



**Lake District
National Park**



Rusland Moss National Nature Reserve

DRAFT Management Plan 2026 - 2031

Contents

1.0 Description

1.1 Location

1.2 Land Tenure

1.3 Site Status

1.4 Physical Features

1.5 Biological Features

1.6 Cultural Features

1.7 Access Features

1.8 Summary of Site Features

Table 1.8.1 Geological and Biological Features

Table 1.8.2 Landscape Features

Table 1.8.3 Socio-economic Use

Table 1.8.4 Education, Research & Demonstration

Table 1.8.5 Public Access

Table 1.8.6 Other Estate Assets

2.0 Evaluation

2.1 Site Analysis

2.2 Site Management Policy

2.3 The Vision

2.4 Objectives

3.0 Action Plan

3.1 Identification of Projects

3.2 Five Year Plan

Figure 1: Intact lowland raised mire (bog)

Figure 2: Changes to the density of tree and shrub encroachment on Rusland Moss

Figure 3: SSSI site unit boundaries

Map 1: Location of Rusland Moss NNR

Map 2: Land tenure

Map 3: SSSI and NNR Boundaries

Map 4: Access

Map 5: Indicative Tree Removal Areas for Peatland Restoration on the NNR

1.0 Description

1.1 Location

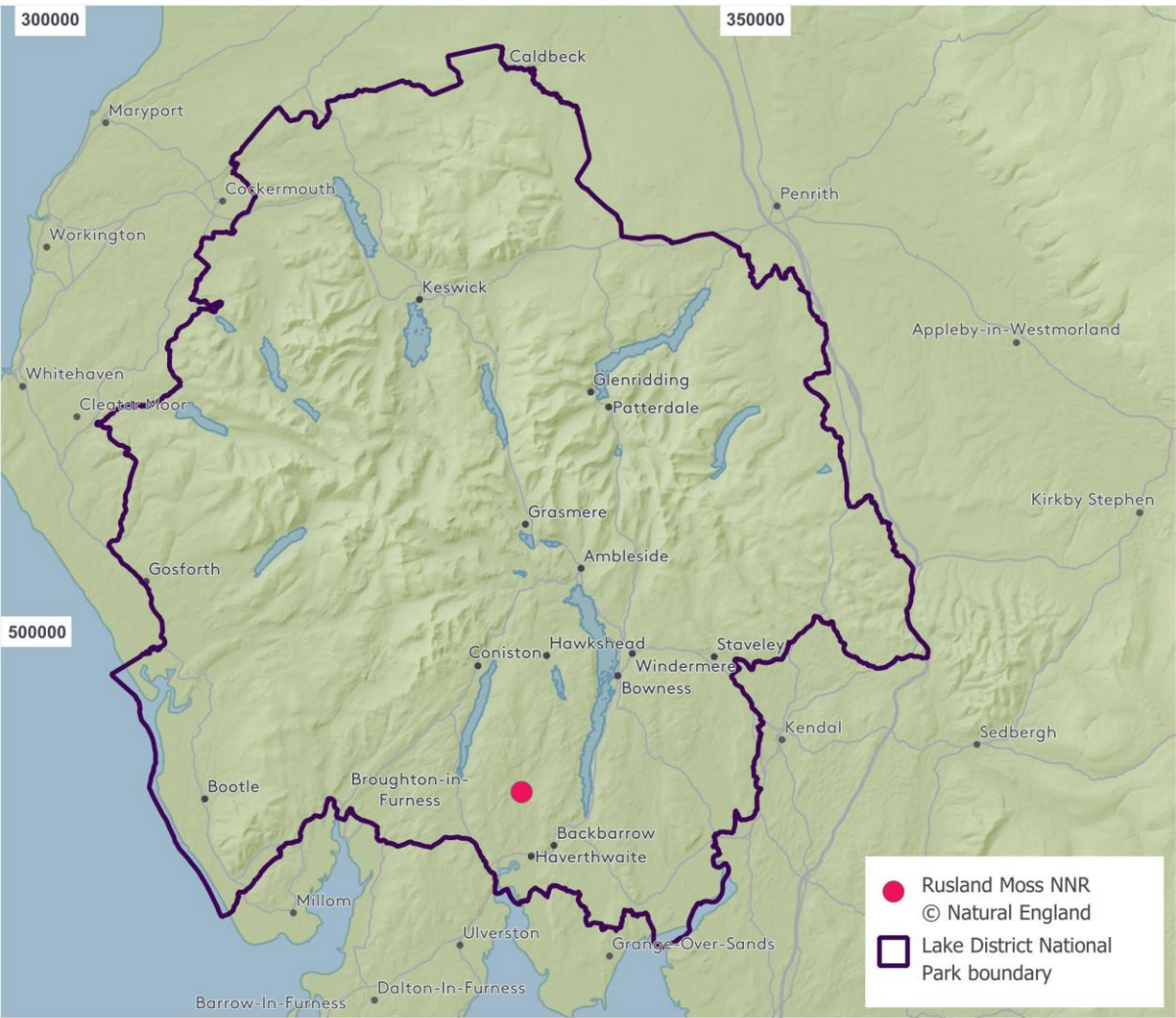
		Notes
Location	Rusland Moss 4km north-west of Newby Bridge	Refer to location map on page 5
Parish	Colton	
County	Cumbria	
District	Westmorland and Furness Council	Unitary Authority
Local Planning Authority	Lake District National Park Authority (LDNPA)	
National Grid Reference	SD 333 887	Centre of site

1.2 Land Tenure

	Area (ha)	Notes
Total area of NNR	22.3	Refer to Rusland Moss NNR Tenure map on page 8
Freehold	16.8	Ownership transferred to LDNPA (from the Archibald family) in 1981 (map 2)
Leasehold	6.2	From Natural England (map 2)
S 35 Agreement	x	
S 16 Agreement	x	
Other Agreements	22.3	The Nature Reserves Agreement
Legal rights of access		LDNPA has various rights of access to areas of land owned and leased. <u>Public rights of way</u> Public footpath, FP 511036, runs from Rusland Cross,

		over Rusland Pool Bridge and runs through the centre of the site, and joins FP511035 on the eastern boundary of the Moss. Public footpath FP 511037 crosses the southern boundary at Hulleter. There is also a public footpath, FP 511035, that heads north from Low Hay Bridge to link with FP 511037 and FP 511036 (see map 4). <u>Open Access Land</u> None of the NNR is designated as access land. <u>Electricity wayleaves – n/a</u> <u>Water main – n/a</u>
Other rights, covenants, etc.		n/a

Map 1 Location of Rusland Moss National Nature Reserve (NNR)



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Date
Authored:
24/11/2025



0 5 10 km

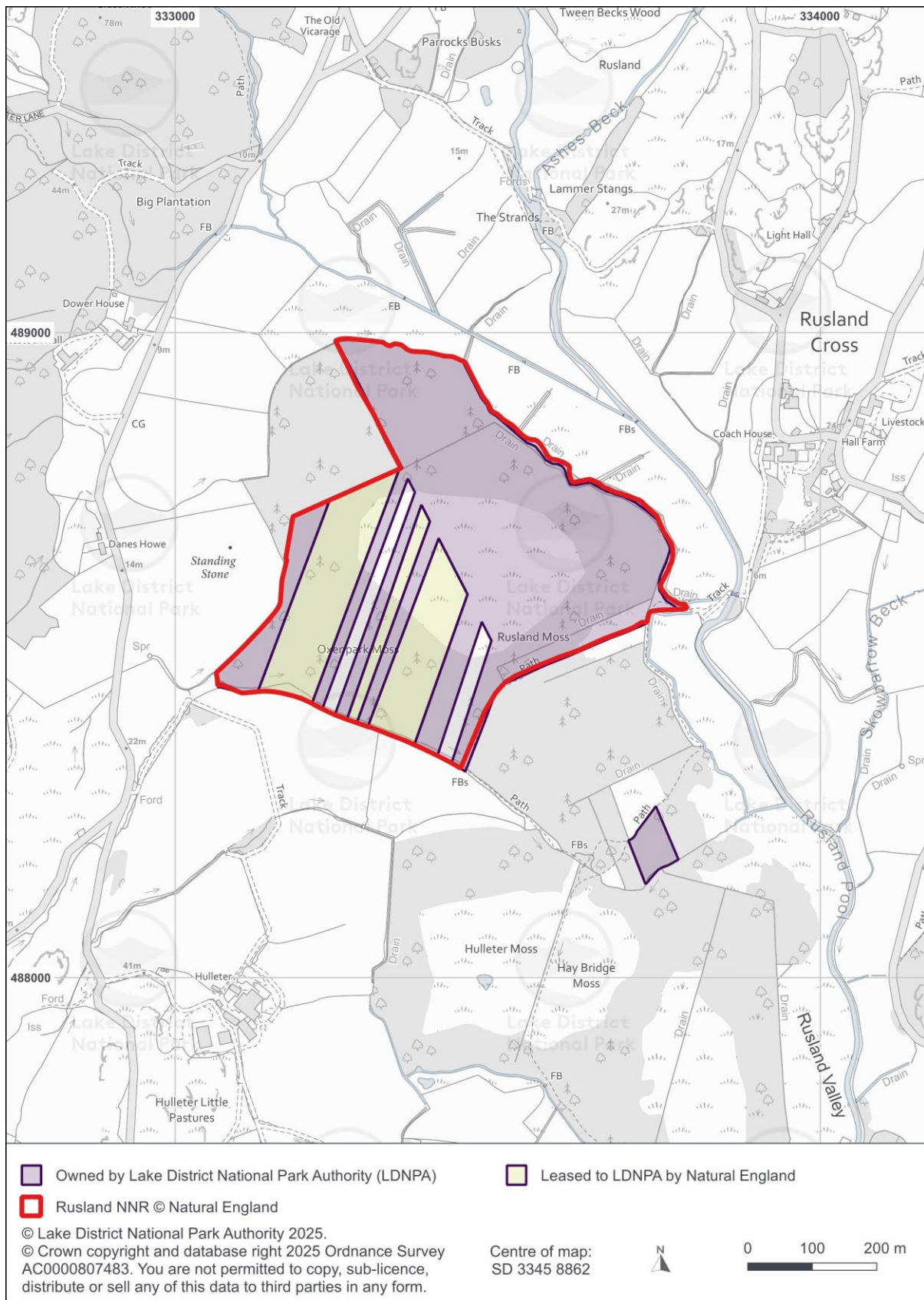
1.3 Site Status

Designation	Area (ha)	Date	Notes
Special Area of Conservation (SAC)	x	x	x
Special Protection Area (SPA)	x	x	x
Ramsar	x	x	x
National Nature Reserve (NNR) Refer to map on page 2	22.3	Designated in 1958, (with an extension added in 1964)	Established under Section 16 of the National Parks and Access to the Countryside Act 1949. Nature Reserve Agreement between Nature Conservancy and His Honour Judge Archibald from 17/06/1957. ¹
Site of Special Scientific Interest (SSSI)	22.3	Notification (1981 Act) 1986	Part of Rusland Valley Mosses SSSI covering a total of 95.6ha
Geological Conservation Review (GCR)	x	x	x
Other designations (site)	x	x	x

¹ In 1981 the Lake District Special Planning Board bought the land from one of the Archibald family. The land was subject to a 999 year Nature Reserve Agreement between Nature Conservancy Council (NCC) and His Honour Judge Archibald from 17th June 1957. NCC and then English Nature managed the NNR until 2000, when LDNPA took over its management. English Nature leased a strip within the NNR to the NP for 21 years and assigned a lease from National Trust.

Wider designations			Rusland Moss lies within the Lake District National Park and English Lake District World Heritage Site
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Map 2: Rusland Moss National Nature Reserve Land Tenure and Boundaries



1.4 Physical Features

The physical aspects of the reserve which form part of the site's importance, or which have a bearing on its management.

General Description

Rusland Moss is contiguous with the Rusland Valley Mosses SSSI, forming part of the flood and tidal plain to the western banks of the Rusland Pool, but remains separate due to its elevation above the flood plain. The plan will refer to Rusland Moss NNR as the Moss. The Rusland Valley Mosses SSSI will be referred to as the Mosses.

Rusland Moss NNR forms part of the Rusland Valley Mosses SSSI, a 94-hectare system of lowland raised mires situated near the head of the Rusland Valley, 4 km northwest of Newby Bridge. The Mosses comprises of what was once three separate domes, Hulleter Moss, Hay Bridge Moss and the highest, Rusland Moss measuring 8m above sea level. They represent part of a formerly extensive range of estuarine raised mires around Morecambe Bay. Together the Mosses complement the raised mire habitat found elsewhere in South Cumbria (see Map 3 – page 30).

Lowland raised bogs are peat-forming ecosystems that have developed during thousands of years of peat accumulation, to such an extent that the depth of peat isolates them from the influence of groundwater. Typically, lowland raised bogs form a raised dome of peat irrigated solely by rainfall. Such rainwater-fed ecosystems are very acid and poor in plant nutrients and typically support a restricted range of species, some of which are otherwise abundant only in the cooler and wetter uplands of the UK.²

Peat has been a valuable resource in the past but due to historic peat extraction (or winning) little of the intact mire or bog surface remains. This, coupled with internal and peripheral drainage for agricultural has lowered the water table within the peat dome and led to the drying out of the peat surface, damaging the bog and resulting in the colonisation by birch (*Betula pubescens*), pine (*Pinus sylvestris*) and

² [JNCC 7110 Active Raised Bogs](#)

rhododendron (*Rhododendron ponticum*). Aerial photographs taken in the 1960s show far fewer trees on the Moss compared with aerial photographs taken in the 1980s - see figure 2. Ordnance Survey maps dating back to the 1840s have shown that tree cover on the Moss has fluctuated. Local people remember the extraction of selected mature Scots pine from the Mosses, as recently as the 1950s.

Past exploitative management of raised bogs means that they are now one of our most uncommon and threatened habitats.³ It is estimated that Britain now only has around 5% of its former extent of lowland raised bog, all damaged, and that about half of England's remaining raised bogs are in Cumbria.

Geology

The Moss and Mosses are exclusively underlain by the Bannisdale Formation, which is fluvial in origin (either river or estuarine) and comprised of beds of varying characteristics depending on the depositional environment. It was deposited in the Silurian and subsequently metamorphosed, uplifted and deformed during the Devonian mountain-building phase (the Acadian orogeny) around 400 million years ago, leading to the formation of the slate found in the region and regional folds. The Mosses are located on the southern limb of the regional Lowick anticline fold (British Geological survey 2019).

Hydrology

It is thought that the Mosses took around three thousand years to develop, but the area has been a wetland for much longer than this. Historically, Rusland was a tidal valley in which impeded drainage created a lagoon, resulting in the accumulation of peat, gradually building up above the level of the water table over time. This led to the development of a series of ombrotrophic (rainwater-fed) raised bogs and other wetlands alongside the Rusland Pool.

Estuarine raised bogs originally covered much of the low lying coastal plain and valleys of South Cumbria. Apart from the Rusland Valley Mosses remnant other

³ Lindsay, R. A., Immerzi, C. P. 1996

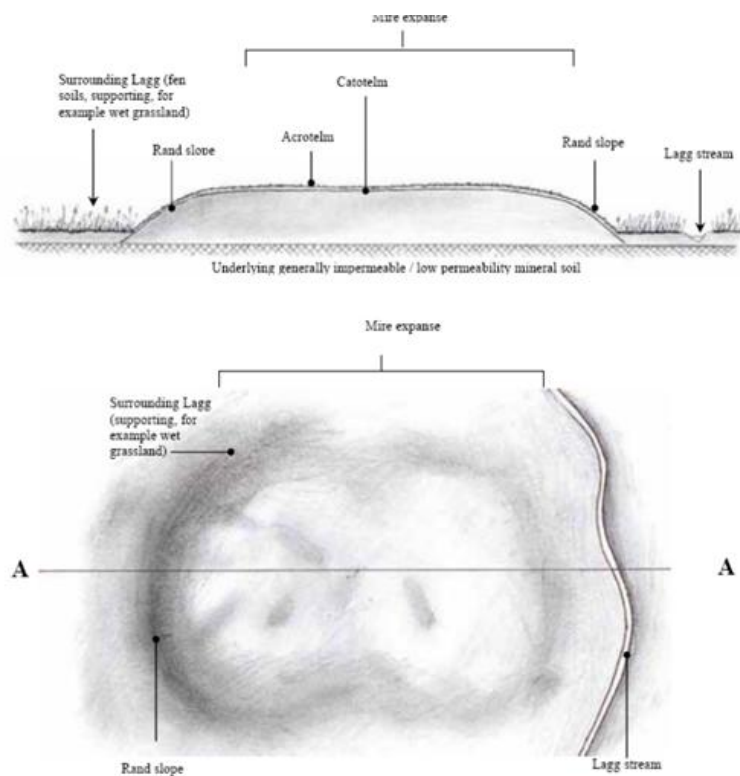
raised bogs have survived at Duddon Mosses, Roudsea, Foulshaw and within the Lyth valley.

A lowland raised bog is an unusual habitat where a thin layer of peat-forming vegetation (acrotelm) lies on top of permanently waterlogged peat that is several metres deep (catotelm). The acrotelm provides the plant material that becomes peat and, where undrained, has an undulating surface including bog pools and hummocks. Due to the hydrological properties of peat and the peat-forming vegetation, the water table of the bog is higher than and separate from that of the surrounding land and the height of the peat means that the bog vegetation obtains all its water from rainfall.

Attempts to drain the bog has caused compaction, degradation of the bog vegetation and direct loss of peat through oxidation as well as changes in the water chemistry and water-retaining properties of peat over a wider area. Hydrological restoration is focussed on re-instating a high and stable water table to conserve the peat resource and re-start peat formation.

An undamaged lowland raised bog has one or more domes of peat. The majority of the dome is fairly flat and wet and is known as the mire expanse. This is where most of the new peat is formed. The sloping edge is called the rand and is drier, with slightly different vegetation. There is normally a surrounding wetland called lagg, which has more nutrients and is less acidic as it receives water from both the bog and surrounding land. The vegetation of the lagg varies with local topography and geology (see Figure 1 – page 12).

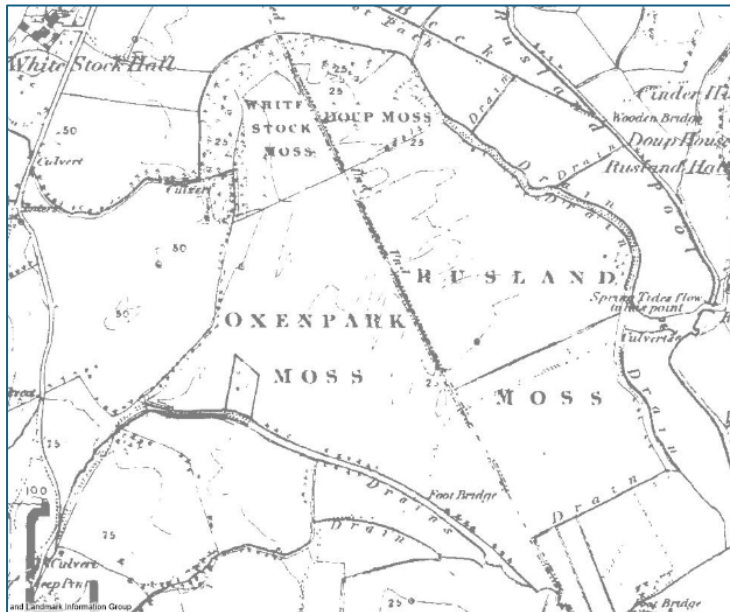
Figure 1: Intact lowland raised mire (bog)⁴



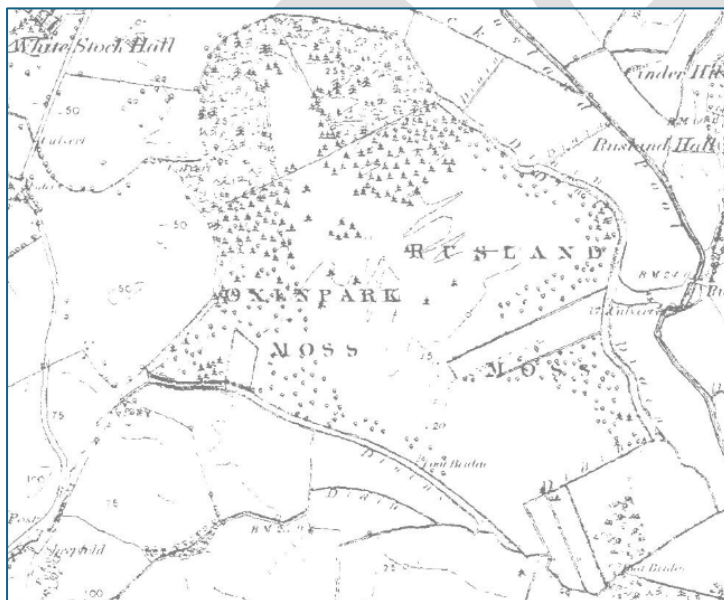
The grazing of cattle and sheep, haymaking and small-scale peat winning by local people have all featured, right up to middle of the twentieth century. Also, tree and shrub encroachment is responsible for accelerating the amount of water loss through transpiration.

⁴ Morgan Jones et al. 2005

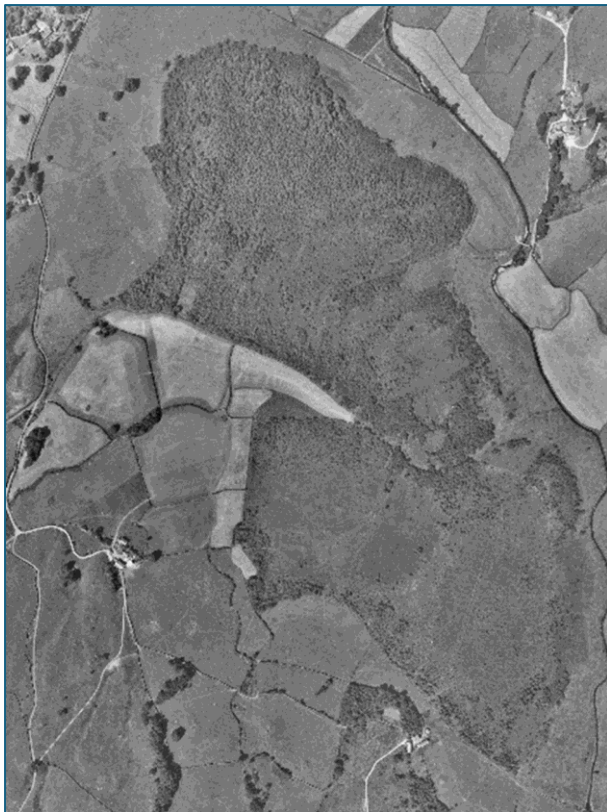
Figure 2: Changes to the density of tree encroachment on Rusland Moss over-time



1. 1st Edition OS Map 1870. Map shows no trees on main moss area but possible encroachment or planting around northern end. Faint reference to drains and contours, possibly indicating peat cutting.



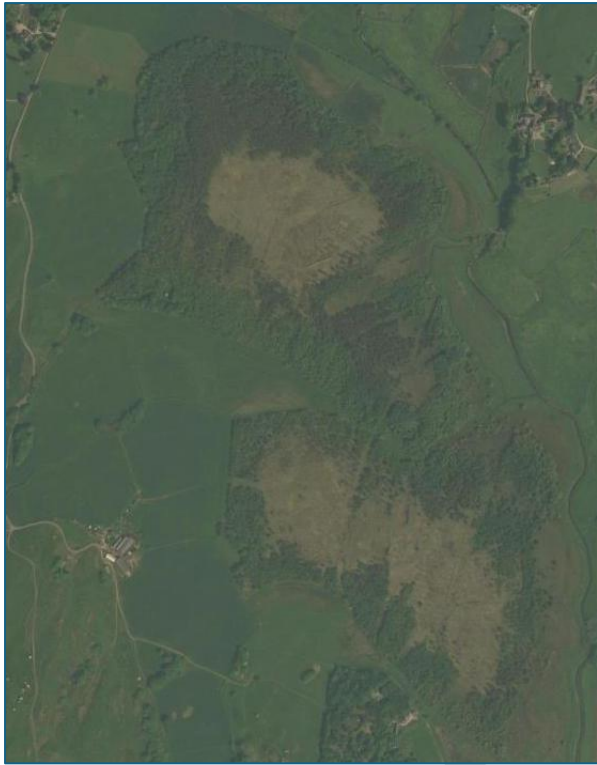
2. Circa 1918. OS Map shows a clear expansion of tree cover probably linked to the effects of drainage and drying out of the peat.



Huntingdon Surveys Ltd. 1963



© MAFF 1983



3. Post tree clearance and bunding works 2009 - © Bluesky International Ltd and Getmapping Plc [2009]



4. Present day

2025 © Bluesky International Ltd and Getmapping Plc [2025]. You are permitted to use this data solely to enable you to respond to, or interact with, the organisation which has provided you with the data. You are not permitted to copy, sub-license, distribute or sell any of this data to third parties in any form.

In 2009 the central area of the Moss was clear-felled, and several drainage ditches were blocked (see Figure 2, photograph 3 – page 15). A large number of sawn logs, mostly pine with some birch, were left on site either piled or scattered where felled. The area retains a large amount of standing water, and the peat is very soft. There are still rotting logs and some erosion from site works is still evident on site. Large areas of bare peat are also apparent. However, the central area has a rich species diversity of bog plants including Bog cranberry (*Vaccinium oxycoccos*), Cross-leaved heath (*Erica tetralix*), White beak-sedge (*Rhynchospora alba*), Bog Rosemary (*Andromeda polifolia*) and a variety of Sphagnum species.

The trees surrounding the central bog is Scots pine (*Pinus sylvestris*), merging to silver birch (*Betula pendula*) dominated, with occasional oak and willow wet woodland towards the outskirts. There is a distinctive, large area of Bog Myrtle (*Myrica gale*) noted at SD 33475 88390 on the West side of the boardwalk. Purple moor-grass (*Molinia caerulea*) is generally the dominant ground cover, and common heather / Ling (*Calluna vulgaris*) is almost absent. At the southern edges of the open bog area and in the tree and woodland areas are linear ridges, which are perhaps from peat cutting in strips and remnants of access tracks during peat harvesting.

The site has been subject to historical peat cutting. The edges of the uncut peat are truncated, steep and are actively slumping. Where restoration work has not yet been conducted, the water tables are closer to the level of the cuttings. Drying of the bog surface had enabled the establishment of scrub and rhododendron, although this was partly addressed in the 1990's by a programme of scrub and tree removal and periodic herbicide treatment of the regeneration. Scrub and trees are responsible for significant interception of annual precipitation reaching a mire surface. Coupled with increased loss through evapotranspiration, this causes a significant drying of the mire.

Since the early 2000s, hydrological restoration works have been carried out over the NNR. These have been successful at raising the water table in the peat so that the bog vegetation has been able to recover or to re-establish, except in degraded areas where bracken or purple moor grass is dominant.

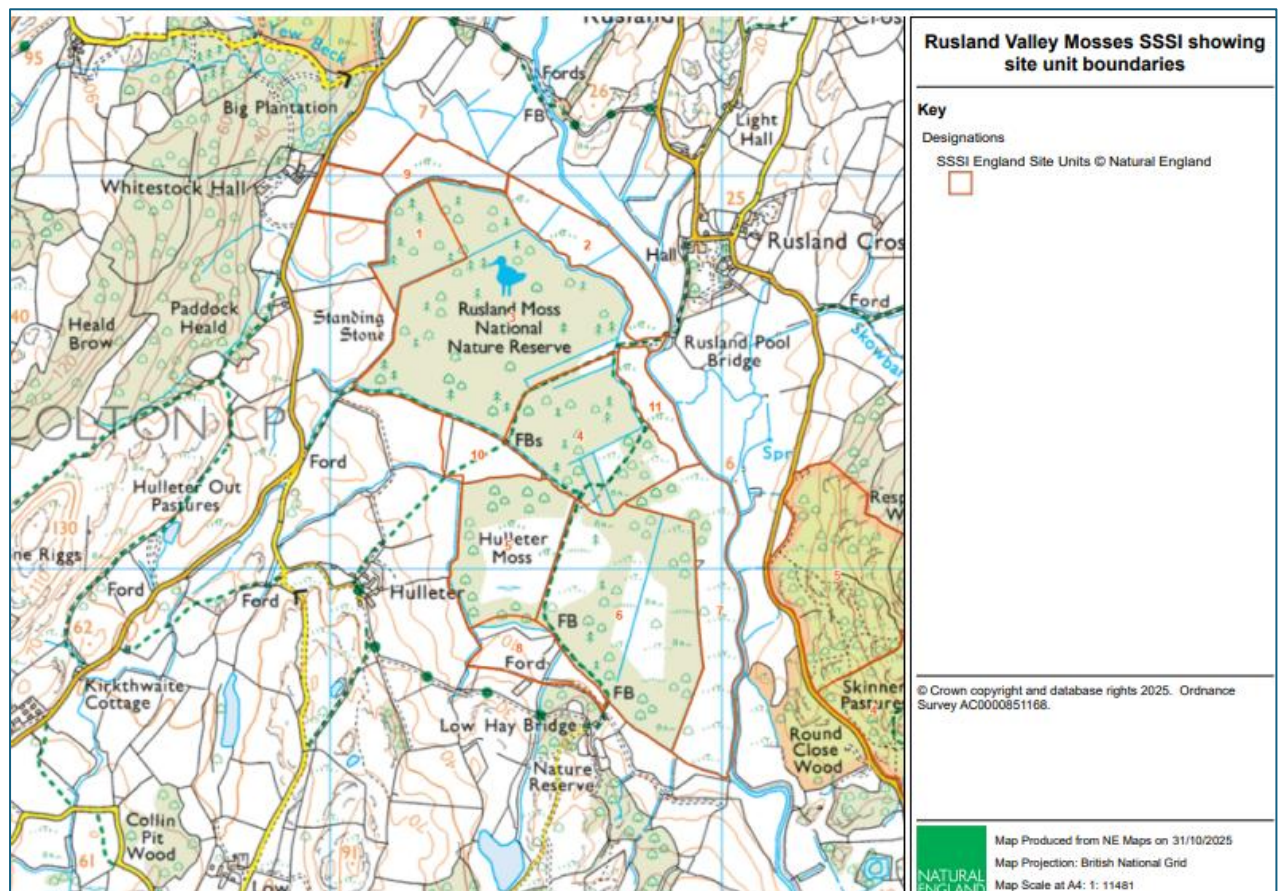
SSSI Units

Rusland Moss is separated from Hulleter and Hay Bridge Mosses by a watercourse that runs approximately west to east. Hulleter and Hay Bridge Mosses are essentially a continuous area of raised bog, split by a track and peat cuttings. Figure 3 shows the current SSSI units. Unit 3 is located in the NNR, 1, 2 and 3 make up Rusland Moss, 5 Hulleter Moss and 6 Hay Bridge Moss. Each of the three Mosses is described separately below (see Figure 3 – page 18).

It is notable that the SSSI units are in an ‘unfavourable declining’ condition which is mainly due to the mixture of dense trees and Scots pine in the north end of the Moss where the bog surface is non-existent and no indicator species present the unit is declining if not part destroyed as the peat continues to dry out and oxidise. Also, the level of scrub encroachment, inappropriate water levels effected by existing drainage, numbers of red deer using the site and grazing the desirable bog species as well as air pollution.⁵

⁵ Summarised from Natural England condition assessment 2021

Figure 3 : SSSI site unit boundaries



References

Lindsay, R and Immirzi, P. An inventory of lowland raised bogs in Great Britain. 1996.
JBA Consulting. Rusland Valley Mosses SSSI Conceptualisation, Monitoring and Restoration Plan Final Report. November 2014.

1.5 Biological Features

The plants, animals and habitats which form part of the reserve's importance, and which contribute to national and local biodiversity. The wet, nutrient-poor growth conditions found on raised mires means they support unique communities of specialised plants and animals.

Flora

The main surface of the bog is degraded but retains some typical bog flora including heather (*Calluna vulgaris*) and crossed-leaved heath (*Erica tetralix*). Bog mosses (*Sphagnum* sp.) occur together with other species such as white beaksedge (*Rhynchospora alba*), bog asphodel (*Narthecium ossifragum*), bog rosemary (*Andromeda polifolia*), cranberry (*Vaccinium oxycoccus*) and round-leaved and intermediate sundew (*Drosera rotundifolia*) and *D. intermedia*. *Sphagnum papillosum*, *Sphagnum subnitens* subsp. *subnitens* and *S. tenellum* form hummocks.

The vegetation of the peat bodies is heavily influenced by past management, together with more recent drain blocking and tree clearance. A community of purple moor-grass (*Molinia caerulea*) interspersed with bog myrtle (*Myrica gale*) has developed where the mire surface has been disrupted along old peat cuttings and also in areas of young woodland. This merges into willow *Salix* spp., and birch (*Betula pubescens*) woodland which surrounds the Moss. The waterlogged ground supports species such as common valerian (*Valeriana officinalis*), marsh cinquefoil (*Potentilla palustris*), hemp-agrimony (*Eupatorium cannabinum*) and reed canary grass (*Phalaris arundinacea*).

At its northern end, Rusland Moss has a mature woodland stand of Scots pine (*Pinus sylvestris*) and in one area, of oak *Quercus* sp. The ground flora is limited in diversity, consisting of a dense cover of bilberry (*Vaccinium myrtillus*), purple moor-grass and a carpet of mosses including (*Leucobryum glaucum*) under pine while under oak tufted hairgrass (*Deschampsia cespitosa*) dominates. A number of ferns are also found within the woodland including the local royal fern (*Osmunda regalis*), the broad and narrow buckler ferns (*Dryopteris dilatata* and *D. carthusiana*) along with the hybrid of the two, *Dryopteris x deweveri*. On the margins of the peatland a variety of grassland types are found. On wetter ground purple moor-grass, Yorkshire

fog (*Holcus lanatus*) and creeping bent (*Agrostis stolonifera*) are present in a sward that contains soft rush *Juncus effusus*, meadowsweet (*Filipendula ulmaria*) and lady's smock (*Cardamine pratensis*). Elsewhere, in drier stands small amounts of devil's-bit scabious (*Succisa pratensis*) and lady's mantle (*Alchemilla xanthochlora*) occur.

In other areas the carr woodland has been cleared and a rich sward containing globeflower (*Trollius europaeus*), wild angelica (*Angelica sylvestris*), purple loosestrife (*Lythrum salicaria*), common sedge (*Carex nigra*) and bottle sedge (*C. rostrata*) has developed.

National Vegetation Classification (NVC) Communities⁶

It is important to note that the NVC descriptions provided are of the current vegetation and therefore some of the floristic communities represent degraded or successional lowland raised bog habitats due to the damaged hydrology. Therefore, they should not necessarily be regarded as site features that require management or retention. However, communities such as W4 *Betula pubescens* – *Molinia caerulea* woodland and M25 *Molinia* – *Potentilla* mire are plant communities that we aspire to recover and / or enhance.

The central unwooded bog surfaces are covered in a mix of communities derived from M18 *Erica tetralix* – *Sphagnum papillosum* mire vegetation. Some areas are close in species composition to the M18a *Sphagnum magellanicum*-*Andromeda polifolia* sub-community, albeit modified structurally by heavy deer grazing, but the majority of the surface is a more modified vegetation with abundant *Sphagnum cuspidatum* which is mapped as M2a/M18a. This is probably a response to the rewetting of much of the bog surface due to drain blocking and the colonisation of bare peat or shallow open water by *Sphagnum cuspidatum*.

Drier, mainly peripheral, parts of the bog surface are mostly covered by M25a *Molinia caerulea* – *Potentilla erecta* mire, *Erica tetralix* sub-community, however slumping areas of Rusland Moss also support stands of a *Molinia* rich intermediate

⁶ Information and mapping located in Rusland Valley Mosses SSSI NVC Survey. Jerram. R. 2014.

between M15 *Trichophorum cespitosum* – *Erica tetralix* wet heath and M25 *Molinia* – *Potentilla* mire. W4 *Betula* – *Molinia* woodland covering the northern part of the Moss. The outer areas of the peat body however are largely wooded, and the vegetation communities present are influenced by historic peat cutting and drainage. The highest, driest areas are covered by a drier variant of the W4 *Betula pubescens* – *Molinia caerulea* woodland alongside a canopy composed of *Pinus sylvestris* (W4Psyl). Lower and/or wetter areas of the site, made up predominantly by historic peat cuttings, are covered by W4c *Betula* – *Molinia* woodland with the sub- community of *Sphagnum* spp.

Around the low-lying margins of the moss, where ground and surface waters have a greater influence on the vegetation, stands of W1 *Salix cinerea* – *Galium palustre* woodland are present. There are also some large areas of wet woodland showing a mix of characteristics between the W4 *Betula* – *Molinia* and W1 *Salix* – *Galium* woodlands on peat cuttings where the minerotrophic and ombrotrophic influences are more balanced. These stands are mapped as W4/W1.

Non- native invasive species

Rhododendron. There has not been any active management of rhododendron on site for at least 5 years. The rapid growth and re-growth of invasive rhododendron (*Rhododendron ponticum*), throughout the site and on adjoining properties, is a continuing concern.

Skunk cabbage. A programme of spraying treatment has been undertaken over the last 5 years, but there have been issues with accessing areas. Skunk cabbage (*Lysichiton americanus*) has been classified as an invasive species by the EU in 2016. Skunk cabbage has established itself on site, forming dense colonies and have spread aggressively through rhizomes and seeds.

Yellow loosestrife (*Lysimachia vulgaris*). This species is not native to the site and has spread through creeping rhizomes and can potentially outcompete other active plants.

Bryophytes, Lichens and Fungi

Historical records dating back to 1963 for *Cladonia sylvatica* and *Cladonia squamosa* (the latter is unverified). Other than these there are no records for these groups other than occasional records for common bryophytes amongst species lists for higher plants.

Fauna

Mammals

Otter (*Lutra lutra*) have increased in numbers considerably in the Rusland Valley since the mid-1990s. Otter tracks have recently been recorded on the southwestern boundary ditch.

American mink *Mustela vison* has been recorded in the Rusland Valley.

Red (*Cervus elaphus*) and roe (*Capreolus capreolus*) deer frequent the woodland in significant numbers. A 2024 thermal drone survey of the South Lakes found deer density in the Rusland Valley to be notably high; approximately 33 per km² (red and roe).⁷ The SSSI condition survey for 2022 site red deer numbers are too high and impacting on SSSI condition.

It is reported that Polecat (*Mustela putorius*) has been caught and recorded twice on the NNR but there is no verified reference to this.⁸

The presence of mature Scots pine around the Moss is a potential habitat for red squirrel, although none have been sighted in recent years.

Reptiles and amphibians

There are no records for these groups.

⁷ Thermal Imaging Deer Drone Census – Central Lakes. BH Wildlife Consultancy. 2024

⁸ LDNPA Rusland Moss Management Plan 2007 – 2012.

Birds

The breeding bird community includes species such as red kite, spotted flycatcher, tree pipit and wood warbler.

Invertebrates

The Mosses are listed as an Important Invertebrate Areas (IIAs) for the rich nationally significant invertebrate populations and their habitats. Records for Rusland Moss include the rare large heath butterfly (*Coenonympha tullia*). A number of uncommon spiders have also been recorded, notably *Walckenaera nodosa*, *Gongylidiellum latebricola*, the raft spider (*Dolomedes fimbriatus*) and *Maro lepidus*, which was first recorded in Britain on Rusland Moss

The Centre for Ecology and Hydrology are currently using acoustic monitoring to inform an understanding of species utilising Rusland Valley Mosses.

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1.6 Cultural Features

Landscape importance, historical and archaeological features of the NNR and its use for purposes other than nature conservation.

Lake District World Heritage Site

Rusland Moss NNR lies within the Lake District World Heritage Site and contributes directly to the Outstanding Universal Value of the area as recognised by the World Heritage Site nomination through the Wealth of Habitats and Wildlife and Opportunities for Quiet Enjoyment Special Qualities which are significant features of the NNR.

Landscape Character

Rusland Moss falls within the South Cumbria Low Fells National Character Area. The area is characterised by undulating low fells and ridges which, in the central section, are dissected by the two major lakes – Windermere and Coniston Water – and minor river valleys and is one of the most densely wooded areas in England, with extensive areas of broadleaved and conifer woodland and parkland. The higher ground supports a mosaic of upland heathland, interspersed with rocky outcrops, tarns, fast flowing becks and stretches of bracken. Valleys support a working (principally pastoral) landscape, with fields bounded by drystone walls reflecting the geology of the area. East of Kendal, and also in the far west, the landscape is more open and pastoral, with fewer trees. The South Cumbria Low Fells NCA contains several sites of international significance for their biodiversity, designated as Special Areas of Conservation (SAC). These include the mires at Subberthwaite, Blawith and Torver Common, the slopes and crags of Yewbarrow Woods (containing yew groves in association with old sessile oak woods), and the lowland raised bog complex of the Duddon Mosses.

Archaeological and Historical Features

Rusland Valley is a rich cultural landscape of some antiquity and includes a large number of archaeological sites and historic landscape features. The archaeological potential of this area is high, and it contains sites dating from the prehistoric period to the recent past. Many of the recorded archaeological sites are connected to industries which utilised the natural resources of the region. The local resources

which were important comprised wood, charcoal, and waterpower, which were variously used to smelt iron, manufacture bobbins and gunpowder, drive mills and create products such as swill baskets, besoms, clog and hoops and tool handles.

Table 1: Historical and archaeological sites and finds in the immediate area

LDNPA HER No.	NGR (centre)	Description
16429	SD3308 8867	Standing Stone
16417	SD3345 8832	Footbridge
16416	SD3373 8815	Footbridge
16418	SD3368 8887	Footbridge
2545	SD3301 8899	Stone Axe
2540	SD3313 8923	Bloomery

The site has a high potential for surviving paleo-environmental remains, important for the study of past vegetation cover and climate changes in the area. These studies can also give us information on the structure of peat deposits, which may be useful in planning future management of the site. Peat cutting has been an important activity in the past, leaving a legacy of damage to the peat levels across the bog. Stratigraphy and palynological assessments of the Mosses and its environs has enabled scientists to reconstruct the history of vegetation at the site through time and past climate conditions. Data collected shows that 4000 years ago the NNR was part of an estuarine lake filled by a *Phragmites* swamp, which impeded local drainage forcing the water table to rise. As more acid conditions developed, an *Calluna vulgaris* – *Eriophorum vaginatum* bog was formed and succeeded, about 3000 years ago, by three raised bogs, now the Mosses of Rusland, Hulleter and Hay Bridge.⁹

⁹ The Development of the Raised Bog Complex Near Rusland in the Furness District of North Lancashire. Winifred Dickinson. Journal of Ecology, Vol. 61, No. 31973.

Land use history

Socio-economic Use

Education

The site does have potential for educational use, particularly survey and monitoring work by college and university students. There have been several requests during the past five years for survey work. Hay Bridge Reserve is well placed to offer educational facilities and study.

Hay Bridge Nature Reserve

Adjacent to the NNR is the Hay Bridge Nature Reserve. The Hay Bridge Reserve Society, established in 1972, is a registered charity. Its purpose is, to conserve and enhance the natural beauty and amenity of the countryside and the wildlife for the benefits of its members, the public and to provide educational facilities and opportunities. In 1998 the Reserve land was purchased by the John Strutt Conservation Foundation (JSCF). The Society now works in partnership with the JSCF. The provides annual programme of walks, talks and other events and offers opportunity for potential partnership working to promote the NNR.

Research Use

As part of the Cumbria Mires and Fens Protected Site Strategies (PSS) Pilot, several research projects have been undertaken between 2023-time of writing. These include the following:

Cumbria Atmospheric Nitrogen Strategy (CANS), is a PSS pilot project for raised bogs affected by air pollution. CANS is designed to establish methods for monitoring pressures from atmospheric nitrogen (N) pollution on raised bogs and impacts of this pollution on this habitat and its biodiversity to achieve the principal aim of a new strategy for assessing the impacts of atmospheric N with the example locations of three raised bog SSSIs in South Cumbria, including Rusland Valley Mosses SSSI. The project aims to measure concentrations and deposition of atmospheric N and assess impacts on the flora and fauna.

University of Cumbria are undertaking research into the effectiveness of sheep's wool as a surface covering to facilitate or enhance the establishment of peat-forming vegetation on degraded peat. The bare peat on Rusland Moss makes it a suitable site for trialling this method for restoration, so the research is being part funded by the PSS pilot.

Rusland Mosses SSSI Deer Impact Implementation Plan looking at the red and roe deer populations, herd dynamics, the existing mosaic of deer management across the Rusland Valley and wider catchment, and the effects of deer activity on the NNR and neighbouring land. The study will also review access constraints for carcass extraction, which have been identified as a barrier to effective deer management.

Demonstration

The Moss has the potential to provide a learning resource for lowland raised mire management, both for Lake District National Park Authority staff and others.

1.7 Access Features

Accessibility and visitor appeal, public transport routes, access routes and visitor facilities

Visitor Appeal and Suitability for Access

Access provision

Public footpath, FP 511036, runs from Rusland Cross, over Rusland Pool Bridge on the eastern boundary of the Moss and then crosses the centre of the site, or joins with public footpath FP 511035 that follows the eastern boundary of the Moss to join public footpath FP51137 that crosses the southern boundary at Hulleter. There is also a public footpath, FP 511035, that heads north from Low Hay Bridge to link with FP 511037 and FP 511036 (see Map 4 – page 31). These public footpaths are well signposted, and way marked throughout the Mosses. Extensive sections of these routes, within the Mosses, are served by boardwalk and bridges, providing good public access around the entire site. However, several sections of the boardwalk are rotting and large sections of boardwalk through the centre of the site (FP511036) have been removed.

Tidal reach up the valley, as far as the Rusland Pool Bridge from the Leven estuary, combined with periods of heavy rainfall, can often render the NNR inaccessible at any time of the year but especially during the winter. Walkers and visitors are advised to closely follow the waymarked routes (wooden posts positioned at regular intervals) at all times.

Visitors wishing to visit the NNR, or other areas of the Mosses not served by public rights of way, are advised to contact the site manager. Those with limited mobility are also advised to contact the site manager for advice and help. There is no vehicular access onto the NNR. Access is usually on foot via Rusland Pool Bridge at the northern end or, from Low Hay Bridge Nature Reserve at the southern end. Parking at Low Hay Bridge private car park, is only with the landowner's permission.

The Greenwood Trails are an excellent, free walking leaflet to the area, produced by Rusland Horizons and the Lake District National Park Authority and available at local outlets or, go to [Routes : Lake District National Park](#)

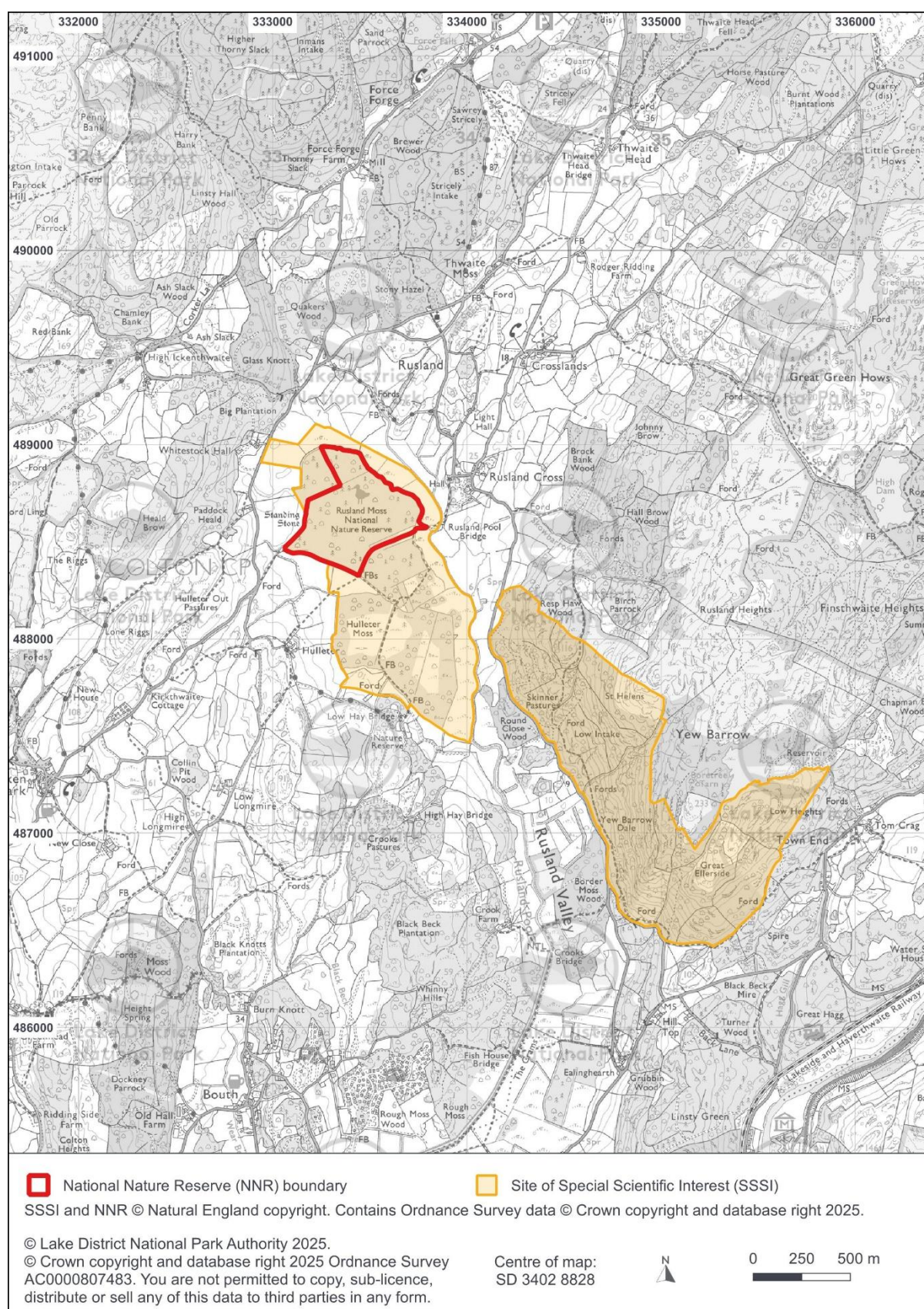
Visitor facilities

Limited to boardwalks and paths, and to the provision of on-site and off-site NNR signage. The location of access will be reviewed as restoration of the bog continues but will always aim to give visitors experience of the typical bog flora and fauna. Pathways will need to be kept clear of vegetation annually to enable appropriate public access.

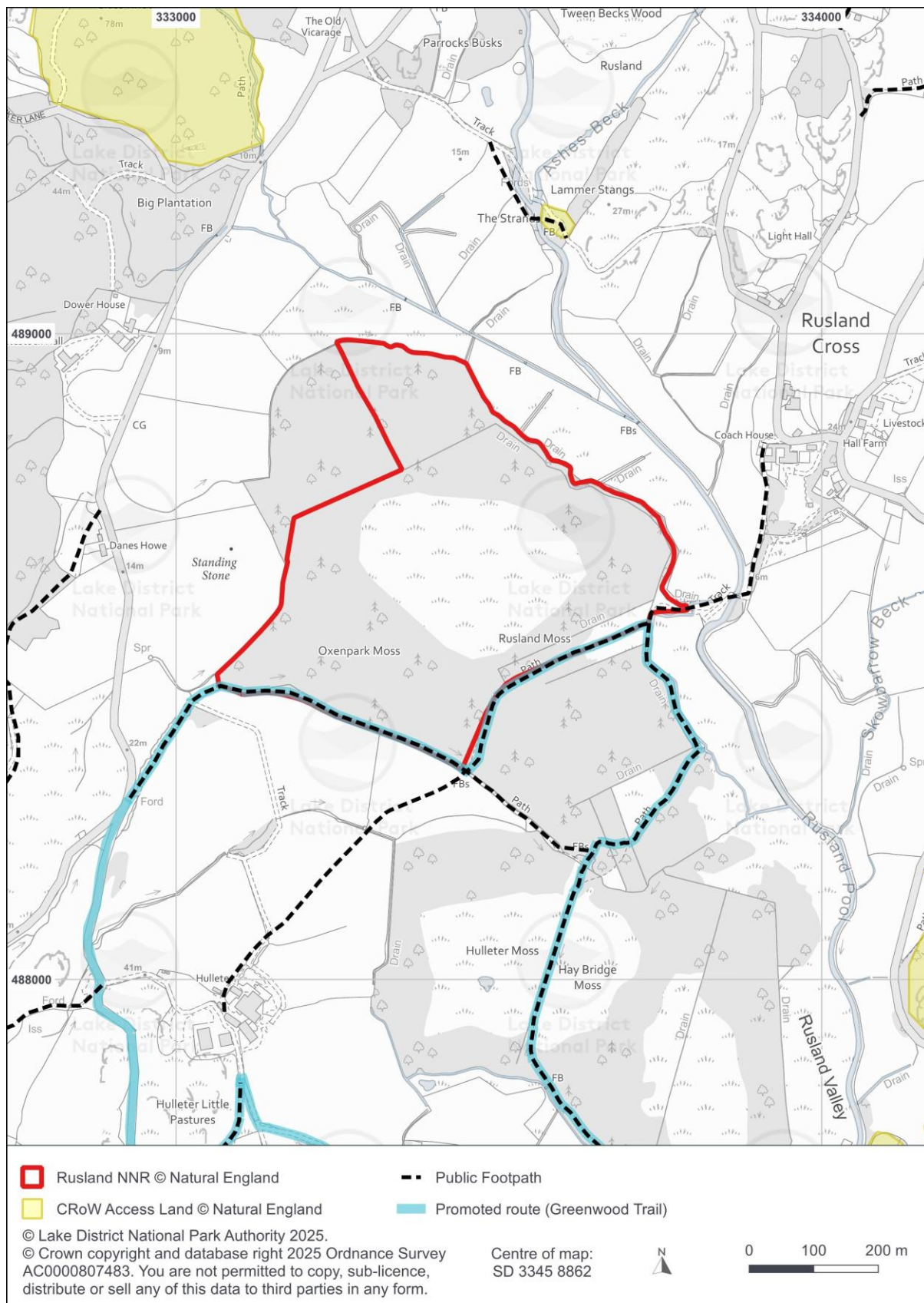
Information

There is a sign on public footpath 511036, approximately 300m south- west of Rusland Pool Bridge, as you enter the Moss. However, it is a very old timber sign with limited information and needs to be replaced with a more informative panel.

Map 3: Rusland Valley Mosses SSSI and Rusland Moss NNR



Map 4: Access Map



1.8 Summary of Site Features

Tables summarising the site's features of importance

Table 1.8.1 Geological and Biological Features

Feature No.	Broad Habitat Type or Geological Site type	Specific Feature	Explanation of Feature or Ranking	Legal Site Designations					Other Designations					
				SAC	SPA	Ramsar	SSSI	Other	European	S41 NERC	Nationally rare	Nationally Protected	Character Area	Other
1.	Bogs	Raised Bog (Lowland)	One of the few remaining examples of the formerly extensive system of estuarine raised mires / bogs around Morecambe Bay.				x				x	x	x	
2.	Bogs	Invertebrate assemblage W312 sphagnum bog	Specific Assemblage Type (SAT) - invertebrate communities in relation to habitat type. W312				x				x			

Feature No.	Broad Habitat Type or Geological Site type	Specific Feature	Explanation of Feature or Ranking	Legal Site Designations						Other Designations						
				SAC	SPA	Ramsar	SSSI	Other	European	S41 NERC	Nationally rare	Nationally Protected	Character Area	Other		
			represents the invertebrate fauna characteristic of Sphagnum bogs —peat-forming wetlands dominated by <i>Sphagnum</i> mosses, including: the rare money spider <i>Maro Lepidus</i> , raft spider <i>Dolomedes fimbriatus</i> , Bog bush cricket <i>Metrioptera brachyptera</i>													
3	Bog	Butterflies which have experienced substantial	The Large Heath butterfly <i>Coenonympha tullia</i> is a bog-specialist associated				x			x						

Feature No.	Broad Habitat Type or Geological Site type	Specific Feature	Explanation of Feature or Ranking	Legal Site Designations						Other Designations					
				SAC	SPA	Ramsar	SSSI	Other	European	S41 NERC	Nationally rare	Nationally Protected	Character Area	Other	
		declines - Coenonympha tullia, Large Heath	with <i>Sphagnum</i> rich mire habitats with hare's tail cottongrass <i>Eriophorum vaginatum</i> . It is highly vulnerable to the degradation, drainage, and fragmentation of lowland raised bogs.												
4.	Broadleaved, mixed and yew woodland	Breeding birds	Species listed under Section 41 NERC Act 2006: Species of principle importance in England: tree pipit; spotted flycatcher; wood warbler							x			x		

Feature No.	Broad Habitat Type or Geological Site type	Specific Feature	Explanation of Feature or Ranking	Legal Site Designations						Other Designations					
				SAC	SPA	Ramsar	SSSI	Other	European	S41 NERC	Nationally rare	Nationally	Protected	Character Area	Other
5.	Broadleaved, mixed and yew woodland	Schedule 1: Breeding Birds	Species listed in Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) as having special protection during the breeding season: Red kite									x	x		

Table 1.8.2 Landscape Features

Feature No..	Specific Feature	Explanation of Feature/Ranking	Legal Designations				Other Classification s	
			World Heritage Site	National Park	AONB	Heritage Coast	Joint Character Area	Other
6.	Lowland Raised Bog	World Heritage Site part of the Outstanding Universal Value (OUV). Attribute: <i>extraordinary beauty and harmony</i>: The physical natural landscape of mountains, rivers, lakes, and valleys. National Park part of the Special Qualities: 6: Wealth of Habitats and Wildlife South Cumbria and Low Fells National Character Area	x	x			x	

Table 1.8.3 Socio-economic Use

Feature No.		Very Important	Important	Insignificant
7.	Economic Use			x
8.	Community Involvement		x	

Table 1.8.4 Education, Research & Demonstration

Feature No.		Very Important	Important	Insignificant
9.	Education		x	
10.	Research		x	
11.	Demonstration		x	

Table 1.8.5 Public Access

Feature No.		Very Important	Important	Insignificant
12.	Public Access	x		

Table 1.8.7 Other Estate Assets

Site assets, not listed in preceding summary tables, which the management plan needs to address.

Feature No.	Asset Description	Requirements	Notes
13.	Trees and woodland	Standing timber value	Areas of standing pine trees and other trees to be removed as part of peatland restoration to be considered for standing timber value

2.0 Evaluation

Policy background

This section has a brief introduction to the Natural England guidance that helps us put Rusland Moss NNR into context with other NNRs and the Government's vision for the countryside.

2.1 Strategies

Natural England's Conservation 21 (C21) strategy. The government's ambition is for England to be a great place to live, with a healthy natural environment on land and at sea that benefits people and the economy.

[Conservation 21: Natural England's conservation strategy for the 21st century](#) sets out our thinking on what we need to do differently and how we need to work with others, to better deliver this shared ambition. The C21 strategy will frame everything we do.

C21 brings together our own and others' experiences of what works and the latest science and evidence, with innovative approaches, new partnerships, and different ways of thinking about nature and the benefits it provides. The strategy's 3 guiding principles are to:

- create resilient landscapes;
- put people at the heart of the environment;
- grow natural capital.

National Nature Reserve Joint Strategy - Our most special places for nature.

The founding purposes for NNRs - conservation, science, and places for people to enjoy nature – remain a priority, despite a radically changing and pressured environment. Nevertheless, NNRs are often islands of richness in simplified landscapes with far fewer species. We need a rejuvenated effort to ensure NNRs continue to be beacons of landscape-scale diversity, with people and communities at their heart. That is why many partners – public bodies, wildlife charities, and private estates – have come together in partnership to create a new common purpose for

NNRs, placing them at the centre of conservation for the 21st Century. Together we will create broad and diverse landscapes that brim over with natural abundance, enriching the wider countryside.

The National Nature Reserves Joint Strategy is available from this link:

<https://publications.naturalengland.org.uk/publication/6291868196798464>

[NNR Management Standard](#) Natural England has shared standards across the NNR series with other managers, facilitating the exchange of learning about site management and promoting understanding and support for the NNR series among government and the public.

2.2 Site Analysis

The issues which have a positive and a negative effect on the management of the site.

Site Strengths	Site Weaknesses	External Opportunities	External Weaknesses
<u>Size and Site in wider context</u> Although the Moss is one of the smaller examples of lowland raised mire in Cumbria, its value is enhanced by its connectivity to the Rusland Valley Mosses SSSI. In addition to the peat dome at Rusland Moss the 94-hectare SSSI comprises of two additional, separate domes at Hulleter Moss, Hay Bridge Moss. The highest dome is at Rusland Moss which rises to 8 m above sea level. Together the Mosses form one of the few remaining examples of the	<u>Connectivity with landscape</u> Lack of hydrological connectivity with the wider landscape, including the isolation from other associated transitional habitats such a lagg fen due to surrounding land use and drainage. <u>Hydrology connectivity</u> Historical use of lowland raised bogs has focussed on draining the bogs in order to dry out and use the peat either for fuel, animal bedding or to run livestock on the drier land. In many situations turbary (peat-cutting rights) has resulted in	<u>Adjacent land use</u> Adjacent land holdings surrounding the site opportunities for partnership working to support the recovery of the bog and NNR. For example, to the south of the NNR is land owned by the conservation charity the John Strutt Foundation at Haybridge and Hulleter which forms the rest of the Rusland Valley Mosses SSSI. <u>Hydrological connectivity</u> Management opportunities explored and identified through the Protected Sites Strategy	<u>Adjacent land use</u> Drainage of surrounding land on peat has the ability to significantly influence the bog in a positive or negative manner. Spreading of lime, fertiliser, slurry or manure has the potential to cause nutrient enrichment of the nutrient-poor bog habitat and damage the peat and bog vegetation. <u>Diffuse pollution</u> Potential source from agricultural land to north, west and east of the NNR.

formerly extensive system of estuarine raised mires around Morecambe Bay. Raised mires cover less than 10,000 hectares of the UK and is therefore considered a rare habitat both nationally and at county level. <u>Species populations</u> The main surface of the Moss still retains a typical bog flora. Breeding Red kite have been recorded on site. <u>Demonstration and research</u> Due to its accessibility the NNR provides an excellent demonstration/test site for range of management techniques and research.	individual land areas being cut over for peat extraction. These combined uses have led to disruption of the natural hydrology of the area causing extensive drying and a steady decline in natural plants, particularly peat forming sphagnum. led to bogs becoming hydraulically isolated. <u>Lack of lagg habitat</u> The lagg (marginal fen) is an important part of the function and ecology of the bog and is not a 'buffer' or optional extra. The lagg is where excess rainwater from the bog surface meets groundwater and would normally be occupied by fen,	Pilot projects for the restoration of the whole Rusland Valley Mosses SSSI and reverse declines in biodiversity, water retention ability and carbon sink potential as well as provisioning for bog species specialists and achieve favourable condition status. Opportunities to work with neighbours to encourage sympathetic management of land adjacent to the SSSI whilst recognising sensitives such as drainage. <u>Access & Interpretation</u> The NNR lies in an area with high levels of rural tourism with significant opportunity for joint	<u>Agricultural uncertainty</u> Over the last few years, the UK's agricultural sector has faced a uncertainty due to shifting trading relationships internally (with the UK Internal Market Act) and externally (with new trade agreements and changes to market access) as well as profound modifications to agricultural policies and financial support and clarity of available agri-environment schemes. <u>Lack of fen habitat</u> The lagg (marginal fen) is an important part of the function and ecology of the bog and is not a 'buffer' or optional extra. The lagg is where excess
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<u>Community involvement</u> The LDNPA have good links with local communities and high level of community “ownership” <u>Public access</u> There is an extensive network of public and permissive footpaths linking the NNR to the wider countryside. <u>Visitor appeal</u> The Moss has diverse visitor appeal -dramatic views, sense of isolation, historical interest and dramatic natural events such as summer birds.	swamp or Carr (wet woodland). Having a lagg decreases the hydrological gradient between bog and agricultural land and provides an ecological transition from bog to drier habitats and potential space for the bog to assume a more natural shape by spreading laterally. <u>Species populations</u> There is no current baseline data available for key species on site such as red squirrel. The baseline condition for invertebrates’ assemblages and Large Heath for SSSI condition assessment is taken from historic unit specific conditions.	interpretation, marketing and formulation of regional access strategy. <u>Atmospheric Pollution</u> Outputs from UKCEH work to add here. <u>Deer Management</u> The Lake District Wild Deer Management Strategy establishes the need for a Rusland Valley / South Lakes collaborative management approach. Natural England proposal through the Protected Sites Strategy to research deer populations, management and planning to enable the SSSI to recover.	rainwater from the bog surface meets groundwater and would normally be occupied by fen, swamp, or Carr (wet woodland). Having a lagg decreases the hydrological gradient between bog and agricultural land and provides an ecological transition from bog to drier habitats and potential space for the bog to assume a more natural shape by spreading laterally. More attention is required on the surrounding land use and management, in particularly opportunities for the restoration of lagg around the Moss.
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	<u>Management issues</u> The perceived agricultural requirement for drainage to protect surrounding agricultural land use. <u>Invasive non-native species</u> Rhododendron (<i>Rhododendron ponticum</i>) has flourished on the site to the detriment of the bog vegetation and considerable effort has been put into removing it by cutting and treatment of regrowth with herbicide. If this follow-up work is not undertaken within around 2 years, the plants have to be re-cut with a cost of staff time as well as a financial cost. Management requires intensive	The removal of the Scots Pine will reduce the available habitat for deer to shelter in. <u>Water vole species recovery</u> In 2025 FiPL funded 1 year of a Rusland Valley scale Mink Eradication project. The intention is to continue to role this project out over several years. There is potential to re-introduce Water Voles into the Rusland valley post eradication.	<u>Atmospheric nitrogen pollution</u> Peatlands can be damaged by deposition of pollutants from the atmosphere. Atmospheric pollutants are deposited onto peatlands as gases and particles (dry deposition), in rain (wet deposition) and in cloud droplets (occult deposition). The importance of wet and occult deposition increases to the west of the UK and with increasing altitude. The sulphur and nitrogen compounds have direct effects on peatland vegetation and on peat chemistry. They also cause acidification. Peatlands are well known to be naturally acidic, due to decomposing
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	funding and staff time over the long-term in order to eradicate rhododendron from the site. Skunk Cabbage as above. <u>Wild Deer</u> In the Rusland Valley native red and roe deer have an important cultural, historical and natural place, high numbers on the Moss are having a negative impact upon the habitat. Rusland Valley Mosses SSSI (the SSSI) is currently in 'unfavourable, declining' condition. This is in part attributed to the effects of deer using the site for shelter, feeding, passage across the		plant material which forms peat and produces organic acids, which are "weak" acids and a natural part of the system; hence peatland vegetation is made up of acid loving species, IUCN (2016). It is currently unknown to what extent atmospheric nitrogen is impacting on the Moss. <u>Wild Deer</u> Wild deer movement through the SSSI to take refuge and shelter in the mature Scots pine is impacting on the condition of important habitat. The damage caused by deer has created large areas where sensitive peat-forming species have been grazed out or
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	site and wallowing. Large stands of mature Scots pine on the SSSI provide shelter for the deer. The damage caused by deer has created large areas where sensitive peat-forming species have been grazed out or trampled, resulting in bare peat, which degrades further once exposed to the elements. Furthermore, areas of the site that have seen restoration efforts in the form of cell bunding¹⁰ are experiencing destruction of the bunds through the repeated passage of deer.		trampled, resulting in bare peat. However, the removal of Scots pine during restoration of the Moss will also push deer from the site into the wider landscape. Therefore, a management strategy for deer must be incorporated into peatland restoration plan.
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¹⁰ Bunding is a technique that aims to retain water on site, by either creating internal peat dams to impede water movement through the peat body and/or surface bunds to hold back surface water in shallow pools

	<u>Unknown land ownership</u> Some areas of the Moss are unclaimed and there are no records of historical ownership. Areas of land not in LDNPA or Natural England ownership cannot be restored under management agreements if landowner remains unknown. <u>Scrub/tree colonisation</u> Where the peat is drying out, scrub and trees are able to grow and in turn accelerate the drying and shrinkage of the peat. Where the water table is restored following removal of trees, further work should not be necessary. Where this is not possible, follow-up treatment of scrub/tree regrowth will be		
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	necessary along with felling of damaging or dangerous trees. <u>Access</u> The majority of the older boardwalks on site require replacing. This is subject to funding. The route of the footpath west side of the NNR is on an eroded peat ridge and the section adjacent to the watercourse through the SSSI is often flooded. There is scope for reviewing the route to reduce the expense of maintenance and providing a better experience without impacting the biodiversity.		
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	The provision of on-site information requires reviewing and up-grading.		
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DRAFT

2.3 Site Management Policy

The broad management policies for the site and the reasons why these options have been chosen.

The primary objective for the NNR is to restore, as far as possible, conditions favourable for active (peat-forming) bog, which include: the bog receiving all its water from rain and other precipitation; and a stable and near the surface water in the peat. This involves actions which restore the hydrology of a peatland when it has been affected by drainage and/or alteration to its vegetation and wider surface integrity. This will require securing internal and external sources of funding to support management. As a National Park and Public Body, the LDNPA currently do not appear to be eligible for Countryside Stewardship High Tier and so will need to investigate other grants and funds, including Natural England CES funding and any further extension to Defra's Climate for Nature Peatland Restoration Fund. Opportunities for investigating funding and revenue can be explored through the Protected Site Strategy pilot 'offer' via in-depth working on the finances with Harper Adams University

This plan will provide an overview of the procedural and technical requirements for peatland restoration and describe best practices associated with restoration interventions that have been applied to date by Nature Scot, Natural England and Cumbria Wildlife Trust on other lowland peatland sites, including local sites in South Lakes i.e. Foulshaw Moss and Meathop Mosses.

For more information see Nature Scot Peatland ACTION – [Technical Compendium](#).

The works required to achieve this include:

- Restoration of artificial drains - blocking historic ditches, peat cracks/pipes
- across the bog using dams
- Stabilising slumping faces around former peat cuttings
- Bunding interventions above and below ground to slow the loss of rainwater from the slumping or cut-over bog
- Tree and scrub removal - removing trees and scrub where they are affecting the water table or preventing access for management

- Managing key invasive species - removing rhododendron and skunk cabbage to reduce the risk of further encroachment across the site and to other areas of the SSSI.
- Management of red and roe deer – reduce numbers prior to restoration to reduce pressure from neighbouring land through displacement and to ensure reduction of negative grazing and trampling impacts on SSSI post restoration.
- The creation transition habitat surrounding the raised bog integral to the hydrology of the bog, influencing the water table and supporting invertebrates and plants, such as lagg fen.
- Planting should only be required, post restoration, on areas of bare peat

Restoration of artificial drains

On-going drainage across the site is a contributing factor to the sites current condition and blocking these drainage features will help restore the sites hydrology. The blocking of drains can be undertaken through key techniques such as peat dams, piling dams, wooden and composite dams, drain re-profiling in combination with drain blocking. Timber dams will not be effective as will not block ditches due to cracks in the peat allowing water to escape.

There are a number of shallow drainage channels on site, particularly to the north and centre of the site. Blocking these drains will help to restore hydrological function to the site and positively impact the sites suitable for currently present bog species to proliferate. One of the central drainage features has previously been blocked with plastic piling.

Given the approximate average peat depth for the SSSI is 367.87cm¹¹ (518cm east side of peat dome) peat dams would be the most cost-effective approach to block these drainage channels.

Peat dams should be created and keyed into the edges of the channels to ensure water is retained and does not score around the edges of any peat dam. They should also be spaced at approximately 10m intervals with consideration given to the

¹¹ Rusland Moss Phase 1: Restoration Plan. Hankinson, A. Cumbria Wildlife Trust. 2023.

dam slumping post restoration. Existing vegetation should be used to cover over the new dam whilst any bare edges left should be planted with suitable bog species and translocated sphagnum clumps.

Following restoration works, excess rainwater will continue to leave the site via the existing agricultural ditch network. The design of hydrological restoration works will take adjoining land uses into account so as not to impact on them without the agreement of the land manager. Where restoration works have been carried out there has been a reduction in the number of trees becoming established. It is hoped that the raised water table will prevent these from becoming dominant. This needs to be monitored.

Stabilising peat faces

Reprofiling to no more than 30-degree slope and add cross-slope and finger bunds if required.

Bunding interventions above and below ground

Management interventions may be required not only in artificial drain channels but may be necessary to stop subsurface flow and water loss from an area or to stop surface flow of water to reduce water loss and erosion. In some instances, both surface and subsurface intervention is required. The term used for this is bunding.

Tree and Scrub Removal

Trees and scrub that naturally regenerate on drained, degraded peat can further lower water tables by drawing water out of peatlands and intercepting rainfall, drying out the habitat, especially before, during, and after drought periods. This action accelerates carbon loss and hinders restoration. Trees can also shade out developing peatland plant species, change the ground conditions through leaf accumulation, intercept higher levels of aerial nutrients and damage peat when they fall over. This is clearly the case on the NNR therefore tree and scrub removal will be required as part of plans for peatland restoration and longer-term management.¹²

¹² [Native Trees in peatland Landscapes. IUNC and National Trust. 2026](#)

The current extent of tree cover, particularly mature Scots pine, is a key factor contributing to the SSSI's unfavourable declining condition. Felling the pine woodland, alongside re-wetting and deer management, will remove these pressures and allow the hydrology and bog vegetation to recover. This will support the re-establishment of peat-forming Sphagnum and other characteristic bog species, reduce bare and drying peat, and help move the SSSI from unfavourable declining towards favourable recovering condition (see Map 5 – page 59).

Process will involve felling, stump treatment and mulching where applicable, whilst the more mature trees of commercial value can be sold for Timber subject to securing feasible abstraction routes.

Control of tree regrowth is not normally necessary once the water table has been restored but birch scrub should be pulled where it is possible to do so.

Managing key invasive species

Rhododendron

Rhododendron poses an issue for the site and is noted in some of the SSSI units as being present and one of the failing criteria noted for the 'Unfavourable declining' condition.

Rhododendron, across the Moss, should be cut to the stump and treated with a herbicide suitable for use in and around watercourses. Arising's from the Rhododendron should be piled and burned on site in a specified burn site. This process should span a 3-year period to ensure greater success in reducing cover. Stem scraping/notching and treatment can also be used which allows the shrub to die standing. This operation maybe more practical on small and medium shrubs where you access provision for hydrological restoration is not required.

Skunk Cabbage

Skunk cabbage has a large seedbank that can remain viable for up to 10 years so on-going control will be required both before and after restoration. Physical removal from digging out all plant material, including rhizomes, or spraying with glyphosate should be done in the year prior to restoration.

Management of Wild Deer

In a 2024 deer drone census density of wild deer in the Rusland Valley was noted as notably high; approximately 33 per km² (red and roe).¹³ The management of deer on site will be important in advance of the removal of the pine woodland as part of restoration works outlined above. Red deer use the woodland as daytime refuge and are often on site in large number (>80 adult individuals).

A second drone survey¹⁴ focusing on the SSSI and adjacent land holdings (including woodlands) surveyed densities of red 28.1 per/km² and roe 2.38 per km² giving an overall density of deer 30/km² – slightly less than the 2024 survey but as significant. The 2026 Rusland Valley Mosses SSSI Deer Management Strategy and Implementation Plan¹⁵ suggests that red deer populations would need to be reduced to a density of 5 reds/km² and 12 roe/km², and in-combination to 13 deer/km² - a reduction of 82% of the red deer population. The study also suggests that roe deer are currently at an acceptable level on the Moss although evidence from drone surveys and the landowners suggests they are having a significant impact in surrounding woodland. The report also contains an indicative deer management implementation action plan and advocates a collaborative approach to future deer management.

In combination with other restorative management practices deer management will also remove pressures on the site, allowing the re-establishment of peat-forming Sphagnum and other characteristic bog species, reducing bare peat, and helping the condition of the SSSI move towards favourable recoverin.

Restoration without adequate management potentially will displace large numbers of deer onto adjacent land holdings and further impact nature recovery on site. A strong evidence base from continued monitoring and collaborative working with adjacent landowners will ensure more effective management of wild deer.

¹³ Thermal Imaging Deer Drone Census – Central Lakes. BH Wildlife Consultancy. 2024

¹⁴ Thermal Imaging Drone Deer Census Report. Boddy Environmental Limited. March 2026

¹⁵ Rusland Valley Mosses SSSI Deer Management Strategy and Implementation Plan. Mike Harding. April 2026.

Lagg Creation

Fen vegetation is commonly associated with lowland bogs. When they were first formed, many lowland raised bogs would have been surrounded by an area of fen vegetation, called a lagg fen. However, lagg can also contain swamp and carr woodland habitats depending on the local conditions.

Lagg fens are fed by a mixture of nutrient poor water seeping from the bog and more mineral-rich water from the surrounding area.

In many cases the areas of lagg fen have been drained or improved but where they do occur together, the management of both bog and fen habitats is often linked, although their requirements may be different.

The wider ambition of the plan is to identify and manage defined buffer areas around the NNR and SSSI.

Ideally a strip of land minimum of 10m wide depending on the gradient, soil type and management of the surrounding land, should be identified. Ideally, it should be created by erecting temporary electric fencing or stock fencing to exclude stock. The buffer area will require a period of grazing or mowing each year to manage the habitat.

Planting

The site already supports a variety of desirable bog species; as such the floral assemblage on site is unlikely to require further additions. Through the improvement of hydrological function these species already present should flourish.

However, there are likely to be bare areas when pine is removed. Sphagnum is key to bog communities and *S. fallax* is the most resilient. If required, Sphagnum could also be harvested sustainably from Roudsea using the established Natural England protocols.

Other considerations

Site Access

It is important that at least the current level of site accessibility is maintained. Public footpaths form a network of paths from Rusland Pool on the eastern boundary adjoining the southern boundary at Hulleter and north from Low Hay Bridge to Rusland Pool (see Map 4 – page 31). Work to date has focussed on improving and

maintaining access. The public footpaths are well signposted, and way marked throughout the Moss and served by boardwalk and bridges. Sections of boardwalk need repair and / or replacement. Natural England has raised concern that the current route through the NNR could be interfering with the natural hydrological function of the site. A review of access will be carried out to explore alternatives to boardwalks and whether paths can be aligned and managed in a way that minimises disruption to peatland hydrology, surface flow pathways and recovering bog vegetation.

Other signage and information boards, both of and on site, need upgrading to increase maintain public awareness of the site and access over the NNR. Further development of access will be balanced against the need to manage the site and maintain the wildlife interest (including ground-nesting birds). Experience shows that most visitors remain on maintained paths and boardwalks.

Access restrictions required for public safety during peatland restoration works will be planned in advance, consulted on and included in the final restoration plan.

Archaeology

An archaeological survey and report / watching brief will be prepared and provided to the peat restoration contractor and any identified implications, in terms of operational working, discussed prior to any works taking place.

Restoration Management and Post Monitoring

Restoration will be undertaken by experienced contractors and will be monitored by experienced LDNPA and their contractors. The restoration work will be overseen by external project management with experience in lowland raised bog restoration.

Once restoration is complete monitoring will need to be carried out. Eyes on the Bog' methodology directly measures peat loss/accumulation and minimum water levels at very little cost and can be serviced by volunteers. Recording the vegetation will be undertaken by a suitably qualified field ecologist using the protocol that was used to carry out the previous surveys.

Consent

Consent may be needed from the following organisations:

- Natural England SSSI assent for works not covered by the other permissions or where NE was not a consultee.
- Westmorland and Furness Council – Ordinary Water Course consent
- Environment Agency - Flood Activity permit.
- LDNPA - Planning permission to undertake lowland restoration works, including a Biodiversity Net gain (BNG) assessment.
- Forestry Commission – Felling License
- Natural England – Wildlife License – to disturb or remove wildlife or habitats from a work area.
- LDNPA – Temporary Closure of Rights of Way

In addition, a heritage Impact Assessment will be required to mitigate any impacts to the World Heritage Site.

Environment Impact

Healthy peatlands can sequester atmospheric carbon, reduce flood risk, reduce dissolved organic carbon and particulate organic carbon downstream, protect historic records and provide habitat for flora and fauna. Healthy peatlands are the most significant terrestrial habitat in their role of sequestering atmospheric carbon and its long-term storage. Damaged peatlands no longer sequester carbon from the atmosphere and are returning oxidised carbon back to the atmosphere thus increasing greenhouse gas emissions. The UK peatland carbon store can only be maintained if peatlands remain wet and vegetated or are restored.

Healthy peatlands play a significant role in flood amelioration. Recent studies show that restored peatlands can have been shown to significantly reduce flood risk and reduce peak storm contributing to natural flood management.¹⁶ (Shuttleworth *et al.* 2019).

¹⁶ Shuttleworth, E.I et al Restoration of blanket peat moorland delays storm flow from hillslopes and reduces peak discharge. 2019.

- Lowland bog will provide habitat for a range of fauna and flora.
- Restoring the eroding areas of peat will also keep the archaeological record safe under acid, anoxic peat. If let to erode the archaeological records could be destroyed.
- Besides the carbon benefits of the project the condition of degraded peatland habitat will be significantly improved. Potentially fish, invertebrates and aquatic plants may benefit from the reduced sediment load and quantity of organic material in Rusland Pool.
- The planned restoration work will help slow the flow of water coming from the catchment reducing erosion and the amount of particulate organic carbon entering Rusland Pool.
- Rewetting the site and raising the water table will also help to make the site more resilient to climate change, helping to preserve the wide range of species which rely on this habitat.
- The planned rewetting works will also reduce the risk of wildfire across the site helping protect the biodiversity of the area and its carbon store.

Social Impact

Positive

- Restoration works will bring work to the local area, supporting local contractors:
- The project will also contribute towards preserving the distinctive character and natural beauty of the Cumbrian Landscape and may be of financial benefit to the wider community through tourism.
- The higher water table and lower fuel load will also reduce the wildfire risk, helping to protect nearby communities and infrastructure.
- Protects biodiversity, improving opportunities for recreation, education and wildlife watching.
- Supports local economies through increased visitor spending and environmental projects.

Negative

- Temporary disruption from restoration work such as machinery on site and restricted access.
- Potential conflicts between peatland restoration goals and perception of increased risks from localised rising of water level and / or likelihood of flooding. Local landowners or farmers.

References

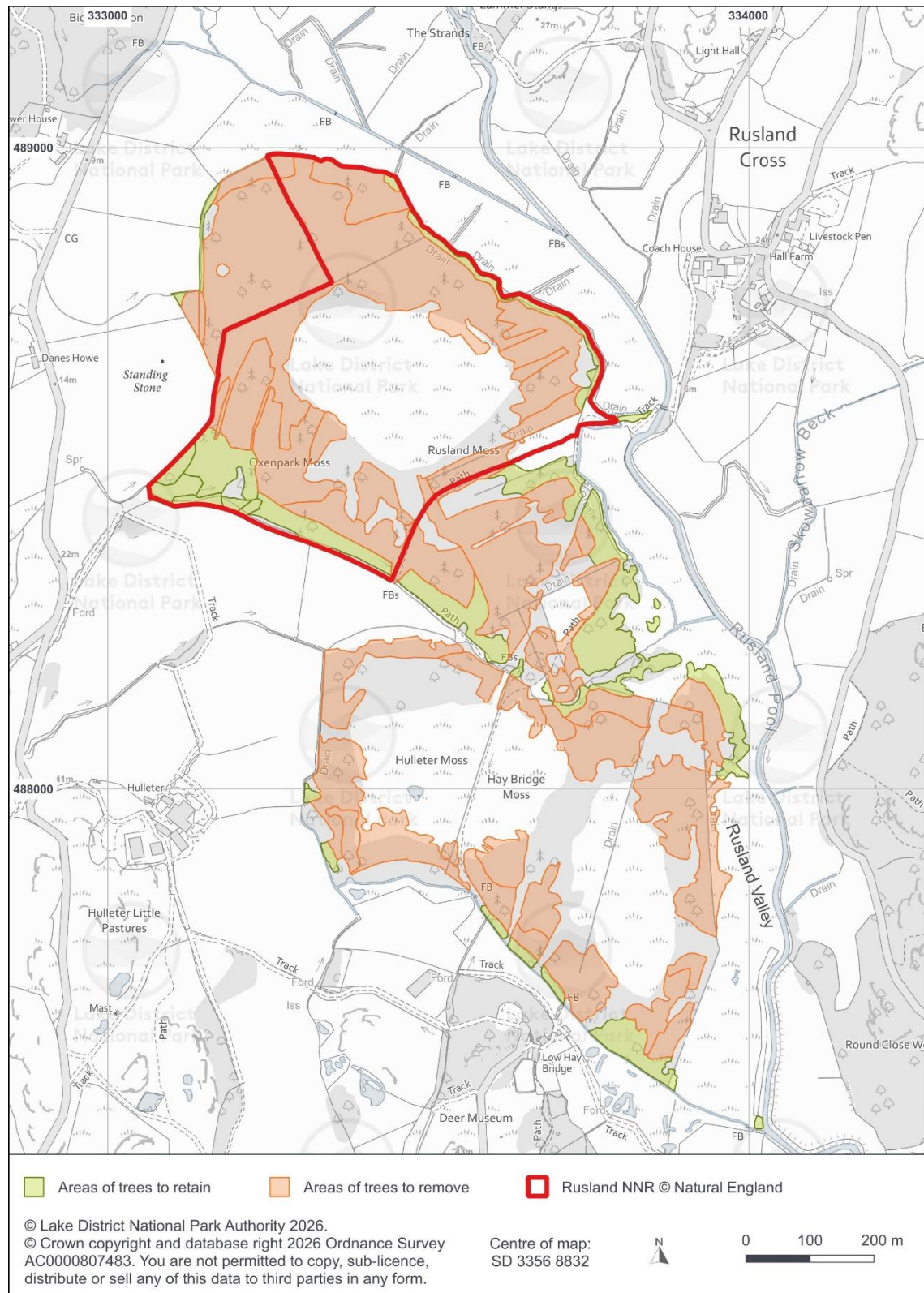
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Nature Scot Peatland ACTION – Technical Compendium

Thermal Imaging Deer Drone Census – Central Lakes. BH Wildlife Consultancy. 2024

Lake District Wild Deer Management Strategy Deer 2025

Map 5: Indicative Tree Removal Areas for Peatland Restoration on the NNR (subject to protected species surveys)¹⁷



¹⁷ Data provided by Natural England from Jerram, R. Rusland Valley Mosses SSSI, Cumbria. National Vegetation Classification Survey. 2014.

2.3 50 Year Vision

Long-term, the aim is to work towards the 50-year Vision, see below.

The rain fed Moss will have a stable water table supporting peat forming sphagnum mosses and other diverse plants like cotton grasses, cross leaved heath and heather with bog rosemary, cranberry, and bog asphodel. The raised bog is flanked by distinct bog edge habitats like wet woodland, fen and reed-bed. Invasive Rhododendron is absent, and the site boasts diverse wildlife, including breeding birds like spotted flycatcher and wood warbler, snipe and osprey. The Rusland Valley herd of red deer and roe deer range across the reserve, in balance with nature and natural functioning of the bog. The Moss is rich with insect fauna, among which the raft spider, waved carpet moth, small pearl-bordered fritillary butterflies the white-faced darter and bog bush cricket are notable. The NNR is well connected to the public rights of way and local path network and is valued by visitors for supporting native bog wildlife and providing opportunities to appreciate natural beauty, while minimising visitor impact and promoting wellbeing.

2.4 Management Objectives

The objectives outline what we want to do during the period of the plan to take us towards realising the Vision. Each of the following objectives is required to ensure we manage the NNR appropriately and to take us towards realising the 50-year vision. The objectives address specific features and have clear attributes and targets that help us to attain the objectives.

Objective 1

Subject to natural change establish the conditions required to restore the lowland raised mire towards actively forming peat.

Features addressed by this objective

1. Lowland Raised Bog

Attributes / targets for key features

Attribute: Hydrology

Target: To restore and maintain the natural hydrological processes on the NNR to provide the conditions necessary to sustain the active formation of peat.

Attribute: Creation and restoration of surrounding habitat on adjacent land

Target: Maintain and restore the extent, quality and spatial configuration of land or habitat surrounding or adjacent to the site which is known to support the feature: swamp and wet woodland.

Attribute: Vegetation composition: indicators of negative change – Invasive non-native species

Target: Invasive non-native species (e.g. *Symplocarpus americanus*, *Impatiens glandulifera*) should be absent, or no more than rare if present.

Objective Methods

Peatland Restoration

A considerable amount of work was undertaken over 10 years ago to restore the hydrology of unmanaged areas of the Moss and eradicate rhododendron. This included the damming of the main central ditch, in several places, north to south. Peatland restoration will continue to be the main focus, and further works will be undertaken to restore the raised bog by removing trees and scrub where they have been identified as drying out the peat. Other works will include blocking ditches and building peat dams or bunds and stabilising collapsing peat faces – see section 2.3 Site Management Policy.

Before work commences a Preliminary Ecological Assessment (PEA) will be undertaken to evaluate and identify ecological features and potential constraints to development. The study area will include areas used for access and storage external to the NNR itself. The PEA will also inform the requirement for Protected Species Surveys and licensing, mitigation and planning for the following species: red squirrel, bats, pine marten, water vole, breeding birds, badgers and adders.

This work will require permissions and consents from other bodies, including:

Planning Permission – Lake District National Park Authority (LDNPA)

Flood Risk Assessment – Environment Agency / LDNPA for planning.

Flood risk activities – environmental permit - Environment Agency

Ordinary Watercourse Flood Defence Consent – Westmorland and Furness Council

Felling Licence – Forestry Commission

Site of Special Scientific Interest (SSSI) Assent – Natural England.

The work will also require us to produce a World Heritage Site Heritage Impact Assessment (HIA).

Invasive Non-native Species (INNS)

The cutting back and treatment of INNS, mainly rhododendron and skunk cabbage, will be carried out annually. This will require follow-up treatment over time.

Recommended control of non-native invasive species

American skunk cabbage

The presence of the introduced Skunk cabbage (*Symplocarpus foetidus*) and its spread into the Moss vegetation is a continual threat as it is a rapid coloniser and difficult to control.

The plant can be dug out by hand ensuring that the main rhizomes are removed as new plants can establish from rhizome fragments. Care is needed to collect all plant matter if digging up and material must be destroyed through burning, drying out (away from watercourses) or secure composting.

Chemical control is the recommended option for treating American skunk cabbage, especially for dense stands. Glyphosate weed wipe could be used in mixed stands of vegetation. To be applied between June to October.

Rhododendron

The safest and most efficient methods of controlling rhododendron depend on the size, life stage and accessibility of the target bush. In general stem treatment is the most effective and efficient method of killing large rhododendron bushes. Where there is no access to treat the stems, an overall foliar spray is the next option. Small bushes are easily treated, but foliar sprays cannot be applied safely to larger bushes, which must therefore be reduced in size before a safe application of herbicide can be given. There are two main ways to reduce bush size: using a mechanical flail or by manual cutting. Management should occur between October and March.

Deer Management

A deer management plan for the Rusland Valley Mosses will be developed prior to restoration works.

Air Pollution

High deposition rates of Atmospheric Nitrogen, characteristic of the UK and Europe are known to limit the development of peat forming species, such as Sphagnum, in favour of faster-growing vascular plants such as grasses (IUCN 2016).

Monitoring methods

Peatland Restoration

- Monitoring of water levels on site and peat accumulation – Eyes on the Bog.
- Fixed quadrats to set a baseline and for monitoring the development of vegetation and condition post works.
- No vegetation targets have been set for lag fen and other transitional habitats; however, it is expected that all existing habitats will gradually change due to rising water levels on the Moss and fixed quadrats will allow monitoring of these.

- Comparison of aerial drone photography for detecting larger scale changes. Controlled drone flights will be undertaken at appropriate times of year.
- Establish points for fixed-point photography and repeat annually.

Invasive non-native Species (INNS)

The site will be monitored annually for INNS using INNS Mapper (or similar as approved by Natural England).

Deer

Conduct annual deer impact surveys to measure current levels of impact on site and to monitor changes over time - see The Deer Initiative: Deer Signs (Species Ecology). Implement the action plan as outlined in the Rusland Valley Mosses SSSI Deer Management Strategy and Implementation Plan (2026).

Air Pollution

The control and amelioration of atmospheric nitrogen impacts will need to take place off-site, possibly at a national level. It may be possible to continue monitoring air quality using systems set up by UKCEH on Hulleter Moss as part of Natural England's Protected Sites Strategy monitoring (2023-25) and use the data observationally and compare to rates of re-colonisation of peat forming Sphagnum spp. However, the site is already so damaged that it would be hard to separate out the impacts of air pollution from those from centuries of hydrological damage, deer, trees colonisation in the short term. It's possible that some of the hummock forming species of sphagnum have been lost from the site and may need to be reintroduced in future.

Objective 2

Subject to natural change maintain and restore conditions that support bog specialist invertebrate assemblages.

Features addressed by this objective

2: W312 invertebrate assemblages – bog specialist invertebrates.

money spider *Maro Lepidus*; raft spider *Dolomedes fimbriatus*; Bog bush cricket *Metrioptera brachyptera*

3: Butterflies which have experienced substantial declines -Large Heath *Coenonympha tullia*.

Attributes / targets of key features

Features: Bog specialist invertebrates: money spider *Maro Lepidus*; raft spider *Dolomedes fimbriatus*; Bog bush cricket *Metrioptera brachyptera* and Large Heath *Coenonympha tullia*.

Attribute: Composition and distribution

Target: To create a baseline of invertebrate assemblages pre peatland restoration works.

Objective Methods

- a. There has been no comprehensive survey of the invertebrate assemblages present within the NNR. To remedy this, funding will need to be secured to undertake a survey of the invertebrate assemblages present with focus on the lowland raised mire communities, including those referenced above: 14 money spider *Maro lepidus*; 15 raft spider *Dolomedes fimbriatus* and Large Heath *Coenonympha tullia*.
- b. A data review should also be undertaken using existing species records from Cumbria Biodiversity Data Centre (CBDC), Butterfly Conservation, Buglife and other historical data sets.

Monitoring Methods

- Conduct a data review of invertebrate species records.

- To commission a Cumbria Biodiversity Data Centre (CBDC) to Nature Watch Citizen Science event.
- Commission an invertebrate survey of raised bog communities.

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Objective 3

Subject to natural change and habitat restoration maintain and enhance breeding bird populations.

Features addressed by this objective

- 4: Section 41 breeding bird species: tree pipit, spotted flycatcher, wood warbler.
- 5: Schedule 1 breeding bird species red kite.

Attributes / targets of key features

Features: Key breeding bird species: tree pipit, spotted fly catcher, wood warbler and red kite.

Attribute: Population size.

Target: To create a baseline of breeding birds.

Objective Methods

- a. There has been no comprehensive survey of the breeding birds present within the NNR.
- b. Red kites were recorded nesting on site in 2024 and grey heron in 2025.
- c. British Trust for Ornithology's (BTO) Breeding Bird count will be used for monitoring the population changes of common and widespread breeding birds but will be used to monitor the status of the site's key species.
- d. Subject to funding the use of automated acoustic monitoring equipment to remotely capture long-term data from a fixed location will be used.
- e. Analysis using AI to generate high quality ecological data to be verified by ornithologist.

Monitoring Methods

- To conduct a BTO Breeding Bird Count.
- Forestry England will monitor the site for breeding red kites as part of their release programme monitoring commitments.
- To undertake automated acoustic monitoring

Objective 4

To maintain public access to specified areas of the Moss and provide interpretive material, where compatible with nature conservation objectives and landscape considerations.

Features addressed by this objective

12: Access

Attributes / targets of key features

Feature: Public access

Attribute: Accessibility

Target: No decline in current levels of public access, but no significant increase in public access in terms of both the extent of NNR to which there is public access and numbers of visitors.

Feature: Information and interpretation

Attribute: Provision of information

Target: Site interpretation is reviewed, upgraded and accessible.

Objective Methods

- a. Continue to manage recreation on site and address any arising issues.
- b. Create a Rusland Moss NNR webpage to support communication with users.
- c. Secure funding and upgrade existing boardwalks improve accessibility on site.
- d. Review the provision of access on site.
- e. Review and upgrade site information (subject to funding).

Monitoring methods

- Continue to monitor Public Rights of Way as part of LDNPA PRow management.
- Continue to monitor site infrastructure through annual property surveys.

Objective 5

To encourage community involvement on the reserve and encourage its use for education, research, and demonstration where this does not conflict with the other objectives.

Features addressed by this objective

8 Community Involvement; 9 Education; 10 Research; 11 Demonstration.

Attributes / targets of key features

Feature: Community involvement

Attribute: Volunteers

Target: Minimum of 2 volunteers work parties to support management of the site.

Feature: Education and Demonstration

Attribute: Provision of information

Target: Organise a minimum of 1 event per year to showcase and inform on site management.

Objective Methods

- a. Volunteers to support practical work party sessions on site with the LDNPA Ranger Service.
- b. Organise a minimum of one event per year to showcase and inform community and public on site management.
- c. Encourage research where it supports better understanding of peatland management for climate change resilience, atmospheric pollution, carbon capture, and species recovery.
- d. Conduct a literature review of existing research to identify gaps in understanding about site management.

Monitoring methods

- Feedback from events.
- Collate research papers.

3.0 Action Plan

3.1 Identification of Projects

The management required to achieve the plan objectives.

Objective	Project Ref #	Project Title
1. Subject to natural change establish the conditions required to restore the lowland raised mire towards actively forming peat.	O1/1.1	Prepare five-year Management Plan
	O1/1.2	Prepare/revise plan, fire protection/control. Prepare contingency/planning for wildfire – Climate Change response.
	O1/1.3	Liaise with adjacent landowners over inclusion of land in project to raise water levels.
	O1/1.4	Seek to acquire freehold of unregistered land parcels.
	O1/1.5	Produce a final peatland restoration delivery plan
	O1/1.6	Secure environmental permit from Environment Agency for the duration of this Management Plan
	O1/1.7	Secure ordinary water course consent from Westmorland and Furness for bunds/ditches for the duration of this Management Plan
	O1/1.8	Secure planning permission (if required) for habitat restoration/creation and access works for the duration of this Management Plan
	O1/1.9	Identify and secure access routes for plant machinery and timber extraction.
	O1/1.10	Secure felling licence from Forestry Commission for the duration of this Management Plan

Objective	Project Ref #	Project Title
	O1/1.11	Identify trees to be sold as standing timber
	O1/1.12	Engage with stakeholders.
	O1/1.13	Fell trees...
	O1/1.14	Raise water levels by installing bunds and blocking ditches on...
	O1/1.15	Raise water levels by installing leaky dams...
	O1/1.16	Manage Habitat, bog/mire/flush, by other activities. Check that activities are not impacting on adjacent landowners.
	O1/1.17	Sphagnum planting
	O1/1.18	Manage wild deer numbers on site.
	O1/1.19	Cut and treat rhododendron
	O1/1.20	Monitor sphagnum species present
	O1/1.21	Monitor peat loss or accumulation through Eyes on the Bog
	O1/1.22	Monitor for indicator species, including sphagnum cover.
	O1/1.23	Fixed point photography -fix locations on site.
	O1/1.24	Investigate the use of drone aerial photography.
	O1/1.25	Monitor wild deer numbers on site.
	O1/1.26	Monitor water levels
	O1/1.27	Monitor INNS on site using INNS Mapper

Objective	Project Ref #	Project Title
2. Subject to natural change, to maintain areas on site that transition to woodland and associated transitional fen and fen woodland communities.	O2/1.1	Produce and implement rhododendron management plan.
	O2/1.2	Fixed point photography -fix locations on site.
3. Subject to natural change maintain and restore conditions that support nationally important wet mire invertebrate assemblages.	O3/1.1	Collect data, Lepidoptera monitor Large Heath butterfly
	O3/1.2	Train volunteers to collect data, Lepidoptera monitor Large Heath butterfly
	O3/1.3	Collect data, other invertebrates, raft spider, monitor
	O3/1.4	Collect data, other invertebrates, money spider, monitor
4. Subject to natural change and habitat restoration maintain and enhance breeding bird populations.	O4/1.1	Collect data, bird surveys, breeding birds, Section 41 breeding birds.
	O4/1.2	Collect data, bird surveys, breeding birds, Schedule 1 breeding birds, red kite, monitor
	O4/1.3	Collect data, bird surveys, breeding bird count.
5. To maintain public access to specified areas of the Moss and provide interpretive material, where compatible with nature conservation objectives and landscape considerations.	O5/1.1	Annual property survey: boardwalks, fencing, platforms, other infrastructure for H&S.
	O5/1.2	Carry out cyclical Public Rights of Way inspections.
	O5/1.3	Cut back overhanging scrub and branches along the board walk to allow access
	O5/1.4	Maintain footpaths and boardwalks in good condition and free from scrub and vegetation.

Objective	Project Ref #	Project Title
	O5/1.5	Install new boardwalks
	O5/1.6	Maintain NNR signs at all main access points
	O5/1.7	Review and install new interpretation panels on site.
	O5/1.8	Main webpage with up-to-date site information.
6. To encourage community involvement on the reserve and encourage its use for education, research and demonstration where this does not conflict with the other objectives.	O6/1.1	Provide events to relevant interest groups
	O6/1.2	Run one demonstration day for conservation professionals and/or local landowners
	O6/1.3	Recruit volunteers for site surveys and monitoring
	O6/1.4	Support volunteers through appropriate training
	O6/1.5	Liaise with neighbours over works required on boundaries
	O6/1.6	Liaise with stakeholders' and landowners
	O6/1.7	Liaise with stakeholders national/local authorities

Appendix 1: Examples of peatland restoration techniques (Open Spaces)

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Peat Dams - Method of Installation **Restoration Technique 1**

(This method of installation should be read in conjunction with Peatland Re-wetting Design & Specification Sheet – 01 – Peat Dams)

Peat Dams (also known as Peat Plugs) are a rewetting technique to raise general water levels in small to medium sized ditches. The types of ditches include small grip drains, single medium drains, some forestry drains and large peat cracks. Some locations of high water flow or steep slopes may restrict the use of this technique. Peat dams use insitu peat to create the dam which blocks water flow in the ditch and raises peat water levels in the surrounding land. The peat for the dam is taken from a borrow pit within the ditch upstream of the dam location. Typically the dam should be at least 1.5m in length to provide enough peat to provide structural integrity and depth of peat to hold back water. The ultimate aim of a peat dam is to raise water levels and push water out of the ditch to the sides, thus reversing the drying effects of the ditch.

Dam Location

The location of the dam is determined by the restoration objectives, on-site conditions and constraints. Typically, peat dams are spaced 8m – 15m apart, but this depends on the gradient of the peat surface and ditch conditions. Usually the steeper the gradient, the closer the dams need to be to ensure water backs up to the next dam. There is a general rule to install a dam at every 30cm of ditch fall. This may not always be viable and dams installed at every 10-15m apart will be sufficient. The installer needs to examine the ditch and ditch sides, looking for cracks in the peat and other water loss features. The peat dam must extend outwards beyond the ditch sides and any peat cracks, to ensure water does not flow around the dam. The final dam width is wider than the ditch.

Installation Procedure

- The excavator first removes any vegetation from the ditch sides and ditch bottom and places this to one side of the ditch to be re-used later.
- Next the excavator digs out the sides of the ditch to expose wet 'putty' peat and digs out beyond the peat cracks (if present). The degraded or cracked peat is removed and placed to one side of the ditch for use later.
- The newly exposed ditch bottom must be dug out to a depth of one bucket full to allow the operator to inspect the peat below. If the exposed peat is confirmed wet 'putty' peat the peat dug out is returned to the ditch bottom by turning over and pressing/squashing down by the back of the excavator bucket. This is essential to ensure the squashed peat joins with the ditch peat to create a seal which restricts water flow.
- To construct the core of the dam, peat is taken from a borrow pit, created in the ditch upstream of the dam. To expose wet 'putty' peat the vegetation and/or degraded peat from the borrow pit is scrapped off and placed to one side. This exposes the wet 'putty' peat. This is dug up and placed in to the core of the peat dam. Each bucket full must be pressed and squashed down to ensure the peat is joined together to create a seal.

- To complete the core of the dam, it is crucial the wet 'putty' peat is wider than the original ditch, and aim for a finished height of at least 20cm above ground level. This will allow for settling after installation.
- To complete the dam, the degraded peat is placed on top of the dam core. This is pressed and squashed down firmly. Finally, the vegetation put to one side is placed on top of the degraded peat and pressed down firmly using the back of the excavator bucket. Finished dam height is about 30cm above the ditch sides. This will allow for settlement in a few months.
- Finally, the borrow pit must be finished off by placing the degraded peat back in to the borrow pit. The pit sides are pulled in to create shallow sides and the previous vegetation placed back in. This is pressed down firmly to finish off the bottom of the borrow pit and leave it as shallow as possible.



Fig. 1

Example of a small peat plug dam installed on a lowland raised bog

NOTE: the finished dam is wider than the ditch and protrudes above ground level (up to 30cm). The dam length is at least 1.5m in length. The borrow pit (open water area) is upstream of the dam.

Machinery & Equipment

All machinery must be low ground-pressure tracked machines with a PSI below 3.5. Bio-hydraulic oils must be used and the machines should be clean and free of oil/fuel leaks. Some locations may require the use of bog mats to work on very wet ground. Digger buckets should be chosen appropriately to create the dam size required.

Plastic Piling - Method of Installation **Restoration Technique 2**

(This method of installation should be read in conjunction with Peatland Re-wetting Design & Specification Sheet – 02 – Plastic Piling)

Plastic piling dams are a re-wetting technique installed in place of peat plugs where the ditch is large or where water flows are high or on steeper gradients. Often they are installed at the end of a ditch before it discharges in to a boundary ditch. Plastic piling provides additional structural strength to the dam and this allows deeper water with higher water pressure to be retained. It ensures the dam does not fail or erode due to water movement. It can also be used as a sluice dam where water is controlled before discharging off site and in to the boundary ditch.

The plastic piles interlock and act as an impervious barrier to water flow and this raises water within the ditch. Since the piling dam is impervious it is important that the plastic piling is installed correctly to create a structurally strong structure. To ensure the dam is 'fixed' in to the side and bottom of the ditch it is essential the ditch dimensions are known to allow the dam size and piling lengths to be calculated. Some dams may require additional strengthening by installing a fixed brace on the downstream side (wood or plastic rails/posts). Some dams are adequately supported by using locally borrowed peat placed behind the piling.

Plastic piles are made of recycled plastic and are only supplied by a limited number of companies. Each company has a slightly different design but as a general rule the pile is about 300mm wide, with a thickness of 5.5mm and they can be cut to any length (up to 16m). As a general rule piling dams will not be deeper than 6m as this becomes a very large dam and other engineering principals will be required. Each pile connects to the next one using a circular clutch to interlock. The ultimate aim of a plastic piling dam is to raise water levels and push water out of the ditch to the sides, thus reversing the drying effects of the ditch.

Plastic Piling Location

The location of the dam will determine the exact width and depth of the dam, and give an indication of how deep to place the piling. The installer needs to examine the ditch and surrounding ground, looking for cracks in the peat that runs parallel to the ditch. The dam needs to extend outwards beyond the ditch sides and any side cracks, to ensure water does not flow around the dam. The ditch width and depth is measured and from this the size and number of pile can be determined. As a general rule the length of pile should be up to $1\frac{1}{3}$ to $1\frac{1}{2}$ deeper than the ditch depth and go beyond the bottom of the ditch. This ensures water does not go under the piling dam.

Typically, the plastic piling will be spaced 8m – 15m apart, but this depends on the gradient of the ditch (the steeper the gradient, the closer the dams need to be). On some slopes, spacing should aim to allow for a fall between dams of about 30cms but this may not always be possible. If the peatland site is located on shallow peat, where the piling may interact with the underlying substrate, there may be a requirement to determine if the piling will drive beyond the ditch bottom. Some locations the substrate is not suitable for using plastic piling.

Installation Procedure

Depending on the size of the piling dam the installation can be undertaken by hand or using mechanical methods. Small piling dams are usually installed using hand held rubber mells. Larger piling dams are installed using excavators or specialist piling driver equipment.

Hand or manual installation

- Using a spade, the line of the piling dam is dug by cutting the peat vegetation to create a slit for the piling to drive through. It is important the piling dam is installed across the ditch and 90 degrees to the ditch sides. To ensure the dam line is in the correct location a pole or wooden beam can be used to create a straight edge. For some dams the use of a piling guide (channel to ensure the piling creates a straight dam) can be used.
- Starting in the centre of the ditch the first pile is inserted by hitting the top of the pile with a rubber mell (or metal mell using a piece of wood over the top of the pile). The mell should hit the top of the pile at the centre, ideally where the pile kinks, as this is stronger.
- Drive the pile in to the ditch but ensure it is level on both top and the side by using a spirit level. Ensure the first pile is only driven in so as leaving it high (about 30cm above the ditch sides) this to allow for alteration with the levels but also assisting with the installation of the next pile. The final level will be lower than this height.
- Interlock the second pile by connecting the 'clutch' ends and ensuring the correct end is connected. Some dams are installed in a 'Z' or 'S' shape while others create a 'C' shape. The design of the piling shape should be determined before installing.
- Once the second pile is driven in to the level of the first pile continue to add piles as per the designed width. The piles should be driven wider than the ditch edge and past any side ditch cracks. The overall width is to be determined by the installer but it is essential the dam is wide enough and deep enough to stop water loss.
- As a general rule the pile depth is twice the depth of the ditch and the dam width is about 50% wider than the ditch width.
- When all the piles have been installed to up to temporary height, all the piles are driven in to the final height, usually 10cm above the ditch sides. As a general rule the piling will be set against the side of the ditch which is higher. It should be noted that when driving the piles to the final level it is usual to do one pile at a time and looking out for any piles which 'nip' the other causing two to move down. This can be rectified by hitting the opposite edge and being careful with the down force.
- The final dam is finished with all the piles being set at the same level and the top being reasonably level (where conditions allow). The finished dam will restrict water flow with the aim to push water around the dam edge. Where the piling dam is located at the end of a ditch, and where water flow needs controlled, the final option may involve creating a sluice. This involves knocking down the centre pile a further 5-10cm lower than the other piles to ensure water flows through the middle of the ditch.
- Usually small pile dams are not supported but there may be a requirement to install a wooden or plastic support brace.

Mechanical installation

The procedure for installing large dams follows the same design and process as above. The size of the piling may need the use of an excavator/specialist pile driver to install the plastic piling.

- For large ditches the excavator should lightly scrape out the bottom and ditch side vegetation. It is essential the excavator does not dig too deep in to the ditch side especially beyond any side cracks.
- The vegetation removed from the ditch should be stored to one side for use later.
- The excavator digs down in the centre of the ditch only to ensure the first pile can be driven in to the bottom of the ditch.
- If the dam is very wide, a piling guide may be necessary (placed over the top of the ditch) to keep the piles straight and assist installation.
- The piling should be installed as per the manual procedure but there may be a requirement to hold the long piles with a guide. The mechanical installation often requires covers for the piling and these should be fitted as per the machine being used.
- When the plastic piling has been installed there may be a requirement to install a support structure. This provides additional support and can be a wooden/plastic brace or borrowed peat placed behind. Some design options allow for using both.



Fig. 1

Interlocked plastic piles, here seen with a wooden brace to provide extra support. The finished height of the piling is about 10cm above the ground level

NOTE: the piling extends into the ditch side to seal off any cracks and provide strength. The ditch water rises to flow over the end of the dam rather than over the centre section



Fig. 2

Finished large plastic piling dam with both wooden brace and peat used to provide support and landscape the dam in to the surrounding land. This large dam is 6m wide and 5m deep piles.



Fig. 3

Finished plastic piling dam with peat used to provide support and landscape the dam in to the surrounding land. The dam was wide at about 4m but shallow with only 1.5m long piles installed.

Machinery & Equipment

All machinery must be low ground-pressure tracked machines with a PSI below 3.5. Bio-hydraulic oils must be used and the machines should be clean and free of oil/fuel leaks. Some locations may require the use of bog mats to work on very wet ground. Specialist piling heads can be fitted to wide tracked excavators or simple metal plates to assist with driving in the piles. Each machinery will use bespoke piling guides or protection covers for the top of the pile. It is essential the tools or machinery chosen are fit for purpose and will reduce the impact on the pile by stopping the piles breaking.

Small Bunds - Method of Installation **Restoration Technique 3**

(This method of installation should be read in conjunction with Peatland Re-wetting Design & Specification Sheet – 03 – Small Bunds)

Small bunds are a re-wetting technique installed usually in upland peatlands. The most common application of a small bund is where the peat surface has a wide but shallow gully or similar natural feature, which leads to water loss (sometimes they have a small ditch or drain in the bottom). These features often drain areas which connect to an adjacent ditch network. The small bunds create small scale re-wetting features typically installed alongside other techniques such as peat or plastic piling dams. They differ from other bunds in that they are typically a single feature rather than being a long linear bund. The installation process is similar to the deep trench technique. Small bunds are useful to create isolated standing water areas and often benefit other species on site. The ultimate aim of the small bund is to raise water levels in the gully and push water out to the sides and reverse the drying effects of the gully or ditch.

Small Bund Location

The site location and surface conditions will determine the exact shape and size of the bund. Most gullies or natural features are shallow but wide. They may also link in to adjacent ditch network and may have a small grip drain cut in the bottom. These features have dry sides and the water loss from the peat surface is broad. Some natural features, such as old peat hags, may have been slightly modified by cutting a channel which increases water flow and the effects of water erosion. The small bund is to be installed at the most appropriate location to achieve water retention. On some sites there may be an opportunity to install a series of small bunds.

Typically, the small bund is about 4-8m wide with a finished height of about 50cm. The bund uses the deep trench technique but the trench is usually at shallow depths of 0.5m – 1m. If a series of small bunds are installed the aim is to raise general water levels to push water uphill to the next bund.

Installation Procedure

- Once the location has been chosen the operator should inspect the ground conditions to identify if the small gully/natural feature has a small ditch or side cracks.
- The excavator first removes the vegetation ensuring the line of the bund is 90 degrees the gully sides. The any vegetation is placed to one side to be re-used later.
- The excavator next digs down and along the bund line to create a trench. The peat is dug up and the trench inspected to investigate if there are peat crack and if wet 'putty' peat is exposed. If the peat is considered degraded it is dug up and placed to one side for use later.
- The width of the trench should be at least 80-90cm wide to ensure there is some structural strength to the bund and improve water retention.
- The newly exposed trench bottom with wet 'putty' peat is then dug up and the peat turned over. This is pressed with force and squashed by the excavator bucket as this is essential

to create a seal to create the core of the bund below ground level. The aim is to reduce sub-surface water loss.

- The core of the bund is to be built up to a height of about 20cm above the gully side. NOTE – Some bunds may only be placed in the bottom of the gully and therefore they do not go to the top of the gully/natural feature sides.
- To obtain additional wet 'putty' peat a borrow pit is created upstream of the bund. This provides a source of fresh wet peat.
- The vegetation and/or degraded peat is scraped off the borrow pit and placed to one side for use later. Wet 'putty' peat is exposed and this is dug up and placed in to the core of the bund. Each bucket full must be pressed and squashed down to ensure the peat is joined together to create a seal.
- It is crucial the core of the bund has a finished height of at least 20cm above ground level to allow for settling later.
- To complete the bund, the degraded peat is placed on top of the dam core. This is pressed and squashed down firmly. Finally the vegetation put to onside is placed on top of the degraded peat and pressed down firmly using the back of the excavator bucket. Finished bund height is between 30-50cm. This will allow for settlement in a few months.
- Finally, the borrow pit must be finished off by placing the degraded peat back in to the borrow pit. The pit sides are pulled in to create shallow sides and the previous vegetation placed back in. This is pressed down firmly to finish off the bottom of the borrow pit and leave it as shallow as possible.



Fig.1

Small bund installed in a small gully on upland moorland. The feature had a small ditch running down the middle creating a dry slope.

NOTE: the finished bund is wider than the ditch and protrudes above ground level (up to 50cm). The bund length at this location is about 4m. The borrow pit (open water area) is upstream of the dam.

Machinery & Equipment

All machinery must be low ground-pressure tracked machines with a PSI below 3.5. Bio-hydraulic oils must be used and the machines should be clean and free of oil/fuel leaks. Some locations may require the use of bog mats to work on very wet ground. Digger buckets should be chosen appropriately, according to the size of the bund required

Shallow Bunds - Method of Installation Restoration Technique 4

(This method of installation should be read in conjunction with Peatland Re-wetting Design & Specification Sheet – 04 – Shallow Bunds)

Shallow bunds are typically required on sites where there is open vegetation and/or the ground is generally wet. For reference, where the ground has open vegetation but is highly damaged, or where there are stumps / forestry, then the deep trench technique is normally best practice (*technique 5*). Shallow bunds may have a range of shapes including fish scales, horseshoe, rectangular or circular but always to a depth of approx. 0.5m (up to a maximum of 1m).

The shallow bund technique differs from the deep trench technique in that only one machine is necessary, rather than two. This means the installation process is quicker and cheaper, but it must only be used on suitable land; if the shallow bund technique is chosen purely because it is the cheaper method, when in fact the deep trench is more appropriate, then the underground water flow will not be affected and the peat surface will remain cracked and dry. The excavator moves in a linear direction first digging out the trench in a short section, then adding the bund on top, before tracking forward to repeat the process. A ditching bucket (non-toothed) is used.

Shallow Bund Location

The site location and surface conditions will determine the exact shape and size of the shallow bund, and typically the trench will only have a depth of up to 0.5m deep. The actual shape of the bunds, and how they interlock, is dependent on a number of factors. Usually a bund should be installed against the slope of a site to gain maximum water retention, and generally over the last few years the two main bunding layouts most contractors choose are the fish-scale and rectangular techniques. Both employ the same installation process with the main difference being the shape of the finished bund.

Installation Procedure

- The first process is to dig the line of the bund according to the topography of the land. The bund should be placed at 90 degrees to the slope, to ensure best water retention
- The excavator scrapes off the top vegetation and places to one side, exposing the peat. The excavator is aligned to the side of the trench at 90 degrees, allowing the operator to track sideways whilst the bucket still points towards the trench

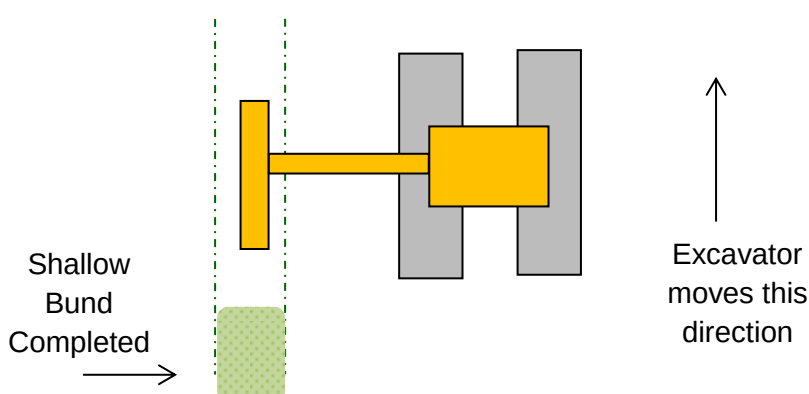


Fig. 1

Simple diagram showing an excavator aligned to the side of the trench at 90 degrees, with the bucket to the side

- As the excavator digs the shallow trench, exposing the wet 'putty-like' peat, it is turned upside down and compacted down with the back of the bucket, to create a seal
- If additional peat is required, a borrow pit may be dug upslope of the trench- but this peat must also be wet 'putty-like' peat. Once the peat is firmed down in line with the top of the trench, a completed peat seal is achieved
- A small raised bund is created on top of the trench using wet 'putty' peat from the borrow pit (if required), firming down the peat to create a seal with an average height of 150mm-00mm above the peat surface.
- To complete the bund, the original excavated turf is re-laid on top and firmed in
- Finally, the borrow pit must have its sides levelled and made as shallow as possible, with surplus vegetation put back in



Fig. 2

Curved bund on raised bog

NOTE: the bund was dug no deeper than 0.5m metres and due to the movement of water the final height was 0.5m. All bunds will settle and the final height would be nearer 40cm. However, the top 15cm of this would be a little more free-draining with about 30cm of the top bund being wet peat.

Machinery & Equipment

All machinery must be low ground-pressure tracked machines with a PSI below 3.5. Bio-hydraulic oils must be used and the machines should be clean and free of oil/fuel leaks. Some locations may require the use of bog mats to work on very wet ground. Digger buckets should be chosen appropriately, according to the size of the trench required

Deep Trench Bunds - Method of Installation

Restoration Technique 5

(This method of installation should be read in conjunction with Peatland Re-wetting Design & Specification Sheet – 05 – Deep Trench Bunds)

Deep trench bunds are a re-wetting technique installed on degraded peat bogs where the general peat watertable is low. The technique is suited for sites where there is open vegetation but the peat is damaged from deep drains or a high density of drains. It is best used on peat habitat damaged from peat extraction sites (hand cutting or milled surface), dense scrub, natural woodland or forestry plantation ground. This is the most appropriate bunding technique to seal the underground peat cracks or peat pipes on peat edge features including peat cut face, peat hags or peat slopes.

The main aim of the deep trench bund is to restrict sub-surface water flow, with a top bund slowing surface water movement. On highly damaged sites ditches, peat cracks, slumping or tree-root damage draw water away from the peat surface and this restricts peat forming conditions. The deep trench restricts the water loss by creating an underground 'wall' of wet 'putty' peat which slows water movement. This improves hydrological connectivity and re-hydrates the entire peat resource with improved general watertable conditions. The long-term improvement in peat surface wetness should lead to peat forming conditions for suitable peat forming vegetation.

Deep Trench Location

The technique of installing the deep trench will vary depending on the site location and peat surface conditions. Although the trench procedure is maintained the bund shape above ground does alter with the ground conditions. The shape is mainly determined by the surface gradient and location to other features on site.

On peat slopes or re-profiled edges the usual bund layout will be individual bunds with bund fingers. The aim for the bund is to push water back up the slope and stop lateral movement. The bunds should be installed at the correct location to achieve general peat re-wetting with a general rule of a 30cm fall in gradient between bunds. On areas where the gradient is less steep or there is generally only one fall across the surface, bunded cells can be considered. The aim of the cells is to retain water within the cell and spread the re-wetting across a wide area. To achieve this, bunded cells of different sizes and shapes are installed. Since the bunded cells are linked it is essential the trench below ground is connected to create a peat seal.

Deep trench bunds generally are used from 0.5m down to 3.5m and require a borrow pit to supply additional wet 'putty' peat. The top bund is generally 30cm high above the peat surface but some bottom bunds on peat slopes are higher up to 50cm. To ensure there is some structural strength and to improve water retention the bund peat should be 80-90cm wide. With the vegetation placed back on top the bund may be wider. The general shape of the bunded cells ranges from 10m² up to 40m² or variations on this, with some being rectangle or crescent shape.

The deep trench technique differs from the shallow bund technique by three points. Firstly, the trench is dug deeper with the peat taken out to expose the water loss features. Secondly, to achieve the best results two excavators are used. One machine excavates the trench using an 800-900mm wide digging bucket (with teeth) the second machine creates the top bund wide ditching bucket (no teeth). If using one excavator, the machine will need to swap between both types of bucket. Thirdly, the deep trench technique requires the digging of a borrow pit to provide wet 'putty' peat for the core of the peat bund.

For reference, where the ground has open vegetation but is only slightly damaged by small ditches but does require improvements in the water table the shallow bund technique will usually be adequate (*Technique 4*).

Installation Procedure

- The bunding design will determine the bund shape and the gradient will determine if they are bunds with fingers or bundled cells.
- The operator should walk the line of the bund and set out the line with marker canes. The bund should aim to follow a set contour to maintain a fixed height along the top of the bund. The bund should aim to be 90 degrees to the peat slope to ensure best water retention.
- The excavator straddles the line of the trench and digs the trench towards the machine. This allows the excavator operator to see down the trench and enable the machine to dig deeper into the trench.
- To begin the operation there is a requirement to undertake an inspection dig to identify the depth of the water loss feature within the peat. This will assist in determining the average depth the trench bund is to be dug out. The inspection dig should be a trench 5-10m long and dig down deep enough to identify the condition of the peat and the depth of the water loss. Once this has been identified the following procedure is undertaken.
- The excavator first scrapes off the top vegetation and places this to one side, exposing the degraded peat. The degraded peat is dug up and placed to one side, this usually the depth of a digger bucket.
- The operator continues to dig in to the trench until the water loss features are observed or the wet 'putty' peat is exposed. For some sites there may be a requirement to dig down and take out the peat for use later.

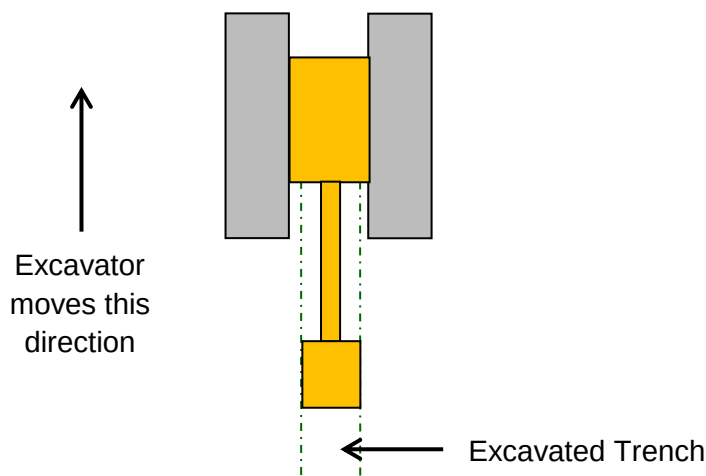


Fig.1

Simple diagram showing excavator straddling the trench and digging the trench towards the machine.

- Once the water loss depth has been observed the excavator digs down about a bucket's depth and turns the peat upside down. The peat is firmly compacted with the back of the digger bucket, to create a seal. Using the digging bucket and the excavator straddling the trench allows for better compaction of the peat and improves the sealing effect of the peat.
- The peat in the bund core is built up with additional wet 'putty' peat. Wet 'putty' peat is taken out of a borrow pit dug upslope of the trench. Each bucket full is put in to the trench and firmly compacted to create a seal. This is undertaken until the peat is built up to the vegetated surface. At this point the first machine has completed its operation.
- To create the above surface bund the second machine moves to the side of the trench. Using a wide ditching bucket (1.2-1.5m wide) the excavator places one bucket of wet 'putty' peat (from the borrow pit) on to the trench and begins to shape a bund. The excavator then places the degraded peat on top of the wet putty peat and presses down firmly. The operator shapes the surface bund in line with the standard specification, and ensures each bucket-full is pressed firmly. The final height of the peat bund is an average height of 250mm-300mm above the peat surface.
- To complete the surface bund, the excavated turf is re-laid on top and pressed down firmly.
- To complete the operation the borrow pit is filled in and the sides levelled and made as shallow as possible, with surplus vegetation put back in. The operator also generally flattens the surrounding area to reduce the impact to the peat surface.

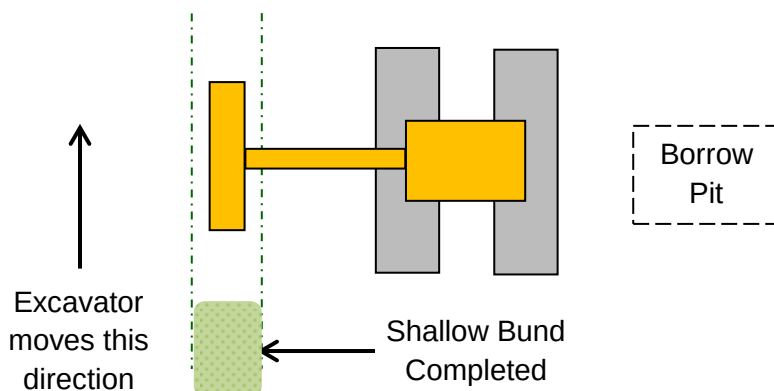


Fig. 2

Simple diagram showing an excavator aligned to the side of the trench at 90 degrees to complete the surface bund. The machine finishes off the bund and fills in the borrow pit.

Additional Installation Procedure

- If installing deep trench bunds with bund fingers the first excavator digs out both the bund and bund finger as per the procedure above. The bund line is according to the topography of the land. The bund should be placed at 90 degrees to the slope, to ensure best water retention. The first excavator ensures the bund and bund finger are joined correctly and the peat is firmly pressed in place to create an underground seal. Bund fingers are installed at 90 degrees to the main bund to ensure there is no lateral water movement.
- The bund finger is usually about 5-8m in length up the slope. The second machine finishes off the surface bund as above.
- If installing banded cells the first excavator must link all the sides of the cell to ensure the peat is sealed underground. The shape is determined by the site conditions and both machines complete their operation as per the above specification. Each cell must be joined to the next cell by firmly pressing peat at each connecting bund.



Fig. 3

Photo shows the finished deep trench with peat firmly compacted down, ready for the surface bund to be shaped on top.



Fig. 4

Deep trench bund with bund fingers on a lowland raised bog (SSSI site)

NOTE: The water collects in the borrow pit first. The bund is set against the slope with the finger coming off at 90 degrees.



Fig. 5

Bunded cells using the deep trench technique on a lowland raised bog (SSSI site). The cells are 10m x 10m and are set against the slope to achieve maximum water retention.

NOTE: the vegetation developing on the bunds is growing 1 year on, following installation.

Machinery & Equipment

All machinery must be low ground-pressure tracked machines with a PSI below 3.5. Bio-hydraulic oils must be used and the machines should be clean and free of oil/fuel leaks. Some locations may require the use of bog mats to work on very wet ground. Deep trench bunds often require excavators in the 5-10 tonne range. Digger buckets should be chosen appropriately, according to the size of the bund required

Peat Edge Re-Profiling - Method of Installation **Restoration Technique 6**

(This method of installation should be read in conjunction with Peatland Re-wetting Design & Specification Sheet – 06 – Peat Edge Re-Profiling)

Peat edge re-profiling is often required where the peat has been subject to either peat extraction- usually hand cutting; or the re-wetting works are located on the edge of the site. The technique aims to remove or reduce any steep slopes or peat cut faces by re-profiling the peat surface. There is also a requirement to undertake re-wetting techniques which link in with other work on site. The usual re-wetting technique is the installation of deep trench bunds (*Technique 5*). The main aim is to reduce water loss from the peat surface, it is common at these locations for water to be lost underground through cracks or peat pipes.

Once the peat edge, peat hagg or cut face has been regarded water flow can be minimised through a deep trench bund near the top of the slope (with a borrow pit upslope) and a second deep trench bund placed lower down the slope (again with a corresponding borrow pit upslope of the bund). The deep trench restricts the water loss by creating an underground ‘wall’ of wet ‘putty’ peat which slows water movement. This improves hydrological connectivity and re-hydrates the entire peat resource with improved general watertable conditions. The long-term improvement in peat surface wetness should lead to peat forming conditions for suitable peat forming vegetation.

Peat Edge Re-Profiling Location

The technique of peat edge re-profiling will vary depending on the site location and surface conditions. There will be differences in the proposed design depending on the size and scale of the peat slope or peat edge. Some locations will only require small scale work with a single bund as being adequate. For more degraded sites and where the peat water loss is deeper there may be a requirement to employ a range of bunds and other re-wetting techniques. However, as a general rule the deep trench bund technique is used to reduce sub-surface water loss.

Since most of these areas have been highly modified, it is essential that before re-wetting proposals are designed there should be some in-depth investigation to determine the nature of the water loss and identify other constraints. If the site is located near adjacent non-peat land (e.g. farmland) the scheme must ensure there is no impact to these areas.

On peat slopes or re-profiled edges the usual bund layout will be individual bunds with bund fingers. The aim for the bund is to push water back up the slope and stop lateral movement. The bund or bunds should be installed at the correct location to achieve general peat re-wetting with a general rule of a 30cm fall in gradient between bunds. On areas where the gradient is less steep or there is generally only one fall across the surface, banded cells can be considered. The aim of the cells is to retain water within the cell and spread the re-wetting across a wide area. This will therefore create banded cells of different sizes and shapes to achieve this.

Deep trench bunds generally are used from 0.5m down to 3.5m and require a borrow pit to supply additional wet 'putty' peat. The top bund is generally 30cm high above the peat surface but some bottom bunds on peat slopes are higher up to 50cm. To ensure there is some structural strength and to improve water retention the bund peat should be 80-90cm wide. With the vegetation placed back on top, the bund may be wider.

Installation Procedure

- The peat edge design will determine the actual shape and re-wetting features required but the following procedures will generally be required.
- The first operation is to remove or reduce the steep slope or peat cut face or peat hagg edge. The excavator takes off the top vegetation (if any) and places to one side. This should be undertaken from the top to the bottom creating a 4-5m wide strip of removed vegetation. Once the peat is exposed the slope or edge is re-profiled by pulling down the peat from the top to the bottom of the slope. This reduces the steepness or removes the peat edge. The re-graded peat is pressed firmly with the back of the bucket (best to use a wide ditching bucket 1.5m-1.8m wide).
- The re-graded slope aims to achieve a slope of about 30 degrees or less. This at some locations may not be possible but the manipulation of the edge will improve the general peat surface conditions.
- When the 4-5m wide strip has been re-graded the vegetation taken off is replaced, again from the top to the bottom. The turfs are firmly pressed in place. There will be a requirement to leave about 1m open to create an overlap, to allow the lifting of the next 4-5m wide strip. When this has been re-profiled the 1m strip is covered with the next 3-4m. The excavator works along the peat edge working the peat and replacing turfs.
- Once the peat edge or slope has been re-profiled the peat re-wetting features are installed.
- If the works are located on a peat slope then it is usual to install deep trench bunds with bund fingers. On some slopes there may be the opportunity to install bundled cells usually 10mx10m in size and cut against the slope to achieve maximum water retention.
- For peat cut face or peat hagg areas where the feature is usually narrow there may only be space to install one top bund and one bottom bund. Usually these would be deep trench bunds with bund fingers.
- The top bund is usually installed first with the surface bund being about 30cm in height and the trench going deep enough to ensure the water loss feature is sealed (see Technique 5 for detailed information).
- To complete the peat edge work the bottom bund is installed using a deep trench bund with fingers. The surface bund height is usually higher to accommodate the fall of the slope. General height of bottom bund is about 50cm.
- On some projects the peat edge work may link in with other re-wetting features. These should be incorporated as per the agreed specification.

Machinery & Equipment

All machinery must be low ground-pressure tracked machines with a PSI below 3.5. Bio-hydraulic oils must be used and the machines should be clean and free of oil/fuel leaks. Deep trench bunds

often require excavators in the 5-10 tonne range. Digger buckets should be chosen appropriately, according to the size of the dam required



Fig. 1 (before)

Simplified profile of typical peat edge or peat cut face showing steep edge and degraded peat

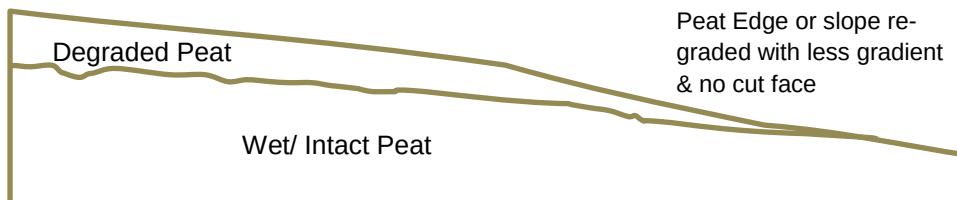


Fig. 2 (after)

Diagram showing re-profiled peat edge with a gentle slope. The proportion of degraded peat is much less and the peat has been compacted.



Fig. 3

One deep trench bund with bund finger over a peat slope on a lowland raised bog (SSSI site). The bund trench was dug about 2m deep, the surface bund is 60cm high and bund fingers are installed every 15m. The bund is set against the slope to achieve maximum water retention.

NOTE: the vegetation is placed on top but with some bare peat. This is not an issue since vegetation covers the bund within 1 year.



Fig. 4

Bundled cells on a re-graded peat cut face with trees (lowland raised bog – SSSI site). There are 3 main bunds with the cells being about 20m wide and 10m long. The bund trench was dug about 2.5m deep, the surface bund is 60cm high and side bunds are installed every 20m. The bund is set against the slope to achieve maximum water retention.

Appendix 2: Visualisations of Rusland Moss NNR Restoration (before and after)

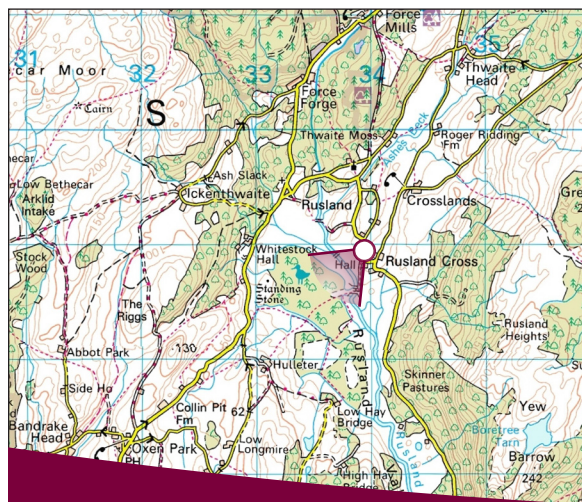


Rusland Moss Restoration

Bethecar Moor

Viewpoint 2

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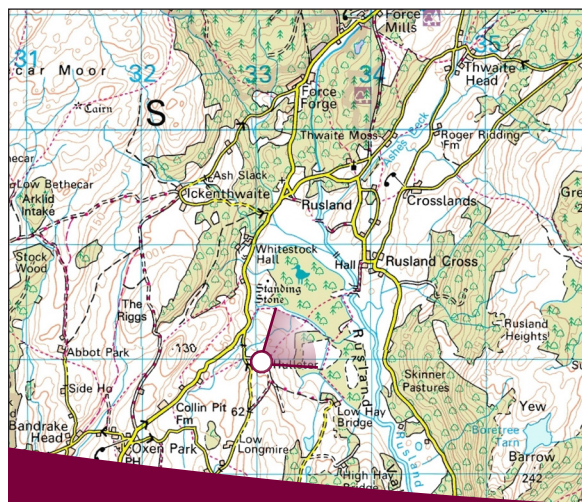


Rusland Moss Restoration

Cinder Hill, Rusland Cross

Viewpoint 3

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Rusland Moss Restoration

Hulleter Farm

Viewpoint 4

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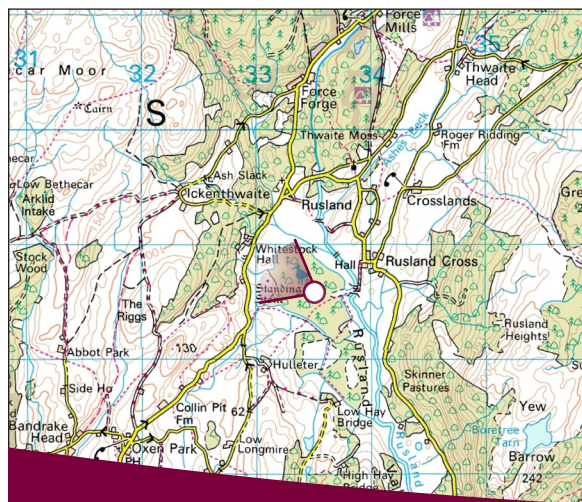


Rusland Moss Restoration

Lone Rigg

Viewpoint 5

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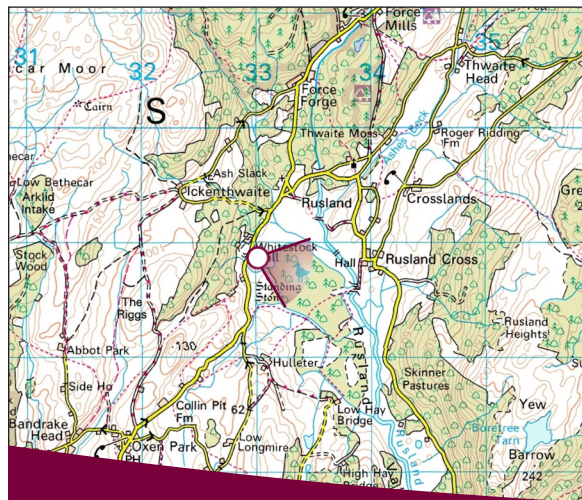


Rusland Moss Restoration

Oxen Park Moss

Viewpoint 6

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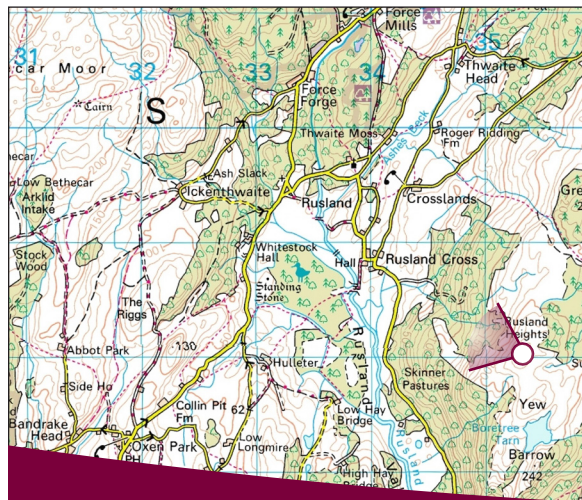


Rusland Moss Restoration

The Dower House

Viewpoint 8

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Rusland Moss Restoration

Rusland Heights

Viewpoint 7

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Appendix 3: Deer Densities on Rusland Valley Mosses SSSI

Rusland Valley Mosses SSSI - Heat Map

