University of East London: the biodiversity evidence-base

UEL University of East London

ERG Environmental Research Group

University of East London: the biodiversity evidence-base

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"Tell me not of joy: there's none,

Now my little Sparrow's gone"

William Cartwright, 17th Century poet

Cover photo: Ox-eye daisy - *Leucantheum vulgare* in flower at UEL's Docklands campus, May 2010 © Stuart Connop

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Executive Summary

- Biological diversity is a multidimensional concept that encompasses genes, species, ecosystems and their functions. Biodiversity is in decline, and the importance of urban areas in protecting biodiversity is being increasingly recognised.
- In terms of land area, the campuses of UK FE & HE institutions amount to 38,000 ha (Dixon *et al.*, 2007). There is therefore the potential to significantly contribute to national and local biodiversity if campuses are managed in a sympathetic manner. It is recognised that the UEL estate is set in an urban area and biodiversity management should reflect this.
- The Environmental Research Group (ERG) at UEL was commissioned to carry out a scoping survey of the current and potential biodiversity interest of the UEL estate.
- A total of 110,422m^2 (0.11km^2) were surveyed across both campuses (Stratford & Docklands). Roof-space (and therefore buildings) accounted for 36% of the survey area, 14% of which were flat roofs. Excluding buildings, hard-space and green-space accounted for 69% and 31% of the survey area respectively. A total of 274 trees were recorded at both campuses and a number of biodiversity hotspots were identified.
- In terms of green-space amenity grassland accounted for more than 50% (11,958m^2) of the survey area. A total of 2,727m^2 of ornamental hedges and 1,039m^2 of ornamental borders were also recorded. Other notable areas of green-space were tree buffers, flower-rich meadows and gravel and shingle.
- The footprint of the Stratford campus measured 27,130m^2 – 12,655m^2 was occupied by buildings of which, 4,922m^2 had flat roofs. Excluding the buildings 68% of Stratford campus was categorised as hard-space and 32% green-space.
- Duncan House survey area was 3,957m^2 with 633m^2 of green-space, made up of amenity grassland and ornamental beds.

- Docklands is the larger campus with a footprint measuring 78,905m^2. In total 177 trees were recorded. Excluding buildings 70% of the footprint was hard-space and 30% green-space. There was more diversity of green-space at Docklands. Nevertheless the majority was still classified as amenity grassland (51%). Flower-rich meadows were recorded at Docklands with 58 species present in 1,565m^2, 3.7 species per 100m^2. This was by far the most species rich habitat recorded for the UEL estate.
- UEL IPAD is a rented dance studio at Trinity Buoy Wharf, which consists of the building, concrete and temporary metal containers.
- A number of recommendations to increase biodiversity across the UEL estate are made; these are broken down into general and specific recommendations. General recommendations include the addition of native planters, creation of flower-rich meadows, sympathetic management of amenity grassland, retro-fitting green roofs where possible and creating areas of permanent and ephemeral standing water.
- More specific recommendations are targeted at species identified in the Newham Local Biodiversity Action Plan (LBAP), including hedgehogs, house sparrows, starlings, and various invertebrates including bumblebees. Supplementary feeding and the provision of nest boxes as well as planting of nectar rich plant species would increase biodiversity interest.
- Some examples of specific actions that could be taken to increase biodiversity for the UEL estate are given for both Stratford and Docklands campuses.
- Finally, further survey work would significantly add to the present baseline and a commitment to improving the biodiversity interest of the UEL estate would benefit students, staff and the local community as well as wildlife.

1 Introduction

2010 is the United Nations (UN) International Year of Biodiversity, making the timing of this work particularly apt. Biodiversity is a word (much like sustainability) that rolls off the tongue very easily, often with little thought given to its actual meaning (Lautenschlager, 1997). So what, then, is biodiversity?

In 1992 the United Nations Convention on Biological Diversity (CBD), also known as the *Rio Convention*, was set up to conserve global biodiversity and ensure the sustainable use of its components. The Convention defined biodiversity as:

"The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." CBD Article 2 (UNEP, 1992)

Biological diversity is thus a multidimensional concept, encompassing genes, species, ecosystems and ecosystem functions (UNEP, 1992; Wilson, 1992). It is no secret that biodiversity is declining and that much of this decline is due to anthropogenic factors. Human-driven climate and land-use change are the greatest threats to biodiversity, particularly in relation to terrestrial biodiversity (Millennium Ecosystem Assessment, 2005a; IPCC, 2007). Furthermore, current predictions show that pressure on biodiversity is almost certainly going to increase (Millennium Ecosystem Assessment, 2005b; Eppink & van den Bergh, 2007). There is a clear economic and moral imperative to conserve biodiversity.

While there are no explicit habitat exemptions in the above definition, the term 'biodiversity' and its associated concepts have traditionally been associated with rural areas: the countryside. Until relatively recently, urban areas have been regarded as having a negative impact on biodiversity, largely as a result of habitat encroachment (Wackernagel & Rees, 1996). While the urban environment is undoubtedly extensively developed and artificial, it is becoming increasingly recognised for its potential to provide a diverse and complex ecosystem, capable of supporting high levels of biodiversity (Savard *et al.*, 2000; Goddard *et al.*, 2009).

1.1 Biodiversity in the UK

The UK Biodiversity Action Plan (UKBAP) was the response of the UK Government to the Convention on Biological Diversity. It "*describes the biological resources of the UK and provides detailed plans for conservation of these resources*" (JNCC, 2010). Within this national framework London is one of nine regions which have their own Biodiversity Action Plan (BAP). This provides an overarching framework for nature conservation in London.

There are also a number of Local Biodiversity Action Plans (LBAP) that are responsible for local priorities and biodiversity interest. In essence this framework is designed to protect, promote and enhance biodiversity across the UK. It is no longer acceptable to only protect biodiversity in designated areas.

1.2 Role of the Higher Education (HE) sector

The HE sector has the potential to play a huge role in conserving biodiversity. Just in terms of land area, UK colleges and universities cover approximately 38,000 hectares (Dixon *et al*., 2007). By protecting and enhancing biodiversity, universities can benefit both their students and staff by providing a pleasant and stimulating environment in which to study and work (English Nature, 2003). Biodiversity-friendly management of estates can also provide a very visible form of environmental action which helps to reinforce other environmental policies and contributes towards the University's role supporting the local community by conserving natural heritage.

1.3 University of East London

The UEL estate has two campuses in the London borough of Newham, which is an urban borough (see Figure 1). It is the third most deprived borough in London and the sixth most deprived in England (Shackleton, 2007). Almost 20% of Newham is classified as green-space with the potential to support wildlife (LUC, 2009). This green-space incorporates a range of habitats including 40 Sites of Importance for Nature Conservation (SINCs) and a number of nationally or locally important species of mammals, birds and invertebrates are found in the borough (LUC, 2009).

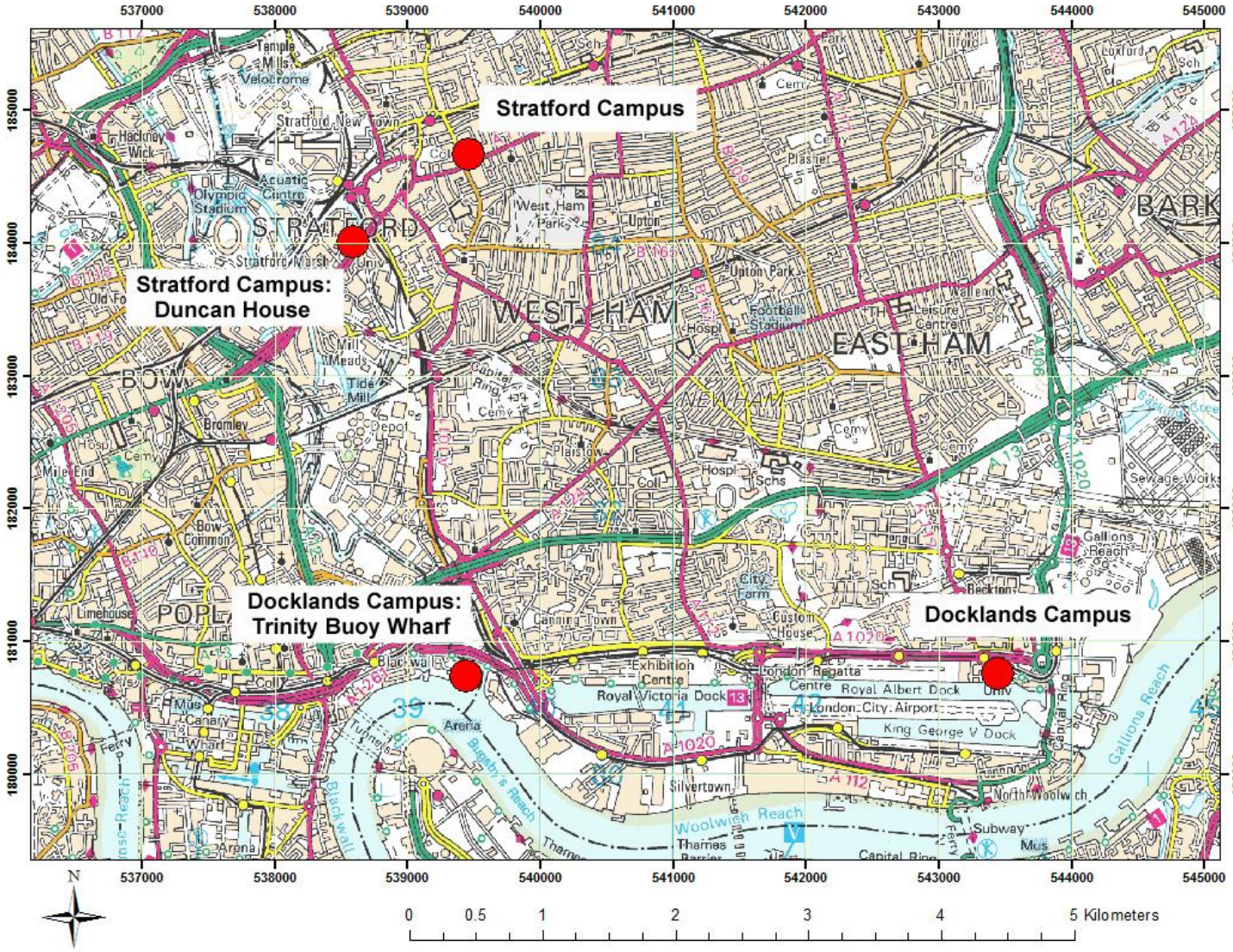


Figure 1: The UEL Estate with Ordnance Survey backdrop. Docklands campus (including Trinity Buoy Wharf) is situated on or near the River Thames whilst the Stratford campus is in the heart of Newham next to the Olympic Park. OS backdrop © Ordnance Survey

2 Purpose of the present report

In order to protect and enhance biodiversity at any site (be it rainforest or university campus) it is very important first to recognise what is already there – that is, the current 'natural capital'.

To this end, the UEL Environmental Research Group (ERG) was commissioned to carry out a baseline survey of biodiversity for the UEL estate, comprising Stratford and Docklands campuses. The survey measured (mapped and described) current biodiversity levels, and this report presents these results and makes recommendations for enhancing biodiversity across the estate.

It is worth noting that while we recognise there are a number of conflicting interests and aims in estates management, this report is written in the form of best practice in terms of biodiversity management.

3 Methodology

Biodiversity is a multidimensional concept and can be measured on a number of spatial and temporal scales, in a hierarchical system. It is therefore important in any survey to recognise the scale at which one is measuring biodiversity (Savard *et al.*, 2000; Lindsay, 2010). As mentioned above, this particular survey was designed as a scoping study, with the objective of gathering a range of useful baseline information. In effect, we were measuring biodiversity at a broad-scale, compartmentalising the university campus. Based on the defined compartments, recommendations were made for areas (within the UEL estate) that warranted more detailed, finer-scale study.

It was decided that a set of broad-scale data should be gathered to provide a baseline dataset on which further surveys could be built upon. In the first instance we wanted to be able to categorise the survey area, Stratford (including Duncan House) and Docklands (including Trinity Buoy Wharf) campuses, into meaningful descriptive units or habitat types.

To this end, aerial photography of UEL campuses was purchased (from www.getmapping.com) at 25 x 25 cm resolution and geo-referenced using ArcGIS (ESRI). A land-use footprint was generated for each campus and a set of detailed maps produced (see for example Figure 2).

The survey was carried out on the 18th, 19th and 20th May 2010 by Dr Stuart Connop and Jamie Freeman. During the survey, maps were ground-truthed and each site was categorised into a set of descriptive units. Methodology was loosely based on Phase 1 Habitat Survey (NCC, 1990). However, given the nature of the survey area a number of specific units (at a finer scale than Phase 1 Habitat Survey) were developed in order to capture an extra level of detail. Descriptive units are shown in Table 1.

Recorders surveyed all campuses from the roof-space down to ground level, breaking them down into their descriptive units (habitat types). The extent of each unit was noted on maps, a description made and species noted where appropriate. Nomenclature for flora follows Stace (2010). This provided a good estimate of areas for each habitat type. It should be noted that biodiversity interest on vertical surfaces (although recorded) will be under-represented in terms of area as a result.

Due to the spatial scale at which biodiversity was measured for this particular survey lower plants (in particular mosses and lichens) were not recorded. However these should not be entirely overlooked and there are some important implications for estates management that will be discussed below.

During the survey an explicit note of areas we considered to be of (relatively) high biodiversity interest, in order that they are recognised and protected (where possible). Such

areas were also flagged as requiring further, fine-scale survey work. This is a widely accepted ecological management tool and these areas are termed 'biodiversity hotspots' (Kati *et al.*, 2004)[1].

All baseline data were stored in an Excel database and are available from the ERG on request. All descriptive units were also digitised into GIS in order to produce the maps and area measurements contained within this report. These data form a comprehensive baseline that can be updated as and when appropriate.

In addition, notes were made of all mammals, birds and invertebrates encountered during the course of the survey. Here nomenclature follows MacDonald and Barrett (1993), Mullarney (1999) and Chinery (1993).

[1] Although a widely accepted ecological management tool it is most commonly used on a much larger, global scale. For example, 44% of the known species of all plants occur on just 12% of the earth's surface and are endemic to 25 'biodiversity hotspots' (Myers *et al.*, 2000; Mittermeier *et al.*, 2000). Here we have borrowed the term for areas of potential biodiversity interest within the UEL estate.

Table 1: Complete list of descriptive units for UEL estate with code, habitat type and a brief description. A total of 34 descriptive units were recorded during survey, reflecting the complex and variable nature of the survey area.

Code	Habitat type	Description
AG	Amenity grassland	established grassland, regularly mown
BA	Balcony	small number of balconies recorded
BS	Bare soil and hardcore	heavy use (no/sparse vegetation)
BU	Tree buffer	raised bed with a number of planted trees
CH	Chimney	large chimney stack
CN	Container	temporary or permanent metal storage
CO	Concrete and tarmac	paved areas and car parks
CS	Cycle shed	Perspex-covered cycle sheds
DE	Decking	wooden landscaping feature
FM	Flower rich meadow	species-rich grassland, cut annually
FR	Flat roof	flat roofs (potential for green roofs)
GA	Gabion wall	lose stone wall constructions
GD	Garden	managed gardens
GN	Greenhouse	in Stratford atrium
GR	Gravel and shingle	potential invertebrate habitat
MF	Metal frame	climbing plants could be added
MW	Mud wall	temporary structures outside rear of AVA building
NE	Nest	probable site of bird nests
OB	Ornamental bed	ornamental plantings/flowerbeds
OH	Ornamental hedge	hedgerows, largely planted with ornamental species
OW	Old wall	old brick walls, potential invertebrates habitat
PO	Porch	small porches
PR	Pitched roof	roof-space with a steep pitch
SB	Shrub	includes large shrubs and small sprays (e.g. *Buddleja*)
SP	Stereo-photos	site where stereo-photographs were taken
SR	Sloping roof	with a more gentle slope than PR
ST	Staircase	potential for climbing plants/green walls
TB	Tree base	raised base for single tree plantings
TE	Tree	several species recorded
TR	Terraced roof	roof to new conference centre at Stratford
TS	Tree site	obvious former site of tree planting
TU	Turf	recently laid turf
WF	Wooden frame	ornamental trellis feature
WM	Water margin	edge of dock at Docklands campus

4 Results

A total area of 110,422m^2 (0.11km^2) was surveyed across both campuses. At all sites the amount of hard-space (e.g. concrete and tarmac) substantially exceeded that of green-space (e.g. amenity grassland, ornamental hedges and gravel and shingle). At ground level, a total of 48,167m^2 of hard-space was recorded, compared with 21,252m^2 of green-space. Roof-space (and therefore buildings) accounted for 40,338m^2 of the survey area. The remainder (665m^2) was made up of small areas with cycle sheds or greenhouses, for example.

Of the total roof-space, 31% (17,828m^2) comprised flat-roofs with an additional flat area of 612m^2 in the form of temporary and permanent metal containers. These areas have the potential to form an extensive habitat network (14% of the total survey area) in the form of green roofs.

Discounting buildings, 69% and 31% of the survey area was hard-space and green-space respectively. In terms of green-space, amenity grassland accounted for more than half (11,958m^2) of the total area. A further 2,727m^2 of ornamental hedges and 1,039m^2 of ornamental borders were also recorded. In addition a total of 274 trees were recorded for both campuses. A number of biodiversity hotspots were identified at both Stratford and Docklands.

4.1 Stratford campus

4.1.1 Stratford Main Campus

Located in the heart of Stratford (at the corner of Romford Road and Water Lane), UEL's historic campus is a mixture of old and modern buildings. University House was built in 1898 (it subsequently burned down and was rebuilt in 1899) at which time it was known as West Ham Technical Institute. The Arthur Edwards building was added in 1982 and the Clinical Education Centre, Cass School of Education and Computer Conference Centre have all been added in the last decade. There are also a number of temporary buildings at Stratford, the largest of which is the R-Building.

The survey of Stratford campus was carried out on the 18th May. At the time of the survey, the Stratford footprint occupied an area of 27,130m^2 (0.027km^2). Hard-space comprised 9,698 m^2 (68%) and green-space 4,597m^2 (32%) (see Figure 2). Hard-space was predominantly made up of concrete (CO: 7,861m^2) with a smaller amount of bare soil and hardcore (BS: 1,837m^2) at the car-park on the far north of the site. It should be noted here that the car park has recently been re-laid with tarmac, subsequent to the present survey. The habitat types and areas of green-space are shown in Table 2.

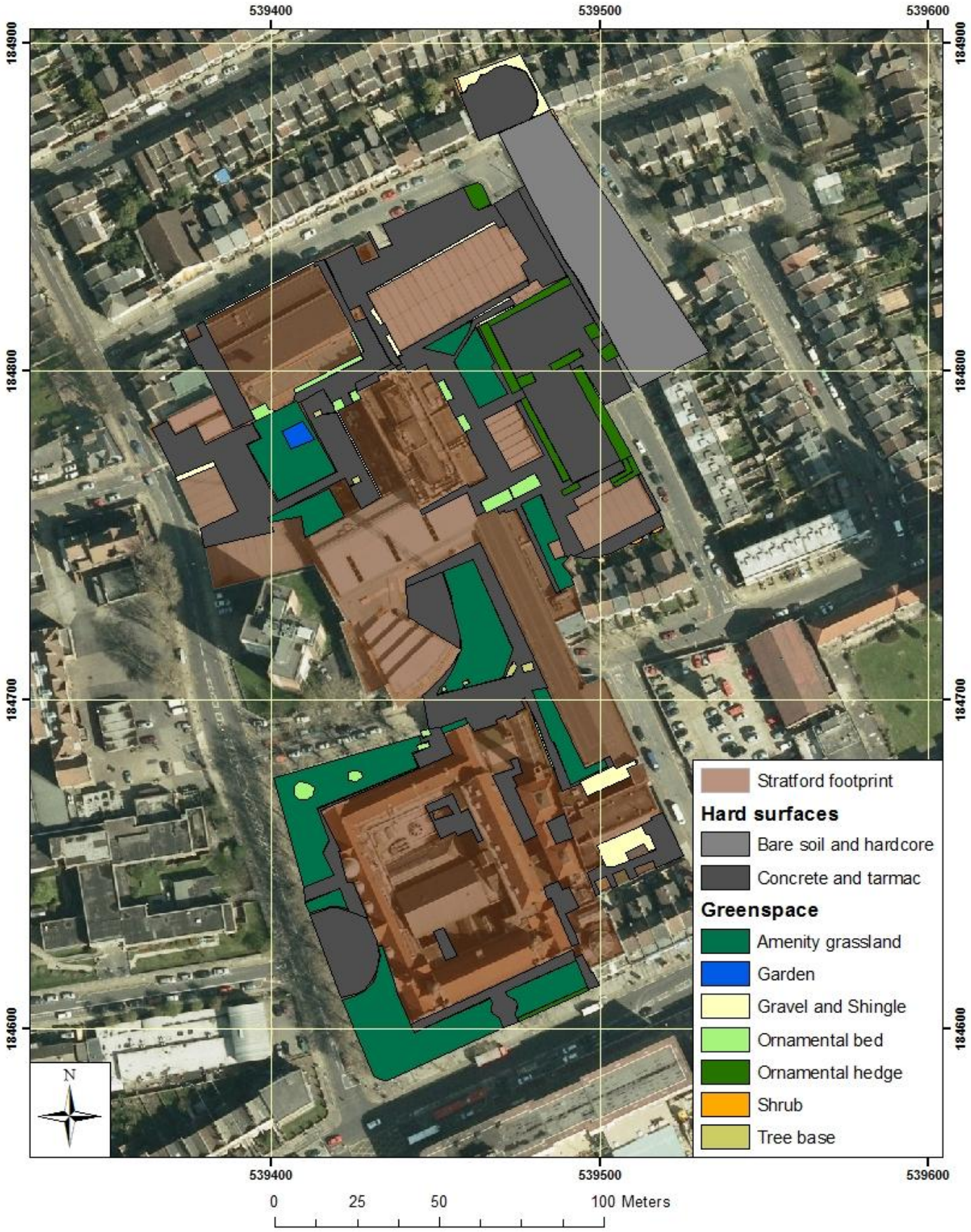


Figure 2: Footprint for Stratford campus showing amount of hard-space (68%) compared with green-space (32%). Aerial photograph backdrop © Getmapping.com

As can be seen from Table 2, amenity grassland comprised by far the largest area of green-space at Stratford, with substantial areas of gravel and shingle (GR), ornamental hedges (OH) and borders (OB). The garden (GD) unit recorded was an ornamental garden situated outside Cass School of Education.

Table 2: Green-space at Stratford Campus showing the different habitat types and corresponding areas with associated pie chart. Amenity grassland clearly accounts for the majority (74%) of green-space at Stratford.

Code	Habitat type	Area (m^2)
AG	Amenity grassland	**3405**
OH	Ornamental hedge	**477**
GD	Garden	**470**
GR	Gravel	**391**
OB	Ornamental border	**234**
TB	Tree border	**30**
SB	Shrub	**13**

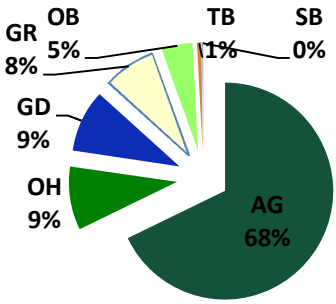


Figure 2 shows that much of the amenity grassland was distributed around University House with smaller areas between University House and the Arthur Edwards building and near the Cass School of Education and R-building. Almost all the ornamental hedges were situated around the car park at Stratford.

The distribution of ornamental beds can also be seen in Figure 2. These comprise ornamental rose (*Rosa spp*.) beds outside University House in addition to two small lavender (*Lavendula spp*.) beds. A large raised planter was also recorded outside Arthur Edwards building. This was planted with herbs (sage, thyme and rosemary) and ivy (*Hedera helix*). There were also a number of smaller beds outside Cass School of Education and Arthur Edwards, predominantly planted with lesser periwinkle (*Vinca minor*). Tree bases are planted with ivy (*Hedera helix*).

A total of 77 trees were recorded at Stratford comprising 13 different species. The distribution of trees can be seen in Figure 3. The distribution of trees predominantly followed that of the amenity grassland and ornamental hedges. Black poplar (*Populus nigra*), London plane (*Platanus x hispanica*), false acacia (*Robinia pseudoacaia*) and wild cherry (*Prunus avium*) were planted around the grassland outside University House. Hazel (*Corylus avellana*) was planted in the hedge that borders the car park.

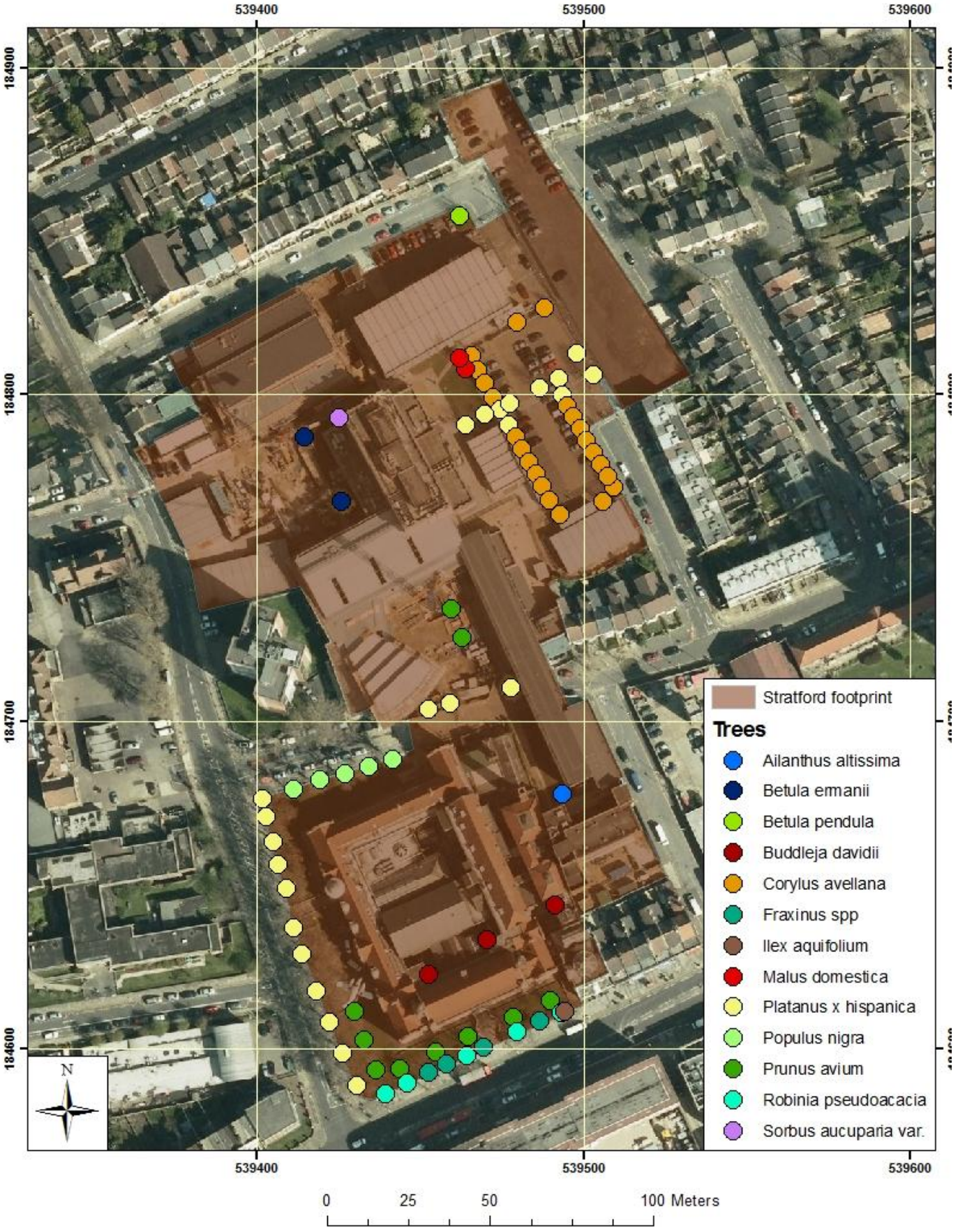


Figure 3: Distribution of trees at Stratford campus. There are a number of mature trees (some with Tree Preservation Orders) around University House (building at the bottom of the present figure). Aerial photograph backdrop © Getmapping.com

In terms of roof-space there was a total area of 12,655 m^2 comprising: pitched roofs (PR: 6627m^2), flat roofs (FR: 4,922m^2), terraced roofs (TR: 506m^2), sloping roofs (SR: 483m^2) and containers (CN: 117m^2). As can be seen from Figure 4, many of the modern buildings (excepting Clinical Education) have flat roofs, as does the Arthur Edwards building. University House comprises a number of small flat roofs at varied heights which the authors believe were originally designed to store rainwater (Personal Communications).

A number of biodiversity hotspots were identified and are shown in Figure 5. These were pre-dominantly areas of gravel and shingle as well as old walls. The larger areas of gravel and shingle may well be important for invertebrates due to the numerous cavities and warm environment of such substrates. Even the smaller areas may act as small refugia and biodiversity corridors. There are two old walls (of biodiversity interest) at Stratford, the first is on the eastern side of University House and is covered in well established ivy (*Hedera helix*). This is likely to be an important habitat for birds on the campus, potentially supporting nesting house sparrows (*Passer domesticus*) a UKBAP species. The second wall is next to M-block and the crumbling brickwork has the potential to be exploited by solitary bees (e.g. *Osmia spp.*). Also identified were 2 ornamental beds outside the entrance to University House, these were planted with lavender (*Lavendula spp.*) and were observed to be a feeding station for bumblebees and honey bees especially. Although not during the present survey, later in the year the authors recorded more than 30 bees (including several *Bombus spp.* and *Apis mellifera*) feeding at any one time. This was in an area of only 10m^2.

Additional species recorded on the day of survey were: fox (*Vulpes vulpes*), woodpigeon (*Columba palumbus*), feral pigeon (*Columba livia*), blackbird (*Turdus merula*) and house sparrow (*Passer domesticus*). Invertebrates were: large white butterfly (*Pieris brassicae*), buff-tailed bumblebee (*Bombus terrestris*), 7-spot ladybird (*Coccinella septempunctata*), St. Marks fly (*Bibio marci*), black garden ant (*Lasius niger*) and woodlouse (*Isopoda spp.*). Further survey would be expected to significantly increase this list.

It is thought that there are two pairs of foxes that regularly breed on the site. The present authors regularly see a resident grey squirrel (*Sciurus carolensis*) outside University House. Pied wagtail (*Motacilla alba*) are regularly seen feeding on the amenity grassland between University House and Arthur Edwards building. A kestrel (*Falco tinnunculus*) has also been spotted on campus recently.

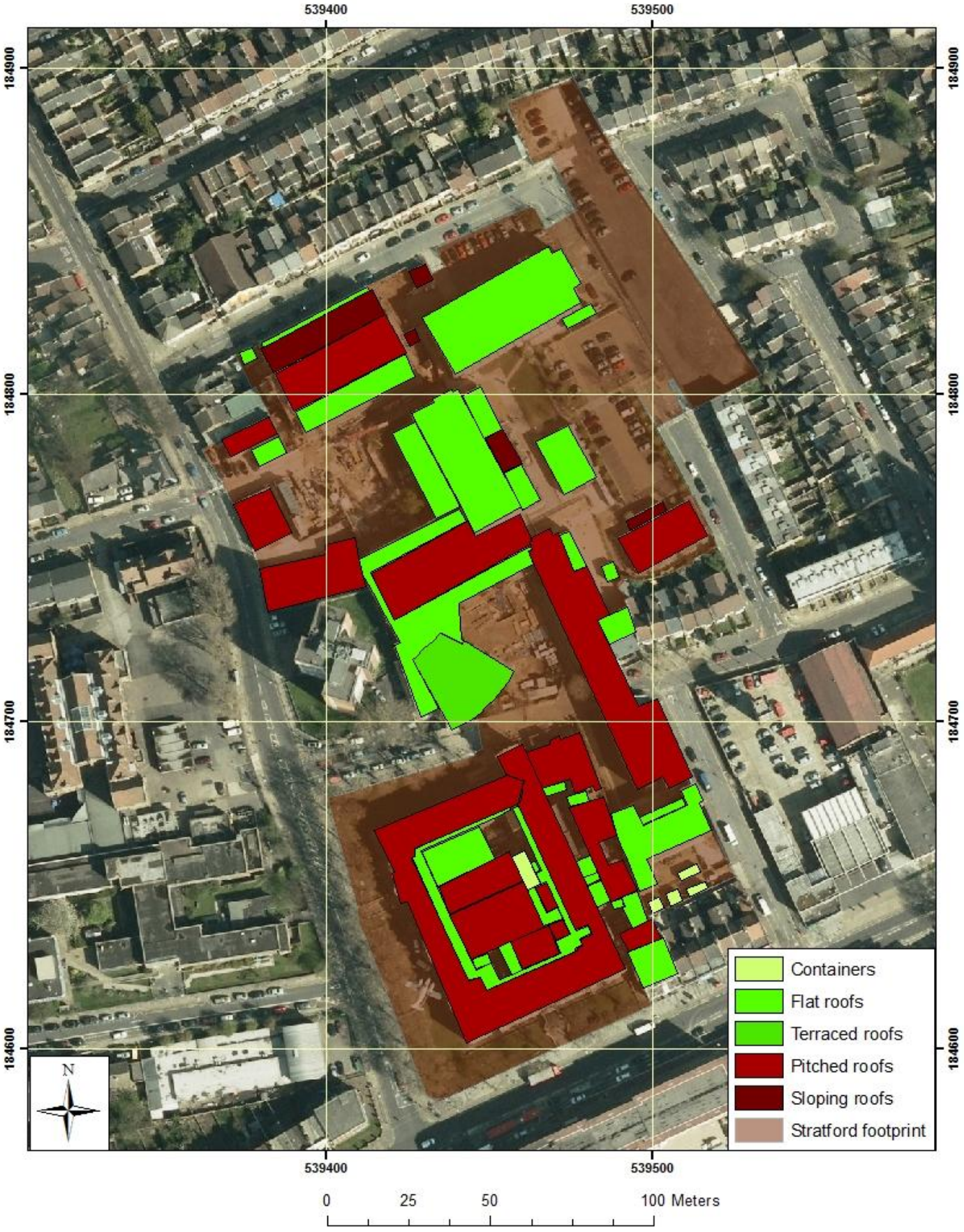


Figure 4: Showing roof space at Stratford campus. The Computer Conference Centre and Arthur Edwards buildings have extensive flat roofs that are potentially suitable for green roofs. Aerial photograph backdrop ©

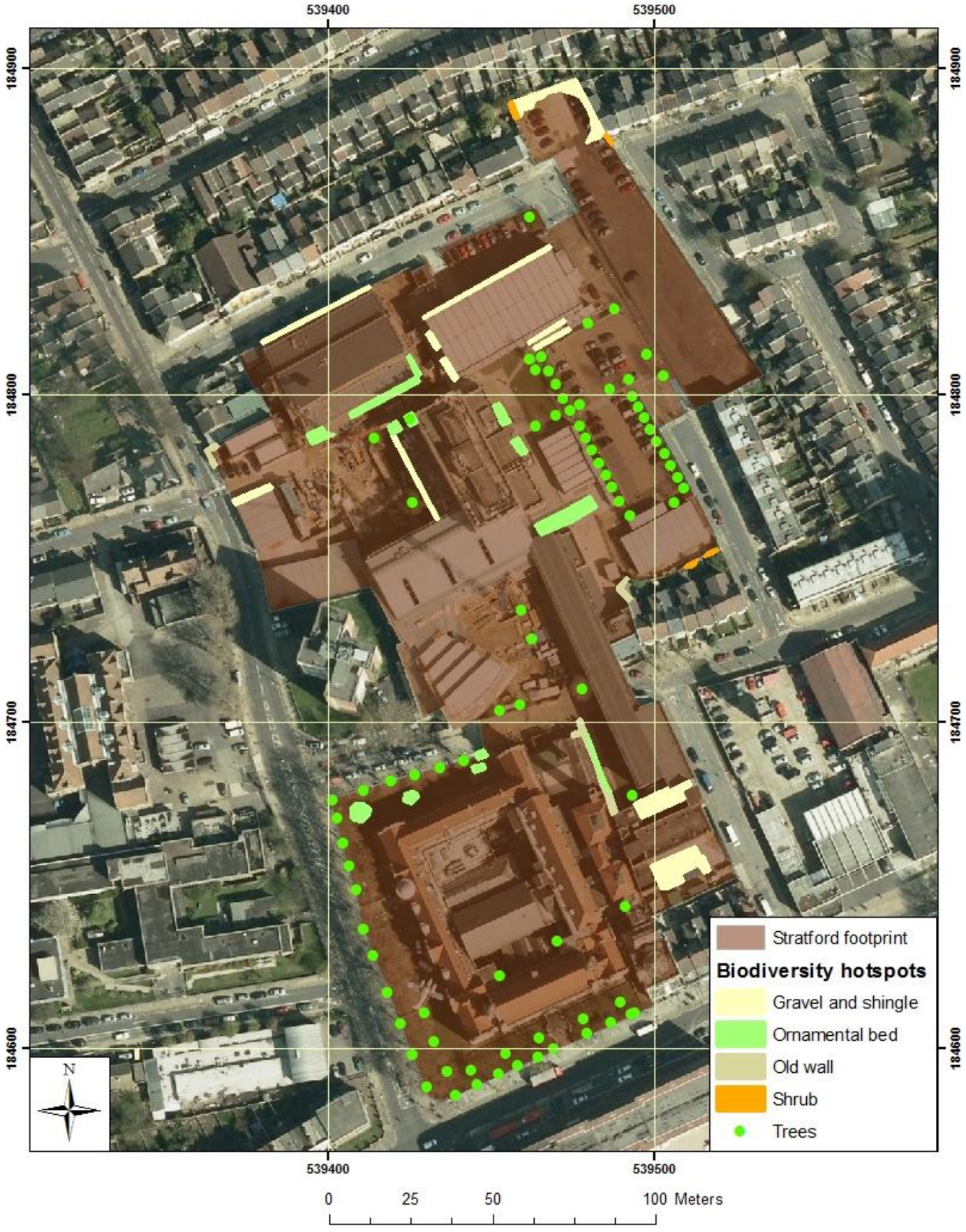


Figure 5: Biodiversity hotspots at Stratford campus, including old walls with ivy, ornamental beds, shrubs and trees

(particularly the mature trees outside University House). These areas merit further survey work. Aerial photograph backdrop © Getmapping.com

4.1.2 Duncan House

An outlier of the Stratford Campus, Duncan House is situated just outside Stratford town centre on Mile End road housing HR Services and the School of Law.

A total area of 3,957m^2 was surveyed on the 20th May. At ground level, hard-space accounted for 1,228m^2 (66%), all of which was concrete and tarmac (CO).Green-space amounted to 633m^2 (34%) of the footprint (excluding the building - see Figure 6). Green-space was a mixture of amenity grassland (AG: 482m^2; 76%) and ornamental hedges (OH: 151m^2; 24%) the distribution of which can also be seen in Figure 6.

In total 20 trees were recorded at Duncan House; *Acer campestre* (7), *Acer pseudoplatanus* (4), *Betula pendula* (2), *Rhododendron spp*. (3) and *Robinia pseudoacacia* (4). These were mainly distributed around the front entrance and amongst the ornamental hedge that encircled the car-park (see Figure 7).

The roof-space at Duncan House consisted of a flat roof (FR: 2,081m^2) over the main building and a small porch (PO: 15m^2) over the front entrance (see Figure 8).

No additional species were noted at Duncan House and no biodiversity hotspots were identified. Further survey work would potentially identify some mammals, birds and invertebrates.

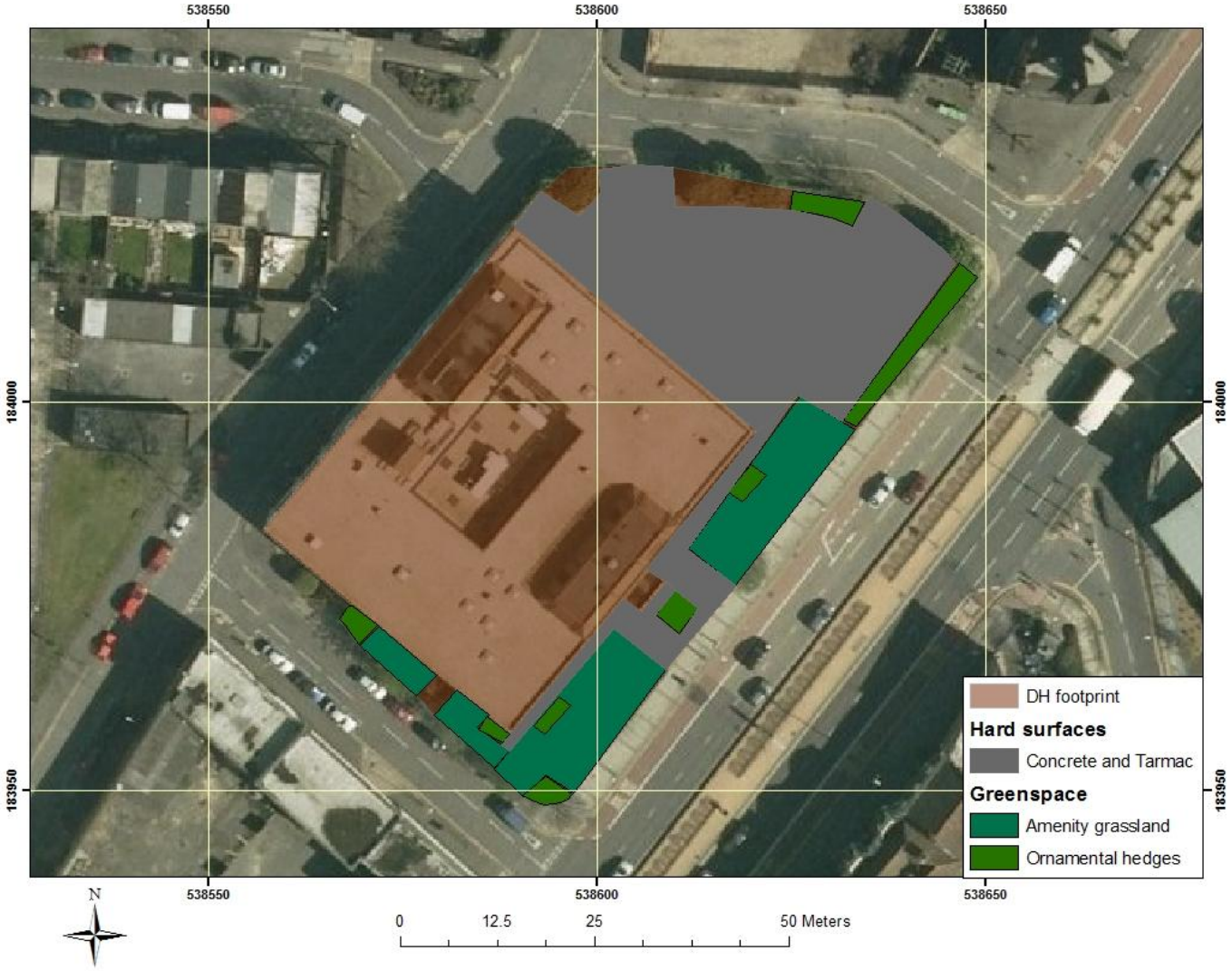


Figure 6: Hard-space and green-space at Duncan House, comprising 66% and 34% of the footprint respectively (excluding the building). All of the hard-space at Duncan House was concrete whilst the green-space was predominantly amenity grassland with small ornamental beds. Aerial photograph backdrop © Getmapping.com

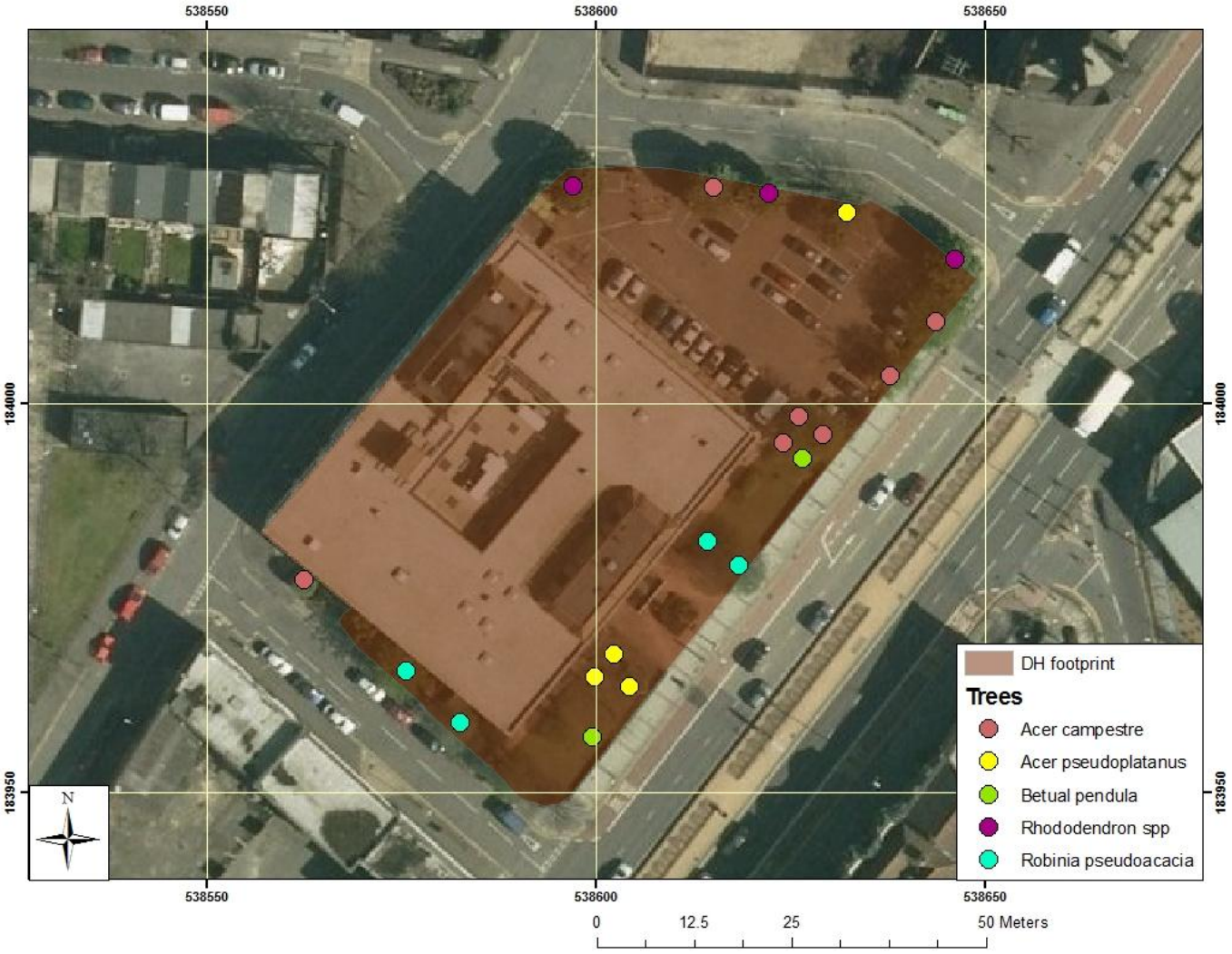


Figure 7: Distribution of tree species at Duncan House. A total of 20 trees were recorded at Duncan House. Aerial photograph backdrop © Getmapping.com

Figure 8: Duncan House featured a large flat roof on the single building, with a small porch. This comprised potential for a retro-fit green roof. Aerial photograph backdrop © Getmapping.com

4.2 Docklands campus

4.2.1 Docklands Main campus

Docklands is modern campus, having opened in 2000. It is situated on the north shore of Royal Albert Dock with a waterside setting adjacent to City Airport. Home to a number of schools and services, it also includes the Knowledge Dock Business Centre (an enterprise development service) and halls of residence which house approximately 1,000 students.

Survey of the Docklands campus was carried out on the 19th May. Docklands occupied a footprint of 78,905m^2 (0.079km^2). At ground-level, hard-space accounted for 37,199m^2 (70%) of the footprint, while green-space comprised 16,022m^2 (30%) (excluding buildings - see Figure 9). Again, concrete and tarmac (CO: 36,822m^2) formed the vast majority of the hard-space with very small areas of bare soil and hardcore (BS) and decking (DE). A breakdown of the green-space is given in Table 4.

By far the largest amount of green-space was amenity grassland (AG: 8,071m^2). Ornamental hedges (OH: 2,099m^2) and flower rich meadows (FM: 1,565m^2) also accounted for substantial areas of green-space at Docklands. Tree buffers (BU), gravel and shingle (GR), ornamental borders (OB), garden (GD), turf (TU), gabion walls (GA), tree borders (TB) and tree sites (TS) accounted for much smaller areas. The garden (GD) recorded was part of the nursery.

The flower-rich meadows (two sites) were located at the far eastern end of the site, and a species list is presented in Table 3 (also see Figures 10 and 11). A total of 58 species were recorded for both sites, making them the most species-rich of all the recorded descriptive units. The majority of amenity grassland was distributed towards the eastern end of the site, around the student accommodation, with smaller areas breaking up the main buildings on the campus. There was also a long strip that bordered the road into the site. A newer turfed area ran along the north side of the AVA building.

The distribution of ornamental hedges (OH: 2,224m^2) can also be seen in Figure 9. There was an extensive planting around the car park, on the northern side of the student accommodation, and around the AVA and Knowledge Dock buildings.

In total 177 trees were recorded at Docklands comprising 15 different species. The distribution of trees can be seen in Figure 12.

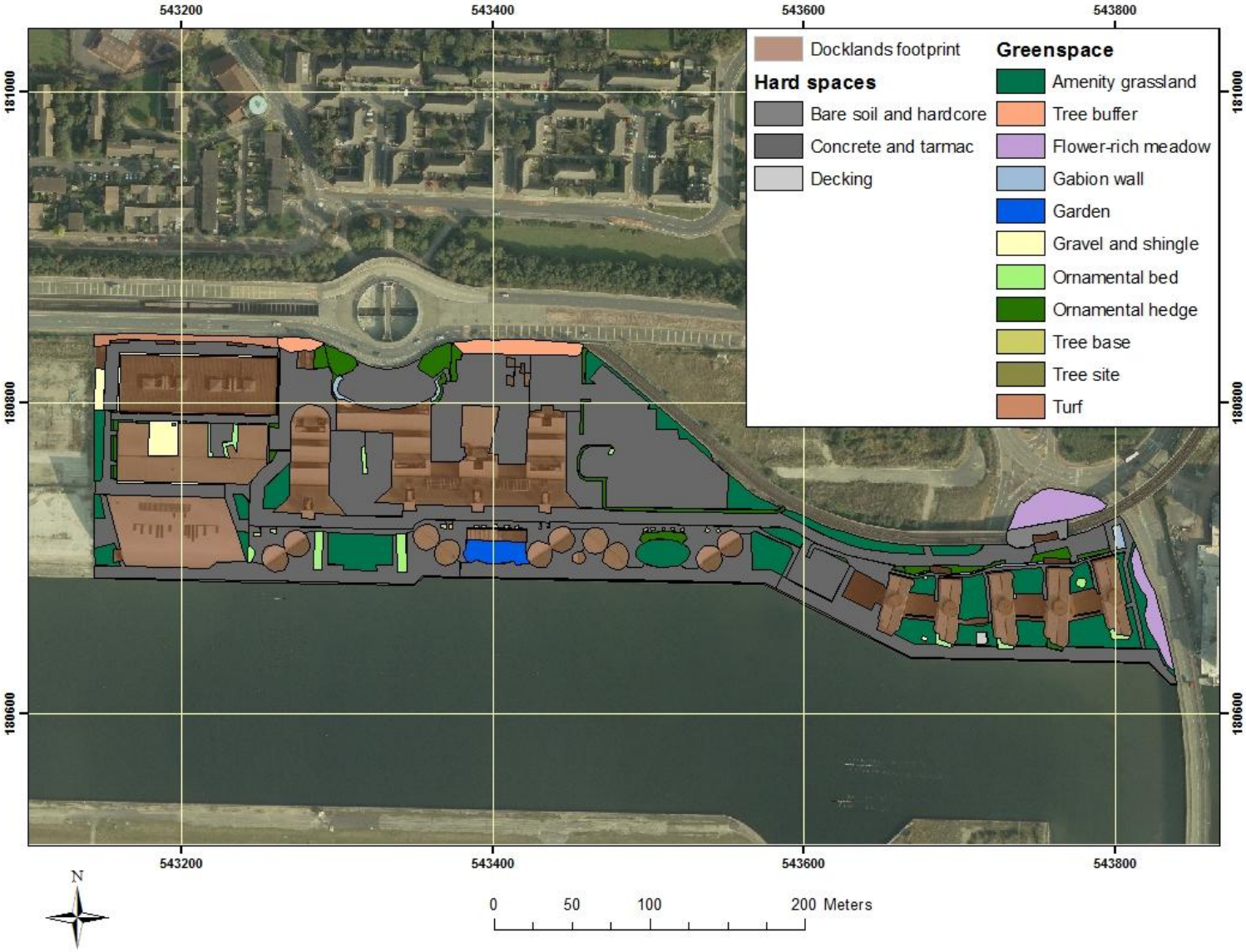


Figure 9: Distribution of hard-space and green-space at Dockland campus. Again, the footprint, excluding buildings was predominantly made up of hard-space which accounted for 70% of the area. Green-space comprised 30% of the area. Aerial photograph backdrop © Getmapping.com

Table 3: Complete species list of higher plants for the 2 flower rich meadows at Docklands campus

Common name	Scientific name
Yarrow	*Achillea millefolium*
Sweet Vernal Grass	*Anthoxanthum odoratum*
Cow Parsley	*Anthriscus sylvestris*
Lesser Burdock	*Arctium minus*
False Oat Grass	*Arrenathium elatius*
Horse-radish	*Armoracia rusticana*
Mugwort	*Artemisia vulgaris*
Sterile Brome	*Bromus sterilis*
Daisy	*Belis perennis*
Borage	*Borago officinalis*
Butterfly Bush	*Buddleja davidii*
Common Knapweed	*Centaurea nigra*
Greater Knapweed	*Centaurea scabiosa*
Common Mouse-ear	*Cerastium fontanum*
Creeping Thistle	*Cirsium arvense*
Hemlock	*Conium maculatum*
Field Bindweed	*Convolvulvus arvensis*
Cock's Foot	*Dactylis glomerata*
Annual Wall Rocket	*Diplotaxis muralis*
Wild Teasel	*Dipsacus fullonum*
Red Fescue	*Festuca rubra*
Fennel	*Foeniculum vulgare*
Cleavers	*Galium aparine*
Ladys Bedstraw	*Galium verum*
Cut-leaved Crane's-bill	*Geranium dissectum*
Dovesfoot Crane's-bill	*Geranium molle*
Yorkshire Fog	*Holcus lanatus*
Great Lettuce	*Lactuca virosa*
Red Dead-nettle	*Lamium purpureum*
Ox-eye Daisy	*Leucantheum vulgare*
Purple Toadfla	*Linaria purpurea*
Perennial Rye Grass	*Lolium perenne*
Bird's-foot-trefoil	*Lotus corniculatus*
Common Mallow	*Malva sylvestris*
Black Medick	*Medica Arabica*
Ribwort Plantain	*Plantago lanceolata*
Meadow Buttercup	*Ranunculus acris*
Wild Migonette	*Reseda lutea*
Bramble	*Rubus fruticosus* agg
Common Sorrel	*Rumex acetosa*
Clustered Dock	*Rumex conglomeratus*
Curled Dock	*Rumex crispus*
Broad-leaved Dock	*Rumex obtusifolius*
Great Burnet	*Sanguisorba officinalis*
Oxford Ragwort	*Senecio squalidis*
Groundsel	*Senecio vulgaris*
Red Campion	*Silene diocia*
White Campion	*Silene latifolia*
Tall Rocket	*Sisymbrium altissimum*
Common Chickweed	*Stellaria media*
Common Comfrey	*Symphytum officinale*
Tansy	*Tanacetum vulgare*
Dandelion	*Taraxicum officinalis* agg.
Hop Trefoil	*Trifolium campestre*
Red Clover	*Trifolium pratense*
White Clover	*Trifolium repens*
Common Nettle	*Urtica dioca*
Common Vetch	*Vicia sativa*

Figure 10: Section of flower rich meadow (D.922) at eastern end of Docklands campus. The white flowers are ox-eye daisy (*Leucantheum vulgare*), which were abundant and flowering on the day of the survey. The tree in the foreground is *Alnus cordata*. Photo © Stuart Connop

Figure 11: *Bombus hortorum* feeding on red clover (*Trifolium pratense*) at flower rich meadow site (D9.22), Docklands campus. Photo ©Stuart Connop

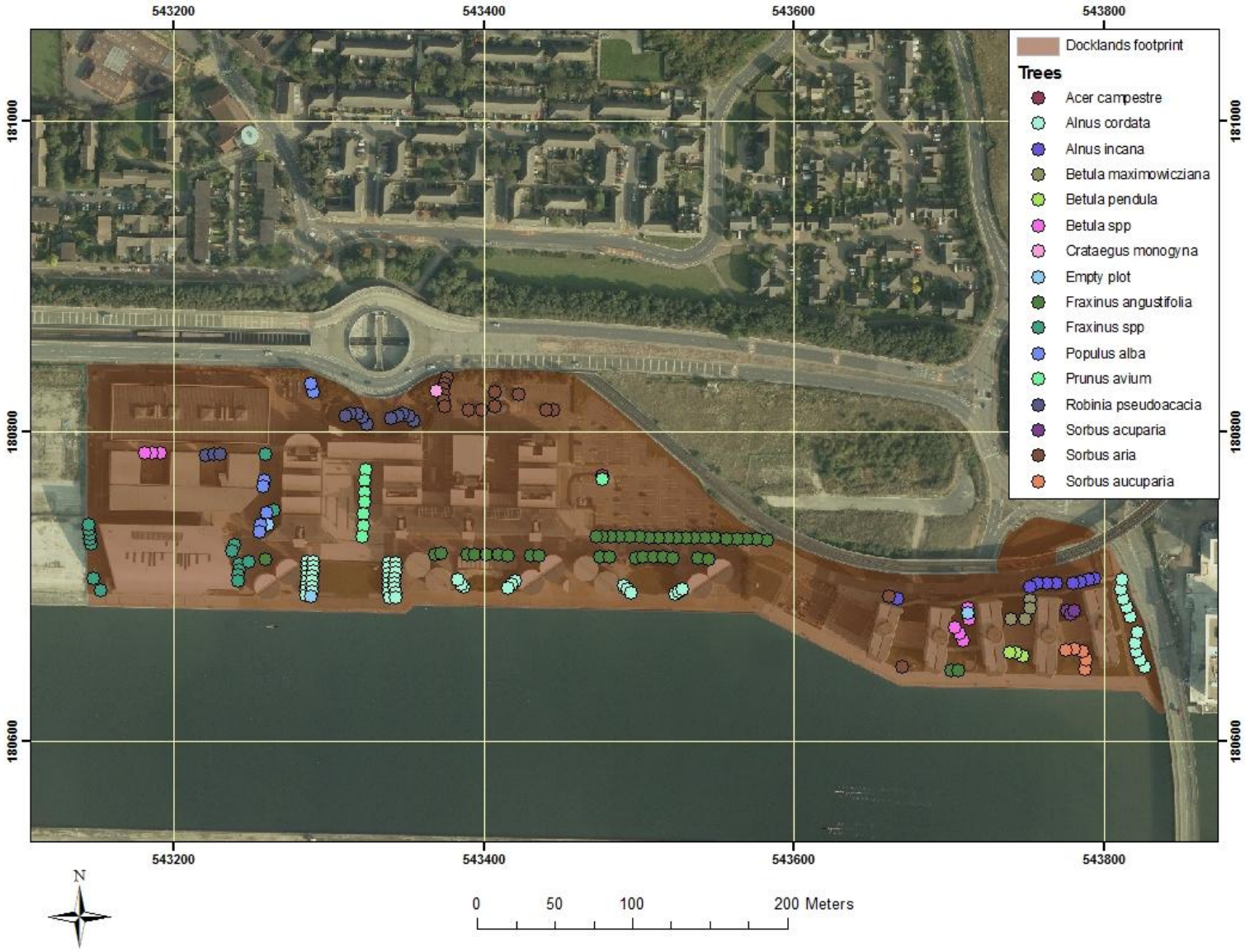
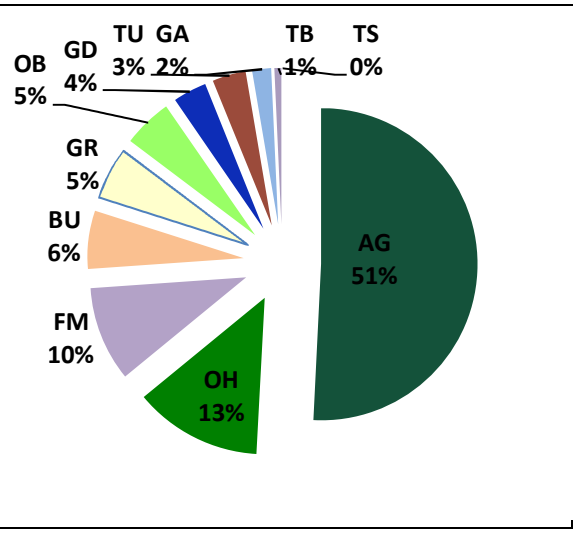


Figure 12: Distribution of trees recorded at Docklands campus. The 177 trees recorded included trees counted in the tree buffers which are not shown here. Aerial photograph backdrop © Getmapping.com

Table 4: Habitat type and area of green-space at Docklands Campus including associated pie chart. Amenity grassland accounted for more than half (51%) of the area of green-space. Ornamental hedges (13%) and flower rich meadows (10%) also contributed significant areas.

Code	Habitat type	Area (m^2)
AG	Amenity grassland	**8071**
OH	Ornamental hedge	**2099**
FM	Flower rich meadow	**1565**
BU	Tree buffer	**953**
GR	Gravel and shingle	**855**
OB	Ornamental border	**805**
GD	Garden	**553**
TU	Turf	**548**
GA	Gabion wall	**315**
TB	Tree border	**109**
TS	Tree site	**4**



There was 25,169m^2 of roof space at the Docklands site, comprising flat (FR: 10,825m^2) and sloping roofs (SR: 14,033m^2, and several containers (CN: 311m^2). For the spatial distribution of the different roof-spaces see Figure 13.

A number of biodiversity hotspots were identified at Docklands (see Figure 14) including:

- Flower-rich meadows
- Garden
- Tree buffers
- Gravel and shingle
- Gabion walls
- Mud walls

No mammals were spotted during the survey of the Docklands site. However, it is likely that there are at least resident foxes (*Vulpes vulpes*) and perhaps grey squirrels (*Sciurus carolensis*). Black-headed gulls (*Larus ridibundus*) and blackbirds (Turdus merula) were spotted as well as a goldfinch (*Carduelis carduelis*) in the Nursery garden. Buff-tailed bumblebee (*Bombus terrestris*), white tailed-bumblebee (*Bombus lucorum*) and two species of solitary bee (one *Osmia spp*. and one *Megachilidae spp*.) were also noted.

A number of invertebrates were recorded at one of the flower rich meadow sites (D9.22). Buff-tailed bumblebee (*Bombus terrestris*.), white tailed-bumblebee (*Bombus lucorum*), garden bumblebee (*Bombus hortorum*), red-tailed bumblebee (*Bombus lapidarius*), common carder bee (*Bombus pascuorum*), wasp (*Vespula vulgaris*), hoverflies (Syrphidae), a number of micro-moths (Lepidoptera) and a 7-spot ladybird (*Coccinella septempunctata*) as well as the caterpillar of six-spot burnett moth (*Zygaena filipendulae*).

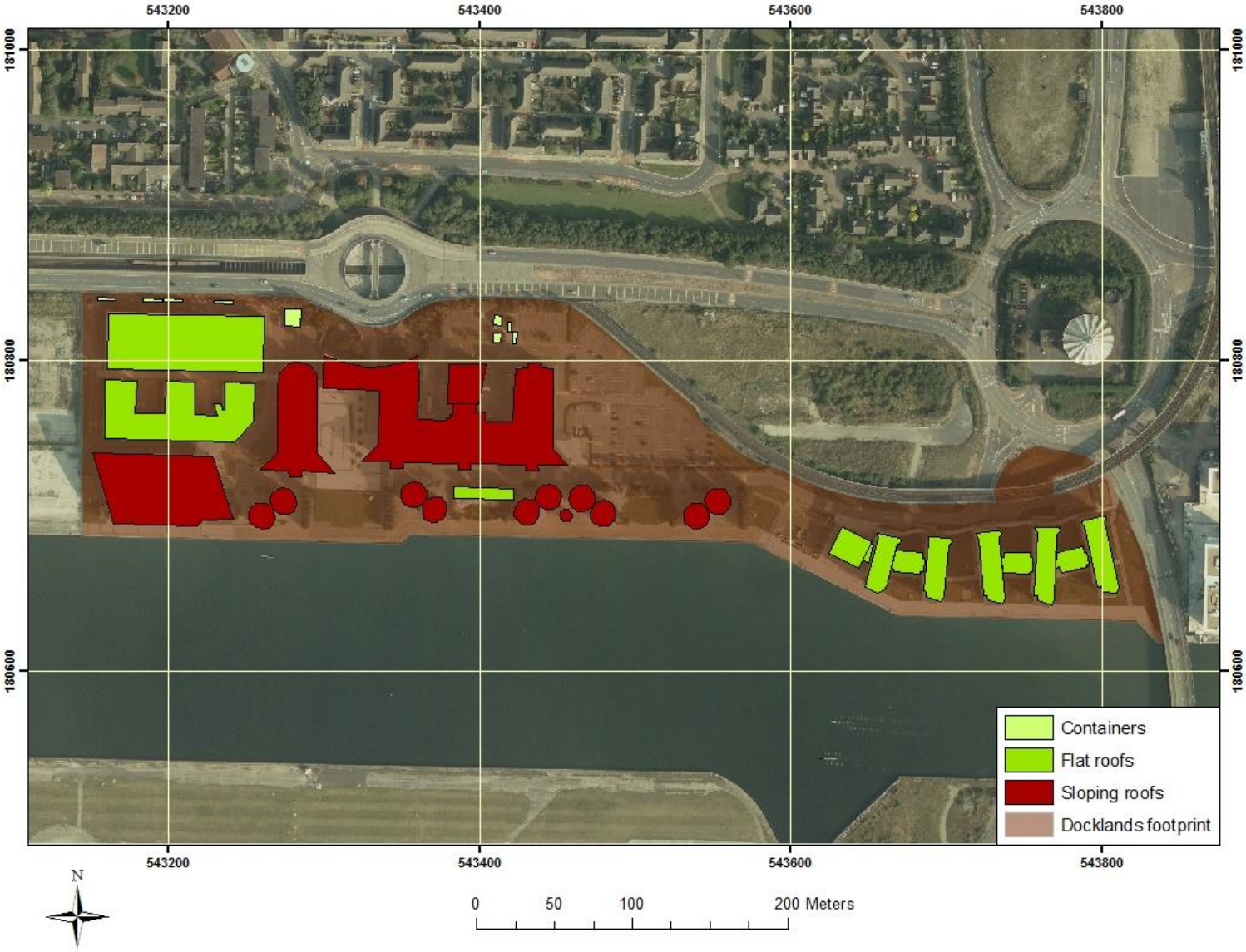


Figure 13: Roof space for Docklands campus. There are large areas of flat roofs on the student accommodation (to the east) which might support green roofs, indeed, one already had a green roof installed. Flat roofs were also present on the AVA and Knowledge Dock buildings. Aerial photograph backdrop © Getmapping.com

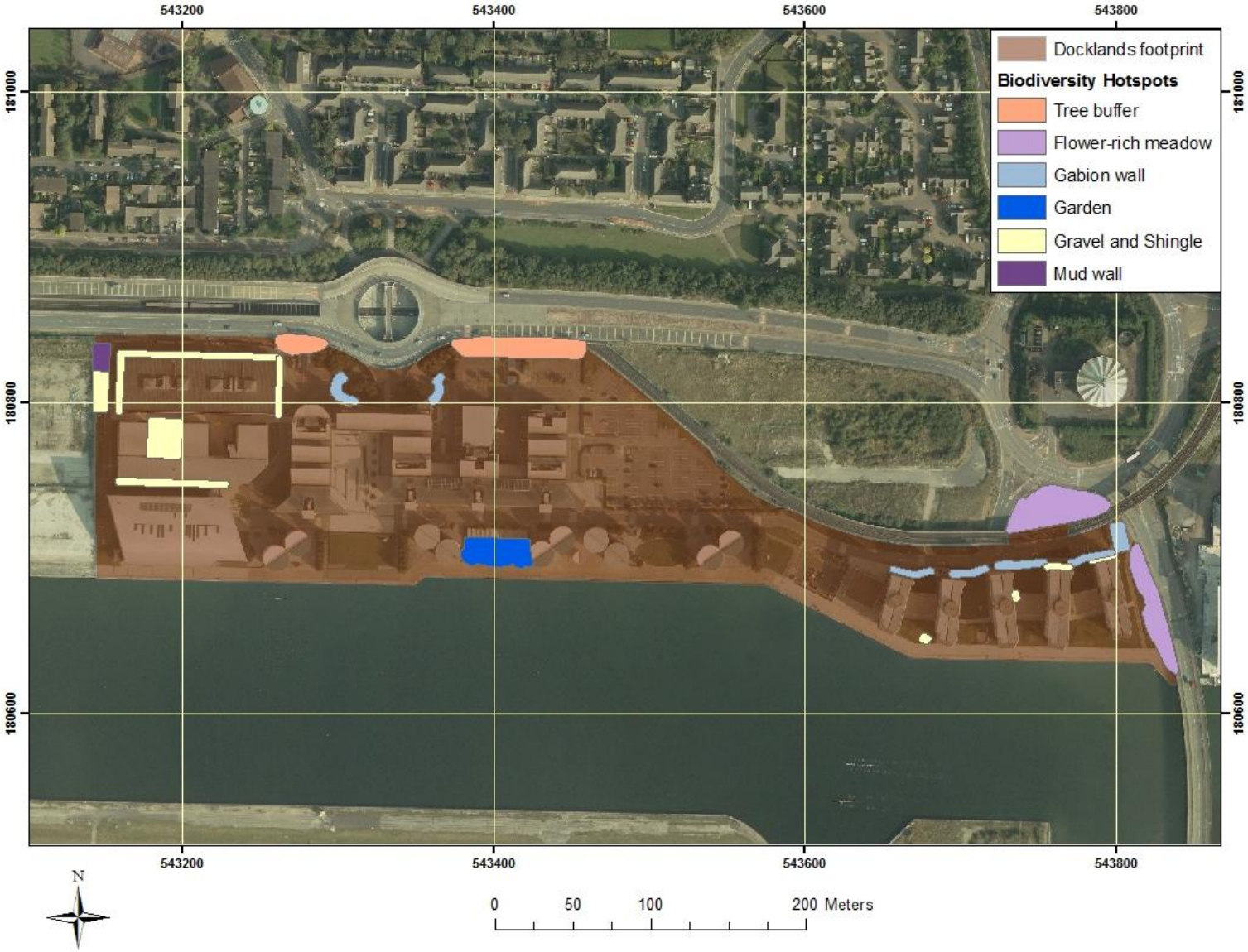


Figure 14: Showing distribution of biodiversity hotspots at Docklands campus, of particular note were the two flower rich meadows to the east of the campus. These were the most species rich of all the descriptive units with 58 species recorded at both sites. Aerial photograph backdrop © Getmapping.com

4.2.2 IPAD, Institute for Performing Arts Development (Trinity Buoy Wharf – Docklands campus)

IPAD at Trinity Buoy Wharf is a dance studio space rented by UEL near the main Docklands campus. The survey for this area was also carried out on the 19th May. The total footprint measured 430m^2. The majority of this was the main building with a pitched roof (PR: 264m^2). There was also 124m^2 of container space (CN). At ground level, only hard-space (CO: 42m^2) was recorded (see figure 15). No additional species were noted, though due to the site's proximity to the River Thames, the roof may be used as a bird perch. Further survey could confirm this.

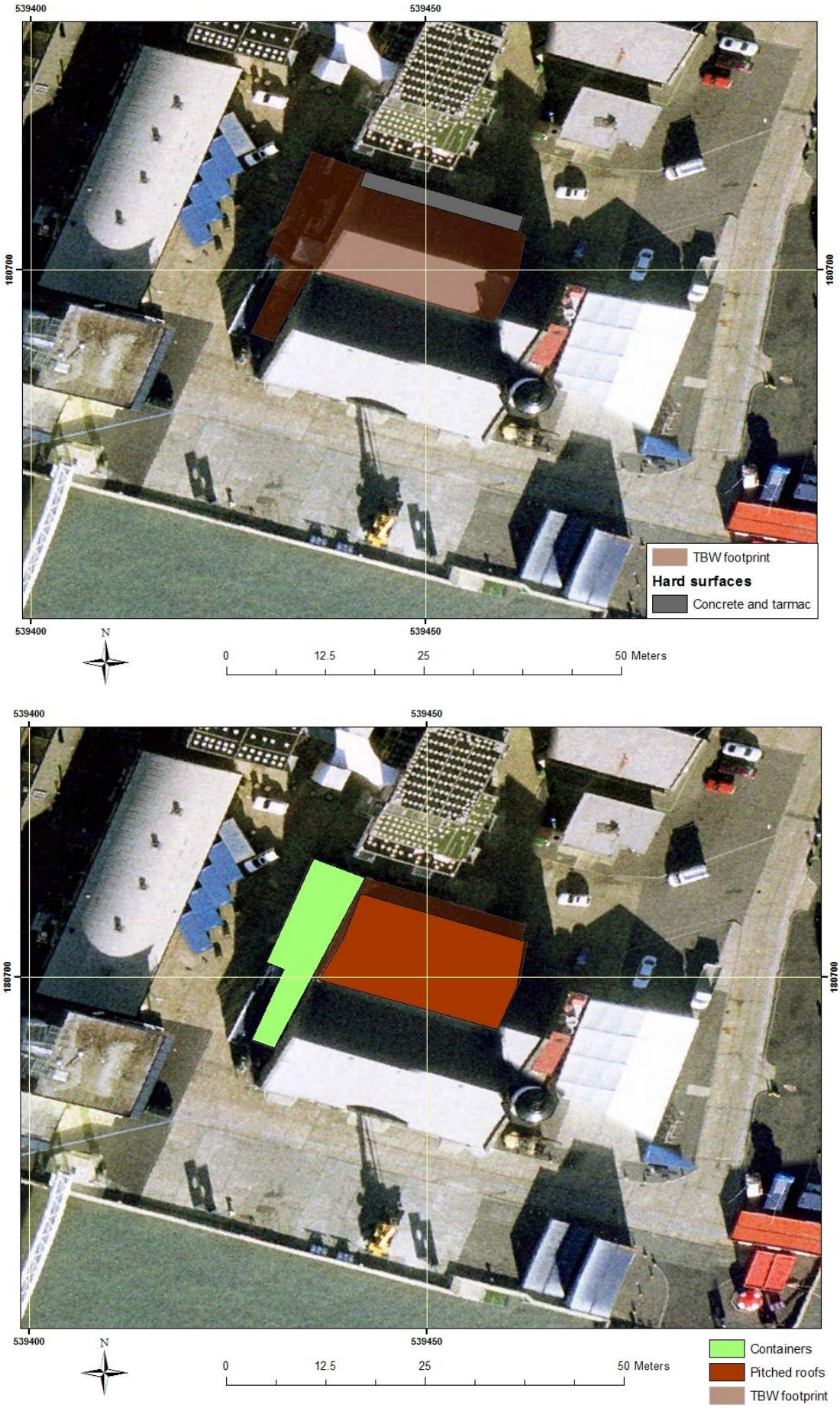


Figure 15: Hard space (top) and roof space (bottom) at UEL IPAD, Trinity Buoy Wharf. Aerial photograph backdrop © Getmapping.com

5 Conclusions

The survey area for both campuses could be broadly categorised into building roof-space (37%), hard-space (44%) and green-space (17%).

5.1 Roof-space

It is interesting to note the amount of flat-roof space across the survey area amounted to 31% of the total area of roof-space. Flat and gently sloping roofs offer enormous potential as green roof systems managed for biodiversity in urban areas. In addition to their capacity to support biodiversity, green roofs provide a means of attenuating rainwater, enhancing the thermal insulation properties of the roof system, increasing the lifespan of the roof construction elements and providing a 'greener' environment for staff and students.

Much of the flat-roof space on UEL's campuses can be attributed to the modern buildings at Docklands and the new additions to the Stratford campus. These developments represent missed opportunities for green roof establishment, as it is easier to install green roofs at the design stage of a new build than to install them after construction. However, given the large area involved, there is potential to retro-fit green roofs to any flat roofs capable of holding the associated loads. In addition, there was 552m^2 of roof-space on the containers spread across the survey area. While some of these may only be very temporary in nature, a number were almost certainly more permanent. The permanent (and perhaps even semi-permanent) containers make ideal candidates for container-designed green-roof systems. Indeed, www.livingroofs.org.uk have recently designed green roofs which can be loaded and transferred between semi-permanent storage containers.

5.2 Ground-space

Given the urban nature of the survey area it is not a surprise that a large proportion of the campus was classified as hard-space, the vast majority (95%) of which was concrete and tarmac. In fact, considering that concrete accounted for 42% of the total survey area (or 65% excluding buildings), there is no question that the overall impression is one of predominantly concrete expanse.

Although only 17% of the survey area was considered to be green-space, this still amounts to a reasonably large area - 21,252m^2. It should also be noted that the proportion of green-space was very similar to that of the local area (20% in Newham: LUC, 2009). As might be expected, over half of this green-space was amenity grassland (56%). Ultimately, this is both a consequence of intensive management and land-use. Grassland is either on display and thus managed as a manicured lawn, or is in heavy use, and managed as a short sward for that reason. In either case, biodiversity interest is minimal. There were notable exceptions - the flower-rich meadows at Docklands - and these have been classified as both

biodiversity hotspots (see below) and models for how more of UEL's grassland areas might be managed.

In total there were 2,727m^2 of hedgerow across all campuses. Most of the hedges were planted with ornamental varieties of cotoneasters (*Cotoneaster spp.*) and firethorns (*Pyracantha spp*), both of which can be beneficial for wildlife. Honeybees (*Apis millifera*), bumblebees (*Bombus spp.*) and hoverflies (Syrphidae) all feed on the white flowers of cotoneaster and firethorn in early summer. Both hedge species also produce abundant berries that many birds will feed on. However, several cotoneasters are becoming invasive in the wild (Thomas, 2010), and further survey of the hedgerows to identify any of these species should be considered. While the biodiversity benefits of these hedge systems are very positive, it should be noted that these are still very homogenous and typical plantings. Biodiversity thrives on landscape heterogeneity, therefore if there are to be any new hedge plantings, different species should be considered in order to add to the structural and functional complexity.

1,039m^2 of ornamental borders were present across the survey area. Most of these were planted with ornamental species, and in most cases with one single species. Indeed, some examples were planted solely with ivy (*Hedera helix*).

In total, 274 trees were recorded across the estate. This equates to the same number as a small woodland – which is extremely positive. Considering the UEL estate as a whole, there is a very good mixture of mature and young trees, which reflects the age of the two campuses. There are some fantastic mature trees at Stratford, some of which are protected by Tree Preservation Orders. These trees are almost certainly very important for (local) biodiversity, particularly for invertebrates, and further survey here would be extremely interesting. Recent choices to plant ornamental tree varieties instead of native species – mainly at Docklands - represent missed opportunities. Native species support many more species of insect than comparable ornamental varieties and there are many natives (see Table 5) that are small enough to even be planted in an average size garden, never mind university campus (Baines, 2000).

It should also be noted that the trees alone are not what make woodland (or rainforest) areas of incredible biodiversity interest. The trees merely characterise woodland. The campus areas predominantly contain short manicured lawns and lollipop trees, as is the case in many parks. With a little more creativity it would be possible to produce something more ecologically and visually interesting with significantly increased biodiversity interest. The most diverse area of any woodland is the edge (the ecotone), which is inhabited by species typical of the deep shade as well as those that require more open conditions - it is reasonably simple to re-create such conditions (Baines, 2000).

Table 5: Native tree species and the number of associated insects, adapted from Baines (2000). Larger species such as oaks (*Quercus robur* and *Q. petraea*) also support very good numbers of insects.

Common name	Scientific name	Number of associated insects	Other interest
Silver birch	*Betula pendula*	229	Old trees are good for Woodpeckers (*Dendrocopus spp.*)
Downy birch	*Betula pubescens*	>200	Prefers moist/wet soil
Hawthorn	*Crataegus monogyna*	149	Berry crop is fantastic for birds
Aspen	*Populus tremula*	>90	Stunning gold leaves in autumn
Crab apple	*Malus sylvestris*	>90	Many ornamental species
Alder	*Alnus glutinosa*	90	Prefers wet soil but seeds popular with birds in autumn and winter
Rowan	*Sorbus aucuparia*	28	Very decorative with orange berries for birds
Wild cherry	*Pruns avium*	No figures available	Berries are also favoured by many birds

A number of biodiversity hotspots were identified at both Stratford and Docklands. It is suggested that these areas should be prioritised for protection wherever possible and that further fine-scale survey of these areas should be carried out. More detailed survey would highlight areas of particular biodiversity interest where regular monitoring would be most beneficial. At the very least, these hotspots should be protected until more detailed survey can be carried out.

5.3 Increasing biodiversity interest

Typically, this is the section that Estate Managers used to dread. This is the section that recommends that traditional management practices be forgotten: the grass is allowed to grow long and the weeds flourish. If only it were that easy – we are well aware that any approach to increase biodiversity must be grounded in the real world and it is understood that the UEL estate must serve a number of functions.

In managing the UEL estate, it is recognised that there must be a balance between increasing biodiversity interest, and serving the many other functions of UEL sites. Nevertheless, as will be shown, it is possible to not only increase biodiversity interest but also to improve the aesthetics of the estate.

The recommendations below are separated into two categories: general management practices that can be adopted across the university and more specific schemes that relate to certain areas of the estate.

5.4 General recommendations

Huge strides could be made very quickly and with very little investment if UEL builds on its current strengths.

UEL has urban campuses, and must therefore work within this context. The urban habitat is complex, with a higher degree of heterogeneity than many natural systems which can sometimes mean it is more species rich (Gilbert, 1989; McKinney, 2008). Urban nature is often a mix of native and non-native species in quite unique (and therefore valuable) assemblages (Harrison & Davies, 2002). Moreover, with a decrease in habitat quality in rural areas (due, at least in part, to agricultural intensification) cities are becoming important refuges for some native biodiversity (Goddard *et al*., 2009). *"Nature conservation is no longer only a countryside concern – urban nature also requires conserving"* (Harrison & Davies, 2002).

As is clear from the conclusions above, the UEL campuses are predominantly homogenous. In order to increase biodiversity interest, the complexity of the habitat should be developed, by increasing the variety of existing green-space, and establishing further green space to interrupt large areas of concrete.

5.4.1 Planters

Large areas of concrete could easily be broken up with planters, albeit taking in account issues such as health and safety, security and maintenance. The greatest biodiversity value would be added by planting with native species. A number of studies comparing gardens planted with native species compared with more conventional gardens (with exotic species) found that bird and butterfly diversity was greater in 'native gardens' (French *et al*., 2005; Daniels & Kirkpatrick, 2006; Burghardt *et al*., 2009). Corbet *et al*. (2001) found that native insects rarely make use of exotic species when compared with natives. There are a number of British native species that can be planted in a conventional gardening manner to provide a wonderful show throughout the summer (Baines, 2000).

5.4.2 Flower rich meadows

The UEL estate has considerable areas of amenity grassland, and while some serve a purpose that should not be ignored (such as picnic areas in the summer), there is potential for some areas to be used in alternative ways. Some for example, could be converted into flower-rich meadows such as those at Docklands. In terms of flora, the species richness of these tiny patches of flower-rich meadow (58 species) far exceeds that of the 21,252m^2 of amenity grassland (24 species). In terms of species area this equates to 3.7 and 0.11 species per 100m^2 for the flower-rich meadows and amenity grasslands respectively. There are a number of small pockets of amenity grassland that could be identified across the estate and converted into flower-rich meadow with a change in management, and for the small price of some native seed mix.

5.4.3 Staff and student involvement

There are other areas of amenity grassland that might be more suitable for other purposes. For example, the present authors are aware of plans to construct a Medicinal Herb Garden and perhaps even a small allotment area at Stratford. This will all add to the diversity of habitats at Stratford and has the added benefit of getting both staff and students directly involved with the management of the estate and in contact with biodiversity.

5.4.4 Management of amenity grassland

There are yet other areas of amenity grassland which are not used but are necessarily kept well manicured, such as those outside University House, Stratford. In such areas there is no reason that bulbs could not be planted (at very little cost) that would provide a striking show in spring. The native daffodil (*Narcissus pseudonarcissus*) may have a smaller flower than the horticultural varieties but when planted en masse it can provide just as magnificent a show. As it is, the areas of amenity grassland could be managed in a more sympathetic manner. If the grass was cut on a slightly less intensive cycle it may improve the biodiversity interest slightly, and would certainly help to avoid the brown lawns that are seen every summer, as longer grass helps to hold the moisture. This would have the added bonus of costing the university less time in terms of management, and ultimately less money.

5.4.5 Trees

As stated above, there are a large number of trees planted across the campuses. Although it is a shame that more of these are not native species, they still provide valuable roosting places for birds, and habitat for mammals such as the grey squirrel (*Sciurus carolensis*)[2].

[2] Whilst the grey squirrel (*Sciurus carolenensis*) is non-native species it is (at least in the mind of most people) widely accepted and valued in urban cities in southern England.

There are still a number of potential ways to increase biodiversity by adding complexity. It would be valuable, for instance, to add climbing plants to grow up a number of trees – adding another layer of structure and diversity ('doubling your money'). Planting could be as simple as growing ivy (*Hedera helix*) or more elaborate (and thus expensive) in the form of flowering climbers, of which there are plenty of native options, including old man's beard (*Clematis vitalba*) or honeysuckle (*Lonicera periclymenum*). Even a simple planting would attract more invertebrates, as well as create habitat for birds. In addition, if nest boxes were to be added to the few already existing at the main Stratford campus, this would provide valuable cover for nesting birds.

There is a substantial area of tree bases (particularly at Docklands), that is, areas of soil around trees planted into pavements or on concrete. In some cases these are planted with ivy (*Hedera helix*), but it would be just as plausible to plant typical woodland ground flora to add further biodiversity interest. In some areas it should even be possible to create a woodland edge type habitat. This would entail adding extra layers - shrubs and ground flora that are typical of the woodland edge.

The species that would be attracted would be representative of those typically encountered in many woodlands – woodpigeons and tits can be seen in the canopy, finches and robins inhabit the shrub layer, and wrens and blackbirds are often seen scrabbling around in the leaf litter.

Although more sympathetic management (for example leaving some leaf litter) would be beneficial, it is not necessary to create an area that looks unkempt: untidiness does not necessarily correspond with more species diversity. However, often, as long as people can see that somewhere is being actively managed, a certain amount of untidiness goes unnoticed.

5.4.6 Hedgerows

There is a fairly substantial planting of hedgerows throughout the survey area. As already mentioned, it is a shame that almost all the plantings are non-native ornamental species. Any new hedges to be planted on the estate would increase biodiversity interest, especially if native, deciduous, mixed hedges were considered.

Mixed hedges of for example, hawthorn (*Crataegus monogyna*), blackthorn (*Prunus spinosa*) and dog rose (*Rosa canina*) create huge interest in a small amount of space that can be further enhanced with climbers such as old man's beard (*Clematis vitalba*), honeysuckle (*Lonicera periclymenum*) and hop (*Humulus lupulus*). This would help provide habitat for many species of invertebrates and birds and perhaps even hedgehogs (*Erinaceous*

europaeus) and other small mammals. Hedgehogs, for example, are a Key Species in the LBAP for Newham, which have declined by 27% nationally (LUC, 2009).

Most of the plantings are distributed around the car parks, and there is almost certainly too much disturbance to provide nesting habitat for birds. If areas of hedgerow are to be replaced in the future, it would also be worth considering native evergreen species such as holly (*Ilex aquifolium*), wild privet (*Ligustrum vulgare*) or yew (*Taxus baccata*). In addition, these shrubs are typically managed very intensively at all campuses and this drastically reduces the crop of flowers and berries, and therefore the majority of the biodiversity interest (Thomas, 2010). It is noted here that it is not possible to plant fruit bearing hedgerows at Docklands that would attract birds because of the proximity to London City Airport.

5.4.7 Green roofs

In addition to ground-level biodiversity enhancements, greening at roof level can create enormous potential for biodiversity enhancement, and overall environmental sustainability, of urban environments. However, similarly to grassland and hedgerow management, the effectiveness of green roof systems in supporting biodiversity is dependent upon their habitat complexity.

While the recent trend in sedum-based roof systems are no doubt of environmental benefit, if green roofs are to achieve anything approximating a replacement of the habitat lost to urban development in the region, green roofs must be designed to incorporate the interest features and habitat complexity of the East Thames Corridor's natural landscape. This can be achieved through the incorporation of habitat interest features such as structural diversity, micro-topography and varied planting regimes into green roof design.

Implementation by UEL of such design into retro-fit and new-build green roofs would not only substantially enhance biodiversity at the campus, but would also represent a very visual commitment to protect the East London community's local natural heritage.

5.4.8 Water

Standing, shallow water is a key habitat type that is missing from the UEL estate, and which must be considered in order to significantly increase biodiversity interest. It is here more than anywhere else that it may truly be said that urban nature conservation has made a significant difference. Many species that we first learn about at primary school, such as the Common Frog (*Rana rana*), Diving Beetles, Damselflies and Pond Skaters, would perhaps be extinct were it not for the garden pond (Baines, 2000).

As with woodlands above, it is the ecotone that has the greatest potential for biodiversity. The warm, shallow areas of water with marginal vegetation and the wet, boggy surrounding land all have their distinct plant and invertebrate communities. Birds also utilise the shallow water to bathe – in order to cool off in the summer and stay warm in the winter. It cannot be emphasised enough that the creation of these habitats, both ephemeral and permanent, would substantially add to the biodiversity interest on both campuses.

5.5 Specific recommendations

The general theme above has largely been one of 'get the habitat right and the rest will follow'. However, it is worth at least briefly considering biodiversity enhancements for more specific species. There is movement in certain areas of nature conservation to promote the conservation of key or umbrella species and there are certain advantages to this (Roberge & Angelstam, 2004). Promoting the conservation of particularly charismatic species can reinforce other, less visible conservation actions. Here it would seem most sensible to consider species that are actively being conserved locally, such as those in the Newham LBAP. Key species in Newham are listed under each of the four Habitat Action Plans (HAP) for the borough and include: kestrel (*Falco tinnunculus*), swift (*Apus apus*), swallow (*Hirundo rustica*), starling (*Sturnus vulgaris*), black redstart (*Phoenicurus ochruros*), house sparrow (*Passer domesticus*), song thrush (*Turdus philomelos*), bats, hedgehog (*Erinaceous europaeus*), amphibians and reptiles as well as butterflies, honeybee (*Apis millifera*) bumblebees and burrowing bees and wasps (LUC, 2009).

Whilst many of the suggested conservation measures will benefit the above species, it is worthwhile considering specific, targeted measures. Many of the birds listed above would benefit from the provision of regular supplementary food, particularly in spring and winter (Thomas, 2010). The provision of nest boxes is especially important in urban habitats, as there are not enough natural tree holes or spaces in modern buildings. Common birds to use nest boxes are blue tits (*Parus caeruleus*), great tits (*Parus major*) and robins (*Erithacus rubecula*), but house sparrows (*Passer domesticus*) and starlings (*Sturnus vulgaris*) would make much more use of them if more appropriately sized boxes were provided. Likewise bats, bumblebees, solitary bees and wasps, as well as a number of other insect groups would benefit from the provision of nest boxes, and it would be worth considering putting up a number of boxes across the estate for each group.

More specific recommendations for increasing biodiversity interest across the UEL estate are listed below. These are predominantly ideas that were developed as a direct result of the survey.

Specific recommendations for Stratford campus are:

i. Creation of native woodland edge habitat around at least part of University House to add to the interest already present in the form of mature trees. Whilst it is recognised that this would need to be kept tidy the addition of a mixed, native, deciduous hedge and typical woodland ground flora would greatly add to the biodiversity interest here.
ii. The addition of climbers (particularly native species) would add another level of complexity and therefore diversity to the mature trees around University House. A mixture of different native species would be the most beneficial.
iii. The area of amenity grassland around University House would also be suitable for bulb planting, particularly if a woodland edge habitat was created. The planting of native bulbs could create a striking show in early spring.
iv. The mature trees here would also make a fantastic site for bird boxes. Nest boxes suitable for sparrows and starlings should be given priority. At least one nest box should have a camera providing a live-feed that can be uploaded to the web. This would be a fantastic way of promoting conservation efforts at the university.
v. Continuing with the bird theme, it is worth considering providing food at Stratford campus. A range of feeding stations could be utilised across the campus and would substantially increase the bird interest at Stratford.
vi. There are very few areas that are suitable for the creation of wildflower meadows at Stratford because many areas of green-space are high-visibility. However, the small area of amenity grassland between TL02 and the R-building would be just such a suitable, although small area.
vii. Stratford campus has many little pockets of amenity grassland, and in at least some of these spaces it would be beneficial to plant formal but nevertheless nectar-rich beds.
viii. It would be useful to introduce planters to break up large areas of concrete at the campus. It would be nice to plant here with some of the most attractive brownfield species such as rosebay willowherb (*Epilobium angustifolium*). Obviously, planters require watering, but this could be developed in association with rainwater harvesting across the estate.
ix. Nest boxes could also be installed for bumblebees, solitary bees and other insect groups.
x. Finally, it would be fantastic to start keeping honeybees on the Stratford campus and producing our own honey – what better way to promote UEL's commitment to biodiversity?

A number of specific recommendations for the Docklands campus are also made below:

i. The northern edge of the Docklands campus runs along Royal Albert Docks adjacent to City Airport. Presently, this is a large pathway of concrete. This could be broken up with a series of planters with native species typical of water-margins. Such habitat is absent from this harsh waterside edge. Clearly, planters with these types of species would require a large amount of water, nevertheless there is the potential for rainwater harvesting and grey water recycling here.

ii. There is significant potential for the additional creation of species-rich meadow on amenity grassland areas, especially surrounding the main car park.

iii. Tree planters and tree buffers provide a large space for planting native woodland flora

iv. A green roof is already installed on one of the student accommodation buildings – why not the others?

v. The nursery in the centre of the Docklands campus would make an ideal site for a green roof. Designed to be energy efficient, the large south-facing windows mean that this building warms up excessively during the summer months. A green roof would help to insulate this building from extreme summer and winter temperatures and would also add to the significant biodiversity already supported within the nursery gardens.

vi. There are many metal frames between the accommodation buildings with bike racks. Simply growing native climbers would add biodiversity value and if species which regularly flower for a lot of the summer were chosen this could be very aesthetically pleasing.

vii. Brownfield sites are a very important, local habitat feature (discussed in more detail below) and small areas should be managed for species typical of this habitat. This has the potential to significantly contribute to local biodiversity.

viii. The tree buffer areas that shield the campus from the main road to the north of the site could, with a little sympathetic management and habitat creation be converted into more typical woodland habitat.

5.6 Construction projects

The Thames Gateway has been designated a national priority for urban regeneration and sustainable development. However, the area is also recognised under Natural England's 'Natural Area' designations for its distinctive and unique nature conservation value, in terms of wildlife and natural features. In addition to statutory designation, the value of brownfield sites in the area is being increasingly recognised. A series of post-industrial sites have been found to support nationally significant populations of numerous UK Biodiversity Action Plan (UKBAP) and Red Data Book (RDB) invertebrates (Harvey, 2007; Jones, 2007). Indeed, this habitat has been deemed of such value nationally that it has been designated a UKBAP habitat: 'Open mosaic habitat on previously developed land'.

Situated in the heart of the East Thames Corridor, UEL is intrinsically linked with the regeneration of the region, both with recent developments such as the Docklands campus, and future planned projects such as a new Sports and Academic Building at Docklands campus, a new library at Stratford campus and Stratford Island University Centre (a joint development with Birkbeck). By definition, the footprints of such developments will impact on local space. If designed effectively, future development projects provide an ideal platform for UEL to demonstrate its commitment to protecting the ecosystem services and unique biodiversity of the Thames Corridor. As such, the authors recommend that brownfield biodiversity be fully taken into account in the planning, design and building of all future construction projects.

6 Future work

Whilst this particular survey has highlighted many areas in which biodiversity interest can be added to the UEL estate it is very positive to note that there is already small but significant pockets of species rich habitat. This report provides a good baseline for us to build on. If we want to be able measure the success of any schemes that attempt to attract more wildlife to the estate we must monitor it. Any monitoring will also inform future biodiversity enhancement schemes. If we do not monitor the changes in wildlife across the estate how will we know if any of the improvements we decide to attempt have been successful? However, the present survey was only a scoping survey; further, finer scale work would be extremely beneficial. Further survey might include:

- The establishment of permanent vegetation and invertebrate monitoring at selected biodiversity hotspots.
- Specific bird surveys at both Stratford and Docklands campuses in order to provide a more comprehensive baseline.
- Small mammal trapping at both campuses in order to judge the biodiversity interest, if any, of this group.
- A survey of lower plants (mosses and liverworts) and lichens would be useful. These groups are often overlooked even though they are of significant biodiversity interest.
- It would be valuable to establish a database of species records for all of the UEL estate that could be constantly updated as new records came in. The university could encourage staff and students to provide records of their sightings.

7 Concluding remarks

This survey and the present report represent one of the first steps in the university's commitment to biodiversity. Whilst very positive it is still only one step forward and we hope that the conclusions and recommendations we have made will be taken on board and given serious consideration. There is no reason why this should represent a serious financial commitment - indeed many measures may even save the university significant amounts of money. There are also a number of bodies that provide funding for novel projects that increase biodiversity, especially in urban areas. Universities are places that educate the next generation and unfortunately many people growing up in urban areas are now disconnected from the natural world. We have a real opportunity to create a wonderful legacy for our students, staff and the local community – as well as the local wildlife.

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