

# **A Climate of Change**

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## **Conference Report**

## About GreenSpace

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GreenSpace is the only UK charity dedicated to improving parks and green spaces. It aims to promote the benefits of parks to local and national government, agencies and the wider public.

As a networking hub and resource centre for the parks sector, GreenSpace organises conferences, publishes a magazine, Spaces&Places, and runs the GreenSpace Online website. It also provides support to a network of over 3,000 green space community groups. In September this year, it launches as a professional institute dedicated to the parks sector.

GreenSpace also works to promote the benefits of parks to the wider public. In April 2006 it published the first Good Parks Guide in partnership with the Royal Horticultural Society. This year also saw the first Love Parks Week, running between 18 – 25 June, which is set to become an annual event.

# Welcome

## Sir Richard Leese

### Leader of Manchester City Council

We are very proud of our parks and green spaces although our Victorian industrial legacy means that in some respects we are a very tarmacked place –something like 11% of our surface area is parks and green spaces, although the view from our tall buildings looks remarkably green because we do actually have a lot of tree cover that isn't within those parks and green spaces. The fact that we have 17 green flag parks is an indication of how seriously we take our green spaces but we are also looking to increase the impact of greenness, both by creating new parks and new gardens and go down to the other end of the city centre, see a space like Cathedral Gardens – a new green space created within the city in the last ten years, and just outside the Town Hall you can see where mature trees have been planted in the last 12 months. An ambitious programme of planting new trees and greening our streets all over the city. That's a start to the contribution we make – it's a contribution we all need to make. We certainly take it very seriously in Manchester, that's why we're particularly pleased to be able to welcome this conference here today as the parks and green spaces, they are part of a pleasant present but are also part of a sustainable future. I am sure you will have a very rewarding day today and the outcomes will make a real contribution to preserving our planet. Thank you very much.

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**Sarah Lindley**

**Spacial Analysis Specialist**

**University of Manchester**

**Keynote presentation: A Climate of Change**

Good morning everybody. I've been tasked with a fairly big challenge this morning which is to explain climate change and the human role in climate change all in a space of half an hour together with the impact on parks but I'll try and do my best with that. The first thing I want to say is that I'm not the only person that has contributed to the work that has gone into this presentation – the key person really is Susannah Gill, whose PhD is just coming to a close and whose work has contributed to a lot of the findings to the second part of this presentation and Susannah is sat over on the table at the front, if you could wave, Susannah, so that if there are any questions you can ask her as well as me. And some other people as well: John Handley, Roland Denos and Gina Caven.

I want to really start at the beginning so apologies if this are common knowledge to some of you but really just to make a few points about the climate system. Firstly, there are obviously a lot of influences on the climate system. Some of those influences are from within the system itself such as the building of mountain ranges that affect climate and some of them are from outside of the system so changes in solar radiation. So these changes, some of them happen over very long time periods, which means that there have been gradual changes to the climate over time over history but climate is still inherently variable over time and space. So we've not just got these particular factors that are affecting climate, we also have some interactions between various land cover types and climates so we see some interactions and feedbacks.

Now the key issue that is interesting at the moment is the role of humans in the climate system and particularly the role of humans in releasing carbon stores in fossil fuels into the atmosphere. So it's this atmospheric composition that is the key issue for the time being. I have talked about the inherent variability over geological time of the climate system but

there's also these changes that have taken a long time to actually appear with a climate signal. Since the last ice age, our climate has actually been fairly stable and we can see that over the last thousand years the grey line signifies the average temperature over the last thousand years, but if we move to the right hand side of the chart near to the 1900's, we can start to see that there is a rise from this gradual signal of the post ice age climate and the pink line represents what we have actually measured in the atmosphere for temperature.

Now, if we look at that pink line, we can actually create an average of the climate for the current base line. When I talk about the current base line, what I'm talking about is the period 1961 to 1990 so that's what all our climate change projections are relative to and there's a grey line which is actually fairly faint on the slide but I hope that you can see it, which represents the average climate for that 1961 to 1990 period. You can see that for most of the time during the past thousand years, the climate variability has actually been a little bit below that so that our climate has been relatively cool, but when we look at the actual monitoring you can see that we are actually rising above that line, so we are relatively warm compared to this 1961 to 1990 period. Then when you start looking at the black line, the orange line and the green line, which represent the climate projections from the climate model you can see that we are actually now getting dramatically over this average for the 1961/1990 period.

We have seen that climate is variable but what is the key issue, what actually makes this different? Well, first of all, it's because of this relationship to the human drivers and second of all, it's about the rates of change that we are actually seeing. Over the last few years, we have seen a rise of 0.17 degrees C plus or minus .05 deg C per decade rise which is apparently, according to the European Environment Agency, a faster rate of change that we have seen in the whole of this thousand year period. So this is really obviously giving evidence that something is happening.

So where is the link then to humans? Well if we look at carbon dioxide concentration for this same time period, we can see a very similar trend to that of temperature. Ice core analysis tells us something about the composition of the atmosphere over this thousand year period. Carbon dioxide concentrations you can see have been relatively stable like the stability of the temperature but with the onset of industrialisation, you can see that those concentrations started to go up and now we're at very high rates of change in CO<sub>2</sub> concentrations and those concentrations have obviously been reflected but with the time lag in the temperatures.

But still, it doesn't really tell us anything about cause and effect – there is obviously a relationship there that you can sort of make a judgement about but it doesn't actually prove that humans are actually causing the change. One of the reasons that it's complicated to make the link is because some of the elements in the atmosphere have a warming effect and some of the elements have a cooling effect and indeed human influences cause both warming and cooling, but what scientific research has found over time is that we are much more confident about the green house gas contributions and also pretty certain that they outweigh the cooling effects of other sorts of emissions to the atmosphere from either natural or from anthropogenic sources.

That still doesn't necessarily prove for everybody that there is a link so the IPCC ran a series of modelling experiments to look at this further and what they've run is a model that just looks at natural forcing effects and that's the diagram on the top left. The grey is the model output and the red is actually observed temperature in the atmosphere and on the top right just modelling the anthropogenic affect only so that you can see that it doesn't match the red and grey lines either. So the final graph at the bottom is the only one that actually explains the trend so here you can see the grey line and the red line match pretty well and this is what is actually been found by modelling both the natural and also the anthropogenic forcing factors.

So this has really proved to the scientific community, by and large, that this effect is real and this effect is partly caused by what we are actually emitting into the atmosphere. So that in a nutshell is really what we are facing, so we are facing the human drivers and we are facing the rates of change that are actually causing a lot of problems for natural systems to adapt to, semi-natural systems and also human systems. So what does this actually mean then for the UK?

Well to actually find out what it means to the UK, the United Kingdom Climate Impact Programme (UKCIP) was established in 1997 to actually run a series of projections for the UK to look at what the temperature and other climate parameters might be under future scenarios. So they chose four emission scenarios that match with the IPCC Commission's mock scenarios once used internationally and these really look at different futures for the world based on potential economic technological government decisions and forces. None of these scenarios are any more probable and really they are used to give a range of likely impacts that might be on the climate.

So these four emissions scenarios – low, medium low, medium high and high first of all, then the models are run for these emission scenarios in three time slices and you remember that I said that all the projections are relative to the current case and the current case is 1961 to 1990. So these three future time slices are 2020's which is 2011 to 2040, the 2050's which is 2041 to 2070 and the 2080's which is 2071 to 2100. The data that UKCIP produced relate to a 50 kilometre spatial resolution so its fairly crude for a lot of the UK for some of the climate parameters so because of this the baseline date of the spatial baseline data in the current year perhaps should have been used to map out finer spatial resolution for some of these variables so that actually allows us to get to 5 km for some of the variables of interest which is obviously very useful if you are looking for specific impacts to particular parks, urban areas or other areas.

So this is really what we are dealing with and this is what the majority of my presentation will actually deal with from this point on – these UKCIP 02 scenarios are based on that framework and there are various climate variables that actually come out of these models including temperature, precipitation rate, wind speed, specific humidity, relative humidity and so on. I have to say that some of them are projected with more certainty than others and temperature with relative certainty, compared with others like wind speed which the scientists are less certain about. The only thing I will need to mention additional to this before moving on to the climate scenarios themselves, is to say that by 2008, we will have a new set requirement output called UK CIP Next which some of you may have heard of and these are actually going to be based on probabilistic output so talking about frequency of specific events and some of the other issues that they will actually be dealing with is providing data to a finer spatial resolution which is obviously much more useful for us looking at specific impacts to fairly discreet areas.

So let's look at some of these changes then for the UK that have come out of the models. Well, first of all, looking at temperature, you can see that first of all, the thing that is most striking is there is quite a marked north west/south east gradient with temperature rises in the south east being larger than in the north west. By the 2020's, because of the inertia of requirement system, there is actually not very much difference with the source of temperatures that we looked at in the current baseline but you can start to see that by the 2050's and the 2080's, the changes are becoming much more marked.

We heard about the one degree Centigrade change that has now been reported and that's largely because we're almost at the 2020's climate

projections but by the 2050's we'll see at least one to one and a half degrees C increase everywhere across the British Isles and by 2080 it could be up to four and a half degrees Centigrade in the south east under the high emissions so quite a dramatic change in the average annual temperatures. We can see some seasonal differences, if I just put up the winter and the summer maps. The point here to make is that the winter temperatures will warm but they won't warm as fast as summer temperatures will, so we are going to see relatively hot summers and some warming of winters, but the same rate as we are going to see in summer.

Some facts and figures really just to put this in context – for the north west by the 2050's and 2080's, especially the 2080's – we are likely to see a completely average mean temperature in winter that means its above zero, so an average temperature above freezing. We are also going to see, if you remember back to the August 1995 heat wave, we are going to see by the 2080's that kind of event happening in six out of ten years rather than obviously being a very one-off event in our current climate scenarios and the amount of days that are over 31 degrees will increase from 1% to 11% under the medium high emissions scenarios. You can see that we are actually seeing changes in these average temperatures but we're also seeing changes in the extremes as well, so we are likely to see more and more of that over time. That's one of the things that the UKCIP Next will be looking at in more detail.

Those temperature changes obviously then have an effect on the thermal growing season as well so we can expect by the 2050's for example, under the low emissions scenario, we will see anything from 20 to 45 days increase in the thermal growing season and under the high emission scenario, 40 to 70 days increase. By the 2080's up to a 100 days more on the thermal growing season than under the current 1961 to 1990, so clearly that has implications for management of park lands.

Moving on to look at precipitation – actually precipitation is quite a complex issue to look at because its less certain than temperature and also if you look at the annual patterns, there's actually not that much difference, there's a gradual reduction across parts of the UK even under the 2080's high and low emission scenarios but that's actually masked something quite important. If we look at the average temperature precipitation change for winter, we will see that there is actually a big difference in winter precipitation so we are seeing very high increases in precipitation rates during the winter and we think that those will be associated with high intensity rainfall events as well but in the summer a big reduction

in precipitation so there will be 10 to 35% wetter winters and 35 to 50% drier summers so clearly more seasonality than we are experiencing at the moment in terms of rainfall.

This has an effect on soil moisture where we are expecting to see in an average year soil moisture being reduced by about 10% but again there are differences across the UK for that as well. The key thing here is that the trend is towards drying. That's a kind of whistle stop tour of some of the outputs from the UKCIP 02 scenarios. So what does this actually mean for green space?

Well, we've seen that an extended growing season is likely to occur and that some of the other climate rises are going to have an influence on changes to species relating to phenology, physiology and behaviour as well so we've heard in the literature that the Beech and Scots Pine are going to be less suitable for growing in this country. There are also going to be more issues, such as more insects, pests and disease to cope with – and those diseases and pests not only relate to green space, the plants and the trees in green space areas, but also to water bodies within parks, so the Environment Agency for example, have been reporting that there has been a big increase in algal bloom in water bodies, so that has clearly quite a lot of implications for health and safety. We also have problems such as drying trees and the soil causing subsidence and increased water demands during dry periods. Coupled with this, we also have increased demand for green space as obviously this is where human being can get cooling and as I look at the second half of this presentation, there is a need to look at the multi-functional role of green space as well. So to do that, I'm going to focus on urban green space.

Urban areas are important to look at because they are associated with climate extremes and also associated with particular microclimate effects and also changes in hydrology. So if you look at urban areas and rural areas, they behave very differently. I don't want to go into this diagram in too much detail but just to make the point really that urban and rural areas respond very differently in terms of temperature characteristics and hydrology characteristics and climate change is actually going to change those as well. This has an influence on the planning and management for green space because it gives both challenges and also opportunities and it's these opportunities that the adaptation strategies requirement change in the urban environment project was actually focused on looking at, so I want to talk about some of the opportunities and some of the threats in the context of this project.

The project was actually quite wide and as you can see, involved quite a lot of people but I'm going to focus on the urban green space elements of that project in particular. The aim of this was to look at the urban green space in relation to climate change impacts and to investigate adaptation strategies. This was done by looking first of all at characterising the urban environment, looking at surface cover and quantifying environmental functions in relation to climate change and it led to a detailed assessment of impacts and also the construction of adaptation strategies. We started off by actually mapping the urban environment using aerial photography delineating areas that we felt were biophysical units and would operate as discreet areas. We classified all of these into national land use database classifications including for more recreation such as golf courses and formal open space like parks and so on. We came up with a land use map for Greater Manchester that looked like this. What we did once we had this categorisation was to look at the surface cover types in each of these urban morphology units. This was done by randomly locating four hundred points in each of these UMT categories so for example for formal open space or informal open space and then deriving an average picture of what those units actually were made up of when you looked at paths, grass, trees and shrubs, so it gave us an idea of what an average parcel of formal open space or informal open space is actually made up of.

The reason we did this is we wanted to look at the transpiring cover as well as the non-transpiring cover and I'm going to call the transpiring cover – green area – and the non-transpiring area, the grey area for the remainder of the talk. This was very important to actually to use as an input into our models. The first model we looked at was surface temperature model and this attempted to quantify what the cooling effect of green space was and what that actually might do for adapting to future projections of heat in the urban environment and what we found when we ran the models was that we saw, as you'd expect, city centre areas were a lot warmer than the surrounding green space with a lot of transpiring green cover and this model allowed us to actually look at what the influence of adding green space might be to reducing this surface temperature.

If we take for example, high density residential areas, the grey dotted line represents the current base line surface temperature for that particular urban morphology unit type and the red bars represent if we add 10% of area of non-transpiring surfaces as grey cover so if we lose a park that's 10% of that area for example then we can see that the surface tempera-

ture in that urban morphology unit actually increases significantly over that base line that is represented by the grey line. If we introduce 10% of green space then we can actually see that we can keep the surface temperatures below that current line almost up to the 2080's so it's a very important cooling function.

So it's important to state that this is surface cover rather than air temperature but obviously there is a relationship between those two things and we would expect that doing this would actually give a good cooling effect for air temperatures. That also doesn't take account of shading and here is a graph showing the difference in surface temperatures with trees and where there are no trees, the shaded line being under trees. One of the issues that you have seen from the presentation is this issue with drought so one of the things we need to look at is what is a likely implication of the current scenarios for drought in urban areas on green space and what we looked at was the proportion of the time that the grassland will actually need watering.

Now I can't actually explain this in too much detail as I'm running out of time but really what we're interested in is assessing the portion of time where the actual transpiring effect, the actual cooling effect, of the grassland itself is less than it could be, so we are going to end up with perhaps more time with Piccadilly Gardens and other grassland areas, looking like this photograph here, dried out and brown – and if that happens, it's very important, because we lose the cooling effect of the urban green space. Just taking two examples of soil types in Greater Manchester, the grey line represents the current case and the grey dotted line is the point at which grass starts getting water stressed.

So you can see under normal conditions on Soil A on the left, we actually only have about a month where the grassland is under water stress, whereas under every other climate change scenario, we see that being increased to at least three months. So we are looking at at least that much extra demand for water to actually keep the grass land cooling and transpiring. There is obviously some differentiation with some of the different soil types and so this gives you a spatial impression in terms of what that means for water stress in respect of Greater Manchester once you've looked at all the different soil types and you can see that for some of the 2080's high scenarios, we're up to as much as five to five and a quarter months of potential water stress for the grasslands. That's the implication really for what we are going to have to do for water to keep the plants healthy and also to keep the cooling effect. What can we

do about this because obviously we have a problem as we need to get the water to water the grasslands and other plants in order to keep this potential adaptation strategy in place. We might have a solution in the fact of this extra winter rainfall.

Now we originally looked at rainfall from a different perspective altogether because we were interested in how green space could actually adapt against flooding, or too much run off in winter, so our studies looked at calculating run off as a function of green space and soil conditions and so on and we found that there were quite dramatic changes in run off as well from about 18mm with the top 1% of rainfall events through to 28mm by the 2080's.

So we looked at the potential contribution of green space to reduce this run off but actually this was quite disappointing in the fact that really there was only a little effect that we could find with different land cover changes, so even now land cover can actually reduce run off by about 20%, the actual increase in precipitation is going to far outweigh that. So that was initially quite disappointing but one of the things that comes out of this is that we need to think that green space doesn't help with run off. One of the things that we need to think about is the role that green space has for infiltration measures so this is a case for retaining our current green space so that we can reduce run off and of course importantly channel in that run off and keep it stored so that we can use it as a water source in the summer. All of this should be perfectly possible even at the scale of individual parks.

I will just conclude that climate change is already with us and I hope that I've explained fairly readily why we've come to the conclusions that we have. We are going to see hotter, drier summers and warmer, wetter winters and a higher frequency of extreme events. This leads to a range of issues for planning green space and managing green space and we need to identify and manage the threats that we have observed and ensure that forward planning for green space is climate conscious and that we can maximise these opportunities for wider adaptation. One of the important things is moderation of urban temperatures and one of the greatest threats to that is drought and so we really need to look at this storage of excess winter rainfall.

Thank you very much.

## **Andrew Tucker**

**London Climate Change Partnership Manager, Greater London Authority**

### **A city-wide approach**

Climate change at the moment is everywhere. Last week's Economist, the Scientific American and New Scientist all ran major articles looking at it. Pretty much all of this looks at mitigation. A quick definition, if you haven't been reading these things, there are two methods of actually addressing climate change: mitigation and adaptation.

Mitigation is the reduction of green house gas emissions through our activities and our design and our purchasing interaction and the adaptation is adapting to the climate change that is inevitable, the unavoidable climate change. The stuff that we have been emitting over the last hundred or so years has built up a buffer in the atmosphere and we actually have a dedicated time that we know we can expect some form of change.

That's kind of why we are here today because green space has formed an integral part of this action. I didn't realise just how complex things can be until you come to work in the London-based governance and planning system! It's incredible – it's quite exciting but the important thing is that climate change is actually now bringing together people who we normally wouldn't see sitting around the same table. It's bringing together a co-ordinated effect to get a common answer and you can address a number of different adaptation issues or agendas through the one process and that process is through green space.

I've been asked today to come along and have a chat about how green infrastructural green space, fits in with a city-wide planning. What we're doing in London now – the London Climate Change Partnership has a role within that and some of the planning systems that are in place are what we are trying to get over the next year or two. I will quickly give a very brief overview of climate change, particularly with London, and

provide a background of policy framework that we are looking at here, which is the London Plan.

I'll give you a case study example which is the East London Green Route – there are a number of people here today who may have been involved in this – Mike from Barking & Dagenham, Jennifer from the Corporation of London. It's a case study about how to actually go down through the layers of hierarchy and get a top down and bottom up effect to address climate change, water shortage, surface water run off, access ability, quality of green space and quality of life, through one simple project. Then I'll finish off with some global climate change partnership information and summarise that.

This is the same type of graph that you've seen with Sarah. I want you to concentrate on the black line. That was the heat wave of 2003, move a couple of centimetres over and you will have the heat wave of 2006 which was about the same. If you look further across you will see by about 2050 that might become the norm or even what we consider a cool summer. How do we adapt to that? We can stop green house gas emissions, and we'll still have to deal with that. Green space is incredibly important for this. This is the rainfall change for the south east of England. If you look across to June/July areas, we are expecting hotter and drier summers and a greater variability with possibly warmer, wetter winters. Now the greater variability means that your actions whether in a park or in a spatial planning sense or a strategic policy development, needs to consider this. If you walk away today with one thing, you must incorporate climate change in your daily decisions. You need to set a budget for the next fifty years, not for just the next year or three years because that's what your accountants have asked you to do. You need to consider everything.

Am I going to be requiring more funds coming in from revenue for maintenance, do I actually need to buy new infrastructure, incorporate greater water piping systems in my areas of responsibility? It needs to be embedded in policy as well. We are also looking at a sea level rise, a storm surge rise. London is actually one area in the world which is at a high risk of climate change – not only does it have a huge capital infrastructure which means that the consequences or actions are more, but we are also at higher risk of storm surges.

We had thousands occur across the sea in Holland and we are expecting these sea level rises and the intensity and possibly the frequency

of storm surge events also increase with climate change. How do we incorporate that? Green infrastructure is one of them that we are looking at now – how to do that? We're expecting warmer, wetter winters and hotter, drier summers. Seven of the top ten hottest years, especially in London, have occurred in the last ten or so years, expect that to be the norm now. Even if you are the most amazing sceptic on climate change, we still have hotter weather to deal with, regardless of what you actually decide is the cause, I still need to consider how I cope with it, regardless of where it comes from.

Rainfall then will become more intense, London is incredibly at risk of flash floods from storm water and surface water drainage problems. In fact, it's its greatest risk. Everyone talks of the sea, but London tidal defences are fantastic, and we suffer every single time a small intense rainfall comes down. Houses are flooded, roads are blocked, and storm water drain systems are blocked. I mentioned sea level rise and also tidal surges and a possible increase with winter storms with the predicted increase in winter rain.

Through the summer in a high emission scenario, which Sarah provided before, up to the 2050's, a possible three degree increase in temperature and a reduction during summertime of up to 40% rainfall, that's a lot to deal with. Where do I get that water from? How do I incorporate that into my management plans? How am I paying for it? And for winter you will see a slight increase in temperature and a possible increase in rainfall patterns. How is London vulnerable to climate change?

I have mentioned flooding and also the water resources. Thames Water has just taken back their application for a drought order. London actually gets less rain than Rome, Istanbul and Israel. We don't manage the water the same way. We still want to have our luxuries and we still want to use the same amount of water we've done for the last 100 years. How do we incorporate that and how do we make people aware of it in the first place? It's not all doom and gloom but we've got to get the message across.

I also want to talk about overheating later on, that Sarah has already mentioned, the urban heat island effect. The other ones are substance and heat, windstorms, and also the impacts of global climate change on our financial institutions.

There are three cities in the world, Tokyo, New York and London, with

respect to financial areas. Now what occurs elsewhere in the world also has an impact on here. We have banks, hedge funds, actuaries, insurance, and pension superannuation. They invest overseas – are they considering climate change impacts? Not only mitigation and incorporation for the next 100 or 200 years, but are they adapting and incorporating adaptation issues? They're at risk and it's all about risk management.

This is a quick summary at the bottom here of some of the things that have occurred in recent years that you have to consider how risky the process can be. One inch of intense rainfall shut down, on the 7th August 2001, London's five main line stations. These are the hubs for getting people in and out of London – business, tourism, leisure. That was shut down for the afternoon; nobody has actually calculated the monetary loss there but it's tremendous. We're talking about one inch of rain!

600 people died in London in the 2003 heat wave over and above the standard mortality rate that would normally be attributed to heat-related deaths. Over 16,000 died in France in the same month. Will this be the norm in 30 to 40 years' time? In 100 years' time will this be considered a cold environment? How do we incorporate this into our building design? People want to get out of their buildings and move into an open space. How does that incorporate greater pressure on management schemes in your areas?

A month ago, Oxford Street and the West End had a blackout because of a power surge. It was a hot day; it was just over 30 degrees, even hotter when you are inside an old building with a thousand different tourists. Air conditioning is becoming standard practice and we can expect to see a lot more of that now. We increase the energy, we use the carbon we emit from that process and we black out the city. Is this something we can expect to see over the next five or a hundred years? Yes it is.

The value of land and property in the Thames flood risk area – a huge proportion of London sits within the tidal flood zone of the Thames. The Thames isn't what it always used to be. Several hundred years ago it would have been three to four times as wide; we've brought that in now. We're fighting Mother Nature and Mother Nature wants to get the water back. How do we make space for water? How do we use the green infrastructure here to offset the effects, financial, physical and social impacts of flooding in homes? We only have to look at the evidence of Carlisle to see the impacts of that. They are still going through it now.

Within London it is estimated we've got about £80 billion worth of property within the tidal flood zone. Every day 1.25 million people live and work within those tidal boundaries. That's just the tidal and the greatest flood risk comes from surface water drainage. So pluvial and fluvial, the stuff that comes down the rivers systems, down from rainfall events onto a hard infrastructure. London's run off co-efficient is very high, so basically if you have a run off co-efficient of one, means what comes down onto the ground, runs off the ground, that means I've got to hold that water somewhere. How are we actually using our green spaces to do that? Are we considering that in our initial design or more importantly, are we even looking at it actively now to say I've got these green spaces right in front of me, are they holding water instead of it going down into someone's home or down into someone's business. If they're not, why not?

As I mentioned before about the value of the financial standards within the town itself, at the moment the London Climate Change Partnership has a financial group and we're getting together the heads of people like HSBC, Deloitte, Price Waterhouse, the University Superannuation Fund which has 14 ½ billion pounds invested in the future areas. Get them around a table. I know you are considering mitigation and how to reduce your green house gas emissions but are you asking your people that you invest in, give money to, to actually consider are you adapting? Are you minimising your risk for future years?

Green space is a key component of that because it does so many things there. Sarah mentioned ten minutes ago about the value of multi-functionality. We need to stop looking at our parks and green spaces as a park and a green space. Think pound sign – that's exactly what we need to do. These are multi-functional pieces of land; they can do more than one thing that we've considered over the last 50 to 100 years.

The map on the right is the indicative tidal flood zone for London – those red dots are our tube stations and there are about 64 of them actually lying in the flood zone although they are behind very good barriers and high defences but it is something that has been considered for a long time and how do we actually do that. In a survey some time ago 30% of Londoners said that during a flood, they would go to the Underground. That occurred during the Blitz, slightly different driver, however these are the things we've got to get through and it comes down to communication. Out of all these different things you look at whether it's a spatial planning or a financial planning, whether it's an actual physi-

cal on ground effect of changing or incorporating your open space into your management schemes, the most important thing is actually communication. To get the right message through.

What we're also finding out now is that things like this are also acting as a bit of a scare tactic; putting people off and making sceptics. You've got to remember that we are not here to actually preach to the converted so when you leave here, your target audiences generally don't speak the same language as you. The only language that is generally considered across all fields is money, so turn your actual systems into pound signs, money, long term investment, revenue.

The bottom part is what we have to consider every single day – climate change will increase the probability of risk. However we are actually increasing London's population and built infrastructure investment, therefore we are actually increasing the consequence so a simple risk matrix comes out showing this is a pretty bad thing. We must actually address it from the very start. It's expensive to do but it's cheaper to incorporate it now during the planning process than during a retrofit, however 95 to 97% of our infrastructure is built already.

We always have to consider actively – can we retrofit this problem? This is another graph of the urban heat island. Next month we will publish the urban heat island study for London which shows a bit more detail but this is just a rough shot of modelling that's done. If you can envisage a map under it – the two red spots in the centre are central London. You've got areas such as the Bridge Museum, the Baking district, you've got tube stations such as Bank, Piccadilly Circus and across to Victoria on the left hand side. You can see the heat intensification there – the graph on the outside shows the actual changes in temperature.

London generally experiences the hottest temperatures in the country regardless of the variations in general climate distribution. Now the two points there are the cooler areas which are the park systems, so you've got places like Regents Park, Hyde Park and Richmond Park. Straight away they have a cooling effect.

The urban heat island effect in London is quite dramatic; it is the major contributing factor to our 600 deaths in 2003. In some month's time we'll get the figures back for 2006, we won't have as much mortality because we are actually a little bit better prepared for this but this is going to be the norm. London actually has the highest number of heat-related

deaths in the UK because of this factor and you also have to overlay that with the index of social deprivation and you pick out the more vulnerable communities – the elderly, the homeless. Where are they sitting and how that does reflect with our urban heat island effect? Can we actually implement planning or active retrofit now to reduce that risk?

Green space is one of those areas – are we talking green roofs – are we talking a sustainable drainage system along the pathway there? Further development will only intensify this effect and that's something we have to be mindful of right from the word go.

Within a policy framework it comes under basically one thing – the London Plan- and it falls down to the regional spatial strategies and Boroughs to implement their local development documents or local development frameworks. Climate change is being embedded in the new London plan. The updated version is being written now, it's for the further alterations of the London Plan – during that process of review a further 23 policies (as if we didn't have enough policies) - the majority of those are climate change focussed.

We're embedding climate change considerations in everything we try and do because is just such a risky process for us. We're incorporating both mitigation and adaptation issues into the policy framework. The DCLG, has issued new powers to the Mayor of London, and two of those new powers will be climate change strategies and the idea is to go to a statutory process. We're still working out what that actually means both financially and legally but we are producing climate change and energy strategies during the next year and a half. The London climate change adaptation strategy is most of the way there. It's going through a sustainability appraisal right now.

The idea is to make London an exemplary world city in mitigating and adapting to climate change, and a more attractive well-designed green city. We have a lot of green spaces but it's the quality of those we have to be looking at. The London approach to climate change is both mitigation and adaptation. It's not just an environmental challenge, we've got to get away from that and not preach to the converted. This is an economic and social problem.

Policy frameworks in green infrastructure – how it all fits together there and the London plan recognises the value and benefits of green space. Sarah said it perfectly earlier on – multifunctionality is the way we have

to look at this process here. How do we get one piece of land and different players to achieve our multiple agendas? We can do that, it's been done before, inside the UK, inside London, inside Manchester and around the world. The information is out there, we don't have to invent this as we go along. We need to get the best bit of information that is out there and design it and cater it to your area of interest.

Further alterations on the plan will show that green space has provided a role for mitigation and adaptation in climate change – that's a key thing; it's like the first line that's there. It's protecting biodiversity and reducing flood risk. We have an incredible flood risk in London. All major developers should be expected to incorporate an element of open space to make a positive contribution to the wider network.

I'll go on to a system called the Eastern Green Grid a little later on to provide a case study of how it has been approached on all different levels – on a local level of delivery and a partnership level, on a regional spatial strategy and incorporated in the London Plan.

The London Plan uses an open space hierarchy; typically this has been a simple process of just allocating different types to different definitions of open space according to the size. If it's a regional park, it's this big; if it's a local it's that big. We are changing that now – we are trying to get away from the size as we don't have the luxury of brand new open spaces to be able to say, well I want to put biodiversity space over there, I want to put a surface water management space over here. We just don't have that room – London has been developed for quite some time so we have to make better use of what we've got so we've got to try and change the definitions to incorporate the space you've got available to you.

This also sets the guidance for sub-regional frameworks and also the borough's Open Space Strategies. This is London open space strategy and actually looks quite similar to the Manchester map but what it does show there are the open spaces in the green up to a certain size and it picks out metropolitan park lands. This is just one example of the many different maps you are going to have there. .

You also pick out areas of deficiency. So how do we use simple processes like this to affect our planning? We also should be talking, you gauge your argument, to the potential funders of this thing. You've got deficient land there, we can reduce that deficiency to the local community. They are considered as vulnerable areas so how do we actually imple-

ment it there? Let's concentrate on actively getting a physical change on the ground in those locations.

On a sub-regional area, this is a map of London stylising and on the right it shows the eastern and green grid. Now it falls in the area of Thames Gateway which is Europe's largest focus on regeneration. These numbers change pretty much from day to day and I'm pretty sure by the time we get out of here this afternoon, those numbers will change again. However we are looking at 157,000 new homes by 2016 and well over 350,000 new jobs within the area. This falls in London and all along the Thames itself. Most of this area falls within the high risk flood areas of Zones 2 and 3, according to the Environmental Agency.

It's essential to incorporate high quality multi-functional green space; that's exactly what the green grid is trying to do. One of the most important things is improved surface and water storage management. How do we actually use this area to hold water instead of it running into someone's home? That's a stylised map of the Eastern and Green grid, this is Canary Wharf, the fastest growing business area in Europe. So there's a lot of focus on the area. Now the green grid is split up into certain areas to actually deal with the physical mechanism to get change done on the ground. Our vision is to improve access connectivity, open space quality and also incorporate this with the development that has been proposed in the area.

Multi-functional – let's go and pick out a couple here. Surface water management; its reducing our residual risk and it's also, the one below, adapting to climate change. It's a key component to reducing our urban heat island effect. That's exactly what we should be pushing there.

On a city-wide approach, it's a single programme to actually address and improve social, economic and environmental values, all in the one bag. What this does, is open up to different funders, different targets that you would not necessarily associate with green space and that's what we should be concentrating on now. It's embedded in the planning process and also policy frameworks and down the bottom there, it widens the target audience to improve the actual financial support that comes to it.

I think if I mention one word here – revenue, yes it's the hardest thing to find – probably the most important thing to find to keep this process going. Dealing in issues such as climate change, surface water management, opens out the areas for potential long term revenue and pepe-

tuity. That is a map of East London and there is Canary Wharf and the Olympic sign is about half way up there. That is the residual flood risk map for East London and we are also looking at the biggest regeneration site of brown fill areas and new development in Europe.

It's all sitting within the highest flood risk zone too, so there are also issues about planning, design and construction around that but how do we use our green infrastructure? Where is our green infrastructure? Where are our green spaces and where aren't our green spaces? Are they being used for holding water – are they being used to displace water or being used as a sponge for the public realm? Are our chief executives for our planning authorities aware of it and are they pushing it from the top down, if not, why not?

This is a quick example and I'll finish off here. Chimbroom Meadows is a project by one of the local Boroughs and the Environment Agency that incorporated digging concrete channels that had gone through an existing park creating a natural meander, that's the area now. What is did do is a number of things. CABE Space published some research a year and a half ago, Does Money Grow on Trees, actually adding a financial value to green space. This is a shining example – house prices in that area have gone up because the quality of the green space has gone up, residual flood risk to the area has gone down and the insurance premiums have gone down because the water wants to go there instead of their homes. It's a higher-quality space and the usage has gone up and biodiversity values have gone up. About five or six different key agenda items all with different types of audiences done by the one project, that's what we should be concentrating on.

Quickly now I'll finish up on the Climate Change Partnership – we've got about 30 private and public voluntary area groups sitting within the actual partnership itself. Our aim is to help London prepare for inevitable or unavoidable climate change, so we are just concentrating on the adaptation issue. There's no point in reducing our green house gas emissions or mitigating climate change if we are not even going to be dealing with surviving certain parts of the climate change we can't stop. It's a dual effect, there are overlaps which we should be looking at as well.

Current work streams – we are looking at finance, transport and new development as a key component and also in future there is retrofit. How do I retrofit in an open space area, built infrastructure, commercial installation, to deal with this; to minimise and adapt? It's harder to give a

physical adaptation component of it – it's easy to do the policy stuff first which is exactly what we are concentrating on there and halfway down there we are trying to ensure London's growth also goes along to reduce our climate change risk. PBS25 is a component of that which is planning policy statement No 25, the Environment Agency, Development of Flood Risk.

At the moment it is asked that new developers not only manage flood risk using green spaces as one of the primary areas for that but it should show a reduction in flood risk. We have just published a document called Adapting to Climate Change: Lessons for London. It's a case study compilation of some examples. Tokyo is promoting and using green space to reduce their urban heat island. Seattle is actually using green space along roads to reduce surface water run off and insurance premiums, and also beautify the area.

In summary, green space offsets the urban heat island and enhances the permeability of the urban realm. I'm just going to the very last two things here. Opportunities for parks are there to communicate the key issues. It's the one thing that everyone understands and can appreciate. Use the park system as a process to getting through to all your targets and change the funding priorities climate change.

Thank you for the opportunity to come and speak and best of luck for the Ashes!

## Question and answer: session 1

### Question 1:

Everything to date indicates that we are getting hotter, but what happens if the Gulf Stream switches off because I gather then there's a prospect of a climate like Sweden or Russia?

### Answer 1 (Sarah Lindley):

The climate scenarios do actually take account of potential cooling of the Gulf Stream so it is actually taken into consideration in the projections that we are looking at. Importantly, though, the probability of it actually switching off altogether is extremely low, so it's much more likely that we are going to be dealing with a warming world than with that kind of very cold scenario.

### Question 2:

I'm a little bit puzzled by the dichotomy in the conference today between parks and green spaces and, picking up one of Andrew's points, to what extent are we talking about the wider network of open spaces as opposed to parks specifically when we look at these impacts? There are big chunks of very hot areas in London which presumably can't be changed by focussing on parks, there has to be some other kind of green space as well.

### Answer 2 (Andrew Tucker)

In a lot of the areas within London, and any sort of urban area of course, you don't physically have the space to have an on ground change of land use incorporating a large quantity of green space. Green roofs are a key component of potential there. The other one is the materials and the design of our infrastructure itself. There's a lot of work going on now from a number of different agencies, government and private, looking at the types of material that provide greater absorption and reduce the amount of reflective radiation.

The other component is how we manage our green space, whether its new or existing. Last week we got new SAT photos of London for this urban heat island study and it shows the parks during the hot time in August and July, where we pretty much had a drought. Did anyone see the photos of Hyde Park and Regents Park in the papers around that time? They were really dramatic. It showed Hyde Park pretty much on the front of every paper, and you could have sworn it was in the middle of the Australian Outback or in the middle of Egypt – it was bone dry and during those times those green spaces act as the biggest storers of energy and causes of the urban heat island, so it comes as a double edged sword. They also have the potential to reduce it dramatically if they are managed correctly and they can also add to it if they are not.

Question 3:

I've been in parks management for a while and we've heard the many integrated benefits of high quality park management. In this case how do you make the key beneficiaries, which are often in increased house prices and reduction in insurance premiums, actually pay for doing all the capital works to create these benefits in the parks that you have shown?

Answer 3 (Andrew Tucker):

I've no idea is a straight answer and I think we've got a few challenges in front of us.

I was at a talk last week about the Olympic legacy, which everyone has been talking about, at which the question was posed by the speaker, not a member of GreenSpace, I hasten to add, who said that he wondered whether or not the Olympic Park, as it was currently laid out, was too big. Did London need another piece of green space that big? So I think we've got some campaigning to do as a group.

We've got to try and balance these pressures and probably we've sat back a little bit and seen what it means from a park management point of view, whereas I think from what the speakers said this morning is that actually our responsibility is wider than that and we've got to try and get that message out to local people and also to people who make the decisions on things like the size of the Olympic Park and so on. Does that answer part of your question?

Reply:

I just think it's the same old chestnut we've heard – health and education, those benefits of parks have been realised and a lot of good park managers have been bringing those in but you still get very few crumbs

from the education or health budgets and I think that the financing is absolutely key here.

Reply:

But isn't that a call for more campaigning from all of us?

Reply:

Yes, I think so – I mean we're back into getting some statutory or legislative mechanisms that force developers or other people who are gaining these benefits from our parks, to actually put the cash up to start with.

## **Andy Barnard**

### **Manager, Burnham Beeches**

### **Planning for climate change**

I'm going to try and start off doing two things, the first one is to tell you a wee bit about the organisation that I work for. That is the City of London, what it does and why, and what it's doing about climate change. The main part of the talk is about Burnham Beeches, the site that I manage, the impact of climate change on that site, the mitigation, the research, the monitoring and the adaptation that we're doing to manage Burnham Beeches.

So, the City of London – what is it? Well, it's the local authority for the square mile. It has a Lord Mayor, it's not Ken Livingstone, it's the Dick Whittington type Lord Mayor, the one with the black cat. We have a franchise of about ten thousand people who live within the boundaries and it also provides local government services to the commercial, financial heart of Britain. It has all the usual local authority functions and responsibilities including a police force, education and open spaces and if there's one thing you should remember about the City of London, it is that its been around for 900 years.

The open spaces came to the City of London at the turn of the 19th century around about 1880 – it acquired several large pieces of land, most notably perhaps Epping Forest, and it acquired this land because it was concerned that there was nowhere for people to recreate. Having acquired Epping Forest through its own Open Spaces Owner and Forest Act, it went on to form an Open Spaces Act that allowed it to buy land like Burnham Beeches 25 miles from the city centre. The City now also owns places like Hampstead Heath and Queens Park, some amazing open spaces, amounting to about ten and a half thousand acres.

Following on from Andrew's talk earlier on, he was talking about the London Climate Change Partnership, well the City of London sits in the

heart of all those issues and its working hard to try and adapt to climate change. Currently it is devising its climate change strategy along with the London Climate Change Partnership. It's been instrumental in establishing the UK's first Emissions Trading Scheme and it's offsetting for example Co2 from office and members travel.

Now it's a moot point whether those things work or not and I would be very interested to hear some views later on. It has invested heavily in the renewable energy market; most of its buildings are from green energy sources. It's also using the combined heat and power to make energy production as efficient as possible. So that's the City, that's the organisation that I work for but what's dearest to my heart is Burnham Beeches National Nature Reserve.

Burnham Beeches has been owned by the City of London since 1880, before which it had been owned by one family and managed as wood pasture for about 600 or 700 years. Wood pasture is where wood production from the trees was managed by pollarding or coppicing and we also had grazing animals underneath that were providing food and fleeces and other goods.

Burnham Beeches is 540 acres, it's a square mile in itself, but it has 500,000 visitors each year which makes it the second busiest national nature reserve in the country. It's been an SSI (Site of Special Scientific Interest) since the 1950's and a NNR (National Nature Reserve) since 1993. Importantly, it is a special area of conservation.

I thought I'd throw this in to give you an idea of what a square mile of woodland looks like, it's most of the stuff under that grid. It give a fair impression of where Burnham Beeches in Buckinghamshire is, and what surrounds it to the north and to the east and to the west, it's largely rural but to the south you only have to go a mile and you bump into Europe's largest trading estate, good old Slough Trading Estate. You don't have to go much further to bump into the M4 in one direction, the M40 or the M25, so it's sat in a very busy area of the south east of England.

The site itself has very many habitats - I've mentioned the wood pasture - and now we have about 470 of these ancient trees, these ancient pollards of which 85% are beech and 15% are oak, and we know that since the 17th century, these numbers have diminished hugely and today we only have about 460/470. I'm bringing these issues up because we are learning from these old trees and it's quite interesting what we are

finding out. Burnham Beeches isn't just about beech tree management, we also have heath lands, we have Buckinghamshire's largest wetland, the Myer system, it's only a few acres, and that says rather more about Buckinghamshire than it does about the quality of Burnham Beeches wetland but a good assemblage of animals, of bats, of invertebrates, of amphibians, of birds and reptiles.

But it's these guys, the things that generally make people go "yuk", that are most important to the site. Burnham Beeches is full of dead wood, trees that are rotting, standing up or lying down and over the centuries lots and lots of species have moved into those. So for example we have 63 Red Data book species of insects. We don't just have Red Data Book species, in our research we find we have species that are new to science. Things that have never been seen before, which is absolutely amazing, just in the last twelve months and other things that are there, are things that you are likely to walk over and not notice. Things like the mosses and lichens. I've mentioned the 500,000 people and they are also having an impact, so I provide this for you as background to bear in mind as I progress.

We are working to a five-year management plan, nothing new there, most people in this room will be doing the same. This is the fourth incarnation of our management plan. The current one is based firmly on the principals of sustainability, the first one hadn't even heard of the word because it hadn't been invented in those days so we are moving on. But for the first time this management plan is making a direct reference to the potential impact of climate change on Burnham Beeches. It also contains some very broad projects that will investigate climate change issues and interestingly we have a five hundred year vision for this site and we don't have that because we are in competition with anybody who has got a hundred year vision, which is always very impressive.

We have it for one reason and one reason only, our ancient trees will generally tend to last about five hundred years. If we don't have a vision for what we want the site to look like in five hundred years, how are we ever going to get there. So it does some fairly simple things, this vision. Firstly we aim to provide an attractive and varied landscape with grazing animals; in other words, exactly what the site has been groomed for for the last five hundred years, it's not exactly rocket science I suppose.

But we want to make sure that visitor activity is managed to enhance enjoyment but to prevent harmful impacts, that gets more challenging

and then moving into the climate change issues more directly, the site will form part of a larger network of green spaces to allow migration of species across the UK and a place where harmful pollution, whether it be Co2, whether it be local impacts, whether it be general impacts, is no longer of concern. We on the site, and the City of London in general, are carrying out long term monitoring that has contributed to the international debate and action on major ecological issues including climate change. So that's our vision for five hundred years.

Because I manage beech woodlands, most of what I talk about is going to be about beech trees, but that's quite useful because they are a very good indicator of what the impacts of climate change may be and you will be pleased to know that this is the only slide I've got with tiny little figures on it. Just concentrate on the top left hand map of the UK there, those black dots at the bottom show the natural range of beech at the moment, so it's largely in the south east and the south west of England.

If you look at the bottom right map, that's climate change with a high Co2 scenario, which we heard about earlier on this morning by 2050 and what that is showing is that beech's natural range has moved very firmly northwards and westwards and to some extent on the east coast and to the south west, but where it isn't, is in its strongholds at the moment, the beech woodlands of the Chilterns and the Burnham Beeches, so we have a problem and the trouble with this scenario is that's the one we are heading for right now and if we don't do anything, this is what we got to plan for.

So we have lots of threats around the Beeches. We have increased traffic levels, we have air pollution, we have increased urbanisation, we have Heathrow Airport, you couldn't really throw much more at an SSI than Burnham Beeches does have. But what it does make it because of its small size and its compactness in one respect, is that it's a very interesting laboratory to examine the impacts of climate change and other changes that are happening to our environment. So we know a few things, well we think we do, about climate change and how it will affect a national nature reserve like Burnham Beeches. It's already been mentioned that the experts are saying that we will have hotter, drier summers and warmer, wetter winters.

That top left hand slide there shows the beech canopy this summer. It looks more like a winter shot really, the only bits of green are largely the birch trees and the bottom picture there shows our ponds, which are

about two feet lower than normal, which is not very healthy. How this affect beech trees? Well we know that drought episodes are increasing and we also know that the drought episodes on beech trees are cumulatively harmful but it's OK having a drought now and again.

A beech tree, like most species, will recover to some extent or another, given time. The problem we have at the moment is that the drought episodes are happening so frequently that the beech trees can't recover so their health is declining. The other seasonal problem is that winter flash flooding is also a problem for the beech trees. Most of you will have seen a beech tree root when it has fallen over - it's about 70cm deep - and it can actually access soil down to about two metres deep without having any root structure down there because of the way moisture moves through soil. Its also very susceptible to very swift rises in the water table so it doesn't like to have its roots too dry but it certainly doesn't like to have them too wet either, so it's a double whammy for the beech tree. It's going to push it out of its natural range simply by being too hot at one time of year and too dry and too moist at the other time of year.

Already we have mentioned pests and diseases this morning, I hate those terms because a pest is a subjective term in many ways, I'm quite tolerant of pests in woodlands but there are number of issues that are beginning to occur. We've lived with our good friend the grey squirrel for many years and the woodlands seem to cope but couple that with drought episodes and winter flooding episodes, and the addition of grey squirrel damage, which you can see on a young pollard tree here at the top, kills the tree. We are also concerned that species and diseases will migrate. This year's disease seems to be the horse chestnut, last year or two years ago its was Sudden Oak Death and I think we still have to hear a lot more about that particular issue, I think that one's only just got going.

But just those two issues, they're two things we know about. What else will come across from Europe, from America, we have no idea at the moment really. I do wonder whether we need to redefine pest species. Years ago, when I first started in this business, sycamore was decreed to be a terrible pest and must be chopped down in all circumstances. Nowadays I would argue differently, it's not a pest, it actually may have a great deal of use under certain circumstances because of climate change. It's also been mentioned that there are likely to be more storm events and there's a bit of a problem with storm events in woodlands, particularly woodlands that have half a million wandering through them

almost every day of the year; storm events tend to make trees cast their branches. So does drought and so do grey squirrels, and we are trying to manage these woodlands safely. We have a legal obligation to keep them scientifically interesting and we also have a legal obligation to maintain them as safe places for people to visit. And that is going to be, I feel, an increasingly difficult balance for us all, as park managers, to actually maintain.

And then, of course, drought and heath lands don't necessarily go together very well. Heath lands quite readily accept management by fire but they don't like too much of it, and with much drier heath lands and wetlands that are turning into heath lands, there's every chance that fire will become a major detractor of heath lands in the south east of England. I was talking about the pollards earlier on and the older beech trees on the woodlands. We know that there is a clear decline in beech tree health across the south east of England, but we've also learned from work that we have been doing at Burnham Beeches that small increases of Co2 appear to be helpful to the old trees. But we also know that if it gets above a certain level, it appears to be harmful to all trees, whether they be pollards or not and the theory behind this is that when you cut a pollard or a coppice, the tree immediately goes into its growth spurt and it starts to utilise Co2 as energy, and in that way it copes, it rather demands Co2, but the moment it gets mature, it needs rather less and that's why we're seeing, we think, the decreasing canopies in very mature tall beech trees, but not so much in pollards and the younger trees.

We are doing a few things as well, we know what one or two of the problems are, and Andrew earlier on said that the thing we need to do is to get out and spread the message to people and I think as open space managers that's one of the most critical jobs we have to do.

This slide shows that we converted the features on the top left hand side into the ones you can see on the right hand side. Now that building contains lots of interesting and useful messages to our audience. It uses all the old buildings that were there originally; the old saw mill, the old portal frame, that green shed on the right. They are still there under the skin. The skin of our building is oak from our own forests. The insulation is newspaper, the roof slates are recycled roofing slates. Those stories are important, they're easy to say but not so easy to demonstrate and when people see them there's nothing better than connected learning.

It also produces its own energy, so hot water and electricity are produced by the building and in sufficient amount that when we are producing electricity we can put a wee bit more back into the grid and we've reduced our energy bills phenomenally and that's at least taking into account some of the rises in energy costs recently. So that's a very pragmatic way in which we are trying to do it but we have also looked at our own management in some detail as well, when we are out in the field. We used to have a very large vehicle fleet; we've looked at that very critically and we have reduced our tractor fleet from three to one, we've reduced the size of our vehicles wherever possible and the type of fuel that they are using. So we now have vehicles that are on liquid petroleum gas for example, and have balloon tyres. Again not rocket science, lots of people are doing this.

Woodland managers love to do one thing and that's burn stuff. Nowadays, we do it very little. We are well aware of the impact that burning can have. We generally do it for one material only, and that's for our good friend, the rhododendron. When we do burn, we put it on a burning platform so we are not destroying the forest floor. We have been conservation grazing these characters here, the sheep in the bottom left hand corner, for the last 15 years. Extensive conservation grazing over large areas is a brilliant management tool and we are putting a lot of energy into trying to make that a reality. We are doing that very locally at the moment, but it does maintain natural systems and when you are managing woodlands that have had grazing for hundreds of years and all the flora and fauna has adapted to that then keeping grazing animals in a sustainable and extensive way in the woodland system is vital and helps mitigate climate change.

We are also having to look to the number of people coming to the site. The theory is that numbers will increase – my experience at the moment is honestly the other way around. When it's stinking hot as it has been this summer, the site has been very empty. I think that people need to learn the trick that actually the woodlands are quite a few degrees cooler in the summer and when they do learn that trick I think they will start to come out in droves so what we are having to do is manage our pathway systems. There is open access wherever you want to go on Burnham Beeches 365 days a year but most people are creatures of habit and they want to walk in the same places so we are beginning to harden those paths and provide boardwalks etc.

I feel one of the most important things that we are doing is back to this message of convincing people. I spend a large part of my role now not necessarily thinking about issues directly at Burnham Beeches, but the things that are going on around it, and that means trying to influence local and regional development plans and policies so getting in there with the south east of England plan, telling them about the importance of our green spaces in terms of mitigating and adapting to climate change, implementing the EU habitat regulations.

These regulations give us a very special power if you're an SSC. Any plan or development that somebody want to make around Burnham Beeches, they have to carry out an appropriate assessment and prove beyond reasonable doubt that it won't have a harmful affect. It's proving rather less useful that I'd hoped initially but the message is getting across to developers that you can't just go and use the best bit of countryside and make the most money out of it. You've actually got to show that it won't have a harmful effect and in that way we are slowing down some of the worst planning decisions that are being made and we are also putting a lot of energy into local transport. When Burnham Beeches was acquired in 1880, unless you happened to live next door and very few people did in those days, the only way you could get there was by public transport and they did, they came in their thousands, they came by train and in charabancs, and that all changed in the 50's and the 60' s with the advent of the car.

The roads around Burnham Beeches used to be drover roads for all the grazing animals that grazed across the heath lands and the woodlands. They've now become the rat runs as people try and avoid the trunk roads, quite understandably in some cases. What we are trying to do is to get rid of the rat running that is going on and give the roads back to the people that can make the best use of them. The visitors to the site, give them the opportunity to come to Burnham Beeches by foot or by bicycle or by car because although we have 500,000 visitors, we have 300,000 visitors who come by car, and most of them live within a mile or two of the site so they could walk here if conditions were right. They could catch the bus if the bus services came close enough, but they don't at the moment so we are trying to invigorate the public transport system as well as take control of the roads again by putting on vintage bus events, and they are probably the most polluting vehicles you will ever see on the road but they do draw people in and they get them thinking about how they are getting to Burnham Beeches.

Andrew mentioned the Green Grid this morning, there is another initiative going on in the south east of England and indeed in other parts of the UK, and that's the Green Arc. The Green Arc is another partnership project between land owners and land users, be they government or non-government organisations or private individuals, and the idea is to pull together all the bits of green space, rivers, woodlands, parks, you name it, and try and make them a cohesive unit, so that they link from the metropolitan boroughs right out into the wider countryside, which around London, includes the South Downs, or the Chilterns AOMD.

In that way Burnham Beeches, back to that 500 year vision, can be part of a wider network that allows species to migrate, because many of those bugs and beetles I showed you find it very difficult to migrate, and without those channels they are never going to do it. Another thing we know a little bit about is although some species can adapt to this wonderful climate in the north here, a lot of them can't, so we will lose them permanently. We must try and manage for that.

There is one other audience as well and often it's the most difficult in some ways and that's our frequent visitors – people who come into the countryside a lot and think they know a lot about the countryside, and some of them do but they are not often switched on to the issues of climate change and how the site that they are on is being affected by it and I think sometimes that also applies to staff as well. We are spending a lot of time and a lot of money monitoring what is going on at the site, we have a meteorological station that feeds into the national network, we are monitoring on lichens and there again, there's international research, of which we are a part, to discover how lichens are reacting to Co2 levels and we are measuring our water table.

If you do one thing as a site manager or a director, get people out measuring their water tables and find out what is going on. We are liaising and we are learning and we are hosting and attending conferences like this one, we are working closely with other organisations and we are feeding that monitoring result into national networks. Wherever anybody will listen, we are trying to get that message across.

To conclude, there are several adaption options available to the beech woodland in the south of England. We can accept the loss of beech in the south and the south east and tolerate whatever replaces it, that's a simple answer. Or we can enhance regeneration, we can try and get it growing everywhere in the south east in the hope that it clings on some-

where, and it might do in certain areas. We could try and select new sites in the south east where beech might just survive, where the soils and the aspect are more suitable. Or we could manage beech in the south east as pollard or coppice, bearing in mind the research we've carried out that shows that they tend to respond slightly better to higher Co2 scenarios. We could try selective genetics – our beech trees are six or seven hundred years old and have already lived through several climate change episodes, they've been through a mini heatwave in the medieval period, through a mini ice age later on. Those trees are survivors, what is it in their genes that has helped them to survive and perhaps others to fail? We need to look into that.

We can also look at those alternate species. Burnham Sycamores doesn't quite have the same ring about it but maybe that's one route that we can look at and we can certainly try and adapt in that way. We should allow beech to flourish in the north of England. Now there's an interesting argument here because many of my colleagues in the north of England are busy chopping down beech trees so I put a plea to you to stop, for the moment anyway. We are doing one easy adaptation project at Burnham Beeches already. We had 85% beech and 15% oak; we've now got in our new trees that we are creating, 65% beech, 15% oak and the remainder 20% are other species so we are hoping that the other species may give us a little bit of spread but if you like, for want of a better word.

To conclude, climate change will alter Burnham Beeches in terms of biodiversity. The loss of beech will be bad news for certain species; they won't have other niches. It may alter patterns of visitor activity and we have to be prepared for that. Beech will probably linger in the south east but it's most likely to migrate to the north. I think we are doing the obvious things at Burnham Beeches but that's about it. Probably the key message really is that open space managers have a responsibility to raise awareness of the issues and I think that's local, regional and national as well. We have many choices and there's a philosophical debate to be had here, the business of beech trees being chopped down in the north of England is a case in point and we haven't started to talk about that yet.

Finally three issues that I will leave you with. Additional resources are required. There are no additional resources coming to sites that I am aware of that will allow the luxury of looking into these issues in any scientific way. We have to ask ourselves are we communicating effectively and we have to ask ourselves are we working together effectively because only in those two ways will we actually make a difference.

## **Richard Critchley**

**Water Resources Planning Manager**

**United Utilities**

### **Water strategies for climate change**

I'm going to talk about water, drought and climate change. My job's about planning our water supplies across north west England in order to make sure that we've got enough water for the future. I want to talk about some of the things that I've learnt in my job so we can see perhaps if there are things which you can benefit from as park managers in managing your parks.

I want to tackle three questions. Why do we have water shortages? What do we mean by climate change and drought? What should water companies and park managers be doing to avoid water shortages?

Firstly, why on earth in a modern society like ours, in a highly developed nation, do we still have water shortages? The fundamental answer to that is because we do have periods of low rainfall. These pictures show Hawswater Reservoir, which is the largest reservoir in north west England, and you can see the way in which the water levels have plummeted just between April and September in 1995. That was simply because of very low rainfall whilst we kept maintaining supplies to customers, so the fundamental reason that we do have water shortages and we do have water restrictions is because of lack of rainfall.

We could build new reservoirs, new water supplies, and do other things in order to ensure that we never had any water shortages. We could do that but it would come at an enormous cost to the environment because we would be having to extract more and more water when the water environment was at greater stress and it would also come at an enormous cost to customers in terms of their water bills. So what water companies have to do is to try and strike the right balance. We do that by talking to our customers, talking to regional stakeholders to try and find out from them the things that they value and so we can get that

right balance between on the one hand providing a secure continuous reliable supply of water and on the other hand protecting the environment and customers' bills.

I've gone through that just to explain to you why occasional water restrictions are necessary. This is not something that will go away. Climate change, as we've already heard, is about the way in which our weather is changing and of particular concern to me in this talk is the way in which droughts or periods of very dry weather are going to become more frequent and more severe in the future than they have been in the past. Water companies have to make sure we include that in our forward plans. Drought however refers to specific events and there's been a severe drought in southern England this year.

Now I suspect that droughts happen irrespective of climate change. I suspect that the drought that we had this year would have happened anyway but I also suspect that it's been more severe in its nature than it would otherwise have been because of climate change. Water companies have a key responsibility to prepare very detailed drought management plans. These set out in a lot of detail the things that we do before a drought occurs and during a drought and each company puts their drought plan on their website so any of you can go and look at it and see what it says. Officially the word drought is used on occasions when drought powers are actually required. A common drought power is that of a hosepipe ban but one that we also need to think about and I'll talk about that later and that is the non essential uses ban.

This graph summarises the way in which we manage droughts. It's a very simple form of what we do but there are four curves going through time. The X axis is the calendar year and the Y axis is the storage in our reservoirs and other water supplies. If our storage is good and we've got enough water when we are above the highest curve, we are OK and can carry on with normal operations. If we are in a dry period and our storage levels are down, we have to carry out different actions.

The first trigger point is about planning, not that the drought has happened but it's about the possibility of a drought occurring and so we work out our detailed plans and if we need to do actions there and then, we do them. The second trigger point is about starting to implement actions so at that point we'll be actively communicating with customers through the press asking them to voluntarily reduce consumption. We'll have changed the way in which we are operating our system, using

more and more of our emergency water supplies. We will be talking to environment agencies and others about the things that need to be done. When we hit the third trigger point we will be doing more and more of those and intensifying our actions but also at that point in time we will be applying for drought powers.

The most frequent drought power that we apply for is the hosepipe ban and then if we are unfortunate enough to get to the fourth trigger level, that is when we need to have drought powers in place enforced. Now I've gone through that just to try and explain to you that water companies have been working and planning and trying to do things to prevent or mitigate a drought long before you hear about it in the media and it isn't something that catches us unawares, just in case you thought that.

So what else are water companies doing? We've talked about our drought management plans, we also prepare detailed water resources plans. What these do is look at what's ahead and work out what we need to do now in order to prevent or minimise water shortages in the future. As you can imagine we have to look at a lot of different things, I've listed some of them there. I think climate change is clearly one of the important things we need to take account of. The effect of climate change on people's desire to use water and also the effect of climate change on the amount of water that will be available in our water sources.

We carry out detailed modelling and we take the results from the sort of things that Sarah was talking about earlier and we carry out our own assessments to understand what it actually means in practice, what climate change would mean in detail for our water sources. As a general guide we reckon that the effect on the amount of water that is going to be available in our water sources is going to be about 10% less in 20 years' time than it is now, and that is a lot of water, and so our plans are geared on the basis of having to provide for that. The blue line, which is increasing, that is a demand forecast and the red line is the supply forecast, so this is a typical demand and supply forecast that we might come up with for an area. Typically it would show deficiencies in water supply in the future.

Basically there are two types of things we can do to close that gap. We can increase the supply – a lot of companies in southern England are planning to build new reservoirs for instance. The other thing we can do is seek to reduce demand.

We can reduce leakage or encourage customers to reduce their consumption. We do a lot of work to reduce leakage and we are going to have to more. We have invested in the latest technology in order to monitor leakage levels in order to detect exactly where they are occurring and also to control the pressure in the water supply system. We advertise the phone line that we have for customers to be able to phone in and tell us about leaks. We also work to promote water efficiency with our customers. There's all sorts of water savings packs, different types of packs for different types of customer that we provide free of charge. We supply water butts at discounted prices, we hold environmental classrooms where we teach children about water and water conservation and we provide a free meter option, whereby any customer who wishes to go onto a meter, can do so free of charge.

There are lots of other things that water companies are doing to try and encourage that message to get out to our customers, to be more careful and wiser in the way they use water. I'll give you some examples on this. I'm predicting that there will be a significant change in what water companies do; that the messages that we put out will become much more visible and there will be an enormous amount more spending in that area in the next few years.

Now, what does this all mean for you as park managers? I've set out here five actions or strategies that I'd like to just talk through.

The first one is actually a risk assessment, to understand potential frequencies of restrictions and impacts. It's about understanding the probability or the frequency at which water companies might be placing water restrictions and then thinking what the consequences are. What I want to talk about is that the frequencies of events are probably going to be low, so are the consequences going to be very big? It's really over to you then to work out how much money or effort is it worth my investing in order to overcome those problems.

The most frequent water restriction which water companies use is the hosepipe ban. In north west England we plan for frequency of one in 20 years and that was based on the communications that we have with our customers which I talked about on that earlier slide. Water companies in southern England, where water is generally more scarce, probably have more frequent hose pipe bans, typically one in about ten years, but it does vary from company to company.

Now a hose pipe ban is directed primarily at domestic customers and it also applies to the watering of gardens around hotels, offices and such-like, but it does not have any legal effect on the watering of parks, sports grounds or golf courses for instance. So if you are in an area where there is a hosepipe ban there is no legal obligation upon you to change the way you use water, however I would suggest to you that there is a moral obligation partly because of all the things that we've already heard about this morning about the effect of water shortages on the environment, so I want to suggest to you that you do have a moral obligation that you are seen to be very careful and wise in the way in which you do use water in watering your gardens or your grounds, in the event of a hosepipe ban.

The other type of water restriction that water companies can apply is the non-essential uses ban which is also called the prescribed uses ban. Now this does have a very direct bearing on you. What it does is that it gives water companies powers to define certain uses of water which will be prohibited or banned completely, and that will include use of water for parks, gardens, golf courses and sports grounds. If you are in an area with a non-essential uses ban, unless you have been able to work something with your water company, you won't be able to do any watering.

These events are relatively infrequent. Here in the north west we plan such powers to be used about once in every 35 years and in southern England about one in 20 years but it does vary from company to company. You can go on each company's website, look at their drought plan and you will be able to see what frequencies they are planning for. It's really just to say that you can begin to see that these events are relatively infrequent.

During this last summer there was a very severe drought in southern England, and as far as I know only one water company, that was Southern and East Surrey, actually implemented a non-essential uses ban. There were at least three other companies that applied for and had been granted the powers but as far as I know, have not implemented them. Thames Water, who have very openly declared that they just don't have enough water to meet their customers needs, even they have not required a non-essential uses ban, they've needed a hosepipe ban this year and the previous time that they needed one was ten years ago.

I just wanted to present all of that just to put into context the relative frequency of events. But if a non-essential uses ban does occur in your area, then you've got significant issues because you won't be able to use

drinking water at all. The next one, understand your consumption. That's fairly obvious but not many people actually do it – actually look at the amount of water that you are using in your parks. To understand where the water's going, and anyone who does that will be surprised and find that there are things that water is being used for, or being wasted, that needn't happen.

The third action is to avoid wastage and leaks. Again very straightforward but there are things like getting leaks repaired, stopping dripping taps, putting trigger devices on hoses, anything to stop those continuous dribbles of water which you think are very low volumes but accumulate over a period of time, if they are running continuously, to an enormous amount of water.

Action four – reduce consumption. You, like water companies, like everyone, we all have a joint responsibility to avoid using water when we don't need to. If you have got toilet blocks then maybe your cisterns are flushing more water than they need to and can be adjusted, maybe you have gents loos where the urinals are flushing every 20 minutes through the day regardless of whether or not they are being used. Simple controllers on them will reduce a lot of water. The planting of drought resistant plants can reduce the watering that you require.

The fifth action is to increase your water supply. If you are in a situation where you are not allowed to use drinking water then perhaps there is other water that you can get hold of. The most obvious source would be rainwater – now this obviously depends on your particular situation and whether or not you have got roof space at your offices or at the park itself, whether you actually have space to install a rain water catcher, or rain water collection vessels, but if you can that would be an excellent way of being able to collect water for use when you can't use drinking water. Otherwise you could look for a ground water supply, perhaps your authority or a private company nearby may have a borehole, a private supply that you could get water from and transport in.

Or else you can go and talk to your friendly sewage works and get some final treated effluent from there, obviously there are public health issues depending on how you are going to use it but if you talking about extreme events, then maybe extreme solutions are required.

In conclusion, I hope you found that helpful, to understand why water shortages and water restrictions occasionally are required. I hope I've

reassured you that water companies are trying to do their part and have very detailed plans in place for drought events and for planning for the future. I hope I've also illustrated some of the things which you can be thinking about and actions which you can take in the event of water restrictions.

Thank you

## Question and answer: session 2

Question 1: Alan Barber

Could we just lay to rest this myth that the reason for water shortage in this country is due to a lack of rainfall. Ask the people of Carlisle, of Shrewsbury, the people of Nottingham, whether there is a shortage of rainfall – there isn't. Talking to the Director of UK CIP only four days ago, he clarified that the net rainfall on the country is very little changed even over the range up to 2080.

There are variations in parts of Britain and big variations in summer and in winter. We saw earlier the pictures that Andrew Tucker put on a screen of a map which showed the cooling effect of major open spaces in London and he also told us how they turn into the most vociferous of heat islands if that polarity is reversed. Now what does that suggest to everybody in this audience – that you are going to have to irrigate them.

The one thing that we have to do with the green infrastructure of urban settlements to protect the welfare and the happiness of our citizens through 2080 and the periods of climate change as far as they are projected, is to make sure that we have irrigation. It's going to take millions and millions of gallons of water and it is not going to come from the hair shirt attitudes of water authorities who haven't built a reservoir for the last two generations but can still jabber on about sustainability and the rest of it.

We really have to get away from the idea that there is a lack of rainfall when what there is, is a lack of investment in the infrastructure to collect fresh water, to store it and to distribute it and that must be the water authorities and the environment agencies, the only people in this country that have never heard of a technical device called a pipe which will actually solve it.

Now I don't think that all of these things will actually be solved by simply mains water and certainly not left to the atomised water industry that we have got now on our hands, a lot can be done locally. I've just had a look at two excellent new parks in Birmingham, all around them is a regeneration area with new apartment blocks being built. All of the water that falls on those apartment blocks will go down into the drains to increase flooding in the winter and the pressure on our drainage system. None of it is being collected to water the park in summer.

What we want to hear from the water companies and the environment agencies downwards, is a way in which we can practically, for the sake of future generations, for our grandchildren, make sure that have got liveable urban areas by making sure that green infrastructure is properly irrigated and let's have less of this nonsense that we have just heard this morning.

Reply (Richard Critchley):

Obviously there is plenty of water – what could be done is to build extra reservoir or other water supplies to catch that water and make it available. From a civil engineering point of view that is quite feasible, but I explained to you that that comes at a cost and we talk to the environment agency, we talk to English Nature, we talk to all of our stakeholders. The next water resources plan round all of your organisations will have a statutory right to contribute to our water resources plans.

I know that all of us in this room are very environmentally aware and concerned and would pay more but you ask Mr Average on the street, which is what we do and which consumer bodies do on behalf of the water industry, and Mr Average is not prepared to pay more. We as water companies seek to strike the right balance and we are set guidelines under which we have to operate and what we do is try and get that balanced view from stakeholders, regulators and environmental groups to try to get the right balance and we believe in North West Water we've got that right balance.

Reply (Alan Barber):

Just a couple of points – the first is that Mr Average in 2080 will be singing rather a different song. The second point you are saying that all this comes at a cost. Do you seriously think that not doing something doesn't come at a serious cost and do you not think that it also doesn't come at a serious cost also to the environment. There has to be some planning here for the future – other countries invest in their infrastruc-

ture. Water is cheaper in Dubai than it is in Britain. This is a problem that needs sorting and we expect water authorities and the environment agency to come up with a plan which long before 2080 will ensure that this country has the water supplies that it needs including irrigation of the green space infrastructure. You are nowhere near that. You've not given it a second's thought as far as I can tell and it's about time that you got your skates on and got us a plan to take us to the water resources that we need for the next hundred years.

Reply (Richard Critchley):

I just completely refute that – we have made detailed plans and they are made public and you can comment on them. We spend enormous quantities of money and time planning and working out exactly what is the best thing to do. You may have a different opinion and you may not think that our plan is the right plan, but we do take it very seriously and very carefully. The things which you as local authorities provide for your customers, no service supplier is ever able to meet the absolute maximum capacity or peak requirement and we are in the situation where the cost of providing for the absolute most extreme event is very high – it's just not going to happen.

Comment from the floor:

I'm no water expert but what strikes me from Sarah's presentation this morning and the presentation from Richard just now and Alan's comments, is there is not any happy medium between large scale reservoirs up in the Peak District and then the kind of water butt collecting water from one park building in a local authority park. Is there not some kind of issue of scale here. Maybe there is something in between which would be a more efficient and effective way of collecting rain water and using it effectively on park land and green spaces.

Reply (Richard Critchley):

I think the question is that we need to be looking widely at as many options and novel and innovative solutions to collecting water or to providing water supply and I completely agree with that and none of us must be get stuck into thinking that we must do things as we did in the past. The new technologies and the options are becoming available.

If I can just add, I think you have hit the nail on the head; we can berate the water companies and agree or disagree with them. We have our own personal responsibilities as well but in the middle ground there is planning legislations that does nothing to make sure that we do that

and that is one of the areas that we do need to get to grips with and let's make this a legal requirement. Let's make sure that every new building that is being built in the south east, the north west, has that infrastructure built in so that the water can be re-used and then I think we'll be going a long way towards meeting both these issues that have been raised there.

Comment from Andrew Tucker:

Just a quick point: I think everyone has raised issues that are relevant and correct. Please use international examples, we are heading towards a climate that other countries are experiencing now that have come along this way. I've grown up in Australia and the winters that I used to have are closer to the summers that we have here. They manage their parks fine, it's about managing what we've got for future use but it's also about reducing what we've got now. We just need to be a bit smarter about how we use our water. We've got plenty of water to go around. I came over here with the stereotype of international visitors: "My God – it's always raining".

You do have enough water here but the other point that Richard raised is that it's the parks that people look at. You drive past parks, and you know there's a water restriction in place and you see people watering parks, you get quite angry about it. There are other methods of doing it a lot better.

Two programmes I'd like you to check out. Look at the Home Water Wise Programme – just type in home water wise. It's a new thing that's being put together in Queensland. We keep calling these areas drought areas. We get this every single year back home; it's not drought, it's just normal. It will probably happen here soon too. Home Water Wise programme brings along all the members in the area, you pay a little bit of money then someone comes round to your home and they install all efficient devices and they teach you how to do it properly, that's it, you just halve your water usage and it costs next to nothing, specially when you convert back to pounds. They also have things in there about how to manage water in your back yard's open spaces.

Another thing there – type in hydro-illogical cycle – it's a small chart that was developed by a professor in a university in the US. It is brilliant – it shows what we don't do in respect of our water usage on a seasonal rate. We look at what happens now, oh my gosh, we're in drought, we must have lower usage, we'll bring in hosepipe bans, we will bring in

drought restrictions – all of a sudden we get rain, the reservoirs are filled, the ground water table is filled, we go back to our old practices.

Our practices that we bring in during times of drought aren't practices for drought. They're practices all the time, it's called common sense – we just need to do it better than what we are doing now. Polly mentioned another thing we could do in the planning process and yes they are and you're right, we don't have them in planning now, for example rain water harvesting. I only know this because my folks back home are building a house and you can't build a new house or commercial building back home, you will not get it through planning process if it does not have a rain water harvesting tank. We can do that here, it's common sense. We just don't get it done.

## **Guy Barter**

Head of Horticultural Advisory Services, Royal Horticultural Society

### **Sustainable horticulture**

Just to go through from a horticultural point of view what we've already covered, climate change looks like reduced frosts, earlier springs, higher average temperatures all year round, increased winter rainfall, risk of winter flooding and hotter drier summers increasing risk of drought. So that obviously has severe implications for the kind of plants you grow and the way you grow them and which ones you choose in particular.

A bit about the RHS. I suppose a lot of you are labouring under the delusion that we've an organisation for posh people who run the Chelsea Flower Show and I like to think we're a bit wider than that. Our belief is that gardens and horticulture are very important and they have a major role in reducing the effect of climate change and improving the environment where people live and we have been looking at climate change for quite a while.

In 2002 we worked with UKCIP to produce a document called Gardening in the Global Greenhouse. Things have moved on a bit since then especially the research and the projections but if you want to look at the old document it's still available on our website and it gives you a broad outline of what we think is going to happen, the model to which we subscribe. People mentioned earlier what happens if the Gulf Stream switches off, our science team have been monitoring the evidence very closely and we still believe that the model where the Gulf Stream switches off is not particularly likely as far as we know at the moment.

Just to say what we consist of, we have a science team obviously who have a small group of soil scientists, plant physiologists, botanists and experts in pests and diseases and we have an advisory team who are general gardening experts in one way and another and we also have a gardening team who run our gardens, so we've got a lot of expertise

and our role is to harness this in doing the things in which we believe and in particular in the area of climate change and in the context of this meeting.

Our goal is to help people share a passion for plants and to encourage excellence in horticulture and to inspire all those who have an interest in gardening. I put a picture up of one of our neighbourhood award schemes where we encourage local groups to undertake gardening, just to show that ordinary people are supported by the RHS. In fact there may even be members of the RHS in this room. You notice that the people in the picture are holding hanging baskets, which is relevant in this particular instance because the hanging basket is the best device invented by horticulture to use up lots and lots of water and yet they are extremely popular and part of our gardening tradition.

Amongst the initiatives that we've been up to in the last few years are the front gardens, where we undertook some research to look into the extent to which front gardens have been paved over in Britain and this has relevance to the earlier speakers who were talking about the prospects for flooding and sudden rain events causing local flooding and of course the front garden being paved over, immediately increases by a small amount, the amount of water going into the flood systems, into the rain water systems and when you've got huge areas of our cities being paved over, then that's huge areas of extra water so our work with gardeners and gardens are having a major influence on climate change.

At the moment we are looking into the back garden as the front garden is pretty much a lost cause perhaps, because so many have been paved over, but what about the back garden? So that's something that we are interested in. Back gardens are being covered in patios, conservatories; they're being sold off as building plots. In fifty years' time perhaps people won't have anywhere to garden, people will rely even more on parks as places where they will experience horticulture and open space, so we're very interested in parks although much of our work is to do with home gardeners, parks are going to be more and more important.

We are looking at things like more extreme weather events – hotter drier summers, wetter milder winters, overall decline in rainfall, this has a severe horticultural concept. One of the most interesting things I've noted in this meeting so far is that no one has mentioned soil, or very little, and it may come as a surprise in the context of what we've heard so far and that is that the vast amount of agriculture and forestry in Britain is rainfall

fed and indeed that most natural and semi-natural environments are rainfall fed.

You don't see rain guns trundling through Burnham Beeches as far as I'm aware, so the answer really does lie in the soil. It's the soil that holds the moisture in Britain and one of the joys of working for the RHS is that I'm exposed to a lot of amenity horticulturists. My background is in horticultural science and I suppose I'm a refugee from the vegetable industry and the nursery stock industry. The root environment is particularly important to us and I think that this is an area that is neglected by amenity horticulturalists.

Another interesting facet which hasn't been much mentioned is evapotranspiration; this is what plants do, they drag the water out of the soil, and they spew it out into the atmosphere when their stomata are open and they're fixing carbon bi-photosynthesis and with hotter, drier summers, there's going to be a great deal more evapo-transpiration. Plants are going to have to open their pores more, they are going to lose more moisture and when rain does fall, winter or summer, the higher air temperatures are going to lead to a lot more evaporation and all in all soils are going to be extraordinarily dry in the summers of the future.

One of the ways in which one can work on this, the agronomy if you like, is to make soils deeper, encourage deeper rooting, boost their water-holding capacity and generally increase the contribution of the soil to the water supply plants. The word irrigation has been mentioned and irrigation is fantastically expensive. The RHS was given a large area of land just outside Woking in Surrey, Wisley, and as a result decided to build its garden in a area where there's an annual rainfall of 25 inches and the soil could be and indeed has been, sold to builders for construction purposes as sand.

This is an area where the effect of rain and soil holding capacity of the soil is particularly relevant and one of the problems that we've made for ourselves is perhaps our choice of plants. If you set yourself up as a horticultural charity to demonstrate growing a wide range of plants, you have to grow rhododendrons and the rhododendron plants that come from the high rainfall areas of mountains like the Himalayas, so when you put it in the sandy soil of the Thames Valley, with low rainfall, of course you're doing it a terrible mischief and you have to pump water night and day to keep them going.

It's no secret that the RHS spends a lot of money pumping water and running irrigation equipment and it's an expense that one just can't do without. Irrigation has got a major cost implication and so we are fortunate we have managed to acquire gardens in cooler, moister areas where the climate is much more suited to rhododendrons, so our rhododendrons will be going north and west as indeed most other people's rhododendrons will have to do in the next fifty years.

There is a plus side from the plant's point of view; the growing season will be longer, it's possible there will be less cloud and the light levels will be higher and there is more carbon dioxide in the atmosphere which will promote growth. If the carbon dioxide concentration is higher, the stomata have to be open for a shorter period to get the carbon necessary for photo synthesis and there's less water loss. So there are plus points.

On the other hand if the soil is so dry that plants can't take advantage of any of these plus points then that pretty well negates them and also in the winter, if the soil is so wet, the plants don't develop the root systems to survive the summer, then these plus points will not necessarily take place. For example, in many districts frost and snow will become rare and this has a number of advantages. The C4 metabolism plants, which are many of the grasses that have enzyme systems that are frost sensitive, will be able to thrive and the C4 enzyme system is much more economical of carbon dioxide than the C3 system that most plants have. The C4 system is found in things like maize and many grasses, in particular frost-sensitive grasses. So there are a number of things coming together there.

Climate change is a long-term process. We've looked at it at Wisley where we are trying to imagine what it is going to be like in the future to inform our planting and our research, and in 2050 we imagine that the climate will be similar to the Loire Valley in France, but with lower light levels. We are not getting any closer to the equator, the sun is not getting any higher in the sky so we are not going to get light levels going up that much, although there might be fewer clouds and by 2080 we suggest that moisture stress levels might be more like the Bordeaux area in France.

In that area one of the main trees are pines and the pine tree is widely found in Mediterranean areas – Portugal, Spain, Italy – and is highly adapted to drought. The pine that is in this country that already comes from that area is the Corsican Pine which is much-used for forestry in

the Brecklands and in the Dorset Heaths. Unfortunately another aspect of climate change comes to bear as well and that is this pine, which is apparently ideally suited for the climate of the future, has brought along a little pest of its own and so now this pest has hitched a ride and is causing trouble in the Corsican Pine plantations and the reason it can thrive is probably not unrelated to the slight increase in temperatures that we've experienced so far.

So we're looking into the future and thinking what effect this is going to have on the plantings that we hope to make. You can look at plantings, I think, in terms of short term, medium term and long term. In the short term, you are looking at annual plantings - plantings of just a few years, beds and borders and then you go on to shrubs, ground cover, perhaps turf for medium term and in the long term, perhaps wild flower plantations plantings might last, small trees and then there's posterity.

At the moment we are reaping the rewards of posterity. Our parks, ancient woodlands, wood pastures – all these trees have been around for hundreds of years and we've got more than anywhere else in Europe I believe, and will that be the case in the future, we ask ourselves. Possibly not unless we swing into action now.

We suspect from our close association with the home gardener that the garden tree has a life of about eight to 12 years because people move house, they have a change in design, they put up a conservatory, they want a pond, and then trees tend to get cut down. So perhaps for garden use, choosing trees isn't so important, but for landscape use and for public parks and other public areas, then the choice of trees and indeed medium term plantings becomes that much more important.

One of the themes that we constantly emphasise is that you choose the plant that is suited to the soil. If you choose a plant that is suited to the soil, then it's going to be much more able to take whatever the future is going to throw at it. Now I've already explained how we conspicuously failed to do that at Wisley with our rhododendrons but I think the principal is still maintained and there's not just the soil, it's the site. There's a very big difference between a south-facing site and a north-facing site. We've discussed beech trees. Beech trees on a south facing piece of Downs land in the south eastern counties is going to be a lot more stressed than beech trees on a north facing slope or on a moist valley so one has to take into account the topography as well as the expected change in climate for that particular part of the British Isles.

Choosing plants is particularly fraught because private gardeners are determined to grow plants that are completely unsuited to the soil and unfortunately my job is servicing the membership of the RHS, it falls to me to explain as gently as I can that if you live on chalk, you really shouldn't waste your time and money growing rhododendrons and so on. So a certain amount of education is needed so that the wise gardener, whether professional or amateur, chooses plants to suit the site, not to suit their necessarily preconceived notions of what they should grow.

We've got a tradition in Britain of short term plantings, our bedding containers, hanging baskets, and a short term planting is under a number of disadvantages. All the growing has to be completed in one season, admittedly the season of the future is likely to be longer but towards the end of that longer season, the drought stress is likely to be higher. One of the ways around this is to choose drought resistant plants, plants that can shrug off drought in ways that other more moisture demanding plants would fail to perform in; begonias and impatiens, those old favourites, are plants that need a lot moisture.

But there are a lot of others, for example arctotis and scevola, that have much lower water demands. Another factor might be over-wintered plants; with the milder winters, it's very possible that the planting in the autumn for spring and summer displays could result in plants with well-developed root systems, better able to exploit the soil moisture and survive droughts. Bedding out larger drought resistant plants might be the way to cover that difficult late summer period and it's possible to intervene with annual plants.

If there's a drought, it's possible to remove the plants and choose something else but there's also water logging episodes in winter as well which is going to severely affect those plants that are growing in the winter. One of the things about water in winter, water logging is particularly damaging when plants have warm roots. If the soil is cold, then a bit of water logging doesn't matter too much but if it happens when the plant roots are wet, then severe damage can take place, so that is one of the challenges that has to be faced.

You might think they've plenty of time with short-term planning but I'm not so sure. I feel that the soil science, the agronomy, the plant breeding and research has got to be started now. I was rather surprised to hear someone say earlier that there could be too much science – I don't

think there can be too much science. I think we need a lot more science and I'm happy to say that the RHS is doing a bit more science. We've got plant physiologists working with the University of Reading who have already looked at watering bedding plants and hanging basket plants and are producing evidence that the usual watering regime is far too generous and you can get just as good results by limiting the amount of water.

A few pictures, arctotis, begonia and the kind of luxuriant late summer displays which we have become used to which will become far more difficult to do in the future. Medium term plantings, they can fairly easily be changed to shrubs and herbaceous borders. It's the late summer period when things are at risk and drought resistant plantings of those Mediterranean plants are that much more susceptible to winter water logging events but it's possible to intervene. It's possible if resources are available to water and it's possible at very great expense to put in land drainage.

These are a couple of pictures, one is a picture of herbaceous borders at Hampton Court Palace Gardens, a luxuriant herbaceous border that we love now and what we might expect in future at Wisley where we've mulched a ground with pebbles and planted it with things like grasses including these C4 grasses, agapanthus that need a good baking. It's a good system except for the children who go off with the pebbles and leave them all over the place where people can trip up.

It's the longer term plantings that are of particular interest. There's an increased risk of succumbing to changing climate; there's not a lot you can do. This year, one of our most favourite plants at Wisley, the cornish trynansis cousa, that people come for miles to visit, suddenly started wilting and it appeared that so many visitors had been tramping around the base, that it had compacted the soil and killed the roots.

We get a dry summer and the poor old thing starts wilting, so we pumped water night and day around it and I think we've managed to save it. But it's an example of how it's possible to do these things if you neglect your soil. This risk reduction strategy that we've already heard people mention; you plant a wide range of things, some things are going to fail, some things are insurance, some things you're pushing your luck a bit. So you might plant brooms for example as an insurance measure, a drought resistant plant, and you might push your luck with some big fleshy leaved evergreens like scinias so you can intervene later as things go on because it's relatively easy to do that compared with the plantings for posterity.

We would suggest that one looks at one's current plantings now and makes plans to replace plants that are right on the verge of where they thrive. So if you have a tree that likes a fair bit of moist soil, for example this ornamental maylis at Wisley, that is going to be at risk in the future. Its going to get drought stressed, it's not going to grow and it's going to suffer from diseases. So we might think that the maylis has not got a good long term future. What about magnolias – they are adapted to hot dry late summers, so we might plant something now to take over in the future.

So good choices now will make a difference in 80 years time. I've got a garden I photographed at Hampton Court Palace Flower Show showing lots of luxuriant plantings, grass growing right up to the trees. These things could be hard to sustain in the future. On the other side is a photo taken at West Green Gardens in Hampshire where large lime trees, the tree that might be reasonably expected to do well under the changing climate, have been planted to cast shade and shelter that we are going to like by the time it gets hotter and drier and we are going to appreciate more shade.

This posterity is perhaps the most interesting thing and a couple of years ago we had a conference with the National Trust and with English Heritage and the Forestry Commission to discuss what is going to happen to trees in posterity and this is a real step into the unknown. We've got a fair idea of what is going to happen, but when the next set of UKCIP predictions come round, we might have to change our views considerably. We are going to look at a risk reduction strategy. Beech trees look like a dodgy prospect in the south east, so obviously we are going to limit the number of beech tree planting and perhaps look at hornbeam, a species that is thought to thrive further south than the beech tree generally does, and make plantings that are going to be able to cope with whatever comes up.

Current plantings are going to need to be reviewed. At Wisley we rely on a large number of sorbis and mountain ash. The likelihood is that these northern trees are not going to do so well in the future and we need to be looking at trees from more southern and drier atmospheres and there's not a long you can do with intervening with a mature tree. They don't respond that well to watering or feeding so the choices you make now are going to be of enormous importance in the future and so I think one has to spread one's risks and that means investing now.

There are a couple of examples, one is evergreen oaks; our tree experts at Wisley have been planting evergreen oaks. These are trees of hot dry climates; in the past, winter damage has caused them to suffer so they haven't been popular, but in 80 years' time they could be just the ticket and that brings another problem. Evergreen oaks have been seen as an invasive alien on the south Downs, so by introducing a drought resistant tree, we may be introducing an alien that is going to cause problems to what is left of the natural plantings that we have in southern England.

Cherries, for example, need winter chilling if they are to flower. If they don't get winter chilling, the flower is delayed and reduced. Will we get enough winter chilling in 80 years' time? If not what cultivars do we chose now to plant that will get enough chilling to flower on time in the warmer winters of the future? Conifers come from north west America – cool damp climates. They may need to move further north in the future.

I just want to say that parks are leaders of change as I see it in the same way that the RHS should be a leader of change. Green roofs to slow down water reaching the ground, insulating buildings better. I'm sorry to say we don't have any green roofs in the RHS at the moment of a large nature. We are extremely jealous of our near neighbours at the Saville Gardens who have a new building constructed with a green roof; they are clearly of much greater importance in the future. Here are a couple of photos and one of the them is at Sheffield, taken at a recent conference and one of them is actually a water garden on the roof of a department store in Guildford which I think would be a fantastic thing to have in the climates of the future, where you have water and coolness on the roof. I presume that it recycles water collected from the roof.

Parks should be leaders in low input plantings. Low input plantings have got a bad press, I suppose probably because the agronomy and the husbandry has not been worked out properly yet. We are working with the University of Sheffield to look into the management and the acceptability of wild flowers and naturalistic plantings and other ways of low maintenance, low input plantings for urban areas.

Finally, I've got a picture here of Paynes Hill Park which is just near Wisley – it was planted two hundred years ago by a gentleman who had done the grand tour and had made all sorts of fantastical landscapes, it survived for 200 years, it's got amazing Champion trees. I like to think

that if we act now and use our knowledge of plant science to design landscapes, that we can leave something for posterity in 200 years time and they will bless us as we blessed Mr Hamilton when he made Paynes Hill Park.

Thanks for listening to me.

## **Clive Walmsley**

**Environmental Change Adviser, Countryside Council for Wales**

### **Changing wildlife, challenging choices**

Firstly, a few points about the Countryside Council for Wales. We deal with more than just the countryside, we are also interested in urban areas, so that's the first point. We are not councillors, certainly not in the sense that most of you think of - just to put things in context, we are not just interested in the countryside.

I'm going to present to you one or two examples of climate change happening now and just emphasise points made repeatedly in a number of talks, that it really is happening now and it's a serious issue. I'm going to present to you some examples of changes in biodiversity which we have observed to date, and also some of our predictions of what is going to occur in the future and, based on that, present to you some guidelines for adaptation for nature conservation and wildlife biodiversity that I think they will be really quite relevant to the parks and open space sector as well, and finally summarise and try and link the biodiversity work that I am describing to you to the parks sector.

This is a glacier in Greenland. The reason I'm showing you this NSSA image is that this was taken in 2001 and the next one is taken in 2002 and the next one still is 2003 and you will notice how the glacier is decreasing. It's hard to get the scale but just have a quick guess at how far it is from there through to here; that it 30 miles loss of glacier. The thickness of the Greenland icesheet is decreasing in some parts, it's very variable but up to 15 metres a year and that's just an example and in fact since 1997 to 2003, the rate of flow on this glacier has doubled. Just another graphic example. This is another aerial shot, this time in the tropics, not in the polar regions which are suffering severe climate change; this is actually Kilimanjaro in 1993, that's in 2000 and you can see a massive reduction, and that's in 2002. So the actual crater is being exposed for the first time in over 11,000 years, and by 2020 all snow and ice will be

gone from Kilimanjaro and the snow and ice melt from this volcano is the source providing all the water for the surrounding biodiversity in the national park surrounding. There are some graphic examples.

Next the new ground zero, and I'll show you a sequence here. This is Hurricane Katrina and these are daily photographs, this shows the daily development of the hurricane, now a blob in the middle of the first photograph and you will see it develop until it reaches landfall straight on to the mainland and we all know about the chaos it caused. I think what this demonstrates is that we can't put this individual event down to climate change but what we can say is that our ability to adapt and our ability to handle extreme events in the many effects of climate change, was demonstrated by this event that we really haven't got a handle in dealing with climate change.

So I want to go on now and talk about biodiversity aspects and I want to talk in terms of the effects that we are monitoring today or we have monitored up 'til now. I want to talk about phenology, which is obviously the timing of natural events which I am sure many of you are aware of and which has been monitored very intensively through the UK Phenology network, their very popular Springwatch BBC programme and so on.

Just one or two figures for the blackbird. The blackbird's time of nesting has changed by two weeks since the 1970's. For the bluebell, since the 1950's up until now, the first timing of flowering has moved forward in spring a whole month. The bird that you see up on the top there is actually the Blackcap and the Blackcap is a migratory bird and up until a few decades ago, it basically occurred in Britain during the summer. It now occurs year round, the reason being that it's not actually the same bird surviving here or staying here but actually the Scandinavian bird that used to migrate further south are now finding it quite happy to stay and overwinter here.

The frog is one where again it's spawning, with the tadpole emergence having moved forward by two weeks since the 1970's. This is another graphic example. You can see the huge variation due to annual changes in the weather, but you can see from 1950 to 2000 and beyond how the appearance of the first oak leaf in Surrey has moved from the end of April through to almost down to the end of March, almost a month's difference. And one more example from the 1980's to 2000, looking at the first flowering of snow drops, we can see again from 21st February down to the beginning of February and that's only in a period of twenty years.

So quite a lot of dramatic changes. You may say well does that really matter? One of the points is the lack of synchrony between birds and the prey they need; there can be real issues involved if different species are not responding at the same rate and this is certainly the case.

Now this is probably the most complicated graph I'm going to show you but it's very important. It comes from some work by the University of York and the CEH, the Centre for Ecology and Hydrology, and they looked at the distribution data for a whole range of species that have ringed boundaries, ie they occur in Britain but somewhere within Britain was their northerly limit.

What they did was to look at two time periods, about 25 years apart, and they looked at the distribution of that species. Each of these groups are above the zero; basically if these groups showed no change in their distribution they would be along this line. The fact that all the groups are above the line and most of them are significantly above the line indicates that a lot of the species are moving northwards. We now have got good evidence that this is happening.

With amphibians and reptiles there are other factors in terms of their habitat and so on which are possibly causing them to move in the opposite direction. This is just one example of the common butterfly just to show you some data – the blue area is the original distribution before 1979 to 1982 and you can see the red and golden dots indicates spread in the recordings between 1995 and 1999.

We can put on a couple of lines here which indicate, based on a 1.5 to 2 degree rise, the kind of position, somewhere between those two arrow points, where we expect the distribution to move to once we've had a rise between 1.5 and 2 degrees.

I know this is a parks meeting but I wouldn't ignore marine biodiversity. This is a range of species showing that in the marine environment we are getting exactly the same trends and changes. Some of this seaweed *Ulva* is actually declining and retreating northwards and so we are seeing the same trends in the marine environment as well as fresh water.

As well as seeing changes in phenology and also changes in distribution, we are also seeing changes in the abundance of species as you might expect. These are two examples for the *Pyronia tithonus* butterfly on the top and the marbled white on the bottom and the important point

is that the red shows when the abundance is below normal and the blue is when it's above normal and the important point is that this runs through from 1800 (this is partly based on modelling for the earlier part and actually on real base for the last part), but what you can see is that we are moving very much into the blue territory for these species and they are showing an increased abundance and we believe this to be and have certain evidence to link it to climate change.

So that's all I'm going to say in my examples of what happened up to now and now I want to look at what is going to happen in the future.

What you can see here is the observed distribution for species, and it doesn't really matter what species it is. I'm just going to describe the methods that we went through.

The next image is for a modelled output; a simulated distribution. This is based on a neuro network model and this is work we carried out with a huge partnership called Monarch. There are some leaflets and reports on the back desk for those that are interested and there will be a final Monarch report coming out at the beginning of next year.

This simulated distribution, you can see that while it is not perfect its does delimit the northern boundaries quite well. What we've done there is that we've looked at the species distribution and we've looked at the bio-climate – what kind of climate a species likes. We have then interpreted that to identify the bio-climate of the future and we've taken that bio-climate for each species and identified the parameters it requires. Then we go on and we project, this is actually an observed distribution for the cochlearia scotia, Scottish scurvy grass. That is the observed distribution and that is the simulated distribution and the reason why it looks so widespread is because it's not taking account of habitat, we can overlay a mask and identify the coastal areas, being a coastal species.

This is just for the 2080's high scenario and we've had the scenarios explained earlier. These are the UKCIP scenarios. What you can see is all that red indicates areas which have become unsuitable, I know it's only coastal but you will see in a minute. You can see that if we look at it in terms of the coastal areas, most of the habitat is going to become, the models predict anyway, we can't say it for certain, that those areas are going to become unsuitable for the species.

One more example, this is for the wood cranes bill, a pretty flower, which as you can see, currently based on 1961 to 1990 distribution, occurs

down to just a bit south of Manchester and is quite widespread in Wales. The models are predicting that by 2020's, with low levels of green house gas emissions, there will be some retreat but not a lot.

If we then go to the 2050's and look at the high levels, we see the potential extinction of the species in Wales and its loss in most of northern England. We don't actually see that much spread because it occurs fairly widely in the north and it's not actually moving up. So what the Monarch has shown is that there are going to be winners and losers – in Monarch we described the beech as a winner, because it's going to be moving northwards.

But species which have a northern distribution, such as the white fish and the purple saxaphragia, are going to be species which we are likely to lose and we based our work on trying to present in terms of visualising the landscape change and one of the species that we looked at was bracken.

Bracken generally occurs in valley bottoms and valley sides which is what you see here. This is a visualisation so this is only suggesting what it might look like in future, but we are predicting that it could spread up onto other parts of the mountains, displacing heath and habitat and potentially go even further.

Very briefly I want to talk about agriculture. Wales being a rural country, we have a great deal of interest in the agricultural sector. You may wonder why I have got a headline from El Pays, the Spanish newspaper, back from August 2003, but we heard earlier about the 2003 summer, which was incredibly hot.

This is saying that the price of agricultural produce in Britain actually went up and particularly the price of produce in southern Europe went up due to a crash in production. There was actually quite a dramatic effect and it was an incentive for greater production in Northern Europe and this is a possible scenario for the future.

Currently much of northern England and Wales is very pastoral as you see here. Just going with a bit of visualisation, we can foresee new crops coming in, a dramatic change in the landscape with potential mitigating measures such as wind farms and so on and the other factor we talked about earlier controversially, was water supply and the possibility in the future of on-farm reservoirs, even on a small scale to provide for

crop irrigation. So I think changes in agriculture will be also be crucial in determining how wildlife responds in the future and we don't really fully understand what those changes will be.

Here we have a map for Wales of the SSSI's and the SSI's that are preserved or protected. We also have in green the environment schemes trying to improve the landscape and to improve the ability of wildlife to survive, but the question I pose is are we trying to play Canute in believing that we can actually keep our species within these red areas? I could equally well have overlaid on that parks for example, along with local and national nature reserves, etc. But whatever I would have done, it would have been a fragmented network and I want to explore that a little bit more.

But before I do I just want to talk about the biodiversity action plan, which many of you will be familiar with and guidelines that we are developing for adaptation to climate change and I'm going to briefly go through these guidelines.

First of all, we don't want to throw away what we've already got. We want to conserve protected areas and other high quality habitats – I've heard many people saying that we don't need SSI's – rubbish. We need to conserve protected areas and other high quality habitat. Principal No 1 is most important.

Principal No 2 is to reduce other sources of harm. The presentation we had on Burnham Beeches made the case quite strongly that if we manage grazing, if we reduce pollution and all sorts of other factors, that reduces the pressure on biodiversity and climate change. We need to conserve the range and ecological variability for habitats and species and on a smaller scale conserve and enhance the patch variations, so a patchy area is one that has wet areas, dry areas, different aspects and slopes and so on, there is a greater probability of species hanging on in those than there is in monocultures of wildlife.

I'm going to talk a bit more about establishing ecological networks in a minute. We need to analyse the course of change because there is a tendency for people to say, we've seen this change, it must be down to climate change. It's not always the case and we need to be clear on which changes are due to climate change and which are not. We need to use adaptive conservation targets and priorities so we need to change our targets and priorities of conservation management plans.

The final item is to integrate both mitigation and adaptation issues into conservation management planning. Just to talk a little bit about connecting impermeability and fragmentation, you can see this just illustrates the woodland in Wales, what a fragmented woodland network we have. This is some work that Jim Latham, a colleague of mine, has been working on to create a green infrastructure network for Wales. These are based on the yellow areas which are the SSI's, which you saw in red earlier, they are now yellow. These broad green areas are like the primary corridors that we are proposing, like the motorways, which are biodiversity. And then we've got the A roads here in yellow and then we've actually got finer networks linking SSI's which are rather isolated.

This is just work in progress but what I'm trying to present is identifying areas that we want to prioritise for biodiversity and accepting that obviously we can't have biodiversity across the whole of Wales, we need to identify where the priorities lie.

This is just for Abergevenny, the Usk Valley, just to give you a visualisation that is the area as it is now and that's it with the woodland network. We can even add in some bio fuel crops in areas that are suitable, so we can visualise potentially what we would be creating and this is work that's in progress and that we are taking on. This is going on elsewhere, for example this is going on in Central America, this is the Central American biological corridor and the dark green and red areas are actually protected areas and the light yellow green areas is the proposed network and that is something that is under development. The Dutch are also doing similar work, in fact the Dutch are actually so keen on it, they're actually demolishing factories and industrial estates in order to recreate areas of biodiversity because that is where they want to have their network. We are certainly nowhere near there.

So finally, to summarise, we will be getting earlier springs, later autumns, longer growing seasons, fewer frosts, not so much snow, many new species coming in from the Continent and a greater prevalence of diseases.

These factors are common to the presentation that we had from Guy in terms of introduced plants and garden plants, parkland species, but they also equally apply to wildlife. The big difference is that while the management of non-native species in cultivation gives me a great deal more assurance that we will be able to adapt, wildlife is far less certain. We can see the potential for new trees and plants in parks, we can select seeds

from more southerly parts, say from France rather than from Britain and those seeds from that source should be more suitable.

We can change our lawn management regimes and so on, we can accept that they remain brown in the summer, we can use irrigation and we can assess the risks in response to extreme events but many of those measures are not appropriate to wildlife. Therefore I strongly believe that parks need to play a crucial role in contributing to connectivity for biodiversity – I think that's something that seriously needs to be considered.

Thanks very much.

## **Paul Bramhill**

### **Chief Executive, GreenSpace**

### **Future parks**

I think one of our trustees who isn't here today, Stuart Harding, said what do people not like about grass, trees and water? I think it's a very good opener because most of our green space that we have in urban areas consists of either grass, trees, water or plantings. One of the things that we are looking at here is how are other countries adapting, how will the future take us into new landscapes within our cities?

What I've tried to do here is draw on some of the examples I came across during a tour of Australia and New Zealand earlier in the year, when I attended a conference. I'd like to try and maximise some of the learning that was coming out from the conference.

Here we have a typical example of a British square – it happens to be private, sadly, but it really embraces an awful lot that we would like to see about green space. It's got shade, it's got diversity of planting, hopefully it's got some biodiversity, it's got some sculpture; sadly, it's private, so it's got no people, but it's basically the kind of green space we'd like to see.

This slide here is Highlands, a recently restored landscape with beautiful vistas across to the lake down into the distance. Large landscapes.

Smaller landscapes, this is actually Mile End and again we are looking at new ways of creating grasslands in our urban environments but how sustainable are they and how could they be managed?

Well, this is Centennial Park in Sydney; they still have grass and Sydney has had drought for the last four years. Water is a major issue but through the selection of species they are still able to keep relatively green areas. So they still do manage to keep green grass but it does brown off more dramatically during their peak summer.

This is Singapore, not quite the climate we are predicting here, but just to show that there are different grasses. That looks like a lawn but when you actually come up close to it, it's nothing like the grass we've ever sat on before. It's a very coarse grass species.

Our major avenues that we love so much in our parks, well they equally love them in Australia, and that's Canberra. It was a city designed by Dame Sylvia Crow and you can see this very striking central axis running through the settlement with this dammed river creating a water body. Trees are a vital part of the whole urban environment here. They have got to try and replace seven thousand trees very rapidly within that settlement, basically because of drought, but also because the trees don't live anything like as long. This was planted in the 1950's and already trees are needing to be replaced.

So this thing about a warmer climate means that many of the species we know today will have a much shorter lifespan and therefore perhaps it gives us a chance to plan into the future by experimenting with some and by replacing others as we find they are not so successful. It's certainly indicating that trees in the future won't have the lifespan of two to three hundred years that we can find with some of our structural trees here.

The park is pretty similar so a lot of western and European design; the early settlers looking at the parks of their childhood, tried to recreate them, and often with many of the European species.

It's very interesting that in Melbourne and this part of Canberra, these are the places where you experience autumn in Australia, nowhere else because the flora is evergreen. But they do actually provide in the peak of summer corridors through which you can circulate through the landscape so here is someone sitting just on the edge, but this whole belt of trees is where people are walking, they aren't walking out in the open space. They weren't out in the grasslands, they were trying to look at shade to be able to navigate around.

This is Centennial Park – it's a huge parkland about the size of Hyde Park and Kensington Gardens together, and to actually get around it, people are actually navigating by the tree belts. Again I was amazed to see an avenue of elm, lost to this country, a beautiful avenue of trees but again now coming under stress.

More native species – again strong avenues, but when it comes to roadside planting, hardly any of the examples I saw were of native trees for the very reason that they haven't had as much time to select for the same standard form of tree so a lot of the native flora and fauna is unpredictable in how it will grow. This looks to be quite a regimented roadside.

But the other thing you should notice about it and I noticed throughout was short grass. What they say is that we don't want long grass as it's a fire risk and the idea that a lot of us are moving towards more natural planting, but as we warm up this may become something that we don't actually want to use so extensively. We have to manage things carefully into the future.

Again if you are travelling through a hot landscape you want shelter and shade and this is in the Sydney Olympic Park and we've got a whole run of fig trees providing that lovely avenue, you can walk under it. Across the road, these amazing lamp standards, which are actually solar lights, and collect enough power not only to light and provide electricity for the park but also to put electricity back into the grid. Again the kind of things that we could expect in the future. No one is walking on that side of the road because it's too hot so again this is providing the natural corridor through that landscape.

To take you to an extreme in terms of roadside landscape, this is Singapore, and just about every square metre is used and greened. It's the symbol of the city and they want to be known as the greenest city in the world and they put an awful lot of effort into it. So here's a simple road interchange planted along the top of the barrier, a simple walkway just going across the road – this is Singapore's average roadside landscape, something that we just don't even aspire to at the moment.

Water, one of the major elements of our appreciation of landscape, and clearly from what we have heard today, water is going to be a major issue into the future. Not only in the fact that its coming down in short bursts, but because it's coming down in short bursts we need to capture it and I think the suggestion that is starting to percolate through shall we say, is that we are capturing it in our parks as well and we need to start using parks as storm water run off resources, we need to make sure that water is an essential part of our planning for our green space and we need to identify how we are going to manage it.

Again if we look to Canberra, they've done this lake and they can actually manage this water resource and even have a fountain, even in a very hot landscape. Sydney again, the Olympic Park, beautiful fountain and again the water supply is not an issue because they've done an awful lot to conserve their water. In Centennial Park, a much older structure, much more difficult, and in fact they've had to let, as you can see, the water level go down here and they now manage their water to a lower level and there is clearly an issue following up. If the drought that has gone on for four years continues, then perhaps they will have to readdress their water treatment to their ponds and to start looking at perhaps other things, like lakeside planting.

In the Olympic Park, they have been fortunate, and it wasn't actually planned in this way, this was due to be a multi-storey car park and filled in but they found a rare toad in here and were therefore prohibited to develop it. The benefits have been enormous, it provides a huge reservoir now for the whole site and that water had to be re-interpreted and they put this whole walkway all around it and that is very attractive. But they recycle 850 million litres of water to go back into the water system from the park. I'm told that it's perfectly fit to drink but the Australians don't like to think that they are drinking sewage so its used in different ways but the actual fact that they are recycling to such a level I think puts many of us to shame.

Again some new developments, water is involved for run off purposes but also aesthetics and actually managing the water resources very well. Again it doesn't always have to be canalised so it's much more informal and again with the example of Chimbrook Meadows earlier. It doesn't mean to say that we can't have fantastic designed elements of water.

This one is from San Francisco, and perhaps we should start to soften some of these designed with waterside planting which will also give the ability to start varying this water edge with different kinds of planting depending on what level of water is within the water body.

Just a fascinating one I couldn't resist; Singapore has rainfall about four or five o'clock every day and they actually have a water shortage because no one has ever bothered to collect it and I think that sends a message back to us about the future. If we don't bother to collect the water, it doesn't matter how often it rains you don't have it at your fingertips to use when you want to.

Flowers, again everyone loves flowers, adding interest to public space but if we are going to manage these flowers, we need to adapt them to the climate. Looking at the soil type, we can actually adapt planting and still have interesting planting areas. In San Francisco they have perlargoniums all year round, but equally they use water in a way that catches the water in this pond and therefore they can grow papyrus.

A little rant – benches- if we are trying to plan for the future, it's not just the planting, it's how people use the sites and this is a big area where perhaps contemporary design is completely missing. That's a perfectly nice bench, fit for use, someone has thought about nice planting around it, there's a tree that's gone in the background that will grow up and provide shade. Here we are in San Francisco with lovely planting, a nice tree; shame about the bench being on a slant, nobody wants to sit on a sliding bench; we can actually see where people have found a flat surface further up.

This is a new bench that has gone up in a park not a million miles away from us. We have a responsibility to point out that a solid metal bench in the full sun is not going to be a pleasant place to sit and this is the kind of thing where managers really do have a responsibility. Sometimes we might have a stab at designers for getting the initial design wrong but managers should be learning from any mistakes and actually putting something back that is better. That's perfectly unusable in the summer and will actually get worse as climate change gives us a hotter season.

Similarly, here is a nicely designed wooden bench, but would you like to sit in the glaring sun with all this white reflective stone and no tree or shade behind it? I think we are getting carried away with design and aesthetics without thinking about the comfort of use.

Here's an example in Manchester, the much vaunted Piccadilly Gardens: same issue. We have got seats out in the full sun, no shelter or shade. Here at Forbury Gardens in Reading the benches are suitably shaded with trees nearby, wood seating; a pleasure to sit on.

There are a whole host of issues to do with play. This is a standard playground in Liverpool. Fascinatingly in Singapore, all the playgrounds had sand on the floor. It was because they have a high standard of maintenance and management and therefore can therefore manage that as the safest surface they know for kids to play on.

Inn the Park in St James' Park has a grass roof, all these kinds of things, looking to a more sustainable building into the future and there is a real example here, a real challenge, that we should be leading by commissioning the right sort of buildings in our parks that show that we are looking at sustainability and we understand climate change and that we don't put any old rubbish into our parks. If we start to lead by example we can show that we are serious about the issues that we advocate.

This is the new restaurant in Albert Park in Melbourne opposite the hotel where I was staying, but apparently it did pass a water audit and a sustainability audit, you just can't see it. I'm told that it's a very energy efficient building but again it didn't exactly communicate this.

This is the showcase park, for Parks Victoria, and they are mainly managing wilderness areas and protected areas and this whole landscape didn't suggest that that's their business that they're in. So I think it's also trying to link what we do and communicate it to the public to get that message across.

Another trend that we are likely to see is the use of parks much more for local food production. Here Dig for Victory was something that we all knew about, we may not have been around at the time, but we certainly have heard about it, and these very grainy slides of Greenwich Park before the war and during, being dug up for vegetable production. But it does raise an issue that surrounding our parks, we shouldn't lose sight of the fact that local production is going to become ever increasing, fuel costs going up, the health benefits, the enthusing of getting people to get out and use allotments, that's going to be a trend that perhaps we should be inviting in to parks and urban green spaces.

Here are superb community gardens. There are really not many of this kind or nature in the UK but certainly in the US, very similar, this combines play, vegetable growing, family fun, you name it. It's not about aesthetics, it's about getting involved and doing your own thing.

Fascinatingly, from a building that I was visiting on Monday, just looking out over the Manchester roofscape and it really does hit you, how un-green it is and we've got here buildings that have been refurbished and put in place recently and I think there is a major area there in terms of roof gardens, to really make a change to that kind of landscape so that when we are looking out, that turns green and is not dominated by air conditioning plants.

Again this thing's about trying to make landscapes liveable. Federation Square in Melbourne has won every award going, I believe, but it's a really unpleasant place to be on a hot day, I can assure you. Great to be in the margins of it but in terms of the design of it, absolutely everything actually appalled me, you couldn't see where you were stepping, no idea of about what level you were on, and very few trees. Again opposite this building, was a fabulous old museum, this is the new museum, really sterile, no one wanted to be anywhere near this part of the landscape, just trying to get into the building.

A simple square in London and getting a lot of things right, it might be in the middle of a traffic island, but just wandering through, just snapping some of the things that were going on, it's an urban space with benches, shade, people sitting, a flower stall came, someone actually found it so attractive that they were sitting there painting it. So it's very simple, the equations, one of the comments that Andrew made earlier, he couldn't believe coming to the UK, how we site so many benches in the middle of nowhere and we just ignore what people want.

This is the Peace Gardens and this has the potential to be a really attractive space but no one is using it at the moment because they are not too sure about the vegetation, what's in there, and how they should use it.

Whereas here is a classic example, and I must thank Alan Barber for the slide, of some gardens in Boston where they seem to have got everything right. They have provided seating around, it is lovely wooden seating as you can see, it's so popular people are also using the concrete areas. There's water, there's shade, there's nice inviting planting and it's actually getting that balance and I think that one of the things we've got to concentrate on is how do we sustain this kind of landscape because into the future we are going to have hotter environments, we are going to need more shade and shelter, we've got make our environments much more comfortable and that needs much more investment, much more irrigation and a balance of understanding how we are going to do it and what is it going to cost to provide it.

Thank you

## Question and answer: session 3

### Question 1:

We've talked about irrigation and drier summers and Guy mentioned soil help, but no one has really touched on the use of compost as a mulch and it would be interesting to hear what the panel had to say about that.

### Reply 1 (Guy Barter):

Mulching is by and large beneficial in that it stops evaporation from the surface of the soil, but the vast amount of moisture loss from the soil is from roots and roots are brilliantly designed to extract moisture from the soil, so you can't expect too much from mulch. But what mulch does is that it tends to get taken down by natural process into the soil and improves it, so by and large mulch is very beneficial activity for horticulturists to do and we are having a bit of a debate at Wisley at the moment when our head tree man has gone into the woods and noticed that the natural mulch in the woods is about two inches thick and the Wisley gardeners apply about six inches. So exactly how much mulch is beneficial and how much is harmful is something that we are quite interested in, but by and large I think it's a good thing.

### Question 2:

In Mile End Park we have tried to do large areas of what we call wild meadow, I think you have a different description of it, but we do our best. This year particularly it's been so dry. We are just about getting the public on our side now, they're thinking yes we can support this and then they go completely like straw fields and the kids come along and set fire to them and I'm just wondering whether we are doing more damage than good in some way. Have you got any thoughts about this at all?

Reply 2 (Clive Walmsley):

Well, fire is definitely an issue and fire is more of an issue in urban areas for the reason you gave, but I think again, it's one of a number of risks that you have to try and manage and in places like Australia, fire management is really important. I agree I think it's a potential issue but we shouldn't be defeatist about it. We should be positive and seek to manage those risks and one of the really important things that we try to do on some of our sites which are quite close to urban areas is to try and engage the local community. It will take time and it's a long term game.

