



Urban development around Burnham Beeches SAC: a synthesis



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Summary

Urban Development and Burnham Beeches SAC

Burnham Beeches is an internationally important site for wildlife and this has been recognised in its designation as a Special Area for Conservation (SAC). Burnham Beeches is one of the best sites in Britain for Beech Forest and supports ancient Beech and Oak pollards hundreds of years old. The Beech trees' health is declining and a higher proportion of the ancient pollards are dying than might be expected for their age.

Burnham Beeches is a relatively small site and is surrounded by a relatively high level of urban development, which has been steadily increasing in recent years. Prompted by growing concern about the pressures of development on the site, the Corporation of London (who own and manage the site) have commissioned a series of studies that relate to the impacts of urban development. These included research on soil health, tree health, visitor numbers and behaviour, hydrology and epiphytic lichens. This report synthesises the findings of these studies and considers these findings alongside previous work on the effects of climate change and air quality.

Viewed together, the findings highlight the pressure that the site is under, from increased recreation, nutrient enrichment, air quality impacts, changes to the site's hydrology and changes in water quality. The combination of urban effects is currently impacting on the SAC interest of the site. New development will add to this impact, as such new development will have a likely significant effect on the site.

The report considers a series of actions that would avoid or mitigate further impacts of these combined urban effects. The issues are complex and cannot be resolved in their entirety simply by changing management at Burnham Beeches. Options could include limiting development within the vicinity of the SAC; consideration of additional green infrastructure; application of dog-control measures and changes to management of access at nearby sites. Long-term monitoring is necessary and there are areas where further research would be beneficial.

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1 Introduction

- 1.1 Urban development including residential housing and associated infrastructure, can result in a wide range of impacts to sites which are important for nature conservation. These impacts include fragmentation, changes in plant communities, disturbance of wildlife by people, fires, predation by cats, trampling, impacts of dogs such as eutrophication and disturbance of wildlife, pollution and eutrophication through changes in air quality and changes to hydrology (Underhill-Day 2005). These impacts can have a direct effect on the nature of a site, such as predation of animals by domestic cats; or an indirect effect, for example eutrophication causing a change from a valued plant community to a less valued one, caused by gases in vehicle emissions. Individual impacts may also have a significant effect on their own, or in combination with other impacts.
- 1.2 Burnham Beeches extends to over 380 hectares and is recognised as an internationally important site for its wildlife, leading to its designation as a Special Area for Conservation (SAC) under the European Habitats Directive (Council Directive 92/43/EEC), which is transposed into domestic legislation by the Conservation of Habitats and Species Regulations 2010, as amended, most commonly referred to as the 'Habitats Regulations.' Its designation as a National Nature Reserve is also evidence of its recognised value.
- 1.3 Concern has been building at Burnham Beeches for many years that urban development in the vicinity of Burnham Beeches is potentially having an adverse effect on the highly valued natural features found within the reserve, including ancient beech and oak pollards and associated rare species; and Beech Forest.
- 1.4 As a response to these concerns, the Corporation of London commissioned a review of urban effects from Footprint Ecology (Liley *et al.* 2012). This review identified a number of causes for concern and recommended specific studies to establish whether these concerns were justified. These included changes in hydrology, soils, tree health and an accurate assessment of visitor pressure.
- 1.5 As a result, in addition to research on the impacts of climate change and air quality that had already been undertaken, the Corporation of London (and in the case of hydrology South Bucks District Council) commissioned further work on the following aspects of urban effects:
- Visitor numbers, origins and behaviour (Liley *et al.* 2012).
 - Hydrology (Wallingford Hydrosolutions 2014)
 - Lichens (Purvis, Bengtsson and Read 2014)
 - Soils (Fay 2014)
 - Tree Health (MJ Consultants 2013)
- 1.6 This report brings together the previous studies on climate change and air quality, the commissioned studies on visitors, hydrology, lichens, soils and tree health, and

Footprint Ecology's own research and expert knowledge of urban effects, to consider all the evidence and its ramifications. The report concludes with an assessment of measures which could be taken to mitigate these impacts.

2 Context: Burnham Beeches, protection and management

Change in Urban Development around Burnham Beeches SAC since 2001

2.1 National postcode data files that give the number of residential properties per postcode, have been purchased by Footprint Ecology and it is possible to extract data from a range of different years, extending back to 2001. Postcodes can change between years, for example in location or extent, but these data do provide an indication of the levels of housing change.

2.2 Between August 2001 and February 2014 these data suggest that the number of residential properties within a kilometre of Burnham Beeches has risen from 1854 to 2003 properties, an increase of 8% and equivalent to 11.8 new properties per year (roughly one per month). Looking at data from individual years would suggest that the increase has been steady and this rate has been even between years (Figure 1)

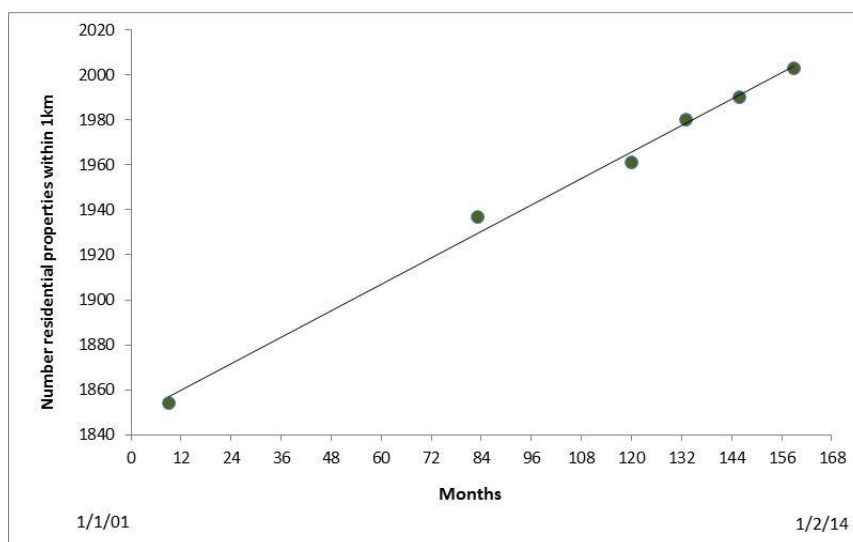


Figure 1: Housing increases within 1km of Burnham Beeches 2001-2014. Plot derived from postcode data held by Footprint Ecology for different years.

2.3 Future Housing levels are set out in the South Bucks Core Strategy Policy 1 Housing Provision and Delivery. The South Bucks District Council Monitoring Update: Housing Trajectory (2012/13) indicates that house building across South Bucks is well ahead of the predicted trajectory (187 units per year), based on the annualised core strategy lower-end target of 110 units per year. This is reflected in the number of new units built or with planning permission for the Farnham Common area within the Burnham Beeches hydrological catchment. A total of 201 units have already been built, or have planning permission, a figure which already meets the predicted figure for the period to 2026.

The Burnham Beeches management plan

- 2.4 The conservation of Burnham Beeches is guided by the 10 year Management Plan (Burnham Beeches 2010). This includes a 500 year vision for the reserve *“Burnham Beeches, conserved and protected for ever, will be a first class, sustainable public open space and a site of international conservation importance.”*
- 2.5 Shorter term objectives include *“to restore and maintain the key habitats of Burnham Beeches in favourable condition”*. Primary among these habitats are the old beech and oak pollards, and the beech forest for which the site is designated as a Special Area of Conservation.
- 2.6 Within the objective *“To encourage the sustainable use of Burnham Beeches for the recreation and enjoyment of the public; to promote public involvement and foster greater understanding of the reserve”* the management plan identifies the need to *“produce an access strategy”* and *“limit as far as possible the negative impacts of dogs on other visitors and on the reserve”*.
- 2.7 The staff at Burnham Beeches have carried out a wide range of activities to mitigate the impact of visitors on the valuable wildlife and other features of the reserve. They have reduced the number of car parks, introduced dog-faeces bins, directed visitors away from sensitive locations using signage, undertaken footpath management and interpretation. They have now turned to investigating what other options are available to them to further mitigate for this impact.
- 2.8 The management plan does not directly mention the impact of additional residential (and other) development within the vicinity of Burnham Beeches on the reserve, nor does it reference the fact that such developments have impacts that are permanent. Permanent potential impacts therefore require long term mitigation to prevent such impacts from occurring. This is often referred to as impacts and mitigation needs being *“in perpetuity”*. With increasing levels of development taking place around the reserve, and an increasing local human population, there is a challenge to enable sustainable recreation use whilst maintaining the nature conservation interest of the site. These are long term challenges that cannot be achieved by Burnham Beeches staff in isolation.

SAC features of interest

- 2.9 Burnham Beeches is designated as a SAC for its beech forests on acid soils with holly and yew. One particularly rare and endangered moss, the Knothole yolk-moss *Zygodon forsteri*, which lives in knotholes of old beech trees, is specifically mentioned within the site details, as are saproxylic invertebrates, such as beetles associated with old trees and dead wood. Only four other sites have been selected as SACs for this habitat type in the UK, and elsewhere in Europe it is only found in specific locations along the western seaboard of Europe, in Brittany and northern Spain.
- 2.10 The interest feature for the site is ‘Atlantic acidophilous beech forest,’ which, as a habitat interest feature is the product of all that contributes to the forest ecosystem. In determining what might constitute the interest feature, and therefore what might constitute an effect on the interest feature, it is necessary to consider the key species,

essential processes and support systems that contribute to the interest feature. There may be some debate around these issues until the site has the benefit of site specific details to support its conservation objectives, which are currently being prepared by Natural England for all European sites in England¹. As a starting point it is important to make clear that the beech forest feature does not simply comprise of the beech trees and pollards themselves. As the term ‘forest’ suggests, the wider interpretation is of all that provides an essential contribution to the forest ecosystem and sustains or is sustained by the trees. What is more difficult to determine is the additional species that are critical and central to the beech forest ecosystem, the health of which in turn contributes to achieving Favourable Conservation Status for the interest feature, being one of the overarching objectives of the Habitats Directive.

- 2.11 For Burnham Beeches it is suggested that some of the most important typical species that contribute to the habitat type are the epiphytic lichens and saproxylic invertebrates, the knothole yolk-moss, the tree species that typically accompany beech in this habitat type, primarily holly, yew and oak, and the shrub and ground flora that increases biodiversity, particularly in open areas in between the large veteran trees. Underlying supporting processes that are essential for the habitat would include soil and hydrology, whereby any degradation of these support systems could potentially harm the habitat.
- 2.12 The site is designated as a SAC, which means that Burnham Beeches is protected by the Habitat Regulations. The Regulations require that European sites are maintained or restored to enable them to meet their site level conservation objectives and fully contribute to the favourable conservation status of the habitats and species for which they are designated. Of particular relevance is the requirement for plans or projects to be assessed to determine whether they may have an adverse effect on the integrity of the SAC. Responsibility for assessing any potential effects lies with the ‘competent authority,’ which is the relevant public body responsible for either undertaking the plan or project themselves, or authorising another to do so. Plans or projects include, but are not confined to, residential development in the vicinity of Burnham Beeches and the local planning authority as competent authority must consider the urban effects associated with residential development before allowing new residential development to proceed. The assessment process is referred to as the ‘Habitats Regulations Assessment.’

SSSI conservation objectives

- 2.13 Burnham Beeches is a Site of Special Scientific Interest (SSSI), a National Nature Reserve and a SAC under the Habitats Regulations. As Burnham Beeches is a SSSI, English Nature, a founding body of Natural England, prepared a set of conservation objectives in 2004. These have not been updated for the last 10 years but are currently being reviewed by Natural England. One of the objectives of the review is to ensure that there is a clear distinction between the criteria used to define SSSI favourable condition,

¹ currently each European site only has high level generic conservation objectives

and the conservation objectives set for the European level designation. It is important to make a clear distinction between the two, because interest features can differ between the national and European designations, and the criteria are set for different purposes, in accordance with the specific requirements of the national and international legislation for the two designation types.

- 2.14 The original SSSI conservation objectives are focused on ensuring the correct management is in place for the site, and do not consider urban effects or visitor pressure as impacts that may affect the site's ability to fully contribute to favourable conservation status of Atlantic acidophilous beech forest.
- 2.15 Natural England will now prepare new European level conservation objectives for Burnham Beeches. These objectives should provide a clearer understanding of the features of interest for the site, the thresholds at which potential impacts may become significant, and what is required to maintain interest features at a level that ensures their full contribution towards the favourable conservation status of this habitat type. This additional and more detailed information within the new conservation objectives will in turn inform the assessment of any potential impacts arising from plans and projects and the degree to which they can be mitigated.

3 New and Existing Evidence of Urban Effects

- 3.1 In this section we summarise and bring together the new information since the previous Footprint Ecology report on Burnham Beeches. We focus on the specific studies that relate directly to Burnham Beeches. More general reviews of the impacts of access may be found in a range of studies, including (Corney *et al.* 2008; Lowen *et al.* 2008; Liley *et al.* 2010)

Visitor Numbers

- 3.2 Burnham Beeches is an attractive and popular green-space, providing high quality visitor facilities. In 2003 a visitor survey estimated 560,000 visits per year (Wheater & Cook 2003). This had increased to 585,000 visitors per year in 2010/11 (Wheater & Cook 2012), accompanied by an estimated 215,000 dogs.
- 3.3 A visitor survey commissioned by the Corporation of London and South Bucks District Council, at Burnham Beeches in 2013 (Liley, Floyd & Fearnley 2014) interviewed a random sample of visitors; over half (56%) were dog-walkers and the median distance between people's home and the interview location was 3.1km, i.e. half of visitors had travelled from homes within 3.1km of the survey points. The results show that visitor rates decline with distance – i.e. people who live closer to Burnham Beeches visit the site more regularly. We can derive a weighting for successive 500m distance bands (out to 15km), based on the visit rates and we can use this weighting to work out the percentage increase in housing (2001-2014) within the catchment of the SAC. This is essentially the increase in access that would be expected given the change in housing over that same time period (and assuming all other factors, such as occupancy rates remain equal). That increase is 7.6%. Over the period 2003 to 2011 (the two years with estimates of visitor numbers), the change in our weighted housing variable was an increase of 4.9%, broadly similar to the 4.5% change in access over the same period. This provides strong indication that changes in visitor numbers relate very closely to changes in local housing.
- 3.4 Dog-walking at the site causes the deposition of approximately 50 Tonnes of dog faeces and 30,000 litres (or 30 Tonnes) of dog urine (Barnard 2003) per annum. Only a relatively small proportion of dog faeces is collected by owners - this was estimated at 30% in 2003.

Hydrology

- 3.5 A recent review was carried out, on behalf of South Bucks District Council and The Corporation of London, of the impact on the hydrology of Burnham Beeches from existing and possible future urban development (Wallingford Hydrosolutions 2014). This review identified a number of possible hydrological impacts from adjacent urban development, including reduction of flow through watercourses and ground-water in Burnham Beeches; and changes to water quality. Under a worst case scenario urban development currently causes a 22% reduction to water in the Withy catchment and a 13% reduction in the Nile stream, due to diversion from the natural catchment into artificial drainage. Further urban development within the catchment of the streams

which enter Burnham Beeches would exacerbate this problem, unless effectively mitigated by Sustainable Urban Drainage Schemes (SUDS).

- 3.6 This report also notes that the Nile stream and an un-named stream provide water to areas supporting beech forest, and that these streams disappear into swallow-holes. The authors recommend taking a precautionary approach and have made the assumption that these swallow-holes do convey water to the roots of Beech trees.

Air quality

- 3.7 Air quality at Burnham Beeches has the potential to directly affect the integrity of the SAC features. Nitrogen gases from vehicle emissions can increase levels of nutrients in the soils at Burnham Beeches which are highly infertile. The soils at Burnham Beeches are also acidic and any change of acidity will cause the vegetation communities to alter. Ammonia from agricultural sources also acts as a fertiliser as well as changing the acidity of soils. Dust from alkaline sources, can alter soil acidity too.
- 3.8 The impacts from air quality at Burnham Beeches were reviewed by the Environment Agency (Scriven 2006). This report highlighted that Nitrogen gases were at or above levels where they have an impact on the vegetation at Burnham Beeches (exceeding critical loads); and that there were seasonal peaks in ammonia which also exceeded recommended limits for environmental impact. The Natura 2000 data form for the Burnham Beeches SAC advises that the site is vulnerable to air pollution, referring to sulphur and nitrogen oxides being at critical levels for sensitive vegetation.

Climate Change

- 3.9 A review of the projected impacts of climate change on Burnham Beeches was prepared in 2009 (Berry and Paterson 2009). This review concluded that Burnham Beeches would no longer be suitable for a range of key features, including heather heathland and pedunculate oak, under projected climate change with a temperature increase of 3.2C (by 2080), although beech trees would still be able to grow at Burnham Beeches. The review also identified a number of more immediate impacts on the ancient beech trees and the beech forest, including severe drought.
- 3.10 The authors recommend a series of measures including adaptive management to reduce the impact of climate change on the reserve, especially relating to water stress. The implication is that water stress will compound the impacts of climate change.

Lichens

- 3.11 Lichens have been monitored at Burnham Beeches for two decades, and the monitoring data shows the decline in sulphur dioxide pollution, as a result of European-wide measures taken to address acid rain in the 1980s. As this gas has receded, lichens have recolonized the trees at Burnham Beeches, such that lichen diversity has increased on monitored trees five-fold during a twenty year period from 1993 to 2013 (Purvis, Bengtsson and Read 2013)). However, the species of lichen recolonizing indicate a higher level of nitrogen and more alkaline conditions than would normally be expected for oak bark in these conditions.

- 3.12 This trend indicates that high nitrogen levels are having an impact on the interest features of the SAC, including the beech trees. Nitrogen loving lichen species have increased from 4% to 15% per tree trunk from 1993-2013, while acid loving lichens have decreased from 87% to 40% during the same time period.
- 3.13 As discussed earlier, whilst lichens are not a specifically mentioned feature of interest within the SAC, it is suggested that they form one of the key components of the habitat types. Notably, one particular species of lichen is named in the JNCC habitat description for Atlantic acidophilous beech forests, *Agonimia octospora*. This lichen is rare in Britain and now mostly confined to coastal locations. It is indicative of an epiphyte community associated with very long-established open woodlands in low pollution areas.
- 3.14 The establishment of a lichen community is a welcome development, as a result of the reduction in sulphur dioxide in the atmosphere. However, the development of a nitrogen-loving lichen community at Burnham Beeches is indicative that the reserve is still subject to pollution, but of a different kind.

Soils

- 3.15 Soils are a key component of a forest ecosystem. In 2013 The Corporation of London commissioned an investigation (Fay 2014) of the soils adjacent to a sample of beech trees which had not been monitored previously. Soil samples were collected and analysed to investigate whether visitor pressure was affecting soil health and therefore tree health.
- 3.16 Although the sampling area was relatively small, the investigation found that, compared with soils in areas with low or no visitor pressure, soils in areas of high visitor pressure,
- Were more compacted
 - Were more alkaline,
 - Had more bacteria and less fungi;
 - Had more phosphate
 - Had more nitrogen.
- 3.17 The report concluded that these factors “may affect tree health, particularly the less resilient ancient cohort.”
- 3.18 While compaction can be directly referred to visitor pressure through trampling, chemical changes are more complex. One likely cause of these soil changes is the deposition of dog faeces and urine. Faeces contribute nitrogen and phosphate to the soils while dog urine contains Nitrogen salts and alters soil pH (Taylor et al. 2005, Liley et al. 2010). Evidence from grasslands indicates that addition of nitrogen and phosphate beyond critical thresholds alters the balance between bacteria and fungi in soils (Bardgett et al 2007), favouring bacteria. Mycorrhizal fungi are essential to plant growth and tree health. Significantly lower levels of soil fungi were found in areas of high visitor pressure than those locations with low or no visitor pressure.

- 3.19 These results are indicative of a causal relationship, although more research is required to accurately describe the complex relationship between soil fertility, fungal activity and tree health.

Tree Health

- 3.20 The Corporation of London recently commissioned a review of the condition across time of a selected sample of maiden beech trees at Burnham Beeches (MJ Consultants 2013). This review assessed changes in tree condition since initial surveys were carried out in 1987 and 2013. The review concluded that there had been significant decline in beech tree health as recorded by measuring crown thinness and canopy architecture. Significant changes (across time) in these measures, both of which are accepted as indicators of tree health, were only found for the older beech trees first monitored in 1987. While trees that are older are perhaps more likely to show declines in health because of their age, they are also the most sensitive indicators of change.
- 3.21 Trees may deal with stresses from multiple directions and then catastrophically fail when an additional stress is introduced, such as with acute oak decline. Multiple factors such as weather and insect attack can for example have synergistic effects (La Spina *et al.* 2013). A slow decline of health may appear to be of only limited cause for concern, but a few drought years or a particular pollution incident (for example) when combined with the excessive levels of soil nitrogen, reduced functioning of soil mycorrhizae, squirrel damage and soil compaction could lead to the sudden death of a significant proportion of trees.
- 3.22 It is also worth noting that two thirds of Burnham Beeches' Beech and Oak pollards were lost between 1931 and 2007 (Read, Forbes and Young 2007) and this has major implications for the conservation status of Burnham Beeches as a SAC and SSSI.

4 Implications of Urban Effects

- 4.1 Urban effects on heathland are well known (Underhill-Day 2005), while urban effects in woodland and wood pasture are much more poorly understood. Urban effects include dog-walking and fouling, predation by cats, trampling, fires, rubbish-dumping, changes to water quality and hydrology, reduction in air quality and vehicle damage. A sub-set of these effects occurs at Burnham Beeches.
- 4.2 In 2013, Natural England commenced an Improvement Programme for Natura 2000 sites (IPENS). As part of this programme NE has identified recreation impacts as threats to sites (with a particular focus on Marine, Coastal and bird sites), and recreation (including dog walking) is one of the broad themes in IPENS (Erian 2013; Natural England 2013).
- 4.3 Direct urban effects at Burnham Beeches are trampling by visitors and dog-fouling. As the evidence shows, these effects can be detected currently. Soil compaction is higher in areas with high visitor pressure than in areas of low visitor pressure, signifying the results of trampling. Soil chemistry is also adversely affected in areas of high visitor pressure (primarily attributed to dog-fouling), with knock-on effects on soil and tree health.
- 4.4 There is a direct correlation between residential development within the catchment of Burnham Beeches and increased visitor numbers to the reserve. Residential development within 1km of the reserve has increased by 7% between 2001 and 2014; most visitors to Burnham Beeches live locally (within 3km), especially dog-walkers, who make up over half of visits. It is therefore reasonable to suppose that additional residential development within a zone around Burnham Beeches will lead to increased numbers of visits and that the majority of these additional visits will be by dog-walkers.
- 4.5 Other urban effects are having an indirect impact on Burnham Beeches. Residential development has occurred within the catchments of three streams which enter the reserve from the east. This development has already affected the hydrology of those streams. Any further development, unless suitably mitigated, is likely to have a further effect on those streams and wildlife features dependent on those streams, such as beech trees and wildlife associated with mires and ponds. Evidence will need to be collected to show that SUDS will mitigate the impact of further development on the hydrology of Burnham Beeches. Atmospheric pollution in the form of nitrogen oxides, is produced from vehicle emissions and a nearby power plant. This pollution is contributing to excess nitrogen in Burnham Beeches soils and on the bark of trees, encouraging a nitrogen-loving lichen community instead of the desired community.

In Combination Effects

- 4.6 The Habitats Directive and domestic Habitats Regulations recognise that effects on the interest features of European sites (including SACs such as Burnham Beeches), can occur singly or in-combination, i.e. the synergistic effect of a number of influences.

While it is possible that each separate factor described above may not have a significant effect on its own, the in-combination effects must also be considered.

- 4.7 The evidence indicates current impacts, from the combination of trampling, dog-fouling, hydrology, atmospheric pollution and climate change. These impacts directly relate to the SAC interest. The Corporation of London at Burnham Beeches has implemented a wide range of existing measures on-site to attempt to mitigate these impacts. Despite these measures, there is evidence of deterioration on the SAC interest.
- 4.8 These effects are the result of a long and continuing history of trampling and the deposition of dog-faeces, from the currently recorded 585,000 visits per year. Access to Burnham Beeches is governed by statute which requires the whole site to be publicly accessible. This limits the options available to the Corporation of London to mitigate, on-site, the impacts of that public access on the interest features of the SAC.
- 4.9 Further development in the vicinity of Burnham Beeches will only exacerbate the already significant problems. As such new development (in-combination) will have a likely significant effect on the SAC. Although the incremental increase in residential development around Burnham is relatively small compared with larger European sites such as the Thames Basin Heaths, the small size of Burnham Beeches and its popularity as a destination for visitors and dog-walkers concentrates the effects of these additional residences. Homes are specifically marketed as being near to “the wooded parkland of Burnham Beeches”, and this is likely to increase the proportion of new residents using the Beeches either to walk or to walk their dogs.
- 4.10 It is potentially difficult to separate the additional impacts of new residential developments from existing impacts, and this means that it is currently difficult to envisage how new development in the vicinity of the SAC can rule out an adverse effect on the integrity of the SAC without some carefully considered and implemented approach to avoiding and mitigating impacts.

6 Mitigating the Urban Effects – mechanisms

Introduction

- 6.1 The Habitats Directive, and domestic Habitats Regulations, require competent authorities to only proceed with or authorise plans or projects where adverse effects on the integrity of European sites can be ruled out. If it is not possible to conclude that urban effects are having no adverse effect on the integrity of the SAC, a planning authority must consider whether a series of steps to mitigate these effects can be implemented, in order to enable new development to proceed. Whilst mitigation measures are possible, they are potentially complex to deliver and would require a number of bodies to work together, potentially to agree an overall strategy. Such a mitigation strategy could include changes to local planning policy regarding residential development within an area around Burnham Beeches; provision of greenspace to attract visitors away from Burnham Beeches; dog control measures to reduce the impact of dog-walking on the reserve; restricting access to parts of the reserve; changes to parking in and around Burnham Beeches, emergency action to improve tree health; a long term monitoring programme; and future research. Appendix 1 provides some examples of Local Planning Authorities currently implementing or establishing such Strategic Mitigation Schemes.
- 6.2 Any approach will need to address the deterioration of the habitats for which the SAC is designated, as a result of existing activities. The Habitats Directive includes overarching objectives for the restoration of habitats as well as their maintenance. The legislation therefore requires habitats which are not meeting their site level conservation objectives to be restored to enable their full contribution to the favourable conservation status of that habitat across its natural range.
- 6.3 This requirement is specifically stated at Article 6(2) of the Habitats Directive, which requires Member States to take appropriate steps to avoid the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated. Article 6(2) states that “member states shall take appropriate steps to avoid..... deterioration of natural habitats.... as well as disturbance of the species...”The wording therefore puts a responsibility on the member state to address such issues where they arise.
- 6.4 In recent years, there has been an increasing body of evidence to indicate that urban effects are significant for a number of interest features on other European sites. This research has primarily related to Special Protection Areas (SPAs), which are classified under the Birds Directive, although there are SAC sites (which are not SPAs) where strategic mitigation has been established to resolve urban effects. These include heathland sites in Dorset and Dawlish Warren SAC in Devon.
- 6.5 In many of these cases, mechanisms have been incorporated into Local Plans to mitigate the impact of visitors arising from additional residential development in the ‘catchment’ of the European Sites. Where it is concluded that it is not possible to mitigate the impact of urban effects, such as cat predation or dog-walking disturbance

of ground-nesting birds, an exclusion zone (to date this has commonly been 400m) around each European site is created where no additional development can take place. Such an exclusion zone around Burnham Beeches may be effective in reducing further visitor pressure on Burnham Beeches. Such a zone would need to be determined from the evidence relating to where most visits currently originate. A specific, limited exclusion zone relating to hydrology has already been established and set out in guidance produced by South Bucks District Council², and this guidance also sets out the need for Sustainable Urban Drainage Schemes (SUDs).

- 6.6 One of the other main mechanisms used to mitigate urban effects is the requirement for developers to either carry out actions or make financial contributions to actions which will mitigate the impact of their developments on nearby European sites. Developer contributions have been used to improve wardening and management of the relevant sites, or to fund provision of additional green infrastructure. Such contributions in other areas are collected under Section 106 Agreements or allocated through the Community Infrastructure Levy. The zone around Burnham Beeches from which such Developer Contributions could be collected would be defined so as to encompass the zone from which the majority of additional visitors are likely to originate. Previous studies have indicated that a 5km zone is necessary to capture 75% of visitors to heathlands (eg Liley, Sharp & Clarke 2008). Whilst any zone of influence is site specific and should be based on relevant local evidence, it is noted that two thirds (66%) of visitors travel from within 5km of Burnham Beeches (Liley *et al.* 2012). A zone of this order for Burnham Beeches should therefore be considered further.

Additional Greenspace – provision, location, funding.

- 6.7 In order for them to be successful in attracting visitors away from European sites, alternative greenspace sites need to be in the right place, providing the right experience and having sufficient financial support so they can be maintained and wardened into the future (Liley, Underhill-Day & Sharp 2009). If such an approach is adopted for Burnham Beeches, it will be essential to identify the best locations, and this will in part depend on where future residential development takes place. Identifying sites will be complex, due to the asymmetric visitor pressure - development is concentrated on the eastern boundary - and initial investigations indicate that there may be a lack of available land to provide additional green infrastructure on that side. One possible location would be at East Burnham quarry.
- 6.8 The Habitats Regulations Assessment for a major development proposal at Wilton Park, Beaconsfield, at 3km from Burnham Beeches recognises the potential likely significant effect of additional development on the reserve (ACD Ecology 2013). To mitigate for this potential impact, the proposed development includes 17ha of greenspace in its Masterplan. The other major development identified in South Bucks District Council Core Strategy is at Mill Lane Taplow. The Habitats Regulations Assessment for this

² <http://www.southbucks.gov.uk/CHttpHandler.ashx?id=4887&p=0>

development does not consider additional visitor pressure on Burnham Beeches, nor does it propose any on-site greenspace provision. While the 17ha of new greenspace proposed at Wilton Park may provide local benefits, it is advised that this is unlikely to significantly alter the behaviour of most visitors to Burnham Beeches. A strategic approach to the creation of green infrastructure would utilise financial resources from such developments at Wilton Park and Mill Lane to provide strategically located greenspaces where they would best mitigate the impact on Burnham Beeches.

- 6.9 There is perhaps scope for innovative approaches that differ from the 'SANGs' (Suitable Alternative Natural Greenspace) promoted in areas such as the Thames Basin Heaths. Measures relevant to Burnham Beeches could be targeted and very specific, given the site's small size. For example a long term aim of setting car-parking further back from the SAC boundary could have merit.

Restricting dog access within Burnham Beeches

- 6.10 Whilst measures can be taken to prevent any additional visitor pressure from building, other measures can be taken to mitigate for the impact of visitors already visiting the reserve, especially dog-walkers. Dog control orders are already available to manage dog access on publicly accessible sites³, and they are likely to come into force at Burnham Beeches. The Corporation of London is currently consulting on the option to use its secondary authority powers to implement Dog Control Orders that would require dog walkers to pick up at all times in all parts of the site and require dogs to be on leads at all times in part of the site.
- 6.11 At the moment it is not certain that the Dog Control Orders will be introduced, when they would be established and how effective they might be in reducing the impact of dog fouling. Even with Dog Control Orders in place it is unrealistic to assume that all dog faeces will be picked up by their owners. It may be necessary to consider whether dogs should be prevented from accessing certain areas at all times, such as in the vicinity of pollards, other ancient trees or areas of beech forest where tree health is in decline, but this may be very difficult and complex to instigate. If a strategic mitigation approach provided the opportunity to create additional greenspace nearby or even adjacent to Burnham Beeches, the implementation of Dog Control Orders could be used to draw dog-walkers onto this land, although the risk that additional greenspace will attract even more visitors needs to be considered and the right location is therefore essential.

Other Measures

- 6.12 As Burnham Beeches has to maintain full public access, it is not possible to use fencing to prevent access under the veteran trees, to protect them. Fencing around trees would need to extend to the periphery of the roots⁴ and in many parts of the site this

³ they have now been subsumed into the Antisocial behaviour, crime and policing Act (2014)

⁴ Typically 15x the diameter of the trunk or to the drip line, whichever is the larger (Lonsdale 2013)

would result in a large, continuous area with no access. Mulching and use of brash to protect soil around the base of trees is already undertaken by Burnham Beeches staff.

- 6.13 Soil decompaction has been undertaken to rejuvenate compacted in parkland (Kirkham 2008). Trees at Kew which have suffered from compaction are being restored using soil decompaction, mulching and exclusion zones out to their drip line. Whether this approach lends itself to the less formal conditions at Burnham Beeches remains to be seen, but even if it did prove effective it would need to be seen as one small part of a wider strategic approach.

Need for and type of Long Term Monitoring

- 6.14 Monitoring is essential to assess both changes in the condition of Burnham Beeches and to elucidate the causes of those changes. Monitoring currently focuses on tree health, lichens and visitor behaviour. A wider assessment of soil quality would prove beneficial, leading to a longer term soil monitoring programme. This would refine understanding of the relationship between tree health, visitor pressure and dog-walking.

Future areas of research

- 6.15 Recommendations for future areas of research were made in 2012 (Liley *et al.* 2012). Many of these recommendations have been followed, and their findings have informed this report. These suggestions arise from those findings.
- 6.16 More research is needed to further our understanding of the impact of visitors, especially those with dogs, on the health of the veteran trees, Beech Forest and the valuable wildlife associated with those features. If Dog Control Orders do limit access to certain areas, this will provide an opportunity to monitor changes in vegetation, soil health and tree health in dog-free areas compared with areas where dogs still have access.
- 6.17 A broader soil monitoring programme would prove beneficial, with a baseline for soil health established beyond the relatively small areas located near to trees monitored for tree health.
- 6.18 Visitor surveys will continue to play a valuable role in monitoring the changes in visitor numbers, origins and how their behaviour changes in response to measures taken on the reserve and elsewhere. A visitor survey encompassing a wider range of locations within the vicinity of Burnham Beeches would also aid in the preparatory work for identifying and creating SANGs.

7 Conclusion

- 7.1 Burnham Beeches is an internationally important site for wildlife, and this has been recognised in its designation as a SAC. But its special wildlife is declining; the iconic Beeches – ancient pollards hundreds of years old, are slowly dying and other Beeches' health is declining. Urbanisation in the area surrounding Burnham Beeches continues to place a burden on Burnham Beeches. Urban effects on wildlife have been recorded at Burnham Beeches, and these are principally caused by visitor pressure, especially dog-walking.
- 7.2 As a result of an investigation into the impact of urban effects at Burnham Beeches in 2012, The Corporation of London commissioned a number of pieces of research to answers some of the questions raised in the investigation. Soil health, tree health, visitor numbers and behaviour, hydrology and epiphytic lichens have all been assessed and these assessments have been reviewed along with previous work on the effects of climate change and air quality on Burnham Beeches.
- 7.3 We conclude that the combination of urban effects is currently impacting on the special features of Burnham Beeches for which it was designated an SAC. . New development will add to this impact and will clearly have a likely significant effect on the site
- 7.4 We recommend a series of actions to mitigate the impact of these combined urban effects, potentially including new approaches to development control within the vicinity of Burnham Beeches; SUDS, additional green infrastructure; application of dog-control measures and restricted access zones; a long-term monitoring programme; and future areas for further research.

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9 Appendix 1: Examples of Strategic Mitigation Schemes

This table is a summary of some of the different mitigation schemes relating to European sites. Each site is different and the approaches are different in each case. The table is an attempt to summarise the range of different sites, habitats and parts of the country where urban issues are being addressed through mitigation. 'Constraint zones' are zones where development is not promoted in local plans and is identified as areas where mitigation is not thought possible and therefore where development would have an adverse effect on integrity.

European Site	No. of Local Authorities	400m 'constraint' zone?	Other Constraint Zone?	Outer Zone for Developer Contributions	SANGS part of mitigation	Notes
Ashdown Forest SPA/SAC	4	✓		7km	✓	
Breckland SPA	4	✓	1500m			1500 exclusion zone of stone curlews. No strategic mitigation scheme but some consistency between LPAs, no developer contributions
Cannock Chase SAC	11	✓		15km	?	
Dawlish Warren SAC	3			10km	✓	Strategic mitigation scheme addresses 3 different SPAs (Exe, Dawlish and Pebblebeds)
Dorset Heathlands SPA/Dorset Heaths SAC	5	✓		5km	✓	Zones apply to areas that are SAC only
East Devon Pebblebed Heaths SPA/SAC	3	✓		10km	✓	Strategic mitigation scheme addresses 3 different SPAs (Exe, Dawlish and Pebblebeds). SANGs not finalised
Exe Estuary SPA	3			10km	✓	Strategic mitigation scheme addresses 3 different SPAs (Exe, Dawlish and Pebblebeds)
Langstone & Chichester Harbours SPA	13			5.6km		13 LPAs within 5.6km of the three Solent SPAs
Medway Estuary & Marshes SPA	5			6km		Mitigation strategy to be finalised. 6km zone suggested
New Forest SPA/SAC	5				✓	
Pagham Harbour SPA	2			5km		Chichester and Arun Districts have different distance bands
Portsmouth Harbour SPA	13			5.6km		13 LPAs within 5.6km of the three Solent SPAs
Poole Harbour SPA	1					
Solent & Southampton Water SPA	13			5.6km		13 LPAs within 5.6km of the three Solent SPAs
Tamar Estuary SPA	2					No zone for contributions, but strategic mitigation in place

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European Site	No. of Local Authorities	400m 'constraint' zone?	Other Constraint Zone?	Outer Zone for Developer Contributions	SANGS part of mitigation	Notes
						relating to development plans
Thames Basin Heaths SPA	11	✓		5km (7km for large developments)		
Thames Estuary and Marshes SPA	5			6km		Mitigation strategy to be finalised. 6km zone suggested
Thanet Coast & Sandwich Bay SPA	1					Work in progress to understand zone of influence and mitigation
The Swale SPA	5			6km		Mitigation strategy to be finalised. 6km zone suggested
Wealden Heaths SPA	2					400m referred to within E Hants plan but not proposed as a particular zone

