches are surrounded by rough grass and have no pavilion or changing rooms. The long distance Route 66 cycle route passes through the Orchard Park but this stretch of the route is described as unpleasant and offers considerable opportunities for upgrading. There is no formal circular walking track or trim track or any other cycling, BMX or skateboard facilities for young people. The Beverly and Barmston green corridor and waters are underused. Natural areas such as Oppy Wood are reported to mainly be

used for local dog walking and do not attract visitors from beyond the very local area. This is due to a combination of lack of facilities, orientation of housing towards Orchard Park and the south and perhaps also due to safety concerns.

3.3.6 Landscape, visual amenity and health

Orchard Park and Greenwood ward greenspace has limited aesthetic appeal, with extensive areas of uniform mown grass, limited trees and other vegetation and no strong sense of place.

Health is a key issue. Life expectancy in Hull has been consistently lower than regional and national averages since 1998. Hull Health and Lifestyle survey (2007), conducted by the Primary Care Trust, and estimated that nearly a quarter of the population's activities are limited by a long term illness or disability. Orchard Park communities suffer even worse health than Hull as a whole with nearly 14% of people describing themselves as not in good health, nearly a quarter of the working population affected by long term limiting illnesses and 12% economically inactive because they are permanently sick.

The LNP is keen to promote the health and wellbeing benefits of the natural environment – including social inclusion and cohesion, and access to good quality green space. Any initiatives which can help to promote healthier lifestyles and encourage a larger percentage of the population to take more active exercise could help to combat cardio-vascular, respiratory diseases and diabetes. The benefits in terms of costs avoided by the NHS could be considerable, but at this early stage the new Health and Wellbeing Board is not expected to be in a position to be a primary buyer for a PES scheme.

3.3.7 Other

Food and biomass production

There are currently no allotments in the study area (although there may have been in the past) and food production is limited to Hull Tech horticultural college (see figure 3.2) and any vegetables being grown in private gardens. There are opportunities to develop new allotments, city farms and/or community/school growing areas – if there is demand – and food could make a small but significant contribution to family incomes, health and social cohesion. There is potential to increase food production through development of community and school growing areas and front and back garden vegetable gardens.

There is currently no production of timber, wood chip or other biomass in the study area. However, sustainable use of natural resources is one of four objectives of Hull council's Environmental and Climate Change Strategy for Hull (2010) and an audit of renewable energy opportunities has identified financially viable opportunities for wind turbines on BSF sites and solar panels on council housing and car parks. Opportunities for installing micro generation and energy efficiency technologies have also been investigated but there are currently no buildings in the study area which have biomass boilers installed. There could be opportunities for biomass from new tree planting and through better management of the 1,600 or so existing trees in the ward and Oppy Wood and any new parkland planting. Production of biomass could potentially be a source of employment and income for a local social enterprise or community group.

Social cohesion and employment

Local communities suffer poor housing (with high rise blocks identified for renewal), low income levels, very limited local employment opportunities (with no major manufacturing or service employers in the ward) and benefit dependency with some households now experiencing third generation unemployment. Adult skills levels and qualifications are amongst the lowest in the city. No figures are available for recent youth unemployment but this is expected to have risen significantly in the last couple of years and with it crime and anti-social behaviour.

A survey by Hull Community and Voluntary Services (CVS) in (Nov 2009) identified 38 Voluntary and Community groups that reported that they were working in some capacity in Orchard Park and Greenwood. However, there are a limited number of organisations involved with greenspace management. These include Bransholme Green Enterprises, Latitude and Yorkshire Wildlife Trust and Groundwork who all work on environmental projects with local groups within the Northern Area.

The LNP is keen to develop Green infrastructure's contribution to the economy and involve local businesses in developing the role that the natural environment plays in local economic development and to engage local businesses to promote ecosystem services and explore biodiversity offsetting. In the project area any initiatives which can help to create opportunities for developing skills and local employment opportunities and social enterprises will be welcomed.

3.4 SUMMARY AND CONCLUSIONS

The study area experiences a complex combination of surface water flood risks, socio economic deprivation (low income, poor employment and skills opportunities, and ill health) and limited access to high quality greenspace.

Flood regulation is the overriding need for ES enhancement. Some 16% of properties (885) were affected by flooding in 2007. 1644 properties in Orchard Park and over 6000 properties across the city are still at flood risk from similar events 1 in 100 year events. A large proportion of these households in the study area are particularly vulnerable and a large, but unknown, number have no insurance cover.

Flood regulation involves three government agencies (Hull and East Riding councils and the Environment Agency) and one business, Yorkshire Water Services, and a number of strategic planning processes which have fed into identifying the best opportunities for a pilot PES. Stakeholder consultations have suggested that retrofitting SuDS measures at large or small scale across the study area could deliver flood regulation benefits both to the local area and downstream. SuDS measures which reduce the volume of run off to combined sewers could also result in monetary savings to YWS, reducing the need for investment in additional sewer and pumping capacity and in treatment costs for storm water.

Table 3.4 summarises the key opportunities for increasing ESs in the study area and how the marginal changes in delivery of each type of ES could be valued. Considerable scope has been identified for greenspace improvements ranging from very small pockets of garden and park to a larger central park for the wider community, which the area currently lacks. Each of these

greenspace improvements could simultaneously deliver a mix of flood regulation and wider ES benefits including improving the quality and quantity of groundwater, recreation, habitat for wildlife, climate regulation (Urban Heat Island effect and carbon sequestration) and landscape and amenity (principally health). New and enhanced greenspace could also provide opportunities for residents to grow their own food and to create job and social enterprise opportunities from long term management of greenspace, biomass harvesting and SuDS related construction activities.

The most significant ES to which a value can be attached in the project area is flood regulation. Based on Hull CC's SWMP a 1:100 year event would potentially affect 1,644 properties of which 1,200 would be affected by shallow flooding (0.15-0.3m), 390 by medium level flooding (0.3m-0.6m) and 54 by severe flooding (>0.6m). Based on HM Treasury agreed damage costs of £26k, £29K and £31k per property for low, medium and severe flood damage costs respectively this implies damage costs for Orchard Park and Greenwood would be about £44.2 mn. Any SuDS measures that could reduce these risks could deliver a significant benefit to the 30% of households in the project area which could otherwise potentially be affected by flooding. Extrapolating WTP values from an RPA and FHRC study (2004) would imply that affected households in Orchard Park might be willing to pay £0.33 mn pa equivalent to a present value sum of £8.2 mn over 50 years.

However, given high levels of unemployment, low incomes and low property values, it is clear that individual households will not currently be able or willing to pay directly for a user-financed PES Scheme. Likewise, although downstream flood prone businesses, insurance companies, developers and the manufacturing sector may be interested in contributing to a PES in the longer term, they are not currently in a position to do so because of the ongoing economic recession. This suggests that the most realistic option for the study area is a public payment based PES scheme. Potential options are summarised in Table 3.5. This analysis has been used as the basis for designing two PES pilots described in Section 4.

Table 3.4 Opportunities for Improving ESs delivery in the Study Area and their Potential Value

Ecosystem Service	Opportunities for enhancing delivery	Potential Monetary Value as a basis for PES Design
WATER 	Changes in groundcover and removal of impermeable pavements could help to filter storm water runoff and improve water quality.	Could be valued on the basis of reduction in downstream treatment costs at YWS water treatment plants (as for other water catchment based PES) but likely to be secondary to flood risk management benefits.
FLOOD RISK 	Reducing surface water run-off through SuDS schemes would have major benefits in reducing 1 in 100 year flood risks for 1644 properties locally plus downstream properties	Can be valued based on change in probability x Treasury rates of damage costs avoided (£26K-£31K/property depending on the depth of flooding). This could be compared to an estimated WTP to avoid flooding of £200/Household from other studies. Based on future YWS modeling flood damage costs can be compared with investment in sewage network costs avoided or deferred.
CO2 & CLIMATE 	Any increase in vegetation or woodland has the opportunity to increase carbon sequestration and address UHI.	UK NEA estimates net carbon sequestered (i.e. benefits) annually at a marginal value of £239/ha p.a for new woodland. Woodland Carbon Code provides a range of values for different species and types of planting which can be used for new planting.
HABITAT for WILDLIFE 	Opportunities to improve the connectivity and size and introduce more diverse habitats including grassland, water and woodlands	Garrod and Willis (1990, 1991) suggest values per person for casual uses such as: dog walking £0.15-0.24; shortcut taking £0.21; cycling £0.31; walking £0.32-0.37; and wildlife viewing £0.43-0.46, uplifted from 1990 to current prices. Nature tourism can generate values of £4/pcd or £2,750/ha of wetland a year but may be difficult to capture initially in the project area. Angling on new ponds with day licenses could generate income for managers. In other areas the value of new woodland within 1 km of homes in cities can be worth £10/person p.a.
RECREATION 	Opportunities for improvements in the quality of playing fields, amenity greenspace and water could significantly improve recreation opportunities for the local community and rest of Hull.	
LANDSCAPE and AMENITY 	Health benefits from creation of new circular walks could be significant. Improved landscapes could improve the market value of privately owned homes.	RSPB study on the value of a new 3km circular PROW and a new 20ha park can reduce rates of physical inactivity in the local population by 16% and could save the NHS £0.55 mn pa and £0.18 mn respectively in this area of Hull. New facilities can also provide health related savings to the local economy although these are likely to be limited in the study area due to high levels of unemployment. New or better managed nature reserves, woodlands or wetlands could generate educational opportunities valued on basis of school coach trips avoided to access similar resources.
OTHER: FOOD, BIOMASS, EMPLOYMENT and VOLUNTEERING	There could be a small but important increase in food grown on allotments, gardens and community spaces and biomass in new and existing wooded areas	Valued on the basis of the growing area and typical yields a well husbanded average '10 pole plot' (250 m2) has been estimated to produce £1,128/pa worth of produce at current market prices (UKNEA 2011). Value of biomass production could eventually be considerable from new planting and well managed forests and will be sold to generate income for local businesses or community groups. Social cohesion can be valued using volunteering as a proxy (see Gorman et al, 2009) using rates of £50, £150 and £300 for unskilled, skilled and expert inputs respectively.

Table 3.5 Summary of potential PES approaches in the study area

Configuration of buyers and sellers	Packaging of multiple ESs			Brief description of ESs to be sold, payment mechanisms and the role of intermediaries
	Bundling	Layering	Piggy Backing	
One to One	√			HCC invests in and adopt SuDS on their own land: YWS contributes to capital costs for retrofitting large scale elements (such as swales, bunds, storage areas) based on catchment modeling results demonstrating that reductions in Surface water will avoid the need or defer investment in sewage systems. Ongoing costs may or may not be passed on to water customers in the catchment as an annual cost depending on Ofwat decisions.
One to Many	√			HCC, households and community groups invest in SuDS on their own land or property: Land Trust maintains them on their behalf and acts as an intermediary to collect payments; YWS pays for initial capital costs, as above.
Many to One		√		Hull CC invests in and adopts SuDS on publicly owned greenspace. A variety of beneficiaries including YWS, EA, businesses, households and developers contribute to annual maintenance costs of greenspace through various mechanisms including water bills, local precepts/surtaxes on flood risk properties rent or rates, S106 payments. This would require a very detailed breakdown of the costs and benefits of different ESs delivered or an effort based approach. Given the complexity there would be a role for an 'honest broker' intermediary such as Land Trust in collection of payments and long term management of greenspace.
Many to Many			√	Households and Community groups develop SUDS; Land Trust acts as an intermediary in collecting payments from multiple buyers – principally YWS through water bills. Other beneficiaries including HCC, businesses, EA, and downstream beneficiaries (businesses and households) piggy back on wider benefits but contribute to capital costs through upfront investment, volunteering etc.

4. PILOT PES SCHEMES FOR NORTH HULL

4.1 INTRODUCTION

Analysis of sub habitats and ecosystem services provided in the study area confirm that the particular sub habitats that are lacking in Orchard Park are those most likely to provide a diversity of ESs – particularly recreation, healthy exercise opportunities, biodiversity and regulating functions – while those types of greenspace that are abundant in area – sports grounds, amenity greenspace and domestic gardens – generally provide lower or single ecosystem service benefits. Based on the literature review the greatest need and opportunity within the study area is to focus on opportunities for introducing sustainable drainage systems (SuDS) which alleviate flood risks while also delivering wider ESs.

The aim of SuDS schemes is to manage storm water as close as possible to its source, so reducing run-off volumes and rates. This is achieved by improving soils, removing non permeable surfaces and building trenches to increase filtration, and by collecting, temporarily storing and then slowly discharging storm water at a controlled rate to the sewer system and receiving water bodies. Where SuDS capacity is exceeded swales and retention ponds may still drain to the conventional sewage system so the rest of the landscape needs to be designed to provide for extra conveyance and/or storage in the landscape.

As well as reducing surface water flood risks in the immediate locality, SuDS reduce the downstream impact and the need to increase the capacity of downstream conveyancing systems and offer some opportunities for improving water quality. Well designed SuDS can also provide substantial cultural (recreation, health and aesthetic) and regulatory (carbon sequestration, air quality, climate adaptation) and habitat for wildlife benefits.

Within Orchard Park and its surrounding greenspace in East Riding of Yorkshire there are opportunities to:

- replace impermeable surfaces with porous materials, wherever opportunities arise;
- build in bunds, swales/ infiltration trenches/detention basins and filter strips to direct and retain water in key areas;
- develop ponds, wetlands and floodable sports pitches to accommodate flood waters when necessary;
- manage domestic and school gardens and buildings to reduce the volume of water discharged to sewers e.g. by installing water butts, soakaway gardens, mini allotments and green roofs; and
- enhance vegetation and tree cover to slow surface water run-off and provide wider ESs benefits.

During Phases 2 and 3 a range of SuDS approaches – effectively a mosaic of new and better managed mini sub-habitats – have been explored in terms of their costs, effectiveness in delivering wider ES and their applicability at different scales. An initial review of SuDS treatments, costs and benefits was included in the Interim report. Table 4.1 summarises their potential contribution based on expert judgement of the team. In addition the project team has prepared a package of materials giving more detail on different types of woodland, grassland and SuDS measures which together represent a palette of treatment options at the large or street scale which will underlie the PES

schemes. This material is shown at Annex C. Web resources on these different resources are summarise in Annex D.

Table 4.1 Summary of Ecosystem Services benefits from SuDS measures in Orchard Park

Type of Ecosystem Service/ improvement to green & bluespace	Bunds and swales	Tree planting	Aqua sports pitches	Allotments	Soakaway gardens & water butts	Green roofs	Permeable Roads, paths & drives	Ponds and wetlands
Water Quality and waste treatment	++	+	++	+	++	++	++	++
Water/flood management	+++	+	++	O	++	++	+++	+++
Climate Regulation (UHI, Carbon Sequestration & natural hazard	++	++	+	+	+	++	+	++
Habitat for wildlife	+	+++	O	+	+	++	+	+++
Recreation and tourism	+	++	+++	O	O	O	O	++
Landscape, aesthetic and health amenity	++	+++	++	++	+	+	O	++
Other Social cohesion	+	+	+	++	+	O		++
Employment, education + training	+	+	++	++	+	+	+	++
Food, timber and biomass	O	+++	O	++	O	O	O	O
Scale: **O No opportunity** **+ Slightly positive** **++ Positive** **+++ Significantly positive**								

Based on this analysis and the outcomes of the PES design workshop during Phase 2 two different scale PES pilots have been developed for the Orchard Park area as follows:

- **Dane Park** – a large integrated PES approach to creating a country style park reflecting the needs for flood protection, recreation, wildlife for habitat and landscape amenity across the ward and with a view to the opportunities for broader regeneration of the area;
- **A street level mini-PES** approach which is applicable to specific flood prone streets in Orchard Park, but will also be applicable to many other streets across Hull City and other areas subject to flood risks and sewers currently at capacity.

The two different approaches are described in sections 4.2 and 4.3 respectively.

4.2 DANE PARK: AN INTEGRATED LARGE SCALE PES SCHEME

4.2.1 Introduction

Orchard Park is made up of four distinct and separate areas of housing and is currently perceived as a socially, economically and physically depressed part of the city, largely unvisited by outsiders.

'The Danes' is one of the four housing communities and comprises 13 short roads of terraced housing leading off Danepark road. This is effectively the boundary between Hull City and East Riding (see Figure 4.1). A well designed country style park based on SuDS principles could help to overcome some of the stigma attached to the area and redefine it as an important contributor of Blue Green services - including flood protection, recreation, food and biomass and biodiversity and wildlife services - to the city.

Currently 'the Danes' is isolated from the neighbouring 'Thorpes' because of a lack of transport and greenspace connectivity. The Danes is linked to Hall Road and its shopping precinct and bus stops by footpaths through manicured amenity grassland with little visual, recreational, wildlife or sustainable drainage interest. In the past the area's character has been defined by its tower blocks – half of which have already been demolished while the rest are readied for demolition by 2014. Past demolition and remodelling has resulted in blocked footpaths and limited connectivity to the wider area. However, there are now opportunities for selectively demolishing a few void units and reconfiguring greenspace to deliver an integrated PES scheme.

As described in Section 3, existing ESs provided by the area are mainly recreation, with 8 grass football pitches, but with no pavilion, changing room, cafe or other facilities to make the facilities attractive to wider users. There is space to develop 16 pitches carefully designed so that the pitches can also fulfil a flood attenuation function during periods of heavy rain. There are also opportunities to greatly extend the informal recreational offer of the area including circular walks and trim tracks (with healthy living benefits) and connecting cycle tracks to an improved stretch of the long distance 'Route 66' which passes through the area.

As well as making the greenspace work better for the local community by linking it to the under used woodlands, golf course and grassland on the East Riding side of the boundary, greenspace could be connected to other parts of the city by green corridors (eg passing behind the police training centre and connecting through to the electricity sub-station next to Bainton Grove).

4.2.2 Objective of the PES

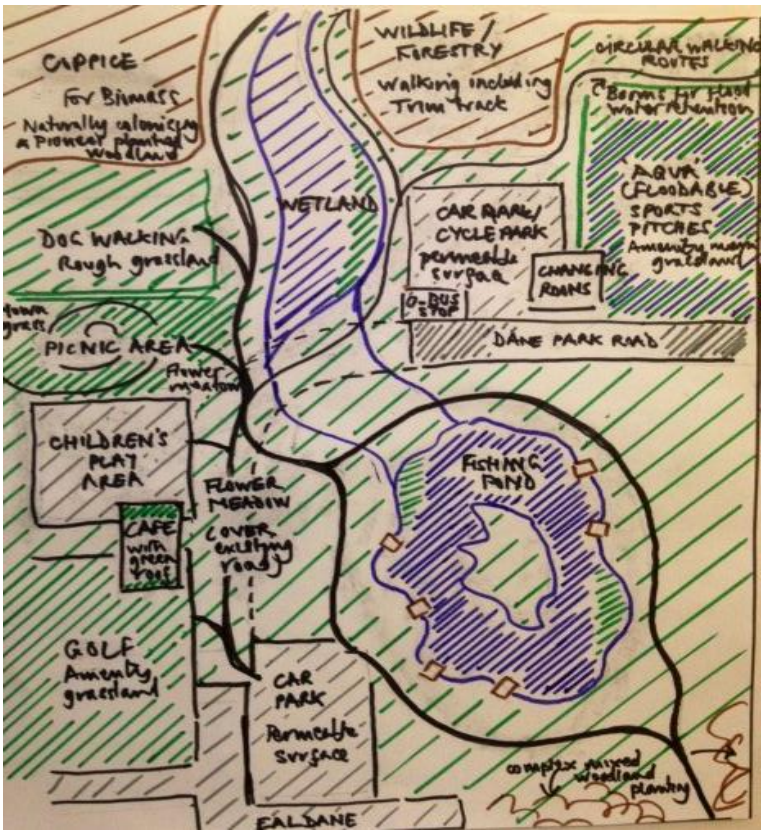
The primary objective of the Dane Park pilot PES is to manage surface water flood risks to Orchard Park and downstream and develop a new image for this isolated corner. The PES will fund the development and management of a country style park designed to create multi-functional space with strong connections to the local community and connectivity to the rest of the city. The park will both provide for active and passive recreation for local residents and attract city-wide users. Figures 4.1 and 4.2 show sketch maps of the overall concept for the park and the palette of different SuDS treatments within the park designed to deliver the following key ESs:

- **Drainage** – creating a landscape with greater capacity for water storage /infiltration and strong water features (swales, wetlands and retention ponds), enriched planting and new woodland and landscape features such as hills, bunds and berms which provide visual variety and vistas to the north and south.
- **Recreation** – linkages between different activity centres with provision for cricket, golf, football, cycle training and BMX facilities, a trim track and Adizone fitness area and improving 'Route 66' (which would not be economically justified as a standalone project).

- **Habitats for wildlife** – an improved range, size and quality of habitats including enrichment of existing amenity grassland with a variety of woodland types, wild flower meadows and rough grassland, swales and permanent ponds and wetlands.

Figure 4.1 Sketch Map of Dane Park in "The Danes" area of Orchard Park

Figure 4.2 Sketchmap of palette of different SuDS treatments within Dane



- **Production/provisioning** – including elements of economic value and production opportunities consistent with values and aesthetics of the setting including allotments, market gardens, biomass or other renewable energy (e.g. small wind turbines).

Dane Park will be developed in several phases. The first phase will focus on flood risk management and recreation opportunities. The second phase will develop food production, market gardening and biomass production for job and business creation. The fist phase will bring together:

- **A strong design element** which links water features with higher ground (raised footpaths, hillocks, a larger landscaped destination mound) and selective demolition of a few houses between Hall Park and the existing demolished school site to widen the entrance and provide a visual connection and gateway from Hall Road across existing greenspace to the park. Designs will be based on a cut and fill approach, creating raised flood retention bunds and berms from clay and material excavated from creation of retention ponds and swales and aggregate from demolition waste from tower blocks and demolished housing units.

- **Grassland** – conversion of large areas of amenity grassland to a combination of flower meadow grassland (created from blocking off the corner of Dane Park Road) to create a connection to rough grassland (for dog walking), amenity grassland for a miniature golf course, a picnic area and along pathways straddling the Hull/East Riding boundary. Much of the new grassland will have a higher value as habitat for wildlife and will be more visually attractive, but potentially with much lower establishment and maintenance costs that existing mown amenity grass.

- **New Water Features** – new water features will include a new fishing pond for water retention (on the site of the demolished school) incorporating an island and areas of wetland designed for wildlife. The pond will be fed by a system of swales throughout the park to increase surface water infiltration and flood water attenuation during heavy rainfall. The swales will be a key design feature in connecting open space.

- **A variety of woodland areas** – new areas of naturally colonising and pioneer style planted woodland will be designed for wildlife habitat and informal recreation and other areas planted for coppicing on scrubby farmland to the north of the area. During phase 2 biomass production will be developed to supply renewable energy for biomass boilers and district heating for 'the Danes' and local schools.

- **Recreational facilities** – 'Aqua' pitches will be designed with a dual purpose of flood control during extreme rainfall events and sport pitches at other times. Berms and swales around the pitch will direct and hold flood waters until they can be safely released to the sewer system. Berms will be constructed using material from water features and demolition waste and designed to work as circular footpaths allowing vistas back over the park. Walking and cycling tracks around the pond will connect to long distance cycle routes.

- **Car parking facilities** – new car parks will be provided at the entrance to the park on Hall road and at Danepark road (near the golf course and adjacent to the sports pitches). Car parks will use permeable concrete or pavers or reinforced grass to maximise sustainable drainage and incorporate soak away gardens to minimise any additional burden on the sewers. The combination of surfacing and soakaways will allow infiltration to soil, filtering of pollutants and retention of storm waters.

- **Opportunities for food production** – Dane Park will incorporate two new areas of allotments amongst housing and on underutilised amenity grassland created by past and planned demolition of tower blocks. There may also be scope for additional horticultural activities at Hull TEC and at Sir Henry Cooper site to the east of the park. During the second phase opportunities to develop market gardening on land north of Dane Park will be explored.

- **Employment, skills training and volunteering opportunities**. The park design will also create opportunities for small businesses or new social enterprises in running a cafe, sports facilities and in carrying out some of the initial construction works and long term maintenance of greenspace, woodland and ponds.

Once mature Dane Park area will appear as an urban forest, with open spaces and gardens mimicking woodland glades and with ponds and swales linking together to form a rich mosaic of wildlife habitats making a significant contribution to nature conservation while providing recreational opportunities for residents across the city.

4.2.3 Ecosystem Services to be provided

As shown in Table 4.2 the different elements of Dane Park will each contribute to the delivery of a large integrated PES scheme for Orchard Park. Each of the elements will be designed primarily for

flood regulation and recreation, but will also contribute wider ecosystem services. Table 4.3 summarises the benefit of each type of element and shows estimated costs (annual costs per hectare) for wood and grassland treatments, and capital costs for other elements where these are known. More detail is provided on each treatment in Annex C.

Table 4.2 Palette of SuDS treatments to incorporate within Dane Park pilot PES

PES activity		Description
Swales, filter strips and Bunds		A swale is a broad, shallow channel with a dense stand of vegetation covering the side slops and bottoms used to collect and/or move water and also remove pollution from it. Swales are used in lieu of curbs and gutters in low density development. Filter strips are gently sloping areas of grass that water flows onto and across, usually towards a swale or filter drain. The main purpose of the filter strip is to remove any silt in the water so that it does not clog up the swale or filter drain. Maintenance costs are similar to amenity grassland with occasional removal of silt. Engineering work costs will depend on materials used. Retrofitting by roads is best undertaken in conjunction with routine re-surfacing.
Wildflower meadow grassland		Informal grassland designed for less used areas of urban parks. The grass is only cut once a year using a forage harvester/cutter bar and baler so cuttings can be removed. Requires much lower frequency of litter collection than amenity grassland and requires only foot worn or mown paths – with path edges trimmed - rather than hard surface. Establishment costs are estimated at £630/ha pa. A species rich sward can encourage the growth of less vigorous grasses and wildflowers and provides valuable habitats for wildlife and visual interest and amenity. The rate of run-off for surfaces with trees and grass is estimated to be 10-20%, compared to 60-70% for hard landscaped urban areas.
Rough grassland		Informal grassland suitable for country parks or less used areas of urban parks. Grass only needs to be cut twice a year using a tractor: cuttings are left. Only limited litter collection is required and paths are made of gravel or wood chip – with strimmed edges - rather than tarred paths. Annual maintenance costs of about £580 ha pa. Rough grassland is suitable for informal recreation (walking, dog walking) and provides more diverse habitat for wildlife than amenity grassland. Can be contoured with bunds and swales to enhance flood water retention. The rate of run-off for surfaces with trees and grass is estimated to be 10-20%, compared to 60-70% for hard landscaped urban areas.
Car park with permeable pavement		Permeable pavement contains many small holes, allowing water to pass into the ground. It can be interlocking pavers or can be poured like regular concrete for car parks or pavements. Rainwater then seeps into the ground or is sent to a rain garden, swale, or infiltration trench. Typical costs are £0.70-3.85 sq ft for permeable concrete, £1.30-4.30 sq ft for grass/gravel and pavers and £3.30-6.70 sq ft for interlocking blocks. Additional costs include breaking up and removing existing concrete/tarmac, but some material could be used for other features such as bunds or landscape features.
Ponds		Park ponds can provide SuDS elements for a park and neighbouring housing, roads and driveways. A new pond would be designed to slow down and retain storm water flows on site as long as possible. Creation of the pond will require earth removal, import of aggregates and sub soil and geotextile lining. Careful design (e.g. with undulating bottoms so that some areas of deep water remain even in dry periods) and planting around the margins can maximise biodiversity and recreational benefits. Maintenance of ponds is relatively straight forward for landscape contractors and typically there is only a small amount of extra work required for a SuDS pond with occasional

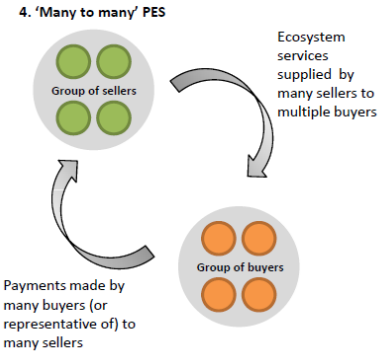
		inspection of control structures and silt and/or vegetation removal.
Allotments		May include standard 250m2 allotments with infrastructure (running water and roads) or innovative smaller units which could be mobile (e.g. in partially sunken containers) as 'meanwhile uses' on development land or on aqua green areas. Allotments could also be incorporated into school grounds, community gardens and in containers by buildings and in front gardens. Estimated establishment costs are £2500 for a standard plot but this is an average across a wide variety of site types and creating a site on existing grassland (where soils should be reasonably good) may cost less. A well husbanded standard plot can produce at least £1000 worth of produce pa.
Woodland in managed greenspace		Informal woodland within urban parks is mainly designed for public access. Planting is at about 2,500 trees/ha in 1m diameter weed free circles and is weeded during establishment (first 3 years) but also kept tidy by strimming vegetation between the trees and collecting litter more frequently. Establishment costs are estimated at about £1,500 ha pa (3 years) falling to about £700 pa until year 10. Increasing tree cover in urban areas by 10% has the potential to reduce surface water run-off by almost 6% and can mitigate for a 3^{o}C rise in urban temperatures and decrease peak temperatures. Woodland also improves landscape and amenity and informal recreation opportunities compared to mown grassland. Wildlife benefits are provided by a mix of pioneer and hardy indigenous species including alder, birch, willow, wild gean, ash and appropriate shrubs (including nitrogen fixers). A mature oak can host up to 5,000 different species of invertebrate that will form the basis of a healthy food chain that benefits birds and mammals. The rate of run-off for surfaces with trees and grass is estimated to be 10-20%, compared to 60-70% for hard landscaped urban areas.
Sports pavilion with green roof		A sports pavilion with an extensive green roof with a mix of sedum plans would add additional costs of £35-40/m for roof costs including the green layer plus perforated edge trim, if required (less savings from alternative roof type). Green roofs reduce surface water flow and discharge to sewers (and can tolerate short periods of saturation from heavy rains), improve water quality and the micro climate (through evapo transpiration), provide shade and enhance wildlife habitats (birds, insects, bees).
Aqua sports pitches and golf courses		Multi use play areas/sports fields designed within a Sustainable Urban Drainage (SuDS) scheme can be designed to act as a retention and/or infiltration basin. While the pitches will normally be dry during heavy rainfall they are used to store water for a short time and so they fill with water. Particularly suited to clayey soils. This approach is being considered in a number of areas across Scotland particularly in sites where pitches are already prone to regular flooding. The costs of maintenance are similar to ordinary pitches but may require more intensive treatment after flooding.

Table 4.3 Ecosystem services provided by the elements making up Dane Park PES

	Wildflower meadow grassland	Rough grassland	Ponds	Car park with permeable surface	Naturally colonising woodland	Woodland in managed greenspace	Aqua Sports pitches & golf course
COST £/HA 1-4 yrs	710	580		£65-600/ car space depending on the selected treatment	90	1500	1620-2280
COST £/HA 5-9 yrs	630	580			110	710	1200-2280
COST £/HA 10-50 yrs	710	580			350	1050	1620-2750
FLOOD RISK 	✓	✓	✓	✓	✓	✓	✓
CO2 & CLIMATE 	✓	✓	✓	✓	✓	✓	
WILDLIFE 	✓	✓	✓		✓	✓	
RECREATION 	✓	✓	✓		✓	✓	✓
LANDSCAPE 	✓		✓		✓	✓	
OTHER: EMPLOYMENT			✓		✓	✓	✓
WATER 	✓	✓	✓	✓	✓	✓	

4.2.4 Key PES Characteristics

PES Buyer and Sellers



The multiple ESs shown in Table 4.3 will be packaged as a public payment scheme involving many potential buyers and a number of different providers as shown in Table 4.4. Initially flood regulation will be the main ES with other ESs piggy backing on it. In the longer run, once Dane Park is established and the economic situation allows other buyers to participate, the PES scheme will evolve into a 'many to many' layered PES, with different buyers found for distinct ESs wherever possible.

During the establishment phase the Dane Park PES will be a 'many to one' scheme. Many of the sites earmarked for the scheme – including amenity grassland, schools grounds, sports pitches, roads and verges - are owned or leased by Hull City Council and allocated to SuDS treatments as the basis of the Country Park. Amenity grassland in particular has very low opportunity cost and other treatments would have some initial capital costs but may reduce ongoing maintenance costs. Amenity grassland, verges, the golf course and rough grassland are all under used and do not generate revenues but incur management costs for the city in excess of £1000/ha pa. Thus Hull City Council parks department would be the principle provider of flood regulation, water quality, recreation (sports pitches, pavilion, fishing ponds and circular walking routes), landscape and amenity and climate regulation ESs but would also be a beneficiary.

The scheme will initially involve a piggy-backing approach. A single service – reduction in surface water runoff to the sewer system – will be offered to Yorkshire Water Services on the basis that the SuDS treatments, and particularly swales, retention ponds and aqua greens will reduce surface water runoff during extreme rainfall events and reduce investment needs to upgrade sewer and pumping capacity in Orchard Park and in the lower catchment. Flood regulation will be an umbrella for the other ESs which will simultaneously be provided to beneficiaries including local and city wide residents. However, other organisations and the local community will be expected to contribute towards the set up costs of the Park through participation in design, volunteer works and bringing in grant funding wherever possible.

Formal recreation such as use of sports pitches and golf facilities will be paid for directly by the users and will be set at levels designed to cover ongoing maintenance costs.

Whether or not YWS is interested in becoming the main buyer for flood regulation from this integrated scheme, Hull City Council intends to draw down external and research funding on behalf of local beneficiaries. The aim will be to deliver worked interventions to show proof of concept at test sites to engage internal and external partners.

Table 4.4 Potential providers, buyers and intermediaries for Dane Park PES

	Potential provider	Potential Buyer	Intermediary	Providing Expertise
WATER QUALITY 	HCC (public realm, Schools) Community groups (ponds)	Yorkshire Water Services (YWS) on behalf of water customers	HCC	Environment Agency (EA), YWS and engineers
FLOOD RISK 	HCC, EA, Schools, Community groups	YWS on behalf of its customers; Hull City Council and RSLs for social housing, private insurance buyers	Land Trust	EA, YWS and engineers
CO2 & CLIMATE REGULATION 	HCC (woodland in parkland, street trees, grassland) Yorkshire Wildlife Trust (YWT - woodlands)	Local businesses/ individuals for carbon offsets NHS (for Urban Heat Island effect)		Woodland Carbon (FC) , HEYWOODS
WILDLIFE 	YWT Community groups (ponds etc)	Conservation groups on behalf of members Businesses for biodiversity offsets	Hull and East Riding Local Nature Partnership	Natural England
RECREATION 	HCC and local recreation trust	User groups (e.g. anglers, football clubs, golfers)	Land Trust managing land on behalf of local trusts	HCC, Sustrans
LANDSCAPE & health 	HCC, EA, BTCV	HCC, NHS Health and Well Being Board	Groundwork	
OTHER: FOOD AND BIOMASS	Allotment holders, Community groups		Bransholme Green Enterprises, Latitude and Bude Allotments	HCC
EMPLOYMENT AND SOCIAL COHESION	Groundwork, Bransholme Green Enterprises, Latitude, other CSV	Individuals and community groups	Land Trust	HCC, Groundwork

Approaches to Defra pathfinder and EU Wild Cities funding have been influenced by the PES pilot project and have been designed to deliver potential flood risk and urban gardening outputs. Hull City Council and partners will also explore further funding opportunities such as Interreg or delivery of pilot installations through partnership funding including:

- Environment Agency /DCLG growth funds. The Chancellor's Autumn statement provided a stimulus for growth and Hull City Council intends to make the case for flood risk (green and blue) infrastructure to be eligible to bid for these funds.
- City Deal. Hull City Council is in the second tranche for this fund and the Corporate Director is preparing a bid which will include flood risk management and green infrastructure as part of Hull's Green City initiative.
- Environment Agency. Hull City Council is in discussion with the EA on a partnership funding approach which seeks to maximise the regeneration benefits of SuDS investments.

- Lancaster University – Hull City is working with the University on a project which will focus on the relationship between soil quality and urban food production which could take in the allotment and market gardening aspects of the PES. Several integrated plans need developing to maximise economic opportunities, job creation and a flood prevention/ landscape/woodlands sculpting the ground scape for the next 10 years.

In the longer run this PES would aim to become a 'many to many' layered PES, involving a range of different buyers for specific ES aspects.

Buyers for flood regulation services such as businesses downstream in the catchment who would benefit from reduced flood risks and reduced insurance premiums. Hull City Council is keen to work with groups of insurance companies and their clients to support and endorse approaches which may help others underwrite aspects of delivery and provide more affordable household insurance premiums and make sure that a larger proportion of households have coverage. Hull City Council has started discussions with a group of major insurance companies to explain the links between SuDS approaches and flood risk management, but it has not been possible to link outcomes to the pilot PES scheme within the timeframe of this research project.

Buyers for habitats for wildlife will include businesses in Hull and the Humber estuary involved in developments that involve biodiversity losses, who may be interested in compensating for onsite losses by biodiversity offsetting like approaches at designated receptor sites in the project area. This approach is being explored by the Humber Local Nature Park working with chemical companies on the south side of the Humber estuary and would also be of interest to Hull and East Riding LNP.

The Role for Intermediaries

Other organisations such as Yorkshire Wildlife Trust, Groundwork in Hull, Bransholme Green Enterprises and Latitude will also be involved in providing wider benefits such as employment and training schemes, food and biomass production. During the ongoing maintenance stage there is a potential role for the Land Trust to act as an intermediary in taking on long term management of the land, collecting payments, and working with the local community or social enterprises to manage some areas such as woodland, grassland, ponds and recreational facilities.

4.2.5 Next steps

The next steps in taking this integrated PES pilot forward are to undertake:

- More detailed discussions with YWS as a potential buyer based on the outcomes of catchment modelling;
- More detailed landscape and SuDS design work by Hull City Council and engineers to confirm areas where treatments will have the greatest surface water management benefits;
- More detailed mapping with local community consultation and involvement in design charettes to progress designs to the point at which they can be costed; and
- Joint bids between Hull City Council, the LNP and others for external funding for construction of phase 1 of the project.

4.3 STREET LEVEL SUDS: A SMALL SCALE FLOOD REGULATION LED PES

4.3.1 Overview

This is a very small scale Street level PES scheme applicable to residential streets in North Hull. The scheme has been designed on the basis of a typical street (Bainton Road in Orchard Park) of two bed owner occupied terraced housing but would also be applicable to typical socially rented housing in the area. Each house is slightly set back from the street with a front garden about 5 m wide by 4 m deep. Most houses have paved over their gardens with impermeable concrete for paths and hard standing for off-street parking. Front gardens give directly on to pavements with low curbs and tarmac road surfaces. House roofs drain to downpipes connected to combined sewers operated by Yorkshire Water Services (YWS). Drainage from front gardens, pavements and the roads is directly to the sewers with no street trees, grass verges or planting to intercept storm waters and reduce the rate of runoff. The case study street also includes a derelict greenspace earmarked for future development, with some biodiversity value but inaccessible to local residents.

Figure 4.4 Typical street scene and derelict grassland suitable for street level PES scheme

Modelling carried out by YWS during 2012 demonstrates that the sewers conveying storm water from these streets are likely to be compromised from more than a 1 in 30 storm event if there is no further investment in upgrading. This mini pilot PES scheme aims to encourage households to provide flood regulation as an ecosystem service to support the future aspirations of YWS.

4.3.2 Objectives of the pilot PES

The aim of this street level pilot is to manage the street scene and individual curtailments to reduce risks of surface water flooding while creating wider benefits to residents in terms of visual improvements to the street scene, water saving during summer and drought months, food production and enhanced wildlife and biodiversity. Improvements may add value to properties. There may also be opportunities for wider socio-economic benefits in the form of creating small business and employment and/or training opportunities in carrying out retrofitting works, similar to green deals for energy efficiency retrofitting. If successful this street level pilot approach could be replicated in many other streets across Hull City, and potentially in other flood prone areas.

4.3.3 ES to be provided

The proposed mini PES is focused primarily on provision of a single ecosystem service – flood regulation - by reducing the amount of rainwater entering combined sewers. A palette of six different treatments guaranteed to reduce volumes of surface water has so far been developed and is summarised in Table 4.5.

Table 4.5 Palette of possible treatments for individual building to deliver PES

PES activity		Description
Disconnect downpipe		Disconnecting a downpipe reduces the amount of rainwater sent into storm sewers and instead channels it onto the ground and into the soil. The rate of run-off for surfaces with grass is estimated to be 10-20%, compared to 60-70% for hard landscaped urban areas.This will provides savings to YWS in terms of both treatment costs avoided and reducing the need for new investment in upgrading capacity of existing sewer systems. Disconnecting a downpipe can be done easily by the homeowner, with materials and tools costing less than £20. The activity would also be suitable for community action (similar to a litter pick) or for trainees on work programmes or for local small businesses.
Water butts		Storm rainwater from downpipes can also be held above or below ground in water butts or storage tanks. During very heavy storms overflow will still need to be discharged to soil or the sewers. Stored water can be used later for watering gardens or washing cars. Costs are typically £25-35 for a basic 110L-210 L water butts with tap and a further £12 for a diverter kit (£12) to connect to the downpipe. Again this is an easy DIY job requiring a hacksaw and fittings available at any hardware stores which can be installed by house owners, community groups or small businesses.
Car space with permeable surface		Permeable pavement contains many small holes, allowing water to pass into the ground. It can be interlocking pavers or can be poured like regular concrete, great for driveways and sidewalks. Rainwater then seeps into the ground or is sent to a rain garden, swale, or infiltration trench along a road. The rate of run-off for surfaces with grass is estimated to be 10-20%, compared to 60-70% for hard landscaped urban areas.Typical costs for replacing a 90 sq ft area of concrete with permeable hard standing would be £65-350 for permeable concrete, £120-400 for grass/gravel and pavers and £300-600 for interlocking blocks. Additional costs would include breaking up and removing existing impermeable concrete surface. This is a larger job but could be suitable for a community, work programme or small building company. (see www.depave.org)
Soak away garden		A Rain Garden is a man-made depression in the ground that collects and stores runoff and is filled with particular plants that help filter and clean the water as it is allowed to seep into the ground. The rate of run-off for surfaces with grass and vegetation is estimated to be 10-20%, compared to 60-70% for hard landscaped urban areas. Street gardens near intersections and drain inlets allow runoff to enter a planter through a curb cut and filter through the soil. This treatment is suitable for both individual front gardens and greenspace around social housing to improve visual amenity and wildlife benefits (see www.raingardens.info)
Square metre garden		A mini allotment concept suitable for any site with 6-8 hours of sunshine, allowing leafy vegetables, root vegetables, fruits and herbs to be grown in small 1m2 beds ideal for a front garden. An easy DIY project requiring 4 pieces of timber (1m x 15 cm), mixed compost and soils and seeds. Can provide a family of 4 with fresh vegetables throughout the growing season and is also suitable for school and community gardens and allotments. Probe in Hull has developed this concept in East Hull. This is ideal for front gardens with disconnected downpipes or water butts and can be laid on a concrete or soil base. Flat back kits are available for about £50, DIY versions

		would cost less than £20 plus seeds and compost mix. (see www.growveg.com/square-foot-gardening.aspx or www.squaremetregardening.co.uk/)
Car port with Green roof		A simple car port with extensive green roof with a mix of sedum plans. DIY garage packages from suppliers such as Optigreen available at £35-40/m for the green layer plus perforated edge trim if required to apply to a simple shelter structure. Green roofs reduce surface water flow (and can tolerate short periods of saturation from heavy rains) and discharge to sewers, improve water quality and the micro climate (through evapo transpiration), provide shade and enhance wildlife habitats (birds, insects, bees). Assuming a 10 sq metre area DIY costs would be £350 for seeds/cuttings and £400 for an established matt including protective fleece layer, structured drainage board and substrate of about 60 mm depth. (see www.thegreenroofcentre.co.uk or www.livingroofs.org)

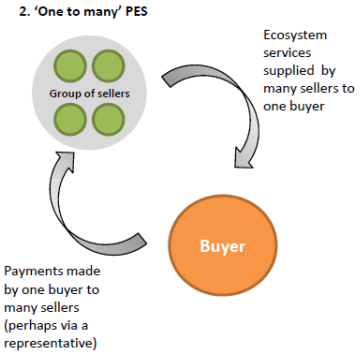
Table 4.6 Ecosystem services provided by the elements making up Dane Park PES

	Disconnect downpipes	Water butt	Permeable surface	Square metre garden	Soak away gardens	Car port with green roof
COST £	<£20	£25-50	£65-600/ depending on surface	£50-100	£100	Based on 5.5 x 2.4 m/car £450-600
FLOOD RISK 	✓	✓	✓	✓	✓	✓
CO2 & CLIMATE 		✓	✓	✓	✓	✓
WILDLIFE 				✓	✓	✓
RECREATION 				✓	✓	
LANDSCAPE 			✓	✓	✓	✓
OTHER: EMPLOYMENT	✓		✓	✓	✓	✓
WATER Quality 	✓	✓	✓	✓	✓	✓

Interested householders will be able to choose a treatment that best meets their needs and budget. The wider ESs – over and above flood regulation – that each option will provide is summarised in Table 4.6 above. These multiple ESs would be enjoyed by the individuals implementing the measures and by the wider community, but would not be traded through the PES scheme.

4.3.4 Key Characteristics of the pilot PES

PES Buyers and Sellers



This street level approach will be a 'one to many' scheme with a group of individual sellers on each street (or Hull City Council acting as their representative or a tenant's association for social housing) receiving payments in the form of a grant towards the cost of delivering one of a range of treatments from the SuDS palette. The results of modelling completed in December 2012 and initial discussions suggest that YWS may be interested in becoming the primary buyer of surface water saving treatments on behalf of their customers within the Hull and Haltemprice catchment. This PES would be akin to the approach already taken by water companies in providing low cost water saving devices (hippos, water efficient tap fittings, shower heads etc) to their customers and by the energy utilities in contributing to the costs of renewable energy retrofitting. If YWS were successfully in bidding to OFWAT as part of the PR14 water industry bid for reinvestment of water service charges, YWS would also effectively become a broker of a many (customers) to many (customers) scheme to suppress overall the costs by using natural infiltration processes.

There are potentially 4,930 terraced and semi detached houses in Orchard Park and Greenwood ward that would be eligible to participate, three quarters of which are owned by Hull City Council or RSLs. An initial budget of £100,000 would allow all of these properties to apply the lowest cost measure – disconnecting a downpipe, but resources could be applied to other treatments if a larger scale community or social enterprise approach was taken to delivery of SuDS treatments working with local third sector organisations such as Bransholme Green Enterprises and Groundwork. If successful the scheme could be extended to other suitable parts of Hull.

Intermediaries who could also be involved in the pilot PES include:

- **Engineers** involved in YWS and HCC flood risk modelling to identify the priority streets for early piloting, and quantifying the potential water savings from applying the different options in priority areas of Orchard Park and the potential investment and operational cost savings to YWS.

- **Hull City Council** could also act as an intermediary or 'honest broker' in a number of different roles:
  - holding PES funds on behalf of YWS and sellers. As intermediary the council could disburse grants to owners, occupiers or tenant groups that want to implement SuDS solutions and ensure that works are carried out to approved standards. This is analogous to the Green Deal role played by many LAs in facilitating retrofitting of energy efficiency measures to households on behalf of Energy utilities.
  - Working with intermediaries such as Groundwork to prepare leaflets with simple DIY instructions (see Annex C for an example on Disconnecting Downpipes) and creating lists of potential suppliers (e.g. for water butts, permeable pavements and green roofing etc) and social enterprise contractors able to carry out small works.

- Working with training providers and the voluntary sector to identify the scope for construction trainees (NEETs, ex offenders) and volunteers to work with community groups or vulnerable households to carry out more extensive works (such as 'depaving' ie breaking up concrete front yards or constructing shared communal car port with green roofs).

- **Local third sector organisations** such as Groundwork and Bransholme Green Enterprise within North Hull and PROBE Hull (who have particular experience in square metre gardening) will also be involved as intermediaries assisting YWS and the City council prepare communication materials and talk to individual households (door knocking) or organising local meetings to explain and promote the measures. In a similar way to current litter picking events, Groundwork could also help to organise working days in key street around particular SuDS treatments (e.g. disconnecting downpipes, building square metre mini allotments and soak away gardens).

4.3.5 Next steps

The next steps in further developing this PES pilot are:

- Hull City Council will hold ongoing discussions with YWS to assess the omplications of its PR14 modelling and the best way to make and present a business case to Ofwat, including any advice that might be required from Defra;
- Additional work by Hull City Council /Arup to refine the palette of options so that they are applicable to all housing types and modelling of the potential surface water savings and cost saving implications to YWS;
- Identifying the priority streets/blocks for early piloting within Orchard Park, based on potential benefits to sewers and streets which are scheduled for routine re-surfacing. In addition to household level treatments Hull City council will re-profile roads and pavements on key streets including replacing tarmac with permeable paving, kerbing, installing swales down the middle of roads and directing water flows to soak away gardens. Carrying out these works on streets requiring routine re-surfacing will help to minimise incremental costs.
- Development of a test bed site demonstrating the palette or options either at the vacant site identified on Bainton Road or at alternative site within Orchard Park. Space could also be allocated to trading of recycled materials (e.g. timber) and for sponsors and local small businesses to showcase their offers.
- Testing the approach in a small pilot area (a couple of streets or blocks) with the involvement of intermediaries. Some training will be required for local micro businesses and social enterprises interested in getting involved in SuDS installation. There will also be opportunities to work with local workshops and recycling projects for manufacturing square metre gardens of planters.
- Evaluation of the take up and lessons learnt from the pilot.
- Roll out of the scheme wider across Orchard Park and other areas of the city.

At this stage it would be useful to develop a web based tool and smart phone app similar to the Green Box Stormwater[2] calculator in the US which would help households, businesses and schools

[2] http://logan.cnt.org/calculator/calculator.php which allows calculation of how different stormwater management treatments reduce run off and impact on costs

to identify opportunities and the best options for their situation, including step by step guides, planting suggestions and costs. At the roll out stage the PES scheme will look to work with additional sponsors such as a construction materials supply company (e.g. Marshalls), Hull Green City initiative and local businesses such as Siemens and local supermarkets.

5. CONCLUSIONS AND LESSONS LEARNT

5.1 CONCLUSIONS

5.1.1 Project context

This research pilot was designed in December 2011 to build on a number of processes which had been identified as providing opportunities for developing a PES pilot. During the course of the pilot circumstances have changed significantly with a number of key processes having major impacts on the design of the pilot:

- Building Schools for the Future (BSF) in Hull, which in late 2011 had a substantial allocation for greenspace investment and could have provided the basis for capital costs of a multi-layered PES project, experienced significant budget cuts in 2012 and was not able to participate in the PES pilot;
- The EA/HCC/ERYC so called 'aqua green' flood alleviation project around Cottingham was expected to identify opportunities for large scale SuDS approaches to flood alleviation which could form the basis of the PES scheme: modelling during 2012 demonstrated that engineering works higher in the catchment could address some of the flood risk issues and investment in green space in Northern Hull and the incentive to participate in a pilot PES scheme has been removed;
- Yorkshire Water modelling of the Sewage system for its future investment in increased capacity has taken longer than initially expected to report and was not completed until the end of December. However, the results of modelling have shown a justification and interest in further investigating PES approaches.

It has therefore proved necessary to adapt the proposed pilot to changed circumstances and to accommodate delays in information availability or decision points. As a result it has not been possible to progress a PES scheme to the point of implementation within the 12 month period, but Hull City Council remains committed to taking forward the two PES proposals developed within the pilot and dovetailing them with new decision making processes and funding opportunities as they emerge.

5.1.2 Achieving pilot study aims

Despite the changing project context the pilot has broadly achieved its three research aims:

- **Identifying how green and blue space currently delivers ES** to its residents and identifying opportunities for how ESs could be enhanced for the wider community benefit in the future.
- **Identifying community and local business preferences** for enhanced ES delivery including regulation (flood alleviation, climate, air quality and water), provisioning (food, biomass), cultural (recreation, landscape and health benefits) and supporting services (biodiversity) – although for reasons described below stakeholder engagement has been mainly through representative organisations rather than with individual community members;
- **Designing a sustainable mechanism for providers to deliver flood risk management measures and for beneficiaries to pay them**. The research has been a catalyst for the development of two

proposed PES approaches at a wider area and very local scale. As described below these PES are not yet at the implementation stage but there is a commitment amongst partners to take them forward in tandem with locally important processes and funding opportunities.

5.1.3 Research outcomes

The PES pilot project has produced outcomes with policy relevance at several levels:

- **Locally:** the two proposed PES schemes are tailored to meet local needs and opportunities. The Dane Park proposed PES is very specific to the characteristics of the local area and its environmental, social and economic needs. The street level PES has been designed with the characteristics of typical streets in Orchard Park in mind, but would also be relevant to other flood-prone areas of the city.
- **Sub-regionally**: as noted above the HCC/ERYC/EA 'Aqua Green' proposal to Defra/DCLG no longer provides a relevant opportunity for the PES pilots but the street level approach, if successful, could also be applied by Yorkshire Water to other towns and neighbourhoods where they are facing limited capacity in combined sewers and will face high investment costs to meet future flood risks.
- **Nationally**: the team have taken part in events organised by the EKN and shared lessons with other PES pilots. The emerging lessons have also been shared with other national stakeholders such as the network of Local Nature Partnerships through the ongoing Defra Evaluation process of LNPs and with the TUC representative to the Green Economy Council.

5.2 LESSONS LEARNT

5.2.1 ES and PES Concepts

Applicability to Urban Areas

The literature review has highlighted the importance of urban sub-habitats in providing multiple ESs. In most urban areas deterioration in habitats opens up many opportunities for increasing ES delivery through better management, better connectivity and increased areas of green and blue space. The PES best practice guide suggests that the greatest opportunities are in providing recreation, water quality, flood regulation, recreation, landscape and habitat for wildlife which will often be provided as a bundle by each hectare of improved habitat. This small group of ESs has been used as the basis for identifying existing ES provision and future opportunities in North Hull.

However , compared to rural areas and lessons from established PESs many of which focus on water quality improvements, there is so far limited evidence on the quantitative relationship between sub-habitat management and ESs delivered. There is even less valuation data which could be used as the basis for an output-based (valuation of services delivered) PES approach, although the literature on the economic and social contribution made by urban green infrastructure or greenspace in general and woodlands in particular is growing.

Flooding regulation is the exception – there is plentiful data on the economic benefits of flood risk reduction in the literature (based on damage costs avoided techniques) and also information on the

efficacy and costs of delivering sustainable drainage treatments from practical implementation in the UK, Netherlands and the US. This is the most significant ES to which a value can be attached in the project area. Based on Hull City Council's Surface Water Management Plan a 1 in 100 year event would potentially affect 1,644 properties of which 1,200 would be affected by shallow flooding (0.15-0.3m), 390 by medium level flooding (0.3m-0.6m) and 54 by severe flooding (>0.6m). Based on HM Treasury agreed damage costs per property of £26k, £29K and £31k for low, medium and severe flood damage costs respectively, this implies damage costs for Orchard Park and Greenwood would be about £44.2 mn. The pilot PES scheme has therefore been focused on flood regulation through a wide range of Sustainable Drainage (SuDS) improvements to urban sub-habitats. SuDS approaches also deliver a package of wider ES benefits – particularly recreation, habitat for wildlife, landscape and health benefits and climate regulation.

Ideally a PES scheme would try to capture the costs avoided by flood prone households and businesses as payments to a single provider – such as the Local Authority – able to deliver SuDS treatments to alleviate their flood risks. However the land ownership and management in urban areas is complex (and includes peri-urban farmers, businesses, and schools, those with gardens or allotments as well as the Local Authority) who all need to be involved in ES delivery. It is also less likely that there will be a single primary buyer than in rural areas. Instead there may be secondary buyers such as water utilities, insurance companies or NGOs willing to buy a single ES such as water quality, flood regulation, biodiversity or angling on behalf of their clients/members or a tertiary buyer – such as the Local Authority or an LEP – that could buy ESs on behalf of its communities.

While ideally multiple ESs in urban areas would be sold as layers to each of the interested buyers, in practice the complexity means it will be much more practical for a secondary buyer (eg a water company) or a tertiary buyer – such as Local Government – to buy a key ES such as flood regulation on behalf of residents, while other beneficiaries such as community groups, businesses, government agencies piggy back on this arrangement but contribute to the delivery of the project in whatever ways prove practical.

The two pilot PES schemes developed during the study are both based on this piggy backing approach, although the larger scale scheme could develop as a layered scheme in the future as the ESs delivered by Dane Park become easier to quantify and value in monetary terms.

Making ES / PES concepts understandable

The pilot study has shown that ES/PES concepts can be easily understood by interested stakeholders within the task group and local experts and community representatives. In the workshop event and development of materials on SuDS approaches a conscious effort has been made to use accessible language, visuals and icons to represent key ESs and the language of 'wider values of greenspace and natural areas' has been used wherever possible. Avoiding the ES jargon has made it easy to communicate the potential benefits of ES/SuDS concepts and approaches to those without a technical background. The one page descriptions of different landscape treatments and SuDS measures proved a useful discussion tool for the workshops and have since been further developed as a palette of available treatments (see Annex C).

Communicating ES/PES schemes

Hull CC and EA's experience of involving the wider public in awareness raising events on managing flood risk has shown that even those who were badly flooded during 2007 now have very limited interest or capacity to be actively involved in discussions about preventing flooding and although flood risk management is the primary purpose of both pilot PESs, we have underplayed the flooding issue of the proposed PES schemes and concentrated on promoting the multiple wider benefits that better managed SuDS greenspace or property frontages will provide. Participants in the discussions and design charette had a greater interest in the cultural ESs which would be delivered from the schemes – such as recreation, a new image for the area and visual amenity – than the flood aspects per se.

5.2.2 Engaging ES providers/sellers

The study area experiences a complex combination of surface water flood risks, socio economic deprivation (low income, poor employment and skills opportunities, and ill health) and limited access to high quality greenspace.

Flood regulation is the overriding need for ES enhancement. Some 16% of properties (885) were affected by flood risk in 2007. 1644 properties in Orchard Park and some 4500 properties across the city are still considered at flood risk from similar events. However, given high levels of unemployment, low incomes and low property values, it is clear that individual households are not currently able or willing to pay directly for a user-financed PES Scheme. Likewise, businesses that may be interested in contributing to a PES in the longer term – downstream flood prone businesses, developers and the manufacturing sector – are not currently in a position to participate because of the economic recession. This pilot scheme has therefore focused on options for public payment based PES schemes.

In the current economic climate the layered PES approach of getting the most out of assets and delivering multiple benefits from carefully designed interventions has a real appeal to local government departments, Defra agencies and third sector organisations facing budget cuts. The large scale integrated PES scheme proposed for Dane Park would bring together multiple partners in a 'Total Environment' style package where local government and partners could work together to make sure that the resources they spend on one locality are optimised to achieve each organisations' objectives but with greater benefits for the area as a whole. While this is not a PES approach in its strictest sense this pragmatic approach would bring together multiple sellers and multiple buyers in a piggy back scheme with scope to evolve into a layered scheme with multiple sellers and buyers in due course. There are precedents for this approach in Total Environment pilots around the country.

Project partners HCC, EA and YWS are committed to working together on the next phase of the larger scale and street level PES to deliver different aspects of the scheme and bring in other 'buyers' in the form of grant and funding pots as the scheme develops. At the mini PES level the willingness of householders to supply street level PES still needs to be tested as the pilot PES is rolled out. Willingness to participate will be one of the key criteria for identifying the streets or housing areas where the pilot scheme is initially tested.

5.2.3 Engaging PES buyers

Businesses

At the early stages of this pilot the hypothesis was that businesses would be amongst the potential buyers for a flood alleviation focused PES. The assumption was that businesses might benefit from and therefore buy different aspects of a PES including:

- businesses downstream in the catchment, who would benefit from reduced flood risk and reduced insurance premiums;
- housing developers who could contribute to off-site SuDS measures to meet their obligations under the planning system using S106 payments or a Community Infrastructure Levy (CIL) as a payment mechanism;
- businesses along the Humber estuary, who might be required to offset any biodiversity losses from expansion activities and would be prepared to pay for sub-habitat creation at receptor sites in the project area as a form of biodiversity offsetting; and
- The water company who might be prepared to pay for land use or other SuDS measures to avoid the need for investment in upgrading sewer capacity and reduce the costs of treating storm water at their downstream treatment plants.

In the context of the ongoing economic recession and total lack of new development activity in Hull it has proved very difficult to engage with local businesses or insurance companies. Yorkshire Water Services has proved to be the only potential business buyer for either the large scale or street level PES schemes. However, project partners still hope that if they are able to implement the proposed PES schemes that some or all of these buyers might become involved in the schemes in the future.

Households

One of the premises of the pilot was that households that had experienced extreme flooding during 2007 would be interested in either providing or buying ESs that helped reduced their future risks. Extrapolating WTP values from an RPA and FHRC study (2004) would imply that affected households in Orchard Park might be willing to pay £0.33 mn pa equivalent to a present value sum of £8.2 mn over 50 years for SuDS approaches which avoid flood risk. However, a large proportion of these households in the study area were found to be particularly vulnerable and up to 65% of households may have no insurance cover or the ability to pay premiums.

The street level PES project has therefore helped to identify a palette of different treatments ranging from very low cost measures (less than £20 to disconnect a downpipe) up to £600 (for a car port with a green roof) which would provide immediate wider ES benefits to householders who invest in them and flood regulation benefits to other flood prone households downstream. However, given the very high levels of unemployment and benefit dependency in the Orchard Park area it is very unlikely households will be willing to prioritise what may be perceived as cosmetic investment unless they received a grant to do so. This will be tested in the next stage of the work carried out by Hull City Council with YWS which will further develop the palette of treatments and test interest amongst householders. The next stage will therefore focus on working with YWS as a potential buyer of the PES and develop grants for the lower cost treatments such as disconnecting downpipes, fitting water butts and repaving front yards, working in close cooperation with Hull City Council.

5.2.4 Importance of stakeholder participation

Stakeholder participation has been an important element of the project through:

- A task group which brought together a number of different departments in Hull City Council and local organisations with a real enthusiasm for applying the PES concept to environmental management and regeneration in the city. The group has steered the pilot and added real value. The group helped to define the initial scope, identify challenges and opportunities, provide data and information, test concepts and language and shape the proposed PES schemes. However, the time implications for arranging and convening steering group meetings needs to be fully reflected in project design and the time implications for the project fully understood.

- The "HU6 Whatever the Weather" design workshop was a real success in bringing together a group of professionals from different disciplines and representatives of third sector organisations working in North Hull. The workshop generated some exciting design ideas for multi functional greenspace and street level treatments for reducing surface water run-off which underlie the proposed PES schemes.

However, in the current economic climate it proved very difficult to get any business interest at this conceptual stage and the steering group agreed it was also too early to involve individual members of the public in any meaningful way. Wider communication of the PES idea and testing of the specific proposals will therefore be undertaken by HCC and Groundwork in relation to the street level PES once the offering has been further refined and it is clear whether grants will be available from YWS.

5.2.5 Timing

The pilot project design was ambitious in hoping that the pilot would be able to progress from the very early concept of an urban PES through to implementation within the research project time scale. This has not proved possible because of the number of potential ESs, providers and sellers involved and the need to remain flexible and work opportunistically with evolving information gathering and strategic decision making processes which could eventually contribute to a successful PES. As noted above many of the processes that seemed important at the outset of the project have either halted due to worsening economic conditions or proved much slower than expected. Ideally the pilot would have been carried out in the wake of EA and YWS modelling results being completed before designing the PES pilot, which could then have progressed more quickly.

However, given the pilot research timeframe the team has continually adapted proposed PES designs to anticipate emerging opportunities and this has illustrated the need for an adaptive management approach. In other circumstances PES design and implementation will not be timebound and it is important to recognise that complex PESs need time to fit with local processes and decision cycles, with the ability to evolve over time if they are to be successful in urban settings.

This pilot stage has framed two potential PES schemes and acted as a catalyst for further action by HCC and partners but it has not proved possible to get a practical PES scheme off the ground within the 12 month timeframe. Implementation is likely to take some years and will now be partly

dependent on whether YWS is successful in its bid to Ofwat to increase prices for customers to address the special flood situation in Hull. It will also depend on whether Hull City Council and partners are able to make a successful bid(s) for development funds for Dane Park. However, project partners remain committed to taking one or both of the pilot PES schemes forward.

Annex A: Socio Economic Profile of the Study Area

Unemployment and income

Hull has a working age population of about 180,000 of which around 14.5% were unemployed in 2010. In Orchard Park unemployment is 50% higher than the rest of the city and local rates are probably now approaching 20%. There are no major local manufacturing or retail employers. The city as a whole suffers from high levels of benefit dependency with 22.6% of the working population (40,450 individuals) claiming benefits (February 2010) compared with 14.7% nationally and over 8% of the workforce on ESA and Incapacity Benefit. In Orchard Park benefit dependency is even higher with a number of families experiencing third generation unemployment. Average income across the city falls are amongst the lowest 10 of English Local Authorities. The median weekly residence based pay in Hull is £407.70 (2009) only 82% of the national average: in Orchard Park and Greenwood incomes are lower still. Opportunities to create social enterprises and small businesses involved with greenspace management could make a small but significant contribution to tackling unemployment and income deprivation in the study area.

Skills, Training and Education and Anti Social Behaviour

Hull suffers from a poor skills profile in the working age population: although NVQ 20% of the workforce now has NVQ4 or higher, this is still well below the national average of 30% and nearly 20% of the population still has no formal qualifications (compared with only 12% in England). In Orchard Park and Greenwood the skills profile is worse still with nearly 60% of 16-74 year olds in 2001 having no formal qualifications – twice the UK average and even in 2009 the percentage of young people aged 16 to 18 classed as 'not in education, employment or training' (NEET) across Hull was 11%. At that time this represented a significant improvement compared to 2001 (with 17% NEETs) but this figure is likely to have risen again in the last few years in the study area.

Across Hull total recorded crime has fallen rapidly but at 120.2 recorded crimes per 1,000 population in 2009/10, the rate is still significantly above the regional (83) and national (79) figures.

In 2009 76% of primary pupils in Hull achieved a Level 4 + in English and Maths at Key Stage 2 (compared to 80% for English and 79% of maths nationally) while 37% of 16 year olds achieved 5+ GCSEs A*-C including English and mathematics. While this is still low nationally it represents much faster than average improvement in Hull.

Within the study area the Building Schools for the Future redevelopment of Thomas Ferens Academy is an opportunity to continue with improvements in GCSE attainment, involve the local community in extended schools programmes and maximise the educational benefits of better management of greenspace and local food growing opportunities. Opportunities to involve vulnerable people and those at risk of exclusion in skills development and training in managing greenspace and horticulture could have real social and economic benefits.

Health

Life expectancy in Hull has been consistently lower than regional and national averages since 1998. Despite improvements over recent years and a narrowing gap between males and females, average mortality in the three years to 2008 was almost three years below the national average for both males (75 years) and females (79.5). Hull 2007 health and lifestyle survey, conducted by the Primary Care Trust, estimated the percentage of the population in Hull whose activities are limited by a long term illness or disability at 23.4 per cent. The survey also suggests that 4.6 per cent of residents self report poor health and 25.5 per cent experience poor mental health. In the study area the 2001 census showed that 24% of the population had a long term limiting illness or disability, 11.9% reported their health as 'not good' (cf to 9% in England) and 11.9% of the population were economically inactive due to poor health. Any initiatives which can help to encourage a larger

percentage of the population to take more active exercise could help to combat cardio-vascular, respiratory diseases and diabetes and encourage more healthy lifestyles.

Housing

In Orchard Park there are some 5,800 properties on the council tax register of which less than 20% are owner occupied: the vast majority (72.5%) of households live in council and social landlord rented accommodation – more than twice the Hull average and 3.5 times the England average. Housing is predominantly terraced (62%) or semi-detached (23%), but includes a few tower blocks earmarked for demolition. Some 98% of the housing stock is in Council Tax band A (compared to only 25% nationally) with the remainder mostly in Band B. Large areas of housing stock would benefit from improvement but large scale renewal is unlikely to proceed in the next few years.

Extent of deprivation in the study area, by ward, 2004 and 2007

	IMD 2007				IMD 2004		
	Index Score	Local rank (out of 23)	National rank (out of 7,932)	National percentile	Index Score	Local rank (out of 23)	National rank (out of 7,932)
Orchard Park & Greenwood	66	2	23	1	66.8	2	28
Beverley	16.9	21	3355	42	18.7	23	2842
University	34.1	11	934	12	37.5	11	699

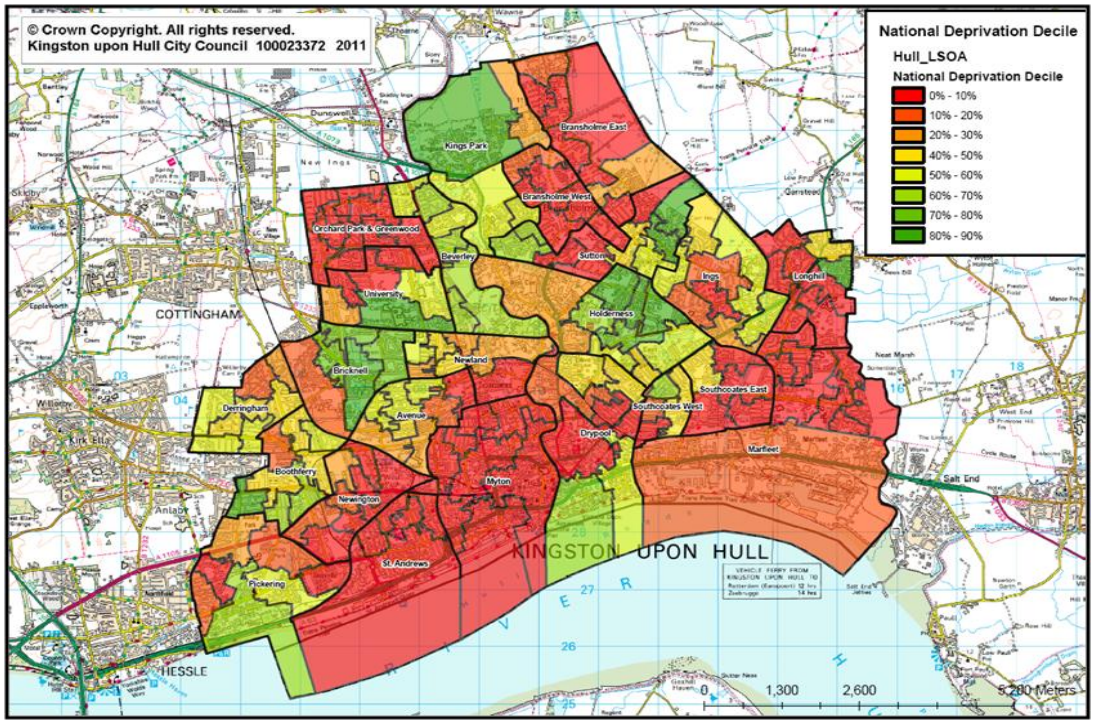
Source: ONS

Key socio economic characteristics of the Orchard Park and Greenwood Ward

	Orchard Park and Greenwood	Hull city	UK
Population	13,999	243,589	
Total households	5,791	104,288	
% considering themselves not in good health	13.7%	11.2%	
% with long term limiting illness	24.3%	20.7%	
% Unemployment (16-74 year olds)	9.6%	6.2%	
Economically inactive (permanently sick)	11.9%	7.4%	
Economically inactive (other)	6.2%	4.0%	
• **Housing tenure: Owner occupied (outright, mortgage, shared ownership)**	19.53%	52.15%	68.72%
• **Social rented (LA, Housing Association, RSL)**	72.50%	33.23%	19.26%
• **Rented privately**	7.97%	14.62%	12.02%

Source: ONS Neighbourhood Statistics and Hull City Council Database

Multiple Deprivation in Hull, 2007



Annex B "HU6 – whatever the weather workshop"
(Hull Pilot PES scheme workshop)

18th September, Orchard Centre, Hull HU6

Participants: Mike Dearing (Thorpe's Residents Association), Nick Middleton (Hull and East Riding Community Foundation), David Raynor (Architect), Mark Hodson (architect), Sue Rahman (HCC area team); Diana Brown (Groundwork); Steve Fraser (Groundwork), Martin Budd (HCC); Andy Wilson (HCC). Apologies: Jeannie Webster (Rainbow gardens); Steve Smith; Dennis Wood (Unity in the Community)

Facilitators: Lead facilitator. Richard Scott (facilitator), architect and landscape design champion for Hull Building Schools for the Future. Steve Wragg (HCC), Karen Tozer (Groundwork in Hull), Anna MacGillivray (URSUS).

Annex C
Palette of Potential Treatments for SuDS for Orchard Park Pilot PES

MEADOW GRASSLAND


What is it?

Informal grassland designed for less used areas of urban parks. The grass is only cut once a year using a forage harvester/cutter bar and baler so cuttings can be removed. Path edges are trimmed and obstructions strimmed around. Compared to amenity grassland meadow grassland requires much lower frequency of litter collection and requires only foot worn or mown paths rather than hard surface.

What does it cost?

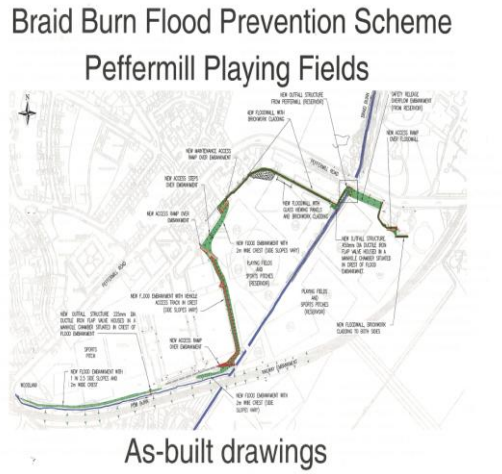
Average Annual costs (£/ha) – (Based on a 1 ha site (50 X 200m) with a suitable path going through)		
Years 1-4 (establishment	Years 5-9	Years 10-50
£710	£630	£710

Source: Trees or Turf? Best Value In Managing Urban Green Space – a report prepared for the Woodland Trust by Land Use Consultants (2011)

What are the wider benefits?

WATER QUALITY 	Improved vegetation cover and soils can filter pollutants and improve water quality
FLOOD RISK MANAGEMENT 	Flood prevention – slower surface water run-off than amenity grassland due to less hard paths and compacted soil
HABITAT FOR WILDLIFE 	Biodiversity – a species rich sward can encourage the growth of less vigorous grasses and wild flowers and provide valuable habitats for wildlife.
RECREATION 	Recreation – less public use than for amenity grassland, mainly walking and dog walking
LANDSCAPE & AMENITY 	Visual – generally considered more attractive than amenity grassland
OTHER: EMPLOYMENT	Local employment, skills and volunteering opportunities

AQUA SPORTS PITCHES



What it is?

Multi use play areas/sports fields designed within a Sustainable Urban Drainage (SUDS) scheme designed to act as a retention and/or infiltration basin. While the pitches will normally be dry during heavy rainfall they are used to store water for a short time and so they fill with water. This approach is particularly suited to clayey soils as in North Hull. This approach is being considered in a number of areas across Scotland particularly in sites where pitches are already prone to regular flooding.

What does it cost?

Ongoing maintenance of basins is relatively straightforward for landscape contractors and typically there is only a small amount of extra work compared to maintaining amenity grassland mowed about 15X year (£1,620-2,280/ha) such as management of control structures. More intensive maintenance works such as silt removal is only required intermittently. Post flooding the re-establishment costs may be much higher.

Wider benefits

WATER QUALITY 	Basins remove some pollution from rainwater runoff but still require source control upstream to operate most effectively.
FLOOD RISK MANAGEMENT 	Large shallow depressions can potentially provide relatively large areas of storage. During heavy rainfall the water level rises slowly. Afterwards the water level drops slowly as the water flows out of the basin into a nearby watercourse or sewer.
HABITAT FOR WILDLIFE 	Can incorporate local areas of wetland depending on the design. Should retain all native trees and vegetation but planting should be designed to be tolerant to up to 1m inundation for up to 48 hours. Planting to improve ecology can actually make basins more effective by slowing down flows and keeping the soil free draining.
RECREATION 	Opportunities for pond dipping, fishing, walking, cycling, running etc enhanced around ponds compared to flat amenity greenspace.
LANDSCAPE & AMENITY 	Should be designed to provide attractive landscape which is not just vast expanse of flat grassland

DISCONNECTING DOWNPIPES

What it is?

Typically storm water downpipes are connected to combined sewers which also take sanitary waste taken to a sewage treatment plant for treatment. But typically, storm water is relatively clean only picked up a slight amount of sediment from the roof, front gardens or pavements and does not require expensive treatment. Disconnecting downpipes allows water to filter naturally through the soil or a soak away garden or to a water butt. This provides savings to the operators of the sewage system both in terms of treatment costs avoided and avoiding new investment in upgrading capacity of existing sewer systems.

What does it Cost

This can be carried out very cheaply as a DIY job requiring a hacksaw, a plastic elbow and extension pipe and cap for the disconnected sewer. Total costs are estimated at less than £20/downpipe. The only maintenance required is to clean gutters and downpipes twice annually to keep them clear of leaves and debris. Installing leaf guards and filters will make this easier, but will add to the initial costs.

Wider benefits

WATER QUALITY 	Soil is a very effective treatment system for water containing organic materials.
FLOOD 	Reduces storm runoff to sewers so avoiding risks of drain back up and flooding in areas downstream where combined sewers are at full capacity.
HABITAT FOR WILDLIFE 	Sending water back to the soil recharges the groundwater system and nourishes plants
LANDSCAPE & AMENITY 	No negative impacts on street scene
OTHER: EMPLOYMENT	Opportunities for employment for local contractors or for a social enterprise or training scheme (e.g. the Work Programme)

RAIN GARDENS and SOAKAWAY GARDENS



What is it?

A Rain Garden is a man-made depression in the ground that collects and stores runoff and is filled with particular plants that help filter and clean the water as it is allowed to seep into the ground. Street gardens near intersections and drain inlets allow runoff to enter a planter through a curb cut and filter through the soil. Soak away gardens are being developed as part of Islington Councils SuDS strategy.

What does it Cost?

Rain gardens in car parks in the US estimated at £8,500 - considerably cheaper than conventional storm water techniques for car parks which would have cost £35,200.

Wider Benefits

WATER QUALITY 	Positive impacts on water availability, especially during summer and periods of drought.
FLOOD RISK MANAGEMENT 	A form of source control designed to manage rainfall close to where it hits the ground instead of allowing it to become a problem elsewhere. Most frequent rainfall events simply soak into the ground and extreme events are stored in the basin before being allowed back into the sewer at much reduced rates.
HABITAT FOR WILDLIFE 	Considerable improvement depending particularly where planting is based on native species, tolerant to flooding.
RECREATION 	Provides attractive landscaping within new housing or developments or retrofitted with existing housing areas
LANDSCAPE & AMENITY 	Can provide real improvement to the appearance of buildings and street scene
OTHER	Could potentially reduce drainage charges and water bills for households or for the council. Soils - added benefit in areas with clay soils is the reduction in the drying out and shrinkage of soils caused by trees, so minimising the risks of subsidence

WATER BUTTS



What it is

Water Butts store rainwater from roof drainage and are applicable for domestic properties and schools. The Environment Agency estimates that up to 90% of semi and detached properties and 45% of terraced houses can potentially fit them. Not applicable to flats but could be applicable for up to 1,500 detached/semi-detached and 1630 terraced properties in North Hull.

What does it Cost?

Plastic water butts cost from £25 for a 110L standard to about £35 for a 210L standard butt and most come with taps pre-fitted. More decorative water butts e.g. in wood or wall mounted can cost several hundred pounds. Grey water recycling tanks which take grey water from baths and can be considerably more expensive costing several hundred pounds. A diverter kit is about £25. Maintenance costs for plastic butts are very low.

Wider Benefits

WATER QUALITY 	Positive impacts on water availability, especially during summer and periods of drought.
FLOOD RISK MANAGEMENT 	Reduces water runoff and source and therefore reduces surface water run-off during flood events. However, benefits are likely to be reduced during prolonged storm events as butts are likely to already be full and excess will discharge to sewers.
OTHER: EMPLOYMENT	Could potentially reduce drainage charges and water bills for households or for the council.

GREEN ROOFS FOR BUILDINGS AND GARAGES



What is it?

Extensive (sedum) or intensive (sedum and wildflower) green roof cover for flat roofs. Green roofs have a thin layer of soil like material known as substrate that is planted to meet the specific c visual and biodiversity requirements of the roof and location. They are applicable to domestic and non domestic buildings, garages and sheds with flat roofs or gently sloping roofs. Green roofs are generally more suited to new buildings but can be retrofitted to extensions or during renovation of flat roofs.

Costs

DIY green roofing is available as a 3 layer mat which can be laid very simply on a suitably strengthened flat or gently inclining roof. Mats include a layer to protect roof surface from roots, substrate and soils and may include seeds and cuttings which will take 18 months to establish or pre-grown. DIY kits for carports or garden buildings range in cost from £35 to £45 Sq metre.

Wider Benefits

WATER QUALITY 	Green roofs help reduce water pollution from runoff in urbanized areas by absorbing and cleaning rainwater
FLOOD RISK MANAGEMENT 	Green roofs are very effective as part of a SUDS system, retaining water even during heavy rainfall and helping to reduce the volume of ground level storage required.
CO2 & CLIMATE 	Reduce extremes of temperature and humidity and can help to create a micro-climate and provide shade during the summer. Also improves thermal efficiency (so reducing energy & CO2 emissions) and prolong roof life
HABITAT FOR WILDLIFE 	Simple sedum mats offer the least biodiversity but will still provide improved habitat compared to concrete hard standing or conventional flat roofs providing habitat for bees, birds and insects.
LANDSCAPE & AMENITY 	Carefully chosen designs could add visual interest to the street scene.
OTHER	Employment opportunities for local contractors or for a social enterprise or training scheme (e.g. the Work Programme).

PERMEABLE PATHWAYS and PAVEMENTS

Resources: www.depave.org Greenspace Scotland Car parks

What is it?

Use of permeable paving instead of concrete or impervious bitumen. Permeable pavements can be used in driveways, parking areas and some roads. They allow water to soak through the surface into the gravel sub-base below. There are a variety of surfacing materials available. The most common are concrete or clay permeable block paving. Other surfaces include porous asphalt, reinforced grass and gravel. It is now law in England that new and refurbished driveways in front gardens must be constructed using permeable surfaces, otherwise planning permission will be required for the construction.

What does it Cost?

Making parking areas permeable and linking them to sustainable drainage will have significant capital costs and, unless there is an urgent need to address flooding, will probably need to be approached on a site by site basis as maintenance and repair is required (usually every 20-40 years). This approach could be applicable to 50% of off-road hard standing according to the Environment Agency. Comparative initial costs of different parking surfaces per sq ft installed (adapted from New York State[1])

- Conventional Asphalt £0.30-60
- Permeable Concrete £0.70-3.85
- Grass/Gravel Pavers £1.30-4.30
- Interlocking Concrete Blocks £3.30-6.70

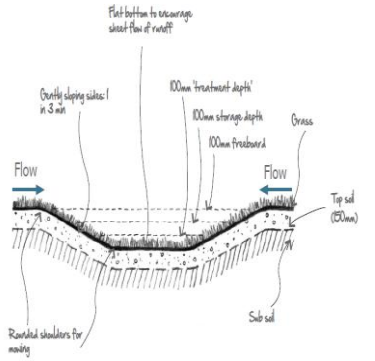
Wider Benefits

WATER QUALITY 	Permeable pavements are very effective at controlling the flow of water and removing pollution from it.
FLOOD RISK MANAGEMENT 	A form of source control designed to manage rainfall close to where it hits the ground instead of allowing it to become a problem elsewhere. Permeable surfaces can temporarily hold the water before allowing it to either soak into the ground or pass to an outfall, often to another SUDS feature such as a swale
CO2 & CLIMATE 	Can reduced the Urban Heat Island (UHI) effect relative to black top surfaces

[1] New York State Storm water Design Manual: www.rpi.edu/~kilduff /Storm water/ permpaving1.pdf.

HABITAT FOR WILDLIFE 	Improvement where surrounded by tree and shrub planting designed to provide biodiversity benefits, by planting appropriate species, and to link to woodland areas elsewhere in the park.
LANDSCAPE & AMENITY 	Carefully chosen designs could add visual interest to the street scene.
OTHER: EMPLOYMENT	Opportunities for employment for local contractors or for a social enterprise or training scheme (e.g. the Work Programme).

SWALES and FILTER STRIPS




Cross section of a swale, swale in a residential area, children playing in a swale at Red hill primary school, Worcester.

What is it?

A swale or bioswale is a broad, shallow channel with a dense stand of vegetation covering the side slops and bottoms used to collect and/or move water and also remove pollution from it. They are used in lieu of curbs and gutters in low density development. Swales can be covered in grass or other vegetation and have shallow side slopes and a flat bottom which means that for most of the time the water flows in a thin layer through the grass or other vegetation. Filter strips are gently sloping areas of grass that water flows onto and across, usually towards a swale or filter drain. The main purpose of the filter strip is to remove any silt in the water so that it does not clog up the swale or filter drain.

What it costs

Maintenance of swales and filter strips is relatively straight forward for landscape contractors and typically there is only a small amount of extra work required over and above that required for any open space. More intensive maintenance work such as silt and/or vegetation removal is only required intermittently but it should be planned to be sympathetic to wildlife requirements.

Wider benefits

WATER QUALITY 	The vegetation filters pollution and particulates and increase groundwater recharge.
FLOOD RISK MANAGEMENT 	Slows water to reduce flood risk and maximise infiltration to groundwater.
CO2 & CLIMATE 	Can reduce the Urban Heat Island (UHI) effect relative to black top surfaces.
HABITAT FOR WILDLIFE 	Design should respect existing trees and their root systems and planting should be with native margin species tolerant to different water levels and some pollution. Good for amphibians, invertebrates such as dragon flies. Provide opportunities to contribute to local and regional Biodiversity Action Plans e.g. by linking to existing wildlife corridors.
RECREATION 	Well designed swales in housing and around schools provide play areas when swales are dry and visual amenity.

LANDSCAPE & AMENITY 	Swales can provide attractive landscaping for new and existing housing developments.
OTHER: EMPLOYMENT	Opportunities for employment for local contractors or for a social enterprise or training scheme (e.g. the Work Programme) in long term maintenance of grass areas.

PONDS and WETLANDS



Whitwood Balancing Pond, Wakefield and Sandfield Park, Lancashire (Pond Conservation)

What it is?

Park ponds and wetlands can provide elements of the sustainable urban drainage (SUDS) both for a park and neighbouring housing, roads and driveways. This may involve engineering SUDS to use existing ponds – which may need naturalising – or creating new ponds in places where they can slow down and retain any water flows on site as long as possible. Careful design (e.g. with undulating bottoms so that some areas of deep water remain even in dry periods) and planting around the margins can maximise wider benefits.

What it costs?

Likely to involve earth moving, import of aggregates and sub soil and geotextile lining. Maintenance of ponds is relatively straight forward for landscape contractors and typically there is only a small amount of extra work required for a SUDS pond or wetland. More intensive maintenance work such inspection of control structures and silt and/or vegetation removal is only required occasionally but should be planned to be sympathetic to wildlife requirements. (Maintenance costs will be low compared to costs of gully emptying, culvert jetting, desilting etc of traditional road drainage schemes).

Wider benefits

WATER QUALITY 	Can also filter pollutants from roads and driveways through a system of reeds before the water is allowed into local watercourses or drains.
FLOOD RISK MANAGEMENT 	As part of a SUDS scheme or reinstatement in flood plains can reduce flood risks elsewhere and reduce risks of economic and community damage during flooding events.
CO2 & CLIMATE 	Ponds can capture and store carbon at a rate of between 250g – 5kg C equivalent per metre square so a 15x15m pond can store as much carbon as a 100x100m woodland (source: Pond Conservation).
HABITAT FOR WILDLIFE 	Typical plantings of up to 20 native marginal species such as rushes **(Juncus sp.)**, Yellow Flag Iris **(Iris pseudacorus)** and Flowering Rush **(Butomus, umbellatus)** ***which can be collected from naturally colonised pools on derelict sites etc***. Islands and slopes can be planted with native wildflower mixes. Good for amphibians, water voles and invertebrates such as dragonflies.
RECREATION 	Greatest opportunities where designed as shallow ponds with natural banks e.g. for pond dipping. Deep straight-sided pits would need to be fenced off for health and safety.
LANDSCAPE & AMENITY 	Landscape improvements of well designed ponds and opportunities for community involvement by local groups, schools and wildlife trust involved in design for wildlife and recreation and planting.

OTHER: EMPLOYMENT	Employment collecting and growing plants and seed; landscape style maintenance tasks for a local social enterprise or training scheme (e.g. the Work Programme) in long term maintenance of grass areas. Pupils from local schools can work with voluntary organisations to maintain ponds and learn practical countryside management skills they can then use in jobs or volunteer tasks in the future.

ALLOTMENTS and COMMUNITY GROWING SPACES



Allotments in Hull, square metre gardening (Probe, Hull), skip allotments as a meanwhile use

What it is

Standard 250m2 allotments or innovative smaller units which could be mobile (eg in partially sunken containers) meanwhile uses on development land or on aqua green areas. Need not just be allotments but could also include green roofs, food growing in flower beds, orchards, edible landscapes and community gardens. A project in Middlesbrough used >260 sites across the town including people growing in containers, school grounds, parkland in the town, land at the side of public footpaths and even roundabouts as makeshift allotments.

What it costs

Edinburgh's Strategy is based on the estimate that creating a new allotment site will cost approximately £2500 per plot. It should be noted that this is an average across a wide variety of site types and that creating a site in a park (where soils should be reasonably good and where there may already be a water supply etc.) may cost less. Pre constructed flat back square metre gardens are available in the US for £50-85 depending on materials (wood or recycled plastic respectively). DIY square metre gardens could be made for less than £10 plus the cost of a bag of mixed soil and compost and the costs of seeds. Large seeds providers such as Suttons have started to produce mixed packages suitable for square metre gardens and mini plots.

Wider Benefits

WATER QUALITY 	Increased use of water, especially during the growing system but unlikely to be a major issue if water retention and storage systems are incorporated.
FLOOD RISK MANAGEMENT 	Growing sites need to incorporate systems for water retention, storage and re-use – this could include water capture from buildings within the site, creation of retention ponds or other storage systems within the growing area
CO2 & CLIMATE 	Edinburgh strategy estimates that if two people are benefiting (from each allotment plot) each year at least 1 tonne of CO2 is saved by each standard allotment plot every year and a one hectare allotment site saves 50 tonnes of CO2 per annum.
HABITAT FOR WILDLIFE 	Potential to contribute to local biodiversity and wider habitat networks if they are appropriately designed and managed. This involves plant selection both in the growing plots and for 'edge planting' around the site. The provision of wilder areas within the site will also enhance biodiversity. Reducing or eliminating pesticide use will also be beneficial.
RECREATION	Education/training benefits - working with disabled, NEET, young offenders and other disadvantaged groups) on Grow Your Own projects.

	Community cohesion - As an activity which brings people together, growing projects can play an important part in building community strength and interaction.
LANDSCAPE & AMENITY 	Health benefits - Community growing projects have been shown to have beneficial impacts on physical activity levels, mental health and wellbeing and the promotion of healthy eating.
OTHER:	Food production: estimated values from a 250m2 allotment of at least £1000 worth of produce pa from a well husbanded plot. Local food growing is an end in itself – but it also encourages community action and engages local citizens in their communities. Employment opportunities - growing produce in parks for use in on-site cafes and community centres.

NATURALLY COLONISING WOODLAND

What is it?

Natural colonising woodland is woodland which is left to establish itself on neglected and derelict sites, with birch and alder colonising naturally from seed. Minimal management is required for establishment and to maintain safe public access on paths worn by foot. Limited management is required to promote healthy woodland by occasional planting and thinning where needed.

What it costs?

Average Annual costs (£/ha) – (Based on a 1 ha site (50 X 200m) with a suitable path going through)		
Years 1-4 (establishment	Years 5-9	Years 10-50
£90	£110	£350

Source: Trees or Turf? Best Value In Managing Urban Green Space – a report prepared for the Woodland Trust by Land Use Consultants (2011)

Wider Benefits

WATER QUALITY	Water quality is improved as trees act as natural filters. Improved vegetation cover and soils can filter pollutants and improve water quality
FLOOD RISK MANAGEMENT	Flood prevention - Increasing tree cover in urban areas by 10% has the potential to reduce surface water run-off by almost 6%
CO2 & CLIMATE	1 hectare of trees and shrubs can absorb 1 tonne of CO2 – equivalent to 100 family cars – a single tree will produce enough oxygen for 10 people. Urban Heat Island Effect – 10% increase in cover can mitigate for a 3^{o}C rise in urban temperatures and decrease peak temperatures. Environments with trees are more robust. The root systems of trees also counter soil erosion.
HABITAT FOR WILDLIFE	Mix of alder, birch, willow, wild gean, ash and sycamore. Species such as hedgehogs, frogs, songbirds and butterflies thrive in leafier habitats.
RECREATION	Suitable for a range of informal recreation including walking, running, dog walking, forest school visits etc.
LANDSCAPE & AMENITY	A greenspace survey of 6000 respondents found that 97% agreed with the statement: Trees and open spaces can improve the appearance of the town. Trees can help to absorb nitrogen dioxide, sulphur dioxide and sulphur from the atmosphere and canopies of trees act as a filter for particulates and lead.
OTHER: EMPLOYMENT	Local employment, skills and volunteering opportunities in woodland management and sales (woodchip, mulching, biomass as renewable energy from harvesting and prunings.

PIONEER STYLE PLANTED WOODLAND


What is it?

Informal woodland relatively extensive woodland (about 2,500 trees/ha) designed for rapid establishment. Transplants (20-120 cm) are planted in 1m diameter weed free circles and weeded for the first three years of establishment.

What it costs

Average Annual costs (£/ha) – (Based on a 1 ha site (50 X 200m) with a suitable path going through)		
Years 1-4 (establishment)	Years 5-9	Years 10-50
£310	£190	£400

Source: Trees or Turf? Best Value In Managing Urban Green Space – a report prepared for the Woodland Trust by Land Use Consultants (2011)

Wider Benefits

WATER QUALITY 	Improved vegetation cover and soils can filter pollutants and improve water quality
FLOOD RISK MANAGEMENT 	Increasing tree cover in urban areas by 10% has the potential to reduce surface water run-off by almost 6%
CO2 & CLIMATE 	1 hectare of trees and shrubs can absorb 1 tonne of CO2 – equivalent to 100 family cars – a single tree will produce enough oxygen for 10 people. Urban Heat Island Effect – 10% increase in cover can mitigate for a 3°C rise in urban temperatures and decrease peak temperatures. Environments with trees are more robust. The root systems of trees also counter soil erosion.
HABITAT FOR WILDLIFE 	Pioneer and hardy indigenous species including alder, birch, willow, wild gean, ash and appropriate shrubs (including nitrogen fixers).
RECREATION 	Suitable for a range of informal recreation including walking, running, dog walking, forest school visits etc.
LANDSCAPE & AMENITY 	A greenspace survey of 6000 respondents found that 97% agreed with the statement: Trees and open spaces can improve the appearance of the town. Trees can help to absorb nitrogen dioxide, sulphur dioxide and sulphur from the atmosphere and canopies of trees act as a filter for particulates and lead.
OTHER: EMPLOYMENT	Local employment, skills and volunteering opportunities in woodland management and sales of timber and woodfuel.

WOODLAND WITHIN MANAGED GREENSPACE


What is it?

Informal woodland within urban parks is designed for public access. Typically this involves planting of about 2,500 trees/ha planted in 1m diameter weed free circles. Woodland is weeded for the first three years of establishment but is also kept tidy by strimming vegetation between the trees and collecting litter.

What it costs

Average Annual costs (£/ha) – (Based on a 1 ha site (50 X 200m) with a suitable path going through)		
Years 1-4 (establishment	Years 5-9	Years 10-50
£1,500	£710	£1,050

Source: Trees or Turf? Best Value In Managing Urban Green Space – a report prepared for the Woodland Trust by Land Use Consultants (2011)

Wider benefits

WATER QUALITY 	Improved vegetation cover and soils can filter pollutants and improve water quality
FLOOD RISK MANAGEMENT 	Flood prevention - Increasing tree cover in urban areas by 10% has the potential to reduce surface water run-off by almost 6%
CO2 & CLIMATE 	1 hectare of trees and shrubs can absorb 1 tonne of CO2 – equivalent to 100 family cars – a single tree will produce enough oxygen for 10 people. Urban Heat Island Effect – 10% increase in cover can mitigate for a 3°C rise in urban temperatures and decrease peak temperatures. Environments with trees are more robust. The root systems of trees also counter soil erosion.
HABITAT FOR WILDLIFE 	Pioneer and hardy indigenous species including alder, birch, willow, wild gean, ash and appropriate shrubs (including nitrogen fixers) provide enhanced habitats for wildlife.
RECREATION 	Suitable for a range of informal recreation including walking, running, dog walking, forest school visits etc.
LANDSCAPE & AMENITY 	A greenspace survey of 6000 respondents found that 97% agreed with the statement: Trees and open spaces can improve the appearance of the town. Trees can help to absorb nitrogen dioxide, sulphur dioxide and sulphur from the atmosphere and canopies of trees act as a filter for particulates and lead.
OTHER: EMPLOYMENT	Local employment, skills and volunteering opportunities in woodland management and sales of timber and woodfuel.

COMPLEX MIXED WOODLAND PLANTING


What is it?

This is densely planted woodland (about 10,000 trees/shrubs/ha) with an unusually varied assortment of trees and shrubs designed to have a strong structure and visual impact soon after planting. This is the most expensive type of woodland to establish because of initial planting costs and ongoing weeding and litter collection. However costs are comparable to intensively mowed amenity grassland but with wider visual, biodiversity, water quality and flood control and recreation benefits.

What it costs

Average Annual costs (£/ha) – (Based on a 1 ha site (50 X 200m) with a suitable path going through)		
Years 1-4 (establishment	Years 5-9	Years 10-50
£1,650	£1,620	£1,750

Source: Trees or Turf? Best Value in Managing Urban Green Space for the Woodland Trust by Land Use Consultants (2011)

Wider benefits

WATER QUALITY 	Improved vegetation cover and soils can filter pollutants and improve water quality
FLOOD RISK MANAGEMENT 	Increasing tree cover in urban areas by 10% has the potential to reduce surface water run-off by almost 6%
CO2 & CLIMATE 	1 hectare of trees and shrubs can absorb 1 tonne of CO2 – equivalent to 100 family cars – a single tree will produce enough oxygen for 10 people. Urban Heat Island Effect – 10% increase in cover can mitigate for a 3°C rise in urban temperatures and decrease peak temperatures. Environments with trees are more robust. The root systems of trees also counter soil erosion.
HABITAT FOR WILDLIFE 	A mix of trees including poplar, alder, birch, willow, wild gean, oak, ash and appropriate shrubs planted to provide an understory and at the woodlands edge.
RECREATION 	Suitable for a range of informal recreation including walking, running, dog walking, forest school visits etc.
LANDSCAPE & AMENITY 	A greenspace survey of 6000 respondents found that 97% agreed with the statement: Trees and open spaces can improve the appearance of the town. Trees can help to absorb nitrogen dioxide, sulphur dioxide and sulphur from the atmosphere and canopies of trees act as a filter for particulates and lead.
OTHER: EMPLOYMENT	Local employment, skills and volunteering opportunities for biomass thinning 25% (i.e. 2,500 trees/ha over first 10 years)

AMENITY GRASSLAND

Amenity grassland in North Hull

What is it?

Amenity grassland is typically found in parks, recreation grounds and around housing and development. Large expanses of grass are mown by tractor while pedestrian mowers and strippers are used for more restricted areas, around flower beds, paths and steep banks. Where grass is used for recreation there is a need for intensive litter picking and hard surface paths. Picnic furniture and litter bins are often provided.

What it costs

Average Annual costs (£/ha) – (Based on a 1 ha site (50 X 200m) with a suitable path going through, lowest cost where no hand mowing, highest where up to 50% hand mown)		
Years 1-4 (establishment	Years 5-9	Years 10-50
£1,620-2,280	£1,200-2,280	£1,620-2,750

Source: Trees or Turf? Best Value In Managing Urban Green Space – a report prepared for the Woodland Trust by Land Use Consultants (2011)

Wider benefits

WATER QUALITY 	Application of fertiliser, herbicides or pesticides can affect water quality
FLOOD 	Surface water run-off slower than hard non-porous surfaces but faster than woodland or others types of grassland, particularly in compacted areas
HABITAT FOR WILDLIFE 	Over-management of improved grassland, mainly regular mowing and the application of fertilisers and pesticides, has reduced the wildlife value of many areas.
RECREATION 	Recreation – often heavily used e.g. for football or dog walking , picnicking, hanging around, taking short cuts
LANDSCAPE & AMENITY 	Visual - limited value, but some people consider it preferable to more 'unkempt' rough grassland or meadow. Requires intensive litter picking.
OTHER: EMPLOYMENT	Local employment, skills and volunteering opportunities for management

ROUGH GRASSLAND


What is it?

Rough grassland is informal grassland suitable for country parks or less used areas of urban parks. The grass is cut twice a year using a tractor and cuttings are left. Path edges are trimmed, with strimming around obstructions, but there is limited litter collection and gravel is used rather than tarred paths.

What it costs

Average Annual costs (£/ha) – (Based on a 1 ha site (50 X 200m) with a suitable path going through)		
Years 1-4 (establishment	Years 5-9	Years 10-50
£580	£580	£580

Source: Trees or Turf? Best Value In Managing Urban Green Space – a report prepared for the Woodland Trust by Land Use Consultants (2011)

Wider benefits

WATER QUALITY 	No application of fertiliser, herbicides or pesticides improves water quality
FLOOD RISK MANAGEMENT 	Surface water run-off – slower than amenity grassland
HABITAT FOR WILDLIFE 	Biodiversity – higher than amenity grassland
RECREATION 	Recreation – public use a bit lower than amenity grassland - mainly walking and dog walking
LANDSCAPE & AMENITY 	Visual - generally considered more attractive and wild than amenity grassland
OTHER: EMPLOYMENT	Local employment, skills and volunteering opportunities for management

Disconnect Your Downpipe

D-I-Y Instructions

What you'll need:

- Small saw
- Tape measure
- Hammer
- Screwdriver
- Drill
- Pliers
- Brackets to secure downpipe
- Protective equipment (gloves, safety glasses)
- Metal file
- Sheet metal screws
- Rubber or PVC cap
- Downpipe elbow
- Splash pads (optional)
- Ladder
- Downpipe extension

Step one:

- Measure 23cm (9") from where the downpipe enters the sewer connection.

Step two:

- Cut the downpipe with a fine blade saw. Make sure to remove the cut piece and do not drop it down the drain. Use a metal file to remove the rough edge of the downpipe.

Step three:

- Be sure to cap the sewer standpipe (the open pipe remaining when the downpipe is disconnected). This prevents rain water from entering. It also stops animals from falling into the opening, getting trapped, and having to be rescued.
- You can use a simple rubber cap secured by a hose clamp, PVC cap or a wingnut test plug and concrete if available cap sizes don't fit.

Step four:

- Insert the downpipe into the elbow (if you put the elbow into the downpipe it will leak). You may need to crimp the end of the downpipe with a pair of pliers to get a good fit.

Step five:

- Attach a downpipe extension to carry water away from the house and foundations. You can use a small saw to cut the extension to the desired length.

Be sure to insert the elbow into the extension to prevent leaks. Drill a hole on either side and secure the elbow and extension with sheet metal screws.

It's really important to make sure that:

- **Water flows away from your foundation walls**
- **Water doesn't negatively impact your neighbours**
- **Water doesn't flow directly onto the pavement or road**

Annex D References

Web Resources

Ecosystem service topic	Organisation	Online links
General ES Assessment	UK National Ecosystems Assessment	http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx Chap 10 Urban Ecosystems Chap 22 Economic valuation of ecosystem services
Sustainable Drainage Systems (SuDS)	CIRIA Environment Agency Islington Council Netherlands examples Ponds and wetlands Building Regs Part H – Drainage (2010) US SuDS calculator	www.ciria.com.suds www.environment-agency.gov.uk/suds Sustainable Drainage Systems Good Practice Guide 2 8 case studies from the Netherlands, www.pondconservation.org.uk Ponds for climate adaptation in Scottish parks www.planningportal.gov.uk/buildingregulations/approveddocuments/parth/approved http://logan.cnt.org/calculator/calculator.php
Adapting to climate change, UHI	DCLG urban greenspace GreenSpace Scotland– adapting urban parks Greenspace UK	CChange project for cities http://www.greenspacescotland.org.uk/1creating-climate-change-parks.aspx http://www.greenspace.org.uk/downloads/Publications/Blue-sky-green-space_Climate-Change.pdf
Developing Urban Green infrastructure	Defra Natural England CABE Scottish GreenSpace BRE	Defra Green infrastructure Natural England Green infrastructure CABE, (2009) Grey to Green: How we shift funding and skills to green our cities' Scottish Urban Greening How best to green the city
Disconnect Downpipes	North America programmes	www.toronto.ca/water/protecting_quality/downspout.htm www.portlandoregon.gov/bes/54651 www.seattle.gov/util/groups/public/@spu/.../spu01_006284.pdf
Depaving	Portland programme Greenspace Scotland	www.depave.org Car parks
Rainwater gardens	Rain gardens Low impact development BBC Rain Gardens	www.raingardens.info Low impact development including rainwater gardens Gardening for rain
Green roofs	Sheffield Green Roof Centre Living Roofs Scottish forum Toronto guidance Islington Council	http://www.thegreenroofcentre.co.uk www.livingroofs.org http://www.sgrf.org/Policyguidance http://www.toronto.ca/greenroofs/pdf/makingsection2_nov16.pdf Good Practice Guide 1- Green-roofs-and-walls
Community Growing and allotments	Growing in parks Square metre gardens Planning veg plots	Greenspace Scotland Probe Hull Suttons Seeds Grow Veg Organisation
Benefits of woodlands and grassland	Independent Panel Woodland Trust Woodland Carbon Code Greenspace Scotland	Independent Panel on Forestry Trees or Turf www.forestcarbon.co.uk calculator for carbon sequestration Greenspace Scotland trees for climate adaptation in parks and grassland
Playing fields	Greenspace Scotland	Adapting pitches for climate change

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