



# **Natural Solutions: Creating Green and Resilient Communities**

**Lower Shaw Farm, Swindon  
17<sup>th</sup> November 2010**

# Aim for today

- To demonstrate the evidence that Green Infrastructure e.g. trees, parks and allotments are an effective and affordable solution to the impacts of climate change.

# Agenda

## **10.00 Arrival & Coffee**

10.30 Welcome & Ice Breaker

10.45 Introduction to Green Infrastructure

11.15 Shaw Forest Park (Site visit)

## **12.45 Lunch**

1.30 Short think piece

13.40 Understanding the Evidence

14.10 Design Green Infrastructure

15.00 Group Feedback and debate

15.25 Where to go from here – Sources  
of help

## **15.30 End**

# **Introduction to Green Infrastructure**

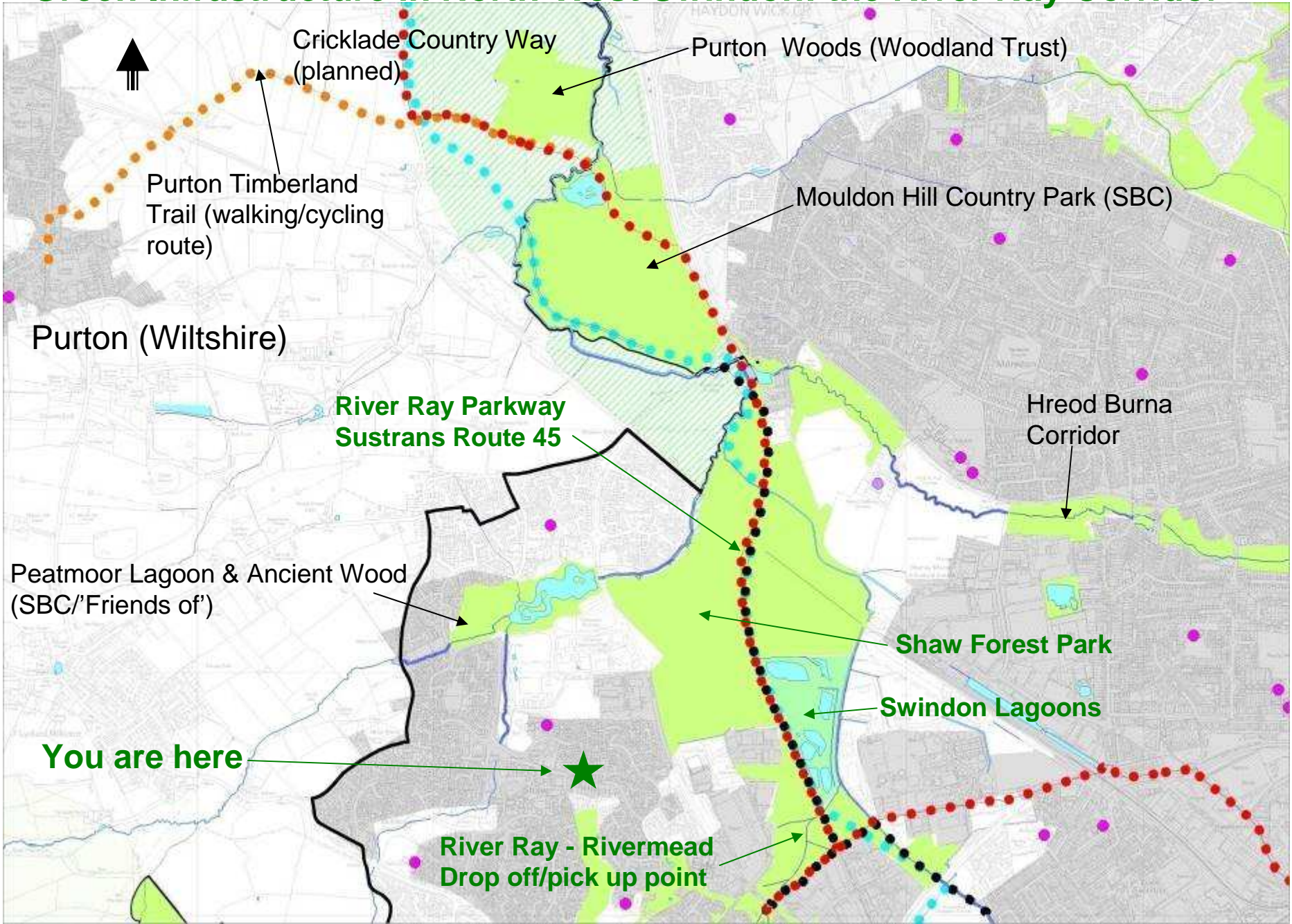
**Peter Wilkinson – Chair of Greenspace SW**

# Shaw Forest Park

Site Visit



# Green Infrastructure in North-West Swindon: the River Ray Corridor



# River Ray (Swindon Borough Council & Wiltshire Wildlife Trust) – Rivermead

River Ray looking upstream (south) from cycle bridge at Rivermead in 2007. Before this, the river was 'canalized' and had no access to its floodplain. The works restored, meanders, riffles, beaches, fish passes, backwaters, scrapes, paths and view points. Conventional piped drainage systems reduce the amount of water flowing into watercourses and recharging aquifers.

- ✓ Broadleaved woodland can reduce small local floods and on floodplains can mitigate large floods by absorbing and delaying release of flood water.
- ✓ There have been three 1 in 100 year +20% floods since works commenced in 2005 (but no properties flooded downstream)
- ✓ Huge amount of community involvement - managed as a community reserve on a ten year agreement.
- ✓ Water voles have returned, huge increase in reptiles, Reed Bunting numbers increasing (and now breeding).



## Swindon Lagoons (Thames Water & Wiltshire Wildlife Trust)

Since the 1860s, the site was used as settling beds (sewage treatment) but this ceased in the 1970s. The site has since been cleaned up. Part is an old brown field site. It is a 'hidden' site with no access.

✓ The new wetlands are being formed within the River Ray corridor and form a crucial 'stepping stone' for wetland wildlife. For example, Reed Buntings rung at the lagoons have been recaptured at Blakehill and North Meadow National Nature Reserve, to the north.

✓ Huge quantities of carbon locked up by fen soils (peat).

✓ To alleviate local flooding, green roofs, ponds and swales all need to be part of the solution.

✓ To alleviate urban heat, green and blue space needs to be integrated (starved of water, amenity grasslands behave rather like tarmac)!



## Tree planting in Shaw Forest Park (2006)

Thousands of people have helped to create Shaw Forest Park over the last decade. Forestry test plots were established to test survival of different tree species in the poor soils and exposed location. A wetland treatment system for landfill leachate was recently installed by SBC with the Wildfowl & Wetland Trust and filters water before discharging into the River Ray. Trees planted over fifteen years ago with potential for biomass in mind.

✓ River Ray  
Parkway/Sustrans Route 45  
promotes activity and  
reduces emissions

✓ Wind-shielding by trees  
can reduce home heating  
costs by 15 per cent



## 'Chester's Web' Play Park & Toothill Primary School Green Roof

✓ Street trees cool the local environment by up to 2°C.

✓ In Ottawa, Canada, a conventional roof reached temperatures higher than 70°C in summer, while the surface temperature of the green roof only reached 30°C.



# **Understanding the Evidence**

# Flooding – the problem

- Climate of the last 40 years = 29% more autumn rain + 9% less summer rain<sup>a</sup>
- Urban flooding costs £270 million a year in England and Wales and is predicted to increase to between £1 and £10 billion a year by 2080, unless preventative action is taken<sup>b</sup>
- Hard surfaces, compacted farmland and culverted rivers all increase flood risk<sup>c</sup>
- Urban runoff is high in pollutants such as pesticides and petroleum residues, which harm wildlife and contaminate drinking supplies<sup>d</sup>



a) UK Climate Projections 2009

b) Parliamentary Office of Science and Technology (2007). Urban flooding.

c) Holman, I., et.al. (2003). The contribution of soil structural degradation to catchment flooding: a preliminary investigation of the 2000 floods in England and Wales. *Hydrology and Earth System Sciences*, 7, 755-766.

d) Moran et.al. (2005). Hydrologic and water quality performance from green roofs in Goldsboro and Raleigh, North Carolina. Paper presented at the Third Annual Greening Rooftops for Sustainable Communities Conference, Awards and Trade Show, 4–6 May 2005, Washington, DC.

# Flooding – the natural processes



- When it rains, tree canopies slow the rate at which water reaches the ground<sup>a</sup>, giving drains more time to carry away the water.
- Broadleaved woodland can reduce small local floods<sup>b</sup> and on floodplains can mitigate large floods by absorbing and delaying release of flood water<sup>c</sup>.
- Woodland soils have more organic matter and better structure compared to more intensive land uses<sup>d</sup>.
- ‘Sponge’ - soil infiltration was up to 60 times higher under young native woodland compared with heavily grazed pasture<sup>e</sup>.
- In ponds, swales, and reedbeds, pollutants are filtered, incorporated into the soil and decomposed by microbes<sup>f</sup>.

a) Soltis, D. (1997). Loss of trees increases storm water runoff in Atlanta. *Water Engineering and Management* 144.

b) Nunez et al (2006). Forests and water: the value of native temperate forests in supplying water for human consumption. *Ecological Economics*, 58, 606-616.

c) Hughes, F.M.R. (ed.) (2003). The Flooded Forest: Guidance for policy makers and river managers in Europe on the restoration of floodplain forests. *FLOBAR2*, Department of Geography, University of Cambridge, UK.

d) Nisbet et al.(2004). A guide to using woodland for sediment control. *Forest Research*.

e) Carroll et al. (2004). Can tree shelterbelts on agricultural land reduce flood risk? *Soil Use and Management*, 20, 357-359.

f) Environment Agency (2003). Sustainable Drainage Systems (SUDS) – a guide for developers.

# Flooding – the green solution

- The restoration of the River Quaggy has created 85,000 m<sup>3</sup> of flood storage capacity<sup>a</sup>. Lewisham has not flooded since and income of local businesses is up by 10%.
- Mathematical modelling suggests that a 2.2 km reach of floodplain woodland on the River Cary in Somerset increased flood storage by 70% and delayed flood peak downstream by 140 minutes for a 1 in 100 year flood event<sup>b</sup>.
- In Brussels, roof greening (to a depth of 100 mm substrate) on just 10% of the buildings would reduce runoff by 3.5% for the city and of 54% for the individual buildings<sup>c</sup>.

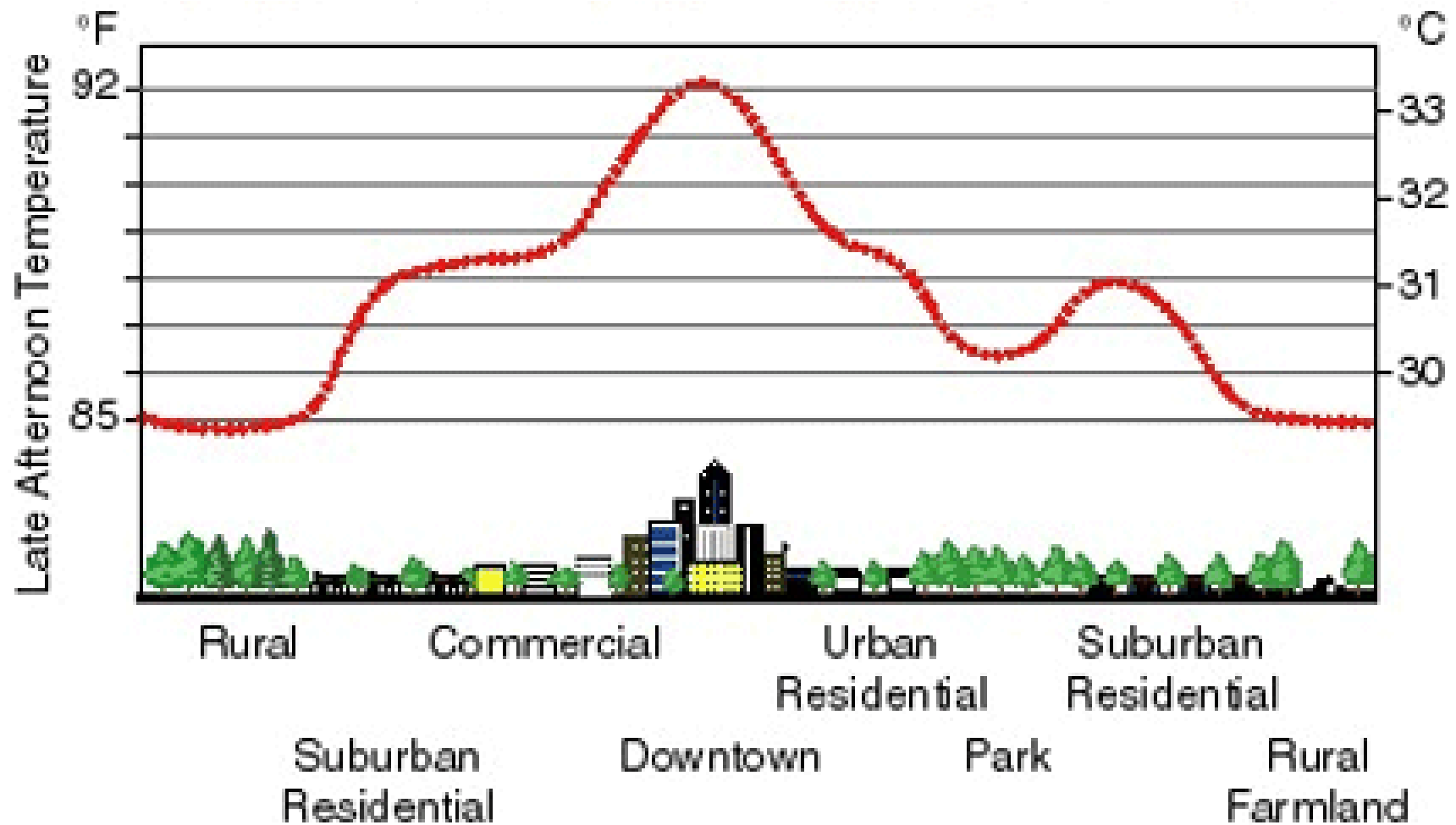


a) <http://www.cabe.org.uk/case-studies/quaggy-river>

b) Thomas, H. & Nisbet, T.R. (2007). An assessment of the impact of floodplain woodland on flood flows. *Water and Environment Journal*, 21, 114-126.

c) Mentens, J., et al (2006). Green roofs as a tool for solving the rainwater runoff problem in the urbanized 21<sup>st</sup> century? *Landscape and Urban Planning*, 77, 217-226.

# Urban Heat Island Effect – what is it?



# Urban Heat Island Effect – the problem

- In London, during the August 2003 heatwave, the maximum temperature difference between urban and rural locations reached 9°C on occasions<sup>a</sup>.
- An estimated 15,000 excess deaths were attributed to the heat wave across France in August 2003<sup>b</sup>.
- 24,000 people die prematurely as

a) National Health Service (2010). Heatwaves Plan for England.

b) Fouillet, A., et al. (2006). Excess mortality related to the August 2003 heat wave in France. *Int. Arch. Occ. Environ. Health*, 80, 16–24.

c) HM Government (1998). UK environmental accounts.



An elderly woman drinks after she was brought by firefighters to the Saint Antoine hospital in Paris, Monday, 11 August 2003.

Keystone

# Urban Heat Island Effect – the natural processes

- Evapo-transpiration cools leaves and the surrounding air<sup>a</sup>.
- Trees provide shade, making streets and buildings cooler in summer<sup>b</sup>.
- Trees remove large numbers of airborne particles and hence improve the quality of air in polluted environments<sup>c</sup>.
- Honeydew from trees has a very beneficial effect in that it traps dust and particles and so helps reduce airborne pollution<sup>d</sup>.



- a) Taha, H., et al. (1988). Residential Cooling Loads and the Urban Heat Island: The Effects of Albedo. *Building and Environment*, Vol. 23, No. 4, pp. 271-283.
- b) Huang J., et al. (1987). The Potential of Vegetation in Reducing Summer Cooling Loads in Residential Buildings. *Journal of Climate and Applied Meteorology*, Vol. 26, No.9, 1103-1116.
- c) Beckett, K.P., et al. (1998). Urban woodlands: their role in reducing the effects of particulate pollution *Environmental Pollution, Volume 99, Issue 3, 347-360.*
- d) Forest Research (2007). *Particulate Pollution.*

# Urban Heat Island Effect – the green solution

- A 10% increase in green cover in town centres and high-density residential areas of Greater Manchester could stabilise maximum surface temperatures at present levels up to the year 2080<sup>a</sup>.
- On average, parks are 1°C cooler than surrounding areas (1.15°C at night)<sup>b</sup> and the affect extends outside the park boundary by as much as 1 km for large (156 ha) parks<sup>c</sup>.



- a) Gill, S.E. et.al. (2007). Adapting Cities for Climate Change: The Role of the Green Infrastructure. *Built Environment*, 33, No 1, 115-133.
- b) Bowler, D.E., et.al. (2008). How effective is 'greening' of urban areas in reducing human exposure to ground level ozone concentrations, UV exposure and the 'urban heat island effect'? *Collaboration for Environmental Evidence*, Systematic Review No.41.
- c) Upmanis, H., et.al. (1998). The influence of green areas on nocturnal temperatures in a high latitude city (Goteborg, Sweden). *International Journal of Climatology*, 18(6), 681-700.

# Urban Heat Island Effect – the green solution

- In Madrid, a green roof on an eight-story residential building reduced the cooling load by 10% for the entire building<sup>a</sup>.
- In the UK, the net benefit of improved air quality by forests and woodland was estimated to be around £11 million per annum<sup>b</sup>.



- a) Saiz, S., et.al. (2006). Comparative life cycle assessment of standard and green roofs. *Environmental Science and Technology* 40: 4312–4316.
- b) Forestry Commission (2004). Sustainable forestry in brief: social and environmental benefits of forestry.

# Carbon - stewardship

Environmental Stewardship in England reduces greenhouse gas emissions from agriculture by 11% per annum<sup>a</sup>



a) University of Hertfordshire (2007). Research into the current and potential climate change mitigation impacts of environmental stewardship. Report to Defra. Code BD2302.

# Carbon - revenue

- Increasing UK woodland to 16% by 2050 could abate emissions by 10%<sup>a</sup>.
- Mixed woodlands managed for multiple objectives can deliver abatement at less than £25 per tonne CO<sub>2</sub><sup>a</sup>.
- NW woods valued at £601m in possible markets for carbon capture (wetlands also a major resource)<sup>b</sup>.
- Timber is a potential long-term **renewable energy resource**<sup>c</sup>.



- a) Rea, D. (2009). Combating climate change – A role for UK forests. An assessment of the potential of the UK's trees and woodlands to mitigate and adapt to climate change. The synthesis report. The Stationery Office, Edinburgh.
- b) Defra (2005). The economic, social, and ecological value of ecosystem services. EFTEC.
- c) Forestry Commission (2007). A woodfuel strategy for England.

# Conclusion

If your aim is to see (deep rooted, sustainable and secure) **economic prosperity** in your area, you need to see the natural environment as **critical infrastructure**, worthy of strategic planning and investment.

# **Design Green Infrastructure**

# Design Green Infrastructure

Using the evidence just presented, create a master plan for no more than 4,500 houses, employment, commercial uses, shopping and green space.

## Constraints Plan

- Tree Preservation Orders and hedgerows
- Flood plain associated with the River Ray and smaller brooks
- The development is designed to be protected against a 1 in 100 year flood event plus 20% allowance for climate change
- Scheduled Ancient Monuments

## Development Phasing Plan

Use this as the basis of your master plan. Cut and paste land use paper!

# Sources of Help

- Forestry Commission – Benefits of Green Infrastructure Knowledge Portal.

<http://www.eforestry.gov.uk/forestdss/webpages/bgi/home.jsp>

- CABE – Sustainable Places

<http://www.cabe.org.uk/sustainable-places/green-infrastructure>

- Green Infrastructure SW

<http://www.greeninfrastructurenw.co.uk/html/index.php?page=index>

# Thank You

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