



018530 - SWITCH

Sustainable Water Management in the City of the Future

Integrated Project
Global Change and Ecosystems

D2.3.1.e: A demonstration facility for the dissemination of green and brown roof techniques and value

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PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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1 Introduction

Green roof is a general term for any roof covered with a growth substrate with plants growing on it, and as such, green roofs vary enormously in their type and function. They are generally split into two main types: **intensive green roofs**, which are essentially roof-top parks and gardens, which are characterised by deep growth substrates, high maintenance and high costs; and **extensive green roofs**, which are characterised by thin growth substrates, low maintenance and lower costs; but both of these terms encapsulate a huge array of roof types. The term **brown roof** has been used in a variety of contexts, but is here used to describe a type of extensive green roof that is designed to mimic **brownfield** sites at an early stage of succession. When choosing a type of green roof it is very important to realise that the way a roof is designed will influence the environmental benefits associated with that roof, and that designing a roof to maximise one environmental benefit can potentially trade off against other environmental benefits.



The most important environmental benefits associated with green roofs are: the thermal insulation of buildings, increased roof longevity, urban cooling, improved urban aesthetics, reduced roof run-off, and habitat creation. The SWITCH project mainly aims to: (1) develop a strong scientific understanding of the ability of brown roofs to (a) act as substitute brownfield habitat, (b) reduce roof run-off and (c) explore the thermal energy balance on the roof, and (2) share this understanding with practitioners and the general public through workshops and demonstration projects. In most countries, green roofs are often seen as quirky projects associated with environmentalists. This will remain the case until the development of a depth of scientific understanding of the environmental benefits of green roofs and the way they trade off against each other, and practitioners and the public are more widely familiar with the green roof concept. Only when these two barriers to the uptake of green roof technology are removed will green roofs be used on a large enough scale to really make a difference to the multiple environmental problems facing urban areas.



This report provides basic details of two brown roof demonstration projects in Birmingham's city centre, the [BVSC](#) (Birmingham Volunteer Service Council) brown roof, and the [ICC](#) (International Convention Centre) brown roof. Information on the ecology and development of these roofs has been updated on the Birmingham Learning Alliance website, when it is available. This report is a compendium of the most recent information uploaded to the site. Importantly, lists of species using the roofs and monthly photographs of the development of each roof are posted on the site and are included here in appendices for the two roofs. Also included is a summary covering various [green roof workshops and tours](#) that were organised in the first 3 years of the project. Additionally one of the many presentations given to disseminate the implementation of extensive green roofs nationally (within UK) and internationally is included in a separate appendix, along with a list of the presentations given. Understanding what species are likely to use a roof, and how green roofs *really* look at all ages and different stages of the year is a crucial factor when deciding what type of green roof to choose. Pictures of the green roof demonstrations illustrating their appearance are provided with the overviews of the two roofs.



2 The ICC brown roof

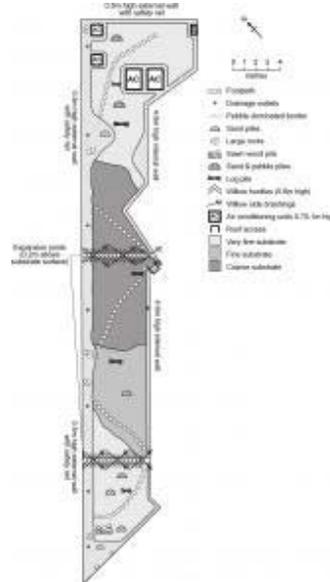
2.1 Overview

The brown roof occupies a sub-section (300 m²) of the International Convention Centre (ICC) building off Broad Street in Birmingham, in the UK. It is designed to provide demolition site brownfield type habitat in early to mid stages of succession. It aims to provide habitat for the rare, Schedule 1 protected (Wildlife and Countryside Act, 1981) bird, the black redstart (*Phoenicurus ochruros*), and a wide range of brownfield associated birds, plants and invertebrates. The project was funded by SITA Trust from the Landfill Communities Fund, SWITCH and the Birmingham Environmental Partnership. It was led by Groundwork Birmingham and Solihull in partnership with Advantage West Midlands, the East Birmingham North Solihull Regeneration Zone, Birmingham and Black Country Biodiversity Partnership, Birmingham and Black Country Wildlife Trust, Birmingham City Council, Birmingham Environmental Partnership, the Environment Agency, The NEC Group, LivingRoofs, the Green Roof Consultancy and the University of Birmingham. The development of the roof is being monitored by The University of Birmingham.

2.2 Roof description

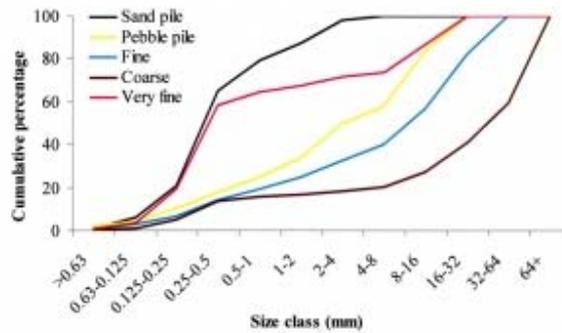
The substrate on the brown roof is a mix of (1) cobbles that were already present on the roof to hold the roof insulation down, (2) quarried gravel, (3) sand, and (4) recycled demolition aggregate (silt and clay removed in processing) generously supplied by Coleman and Company. Several additional habitat resources were included in the roof design; namely, pure sand piles that can act as nest sites for ground nesting bees and wasps, large rocks for invertebrates to hide and over-winter under, and small log piles that invertebrates can hide under and birds can perch on.

2.2.1 Map of roof



2.2.2 Sediment size distribution by weight in different microhabitats of the ICC brown roof

The figure below provides a description of the variation in sediment fractions used to form different features across the ICC brown roof.



2.2.3 Development photographs

The following photographs show the same zone of the ICC roof at different times over the first eighteen months following the installation of the roof.

VIEW 1

	Taken 20-12-07		Taken 5-03-08
	Taken 9-04-2008		Taken 9-05-2008
	Taken 11-06-2008		Taken 15-07-2008
	Taken 4-09-2008		Taken 5-03-2009
	Taken 12-06-2009		

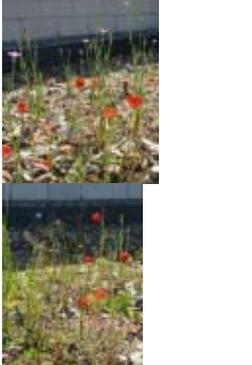
VIEW 2

	Taken 20-12-2007		Taken 5-03-2008
	Taken 9-04-2008		Taken 9-05-2008
	Taken 11-06-2008		Taken 15-07-2008
	Taken 4-09-2008		Taken 5-03-2009
	Taken 12-06-2009		

2.3 Gallery

The images below provide a simple gallery of the plants and birds that have been found on the ICC roof at different times of the year.

	Viola-tricolor		Viola-tricolor
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	Viola-tricolor		Veronica-persica
	Coccinella-punctata		General view
	General view		Agrostemma - githago
	Wheatear		

2.4 Species known to have used the brown roof as habitat

Appendix 1 provides a summary of the species that have been identified using the ICC brown roof.



3 The BVSC roof

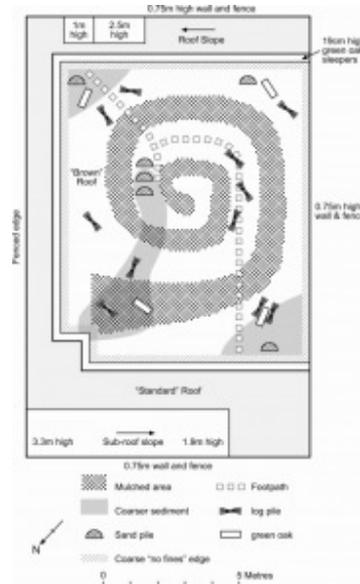
3.1 Overview

The brown roof occupies a sub-section (100 m²) of the Birmingham Voluntary Service Council (BVSC) building at 138 Digbeth in Birmingham in the UK. It is designed to provide demolition site brownfield type habitat in early to mid stages of succession. It aims to provide habitat for the rare, Schedule 1 protected (Wildlife and Countryside Act, 1981) bird, the black redstart (*Phoenicurus ochruros*), and a wide range of brownfield associated birds, plants and invertebrates. The project was funded by [SITA Trust](#) from the Landfill Communities Fund, SWITCH and the Birmingham Environmental Partnership. It was led by Groundwork Birmingham and Solihull in partnership with Advantage West Midlands, the East Birmingham North Solihull Regeneration Zone, Birmingham and Black Country Biodiversity Partnership, Birmingham and Black Country Wildlife Trust, Birmingham City Council, Birmingham Environmental Partnership, the Environment Agency, BVSC, LivingRoofs, the Green Roof Consultancy and the University of Birmingham. The development of the roof is being monitored by The University of Birmingham.

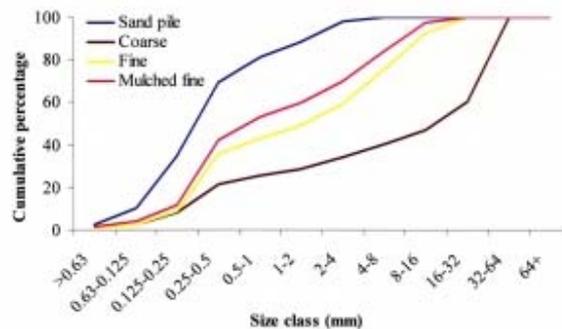
3.2 Roof description

The roof waterproofing was installed by Index Building Products Ltd. From the bottom up, it consists of the existing mastic asphalt, a 5mm thick Index Proteaduo composite underlay, a 4mm thick Index Defend antiroots H (anti-root barrier), and a combination protection/water retention mat on the top. Groundwork Birmingham and Solihull installed the brown roof itself and laid a mix of (1) quarried gravel, (2) sand, and (3) recycled demolition aggregate (silt and clay removed in processing) generously supplied by Coleman and Company on top of the water retention mat. The entire roof was seeded with a wildflower mix developed by Emorsgate Wild Seeds, LivingRoofs and The University of Birmingham. Additional habitat resources were included in the roof design; namely, pure sand piles that can act as nest sites for ground nesting bees and wasps and small log piles that invertebrates can hide under and birds can perch on.

3.2.1 Map of roof



3.2.2 Sediment size distribution by weight in different sections of the BVSC brown roof



3.2.3 Demonstration facilities

Green roofs are rarely fully accessible to all mainly due to health and safety reasons, but BVSC undertook several initiatives to make their brown roof more accessible. They installed a glass pained door that leads onto the roof so that the roof can be viewed at close proximity even if it is windy and they have installed a video camera that beams live images of the brown roof into their foyer and onto the web. These images can be viewed at <http://www.bvsc.org/greenroof/>.

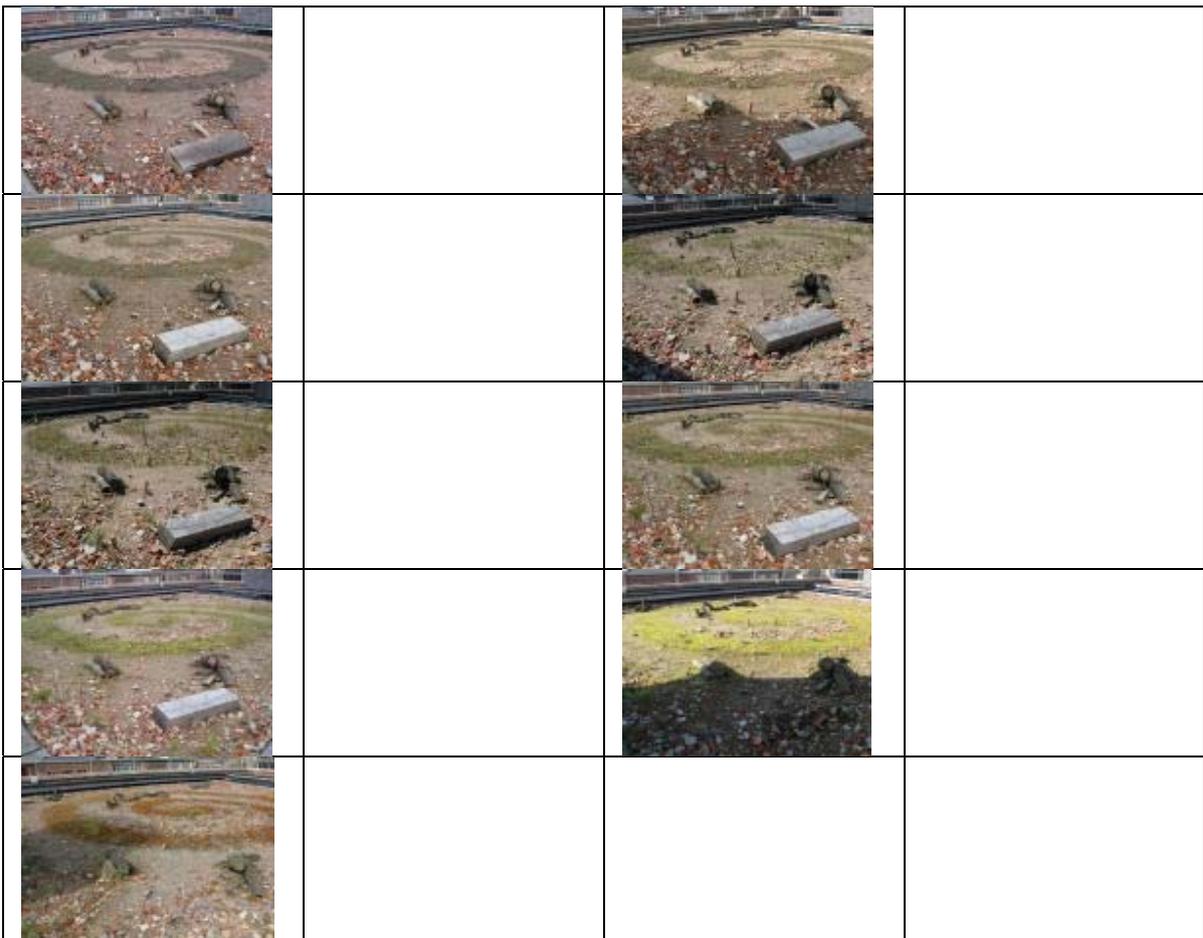


3.2.4 Television programme coverage

The BVSC brown roof was filmed for a programme for Teachers TV in 2008.

3.2.5 Development photographs

View 1



View 2



3.3 Gallery

Hover mouse over photograph to see the photograph caption and click to enlarge.

	General view		General view
			Cornflower
	Hairy bittercress		Papaver Rhoeas
	Scented mayweed		Viola-tricolor

3.4 Species known to have used the brown roof as habitat

Appendix 1 provides a summary of the species that have been identified using the ICC brown roof.

4 Illustration of Dissemination activities

The following activities are presented in reverse chronological order

4.1 Green Infrastructure – Assets and Benefits – 8/1/09

A poster was presented by Dr Adam Bates that looked at the way that green roofs can help to mitigate the effects of climate change. The day of seminars was organised by Natural England and was held at the BVSC; it included a wide variety of talks on the future of sustainable infrastructure construction.

4.2 RIBA/RICS green roof presentations and tour of the Fort Dunlop green roof – 8/10/08

A presentation was given by Dr Adam Bates that introduced green roofs, aimed to justify the installation of green roofs and discussed the trade-offs associated with different types of green roofs. This was followed by a presentation by Liam Foster of Hyder Consulting that discussed the various environmental advantages associated with green roofs. There then followed a tour of the Fort Dunlop *Sedum* mat green roof. The event was organised by the RIBA and the RICS, and well attended by around 20 architects and chartered surveyors.

4.3 Birmingham Climate Change Festival green roof tours – 3&4/6/08

Two lunch time green roof tours were put on for the nine-day Birmingham Climate Change Festival. The first (rainy) tour (3/6/08) was organised by CABI and RIBA West Midlands, led by Dr Adam Bates and comprised visits to: an intensive green roof at The University of Birmingham, the university brown roof research facility, and the BVSC brown roof. Twenty people, who were mainly architects, from the following companies came on the tour: Friends of Cannon Hill Park, Arthur Amos Associates, Yapp Design, John Dutton Architects, University of Birmingham, SVSMO Sustainable Moseley, Peter Poon Architects, CABI, RIBA West Midlands, and Birmingham City Council.



The second tour (4/6/08) was organised by CABI and RIBA West Midlands, was led by Dr Adam Bates and Dr Stefan Bodnar (Birmingham City Council) and comprised visits to: a combined acid heathland/*Sedum* mat green roof at the Alexander Stadium's new Gymnastics and Martial Arts Centre and the Fort Dunlop *Sedum* mat green roof. Twenty five people, from the following companies came on the tour: Atkins, Lloyds TSB GPM, Exeter City Council, Birmingham City University, Birmingham City Council, DTZ, CABI and RIBA West Midlands.



The festival also included a display showing a photograph of the BVSC brown roof.



4.4 Midlands Environmental Business Company (MEBC) green roof tour – 23/4/08

Organised by the MEBC and Dr Adam Bates of the University of Birmingham, led by Adam Bates and sponsored by Alistair Moseley from the WSP Group.



The day included an introductory talk on green roofs, a visit to the [Fort Dunlop Sedum](#) matt green roof, a visit to the University of Birmingham's brown roof research facility, and a visit to the Birmingham Voluntary Service Council's ([BVSC](#)) brown roof. Attendees ranged widely and included aggregate suppliers, planners, environmental consultants, engineering consultants and representatives from industry. Overall, twenty four people attended the tour from the following twenty one companies: Alfa Aggregates Products, Birmingham City Council, Warwickshire County Council, Sustainable Procurement Ltd., Jaguar Cars Ltd, Globally Local, Environment Agency, WSP Buildings, WSP Environment & Energy, WSP Group, Stuart Guy Consulting, EBC Ltd., Arcadis AYH, Lister Associates, Wardell Armstrong LLP, Marley Eternit, MEBC, Land Rover, Arup, BCC, and BBEM.



4.5 Tour of the University of Birmingham brown roof research facility - 7/8/07

This was part of a tour organised by Rosemary Coyne (then of the Eastside Sustainability Advisory Group) that aimed to make architects aware of the advantages of using green roofs. The University of Birmingham sub-section of the tour consisted of a quick look at an old turf intensive green roof on campus, followed by a tour of the University of Birmingham brown roof research facility.

4.6 Actions to combat climate change and benefit biodiversity in an urban environment – 25/7/07

Organised by Land Care Associates, the University of Birmingham, Birmingham and Black Country Biodiversity Action Plan, The Wildlife Trusts (WT), and Natural England, and held at the University of Birmingham.

This was a one day seminar that included tours of the Fort Dunlop *Sedum* matt green roof and the University of Birmingham brown roof research facility. A wide range of speakers gave presentations on green roofs and the wider urban environment, particularly focusing on their role in combating climate change. The speakers were: Dr Stefan Bodnar (Birmingham City Council), Dr Jon Sadler (University of Birmingham), Dr Nigel Dunnett (The Green



Roof Centre, Sheffield) and Dr Rossa Donovan (then with the University of Birmingham, now at White Young Green Consultants). Attendees included landscape architects, planners, environmental consultants and ecologists.

4.7 Tour of the University of Birmingham brown roof research facility as part of 'What makes green roof affordable' – 20/3/07

This was part of a two-day workshop organised by Rosemary Coyne (then of the Eastside Sustainability Advisory Group) in partnership with Hyder Consulting, The green roof consultancy and LivingRoofs that made the business case for green roofs. The University of Birmingham sub-section of the tour consisted of a short introductory talk by Dr Adam Bates, a quick look at an old turf intensive green roof on campus, followed by a tour of the University of Birmingham brown roof research facility.

4.8 Green Roofs and Biodiversity Seminar – 15/11/06

Organised by Land Care Associates and the University of Birmingham and held at the University of Birmingham.

This one day seminar mainly focused on the role of green roofs in biodiversity conservation but also analysed the wider benefits of their installation. The seminar was mainly targeted at members of the Wildlife Trust (WT) and the Association of Wildlife Trust Consultancy (AWTC) members. There were talks from speakers with wide-ranging expertise, namely: Dr Rossa Donovan (then with the University of Birmingham, now at White Young Green Consultants), Dr Jon Sadler (University of Birmingham), Dusty Gedge (Livingroofs.org), Dr Adam Bates (University of Birmingham), and Tim Moughtin (Land Care Associates).

4.9 Using green roofs as a teaching resource at the University of Birmingham

The University of Birmingham brown roof research facility is currently used as a teaching resource for the third year Geography course GGM312 – Landscape and Urban Ecology that includes Geography, Environmental Science and Environmental Management students.



Appendix 1

ICC Demonstration Roof - observed species

Flowering plants

Acer pseudoplatanus (Sycamore)
Agrostemma githago (Corn cockle)
Anthyllis vulneraria (Kidney vetch)
Arabidopsis thaliana (Thale cress)
Buddleja davidii (Butterfly-bush removed)
Capsella bursa-pastoris (Shepherd's purse)
Cardamine hirsuta (Hairy bitter-cress)
Centaurea cyanus (Cornflower)
Cerastium fontanum (Common mouse ear)
Cerastium glomeratum (Sticky mouse ear)
Conyza canadensis (Canadian fleabane)
Daucus carota (Wild carrot)
Echium vulgare (Viper's-bugloss)
Epilobium ciliatum (American willowherb)
Epilobium montanum (Broad-leaved willowherb)
Epilobium parviflorum (Hoary willowherb)
Epilobium tetragonum (Square-stalked willowherb)
Galium aparine (Cleavers or goosegrass)
Geranium columbinum (Long-stalked crane's-bill)
Leontodon hispidus (Rough hawkbit)
Leucanthemum vulgare (Oxeye daisy)
Linaria vulgaris (Common toadflax)
Lotus corniculatus (Common bird's-foot-trefoil)
Matricaria recutita (Scented mayweed)
Medicago lupulina (Black medick)
Myosotis ramosissima (Early forget-me-not)
Papaver dubium (Long-headed poppy)
Papaver rhoeas (Common poppy)
Plantago lanceolata (Ribwort plantain)
Polygonum aviculare (Knotgrass)
Prunella vulgaris (Selfheal)
Ranunculus bulbosus (Bulbous buttercup)
Rumex obtusifolius (Broad-leaved dock)
Sagina procumbens (Procumbent pearlwort)
Sanguisorba minor (Salad burnet)
Sedum acre (Biting stonecrop)
Senecio jacobaea (Common ragwort)
Senecio vulgaris (Groundsel)
Silene vulgaris (Bladder campion)
Sisymbrium officinale (Hedge mustard)
Sonchus asper (Prickly sowthistle)
Sonchus oleraceus (Smooth sowthistle)
Stellaria media (Common chickweed)
Trifolium arvense (Hare's-foot clover)
Veronica persica (Common field-speedwell)



Veronica serpyllifolia (Thyme-leaved speedwell)
Viola tricolor (Wild pansy)

Invertebrates

Aleochara bipustulata (a rove beetle)
Aloconota gregaria (a rove beetle)
Aloconota planifrons (a rove beetle)
Aloconota sulcifrons (a rove beetle)
Amischa analis (a rove beetle)
Amischa forcipata (a rove beetle)
Anotylus nitidulus (a rove beetle)
Bathyphantes gracilis (a money spider)
Bembidion quadrimaculatum (a ground beetle)
Carpelimus zealandicus (a rove beetle)
Cercyon haemorrhoidalis (related to water beetles)
Coccinella 7-punctata (seven-spotted ladybird)
Cryptophagus acutangulus (a silken fungus beetle)
Diplocephalus cristatus (a money spider)
Erigone atra (a money spider)
Erigone dentipalpis (a money spider)
Lepthyphantes leprosus (a money spider)
Lepthyphantes tenuis (a money spider)
Liogluta longiuscula (a rove beetle)
Mocyta amplicollis (a rove beetle)
Mocyta fungi agg. (a rove beetle)
Monocephalus fuscipes (a money spider)
Oedothorax apicatus (a money spider)
Oedothorax fuscus (a money spider)
Oedothorax retusus (a money spider)
Omalius excavatum (a rove beetle)
Oxypoda brevicornis (a rove beetle)
Oxypoda haemorrhoea (a rove beetle)
Porrhomma pygmaeum (a money spider)
Trechus quadristriatus (a ground beetle)

Birds

Corvus corone corone (Carrion crow)
Oenanthe oenanthe (Wheatear)
Motacilla alba (Pied wagtail)

Appendix 2

BVSC Demonstration Roof - observed species

Flowering plants

Agrostemma githago (Corn cockle)
Anthyllis vulneraria (Kidney vetch)
Arenaria serpyllifolia (Thyme-leaved sandwort)
Buddleja davidii (Butterfly-bush - plants removed)
Cardamine hirsuta (Hairy bitter-cress)
Centaurea cyanus (Cornflower)
Cerastium fontanum (Common mouse ear)
Cerastium glomeratum (Sticky mouse ear)
Chenopodium album (Fat-hen)
Conyza canadensis (Canadian fleabane)
Coronopus didymus (Lesser swine-cress)
Cymbalaria muralis (Ivy-leaved toadflax)
Daucus carota (Wild carrot)
Echium vulgare (Viper's-bugloss)
Epilobium ciliatum (American willowherb)
Epilobium parviflorum (Hoary willowherb)
Fragaria vesca (Wild strawberry)
Galium aparine (Cleavers or goosegrass)
Geranium columbinum (Long-stalked crane's-bill)
Lactuca serriola (Prickly lettuce)
Leontodon hispidus (Rough hawkbit)
Leucanthemum vulgare (Oxeye daisy)
Linaria vulgaris (Common toadflax)
Lotus corniculatus (Common bird's-foot-trefoil)
Matricaria discoidea (Pineappleweed)
Matricaria recutita (Scented mayweed)
Medicago lupulina (Black medick)
Papaver dubium (Long-headed poppy)
Papaver rhoeas (Common poppy)
Persicaria maculosa (Redshank)
Plantago lanceolata (Ribwort plantain)
Polygonum aviculare (Knotgrass)
Prunella vulgaris (Selfheal)
Ranunculus bulbosus (Bulbous buttercup)
Reseda luteola (Weld)
Rumex obtusifolius (Broad-leaved dock)
Sagina procumbens (Procumbent pearlwort)
Sanguisorba minor (Salad burnet)
Sedum acre (Biting stonecrop)
Senecio jacobaea (Common ragwort)
Senecio vulgaris (Groundsel)
Silene vulgaris (Bladder campion)
Sonchus asper (Prickly sowthistle)
Sonchus oleraceus (Smooth sowthistle)
Stellaria media (Common chickweed)



Trifolium arvense (Hare's-foot clover)
Trifolium pratense (Red clover)
Trifolium repens (White clover)
Verbascum thapsus (Great mullein)
Veronica hederifolia (Ivy-leaved speedwell)
Vicia sativa (Common vetch)
Viola tricolor (wild pansy)

Invertebrates

Aloconota gregaria (a rove beetle)
Amara familiaris (a ground beetle)
Amaurobius similis (a lace webbed spider)
Amischa analis (a rove beetle)
Amischa forcipata (a rove beetle)
Anthophora furcata (a flower bee)
Bathypantes gracilis (a money spider)
Bombus pascuorum (a bumble bee)
Bombus terrestris (a bumble bee)
Coccinella 7-punctata (seven-spotted ladybird)
Erigone atra (a money spider)
Erigone dentipalpis (a money spider)
Gymnetron antirrhini (a weevil)
Harmonia axyridis (Harlequin Ladybird)
Hippodamia variegata (Adonis Ladybird)
Hyalus hyalinatus (a white faced bee)
Lepthyphantes tenuis (a money spider)
Lesteva longoelytra (a rove beetle)
Liogluta longiuscula (a rove beetle)
Meioneta rurestris (a money spider)
Micargus herbigradus (a money spider)
Milleriana inerrans (a money spider)
Mocyta fungi agg. (a rove beetle)
Oedothorax fuscus (a money spider)
Oxypoda brevicornis (a rove beetle)
Prinerigone vagans (a money spider)
Pseudeuophrys lanigera (a jumping spider)
Savigna frontata (a money spider)
Sitona lineatus (a weevil)
Sitticus pubescens (a jumping spider)
Trechus quadristriatus (a ground beetle)

Birds

Columba palumbus (Wood pigeon)
Corvus corone (Carrion crow)
Sturnus vulgaris (Starling)