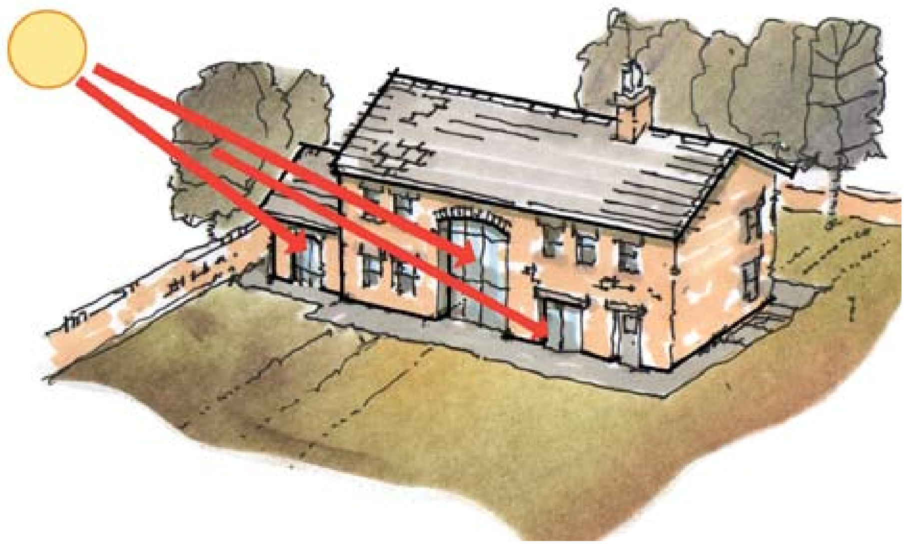
City of Bradford Metropolitan District Council

Supplementary Planning Document

www.bradford.gov.uk

Sustainable Design Guide SPD

Increasing the lifetime value of new development and refurbishment



November 2006

Sustainable Design Guide

This Supplementary Planning Document (SPD) was adopted by Executive on 28th February 2006.

The SPD provides further guidance in support of policies UDP3, UDP5, UDP8, UDP9, UR2, TM8, TM19, TM19A, D1, D2, D5, D6, D7, D14, NE5, NR12, NR13, NR16 and P7 of the Replacement Unitary Development Plan (RUDP, adopted October 2005).

The SPD has undergone consultation in line with the Town and Country Planning (Local Development) (England) Regulations 2004, and will therefore function as an SPD to the emerging Local Development Framework (LDF), which, in time, will replace the RUDP.

Contents

1.0 Introduction

1.1 What is Sustainable Development?

The commonly accepted definition of sustainable development is:

"*...development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" Brundtland Commission Report, 1987.

The Government's '*A Better Quality of Life: A Strategy for Sustainable Development in the United Kingdom*' (1999) rephrases this concept as:

"*The simple idea of ensuring a better quality of life for everyone, now and for generations to come*"

This same document identifies four key objectives for achieving sustainable development:

- Social progress that recognises the needs of everyone.
- The effective protection of the environment.
- The prudent use of natural resources.
- Maintaining high levels of economic growth and employment.

The Government's 'Securing the Future: Delivering the UK Sustainable Development Strategy' (2005) sets out the guiding principles to achieving sustainable development as:

- Living within environmental limits.
- Ensuring a strong, healthy and just society.
- Achieving a sustainable economy.
- Promoting good governance.
- Using sound science responsibly.

1.2 Sustainable Development: Context and Principles

The principles and objectives of sustainable development lie at the heart of the UK planning system, with national, regional and local policy all advocating development which meets the economic, social and environmental goals of sustainable development. Bradford is no exception to this. The core policies in its Unitary Development Plan seek to:

- Support economic growth and prosperity
- Safeguard undeveloped greenfield land by channelling development to previously developed brownfield land
- Safeguard areas of natural and ecological importance
- Ensure that housing provision meets the district's needs.
- Protect Bradford's heritage and local distinctiveness
- Ensure a high quality of design of buildings, streets, spaces and neighbourhoods.
- Improve accessibility and promote non-car modes of transport.

- Manage the district's natural resources, including energy, efficiently and with care
- Minimise and efficiently manage waste and pollution.

1.3 Sustainable Design

Sustainable design is nested within the concept of sustainable development and concentrates on how individual buildings or groups of buildings can meet the objectives of sustainable development. Sustainable design is concerned with ensuring that:

- The construction of buildings minimises the amount of resources, including energy, needed as well as waste and pollution.
- The materials used for construction are environmentally friendly.
- The existing built fabric is re-used as far as possible.
- Buildings use or have the potential to use renewable energy sources.
- Buildings are energy efficient.
- Buildings have a long lifespan and can be easily adapted during the course of their life.

There is a particular focus on long-term benefits rather than short-term savings, with the whole lifetime of a building considered rather than the here and now. Over its lifetime, a sustainably designed building will have cost less to build, heat and light than a conventional building; and will have had a much smaller impact on the environment in terms of the amount of resources it has consumed and waste and pollution produced during its lifetime. These economic and environmental gains have direct impacts on the quality of life in terms of the occupier of a building and society as a whole.

Opposite page: woodland at Tong Park, Tong (upper) and the foot of Nan Scar, Leeming (lower).

Left: Haworth Main Street: a high quality space which has successfully adapted over time.

1.4 The Purpose and Status of the Sustainable Design Guide

In order to fully pursue the objectives of sustainable development, City of Bradford Metropolitan District Council must ensure that the principles of Sustainable Design are adhered to by new development. It is therefore essential that people who apply for planning permission, whether they are large-scale developers or householders, are provided with guidance as to how their proposals can meet the principles of sustainable design.

To this effect the Council has produced this Sustainable Design Guide, which will function as a Supplementary Planning Document (SPD) linked to a number of policies of the UDP. The policies of the UDP which apply to this Guide have been reproduced in Section 5 of this document *(pages 28-29)*.

In time, the UDP will be replaced by the Local Development Plan (LDP). This Guide provides an elaboration of the UDP and forthcoming LDP policies which concern sustainable design. When determining planning applications the Council will treat this Guide as a material consideration to the adopted UDP or LDP. Therefore developers must ensure that they demonstrate they have applied the principles and guidance contained in this document and conform to the respective UDP or LDP policies.

1.5 How to Use this Guide

Sustainable design is not limited to larger scale development, such as building from scratch. The principles are just as applicable to smaller scale development such as the extension or conversion of a building. The table on this page summarises which sections of this guide (i.e. which components of sustainable design) are relevant to different types of development. It also indicates which sections of the Council would also need to be involved when undertaking these different types of development.

	Project					
Contact or Consider	**New Build**	**Extension**	**Conversion/ change of use**	**Internal Refit works**	**Landscaping /external**	**Demolition**
Sustainable Design Guide	✔	✔	✔	✔	✔	✔
Planning Permission	✔	✔	✔		✔	✔
Building Control	✔	✔	✔	✔		✔
Environmental Health					✔	✔
Public Rights of Way	✔	✔	✔		✔	✔
Site Appraisal	✔	✔			✔	
Principles of Sustainable Development	✔	✔	✔	✔	✔	✔
Re-use of Buildings	✔		✔			✔
Reclamation of Materials	✔		✔	✔	✔	✔
Sustainable Construction	✔	✔				
Construction Waste Management	✔	✔	✔	✔	✔	✔
Building Materials	✔	✔	✔	✔	✔	
Building Layout	✔	✔	✔	✔		
Sustainable Energy Use	✔	✔	✔	✔		
Passive Solar Energy	✔	✔	✔	✔	✔	
Natural Ventilation	✔	✔	✔	✔	✔	
Insulation	✔	✔	✔	✔		
Heating	✔	✔	✔	✔		
Renewable Energy	✔	✔	✔			
Water Management	✔	✔	✔	✔	✔	
More Efficient Water Fixtures	✔	✔	✔	✔		
Water Re-use	✔	✔	✔	✔	✔	
Drainage	✔	✔	✔		✔	✔
Noise	✔	✔	✔	✔	✔	✔

2.0 Sustainable Development

The benefits of sustainable design are maximised when used in conjunction with the principles of sustainable development. Therefore before going into the main focus of this guide, it is worth briefly looking at how the principles of sustainable development can be applied when putting together a proposal for a site. This is done in two stages: the site appraisal, and an exploration of how the site can best meet the objectives of sustainable development.

2.1 Site Appraisal

In order to make the most out of a site, it is necessary to gain a full understanding of the opportunities and constraints it presents before even considering the design of the proposed development. In this respect, site appraisals can be valuable tools in ensuring that the proposal is working with the site, rather than being imposed upon it. There is also an opportunity to come up with a better solution which is specific to the site which might not otherwise have been reached.

A full site appraisal should clearly show the existing content and context of the site in a visual and/or written format. They should be submitted alongside the application, but would ideally be available at the pre-application stage.

While a full site appraisal is necessary for all major planning applications, a much smaller application, such as a house extension would only need a brief statement or perhaps photographs or an annotated plan showing the key considerations.

Information in a site appraisal should as a minimum include an analysis of:

- **Movement and accessibility**. Where are there access points to the site? What are the existing movement patterns through and around the site? How accessible is the site by public transport, foot, cycle and car? How well is the site linked to shops and services? What existing public rights of way serve the site? Is there potential for enhancement of the rights of way network?
- **The character of the area.** What are the features of the surrounding area? What context do the adjacent land and buildings provide? Are there any key landmarks or features? Are there any important views into, out of or involving the site?
- **Site stability and contamination.** Is the land contaminated? Are any remedial earthworks needed?
- **Existing buildings on the site and their potential for re-use.**
- **Historic Interest.** Is the site within or does it affect the setting of a conservation area? Does the site contain or impact the setting of a listed building? Is the site of archaeological interest?
- **Water, natural interest and biodiversity.** What is the existing vegetation on the site? Where are there trees? Are there any bodies of water or watercourses? What natural habitats exist in and around the site?
- **Sunlight.** How much sunlight does the site receive? Which direction(s) does it come from? Are there any variations across the site?
- **Microclimate, soil, drainage and water table.** How will water entering the site be managed to provide adequate flood protection for the development and to prevent adverse impacts to others?
- **Boundary features and their value to the site.**
- **Levels of atmospheric and noise pollution.**
- **The potential for a Combined Heat and Power scheme.**
- **Wind speed and direction.**

The reuse of vacant buildings is inherently more sustainable than demolition and building anew.

2.2 Sustainable Development and the Site

The next step is to determine how development which adheres to the principles of sustainable development could take place on the site, while taking into account the opportunities and constraints identified in the site appraisal. The following sustainable development considerations seek to ensure that the development minimises resource and energy consumption, has a minimal environmental impact and makes the best use of the site's assets.

If the site is Greenfield:

- If the site has not been previously developed, then strong justification is needed for any development on this site rather than the recycling of a brownfield site. For example, the site may be easily accessible by a range of modes of transport or development would not harm amenity or biodiversity.
- The criteria for developing a site, whether it is Greenfield or Brownfield are outlined in the Replacement UDP.
- Much of the District's greenfield land lies within Green Belt and there is a presumption against developing Green Belt land.

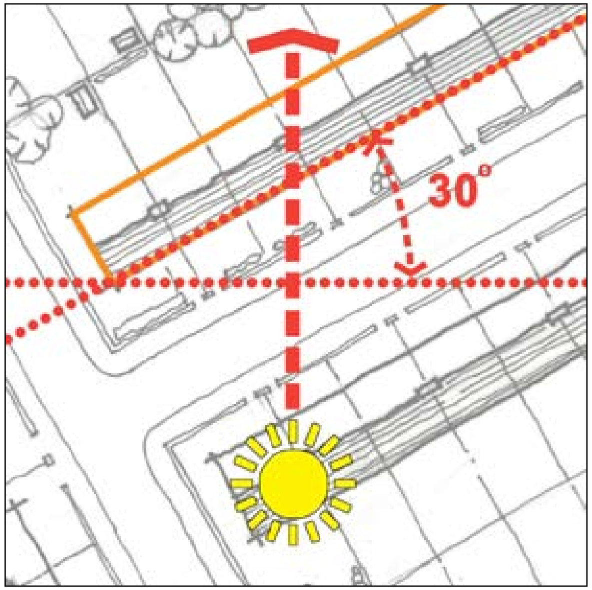
If the site is Brownfield:

- Brownfield sites are often the most sustainable option as they usually already lie within built up areas and are served by existing infrastructure. The urban location of many brownfield sites also allows for higher densities and therefore a more efficient use of the land.
- With a brownfield site is it worth considering how any existing buildings or infrastructure, such as roads, public rights of way and pipework, already on the site could be incorporated into the new development; saving money, energy and minimising the impact of the development on the environment.
- If the site is contaminated, it is necessary that health and the environment are not placed at risk by contamination; no land is underused because of contamination; and the economic cost of contamination is kept to a minimum.
- If remediation works are necessary, simply covering up contaminated land, though low cost, may not be the best solution in terms of health and the environment. This, coupled with the cost associated with removing contaminated soil, means that on-site techniques such as bio-remediation, soil vapour extraction and soil washing are often preferable as they are cheaper.

Site Layout and Building Orientation

- Buildings should be oriented to face within 30º of due south in order to maximise the potential for the radiation of the Sun to heat the building (passive solar heating). This orientation also increases the potential for using natural daylight to light the building and using solar energy and water heating technology.
- The layout of buildings should not increase wind speeds or create funnels as both would exacerbate heat loss, impact the site's microclimate and lower amenity.

In order to maximise solar gain, natural daylight and water heating technology, buildings should be orientated to face within 30º of due south.



Vegetation

- There should be a presumption to retain mature trees and hedges and the opportunity should be taken to supplement this with more planting.
- Trees and other vegetation are aesthetically pleasing and have an important bearing on the microclimate of the site by providing a 'heat sink', shelter from winds, a privacy screening and a barrier to noise and traffic pollution.
- Deciduous trees are preferred to coniferous trees as they provide shade in the summer and the lack of leaves during winter allows sunlight penetration.
- Native species should be retained and introduced to the site as these are most likely to thrive and will strengthen the existing network of habitats and ecosystems.

Landscaping

- Areas of hard surfacing should be minimised by design or by planting to minimise water runoff and the potential of flooding.
- Where hard surfacing is used, it could incorporate gaps which allow vegetation to grow through. Alternatively, water permeable paving could be used.
- The potential for rainwater to be retained on site in surface ponds or in Onsite Stormwater Detention systems should be assessed.
- Landscaping and facilities introduced should be attractive, environmentally sound and should cater for all users.
- 'Shelter belts' of trees and other vegetation should be planted to shelter buildings from the prevailing wind, minimising heat loss, but ensuring passive solar gain.

Movement and Transport

- Existing rights of way across the site should be preserved where possible. Any changes may need a legal order.
- The site should be easily accessible for pedestrians and cyclists, with safe, convenient routes which link with a wider network of routes, encouraging the use of these methods of transport.
- The accessibility of sites and buildings should satisfy the Disability Discrimination Act (DDA).

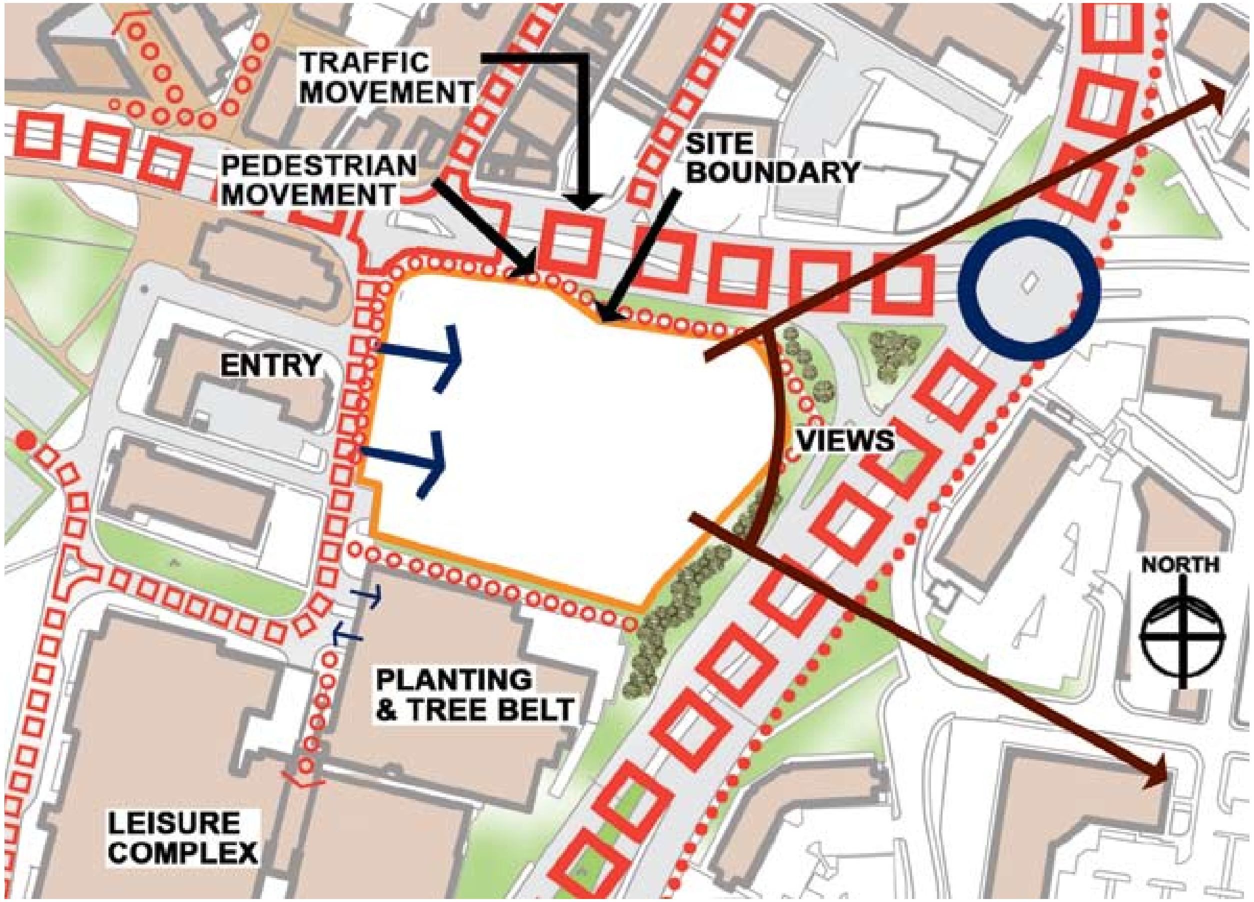
- The development should encourage the use of public transport through safe convenient links to services and stations/stops.
- Provision should be made for car club vehicles and facilities for non-petrol vehicles.
- Although access by private car may be necessary, the development should not be dominated by roads and vehicles movement.
- Consider the appropriateness and desirability of creating car free developments or home zones, where speed limits are lowered and the street is more open to use as a safe play area for children.

Water Management

- The potential for the site to accommodate systems which collect, store and re-use rainwater for watering plants and open spaces and for flushing toilets should be investigated.
- The potential for the site to accommodate infrastructure for waterless or composting toilets should be investigated, as well as the provision for the composting of organic waste and facilities where recyclable waste can be separated and stored.
- The potential for the site to incorporate a Sustainable Urban Drainage System (SUDS) should be investigated. Contact the Council's Drainage section to see if a SUDS is possible. A SUDS will have to meet the requirements of the Interim Code of Practice for Sustainable Drainage Systems.

Efficiency

- Higher densities make more efficient use of land and are also better for potential combined Heat and Power (CHP) schemes.



Transport nodes and existing movement patterns through and around a site are important considerations when planning its future use and development.

3.0 Sustainable Building Design

3.1 Introduction

To design an individual building to be sustainable requires consideration of a number of issues from very early on in the planning and inception stage such as use of materials, adaptability for future uses and energy efficiency. Whilst early consideration of these issues maximises the opportunities for sustainability to be built into a project, it is possible to improve a project's sustainability even late in the stages of the development, while most existing buildings can be adapted to improve energy efficiency and environmental impact. The key principles of flexible building design can be summed up as follows:

- **Environmentally Friendly Building Materials -** Where possible, building materials should be sourced locally and from renewable sources. Where possible, avoid products which are highly manufactured as these tend to require high levels of energy in their production. Make best use of any materials left on site - recycling existing materials and utilising materials that are a by-product of other processes.

- **Flexible Buildings** - Creating flexible buildings and spaces that can be adapted to meet changing needs allows buildings be more easily reused. The mantra 'Long Life, Loose Fit' should be borne in mind when designing buildings. The more easily reusable or adaptable a building is, the smaller the amount of resources it will consume when a change of use or alteration to the existing accommodation is required. This approach can be applied from large scale developments such as factory and office buildings, where the needs of different occupants may change over time, right through to the design of a dwelling where the needs of successive occupants may vary, or the needs of an individual occupant may change over their life.

- **Renewable Energy Sources** - Buildings should be constructed, wherever possible to utilise renewable sources of energy. These are usually most cost effective if incorporated in the earliest stages of the building's life. If this is not possible, constructing the building in such a way as to allow the building to be easily adapted to use renewable energy sources leaves this option open to others in the future.

In an ideal world, every new development or conversion of refurbishment would incorporate as many elements of sustainable design as possible and the Council encourages this. However, even small changes at the design stage, such as raising insulation levels and passive solar gain and using environmentally friendly materials can make a big reduction of the environmental impact of new development and the costs over its lifetime.

At present BREEAM (the Building Research Establishment's Environmental Assessment Method) is the most commonly used method of measuring the environmental performance of buildings. BREEAM focuses on all aspects of a building, including energy use, health and well being, ecology, materials and water consumption and efficiency. The BREEAM ratings can be applied to a range of building types, including houses (where it is known as Ecohomes).

The BREEAM ratings are 'pass', 'good', 'very good' and 'excellent'. As well as demonstrating compliance with environmental requirements, obtaining a BREEAM rating shows that a building will have financial and well being benefits for its occupants, and it is therefore beneficial when it comes to marketing a building. For more details on BREEAM and EcoHomes see www.breeam.org.

The Grade II Listed National Trust property, Gibson Mill, near Hebden Bridge, has been refurbished using natural materials and incorporates renewable energy generation, including the photovoltaic and solar water heating panels on the roof.

3.2 Re-Use of Buildings

The vast majority of energy expended during the life of a building is used during its construction - the acquisition of materials, transportation of goods and construction of buildings, especially high specification commercial buildings, uses vast quantities of energy in comparison to the energy used to maintain and run the building during the rest of its lifespan. The current building stock in the district represents a huge investment in terms of environmental capital (i.e. buildings and spaces which create a sense of place and people identify with) and energy. The re-use of buildings should always be a priority as by this token re-use is an inherently sustainable activity.

Most existing buildings have the capacity to be restored and refurbished to suit a variety of modern requirements. Indeed the restoration and conversion of a building often provides the opportunity to upgrade and improve upon insulation standards, heating lighting and ventilation.

Key considerations before deciding to demolish a building should be:

- Can the building be reused or adapted to meet the requirements of the development or indeed any other relevant uses?
- Are there opportunities for improving the energy efficiency of the building?
- Is there any contamination or hazardous materials (e.g. asbestos) that need to be removed?

3.2.1 Historic Buildings

The Metropolitan District of Bradford has a rich architectural and cultural heritage displayed through a wide variety of historic buildings. These buildings have an invaluable role to play in fostering local distinctiveness, pride and creating sustainable communities. Some of these buildings are recognised and protected through Listed Building and Conservation Area Legislation (Planning Listed Buildings and Conservation Areas Act 1990).

Proposals to redevelop sites containing buildings of architectural or historic merit should always proceed with the greatest of care.

Historic buildings are a finite resource and demolition should always be the very last resort, particularly as the energy expended in demolishing an old building and building a new one is the least sustainable option. It is also the most expensive option: recent research undertaken by English Heritage in the North West of England found that, on the basis of repair cost projections over 30 years, the cost of repairing a typical Victorian terraced house was between 40% and 60% cheaper (depending on the level of refurbishment) than replacing it with a new home.

Much of the historic building stock in the district is robust, highly adaptable, and with regular maintenance could survive almost indefinitely. Research for English Heritage's 'Heritage Counts 2003' has shown that older housing costs less to maintain and occupy over the long-term life of the dwelling than more modern housing.

With imagination and well thought out ideas, most historic buildings can be successfully reused or adapted to meet modern day requirements. However it is a key principle that any works to such buildings should respect and enhance their historic character.

An important partof local character and distinctivenesss, historic buildings can also been seen as energy which has already been expended in terms of obtaining and transporting the materials the building is made of and the manpower used in their construction.

Works to Listed Buildings and unlisted buildings in conservation areas usually need consent from the Council and therefore it is wise to consult the appropriate Planning Office well in advance of any proposed works. Key principles when working with historic buildings are as follows:

- Minimal intervention
- Repair not replace
- Good Stewardship - regular inspections and maintenance (a stitch in time...)
- Reversible alterations
- Natural materials and traditional repair techniques

Historic buildings have an important role to play in the regeneration of the district. These buildings can add quality to a development and are usually constructed from high quality materials and building techniques. Most historic buildings, if sensitively maintained and repaired have a lifespan that vastly exceeds many modern day buildings and will go on to give many more years of usefulness.

3.3 Mothballing Buildings

When the original or existing use of a building ceases, there can be a period of a few months or even several years before a new use or occupier for a building is found. This is particularly true for historic buildings such as textile mills, or churches, and more recent buildings like office blocks. In the interests of safety and maintaining buildings of townscape value, it is important that disused buildings are kept secure and weathertight.

The mothballing of a building is not a means to an end, but it does improve the likelihood of re-using a building, and increases the potential for salvaging or re-using the fabric of a building.

In terms of sustainability, a vacant building which has been mothballed will be more readily re-useable, as, for example, it will not have been damaged by arson or vandalism, or damp has caused windows and doors to rot or caused structural damage, raising the cost of returning the building to use and requiring more resources to be consumed in repairing and refurbishing the building. Equally if it can be shown that demolishing a mothballed building is the only option, more fittings and materials can be salvaged from the building, producing an economic return and allowing the fabric of the building to be recycled rather than disposed of.

If a building becomes vacant and it seems likely that it will be some time before it will return to use, the following steps should be taken:

- Carry out a survey of the physical condition of the property, paying particular attention to the roof(s) and rainwater goods. Carry out any repairs if necessary. If the roof(s) and rainwater goods are in good working order, there is much less chance of damage to the fabric of the building by damp.

- Ensure all windows, doors and other openings are securely locked and if necessary, seal them with boards or shutters. If the property is set in a larger site, ensure that access to the site is controlled - secure and lock any gates, ensure that boundary walls or fences are robust and are free of breaches.

- Regularly inspect the building and/or site for damage, dumping and signs of intrusion. Make the site or buildings more secure if people have been trespassing. An untidy or vandalised building or site will attract more misuse.

- Check the gutters and downpipes are clear every six months to prevent damage from damp. Similarly, inspect the roof annually and carry out any repair if necessary.

- Most importantly, minimise the time a building or site is empty by working with the Council to find a new use for it. Obtain consents to do this from the Council, if necessary. If you are unable to upgrade the building or site or redevelop it yourself, market it so it can be sold to someone who will.

This elevation is part of a large, redundant complex. The complex is vacant, but is in a good state of repair with all entrances t the building secured. However, the longer a building stands empty the less likely it will be able to be re-used or its fabric recycled.

3.4 Demolition/Reclamation of Materials

The first preference is to retain and reuse existing good quality buildings. However, where demolition is necessary, the contractor should consider following a selective programme which allows the most valuable or potentially contaminating materials and fittings to be removed safely for later re-use or processing before the demolition starts.

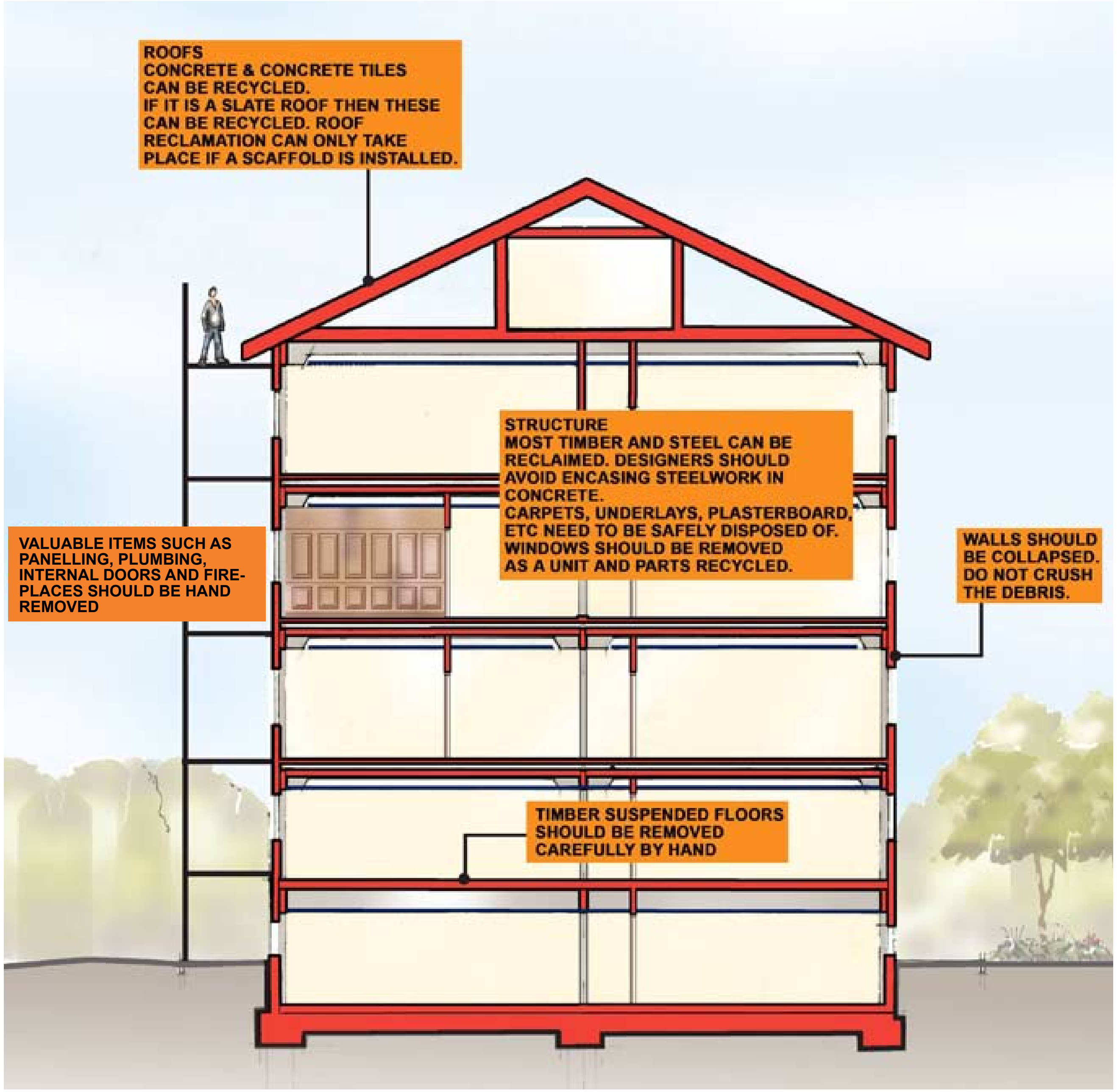
Deconstruction of buildings is preferable to wholesale demolition; this involves the dismantling of a structure in the reverse order to which it was constructed. This is the most efficient practice for separating materials for reuse, recycling and disposal.

Time is the most important resource when deconstructing and reclaiming materials as it is time consuming and so needs to be adequately programmed into the schedule.

Deconstruction can be more cost-effective than demolition when taking into account the reduction in landfill disposal costs and the revenues from sale of salvage materials. Deconstruction has many benefits, including the creation of low cost building materials, greater savings and job creation, reducing waster, saving energy and reducing demand for finite resources.

3.4.1 Extensions

- Variations in building materials can occur between the original building and later extensions. Entire extensions should be removed at one time and materials removed in reverse order.
- If the extension is an entirely freestanding structure, it could be retained until later in the process to provide a working surface for other parts of the building.



Each component of a building, from internal decoration to the building structure and foundations has the potential to be re-used or recycled, reducing the environmental impact of demolition and generating income.

3.4.2 Roofing Materials

- There is a high demand for all natural slates for re-use. Concrete tiles can usually be crushed and screened to create recycled aggregate (RCA).
- The Health and Safety Executive only allows roof reclamation if there is scaffolding on the building to the reclamation level.

3.4.3 Steel Sections and Structural Timbers

- Ubs, RSJs, Angles, Channels etc are easily disassembled using mobile cranes and trained riggers.
- Designers should try to avoid encasing them in concrete as this makes reclamation very difficult - connections should be bolted throughout.
- Structural timbers always have a high resale value. Large roof trusses should be lifted down intact with a crane and disassembled on the ground.

3.4.4 Stripping Out the Building

- Firstly there should be a selective strip out of all valuable and reusable fittings such as hardwoods, panelling, light fittings, plumbing systems etc.
- Remaining materials should be stripped and sorted at ground level.
- All timber except laminated is recyclable for chipboard etc.
- There is no recyclable use for carpets, underlays, plasterboard or fibreglass at present and these need to be disposed of.
- Windows should be removed intact if possible and the elements recycled.
- Timber floors and joists should be stripped using mostly hand tools. Safety is a key issue when stripping suspended timber floors

3.4.5 Masonry Walls

- Masonry walls should be demolished using a simple collapse system.
- It is best to avoid pulverising or balling down walls and wheeled loading shovel should be used as opposed to a tracked excavator or bulldozer in order to reclaim as much material as possible.

3.5 New Build / Extensions to Existing Buildings

3.5.1 Sustainable Construction

The construction industry consumes energy and resources and generates waste on a scale which dwarfs most other industries (DETR, 2000: Building a Better Quality of Life'). Each year 360 million tonnes of construction material are used in the UK and 70 million tonnes of waste are generated by construction and demolition. The UK is running out of suitable sites for landfill and the cost of landfill is increasing. Construction is also responsible for 30% of all road freight in the UK (Brent Council, 2004).

On a smaller scale, each construction site impacts the natural environment in terms of habitats, water and air, and people in terms of noise, fumes dust, and amenity.

Therefore there are potentially massive savings in the amount of energy and resources used by the construction industry and a reduction in the amount of waste generated if the principles of sustainable construction are applied. As well as saving money, energy and physical resources, a sustainable construction industry would have spin-offs which would benefit society at large.

Construction Waste Management

- The opportunities for minimising waste and recycling materials should be considered from the outset.
- If possible, employ contractors who are signed up to The Construction Industry Board's 'Considerate Contractor Scheme'. Approved contractors work in ways which minimise the impact of construction on the environment and local amenity.
- Agree with subcontractors how much waste (as a percentage) is acceptable before work begins and monitor the amount of waste generated.
- Give subcontractors the responsibility for purchasing and disposing of materials. This gives them a direct financial incentive to minimise waste.
- Segregate construction waste to keep disposal charges to a minimum. This includes waste which

decomposes which needs to be stored separately and taken to a composting site.
- Store chemicals, oils and diesel in labelled containers. Ensure there are no drips and report spillages immediately.
- Avoid wasting water by monitoring all water connections and repairing or replacing leaking pipes, hoses and installations.
- Maintain an inventory of materials on site.
- Obtain a list of potential buyers and sellers of used or recycled materials.

The long distance transportation of raw materials and building materials not only adds to the cost of development, it also has a greater environmental impact.

3.5.2 Building Materials

The choice of materials used for a building or extension has a considerable bearing on its long-term sustainability as factors such as the energy required to manufacture and transport, the lifespan, the ability of repair or renew, the potential for recycling, cost of disposal, and ecological impact in terms of use and disposal all vary from material to material.

The average modern building built in the UK has an expected life of about 60 years. By thinking carefully about the design of buildings, the protection given to them and the materials used, this can be extended to up to 200 years or more, a lifespan which is comparable to many of the historic buildings which characterise the Bradford District. Buildings with longer lifespans are inherently more sustainable than those with shorter lifespans as the construction of buildings is an energy and resource intensive process. At present the energy used in the manufacture and transport of building materials amounts to 24% of all energy used by industry in the UK.

The manufacture of some building materials is unsustainable in terms of the volumes of energy and resources needed to make them. This includes commonly used building materials such as concrete, uPVC, PVC and extruded polystyrene. The manufacture of these materials and others such as alkyd (oil based) paints and phosphogypsum (used in plasterwork) generate pollution and toxic compounds which can harm ecosystems and human life. Manmade or artificial materials can be toxic and/or harmful to human health as they gradually decay over time and can present problems when it comes to disposing of them safely or using methods other than landfill, particularly as heavily processed materials are not biodegradable. The use of artificial building materials, lining and insulation and the use of synthetic or petrochemical decoration can mean that the inside of a house can be up to ten times more polluted than the outside. This has clear impacts on health, particularly as society spends increasingly more time indoors. The most common by-products of the decay or disposal of some artificial building materials are believed to produce carcinogenic substances; organic compounds and solvents associated with headaches and nausea and are harmful to the nervous system; and phthalates which are suspected hormone disrupters.

Fortunately, there is a choice of materials available for any type of building component or installation, with varying environmental soundness and impacts on health. It is simply a case of being aware and considering the benefits of alternative building materials. It does not necessarily follow that environmentally sound materials are vastly more expensive than commonly used materials. In fact, in some cases they are cheaper. In some cases there is a trade-off between spending slightly more for a material which is not harmful to health and/or could be easily sold on, recycled or disposed of at the end of the building's lifespan.

The Technical Appendix of this Sustainable Design Guide contains lists of building materials for certain components of buildings with an indication of their preference in terms of environmental impact and any health risks associated with their use. The list is by no means absolute and exhaustive, but should be seen as the first step in considering sustainable building materials.

In most cases choosing a building material will be a matter of finding a balance between the following criteria:

- Clean or non-polluting
- Healthy (to humans and domestic animals)
- Renewable
- Abundant
- Natural
- Recyclable
- Energy-efficient
- Locally obtained
- Durable
- Design efficient

The Waste and Recycling Action Programme (WRAP) is a government-funded organisation which promotes recycling and supports the recycled materials industry and market. WRAP's website (www.wrap.org.uk) includes a directory of over 3,200 recycled products including materials used for construction and landscaping.

Timber
- Use timber which is locally produced and from a certified sustainable source (where felled trees are replaced by new planting). If this is not possible, use Forest Stewardship Council approved imported timber. This guarantees that the source is renewable and is not contributing to the destruction of the world's forests.
- European softwoods are preferred as these have to travel a shorter distance, unlike tropical hardwoods (including plywoods).
- Find out whether suitable recycled timber is available at local timber merchant's.
- Avoid timber which has been treated using harmful chemical-based preservatives such as Copper Chrome Arsenate.
- Use natural oil and wax preservatives as these allow the pores of the timber to stay open, enabling the wood to breathe and stabilise the relative humidity of the building.

Stone
- Stone is the district's traditional building material and therefore should be used in conservation areas and at listed buildings.
- Stone or stone cladding provides durable, low maintenance building elevations, walls and surfaces.
- Due to its cost, non-renewable nature and the impact of its extraction, stone should not be used wastefully. For example, if rubble or hardcore is required, use broken bricks, recycled crushed concrete, material from road surfacing or minestone (waste stone from coal or ore extraction) instead of stone.

Brick
- Brick has much of the durability and low maintenance of stone and also comes from non-renewable sources.
- Unlike stone, brick is an energy and resource intensive material to produce and is not part of Bradford District's identity.
- Recycled bricks are preferable to new.

Concrete
- Like brick, concrete is energy and resource intensive in its manufacture and uses non-renewable aggregates and should therefore be used sparingly.
- Concrete is very difficult to repair and can only be recycled by crushing it.

Mortars
- Cement is energy and resource intensive to produce and should be used sparingly.
- Cement is harder than brick and stone and can damage brick and stone by preventing them from naturally expanding and contracting and can cause water to become trapped in the stone or brick.
- Lime mortars have been used for centuries. They allow stone or brick to expand and contract, do not trap moisture, and unlike cement, can be cleaned from brick or stone, allowing them to be recycled.

Plastic
- PVC (Polyester Vinyl Chlorine) is widely used in building materials such as cables, window frames, doors, walls, panelling, shopfronts, water and wastewater pipes and in vinyl flooring, vinyl wallpaper and window blinds.
- PVC-u (unplasticised PVC) is the most environmentally damaging of all plastics and should in the least be substituted for ethylene-based plastics, or better still, more environmentally friendly materials such as timber.
- PVC-u requires hazardous chemicals and very large amounts of energy in its production, which releases harmful emissions and creates toxic waste.
- PVC-u is not biodegradable and only has a useful lifespan of about 15-20 years. High performance

Utilising local and/or natural building materials can allow modern development to sit successfully within its setting as well as making the development more sustainable.

factory stained timber windows are guaranteed for 30 years, while any timber window can last for generations if it is well maintained.
- PVC-u cannot be repaired or improved. Any damage means it must be replaced.
- Recycled PVC is inferior to virgin PVC, therefore disposal to landfill is often the only option when uPVC comes to the end of its useful life. As landfill costs are set to rise, the disposal of uPVC will become more expensive.

Aluminium and Steel
- Aluminium and steel are very energy intensive in their production and a more environmentally friendly material such as timber is preferred.
- Aluminium and steel are is easily and commonly recycled and are preferable to using ‘new’ aluminium or steel.

Green or Living Roofs
- Green or living roofs consist of vegetation such as sedum planted on a substrate a few centimetres thick on top of a waterproof membrane.
- A number of manufacturers have developed substrates, drainage layers, waterproof membranes and pre-planted mats, meaning green roofs can be easily made to measure.
- Green roofs can be installed on roofslopes between 1.5 and 20 degrees, and with more complex systems, green roofs are possible on slopes of up to 30 degrees.
- Living roofs provide higher levels of insulation, reducing power used by heating and air conditioning and making buildings more comfortable to occupy.
- Living roofs typically absorb between 50% and 80% of the rain that falls on them, reducing the chances of flash flooding. The retention of moisture helps to reduce the ‘heat island’ effect in urban areas in summer.
- Living roofs absorb atmospheric and noise pollution.
- As well as providing visual amenity, living roofs can provide an undisturbed habitat for birds and insects.
- Although they can be energy intensive to manufacture, the environmental and economic benefits of green roofs can offset this.

Rammed Earth
- A moistened subsoil made up of a suitable balance of gravel, sand, silt and clay (sometimes with added lime or sugar paste) is compacted to create a dense, hard, stone-like monolithic wall.
- The standard thickness for earth walls in houses is 300mm, though internal partitions can be as thin as 100mm, while in other buildings external walls can be up to 1000mm thick.
- Rammed earth walls offer high levels of insulation, evening out temperature changes between day and night.
- The thickness of rammed earth walls means they offer high levels of acoustic insulation.
- Nearly every finish that can be applied to brick or concrete can be applied to rammed earth, including tiles, render, plaster and paint.
- Rammed earth has a very low environmental impact compared to other wall materials, as there is not heating involved, just the mechanical compacting of the subsoil. Rammed earth is completely non-toxic and natural.
- Rammed earth buildings have lasted for centuries and require very little maintenance.

Green roofs are not only attractive and eco-friendly, they can be made to measure and used on most roofs with a slope of 30^{o} or less

Paints and Finishes
- Conventional synthetic paints and finishes (whether oil based or water based) contain complex petro-chemicals with additives in the form of pigments, binding agents, hardeners, dryers, thickeners, surficants, anti-foaming agents, emulsifiers, fungicides and so on. The manufacture is energy intensive and produces an amount of waste which is at least equal to the amount of paint produced.
- Many conventional paints and finishes contain Volatile Organic Compounds (VOCOs) which evaporate rapidly and contribute to atmospheric pollution.
- The blend of chemicals and solvents in conventional paints and finishes means that they are very slow to biodegrade and release toxic substances in the process. These toxins can cause headaches, nausea, skin irritation, and respiratory illnesses.
- Conventional paints and finishes lower the air quality inside buildings and can impact the health of the occupants.
- Many conventional paints and finishes form a non-porous airtight seal over walls, joinery, etc., leading to a build up of condensation.
- Natural paints and finishes are based on plant and

mineral ingredients which are manufactured in a less energy intensive and polluting way than conventional synthetic paints. Some firms manufacture paints which contain no petrochemicals.

- Natural paints and finishes can be non-toxic and free of VOCOs.
- Natural paints and finishes allow walls and joinery to 'breathe'

3.5.3 Building Layout

A well-planned building layout should maximise the potential offered through solar gain, natural light and ventilation and minimise reliance on extra building energy services. Site layout and building orientation play a key part in this and have been discussed fully in section 2.2. However, on a more localised scale and of particular relevance to conversions of existing buildings, the orientation of rooms within a building and careful consideration of the layout of floor plans can make an important contribution to the environmental impact and sustainability of the development.

- Habitable rooms such as living rooms and bedrooms should be located on the south of the house to maximise solar gain. Kitchens, halls, bathrooms and utility rooms should generally be orientated to the north.
- By the same token in commercial buildings kitchens, storage spaces and toilets should be located on the north side of the building.
- Spaces should be designed to be easily adaptable in the future - stairwells and service ducts are of particular importance as these are expensive to alter in the future.
- Provision should be made for convenient and secure cycle storage in both commercial and residential development.
- Provision should be made for recycling facilities in both commercial and domestic development. Where practical these should be communal, minimising the resources and space required.

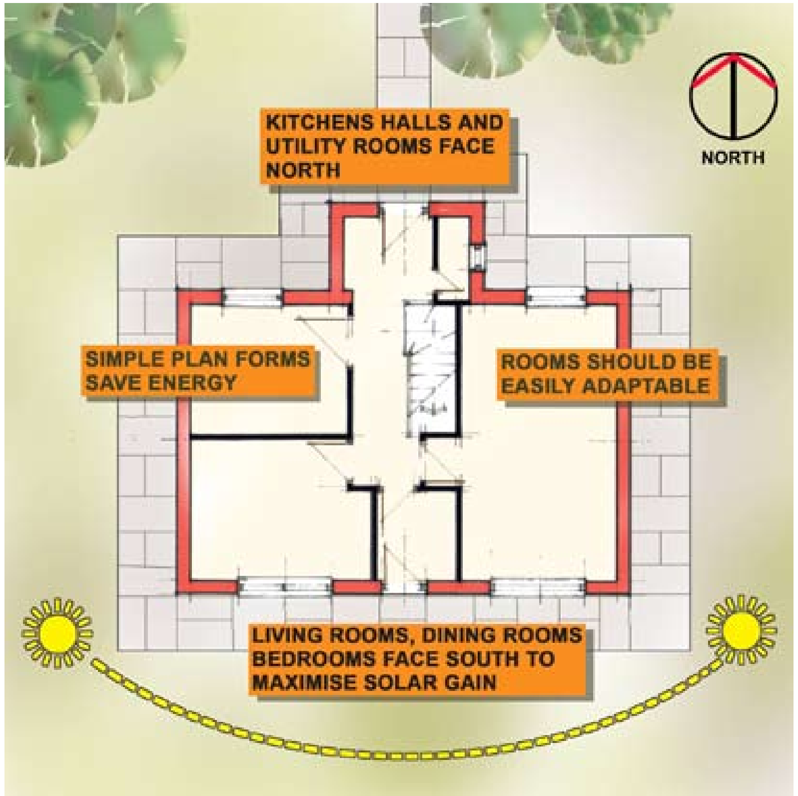
As property prices rise it is becoming more common for people to look to maximise the space they have in their properties by extending into spaces in the roof or the basement and by adding additional rooms, such as conservatories onto the building. However, homeowners should first ensure that there is no unused space within the confines of the existing walls that could be converted. A look at different storage options could also pay dividends as this could save space, money and encourage more efficient use of the property. If these measures have all been carried out and there is still a need to increase accommodation without moving then a sustainably built extension or loft conversion may be the next consideration.

The following are key issues to consider when adding an extension, conservatory or extending into the loft space of a house:

- Locate conservatories on south, east or west facing walls. The conservatory should not be heated and there must be a properly insulated wall between the conservatory and main house.
- Position extensions so that they do not cut out natural sunlight and daylight to the rest of the house or neighbouring houses.
- Setting the buildings into the ground or using unheated intermediate spaces, such as extensions, lobbies and conservatories to act as a thermal buffer to the main house will reduce the external surface area of the building thus provide fewer opportunities for heat to escape.
- High and low level vents and blinds should be provided to regulate summer and afternoon heat which may render a conservatory uncomfortable or even unusable.
- Using double glazing or low emissivity glazing will let light in but stop heat escaping.
- Choosing environmentally friendly materials, such as timber from renewable sources rather than uPVC should be considered.

Extending into the basement or substructure tends to involve substantial structural works and should not be undertaken lightly. The following should always be considered:

- Large areas of cut and fill should be avoided where materials will have to be transported to and from the site. Seek to minimise impacts on soil resources.
- Avoid damage to tree roots and consider impacts on the water table and surface run off.
- Partial depth basements provide better natural ventilation, lighting and damp proofing.
- Basements should be carefully designed to avoid the



creation of substandard living accommodation

- Basements can provide a substructure that is less susceptible to frost heave, moisture changes in soil and settlement.

3.5.4 Flexible Building Design

Buildings designed with flexibility and adaptability in mind are inherently more sustainable, as they are less likely to require complete replacement or large scale alteration or refurbishment to meet the changing needs of an occupant or the different needs of successive occupants. This means that flexible buildings require fewer resources in terms of the materials and energy, as demolition and construction are both energy and resource intensive. The built-in flexibility of buildings has economic implications as well - the fewer physical changes that need to be undertaken to a building during its lifetime, the lower the costs.

The Joseph Rowntree Foundation established the concept of 'Lifetime Homes' in the 1980s. Lifetime homes is concerned with designing homes to be suitable for, or easily adapted to cope with any change in mobility during the lifetime of its occupier. Examples include: "a teenager with a broken leg, a family member with a serious illness, or parents carrying in heavy shopping and dealing with a pushchair" (quote taken from http://www.jrf.org.uk/housingandcare/lifetimehomes/).

The Foundation has produced a list of 16 standards which new houses or flats should meet in order to achieve 'Lifetime Homes' status. These standards compliment Part M of the Building Regulations Act (which deals with ensuring an equal standard of access for all) and the Housing Corporation's Scheme Development Standards. The 'Lifetime Homes' standards are concerned with the following design issues:

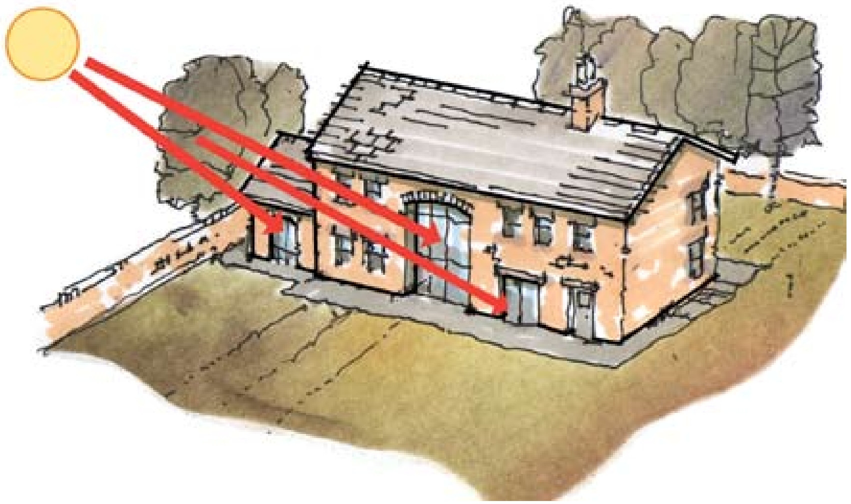
- having space to get into and out of cars close to the home;
- suitably wide pathways that are either level or gently sloping;
- level and suitably wide building entrances;
- the accessibility as ease of use of (communal) stairs and lifts;
- ensuring building entrances are covered and are adequately lit;
- ensuring that doorways, hallways and stairs are wide enough for people with mobility impairments to use;
- ensuring there is enough space in living rooms and dining rooms for wheelchairs to turn in, and that there is adequate circulation space for wheelchairs in kitchens and bathrooms;
- having living rooms, WCs and a room which could potentially be used as a bedroom at ground or entrance level;
- providing showers or space and drainage for showers in ground or entrance level WCs;
- ensuring walls in toilets and bathrooms would be capable of accommodating adaptations such as handrails;
- ensuring that stairways are deigned so that they could easily accommodate stairlifts;
- building bedroom and bathroom ceilings that are strong enough to support a hoist;
- ensuring ease of access in bathrooms to the bath, WC and wash basin;
- positioning windows so that anyone in the room can open them and see outside;
- placing switches, sockets and other controls where they can easily be used.

Whilst intended for the home, the majority of the above standards could and should be applied to buildings used for business, public use, and so on. Policy D3 of the RUDP requires buildings with public access to provide adequate means of access for people with physical disabilities.

3.5.5 Sustainable Energy Use

Energy used in buildings accounts for nearly 50% of carbon dioxide emissions in the UK. Energy is used to provide heating, cooling, hot water, lighting and for other appliances. The amount of energy used and therefore the amount of carbon dioxide produced varies greatly according to the design of the building and how energy efficient the building is. Having an energy efficient building will have a considerable effect on the cost of occupying a building and its impact on the environment. Therefore achieving energy efficiency should be considered prior to installing renewable energy sources.

In addition to the guidance in this section, the Energy Saving Trust provides detailed guidance and information to householders and other building owners relating to energy efficiency and insulation (website: www.est.org.uk).



Passive Solar Energy

This concept involves designing buildings so that they make the best use of energy available freely from the sun in the form of solar heat, daylight and wind; minimizing the need to provide heating lighting and ventilation by artificial means. However, conversely a building must also be designed to avoid overheating, under ventilating and excessive heat loss through large windows.

- *Heating* - Solar gain can make a significant contribution to the heating of a building although care has to be taken, particularly for buildings with large glazed areas to ensure that overheating is avoided in summer. This could potentially lead to the need for air conditioning and lead to uncomfortable working conditions. The following should be considered:
    - A building should be orientated within 30º of due south to maximise solar gain.
    - Glazed areas should be made to a high specification to ensure that heat gains exceed heat loss (over the course of a year).
    - Where possible use skylights or tall windows on the southerly facing elevations as this will allow more light and warmth into the building, especially in winter.
    - Include some shading such as blinds and curtains so that the building does not overheat in summer or lose too much heat in winter.
    - Make any windows on north facing sides smaller as these do not get as much sun and tend to face onto colder northerly winds - this may not always be possible if the house is listed or located within a conservation area.
    - Using windows that are capable of opening should encourage natural ventilation. Secure fanlights or trickle vents can be used at night and for background ventilation.
    - *Natural Daylight* - Day lighting is the controlled entry of natural light into a building through windows, skylights, etc. A properly designed system should only allow as much light as is necessary and distribute it evenly, avoiding glare. Daylight can offer users of the building a pleasant and highly valued connection to the outdoors that can promote well being and morale.
- Diffuse light to create an efficient and effective source of light
- Sunpipes can be used to bring natural light into a windowless space such as a corridor or stairwell.

Natural Ventilation

Natural ventilation uses the passive stack effect and pressure differentials to bring in cool air from the outside whilst extracting air from within the building. This process is undertaken without the use of mechanical systems to cool the building and improves the internal conditions. Energy demand for air conditioning should be reduced or even eliminated. Natural ventilation can be provided by:

- Openable windows
- Roof mounted 'wind catchers'

Maximising passive solar heating is not a new concept! Historic buildings, such as this 18th century vernacular house were often built with large windows in their south facing elevations to allow natural daylight and warmth into the building.

Insulation

Insulation can be integrated into walls, roofs, and floors. It is cheap to obtain and has the single largest influence over how much energy a building needs to be heated. While significant amounts of heat escape from the average house, there are many examples of buildings in the UK where a high level of insulation means that little additional heating is needed throughout the year other than natural heat gains from body heat, lights and appliances.

Cavity walls are better at keeping heat in than solid walls and there is a variety of materials which can be used, each with varying levels of conductivity. Many of the commonly used insulation materials, such as foamed glass, glass wool, expanded and extruded polystyrene, Rigid Urethane Foams, Vermiculite and Woodwool slabs are all poor in sustainability terms due to their impact on the environment. Their production is energy intensive, the chemicals used can be hazardous and the safe disposal of these materials can be problematic, particularly as they mostly do not biodegrade. The list of following insulation materials are all environmentally friendly, biodegradable, come from renewable sources, are comparable in price to more commonly used synthetic insulation and are becoming increasingly more available on the market:

- *Cellulose Fibres*: made from processed waster paper. Treated with borax, a fire retardant.
- *Compressed Straw Slabs*: chemical free and compacted using heat and pressure only, the slabs are bound together with paper.
- *Cork*: a renewable crop, cork is the bark of a type of evergreen oak tree which can be removed without killing the tree. Cork board is made by heating up granules of this bark which bond using their own natural resin.
- *Wool*: raw unscoured sheep fleeces are folded into the wall with quassia chips to deter moths.
- *Flax*: flax fibres are bound together using potato starch, making the product completely natural. Borax is sued for fire protection and to resist insects.

Heating

- The better insulated a building is, the smaller the heating boiler and radiators needed.
- Boilers are at their most efficient when running near a full load, therefore running a larger boiler well below its load wastes money and energy.
- Although they cost slightly more, condensing boilers are more fuel efficient than non-condensing boilers and save money in the long run.
- Controls should be easy to understand and use so that they are more likely to be used, ensuring maximum comfort for the occupants of a building and allowing the amount of heat produced to be better managed.
- In larger complexes it should be possible to change the heating levels of different parts of the building in order to minimise the amount of wasted heat.

3.5.6 Renewable Energy Sources

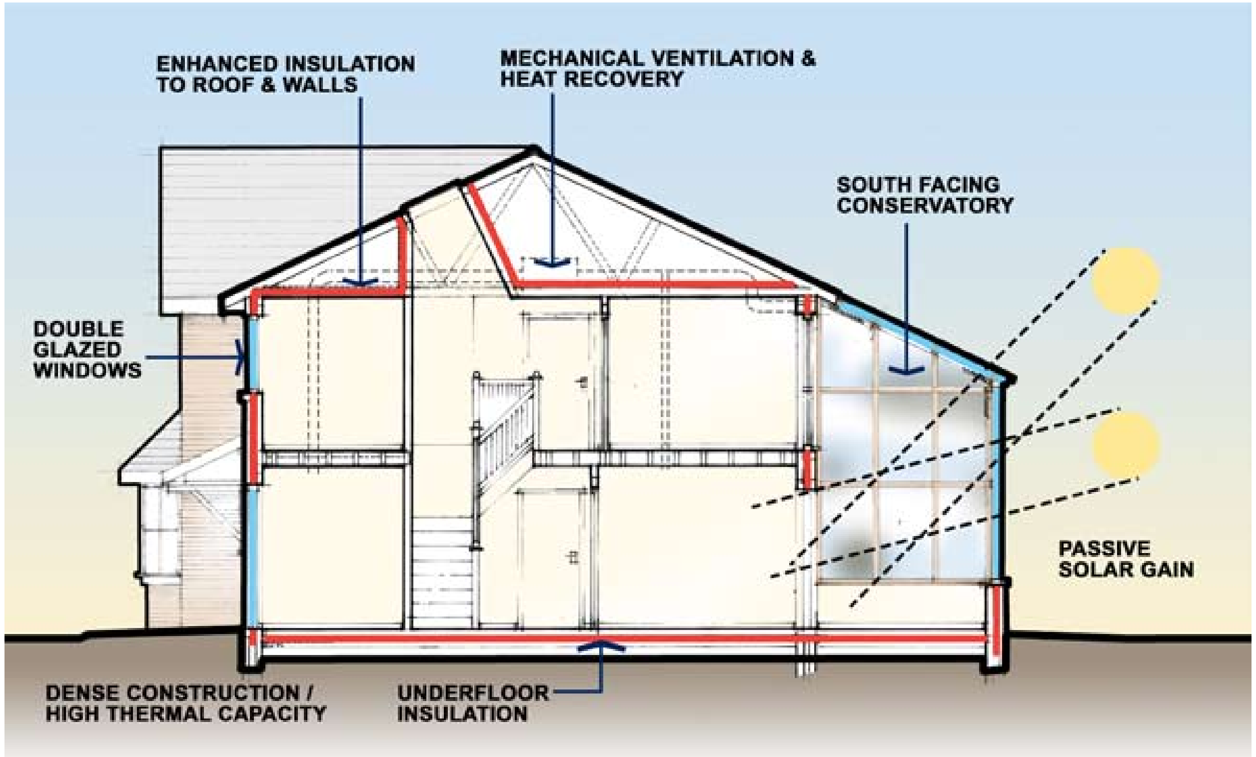
At present most of our energy requirements are supplied by the burning of fossil fuels, such as coal and natural gas, as well as nuclear power. Fossil fuels are a finite resources and their burning in power stations produces large volumes of Carbon Dioxide (CO2), which is chiefly responsible for global warming and climate change. Nuclear power produces deadly waste which cannot be processed and must be stored indefinitely as it cannot safely re-enter the outside world.

The use of renewable energy resources can reduce our present dependence on energy sources which pose a threat to all life on this planet and, by nature, will never run out. Many of these renewable energy sources can be incorporated into new development and also saving the occupier of building money spent on electricity and heating. However, an energy efficient building will require less energy in the first place. Therefore it is important that the measures in 3.5.5 of this Guide have been designed into a new development, otherwise money and resources will be wasted generating heat and power unnecessarily.

The Government is committed to reducing our reliance on fossil fuels and nuclear energy by promoting renewable energy. The Yorkshire region has been set targets for the amounts of energy to be generated by renewable sources for 2010 and 2020. To this end, the Department of Trade and Industry (DTI) is providing grant funding for householder and community renewable energy schemes and installations through the Low Carbon Buildings Programme which will run from March 2006 until 2012. Details of the Low Carbon Buildings Programme are available from the DTI website (www.dti.gov.uk).

Government guidance relating to the planning and other constraints and issues concerning the installation or construction of renewable energy sources can be found in Planning for Renewable Energy: A Companion Guide.

The Trust also provides detailed guidance and information to householders and other building owners relating to renewable energy (website: www.est.org.uk).



When coupled with the principles of solar gain, higher standards of insulation saves money and resource consumption by making a building easier to keep warm.

Photovoltaics (PV)

- Photovoltaic technology converts light into energy. PVs need only daylight rather than direct sunlight to work and generate electricity in any weather during daylight hours.
- By connecting a PV system to the National Grid, the surplus daytime electricity that has been generated can be sold to the local utility provider, who would supply electricity outside of daylight hours. At least 10m^2 of PV is needed.
- PV products can be used on all types of roofs - even flat ones, though the optimal roof angle is 30^o to 40^o in the UK.
- A north facing PV roof will generate 60% of the amount of electricity that a south facing roof would.
- PV tiles can be used as a roof covering and are maintenance free. The PV tiled roof of a house could prevent 34 tonnes of greenhouse gas emissions during its lifetime.
- PV tiles cost at least £500 per m^2, but they do act as a roof covering, save money on electricity and surplus energy can be sold. At present, however, the payback period is long.

Solar Water Heating

- These systems operate by allowing the Sun to heat a fluid in a solar roof panel which circulates through the system and heats the water tank. This preheats the water, reducing the amount of other energy needed from elsewhere to heat the water.
- Solar Water Heating systems are most effective in large family homes and large building complexes where large quantities of hot water are needed.
- Solar Water Heating systems can supply 50% of hot water use.

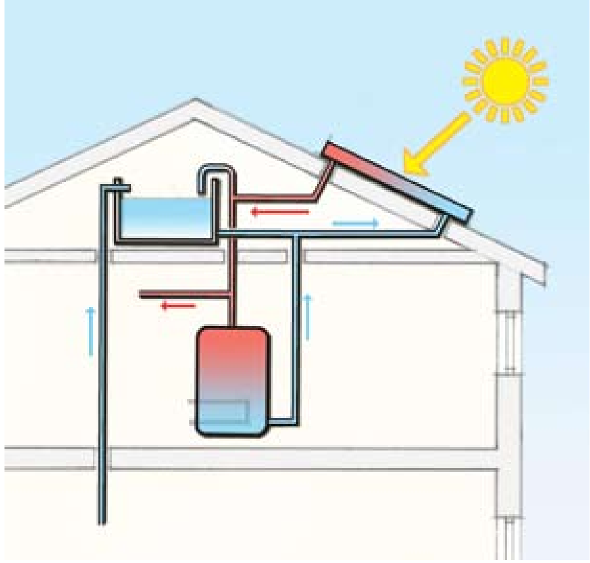
Wind Power

- A wind turbine with blades mounted on a horizontal axis are set in motion by the wind and can directly drive a generator to produce electricity.
- The electricity generated can be linked to the National Grid or can be used to charge batteries.
- Modern wind turbine designs tend to be very near silent in operation such that the wind in the leaves on trees can be louder.
- Wind turbines typically cost from £2,500-£5,000 per kilowatt of generating capacity installed.

Biomass

- Biomass involves the growing of crops such as willow (harvested every 2-4 years) or grasses such as miscanthus or straw (harvested annually) that is dried and fed into a boiler from where the collected gas is used to produce electricity. Forestry and wood waste can also be used.
- The carbon dioxide produced by the incineration is more than offset by the carbon absorbed by the biomass crop in its lifetime.
- The biomass crops can be herbicide or pesticide free (or at least consume very little), and, if coppice-type crops are used, can benefit biodiversity.

Solar heating using a roof panel on a south facing roof can preheat water entering a conventional system, cutting fuel bills and providing up to 50% of hot water requirements.



Ground Source Heat Pumps

- A couple of metres below the Earth's surface, the temperature is a constant 10-12^{o}C. Water can be circulated to this depth and warmed to this temperature before passing through a heat pump.
- Every kilowatt of electricity consumed by a heat pump produces 3-4kilowatts of heat energy, making them as efficient as a condensed gas boiler.
- These systems are most effective if they form part of an under-floor heating system.
- Typical household systems cost £4,000 to £6,000, though site-specific factors can increase costs significantly.
- Ground Source Heat Pumps require a borehole, trench to accommodate the 'ground loop' which transfers heat from below the ground to a building. Suitable space free of obstructions is needed for a trench, while boreholes require less space, but are more costly.

Combined Heat and Power (CHP)

- Hydrogen fuel cells have been used to power a small number of different community CHP systems across the world.
- Hydrogen is produced by electrolysing water and the hydrogen is then piped to where the electricity is generated by burning the hydrogen, with water and energy the only by-products.
- The heat and energy produced by this reaction can be used to heat and power nearby buildings.
- At present this is a new method of generating heat and electricity, but may well become a more important energy source in the future.

Micro CHP

- Domestic sized Combined Heat and Power units (no larger than a dishwasher) have been developed. Like larger scale CHP, these generate heat and power simultaneously in a single process.
- These units act like a normal energy efficient boiler, but the steam is used to generate electricity, which, if not used within the house, is fed back into the electricity grid, reducing utility bills.

- Units currently being trialled by a housing association are expected to supply all of the heat and 75% of the electricity needed year round in each house.
- As this technology is new, it has not been tested in the long-term, therefore it is difficult at this stage to ascertain its overall contribution to sustainability.

Microhydro

- Hydroelectric power is generated by channelling a flow of water from a reservoir or river through a turbine connected to an electricity generator.
- The District has a long history of using water power, from medieval grinding and fulling mills to the early textile mills.
- Although there is no scope for large hydro schemes in the District, 'microhydro' schemes of under 60kilowatts are possible, usually without the need for a dam or weir.
- Provided there is no ecological impact of diverting water flow, microhydro is pollution free and has a negligible environmental impact.
- A licence is required from the National Rivers Authority to extract water from any river or stream.

Photovoltaic panels make good use of the flat roof at Bradford Central Library.

3.5.7 Water Management

Clean drinking water is essential to human life. Despite being reminded in recent years by water shortages how its supply is finite, we collectively waste this resource through excessive consumption and the use of expensively treated drinking water for uses such as flushing toilets, washing cars and watering gardens.

While it is everyone's responsibility to use water wisely, it is possible to design into new development measures which will reduce the amount of water we consume which is fit for drinking.

More Efficient Fixtures

- Waterless urinals and toilets are becoming more common in schools, universities and other large complexes of buildings, but are also used domestically in the UK and Europe. There are two types: the composting toilet and the incinerating toilet.
- Dual flush toilets which have the option of a flush which uses the full amount of water or half the amount of water.

This recently refurbished block of flats in bradford city centre has been fitted with a silent wind turbine (on the left) which helps power the building.

- Smaller toilet cisterns use less water, or alternatively, fit cistern dams in larger old cisterns.
- Use spray taps in sinks rather than standard pillar taps. These typically save up to 80% of the water and energy used in pillar taps as the spray is more effective for washing, rinsing etc.
- Use sensor and push taps in order to save water in situations where taps may unnecessarily be left running.
- Provide showers as well as or instead of baths. However, power showers can use as much water as a bath in under 5 minutes. Opt for water saving showerheads which require mains pressure.

Grey Water Reuse

- Water which has passed through basins and kitchens can be filtered re-used for uses where water which is fit for drinking is not needed, such as toilets, urinals, watering the garden etc.

Rainwater Reuse

- Rainwater collected from roofs can be gathered in a tank and used for uses which do not need water which is fit for drinking such as washing machines, flushing toilets and gardening.
- Rainwater could be collected in butts and used for gardening, and cleaning vehicles, windows, patios etc.

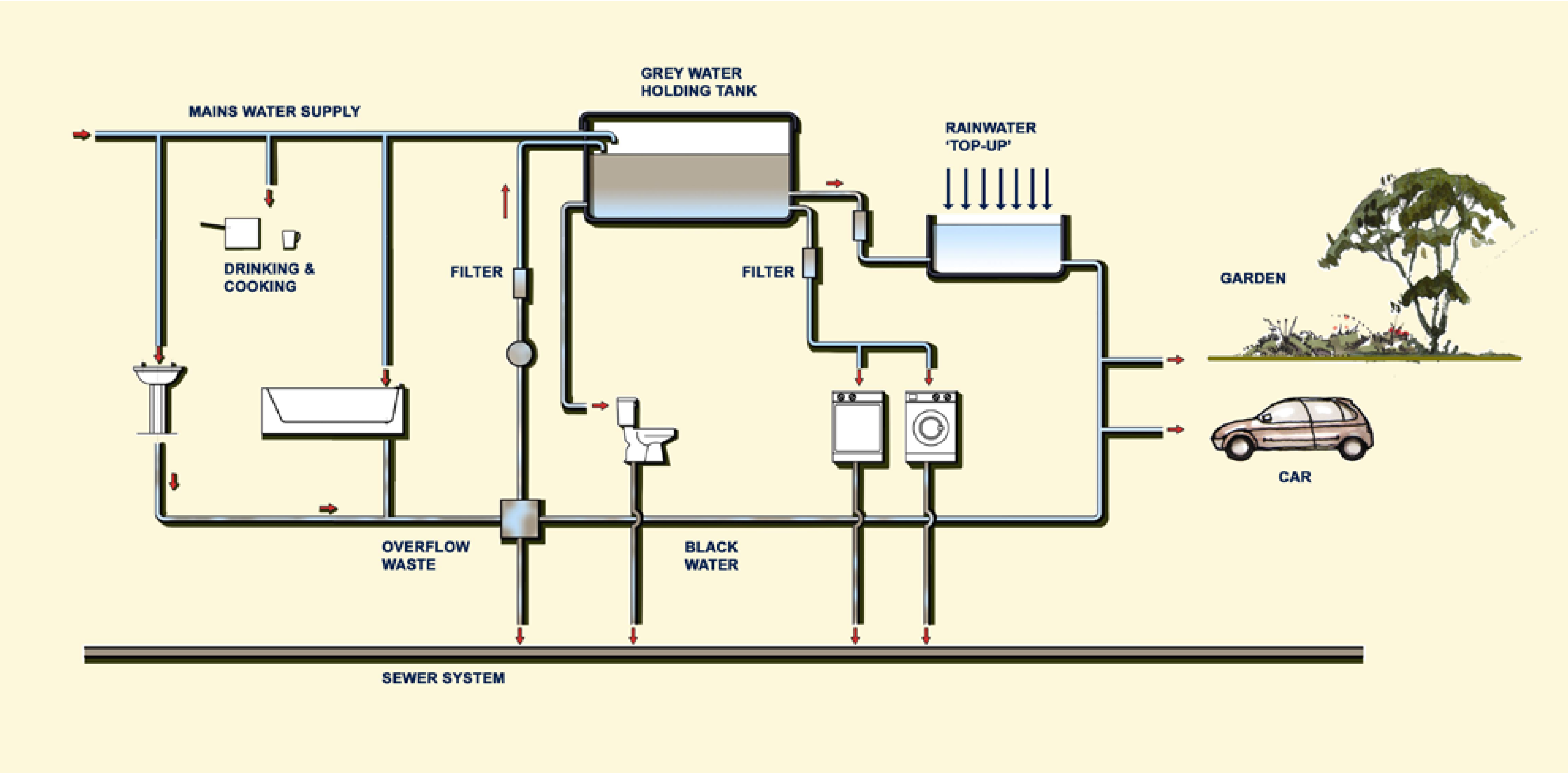
Sustainable Urban Drainage Systems (SUDS)

- SUDS are environmentally and physically safer than conventional drainage systems as they reduce the risk of flooding and help clean up polluted runoff.
- They work by mimicking natural drainage patterns and allow the permeation of rainwater into soil and into the substrata as ground water as well as the containment of water in ponds or other bodies of water which link into natural watercourses.
- By their nature, SUDS present the opportunity of protecting or enhancing water quality and providing more habitats for wildlife along watercourses.

Onsite Stormwater Detention (OSD)

- In situations where ground or soil conditions are not suitable for SUDS, OSD is an option.
- During heavy rain, surface runoff from roofs and areas of hardstanding is drained into a storage tank. The water is then discharged into the mains sewer at a steady rate.
- The tanked runoff can be used for watering the garden or landscaping or in water features such as fountains.

Providing low phosphate cleaning products have been used, grey water can be recycled and used for a wide variety of uses in the house and garden.



3.5.8 Pollution Control

For a development to be fit for use, it must be designed with the quality of life if its users / inhabitants in mind. To this end, new development should seek to minimise the invasive impact of various forms of pollution such as noise and light and meet the future requirements of its users/inhabitants.

Noise

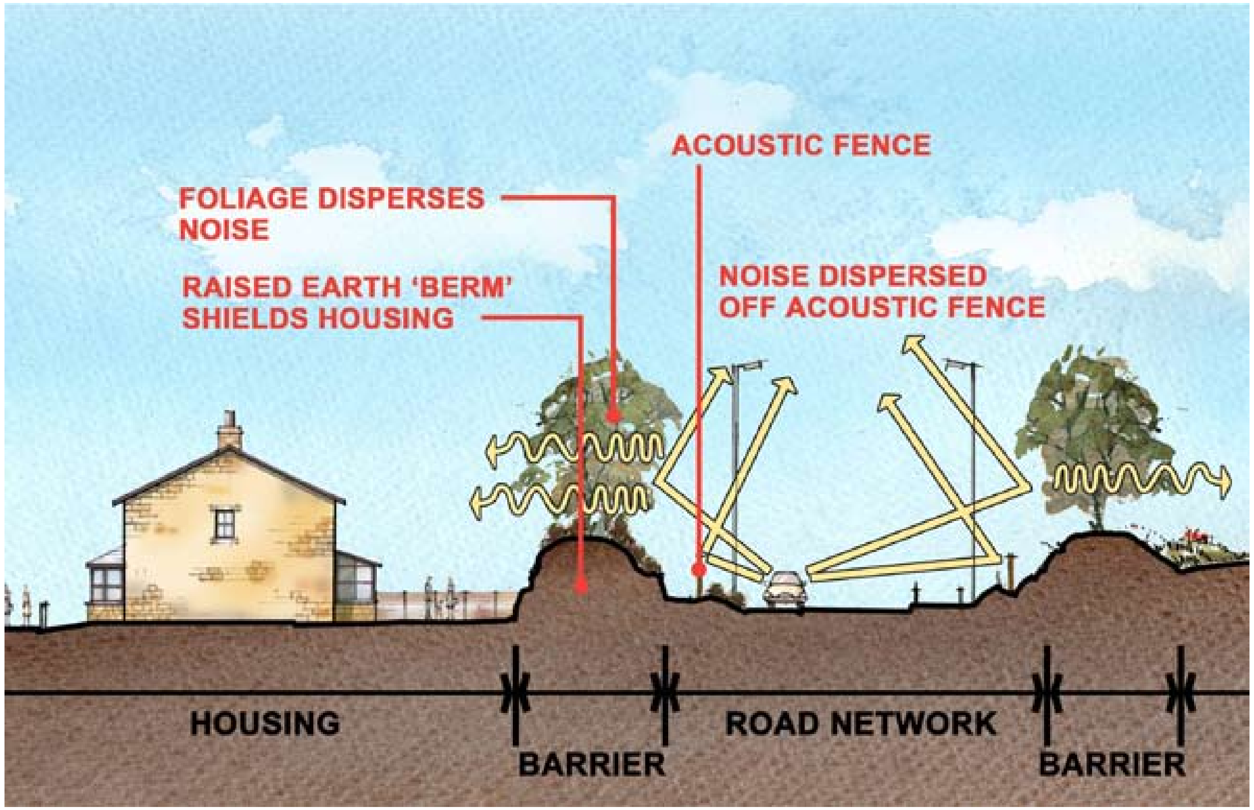
- Noise has become an increasingly important issue in development, with sources including neighbours with conflicting lifestyles, deliveries / services and industrial and commercial activity.
- If there is a particular noise source, such as a busy road or factory, the non-habitable rooms of dwellings should face towards the noise source.
- Flats should have a like-for-like layout (i.e. with bedrooms over bedrooms). Stairways and hallways should be carpeted, applied with sound absorbent material and must not adjoin bedrooms.
- In mixed use developments (including flats over shops) the habitable rooms should be away from sources of noise such as the service access.
- New commercial/industrial development should not impact the levels of noise in the nearest residential properties.
- Porous road surfaces absorb the sound generated by running engines and the sound of tyres running on the road.
- Loose aggregate surfaces can absorb the sounds of footfalls and voices.
- Vegetation 'shelter belts' and thick boundary walls are effective noise barriers.
- Earth berms can absorb noise from busy roads.
- The sound of flowing water can mask traffic noise.

Light

- Ensuring external lights are well placed and directed can mean that less energy is consumed in illuminating an area and none is wasted.
- 'Uplighting', light which points up towards the sky from a lamp, should be eradicated.
- Dimmer systems could be used where the level of lighting can vary as full street lighting is often not required throughout an entire night.

Clean Fuel Vehicles

- Provision should be made for the safe storage of bicycles at new developments.
- Petrol stations or other suitable outlets should have facilities for the sale of cleaner fuels such as Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG) and electric charging points.
- Convenient points for refuelling or recharging clean fuel vehicles are designed into development schemes.



4.0 Case Study: Ecology Building Society, Silsden

The Ecology Building Society was founded in Yorkshire in 1981 and is the UK's youngest building society. The Building Society's ethos is to provide mortgages on properties and projects which help the environment.

The firm outgrew its premises in Cross Hills and in 2003 moved to nearby Silsden to purpose-built premises which were constructed with the principles of sustainable design and sustainable development at its heart. The Headquarters was designed by Hodson Architects, members of the Association for Environment Conscious Building, and won the Building of the Year Award at the 2004 Bradford District Design Awards.

As well as being a good advertisement for the Ecology Building Society, the new headquarters is an excellent example of how an office building or any new development can be more environmentally sound.

Sustainable Development features of the Ecology Building Society Headquarters are:

- The site is Brownfield and reuses previously developed land within the built up area of Silsden.
- The site is within easy walking distance of the centre of Silsden and the shops, services and access to public transport available there.
- Mature trees have been retained and are engaged with the new building.
- The development retained existing dry stone wall boundaries.
- Distant views into and out of the site were an important consideration, with the approach to the main entrance to the building enjoying views across the Aire Valley.
- The design of the building responds to the sloping topography of the site, with the building stepping up the hillside.

Much of the site of the Ecology Building Society takes the form of a native meadow and wildflower habitat. The sedum roof of the building absorbs rainwater and supplements the internal insulation.

Sustainable Design features of the Ecology Building Society Headquarters are:

- The building was designed to be easily extended in the future with minimum disruption to the site and building.
- The development has introduced native meadow and wildflower vegetation to the site.
- The building is sited well away from neighbouring dwellings, minimising the impact in terms of noise and amenity.
- The cross section design of the building allows daylight to reach all parts of the interior of the building and facilitates natural ventilation. Sunpipes provide natural daylight where there are fewer external windows. Daylight modelling was undertaken as part of the design process.
- The roadside face of the building is clad in locally sourced reclaimed drystone. The massing of this material, coupled with fewer windows, minimises the intrusion of traffic noise into the building.
- The roof is pitched and the gables are clad in untreated timber with lime mortar, environmentally sound materials. The roof itself is a mixture of 80% recycled aluminium and a sedum planted green or turf roof. The sedum roof adds insulation value to the roof, encourages insect and bird life, and absorbs rainwater.
- Low energy requirements have been achieved through producing an airtight structure (when the windows are closed) with very low leakage and high levels of insulation. The building is on course for a BREEAM rating of 'excellent'.
- Materials used were where possible either from renewable sources, recycled or of low toxicity.
- The timber used was either recycled or came from Forestry Stewardship Council approved (i.e. sustainable) sources.

- The bricks used in the piers supporting the internal mezzanine floor are recycled.

- The paints and finishes used are made from natural products and are solvent free.

- The floor coverings are made from natural materials and include a natural latex based rubber material, wool carpets and a linoleum/hessian based floor covering.

- The roof is insulated with recycled paper and its design allows as much room for insulation as possible.

- The windows are constructed from timber which came from a sustainable source and have double high performance argon filled glazing with a coating to further improve heat retention.

- The heating system is designed to run at low temperatures due to the highly insulated nature of the building. It is powered by a high-efficiency condensing boiler. Each radiator has a thermostatic control allowing greater control of heat levels and less wasted heat.

- A mechanical air handling unit changes the air in the building and a heater exchanger uses the warmth of the expelled air to heat the incoming air.

- Opening windows have been used in favour of energy-consuming air conditioning.

- Runoff from the aluminium roof is stored in an underground tank and is used to flush the toilets. The toilets themselves consume small amounts of water when they flush.

- The car park is porous, allowing rainwater to drain into the soil below rather than become runoff.

- In 2004, Photovoltaic panels were installed, providing the headquarters with a renewable solar energy source. The cells are connected to the National Grid and any surplus power produced by the panels can be sold on.

- In April 2005, an extension with a straw bale structure was added to the Headquarters. This material has good insulation properties and comes form a renewable source. The use of shallow foundations limited the volumes of building materials required, reducing the environmental impact of the extension. It was the first building with shallow foundations in the UK to be approved by Building Regulations and is expected to stand for 400 years.

Below: the striking modern design of the Ecology Building Society is clad in reclaimed stone and its southern elevation is topped by a long window which illuminates the room below.
Right: This closer view of the southern elevation shows the photo-voltaic panels which were later added onto the recycled aluminium roof. Note how blinds are used to regulate the levels of passive solar energy entering the building.

5.0 Policy Context of the Sustainable Design Guide

The status of this Guide as a Supplementary Planning Document to the Adopted Unitary Development Plan (UDP) and the Local Development Framework is outlined in section 1.4 (page 4) of this document.

This section reproduces the saved policies of the UDP which are relevant to the Sustainable Design Guide.

NB *while some policies have been reproduced in full, others have been amended so that only those elements which are relevant to the Sustainable Design Guide remain. Ellipses (...) indicate where text has been removed in order to keep this summary brief. The full text of each policy can be found in the source document.*

RUDP Policies

Policy UDP3: New development will need to ensure that the quality of the built and natural environment is maintained and where practical improved. In particular development should:

(1) Promote sustainable design and enshrine the principles of good urban design.
(2) Maintain or enhance heritage assets, environmental resources and biodiversity.
(3) Maintain or enhance the character or quality of the environment.

Policy UDP5: Provide for the needs of the communities in appropriate locations including: ...

(2) Ensuring the wide ranging housing needs of the community are met. ...

Policy UDP8: Encourage the sustainable and efficient use of the district's natural resources and the development of renewable energy resources.

Policy UDP9: Contribute to the management of pollution, hazards and waste through relevant control measures, risk minimisation and the encouragement of reuse and recycling.

Policy UR2: Development will be permitted provided that it contributes to the social, economic and environmental aspects of sustainable development and: Makes efficient use of existing physical and social infrastructure and minimises adverse impacts from the development.

Provides appropriate mitigation where negative impacts are identified. ...

Policy TM8: The Council will require the provision, where appropriate, of new pedestrian and cycle links through development sites and open spaces, especially where these will provide links to existing routes.

Policy TM19: The Council will require provision of parking space for cycles in development schemes to the minimum levels as indicated in the Council's adopted standards... The Council will ensure that an adequate number of spaces are provided for cycles in public off-street car parks.

TM19A: In determining planning applications the Council will consider the potential impact on traffic management and road safety and will seek any consequential improvements.

Policy D1: All development proposals should make a positive contribution to the environment and quality of life through high quality design, layout and landscaping. In particular they should: ...

(6) Incorporate adequate design arrangements for servicing, waste handling, recycling and storage;
(7) Allow flexibility to adapt to meet changing needs and circumstances and provide for access for those with physical disabilities;
(8) Not harm the amenity of prospective or existing users and residents. ...

Policy D2: Proposals should maximise opportunities to conserve energy and water resources through the layout and design of development. In considering planning applications the Council will encourage where appropriate:

(1) The use of solar energy, passive solar gain and heat recycling (such as combined heat and power);
(2) Layouts which reduce windchill and maximise the efficient use of natural light; and,
(3) The use of rain water and grey water recycling and sustainable drainage systems.

Policy D3: Development proposals including change of use should ensure adequate means of access for people with physical disabilities to buildings and their curtilages with respect to the following types of buildings:

- Shops
- Community facilities
- Health facilities
- Places of entertainment
- Places of work and any other buildings with public access.

Policy D5: Development proposals should be designed so that important existing and new landscape features are incorporated as an integral part of the proposal. In particular proposals should:

(1) Conserve and integrate existing natural features
(2) Use new landscape features such as planting, shelter belts, green wedges and green corridors to integrate development with the wider landscape
(3) Integrate new and existing development at the boundaries through the continuity of landscape
(4) Create areas of habitat value from additional planting rather than purely decorative planting

Policy D6: Development proposals including environmental improvements, highway improvements and traffic management schemes should incorporate appropriate facilities to meet the needs of pedestrians and people with special needs. In particular the design of development proposals should take into account the following:

(1) Pedestrian links should have priority over other links including those for cycles and cars as appropriate to the development;
(2) The layout of development so that car parks do not deter pedestrian access and use;
(3) The provision of adequate and safe pedestrian facilities within the development and safe access onto existing pedestrian links and network of routes;
(4) Ensuring existing pedestrian links are not severed nor their safety or amenity harmed unless suitable alternative provisions are provided by the developer.

Policy D7: Development proposals including environmental improvements, highway improvements and traffic management schemes, should incorporate appropriate facilities to meet the needs of cyclists. In particular the design of development proposals should take into account the following:

(1) Provision of safe convenient direct and coherent cycle routes and priority measures as appropriate to the development;
(2) Provision of convenient and securely located cycle parking or storage facilities in appropriate new developments including those in town centres, at transport interchanges, educational institutions and public car parks.
(3) Development proposals should not sever existing or planned cycle links, to other parts of the cycle network or reduce their safety or amenity unless acceptable suitable alternative provision is made.

Policy D14: Proposals which consist of or include new external lighting will be required to ensure that the scheme is the minimum required to undertake the task and minimises light pollution from glare and spillage. In particular the design of the external lighting should ensure:

(1) Lights are angled downwards to illuminate target areas, not upwards; and,
(2) Where there is no alternative to up-lighting, shields and baffles are used to minimise light spillage;
(3) Where areas of ground are to be illuminated, the equipment is designed so that it will minimise the spread of light above the horizontal, and restrict the spread of illumination to within the boundary of the site.

Proposals which would adversely affect dwellings, sites of nature conservation importance and rural areas in which dark skies are an important part of the nocturnal landscape, will not be permitted.

Policy NE5: On development sites the Council will require the retention of those trees which are healthy and which would have a clear public amenity benefit. The Council will require the protection during construction of trees to be retained and, where appropriate, replacement tree planting for trees lost or damaged during construction.

Policy NR12: Development proposals for the generation of power from renewable energy sources will be encouraged. Proposals will be permitted provided that there is no significant conflict with other policies in the plan, and there is no adverse environmental impact to nearby communities. Where a proposal fails to meet the requirements, the benefits of the following will be taken into consideration:

(1) the potential contribution to meeting local, regional and national energy needs and reducing global pollution;
(2) the extent to which the development would provide research benefits which would assist the further development of renewable technologies.

In doing so it will be acknowledged that certain renewable energy sources can only be harnessed where the resource occurs.

Policy NR13: Proposals for the development of wind farms and individual wind turbines will be permitted provided that:

(1) the development will not adversely affect:
   (a) the character of the landscape
   (b) upland or moorland areas which currently have no or little development or contain areas of historical interest;
(2) Special attention is paid to the relationship of proposals to other wind farms/turbines in the area;
(3) The development is located to ensure that there are no unacceptable noise problems for local residents;
(4) The siting, design, materials and colour of the turbines and ancillary structures are such that their visual impact is minimised;
(5) The developer undertakes to remove structures and to restore fully the site to the satisfaction of the Council, should all or part of the site become non-operational for more than six months.

Policy NR16: Development proposals which add to the risk of flooding or other environmental damage, as a result of surface water run-off will not be permitted unless effective control measures are provided. Development proposals will be required to incorporate sustainable drainage systems, which control surface run-off, as close to source as possible, wherever practicable.

Policy P7: Where development proposals give rise to an unacceptable noise problem by virtue of their nature and/or location, developers will be required to carry out any remedial measures necessary to satisfactorily overcome the problem. Where noise problems cannot be satisfactorily overcome planning permission will not be granted.

6.0 Council Contacts

Local Development Framework / Unitary Development Plan

Tel: (01274) 433679 Fax: (01274) 434606

Development Control

The Development Control service processes planning applications and provides advice on planning matters. The Bradford District is divided into a number of area teams for Development Control Service purposes. The following are the Development Control contacts for these areas:

The Development Control Teams across the District can all be contacted by telephone via: (01274) 434605

Bradford West
Includes Heaton, Manningham, Thornton, Clayton, Queensbury, Great Horton and Buttershaw.
Fax: (01274) 722840
Email: planning.enquires@bradford.gov.uk

Bradford City Centre
Fax: (01274) 722840
Email: planning.enquires@bradford.gov.uk

Bradford East
Includes Thackley, Idle, Greengates, Eccleshill, Fagley, Bowling, Odsal, Low Moor and Wyke.
Fax: (01274) 722840
Email: planning.enquires@bradford.gov.uk

Shipley
Includes Shipley, Bingley, Baildon, Idle, Thackley, Wrose, Harden, Denholme, Cullingworth and Wilsden.
Fax: (01274) 437090
Email: planning.shipley@bradford.gov.uk

Keighley
Includes the Worth Valley, Keighley, Riddlesden, Silsden, and Steeton.
Fax: (01535) 618450
Email: planning.keighley@bradford.gov.uk

Ilkley
Includes Ilkley, Addingham, Burley-in-Wharfedale and Menston.
Fax: (01943) 816763
Email: planning.ilkley@bradford.gov.uk

Design And Conservation

The Design and Conservation Team advises on matters relating to urban design, Listed Buildings and Conservation Areas.
Tel: (01274) 437495
Fax: (01274) 433767
Email: conservation@bradford.gov.uk

B-equal / Equalities Service

Promoting equal opportunities including disabled access. Tel: (01274) 432034

Building Control

Building Control can provide you with all you want to know about buildings, building work, safe environments and how to organize public events safely. The Building Control Services have two offices in the District:

Bradford
Tel: (01274) 433807
Fax: (01274) 722840

Keighley
Tel: (01535) 618010
Fax: (01535) 618450

Environmental Protection

Environmental Protection seeks to safeguard and improve the environmental quality of the district. This section is responsible for monitoring air quality and working with contaminated land and remediation. The Area Environmental Protection Teams are backed up by the specialist Pollution Control section, which provides information and training and co-ordinates pollution work done throughout the division.

Bradford West
Includes the City Centre, Manningham, Heaton, Clayton and Thornton
Tel: 01274 432053

Bradford North/South
Includes Queensbury, Horton, Odsal, Wyke, Tong, Bolton and Idle
Tel: 01274 433962

Shipley
Includes Shipley, Baildon, and Menston
Tel: 01274 437057

Bingley
Includes Bingley, Harden, Wilsden, Denholme and Cullingworth
Tel: 01274 438750

Keighley
Includes Keighley, the Worth Valley, Riddlesden, Morton, Steeton, Silsden and Addingham.
Tel: 01535 618040

Ilkley
Includes Ilkley and Burley-in-Wharfedale.
Tel: 01943 436216

Pollution Control Team

Email: pollution@bradford.gov.uk

Waste Management

For information about waste disposal, household waste recycling centres, chemical collections, recycling composting and trade waste in the district visit: www.bradford.gov.uk/council/wate_management/index.asp or email: letsgetitsorted@bradford.gov.uk

Drainage Services Unit

Tel: (01274) 433904

Rights Of Way Section

Tel: (01274) 432666
Email: rightsofway@bradford.gov.uk

7.0 Useful Organisations

Alternative Technology Centre - useful local contact point for information about environmentally sound building and energy efficiency.
Hebble End Mill, Hebden Bridge,
West Yorkshire HX7 6HJ
Tel: 01422 842121 (day)
info@alternativetechnology.org.uk

Association for Environmentally Conscious Building - promoting sustainable building.
www.aecb.net
PO Box 32, LLandysul, SA44 5ZA
Tel: 0845 4569773
Email:email@aecb.net

Association of Noise Consultants - lists consultants who deal with noise and vibration.
www.association-of-noise-consultants.co.uk

Boiler and Radiator Manufacturers' Association
www.barma.co.uk

Building Research Establishment (Bre) - Research and useful information relating to construction, energy and the environment. BRE also assess the environmental performance of buildings (BREEAM ratings and EcoHomes).
www.bre.co.uk - contains *Centre for Sustainable Construction.*
www.breeam.org - contains information on BREEAM and EcoHomes.
BRE, Garston, Watford WD25 9XX
Tel: 01923 664000
Email: enquiries@bre.co.uk

Combined Heat and Power Association - information relating to CHP schemes.
www.chpa.co.uk
Tel: 020 7828 4077
E-mail: info@chpa.co.uk

CABE - Commission for the Built Environment. A non-government organisation championing high quality design in the built environment
www.cabe.org.uk

CIRIA - Construction Industry Research and Information Association.
www.ciria.org.uk
Tel: 020 7549 3300

Department of Trade and Industry (Dti) - Government Department which will provide the grant funding for the 'Low Carbon Buildings Programme', which will provide grants to householders and community organisations for installing renewable energy sources between March 2006 and 2012.
www.dti.gov.uk
Tel: 020 7215 5000

Eaga Partnership - offers grants for improving the energy efficiency of homes.
www.eaga.co.uk
Eaga Partnership Ltd, Freepost NEA 12054,
Newcastle upon Tyne NE2 1BR
Tel: 0800 3166011
Email: enquiry@eaga.co.uk

Energy Efficiency Advice Centre - Leeds-Bradford-Hull
Tel: 0800 512012

Energy Saving Trust - Provides advice on energy efficiency, insulation and renewable energy.
www.est.org.uk

English Heritage
www.english-heritage.org.uk
37 Tanner Row, York, YO1 6WP
Tel: 01904 601901

Environment Agency
General Enquiries: 08708 506 506
enquiries@environment-agency.gov.uk

Heating and Ventilating Contractors' Association
www.hvca.org.uk
Tel: 020 73134900
Email: contact@hvca.org.uk

Joseph Rowntree Foundation - Undertakes research into social policy, including the provision of housing for all. The charity's Housing Trust produced the Lifetime Homes standards.
Joseph Rowntree Foundation
The Homestead, 40 Water End York,
North Yorkshire YO30 6WP
www.jrf.org.uk
Tel: 01904 629241
Email: info@jrf.org.uk

National Federation of Demolition Contractors
www.demolition-nfdc.com
Tel: 01923 664461
Email: info@demolition-nfdc.com

Scandinavian Green Roof Institute - source of information and research relating to green roofs.
www.greenroof.se

Solar Energy Society - UK branch of the International Solar Energy Society. Information on renewable energy.
www.thesolarline.com
Email: ukises@brookes.ac.uk

Thermal Insulation Manufacturers and Suppliers Association
www.timsa.org.uk
Tel: 01252 739154
Email: info@associationhouse.org.uk

Waste And Resources Action Programme (Wrap) - A non-government organisation aiming to make more efficient markets for recycled products and promoting waste minimisation, re-use and recycling. Website includes information relating local recycling centres and a directory of over 3,200 recycled products.
www.wrap.org.uk

The following firms are involved with various aspects of sustainable design. Bradford Council does not endorse or recommend these companies or take any responsibility for the products or services they offer. This list is by no means comprehensive and is subject to change.

Ecology Building Society - Local firm with award winning sustainably built headquarters.
www.ecology.co.uk
7 Belton Road, Silsden West Yorkshire BD20 0EE

Green Building Store - fairly local green building product supplier
www.greenbuildingstore.co.uk
11 Huddersfield Road, Meltham, Holmfirth, West Yorkshire HD9 4NJ
Tel: 01484 854898
Email: info@greenbuildingstore.co.uk

Green Register of Construction Professionals - links clients (from homeowners to large firms) with architects, engineers, builders, surveyors and tradespeople who show a commitment to sustainable building practices.
www.greenregister.org
Tel: 020 7820 3159
Email: info@greenregister.org

Natural Building Technologies - website contains useful information regarding building materials and construction practice.
www.natural-building.co.uk

Salvo Materials And Information Exchange - Online exchange for buying and selling construction materials for recycling and reuse.
www.salvomie.co.uk

Womersley's Ltd - A local green building product supplier.
Walkley Lane, Heckmondwyke,
West Yorkshire WF16 0PG
Tel: 01924400651
www.womersleys.co.uk

8.0 Bibliography and Useful References

Key References:

Brent Council (2004) *SPG19: Sustainable Design, Construction and Pollution Control* (2nd Ed.) Brent Council.

Enfield Council (2002) *Greening Your Home: A Householder's Guide to Sustainable Design and Construction* Enfield Council.

Enfield Council (2000) *Sustainable Design and Construction Guide for Developers and Building Professionals* Enfield Council

Leeds City Council;(1998) *SPG 10: Sustainable Development - Design Guide*; Leeds City Council.

City of Bradford MDC Documents

City of Bradford Metropolitan District Council (2005) *Unitary Development Plan*, Bradford MDC

City of Bradford Metropolitan District Council (2003) *Replacement Unitary Development Plan: Background document: No.2 Sustainability Appraisal - to ensure plan promotes sustainable development.* Bradford MDC

City of Bradford Metropolitan District Council Supplementary Planning Guidance (SPG) (2000) *Access to Buildings and their surroundings*, Bradford MDC

City of Bradford Metropolitan District Council Supplementary Planning Guidance (SPG) (1998) *Nature Conservation Strategy 'Nature & People',*

Bradford MDC Bradford Vision and Bradford Metropolitan District Council (April, 2000) *2020 Vision - A 20-year vision for the Bradford Metropolitan District*,

Bradford Vision. Bradford Vision (2002) Bradford *Multi-Agency Environmental Strategy 2002-2007: Draft for Consultation*. Bradford Vision

West Yorkshire Local Transport Plan Team; (2000) *West Yorkshire Transport Plan 2001-2006*; West Yorkshire PTE, Leeds.

Government Guidance

The Brundtland Report. World Commission on Environment and Development (1987) *Our Common Future.*

Department of the Environment (1990) *This Common Inheritance*. HMSO. London.

Department of the Environment, Transport and the Regions (1999) *A Better Quality of Life: A Strategy for Sustainable Development*. HMSO, London.

Department of the Environment, Transport and the Regions (1998) *Planning for Sustainable Development: Towards Better Practice*, HMSO, London.

Department for Environment, Food and Rural Affairs (2005) *Securing the Future: the UK Sustainable Development Strategy*. HMSO, London

Local Government Management Board (LGMB) (1994) *Characteristics of a Sustainable Society - Checklist for local Authorities*, LGMB.

Barton, H. Davis, & Guise, R. (1995) *Sustainable Settlements. A Guide for Planners, Designers and Developers*. University of the West of England and The Local Government Management Board.

The Urban Task Force (1999) *Towards an Urban Renaissance: the final report of the Urban Task Force*, EF & N Spon, London.

Department of the Environment, Transport and the Regions (DETR) (2000) *Our Towns and Cities: The future - Delivering an urban renaissance,* DETR, London.

National SUDS Working Group (2004) *Interim Code of Practice for Sustainable Drainage Systems*. National SUDS Working Group

Office of the Deputy Prime Minister (2004) *Planning for Renewable Energy: A Companion Guide*. HMSO, London

Sustainable Buildings

Rudlin, D. & Falk, N. (1999) *Building the 21st Century Home - The Sustainable Neighbourhood*; Architectural Press, Butterworth-Heinemann, Oxford.

Carrol C et al (1999) *Meeting Part M and Designing Lifetime Homes*, Joseph Rowntree Foundation.

Brewerton, J & David (1997) *Designing Lifetime Homes*, Joseph Rowntree Foundation York.

Joseph Rowntree Foundation (2002) *An Introduction to Lifetime Homes.*

Roaf, S, Fuentes, M and Thomas, S (2001) *Ecohouse: A Design Guide*, Architectural Press, Oxford.

DETR & DTI (1999) *Planning for passive solar design*, BRECSU & BRE, Watford.

DTI (1999) *Photovoltaics in buildings: A design guide.*

Building Research Establishment (BRE) (1995) *Environmental Standards - Houses for a Greener World*, BRE, London.

9.0 Technical Appendix: Building Materials Sustainability Guide

Section 3.4.2 of this Sustainability Design Guide provides an overview of the suitability of using certain building materials and the importance in terms of the environment and human health in using environmentally sound, sustainable materials. This Technical Appendix is adapted from that compiled by Brent Council and used as an Appendix to their SPG 19: 'Sustainable Design, Construction and Pollution Control'. The tables are laid out from below ground level upwards. The Preferences are ranked in order of their relative impact on the environment (with the 1st Preference having the least impact) while materials which have an unacceptable environmental impact or have proven or suspected health risks appear in the Not Recommended column. This list is not exhaustive and the relative prices of materials are subject to change.

Part of Building	Component	1st Preference(s)	2nd Preference(s) (Unsustainable)	3rd Preference(s) (Most Sustainable)	Not Recommended	Relative Costs
Foundations to Below Floor Level	Foundation Posts	Local Sustainable or Forestry Stewardship Council (FSC) Timber with concrete top	Concrete with reclaimed aggregate		Concrete with primary aggregate	Sustainable Preferences are cheapest.
	Ground Under Suspended Floors	Shells	Foamed Concrete/Sand	Expanded Clay Granules/ Polythene Membrane	PVC Membrane	2nd and 3rd Preferences are the cheapest.Cost of 1st Preference varies.
	Damp-proof membrane	Low Odour Chemical DPC	Polyethylene DPC/DPM	Engineering Brick Slate/ Thin Steel Sheeting	Chemical Solvent DPC Bituminous DPC/DPM	2nd Preference and unsustainable options are cheapest.
Landscaping	Hard Paving	Recycled aggregate concrete slabs Concrete slabs Turf	Brick pavoirs Concrete blocks Granite setts		Asphalt In-situ concrete	Concrete slabs and asphalt are the joint cheapest. The rest of the 1st and 2nd preferences are all cheaper than in-situ concrete.
	Semi-hard paving	Wood / bark chippings	Recycled glass sand	Sand	Gravel	2nd Preference is cheapest, then 1st Preference and gravel.
	Garden Separation	Hedges	Woven Wood Waste	Untreated sustainable local softwood on concrete spur posts	Recycled PVC fencing Non-FSC Tropical timber Copper Chrome Arsenate (CCA) treated timber	1st preference is cheapest. 2nd preference and unsustainable options cost the same.
	Privacy Screens	Hedges	Local sustainable or FSC timber with concrete footing	Masonry	Non-FSC Tropical Wood CCA treated timber	Preferences 1 and 2 are cheapest.
	Bin Stores	Local Sustainably Forested Timber FSC Durable Timber	Untreated softwood on concrete spur posts	Masonry Prefabricated concrete Recycled polyvinyl	Non-FSC Tropical Wood CCA treated timber	2nd Preference and pre-fab. concrete are comparable to unsustainable options.

Part of Building	Component	1st Preference(s)	2nd Preference(s) (Unsustainable)	3rd Preference(s) (Most Sustainable)	Not Recommended	Relative Costs
Ground/Intermediate Floor Construction	Ground Floor	Local Sustainably forested or FSC Timber (suspended floors) / hollow ceramic elements	Hollow concrete elements with recycled aggregate or limestone	Solid Concrete with reclaimed aggregate or limestone	Solid Concrete with primary aggregate	1st Preference cheapest, 2nd is 2nd cheapest and 3rd is 3rd cheapest.
	Ground Floor Thermal Insulation	Mineral Wool / Expanded Polystyrene	Foamed Glass	Perlite/Vermiculite	Extruded Polystyrene Polyurethane	1st Preference is comparable to unsustainable options.
	Party/Intermediate Floors	Local Sustainably Forested Timber FSC Timber	Hollow ceramic and concrete elements with recycled aggregate or limestone	Solid Concrete with reclaimed aggregate	Solid Concrete with primary aggregate	Sustainable Preferences are all cheaper than unsustainable options.
	Floor / Ceiling Acoustic Insulation	Cocoanut Fibreboard Flax Felt Strips / Rolls Natural Wool Felt	Wood-fibre Boards Recycled Natural Rubber & Cork			Wood fibre boards, Natural wool felt and flax felt strips are cheapest 3 (in that order)
	Balconies	Local Sustainably Forested Timber FSC Durable Timber	Sectional Steel/Aluminium	Prefabricated Concrete with recycled aggregate	Concrete with primary aggregate Non-FSC Tropical wood	2nd Preference is cheapest. 1st and 3rd Preferences cheaper than concrete with primary aggregate.
	Floor Screeds	Flue-gas gypsum anhydrite	Natural gypsum anhydrite	Sand-cement	Phosphogypsum anhydrite	1st Preference is cheapest, 3rd Preference is next cheapest.
	Bath / WC floors	Granite / terrazzo	Ceramic tiles	Polyester	PVC (vinyl tiles)	Sustainable Preferences cost significantly more.
	Floor Coverings	Cork floor tiles Linoleum with natural fibre backing Sisal & Coir (cocoanut fibre) carpet with natural backing Maize, rush and seagrass matting Untreated wool carpet with a jute / natural latex / wool backing Untreated wool & nylon carpet with natural backing	Tongue & groove softwood flooring Ceramic tiles FSC hardwood strips Quarry stone tiles		Vinyl (PVC) Synthetic carpets Woolmark carpets with a synthetic latex backing	Tongue & groove softwood flooring cheapest, then cork floor tiles; sisal and coir carpet; maize, rush & seagrass matting; and vinyl (all 4 are the same price). Untreated wool & nylon carpet is 6th cheapest

Part of Building	Component	1st Preference(s)	2nd Preference(s) (Unsustainable)	3rd Preference(s) (Most Sustainable)	Not Recommended	Relative Costs
Drainage, Gutter and Drainpipes	Sewers	Vitrified Clay	Polyethylene/ Polypropylene Concrete	Recycled PVC	PVC	Polyethylene/ Polypropylene cheapest, then PVC, and then 1st Preference.
	Gutters	Local Sustainably Forested Timber FSC timber	Polyester coated / galvanised steel	Coated aluminium Recycled PVC	PVC Zinc Copper	Unsustainable options are all cheaper, apart from Zinc which is more expensive than 1st Preference.
	Lining	EPDM / modified bitumen	Blown bitumen	Polyester	PVC Zinc Lead	3rd Preference is cheapest. 1st and 2nd Preferences are half the cost of PVC.
	Drainpipes / Drainpipes	Polyethylene/Polypropylene	Polyester	Steel Recycled PVC	PVC Copper	1st and 2nd Preferences are the two cheapest options.
External Cavity Wall	External Wall Skin	FSC durable timer / clay honeycomb block Loam/cob/recycled brick & lime mortar	Masonry (new stone or brick with lime mortar)	Fibre-cement / new stone or brick & cement mortar Resin-bonded plywood	Non-FSC Tropical Wood Preserved softwood	2nd preference is cheapest. 3rd Preferences are comparable to unsustainable options.
	Internal Wall Skin	Local Sustainably Forested Timber FSC Timber elements	Sand-lime blocks Flue-gas gypsum blocks	Cellular concrete blocks Natural gypsum blocks	Concrete	All sustainable options are cheaper than concrete.
	Cavity Wall Insulation	Cork Board Cellulose (recycled paper)	Mineral / Rockwool Expanded Polystyrene	Glass wool / foamed glass	Polyurethene Extruded Polystyrene	Cellulose is the cheapest, then Cork Board.
	Cladding	Local Sustainably Forested Timber or FSC timber / compressed unfired clay brick	Sustainable plywood	Fibre cement Recycled Profiled Steel or Aluminium Cladding	Non-FSC Tropical Wood Composite Steel Panels Composite Aluminium Panels	3rd Preferences are the cheapest. Unsustainable options are next cheapest, then 2nd Preference.
	External Wall	Ceramic Tiles Rendering	Mineral Render	Synthetic Render		2nd Preference is cheapest, then 1st Preference, then 3rd.

Part of Building	Component	1st Preference(s)	2nd Preference(s) (Unsustainable)	3rd Preference(s) (Most Sustainable)	Not Recommended	Relative Costs
Internal Wall Construction	Party Walls	Earth-based (loam) Local Sustainably Forested or FSC Timber Frame	Brick (sand-lime) Cellular concrete block	Porous Brick Limestone Concrete with Recycled Aggregate	Solid concrete with primary aggregate	All sustainable Preferences are cheaper than unsustainable option.
	Solid Walls	Earth-based (loam)	Flue-gas gypsum block Brick (sand-lime)	Cellular concrete block Natural gypsum block	Pre-cast concrete elements	Sustainable options are between 4% the cost (Earth-based) and 20% the cost (cellular concrete block) of the unsustainable option.
	Plasterwork	Flue-gas gypsum	Lime mortar	Natural gypsum	Phosphogypsum	1st and 3rd preferences are cheapest. 2nd preference and unsustainable option cost the same.
	Wall & Ceiling Framing Systems	Softwood	Steel	Aluminium		1st Preference is cheapest, then 3rd preference.
	Wall & Ceiling Panelling Systems	Karlite medium board Flue-gas gypsum board	Natural gypsum (plasterboard)	Formaldehyde-free MDF	Phosphogypsum board Medium density fibreboard (MDF)	Flue gas gypsum and natural gypsum are comparable in price to the unsustainable options.
Plumbing & Internal Water	Water Supply Piping	Polyethylene (cold water only) Polybutylene/Polypropylene	Stainless Steel	Copper	Lead	Sustainable Preferences are all cheaper than lead.
	Internal Waste Pipes	Ceramic	Polypropylene / Polyethylene	Recycled PVC	PVC	2nd Preference is cheapest. 1st & 3rd Preferences cost slightly more than PVC.
Heating Installations (for highly insulated buildings)	Individual Space Heating	Gas Wall Heaters Low Wattage Electric Heater (wall mounted)				Gas wall heaters cost slightly more.
	Central Space / Water Heating	Correctly-sized Solar & Condensing Boilers	Condensing Combination Boiler	High-Efficiency Combination Boiler	Standard Oversized Boiler Standard Combi-Boiler or Electric Water Heater	Sustainable Preferences all cost extra, but save money in the long run.

Part of Building	Component	1st Preference(s)	2nd Preference(s) (Unsustainable)	3rd Preference(s) (Most Sustainable)	Not Recommended	Relative Costs
Window Frames and Doors	External Door / Window Frames	Local Sustainably Forested Timber FSC Durable Timber Untreated Softwood	Softwood with sodium borate implant Sustainable plywood (door)	Aluminium Preserved softwood Recycled uPVC	Non-FSC Tropical Wood uPVC	1st Preferences are comparable in price to unsustainable options. Other preferences are more expensive.
	External window / door cills	Ceramic Concrete Natural Stone	Prefabricated Concrete Cast Stone Fibre Concrete	Synthetic stone Aluminium		Concrete and Prefab. Concrete is cheapest, then ceramic. Natural stone is most expensive.
	Internal Window Frames	Local Sustainably Forested Timber FSC Timber	Galvanised & coated steel		Non-FSC Tropical Wood	1st Preference costs slightly more than unsustainable option.
	Internal Window Sills	Ceramic Tiles Natural Stone Softwood	Sustainable Plywood Cast Stone	Fibre Cement Chipboard Synthetic Stone		Chipboard is cheapest, then Fibre cement, then sustainable plywood and ceramic tiles. Natural, cats and synthetic stone are the most expensive.
	Internal Doors	Honeycomb with hardboard skins	European Softwood	Sustainable Plywood Chipboard	Non-FSC Tropical Wood	Unsustainable option is cheapest, followed by 1st preference and chipboard.
	Internal Door Thresholds	FSC Durable Wood	Sustainable Softwood	Steel with coating	Non-FSC Tropical Wood	2nd Preference and unsustainable option can cost the same. 1st & 3rd Preferences cost slightly more.
Glazing	Glazing Type	Argon-filled low emissivity	Air-filled low emissivity Double		Single	1st and 2nd Preferences are the most expensive.
	Installation	Dry*	Semi-dry	Wet*		Dry & Semi-dry are cheapest.

* 'Dry' glazing installation involves the use of extruded rubber gaskets to seal the edge of the glazing, while 'wet' installation uses a sealant over a pre-formed tape to seal the windows.

Part of Building	Component	1st Preference(s)	2nd Preference(s) (Unsustainable)	3rd Preference(s) (Most Sustainable)	Not Recommended	Relative Costs
Roof Structure	Roof Shape	Pitched	Arched	Flat		Pitched is cheapest, then flat then arched.
	Pitched Roof Construction	Local Sustainably Forested Timber FSC Timber	Box Panels / Sustainable Plywood Chipboard (low formaldehyde)	Chipboard	Plywood from Non-FSC Tropical Wood	Both types of chipboard are cheapest, followed by unsustainable option and box panels / sustainable plywood.
	Pitched Roof Insulation	Cork Cellulose Sheep's Wool Flax	Mineral Wool Expanded Polystyrene		Polyurethane / Polyisocyanurate Extruded Polystyrene	1st and 2nd Preferences cost slightly more than Polyurethane/ Polyisocyanurate but are cheaper than extruded polystyrene.
	Pitched Roof Covering	Green (turf) Timber Shingle Reed Reclaimed Tiles	Clay or Concrete Roof Tiles Natural Slate	Fibre-cement slates / Bituminous Slates Corrugated Panels / Copper	Zinc with PVC / PVF coating Asbestos Cement	2nd and 3rd Preferences are all half the price of the unsustainable options. 1st Preferences are cheaper than asbestos cement, but slightly more than coated zinc.
	Flat Roof Construction	Softwood Rafters & Joinery	Steel Sheets / Cellular Concrete Concrete with Reclaimed Aggregate		Concrete with primary aggregate	Sustainable Preferences are all vastly cheaper than the unsustainable option.
	Flat Roof Insulation	Cork	Expanded Heavy Duty Polystyrene / Dense Mineral Wool Foamed Glass	Perlite	Polyurethane / Polyisocyanurate Extruded Polystyrene	Foamed Glass is cheapest, followed by Cork. Extruded Polystyrene is the most expensive material, while the rest are comparable in price.
	Flat Roof Covering	Green (turf)	EPDM sheet / Natural Rubber	Modified Bitumen Felt Blown Bitumen Felt / EPDM with Bitumen layer Recycled PVC Stainless Steel / Aluminium / Copper / Zinc sheet	Steel with Organic Coating PVC Sheet	2nd Preference, Bitumen Felt options and Recycled PVC are all significantly cheaper than coated steel, but slightly more than PVC. Metal sheets and turf roof are the most expensive options.

Part of Building	Component (Unsustainable)	1st Preference(s) (Most Sustainable)	2nd Preference(s)	3rd Preference(s)	Not Recommended	Relative Costs
Roof Structure (cont)	Flashings	Polyethylene Membrane EPDM Membrane Polyisobutene (PIB) with Al. gas			Lead Zinc	All of the 1st Preferences are cheaper than lead, particularly polyethylene membrane which is also half the price of zinc.
Paint Finishes	Interior Painting (Wood)	Natural Wax Waterborne Natural Stain	Waterborne Acrylic (gloss) Waterborne Alkyd	Natural Paint High-solids Alkyd	Alkyd (oil based) paint	Waterborne Alkyd is cheapest, followed by unsustainable option. The rest of the sustainable preferences cost slightly more.
	Exterior Painting (Wood)	Natural Paint Boiled Paint	High-solids Alkyd Waterborne Alkyd	Waterborne Acrylic (gloss)	Alkyd (oil based) paint	Waterborne Alkyd is cheapest, followed by unsustainable option. The rest of the sustainable preferences cost slightly more.
	Wall Surface Preparation	None	Natural Preservative	Waterborne Preservative	Solvent-based Preservative	Unsustainable option is cheapest, followed by 3rd Preference then 2nd Preference.
	Interior Painting (Walls)	Whitewash	Linseed Oil Emulsion Mineral Paint Water Bourne Natural Stain	Natural Paint Waterborne Acrylic Emulsion	Alkyd (oil based) paint	1st Preference and Natural Paint are cheapest. Other Sustainable Preferences cost more than unsustainable option.
	Exterior Painting (walls)	Mineral Paint Waterborne Natural Stain	Natural Paint	Waterborne Acrylic Paint	Alkyd (oil based) paint	2nd Preference is the cheapest. Waterborne natural stain costs slightly more than the unsustainable option.
	Ferrous Metal Painting	Natural Paint Duplex Galvanising	High-solids Alkyd	Alkyd (oil based) paint	Lead Red Lead Epoxyl Alkyd Paint Thermal Galvanising	3rd Preferences are comparable in price to the unsustainable options. 2nd Preference is the next cheapest.

Produced by the Design and Conservation Team
November 2006