



HAWESWATER AQUEDUCT RESILIENCE PROGRAMME

PROPOSED BOWLAND SECTION

BOWLAND SSSI ASSESSMENT

RVBC-BO-APP-009

TEP
Genesis Centre
Birchwood Science Park
Warrington
WA3 7BH

Tel: 01925 844004
Email: tep@tep.uk.com
www.tep.uk.com

Offices in Warrington, Market Harborough, Gateshead, London and Cornwall

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Author	Mike Walker
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Checked	Elizabeth Seal
Approved	Elizabeth Seal

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APPENDICES

APPENDIX A: SSSI Citations

Executive Summary

1. This document provides an assessment of potential impacts on Sites of Special Scientific Interest (SSSI) from the proposed works at the Bowland Section associated with the Haweswater Aqueduct Resilience Programme and supports associated planning applications to Ribble Valley Borough Council (RVBC) and Lancaster City Council (LCC).
2. United Utilities maintains and operates the Haweswater Aqueduct, a pipeline running 110 km from Cumbria through Lancashire to Greater Manchester. Inspections of the aqueduct identified areas of concern that posed a potential future risk to water supply. In response UU is submitting several planning applications for the replacement of all tunnel sections of the aqueduct, collectively this is known as the Haweswater Aqueduct Resilience Programme (HARP).
3. This document assesses the potential for impacts on SSSIs resulting from the proposed replacement of a tunnel section known as Bowland, starting near Newton-in-Bowland (within RVBC) at the southern end and ending 4 km southeast of Wray (within LCC) at the northern end. The Project broadly comprises an above-ground launch facility, from which the tunnel boring machine would drive approximately 16 km northwards below-ground to an above-ground reception facility. Above-ground works include a mix of temporary construction activities and permanent installations. A number of highways improvements works are required to facilitate construction traffic access to the rural compounds including road widening and passing places (within RVBC and LCC), a potential new crossing of the River Ribble and use of existing parking facilities near Clitheroe (within RVBC), in turn these works would need their own temporary compounds.
4. Eleven SSSIs are located within 5 km of the proposed works, the closest to a main compound is Far Holme Meadow SSSI, located 0.68km east of the Lower Houses Compound (within LCC). This SSSI is designated for its species rich grassland communities which resemble traditional hay meadows, which represent a highly vulnerable habitat, scarce in Lancashire. The air quality assessment identified a potential for impacts to arise on this designation as a result of generator emissions associated with the nearby compound, however, additional investigation concluded no significant impacts on the SSSI habitats. All other SSSIs are at least 2 km away from the main works compounds and no air quality impacts are predicted for these nine SSSIs.
5. With the exception of Far Holme Meadow, all SSSIs are 2 km or more from main compounds, however, some proposed highways improvement works within LCC are closer than the main compounds and within 2 km of three of the SSSIs (Robert Hall Moor SSSI at 0.38 km, Roeburndale Woods SSSI at 0.37 km and Clear Beck Meadow SSSI at 0.84 km). All SSSIs are outside the zone of influence for potential impacts to arise on ground water dependant terrestrial ecosystems (GWDTE) and there are no hydrological links with any SSSI habitats and no impacts are predicted.
6. There is potential for GWDTE effects to arise as a result of the decommissioning the existing asset, however, the Bowland Fells is the only SSSI that the existing asset

travels beneath. Due to the significant depth of the existing tunnel as it travels beneath the fells, GWDTE impacts are ruled out.

7. The only SSSI with faunal interest listed in the citation is the Bowland Fells SSSI. At its closest point to above ground works, the Bowland Fells SSSI lies 2.7 km from the Newton in Bowland Compound (within RVBC) and 4.2 km from the Lower Houses Compound (within LCC). Due to the distance of the proposals from this SSSI, as well as the absence of suitable habitat or breeding bird records within or near the site for the wider ranging species for which the SSSI is designated, there are no impacts predicted on the Bowland Fells SSSI.
8. It is concluded that there would be no significant impact from the proposed development on any SSSI designated sites.

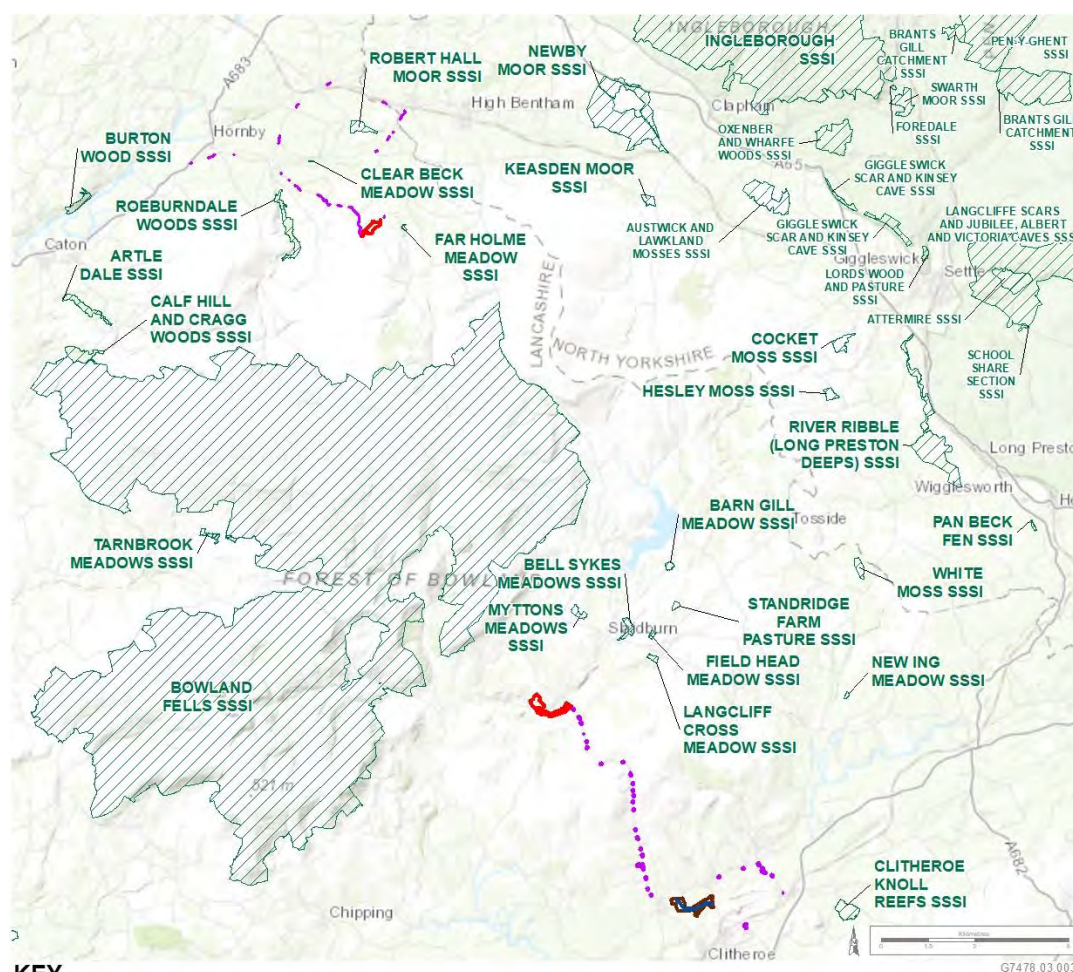
1.0 Introduction

- 1.1 TEP was commissioned by United Utilities to complete an assessment of potential impacts on Site of Special Scientific Interest (SSSI) sites that might arise as a result of the proposed Bowland Section of the Haweswater Aqueduct Resilience Programme, located in north east Lancashire within Ribble Valley Borough Council (RVBC) and Lancaster City Council (LCC).

Site Proposals

- 1.2 United Utilities (UU) maintains and operates the Haweswater Aqueduct, a pipeline running 110 km from Cumbria, through Lancashire to Greater Manchester. The pipeline is comprised of multiple pipe and single tunnel sections. Inspections of the aqueduct identified areas of concern that posed a potential future risk to both water quality and supply. In response UU is replacing all tunnel sections of the aqueduct. Each tunnel section is an independent development, the completion of which is not reliant on any other tunnel section, therefore each section will be accompanied by its own Environmental Statement to support the planning application (some tunnel sections require multiple planning applications where they cross planning authority boundaries). Collectively this is known as the Haweswater Aqueduct Resilience Programme (HARP).
- 1.3 The Environment Partnership Limited (TEP) was commissioned by United Utilities to undertake an assessment of any impacts that may occur to SSSIs as a result of the scheme. This work is in addition to the assessment of potential impacts on European sites which is provided in the Habitats Regulations Assessment (HRA) Screening Report (RVBC-BO-APP-010).
- 1.4 This assessment covers the Proposed Bowland Section (henceforth referred to as 'the Project'), located in northeast Lancashire between National Grid References SD 689 503 and SD 637 655. It comprises the replacement of the tunnel section towards the centre of the existing Haweswater Aqueduct between Newton-in-Bowland (within RVBC) at the southern end and 4km south east of Wray (within LCC) at the northern end (Figure 1).
- 1.5 The existing aqueduct between these areas would be replaced with a single tunnel. The new tunnel would be created using a tunnel boring machine (TBM) boring via a portal opening from the southern end, 16 km north to a 15 m deep reception shaft at the northern end. Tunnel boring activities will be at depths of approximately 150 m depth for the majority of the section, increasing to 380 m below the surface when passing under White Hill in the Trough of Bowland.
- 1.6 Above-ground works include a mix of temporary construction activities and permanent installations. Above-ground works consist of two main working areas:
- Newton-in-Bowland Compound would be the launch facility in the south, located approximately 440 m west of Newton-in-Bowland.
 - Lower Houses Compound would be the reception facility in the north, located approximately 4 km south east of Wray.

1.7 The Lower Houses Compound would include permanent surplus materials storage (arising from the reception shaft) within its boundaries but all arisings from the tunneling would be extracted at the southern (launch) compound and transported to Waddington Fell Quarry, accessed by the B6478, for permanent treatment and storage.



KEY

- Development area
 - Highways improvements works
 - Environmental assessment area
 - Ribble Crossing proposed route
- Ecological Constraints**
- Sites of Special Scientific Interest (SSSI)

Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Figure 1. Location of above ground works associated with the Bowland Section and SSSI designations within surrounding landscape.

- 1.8 Transport routes for the Newton-in-Bowland Compound for light vehicles and HGVs would be from Junction 31 of the M6 along the A59 then the A671 Pimlico Link Road and B6478, with an adapted route along Clitheroe Road for abnormal loads. An alternative route to minimise construction traffic through the villages of West Bradford and Waddington is also proposed and included in this assessment. This is referred to as the Ribble Crossing as it would require a temporary road bridge crossing the River Ribble just north of Clitheroe. The location is shown at Figure 1.
- 1.9 Site access for the Newton-in-Bowland Compound would be via a temporary haul road approximately 1 km in length running from the B6478 just south of Newton-in-Bowland and crossing the River Hodder with a temporary new bridge to reach the compound area.
- 1.10 Transport routes for the Lower Houses Compound for light vehicles and limited HGVs would be from the A683 along the B6480 and continuing onto Long Lane with an adapted route through Wray for abnormal loads.
- 1.11 Site access for the Lower Houses Compound would be from Park House Lane in the north east with site traffic exiting by the unnamed road on the western edge of the compound. Abnormal loads and HGVs that can't use the north east entrance would both access and depart the site via the western access.
- 1.12 A number of highways improvement works are proposed which would include road widening and installation of additional passing places to reach both compounds. Passing places would typically be 2.5 m in width, with a construction depth of 850 mm.
- 1.13 Construction activities are anticipated to continue for a period of 6 years, (Q2 2023 to Q4 2028) excluding commissioning (connecting to the existing asset) and land reinstatement. The exact timing of commissioning depends on the connection approach and if requiring a full outage of the aqueduct this can only be undertaken once (in September/October) every two years. Land reinstatement would be carried out progressively, starting as early as possible at each of the construction compounds. This involves land restoration activities being commenced in appropriate locations at the compounds whilst construction and commissioning activities are still underway. Blasting works to form the drive portal at the launch compound (Newton-in-Bowland Compound) is anticipated to occur over a three to four month period in the latter part of 2023.
- 1.14 Construction compounds are the locations within which construction activities would be undertaken. The construction compounds would contain tunnel launch and reception facilities, tunnel slurry treatment facilities, diesel generators (where necessary), welfare and administration facilities, vehicle parking, surplus materials storage areas, and water management areas. Tunnel launch would be via a portal and tunnel reception via a vertical shaft. Lighting would be required for safety reasons and where 24-hour working is required. Lighting designs and locations would minimise light spill towards any sensitive locations.
- 1.15 The locations of construction compounds and highways works for the proposed Bowland Section are shown at Figure 1.

- 1.16 Enabling works would include fencing working areas and preparing sites. Working areas would be topsoil stripped and construction phase drainage installed where required. As required, trees would be felled and vegetation would be cleared. Compounds and laydown areas would be constructed and safe access and egress to and from the sites would be provided via the local road network.
- 1.17 Open-cut trenching would be required when connecting the new single line aqueduct into the existing aqueduct. Trenches would be excavated in the ground with pipes being placed in the trenches prior to backfilling with excavated or imported material.
- 1.18 For the majority of the length of the replacement aqueduct there would be no permanent above-ground structures with much of the new sections of aqueduct being located deep below ground level. Permanent new valve houses would be built at the end of each replacement tunnel section, these would be single storey structures approximately 11 m wide by 12 m long.
- 1.19 Land used for temporary compounds would be reinstated after completion of construction works with temporary access roads being removed. Where launch and reception facilities (e.g. shaft and portal) exist, these would be covered and reinstated at ground level.
- 1.20 The new tunnel sections would connect to the existing overflow pipes that allow the aqueduct to be drained to existing outfall points. The overflows are only used in an emergency or for rare maintenance requirements and represents no change to the existing operational activities of the aqueduct. The only operational phase change resulting from the proposed development is the discharge of water from the decommissioned asset via the existing overflow pipes as a result of water ingress into the unused tunnel sections.

Previous Consultation

- 1.21 A consultation response was received from Natural England (NE) on 28th October 2020 regarding the wider Haweswater Aqueduct Resilience applications, including the application for the Bowland section. The response stated *'there are many SSSIs close to the compound sites which have different designated features which may be impacted by the development. Many of these are not classified as an SAC, SPA or Ramsar site. Therefore SSSI assessments will be required for all the compound sites and we would like to review these once they are available'*.

Document Purpose

- 1.22 The purpose of this document is to assess the potential impacts of the proposals on any SSSIs within influencing distance of the proposed works. From initial assessment within the Environmental Impact Assessment, this zone of influence has been determined to be 5 km from the proposed works for SSSIs. There are eleven SSSIs within 5 km of the proposed works, six of these are within 5 km of the launch compound at Newton-in-Bowland and five are within 5 km of the reception compound at Lower Houses (the Bowland Fells SSSI is the only site within 5 km of both compounds). The assessment therefore focuses on these SSSIs to determine if any mitigation is required to reduce these impacts to an acceptable level, and detail what this mitigation will be.

2.0 Protected Sites Background

2.1 The following SSSIs are located within 5 km of the launch compound (Newton -in-Bowland Compound within RVBC authority area):

- Myttons Meadows SSSI - located 2.2 km northeast
- Bowland Fells SSSI - located 2.7 km northwest.
- Bell Sykes Meadows SSSI - located 3.1 km northeast
- Langcliff Cross Meadows SSSI - located 3.6 km northeast
- Field Head Meadows SSSI - located 4 km northeast
- Standridge Farm Pasture SSSI - located 4.5 km northeast

2.2 The following SSSIs are located within 5 km of the reception compound (Lower Houses Compound within LCC authority area):

- Far Holme Meadow SSSI - located 0.68 km east
- Robert Hall Moor SSSI - located 2 km north
- Roeburndale Woods SSSI - located 2 km west
- Clear Beck Meadow SSSI - located 2.7 km northwest
- Bowland Fells SSSI - located 4.2 km south

2.3 The following SSSI is located within 5 km of the highways improvement works (within LCC authority area):

- Burton Wood SSSI - located 3.3 km west

2.4 Further details are provided regarding each of these protected sites in Table 1 below.

Table 1. SSSI designations within 5 km of the proposed above ground works at the Bowland Section. Distances are shown from the closest compound, as well as the distance from the nearest highway improvement works when this is closer.

Name	Distance from nearest compound * distance from highways works if closer	Area (ha)	Description	Condition
Bowland Fells SSSI	2.7 km	15,759	Extensive upland fells supporting the largest expanse of blanket bog and heather moorland in Lancashire and provide suitable habitat for a diverse upland breeding bird community which includes hen harrier, merlin and peregrine. Additional interest is provided by the existence of one of the largest lesser black-backed gull colonies in Great Britain, the presence of a number of nationally or locally uncommon plant species and a variety of upland habitats and their associated avifauna.	The SSSI Unit closest to the Proposed Bowland Section comprises unit 1011820, which was last reported to be in 'favourable' condition.
Myttons Meadows SSSI	2.2 km	10	The site comprises a series of three fields below Myttons Farm and part of another field to the south, which together represent the largest and best surviving example of traditionally managed, species-rich meadow grassland identified in Lancashire.	All four units are in 'favourable' condition.

Name	Distance from nearest compound <small>* distance from highways works if closer</small>	Area (ha)	Description	Condition
Bell Sykes Meadows SSSI	3.1 km	13.7	The site consists of six fields of unimproved, enclosed, herb-rich grassland. The river alluvium of the flatter ground close to the River Hodder supports three fields of herb-rich flood meadow. The field on the higher ground to the east supports herb-rich northern hay meadow, whilst the leached soils overlying carboniferous limestone on the west facing slope supports two fields of herb-rich seasonally grazed pasture. Bell Sykes Meadows is one of the few remaining unimproved herb-rich grasslands present in this part of Lancashire. A small amount of woodland and scrub is also present on the site.	Three units are in 'favourable' condition. The two units closest to the development are in 'unfavourable, recovering' condition with recent improved changed to grazing management.
Langcliff Cross Meadows SSSI	3.6 km	5.3	Represents one of the best examples of the few remaining species-rich meadow grasslands in the county. Contains a high diversity of grass and herb species with many plants representative of unimproved meadows.	The SSSI Unit (1011637) was last reported to be in 'favourable' condition.
Field Head Meadows SSSI	4 km	3.3	Field Head Meadows consists of a single field of enclosed, moderately herb-rich hay meadow, typical of its type in northern England. Field Head Meadow is one of the few remaining herb-rich grasslands present in this part of Lancashire.	The SSSI Unit (1022962) was last reported to be in 'favourable' condition.

Name	Distance from nearest compound * distance from highways works if closer	Area (ha)	Description	Condition
Standridge Farm Pasture SSSI	4.5 km	4.46	<p>The site consists of an unimproved enclosed herb-rich flushed pasture on a north-facing slope. The underlying Bowland Shales give rise to base-rich conditions and impeded drainage, which results in much spring-fed flushing of the slope with ground water.</p> <p>Standridge Farm Pasture is one of the few remaining unimproved herb-rich pastures present in this part of Lancashire.</p>	The SSSI Unit (1016758) was last reported to be in 'favourable' condition.
Far Holme Meadow SSSI	0.68 km *0.62 km	1.7	<p>The grassland plant communities present support many species characteristic of old hay meadows which have been traditionally managed and left unimproved for many years. Such communities are now scarce nationally and represent a highly vulnerable habitat which, in Lancashire, has been severely reduced by agricultural intensification.</p>	The SSSI Unit (1011696) was last reported to be in 'favourable' condition.
Robert Hall Moor SSSI	2 km *0.38 km	10.3	<p>The site contains an area of wet unimproved grassland, flushes and scrub situated on a drumlin. The site is remarkable for the range of plants represented, including two nationally rare communities and several species which are rare or very limited in their distribution. This assemblage of species is unique in Lancashire. Its most outstanding feature as a habitat is that it is the only extensive example of species-rich undrained and unimproved base-flushed neutral grassland known to remain in the county.</p>	The SSSI Unit (1011731) was last reported to be in 'favourable' condition.

Name	Distance from nearest compound * distance from highways works if closer	Area (ha)	Description	Condition
Roeburndale Woods SSSI	2 km *0.37 km	20.3	The extensive woodlands of the Roeburn gorge contain the best examples of the range of northern deciduous woodland types characteristic of the River Lune and its tributaries draining the north side of the Bowland Fells.	Units 2, 3, 6 & 7: 'favourable'. Units 4 & 5: 'unfavourable no change'. Unit 1: 'unfavourable declining'.
Clear Beck Meadow SSSI	2.7 km *0.84 km	0.5	Although small in size the site represents one of the best examples of species-rich meadow grassland in Lancashire. Unlike the larger, more accessible fields adjacent to it, Clear Beck Meadow has not been agriculturally improved and supports an exceptionally diverse grassland flora.	The SSSI Unit (1011480) was last reported to be in 'favourable' condition.
Burton Wood SSSI	8.5 km *3.3 km	18.0	This SSSI contains good examples of several of the northern deciduous woodland types characteristic of the Lune valley and its tributaries draining the north side of the Bowland Fells. An outstanding feature is the development of ash-wych elm woodland.	The SSSI Unit (1011474) was last reported to be in 'unfavourable recovering' condition.

2.5 Robert Hall Moor SSSI, Roeburndale Woods SSSI, Clear Beck Meadow SSSI and Burton Wood SSSI are the only sites located closer to proposed highway improvement works than they are to either of the main compounds (0.38 km, 0.37 km, 0.84 km and 3.3 km away respectively). The nearby highways improvements all fall within LCC.

3.0 Assessment of Potential Impacts

- 3.1 There would be no works within any of the SSSIs. The closest part a compound to any SSSI is 0.68 km away and the closest highways works is 0.37 km away. There would therefore be no direct impacts on any SSSI.
- 3.2 The potential impact pathways that could affect the SSSIs listed earlier within this document Include the following:
- Impacts on SSSI habitats resulting from dust pollution generated by works at compounds or road improvement works.
 - Waterborne pollution impacts from compounds or road improvement works.
 - Habitat impacts through changes to groundwater conditions.
 - Air quality impacts through vehicle exhaust emissions and through generator use at compounds.
 - Disturbance to birds associated with the Bowland Fells SSSI.
- 3.3 The air quality chapter of the Environmental Statement (Chapter 18) and the Construction Code of Practice (CCoP) (LCC_RVBC-BO-TA-003-003) identifies that the proposed development would have a dust management plan in place. In addition highways improvements are over 350 m away from SSSIs and compounds at least 2 km away. Due to the distance from the proposed works and measure in the CCoP, there would be no dust impacts on the SSSI designations.
- 3.4 Table 2 confirms that no hydrological linkages have been identified between the proposed works and any of the SSSIs. Therefore no waterborne pollution impacts on SSSI designations sites are anticipated.

Table 2 - Potential for hydrological links to designations within 1 km of proposed works

SSSI Name	Location in relation to proposals	Potential hydrological links
Robert Hall Moor	0.38 km west of road widening RW10 on Long Lane <i>(other works within 0.5 -1 km are RW08, RW09 and RW11 all on Long Lane)</i>	Although the designation contains wetland habitats these result from local springs, there are no watercourses within or adjacent to the site. The works are on the far side of Long Lane and several fields, properties and roads/tracks separate the designation from the proposed working area. No pollution pathways are anticipated.

SSSI Name	Location in relation to proposals	Potential hydrological links
Roeburndale Woods	0.37 km south of passing place PP06 <i>(other works within 1 km are PP05, PP04 and RW22 all on the same road)</i>	The SSSI contains woodland habitat which is adjacent to the River Roeburn. PP06 is adjacent to a stone farm building and further separated from the designation by fields, a wooded valley, and Hunts Gill Beck. Whilst the Beck may flow into the River Roeburn this would not provide a pathway for pollution of the SSSI woodland from the proposals.
Far Holme Meadow	0.62 km east of road widening RW12 and 0.68 km east of Lower Houses Compound <i>(no other works within 1 km)</i>	The SSSI contains hay meadow habitat which is adjacent to the River Hindburn. RW12 and the Lower Houses Compound are separated from the designation by fields, a wooded valley and the River Hindburn. Whilst several watercourses located within or near the proposals may flow into the River Hindburn this would not provide a pathway for pollution of the SSSI hay meadow.
Clear Beck Meadow	0.84 km northeast of passing place PP06 <i>(other works within 1 km are PP05, PP04 and RW22 all on the same road)</i>	The SSSI contains species-rich meadow and a watercourse runs through the southern edge. PP06 is separated from the designation by fields, woodland, roads / tracks and the River Hindburn. No pollution pathways are anticipated.

- 3.5 The Water Environment Chapter of the Environmental Statement (Chapter 7) includes a ground water assessment (Ref: LCC_RVBC-BO-TA-007-002) which determined that the zone of influence for GWDTEs extended to 200 m in all directions around the surface works proposed development envelope with dewatering effects predicted to extend to 25 m from the shafts. There are no SSSIs within 200 m of a proposed compound or highways works areas, therefore ground water related impacts are scoped out of this SSSI assessment.
- 3.6 The potential for dewatering effects on GWDTEs to arise as a result of decommissioning the existing asset are dependent on the construction type and depth of the existing Haweswater Aqueduct (HA) and the geological conditions between the asset and the surface. Therefore a detailed assessment has been undertaken to identify any lengths of the HA where effects on GWDTEs might occur and estimate a dewatering zone of influence. Based on this assessment, lateral effects at the surface are expected to extend no further than 200 m.

- 3.7 The existing tunnel section proposed for decommissioning passes beneath the Bowland Fells SSSI. Where the tunnel is close to the surface, there is potential for water ingress into the decommissioned tunnels which in turn could have an effect on ground water dependant habitats above the asset. The Water Environment assessment (Environmental Statement Chapter 7, Ref: LCC-RVBC-BO-ES-007) confirmed that any dewatering effects occurring at depth would not impact on surface receptors such as watercourses and GWDTEs. The current tunnel section is at a depth of 370 m at its deepest point, with the deeper sections passing beneath the Bowland Fells SSSI. Where the existing tunnel section proposed for decommissioning passes beneath the SSSI, it is at sufficient depth that there will be no impact on this SSSI. The section proposed for decommissioning (between the Newton-in Bowland valve house in the south and the Lower Houses valve house in the north) does not travel beneath any other SSSIs, nor does it come within 200 m of any SSSI and therefore no impacts on SSSIs would result from the decommissioning works.
- 3.8 The Air Quality Assessment identifies that there would be no impacts on any protected sites further than 2 km from the proposed works. Therefore all SSSIs further than 2 km from the proposals have been scoped out of further assessment regarding air quality impacts. The only SSSI scoped in for further consideration regarding air quality is therefore Far Holme Meadow, located 0.68 km east of the Lower Houses Compound (within LCC). Far Holme Meadow SSSI will therefore be assessed further regarding potential air quality impacts on habitats.
- 3.9 Although the Bowland Fells SSSI lies 2.7 km northwest of the Newton in Bowland Compound and 4.2 km south of the Lower Houses Compound, birds associated with this designation may be reliant on habitats outside of the designation. The Bowland Fells SSSI will be assessed further regarding potential for disturbance impacts to birds from both the Lower Houses Compound (with LCC) and the Newton in Bowland Compound (within RVBC).

Far Holme Meadow SSSI - Air Quality Impacts

- 3.10 The following nitrogen sensitive habitats are known to be present within the SSSI as detailed within the APIS description¹:
- Neutral grassland (*Anthoxanthum odoratum* - *Geranium sylvaticum* grassland) (NVC: MG3)
 - Neutral grassland (*Alopecurus pratensis* - *Sanguisorba officinalis* grassland) (NVC: MG4)
 - Neutral grassland (*Cynosurus cristatus* - *Caltha palustris* grassland) (NVC: MG8)

¹ <http://www.apis.ac.uk/src/select-a-feature?site=1006609&SiteType=SSSI&submit=Next>

- 3.11 All of the habitats present are sensitive to nitrogen, with the MG3 *Anthoxanthum odoratum* - *Geranium sylvaticum* grassland habitat of greatest sensitivity with a nitrogen critical load of 10 - 20 kg N/ha/yr (nitrogen critical load class: Mountain hay meadows). The other two neutral grassland types have a nitrogen critical load of 20 - 30 kg N/ha/yr (nitrogen critical load class: low and medium altitude hay meadows).
- 3.12 Influences of nitrogen loading on the neutral grassland present includes increases in nitrophilous graminoids and changes in diversity for the MG3 *Anthoxanthum odoratum* - *Geranium sylvaticum* habitat, and an increase in tall grasses and decrease in diversity in the MG4 and MG8 habitats.
- 3.13 The existing nutrient N deposition at the SSSI is 24.6 kg N/ha/yr. The existing acid deposition is 1.80 kEqH+/ha/yr nitrogen and 0.30 kEqH+/ha/yr sulphur.

Air Quality Assessment and Modelling

- 3.14 The Air Quality Assessment (reported within Chapter 18 of the Environmental Statement) for Far Holme Meadow SSSI concluded that temporary short-term impacts arising from the operation of generators within the compounds, associated with an increase in acid deposition, was above imperceptible and therefore would require further ecological assessment. Associated increases in relation to nitrogen deposition at the SSSI was identified to be not significant.
- 3.15 The air quality modelling is based on a worst-case-scenario which means the predicted change is likely to be an overestimate of what may occur in practice.
- 3.16 The assessment assumed that all of the diesel generators at each compound were to operate at maximum load for 8,760 hours each calendar year (24hrs/day for 365 days/year). In practice, the generators will have periods of shut-down and maintenance and may not always operate at maximum load, particularly at reception compounds (Lower Houses is a reception compound) where electricity demand peaks only when the tunnel boring machine is removed from the shaft, and electricity demand outside of this period is relatively minor.
- 3.17 Twenty four hour working at the Lower Houses Compound where the generators will need to operate constantly will only be required during two periods:
- A four week period during recovery of the tunnel boring machine (TBM) - the ground around the tunnel can become unstable during this process so 24 hour working is required to ensure the activity can be completed safely.
 - A nine week period when the connection is made to the existing aqueduct - 24 hour working is needed to reduce the number of weeks required to complete the task. An outage is required for these works and the water distribution network can only accommodate a limited period of having the existing aqueduct offline.

- 3.18 The Air Quality Assessment is highly precautionary and largely overestimates the actual generator usage at the nearest compound (Lower Houses). Even if both periods of 24hr working occurred in the same 12 months, this would be 91 days out of the 365 days modelled. Even assuming a precautionary 12hr generator operating period for the remaining 274 days² this reduces generator hours to 5,472 hours as a maximum in a calendar year. This is still precautionary as it assumes generators operating at maximum load. This confirms that the assessment is likely to be modelled on an unrealistic worst case.
- 3.19 The modelling process includes atmospheric dispersion modelling, which provides an estimate of concentrations arising from input emissions and historical meteorological data. In terms of the meteorological data used for the modelling, the highest predicted concentrations identified across 5 years of data was used in the assessment. During a typical year the ground level concentrations and associated acid or nitrogen deposition are likely to be lower.
- 3.20 It was also assumed that in a worst case scenario, ammonia (NH₃) would be emitted by the diesel generators due to 'ammonia slip' from the Selective Catalytic Reduction (SCR) system used to reduce oxides of nitrogen (NO_x) emissions to the emission limit values, and that an ammonia slip catalyst is not installed.

Predicted Contribution (PC)

- 3.21 For Far Holme Meadow SSSI the PC is 1.6% of the critical load, and the critical load is already exceeded due to existing acid deposition rates.
- 3.22 The actual predicted change in acid deposition compared to the existing baseline deposition rate is 0.5% (i.e. 0.01 process contribution compared to existing deposition of 1.8 + 0.3 nitrogen and sulphur derived acid deposition). Therefore the contribution itself would not have exceeded the critical load had the critical load not already been exceeded by the existing atmospheric deposition.

Historical Trend

- 3.23 Comparing historical data of acid deposition for the site on the APIS website³ which shows that the total acid deposition from 2005 onwards (up to the most recent 3-year mean for 2016-18 used in this assessment) has generally been around 2.5 keq/ha/year. Data associated with the 3-year mean for 2013 has a range of 2.3 to 2.5 keq/ha/year.
- 3.24 The total deposition used in the air quality assessment was 2.1 keq/ha/year, which is lower than historical deposition rates. The increase in acid deposition during the construction phase is temporary, relatively short-term and remains below recent deposition levels from at least the last 10 years.

² Although the launch compound will be active throughout the construction period, the Lower Houses reception compound will only be active during establishment of the site and creation of the shaft and during removal of the TBM, connection to the existing aqueduct and reinstatement of the land.

³ <http://www.apis.ac.uk/src/select-a-feature?site=1006609&SiteType=SSSI&submit=Next>

Conclusions

- 3.25 If the habitats and plant species on site were already suffering from acid deposition as a result of the critical load being exceeded from the atmospheric deposition, it is likely that this would be noted in the SSSI condition assessment in 2013 as a change in habitat structure as a result of a decrease in species richness, increase in coarser grass species and a decrease in positive indicator species. This is not the case, and the overall ratio of herbs to grass is noted to reflect the herb richness of the meadow by being relatively high for the most part (i.e. 60-40 %). The assessor also commented that it is “*a much improved situation compared with previous years.*” *The condition assessment also notes that the “absence of negative indicator species such as docks and cow parsley suggested that the meadow was also being managed favourably”.*
- 3.26 As the location of the SSSI is largely surrounded by woodlands and watercourses, it is possible that these woodlands would inhibit or influence pollutant dispersal. Therefore the air quality calculations may overestimate the acid deposition within the SSSI.
- 3.27 Based on the historical trend, and the fact that the worst-case-scenario modelled would not occur, as well as the comments in the most recent condition assessment of the SSSI (Favourable Condition with a high species diversity), it is considered highly unlikely that the minor worst-case short-term additional contribution to acid deposition arising from the operation of generators would cause a significant impact on the habitats and species associated with the Far Holme Meadow SSSI.

Bowland Fells SSSI

- 3.28 The Bowland Fells SSSI is designated for supporting internationally important numbers of breeding hen harrier, merlin and lesser black backed gull, as well as important numbers of other raptor species including peregrine and short-eared owl and a wide range of wader species and other upland birds.
- 3.29 No hen harrier or merlin were recorded within or near to either the Lower Houses (within LCC) or Newton in Bowland (within RVBC) compounds during the winter bird survey (Ref LCC_RVBC-BO-TA-009-01-06). It is highly unlikely that these species use the works area or land near to them for nesting, and due to the distance from the SSSI it is highly unlikely that these areas provide valuable foraging habitat.
- 3.30 Records of a number of known hen harrier winter roost sites within the wider surrounding area near to the Lower Houses Compound have been obtained from the RSPB. It is the view of the RSPB (Bray, Pers comms, November 2020) that the proposed works would not have a negative impact on roosting hen harrier, due to no known roosting locations being present within 500 m of the works and the topography preventing any line of sight between the works and the roost sites. In addition there is no suitable roosting habitat within 500 m of the works.
- 3.31 There are no known hen harrier or merlin nest sites that could be impacted by the works and the habitat surrounding the sites is not suitable for nesting by these species. There would therefore be no disturbance impacts on hen harrier or merlin.

- 3.32 The nearest large lesser black-backed gull colony is 10.3 km northwest of the Newton-in-Bowland compound and 7.6 km southwest of the Lower Houses compound. During the breeding season lesser black-backed gull were only recorded within the Lower Houses Compound during the April survey visit with 16 individuals within the site. A peak count of 25 individuals were recorded within 500 m of the Lower Houses compound during the breeding bird survey. A peak count of 8 lesser black backed gull were recorded within the Newton-in-Bowland compound, with a peak count of 42 individuals within 100 m and 100 individuals within 500 m.
- 3.33 It is highly unlikely that lesser black-backed gull nest within 500 m of the site. Due to the very low usage of the compounds and low usage within 500 m of the compounds, as well as the known high tolerance of this species to disturbance the proposals are highly unlikely to result in any disturbance impacts on breeding lesser black-backed gull. Most of the lesser black backed gull observed were between 100 m and 500 m of the site and there is an abundance of suitable feeding habitat for this species in the wider surrounding area. Very little usage was observed within the footprint of the works.
- 3.34 It is therefore highly unlikely that the works would result in a loss of feeding or nesting habitat for lesser black backed gulls and would not have an impact on the Bowland Fells SSSI population.
- 3.35 The majority of nesting upland birds for which the Bowland Fells SSSI is designated are highly unlikely to use the more lowland areas associated with the proposed works. The SSSI citation stated that the rushy lower slopes of the SSSI provide ideal habitat for waders such as redshank, curlew, lapwing, snipe and oystercatcher.
- 3.36 During the 2020 breeding bird survey undertaken at the compound areas, small numbers of confirmed or probable breeding waders were recorded including two pairs of curlew, three pairs of lapwing and five pairs of oystercatcher within and near the Newton-in-Bowland Compound, and three pairs of curlew, four pairs of lapwing, three pairs of oystercatcher and one pair of snipe within and near the Lower Houses Compound.
- 3.37 During the breeding season the birds at the compounds are likely to occupy territories containing the land within the compound and immediate surrounding land. Due to the distance of the compounds from the SSSI (2.7 km at closest point) it is highly unlikely that these are the same birds that breed within the SSSI. The populations of birds that use the SSSI will therefore not be affected.

4.0 Conclusions

- 4.1 The proposed Bowland Section of the Haweswater Aqueduct Resilience Scheme (HARP) comprises the replacement of an existing pipeline located in Lancashire.
- 4.2 The above ground works comprise two site compounds (Newton-in-Bowland within RVBC and Lower Houses within LCC), construction access and a number of highways improvement works, including road widening and passing place construction. Eleven SSSI designations are located within 5 km of the proposals including the highways improvement works, five of which are within 5 km of the northern compound (Lower Houses Compound) and six of which are within 5 km of the southern compound (Newton-in-Bowland Compound). The closest of these, Far Holme Meadow SSSI, is located 0.68 km east of the Lower Houses Compound.
- 4.3 With the exception of Far Holme Meadow, all SSSIs are 2 km or more from main compounds, however, some proposed highways improvement works within LCC are closer, and are within 2 km of three of the SSSIs (Robert Hall Moor SSSI at 0.38 km, Roeburndale Woods SSSI at 0.37 km and Clear Beck Meadow SSSI at 0.84 km).
- 4.4 Due to embedded mitigation, distance from works and/or lack hydrological links, no impacts from dust or waterborne pollutants are predicted and no impacts on ground water dependant terrestrial ecosystems would occur.
- 4.5 The Air Quality Assessment determines that a minor worst-case short-term additional contribution to acid deposition arising from the operation of generators at the Lower Houses Compound (within LCC) could occur at the Far Holme Meadow SSSI. However the assessment used greatly overestimates the length of time the generators would be used for the project, uses worst case meteorological data in the modelling and also assumes that an ammonia slip catalyst is not installed. The air quality impacts are therefore likely to be greatly overestimated in the assessment. The predicted increase in acid deposition during the construction phase is temporary, relatively short-term and remains below recent deposition levels from at least the last 10 years. As Far Holme Meadow is currently in favourable conservation status, it is therefore highly unlikely that this would cause a significant impact on the habitats and species associated with the Far Holme Meadow SSSI.
- 4.6 The proposals are within 5 km of the Bowland Fells designated primarily for nesting hen harrier and merlin, however due to the distance from the SSSI as well as the lack of suitable habitat within or near to the proposed works and the absence of records of these species from the breeding bird survey, it is considered that there would be no impact on the populations of these species associated with the SSSI. It is also considered that there would be no impact on the populations of other species for which the Bowland Fells SSSI is important due to the distance from the protected site.
- 4.7 It is concluded that no significant impact would result from the Proposed Bowland Section on any SSSI, including the Far Holme Meadows SSSI and the Bowland Fells SSSI.

APPENDIX A: SSSI Citations

COUNTY: LANCASHIRE

SITE NAME: BELL SYKES MEADOWS

DISTRICT: RIBBLE VALLEY

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981 as amended.

Local Planning Authority: Ribble Valley Borough Council

National Grid Reference: SD 718526

Area: 13.68 (ha.) 33.80 (ac.)

Ordnance Survey Sheet 1:50,000: 103

1:10,000: SD 75 SW

Date Notified (Under 1981 Act): 26 May 1999

Other Information:

1. This is a new site.
2. The site lies within the Forest of Bowland AONB.

Description and Reasons for Notification:

Bell Sykes Meadows lies at an altitude of between 140--150m OD, approximately 0.5km north-east of the village of Slaidburn. The site consists of six fields of unimproved, enclosed, herb-rich grassland. The river alluvium of the flatter ground close to the River Hodder supports three fields of herb-rich flood meadow. The field on the higher ground to the east supports herb-rich northern hay meadow, whilst the leached soils overlying carboniferous limestone on the west facing slope supports two fields of herb-rich seasonally grazed pasture. Bell Sykes Meadows is one of the few remaining unimproved herb-rich grasslands present in this part of Lancashire. This vulnerable habitat has become increasingly scarce nationally and has been largely destroyed in Lancashire due to agricultural intensification.

The seasonally-flooded meadows support a herb-rich, neutral grassland community, typical of its type in northern England. This community is characterised by meadow foxtail *Alopecurus pratensis*, Yorkshire fog *Holcus lanatus*, sweet vernal-grass *Anthoxanthum odoratum*, red fescue *Festuca rubra*, soft brome *Bromus hordeaceus* and crested dog's-tail *Cynosurus cristatus* with greater burnet *Sanguisorba officinalis*, meadowsweet *Filipendula ulmaria*, yellow rattle *Rhinanthus minor*, lady's mantle *Alchemilla glabra*, meadow vetchling *Lathyrus pratensis*, eyebright *Euphrasia* agg, smooth hawk's-beard *Crepis capillaris* and pignut *Conopodium majus*. Other species present also include abundant ribwort plantain *Plantago lanceolata*, red clover *Trifolium pratense*, meadow buttercup *Ranunculus acris*, daisy *Bellis perennis* and common sorrel *Rumex acetosa*. The diversity of these meadows is further enhanced by the presence of meadow cranesbill *Geranium pratense* and melancholy thistle *Cirsium heterophyllum* along the field edges.

The west facing, sloping ground supports herb-rich meadow and, on the steeper ground, herb-rich pasture. These are characterised by common bent *Agrostis capillaris*, sweet vernal-grass, red fescue, crested dog's-tail and field woodrush *Luzula campestris* with greater burnet, lady's mantle, eyebright, yellow rattle, pignut, common cat's-ear *Hypochoeris radicata*, common bird's-foot trefoil *Lotus corniculatus* and selfheal *Prunella vulgaris*. The pasture on the steeper ground, which supports a mosaic of neutral and acidic grassland, is also characterised by sheep's fescue *Festuca ovina*, tormentil *Potentilla erecta*, heath bedstraw *Galium saxatile* and bitter vetch *Lathyrus montanus*.

A small amount of woodland and scrub is also present on the site.

Date Notified: 28th March 1988

File ref: (L) SD 65/2

County: Lancashire **Site Name:** Bowland Fells

District: Lancaster, Ribble Valley, Wyre

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981.

Local Planning Authority: Lancaster City Council, Ribble Valley Borough Council, Wyre Borough Council

National Grid Reference: SD 620570 **Area:** 15,759.0 (ha) 38,940.5 (ac)

Ordnance Survey Sheet 1:50,000: 97, 98, 102, 103 **1:10,000:** SD 54 NE, NW, SE
SD 55 NE, NW, SE, SW
SD 56 SE, SW
SD 64 NW, SW
SD 65 NE, NW, SE, SW
SD 66 SE, SW
SD 75 NW

Date Notified (Under 1949 Act): 1951 **Date of Last Revision:** 1979

Date Notified (Under 1981 Act): 1988 **Date of Last Revision:** 1988

Other Information:

1. The site includes the former West Bowland Fells and Mallowdale and Bottom Head Fells SSSI.
2. The boundary has been amended by minor deletions and a large extension at this revision.
3. The site is situated within the Forest of Bowland AONB.

Description and Reasons for Notification:

This site encompasses the main upland block within the area of Lancashire known as the Forest of Bowland, an outlier of the Pennine Range situated in the north of the county and to the east of the M6 motorway. Most of this land, stretching from Clougha and Whitray Fell in the north to Parlick in the south, is over 250 m OD and rises sharply to a stream – dissected plateau with the highest point being Ward’s Stone at 561 m. The underlying rock is Millstone Grit beneath which lies Carboniferous Limestone.

These extensive upland fells support the largest expanse of blanket bog and heather moorland in Lancashire and provide suitable habitat for a diverse upland breeding bird community which includes three species (hen harrier, merlin and peregrine), which are afforded special protection under the Wildlife and Countryside Act 1981 by virtue of their rarity or vulnerability. Additional interest is provided by the existence of one of the largest lesser black-backed gull colonies in Great Britain, the presence of a number of nationally or locally uncommon plant species and a variety of upland habitats and their associated avifauna.

The most extensive plant communities within the site are dry heather-dominated heathland, generally found on the steeper slopes, and heather *Calluna vulgaris* and cottongrass *Eriophorum vaginatum*-dominated blanket bog which covers the tops of the ridges and shallow slopes.

Within the blanket bog communities bog mosses *Sphagnum* spp. are sparse, due to the effects of past burning practices, although bog rosemary *Andromeda polifolia*, a nationally scarce species, cranberry *Vaccinium oxycoccus*, crowberry *Empetrum nigrum*, and cloudberry *Rubus chamaemorus* are all widely distributed. Some areas of bog have been more heavily burnt and this, perhaps coupled with greater numbers of grazing sheep, has resulted in the loss of heather to give bilberry *Vaccinium myrtillus* and cottongrass bog. In some areas dwarf shrub component has been reduced still further to produce a cottongrass dominated degraded blanket bog community. In places within the site there is active and extensive peat erosion leaving large mounds and hags surrounded by shallow peat and a stony mineral soil.

The extensive areas of *Calluna* heath are generally managed by small patch burning to encourage red grouse. On recently burnt areas, bilberry is quick to recover and is at first dominant over the regenerating heather but the bilberry later becomes less conspicuous as the heather eventually reasserts its dominance. Heavy burning and high levels of sheep grazing have in some areas resulted in the loss of heather and its replacement by a bilberry/wavy hair-grass *Deschampsia flexuosa* community. In other places cowberry *Vaccinium vitis-idaea* has become co-dominant with bilberry, as on the summit plateau of Ward's Stone where these species are associated with a variety of lichens. Where grazing has been heavier still, the dwarf shrubs are replaced by species-poor acid grassland dominated by mat-grass *Nardus stricta* or, to a lesser extent, heath rush *Juncus squarrosus*, or purple moor-grass *Molinia caerulea*. Despite such modifications, the site is of particular value for the extent of heather moorland still remaining, and represents a good example of a habitat type which has been significantly reduced across upland Britain.

On the lower ground, bracken forms extensive stands in some areas. Dense growth of bracken suppresses the ground flora but where it is less dense bilberry community grows beneath, along with other plant species more usually associated with woodland, such as wood sorrel *Oxalis acetosella* and climbing corydalis *Corydalis claviculata*. Chickweed wintergreen *Trientalis europaea* has also been recorded on the site growing beneath bracken and here is nearly at its southern limit and in its only Lancashire location.

A number of interesting plants grow on the Millstone Grit crags, where they are protected from grazing and burning. These include fir clubmoss *Huperzia selago* and also Scottish filmy-fern *Hymenophyllum wilsonii* and hayscented buckler-fern *Dryopteris aemula* in their only Lancashire sites.

Flushes and springs are not common but provide a habitat for the Lancashire rarities lesser twayblade *Listera cordata*, broad-leaved cottongrass *Eriophorum latifolium* and pale forget-me-not *Myosotis stolonifera* – a nationally scarce species. Tree cover in the form of oak *Quercus petraea* scrub is fragmented and occurs on the steep slopes and in the cloughs, adding to the diversity of habitats within the site. Many of the trees are of great age, supporting a variety of lichens, and the shelter they provide allows the growth of carpets of tall ferns.

The maintenance of heather moorland over much of the site has provided an excellent habitat not only for red grouse for which the moors have primarily been managed, but for other moorland birds requiring the presence of heather for nesting cover and as a source of prey. Of these the hen harrier is the most notable: the Bowland Fells represent the only regularly-used

breeding locality in England and thus supports a very important breeding nucleus for this species which is in decline and increasingly experiencing a reduced success in breeding performance. Other nesting predatory birds (raptors) include merlin (another species suffering a continued decline in numbers), peregrine, short-eared owl, sparrowhawk and kestrel. The open moorland and blanket bog communities support other upland birds such as golden plover, ring ouzel, meadow pipit, skylark, whinchat and wheatear while the damp, rushy lower slopes provide ideal habitat for waders such as redshank, curlew, lapwing, snipe and oystercatcher. The fast-flowing upland streams are the typical habitat for common sandpiper, dipper and grey wagtail while the presence of tree cover adjacent to open moorland is ideal for woodcock, redstart and spotted flycatcher.

Mallowdale and Tarnbrook Fells also support one of the five largest breeding colonies of lesser black-backed gulls in Great Britain which probably contains over 10% of the British and 1% of the European populations.

COUNTY: LANCASHIRE

SITE NAME: BURTON WOOD

DISTRICT: LANCASTER

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981.

Local Planning Authority: Lancaster City Council

National Grid Reference: SD 543664

Area: 18.0 (ha.) 44.4 (ac.)

Ordnance Survey Sheet 1:50,000: 97

1:10,000: SD 56 NW

Date Notified (Under 1949 Act): 1976

Date of Last Revision: –

Date Notified (Under 1981 Act): 1984

Date of Last Revision: –

Other Information:

1. This site is listed in 'A Nature Conservation Review' edited by D A Ratcliffe (1977), Cambridge University Press.
2. The boundary of the site remains unchanged.
3. The site is within the Forest of Bowland A.O.N.B.

Reasons for Notification:

Burton Wood is situated on the steep south facing side of the Lune valley 2km upstream of Caton. It contains good examples of several of the northern deciduous woodland types characteristic of the Lune valley and its tributaries draining the north side of the Bowland Fells. These types are developed on soils ranging from shallow acidic podsoils to flushed brown earths derived from the underlying Carboniferous sandstone, mudstone and calcareous shales of the Bowland Series. Burton Wood is the second best example of these stand types in the area, the best example being Roeburndale Woods.

The main stand type is upland sessile oak woodland with an uneven aged canopy including gean. There are smaller areas of acid sessile oak-hazel-ash woodland on the slopes and western valley ash-wych elm woodland in the gullies. The ground flora is dominated by bilberry and wavy hair grass on the acidic soils, with dog's mercury, bluebells and ferns on the more neutral soils.

An outstanding feature of this wood is the development of ash-wych elm woodland on the lower slopes and extending up the sides of the numerous stream gullies, containing elm, ash and oak with frequent small-leaved lime and a shrub layer (noticeably absent elsewhere in the wood) of rowan, hazel and hawthorn. These represent pockets of relict woodland which have probably never been cleared and are little altered in composition by past management. In other woods in this area alder woodland typically occupies this habitat.

Further interest is added by the flushes which support both the opposite -- and the alternate -- leaved golden saxifrages, and pendulous sedge whilst abundant soft shield fern and the very local liverwort *Lophocolea fragrans* grow in the ravines.

Date Notified: 21 March 1988

File ref: (L) SD 66/4

County: Lancashire **Site Name:** Clear Beck Meadow

District: Lancaster

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981.

Local Planning Authority: Lancaster City Council

National Grid Reference: SD 616676 **Area:** 0.5 (ha) 1.2 (ac)

Ordnance Survey Sheet 1:50,000: 97 **1:10,000:** SD 66 NW

Date Notified (Under 1981 Act): 1988 **Date of Last Revision:** –

Other Information:

1. This is a new site.
2. The site lies within the Forest of Bowland AONB.

Description and Reasons for Notification:

Clear Beck Meadow is situated in the valley of the River Hindburn approximately 1½ km to the east of the village of Wray and at an altitude of 60 m OD. Although small in size the site represents one of the best examples of species-rich meadow grassland in Lancashire. This nationally scarce and highly vulnerable habitat has, in Lancashire, been almost completely destroyed by agricultural intensification, so that a site displaying such an exceptional diversity of plants and containing many species representative of unimproved meadows is regarded as being of outstanding importance in the County context.

The site lies at the foot of a steep, wooded slope on the edge of the floodplain of the River Hindburn and is enclosed on its southern side by Clear Beck, a tributary stream of the Hindburn. Unlike the larger, more accessible fields adjacent to it, Clear Beck Meadow has escaped agricultural improvement and supports an exceptionally diverse grassland flora. Over 80 species have been recorded from within the main sward, while the associated habitats of woodland and open water contribute a further 57 species, located around the edges of the meadow, to the overall range of plants within the site.

The community is of the “northern hay meadow” type, containing a total of 19 different grass species, co-dominated by sweet vernal-grass *Anthoxanthum odoratum* and red fescue *Festuca rubra*, with crested dog’s-tail *Cynosurus cristatus*, Yorkshire fog *Holcus lanatus*, rough meadowgrass *Poa trivialis* and downy oat-grass *Avenula pubescens* occurring frequently within the sward. Other grasses include quaking grass *Briza media* and yellow oat-grass *Trisetum flavescens*, occurring locally within the site and indicative of more base-rich conditions. Notable by its very low frequency is perennial rye-grass *Lolium perenne*, a species much favoured in modern farming practice and commonly an indicator of agricultural improvement.

The grassland is herb-rich throughout, and supports many species characteristic of old meadows, notably pignut, great burnet, wood anemone, ox-eye daisy, common bistort, two

species of lady's mantle *Alchemilla glabra* and *A. xanthochlora*, yellow rattle, betony, eyebright and meadowsweet. In addition are certain old meadow species indicative of base-rich conditions such as rough hawkbit, crosswort and spring sedge *Carex caryophyllea*. Of particular note are the colonies of common and heath spotted orchids *Dactylorhiza fuchsii* and *D. maculata* spp. *ericetorum*, and the occurrence of the early purple orchid *Orchis mascula* and the locally scarce adder's tongue fern *Ophioglossum vulgatum*. Orchids and sedges, along with other susceptible species such as adder's-tongue fern, are among the first plants to be lost by an intensification of agricultural practice and are, consequently, rarely found now within hay meadows or pastures. The occurrence of such species, the exceptional range of plants characteristic of old meadows and the site's overall floral diversity, combine to make this one of the most important examples of a habitat type which has all but disappeared from the Lancashire countryside.

Date Notified: 18 March 1994

File ref: (L) SD 66/5

County: Lancashire **Site Name:** Far Holme Meadow

District: Lancaster

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981.

Local Planning Authority: Lancaster City Council

National Grid Reference: SD 645655 **Area:** 1.66 (ha) 4.10 (ac)

Ordnance Survey Sheet 1:50,000: 97 **1:10,000:** SD 66 NW

Date Notified (Under 1981 Act): 1994 **Date of Last Revision:** –

Other Information:

1. This is a new site.
2. The site lies within the Forest of Bowland A.O.N.B.

Description and Reasons for Notification:

Far Holme Meadow is an area of lowland grassland situated in the valley of the River Hindburn approximately 4½ km to the south west of the village of Wray. It lies at an altitude of 105 m and supports three types of herb-rich neutral grassland in which over 80 species of plants have been recorded.

The meadow lies at the foot of a wooded slope on the edge of the flood plain of the River Hindburn and is enclosed on its northern and western sides by a river. The grassland plant communities present support many species characteristic of old hay meadows which have been traditionally managed and left unimproved for many years. Such communities are now scarce nationally and represent a highly vulnerable habitat which, in Lancashire, has been severely reduced by agricultural intensification.

The majority of the field supports a hay meadow community with sweet vernal-grass *Anthoxanthum odoratum*, cock's-foot *Dactylis glomerata* and red fescue *Festuca rubra*. Other grass species present include meadow foxtail *Alopecurus pratensis*, Yorkshire-fog *Holcus lanatus* and common bent *Agrostis capillaris*. Herbs are well represented within the sward and include such species as great burnet *Sanguisorba officinalis* and intermediate lady's-mantle *Alchemilla xanthochlora*, which are frequent throughout. Smooth lady's-mantle *A. glabra*, meadow vetchling *Lathyrus pratensis* and bitter-vetch *L. montanus* also occur, as do pignut *Conopodium majus*, common knapweed *Centaurea nigra*, rough hawkbit *Leontodon hispidus* and autumn hawkbit *L. autumnalis*.

This grassland is representative of the meadow foxtail – great burnet flood-meadow community, which is especially characteristic of areas where traditional hay meadow treatment has been applied to seasonally flooded land on alluvial soils. Unlike the great majority of hay fields in Lancashire, this site has escaped extensive agricultural improvement and continues to support a diverse grassland flora. The presence of soft-brome *Bromus hordeaceus*, rough meadow-grass *Poa trivialis* and perennial rye-grass *Lolium perenne* in the sward indicates some

agricultural improvement of the field, as does the absence of sedges *Carex* species. Nevertheless, this site represents the only example of this particular vegetation type remaining in the County.

A species-rich bank occurs in the south-eastern corner of the site and where common spotted-orchid *Dactylorhiza fuchsii* and common twayblade *Listera ovata* are frequent. Many of the plants found within the main sward also occur here, together with marsh hawk's-beard *Crepis paludosa*, primrose *Primula vulgaris* and devil's-bit scabious *Succisa pratensis*. This small area is representative of the quaking-grass sub-community of the sweet vernal-grass–wood crane's-bill meadow community.

A damp area at the foot of the wooded slope contains a variety of species characteristic of wet conditions, some of which are indicative of a base-rich influence. Species present include marsh marigold *Caltha palustris*, meadowsweet *Filipendula ulmaria*, wild angelica *Angelica sylvestris* and common mouse-ear *Cerastium fontanum*, with grasses such as crested dog's-tail *Cynosurus cristatus* and sweet vernal-grass. This combination of plants is characteristic of the crested dog's-tail–marsh marigold flood-pasture community.

COUNTY: LANCASHIRE

SITE NAME: FIELD HEAD MEADOW

DISTRICT: RIBBLE VALLEY

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981 as amended.

Local Planning Authority: Ribble Valley Borough Council

National Grid Reference: SD 725524

Area: 3.29 (ha.) 8.13 (ac.)

Ordnance Survey Sheet 1:50,000: 103

1:10,000: SD 75 SW

Date Notified (Under 1981 Act): 25 May 1999

Other Information:

1. This is a new site.
2. The site lies within the Forest of Rowland AONB.

Description and Reasons for Notification:

Field Head Meadow lies at an altitude of 210m OD, approximately 1.3km east of the village of Slaidburn. The site consists of a single field of enclosed, moderately herb-rich hay meadow, typical of its type in northern England. Field Head Meadow is one of the few remaining herb-rich grasslands present in this part of Lancashire. This vulnerable habitat has become increasingly scarce nationally and has been largely destroyed in Lancashire due to agricultural intensification.

The meadow is a variant of the 'northern hay meadow' type. It is characterised by sweet vernal-grass *Anthoxanthum odoratum*, red fescue *Festuca rubra*, Yorkshire fog *Holcus lanatus*, crested dog's-tail *Cynosurus cristatus*, rough meadow-grass *Poa trivialis* and field woodrush *Luzula campestris* with greater burnet *Sanguisorba officinalis*, yellow rattle *Rhinanthus minor*, lady's mantle *Alchemilla glabra*, eyebright *Euphrasia* agg and pignut *Conopodium majus*. Other species present also include abundant ribwort plantain *Plantago lanceolata*, red clover *Trifolium pratense*, meadow buttercup *Ranunculus acris*, daisy *Bellis perennis* and common sorrel *Rumex acetosa*. Yellow oat-grass *Trisetium flavescens*, common knapweed *Centaurea nigra*, autumn hawkbit *Leontodon autumnalis*, common bird's-foot trefoil *Lotus corniculatus*, smooth hawk's-beard *Crepis capillaris* and meadow vetchling *Lathyrus pratensis* are also occasionally present in the sward.

County: Lancashire **Site Name:** Langcliff Cross Meadow

District: Ribble Valley

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act, 1981.

Local Planning Authority: Ribble Valley Borough Council

National Grid Reference: SD 726517 **Area:** 5.3 (ha) 13.1 (ac)

Ordnance Survey Sheet 1:50 000 103 **1:10 000** SD 75 SW

Date Notified (Under 1949 Act): – **Date of Last Revision:** –

Date Notified (Under 1981 Act): 1989 **Date of Last Revision:** –

Other Information:

1. This is a new site.
2. The site lies within the Forest of Bowland AONB

Description and Reasons for Notification:

Langcliff Cross Meadow lies approximately 1g km to the east of the village of Slaidburn and at an altitude of 190 m OD. It represents one of the best examples of the few remaining species-rich meadow grasslands in the county. This nationally scarce and vulnerable habitat has, in Lancashire, been almost completely destroyed by agricultural intensification so that a site displaying such a high diversity of grass and herb species and containing many plants representative of unimproved meadows, is regarded as being of very great importance in the county context.

The community is a variant of the ‘northern haymeadow’ type and contains a total of 19 grass species, co-dominated by sweet vernal-grass *Anthoxanthum odoratum* and red fescue *Festuca rubra*, with crested dog’s-tail *Cynosurus cristatus*, Yorkshire fog *Holcus lanatus*, common bent *Agrostis capillaris* and downy oat-grass *Avenula pubescens* frequent within the sward. The local occurrence of quaking grass *Briza media* and yellow oat-grass *Trisetum flavescens* along with spring-sedge *Carex caryophyllea* indicate pockets of more base-rich conditions.

The grassland is herb-rich throughout and includes many species characteristic of old meadows such as pignut *Conopodium majus*, great burnet *Sanguisorba officinalis*, smooth lady’s-mantle *Alchemilla glabra*, yellow rattle *Rhinanthus minor* and meadowsweet *Filipendula ulmaria*.

The diversity of species found within the site is increased by the presence of a wet area at the eastern end of the field which supports marsh marigold *Caltha palustris*, marsh arrowgrass *Triglochin palustris* and floating sweet-grass *Glyceria fluitans*.

County: Lancashire **Site Name:** Myttons Meadows

District: Ribble Valley

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act, 1981.

Local Planning Authority: Ribble Valley Borough Council

National Grid Reference: SD 703531 **Area:** 10.0 (ha) 24.7 (ac)

Ordnance Survey Sheet 1:50 000 103 **1:10 000** SD 65 SE
SD 75 SW

Date Notified (Under 1949 Act): – **Date of Last Revision:** –

Date Notified (Under 1981 Act): 1985 **Date of Last Revision:** –

Other Information:

1. This is a new site.
2. The site lies within the Forest of Bowland AONB.

Reasons for Notification:

Myttons Meadows are situated on the south-eastern edge of the Forest of Bowland at an altitude of between 155 m and 180 m OD, approximately 1 km north-west of Slaidburn. The site comprises a series of three fields below Myttons Farm and part of another field to the south, which together represent the largest and best surviving example of traditionally managed, species-rich meadow grassland identified in Lancashire. This nationally scarce and highly vulnerable habitat has, in Lancashire, been almost completely destroyed by agricultural intensification so that, in the county context, this site is regarded as being of outstanding importance.

The soils are derived from glacial drift containing fragments of the underlying Carboniferous Limestone and tend to be neutral to calcareous in nature. The variations in depth of drift, soil moisture content and base status are reflected in slight floristic differences evident within the site, while management practices have had a significant effect upon the species composition of the vegetation within the individual fields.

The eastern field adjacent to Croasdale Brook is managed as a traditional hay meadow and supports a uniformly rich and diverse grassland flora with over 95 species having been recorded. The community is of the 'northern hay meadow' type, containing a range of grass species co-dominated by sweet vernal-grass and red fescue with soft brome, hairy oat-grass, Yorkshire fog and common bent occurring frequently within the sward. The uncommon hybrid fescue is also found here along with perennial rye-grass, meadow foxtail and rough meadow-grass. The field is herb-rich throughout

and supports many species characteristic of old meadows, notably wood anemone, common bistort, two species of lady's mantle *Alchemilla glabra* and *A. xanthochlora*, pignut, great burnet, yellow rattle and meadowsweet. In addition are certain old meadow species indicative of base-rich conditions such as rough hawkbit, meadow crane's-bill and cross-wort. A range of sedges occur within the community including spring *Carex caryophyllea*, carnation *C. panicea*, hairy *C. hirta*, glaucous *C. flacca*, flea *C. pulicaris* and pale sedge *C. pallescens*, while occasional wetter areas are dominated by lesser pond-sedge *C. acutiformis* in association with brown sedge *C. disticha*, water avens, marsh marigold and marsh hawk's-beard. Most notable amongst the low-frequency associates of the main community are melancholy thistle (occurring mainly along the edges but also within the main sward), globeflower, common spotted orchid and common twayblade which occur between the Eller Beck and a wall which forms the southern boundary of the field.

The adjacent field to the south contains a small knoll which, presumably because of its shape, has escaped agricultural improvement. The community is akin to that described above but, in addition to melancholy thistle, common spotted orchid and twayblade, includes such notable species as fragrant orchid and the locally scarce adder's-tongue fern.

To the west is a small field formerly part of the larger hay-field above it but fenced off because of steeply sloping ground and waterlogged conditions at the foot of the slope. The management of this field differs from those on either side of it as it is grazed rather than mown, and this is reflected in the patchiness and uneven height of the vegetation. The lower part of the field is wet and the vegetation is dominated by lesser pond-sedge with Yorkshire fog, red fescue, tall fescue and rough meadow-grass and abundant meadowsweet, marsh marigold, creeping buttercup and water avens. Along the eastern boundary the banks of a small stream support globeflower, marsh valerian, marsh hawk's-beard, bitter vetch and great hairy willow-herb with abundant glaucous sweet-grass in the shallow water. The middle section of the field is occupied by a steep bank supporting the same species-rich, northern hay-meadow community as the adjacent fields. Species indicative of base-rich conditions occur, such as hairy oat-grass, quaking grass, glaucous sedge, spring-sedge and rough hawkbit, but in contrast other areas on the upper slopes support species typical of more acid conditions such as mat-grass, common bent, oval sedge, many-headed wood-rush and tormentil.

To the north-west is the largest of the three fields which is also under traditional hay-meadow management with aftermath grazing. The higher frequency of soft brome and perennial rye-grass in this field plus the apparent absence of sedges, is indicative of more intensive agricultural management practices in the past which have altered the species composition to some extent. However, the sward is uniformly rich throughout in grasses and herbs and is typically co-dominated by sweet vernal grass, crested dog's-tail, soft-brome and red fescue, with an abundance of great burnet, yellow rattle and pignut, frequent oxeye daisy, rough hawkbit, meadow buttercup, red clover and lady's mantle *Alchemilla glabra* and *A. xanthochlora* and occasional wood anemone, tufted vetch and burnet saxifrage.

COUNTY: LANCASHIRE

SITE NAME: ROBERT HALL MOOR

DISTRICT: LANCASTER

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981.

Local Planning Authority: Lancaster City Council

National Grid Reference: SD 632688

Area: 18.8 (ha.) 46.5 (ac.)

Ordnance Survey Sheet 1:50,000: 97

1:10,000: SD 66 NW

Date Notified (Under 1949 Act): 1979

Date of Last Revision: –

Date Notified (Under 1981 Act): 1984

Date of Last Revision: 1984

Other Information:

1. Boundary revised by partial deletion at renotification.

Reasons for Notification:

Robert Hall Moor is an area of wet unimproved grassland, flushes and scrub situated on a drumlin (a glacial mound) rising from about 90m to a height of 107m, 4km south west of Wennington. The site is remarkable for the range of plants represented (over 150 species have been recorded), including two nationally rare communities and several species which are rare or very limited in their distribution. This assemblage of species is unique in Lancashire. Its most outstanding feature as a habitat is that it is the only extensive example of species-rich undrained and unimproved base-flushed neutral grassland known to remain in the county.

The remains of hedges and ditches mark old field boundaries within the site but there is no indication that the land, which is currently used as pasture, has ever been ploughed, re-seeded, under-drained or otherwise improved. The land is wet due to the general impermeability of the clayey soil such that water seeps out of the slopes as numerous flushes or emerges as springs lower down. It supports extensive plant communities which elsewhere are confined to small flushes or have been eliminated altogether by drainage. The water is base-enriched, creating basic influences where it emerges and neutral rather than acid conditions over much of the site.

Most of the grassland consists of a community of purple moor-grass *Molinia caerulea* with an abundance of small sedges *Carex demissa*, *echinata*, *flacca*, *hirta*, *hostiana*, *nigra*, *ovalis*, *panicea*, *pilulifera* and *pulicaris*, with creeping willow and numerous herbaceous species among which jointed rush, devil's-bit scabious, knapweed and marsh ragwort are conspicuous. More open areas, particularly the flushes, support a number of species which have a very local distribution in Lancashire including butterwort, saw-wort, bog pimpernel, bog asphodel, grass of Parnassus, marsh orchid and bird's-eye primrose which is a notably rare plant nationally. This species-rich type of *Molinia* community (as opposed to species-poor *Molinia* which is common on peat) which once no doubt was widespread, has been reduced so much by drainage that it is now considered to be a rare and endangered habitat in Britain. On top of the drumlin and also on higher ground in various places which is not influenced by emergent water there are small areas of acidic marshy grassland, rush dominated and species-poor.

At the base of the drumlin on the south side is another rare community: a small area of marsh dominated by blunt-flowered rush *Juncus subnodulosus* accompanied by characteristic marsh plants such as meadowsweet, water mint, marsh pennywort, angelica, ragged robin, marsh cinquefoil and marsh ragwort. The blunt-flowered rush community, which is associated with basic groundwater, is rare in Britain. The rush itself is rare in

Lancashire, known only at Crag Bank SSSI and a few other scattered locations, and is uncommon in the north west of England as a whole.

There is extensive scrub on the site, mainly of common gorse but also the less common western gorse *Ulex gallii*, hawthorn and rose. Uncommon species such as petty whin and dyer's greenweed have also been recorded. The gorse grades into birch scrub and woodland at the eastern end. The site is crossed by the Thirlmere aqueduct, the route of which is marked by a strip of reseeded grassland. There is a small flighting pond in the lowest part of the site, which is being colonised by pondweed spike-rush and bottle sedges.

County: Lancashire **Site Name:** **Roeburndale Woods**

District: Lancaster

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act, 1981.

Local Planning Authority: Lancaster City Council

National Grid Reference: SD 609657 **Area:** 41.7 (ha) 103.0 (ac)

Ordnance Survey Sheet 1:50 000 97 **1:10 000** SD 66 NW, SW

Date Notified (Under 1949 Act): 1976 **Date of Last Revision:** –

Date Notified (Under 1981 Act): 1983/1984 **Date of Last Revision:** 1983

Other Information:

1. This site is listed in 'A Nature Conservation Review', edited by D. A. Ratcliffe (1977), Cambridge University Press.
2. The site contains red squirrels, a protected species listed in Schedule 5 of the above Act.
3. The boundary of this site has been revised by a small extension.
4. The site is within the Forest of Bowland AONB.

Reasons for Notification:

The extensive woodlands of the Roeburn gorge lie south of the village of Wray in the Lune valley. They contain the best examples of the range of northern deciduous woodland types characteristic of the River Lune and its tributaries draining the north side of the Bowland Fells. These nationally important woods lie mainly on the steep east side of the gorge but extend in places onto the plateau above. They are ungrazed by farm stock, have been little altered by conifer planting, are believed to be an ancient woodland site, and constitute one of the largest areas of broad-leaved woodland in the county.

The Carboniferous sandstone, mudstone and calcareous shales of the Bowland Series give rise to a wide range of soils from acidic podzols to the very basic brown earths which is reflected in the range of woodland types. The most extensive of these is the upland sessile oak wood with a characteristic ground flora including wavy hair-grass, bilberry and heath mosses in the most acid locations such as on the sandstone outcrops of Hill Kirks Scar, but dominated by ferns on the gentler slopes of

Outhwaite Wood where a high proportion of birch occurs in many places. The basic soils of Hill Kirks Wood support western valley ash-wych elm wood with a characteristic ground flora including dog's mercury, wood brome and ramsons. Between this and Outhwaite Wood, and downstream in Alcocks Wood, areas of more intermediate soils support acid sessile oak-hazel-ash woods. The lines of streams are marked by narrow strips of valley alder wood and this expands to occupy Bowskill Wood End and Pasture Wood at the upstream end of the SSSI. On the flood plain below Outhwaite Wood is a small area of bird cherry-alder wood. Small-leaved lime occurs at scattered locations including some fine trees in Bowskill Wood. Other plants of interest include a colony of the rare grass wood fescue *Festuca altissima* and the rare moss *Rhytidiadelphus subpinnatus*. Red squirrels, a protected species, are resident in the wood.

County: Lancashire **Site Name:** Standridge Farm
Pasture

District: Ribble Valley

Status: Site of Special Scientific Interest (SSSI) notified under Section
28 of the Wildlife and Countryside Act, 1981, as amended.

Local Planning Authority: Ribble Valley Borough Council

National Grid Reference: SD 733534 **Area:** 4.46 (ha) 11.02 (ac)

Ordnance Survey Sheet 1:50 000 103 **1:10 000** SD 75 SW

Date Notified (Under 1949 Act): – **Date of Last Revision:** –

Date Notified (Under 1981 Act): 14 May 1998 **Date of Last Revision:** –

Other Information:

1. This is a new site.
2. The site lies within the Forest of Bowland AONB.

Description and Reasons for Notification:

Standridge Farm Pasture lies at an altitude of between 225–250 m OD, approximately 2.5 km north-east of the village of Slaidburn. The site consists of an unimproved enclosed herb-rich flushed pasture on a north-facing slope. The underlying Bowland Shales give rise to base-rich conditions and impeded drainage, which results in much spring-fed flushing of the slope with ground water. Standridge Farm Pasture is one of the few remaining unimproved herb-rich pastures present in this part of Lancashire. This vulnerable habitat has become increasingly scarce nationally and has been largely destroyed in Lancashire due to agricultural intensification.

The site supports a mosaic of flushed mire and neutral grassland communities. The flushed mire community is characterised by purple moor-grass *Molinia caerulea*, quaking grass *Briza media*, common sedge *Carex nigra*, carnation sedge *C. panicea*, glaucous sedge *C. flacca* and jointed-rush *Juncus articulatus*, with bird's-eye primrose *Primula farinosa*, globeflower *Trollius europaeus*, marsh valerian *Valeriana dioica*, grass-of-Parnassus *Parnassia palustris*, devil's-bit scabious *Succisa pratensis* and sneezewort *Achillea ptarmica*. Round-leaved sundew *Drosera rotundifolia* is occasionally present in more acidic flushes.

The grassland communities are characterised by sweet vernal-grass *Anthoxanthum odoratum*, red fescue *Festuca rubra*, crested dog's-tail *Cynosurus cristatus* and Yorkshire fog *Holcus lanatus*, with greater burnet *Sanguisorba officinalis*, early-purple orchid *Orchis mascula*, saw-wort

Serratula tinctoria, common knapweed *Centaurea nigra*, tormentil *Potentilla erecta*, dyer's greenweed *Genista tinctoria*, meadow buttercup *Ranunculus acris* and selfheal *Prunella vulgaris*.



HEAD OFFICE

Genesis Centre,
Birchwood Science Park,
Warrington
WA3 7BH

Tel: 01925 844004
E-mail: tep@tep.uk.com

**MARKET
HARBOROUGH**

No. 1 The Chambers,
Bowden Business Village,
Market Harborough,
Leicestershire,
LE16 7SA

Tel: 01858 383120
E-mail: mh@tep.uk.com

GATESHEAD

Office 26, Gateshead
International Business
Centre,
Mulgrave Terrace,
Gateshead
NE8 1AN

Tel: 0191 605 3340
E-mail: gateshead@tep.uk.com

LONDON

8 Trinity Street,
London,
SE1 1DB

Tel: 020 3096 6050
E-mail: london@tep.uk.com

CORNWALL

4 Park Noweth,
Churchtown,
Cury,
Helston
Cornwall
TR12 7BW

Tel: 01326 240081
E-mail: cornwall@tep.uk.com
