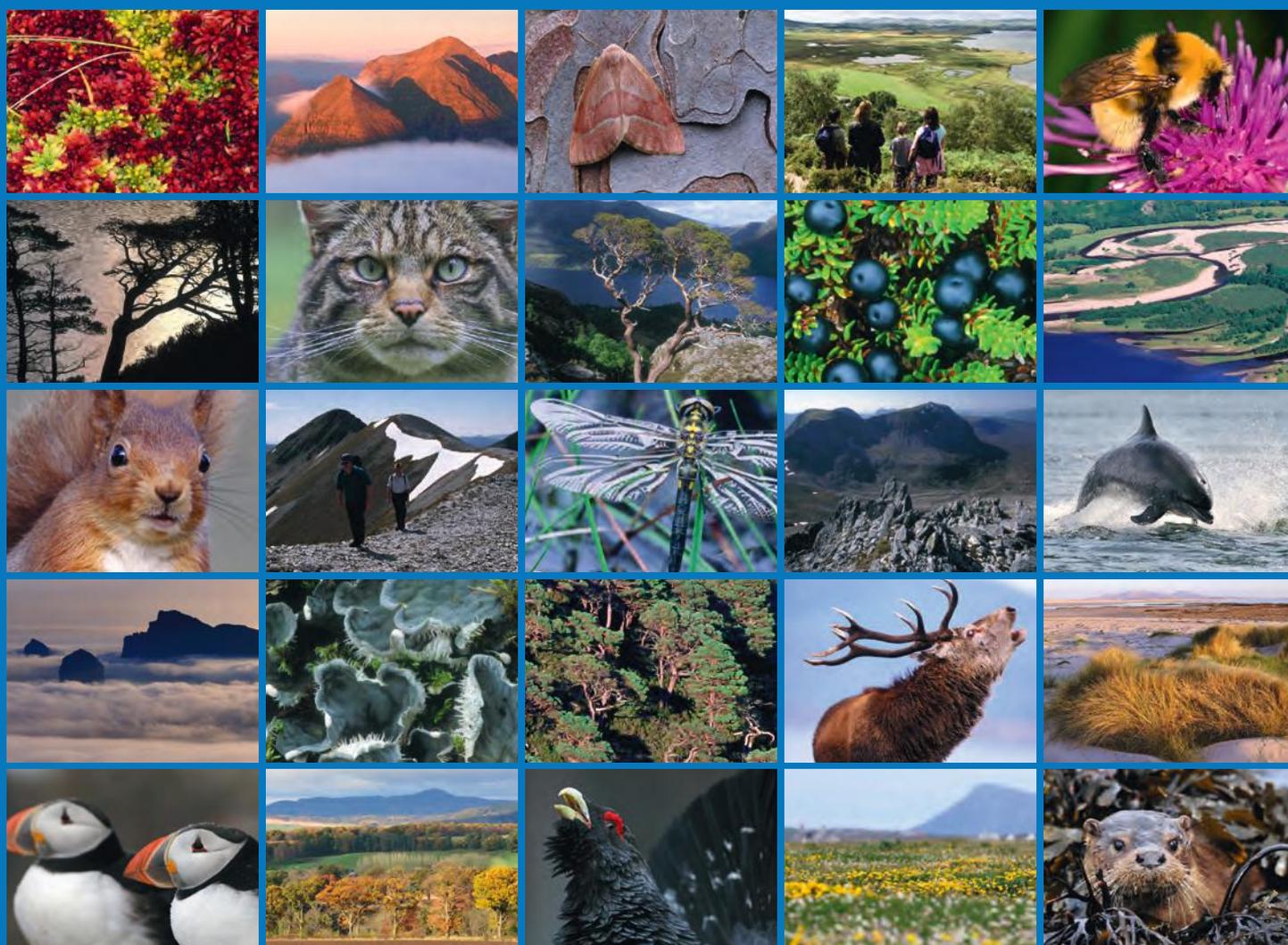


Open mosaic habitats on previously developed land: survey and recommendations for habitat planning and management in Scotland





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COMMISSIONED REPORT

Commissioned Report No. 606

**Open mosaic habitats on previously
developed land: survey and
recommendations for habitat planning and
management in Scotland**

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COMMISSIONED REPORT

Summary

Open mosaic habitats on previously developed land: survey and recommendations for habitat planning and management in Scotland

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Background

The rich industrial heritage of Scotland has resulted in over 10,000 ha of land being listed as vacant or derelict. These so-called 'brownfield' sites can be incredibly important for United Kingdom (UK) biodiversity, often supporting nationally important populations of rare and endangered invertebrates, alongside other wildlife such as birds, reptiles, plants and lichens. Wild areas within the urban environment are crucial to the survival of many increasingly threatened species in the UK. As a result, Open Mosaic Habitat on Previously Developed Land (OMHPDL) has been recently included as a UK Biodiversity Action Plan (UKBAP) priority habitat.

The National Planning Framework for Scotland 2 (NPF2) aims to bring brownfield sites back into productive use for housing, for economic purposes and to create attractive environments by 2030. Sites supporting OMHPDL can contribute to this vision, allowing the public access to wildlife in the heart of urban areas. Furthermore, NPF2 also aims to provide a greener Scotland by protection of both the built and natural environments, and identifies National Ecological Networks (NEN) as key to delivering this. The use of Integrated Habitat Network (IHN) models is an essential tool to help deliver this aim. It is therefore important that OMHPDL is properly included in IHN models and appropriately considered by decision makers.

This project reviews the habitat features of Scottish brownfield sites, reviews the remote assessment and ground truthing methodologies developed by Riding *et al.* (2010) in a Scottish context, and discusses the importance of OMHPDL and application of these methods for IHN and development planning.

Main findings

- The project provides a review of the habitat features of Scottish brownfield sites and provides a definition of OMHPDL.
- A remote assessment methodology was used to assess the sites listed as 'vacant' on the Vacant and Derelict Land Register 2009 in Scotland, excluding those in the CSGN area. Of the 382 sites identified, 67 qualified as OMHPDL. The aerial photography used to identify a further three sites was obscured so these could not be assessed.

- The main limitation to the remote assessment methodology was the availability of suitable aerial photography. The quality and resolution of aerial imagery can prevent remote assessment. The age of the aerial photography can also be a limiting factor, as in some cases this may be more than 10 years old. However, Google Street View may aid remote assessment for sites close to public roads.
- A previous application of the remote assessment methodology was tested by selecting a subset of 12 sites classified as 'derelict' land for assessment using published ground truthing methods. These represented a geographic spread, differing aerial photography ages, and included rural, peri-urban and urban situations.
- The ground truthing methods were found to be useful. However, as many factors influence the habitats and wildlife present on brownfields, a characteristic list of species present on all or even most OMHPDL is not possible. A more generic plant list would be more useful as often dominant species were not included, and this would also allow less specialised ecologists to undertake assessments. An overall site description should always be undertaken by the assessor, to include biodiversity observations and abundant plant species even if these are not included in the assessment methods as they may still be of local importance.
- Brownfield sites supporting OMHPDL are an important component of a local IHN as they act as 'stepping stones'. Areas of OMHPDL permit the movement of rare and endangered species within the urban and peri-urban environment.
- A strategic approach to the redevelopment of brownfield sites should be adopted as part of development planning. This should consider the quality of OMHPDL present, and its geographical position within the IHN.
- A simple flow chart is provided that allows planners to quickly identify if a site may qualify as OMHPDL.

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Abbreviations and Glossary

CSGN	Central Scotland Green Network
IHN	Integrated Habitat Network
NEN	National Ecological Network
NPF2	National Planning Framework 2
OMHPDL	Open Mosaic Habitat on Previously Developed Land
UKBAP	United Kingdom Biodiversity Action Plan
Brownfield	Land which has previously been developed and has (had) a permanent structure and associated surface infrastructure. Both derelict land and vacant land are included within this definition.
Derelict land	A landuse category, recorded as part of the Scottish Vacant and Derelict Land Survey. "Derelict land (and buildings) is land which has been so damaged by development, that it is incapable of development for beneficial use without rehabilitation. In addition the land must currently not be used for the purpose for which it is held or a use acceptable in the local plan. Land also qualifies as derelict if it has an unremedied previous use which could constrain future development. For urban vacant and derelict land, site records must be at least 0.1 ha in size to be included." ¹
Greenspace	'Greenspace' includes public and private gardens, parks and grounds, amenity land, sports and play areas, green corridors, natural and semi-natural areas, allotments and community growing spaces, burial grounds and other functional green areas. ²
Green Network	A network of greenspace.
Integrated Habitat Network	A habitat network is a network focused upon a single habitat. An integrated habitat network is a network combining the needs of multiple habitats. ³
Open Mosaic Habitat on Previously Developed Land	A UK Biodiversity Action Plan priority habitat comprising a characteristic mosaic of different habitats. The habitat is associated with brownfield sites, but only a small proportion of brownfield sites support good examples of this habitat.
Vacant land	A landuse category recorded as part of the Scottish Vacant and Derelict Land Survey. "Vacant land is land which is unused for the purposes for which it is held and is viewed as an appropriate site for development. This land must either have had prior development on it or preparatory work has taken place in anticipation of future development." ⁴

¹ Scottish Government. Scottish Vacant and Derelict Land Survey 2010. PLG/2011/1

² SNH website. <http://www.snh.gov.uk/about-scotlands-nature/habitats-and-ecosystems/greenspaces-and-gardens/>

³ SNH website. <http://www.snh.gov.uk/land-and-sea/managing-the-land/spatial-ecology/types-of-network/integrated-habitat-networks/>

⁴ Scottish Government. Scottish Vacant and Derelict Land Survey 2010. PLG/2011/1

1. INTRODUCTION

The rich industrial heritage of Scotland has resulted in over 10,000 ha of land being listed as vacant or derelict (Scottish Government, 2011). These so-called 'brownfield' sites can be very important for UK biodiversity, often supporting nationally important populations of rare and endangered invertebrates, alongside other wildlife such as birds, reptiles, plants and lichens. A recurring attribute of the best brown field sites for biodiversity is that they usually support a mosaic of different habitat types. Such a mosaic has been recognised as a habitat feature in its own right and referred to as Open Mosaic Habitat on Previously Developed Land (OMHPDL). With the loss of natural habitats in the wider countryside through agricultural intensification and development, wild areas within the urban environment have become crucial to the survival of many increasingly threatened species in the UK. As a result OMHPDL has been recently included as a UK Biodiversity Action Plan (UKBAP) priority habitat (Maddock, 2008). Previous assessments (Macadam, 2010a; Macadam, 2010b) of sites listed as 'derelict' on the Scottish Vacant and Derelict Land Register found that 406 sites had the potential to satisfy the criteria for OMHPDL.

It has long been recognised that brownfield may have as many associated Red Data Book (RDB) and Nationally Scarce invertebrate species as ancient woodlands (Jones, 2003). At least 194 invertebrate species of conservation importance, including 50 RDB and 131 Nationally Scarce species, have been recorded from brownfield sites in the UK. This includes 50% of rare solitary bees and wasps and 35% of rare ground beetles (Bodsworth *et al.* 2005). It is therefore essential that terrestrial invertebrates are properly surveyed and impacts assessed.

This project identifies the sites where OMHPDL is thought to occur and will enable planning authorities and others to consider strategic redevelopment of derelict sites, while also delivering conservation action for the OMHPDL UKBAP priority habitat and associated biodiversity.

2. AIMS

- To assess sites listed as 'vacant' on the Scottish Vacant and Derelict Land Register for their potential to satisfy the criteria for the UKBAP priority habitat: OMHPDL.
- To review the habitat features on Scottish brownfield sites (found on either vacant or derelict land), which are considered the most important for wildlife and to comment on any regional variation in these features.
- To review the remote assessment methodology described by Riding *et al.* (2010).
- To undertake field assessments on a selection of sites identified as potentially satisfying the criteria for OMHPDL.
- To review the field assessment methodology described by Riding *et al.* (2010).
- To make recommendations on the role of OMHPDL in integrated habitat networks and other landscape scale initiatives.
- To make recommendations on the management of OMHPDL in Scotland.

3. REVIEW OF HABITAT FEATURES ON SCOTTISH BROWNFIELDS

The lack of management on previously developed land commonly known as 'brownfield' sites often creates an open mosaic of habitats such as bare ground, species-rich grassland and early successional habitats (Key, 2000; Bodsworth *et al.*, 2005; Harvey *et al.*, 2008). This, combined with a low nutrient content of the soil which prevents fast growing plant species becoming dominant, provides a continuity of resources for invertebrates throughout the season (Harvey *et al.*, 2008). In addition, a mosaic of habitats provides a home for a wide range of species and allows many to complete their life cycles within the same site (Bodsworth *et al.*, 2005).

Every brownfield site is different as a result of the previous use of the site (e.g. quarry, railway land, disused airstrip, etc.) and local conditions such as weather, location and contamination. The age of the brownfield site is an important factor in determining its importance for biodiversity. Kattwinkel, *et al.* (2011) found that the biodiversity importance of sites peaked at between 15 and 20 years. In order to help identify which brown field sites support OMHPDL, Riding *et al.* (2010) list five criteria that must all be met for a site to qualify as OMHPDL:

Criterion 1	The site is at least 0.25 ha in size
Criterion 2	Known history of disturbance at the site or evidence that soil has been removed or severely modified by previous use(s) of the site. Extraneous materials/substrates such as industrial spoil may have been added.
Criterion 3	The site contains some vegetation. This will comprise early successional communities consisting mainly of stress tolerant species (e.g. indicative of low nutrient status or drought). Early successional communities are composed of a) annuals or b) mosses/liverworts or c) lichens or d) ruderals or e) inundation species or f) open grassland or g) flower-rich grassland or h) heathland.
Criterion 4	The site contains un-vegetated, loose bare substrate and pools may be present.
Criterion 5	The site shows spatial variation, forming a mosaic of one or more of the early successional communities plus bare substrate, within 0.25 ha.

The habitats described in this section are typical of brownfield sites and are likely to be part of the mosaic of habitats which defines OMHPDL.

3.1 Bare ground

Bare ground on brownfield sites can be recognised as any area which is lacking vegetation. This includes bare areas of soil, sand, gravel and concrete. These areas of bare ground may have been recently disturbed and can be fully or partially compacted. Areas of bare ground can have various species of lichen and moss associated with them and may have sparse vegetation.

Bare ground is important for thermophilic (warmth-loving) invertebrates such as spiders, ground beetles, solitary bees and wasps (Key, 2000; English Nature, 2005b; Whitehouse, 2008). Recently disturbed and loose bare ground is a perfect habitat for ground nesting solitary bees and ground beetles such as the green tiger beetle (*Cicindela campestris*). The soil under bare ground is significantly warmer than soil under vegetation and this allows eggs and larvae of ground nesting invertebrates to develop faster.

Concrete on brownfield sites may be partly broken up due to the weather and other on-site factors. This can provide a very important habitat for a number of animal and plant species. Bare ground is also important for a number of vertebrate species, especially for basking reptiles.

3.2 Species-rich grassland

Low nutrients in the soil at many brownfield sites often create species rich grassland as the lack of nutrients prevents fast growing plant species becoming dominant. These rich areas can often be recognised by the number of wildflower and grass species within a meadow. Within this rich grassland there may also be a range of lichen and moss species. This meadow may be relatively short in height with some taller areas and there may also be tussocks of grass or rush. These tussocks provide a valuable home to many over-wintering species of invertebrates as well as birds, mammals and amphibians.

Diverse flower-rich habitats are important to insects that develop on or inside roots, leaves, stems, fruits and seeds, as well as the predators that feed on or parasitize these species. Flower-rich habitats also provide essential nectar and pollen resources for pollinators such as bees, hoverflies and butterflies, many of which have preferences regarding which flowers they use or may be associated with single plant species.

3.3 Tall ruderal plants

Through natural succession, nitrogen fixing legumes such as clovers and vetches found in species-rich grasslands can alter the nutrient levels at a site. This creates high levels of nutrients in the soil and allows fast growing ruderals to become dominant. Ruderal species include common nettle (*Urtica dioica*), bramble species (*Rubus fruticosus* agg.), rosebay willowherb (*Chamerion angustifolium*), thistle species (*Cirsium* spp.) and dock species (*Rumex* spp.).

The success of ruderals depends on soil makeup and site history. Varied nutrient levels in the soil across brownfield sites can create mosaics of different plant species assemblages. Patches of ruderals can for example be found alongside or within an area of species-rich grassland.

Ruderals can become a problem and invasive as they can grow fast and quickly become dominant. They also change the soil composition on a site as when these early pioneering species die they create plant litter that over time breaks down to modify the organic content of soil. Over several years this can create soil that is suitable for scrub to develop.

Many species are associated with ruderal plants including invertebrates, small mammals, birds and amphibians. Bramble is particularly important for a number of species that feed on its leaves and berries and for the many invertebrates that live in the stems.

Several invasive non-native ruderals such as Japanese knotweed (*Fallopia japonica*) and Himalayan balsam (*Impatiens glandulifera*) can very quickly become established and become dominant on a site. They ultimately reduce biodiversity across a site through severe competition with native species. They can even outcompete native ruderals such as rosebay willowherb and bramble mentioned above.

3.4 Scrub

Scrub is a plant community characterised by vegetation dominated by woody plants and shrubs between 5 and 8 m tall (Kirby, 1992). Shrub species include alder (*Alnus glutinosa*), wild rose species (*Rosa* spp.), juniper (*Juniperus communis*), gorse (*Ulex europaeus*) and birch (*Betula* spp.) as well as many others.

Scrub is an extremely important habitat as it provides a plentiful supply of food and cover for numerous wildlife species. A variety of scrub species within the same site is highly beneficial. Shrubs such as willow (*Salix* spp.) and wild rose species are particularly important to many insect pollinators including bees, hoverflies and butterflies. Invasive non-native shrubs such as cotoneaster (*Cotoneaster* spp.) and buddleia (*Buddleia davidii*), whilst providing nectar and pollen for a number of invertebrate species, are aggressive colonisers and are ultimately detrimental to the native flora found on brownfield sites.

3.5 Shelter

Shelter on site is exceptionally important to many plants and animals. Not only does it provide nesting sites and a food resource for many species, it also provides resting areas. Shelter may be created by a group of trees or shrubs or even by an old wall.

Shelter can help shield areas of bare ground and short/sparse vegetation helping to create sun traps. These sun traps can be vital to warmth loving ground nesting species if there are no south facing slopes within the area.

Climbers associated with tall trees such as ivy (*Hedera helix*) and honeysuckle (*Lonicera periclymenum*) provide shelter for several species. Ivy is particularly important as its flowers are very rich in nectar and are an important early spring and late autumn food source to pollinators.

As trees grow older and start to die back they create areas of standing and fallen dead wood. Dead wood provides homes and food to a number of species including fungi and invertebrates such as longhorn beetles and hoverflies.

3.6 South facing slopes and banks

Varied topography, with hollows, mounds and south facing banks provide structural and hydrological diversity. This can lead to the development of vegetation with a varied species composition and structure, with a resultant associated high invertebrate diversity.

South facing slopes and banks are especially important to ground nesting thermophilic invertebrates such as many bees, wasps and beetles. Flat, sloping and banked areas may be utilised and favoured by different species, but vertical banks take much longer to vegetate making them more attractive to many species. Slopes with sparse vegetation and bare ground are particularly beneficial to wildlife.

3.7 Seasonal ponds and damp areas

Hollows and mounds, in combination with variously free draining, compacted and impermeable substrates provide various degrees of permanent or seasonal wetness and drought conditions. These permanent and seasonal ponds subsequently develop a variety of plant and invertebrate communities.

A pond is any body of water that varies in size from 1 m² to 2 ha and which holds water for four months of the year or more (Collinson *et al.*, 1995). Ponds can vary in size considerably between years and are dependent on local weather and habitat conditions.

Many temporary or seasonal ponds have a range of specialised and rare plants and animals associated with them. These habitats are particularly important for amphibians and invertebrates such as water beetles and aquatic snails.

All pools and any area with damp soil should be noted on site as these may be part of more extensive seasonal pond habitats that are important for many species.

4. REMOTE ASSESSMENT OF VACANT LAND

4.1 Methods

This project assessed 382 sites listed as 'vacant' on the Scottish Vacant and Derelict Land Register 2009 for their potential to qualify as the UKBAP habitat 'OMHPDL'. This assessment excluded those sites located within the Central Scotland Green Network (CSGN) area. As the largest urban and peri-urban area in Scotland the CSGN would merit a separate, but similar study based upon the findings of this project.

Sites potentially supporting OMHPDL and listed as 'derelict' on the Scottish Vacant and Derelict Land Register 2009 had previously been assessed (Macadam, 2010a, b). The large number of potential sites present in the current study made field visits to every site impracticable. A desk study was therefore undertaken in accordance with the Remote Assessment Approach for OMHPDL Priority Habitat Sites (Riding *et al.*, 2010) to identify sites that could potentially fit the criteria for OMHPDL. This approach had successfully been trialled to identify OMHPDL on "derelict" sites (Macadam, 2010a, b).

As a first step, sites listed as 'vacant' on the Scottish Vacant and Derelict Land Register 2009 were excluded from consideration if they were under 0.25 ha in area. The remaining sites were plotted on Google Earth and aerial photography was examined in relation to each of the remaining OMHPDL priority habitat definition criteria. Sites were excluded from further consideration if they (i) were recently developed; (ii) were landscaped; (iii) lacked any vegetation; (iv) were completely covered with late successional vegetation such as woodland, scrub or homogeneous grassland or (v) were under agricultural use. The apparent absence of a mosaic was not used as an excluding factor, since the mosaic cannot necessarily be seen from aerial photography. Where aerial photography was obscured or at too low a resolution to assess the presence or absence of these features a conclusion could not be made regarding the likely presence or absence of OMHPDL. Details of the decision making process, plus any notes on the sites were stored in a Microsoft Excel spreadsheet, and presented as a separate Annex to this report.

Sites which satisfied the OMHPDL criteria were allocated for ground truthing and their boundaries digitised using ArcGIS 10.

4.2 Results

Sixty seven sites were identified that were considered likely to support OMHPDL, but which would require ground truthing to confirm whether they qualified as sites with OMHPDL (Table 1 and 2). For an additional three sites the aerial photography was obscured and remote assessment was not possible.

Table 1: Sites selected for ground truthing by Local Authority area (sorted alphabetically).

Local Authority	Yes	No	Unknown	Total
Aberdeen City	7	10	-	17
Aberdeenshire	6	24	-	30
Angus	8	11	-	19
Argyll & Bute	7	17	2	26
Dumfries & Galloway	1	27	1	29
Dundee City	11	102	-	113
Eilean Siar	3	1	-	4
Highland	13	75	-	88
Moray	6	18	-	24
Orkney Islands	-	1	-	1
Perth & Kinross	2	8	-	10

Local Authority	Yes	No	Unknown	Total
Scottish Borders	2	13	-	15
Shetland Islands	1	5	-	6
Total	67	312	3	382

Table 2: Sites selected for ground truthing by Local Authority area (sorted by number selected).

Local Authority	Yes	No	Unknown	Total
Highland	13	75	-	88
Dundee City	11	102	-	113
Angus	8	11	-	19
Aberdeen City	7	10	-	17
Argyll & Bute	7	17	2	26
Aberdeenshire	6	24	-	30
Moray	6	18	-	24
Eilean Siar	3	1	-	4
Perth & Kinross	2	8	-	10
Scottish Borders	2	13	-	15
Dumfries & Galloway	1	27	1	29
Shetland Islands	1	5	-	6
Orkney Islands	-	1	-	1
Total	67	312	3	382

In total over 116.11 ha of vacant land potentially satisfies the criteria for OMHPDL. The majority of this land, nearly 69%, is in Angus and Dundee City (Table 3).

Table 3: Area of sites selected for ground truthing.

Local Authority	Area (Ha)
Angus	31.24
Dundee City	28.12
Highland	12.55
Argyll & Bute	9.99
Aberdeen City	8.98
Eilean Siar	8.93
Aberdeenshire	5.94
Scottish Borders	3.44
Moray	3.08
Dumfries & Galloway	2.62
Perth & Kinross	0.83
Shetland Islands	0.39
Orkney Islands	-
Total	116.11

Of the 312 sites that were not considered to satisfy the criteria for OMHPDL the main reason for exclusion was that many were landscaped and were regularly cut as amenity grassland (Figure 1). Several sites appeared to lack any vegetation while others had been recently developed or had late successional vegetation and were therefore not eligible for listing as a UKBAP priority habitat. Forty one sites were excluded from ground truthing due to a lack of any vegetation on the site. It should be noted that some of the aerial photography used to assess these sites was over 10 years old, which leads to limitations in the assessment. For sites that lacked vegetation and had old aerial imagery, Google Street View was used as this

imagery is more recent than the available aerial image. Google Street View proved to be effective as a tool to identify OMHPDL in many cases.

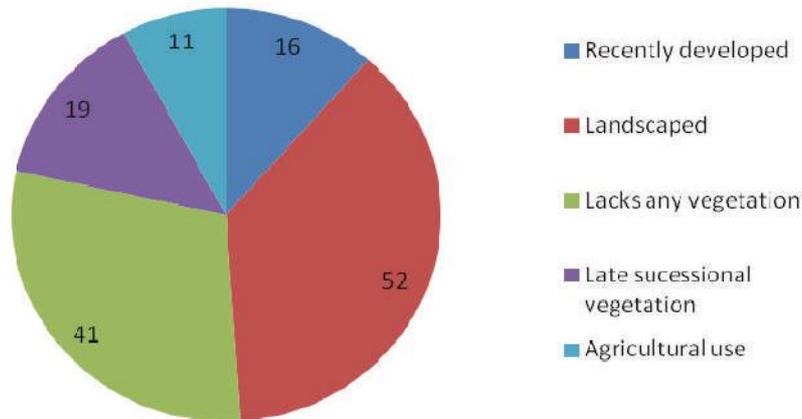


Figure 1: Reasons for excluding sites from ground truthing (NB some sites may be represented more than once as an individual site may exhibit more than one of the exclusion criteria).

4.3 Review of remote assessment methodology

The remote assessment methodology described by Riding *et al.* (2010) and used in this project relies on the examination of aerial photography. Aerial images, by their very nature, are a snapshot in time and it was recognised during this and previous work (Macadam, 2010a, b) that the availability of up to date images varies across Scotland. At least four sites that are listed as vacant land and 284 sites listed as derelict land had aerial imagery that is over 10 years old. The redevelopment or landscaping of sites can change the situation on the ground in a short period of time – a fact which was noted during ground truthing. Examination of photography from both Google (maps.google.com) and Bing (maps.bing.com) is helpful as each supplier has differing ages and quality of aerial photography.

Aerial photography for some areas of Scotland, particularly in the Highlands and Perth and Kinross, is currently only available at a low resolution which makes the identification of OMHPDL on sites impossible. However, it is sometimes possible to use Google Street View to view the site from ground level, although this is only possible for sites close to the public road network and where the field of view is limited to areas adjacent to the road.

4.4 Conclusions

- The remote assessment methodology (Riding *et al.*, 2010) identified areas of OMHPDL at 67 (possibly 70) vacant sites and 393 (possibly 406) derelict sites.
- Remote assessment also identified sites that have recently been developed, are landscaped, have late successional vegetation, have no vegetation or are used for agriculture
- Age of aerial imagery varies across Scotland and may be over 10 years old.
- The resolution of aerial imagery varies and low quality images prevented the assessment of several vacant and derelict sites.
- Google Street View may provide more recent images than aerial imagery, but is limited to sites close to the public road network

5. GROUND TRUTHING OF SELECTED SITES

5.1 Methods

Sites for the field based ground truthing were chosen to reflect a) the geographic spread of sites identified in Macadam (2010a, b) to ensure coverage of sites located in rural, peri-urban and urban situations. In addition, to test the efficacy of using aerial photography to identify OMHPDL, sites were chosen that have different ages of aerial photography (1993 – 2009). Details of these sites are given in Annex 1.

Each site was visited during August/September 2011 and assessed according to the methodology contained in Riding *et al.* (2010). A structured walk over of each site was undertaken involving up to 20 stops to provide a quick assessment of the variation within the site. Attributes collected at each stopping point and for the site as a whole are:

1. current use;
2. landscape context;
3. cover/abundance of characteristic plant species;
4. percentage cover of OMHPDL plant communities (see Section 3 for descriptions);
5. presence of invertebrates;
6. presence of other animal group such as reptiles and amphibians, etc;
7. presence of other plant communities or habitats;
8. evidence of environmental stress and bare ground habitats;
9. presence of physical variation, habitat mosaic and negative indicators;
10. evidence of fragmentation of OMHPDL habitat.

Measures of these attributes were recorded using a spreadsheet based [field assessment form](#) provided as an [annex](#) to Riding *et al.* (2010).

During the site visit invertebrate species were collected or observed at each stopping point using a combination of active searching and sweep netting. Particular attention was paid to hoverflies (Syrphidae), beetles (Coleoptera), spiders (Araneae), and bees, wasps and ants (aculeate Hymenoptera) using the site as these groups are good indicators of habitat quality (Eyre, 1996; English Nature, 2005a; Massini *et al.*, 2006; Drake *et al.*, 2007).

5.2 Results

The following section provides details from site visits undertaken during August/September 2011. Each site has a unique code that allows cross-referencing with the full details that are provided in Annex 1. Where possible access permissions were obtained prior to ground truthing; however, there were difficulties in identifying ownership of sites. Where ownership could not be determined efforts were made to complete the assessment from the site boundary or by using existing public access to the site. Where it was not possible to gain access, or access was refused this is noted in the site description.

5.2.1 Quarry (CENGAL103)

This 5.04 ha derelict quarry on the outskirts of Galashiels in the Scottish Borders was visited for ground truthing on 31 August 2011. Remote assessments identified open mosaic habitat with areas of bare ground, grassland and scrub recognised from the aerial imagery. Variation in aspect and gradient across the site was also identified from aerial imagery.

Most of the central area of the site is bare ground with various sized stones some of which form large mounds of previously quarried material. Areas of bare ground have sparse vegetation of wildflowers dominated by groundsel (*Senecio vulgaris*), common ragwort (*S.*

jacobaea) and weld (*Reseda luteola*). Within the central area of bare ground, hay bales and a tractor are being stored by a farmer and there is also a large pool of water.

Around the steep and lower edges of the site there is grassland and scrub. Areas of scrub are dominated by silver birch (*Betula pendula*) and willow (*Salix* sp.) saplings with rosebay willowherb (*Chamerion angustifolium*) and gorse (*Ulex europaeus*). Grassland is poor in species diversity. Edges to the south and south east of the quarry have a very steep gradient.

Wildflowers at the quarry are important for pollinators, including the hoverfly *Melanostoma scalare*, the marmalade hoverfly (*Episyrphus balteatus*) and also for bumblebees including the common carder bee (*Bombus pascuorum*) and buff tailed bumblebee (*B. terrestris*). Other species recorded included a large flock of meadow pipits (*Anthus pratensis*) and the brown hare (*Lepus europaeus*), a UKBAP species.

5.2.2 Station Road (KELSO013)

The site is 0.59 ha in size and was visited for ground truthing on 31 August 2011. No access to the site was available at Station Road, Kelso as it is surrounded by a tall fence with a padlocked gate. Aerial imagery from 2007 shows an area of bare ground to the east of the site from a previously demolished building and around this is open grassland and scrub.

A brief assessment of the site was undertaken from a distance at the padlocked gate entrance. A large area of short grassland surrounded by scrub and rosebay willowherb was seen from the entrance. Some small areas of bare ground through broken up concrete are to the west of the site along with some old dumped tyres. Around the edges are several tall trees and dense scrub. The only other characteristic plant species recorded from the site was black medick (*Medicago lupulina*). However, it was impossible to identify the habitat of the entire site from this viewpoint.

5.2.3 Turfhill (1002)

Turfhill near Kinross is 3.08 ha in size and was visited for ground truthing on 12 August 2011. The remote assessment identified that this site was heavily used by people due to desire lines that go around and across the site. Open mosaic habitat of bare ground, grassland and scrub are present on the aerial image from 1999.

Ground truthing identified open mosaic habitat consisting of areas of bare ground, short grassland with herbs, dense areas of rosebay willowherb, scrub of willow and silver birch and a small wetland area with a pool. Well trodden paths are regularly used by dog walkers as witnessed during ground truthing and there is evidence that quad biking has occurred at the site.

Most of the site is fairly flat although the edges do have a slight change in gradient and these mostly have scrub and dense tall herb of rosebay willowherb around them. To the south east of Turfhill is an area of bare ground that has been created by recent works on the adjacent M90 motorway. This area of bare ground is rich with common mouse-ear hawkweed (*Hieracium pilosella*) and some garden lupin (*Lupinus polyphyllus*).

Wildflowers across the site are important for pollinators including the hoverflies *Melanostoma mellinum* and *Platycheirus clypeatus* as well as six-spot burnet moth (*Zygaena filipendulae*) and common wasp (*Vespula vulgaris*).

5.2.4 Boreland Fell (140000002)

This derelict quarry near Kirkcowan in Dumfries and Galloway is 2.82 ha in size and was visited for ground truthing on 22 August 2011. Aerial imagery from 2003 revealed large areas of bare ground with short grassland and dense scrub. From the remote assessment it was recognised that the west of the quarry has a very steep gradient and derelict buildings stand at the site entrance.

Areas of bare ground across the site are made up of various sized stones from previous quarry works. There is a constant increase in site elevation that starts at the entrance of the quarry and reaches the steep sided rear.

Although not diverse, wildflowers were particularly abundant across the site. A change in plant species dominance was recognised with the change in site elevation. The entrance of the quarry is dominated by common toadflax (*Linaria vulgaris*) and from this the dominant wildflower species changes to black medick, wild strawberry (*Fragaria vesca*) and silverweed (*Potentilla anserina*). The top of the site is very wet, supporting several pools and with common cottongrass (*Eriophorum angustifolium*) abundant.

Species recorded at the site included common groundhopper (*Tetrix undulata*) and pollinators such as bumblebees (*Bombus* spp.) and common carder bee.

5.2.5 Nurseries and Plots 8 & 9 (CENGAL 105)

This 0.92 ha site is adjacent to new housing in Galashiels and was identified from aerial imagery as having OMHPDL. The site was visited on 31 August 2011; however fencing prevented access to the site. It was noted that the site had recently been landscaped and saplings of various tree species had been planted.

5.2.6 Carse Industrial Estate (319 INV1)

Aerial imagery from 2006 shows an area of bare ground surrounded by areas of scrub and grassland on this site in the South Kessock area of Inverness. The site is 3.26 ha in size and was visited for ground truthing on 18 September 2011. The site has recently been prepared for re-development with a new road layout being formed and is surrounded by a tall chain link security fence. No access was available to this site and therefore no ground truthing was undertaken.

5.2.7 Kinmylies Primary School (319 INV3)

This 1.86 ha site was visited for ground truthing on 18 September 2011. No ground truthing was possible at this site as re-development for housing is under way.

5.2.8 North Longman (319 INV114)

This former landfill site, covering 57.04 ha was identified as having open mosaic habitats from aerial photography taken in 2009. These images showed extensive areas of bare ground interspersed with scrub and grasslands. To the west there is a dense area of trees and scrub. This site was visited for ground truthing on 18 September 2011; however, access was refused by the site manager on the day. While the landfill site has closed, the site is still classed as operational while landscaping and restoration works are being undertaken.

5.2.9 Dump at Scretan Bridge (308 CUL7)

Remote assessment identified an area of 1.71 ha that potentially satisfied the criteria for OMHPDL at this site. Ground truthing on 18 September 2011 revealed that the majority of the site was abandoned agricultural land. A further area of land adjacent to the shore of the

Moray Firth was dominated by salt marsh and coastal grassland. Neither of these areas qualify as OMHPDL. A smaller area (0.58 ha) to the north east of the site did contain features indicative of OMHPDL including bare ground and a small pool of standing water. The area was surrounded by dense stands of docks, nettles and rosebay willowherb. Although not particularly floristically rich, red bartsia (*Odontites vernus*) and common mouse-ear (*Cerastium fontanum*) were relatively common and teasel (*Dipsacus fullonum*) was also present. There was evidence of some fly-tipping on the site and the presence of non-native species such as montbretia (*Crocoshmia x crocosmiflora*) and monkey flower (*Mimulus* sp.) is likely to be the result of dumped garden refuse.

5.2.10 Aluminium Works (623 IG14)

This 22.3 ha site on the outskirts of Invergordon was assessed using aerial imagery dating from 2006. The aerial imagery revealed industrial buildings surrounded by grassland along with an area to the east of the site with potential OMHPDL with bare ground, grassland and a pond.

The site was visited on 19 August 2011 for ground truthing. Industrial activity was still evident across the site during this visit. In particular a timber processing yard facility occupied a large part of the site and large stacks of timber were found in several areas of the site. The grassland surrounding buildings on the site is currently being used for grazing livestock.

There was no access to the area with potential OMHPDL at the east of the site due to it being within the timber processing plant and therefore no ground truthing occurred.

5.2.11 Glamis Station (AN-R-02)

Glamis Station is a 2.06 ha site which lies to the north of the village of Glamis. The site is a derelict railway station and associated sidings and remote assessment using images from 2006 identified open grassland, late successional vegetation and some scrub. To the north of this site are large areas of woodland and to the south is agricultural land. Between the agricultural land and the site is a row of cottages.

Glamis Station was visited for ground truthing on 21 August 2011. Part of this site has been redeveloped and an area to the south of the site has been incorporated into the garden of the cottages. The disused railway to the west of the site appears to be well used by walkers and horse riders. OMHPDL within this site includes areas of bare ground with rubble and ballast along with open grassland with some ruderals and scrub. Ruderals include large areas with rosebay willowherb and some common nettle.

Various wildflowers are present in the open grassland including knapweed (*Centaurea nigra*), tufted vetch (*Vicia cracca*) and black medick. These wildflowers are recognised as being important for pollinators, especially for the butterflies small copper (*Lycaena phlaeas*), small blue (*Cupido minimus*), and the UKBAP species small heath (*Coenonympha pamphilus*). An elephant hawkmoth (*Deilephila elpenor*) was recorded on site as well as common hawkler (*Aeshna juncea*), field grasshopper (*Chorthippus brunneus*) and common green grasshopper (*Omocestus viridulus*).

5.2.12 Brick and Tile Works (CRU1)

This derelict brick and tile works at the north of Cruden Bay in Aberdeenshire is 10.8 ha in size. Recent aerial imagery (2009) shows a large pond within the central area of the site that is surrounded by grassland. In the south-east corner is a large area of open bare ground comprising broken up concrete. A large housing estate lies to the south of this site and agricultural land lies to the north.

The site was visited for ground truthing on 20 August 2011. Flower-rich grassland occurs across the site with red clover (*Trifolium pratense*) and birds foot trefoil (*Lotus corniculatus*) dominating the meadow. There are several smaller areas of rank grassland. This site was identified as being extremely important for pollinators which were recorded feeding within the meadow areas. Species noted include early bumblebee (*Bombus pratorum*), small tortoiseshell butterfly (*Inachis io*) and large white butterfly (*Pieris brassicae*).

As well as the large pond there are several smaller ponds across the site. These ponds are important for dragonflies and damselflies as several species were recorded including black darter (*Sympetrum danae*), emerald damselfly (*Lestes sponsa*) and four spotted chaser (*Libellula quadrimaculata*). The large pool of water may have been created through aggregate extraction from previous industrial activity at the site.

Apart from the area of broken up concrete in the south east of the site, there is very little bare ground within the meadows. Several piles of rubble were found that were made up of bricks from previous industrial activity at the site.

The site is currently used as informal greenspace by local people and there is direct pedestrian access from the nearby housing estate. There is currently an application with Aberdeenshire Council for the redevelopment of this site for housing.

5.3 Discussion

The field assessment methodology described by Riding *et al.* (2010) proved useful for assessing the presence of OMHPDL. There are, however, a number of limitations identified and observations made by the assessors.

Many factors, such as geology and previous and current management influence the habitats and wildlife present on brownfield sites. This variation means that there are no characteristic plant species which are consistently found across all brownfield habitat. Some ruderals that usually grow in areas of high nutrients such as bramble, common nettle and rosebay willowherb are, however, often present.

The ground truthing protocol recognises that plant communities vary around the UK; however, only five characteristic plant lists are offered: Southern England, Northern England, Scotland, South Wales and Thames Gateway. The characteristic plant species list provided for Scotland was useful when ground truthing; however, despite the concession to the regional differences in plant species, the authors feel that this plant list does not adequately reflect the regional variations within Scotland. The species listed are typical of Scotland's Central Belt and include species such as hard rush (*Juncus inflexus*), meadow salsify (*Tragopogon pratensis*) and Oxford ragwort (*Senecio squalidus*) that are scarce in northern Scotland. The current survey identified 21 of the 37 characteristic plant species used in the ground truthing assessment, whereas previous work on brownfield sites in Falkirk (Bairner and Macadam, 2011) identified 23 of the plant species, seven of which were not recorded in the current study. Several wildflower species were not recorded at all during the current study, including Michaelmas daisy (*Aster novi-belgii*), chicory (*Cichorium intybus*) and hemlock (*Conium maculatum*). These species are widespread in Scotland although not common in the north. Michaelmas daisy is more common in Scotland's Central Belt whereas chicory and hemlock are common towards the east.

Aerial imagery of sites visited for ground truthing varied in age considerably. The oldest image was from Turfhill (1002) in Perth and Kinross and was dated from 1999. Sites with OMHPDL are often transitory in nature due to natural succession and if left unmanaged and undeveloped they have a typical lifespan of between 15 and 20 years, or in some cases even longer (Key, 2000; Bodsworth *et al.* 2005; Kattwinkel, *et al.*, 2011). Plant species that

inhabit these sites will colonise and retreat in response to the availability of the habitat in the area and also in response to variation in soil make up and climate (Bairner and Macadam, 2011). As the composition of plant species across brownfield sites is so varied, this implies that a typical plant species list may not be suitable for widespread use.

Many of the species on this list are closely related: for example, hop trefoil (*Trifolium campestre*), lesser hop trefoil (*T. dubium*), black medick and the clovers - zigzag clover (*T. medium*), alsike clover (*T. hybridum*) and red clover. Recording these closely related species is time consuming and restricts the application of ground truthing to surveyors with extended botanical experience. It is suggested that a more general species list should be used to cover groups of plants that are similar in appearance and still typically found on brownfields such as clovers, knapweeds, umbellifers, daisies and mayweed (see Table 4 below). This would allow wider application of the assessment methods by less specialised ecologists.

Table 4: Suggested plant species list for ground truthing OMHPDL in Scotland.

Scientific Name	Common Name
<i>Artemisia vulgaris</i>	mugwort
<i>Centaurea nigra</i>	black knapweed
<i>Centaureum erythraea</i>	common centaury
<i>Cerastium fontanum</i>	common mouse ear
<i>Echium vulgare</i>	vipers bugloss
<i>Euphrasia</i> spp.	eyebright
<i>Fragaria vesca</i>	wild strawberry
<i>Geranium</i> spp.	cranesbills
<i>Hypericum perforatum</i>	St. John's wort
<i>Hypochoeris radicata</i>	cats ear
<i>Leucanthemum vulgare</i>	oxeye daisy
<i>Linaria vulgaris</i>	toadflax
<i>Linum catharticum</i>	fairy flax
<i>Matricaria discoidea</i>	pineappleweed
<i>Medicago lupulina</i>	black medick
<i>Myosotis</i> spp.	forget-me-nots
<i>Odontites vernus</i>	red bartsia
<i>Plantago lanceolata</i>	ribwort plantain
<i>Ranunculus</i> spp.	buttercups
<i>Reseda</i> spp.	mignonette species
<i>Silene dioica</i>	red campion
<i>Trifolium</i> spp.	clovers and related species
<i>Tripleurospermum</i> spp.	mayweeds
<i>Tussilago farfara</i>	coltsfoot
<i>Umbelliferae</i> spp.	umbellifers
<i>Veronica</i> spp.	speedwells
<i>Vicia</i> spp.	vetches

Negative indicators can also be assessed using the field assessment form. Invasive non-native plant species can be a problem as they can quickly colonise an area and become dominant. The guidance notes suggest that regional lists can be compiled to include invasive non-native plant species such as Japanese knotweed (*Fallopia japonica*), Himalayan balsam (*Impatiens glandulifera*) and giant hogweed (*Heracleum mantegazzianum*). Some native plant species can also become dominant on brownfield sites. Species such as broad-leaved dock (*Rumex obtusifolius*), common nettle, common ragwort and bramble are important for a range of invertebrate species as well as other wildlife. Whilst in general these native species are not negative indicators of site quality, it is

important to record whether any of these species are present on the site, as large stands can outcompete other native vegetation. Where any of these species are dominant at a number of recording points this is likely to be detrimental to the overall quality of the OMHPDL present.

The field assessment form (see Section 5.1) allows a surveyor to describe certain attributes of the site such as whether the open mosaic habitat is entire or fragmented or if the site is in context with the surrounding landscape. It also allows the surveyor to record substrate type, colour and particle size, physical variation, including topography and aspect, plant communities present, and the extent of the habitat mosaic. Many of these factors are recorded as percentage cover, requiring considerable time to be spent on site. Despite the high level of effort estimating percentage cover on site, it proved difficult to present an accurate representation of what each site looked like.

There is a lack of available guidance on how to interpret the results of the field assessment process. It is important that this information should be available in the future so that sites can be assessed objectively.

5.4 Conclusions

- A total of 12 derelict sites were ground truthed using the field assessment methodology outlined in Riding *et al.* (2010).
- OMHPDL was identified on six sites; a further three sites have the potential to have OMHPDL; however, access was not possible.
- A more generic list of plants to use when ground truthing than that used by Riding *et al.* (2010) would ensure that OMHPDL can be assessed by non-specialists.
- Every brownfield site is different and may be dominated by particular wildflower species that might not be included within the characteristic plant species form. Additional species which are abundant on the site should be recorded by the assessor as these may be of importance in a local context.
- Only invasive non-native species should be classed as negative indicators of site quality, although native invasive species should also be recorded.
- An overall summary of the site, the habitats and species present and the overall biodiversity value should be made while ground truthing.

6. IMPORTANCE OF OMHPDL AS A COMPONENT OF INTEGRATED HABITAT NETWORKS

Habitat network modelling is a tool to identify the relationship between habitat ‘patch’ size, shape and quality, the degree of isolation of patches from each other, and how permeable the intervening land is to species movement. Development and land use changes have fragmented habitats across Britain and this has had a direct impact on many animal and plant species. As habitats become fragmented they often become smaller and more isolated from other habitats within the integrated habitat network. Declining patch size and increased isolation make it increasingly difficult for species to survive and move, which is especially a concern as our climate changes.

The National Planning Framework for Scotland 2 (NPF2) aims to promote a greener Scotland through protection of both built and natural environments by 2030. NPF2 highlights that a National Ecological Network (NEN) will be key to achieving this aim, through providing a network of interconnected habitats that will allow species to move from one area to another. This would allow species to colonise new areas, thus potentially improving their conservation status. Areas of habitat supporting species can become unsuitable for the species over time as a result of factors such as climate change. The NEN could provide opportunities for species to move to new areas of suitable habitat from areas that are no longer suitable, and might make local and national extinctions less likely.

Integrated Habitat Network (IHN) models are a key tool for developing the NEN. IHN models map the connectivity of more than one habitat within an area. The IHN model therefore offers a powerful tool for planners, greenspace managers and others to help make decisions which will counter the effects of habitat fragmentation. The Central Scotland Green Network (CSGN) aims to deliver an IHN that has wildlife corridors joining up key sites and habitats, and is the first large scale pilot application of the NEN. The CSGN project aims to diversify habitats that are already present in the local landscape, increase biodiversity of the area and also provide connections with other habitats in the wider environment.

The OMHPDL data set created as an output of this project could be used to assist with IHN modelling outwith the CSGN area. A similar exercise to map OMHPDL within the CSGN could assist with IHN modelling within the CSGN area.

Access to high quality greenspace, including a network of habitats allows for greater recreational enjoyment as public access is improved. This is extremely important as access to Scotland’s greenspace will benefit both physical and mental health and develop a sense of wellbeing (Greenspace Scotland, 2008). Scotland’s greenspace has been mapped and is available online.⁵ Of the available greenspace only a small proportion is likely to support OMHPDL.

IHN models can be used to contribute information and ideas in the planning process such as location, specification and types of habitat needed to complement and mitigate development impact and inform wider land use policy processes. Habitat networks can also provide a valuable tool to deliver Local Biodiversity Action Plan targets for related habitats and species.

OMHPDL with varying stages of natural succession is scarce in the over-managed and farmed countryside. These sites have been identified as being important for a number of animal and plant species – particularly for invertebrates. It is the lack of apparent management and ‘untidiness’ that makes brownfield sites attractive for wildlife.

⁵ <http://www.snh.gov.uk/planning-and-development/advice-for-planners-and-developers/greenspace-and-outdoor-access/open-space-audits-and-strategies/dataset/>

If properly 'managed', brownfield sites with a high value for biodiversity can not only deliver suitable habitat for many rare and endangered species, but can also transform themselves into wild city spaces full of wildflowers that will attract pollinators and other animals. Such sites are an important part of the habitat network, providing 'stepping stones' for species to disperse around and through urban areas.

Brownfield sites can provide valuable open spaces for local people and are often seen as being the only truly 'wild' city spaces remaining for the public to enjoy the 'unofficial countryside'. Many brownfield sites are used as informal greenspace by the public for recreational activities such as walking, cycling and horse riding. These sites are also used as thoroughfares between other urban areas as part of a green network. There is great potential to make many of these sites more accessible, safe and enjoyable through imaginative planning and positive management.

In many built-up areas, brownfield sites may be the sole semi-natural greenspace available. If properly managed, they could help significantly to reduce the number of areas deficient in accessible open space, and contribute to the delivery of urban green networks. Improving access to sites with OMHPDL as part of a greenspace network will bring attendant quality of life and health benefits to residents, as well as economic benefits.

Vacant and derelict sites identified through this project as having OMHPDL should be included in the local IHN as a component of the NEN. It is important to include a range of sites with varying ages and stages of natural succession within the NEN, as brownfield sites support transient habitat mosaics which if left unmanaged might only last for between 15 and 20 years (Key, 2000; Bodsworth, *et al.* 2005; Kattwinkel, *et al.*, 2011). Ensuring that there is a network of interconnected brownfield 'stepping stones' at varying stages of succession might allow populations of rare and endangered species to move to another suitable site as the current one becomes naturally unsuitable through succession, and to expand their ranges by establishing populations at new sites. Furthermore, the inclusion of brownfield sites as part of a NEN would allow for movement and mixing of species between brownfield sites and more natural areas of habitats such as woodland, river systems and grassland within an urban setting.

Retaining a mosaic of brownfield sites which contributes towards a NEN would require the creation and development of brownfield sites to be actively considered as a biodiversity related measure in planning and development control. Using modelling technology in relation to species dispersal it would be possible to coordinate the development of brownfield sites to retain suitable habitats and species associated with OMHPDL. In addition, a large proportion of land currently recognised as urban greenspace could be improved for biodiversity if attributes of OMHPDL were to be incorporated into the greenspace management. For example incorporating areas of bare ground, banks and vegetation of different heights might benefit species associated with OMHPDL. Even small areas of land, managed correctly, can provide significant benefits for urban biodiversity.

6.1 Conclusions

- The importance of OMHPDL on brownfield sites for wildlife in urban areas should be recognised and incorporated into IHN models.
- The value of OMHPDL as a type of greenspace should be investigated further, management guidance produced and the habitat incorporated into green network planning.
- There are opportunities to enhance existing greenspace sites through targeted management, in particular by encouraging the development of attributes associated with OMHPDL.

7. IMPORTANCE OF OMHPDL FOR PLANNING AUTHORITIES AND DEVELOPERS

NPF2 aims to bring vacant and derelict land back into productive use for housing, for economic purposes and to create attractive environments by 2030. Looking after those brownfield sites which support OMHPDL will allow this habitat to contribute to NPF2. The habitat is not only diverse in wildlife, but is often attractive for informal recreation, a place to visit and observe plants and animals within the urban environment. As most of Scotland's people live within urban areas, the importance of brownfield sites should not be underestimated.

In times of economic prosperity or during major infrastructure improvement projects, when development of brownfields is most prevalent, sites with OMHPDL provide important refugia for wildlife. At other times, when redevelopment is at a slower pace there is greater scope for wildlife to spread out from these refugia to other brownfield sites.

Addressing OMHPDL as part of development planning can be divided into four separate, but linked stages.

7.1 Identification of brownfield sites supporting OMHPDL

Prior to the redevelopment of any urban site the presence of OMHPDL should be assessed using the field methodology described by Riding *et al.* (2010) and discussed in Section 5. A field guide to identifying OMHPDL is presented as a flow chart in Figure 2.

The flow chart shown in Figure 2 should be used in conjunction with the ground truthing methodology described in Section 5, and habitat descriptions detailed in Section 3. The importance of a particular area of OMHPDL as a link in a habitat network in the wider context should also be assessed using an IHN model wherever possible. In the case of individual developments, ground truthing should be completed by the developer through appointment of a suitably qualified and experienced ecological consultant so as to provide the planning authority with the necessary information to make an informed decision. Ground truthing should also be undertaken by the relevant authority when developing new Local Development Plans or equivalent to ensure brownfield sites are allocated for development only where appropriate.

Where a site contains habitat which qualifies as OMHPDL ecological surveys should be undertaken to identify the importance of the site within the local IHN. These surveys should include, but are not limited to terrestrial and freshwater invertebrates, reptiles, amphibians and plants, and must be completed by a suitably qualified and experienced ecologist, and follow current guidance and best practice, such as Buglife – The Invertebrate Conservation Trust (2009).

7.2 Adoption of a strategic approach to the redevelopment of brownfield sites

It is important that a strategic view is taken regarding the redevelopment of vacant and derelict land. By ensuring that areas of OMHPDL are retained in urban areas it is possible to provide 'stepping stones' for the wildlife as part of a wider IHN.

OMHPDL is by its nature a temporary habitat. Without management intervention OMHPDL is likely to have an average lifespan of between 15 and 20 years and may take up to 15 years to achieve its biodiversity potential (Key, 2000; Bodsworth, *et al.* 2005; Kattwinkel, *et al.* 2011). By prioritising the re-development of brownfield sites it would be possible to produce a redevelopment schedule whereby sites without OMHPDL or those with OMHPDL coming to the end of its natural lifespan were developed first. Where sites with OMHPDL need to be redeveloped, IHN models may assist in identifying which sites are the most important as "stepping stones".

Reviewing the availability of OMHPDL on a 5 yearly basis and adjusting protection appropriately would ensure that sufficient 'stepping stones' were present to allow the associated wildlife to prosper. This review should follow the remote assessment methodology described in Section 4.

7.3 Incorporation of mitigation as part of the redevelopment of brownfield sites

Consideration should be given to the retention of features of open mosaic habitats within the grounds of new developments on brownfield sites. This would allow development to proceed, yet retain the most important attributes of an open mosaic habitat. Examples of such mitigation include green roofs, flower-rich meadows and bee banks.

Although the criteria for selecting OMHPDL requires an area to be greater than 0.25ha, if such a site is to be redeveloped, retaining smaller areas of the most important attributes can be beneficial for wildlife.

7.4 Long term management of the most important sites supporting OMHPDL

Where a brownfield site is found to be particularly important for biodiversity within a regional setting, the long term retention of this site as open mosaic habitat should be considered by the Planning Authority. Within development plans such areas should be identified as greenspace and recognised as a component of the NEN. To retain features of OMHPDL in the longer term would require active management, e.g. the retention of areas of open ground.

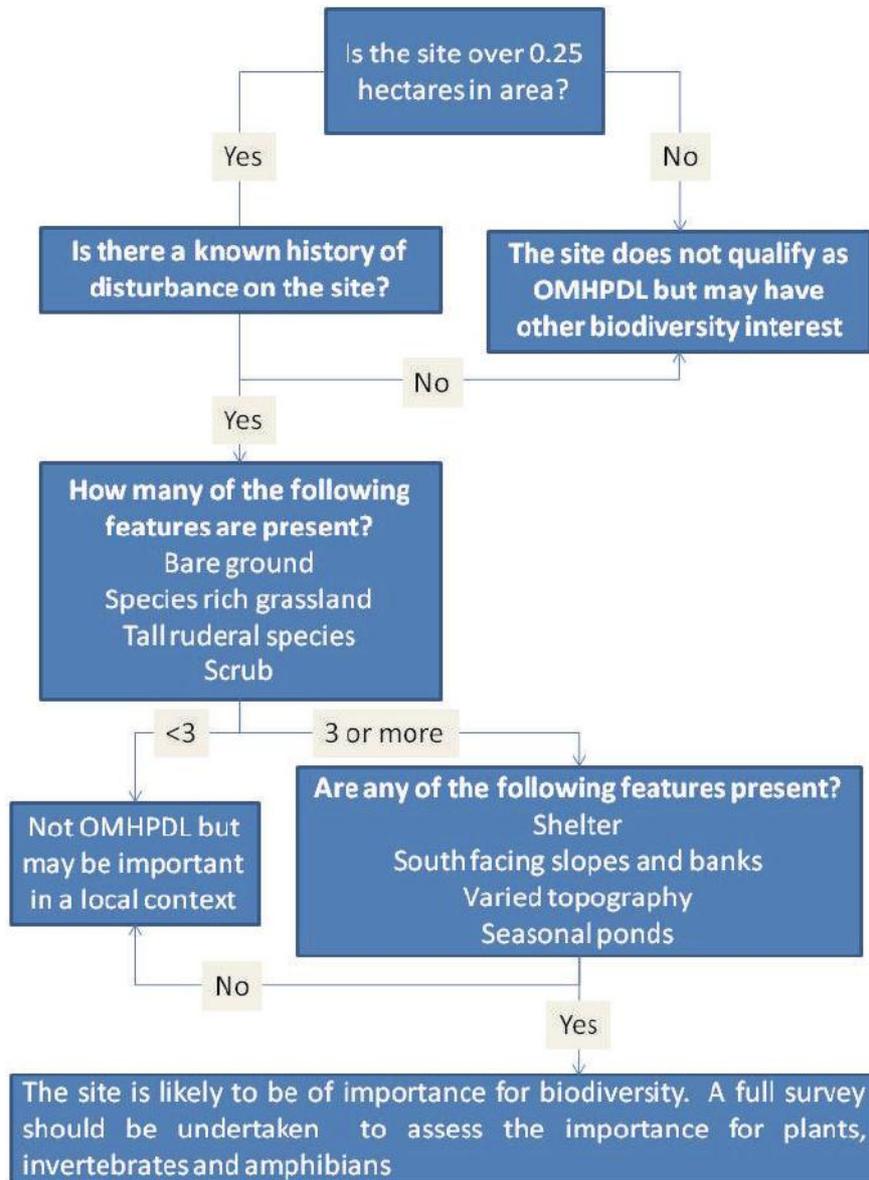


Figure 2: Flow chart to aid identification of sites with OMHPDL

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ANNEX 1: LIST OF SITES VISITED FOR GROUND TROTHING

Local Authority	Site Code	Site Name (if supplied)	Site Size (Hectares)	Location of Site	EAST	NORTH	Aerial Photography date	Notes
Aberdeenshire	CRU1	BRICK AND TILE WORKS	10.8	Peri-urban	408804	836897	06/08/2009	Large site with a sizable pool of water as well as open mosaic habitat of bare ground and grassland.
Angus	AN/R/02	GLAMIS STATION	2.06	Rural	337570	748800	01/01/2006	Site to the left of the marker with a derelict building and land with scrub, meadow and some late successional vegetation. Desire lines run through site.
Dumfries & Galloway	14000002	BORELAND FELL	2.82	Rural	234850	559350	01/01/2003	Lots of bare ground on site and as image is 8 years old this may not be interesting to look at. A couple of derelict buildings and some late successional vegetation. Surrounding meadow is also interesting.
Highland	319 INV1	CARSE INDUSTRIAL ESTATE	3.26	Urban	265404	846588	31/01/2006	Area with lots of bare ground as well as grassland, scrub and some late successional vegetation.
Highland	623 IG14	ALUMINIUM WORKS	22.3	Peri-urban	271421	870445	31/01/2006	Derelict buildings with lots of land

								around it that is open mosaic habitat with bare ground, grassland and some scrub and also a pool of water.
Perth & Kinross	1002	TURFHILLS	3.08	Rural	310938	702405	01/01/1999	Image is over 10 years old and according to Google map street view has open meadow with some scrub and a few scattered trees. There may be seasonal pools on site and desire lines run across site.
Scottish Borders	CENGAL103	QUARRY	5.04	Rural	346716	637233	01/01/2007	Old quarry with slopes of varying elevation and lots of bare ground with some vegetation. Scrubland around edges of site.
Scottish Borders	KELSO 013	STATION ROAD	0.59	Urban	373065	633218	01/01/2007	Site to the left of the marker with bare ground as concrete, grassland and some scrub on site.

List of extra sites visited for ground truthing:

Local Authority	Site Code	Site Name (if supplied)	Site Size (Hectares)	Location of Site	EAST	NORTH	Aerial Photography date	Notes
Highland	308 CUL7	DUMP AT SCRETAN BRIDGE	1.71	Urban	270054	846403	31/01/2006	Site is next to Moray and is hard to see. May be scrub, grassland and some late successional vegetation.
Highland	319 INV114	NORTH LONGMAN	57.04	Rural	267940	846501	31/01/2006	A large site next to the Moray that has large area of open grassland and scrub and some late successional vegetation. Looks as if there is also bare ground on the site.
Highland	319 INV3	KINMYLIES PRIMARY SCHOOL	1.86	Rural	264940	844730	31/01/2006	Site with meadow and pool of water and some scrub. Maybe some bare ground. Site is to the left of the marker.
Scottish Borders	CENGAL 105	NURSERIES AND PLOTS 8&9	0.923711	Rural	347870	637634	01/01/2007	Site with open mosaic habitat with mostly grassland but also some areas of bare ground and scrub on site. Site is slightly to the left of the marker.

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