
# Thames Gateway Environmental Standards

Supporting case studies

Final Working Draft May 2009

# Contents

# 1 Case Studies supporting the Environmental Standards

## Environmental infrastructure

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| **Barking Riverside** | The advantage of Barking Riverside's large open spaces is that it allows a balance between residential, recreational and ecological areas to be created. The open space takes up 40% of the entire site and will be divided between the natural landscape and public parks shaped and integrated into neighbourhood areas, whilst areas of ecological interest remain protected.<br><br>The scheme emphasises the use of public transport and preserves valuable ecological habitats. Environmental concerns have been integrated into every aspect of the development, not least by creating a place where everyday needs can be met locally. Our energy efficient infrastructure will make low demands on natural resources and we will be open to new environmental techniques throughout the lifetime of the development.<br><br>All homes at Barking Riverside will have to reach high sustainability standards which balance environmental performance with the need for a high quality of life and a healthy environment. |

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| **Mile End Park** | Mile End Park is formed of ninety acres of linear open space link two parts of the park and form an invaluable green chain of open space through the heart of London's East End, running north-south along a mile of the Grand Union Canal.<br><br>Before its refurbishment the park was a bleak, fragmented, under-used open space in the centre of the London Borough of Tower Hamlets, an authority with a large population and little good quality open space.<br><br>The park now also provides safe and attractive pedestrian and cycle routes, significantly contributing to pollution reduction where neighbouring roads are heavily used and congested.<br><br>The refurbishment creates an entirely new landscape which incorporates both access and recreation. The Green Bridge, a modern structure constructed of steel and timber provides pedestrian and cycle routes, which link two areas previously separated by a major road.<br>The Pathway, running the length of the park, provides separate paths for pedestrians and cyclists, careful grading for wheelchairs, and connects the Play Arena with the Art and Ecology Parks. |

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| **Stratford City, London** | Stratford City is a proposed new metropolitan centre for East London on 60 hectares of brownfield land in the Lower Lea Valley. It is anticipated that 4,500 new homes could be built by 2015. The aim is to deliver a 'place of many places' with five main objectives:<br><br>o To integrate with the Lee Valley Regional Park in order to extend habitats and fulfil metropolitan park functions;<br><br>o To provide a network of continuous open spaces linked to pedestrian and cycle networks and the wider public realm;<br><br>o To provide play facilities and recreational provision, which will serve areas |

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| | of high density housing;<br><br>o To preserve, manage and enhance principal ecological areas to provide rich and diverse ecological habitats.<br><br>The open space strategy establishes a hierarchy of open spaces, and also establishes a complementary role for private and communal spaces, exploring space typologies and how they relate to different residential densities. |

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| **Wandel Village Park** | Wandle Village Park site, the site of the former Croydon Gas works, lies 2kms west of Croydon Town centre, adjacent to the Purley Way Retail Park. The culverted River Wandle runs through the site.<br><br>Along with the development of a residential area and community facilities, the brownfield area is landscaped and naturalises, Cycle paths and pedestrian access is opened up. .<br><br>Improvements :<br>• Managing contaminated land from previous industrial uses<br>• Promoting improved biodiversity<br>• Maintaining fluvial flood defences while advising on innovative methods to develop the channel to 'naturalise' the river<br>• Promoting sustainable drainage systems<br>• Promoting access to rivers and green space, and linking greenspaces<br><br>The development will secure the following environmental improvements:<br>• Deculverting and Naturalising of the River Wandle<br>• Green roofs throughout the development<br>• New green space<br>• Linkage with the existing Wandle park and the possibility of further deculverting and/or raising the channel to 'naturalise' the river through the park<br>• Improved visual amenity on a former industrial site.<br>• Removal of invasive species (Japanese Knotweed)<br>• Decontamination and innovative new forms of remediation<br>• Solar water heating for parts of the development<br>• Biomass boilers in the development<br>• Photovoltaic cells on the ground and first floors of one of the buildings |

# Energy resources are used efficiently

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| **One Gallions** | One Gallions is the GLA's flagship net zero carbon scheme in Beckton, in the London Borough of Newham within the Thames Gateway area. Crest Nicholson Bioregional Quintain (Gallions) LLP is proposing to develop this as an annual net zero carbon development with 260 residential units and associated community facilities in accordance with the 10 One Planet Living (OPL) principles[1], to create a sustainable community.<br><br>  <br><br><br>The approach to be applied will significantly reduce potential carbon emissions and wider environmental impacts, through a host of measures such as renewable energy, energy efficient architecture, use of natural and recycled materials, as well as integrated waste management, on-site food growing and sustainable transport measures.<br><br>The site will be compliant with Code for Sustainable Homes Level 4 requirements. In terms of energy efficiency, it is proposed that Level 6 standards are met.<br><br>**Climate Change Mitigation Measures**<br>Several different types of Climate Change mitigation measures will be applied at the One Gallions development and can be broadly categorised as follows:<br><br>**Energy efficiency**: In order to meet the Code for Sustainable Homes Level 6 energy efficiency standards, such as maximum Heat Loss Parameter of 0.8 W/m² K, the fabric elements are required to perform substantially better than current Building Regulations requirements. Iterative analysis has been carried out to establish the performance criteria of each principle element.<br><br>In summary, the following measures will be implemented:<br><br>• Improved U Values for windows, walls & floors.<br>• Optimised window sizes and frame materials for enhanced sustainability and insulating ability.<br>• Good passive solar design through applied shading & window reveal design.<br>• Mechanical Ventilation with Heat Recovery (MVHR) in all dwellings.<br>• No significant thermal bridges or gaps in the building envelope<br>• Airtight building envelope (max. 2m3/hr/m2 @ 50Pa)<br>• Design for maximised day lighting<br>• Solar control measures to reduce the need for cooling and avoid overheating<br>• Exposed thermal mass on ceiling soffits to allow night time cooling |

[1] http://www.oneplanetliving.org/index.html

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| | Further energy efficiency measures include 100% low energy lighting throughout dwellings as well as efficient appliances, pumps and ventilation. Where supplied, A+ rated electrical appliances will ensure unregulated emissions targets are achievable. Energy efficient supply of hot water will be ensured by specifying low flow taps and showers. Consumption will be metered to support responsible use of resources.<br><br>**Energy generation**: The 90kWe/200kWth hot air turbine biomass Combined Heat and Power (bCHP) unit manufactured by Talbotts has been identified as being the most suitable system currently available for the One Gallions site. In addition, a gas boiler will be installed to provide heat during maintenance of the bCHP unit and cover peak demand during very cold periods of the year. Modelling assessments associated with this system suggest that the One Gallions scheme has the potential to operate in net zero carbon mode. As annually more electricity will be generated on-site than demand requires, carbon savings of surplus electricity that will be fed into the grid can be used to off-set emissions from biomass fuels and top up gas.<br><br>**Energy Services Company**: It is intended that a Community Energy Services Company (ESCO) will be established as a vehicle for operating and maintaining the proposed energy system at One Gallions. The ESCO would be required, through a service contract, to operate the energy systems on behalf of the management company. It will provide metering and billing services, maintain and make provision to replace the assets and all in such a way as to provide end-users with utility services at a fair price. Under normal operating conditions the residents total energy bill equates to about 10% less than their energy bill had they been occupying a new flat built to the current building regulations. |

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| **Barking Town Centre Energy Action Area (EAA)** | An ambitious redevelopment to create a vibrant town centre. Over 15 years, 7,000 new homes will be built, a new hub for cultural industries, new public squares and the opening up of the Town Quay river frontage. As a pilot EAA, standards for generating and using energy efficiently are very high. Two developments have already been approved - Battery Wharf and the Heath Centre in the town square, more are at the planning application stage. Green facts<br><br>• 32 per cent carbon reduction from all new developments to be achieved through a low carbon district heating network and electricity generating renewable technologies.<br><br>• Discussions are taking place with Government to deliver the Barking Power Station Heat Network Project, using waste heat as a low carbon heat source piped into the district heating network.<br><br>• Streetscape incorporating renewables - a public arts project of three turbines on a roundabout to provide electricity for Abbey leisure centre will be completed in February 2008. Solar powered parking meters are common place.<br><br>• This EAA is being used as best practice across London by the London Energy Partnership.<br><br>The council is also leading on a sustainable off-site manufacturing capability in the Thames Gateway with partners from the private and public sector. It is delivering low carbon construction techniques to new developments in the Gateway, to high manufacturing standards of insulation |

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| **BowZED** | BowZED is a block of 4 flats, just off the Bow Road in East London. Each flat benefits from its own south-facing terrace and conservatory, which have enough photovoltaic cells incorporated into the glass to meet at least half of the occupants' annual electricity demand.<br><br>The other half is planned to be met by a recently installed micro wind turbine mounted on the communal stair tower. This building will generate as much energy from renewable sources in a year as it consumes. Finished to the high levels you would expect for a modern urban 'for sale' development, the building has also been built to ZED standards[2].<br><br>This means the levels of insulation and thermal mass are such that no central heating system is required. The flats obtain enough heat from occupants, the solar gain from south-facing windows, and incidental gains from cooking and appliance use. This enables a single 15kW wood pellet boiler to supply the whole block with hot water and back-up heating.<br><br>This building shows how a Zero (fossil) Energy Development (ZED) can be delivered on a tight urban site as a conventional development opportunity. The sales prices for the flats achieved by the developer were better than expected, and well above local comparable property showing there is a healthy appetite for eco-housing in the market place. |

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| **Purfleet Environment & Education Centre** | The Purfleet Environment & Education Centre, which was amongst the first major projects funded within the Thames Gateway, is an exemplar of high quality design, a friendly multi-use space that adheres to the highest environmental standards.<br><br>The building has been designed to reach the Building Research Establishment Environmental Assessment Method (BREEAM) 'Excellent' rating and we aspire for it to be a carbon neutral operation; that is, having no requirements for energy from fossil fuels (coal, oil or gas).<br><br>The microgeneration on site includes an extensive photovoltaic array using Sanyo Hybrid 190W modules, which it is hoped will achieve 100% of the heating demands of the building, covering 50m² on the roof of the building. These are expected to generate 10.6 kWp of installed DC power.<br><br>There are plans to add a 15 kW wind turbine, but there are concerns about birds getting injured on it. There are also budgetary concerns for the centre. There is also a 26 kW ground source heat pump system (Viesmann BW 226) with six 80m deep bore holes. Sheep's wool was used for insulation as well as a sealed building envelope.<br><br>Passive solar heating is also used and no fans or air conditioning should be needed to keep the building cool in summer. This building has a natural stack ventilation system (see diagram).<br>The annual energy consumption for the building is predicted as follows:<br><br>● Space and water heating:10,000 kWh.<br><br>● Electrical Requirement: Building 24,000 kWh –<br>Sewage Treatment Plant 26,000 kWh<br><br>● $CO^2$ emissions/m²: Building 22 kg/m²<br>Sewage Treatment Plant 25 kg/m²<br><br>Using rainwater |

[2] http://www.zedstandards.com/

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| | Rainwater harvesting also takes place within the building to supply water for the toilets. The centre claims that “90% of flushing demand is predicted to be met by rainwater in the first year of operation and 30% after ten years as demand increases”.<br>They also say that this will save 130 tonnes of mains water per year. Low flow and automatic shut off systems are used in the basins and taps throughout the building. The building also uses waterless urinals. These urinals use a filter system which seals the pipework stopping odours with a microbiological fluid held in the pipes.<br><br>These systems use 100% less water and have less mechanical hardware, making them lower maintenance. Lack of general maintenance however, will lead to problems, like limescale build up. The windows and roof lights provide the centre with excellent day lighting, which is enough to light the building up to 80% of working hours. |

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| **225 Court Farm Road, Mottingham , London.**<br><br>**hyde, ECD Architects, MEARS** | The refurbishment of a vacant 1930’s mid terrace residential house in order to establish the most effective package of retrofit measures to achieve an 80% reduction in $CO^2$ emissions, the attitudes of the future residents over a 24 month period and finally to report on a cost / benefit analysis to enable Hyde and fellow developers to make efficient and effective choices on how to apply energy saving actions as part of large scale retro fit programmes.<br><br>An initial SAP assessment was carried on the property which was found to have the rating of 60, well above the national average of 48, therefore presenting a significant challenge to reach the 80% $CO^2$ reduction target. This initial test was to provide a base line to aid future comparison. Along with the SAP testing, an air tightness test was also taken.<br><br>The Retrofit Proposals for the property were to minimise heat loss from the building fabric, to install an easily replicable, efficient form of space heating, to reduce the energy requirement from lighting, to utilise the most appropriate form of renewable micro generation.<br><br>Heat loss was addressed by insulation to the floors, external walls and roof and the addition of high performing windows and doors. A mechanical ventilation system which recovered heat from the extracted air was also installed.<br><br>Phenolic foam insulation was chosen for the insulation of both the suspended floors and external walls. A combination of insulation was used in the roof space, Kingspan themapitch laid on an airtight vapour barrier over the existing ceiling joists and a multi foil lining on the existing rafters and party walls.<br><br>A heat exchange system was fitted to the party wall in the loft space which extracts air from the kitchen and the bathroom and reclaims around 90% of the heat to pre-warm incoming fresh air which is then supplied to the bedrooms and living areas. There is an in built bypass system to extract the air directly outside, which is particularly suitable for warmer summer months.<br><br>These insulation measures have made an estimated reduction in heating requirements from 17,238kWh/yr to 2,410kWh/yr – an 86% drop.<br><br>Ground Source Heat Pumps were discounted due to instillation time and costs, and a Wood Chip Boiler was also discounted due to the pressures it would place on future tenants to maintain and source flues. The existing gas boiler was therefore upgraded to a condensing boiler of greater efficiency. The boiler supplies hot water to the property, but will be supplemented by intelligent control solar thermal collectors located on the roof. It is predicted that the solar system will provide 60 – 70% of the properties hot water needs. |

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| | Lighting will account for a significant proportion of the properties electricity loading. To counter this, LED technology will be used in all fittings. LED units were chosen, both for their longevity and there recyclability, being that they contain no CFCs, mercury or phosphor.<br><br>The two bathrooms in the property were fitted with low dual flush toilets, aerated taps, eco shower fittings and a low volume bath. An underground rainwater storage tank was discounted as not viable in this situation. A gravity fed header rain water tank was therefore fitted into the loft space which is directly fed from external down pipes. It is calculated that virtually all water required for the toilets could be supplied from the annual local rainfall, there is a backup supply attached to a meter. |

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| **North Kent Police Station, Northfleet, Kent** | The new police station in Northfleet Kent a 11,500m² four-storey building housing offices for police and civilian staff, the division's store for evidential and lost & found property and a custody suite of 40 cells.<br><br>The building was developed with sustainability in mind and is centred around a large atrium or "street" that runs the length of the building providing communal areas, break-out areas and a restaurant.<br><br>All heating and cooling is provided by ageothermal system laid in the grounds of the building, supplying water at a constant temperature to heat pumps, which in turn supply heated and chilled water for the air conditioning system. There are pipes buried in the structural piles and a total of 26,000m of geothermal pipe laid in an additional geothermal field located below the car park. The estimated saving on the energy bill is approx. £18,000 per year, with an expected pay back within seven years. Rainwater harvesting systems, factoring in local annual rain fall is sufficient to run all toilets within the building. |

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| **Sherwood Energy Village, Nottinghamshire** | Built on a former colliery site, plans for the development from the out set wanted to ensure that it *'..was not just another industrial site on a former colliery…'* .<br><br>The E-Centre at the heart of the Sherwood Energy Village provides both the administrative centre for the village and office spaces for rent, particularly to companies within the environmental sector.<br><br>The crescent-shaped building, incorporates a full height winter garden, acting as the 'lungs' of the building, capturing light, heat and passive ventilation. The building also has green roofs, rainwater harvesting and heat from ground source heat pumps providing both heating and cooling.<br><br>Sherwood Energy Village was primarily about economic diversification and job creation at the time of pit closure.<br><br>Rejecting the potential to sell off 11 acres of the site to external developers, the SEV decided to do their own residential development. Properties developed were to include:<br>• Reduced energy costs<br>• Water efficiency<br>• Well-built, architect-designed dwellings<br>• Sense of space, community spirit<br>• Safe, secure environment |

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| | • Walking distance from shops and services<br>• A nice place to live, work and play, and which people can buy to occupy<br>There are 196 dwellings planned for the Energy Village ranging from single dwelling bungalows and apartments through to terraced, semi-detached and detached housing. Greenspace has been incorporated into the SEV with a central garden providing public amenity to both residents and workers. With an additional 6.46 hectares of green space called the 'Arena', surrounded by mature trees and clay-lined swales on one side have formed a wetlands area, adding to the site's evolving bio-diversity. The rest of the Arena is designated for the development of sporting and recreational pursuits. |

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| **Centre for Engineering and Manufacturing Excellence (CEME)** | CEME is a not-for-profit organisation and an urban regeneration project that supports the development of individuals and organisations – with a specific focus on the Engineering, Manufacturing and Technology sector; and is located in Rainham.<br><br>The centre provides both conference and office spaces and teaching space for business development.<br><br>The centre seeks to :<br><br>• The prevention of polluting emissions to air, land or water.<br>• The control of noise, dust, fumes or other nuisance or environmental impact which may cause offence to the local community or environment.<br>• Waste minimisation.<br>• Management of waste disposal including recycling where appropriate.<br>• Suitable arrangements for the selection, use, handling, storage and transport of articles and hazardous substances.<br>• Promoting best practice environmental management to all customers, students, visitors, contractors and members of the public.<br><br>As well as working towards:<br><br>• Waste minimisation<br>• Recycling and waste management Energy Consumption<br>• Environmental audits & monitoring of performance<br><br>Key to this development's success was the incorporation of sustainable elements into the construction process. The 115kWp Photo Voltaic (PV) installation was split between the street roof, service screen and used semi-transparent 'glass-glass' PV canopy arrays over the entrance. Supported by DTI, now DBERR, and EU funding, which subsidised 65% of the PV costs, it is one of the largest installations in the UK and contributes approximately 15% of the site's electricity requirements.<br><br>Natural ventilation to the street and workshop areas, together with low level air displacement with heat recovery and daylight sensitive lighting controls further reduce the energy requirements of the building.<br><br>Rainwater recycling reduces consumption of potable water. A 'balancing' lake providing water attenuation from hard landscaped areas was designed in consultation with the Environment Agency to also provide habitat for water voles, newts etc.<br><br>The contractors signed up to the Considerate Contractor Scheme (CCS), and used British Research Establishment (BRE) SmartWaste procedures. A comprehensive strategy was implemented for the building in use to reduce land fill waste. Use of local suppliers and contractors supported the local economy and reduced transport related carbon emissions. |

# A sustainable construction approach is adopted

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| **Centre for Engineering and Manufacturing Excellence (CEME)** | CEME is a dynamic hub of education, enterprise and manufacture. It is situated in the Thames Gateway sub-region, the largest brownfield development area in London and also the most deprived and largest area of growth and regeneration in the UK.<br><br>The Centre was set up as a unique not-for-profit partnership in the public and private sector including London Development Agency, Barking College, Havering College, Ford Motor Company, and Heart of Thames Gateway, to cater to local people of all ages and stages of vocational development.<br><br>Key to this development's success was the incorporation of sustainable elements into the construction process. The 115kWp Photo Voltaic (PV) installation was split between the street roof, service screen and used semi-transparent 'glass-glass' PV canopy arrays over the entrance. Supported by DTI, now DBERR, and EU funding, which subsidised 65% of the PV costs, it is one of the largest installations in the UK and contributes approximately 15% of the site's electricity requirements.<br><br>Natural ventilation to the street and workshop areas, together with low level air displacement with heat recovery and daylight sensitive lighting controls further reduce the energy requirements of the building.<br><br>Rainwater recycling reduces consumption of potable water. A 'balancing' lake providing water attenuation from hard landscaped areas was designed in consultation with the Environment Agency to also provide habitat for water voles, newts etc.<br><br>The contractors signed up to the Considerate Contractor Scheme (CCS), and used British Research Establishment (BRE) SmartWaste procedures. A comprehensive strategy was implemented for the building in use to reduce land fill waste. Use of local suppliers and contractors supported the local economy and reduced transport related carbon emissions. |

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| **Red Kite House** | Red Kite House is home to the Environment Agency's West Area headquarters and is a 3-storey naturally ventilated building which achieves a BREEAM "excellent" rating.<br><br>The physical envelope of the building helps prevent overheating in the summer thanks to large areas of external shading. This combined with solar control glass helps maximise daylight into spaces and minimises solar gain. The main façade of Red Kite House is curved to help improve the effectiveness of the natural ventilation strategy.<br><br>Roof mounted turbines are used to draw air into the top floor of the building. The top floor is most at risk from overheating and this technique decreases the risk of this. The roof of the building is used to collect rainwater which is then re-used in the building for toilet flushing.<br><br>Photovolatic cells are also integrated into the south facing façade of the structure and these generate around 20% of the buildings annual electrical demand. |

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| | Solar water heating panels are installed on the roof to help reduce the building hot water demand. |

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| **Modular construction with high thermal mass for residential development:** *Project Meteor, Northampton* | Adaptation of construction techniques on site may be appropriate for future development due to more frequent periods of extreme weather. Project Meteor is a fully modular housing scheme where large sections of the house are constructed off-site in factories and delivered to site where they are lifted into place and finished.<br><br>The safety of site staff may be affected by changes in climate from greater exposure to UV and heat. Techniques which can reduce or modify site based activities may present opportunities to adapt<br><br>The potential for UV damage to stored materials on site is also a consideration which makes pre-fabricated and modular construction a potentially attractive option.<br><br>A feature of the pre-fabricated structure of the Meteor project was the large areas of exposed thermal mass, providing passive cooling and improving the adaptation potential of the dwellings. |

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| **Brockholes Wetland and Woodland Reserve** | Development due begin in late 2009 to construct a 'floating world' at Brockholes Wetland and Woodland Reserve in Preston, Lancashire.<br><br>Adam Khan Associated won a RIBA competition, to design and innovative and sensitive development for the reserves visitor centre. Their winning design incorporates A set of zero-carbon floating buildings made of low embodied energy materials such as thatch, willow and timber, drawing on the heritage of wetland dwellings and embodying a sustainable agenda. Off-site prefabrication and on-site energy generation and waste treatment further reduce the project's impact. Built on an island of floating pontoons over a former 67-acre gravel pit, |

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| **Upton Sustainable Urban Extension** | The need for new housing in Northampton meant building a high density development on a large site on the edge of the flood plain. Northampton had experienced severe flooding in 1998 therefore it was imperative that any future development, not increase the flood risk issues.<br><br>A design code was developed and agreed by the Local Authority and developers invited to tender. Advanced infrastructure was provided by English Partnerships to speed development. This included SuDS systems, open space, playing fields and a road network.<br><br>The development is now well under way, and when complete will include:<br><br>• In excess of 1300 dwellings of different housing types, plus commercial and retail units. These all contain green design and technology features such as rain water harvesting, solar heating, green roofs, ground source heat pumps, wood pellet boiler community heating and sockets for electric cars in courtyards.<br><br>• Community playing fields with a high quality changing facility/community meeting hall, partially powered by a wind turbines and including an educational area that uses renewable technologies and design innovation<br><br>• a public transport system which links Upton with Northampton town centre and the railway station<br><br>• a primary school accommodating 420 children. |

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| | All homes have met the EcoHomes Excellent post construction review. Twenty-two per cent are affordable homes for rent or shared ownership, spread throughout the site with no more than three units together, so that social housing is indistinguishable from owner-occupied units. |

# Land quality is improved and brownfield land is appropriately developed

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| **New South Quarter, Croydon – Barratt Homes** | Approximately 700 residential units, commercial units and additional community uses such as a nursery, footpaths, cycle paths and access to the adjacent park. The River Wandle runs through the site in a culvert.<br><br>1 million pounds was secured within the Section 106 agreement for a river restoration and park enhancement scheme in adjacent Wandle park. The agreement also includes a maintenance programme for the restored channel on the development site.<br><br>**Flood risk management**<br>• 280 metres of the River Wandle to be de-culverted and naturalised with increased set back between the development and the river.<br>• Increased space for water in the channel in line with Government Policy.<br>• 1266m3 of surface water attenuation storage has been provided for the 1 in 100 plus climate change critical storm.<br>• Surface water drainage rates into the river returned back to Greenfield run off rates on an existing Brownfield site. All development is compliant with Planning Policy Statement – 'Development & Flood Risk'<br><br>**Land decontamination**<br>• Former Gas works means this is a highly contaminated Brownfield site<br>• Permeable Reactive Barrier in use to clean contaminated groundwater as it flows through the site. Area of land remediated to be confirmed once works completed in 2009<br><br>**Increased habitat**<br>• Landscape management plan and connectivity with adjacent Wandle Park<br>• New habitat creation, nesting boxes, roosting posts and green space<br>• Removal of invasive species (Japanese Knotweed) from the site<br><br>**Increased river recreation**<br>• Deculverting and creating an open channel will create a new amenity space for the community and increase awareness of the river in a highly urban environment |

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| **The Ram Brewery Site**<br><br>**Wandsworth Town Centre - Minerva Ltd** | The site adjoins the tidal or downstream part of the River Wandle before it meets the Thames. For over 150 years, the Young's Brewery has been a familiar local landmark for both Wandsworth residents and visitors.<br><br>The scheme provides 2.9 acres of public realm, with two public open squares, each framed by listed buildings, and over 300 metres of riverside walkways<br><br>**Flood risk management**<br>• 400 Metres of replaced or refurbished defences<br>• Retreated flood defence line across along the river corridor to create space for intertidal terracing<br>• 450 cubic metres of additional flood storage<br>• Safeguarding of the riverwall integrity from underground and overground development pressures and creating access space to the river defences for maintenance and inspection purposes.<br>• Surface water drainage in line with the SUDS heiracrchy which decreases flows to allready overloadined combined sewer systems. |

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| | **Land decontamination**<br>• The main sources of contamination are the former fuel tanks and the infilled canal.<br>• A basement is proposed and it is anticipated that removal of material for basement construction would remove the majority of contamination.<br><br>**Sustainable construction**<br>• 'Excellent' Eco Homes rating<br>• Green roofs throughout the development and water conservation measures such as rainwater harvesting for irrigation purposes<br><br>**Increased habitat**<br>• Creation and improvement of tidal habitat through intertidal terraces<br>• New habitat creation through landscaping<br><br>**Increased river recreation**<br>• A new riverside walkway and pedestrian bridge designs in order to create walkways and connectivity to upstream and downstream parts of the rivers |

# Air is cleaner and healthier

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| **The 'Big Dig', Boston** | The "Big Dig," completed 2005 was a massive highway project to build an eight-lane highway under downtown Boston (US). A significant proportion of the £14.6bn budget was spent on mitigating the negative impacts of the project.<br><br>Extra controls on exhaust emissions from plant and other construction vehicles were mandated for the project. This included retrofitting machinery with Emission Control Devices and/or use Clean Fuels in order to reduce diesel emissions. Similar mitigation has been used in Switzerland and Sweden. Using low sulphur tax-exempt diesel on site will automatically reduce emissions of particles by 30 per cent from the exhaust. The additional use of exhaust filtration measures for high risk sites will reduce the remaining particulate emissions by a further 85 per cent. |

# Biodiversity is protected and enhanced

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| **Barking Riverside** | Built in four phases culminating in 2025 integrating retail, office and recreation facilities, creating employment for 1500 people.<br><br>• All homes and facilities will have a 50 per cent smaller carbon footprint than required by 2006 building regulations.<br>• 40 per cent open space, reducing the heat island effect and providing flood storage.<br>• "Green Bracelets" will be developed around each development to reduce the microclimate impacts.<br>• Reduce carbon emissions by improved public transport links (DLR, bus and tram) and separated cycle lanes throughout<br>• Land raised by approximately 15m, using waste soil from the London Channel Tunnel rail link reducing the risk of flooding from the Thames<br>• Environmental standards will be higher than current UK best practice. Water efficiency standards will be higher than ever achieved in the UK, following European best practice.<br>• An on-site construction factory will reduce transport of materials, while training local employees.<br><br>**Environmental standards**<br>The Council has designed, with the developers (Barking Riverside Ltd) and Building Research Establishment, an Environmental and Energy Strategy and Assessment Tool (EESAT) to set the environmental standards for all developments. This will be updated after every 2,000 units. The lowest standard that can be achieved will always be higher than current regional and national standards. Planning permission will only be granted if an overall score of 70 per cent is achieved.<br><br>The EESAT will include:<br><br>• Site layout - solar gain and passive cooling design.<br>• Open spaces and landscaping - flood defences and urban heating.<br>• Transport and the movement framework - enforcement of cycling, safe walking routes.<br>• Material procurement - locally sourced materials will earn more points.<br>• Sustainable resource consumption - reusable and recyclable materials earn more points.<br>• Carbon reduction and climate change — higher thermal standards, energy supply from decentralised sources such as CHP and renewable energy technologies.<br>• Waste management - recycling centre and an exchange system is planned for the site, run by a community trust.<br>• Influencing behaviour in use - interactive displays in every house showing energy usage and generation and delivering the latest local travel news.<br><br>**Carbon reduction**<br>With the developer and the Greater London Authority, the Council has set up an energy panel to implement and support high standards of carbon reduction.<br>A single, site-wide district heating network linking every building will offer approximately 12 per cent carbon saving. The developer has to reduce carbon further in each phase, through the heating network and electrical generating renewables, in order to achieve the overall carbon targets:<br><br>Phase 1 (2008-12) – 30 per cent carbon reduction target.<br>Phase 2 (2009-13) – 50 per cent target. |

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| | Phase 3 (2013-20) – 50 per cent target.<br>Phase 4 (2020-25) – 80 per cent target.<br><br>These schemes allow for future proofing and new technologies such as hydrogen cells. |

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| **The Dagenham Washlands** | The Dagenham Washlands enhancement project will provide 53ha of multifunctional green space within Dagenham, East London. The environmental enhancements are a key part of a scheme that will reduce flooding of downstream landholding protecting the Ford and Dagenham East sites that are valued at c£1.5billion. The proposal will secure the site for the benefit of local businesses and people creating an area of quality greenspace to be managed in perpetuity for existing and future communities.<br><br>Phased capital works programme that will provide:<br>• At least three new gateways and routeways with an estimated 8km of pathways of which 4km will be suitable for cyclists.<br>• Routeways that link and inter-connect all the existing and potential new communities across South Dagenham - create logical east-west and north-south axis linking with surrounding pedestrian and cycle routes and the Dagenham Village Trail 'Greenway'.<br>• A strong greenspace identity with associated streetscape enhancements for existing and potential new communities across South Dagenham creating a safe and secure site for local people.<br>• Significant habitat enhancements including creation of and improvements to acid grassland, mixed deciduous woodland and a rich and varied mosaic of wetlands.<br>• 53ha of washland promoted as an exemplar of multifunctional greenspace that will deliver improved flood storage to help meet climate change.<br>• A single management regime for the landscape, to ensure continued access, biodiversity, conservation and safeguard these in perpetuity.<br><br>Community consultation and engagement that will:<br>• Maximise participation of local communities to ensure they have a chance to input into the design, implementation and ongoing management of the site.<br>• Provide an estimated 200 local people (30% from BMEs) with the opportunity to gain expertise in environmental regeneration enabling them to shape a fresh, inclusive identity for South Dagenham.<br><br>The Dagenham Washlands are located in the Lower Beam Valley, in the London Borough of Barking and Dagenham. Part of the site is owned and managed by the Environment Agency as a Flood Storage Area (FSA), to retain up to 430,000$m^3$ of floodwater, upstream of the tidal Thames outfall. The remainder of the site is owned and managed by the London Borough of Barking and Dagenham as informal public open space.<br><br>The Environment Agency has committed to increasing storage capacity by a further 30,000$m^3$ as part of their Flood Risk Management (FRM) Capital Improvement Scheme Contract. The FSA safeguards over 90 commercial and industrial properties and 570 homes. |

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| | The Dagenham Washlands Enhancement Project will build upon the investment made by the Agency and deliver a wider range of economic, social and environmental benefits in addition to the FSA work. This will provide significant benefit to surrounding wards that suffer from deprivation with those in Village Ward falling within 1-10% of the most deprived in England. It will connect the Beam Valley to the river Thames for 40,000 people for the first time in 90 years. The project will link fragmented communities and engage local groups and people with education and volunteering opportunities, create and improve access networks, improve leisure and recreation opportunities, deliver health benefits and provide opportunities for sustainable travel for workers. The scheme will also deliver Biodiversity Action Plan targets including 31ha of acid grassland, 13ha of new and existing wetlands, 6ha of mixed deciduous woodland and 0.5km of new and in filled hedgerow planting.<br><br>The Land Restoration Trust has been established to improve the environment and quality of life for communities by providing long-term sustainable management of public spaces across England. The Trust will lease the land owned by the Environment Agency and London Borough Barking and Dagenham and secure the funding to improve and enhance the site and manage and maintain in perpetuity. The Trust owns a wider range of sites that support a range of activities and uses.<br><br>The Trust works with local groups and bodies to provide the support and mechanism for smaller organisations to take on management of sites without the legal and financial pressures that might preclude them from doing so in their own right. The Trust is delivering greenspace projects across all three regional areas within Thames Gateway with Dagenham Washlands the current focus of work in London. The Trust has a proven track record of delivery and successful engagement of local communities and is committed to providing quality greenspace for the benefit of wildlife and people. |

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| **Wandle Park Village** | Wandle Village Park site, the site of the former Croydon Gas works, lies 2kms west of Croydon Town centre, adjacent to the Purley Way Retail Park. The culverted River Wandle runs through the site.<br><br>Along with the development of a residential area and community facilities, the brownfield area is landscaped and naturalises, Cycle paths and pedestrian access is opened up. .<br><br>**Improvments :**<br>• Managing contaminated land from previous industrial uses<br>• Promoting improved biodiversity<br>• Maintaining fluvial flood defences while advising on innovative methods to develop the channel to ‘naturalise’ the river<br>• Promoting sustainable drainage systems<br>• Promoting access to rivers and green space, and linking greenspaces<br><br>The development will secure the following environmental improvements:<br>• Deculverting and Naturalising of the River Wandle<br>• Green roofs throughout the development<br>• New green space<br>• Linkage with the existing Wandle park and the possibility of further deculverting and/or raising the channel to ‘naturalise’ the river through the park<br>• Improved visual amenity on a former industrial site.<br>• Removal of invasive species (Japanese Knotweed)<br>• Decontamination and innovative new forms of remediation<br>• Solar water heating for parts of the development<br>• Biomass boilers in the development<br>• Photovoltaic cells on the ground and first floors of one of the buildings |

# Access to the environment is improved and promoted

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| **Mile End Park, Tower Hamlets** | An area of 90 acres of open park linked together in two sections, forming a chain of green space across the East End of London following the route of the Grand Union Canal.<br><br>The park previously was an underused, poorly managed 'chunks' of non linked open space within the borough of Tower Hamlets, and area of large population, but little green space.<br><br>Through the regeneration of this green space the residents of Tower Hamlets now have access to safe and attractive pedestrian and cycle routes, which aids in the reduction of air pollutions, reduces traffic congestion and increases access to better health through improved mobility of the local population. |

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| **Regeneration at Tavy Bridge, Thamesmead** | The regeneration project aims to refurbish existing residential properties development of 827 new dwellings. An ambitious and innovative scheme will create a mixed tenure, sustainable community including a new library, children's play, leisure and community facilities, as well as commercial and retail provision.<br><br>Proposals include major environmental improvements:<br>• Set back of buildings from lake edge<br>• Creation of new reed beds<br>• Softer landscaping to lake boundaries<br>• Increased recreational use of the lake New fishing platforms<br>• New lakeside walks and viewing areas<br>• Prevention of proposed infilling to part of the lake<br>• Sustainable construction techniques |

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| | • New green areas and community parks |

# The risk of flooding is understood, managed and reduced

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| **Deventer, Neatherlands** | A project to investigate ways to improve the flood defences in Deventre, Netherlands to a worse case scenario of 1:1250 years. The project stipulated that life along the river must be encouraged and new recreation areas and housing must be created.<br><br>The quay wall provided the only existing flood defence and was regularly breached onto the quayside. The project concluded that:<br><br>• All future development should be stepped back from the Quayside, existing hard core forecourts to be remodelled to create SuDS systems and provide flood waters room to breach.<br>• New buildings will be flood proofed. Living areas will be above ground, with recreational areas and car parking at ground level.<br>• A new flood proofed road tunnel creates space for new recreational space and buildings above.<br>• The project showed that flood defences do not have to be limited to one use, but can and should be multi functional.<br>• Riverside is opened up and is more attractive to residents and visitors. |

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| **Greenwich Peninsular** | A highly contaminated site, enclosed to the north and north east by the River Thames. The site was extensively developed ahead of the Millennium celebrations, where the Millennium Dome (now O2 Centre) formed the main stage of UK celebrations.<br><br>A length of 1.24km of existing river site frontage needed to be replaced, providing an opportunity for innovative designs. 130m length of existing defence was retreated by 10 m inland to create an extensive habitat, access and viewing points for public. Areas of salt marsh were allowed to develop and the use of timber fenders which helped to provide habitats for estuarine animals and plants.<br><br>Within the tidal zone surrounding the site several redundant structures within the river were retained and now form ecological structures. |

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| **Portland Green Streets.**<br><br>**Portland Oregon, USA** | A project designed to reduce urban runoff within Portland, by developing on street SuDS systems which are branded 'Green Streets'. Four main 'street' types have been developed across the city:<br><br>**Stormwater Curb Extension**<br>Extending into the pavement area, stormwater curb extensions transform the curb lane into a landscape area. Curb extensions can conveniently integrate a ramp for safe pedestrian crossing.<br><br>**Stormwater Street Planter**<br>Stormwater Street Planters – raised beds, between the pavement and the curb work well in areas with limited space, and they allow for adjacent street parking or travel.<br><br>**Rain Gardens**<br>In areas with plenty of space, wide ground beds are opened up allowing direct filtration of rain water . They can also transform awkward junction into safe pedestrian and bicycle crossings.<br><br>**Simple Green Street** |

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| | Excavating an existing planting area behind a reinforced curb, with breaks in the curb stones to allow flow of water to the garden and landscaping with appropriate vegetation is a simple approach to capture and treat runoff.<br><br>The gardens provide rainwater attenuation reducing street flooding overloading of the sewer system, and reduced regular discharges from CSOs to the Willamette River.<br><br>The Green Street gardens aid improvements to :<br><br>• Clean and cool air and water<br>• Increase community, amenity and property values<br>• Enhance pedestrian and bicycle access and safety by improving road crossing points<br>• Protect valuable surface and groundwater resources<br>• Add urban green space and wildlife habitat<br>• Help meet regulatory requirements for pollutant reduction and watershed resource management<br>• Reduce stormwater in the sewer system<br>• Save money on wastewater pumping and treatment costs |

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| **Sutcliffe Park Kidbrooke** | For years the River Quaggy at Sutcliffe Park was lost underground in a culvert. Local residents only became aware that a river was there when their homes flooded more frequently as development increased.<br><br>Sutcliffe Park in Kidbrooke is now an open public recreational space which also acts as a holding space for high river flows from the River Quaggy.<br><br>• The 'culverted' river was returned back to its natural state. In the process, the opportunity was taken to turn the bare, uninteresting park into a popular green space.<br><br>• A flood storage area was constructed that can hold up to 85,000m3 of flood<br>Water. It now protects 600 homes and businesses from flooding.<br><br>• Boardwalks, bridges and footpaths were installed, trees and wildflower meadows planted, and an outdoor classroom created.<br><br>Sutcliffe Park demonstrates cross-borough collaboration providing a solution in one borough (Greenwich) to flood-risk communities in another (Lewisham). |

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| **Chambers Wharf, Southwark - St Martins Property Investments Ltd** | This site is located near to Tower Bridge on the site of a former wharf on the south bank of the River Thames. Key features of the development include:<br><br>Six new buildings with 596 residential units – 189 of which will be affordable. There will be some commercial and retail units at ground level, fronting Chambers Street<br><br>**Flood risk management**<br>• 160 Metres of renewed defences<br>• 232 cubic metres of additional flood storage volume provided<br>• Ground level will be 1m higher at 5 m AOD to reduce residual flood risk.<br>• The buildings are being set back 9 metres from the new retreated Flood Defence to provide operational access<br><br>**Brownfield regeneration**<br>• The site was formally an 18th and 19th century shipyard. The river warehouse |

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| | was initially built in the 1930s as a warehouse/cold store for imported meat and other food, and was used for this purpose up until the 1980s.<br><br>**Sustainable design & construction**<br><br>• Green roofs across the site. 3,900 sq m2 of amenity and biodiversity roofs<br>• 'Excellent' Eco Homes rating Carbon emission reduction: in excess of 30% lower than Building Regulations Part L 2006<br>• Renewable energy: Combined heat and power units; ground source heat pumps; solar thermal panels; rainwater harvesting and wind turbines<br><br>**Habitat and conservation value**<br>• Removal of old jetty structure to create new foreshore habitat and reversing encroachment into the Thames<br>• New habitat creation, nesting boxes, roosting posts and green space<br><br>**Increased riverside recreation**<br>• A new 160 metre riverside walkway with public and private gardens adjacent to the river will be created. |

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| **Greenwich Peninsula – Meridian Delta Ltd** | 190 acre development site - London's largest regeneration scheme. 11 000 new homes, 29 000 new jobs**,** 3.5 million square feet of office space - a brand new business district for London**,** 150+ shops and restaurants. Being developed in phases / plots in line with overall masterplan by Terry Farrell and Partners.<br><br>**Flood risk management**<br>• 1.7km of replaced/ refurbished flood defences already in place on the eastern side, with a further 700m proposed on the western frontage<br>• Flood defences designed to protect from tidal flooding for the 1 in 1000 year event, plus an additional 600mm freeboard for climate change<br>• Surface water flood risk reduction on each plot will be provided in line with the London Plan<br><br>**Sustainable construction**<br>• There is a green roof masterplan covering the whole site. It is expected to form Europe's largest mass of green roofs<br>• Aspiration for the highest environmental standards for new buildings. Code for Sustainable Homes Score level 4 rating with an expectation to reach Code level 6 by 2012<br>• The designs will result in lower water demand, grey water recycling and rainwater harvesting and will promote minimisation of waste<br><br>**Land decontamination**<br>• Former contaminating uses including gas works<br>• One of the most extensive ground contamination remediation exercises ever carried out in the UK<br><br>**Increased habitat**<br>• 850m inter-tidal terracing for habitat creation, salt marsh, timber fenders and areas of newly planted Habitat<br>• Incorporation of a continuous buffer zone of widths between 10m and 50m. This also allows for access to the flood defenses<br>• Creation of green piers retained and turned into ecological features<br><br>**Increased riverside recreation**<br>• 19ha of new public open space<br>• 2.2 km of river walkways along the Thames path, increased amenity space, interpretation boards and viewing platforms |

# A climate change adaptation plan is in place

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| **One Gallions**[3] | One Gallions is the GLA's flagship net zero carbon scheme in Beckton, in the London Borough of Newham within the Thames Gateway area. Crest Nicholson Bioregional Quintain (Gallions) LLP is proposing to develop this as an annual net zero carbon development with 260 residential units and associated community facilities in accordance with the 10 One Planet Living (OPL) principles[4], to create a sustainable community.<br><br>  <br><br><br>The approach to be applied will significantly reduce potential carbon emissions and wider environmental impacts, through a host of measures such as renewable energy, energy efficient architecture, use of natural and recycled materials, as well as integrated waste management, on-site food growing and sustainable transport measures.<br><br>The site will be compliant with Code for Sustainable Homes Level 4 requirements. In terms of energy efficiency, it is proposed that Level 6 standards are met.<br><br>**Climate Change Adaptation Measures**<br>A range of Climate Change adaptation measures will be applied to future proof the development. The following measures reflect the adaptation strategy of One Gallions:<br><br>**Use of ground floor:** No habitable rooms will be located on ground floor level. This significantly reduces the flooding risk of residential dwellings at the One Gallions development.<br><br>**Cooling:** A future proofed cooling strategy will be applied to allow adapting to potential impacts of climate change such as increased solar gain. This includes exposed thermal mass on ceiling soffits and mechanical ventilation.<br><br>**Building orientation:** The orientation of the buildings maximises natural light yet considers the potential of overheating during hot summers and the likely increases in temperature due to climate change.<br><br>**SuDS:** Sustainable drainage systems (SuDS) such as rainwater storage for irrigation of roof gardens have been included in the design to adapt to the likely increase of heavy rainfalls in the future. |

[3] http://www.onegallions.com/
[4] http://www.oneplanetliving.org/index.html

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| | **Benefits of Reducing Climate Change Impacts**<br>The careful consideration of climate change impacts in new developments is an important step in managing business risk as well as providing a better quality product for customers. These measures help to reduce costs in use for our customers as well as reducing the social cost of climate change for UK plc. The risks associated with global climate change are becoming increasingly clear even if the actual outcome for UK homeowners is still uncertain. It is not possible for Crest Nicholson to foresee all of the risks associated with climate change, but these measures attempt to future proof our new homes so that exposure to climate change risks is limited. |

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| **Plantation Place, City of London** | Plantation Place[5] is in the heart of the City of London and provides an adaptable and efficient workplace for almost 4000 people.<br><br>The layout and massing of the building provides opportunities for natural ventilation in a city centre location. The building achieved BREEAM 'Very Good' level[6].<br><br>The top two sections of the building are set back from street level and a double skin façade, combined with a smaller floorplate provides the option of mixed mode ventilation (air conditioning and natural ventilation) and in the case of the top section- full natural ventilation.<br>As well as improving comfort, the mixed-mode strategy helps reduce energy consumption, therefore reducing CO2 emissions from the building.<br><br>The setting back of the upper sections of the building also provides roof garden terraces which provide outdoor space for building occupants and green planting. Large masonry "fins" which act as shading devices reduce solar heat gain to the office spaces. |

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| **Portcullis House, Westminster** | Portcullis House[7] in Westminster provides office space and meeting rooms for Members of Parliament and was designed to provide comfortable internal conditions with a low energy ventilation system.<br><br>The building structure uses wave shaped concrete slabs whose undersides are left exposed, forming the ceiling of the spaces within the building.<br>The exposed concrete slab provides thermal mass to the occupied space and the wave shape of the slab increases the free area of thermal mass.<br><br>Thermal mass is used to absorb heat in space and stop internal areas heating up so quickly. It is used most effectively when air is passed over it to release the stored heat during the night time.<br>By designing a thermally heavy building the ventilation strategy could be designed to be less energy intensive whilst maintaining comfortable internal conditions.<br>Layout of accommodation within building minimises solar gain to meeting rooms and spaces with a typically higher cooling load.<br><br>The fourteen chimneys of Portcullis House exhaust stale air gathered up form shafts connected to the offices below and draw in fresh air at their base through heat recovery units to supply the fans housed in the roof space. |

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| **Barclays Bank PLC, 1 Canada** | The Barclays Building's 160 meters above ground level, 400 $m^2$ wildflower green roof is one of many green roofs within the Canary Wharf Group Estate, totalling approximately 6000 $m^2$. |

[5] http://www.arup.com/facadeengineering/project.cfm?pageid=1794
[6] http://www.arup.com/europe/newsitem.cfm?pageid=1069
[7] http://www.galinsky.com/buildings/portcullishouse/index.htm

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| **Square, London.** | The roof was built principally for biodiversity improvement, but the combined area of all of Canary Wharf's green roofs also contributes to reducing surface run-off, internal heating and contribution to the local urban heat island. Reducing heat island effect can in part be achieved by providing green roofs with vegetation which absorb heat and use it through evapotranspiration- a natural process for plants.<br><br>At the Barclays Building the roof is an extensive (lightweight and self sufficient, accessible only for maintenance) type roof planted with drought and wind tolerant plants 160m above ground level.<br><br>The Barclays green roof is also an excellent SUDS example, reducing run-off by around 40-60%. |

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| **Howberry Park, Oxfordshire** | When complete the Park will have a total developed area of 360,000 sq ft (33,449 sq m) gross, with potential for further recycling of earlier phases. Set in a mature landscaped environment, the Park has extensive views across the farmland and the Chilterns and is set next to the River Thames at Wallingford, Oxfordshire.<br><br>Howbery Park has been designed in keeping with its surroundings encouraging the natural environment to form a creative and efficient working place. Buildings have been developed to minimise their impact upon the environment, feature include natural ventilation and cooling, increased energy efficiency of fittings and rainwater harvesting systems.<br><br>The park is located close to major conurbations with excellent links by road, rail and bus. Tenants also have use of a pool of bikes to transport themselves around the business park and have access to recreational activities not normally associated with business parks, such as boating activities, nature walks. The park even boasts an active running club. |

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| **ZED (Zero Energy Developments) Factory** | The now well recognised BEDZED development is now one of a number development ranging in size and location by the ZED team.<br><br>Though the developments vary from two apartment builds to developments of 80+ dwellings, each project is built using the ZED Standards each aimed at reducing the environmental and carbon foot print of the development.<br><br>• Super-insulated building fabric. Uvalue 0.1w/per/m2<br>• All glazing to have overall frame & glass<br>• Airtight construction tested to achieve 1.5 air changes per hour at 50 pascals.<br>• Passive heat recovery ventilation using a wind cowl.<br>• Passive solar gain where possible.<br>• Energy saving lighting throughout.<br>• Maximised day lighting to all habitable rooms & workspaces.<br>• Solar shading covering 100% of the glazed aperture at noon in summer.<br>• Night time purge ventilation.<br>• Thermally massive ceilings walls and floors with a minimum of 50mm dense concrete (or equivalent) of 75% of visible surface area.<br>In all developments fossil fuels have been designed out - the properties require no fossil fuel use and renewably- powered transport<br>options have been integrated into all the developments<br>• Residents have an Ecological footprint of less than 2 global hectares per person<br>• Residents have CO2 emissions of less than 2.1 tonnes per person<br>• The developments use no more energy that could be provided from native renewable sources (in this case from the UK). |

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