2

Section

Section 2

2.01 Introduction

2.01.01

This chapter explores how to embed high quality green infrastructure, climate change and sustainability principles into the design and development process. It looks at the different stages in the design process, and the different scales of development, highlighting the key design considerations.

2.01.02

Early consideration of green infrastructure and sustainability in the design and development process allows for many statutory requirements to be met in a joined up way, and for many social economic and environmental objectives, that underpin Central Bedfordshire's Development Strategy to be met.

2.01.03

Economic Benefits

- Creating the setting for economic growth and employment
- Improving access for sustainable access to employment
- Resource efficiency – reduced bills

2.01.04

Social Benefits

- Providing space for an active, healthy lifestyle
- Providing space for community cohesion
- Providing space for leisure activities

2.01.05

Environmental Benefits

- Protection from pollution
- Sustainable use of natural resources
- Adapting to climate change
- Mitigating flood risk
- Protecting and enhancing biodiversity, landscape, woodlands, trees and hedgerows

A joined up design process that integrates green infrastructure, climate change adaptation and environmental sustainability enables good design solutions to be developed. It also allows for efficient use of space, where innovative design can allow for the multifunctional use of land within the development to deliver a range of green infrastructure and environmental sustainability benefits on one space.

2.01.06

Green Infrastructure

Green infrastructure is the network of multifunctional green spaces, both new and existing, both rural and urban which supports the natural and ecological processes and is integral to the health and quality of life of sustainable communities.

2.01.07

The functions that green infrastructure delivers (providing habitats and access to nature, space for access, recreation, movement and leisure, creating an attractive landscape, water resource management etc.) should not be seen in isolation but as a series of interrelated functions that complement one another.

2.01.08

The various components and functions of green infrastructure are considered in more detail in this chapter. They include landscape, biodiversity, access, movement, recreation and leisure, sustainable water management, trees, climate change adaptation and resource efficiency.

2.01.09

Green Infrastructure can provide many social, economic and environmental benefits close to where people live and work including:

- Space and habitat for wildlife with access to nature for people
- Places for outdoor relaxation and play
- Climate change adaptation - for example flood alleviation and cooling urban heat islands
- Environmental education
- Local food production - in allotments, gardens and through agriculture
- Improved health and well-being – lowering stress levels and providing opportunities for exercise

Integration of green infrastructure with the built environment that surrounds it is crucially important if benefits are to be maximised.

2.01.10

Benefits will be achieved most successfully if green infrastructure design is integrated with more traditional built infrastructure planning. An important consideration is the spatial positioning of the component parts of the green infrastructure. Some benefits depend on a strong connectivity between location and user. Others, such as wildlife habitat, may depend on the inter connectedness of the component parts of the green space 'jigsaw'.

2.01.11

While the rest of this chapter looks in detail at the various components of the green infrastructure network, a joined up approach across all these areas is necessary to maximise the benefits of good green infrastructure design.

Green infrastructure needs to be considered both within and beyond the 'red line' boundary of a development site, considering the context and setting of the development, and the connectivity of green spaces with the wider green infrastructure network.

Please see page 4 and 5 of the Landscape Institute Green Infrastructure guide for further details ;

www.landscapeinstitute.org/PDF/Contribute/2013GreenInfrastructureLIPositionStatement.pdf

2.01.12

Across Central Bedfordshire, green infrastructure plans have been prepared at a range of scales, identifying green infrastructure assets and opportunities from the strategic to the community level. These plans should be considered when new developments are proposed.

For county and district level GI Plans see:
www.bedsandlutongreeninfrastructure.org

For community level GI Plans see:
www.voluntaryworks.org/brcc/green-infrastructure

2.01.13

Sustainability

In addition to this design guide, there are a number of tools to support the design and delivery of sustainability within the development. These are signposted throughout the chapter, but include BREAAM Buildings, BREEAM Communities, and the Code for Sustainable Homes.

The following chapter highlights key design opportunities for designing in various green infrastructure and sustainability components and functions. It aims to stimulate inspiring and innovative thinking about how to reflect green infrastructure needs and opportunities in the design of sustainable communities.

CENTRAL BEDFORDSHIRE LANDSCAPE CHARACTER AREAS

- County Boundary
- District Boundary
- Urban Areas
- 1 Clay Farmland
- 4 Clay Valleys
- 5 Clay Vales
- 6 Wooded Greensand Ridge
- 7 Greensand Valley
- 8 Clay Hills
- 9 Chalk Escarpments
- 10 Rolling Chalk Farmland
- 11 Chalk Dipslope
- 12 Chalk Valleys

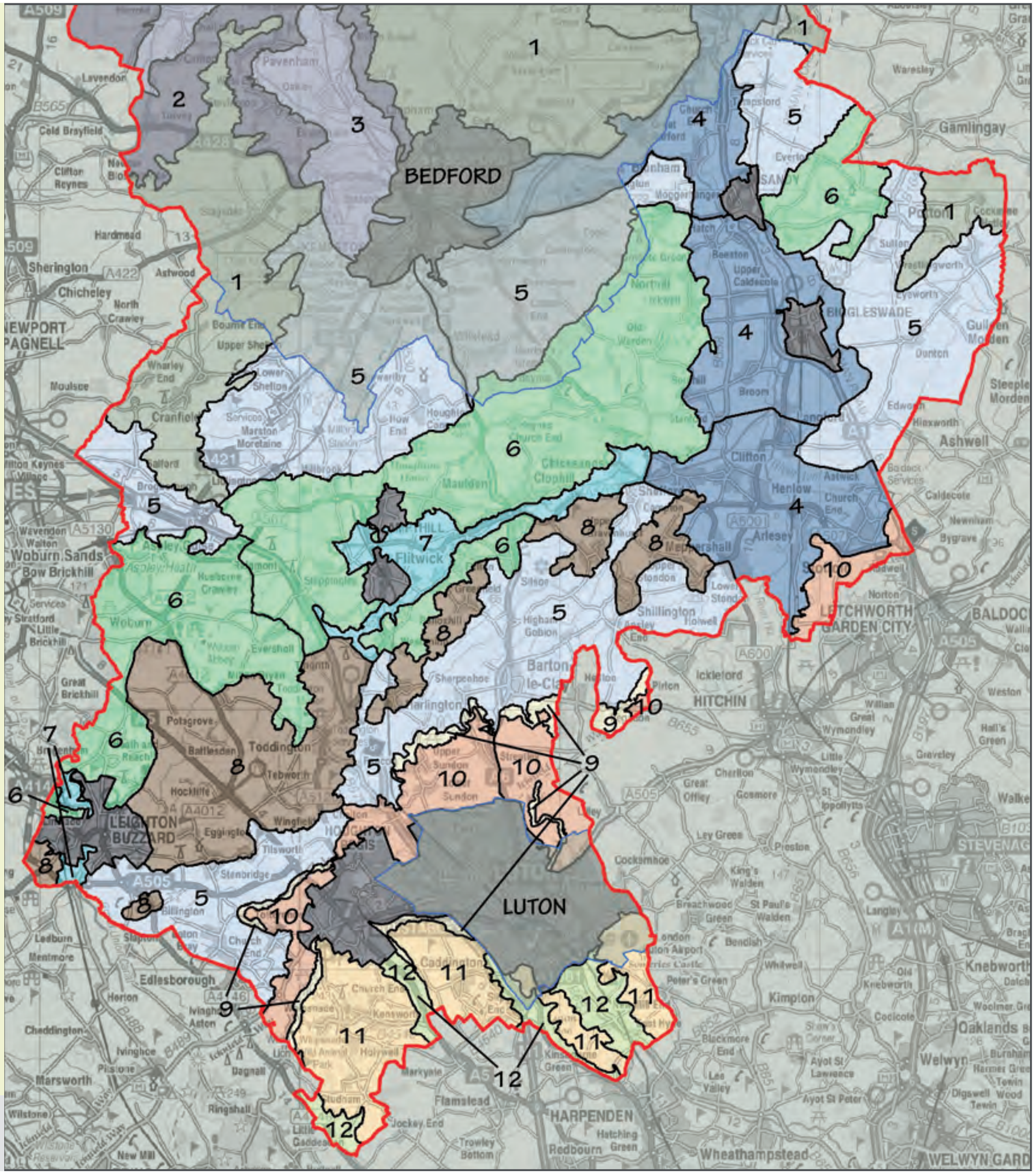

Fig 2.1 This map shows the landscape character areas of Central Bedfordshire, defined for the purposes of this guide.

2.02 Landscape Setting and Context for Development

2.02.01

Introduction to Central Bedfordshire's Landscape

Central Bedfordshire has a rich and varied landscape, including parts of the Chiltern Hills Area Of Outstanding Natural Beauty, the major escarpment of the Greensand Ridge and also many clay hills, vales and river valleys. Design leads can be taken from these characteristic landscape features. There are landscapes where land use is extensive and little landscape structure and character remains. In these locations development can beneficially restore features.

2.02.02

The urban landscape also varies in extent and quality both in terms of setting and character and availability of green space within the towns. Dunstable, Leighton Buzzard and Ampthill in particular are set within landscapes of great environmental value. Reciprocal views are important between town and country and can be highly significant where landmarks or green spaces are concerned. Rural land between settlements is significant in terms of retaining the individual identity of market towns and villages.

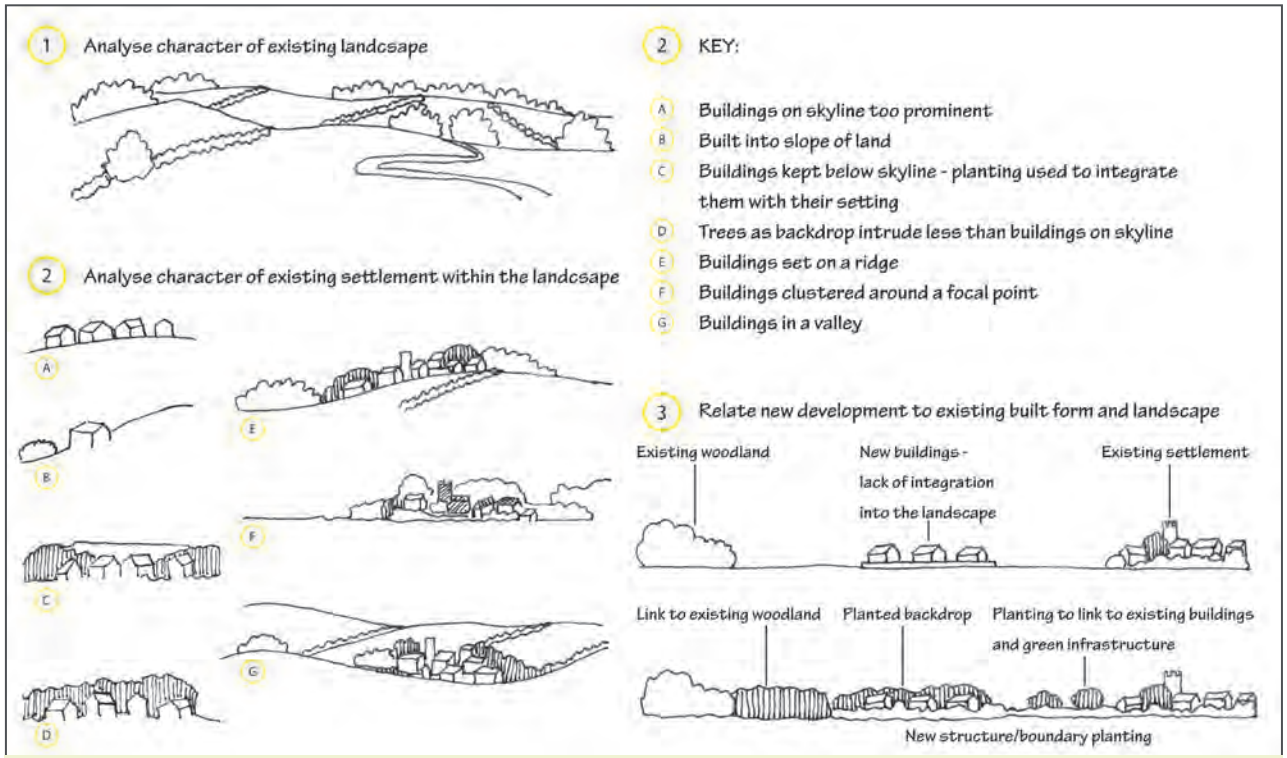

Fig 2.2 Landscape character assessment to ensure new development relates to the site context

Section 2

Design Considerations
Masterplan Scale

2.02.03

Landscape Character

Understanding and responding sensitively and in scale with local character is fundamental to the delivery of a well designed development. Central Bedfordshire Landscape Character Assessment provides developers and designers with a useful tool, informing the design of new development by providing information on;

- Key characteristics – distinctive landform, skylines, heritage, biodiversity and vernacular factors specific to the locality
- Evaluation of change and the forces for change
- Landscape Character sensitivity
- Visual sensitivity

It also provides advice on:

- Development Guidelines
- Landscape Management and conservation priorities

2.02.04

Integration of Development within the Landscape

- **Selection of site:** The character of the site and surrounds needs to inform development ; utilising site topography, hydrology, planting structures - plus wider landscape setting and views - can assist in integrating and mitigating development, ensuring development 'fits' and contributes to quality urban and landscape enhancement. Some sites may be of higher landscape or visual sensitivity, including historic and ecological sensitivities, which may limit development opportunity but can also reinforce character of development and local distinctiveness with appropriate treatment.
- **Site layout:** Organising development in relation to landscape topography, existing development and planting can assist in key design decisions. This will involve utilising natural features of the site, determine the location of built form and new structure planting to reinforce existing, whilst maintaining and creating views and vistas.

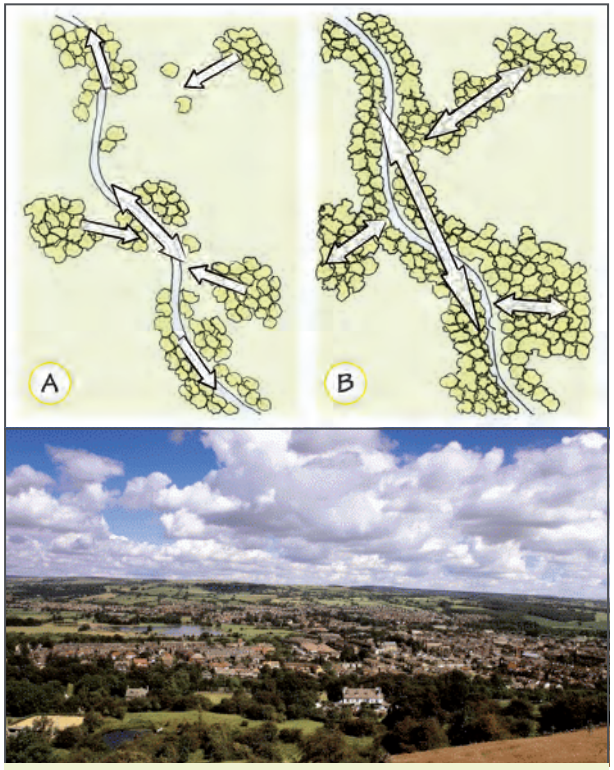

Fig 2.3 Existing landscape features (A) should be connected and reinforced to create a green framework (B) with development integrated within landscaped setting



Fig 2.4 Landscape connections extending green corridors through development



Fig 2.5 Informal and formal public open space with adequate space to allow extensive planting, including significant trees



Fig 2.6 High quality, well-maintained planting reflects quality in the environment, encouraging sense of place, outdoor recreation and community cohesion

Fig 2.7 Well designed and maintained landscaping along infrastructure corridors

Fig 2.8 Multifunctional landscapes offer opportunities for informal play

Fig 2.9 Wixams, Central Bedfordshire - this development blocks views of the Greensand Ridge without adding any distinctive features to enhance the skyline

2.02.05

Connections

As with urban design the development of landscape design needs to ensure that development not only fits visually within and compliments the character of surrounding landscape but also function as a component within the surrounding landscape and environment.

2.02.06

Connecting landscape features including water courses, ecological habitats, woodland blocks, hedgerows, historic boundaries and recreational paths can strengthen the landscape framework and inform the layout and character of development.

2.02.07

Strategic green infrastructure corridors extending into and through development can create the support for a network of multifunctional green spaces which host the built environment.

2.02.08

With strategic green infrastructure directly informing the development framework and extended through the site via the landscape masterplan green infrastructure permeates through to detailed landscape plans. But it is imperative that adequate space is allocated to ensure various uses and purposes can function properly.

2.02.09

Conserved Landscapes

Central Bedfordshire contains two designated landscapes, part of the Chiltern Hills Area of Outstanding Natural Beauty (AONB), and part of the Marston Vale Community Forest. Development in the Chilterns AONB, and within the setting of the AONB should take account of the Chilterns Building Design Guide, in addition to this design guidance. The Marston Vale Community Forest is an environmentally led regeneration project, creating a new landscape in the Marston Vale, with a target to achieve 30% tree cover by 2030. Development within the Community Forest will need to give consideration to creating substantial woodland areas through the development process.

2.02.10

Skylines

The wooded skylines of the Greensand Ridge and the escarpments and elevated plateaux of the Chilterns strongly define the setting of the adjacent vales but other more locally important skylines can be significant e.g. formed by the Clay Hills and the Cranfield Ridge. Although largely undeveloped, features such as church towers and water towers form landmarks. The skylines, established landmarks, wooded ridgelines and other positive long views should be taken into account when considering the massing and layout of development. The skyline of new development should aim to enhance or respond to the character of its setting – a key design principle being whether it becomes a strongly visible feature or remains below the skyline.

2.02.11

Landscape Plans

Landscape plans will be required to demonstrate the evolution of the design concept through to detailed drawings and planting specifications.

For larger, complex or controversial Applications, CBC welcome the use of visualisation techniques such as fly-throughs, computer generated visualisation as well as photomontages and wireframe drawings. A model of a proposed development may also be appropriate.

Effective integration of development within the established landscape and setting of site can reduce the need for additional 'add on' mitigation measures – and additional development costs.

ON SITE

2.02.12

Ground Modelling

Adjusting site levels may be required to facilitate development but more significant changes in levels and earthworks can result in inappropriate features which are out of character and visually intrusive. Overuse of bunds can lead to the creation of awkward features, and the loss of soil as a resource. Where required, the height and form of bunds and mounds must relate to local character within and beyond the site to ensure integration. Planting on top of bunds and earthworks can exacerbate the visual impact of earthworks as can the selection of inappropriate tree and shrub species. If planting is required, it should be limited to the side of bunds, with appropriate species.

2.02.13

Landscape Integration

The pattern of landform and existing features will influence the landscape design, which should seek to secure a sympathetic response to the setting and avoid overly linear solutions. Although screening will be an aspect, a successful scheme will unite the land use, including existing development and avoid sudden contrasts in character.

2.02.14

The Development Edge

It is important to consider how the edges of development relate to external landscapes and the extent of spatial buffer required to be included in the development masterplan.

Access roads and backs of development can form a visually harsh, intrusive boundary and should be avoided; turning development to face the site boundary with adequate and effective space and landscaping can assist in creating a positive edge to development and rural interface.

Community and amenity uses including sports pitches, allotments, pony paddocks and cemeteries can also be considered as appropriate uses at development edges but the character of the landscapes associated with these activities can present an urban image at the rural interface and therefore great care in planning and design is required to ensure that adequate space is included for appropriate and effective landscape mitigation.

2.02.15

Boundary Treatments

Use materials to reflect local vernacular where possible e.g. with colour of brick or timber treatment. Security fences and gates should not dominate the street scene in urban areas . In rural areas, native hedging should be used where possible and to screen incongruous boundary treatments.

Fig 2.11a Drainage ditches, Steppingley

Fig 2.11b Woburn picket fences

Fig 2.11c Holly hedges, Eversholt

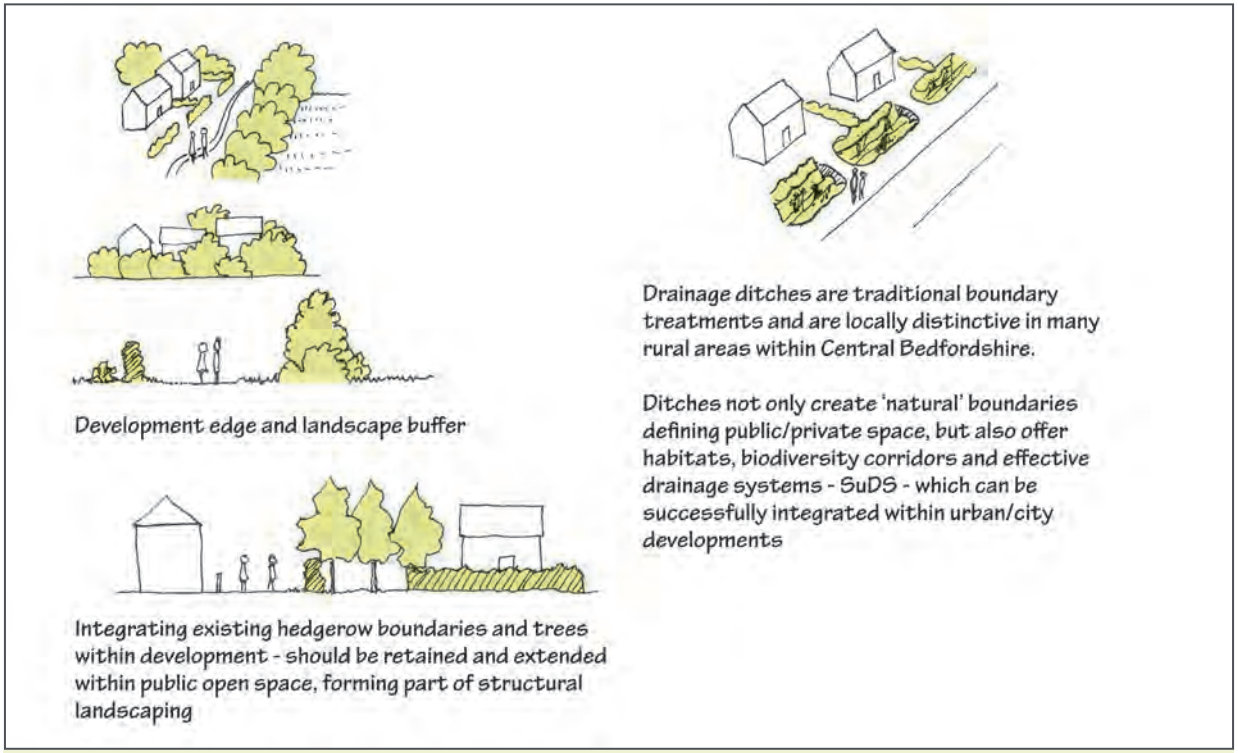

Fig 2.10 Types of Boundary Treatment

Fig 2.11d Ironstone walling

2.02.16

Planting

Structure planting can assist in integrating development within the landscape but it is essential that the design of planting and selection of species compliments and reinforces local distinctiveness. It is also essential that adequate space be allocated for structure planting, that advanced planting be included especially on larger development sites according to phasing, and off site planting be considered to assist in mitigation of development and landscape enhancement.

2.02.17

Form, Materials and Design of Structures

Often built form cannot be screened – screening is not necessarily desirable and can result in screening itself being out of character, visually intrusive and costly. The form, height, massing, materials colours and textures of built development and structure planting appropriate to the site and surrounds will assist in integrating development.

2.02.18

Reinforcing Local Distinctiveness

Strategic landscape planting sympathetic to Central Bedfordshire will largely comprise of species typical of lowland England. Within Central Bedfordshire there is scope to reinforce character through the selection of locally occurring native species. Although many species are in common, there is scope to create variation across Central Bedfordshire not only with the trees but also with the shrub and grassland areas, with careful selection of grass and wildflower mixes. Ornamental trees and shrubs can be useful in order to reference a cultural feature or provide variation in the street scene . The following list aims to encourage planting appropriate to the character type. It is also of great ecological importance to use stock from local provenance where possible.

GUIDE TO PLANTING WITHIN LANDSCAPE CHARACTER AREAS

2.02.19

Clay Farmland, Clay Hills, Clay Vales (1,5,8)

Landscapes which have almost entirely declined in character, where planting is required to renew and create features. Woodlands and roadside hedgerows may be locally significant.
Urban fringe pressures.

- Structure planting based on oak, ash, field maple, wild cherry, crab apple
- Specimen trees: lime –often linked to churches and estates, hornbeam
- Shrubs – hawthorn, blackthorn, spindle, dogwoodHedges – mainly hawthorn, blackthorn, hazel, dogwood.

2.02.20

Clay Valleys (4)

River valleys of the Great Ouse and Ivel have declined in character and require renewal of traditional features and creation where structure lost. Remaining pasture a conservation priority. Urban fringe pressures.

- Structure planting based on – white willow, crack willow, ash,
- Riverside planting – willow, sallow, alder
- Shrubs - Guelder rose, dogwood, sallow, osier
- Hedges- hawthorn with blackthorn, dogwood, field-maple

2.02.21

Wooded Greensand Ridge (6)

Highly sensitive , extensively wooded landscape which is in decline. Strong vernacular of ironstone. Opportunities to create and enhance landscape features, particularly heathland and acidic grassland.

- Structure planting – oak, field maple, sweet chestnut, birch, rowan
- Scot's pine, Corsican pine
- Shrubs – gorse, broom, holly
- Hedges - Holly characteristic of villages; well managed "Estate " hawthorn hedges frequent.

2.02.22

Greensand Valley (7)

Flit Valley –declined landscape with urban fringe pressures ; unique for wet fen woodland**.** Alder, ash, willow as roadside features.

Ouzel Valley and Grand Union Canal- declined landscape with strong character, riverside species such as willow, alder but also influenced by Estates and pastoral landscape.

- Structure planting -alder, willow, oak , sash, willow.
- Riverside planting- alder, willow, black poplar.
- Specimen trees- lime, hornbeam.
- Hedges- hawthorn with blackthorn, wayfaring tree, field maple

2.02.23

Chalk Escarpments (9)

AONB protected landscape –with priority of chalk grassland conservation, development or planting unlikely unless linked to adjacent permission . If planting required, appropriate species include – beech, field maple,birch, wild cherry, wayfaring tree, dogwood, wild privet.

2.02.24

Rolling Chalk Farmland (10)

Declining landscape, some within AONB; urban fringe influence in parts. Opportunities for landscape renewal. Connection to chalk hills important visually and for green infrastructure.

- Structure planting -oak, ash , field maple ,wild cherry, beech
- Shrubs- wild privet, wayfaring tree, dogwood, spindle
- Hedges – hawthorn, blackthorn, wayfaring tree, wild privet.

2.02.25

Chalk Dipslope (11)

Declining landscape with scope for conservation and renewal – often elevated farmland ,also strong Estate influence

- Structure planting -oak, ash, field maple, wild cherry
- Specimen trees -lime, beech, hornbeam
- Hedges – hawthorn, spindle, dogwood, wild privet, field maple

2.02.26

Chalk Valleys (12)

Series of valleys lacking identity through declined condition and urban fringe influence; scope for enhancement and renewal.

- Structure planting -oak, ash , field maple, wild cherry, willow
- Shrubs - wayfaring tree, spindle, dogwood
- Hedges – hawthorn, blackthorn , field maple , shrubs as above.

2.02.27

Landscaping of Verges and Roundabouts

The character of grass verges is important. The width should relate to the historic pattern rather than a set distance.

Where possible, the aim should be to establish flower enriched verges where possible, using native seed mixes:

- Clay soils - aim to introduce locally native , persistent species such as cowslip , meadow cranesbill , birds foot trefoil to native grass mix
- Sandy soils - seed at low density with appropriate grasses and allow natural colonisation where possible, or sow an appropriate mix.
- Chalk soils – seed if necessary at low density with appropriate grasses and allow natural colonisation.

2.02.28

Development often requires the introduction of roundabouts into a road with otherwise rural character. The landscape treatment can help to mitigate this intrusion or conversely could add to the urban character. In almost all locations, the surrounding features of the countryside should inspire the planting scheme, with native species predominating. Certain ornamental species are more acceptable in the countryside e.g. cultivars of native species or berry-bearing species and

Fig 2.12 Barton roadside nature reserve serves to enrich and maintain the character of verges

smaller trees such as winter-flowering cherry. Space for larger trees is limited but care has to be given before the use of fastigiate trees, or overly geometric patterns as these can urbanise a setting.

2.02.29

Local character and identity can be developed through the use of low-nutrient soils and local stone. Wildflower grassland can be particularly successful on chalk. Heather and acidic grassland species could provide a distinctive solution in the greensand areas.

2.02.30

Lighting

Although a necessity of most development lighting can result in significant visual intrusion especially in more rural areas with dark night skies. Modern lighting systems and luminaires produce efficient and directional lighting which can help reduce visual impact at night time as can the design and layout of development. Domestic lighting, including household security lighting, is more difficult to manage and control - the setting of development and roads away from rural edges can assist in reducing light intrusion.

2.02.31

Management and Maintenance

The future management and maintenance of planting and landscaping associated with development need to assured to ensure that landscaping can mature and remain a feature of the development.

Ownership and responsibility for maintenance needs to be agreed and a landscape management plan established as part of the formal planning process.

2.02.32
Landscape Checklist

- **Has the Applicant utilized the advice given in the Landscape Character assessment to inform the design and layout of the scheme, and in particular demonstrated adherence to the development guidelines and landscape strategy for the specific Character area?**

- **Does the design respond to the setting in terms of allocation of built and open space?**
  - Does development relate to site levels and surrounding topography?
  - Does the design safeguard important views both internally and from outside of the development?
  - Has the existing landscape structure been retained and adequately protected and integrated on site, and employed to enhance the character of the scheme, and its connections with its setting?

- **Are the edges of development effectively integrated within the landscape character?**
  - Does the development breach the skyline and if so, what is the consequence of this?
  - Should development be set back from skylines?
  - If landscape mitigation is needed to integrate development is adequate space allocated to ensure effective and mitigation can be achieved?
  - Does the character of the edge reflect and enhance local planting character and appropriate species?
  - Is development of a height, orientation and layout to minimise visual intrusion?
  - Will use and activities at the site boundaries, including sports pitches, require mitigation?
  - Will lighting at the edges of development impact on dark rural landscapes and skylines?

- **Are infrastructure corridors included in landscape proposals ?**
  - Can entry points to and road junctions within the development be integrated and enhanced?
  - Access routes including roads, cycleways and footpaths with treed avenues and varieties of shrubs and grassed verges?
  - Surface water management/Sustainable Urban Drainage conduits , attenuation arras and features
  - Utility corridors
  - Linked to green infrastructure/ green corridors

Section 2

- **Will development of the site require significant changes in existing ground levels?**
  - Will cut and fill be accommodated on site, how will excess soil be dispersed?
  - How will retained soil be designed into the proposals and reflect local landscape character?
  - If bunds are required to screen development, e.g. from visual or noise intrusion, are these of form and height reflecting local character?
  - Will planting be included, and if so, how?
- **Is strategic landscaping including landscape mitigation appropriate to the site, surrounds and scale/character of development?**
  - Is adequate space allowed for significant structure planting and mitigation?
  - Is the strategic landscape scheme based on locally occurring native species?
  - Does strategic landscaping compliment and support multifunctional green spaces/ green corridors?
  - Do proposals respond to and relate to site context in terms of form and species.
  - Are the materials used for external space of appropriate quality and where possible, characteristic of the locality?
- **Is the landscape mitigation and internal landscape structure in scale with the development, different uses and enhances a sense of place?**
  - Does the landscape design include character areas in locations appropriate to uses including formal civic squares, public parks, neighbourhood 'village' greens and allotment, school grounds, informal public open spaces and natural habitat areas?
  - Are these areas linked via green corridors, trees, hedgerows and grass areas? Has adequate space been allocated for major specimen trees?
- **Do landscape proposals link to play strategies, play areas and informal recreation?**
  - Do formal and informal play areas utilise planting for play, to engender sense of place and provide amenity/shade?
  - Are areas for natural play and exploration included in landscape proposals, possibly linked to SuDS, changes in levels or woodland areas?
  - Are grassed areas included for informal recreation and do they vary in character and optimise wildlife value where appropriate?
- **Is the future ownership and responsibility for management of landscaping agreed and confirmed?**
  - Are management plans developed, are there appropriate plans and provision for long-term management?
  - Do these cover phasing of development?
  - Do these cover changes in land ownership?

- **Are the scales of drawings and level of planting specification supplied appropriate?**
- **Are detailed planting plans and matrices illustrating strategic planting provided?**
- **Does the landscaping of the development avoid;**
  - Overuse of suburban species in rural areas – whitebeam, rowan, birch
  - Bulb planting on rural road verges – unless specifically linked to a built feature or village gateway, village hall or war-memorial or similar.
  - Ornamental evergreen hedging in urban mews planting – space rarely sufficient
  - Formal or over-ornamental planting schemes on rural roundabouts
- **Have the following been considered in the landscaping of the development;**
  - Use of native or ornamental berry bearing hedging within urban areas
  - Climbers on walls or trellis , both in housing and employment and industrial areas
  - Green divisions – climbers on fences where insufficient space for a hedge
  - Wildflower quality of grassed areas – verges, vision splays, swathes within parks or school grounds – using an appropriate mix for soil type and management regime.

2.02.33
Links and References

Mid Bedfordshire and South Bedfordshire Landscape Character Assessments

http://www.centralbedfordshire.gov.uk/environment/natural-environment/natural-environment-landscape-character-assessment.aspx

Chilterns Building Design Guide

http://www.chilternsaonb.org/uploads/files/ConservationBoard/PlanningDevelopment/BuildingsDesignGuide2010.pdf

2.03 Trees

2.03.01

The trees of Central Bedfordshire enhance the landscape, its geological features and shape its character. Trees are also an important part of the urban landscape, complementing buildings, providing landmarks and creating a sense of place. Trees make for a better place to live and work.

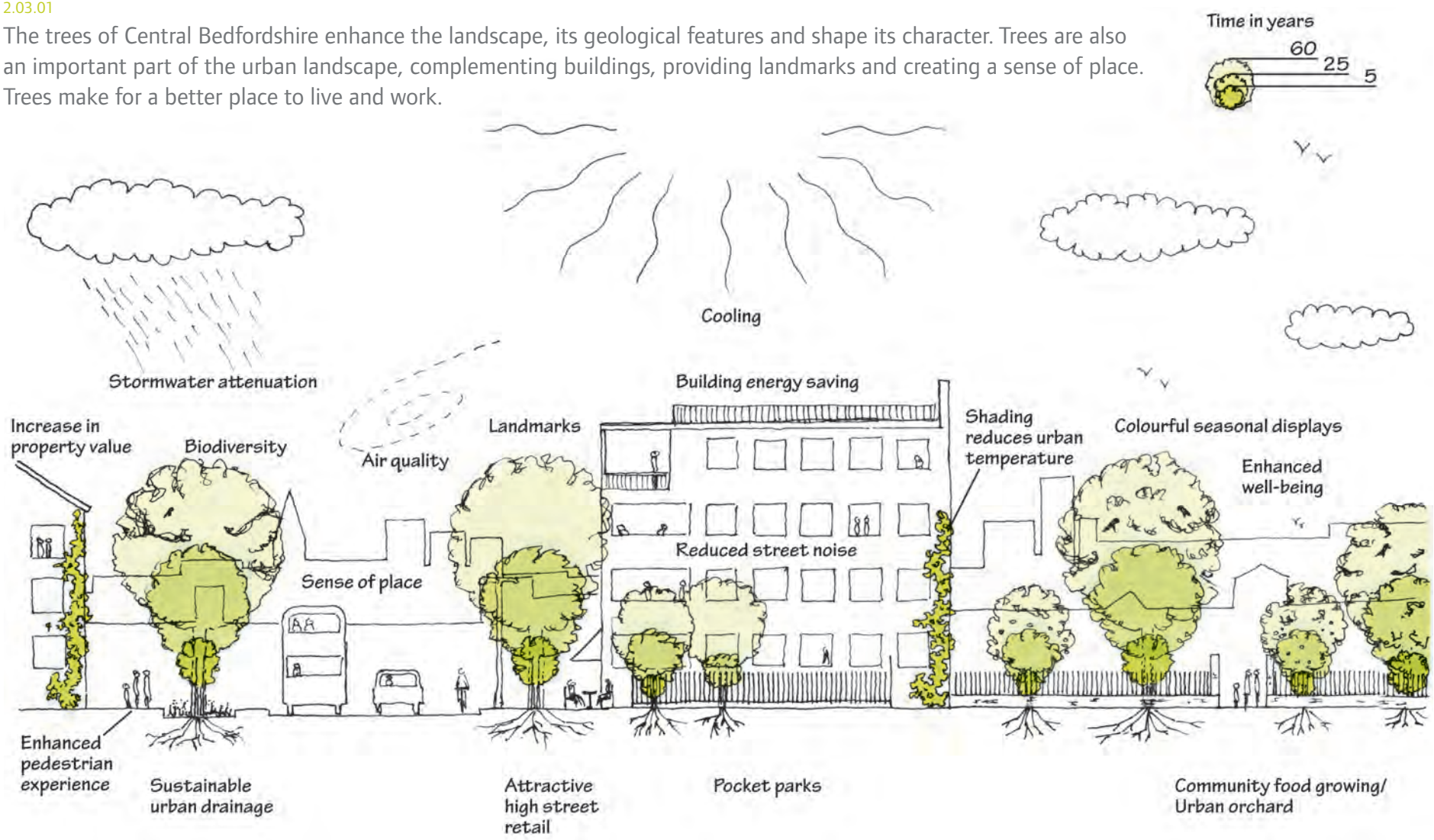

Fig 2.13 Trees provide a number of benefits when incorporated into the urban landscape

Design Considerations

On Site

2.03.02

Woodland

Central Bedfordshire is lightly wooded with less than 10% of its area covered in trees and woods. Ancient semi-natural woodland is mostly found fragmented or planted for productive forestry. Historically ash with an under-storey of Field maple would have been a naturally occurring mix, with oak planted for timber. In the south of the county on calcareous soils beech have been planted for both timber and amenity since the 1750's and mature beech now highlight the chalk ridges. Commercial forestry is found on the Greensand Ridge managed by private estates or the Forestry Commission. Opportunities to retain and increase woodland cover through development should be taken as much as possible.

Fig 2.14 Ancient woodland - Everton Bluebells

2.03.03

Trees & Hedgerows

Individual trees contribute greatly to the appearance and character of Central Bedfordshire. Dramatic changes in the landscape following the loss of thousands of elm trees and hedgerows from Elm Disease has left individual mature trees as important local landmark trees with high amenity value. Trees and hedgerows form vital habitats for wildlife, and can provide important corridors between woodland and other isolated habitats. Existing trees and hedgerows should therefore be retained where possible, and opportunities taken to create new areas of tree and hedgerow planting to provided spaces and links for wildlife.

2.03.04

Central Bedfordshire's heritage trees are mostly confined to ancient oak. Veteran tree management and retaining veteran trees safely within development is an important consideration requiring long-term commitment.edges are predominantly hawthorn with post Enclosure Act hedges, created in Sutton in 1741 until the last Enclosures in Totternhoe in 1891, being mostly of this single species. Older hedges are more likely to include a mix of native species, including hazel, blackthorn, dogwood and spindle. Some hedges contain a large proportion of cherry plum. Planting of new hedges should use stock grown from local provenance, seed sourced from ancient Bedfordshire hedgerows and woodland.

Fig 2.15 Ancient hedgerow

Fig 2.16 Bunyan's Oak

Fig 2.17 Bunyan's Oak - part of the Harlington Heritage Trail

2.03.04

Orchards

Fruit trees were once an important feature of every town and village. Many pre 1950 orchards have been cleared or are now fragmented with individual trees surviving within private gardens. The restoration of orchards, planting new and conserving old varieties is considered important in preserving local heritage, and development sites including or near to orchards should ensure that they are protected and enhanced through replanting where appropriate.

2.03.05

Retaining Trees on Development Sites

Trees on development sites are protected by BS5837 2012 Trees in relation to Design, Demolition and Construction. Retention of large trees should be seen as adding value to the finished development.

A tree survey must be conducted early in the planning stage. Special note should be made of retaining veteran trees for wildlife habitat and may have protected species already associated with them. Old orchard trees may be particularly valuable and create a sense of heritage within a new development. Small trees of good form may adapt better for long term retention than some bigger trees. A tree protection plan and method statements should be in place as early as possible and throughout the development.

2.03.06

Street Trees

Planted mature trees tend to be either Victorian, 1950's or post 1970. Victorian plantings include beech, False acacia, sycamore and Norway maple. Larger towns, Dunstable, Houghton Regis and Leighton Buzzard have the largest number of mature Victorian trees.

2.03.07

Post War planting is reflected in new street development of that time, the Festival of Britain (1951) and the beautifying of villages with flowering cherry, rowan, flowering thorn and laburnum. The village of Clifton is known locally as the "village of the cherry" and recent street plantings have maintained this theme as part of a local plan. The choice of new street trees should reflect the local heritage.

2.03.08

A legacy of post War planting is a lack of diversity within street trees. More diversification is considered desirable to reduce the effect of disease and climate change. The dominance today of Acer species such as Norway maple and Field maple, is mostly a direct result of Elm Disease and a knee-jerk reaction to plant fast growing trees that tolerate the variety of soil conditions found in Central Bedfordshire. Most were from unknown seed sources in Europe resulting in trees of poor form becoming a drain on maintenance resources. New developments should take the opportunity to include a more diverse, locally characteristic range of street trees. Information about local characteristic species can be found in the landscape section of this guidance.

Fig 2.19 Fruit trees at Sewell Farm

Fig 2.18 New hedge planting

2.03.09

Pests and Diseases

The Bedfordshire landscape has been greatly affected by tree pests and diseases, notably Dutch Elm Disease in the 1970s. Current diseases are affecting elm, oak, Horse chestnut, larch, Poplar and Ash. The latest guidance on plant health and plant movement is available from the Forestry Commission and DEFRA and should be adhered to.

Fig 2.22 Ash make up 7% of urban trees, of which all European species are susceptible to Ash Dieback Disease

2.03.10

New Planting

Diversification using a mix of species, rather than single species in streets or large blocks in woodland planting schemes, is recommended. Planting stock should be from traceable and disease free nurseries. For native plantings trees and shrubs should be sourced from local provenance, their seed collected from recognised ancient woodland and hedgerows and grown in the UK. Where local provenance isn't available plants should be of UK origin with traceable provenance.

Fig 2.20 Victorian street planting, Dunstable

2.03.11

Select species that:

- Represent the character of the landscape
- Tolerate local soil conditions
- Will grow to maturity within the confines of buildings and underground services
- Will not create excessive nuisance or likely to pose future risks to property and other structures
- Have minimal long term management considerations

Fig 2.21 1950's ornamental planting

2.03.12

Other considerations for new planting

- Source quality planting stock
- Ensure planted trees have access to nutrients, oxygen and water
- Plan for post-planting maintenance
- Be aware of the location of water supply and sewer infrastructure and ensure the species planted do not disrupt the network.

Building foundations should take into account local soil conditions and the potential mature size of existing young trees and proposed new planting.

Fig 2.24 Adam's Laburnum, a feature of post war planting in Dunstable, now considered rare.

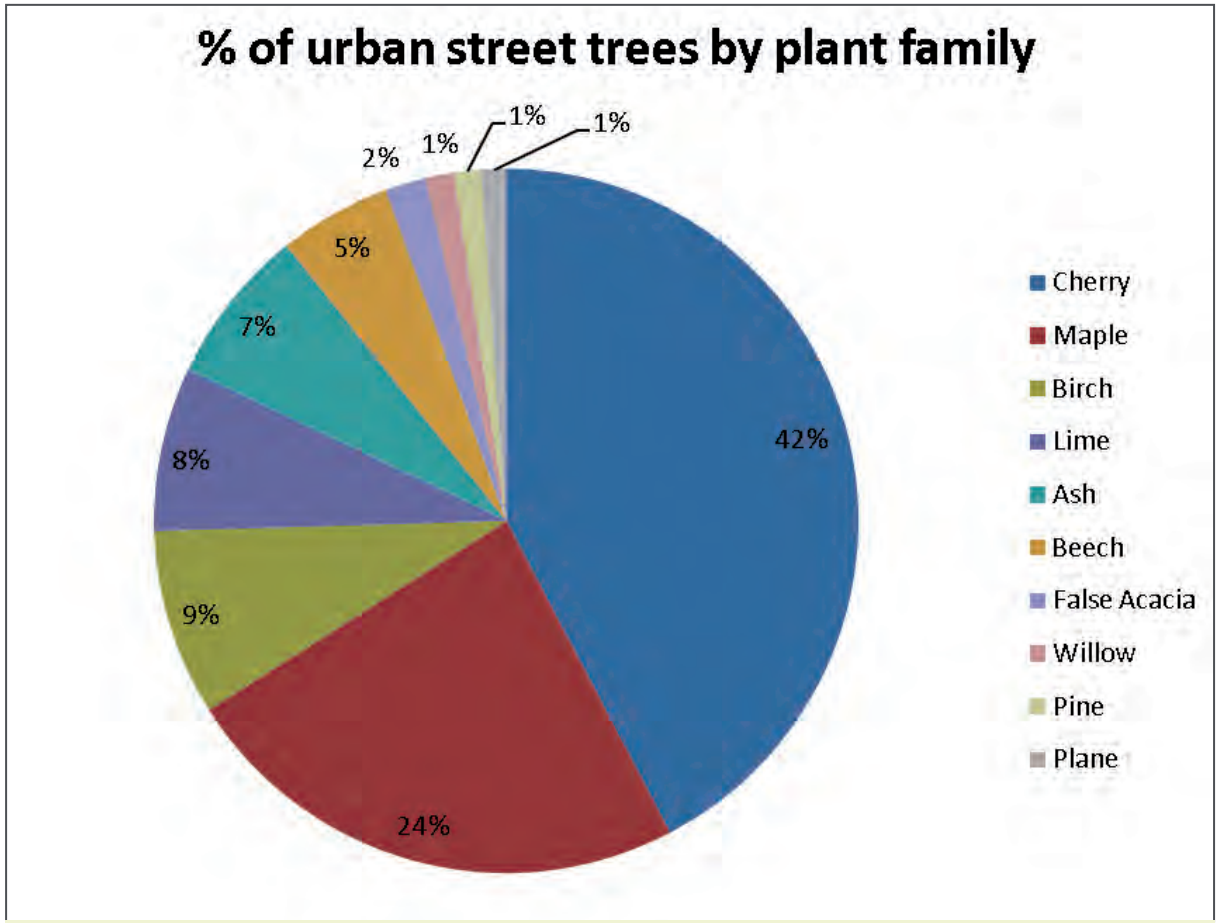

Fig 2.25 Urban street tree ratios in Central Bedfordshire

2.03.13
Trees Checklist

- [ ] **Does the design of the development provide enough room to retain existing large canopy trees or the planting of new trees?**
- [ ] **Does the design of the development retain semi mature trees that can adapt to the development and are appropriate to its landscape character?**
- [ ] **Does the design of the development retain veteran trees safely for habitat and heritage value?**
- [ ] **Does the design of the development retain orchard trees and plant community orchards?**
- [ ] **Does the planting create a more diverse population of species to reduce the effect of disease?**
- [ ] **Does the planting include large canopy trees wherever possible to increase the beneficial effects trees provide?**
- [ ] **Does the planting enhance existing local character?**
- [ ] **Will the development involve planting a minimum of two trees for every one removed?**
- [ ] **Does the scheme involve planting hedgerows of local provenance to link existing hedgerows and woodland?**
- [ ] **Does the scheme involve planting specimen trees of known origin of good form?**
- [ ] **Have new trees been given space to grow to maturity?**

2.03.14
Links and References

Trees in the Townscape

http://www.tdag.org.uk/trees-in-the-townscape.html

2.04 Biodiversity

2.04.01

Introduction to Central Bedfordshire's Biodiversity

Central Bedfordshire contains a variety of habitats, contributing to its character, and the quality of life of its residents. However, the biodiversity resource is becoming fragmented, with various habitats becoming isolated islands. It is important that development does not further reduce this trend. Designing in biodiversity at the start of the process, building on opportunities and mitigating impacts on constraint issues will help to secure a net gain for biodiversity, as required by national and local planning policy.

2.04.02

Ecological impacts will vary depending on the scale of the development, from large areas of open grassland to individual bat roosts in a single dwelling.

2.04.03

Through ecological site assessment developers will be able to understand opportunities for and constraints on the site. Much of our wildlife survives in small pockets, natural movements restricted by development. Stepping stones are crucial links between remnant habitats which can provide opportunities to connect up otherwise isolated species. Sites may be surrounded by land on which it may be possible to create new habitat or to establish less intensive management regimes to buffer adverse impacts on the key sites. It is in these locations that it would be sensible to seek opportunities to link habitats or to create new habitat blocks to form stepping stones that would allow species to move more easily between habitat patches.

The following table sets out the features that can be incorporated into development to improve connectivity for biodiversity at different scales:

GI	Strategic		Site		Plot	
	Include	Connect	Include	Connect	Include	Connect
Allotments	*	*	*			*
Wildlife Gardens	*	*	*		*	
LNR		*		*		*
Woodlands	*	*		*		*
Corridor Water/Hedge	*	*		*	*	*
Wild Churchyard		*		*		*
SUDS	*		*		*	*
Green Roofs	*		*		*	
Community Orchards	*	*	*	*		*
Managed Open Space	*	*	*	*		*

Design Considerations

Masterplan Scale - Development Context

2.04.04

Biodiversity Opportunity Networks

Biodiversity opportunity networks have been identified and mapped. These show where the areas of greatest potential for the conservation enhancement, restoration and creation of priority habitats are, and what opportunities there are to reduce fragmentation of habitats by building ecological networks across landscapes.

2.04.05

The context of the development in relation to the biodiversity opportunity network, and other designated biodiversity site should be identified, to ascertain the priority biodiversity improvements appropriate to the location of the development, and to inform what ecological benefits the development should aim to deliver.

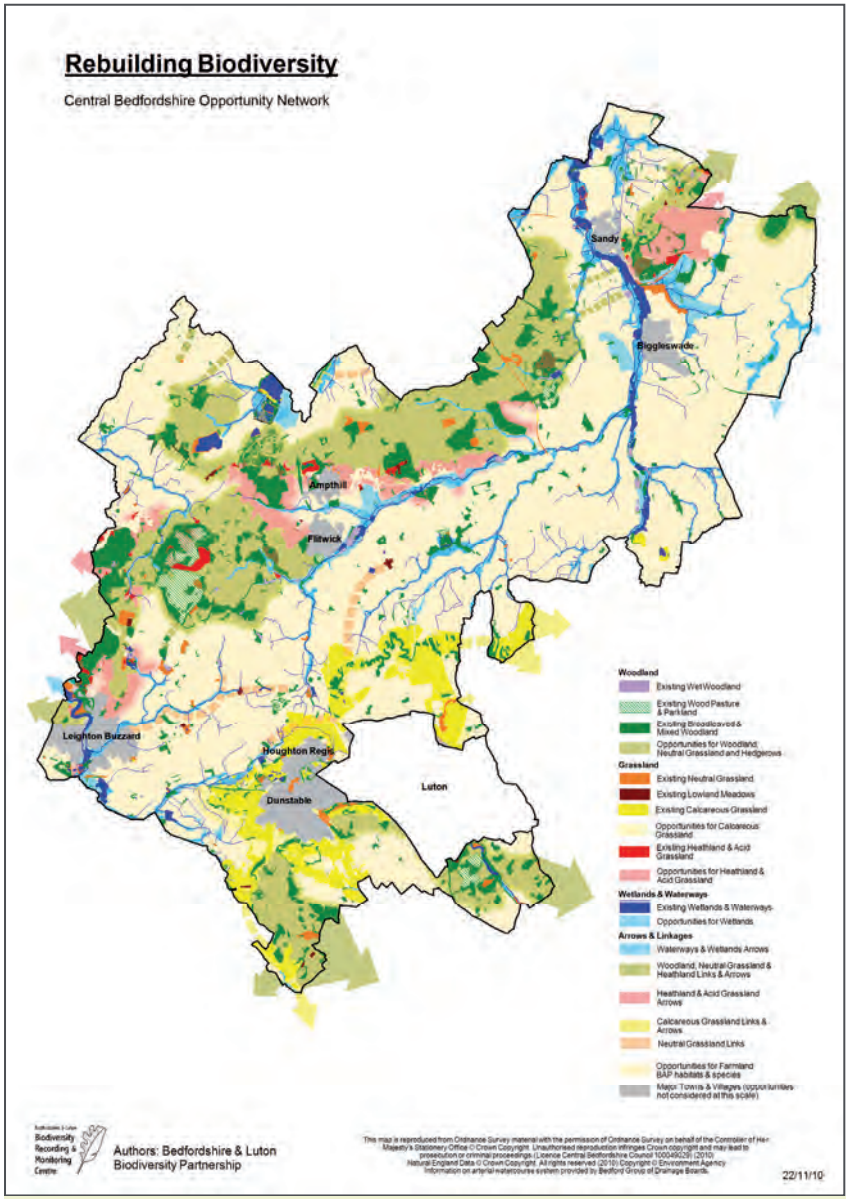

Fig 2.26 Central Bedfordshire Rebuilding Biodiversity Opportunity Network

Masterplan Scale - Linking Development to the Wider Context

2.04.06

Overcoming Barriers to Movement

Good design will limit barriers to ecological connectivity. However, where barriers cannot be designed out, the following can be used to overcome them;

- Mammal tunnels,
- Eco passages/underpasses provide more than culverts but also allow for dry habitat connectivity,
- Green Bridges provide safe access across roads.

Fig 2.27 Underpass allows not only aquatic life to pass in the canal, but also provides a means of dry habitat connectivity

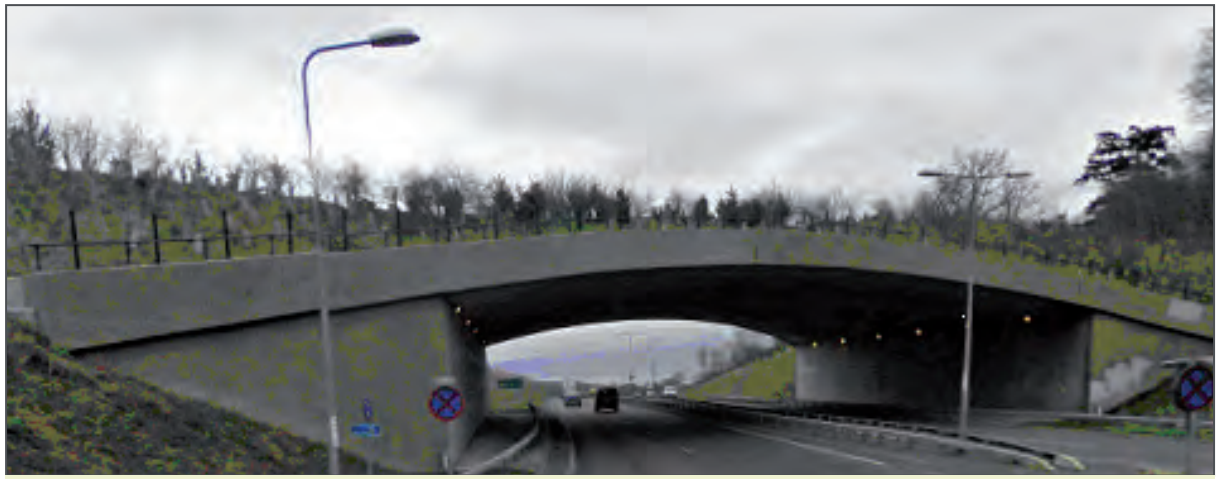

Fig 2.28 Green bridge over A21, Kent

On Site

2.04.07

Legislation

The presence of protected habitats and species within a development is a material consideration in planning and licences may be required.

- European Protected Species are covered by the 2010 Habitat Regulations and include all species of bat, otter and Great Crested Newt (GCN)
- The Wildlife and Countryside Act 1981 covers native plants, birds and animals, includes water vole.
- Section 41 of the Natural Environment and Rural Communities Act 2006 habitats and species of principal importance for biodiversity (Priority habitats and species). Includes brown hare and hedgehog.
- Updated BAP targets within Bedfordshire are expected later in 2013.
- Protection of Badgers Act 1992 – protects against killing, injury or interference with setts.
- Bats account for almost a third of all mammal species in the UK, occupying a wide range of habitats. Loss of natural roosts has increased the importance of man-made structures in providing artificial roost sites such as in houses, barns and under bridges. Having bats does not mean that building work cannot take place but, as they are protected species, ecological advice will be required to ensure no offence occurs.
- The nests and eggs of all birds are protected during the nesting season. Site clearance of scrub should be undertaken outside the breeding season. Failure to do so could result in legal implications and delay in construction. A number of building dependent birds (particularly swift and house sparrow) have declined in recent years. Protection of existing and provision of new nests within the fabric of a building will contribute to maintaining existing populations.
- The great crested newt and its habitat are protected by law because the species has declined significantly over recent decades, largely due to habitat loss. Great crested newts breed in ponds but spend much of their lives on land, sometimes venturing several hundred metres from the pond. Their populations are often dependent on there being several ponds close together, linked by suitable land habitats. Developments for which planning permission is not required still need to take account of great crested newts, and licensing may still be necessary.

2.04.08

Design Principles

Sites can include appropriate areas of habitat, along with a wide range of more formal green spaces enhanced for wildlife, even where nature conservation may not be the primary objective. The built environment should aim to be permeable to wildlife, incorporating design features aimed at sustaining and increasing the population of particular species and facilitating climate change adaptation.

- Retain and enhance existing semi-natural habitats.
- Create new habitats, including semi-natural grasslands, woodland, wetland and ponds.
- Avoid fragmentation of habitats and increase linkages through ‘green corridors’, linear habitat features, etc.
- Provide buffers of less intensively managed land around key habitat features.
- Ensure new planting uses native species of local provenance.
- Consider lighting impacts on wildlife corridors and use directional lights with no spillage.

2.04.09

Hibernacula would be suitable for locating on an impermeable substrate. On free-draining substrates the bulk of the fill would be sited in an excavated depression. Hibernacula should always be positioned in suitable terrestrial habitat.

2.04.10

Sustainable Drainage Systems (SUDs) can benefit many priority habitats and species, including Great Crested Newts and Watervoles. However, to achieve this guidance is needed at the master planning/design stage and ecological advice should be sought to secure a positive outcome for wildlife. Further detail on SUDS can be found later in this chapter.

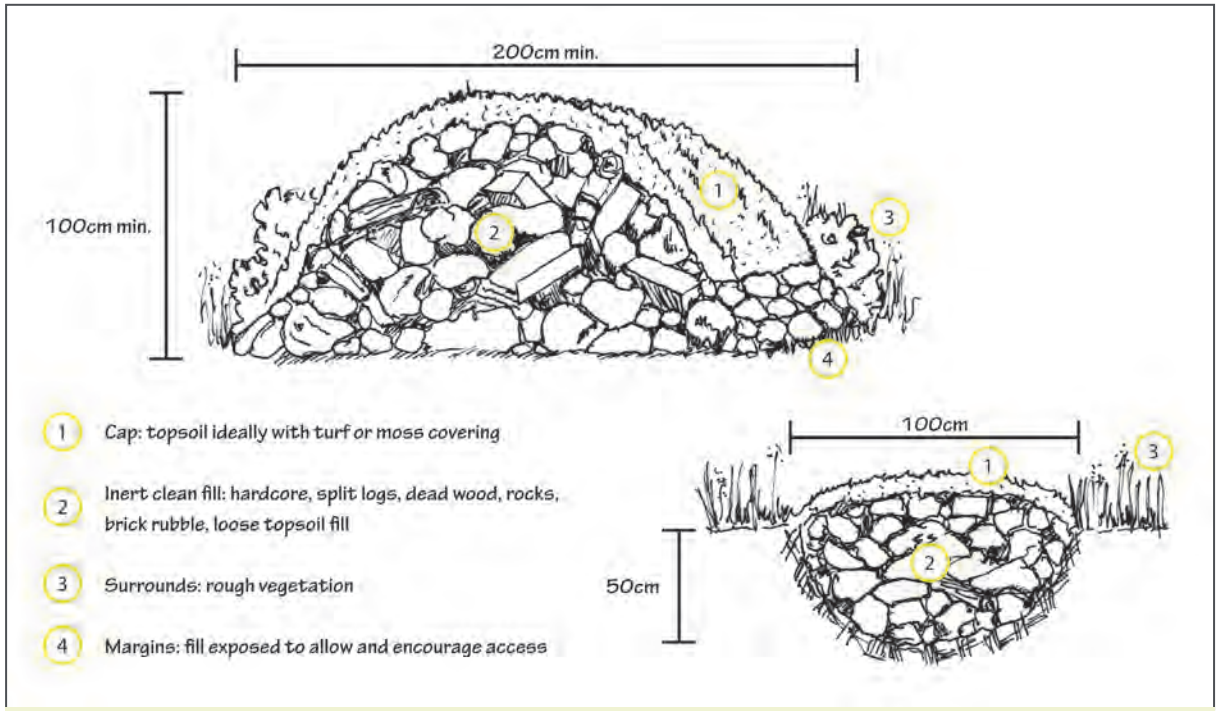

Fig 2.29 Hibernacula suitable for Reptiles and Amphibians

2.04.11

Plot Scale

A number of design solutions can improve ecology within buildings; detailed design should consider the incorporation of these features.

01 Bird boxes (shady orientation)
02 Green/brown roofs
03 Integrated bat boxes
04 Trees
05 Hedgehog passages (+15cm gap)
06 Hedgerows
07 Climbing plants
08 Permeable paving
09 Habitat walls
10 Planters and hanging baskets
11 Rain gardens
12 Wildlife ponds
13 Street trees
14 Unmown edges and verges

Fig 2.30 Ecological features that can be included on plot as part of the building design to increase biodiversity

2.04.12 Biodiversity Checklist

Biodiversity Toolkit:	Strategic sites, inc. commercial	Site up to 10 homes	Plot - householder
Has an ecological appraisal been carried out and constraints and opportunities considered? Important to use suitably qualified ecological consultants. (refer to www.cieem.net for professional directory) ☐	EIA	Phase 1 survey Protected species surveys	Desk Study Protected species surveys
Have Biodiversity Opportunity Networks been addressed? ☐	Is land identified within a biodiversity opportunity network – if so what enhancement has been proposed?	Is a biodiversity opportunity network nearby and can it be connected to the development?	Is a biodiversity opportunity network nearby and can it be connected to the development?
Is there any Protected species interest on/ near the site? Are licences required? ☐	Woodlands, large trees, other habitats; Retention/mitigation	Large trees, badger setts, wetlands; Retention/mitigation	Large trees/bats in loft/old buildings; Retention/mitigation
Are there any Important Hedgerows on site? See Hedgerow Regulations 1997. ☐	Permission to remove must be obtained from LPA	Permission to remove must be obtained from LPA	Permission to remove must be obtained from LPA
Are any habitats/species of principal importance identified? ☐	Protection/enhancement	Protection/enhancement	Protection/enhancement
What ecological enhancements are proposed in accordance with the NPPF? ☐	Habitat creation & wider species opportunities, use of native species	Species and habitat opportunities. Planting native species	Species focus, bird/bat boxes, wildlife refugia
Production and implementation of a maintenance and management plan ☐	Site wide landscape management, adoption	Management company	Individuals
What future management/stakeholder involvement does the site have? ☐	Wildlife Trust, GST, local conservation groups	Local conservation groups, individuals	Individuals

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2.04.13

Case Study: Shefford Leys, Bloor Homes

The site comprises an area of 8.02ha bisected by the River Flit. Divided into three parts the site comprises a developable area to the north of the river, a County Wildlife Site (CWS) and an island flood meadow to the south of the river.

This application followed the master planning process, particular constraints were the CWS and protected species close by.

- Existing site use was agriculture.
- Final product – subject to completion – 95 dwellings including a LEAP.
- The CWS is retained and buffered from the new development.
- Enhancements come through additional wildflower grassland and marsh habitat creation and management of the open space.
- New tree and hedgerows are of locally native species.
- Erection of bird and bat boxes and log piles for reptiles and invertebrates.

Fig 2.31 Shefford Landscape Masterplan, Bloor Homes

2.04.14

Links and References

Biodiversity Planning Toolkit

www.biodiversityplanningtoolkit.com

The Biodiversity Planning Toolkit is an online resource - aimed at helping users to incorporate biodiversity into the planning system and new development. Created by the Association of Local Government Ecologists (ALGE) in partnership with a wide range of conservation and planning organisations.

How to build a Living Landscape – Hertfordshire & Middlesex Wildlife Trust 2012

Rebuilding Biodiversity in Bedfordshire – biodiversity opportunity mapping

http://www.bedscape.org.uk/BRMC/newsite/index.php?c=bedslife_rebuild

Bats in Buildings – Bat Conservation Trust 2012.

TCPA (2004) Biodiversity by Design: A Guide for Sustainable Communities. London: Town and Country Planning Association. http://www.tcpa.org.uk/pages/biodiversity-by-design.html

Great Crested Newt Mitigation Guidelines 2001 English Nature

Planning for a Healthy Environment – good practice guide for green infrastructure and biodiversity – TCPA/The Wildlife Trusts 2012

Landscape and urban design for bats and biodiversity Bat Conservation Trust 2012

Dale, K., Thompson, C., Kelly J. Delivering Biodiversity Benefits through Green Infrastructure CIRIA 2011

www.swift-conservation.org - Advice on siting of swift nest boxes, new build and retrofit.

www.bats.org.uk Bat Conservation Trust, - advice on bats in buildings

www.naturalengland.org.uk Natural England, - Statutory body advising on the natural environment.

Designing for biodiversity; a technical guide for new and existing buildings. Bat Conservation Trust and RIBA publishing, 2013. This guide advises on how to incorporate provision for biodiversity within developments. It looks at different building reliant species, and how their habitat provision can be incorporated into designs.

Delivering biodiversity benefits through green infrastructure, CIRIA, 2011.

2.05
Access, Movement, Recreation and Leisure

2.05.01

Introduction

Open spaces are places for informal recreation, important for our physical and mental health and wellbeing. They can play a big part in building community cohesion, can stimulate the economy and attract enterprise. Open spaces are vital for encouraging biodiversity, supporting a resilient environment and providing important opportunities for learning.

2.05.02

Greenspace and access/rights of way provision should be an integral aspect of the and development process. The incorporation of high quality, sustainable and multifunctional green space can provide a range of economic, environmental and social functions (or services) that are essential in creating and sustaining well-designed places for living, work and play. This applies equally to regeneration of urban areas and new sustainable urban extensions.

2.05.03

Open spaces perform a variety of functions from individual small green spaces within urban centres through to the landscape scale in the wider countryside.

2.05.04

There is increasing evidence to support the economic case for quality open space which demonstrates that investment in them makes good business sense for developers.

2.05.05

Well designed open space has a significant impact on the economic life of urban centres . The presence of good parks and open spaces offers a vital economic lever to first attract and then retain new businesses.

Design Considerations

2.05.06

Masterplan Scale - Open Space

Open space in new development should be strategically planned and contribute to enhancing the connectivity of the Green Infrastructure Network where possible. The Council will require the provision of new open space to meet the standards as defined in the forthcoming Leisure Strategy.

2.05.07

The public should have appropriate access to quality local, neighbourhood and major open space sites. Indicative sizes for sites, accessibility standards and quality standards will be provided in the Leisure Strategy, the aim being to ensure appropriate levels of provision of good quality and accessible open space. In order to deliver larger open space sites, it is important that these guidelines are taken into account during the masterplanning of development allocations.

2.05.08

Resilience and Management

Open spaces and access routes should be designed with longevity and management in mind. Open spaces can suffer from vandalism or a lack of maintenance and therefore become an eyesore and a detraction to the development. Developers should devise a management plan for all open space to ensure there is full conservation of the future management of open spaces.

2.05.09

The Masterplan Phase – Open Space

The design of public open space and access corridors should be considered at the earliest opportunity and should be considered as an integral element of the vision for the site's overall layout and design. Well designed public open spaces can provide a high quality setting for a new development. The public open space and access routes should be design in a location that provides the greatest landscape, biodiversity and access opportunities. The open space provision should be considered in context to other infrastructure and public realm areas such as school, shops, squares, etc. Developers should aim not put open space on that land which may be unsuitable for built development unless that is also the best location for the open space.

2.05.10

Designers should consider the following in the Masterplan/design phase:

- Establish the quantity standards for provision by reference to the Leisure Strategy
- Consider the countryside/landscape setting
- Establish any GI opportunities that could be exploited/enhanced.
- Establish any rights of way on site and access opportunities.

2.05.11

Delivery of Other Strategies and Strategic Projects

Developers and designers should consider the strategic context of the open space provision and examine and explore whether the open space offer can help towards strategic opportunities and projects such as:

- The Marston Vale Community Forest
- The Milton Keynes to Bedford Waterway
- The Biggleswade Green Wheel
- The Leighton Green Wheel

Information about the Forest of Marston Vale and its impact on design considerations is covered in the 'landscape' section of this document.

2.05.12

It is the council's policy that development along the route of the Bedford to Milton Keynes Waterway includes the delivery of the Waterway and the associated green corridor. Guidance about the value of providing for the Waterway in development, and on the space, design and technical considerations can be found here and here (links TBC once guidance is finalised and hosted online.)

2.05.13

Masterplan Scale - Rights of Way

The relationship of a proposed development with the established landscape should be considered when looking at how public rights of way and the countryside access network are to be incorporated into a development.

Public rights of way often provide valuable links between communities (between villages) and to community facilities such as schools, shops, pubs, etc.

2.05.14

Developers and designers should consider access and movement, in and around, a site early in the design phase. Residential developments should provide access routes through green corridors or green space. Connections to the wider countryside should be given a high priority and designers should ensure that any development provides, and enhances, the links to the wider countryside and to nearby shops and facilities. Careful thought should be given to gateway features, transitions into the countryside, dog waste and litter bins and other factors which ensure the new residents can have access to the countryside.

2.05.15

New developments will place pressure on the public rights of way network and can provide an opportunity for localised enhancements. In some cases, development may have a detrimental impact on access to the countryside and this can be avoided by better design or contributions towards off site mitigation or improvements.

2.05.16

Public rights of way run through all types of development areas. Designers should consider the design of the public rights of way at the earliest opportunity and develop of a rights of way scheme that will ensure that the planning process runs smoothly and public access is properly design into the Masterplan/design phase.

2.05.17

The rights of way scheme will be a discrete document that will be submitted with the planning application and will detail what is proposed for any existing rights of way (including whether the paths are to be incorporated into the design or diverted), landscape proposals for the paths and details regarding new routes and connections to the rights of way and access network.The rights of way scheme should also include details regarding how any rights of way are to be dealt with during construction – including the provision for temporary routes.

2.05.18

Diversion of Rights of Way

It is not always practical to keep a public right of way on its original line and a diversion under the Town and Country Planning Act 1990 may be required, however, the Council does not support the incorporation of rights of way along estate roads, permanent extinguishments, or unofficial diversions and encroachments and will oppose any planning proposal which does not give due consideration to rights of way and their links with nearby communities and the existing rights of way network. Any diversions (whether temporary or permanent) should be detailed in the rights of way scheme.

This scheme should include details regarding how any rights of way are to be dealt with during construction.

2.05.19

A development site which is affected by Public Rights of Way requires careful planning. It is not always practical to keep a public right of way on its original line and a diversion under the Town and Country Planning Act 1990 may be required.

2.05.20

Central Bedfordshire Council does not support the incorporation of rights of way along estate roads, permanent extinguishments, or unofficial diversions/ encroachments and will oppose any planning proposal which does not give due consideration to rights of way and their links with nearby communities and the existing rights of way network.

2.05.21

Public rights of way often provide valuable links between communities (between villages) and to community facilities such as schools, shops, pubs, etc.

2.05.22

New developments may place pressure on these paths or provide an opportunity for localised enhancements. In some cases, development may have a detrimental impact on these links and this can be avoided by better design or contributions towards off site mitigation or improvements.

2.05.23

The relationship of a proposed development with the established landscape and the standards within the design guide are key principles that should be considered when looking at how public rights of way and the countryside access network are to be incorporated into a development.

Detailed Design Scale

2.05.24

Flood Attenuation, SUDS and Water Management

SUDS and Flood attenuation should be carefully integrated into the open space offer. Water features can provide key features within an open space and a development, and are key in enabling sustainable drainage and flooding solutions. See Section X for specific details on SUDS and Flood Attenuation.

2.05.25

Addressing Public Safety Issues; Secured by Design Principles

Open Spaces and access routes should encourage mutual surveillance between houses, roads, footpaths and cycle ways. Developers should avoid designing secluded routes.

2.05.26

Developers should avoid designing accesses leading along the rear boundaries of houses, as they are not only a potential source of nuisance to the occupiers but also tend to be secluded.

2.05.27

The point of access between roads or pathways leading to the buildings or open spaces they serve should be open to view and not hidden.

2.05.28

Design Principles

There is a need to increase the use of native species to reinforce local landscape character and enhance biodiversity.

2.05.29

Within open spaces, signs, seats etc. should reflect local character and where possible utilise local materials to ensure that it is appropriate to local sense of place.

- Encourage good design of signs reflecting local character and sense of place.
- Consider linking signs or interpretation boards with a common logo or design placed on posts or gates.
- Ensure that steps and boardwalks make use of locally provenanced materials and are accessible to people with all levels of mobility.
- Ensure interpretation boards are clear, attractive and of robust design.
- Consider the use of timber posts for highway signs.
- Avoid a plethora of different sign designs in one location.
- Ensure simple robust designs for all fencing, gates, bollards, seating, benches etc.
- Ensure use of native timber, i.e. English oak, sweet chestnut.
- Use local materials wherever possible.
- Ensure all designs are accessible to people with all levels of mobility.

2.05.30

Signs, seating, benches, litterbins, bollards and other furniture used in open space can sometimes create a negative image characterised by poor location, siting, design and maintenance.

- Use appropriate materials and rural details which respect local vernacular in the countryside and in small settlements, such as locally sourced hardwood timber and wrought iron.
- Avoid suburban detailing in rural locations.

2.05.31

Enclosure and Boundaries; various options will be appropriate, determined by local context

- Native Hedges.
- Cleft chestnut post and rail fencing.
- Sawn oak post and softwood rail fencing.
- Picket fencing.
- Railings and park fencing.
- Brick.

Fig 2.32 Rural seating

2.05.32

Path Surfacing; various options will be appropriate, determined by local context

- Bound gravel.
- Tar spray and gravel chippings.
- Crushed granite chippings.
- Hoggin type.
- Bark chippings.
- Mown pathways.

2.05.33

Rights of Way

Central Bedfordshire Council would like rights of way to run in green corridors which connect to other paths, rights of way and to nearby facilities and amenities. Local character and distinctiveness should be factored into the design on new access routes. The priority is to create an enjoyable, easy accessible, direct route for our users.

2.05.34

The best route for the right of way may be away from the original line of the path, which means a diversion order would be required. Central Bedfordshire Council will work with developers to divert rights of way as quickly as possible ensuring minimal impact on the development.

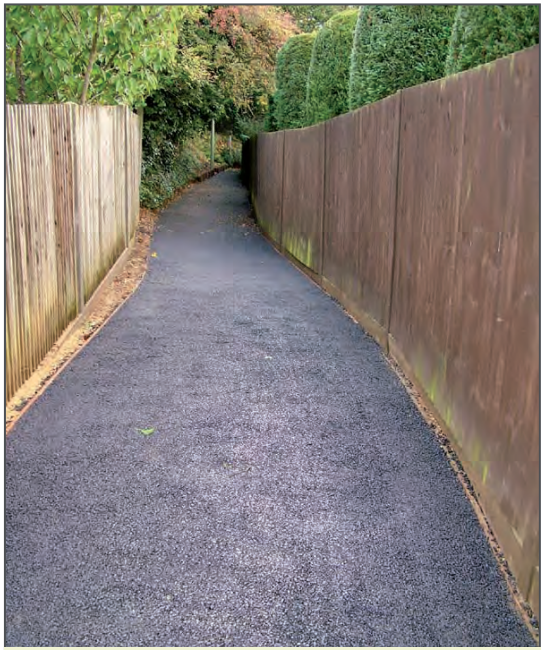

Fig 2.33 Badly designed urban pathway - long, narrow corridor with high fences either side

Fig 2.34 Access provision for all potential users must be considered equally (Bridge at Stockgrove)

2.05.35

Legislation requires that access provision for disabled people has to be considered equally with that of other visitors. The principle of least restrictive access is that the improvements will benefit all users not only those with restricted mobility.

2.05.36

Country walking, cycling and riding is on the increase and the proportion of users with decreased mobility is also increasing. These users range from parents with pushchairs, who are keen to take their young children out into the countryside, to people who may have mobility related disabilities.

Fig 2.35 Examples of well designed urban, rural, and urban fringe pathways

2.05.37

Access and Open Space Checklist

- [ ] Are the forthcoming Leisure Strategy Standards addressed?
- [ ] Are there any strategic opportunities to inform the green space and access design?
- [ ] How will the open space link to existing access routes?
- [ ] How will the Open Space link into and through the development?
- [ ] How will the public rights of way within the site be dealt with?
- [ ] What future management/stakeholder involvement does the site have?
- [ ] Does the open space and access meet accessibility and least restrictive access principles?
- [ ] Does the open space and access consider secured by design principles?
- [ ] It the open space and access provision resilient and sustainable? Consider the production of a management plan.
- [ ] Can other design elements be incorporated into the open space and access – such as art?

2.06 Sustainable Water Management and Sustainable Drainage Systems (SuDS)

2.06.01

Introduction

Sustainable Water Management and SuDS can manage flood risk, improve water quality, manage water pollution and provide attractive, multifunctional spaces; these are all important considerations for compliance with national and local planning policies. They can help developments achieve the Code for Sustainable Homes and BREEAM, and will help ensure the right to connect developments to sewer and lateral drains once Flood and Water Management Act 2010 is fully adopted. They can also reduce drainage costs, given appropriate and timely design solutions.

2.06.02

Sustainable Water Management requires us to manage our water resources while taking into account the needs of present and future users.

2.06.03

We must deal with water holistically, and recognise it within a cycle where:

- Clean water is a finite resource.
- Treated water contains embedded carbon and energy costs.
- Water itself is not a waste material and is a 'friend not an enemy'.
- Water provides a host of vital benefits and defines landscape character.

2.06.04

The life-supporting benefits to people and the environment which natural resources provide are known as ecosystem services; for water these include:

- Flood attenuation
- Food production
- Habitat provision
- Waste management
- Clean drinking water
- Provision of amenity & sense of place

Fig 2.36 Water is key to natural and managed landscapes

2.06.05

Water Sensitive Urban Design (WSUD) is a way of integrating sustainable water management into the built environment through consideration, from master-planning through to construction, of all aspects of water, from watercourse resource quality to supply and demand of clean water and rainfall, wastewater and flood management.

Increased energy efficiency, resource security and resilience to climate change, floods and drought can all be achieved through water sensitive urban design, for example by the provision of grey water reuse features, rainwater harvesting, green or living roofs and SuDS.

2.06.06

SuDS: The Health, Wellbeing and Educational Effects

Access to and the visibility of green space and natural landscape have been associated with significant physical and mental health benefits by large volumes of research over recent years. Behavioural and educational improvements in children have also been recognised and may even contribute to literacy levels.

2.06.07

SuDS are an excellent opportunity to bring these benefits nearer to communities and to help *connect people, particularly children, with the natural world*.

2.06.08

Research suggests that the most valuable types of green space in terms of potential benefits involve a water setting with *high biodiversity* and *safety designed in explicitly*.

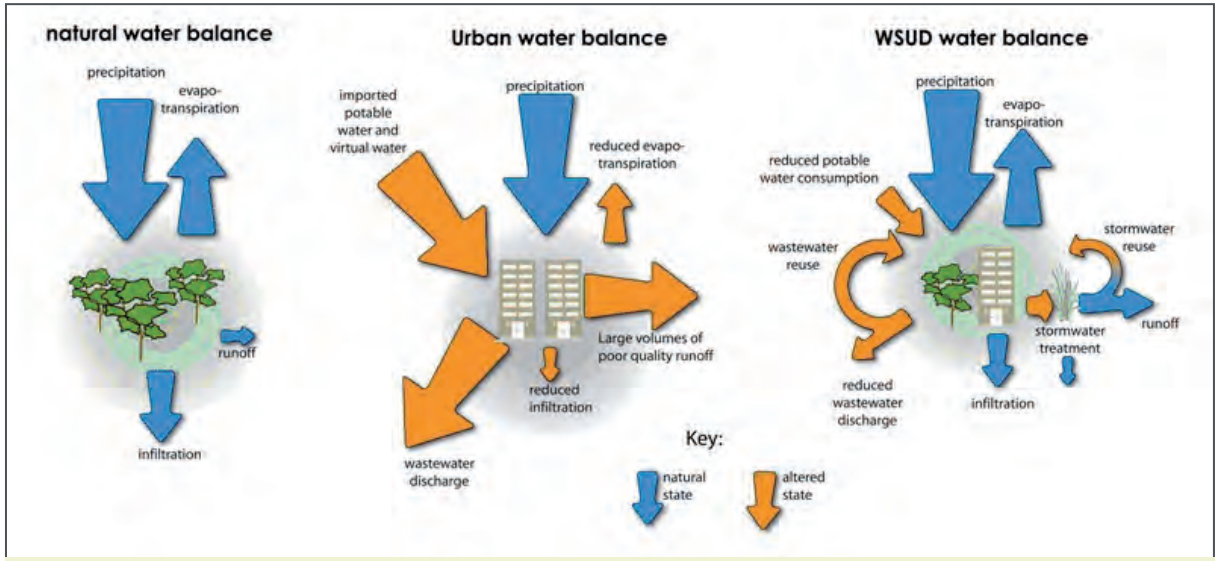

Fig 2.37 WSUD reduces rates of 'altered' (polluted or waste) water and increases infiltration

2.06.09

SuDS can be adapted to suit any site and can contain radically different components, with myriad distinct applications and benefits, which work together to achieve sustainable water management.

Design Considerations

2.06.10

Masterplan Scale

Consider water demand/efficiency, space provision, river corridors, habitats, soils/geology, landscape and constraints and opportunities: e.g. Environment Agency, Internal Drainage Boards, Water & Sewerage Companies, local Flood Strategies, River Basin Management Plans and Biodiversity/Habitat Action Plans etc.

2.06.11

On Site

Consider existing natural drainage patterns, runoff rates and a storm-water train of features sensitive to amenity needs, 'place-making' and landscape character. Multi-functional use areas should be identified and constraints explored.

2.06.12

Building Scale

Consider water efficiency features (see Climate Change Adaptation and Sustainable Building sections) and green roofs, living walls, water butts etc.

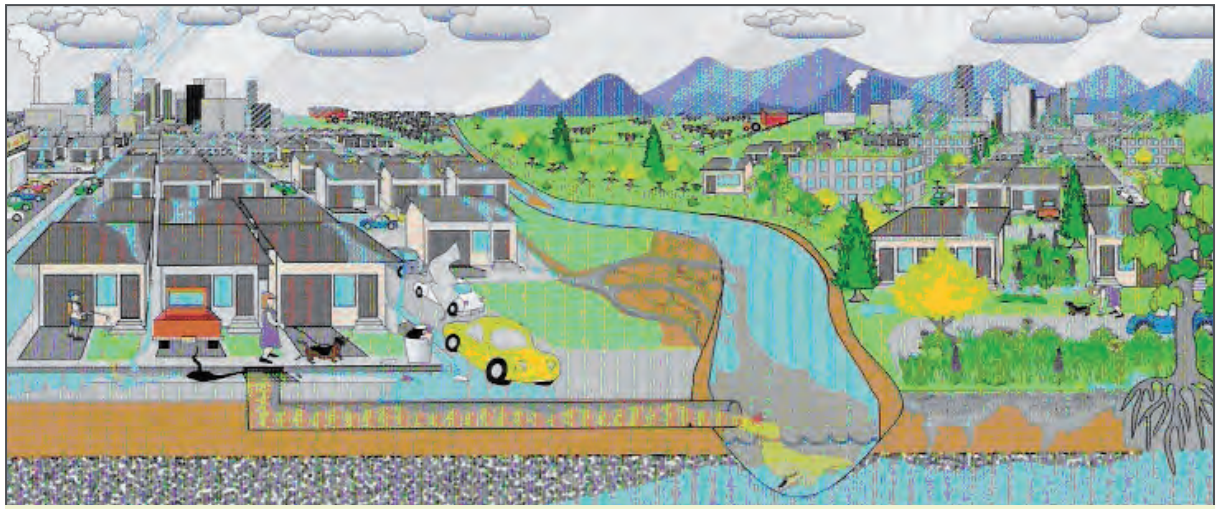

Fig 2.38 The typical urban relationship with water is to view it as a nuisance or vehicle for waste

2.06.13

Timescale Considerations

Early inclusion in design process is paramount for efficient and cost effective measures; pre-application consultation with the SuDS Approving Body and stakeholders is key.

Post-development, measures should be simple to maintain and adopt where appropriate, with concise, published management plans. Commuted sums can contribute to handover regimes.

2.06.14

Sustainable Drainage Systems (SuDS)

SuDS seek to mimic natural hydrological processes as close to source and surface as possible, in order to replace traditional sub-surface piping systems for the storage, transit and treatment of water, bringing multiple benefits to many stakeholders.

SuDS should balance equally quantity and quality controls with amenity and biodiversity goals; as in the 'SuDS Triangle'.

2.06.15

Effective SuDS deliver:

- Reduced flood damage by slowing water runoff while encouraging infiltration
- Improved Water Quality by settling out silt and adhered pollutant particles
- Climate Change adaptation and a reduced 'heat island' effect
- Significant biodiversity and habitat opportunities (including species 'stepping stones')
- Improved amenity, public health and educational resources
- Green Infrastructure
- Recharged ground aquifers for water abstraction and agriculture
- Watercourses protected from sewage surcharge, pollution and erosion
- Cost savings around engineering, maintenance and sewer connections
- Potentially higher property values with attractive landscape features

2.06.16

Good, adoptable SuDS design must fundamentally protect people and property from flooding. It should ensure that the impact of a development does not exacerbate flood risk at any point upstream or downstream of the water catchment by limiting the rate of discharge of the urban runoff to the equivalent Greenfield Runoff Rate for the site via the provision of storage (Attenuation/ Retention/Detention) and engineered flow controls (where necessary), up to and including a 1 in 100 year storm event.

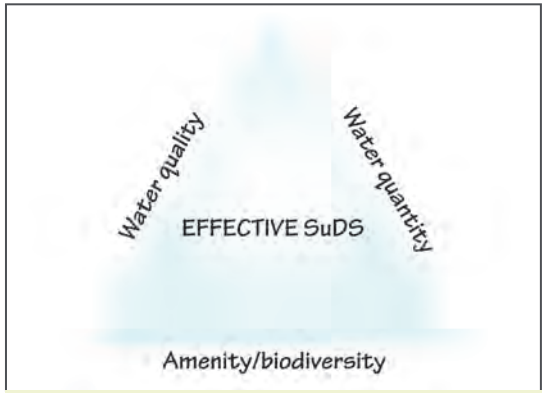

Fig 2.39 'SuDS Triangle' - The effective balance of a system

2.06.17

SuDS are by law expected to be the default approach across the country and the National Standards seek to embed the SuDS approach into most current developments, supporting SuDS Approving Bodies (SABs) with the adoption of all SuDS (See forthcoming CBC SuDS Design Guide). Under current arrangements the Environment Agency (EA) handle planning requirements for SuDS and therefore **early consultation with the EA on the hydraulic aspect of design is very important. The EA are likely to remain a significant contributor to the future SuDS Approval Body (SAB).**

2.06.18

SuDS can be more cost-effective than conventional drainage especially when designed in early.
Risks to health and safety can be anticipated and minimised, (see section on Potential Risks).

Multiple-functionality is very achievable, and agreed lifetime management plans can allow for successful adoption and handover.

SuDS seek to slow the run-off rate of rainwater and control the quantity and quality of water through a series of connected sub-catchment or control areas, laid out along a 'management or treatment train' of component SuDS units along a conveyance gradient:

2.06.19

SuDS: Step-by-step

Step 1: For Greenfield sites SuDS should be designed to mimic natural 'greenfield' site runoff rates. For Brownfield sites, SuDS should also ideally be designed to mimic the greenfield rates, or at minimum the existing rate, plus a 20-30% additional climate change factor.

2.06.20

Step 2: All run-off rates must be calculated according to overall site area, area of impermeable surfaces, rainfall rates and geology type. Predicted storm durations and scale, up to 1 in 100 year probability (including anticipated climate change adjustments over a system's lifetime), must be considered as well as the permeability of the ground and the height of the water table.

Infiltration SuDS must maintain the quality and utility of controlled waters and not present a pathway for contamination.

2.06.21

Step 3: Following Source Control SuDS should allow water to filter into, or infiltrate, the ground where possible; impermeable clay or high water table constraints should be designed around and existing drainage patterns/'blue and green corridors' identified.

2.06.22

Step 4: Species rich green roofs, living walls and permeable pavements should replace traditional hard surfaces to significantly assist in achieving greenfield run-off rates and ecological gains, which should refer to the Biodiversity Action Plan and Opportunity Areas.

2.06.23

Step 5: Where infiltration is insufficient to reduce run-off rates sufficiently Site Control is required; swales/rills allow conveyance to 'Final Treatment' ponds, detention/retention basins/wetlands for Regional Control. Consider landscape character of water corridors.

2.06.24

Step 6: At surface SUDS such as swales or rain gardens must be designed for habitat creation and amenity provision, with 'place-making' and locally responsive visual attractiveness ensured. Maintenance, safety and integrity design and provisions should be considered for the lifetime of a system, and negotiated with the Local Authority and others as part of a costed and documented handover.

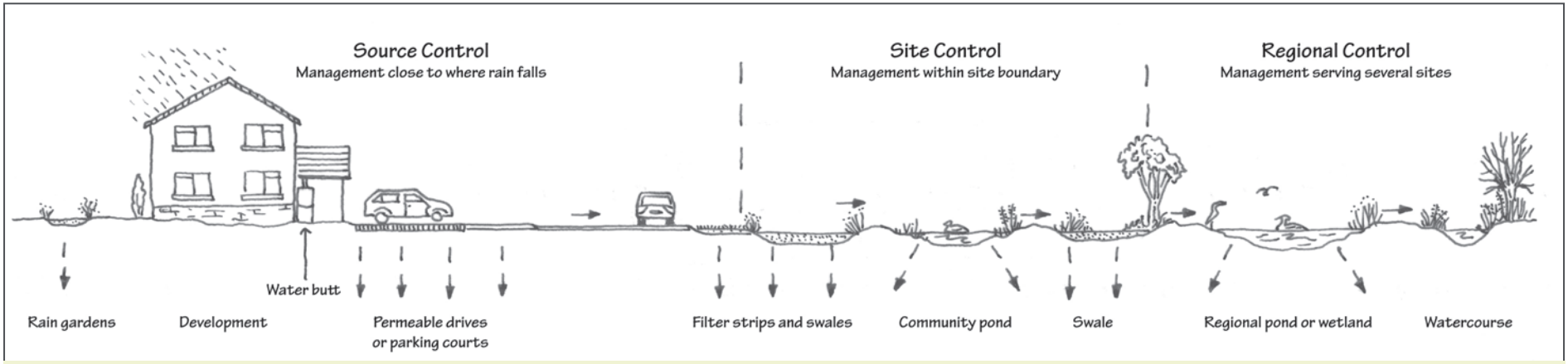

Fig 2.40 SUDS management train/Conveyance gradient

2.06.25

Components of a SuDS System

Community Engagement

By clearly identifying the flow routes through the site using information boards and awareness raising techniques, a legible, understandable design can be used to win community engagement and as a learning and demonstration resource for schools and visitors.

2.06.26

Water Cleansing

As the stormwater management train progresses, each component should incrementally reduce the pollutant load of the water it carries, by the settlement of silt particles and the action of biological agents and UV light; potential for integration into the landscape and enhancement of habitat and biodiversity provision thereby increases.

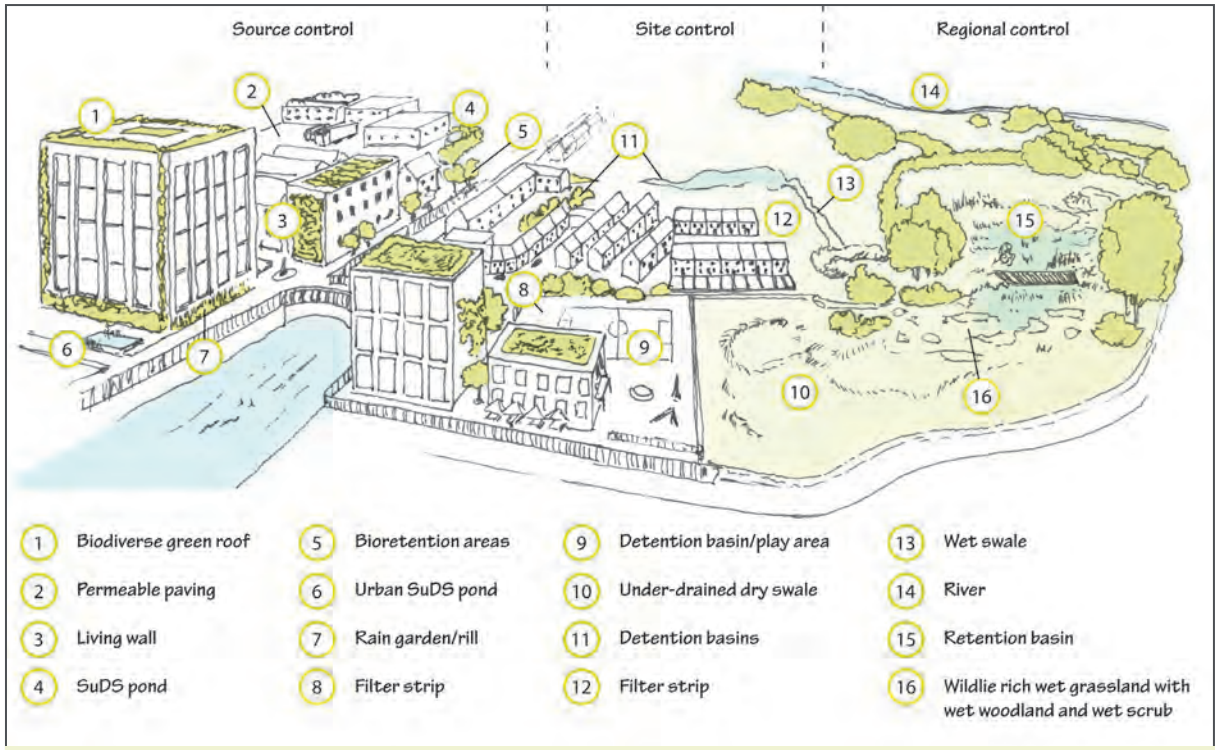

Fig 2.41 Components of a SuDS system - features are highly adaptable to the urban environment

2.06.27

Designing SuDS to Maximise Ecology and Amenity Benefits

The water treatment train and runoff source control is best initiated with provision of **green roofs** which, depending on substrate type, depth and topography can attract different varieties of pollinating insects, invertebrates and even ground-nesting birds on larger roofs.

All flat and gently sloping roofs should be treated with a sedum and native wildflower mix, either by plug or seed (not blanket or mat) on a crushed local stone/soil substrate with structurally variable topography. Planting should occur around September/October if possible.

Additional layering for waterproofing and construction design should also feature stone piles, logs, bird boxes and insect refugia or 'hotels'.

2.06.28

Living Walls will need greater provision of supported watering and nutrition systems based on harvested rainwater or grey water; planting should be aspect specific and can include creeping herbaceous perennials, ferns, grasses, sedums, small shrubs and even food plants.

Additional ledges and bat or bird boxes will add to the cover provision for wildlife and native species such as ivy, interspersed with flowering plants, will attract pollinators and insects. Noise reduction and airborne pollution control can also be achieved.

Both components can provide informal amenity, green space and educational benefits, as places to gather and meet, or even harvest food produce.

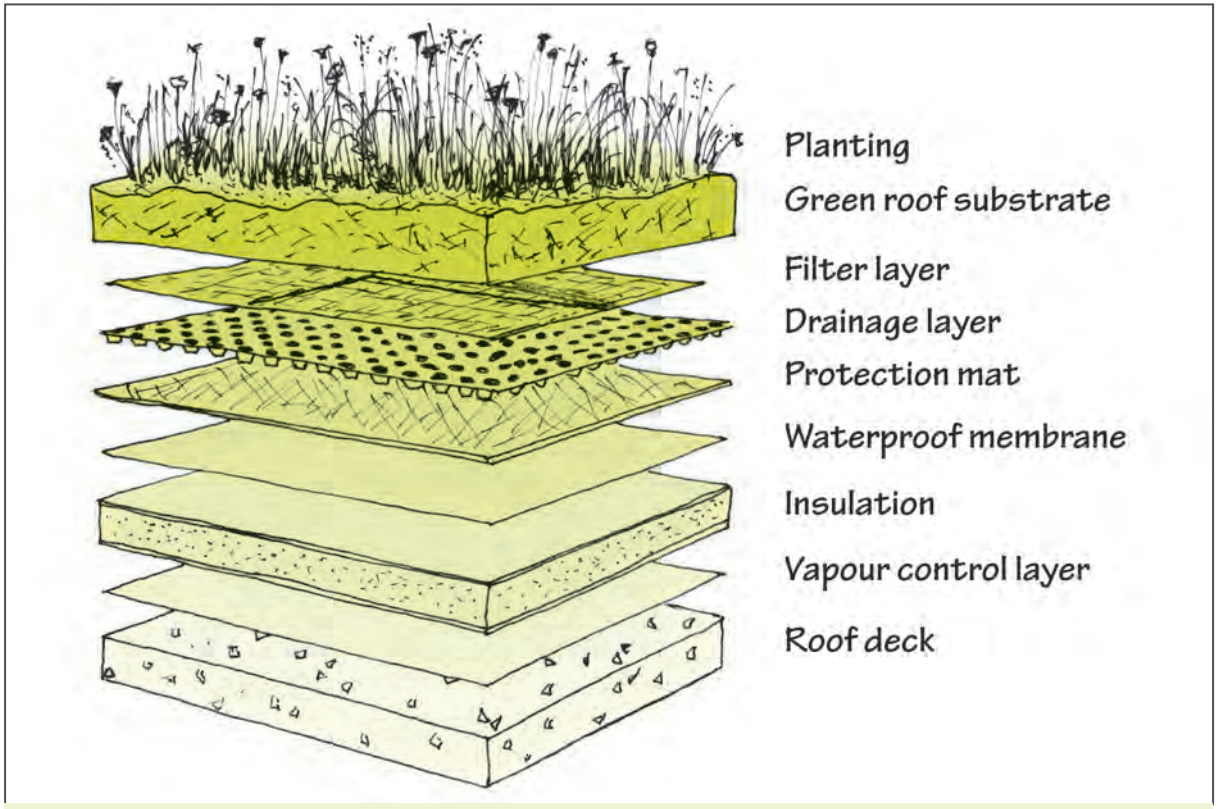

Fig 2.42 Green roof construction

2.06.29

Rain Gardens

These shallow depressions in free-draining soils should be planted with inundation-resistant species; they can be engineered where soils don't naturally suit them and integrated into hard-standing areas. Flowering plants and insect 'hotels' can provide good 'stepping stone' habitats. Located near dwellings, these features can provide aesthetically pleasing green space for relaxation and enjoyment and connect up fragmented habitats while providing food for birds.

Fig 2.43 Rain garden (Ashby Grove, London by CIRIA)

2.06.30

Permeable Paving

Surfaces which allow water to drain through gaps between blocks can either permit infiltration or collect water in a chamber; this dual use reduces land take and also ensures useful, dry amenity ground after storm events.

The space between blocks should be filled with a fine gravel of appropriate technical specification and seeded with resilient, fragrant pollinator species.

Fig 2.44 Insect 'hotel' (courtesy of Caroline Bryden & John Little - Grass Roof Company)

2.06.31

Case Study: Lamb Drove, Cambourne, Cambs.

Source control including permeable paving and under-drained swales within the development envelope ensured a flow of clean water to surface SuDS featuring wildflower seeding and plug planting which have established slowly over time. Structural diversity within the grassed areas is encouraging colonisation by local native plants and animals and is being fully monitored, see: http://www.cambridgeshire.gov.uk/environment/planning/drainagesystems/monitoring.htm

2.06.32

Filter Strips

Vegetated gentle slopes which intercept sheet flow run-off and direct it into another SuDS unit such as a swale; these can be seeded with wildflower meadow species, and sculpted with earth tussocks for significant biodiversity gains.

Strips can be attractive green spaces for informal recreation and picnics etc., with particular scope for **educational boards**, benches and tables. Particular mowing schedules must be assured with a 100mm minimum sward in a 3-year **mosaic rotation pattern** preferred.

2.06.33

Bio-retention Areas

Landscaped shallow depressions adjacent to hardstanding which are under-engineered with sands, and can be planted with both natives and non-invasive ornamentals at agreed densities. Good for green space urban areas, these features can be planted with pollen-rich natives or ornamentals and provide food and cover for insects and foraging birds.

2.06.34

Swales/Rills

These conveyance features are typical SuDS components that link Source and Site Control measures. **Swales** are wide, shallow grassed channels slow water and can allow for infiltration; or be 'under-drain' engineered if necessary to form a **dry swale**. Small check dams can create shallow pools for mini-wetland environments and limit erosion.

2.06.35

Architectural hard landscaping can also be integrated in urban areas to form a **rill**, or otherwise associated with raingarden basins and public open space (**Fig 2.47**).

2.06.36

Both features can afford good amenity such with seating, interpretation boards or more formal recreation provision. Slopes must be no greater than 1:3 and can be asymmetric.

2.06.37

Commercial pre-seeded wildflower turf can allow near-immediate water treatment but plug planting of native plants with grass and flower seeding is cheaper; either way a closed sward must be ensured before connection. In order to allow free flow from hard surfaces and avoid silting, turf must be designed to be 20-25mm below adjacent kerbs at final levels.

2.06.38

Case Study: Red Hill Primary School, Worcester

Swales provide a habitat linkage from the green space at one end of the site to an attractive 'swale maze' and pond containing frogs, dragonflies, aquatic invertebrates and wetland plants.

2.06.39

Ponds, Detention Basins & Retention Basins with associated wetlands

These Site Control measures include **Urban Ponds** which can be naturalistic or form part of hard landscaping; appropriate planting can attract

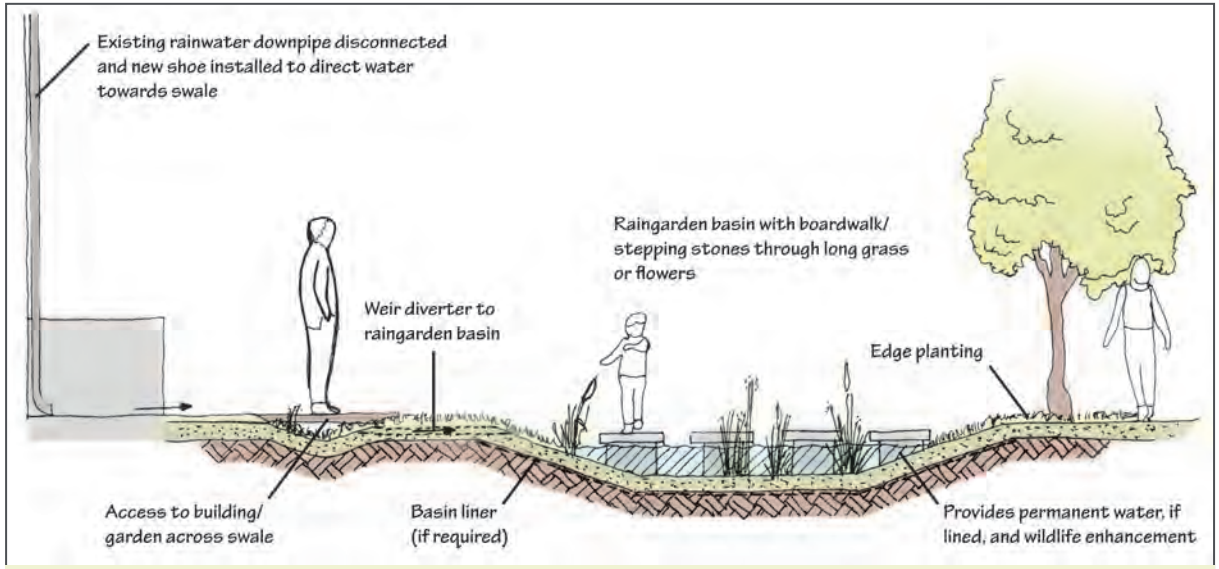

Fig 2.45 Swale and rain garden in public open space

wildlife in a community setting. In terms of amenity and community engagement, research suggests that residents appear to value ponds more greatly than swales, particularly where ponds are attractive to wildlife. Ponds and wet basins should therefore be prioritised where appropriate.

2.06.40

Detention Basins

Vegetated depressions which can hold water for different periods of time; multiples with varying profiles are preferred. Often very adaptable, these can be planted with trees or used for play or interpretative nature walks. Shelves and shallow gradients with convoluted edges are best for wildlife, as is planting with species rich grass and wildflowers. Log piles and spoil heaps can help with varied topography and refugia.

2.06.41

Retention Basins and Wetlands

These final storage/treatment features are permanently wet so true wetland habitats can be considered, including planted wet woodlands. Excellent amenity can be ensured with hides, trails, ephemeral pools, dipping platforms and interpretive boards, along with potential for grazing animals or log pile refugia; a full complement of invertebrate and vertebrate species can be supported and integrated into local and regional strategies etc. Shallow undulating sides should be ensured, with flower-rich grass buffers and filter strips. Natural succession of local flora and fauna should be prioritised in wetland habitats, though some ornamental planting can be acceptable with the appropriate density and management options in place.

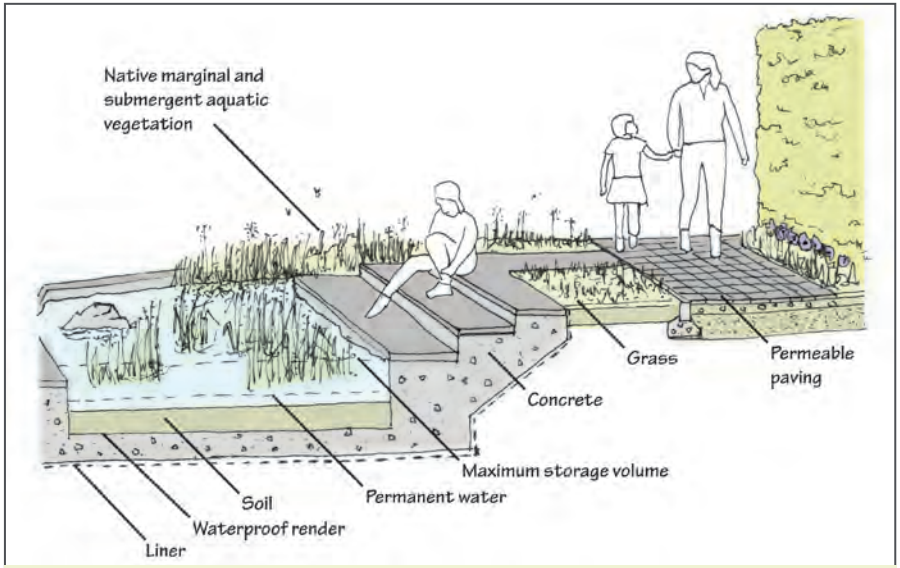

Fig 2.46 Urban pond diagram

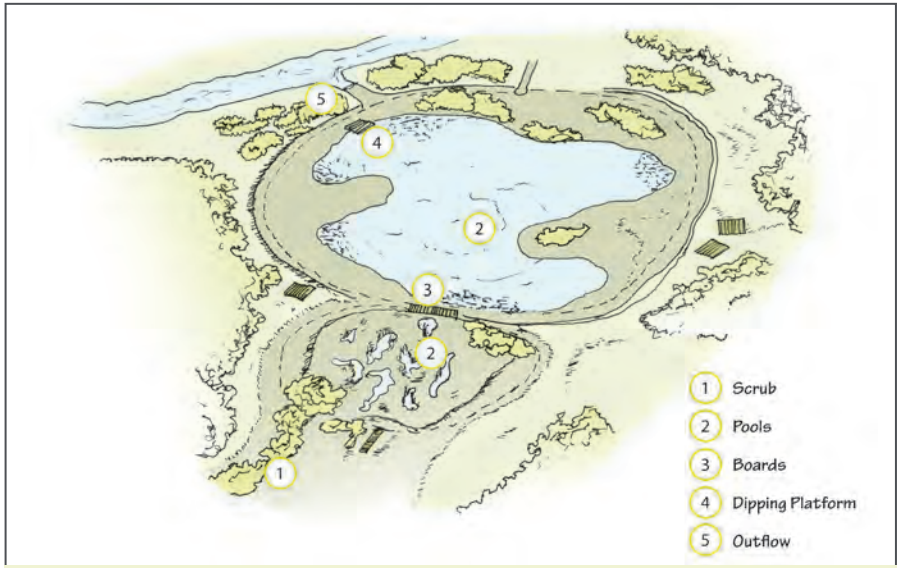

Fig 2.47 Features of a typical wetland

2.06.42

Naturalistic Ponds

Where these can be enhanced or created in the natural state then this is preferable, but liners and clay engineering can be used to make a mosaic of pond habitats near non-intensive land use if possible for colonisation optimisation. Ponds should be designed in multiples and in shallow but varying profiles in order to be pollution resistant and provide the highest biological diversity.

Fig 2.48 Eventual natural succession is the ideal; note the clarity of the water in this pond (courtesy of Andre Douglas)

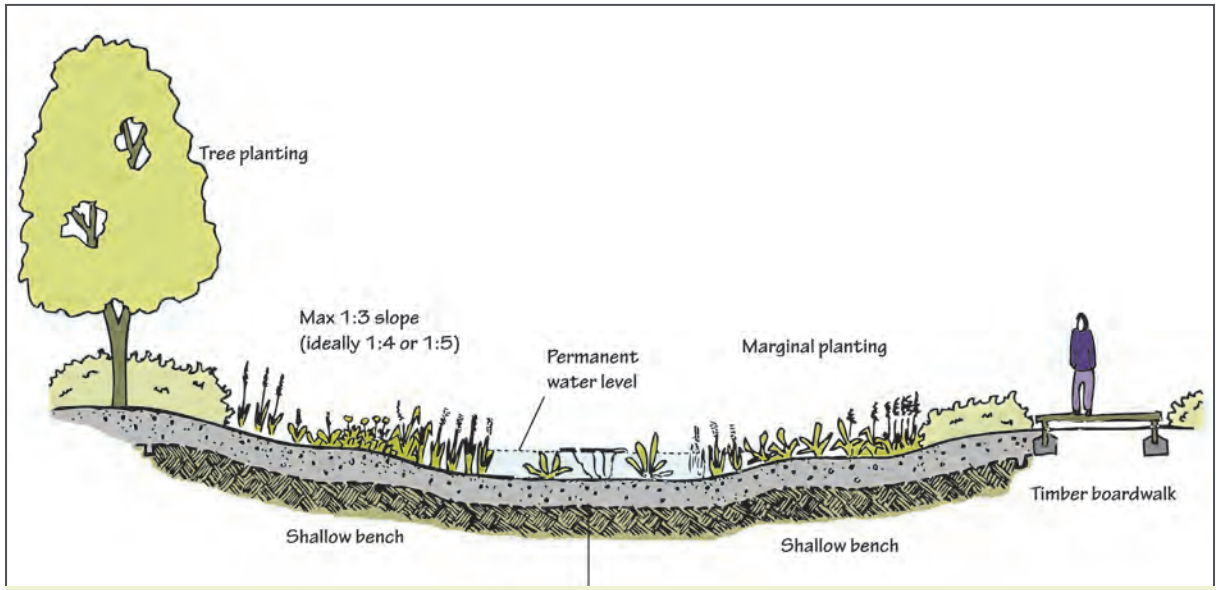

Fig 2.49 Section through a naturalistic pond

2.06.43

Depths of 25cm, 10cm or even 5cm are very valuable for wildlife, and ensure high oxygen levels for pollution breakdown. Anything deeper than 0.6m is sub-optimal for diversity as well as risk management. Very shallow gradients at pond edges are good for seasonally inundated plant species which are more tolerant of pollutants.

2.06.44

A shallow 'wet bench', along with a 'dry bench' should be designed into pond profiles for safety, with a 1:3 gradient an absolute maximum. Toddler fences of some 40cm height can be considered in vulnerable cases, but generally access and visibility should be assured, with benches and trails between connected ponds maximising amenity. A 5-10 year maintenance programme is essential.

2.06.45

Pond floors should also be 'hummocky', layered with some dead wood and generally, an over-tidy appearance for ponds should be avoided. Surrounding trees and wet woodlands/scrub provide tannins which suppress algal blooms, which are inevitable in the first year of most pond's lives. A mosaic of margin plant species should be encouraged at the margins, and partial clearance of surface vegetation in a rotating pattern should be agreed in advance, with dewatered material piled up nearby as refugia for e.g. grass snakes.

Habitat and Species Considerations

2.06.46

Bedfordshire Biodiversity Action Plan (BAP) priority habitats which SuDS can enhance include:

- Hedgerows
- Wet woodland
- Reedbeds
- Ponds
- Lowland meadows
- Floodplain grazing marsh

2.06.47

The support and establishment of the above may provide opportunities for Bedfordshire's many endangered species of plants including stoneworts, sphagnum and Listed/Priority species such as Crested Cow-wheat, Fly Orchid, Tubular Water-dropwort and Greater Water-parsnip

2.06.48

Protected mammals like the otter and water vole, reptiles like the adder, grass snake, common lizard, slow worm and amphibians such as the great crested newt and common toad may in time colonise SuDS which will be a major contribution to enhancing the ecology of the area.

2.06.49

Established sedges and reeds may also attract birds of a protected status such as the sedge warbler and reed bunting, but many other desirable creatures will utilise SuDS in some way.

Fig 2.50 SuDS pond at Stratton, Central Bedfordshire, hosting good bird and invertebrate populations

Fig 2.51 Sedge Warbler

Fig 2.52 Reed Bunting

Designing SuDS - Dealing Confidently with Risks

2.06.50

Risks are associated with almost all activities in the home, workplace or public domain; many are unavoidable, such as hazards from road traffic, but are deemed socially acceptable because of the benefits that arise from the activity.

2.06.51

Effective safety is about mitigating significant risks. It is not about avoidance of all risks. Attempting to avoid all risks is now recognised as futile and essentially counter-productive for the environment and our enjoyment of it. The multiple benefits from SuDS make the very small residual risks after key design considerations worthwhile to society.

2.06.52

The biodiversity and amenity goals of SuDS are completely compatible with creating safe and easily managed wet features using:

- A series of earth 'benches' on the approach to a pond provide safe vantage points and opportunities to stop and consider safety.
- Gentle (less than 1:3) sloping edges and dry and wet benches which allow for safe entry and exit of shallow pools and other wet features.
- Maximum depths designed to be under 1m.
- 40cm 'toddler fences' where very young children may access standing open water.

2.06.53

Any hard surfaces or engineered control points should be assessed for safety, particularly slips and trips, with the latter positioned at least 1m back from the water edge to reduce risk from falls near open water.

2.06.54

For full details and advice on managing risk around waterbodies, consult the ROSPA website at:http://www.rospa.com/leisuresafety/adviceandinformation/watersafety/pondgardenwatersafety.aspx

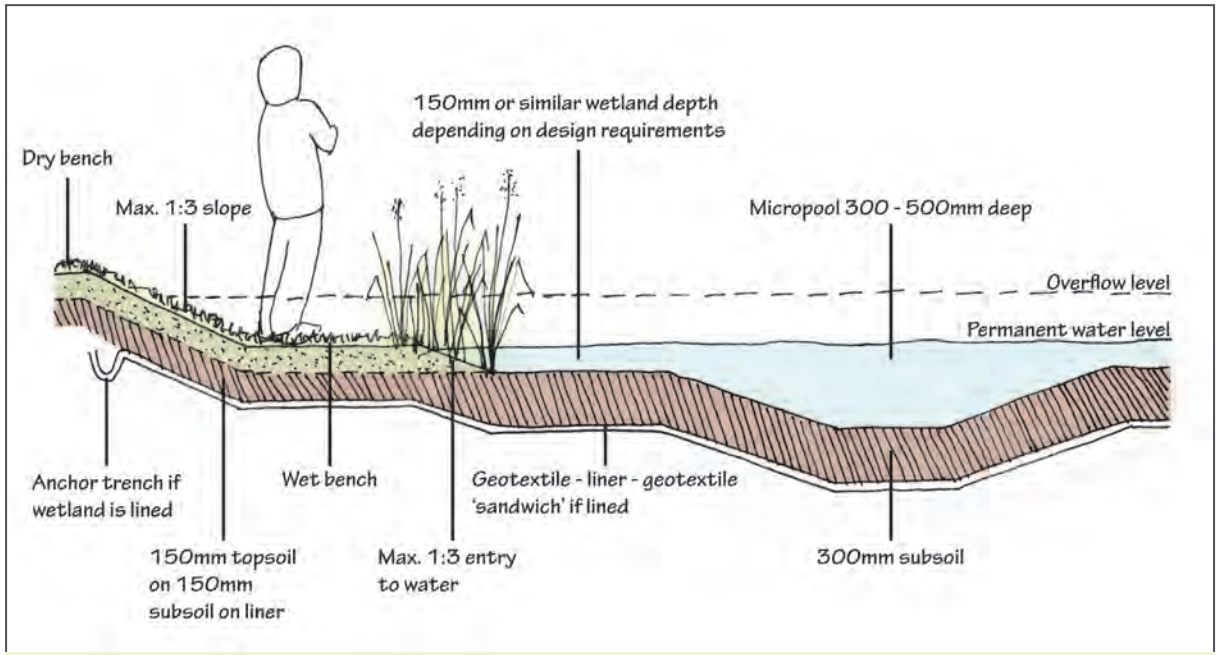

Fig 2.53 Mitigating the risks associated with SuDS

2.06.55 SuDS Checklist

Have you considered;

Planning Phase	Implementation phase
The local water corridor landscape character and a sensitive response to it	Telling a 'stormwater story' using signage and interpretive boards
The view of a site from any escarpments and maximising the vegetated view	Setting a maintenance programme that ensures visual attractiveness throughout the year.
Hedgerows, trees and topography and how lines of sight and defined areas can be maintained	Maximising aesthetic appeal with varied vegetation and landscaping techniques
Informing and educating buyers of the many different roles played by SuDS	Using Local stone in any hard features e.g. gabion cages
Liaising with local schools and communities	Providing seating, hides or dipping platforms where appropriate
Designing out risks to health and safety with dry benches, maximum gradients etc.	Linking features to surrounding facilities
Identifying local priority habits and species for enhancement	Ensuring topsoil slopes away from hardstanding and pond edges shallow etc.
Retaining and enhancing natural drainage systems	Setting a simple maintenance programme for long sward, mosaic rotation etc.
Locating SuDS in or near non-intensively managed landscapes	Using an accredited source guaranteeing native provenance for turf, seed and plants
Creating a wide range of habitat types approved by ecologists and consultees	All turf or seed has established sward before connecting conveyance features
Planting native trees and shrubs to enhance SuDS features	Cutting techniques that are not too short for filtering or too tidy for wildlife
Adding bird & bat boxes, insect holes and log pile refugia to SuDS features	Creating well vegetated shallow bays and establish areas of marsh where possible

Have you used the Landscape Character Assessment tool to identify features that give a locality its sense of place and seek to align designs to it?

Have you used the Biodiversity Opportunity Maps & Action Plan to identify greatest potential for priority habitats & species, and what opportunities there are to reduce habitat fragmentation by building ecological networks across landscapes? The Biodiversity Planning Toolkit is useful: http://www.biodiversityplanningtoolkit.com

2.06.56 Links and References

For SuDS in rural/agricultural locations see:

Rural Sustainable Drainage Systems

Environment Agency, 2012

This guidance provides an overview of the suitability and practicalities of using SuDS components to manage rural surface water runoff.

For SuDS in Highways:

SUDS for roads whole life cost and whole Life carbon toolkit

SCOTS, 2012

This toolkit has been designed to help calculate WLC and carbon for a range of SUDS components for highway drainage.

SUDS Guidance

NHBC, 2011

This guide introduces the concept of SUDS and the policy context.

A guide to SuDS in the urban landscape

Hydro International, 2011

This e-guide promotes the use of SuDS in the urban landscape.

Play with rainwater & SuDS

London Play, 2010

This guide highlights the many ways of incorporating SuDS schemes in play areas.

SUDS - Do's and don'ts guide

SEPA, 2006

This leaflet provides a quick checklist of DOs and DON'Ts to consider when planning and designing SuDS (in Scotland).

Interim code of practice for SUDS

NSWG, 2004

This guide facilitates the implementation of sustainable drainage in developments in England and Wales by providing model maintenance agreements and advice on their use. There are associated model agreements.

SuDS: maximising the potential for people and wildlife

RSPB & WWT 2013

A guide for developers and local authorities on delivering sustainable drainage systems that benefit local wildlife.

Maximising the ecological benefits of Sustainable Drainage Schemes

HR Wallingford, 2003

This report reviews and provides guidance on the ecological benefits of SuDS compared to traditional systems. It also suggests designs and maintenance that maximises ecological performance.

Use of SUDS in high density developments - guidance manual

HR Wallingford, 2005

This guide has been developed to assist achieving drainage best practice on all new developments, with specific support on SuDS for high density sites.

Whole life costing for sustainable drainage

HR Wallingford, 2004

This guide provides advice on the assessment of whole life costs for SuDS.

Ponds, pools, lochans

SEPA et al, 2000

This guide provides best practice guidance on the management of ponds, pools and lochans in Scotland.

Guidance on green roofs/living roofs

Livingroofs.org

This website provides information on green roofs, the types and benefits as well as access to guidance on domestic green roofs.

Planning with Paving

Interpave, 2012

This document explores the latest approaches to planning, urban design and 'place shaping', in the context of the 2012 National Planning

Policy Framework.

Rain garden guide

Raingardens.info, 2012

This guide provides on the benefits, design, construction and maintenance of rain gardens.

Green roof toolkit

Environment Agency, 2009

Reclaimed water systems. Information about installing, modifying or maintaining reclaimed water systems

WRAS, 1999

This guide sets out to encourage the development of good practice through practical experience with reclaimed water systems.

UK SuDS guidance and tools

HR Wallingford, 2012

A website that provides tools for the management surface water from developments.

Essex County Council: SuDS - Design and adoption guide

Essex County Council, 2012

This guide is for the planning, design, construction and adoption of SuDS

SuDS adoption manual

Anglian Water, 2011

This guide is for the design, construction and adoption of SuDS.

SuDS guidance

Anglian Water, 2011

This guide is intended to help those involved in planning and implementing new development to provide background around SuDS.

Surface Water Management: Interim guidance for developers

Shropshire Council, 2011

This document outlines the requirements for the management of surface water for all planning applications made to Shropshire Council.

Islington – SuDS guide

Islington Council, 2010

This guide provides information and ideas for decision makers & designers to support the application of SUDS.

Cambridge City – SuDS design and adoption guide

Cambridge City Council, 2009

This guide is primarily aimed toward developers and their consultants seeking adoption of SUDS under the remit of Cambridge City Council.

2.07 Resource Efficiency and Climate Change Adaptation

Introduction

2.07.01

The Council believes that all new development should use resources such as energy and water efficiently and future proof against climatic impacts such as flooding, draught, subsidence and the urban heat island effect. Such development will provide comfortable and healthy accommodation with low running costs for both the residential and commercial market.

2.07.02

Resource efficiency and climate change adaptation measures should be considered at the earliest possible stage of development design (at the master plan, development brief or site layout) to ensure that they can be achieved in the most cost effective way, for example:

- Good solar orientation and application of passive design principles can reduce energy demand of buildings and need for technological solutions (e.g. renewable energy);
- Well located and designed green infrastructure can compensate for future changes in climate by providing urban shading and cooling, integrating SuDS and increasing biodiversity.

2.07.03

Zero Carbon Buildings and Energy Hierarchy

All development should be designed in accordance with the energy hierarchy presented in **fig 2.54.**

The initial building plan should consider orientation and layout to minimise energy demand and increase energy efficiency of buildings. Higher energy efficiency can be achieved through use of low U-value materials, avoiding thermal bridging and maximising air tightness. Carbon emissions can then be further reduced through use of efficient heating/cooling systems, energy efficient appliances, and the installation of renewable energy technologies. Carbon emission reductions which can not be achieved in individual dwellings or within the site can be offset through investment in an appropriate 'allowable solutions' project.

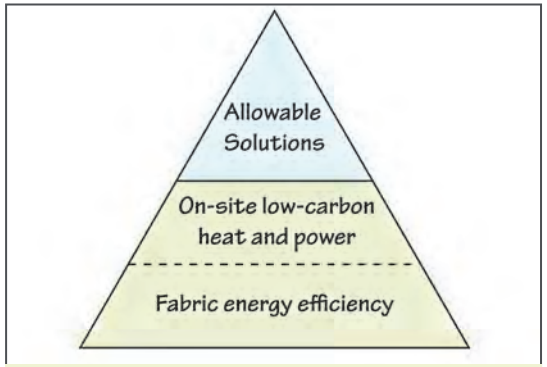

Fig 2.54 Energy Hierarchy - steps to achieving zero carbon

2.07.04

Water Efficiency

The Council's Climate Change Risk Assessment identified that the Central Bedfordshire area is within a region that already faces water stress, a situation which is expected to worsen in the future. The study highlights Anglian Water's assessment of deployable water output for the region estimates that even in a 'typical' rainfall scenario, without factoring any additional housing growth or other development, they will face a shortfall of 6% in deployable water supply by 2020, rising to a 25% shortfall by2030.

2.07.05

The predicted growth in Central Bedfordshire will put additional stress on our water resources, making it essential that any new development is as water efficient as possible. To reduce risk of potable water shortages, the Council has set water efficiency standard above the national level. All new dwellings should aim to reduce potable water usage to the equivalent of 110 litres per person per day in residential buildings, and meet the BREEAM excellent rating for non-residential buildings.

2.07.06

Climate Change Resilience

The Council's Climate Change Risk Assessment also identified a number of climate change impacts affecting the Central Bedfordshire area: flooding, draught and water shortages, overheating and the urban heat island effect, subsidence and severe weather events. The future risk of climate change impacts affecting the proposed development should be assessed and mitigation measures designed into site layout and individual buildings to minimise the risk and provide a higher degree of 'future proofing'.

2.07.07

Design Codes

Design Codes such as BREEAM and Passivhaus can act as a drive for more sustainable buildings as well as demonstrate the sustainability credentials of the development. BREEAM assesses development against a number of categories including:

management, health and wellbeing, energy, transport, water, materials, waste, land use and ecology, and pollution.

2.07.08

Passivhaus standard helps to reduce energy demand of the building primarily through specification of fabric with high energy efficiency and optimal solar orientation. Such orientation maximises solar gain in winter to reduce need for heating whilst limiting solar gain in summer months to avoid overheating. Passivhaus standard introduces principle requirements that are additional to the UK Building Regulations. These are presented in the following table:

Additional Passivhaus guidelines
Insulation
U-values of walls, floors and roofs. 0.15 W/m2K
Glazing
Triple-pane windows with insulated frames U-values (including doors). 0.8 W/m2K
Solar orientation
Windows largely south-facing
Thermal bridging
Minimal (ideally non-existent) psi-($f\mu$) values. 0.01 W/mK
Ventilation
High-efficiency MVHR system Heat recovery efficiency. 75%, specific fan power. 1.62 W/(l/s)
Appliances
Low-energy lights and appliances throughout
Overheating
Special care to avoid summertime overheating

2.07.09

Design Considerations

The larger development site will provide more opportunities and fewer constraints to delivering resource efficient and climate change resilient development. The scale will have a bearing on selection of suitable measures. The following sections contain examples of potential suitable measures to be considered at:

- Strategic scale (at the development site scale);
- Individual building scale;
- Extensions and, or retro-fitting of existing buildings.

2.07.10

Strategic and Development Site (Masterplan) Scale

Site Layout to Reduce Energy Demand

Site layout and orientation of buildings has a significant impact on the amount of passive solar gain and energy demand for heating and cooling. Energy demand can be significantly reduced by orientating the longest face of the building within 30 degrees of south **(fig 2.55)** and therefore roads should be aligned east-west. South easterly orientation is preferable to south westerly as it maximises early morning solar gains and reduces overheating in the afternoons. To avoid summer overheating, especially in buildings with south to west facing elevations, shading or other solar control measures should be considered in the design of a building (more detail in the building scale section). Deciduous trees are very effective in providing shade in summer and allowing sun light to get through in winter months **(fig 2.56)**.

Fig 2.55 South easterly orientation maximises early morning solar gains and reduces overheating in the afternoon

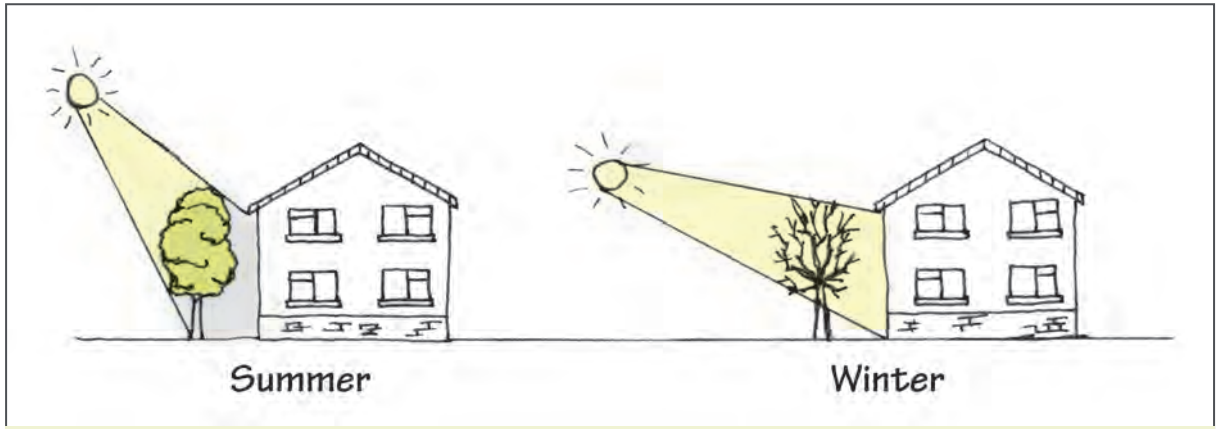

Fig 2.56 Deciduous trees provide effective shading from the summer sun, whilst allowing warming sun rays through in winter months

2.07.11

Large Scale Energy Solutions

The characteristics of the development and the site's constraints will favour different low and zero carbon technologies and a range of approaches should be explored. These could include:

2.07.12

Combined Heat and Power (CHP) as the engine for a District Heating Network, can provide community heating and cooling **(fig 2.58)**. CHP units, which can be powered by a range of fuels, such as gas or biomass, is most efficient when run at full capacity continuously. This would mean that heat generated during low demand periods from one user should be exported to another user(s) to avoid the 'dumping' heat to the environment.

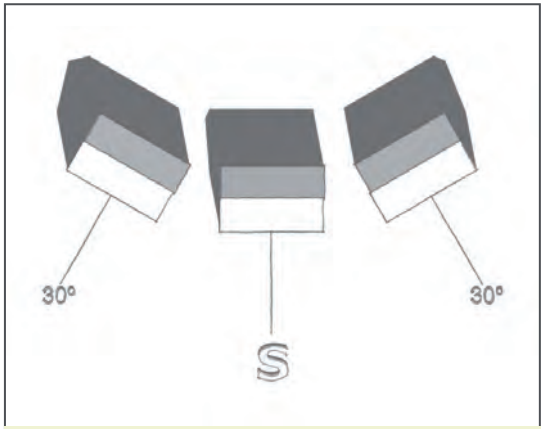

Fig 2.57 Solar orientation for passive solar heating

2.07.13

The energy demand profile of different occupiers within the development site will need to be analysed to determine the suitability of CHP. As a rule of thumb CHP is most likely to be suitable for mixed use sites which have a high heat user all year round, for example an industrial heat user or leisure complex.

- The electricity produced by the CHP unit can either be used by occupiers of the site or exported to the National Grid and receive the Feed-in Tariff Payment.
- Wind turbines and ground level solar PV arrays can supply renewable electricity to the scheme or export it to the National Grid and receive the Feed-in Tariff Payment.
- For more guidance on large scale renewable development please refer to the Council's technical guidance notes for large scale Renewable Energy.

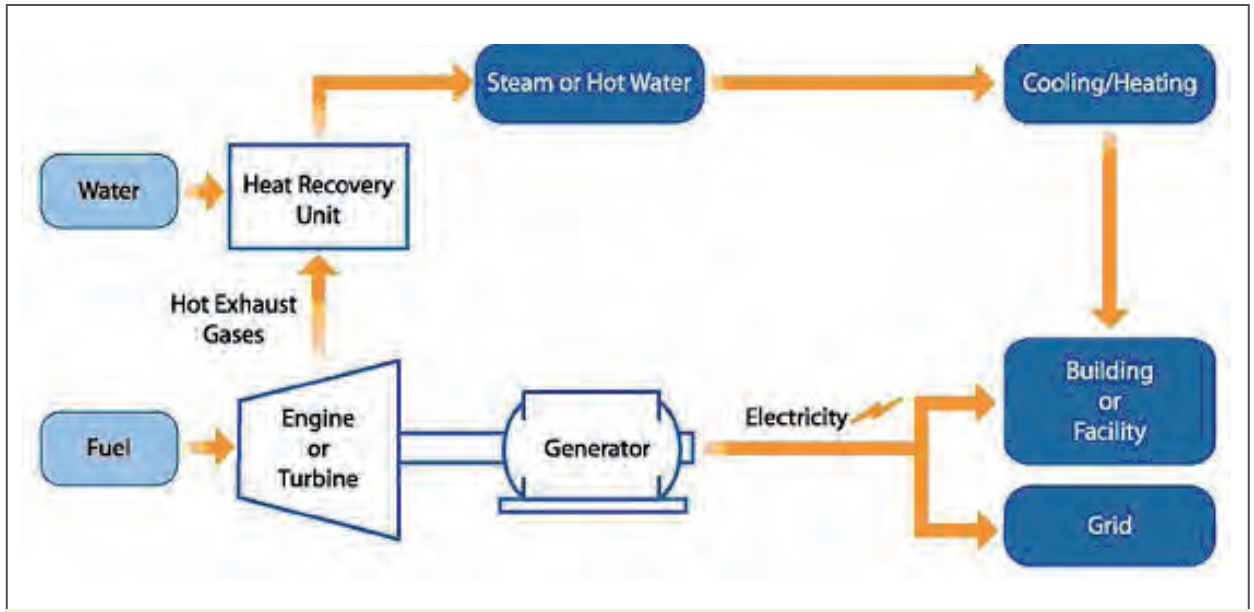

Fig 2.58 CHP system

2.07.14

Mitigating Climate Change Impact

The urban heat island effect can be reduced within and beyond the development site through integration and inclusion of:

- Trees to provide summer shading for buildings and transport/movement networks such as streets, walking and cycling paths (please refer to the tree section for more information on species selection).
- Green open spaces should be maximised to provide urban cooling through evapotranspiration
- Water features such as ponds, fountains and well designed Sustainable Drainage Systems (SuDS) can provide summer cooling (please see SuDS section for more information).

2.07.16

It is important to state that good site design which integrates passive solar layout, green (trees and open spaces) and blue (SUDS and water features) infrastructure is key to avoid summer overheating and provide future adaptation for a rising temperature.

2.07.15

Flood risk can be reduced through good design of SUDS, minimising hard impermeable surfaces and increasing permeable, preferably green spaces in the development.

Fig 2.59 Wind farm

2.07.16

Risk of subsidence due to soil shrink-swell can be reduced through designing foundations that are strong and deep enough to withstand seasonal variation in moisture content (taking into account predicted climatic changes in precipitation patterns over the expected lifespan of the development) or through use of pile foundations.

2.07.17

Water Efficiency

All development should consider how water efficiency will be achieved and appropriate measures should be established early on in the design process. Such measures may include community scale rainwater harvesting or grey water recycling schemes. A community rainwater harvesting system could be delivered alongside SuDS, e.g. through utilising retention ponds or underground storage.

Building Scale

2.07.18

Energy efficiency and carbon dioxide emission reduction should be achieved by following the energy efficiency hierarchy. This starts with good passive solar design, efficient fabric of the building, efficient heating and cooling systems, provision of energy from zero and low carbon sources and as a last resort the use of carbon offsetting and allowable solutions. Below is a range of practical examples of how the energy hierarchy could be delivered at an individual building scale.

Passive Design and Energy Efficient Fabric Solutions

Consideration should be given to the following measures:

2.07.19

Orientation:

- Energy demand for heating can be reduced by locating the façade of the main living rooms within 30° of South **(fig 2.60)** and minimise or make smaller windows on the northern elevation to reduce potential heat loss.
- Overheating in commercial and public buildings that are in continuous use throughout the day can be reduced by avoiding the design of rooms with predominantly south or west facing windows.

2.07.20

Shading or other solar control measures:

- Should be considered in the design to avoid summer overheating. This will avoid the solar gain adding to the internal heat gain through the day, making it more difficult to keep the space at a comfortable temperature without mechanical air conditioning.

2.07.21

Thermal mass:

- Ensure that sufficient shading or other solar control measures are considered in the design to avoid summer overheating. This could include overhanging eaves and canopies, external blinds and shutters, brise soleil, solar control glazing with heat reflecting films, deciduous trees or bushes.
- Overheating in summer months and heating requirement in winter months can be reduced by including building materials with thermal mass. The thermal mass of materials absorbs heat during hot days and dissipates heat during cold days **(fig 2.61)**.

2.07.22

Natural light

- Designing living rooms with an open floor plan, and making use of skylights, sun pipes and catchers on southern elevations to bring natural daylight into darker areas, can reduce need for artificial lighting.
- Specify fabric with high energy efficiency and avoid thermal bridges. Ensure that walls, floors, roofs, water tanks, ducts and pipes, and external doors are insulated. Also ensure that windows are double or triple glazed and have excellent energy rating

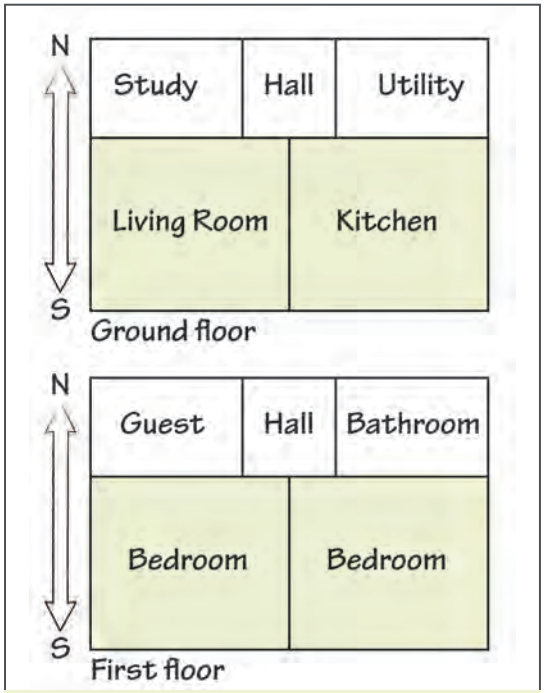

Fig 2.60 Internal layout designed to suit solar orientation

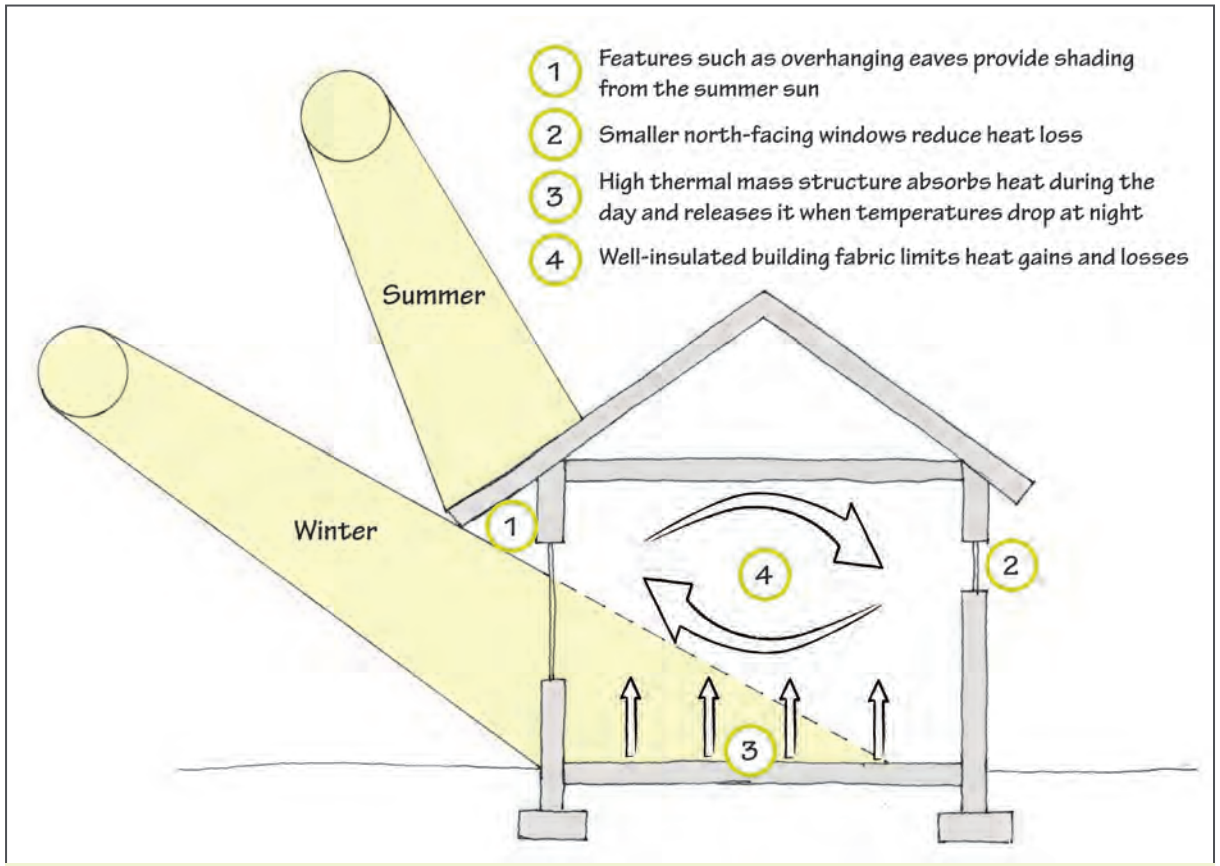

Fig 2.61 Passive design principles including shading, thermal mass and insulation help to reduce overheating during the summer and heat loss during the winter

2.07.23

Carbon Compliance Solutions

Carbon compliance measures which reduce carbon dioxide emissions are:

- Efficient heating/cooling systems and appliances: Ensure that the boiler is a high efficiency condensing/combi boiler and that any white goods being installed are AA or A+++ rated.
- Efficient lighting: All internal and external lights should be low energy bulbs fixtures and controls.
- Efficient ventilation system: Ensure that sufficient natural or mechanical ventilation is designed in to how the building will operate. The simplest form of natural ventilation is cross ventilation which requires openable windows on opposite sides of the building.
- Renewable energy technologies such as solar PV, solar hot water, biomass boilers, air source and ground source heat pumps are suitable for use in individual dwellings and commercial buildings. CHP units are less suitable for domestic settings due to likely disparity between periods of heat and electricity demand. In domestic settings biomass boilers and stoves are usually better suited.

2.07.24

Allowable Solutions

The government recognises that it may not be possible to achieve zero carbon homes standard on site and allows for part of the emissions to be offset off-site through allowable solutions. The Council would like any potential allowable solution projects arising from the development to benefit its residents.

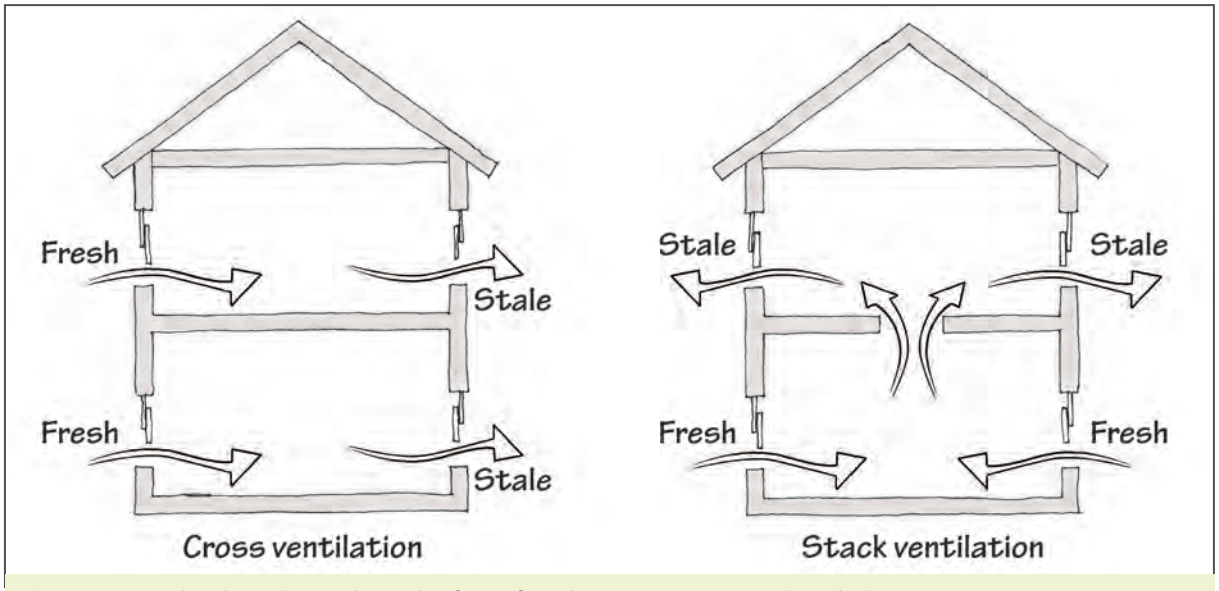

Fig 2.62 Cross and stack ventilation - the simplest forms of ventilation not requiring a mechanical solution

2.07.27

Water Efficiency

Water efficiency in individual buildings can be achieved through following measures:

- Water efficient fittings and appliances such as low flow taps, dual/low volume flush toilets, water efficient aerated showerheads, water efficient washing machines and dishwashers.
- Rain water collection and grey water recycling systems replace the use of mains fed, potable water with collected from the roof rainwater or recycled grey water that has been already used, e.g. for bathing. Harvested rain water is filtered and then stored for use in the garden, flushing WCs and washing clothes. Collected greywater is filtered, treated and disinfected to remove pathogens and used for flushing WCs.
- Water offsetting: In situations where the water standard cannot be achieved on an individual building scale, the developer can pay for water efficiency measures to be fitted elsewhere to achieve the remaining water usage reduction.

2.07.25

Extending and Retrofitting Existing Buildings

When designing an extension to or retrofitting an existing building, consideration should be given to how the original building can be improved in terms of energy and water use. Measures which should be considered are broadly the same as those examples given for a new build (above). There might however be some constraints such as the original building construction (e.g. solid wall), designation (e.g. listed building) or setting (e.g. conservation area). These issues require careful consideration and consultation with the Council's Conservation officer, ecologist and structural engineer as appropriate.

2.07.26

Energy and Water Efficiency

The Council's policy requires that all planning applications for extension are to include information on what measures would be installed to improve energy and water efficiency of the existing part of the building.

- The Government's Green Deal scheme allows homeowners to carry out energy efficiency work without up front expenditure and the cost of the measures is re-paid through savings in energy bills. Energy efficiency can be improved through installation of loft insulation; cavity or solid wall insulation, draught proofing, efficient heating and hot water system including renewable technologies, replacement of windows and doors.
- Water efficiency can be improved through the installation of water efficient fittings (such as flow restrictors and water aerating devices), hippo bags; low flow taps, low volume dual flush toilets; and retrofitting grey water recycling or rain water harvesting systems and garden water butts.

2.07.27

Climate Change Resilience Measures

If a building is at risk of being affected by climatic factors a careful consideration should be given to design in measures which will increase building resilience. For example: in case of flooding risk, air brick of a building can have removable covers, an electric socket can be positioned above potential flooding level to minimise damage.

2.07.28
Resource Efficiency and Climate Change Adaptation Checklist

- **How will the design of the new building contribute to reducing energy demand for:**
    - Heating,
    - Cooling,
    - Lighting?
- **What energy efficiency measures will be used to further reduce energy demand for:**
    - Heating,
    - Cooling,
    - Lighting?
- **What renewable technology will be used to reduce carbon dioxide emissions arising from energy use?**
- **What water efficiency measures will be used to reduce potable water usage?**
- **What water recycling technologies were considered and will be used to reduce potable water usage?**
- **How will the new building be designed to reduce its vulnerability to climate change impacts such as:**
    - Overheating,
    - Severe storms,
    - Flooding, and
    - Subsidence due to soils shrink-swell?

2.07.29

Useful Links and References

- Building Regulations www.planningportal.gov.uk
- Energy hierarchy and zero carbon hub www.zerocarbonhub.org
- Passivhaus standard www.passivhaus.org.uk
- CSH standard www.planningportal.gov.uk
- BREEAM standard www.breeam.org
- Renewable energy and technologies www.energysavingtrust.org.uk; www.microgenerationcertification.org
- Green roofs www.greenroofcode.co.uk
- UK Rainwater Harvesting Association www.ukrha.org
- Waterwise www.waterwise.org.uk
- Your home in changing climate: retrofitting existing homes for climate change impacts. Arup, February 2008
- Designing homes for the 21st Century: Lessons for low energy design. NHBC Foundation, May 2013
- Understanding overheating - where to start: An introduction for house builders and designers. NHBC Foundation, July 2012
- Overheating in new homes. A review of the evidence. NHBC Foundation, November 2012
- Lessons from Germany's Passivhaus experience. NHBC Foundation, December 2012