Lowland Raised Mire (LRM)

Habitat Action Plan

Doncaster Local Biodiversity Action Plan
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1. Description

1.1 Lowland raised mires are peatlands that receive water exclusively by precipitation (as opposed to those mires which are fed by surface waters or groundwater in addition to precipitation). An intact lowland raised mire is a mounded structure. The centre can be several metres above the level of the groundwater. The mound is created by many years of accumulation of dead plant material; initially litter accumulating in the poor fen habitat and later, colonisation by Sphagnum and then accumulation of dead bryophyte and other plant material. In their natural state, raised mires are surrounded by an extensive fringe of lagg fen, which stretches toward the meandering and sluggish waters of the lowland rivers.

1.2 Secondary mires are those mires that have been damaged due to peat extraction or other activities, but where the water table has stabilised. The surface vegetation of these mires is dominated by secondary growth of Sphagnum moss and cotton grass (*Eriophorum spp)*. They can be active (i.e. laying down peat) or degraded (capable of restoration).

1.3 In Doncaster lowland raised mire is found on two sites, Thorne Moors and Hatfield Moors. These mires extend into the adjacent counties of the East Riding of Yorkshire and North Lincolnshire. The area is known as the Humberhead Peatlands and, historically, as the Hatfield Chase. These areas include a number of National Vegetation Classification communities; however, the nature and range of communities present today follows a prolonged period of serious habitat degradation (caused by drainage and peat extraction). These communities may not necessarily be representative of those communities that will become established if the drainage is controlled, following cessation of peat milling.

1.4 NVC mire communities in the Doncaster Borough are as follows[1]:

- M2b *Sphagnum cuspidatum/recurvum* bog pool community *Sphagnum recurvum* sub-community is typically found in pools and 'lawns' on very wet and base-poor raw peats. It can readily colonise shallow flooded workings.

- M3 *Eriophorum angustifolium* bog pool community. Typically found as small stands on barer exposures of acid raw peat in depressions, erosion channels or shallow peat cuttings. This community is an important coloniser of bare peat and on the Humberhead Peatlands includes a small quantity of bog rosemary (*Andromeda polifolia)* and cranberry **(***Vaccinium oxycoccos)*.

- M10 *Carex dioica-Pinguicula vulgaris* mire community. Calcicolous flush vegetation in which small sedges, mosses and herbs predominate. Typically found in shallow peats that are kept wet by base-rich calcareous water. On Thorne Moors this calcareous influence is likely to come from the limestone trackways laid over the peat to facilitate the removal of harvested peat.

- M18 *Erica tetralix* - *Sphagnum papillosum* raised and blanket mire. This community type is generally dominated by bog mosses (*Sphagna*) with cross-leaved heath (*Erica tetralix),* and roundleaved sundew (*Drosera rotundifolia)*, cranberry and bog rosemary typically occurs at low altitudes and is a major component of active raised bogs. *Sphagnum papillosum* has been recorded by a member of the Thorne and Hatfield Moors Conservation Forum in the north and south canal systems on Thorne Moors. It has not been recorded on Hatfield Moors since the 1970's, despite specific searches for this species.

[1] Rodwell, J.S. (1991), British Plant Communities (Volume 2) Mires and Heaths. Cambridge

- M20 *Eriophorum vaginatum* blanket and raised mire is dominated by tussocks of hare's-tail cottongrass (*E. vaginatum*). It is commonest on upland blanket mires but is also found on 'run-down' raised bogs where it replaces the M18 community. It often occurs around the margins of mires, where it forms part of the transition to rush and purple moor-grass (*Molinia caerulea*) vegetation on the edge of raised mires.

- M22 *Juncus subnodulosus - Cirsium palustre* fen meadow is a community which has an abundance of rushes and sedges which create a rank sward on moist peats and mineral soils around the edge of mires, where it forms a component of the lagg fen.

- M27 *Filipendula ulmaria – Angelica sylvestris* mire, in which meadowsweet is dominant, is typically found where moist, rich, soils occur in situations protected from grazing. It is found around the edge of mires and is especially typical of the silting margins of slow-flowing streams and along drains and ditches.

1.5 Almost six thousand species of plants and animals, including 25 of Britain's rarest, live on lowland raised bogs. Characteristic plant species of Doncaster lowland mires at Thorne and Hatfield Moors include the *Sphagnum* mosses; *Sphagnum palustre, S. fimbriatum, S. fallax* (formerly *S. recurvum)*, *S. cuspidatum, S. capillifolium, S.subnitens,* and also *S. papillosum* and *S. squarrosum,* although it is thought by local recorders that the latter two species are now confined to Thorne Moors. Another moss species, ***Sphagnum balticum*** was refound on the Moors in 1980. Characteristic vascular plants include heather (*Calluna vulgaris*), cranberry (*Vaccinium oxycoccos*), cross-leaved heath (*Erica tetralix*) and cotton grasses (*Eriophorum vaginatum*) and (*Eriophorum angustifolium*). Round-leaved sundew (*Drosera rotundifolia)* also occurs, as do **bog rosemary** (*Andromeda polifolia*) and bog myrtle (*Myrica gale*). The moors have supported dune helleborine (*Epipactis dunensis*), **greater yellow rattle** (*Rhinanthus angustifolius*), **pale St John's-wort** (*Hypericum montanum*), oblong-leaved sundew (*Drosera intermedia*), heath spotted orchid (*Dactylorhiza maculata*), white sedge (*Carex curta*), the moss (*Drepanocladus lycopodoides*) and the **stonewort** (*Tolypella intricata*).

1.6 **Whorled water milfoil** (*Myriophyllum verticillatum*), bog pondweed (*Potamogeton polygonifolius*), **water violet** (*Hottonia palustris*), alternate-flowered water milfoil (*Myriophyllum alternflorum*), **long-stalked pondweed** (*Potamogeton praelongus*), southern marsh and common-spotted orchids (*Dactylorhiza praetermissa* and *D. fuchsii*), *narrow* buckler fern (*Dryopteris carthusiana*) and alder buckthorn (*Frangula alnus*) are additional species listed as features of interest on Hatfield Moors Site of Special Scientific Interest (SSSI). Also on Thorne Moors are **marsh cinquefoil** (*Potentilla palustris*), grey clubrush (*Schoenoplectus tabernaemontani*), common reed (*Phragmites australis*), greater bladderwort (*Utricularia vulgaris*) and bulbous rush (*Juncus bulbosus*). Recent work by local recorders has identified a number of previously unknown locations for mire plant species, and this may be indicative of improving conditions within Thorne and Hatfield Moors.

1.7 Plants historically associated with bog pools on Thorne Moors, included bogbean (*Menyanthes trifoliata*), royal fern (*Osmunda regalis*), common spike-rush (*Eleocharis palustris*), bog sedge (*Carex limosa*), white beak sedge (*Rhynospora alba*) and **rannoch rush** (*Scheuchzeria palustris*). Bog asphodel (*Narthecium ossifragum*) and great and intermediate sundews (*Drosera anglica* and *D. intermedia*), **crested buckler fern** (*Dryopteris cristata*) and **masterwort** (*Peucedanum palsutre*) were also collected from the Moors. Butterwort (*Pinguicula vulgaris*), lesser bladderwort (*Utricularia minor*), **fen violet** (*Viola persicifolia*), stag's-horn clubmoss (*Lycopodium clavatum*) and bogmoss flapwort (*Odontoschisma sphagni*) have been recorded from the moors, but records for these species are rather old.

1.8 The practice of land reclamation by a process known as 'warping' has resulted in the deposition of alluvial silts over the peat surface, enabling very productive arable cultivation and the almost total loss of the lagg fen zone around lowland raised bogs in the Humberhead Levels. Where a transition zone does exist this is dominated by common reed (*Phragmites australis*), with purple loosestrife (*Lythrum salicaria*), common meadow rue (*Thalictrum flavum*), ragged robin (*Lychnis flos-cuculi*) and, rarely, **marsh pea** (*Laythyrus palustris*). **Great fen sedge** (*Cladium mariscus*), bulrush (*Typha latifolia*) and marsh pennywort (*Hydrocotyle* vulgaris) also occur. Fen violet (*Viola persicifolia*) was also recorded in the remnant fens on the western edge of Thorne.

1.9 Lowland raised mires support a range of distinctive plants and animals including many wetland birds and invertebrates. In excess of 50 Red Data Book (RDB) invertebrate species have been recorded from the Moors (Skidmore 2006). The Moors are notable as the only British localities for the Red Data Book (RDB1) ground beetle (***Bembidion humerale***) and the RDB1 **mire pill beetle** (*Curimopsis nigrita*), both of which are rare throughout Europe. *Phaonia jaroschewskii*, a RDB2 Muscid (known as the 'Hairy canary') has only been recorded in the UK from the Moors. Red Data Book species listed as features of interest on Thorne Moors Site of Special Scientific Interest comprise a snail-killing fly *Dichetophora finlandica*, a cranefly *Ctenophoria atrata*, the flies *Eccoptomera ornata*, *Campsicnemus magius*, *Phalacrocera replicata*, *Phania atriceps*, *Pherbellia grisescens*, *Rhacochlaena toxoneura*, *Helina tetrastigma*, *Stratiomys potamida* and *S. singularior*, the midge *Dixella serotina*, the shorebugs *Micracanthia marginalis* and *Saldula fucicola*, the ground beetles *Dromius longiceps* and *Dromius sigma*, the water beetles *Laccophilus obseletus* and *Hydrochus ignicollis*, the rove beetles *Aleochara inconspicua* and *Scopaeus gracilis*, the reed beetle *Donacia obscura*, **robin's darkling beetle (**Corticeus unicolor), the net-winged beetle *Pyropterus nigroruber*, the bark beetle *Xyleborus dispar*, the weevils *Hypera diversipunctata* and *Omiamima mollina*, the **scarce vapourer moth** (*Orgyia recens*), plume moth (*Bankesia douglasii*) and moth *Buckleria paladum*, **mud water snail** (*Lymnaea glabra*), and white-faced darter dragonfly (*Leucorrhinia dubia*). *Bembidion humerale*, the mire pill beetle, snail-killing fly *Dichetophora finlandica*, 'hairy canary' fly, scarce vapourer, net-winged beetle *Pyropterus nigroruber, the* flies *Eccoptomera ornata, Helina tetrastigma* and *Xylomyia marginata,* scuttle fly *Aenigmatias franzi,* cranefly *Erioptera meijerei,* capsid bug *Capsus wagneri* and mud water snail (*Lymnaea glabra)* are all Red Data Book species listed as features of interest on Hatfield Moors Site of Special Scientific Interest. Other rare species of the moors include **large heath** butterfly (*Coenonympha tullia*) (Thorne Moors only)*,* raft spider (*Dolomedes fimbriatus*) (Thorne Moors only), and **bog bush cricket** (*Metrioptera brachyptera*)*.* A recent notable discovery has been the recording of the water beetle *Agabus striolatus* on Inkle Moor.

1.10 In his recent work 'An Inventory of the Invertebrates of Thorne and Hatfield Moors' (Skidmore 2006), Peter Skidmore identified several distinct habitat categories for invertebrates recorded on the Moors. The number of invertebrate species from this habitat category is given below, together with a summary figure for the number of RDB species, plus the number of additional RDB species recorded only in fossil form in the peat deposits.

Peatland

1.11 **225** species including 7 RDB species, plus 1 RDB species as a fossil record. This habitat includes acidic moors, bogs and wet peaty heaths and also includes acidic water bodies in such places. This habitat is found on both Thorne and Hatfield Moors. The optimum habitat for one of the national peatland rarities, the 'hairy canary' fly lies at the interface between the mire and peripheral carr woodland and lagg fen.

Wetland

1.12 **982** species including 7 RDB species, plus 7 RDB species as a fossil record. This includes non-acidic and non-brackish wetlands comprising not only the water bodies themselves but also marsh and fens, which are neither acidic nor strongly saline.

Brackish

1.13 **50** species including 2 RDB species. This habitat includes estuarine and at least slightly saline wetlands. The richest brackish marsh on Hatfield Chase is located around Bell's pond on the western edge of Thorne Moors. Insects collected in 1837 and 1841 clearly indicated a saline influence in this locality. It has frequently been argued that the rich brackish marsh fauna centred on Bell's pond results simply from the saline water pumped out of Thorne Colliery or from the 19th Century land-warping programmes. However, a 1837 record of short-winged cone-head (*Conocephalpus dorsalis*) proved otherwise since warping here commenced only after 1861 and the colliery was sunk much more recently (after 1900) (Skidmore 2006). Whilst the sediments beneath the peat do not provide evidence for estuarine influence, there is some evidence of 'halobionts' in the fossil beetle faunas from Thorne and Hatfield Moors. The

saline influences around Bell's Pond were no doubt enhanced by the pumping of saline waters from the colliery working, and from the warping.

Woodland, trees and saproxylic fauna

1.14 **1428** species including 5 RDB species, plus 15 RDB species as a fossil record. This habitat includes dead wood, woodlands, hedgerows and other wooded habitats. Lindholme Island in the middle of Hatfield Moors supports one of the very few remaining stands of old oak (Quercus) trees in the Humberhead Levels. The diversity of living (as opposed to fossil) saproxylic beetles is particularly high and Hatfield and Thorne combined have, possibly, the greatest diversity of these species for any site in Yorkshire recorded to date. Alder and willow carr is the tree-dominated habitat of the lagg-fen and carr-land zone around raised mires. This subset of the woodland habitats is home to 118 species including 2 RDB as a fossil record only. Scots Pine specialist invertebrates includes 45 species, of which 2 are RDB species found as fossil records. Documentary reports from the 17th Century included references to 'elderly local inhabitants' who could remember seeing large dead standing **Scots pine** (P*inus sylvestris)* on Hatfield Moor. It therefore appears that up to the reign of Elizabeth I scattered old pines occurred widely across Hatfield Chase, but by the time of the Civil War they were virtually gone. (Skidmore 2006). The strain of Scots pine on Hatfield Moors requires research. It has, presumably undergone hybridisation with alien pines which have periodically been planted in the vicinity, but it seems likely that the existing trees have continuous genetic links with the original native stock. Today, Thorne Moors is virtually bereft of conifers.

Arable farmland

1.15 **13** species. This includes the very productive arable land that is located on the warp land and has been used to grow a variety of crops, particularly potatoes then flax and cereals.

Dry grassland and heathland

1.16 **353** species including 2 RDB species. It was heathland that originally gave Hatfield its name. Very extensive areas of blown sand, locally forming

dunes, were recorded by de la Pryme in 1701. Such features are being created today as a bi-product of extensive sand and gravel quarrying on the western and southwestern margins of Hatfield Moors. Herb-rich grassland, 'with a strong calcareous element in its flora and fauna, a result of the limestone component in the underlying last glacial deposits' is a feature of the Lindholme moraine or Lindholme Island. The invertebrate fauna of dry grassland and heathland is decidedly richer at Hatfield Moors than at Thorne.

Non-specialists

1.17 Species include 5 RDB species. These are Invertebrates that occur in a wide range of wooded-to-open or dry-to-wet habitats.

Synanthropic invertebrate fauna (species associated with man)

1.18 **26** species, none of which are notable species**.**

1.19 Over seventy species of breeding bird are found, including **nightjar** (*Caprimulgus europaeus*), **nightingale** (*Luscinia megarhynchos*), long-eared owl (*Asio otus*), **teal** (*Anas crecca*), **whinchat** (*Saxicola rubetra*), **water rail** (*Rallus aquaticus*), **curlew** (*Numenius arquata*) and **woodlark** (*Lullula arborea*). Hobby (*Falco subbuteo*), **hen harrier** (*Circus cyaneus*), **merlin** (*Falco columbarius*), **kingfisher** (*Alecdo atthis*), **lapwing** (*Vanellus vanellus*), **snipe** (*Gallinago gallinago*), **shelduck** (*Tadorna tadorna*), **tree pipit** (*Anthus trivialis*), great spotted woodpecker (*Dendrocopos major*), **green woodpecker** (*Picus viridis*), **twite** (*Acanthis flaviostris*) and sparrowhawk (*Accipter nisus*) are also present. **Common toad** (*Bufo bufo*) and **common frog** (*Rana temporaria*), **smooth newt** (*Triturus vulgaris*), **common lizard** (*Lacerta vivipara*), **grass snake** (*Natrix natrix*) and **adder** (*Vipera berus*) are found on Thorne and Hatfield Moors. **Great crested newt** (*Triturus cristatus*) is also found on Thorne Moors. Also present are **water vole** (*Arvicola terrestris*), **brown hare** (*Lepus europaeus*), fox (*Vulpes vulpes*), **roe deer** (*Capreolus capreolus*) and **red deer** (*Cervus elaphus).*

1.20 The Moors constitute an important archaeological site, as the peat preserves both human history and indicators of climatic change such as pollen, plant and invertebrate remains. Notable finds include the Bronze Age Trackway on Thorne Moors and the recent discovery in October 2004 of a Neolithic Trackway near Lindholme on Hatfield Moors. Ancient features of Thorne Moors, for which no records exist for Hatfield Moors, were deep peat pools, called 'wells' or 'pits'. It appears that these could remain unchanged for centuries and were often steeped in local folklore. Prehistoric ritual human sacrifices into such pools have been recorded and Hatfield Chase is the most important area in England for such bodies. Over a hundred 'wells' formerly existed on Thorne Moors. (Skidmore 2006). Archaeological information gathered from the Moors is extensive but requires further collation and research.

2. National status

2.1 Intact lowland raised bogs are one of Europe's most threatened habitats. They once occurred throughout the UK in flat low-lying locations or basins. Since the start of the 19th Century the extent of primary, active lowland raised mire has decreased by 94%, to just 6000ha.

3. Local status

3.1 On Hatfield Moor, the total area of peat is calculated to be 1207 ha. This excludes the areas stripped for gravel working, and the area of the factory hard standing. Within the Doncaster Borough, the total area of peat soils on Thorne Moors is 1227 ha. This figure excludes Inkle Moor and Bell's Pond, as these are considered to be fen rather than mire areas. This figure does include the 74 ha of Will Pitts Wood but this area is unlikely to revert to active raised mire in the short-to-medium term. These peat soil habitats are considered to be degraded lowland raised mire, which, with appropriate restoration and the correct management, has the capacity to revert to active peat growth. Of the 1227 ha total for Thorne, the 'Dutch Canals' area represents the best mire habitat and may be actively accruing peat. The Dutch Canals lie in the central to southwestern quadrant of Thorne Moors and cover an area of 70 ha, of which approximately half is baulks, drains and tracks. Therefore the total area of potentially active mire covers only 30-35 ha. There is an additional 406 ha of peat soils in the East Riding of Yorkshire and 257 ha in the North Lincolnshire parts of Thorne Moors. These represent degraded mire habitat. The previously much greater extent of lowland raised mire has been subject to approved commercial peat extraction for a number of years, until recent application of the Habitats Regulations[2] has enabled much of the extant permissions to be reconsidered in terms of their impacts on the important wildlife features of these European wildlife sites.

3.2 The low-lying and exceptionally level topography of the Humberhead Levels has been created by lacustrine deposits from 'Lake Humber,' which was impounded by a glacier at the mouth of the Humber. The lake covered much of the Humberhead Levels area towards the end of the last glaciation. Rising sea level and increased runoff as a result of forest clearance over the last 5000 years led to the formation of peat. Peat is composed of partially decomposed plants that have accumulated in areas that were permanently waterlogged where the normal processes of decomposition could not take

[2] Conservation (Natural Habitats, &c.) Regulations 1996 (most commonly referred to as the 'Habitats Regulations').'

place (Buckland & Smith 2003[3]). Raised mires such as Thorne, Crowle and Goole Moors, and Hatfield Moors were created by the raised water levels allowing the build up of S*phagnum* moss. As the mire grew, the plants became more reliant upon nutrient-poor rainfall.

3.3 Thorne Moors once supported an extensive mosaic of hummock and hollow topography of NVC M2 and M18 mire but now these habitats occur in only isolated fragments. Elements of M20 mire are associated with the drier fringes of the remaining fragments of M18 mire. The site supports areas of wet heath but much of the land surface is still bare peat following the recent partial cessation of peat milling. Some areas are still thought to be active and are being dealt with by the Review of Consents under the Habitats Regulations[4]. Provided appropriate water levels can be reinstated, the bare areas are capable of regeneration of wet heath but the prospects for the re-establishment of bog vegetation is less certain.

3.4 These raised mires have long been exploited for fuel and animal bedding. Until very recently they were exploited for horticultural use. Commercial peat cutting began on Thorne Moors in the 1880s but the methods used were such that large areas were left undrained between cutting episodes. This allowed plants and animals to recolonise. Once the use of peat in gardening became widespread, advances in technology followed which enabled efficient drainage and machines were developed which were able to strip peat over large areas. In consequence most of the Moors have been stripped of all but a metre or two of peat and in many places the underlying sands and gravels or Lake Humber clay-silts have been breached.

3.5 Many of the outer fringes of the lowland raised mires, including much of Thorne Moors, have been extensively drained and improved for agriculture. These edges, which would normally support a type of lagg fen vegetation, have

[3] Buckland, P.C. and Smith, B.M. (2003) Equifinality, Conservation and Origins of Lowland Raised mires. The Case of Thorne and Hatfield Moors. Thorne & Hatfield Moors Papers 6: 30-51

[4] Conservation (Natural Habitats, &c.) Regulations 1996 (most commonly referred to as the 'Habitats Regulations').'

been taken into arable cultivation. The practice of warping (deliberate and managed flooding of meadows with silt-laden tidal river waters by means of a specially constructed drain network) obliterated the ancient semi-natural soils and vegetation over much of the peatland levels. Warping began around Thorne in 1860 (Limbert 1987) but is no longer practiced. The drains remain and are primarily used for land drainage and, more recently, as a means of providing water for spray irrigation. This drainage, stripping, and removal of edge habitats has affected the way in which water can be retained, so that in many cases the conditions necessary for peat to form are no longer present.

3.6 The land was acquired in 1994 by English Nature (now Natural England). A legal agreement was completed in 2002 between English Nature and the major peat operator in relation to Thorne and Hatfield Moors. The major period of peat milling on Hatfield Moors was 1987-2004 and on Thorne Moors between 1988-2001. (Skidmore 2006). A legal agreement requires the landowner, in close collaboration with Natural England, to initiate works that will restore the moors and return them to a raised bog that is actively accruing peat. Current workings are now restricted to two areas of Hatfield Moor. Negotiations between the landowner and the Local Authority are currently taking place, under the provisions of the Habitats Regulations, with the aim of modifying permissions to ensure that no further peat will be extracted from the site, while at the same time allowing for the restoration, reclamation and aftercare to take place on the areas of the moors affected by the peat extraction. Under the planning permissions, there is a requirement to produce a restoration plan. One exists for Thorne but not for Hatfield Moors.

3.7 In terms of the invertebrate fauna the wetland invertebrate species have fared better on Thorne Moors than on Hatfield. Fossil invertebrate evidence seems to indicate that Hatfield Moors has experienced much greater, and more sustained, habitat desiccation than Thorne Moors but recent sand and gravel extraction on the western margins is re-introducing wetland habitats. Hatfield Moors is not merely an ecologically poorer version of Thorne. The two moors were (ecologically) very different, the disparity going right back to the Bronze Age. - (Skidmore 2006)

4. Legal status

4.1 Much of the remaining peatland of Thorne and Hatfield Moors has been notified as a Site of Special Scientific Interest (SSSI), Special Protection Area (SPA) and Special Area of Conservation (SAC) and forms the Humberhead Peatlands National Nature Reserve (NNR). They qualify as Wetlands of International Importance under the terms of the Ramsar Convention. The area known as Bell's Pond is included within the SSSI, SPA and SAC boundary but is not included within the NNR

4.2 Both active and degraded raised mires are listed in Annex 1 of the EC Habitats Directive. In 1992 the European Community adopted Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (EC Habitats Directive). This is the means by which the Community meets its obligations as a signatory of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). The provisions of the Directive require Member States to introduce a range of measures including the protection of species listed in the Annexes, to undertake surveillance of habitats and species and to produce a report every six years on the implementation of the Directive. The 189 habitats listed in Annex I of the Directive and the 788 species listed in Annex II, are to be protected by means of a network of sites, known as Natura 2000 sites.

4.3 Some areas of warp land, wetlands and remnants of lagg fen around the edge of the moors are locally designated as Sites of Scientific Interest (SSIs). These include; Jones Cable (SSI 9.18), Whittaker’s Plantation (SSI 9.21), Lindholme Hall (SSI 9.40b), 9.40c Old Oil Well Site (SSI 9.40c), 9.40d Hatfield Moor West (SSI 9.40d), 9.40e Hatfield Moors East (SSI 9.40e) and candidate SSI Thorne Colliery (SSI 9.44).

4.4 The Countryside and Rights of Way Act 2000 (CROW Act) gave people new rights to walk on areas of access land. All of this access land lies within Natural England's Thorne Moors, part of the Humberhead Peatlands NNR. Natural England also plans to dedicate a further 2328 hectares of the NNR as Access Land by 2007. The Open Access Management Plan for the Borough's access land aims to improve and create access to the new areas of Access Land and to promote and encourage responsible use of the land. It makes recommendations for a 5-year programme of access improvements (both physical and intellectual).

5. Links to associated habitats & species

5.1 The Lowland Raised Mire habitat action plan is linked to the following Habitat Action Plans:

- Lowland Heathland/ Acid Grassland Mosaic (HAG)
- Rivers, canals, oxbows, major streams and subsidence wetlands (RCF)
- Minor streams, springs, fens, flushes, mires and fenny fields (SFM)
- Marshes and swamps, lakes and ponds, ditches and drains (MLD)
- Reedbeds (RB)
- Neutral and wet grassland (NWG)
- Wet woodland (WW)

5.2 **'A Species Audit of Doncaster Borough'** has been produced as part of the Doncaster Local Biodiversity Action Plan. Species highlighted in bold within the Habitat Action Plans are identified within Doncaster's Species Audit and are conservation priorities. The Audit identifies **77** species associated with Lowland Raised Mire. This relatively low number is an indicator of the need for further research, rather than a true reflection of the importance of these habitats to species of conservation concern.

6. Current factors causing loss or decline

6.1 Peat extraction has severely damaged large areas of lowland raised mire on Thorne and Hatfield Moors. Extraction from the majority of the site has now ceased, but some areas are still to be assessed under the requirements of the Habitats Regulations[5]. Work on this complicated issue is ongoing. Paleo-environmental records (such as pollen records) in the peat are lost once vegetation has been removed and the peat has dried out.

6.2 The irreplaceable nature of peat is not reflected in the low price that is paid for peat products. Cessation of peat milling at the Humberhead Peatlands may unfortunately, mean that foreign lowland mires come under threat because there is still demand for peat from the horticultural industry.

6.3 Extraction of the minerals that lie below the peat has the potential to affect the already-damaged mire (for example coal extraction may affect the future of Thorne and Hatfield Moors with the proposed re-opening of Hatfield colliery and possible continuation of seams beneath the Moors). Whilst some of these activities may already be 'licensed' by permitted development rights, an 'Appropriate Assessment' may still be required to ensure that the development does not adversely affect the Moors. Widespread subsidence of the surface of the Moors could result in the already-depleted bog 'dome' dropping below the water table. This threatens to cause the surface to be deeply inundated. This would drown-out the ombrotrophic rain-fed bog habitats and result in the loss of faunal species that these unique habitats support. Effectively managed, however, any lowering of the ground surface could be to the advantage of regeneration of other wetland habitats.

6.4 The adjacent land use affects the nature conservation interest of particular features of the moors. When raised mire and fen, which needs high water tables, is surrounded by actively drained, intensively managed farmland, it is difficult to maintain the requisite amount of water on site. This is particularly

[5] Conservation (Natural Habitats, &c.) Regulations 1996 (most commonly referred to as the ‘Habitats Regulations').’

important in the case of Thorne and Hatfield Moors, which are surrounded by extensive areas of intensive agriculture.

6.5 Warping - the 'traditional' flooding of the agricultural land around the moors resulted in deep layers of silt overlaying the peat, or the loss of the once extensive lagg fen communities to arable cultivation. Layers of warp can be up to 1m deep.

6.6 The current climate may be warmer and drier than in the time when the lowland bogs were actively forming. Some *Sphagnum* species may have been lost due to climate changes rather than as a direct result of drainage or peat mining (Buckland and Smith 2003). A drier climate may be exacerbating drying-out of mires already affected by drainage. Provided the raised water table can be maintained, underground peat fires (which can burn for many months, particularly in drought periods, and have affected large areas of milled peat and semi-natural vegetation in the past) should be avoided. Rising sea levels may also cause increased salinity of the ground water and affect the drainage of the land.

6.7 Acid deposition and precipitation from air pollution is believed to affect mire vegetation. Continual increase in traffic generally is an issue at the local level and globally. Occasionally specific developments have the potential to have an adverse effect on the important mire habitat that lies within the designated sites of the Doncaster Borough. Any proposals for such developments (either planning applications or development plan documents) should be screened to determine whether or not an Appropriate Assessment is required by the Habitats Regulations[6], ensuring that any development likely to cause an adverse effect on the integrity of a European site will not normally be allowed.

[6] Conservation (Natural Habitats, &c.) Regulations 1996 (most commonly referred to as the 'Habitats Regulations').'

6.8 Due to the uncertain nature of its origin, it is not clear whether Bell's Pond is in decline and, if so, what the current threats are. It is likely that any change would be due to alterations in neighbouring land uses.

6.9 To prevent damage to fragile habitats, public access needs to be managed. The National Nature Reserve has a network of accessible trackways. The Peatlands Way, a new long-distance trail takes in both Thorne and Hatfield Moors. The Countryside and Rights of Way Act gives greater access rights to areas of open land but certain restrictions can be applied in order to protect ecological interests. The re-wetted workings and deep drains of the Moors are dangerous and walkers are always advised to stick to way marked walks and other footpaths.

6.10 Genetic purity needs to be maintained if any translocation of species is to take place. Re-introductions can be contentious and require careful and intensive planning and management to ensure success. Introduction of plant material carries with it the risk of unintended introductions of flora and fauna. Vulnerable endemic species may need to be propagated before they are translocated to other parts of the moors.

7. Current local action

Research & Monitoring

7.1The Thorne & Hatfield Moors Conservation Forum (THMCF) undertook the most extensive baseline assessment of the invertebrate assemblage in 1990. The Forum also recently commissioned a botanical survey of the Bell's Pond area.

7.2 As a result of proposals to reintroduce the Large Heath butterfly, a survey was undertaken in 2005 by THMCF to establish the validity of unsubstantiated assertions that the species was extinct. (Report in preparation.)

7.3 Doncaster's raised mire habitats have been identified as SSSIs, SAC and SPA and Natural England has commissioned a range of surveys with this in mind. A survey of invertebrates on selected areas of Thorne and Hatfield moors has taken place to support restoration work. Nightjars are monitored annually, and reptiles and water voles are being monitored as part of a staff – student project. A deer survey has been commissioned to look at numbers and genetic diversity of the existing population. An invertebrate survey is taking place on selected areas of Thorne and Hatfield Moors to support restoration work and an archaeological survey is supporting the monitoring and restoration of the neolithic trackway. To restore and maintain active peat formation the water table has to be at the correct level; therefore, monitoring of the aquifer water level is regularly carried out. Finally, Natural England, as part of its remit as owner and conservator of the peatlands, has a responsibility to carry out an annual condition survey and vegetation monitoring.

7.4 The Thorne and Hatfield Moors Conservation Forum and (to a lesser extent Doncaster Naturalists' Society) have carried out detailed surveys of both Thorne and Hatfield Moors. Records are kept by members of the Forum and research results have been published in Thorne & Hatfield Moors Papers and will be entered into the Biological Database at the Museum’s Local Biological Records Centre.

7.5 Funding from the Big Lottery's Transforming Your Space initiative has enabled the further development of the Biological Records Centre at Doncaster Museum. The biological data collected as part of the project, particularly botanical information for local sites, species and habitats has enhanced the modern dataset. Historical biological information has also been transferred to the database.

Communications & Publicity

7.6 Natural England provides interpretive leaflets, and runs practical management events aimed at involving local people in the care of lowland raised mires. Volunteer groups carry out management tasks on the moors.

7.7 The Yorkshire & Humber Biodiversity Forum has produced a leaflet on wetland and water management; outlining current issues, local action and conservation priorities. This and further information is available from www.yhbf.org. The leaflet was launched at a 'Planning for a wetter future' Conference, organised in partnership with the Yorkshire & Humber Assembly.

Safeguarding & Management

7.8 Much of Thorne and Hatfield Moors is owned and managed by Natural England. However, there are areas in private ownership, including Lindholme and its environs. The central moraine is not an SSSI. The area adjacent to Lindholme is the only area on Hatfield Moors not to have suffered from peat extraction, although parts of Packards South are similarly considered as having not been cut over for peat. Work to initiate restoration of the moors to a raised bog that is actively accruing peat is underway.

Links to other Strategies & Plans

7.9 The IDB is currently preparing a Water Level Management Plan for Thorne Moors. A Water Level Management Plan has been prepared for Hatfield Moors and the Environment Agency is addressing the revisions. The Hatfield plan is due for completion by the end of 2006 and will be implemented as part of the EA's obligations under the Habitats Regulations[7] and Water Framework Directive[8].

7.10 The Environment Agency (EA) has produced Catchment Area Management Plans for various river catchments. Lying within a water level dependent environment, rather than a catchment with flowing watercourses, Hatfield and Thorne Moors have been identified as areas of 'high ecological value'. (The whole of Hatfield Moors lies within the Idle and Torne plan, whereas Thorne Moors is predominantly located within the area covered by the Don and Rother catchment. The southern-eastern outskirts of Thorne

[7] Conservation (Natural Habitats, &c.) Regulations 1996 (most commonly referred to as the 'Habitats Regulations').

[8] Water FrameworkDirective 2000/60/EC

Moors lie within the Idle and Torne catchment). The EA reviews abstraction licences, including consents for drinking water abstractions. The Idle and Torne Catchment Area Management Plan will propose that the surrounding watercourses around the Moors (drains) remain closed to further abstractions. Both surface and ground water have been identified as being both over-licensed and over-abstracted. The Habitats Directive 'Review of Consents' process is the primary means of reviewing the impacts of abstractions on the Moors.

Funding & Resources

7.11 The new Environmental Stewardship Scheme provides funding for maintenance or restoration of lowland raised bogs to 'maintain or restore lowland raised bog to provide habitat for the specialist plants and wildlife that are associated with them'. Sites suitable for restoration will usually occur on acid peat deposits, be part of a wider wetland habitat and have at least some typical bog plants. Management will include: 'retaining rainfall to maintain a high water table throughout the year; maintaining water control structures in good working order; not digging or turning over peat; and no fertilisers. Restoration may include removing scrub and tree cover to below 10% cover of the site area and/or filling or blocking ditches.'

7.12 The higher-level stewardship scheme also targets the creation of new habitat on land adjacent to, buffering or linking SSSIs or UK BAP habitats. It also targets the maintenance and restoration of habitats in Sites of Importance for Nature Conservation, known locally as SSIs.

8. Objectives, targets & proposed actions

Please refer also to the Generic Actions in the LBAP Introduction & Overview document.

Objective	Target	Ref	Action	Lead Partners	Costs	Category
1) To ensure the protection and maintenance of lowland raised mire.	2007 onwards. No further instances of development led damage to lowland raised mire in the borough.	1.1	Prevent degradation and loss of lowland raised mire habitat resulting from development and/ or the delivery of statutory functions by: 1) Having regard to the protection and enhancement of habitats when considering the allocation of sites, in line with the approach set out in PPS9 and the priorities set out in the LBAP. 2) Having regard to the assessment, retention and enhancement of habitat types when formulating and making Development Control Policies and decisions, in line with the approach set out in PPS9 and the priorities set out in the LBAP.	DMBC, Natural England (NE)	Staff costs	Advisory/ Safeguarding & Management

Objective	Target	Ref	Action	Lead Partners	Costs	Category
			3) Providing advice to Development Control and Developers on appropriate types of survey i.e. ecological and/or hydrological, the interpretation of survey results and methods of incorporating habitat retention and enhancement into development proposals (for both designated sites and non-designated features of biodiversity value, as identified in the LBAP. 4) Having regard to the priorities set out in the BAP in the interpretation of UDP/LDF policies (and any supporting SPGs/SPDs). 5) Providing technical advice on the severity, implications and nature of suspected breaches in planning control (either conditions or unauthorised development).			

Objective	Target	Ref	Action	Lead Partners	Costs	Category
			6) Awarding appropriate site protection through designation, based upon routine environmental monitoring and assessment. 7) Ensuring that all Partners and relevant landowners, service providers and operational contractors are informed of the existence and importance of lowland raised mire habitats (both designated and non-designated).			

Objective	Target	Ref	Action	Lead Partners	Costs	Category
	Continuous.	1.2	Continue to collect and maintain up-to-date, standardised, biological data using the Museum's Local Record Centre. Promote and initiate appropriate management, monitoring and the exchange of environmental data, to ensure the maximum level of site protection is awarded and habitat condition is maintained.	DMBC, NE, Doncaster Naturalists' Society (DNS), Internal Drainage Boards (IDBs), Thorne & Hatfield Moors Conservation Forum (THMCF), Environment Agency (EA)	Staff costs and volunteer time. Other costs to be evaluated	Future Research & Monitoring
	By 2008.	1.3	Expand DMBC's Environmental Planning protected species protocol to include LBAP habitats and species.	DMBC	Staff costs	Advisory
	2007 onwards. No further instances of development led damage to lowland raised mire in the borough.	1.4	Neighbouring Local Authorities to co-ordinate local plan and service policies.	DMBC, NE, all Neighbouring Local authorities, IDBs, EA	Staff costs	Policy & Legislation

Objective	Target	Ref	Action	Lead Partners	Costs	Category
	By 2009.	1.5	Identify remnant mire habitats within the borough and evaluate against SSI site selection criteria to see if any currently undesignated sites can be protected.	NE, DMBC	To be evaluated	Safeguarding & Management
	By 2010.	1.6	1) Preserve peat undisturbed *in situ*. 2) And survey the extent of the peat 'resource'.	NE, THMCF	To be evaluated	Safeguarding & Management/ Future Research & Monitoring
	By 2010.	1.7	Secure cessation of mineral extraction over all remaining areas of peat.	NE, DMBC	Staff costs	Safeguarding & Management
	By 2008.	1.8	Adopt an Open Access Management Plan for the Moors, which balances access rights with the need to preserve undisturbed habitats and 'wilderness'.	NE, DMBC	Staff costs	Safeguarding & Management

Objective	Target	Ref	Action	Lead Partners	Costs	Category
2) To restore degraded sites and ensure appropriate management of lowland raised mire.	Restoration of 1 ha of degraded habitat underway by 2009.	2.1	1) Make areas of mire habitat viable so that they can support populations of specialist species identified as LBAP priorities. 2) Attempt to re-instate conditions where active mire formation can occur (use research to determine whether this is, ultimately, a feasible option). 3) Consider translocation or re-introduction as a last resort once extensive survey effort has concluded that the species is not present and that suitable habitat is present to support a viable population.	THMCF, NE, FWAG	To be evaluated	Safeguarding and Management/ Habitat Creation & Restoration/ Species Management & Protection

Objective	Target	Ref	Action	Lead Partners	Costs	Category
	2010 and beyond.	2.2	1) Return the water table to a state in which it is able to support wetlands and thereafter manage it sustainably. 2) Bring all warp land around the lagg fen areas bordering the Moors SSSI boundary into Environmental Stewardship and all land within 1km of the moors into HLS. 3) Ensure that Water Level Management Plans give due regard to nature conservation, geology, archaeology and to the record of the past environment. Implement the Hatfield WLMP and complete and implement the Thorne Moors WLMP. 4) Provide advice & information to challenge the common local perception that land drainage is a desirable end in itself.	NE, EA, IDBs, Yorkshire Water, FWAG, DMBC Partners of the Humberhead Levels Land Management Initiative (Value in Wetness)	To be evaluated	Safeguarding & Management Habitat Creation & Restoration

Objective	Target	Ref	Action	Lead Partners	Costs	Category
3) To create 2 ha of wetland habitat that could succeed to Mire habitat and to create 2 ha of complementary habitat adjacent to mire areas	Complete Research by 2010.	3.1	1) Research and identify former areas of lowland raised mire, outside the current Natura 2000 boundary. Carry out hydrological investigation to identify areas suitable for habitat creation work. 2) Based on the above research and the 'Natureonthemap' targeting and planning map, incorporate site-specific habitat creation targets into priorities and budgets for the Humberhead Levels Environmental Stewardship Scheme.	All DBAP partners, NE and FWAG	To be evaluated	Future Research & Monitoring/ Advisory

Objective	Target	Ref	Action	Lead Partners	Costs	Category
	By 2010 establish 1 restoration site with wetland habitat that will be managed to succeed towards a mire habitat in the long term.	3.2	1) Create mire habitat, as a result of long term management on a purposely- created wetland site, e.g. in the Torne floodplain or on mineral sites within the Hatfield Chase. 2) Review the management of water abstraction and wastewater at mineral extraction sites. Achieve more recycling of water and the use of wet abstraction methods by including appropriate policies in the LDF documents and through the use of planning conditions.	THMCF, NE, EA, DBAP and Partners of the Humberhead Levels Land Management Initiative (Value in Wetness)	To be evaluated	Habitat Creation & Restoration/ Advisory

Objective	Target	Ref	Action	Lead Partners	Costs	Category
	Continuous.	3.3	Develop a Humberhead Peatlands 'Project' similar to 'The Great Fen Project' by i) Restoring mire habitats, ii) Linking the two Moors by changing local land management to allow the spread of less mobile species iii) Enlarging the Reserve to ensure protection of the raised mire habitat. (Achieve this by acquiring land or entering into management agreements with landowners) Commission a survey and literature review to establish the extent of warp land and lagg fen around both Moors.	THMCF	To be evaluated	Habitat Creation & Restoration/ Safeguarding & Management

Objective	Target	Ref	Action	Lead Partners	Costs	Category
4) Raise public awareness of the importance of and special characteristics of lowland raised mire habitats.	By 2010.	4.1	Run a mire species survey and identification workshop open to the general public.	DNS, THMCF	Volunteer time	Communications & Publicity/ Advisory
	Continuous.	4.2	Encourage all partners to adopt a Peat Free policy and promote sustainable planting materials to the public.	All DBAP Partners	Staff costs & volunteer time	Communications & Publicity/ Advisory

Objective	Target	Ref	Action	Lead Partners	Costs	Category
	Promotion project underway by 2008. Completion of Specific research projects by 2015.	4.3	Promote, secure and enhance the geological, palaeo-ecological and archaeological archive found in the Levels by commissioning collation and research work, including: 1) Collation and cataloguing of archaeological survey findings and research to provide interpretation of the Moors in Human history. 2) Surveys of under-recorded groups: e.g. microscopic water life, Mollusca and Lepidoptera. Use a variety of survey techniques, including year-round fixed point monitoring and pitfall trapping. 3) Monitoring of natural succession on recently worked-out quarries and un-vegetated peat fields as part of the NNR management commitment.	DMBC, NE, DNS, English Heritage (EH), THMCF, Local Colleges and Universities	To be evaluated	Communications & Publicity/ Future Research & Monitoring

Objective	Target	Ref	Action	Lead Partners	Costs	Category
			4) Commission a detailed study of the invertebrates and fungi associated with the Scots pine on Hatfield Moors. 5) Commission a detailed literature review of Scots pine on Hatfield Moors and carry out DNA analysis of Hatfield Pines. 6) Carry out limited excavations and analysis of unexposed pine logs near existing trees on Poor Piece to survey invertebrates and fungi associated with Scots pine. 7) Survey for nationally notable invertebrate species not recorded since1989.			

Objective	Target	Ref	Action	Lead Partners	Costs	Category
			8) Survey to establish the current status of individual species, selected on the national rarity basis. The study should involve locating extant populations and should trigger investigations into the precise ecological requirements, flight period diurnal activity etc. 9) Survey for species currently believed to be locally extinct for which re-introduction may be considered. Large Heath Butterfly, the white-faced darter dragonfly the Manchester treble bar moth are possible candidates. Scarce vapourer might be considered for 'support of extant populations' through captive breeding and release. All re-introduction and actions to support existing populations must be carefully recorded and monitored.			

Objective	Target	Ref	Action	Lead Partners	Costs	Category
			10) Mark and recapture investigations to measure faunal movements between the Moors. 11) Carry out a full invertebrate survey modelled on the 1990-92 surveys to provide a baseline marking the end of large-scale commercial peat milling and aggregate extraction. 12) Identify which may be moving in response to climate changes are merely 'passing through' or are likely to become well-established residents. Such surveys would also identify 'old' resident species whose presence, for some reason, had been unsuspected.			