Appendix 7A

Extended Phase 1 Habitat Survey Report

Welsh Government

Global Centre for Rail Excellence (GCRE)

Extended Phase 1 Habitat Survey Report

Issue | 17 June 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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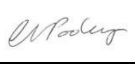
		Signature			
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1 Introduction

1.1 Background

Ove Arup & Partners Ltd (Arup) was commissioned by the Welsh Government (WG) to undertake a range of consultancy services in relation to the Global Centre for Rail Excellence (GCRE), hereafter referred to as 'the Project'.

As part of that commission, a range of ecological surveys have been undertaken to identify the baseline ecological conditions of the Project area, to inform the assessment of impacts as part of the Environmental Impact Assessment (EIA) process.

This document reports on the Extended Phase 1 Habitat Survey undertaken for the Project.

1.2 Objectives

The aim of the Extended Phase 1 Habitat Survey is to:

- Establish the presence of habitats and species on site and in the surrounding area through a desk study and a field survey; and
- Assess the potential of the site for supporting protected and/or notable species.

2 Project Description and Context

The WG are proposing to develop a rail testing, maintenance, research, development and storage facility (also referred to as the Global Rail Centre for Excellence) at the site of the Onllwyn washery and Nant Helen open cast mine site. The site for development is approximately 475 ha.

The proposed site is currently being mined by Celtic Energy, who will cease extraction operations in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and agreements with Powys County Council (PCC) and Neath Port Talbot County Borough Council (NPTCBC). This includes Section 106 planning obligations and planning conditions that need to be discharged.

Celtic Energy has submitted two recent planning applications for the site, including: the revised restoration strategy for approval (Planning reference number: 19/1899/REM) which would change the existing approved restoration scheme (for planning application ref 18/1070/REM). And, the Nant Helen complementary earthworks application for approval (Planning reference number: 20/0738/FUL) The purpose of these applications is to allow for a ‘flexible and adaptable landform for a variety of future uses on restoration, including the use of the site as a rail testing and storage facility, proposed by the WG.

3 Site Description

The study area is shown on Figure 1 and is hereafter referred to as the ‘site’.

The site is within the Dulais Valley located within Powys and Neath Port Talbot, with the Brecon Beacons National Park Authority boundary immediately to the north. Nearby settlements include Onllwyn, Seven Sisters, Ystradgynlais, Caehopkin, Abercrave or Coelbren.

The site is predominantly brownfield land that has been heavily worked by open cast mining. Much of the site has been revegetated.

4 Study Area

The study area encompasses the majority of land within the Nant Helen open cast operational site, which at the time of commencing the ecological surveys was considered to be the likely boundary of the project site.

5 Legislation

A framework of international (European), national and local legislation and planning policy guidance exists to protect and conserve wildlife and habitats. The following legislation exists to protect habitats and species of nature conservation importance:

i. The Conservation of Habitats and Species Regulations 2017 (the Habitat Regulations) (as amended) which transposes Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive) into UK law;

ii. The Birds Directive (Council Directive 2009/147/EC on the conservation of wild birds) (the Wild Birds Directive);

iii. Wildlife and Countryside Act 1981 (as amended) (WCA);

iv. The Invasive Alien Species (Enforcement and Permitting) Order 2019;

v. Environment (Wales) Act 2016;

vi. The Countryside and Rights of Way Act 2000;

vii. The Hedgerow Regulations 1997; and

viii. Protection of Badgers Act 1992.

These pieces of legislation include a number of offences relating to protected species and requirements for licences to allow construction works to proceed. In addition, the Habitats Regulations set out the requirement for the consideration of the potential effects of a project on European designated sites.

Actions which are prohibited by legislation can be made lawful on the approval and granting of a licence from Natural Resources Wales (NRW), subject to conditions.

Full details of the legislation are provided in Appendix A.

6 Methodology

6.1 Existing Data Review

The desk study element involved two methodologies: a review of existing ecological reports and an ecological data search.

Existing ecological data that informed the 2011 Environmental Statement[1], including previous desk study results and further surveys, were reviewed.

6.2 Desk Study

An ecological data search was carried out to identify statutory designated sites within 5 km of the Site centre point. Online searches were carried out using the Multi Agency Geographic Information for the Countryside (MAGIC)[2], Natural Resources Wales website[3] and the Joint Nature Conservation Committee (JNCC) website[4].

In addition to this, protected and notable[5] species, invasive non-native species[6] and non-statutory site data within 5 km of the Site centre point were obtained from the Biodiversity Information Service for Powys & Brecon Beacons National Park (BIS)[7] on 21st November 2018.

6.3 Field Survey

6.3.1 Habitats

An Extended Phase 1 Habitat survey was carried out on the site in accordance with standard JNCC Phase 1 Habitat Survey methodology[8] on the following dates:

- 26th November 2018,
- 25th April 2019,
- 26th April 2019; and

[1] Environmental Statement (2011), Celtic Energy.
[2] http://magic.defra.gov.uk/ Accessed online 12/11/2019.
[3] https://naturalresources.wales/conservation-biodiversity-and-wildlife/find-protected-areas-of-land-and-seas/designated-sites-search/?lang=en Accessed online 21/11/2018.
[4] http://jncc.defra.gov.uk Accessed online 12/11/2019.
[5] Notable' species and habitats considered in this report include species and habitats of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales, under section 7 of the Environment (Wales) Act 2016, in addition to any species considered to be of significance for nature conservation such species listed in red data books, the Royal Society for the Protection of Birds (RSPB) 'Birds of Conservation Concern' lists and or Local Biodiversity Action Plans (LBAPs).
[6] As listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) and/or Part 2 Schedule 2 of The Invasive Alien Species (Enforcement and Permitting) Order 2019
[7] https://www.bis.org.uk/home Accessed online 12/11/2019.
[8] Joint Nature Conservation Committee, (2010). *Handbook for Phase 1 habitat survey – a technique for environmental audit*. http://jncc.defra.gov.uk/page-2468.

- 29th May 2019.

Surveys were carried out by Arup ecologists. Habitat areas greater than 0.1 ha were mapped and Target Notes (TN) were used to highlight any features/habitats of interest and/or suitable habitat for protected species. For completeness, any Target Notes identified as incidental records during other surveys on site have also been included.

6.3.2 Species

In conjunction with the Extended Phase 1 Habitat Survey, the potential for the site to support any legally protected species and/or other notable species were recorded.

Relevant species included all those protected by European or UK law, and notable species including those identified as being of principal importance in Wales, under Section 7 of the Environment (Wales) Act 2016 (Appendix A).

Detailed faunal surveys were not undertaken at this time, rather the potential for the site to support each species/species group was assessed based on the known range of each and the suitability of the habitats within the site. Any field evidence or sightings of such species was recorded as seen. The following species were considered:

6.3.2.1 Badger (*Meles meles*)

Any evidence of badger setts or other badger activity such as paths, latrines or signs of foraging found during the Extended Phase 1 Habitat Survey was target noted and mapped. The survey methodology used was in accordance with best practice survey guidance[9], including the classification of any setts recorded.

6.3.2.2 Bats

Any buildings, structures and or trees within the study area were appraised (from the ground) for their suitability to support breeding, resting and hibernating bats using survey methods outlined in best practice survey guidance[10]. In addition, habitats were appraised for their suitability to support foraging and commuting bats.

6.3.2.3 Hazel Dormouse (*Muscardinus avellanarius*)

The site was assessed for its suitability to support hazel dormice, based on best practice survey guidance[11].

[9] Harris, S., Cresswell, P. and Jefferies, D., (1989). *Surveying Badgers.* Mammal Society.
[10] Collins, J. (ed.) (2016). *Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn).* The Bat Conservation Trust, London.
[11] Bright, P. *et al* (2006). *The Dormouse conservation handbook – second edition*, English Nature.

6.3.2.4 Otter (*Lutra lutra*)

Water bodies, if present on the site were assessed for their suitability to support otter, in accordance with best practice survey guidance[12].

6.3.2.5 Water Vole (*Arvicola amphibius*)

If present, water bodies on site were assessed for the suitability for water vole using best practice survey guidance[13].

6.3.2.6 Birds

The site was surveyed for habitat suitable to support protected bird species and species of conservation significance, including nesting and wintering habitat. Any bird species seen at the site were recorded and any further evidence of species such as old nests or owl pellets was noted.

6.3.2.7 Reptiles

The site was appraised for its suitability to support reptiles, in accordance with published guidance[14].

6.3.2.8 Amphibians

The site was appraised for its suitability to support amphibians, both protected species and species of conservation concern.

6.3.2.9 Other Species

The site was also appraised for its suitability to support other protected or notable fauna including mammals and invertebrates.

6.3.2.10 Invasive Non-Native Plant Species

The site was searched for evidence of invasive plant species as listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) and/or Part 2 Schedule 2 of The Invasive Alien Species (Enforcement and Permitting) Order 2019, such as Japanese knotweed (*Fallopia japonica*), Himalayan balsam (*Impatiens glandulifera*) and giant hogweed (*Heracleum mantegazzianum*).

[12] Chanin, P., (2003). *Monitoring the Otter, Lutra lutra. Conserving Natura 2000 Rivers Monitoring Series No. 10.*, English Nature, Peterborough.
[13] Strachan R, Moorhouse T and M Gelling (2011) *Water vole conservation handbook, Third edition*, Wild Cru, Oxford University.
[14] Gent, T. and Gibson, S. (2003). *Herpetofauna Workers Manual.* JNCC, Peterborough.

6.4 Limitations

A number of the surveys visits were undertaken outside of the optimal period for undertaking botanical surveys (April-October); however, it is considered that sufficient (botanical) species information was obtained in order to classify the habitat types on site.

Whilst not a full protected species or botanical survey, the Extended Phase 1 Habitat Survey methodology enables an experienced ecologist to obtain a sufficient understanding of the ecology of a site in order to either confirm the conservation importance of the site, and assess the potential for impacts on habitats/species likely to represent a material consideration in planning terms, or to ascertain that further surveys will be required before such confirmation can be made.

The findings presented in this study represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys are limited by factors which affect the presence of flora and fauna, factors such as the time of year and natural behaviour of the animals. Nevertheless, these surveys were conducted at the optimal survey periods and using methodologies which are in accordance with published guidelines.

7 Results

7.1 Existing Data Review

The data in Table 1 below were collated from the surveys that were undertaken to inform an Environmental Statement that was prepared for the site in 2011 for a western extension to the Nant Helen (Extension) Surface Coal Mine, and additional surveys that were conducted on site between 2012 and 2016. The site for the 2011 Environmental Statement encompassed the existing and operational Nant Helen Site and a proposed extension (approximately 25 ha) to the south-west.

Table 1. Summary of existing survey data

Survey	Methodology
Extended Phase 1 Habitat Survey	An Extended Phase 1 Habitat Survey, undertaken on a number of visits between April and August 2010 of the site and surrounding areas, recorded a variety of habitats including plantation woodland, broadleaved woodland, hedgerows, scrub, acid marshy/grassland, mire, ephemeral/short perennial, watercourses and standing water.
Phase 2 Vegetation Survey	Grassland vegetation and areas dominated by purple moor grass (*Molinia caerula*) within the site were subject to National Vegetation Classification (NVC) surveys, in July 2010. An NVC survey was undertaken on restored grassland areas at Nant Helen in August 2013. Bog pool, mire and various grassland communities were identified on site.
Bryophyte & lichen Survey	A bryophyte and lichen survey was undertaken on an area of translocated bog and surrounding engineered mounds over two days in August 2012. Although the bryophoyte and lichen communities on site were relatively diverse, no protected or notable species were identified.
River Corridor Surveys	A survey to describe the physical characteristics of the watercourses on and near the site was undertaken following the methods outlines in the River Habitat Survey[15]. The majority of the watercourses within the site have been previously destroyed and restored to stone-line channels that only discharge water during heavy rain. One of two natural watercourses is a remnant section of the Nant Gyrlais, which above and below this undisturbed section has been lost to previous opencasting. The Nant Penrhos is a wooded gorge, disturbed in part by deep mine tips.
Badger Survey	Signs of badger presence, including setts, latrines, paths, prints, hairs and snuffle holes were searched for on and adjacent to the site. No signs of badgers were identified during the survey.
Bat Surveys - roosts	All trees and buildings within and adjacent to the site were assessed for their suitability to support roosting bats in June 2010, in-line with good practice guidelines of the time[16][17]. Trees that were assessed from the ground as being suitable for bats were subject to aerial inspections. Only one tree was identified

[15] Environment Agency (2003). *River Habitat Survey in Britain and Ireland*. Field Survey Guidance Manual.
[16] Mitchell-Jones, A. J. (2004). *Bat Mitigation Guidelines*. English Nature.
[17] Bat Conservation Trust (2007). *Bat Surveys – Good Practice Guidelines*. Bat Conservation Trust, London.

Survey	Methodology
	from aerial surveys as being suitable for roosting bats and a single pipistrelle was found in a small cavity. Twenty bat boxes were installed on site in 2014 and 2015 as mitigation for previous expansion of the Nant Helen mine. These were inspected for signs of use by bats in 2015 and 2016, using a torch. In 2015, two boxes were found to be occupied by a pipistrelle bat. In 2016, 3 boxes were found to be occupied by a pipistrelle bat.
Bat Surveys – transect and static monitoring	Activity surveys in the form of walked transects and the deployment of static detectors were also undertaken. Seven bat species (common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle *P. pygmaeus*), Nathusius pipistrelle (*P. nathusii*), brown long-eared (*Plecotus auratus*), noctule (*Nyctalus noctula*), serotine (*Eptisecus serotinus*) and Leisler's (*N. leislerii*)) were recorded commuting/foraging within and adjacent to the site during the static and transect surveys, with most records comprising pipistrelles.
Dormouse Survey	One hundred dormouse nest tubes were deployed in July 2010 in four representative areas of suitable habitat on site. The tubes were then checked for presence/signs of dormice once per month in August, September, October and November 2010. Additionally, an inspection of hazel nuts was undertaken, to determine whether they had been opened by dormice. No dormice or signs of dormice were identified during the nest tube checks and no hazel nuts were found to have been opened by dormice.
Otter Survey	Three watercourses (Nant Penrhos, Nant Gyrlais and an unnamed watercourse) were surveyed in July and September 2010 for their suitability to support otters and for any signs of otter presence, including spraints, feeding remains and holts. No signs of otter were identified in proximity to any of watercourses or waterbodies that were surveyed.
Water Vole Survey	Watercourses and waterbodies were surveyed for signs of water voles. The watercourses were found to be generally unsuitable due to being dry for extended periods. No signs of water vole were identified in proximity to any of watercourses or waterbodies that were surveyed.
Breeding & Wintering Bird Surveys	Breeding bird surveys were undertaken on five visits between April and July 2010 using an abbreviated form of the Common Bird Census methodology.[18] An additional survey was undertaken in March 2010 to record any early breeding species. Surveys at dusk were undertaken on three occasions in June and July 2010 to record crepuscular species. A wintering bird survey was undertaken on four visits between November 2009 and February 2010. Twenty-one species were recorded as breeding/possibly breeding within and adjacent to site. Six of these species were listed on Section 42 of the Natural Environment and Rural Communities Act (NERC)[19] and five species were red listed on the Birds of Conservation Concern 3 (BoCC).[20] No crepuscular species were recorded. Crossbills (*Loxia curvirostra*) were recorded, which are listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended), but no evidence of breeding was recorded. Five species listed on Section 42 were recorded, four of which were also red listed on BoCC 3.

[18] Bibby *et al.* (2000). *Bird Census Techniques Second Edition*.
[19] Section 42 of the NERC act as been replaced by Section 8 of the Environment (Wales) Act 2016.
[20] BoCC 3 has now been replaced by BoCC 4. There is also a BoCC applicable to Wales.

Survey	Methodology
Specialist Bird Surveys	Specific honey buzzard (*Pernis apivorus*) surveys were undertaken on five visits between July and August 2010. Observations were also made for other raptor species and a search for old nests was conducted. No nesting honey buzzards were recorded on or adjacent to the site. Neither goshawk (*Accipiter gentilis*) nor peregrine (*Falco peregrinus*) were recorded but three old buzzard (*Buteo buteo*) nests were found. No barn owl (*Tyto alba*) were identified during bat survey work but tawny owl (*Strix aluco*) were heard.
Reptile Survey	One hundred and ninety artificial refugia (roofing felt) were deployed along 22 transects between May and July 2010. The artificial refugia, along with any natural refugia (e.g. log piles) were checked a minimum of six times between June and October 2010 in suitable weather conditions. Common lizard (*Zootoca vivipara*) and slow worm (*Anguis fragilis*) were both recorded in low numbers across the site.
Great Crested Newt Survey	Bottle trapping, torching and egg searching were undertaken on all waterbodies on site in 2009 and 2010. All surveys in 2009 and 2010 were negative for great crested newts. Good populations of palmate newt (*Lissotriton helveticus*) were identified on site. Common toad (*Bufo bufo*) and common frog (*Rana temporaria*) were also present.
Invertebrate Surveys	Sweep netting and a direct searching survey was undertaken in August 2009. Moth trapping was conducted on five evenings between May and September 2010 in representative habitat types across the site. Seven routes on site were walked to record butterflies on six visits in 2010 between May and July. Surveys for marsh Fritillary (*Euphydryas aurinia*) adults carried out during May-June 2010 and larval webs were searched for in August and September 2010. Eighty-six invertebrate species were recorded including one Red Data Book and one Nationally Scarce species. Ninety-two moth species and nineteen other invertebrates were recorded during the moth trap surveys, including one nationally scarce moth and 11 UK Biodiversity Action Plan (UKBAP) species. Thirteen butterfly species were recorded, two of which were listed on Section 42 and on the UKBAP[21]. No adult or larval marsh fritillary were identified on site.

7.2 Desk Study

BIS provided records of non-statutory designated sites and protected/notable species on 21st November 2018, within a 5 km search radius from the Site and only records from within the last 10 years were requested. Statutory designated sites within 5 km were identified using MAGIC.

7.2.1 Statutory Designated Sites

Fourteen statutory designated sites were identified within 5 km of the Site. They comprised one Special Area of Conservation (SAC), 12 Sites of Special Scientific Interest (SSSI) (one of which is also designated as a National Nature Reserve (NNR)) and one National Park. They are detailed in Table 2 below and shown in Figures 2 and 3.

[21] The UKBAP was succeeded by the 'UK Post-2010 Biodiversity Framework' in July 2012. The UK list of priority species, however, remains an important reference source and has been used to help draw up statutory lists of priority species.

Table 2. Statutory designated sites within 5 km of the Site

Site Name	Designation	Features	Approximate Distance and Orientation from Site
Coedydd Nedd a Mellte	SAC	Annex I habitats that are a primary reason for selection of this site include Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles. Coedydd Nedd a Mellte is a very large and diverse example of old sessile oak wood in south Wales. The woods extend along a series of deeply incised valleys and ravines, and contain complex mosaics of sessile oak *Quercus petraea* woodland, ash *Fraxinus excelsior* woodland (some of which is referable to Annex I type 9180 *Tilio-Acerion* forests of slopes, screes and ravines), and transitions to lowland woodland types. The whole site is biologically rich, with many woodland plant communities represented and rich bryophyte and lichen assemblages. Notable higher plant species include wood fescue *Festuca altissima* and the ferns *Dryopteris aemula, Hymenophyllum tunbrigense* and *Asplenium viride*.	2.9 km south-east
Nant Llech	SSSI	The Nant Lech, flowing off the Millstone Grit rocks and on to Coal Measure shales has carved a steep-sided valley of special interest on account of its rich variety of woodland and cliff plant communities. A range of woodland types has formed in response to variations in soil moisture content and soil chemistry. Bird life is rich and the uncommon soldier beetle (*Podabrus alpinus*) has been recorded from the wood.	100 m north-east
Gors Llwyn, Onllwyn	SSSI	This site contains a range of peat-depositing vegetation communities. Peat deposition has been sufficiently great in part of the site to form a dome shaped mass of peat above the general water table, known as a raised mire. There are very few other examples of this formation known in mid and south Wales. North-east of the complex of mires is an area of acidic pasture. Drier ridges divide up a series of wet flushes which support a range of wetland species e.g. whorled caraway	40 m east

Site Name	Designation	Features	Approximate Distance and Orientation from Site
		(*Carum verticillatum*), meadow thistle (*Cirsium dissectum*) and sharp-flowered rush (*Juncus acutiflorus*). These plants form a clearly defined community of extremely limited distribution in Europe, occurring only along the southern Atlantic seaboard.	
Caeau Ton-y-Fildre	SSSI	The site comprises two unimproved herb-rich pastures on the north bank of Nant y Bryn. The western field supports a wide range of species characteristic of damp, flushed peaty pasture, including globeflower (*Trollius europaeus*), meadow thistle, whorled caraway and marsh arrowgrass (*Triglochin palustris*). Notable species in the eastern field include greater butterfly-orchid (*Platanthera chlorantha*), saw-wort (*Serratula tinctorial*), dyer's greenweed (*Genista tinctora*) and petty whin (*G. anglica*). Over 100 species of flowering plants and ferns having been recorded. The area also supports invertebrates, especially butterflies.	260 m east
Waun Ton-y-Spyddaden	SSSI	A series of small, unimproved, herb-rich hay meadows lying on a very gentle slope. The site demonstrates well the effects of traditional management on the moorland vegetation to be found on the better soils in this part of Wales. A vivid gradation in plant communities can be seen as the slope descends from north to south. At the top end is a typical moorland community of mat-grass (*Nardus stricta*), heath rush (*Juncus* squarrosus), deergrass (*Scirpus cespitosus*) and sheep's-fescue (*Festuca ovina*). This changes into grass heath communities of brown bent (*Agrostis canina*), red fescue (*Festuca rubra*), lousewort (*Pedicularis sylvatica*) and heath spotted-orchid (*Dactylorhiza maculata* spp. e*ricetorum*), which in turn grade into purple moor-grass/sedge associations.	2.2 km north-east
Rhos Hen-Glyn-Isaf	SSSI	This site comprises an extensive and varied area of damp/wet heathy pasture above the valley of the River Giedd, near Ystradgynlais. It is noted for its wide variety of plant species, including several that are uncommon in Brecknock. A large part of the site supports a sward dominated by purple moor-grass, sedges and common cottongrass (*Eriophorum angustifolium*). Other species include bog pimpernel (*Anagallis tenella*), round-leaved sundew (*Drosera rotundifolia*)., few-flowered spike-	2.7 km north-west

Site Name	Designation	Features	Approximate Distance and Orientation from Site
		rush (*Eleocharis quinqueflora*), common butter-wort (*Pinguicula vulgari*) and devil's-bit scabious (*Succisa pratensis*). Additional interest is provided by stands of alder (*Alnus glutinosa*) and by ditches which support species such as hemp-agrimony (*Eupatorium cannabinum*), bogbean (*Menyanthes trifoliata*), bog pondweed (*Potamogeton polygonifolius*) and the locally uncommon fern (*Osmunda regalis*).	
Mynydd Du	SSSI	This is an important upland site of special interest for its vegetation, open water and birdlife. In addition to the Old Red Sandstone there are significant outcrops of Carboniferous Limestone and Millstone Grit. The summit ridges are notable for their extensive grassland, dominated in the main by matgrass. Small areas still support heather *Calluna vulgaris* and bilberry *Vaccinium myrtillus.* The north and east facing cliffs of Bannau Sir Gaer and Bannau Brycheiniog support an interesting arctic-alpine flora, with such species as northern bedstraw (*Galium boreale*), dwarf willow (*Salix herbacea*), lesser meadow-rue (*Thalictrum minus*) and roseroot (*Sedum rosea*), together with a rich moss and liverwort flora.	3 km north
Ogof Ffynnon Ddu	SSSI	The site contains part of an extensive cave system which has at least 40 kilometres of passages, the largest length in any Welsh cave, situated within a vertical range of 300 metres, which is the greatest in any cave in Britain. A number of rare crustacean species restricted to subterranean habitats are of particular note.	3.3 km north-east
Ogof Ffynnon Ddu - Pant Mawr	SSSI, NNR	The undulating upland plateau above the cave system supports the finest limestone pavement in mid and south Wales. It is rich in plant species, including such rarities as lily-of-the valley (*Convallaria majalis*), soft-leaved sedge (*C. montana*), mountain melick (*Melica nutans*), lesser meadow-rue (*Thalictrum minus*) and the nationally rare hairy greenweed (*Genista pilosa*). These areas of sheltered, deep heather provide suitable habitat for nightjar (*Caprimulgus europaeus*), offering probably one of the last breeding localities in Brecknock for this	3.3 km north-east

Site Name	Designation	Features	Approximate Distance and Orientation from Site
		summer-visiting bird. Also present within the site are a number of peat-bottomed pools with a well-developed upland dragonfly and damselfly population.	
Nant y Rhos	SSSI	The site consists of a single, gently sloping enclosure on the west side of the Nant y Rhos, 2.5 km south-east of Ystalyfera, at an altitude of 140 m above sea level. The geology of this area comprises Middle Coal Measure shales, overlain for the most part by boulder clay. The site is of special interest for its species-rich fen meadow vegetation, which includes large populations of meadow thistle and whorled caraway. Most of the site supports vegetation that is dominated by purple moor-grass, accompanied by a range of characteristic associates including meadow thistle, flea sedge (*Carex pulicaris*), carnation sedge (*C. panicea*) and tawny sedge (*C. hostiana*).	3.5 km south-west
Craig y Rhiwarth	SSSI	The west-facing limestone escarpment of Craig y Rhiwarth on the east bank of the Afon Tawe, above Craig-ynos, supports some of the finest limestone plant communities in Brecknock. The limestone is covered in places by acidic boulder clay, where communities of plants demanding more acidic conditions are confined and contrast with the calcicolous communities elsewhere. Areas of acidic glacial drift support contrasting oak and birch woodland and contribute to the great species diversity of the site, with over 170 species of higher plants and a similar number of lower plants known to grow here.	3.6 km north-east
Dyffrynoedd Nedd a Mellte a Moel Penderyn	SSSI	Dyffrynnoedd Nedd a Mellte, a Moel Penderyn is of special interest for its extensive and diverse semi-natural woodland, important populations of several flowering plants and supporting outstanding assemblages of mosses, liverworts and lichens. The site includes a range of geological features, well-exposed in the cliffs and rocky river beds. These include exposures at Moel Penderyn, Craig y Ddinas and Bwa Maen and geomorphological features within parts of the valleys of the Hepste and Mellte are also of special interest. This site includes the wooded valleys of the rivers Nedd and Mellte, and their tributaries above Pontneddfechan, as they pass through a Millstone Grit and limestone plateau, and	2.9 km south-east

Site Name	Designation	Features	Approximate Distance and Orientation from Site
		Moel Penderyn, which lies to the east. The plateau lies at about 300 m, the rivers having eroded deep, narrow valleys with gorges, river cliffs, block scree and waterfalls.	
Caeau Nant y Llechau	SSSI	This is the largest area of traditional unimproved hay meadow known in Brecknock. The collection of gently sloping, south-east facing fields on the upper valley side of the Nedd support a wealth of plant species. Developed on boulder clay overlying millstone grit, flushed in part by springs and drained by a number of well wooded streams, the varying topography is reflected in the diverse flora, with over 110 species of higher plants recorded from the grassland areas.	4.5 km east

7.2.2 Non-Statutory Designated Sites

Non-statutory designated sites within 5 km of the site were returned in the desk study records from BIS. Eighteen sites were identified, all of which are adopted Sites of Importance for Nature Conservation (SINC). They are listed in Table 3 below.

Table 3. Non-statutory designated sites within 5 km of the site

Site Name	Designation	Approximate Distance and Orientation from Site
Gorsllwyn Meadows	SINC	200 m east
Aberhenwaun Uchaf	SINC	600 m south
Onllwyn Coal Washery	SINC	700 m east
Dyffryn Cellwen	SINC	800 m east
Land behind Marigold Place	SINC	800 m south
Glyn yr Hebog Wood 1 Afon Tawe	SINC	1.3 km north-west
Glyn yr Hebog Top Field 1-5	SINC	1.4 km north-west
Adjacent to Gors Llwyn	SINC	1.4 km east
Intervalley Road, Banwen	SINC	1.4 km east
Sarn Helen	SINC	1.5 km south-east
Banwen Pond	SINC	1.6 km south-east
Glyn yr Hebog (The Waun)	SINC	1.6 km south-west
Heol Heddwch	SINC	1.6 km south
Coed Glynn Gwennws, Pen-y-Cae	SINC	1.7 km north-east
Blaendulais Marshy Grassland	SINC	1.9 km south-west
Nant y Cafn	SINC	2.2 km south-west
Ynysdawle	SINC	3 km south-west
Rhos Common	SINC	3.9 km south-west

7.2.3 Other Notable Habitats

Other notable habitats within 5 km were returned in the desk study records from BIS.

A Wildlife Trust Reserve is present approximately 1 km west of the site. Marsh fritillary butterflies are present within the reserve.

There were 57 areas of ancient woodland, the closest of which is within the site. Areas of ancient woodland within 1 km of the site are shown on Figure 4.

Habitats listed as Habitats of Principal Importance (HPI) in response to the requirements of Section 7 of the Environment (Wales) Act 2016 were also identified. These included: blanket bog and limestone pavement.

7.2.4 Protected and Notable Species

Records of protected and/or notable species identified within 5 km of the site are summarised in Table 4 below. The distance given is that to the closest point on the site boundary.

Table 4. Protected and notable species within 5 km of the site

Species / Group	Scientific Name	Status[22]	Number of Records	Approximate distance of closest record (m)
Bats				
Soprano pipistrelle	*Pipistrellus pygmaeus*	EPS, WCA	10	300
Common pipistrelle	*Pipistrellus pipistrellus*	EPS, WCA	27	400
Unidentified bat	*Chiroptera*	EPS, WCA	10	400
Daubenton's bat	*Myotis daubentonii*	EPS, WCA	7	400
Noctule bat	*Nyctalus noctula*	EPS, WCA	11	400
Pipistrelle species	*Pipistrellus* spp.	EPS, WCA	14	600
Brown long-eared bat	*Plecotus auritus*	EPS, WCA	7	1000
Myotis bat	*Myotis* spp.	EPS, WCA	2	1700
Nathusius' pipistrelle	*Pipistrellus nathusii*	EPS, WCA	2	2000
Natterer's bat	*Myotis nattereri*	EPS, WCA	2	2000
Lesser horseshoe bat	*Rhinolophus hipposideros*	EPS, WCA	1	2000
Other mammals				
Hare	*Lepus europaeus*	S7	3	Within the site
Otter	*Lutra lutra*	EPS, WCA, S7	27	400
Badger[23]	*Meles meles*	BA	3	700
Hedgehog	*Erinaceus europaeus*	S7	32	800

[22] EPS = European Protected Species as listed under Schedule 2 of the Conservation of Habitats and Species Regulations (2017).
HDir = Animals and plants that receive protection under the Council Directive 92/43/EEC (The Habitats Directive).
BDir = Birds that receive protection under the Directive 2009/147/ED (The Birds Directive).
WCA = Species protected under Schedule 1 (birds), Schedule 5 (animals) or Schedule 8 (plants) of the Wildlife and Countryside Act (1981) as amended.
S7 = Species listen on Section 7 of the Environment (Wales) Act 2016.
[23] BA = Protection of Badgers Act (1992).

Polecat	*Mustela putorius*	HDir, S7	4	1500
Harvest mouse	*Micromys minutus*	S7	1	2000
Birds				
Cuckoo	*Cuculus canorus*	S7	23	Within the site
House sparrow	*Passer domesticus*	S7	81	Within the site
Kestrel	*Falco tinnunculus*	S7	27	Within the site
Lesser black-backed gull	*Larus fuscus*	BDir	6	Within the site
Red kite	*Milvus milvus*	WCA, BDir	44	Within the site
Starling	*Sturnus vulgaris*	BDir, S7	68	Within the site
Hawfinch	*Coccothraustes coccothraustes*	S7	1	100
Dunnock	*Prunella modularis*	S7	51	300
Merlin	*Falco columbarius*	BDir, WCA	1	300
Mistle thrush	*Turdus viscivorus*	BDir	31	300
Bullfinch	*Pyrrhula pyrrhula*	S7	24	400
Common crossbill	*Loxia curvirostra*	WCA	24	400
Skylark	*Alauda arvensis*	BDir, S7	26	400
Woodcock	*Scolopax rusticola*	BDir	12	400
Grasshopper warbler	*Locustella naevia*	S7	12	600
Pied flycatcher	*Ficedula hypoleuca*	S7	11	600
Wood warbler	*Phylloscopus sibilatrix*	S7	13	600
Barn owl	*Tyto alba*	WCA	5	700
Curlew	*Numenius arquata*	BDir, S7	4	800
Linnet	*Linaria cannabina*	S7	9	800
Mallard	*Anas platyrhynchos*	BDir	33	800
Snipe	*Gallinago gallinago*	BDir	17	800
Song thrush	*Turdus philomelos*	BDir, S7	57	800
Brambling	*Fringilla montifringilla*	WCA	1	900
Fieldfare	*Turdus pilaris*	BDir, WCA	13	900
Lapwing	*Vanellus vanellus*	BDir, S7	7	900
Redwing	*Turdus iliacus*	WCA, BDir	17	900
Reed bunting	*Emberiza schoeniclus*	S7	27	900
Peregrine	*Falco peregrinus*	BDir, WCA	18	1000

Lesser redpoll	*Acanthis cabaret*	S7	32	1200
Hen harrier	*Circus cyaneus*	BDir, S7	2	1300
Jack snipe	*Lymnocryptes minimus*	BDir	3	1400
Water rail	*Rallus aquaticus*	BDir	2	1500
Hobby	*Falco subbuteo*	WCA	4	1600
Honey buzzard	*Pernis apivorus*	BDir WCA	2	1600
Goshawk	*Accipiter gentilis*	WCA	7	1700
Herring gull	*Larus argentatus*	S7	7	1700
Tree pipit	*Anthus trivialis*	S7	15	1700
Nightjar	*Caprimulgus europaeus*	BDir, S7	8	1800
Osprey	*Pandion haliaetus*	BDir, WCA	1	1900
Short-eared owl	*Asio flammeus*	BDir	3	2000
Spotted flycatcher	*Muscicapa striata*	S7	2	2500
Goosander	*Mergus merganser*	BDir	9	2900
Kingfisher	*Alcedo atthis*	BDir, WCA	2	2900
Willow tit	*Poecile montana*	S7	1	3400
Yellowhammer	*Emberiza citrinella*	S7	2	3400
Golden plover	*Pluvialis apricaria*	BDir, BDir, S7	1	3600
Wigeon	*Anas penelope*	BDir	2	3600
Mute swan	*Cygnus olor*	BDir	9	3700
Ring ouzel	*Turdus torquatus*	S7	1	4000
Reptiles and Amphibians				
Common toad	*Bufo bufo*	WCA	12	200
Common lizard	*Zootoca vivipara*	WCA	14	700
Common frog	*Rana temporaria*	WCA	32	700
Grass snake	*Natrix helvetica*	WCA	7	1000
Palmate newt	*Lissotriton helveticus*	WCA	5	1700
Slow worm	*Anguis fragilis*	WCA	10	2000
Fish				
Atlantic salmon	*Salmo salar*	HDir, S7	2	600
Bullhead	*Cottus gobio*	HDir	2	2000
Invertebrates				
Broom moth	*Ceramica pisi*	S7	7	800
Marsh fritillary	*Euphydryas aurinia*	EPS, WCA, S7	49	900

Dark-barred Twin-spot Carpet	*Xanthorhoe ferrugata*	S7	9	900
Small phoenix	*Ecliptopera silaceata*	S7	9	900
Small heath	*Coenonympha pamphilus*	S7	16	1000
Knot grass	*Acronicta rumicis*	S7	7	1200
Dot moth	*Melanchra persicariae*	S7	2	1300
Rosy minor	*Litoligia literosa*	S7	2	1300
Rosy rustic	*Hydraecia micacea*	S7	2	1300
Sallow	*Cirrhia icteritia*	S7	2	1300
Ear moth	*Amphipoea oculea*	S7	2	1400
Oak hook-tip	*Watsonalla binaria*	S7	1	1500
Oblique carpet	*Orthonama vittata*	S7	4	1500
Autumnal rustic	*Eugnorisma glareosa*	S7	2	1500
Hedge rustic	*Tholera cespitis*	S7	1	1600
Grayling	*Hipparchia semele*	S7	9	1800
Double dart	*Graphiphora augur*	S7	1	1800
Blood-vein	*Timandra comae*	S7	1	1900
Buff ermine	*Spilosoma lutea*	S7	2	1900
Garden tiger	*Arctia caja*	S7	2	1900
Shoulder-striped wainscot	*Leucania comma*	S7	1	1900
Small square-spot	*Diarsia rubi*	S7	5	1900
White ermine	*Spilosoma lubricipeda*	S7	5	1900
Centre-barred sallow	*Atethmia centrago*	S7	1	1900
Dusky brocade	*Apamea remissa*	S7	1	1900
Ghost moth	*Hepialus humuli*	S7	2	1900
Small Pearl-bordered Fritillary	*Boloria selene*	S7	4	2200
Small blue	*Cupido minimus*	WCA, S7	1	2300
Wall	*Lasiommata megera*	S7	15	2300
Brindled beauty	*Lycia hirtaria*	S7	1	2400

Cinnabar	*Tyria jacobaeae*	S7	3	2500
Narrow-bordered bee hawk-moth	*Hemaris tityus*	S7	1	3700
Dingy skipper	*Erynnis tages*	S7	2	4000
Vascular plants				
Small-flowered Sticky Eyebright	*Euphrasia officinalis subsp. anglica*	S7	1	100
Bluebell	*Hyacinthoides non-scripta*	WCA	47	100
Globeflower	*Trollius europaeus*	S7	1	600
Eyebright	*Euphrasia officinalis subsp. pratensis*	S7	1	1700
Bryophytes & lichens				
A lichen	*Parmotrema perlatum*	S7	6	Within the site
A lichen	*Usnea articulata*	S7	6	Within the site
Scarce Turf-moss	*Rhytidiadelphus subpinnatus*	S7	6	500
Witches' Whiskers Lichen	*Usnea florida*	S7	2	1300
Varnished Hook-moss	*Hamatocaulis vernicosus*	HDir, WCA	1	1400
A lichen	*Pachyphiale carneola*	S7	1	1900
A lichen	*Pannaria conoplea*	S7	1	1900
A lichen	*Parmeliella triptophylla*	S7	1	1900
A lichen	*Phyllopsora rosei*	S7	1	1900
A lichen	*Sticta canariensis (dufourii)*	S7	1	1900
A lichen	*Sticta fuliginosa*	S7	2	1900
A lichen	*Sticta limbata*	S7	2	1900

7.3 Field Survey

A brief description of each of the habitats found within the site boundary is given in Section 7.3.1 below. An assessment of the site for supporting protected species is given in Section 7.3.2 and target notes recorded during the field survey and other surveys on site during 2019 are given in Section 7.3.3.

7.3.1 Habitats

Forty habitat types were identified within the Site. These are described below and shown on Figure 5.

Broadleaved woodland – semi-natural

There were areas of semi-natural broadleaved woodland on the edges of the Site. Species compositions were broadly similar throughout the site and comprised willow (*Salix* sp.), silver birch (*Betula pendula*), hawthorn (*Crataegus monogyna*), rowan (*Sorbus acuparia*), sessile oak (*Quercus petraea*) and hazel (*Corylus avellana*). Along the access road to the Nant Helen site, there was a small area of large mature oak trees with a bluebell (*Hyacinthoides non-scripta*) understorey (TN51, Figure 5). This area of woodland is on the Ancient Woodland Inventory.

Broadleaved woodland – plantation

Small areas of semi-mature planted woodland were present throughout the Site and formed some of the previously restored mining areas. Species compositions were similar to those of the semi-natural woodlands on Site.

Coniferous woodland – plantation

A large conifer plantation was present in the north-west of the Site and extends outside of the site boundary. Larch trees (*Larix* sp.) were the dominant species, with pine (*Pinus* sp.) and spruce (*Picea* sp.) also present. The ground flora was sparse and was dominated by mosses and common wintergreen (*Pyrola minor*), which occurred extensively through the plantation. Bee orchids were identified within the woodland, but they were outside of the site boundary (TN1, Figure 5). In parts of the woodland, the understorey supported establishing broadleaved species such as oak and birch.

It is noted that part of this area is recorded as PAWS (in the Ancient Woodland Inventory[24]), although did not support any indicator species of ancient woodland. Furthermore, a separate technical note (Appendix C) confirms that the plantation is on backfilled material following mining and extending over the area recorded as a PAWS; rather than as implied, the plantation replacing semi-natural woodland on the in situ woodland soils.

Mixed woodland – plantation

This habitat type was present in restored mining areas on Site. Species present included: larch, spruce, hazel, hawthorn, field maple (*Acer campestre*) and willow species.

[24] https://naturalresources.wales/evidence-and-data/research-and-reports/ancient-woodland-inventory/?lang=en

Scrub – dense/continuous

Dense scrub was present around settling lagoons in the south-east of the Site. Bramble, European gorse (*Ulex europeaus*), dogwood (*Cornus sanguinea*), willow and self-seeded birch trees were present.

Scrub – scattered

Scattered willow and gorse scrub was present throughout the Site. Other species present included bramble and birch seedlings.

Broadleaved parkland/scattered trees

Scattered broadleaved trees were present throughout the site. Species present included English oak (*Quercus robur*), willow, hawthorn and rowan.

Coniferous parkland/scattered trees

An area of scattered larch, pine and spruce trees was present in the north of the Site.

Coniferous woodland – recently felled

A recently felled conifer plantation was present in the south-west, just outside the site boundary. It has been colonised by scrub species including bramble and willow. Stacked logs were present throughout the area.

Neutral grassland – unimproved

Areas were present alongside tracks within the Washery and comprised a moderately diverse flora including grasses: Yorkshire fog (*Holcus lanatus*), sweet vernal grass (*Anthoxanthum odoratum*), false oat-grass (*Arrhenatherum elatius*), crested dogs tail (*Cynosurus cristatus*), creeping bent (*Agrostis stolonifera*), and sedges: glaucous sedge (*Carex flacca*) and black sedge (*C. nigra*). Herbs included common yellow rattle (*Rhinanthus minor*), cowslip (*Primula veris*), hairy tare (*Vicia hirsuta*), cuckoo flower (*Cardamine pratensis*) and marsh thistle (*Cirsium palustre*). In unmanaged areas, ruderal and scrub species were present including rose-bay willowherb (*Chamerion angustifolium*), docks (*Rumex* spp), rushes (*Juncus* spp) and tufted hair grass (*Deschampsia cespitosa*), in addition to willow and hawthorn scrub, and oak saplings.

Acid grassland – semi-improved

The centre of the Site comprised short acid grassland. Species present included red fescue (*Festuca rubra*), sheep's fescue (*F. ovina*), cat's ear (*Hypochaeris radicata*), heath grass (*Danthonia decumbens*), bent grass (*Agrostis* sp.), tormentil (*Potentilla erecta*), pearly everlasting (*Anaphalis margaritacea*) and wild strawberry (*Fragaria vesca*).

Improved grassland

Grazed fields were present to the east of the Site. They were dominated by perennial rye-grass (*Lolium perenne*). Other species present included Yorkshire fog, white clover (*Trifolium repens*) and rush species.

Marsh/marshy grassland

Large areas of the site comprised grasslands dominated by rushes. Species present included hard rush (*Juncus inflexus*), soft rush (*Juncus effusus*), yarrow (*Achillea millefolium),* meadowsweet (*Filipendula ulmaria*), cock's foot (*Dactyla glomeratus*), valerian (*Valeriana* sp.), common sorrel (Rumex acetosa), ribwort plantain (*Plantago lanceolata*), vetch species (*Viccia* spp.), Yorkshire fog and teasel (*Dipsacus fullonum*). Some areas of this habitat were dominated by purple moor grass. These grasslands were often heavily grazed by sheep, cattle and horses.

Poor semi-improved grassland

A species-poor semi-improved grassland was present south of the improved fields. Species here included: Yorkshire-fog, soft rush, creeping thistle (*Cirsium arvense),* creeping buttercup (*Ranunculus repens*) and stitchwort (*Stellaria* sp.)

Bracken – scattered

Stands of bracken (*Pteridium aquilinum*) were present within grasslands outside the site boundary to the west.

Dry dwarf shrub heath – acid

This habitat, which occurred in the north east corner of the site and in a smaller area which was restored from previous mining activities; was dominated by common heather (*Calluna vulgaris*). Other species present included purple moor grass (*Molinia caerulea*), bilberry (*Vaccinium myrtillus*), soft rush, marsh willowherb (*Epibolium palustre*), hawthorn, Yorkshire fog, willow, bracken, foxglove, red fescue, silver birch, rowan, and Cladonia lichens (*Cladonia* spp.).

Wet dwarf shrub heath

The area that was restored from previous mining activities in the centre of the site comprised an area of wet heath. Common heather and cross-leaved heather (*Eric tetralix)* were present, along with purple moor grass and sphagnum mosses (*Sphagnum* spp.).

Dry heath/acid grassland

An area of heath/acid grassland mosaic was present south of the overburden mound. Species present included: common heather and European gorse, mouse-

ear-hawkweed (*Pilosella officinarum*), cowslip (*Primula veris*) and great wood-rush (*Luzula sylvatica*), with locally abundant willowherb (*Epibolium* sp.).

Acid/neutral flush

A flush was present within the field in the restored mining area and was dominated by rush species. Water was present at the time of the survey.

Fen – basin mire

A fen was present within the restored mining area, likely to be fed by the flush within the same field. Common cotton-grass (*Eriophorum angustifolium*) and common club-rush were present (*Schoenoplectus lacustris*).

Swamp

A reedbed was present on site close to settling lagoons. The vegetation here was dominated by common reed (*Phragmites australis*).

Standing water

Numerous lagoons and settling ponds were present across the site. The lagoons were generally bordered by scattered scrub or ruderal vegetation with reedmace (*Typha* spp.) often present. Four ponds were present in the centre of the site in a previously restored mining area. These were bordered by rushes, reedmace and sphagnum mosses.

Running water

Various drains and streams were present throughout the Site. These were typically up to 1 m wide with beds formed of rocks. The River Dulais flows east to west, from the Washery, in the south eastern corner of the site.

Acid/neutral natural inland cliff

A sharp rock face was present in the acid grassland towards the south of the site.

Quarry

The opencast mine site comprises a large quarry to the north-west of the Site. A pool of standing water is present at the bottom of the quarry.

Spoil

Multiple spoil heaps were present on Site, comprised of coal.

Amenity grassland

A small area of amenity grassland formed an island along Onllwyn Road in Onllwyn village.

Ephemeral/short perennial

Various areas of the mine site had been colonised by ephemeral/short perennial vegetation. Colt's foot (*Tussilago farfara*) was abundant. Foxglove (*Digitalis purpurea),* mouse-ear hawkweed, and mosses were also present.

Intact hedge – species-poor

Hawthorn-dominated hedges formed borders between fields in the east of the Site.

Species-poor intact hedge with fence

A network of species-poor hedgerows was present in the restored land to the east of the Site. Hawthorn was the dominant species present. A stock fence ran along the hedges and earth banks were present on both sides.

Defunct hedge – species-poor

Species poor hedges with large gaps were present in the restored area to the east of the Site. The dominant species present was hawthorn with occasional willow.

Fence

Stock fences formed borders around fields throughout the Site.

Fence with trees

Part of the access road to Site was bordered by a fence with broadleaved trees, including oak, hazel, hawthorn and willow.

Wall

A length of brick wall was present along an access road connecting the Nant Helen site to the coal Washery.

Dry ditch

Dry ditches formed borders between fields to the west of the site.

Earth bank

Earth banks were present on both sides of species-poor hedgerows in the east of the Site.

Buildings

Single-storey buildings and cabins were present at the Nant Helen opencast mine site.

Bare ground

Areas of bare ground were present on site in the operational mining areas.

Gravel/hard standing

Car parks and operational areas on site comprised areas of hard standing.

Tarmac surface

Tarmac access roads were present at the Nant Helen opencast mine site. The site is bordered to the north and east by the A4221 and to the south by the A4109.

7.3.2 Species

7.3.2.1 Badger

The site contains large areas of woodland and grasslands that offer suitable habitat for badger sett building, commuting and foraging.

During the field survey, two badger outlier setts were recorded in the east of the site (TN3 and TN4, Figure 5). Badger latrines were identified in the grassland to the west of the site (TN5, Figure 5) and in the conifer plantation north of the site (TN6 & TN7, Figure 5). A badger footprint was found in the mud to the north of the site (TN8) and pathways and snuffle holes were also recorded (TN9, TN10 & TN11, Figure 5). Additionally, during a bat transect survey, a badger was seen crossing the site (TN12, Figure 5). During the fungi survey, badger activity was recorded across the site in the form of an outlier sett (TN13, Figure 5), badger hair (TN14, Figure 5) and foraging activity and footprints (TN15, Figure 5).

7.3.2.2 Bats

There are woodlands, hedgerows and waterbodies on site that could be used by bats for foraging and commuting. There are also buildings, structures and trees that may support bat roosts.

Various trees were identified during the field survey as having potential roosting features (TN16, TN17, TN18, TN19, TN20 & TN21, Figure 5). Additionally, three trees with bat boxes were recorded in woodland in the west of the site (TN22, TN23 & TN24, Figure 5). A road bridge (TN25, Figure 5) and railway bridge (TN26, Figure 5) are present to the south-east of that site that may also provide roosting opportunities for bats.

7.3.2.3 Dormouse

No records of dormouse were returned from the desk study and no dormice were found during previous surveys.

However, there is suitable habitat for dormice on site in the form of broadleaved woodland, scrub and hedgerows. These habitats are relatively well connected to other suitable woodland and scrub habitats in the wider area.

7.3.2.4 Otter

There are numerous watercourses on site, which may provide suitable commuting and foraging opportunities for otter. The woodlands and scrub on site may also provide suitable terrestrial habitat for this species.

During the field survey, an otter spraint and a mammal pathway were identified in a stream bed in the north-west of the site (TN27, Figure 5).

7.3.2.5 Water Vole

No records of water vole were returned from the desk study and no signs of water vole were recorded during previous surveys.

However, there are small watercourses on site, which may provide suitable habitat for water vole.

7.3.2.6 Birds

There are woodlands, hedgerows and scrub on site that provide suitable nesting opportunities for birds. The opencast mine may also provide nesting opportunities for species such as peregrine. The wet grasslands on site may provide suitable habitat for wintering bird species. A reedbed was present within the centre of the site (TN54, Figure 5) that may also provide suitable nesting/wintering habitat.

During the field survey, a peregrine was seen flying just south of the mine (TN28, Figure 5). Skylark and cuckoo were also heard on site (TN29, Figure 5). A snipe was seen on top the spoil from the mine and a lapwing was heard here (TN30, Figure 5). During bat transect surveys, nightjars have been heard and seen in recently felled woodland (TN31, Figure 5).

7.3.2.7 Reptiles

The majority of the site provides suitable foraging habitat for common reptiles (adder (*Vipera berus*) common lizard, grass snake and slow worm)) in the form of scrub, tussocky grasslands. Linear features, including pathways, roads, railways and hedgerows may provide suitable habitat for basking reptiles.

7.3.2.8 Amphibians

No records of great crested newts (GCN) were identified and none were recorded during previous surveys.

Numerous waterbodies are present within the site, which may support GCN and other amphibians. The woodland and scrub on site may provide suitable terrestrial habitat for these species. Additionally, seven smooth/palmate newts (*Lissotriton* sp.) were recorded in a puddle during the field survey (TN32).

7.3.2.9 Other Species

Mustelid[25] pathways, footprints and scats were recorded on site during the field survey (TN33, TN34, TN35 & TN36, Figure 5). A brown hare was seen during the field survey in the south-west of the site (TN52, Figure 5).

The grassland on site may provide suitable habitat for notable invertebrate species, although none were recorded during the field survey.

7.3.2.10 Invasive Non-native Species

Japanese knotweed (*Fallopia japonica*), montbretia (*Crocosmia x crocosmiiflora*), wall cotoneaster (*Cotoneaster horizontalis*) and rhododendron (*Rhododendron ponticum*) were all identified on or near the site (TN37, TN38, TN39, TN40, TN41, TN42 & TN43). A potential American mink (*Neovision vision*) scat was recorded in a ravine on site (TN44). These species are all listed on Schedule 9 of the WCA and/or Part 2 Schedule 2 of The Invasive Alien Species (Enforcement and Permitting) Order 2019.

7.3.2.11 Fungi

Various wax cap mushrooms were identified on site during the field survey (TN45, TN46, TN47 & TN48, Figure 5). They were not identified to species level.

7.3.3 Target Notes

The target notes identified during the field survey are described in Table 5 below. Photographs are given in Appendix B.

Table 5. Target notes recorded on site.

Target Note Number	Target Note Description
TN1	Bee orchid in woodland.
TN2	Ant hills present within the grassland. Suitable reptile habitat.
TN3	Badger outlier sett on bank.
TN4	Badger outlier sett. Recent use but not currently in use.
TN5	Badger dung in grassland.
TN6	Badger latrine on edge of footpath and well-worn low-lying path running across footpath.

[25] Of the Mustelidae family, including pine marten (*Martes martes*), polecat, American mink, stoat (*Mustela erminea*), weasel (*M. nivalis*), badger and otter.

Target Note Number	Target Note Description
TN7	Badger latrine.
TN8	Badger footprint.
TN9	Badger path crossing a track.
TN10	Mammal track.
TN11	Badger snuffle holes in moss and needles.
TN12	Badger seen on purple bat transect route crossing haulage road from the north.
TN13	Badger outlier sett identified during fungi survey. Three holes and has signs of current use (badger hair and footprints).
TN14	Badger hair on fence.
TN15	Badger foraging activity/ prints, mammal path under fence and hair on fence.
TN16	Oak tree with high bat roost suitability. Knot holes present and possible smoothing from use.
TN17	Oak tree with high bat roost suitability. Knot holes and staining present.
TN18	Oak tree with high bat roost suitability. Multiple cavities and rotten limbs.
TN19	Mature birch tree with bat roost suitability. Large callous cavity at base of trunk to 1.5m high.
TN20	Oak tree with bat roost suitability. Multiple holes and cracks.
TN21	Tree with 3 bat boxes. No bats present.
TN22	Tree with 3 bat boxes. No bats present.
TN23	Tree with knot hole and possible cavity. Bat roost potential.
TN24	Oak with two wooden bat boxes. No bats visible but possible staining. Need long extension inspection camera to check fully.
TN25	Road bridge in good condition. Some holes in brickwork on adjoining wall and under the bridge. Low bat roost suitability.
TN26	Railway bridge. Not possible to view closely to assess bat roost suitability.
TN27	Otter spraint on rock in stream bed by culvert. Mammal path crossing track over top.
TN28	Peregrine spotted flying over the opencast mine.
TN29	Skylark seen. Cuckoo heard in the distance.
TN30	Snipe seen. Lapwing heard in distance.
TN31	Nightjar seen in recently felled woodland.
TN32	Seven newts (*Lissotriton* sp.) in puddle on track.
TN33	Mustelid tracks, 40cm stride.
TN34	Mustelid prints.
TN35	Small mustelid prints.
TN36	Mustelid scat x2. Twisted at end. Unpleasant odour but not of fox or mink. Fur in scat.
TN37	Single Japanese knotweed stand in coal washery just outside fenced ponds.
TN38	Montbretia along cycle track.

Target Note Number	Target Note Description
TN39	Cotoneaster near path.
TN40	Cotoneaster near path.
TN41	Rhododendron in woodland.
TN42	Various stands of rhododendron.
TN43	Japanese knotweed, 10 m x 5 m stand.
TN44	Potential mink scat. Unpleasant odour.
TN45	Wax caps.
TN46	Wax caps.
TN47	Wax caps.
TN48	Wax caps.
TN49	Railway track.
TN50	Sand horse arena.
TN51	Woodland with bluebell understorey.
TN52	Brown hare sighting.
TN53	Flower-rich marshy grassland.
TN54	Reedbed. Suitable for breeding/wintering birds.

8 Conclusions

The site is in close proximity to fourteen statutory designated sites, the closest of which is Gors Llwyn, Onllwyn SSSI. Eighteen non-statutory designated sites (all SINCs), were identified within close proximity to the site, three of which were within the site: Dyffryn Cellwen, Gorsllwyn Meadows and Onllwyn Coal Washery.

Semi-natural broadleaved woodlands and conifer plantations were present on the borders of the site, with marshy and acid grassland making up the majority of the central area of the site. Scrub and ephemeral vegetation were present in the operational areas of the opencast mine. Buildings, tarmac and bare-ground were also present in operational areas of the site. Previously restored mining areas comprised heathland habitat and semi-improved grasslands. Improved and semi-improved fields on site were generally bordered by species-poor hedgerows and various flowing ditches bisected the site. Standing water bodies were also present on site in the form of ponds and settling lagoons.

Habitat with the potential for supporting the following protected and/or notable species was identified during the surveys: badger, bats, dormice, otter, water vole, birds, reptiles, amphibians, other mammals, invertebrates and fungi. Invasive non-native species were also identified within the site, comprising rhododendron and cotoneaster.

A full ecological impact assessment will be included within the Environmental Statement for the project and this will include an assessment of the significance of impacts from the project on the ecological receptors on site. This will also detail any necessary mitigation or compensation measures required to ensure there is no significant effect on ecological receptors within the site.

This report is the result of the survey work undertaken between November 2018 and November 2019. This report refers, within the limitations stated, to the condition of the site at the time of the surveys. Changes in legislation, guidance, best practice, etc. may necessitate a re-assessment/survey. No warranty is given as to the possibility of future changes in the condition of the site.

The results of these surveys are considered valid for a minimum of 18 months to a maximum of 3 years. If more than 18 months elapses before any planning application is submitted, the requirement for repeat surveys should be reviewed[26].

[26] Chartered Institute of Ecology and Environmental Management (2019). *Advice Note on the Lifespan of Ecological Reports and Surveys*.

Figures

Figure 1 Site Location

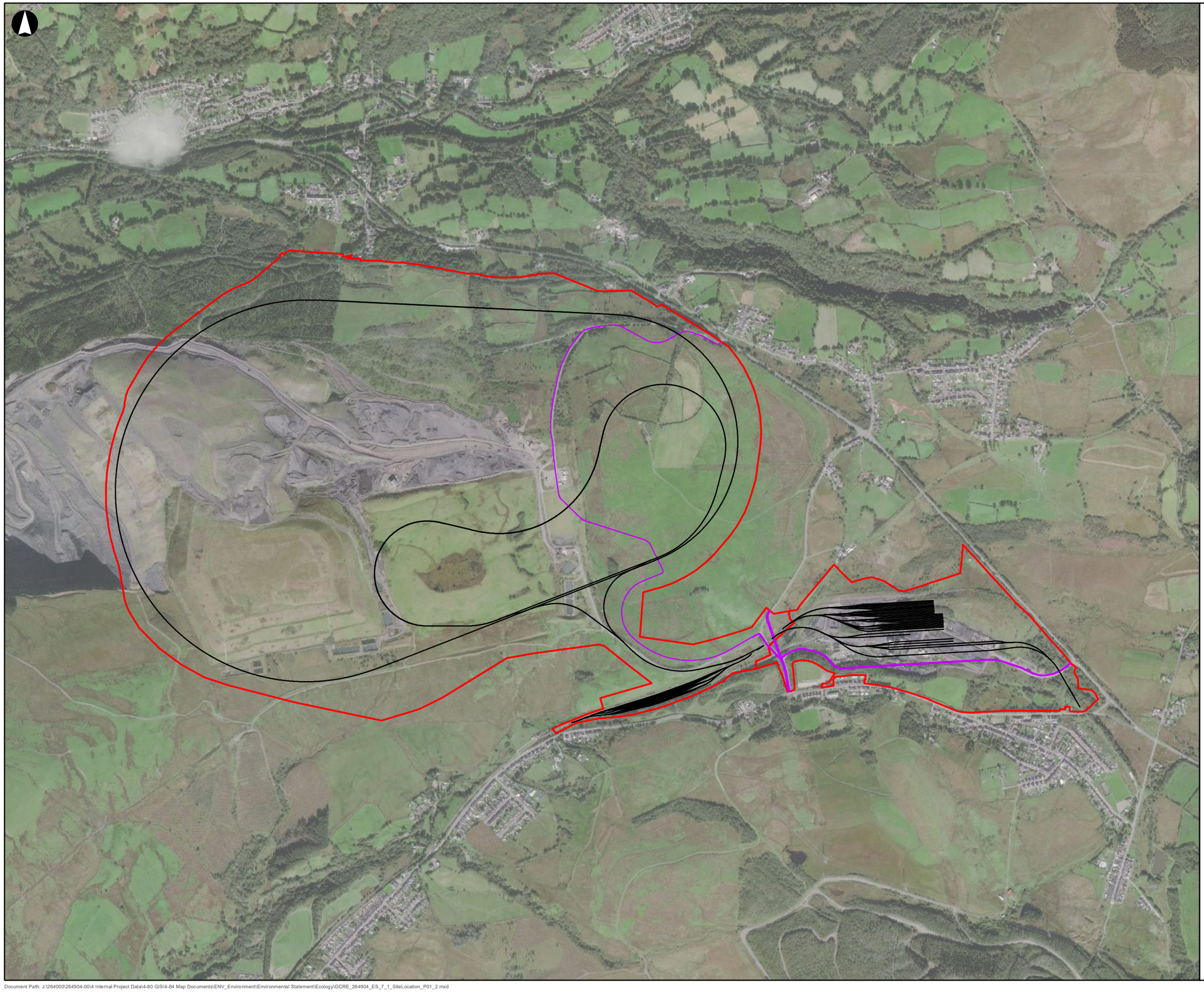
Figure 2 Internationally Designated Sites

Figure 3: Nationally Designated Sites

Figure 4: Ancient Woodland Sites

Figure 5 Extended Phase 1 Habitat Survey

A3



Legend

- Planning Development Boundary
- Site Layout Plan
- Proposed Access Road

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Issue	Date	By	Chkd	Appd
P01.3	2020-08-05	KD	CP	NH

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SITE LOCATION

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264904	**For Issue**

Drawing No	Issue
Figure 7.1	**P01.3**

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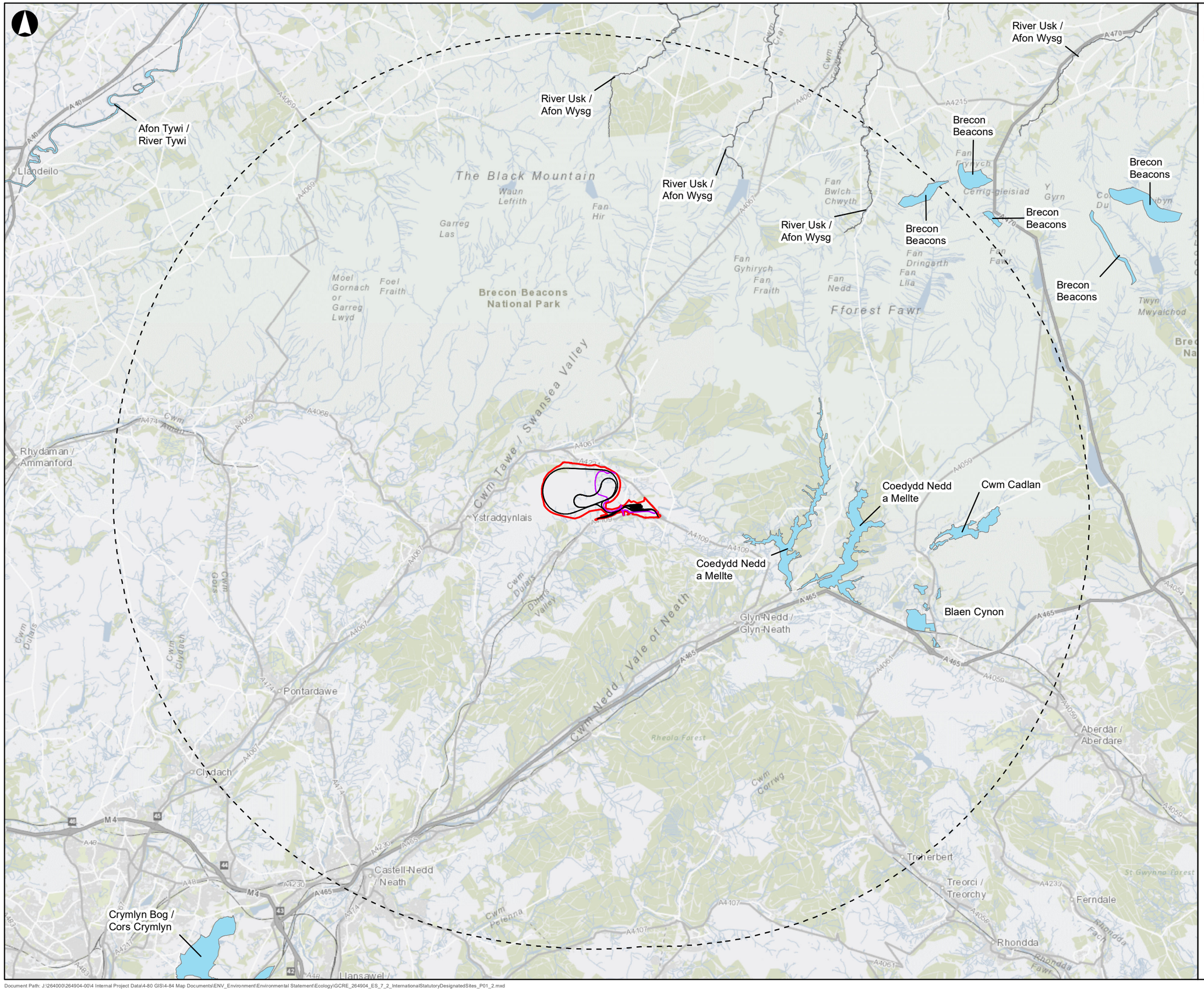

Legend

- Planning Development Boundary
- Site Layout Plan
- Proposed Access Road
- Study Area - 15km Buffer
- Special Area of Conservation (SAC)

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INTERNATIONAL STATUTORY DESIGNATED SITES

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Figure 7.2	**P01.3**

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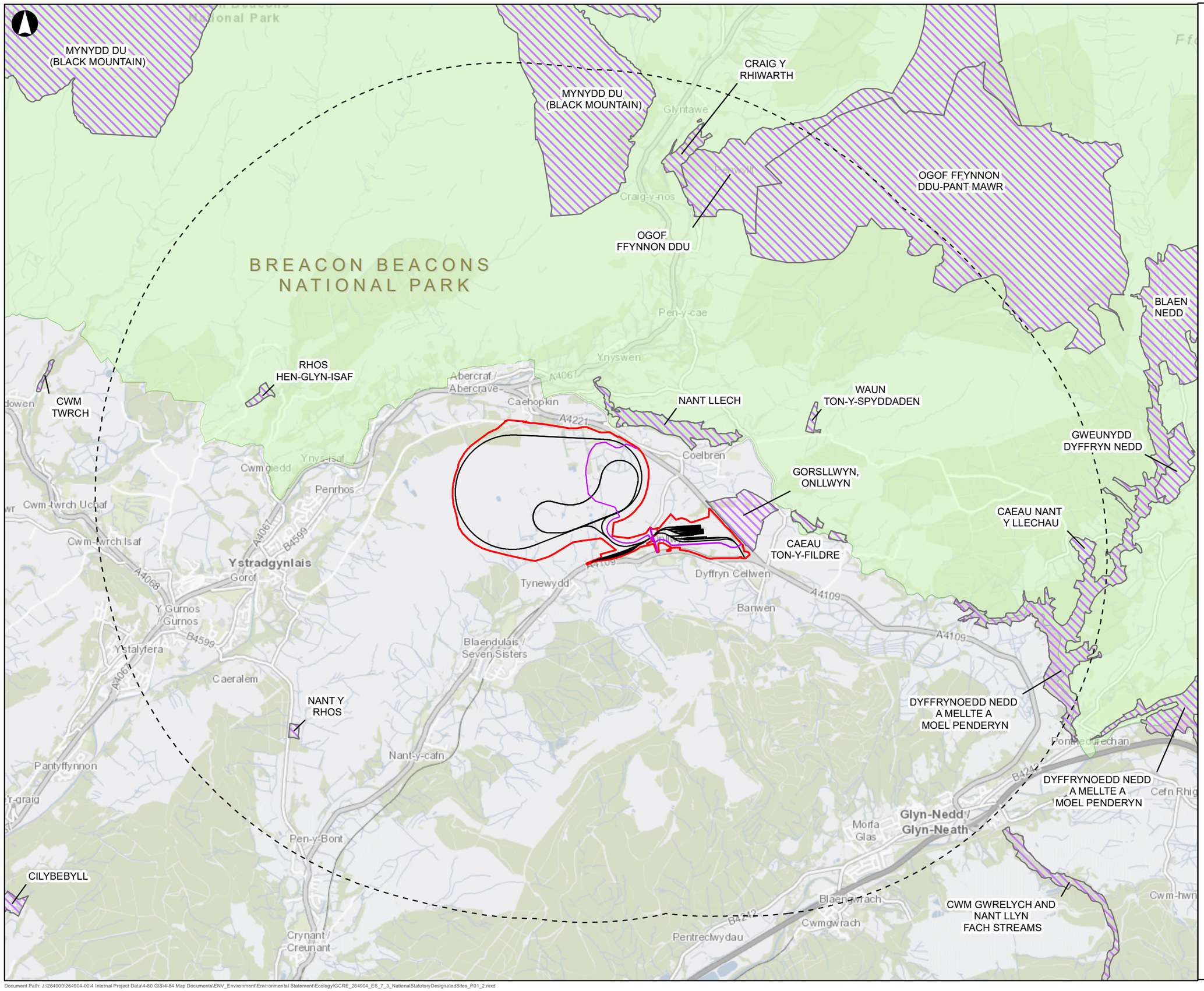

Legend

- Planning Development Boundary
- Site Layout Plan
- Proposed Access Road
- Study Area - 5km Buffer
- National Park
- Site of Special Scientific Interest (SSSI)

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NATIONAL STATUTORY DESIGNATED SITES

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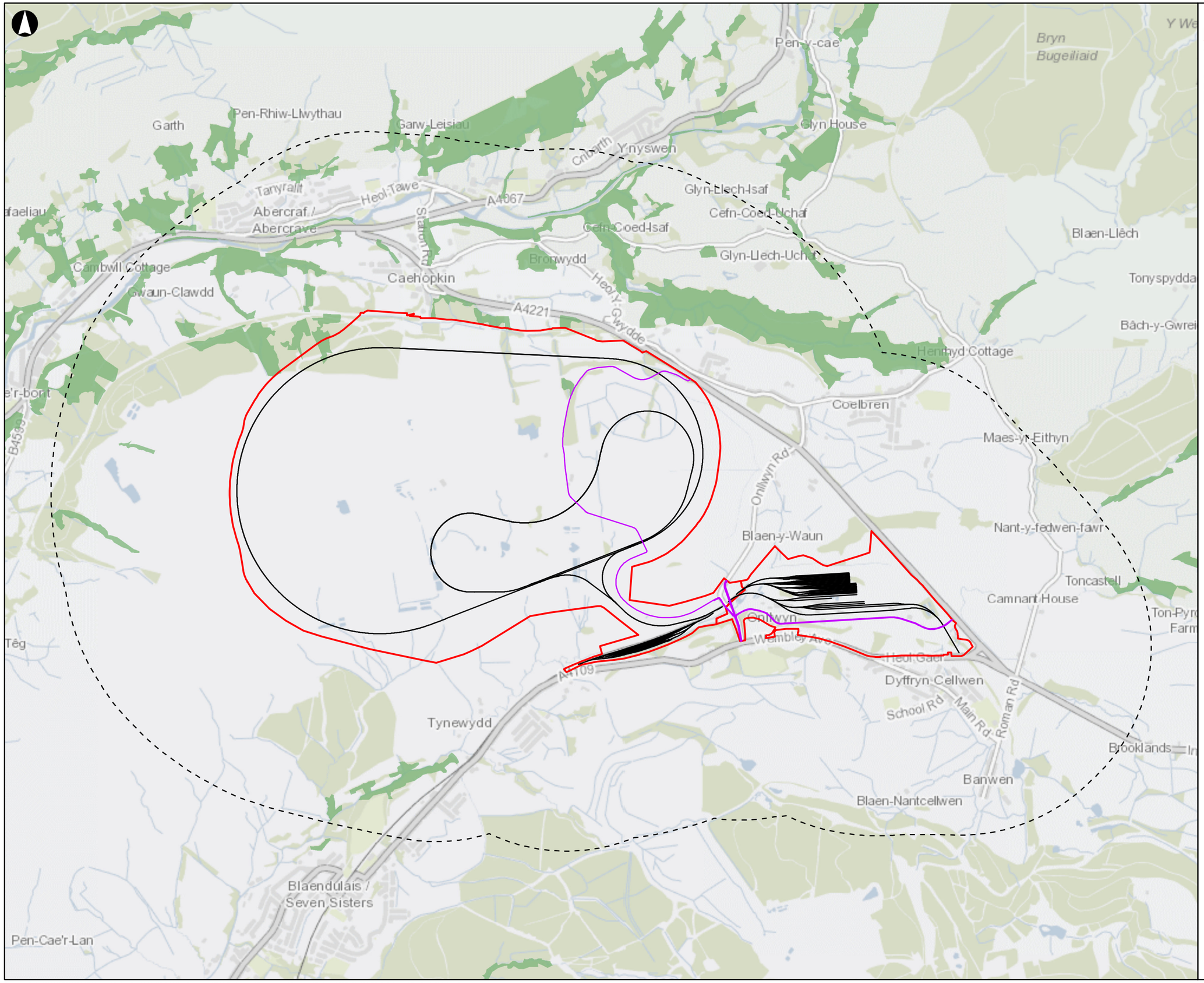

Legend

- Planning Development Boundary
- Site Layout Plan
- Proposed Access Road
- Study Area - 1km Buffer
- Ancient Woodland Inventory

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ANCIENT WOODLAND

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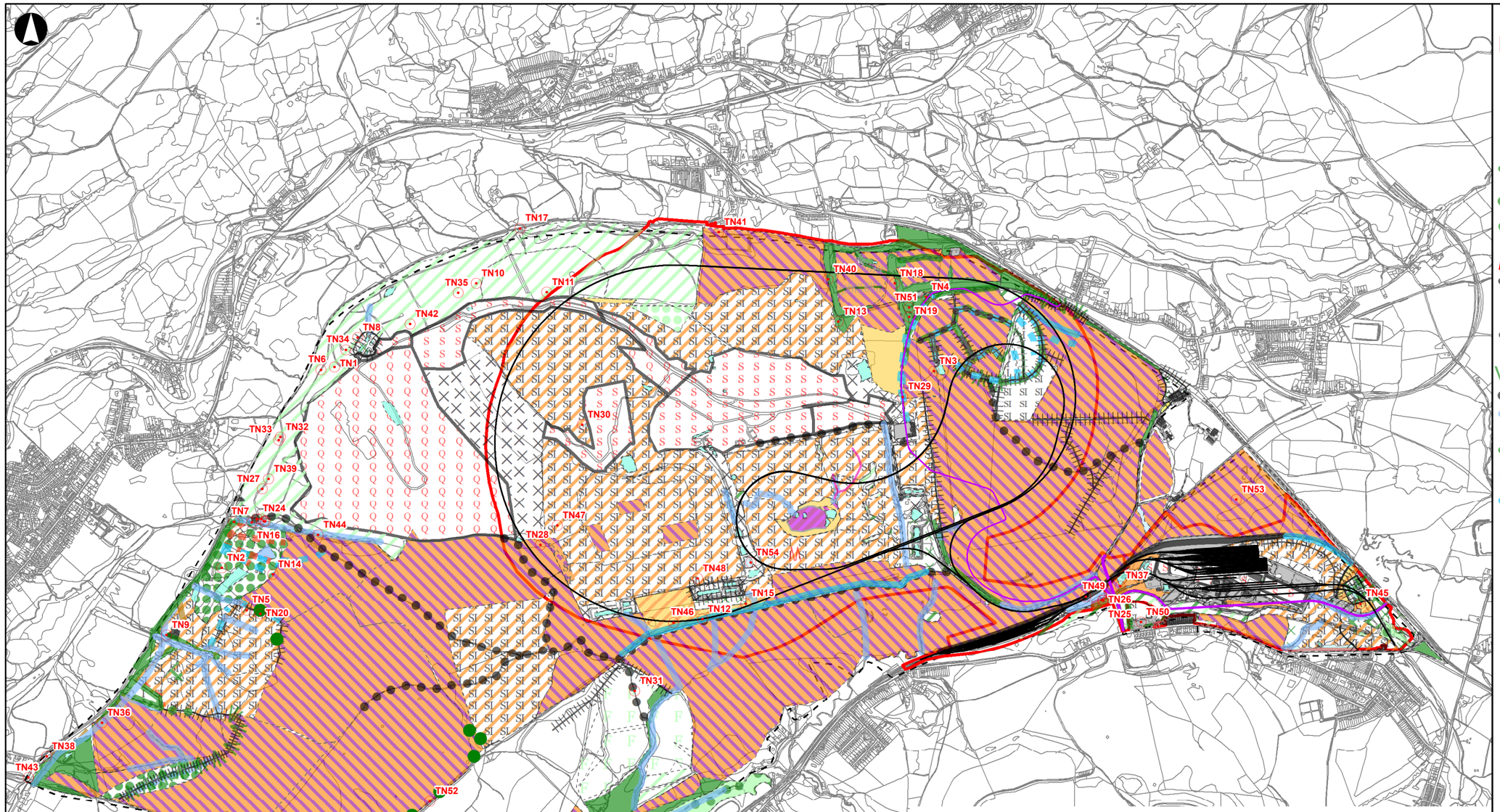

Legend

Phase 1 - Areas

- A1.1.1 - Broadleaved woodland - semi-natural
- A1.1.2 - Broadleaved woodland - plantation
- A1.2.2 - Coniferous woodland - plantation
- A1.3.1 - Mixed woodland - semi-natural
- A1.3.2 - Mixed woodland - plantation
- A2.1 - Scrub - dense/continuous
- A2.2 - Scrub - scattered
- A3.1 - Broadleaved parkland/scattered trees
- A3.2 - Coniferous parkland/scattered trees
- A4.2 - Coniferous woodland - recently felled
- B1.2 - Acid grassland - semi-improved
- B2.1 - Neutral grassland - unimproved
- B4 - Improved grassland
- B5 - Marsh/marshy grassland
- B6 - Poor semi-improved grassland
- C1.2 - Bracken - scattered
- D1.1 - Dry dwarf shrub heath - acid
- D2 - Wet dwarf shrub heath
- D5 - Dry heath/acid grassland
- E3.2 - Fen - basin mire
- F1 - Swamp
- G1 - Standing water
- G2 - Running water
- I2.1 - Quarry
- I2.2 - Spoil
- J1.2 - Cultivated/disturbed land - amenity grassland
- J1.3 - Cultivated/disturbed land - ephemeral/short perennial
- J2.2.2 - Defunct hedge - species-poor
- J3.6 - Buildings
- J4 - Bare ground
- J5 - Gravel/hard standing
- J6 - Tarmac surface

Legend

- Planning Development Boundary
- Site Layout Plan
- Proposed Access Road
- Study Area
- TN - Target note

Phase 1 - Linear Features

- A1.1.1 - Semi-natural broadleaved woodland
- A3.1 - Broadleaved parkland/scattered trees
- A3.3 - Mixed parkland/scattered trees
- E2.1 - Acid/neutral flush
- I1.1.1 - Acid/neutral natural inland cliff
- Railway
- J2.5.4 - Derelict wall
- J2.6 - Dry ditch
- J2.8 - Earth bank
- J2.4 - Fence
- J2.4.1 - Fence with trees
- J4 - Bare ground
- G2 - Running water
- J2.2.2 - Defunct hedge - species-poor
- J2.1.2 - Intact hedge - species-poor
- J2.1.2.1 - Species-poor intact hedge with fence
- G1 - Standing water
- J2.5 - Wall

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EXTENDED PHASE 1 HABITAT MAP

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Drawing No	Issue
Figure 7.5	**P01.3**

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Appendix A

Legislative Context

A1 A1 Legislative Context

A framework of international, European, national and local legislation and planning policy guidance exists to protect and conserve wildlife and habitats. This is described in the following sections. The reader will refer to the original legislation for the definitive interpretation.

A1.1 Statutory Designated Sites

A network of nationally designated sites has been established through the designation of Sites of Species Scientific Interest (SSSI) under the Wildlife and Countryside Act 1981 (as amended). The protection afforded by the Act means it is an offence to carry out or permit to be carried out any operation listed within the notification without the consent of the Statutory Nature Conservation Organisation[27] (Natural Resources Wales).

The protection afforded to SSSIs is used to underpin the designation of areas at a European Level. European sites comprise:

- Special Areas of Conservation (SAC) designated under the Conservation of Habitats and Species Regulations 2017 (as amended) (known as the Habitats Regulations);
- Special Protection Areas (SPA) designated under the Wildlife and Countryside Act.

Wetlands of International Importance (Ramsar sites) declared under the Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971 are normally also notified as SSSIs but are only considered European sites as a matter of UK and Local Government Policy.

The Habitats Regulations transpose the requirements of Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive) in to law within England and Wales, while the Wildlife and Countryside Act transposes Directive 79/409/EEC on the Conservation of Wild Birds (the Birds Directive) in the law within England and Wales. Equivalent legislation exists to transpose these directives in the law within Scotland and Northern Ireland.

The Habitats Regulations require that consideration is given to the implications of plans and projects (developments) on European sites are considered. Specifically, Regulation 61(1) states:

"*A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which –*

[27] Section 28 of the Wildlife and Countryside Act 1981 (as substituted by Schedule 9 of the Countryside and Rights of Way Act 2000).

(a) is likely to have a significant effect on a European site or European marine site (either alone or in combination with other plans or projects), and

(b) is not directly connected with or necessary to the management of that site, must make an appropriate assessment of the implications for that site in view of that site's conservation objectives."

The formal consideration of effects on European sites is therefore undertaken by the determining authority such as the Local Planning Authority.

Local Nature Reserves can be given protection against damaging operations through powers within the National Parks and Access to the Countryside Act 1949 (as amended). However, this protection is usually conveyed through inclusion of protection within local planning policy relating to these sites and other non-statutory sites such as sites of Importance for Nature Conservation.

A1.2 European Protected Species

The Habitats Regulations convey special protection to a number of species which are listed in schedule 2 of the Regulations and are referred to a European Protected Species (EPS):

- All UK resident bat species;
- All whale and dolphin species;
- Large blue butterfly (*Maculinea arion*);
- Common dormouse (*Muscardinus avellanarius*);
- Pool frog (*Rana lessonae*);
- Sand lizard (*Lacerta agilis*);
- Fisher's estuarine moth (*Gortyna borelii lunata*);
- Great crested newt (*Triturus cristatus*)
- European otter (*Lutra lutra*)
- Wild cat (*Felis silvestris*);
- Lesser Whirlpool Ram's-horn Snail (*Anisus vorticulus*)
- Smooth snake (*Coronella austriaca*);
- Sturgeon (*Acipenser sturio*);
- Natterjack toad (*Bufo calamita*); and
- All marine turtles.

Regulation 41 makes it an offence to:

a) Deliberately capture, injure or kill any wild animal of a EPS;

b) Deliberately disturb wild animals of such a species;

c) Deliberately takes or destroys the eggs of such a species;

d) Damages or destroys a breeding site or resting place of such an animal.

Disturbance in the context of the offences above is disturbance which is likely to impair the ability of the animals to survive, to breed or reproduce, to nurture their young, to hibernate, to migrate; or to affect significantly the local distribution of the species.

Licences can be granted by the relevant SNCO for developments (sometime referred to as EPS Licences or Derogation Licences) providing the purposes of the licence is for "*preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment*".

A1.3 UK Protected Species

The Wildlife and Countryside Act 1981 provide protection to both EPSs and other species including wild birds, water voles and reptiles.

All wild birds, their nests and eggs are protected with some rare species afforded extra protection from disturbance during the breeding season (these species are listed in Schedule 1 of the Act). It is illegal to take any wild bird or damage or destroy the nests and eggs of breeding birds. There are certain exceptions to this in respect of wildfowl, game birds and certain species that may cause damage.

Water vole receive protection under the Wildlife and Countryside Act 1981 which prohibits the killing, injuring or taking by any method.

All native reptile species in the UK are subject to partial protection from intentional or reckless killing or injury only.

Badger and their setts are protected under the Protection of Badgers Act 1992 which makes it an offence to kill, injure or take a badger, or interfere with a sett.

A1.4 Other Legislation Relating to Species

Section 6 of the Environment (Wales) Act 2016 includes a duty on all public authorities to "seek to maintain and enhance biodiversity" so far as it is consistent with the proper exercise of those functions. In so doing, public authorities must also seek to "promote the resilience of ecosystems". This duty applies to government bodies, local authorities and statutory undertakers.

To assist in complying with this duty, public authorities must have regard to relevant evidence provided in the State of Natural Resources Report and any relevant area statement for an area in which the authority exercises functions, as well as having regard to the list of living organisms and habitats published under Section 7 of the Act. Species and habitats listed on Section 7 are considered to be of Principal Importance for the conservation of biological diversity.

The Environment (Wales) Act 2016 replaces the NERC Act 2006; Section 6 replaces Section 40 of the NERC Act and Section 7 replaces the Section 42 lists.

Appendix B

Photographs

B1 Habitat Photographs



Photograph 1 – Showing semi-natural broadleaved woodland habitat.



Photograph 2 – Showing ephemeral/short perennial habitat.



Photograph 3 – Showing marshy grassland habitat.



Photograph 4 – Showing standing water habitat.



Photograph 5 – Showing heathland habitat.



Photograph 6 – Showing acid grassland and scattered scrub.

B2 Target Note Photographs



Photograph 1 – Showing a badger outlier sett (TN4).



Photograph 2 – Showing tree with two bat boxes (TN24).



Photograph 3 – Showing a railway bridge that may have bat roost suitability (TN26).



Photograph 4 – Showing small mustelid prints (TN35).



Photograph 5 – Showing potential mink scat (TN36).



Photograph 6 – Showing wax cap (TN46).

Appendix C

Soil Sampling Technical Note

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Castlegate Business Park
Caerphilly CF83 2AX

Tel: 029 2076 0990

28th April 2020

TECHNICAL NOTE – Nant Helen - Investigation of Soils within Planted Ancient Woodland Site.

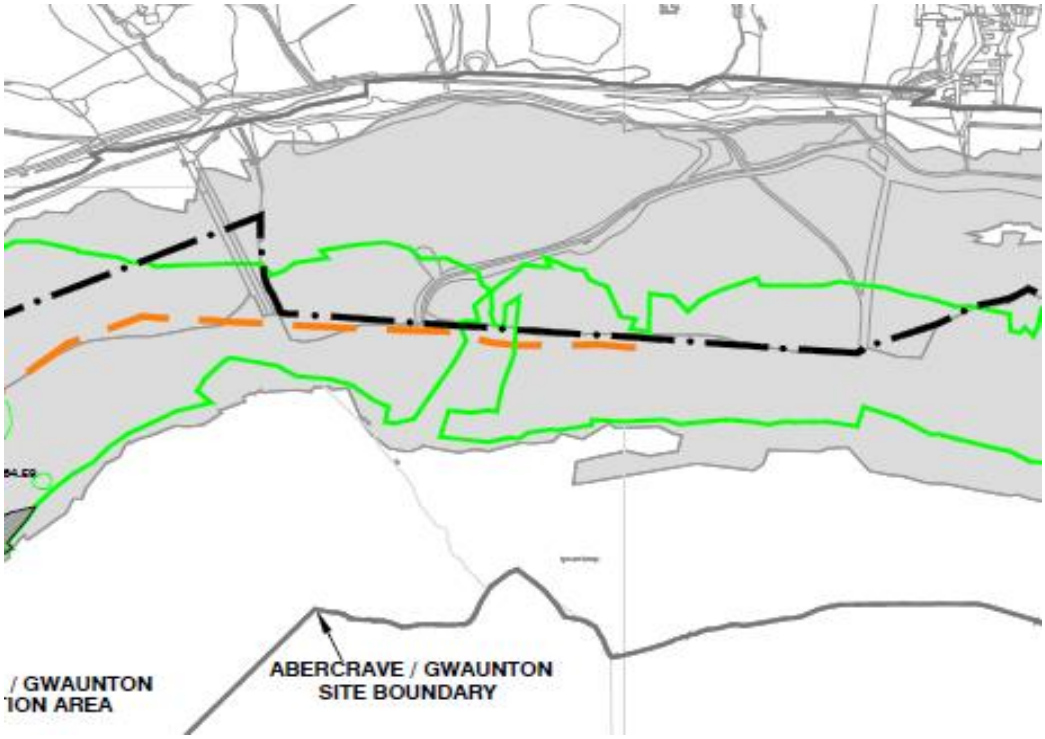
Dr R N Humphries CBiol CSci FRSB FBSSS FIQ

Natural Resources Manager

Background

A Planted Ancient Woodland Site (PAWS) was reported in the draft NANT HELEN COMPLEMENTARY RESTORATION EARTHWORKS EIA (Section 7.14.4) as occurring within the proposed location of an embankment to be built (see EIA Figure 7.4).

The PAWS and the proposed embankment are located within the excavation area of the former Abercrave / Gwaunton surface mine with the mined area no longer having any coal (the grey shadowed fill in the following extract from Figure 14.01 (Celtic Energy, Nant Helen Remainder EIA, 2011)).

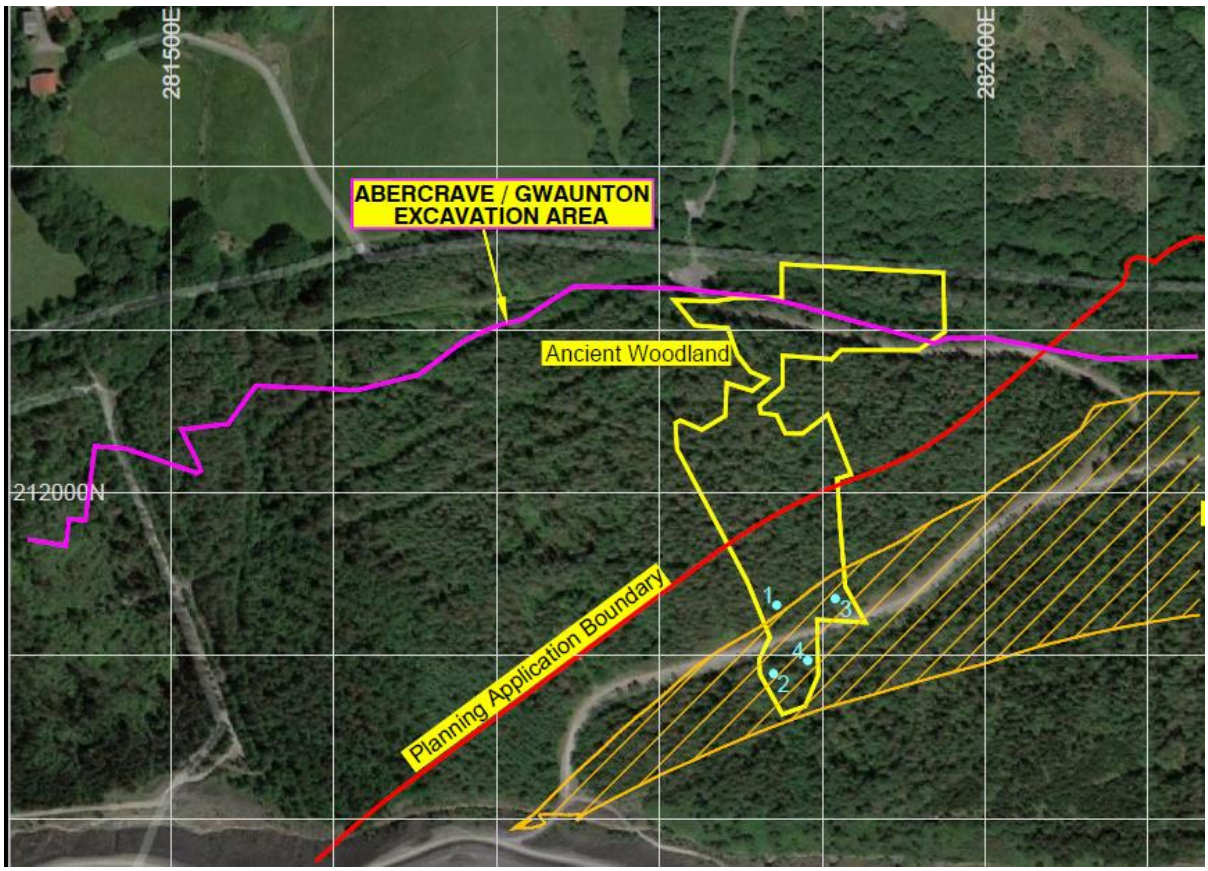


This is compelling evidence that the current plantation is likely to be on backfilled material following mining and extending over the area recorded as a PAWS, rather than as implied, the plantation replacing semi-natural woodland on the in situ woodland soils.

To solve the inconsistency between the recorded 'PAWS' and the mining records, the soils within the area of the 'PAWS' affected by the proposed raising of the embankment were examined to determine if they were backfilled 'spoil' or in situ woodland soils.

Method

The location and extent of the 'PAWS' (yellow line) within the application area (red line) and intersections with the proposed embankment works (orange hatch) on ground were marked using a GPS surveying system (see aerial image below). The purple line is the northern most extent of the surface mined land. Four representative locations (light blue and numbered) within the 'PAWS' and with safe access for a mini-tracked excavator were identified (see below).



Soil pits to a depth of about 1m were dug to expose the soil profile and provide material for examination. The features of the soil profile were recorded using standard soil survey descriptions (Hodgson, 1974). Photographs of each Pit are provided at the end of this Note.

Findings

At all four locations, the soil pits were within the European larch plantation where the ground had been deep 'forestry' ploughed to create parallel 0.3-0.5m high planting ridges at about 2.5m spacing. The pits were dug in the furrows between two ridges.

All four soil pits comprised backfilled Carboniferous Shale material. Soil Pits 1 and 2, and particularly Pit 2, had burnt colliery shale indicating an origin as 'above ground' deposited colliery waste. The predominantly clay profiles of Pits 3 and 4 were likely to be surfaced mined overburden.

Soil Pit 1 – 281872 E 211931 N

Depth cm	Description	Horizon
0-1	Moss/Litter	L
1-3	Dark Brown Humi c/ Stone Free	H
3-10	Clay Loam / 90% Grit / Grey Shale	Ah
10-70	80% Boulders & 20% Small Stones / Grey Shale	C

Soil Pit 2 – 281870 E 211889 N

Depth cm	Description	Horizon
0-1	Moss/Litter	L
1-3	Dark Brown Humic / Stone Free	H
3-10	Heavy Clay Loam / Stone Free / Grey Shale	Ah
10-90	Heavy Clay Loam/Clay / 40% Large Stones / Grey Shale	C

Soil Pit 3 – 281908 E 211935 N

Depth cm	Description	Horizon
0-1	Moss/Litter	L
1-3	Dark Brown Humic / Stone Free	H
3-10	Sandy Clay Loam / Stone Free / Grey Shale	Ah
10-70	Clay Loam / 20% Large Stones / Grey Shale + 30% Red Burnt Shale	C

Soil Pit 4 281891 E 211897 N

Depth cm	Description	Horizon
0-1	Moss/Litter	L
1-3	Dark Brown Humic / Stone Free	H
3-20	Heavy Clay Loam / Stone Free / Grey Shale	Ah
20-90	Heavy Clay Loam/Clay / 50% Large Stones / Grey Shale	C

There was no evidence of buried natural soil layers due to the forestry ploughing resulting in soil inversion in any of the Pits.

Conclusion

Clearly the original ancient woodland within the area now denoted as PAWS was surface mined during the extensive Abercrave / Gwaunton scheme. The in situ woodland soils were most likely disposed of within the progressive workings, as was the general practice into the early 1990s. Hence, the status of the ancient woodland site is more accurately referred to as having been 'destroyed'. The planting of the current conifer plantation after the backfilling of the surface mine workings could

give the impression that it is a PAWS, whereas it is simply a plantation on a destroyed ancient woodland site.

Reference

Hodgson J M, 1974. Technical Monograph nNo. 5: Soil Survey Field Handbook. Soil Survey, Harpenden.



Soil Pit 1



Soil Pit 2



Soil Pit 3



Soil Pit 4

Appendix 7B

NVC Survey Report

Ove Arup and Partners Ltd

Proposed Global Centre for Rail Excellence Nant Helen open cast mine and Onllwyn washery

Vegetation surveys



Version 4 June 2020

Sturgess Ecology

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This report has been updated to exclude the recommendations detailed in the original report. Since the production of the initial report, the design has evolved, and specific up to date recommendations have been incorporated into the Ecology Chapter of the Environmental Statement, to be submitted for the proposed Global Centre for Rail Excellence scheme.

Document reference: C253/D1/V3

Cover photographs: Left: acid grassland on former spoil heaps at Nant Helen; Right: sparse grassland and ruderals on railway sidings at Onllwyn washery.

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1. Introduction

Ove Arup and Partners Ltd ('Arup') have commissioned Sturgess Ecology to undertake vegetation surveys for the proposed Global Centre for Rail Excellence (GCRE) (hereafter referred to as the 'Project'), located on the Nant Helen opencast mine and Onllwyn washery, between Seven Sisters and Abercraf (approximate grid reference SN826110). The survey is required to support the design and assessment process for the Project.

The survey is intended to add botanical detail to the Phase 1 habitat survey, and describe the range of variation within the main habitats of nature conservation significance by categorising them in terms of the National Vegetation Classification (NVC) (Rodwell *et al*, 1991 etc.). Due to the large size of the site and high proportion of transitional habitats and small-scale vegetation mosaics resulting from the mining activities an NVC mapping survey was not considered appropriate to inform the design process and assessment at this point in time.

The fieldwork and assessment were undertaken by Dr Peter Sturgess CEnv MCIEEM. He is an experienced botanist and familiar with the NVC. He has carried out many botanical surveys on former mining sites and quarries in South Wales over more than 20 years.

2. Survey method

The objective was to describe the plant communities in habitats judged to be of highest value for nature conservation using NVC methods. The vegetation types initially selected for study were identified from a Phase 1 Habitat Survey plan produced by Arup. This confirmed the following habitats potentially worthy of investigation were present within the site

- Semi-natural broadleaved woodland
- Acid grassland
- Semi-improved acid grassland
- Neutral grassland
- Marshy grassland
- Flush
- Mire/Fen
- Dry heath
- Wet heath
- Swamp/ standing water/ ponds
- Ephemeral/ short perennial.

The following habitats were also present but considered less likely to be of nature conservation significance:

- Coniferous plantation
- Broad-leaved plantation
- Dense/ continuous scrub
- Improved grassland
- Species-poor semi-improved grassland
- Continuous Bracken
- Bare, recently disturbed ground, or other man-made habitats.

In practice, some of the habitats considered unlikely to be of nature conservation value were more diverse than expected, so were included in the study.

The survey was generally limited to land within the ownership of Celtic Energy. Some information from beyond this was gathered from public rights of way, but it was not possible to access all of the area that was included within the initial Phase 1 Habitat Survey.

The fieldwork was carried out by a walk-through method, using a combination of the habitat survey map and direct observation of habitats to identify vegetation stands for description and quadrat sampling.

A total of 127 quadrats were recorded. The quadrat areas were generally selected as being representative samples of the stand in which they occurred. The survey aimed to collect a minimum of 5 quadrats from each of the main plant communities, aiming to provide a reasonable representation of the vegetation type. Some unusual or poorly represented communities were sometimes described by just one or two quadrats.

Quadrat recording involved recording every species within square 2x2m sample areas (or 4x4m for woodlands). The cover of every species within each quadrat was assessed using the Domin scale, as shown in Table 1. An estimate was also made of the percentage cover by vegetation and the approximate vegetation height (as a rough average through the quadrat). Habitats that are less readily recorded using quadrats were described using a target note approach (e.g. ponds, rock faces), noting the main species present. A total of 23 target notes were collected.

Table 1. Domin scale for recording vegetation cover

Percentage cover	Domin score
91-100%	10
76-90%	9
51-75%	8
34-50%	7
26-33%	6
11-25%	5
4-10%	4
<4% - many individuals	3
<4% - several individuals	2
<4% - few individuals	1
Associate species (within 1m of a quadrat)	A

The quadrats recorded from each broadly similar plant community were grouped together into floristic tables, giving each distinct community its own table. Following NVC methodology, the occurrence of each species within the group of quadrats was assigned a constancy score as indicated in Table 2. The species within each table were then listed in order of their constancy score. Once the tables were completed, they were compared with the communities within the published NVC classification. Comparisons have mostly been made on the basis of the author's experience, rather than use of analytical software. However, TABLEFIT version 2.0 (Hill, 2015) was used to assist in interpreting some of the communities.

Table 2. Constancy scores for quadrat data

Frequency within quadrats	Constancy Score
81 - 100%	V
61 - 80%	IV
41 - 60%	III
21 - 40%	II
1 - 20%	I
Associate species (A) only	

The survey work was carried out during June and July 2019. This is the optimal time of year for this type of vegetation survey because most species of plants are visible and many are in flower. Even so, it is possible that some species might have been overlooked by the survey because they had finished flowering early in the spring (e.g. some woodland or 'winter-annual' species) or species that are only present at very low density.



This single young frond of Royal Fern was the only one found during the survey (near Q48). It is a species that is only present at a very low density and could have easily been overlooked.

3. Survey findings

A list of the plant species recorded during the survey is presented in Appendix 1. This includes the scientific and common names for each species. The list includes every species encountered during the quadrat surveys and target notes. It also includes a number of others that were seen while walking through the site. However, those not recorded in the quadrats are mostly only present at a low density.

The locations of the quadrats and target notes are presented in Appendix 2. They are shown on an aerial photograph background rather than the habitat survey plan to avoid possible confusion resulting from the scale used in habitat plan e.g. some of the quadrats for acid grassland and heath are within areas that were mapped as marshy grassland, because that was the predominant habitat in the wider area. Many of the vegetation types found within the study area are part of habitat mosaics or gradual transitions between two or more habitats.

The vegetation descriptions and constancy tables are presented below (set out in in the approximate order of habitat categories listed in the Handbook for Phase 1 habitat survey, JNCC, 2010). They attempt to describe the vegetation in terms of the Phase 1 habitat types and also the published NVC communities. In some cases it has not been possible to match the vegetation with the published types very precisely, particularly where the plant communities have been subject to disturbance or where they are in a state of transition. The community descriptions are presented together with the quadrat data collected, arranged as NVC vegetation tables. The species in the tables are arranged in order of frequency, as denoted by the constancy score in the right-hand column.

Semi-natural broad-leaved Woodland

Semi-natural broad-leaved woodland is mostly located on steeply sloping ground. The largest areas are dominated by mature Sessile Oak, with a sparse understorey of Rowan, Holly, Hazel and Hawthorn. This is mostly attributable to the NVC category W11 *Quercus petraea – Betula pubescens – Oxalis acetosella* woodland. Quadrats 70, 81 and 82 are from typical examples of this habitat. Frequent ground flora species include Creeping Soft-grass, Bluebell and Wood Sorrel. Q2 is an example of Oak woodland on a damp valley-side where Alder is also prominent. Q5 is an example of Sessile Oak woodland with a very species-poor ground flora, due to grazing by sheep.

On lower valley-sides to the south there is semi-natural Ash-dominated woodland with a relatively diverse ground flora that includes a number of old woodland indicator species such as Bluebell, Yellow Pimpernel, Wood Speedwell and Tutsan. Only one quadrat was recorded from this woodland (Q18) as it is outside the likely works area. This is best classed as W9 *Fraxinus excelsior – Sorbus aucuparia – Mercurialis perennis* woodland.



W11 Sessile Oak woodland (Q82). This particular woodland is included in the Natural Resources Wales Ancient Woodland Inventory.



W9 Ash woodland (Q18).

Table 3. Quadrat data for semi-natural broadleaved woodland (4x4m quadrats)

Species	2	5	18	70	81	82	Frequency
Holcus mollis		2	1	6	2	9	V
Kindbergia praelonga	4	3	3	5	7	6	V
Polytrichastrum formosum	2	3	2	7	4	2	V
Quercus petraea	9	10		8	10	10	V
Rubus fruticosus	5		5	4	5	2	V
Dryopteris dilatata	2		1	2	4	A	IV
Dryopteris filix-mas	1		2	1	2		IV
Juncus effusus	1	1			2	2	IV
Rhytidiadelphus squarrosus		2		7	5	2	IV
Agrostis capillaris	8	9	A		2		III
Crataegus monogyna	1	1	1	A		A	III
Hedera helix sl	2		4	2			III
Sorbus aucuparia			5	2	A	1	III
Alnus glutinosa	10			5			II
Anthoxanthum odoratum	2	2				A	II
Athyrium filix-femina			2	1			II
Atrichum undulatum				2	2	A	II
Betula pubescens	A			4	5		II
Corylus avellana	5		8		A		II
Dactylis glomerata	A	1	1			A	II
Eurhynchium striatum			5			3	II
Fraxinus excelsior	1		9				II
Hyacinthoides non-scripta			5	A	A	4	II
Hypnum cupressiforme					3	3	II
Hypnum jutlandicum	2	2					II
Ilex aquifolium	1		1	A		A	II
Oxalis acetosella			1	5			II
Thuidium tamariscinum	2	2					II
Blechnum spicant			1				I
Brachythecium rutabulum		2					I
Chamerion angustifolium					2		I
Deschampsia cespitosa		2	A	A			I
Deschampsia flexuosa				A	A	3	I
Dicranum majus						2	I
Digitalis purpurea	1			A			I
Diplophyllum albicans					2		I
Dryopteris affinis	A		1				I
Epilobium montanum					2		I
Festuca rubra		3					I
Fragaria vesca			2				I
Galium palustre				1			I
Geranium robertianum			2	A			I
Isothecium myosuroides	2		A				I
Lysimachia nemorum			2				I
Mnium hornum	3					A	I
Peltigera sp.			1				I
Poa trivialis		2					I
Potentilla erecta	1						I
Potentilla sterilis			2				I
Pseudoscleropodium purum	A	2					I
Veronica montana			2				I
Viola riviniana			2				I
Cardamine cf flexuosa				A			
Chiloscyphus polyanthos				A			
Circaea lutetiana	A	A					
Epilobium ciliatum	A						

Species	2	5	18	70	81	82	Frequency
Festuca ovina						A	
Galium aparine				A			
Geum urbanum			A				
Holcus lanatus	A				A	A	
Lophocolea bidentata				A			
Luzula pilosa			A				
Pellia sp.			A	A			
Plagiothecium undulatum					A		
Platyhypnidium riparioides				A			
Polypodium vulgare						A	
Prunella vulgaris			A				
Rhizomnium punctatum				A			
Taraxacum sp.			A				
Urtica dioica		A					
Vaccinium myrtillus				A			
Veronica serpyllifolia			A				
Species total	**21**	**17**	**26**	**16**	**16**	**13**	
Ground flora (cm)	**40**	**30**	**50**	**40**	**60**	**40**	
Canopy (m approx.)	**15m**	**20m**	**20m**	**10m**	**10m**	**10m**	
Ground cover (%)	**100**	**100**	**100**	**100**	**50**	**100**	

Plantation and scrub woodland

Some of the broad-leaved woodland shown on the habitat map comprises plantation woodland, planted as part of coal spoil restoration projects. Canopy species including Field Maple and Grey Alder are frequent in the plantations but would not be expected to occur in these situations naturally. Other relatively new woodland appears to have established from scrub on damp ground. For the purposes of this study these younger woodlands have been grouped together. Quadrats 53, 68 and 83 appear to have been established as plantations. Quadrats 20 and 86 are examples of scrub woodland (which may have been planted) and Quadrat 1 is an example of young Alder woodland.

These woodlands are all characterised by a high proportion of Bramble in their understorey, and there are often remnants of grassland flora persisting in the shade (e.g. Red Fescue, Soft Rush, Common Bent, Common Spotted Orchid). They mostly lack old-woodland indicator species, although a few, such as Wood Sedge, Enchanter's Nightshade and Wood Avens occur locally. Broad-leaved Helleborine orchids are present in many of the young woodlands on coal spoil; often in large numbers.

These young woodlands are difficult to place within the NVC because they are in a transitional state between scrub and woodland. The plantations have a man-made canopy composition and most of the young woodlands have grassland elements in the ground flora. W21 *Crataegus monogyna – Hedera helix* scrub is a reasonable match for much of the plantation woodland, while some damper scrub woodland has elements of W6 *Alnus glutinosa – Urtica dioica* woodland (e.g. Q11).

There were relatively few noteworthy plant species in the young woodlands, but a large plant of Sherard's Downy Rose (or a possible hybrid of it) was seen at a track-side scrub margin south of Quadrat 68. Several non-native invasive Cotoneaster species, particularly Hollyberry Cotoneaster, were also seen in young woodlands.

Table 4. Quadrat data for broadleaved plantation and scrub woodland (4x4m quadrats)

Species	1	20	53	68	83	86	Frequency
Hedera helix sl		9	2	2	2	2	V
Kindbergia praelonga	5	4	3	6	4	8	V
Rubus fruticosus	10	4	10	5	4	8	V
Geranium robertianum		1		2	2	1	IV
Salix cinerea		8	4		4	10	IV
Agrostis capillaris	4		2	2			III
Cardamine cf flexuosa	2		4			2	III
Deschampsia cespitosa	2			3	1		III
Epilobium montanum			3		3	1	III
Poa trivialis				4	2	4	III
Acer pseudoplatanus				2	1		II
Alnus glutinosa	10		7				II
Alnus incana				4	2		II
Athyrium filix-femina		1				2	II
Betula pubescens	1	8					II
Brachythecium rutabulum	A		A	2		3	II
Crataegus monogyna		A	A	1		2	II
Digitalis purpurea	1		2				II
Dryopteris dilatata		1	A	1	A		II
Dryopteris filix-mas	1	A		A		2	II
Epipactis helleborine		1		1	A	A	II
Equisetum arvense				2	1		II
Eurhynchium striatum				2	2		II
Festuca rubra		1	A			2	II
Fragaria vesca		1	1				II
Fraxinus excelsior		1			A	1	II
Peltigera sp.		1				1	II
Polytrichastrum formosum	2		3				II
Quercus petraea			7		5		II
Ranunculus repens	2			2			II
Urtica dioica	5					2	II
Acer campestre				10			I
Atrichum undulatum	2			A			I
Carex remota	4						I
Circaea lutetiana	2				A		I
Corylus avellana		4					I
Dactylis glomerata		1					I
Epilobium palustre				2			I
Fissidens bryoides				2			I
Fissidens taxifolius	2						I
Galium aparine				3			I
Galium palustre	1					A	I
Geum urbanum	2						I
Holcus lanatus			A		1		I
Juncus bufonius				3			I
Lophocolea bidentata		1					I
Mnium hornum						2	I
Plagiomnium undulatum						1	I
Polystichum setiferum				1			I
Prunella vulgaris	2						I
Prunus avium					9		I
Prunus spinosa				2			I
Ranunculus acris						1	I
Rhytidiadelphus triquetrus					7		I
Rumex sanguineus	2						I
Salix caprea			6				I

Species	1	20	53	68	83	86	Frequency
Solanum dulcamara	2						I
Solidago virgaurea		1					I
Sorbus aucuparia		2	A		A	A	I
Stellaria alsine				1			I
Stellaria media				2			I
Taraxacum sp.					1		I
Trifolium repens				2			I
Veronica chamaedrys	1						I
Viola riviniana		1					I
Arrhenatherum elatius					A		
Asplenium scolopendrium	A					A	
Brachypodium sylvaticum	A						
Carex sylvatica					A		
Chamerion angustifolium			A				
Cotoneaster bullatus				A			
Dactylorhiza fuchsii						A	
Epilobium ciliatum		A					
Filipendula ulmaria	A						
Fissidens adianthoides					A		
Heracleum sphondylium					A		
Ilex aquifolium					A		
Isothecium myosuroides						A	
Juncus effusus			A				
Plagiothecium undulatum					A		
Polytrichum commune			A				
Rosa arvensis		A					
Ulex europaeus	A			A			
Viburnum opulus					A		
Canopy (m)	**10m**	**7m**	**10m**	**10m**	**8m**	**8m**	
Height (cm)	**80**	**30**	**80**	**40**	**5**	**80**	
Cover (%)	**100**	**100**	**100**	**100**	**100**	**100**	
Species total	**22**	**19**	**13**	**26**	**17**	**19**	



Broad-leaved plantation (Q53)

Conifer plantation

Conifer plantations were not sampled using quadrats, because the dense tree canopy only supports a sparse ground flora and the plant community was not expected to have much value for nature conservation value. A walk-through of the plantation at the north-west of the study area found that although the vegetation beneath the canopy of Lodgepole Pine, Larch and Sitka Spruce was sparse it was of at least local value due to a very large population of Common Wintergreen (with many thousands of plants present). The moderately diverse range of other species in the ground flora was dominated by mosses and liverworts. Frequent seedlings of Sessile Oak and Downy Birch may give an indication of the type of woodland that might develop in this area naturally.

Table 5. Species-list for coniferous plantation (TN12)

Betula pubescens
Campylopus introflexus
Chamerion angustifolium
Cirsium palustre
Cladonia rangiformis
Deschampsia flexuosa
Dicranum scoparium
Diplophyllum albicans
Epilobium brunnescens
Fragaria vesca
Hypericum androsaemum
Hypnum jutlandicum
Juncus effusus
Juncus tenuis
Kindbergia praelonga
Larix sp.
Lotus pedunculatus
Picea sitchensis
Pinus contorta
Pleurozium schreberi
Polytrichastrum formosum
Prunella vulgaris
Pseudoscleropodium purum
Ptilidium ciliare
Pyrola minor
Quercus petraea
Racomitrium lanuginosum
Rhytidiadelphus loreus
Rumex acetosa
Sanicula europaea
Sorbus aucuparia
Thuidium tamariscinum
Trifolium repens
Ulex europaeus
Vaccinium myrtillus



Coniferous plantation (TN12), showing large numbers of Common Wintergreen plants in otherwise sparse ground flora.

Acid grassland

At this site acid grassland typically exists as part of a mosaic with marshy grassland and heath vegetation. It tends to occur patchily, especially on well-drained sloping ground, where succession to heath is limited by grazing. Much of it also varies in the openness of the sward, depending on slope and grazing intensity. In some cases, where it is developing on relatively young coal spoil it may also be a transitional stage that might eventually become heath. Much of the acid grassland within the site would be best classified semi-improved acid grassland (which is discussed later) due to the heavy grazing of sheep and likely past influences of reprofiling and soil conditioning work carried out to restore coal spoil.

In terms of the NVC the acid grassland forming relatively open swards on dry, stony slopes and spoil heaps is best assigned to U1 *Festuca ovina – Agrostis capillaris – Rumex acetosella* grassland. It supports a relatively high proportion of annuals, bryophytes and lichens. However, it differs from the typical published U1 community as Sheep's Sorrel is relatively scarce.

Table 6. Quadrat data for U1 *Festuca ovina – Agrostis capillaris – Rumex acetosella* dry acid grassland.

Species	**4**	**27**	**29**	**33**	**34**	**57**	**59**	**74**	**96**	**101**	**111**	**Freq.**
Festuca ovina		2	8	5	2	6	5	1	4		3	V
Rhytidiadelphus	2	1	3	4	2			4	4	2	4	V
Cirsium palustre	1		1	1	1	1	1		1		A	IV
Dicranum scoparium			2	4		3	4	3	2	1	4	IV
Galium saxatile		2	2	4		3	3	2	4		2	IV
Hypochaeris radicata		2	4	1	2	2	A	3	A	2		IV
Peltigera sp.			2	1		2	2	A	2	1	2	IV
Cladonia pyxidata			2	2	1	2		1		1		III
Cladonia rangiformis		A		5		3	2	2		1		III
Danthonia decumbens	2	6			4	1	4	A	2			III
Holcus lanatus	4					2	2		5	4	4	III
Hypnum jutlandicum		4	4	7	6				2		2	III
Luzula campestris	1		2			2	1		2	2		III
Pilosella officinarum			2			5	4			2	1	III
Polytrichum commune	A	2		4	1		4	3				III
Polytrichum juniperinum	1		7		A			4	2	2		III
Potentilla erecta	4	2			1		A	2	A		2	III
Agrostis canina		8	2	2					3			II
Agrostis capillaris	8			A		2	7				6	II
Anthoxanthum odoratum	2					4	2		8			II
Calluna vulgaris			4		1			2	A		4	II
Cladonia furcata			2	2	1	A		1		A		II
Festuca rubra	4								6	7	4	II
Juncus effusus	2				1		1					II
Lotus corniculatus			A				2		4	3		II
Luzula multiflora					1				A	3	2	II
Plantago lanceolata									4	3	2	II
Pleurozium schreberi						4	6	4	2	A		II
Pseudoscleropodium	2	A	1			4	3					II
Taraxacum sp.			1						1		2	II
Vicia sativa									2	4	2	II
Aira caryophyllea						2	A			3		I
Aira praecox						2				A		I
Anaphalis margaritacea			4							2		I
Arrhenatherum elatius											1	I
Atrichum undulatum	1									1		I
Betula pubescens	1									A		I

Species	4	27	29	33	34	57	59	74	96	101	111	Freq.
Blechnum spicant					1							I
Calliergonella cuspidata											2	I
Campylopus introflexus										1		I
Carex binervis									1			I
Cerastium fontanum						A				2		I
Chamerion angustifolium										2	4	I
Cirsium vulgare										1		I
Cladonia crispata								1				I
Cladonia foliacea						2						I
Dactylorhiza praetermissa										1		I
Deschampsia flexuosa								8	4			I
Diplophyllum albicans					A		1	2				I
Equisetum arvense										A	1	I
Erica tetralix					1							I
Fragaria vesca										3	4	I
Geranium dissectum											2	I
Hieracium sp.										2		I
Hylocomium splendens							1	1			A	I
Juncus conglomeratus	2											I
Juncus squarrosus		1			4							I
Lophocolea bidentata									2		2	I
Lotus pedunculatus	1											I
Molinia caerulea	A		A		6				A			I
Nardus stricta	2			A	6		A	A				I
Poa pratensis											5	I
Pogonatum urnigerum										3		I
Polytrichum piliferum			3			2						I
Potentilla reptans										1		I
Prunella vulgaris										1		I
Ptilidium ciliare						2						I
Quercus petraea	1											I
Racomitrium cf fasciculare				2								I
Rumex acetosa										2		I
Trifolium dubium						2				2		I
Trifolium pratense										2		I
Trifolium repens			2			2						I
Tussilago farfara										1		I
Vaccinium myrtillus				2			A	1				I
Veronica officinalis			2			3					A	I
Vicia hirsuta									1		3	I
Viola riviniana											2	I
Carex panicea	A											
Centaurea nigra									A			
Ceratodon purpureus	A											
Cladonia floerkeana			A									
Crataegus monogyna							A					
Digitalis purpurea								A				
Epilobium palustre										A		
Picea sitchensis										A		
Ranunculus repens											A	
Salix cinerea									A	A		
Senecio jacobaea						A						
Sorbus aucuparia									A		A	
Ulex europaeus	A	A	A									
Height (cm)	**50**	**25**	**15**	**10**	**40**	**15**	**15**	**30**	**30**	**20**	**30**	
Cover (%)	**100**	**95**	**95**	**100**	**95**	**85**	**95**	**95**	**100**	**95**	**100**	
Species total	**18**	**10**	**21**	**15**	**18**	**24**	**19**	**18**	**23**	**32**	**26**	



Dry U1 acid grassland on a former railway embankment (Q57)

Neutral grassland

Neutral and semi-improved neutral grassland at this site is mostly limited to small patches and road-side strips, where there is more base-enrichment in soils than the more prevalent acid grassland communities. In this case it is likely that the base minerals have originated from shale in coal waste or limestone associated with road building, and this is especially likely with the developing grasslands at the washery (Quadrats 98, 99 and 100). Most are probably best classified as 'unimproved' neutral grassland because it is unlikely that there has been any intentional grassland improvement in most of these areas, except occasional grass cutting. There is a wide range of species in these rather fragmented habitats, reflecting the mix of acid and base minerals in the soils derived from coal spoil. In terms of the NVC the neutral grassland communities are probably closest to MG5 *Centaurea nigra - Cynosurus cristatus* grassland, although some patches of rougher, unmanaged grassland are closer to MG1 *Arrhenatherum elatius* grassland (which was more species-poor and not sampled). In addition to the species recorded in the quadrats, the neutral grassland also included small amounts of Restharrow, Cowslip and Hairy Tare.



MG5 neutral grassland beside access track (Q87)

Table 7. Quadrat data for MG5 neutral grassland.

Species	19	85	87	95	98	99	100	Frequency
Calliergonella cuspidata		4	2	2	2	4	4	V
Cynosurus cristatus	3	4	3	2	A	2	3	V
Festuca rubra	7	4	5	5	6	3		V
Holcus lanatus	7	4	2	1	A	2	4	V
Anthoxanthum odoratum	8	5	4		2		4	IV
Rhytidiadelphus squarrosus		3	4		4	6	2	IV
Trifolium repens	2	2	2	1			4	IV
Carex flacca			5	3	4		4	III
Carex leporina	2		2		A	1	2	III
Cerastium fontanum	1	1	1	A			1	III
Juncus effusus	2		2		1	2	A	III
Lotus corniculatus		1		3	7			III
Lotus pedunculatus	4		2				2	III
Luzula campestris		2	2		2			III
Plantago lanceolata	4	2	2	2				III
Prunella vulgaris	A			1	A	2	3	III
Ranunculus acris	2	3	3		A		2	III
Ranunculus repens	5			1		2	3	III
Trifolium pratense	6		6	A	1		A	III
Vicia sativa		3	1	1		1	A	III
Achillea millefolium				4			2	II
Agrostis capillaris	5				2			II
Agrostis stolonifera						3	1	II
Arrhenatherum elatius		6				2		II
Brachythecium rutabulum		2				2		II
Cardamine pratensis			1			1		II
Centaurea nigra					1		2	II
Cirsium arvense		1				1		II
Cirsium palustre	A		A	1			1	II
Cladonia rangiformis				1	2			II
Cratoneuron filicinum				2			2	II
Dactylis glomerata		4	A	1		A		II
Dactylorhiza praetermissa			1		A	1	A	II
Equisetum arvense	2		A				2	II
Galium palustre	A					3	1	II
Holcus mollis						4	1	II
Hypochaeris radicata				1	4	A		II
Kindbergia praelonga	2	2						II
Linum catharticum				2	1			II
Peltigera sp.				2		1		II
Pilosella officinarum				4	2			II
Poa pratensis		2	A			3		II
Potentilla anserina				2		7		II
Racomitrium ericoides				2	4			II
Sagina procumbens						1	3	II
Silene flos-cuculi			1				1	II
Trifolium dubium				3	3			II
Agrostis canina					2			I
Aira caryophyllea					2			I
Alopecurus pratensis	2							I
Bellis perennis				1	A		A	I
Betula pubescens				1				I
Bromus hordeaceus				3				I
Carex hirta					A	A	5	I
Carex nigra							4	I
Carex pallescens							2	I
Carex spicata							1	I
Centaurium erythraea					A		1	I

Species	19	85	87	95	98	99	100	Frequency
Chamerion angustifolium		2		A				I
Cirsium vulgare						1		I
Daucus carota				1				I
Deschampsia cespitosa			2					I
Equisetum palustre							1	I
Festuca ovina					2			I
Fragaria vesca				2				I
Geranium dissectum						2	A	I
Hypericum perforatum				2	A			I
Hypnum lacunosum				2	A			I
Juncus acutiflorus						2		I
Lathyrus pratensis					A		2	I
Leontodon hispidus			4					I
Leucanthemum vulgare				A	3			I
Lolium perenne	1	A						I
Medicago lupulina			4					I
Mentha aquatica						1		I
Odontites vernus	2							I
Oenothera sp.				2				I
Plagiomnium undulatum						2		I
Poa compressa							1	I
Quercus robur				1				I
Ranunculus flammula	1							I
Rhinanthus minor		A	2					I
Rosa canina				1				I
Rumex acetosa	A	2			A			I
Rumex conglomeratus						1		I
Salix cinerea		A	A	A			1	I
Scorzoneroides autumnalis							1	I
Senecio aquaticus						1		I
Senecio jacobaea					2			I
Stachys palustris						2		I
Taraxacum sp.		1						I
Torilis japonica		1						I
Vicia cracca							1	I
Anaphalis margaritacea				A				
Cladonia sp.				A				
Crataegus monogyna		A						
Dactylorhiza fuchsii					A			
Encalypta streptocarpa				A				
Epilobium palustre	A							
Euphrasia sp.	A							
Filago minima				A				
Fraxinus excelsior			A					
Juncus articulatus							A	
Luzula multiflora		A						
Melilotus cf officinalis				A				
Molinia caerulea							A	
Nardus stricta			A					
Potentilla reptans			A					
Quercus petraea		A						
Reynoutria japonica						A		
Rubus fruticosus	A				A	A		
Rumex crispus	A							
Sonchus oleraceus							A	
Tussilago farfara				A		A		
Urtica dioica						A		
Species total	**20**	**23**	**24**	**33**	**22**	**30**	**34**	
Height (cm)	**60**	**40**	**40**	**10**	**20**	**30**	**30**	
Cover (%)	**100**	**100**	**100**	**90**	**95**	**100**	**95**	

Semi-improved acid grassland

A high proportion of the heavily grazed, short grassland on the site is best classified as semi-improved acid grassland. Most is grazed by sheep and cattle, but a few fields near the washery (represented by Quadrats 119, 124, 126 and 127) are grazed by horses. One of the features of the older semi-improved grassland is the abundance of ant-hills. For the purposes of this study the 'ant-hill grassland' was sampled separately from the other semi-improved acid grassland, because of its very distinct appearance. This fits the NVC community U4 *Festuca ovina – Agrostis capillaris – Galium saxatile* grassland.

Table 8. Quadrat data for semi-improved acid 'ant-hill' grassland.

Species	6	14	17	44	56	89	119	124	126	127	Freq
Agrostis capillaris	8	9	4	6	8	2	2	8	2	2	V
Holcus lanatus	1		5	4	3	4	2	2	1	2	V
Luzula campestris	A	2	3	4	4	1	2	4	1	3	V
Festuca rubra			2	5		8	2	6	2	4	IV
Galium saxatile	4	5	4	A	3	6	2	3		4	IV
Polytrichum juniperinum	3		2		2		2	2	2	2	IV
Rhytidiadelphus squarrosus	4	4	2	4		2	4	4		2	IV
Anthoxanthum odoratum			8	4	4				7	6	III
Festuca ovina	4	4		7	5		2			A	III
Nardus stricta	2	4			5		2	2		2	III
Plantago lanceolata			5	3	2			1	2	4	III
Potentilla erecta	A		4	1	6		4	4		A	III
Agrostis canina	2			4	2						II
Ceratodon purpureus		2	A		2				2	3	II
Cynosurus cristatus			2	4					3	4	II
Danthonia decumbens	2	A			2		1	3			II
Deschampsia flexuosa	3						4	3			II
Epilobium ciliatum						1	2	1			II
Juncus effusus	1			4	A	A	1	2			II
Juncus squarrosus		1					2	3	A	A	II
Prunella vulgaris				2	2				A	1	II
Pseudoscleropodium purum	2				2		2				II
Rumex acetosa			1					2	A	1	II
Rumex acetosella	2								4	5	II
Senecio jacobaea								1	2	2	II
Taraxacum sp.			2	1					2		II
Trifolium repens				4	2				A	2	II
Acer pseudoplatanus										1	I
Achillea millefolium						1			A		I
Aira caryophyllea					2						I
Aira praecox	5										I
Calluna vulgaris							2	1			I
Carex binervis				1							I
Cerastium fontanum				2					A	1	I
Cirsium arvense				1		A					I
Cirsium palustre				2	2						I
Cirsium vulgare						1					I
Dicranum scoparium					A		2				I
Filago germanica									1		I
Hypnum jutlandicum					2		2				I
Hypochaeris radicata			2								I
Juncus acutiflorus			1								I
Juncus conglomeratus			1			1					I
Kindbergia praelonga								2			I
Lolium perenne				2							I
Lotus corniculatus			3						A	1	I
Luzula multiflora							A	1			I

Species	6	14	17	44	56	89	119	124	126	127	Freq
Molinia caerulea			A				6	2			I
Narcissus sp.				4							I
Pedicularis sylvatica							6				I
Peltigera sp.					1			A		A	I
Pilosella aurantiaca										1	I
Pilosella officinarum					A				2		I
Pleurozium schreberi	5				A		3				I
Poa annua									3	A	I
Poa pratensis						4		2			I
Polygala serpyllifolia					A		2				I
Ranunculus repens						A			1	2	I
Sagina procumbens				2						A	I
Scorzoneroides autumnalis									2	2	I
Succisa pratensis										1	I
Trifolium dubium									A	1	I
Vaccinium myrtillus							4	4			I
Valeriana officinalis								2			I
Veronica arvensis				1						1	I
Veronica serpyllifolia				2				1			I
Vicia sativa						1		2			I
Vulpia bromoides				3	1						I
Arrhenatherum elatius						A					
Atrichum undulatum											
Bellis perennis									A	A	
Betula pubescens								A			
Bromus hordeaceus				A	A						
Carex demissa					A						
Carex leporina										A	
Chamerion angustifolium								A		A	
Cladonia rangiformis					A						
Crataegus monogyna								A			
Dactylorhiza fuchsii										A	
Deschampsia cespitosa						A					
Digitalis purpurea	A		A						A		
Erica tetralix							A				
Galeopsis cf tetrahit										A	
Heracleum sphondylium						A					
Homalothecium sericeum				A							
Juncus bulbosus							A				
Juncus tenuis									x		
Lotus pedunculatus									x		
Odontites vernus									x		
Poa trivialis										A	
Polytrichastrum formosum							A				
Quercus x rosacea								A			
Racomitrium aciculare				A							
Ranunculus acris									A		
Rumex obtusifolius									A		
Sphagnum capillifolium							A				
Sphagnum inundatum							A				
Tilia cordata						A					
Ulex europaeus				A						A	
Veronica officinalis									A		
Viola riviniana						A					
Species total	**15**	**8**	**17**	**25**	**21**	**12**	**24**	**26**	**17**	**26**	
Height (cm)	**5**	**10**	**40**	**20**	**10**	**30**	**10**	**10**	**10**	**10**	
Cover (%)	**95**	**100**	**95**	**100**	**95**	**100**	**95**	**100**	**70**	**95**	



U4 semi-improved acid grassland with abundant ant-hills (Q6)

Other semi-improved acid grassland is present that also has a closed sward but does not support the same frequency of ant-hills. Some of this is of relatively recent origin (the large spoil heap where Q30 and 37 were recorded is only about 30 years old). Some appears to be on natural clay soil rather than coal spoil, and with a high proportion of Sweet Vernal-grass, Red Fescue and Crested Dog's-tail is close to MG5 semi-improved neutral grassland (e.g. Q69, 79 and 80). Much of the semi-improved grassland has patchy rushes (especially Soft Rush), and some is transitional with damp grassland (e.g. Q35, which has a high frequency of Purple Moor-grass and has affinity with M25 mire). A few areas with more prominent Mat Grass resemble U5 *Nardus stricta – Galium saxatile* grassland. However, the majority of this close-sward acid grassland still broadly conforms to the NVC community U4 *Festuca ovina – Agrostis capillaris – Galium saxatile* grassland.



Low-diversity U4 semi-improved acid grassland (Q23)

Table 9. Quadrat data for other U4 semi-improved acid grassland.

Species	7	23	30	35	37	69	79	80	Freq.
Agrostis capillaris	9	7	6		6	8	4	4	V
Galium saxatile	2	2	3	1		2	2	2	V
Holcus lanatus	6	4	4		7	6	4	5	V
Rhytidiadelphus squarrosus	2	5	8	2	7	4	4	2	V
Cirsium palustre	A	1	1	A	1	A	1	1	IV
Cynosurus cristatus			1		5	1	2	3	IV
Festuca rubra	2		2		5	4	4	7	IV
Luzula campestris	3	1			2	2	5	7	IV
Nardus stricta	2	6		2	4		2		IV
Potentilla erecta	4	2			2	5	7	8	IV
Trifolium repens	4	1	1		2		3	2	IV
Anthoxanthum odoratum	2	A				5	8	5	III
Cerastium fontanum	1		1		2		A		II
Danthonia decumbens	2			1	A				II
Festuca ovina		7	4	1					II
Juncus conglomeratus				2	4			A	II
Juncus effusus	A	1		A	1	A	A		II
Juncus squarrosus	2			2					II
Luzula multiflora				3	3				II
Molinia caerulea				8	1				II
Plantago lanceolata						2		3	II
Poa pratensis	2	A	A				1		II
Rumex acetosa						4	3	2	II
Senecio jacobaea					1		2		II
Veronica officinalis			1		2				II
Veronica serpyllifolia					1	1			II
Vicia sativa			1			2			II
Agrostis canina			3						I
Carex binervis								2	I
Carex leporina					1				I
Chamerion angustifolium			A			2			I
Cirsium arvense					2				I
Deschampsia flexuosa		2							I
Dicranum scoparium			1						I
Epilobium ciliatum					2				I
Epilobium palustre			1						I
Erica tetralix				2					I
Fragaria vesca			A		1				I
Hyacinthoides non-scripta							1		I
Hylocomium splendens			2						I
Hypericum tetrapterum						1			I
Hypnum jutlandicum				4					I
Lotus corniculatus			A			1		A	I
Peltigera sp.			4						I
Persicaria maculosa						1			I
Pilosella officinarum			1						I
Polytrichum juniperinum				2					I
Pseudoscleropodium purum						1			I
Quercus petraea								1	I
Rumex acetosella			1						I
Thuidium tamariscinum					2				I
Vaccinium myrtillus				1					I
Aira caryophyllea			A						
Aira praecox			A						
Calluna vulgaris						A			
Carex panicea					A				
Carex pilulifera				A					
Crataegus monogyna								A	

Species	7	23	30	35	37	69	79	80	Freq.
Deschampsia cespitosa						A			
Geranium dissectum			A						
Polytrichum commune				A					
Polytrichum piliferum			A						
Sagina procumbens	A								
Salix cinerea						A			
Taraxacum sp.					A				
Trifolium dubium					A				
Ulex europaeus						A			
Species total	**14**	**12**	**19**	**13**	**23**	**18**	**16**	**14**	
Height (cm)	**10**	**10**	**20**	**60**	**40**	**40**	**20**	**15**	
Cover (%)	**100**	**100**	**100**	**100**	**98**	**90**	**100**	**95**	

Sparse grassland on coal spoil and washery sidings

Much of the study area supports sparse vegetation on recently disturbed coal spoil. Similarly, the railway sidings at the washery support sparse vegetation on the limestone ballast forming the tracks, which is also mixed with fine material from the coal. The flora supports a high proportion of annual and low-growing ruderal species, as well as early colonists more typical of heath and grassland vegetation, and seedlings of trees and scrub. Bryophytes and lichens are also locally prominent. The flora supports many species indicative of acid soils, but there are many base-loving species too. This mix is typical of coal spoil and results in a very variable, flower-rich and often high diversity flora. In Phase 1 habitat classification this would usually be classified as 'ephemeral/ short perennial vegetation', although it is often not freely draining as the shale in the coal spoil breaks down into clays. It is not easy to define in terms of the NVC, probably because of the wide variation in the range of species that co-exist on the coal spoil and the presence of so many base-loving plants. The closest matches are probably U1 *Festuca ovina – Agrostis capillaris – Rumex acetosella* grassland community (Quadrats 38 and 72 are good examples of a typical U1 flora on coal spoil), but much of the spoil flora bears little resemblance to U1 and is probably best left unclassified.



Sparse vegetation on coal spoil (Q38).

Table 10. Quadrat data for sparse grassland on coal spoil and washery sidings.

Species	25	38	62	63	72	91	92	94	97	115	116	118	Freq.
Aira caryophyllea	2	2	3	3	3	2	A		3	2	2	1	V
Lotus corniculatus			8	9	2	3	2	2	4	4	2	3	V
Pilosella officinarum	5	3	1	2	2	4	2	2	5	5	6	6	V
Taraxacum sp.	2		1	1	1	2	2	1	2	2	3	1	V
Trifolium dubium	2	4	4	3	2	7	4	3	4	3	6		V
Festuca rubra	5		4	6	1	2		2		5	4	2	IV
Hypochaeris radicata			1	3	3		1		1	4	4	1	IV
Linum catharticum	2	2	3		2	1		3	2	3		A	IV
Agrostis stolonifera	1					3	4	4			2	1	III
Calliergonella cuspidata			2	3		A	6	2			3		III
Campylopus introflexus	4	5			4				5			1	III
Cerastium fontanum			2	2		2	2	2	A		2	A	III
Cynosurus cristatus			3	4	1	1	4	2		A	4		III
Festuca ovina		3	2	A	4	1	A		2			3	III
Fragaria vesca	2	7	2	A	4	2		1	A			4	III
Holcus lanatus			3	6					1	2	3	A	III
Plantago lanceolata				2		4	2	2	2	3	3	A	III
Polytrichum juniperinum	3	4			4						1	2	III
Prunella vulgaris			2		1	3	2	3					III
Rhytidiadelphus squarrosus				2		2	2		3		4		III
Sagina procumbens	1	1			2	2			1				III
Senecio jacobaea	A	1				3	2	2	2				III
Trifolium repens	2	A	3		A	2	5	2	A		2		III
Agrostis capillaris		2			2			2		2			II
Aira praecox	2	2			3		1					A	II
Anaphalis margaritacea		2		A	2			A				2	II
Anthoxanthum odoratum									2	2	4		II
Carex flacca						2			2	5	2		II
Cirsium palustre			A		1		1				1	A	II
Cirsium vulgare	1				1	A						2	II
Cladonia furcata	4	1			2				2				II
Cladonia pyxidata		1			2						1		II
Dactylis glomerata						4	4	2	1				II
Dicranum scoparium	2	2									2		II
Filago minima	1	1			3								II
Geranium dissectum						4	3		A		3		II
Hypnum lacunosum	2				1	4							II
Leontodon saxatilis			2							1	3		II
Luzula campestris		1		1							1	1	II
Peltigera sp.	2	1		A	1						3		II
Poa pratensis	1			1								1	II
Rumex acetosella		3			5				3			A	II
Scorzoneroides autumnalis			1	2							2		II
Vicia sativa				1		2	3					1	II
Achillea millefolium						2		3					I
Achillea ptarmica						2							I
Agrostis canina				2									I
Angelica sylvestris						2							I
Anthyllis vulneraria								5					I
Arrhenatherum elatius						2		A			A		I
Atrichum undulatum											1		I
Bellis perennis							1	2					I
Brachythecium rutabulum								2					I
Bromus hordeaceus						3		3	A				I
Calluna vulgaris	A	A				1			2				I
Carlina vulgaris	A	1											I
Centaurea nigra											4		I
Centaurium erythraea				A						2		A	I

Species	25	38	62	63	72	91	92	94	97	115	116	118	Freq.
Ceratodon purpureus	1												I
Chamerion angustifolium								A				2	I
Cirsium arvense										1	A	1	I
Cladonia floerkeana					1								I
Cladonia foliacea	4	1											I
Cladonia rangiformis	2								3	A		A	I
Cladonia sp.			1							2			I
Climacium dendroides						3							I
Crataegus monogyna									A		1		I
Crepis capillaris							2						I
Danthonia decumbens									3				I
Daucus carota						A		2		3		A	I
Deschampsia cespitosa						A		1					I
Deschampsia flexuosa		2			4								I
Didymodon insulanus								2					I
Digitalis purpurea		1			A								I
Equisetum arvense						1			2				I
Erigeron acris												1	I
Euphrasia cf nemorosa						A			1				I
Euphrasia sp.			2							A			I
Fissidens adianthoides						2				4			I
Galium saxatile					4								I
Hieracium sp.												3	I
Homalothecium lutescens								2					I
Hypericum maculatum						2		1					I
Hypericum perforatum						A	3			1	A	A	I
Hypnum jutlandicum		2		A	2								I
Kindbergia praelonga				2									I
Leucanthemum vulgare										7	A		I
Lolium perenne			3										I
Medicago lupulina							4	A	2				I
Melilotus cf officinalis								2					I
Mentha aquatica									1				I
Nardus stricta	A	A				2			2				I
Oenothera sp.						A	1					A	I
Ophrys apifera										A	1		I
Pilosella aurantiaca											4		I
Plagiomnium undulatum											1		I
Plantago major							1						I
Poa compressa												2	I
Pogonatum urnigerum	2										A		I
Polytrichastrum formosum											1		I
Polytrichum piliferum	2				2					A		A	I
Potentilla reptans						2		1	A				I
Pseudoscleropodium purum									2				I
Racomitrium ericoides	4	A				A			3			A	I
Ranunculus acris											2		I
Rubus fruticosus						1						1	I
Rumex acetosa									1		2		I
Rumex obtusifolius												1	I
Salix cinerea		A			A				A	1		A	I
Silene flos-cuculi									1				I
Thuidium tamariscinum				1									I
Trifolium pratense						A	2	4					I
Tussilago farfara			4					1	A				I
Veronica arvensis	2												I
Veronica officinalis	A	2	A		2				A				I
Viola riviniana						2			2				I
Vulpia bromoides							4					A	I
Arenaria serpyllifolia						A							

Species	25	38	62	63	72	91	92	94	97	115	116	118	Freq.
Buddleja davidii							A		A				
Cardamine pratensis						A							
Cytisus scoparius												A	
Dactylorhiza praetermissa							A		A				
Epilobium montanum												A	
Eupatorium cannabinum								A	A				
Galium palustre			A										
Geranium robertianum									A				
Heracleum sphondylium						A							
Juncus effusus			A		A								
Larix sp.	A	A											
Molinia caerulea	A	A							A				
Phleum pratense											A		
Pinus contorta				A									
Potentilla anglica											A		
Potentilla erecta	A					A							
Primula veris											A		
Quercus petraea				A									
Rumex crispus						A	A						
Sagina filicaulis							A						
Samolus valerandi									A				
Sonchus oleraceus					A							A	
Sorbus aucuparia						A							
Ulex europaeus		A	A										
Vaccinium myrtillus		A											
Valeriana officinalis									A				
Verbascum thapsus												A	
Species total	**27**	**26**	**22**	**20**	**32**	**37**	**26**	**31**	**32**	**22**	**35**	**23**	
Height (cm)	**5**	**10**	**30**	**30**	**10**	**25**	**20**	**30**	**15**	**15**	**20**	**15**	
Cover (%)	**90**	**70**	**90**	**100**	**60**	**90**	**95**	**80**	**90**	**85**	**95**	**60**	



Flower-rich sward on recently colonised coal spoil at the washery, with abundant Bee Orchids (near Q115).

While the Onllwyn sidings and washery spoil support a diverse ephemeral / short perennial community on the drier ground, there are damper areas within this area that support a higher proportion of wetland plants. Two quadrats from this vegetation are presented separately from the others because they are clearly developing towards a damp grassland flora rather than acid grassland or heath. Southern Marsh-orchids, Ragged Robin and a variety of sedges are a prominent feature of most of the damp areas of developing grassland at the washery. The locally rare plant Brookweed is associated with several damp areas by the sidings.

This damp, base-enriched grassland has similarities to some sand dune slack vegetation (e.g. SD15 or SD17), or forms of the M22 mire community. However, it is not a close match for any of the published NVC communities.



Developing damp grassland at the washery, with Ragged Robin and Southern Marsh-orchids (near Q112)

Table 11. Quadrat data for sparse damp grassland on coal spoil and washery sidings.

Quadrat	102	112	Frequency
Anthoxanthum odoratum	2	2	V
Calliergonella cuspidata	7	4	V
Carex demissa	1	2	V
Cirsium palustre	1	2	V
Holcus lanatus	4	2	V
Mentha aquatica	2	2	V
Prunella vulgaris	2	2	V
Ranunculus acris	2	2	V
Salix cinerea	1	2	V
Silene flos-cuculi	4	5	V
Taraxacum sp.	1	2	V
Trifolium dubium	2	4	V
Agrostis stolonifera	4		III
Aira caryophyllea		2	III
Aneura pinguis		2	III
Bryum pseudotriquetrum	1		III
Centaurium erythraea		1	III
Cladonia pyxidata		2	III
Cratoneuron filicinum	2		III
Dicranum scoparium		2	III
Eleocharis palustris	2		III
Epilobium hirsutum	A	1	III
Epilobium palustre	2		III
Equisetum arvense		4	III

Quadrat	102	112	Frequency
Equisetum fluviatile	1		III
Equisetum palustre	3		III
Euphrasia sp.	1		III
Festuca rubra		2	III
Fissidens adianthoides		4	III
Fragaria vesca	A	2	III
Galium palustre	2		III
Hylocomium splendens		2	III
Hypericum tetrapterum	1		III
Hypochaeris radicata		2	III
Juncus articulatus	1		III
Juncus effusus		3	III
Juncus inflexus	4		III
Linum catharticum		1	III
Luzula campestris		2	III
Luzula multiflora	A	3	III
Melilotus cf officinalis	4		III
Nardus stricta		2	III
Peltigera sp.		2	III
Phleum pratense		2	III
Plantago lanceolata	2		III
Poa pratensis		2	III
Polytrichastrum formosum		2	III
Polytrichum juniperinum		4	III
Potamogeton polygonifolius	1		III
Potentilla reptans		2	III
Rhytidiadelphus squarrosus		3	III
Rumex acetosa		1	III
Sagina procumbens		2	III
Samolus valerandi	5		III
Senecio jacobaea		1	III
Trifolium repens		3	III
Valeriana officinalis	1		III
Angelica sylvestris	A		
Athyrium filix-femina	A		
Betula pubescens		A	
Carex echinata	A		
Carex flacca		A	
Cerastium fontanum	A	A	
Cladonia rangiformis		A	
Dactylorhiza praetermissa		A	
Galium aparine	A		
Juncus conglomeratus		A	
Oenothera sp.	A		
Poa palustris	A		
Rubus fruticosus	A		
Typha latifolia	A		
Veronica serpyllifolia		A	
Vicia sativa	A		
Species total	**29**	**40**	
Height (cm)	**40**	**20**	
Cover (%)	**95**	**95**	

Dry heath

Heath is a feature of several areas on older coal spoil, especially where it has not been limited by grazing or shaded by scrub. The largest stands of heath are in the centre of the site which supports a mix of dry heath, wet heath and marshy grassland. Dry heath is also found on steeper slopes of coal spoil, often forming a mosaic with acid grassland (e.g. in Quadrats40, 60, 73 and 113). Most stands of dry heath are dominated by Common Heather and readily conform to the published NVC community H1 *Calluna vulgaris – Festuca ovina* heath.



Ungrazed H1 dry heath, with patchy scrub (Quadrat 52).

Table 12. Quadrat data for dry heath.

Species	40	47	51	52	60	67	73	76	77	113	117	Freq.
Calluna vulgaris	5	9	8	9	6	8	5	9	7	7	5	V
Dicranum scoparium	4	3	2	4	2	2		A	4	5	4	V
Cladonia rangiformis	4	A	5	2	2	A		A	2	3	7	IV
Deschampsia flexuosa		3	4	4		3	6	3	4			IV
Festuca ovina	4	1	1		7	3		2		3	2	IV
Galium saxatile	2			4	4	1	3	A	2	1	2	IV
Hypnum jutlandicum	2	6	2	7	7	4			A	5	2	IV
Hypochaeris radicata	1	A	A		1	3	2	A	1	1	1	IV
Rhytidiadelphus squarrosus		2	2	3	A	3	3		2	6	2	IV
Anthoxanthum odoratum	4				A	2	4			4	1	III
Peltigera sp.	2				1	2			2	1	4	III
Pilosella officinarum	4				A	3	A		1	3	4	III
Pleurozium schreberi			2	6					4	1	2	III
Polytrichum juniperinum					4		2	4	6	2	1	III
Vaccinium myrtillus		1	8	5	1	4			A			III
Agrostis canina			2	2			4					II
Agrostis capillaris	4				2	2	A			4		II
Campylopus introflexus		2						1	4			II
Cladonia furcata	2	A			1		A		2		2	II
Cladonia pyxidata	2	1				1						II
Danthonia decumbens	4				1	A	A	A		2	1	II
Lotus corniculatus					2		5			2	2	II
Luzula multiflora		1	1			A	A			3		II
Molinia caerulea	A	1	4	5		A	5					II
Polytrichum commune		A	2		3	4						II
Potentilla erecta			1	4		3	A		A			II
Aira caryophyllea										2		I
Aira praecox	2				A						A	I
Anaphalis margaritacea					2							I

Aulacomnium palustre						2						I
Carex flacca										2		I
Ceratodon purpureus		2										I
Chamerion angustifolium			2							A	A	I
Cirsium palustre				A			1			1		I
Cladonia cervicornis ssp								2				I
Cladonia gracilis			2									I
Cladonia sp.								2	2			I
Cladonia uncinata			2					2				I
Dicranum majus									2			I
Digitalis purpurea				1					A			I
Diplophyllum albicans								2	2			I
Equisetum arvense							1			1		I
Euphrasia sp.										1		I
Festuca rubra							3				2	I
Fragaria vesca	1									A		I
Hieracium sp.					A						3	I
Holcus lanatus							3			1		I
Hylocomium splendens										2		I
Hypnum lacunosum											2	I
Hypogymnia physodes		A	1						A			I
Lophocolea bidentata										2		I
Lophozia ventricosa		1										I
Luzula campestris							3				A	I
Nardus stricta	3						1					I
Plantago lanceolata										2		I
Polygala serpyllifolia	1											I
Polytrichum piliferum	2	2										I
Potentilla anglica							2			2		I
Potentilla reptans										2		I
Pseudoscleropodium purum										2	1	I
Rubus fruticosus	1			1								I
Rumex acetosella	3		A								2	I
Sorbus aucuparia					1	1		A		A		I
Taraxacum sp.										2	A	I
Veronica officinalis	3									1		I
Vicia hirsuta											2	I
Vicia sativa							1			2	A	I
Achillea millefolium											A	
Betula pubescens									A			
Carex binervis								A	A			
Cladonia cf coccifera	A											
Cytisus scoparius											A	
Dactylorhiza praetermissa												
Erica tetralix			A	A								
Juncus squarrosus					A							
Leucanthemum vulgare											A	
Narcissus sp.							A					
Quercus petraea			A							A		
Quercus robur										A		
Racomitrium lanuginosum											A	
Salix cinerea		A		A								
Thuidium tamariscinum				A								
Trifolium pratense											A	
Trifolium repens							A					
Ulex europaeus	A			A		A						
Height (cm)	**20**	**40**	**35**	**40**	**30**	**10**	**30**	**45**	**20**	**15**	**25**	
Cover (%)	**95**	**100**	**100**	**100**	**100**	**90**	**100**	**85**	**90**	**100**	**95**	
Species total	**22**	**14**	**18**	**14**	**17**	**18**	**18**	**9**	**16**	**32**	**22**	

Wet heath/ marshy grassland mosaic

Wet heath is not a common feature within the site, and where it occurs it is generally a fragmentary form within a mosaic of marshy grassland and mire vegetation. The examples sampled are all dominated by Purple Moor-grass, and the shrubs are a relatively minor element. In terms of the NVC this type of vegetation is best classified as M25 *Molinia caerulea – Potentilla erecta* mire (possibly close to the M25a *Erica tetralix* sub-community)



Wet heath/ marshy grassland mosaic (Quadrat 81).

Table 13. Quadrat data for wet heath/ marshy grassland mosaic.

Species	36	49	50	58	64	Frequency
Erica tetralix	4	6	5	5	2	V
Hypnum jutlandicum	1	3	4	2	3	V
Molinia caerulea	9	8	9	8	9	V
Calluna vulgaris	5	1		2	4	IV
Polytrichum commune	4	3	4	2		IV
Cladonia pyxidata	1	1				II
Eriophorum vaginatum		4	6			II
Holcus lanatus	1				4	II
Hypochaeris radicata	A	A		1	1	II
Juncus squarrosus	1			1		II
Luzula multiflora				2	1	II
Potentilla erecta				2	2	II
Rhytidiadelphus squarrosus			2		3	II
Sphagnum capillifolium		2	2			II
Sphagnum denticulatum		2	2			II
Trichophorum cespitosum		6	4			II
Vaccinium myrtillus	A		2	2		II
Achillea millefolium					2	I
Agrostis canina	1					I
Agrostis capillaris					2	I
Anaphalis margaritacea					2	I
Anthoxanthum odoratum				A	2	I
Betula pubescens			1			I
Calliergonella cuspidata					2	I
Carex demissa	1			A		I
Centaurea nigra					1	I
Cirsium arvense					2	I

Species	36	49	50	58	64	Frequency
Cirsium palustre	A			1		I
Cladonia rangiformis		1				I
Dryopteris carthusiana			1			I
Eriophorum angustifolium		2				I
Festuca ovina	2					I
Galium saxatile					1	I
Hieracium sp.					1	I
Hylocomium splendens				4		I
Juncus conglomeratus	A			1		I
Juncus effusus	2		A			I
Kindbergia praelonga					2	I
Lotus corniculatus					3	I
Mnium hornum		1				I
Peltigera sp.	1				A	I
Plantago lanceolata					2	I
Polygala serpyllifolia				2		I
Rubus fruticosus					1	I
Sphagnum inundatum			2			I
Sphagnum subnitens			2			I
Trifolium repens					1	I
Vicia sativa					2	I
Aira caryophyllea	A					
Blechnum spicant		A	A	A		
Bromus hordeaceus	A					
Carex binervis			A			
Carex nigra			A			
Dicranum scoparium		A	A			
Digitalis purpurea	A			A		
Epilobium ciliatum	A					
Fragaria vesca	A					
Hedera helix sl				A		
Hookeria lucens			A			
Hypericum pulchrum					A	
Leucanthemum vulgare					A	
Pinus contorta					A	
Sagina procumbens	A					
Salix cinerea			A			
Salix repens					A	
Taraxacum sp.					A	
Veronica officinalis	A					
Height (cm)	**30**	**45**	**50**	**30**	**40**	
Cover (%)	**80**	**100**	**100**	**95**	**100**	
Species total	**13**	**13**	**14**	**14**	**24**	

Sphagnum-rich bog vegetation

Several wet areas with Cotton-grasses and *Sphagnum* mosses are present around the margins of the restored coal workings, typically only in small quantity and/or filling ditches. The peaty substratum supports a number of species typical of upland peat bogs, including Common Cotton-grass, Hare's-tail Cotton-grass, Star Sedge, White Sedge, Round-leaved Sundew and a good number of *Sphagnum* species, locally with standing water and Bog Pondweed in wetter parts. A young plant of Royal Fern was also found in this habitat. Only two quadrats were collected from this vegetation. Quadrat 48 is from a bog pool and Quadrat 42 is from a ditch. Both are probably forms of the published NVC community M6 *Carex echinata - Sphagnum fallax/ S.denticulatum* mire.

Table 14. Quadrat data for M6 bog pool mire vegetation.

Species	**42**	**48**	**Frequency**
Eriophorum angustifolium	4	9	V
Sphagnum fallax	4	6	V
Agrostis canina	1	A	III
Athyrium filix-femina	1		III
Aulacomnium palustre	4		III
Cardamine pratensis	1		III
Carex echinata	3		III
Carex leporina	1		III
Eleocharis palustris		2	III
Epilobium palustre	1		III
Galium palustre	3		III
Juncus effusus	8		III
Molinia caerulea	5		III
Polytrichum commune	6	A	III
Potentilla erecta	2		III
Salix cinerea	A	1	III
Scutellaria minor	2		III
Sphagnum capillifolium	4	A	III
Sphagnum denticulatum	4		III
Sphagnum tenellum		3	III
Warnstorffia exannulata	2		III
Calluna vulgaris	A		
Carex curta	A		
Deschampsia flexuosa	A		
Drosera rotundifolia	A		
Dryopteris affinis	A		
Dryopteris carthusiana		A	
Erica tetralix	A		
Eriophorum vaginatum		A	
Holcus lanatus	A		
Juncus acutiflorus		A	
Juncus bulbosus		A	
Juncus squarrosus	A		
Lophocolea bidentata		A	
Nardus stricta	A		
Rhytidiadelphus squarrosus	A		
Sphagnum cuspidatum		A	
Sphagnum squarrosum	A		
Sphagnum subnitens	A		
Trichophorum cespitosum		A	
Species total	**18**	**5**	
Height (cm)	**50**	**40**	
Cover (%)	**90**	**100**	



Sphagnum-rich ditch with Cotton-grass and sundews (near Q42)



Sphagnum-rich vegetation with Sundews (near Q42).

Marshy grassland

The most frequent type of marshy grassland on the site is dominated by Purple Moor-grass and subject to sheep-grazing. It tends to form a mosaic with species-poor semi-improved acid grassland and rush-dominated areas over large areas in the south and west of the site. The associated species are mostly grasses, sedges and rushes, with a very low proportion of flowering herbs.

Within the NVC this mosaic probably represents a wide spectrum of transitional stages between M25 *Molinia caerulea – Potentilla erecta* mire, M23 *Juncus effusus/ acutiflorus – Galium palustre* rush pasture, and *U4 Festuca ovina – Agrostis capillaris – Galium saxatile* grassland.



Sheep-grazed marshy grassland dominated by Purple Moor-grass (Q78)

Table 15. Quadrat data for grazed grassland dominated by Purple Moor-grass.

Species	8	11	13	22	24	31	41	43	45	54	78	110	Freq.
Molinia caerulea	9	8	10	8	7	8	8	9	8	6	9	6	V
Anthoxanthum odoratum	1	2	2		1		4	A	4	4	2		IV
Holcus lanatus	3				5	4	2	3	4	4	4	5	IV
Rhytidiadelphus squarrosus		2	4	A	2	4	3	A	2		4	2	IV
Agrostis canina							4	2	4	5	2	4	III
Agrostis capillaris	4	4	4	6	4						4	7	III
Carex echinata	1		4				2		2	4			III
Cirsium palustre	1				1	1	A	1	A	2			III
Juncus conglomeratus	1		A	A			5		4	4	2		III
Juncus effusus	1	A	4	A	6	4	A	5	A	A	A	2	III
Juncus squarrosus			1	4		2			2			3	III
Polytrichum commune	5		5	4		4			4			2	III
Potentilla erecta		3						3	1	3	5	4	III
Aulacomnium palustre	2			A		A	4		2	2			II
Calliergonella cuspidata					2			A		1		3	II
Deschampsia flexuosa	2	3		2							4		II
Epilobium palustre							1	1		2			II
Eriophorum angustifolium				4			4			2			II
Festuca ovina	3	4		A				A	4			A	II
Galium palustre			A		2		2	4	A	2			II
Galium saxatile		2									1	2	II
Hypnum jutlandicum				3		3					A	1	II
Juncus acutiflorus					6		4	4		5			II
Luzula campestris		2					1	A			3		II
Luzula multiflora	1		1				1			A		2	II
Pleurozium schreberi									2	2	2		II
Sphagnum capillifolium	A						4		2	4			II
Agrostis stolonifera			2		4								I
Anagallis tenella										3			I
Athyrium filix-femina						1		2			A		I
Brachythecium rutabulum								2					I
Campylopus introflexus				4							A	2	I
Carex binervis											2		I
Carex flacca										2			I
Carex leporina					2								I
Carex panicea	1			A									I

Species	8	11	13	22	24	31	41	43	45	54	78	110	Freq.
Ceratodon purpureus												2	I
Danthonia decumbens			1										I
Dicranum scoparium	2			2									I
Dryopteris dilatata	1					A							I
Epilobium ciliatum						2		1					I
Equisetum palustre										3			I
Erica tetralix						A	1		4				I
Kindbergia praelonga								3					I
Lotus pedunculatus	1												I
Myosotis laxa								2					I
Nardus stricta		4									A		I
Peltigera sp.						1							I
Persicaria hydropiper								2					I
Polytrichum juniperinum												2	I
Rumex acetosa	1									2			I
Salix cinerea						1							I
Scapania irrigua				2									I
Scutellaria minor					A				A	1			I
Sphagnum denticulatum	A					4							I
Sphagnum fimbriatum			4										I
Sphagnum inundatum							2						I
Sphagnum papillosum									2				I
Stellaria alsine								2					I
Trichophorum cespitosum	A			4									I
Angelica sylvestris										A			
Calluna vulgaris												A	
Cladonia pyxidata												A	
Cynosurus cristatus								A					
Deschampsia cespitosa											A		
Digitalis purpurea	A								A				
Sagina procumbens					A								
Trifolium repens					A								
Vaccinium myrtillus		A				A						A	
Species total	**18**	**10**	**12**	**11**	**12**	**13**	**17**	**16**	**16**	**21**	**13**	**16**	
Height (cm)	**50**	**30**	**80**	**30**	**90**	**80**	**50**	**90**	**70**	**60**	**50**	**30**	
Cover (%)	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**100**	

Some of the marshy grassland within the site is species-poor and dominated by rank Purple Moor-grass, and this is particularly found in areas where sheep have been excluded. The following examples were all ungrazed at the time of the survey, and supported tall, tussocky Purple Moor-grass. In terms of the NVC they are probably best described as a very species-poor M25 *Molinia caerulea – Potentilla erecta* mire, although the amount of Tormentil and other associated species is much lower than the typical form of this community due to the dominance of the Purple Moor-grass. NB The presence of the Sweet Chestnut, Pedunculate Oak and Rowan in association with Quadrat 90 is due to the area being used for tree planting, which is presumably why sheep have been excluded.



Species-poor marshy grassland dominated by Purple Moor-grass and Soft Rush (Quadrat 90)

Table 16. Quadrat data for ungrazed marshy grassland with Purple Moor-grass.

Species	26	61	71	90	Frequency
Molinia caerulea	9	10	9	9	V
Kindbergia praelonga		2	3	3	IV
Galium saxatile		1	1		III
Juncus effusus		A	A	7	II
Galium palustre	A	1			II
Juncus acutiflorus		2			II
Hypnum jutlandicum	4	A			II
Sphagnum capillifolium	4				II
Erica tetralix	2				II
Deschampsia cespitosa			4		II
Lophocolea bidentata			2		II
Digitalis purpurea		2	A		II
Dryopteris filix-mas		1			II
Sphagnum denticulatum	2				II
Trichophorum cespitosum	2				II
Holcus mollis			2		II
Eriophorum vaginatum	4				II
Potentilla erecta			A		
Juncus conglomeratus			A		
Dryopteris dilatata				A	
Campylopus introflexus	A				
Sphagnum fimbriatum	A				
Carex binervis			A		
Sphagnum papillosum	A				
Sorbus aucuparia				A	
Dryopteris affinis		A			
Dryopteris carthusiana				A	
Quercus robur				A	
Castanea sativa				A	
Fagus sylvatica				A	
Pinus contorta		A			
Sphagnum cuspidatum	A				
Ulex europaeus		A			
Species total	7	7	6	3	
Height (cm)	70	80	90	120	
Cover (%)	100	100	100	100	

A high proportion of the extensively sheep-grazed marshy grassland in the south west of the site, and beside many of the damp ditch margins, is dominated by tall rushes, particularly Sharp-flowered Rush and Soft Rush. Purple Moor-grass is present but not dominant. These damp grassland habitats sometimes support a moderate number of flowering herbs such as Greater Bird's-foot Trefoil, Lesser Skullcap, Bog Stitchwort and Marsh Thistle, and occasional ferns. Within the NVC this grassland is best categorised with M23 *Juncus effusus/ acutiflorus – Galium palustre* rush pasture.

Table 17. Quadrat data for M23 marshy grassland with dominant rushes.

Species	3	12	32	39	46	55	65	109	120	122	123	125	Freq.
Galium palustre	2			2	7	2	4	2	3	2	3	3	V
Holcus lanatus	2	2	6	4	4	7	4	4	4	A	5	1	V
Juncus effusus	2	2	6		4		8	2	6	4	7	6	V
Epilobium palustre	A				1	1	3	2	1	1		3	IV
Juncus acutiflorus	9			9	9	9		7		5		8	IV
Molinia caerulea		8	2	4	2	5		A	5	A	4	5	IV
Athyrium filix-femina	1			4					A	1	1	2	III
Calliergonella cuspidata				2		4		2	4	4	4		III
Cirsium palustre	1		2		A	2		1	A		2	2	III
Kindbergia praelonga	2				2				2		1	2	III
Lotus pedunculatus	2				A	2	4	3		3	2		III
Rhytidiadelphus squarrosus	2	2	7		2		7		2				III
Rumex acetosa	2					2	2		2	A	2	2	III
Stellaria alsine	2				2				2	1	2		III
Agrostis canina	2				4	4						3	II
Brachythecium rivulare									2		2	1	II
Carex echinata		3			A	2			2	1			II
Carex flacca						1	A		2		1		II
Carex leporina							2	2		1	2		II
Carex nigra			5			4				4			II
Cerastium fontanum	1					A		2	1		1		II
Epilobium ciliatum	2		1								1	1	II
Equisetum fluviatile						2			1	4			II
Juncus conglomeratus		8				1	4		A				II
Myosotis laxa					1			A	1	1	2		II
Peltigera sp.			2	1							2		II
Poa trivialis								4	2	2	1	A	II
Potentilla erecta	2		A			2			2				II
Ranunculus acris						1		2	2				II
Ranunculus flammula						A		2	2	2	2	A	II
Ranunculus repens					A			4	5	8	4	A	II
Salix cinerea			A	1			3		A	A	2	2	II
Scutellaria minor	A			2	2		3						II
Silene flos-cuculi								3	3		5	A	II
Agrostis capillaris		7											I
Anthoxanthum odoratum		5	4				A						I
Caltha palustris								1					I
Cardamine pratensis				A	1		2	A		A			I
Carex demissa		1											I
Carex panicea		2						2					I
Carex paniculata				4									I
Ceratodon purpureus												1	I
Chamerion angustifolium			1	A								1	I
Cratoneuron filicinum												2	I
Dactylorhiza praetermissa				2				A					I
Deschampsia cespitosa			4		A	A							I
Digitalis purpurea	1				A						A		I

Species	3	12	32	39	46	55	65	109	120	122	123	125	Freq.
Dryopteris dilatata			A								1	1	I
Dryopteris filix-mas	1												I
Epilobium brunnescens			1										I
Epilobium tetragonum					A				1				I
Equisetum palustre						3			2				I
Eriophorum angustifolium				4									I
Festuca ovina		3											I
Festuca rubra			2				2						I
Hydrocotyle vulgaris				8		4							I
Hypnum jutlandicum			3										I
Juncus articulatus							4						I
Juncus bufonius									1				I
Juncus bulbosus		1											I
Lophocolea bidentata					2	2							I
Luzula campestris			2										I
Luzula multiflora		1					A						I
Mentha aquatica								8	A	5			I
Myosotis secunda							1						I
Nardus stricta		A	2										I
Odontites vernus								2					I
Oreopteris limbosperma	1		A										I
Plagiomnium undulatum	1					1							I
Polytrichum commune	2		2									A	I
Pulicaria dysenterica			6	A									I
Rumex obtusifolius											1		I
Sagina procumbens								1	2		A		I
Scapania irrigua		1											I
Senecio jacobaea							1						I
Sphagnum sp.		2											I
Succisa pratensis									4				I
Taraxacum sp.			1										I
Trifolium repens								2					I
Trocdaris verticillatum										3			I
Urtica dioica											1		I
Veronica scutellata					2					3			I
Veronica serpyllifolia			2										I
Vicia sativa			2					2					I
Viola palustris					2								I
Wahlenbergia hederacea						2							I
Agrostis stolonifera							A						
Anagallis tenella						A							
Arrhenatherum elatius							A						
Atrichum undulatum												A	
Aulacomnium palustre		A											
Blechnum spicant	A												
Carex pilulifera			A										
Dryopteris affinis			A										
Dryopteris carthusiana										A			
Erica tetralix		A	A										
Eupatorium cannabinum				A									
Filago minima			A										
Juncus inflexus								A					
Juncus squarrosus		A											
Lolium perenne												x	
Philonotis fontana								A					
Phleum pratense							A						
Poa pratensis								A					
Potentilla palustris										A			
Prunella vulgaris			A										
Rubus fruticosus									A		A		

Species	3	12	32	39	46	55	65	109	120	122	123	125	Freq.
Sphagnum inundatum												A	
Sphagnum squarrosum					A								
Trifolium dubium			A										
Typha latifolia				A						A			
Valeriana officinalis								A					
Species total	**20**	**15**	**21**	**13**	**16**	**22**	**16**	**22**	**27**	**19**	**26**	**18**	
Height (cm)	**70**	**50**	**50**	**90**	**90**	**70**	**80**	**35**	**95**	**40**	**95**	**50**	
Cover (%)	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**40**	**100**	**40**	**100**	



M23 rush pasture dominated by Sharp-flowered Rush (Q3).

Rush-dominated marshy grassland on the recently restored parts of the site tend to be heavily sheep-grazed and form a mosaic with species-poor semi-improved grassland. The vegetation has a very low proportion of flowering herbs and is generally not of nature conservation significance. However, it covers a relatively large area, so several quadrats were recorded from it to describe it and help to illustrate the variation within the range of marshy grassland types on the site. It is best classified as the NVC community MG10 *Holcus lanatus – Juncus effusus* rush pasture. It differs slightly from the published community as it has a lower proportion of Creeping Bent and Creeping Buttercup, but both species are present and the difference may just be due to the young age of the grassland, the intensity of the sheep grazing or some other local factor.



Species-poor MG10 rush pasture on the recently restored parts of the site (near Q88)

Table 18. Quadrat data for MG10 marshy grassland with dominant Soft Rush.

Species	28	75	84	88	Frequency
Holcus lanatus	5	2	4	7	V
Juncus effusus	9	10	8	9	V
Agrostis capillaris	2		2	2	IV
Cirsium palustre	2	1	1	A	IV
Epilobium ciliatum	2	1	1		IV
Cerastium fontanum			2	1	III
Cynosurus cristatus			2	4	III
Kindbergia praelonga	2	2			III
Poa trivialis		2	5	A	III
Trifolium repens			2	1	III
Agrostis stolonifera			2		II
Anthoxanthum odoratum			A	2	II
Athyrium filix-femina	A	1			II
Calliergonella cuspidata	4				II
Cardamine pratensis		A	2		II
Epilobium palustre	1				II
Equisetum palustre		1			II
Galium palustre		3			II
Galium saxatile	2				II
Rumex acetosa		1			II
Rumex acetosella	2				II
Stellaria alsine		1			II
Urtica dioica		2			II
Veronica serpyllifolia	1				II
Alopecurus geniculatus			A		
Cirsium arvense	A				
Deschampsia cespitosa				A	
Digitalis purpurea		A			
Dryopteris affinis	A				
Dryopteris filix-mas		A			
Festuca rubra				A	
Potentilla erecta	A				
Ranunculus repens			A		
Rhytidiadelphus squarrosus	A				
Species total	**11**	**12**	**11**	**7**	
Height (cm)	**100**	**100**	**80**	**70**	
Cover (%)	**100**	**100**	**100**	**100**	

The marshy grassland flora in and around the washery has a very different character to the other marshy grassland within the study area. This is partly because it is grazed by horses rather than sheep, and also probably because the substratum is base-rich but acidic coal waste rather than natural soil. This marshy grassland has a very diverse sward, characterised by a high proportion of sedges and wetland herbs. Rushes are prominent, but they are represented by several different dominant species. The flower-rich sward includes a number of locally uncommon species, such as Marsh Lousewort and Brookweed. In terms of the NVC this is probably best classified as M23 *Juncus effusus/ acutiflorus – Galium palustre* mire. The base enrichment of the washery soils also adds elements of M22 *Juncus subnodulosus – Cirsium palustre* fen-meadow, although there was no sign of any Blunt-flowered Rush during the survey. Much of the vegetation appears to form transitions between the two communities, and also with swamp vegetation in wetter areas.

Table 19. Quadrat data for flower-rich marshy grassland at the washery.

Species	93	103	104	106	107	108	Frequency
Calliergonella cuspidata		4	7	9	2	8	V
Galium palustre	2	2	3	2		4	V
Juncus effusus	2	4		2	4	6	V
Mentha aquatica	2	1	1		4	4	V
Valeriana officinalis	3	1	3	4		1	V
Epilobium palustre		2	2	2	A	2	IV
Equisetum palustre	1	3	4		4		IV
Holcus lanatus	2		2	2		2	IV
Caltha palustris		2	A	3	2		III
Carex nigra	2		2	2			III
Juncus acutiflorus				8	2	3	III
Lotus pedunculatus	2		2	6			III
Rhytidiadelphus squarrosus	2		4	4			III
Salix cinerea		2	2			2	III
Scutellaria minor			2	2		1	III
Silene flos-cuculi			2	2	A	3	III
Angelica sylvestris	2		1				II
Carex demissa			2		2		II
Carex flacca			2		2		II
Carex panicea		A	2			2	II
Cirsium palustre			A	1		2	II
Dactylorhiza praetermissa	1		A	A	1	A	II
Equisetum fluviatile			1		2		II
Eriophorum angustifolium		8	4				II
Hydrocotyle vulgaris		1	4			A	II
Juncus inflexus	5				8		II
Pedicularis palustris		A	1		2		II
Ranunculus flammula					3	1	II
Rumex acetosa	1			1			II
Achillea ptarmica	2						I
Agrostis canina						2	I
Aulacomnium palustre			A			3	I
Brachythecium rivulare		2					I
Brachythecium rutabulum	2						I
Bryum pseudotriquetrum					2		I
Cardamine cf flexuosa	2						I
Cardamine pratensis		A				1	I
Carex echinata			A			3	I
Carex leporina						1	I
Carex paniculata				4			I
Carex pulicaris			2	A			I

Species	93	103	104	106	107	108	Frequency
Carex rostrata		4					I
Cirsium arvense	1						I
Cynosurus cristatus			2				I
Dactylorhiza fuchsii				1			I
Deschampsia cespitosa	9						I
Eleocharis palustris					4		I
Epilobium ciliatum	1						I
Epilobium parviflorum				3		A	I
Eupatorium cannabinum						1	I
Festuca rubra			2				I
Lathyrus pratensis	2						I
Luzula multiflora	2					A	I
Lycopus europaeus					1		I
Lythrum salicaria		1					I
Molinia caerulea				A		2	I
Myosotis laxa						4	I
Peltigera sp.			2				I
Plantago lanceolata	1						I
Poa trivialis	3			A			I
Potentilla palustris		8					I
Prunella vulgaris	1						I
Ranunculus repens	A		2			A	I
Samolus valerandi					7		I
Sphagnum fimbriatum						2	I
Stellaria alsine						2	I
Typha latifolia						2	I
Valeriana dioica			8				I
Veronica scutellata						3	I
Vicia sativa	1						I
Anthoxanthum odoratum			A				
Betula pubescens			A				
Briza media	A						
Daucus carota	A						
Dryopteris dilatata				A			
Eriophorum vaginatum						A	
Heracleum sphondylium	A						
Nardus stricta	A						
Plagiomnium cf rostratum		A					
Polytrichum juniperinum						A	
Potentilla anserina	A						
Potentilla erecta						A	
Rumex conglomeratus						A	
Salix aurita		A	A	A			
Sphagnum squarrosum			A				
Species total	**25**	**15**	**27**	**18**	**17**	**26**	
Height (cm)	**50**	**90**	**35**	**100**	**90**	**80**	
Cover (%)	**100**	**100**	**100**	**100**	**95**	**95**	



Flower-rich marshy grassland north of the washery, with prominent Greater Tussock-sedges and Ragged Robin (near Q108).



Marsh Lousewort and Brookweed in flower-rich marshy grassland north of the washery (Q119).

Flush vegetation

There are several areas of flush vegetation on gently sloping ground at the lower edges of the site, particularly at the south and west margins. In most cases the flushes are very small and the vegetation is not very different from other rush-dominated marshy grassland. The plant community probably conforms most closesly to the NVC category M23 *Juncus effusus/ acutiflorus – Galium palustre* mire. However, the flushes tend to be relatively diverse examples of this. An area of seepage from coal spoil at the washery (Q114) appears to fit more closely with sand dune slack vegetation but this is probably just an anomaly of the unusual man-made nature of the habitat. Several locally uncommon species were found in association with flushes, including Ivy-leaved Bellflower, Whorled Caraway and Bog Pimpernel (although no quadrats included the Ivy-leaved Bellflower).



Heavily trampled flush vegetation, with Whorled Caraway (Q121)

Table 20. Quadrat data for flush vegetation.

Species	9	10	16	21	66	114	121	Frequency
Calliergonella cuspidata	3	3	2		5	4	4	V
Epilobium palustre	3	2	1		3	3	1	V
Galium palustre	3	3	2		2	2	2	V
Holcus lanatus	5	4	4		4		2	IV
Juncus acutiflorus	9	9	9	2			8	IV
Molinia caerulea	5	6	2	8	2			IV
Rhytidiadelphus squarrosus	2	2		4	2	2		IV
Scutellaria minor	2	1	2		2		2	IV
Agrostis canina		2	A	4	2			III
Anthoxanthum odoratum	2		4	4		2		III
Carex echinata	3	3	4				2	III
Carex panicea	1	1		4				III
Cirsium palustre	3	1				2	2	III
Festuca rubra	2	1		2		A		III
Lotus pedunculatus	5	A	2				2	III
Luzula multiflora	1	1		2		1		III
Pellia sp.		2	1		1			III
Potentilla erecta	2	3		2				III
Ranunculus flammula	1		1				1	III
Anagallis tenella	1	A			1			II
Athyrium filix-femina	2		A		2		A	II
Carex demissa	1		2					II
Carex nigra						5	5	II
Dactylorhiza praetermissa						1	2	II
Digitalis purpurea	1				2			II
Equisetum fluviatile	2						7	II
Juncus bulbosus		A	2	A			3	II
Ranunculus repens	2		A				2	II
Rubus fruticosus			1	A	4			II
Sphagnum denticulatum			6	2				II
Trocdaris verticillatum		1					1	II
Achillea ptarmica		2						I
Agrostis stolonifera	2						A	I
Aulacomnium palustre					4			I
Betula pubescens					2			I
Bryum alpinum						2		I
Bryum pseudotriquetrum						5		I
Calluna vulgaris				2				I

Species	9	10	16	21	66	114	121	Frequency
Cardamine cf flexuosa						1		I
Carex disticha						8		I
Carex flacca		2						I
Carex pulicaris		3						I
Cerastium fontanum	2							I
Cratoneuron filicinum						4		I
Cynosurus cristatus	1							I
Dactylis glomerata						1		I
Dactylorhiza maculata					1			I
Danthonia decumbens				2				I
Dichodontium palustre			2					I
Dicranum scoparium				2				I
Didymodon insulanus						2		I
Dryopteris filix-mas		1			A			I
Erica tetralix		1						I
Eriophorum angustifolium							4	I
Festuca ovina				2				I
Fragaria vesca						1		I
Hypericum tetrapterum			3					I
Juncus conglomeratus		3	A					I
Juncus squarrosus				2				I
Myosotis secunda			1					I
Pedicularis sylvatica				4				I
Philonotis fontana	A	A			2			I
Plantago lanceolata	A					2		I
Pleurozium schreberi		A	A	4				I
Polytrichum commune		A			4			I
Prunella vulgaris	A					2		I
Ranunculus omiophyllus							1	I
Rumex acetosa	2						A	I
Rumex crispus		1						I
Salix cinerea			A		A		1	I
Senecio jacobaea			1			A		I
Silene flos-cuculi						4	A	I
Sphagnum fimbriatum					4			I
Stellaria alsine							1	I
Taraxacum sp.						3		I
Veronica officinalis						1		I
Vicia hirsuta						1		I
Vicia sativa						1		I
Warnstorffia exannulata			1					I
Brachythecium rutabulum					A			
Cardamine pratensis		A						
Carex binervis				A				
Chamerion angustifolium						A		
Eupatorium cannabinum						A		
Isolepis setacea	A							
Juncus effusus				A				
Lotus corniculatus						A		
Lysimachia nemorum	A							
Mentha aquatica		A	A					
Montia fontana	A							
Myosotis laxa	A	A						
Oreopteris limbosperma	A							
Peltigera sp.					A			
Plagiomnium undulatum		A						
Poa trivialis							A	
Primula veris						A		
Pseudoscleropodium purum	A	A			A			
Sphagnum capillifolium					A			

Species	9	10	16	21	66	114	121	Frequency
Succisa pratensis				A				
Tussilago farfara							A	
Ulex europaeus	A							
Veronica serpyllifolia						A		
Species total	**27**	**24**	**21**	**17**	**19**	**24**	**20**	
Height (cm)	**80**	**90**	**60**	**50**	**60**	**20**	**80**	
Cover (%)	**100**	**100**	**95**	**100**	**1100**	**100**	**90**	

Swamp vegetation

Dense stands of tall emergent plants forming swamp vegetation tend to be very localised within the site, and they are mostly low diversity plant communities. Greater Tussock-sedge forms one rather uniform stand beside a small stream, and this has been sampled in Quadrat 15. Tall sedges, Common Reed and Reed Canary-grass are patchily dominant in parts of the wet grassland north of the washery, and a stand of Lesser Pond-sedge has been sampled to represent this (Q105). Bulrush was also present as small stands in several ponds (this was not sampled because it generally exists in deeper water as single-species stands). There is also a small Common Reed reedbed near the centre of the site. NVC classification for these very low-diversity swamp communities in this case is straightforward; the Greater Tussock-sedge swamp is S3 *Carex paniculata* swamp, the Lesser Pond-sedge stand is S7 *Carex acutiformis* swamp, the Bulrush stands are S12 *Typha latifolia* swamp, and the reedbed is S4 *Phragmites australis* swamp.

Common Reed was generally present as a single-species stand in the reedbed, but a list of associated species was obtained from the whole reed bed as a target Note (TN7).



Small reed-bed between coal spoil tips (TN7)

Table 21. Species-list for reed bed (TN7)

Phragmites australis
Agrostis stolonifera
Athyrium filix-femina
Carex paniculata
Cirsium arvense
Cirsium palustre
Digitalis purpurea
Eleocharis palustris
Epilobium brunnescens
Epilobium hirsutum
Holcus lanatus
Molinia caerulea
Potamogeton polygonifolius
Pulicaria dysenterica
Salix cinerea
Salix viminalis
Tussilago farfara
Typha latifolia

Table22. Quadrat data for swamp vegetation.

Species	15	105	Frequency
Carex paniculata	10	1	V
Agrostis canina	1		III
Caltha palustris		2	III
Carex acutiformis		10	III
Epilobium palustre	1		III
Equisetum fluviatile		2	III
Equisetum palustre		1	III
Galium palustre	1	A	III
Juncus effusus	2		III
Mentha aquatica		1	III
Molinia caerulea	1		III
Phragmites australis		2	III
Scutellaria minor	1		III
Sphagnum sp.	2		III
Veronica officinalis		2	III
Alnus glutinosa		A	
Holcus lanatus	A		
Hydrocotyle vulgaris		A	
Persicaria hydropiper	A		
Salix cinerea		A	
Silene flos-cuculi		A	
Species total	**8**	**8**	
Height (cm)	**150**	**100**	
Cover (%)	**100**	**100**	



Greater Tussock-sedge swamp (Q15)



Lesser Pond-sedge swamp (Q105) with Alder scrub and sparse Common Reed.



Bulrush swamp vegetation in a pond at the washery (TN22).

Ponds

The study area supports a high density of ponds; many of these are relatively recent in origin, created for silt control, attenuating high flows and providing water for the mine operations. Some ponds are still very functional, with steep sides and little vegetation, but others are less intensively maintained and support a fringe of wetland plants. These typically include Common Spike-rush, Soft Rush, Sharp-flowered Rush, Bulbous Rush, Lesser Spearwort and *Sphagnum* mosses. Some of the older ponds have a well-developed submerged plant community. The acidic, silty water from the coal spoil that feeds the ponds allows species typically associated with upland pools to grow, such as Bog Pondweed, Cotton-grasses, Star-sedge and the locally rare Floating Bur-reed.

It is difficult to place the pond communities in terms of the NVC as any more than a rough approximation, particularly as each pond had a slightly different character, and elements of several different communities might be present in any pond. The fringing vegetation often has strong elements of M23 *Juncus effusus/ acutiflorus – Galium palustre* mire, which is

similar to much of the nearby marshy grassland. Ponds fringed by Common Spike Rush could be considered to support a narrow band of S19 *Eleocharis palustris* swamp. The boggier margins of some ponds have some similarities with M29 *Hypericum elodes – Potamogeton polygonifolius* soakway vegetation (although there was no sign of Marsh St.John's-wort), M6 *Carex echinata – Sphagnum denticulatum* mire, and the OV35 *Lythrum portula – Ranunculus flammula* community. The aquatic plants could feasibly be described as a species-poor version of the A24 *Juncus bulbosus* community.



Pond at TN10 showing several different plant communities. A wide belt of emergent Common Spike-rush (S19) grades to a zone of abundant Lesser Spearwort and Water Purslane (OV35) at the water's edge, and then into rush-dominated vegetation (M23) further up the bank.



Stoneworts, such as this Nitella *species were present in a pond (TN10).*

Table 23. Species list data for ponds.

Species	TN4	TN5	TN6	TN8	TN9	TN10	TN13	TN14	TN15	TN22	Freq.
Eleocharis palustris	X	X	X	X		X	X	X		X	V
Juncus effusus		X	X	X	X	X	X	X	X	X	V
Callitriche sp.		X		X		X	X	X	X	X	IV
Molinia caerulea	X	X			X	X	X	X			IV
Potamogeton polygonifolius	X	X	X	X		X	X				IV
Ranunculus flammula	X	X		X		X	X	X		X	IV
Salix cinerea	X	X	X			X	X		X	X	IV
Typha latifolia	X		X	X		X	X		X	X	IV
Agrostis stolonifera	X	X					X	X		X	III
Carex nigra		X	X		X	X			X		III
Eriophorum angustifolium	X	X		X	X	X					III
Juncus acutiflorus	X		X	X		X				X	III
Juncus bulbosus		X			X	X		X			III
Polytrichum commune		X				X		X		X	III
Agrostis canina		X				X					II
Athyrium filix-femina	X		X					X			II
Aulacomnium palustre					X	X					II
Calliergonella cuspidata	X					X	X				II
Carex echinata		X			X	X					II
Epilobium ciliatum								X	X	X	II
Epilobium palustre	X					X		X			II
Equisetum fluviatile			X		X						II
Galium palustre									X	X	II
Holcus lanatus		X					X	X			II
Juncus articulatus	X						X				II
Juncus conglomeratus		X	X								II
Lemna minor	X						X				II
Lythrum portula		X		X		X					II
Persicaria hydropiper							X			X	II
Potamogeton natans	X		X								II
Rubus fruticosus			X						X		II
Rumex conglomeratus									X	X	II
Scutellaria minor	X		X					X			II
Sparganium cf angustifolium		X		X		X					II
Sphagnum denticulatum						X		X			II
Sphagnum fallax		X				X					II
Acer pseudoplatanus									X		I
Alopecurus geniculatus		X									I
Anagallis tenella	X										I
Anthoxanthum odoratum										X	I
Betula pubescens										X	I
Calluna vulgaris										X	I
Cardamine pratensis						X					I
Carex demissa		X									I
Carex paniculata			X								I
Chamerion angustifolium									X		I
Chara sp.			X								I
Cirsium palustre								X			I
Dryopteris dilatata									X		I
Dryopteris filix-mas									X		I
Equisetum palustre									X		I
Erica tetralix					X						I
Eupatorium cannabinum			X								I
Euphrasia sp.			X								I
Festuca vivipara			X								I
Glyceria fluitans					X						I
Holcus mollis								X			I
Juncus squarrosus		X									I

Species	TN4	TN5	TN6	TN8	TN9	TN10	TN13	TN14	TN15	TN22	Freq.
Lotus pedunculatus						X					I
Luzula multiflora										X	I
Mentha aquatica									X		I
Myosotis laxa									X		I
Myriophyllum spicatum	X										I
Nitella sp.						X					
Philonotis fontana	X										I
Picea sitchensis									X		I
Potentilla palustris						X					I
Pulicaria dysenterica	X										I
Ranunculus omiophyllus		X									I
Rumex acetosa								X			I
Salix aurita										X	I
Salix caprea									X		I
Silene flos-cuculi										X	I
Sphagnum cuspidatum								X			I
Sphagnum fimbriatum									X		I
Sphagnum sp.					X						I
Typha angustifolia			X								I
Ulex europaeus										X	I
Vaccinium myrtillus										X	I
Warnstorffia fluitans						X					I
Species total	**20**	**23**	**19**	**10**	**11**	**26**	**14**	**18**	**19**	**21**	

Ditches

There are numerous shallow ditches within the study area, but many of them appear to be almost dry most of the time and only support a species-poor rush-dominated flora. A few of the deeper, wetter ditches have a greater proportion of wetland plants, such as Bulrush, Angelica, Water Mint and Common Spike Rush, and the flora resembles that of the pond margins. In most cases the ditches support variations of the NVC community M23 *Juncus effusus/ acutiflorus – Galium palustre* mire. Some ditches support a high proportion of Bulrush or Common Spike-rush and are closer to S12 Typha latifolia swamp and S19 *Eleocharis palustris* swamp respectively. Some ditches which are subject to disturbance or regular management, such as around the washery, support open vegetation communities resembling the OV28 *Agrostis stolonifera – Ranunculus repens* community.

The ditches with greatest botanical conservation significance tend to be those that are permanently wet. Some these support a high proportion of mosses (e.g. Q42, described under *Sphagnum*-rich bog vegetation). Some have a very high proportion of sedges and flowering herbs (e.g. TN20, which has a diverse flora including Common Sedge, Star Sedge, Remote Sedge, Common Yellow Sedge and White Sedge).



The wide, shallow ditch at TN20, dominated by Common Spike-rush and Water Horsetail, but with a high diversity of flowering herbs and sedges.



A wet ditch beside a retaining wall at the washery supports a sparse wetland flora dominated by Creeping Buttercup and Creeping Bent (TN18).



Montbretia (near TN18), an invasive species seen at the washery.

Table 24. Species list data for ditches.

Species	TN16	TN17	TN18	TN19	TN20	TN21	TN23	Frequency
Galium palustre	X	X	X	X	X		X	V
Juncus effusus	X	X	X	X	X	X	X	V
Agrostis stolonifera	X		X				X	III
Angelica sylvestris		X		X	X			III
Athyrium filix-femina			X	X	X			III
Eleocharis palustris	X				X		X	III
Epilobium hirsutum		X	X		X			III
Epilobium palustre	X				X		X	III
Potentilla anserina		X	X			X		III
Ranunculus repens			X	X		X	X	III
Rumex crispus	X					X	X	III
Salix cinerea			X		X		X	III
Silene flos-cuculi				X	X	X		III
Typha latifolia			X		X	X	X	III
Alopecurus geniculatus	X					X		II
Calliergonella cuspidata	X					X		II
Callitriche sp.	X					X		II
Carex leporina	X					X		II
Carex nigra				X	X			II
Cirsium palustre			X			X		II
Dryopteris filix-mas			X	X				II
Equisetum fluviatile				X	X			II
Holcus lanatus	X		X					II
Juncus acutiflorus					X	X		II
Juncus inflexus		X			X			II
Mentha aquatica				X	X			II
Poa trivialis		X					X	II
Ranunculus flammula	X				X			II
Tussilago farfara			X			X		II
Urtica dioica		X					X	II
Valeriana officinalis		X		X				II
Alnus glutinosa			X					I
Calliergon cordifolium							X	I
Cardamine pratensis			X					I
Carex curta					X			I
Carex demissa					X			I
Carex echinata					X			I

Species	TN16	TN17	TN18	TN19	TN20	TN21	TN23	Frequency
Carex remota						X		I
Carex rostrata				X				I
Chamerion angustifolium			X					I
Cratoneuron filicinum			X					I
Cynosurus cristatus	X							I
Dactylorhiza fuchsii				X				I
Dactylorhiza sp.			X					I
Deschampsia cespitosa		X						I
Dryopteris affinis			X					I
Dryopteris carthusiana				X				I
Epilobium brunnescens			X					I
Epilobium ciliatum	X							I
Equisetum palustre			X					I
Eriophorum angustifolium				X				I
Fissidens adianthoides					X			I
Glyceria fluitans		X						I
Heracleum sphondylium		X						I
Holcus mollis		X						I
Hydrocotyle vulgaris					X			I
Hylocomium splendens					X			I
Hypericum tetrapterum							X	I
Iris pseudacorus							X	I
Juncus articulatus			X					I
Juncus bulbosus	X							I
Lythrum portula							X	I
Molinia caerulea					X			I
Myosotis laxa		X						I
Pellia sp.			X					I
Persicaria hydropiper							X	I
Pohlia melanodon	X							I
Pohlia wahlenbergii					X			I
Pulicaria dysenterica					X			I
Ranunculus acris						X		I
Ribes nigrum							X	I
Rumex acetosa				X				I
Rumex conglomeratus		X						I
Sagina procumbens	X							I
Salix alba					X			I
Scutellaria minor					X			I
Stellaria alsine		X						I
Taraxacum sp.						X		I
Trifolium repens	X							I
Valeriana dioica				X				I
Veronica beccabunga		X						I
Veronica scutellata					X			I
Species total	**18**	**17**	**23**	**17**	**28**	**16**	**17**	**136**

Stream

The largest stream within the study area is the Afon Dulais which flows past the southern boundary. It flows just outside the Celtic Energy land ownership boundary so could only be examined from beside the adjacent fence (TN11). The stream is approximately 2-3m wide and flows in a meandering channel. The stream bed is stony and has localised ochre deposits. The channel is bordered by marshy grassland and flush vegetation, which is lightly grazed by sheep. Much of it appears to conform to the NVC category M23 *Juncus effusus/ acutiflorus – Galium palustre* mire, but it locally grades into tall, dense stands of Meadowsweet which are classified as M27 *Filipendula ulmaria – Angelica sylvestris* mire.



Afon Dulais stream at TN11, fringed by marshy grassland and Meadowsweet mire.

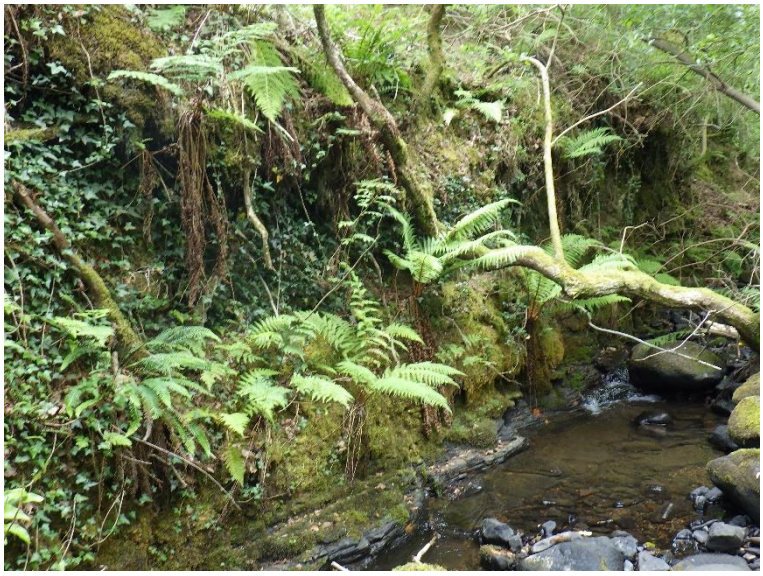
Table 25. Species-list for Afon Dulais stream at TN11

Alnus glutinosa
Angelica sylvestris
Athyrium filix-femina
Cirsium palustre
Deschampsia cespitosa
Epilobium palustre
Equisetum palustre
Filipendula ulmaria
Galium palustre
Glyceria fluitans
Holcus lanatus
Hydrocotyle vulgaris
Juncus acutiflorus
Juncus bulbosus
Juncus effusus
Juncus inflexus
Lotus pedunculatus
Molinia caerulea
Myosotis laxa
Potentilla erecta
Pulicaria dysenterica
Ranunculus acris
Ranunculus repens
Rhododendron ponticum
Rumex acetosa
Scutellaria galericulata
Scutellaria minor
Silene flos-cuculi
Stellaria graminea
Valeriana officinalis
Wahlenbergia hederacea

Damp, shaded cliffs

Several shaded streams within woodland near the study area margins include steep rock outcrops and small waterfalls, creating a humid, moss-covered habitat with abundant ferns. Two of these were investigated during the survey. TN3 is a stream-side cliff, and TN2 a waterfall. Both were too steep and slippery to search fully, but provisional species lists were compiled of the most abundant species.

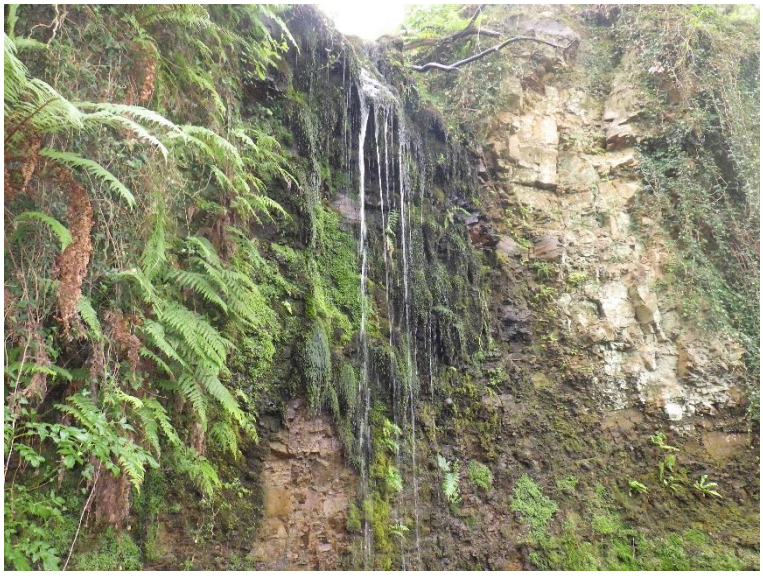
The damp cliff habitat does not easily fit within the NVC, but it is probably best to describe it as local variations within the W11 *Quercus petraea – Betula pubescens – Oxalis acetosella* woodland and W9 *Fraxinus excelsior – Sorbus aucuparia – Mercurialis perennis* woodland that surround these streams. The local high abundance of bryophytes and ferns has affinity with the W17a *Quercus petraea – Betula pubescens – Dicranum majus* woodland *Isothecium myosuroides – Diplophyllum albicans* sub-community, but it is not a good match in the absence of several other species that should be constant in that habitat.



Streamside cliff at TN3

Table 26. Species-list for damp, shaded cliff habitats

Species	TN2	TN3	Frequency
Athyrium filix-femina	X	X	V
Diplophyllum albicans	X	X	V
Dryopteris affinis	X	X	V
Dryopteris dilatata	X	X	V
Dryopteris filix-mas	X	X	V
Fraxinus excelsior	X	X	V
Hedera helix sl	X	X	V
Isothecium myosuroides	X	X	V
Mnium hornum	X	X	V
Pellia epiphylla	X	X	V
Platyhypnidium riparioides	X	X	V
Polytrichastrum formosum	X	X	V
Quercus petraea	X	X	V
Sorbus aucuparia	X	X	V
Thuidium tamariscinum	X	X	V
Asplenium scolopendrium	X		III
Blechnum spicant		X	III
Brachypodium sylvaticum	X		III
Brachythecium rutabulum		X	III
Cardamine cf flexuosa	X		III
Carex remota		X	III
Chrysosplenium oppositifolium		X	III
Conocephalum conicum	X		III
Corylus avellana		X	III
Cratoneuron filicinum		X	III
Deschampsia flexuosa		X	III
Digitalis purpurea		X	III
Festuca gigantea		X	III
Fissidens adianthoides		X	III
Fissidens taxifolius	X		III
Geum urbanum		X	III
Ilex aquifolium	X		III
Kindbergia praelonga	X		III
Lysimachia nemorum		X	III
Metzgeria furcata	X		III
Polystichum setiferum	X		III
Polytrichum commune		X	III
Rubus fruticosus		X	III
Thamnobryum alopecurum		X	III
Viola riviniana		X	III



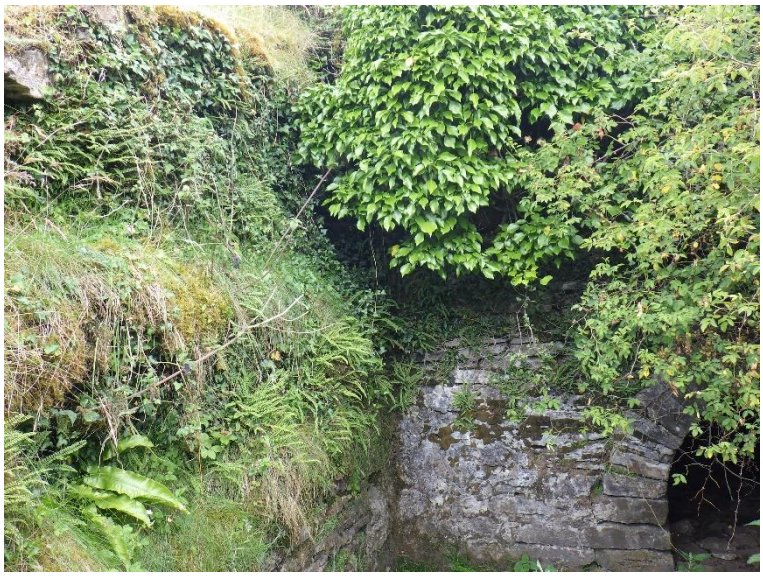
Waterfall at TN2

Vegetation on old stone walls

Several examples of vegetation growing on old stone walls were seen. The largest is a former railway retaining wall in west of the study area. This heavily shaded wall was visible from the cycleway and appears to be largely covered in ferns and Ivy. However, it lies outside the Celtic Energy land ownership boundary so could not be examined closely. Vegetation was also seen on old brickwork on retaining walls at the washery, and the Onllwyn railway bridge, but only in very small quantity. The one example of vegetation on old stone walls that was collected as a target note was from a former mine structure in the south-west of the study area (TN1). In terms of the NVC the closest communities are possibly OV39 *Asplenium trichomanes – A.ruta-muraria* community, or W21 *Crataegus monogyna – Hedera helix* scrub, but it is not a good match for either. Other examples of vegetated stonework may be present at structures outside the Celtic Energy landholding that could not be accessed during the current survey. For example, there is a disused mine shown on the Ordnance Survey map in land at the far west of the study area.

Table 27. Species-list for vegetated old stonework at TN1

Asplenium adiantum-nigrum
Asplenium scolopendrium
Asplenium trichomanes
Epilobium brunnescens
Epilobium montanum
Festuca rubra
Fragaria vesca
Geranium dissectum
Geranium robertianum
Hedera helix sl
Pseudoscleropodium purum
Rosa canina
Rubus fruticosus
Sedum acre
Sorbus aucuparia
Urtica dioica



Vegetation on old stone walls at a disused mining structure (TN1)

4. Evaluation

This section evaluates the nature conservation significance of the plant communities in a geographical context, based on the approach set out in 'Guidelines for Ecological Impact Assessment' (CIEEM, 2018). The criteria used to assist in the evaluation are summarised in Table 28.

Table 28: Evaluation criteria

Level of Value	Habitats
International	Areas designated as Special Areas of Conservation (SAC), Special Protection Areas (SPA) or Ramsar sites in response to European Directives and International Conventions.
National	Areas designated as Sites of Special Scientific Interest (SSSI), National Nature Reserve (NNR), or equivalent for key areas, habitats and plant communities.
Regional	Areas of habitat of suitable size and quality to be considered for notification as SSSI (based on Guidelines for the Selection of Biological SSSIs, JNCC 1998). Extensive areas of Environment (Wales) Act (2016) Section 7 habitats, listed as 'habitats of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales.
County	Areas meeting Wildlife Sites Guidelines selection criteria; areas of Section 7 habitats; areas of Ancient woodland.
District/Local value	Areas of LBAP habitat. Important hedgerows classified under The Hedgerow Regulations 1997. Any non-designated habitat assemblage of moderate biodiversity value.

The study confirmed that there is a wide variety of vegetation types within the study area. A high proportion of the site comprises recently restored, heavily grazed semi-improved pasture and this is very species-poor with negligible botanical interest.

There are no habitats or plant communities that are considered important in a national context. In this case the habitats of greatest value for nature conservation are included within the Welsh Government's Environment (Wales) Act list of Section 7 habitats. The examples of Section 7 habitats present at this site are relatively small or species poor examples of the habitats. This is because the majority of the study area has been heavily affected by human activity, either through mine-working or intensive sheep-grazing, and this has affected the size and quality of the habitats. Consequently the highest value that should be considered from the criteria above is county context rather than regional context in this case.

Several of the plant communities would be deemed to be of county importance on the basis of the Wildlife Sites Guidelines. Each is evaluated in Table 29 below, in the same order that they have been presented in the report. For the purposes of this assessment the value relates only to the vegetation, and not to other wildlife such as birds, mammals or fungi (e.g. a pond might be valued as Local value for its flora, but could potentially be of county value for amphibians or breeding birds, or vice versa).

Table 29. Summary evaluation of habitats within the study area, based on vegetation

Vegetation type	Comments	Evaluation
Semi-natural broad-leaved woodland	Small examples of W11 upland oak woodland, and W9 upland mixed ash woodland present near site perimeter. These are Section 7 habitats and include small remnants of ancient woodland.	**County** value.
Plantation and scrub woodland	Relatively young habitats with limited botanical diversity.	**Local** value.
Conifer plantation	Relatively young and even-aged, with only a sparse ground flora. The large population of Common Wintergreen is of importance in a county context.	Mostly **Local** value, but Common Wintergreen is of **County** value.
Acid grassland	Patchily distributed through much of the study area and mainly represented by U1 and U4 grassland, sometimes forming mosaics with other vegetation. Most of the acid grassland is relatively species-poor and in a heavily-grazed state.	The diverse swards and mosaics with heath vegetation are of **County** value. Low diversity young or sparse swards are of **negligible** value.
Neutral grassland	Mostly limited to small patches and road-side strips, mainly MG5 and MG1 but very variable in species diversity.	**Local** value.
Semi-improved acid grassland	Many extensive examples, especially on well-drained slopes associated with former mining activity. Including some areas with high densities of ant-hills.	Older, diverse swards are of **County** value. Younger, species-poor swards are of **negligible** value.
Sparse grassland on coal spoil and washery sidings	Many variations on U1 grassland. There is a full spectrum of cover and diversity from almost bare spoil to very high diversity vegetation which includes locally uncommon species.	Conservation value reflects the diversity of the swards. Young, species-poor stands are of **Negligible** value, but well established diverse swards are of **Local** and **County** value.
Dry heath	The study area supports very few examples of heath with >25% cover by dwarf shrub species that would qualify as the S7 habitat 'upland heathland'. The largest area is in the restoration area in the centre of the site, which supports H1 heath. Heath is mostly only present as mosaic component amongst acid grassland on former colliery slopes.	**County** value.
Wet heath/ marshy grassland mosaic	Only a few small examples present, and mostly M25 mire, grading into other habitat mosaics. All that were seen support a good range of species.	**County** value.
Sphagnum-rich bog vegetation	Only a few small areas are present, but they all support uncommon plants and all occur in association with other diverse marshy grassland and heath.	**County** value.

Vegetation type	Comments	Evaluation
Marshy grassland	Several relatively large areas are present that are dominated by Purple Moor-grass (M25 mire) and rush pasture (M23 mire). The most diverse would qualify as the S7 habitat 'Purple Moor-grass and rush pastures'. An extensive area of diverse, minerotrophic M23/ M24 marshy grassland is present in wet fields with coal spoil north of the washery. A high proportion of marshy grassland on recently restored farmland is species poor MG10 rush pasture with negligible value.	The diverse M23 and M25 swards are of **County** value. Lower diversity MG23 swards are of no more than **Local** value.
Flush vegetation	Several small M23 flushes are present; mostly at the margins of the grazed upland areas. They support a diverse sward with locally uncommon plant species.	**County** value.
Swamp	Several areas of swamp vegetation are present, but they are mostly too small to qualify as priority habitat. Only one small area of S4 reedbed is present, but this is relatively small and species-poor.	**Local** value.
Ponds	There is an extensive network of ponds within the site. They are of man-made origin but support a variety of vegetation types, including several locally rare plant species such as Floating Bur-reed.	Ponds with rare plant species may be of **County** value. Most individual ponds are of **Local** value.
Ditches	There are a range of ditch types within the site. Most are small with a limited wetland flora. Several larger ones support a more diverse flora.	Most small ditches have negligible value, but some larger ones have **Local** value.
Stream	The Afon Dulais is the only significant stream within the study area. It has a natural channel profile with a naturally meandering course and is bordered by diverse wetland vegetation and therefore meets the wildlife sites qualifying criteria.	**County** value.
Damp shaded cliffs	Local features associated with woodland streams, with a diverse assemblage of ferns and bryophytes.	**Local** value (but some may be part of County value woodland).
Vegetated old stone walls	A small number of man-made features with sparse vegetation. The largest in the study area was not accessible.	**Negligible** value (but some may be part of local value woodland).

The majority of plants recorded during the study are common and widespread species. The only species found that has any special statutory protection under the Wildlife and Countryside Act is Bluebell, which was present in woodland. The protection of Bluebell only relates to sale, so is not relevant to the Project. None of the plants seen are included in the Environment (Wales) Act 2016 Section 7 lists of species of 'principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales'.

Several plants were found that are listed as being rare or in South Wales in the Wildlife Sites Guidelines (Wales Biodiversity Partnership, 2008). Under these guidelines a site is considered significant in a county context if it supports one or more Primary Species or five or more Contributory Species. In this case the rare species recorded are summarised below:

- Bee Orchid (Contributory Species). Locally abundant on sparsely vegetated coal spoil at the washery.
- Bird Cherry (Contributory Species). In plantation/ scrub on restored areas north of Nant Helen mine (probably planted).
- Brookweed (Contributory Species). Locally frequent in base-rich damp ground at the washery.
- Brown Sedge (Contributory Species). Rare on flushed ground on coal spoil at the washery.
- Common Cudweed (Primary Species). Two plants observed in disturbed ground in horse-grazed pasture south-east of the washery.
- Common Wintergreen (Primary Species). Abundant in conifer plantation at north-western boundary.
- Eyebright (*Euphrasia arctica ssp borealis*) (Contributory Species). Occasional in grassland on coal spoil/ washery sidings.
- Floating Bur-reed (Primary Species). Flowering plants confirmed in two upland ponds. Floating leaves of non-flowering plants present in several other ponds suggest that it is probably also present in those, but they could not be confirmed with certainty.
- Lesser Bulrush (Primary Species). Present along margins of water treatment pond at TN6.
- Royal Fern (Contributory Species). A single young plant noted in *Sphagnum*-rich mire near Quadrat 48.
- Small Cudweed (Contributory Species). Locally abundant on sparsely vegetated spoil.
- Spiked Water-milfoil (Contributory Species). Present in ponds at TN4.
- Viviparous Fescue (Primary Species). Several plants noted in sparsely vegetated coal spoil near pond at TN6.



Viviparous Fescue, a 'Primary Species' recorded at TN6.

It is likely that further investigations within the study area would confirm the presence of many more plant species, and that some of these would include additional locally scarce species.



Common Cudweed, a 'Primary Species' recorded in horse-grazed pasture east of the washery (at Quadrat 126). This species might also occur at low density on coal spoil in other parts of the site.



Lesser Bulrush, a 'Primary Species' present beside water treatment pond (at TN6).



A flowering head of Floating Bur-reed; a 'Primary Species' that was confirmed in ponds at TN5 and 10. Floating leaves likely to be this species were also seen in several other ponds but could not be confirmed in the absence of flowering heads.

Two other plants listed in the Wildlife Sites Guidelines were recorded at the washery (by the same surveyor) in 2015, namely Grass Vetchling (Contributory Species) in species-rich neutral grassland, and Fen Bedstraw (Primary Species) in marshy grassland to the north. Although neither were seen during the present study there is a reasonable probability that they may still be present but were not seen during the present survey because the plants only occur at a low density and the whole area could not be searched thoroughly.

In addition to plants noted for their rarity, several species were found that are significant because of their listing on Schedule 9 of the Wildlife and Countryside Act as non-native invasive species. They include the following:

- Japanese Knotweed. Small patches at the washery, and by northern cycleway.
- Montbretia. Several clumps near the washery buildings.
- Hollyberry Cotoneaster. Scattered plants in plantation / scrub and washery coal spoil.
- Himalayan Cotoneaster Scattered plants on washery coal spoil.
- Wall Cotoneaster. Scattered plants on washery coal spoil.
- Entire-leaved Cotoneaster. Scattered plants on washery coal spoil.



Japanese Knotweed at the washery, near Quadrat 99



Himalayan Cotoneaster on coal spoil at the washery (near Q125).

5. References

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Appendix 1. Plant species list

The following species list presents the scientific and common names of all the plant species identified during the vegetation surveys. Due to the size of the site, restrictions on access to some parts, and nature of the sampling, this should not be considered a comprehensive list of every plant species within the study area.

Species	Common name
VASCULAR PLANTS	
Acer campestre	Field Maple
Acer pseudoplatanus	Sycamore
Achillea millefolium	Yarrow
Achillea ptarmica	Sneezewort
Agrostis canina	Velvet Bent
Agrostis capillaris	Common Bent
Agrostis stolonifera	Creeping Bent
Aira caryophyllea	Silver Hair-grass
Aira praecox	Early Hair-grass
Alchemilla sp.	Lady's Mantle
Alnus cordata	Italian Alder
Alnus glutinosa	Alder
Alnus incana	Grey Alder
Alopecurus geniculatus	Marsh Foxtail
Alopecurus pratensis	Meadow Foxtail
Anagallis tenella	Bog Pimpernel
Anaphalis margaritacea	Pearly Everlasting
Angelica sylvestris	Angelica
Anthoxanthum odoratum	Sweet Vernal-grass
Anthyllis vulneraria	Kidney-vetch
Arenaria serpyllifolia	Thyme-leaved Sandwort
Arrhenatherum elatius	False Oat-grass
Asplenium adiantum-nigrum	Black Spleenwort
Asplenium scolopendrium	Hart's-tongue Fern
Asplenium trichomanes	Maidenhair Spleenwort
Athyrium filix-femina	Lady Fern
Bellis perennis	Daisy
Betula pendula	Silver Birch
Betula pubescens	Downy Birch
Blechnum spicant	Hard Fern
Brachypodium sylvaticum	False Brome
Briza media	Quaking Grass
Bromus hordeaceus	Soft Brome
Buddleja davidii	Butterfly Bush
Callitriche sp.	Water Starwort
Calluna vulgaris	Heather
Caltha palustris	Marsh Marigold

Species	Common name
Cardamine cf flexuosa	Wavy Bittercress
Cardamine pratensis	Cuckoo Flower
Carex acutiformis	Lesser Pond-sedge
Carex binervis	Green-ribbed Sedge
Carex curta	White Sedge
Carex demissa	Common Yellow-Sedge
Carex disticha	Brown Sedge
Carex echinata	Star Sedge
Carex flacca	Glaucous Sedge
Carex hirta	Hairy Sedge
Carex hostiana	Tawny Sedge
Carex leporina	Oval Sedge
Carex nigra	Common Sedge
Carex otrubae	False Fox-sedge
Carex pallescens	Pale Sedge
Carex panicea	Carnation Sedge
Carex paniculata	Greater Tussock-sedge
Carex pendula	Pendulous Sedge
Carex pilulifera	Pill Sedge
Carex pulicaris	Flea Sedge
Carex remota	Remote Sedge
Carex rostrata	Bottle Sedge
Carex spicata	Spiked Sedge
Carex sylvatica	Wood Sedge
Carlina vulgaris	Carline Thistle
Castanea sativa	Sweet Chestnut (Planted)
Centaurea nigra	Common Knapweed
Centaurium erythraea	Common Centaury
Cerastium fontanum	Common Mouse-ear
Chamerion angustifolium	Rose-Bay Willowherb
Chrysosplenium oppositifolium	Opposite-leaved Golden-saxifrage
Circaea lutetiana	Enchanter’s Nightshade
Cirsium arvense	Creeping Thistle
Cirsium palustre	Marsh Thistle
Cirsium vulgare	Spear Thistle
Cornus sanguinea	Dogwood
Cornus sericea	Red-osier Dogwood
Corylus avellana	Hazel
Cotoneaster bullatus	Hollyberry Cotoneaster
Cotoneaster integrifolius	Entire-leaved Cotoneaster
Cotoneaster simonsii	Himalayan Cotoneaster
Crataegus monogyna	Hawthorn
Crepis capillaris	Smooth Hawk's-beard
Crocosmia crocosmiiflora	Montbretia
Cynosurus cristatus	Crested Dog’s-tail
Cytisus scoparius	Broom

Species	Common name
Dactylis glomerata	Cock's-foot Grass
Dactylorhiza fuchsii	Common Spotted-orchid
Dactylorhiza maculata	Heath Spotted-orchid
Dactylorhiza praetermissa	Southern Marsh-orchid
Dactylorhiza sp.	Hybrid Marsh-orchid
Danthonia decumbens	Heath Grass
Daucus carota	Wild Carrot
Deschampsia cespitosa	Tufted Hair-grass
Deschampsia flexuosa	Wavy Hair-grass
Digitalis purpurea	Foxglove
Dipsacus fullonum	Teasel
Drosera rotundifolia	Round-leaved Sundew
Dryopteris affinis	Scaly Male-fern
Dryopteris carthusiana	Narrow Buckler-fern
Dryopteris dilatata	Broad Buckler-fern
Dryopteris filix-mas	Male Fern
Eleocharis palustris	Common Spike-rush
Elytrigia repens	Couch
Epilobium brunnescens	New Zealand Willowherb
Epilobium ciliatum	American Willowherb
Epilobium hirsutum	Greater Willowherb
Epilobium montanum	Broad-leaved Willowherb
Epilobium palustre	Marsh Willowherb
Epilobium parviflorum	Hoary Willowherb
Epilobium tetragonum	Square-stalked Willowherb
Epipactis helleborine	Broad-leaved Helleborine
Equisetum arvense	Field Horsetail
Equisetum fluviatile	Water Horsetail
Equisetum palustre	Marsh Horsetail
Equisetum sp.	Horsetail (indeterminate)
Erica tetralix	Cross-leaved Heath
Erigeron acris	Blue Fleabane
Eriophorum angustifolium	Common Cotton-grass
Eriophorum vaginatum	Hare's-tail Cotton-grass
Eupatorium cannabinum	Hemp Agrimony
Euphrasia cf arctica ssp borealis	Eyebright
Euphrasia cf nemorosa	Eyebright
Euphrasia sp.	Eyebright
Fagus sylvatica	Beech (planted)
Festuca gigantea	Giant Fescue
Festuca ovina	Sheep's Fescue
Festuca rubra	Red Fescue
Festuca vivipara	Viviparous Sheep's-fescue
Filago germanica	Common Cudweed
Filago minima	Small Cudweed
Filipendula ulmaria	Meadowsweet

Species	Common name
Fragaria vesca	Wild Strawberry
Fraxinus excelsior	Ash
Galeopsis cf tetrahit	Common Hemp-nettle
Galium aparine	Cleavers
Galium palustre	Marsh Bedstraw
Galium saxatile	Heath Bedstraw
Geranium dissectum	Cut-leaved Crane's-bill
Geranium molle	Dove's-foot Crane's-bill
Geranium robertianum	Herb Robert
Geum urbanum	Wood Avens
Glyceria fluitans	Floating Sweet-grass
Hedera helix sl	Ivy
Heracleum sphondylium	Hogweed
Hieracium sp.	Hawkweed (indeterminate)
Hirschfeldia incana	Hoary Mustard
Holcus lanatus	Yorkshire Fog
Holcus mollis	Creeping Soft-grass
Hyacinthoides non-scripta	Bluebell
Hydrocotyle vulgaris	Marsh Pennywort
Hypericum androsaemum	Tutsan
Hypericum maculatum	Imperforate St. John's-wort
Hypericum perforatum	Perforate St. John's-wort
Hypericum pulchrum	Slender St. John's-wort
Hypericum tetrapterum	Square-stalked St. John's-wort
Hypochaeris radicata	Common Cat's-Ear
Ilex aquifolium	Holly
Iris pseudacorus	Yellow Flag Iris
Isolepis setacea	Bristle Club-rush
Juncus acutiflorus	Sharp-flowered Rush
Juncus articulatus	Jointed Rush
Juncus bufonius	Toad Rush
Juncus bulbosus	Bulbous Rush
Juncus conglomeratus	Compact Rush
Juncus effusus	Soft Rush
Juncus inflexus	Hard Rush
Juncus squarrosus	Heath Rush
Juncus tenuis	Slender Rush
Larix sp.	Larch
Lathyrus pratensis	Meadow Vetchling
Lemna minor	Common Duckweed
Leontodon hispidus	Rough hawk-bit
Leontodon saxatilis	Lesser Hawk-bit
Leucanthemum vulgare	Ox-eye Daisy
Linum catharticum	Fairy Flax
Lolium perenne	Perennial Rye-grass
Lotus corniculatus	Common Bird's-foot Trefoil

Species	Common name
Lotus pedunculatus	Greater Bird's-foot Trefoil
Luzula campestris	Field Woodrush
Luzula multiflora	Heath Woodrush
Luzula pilosa	Hairy Woodrush
Lycopus europaeus	Gypsywort
Lysimachia nemorum	Yellow Pimpernel
Lysimachia nummularia	Creeping Jenny
Lythrum portula	Water Purslane
Lythrum salicaria	Purple Loosestrife
Malus pumila	Apple
Medicago lupulina	Black Medick
Melilotus cf officinalis	Ribbed Melilot
Mentha aquatica	Water Mint
Molinia caerulea	Purple Moor-grass
Montia fontana	Blinks
Myosotis laxa	Tufted Forget-me-not
Myosotis scorpioides	Water Forget-me-not
Myosotis secunda	Creeping Forget-me-not
Myriophyllum spicatum	Spiked Water-milfoil
Narcissus sp.	Daffodil (garden variety)
Nardus stricta	Mat-grass
Nothofagus nervosa	Rauli
Odontites vernus	Red Bartsia
Oenothera sp.	Evening Primrose (indeterminate)
Onobrychis viciifolia	Common Sainfoin
Ononis repens	Restharrow
Ophrys apifera	Bee Orchid
Oreopteris limbosperma	Lemon-scented Fern
Osmunda regalis	Royal Fern
Oxalis acetosella	Wood Sorrel
Pastinaca sativa	Wild Parsnip
Pedicularis palustris	Marsh Lousewort
Pedicularis sylvatica	Common Lousewort
Persicaria hydropiper	Water-pepper
Persicaria maculosa	Redshank
Philonotis fontana	Fountain Apple-moss
Phleum pratense	Timothy
Phragmites australis	Common Reed
Picea sitchensis	Sitka Spruce
Pilosella aurantiaca	Fox-and-cubs
Pilosella officinarum	Mouse-ear Hawkweed
Pinus cf nigra	Austrian Pine
Pinus contorta	Lodgepole Pine
Plantago lanceolata	Ribwort Plantain
Plantago major	Greater Plantain
Poa annua	Annual Meadow-grass

Species	Common name
Poa compressa	Flattened Meadow-grass
Poa palustris	Swamp Meadow-grass
Poa pratensis	Smooth Meadow-grass
Poa trivialis	Rough Meadow-grass
Polygala serpyllifolia	Heath Milkwort
Polygonatum sp.	Solomon's Seal (planted)
Polypodium vulgare	Common Polypody
Polystichum setiferum	Soft Shield-fern
Potamogeton natans	Broad-leaved Pondweed
Potamogeton polygonifolius	Bog Pondweed
Potentilla anglica	Trailing Tormentil
Potentilla anserina	Silverweed
Potentilla erecta	Tormentil
Potentilla palustris	Marsh Cinquefoil
Potentilla reptans	Creeping Cinquefoil
Potentilla sterilis	Barren Strawberry
Primula veris	Cowslip
Prunella vulgaris	Self-Heal
Prunus avium	Wild Cherry
Prunus padus	Bird Cherry
Prunus spinosa	Blackthorn
Pulicaria dysenterica	Fleabane
Pyrola minor	Common Wintergreen
Quercus petraea	Sessile Oak
Quercus robur	Pedunculate Oak
Quercus x rosacea	Hybrid Oak
Ranunculus acris	Meadow Buttercup
Ranunculus flammula	Lesser Spearwort
Ranunculus omiophyllus	Round-leaved Water-crowfoot
Ranunculus repens	Creeping Buttercup
Reynoutria japonica	Japanese Knotweed
Rhinanthus minor	Yellow Rattle
Rhododendron ponticum	Rhododendron
Ribes nigrum	Black Currant
Rosa arvensis	Field Rose
Rosa canina	Dog Rose
Rosa rugosa	Japanese Rose
Rosa sherardii	Sherard's Downy-rose
Rubus fruticosus	Bramble
Rumex acetosa	Common Sorrel
Rumex acetosella	Sheep's Sorrel
Rumex conglomeratus	Clustered Dock
Rumex crispus	Curled Dock
Rumex obtusifolius	Broad-Leaved Dock
Rumex sanguineus	Wood Dock
Sagina filicaulis	Slender Pearlwort

Species	Common name
Sagina procumbens	Procumbent Pearlwort
Salix alba	White Willow
Salix aurita	Eared Willow
Salix caprea	Goat Willow
Salix cinerea	Grey Willow
Salix repens	Creeping Willow
Salix viminalis	Osier
Sambucus nigra	Elder
Samolus valerandi	Brookweed
Sanicula europaea	Sanicle
Scorzoneroides autumnalis	Autumn Hawk-bit
Scrophularia auriculata	Water Figwort
Scrophularia nodosa	Common Figwort
Scutellaria galericulata	Common Skullcap
Scutellaria minor	Lesser Skullcap
Sedum acre	Wall Pepper
Senecio aquaticus	Marsh Ragwort
Senecio jacobaea	Ragwort
Silene flos-cuculi	Ragged Robin
Solanum dulcamara	Bittersweet
Solidago virgaurea	Goldenrod
Sonchus oleraceus	Smooth Sow-thistle
Sorbus aucuparia	Rowan
Sorbus intermedia	Swedish Whitebeam (planted)
Sparganium angustifolium	Floating Bur-reed
Stachys palustris	Marsh Woundwort
Stachys sylvatica	Hedge Woundwort
Stellaria alsine	Bog Stitchwort
Stellaria graminea	Lesser Stitchwort
Stellaria media	Chickweed
Succisa pratensis	Devil's-bit Scabious
Taraxacum sp.	Dandelion
Tilia cordata	Small-leaved Lime (planted)
Torilis japonica	Upright Hedge-parsley
Tragopogon pratensis	Goat's-beard
Trichophorum cespitosum	Deer-grass
Trifolium dubium	Lesser Trefoil
Trifolium pratense	Red Clover
Trifolium repens	White Clover
Trocdaris verticillatum	Whorled Caraway
Tussilago farfara	Colt’s Foot
Typha angustifolia	Lesser Bulrush
Typha latifolia	Bulrush
Ulex europaeus	Common Gorse
Urtica dioica	Nettle
Vaccinium myrtillus	Bilberry

Species	Common name
Valeriana dioica	Marsh Valerian
Valeriana officinalis	Common Valerian
Verbascum thapsus	Greater Mullein
Veronica arvensis	Wall Speedwell
Veronica beccabunga	Brooklime
Veronica chamaedrys	Germander Speedwell
Veronica montana	Wood Speedwell
Veronica officinalis	Heath Speedwell
Veronica scutellata	Marsh Speedwell
Veronica serpyllifolia	Thyme-leaved Speedwell
Viburnum opulus	Guelder Rose
Vicia cracca	Tufted Vetch
Vicia hirsuta	Hairy Tare
Vicia sativa	Common Vetch
Vicia sepium	Bush Vetch
Viola palustris	Marsh Violet
Viola riviniana	Common Dog-violet
Vulpia bromoides	Squirrel-tail Fescue
Wahlenbergia hederacea	Ivy-leaved Bellflower
BRYOPHYTES	
Aneura pinguis	Greasewort
Atrichum undulatum	Common Smoothcap
Aulacomnium palustre	Bog Groove-moss
Brachythecium rivulare	River Feather-moss
Brachythecium rutabulum	Rough-stalked Feather-moss
Bryum alpinum	Alpine Thread-moss
Bryum pseudotriquetrum	Marsh Bryum
Calliergon cordifolium	Heart-leaved Spear-moss
Calliergonella cuspidata	Pointed Spear-moss
Campyliadelphus chrysophyllus	Golden Feather-moss
Campylopus introflexus	Heath Star-moss
Ceratodon purpureus	Redshank
Chiloscyphus polyanthos	St Winifred's Moss
Climacium dendroides	Tree Moss
Conocephalum conicum	Great Scented Liverwort
Cratoneuron filicinum	Fern-leaved Hook-moss
Ctenidium molluscum	Chalk Comb-moss
Dichodontium palustre	Marsh Forklet-moss
Dicranum majus	Greater Fork-moss
Dicranum scoparium	Broom Fork-moss
Didymodon insulanus	Cylindric Beard-moss
Diplophyllum albicans	White Earwort
Encalypta streptocarpa	Spiral Extinguisher-moss
Eurhynchium striatum	Common Striated feather-moss
Fissidens adianthoides	Maidenhair Pocket-moss
Fissidens bryoides	Lesser Pocket-moss

Species	Common name
Fissidens taxifolius	Common Pocket-moss
Funaria hygrometrica	Common Cord-moss
Homalothecium lutescens	Yellow Feather-moss
Homalothecium sericeum	Silky Wall Feather-moss
Hookeria lucens	Shining Hookeria
Hylocomium splendens	Glittering Feather-moss
Hypnum cupressiforme	Cypress-leaved Plait-moss
Hypnum jutlandicum	Heath Plait-moss
Hypnum lacunosum	Great Plait-moss
Isothecium myosuroides	Mouse-tail Moss
Kindbergia praelonga	Common Feather-moss
Lophocolea bidentata	Bifid Crestwort
Lophozia ventricosa	Tumid Notchwort
Metzgeria furcata	Forked Veilwort
Mnium hornum	Swan's-neck Thyme-moss
Pellia sp.	Pellia (non-fruiting)
Plagiomnium cf rostratum	Long-beaked Thyme-moss
Plagiomnium undulatum	Hart's-tongue Thyme-moss
Plagiothecium undulatum	Waved Silk-moss
Platyhypnidium riparioides	Long-beaked Water Feather-moss
Pleurozium schreberi	Red-stemmed Feather-moss
Pogonatum aloides	Aloe Haircap
Pogonatum urnigerum	Urn Haircap
Pohlia melanodon	Pink-fruited Thread-moss
Pohlia wahlenbergii	Pale glaucous Thread-moss
Polytrichastrum formosum	Bank Haircap
Polytrichum commune	Common Haircap
Polytrichum juniperinum	Juniper Haircap
Polytrichum piliferum	Bristly Haircap
Pseudoscleropodium purum	Neat Feather-moss
Ptilidium ciliare	Ciliated Fringewort
Racomitrium aciculare	Yellow Fringe-moss
Racomitrium ericoides	Dense Fringe-moss
Racomitrium cf fasciculare	Green Mountain Fringe-moss
Racomitrium lanuginosum	Woolly Fringe-moss
Rhizomnium punctatum	Dotted Thyme-moss
Rhytidiadelphus loreus	Little Shaggy-moss
Rhytidiadelphus squarrosus	Springy Turf-moss
Rhytidiadelphus triquetrus	Big Shaggy-moss
Scapania irrigua	Heath Earwort
Sphagnum capillifolium	Acute-leaved Bog-moss
Sphagnum cuspidatum	Feathery Bog-moss
Sphagnum denticulatum	Cow-horn Bog-moss
Sphagnum fallax	Flat-topped Bog-moss
Sphagnum fimbriatum	Fringed Bog-moss
Sphagnum inundatum	Lesser Cow-horn Bog-moss

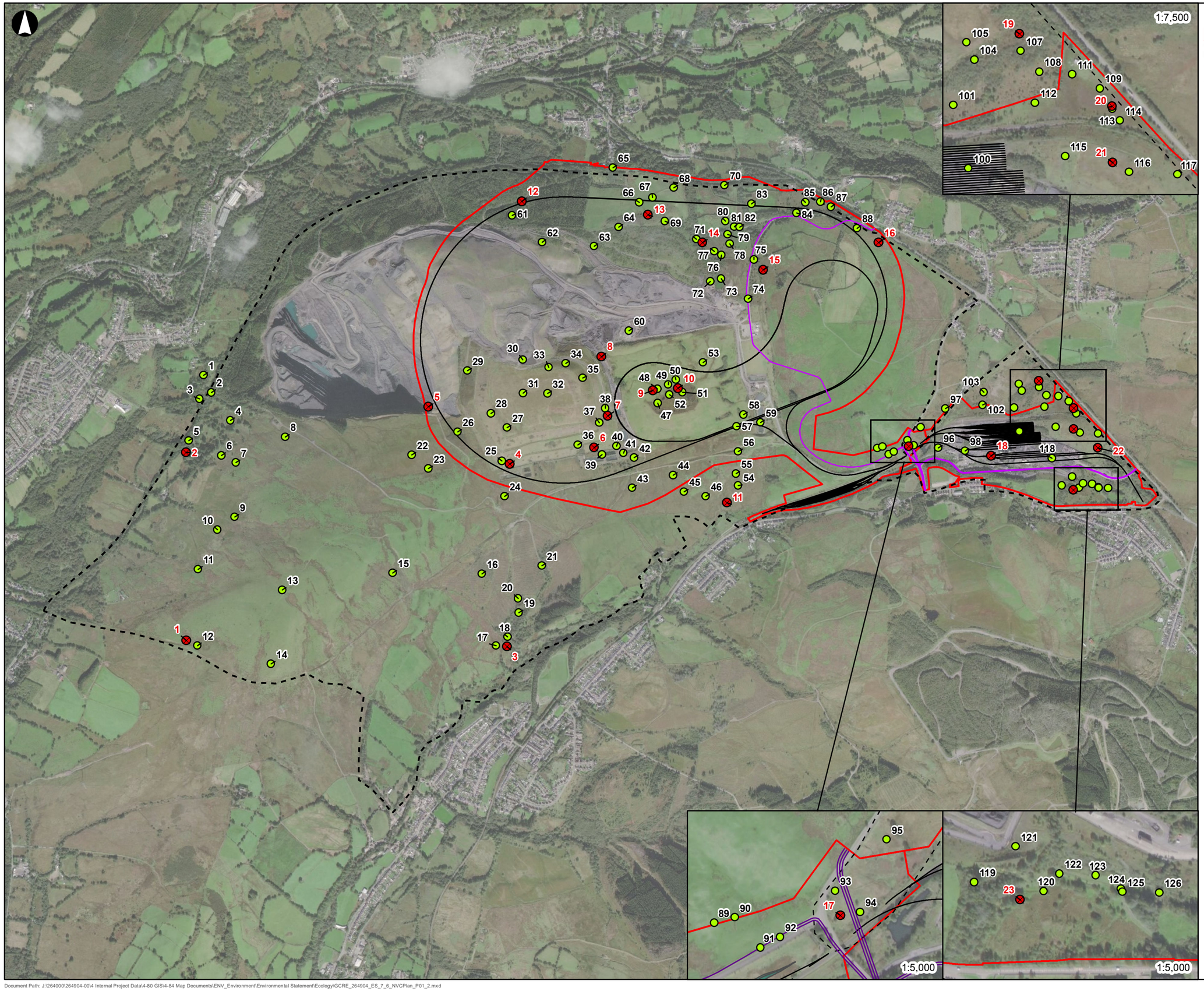
Species	Common name
Sphagnum papillosum	Papillose Bog-moss
Sphagnum squarrosum	Spiky Bog-moss
Sphagnum subnitens	Lustrous Bog-moss
Sphagnum sp.	Bog-moss (ideterminate)
Sphagnum tenellum	Soft Bog-moss
Thamnobryum alopecurum	Fox-tail Feather-moss
Thuidium tamariscinum	Common Tamarisk-moss
Ulota bruchii	Bruch's Pincushion
Warnstorffia exannulata	Ringless Hook-moss
Warnstorffia fluitans	Floating Hook-moss
ALGAE	
Chara sp.	Stonewort
Nitella sp.	Stonewort
LICHENS	
Cladonia cervicornis ssp verticillata	Lichen
Cladonia cf coccifera	Lichen
Cladonia crispata	Lichen
Cladonia floerkeana	Lichen
Cladonia foliacea	Lichen
Cladonia furcata	Lichen
Cladonia gracilis	Lichen
Cladonia pyxidata	Lichen
Cladonia rangiformis	Lichen
Cladonia uncinata	Lichen
Cladonia sp.	Lichen
Hypogymnia physodes	Lichen
Peltigera sp.	Lichen



Locally abundant Ivy-leaved Bellflower in marshy grassland near Quadrat 45.

Appendix 2. Location of quadrats and target notes

A3



Legend

- Planning Development Boundary
- Study Area
- Proposed Access Road
- Site Layout Plan
- NVC Target Note
- NVC Quadrat

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Issue	Date	By	Chkd	Appd
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Welsh Government

Job Title

Global Centre for Rail Excellence

Figure Title

NATIONAL VEGETATION SURVEY (NVC) PLAN

Scale at A3

1:20,000

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264904	**For Issue**

Drawing No	Issue
Figure 7.6	**P01.3**

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Appendix 7C

Fungi Report

Ove Arup and Partners Ltd

Proposed Global Centre for Rail Excellence Nant Helen open cast mine and Onllwyn washery

Grassland fungi survey



Version 3 June 2020

Sturgess Ecology

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This report has been updated to exclude the recommendations detailed in the original report. Since the production of the initial report, the design has evolved, and specific up to date recommendations have been incorporated into the Ecology Chapter of the Environmental Statement, to be submitted for the proposed Global Centre for Rail Excellence scheme.

Document reference: C253/D2/V1

Cover photographs: Left: acid grassland at Nant Helen; Right: *Hygrocybe phaeococcinea* growing out of coal spoil at Onllwyn Washery.

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1. Introduction

Ove Arup and Partners Ltd ('Arup') are currently undertaking surveys for the proposed Global Centre for Rail Excellence (GCRE) (hereafter referred to as the 'Project'), located on the Nant Helen opencast mine and Onllwyn washery, between Seven Sisters and Abercraf (approximate grid reference SN826110). The survey is required to support the design and assessment process for the Project. Several waxcap fungi were observed during ecology surveys carried out during June and July 2019, which indicated that the habitats within the Study Area had potential to support significant populations of grassland fungi. Arup subsequently commissioned Sturgess Ecology to investigate this further by carrying out a survey of some of the most likely areas during the autumn.



Waxcap and Pink-gill fungi seen in acid grassland at Onllwyn washery during botanical surveys in June 2019.

2. Survey method

The field work was carried out by Dr Peter Sturgess CEnv MCIEEM, an ecologist experienced in grassland fungi surveys, and familiar with the types of habitats and terrain that occur on the site.

There are currently no standard survey protocols for grassland fungi, and recording is mostly carried out using walk-over methods. In this case, because the area is so large, and fungi fruit over many months, the survey was limited to a sampling-based approach, focusing on a set of 12 areas considered to have high potential for grassland fungi, and sampling these on 2 occasions spread out through the main autumn fruiting period. Each survey was carried out over 2 days due to the large area to be walked over.

The survey dates were as follows:

Visit 1: 26 & 27 September 2019.

Visit 2: 10 & 14 October 2019.

Visit 3: 5 & 6 November 2019.

The visits all coincided with good conditions for fungi fruiting (i.e. damp conditions with no heavy frosts).

The survey areas are shown in Figure 1. Each visit involved walking through the 12 survey areas, focussing on the patches of vegetation considered to have the highest potential value for grassland fungi; particularly short grassland with no evidence of agricultural improvement by ploughing or use of fertilisers. Patches of scrub, woodland, marshy grassland, recently disturbed ground and other longer grassland were mostly avoided as they have low potential value for grassland fungi. The coverage of each survey area typically took between 1 and 2 hours, depending on the size and complexity.



In a patchy habitat like this (in Area 12) the grassland fungi tended to be limited to the shorter grass. The rush patches and areas of marshy grassland were avoided.

The survey was restricted to three target groups that are generally recognised as being good indicators of nature conservation value for grassland fungi; namely waxcap fungi (*Hygrocybe* spp.), earth tongues (Geoglossaceae) and fairy clubs (Clavariaceae). Pinkgill fungi (*Entoloma spp.)* can also be good indicators of grassland quality, but in this case they were only identified to genus level due to their complex taxonomy and practical difficulties of identifying them (even with microscopy), except where the species has readily distinguishable features. It was possible to identify many of the species during the site survey, but some could not be determined in the field and had to be identified from specimens examined using a microscope. Other fungi were also noted incidentally during the survey, but as a lower priority and most were not identified to species level except where they were readily identifiable in the field.

Fungi taxonomy is currently undergoing major revision as a result of DNA studies, and several of the previously well known names for grassland fungi are changing (e.g. waxcaps are now split into several different genera in some emerging classifications). For the purposes of this study the nomenclature follows Boertmann (2010) for waxcaps, Laessoe & Petersen (2019) for earthtongues, and Kibby (2019) for Fairy Clubs.

The fungi were recorded by compiling a simple species list for each survey area. No attempt was made to quantify or map the fungi fruiting bodies within each area.

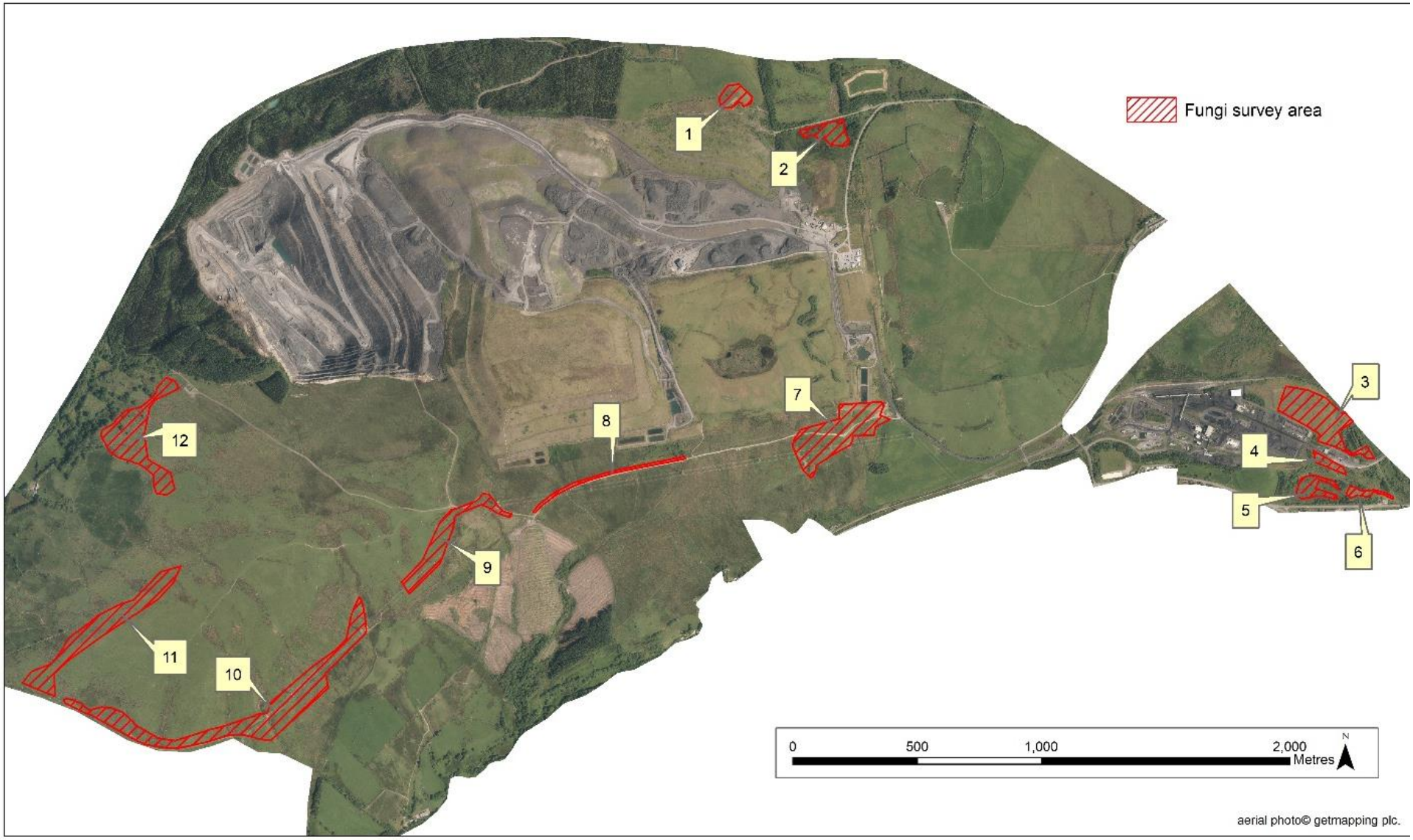

Figure 1. Location of fungi survey areas.

3. Survey findings

A list of all the fungi species recorded during the survey is given in Appendix 1. Lists for the individual survey visits are presented in Appendix 2.

The findings included a total of 27 waxcap species, 5 species of earth tongues and 7 species of fairy clubs. Photographs of some of the key species are presented in Appendix 3.

A breakdown of the target species found in each area and a description of each area in relation to fungi habitat is given in the following section. (A few additional non-target species have also been included, where they are used in some fungi assessment methods.)

Figure 2 has been produced for the Ecology Chapter of the Environmental Statement to show the value of areas surveyed, as well as areas of potential value for fungi.

Area 1



Area 1, showing patchy mix of acid grassland, heath and scrub.

Target fungi species in Area 1

- *Hygrocybe conica*
- *Hygrocybe laeta*
- *Hygrocybe pratensis*
- *Hygrocybe psittacina*
- *Hygrocybe substrangulata*
- *Hygrocybe virginea*
- *Glutinoglossum glutinosum*

Area 1 is a soil mound that is developing a cover of acid grassland with patchy heath and scrub. It appears to be in the region of 25 to 30 years old (although this was not confirmed).

Grassland fungi were relatively sparse on all of the survey visits; the most frequent species were *H.pratensis and H.psittacina*.

Area 2



Area 2, looking north-east from nearby soil mound.

Target fungi species in Area 2

- *Hygrocybe calyptriformis*
- *Hygrocybe cantharellus*
- *Hygrocybe chlorophana*
- *Hygrocybe citrinovirens*
- *Hygrocybe conica*
- *Hygrocybe flavipes*
- *Hygrocybe glutinipes*
- *Hygrocybe lacmus*
- *Hygrocybe laeta*
- *Hygrocybe pratensis*
- *Hygrocybe psittacina*
- *Hygrocybe reidii*
- *Hygrocybe splendidissima*
- *Hygrocybe virginea*
- *Clavulinopsis fusiformis*
- *Clavulinopsis helvola*
- *Clavulinopsis luteoalba*
- *Dermoloma cuneifolium*
- *Entoloma sp.*

Area 2 is a field of grazed pasture on natural ground. It supports semi-improved neutral grassland, grading into semi-improved acid grassland, with occasional trees and scrub.

Grassland fungi were easily found on every survey visit, with *H.pratensis* and *Clavulinopsis fusiformis* being locally abundant. The greatest numbers of fungi were found in the mid-slope section. A patch of the locally uncommon species *H.lacmus* was present near the eastern end. This was the only part of the study area where *H.splendidissima* was recorded.

Area 3



Area 3, showing typical short turf over coal spoil, and patchy heath and scrub.

Target fungi species in Area 3

- *Hygrocybe acutoconica*
- *Hygrocybe calciphila*
- *Hygrocybe cantharellus*
- *Hygrocybe ceracea*
- *Hygrocybe chlorophana*
- *Hygrocybe conica*
- *Hygrocybe insipida*
- *Hygrocybe miniata*
- *Hygrocybe mucronella*
- *Hygrocybe phaeococcinea*
- *Hygrocybe pratensis*
- *Hygrocybe psittacina*
- *Hygrocybe quieta*
- *Hygrocybe reidii*
- *Hygrocybe russocoriacea*
- *Hygrocybe substrangulata*
- *Hygrocybe virginea*
- *Clavulinopsis corniculata*
- *Clavulinopsis helvola*
- *Geoglossum fallax*
- *Glutinoglossum glutinosum*
- *Trichoglossum hirsutum*
- *Dermoloma cuneifolium*
- *Entoloma sericellum*
- *Entoloma sp.*

Area 3 is an area of coal spoil at Onllwyn Washery. It supports a mix of sparse vegetation, with areas of developing heath and scrub. Much of the surface is damp with patchy rushes. The vegetation appears to be in the region of 20 to 30 years old, but this was not confirmed.

Grassland fungi were patchily distributed, with most being found in the better drained areas with the sparsest vegetation, particularly on the eastern slope. The fungi included several small red waxcap species in the very short turf, including *H.miniata* and the locally uncommon species *H.phaecoccinea* and *H.substrangulata.* The presence of *H.calciphila* and *H.mucronella* may indicate a high base mineral content to the substratum, as these are often found in lime-rich habitats. In the absence of management it is possible that several species could be lost to natural successional processes as the vegetation closes and becomes taller.

Area 4



Area 4, showing short turf over coal spoil, with patchy heath, scrub and tall herbs.

Target fungi species in Area 4

- *Hygrocybe conica*
- *Hygrocybe acutoconica*
- *Hygrocybe mucronella*

Area 4 is an area of coal spoil at Onllwyn Washery with a mix of short turf, tall herbs, heath and scrub. There are areas of flushing, supporting mosses and rushes. The vegetation appears to be in the region of 20 to 30 years old, but this was not confirmed.

Grassland fungi were only sparse in this area, and the few that were seen were mostly in ones or twos rather than larger groups. *H.acutoconica* was also recorded here during July.

Area 5



Area 5, showing short-grazed turf, with patchy rushes and scrub, and drier areas with ant-hills.

Target fungi species in Area 5

- *Hygrocybe chlorophana*
- *Hygrocybe conica*
- *Hygrocybe insipida*
- *Hygrocybe psittacina*
- *Clavulinopsis helvola*
- *Trichoglossum hirsutum*

Area 5 is an area of horse-grazed grassland that appears to have developed on very old coal workings. The field includes a mix of short turf, marshy grassland and scrub.

Grassland fungi were only found in small numbers and were limited to the drier grassland on what appear to be old spoil heaps, and a few in the grassy strip beside the north-eastern boundary. The heavy grazing pressure in this field may have meant that some fungi were damaged before they were large enough to be recorded.

Area 6



Area 6, during September survey, showing short-grazed turf with ant-hills.



Area 6, the same field in November survey, with heavy grazing pressure.

Target fungi species in Area 6

- *Hygrocybe acutoconica*
- *Hygrocybe chlorophana*
- *Hygrocybe citrinovirens*
- *Hygrocybe conica*
- *Hygrocybe flavipes*
- *Hygrocybe glutinipes*
- *Hygrocybe helobia*
- *Hygrocybe psittacina*
- *Hygrocybe reidii*
- *Hygrocybe substrangulata*
- *Hygrocybe virginea*
- *Clavulinopsis helvola*
- *Trichoglossum hirsutum*
- *Camarophyllopsis schulzeri*
- *Entoloma sericellum*
- *Entoloma sp.*

Area 6 is an area of horse-grazed grassland that appears to have developed on very old coal workings. The field includes a mix of short turf with ant-hills, with patches of longer grass and scrub near the margins.

Grassland fungi were found in good numbers in the areas of short grass during the first survey, when the field was ungrazed, and these included the only record of *Camarophyllus schulzeri*. Horses were present in the field during the two later surveys and very few fungi were seen on these occasions (except a few damaged specimens).

Area 7



Area 7, showing old dry spoil heap with acid grassland; one of the more diverse parts of the area.



Area 7, showing old spoil heaps with acid grassland, with ant-hills and scattered scrub.

Target fungi species in Area 7

- *Hygrocybe chlorophana*
- *Hygrocybe conica*
- *Hygrocybe glutinipes*
- *Hygrocybe irrigata*
- *Hygrocybe lacmus*
- *Hygrocybe laeta*
- *Hygrocybe miniata*
- *Hygrocybe mucronella*
- *Hygrocybe phaeococcinea*
- *Hygrocybe pratensis*
- *Hygrocybe psittacina*
- *Hygrocybe quieta*
- *Hygrocybe virginea*
- *Clavaria acuta*
- *Clavulinopsis corniculata*
- *Clavulinopsis helvola*
- *Clavulinopsis laeticola*
- *Geoglossum fallax*
- *Geoglossum umbratile*
- *Glutinoglossum glutinosum*
- *Entoloma prunuloides*
- *Entoloma sp.*

Area 7 is an area of old coal workings now supporting semi-improved and acid grassland grazed by sheep and cattle, with intermittent patches of marshy grassland. A particularly diverse spoil heap at the eastern side is only grazed by sheep.

H.conica and *H.virginea* were common through most of the area; the other species tended to be more localised. The locally rare H*.lacmus* and *H.phaeococcinea* were associated with older, steeper coal-spoil heaps.

Area 8



Area 8, showing mix of short grass and rushes on old railway banking.

Target fungi species in Area 8

- *Hygrocybe chlorophana*
- *Hygrocybe citrinovirens*
- *Hygrocybe conica*
- *Hygrocybe intermedia*
- *Hygrocybe irrigata*
- *Hygrocybe laeta*
- *Hygrocybe phaeococcinea*
- *Hygrocybe pratensis*
- *Hygrocybe psittacina*
- *Hygrocybe russocoriacea*
- *Hygrocybe virginea*
- *Clavulinopsis corniculata*
- *Clavulinopsis helvola*
- *Geoglossum fallax*
- *Trichoglossum hirsutum*
- *Dermoloma cuneifolium*
- *Entoloma prunuloides*
- *Entoloma sp.*

Area 8 is a section of former railway banking that supports a patchy mix of semi-improved acid grassland and rushes on its sides. It is grazed by sheep and cattle.

The drier section of south-facing bank supported good numbers of grassland fungi, with *H.pratensis, H.chlorophana* and *H.virginea* being most common. The greatest species diversity was observed towards the eastern end of the surveyed section.

Area 9



Area 9, showing mix of short grass with ant-hills and patchy rushes.

Target fungi species in Area 9

- *Hygrocybe chlorophana*
- *Hygrocybe conica*
- *Hygrocybe lacmus*
- *Hygrocybe laeta*
- *Hygrocybe pratensis*
- *Hygrocybe psittacina*
- *Hygrocybe virginea*
- *Clavulinopsis helvola*
- *Geoglossum cookeanum*
- *Geoglossum fallax*
- *Trichoglossum hirsutum*
- *Dermoloma cuneifolium*
- *Entoloma prunuloides*
- *Entoloma sericellum*
- *Entoloma sp.*

Area 9 was chosen as a representative example of the open common to the south of the surface mine. It is grazed by sheep and cattle. The vegetation comprises patchy semi-improved and acid grassland, with areas of marshy grassland with rushes and Purple Moor-grass.

Grassland fungi were very patchily distributed, with locally abundant *H.conica, H.psittacina, H.virginea* and *Geoglossum fallax*, especially at the margins of areas that have been agriculturally improved (judging from the lack of ant-hills and lower plant diversity). The areas with greater species diversity tended to be the areas of older acid grassland with ant-hills, although the fungi were often sparse in these parts. The locally uncommon *H.lacmus* was only present as a few specimens in the south of the area.

Area 10



Area 10, showing a typical mix of semi-improved acid grassland with abundant ant-hills.

Target fungi species in Area 10

- *Hygrocybe calyptriformis*
- *Hygrocybe cantharellus*
- *Hygrocybe ceracea*
- *Hygrocybe chlorophana*
- *Hygrocybe citrinovirens*
- *Hygrocybe conica*
- *Hygrocybe flavipes*
- *Hygrocybe glutinipes*
- *Hygrocybe insipida*
- *Hygrocybe intermedia*
- *Hygrocybe irrigata*
- *Hygrocybe laeta*
- *Hygrocybe miniata*
- *Hygrocybe pratensis*
- *Hygrocybe psittacina*
- *Hygrocybe quieta*
- *Hygrocybe reidii*
- *Hygrocybe russocoriacea*
- *Hygrocybe virginea*
- *Clavaria fumosa*
- *Clavulinopsis corniculata*
- *Clavulinopsis helvola*
- *Geoglossum fallax*
- *Trichoglossum hirsutum*
- *Dermoloma cuneifolium*
- *Entoloma prunuloides*
- *Entoloma sericellum*
- *Entoloma serrulatum*
- *Entoloma sp.*

Area 10 is an area of common grazed by sheep and cattle, that supports semi-improved acid grassland as is characterised by abundant ant-hills. The remains of old coal workings are present at the western end of the section.

Grassland fungi were generally only found in low numbers through most of the area, mainly in the drier patches of the shortest grass. The most frequent species included *H.pratensis, H.laeta, H.psittacina* and *H.virginea*. However, the old mine workings supported the large numbers of fungi and a very high species diversity. This was the only area where *Clavaria fumosa* was recorded.

Area 11



Area 11, showing the wide slope with short, semi-improved acid grassland and patchy rushes.

Target fungi species in Area 11

- *Hygrocybe conica*
- *Hygrocybe laeta*
- *Hygrocybe pratensis*
- *Hygrocybe psittacina*
- *Hygrocybe reidii*
- *Hygrocybe virginea*
- *Clavulinopsis helvola*
- *Geoglossum fallax*
- *Dermoloma cuneifolium*
- *Entoloma sericellum*
- *Entoloma sp.*

Area 11 is a west-facing slope of the common, grazed by sheep and cattle. It supports semi-improved acid grassland with patchy rushes and several areas of marshy grassland. Ant-hills are scattered through the slope, and there are remnants of several very small-scale coal workings in a few places.

The slope supports an assemblage of fungi typical of upland acid grassland. The fungi were generally limited to the drier parts and the shortest grassland, and were mostly only seen in small numbers. The most frequent waxcap species observed were *H.laeta, H.virginea, H.psittacina* and *H.pratensis*.

Area 12



Area 12, showing semi-improved acid grassland with abundant ant-hills in an area of old workings.



Area 12, showing old fields with anthills.

Target fungi species in Area 12

- *Hygrocybe cantharellus*
- *Hygrocybe ceracea*
- *Hygrocybe chlorophana*
- *Hygrocybe conica*
- *Hygrocybe flavipes*
- *Hygrocybe glutinipes*
- *Hygrocybe insipida*
- *Hygrocybe laeta*
- *Hygrocybe pratensis*
- *Hygrocybe psittacina*
- *Hygrocybe reidii*
- *Hygrocybe virginea*
- *Clavaria acuta*
- *Clavulinopsis fusiformis*
- *Clavulinopsis helvola*
- *Clavulinopsis luteoalba*
- *Geoglossum fallax*
- *Entoloma sp.*

Area 12 spans an area of the common where there are old mine-workings, and several sloping fields with scattered trees. The area is mainly grazed by sheep, although some of the fields are only lightly grazed.

The old workings with short-grazed grass supported good numbers and a moderate diversity of grassland fungi. The most frequent species were *H.virginea, H.laeta, H.chlorophana, H.conica* and *H.psittacina.* Very few fungi were found in the fields, presumably because the grass was too long. However, those present included some large specimens of *H.flavipes, H.irrigata* and *H.pratensis*, which might indicate that additional (smaller) species might be present in the soil and would produce fruiting bodies if closer grazing were to be reintroduced.

4. Evaluation

This section evaluates the nature conservation significance of the grassland fungi in a geographical context, based on the approach set out in 'Guidelines for Ecological Impact Assessment' (CIEEM, 2018). The criteria used to assist in the evaluation are summarised in Table 2.

Table 2: Evaluation criteria

Level of Value	Habitats
International	Areas designated as Special Areas of Conservation (SAC), Special Protection Areas (SPA) or Ramsar sites in response to European Directives and International Conventions.
National	Areas designated as Sites of Special Scientific Interest (SSSI), National Nature Reserve (NNR) or equivalent.
Regional	Areas of habitat of suitable size and quality to be considered for notification as SSSI (based on Guidelines for the Selection of Biological SSSIs, JNCC 1998). Extensive areas of Environment (Wales) Act (2016) Section 7 habitats, listed as 'habitats of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales.
County	Areas meeting Wildlife Sites Guidelines selection criteria; areas of Section 7 habitats; areas of Ancient woodland.
District/Local value	Any non-designated habitat assemblage of moderate biodiversity value.

There are various ways of assessing the value of grassland fungi populations. Most focus on the total number of waxcap species, or the number seen in a single visit. The Wildlife Sites Guidelines includes the "Rald classification method" which is based on the total number of Waxcaps (*Hygrocybe* spp.) recorded from a site as follows:

- National importance = 17-32 species (or 11-20 during a single visit)
- Regional importance = 9-16 species (or 6-10 during a single visit)
- Local importance = 4-8 species (or 3-5 during a single visit)
- No importance = 1-3 species (or 1-2 during a single visit)

The guidelines expand on this to include rarity criteria, and consider the following would be considered as potential wildlife sites (i.e. significant in a county context):

- A site supporting 4-8 or more species of waxcaps, or 3-5 during a single visit. (This criterion was modified in the Selection of SINCs in the Mid-Valleys Area (Caerphilly County Borough Council *et al*, 2008) to require 9 species of waxcaps to qualify as county importance.)
- A site which supports a red data list species, or species included in the Environment Act (Wales) Section 7 'List of species of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales'.
- A site which supports a species recorded from 10 or fewer 10km grid squares in Wales (where the distribution is well known).
- A site which supports a species which is recorded from 3 or fewer sites within a Watsonian Vice County (where the distribution is well known).
- A site which supports a significant population of a Local Priority Species as listed in the relevant Local Biodiversity Action Plan.

The threshold for national importance is generally based on the recently revised SSSI selection criteria (JNCC 2018). For grassland fungi, the main criterion based on waxcap diversity is that a site should be considered for notification if the total waxcap count reaches or exceeds 19. Sites that fail to reach this threshold but have records of 12-18 taxa should be prioritised for resurvey (multiple visits), or may be considered regionally important.

The SSSI thresholds for species other than waxcaps are as follows:

- Clavarioid fungi (clubs, spindles and corals) = 7 species
- *Entoloma sensu lato* (pinkgills) = 15 species
- Geoglossoid fungi (earth tongues) = 5 species
- *Dermoloma, Camarophyllopsis, Hodophilus & Porpoloma* (*Pseudotricholoma metapodium*) (crazed caps, fanvaults and meadowcaps) = 3 species.

The various survey areas used in the current study are evaluated below in Table 3 and shown in Drawing 1.

Table 3. Summary evaluation of survey areas based on grassland fungi diversity

	Waxcap species	Evaluation	Comments
Area 1	6	**Local** value.	Has potential for fungi value to increase as habitat develops.
Area 2	14	**County** value.	Greatest diversity seen in mid-slope.
Area 3	17	**County** value.	Potentially vulnerable to loss of some species to successional processes.
Area 4	3	Negligible value	Ground conditions may be too wet to support a higher diversity.
Area 5	4	**Local** value.	Much of the area is too damp for grassland fungi, but reduction in grazing pressure may allow additional fungi to appear.
Area 6	11	**County** value.	Reduction in grazing pressure may allow additional fungi to appear.
Area 7	13	**County** value.	Highest fungi diversity is associated with the old coal tips.
Area 8	11	**County** value.	Most fungi diversity was seen in the eastern part, on the south-facing slope.
Area 9	7	**Local** value.	Probably typical of the agriculturally improved part of the common. *H.lacmus* was only seen in one patch.
Area 10	19	**County** value.	Most of the species were limited to the old workings in the west, rather than being spread through the whole area.
Area 11	6	**Local** value.	Probably typical of the less improved acid grassland parts of the common
Area 12	12	**County** value.	Highest fungi diversity is associated with the old coal tips. Closer grazing in the western fields may enable more fungi to appear.

Grassland fungi exist within the soil as a mycelial network of microscopic hyphae, only producing their visible fruiting bodies at certain times, usually late summer/autumn. Fungi can be very erratic and unpredictable in their appearing, and some species may go for several years without producing fruiting bodies. It is therefore unlikely that this limited survey will have recorded all of the grassland fungi that are present, and further investigations would probably confirm the presence of additional fungi species. A small number of waxcap species found reasonably frequently on acid soils in the Welsh uplands were surprisingly not seen during the current survey and might be expected to be present. In particular, further survey might be likely to find *H.vitellina* and *H.punicea*.

The mycelium in the soil is very vulnerable to ground disturbance such as ploughing, or compaction by vehicles. It is also easily damaged by agricultural chemicals such as fertilisers or pesticides. The survey findings highlight that certain parts of the site have remained relatively undisturbed for many years. The areas with diverse assemblages of grassland fungi appear to correlate well with the presence of anthills and lack of agricultural inputs.

Two areas (3 & 10) could arguably be considered regionally important, although their diversity is rather patchy and some parts of them only support low diversity. Both of these diverse fungi assemblages have clearly developed on mine spoil. This historic disturbance appears to have increased the range of fungi that they can support, when compared with the otherwise undisturbed parts of the common. It is likely that the soil in the previously worked areas contains a higher proportion of base minerals such as calcium than the more acidic natural ground.

None of the fungi recorded are included within the Welsh Government's Environment (Wales) Act 2018 list of Section 7 species. It is possible that one or more of these species may be present, but was either not fruiting this year, or was only present at too low a density to be recorded during the survey.

Several species were found that are infrequently recorded in Wales. A data collation exercise was undertaken by David Mitchel in 2017/ 2018, on behalf of NRW (http://www.nifgdata.org.uk/waleswaxcaps/species/atlas.htm). This provides an indication of the distribution and abundance of most waxcap species within Wales, in relation to the number of 10km grid squares they occupy. The least common species found during the present survey were *H. substrangulata* (6 post-2000 squares), *H.phaeococcinea* (7 post-2000 squares) and *H.lacmus* (15 post-2000 squares). However, fungi are generally very under-recorded, and not all of the known records from some sources were able to be included in the 2018 data set. It is difficult to determine whether these fungi are genuinely rare or simply overlooked; especially in the case of species that appear in remote upland habitats that are not regularly visited by mycologists.

5. Bibliography

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Appendix 1. Fungi species list

The following species list presents the scientific and common names of the species identified during the survey. In many cases non-target fungi were only identified to genus level.

Species	Common name
Agaricus campestris	Field Mushroom
Agaricus sp.	Mushroom (indeterminate)
Agaricus urinascens	Macro Mushroom
Bovista plumbea	Grey Puffball
Camarophyllopsis schulzeri	Matt Fanvault
Clavaria acuta	Pointed Club
Clavaria fumosa	Smoky Spindles
Clavulinopsis corniculata	Meadow Coral
Clavulinopsis fusiformis	Golden Spindles
Clavulinopsis helvola	Yellow Club
Clavulinopsis laeticola	Handsome Club
Clavulinopsis luteoalba	Apricot Club
Clitocybe fragrans	Fragrant Funnel
Clitocybe nebularis	Clouded Agaric
Conocybe sp.	Conecap (indeterminate)
Coprinopsis sp.	Inkcap (indeterminate)
Coprinus commatus	Shaggy Inkcap
Cordyceps militaris	Scarlet Caterpillar-club
Cystoderma amianthinum	Earthy Powdercap
Daldinia fissa	Gorse Crampball
Deconica coprophila	Dung-loving Psilocybe
Dermoloma cuneifolium	Crazed Cap
Entoloma prunuloides	Mealy Pinkgill
Entoloma sericellum	Cream Pinkgill
Entoloma serrulatum	Blue-edge Pinkgill
Entoloma sp.	Pinkgill (indeterminate)
Galerina sp.	Bell (indeterminate)
Geoglossum cookeanum	Earthtongue
Geoglossum fallax	Deceptive Earthtongue
Geoglossum umbratile	Plain Earthtongue
Glutinoglossum glutinosum	Glutinous Earthtongue
Handkea excipuliformis	Pestle Puffball
Hygrocybe acutoconica	Persistent Waxcap
Hygrocybe calciphila	Limestone Waxcap
Hygrocybe calyptriformis	Pink Waxcap
Hygrocybe cantharellus	Goblet Waxcap
Hygrocybe ceracea	Butter Waxcap
Hygrocybe chlorophana	Golden Waxcap
Hygrocybe citrinovirens	Citrine Waxcap
Hygrocybe conica	Blackening Waxcap
Hygrocybe flavipes	Yellow-foot Waxcap
Hygrocybe glutinipes	Glutinous Waxcap
Hygrocybe helobia	Garlic Waxcap
Hygrocybe insipida	Spangle Waxcap
Hygrocybe intermedia	Fibrous Waxcap
Hygrocybe irrigata	Slimy Waxcap
Hygrocybe lacmus	Grey Waxcap

Species	Common name
Hygrocybe laeta	Heath Waxcap
Hygrocybe miniata	Vermillion Waxcap
Hygrocybe mucronella	Bitter Waxcap
Hygrocybe phaeococcinea	Shadowed Waxcap
Hygrocybe pratensis	Meadow Waxcap
Hygrocybe psittacina	Parrot Waxcap
Hygrocybe quieta	Oily Waxcap
Hygrocybe reidii	Honey Waxcap
Hygrocybe russocoriacea	Cedarwood Waxcap
Hygrocybe splendidissima	Splendid Waxcap
Hygrocybe substrangulata	A waxcap
Hygrocybe virginea	Snowy Waxcap
Laccaria laccata	Deceiver
Lactarius deliciosus	Saffron Milkcap
Lactarius sp.	Milkcap (indeterminate)
Leccinum scabrum	Brown Birch Bolete
Lichenomphalina umbellifera	Heath Navel
Lycoperdon nigrescens	Dusky Puffball
Macrolepiota procera	Parasol
Mycena sp.	Bonnet (indeterminate)
Naucoria sp.	Aldercap (indeterminate)
Panaeolina foenisecii	Brown Mottlegill
Panaeolus papilionaceus	Petticoat Mottlegill
Panaeolus sp.	Mottlegill (indeterminate)
Pseudoclitocybe cyathiformis	Goblet
Psilocybe semilanceata	Liberty Cap
Rickenella fibula	Orange Mosscap
Stropharia semiglobata	Dung Roundhead
Suillus cf bovinus	Bovine Bolete
Tremella mesenterica	Yellow Brain
Trichoglossum hirsutum	Hairy Earthtongue
Tricholoma fulvum	Birch Knight
Vascellum pratense	Meadow Puffball

Appendix 2. Species lists by survey visit

The following lists presents the fungi observed at each site during the different survey visits.

26 & 27 September 2019

TARGET FUNGI SPECIES	1	2	3	4	5	6	7	8	9	10	11	12
Hygrocybe acutoconica			X	X								
Hygrocybe calyptriformis		X										
Hygrocybe cantharellus										X		
Hygrocybe ceracea										X		
Hygrocybe chlorophana		X				X		X	X	X		X
Hygrocybe citrinovirens		X				X						
Hygrocybe conica	X		X	X	X	X	X	X	X	X	X	X
Hygrocybe flavipes		X				X				X		X
Hygrocybe glutinipes		X				X	X			X		X
Hygrocybe substrangulata	X		X			X						
Hygrocybe insipida			X							X		
Hygrocybe intermedia								X		X		
Hygrocybe laeta							X					X
Hygrocybe pratensis		X					X			X	X	
Hygrocybe psittacina		X	X		X	X	X		X	X	X	X
Hygrocybe quieta										X		
Hygrocybe reidii		X	X			X					X	
Clavaria acuta							X					
Clavaria fumosa										X		
Clavulinopsis helvola					X	X		X				X
Clavulinopsis corniculata			X									
Clavulinopsis fusiformis		X										
Clavulinopsis luteoalba												X
Geoglossum fallax								X				
OTHER FUNGI SPECIES												
Agaricus cf campestris								X				
Agaricus urinascens										X		
Bovista plumbea							X			X		
Clitocybe nebularis	X											
Clitocybe fragrans							X					
Conocybe sp.								X				
Coprinopsis sp.								X				
Cystoderma amianthinum	X	X								X	X	X
Daldinia fissa			X									
Deconica coprophila							X	X	X	X		
Dermoloma cuneifolium		X							X		X	
Entoloma prunuloides							X	X	X	X		
Entoloma sericellum			X						X		X	
Entoloma sp.		X	X				X	X	X	X	X	X
Galerina sp.	X		X				X				X	
Handkea excipuliformis			X									
Laccaria laccata	X		X			X						
Lactarius deliciosus			X									
Lycoperdon nigrescens	X	X									X	
Macrolepiota procera										X		
Panaeolina foenisecii							X			X		
Panaeolus papilionaceus								X		X		
Psilocybe semilanceata		X			X	X	X	X	X	X		X
Stropharia semiglobata		X			X		X		X	X	X	X
Vascellum pratense							X					

10 & 14 October 2019

	1	2	3	4	5	6	7	8	9	10	11	12
TARGET FUNGI SPECIES												
Hygrocybe acutoconica			X									
Hygrocybe calciphila			X									
Hygrocybe calyptriformis										X		
Hygrocybe cantharellus		X	X									X
Hygrocybe ceracea										X		
Hygrocybe chlorophana		X	X		X		X	X		X		X
Hygrocybe citrinovirens		X				X		X		X		
Hygrocybe conica		X	X	X	X	X	X	X	X	X	X	X
Hygrocybe glutinipes						X	X					
Hygrocybe helobia						X						
Hygrocybe insipida			X		X							X
Hygrocybe intermedia										X		
Hygrocybe irrigata								X		X		
Hygrocybe laeta		X							X	X	X	X
Hygrocybe miniata										X		
Hygrocybe mucronella			X	X								
Hygrocybe phaeococcinea			X									
Hygrocybe pratensis	X	X	X				X			X	X	X
Hygrocybe psittacina	X	X	X		X	X	X	X	X	X	X	X
Hygrocybe quieta			X							X		
Hygrocybe reidii		X	X							X	X	X
Hygrocybe russocoriacea			X									
Hygrocybe splendidissima		X										
Hygrocybe virginea		X	X			X	X	X	X	X	X	X
Clavaria fumosa										X		
Clavulinopsis helvola		X	X		X	X	X		X	X	X	X
Clavulinopsis corniculata			X							X		
Clavulinopsis fusiformis		X										X
Clavulinopsis laeticola							X					
Clavulinopsis luteoalba		X										
Trichoglossum hirsutum						X						
OTHER FUNGI SPECIES												
Agaricus sp.							X					
Agaricus urinascens												X
Bovista plumbea							X					
Camarophyllopsis schulzeri						X						
Clitocybe fragrans							X					
Conocybe sp.											X	
Cordyceps militaris	X						X	X	X	X	X	
Cystoderma amianthinum	X	X					X		X	X	X	X
Daldinia fissa			X									
Deconica coprophila							X	X				
Dermoloma cuneifolium			X					X	X	X		
Entoloma prunuloides							X			X		
Entoloma sericellum			X			X			X	X		
Entoloma serrulatum										X		
Entoloma sp.		X	X			X	X	X	X	X	X	X
Galerina sp.	X					X		X	X	X	X	X
Handkea excipuliformis			X									
Laccaria laccata	X		X									
Lactarius sp.	X											
Leccinum scabrum			X		X							
Lichenomphalina umbellifera			X									
Lycoperdon nigrescens	X	X					X		X	X	X	X

	1	2	3	4	5	6	7	8	9	10	11	12
Macrolepiota procera											X	
Mycena sp.	X		X		X	X	X	X	X	X		
Panaeolina foenisecii											X	
Panaeolus papilionaceus										X		
Panaeolus sp.						X						
Psilocybe semilanceata	X						X	X	X	X	X	X
Rickenella fibula						X			X	X		X
Stropharia semiglobata							X	X	X	X	X	X
Suillus cf bovinus			X									
Tremella mesenterica		X										
Tricholoma fulvum		X										
Vascellum pratense							X	X		X		

5 & 6 November 2019

TARGET FUNGI SPECIES	1	2	3	4	5	6	7	8	9	10	11	12
Hygrocybe acutoconica						X						
Hygrocybe calyptriformis		X										
Hygrocybe ceracea			X							X		X
Hygrocybe chlorophana			X				X	X	X	X		X
Hygrocybe conica			X			X	X		X	X	X	X
Hygrocybe insipida			X									
Hygrocybe irrigata							X					
Hygrocybe lacmus		X					X		X			
Hygrocybe laeta	X	X					X	X	X	X	X	X
Hygrocybe miniata			X				X					
Hygrocybe mucronella							X					
Hygrocybe phaeococcinea			X				X	X				
Hygrocybe pratensis	X	X	X				X	X	X	X	X	X
Hygrocybe psittacina		X			X	X	X	X		X	X	
Hygrocybe quieta							X			X		
Hygrocybe reidii		X	X									X
Hygrocybe russocoriacea			X					X		X		
Hygrocybe splendidissima		X										
Hygrocybe virginea	X	X	X			X	X	X	X	X	X	X
Clavaria acuta												X
Clavaria fumosa										X		
Clavulinopsis helvola									X	X	X	
Clavulinopsis corniculata			X				X	X		X		
Clavulinopsis fusiformis		X										
Geoglossum cookeanum									X			
Geoglossum fallax			X				X	X	X	X	X	X
Geoglossum umbratile							X					
Glutinoglossum glutinosum	X		X				X					
Trichoglossum hirsutum			X		X			X	X	X		
OTHER FUNGI SPECIES												
Agaricus sp.									X			
Bovista plumbea									X			
Conocybe sp.		X					X		X	X		
Coprinus commatus									X			
Cordyceps militaris		X	X				X		X			X
Cystoderma amianthinum	X	X					X	X	X	X	X	X
Deconica coprophila								X	X	X		
Entoloma sericellum										X		
Entoloma sp.							X			X	X	
Galerina sp.	X		X		X	X	X	X	X	X	X	X
Laccaria laccata					X							
Lichenomphalina umbellifera										X		
Lycoperdon nigrescens		X					X		X	X	X	
Mycena sp.			X			X	X		X	X		X
Naucoria sp.					X							
Panaeolus papilionaceus										X		
Panaeolus sp.					X		X	X		X		X
Psilocybe semilanceata							X	X	X	X		X
Pseudoclitocybe cyathiformis					X							
Rickenella fibula										X		
Stropharia semiglobata					X			X	X	X	X	
Tremella mesenterica										X		

Appendix 2. Photographs of selected species



Photograph 1. *Hygrocybe acutoconica:* Blackening Waxcap (27 Sept 2019).



Photograph 2. *Hygrocybe calciphila:* Limestone Waxcap (14 October 2019).



Photograph 3. *Hygrocybe calyptriformis:* Pink Waxcap (27 September 2019).



Photograph 4. *Hygrocybe cantharellus:* Goblet Waxcap (11 October 2019). A damaged specimen, but confirmed by microscopy.



Photograph 5. *Hygrocybe ceracea:* Butter Waxcap (5 November 2019).



Photograph 6. *Hygrocybe chlorophana:* Golden Waxcap (26 September 2019).



Photograph 7. *Hygrocybe citrinovirens:* Citrine Waxcap (10 October 2019).



Photograph 8. *Hygrocybe conica:* Blackening Waxcap (26 September 2019).



Photograph 9. *Hygrocybe flavipes:* Yellow-foot Waxcap. (26 September 2019). Damaged specimen.



Photograph 10. *Hygrocybe glutinipes*: Glutinous Waxcap (10 October 2019).



Photograph 11. *Hygrocybe helobia*: Garlic Waxcap. (This photo was taken during the botanical survey on 2 July 2019).



Photograph 12. *Hygrocybe insipida*: Spangle Waxcap (10 October 2019).



Photograph 13. *Hygrocybe intermedia*: Fibrous Waxcap (26 September 2019).



Photograph 14. *Hygrocybe irrigata*: Slimy Waxcap (10 October 2019).



Photograph 15. *Hygrocybe lacmus*: Grey Waxcap (5 November 2019).



Photograph 16. *Hygrocybe laeta*: Heath Waxcap (10 October 2019).



Photograph 17. *Hygrocybe miniata*: Vermillion Waxcap (10 October 2019).



Photograph 18. *Hygrocybe mucronella*: Bitter Waxcap (5 November 2019).



Photograph 19. *Hygrocybe phaeococcinea*: Shadowed Waxcap (5 November 2019).



Photograph 20. *Hygrocybe pratensis*: Meadow Waxcap (14 October 2019).



Photograph 21. *Hygrocybe psittacina*: Parrot Waxcap (10 October 2019).



Photograph 22. *Hygrocybe quieta*: Oily Waxcap (26 September 2019).



Photograph 23. *Hygrocybe reidii*: Honey Waxcap (27 September 2019).



Photograph 24. *Hygrocybe russocoriacea*: Cedarwood Waxcap (5 November 2019).



Photograph 25. *Hygrocybe splendidissima*: Splendid Waxcap (14 October 2019).



Photograph 26. *Hygrocybe substrangulata* (10 October 2019).



Photograph 27. *Hygrocybe virginea*: Snowy Waxcap (14 October 2019).



Photograph 28. *Clavaria acuta*: Pointed Club (5 November 2019).



Photograph 29. *Clavaria fumosa*: Smoky Spindles (26 September 2019).



Photograph 30. *Clavulinopsis corniculata*: Meadow Coral (14 October 2019).



Photograph 31. *Clavulinopsis fusiformis*: Golden Spindles (10 October 2019).



Photograph 32. *Clavulinopsis helvola*: Yellow Club (10 October 2019).



Photograph 33. *Clavulinopsis luteoalba*: Apricot Club (26 September 2019).



Photograph 34. *Geoglossum fallax*: Deceptive Earthtongue (5 November 2019).

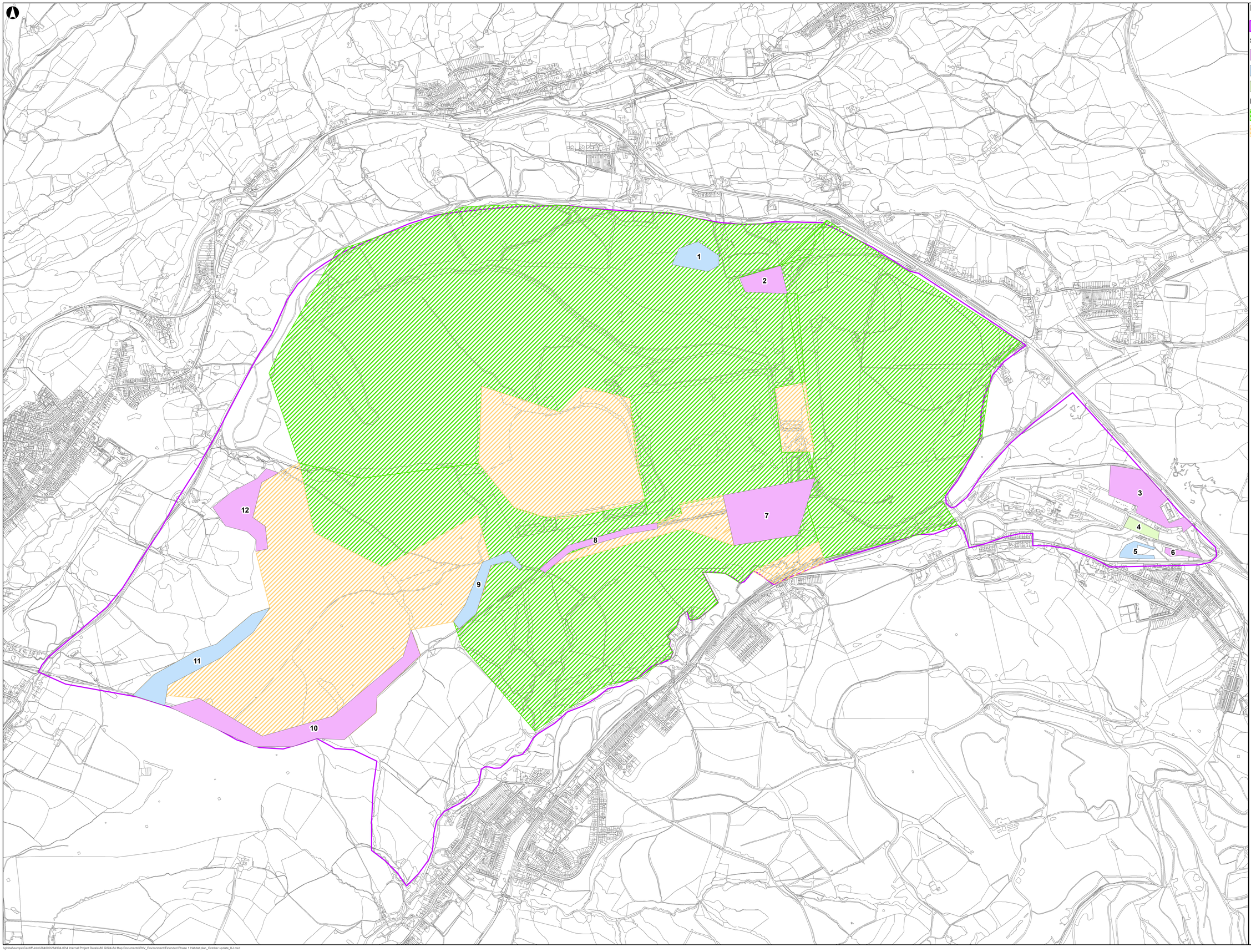


Photograph 32. *Geoglossum cookeanum* (5 November 2019).



Photograph 33. *Trichoglossum hirsutum*: Hairy Earthtongue (14 October 2019).

A1



Legend

- Study Area

Surveyed Areas

- Confirmed County Level
- Confirmed Local Level
- Cofirmed Negligible Level

Habitat Suitability

- Likely Low Level
- Likely Medium Level

Issue	Date	By	Chkd	Appd
F1	2019-11-20	KSJ	CP	NH

Metres
0 120 240 480

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Client

Welsh Government

Job Title

Global Centre for Rail Excellence

Habitat Suitability for Fungi

Scale at A1

1:9,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
2	F1

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Appendix 7D

Invertebrate Report



NANT HELEN AND ONLLWYN INVERTEBRATE SURVEY, MAY – SEPTEMBER 2019 - FINAL REPORT

David Boyce

DC Boyce
Ecologist
November 2019



1. INTRODUCTION

This report details the findings of an invertebrate survey carried out under contract to Arup. It aims to assess the importance for invertebrates of a large area of land lying to the north-east of Ystradgynlais, the location of which is shown on Figure 2.1. This land is in the ownership of Celtic Energy and comprises two blocks: the Onllwyn Washery, lying at the north-eastern end and to the south-west, a second much larger block centred on the Nant Helen opencast coal mine. For the sake of brevity, the site is hereafter referred to simply as 'Nant Helen'.

It is a very large site that straddles the border between the counties of Brecon and Glamorgan (Watsonian vice counties 42 and 41 respectively). A central grid reference approximates to SN818109. It includes parts of four Ordnance Survey 10km grid squares (hectads) namely: SN70, SN71, SN80 and SN81, with most of the area lying within the latter two hectads.

The Nant Helen block consists of the gently sloping ridge of Mynydd y Drum, which reaches a height of 298 metres and is oriented in a north-east to south-west direction. On its eastern margin, it runs down into the valley of the Afon Dulas. To the west, it is bounded by Cwm Tawe, falling to approximately 125 metres at its south-western extremity. All of this land lies in the catchment of the Afon Tawe, but much of the Onllwyn block drains north-east by way of Gors Llwyn into the Afon Pyrddin. Indeed, the fen habitat at WY10 and WY11 is the source of much of the water irrigating the very important soligenous wetland at Gors Llwyn, Onllwyn SSSI.

There are no statutory nature conservation designations covering the site. However, the Gors Llwyn, Onllwyn Site of Special Scientific Interest (SSSI) lies adjacent to its north-eastern boundary, being separated from it by the A4221 road. The SSSI has been notified fo its stands of fen and acid bog habitat, with the latter including a rather degraded area of raised mire. This block of wetland habitat is continued and fed by water from the very extensive area of wetland that occupies the northern part of the Onllwyn sub-site (units WY10 and WY11 on Figure 2.1). The vegetation in these two units is very diverse, including stands of transition mire, species-rich poor fen, marshy grassland and willow scrub. The areas of ungrazed transition mire in WY11 are of outstanding ecological interest, with a very high water table and a diverse plant assemblage that includes abundant water horsetail *Equisetum fluviatile*, marsh cinquefoil *Potentilla palustris*, bogbean *Menyanthes trifoliata* and bottle sedge *Carex rostrata*, plus frequent water mint *Mentha aquatica*, yellow loosestrife *Lysimachia vulgaris*, locally abundant devil's-bit scabious *Succisa pratensis* and a range of other wetland plants. This vegetation is referable to the S27 type of the National Vegetation Classification (NVC). Towards the central drainage line, the vegetation is at first transitional towards taller fen dominated by greater tussock-sedge *Carex paniculata*, slender sedge *Carex lasiocarpa* and common reed *Phragmites australis* and then to grey willow *Salix cinerea* carr.

On somewhat drier ground in WY11, the wet fen described in the preceding paragraph grades towards superb stands of species-rich fen-meadow with abundant rushes *Juncus* spp., common valerian *Valeriana officinalis*, ragged robin *Lychnis flos-cuculi*, southern marsh

orchid *Dactylorhiza praetermissa*, common sorrel *Rumex acetosella*, common vetch *Vicia sativa* and many other species.

WY10 has a mixture of very heavily grazed marshy and acid-neutral grassland and poor fen with shallow runnels. The latter areas are kept very open by the considerable pony grazing pressure and have a short, open sward of rushes, water mint, lesser spearwort *Ranunculus flammula* brooklime *Veronica beccabunga* and marsh lousewort *Pedicularis palustris*, with much bare, poached mud between the clumps of low vegetation. Runnels here have NVC M29-type vegetation dominated by floating mats of bog pondweed *Potamogeton polygonifolius* and emergent growth of marsh St. John's-wort *Hypericum elodes* and bulbous rush *Juncus bulbosus*.

In both WY10 and WY11, there are some more oligotrophic nuclei marked out by the appearance of frequent acidophiles such as common cottongrass *Eriophorum angustifolium* and bog-mosses *Sphagnum* spp. The northern edge of WY11 also has a large stand of rank, species-poor purple moor-grass *Molinia caerulea* bog, which is much less floristically diverse than the other wetland communities in this unit, though it does have a good population of marsh violet *Viola palustris*.

On the Nant Helen block, there are smaller stands of grazed mesotrophic fen in L2 and spring-fed soligenous mires in O2 and O3. These are dominated by a field layer of rushes over a ground layer of 'brown mosses' such as *Calliergon cuspidatum*, *Philonotis fontana* and *Scorpidium scorpioides*.

In addition to the fragments of acid mire vegetation within the Gors Llwyn complex, there is a very high-quality stand of acidic bog on the Nant Helen block, around the pools in survey unit B1. This has carpets of bog-mosses and bulbous rush *Juncus bulbosus* around pool margins, plus drier bog with tussocks of both common and hare's-tail cottongrass *Eriophorum vaginatum*, purple moor-grass, ling *Calluna vulgaris* and cross-leaved heath *Erica tetralix*. Similar vegetation is found on the edge of the pool at R1. Around the margins of the main block of unimproved moorland on Mynydd y Drum (primarily in units O1 and P1) there are numerous acid flushes with *Sphagna*, sharp-flowered rush *Juncus acutiflorus*, soft rush *J. effusus* and small sedges *Carex* spp., such as small yellow sedge *C. demissa*, star sedge *C. echinata* and carnation sedge *C. panicea*.

Across much of the actively worked area of the Nant Helen opencast workings and the Onllwyn Washery, there are areas of sparsely vegetated spoil generated as a result of the mining activity here. Similar habitats are also found locally along track edges through therecently felled coniferous forestry block in survey unit J1. The vegetation in these areas shows a characteristic post-disturbance succession. Initially, the bare ground is colonised by very sparse, rather species-poor growth of early-successional specialists such as coltsfoot *Tussilago farfara*.

Following this, more recognisable mesotrophic grassland with species such as bird's-foot trefoil *Lotus corniculatus*, red clover *Trifolium pratense*, common vetch *Vicia sativa*, tufted vetch *V. cracca*, common dog-violet *Viola riviniana*, hardheads *Centaurea nigra* and oxeye daisy *Lecanthemum vulgare* becomes established. In many places, these more mature

swards have a strong marshy grassland element, with frequent ragged robin, southern marsh-orchid, sedges and rushes. There is also a strong representation of ruderal specialists such as hop trefoil *Trifolium campestre*, lesser trefoil *Trifolium dubium* and black medick *Medicago lupulina* and at this stage, the sward is still short and open, with frequent patches of bare ground. On the Onllwyn Washery, there are unusually species-rich stands of ruderal grassland that have calcicolous species, such as kidney vetch *Anthyllis vulneraria*, ribbed melilot *Melilotus officinalis*, fairy flax *Linum catharticum*, glaucous sedge *Carex flacca* and bee orchid *Ophrys apifera*.

As the sward becomes a little more mature and the spoil is leached of nutrients, the vegetation in turn begins to be colonised by open-structured grass-heath, with increasing representation of acidophilous specialists such as ling, bell heather *Erica cinerea*, western gorse *Ulex gallii*, tormentil *Potentilla erecta*, wavy hair-grass *Deschampsia flexuosa*, common bent *Agrostis capillaris*, and sheep's fescue *Festuca ovina*. In time, this continues to mature towards fairly typical dry heath dominated by ling and bell heather, with abundant cushions of pleurocarpous mosses such as *Hylocomium splendens*, *Hypnum jutlandicum* and *Pleurozium schreberi* in the ground layer.

Along the valley of the Afon Dulas in units K3 and L2, there are stands of typical mesotrophic grassland referable to the NVC MG5 community in which there is a high density of herbs such as greater bird's-foot trefoil, red clover and hardheads. The latter unit has particularly rich stands of the relatively acidic MG5c sub-community in which there is abundant devil's-bit scabious and frequent betony *Stachys officinalis*.

At its south-western edge, the site includes a small part of the Wildlife Trust of South and West Wales' (WTSWW) Ystradfawr Nature Reserve. Much of this has high-quality marshy grassland (known in Wales as rhôs pasture), which supports an important population of the marsh fritillary butterfly *Euphydryas aurinia*. However, the small area of the Reserve lying within the Nant Helen site comprises woodland and dry grassland that is unsuitable for the butterfly.

Though there are large expanses of marshy grassland at Nant Helen (especially in units H1, L3, N4 and O1), these have been degraded by drainage, burning and other forms of agricultural 'improvement'. As a result, they are, for the most part, species-poor and dominated by a few grasses such as bents *Agrostis* spp., purple moor-grass, tufted hair-grass *Deschampsia cespitosa* and soft rush.

The plateau of Mynydd y Drum (unit P1) also has some extensive areas of species-poor rush-pasture and *Molinia* grassland, as well as large areas of unimproved acid grassland (NVC U4, U5 and U6 communities) dominated by common bent, sheep's fescue, mat grass *Nardus stricta* and heath rush *Juncus squarrosus*. There is also a little bilberry *Vaccinium myrtillus* and ling in the sward, but growth of Ericaceous dwarf-shrubs here is strongly suppressed by heavy grazing pressure from cattle, ponies and sheep. Around the fringes of unit P1, as elsewhere on Nant Helen, a feature of stands of unimproved grassland is the abundance of yellow meadow ant *Lasius flavus* nest mounds, indicating the grassland has been subject to very little recent disturbance.

Woodland habitats are generally not well represented on Nant Helen. The most important areas are the wood-pasture in unit G1 and the small stands of semi-natural ash *Fraxinus excelsior* – sessile oak *Quercus petraea* woodland on the steep sides of the Nant Ystalwyn (unit K1) and nearby slopes above the Afon Dulas (unit K2). The steeply sloping gulley in unit N1 also has a small area of sessile oak woodland. Unit K2 also has stands of flushed wet woodland with a low sub-canopy of grey willow and alder *Alnus glutinosa*. Around springs here, the ground and field layers have typical wetland species such as hemlock water-dropwort *Oenanthe crocata* and opposite-leaved golden-saxifrage *Chrysosplenium oppositifolium* and there are also dripping bryophyte-covered rock faces here. Elsewhere, there are numerous small stands of willow carr, with the most siginificant areas being in units H1, I1 and WY11.

The area of wood-pasture in unit G1 have a mix of open-grown mature to over-mature sessile oak and ash with scattered rowan *Sorbus aucuparia*, hawthorn *Crataegus monogyna*, grey willow, alder and hazel *Corylus avellana*. The old trees here have well-developed dead wood (saproxylic) habitat features, such as heart rot, fallen branches and saproxylic fungi. Open areas between the trees here have stands of unimproved marshy or dry acid grassland with the latter having paticualrly well-developed anthills. An additional feature of this unit and I1 to the south is the presence of small streams with waterfalls.

The less recently disturbed areas of mine workings on Nant Helen have open scrub in which grey willow and downy birch *Betula pubescens* are the most frequent constituents, with some hawthorn, blackthorn *Prunus spinosa* alder and hazel, as well as patches of broom *Cytisus scoparius*, European gorse *Ulex europaeus* and bramble *Rubus fruticosus*.

2. METHODS

Survey work in 2019 was undertaken in four blocks spaced out over the period from spring till early-autumn, with the timing of the visits aiming to collect samples across most of the peak period for adult invertebrate activity. For example, the May session coincided with the main flight period of the dingy skipper butterfly and the June visit with that of the marsh fritillary butterfly. A preliminary visit was made on the 10th of May in order to undertake a walk-over of as much of the site as possible and also to receive a site induction setting out required safe working practices on the site. Because it was a large site, it was not feasible to survey the whole area in detail for invertebrates. Rather, by using the results of the initial walkover, the range of invertebrate habitats present on the site could be identified and it was then possible to prioritise those areas where more detailed invertebrate surveys would be undertaken during subsequent visits. The first sampling session was carried out from the 13th till the 16th of May, with the following three visits being on the 17th to 20th of June, 8th till 11th of July and the 4th to the 7th of September.

The main emphasis for more detailed invertebrate surveys was on those habitats likely to have the greatest invertebrate interest (eg. species-rich fen; acid bogs and bog pools; marshy grassland; species-rich neutral grassland; short, ruderal vegetation; semi-natural woodland with dead wood features). Other less promising habitat types (eg. species-poor semi-improved grassland; young secondary scrub; coniferous plantations) were also surveyed in less detail, with the aim being to ensure complete coverage of the whole range of main invertebrate habitats represented across the site.

In addition to general spot-searching techniques, some more specialised sampling methods were used to ensure all potentially important habitat features were sampled effectively. Grassland, wetland and ruderal vegetation was mostly sampled by sweeping the vegetation with a heavy-duty entomological sweep net and tapping tall herbaceous plants over a white plastic tray. Ground-active invertebrates in grass tussocks and litter were sampled by shaking them out over a white plastic tray. Aquatic habitats were either sampled with a pond net or, in shallow margins, with a sieve. Additionally, moth-trapping using an actinic light trap was undertaken on the June, July and September sampling sessions.

Where subsequent microscopic examination was required in order to ensure an accurate identification, specimens were collected into tubes with either ethyl acetate or iso-propyl alcohol. Subsequently, all samples were identified down to species level. A range of invertebrate groups have been covered, with a full checklist of all species identified given in Table 3.1. The choice of invertebrate taxa collected for identification to species level focused on those groups known to include a high proportion of specialists associated with the habitats present on the site. For example dragonflies and damselflies, rove beetles (Coleoptera: Staphylinidae), craneflies (Diptera: Tipuloidea) and money spiders (Araneae: Linyphiidae) were key groups collected in wetland and wet woodland habitats; ground beetles (Coleoptera: Carabidae), phytophagous beetles (Coleoptera: Chrysomelidae and Curculionoidea) and butterflies (Lepidoptera: Rhopalocera) were sampled in ruderal grassland habitats and dead wood invertebrates in the area of wood-pasture.

For the purposes of this study, a series of survey units have been identified. These largely follow the boundaries of distinct areas of habitat, though in the case of some large homogeneous areas of disturbed ground with sparse, ruderal vegetation within the active opencast area (units C1, D1 and E1) they have been further sub-divided. These survey units are shown on Figure 2.1 below.

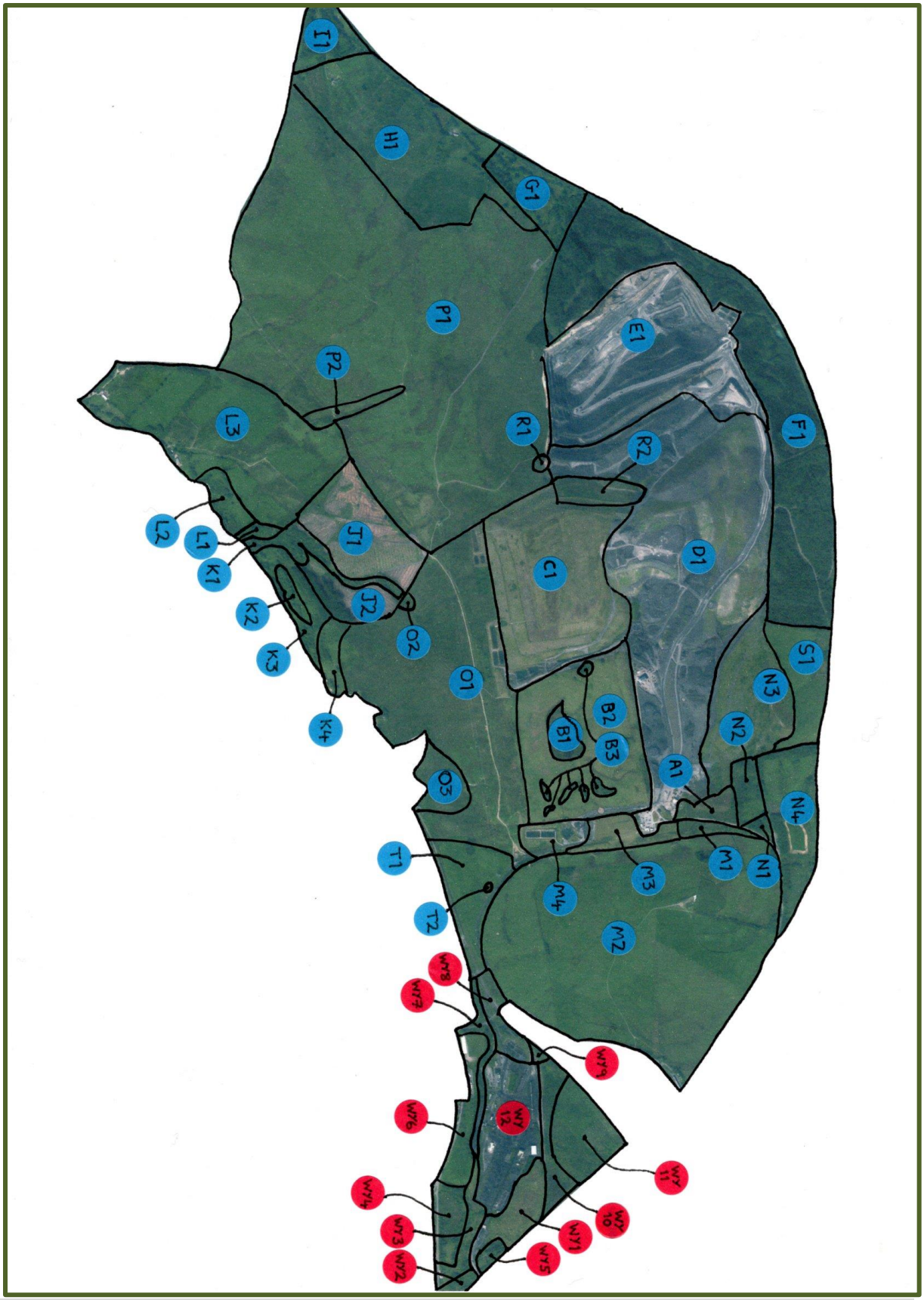

Figure 2.1. Location of invertebrate survey units at Nant Helen and Onllwyn, 2019

3. RESULTS

Table 3.1 below gives a checklist of all the invertebrates recorded during the fieldwork in 2019. Following this, sub-section 3.1 lists all of those with a formal conservation status that are regarded as key species when assessing the importance of the site for invertebrates. In sub-section 3.2, this list of key species is used to produce a list of key habitat features for invertebrates at Nant Helen. Key habitats are defined here as being those that support at least one of the key species identified in sub-section 3.1.

The codes in the final column of Table 3.1 refer to the survey units in which species were recorded in 2019. The location of these survey units is shown on Figure 2.1 above. Note that the record of scarce blue-tailed damselfly *Ischnura pumilio* from unit R1 is entered with a question mark. This record relates to probable larvae of this species and should be regarded as provisional pending identification of adults, because larvae are very difficult to reliably separate with cetainty from the common blue-tail *I. elegans*.

The emboldened status categories given in the third column of Table 3.1 and also after the scientific name in sub-section 3.1 refer to those species having a formal rarity/threat status ascribed to them by the UK government conservation agencies. These are defined as follows:

NT - IUCN UK Red List, Near Threatened. A taxon is Near Threatened when it has been evaluated against the IUCN criteria and does not currently qualify for Critically Endangered, Endangered or Vulnerable status, but is close to qualifying, or is likely to do so soon.
RDB2 – Red Data Book Category 2 – Vulnerable. Taxa which are known from 15 or fewer 10 km squares of the National Grid and which are decreasing and will become endangered in the near future if the causal factors continue operating.
RDB3 – Red Data Book Category 3 - Rare. Taxa with small populations that are not at present Endangered or Vulnerable, but are at risk.
S7 – Species of Principal Importance for the maintenance and enhanement of biodiversity in Wales that are listed in Section 7 of the Environment (Wales) Act, 2016.
Na – Nationally Scarce Category A. Taxa thought to occur in between 30 to 16 10 km squares of the National Grid.
Nb – Nationally Scarce Category B. Taxa thought to occur in between 30 and 100 10 km squares of the National Grid.
N – Nationally Scarce. Taxa which are estimated to occur within the range of 16 to 100 10km squares, but where division into Na or Nb status has not been attempted due to limited availability of information on British distribution. Second status review not yet completed and status therefore taken from first review.
NS – Nationally Scarce. In more recent second status reviews, the Na and Nb sub-divisions have been subsumed into a single category covering species occurring in 16 to 100 10km squares of the National Grid. Unlike the previous 'N' category, which covered the same range, the amalgamation does not necessarily result from inadequate information on the British distribution.
pNS – Provisional Nationally Scarce. The rove beetles *Hadrognathus longipalpis* and *Zyras collaris* will almost certainly be accorded Nationally Scarce status in the forthcoming Review of this group, but they have no formal conservation status currently.

Table 3.1. Checklist of invertebrates recorded at Nant Helen and Onllwyn, 2019			
Species scientific name	**Species English name**	**Status**	**Survey units**
Acroloxus lacustris	Lake limpet		L2
Deroceras reticulatum	Netted field slug		E1,J1,N3,O1
Deroceras laeve	Marsh slug		J1,O2,WY2,11
Arion ater	Large black slug		J1,K3,N3,O3,R2,WY9,11
Arion subfuscus agg.	Dusky slug		N3
Arion intermedius	Hedgehog slug		R2,WY11
Cochlicopa lubrica	Slippery moss snail		WY11
Euconulus alderi	A Euconulid snail		O2,WY11
Euconulus fulvus	A Euconulid snail		J1
Zonitoides excavatus	Hollowed glass snail		J1
Zonitoides nitidus	Shiny glass snail		WY11
Arianta arbustorum	Copse snail		WY11
Cepaea hortensis	White-lipped snail		WY2
Cepaea nemoralis	Brown-lipped snail		J1,K3,WY1,9,11
Lehmannia marginata	Tree slug		E1,K1
Galba truncatula	Dwarf pond snail		L2,WY10,11
Lymnaea palustris agg.	Marsh pond snail		L2,WY10,11
Radix balthica	Wandering pond snail		L2
Aegopinella nitidula	Dull glass snail		WY11
Aegopinella pura	Delicate glass snail		J1,WY11
Oxychilus alliarius	Garlic snail		A1,K1
Nesovitrea hammonis	Rayed glass snail		A1,L2,M1,N3,O2,WY11
Gyraulus crista	Nautilus ram's-horn snail		L2
Succinea putris	Large amber snail		WY10,11
Lestes sponsa	Common emerald damselfly		K3,R1,WY11
Pyrrhosoma nymphula	Large red damselfly		B1,WY2,11

Coenagrion puella	Azure damselfly		WY1,10
Enallagma cyathigerum	Common blue damselfly		B1,R1
Ischnura pumilio	Scarce blue-tailed damselfly	**NT.**	R1?,WY10
Cordulegaster boltonii	Golden-ringed dragonfly		H1
Libellula depressa	Broad-bodied chaser		WY11
Libellula quadrimaculata	Four-spotted chaser		B1,WY1,10,11
Orthetrum cancellatum	Black-tailed skimmer		WY1
Orthetrum coerulescens	Keeled skimmer dragonfly		WY10
Sympetrum danae	Black darter dragonfly		WY10
Sympetrum striolatum	Common darter dragonfly		G1,J1,L2,WY1,10
Coconcephalus discolor	Long-winged conehead		L2
Omocestus viridulus	Common green grasshopper		G1,H1,K3,WY1,2,9,11
Chorthippus brunneus	Field grasshopper		G1,J1,R2,WY3,9,10
Chorthippus parallelus	Meadow grasshopper		G1,H1,J1,L1,M1,O2,R2,WY3,11
Myrmeleotettix maculatus	Mottled grasshopper		R2
Forficula auricularia	Common earwig		G1,K1,N4,WY2
Acanthosoma haemorrhoidale	Hawthorn shieldbug		G1,L2,N4
Elasmucha grisea	Parent bug		K1
Dolycoris baccarum	Hairy shieldbug		E1,WY11
Palomena prasina	Common green shieldbug		J1
Pentatoma rufipes	Forest shieldbug		G1,N4,WY1
Picromerus bidens	Spiked shieldbug		J1
Piezodorus lituratus	Gorse shieldbug		WY10
Rhacognathus punctatus	Heather shieldbug		B1
Troilus luridus	Bronze shieldbug		L2
Zicrona caerulea	Blue shieldbug		B1,WY2,10
Eurygaster testudinaria	Tortoise shieldbug		L2,WY10,11
Pachybrachius fracticollis	A ground bug		B1,L2,WY10,11

Peritrechus geniculatus	A ground bug		N3
Scolopstethus decoratus	A ground bug		A1,L2,WY9
Stygnocoris sabulosus	A ground bug		J1,R2,WY3
Trapezonotus desertus	A ground bug		A1
Pithanus maerkeli	A Mirid bug		J1,K3,N3,WY1,3
Dictyla convergens	A lacebug		WY10
Tingis ampliata	Creeping thistle lacebug		WY2,10
Tingis cardui	Spear thistle lacebug		WY10
Hebrus ruficeps	A Hebrid water bug		L2,O2,WY11
Microvelia reticulata	A Microveliid water bug		R1
Gerris lacustris	A pond skater		R1
Nepa cinerea	Water scorpion		R1,WY10
Ranatra linearis	Water stick insect		R1
Ilyocoris cimicoides	Saucer bug		R1
Plea minutissima	A Pleid water boatman		R1
Hespercorixa castanea	A water boatman		R1
Sigara scotti	A water boatman		R1
Chartoscirta cincta	A shore bug		O3
Livia juncorum	A Psyllid bug		L2
Cercopis vulnerata	Red-and-black froghopper		WY10
Gyrinus substriatus	A whirligig beetle		R1
Agabus sturmii	A diving beetle		R1
Agabus bipustulatus	A diving beetle		L2,R1,WY10
Agabus paludosus	A diving beetle		WY10
Ilybius aenescens	A diving beetle		R1
Ilybius ater	A diving beetle		R1
Ilybius fuliginosus	A diving beetle		L2
Dytiscus semisulcatus	A great diving beetle		WY10

Hydroporus gyllenhalii	A diving beetle		R1
Hydroporus obscurus	A diving beetle		R1
Hydroporus pubescens	A diving beetle		R1
Hygrotus inaequalis	A diving beetle		R1
Nebria salina	A ground beetle		D1,R2
Carabus problematicus	A ground beetle		J1
Cicindela campestris	Green tiger beetle		E1,J1
Elaphrus cupreus	A ground beetle		P2,WY10
Bembidion tibiale	A ground beetle		K3
Bembidion genei	A ground beetle		E1
Bembidion mannerheimii	A ground beetle		N4
Ocys harpaloides agg.	A ground beetle		K1
Abax parallelepipedus	A ground beetle		G1
Poecilus cupreus	A ground beetle		P1
Pterostichus vernalis	A ground beetle		E1
Pterostichus diligens	A ground beetle		B1,O3,WY11
Pterostichus niger	A ground beetle		E1,N3
Pterostichus rhaeticus	A ground beetle		B1,L2,O3,WY11
Pterostichus madidus	A ground beetle		L2
Amara plebeja	A ground beetle		B1
Amara aenea	A ground beetle		N3
Amara lunicollis	A ground beetle		N3
Bradycellus harpalinus	A ground beetle		A1,J1
Bradycellus ruficollis	A ground beetle		A1
Olisthopus rotundatus	A ground beetle		A1,N3
Agonum marginatum	A ground beetle		WY10
Agonum fuliginosum	A ground beetle		O3
Agonum gracile	A ground beetle		B1,O3,P2,WY10

Agonum thoreyi	A ground beetle		WY11
Agonum emarginatum	A ground beetle		O3
Agonum viduum	A ground beetle		L2,N4,P2,WY10
Paranchus albipes	A ground beetle		I1
Dromius quadrimaculatus	A ground beetle		G1
Paradromius linearis	A ground beetle		WY3,11
Philorhizus melanocephalus	A ground beetle		WY11
Helophorus flavipes	A water beetle		R1
Hydrobius fuscipes	A water beetle		O3
Chaetarthria simillima	A water beetle	**NS.**	L2
Anacaena globulus	A water beetle		N1,WY10,11
Anacaena lutescens	A water beetle		R1
Enochrus testaceus	A water beetle		L2
Helochares punctatus	A water beetle	**NS.**	R1
Coelostoma orbiculare	A water beetle		L2,O2,O3
Catops kirbyi	A Leiodid beetle		N1
Leptinus testaceus	A Leiodid beetle		N1
Dropephylla ioptera	A rove beetle		G1
Eusphalerum torquatum	A rove beetle		WY1,2
Hadrognathus longipalpis	A rove beetle	**pNS.**	A1,M1,R2
Lesteva sicula	A rove beetle		G1,N1
Philorinum sordidum	A rove beetle		J1,N3
Megarthrus depressus	A rove beetle		N1
Proteinus brachypterus	A rove beetle		N1
Brachygluta fossulata	A rove beetle		O3
Bryaxis bulbifer	A rove beetle		O3,WY11
Bryaxis curtisii	A rove beetle		O3
Phloeocharis subtilissima	A rove beetle		K1

Sepedophilus nigripennis	A rove beetle		WY3
Tachyporus nitidulus	A rove beetle		WY1
Tachyporus dispar	A rove beetle		N3,WY1
Mycetoporus longulus	A rove beetle		J1
Mycetoporus rufescens	A rove beetle		A1
Lordithon trinotatus	A rove beetle		G1
Ocyusa picina	A rove beetle		WY11
Oxypoda vittata	A rove beetle		N1
Cypha laeviuscula	A rove beetle		A1
Myllaena brevicornis	A rove beetle		B1
Myllaena intermedia	A rove beetle		L2,O3
Myllaena minuta	A rove beetle		B1
Leptusa fumida	A rove beetle		K1
Leptusa ruficollis	A rove beetle		G1,K1
Agaricochara latissima	A rove beetle		G1,K1
Hygronoma dimidiata	A rove beetle		P2,WY11
Amischa analis	A rove beetle		A1,WY3
Amischa cavifrons	A rove beetle		O3
Atheta aquatica	A rove beetle		N1
Atheta crassicornis	A rove beetle		K2
Atheta indubia	A rove beetle		N3
Atheta obtusangula	A rove beetle		B1
Zyras collaris	A rove beetle	**pNS.**	WY11
Oxytelus laqueatus	A rove beetle		WY10
Carpelimus corticinus	A rove beetle		N3
Dianous coerulescens	A rove beetle		I1
Stenus impressus	A rove beetle		A1,J1,L1,N3,O3,R2
Stenus ossium	A rove beetle		A1,E1,J1,R2,WY1

Stenus cicindeloides	A rove beetle		L2,WY2,10,11
Stenus fulvicornis	A rove beetle		J1
Stenus latifrons	A rove beetle		L2,O2,O3,WY10,11
Stenus bifoveolatus	A rove beetle		WY10
Stenus binotatus	A rove beetle		R1
Stenus tarsalis	A rove beetle		O2,WY10
Stenus flavipes	A rove beetle		B1
Stenus nitidiusculus	A rove beetle		L2,O2,O3,WY11
Stenus picipennis	A rove beetle		L2,O2,O3
Stenus boops	A rove beetle		L2
Stenus clavicornis	A rove beetle		WY10
Stenus juno	A rove beetle		O3,WY11
Stenus melanarius	A rove beetle		WY10
Stenus nitens	A rove beetle		O3
Stenus providus	A rove beetle		B1,L2,O3
Stenus brunnipes	A rove beetle		A1,J1
Euaesthetus laeviusculus	A rove beetle	**pNS.**	O2
Euaesthetus ruficapillus	A rove beetle		O3,WY11
Lathrobium fulvipenne	A rove beetle		B1
Tetartopeus terminatus	A rove beetle		B1,I1,L2,WY11
Octhephilum fracticorne	A rove beetle		B1,O2,O3,WY11
Paederus riparius	A rove beetle		L2
Quedius maurus	A rove beetle		N1
Quedius fuliginosus	A rove beetle		O3,WY11
Quedius molochinus	A rove beetle		WY11
Quedius maurorufus	A rove beetle		O3,WY11
Quedius nitipennis	A rove beetle		E1
Quedius plancus	A rove beetle	**Na.**	I1

Bisnius puella	A rove beetle		H1
Philonthus albipes	A rove beetle		H1
Philonthus cognatus	A rove beetle		R2
Philonthus nigrita	A rove beetle		B1,WY11
Philonthus tenuicornis	A rove beetle		H1
Philonthus varians	A rove beetle		H1,R2
Gabrius breviventer	A rove beetle		WY1
Melinopterus sphacelatus	A dung beetle		O1
Hoplia philanthus	A chafer beetle		WY1
Odeles marginata	A marsh beetle		I1,J1
Contacyphon hilaris	A marsh beetle		B1,O2WY11
Contacyphon padi	A marsh beetle		B1,O3,WY11
Contacyphon variabilis	A marsh beetle		B1
Agriotes acuminatus	A click beetle		G1
Agriotes obscurus	A click beetle		M1,N3,WY1
Agriotes pallidulus	A click beetle		H1
Dalopius marginatus	A click beetle		G1,H1
Athous haemorrhoidalis	A click beetle		G1,WY10
Actenicerus sjaelandicus	A click beetle		O2,WY10
Aplotarsus incanus	A click beetle		B1,G1
Prosternon tessellatum	A click beetlle		G1
Zorochros minimus	A click beetle		E1
Cantharis cryptica	A soldier beetle		H1
Cantharis decipiens	A soldier beetle		G1,N3
Cantharis flavilabris	A soldier beetle		N3,O2
Cantharis pallida	A soldier beetle		M1
Cantharis rufa	A soldier beetle		L1
Rhagonycha fulva	A soldier beetle		H1,K3,WY1

Rhagonycha lignosa	A soldier beetle		G1
Rhagonycha nigriventris	A soldier beetle		G1,L1
Silis ruficollis	A soldier beetle		WY10
Malthodes marginatus	A soldier beetle		G1
Elateroides dermestoides	A Lymexylid beetle		J1
Biphyllus lunatus	A Biphyllid beetle		G1
Telmatophilus typhae	A Cryptophagid beetle		WY2,10
Cryptophagus dentatus	A Cryptophagid beetle		G1
Cryptophagus ruficornis	A Cryptophagid beetle	**N.**	G1
Micrambe ulicis	A Cryptophagid beetle		J1,N3,WY2
Psammoecus bipunctatus	A Silvanid beetle		WY11
Kateretes rufilabris	A Kateretid pollen beetle		J1,K1,L2,WY1
Epuraea distincta	A Nitidulid beetle	**Na.**	WY11
Meligethes aeneus	A pollen beetle		WY9
Meligethes atratus	A pollen beetle		H1
Meligethes brunnicornis	A pollen beetle		WY2
Meligethes carinulatus	A pollen beetle		J1,N3,WY11
Meligethes flavimanus	A pollen beetle		H1,J1,N3,WY10
Coccidula rufa	A ladybird		K3,L2,P2,WY10,11
Rhyzobius litura	A ladybird		J1,M1,N3,WY10
Chilocorus renipustulatus	Kidney-spot ladybird		B1,3,K1,N4
Aphidecta obliterata	Larch ladybird		G1,K1
Adalia decempunctata	10-spot ladybird		G1,K1,N4,WY11
Coccinella septempunctata	7-spot ladybird		E1,G1,J1,WY1,3,11
Harmonia axyridis	Harlequin ladybird		K1,M1,WY2,10
Propylea quattuordecimpunctata	14-spot ladybird		N3,WY1
Calvia quattuordecimguttata	Cream-spot ladybird		K1,N4
Litargus connexus	A fungus beetle		G1

Cis boleti	A Ciid beetle		N4
Cis festivus	A Ciid beetle	**Nb.**	K1
Cis vestitus	A Ciid beetle		G1
Ennearthron cornutum	A Ciid beetle		G1
Orchesia micans	A false darkling beetle	**NS.**	K1
Orchesia minor	A false darkling beetle	**NS.**	G1
Orchesia undulata	A false darkling beetle		K1
Mordellistena pumila	A Mordellid beetle		WY11
Oedemera lurida	An Oedemerid beetle		J1,M1,WY1,3,11
Oedemera nobilis	An Oedemerid beetle		WY3
Salpingus planirostris	A Salpingid beetle		G1,L2,N4
Rhagium bifasciatum	A longhorn beetle		J1
Grammoptera ruficornis	A longhorn beetle		G1
Tetrops praeustus	A longhorn beetle		G1
Donacia versicolorea	A reed beetle		R1,WY10
Plateumaris discolor	A reed beetle		B1,K3,L2,O2
Plateumaris rustica	A reed beetle	**NS.**	WY11
Bruchidius varius	A seed beetle		WY1
Bruchidius villosus	A seed beetle		WY1
Cassida flaveola	A tortoise beetle		L2,O2
Cassida rubiginosa	Thistle tortoise beetle		WY2
Cassida vibex	Knapweed tortoise beetle		WY1
Cassida viridis	A tortoise beetle		WY2,11
Chrysolina polita	A leaf beetle		K3,L2,WY2,10,11
Chrysolina brunsvicensis	A leaf beetle		WY10
Chrysolina hyperici	A leaf beetle		WY1
Gastrophysa viridula	Dock leaf beetle		WY1,3,10,11
Phaedon armoraciae	A leaf beetle		P2,WY10

Phaedon cochleariae	A leaf beetle		WY2
Prasocuris glabra	A leaf beetle		WY10
Prasocuris marginella	A leaf beetle		K3,P2,WY10
Prasocuris junci	A leaf beetle		WY10
Prasocuris phellandrii	A leaf beetle		K3
Gonioctena olivacea	A leaf beetle		WY1
Luperus longicornis	A leaf beetle		B3,WY11
Galerucella calmariensis	A leaf beetle		WY11
Galerucella pusilla	A leaf beetle		K1
Galerucella tenella	A leaf beetle		WY11
Lochmaea caprea	A leaf beetle		J1,M1,WY1,4,11
Lochmaea crataegi	A leaf beetle		G1
Lochmaea suturalis	Heather beetle		A1,N3,R2
Luperus longicornis	A leaf beetle		WY11
Sphaeroderma testaceum	A flea beetle		WY1,2
Mantura rustica	A flea beetle	**NS.**	WY11
Crepidodera fulvicornis	A flea beetle		B1,3,J1,K1,M1,WY11
Psylliodes laticollis	A flea beetle		WY2
Aphthona euphorbiae	A flea beetle		WY1
Neocrepidodera transversa	A flea beetle		J1,L1,L2,N3,WY1,3
Hippuriphila modeeri	A flea beetle		WY11
Longitarsus holsaticus	A flea beetle		WY10
Phyllotreta atra	A flea beetle		WY2
Temnocerus nanus	A Rhynchitid beetle		B3,M1,WY11
Caenorhinus mannerheimii	A Rhynchitid weevil		B1
Apion haematodes	A weevil		L1
Apion rubens	A weevil		N3
Perapion curtirostre	A weevil		J1,K3,N3,O2,WY1,3

Perapion hydrolapathi	A weevil		WY1
Perapion marchicum	A weevil		J1,K3
Exapion ulicis	A weevil		J1,N3
Catapion seniculus	A weevil		WY1
Eutrichapion ervi	A weevil		K3,WY3,9
Eutrichapion viciae	A weevil		WY9
Ischnopterapion loti	A weevil		WY3
Ischnopterapion modestum	A weevil		J1,K3,L2,WY10,11
Protapion apricans	A weevil		J1,K3,WY1,3
Protapion assimile	A weevil		WY1
Protapion filirostre	A weevil	**Nb.**	WY
Protapion nigritarse	A weevil		N3,WY1
Protapion trifolii	A weevil		WY1,3
Nanophyes marmoratus	A weevil		WY11
Stenopelmus rufinasus	A weevil		R1
Limnobaris dolorosa	A weevil		WY11
Anoplus plantaris	A weevil		B1
Anthonomus brunnipennis	A weevil	**Nb.**	N3
Anthonomus pedicularius	A weevil		G1,N3,N4
Cionus hortulanus	A figwort weevil		WY2
Cionus scrophulariae	A figwort weevil		WY2
Archarius salicivorus	A weevil		WY11
Dorytomus rufatus	A weevil		K1
Gymnetron beccabungae	A weevil	**Nb.**	L2
Gymnetron veronicae	A weevil	**Nb.**	WY10
Mecinus labilis	A weevil		WY3
Mecinus pascuorum	A weevil		J1,WY1,3
Mecinus pyraster	A weevil		WY3

Rhamphus pulicarius	A weevil		M1,WY11
Tychius picirostris	A weevil		J1,WY1
Bagous lutulentus	A weevil	**Nb.**	WY11
Amalorrhynchus melanarius	A weevil		WY2
Coeliodinus rubicundus	A weevil		B1
Microplontus campestris	A weevil	**Nb.**	WY1
Mogulones asperifoliarum	A weevil		WY1
Poophagus sisymbrii	A weevil		WY2
Trichosirocalus troglodytes	A weevil		WY1,3
Pelenomus waltoni	A weevil	**Nb.**	N3
Rhinoncus perpendicularis	A weevil		WY11
Rhinoncus pericarpius	A weevil		WY11
Strophosoma melanogrammum	A weevil		G1,K1
Phyllobius argentatus	A weevil		N4
Phyllobius glaucus	A weevil		N4
Phyllobius roboretanus	A weevil		B1
Phyllobius pyri	A weevil		B1,G1,J1
Polydrusus formosus	A weevil	**Na.**	WY11
Polydrusus pilosus	A weevil		N4
Polydrusus pterygomalis	A weevil		G1,N4
Andrion regensteinense	A weevil		WY1
Coelositona cambricus	A weevil		L2,WY10
Sitona lineatus	A weevil		WY10
Sitona obsoletus	A weevil		WY1
Sitona striatellus	A weevil		J1,WY1
Sitona suturalis	A weevil		K3,WY3,11
Brachypera zoilus	A weevil		N3
Hypera nigrirostris	A weevil		WY1,3

Hypera plantaginis	A weevil		J1
Hypera postica	A weevil		WY1
Hypera venusta	A weevil		N3
Magdalis carbonaria	A weevil	**Nb.**	N4
Hylesinus varius	A bark beetle		G1
Scolytus intricatus	A bark beetle		G1
Sialis lutaria	An alderfly		B1
Korscheltellus lupulina	Common swift moth		N3,WY1
Korscheltellus fusconebulosa	Map-winged swift moth		B1,M1
Pandemis heparana	Dark fruit-tree tortrix moth		M1
Bembecia ichneumoniformis	6-belted clearwing moth	**Nb.**	WY3
Zygaena trifolii	5-spot burnet moth		H1,L2,WY3,11
Erynnis tages	Dingy skipper butterfly	**S7.**	E1,J1,N3,WY1
Thymelicus sylvestris	Small skipper		H1,K3,WY1
Ochlodes sylvanus	Large skipper		H1,O1,WY1,3,9
Anthocharis cardamines	Orange tip butterfly		E1,G1,J1,N3
Pieris brassicae	Large white butterfly		WY2
Pieris rapae	Small white butterfly		WY3
Pieris napi	Green-veined white butterfly		G1,H1,J1,K3,N3,O2,WY2,11
Gonepteryx rhamni	Brimstone butterfly		WY3
Pararge aegeria	Speckled wood butterfly		G1,J1,N3
Coenonympha pamphilus	Small heath butterfly	**S7.**	J1,N3,O2,WY1,3
Aphantopus hyperantus	Ringlet butterfly		O1,WY1,9
Maniola jurtina	Meadow brown butterfly		B3,L1,O1,WY1,2
Hipparchia semele	Grayling butterfly	**S7.**	WY3
Boloria selene	Small pearl-bordered fritillary	**S7.**	WY1
Argynnis aglaja	Dark green fritillary butterfly		WY1
Vanessa atalanta	Red admiral butterfly		G1,L2,WY3

Vanessa cardui	Painted lady butterfly		H1,J1,R2,WY3,10
Aglais io	Peacock butterfly		B1,J1,P1,WY9
Aglais urticae	Small tortoiseshell butterfly		J1,WY1,9,10
Lycaena phlaeas	Small copper butterfly		WY11
Cupido minimus	Small blue butterfly	**S7.**	WY1
Polyommatus icarus	Common blue butterfly		J1,K3,N3,R2,WY1,3,9
Pyrausta despicata	A Pyralid moth		WY3
Elophila nymphaeata	Brown china-mark moth		R1
Thyatira batis	Peach blossom moth		M1
Euthrix potatoria	Drinker moth		G1,L2,M1
Saturnia pavonia	Emperor moth		J1
Laothoe populi	Poplar hawk-moth		B1
Deilephila elpenor	Elephant hawk-moth		M1
Deilephila porcellus	Small elephant-hawkmoth		M1
Idaea aversata	Riband wave moth	**S7.**	M1
Timandra comae	Blood-vein moth		WY1
Scotopteryx luridata	July belle moth		H1
Xanthorhoe montanata	Silver ground carpet moth		G1,WY1,2,9
Epirrhoe tristata	Small argent and sable moth		H1,M1
Epirrhoe alternata	Common carpet moth		N3
Hydriomena furcata	July highflyer moth		M1
Gandaritis pyraliata	Barred straw moth		L2
Colostygia pectinataria	Green carpet moth		G1,K3
Lomaspilis marginata	Clouded border moth		B1,M1
Chiasmia clathrata	Latticed heath moth		A1
Biston betularia	Peppered moth		M1
Ematurga atomaria	Common heath moth		A1,M1,N3
Cabera pusaria	Common white wave		B3

Cabera exanthemata	Common wave moth		M1
Campaea margaritata	Light emerald moth		M1
Ptilodon capucina	Coxcomb prominent		M1
Spilosoma lutea	Buff ermine moth	**S7.**	B1
Spilosoma lubricipeda	White ermine moth	**S7.**	B1
Arctia caja	Garden tiger moth	**S7.**	B1
Tyria jacobaeae	Cinnabar moth	**S7.**	WY1
Eilema lurideola	Common footman		M1
Euclidia glyphica	Burnet companion moth		J1,K3,N3,WY1,11
Euclidia mi	Mother Shipton moth		P1
Autographa gamma	Silver Y moth		J1,R2,WY9,11
Syngrapha interrogationis	Scarce silver Y moth		B1
Deltote pygarga	Marbled white spot moth		H1,M1
Deltote uncula	Silver hook moth		O2
Acronicta rumicis	Knot grass moth		WY10
Stilbia anomala	Anomalous moth		B1
Hoplodrina blanda	Rustic moth		B1,M1
Denticucullus pygmina	Small wainscot moth		M1
Apamea monoglypha	Dark arches moth		B1,M1
Oligia strigilis	Marbled minor moth		M1
Oligia fasciuncula	Middle-barred minor moth		WY1
Aporophyla lutulenta	Deep-brown dart moth	**S7.**	N3
Polia nebulosa	Grey arches moth		M1
Ceramica pisi	Broom moth		B1
Mamestra brassicae	Cabbage moth		N3
Mythimna turca	Double line moth	**NS.**	M1
Mythimna pallens	Common wainscot moth		B1
Mythimna impura	Smoky wainscot moth		G1,M1

Mythimna ferrago	Clay moth		M1
Agrotis exclamationis	Heart and dart moth		B1,M1
Axylia putris	Flame moth		M1
Diarsia brunnea	Purple clay moth		B1
Diarsia mendica	Ingrailed clay moth		B1,M1
Diarsia rubi	Small square-spot moth		M1
Lycophotia porphyrea	True lover's knot moth		B1
Noctua pronuba	Large yellow underwing moth		B1,M1,WY1
Xestia triangulum	Double square-spot moth		M1
Prionocera pubescens	A Tipulid cranefly	**RDB2.**	B1
Prionocera turcica	A Tipulid cranefly		B1
Tipula fascipennis	A Tipulid cranefly		B1, K3
Tipula marginella	A Tipulid cranefly	**RDB3.**	O2, WY11
Erioconopa trivialis	A Limoniid cranefly		O2
Erioptera flavata	A Limoniid cranefly		O2
Erioptera fuscipennis	A Limoniid cranefly		O2
Eloeophila submarmorata	A Limoniid cranefly		K3
Euphylidorea meigenii	A Limoniid cranefly		B1
Phylidorea ferruginea	A Limoniid cranefly		B1, O2
Pilaria discicollis	A Limoniid cranefly		O2
Dicranomyia lucida	A Limoniid cranefly	**N.**	K3
Dicranomyia aquosa	A Limoniid cranefly	**N.**	K3
Helius flavus	A Limoniid cranefly		O2
Helius longirostris	A Limoniid cranefly		O2
Thaumastoptera calceata	A Limoniid cranefly	**N.**	K3
Bibio marci	St. Mark's fly		N3,P1,P2
Ptychoptera lacustris	A Ptychopterid cranefly		K3
Chrysopilus cristatus	A snipe fly		H1,J1,N3,WY11

Rhagio scolopacea	Downlooker snipe fly		H1
Rhagio tringarius	A snipe fly		WY1
Haematopota crassicornis	A horsefly		WY10
Haematopota pluvialis	A horsefly		H1,O2,WY2,10
Tabanus sudeticus	A horsefly		WY10
Chloromyia formosa	Broad centurion soldierfly		K3
Stratiomys potamida	Banded general soldierfly	**N.**	WY10
Machimus atricapillus	Kite-tailed robberfly		G1
Tachydromia aemula	A dance fly		N3
Empis tessellata	A dance fly		B1
Dolichopus atratus	A long-headed fly		O2
Dolichopus pennatus	A long-headed fly		O2
Dolichopus vitripennis	A long-headed fly		O2
Hercostomus aerosus	A long-headed fly		O2
Rhaphium auctum	A long-headed fly		O2
Baccha elongata	A hoverfly		K3
Cheilosia illustrata	A hoverfly		K3
Chrysotoxum bicinctum	A hoverfly		WY1,11
Episyrphus balteatus	A hoverfly		O2,WY2,10
Eristalis arbustorum	A drone fly		L2,WY1,10,11
Eristalis horticola	A drone fly		WY1,11
Eristalis interruptus	A drone fly		WY11
Eristalis intricarius	A drone fly		WY11
Eristalis pertinax	A drone fly		J1,WY11
Eristalis tenax	A drone fly		J1,R2,WY1,2,11
Ferdinandea cuprea	A hoverfly		J1
Helophilus pendulus	A sun-fly		J1,K3,M1,WY10,11
Meliscaeva auricollis	A hoverfly		WY1

Microdon myrmicae	A hoverfly		WY11
Neoascia podagrica	A hoverfly		O2
Platycheirus albimanus	A hoverfly		WY1
Platycheirus granditarsus	A hoverfly		K3,L2,M1,WY4
Platycheirus rosarum	A hoverfly		K3,O2,WY1,2,11
Rhingia campestris	A hoverfly		WY11
Scaeva pyrastri	A hoverfly		WY1,11
Sericomyia silentis	A hoverfly		J1,R2,WY11
Sphaerophoria scripta	A hoverfly		L2
Syritta pipiens	A hoverfly		K3,L2,WY11
Volucella bombylans	A hoverfly		M1,WY2,9
Volucella pellucens	A hoverfly		J1,K3,WY1,2
Xanthogramma citrofasciatum	A hoverfly		WY1
Sicus ferrugineus	A Conopid fly		K3
Coremacera marginata	A snail-killing fly		K3
Pherbina coryleti	A snail-killing fly		O2,WY11
Sepedon sphegea	A snail-killing fly		WY2
Tetanocera fuscinervis	A snail-killing fly		O2
Mesembrina meridiana	A house fly		G1,P1
Paykullia maculata	A Rhinophorid fly		G1
Gymnocheta viridis	A parasite fly		N1
Abia sericea	A Cimbicid sawfly		L2
Tenthredo scrophulariae	A Tenthredinid sawfly		WY2
Apis mellifera	Honeybee		B3,E1,N3,WY11
Bombus lucorum agg.	White-tailed bumblebee		J1,N3,WY1,11
Bombus lucorum	Buff-tailed/white-tailed bumblebee workers		J1,K3,N3,WY1,2,9,11
Bombus hortorum	Garden bumblebee		B1,WY1
Bombus lapidarius	Red-tailed bumblebee		E1,J1,K3,M1,N3,WY1,2,10,11

Bombus hypnorum	Tree bumblebee		I1,M1,WY11
Bombus monticola	Mountain bumblebee		E1
Bombus pratorum	Early bumblebee		N3,WY1,9
Bombus pascuorum	Common carder bumblebee		G1,J1,K3,N3,R2,WY1,2,11
Formica lemani	Northern negro ant		B1,J1,N4,R2,WY9
Lasius flavus	Yellow meadow ant		A1,G1,H1,J1,N3,O1,P1,R2,WY1,9,11
Lasius niger	Black garden ant		A1,B1,3,G1,J1,M1,N3,O1,R2,WY1,10
Myrmica ruginodis	A red ant		E1,G1,H1,N3,O3,R2,WY3,11
Myrmica scabrinodis	A red ant		L2,M1,N3,O3,R2,WY1,10,11
Gammarus pulex	Freshwater shrimp		WY10
Asellus aquaticus	A water louse		L2,WY10
Trichoniscus pusillus	Common pigmy woodlouse		M1,O2,R2,WY2,11
Oniscus asellus	Common shiny woodlouse		E1,G1,J1,L1,M1,O3,R2,WY11
Philoscia muscorum	Common striped woodlouse		M1
Porcellio scaber	Common rough woodlouse		E1,G1,L2,N3
Nemastoma bimaculatum	A harvestman spider		WY11
Harpactea hombergi	A Dysderid spider		G1
Ero cambridgei	A Mimetid spider		O3
Ero furcata	A Mimetid spider		B1
Theridiosoma gemmosum	A Theridiosomatid spider	**NS.**	WY10
Episinus angulatus	A Theridiid spider		WY11
Pholcomma gibbum	A Theridiid spider		A1
Ceratinella brevipes	A money spider		O3
Walckenaeria antica	A money spider		B1
Walckenaeria kochi	A money spider	**NS.**	B1
Walckenaeria vigilax	A money spider		B1
Gnathonarium dentatum	A money spider		A1,L2,WY10,11
Hypomma bituberculatum	A money spider		O2

Metopobactrus prominulus	A money spider		O3
Pepononcranium ludicrum	A money spider		A1
Pocadicnemis pumila	A money spider		O3
Hypselistes jacksoni	A money spider	**NS.**	B1,L2,WY10
Oedothorax gibbosus	A money spider		O3
Silometopus elegans	A money spider		B1,O2,O3
Cnephalocotes obscurus	A money spider		B1
Lophomma punctatum	A money spider		O3
Gongylidiellum vivum	A money spider		O3
Erigonella ignobilis	A money spider	**NS.**	O2,O3
Diplocephalus permixtus	A money spider		B1
Erigone atra	A money spider		WY11
Aphileta misera	A money spider		B1,O3
Agyneta decora	A money spider		O3
Agyneta olivacea	A money spider	**NS.**	B1,O2
Centromerita concinna	A money spider		B1
Saaristoa firma	Triangle hammock-spider	**S7./NS.**	A1
Tenuiphantes tenuis	A money spider		B1
Palliduphantes ericaeus	A money spider		O2
Microlinyphia pusilla	A money spider		B1
Araneus diadematus	Garden cross spider		J1,R1
Araneus quadratus	An orb-weaving spider		J1,R1,WY11
Larinioides cornutus	An orb-weaving spider		B1,H1
Nuctenea umbratica	An orb-weaving spider		G1,K1
Agalenatea redii	An orb-weaving spider		H1,L2,R1,WY11
Araniella cucurbitina	An orb-weaving spider		B1,3,G1,J1,K3,M1,WY1,10,11
Hypsosinga pygmaea	An orb-weaving spider		B1
Cyclosa conica	An orb-weaving spider		G1

Pisaura mirabilis	Nursery web spider		H1,K3,L2,N4,R2,WY2,11
Antistea elegans	A Hahniid spider		N4,O2,WY11
Dictyna arundinacea	A Dictynid spider		B1
Clubiona trivialis	A Clubionid spider		B1
Clubiona diversa	A Clubionid spider		A1
Clubiona subtilis	A Clubionid spider		O3
Heliophanus flavipes	A jumping spider		N3

3.1. Key invertebrates at Nant Helen and Onllwyn, 2019

Key species are defined as belonging to one of the following status categories:

- EC Annex II Species Directive (EC II);
- IUCN UK threatened or near threatened;
- Section 7 Species of Principal Importance in Wales;
- Red Data Book (RDB), Nationally Rare (NR) or Nationally Scarce (Na, Nb, N, NS).

593 invertebrate species have been recorded at Nant Helen and Onllwyn in 2019. Of these, 40 are key species as defined above. Note that seven Section 7 butterflies and moths recorded here this year; the small heath butterfly and riband wave, buff ermine, white ermine, garden tiger, cinnabar and deep-brown dart moths, have not been included in the key species list. This is because, though they have declined in parts of the English lowlands, they are still relatively common and do not appear to have decreased so markedly in the western part of their range. The rove beetles *Hadrognathus longipalpis*, *Zyras collaris* and *Euaesthetus laeviusculus* have been listed here as key species though they have no formal conservation status currently. This is because they are very likely to be accorded Nationally Scarce status in the forthcoming Species Status Review of this group (Boyce, *in prep.*). Conversely, the weevil *Polydrusus formosus* is listed as Nationally Scarce 'A' in the last review of this group (Hyman & Parsons, 1992). At that time it was only known from wood edges and clearings in a handful of southern English counties. Since then, it has spread across much of England and Wales and is also now known from southern Scotland. It will certainly lose its conservation status in the updated Review of Curculionoidea currently in preparation.

3.1.1. Scarce blue-tailed damselfly *Ischnura pumilio* (Charpentier, 1825). **NT**.

The scarce blue-tailed damselfly is very similar to the much commoner blue-tailed *I. elegans*. Males are most readily distinguished from each other by reference to the differing distribution of blue colouration on the apical abdominal segments. In *I. pumilio* the blue band straddles segments eight and nine, whereas in *I. elegans*, it is confined to segment 8. The shape of the pronotum provides an additional means by which both sexes may be distinguished. The scarce blue-tailed damselfly has a very restricted distribution across southern England and Wales, where it is found in shallow pools and runnels in both natural and man-made habitats. Larval development is very swift, which is thought to be an adaptation to the somewhat ephemeral waterbodies it frequently occupies. Five adults were seen in the northern part of Onllwyn unit WY10 (SN84941076) and a further seven adults were recorded on the southern section of this unit (SN84391075). In both cases, they were flying over heavily pony-poached acid-neutral runnels characterised by bog pondweed and marsh St. John's-wort of the NVC M29 type. Two probable larvae of this species were also recorded by pond netting in the shallow, acidic pool on the edge of the Nant Helen opencast workings (unit R1).This record should be regarded as provisional pending the collection of adults.

3.1.2. A water beetle *Chaetarthria simillima* (Herbst, 1797). **NS.**

Until recently, this species was known as *C. seminulum*, but it has been shown that in Britain, this includes two very closely related species only readily separable by examination of the male genitalia. It is a tiny, black water beetle with a globular body shape. The true *C. seminulum* is a species of fen habitats, while *C. simillima* is a specialist of shallow seepages in acid mires. It appears to be widely but locally distributed across Britain. At Nant Helen, specimens were found by shaking out moss in the wet basin in survey unit L2.

3.1.3. A water beetle *Helochares punctatus* (Baudi, 1848). **NS**.

This water beetle can be distinguished from similar *Enochrus* species by the lack of sutural striae on the elytra and its straighter palps. From the two other British *Helochares*, it differs in its darker colouration, less dense elytral puncturation and the form of the male genitalia. *H. punctatus* is one of the characteristic water beetles of acid bog pools, where it is most frequently found amongst floating rafts of bog-mosses. It is a lowland species, which has its largest populations in southern England and Wales, though it does also occur north as far as southern Scotland. In 2019, it was collected amongst saturated *Sphagnum* at Nant Helen in the shallow margins of the pool at Nant Helen unit R1.

3.1.4. A rove beetle *Hadrognathus longipalpis* (Mulsant & Rey, 1851). **pNS**.

H. longipalpis is a small, reddish-brown Staphylinid beetle that is easily distinguished by the sharply angled, strongly protruding mandibles. Its largest British populations are found in an area of south-central Wales, stretching from the Gower peninsula, Glamorgan, north as far as Radnorshire. Elsewhere, there are single records from Cumbria and the Midlands. It is usually found in open, semi-natural habitats, such as bogs, heaths and acid grassland. It was only found in Britain for the first time in 1987 and has provisionally been listed in the forthcoming second status review of the larger British rove beetles as Nationally Scarce (Boyce, *in press*). At Nant Helen, it appears to be quite frequent, with individuals recorded in survey units A1, M1 and R2.

3.1.5. A rove beetle *Zyras collaris* (Paykull, 1800). **pNS**.

Z. collaris is a medium-sized rove beetle with a red thorax and abdomen and the last three antennal segments yellow. The rest of the body is black, with the elytra having a distinct bluish reflection. It is a very scarce species of open wetlands, including fens, marshy grassland, wet heathsnand bogs. Like other members of the genus, it is an obligate myrmecophile that is associated with red ants of the genus *Myrmica*. The British distribution covers a very thin scatter of sites north as far as Cumbria. It is absent from many sites that appear to have suitable habitat. At Nant Helen, a single specimen was collected in wet litter in the transition mire at WY11.

3.1.6. A rove beetle *Euaesthetus laeviusculus* Mannerheim, 1844. **pNS**.

There are three British species of *Euaesthetus*, all of which are very small pitchy-reddish rove beetles. *E. laeviusculus* can be distinguished from its congeners by the relatively fine and undifferentiated puncturation of the thorax and elytra. The thoracic foveae are much less well-marked than in the commoner *E. ruficapillus* (also found at Nant Helen in 2019) and the form of both the male last abdominal sternite and aedeagus is also diagnostic. It is the scarcest of the three British species, with a very widely scattered distribution across much of Britain. It is found in saturated moss and litter and shows a strong affinity for high quality acid bogs, including raised and blanket mires. At Nant Helen, a single male was collected in mesotrophic brown moss flushes in unit O2.

3.1.7. A rove beetle *Quedius plancus* Erichson, 1840. **Na.**

Within the large rove beetle genus *Quedius*, *Q. plancus* is recognised by a combination of the variegated yellow pubescence on the abdomen, unmetallic elytra, blackened tibiae and the presence of a pair of seta-bearing punctures on the head between the eyes. It is a very scarce insect that is found in a handful of sites in southern England and Wales. It is usually found in coarse, twiggy, flood litter at the edge of fast-flowing woodland streams and rivers. At Nant Helen, a single male was collected in May 2019, from a twig dam at the edge of the small stream in survey unit I1.

3.1.8. A Cryptophagid beetle *Cryptophagus ruficornis* Stephens, 1830. **N.**

Cryptophagus is a large genus of small beetles, most of which are reddish in colour, and are generally difficult to identify without examination of the male genitalia. However, *C. ruficornis* is one of the more distinctive species, having black elytra bearing sub-erect pubescence and the thorax being quite parallel-sided with a strong hook-tooth on its lateral margins. This species is almost always found on cramp-ball fungus *Daldinia concentrica* growing on dead trunks and branches of ash trees. It is found very locally throughout Britain, though most sites lie to the south of a line from the Wash to the Mersey and it is absent from much of west Wales and south-west England. At Nant Helen, a single female *C. ruficornis* was beaten from a dead ash branch with *Daldinia* fruting bodies in the wood-pasture of survey unit G1.

3.1.9. A pollen beetle *Epuraea distincta* (Grimmer, 1841). **Na.**

E. distincta is a small, yellow-brown beetle with darker brown spots on the elytra. Amongst this difficult genus, this species is easily determined with a hand lens by its strongly notched pronotal hind angles. It is a very scarce beetle of wet woodland habitats, which is most frequently encountered in Wales and south-west England. The larvae appear to develop exclusively in the brackets of the maze-gill fungus *Daedaleopsis confragosa*, which is most often found on dead and dying branches of various willows *Salix* spp. At Nant Helen, a few adults were found in association with their host fungus in the central band of willow carr at survey unit WY11.

3.1.10. A Ciid beetle *Cis festivus* (Panzer, 1793). **Nb.**

The genus *Cis* currently includes 15 British species, most of which are small, nondescript brown beetles that are hard to distinguish from each other without careful microsocopic examination. *C. festivus* has the outer edge of the front tibia and the pronotal sides rounded and the elytral bristles quite short. It can be distinguished from the very similar *C. vestitus* by the relatively well-marked fringe of bristles along the front margin of the pronotum, the pale antennal clubs, rich golden-brown colour of the body and the poorly defined fovea on the basal abdominal segment of males. It is widely, but locally distributed across Britain north as far as the southern Scottish Highlands. However, most sites are in Wales and southern England, south of a line between the Mersey and the Wash. Like all other Ciids, it feeds on fungi growing on dead trees, with *C. festivus* being a specialist of encrusting fungi of the genus *Stereum*. It is found most frequently on dead hazel branches, in association with *S.rugosum*, with a few adults being found at Nant Helen in September 2019 in this situation in the ash-oak woodland of survey unit K1.

3.1.11. A false darkling beetle *Orchesia minor* Walker, 1837. **NS.**

This is a small, elongate pitchy-brown beetle, without noticeably 'clubbed' antennae, and with strong spurs on the hind tibiae. It is a dead wood species, which is thought to feed on a range of wood-decaying fungi. *O. minor* is quite widely distributed in Britain, but is very local, and appears to be absent from much of Scotland and south-west England. Many of its sites are in wet woodland, though it can also be found in drier woodland types, especially in the west. A singleton was beaten from dead branches at Nant Helen in the wood-pasture of survey unit G1.

3.1.12. A false darkling beetle *Orchesia micans* (Panzer, 1793). **NS.**

O. micans is a small, elongate, pitchy-red beetle that jumps vigorously when disturbed. It has a wide, but very scattered distribution in woodland and parkland sites throughout Britain. The adults are most easily found by tapping old, decaying brackets of the fungus *Inonotus radiatus* on dead alder snags or *I. hispidus* brackets on ash, but it has also been recorded less frequently in association with a range of other bracket fungi. Adults were found at Nant Helen by beating dead ash and hazel branches in survey unit K1.

3.1.13. A reed beetle *Plateumaris rustica* (Kunze, 1818). **NS.**

P. rustica is a rather dull, metallic coppery-purple reed beetle with reddish-orange legs. The elytra lack well-defined impressions and the thorax has relatively straight sides. It is a very local insect that is confined to scattered sites across Britain, north as far as southern Scotland, though with the majority of sites in southern and central England. It is found in high-quality wetlands where there are an abundance of tall sedges and bur-reeds, these being the usual larval foodplants. Three adults were recorded at Nant Helen in June, from the species-rich fen in unit WY11.

3.1.14. A flea beetle *Mantura rustica* (Linnaeus, 1767). **NS.**

There are four British species of *Mantura*. They are all small, relatively elongate, metallic greenish or bluish flea beetles in which the latero-basal pronotal furrows are not joined by an impressed transverse line. *M. rustica* is very easily distinguished from all other members of the genus by the reddish colour of the apical third of the elytra. It is distributed throughout Britain, north as far as southern Scotland, but it is very local. It feeds on a range of docks and sorrels and is often found in bogs, poor fens and marshy grasslands though it can also be found in drier grassland habitats. A single specimen was swept from fen-meadow vegetation with abundant common sorrel at Nant Helen WY11 in June 2019.

3.1.15. A weevil *Protapion filirostre* (Kirby, 1808). **Nb.**

The genus *Protapion* is quite readily distinguished from other Apionid weevils by the highly domed form of the elytra. This is the only all-black species, its congeners otherwise having variable amounts of orange-yellow colouration on the legs. *P. filirostre* is a scarce insect, restricted to southern counties of England and Wales. It is found in grassland and short, ruderal vegetation, where there are large stands of its main foodplant, black medick. At Nant Helen, a single adult was tapped from this plant growing in species-rich ruderal grassland in unit WY1.

3.1.16. A weevil *Anthonomus brunnipennis* Curtis, 1840. **Nb.**

Within the genus *Anthonomus*, *A. brunnipennis* is one of only two species without a clear pattern of hairs on the elytra. It can be separated from the common *A. rubi* by its smaller size and broader second antennal segment. The elytra are often reddish-brown in colour. It is primarily a northern and western species, with its main populations in Scotland, northern England and Wales. There are also a few 'relict' populations in southern England. It is found in a range of open habitats, such as acid grassland, bogs, heaths and wood edges, where there are good stands of its main foodplant, tormentil. It is also believed to occasionally breed on other *Potentilla* species. A singleton was tapped from tormentil in an area of scrubby acid grass-heath in survey unit N3.

3.1.17. A weevil *Gymnetron beccabungae* (Linnaeus, 1760). **Nb.**

This is one of two species of *Gymnetron* that have a dense coating of yellowish scales on the sides of the pronotum. It can be distinguished from the closely similar *G. veronicae* by the more strongly rounded sides of the pronotum, the more extensive covering of yellowish scales on the thorax and the less conspicuous hair-like scales on the elytra. Also, the elytra of this species usually have a large red mark. It is widely but very locally distributed across the UK in wetlands where there are good populations of its foodplants. It feeds on wetland speedwells *Veronica* spp., with brooklime being especially favoured. At Nant Helen, a single individual was netted from the shallow pool in survey unit L2. Brooklime was frequent in this area.

3.1.18. A weevil *Gymnetron veronicae* (Germar, 1821). **Nb.**

Compared to the very similar *G. beccabungae*, which was also recorded at Nant Helen in 2019, this species can be distinguished by its less rounded pronotal side margins, the less extensive covering of yellowish scales on the thorax and the broader hair-like scales on the elytra. It has a very scattered distribution across England and Wales, with a handful of sites in southern Scotland. It is found on wet mud at the edge of waterbodies or in fens, where there are good populations of wetland speedwells. Like *G. beccabungae* it is most often found in association with brooklime. At Nant Helen, two specimens were tapped from this plant growing on sparsely vegetated mud in the heavily grazed fen in survey unit WY10.

3.1.19. A weevil *Bagous lutulentus* (Gyllenhal, 1813). **Nb.**

B. lutulentus is a small, dark brown weevil with two small white spots on the wing cases. It is one of a number of very similar species in this genus. It is characterised by the wide third tarsomere, relatively elongate form, small size and clearly transverse pronotum. Microscopic examination of the form of the male aedeagus provides an additional confirmatory character. Nationally, *B. lutulentus* has a very scattered distribution across England, Wales and southern Scotland. It is a very local inhabitant of wetlands where its foodplant, water horsetail, occurs. The larvae feed inside the stems of this plant and pupate in its upper parts. A single adult was found in wet litter in the transition mire in survey unit WY11.

3.1.20. A weevil *Microplontus campestris* (Gyllenhal, 1837). **Nb.**

M. campestris is a small, but very attractive weevil with a distinctive pattern of brown, black and white scales on the upper surface. Confirmatory characters for identifying this species include a strongly transverse thorax, which is markedly constricted towards the front and the asymmetric male genitalia. It is quite widely, but very locally distributed in the southern half of England and also across much of Wales, reaching the northern limit of its British range in Lincolnshire and Anglesey. It feeds exclusively on oxeye daisy, with the larvae feeding within the flower receptacles. Two adults were tapped from this plant in an area of very species-rich ruderal grassland in survey unit WY1 in June 2019.

3.1.21. A weevil *Pelenomus waltoni* (Boheman, 1843). **Nb.**

P. waltoni is a small weevil with an attractive pattern of brown, black and white scales. There are conspicuous teeth on the front margin and dorsum of the thorax, and the rostrum is much longer than its congeners. It is found in rather sparsely vegetated hollows that are at least seasonally wet. Typical habitats in Wales are in oxbows and other depressions in the floodplains of larger rivers, or at the margin of pools in wetlands and rhôs pastures. This species appears to be monophagous on water-pepper *Persicaria hydropiper*, with both adults and larvae feeding externally on the leaves. *P. waltoni* has a very scattered distribution across southern England and Wales, with a handful of records further north as far as Cumbria. In Wales, it has a wide but scattered distribution throughout the country. At Nant Helen unit N3, a single adult was tapped from stands of water-pepper growing in a sparsely vegetated damp, clayey hollow in an area of ruderal grassland and scrub.

3.1.22. A weevil *Magdalis carbonaria* (Linnaeus, 1758). **Nb.**

The genus *Magdalis* includes nine British species of small to mid-sized, usually matt black, weevils of elongate form. *M. carbonaria* can be distinguished from other members of the genus by dint of the prominent teeth on the underside of its front femora, its rounded pronotum and convex elytral interstices with broad striae. It is a saproxylic species, which is primarily an inhabitant of recently dead birch branches. *M. carbonaria* is very widely distributed across Scotland, Wales and England, though most sites are in northern and western Britain. A single adult was captured at Nant Helen, by beating alder branches on the edge of survey unit N4.

3.1.23. Six-belted clearwing moth *Bembecia ichneumoniformis* (Denis & Schiffermüller, 1775). **Nb**.

This very attractive clearwing is readily recognised by a combination of the six yellow bands on the abdomen and the orange markings on the wings. It is widely, but very sparsely distributed across England and Wales north as far as Yorkshire. Open habitats such as calcareous and coastal grassland, brownfield sites and pioneer heathland sites are favoured, often on south-facing aspects. Sites selected for breeding also have an abundance of bare ground, which creates the very warm, dry (xerothermic) micro-climate this species requires. The female lays her eggs on isolated clumps of common bird's-foot trefoil and kidney vetch. Many of the British sites of the six-belted clearwing are on the coast, but it also occurs inland where the habitat is suitable, as for example on the downs in south-east England. An adult was swept from species-rich ruderal grassland in survey unit WY3 at Nant Helen in July 2019.

3.1.24. Dingy skipper butterfly *Erynnis tages* (Linnaeus, 1758). **S7**.

This distinctive species is usually single brooded, flying between late-April and late-June, although partial second broods can occur in late-July and August. Larvae feed on common bird's-foot trefoil, horseshoe vetch and greater bird's - foot trefoil. The latter plant being utilised in damp meadows. Adults are frequently seen flying rapidly and low over the ground or basking on bare ground or low vegetation. The dingy skipper occurs in a wide range of habitats, including coastal dunes and undercliffs, chalk grassland, woodland rides, heathland and road verges. Very often breeding habitat includes areas of bare ground, which create xerothermic conditions favourable to the breeding success of this butterfly. It is still quite widely distributed in central and southern Britain but becomes scarcer to the north and east. Scottish and Irish populations are mainly coastal. Although remaining locally common across much of its range, the dingy skipper has disappeared from many of its British sites in recent years and for this reason, has been included on the Section 7 priority species list for Wales. There is clearly a large and important population of this butterfly at Nant Helen, with many sightings in areas of open, ruderal vegetation where there are stands of its foodplants. 2019 records are from survey units E1, J1, N3 and WY1.

3.1.25. Grayling butterfly *Hipparchia semele* (Linnaeus, 1758). **S7**.

The Grayling is the largest of the 'brown' butterflies found in Britain. The upper surface of the wings has attractive orange patches marked with prominent eyespots. However, these are never seen, as it invariably rests with its wings shut, so that it is the underside wing pattern of bands and spots of grey, brown and black that is invariably seen. This patterning makes the butterfly very well camouflaged when it rests on bare ground. It is still found widely across Britain but has undergone a severe decline over the last half century, with losses being particularly acute at its inland localities. For this reason, it is included on the Section 7 priority species list for Wales. Most modern sites are in dry, open, coastal grassland and heathland, though it still has strong populations inland on the lowland heaths of southern England. The larva feeds on a range of grasses, with wavy hair-grass, fine-leaved bents *Agrostis* spp. and fescues *Festuca* spp. being most frequently utilised. Low clumps of grass surrounded by bare ground are favoured, as this provides the very warm, dry microclimate required by the larva. In 2019, a few adults were found flying on dry, ruderal grassland and grass-heath in unit WY3.

3.1.26. Small pearl-bordered fritillary *Boloria selene* ([Denis & Schiffermüller, 1775]). **S7.**

The small pearl-bordered fritillary can be most easily distinguished from the closely similar pearl-bordered *B. euphrosyne* by the more extensive series of silvery-white spots and brown (rather than reddish) ground colour of the underside of the hindwings. Formerly, it was a common butterfly throughout Britain but has been lost from most places in the south and east of its range, which has led to its inclusion on the Section 7 priority species list for Wales. The considerable decline in its British populations relates primarily to the cessation of coppice woodland management in the latter half of the twentieth century, which has resulted in the loss of the warm, sheltered woodland glades with an abundance of common dog-violet, which was its main larval foodplant in such situations. It has remained more widely distributed in northern and western Britain, where it can be found in other habitats; chiefly bracken slopes where there are abundant dog-violets under the bracken canopy and mires and poor fens where it feeds on marsh violet. Only a single specimen was recorded in survey unit WY1 in 2019 and it seems possible that this may be a wanderer from the adjacent Gors Llwyn, Onllwyn SSSI, despite the presence of seemingly suitable habitat here (especially the *Molinia* bog in the northern part of WY11).

3.1.27. Small blue butterfly *Cupido minimus* (Linnaeus, 1767). **S7**.

The small blue is our smallest native butterfly. It has black-brown upperwings with a variable amount of blue dusting at their base. The underwings are silvery-white with small black spots. The small blue flies from late-May to late-June, with a partial second brood in southern England in late-July and August. The small blue shows a marked preference for chalk, limestone and coastal grasslands and man-made quarries, particularly where there is some disturbance to the soil, providing the bare ground favoured by kidney vetch, upon which the larvae feed. Colonies of this species tend to be small, occupying sheltered hollows where the micro-climate is particularly warm Most sites for this species in northern England, Wales and Scotland are coastal, but in central southern England the small blue is also a species of inland calcareous grassland. A considerable decline has occurred, especially in northern England and the Midlands and for this reason, it is listed as a priority species in Wales under Section 7 of the Environment Act. It is a very rare butterfly inland in Wales, so the colony in species-rich ruderal grassland at WY1 is of considerable note.

3.1.28. Double line moth *Mythimna turca* (Linnaeus, 1761). **Nb**.

This is an easily recognised moth, in which the forewings are of a rich reddish-brown ground colour, speckled with fine black barring and two well-marked black transverse lines. There is also a small, but well-defined white discal spot. Formerly, this was designated a BAP Priority Species, but it has been found to be rather more widespread than previously thought and is no longer included on the Section 7 priority species list. Nonetheless, it remains a very local insect that is only encountered with any frequency in rough grassland and wood-edge habitats in south-west England and southern Wales. There are also much more scattered colonies across southern England between a line joining the Mersey estuary and Wash and beyond this, a handful of outlying populations as far north as Cumbria. Adults were abundant in a light trap set up in survey unit M1.

3.1.29. A Tipulid cranefly *Prionocera pubescens* Loew, 1844. **RDB2**.

There are just three British species of *Prionocera*, which lack the whorl of bristles on the antennal flagellum found in the very large genus *Tipula*. They have a dark grey-brown body colour with clear wings and are only distinguished with certainty by reference to the male abdomen, which have distinctively shaped processes on the ninth tergite and tenth sternite. *P. pubescens* is a stenotopic inhabitant of high-quality acid bogs, with most records coming from lowland sites. It has strong populations in north-west Scotland and in England it is well established on the heaths of Hampshire and Surrey and in the mires of Cheshire and Shropshire. It is also known from a few bogs in mid- and west Wales and in northern England. The larval ecology is poorly known, but there appears to be an association with *Sphagnum* bog pools, with the larvae probably being aquatic. A single male was collected at Nant Helen by sweeping the acid bog in unit B1.

3.1.30. A Tipulid cranefly *Tipula marginella* Theowald, 1980. **RDB3**.

The genus *Tipula* has over 60 British species, including some of our commonest and most familiar 'daddy long-legs'. *T. marginella* is placed in the sub-genus *Yamatotipula*, which are characterised by the basal whorl of bristles on the mid-antennal segments and the presence of a thick dark band on the pronotal disc. It is best distinguished from other members of the sub-genus by the shape of the processes on the ninth abdominal tergite of males and by the form of the male genitalia. It is a very scarce species, which is restricted to mesotrophic or acidic wetlands, such as bogs, wet heaths and poor fens, with the larvae being found in saturated mud or peat. There are scattered colonies across Britain, with most colonies being in southern England and south Wales. It is also known from a very few places in the Sottish Highlands. At Nant Helen, a few individuals were swept in the transition mire in unit WY11 and a single male was also swept from mesotrophic flushes in O2.

3.1.31. A Limoniid cranefly *Dicranomyia lucida* de Meijere, 1918. **N**.

D. lucida is a very attractive cranefly in which the wings have the tips darkened, with three strong black spots along the leading edge and crossvein m-cu level with the base of the discal cell. Additionally, the top of the thorax is glossy orange. It is quite widely distributed from Cumbria and north Yorkshire, southwards across England and Wales. It is an inhabitant of wet woodland, especially in sites where hemlock water-dropwort is present. At Nant Helen, an adult was swept in unit K2 from an area of seepages in wet woodland.

3.1.32. A Limoniid cranefly *Dicranomyia aquosa* Verrall, 1886. **N**.

The cranefly genus *Dicranomyia* includes a large number of mid-sized, rather drab species. *D. aquosa* is the only representative of the subgenus *Sivalimnobia* and can be distinguished from congeners by the form of the wing venation, especially the presence of an open discal cell, the absence of hairs on the apical part of the wing membrane, and the distinctive form of the male genitalia. It has a predominantly northern and western distribution in Britain, with most records coming from Scotland, northern England and Wales. There are also a handful of populations in south-west England, most of these being on Exmoor. It is an inhabitant of cliffs and rock outcrops, where the larvae live in wet mosses and liverworts. It can be found in both open situations, on coastal and inland cliffs, and in wooded valleys where there are rock exposures. A few adults were netted at Nant Helen from mossy rock outcrops with water dripping down them in survey unit K2.

3.1.33. A Limoniid cranefly *Thaumastoptera calceata* Mik, 1866. **N**.

There is only one British representative of this genus. It is a very small, lemon-yellow cranefly in which the wing has no discal cell and crossvein m-cu closes the lower basal cell well before the apex of the upper basal cell. The legs are yellow with blackened tips to the femora and tibiae. It is quite widely, but locally distributed across southern England and Wales, north as far as Cumbria and Yorkshire. The larvae construct a case of dead leaves and are found in woodland seepages, usually where the groundwater is at least mildly calcicolous. At Nant Helen, a male was swept from the area of wooded seepages in unit K2.

3.1.34. Banded general soldierfly *Stratiomys potamida* Meigen, 1882. **N**.

With its bold pattern of yellow abdominal bars and its large size, *S. potamida* is an unmistakeable insect. It has a localised distribution in southern England and Wales as far north as the Scottish borders, though it is absent from much of the south-west peninsula and western Wales. It is predominantly a southern species, with its distribution in northern England being much more localised. It is found in a range of relatively base-rich wetland habitats, where there are areas of shallow water in which the larvae can complete their development. Though it does occur in still water, such as pond and ditch edges or flooded fenland, seepages appear to be the most favoured larval habitat. At Nant Helen, a single adult was recorded in flight over heavily poached mesotrophic seepages in survey unit WY10.

3.1.35. A Theridiosomatid spider *Theridiosoma gemmosum* (L. Koch, 1877). **NS.**

T. gemmosum is a small, but unmistakeable spider with a globular abdomen marbled with black and white markings. It occurs across a range of lowland wetland habitats including bogs and fens, where it spins a small orb web low down amongst the vegetation. It is primarily a species of southern and eastern England and it also has strong colonies in south-west Wales and in the fens of the Lleyn peninsula and Anglesey in north Wales. A single female was collected by tapping marsh cinquefoil in survey unit WY10 in 2019.

3.1.36. A money spider *Walckenaeria kochi* (O. P.-Cambridge, 1872). **NS**.

The genus *Walckenaeria* includes over 20 small to moderately large money spiders. *W. kochi* is one of the larger species, the carapace is black, the abdomen dark grey and the legs reddish-orange. The male has a characteristic bifurcated protuberance on the head and both this sex and the female can be reliably determined by microscopic examination of the sex organs. This is primarily a northern species that has its largest populations in Scotland, northern England and Wales, though there are some strong colonies on blanket mires on Exmoor and in the East Anglian fen country, as well as a handful of relict outpost elsewhere in southern England. It is found amongst moss and litter in a range of wetland habitats including saltmarshes, though the majority of its British populations are on acid bogs in both lowland and upland situations. At Nant Helen in 2019, a female was collected in wet moss and litter on the acid bog at survey unit B1.

3.1.37. A money spider *Hypselistes jacksoni* (O. P.-Cambridge, 1902). **NS**.

H. jacksoni is the only British species of the genus. It is a relatively distinctive money spider, in which the carapace and legs are usually bright orange-red and the shiny, coriaceous abdomen is deep black. The sternum is strongly edged with black and in the male, the head is strongly raised, with pitted grooves on each side of this elevation. Both the male palp and female epigyne are characteristic. This is a scarce, but widely distributed spider, which is usually found amongst moss and litter on lowland acid bogs and wet heaths. It has its British stronghold in Wales, with English populations in the Pennines, North York Moors, on the south-west peninsula, and the lowland valley mires of Dorset, Hampshire and Surrey. It also has a wide, but very scattered distribution in Scotland. There are a couple of isolated colonies on relict mire habitats in Norfolk. Two females were collected in wet moss and litter in the acid bog at B1, a single female was found in saturated moss in survey unit L2 and a further female was collected by tapping marsh cinquefoil in WY10.

3.1.38. A money spider *Erigonella ignobilis* (O. P.-Cambridge, 1871). **NS**.

The two British *Erigonella* species are small, rather nondescript reddish-brown to black money spiders in which the male head is moderately raised. *E. ignobilis* lacks the pit and groove on the side of the carapace that is present in the commoner *E. hiemalis*. They are best distinguished by microscopic examination of the male palp or female epigyne. It has a wide but very localised distribution across England and Wales, with a single old record from Scotland. It appears to be most frequent in western Britain and is absent from south-east England. It is found in moss and litter in a range of wetland habitats, though it appears to be most frequently recorded from acid mires. Female were recorded at Nant Helen in brown-moss seepages in survey units O2 and O3.

3.1.39. A money spider *Agyneta olivacea* (Emerton, 1882). **NS**.

The genus *Agyneta* includes six British species of drab-brown Linyphiids, in which the male head is not raised and has palps with a strong dorsal prominence on the cymbium. Reliable identification of them requires careful microscopic examination of the male palps or female epigyne, though the female of *A. olivacea* additionally has moderately inflated palps. It is a northern- and western-distributed species in Britain, with most records coming from Scotland, northrn England and north Wales. The Brecon Beacons marks the southernmost limit of its British range. It is usually found in moss and litter in wetland habitats, though its ecology and distribution is still imperfectly known due to its very close similarity to *A. cauta*. Two females were found amongst wet moss and litter in the acid bog at survey unit B1 and a single female was collected in brown mosses in a mesotrophic flush-bog at Nant Helen O2 in 2019.

3.1.40. Triangle hammock-spider *Saaristoa firma* (O. P.-Cambridge, 1905). **S7/NS**.

The two British *Saaristoa* have an orange carapace and grey abdomen. In *S. firma*, there are only three long spines on the midline of the carapace behind the eyes. The form of both the female epigyne and male palps also enables this species to be distinguished quite easily from the more widespread *S. abnormis* and other Linyphiids. It is widely, but locally distributed across much of Britain, though it appears to be absent from much of the south-west peninsula. It is found in a range of damp, semi-natural habitats, such as bogs, heaths and fens, though it has also been collected in litter under both deiduous and coniferous woodland. Its British populations have undergone a very marked decline over the last few decades and for this reason it is listed as a Priority Species under Section 7 of the Environment (Wales) Act. A single female was collected in moss and litter on open-structured, young *Calluna* heath on an old spoil heap at survey unit A1.

3.2. Key invertebrate habitats at Nant Helen and Onllwyn, 2019

3.2.1. Transition mire and poor fen

Associated key species: Scarce blue-tailed damselfly*; Zyras collaris*; *Euaesthetus laeviusculus Plateumaris rustica*; *Chaetarthria simillima*; *Mantura rustica*; *Gymnetron beccabungae; Gymnetron veronicae*; *Tipula marginella*; banded general soldierfly; *Theridiosoma gemmosum*; *Hypselistes jacksoni*; *Erigonella ignobilis*; *Agyneta olivacea*.

This site supports a range of relatively mesotrophic mire, poor fen and marshy grassland communities that are of outstanding importance for invertebrates and constitute the most important invertebrate assemblage identified at Nant Helen during the 2019 survey. Especially noteworthy is the large area of fen, transition mire and willow scrub on the northern edge of the Onllwyn Washery. Hydrologically, this is part of the same block of habitat as the Gors Llwyn complex that lies immediately to the east of the A4221 road, outside the boundary of the 2019 survey area. The latter is notified as the Gors Llwyn, Onllwyn SSSI.

This area has been divided into two survey units, WY10 and WY11, which respectively correspond to the grazed and ungrazed stands of wetland vegetation. Though the level of grazing by ponies in those parts of unit WY10 with drier stands of acid and marshy grassland is excessive, it is resulting in a species-rich sward with patches of bare, poached mud in adjacent stands of poor fen and seepages. These areas support a very diverse invertebrate assemblage at Nant Helen. In particular, the relatively high grazing pressure is important in maintaining open, muddy runnels that are suitable habitat for larvae of the scarce blue-tailed damselfly and the banded general soldierfly. Bare, poached mud is providing a suitable habitat for colonisation by brooklime and this plant supports a breeding population of the weevil *G. veronicae* here. Areas of bare saturated mud are also important breeding habitat for the rare cranefly *T. marginella*.

The stands of ungrazed wetland vegetation in WY11 are equally important. Particularly noteworthy is the large area of NVC S27 transition mire, though the superb stands of fen-meadow and tall *Carex* fen into which this grades are hardly less interesting. The latter habitat has a strong population of the reed beetle *P. rustica*, which feed on large sedges. The rich flora here supports other scarce phytophagous species, including *B. lutulentus* (on water horsetail) and *M. rustica* (probably associated with *Rumex acetosa* here).

The invertebrate fauna recorded in WY10 and WY11 is of at least comparable interest to that present on the SSSI and is thought to be of regional importance for invertebrates.

Though WY10 is the largest and most important area of this habitat feature at Nant Helen, there are other high-quality stands of less heavily grazed fen in units L2, O2 and O3. A feature of all these areas is that they are fed by quite mesotrophic groundwater, with 'brown mosses' such as *Calliergon cuspidatum* replacing the bog-mosses that are more typical of acidic mires (see sub-section 3.2.4 below). As is the case with most of the habitats at Nant Helen, these fens are not pristine and many if not all have developed on sites affected or created by past mining activity. For example, the fen basin in L2 has developed

in an old man-made reservoir. It now supports a very interesting invertebrate fauna that includes a second Nationally Scarce *Gymnetron*, *G. beccabungae* and the money spider *H. jacksoni*. Brown moss seepages in units O2 and O3 have populations of the rare cranefly *T. marginella* and two other key money spiders: *E. ignobilis* and *A. olivacea*. These other mesotrophic wetlands are assessed to be of county importance in respect to their invertebrate fauna.

Grazing is the key management recommendation for these wetlands. Ideally, the grazing pressure in WY10 should be reduced, as the current level is detrimental to the drier grassland habitats here. However, it is very important that stock numbers are kept at a level that maintains the open, poached poor fen and runnel habitats in this unit. Conversely, the ungrazed wetland habitats in WY11 would benefit from the reintroduction of light grazing. There is already much scrub here and without browsing by stock, it is likely that this will continue to encroach into the very important open mire habitats. If re-stocking is impractical, scrub control could be undertaken, with stumps carefully spot-treated with a herbicide to prevent re-growth.

In addition to being an important invertebrate site in its own right, sensitive management of this area is important in maintaining high water quality in the soligenous wetlands of the Gors Llwyn, Onllwyn SSSI, which have a very similar invertebrate fauna to that recorded this year in WY10 and WY11 (Holmes, Boyce & Reed, 1991) and that are primarily irrigated with water originating here.

Probable larvae of the scarce blue-tailed damselfly were also recorded in survey unit R1 in a shallow pool created by past mining activity. It is therefore also included as an associated key species for that habitat feature (see sub-setion 3.2.7).

3.2.2. Species-rich short ruderal grassland

Associated key species: *Protapion filirostre*; *Microplontus campestris*; six-belted clearwing; dingy skipper; small blue.

Away from wetlands, the most important invertebrate assemblage of invertebrates at Nant Helen is found in early- to mid-successional swards where there is at least a moderately diverse short sward interspersed with patches of bare ground. Such conditions produce a dry, warm (xerothermic) microclimate, which is a key component of the habitat required by many scarce invertebrates. All five key species associated with this habitat feature at Nant Helen are phytophagous: the six-belted clearwing and dingy skipper feeding on bird's-foot trefoil; the small blue on kidney vetch and the weevils *Protapion filirostre* and *M. campestris* on black medick and oxeye daisy respectively.

The relatively calcicolous, herb-rich stands of this vegetation on the Onllwyn block (WY1,2 and 8) are of particular note for their population of small blue butterfly and all of the other key species are also present here. The stands of this habitat on the Onllwyn Washery site are thought to be of county to regional importance. By contrast, only the dingy skipper was recorded in this habitat on the Nant Helen block. The largest stands of this habitat feature here are on the northern periphery of the active opencast in unit N3, with other significant expanses in units M3, M4 and along the rides through the felled foresty of unit J1. The

stands of this vegetation on the Nant Helen block are markedly less calcicolous and seem to move quickly towards acid grassland and heath post-disturbance. Nonetheless, the large colony of dingy skipper here is still of county importance.
This is an ephemeral habitat produced by mine working and processing activities. While these continue, new areas of this habitat will continue to be generated. However, if all or part of the site ceases to be managed in this way, then they will be quickly lost. Other forms of management, such as light to moderate grazing, periodic disturbance and rotational scrub control will then be required in order to maintain suitable conditions for this important invertebrate assemblage. Tree planting should not be undertaken in this habitat. Clearly, the key area in which to maintain and enhance short-sward ruderal grassland is the Onllwyn Washery, where there are more calcareous substrates.

3.2.3. Acidic bog and pools

Associated key species: *Helochares punctatus*; *Prionocera pubescens*; *Walckenaeria kochi*; *Agyneta olivacea*.

Though more fragmented than the mesotrophic wetlands described in sub-section 3.2.1, acid mires with bog-mosses, cottongrasses and purple moor-grass still have a diverse invertebrate fauna that includes four key species. The best area of acid bog surveyed this year is that in survey unit B1. The most important invertebrate recorded here is the Red Data Book cranefly *P. pubescens*, which probably breeds in saturated *Sphagnum* lawns around the edge of the bog pools. The two money spiders were found in both this habitat feature and in more mesotrophic fens and are therefore listed as associates for both. This habitat feature is assessed as being of county importance for invertebrates.

The water beetle *H. punctatus* was collected in a small area of floating *Sphagnum* on the morthern margin of the pool in survey unit R1. This pool was also potentially important for scarce blue-tailed damselfly (see sub-section 3.2.7).

Unit B1 is currently fenced and ungrazed. As a result, pine, birch and willow scrub are colonising the drier areas of mire and heath. Ideally, much of the scrub would be removed and light grazing reinstated.

3.2.4. Acidic grass or heath

Associated key species: *Hadrognathus longipalpis*; *Anthonomus brunnipennis*; grayling; triangle hammock-spider.

Acidic vegetation dominated by species such as common bent, sheep's fescue, wavy hair-grass, ling and bell heather is quite frequent on areas of mine workings that have been left undisturbed for longer than the ruderal vegetation described in the preceding sub-section. In general, there is much less bare ground than in the short-sward ruderal areas, so xerothermic species are less evident. However, in practice these two habitat features form a successional continuum and are frequently found in mosaic with each other. There is therefore considerable overlap between the use of the two habitat features by key species, though I have assigned each key species to one or the other here based on its known autecology and 2019 records from the site.

The management issues are the same as those described in sub-section 3.2.2. There is the potential to create a considerable expanse of new heathland habitat here in areas that are no longer to be used. Tree planting should be avoided. Overall, this habitat feature is thought to be of county importance for invertebrates.

3.2.5. Dead wood

Associated key species: *Cryptophagus ruficornis*; *Epuraea distincta*; *Cis festivus*; *Orchesia micans*; *O. minor*; *Magdalis carbonaria*

Five dead wood (saproxylic) beetles were collected at Nant Helen in 2019. The most important site for saproxylic species here is the area of wood-pasture towards the south-western extremity of the site (survey unit G1), with three of the key species only found here. Of the three remaining, the Nitidulid *E. distincta* was found on *Daedaleopsis confragosa* brackets on dead willow in WY11, the Melandryid *O. micans* was beaten from dead ash branches in K1 and the weevil *M. carbonaria* was beaten from dead alder branches on the edge of unit N4.

The wood-pasture at G1 looked to have considerable potential for saproxylic invertebrates, with a good number of overmature and veteran oak and ash that have well-developed dead wood habitat features (eg. heart rot, fallen limbs, bracket fungi etc.). Given the high apparent quality of the habitat, the dead wood invertebrate fauna was rather disappointing, with none of the more exacting indicators of parkland and wood-pasture habitats recorded. This unit also looked to have considerable potential to support populations of the rare ground beetles *Carabus intricatus* and *Calosoma inquisitor*. None were found during a night search of the site in early-June, this being the optimum time and technique for recording these two species. Overall, the dead wood invertebrate fauna of Nant Helen is assessed as of no more than district importance.

3.2.6. Woodland seepages

Associated key species: *Dicranomya lucida*; *D. aquosa*; *Thaumastoptera calceata*

Sampling in the high-quality area of this habitat feature in unit K2 showed it to have a rich invertebrate fauna that included three key cranefly species. Woodland seepages at Nant Helen have an invertebrate fauna of district importance. No management of this habitat feature is required currently.

3.2.7. Shallow pools created by mining activity

Associated key species: Scarce blue-tailed damselfly

The scarce blue-tailed damselfy also occurs frequently in quarries and other industrial sites in shallow, sparsely vegetated pools, including somewhat epemeral waterbodies such as deep vehicle ruts. The probable records from unit R1 come from a shallow pool on the edge of the active mine workings at Nant Helen. Confirmation of the presence of adults of this species here would justify an assessment of district importance for the invertebrate fauna of this habitat feature.

There is considerable scope for creating new areas of suitable habitat for this species on disused areas of the opencast mine and washery and indeed across much of the rest of the site (eg. within areas of agriculturally improved pasture or degraded stands of marshy grassland where the water table is sufficiently high to hold water).

3.2.8. Scrub and wood edges

Associated key species: Double line moth.

Scrubby 'soft' edge habitats, where open habitats grade into scrub and woodland are known to support a rich invertebrate assemblage nationally. Very extensive stands of this habitat feature are present at Nant Helen, with good examples in the open scrub habitats on the northern edge of the opencast at survey unit N3, the felled area of former conifer plantation in J1 and the scrub-heath mosaic in M1. The latter area produced the only key associate, the double line moth. Caterpillars of this species feed on various grasses growing in sheltered glades and other edge habitats. This habitat feature is assessed as being of local importance for invertebrates.

3.2.9. Streams

Associated key species: *Quedius plancus*.

The Nationally Scarce rove beetle *Q. plancus* was found in a twig and flood refuse dam in the small stream in unit I1. This habitat feature is thought to be of local importance for invertebrates.

3.3. Other invertebrate habitats at Nant Helen and Onllwyn, 2019

3.3.1. Marshy grassland

There are considerable expanses of rhôs pasture at Nant Helen. The largest areas are found on the margins of the central moorland ridge in survey units H1 and L3 and in the Onllwyn Washery block at WY4 and WY10. A major objective of the 2019 survey was to establish the status of the marsh fritillary butterfly, a species of European importance that has strong populations on the south Wales coalfield, including a colony adjacent to the site at the WTSWW Ystradfawr Reserve.

The marshy grassland habitats at Nant Helen were all searched during both the adult and larval activity period of the marsh fritillary. For the most part, these have been rather degraded by agricultural 'improvement' (drainage, over-frequent burning and probably use of herbicides and inorganic fertilisers) allied to heavy grazing pressure. They mostly have species-poor rush-dominated swards with little or no growth of the larval foodplant, devil's-bit scabious and are clearly unsuitable breeding habitat for this buttterfly. The one exception to this was in L2, which had locally very high densities of *Succisa* in marshy to acid-neutral swards. However, despite diligent searching for both adults and larvae, no evidence of marsh fritillary could be found here, or elsewhere and it is concluded that there is not currently an established breeding population at the Nant Helen site.

Techniques have been developed for the restoration of rhôs pastures. Given the presence of a large resource of degraded marshy grassland at Nant Helen and the presence of nearby populations of the butterfly, there is considerable potential to increase the area of suitable habitat for this butterfly when planning the after-use of this site. Creation of new marshy grassland habitat suitable for marsh fritillary in unit H1 would be especially valuable. This area is close to the existing colony and still has a few small patches of better rhôs, with locally frequent devil's-bit scabious.

3.3.2. Improved and semi-improved grassland

In survey unit M2, at the northern end of the Nant Helen block, there is a very extensive area of agriculturally improved and semi-improved grassland and in unit S1 there is a smaller stand of the same vegetation. Parts of M2 have quite high cover of soft rush and are probably derived from former rhôs pastures. These areas are of low importance for invertebrates.

3.3.3. Coniferous plantations

The large block of conifers in unit F1 and the much smaller un-felled area of this habitat feature remaining in J2 are of low importance for invertebrates.

4. CONCLUSIONS

The Nant Helen site supports a diverse invertebrate fauna that includes many species with high conservation status. The area of fen at the northern edge of the Onllwyn Washery (WY10 and WY11) is of particular note, having an invertebrate fauna of comparable quality to the Gors Llwyn, Onllwyn SSSI. Flower-rich ruderal grassland, acid grass-heath and acid bog habitats also support significant invertebrate assemblages, including a large breeding colony of the dingy skipper and a small population of the small blue.

Dead wood, woodland seepages and streams and wood-edges also have diverse invertebrate assemblages that include important species. The survey found no evidence of any breeding populations of the marsh fritillary butterfly.

There is considerable scope in the after-use of the site to create new areas of marshy grassland habitat for this butterfly. It should also be possible to create shallow pools suitable for scarce blue-tailed damselfly and encourage development of flower-rich grassland and heathland habitats that will benefit dingy skipper, small blue and grayling butterflies as well as many other scarce invertebrates.

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6. REFERENCES

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Appendix 7E

Amphibian Report

Welsh Government

Global Centre for Rail Excellence (GCRE)

Amphibian Survey Report

Rev A | 18 June 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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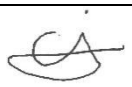
		Signature			
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1 Introduction

1.1 Background

Ove Arup & Partners Ltd (Arup) was commissioned by the Welsh Government (WG) to undertake a range of consultancy services in relation to the Global Centre for Rail Excellence (GCRE), hereafter referred to as 'the Project'.

As part of that commission, a range of ecological surveys have been undertaken to identify the baseline ecological conditions of the Project area, to inform the assessment of impacts as part of the Environmental Impact Assessment (EIA) process.

This document describes the amphibian surveys undertaken for the Project.

1.2 Objectives

The objectives of the amphibian survey were to ascertain the following:

- Presence/likely absence of great crested newts *Triturus cristatus* within the site;
- Population size-class of great crested newts, if present;
- Distribution of great crested newts, if present; and
- An appreciation of other notable[1] amphibian species that may be present.

[1] 'Notable' species and habitats considered in this report include species and habitats of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales, in response to section 7 of the Environment (Wales) Act 2016, in addition to any species considered to be of significance for nature conservation such species listed in red data books, the Royal Society for the Protection of Birds (RSPB) 'Birds of Conservation Concern' lists and or Local Biodiversity Action Plans (LBAPs).

2 Project Description and Context

The WG are proposing to develop a rail testing, maintenance, research, development and storage facility (also referred to as the Global Rail Centre for Excellence) at the site of the Onllwyn washery and Nant Helen open cast mine site. The site for development is approximately 475 ha.

The proposed site is currently being mined by Celtic Energy, who will cease extraction operations in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and agreements with Powys County Council (PCC) and Neath Port Talbot County Borough Council (NPTCBC). This includes Section 106 planning obligations and planning conditions that need to be discharged.

Celtic Energy has submitted two recent planning applications for the site, including: the revised restoration strategy for approval (Planning reference number: 19/1899/REM) which would change the existing approved restoration scheme (for planning application ref 18/1070/REM). And, the Nant Helen complementary earthworks application for approval (Planning reference number: 20/0738/FUL) The purpose of these applications is to allow for a ‘flexible and adaptable landform for a variety of future uses on restoration, including the use of the site as a rail testing and storage facility, proposed by the WG.

3 Site Description

The study area is shown on Figure 1 and is hereafter referred to as the ‘site’.

The site is within the Dulais Valley located within Powys and Neath Port Talbot, with the Brecon Beacons National Park Authority boundary immediately to the north. Nearby settlements include Onllwyn, Seven Sisters, Ystradgynlais, Caehopkin, Abercrave or Coelbren.

The site is predominantly brownfield land that has been heavily worked by open cast mining. Much of the site has been revegetated.

4 Study Area

The study area encompasses the majority of land within the Nant Helen open cast operational site, which at the time of commencing the ecological surveys was considered to be the likely boundary of the project site.

For the present survey, which is detailed in this report, guidance[2] recommends assessing all waterbodies within 500 m of such a project, except where great crested newts are highly unlikely to be present or where the proposed development is unlikely to affect great crested newts.

The study area excludes waterbodies on the other side of such physical barriers (i.e. roads).

[2] English Nature (2001*) Great crested newt survey guidelines*.

5 Legislation

Great crested newt is a European Protected Species (EPS) under the Conservation of Habitats and Species Regulations 2017 (as amended) (known as the Habitats Regulations). The Habitats Regulations protects EPS against the following:

- Deliberate capturing, injuring or killing of any wild EPS;
- Deliberate disturbance of any wild EPS;
- Deliberate removal or destruction of the eggs of any EPS; and
- The damage or destruction of a breeding site or resting place of any EPS.

Great crested newt is also fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) (WCA) along with natterjack toad *Bufo calamita*. Natterjack toad is almost exclusively confined to coastal sand dune systems, coastal grazing marshes and sandy heaths, however, and are therefore unlikely to be found within the study area. The WCA protects great crested newt and natterjack toad against intentional killing, injuring or taking, possession and trade, and disturbance through prohibition of actions that could affect places they use for shelter.

Palmate newt *Lissotriton helveticus*, smooth newt *Triturus vulgaris*, common toad *Bufo bufo* and common frog *Rana temporaria* are only partially protected under the WCA. This protection prohibits the trading of these three species.

Great crested newt, natterjack toad and common toad are listed as priority species of principal importance for the conservation of biodiversity in response to Section 7 of the Environment Act (Wales) 2016. This legislation places the duties on public bodies in Wales to conserve and enhance biodiversity in the exercise of their functions, including the consideration of the resilience of ecosystems in terms of their diversity, connectivity, adaptability, scale and condition.

Lastly, great crested newt, common toad and natterjack toad are all listed as UK Biodiversity Action Plan Priority Species. Action Plans exist for each UK BAP Priority Species to demonstrate the UK's commitment to help reduce or halt the significant losses in global biodiversity.

Actions which are prohibited by legislation can be made lawful on the approval and granting of a licence from Natural Resources Wales (NRW), subject to conditions.

6 Methodology

6.1 Desk Study

A data search was obtained from the Biodiversity Information Service (BIS[3]) for Powys & Brecon Beacons National Park on 21st November 2018. The data search included all historic records of protected and/or notable[1] species from the last 10 years within a 5 km radius of the site (Figure 1). This included protected and/or notable amphibian species, which are summarised in Table 2 in the Desk Study Results section below.

The relevant reports produced for the previous Environmental Statement (ES)[4] for the Project were also reviewed for records of protected and/or notable amphibian species.

All waterbodies within the study area (Figure 2) were identified through a desk study using publicly available ordnance survey mapping and aerial imagery, and the previous ES.

6.2 Field Surveys

6.2.1 Habitat Suitability Index Assessment

All waterbodies within the study area (Figure 2) were assessed for their suitability to support great crested newt using the standard Habitat Suitability Index (HSI)[5;6] methodology. HSI assessments were carried out on the 15th, 16th and 24th April 2019.

The methodology has been designed to evaluate habitat quality in order to assess which waterbodies provide suitability habitat for great crested newts as breeding ponds. The HSI is a numerical index, which ranges from 0 to 1. It is calculated using ten key habitat criteria and is based on the assumption that habitat quality determines great crested newt presence/absence. Using this standard approach, ponds with higher scores are considered more likely to support great crested newts compared to those with lower scores (see Table 1 below).

Table 1: Predicted presence of great crested newts based upon HSI results

HSI	Pond Suitability	Predicted Occupancy
<0.5	Poor	0.03
0.5-0.59	Below average	0.20

[3] Aderyn is a Local Environmental Records Centres (LERC) Wales system, developed and maintained by the Biodiversity Information Service (BIS).
[4] Celtic Energy Ltd (2011). *Environmental Statement*.
[5] Amphibian and Reptile Groups of the United Kingdom, *ARG UK Advice Note 5, Great Crested Newt Habitat Suitability Index*, May 2010.
[6] Oldham R.S., Keeble J., Swan M.J.S. & Jeffcote M.(2000*). Evaluating the suitability of habitat for the Great Crested Newt (Triturus cristatus)*. Herpetological Journal 10 (4), 143-155.

HSI	Pond Suitability	Predicted Occupancy
0.6-0.69	Average	0.55
0.7-0.79	Good	0.79
>0.8	Excellent	0.93

Great crested newt were considered likely to be absent from ponds assessed as 'poor', whilst ponds assessed as 'below average' or above required further survey to determine presence or likely absence. This further survey was in the form of Environmental DNA (eDNA) sampling, which is described in the following section.

6.2.2 Environmental DNA Survey

eDNA tests were carried out on the ten waterbodies (shown on Figure 2) that were assessed as 'below average' or above during the HSI assessment, in line with best practice as detailed above in section 6.2.1.

In accordance with best practice guidelines[7] surveys were undertaken within the optimum timeframes (sampling was undertaken on the 15th, 16th and 24th April 2019) and followed the recommended methodology. Collected samples were sent to NatureMetrics[8] for analysis.

6.2.3 Surveyors

Field surveys were carried out by pairs of ecologists, all experienced in undertaking HSI Assessments and eDNA surveys across a range of projects: Catherine Jones MCIEEM with Rosemary Cripps MCIWEM C.WEM CEnv, and Martyn Owen MCIEEM with Stuart Thomas MCIEEM.

Catherine and Martyn both hold Natural England Great Crested Newt Class Licences (Licence Registration Numbers 2018-33182-CLS-CLS and 2016-19752-CLS-CLS, respectively). Stuart holds an NRW Class Licence (Licence Registration Number 78910:OTH:SA:2018). Rosemary Cripps is an accredited agent on NRW Licence Number S086134/1.

6.3 Limitations

There are a small number of areas that lie within a 500 m buffer around the site, but fall outside of the study area, which were therefore not accessible at the time of the surveys. These areas were checked using publicly available ordnance survey mapping and aerial imagery, and during walkovers (looking onto adjacent land). This confirmed the likely absence of further waterbodies, which may have required assessment in terms of great crested newts. One area to the south was also separated from the site by the River Dulais, which is considered to be a physical barrier to movement by great crested newt.

[7] https://naturalresources.wales/media/3509/guidance-on-use-of-dna-sampling-of-great-crested-newts.pdf
[8] NatureMetrics Ltd. https://www.naturemetrics.co.uk/

The findings presented in this study represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys are limited by factors which affect the presence of flora and fauna, factors such as the time of year and natural behaviour of the animals. Nevertheless, these surveys were conducted at the optimal survey periods and using methodologies which are in accordance with published guidelines.

7 Results

7.1 Desk Study

The BIS provided 12 records of common toad, 32 records of common frog, and five records of palmate newt within 5 km of the site from the last 10 years. These records are summarised in Table 2. No records of great crested newt were returned by BIS.

Table 2: Summary of historic amphibian records within 5 km of the site

Species	Latin name	Status	Number of records	Approximate distance of closest record
Common toad	*Bufo bufo*	WCA (sale only)	12	0.2 km
Common frog	*Rana temporaria*	WCA (sale only)	32	0.7 km
Palmate newt	*Lissotriton helveticus*	WCA (sale only)	5	1.7 km

The surveys carried out for the 2011 ES established the likely absence of great crested newt, and the presence of palmate newt, common frog and common toad within the study area.

A total of 76 waterbodies were identified within the study area through the desk study, all of which are shown on Figure 2.

7.2 Field Surveys

7.2.1 HSI Assessment

Of the 76 waterbodies identified, ten were assessed as having 'below average' suitability and 64 were assessed as having 'poor' suitability for great crested newt during the HSI assessment. The remaining three waterbodies were found to be dry and were thus not subject to a HSI assessment or subsequent eDNA sampling. The HSI calculations for each waterbody are detailed in Appendix A and results of the HSI assessments are shown on Figure 2.

7.2.2 eDNA Survey

The ten eDNA samples that were taken from the 'below average' waterbodies were all returned as negative. The eDNA results are shown on Figure 2 with results forms provided in Appendix B.

7.2.3 Incidental Amphibian Records from Other Surveys

No great crested newt or other amphibians were recorded during any of the HSI or eDNA surveys. However, amphibian species including common frog, common toad, and palmate and/or smooth newt, were recorded on multiple occasions

during the 2019 suite of reptile surveys.[9] The amphibians were recorded within terrestrial habitat either on or near artificial reptile refugia.

It is therefore considered that common amphibian species such as these will be present throughout the survey area where suitable habitats occur. Amphibian species recorded during the reptile surveys are detailed in Appendix C and shown on Figure 3.

[9] Arup (2019) *Nant Helen Complementary Restoration Earthworks: Reptile Survey Report*.

8 Conclusions

Habitat Suitability Index surveys on site identified 64 waterbodies that were of 'below average' suitability for great crested newt and were not surveyed further. There were 10 waterbodies on site that were considered to be of 'poor' suitability. These waterbodies were then subject to eDNA surveys, but all samples were negative for great crested newt DNA.

No great crested newts were recorded during any of the surveys. Great crested newt is therefore considered likely to be absent from the site and no further survey is required at this time. However, common amphibian species, such as common frog, common toad, smooth newt and palmate newt are present in some areas on site.

A full ecological impact assessment will be included within the Environmental Statement for the project and this will include an assessment of the significance of impacts from the project on protected and/or notable amphibian species. This will also detail any mitigation or compensation measures required to ensure there is no significant effect on amphibian species within the site.

This report is the result of the survey work undertaken in April 2019. This report refers, within the limitations stated, to the condition of the site at the time of the surveys. Changes in legislation, guidance, best practice, etc. may necessitate a re-assessment/survey, as may the passage of time.

The results of these surveys are considered valid for a minimum of 18 months to a maximum of 3 years. If more than 18 months elapses before any planning application is submitted, the requirement for repeat surveys should be reviewed[10]. No warranty is given as to the possibility of future changes in the condition of the site.

[10] Chartered Institute of Ecology and Environmental Management (2019) *Advice Note on the Lifespan of Ecological Reports and Surveys.*

Figures

A3

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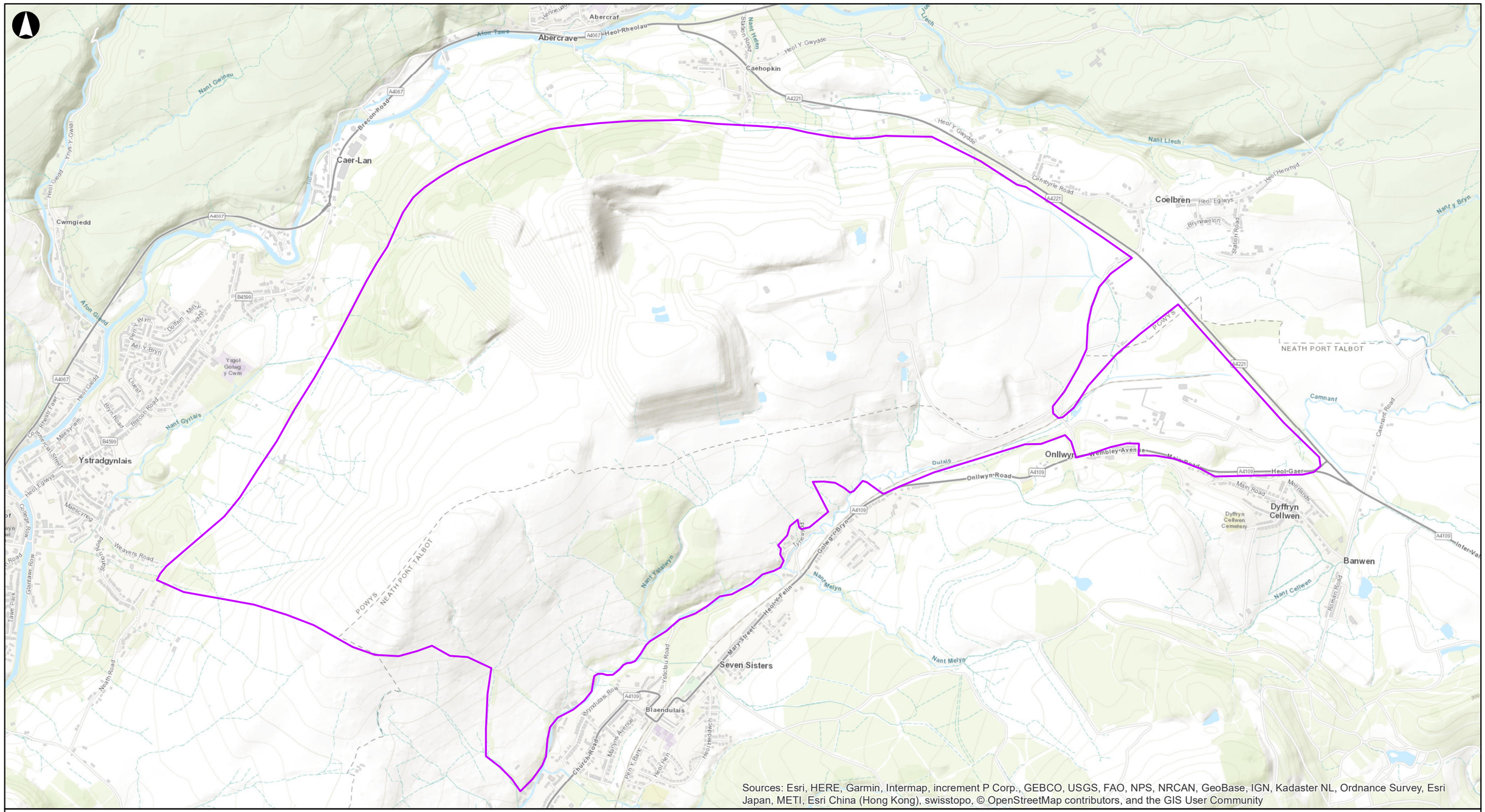

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LEGEND

Study Area

Issue	Date	By	Chkd	Appd
F1	2019-11-14	EA	CP	NH

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Welsh Government

Job Title

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Figure 1
Study Area

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Drawing No	Issue
001	**F1**

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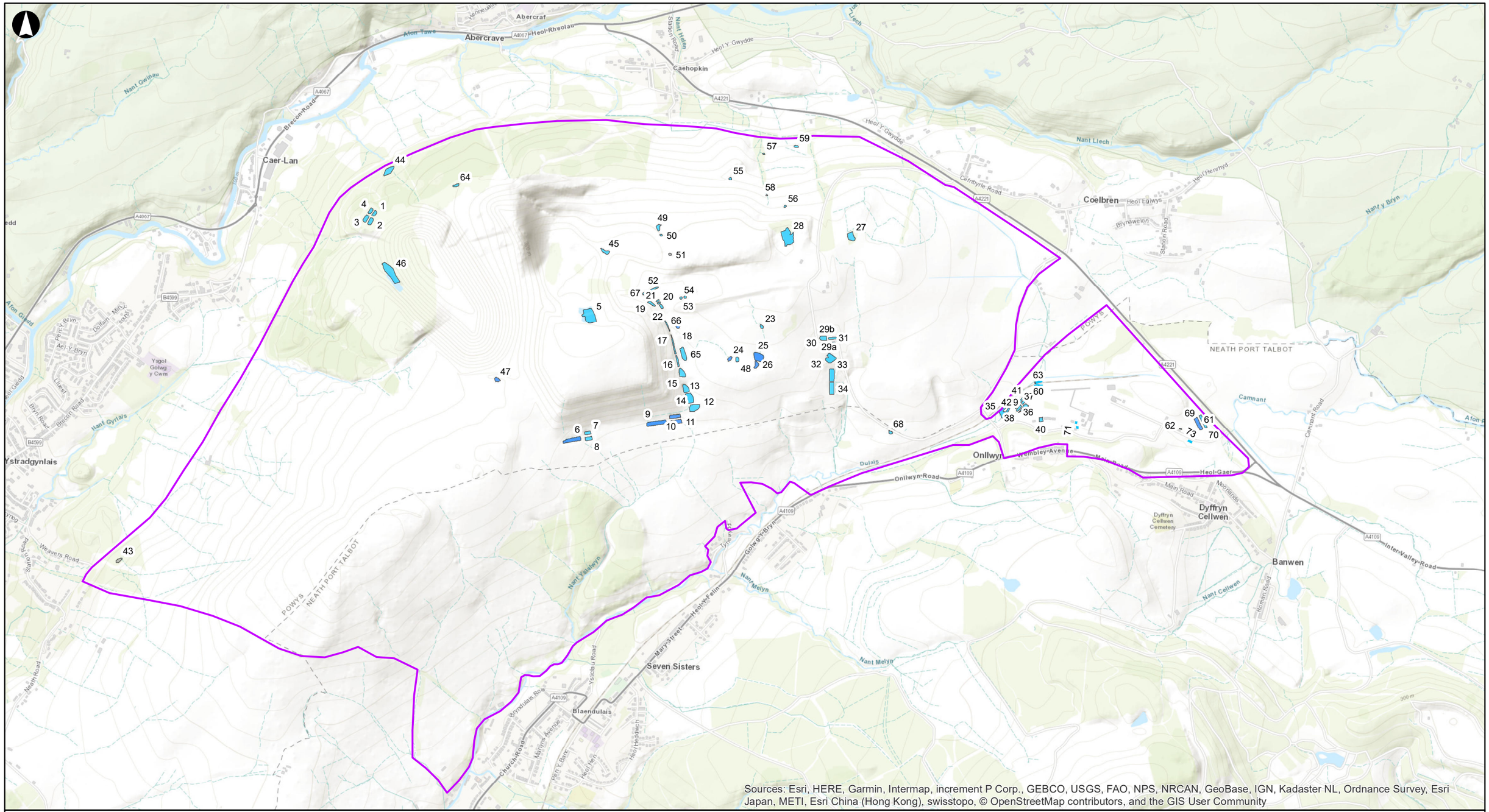

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LEGEND

- Study Area
- Poor HSI score
- Poor HSI score
- Below average HSI score, negative eDNA result
- Dry

Issue	Date	By	Chkd	Appd
F1	2019-11-14	EA	CP	NH

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Figure 2
Waterbody locations and field survey results
Sheet 1

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Drawing No	Issue
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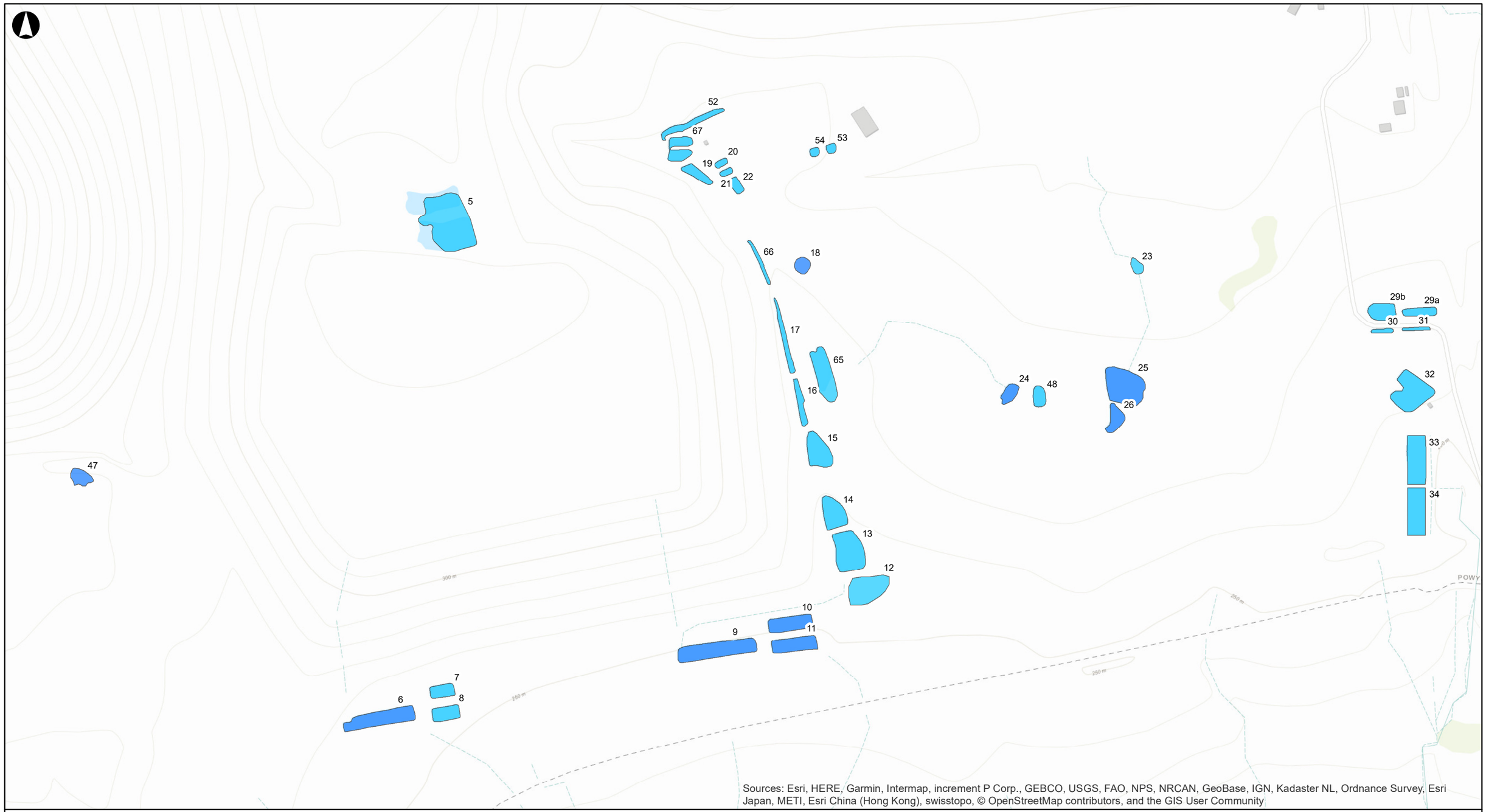

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LEGEND

- Study Area
- Poor HSI score
- Below average HSI score, negative eDNA result

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Figure 2
Waterbody locations and field survey results
Sheet 2

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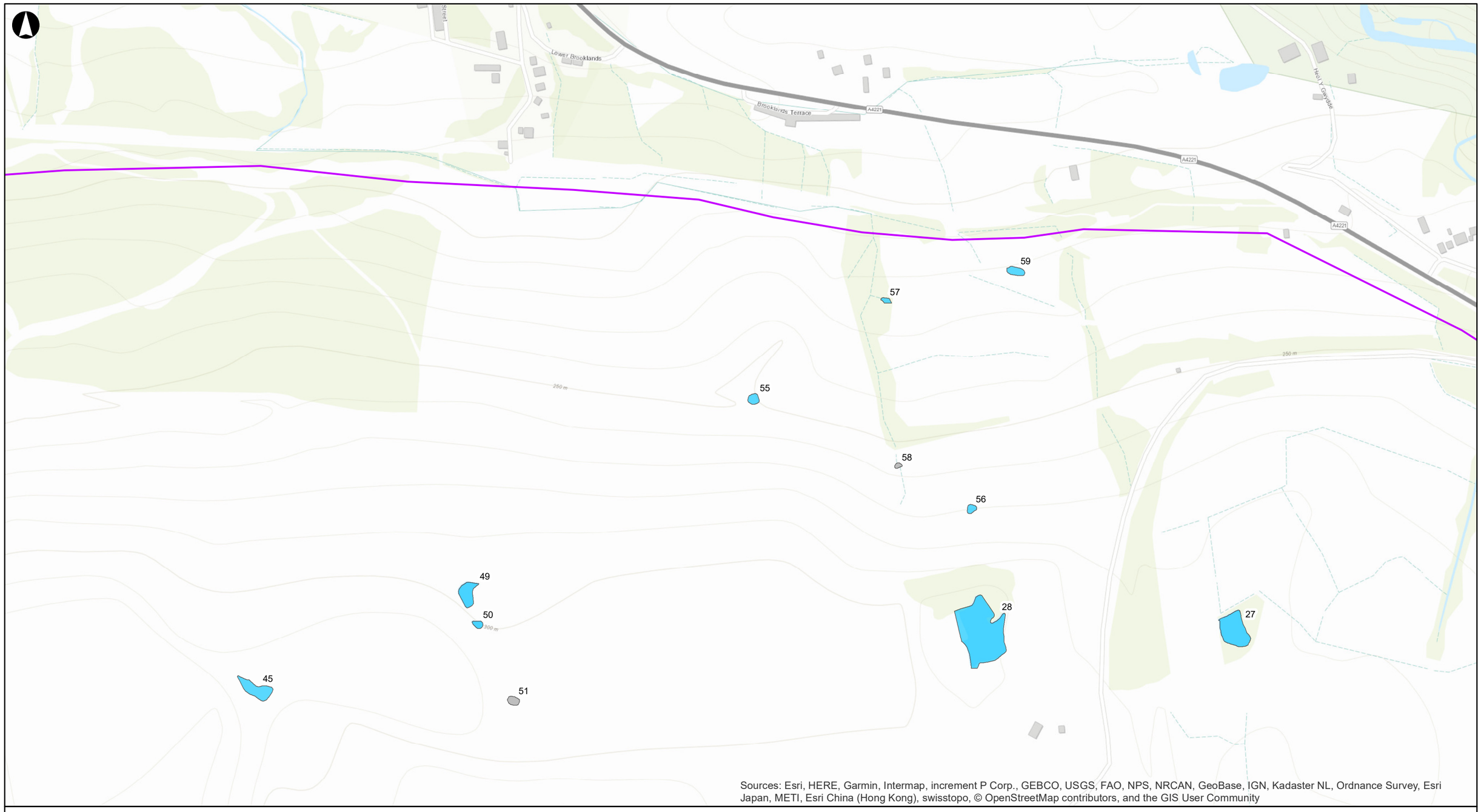

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LEGEND

- Study Area
- Poor HSI score
- Dry

Issue	Date	By	Chkd	Appd
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Figure 2
Waterbody locations and field survey results
Sheet 3

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Drawing No	Issue
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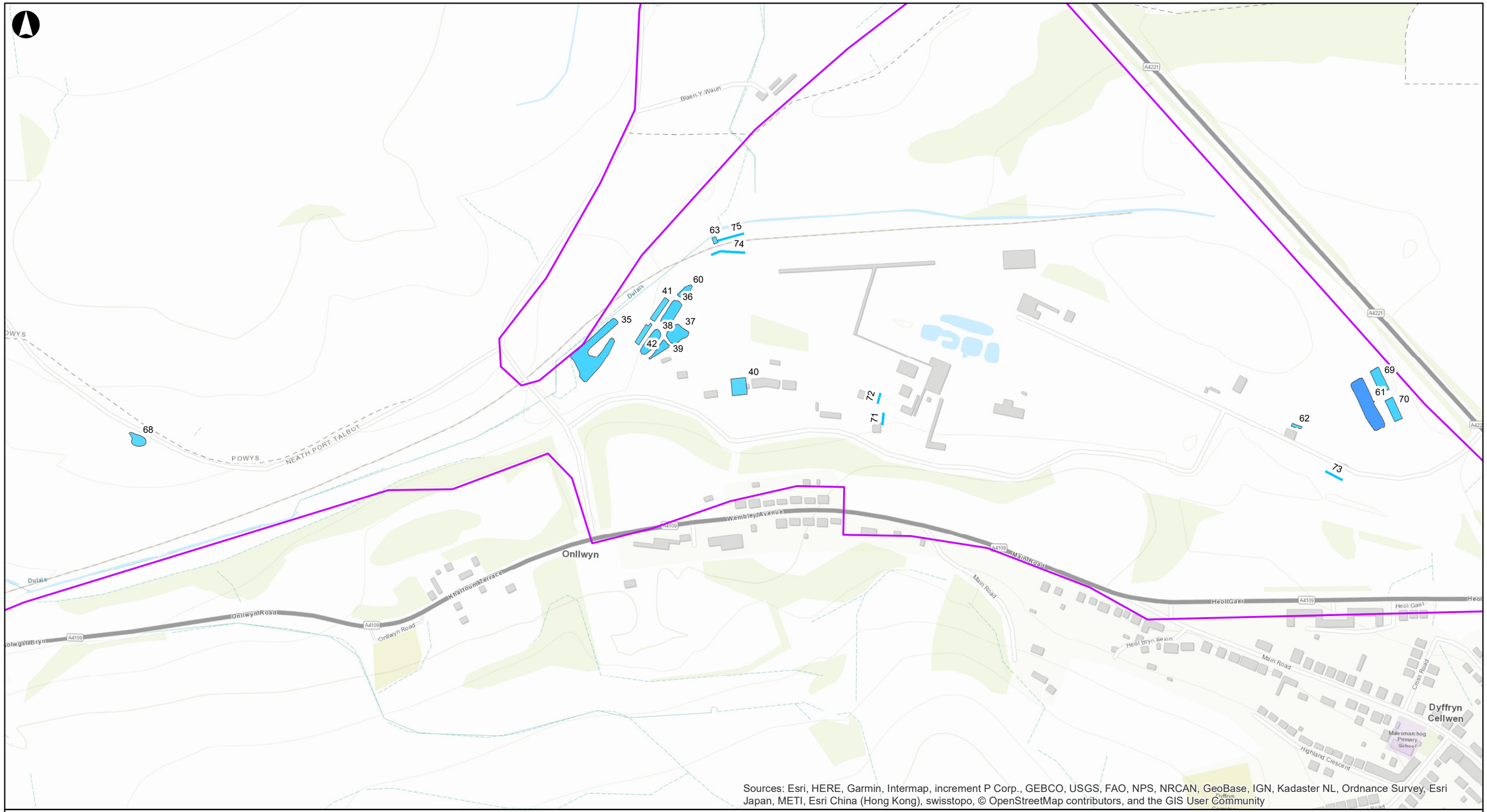

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LEGEND

- Study Area
- Poor HSI score
- Poor HSI score
- Below average HSI score, negative eDNA result

Issue	Date	By	Chkd	Appd
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Figure 2
Waterbody locations and field survey results
Sheet 4

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Drawing No	Issue
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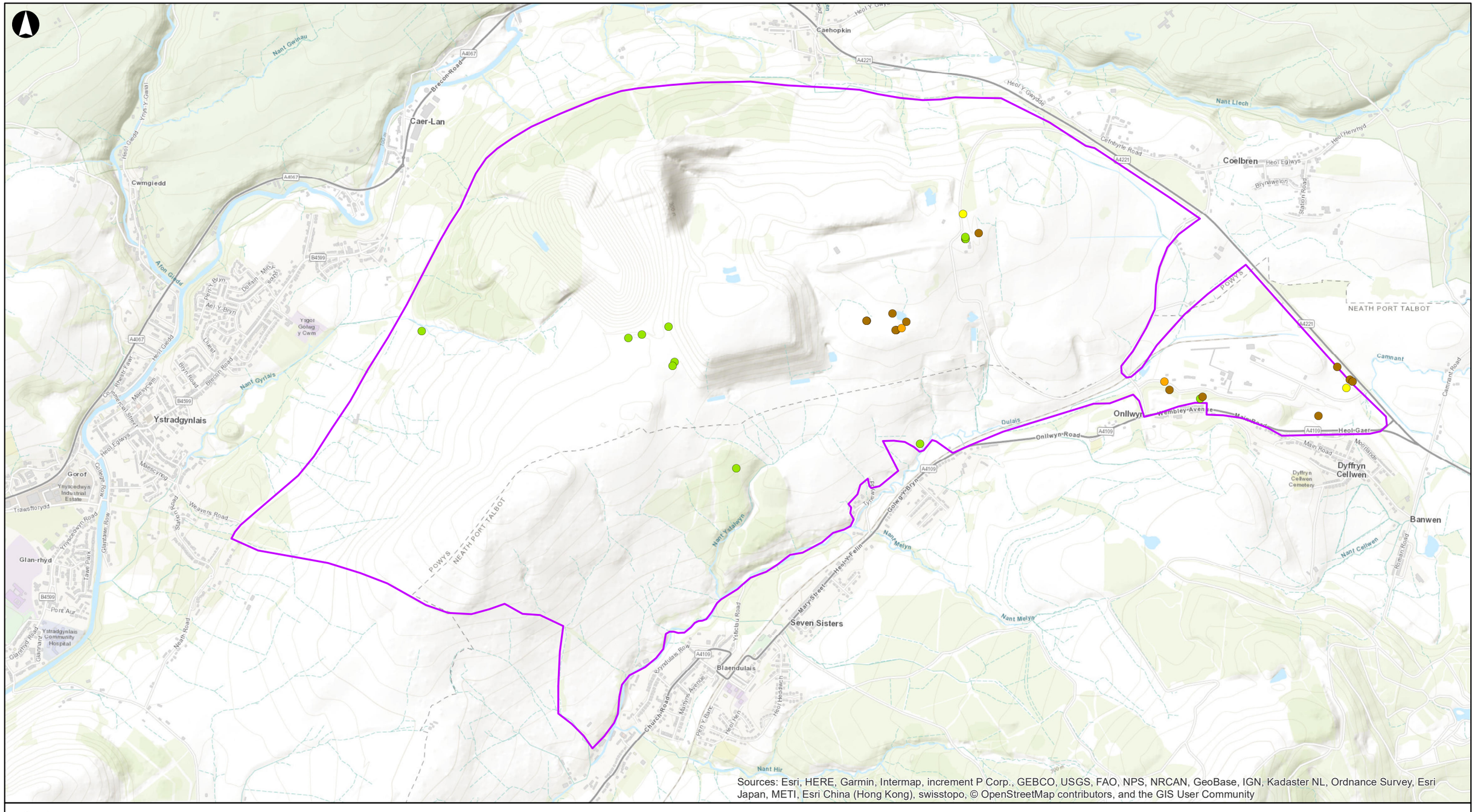
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Cwmgiedd
Ystradgynlais
Onllwyn
Dyffryn Cellwen
Banwen
Glan-rhyd
Seven Sisters
Blaendulais
NEATH PORT TALBOT
POWYS
Nant Gwinau
Nant Llech
Nant Melyn
Nant Hir
Nant Gyrlais
Nant Ydalwyn
Onllwyn-Road
Brecon-Road
Heol Y Glwydde
Celynfyrle Road
Heol Egwys
Brynawelon
Station Road
Heol Henrhyd
Camnant
Camnant Road
Dulais
Main Road
Heol-Gaer
Mountain Rd
Dyffryn Cellwen Cemetery
Gorof
Ynyscedwyn Industrial Estate
Trawsfforydd
Ynyscedwyn Road
Glantaw Row
Tawe Park
Pont Aur
Ystradgynlais Community Hospital
Glanmor Road
Glanaman Road
Neath Road
Station Road
Weavers Road
Maesycwm
Bryn Road
Brecon Road
Heol Cwmrhesyfaenor
Heol Egwys
Heol Cwmgiedd
Aeron Gwyddi
Aeron Fawr
Pen-Y-Bryn
Dolfan Mirtyl
Ael-Y-Bryn
Llaest
Ysgol Gynradd Gymraeg Ystalyfera
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Ysgol Bro Dur
Ysgol Gynradd Gymraeg Y Cwm
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Ysgol Gynradd Gymraeg Alltwen
Ysgol Gyfun Gymraeg Ystalyfera

Appendix A

HSI Assessment Results

A1 HSI Assessment Results

TableA1: Details and results of HSI assessment[11] and eDNA sampling

Water-body No.	NGR	HSI Assessment												Comments
		Date of HSI	SI_1	SI_2	SI_3	SI_4	SI_5	SI_6	SI_7	SI_8	SI_9	SI_{10}	HSI Score	Pond Suitability	
1	SN 80847 11602	15/04/2019	0.01	0.40	0.90	0.67	1.00	0.67	1.00	1.00	0.67	0.51	**0.47**	Poor	Part of settlement complex
2	SN 80826 11559	15/04/2019	0.01	0.40	0.90	0.67	1.00	0.67	1.00	1.00	0.33	0.51	**0.44**	Poor	Part of settlement complex
3	SN 80803 11573	15/04/2019	0.01	0.50	0.90	0.67	1.00	0.67	1.00	1.00	0.33	1.00	**0.48**	Poor	Part of settlement complex, water clear
4	SN 80826 11617	15/04/2019	0.01	0.40	0.90	0.67	1.00	0.67	1.00	1.00	0.33	0.51	**0.44**	Poor	Part of settlement complex
5	SN 81999 11052	15/04/2019	0.01	0.71	1.00	0.33	1.00	1.00	1.00	1.00	0.33	0.31	**0.43**	Poor	Isolated on high ground. Slurry pond pumped from barrel wash
6	SN 81911 10392	16/04/2019	0.01	0.70	0.90	1.00	1.00	0.67	1.00	1.00	0.67	0.81	**0.54**	Below average	Part of three pond complex with good water quality, pond weed and *Typha* spp.
7	SN 81982 10426	16/04/2019	0.01	0.40	0.90	1.00	1.00	0.67	1.00	1.00	0.67	0.41	**0.48**	Poor	Canada goose and mallard in area. Part of three pond complex. Good water quality with some *Potomogeton* spp.
8	SN 81992 10398	16/04/2019	0.01	0.40	0.90	1.00	1.00	0.67	1.00	1.00	0.67	0.41	**0.48**	Poor	Canada goose and mallard in area. Part of three pond complex. Good water quality with some *Potomogeton* spp.
9	SN 82345 10475	16/04/2019	0.01	0.80	0.90	1.00	1.00	0.67	1.00	1.00	0.67	0.41	**0.52**	Below average	Canada goose nesting near pond and mallard on pond. Water clear, though some suspended sediment. Part of complex of three ponds with in and outflow
10	SN 82466 10522	16/04/2019	0.01	0.90	0.90	1.00	1.00	0.67	1.00	1.00	0.67	0.46	**0.53**	Below average	Canada goose nesting near pond and mallard on pond. Water clear, with blue tinge. Part of complex of three ponds with in and outflow
11	SN 82462 10491	16/04/2019	0.01	0.90	0.90	1.00	1.00	0.67	1.00	1.00	0.67	0.41	**0.52**	Below average	Canada goose nesting near pond and mallard on pond. Water clear, with blue tinge. Part of complex of three ponds with in and outflow
12	SN 82551 10556	16/04/2019	0.01	0.30	1.00	0.67	1.00	1.00	1.00	1.00	0.67	0.36	**0.47**	Poor	Small pond not within drainage complex
13	SN 82536 10612	16/04/2019	0.01	0.80	0.90	0.33	1.00	1.00	1.00	1.00	0.67	0.31	**0.47**	Poor	Very steep banks, part of drainage ditch complex
14	SN 82517 10667	16/04/2019	0.01	0.45	0.90	0.33	1.00	1.00	1.00	1.00	0.33	0.71	**0.45**	Poor	Within drainage ditch complex, stand of Phragmites spp.
15	SN 82494 10749	16/04/2019	0.01	0.40	1.00	0.33	1.00	1.00	1.00	1.00	0.33	0.31	**0.41**	Poor	Shallow, part of drainage channel complex. Absence of aquatic vegetation, poor water quality
16	SN 82469 10813	15/04/2019	0.01	0.25	1.00	0.33	1.00	1.00	1.00	1.00	0.33	0.36	**0.40**	Poor	Part of drainage channel complex
17	SN 82448 10894	16/04/2019	0.01	0.40	0.50	0.33	1.00	1.00	1.00	1.00	0.33	0.31	**0.38**	Poor	Shallow, part of drainage ditch system, no surrounding vegetation
18	SN 82469 10994	15/04/2019	0.01	0.45	0.90	1.00	1.00	0.67	1.00	1.00	0.67	0.51	**0.50**	Below average	Natural pond within pasture
19	SN 82329 11119	15/04/2019	0.01	0.10	0.10	0.33	1.00	1.00	1.00	1.00	0.33	0.31	**0.28**	Poor	Shallow, used for storage of wash water
20	SN 82360 11131	15/04/2019	0.01	0.10	0.90	0.01	1.00	1.00	1.00	1.00	0.33	0.31	**0.25**	Poor	Used to store wash water
21	SN 82366 11119	15/04/2019	0.01	0.10	0.90	0.01	1.00	1.00	1.00	1.00	0.33	0.31	**0.25**	Poor	Used to store/pump wash water
22	SN 82381 11100	15/04/2019	0.01	0.09	0.90	0.01	1.00	1.00	1.00	1.00	0.33	0.31	**0.25**	Poor	Used to store/pump wash water
23	SN 82921 10993	15/04/2019	0.01	0.05	1.00	1.00	1.00	1.00	1.00	0.96	0.67	0.70	**0.43**	Poor	Reeds and aquatic vegetation present. Small pond, quite exposed and unfenced.

[11] Suitability Index $(SI)_1$ = geographic location; SI_2 = pond area; SI_3 = permanence; SI_4 = water quality; SI_5 = shade; SI_6 = waterfowl; SI_7 = fish; SI_8 = pond count; SI_9 = terrestrial habitat; SI_{10} = macrophytes.
HSI Score = $(SI_1 \times SI_2 \times SI_3 \times SI_4 \times SI_5 \times SI_6 \times SI_7 \times SI_8 \times SI_9 \times SI_{10})^{1/10}$

Water-body No.	NGR	HSI Assessment												Comments
		Date of HSI	SI_1	SI_2	SI_3	SI_4	SI_5	SI_6	SI_7	SI_8	SI_9	SI_{10}	HSI Score	Pond Suitability	
24	SN 82749 10821	15/04/2019	0.01	0.30	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50	**0.52**	Below average	Fenced
25	SN 82897 10833	15/04/2019	0.01	N/A (too large)	0.90	1.00	1.00	0.67	1.00	0.52	1.00	0.35	**0.54**	Below average	*Typha* spp. present and *Juncus* spp. around edge
26	SN 82892 10788	15/04/2019	0.01	1.00	0.90	1.00	1.00	1.00	1.00	1.00	1.00	0.60	**0.59**	Below average	Kidney-shaped pond. About 25% submerged vegetation, the rest emergent
27	SN 83399 11473	16/04/2019	0.01	0.83	0.90	1.00	1.00	0.67	0.67	0.30	1.00	0.40	**0.46**	Poor	Canada goose nesting on pond edge and another nesting on island. Pond surrounded by willow, reed, bramble and scrub. Water boatman seen.
28	SN 83035 11480	16/04/2019	0.01	N/A (too large)	0.90	0.67	1.00	0.67	1.00	0.08	1.00	0.30	**0.44**	Poor	Pond that collects run-off from slag heap. Canada goose nesting on island
29a	SN 83300 10934	16/04/2019	0.01	0.80	0.90	0.67	1.00	0.67	1.00	0.66	0.67	0.35	**0.47**	Poor	Two Canada geese nesting on pond edge. Ponds collect run-off from road
29b	SN 83249 10933	16/04/2019	0.01	0.98	0.90	0.67	1.00	0.67	1.00	0.66	0.67	0.35	**0.48**	Poor	Collects run-off from road. Some oil on surface of water. Mallard sitting on eggs on pond edge
30	SN 83249 10907	16/04/2019	0.01	0.05	0.10	0.01	1.00	1.00	1.00	0.66	0.67	0.30	**0.19**	Poor	
31	SN 83295 10911	16/04/2019	0.01	0.05	0.10	0.01	1.00	1.00	1.00	0.66	0.67	0.30	**0.19**	Poor	Coal dust settlement ditch, next to wheel wash area, dried out.
32	SN 83288 10826	16/04/2019	0.01	0.81	0.90	0.33	1.00	0.67	1.00	0.66	0.67	0.35	**0.44**	Poor	Very steep-sided. Small amount of macrophytes on western edge. Two Canada geese present.
33	SN 83294 10732	16/04/2019	0.01	0.60	0.90	0.67	1.00	1.00	1.00	0.66	1.00	0.30	**0.48**	Poor	Settling ponds from the wheel wash bay and access road.
34	SN 83294 10665	16/04/2019	0.01	0.70	0.90	0.67	1.00	1.00	1.00	0.66	1.00	0.30	**0.49**	Poor	Settling pond from wheel wash bay.
35	SN 84206 10533	24/04/2019	0.01	0.40	0.90	0.33	1.00	0.01	1.00	1.00	0.33	1.00	**0.29**	Poor	High sediment load in water, water evidently heavily contaminated with coal dust. Canada goose nest and mallard present
36	SN 84322 10598	15/04/2019	0.01	0.40	1.00	0.33	1.00	0.67	1.00	0.74	0.67	0.30	**0.41**	Poor	Pond lined with coal sediment
37	SN 84331 10574	15/04/2019	0.01	0.20	0.50	0.33	1.00	0.67	1.00	0.74	0.67	0.40	**0.37**	Poor	Coal sediment on banks and coal sediment sand banks in pond. Canada goose likely nesting on bank. Bulrush and reeds on one bank but no other macrophyte cover
38	SN 84295 10562	24/04/2019	0.01	0.21	0.90	0.01	1.00	1.00	1.00	1.00	0.33	0.31	**0.27**	Poor	On edge of washery and receiving run-off water from site, resulting in heavy sediment load (coal dust). Bulrushes on banks. Increased water level resulting in overland flow between waterbody 38 and 42, and receiving water from 39
39	SN 84306 10549	15/04/2019	0.01	0.20	0.50	0.33	1.00	0.67	1.00	0.74	0.67	0.35	**0.36**	Poor	Algae in pond, coal sediment banks, waterbody 37 drains into this waterbody
40	SN 84411 10500	24/04/2019	0.01	0.45	0.90	0.01	1.00	1.00	1.00	1.00	0.01	0.36	**0.21**	Poor	Square waterbody. Clear water pumped into this waterbody from polishing ponds after settlement. Very diluted so only trace levels of contaminants present, but water heavily contaminated with coal dust. Used to fill bowsers and wet site. Water within this waterbody also gets pumped.
41	SN 84306 10603	24/04/2019	0.01	0.28	0.90	0.01	1.00	1.00	1.00	1.00	0.33	0.31	**0.28**	Poor	Tank on edge of washery and receiving run-off water from site, resulting in heavy sediment load (coal dust)
42	SN 84285 10572	15/04/2019	0.01	0.40	0.50	0.33	1.00	1.00	1.00	0.44	0.67	0.35	**0.38**	Poor	
43	SN 79477 09747	15/04/2019	DRY												
44	SN 80925 11829	15/04/2019	0.01	0.91	0.90	0.67	0.40	0.67	1.00	1.00	1.00	0.36	**0.47**	Poor	Receives discharge water from settlement lagoons. Water shows turquoise colouration
45	SN 82079 11396	15/04/2019	0.01	0.45	0.50	0.01	1.00	1.00	1.00	1.00	0.01	0.31	**0.19**	Poor	Shallow pond on spoil tip. No vegetation
46	SN 80958 11264	15/04/2019	0.01	0.02	0.90	0.33	1.00	1.00	1.00	1.00	0.01	0.31	**0.21**	Poor	In base of working quarry. 25-30m deep. Water turquoise in colouration
47	SN 81503 10710	15/04/2019	0.01	0.60	0.90	1.00	1.00	0.67	1.00	1.00	0.67	0.41	**0.50**	Below average	Canada goose on nest within pond. Natural pond on edge of workings

Water-body No.	NGR	HSI Assessment												Comments
		Date of HSI	SI_1	SI_2	SI_3	SI_4	SI_5	SI_6	SI_7	SI_8	SI_9	SI_{10}	HSI Score	Pond Suitability	
48	SN 82790 10816	15/04/2019	0.01	0.05	0.10	1.00	1.00	1.00	1.00	1.00	1.00	0.85	**0.37**	Poor	Boggy area with ponding in fenced off area
49	SN 82368 11524	15/04/2019	0.01	0.20	0.90	0.01	1.00	1.00	1.00	1.00	0.01	0.31	**0.19**	Poor	Small pond within works area, reduced in area (dried) compared to mapped area. No surrounding vegetation
50	SN 82382 11485	15/04/2019	0.01	0.10	0.90	0.01	1.00	1.00	1.00	1.00	0.01	0.31	**0.18**	Poor	Small pond within works area. Steep sides and low water quality
51	SN 82428 11381	15/04/2019	DRY												
52	SN 82320 11186	15/04/2019	0.01	0.40	0.90	0.33	1.00	1.00	1.00	1.00	0.33	0.31	**0.41**	Poor	Thin area to hold water from wash plant. Recently re-configured
53	SN 82510 11153	15/04/2019	0.01	0.30	0.90	0.33	1.00	1.00	1.00	1.00	0.33	0.41	**0.41**	Poor	Small circular pond used for wash water. After cleaning, water drains back into pond
54	SN 82489 11148	15/04/2019	0.01	0.30	0.90	0.33	1.00	1.00	1.00	1.00	0.33	0.31	**0.39**	Poor	Small circular pond used for wash water. After cleaning, water drains back into pond
55	SN 82751 11788	16/04/2019	0.01	0.30	0.90	1.00	1.00	1.00	0.67	0.44	1.00	0.85	**0.48**	Poor	In depression and fenced off. Looks to have been used historically as part of the mine as large pipe
56	SN 83044 11639	16/04/2019	0.01	0.05	0.50	1.00	1.00	1.00	1.00	0.44	1.00	1.00	**0.40**	Poor	Infinity pool. Surface area of water 10m x 10m approx.
57	SN 82927 11923	16/04/2019	0.01	0.05	0.50	1.00	0.30	1.00	1.00	0.44	1.00	0.85	**0.35**	Poor	Stream flowing through pond so not conducive to newts. Contains grasses, buttercup and aquatic species
58	SN 82951 11695	16/04/2019	DRY												
59	SN 83105 11959	16/04/2019	0.01	0.98	1.00	0.67	0.30	1.00	1.00	0.37	1.00	0.35	**0.44**	Poor	Pond divided into two by iron drainage pipe. Willow and reed surrounding pond and within it, bulrush present at one end and water boatman present
60	SN 84340 10623	15/04/2019	0.01	0.05	0.50	0.33	1.00	0.67	1.00	0.74	0.67	0.30	**0.31**	Poor	Coal sediment pond at highest point of group of ponds and drains into pond just south of it
61	SN 85254 10476	15/04/2019	0.01	0.91	0.90	0.67	0.90	0.67	1.00	0.30	1.00	0.90	**0.50**	Below average	Lots of bulrush in pond. Surrounded by willow and bramble scrub, and some gorse
62	SN 85158 10448	15/04/2019	0.01	0.05	0.50	0.01	1.00	1.00	1.00	0.30	0.67	0.30	**0.21**	Poor	Concrete sided, square waterbody used as a wheel wash
63	SN 84381 10696	15/04/2019	0.01	0.05	1.00	0.67	1.00	1.00	1.00	0.74	0.67	0.35	**0.38**	Poor	Bulrush present. Fed from ditch adjacent to the railway which has iron oxide. Pond is deep green colour indicative of mine pollution. Coal dust is collecting on pond surface and covers approx. 30% of surface area today
64	SN 81319 11761	15/04/2019	0.01	0.50	0.10	0.33	1.00	1.00	1.00	1.00	0.01	0.31	**0.23**	Poor	Shallow, apparently temporary/drying area of standing water on edge of spoil/roadway. No surrounding vegetation
65	SN 82496 10854	16/04/2019	0.01	0.98	0.50	0.33	1.00	1.00	1.00	1.00	0.67	0.31	**0.45**	Poor	Very shallow and drying. Likely to be 100% dry shortly after survey. Absence of vegetation and poor water quality
66	SN 82417 10997	16/04/2019	0.01	0.40	0.50	0.33	1.00	1.00	1.00	1.00	0.33	0.31	**0.38**	Poor	Shallow, part of drainage ditch system, no surrounding vegetation
67	SN 82299 11159	15/04/2019	0.01	0.80	0.10	0.33	1.00	1.00	1.00	1.00	0.67	0.31	**0.37**	Poor	Shallow, used for storage of wash water
68	SN 83608 10428	16/04/2019	0.01	0.20	0.50	1.00	1.00	1.00	1.00	0.22	1.00	0.85	**0.42**	Poor	Located in sheep field. Bulrush and duckweed present
69	SN 85270 10505	15/04/2019	0.01	0.90	1.00	1.00	0.70	0.67	1.00	0.44	1.00	0.35	**0.48**	Poor	5% cover *Typha* spp. Concrete square waterbody. Moorhen present
70	SN 85287 10469	15/04/2019	0.01	0.90	0.90	1.00	0.70	1.00	1.00	0.30	1.00	0.35	**0.48**	Poor	*Typha latifolia* present. Concrete sided square water body.
71	SN 84606 10446	15/04/2019	0.01	0.05	0.10	0.33	0.70	1.00	1.00	0.44	0.33	0.60	**0.25**	Poor	Ditch between garage and dry coal building. Tadpoles present. Main macrophyte cover is buttercup. Water full of coal solids.
72	SN 84591 10485	15/04/2019	0.01	0.05	0.10	0.33	1.00	1.00	1.00	0.44	0.33	0.60	**0.26**	Poor	Small ditch adjacent to transformers, near dry coal building. Water mint and *Buddleija* spp. scrub present.
73	SN 85219 10377	15/04/2019	0.01	0.05	0.10	0.33	1.00	1.00	1.00	0.44	0.33	0.35	**0.25**	Poor	Ditch adjacent to weighbridge. The ditch dries out regularly but there is always water beneath the weighbridge, the water under the weighbridge always supports large population of frogs. None visible in ditch.

Water-body No.	NGR	HSI Assessment												Comments
		Date of HSI	SI_1	SI_2	SI_3	SI_4	SI_5	SI_6	SI_7	SI_8	SI_9	SI_{10}	HSI Score	Pond Suitability	
74	SN 84397 10687	15/04/2019	0.01	0.05	0.10	0.33	1.00	1.00	1.00	0.44	0.67	1.00	**0.29**	Poor	Ditch is slow flowing, running parallel to rail line and contains iron oxides. Seems to be a lot of bacterial growth and algae covered in iron oxide. Plants include horsetail, bulrush. Drains into waterbody 63 which is on the other side of the railway
75	SN 84395 10702	15/04/2019	0.01	0.05	0.90	0.01	0.80	1.00	1.00	1.00	0.33	0.36	**0.23**	Poor	Flowing ditch with bigger area of connected stagnant water. Bulrushes and water mint present. Looks suitable for amphibians but high sediment load in water

Appendix B

NatureMetrics eDNA Results

Report: 19075-AGL-AC-1 Order number: AGL-19001-AC

Great Crested Newt eDNA Results

Company:	Ove Arup and Partners Ltd (Arup)
Contact:	Adam Cross
Project code|Task code:	GCRE - 264094
Date of Report:	29 April 2019
Number of samples:	18

Thank you for sending your samples for analysis by NatureMetrics. Your samples have been processed in accordance with the protocol set out in Appendix 5 of Biggs et al. (2014).

DNA was precipitated via centrifugation at 14,000 x g and then extracted using Qiagen Blood and Tissue extraction kits.

qPCR amplification was carried out in 12 replicates per sample, using the primers and probe described by Biggs et al. (2014), in the presence of both positive and negative controls.

Results indicate GCN absence in '11', '29A', '29b', '55', '56', 'Pond 10', 'Pond 11', 'Pond 12', 'Pond 14', 'Pond 16', 'Pond 18', 'Pond 27', 'Pond 47', 'Pond 59', 'Pond 6', 'Pond 7', 'Pond 8', and 'Pond 9'. All controls performed as expected and so the results are conclusive.

Results are based on the samples as supplied by the client to the laboratory. Incorrect sampling methodology may affect the results. Note that a negative result does not preclude the presence of Great Crested Newts at a level below the limits of detection.

Sample	Pond ID	Arrived	Inhibition	Degradation	Score	GCN status
355	'11'	18-Apr	No	No	0	Negative
363	'29A'	18-Apr	No	No	0	Negative
364	'29b'	18-Apr	No	No	0	Negative
369	'55'	18-Apr	No	No	0	Negative
352	'56'	18-Apr	No	No	0	Negative
366	'Pond 6'	18-Apr	No	No	0	Negative
365	'Pond 7'	18-Apr	No	No	0	Negative
357	'Pond 8'	18-Apr	No	No	0	Negative
370	'Pond 9'	18-Apr	No	No	0	Negative
375	'Pond 10'	18-Apr	No	No	0	Negative
371	'Pond 11'	18-Apr	No	No	0	Negative
374	'Pond 12'	18-Apr	No	No	0	Negative
373	'Pond 14'	18-Apr	No	No	0	Negative
372	'Pond 16'	18-Apr	No	No	0	Negative
377	'Pond 18'	18-Apr	No	No	0	Negative
362	'Pond 27'	18-Apr	No	No	0	Negative
376	'Pond 47'	18-Apr	No	No	0	Negative
358	'Pond 59'	18-Apr	No	No	0	Negative

End of report

Report issued by: Dr. Cuong Tang

Contact: ct@naturemetrics.co.uk | 01491 829042

Understanding your results

Positive: GCN DNA has been detected in this sample, meaning that at least one of the 12 replicates has amplified. Remember that this is not a quantitative test, so you should not interpret a high eDNA score (e.g. 12/12) as necessarily indicating a larger population of GCN than a low eDNA score (e.g. 1/12).

Negative: No GCN DNA has been detected in this sample, and the internal and external controls worked as expected. This tells us that if there had been GCN DNA in the sample, we would have detected it, so we can be confident in its absence from the sample provided. Samples marked as 'Negative after dilution' are those where inhibition was detected (when the marker added in the lab fails to amplify) but overcome by diluting the DNA. Inhibition can be caused by certain chemicals or organic compounds that may be present in the water sample.

Inconclusive: No GCN DNA was detected in the sample, but the internal controls failed to amplify as expected. This means that any GCN DNA in the sample might also have failed to amplify properly, so we cannot have confidence in this negative result. Inconclusive results can be caused by degradation of the DNA (when the DNA marker contained in the ethanol in the kits fails to amplify) or by inhibition of the reaction (when the marker added in the lab fails to amplify) caused by certain chemicals or organic compounds that may be present in the water sample.

Report: 19082-AGL-AC-1 Order number: AGL-19002-AC

Great Crested Newt eDNA Results

Company:	Ove Arup and Partners Ltd (Arup)
Contact:	Adam Cross
Project code|Task code:	GCRE - 264094
Date of Report:	30 April 2019
Number of samples:	8

Thank you for sending your samples for analysis by NatureMetrics. Your samples have been processed in accordance with the protocol set out in Appendix 5 of Biggs et al. (2014).

DNA was precipitated via centrifugation at 14,000 x g and then extracted using Qiagen Blood and Tissue extraction kits.

qPCR amplification was carried out in 12 replicates per sample, using the primers and probe described by Biggs et al. (2014), in the presence of both positive and negative controls.

Results indicate GCN absence in 'Pond 23', 'Pond 24', 'Pond 25', 'Pond 26', 'Pond 61', 'Pond AB', 'Pond AC', and 'Pond U'. All controls performed as expected and so the results are conclusive.

Results are based on the samples as supplied by the client to the laboratory. Incorrect sampling methodology may affect the results. Note that a negative result does not preclude the presence of Great Crested Newts at a level below the limits of detection.

Sample	Pond ID	Arrived	Inhibition	Degradation	Score	GCN status
354	'Pond 23'	26-Apr	No	No	0	Negative
359	'Pond 24'	26-Apr	No	No	0	Negative
368	'Pond 25'	26-Apr	No	No	0	Negative
360	'Pond 26'	26-Apr	No	No	0	Negative
356	'Pond 61'	26-Apr	No	No	0	Negative
367	'Pond AB'	26-Apr	No	No	0	Negative
353	'Pond AC'	26-Apr	No	No	0	Negative
361	'Pond U'	26-Apr	No	No	0	Negative

End of report

Report issued by: Dr. Cuong Tang

Contact: ct@naturemetrics.co.uk | 01491 829042

Understanding your results

Positive: GCN DNA has been detected in this sample, meaning that at least one of the 12 replicates has amplified. Remember that this is not a quantitative test, so you should not interpret a high eDNA score (e.g. 12/12) as necessarily indicating a larger population of GCN than a low eDNA score (e.g. 1/12).

Negative: No GCN DNA has been detected in this sample, and the internal and external controls worked as expected. This tells us that if there had been GCN DNA in the sample, we would have detected it, so we can be confident in its absence from the sample provided. Samples marked as 'Negative after dilution' are those where inhibition was detected (when the marker added in the lab fails to amplify) but overcome by diluting the DNA. Inhibition can be caused by certain chemicals or organic compounds that may be present in the water sample.

Inconclusive: No GCN DNA was detected in the sample, but the internal controls failed to amplify as expected. This means that any GCN DNA in the sample might also have failed to amplify properly, so we cannot have confidence in this negative result. Inconclusive results can be caused by degradation of the DNA (when the DNA marker contained in the ethanol in the kits fails to amplify) or by inhibition of the reaction (when the marker added in the lab fails to amplify) caused by certain chemicals or organic compounds that may be present in the water sample.

Appendix C

Incidental Amphibian Records

C1 Incidental Amphibian Records

Table C1: Incidental records of amphibians recorded during the 2019 reptile surveys

Date	Reptile refugia Number	NGR	Species	Comments
14/05/2019	N/A	SN 81680 10590	Common frog	Incidental sighting on *Molinia spp*. whilst installing refugia
06/06/2019	N/A	SN 81647 10774	Common frog	Seen near refugia 104
	114	SN 81431 10715	Common frog	
14/06/2019	170	SN 83251 11248	Common toad	Two adult toads under mat
26/06/2019	235	SN 83007 10145	Common frog	Next to refugia
	28	SN 84519 10389	Common frog	
	32	SN 85157 10292	Common toad	
	9	SN 84353 10437	Common toad	Two toads
02/07/2019	97	SN 81670 10560	Common frog	
	170	SN 83252 11251	Common frog	
	165	SN 83323 11287	Common toad	
03/07/2019	65	SN 85327 10496	Common toad	Juvenile under refugia
	70	SN 85343 10484	Common toad	Juvenile under refugia
03/09/2019	N/A	SN 80315 10756	Common frog	
	196	SN 82878 10754	Common toad	
	180	SN 82717 10808	Common toad	
10/09/2019	227	SN 82013 10008	Common frog	Next to refugia
	196	SN 82874 10756	Common toad	
	180	SN 82717 10811	Common toad	
	193	SN 82931 10799	Common toad	
	147	SN 83238 11380	Palmate newt	Adult female palmate newt
16/09/2019	72	SN 85259 10559	Common toad	
	9	SN 84327 10481	Smooth / palmate newt	Juvenile newt
17/09/2019	117	SN 81504 10732	Common frog	
	174	SN 82857 10848	Common toad	
23/09/2019	57	SN 85308 10453	Palmate newt	Two palmate newts
25/09/2019	170	SN 83251 11257	Common frog	
	195	SN 82906 10769	Smooth / palmate newt	Juvenile male newt found
03/10/2019	29	SN 84533 10397	Common toad	

Appendix 7F

Reptile Report

Welsh Government

Global Centre for Rail Excellence (GCRE)

Reptile Survey Report

Rev A | 9 July 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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Document verification

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Draft 1	18 Nov 2019	**Description**	First draft		
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		Name	Dan Wales Kathryn Jones	Claire Pooley	
		Signature			
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		Name	Dan Wales Kathryn Jones	Claire Pooley	Neil Harwood
		Signature			

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Document Verification

Job title		Global Centre for Rail Excellence (GCRE)			**Job number** 264904
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		Name			
		Signature			
		Filename			
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			Prepared by	Checked by	Approved by
		Name			
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				Issue Document Verification with Document	✓

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Figures

Figure 1: Study Area
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Appendices

Appendix A

Reptile Survey Data

Appendix B

Photographs

1 Introduction

1.1 Background

Ove Arup & Partners Ltd (Arup) was commissioned by the Welsh Government (WG) to undertake a range of consultancy services in relation to the Global Centre for Rail Excellence (GCRE), hereafter referred to as 'the Project'.

As part of that commission, a range of ecological surveys have been undertaken to identify the baseline ecological conditions of the Project area, to inform the assessment of impacts as part of the Environmental Impact Assessment (EIA) process.

This document describes the reptile surveys undertaken for the Project.

1.2 Objectives

The objectives of the reptile survey were to ascertain the following:

- The presence or absence of reptile species within the study area; and
- The abundance of any reptile species present within the study area.

2 Project Description and Context

The WG are proposing to develop a rail testing, maintenance, research, development and storage facility (also referred to as the Global Rail Centre for Excellence) at the site of the Onllwyn washery and Nant Helen open cast mine site. The site for development is approximately 475 ha.

The proposed site is currently being mined by Celtic Energy, who will cease extraction operations in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and agreements with Powys County Council (PCC) and Neath Port Talbot County Borough Council (NPTCBC). This includes Section 106 planning obligations and planning conditions that need to be discharged.

Celtic Energy has submitted two recent planning applications for the site, including: the revised restoration strategy for approval (Planning reference number: 19/1899/REM) which would change the existing approved restoration scheme (for planning application ref 18/1070/REM). And, the Nant Helen complementary earthworks application for approval (Planning reference number: 20/0738/FUL) The purpose of these applications is to allow for a ‘flexible and adaptable landform for a variety of future uses on restoration, including the use of the site as a rail testing and storage facility, proposed by the WG.

3 Site Description

The Project site is within the Dulais Valley located within Powys and Neath Port Talbot, with the Brecon Beacons National Park Authority boundary immediately to the north. Nearby settlements include Onllwyn, Seven Sisters, Ystradgynlais, Caehopkin, Abercrave or Coelbren.

The site is predominantly brownfield land that has been heavily worked by open cast mining. Much of the site has been revegetated.

4 Study Area

The study area (Figure 1) encompasses the majority of land within the Nant Helen open cast operational site, which at the time of commencing the ecological surveys was considered to be the likely boundary of the project site.

5 Legislation

Common reptile species receive partial protection under the Wildlife and Country Act 1981 (as amended). Common reptile species include adder (*Vipera berus*), common lizard (*Zootoca vivipara*), grass snake (*Natrix helvetica*), and slow worm (*Anguis fragilis*). Under this legislation, it is an offence to:

- Intentionally or recklessly kill or injure reptile species; and
- Sell, offer or advertise for sale, possess or transport for the purposes of sale these animals, whether alive or dead, or any part thereof.

The Environment (Wales) Act 2016 includes a duty on all public authorities to have regard to the conservation of biodiversity in the exercise of their functions. This duty applies to government bodies, local authorities and statutory undertakers. The Act also requires lists to be published of Habitats and Species considered to be of Principal Importance for the Conservation of Biological Diversity. These are referred as Section 7 habitats and species after the sections of the Act which require the publication of lists in each devolved area. All common reptiles are listed as a Section 7 Species.

All four common reptile species are listed as UK Biodiversity Action Plan (UKBAP) Priority Species. Action Plans exist for each UK BAP Priority Species to demonstrate the UK's commitment to help reduce or halt the significant losses in global biodiversity[1].

[1] The UKBAP was succeeded by the 'UK Post-2010 Biodiversity Framework' in July 2012. The UK list of priority species, however, remains an important reference source and has been used to help draw up statutory lists of priority species.

6 Methodology

6.1 Desk Study

An ecological data search was carried out to identify reptile species within 5 km of the site's centre point. Such data was obtained from the Biodiversity Information Service for Powys & Brecon Beacons National Park (BIS). Data was obtained on 21 November 2018 and is also presented within the Extended Phase 1 Habitat Survey Report in relation to the Project[2].

In addition, existing data for the site is available in the form of a reptile survey undertaken in 2010, to inform the 2011 Environmental Statement for a western extension to the Nant Helen (Extension) Surface Coal Mine[3].

6.2 Field Surveys

The reptile survey methodology followed best practice guidelines[4], utilising artificial refugia placed in representative areas of suitable habitat for reptiles across the site. Artificial refugia comprised roofing felt mats measuring 0.5 m x 0.5 m, placed in 25 transects of 10 mats per transect, spaced approximately 10 m apart.

A total of 250 refugia were placed, primarily in sunny areas, on top of flattened vegetation (where possible). Locations of refuges deployed across the site are shown on Figure 2. Refuges were deployed no less than a week ahead of the first survey, to allow refuges to 'bed in' to the environment.

During each survey, the area around each refuge was first checked from a suitable distance before it was approached. Each refuge was approached slowly to check for basking reptiles; each refuge was then lifted and the area beneath checked for reptiles. Where possible, a photograph was taken of any reptile observed. Once checked, the refuge was replaced in its original location. The order in which all refuges were checked was altered during each survey visit. Incidental records of reptiles that were not under mats were also recorded during the surveys.

Dates of surveys, as well as weather conditions during each survey are presented in Table 1. All of the survey visits were split across two days due to the size of the site.

[2] Arup (2019). *Nant Helen Complementary Restoration Earthworks. Extended Phase 1 Habitat Survey.*
[3] Celtic Energy (2011). *Environmental Statement*.
[4] Gent, T. and Gibson, S. (2003). *Herpetofauna Workers Manual.* JNCC, Peterborough.

Table 1. Survey dates and weather conditions.

Visit Number	Date	Temp. (°C)	Weather Conditions[5]
1a	6 June 2019	11	W: 1 / CC: 60 / P: light showers
1b	14 June 2019	13	W: 1 / CC: 100 / P: none
2a	26 June 2019	15	W: 2 / CC: 80 / P: none
2b	27 June 2019	10	W: 3 / CC: 0 / P: none
3a	2 July 2019	13	W: 2 / CC: 0 / P: none
3b	3 July 2019	14	W: 1 / CC: 0 / P: none
4a	2 Sept 2019	15	W: 1 / CC: 70 / P: none
4b	3 Sept 2019	14	W: 2 / CC: 100 / P: light drizzle
5a	10 Sept 2019	16	W: 2 / CC: 50 / P: none
5b	16 Sept 2019	16	W: 1 / CC: 100 / P: none
6a	17 Sept 2019	15	W: 1 / CC: 5 / P: none
6b	23 Sept 2019	14	W: 2 / CC: 90 / P: none
7a	25 Sept 2019	15	W: 2 / CC: 100 / P: light showers
7b	03 Oct 2019	9	W: 4 / CC: 80 / P: none

All surveys were completed by Suitably Qualified Ecologists (SQE) who are members of the Chartered Institute of Ecology and Environmental Management (CIEEM) and have the relevant experience for undertaking such surveys.

[5] Weather conditions are reported as follows – W: Wind on the Beaufort Scale / CC: Cloud Cover as a % / P: Precipitation

6.3 Assessment of Reptile Populations

The population status of any reptile species recorded on site was assessed against criteria as detailed by guidance published by Froglife[6]. Populations of reptile species are assigned a population size class based on the highest peak count recorded during one day, where the peak count is the total number of adults recorded in any one survey. The population size classes are detailed in Table 2 below.

Table 2. Population size classes of reptiles.

Species	Population size class		
	Low Population	Good Population	Exceptional Population
Adder	< 5	5 – 10	> 10
Grass snake	< 5	5 – 10	> 10
Common lizard	< 5	5 – 20	> 20
Slow worm	< 5	5 – 20	> 20

6.4 Limitations

The majority of the surveys were undertaken in suitable weather conditions (dry, mild days) and during the optimum survey period (April, May and September)[6].

Two survey visits were conducted during light rain/drizzle, which is suboptimal for reptile surveys. However, reptiles were still observed and on one of the visits a "good" population of common lizard was recorded. Therefore, the weather conditions are not considered to have had a negative effect on survey results.

Three survey visits were conducted during July and October (outside of the optimal survey period), however the air temperature was within the optimum range and reptiles were recorded, so this is not considered to be a significant survey limitation.

The findings presented in this study represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys are limited by factors which affect the presence of flora and fauna, factors such as the time of year and natural behaviour of the animals. Nevertheless, these surveys were conducted at the optimal survey periods and using methodologies which are in accordance with published guidelines.

[6] Froglife (1999) *Advice Sheet 10: An introduction to planning, conducting and interpreting surveys for snake and lizard conservation*. Froglife, Peterborough.

7 Results

7.1 Desk Study

Surveys of the site between May 2010 and October 2010[3] demonstrated that common lizard and slow worm were present within the site boundary in low numbers.

Additional records of reptile species present within 5 km of the site provided during the ecological data search by BIS are summarised in Table 3. The distance provided is that to the closest point of the site boundary.

Table 3. Records of reptile species within 5 km of the site.

Species	Scientific Name	Number of Records	Approximate distance of closest record (m)
Common lizard	*Zootoca vivipara*	14	700
Grass snake	*Natrix helvetica*	7	1000
Slow worm	*Anguis fragilis*	10	2000

7.2 Field Surveys

Field surveys identified a “good” population of common lizard and a “low” population of slow worm to be present within the survey area. Peak counts of reptiles recorded within the survey area are shown in Table 4. The locations of reptiles recorded during the surveys are presented in Figure 3. Full reptile survey data is presented in Appendix A. Photographs are given in Appendix B.

In addition to records of adults, there were records of juveniles and sub-adults of both common lizard and slow worm during the surveys, indicating that both of these species breed on site.

Table 4. Peak reptile species populations recorded during seven survey visits.

Species	Scientific Name	Peak count / Visit number	Population size class
Common lizard	*Zootoca vivipara*	17 / Visit 6a	Good
Slow worm	*Anguis fragilis*	2 / Visit 3b	Low

Incidental recordings of reptile species sighted during ecological surveys or site visits throughout 2019, other than the reptile surveys described within this report, are reported in Appendix A. These records are not considered within peak counts of reptile species populations and only relate to common lizard.

8 Conclusions

Seven reptile surveys of the site were completed, surveying any areas of habitat suitable for reptiles within the red line boundary of the survey area. The site was found to support the following populations of reptile species:

- Good population of common lizard; and
- Low population of slow worm.

No other reptile species are thought to be present, though desk study records indicate the presence of grass snake within 1 km of the site.

A full ecological impact assessment will be included within the Environmental Statement for the project and this will include an assessment of the significance of impacts from the project on protected and/or notable reptile species. This will also detail any mitigation or compensation measures required to ensure there is no significant effect on reptile species within the site.

This report is the result of the survey work undertaken between April and September 2019. This report refers, within the limitations stated, to the condition of the site at the time of the surveys. Changes in legislation, guidance, best practice, etc. may necessitate a re-assessment/survey. No warranty is given as to the possibility of future changes in the condition of the site.

The results of these surveys are considered valid for a minimum of 18 months to a maximum of 3 years. If more than 18 months elapses before any planning application is submitted, the requirement for repeat surveys should be reviewed[7].

[7] Chartered Institute of Ecology and Environmental Management (2019). *Advice Note on the Lifespan of Ecological Reports and Surveys*.

Figures

A3



LEGEND

Study Area

19/12/2019 15:59:38

Issue	Date	By	Chkd	Appd
F1	2019-11-14	EA	CP	

Metres

0 270 540 1,080

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4 Pierhead Street
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Client

Welsh Government

Job Title

Global Centre for Rail Excellence

Figure 1
Study Area

Scale at A3

1:20,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
001	F1

\\global\europe\Cardiff\Jobs\264000\264904-00\1 Client\271968 Celtic Energy Application\GIS\Map Documents\2019_Arboreal Mammals_EA.mxd

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A3

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

19/11/2019 09:48:05

Legend

Study Area

Issue	Date	By	Chkd	Appd
F1	2019-11-18	KSJ	CP	NH

Metres

0 105 210 420 630 840 1,050

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Reptile Mat Placement (Overview)

Scale at A3

1:20,000

Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
002a	**F1**

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Legend

Study Area

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Issue	Date	By	Chkd	Appd
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Metres

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Job Title

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Reptile Mat Placement (West)

Scale at A3

1:5,000

Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
002b	**F1**

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Legend

Study Area

Issue	Date	By	Chkd	Appd
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Metres

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19/11/2019 09:47:14

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Reptile Mat Placement (Centre)

Scale at A3

1:6,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
002c	F1

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A3



Legend

Study Area

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Issue	Date	By	Chkd	Appd
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Metres

0 25 50 100 150 200 250

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Job Title

Global Centre for Rail Excellence

Reptile Mat Placement (East)

Scale at A3

1:5,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
002d	F1

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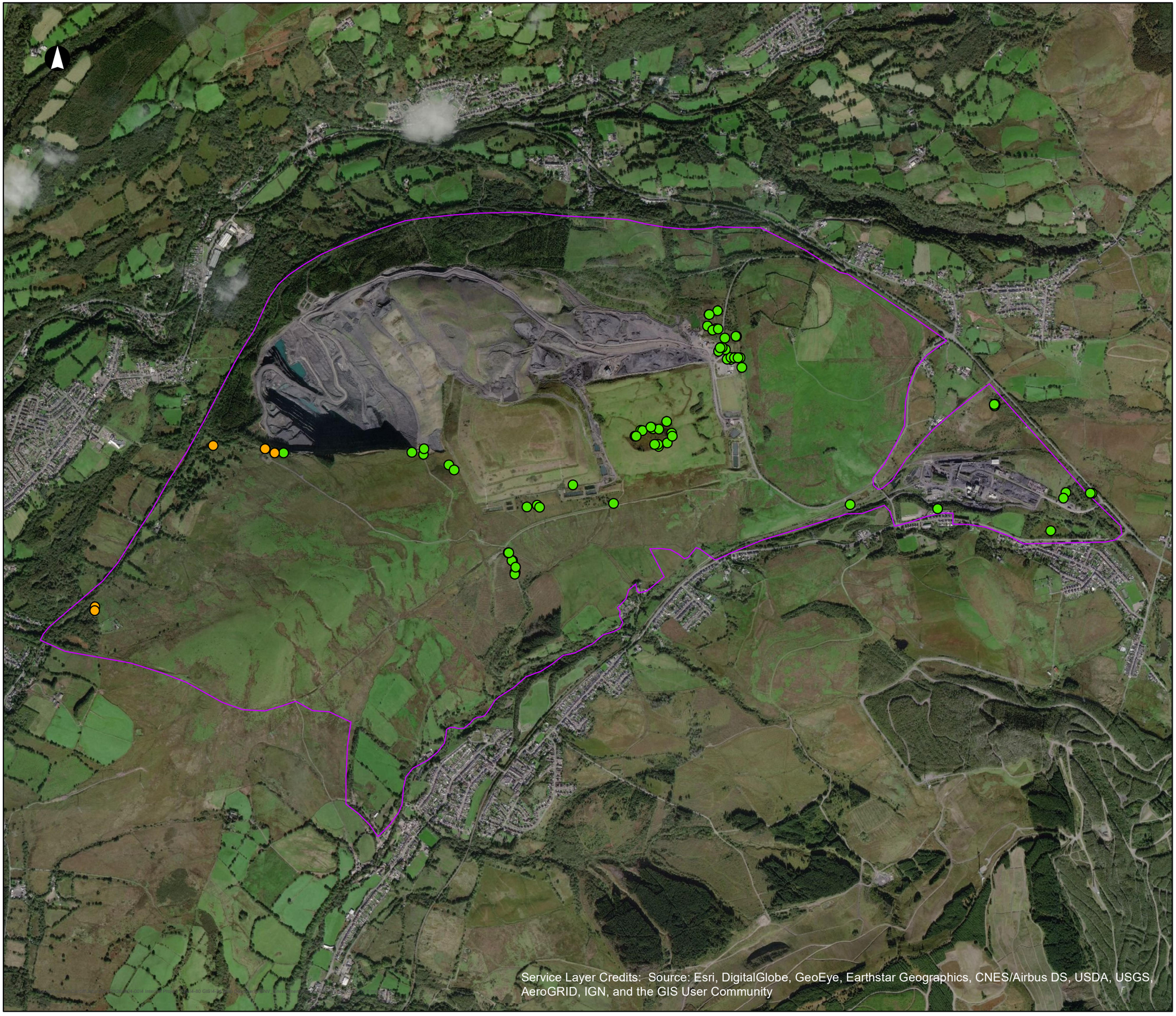

Legend

Study Area

Reptile Survey Reults

- Common Lizard;
- Slow worm;

19/11/2019 09:47:32

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Metres

0 105 210 420 630 840 1,050

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Job Title

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Reptile Survey Results (Overview)

Scale at A3

1:20,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
003a	F1

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A3

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Legend

Study Area

Reptile Survey Reults

- Common Lizard;
- Slow worm;

Issue	Date	By	Chkd	Appd
F1	2019-11-19	KSJ	CP	NH

Metres

0 25 50 100 150 200 250

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Job Title

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Reptile Survey Results (West)

Scale at A3

1:5,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
003b	F1

19/11/2019 09:47:40

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Legend

Study Area

Reptile Survey Reults

- Common Lizard;
- Slow worm;

Issue	Date	By	Chkd	Appd
F1	2019-11-19	KSJ	CP	NH

Metres

0 30 60 120 180 240 300

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Job Title

Global Centre for Rail Excellence

Reptile Survey Results (Centre)

Scale at A3

1:6,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
003c	F1

19/11/2019 09:47:49

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19/11/2019 09:47:57

Legend

Study Area

Reptile Survey Reults

- Common Lizard;
- Slow worm;

Issue	Date	By	Chkd	Appd
F1	2019-11-19	KSJ	CP	NH

Metres

0 25 50 100 150 200 250

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Job Title

Global Centre for Rail Excellence

Reptile Survey Results (East)

Scale at A3

1:5,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
003d	F1

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Appendix A

Reptile Survey Data

A1 Reptile Survey Data

Table A1. Full data from reptile surveys of the site. Count represents the number of individuals counted per reptile species. Bold counts numbers show the peak count for each reptile species recorded on site across all surveys.

Visit Number	Species	Reptile refugia where reptiles found	Incidental records during survey	Total Count
Reptile mat deployment	Common lizard	N/A	3x adult	3
	Slow worm	N/A	1x sub-adult female.	1
1a	Common lizard	114, 175, 178, 223	1x adult	5
1b	Common lizard	142, 144, 147, 164, 169,	2x adults	7
2a	Common lizard	77	None	1
2b	None	-	None	0
3a	Common lizard	180, 195	1x adult	3
	Slow worm	121	None	1
3b	Common lizard	-	1x sub-adult	1
	Slow worm	247, 248	None	**2**
4a	Common lizard	33, 80, 87, 142, 144, 149, 153, 156, 169 (2 lizards), 170	1x adult	13
4b	Common lizard	116 (2 lizards), 178 (2 lizards), 198, 206, 216	None	7
	Slow worm	121	None	1
5a	Common lizard	117, 126, 129, 142, 151, 171, 174, 177, 212, 221, 192	2x lizards	13
5b	Common lizard	87	None	1
6a	Common lizard	63, 87, 144, 149, 152 (2 lizards), 156, 158, 162, 168, 180 (2 lizards), 198, 217, 221, 227 (2 lizards),	None	**17**
6b	Common lizard	199	None	1
	Slow worm	126	None	1
7a	Common lizard	199	None	1
7b	None	-	None	0

A2 Incidental Reptile Records

Table A2. Incidental records of reptiles recorded during other ecological surveys in 2019.

Date	Reptile refugia Number	National Grid Reference	Species	Comments
30/04/2019	N/A	SN 81645 10646	Common lizard	Juvenile running through purple moor grass.
17/07/2019	24	SN 84461 10390	Common lizard	Lizard on top of mat.

Appendix B

Photographs

B1 Photographs



Photograph 1 – Showing adult male common lizard.



Photograph 2 – Showing adult male and adult female common lizards.



Photograph 3 – Showing adult female slow worm.



Photograph 4 - Showing two juvenile common lizards.

Appendix 7G

Breeding Bird Report

Welsh Government

Global Centre for Rail Excellence (GCRE)

Breeding Bird Survey Report; 2019

Rev A | 18 June 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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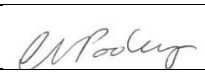
Document verification

ARUP

Job title		Global Centre for Rail Excellence (GCRE)			**Job number** 264904
Document title		Breeding Bird Survey Report; 2019			**File reference**
Document ref					
Revision	**Date**	**Filename**	Nant Helen_Breeding Bird Report_Draft_v1		
Draft 1	1 Oct 2019	**Description**	First draft		
			Prepared by	Checked by	Approved by
		Name	Martyn Owen	Richard Moores	
		Signature			
Draft 2	1 Oct 2019	**Filename**	Nant Helen_Breeding Bird Report_Draft_v2		
		Description	Second draft		
			Prepared by	Checked by	Approved by
		Name	Martyn Owen	Richard Moores	
		Signature			
Draft 2	1 Oct 2019	**Filename**	Nant Helen_Breeding Bird Report_Draft_v2_final		
		Description	Issue		
			Prepared by	Checked by	Approved by
		Name	Martyn Owen	Richard Moores	Paul Clack
		Signature			
Draft 3	12 Nov 2019	**Filename**	Nant Helen_Breeding Bird Report_Draft_v3_final		
		Description	Final, updated with new site boundary		
			Prepared by	Checked by	Approved by
		Name	Martyn Owen	Richard Moores	Paul Clack
		Signature			
				Issue Document verification with document	✓

Document Verification

Job title		Global Centre for Rail Excellence (GCRE)			**Job number** 264904
Document title		Breeding Bird Survey Report; 2019			**File reference**
Document ref					
Revision	**Date**	**Filename**	Nant Helen_Breeding Bird Report_Issue.docx		
Issue	28 Nov 2019	**Description**			
			Prepared by	Checked by	Approved by
		Name	Claire Pooley	Paul Clack	Paul Clack
		Signature			
Rev A	18 Jun 2020	**Filename**	GCRE_Breeding Bird Report_Rev A.docx		
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			Prepared by	Checked by	Approved by
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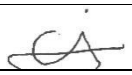
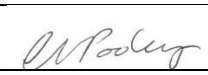
		Signature			
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		Name			
		Signature			
				Issue Document Verification with Document	✓

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Figure 1 Study Area

Figure 2 Transect Details

Figure 3 Drawings 1-15: BBS Results for Species of Conservation Significance

1 Introduction

Ove Arup & Partners Ltd (Arup) was commissioned by the Welsh Government (WG) to undertake a range of consultancy services in relation to the Global Centre for Rail Excellence (GCRE), hereafter referred to as 'the Project'.

As part of that commission, a range of ecological surveys have been undertaken to identify the baseline ecological conditions of the Project area, to inform the assessment of impacts as part of the Environmental Impact Assessment (EIA) process.

This document reports on the breeding bird surveys undertaken to inform the EIA for the Project.

Nomenclature within this report follows the British (English) vernacular name within the British Ornithologists' Union (BOU) British list[1].

1.1 Objectives

The objective of the surveys covered by this report was to provide data on the assemblage, numbers and distribution of breeding birds within the Study Area (Figure 1) and to determine the presence/likely absence of rare breeding species potentially present in the area (namely Goshawk *Accipiter gentilis* and Honey-buzzard *Pernis apivorus*) within appropriate buffer zones.

1 BOU (2015). *The British List; The official list of bird species recorded in Britain* [online] available at: https://www.bou.org.uk/british-list/category-a-b-c-species/

2 Project Background

The WG are proposing to develop a rail testing, maintenance, research, development and storage facility (also referred to as the Global Rail Centre for Excellence) at the site of the Onllwyn washery and Nant Helen open cast mine site. The site for development is approximately 475 ha.

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3 Site Description

The Project site is within the Dulais Valley located within Powys and Neath Port Talbot, with the Brecon Beacons National Park Authority boundary immediately to the north. Nearby settlements include Onllwyn, Seven Sisters, Ystradgynlais, Caehopkin, Abercrave or Coelbren.

The site is predominantly brownfield land that has been heavily worked by open cast mining. Much of the site has been revegetated.

4 Methodologies

4.1 Common Bird Census Survey

Prior to the completion of the first survey, five transect routes were identified (Figure 2). These transect routes were determined with the intention of providing coverage of key areas within the Study Area which may support important species/numbers of breeding birds based on habitat type/extent.

Field surveys broadly followed the 'territory mapping' or Common Bird Census (CBC) methodology[2,3] albeit with a reduced number of visits (three). CBC territory mapping is the most accurate practical way to determine the numbers and distribution of breeding birds where a high level of detail is required. Essentially, the method involves mapping all birds seen or heard during walkover visits to the Study Area, paying particular attention to behaviour which indicates breeding (e.g. singing or carrying nesting material or food). By combining the results of all visits, it is possible to determine the species present within the survey area and provides an indication of the numbers of breeding territories.

Three survey visits were completed, during which each transect was walked, between 23 April 2019 and 24 June 2019 (Table 1).

Surveys commenced around one hour after sunrise and were completed by 13:00. The start point of surveys was alternated between visits to ensure all parts of the Study Area received adequate coverage during peak periods of bird activity.

During each survey the surveyor recorded all observations on field maps using standard British Trust for Ornithology (BTO) coding in relation to species and behaviour. Observations of birds outside the Study Area were also logged when seen.

The direction of surveys was alternated between visits to ensure all parts of the Study Area received adequate coverage during different periods of the day.

4.2 Goshawk Survey

Goshawks breed preferentially within large tracts of mature woodland, but can occupy smaller woods. Nests are usually located in areas with a high density of mature trees and a well-developed canopy. Due to the presence of potentially suitable breeding habitat in the vicinity of the site a Goshawk survey adhering to the methodology outlined within Hardey et al. (2009)[4] was completed.

Surveys focused on all suitable habitat within the Study Area and a 1km buffer zone. All suitable habitat was surveyed twice during suitable weather conditions in March 2019. During these surveys, viewpoints were utilised to provide

2 Bibby, C.J., Hill, D.A., Burgess, N.D. and Mustoe, S. (2000) *Bird Census Techniques*. 2nd Edition. Academic Press: London
3 Marchant, J. H. (1983) *BTO Common Birds Census Instructions*. BTO, Tring.
4 Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B., & Thompson, D. (2009). *Raptors. A field guide for surveys and monitoring.*

coverage of potentially suitable breeding habitat, from which at least two-hour watches were completed to assess the potential presence of displaying birds.

In addition, surveys during June and July were completed of suitable habitat on foot. At this time young would have fledged and birds become more vocal, making the identification of territories easier in dense woodland.

4.3 Honey-buzzard Survey

Survey work was undertaken in a wide area around the Study Area, concentrating on woodland deemed suitable for breeding Honey-buzzards. This included all potential Honey-buzzard breeding woodland in the Crynant valley and liaison with surveyors in the Neath valley (the nearest known nest) for potential flights into the Crynant valley.

Ten days of survey was completed, utilising various viewpoints during the period of maximum potential for observing Honey-buzzards; mid-July to mid-August. This is the period when breeding pairs would be provisioning young with food and undertaking long foraging flights to and from nest sites.

All observation days were undertaken in appropriate weather conditions when foraging birds are most likely to circle up high from nest sites to forage, or from foraging sites to return to the nest.

4.4 Surveyors

CBC and Goshawk Surveys were completed by Martyn Owen MCIEEM and Stuart Thomas MCIEEM.

Martyn is an experienced consultant ornithologist and was Shropshire County Bird Recorder from 2012-2017, former editor of the Shropshire Ornithological Society's' Annual Bird Report and remains on the Shropshire Ornithological Society Rarity Committee. Martyn has completed bird survey work at many sites in Wales (and elsewhere) employing the full range of ornithological survey techniques and data analysis in relation to many projects over the previous 15 years. Martyn holds numerous Natural Resources Wales (NRW) Schedule 1 survey licences (including Goshawk and Honey-buzzard).

Honey-buzzard surveys were completed by Steve Roberts, who has been studying Honey-buzzards for 35 years, in Wales and across much of southern England. He has published land-mark papers on breeding Honey-buzzards in Britain in the ornithological journal British Birds along with several short papers.

Steve holds a NRW schedule 1 licence for Honey-buzzard for the whole of Wales, Kent, Sussex, Surrey, Hants, West Midlands and Dorset. Survey assistants are accredited agents on these licences, if licencing required.

4.5 Survey Details

Detail in relation to survey dates and weather are provided within Tables 1 and 2.

Table 1. CBC and Goshawk survey details

Survey Visit	Date	Surveyor	Time	Weather				
				Wind Speed (Beaufort)	Wind Direction	Cloud Cover (Oktas)	Temp (°C)	Precip.
Common Bird Census Surveys								
Transect 1								
1	23/04/19	ST	07:45-12:15	1-2	SE	2-6	14-20	Nil
2	09/05/19	ST	06:50-10:35	1	SW	8	7-9	Oc. light showers
3	12/06/19	ST	06:20-11:20	1	NE	4-8	10-12	Nil
Transect 2								
1	23/04/19	MO	07:30-12:00	1-2	SE	2-6	14-20	Nil
2	09/05/19	MO	06:50-10:35	1	SW	8	7-9	Oc. light showers
3	13/06/19	MO	08:20[5]-12:30	1	NW	7-8	10-12	Inf. light rain
Transect 3								
1	24/04/19	MO	06:55-10:50	1	S	4-8	11-12	Inf. light showers
2	10/05/19	MO	07:00-11:20	1	SW	4-7	7-12	Nil
3	12/06/19	MO	06:20-11:30	1	NE	4-8	10-12	Nil
Transect 4								
1	29/04/19	MO	07:05-11:25	1	SE	8	9-11	Rain for second half of survey
2	11/05/19	MO	06:50-10:00	0-1	N	2-3	7-12	Nil
3	24/06/19	MO	06:20-10:40	0-2	W	8	14-16	Nil
Transect 5								
1	24/04/19	ST	06:55-10:50	1	S	4-8	11-12	Inf. light showers
2	10/05/19	ST	07:00-11:20	1	SW	4-7	7-12	Nil
3	13/06/19	ST	08:10[4]-13:00	1	NW	7-8	10-12	Inf. light rain
Goshawk Surveys								
1	07/03/19	MO	09:15-11:30	2-3	N	5-8	8-10	Nil
2	21/03/19	MO	07:00-14:00	1-2	N	4-8	12-15	Nil
3	25/03/19	MO	07:45-14:45	0-1	N	1-3	10-12	Nil
4	11/06/19	MO	08:00-13:00	1-2	NE	7-8	9-12	Inf light showers
5	10/07/19	MO	08:00-12:00	1	SW	3-4	14-16	Nil

5 Late start due to early rain.

Table 2. Honey-buzzard survey details

Survey Visit	Date	Time	Weather	Notes
1	13/05/19	08:00-15:00	Mostly sunny, a few clouds, breezy	From SN831075 looking NW over Seven Sisters/Blaendulais
2	25/05/19	08:00-15:30	Cloudy with sunny spells	From SN829085 looking south to South East over forest
3	01/06/19	07:30-16:00	Mainly cloudy ,a few sunny spells	From SN886092 looking N/NE over Coed y Rhaiadr
4	09/07/19	07:00-15:30	Mostly cloudy, short periods of sunshine	From SN875093 Looking NE over Coed y Rhaiadr
5	13/06/19	07:15-15:30	Grey sky, patches of light drizzle	From SN853072 looking SW to N down Neath Valley and up to ridge above Seven Sisters
6	15/07/19	07:30-1500	Sunny in the morning, largely cloudy in the afternoon	From SN861100 looking north over Y Wern forest
7	17/07/19	07:00-15:00	Hazy sunshine early on which cleared late morning. Cloudy in the afternoon.	From SS783053 looking S to NE over Crynant and Seven Sisters.
8	23/07/19	07:45-16:00	Low cloud early on, sunny later	From SN835057 looking N to SW covering the ridge above Seven Sisters and the Neath Valley
9	24/07/19	07:00-15:30	Early haze, clearing to give sunny spells	From SN935085 looking W to N over Coed Y Rhaiadr
10	02/08/19	07:50-15:00	Mostly sunny with patchy clouds, warm with light breeze	From SN845083 looking SW to N down Dulais Valley and over Seven Sisters/Blaendulais forest

4.6 Limitations

The findings presented in this study represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys are limited by factors which affect the presence of plants and animals, such as the time of year, migration patterns and behaviour.

The breeding bird transect routes did not include the entirety of all potential breeding bird habitat within the Study Area, given its size and the uniform nature of much of the area. The number of breeding bird territories reported on within the Study Area may therefore be an under-estimation. No attempt has been made to extrapolate the number of territories present outside of the transect Study Area, given the number of variables associated with breeding, e.g. territory size and habitat quality. However, the transects are likely to provide a fair representation of the bird population within the Study Area.

Three CBC survey visits were completed. Whilst this does not conform to the requirements of a full CBC survey (eight-ten visits), it is deemed adequate in this instance to provide an appropriate indication of the breeding bird assemblage and numbers of pairs within the Study Area.

5 Results

5.1 Common Bird Census Survey

Table 3 provides a summary of all species considered likely to have bred within the Study Area during the survey period. A summary of all other species logged during surveys, but for which no evidence of breeding was identified is included within Table 4.

A total 62 species were logged, of which 52 species were considered to have bred within the Study Area. Of these species ten are included on the Birds of Conservation Concern Wales (BoCCW)[6] 3 Red list, 13 are included on the BoCCW3 Amber list with 14 being included on Section 7 (S7) of the Environment (Wales) Act 2016, being of principal important for the purpose of maintaining and enhancing biodiversity in relation to Wales. The locations of these species of conservation significance are shown on Figure 3.

One species (Common Crossbill *Loxia curvirostra)* that is included on Schedule 1 of the Wildlife and Country 1981 (as amended) bred within the Study Area.

Species considered likely to breed within the Study Area are summarised in Table 3 with non-breeding species results presented in Table 4.

6 Johnstone I., Bladwell S. (2016). *Birds of Conservation Concern in wales 3: the population status of birds in Wales*. Birds in Wales, vol.14 No.1

Table 3. Results summary – breeding species

Species	BTO Code	Conservation Status	Approximate Number of Breeding Pairs					
			Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	TOTAL
Greater Canada Goose *Branta canadensis*	CG	-	-	1	1	-	-	2
Mallard *Anas platyrhynchos*	MA	BoCCW3 Amber	-	-	1	-	-	1
Common Buzzard *Buteo buteo*	BZ	-	1	-	-	1	-	2
Lapwing *Vanellus vanellus*	L.	BoCCW3 Red S7	-	2	-	-	-	1
Curlew *Numenius arquata*	CU	BoCCW3 Red S7	-	-	1	-	-	1
Woodpigeon *Columba palumbus*	WP	-	-	-	1	-	-	1
Collard Dove *Streptopelia decaocto*	CD		-	-	-	1	-	1
Cuckoo *Cuculus canorus*	CK	BoCCW3 Red S7	3	-	-	2	3	8
Nightjar[7] *Caprimulgus europaeus*	NJ	BoCCW3 Amber	-	-	-	1	-	1
Great Spotted Woodpecker *Dendrocopos major*	GS		1	-	-	1	2	4
Jay *Garrulus glandarius*	J.		-	-	-	1	-	1
Magpie *Pica pica*	MG	-	-	-	1	-	-	1
Jackdaw *Corvus monedula*	JD	-	-	-	20	-	-	20
Carrion Crow *Corvus corone*	C.	-	-	1	1	-	-	2
Raven *Corvus corax*	RN	-	-	1	-	-	-	1
Goldcrest *Regulus regulus*	GC	BoCCW3 Amber	4	-	-	2	-	6
Blue Tit *Cyanistes caeruleus*	BT	-	16	-	2	2	6	26
Great Tit *Parus major*	GT	-	7	-	2	1	4	14
Coal Tit *Periparus ater*	CT		2	6	1	1	1	12
Skylark *Alauda arvensis*	S.	BoCCW3 Amber S7	8	43	15	16	57	139
Long-tailed Tit *Aegithalos caudatus*	LT	BoCCW3 Amber	-	-	2	-	-	2
Chiffchaff *Phylloscopus collybita*	CC		6	-	4	3	-	13

7 Identified during nocturnal bat surveys.

Species	BTO Code	Conservation Status	Approximate Number of Breeding Pairs					
			Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	TOTAL
Willow Warbler *Phylloscopus trochilus*	WW	BoCCW3 Red	25	24	21	16	23	109
Blackcap *Sylvia atricapilla*	BC		22	-	15	3	2	42
Garden Warbler *Sylvia borin*	GW		8	-	-	-	-	8
Whitethroat *Sylvia communis*	WH	BoCCW3 Red	1	2	1	7	-	11
Grasshopper Warbler *Locustella naevia*	GH	BoCCW3 Red	2	-	4	9	17	34
Sedge Warbler *Acrocephalus schoenobaenus*	SW		-	4	5	2	-	11
Wren *Troglodytes troglodytes*	WR	-	45	8	27	9	20	109
Starling *Sturnus vulgaris*	SG	BoCCW3 Red S7	-	-	-	-	1	1
Blackbird *Turdus merula*	B.	-	12	2	5	3	7	29
Song Thrush *Turdus philomelos*	ST	BoCCW3 Amber S7	9	4	4	5	1	23
Mistle Thrush *Turdus viscivorus*	M.	BoCCW3 Amber	1	1	-	-	1	2
Robin *Erithacus rubecula*	R.	-	23	-	12	3	2	40
Redstart *Phoenicurus phoenicurus*	RT		1	-	-	-	3	4
Stonechat *Saxicola rubicola*	SC	-	-	15	2	12	20	49
Wheatear *Oenanthe oenanthe*	W.		-	8	-		1	9
Dunnock *Prunella modularis*	D.	S7	3	-	1	-	1	5
House Sparrow *Passer domesticus*	HS	BoCCW3 Amber S7	-	-	5	-	-	5
Pied Wagtail *Motacilla alba*	PW	-	-	4	4	-	1	9
Grey Wagtail *Motacilla cinerea*	GL	BoCCW3 Amber	-	-	-	1	-	1
Tree Pipit *Anthus trivialis*	TP	BoCCW3 Amber S7	1	1	-	1	-	3
Meadow Pipit *Anthus pratensis*	MP	BoCCW3 Amber	8	27	14	42	48	139
Chaffinch *Fringilla coelebs*	CH	-	23	4	13	6	4	50
Bullfinch *Pyrrhula pyrrhula*	BF	BoCCW3 Red S7	-	-	4	2	-	6
Linnet *Linaria cannabina*	LI	BoCCW3 Red S7	-	3	2	2	-	7

Species	BTO Code	Conservation Status	Approximate Number of Breeding Pairs					
			Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	TOTAL
Lesser Redpoll *Acanthis cabaret*	LR	BoCCW3 Amber S7	-	3	5	6	-	14
Crossbill	CR	S1	2	-	-	1	-	3
Goldfinch *Carduelis carduelis*	GO	-	2	-	6	2		10
Siskin *Spinus spinus*	SK		5	-	-	2	1	8
Yellowhammer *Emberiza citrinella*	Y.	BoCCW3 Red S7	-	-	-	-	1	1
Reed Bunting *Emberiza schoeniclus*	RB	BoCCW3 Amber S7	-	5	8	10	9	32

Table 4. Results summary – non-breeding species

Species	Conservation Status	Notes
Goosander *Mergus merganser*	-	29/04/19 – Adult female flew over southeast
Red Kite *Milvus milvus*	BoCCW3 Amber S1	10/05/19 – Adult foraging in north of Study Area 11/05/19 – Adult foraging in south of the Study Area 12/06/19 – adult foraging on the north of the Study Area No evidence of breeding within the Study Areaor adjacent areas. Anecdotally, (farmer, pers comm.), breeding in valley to the north of the site.
Lesser Black-backed Gull *Larus fuscus*	BoCCW3 Amber	24/04/19 - One adult in flight over the Study Area and 15 foraging in pasture. 09/05/19 – Two in flight over centre of Study Area
Herring Gull *Larus argentatus*	BoCCW3 Red S7	23/04/19 – Two adults in flight over the Study Area 24/04/19 - Six adults in flight and 75 foraging within pasture in the east of the Study Area 09/05/19 – one in flight over Study Area
Kestrel *Falco tinnunculus*	BoCCW3 Red S7	09/05/19 – Adult female foraging in centre of Study Area
Hobby *Falco subbuteo*	S1	24/06/19 – Adult in flight in the south of the Study Area
Sand Martin *Riparia riparia*	-	24/04/19 – two in flight in the east of the Study Area 10/05/19 - ten in flight in the east of the Study Area
Swallow *Hirundo rustica*	-	Recorded during each survey foraging over the Study Area
House Martin *Delichon urbicum*	-	24/04/19 – five in flight in the south of the Study Area
Rook *Corvus frugilegus*	-	Logged during each survey foraging within pasture in the north and east of the Study Area

5.2 Goshawk Survey

There were no observations of Goshawk during the targeted surveys, and this species is consequently considered absent from the Study Area and 1km buffer zone.

The sole observations during the survey period related to birds seen on 9 July and 23 July during Honey-buzzard surveys. Both observations were in excess of 4km from the site.

5.3 Honey-buzzard Survey

There was no evidence of breeding Honey-buzzard within the Study Area or 2km buffer zone. Throughout the survey period, there were only two distant Honey-buzzard sightings, both in excess of 4km from the site.

The nearest known nest site in this well studied area is approximately 4.5 km from the site.

6 Summary

A suite of breeding bird surveys to inform the proposed complementary restoration works at Nant Helen was completed during 2019. These surveys included a CBC survey and targeted Goshawk and Honey-buzzard surveys.

During CBC surveys all species observed or heard were recorded. A total 62 species were logged, of which 52 species were considered to have bred within the Study Area. Of these species ten are included on the BoCCW 3 Red list, 13 on the BoCCW 3 Amber list with 14 being included on Section 7 of the Environment (Wales) Act 2016. One species (Common Crossbill) that is included on Schedule 1 of the Wildlife and Country 1981 (as amended) bred within the survey area.

No territories of Goshawk or Honey-buzzard were present within the Study Area or relevant buffers. A number of observations of Red Kite occurred during the survey period, although no evidence of breeding within the Study Area was noted.

Figures

Figure 1 Study Area

Figure 2 Transect Details

Figure 3 Drawings 1-15: BBS Results for Species of Conservation Significance

A3



LEGEND

Study Area

19/12/2019 15:59:38

Issue	Date	By	Chkd	Appd
F1	2019-11-14	EA	CP	

Metres

0 270 540 1,080

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Cardiff CF10 4QP
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Client

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Job Title

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Figure 1
Study Area

Scale at A3

1:20,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
001	F1

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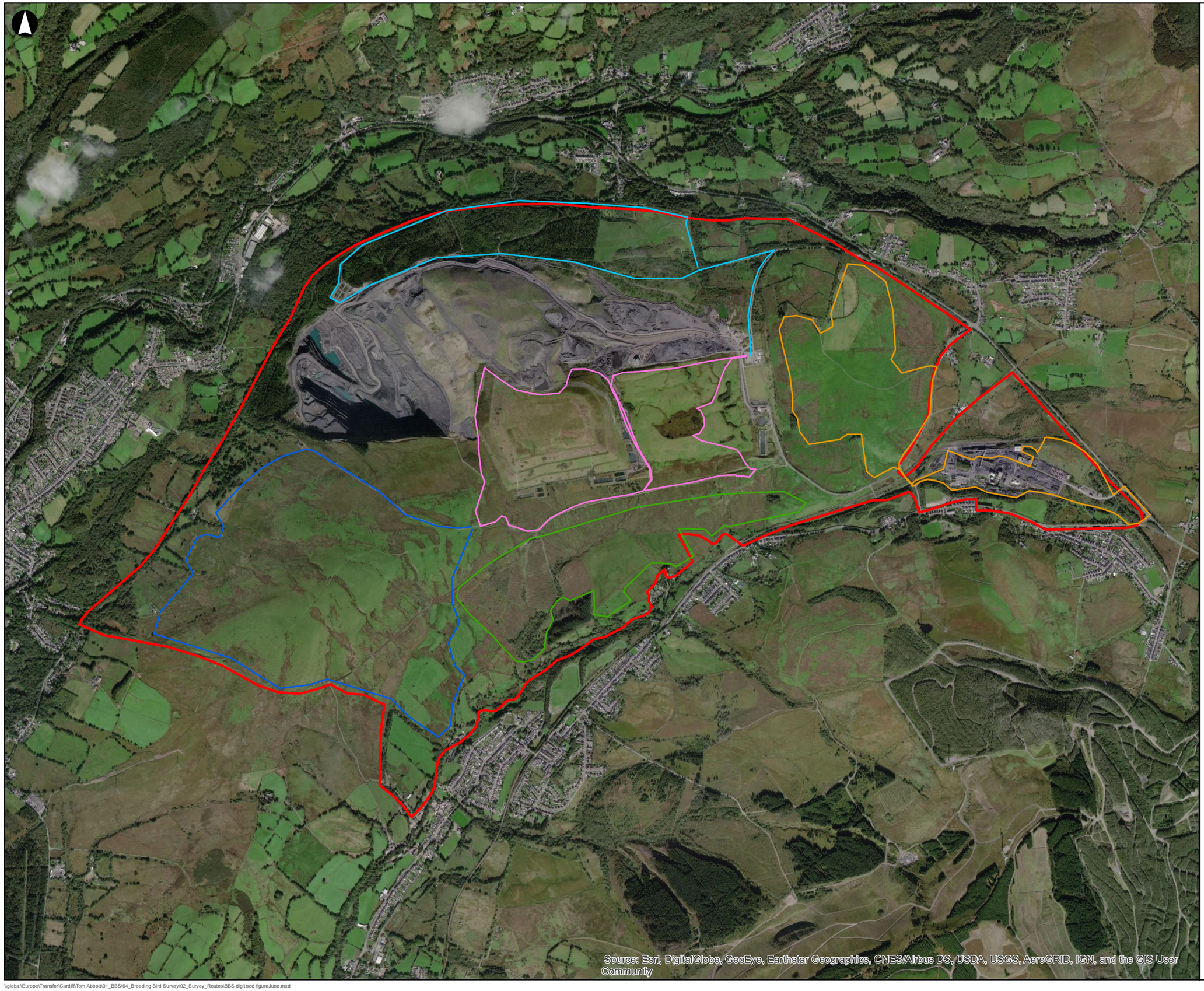
A3



Legend

- BBS Transect 1
- BBS Transect 2
- BBS Transect 3
- BBS Transect 4
- BBS Transect 5
- Survey Area

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Issue	Date	By	Chkd	Appd
P0	2019-11-13	KJ	CP	PC

Metres

0 280 560 1,120

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Survey Details

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Drawing No	Issue
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A3

BF Bullfinch
CK Cuckoo
GC Goldcrest
GH Grasshopper Warbler
LI Linnet
LT Long-tailed Tit
M. Mistle Thrush
MP Meadow Pipit
RB Reed Bunting
S. Skylark
ST Song Thrush
WH Whitethroat
WW Willow Warbler

Legend

- Study Area
- Transect 1
- Transect 2
- Transect 3
- Transect 5
- R. Away
- R. Away, Alarm
- R. Away, Call
- ♂R. Away, Male
- R. - R. Different Simultaneous
- R. Flight
- R. Land
- R. R. Simultaneous
- Alarm
- Call
- ♀ Pair
- R. Sight record
- Song

Metres

0 105 210 420

F1	2020-02-03	AM	PC	PC

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Coordinate System: British National Grid
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus

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Drawing Title
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Role

Suitability
For Issue

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A3

CK Cuckoo
D. Dunnock
GC Goldcrest
L. Lapwing
LI Linnet
M. Mistle Thrush
MP Meadow Pipit
RB Reed Bunting
S. Skylark
ST Song Thrush
TP Tree Pipit
WH Whitethroat
WW Willow Warbler

Legend

- Study Area
- Transect 1
- Transect 2
- Transect 3
- Transect 5
- R. Away
- R. - R. Different Simultaneous
- R. Flight
- R. Flight, Call
- R. Land
- ♂ R. Land, Male
- R. R. Simultaneous
- Song, two locations, same bird
- = Alarm
- _ Call
- * Nest
- R. Sight record
- Song

Metres
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Rev	Date	By	Chkd	Appd
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A3

BF Bullfinch
CK Cuckoo
CR Crossbill (common)
D. Dunnock
GC Goldcrest
GH Grasshopper Warbler
L. Lapwing
LI Linnet
MP Meadow Pipit
RB Reed Bunting
S. Skylark
SG Starling
ST Song Thrush
TP Tree Pipit
WH Whitethroat
WW Willow Warbler

Legend

- Study Area
- Transect 1
- Transect 2
- Transect 3
- Transect 5
- R. Away
- R. Away, Alarm
- R. Away, Call
- R. R. Different Simultaneous
- R. Flight
- Flight, Song
- R. Land
- R. Land, Male
- Land, Song
- R. R. Simultaneous
- Alarm
- Call
- food Call, Food
- Call, Male
- R. Sight record
- Song

Metres

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Coordinate System: British National Grid
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus

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A3

GH Grasshopper Warbler
HS House Sparrow
LI Linnet
MA Mallard
MP Meadow Pipit
RB Reed Bunting
S. Skylark
ST Song Thrush
WH Whitethroat
WW Willow Warbler

Legend

- Study Area
- Transect 1
- Transect 2
- Transect 4
- Transect 5
- R. Away
- R. Away, Alarm
- R. Away, Call
- R. R. Different Simultaneous
- R. Flight
- R. Flight, Call
- R. Land
- R. R Simultaneous
- Alarm
- Call
- Nest
- R. Sight record
- Song

Metres

0 75 150 300

Rev	Date	By	Chkd	Appd
F1	2020-02-03	AM	PC	PC

Coordinate System: British National Grid
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus

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A3

CK Cuckoo
GH Grasshopper Warbler
HS House Sparrow
L. Lapwing
LI Linnet
M. Mistle Thrush
MP Meadow Pipit
RB Reed Bunting
S. Skylark
TP Tree Pipit
WH Whitethroat
WW Willow Warbler

Legend

- Study Area
- Transect 1
- Transect 2
- Transect 4
- Transect 5
- Aggressive
- R. Away
- R. Away, Alarm
- R. R. Different Simultaneous
- R. Flight
- R. Flight, Alarm
- R. Flight, Call
- R. food Flight, Food
- R. Land
- R. R. Simultaneous
- Song, two locations, same bird
- = Alarm
- _ Call
- * Nest
- * on On
- R. Sight record
- Song

Metres

0 75 150 300

Rev	Date	By	Chkd	Appd
F1	2020-02-03	AM	PC	PC

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Global Centre for Rail Excellence

Drawing Title
BBS Transect 2 - May Species of Conservation Significance

Scale at A3
1:6,000

Role

Suitability
For Issue

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005

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A3

BF Bullfinch
CK Cuckoo
D. Dunnock
GH Grasshopper Warbler
GL Grey Wagtail
L. Lapwing
LI Linnet
MP Meadow Pipit
RB Reed Bunting
S. Skylark
SG Starling
SL Lapwing
ST Song Thrush
TP Tree Pipit
WH Whitethroat
WW Willow Warbler

Legend

- Study Area
- Transect 1
- Transect 2
- Transect 4
- Transect 5
- R. Away
- R. Away, Alarm
- R. Away, Call
- R. R. Different Simultaneous
- R. Flight
- ♂ R. Land, Male
- R. R. Simultaneous
- = Alarm
- _ Call
- fam Family
- ♀ Female
- ♂ Male
- * Nest
- R. Sight record
- Song

Metres
0 75 150 300

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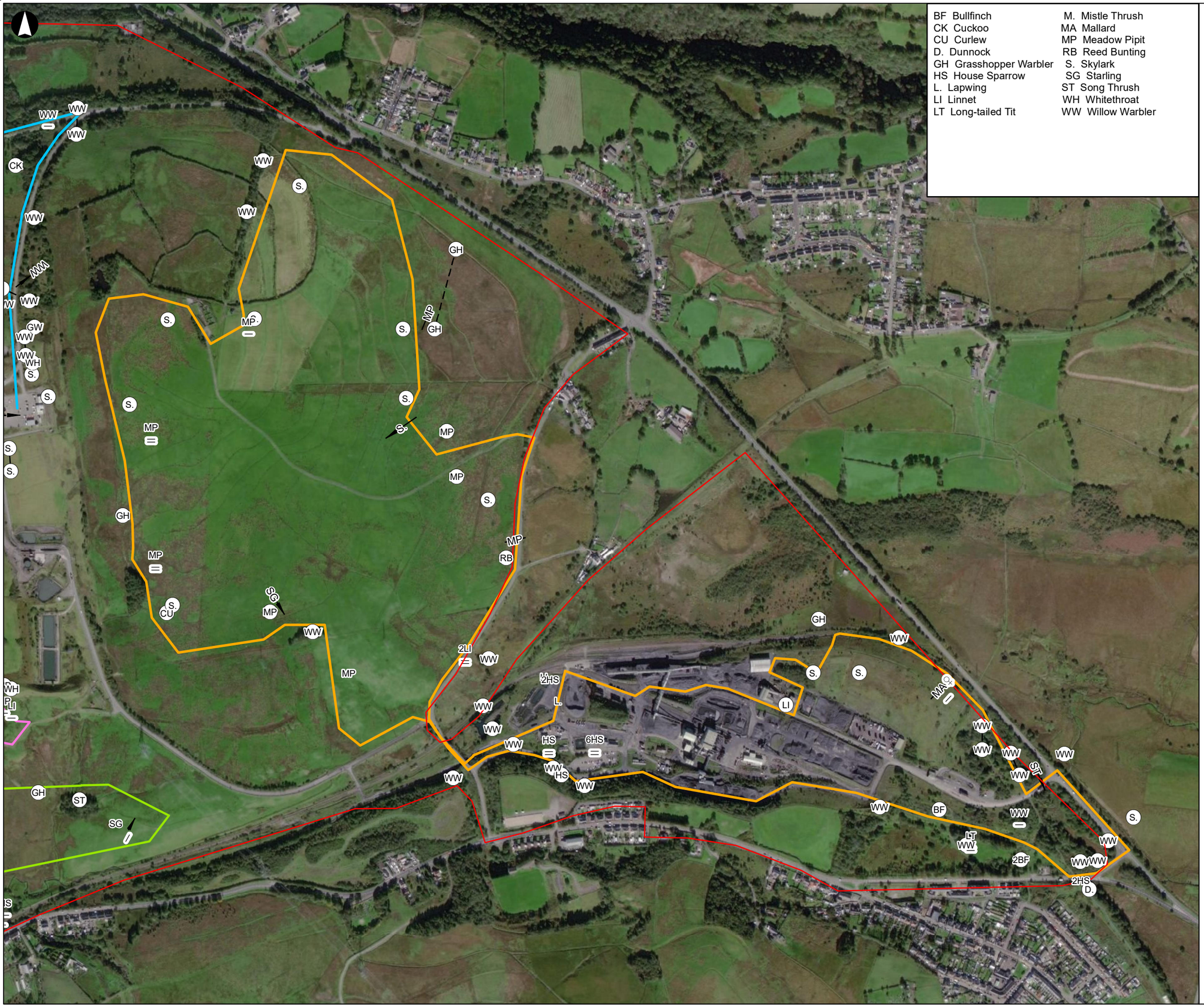
A3



Legend

- Study Area
- Transect 1
- Transect 2
- Transect 3
- Transect 4
- R. Away
- R. Away, Call
- R. R. Different Simultaneous
- R. Flight
- R♀ Flight, Call, Female
- R. Land
- R. R. Simultaneous
- Alarm
- Call
- R. Sight record
- Song

Metres

0 100 200 400

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Role

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A3

BF Bullfinch
D. Dunnock
GH Grasshopper Warbler
HS House Sparrow
LI Linnet
LT Long-tailed Tit
M. Mistle Thrush
MP Meadow Pipit
RB Reed Bunting
S. Skylark
SG Starling
ST Song Thrush
TP Tree Pipit
WH Whitethroat
WW Willow Warbler

Legend

- Study Area
- Transect 1
- Transect 2
- Transect 3
- Transect 4
- Aggressive
- Away
- Different Simultaneous
- Flight
- Flight, Alarm
- Simultaneous
- Song, two locations, same bird
- Alarm
- Call
- Male
- Sight record
- Song

Metres
0 100 200 400

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Role

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A3

BF Bullfinch
CR Crossbill (common)
D. Dunnock
GH Grasshopper Warbler
GL Grey Wagtail
L. Lapwing
LI Linnet
M. Mistle Thrush
MP Meadow Pipit
RB Reed Bunting
S. Skylark
SG Starling
SL Lapwing
ST Song Thrush
TP Tree Pipit
WH Whitethroat
WW Willow Warbler

Legend

- Study Area
- Transect 2
- Transect 3
- Transect 4
- Transect 5
- Away
- Away, Call
- Different Simultaneous
- Flight
- Flight, Alarm
- Land
- Land, Song
- Simultaneous
- Alarm
- Call
- Family
- Female
- Fight
- Food
- Male
- Nest
- Pair
- Sight record
- Song

Metres
0 87.5 175 350

Rev	Date	By	Chkd	Appd
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Role

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For Issue

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A3

BF Bullfinch
CK Cuckoo
CU Curlew
GH Grasshopper Warbler
HS House Sparrow
LI Linnet
MA Mallard
MP Meadow Pipit
RB Reed Bunting
S. Skylark
SG Starling
ST Song Thrush
WH Whitethroat
WW Willow Warbler

Legend

- Study Area
- Transect 2
- Transect 3
- Transect 4
- Transect 5
- R. Away
- R. Away, Alarm
- R. Away, Call
- R. R. Different Simultaneous
- R. Flight
- R. Flight, Call
- R. Land
- Land, Song
- R. R. Simultaneous
- Alarm
- Call
- Nest
- R. Sight record
- Song

Metres
0 87.5 175 350

Rev	Date	By	Chkd	Appd
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Coordinate System: British National Grid
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Scale at A3
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Role

Suitability
For Issue

Arup Job No
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010

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A3

BF Bullfinch
CK Cuckoo
GC Goldcrest
GH Grasshopper Warbler
HS House Sparrow
L. Lapwing
LI Linnet
M. Mistle Thrush
MP Meadow Pipit
RB Reed Bunting
S. Skylark
SG Starling
TP Tree Pipit
WH Whitethroat
WW Willow Warbler

Study Area
Transect 2
Transect 3
Transect 4
Transect 5
Aggressive
Away
Away, Alarm
Different Simultaneous
Flight
Flight, Alarm
Flight, Call
Flight, Food
Land
Land, Song
Simultaneous
Song, two locations, same bird
Alarm
Call
Nesting material
Nest
On
Sight record
Song

Metres
0 87.5 175 350

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For Issue

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A3

BF Bullfinch
CR Crossbill (common)
D. Dunnock
GH Grasshopper Warbler
GL Grey Wagtail
L. Lapwing
LI Linnet
M. Mistle Thrush
MP Meadow Pipit
RB Reed Bunting
S. Skylark
SG Starling
SL Lapwing
ST Song Thrush
TP Tree Pipit
WH Whitethroat
WW Willow Warbler

Legend

- Study Area
- Transect 2
- Transect 3
- Transect 4
- Transect 5
- R. Away
- R. Away, Call
- R.fam Away, Family
- R. - ·R. Different Simultaneous
- ·R. Flight
- R. Flight, Alarm
- ·R. Flight, Call
- R.♂ Flight, Male
- Flight, Song
- R. Land
- ♀ R. Land, Female
- ♂ R. Land, Male
- Land, Song
- R. R Simultaneous
- Alarm
- ♂ Alarm, Male
- ♂♀ Alarm, Pair
- Call
- fam Call, Family
- fam Family
- ♀ Female
- Fight
- food Food
- juv Juvenile
- ♂ Male
- * Nest
- ♀ Pair
- R. Sight record
- Song

Metres

0	87.5	175	350

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Role

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A3

CK Cuckoo
D. Dunnock
GH Grasshopper Warbler
HS House Sparrow
LI Linnet
MP Meadow Pipit
RB Reed Bunting
S. Skylark
SG Starling
ST Song Thrush
TP Tree Pipit
WW Willow Warbler

Legend

- Study Area
- Transect 2
- Transect 4
- Transect 5
- R. Away
- R. Away, Alarm
- R. R. Different Simultaneous
- R. Flight
- Flight, Aggressive
- R. Flight, Call
- Flight, Song
- R. Land
- ♂ R. Land, Male
- Land, Song
- Call
- Fight
- R. Sight record
- Song

Metres

0	87.5	175	350

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For Issue

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A3

CK Cuckoo
GH Grasshopper Warbler
L. Lapwing
LI Linnet
M. Mistle Thrush
MP Meadow Pipit
RB Reed Bunting
S. Skylark
SG Starling
WH Whitethroat
WW Willow Warbler
Y. Yellowhammer

Legend

- Study Area
- Transect 2
- Transect 4
- Transect 5
- Away
- Different Simultaneous
- Flight
- Flight, Alarm
- Flight, Song
- Land
- Land, Song
- Simultaneous
- Song, two locations, same bird
- Alarm
- Call
- Fight
- Sight record
- Song

Metres
0 87.5 175 350

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A3

CR Crossbill (common)
GH Grasshopper Warbler
LI Linnet
M. Mistle Thrush
MP Meadow Pipit
RB Reed Bunting
S. Skylark
SG Starling
ST Song Thrush
WH Whitethroat
WW Willow Warbler

Legend

- Study Area
- Transect 2
- Transect 4
- Transect 5
- R. Away
- R. Different Simultaneous
- R. Flight
- R. Flight, Alarm
- R. Land
- Land, Song
- R. R Simultaneous
- Alarm
- Call
- Call, Male
- Female
- Fight
- Male
- R. Sight record
- Song

Metres

0	87.5	175	350

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Appendix 7H

Wintering Bird Report

Welsh Government

Global Centre for Rail Excellence (GCRE)

Wintering Bird Survey Report 2018/19

Rev A | 9 July 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

Ove Arup & Partners Ltd
4 Pierhead Street
Capital Waterside
Cardiff CF10 4QP
United Kingdom
www.arup.com

ARUP

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1.1 Background 1
1.2 Objective 1

2 Project Description and Context 2

3 Site Description 3

4 Study Area 4

5 Methodology 5
5.1 Surveyors 5
5.2 Survey Details 5
5.3 Limitations 6

6 Results 7

7 Conclusions 11

Figure 1 Study Area
Figure 2 Survey Details
Figure 3.1 Survey Results – 13 December 2018
Figure 3.2 Survey Results – 7 January 2019
Figure 3.3 Survey Results – 13 February 2019
Figure 3.4 Survey Results – 4 March 2019

1 Introduction

1.1 Background

Ove Arup & Partners Ltd (Arup) was commissioned by the Welsh Government (WG) to undertake a range of consultancy services in relation to the Global Centre for Rail Excellence (GCRE), hereafter referred to as 'the Project'.

As part of that commission, a range of ecological surveys have been undertaken to identify the baseline ecological conditions of the Project area, to inform the assessment of impacts as part of the Environmental Impact Assessment (EIA) process.

This document describes the wintering bird surveys undertaken for the Project.

1.2 Objective

The objective of the surveys covered by this report was to provide data on the assemblage, numbers and distribution of wintering birds within the study area.

Nomenclature within this report follows the British (English) vernacular name within the British Ornithologists' Union (BOU) British list[1].

[1] BOU (2015). *The British List; The official list of bird species recorded in Britain* [online] available at: https://www.bou.org.uk/british-list/category-a-b-c-species/.

2 Project Description and Context

The WG are proposing to develop a rail testing, maintenance, research, development and storage facility (also referred to as the Global Rail Centre for Excellence) at the site of the Onllwyn washery and Nant Helen open cast mine site. The site for development is approximately 475 ha.

The proposed site is currently being mined by Celtic Energy, who will cease extraction operations in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and agreements with Powys County Council (PCC) and Neath Port Talbot County Borough Council (NPTCBC). This includes Section 106 planning obligations and planning conditions that need to be discharged.

Celtic Energy has submitted two recent planning applications for the site, including: the revised restoration strategy for approval (Planning reference number: 19/1899/REM) which would change the existing approved restoration scheme (for planning application ref 18/1070/REM). And, the Nant Helen complementary earthworks application for approval (Planning reference number: 20/0738/FUL) The purpose of these applications is to allow for a ‘flexible and adaptable landform for a variety of future uses on restoration, including the use of the site as a rail testing and storage facility, proposed by the WG.

3 Site Description

The Project site is within the Dulais Valley located within Powys and Neath Port Talbot, with the Brecon Beacons National Park Authority boundary immediately to the north. Nearby settlements include Onllwyn, Seven Sisters, Ystradgynlais, Caehopkin, Abercrave or Coelbren.

The site is predominantly brownfield land that has been heavily worked by open cast mining. Much of the site has been revegetated.

4 Study Area

The study area encompasses the majority of land within the Nant Helen open cast operational site, which at the time of commencing the ecological surveys was considered to be the likely boundary of the project site.

5 Methodology

Prior to the completion of the first survey, a transect route was identified (Figure 2). This transect route was determined with the intention of providing coverage of key areas within the study area which may support important species/numbers of wintering birds based on habitat type/extent. Four transects were then completed between 13 December 2018 and 4 March 2019 (Table 1).

The survey route included a walked transect through farmland and a driven transect, with two viewpoints from which 15-minute duration point counts were completed. The route of the walked and driven transect and the viewpoints are shown on Figure 2.

During each survey the surveyor recorded all observations on field maps using standard British Trust for Ornithology (BTO) coding. Observations of birds outside the study area were also logged.

The direction of surveys was alternated between visits to ensure all parts of the survey area received adequate coverage during different periods of the day.

5.1 Surveyors

Surveys were completed by Martyn Owen MCIEEM.

Martyn is an experienced consultant ornithologist and was Shropshire County Bird Recorder from 2012-2017, former editor of the Shropshire Ornithological Society's Annual Bird Report and remains on the Shropshire Ornithological Society Rarity Committee.

Martyn has completed bird survey work at many sites in Wales (and elsewhere) employing the full range of ornithological survey techniques and data analysis in relation to many projects over the previous 15 years. Martyn holds numerous Natural Resources Wales (NRW) Schedule 1 survey licences.

5.2 Survey Details

Detail in relation to survey dates and weather are provided within Table 1.

Table 1: Survey details.

Survey Visit	Date	Time	Weather				
			Wind Speed (Beaufort)	Wind Direction	Cloud Cover (Oktas)	Temp (°C)	Precip.
1	13/12/2018	08:30-14:30	3-4	SE	6-8	5-7	Nil
2	07/01/2019	08:10-12:55	2-3	SW	8	8-10	Nil
3	13/02/2019	08:00-13:55	1-2	SW	7-8	7-8	Nil
4	04/03/2019	08:00-12:55	3-4	SW	8	0-2	Occasional rain

5.3 Limitations

The wintering bird survey covered a four-month period between December 2018 and March 2019. Whilst the late autumn period (October/November) was not included timing of Arup's commission, this is not considered a significant limitation; the results achieved in the survey are considered adequate to describe the wintering bird assemblage that typically uses the study area.

The findings presented in this study represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys are limited by factors which affect the presence of flora and fauna, factors such as the time of year and natural behaviour of the animals. Nevertheless, these surveys were conducted at the optimal survey periods and using methodologies which are in accordance with published guidelines.

6 Results

Table 2 provides a summary of all species observed across the survey period. Within this table the peak count for each species is emboldened. The locations of all observations are provided within Figures 3.1-3.4.

Across the survey period, 34 species were recorded. Of these species, three are included on the Birds of Conservation Concern Wales (BoCCW)3[2] Red list, 12 are included on the BoCCW3 Amber list with seven being included in response to Section 7 (S7) of the Environment (Wales) Act 2016, being of principal importance for the purpose of maintaining and enhancing biodiversity in Wales.

2 Johnstone I., Bladwell S. (2016). *Birds of Conservation Concern in Wales 3: the population status of birds in Wales*. Birds in Wales, vol.14 No.1

Table 2: Results summary

Species	BTO Code	Conservation Status	Total Count within Study Area (Figure 3.1-3.4)				Comments
			Survey 1	Survey 2	Survey 3	Survey 4	
Greylag Goose *Anser anser*	GJ	-	0	**8**	0	0	The sole record related to a flock in flight in the northeast of the Study Area.
Greater Canada Goose *Branta canadensis*	CG	-	0	0	0	**6**	During the final survey, three groups of two birds (presumed pairs) were present within the Study Area.
Mallard *Anas platyrhynchos*	MA	BoCCW3 Amber	6	5	1	**8**	Recorded on ponds within the Study Area.
Grey Heron *Ardea cinerea*	H.	BoCCW3 Amber	**1**	0	**1**	**1**	All records related to a bird fishing on a pond in the northeast of the Study Area.
Red Kite *Milvus milvus*	KT	BoCCW3 Amber	**2**	0	1	1	Foraging birds over farmland within the Study Area.
Buzzard *Buteo buteo*	BZ	-	**2**	0	1	2	Foraging within the Study Area.
Snipe *Gallinago gallinago*	SN	BoCCW3 Amber	**1**	0	0	0	A single record of a bird flushed from a wet area in the west of the Study Area.
Woodpigeon *Columba palumbus*	WP	-	0	0	**4**	0	
Kestrel *Falco tinnunculus*	K.	BoCCW3 Red S7	**1**	0	0	0	A single record of a female foraging in the centre of the Study Area.
Magpie *Pica pica*	MG	-	1	**8**	2	2	
Jackdaw *Corvus monedula*	JD	-	8	37	**54**	19	Flocks of birds present within farmland and associated with buildings in the east of the Study Area.
Rook *Corvus frugilegus*	RO	-	14	0	**32**	0	
Carrion Crow *Corvus corone*	C.	-	19	15	**29**	5	
Raven *Corvus corax*	RN	-	1	1	**4**	1	A nest present on a pylon in the centre if the Study Area, with birds predominantly noted in this area.
Blue Tit *Cyanistes caeruleus*	BT	-	0	3	**5**	1	
Great Tit *Parus major*	GT	-	0	1	0	1	

Species	BTO Code	Conservation Status	Total Count within Study Area (Figure 3.1-3.4)				Comments
			Survey 1	Survey 2	Survey 3	Survey 4	
Skylark *Alauda arvensis*	S.	BoCCW3 Amber S7	0	0	12	**22**	Breeding birds returned to the Study Area from Survey 2, predominantly in the west.
Wren *Troglodytes troglodytes*	WR	-	2	2	3	**4**	
Starling *Sturnus vulgaris*	SG	BoCCW3 Red S7	**42**	4	7	21	Foraging flocks noted in farmland in the east of the site.
Blackbird *Turdus merula*	B.	-	1	**6**	4	2	
Fieldfare *Turdus pilaris*	FF	BoCCW3 Amber	0	3	0	**16**	Maximum flock (12) noted foraging in farmland/scrub in the centre of the Study Area, with scattered records elsewhere.
Song Thrush *Turdus philomelo*	ST	BoCCW3 Amber S7	0	0	**7**	4	Scattered records predominantly in the east of the Study Area from survey 3.
Redwing *Turdus iliacus*	RE	BoCCW3 Amber	0	**4**	0	0	Solely records in flight during survey 2.
Mistle Thrush *Turdus viscivorus*	M.	BoCCW3 Amber	**1**	**1**	0	0	Singletons noted in the centre of the Study Area (survey 1) and southeast (survey 2).
Robin *Erithacus rubecula*	R.	-	0	**1**	0	0	
Stonechat *Saxicola rubicola*	SC	-	0	**2**	1	**2**	Associated with marshy grassland in the centre of the site.
Dunnock *Prunella modularis*	D.	S7	0	0	**2**	1	Records in the centre of the Study Area during surveys 3 and 4.
House Sparrow *Passer domesticus*	HS	BoCCW3 Amber S7	0	**15**	0	11	Birds present around residential areas to the southeast of the Study Area.
Pied Wagtail *Motacilla alba*	PW	-	1	0	2	**2**	
Meadow Pipit *Anthus pratensis*	MP	BoCCW3 Amber	**9**	7	1	5	Scattered records, predominantly in the west of the Study Area associated with pastoral farmland.
Chaffinch *Fringilla coelebs*	CH	-	0	0	**2**	**2**	
Linnet *Linaria cannabina*	Li	BoCCW3 Red S7	**4**	0	2	0	A flock of four in the centre of the Study Area (survey 1) and two in the same area during survey 3.

Species	BTO Code	Conservation Status	Total Count within Study Area (Figure 3.1-3.4)				Comments
			Survey 1	Survey 2	Survey 3	Survey 4	
Goldfinch *Carduelis carduelis*	GO	-	0	**2**	0	0	
Reed Bunting *Emberiza schoeniclus*	RB	BoCCW3 Amber S7	**5**	4	1	**5**	Records during each survey, with records associated with wet pasture in the centre of the Study Area.

7 Conclusions

A wintering bird survey to inform the proposed complementary restoration works at Nant Helen was completed during winter 2018/19. This survey included a walked transect through farmland and a driven transect, with two viewpoints (Figure 2) from which 15-minute point counts were completed. During each survey all species observed or heard were recorded.

Overall, the assemblage of birds recorded is typical of habitats in upland areas of this part of Wales. No particularly rare species or large aggregations of species of conservation concern were recorded. Of the total of 34 species was recorded, three are included on the Birds BoCCW3 Red list, 12 are included on the BoCCW3 Amber list with seven being included on S7 of the Environment (Wales) Act 2016.

A full ecological impact assessment will be included within the Environmental Statement for the project and this will include an assessment of the significance of impacts from the project on protected and/or notable wintering bird species. This will also detail any mitigation or compensation measures required to ensure there is no significant effect on wintering bird species within the site.

This report is the result of the survey work undertaken between April and September 2019. This report refers, within the limitations stated, to the condition or proposed works of the site at the time of the surveys. Changes in legislation, guidance, best practice, etc. may necessitate a re-assessment/survey. No warranty is given as to the possibility of future changes in the condition of the site.

The results of these surveys are considered valid for a minimum of 18 months to a maximum of 3 years. If more than 18 months elapses before any planning application is submitted, the requirement for repeat surveys should be reviewed[3].

[3] Chartered Institute of Ecology and Environmental Management (2019*). Advice Note on the Lifespan of Ecological Reports and Surveys.*

Figures

Figure 1 Study Area

Figure 2 Survey Details

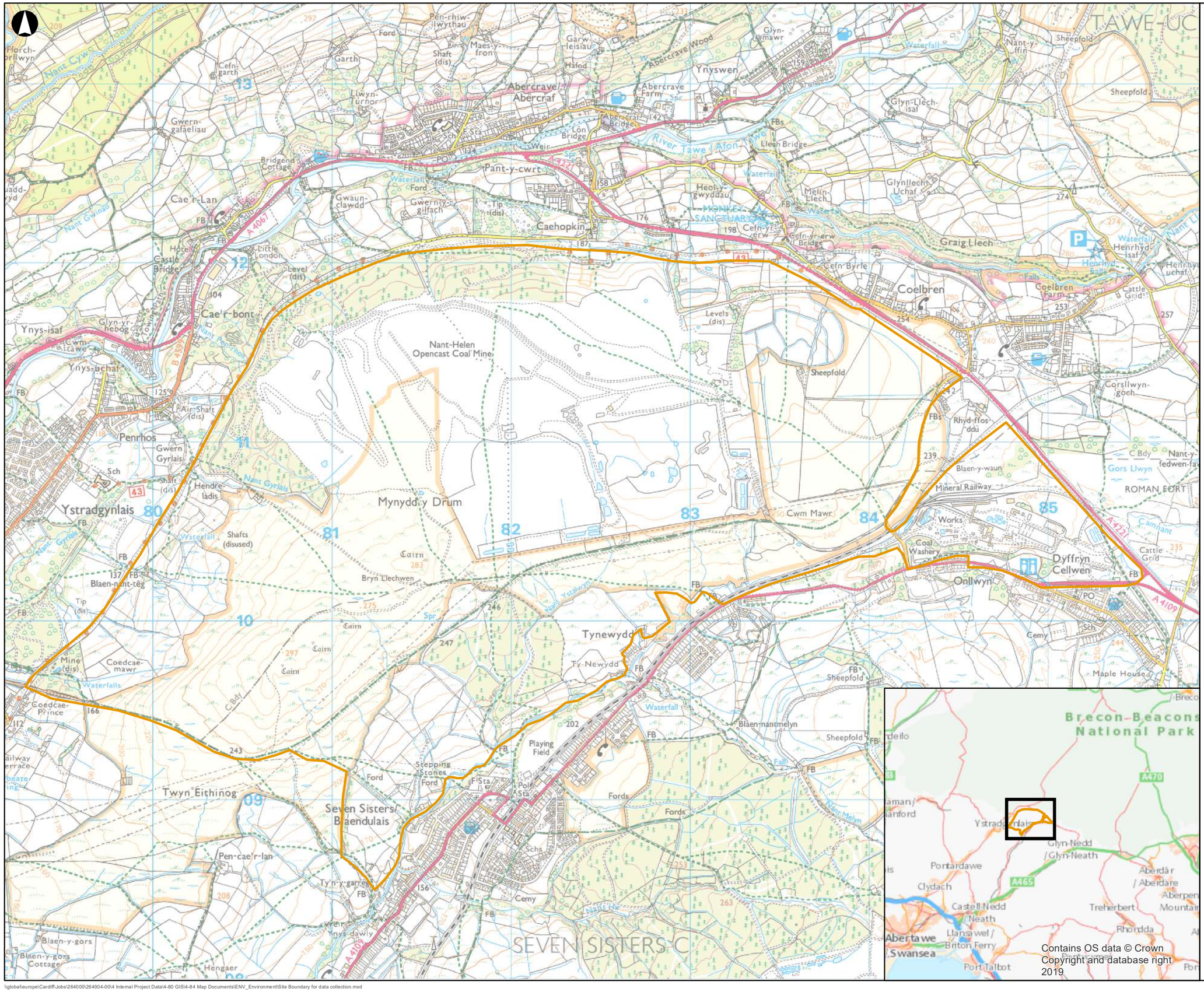
Figure 3.1 Survey Results – 13 December 2018

Figure 3.2 Survey Results – 7 January 2019

Figure 3.3 Survey Results – 13 February 2019

Figure 3.4 Survey Results – 4 March 2019

A3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Mynydd-y Drum
Ynyswen
Abercrave
Abercraf
Pant-y-cwrt
Caehopkin
Coelbren
Graig Llech
Cae'r-bont
Ynys-isaf
Penrhos
Ystradgynlais
Twyn Eithinog
Seven Sisters/ Blaendulais
Tynewydd
Onllwyn
Dyffryn Cellwen
Blaen-nantmelyn
Pen-cae'r-lan
Coedcae-mawr
Coedcae-Prince
Blaen-nant-têg
Blaen-y-gors
Hengaer
Cwm Mawr
Blaen-y-waun
Mineral Railway
Coal Washery
Works
Rhyd-ffos-ddu
Cefn-Byrle
Cefn-yr-erw
Heol-y-gwyddau
Melin-Llech
Glyn-Llech-isaf
Glynllechau Uchaf
Llwyn-Turnor
Gwern-gafaeliau
Gwaun-clawdd
Gwern-y-gilfach
Llwyn-Tudor
Garw-leisiau
Glyn-mawr
Nant-y-ffin
Sheepfold
Corsllwyn-goch
Henrhyd-isaf
Henrhyd-uchaf
Coelbren Farm
Maple Houses
Cemy
Sch
PO
Sta
Pol Sta
Schs
Ford
Fords
Falls
Waterfall
Cattle Grid
Playing Field
Stepping Stones
Air Shaft (dis)
Shaft (dis)
Shafts (disused)
Levels (dis)
Tip (dis)
Mine (dis)
Level (dis)
Lon Bridge
Llwyn Bridge
Cefn-yr-erw Bridge
Abercraf Bridge
Castle Bridge
Bridgend Cottage
Little London
Ty-Newydd
Ty'n-y-garreg
Nant Gwrnant
Nant Gyrlais
Nant Pen-llwyn
Nant Melyn
Nant Llia
Nant Ysgallog
Nant Cyw
Abercrave Wood
Bryn Llechwen
Cairn
Spr
Weir
Ynys-dawlwy
Ynys-uchaf
Glyn-yr-hebog
Cwm-llawe
Hendre-ladis
Gwern Gyrlais
Blaen-y-gors Cottage
Coedcae-mawr
Waterfalls
Maes-y-fron
Pen-rhiw-lwythau
Horch-orllwyn
Garth
Cefn-garth
Haford
Abercrave Farm
Abercraf Bridge
Llwyn-Tudor
Ty-Newydd
Melin-Llech
Glynllechau Uchaf
Cefn-yr-erw
Cefn-Byrle
Graig Llech
Coelbren
Sheepfold
Corsllwyn-goch
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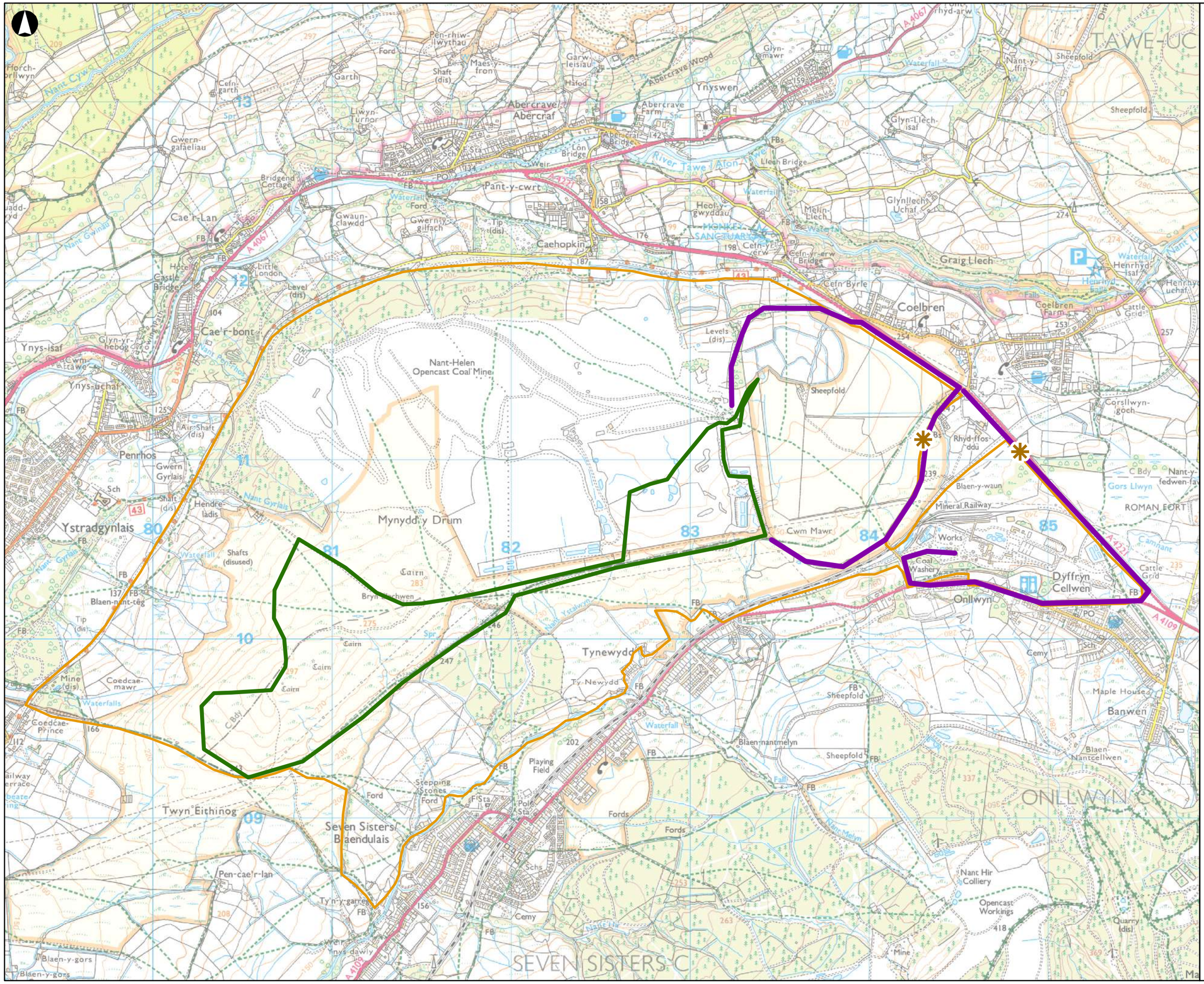
Blaen-y-waun
Mineral Railway
Coal Washery
Works
Onllwyn
Dyffryn Cellwen

A3



Legend

Survey Route

- Driven Transect
- Walked Transect
- Viewpoints
- Survey Area

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Issue	Date	By	Chkd	Appd
F1	06/01/20	JG	AC	PC

Metres
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Job Title
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Wintering Bird Survey Report

Figure 2
Survey Details

Scale at A3
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Job No	Drawing Status
264904	For Issue

Drawing No	Issue
002	F1

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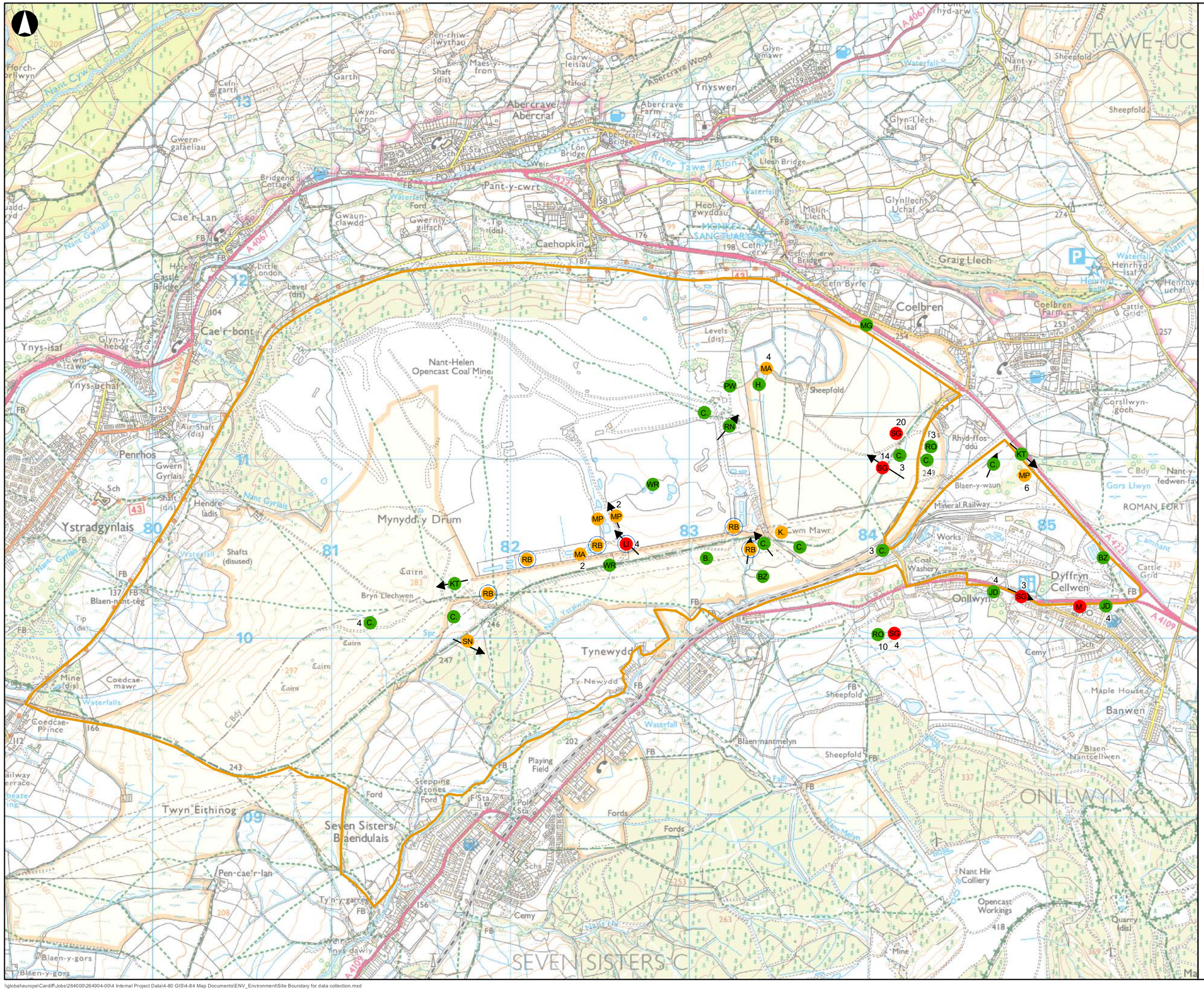

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Legend

Wintering Bird Observations

Welsh Conservation Status

- Red List
- Amber List
- Green List
- Environment (Wales) Act 2016; Section 7 Species
- Flight Lines
- Survey Area

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Wintering Bird Survey Report

Figure 3.1
Survey Results - 13/12/2018

Scale at A3

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Job No	Drawing Status
264904	For Issue

Drawing No	Issue
003.1	F1

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Wintering Bird Observations

Welsh Conservation Status

- Red List
- Amber List
- Green List
- Environment (Wales) Act 2016; Section 7 Species
- Flight Lines
- Survey Area

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Figure 3.2
Survey Results - 07/01/2019

Scale at A3
1:20,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
003.2	F1

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Legend

Wintering Bird Observations

Welsh Conservation

- Red List
- Amber List
- Green List
- Environment (Wales) Act 2016; Section 7 Species
- Flight Lines
- Survey Area

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Figure 3.3
Survey Results - 13/02/2019

Scale at A3

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Job No	Drawing Status
264904	For Issue

Drawing No	Issue
003.3	F1

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Legend

Wintering Bird Observations

Welsh Conservation Status

- Red List
- Amber List
- Green List
- Environment (Wales) Act 2016; Section 7 Species
- Flight Lines
- Survey Area

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Figure 3.4
Survey Results - 04/03/2019

Scale at A3
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Job No	Drawing Status
264904	For Issue

Drawing No	Issue
003.4	F1

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Appendix 7I

Riparian Mammal Survey
Wintering Bird Report

Welsh Government

Global Centre for Rail Excellence (GCRE)

Riparian Mammal Survey Report

Rev A | 9 July 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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Document verification

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Job title		Global Centre for Rail Excellence (GCRE)			**Job number** 264904
Document title		Riparian Mammal Survey Report			**File reference**
Document ref					
Revision	**Date**	**Filename**	Nant Helen_Riparian Mammal Report_v1.docx		
Draft 1	5 Nov 2019	**Description**	First draft		
			Prepared by	Checked by	Approved by
		Name	Martyn Owen		
		Signature			
Draft 2	6 Nov 2019	**Filename**	Nant Helen_Riparian Mammal Report_v2.docx		
		Description	Second draft		
			Prepared by	Checked by	Approved by
		Name	Martyn Owen	Richard Moores	
		Signature			
Issue	15 Nov 2019	**Filename**	Nant Helen_Riparian Mammal Report_v2.docx		
		Description	Issue		
			Prepared by	Checked by	Approved by
		Name	Martyn Owen	Claire Pooley	
		Signature			
Rev A	09 Jul 2020	**Filename**	GCRE_Riparian Mammal Report_Rev A.docx		
			Updated for GCRE		
			Prepared by	Checked by	Approved by
		Name	Kathryn Jones	Claire Pooley	Paul Clack
		Signature			
				Issue Document verification with document	✓

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10 Conclusions 13

Figure 1 Site Location
Figure 2 Surveyed Waterbodies and Survey Results

1 Introduction

1.1 Background

Ove Arup & Partners Ltd (Arup) was commissioned by the Welsh Government (WG) to undertake a range of consultancy services in relation to the Global Centre for Rail Excellence (GCRE), hereafter referred to as 'the Project'.

As part of that commission, a range of ecological surveys have been undertaken to identify the baseline ecological conditions of the Project area, to inform the assessment of impacts as part of the Environmental Impact Assessment (EIA) process.

This document describes the riparian mammal surveys undertaken for the Project.

1.2 Objectives

The objectives of the riparian mammal surveys were to ascertain the following:

- The suitability of watercourses and waterbodies within the Project area for otter (*Lutra lutra*) and water vole (*Arvicola amphibius*); and
- The presence and distribution, or likely absence, of otter and water vole within the Project area.

2 Project Description and Context

The WG are proposing to develop a rail testing, maintenance, research, development and storage facility (also referred to as the Global Rail Centre for Excellence) at the site of the Onllwyn washery and Nant Helen open cast mine site. The site for development is approximately 475 ha.

The proposed site is currently being mined by Celtic Energy, who will cease extraction operations in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and agreements with Powys County Council (PCC) and Neath Port Talbot County Borough Council (NPTCBC). This includes Section 106 planning obligations and planning conditions that need to be discharged.

Celtic Energy has submitted two recent planning applications for the site, including: the revised restoration strategy for approval (Planning reference number: 19/1899/REM) which would change the existing approved restoration scheme (for planning application ref 18/1070/REM). And, the Nant Helen complementary earthworks application for approval (Planning reference number: 20/0738/FUL) The purpose of these applications is to allow for a ‘flexible and adaptable landform for a variety of future uses on restoration, including the use of the site as a rail testing and storage facility, proposed by the WG.

3 Site Description

The site is within the Dulais Valley located within Powys and Neath Port Talbot, with the Brecon Beacons National Park Authority boundary immediately to the north. Nearby settlements include Onllwyn, Seven Sisters, Ystradgynlais, Caehopkin, Abercrave or Coelbren.

The site is predominantly brownfield land that has been heavily worked by open cast mining. Much of the site has been revegetated.

5 Study Area

The study area (Figure 1) encompasses the majority of land within the Nant Helen open cast operational site, which at the time of commencing the ecological surveys was considered to be the likely boundary of the project site.

6 Legislation

6.1 Otter

Otters *Lutra lutra* are protected within the UK as a European Protected Species (EPS) under The Conservation of Habitats and Species Regulations 2017 (as amended) (the Habitats Regulations). The Habitats Regulations transposes the Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive) into UK Law.

It is an offence, under Regulation 43 of the Habitats Regulations, to:

- Deliberately capture, injure or kill any wild animal of a EPS;
- Deliberately disturb wild animals of such a species;
- Deliberately take or destroys the eggs of such a species;
- Damage or destroy a breeding site or resting place of such an animal.

Disturbance in the context of the offences above is disturbance which is likely to impair the ability of the animals to survive, to breed or reproduce, to nurture their young, to hibernate, to migrate; or to affect significantly the local distribution of the species.

The otter is also identified as a species that is a priority for nature conservation (Priority Species) within the 'UK Post-2010 Biodiversity Framework' Biodiversity Action Plan (UKBAP).

The Environment (Wales) Act 2016 includes a duty on all public authorities to have regard to the conservation of biodiversity in the exercise of their functions. This duty applies to government bodies, local authorities and statutory undertakers. The Act also requires lists to be published of Habitats and Species considered to be of Principal Importance for the Conservation of Biological Diversity. These are referred as Section 7 habitats and species after the sections of the Act which require the publication of lists in each devolved area. Otters are listed as a Section 7 Species.

Natural Resources Wales (NRW) issues licences that can permit works that disturb/damage places of rest for otter for development purposes, though these are subject to strict conditions.

6.2 Water Vole

Water voles *Arvicola amphibius* are fully protected under both Schedule 5 and Section 9 of the Wildlife and Countryside Act 1981 (as amended) (WCA).

It is an offence, under the WCA, to:

- Intentionally capture, kill or injure water voles;

- Damage, destroy or block access to their places of shelter or protection (on purpose or by not taking enough care);
- Disturb them in a place of shelter or protection (on purpose or by not taking enough care);
- Possess, sell, control or transport live or dead water voles or parts of them (not water voles bred in captivity).

The water vole is also a species of 'Principal Importance for the Conservation of Biological Diversity' in Wales in response to Section 7 of the Environment (Wales) Act 2016 and is also identified as a species that is a priority for nature conservation (Priority Species) within the 'UK Post-2010 Biodiversity Framework' Biodiversity Action Plan (UKBAP).

NRW cannot issue licences for the specific purpose of development. However, in some circumstances a licence may be issued in relation to a development proposal if the licensed action is going to provide a conservation benefit for water voles.

The reader should refer to the original legislation for the definitive interpretation.

7 Habitat Requirements

7.1.1 Otter

Otter favour still (lakes, lochs, ditches and gravel pits) and flowing (rivers and streams) freshwater systems and are capable of long overland journeys between watersheds. Radio-tracked otters were found to spend over half of their time within, or alongside woodland[1].

7.1.2 Water Vole

Water voles are usually found within 2m of water's edge. Prime sites occur most frequently along densely vegetated banks of ditches, rivers, streams and marshes, generally where the current is slow, but water is present throughout the year[1]. Steep banks for burrowing, the presence of a berm (ledge at water level), nest building opportunities in vegetation above water level, the year-round availability of food sources and a lack of disturbance (through poaching, grazing and/or recent management) are also positive habitat features[2].

[1] Harris, S & Yalden, D. (2008). *Mammals of the British Isles: Handbook*, 4th edition.
[2] Harris, J., Markwell, H., Raybould, B. (2009). *A Method for Assessing Water Vole Habitat Suitability*. In Practice, bulletin of the Institute of Ecology and Environmental Management.

8 Methodology

8.1 Desk Study

An ecological data search was carried out to identify otter and water vole records within 5 km of the site's centre point. Such data was obtained from the Biodiversity Information Service for Powys & Brecon Beacons National Park (BIS). Data was obtained on 21 November 2018 and is also presented within the Extended Phase 1 Habitat Survey Report in relation to the Project[3].

In addition, existing data for the site is available in the form of a riparian mammal survey undertaken in 2010, to inform the 2011 Environmental Statement for a western extension to the Nant Helen (Extension) Surface Coal Mine[4].

8.2 Field Surveys

The otter/water vole field survey involved surveying all waterbodies (25 ponds and nine streams/ditches) present within the study area that had been identified during the Extended Phase 1 Habitat Survey or Ordnance Survey data (Figure 2). Three otter/water vole surveys (spring, summer and autumn) were completed of each of these waterbodies between May and September 2019 (inclusive) (Table 1). Due to the cross-over in habitat requirements and survey methodology both species were surveyed for at the same time.

The water vole survey was completed in accordance with the standard survey guidelines[5],[6]. The survey comprised walking the ditch banks to search for signs of water vole presence, including but not limited to burrows, latrines, footprints, feeding remains and sightings of animals.

The otter survey was conducted in line with relevant survey guidance[7]. This involved accessing the watercourse and walking in-channel (where possible), to search for evidence of otter presence such as resting places, spraints, food remains, prints, slides and holts. Terminology used to describe the resting areas for otters used the standard terminology, such as either a holt (usually a hole in the ground covered by vegetation or under the roots of a bankside tree) or couches (an uncovered laying up or nest-like structure). Natal dens refer to a hidden, secure place where the female rears her young.

[3] Arup (2019). Nant Helen Complementary Restoration Earthworks. *Extended Phase 1 Habitat Survey Report*.
[4] Celtic Energy (2011). *Environmental Statement*.
[5] Strachan R, Moorhouse T and M Gelling (2011). *Water vole conservation handbook, Third edition*, Wild Cru.
[6] Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016). *The Water Vole Mitigation Handbook (The Mammal Society Mitigation Guidance Series)*. The Mammal Society.
[7] Chanin, P. (2003). *Monitoring the Otter Lutra lutra. Conserving Natura 2000 Rivers Monitoring Series No. 10.* English Nature. Peterborough

When encountered field signs were recorded on maps, with the location logged using a Global Positioning System (GPS) unit, and photographs taken when required.

Camera traps (Minox DTC 650) were installed at four locations within the survey area (Table 2, Figure 2) to provide additional data on usage of identified features, or where a complete survey of waterbodies/courses was difficult (due to dense vegetation). The images obtained were checked for otter and water vole.

Surveying was avoided for at least three days after any heavy rain, in order to ensure that field signs were not washed away and that the water level was not too high to obscure any field signs of the two species.

8.2.1 Surveyors

All surveys were undertaken by two surveyors, at least one of them being an experienced ecologist competent in undertaking surveys for these species and identifying their field signs.

Surveys were led by Martyn Owen MCIEEM who has over 20 years' experience in the completion of riparian mammal surveys. Support was provided by Stuart Thomas MCIEEM and Steven Forrester.

Table 1: Riparian mammal survey dates and weather conditions.

Survey Visit	Date	Surveyors	Temp. (°C)	Wind Speed (Beaufort) / Direction	Cloud cover (oktets)	Precipitation
1	24/05/19	Martyn Owen MCIEEM Stephen Forrester	14-16	1-2W	3-8	Infrequent light showers
	12/06/19	Martyn Owen MCIEEM Stuart Thomas MCIEEM	11-14	1-2 SE	4-8	Nil
2	22/07/19	Martyn Owen MCIEEM Stephen Forrester	19-20	1 S	8	Nil
	23/07/19		22-24	2 S	4	Nil
	24/07/19		17-19	3 S	4	Nil
3	18/09/19	Martyn Owen MCIEEM Stephen Forrester	20	1 SE	0-1	Nil
	19/09/19		18	1 SE	0	Nil
	23/09/19		15	2 S	7-8	Occasional light showers
	24/09/19		13-16	2-3 S	7-8	Occasional light showers

Table 2. Camera trap deployment details.

Reference	Location (Figure 2)	Date Deployed	Date Collected
1	P27	12/06/2019	24/09/2019
2	S4	22/07/2019	24/09/2019
3	S2	22/07/2019	24/09/2019
4	S1	22/07/2019	24/09/2019

8.3 Limitations

Full access to waterbodies P27, S2 and S1 was not possible due to the density of marginal/bankside vegetation. These waterbodies were surveyed so far as practicably possible, and camera traps were deployed to supplement the field survey data. It is considered that these complementary methods assist to provide a robust data set in relation to these waterbodies.

The findings presented in this study represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys are limited by factors which affect the presence of flora and fauna, factors such as the time of year and natural behaviour of the animals. Nevertheless, these surveys were conducted at the optimal survey periods and using methodologies which are in accordance with published guidelines.

9 Results

9.1 Desk Study

9.1.1 Previous Survey Data

Three watercourses (Nant Penrhos, Nant Gyrlais and an unnamed watercourse) were surveyed in July and September 2010[4] for their suitability to support otters and for any signs of otter presence, including spraints, feeding remains and holts. No signs of otter were identified in proximity to any of watercourses that were surveyed.

These watercourses were also surveyed for signs of water voles. The watercourses were found to be generally unsuitable due to being dry for extended periods. No signs of water vole were identified in proximity to any of watercourses that were surveyed.

9.1.2 Biological Records

The biological records search yielded 27 records of otter within 5km of the site, the closest of which was 1.8km distant.

There were no recent (i.e. within the last 20 years) records of water vole within the search area.

9.2 Field Survey

9.2.1 Otter

All watercourses within the study area were surveyed; signs of otter presence were identified at a number of locations along watercourse S4. Details of these signs are provided within Table 3 with the locations shown on Figure 2.

No potential holts or natal dens were identified.

Table 3: Otter survey results.

Reference	Survey Period	Location	Details
A	Spring	S4	Spraint
B	Summer	S4	Spraint
C	Summer	S4	2 x spraints

In addition to the above, five spraints and a potential couch were identified incidentally to the southwest of the study area (Photograph 1, Figure 2, Camera Trap Location 2). A camera trap was deployed at this location (Figure 2, Camera Trap Location 2), although it did not capture any images of otter. Furthermore, there were no images of otter captured on any of the other deployed camera traps.

Photograph 1. Location of possible couche marginally outwith the survey area



9.2.2 Water Vole

Streams in the north of the site (S7, P44, P57) were manmade with stone/brick substrate, a steep gradient and consequent fast flow with little marginal vegetation (due to substrate). A network of ditches (S60) were found to be dry throughout the survey period with the exception of small, isolated areas of standing water in depressions. In the south of the site, S4 exhibited a rapid flowrate with stone substrate while S5 was steep in gradient, rendering these watercourses unsuitable for water vole (see Section 1.4.2).

The majority of ponds within the survey area were considered unsuitable, predominantly due to the poorly developed marginal vegetation and water quality/disturbance as a consequence of current site operations.

Streams S1 and S2 were considered to be potentially suitable for water voles (see Section 1.4.2), along with ponds P23, P25, P26, P27, P48, P55 and U . However, comprehensive surveys failed to find any evidence of water vole presence.

There were no images of water vole captured on any of the deployed camera traps.

10 Conclusions

The comprehensive suite of surveys recorded otter presence on the river in the south of the study area (S4), including a possible couch marginally outside the study area. No active breeding sites were found, and survey results indicated that the potential presence of otter within the site with any regularity is unlikely.

Water vole is considered likely absent from the study area due to the absence of records during the site survey and desk study, combined within the limited availability/extent of potentially suitable habitat.

A full ecological impact assessment will be included within the Environmental Statement for the project and this will include an assessment of the significance of impacts from the project on otter/water vole. This will also detail any mitigation or compensation measures required to ensure there is no significant effect on otter/water vole within the site.

This report is the result of the survey work undertaken between May and September 2019. This report refers, within the limitations stated, to the condition or proposed works of the site at the time of the surveys. Changes in legislation, guidance, best practice, etc. may necessitate a re-assessment/survey. No warranty is given as to the possibility of future changes in the condition of the site.

The results of these surveys are considered valid for a minimum of 18 months to a maximum of 3 years. If more than 18 months elapses before any planning application is submitted, the requirement for repeat surveys should be reviewed[8].

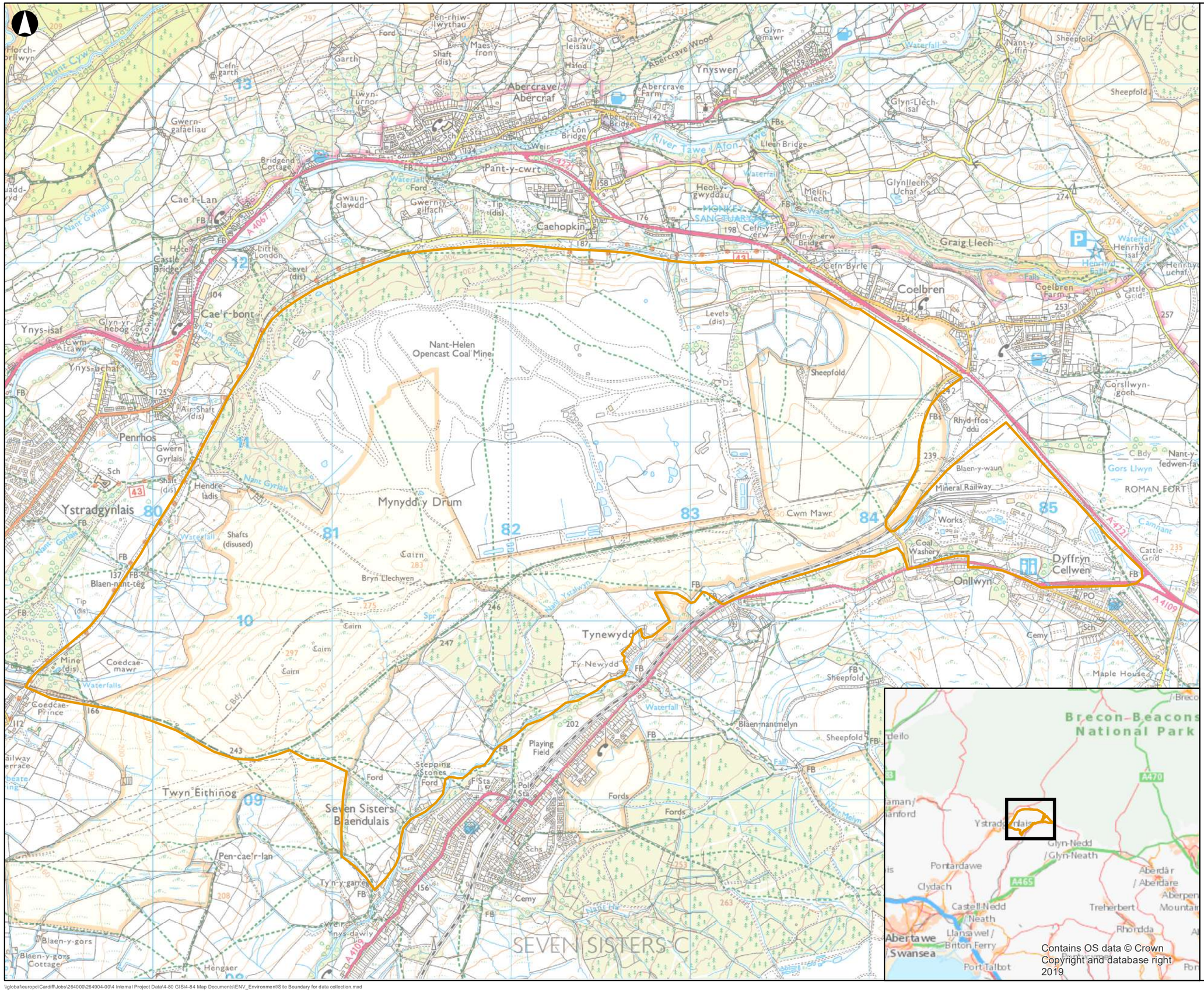
[8] Chartered Institute of Ecology and Environmental Management (2019). *Advice Note on the Lifespan of Ecological Reports and Surveys.*

Figures

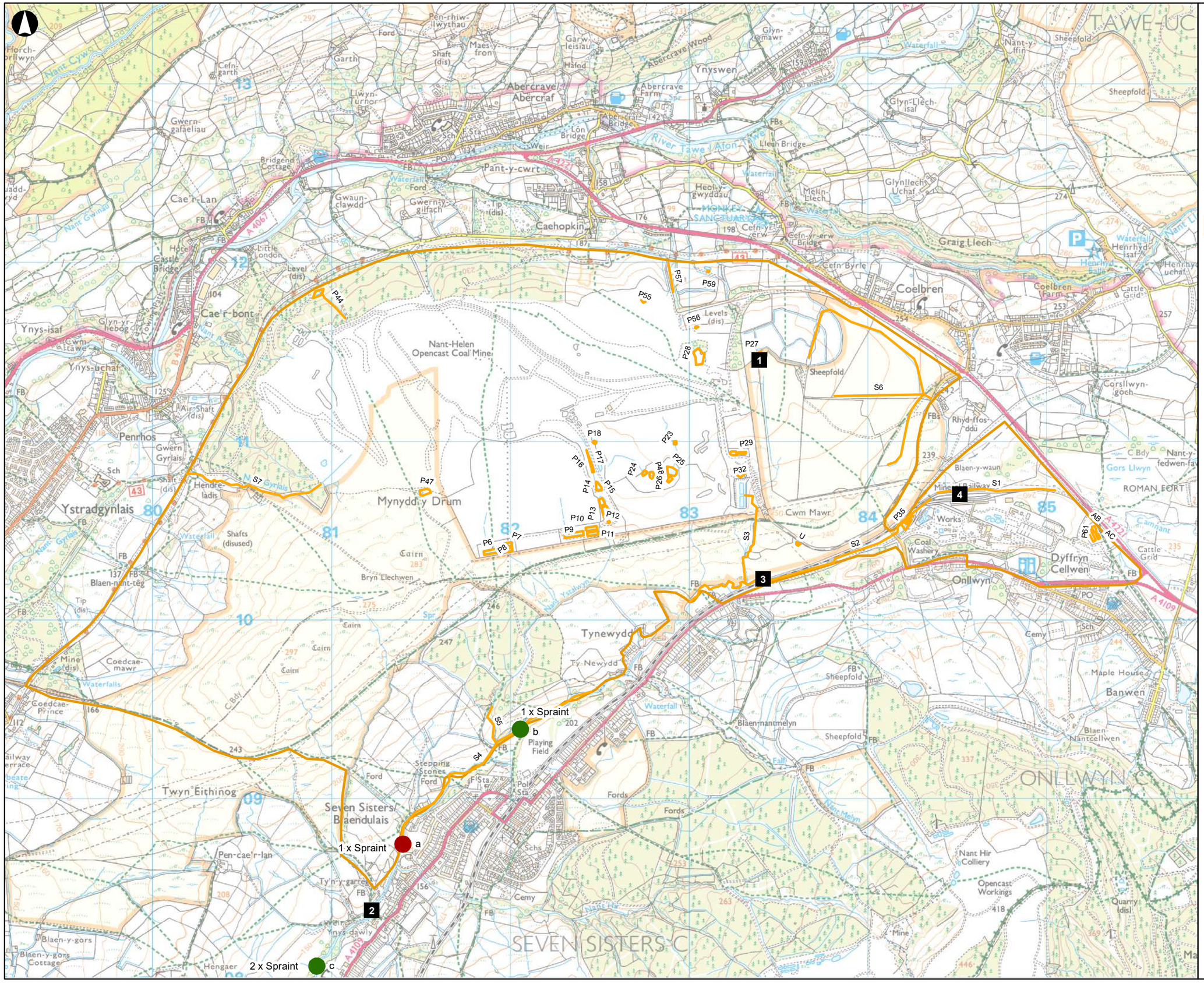
Figure 1 Site Location

Figure 2 Surveyed Waterbodies and Survey Results

A3


Nant-Helen Opencast Coal Mine
Mynydd-y Drum
Seven Sisters/ Blaendulais
Ynystadgynlais
Penrhos
Abercrave/ Abercraf
Ynyswen
Pant-y-cwrt
Caehopkin
Coelbren
Graig Llech
Tynewydd
Twyn Eithinog
Pen-cae'r-lan
Cae'r-bont
Cae'r-Lan
Ynys-isaf
Ynys-uchaf
Penrhos
Gwern Gyrlais
Ystradgynlais
Blaen-nant-têg
Bryn Llechwen
Onllwyn
Dyffryn Cellwen
Blaen-nantmelyn
Sheepfold
Maple House
Cemy
Cwm Mawr
Coal Washery
Works
Mineral Railway
Blaen-y-waun
ROMAN FORT
Gors Llwyn
Rhyd-ffos-ddu
Corsllwyn-goch
Coelbren Farm
Henrhyd Falls
Henrhyd-isaf
Henrhyd-uchaf
Glyn-Llech-isaf
Glynllechs Uchaf
Melin-Llech
Heol-y-gwyddau
MONKS SANCTUARY
Cefn-Byrle
Cefn-yr-erw
Cefn-yr-erw Bridges
Llwyn-Turnor
Abercrave Farm
Abercrave Wood
Garw-leisiau
Glyn-mawr
Pen-rhiw-lwythau
Maes-y-fron
Cefn-garth
Garth
Gwern-gafaeliau
Bridgend Cottage
Gwaun-clawdd
Gwern-y-gilfach
Tip (dis)
Shaft (dis)
Level (dis)
Air Shaft (dis)
Shafts (disused)
Mine (dis)
Coedcae-mawr
Coedcae-Prince
Blaen-y-gors
Blaen-y-gors Cottage
Hengaer
Pen-cae'r-lan
Ty-n-y-garreg
Ty-Newydd
Playing Field
Stepping Stones
Ford
Fords
Schs
Pol Sta
Fi Sta
Levels (dis)
Cairn
Waterfalls
Waterfall
Shafts
Weir
Lon Bridge
Llain Bridge
Cefn-yr-erw Bridges
Abercraf Bridge
Castle Bridge
Little London
Nant Gwrnant
Nant Cyw
Nant Gyrlais
Nant Pen-rhos
Nant Melyn
River Tawe / Afon Tawe
A 4067
A 4121
A 4109
B 4594
Sch
Sta
PO
Cemy
FB
FBs
C Bdy
Spr
Falls
Cattle Grid
Camfant
Nant-y-fedwen-fa
Nant-y-ffin
Sheepfold
Waterfall
Ford
Tip (dis)
Level (dis)
Air Shaft (dis)
Shafts (disused)
Mine (dis)
Cairn

A3



Legend

Otter Field Sign Observations

- Spring Survey Visit
- Summer Survey Visit
- Camera Trap Locations
- Riparian Mammals Waterbodies Surveyed
- Survey Area

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Issue	Date	By	Chkd	Appd
F1	06/01/20	JG	AC	PC

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Job Title
Global Centre for Rail Excellence

Figure 2
Surveyed Waterbodies and Survey Results

Scale at A3
1:20,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
002	F1

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Appendix 7J

Bat Roost Report

Welsh Government

Global Centre for Rail Excellence (GCRE)

Bat Roost Survey Report

Rev A | 18 June 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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ARUP

Document verification

ARUP

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Document title		Bat Roost Survey Report			**File reference**
Document ref					
Revision	**Date**	**Filename**	Nant Helen_Bat Roost Survey Report_v1.docx		
Draft 1	11 Nov 2019	**Description**	First draft		
			Prepared by	Checked by	Approved by
		Name	Martyn Owen	Richard Moores	
		Signature			
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		Description	Second draft		
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		Name	Martyn Owen	Claire Pooley	
		Signature			
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		Description	Issue		
			Prepared by	Checked by	Approved by
		Name	Martyn Owen	Claire Pooley	Paul Clack
		Signature			

Issue Document verification with document ✓

Document Verification

Job title		Global Centre for Rail Excellence (GCRE)			**Job number** 264904
Document title		Bat Roost Survey Report			**File reference**
Document ref					
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		Signature			
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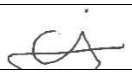
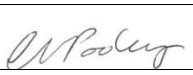
		Description	Updated for GCRE		
			Prepared by	Checked by	Approved by
		Name	Eloise Arif	Claire Pooley	Paul Clack
		Signature			
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Figure 1 Site Location
Figure 2 Building/Structure Survey Results
Figure 3 Tree Survey Results

1 Introduction

1.1 Background

Ove Arup & Partners Ltd (Arup) was commissioned by the Welsh Government (WG) to undertake a range of consultancy services in relation to the Global Centre for Rail Excellence (GCRE), hereafter referred to as 'the Project'.

As part of that commission, a range of ecological surveys have been undertaken to identify the baseline ecological conditions of the Project area, to inform the assessment of impacts as part of the Environmental Impact Assessment (EIA) process.

This document describes the bat roost surveys undertaken for the Project.

1.2 Objectives

The objectives of the surveys were to ascertain the following:

- The presence/likely absence of roosting bats within buildings/structures within the study area; and
- The presence/likely absence of roosting bats within trees in the study area.

2 Project Description and Context

The WG are proposing to develop a rail testing, maintenance, research, development and storage facility (also referred to as the Global Rail Centre for Excellence) at the site of the Onllwyn washery and Nant Helen open cast mine site. The site for development is approximately 475 ha.

The proposed site is currently being mined by Celtic Energy, who will cease extraction operations in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and agreements with Powys County Council (PCC) and Neath Port Talbot County Borough Council (NPTCBC). This includes Section 106 planning obligations and planning conditions that need to be discharged.

Celtic Energy has submitted two recent planning applications for the site, including: the revised restoration strategy for approval (Planning reference number: 19/1899/REM) which would change the existing approved restoration scheme (for planning application ref 18/1070/REM). And, the Nant Helen complementary earthworks application for approval (Planning reference number: 20/0738/FUL) The purpose of these applications is to allow for a ‘flexible and adaptable landform for a variety of future uses on restoration, including the use of the site as a rail testing and storage facility, proposed by the WG.

3 Site Description

The Project site is within the Dulais Valley located within Powys and Neath Port Talbot, with the Brecon Beacons National Park Authority boundary immediately to the north. Nearby settlements include Onllwyn, Seven Sisters, Ystradgynlais, Caehopkin, Abercrave or Coelbren.

The site is predominantly brownfield land that has been heavily worked by open cast mining. Much of the site has been revegetated.

4 Study Area

The study area (Figure 1) encompasses the majority of land within the Nant Helen open cast operational site, which at the time of commencing the ecological surveys was considered to be the likely boundary of the project site.

5 Legislation

All British bat species are fully protected at national and European levels, through their inclusion in Schedule 5 of the Wildlife and Countryside Act 1981 (as amended)[1] and in Schedule 2 of the Conservation of Habitat and Species Regulations 2017 (as amended)[2]. Under this legislation, it is an offence to deliberately kill, injure or take a bat as well as intentionally or recklessly damage, destroy or obstruct access to any structure or resting place used for shelter or protection by a bat or disturb an animal while it is occupying a structure or place which it uses for that purpose. It is also an offence to possess or advertise/sell/exchange a bat of a species found in the wild in the EU (dead or alive) or any part of a bat

Four species of bat, Greater Horseshoe Bat *Rhinolophus ferrumequinum*, Lesser Horseshoe Bat *R. hipposideros*, Bechstein's Bat *Myotis bechsteinii* and Western Barbastelle *Barbastella barbastellus*, are included on Annex II of the Habitats Directive[3,] which requires the designation of Special Areas of Conservation to ensure the maintenance of favourable conservation status (and these are therefore generally considered as perhaps the most important UK species).

Eight bat species are included within Section 7 of the Environment (Wales) Act 2016, these being the list of living organisms of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales. These species are Barbastelle, Bechstein's Bat, Noctule *Nyctalus noctula*, Common Pipistrelle *Pipistrellus pipistrellus*, Soprano Pipistrelle *P. pygmaeus*, Brown Long-eared Bat *Plecotus auritus*, Greater Horseshoe Bat and Lesser Horseshoe Bat.

[1] The Wildlife and Countryside Act 1981 (as amended).
2 The Conservation of Habitats and Species Regulations 2017.
3 Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

6 Methodology

6.1 Desk Study

The desk study element involved two methodologies: a review of existing ecological reports in relation to the site and an ecological data search with the Local Biodiversity Records Centre.

Existing ecological data, obtained in 2011 to inform the Environmental Statement[4], was reviewed which included previous desk study results, habitat and species surveys.

Protected and notable[5] species (including bats), Schedule 9 invasive non-native species and non-statutory site data within 5 km of the site were obtained from the Biodiversity Information Service for Powys & Brecon Beacons National Park (BIS)[6] on 21 November 2018.

In addition, online searches were carried out using the Multi Agency Geographic Information for the Countryside (MAGIC)[7], Natural Resources Wales website[8] and the Joint Nature Conservation Committee (JNCC) website[9] to identify any statutory designated sites up to 5 km from the site, and any designated European sites within 10 km; for which bats are a qualifying feature.

The full desk study results are provided in the Extended Phase 1 Habitat Report for the Project[10].

6.2 Field Surveys

All surveys were completed in line with Bat Conservation Trust (BCT) guidance[11], detail in relation to which is provided below.

The majority of surveys were led by Richard Moores (RM) MCIEEM (Natural England (NE) bat licence no. 2015-12259-CLS-CLS, NRW licence no.: 78258:OTH:CSAB:2018) with assistance from his accredited agent Martyn Owen

[4] Environmental Statement (2011), Celtic Energy.
[5] Notable species and habitats considered in this report include species and habitats of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales, under section 7 of the Environment (Wales) Act 2016, in addition to any species considered to be of significance for nature conservation such species listed in red data books, the Royal Society for the Protection of Birds (RSPB)
[6] https://www.bis.org.uk/home.
[7] http://magic.defra.gov.uk/
[8] https://naturalresources.wales/conservation-biodiversity-and-wildlife/find-protected-areas-ofland- and-seas/designated-sites-search/?lang=en
[9] http://jncc.defra.gov.uk
[10] Arup (2019) Nant Helen Complementary Restoration Earthworks Extended Phase 1 Habitat Survey Report.
[11] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

(MO) MCIEEM (NE bat licence no. 2015-1974-CLS-CLS), Stuart Thomas (ST) MCIEEM (NRW bat licence number: 78183:OTH:CSAB:2018, NE bat licence no. 2016-26245-CLS-CLS) and Steven Forrester (SF), all of whom are experienced bat surveyors.

One of the structures (an old railway tunnel) was surveyed by Pete Wells (PW) CEnv, MCIEEM (NRW licence no. S086930/1) and Claire Pooley (CP) CEcol, MCIEEM (Natural England (NE) licence no. 2015-19288-CLS-CLS and NRW licence no. S087582/1, both of whom are experienced bat surveyors.

6.2.1 Buildings/Structures

6.2.1.1 Preliminary Roost Assessment

The potential suitability of the buildings/structures (which were given a numeric refence, the locations of which are shown on Figure 2) for roosting bats within the study area was assessed and allocated to one of the categories detailed within Table 1. These inspections were completed by experienced ecologists (Table 2).

A systematic search of the interior and exterior of all buildings/structures within the study area was completed to identify potential or actual bat access points and roosting sites, and to locate any evidence of bats such as live or dead specimens, bat droppings, urine splashes, fur-oil staining and/or squeaking noises.

The external inspection also included the examination of the ground, particularly beneath any potential bat access points, for example any windowsills, window panes, walls, behind any peeling paintwork or lifted rendering, hanging tiles, weatherboarding, eaves, soffit boxes, fascias, lead flashing, gaps under felt, and under tiles/slates where present and accessible.

It should be noted that occasionally bats leave no visible sign of their presence in a building’s interior or on its exterior, particularly when there are hidden cracks, crevices and/or voids.

Table 1 Guidelines for assessing the potential suitability of roosting habitats for bats.

Suitability	Description of Roosting Habitats
Negligible (0)	Negligible habitat features on site likely to be used by roosting bats.
Low (1)	A structure with one or more potential roost sites that could be used by individual bats opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions and/or suitable surrounding habitat to be used on a regular basis or by larger numbers of bats (i.e. unlikely to be suitable for maternity or hibernation).
Moderate (2)	A structure with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but unlikely to support a roost of high conservation status (with respect to roost type only – the assessments in this table are made irrespective of species conservation status, which is established after presence is confirmed).
High (3)	A structure with one or more potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.

Table 2 Preliminary roost assessment survey details.

Date	Surveyors	Temp (°C)	Cloud Cover	Wind (Beaufort)	Precipitation
12/06/2019	MO, ST	10-16	5/8-8/8	1 SE	Nil
22/07/2019	MO, SF	16-18	8/8	1 S	Occasional light rain
23/07/2019	MO, SF	18-23	3/8-5/8	1-2 S	Nil
24/07/2019	MO, SF	17-22	5/8-3/8	2-3SW	Nil
26/9/2019	PW, CP	21	8/8	2-3SW	Light rain

6.2.1.2 Nocturnal Surveys

Following the preliminary roost assessment (PRA) inspections, nocturnal bat activity surveys (i.e. emergence or re-entry surveys) of all buildings within the study area assessed to be of at least 'Low' suitability (Table 1) for roosting bats was completed (Figure 2). At least one survey of all buildings/structures of low potential was completed with at least two surveys of buildings/structures of moderate potential, with further surveys to be completed depending upon the results of these initial surveys. No buildings/structures of high potential were identified during the PRA.

Surveyors were equipped with electronic bat detectors (EM3, EM Touch Pro 2, Anabat SD2, Batlogger M or Peersonic) and any sound files were analysed with appropriate bat analysis software (Kaleidoscope) once the surveys were completed, if required.

The nocturnal bat surveys were undertaken in weather conditions considered appropriate for surveys of this kind (Table 3).

One of the structures (an old railway tunnel, Building 36) was not subject to an emergence or re-entry survey, since roosting by small numbers of pipistrelle bats

had been confirmed during transect surveys[12], and during an inspection of this structure in September, when a Natterer's bat was found roosting. Furthermore, this structure was known not to be affected by the Project.

[12] Arup (2020) Nant Helen Bat Activity Survey Report.

Table 3 Nocturnal survey details.

Building Ref	Survey Number	Date	Dusk/ Dawn	Sunset/ sunrise	Survey Start	Survey End	Surveyors	Temp (°C)	Cloud Cover (/8)	Wind (Beaufort)	Precipitation
4	1	22/07/19	dusk	21.19	21.04	23.19	MO, SF	16-18	5-6	1SW	Nil
13	1	23/07/19	dusk	21.24	21.09	23.24	MO, ST, SF	20-22	7-8	1SE	21.09 - nil. 22.56 - Light rain
19	1	24/07/19	dawn	05.24	03.30	05.39	MO, ST, SF	20-22	5-7	2SW	Nil
14	1	07/08/19	dusk	20.54	20.39	22.54	MO, ST, SF	15	2-4	1SW	Nil
6a	1	08/08/19	dawn	05.46	03.50	06.01	MO & RM	13	4-6	0-1SW	Nil
16	1	08/08/19	dawn	05.46	03.50	06.01	ST & SF	13	4-6	0-1SW	Nil
12	1	12/08/19	dawn	05.50	03.47	06.02	MO, RM, SF	10	6-7	1W	Nil
24	1	12/08/19	dusk	20.45	20.30	22.45	ST, RM, MO, SF	13-14	3-6	0-1E	Nil
15	1	13/08/19	dawn	05.56	03.56	06.11	RM, MO	11-12	4-5	1W	Nil
35	1	15/08/19	dawn	06.00	04.00	06.15	ST, MO, SF	14-15	8	1-2W	Nil
13	2	19/09/19	dawn	06.56	05.00	07.10	MO, SF, RM	10-11	1	1E	Nil
19	2	20/09/19	dawn	06:57	05.00	07.10	MO, SF, RM	12	0-1	1E	Nil
24	2	18/09/19	dawn	06.55	05.01	07.11	ST, RM, MO, SF	10-12	2	!E	Nil
35	2	20/09/19	dusk	19.20	19.05	21.15	ST, MO, SF	11-12	2-4	1E	Nil

6.2.2 Trees

6.2.2.1 Ground Level Inspection

To evaluate the potential suitability of trees in areas to be impacted (directly or indirectly) within the study area (Figure 2) for roosting bats a Preliminary Ground Level Inspection (PGLI) survey was completed in accordance with relevant guidelines[13]. This required the detailed inspection of the exterior of a tree from ground level to look for features that bats could use for roosting, in addition to any bat evidence. Details of this survey are provided within Table 4.

Table 4 Ground level inspection survey details.

Date	Surveyors	Temp (°C)	Cloud Cover	Wind (Beaufort)/ Direction	Precipitation
13/08/19	MO, SF	17-19	0/8-3/8	1-2W	Nil
14/08/19	MO, SF	14-16	8/8	1SSE	Rain

6.2.2.2 Aerial Inspection

During the PGLI a number of trees were identified which Potential Roost Features (PRFs) that could support roosting bats. Consequently, these trees were climbed by Martyn Owen MCIEEM and Richard Moores MCIEEM (both qualified in tree climbing and aerial rescue) to inspect these features in detail using a torch, endoscope and dental mirrors. Details of this survey are provided within Table 5.

Table 5 Aerial inspection survey details.

Date	Surveyors	Temp (°C)	Cloud Cover	Wind (Beaufort)/ Direction	Precipitation
17/09/19	MO, RM	19-21	0/8	1S	Nil
18/09/19	MO, RM	18-21	1-2	1S	Nil

[13] Bat Tree Habitat Key (2018). *Bat Roosts in Trees – A Guide to Identification for Tree-care and Ecology Professionals*. Exeter: Pelagic Publishing.

6.3 Limitations

Full access to all roof voids within buildings to assess presence/likely absence of PRFs was not possible in a number of buildings due to health and safety and/or access restrictions. Full inspection of building exteriors was possible and when full internal assessment was not possible and the presence of PRFs was considered possible, nocturnal surveys were completed. This is not therefore considered to represent a significant limitation.

The findings presented in this study represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys are limited by factors which affect the presence of flora and fauna, factors such as the time of year and natural behaviour of the animals. Nevertheless, these surveys were conducted at the optimal survey periods and using methodologies which are in accordance with published guidelines.

7 Results

7.1 Desk Study

7.1.1 Existing Survey Data

A full summary of the existing survey data collated from the surveys undertaken to inform the Environmental Statement for the site in 2011 is provided within the Extended Phase 1 Habitat Report[10]. A summary of bat roost survey data results is as follows;

All trees and buildings within and adjacent to the site were assessed for their suitability to support roosting bats in June 2010, in-line with good practice guidelines of the time[14]. Trees that were assessed from the ground as being suitable for bats were subject to aerial inspections. Only one tree was identified from aerial surveys as being suitable for roosting bats and a single pipistrelle was found in a small cavity.

Twenty bat boxes were installed on site in 2014 and 2015 as mitigation for previous expansion of the Nant Helen mine[15]. These were inspected for signs of use by bats in 2015 and 2016, using a torch. In 2015, two boxes were found to be occupied by a pipistrelle bat. In 2016, 3 boxes were found to be occupied by a pipistrelle bat. *Pipistrellus sp*. were confirmed to be roosting in the following boxes;

Table 6. Positive inspection results of bat boxes 2015-2016 by Sylvan Ecology.

Bat Box No.	GPS	Tree No.
7	SN 80427 10771	3
8	SN 80427 10771	3
11	SN 80403 10775	5
19	SN 80288 10812	8

[14] Bat Conservation Trust (2007). Bat Surveys – Good Practice Guidelines. Bat Conservation Trust, London.
[15] Sylvan Ecology (2016) Bat Box inspection Report 2016, Nant Helen Surface Mine.

7.1.2 New Data Search

7.1.2.1 Protected and Notable Species

The data provided by BIS in November 2018 detailed records of bat species identified within 5 km of the site, as summarised below. The distance given is that to the closest point on the site boundary.

Table 7 Bat species recorded within 5 km of the site

Species/Group	Scientific Name	Status	Number of Records	Approximate distance of closest record (m)
Soprano pipistrelle	*Pipistrellus pygmaeus*	EPS, WCA, Sec 7	10	300
Common pipistrelle	*Pipistrellus pipistrellus*	EPS, WCA, Sec 7	27	400
Unidentified bat	*Chiroptera*	EPS, WCA, Sec 7	10	400
Daubenton's bat	*Myotis daubentonii*	EPS, WCA, Sec 7	7	400
Noctule bat	*Nyctalus noctula*	EPS, WCA, sec 7	11	400
Pipistrelle species	*Pipistrellus* spp.	EPS, WCA, sec 7	14	600
Brown long-eared bat	*Plecotus auritus*	EPS, WCA, Sec 7	7	1000
Myotis bat	*Myotis* spp.	EPS, WCA, sec 7	2	1700
Nathusius' pipistrelle	*Pipistrellus nathusii*	EPS, WCA, sec 7	2	2000
Natterer's bat	*Myotis nattereri*	EPS, WCA, Sec 7	2	2000
Lesser horseshoe bat	*Rhinolophus hipposideros*	EPS, WCA, sec 7	1	2000

7.1.2.3 Statutory and Non-Statutory Designated Sites

Fourteen statutorily designated sites were identified within 5 km of the site. They comprised one Special Area of Conservation (SAC), one National Park and 12 Sites of Special Scientific Interest (SSSI), one of which is also designated as a National Nature Reserve (NNR). No sites designated for bats were identified within 10 km of the site however. The identified sites are detailed within the Extended Phase 1 Habitat Report[10].

7.2 Field Surveys

7.2.1 Building/Structures

The results of the PRA and nocturnal surveys are presented within Table 8 below, with building/structure locations shown on Figure 2. A bat roost was confirmed within a stone tunnel (No. 36), at the western end of the study area. No other evidence or roosts were found within any buildings/structures in the study area.

Table 8 Building survey results.

Building Reference (Figure 2)	Preliminary Roost Assessment Results	Bat Roost Potential Assessment	Number of Nocturnal Surveys Completed	Roost/s identified?
1	Offices. Constructed of prefabricated panels with flat (felted) roof. Plastic fascias with narrow gap between fascia and wall. Small wooden porch on north side, with gaps in wooden fabric (through water damage).	0	0	No
2	Offices. Constructed of prefabricated panels with flat (felted) roof. Wooden fascias with numerous areas of damage/lifting. Detailed inspection of all potential access/roost sites checked with endoscope/mirrors. No evidence of bats. All damage to fascia boards due to water ingress, and all potential roost features noted to be wet and unsuitable for bats.	0	0	No
3	Offices. Constructed of prefabricated panels with flat (felted) roof. Plastic fascias with narrow gap between fascia and wall.	0	0	No
4	Boiler House. Brick, two-storey with flat (felted) roof. Wooden fascias with soffit box and grills (on underside) on north and south side, damaged in places. Numerous areas of missing mortar in brickwork. Non-fresh bat dropping on ground (slab) on south side (likely from flying bat). Not possible to inspect roof area due to height. Red brick outer skim with breeze block interior, possibly cavity between. Warm within building due to boilers.	1	1	No
5	Constructed of prefabricated panels with flat (felted) roof. Plastic fascias with narrow gap between fascia and wall. Areas of damaged fascias on corners providing access to cavity. Detailed inspection of all potential access/roost sites checked with endoscope/mirrors.; no evidence of bats. All damage to fascia boards due to water ingress, and all potential roost features noted to be wet/unsuitable for bats.	0	0	No

Building Reference (Figure 2)	Preliminary Roost Assessment Results	Bat Roost Potential Assessment	Number of Nocturnal Surveys Completed	Roost/s identified?
6	Sheet metal shed with corrugated sheet metal roof. Much external lighting.	0	0	No
6a	Rail weighbridge. Brick built with flat (felted) roof and plastic fascias (lifting in places). Detailed/full endoscope survey of external areas. No signs of bats and no limitations. However, numerous potential PRFs considered to be of low value.	1	1	No
7	Pumphouse. Brick built with flat (felted) roof with wooden soffit boxes. Much noise from pumps. Much damage to wooden soffits. Detailed/full endoscope survey of external areas. No signs of bats and no limitations. Wet fascias and roof. Roof constructed of wood, overlain with felt, due to leaking this was then covered in metal sheeting.	0	0	No
8	Corrugated iron shed.	0	0	No
9	Metal two-storey shed. Internally illuminated through plastic roof panels within metal roof.	0	0	No
10	Metal two-storey shed. Internally illuminated through plastic roof panels within metal roof.	0	0	No
11	Pumphouse. Breeze block rendered walls, corrugated iron roof with wooden fascias, missing in places. Detailed/full endoscope survey of external areas. No signs of bats and no limitations. PRFs all wet/unsuitable for bats.	0	0	No
12	Offices. Brick built, single storey with pitched metal roof. Hanging ceiling within building. Wooden fascias, missing in places. Metal overhanging gable walls. Endoscope and internal inspection completed. Roof steel framed with insultation panels under and sheet metal roof. Roof void very dusty with coal dust. No bat evidence encountered and roosting opportunities limited.	1	1	No

Building Reference (Figure 2)	Preliminary Roost Assessment Results	Bat Roost Potential Assessment	Number of Nocturnal Surveys Completed	Roost/s identified?
13	Office/reception. Pebble-dashed/rendered walls. Slate roof with clay ridge tiles (some missing/damaged). Plastic soffit boxes. Gaps under lead flashing and tiles. Hanging ceiling below original ceiling, with no access to void.	2	2	No
14	Visitor Centre. Rendered walls, pitched slate roof of recent construction. Plastic soffit boxes. Some lifting tiles. Constructed five years ago. Very narrow, low roof void running length of building. Roof lined with breathable membrane in excellent condition. No bat evidence within roof.	1	1	No
15	Brick walls with corrugated iron roof. Subject to much disturbance next to weighbridge. Much missing mortar. Fully inspected internally and externally. No evidence of bats, building generally wet inside/dilapidated although numerous PRFs considered to be of limited value to bats present.	1	1	No
16	Chemical Store. Brick walls with sheet metal roof. No access to interior (chemicals). Roof void present, although no access hatch.	1	1	No
17	Laboratory. Metal and brick walls of pitched roof section, roof void above hanging ceiling. Flat roof extensions rendered with felt roof. Roof void and exterior fully inspected. Much ventilation apparatus/noise in roof, which was constructed of metal, generally unlined though areas of insulation board present. No bat evidence in roof and no PRFs.	0	0	No
18	Substation. Red brick walls with cement (felted) roof. Wooden fascias in very poor condition, no PRFs.	0	0	No
19	Two sections. 1. Large slate pitched roof with red brick walls and wooden fascias. 2. Small sheet metal roof with red brick walls and wooden soffits. Slates slipped and numerous gaps in ridge/flashing. No roof void in slated section, lined inside with wood on pitched roof. Hanging ceiling below corrugated metal section, no access. No bat evidence but PRFs present.	2	2	No

Building Reference (Figure 2)	Preliminary Roost Assessment Results	Bat Roost Potential Assessment	Number of Nocturnal Surveys Completed	Roost/s identified?
20	Workshop. Red brick with sheet metal cladding. Metal and plastic roof. Full internal inspection. No bat evidence and no PRFs.	0	0	No
21	Metal coal processing shed. No PRFs.	0	0	No
22	Metal coal processing shed. No PRFs.	0	0	No
23	Metal coal processing shed. No PRFs.	0	0	No
24	Stone wall with numerous gaps, though some gaps appeared full of sediment, others appeared deeper. Some large deep (c.1.5m) holes, where beams were previously present, or for drainage. Inspected with endoscope, although full inspection impossible due to depth. No bat evidence although many PRFs.	2	2	No
25	Metal coal processing shed. No PRFs.	0	0	No
26	Brick and metal sheds. Metal roof. No PRFs	0	0	No
27	Metal coal processing shed. No PRFs.	0	0	No
28	Metal coal processing shed. No PRFs.	0	0	No
29	Metal coal processing shed. No PRFs.	0	0	No
30	Metal coal processing shed. No PRFs.	0	0	No
31	Metal coal processing shed. No PRFs.	0	0	No
32	Metal shed. No PRFs.	0	0	No
33	Brick substation with flat roof. No PRFs.	0	0	No
34	Metal open-sided weighbridge shed. Adjoining metal shed. No PRFs.	0	0	No

Building Reference (Figure 2)	Preliminary Roost Assessment Results	Bat Roost Potential Assessment	Number of Nocturnal Surveys Completed	Roost/s identified?
35	Two-storey red brick walls with pitched roof of concrete roof/ridge tiles, though some gaps. Plastic and wood soffit boxes with numerous gaps. Cement pointing at verge missing in places. Roof void c. 1m high and many wooden roof supports making full inspection impossible. Areas in vicinity of two roof access hatches inspected in detail and no bat evidence although much coal dust making the identification of droppings (if present) difficult. Roof lined with plastic, beneath tiles, and bitumen beneath plastic. Numerous access points to roof void.	2	2	No
36	Old railway tunnel, approximately 20m long and open at both ends. numerous crevices between stones suitable for small numbers of roosting bats. A natterer bat was found in one crevice at the northern end of the tunnel.	2	0	Yes

7.2.2 Trees

The results of the ground level inspection and tree climbing assessment surveys are presented within Table 9 below, with tree locations shown on Figure 3. No bat roosts were identified within any tree within the study area.

Table 9 Tree survey results.

Tree Reference (Figure 3)	Tree Species	Diameter at Breast Height (m)	Feature Description	Height Above Ground (m)	Side of Tree	Feature Orientation	Distance from Trunk (m)	PGLI Bat Roost Potential Assessment (BRP)	Comment(s)	Tree Climb Results	Updated BRP
2.01	Sycamore	0.4	Lifting bark	0.2-4.0	All	All	0.0	1	Dead tree	Full assessment, no signs	1
2.02	Sycamore	0.4	Lifting bark	0.2-0.3	All	All	0.0	1	Dead tree	Full assessment, no signs	0
3.01	Oak	1.0	Knothole	5.0	SW	W	0.5	1		Full assessment, no signs	1
			Knothole	5.0	S	S	2.5	1		Full assessment, no signs	1
3.02	Oak	0.75	Woodpecker hole x3	6.0	N	N	0.0	2	Sections of trunk appear hollow, which may be accessible via holes.	Two holes do not extend. One hole extends, although no signs	2
3.03	Dead Field Maple (?)	0.30	Lifting bark	1.0-4.0	All	All	0.0	1		Full assessment, no potential	0
3.04	Oak	1.30	Rot Holes	2.0	E	S	0.0	1		Full assessment, no potential	0

Tree Reference (Figure 3)	Tree Species	Diameter at Breast Height (m)	Feature Description	Height Above Ground (m)	Side of Tree	Feature Orientation	Distance from Trunk (m)	PGLI Bat Roost Potential Assessment (BRP)	Comment(s)	Tree Climb Results	Updated BRP
			Knot Hole	8.0	W	N	1.0	1		Full assessment, no potential	0
			Knothole	4.0	E	S	1.0	1		Full assessment, no signs	1
3.05	Oak	1.0	Rot Hole	4.0	N	N	0.0	1		Full assessment, no potential	0
3.06	Oak	1.0	Knot Hole	3.0	E	E	0.0	1		Full assessment, no signs	1
3.07	Oak	1.3	Rotting central trunk with numerous features	2.0-4.0	All	All	0.0	1		Full assessment, no signs	1
3.08	Oak	1.0	Knot Hole	5.0	W	W	1.0	2		Full assessment, no potential	0
			Rot Hole	4.0	W	W	1.0	1		Full assessment, no potential	0
			Knot Hole	2.0	N	E	1.0	1		Full assessment, no potential	0

Tree Reference (Figure 3)	Tree Species	Diameter at Breast Height (m)	Feature Description	Height Above Ground (m)	Side of Tree	Feature Orientation	Distance from Trunk (m)	PGLI Bat Roost Potential Assessment (BRP)	Comment(s)	Tree Climb Results	Updated BRP
3.09	Oak	1.30	Thick-stemmed ivy	0.0-5.0	NW	All	0.0	1		Considerable amount of Ivy. Inspected; no signs	1
3.10	Oak	1.30	Knot Hole	3.5	W	W	0.0	2		Full assessment, no potential	0
3.11	Oak	1.5	Thick-stemmed ivy	1.0-10.0	All	All	0.0	1		Full assessment, no signs	1
3.12	Oak	0.5	Rot Hole	1.0	W	SW	0.0	1		Full assessment, no signs	1
3.13	Oak	1.2	Woodpecker Hole	2.0	W	NW	0.0	1		Full assessment, no signs	1
			Woodpecker Hole	3.0	W	W	0.0	1		Full assessment, no potential	0
			Woodpecker Hole	2.5	W	W	0.0	1		Full assessment, no potential	0
3.14	Oak	1.0	Knot Hole	1.3	S	S	0.0	1		Full assessment, no potential	0

Tree Reference (Figure 3)	Tree Species	Diameter at Breast Height (m)	Feature Description	Height Above Ground (m)	Side of Tree	Feature Orientation	Distance from Trunk (m)	PGLI Bat Roost Potential Assessment (BRP)	Comment(s)	Tree Climb Results	Updated BRP
			Knot Hole	1.5	S	S	0.25	1		Full assessment, no potential	0
3.15	Oak	0.75	Rot Hole	2.5	S	SE	0.2	1		Full assessment, no potential	0
			Rot Hole	3.0	S	S	2.0	1		Full assessment, no potential	0
			Dead Branch/Cracks/Lifting Bark	3.0	N	NE	0.5	1		Full assessment, no potential	0
			Large split on broken branch	3.0	N	NE	0.5-1.0	1		Full assessment, no potential	0
			Calloused split	3.0	S	NE	0.0	1		Full assessment, no signs	1
3.16	Oak	0.75	Rot Hole	3.0	E	N	0.3	1		Full assessment, no potential	0
3.17	Oak	0.5	Knot Hole	3.0	N	N	0.5	1		Full assessment, no potential	0

Tree Reference (Figure 3)	Tree Species	Diameter at Breast Height (m)	Feature Description	Height Above Ground (m)	Side of Tree	Feature Orientation	Distance from Trunk (m)	PGLI Bat Roost Potential Assessment (BRP)	Comment(s)	Tree Climb Results	Updated BRP
3.18	Oak	1.25	Knot Hole	3.0	S	SE	3.0	1		Full assessment, no potential	0
3.19	Oak	1.0	Knot Hole	2.5	S	S	0.0	2	Dying tree	Full assessment, no potential	0
3.20	Oak	0.75	Broken Brank/Cracks	5.0	NW	N & S	2.5	1		Full assessment, no potential	0

8 Conclusions

The comprehensive suite of bat roost potential surveys in relation to buildings and trees within the study area did not identify any bat roosts. One of the structures – an old stone railway tunnel, was found to support a bat roost however. It is not anticipated that this roost will be affected by the Project. However, if this roost were to be disturbed by any works, a European Protected Species (EPS) mitigation licence application would be required to ensure compliance with legislation.

In addition, following a tree climbing assessment, 12 trees (Table 9, Figure 3) still retained bat roost potential (having low or moderate bat roost potential). As such, these 12 trees should be retained if possible. However, if removal/works are required these trees should be subject to updated tree climb inspections immediately prior to removal/works (if required), and only be felled/pruned if confirmed as being clear of any roosting bats.

If any bats or evidence of bats is found to be present during the updated tree climb inspection then further survey work, in the form of nocturnal surveys to establish species and numbers of bats present, would be required during the bat active season (May-September inclusive) that would inform a European Protected Species (EPS) mitigation licence application to enable tree works to be undertaken legally.

A full ecological impact assessment will be included within the Environmental Statement for the project and this will include an assessment of the significance of impacts from the project on bat species. This will also detail any mitigation or compensation measures required to ensure there is no significant effect on bat species within the site.

This report is the result of the survey work undertaken between June and September 2019. This report refers, within the limitations stated, to the condition or proposed works of the site at the time of the surveys. Changes in legislation, guidance, best practice, etc. may necessitate a re-assessment/survey. No warranty is given as to the possibility of future changes in the condition of the site.

The results of these surveys are considered valid for a minimum of 18 months to a maximum of 3 years. If more than 18 months elapses before any planning application is submitted, the requirement for repeat surveys should be reviewed

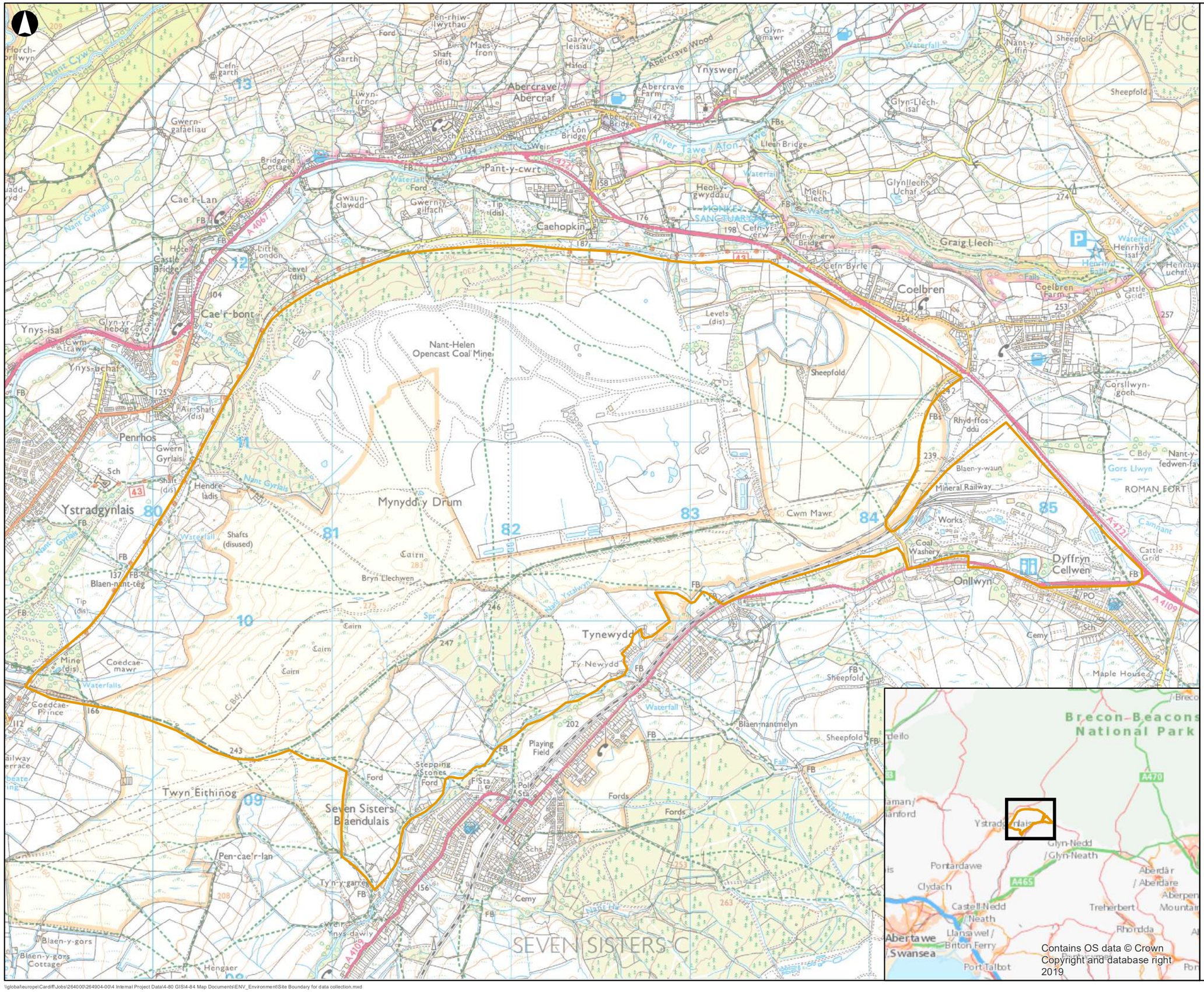
Figures

Figure 1 Site Location

Figure 2 Building/Structure Survey Results

Figure 3 Tree Survey Results

A3



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Legend

Survey Area

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Issue	Date	By	Chkd	Appd
F1	06/01/20	JG	AC	PC

Metres

0 100 200 300 400 500 1,000

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Client

Welsh Government

Job Title

Global Centre for Rail Excellence

Figure 1
Site Location

Scale at A3

1:20,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
001	F1

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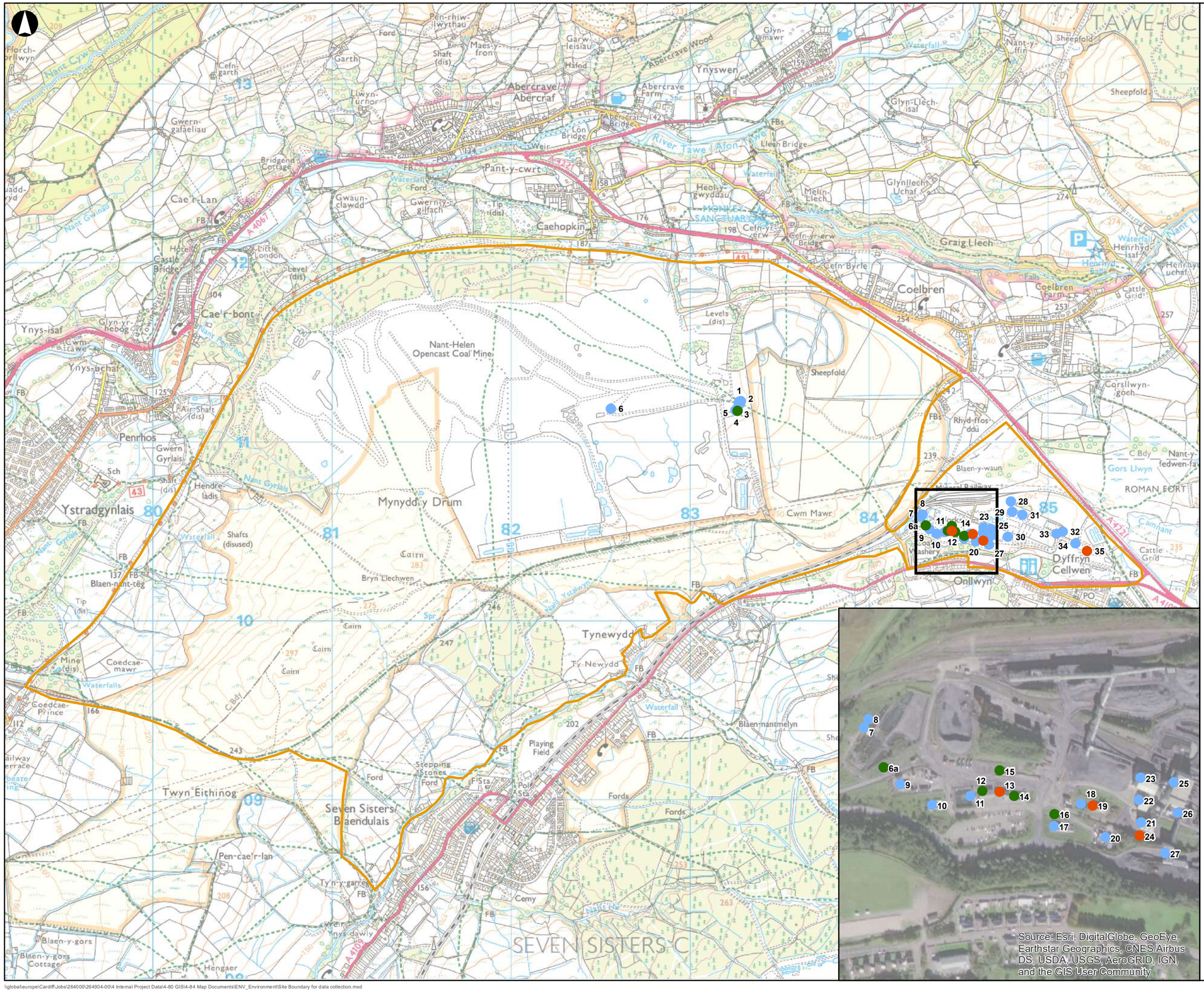

Legend

Bat Roost Potential Suitability

- Moderate
- Low
- Negligable
- Survey Area

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Issue	Date	By	Chkd	Appd
F1	06/01/20	JG	AC	PC

Metres
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Figure 2
Building/Structure Survey Results

Scale at A3

1:20,000

Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
001	**F1**

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A3

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Legend

Bat Roost Potential Suitability

- Moderate
- Low
- Negligable
- Survey

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Issue	Date	By	Chkd	Appd
F1	06/01/20	JG	AC	PC

Metres
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Job Title

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Figure 3
Tree Survey Results

Scale at A3

1:20,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
001	F1

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Appendix 7K

Badger Survey Report

BADGER SURVEY
GCRE Project No 264904
Seven Sisters
NPT
Report

For ARUP

May 2019

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Dyfrig Jones

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TerrAqua Ecological Services Ltd Company Registration Number 805342

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Appendix I Plate 1-9
Appendix II Drawing TQ: ARUP/GCRE Badger V1

Table 1 Mammal Activity Results Seven Sisters

1 Introduction

1.1 Client Details

The following survey report has been produced by TerrAqua Ecological Services Ltd on behalf of ARUP following instructions to proceed by Chloe Delgerry, Senior Ecologist, 8 St Thomas Street, Winchester, Hampshire, SO23 9HE.

1.2 Survey Brief

A badger survey of the designated area as supplied by ARUP was undertaken by TerrAqua Ecological Services in May 2019. The survey was undertaken as part of an extensive suite of ecological surveys and assessments at the site of the operational Celtic Energy opencast site and washery at Seven Sisters, NPT. The surveys were undertaken as part of the engineering, planning and environmental assessment services to support Welsh Government in a future planning application associated with site redevelopment. The survey brief included:

- Badger surveys;
- Mapping of any field signs;
- Submission of associated field survey results and data in agreed format (factual report).

2 Background

This report presents the findings of the Badger survey of the land within the survey boundary as shown in Drawing TQ: ARUP/GCRE Badger V1. The survey aims to identify the use, if any, being made of the site by badger in order to ascertain if measures will be required to ensure that any proposed future works will not contravene the Protection of Badgers Act (1992).

Prior to the survey work commencing a full data search was undertaken on behalf of ARUP by the South East Wales Biodiversity Records Centre (SEWBReC) in order to identify any known badger setts or activity within or adjacent to the site boundary. These records were used to assist in the interpretation of recorded field signs and extent of badger activity within the site boundary.

2.1 Legal Protection

Badgers and their setts are afforded protection under the Protection of Badgers Act (1992 as amended) which makes it an offence to: kill, injure, take or possess a badger or attempt to do so; to damage, destroy or obstruct access to any structure or place that a badger uses for shelter or protection; or to disturb a badger whilst it is occupying a structure or place which it uses for shelter or protection. Badgers are a relatively common species and the legal protection afforded to them is intended to prevent ill-treatment such as badger baiting and not for reasons of rarity.

3 Methodology

3.1 Survey Extent

In order to understand the use being made of the site by badger all accessible land within the survey boundary was surveyed. This included a wide range of habitats including open moorland, semi improved grasslands, broadleaf deciduous woodlands, wood pasture, conifer plantations, hedgerows and operational industrial areas.

As badger territories/foraging areas can extend over considerable distances normal survey practise would be to survey 50m beyond a given survey boundary, however in this instance access was confined to the survey area and no survey work was undertaken outside of the designated boundary.

3.2 Survey Personnel

The survey was undertaken by Carmen Jones MCIEEM and Dyfrig Jones BSc both highly experienced ecologists with over eighteen years' experience in surveying for badger and other mammals.

3.3 Survey Methods and Recording

The survey was undertaken over a three day period, 16th, 17th and 22nd May 2019. The surveys were completed by two experienced surveyors from TerrAqua Ecological Services and followed the principles of Neal and Cheesman (1996).

The surveys were undertaken during daylight hours and included the walking of all accessible habitats in order to identify any field signs or evidence of badger activity. All mammal activity was recorded on an aerial image of the site using numerical target notes (Appendix II). Particular attention was paid to areas often associated with the creation of setts such as banks, woodlands, hedgerows and dense scrub. All identified badger setts and specific field signs or points of interest were photographed for future reference. The following field signs/observations were used to ascertain the presence of badger:

3.4 Setts

Badgers live in social groups and can occupy large territories. Within the territory group will have a number of different setts of differing sizes and subject to varying levels of use. The main sett is usually permanently occupied and will be used as breeding site while annexe, subsidiary and outlier setts will be used on a less frequent basis.

Badger setts (access holes) can usually be identified by their semi-circular and flat based appearance. The access holes vary in size but are generally 22 to 25cm wide or greater, with a height of approximately 20cm. Badger setts can form part of a regularly used complex or form part of a less frequently used subsidiary or outlier sett. Setts can also be abandoned for long periods and then reactivated or can become permanently disused. The levels of activity associated with an identified sett can be used to assess the use being made of the sett and the frequency to which it is currently used. Discarded bedding and fresh digging indicating an active sett while evidence of dry leaves and lack of digging around sett entrances is likely to mean the sett is unoccupied at that time. Badgers have large territories and move between setts according to season and fluctuations in food availability.

All burrows considered suitable for use by badger either grouped or individual were recorded as part of the survey including those with no obvious signs of current use.

Main Sett- these typically possess a large number of entrances compared to the other setts usually eight to thirty or more depending on the group size and environmental factors. A main sett will be constantly occupied by badgers and is typically used for breeding by the dominant female.

Annexe Sett- these are linked to the main sett by well-worn tracks. They can comprise any number of entrances and are usually in frequent use, but they are not necessarily constantly occupied. Can occasionally be used for breeding by non-dominant females.

Subsidiary Sett- these support a number of entrance holes, normally three to eight, and are not connected to the main sett by well-worn tracks. The frequency of use of subsidiary setts varies greatly, but are rarely constantly occupied and often they are in sporadic use. Can sometimes be used for breeding by non-dominant females.

Outlier sett –these usually comprise one or two entrances only and are not connected to the main sett by well-worn tracks. They are often in sporadic use, but may show periods of high use when local seasonal food resources are available. May occasionally be used for breeding by non-dominant females.

3.5 Activity levels

The level of activity associated with an identified sett will help to establish the frequency with which a particular sett is used. Activity levels are based on the interpretation of field signs and surveyor experience and represent a general indication of activity rather than a quantitative assessment. Levels of activity were assessed for each identified sett based on the following criteria:

Inactive/discussed-No evidence of badger activity with vegetation growth etc. around the sett entrance indicating no activity for a period of several months. No clear pathways from sett into surrounding vegetation.

Low-sett entrance will contain a lot of leaf debris but burrow entrance will be intact and accessible. No evidence of recent digging or clearing of burrow but may show some scattering of dirt outside the sett. No clear pathways from sett into surrounding vegetation. Such setts are likely to be used by badger less than once a month and possibly only once in several months.

Moderate- sett entrance shows signs of clearing with some evidence of new excavation around burrow entrances. Some signs of discarded bedding material may be present along with possible bundles of new bedding. Some evidence of pathways from the sett into surrounding areas. Moderately active setts are likely to be used on a monthly basis and seasonally as high as weekly.

High-sett with a high level of activity will be clear of leaf-litter and there will usually be a large amount of freshly excavated spoil on the surface of the spoil heap. Fresh prints may be visible within newly dug soil. Large volumes of discarded bedding may be present. Burrow entrances will be clear with no encroachment by vegetation. Clear well-worn paths will be visible across spoil heaps leading into surrounding vegetation. Highly active setts will be in use several times per month and possibly more than once a week.

Very High- Permanently occupied sett usually with extensive spoil heaps and discarded bedding. All sett entrances will be clear of vegetation with clear pathways between entrances and surrounding vegetation, such pathways may show a smooth or polished appearance due to the constant sweeping of the path by the badger's coat.

3.6 Mammal Pathways

All mammal pathways were recorded during the survey, these included those assessed as being used by badger and those used by other mammals such as fox. Badger runs/pathways are identifiable by their clear and broad nature. Badgers are short legged animals and in traversing the ground effectively sweep the vegetation with their underside hairs leading to clear characteristic badger pathways. The regular use of such pathways leading from setts to feeding areas means that over time such paths can become very clear and identifiable although in some habitats such as dense conifer plantations and areas lacking ground vegetation such tracks are less obvious.

3.7 Tracks/Prints

Badgers have very powerful claws and their tracks are easily identifiable where left in soft mud and spoil heaps. All areas of soft earth were search for evidence of badger tracks during the survey.

3.8 Latrines

Badgers usual defecate into prepared pits, providing a characteristic field sign of their presence. A number of pits may be found together, forming a latrine. Dung pits and latrines are often used by badgers to mark territorial boundaries and are often found along boundaries such as hedgerows, woodland edges and fence lines. The survey included the search for latrines at suitable locations.

3.9 Digging

Badgers habitually forage with their nose down and typical field signs of badger activity include marks made by snuffling and digging. Typical claw marks are often visible where badgers have been digging for worms and around destroyed ant nests.

3.10 Badger Hairs

Badgers frequently crawl beneath fence lines while moving around the countryside. As a result hairs can be displaced from the badger and become attached to the bottom of fences and strands of wire. The presence of badger hair at these locations can help to confirm the presence of badger and identify commuting routes. All fence lines under which evidence of mammal activity was observed were checked for the presence of badger hairs.

4 Survey Limitations

The survey was confined to areas immediately within the given boundary. No survey work was undertaken outside of this area. Field signs were found in very close proximity to the survey boundary indicating unrecorded setts may be present close to the survey limit. This was

particularly noticeable along the northern boundary of the site in close proximity to the cycle track.

Some small areas of conifer woodland immediately adjacent to the edge of the current workings were not searched due to the extreme drops into the opencast area and potential for land slippage. These uncovered areas were not extensive and it is likely that were badgers present within these areas then field signs of badger would have been detected in the surrounding survey area. As a result these omissions are not thought likely to have a significant negative impact on the overall survey results.

5 Results

Badger activity across the site as a whole was low with recorded activity confined to the northern perimeter of the site and an area close to the main site access road. No currently occupied setts were found during the survey. Three setts were recorded all with low levels of current activity:

A single outlier sett was recorded close to the cycle track at the northern boundary of the site (TN9). Relatively recent activity in the form of a number of badger latrines and badger runs was recorded close to the northern boundary near to the cycle track.

A three hole subsidiary sett was located within woodland adjacent to the main access road into the site (TN21). No current badger activity was recorded around the sett.

A more complex five hole subsidiary sett, also showing low activity levels, was recorded within the same woodland and some 30m from the above subsidiary sett (TN22).

All mammal activity, including badger, was recorded during the survey, full results are shown in Drawing No TQ: ARUP/GCRE Badger V1 and table 1:

Table 1 Mammal Activity Results Seven Sisters

Target Note	Field Signs	Comments
TN1	Mammal run beneath fence with single hole beneath mature oak. No evidence of badger.	Probable fox Den
TN2	Mammal run in undergrowth... No evidence badger	Probable Fox
TN3	Mammal run adjacent to cycle track. No evidence of badger	Probable Fox
TN4	Mammal run crossing cycle track. No evidence of badger.	Probable fox
TN5	Mammal run near cycle track. No evidence badger.	Probable Fox
TN6	Digging in woodland adjacent to cycle track. No evidence of badger.	Probable Rabbit
TN7	Mammal run crossing cycle track. No evidence of badger.	Probable Fox
TN8	Mammal run crossing cycle track. No evidence of badger.	Probable Fox
TN9	Mammal runs (several) across cycle track and associated digging on track edge. Runs through woodland with possible old outlier sett within woodland close to cycle track (Plate 1)	Outlier sett with low activity levels SN8038111141
TN10	Badger latrines close to fence line along track. Evidence of previous cutting of fence to allow badger movement between woodland and track. Badger runs crossing beneath wire fence (Plates 2 & 3)	Badger Latrines and runs SN8048211711
TN11	Mammal runs	Probable Badger
TN12	Washery site, mammal tracks across railway line into open fields. No evidence of badger.	Probable Fox
TN13	Washery site, single hole on grass bank with feeding remains outside (Plate 4). No evidence of badger.	Confirmed Fox
TN14	Mammal runs-extensive. No evidence if badger	Probable Fox
TN15	Mammal runs and paw prints of fox and cubs. No evidence badger.	Confirmed Fox
TN16	Mammal runs between clear fell areas and conifer forest block. No evidence badger.	Probable Fox
TN17	Mammal runs across bank into adjacent fields. No evidenced badger.	Probable Fox
TN18	Mammal runs and digging around ant hills. No evidence of badger.	Runs probable fox with digging by Rabbit
TN19	Digging around tree roots possible badger.	Possible badger although no runs apparent in surrounding

		damp vegetation
TN20	Digging/foraging and Badger latrines	Confirmed Badger SN80382 11173
TN21	Currently unoccupied three hole subsidiary sett no evidence of recent use within woodland (plate 7,8 &9)	Subsidiary Sett unoccupied SN8324111748
TN22	Subsidiary sett located on bank within woodland. Five holes no recent badger activity (old latrine found in woodland), No runs from sett to surrounding vegetation and no evidence of badger in adjacent field. (Plates 5 & 6)	Subsidiary sett with low activity and no signs of recent use by badger. One hole shows some evidence of recent excavation but likely to be that of fox utilising existing burrow. SN8324211745
TN23	Mammal run along road verge. No evidence of badger.	Probable Fox
TN24	Mammal runs crossing main access drive. No evidenced badger.	Probable Fox

6 Conclusions-General Summary

The badger survey confirmed the location of three badger setts. One was assessed as being an outlier sett and comprised a single hole. A subsidiary sett of three holes was located within woodland close to a more complex subsidiary sett comprising a total of five holes. None of the setts had evidence of recent use by badger. The single hole outlier sett near the northern boundary of the site did have evidence of badger activity in the general vicinity but not within the actual sett. The subsidiary setts showed no evidence of current use by badger but some digging out was apparent in one of the holes and this was attributed to possible use by fox rather than badger.

Badger activity in the form of runs and presence of latrines was concentrated along the cycle track along the northern site boundary with a number of runs observed crossing the track from woodland within the site boundary to areas outside the survey area. Latrines were recorded along the track at this northern end of the site approximately 30m from the identified outlier sett.

It was observed during the survey that the stock proof fencing bordering a track/green lane leading from the cycle track towards the common (within the site boundary) had previously been cut presumably to allow badgers passage across the site. This would suggest that a badger sett has previously been identified, potentially during the creation of the cycle track, in relatively close proximity, possibly north of the survey boundary, although no records of such were found during the data search.

Along the eastern boundary it was noticed that a ground level strand of barbed wire would prevent free movement of badger and other mammals expect in exceptional circumstances.

No evidence of badger activity was recorded within the active working area of the opencast mine or within the area of the coal washery.

Appendix I

Plates 1-9



Plate 1 Outlier Set TN9



Plate 2 badger Latrine TN10



Plate 3 Cut Fence (Badger Access) TN10



Plate 4 Fox Den Washery Site TN13



Plate 5 Location of Subsidiary Sett TN22



Plate 6 entrance Hole TN22



Plate 7 Entrance Hole TN21



Plate 8 Entrance Hole TN21



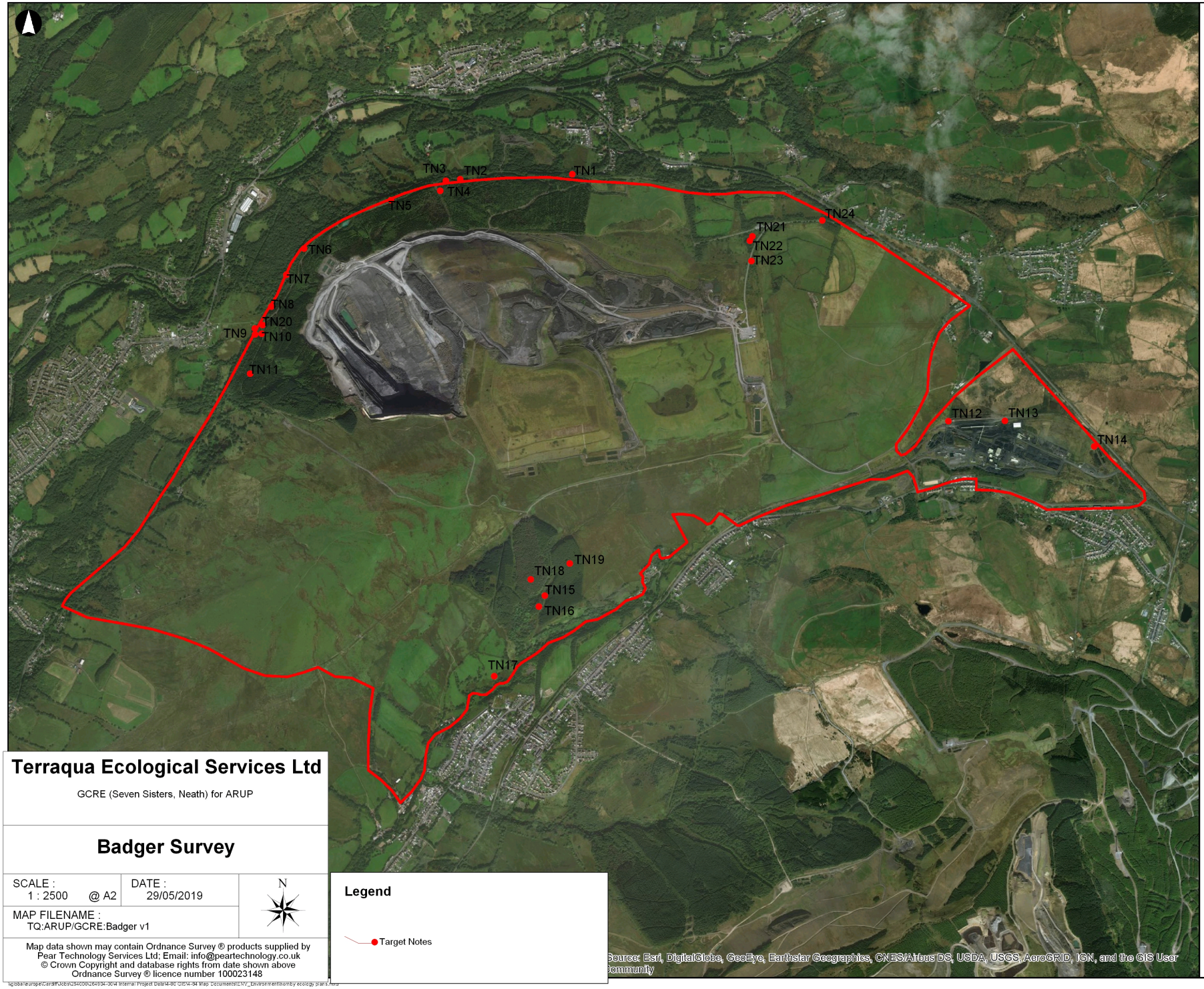
Plate 9 Entrance Hole field boundary TN21

Appendix II

Badger Survey Results

Drawing No TQ: ARUP/GCRE Badger V1

A3



Legend

Study Area Boundary

08/02/2019 14:21:54

Issue	Date	By	Chkd	Appd
P0	2019-02-08	PW	PC	DB

Metres

0 275 550 1,100

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Welsh Government

Job Title

Global Centre for Rail Excellence

Study Area Boundary

Scale at A3

1:20,556

Job No	Drawing Status
264904-00	**Preliminary**

Drawing No	Issue
001	**P0**

Terraqua Ecological Services Ltd

GCRE (Seven Sisters, Neath) for ARUP

Badger Survey

SCALE :	DATE :	N
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MAP FILENAME : TQ:ARUP/GCRE:Badger v1		

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Legend

Target Notes

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Appendix 7L

Dormouse Survey Report

Welsh Government

Global Centre for Rail Excellence (GCRE)

Dormouse Survey Report

Rev A | 18 June 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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ARUP

Document verification

ARUP

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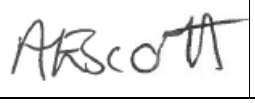
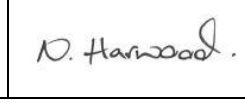
		Signature			
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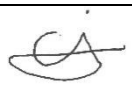
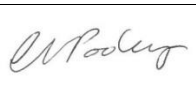
		Signature			

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Appendix A
Survey Weather Conditions

1 Introduction

1.1 Background

Ove Arup & Partners Ltd (Arup) was commissioned by the Welsh Government (WG) to undertake a range of consultancy services in relation to the Global Centre for Rail Excellence (GCRE), hereafter referred to as 'the Project'.

As part of that commission, a range of ecological surveys have been undertaken to identify the baseline ecological conditions of the Project area, to inform the assessment of impacts as part of the Environmental Impact Assessment (EIA) process.

This document describes the hazel dormouse (*Muscardinus avellanarius*) surveys undertaken for the Project.

1.2 Survey Objectives

The aims and objectives of the surveys were to:

- Determine the presence and distribution, or likely absence of dormouse within the study area; and
- Where present, to determine the likely population size of dormouse within the study area.

2 Project Description and Context

The WG are proposing to develop a rail testing, maintenance, research, development and storage facility (also referred to as the Global Rail Centre for Excellence) at the site of the Onllwyn washery and Nant Helen open cast mine site. The site for development is approximately 475 ha.

The proposed site is currently being mined by Celtic Energy, who will cease extraction operations in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and agreements with Powys County Council (PCC) and Neath Port Talbot County Borough Council (NPTCBC). This includes Section 106 planning obligations and planning conditions that need to be discharged.

Celtic Energy has submitted two recent planning applications for the site, including: the revised restoration strategy for approval (Planning reference number: 19/1899/REM) which would change the existing approved restoration scheme (for planning application ref 18/1070/REM). And, the Nant Helen complementary earthworks application for approval (Planning reference number: 20/0738/FUL) The purpose of these applications is to allow for a ‘flexible and adaptable landform for a variety of future uses on restoration, including the use of the site as a rail testing and storage facility, proposed by the WG.

3 Site Description

The Project site is within the Dulais Valley located within Powys and Neath Port Talbot, with the Brecon Beacons National Park Authority boundary immediately to the north. Nearby settlements include Onllwyn, Seven Sisters, Ystradgynlais, Caehopkin, Abercrave or Coelbren.

The site is predominantly brownfield land that has been heavily worked by open cast mining. Much of the site has been revegetated.

4 Study Area

The study area (Figure 1) encompasses the majority of land within the Nant Helen open cast operational site, which at the time of commencing the ecological surveys was considered to be the likely boundary of the project site.

5 Relevant Legislation and Biodiversity Framework

The dormouse is protected as a European Protected Species (EPS), under the Conservation of Habitats and Species Regulations 2017 (as amended), commonly referred to as the Habitats Regulations. Under this legislation it is an offence to:

- deliberately or recklessly kill, injure or capture a dormouse;
- to deliberately or recklessly disturb a dormouse such as to affect its ability to breed or its local distribution, and;
- Or to damage, destroy or obstruct access to a breeding site or resting place (e.g. shelter) used by a dormouse.

Dormice are also fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). Legal protection makes it an offence to:

- intentionally kill, injure or take (capture) a dormouse;
- possess or control alive or dead dormouse, or any part of a dormouse; and
- intentionally or recklessly damage, destroy or obstruct access to any structure or place which dormouse use for shelter or protection, or disturb dormouse while they are using such a place.

The Environment (Wales) Act 2016 includes a duty on all public authorities to have regard to the conservation of biodiversity in the exercise of their functions. This duty applies to government bodies, local authorities and statutory undertakers. The Act also requires lists to be published of Habitats and Species considered to be of Principal Importance for the Conservation of Biological Diversity. These are referred as Section 7 habitats and species after the sections of the Act which require the publication of lists in each devolved area. Dormice are listed as a Section 7 Species considered of Principal Importance for the Conservation of Biological Diversity.

Actions that are prohibited by legislation can be made lawful on the approval and granting of a licence from Natural Resources Wales (NRW), subject to conditions.

6 Methodology

6.1 Desk Study

Dormouse records within 2 km of the study area were obtained from a review of existing ecological data and a new ecological data search. Existing ecological data that informed the 2011 Environmental Statement[1] was reviewed, and a new ecological data search was requested from the Biodiversity Information Service for Powys & Brecon Beacons National Park (BIS[2]).

Freely available web-based mapping and aerial imagery resources such as MAGIC[3] and Google[4] were used to assess the likely suitability of habitat for dormice, taking into consideration the connectivity of woodland and hedgerow habitat within the wider landscape. This was prior to Arup ecologists completing the Extended Phase 1 Habitat Survey on 26th November 2018, and 25th April, 26th April, 29th May and 7th November 2019. During these surveys, potential habitats were assessed further for their suitability to support dormouse.

BIS data was obtained on 21 November 2018 and is also presented within the Extended Phase 1 Habitat Survey Report in relation the Project[5], along with results of the review of existing data.

6.2 Presence / Likely Absence Survey

Dormouse presence/absence surveys were undertaken using nest tubes and nest boxes, according to best practice guidelines in the Dormouse Conservation Handbook[6].

Nest tubes are an effective method to survey for dormice, who use them for breeding as well as daytime shelter. Dormouse nest tubes consist of a length of corrugated plastic tubing with a wooden sliding tray which also forms the end of the tube. Tubes are attached horizontally within trees and scrub using wire. Nest tubes are used by dormice as an alternative to tree holes and other suitable nesting sites. Other species, such as wood mice *(Apodemus sylvaticus)* or birds, may also use the dormouse nest tubes. However, dormice build tightly woven nests which are usually readily identifiable from the nests of other species.

Habitats were considered for their potential to contain suitable fruiting and flowering species that could be used as a food resource for dormouse. Dormice are known to favour deciduous woodland habitat with a diverse scrub understorey and readily colonise connected scrub and species-rich hedgerow habitats[6].

[1] Environmental Statement (2011), Celtic Energy Ltd.
[2] https://www.bis.org.uk/home Accessed online 21/11/2018
[3] https://magic.defra.gov.uk/
[4] https://www.google.co.uk/maps/@51.7836206,-3.7070783,6384m/data=!3m1!1e3?hl=en
[5] Arup (2019) *Nant Helen Complementary Restoration Earthworks Extended Phase 1 Habitat Survey Report*
[6] Bright, P, Morris, P, & Mitchell-Jones, T. (2006). The Dormouse Conservation Handbook (2nd ed.). English Nature

In addition, nest tubes and nest boxes were also placed in coniferous plantation areas of the study area. Although traditionally associated with hazel, dormice can occur in a wide variety of woody habitats. They are also increasingly reported living in hedgerows, areas of plantation conifers and rural gardens. Certain softwood species may support sufficient insects (aphids and caterpillars for example) to sustain a small dormouse population in the absence of more conventional food. It is also possible that dormice can make use of sap as a food source in such habitats[5].

Nest boxes were also deployed to provide an alternative nesting option for dormice potentially present within coniferous plantation habitat. Due to the sparse understorey in this habitat, it was also practical to install these here. These are wooden and similar to bird boxes, but with the entrance hole facing the supporting tree or branch, are readily used by dormice and offer a means of detecting the animals in the absence of gnawed hazel nuts. Spacing bars above and below the entrance allow easy access to the entrance hole, which is about 35 mm in diameter. Boxes were attached using a wire sling, for ease of removal for inspection.

Nest tubes and boxes tend to be most frequently occupied in May and August to September[5]. Guidance recommends the use of at least 50 tubes to sample a site, with tubes deployed and spaced at about 20 m intervals in suitable habitat, e.g. dense hedgerow shrubs. As such, based on the size of the site and habitats present, 279 nest tubes and 20 nest boxes were installed (Figure 1) at intervals of approximately 20 m, where access was possible on the following dates:

Table 1. Dormouse nest tube and nest box installation dates.

Tube-Box Ref	Installation Date
Tubes 1 - 60	14.05.19
Tubes 61-100	15.05.19
Tubes 111 - 115	16.05.19
Boxes 1- 20	16.05.19
Tubes 116-165	20.06.19
Tubes 1 - 64 - Restored Hedgerows	07.06.19
Tubes 1 - 50 - The Washery	13.06.19 20.06.19

The nest tube and box locations are shown in Figure 1.

The tubes were inspected 5 times on a monthly basis between July and November (inclusive) on the following dates, noting it took more than one day for some of the monthly checks:

Table 2. Table of nest tube and nest box inspection dates.

Date	Notes
17.07.2019 23.07.2019	Washery and conifer plantation Northern area and hedgerows
19.08.2019 20.08.2019	All tubes and boxes
25.09.2019 26.09.2019	All tubes and boxes
16.10.2019 17.10.2019	All tubes and boxes
18.11.2019 19.11.2019 20.11.2019	All tubes and boxes

In accordance with the Dormouse Conservation Handbook, adequate survey effort was achieved using the scores provided in Table 3 (which are per 50 nest tubes), derived from the index of probability in the Handbook. Using this method, the survey effort provided a score of 119.6, indicating that the survey effort was sufficient.

Table 3. Index of probability of finding dormice present in nest tubes in any one month (based on 50 nest tubes). Months denoted with a * are months in which survey visits took place.

Month	Score
April	1
May	4
June	2
July*	2
August*	5
September*	7
October*	2
November*	2
Total for 50 tubes	18
Total for 279 tubes + 20 boxes	**20 x 5.98 = 119.6**

Charlotte Phillips (Arup) was responsible for overseeing the dormouse surveys (accredited under Natural Resources Wales dormice licence number 79949:OTH:SA:2018, Debbie Brown) and was aided by accredited agents Kathryn Jones, Alexandra Escott and Alexandra Kinsey (accredited under Debbie Brown or Claire Pooley, Natural Resources Wales dormouse licence number

77661a: OTH:SA:2017) plus assistants (Martyn Owen, Biome Consulting). Surveys were also undertaken by Matt Levan (Levan Ecology Ltd, dormouse licence number 79534:OTH:SA:2018). All surveys were undertaken in suitable weather conditions, details of these and which staff member attended each site visit are in Appendix A.

There was a limited presence of fruiting hazel within the study area, so a nut search was not undertaken; however, the survey score above, with the addition of nest boxes, provides a sufficient survey effort for the site in accordance with best practice survey guidance.

During each survey, a record was taken of positive and negative results, at each nest tube location. The GPS location of each nest tube was also recorded, along with any other comments such as any fallen trays of tubes that had been tampered with. Field signs or features relevant to the survey were photographed, with a GPS location attached to the digital image. Evidence of any other small mammal activity was also recorded where this occurred.

6.3 Limitations and Assumptions

It should be stressed that the findings presented in this study represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys are limited by factors which affect the presence of species, such as weather conditions, movement patterns and behaviour.

Nevertheless, these surveys were conducted at an appropriate time of year and using appropriate methods. Every effort has been made to ensure that the findings of the study present as accurate an interpretation as possible of the status of dormice within the study area.

7 Results

7.1 Desk Study

7.1.1 Existing Data

Existing data that informed the 2011 Environmental Statement included a dormouse survey where one hundred dormouse nest tubes were deployed in July 2010 in four representative areas of suitable habitat on site. The tubes were then checked for presence/signs of dormice once per month in August, September, October and November 2010. Additionally, an inspection of hazel nuts was undertaken, to determine whether they had been opened by dormice. No dormice or signs of dormice were identified during the nest tube checks and no hazel nuts were found to have been opened by dormice.

Study of the site using aerial imagery and in the field during the Extended Phase 1 Habitat Survey showed that suitable habitat for dormouse existed in areas of semi-natural broadleaved woodland on the northern boundary of the site. Species compositions were broadly similar throughout the site and comprised willow (*Salix* sp.), silver birch (*Betula pendula*), hawthorn (*Crataegus monogyna*), rowan (*Sorbus acuparia*), sessile oak (*Quercus petraea*) and hazel (*Corylus avellana*). Along the access road to the Nant Helen site, there was a small area of large mature oak trees with a bluebell (*Hyacinthoides non-scripta)* understorey.

Small areas of semi-mature planted woodland were present throughout the site and formed some of the previously restored mining areas. Species compositions were similar to those of the semi-natural woodlands on site. A large conifer plantation was present to the north-west of the site. Larch trees (*Larix* sp.) were the dominant species, with pine (*Pinus* sp.) and spruce (*Picea* sp.) also present. The understorey was sparse and was dominated by mosses and common wintergreen (*Pyrola minor*). A small area of semi-natural mixed woodland was present in the south-east corner of the site, bordered by the A4221 and A4109 which was willow dominated, with occasional hawthorn, pine and spruce species. Ground flora primarily consisted of bramble and European gorse (*Ulex europeaus*) with rare incidences of heather (*Calluna vulgaris*).

A network of intact species-poor hedgerows was present in the restored land to the east of the site, where hawthorn was the dominant species present. Species-poor hedges with large gaps were also present in the restored area to the east of the site. The dominant species present was hawthorn with occasional willow.

7.1.2 New Data Search

The biological records centre (BIS) did not return any records of dormouse from the previous 10 years (2009 to 2019 inclusive) within 2 km of the study area

7.2 Field Survey

No dormice were found during the course of the survey. In addition, no nests or other evidence to suggest the presence of dormice was found. Table 4 below indicates evidence of other small mammals recorded.

Table 4. Table of dormouse survey results.

Survey Date	Nest tube number	Result
17.07.2019	/	All empty
23.07.2019	/	All empty
19.08.2019	/	All empty
20.08.2019	/	All empty
25.09.2019	24	Wood mouse nest
	41	Wood mouse food cache
26.09.2019	/	All empty
16.10.2019	33	Wood mouse nest
	35	Wood mouse nest
	62	Wood mouse nest
17.10.2019	/	All empty
18.11.2019	3	Wood mouse food cache
	4	Seed cache
	24	Droppings
	33	Wood mouse nest
19.11.2019	34	Wood mouse nest
	35	Wood mouse nest
	38	Wood mouse food cache
	39	Feeding remains
	59	Droppings
	62	Wood mouse nest
	63	Droppings
	B13	Droppings
	B12	Droppings
20.11.2019	11	Droppings
	17	Chewed nuts (probable wood mouse)
	18	Wood mouse nest
	19	Wood mouse nest
	23	Wood mouse food cache
	28	Wood mouse nest
	35	Wood mouse nest
	39	Droppings

8 Conclusions and Recommendations

No dormice were recorded during the survey and it is therefore assumed that this species is likely absent from the site.

A full ecological impact assessment will be included within the Environmental Statement for the project and this will include an assessment of the significance of impacts from the project on dormouse. This will also detail any mitigation or compensation measures required to ensure there is no significant effect on dormice within the site.

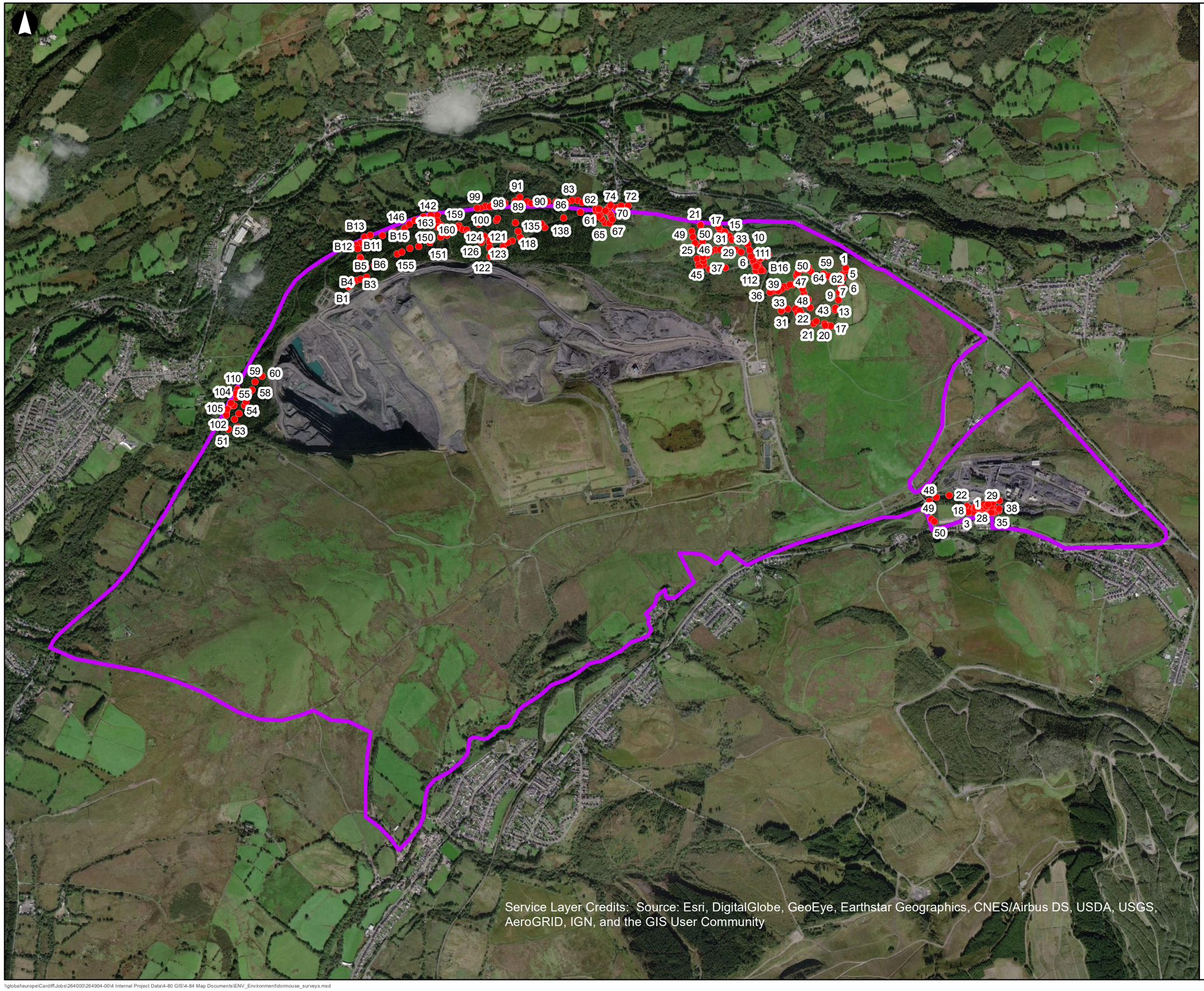
This report is the result of the survey work undertaken between April and November 2019. This report refers, within the limitations stated, to the condition of the site at the time of the surveys. Changes in legislation, guidance, best practice, etc. may necessitate a re-assessment/survey. No warranty is given as to the possibility of future changes in the condition of the site.

The results of these surveys are considered valid for a minimum of 18 months to a maximum of 3 years. If more than 18 months elapses before any planning application is submitted, the requirement for repeat surveys should be reviewed[7].

[7] Chartered Institute of Ecology and Environmental Management (2019) Advice Note on the Lifespan of Ecological Reports and Surveys

Figures

A3



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

19/12/2019 15:55:06

Legend

- Dormouse Tubes and Nest Boxes
- Study Area Boundary

Issue	Date	By	Chkd	Appd
F1	2019-07-01	PW	PC	DB

Metres

0 270 540 1,080

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Job Title

Global Centre for Rail Excellence

Study Area and Nest Tube/Nest Box Locations

Scale at A3

1:20,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
001	F1

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Appendix A

Survey Weather Conditions

A1 Survey Weather Conditions

Date	Temperature (°C)	Wind Speed (Bft)	Wind Direction	Cloud Cover (%)	Conditions	Surveyors	Notes	Results
17.07.2019	17	2	W	100	Dry	Alex Escott/Kathryn Jones	Washery and conifer plantation	No dormice found
23.07.2019	15	2	E	10	Sunny	Kathryn Jones/Alex Kinsey	Northern section and hedgerows	No dormice found
19.08.2019	14	3	W	90	Dry	Kathryn Jones/Alex Kinsey	All tubes	No dormice found
20.08.2019	16	1	W	70	Sunny			No dormice found
25.09.2019	15	2	W	100	Light showers	Kathryn Jones/Alex Kinsey	All tubes	No dormice found
26.09.2019	13	2	SW	90	Heavy showers			No dormice found
16.10.2019	13	1	E	50	Dry	Martyn Owen (Biome Consulting)	All other tubes	No dormice found
17.10.2019	14	2	N	20	Sunny	Alex Escott	Coniferous plantation	No dormice found
18.11.2019	3	1	SSE	100	Dry	Matt Levan (Levan Ecology Ltd)	Washery	No dormice found
19.11.2019	6	1	SSE	100	Dry		Hedgerows and northern section	No dormice found
20.11.2019	7	2	SSE	100	Dry		Remaining tubes	No dormice found

Appendix 7M

Arboreal Mammal Survey Report

Welsh Government

Global Centre for Rail Excellence (GCRE)

Arboreal Mammal Survey Report

Rev A | 18 June 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

Ove Arup & Partners Ltd
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Bristol BS1 6JZ
United Kingdom
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Document verification

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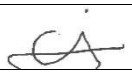
Job title		Global Centre for Rail Excellence (GCRE)			**Job number** 264904
Document title		Arboreal Mammal Survey Report			**File reference**
Document ref					
Revision	**Date**	**Filename**	Arboreal Mammals Survey Report_EA_draft_v1.docx		
Draft 1	31 Oct 2019	**Description**	First draft		
			Prepared by	Checked by	Approved by
		Name	Eloise Arif	Pete Wells	
		Signature			
Draft 2	14 Nov 2019	**Filename**	Arboreal Mammals Survey Report_EA_draft_v2.docx		
		Description	Addressing Pete's comments		
			Prepared by	Checked by	Approved by
		Name	Eloise Arif	Claire Pooley	
		Signature			
Issue	20 Nov 2019	**Filename**	Nant Helen_Arboreal Mammals Survey Report_Issue.docx		
		Description			
			Prepared by	Checked by	Approved by
		Name	Eloise Arif	Claire Pooley	Neil Harwood
		Signature			

Issue Document verification with document ✓

Document Verification

Job title		Global Centre for Rail Excellence (GCRE)			**Job number** 264904
Document title		Arboreal Mammal Survey Report			**File reference**
Document ref					
Revision	**Date**	**Filename**	GCRE_Arboreal Mammals Survey Report_Rev A.docx		
Rev A	18 Jun 2020	**Description**	Updated for GCRE		
			Prepared by	Checked by	Approved by
		Name	Eloise Arif	Claire Pooley	Paul Clack
		Signature			
		Filename			
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			Prepared by	Checked by	Approved by
		Name			
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		Name			
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		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	✓

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Appendix A

Weather Conditions

Appendix B

EcoWarwicker Scat DNA Analysis Results

1 Introduction

1.1 Background

Ove Arup & Partners Ltd (Arup) was commissioned by the Welsh Government (WG) to undertake a range of consultancy services in relation to the Global Centre for Rail Excellence (GCRE), hereafter referred to as 'the Project'.

As part of that commission, a range of ecological surveys have been undertaken to identify the baseline ecological conditions of the Project area, to inform the assessment of impacts as part of the Environmental Impact Assessment (EIA) process.

This document describes the arboreal mammal surveys undertaken for the Project.

1.2 Objectives

The objectives of the arboreal mammal survey were to ascertain the presence/likely absence of the following protected and/or notable[1] arboreal mammal and mustelid[2] species (the 'target species'):

- pine marten (*Martes martes*);
- red squirrel (*Sciurus vulgaris*); and
- polecat (*Mustela putorius*).

Otter (*Lutra lutra*) and badger (*Meles meles*), are reported separately.

[1] 'Notable' species and habitats considered in this report include species and habitats of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales, in response to section 7 of the Environment (Wales) Act 2016, in addition to any species considered to be of significance for nature conservation such species listed in red data books, the Royal Society for the Protection of Birds (RSPB) 'Birds of Conservation Concern' lists and or Local Biodiversity Action Plans (LBAPs).

[2] Of the Mustelidae family, including pine marten, polecat, American mink, stoat, weasel, badger and otter.

2 Project Description and Context

The WG are proposing to develop a rail testing, maintenance, research, development and storage facility (also referred to as the Global Rail Centre for Excellence) at the site of the Onllwyn washery and Nant Helen open cast mine site. The site for development is approximately 475 ha.

The proposed site is currently being mined by Celtic Energy, who will cease extraction operations in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and agreements with Powys County Council (PCC) and Neath Port Talbot County Borough Council (NPTCBC). This includes Section 106 planning obligations and planning conditions that need to be discharged.

Celtic Energy has submitted two recent planning applications for the site, including: the revised restoration strategy for approval (Planning reference number: 19/1899/REM) which would change the existing approved restoration scheme (for planning application ref 18/1070/REM). And, the Nant Helen complementary earthworks application for approval (Planning reference number: 20/0738/FUL) The purpose of these applications is to allow for a ‘flexible and adaptable landform for a variety of future uses on restoration, including the use of the site as a rail testing and storage facility, proposed by the WG.

3 Site Description

The study area is shown on Figure 1 and is hereafter referred to as the ‘site’.

The site is within the Dulais Valley located within Powys and Neath Port Talbot, with the Brecon Beacons National Park Authority boundary immediately to the north. Nearby settlements include Onllwyn, Seven Sisters, Ystradgynlais, Caehopkin, Abercrave or Coelbren.

The site is predominantly brownfield land that has been heavily worked by open cast mining. Much of the site has been revegetated.

4 Study Area

The study area encompasses the majority of land within the Nant Helen open cast operational site, which at the time of commencing the ecological surveys was considered to be the likely boundary of the project site.

The survey was carried out within the coniferous plantation woodland to the north-west of the study area. This was considered to be the only habitat suitable to support the target species, in particular pine marten and red squirrel, within the study area.

5 Legislation

Pine marten and red squirrel are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) (WCA). This protects them against intentional killing, injuring or taking, and against their possession and trade. They are also protected from disturbance through prohibition of actions that could affect places they use for shelter.

Pine marten and red squirrel, along with polecat are also listed as priority species of principle importance for the conservation of biodiversity in response to Section 7 of the Environment Act (Wales) 2016. This legislation places duties on public bodies in Wales to conserve and enhance biodiversity in the exercise of their functions, including the consideration of the resilience of ecosystems in terms of their diversity, connectivity, adaptability, scale and condition.

Pine marten, red squirrel and polecat are also all listed as UK Biodiversity Action Plan Priority Species. Action Plans exist for each UK BAP Priority Species to demonstrate the UK's commitment to help reduce or halt the significant losses in global biodiversity[3].

Actions which are prohibited by legislation can be made lawful on the approval and granting of a licence from Natural Resources Wales (NRW), subject to conditions.

[3] The UKBAP was succeeded by the 'UK Post-2010 Biodiversity Framework' in July 2012. The UK list of priority species, however, remains an important reference source and has been used to help draw up statutory lists of priority species.

6 Methodology

6.1 Desk Study

A data search was obtained from the Biodiversity Information Service (BIS[4]) for Powys & Brecon Beacons National Park on 21st November 2018. The data search included all historic records of protected and/or notable[1] species from the last 10 years within a 5 km radius of the site (Figure 1). This included records of the target species, which are summarised in the Desk Study Results section below.

Targeted surveys for these species were not undertaken in preparation for the previous Environmental Statement (ES) undertaken by Celtic Energy[5]. Nevertheless, the previous ES was reviewed for any incidental records, along with publicly available ordnance survey mapping and aerial imagery to identify suitable habitat[6;7;8] for the target species within the study area (Figure 1).

6.2 Field Surveys

6.2.1 Transect Survey

The transect route was located within an area of coniferous plantation woodland to the north-west of the study area, which was considered suitable habitat for the target species. The route was approximately 8.5 km in length and is shown on Figure 2. The transect survey was carried out six times: once per month between May and October 2019 (inclusive).

Surveyors (Suitably Qualified Ecologists (SQE)) walked the transect looking for evidence of target mammal species including footprints, trails, scats (pine marten and polecat), live sightings, red squirrel feeding remains and red squirrel dreys (nests), as per best practice guidance[9],[10]. Any mustelid scats found were collected and sent for DNA analysis at EcoWarwicker Ecological Forensics[11]. The dates and the weather during each of these transect survey visits are detailed in Appendix A.

[4] Aderyn is a Local Environmental Records Centres (LERC) Wales system, developed and maintained by the Biodiversity Information Service (BIS).
[5] Celtic Energy Ltd (2011). *Environmental Statement.*
[6] https://www.britishredsquirrel.org/red-squirrels/dreys-nests/ Accessed 13th November 2019.
[7] https://www.mammal.org.uk/species-hub/full-species-hub/discover-mammals/species-pine-marten/ Accessed 13th November 2019.
[8] https://www.mammal.org.uk/species-hub/full-species-hub/discover-mammals/species-pine-marten/ Accessed 13th November 2019.
[9] O'Mahony et al. (2006). *National Pine Marten Survey of Ireland 2005.*
[10] Gurnell et al. (2009). *Practical techniques for surveying and monitoring squirrels.* Practice Note. Forestry Commission.
[11] https://warwick.ac.uk/fac/sci/lifesci/research/archaeobotany/ecological_forensics/

6.2.2 Camera Trapping Survey

Three feeding stations were installed along the transect route with two motion-sensitive camera traps (Bushnell Trophy Cam HD) placed at each station (six camera traps placed in total). Feeding station 1 was located at National Grid Reference (NGR) SN 80770 11642, feeding station 2 was located at NGR SN 81159 11820 and feeding station 3 was located at NGR SN 82196 11866. The feeding station locations are shown on Figure 3.

Bait (dried mealworms, nuts, seeds, jam sandwiches, peanut butter, eggs and/or dog food) was placed on a platform in the centre of the two camera traps at each feeding station. Feeding stations were deployed for 125 days between 14th June 2019 and 17th October 2019. The SD cards within the cameras, and the bait on the feeding platform were refreshed once per month during the transect surveys.

Camera trap footage was recorded as a combination of jpeg images and ten-second mp4 video clips onto SD cards, which were subsequently analysed to determine the presence of target species.

6.2.3 Surveyors

Field surveys were carried out by a combination of SQE: Pete Wells BSc MSc CEnv MCIEEM, Alexandra Escott BSc (Hons) MSc, Eloise Arif BSc (Hons) ACIEEM, and Alexandra Kinsey BSc (Hons).

6.3 Limitations

Surveyors were unable to find feeding station 1 during the August survey visit due to a GPS mapping error. As such, the bait was not refreshed in August at feeding station 1. This is not considered to have negatively affected the survey results however, as animals were still recorded visiting feeding station 1 between the August and September survey visit, and the survey effort overall is considered to still be sufficient enough to be confident in the results.

The findings presented in this study represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys are limited by factors which affect the presence of flora and fauna, factors such as the time of year and natural behaviour of the animals. Nevertheless, these surveys were conducted at the optimal survey periods and using methodologies which are in accordance with published guidelines.

7 Results

7.1 Desk Study

The BIS provided four records of polecat within 5 km of the site from the last 10 years. The closest of these was located approximately 1.5 km north east. No recent records of red squirrel or pine marten were returned, although there was one record of a red squirrel sighting from 1998 located approximately 3.7 km south west.

The desk study identified one area of coniferous plantation woodland to the north west of the site, which was considered the only habitat suitable to support pine marten and red squirrel within the study area. Polecat, if present, would also use this habitat.

7.2 Field Surveys

7.2.1 Transect Survey

The transect survey results are shown on Figure 2. One scat was collected during the August transect survey visit, and five scats were collected during the September transect survey visit for DNA analysis. All six scats collected were considered to potentially be from pine marten, due to their shape (dark and coiled) (Photograph 1) and their smell (musty sweet scent, not unpleasant)[12]. However, the DNA analysis revealed that all six scats were produced by fox, not pine marten.

Mustelid prints were identified on three occasions during the May transect: prints with a 40 cm stride were identified at the western end of the transect route (Photograph 2), prints that were considered too small for pine marten were identified near feeding station 3 (Photograph 3) and small prints were identified near feeding station 2 (Photograph 4). Due to the small size of these prints, it was considered more likely that they were from polecat, ferret (*Mustela furo*), or a polecat-ferret hybrid[13], rather than pine marten[14;15].

Squirrel feeding signs in the form of a stripped pine cone[16] (Photograph 5 and Photograph 6) were also identified in May. However, grey squirrels (*Sciurus carolinensis*) and red squirrels both feed in this distinctive way[17] and as such, this

[12] https://pine-marten-recovery-project.org.uk/our-work/field-signs Accessed 5th November 2019
[13] The Vincent Wildlife Trust (2014) Polecats and Ferrets. https://www.vwt.org.uk/wp-content/uploads/2015/04/polecat-ferret-leaflet-.pdf Accessed 8th November 2019
[14] The Vincent Wildlife Trust (2017) A guide to identifying evidence of pine martens in Wales. https://www.vwt.org.uk/wp-content/uploads/2017/11/Evidence-of-Pine-Martens-in-Wales.pdf Accessed 8th November 2019
[15] Wiltshire Mammal Group (2015) Small mustelid footprint ID guide.
[16] https://www.mammal.org.uk/sites/default/files/Red%20Squirrel%20Field%20Sign%20Guide%20PDF.pdf Accessed 7th November 2019
[17] https://treesforlife.org.uk/into-the-forest/trees-plants-animals/mammals/red-squirrel/red-squirrel-feeding-signs/ Accessed 7th November 2019

cannot be considered conclusive proof of red squirrel presence within the woodland. Grey squirrels were observed on several occasions during the transect surveys.

No other signs of target species were identified during the transect survey.

7.2.2 Camera Trapping Survey

The camera trapping survey recorded one instance of a polecat on 6th October at feeding station 3 (Photograph 7). No activity of other target species (pine marten and red squirrel) was recorded. Non-target species recorded include red fox (*Vulpes vulpes*), rabbit (*Oryctolagus cuniculus*) some unidentifiable mouse species (considered most likely to be wood mouse (*Apodemus sylvaticus*)), birds, and numerous instances of grey squirrel, a naturalised non-native species listed on Schedule 9 of the WCA.

The volume of grey squirrel activity recorded is considered to contribute to the lack of red squirrel activity. The species identified at each feeding station in each month are summarised in Table 1, and locations of feeding stations are shown on Figure 3.

Table 1: Species recorded at each feeding station during camera trapping survey

Month	Feeding Station Ref.	Target Species Recorded	Other Species Recorded
June	1	None	Birds (robin (*Erithacus rubecula*), jay (*Garrulus glandarius*), coal tit (*Periparus ater*), great tit (*Parus major*)); mice; grey squirrel; red fox.
	2	None	Grey squirrel; mice.
	3	None	Red fox; rabbit; grey squirrel; mice.
July	1	None	Grey squirrel; mice; birds (robin, great tit, blue tit (*Cyanistes caeruleus*), great spotted woodpecker (*Dendrocopos major*), blackbird (*Turdus merula*)).
	2	None	Red fox; grey squirrel; mice; birds (jay).
	3	None	Red fox; grey squirrel; mice; birds (jay, blackbird); rabbit.
Aug	1	None	Red fox; grey squirrel; mice; birds (robin, blue tit, jay).
	2	None	Red fox; grey squirrel; mice; birds (jay).
	3	None	Red fox; rabbit; grey squirrel; mice; birds (great tit, jay).
Sept	1	None	Mice; birds (great tit, jay, robin, blue tit).
	2	None	Red fox; grey squirrel; mice; birds (robin, great tit, blue tit, jay).
	3	None	Red fox; rabbit; grey squirrel; mice, birds (jay, robin, great tit).
Oct	1	None	Red fox; mice; birds (passerines, magpie (*Pica pica*)).

Month	Feeding Station Ref.	Target Species Recorded	Other Species Recorded
	2	None	Grey squirrel; birds (jay).
	3	Polecat	Red fox; rabbit; grey squirrel; mice; birds (jay).

Red squirrel are considered likely to be absent from the survey area due to the lack of recent and nearby desk study records, the high volume of grey squirrel activity, and the inconclusive feeding signs identified during the transect survey.

Pine marten are also considered likely to be absent from the survey area due to the lack of desk study records and the lack of evidence identified during the field surveys. However, it should be noted that a pine marten re-introduction project has been undertaken in mid-Wales[18], and, as such, pine marten are likely to be present (in low numbers) in the vicinity of the study area despite the lack of records.

[18] https://www.vwt.org.uk/projects-all/pine-marten-recovery-project/ Accessed 14th November 2019

8 Conclusions

The camera trapping survey identified the presence of polecat at feeding station 3 in October. Red squirrel and pine marten were found likely to be absent from the survey area. Numerous other native UK species were recorded during this suite of surveys, including red fox, rabbit, jays, mice, and numerous bird species.

A full ecological impact assessment will be included within the Environmental Statement for the project and this will include an assessment of the significance of impacts from the project on protected and/or notable mammal species. This will also detail any mitigation or compensation measures required to ensure there is no significant effect on arboreal mammals within the site.

This report is the result of the survey work undertaken during 2019. This report refers, within the limitations stated, to the condition of the site at the time of the surveys. Changes in legislation, guidance, best practice, etc. may necessitate a re-assessment/survey, as may the passage of time.

The results of these surveys are considered valid for a minimum of 18 months to a maximum of 3 years. If more than 18 months elapses before any planning application is submitted, the requirement for repeat surveys should be reviewed[19].

[19] Chartered Institute of Ecology and Environmental Management (2019). *Advice Note on the Lifespan of Ecological Reports and Surveys.*

Figures

A3



LEGEND

Study Area

19/12/2019 15:59:38

F1	2019-11-14	EA	CP	NH

Issue	Date	By	Chkd	Appd

Metres

0 270 540 1,080

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Client

Welsh Government

Job Title

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Figure 1
Study Area

Scale at A3

1:20,000

Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
001	**F1**

\\global\europe\Cardiff\Jobs\264000\264904-00\1 Client\271968 Celtic Energy Application\GIS\Map Documents\2019_Arboreal Mammals_EA.mxd

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A3



LEGEND

- Study Area
- Arboreal mammal transect route
- Mustelid prints
- Squirrel feeding signs
- Scats collected for DNA analysis

19/12/2019 15:59:18

Issue	Date	By	Chkd	Appd
F1	2019-11-14	EA	CP	NH

Metres

0 87.5 175 350

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Job Title

Global Centre for Rail Excellence

Figure 2
Arboreal mammal transect route and transect survey results

Scale at A3

1:6,500

Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
002	**F1**

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A3



LEGEND

- Study Area
- Feeding stations

19/12/2019 15:59:28

Issue	Date	By	Chkd	Appd
F1	2019-11-14	EA	PW	NH

Metres

0 87.5 175 350

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Job Title

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Figure 3
Feeding station locations

Scale at A3

1:6,500

Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
003	**F1**

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Photographs



Photograph 1: Scat collected during September transect



Photograph 2: Mustelid tracks with 40cm stride identified during May transect



Photograph 3: Mustelid prints considered too small for pine marten, identified during May transect



Photograph 4: Small mustelid prints identified during May transect



Photograph 5: Squirrel feeding signs identified during May transect



Photograph 6: Squirrel feeding signs identified during May transect



Photograph 7: Polecat at station 3 in October



Photograph 8: Rabbit at station 3 in June



Photograph 9: Passerines at station 1 in July



Photograph 10: Grey squirrel at station 2 in July



Photograph 11: Jays at station 2 in July



Photograph 12: Red fox at station 3 in August



Photograph 13: Mouse at station 3 in September

Appendix A

Weather Conditions

A1 Weather Conditions

Table A1: Weather conditions during arboreal mammal transect survey visits

Survey Visit	Date	Temp. (°C)	Wind Speed (Beaufort Scale)	Wind Direction	Cloud Cover (%)	Comments
Transect 1	23/05/2019	18	2	SW	10	Sunny
Camera trap and feeding station install	14/06/2019	13	1	E	100	Dry
Transect 2	28/06/2019	21	4	NE	0	Sunny
Transect 3	25/07/2019	27	2	SW	20	Sunny
Transect 4	29/08/2019	14	2	SW	100	Light drizzle
Transect 5	11/09/2019	16	3	W	100	Stead rain
Transect 6	17/10/2019	12	2	S	90	Dry

Appendix B

EcoWarwicker Scat DNA Analysis Results

WARWICK
THE UNIVERSITY OF WARWICK

EcoWarwicker
Ecological Forensics

8 October 19

Re: Identification Results for Alexandra Kinsey, Arup

Job number 14632, received 19 September 2019
Sample labelled: GCRE Pine marten transect. Poss. Mustelid scat sample 1
PCR amplification successful. DNA sequence:
CCACCTACACACCTCAAAACAACGTGGGATAATATTCCGACCCCTTAGTCAATGCCT
ATTCTGACTTCTAACCGCAGACC

Phylogenetic analysis identification: *Vulpes vulpes*

Confirmed by maximum likelihood, maximum parsimony, bootstrap 100%.

Best regards,

Professor Robin Allaby

The results and conclusions in this report are based on an investigation of mtDNA sequence analysis. The results obtained have been reported with accuracy. The interpretation represents the most probable conclusion for the DNA sequence obtained rather than the sample provided given current levels of species data. It should be borne in mind that different circumstances might produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial recommendations.

Professor Robin Allaby

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EcoWarwicker
Ecological Forensics

8 October 19

Re: Identification Results for Alexandra Kinsey, Arup

Job number 14633, received 19 September 2019
Sample labelled: GCRE Pine marten transect. Poss. Mustelid scat sample 2
PCR amplification successful. DNA sequence:
CCCATAATGATGAAAGGGTGTCCACCTACACACCTCAAAACAACGTGGGATAATATT
CCGACCCGTTAGTCAATGCCTATTCTGACTTCTAACCGCAGACCTC

Phylogenetic analysis identification: *Vulpes vulpes*

Confirmed by maximum likelihood, maximum parsimony, bootstrap 100%.

Best regards,

Professor Robin Allaby

The results and conclusions in this report are based on an investigation of mtDNA sequence analysis. The results obtained have been reported with accuracy. The interpretation represents the most probable conclusion for the DNA sequence obtained rather than the sample provided given current levels of species data. It should be borne in mind that different circumstances might produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial recommendations.

Professor Robin Allaby

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Ecological Forensics

8 October 19

Re: Identification Results for Alexandra Kinsey, Arup

Job number 14634, received 19 September 2019
Sample labelled: GCRE Pine marten transect. Poss. Mustelid scat sample 3
PCR amplification successful. DNA sequence:
CCACCTACACACCTCAAAACAACGTGGGATAATATTCCGACCCCTTAGTCAATGCCT
ATTCTGACTTCTAACCGCAGACCTCCTCAC

Phylogenetic analysis identification: *Vulpes vulpes*

Confirmed by maximum likelihood, maximum parsimony, bootstrap 100%.

Best regards,

Professor Robin Allaby

The results and conclusions in this report are based on an investigation of mtDNA sequence analysis. The results obtained have been reported with accuracy. The interpretation represents the most probable conclusion for the DNA sequence obtained rather than the sample provided given current levels of species data. It should be borne in mind that different circumstances might produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial recommendations.

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Ecological Forensics

8 October 19

Re: Identification Results for Alexandra Kinsey, Arup

Job number 14635, received 19 September 2019
Sample labelled: GCRE Pine marten transect. Poss. Mustelid scat sample 4
PCR amplification successful. DNA sequence:
CCACCTACACACCTCAAAACAACGTGGGATAATATTCCGACCCCTTAGTCAATGCCT
ATTCTGACTTCTAACCGCAGACCTCCTCAC

Phylogenetic analysis identification: *Vulpes vulpes*

Confirmed by maximum likelihood, maximum parsimony, bootstrap 100%.

Best regards,

Professor Robin Allaby

The results and conclusions in this report are based on an investigation of mtDNA sequence analysis. The results obtained have been reported with accuracy. The interpretation represents the most probable conclusion for the DNA sequence obtained rather than the sample provided given current levels of species data. It should be borne in mind that different circumstances might produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial recommendations.

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Ecological Forensics

8 October 19

Re: Identification Results for Alexandra Kinsey, Arup

Job number 14636, received 19 September 2019
Sample labelled: GCRE Pine marten transect. Poss. Mustelid scat sample 5
PCR amplification successful. DNA sequence:
CCACCTACACACCTCAAAACAACGTGGGATAATATTCCGACCCCTTAGTCAATGCCT
ATTCTGACTTCTAACCGCAGACCTCCTCA

Phylogenetic analysis identification: *Vulpes vulpes*

Confirmed by maximum likelihood, maximum parsimony, bootstrap 100%.

Best regards,

Professor Robin Allaby

The results and conclusions in this report are based on an investigation of mtDNA sequence analysis. The results obtained have been reported with accuracy. The interpretation represents the most probable conclusion for the DNA sequence obtained rather than the sample provided given current levels of species data. It should be borne in mind that different circumstances might produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial recommendations.

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Ecological Forensics

8 October 19

Re: Identification Results for Alexandra Kinsey, Arup

Job number 14638, received 19 September 2019
Sample labelled: GCRE Pine marten transect. Poss. Mustelid scat sample 7. Point D.
PCR amplification successful. DNA sequence:
CCACCTACACACCTCAAAACAACGTGGGATAATATTCCGACCCCTTAGTCAATGCCT
ATTCTGACTTCTAACCGC

Phylogenetic analysis identification: *Vulpes vulpes*

Confirmed by maximum likelihood, maximum parsimony, bootstrap 100%.

Best regards,

Professor Robin Allaby

The results and conclusions in this report are based on an investigation of mtDNA sequence analysis. The results obtained have been reported with accuracy. The interpretation represents the most probable conclusion for the DNA sequence obtained rather than the sample provided given current levels of species data. It should be borne in mind that different circumstances might produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial recommendations.

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Appendix 7N

Bat Activity Report

Welsh Government

Global Centre for Rail Excellence (GCRE)

Bat Activity Survey Report

Rev A | 18 June 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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Cardiff CF10 4QP
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ARUP

Document verification

ARUP

Job title		Global Centre for Rail Excellence (GCRE)			**Job number** 264904
Document title		Bat Activity Survey Report			**File reference**
Document ref					
Revision	**Date**	**Filename**	Nant Helen_Bat Activity Survey Report_Draft_AK.docx		
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			Prepared by	Checked by	Approved by
		Name	Alexandra Kinsey		
		Signature			
Draft 2	19 Nov 2019	**Filename**	Nant Helen_Bat Activity Survey Report_AE.docx		
		Description			
			Prepared by	Checked by	Approved by
		Name	Alex Escott	Claire Pooley	
		Signature			
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		Description			
			Prepared by	Checked by	Approved by
		Name	Martyn Owen	Claire Pooley	
		Signature			
Issue	27 Mar 2020	**Filename**	Nant Helen_Bat Activity Survey Report_Issue.docx		
		Description	Final report		
			Prepared by	Checked by	Approved by
		Name	Martyn Owen/Pete Wells	Claire Pooley	Paul Clack
		Signature			
				Issue Document verification with document	✓

Document Verification

Job title		Global Centre for Rail Excellence (GCRE)			**Job number** 264904
Document title		Bat Activity Survey Report			**File reference**
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Revision	**Date**	**Filename**	GCRE_Bat Activity Report_Rev A.docx		
Rev A	18 Jun 2020	**Description**	Updated for GCRE		
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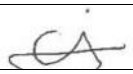
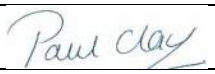
		Name	Eloise Arif	Claire Pooley	Paul Clack
		Signature			
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			Prepared by	Checked by	Approved by
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			Prepared by	Checked by	Approved by
		Name			
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		Filename			
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		Name			
		Signature			
				Issue Document Verification with Document	✓

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1 Introduction

1.1 Background

Ove Arup & Partners Ltd (Arup) was commissioned by the Welsh Government (WG) to undertake a range of consultancy services in relation to the Global Centre for Rail Excellence (GCRE), hereafter referred to as 'the Project'.

As part of that commission, a range of ecological surveys have been undertaken to identify the baseline ecological conditions of the Project area, to inform the assessment of impacts as part of the Environmental Impact Assessment (EIA) process.

This document describes the bat activity survey undertaken for the Project. It should be read in conjunction with the bat roost survey report for the Project[1].

1.2 Survey Objectives

The surveys were conducted with the following objectives:

- To record bat activity levels and make observations on bat behaviour along walked transects, sampling habitats within the Study Area;
- To record and identify levels of bat activity, using static bat detectors at different locations spaced within the Study Area; and
- To identify the range of species present and their relative abundance in terms of activity levels at these locations.

[1] Arup (2020). Nant Helen Bat Roost Survey Report.

2 Project Description and Context

The WG are proposing to develop a rail testing, maintenance, research, development and storage facility (also referred to as the Global Rail Centre for Excellence) at the site of the Onllwyn washery and Nant Helen open cast mine site. The site for development is approximately 475 ha.

The proposed site is currently being mined by Celtic Energy, who will cease extraction operations in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and agreements with Powys County Council (PCC) and Neath Port Talbot County Borough Council (NPTCBC). This includes Section 106 planning obligations and planning conditions that need to be discharged.

Celtic Energy has submitted two recent planning applications for the site, including: the revised restoration strategy for approval (Planning reference number: 19/1899/REM) which would change the existing approved restoration scheme (for planning application ref 18/1070/REM). And, the Nant Helen complementary earthworks application for approval (Planning reference number: 20/0738/FUL) The purpose of these applications is to allow for a ‘flexible and adaptable landform for a variety of future uses on restoration, including the use of the site as a rail testing and storage facility, proposed by the WG.

3 Site Description

The site (Figure 1) is within the Dulais Valley located within Powys and Neath Port Talbot, with the Brecon Beacons National Park Authority boundary immediately to the north. Nearby settlements include Onllwyn, Seven Sisters, Ystradgynlais, Caehopkin, Abercrave or Coelbren.

The site is predominantly brownfield land that has been heavily worked by open cast mining. Much of the site has revegetated.

4 Study Area

The Study Area encompasses the majority of land within the Nant Helen open cast operational site, which at the time of commencing the ecological surveys was considered to be the likely boundary of the Project.

The Study Area is shown in Figure 1 and is hereafter referred to as the ‘site’.

5 Relevant Legislation & Biodiversity Framework

All UK bat species are afforded protection under both European and national law. All bats are listed as European Protected Species (EPS) under the provisions of the Conservation of Habitats and Species Regulations 2017 (as amended) (known as the 'Habitats Regulations'). Additionally, all bat species are afforded protection under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) (WCA).

Together this legislation makes it an offence to:

- Intentionally or recklessly kill, injure or capture a bat;
- Intentionally or recklessly disturb a bat such as to affect its ability to survive, breed or rear its young;
- Damage, destroy or obstruct access to a breeding site or resting place (e.g. roost) used by a bat, or disturb bats while they are using such a place; and
- Possess or control a live or dead bat, or any part of a bat.

Four species of bat, Greater Horseshoe Bat *Rhinolophus ferrumequinum*, Lesser Horseshoe Bat *R. hipposideros*, Bechstein's Bat *Myotis bechsteinii* and Western Barbastelle *Barbastella barbastellus*, are included on Annex II of the Habitats Directive[2], which requires the designation of Special Areas of Conservation to ensure the maintenance of favourable conservation status (and these are therefore generally considered as perhaps the most important UK species).

Various bat species are also listed as Species of Principal Importance for the conservation of biodiversity in Wales, under the provisions of Section 7 of the Environment (Wales) Act 2016 (Section 7 species). The Act includes a duty on all public authorities to have regard for the conservation of biodiversity in the exercise of their functions. This duty applies to government bodies, local authorities and statutory undertakers.

Actions that are prohibited by legislation can be made lawful on the approval and granting of a licence from Natural Resources Wales (NRW), subject to conditions.

[2] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

6 Methodology

6.1 Desk Study

The desk study element involved two methodologies: a review of existing ecological reports in relation to the site and an ecological data search with the Local Biodiversity Records Centre.

Existing ecological data, obtained in 2011 to inform the Environmental Statement[3], was reviewed which included previous desk study results, habitat and species surveys.

Protected and notable[4] species (including bats), Schedule 9 invasive non-native species and non-statutory site data within 5 km of the site were obtained from the Biodiversity Information Service for Powys & Brecon Beacons National Park (BIS)[5] on 21 November 2018.

In addition, online searches were carried out using the Multi Agency Geographic Information for the Countryside (MAGIC)[6], Natural Resources Wales website[7] and the Joint Nature Conservation Committee (JNCC) website[8] to identify any statutory designated sites up to 5 km from the site, and any designated European sites within 10 km; for which bats are a qualifying feature.

The full desk study results are provided in the Extended Phase 1 Habitat Report for the Project[9].

6.2 Field Surveys

Details of transect and static detector monitoring are provided below. All surveys were undertaken in line with guidelines published by the Bat Conservation Trust (BCT)[10].

[3] Environmental Statement (2011), Celtic Energy.
[4] Notable' species and habitats considered in this report include species and habitats of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales, under section 7 of the Environment (Wales) Act 2016, in addition to any species considered to be of significance for nature conservation such species listed in red data books, the Royal Society for the Protection of Birds (RSPB)
[5] https://www.bis.org.uk/home.
[6] http://magic.defra.gov.uk/
[7] https://naturalresources.wales/conservation-biodiversity-and-wildlife/find-protected-areas-ofland- and-seas/designated-sites-search/?lang=en
[8] http://jncc.defra.gov.uk
[9] Arup (2019) Nant Helen Complementary Restoration Earthworks Extended Phase 1 Habitat Survey Report.
[10] Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

6.2.1 Transect Surveys

Habitats within the site were assessed during the Extended Phase 1 Habitat survey as having moderate suitability to support foraging and commuting bats. Therefore, in line with Good Practice Guidelines[10], transect surveys were carried out once per month between April and October.

Five transect routes (colour coded as Green, Purple, Orange, Yellow and Blue) were designed to sample bat activity around suitable habitat (e.g. hedgerows and treelines) within the site. The locations of the transect routes are shown in Figure 2.

The transect routes were generally circular, and each walked once per month from April to October 2019 inclusive, therefore they were each surveyed seven times. The dates of each survey, along with sunset times, survey start and finish times are given in Table 1. Table 2 details dates of the transect surveys, and weather conditions.

Blue, orange and yellow transect surveys were led by Martyn Owen MCIEEM (Biome Ltd) (NE bat licence no. 2015-1974-CLS-CLS)[11], with assistants. Green and purple transects were led by Alex Escott (Arup ecologist), and assistants. Martyn and Alex are both experienced bat surveyors.

[11] Martyn Owen is also an accredited agent on an NRW bat licence, although no licences are required to carry out transect surveys.

Table 1. Dates and Times of Transect Surveys

	Transect																			
	Green				Purple				Orange				Yellow				Blue			
	Date	Sunset/ sunrise	Start	End	Date	Sunset/ sunrise	Start	End	Date	Sunset/ sunrise	Start	End	Date	Sunset/ sunrise	Start	End	Date	Sunset/ sunrise	Start	End
Apr	25th	20:46	20:28	22:28	29th	20:54	20:35	22:38	15th	20:26	20:13	22:09	24th	20:44	20:31	21:58	23rd	20:42	20:25	22:10
May	16th	21:25	21:02	23:13	23rd	21:37	21:12	22:46	9th	21:13	20:51	23:00	19th	21:31	21:07	22:48	24th	21:39	21:14	23:14
Jun	17th	21:00	21:35	23:36	27th	21:02	21:37	23:16	13th	20:59	21:34	23:17	19th	21:01	21:37	23:21	20th	21:01	02:55	04:52
Jul	9th	22:00	21:32	23:33	16th	21:53	21:26	23:26	17th	21:51	21:24	23:55	10th	21:59	23:01	23:01	9th	22:00	21:36	23:06
Aug	28th	20:27	20:09	22:09	15th	20:58	20:39	22:38	4th	20:21	20:41	22:30	13th	21:02	20:42	22:18	13th	21:02	20:42	22:42
Sep	11th	19:52	19:39	22:06	5th	20.07	19:53	21:38	19th	19:29	19:21	20:59	24th	19:18	19:09	20:40	18th	19:34	19:23	21:15
Oct	16th	18:23	18:19	20:38	2nd	18:58	18:51	20:56	16th	18:23	18:19	19:59	6th	18:48	18:40	20:29	13th	18:31	18:24	20:20

Table 2. Weather Conditions During Transect Surveys

Date	Temperature (ºC) at Start	Temperature (ºC) at End	Wind Speed (Beaufort)	Wind Direction	Cloud Cover (%)	Conditions
25.04.2019	10	8	1	N/A	60	Dry
29.04.2019	12	11	1	N/A	80	Dry
15.04.2019	11	9	1	SE	90	Dry
24.04.2019	12	11	1	SE	60	Dry
23.04.2019	16	14	1	E	90	Precipitation

Date	Temperature (ºC) at Start	Temperature (ºC) at End	Wind Speed (Beaufort)	Wind Direction	Cloud Cover (%)	Conditions
16.05.2019	14	11	1	NE	70	Dry
23.05.2019	14	12	2	NW	90	Dry
09.05.2019	10	8	1	SW	90	Dry
19.05.2019	11	10	N/A	N/A	50	Dry
24.05.2019	13	11	1	W	50	Dry
17.06.2019	13		1	E	90	Dry
27.06.2019	18	18	5	NE	0	Sunny. Progressively windier throughout survey
13.06.2019	11	11	1	W	90	Light showers
20.06.2019	10	11	1	SW	60	Dry
19.06.2019	11	10	1	W	10	Dry
09.07.2019	20	17	1	N/A	80	Dry
16.07.2019	18		1	W	10	Dry
17.07.2019	16	14	2	SW	100	Dry
10.07.2019	16	15	1	SW	100	Dry
09.07.2019	18	16	1	SW	40	Dry
29.08.2019	16	14	1	SW	100	Dry
15.08.2019	14	12	1	SW	40	Dry
04.08.2019	16	15	1	W	100	Dry
13.08.2019	13	13	1	SW	40	Dry
13.08.2019	13	13	1	SW	40	Dry

Date	Temperature (ºC) at Start	Temperature (ºC) at End	Wind Speed (Beaufort)	Wind Direction	Cloud Cover (%)	Conditions
11.09.2019	16	10	1	SW	80	Dry
05.09.2019	12	9	1	SE	5	Dry
19.09.2019	16	15	1	E	0	Dry
24.09.2019	14	14	2	SW	100	Light rain
18.09.2019	13	11	1	NE	0	Dry
16.10.2019	11	9	1	SW	20	Sunny. Light rain 19.30
02.10.2019	10	8	1	NW	70	Dry
16.10.2019	11	10	1	W	40	Dry
06.10.2019	10	9	1	NW	100	Dry
13.10.2019	12	9	1	E	50	Dry

Transect surveys were undertaken at dusk and began at sunset and lasted for 1.5-2.5 hours after sunset. One of the surveys was undertaken at dawn and began 2 hours before sunrise and finished at sunrise.

Batlogger M (Elekon) and Echo Meter Touch (Wildlife Acoustics) bat detectors were used to record bat calls during the surveys. Following the surveys, all bat recordings were analysed to identify species using the relevant bat analysis software packages (see further details below in section 6.2.2.2) to species level where possible.

Observations such as numbers and species of bats heard/seen, the direction of flight, height and the behaviour (e.g. foraging or commuting) were noted when seen.

The Green and Purple transect routes were subject to amendment for the months of June-October due to health and safety concerns with the presence of bulls and cows with young across the survey area. The amended routes are indicated in Figure 3. Due to the open nature of the common land containing the Purple transect, a car based transect survey was deemed more appropriate for health and safety. To ensure a robust survey effort, part of this transect was walked where possible (within the fenced felled conifer plantation habitat) and four 10-minute listening points incorporated within areas of suitable habitat for commuting and foraging bats (see Figure 3).

6.2.2 Static Detector Surveys

6.2.2.1 Data Collection

A static detector survey was carried out to assess bat activity along suitable habitats identified within the site in accordance with best practice survey guidelines[10]. Song Meter SM2 BAT detectors were deployed at Locations 1 – 16 (shown in Figure 4) to record bat calls of species commuting and foraging. Static monitoring was completed during the months of April, May, July, August, September and October 2019 (going into November 2019)[12].

Table 3. Static detector monitoring periods

Month (2019)	Start	End
April	25.4.2019	29.4.2019
May	15.5.2019	31.5.2019
July	18.7.2019	25.7.2019
August	1.8.2019	19.8.2019
September	1.9.2019	16.9.2019
October	30.10.2019	03.11.2019

[12] No survey was carried out in June due to logistical difficulties.

Song Meter SM2 BAT detectors are robust and weatherproof, which record full spectrum bat calls over several days. These were installed at the locations shown in Figure 4 and left for five to seven days each time, ensuring the microphones were directed away from dense vegetation to record bat activity for consecutive nights each month in line with the recommended effort within the Good Practice Survey Guidelines[10].

The detectors were set up with the settings shown in Table 4 below to record bat activity between 18:00 and 07.00 each night.

Table 4. SM2 + BAT Settings used during data collection

Parameter	Setting
2.5V Microphone Bias	Off
Low noise filter	1kHz
Microphone pre-amp gain	12dB
Sample rate	354800
Monitoring schedule	Daily from 18:00
Monitoring duration	13 hrs

The microphones used with the detectors during the course of the surveys were regularly checked and calibrated using a Wildlife Acoustics Calibration Unit to ensure that they were functioning properly. Microphones that were found not to show a significant response to the output of the calibration unit were replaced.

Detector locations (Figure 4) remained consistent across the monitoring period. The locations were determined to provide coverage of the site, and included a variety of habitats, as indicated within Table 5 below.

Table 5. Static detector location details

Monitoring Location (Figure 4)	Notes
1	Adjacent to access road, near deciduous woodland and pasture.
2	Next to hedgerow within pasture.
3	Next to hedgerow/trees within pasture.
4	Near road, with trees, housing and pasture (including wet pasture/drains) nearby.
5	Near entrance to Washery. Mature/semi-mature trees, scrub and ponds nearby.
6	Within scrub/semi-mature trees. Ponds nearby
7	Near hedgerow including mature trees, and woodland. Pasture and scrub nearby.
8	Within scattered scrub in pastoral field.
9	On edge of conifer plantation. Scrub nearby.
10	Near pond complex on edge of works area. Coniferous plantation nearby.
11	On edge of plantation coniferous forestry. Wet pasture nearby.
12	On edge of work area. Scrub, pond (ephemeral) and wet grassland nearby.
13	On edge of plantation forestry within wet grassland.

14	Near pond complex, within scrub. Wet grassland nearby.
15	Near stream in wet pasture.
16	Within wet pasture.

Static surveys were undertaken by Neil Also and Ray Houghton: acousticians at Arup.

6.2.2.2 Data Processing and Analysis

Detectors recorded bat activity in Wildlife Acoustics Compression files (.wac). These files were downloaded from the detectors and processed using Kaleidoscope Pro Software to produce audio files (.wav) and zero crossing files. The processing also included the automatic identification of bat species based on the classifiers developed by Wildlife Acoustics (Bats of Europe 3.0.0).

The files produced by the processing were reviewed to ensure correct identification of species and to identify where possible the bat species for any calls which could not be recognised by the software. All calls identified as being either common pipistrelle (*Pipistrellus pipistrellus*) or soprano pipistrelle (*P. pygmaeus*) were not reviewed, except where high levels of insect noise had been recorded leading to uncertainty over the accuracy of identification. All other calls were checked by Richard Moores, a bat specialist with over 20 years of experience in bat work and holder of a current NRW bat survey licence (Licence number: SO87731-1), as well as holding Scottish Natural Heritage (SNH) (27405) and Natural England (NE) licences (2015-12259-CLS-CLS and 2015-12257-CLS-CLS).

The number of files (sound clips) recorded by the detectors each night were taken as a proxy value to the number of bat passes. This was then used to calculate a Bat Activity Index (BAI) by dividing the number of passes by five (the number of monitoring nights) for each species at each location during each session. The BAI is calculated using data from the first five monitoring nights recorded each month. In some cases, the detector also recorded data on the sixth and sevenths nights. These additional nights were excluded from the BAI as it could not be certain that the detector had recorded data for the entire night. However, where rarer or more notable species were recorded on these additional nights, they were included to ensure their representation within the data in terms of species diversity.

The average BAIs for all species (sum of individual BAIs) at each location was also calculated over the active months.

The time of recording of the first bat of each species, each night, was also assessed to infer the potential proximity of roost sites.

6.3 Limitations

The findings presented in this report represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys can be limited by factors affecting the presence of plants and animals, such as the time of

year, migration patterns and behaviour. The absence of evidence of any particular species should not be taken as conclusive proof that the species is not present or that it will not be present in the future. However, the likely presence of protected and/or other notable species could be adequately determined from the surveys carried out and further surveys were recommended where any uncertainty on presence or absence remained.

The identification of bat calls can be highly subjective based on decisions on the shape and characteristics of the calls. However, experienced bat ecologists have been used in the analysis of data, as well as Kaleidoscope software that assists in the identification of calls. As is standard practice, no attempt to differentiate between the *Myotis* species or *Plecotus* species has been made.

Whilst every effort was made to programme and undertake surveys during suitable weather conditions, the long-term nature of the static activity monitoring surveys means that, on some occasions, these surveys included nights during which there were lower temperatures, periods of rainfall and strong winds. However, the number and range of recordings made provide a robust indication of bat activity levels across the site during the active season for bats.

The Green and Purple transect routes were subject to amendment from June to October (as shown in Figure 3), due to the presence of bull and cattle with young across the site. However, it is considered that these areas were adequately covered by the amended routes and methodologies used in all surveyed months, and survey effort was therefore not compromised.

Due to logistical difficulties no static data was collected during June, and only one location (Monitoring Location 6) was sampled in August. In addition, detectors deployed at Monitoring Locations 2 (April), 3 (July), 5 (September), 7 (October), 11 (July, September) 12 (April, July, September), 14 (July, September, October), 15 (September, October), 16 (September) failed to record any bat calls indicting detector (or microphone) failure. However, these variations in coverage have been factored into the analyses, and a comprehensive set of surveys have been completed. The omission of these months/monitoring locations is not considered to compromise the objectives of the surveys detailed within this report.

7 Baseline Environment

7.1 Desk Study

7.1.1 Existing Survey Data

A full summary of the existing survey data collated from the surveys undertaken to inform the Environmental Statement for the site in 2011 is provided within the Extended Phase 1 Habitat Report[9].

7.1.1.1 Bat Activity Surveys (Transect and Static monitoring)

Activity surveys in the form of walked transects and the deployment of static detectors were undertaken[3]. Seven bat species (common pipistrelle, soprano pipistrelle, Nathusius' pipistrelle (*P. nathusii*), brown long-eared (*Plecotus auritus*), noctule (*Nyctalus noctula*), serotine (*Eptisecus serotinus*) and Leisler's (*N. leislerii*)) were recorded commuting/foraging within and adjacent to the site during the static and transect surveys, with most records comprising pipistrelles.

7.1.2 New Data Search

7.1.2.1 Protected and Notable Species

The data provided by BIS in November 2018 detailed records of bat species identified within 5 km of the site, as summarised below. The distance given is that to the closest point on the site boundary.

Table 6. Bat species recorded within 5 km of the site

Species/Group	Scientific Name	Status	Number of Records	Approximate distance of closest record (m)
Soprano pipistrelle	*Pipistrellus pygmaeus*	EPS, WCA, Sec 7	10	300
Common pipistrelle	*Pipistrellus pipistrellus*	EPS, WCA, Sec 7	27	400
Unidentified bat	*Chiroptera*	EPS, WCA, Sec 7	10	400
Daubenton's bat	*Myotis daubentonii*	EPS, WCA, Sec 7	7	400
Noctule bat	*Nyctalus noctula*	EPS, WCA, sec 7	11	400
Pipistrelle species	*Pipistrellus* spp.	EPS, WCA, sec 7	14	600
Brown long-eared bat	*Plecotus auritus*	EPS, WCA, Sec 7	7	1000

Species/Group	Scientific Name	Status	Number of Records	Approximate distance of closest record (m)
Myotis bat	*Myotis* spp.	EPS, WCA, sec 7	2	1700
Nathusius' pipistrelle	*Pipistrellus nathusii*	EPS, WCA, sec 7	2	2000
Natterer's bat	*Myotis nattereri*	EPS, WCA, Sec 7	2	2000
Lesser horseshoe bat	*Rhinolophus hipposideros*	EPS, WCA, sec 7	1	2000

7.1.2.2 Statutory and Non-Statutory Designated Sites

Fourteen statutorily designated sites were identified within 5 km of the site. They comprised one Special Area of Conservation (SAC), one National Park and 12 Sites of Special Scientific Interest (SSSI), one of which is also designated as a National Nature Reserve (NNR). No sites designated for bats were identified within 10 km of the site however. The identified sites are detailed within the Extended Phase 1 Habitat Report[9].

7.2 Field Survey

7.2.1 Transect Activity Surveys

Transect survey data are shown on Figures 5 – 11 (a-e). The bat species are labelled on the figures with the time that the bats were recorded. Table 7 provides a summary of the data obtained in relation to each transect during each month. During transect surveys soprano and common pipistrelle were by far the most abundantly logged species, with records from each transect.

Table 7. Summary of Transect Results

Transect	Summary of Results
April	
Purple	Low level of common and soprano pipistrelle activity. Activity recorded at ponds at end of survey (22:16). Majority of activity detected within broadleaved woodland and felled coniferous plantation habitat at the south-western corner of the transect (between 20:49-21:06), and broadleaved woodland at the western extent of the transect (21:26-21:50).
Green	Very low bat activity – two soprano pipistrelle heard towards the end of survey at 21:23 and 21:27. Heavy rain showers prior to start of survey.
Orange	Low bat activity. Common and soprano pipistrelle heard at the south-eastern corner of the transect along a series of hedgerows (20:29-20:44), and at the north-western transect section (21:52).
Yellow	Moderate bat activity. Common and soprano pipistrelle recorded throughout the transect route. Myotis sp. were recorded around the series of ponds to the west of the transect (21:16 and 21:19).
Blue	Low levels of activity. Common and soprano pipistrelles recorded along the northern transect line (20:50-22:01) and a common pipistrelle heard at the centre of the transect (21:40).

Transect	Summary of Results
May	
Purple	Common and soprano pipistrelles heard foraging within the felled forestry area and woodland to the southwest (21:49-22:07). Low levels of activity.
Green	Most activity was observed around hedgerows and the treeline along Onllwyn Road/A4221 (21:26-22:04). Low levels of activity throughout the Washery (22:33-22:50). A noctule was recorded at 21:29.
Orange	Very low activity - one common pipistrelle heard at 22:30.
Yellow	Moderate bat activity - pipistrelle species recorded throughout woodland area (21:20-21:52). Myotis sp. recorded at western ponds (21:57) and north-eastern corner (21:20.
Blue	Low activity, similar to April transect – common and soprano pipistrelle recorded throughout the central transect area, northern extent and south-western corner and around waterbodies.
June	
Purple	Low levels of bat activity. Common and soprano pipistrelles foraging along the Nant Ystalwyn/woodland area (22:23-22:45).
Green	Fairly constant pipistrelle activity throughout the survey, including in the sheep fields (21:44-21:49), along Onllwyn Road and the A4221 (22:05-22:26), and in the Washery (22:28-23:21).
Orange	Low level common and soprano pipistrelle activity. Most activity at southwestern corner of transect and north-western extent. A Myotis sp. was also heard at 22:53 within this area. A tunnel was found at Grid Reference SN80138 09411, where a pipistrelle species was considered likely to have emerged (22:00).
Yellow	Moderate activity – common and soprano pipistrelle. Myotis sp. recorded at north-eastern transect corner at 22:51. The majority of activity recorded at western transect area (22:12-22:27).
Blue	Low level activity – four common/soprano pipistrelles recorded at southern transect line.
July	
Purple	Relatively high bat activity. Pipistrelle species observed within recently felled woodland area and conifer plantation (22:05-22:23). Low level of pipistrelle and Myotis activity along the haulage road (23:19-23:27). Pipistrelles also heard by the sheep fold/broadleaved woodland area at north-western extent of transect (22:45-23:13).
Green	Similar to previous surveys – moderate level of pipistrelle activity, the majority observed along Onllwyn Road/A4221 (22:10-22:24), and over scrub/grassland habitat within the Washery (22:35-23:26).
Orange	Rain during survey and low levels of activity (common and soprano pipistrelle).
Yellow	Moderate activity – common and soprano pipistrelle. Noctule recorded 22:14 at south-western transect extent.
Blue	Moderate common and soprano pipistrelle activity. Noctule recorded at 22:08 at the north-western corner of transect near larger pond.
August	
Purple	Moderate pipistrelle activity, foraging along stream and woodland habitat (21.05 – 21.20). Noctule heard 21.13. Moderate activity along the haulage road. A Myotis species was recorded at 21.57 along the haulage road.
Green	Relatively high pipistrelle bat activity level long Onllwyn Road/A4221 throughout survey. Noctules recorded at 20:32 and 22:04.
Orange	Myotis sp. recorded at the western extent between 21:02 and 21:39, and along the northern extent (22:14-22:17). Common and soprano pipistrelle recorded with these areas also. Low - moderate activity levels.
Yellow	Moderate activity – common and soprano pipistrelle. Noctule recorded at the finish point (22:14) and Myotis sp. recorded at northern edge of the woodland (21:35).

Transect	Summary of Results
Blue	Moderate activity – common and soprano pipistrelle. Myotis sp. recorded at the southern extent near ponds (22:10) and noctule recorded near the start/finish point (22:36 and 22:42).
September	
Purple	Moderate levels of common and soprano pipistrelle activity; observed foraging along the track through woodland/coniferous plantation area (20:30-20:53) and along the haulage road. Noctules heard at 20:11 and 20:39.
Green	Similar activity level of common and soprano pipistrelle to previous surveys and a few Myotis sp. recorded. Noctule observed flying over A4221 at 20:26.
Orange	Low level activity of common and soprano pipistrelle. Likely emerging from tunnel at stone structure at 19:48.
Yellow	Lower activity levels than at previous surveys – sub optimal conditions (rain during survey). Common and soprano pipistrelle activity. Myotis sp. recorded at western ponds (19:50) and along the northern woodland edge (19:57-20:25).
Blue	Moderate common and soprano pipistrelle activity throughout the transect. Myotis sp. recorded around ponds at central transect line (20:39) and eastern extent at larger pond (21:02). Noctule recorded at north-eastern corner (21:12).
October	
Purple	Low bat activity. Few pipistrelle passes within woodland/coniferous plantation area (19:32-19:56). Myotis sp. also recorded here (19:43) and along haulage road (20:21-20:55).
Green	Low bat activity. Pipistrelles recorded foraging along Onllwyn Road and A4221 (18:41-19:08). One common pipistrelle recorded in the washery (19:16).
Orange	Low level of activity of common and soprano pipistrelle throughout the transect. Myotis sp. was recorded at 19.20 at the south-western (19:20) and northern (19:42) corners of the route.
Yellow	Moderate level of activity of common and soprano pipistrelle. Myotis sp. were recorded at the western extent of the transect around the ponds at (19:46-19:29). Noctule were also recorded at the end of the survey (20:27).
Blue	Low-moderate common and soprano pipistrelle activity throughout the survey. Noctule recorded at the end of the transect at 20:11 and 20:17.

7.3 Static Detector Surveys

Static detector survey data are summarised within Tables 8-10 and Charts 1-6. The identification of six species was confirmed, with *Myotis* sp. and long-eared bat *Plecotus* sp. also logged. Figure 12 (a-f) shows the proportion of each bat species recorded at each static location in each month, while Figure 13 (a-f) shows the average BAI at each static location, in each month.

Table 8 summarises activity levels by species across all survey locations. Common pipistrelle and soprano pipistrelle were by far the most commonly recorded species, with both logged at all monitoring locations. *Myotis* sp. and Noctule were also logged at all locations. Of those species identified to species-level, (what was considered to be) serotine (two passes, monitoring locations 1 and 8) and greater horseshoe bat (five passes, monitoring locations 3, 7, 9 and 16) provided the fewest records.

Table 8. Summary of all bat passes by species

Species	Total Number of Bat Passes at all Monitoring Locations
Unidentified bat	1
Serotine	2
Myotis sp.	3,824
Noctule	522
Nyctalus sp.	7
Nathusius' Pipistrelle	21
Common Pipistrelle	69,131
Soprano Pipistrelle	64,394
Pipistrelle sp.	1,914
Long-eared bat *Plecotus* sp.	242
Greater Horseshoe Bat	5

Table 9 summarises data by monitoring location; due to variations in the duration of monitoring from each location the mean number of bat passes per hour (*i.e.* total number of bat passes divided by total survey hours by location) is provided. These data are illustrated within Chart 1.

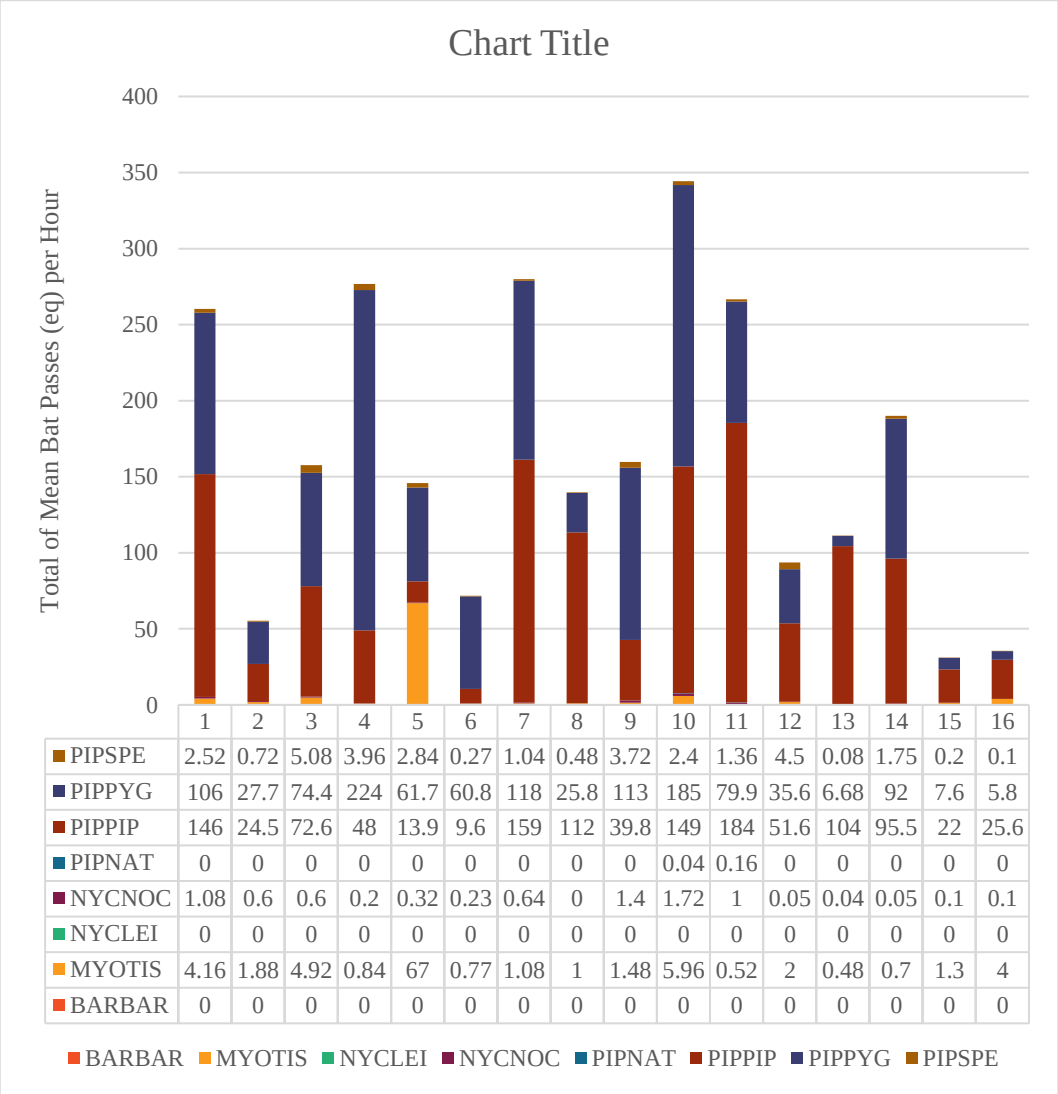
As shown, the greatest level of activity was encountered at monitoring location 4, followed by 10, 1, 14 and 11 all of which recorded in excess of an average of 47 bat passes per hour. Monitoring locations 4, 10 and 1 are located in the north of the site, at relatively low elevations. Locations 14 and 10 are situated near to water. Location 1 is situated near to mature deciduous woodland.

A mean of fewer than ten bat passes per hour were logged at monitoring locations 16, 6, 12 and 2. Locations 12 and 16 are located in the western portion of the site, at relatively high elevations (compared to other locations) whereas locations 2 and 6 are near to roads which may account for the reduced levels of activity.

Table 9. Summary of all bat passes by monitoring location

Monitoring Location	Total Number of Bat Passes	Total Monitoring Hours	Mean Number of Bat Passes Per Monitoring Hour
1	13,856	258.87	53.52
2	1,934	214.6	9.01
3	9,992	355.59	28.10
4	15,633	271.77	57.52
5	9,458	304.02	31.11
6	2,079	362.21	5.74
7	12,092	328.84	36.77
8	15,776	494.66	31.89
9	12,552	492.97	25.46
10	23,775	442.64	53.71
11	7,120	150.56	47.29
12	1,570	180.35	8.71
13	6,973	260.14	26.80
14	4,363	85.5	51.03
15	1,523	133.19	11.43
16	1,368	324.45	4.22

Chart 1. Total of mean bat passes per hour by monitoring location[13]



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PIPSPE	2.52	0.72	5.08	3.96	2.84	0.27	1.04	0.48	3.72	2.4	1.36	4.5	0.08	1.75	0.2	0.1
PIPPYG	106	27.7	74.4	224	61.7	60.8	118	25.8	113	185	79.9	35.6	6.68	92	7.6	5.8
PIPPIP	146	24.5	72.6	48	13.9	9.6	159	112	39.8	149	184	51.6	104	95.5	22	25.6
PIPNAT	0	0	0	0	0	0	0	0	0	0.04	0.16	0	0	0	0	0
NYCNOC	1.08	0.6	0.6	0.2	0.32	0.23	0.64	0	1.4	1.72	1	0.05	0.04	0.05	0.1	0.1
NYCLEI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MYOTIS	4.16	1.88	4.92	0.84	67	0.77	1.08	1	1.48	5.96	0.52	2	0.48	0.7	1.3	4
BARBAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[13] RHIFER= greater horseshoe, PLASPE = *Plecotus* sp., PIPSPE = pipistrelle sp., PIPPYG = soprano pipistrelle, PIPPIP = common pipistrelle, PIPNAT = Nathusius' pipistrelle, NYCNOC = noctule, NYCLEI – Leisler's bat, MYOTIS = *Myotis* sp, BATSP = bat sp.

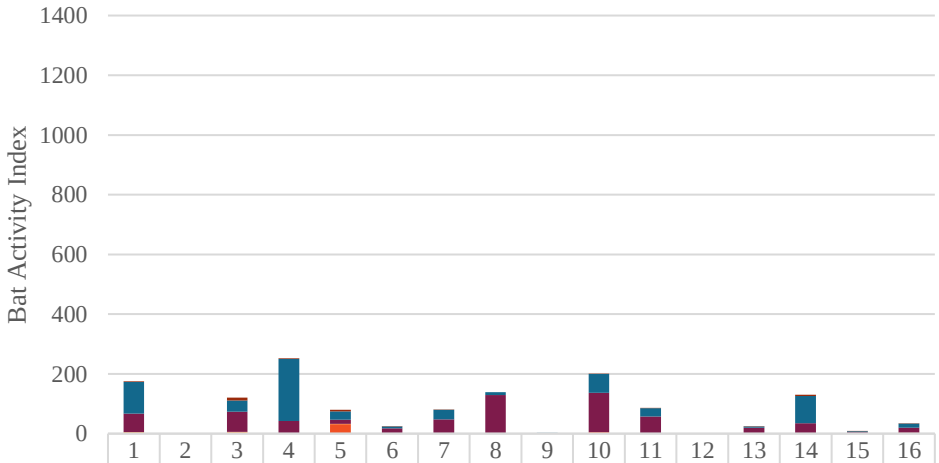
Table 10. Summary of static monitoring data by species and location

Monitoring Location (Survey Nights)	Number of Survey Nights Recorded/Mean Bat Passes per Hour (average time that first recorded on each night)										
	Bat sp.	**Serotine**	**Myotis sp.**	**Noctule**	**Nyctalus sp.**	**Nathusius' Pipistrelle**	**Common Pipistrelle**	**Soprano Pipistrelle**	**Pipistrelle sp.**	**Plecotus sp.**	**Greater Horseshoe**
1 (29)	-	2/0.01 (23:14)	21/1.05 (23:28)	18/0.22 (00:20)	2/0.01 (23:44)	2/0.03 (00:01)	29/32.94 (01:01)	28/18.63 (00:53)	19/0.55 (01:11)	10/0.08 (00:36)	-
2 (24)	-	-	9/0.14 (00:55)	6/0.08 (00:03)	1/0.00 (02:26)	-	18/4.03 (01:09)	18/4.57 (01:05)	12/0.15 (00:30)	4/0.02 (23:03)	-
3 (37)	-	-	32/1.15 (00:00)	12/0.07 (01:48)	-	-	34/13.86 (23:00)	36/12.38 (23:04)	26/0.55 (23:18)	18/0.09 (00:43)	1/0.00 (04:52)
4 (28)	-	-	15/0.42 (01:26)	5/0.03 (23:55)	-	2/0.01 (23:00)	25/8.68 (23:20)	18/46.52 (23:51)	19/1.84 (23:41)	4/0.02 (00:44)	-
5 (35)	-	-	29/6.83 (01:29)	8/0.05 (00:30)	-	-	33/7.08 (23:24)	34/16.17 (23:15)	26/0.98 (00:07)	1/0.00 (00:09)	-
6 (42)	-	-	16/0.11 (01:33)	4/0.03 (03:03)	-	-	39/3.76 (23:44)	40/1.74 (23:55)	17/0.10 (23:59)	1/0.01 (23:50)	-
7 (35)	-	-	24/0.24 (23:47)	20/0.16 (00:03)	-	-	34/21.46 (23:56)	35/14.77 (00:36)	14/0.12 (00:33)	3/0.02 (02:07)	1/0.00 (05:21)
8 (52)	-	1/0.00 (23:24)	29/0.17 (00:44)	5/0.01 (22:50)	-	2/0.00 (21:32)	48/24.21 (23:50)	50/7.3 (23:14)	31/0.15 (00:10)	16/0.05 (01:26)	-
9 (52)	-	-	39/0.23 (00:10)	29/0.44 (23:52)	-	1/0.00 (00:28)	48/7.44 (23:45)	23:26 (52/16.92)	00:49 (20/0.25)	01:40 (23/0.18)	00:28 (2/0.00)
10 (48)	-	-	35/0.66 (00:59)	9/0.14 (02:33)	1/0.00 (00:10)	2/0.00 (23:14)	45/21.47 (00:20)	48/30.62 (23:52)	30/0.75 (00:29)	15/0.07 (00:52)	-
11 (15)	-	-	6/0.10 (20:52)	6/0.19 (06:47)	-	1/0.03 (02:25)	15/32.84 (00:09)	13/13.85 (00:54)	8/0.27 (00:02)	1/0.01 (02:20)	-
12 (22)	-	-	18/0.36 (00:01)	5/0.09 (22:18)	-	-	21/5.61 (23:27)	20/2.39 (23:08)	16/0.25 (23:16)	1/0.01 (23:01)	-
13 (27)	-	-	7/0.17 (01:36)	2/0.01 (01:38)	-	-	24/24.42 (02:28)	23/2.19 (23:51)	5/0.02 (22:46)	-	-
14 (10)	1/0.01 (01:28)	-	7/0.16 (00:36)	1/0.01 (03:40)	1/0.02 (23:48)	-	10/26.82 (00:47)	10/23.59 (23:56)	7/0.41 (23:16)	-	-
15 (16)	-	-	13/0.38 (00:48)	2/0.02 (22:57)	1/0.01 (22:43)	-	16/8.20 (23:48)	13/2.61 (23:06)	8/0.08 (22:39)	5/0.15 (23:48)	-
16 (37)	-	-	23/0.38 (23:47)	4/0.01 (21:41)	-	-	35/3.22 (23:30)	28/0.57 (22:28)	5/0.03 (23:09)	-	1/0.00 (23:47)

Charts 2-6 below summarise the calculated BAI during each month, by species and monitoring location. Due the absence of data from June, and the largely incomplete dataset from August, no charts are provided for these months. Figure 13 (a-f) also show the BAI recorded in each month, at each static location.

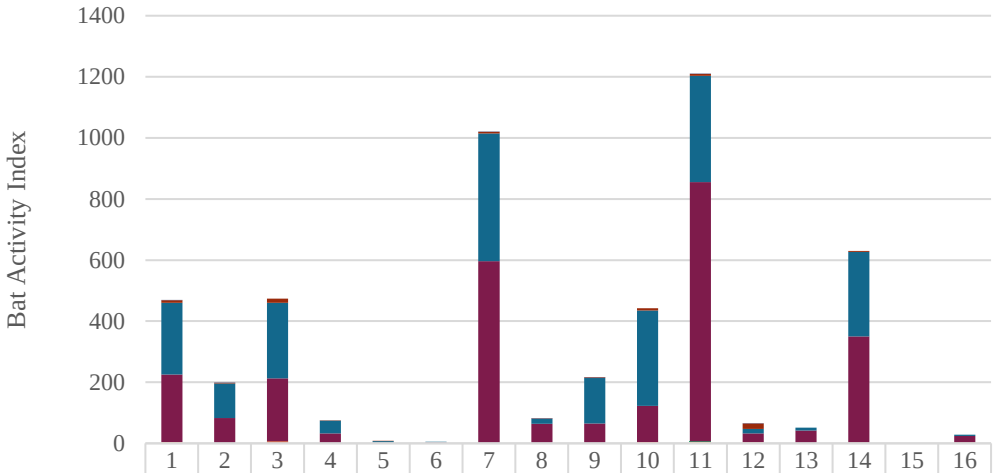
April and October provided markedly fewer registrations in comparison to May, July and September.

Chart 2. BAI - April



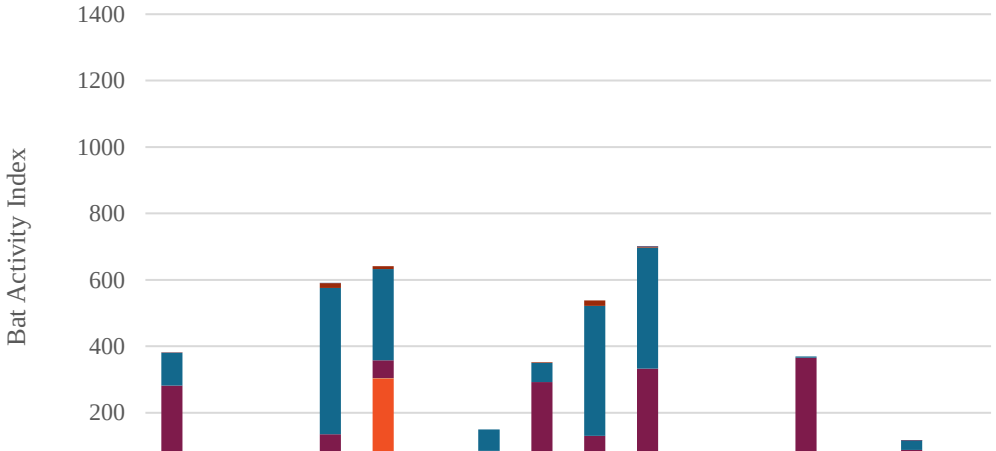
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
RHIFER	0		0	0	0	0	0	0	0	0	0		0	0	0	0
PLESPE	0		0	0	0	0	0	0	0	0	0		0	0	0	0
PIPSPE	2		10	2	5	1	1	0	0	1	1		0	4	0	0
PIPPYG	106		37	207	29	7	32	10	1	63	27		4	92	3	13
PIPPIP	62		68	41	14	18	47	128	2	132	57		20	34	4	17
PIPNAT	0		0	0	0	0	0	0	0	0	0		0	0	0	0
NYCNOC	2		2	1	1	0	0	0	0	0	0		0	0	0	0
NYCLEI	0		0	0	0	0	0	0	0	0	0		0	0	0	0
MYOTIS	3		4	1	32	0	0	0	0	5	0		0	1	0	3

Chart 3. BAI - May



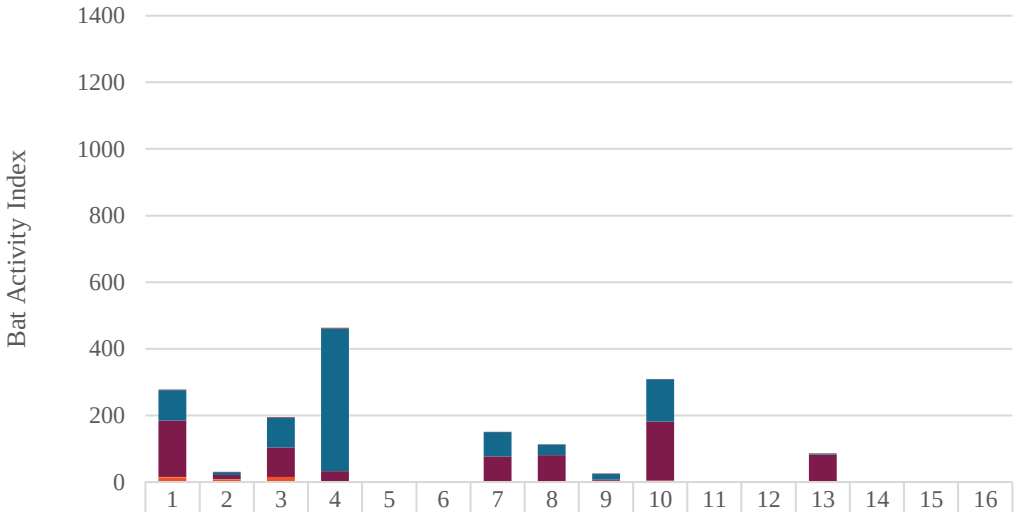
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
RHIFER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLESPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PIPSPE	9	2	14	1	0	0	4	1	2	8	6	18	0	3	0	0
PIPPYG	235	114	247	41	5	2	418	17	149	312	348	15	10	276	0	4
PIPPIP	221	82	206	33	1	3	595	63	64	118	849	30	41	348	1	22
PIPNAT	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
NYCNOC	1	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0
NYCLEI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MYOTIS	3	0	6	0	0	0	1	1	1	5	1	3	1	2	0	2

Chart 4. BAI - July



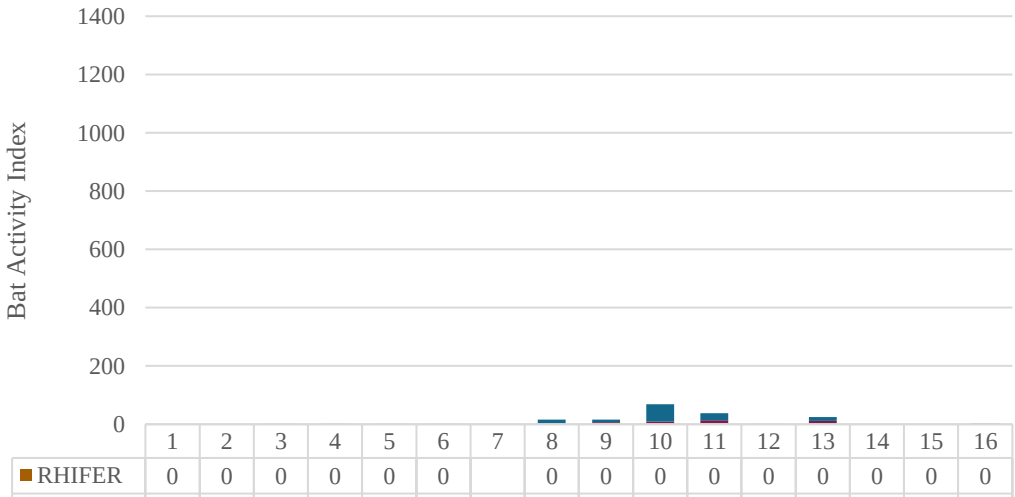
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
RHIFER	0	0		0	0	0	0	0	0	0			0		0	0
PLESPE	0	0		0	0	0	0	0	0	1			0		2	0
PIPSPE	1	1		15	9	1	0	1	16	3			0		0	0
PIPPYG	98	15		440	274	9	65	58	392	364			4		28	5
PIPPIP	280	29		133	55	33	82	292	124	309			366		83	60
PIPNAT	0	0		0	0	0	0	0	0	0			0		0	0
NYCNOC	1	2		0	0	0	1	0	5	8			0		0	0
NYCLEI	0	0		0	0	0	0	0	0	0			0		0	0
MYOTIS	1	1		3	303	3	2	1	2	16			0		5	11

Chart 5. BAI - September



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
RHIFER	0	0	0	0		0	0	0	0	0			0			
PLESPE	1	0	1	0		0	0	1	1	0			0			
PIPSPE	0	0	2	2		0	0	0	1	0			0			
PIPPYG	92	9	88	428		0	73	31	16	127			3			
PIPPIP	169	12	89	32		0	73	78	4	177			82			
PIPNAT	0	0	0	0		0	0	0	0	0			0			
NYCNOC	1	1	0	0		0	1	0	2	0			0			
NYCLEI	0	0	0	0		0	0	0	0	0			0			
MYOTIS	14	8	15	1		0	2	2	2	5			0			

Chart 6. BAI - October



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
RHIFER	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
PLESPE	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
PIPSPE	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
PIPPYG	0	0	0	1	0	1		14	8	59	24	0	12	0	0	1
PIPPIP	0	0	0	1	0	0		1	5	10	12	0	11	0	0	3
PIPNAT	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
NYCNOC	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
NYCLEI	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
MYOTIS	0	0	0	0	0	0		0	3	0	1	1	1	0	0	0

8 Conclusions

A desk study and comprehensive suite of transect surveys and static detector monitoring has been completed at the site. During transect surveys soprano and common pipistrelle were by far the most abundantly logged species, with records from each transect, in addition noctule and Myotis species were recorded.

A minimum of eight bat species were recorded during static monitoring, of these, common and soprano pipistrelle were by far the most commonly recorded, comprising 96.78% of all bat calls recorded (common pipistrelle - 49.36%, soprano pipistrelle - 45.97% and pipistrelle species (common or soprano) - 1.37%). *Myotis* sp. (3,824 calls representing 2.73% of all bat calls recorded) and Noctule (522 calls representing 0.37% of all bat calls recorded) were the next most commonly recorded species/species group. Of those species identified to species-level, serotine (two passes, static monitoring locations 1 and 8) and greater horseshoe bat (an Annex II species), (five passes, static monitoring locations 3, 7, 9 and 16) provided the fewest records.

During static monitoring, bat activity levels increased through spring to peak in May and July (no data for June) before tailing off in the autumn, quite considerably in October. Such a pattern is typical, but the large drop in bat activity in October, when bats are still active, would suggest that the site is a ‘summer’ (maternity period) feeding area predominantly. Bat activity levels (and activity by rarer species: greater horseshoe and serotine) were highest at lower elevations and/or when near to optimal foraging habitat (e.g. woodland/water), and lowest at higher elevations and/or near to busier roads (as opposed to access tracks around the site).

During transect surveys, a likely bat roost was noted at the Orange transect (Grid Reference SN80138 09411) where common and soprano pipistrelle bats are considered likely to have emerged during the June and September surveys. This likely roost consists of an old stone tunnel approximately 20 m long, and open at both ends. A Natterer’s bat roost was also recorded here during inspections of buildings and structures, and is reported separately[14].

The results obtained during the surveys fully detailed within this report are broadly consistent with data collected to inform the Environmental Statement in 2011. The differences being an absence of Leisler’s and lesser horseshoe records in 2019 while greater horseshoe bat was not recorded prior to 2019.

A full ecological impact assessment will be included within the Environmental Statement for the project and this will include an assessment of the significance of impacts from the project on bats. This will also detail any mitigation or compensation measures required to ensure there is no significant effect on bat species within the site.

This report is the result of the survey work undertaken between April and October 2019. This report refers, within the limitations stated, to the condition or proposed works of the site at the time of the surveys. Changes in legislation, guidance, best

[14] Arup, 2019. Nant Helen earthworks: bat roost survey report.

practice, etc. may necessitate a re-assessment/survey. No warranty is given as to the possibility of future changes in the condition of the site.

The results of these surveys are considered valid for a minimum of 18 months to a maximum of 3 years. If more than 18 months elapses before any planning application is submitted, the requirement for repeat surveys should be reviewed[15].

[15] Chartered Institute of Ecology and Environmental Management (2019) Advice Note on the Lifespan of Ecological Reports and Surveys

Figures

A3



LEGEND

Study Area

19/12/2019 15:59:38

Issue	Date	By	Chkd	Appd
F1	2019-11-14	EA	CP	PC

Metres

0 270 540 1,080

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Figure 1
Study Area

Scale at A3

1:20,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
001	F1

\\global\europe\Cardiff\Jobs\264000\264904-00\1 Client\271968 Celtic Energy Application\GIS\Map Documents\2019_Arboreal Mammals_EA.mxd

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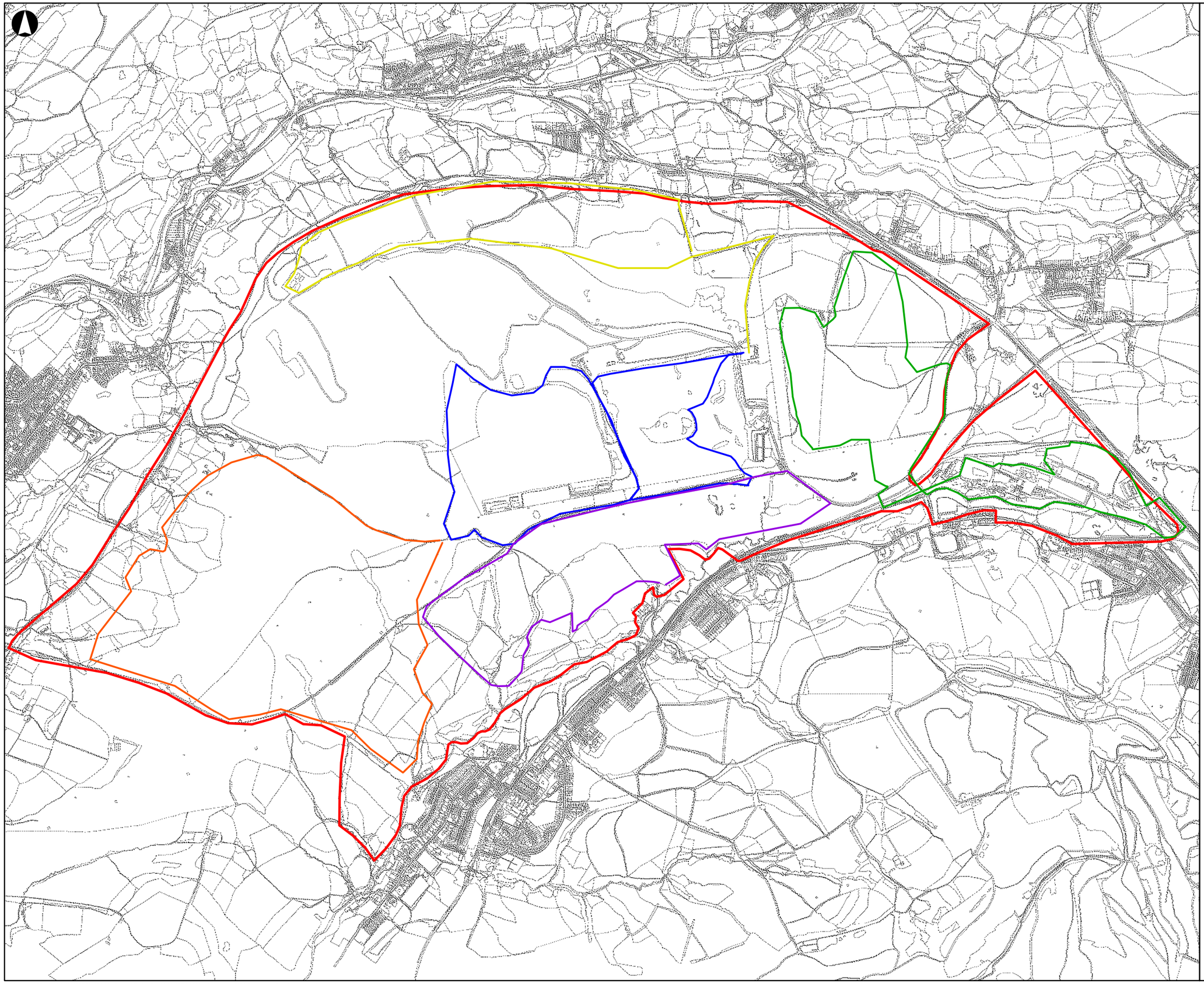
A3



Legend

Study Area Boundary

Indicative Transect Routes

- 1
- 2
- 3
- 4
- 5

13/05/2019 13:04:47

Issue	Date	By	Chkd	Appd
P0	2019-04-29	PW	PC	DB

Metres

0 255 510 1,020

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Bat Transect Routes

Scale at A3

1:19,095

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
002	F1

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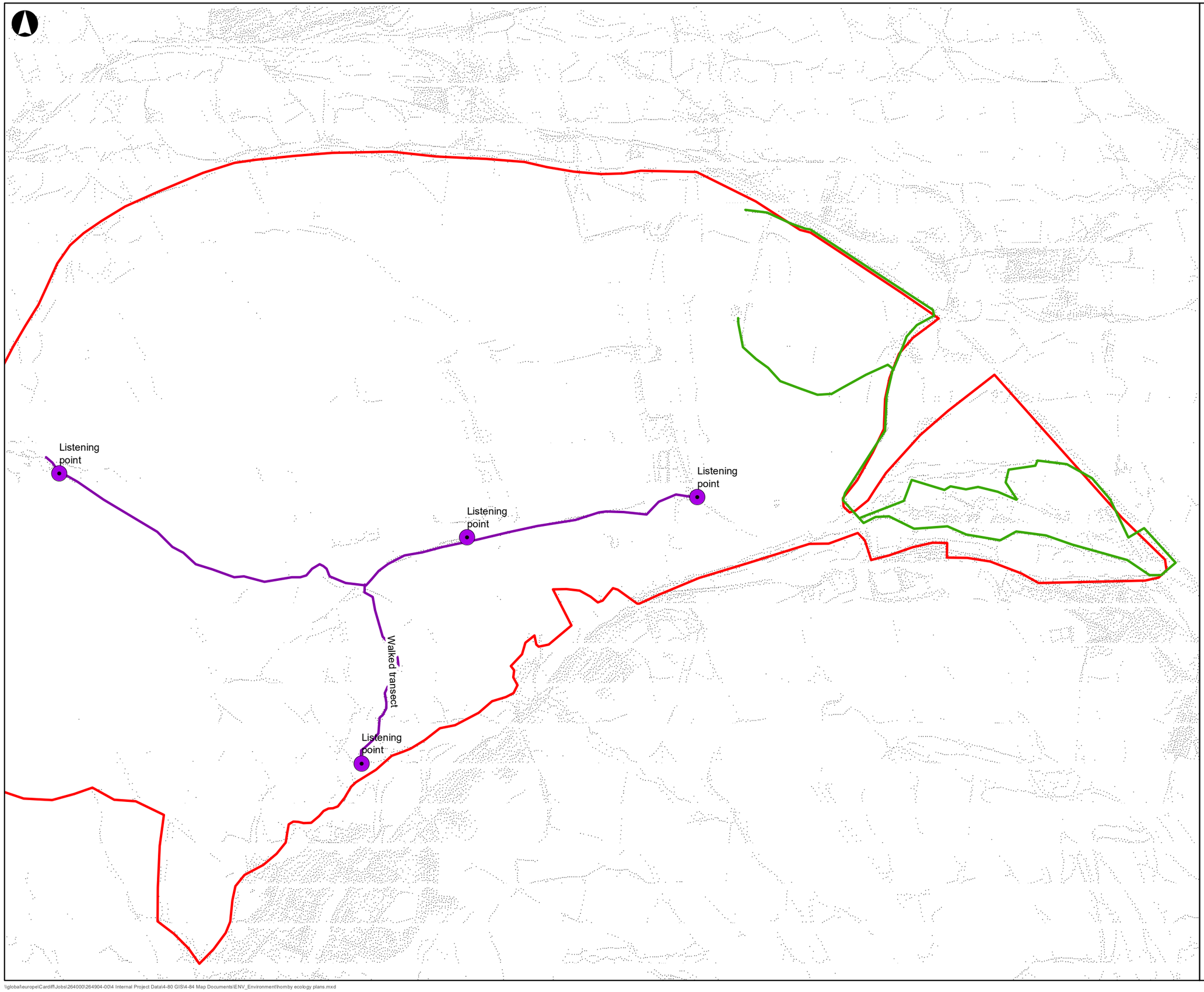
A3



Legend

- Listening Points
- Study Area Boundary
- Amended Green Transect
- Amended Purple Transect

29/04/2019 15:53:06

Issue	Date	By	Chkd	Appd
P0	2019-03-25	PW	PC	DB

Metres
0 215 430 860

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Amended Transect Routes

Scale at A3
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Job No	Drawing Status
264904	For Issue

Drawing No	Issue
003	F1

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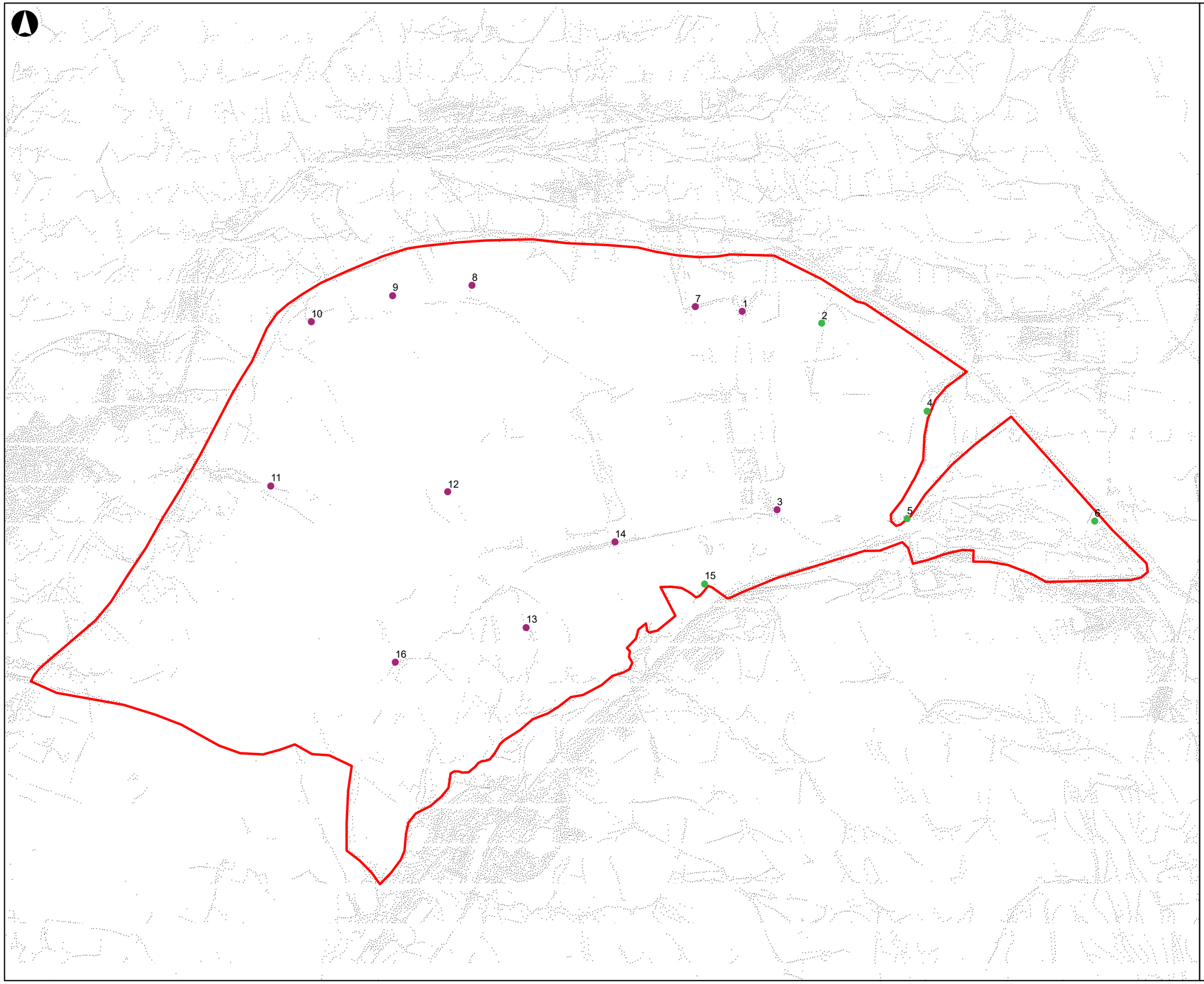
A3



Legend

Study Area Boundary

First Deployment

- 25/04/2019
- 26/04/2019

Issue	Date	By	Chkd	Appd
P0	2019-03-25	PW	PC	DB

Metres

0 270 540 1,080

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Static Detector Locations

Scale at A3

1:20,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
004	F1

29/04/2019 15:53:06

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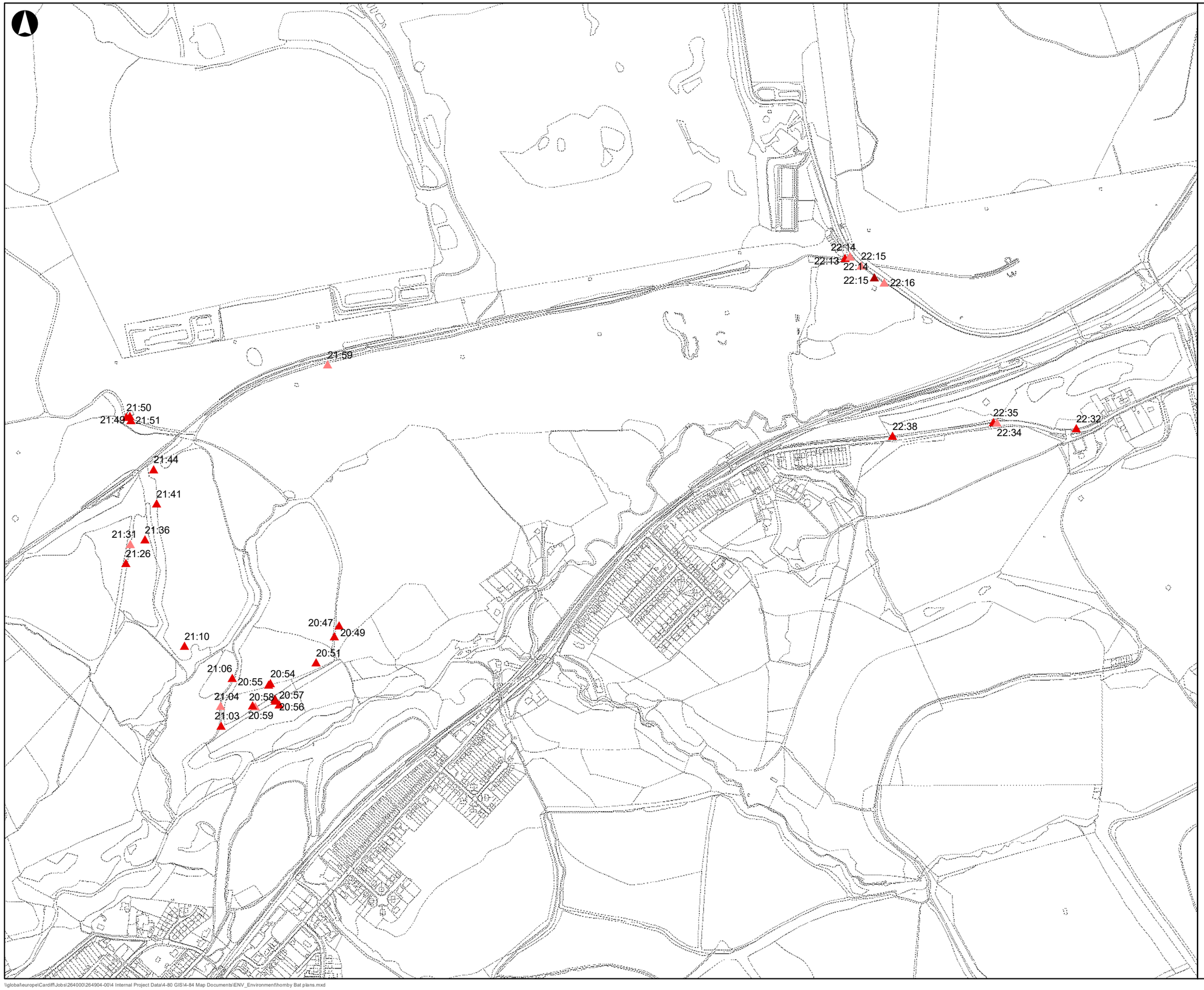

Legend

Species

- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 11:46:41

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

0 105 210 420

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Bat Transect Results April Purple Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
005a	F1

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A3



Legend

Species

- Soprano pipistrelle

26/03/2020 11:51:39

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres
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Bat Transect Results April Green Transect

Scale at A3
1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
005b	F1

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A3



26/03/2020 11:57:41

Legend

Species

- Common pipistrelle
- Soprano pipistrelle

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

0 105 210 420

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Bat Transect Results April Orange Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
005c	**F1**

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Legend

Species

- ★ Myotis species
- ▲ Common pipistrelle
- ▲ Soprano pipistrelle

26/03/2020 12:20:10

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres
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Bat Transect Results April
Yellow Transect

Scale at A3
1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
005d	F1

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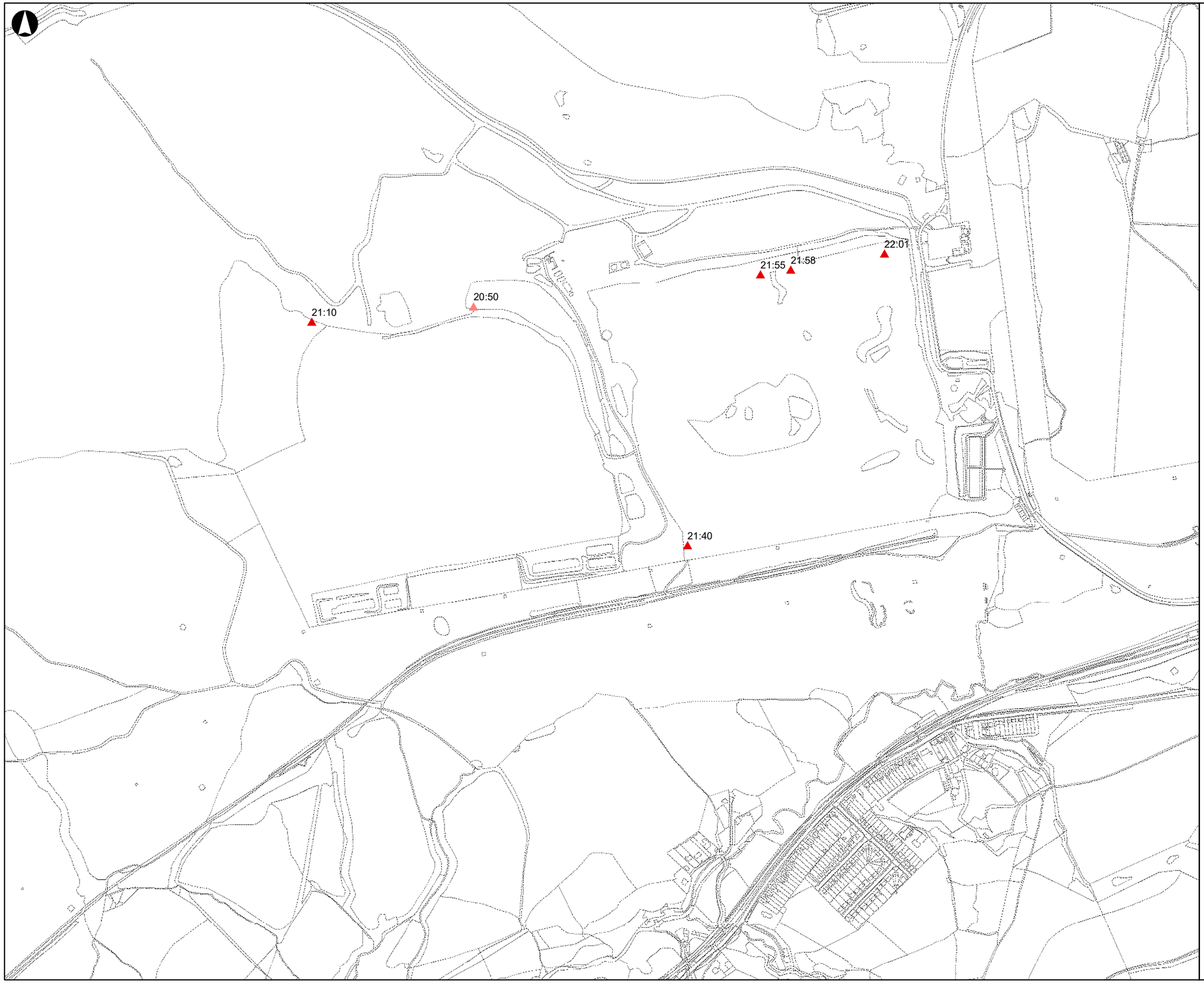

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Species

- Common pipistrelle
- Soprano pipistrelle

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

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Bat Transect Results April
Blue Transect

Scale at A3
1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
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Legend

Species

- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

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Bat Transect Results May Purple Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
006a	F1

26/03/2020 15:25:11

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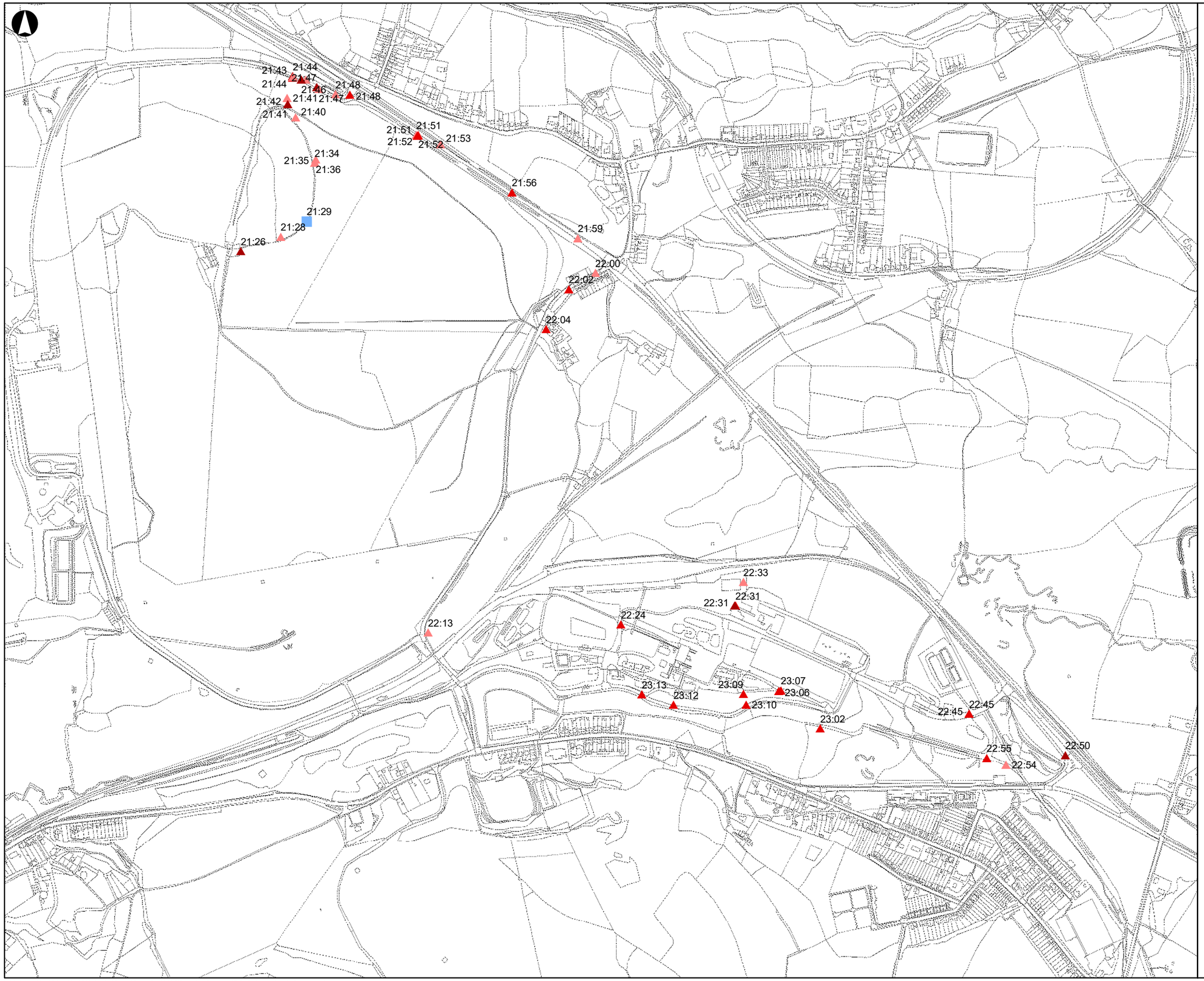

Legend

Species

- Noctule
- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres
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Bat Transect Results May
Green Transect

Scale at A3
1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
006b	F1

26/03/2020 15:42:03

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Legend

Species

▲ Common pipistrelle

26/03/2020 15:48:34

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

0 105 210 420

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Bat Transect Results May Orange Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
006c	**F1**

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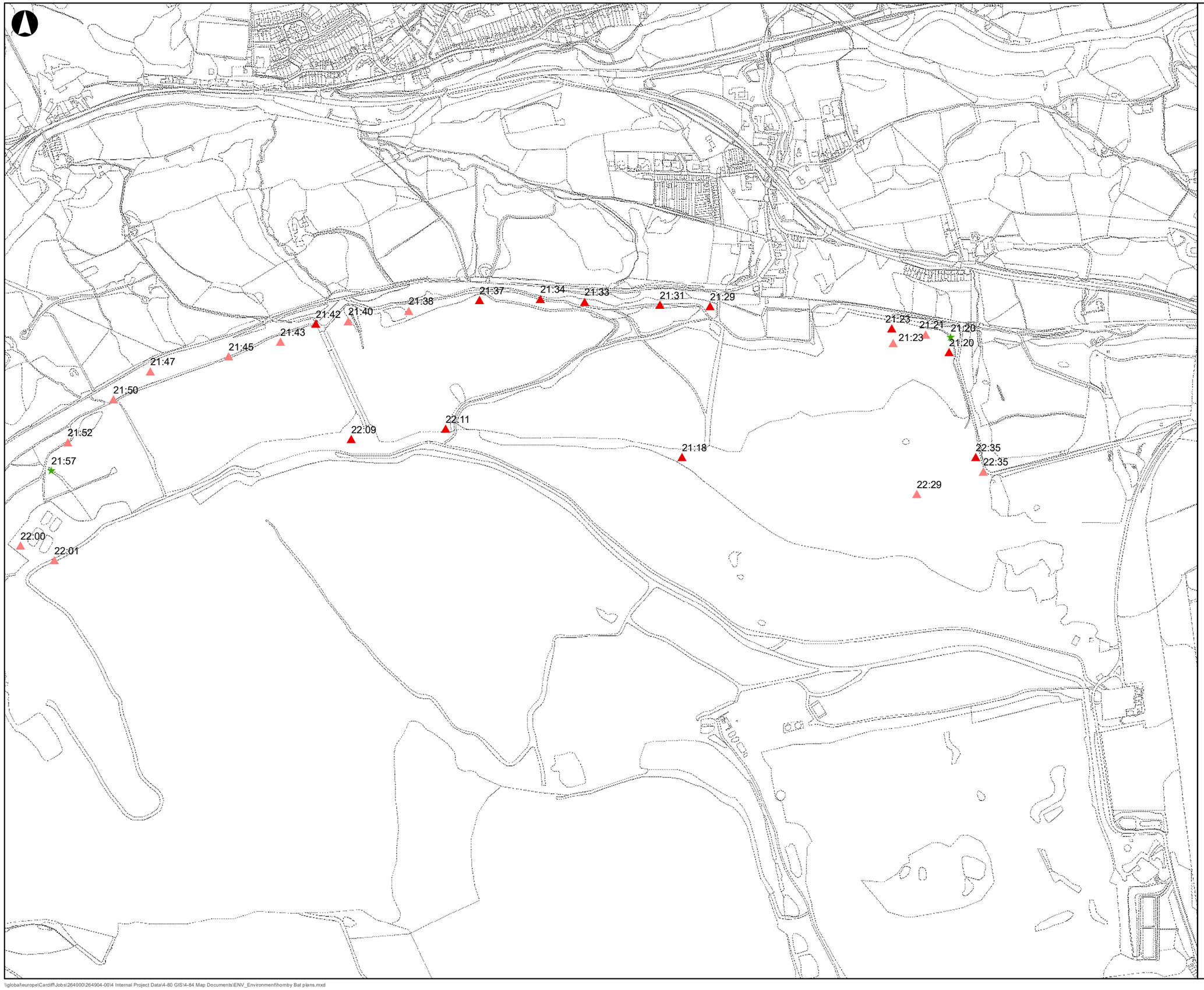

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Species

- Myotis species
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 15:57:17

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres
0 105 210 420

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Bat Transect Results May Yellow Transect

Scale at A3
1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
006d	F1

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Legend

Species

- Common pipistrelle
- Soprano pipistrelle

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

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Bat Transect Results May Blue Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
006e	F1

26/03/2020 16:03:02

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Legend

Species

- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

0 120 240 480

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Bat Transect Results June Purple Transect

Scale at A3

1:9,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
007a	F1

26/03/2020 16:55:43

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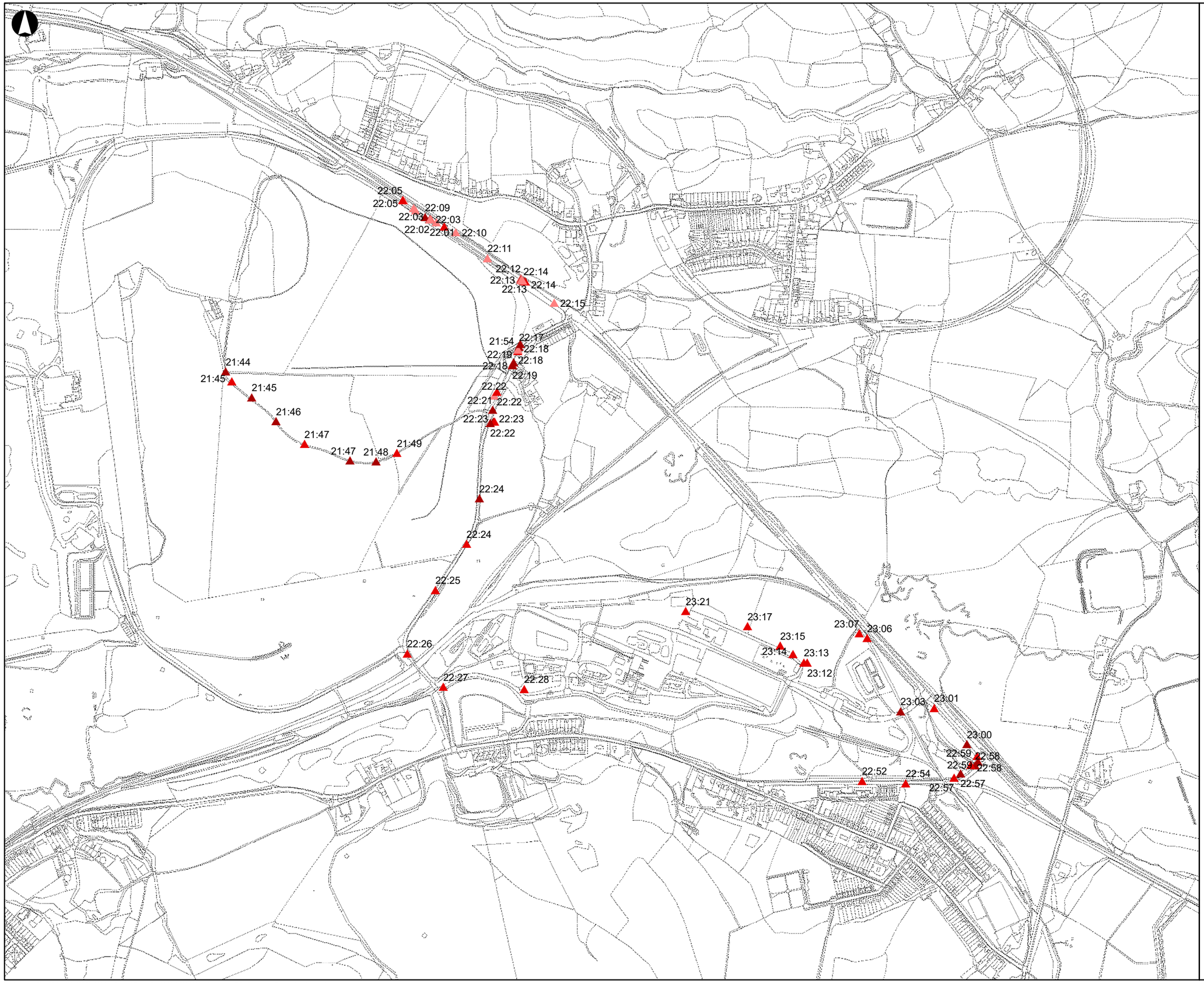

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Species

- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

30/03/2020 12:52:14

Issue	Date	By	Chkd	Appd
F1	2020-03-30	KJ	CP	PC

Metres

0 120 240 480

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Bat Transect Results June
Green Transect

Scale at A3

1:9,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
007b	F1

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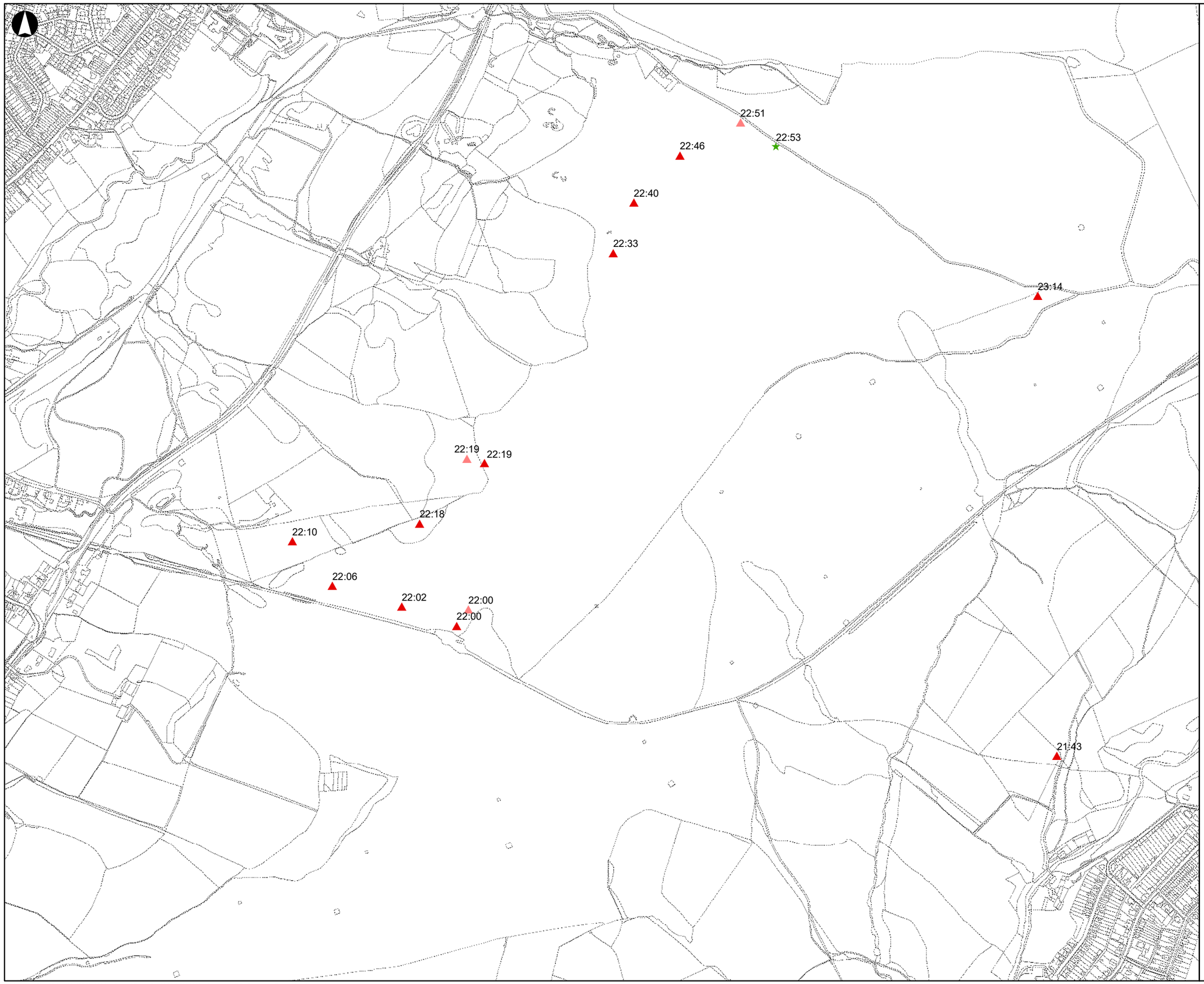

Legend

Species

- Myotis species
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 16:29:21

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

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Bat Transect Results June
Orange Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
007c	F1

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A3



Legend

Species

- Myotis species
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 16:33:30

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres
0 105 210 420

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Job Title
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Bat Transect Results June
Yellow Transect

Scale at A3
1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
007d	F1

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A3



Legend

Species

- Common pipistrelle
- Soprano pipistrelle

26/03/2020 16:39:19

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

0 105 210 420

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Client

Welsh Government

Job Title

Global Centre for Rail Excellence

Bat Transect Results June Blue Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
007e	F1

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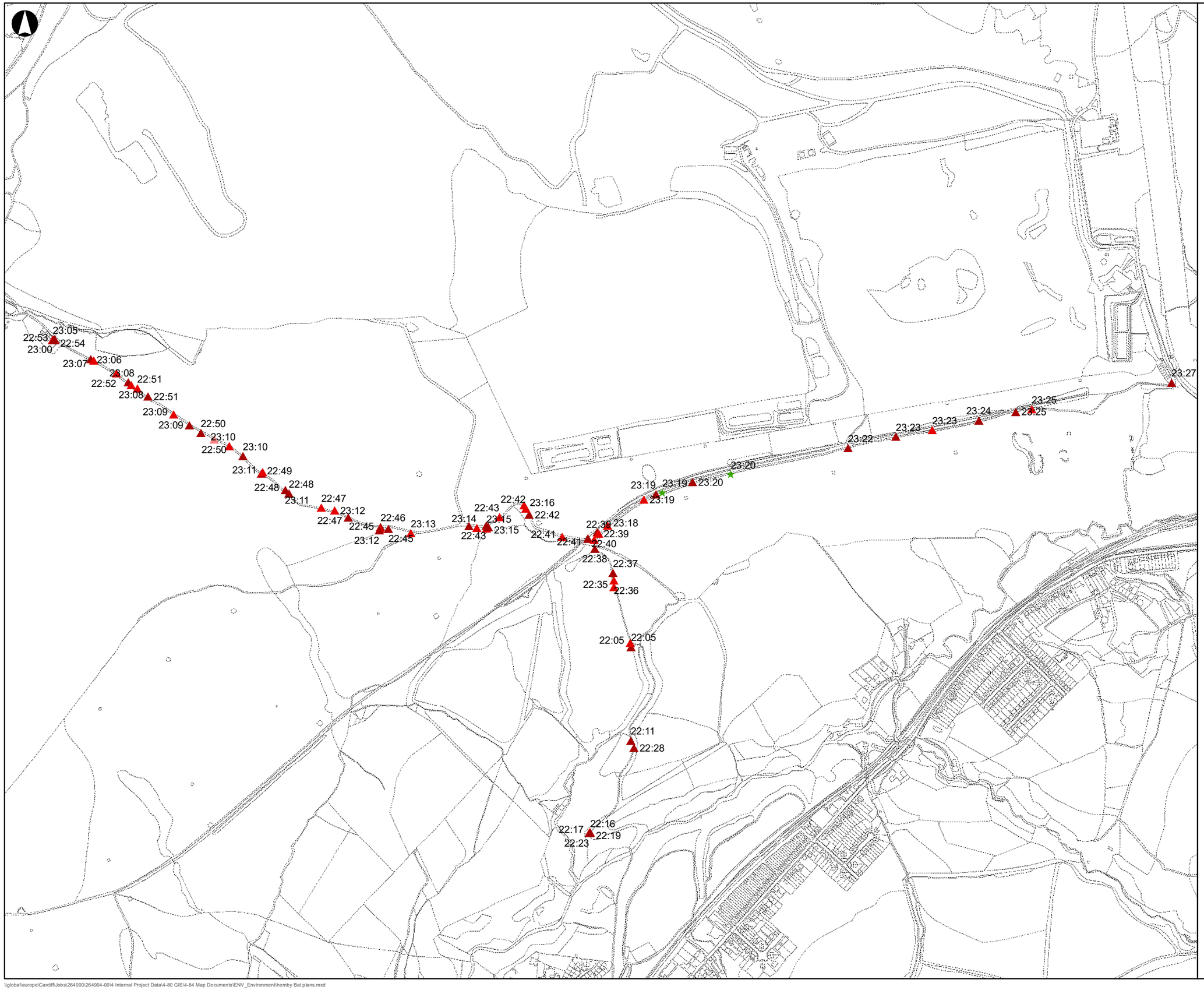

Legend

Species

- Myotis species
- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 16:47:53

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

0 120 240 480

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Job Title

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Bat Transect Results July Purple Transect

Scale at A3

1:9,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
008a	F1

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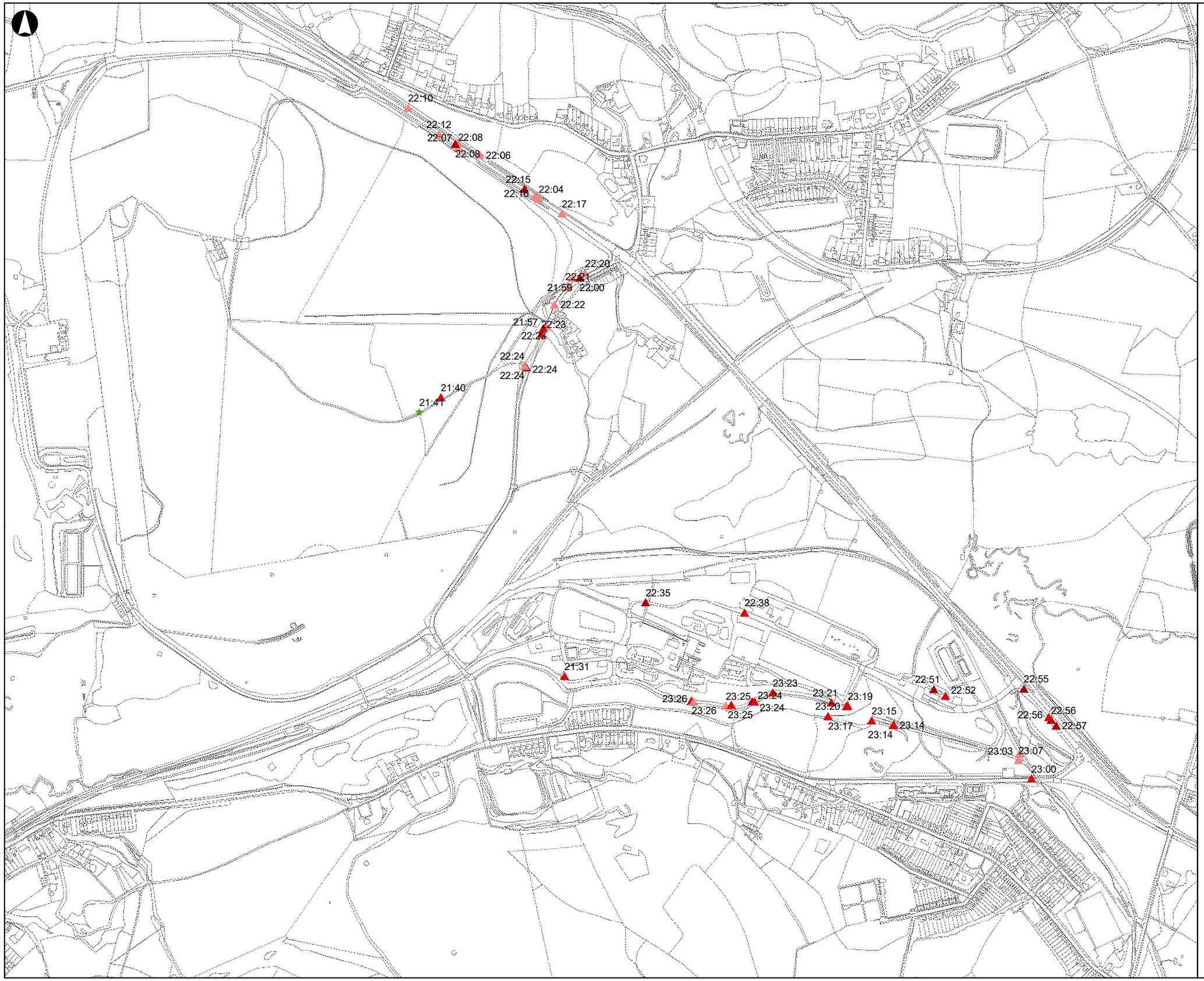

Legend

Species

- Myotis species
- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 17:06:00

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

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Bat Transect Results July
Green Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
008b	F1

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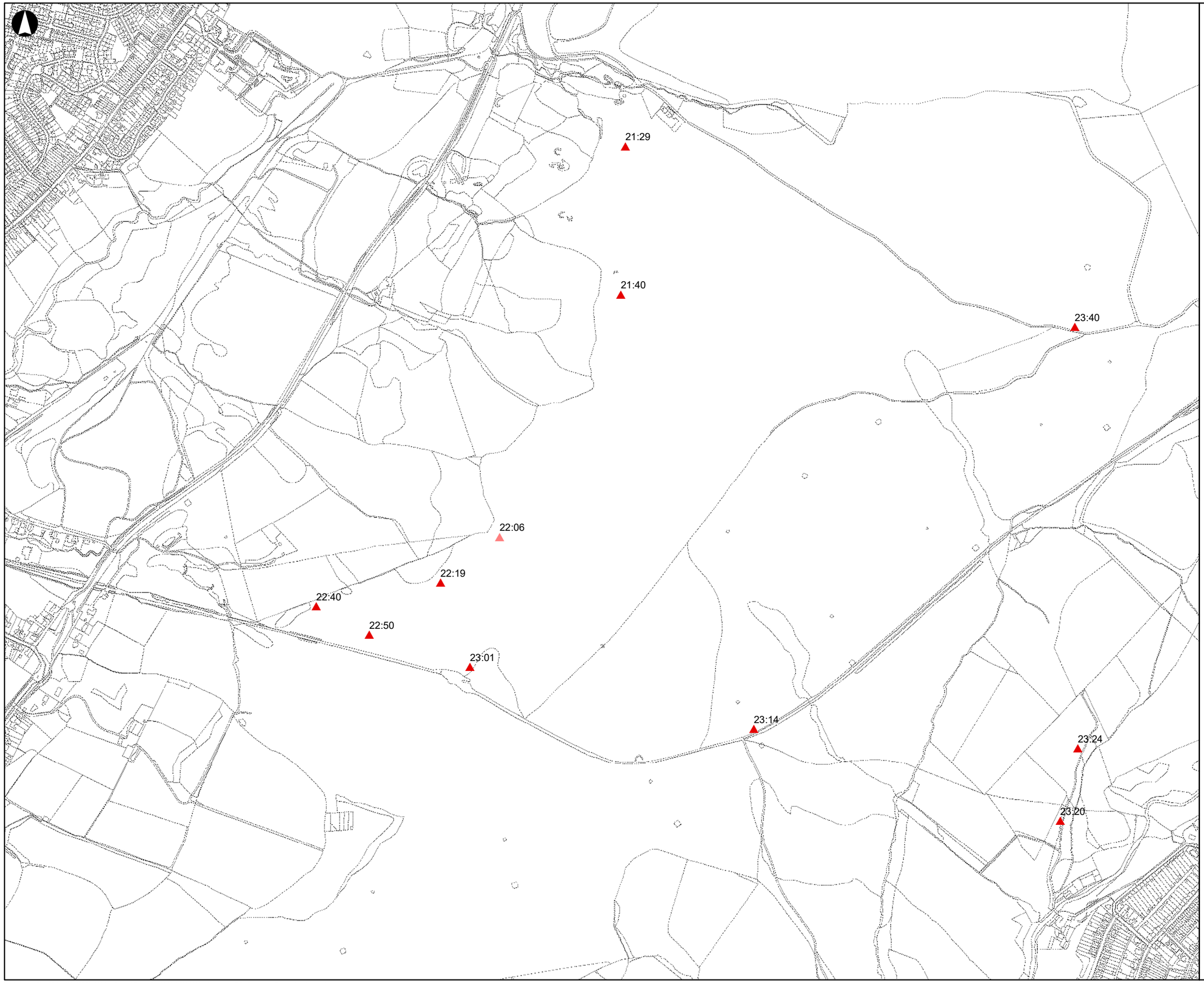

Legend

Species

- Common pipistrelle
- Soprano pipistrelle

26/03/2020 17:12:13

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres
0 105 210 420

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Job Title
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Bat Transect Results July
Orange Transect

Scale at A3
1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
008c	F1

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Legend

Species

- Noctule
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 17:16:20

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres
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Job Title

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Bat Transect Results July Yellow Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
008d	F1

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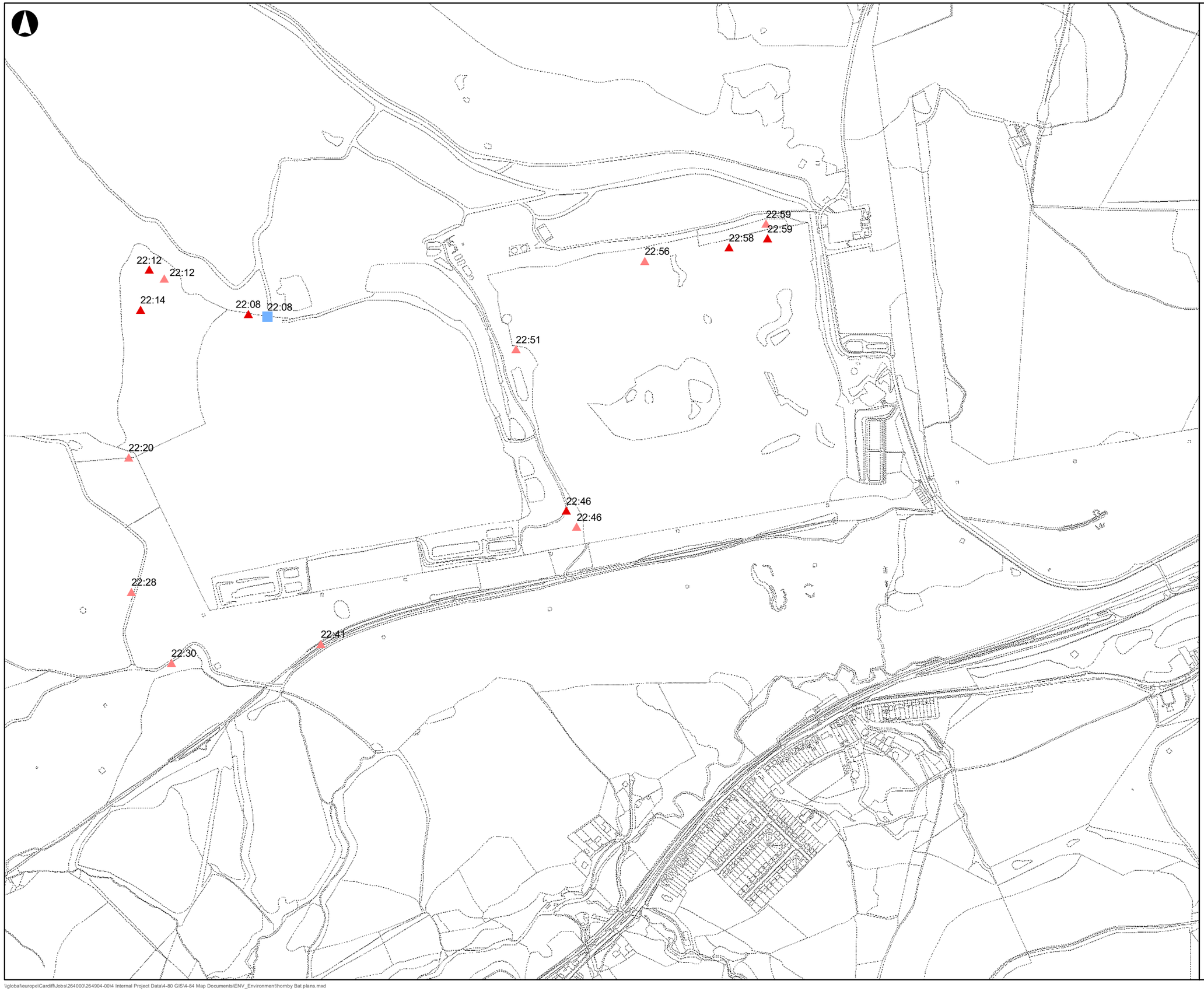

Legend

Species

- Noctule
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 17:32:50

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

0 105 210 420

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Job Title

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Bat Transect Results July
Blue Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
008e	F1

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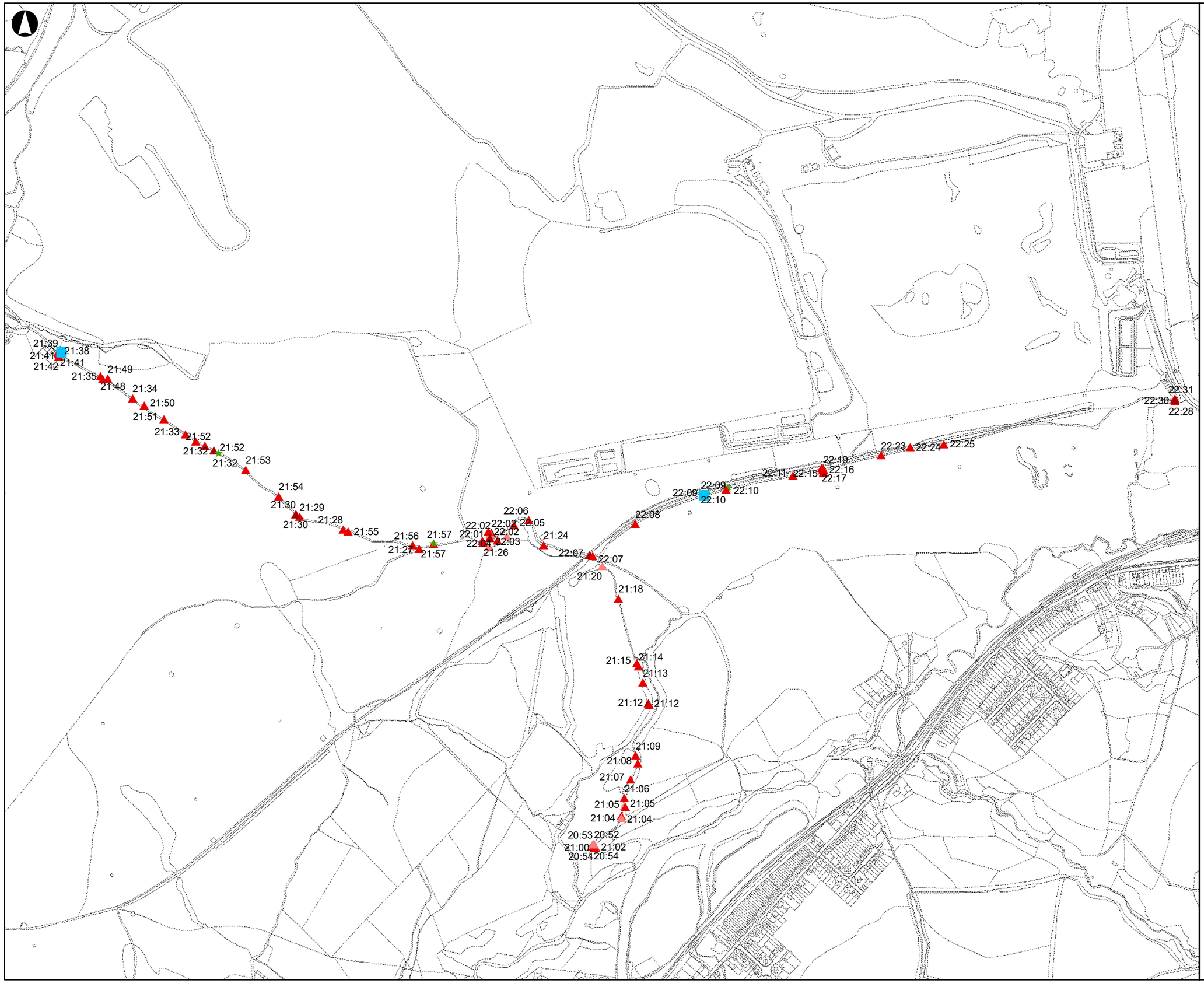

Legend

Species

- Myotis species
- Long-eared species
- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

27/03/2020 15:41:49

Issue	Date	By	Chkd	Appd
F1	2020-03-27	KJ	CP	PC

Metres

0 120 240 480

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Job Title

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Bat Transect Results August Purple Transect

Scale at A3

1:9,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
009a	F1

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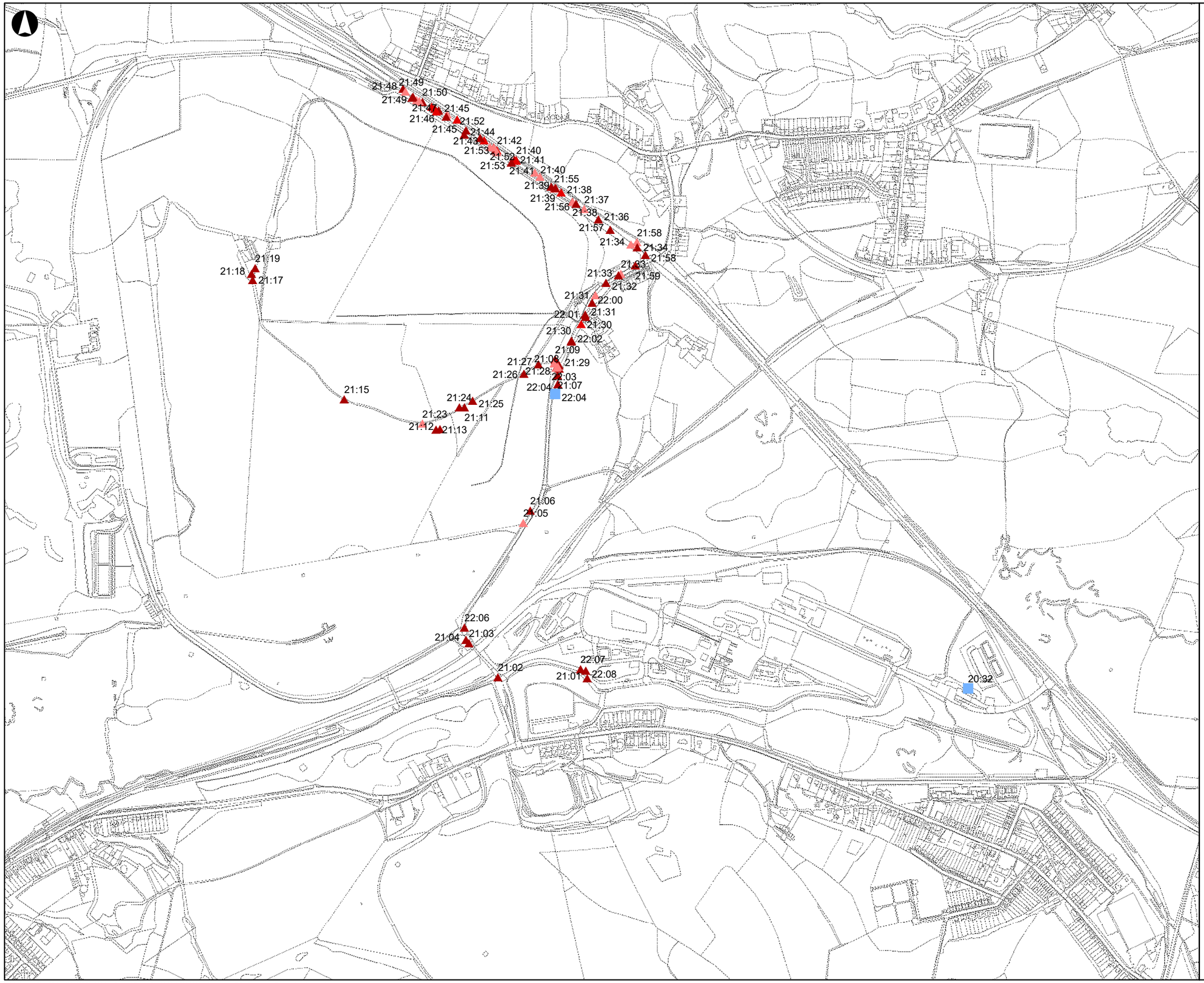

Legend

Species

- Noctule
- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 17:48:49

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

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Job Title

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Bat Transect Results August Green Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
009b	**F1**

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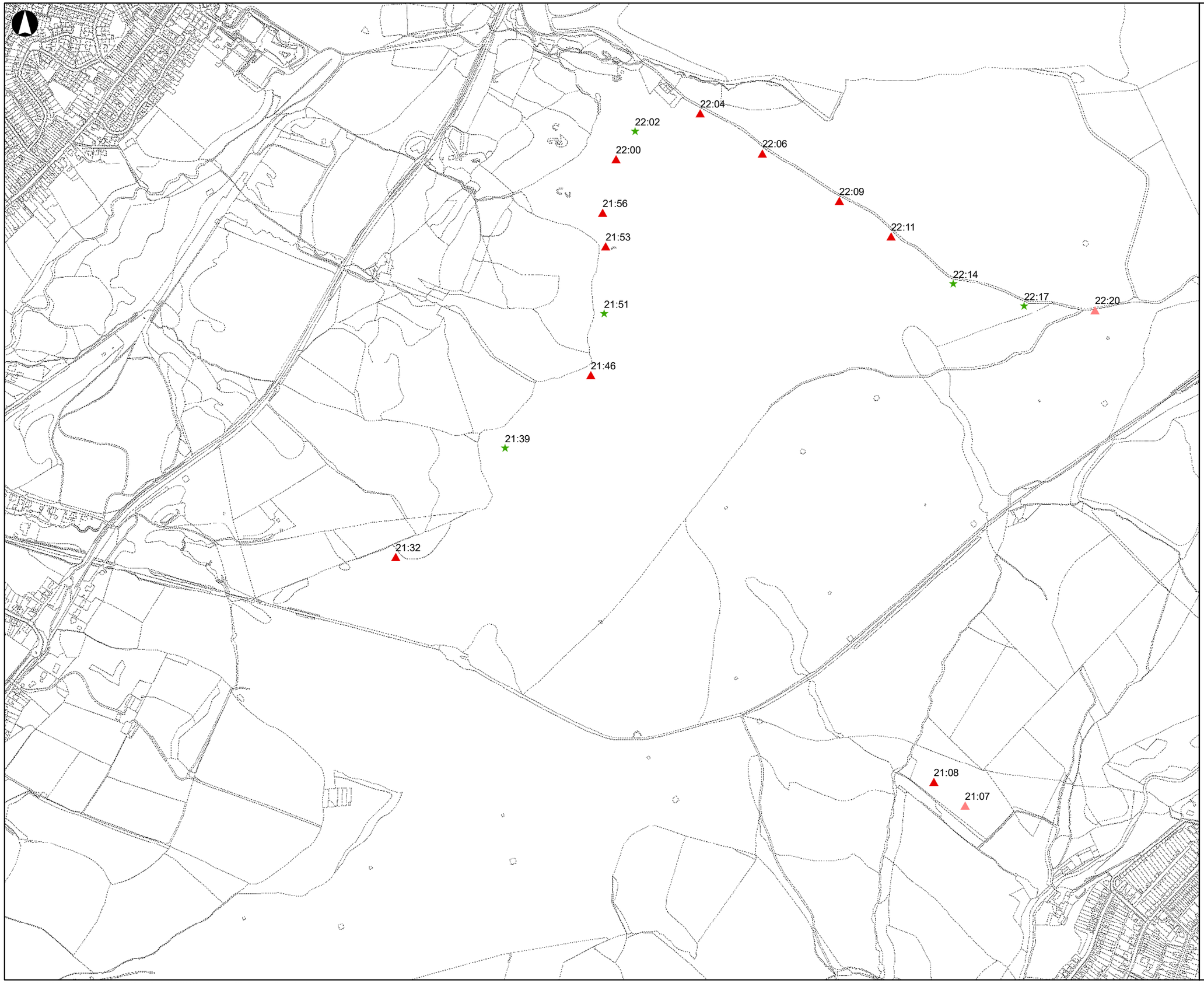

Legend

Species

- Myotis species
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 17:53:49

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

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Bat Transect Results August Orange Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
009c	**F1**

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Legend

Species

- Myotis species
- Noctule
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 17:56:41

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres
0 105 210 420

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Job Title

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Bat Transect Results August Yellow Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
009d	F1

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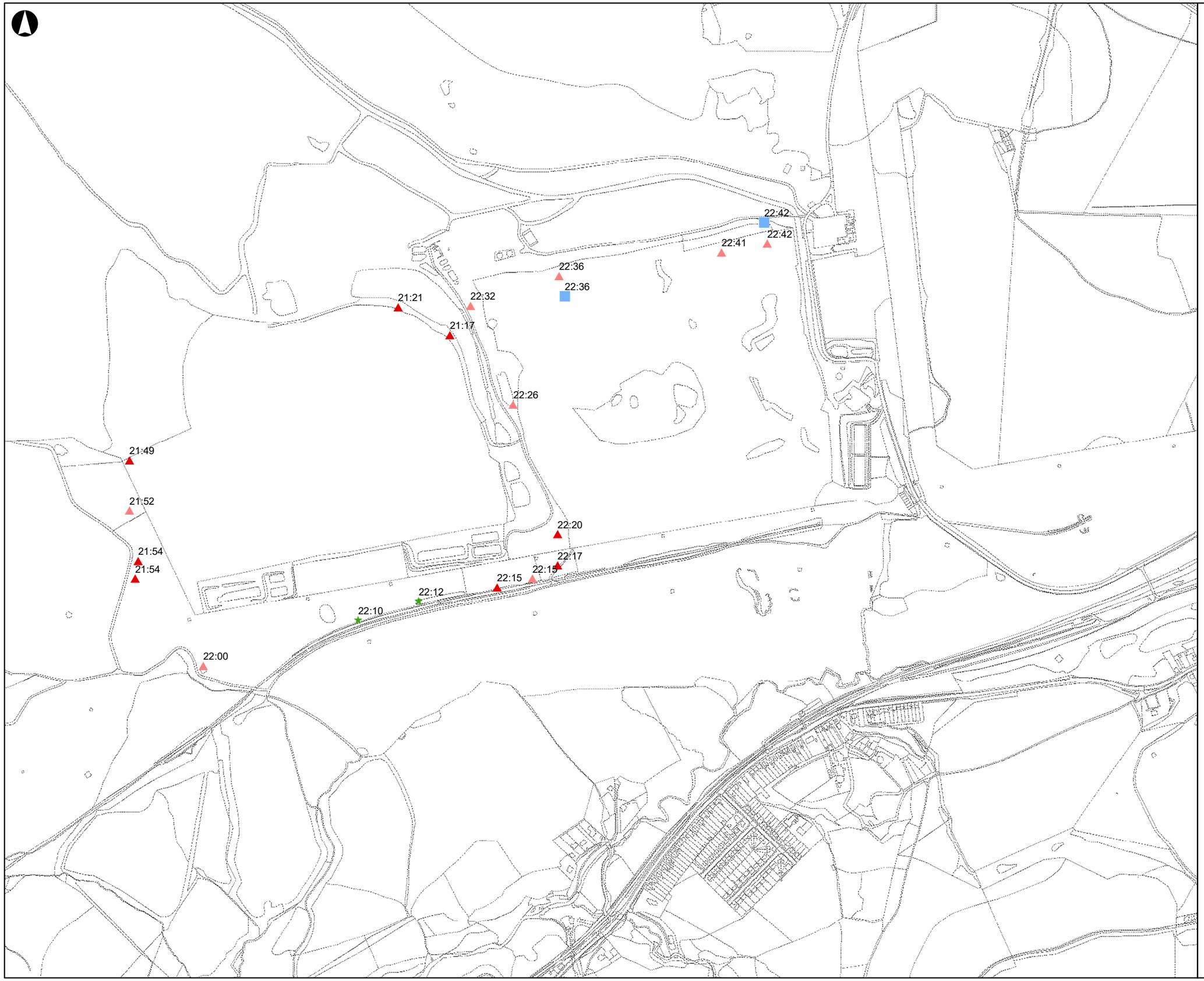

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Species

- Myotis species
- Noctule
- Common pipistrelle
- Soprano pipistrelle

26/03/2020 17:59:51

Issue	Date	By	Chkd	Appd
F1	2020-03-26	KJ	CP	PC

Metres

0 105 210 420

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Job Title

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Bat Transect Results August Blue Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
009e	F1

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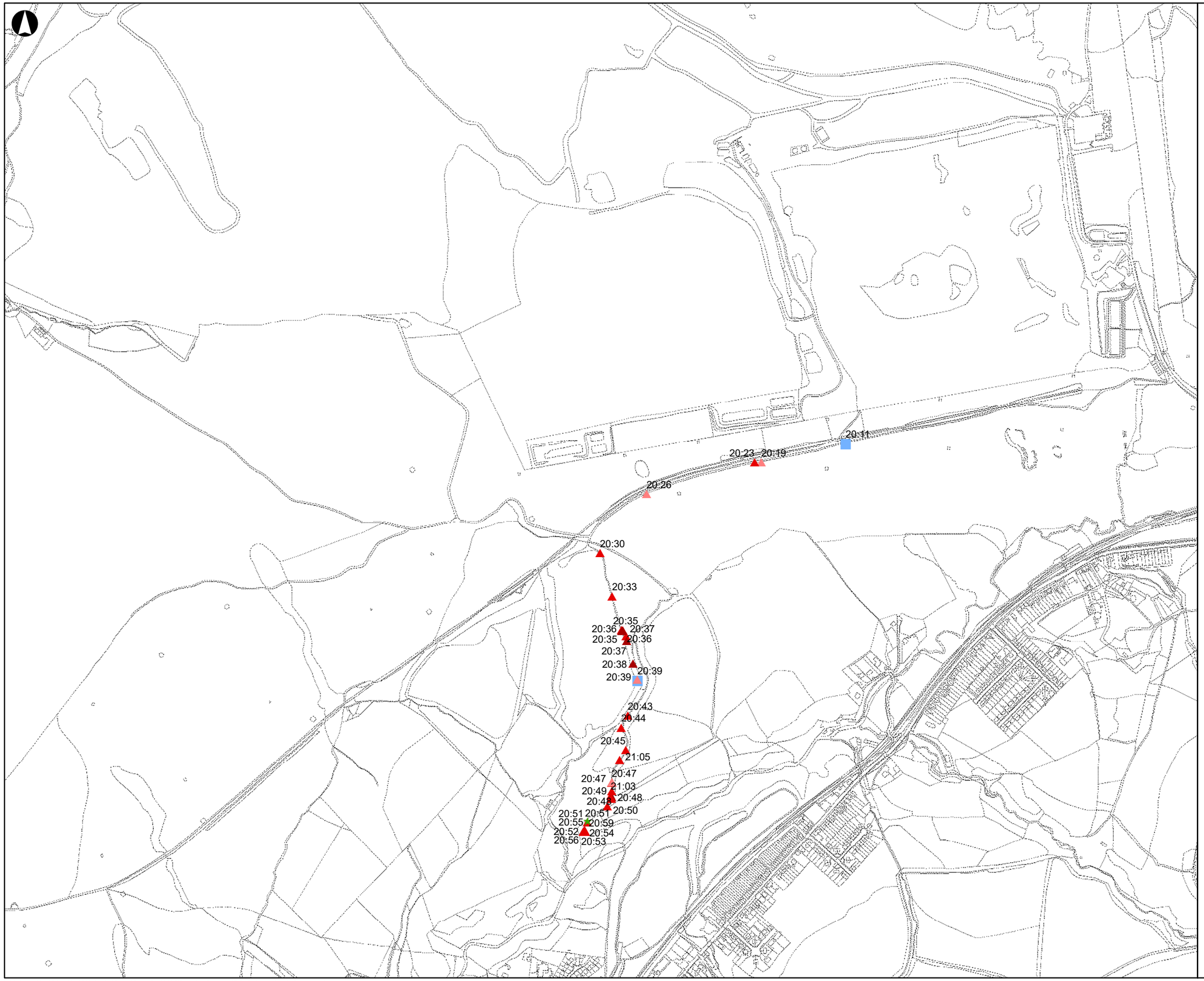

Legend

Species

- ★ Myotis species
- ■ Noctule
- ▲ Pipistrelle species
- ▲ Common pipistrelle
- ▲ Soprano pipistrelle

27/03/2020 08:40:59

Issue	Date	By	Chkd	Appd
F1	2020-03-27	KJ	CP	PC

Metres

0 120 240 480

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Job Title

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Bat Transect Results September PurpleTransect

Scale at A3

1:9,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
010a	F1

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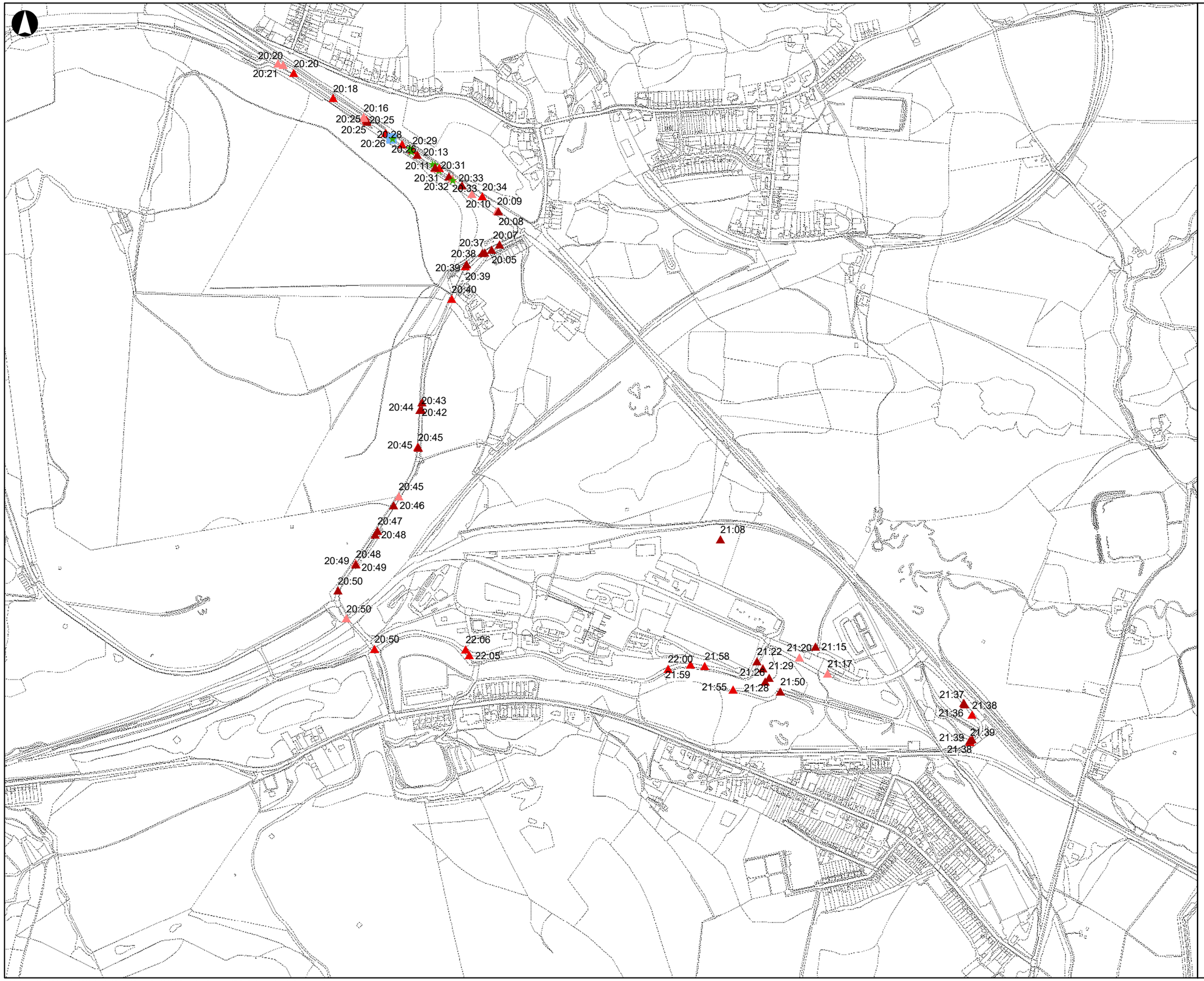

Legend

Species

- Myotis species
- Noctule
- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

27/03/2020 08:47:25

Issue	Date	By	Chkd	Appd
F1	2020-03-27	KJ	CP	PC

Metres

0 105 210 420

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Bat Transect Results September GreenTransect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
010b	F1

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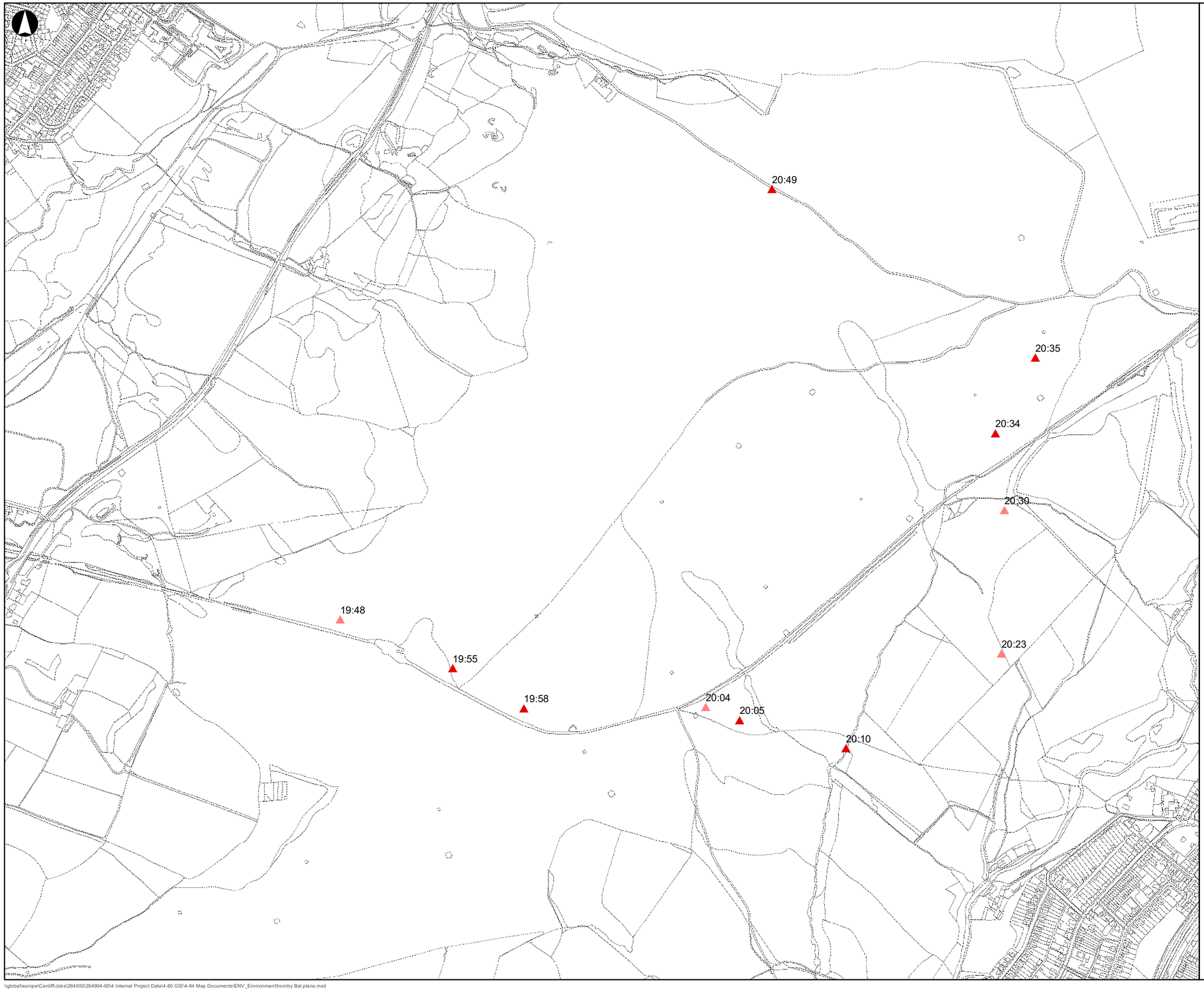

Legend

Species

- Common pipistrelle
- Soprano pipistrelle

27/03/2020 08:51:17

Issue	Date	By	Chkd	Appd
F1	2020-03-27	KJ	CP	PC

Metres
0 105 210 420

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Bat Transect Results September Orange Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
010c	F1

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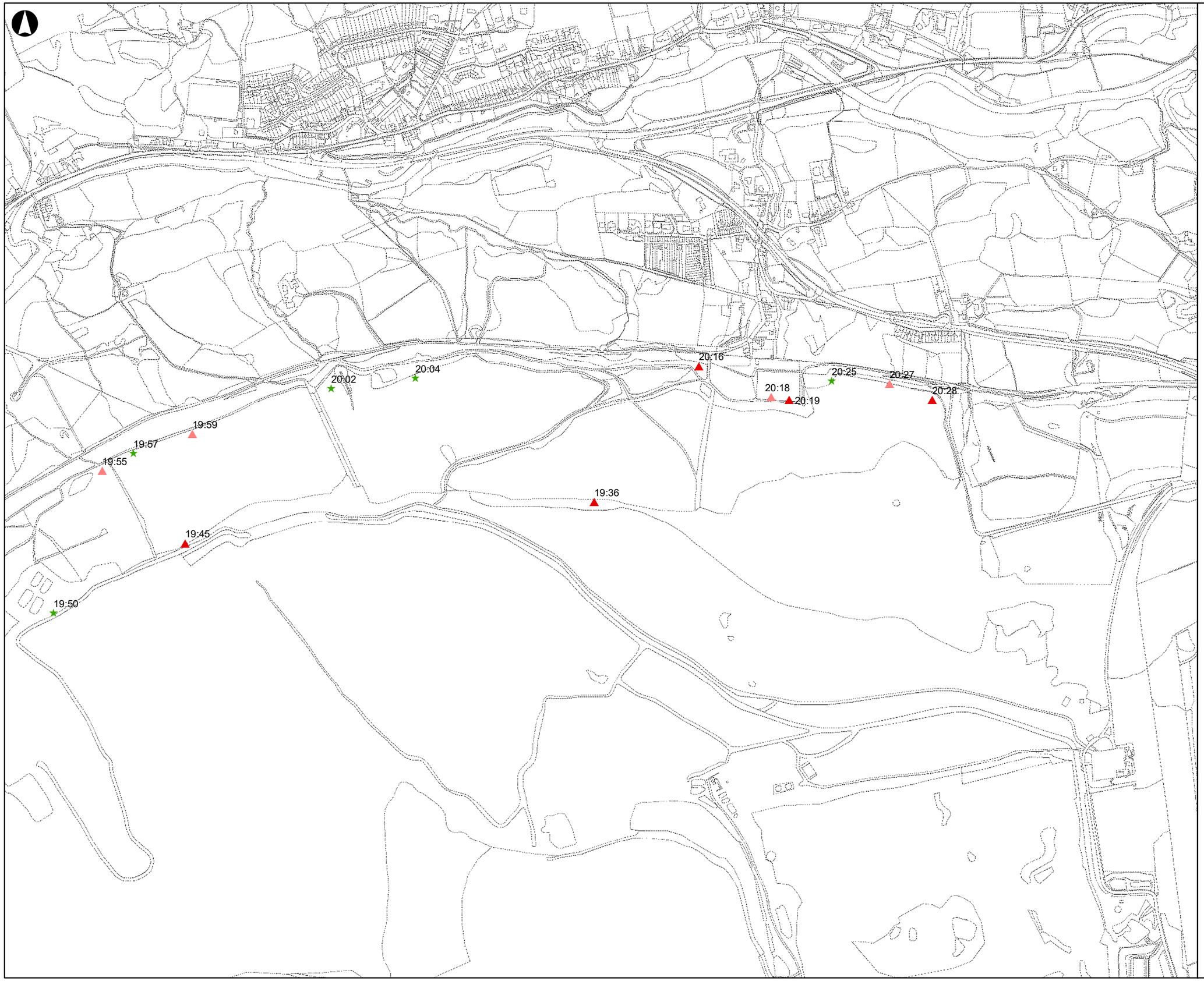

Legend

Species

- Myotis species
- Common pipistrelle
- Soprano pipistrelle

27/03/2020 08:54:28

Issue	Date	By	Chkd	Appd
F1	2020-03-27	KJ	CP	PC

Metres

0 105 210 420

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Job Title

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Bat Transect Results September Yellow Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
010d	F1

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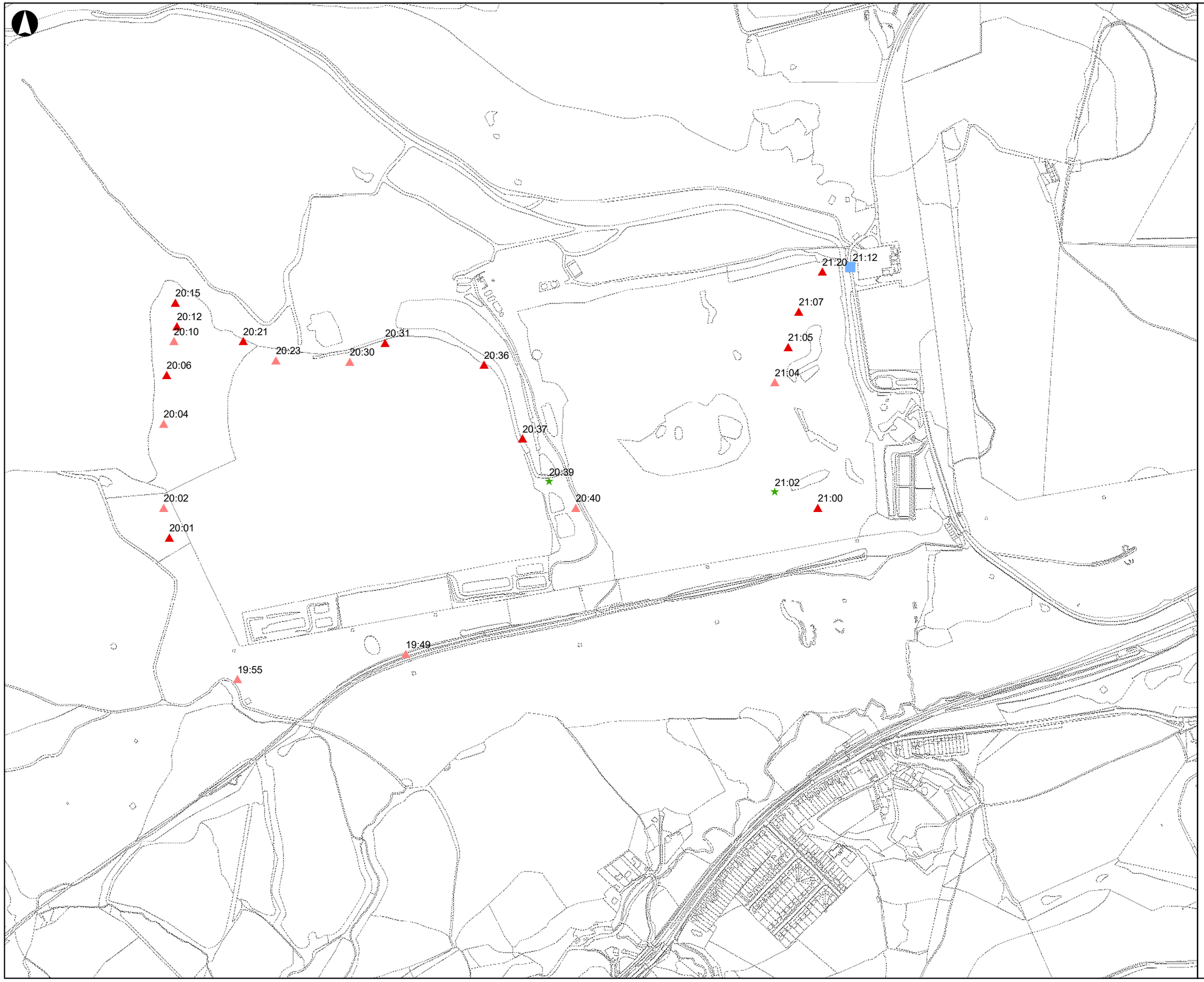

Legend

Species

- Myotis species
- Noctule
- Common pipistrelle
- Soprano pipistrelle

27/03/2020 08:58:05

Issue	Date	By	Chkd	Appd
F1	2020-03-27	KJ	CP	PC

Metres
0 105 210 420

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Job Title

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Bat Transect Results September Blue Transect

Scale at A3

1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
010e	F1

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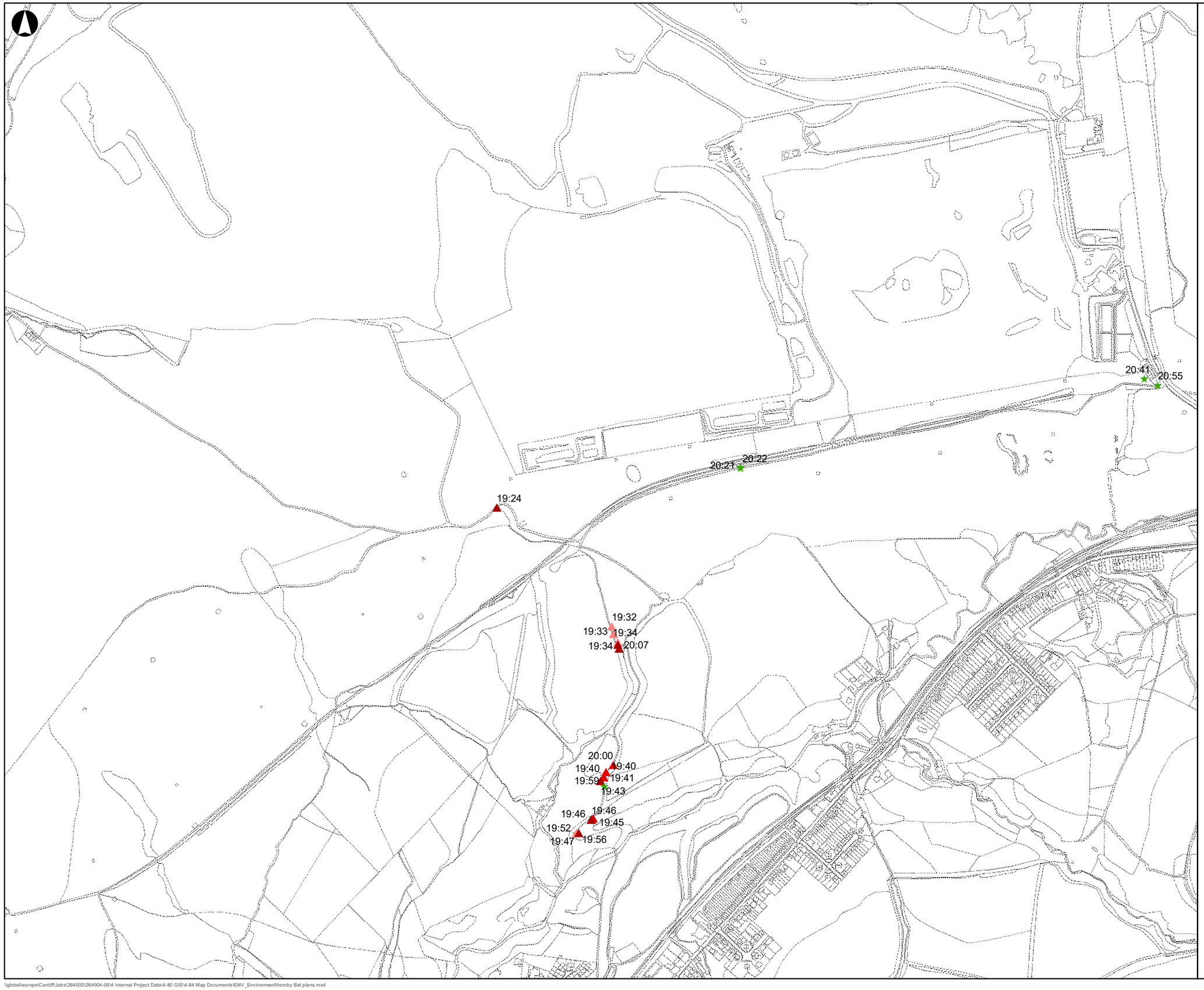

Legend

Species

- Myotis species
- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

27/03/2020 09:04:59

Issue	Date	By	Chkd	Appd
F1	2020-03-27	KJ	CP	PC

Metres

0 120 240 480

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Bat Transect Results October Purple Transect

Scale at A3

1:9,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
011a	F1

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Legend

Species

- Pipistrelle species
- Common pipistrelle
- Soprano pipistrelle

27/03/2020 09:09:36

Issue	Date	By	Chkd	Appd
F1	2020-03-27	KJ	CP	PC

Metres

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Bat Transect Results October Green Transect

Scale at A3

1:9,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
011b	F1

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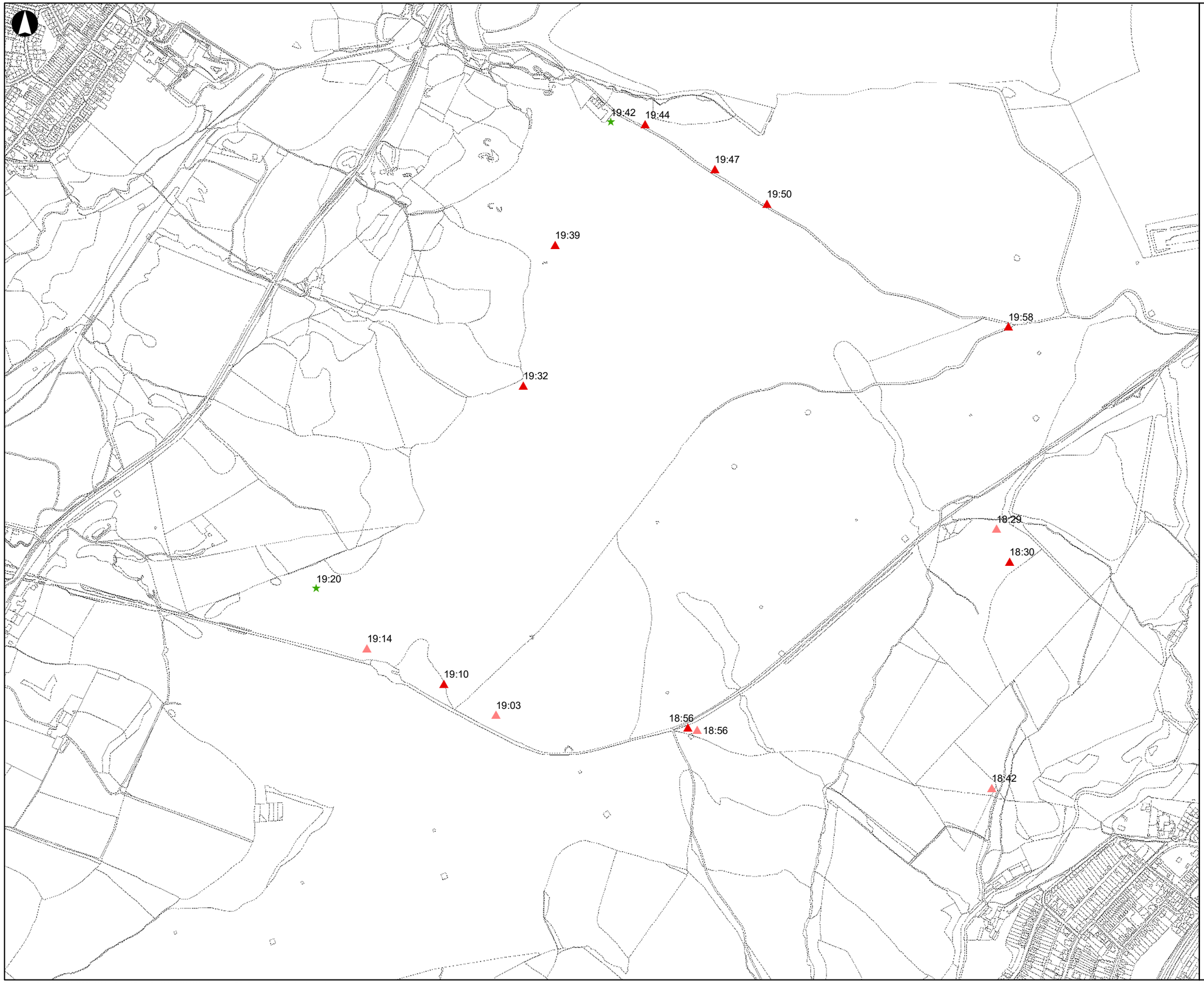

Legend

Species

- ★ Myotis species
- ▲ Common pipistrelle
- ▲ Soprano pipistrelle

Issue	Date	By	Chkd	Appd
F1	2020-03-27	KJ	CP	PC

Metres
0 105 210 420

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Client
Welsh Government

Job Title
Global Centre for Rail Excellence

Bat Transect Results October Orange Transect

Scale at A3
1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
011c	F1

27/03/2020 09:41:03

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Legend

Species

- Myotis species
- Noctule
- Common pipistrelle
- Soprano pipistrelle

27/03/2020 09:47:39

Issue	Date	By	Chkd	Appd
F1	2020-03-27	KJ	CP	PC

Metres
0 105 210 420

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Client
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Job Title
Global Centre for Rail Excellence

Bat Transect Results October Yellow Transect

Scale at A3
1:8,000

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
011d	F1

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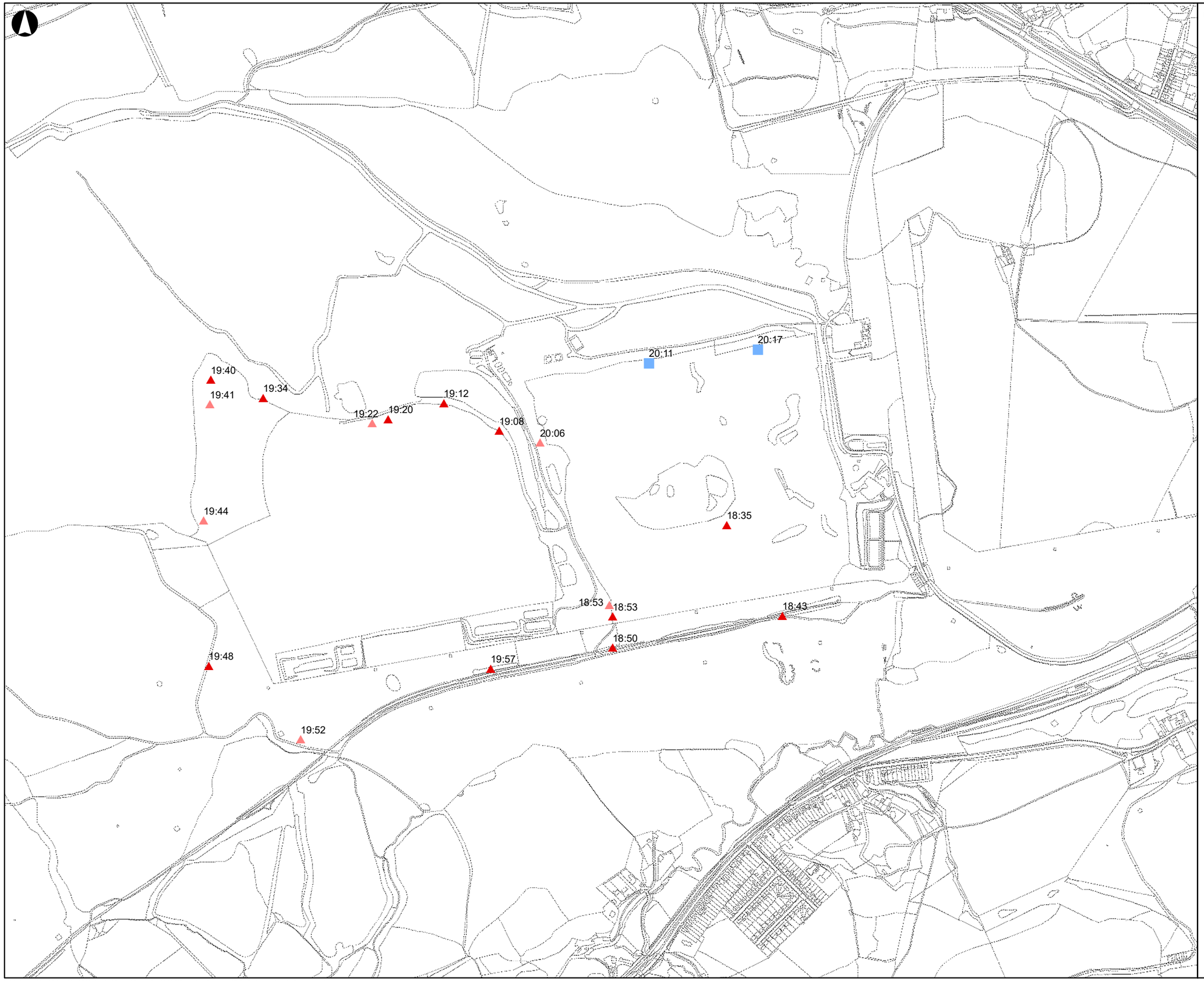

Legend

Species

- Noctule
- Common pipistrelle
- Soprano pipistrelle

27/03/2020 09:53:36

Issue	Date	By	Chkd	Appd
F1	2020-03-27	KJ	CP	PC

Metres

0 120 240 480

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Job Title

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Bat Transect Results October Blue Transect

Scale at A3

1:8,848

Job No	Drawing Status
264904	For Issue

Drawing No	Issue
011e	F1

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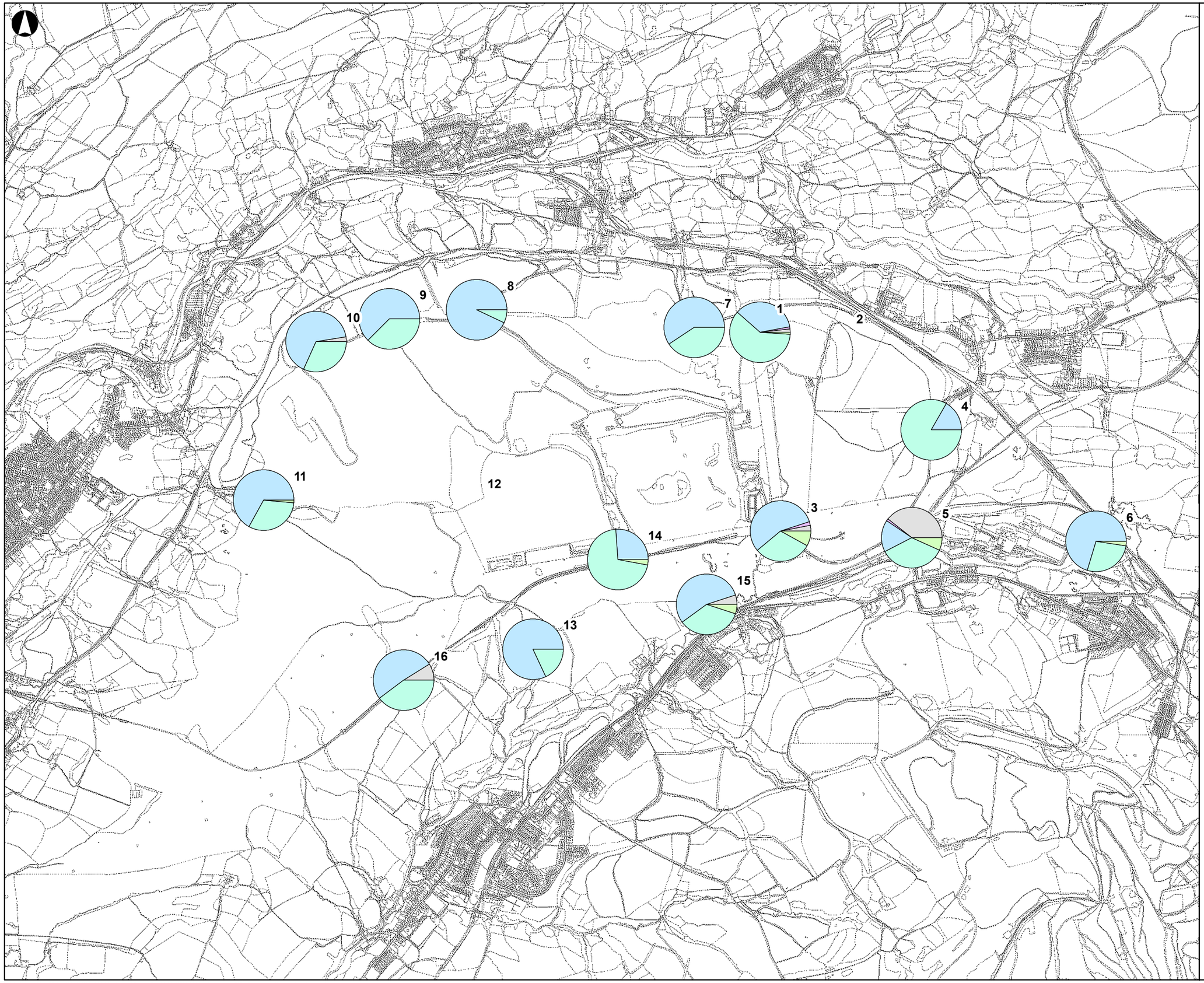

Legend

April Bat Species

- BARBAR
- EPTSER
- MYOTIS
- NYCLEI
- NYCNOC
- PIPNAT
- PIPPIP
- PIPPYG
- PIPSPE
- PLASPE
- RHIFER
- RHIHIP

Issue	Date	By	Chkd	Appd
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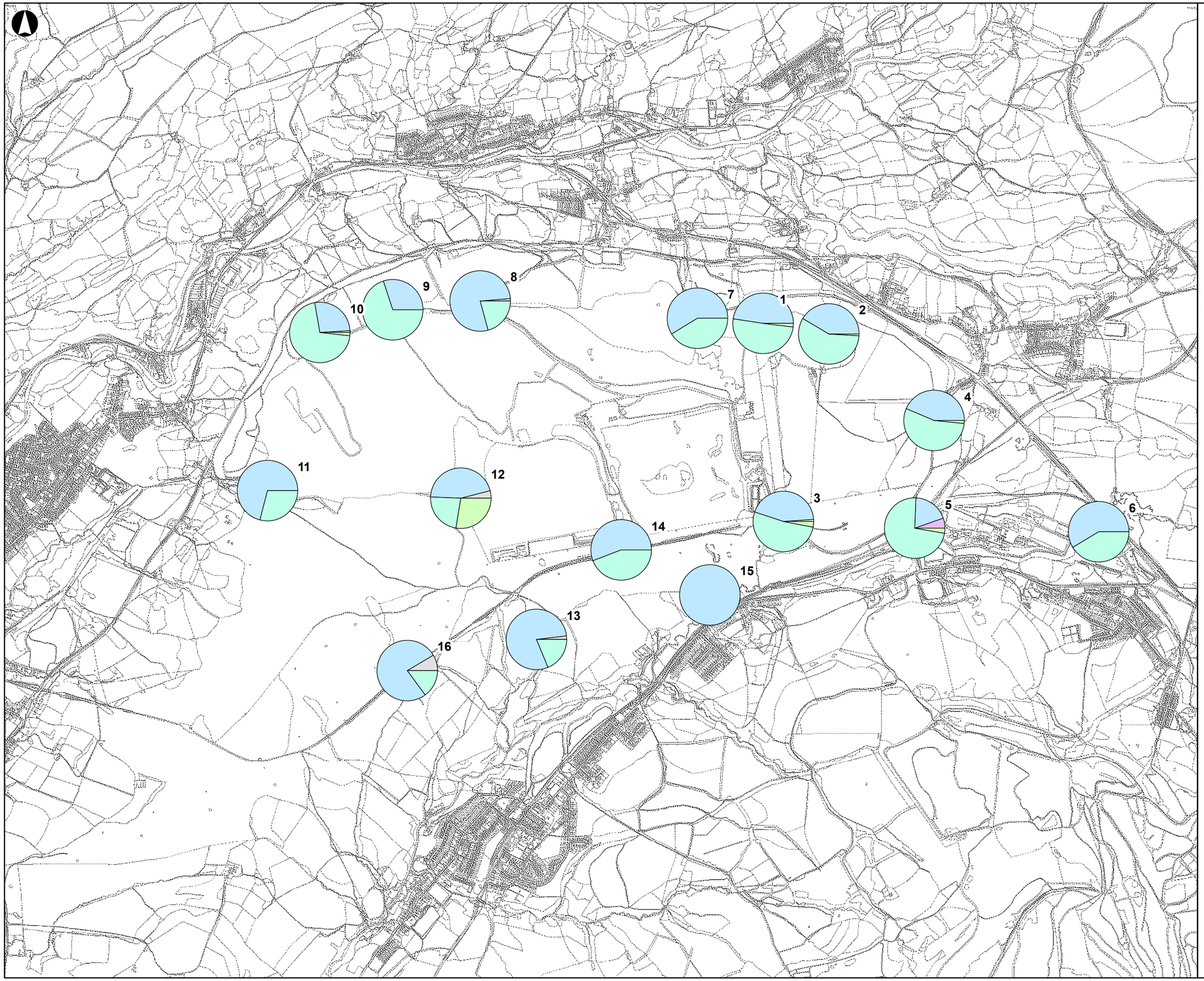

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May Bat Species



- BARBAR
- EPTSER
- MYOTIS
- NYCLEI
- NYCNOC
- PIPNAT
- PIPPIP
- PIPPYG
- PIPSPE
- PLASPE
- RHIFER
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July Bat Species

- BARBAR
- EPTSER
- MYOTIS
- NYCLEI
- NYCNOC
- PIPNAT
- PIPPIP
- PIPPYG
- PIPSPE
- PLASPE
- RHIFER
- RHIHIP

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August Bat Species

- BARBAR
- EPTSER
- MYOTIS
- NYCLEI
- NYCNOC
- PIPNAT
- PIPPIP
- PIPPYG
- PIPSPE
- PLASPE
- RHIFER
- RHIHIP

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September Bat Species

- EPTSER
- MYOTIS
- NYCLEI
- NYCNOC
- PIPNAT
- PIPPIP
- PIPPYG
- PIPSPE
- PLASPE
- RHIFER
- RHIHIP

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October Bat Species

- BARBAR
- EPTSER
- MYOTIS
- NYCLEI
- NYCNOC
- PIPNAT
- PIPPIP
- PIPPYG
- PIPSPE
- PLASPE
- RHIFER
- RHIHIP

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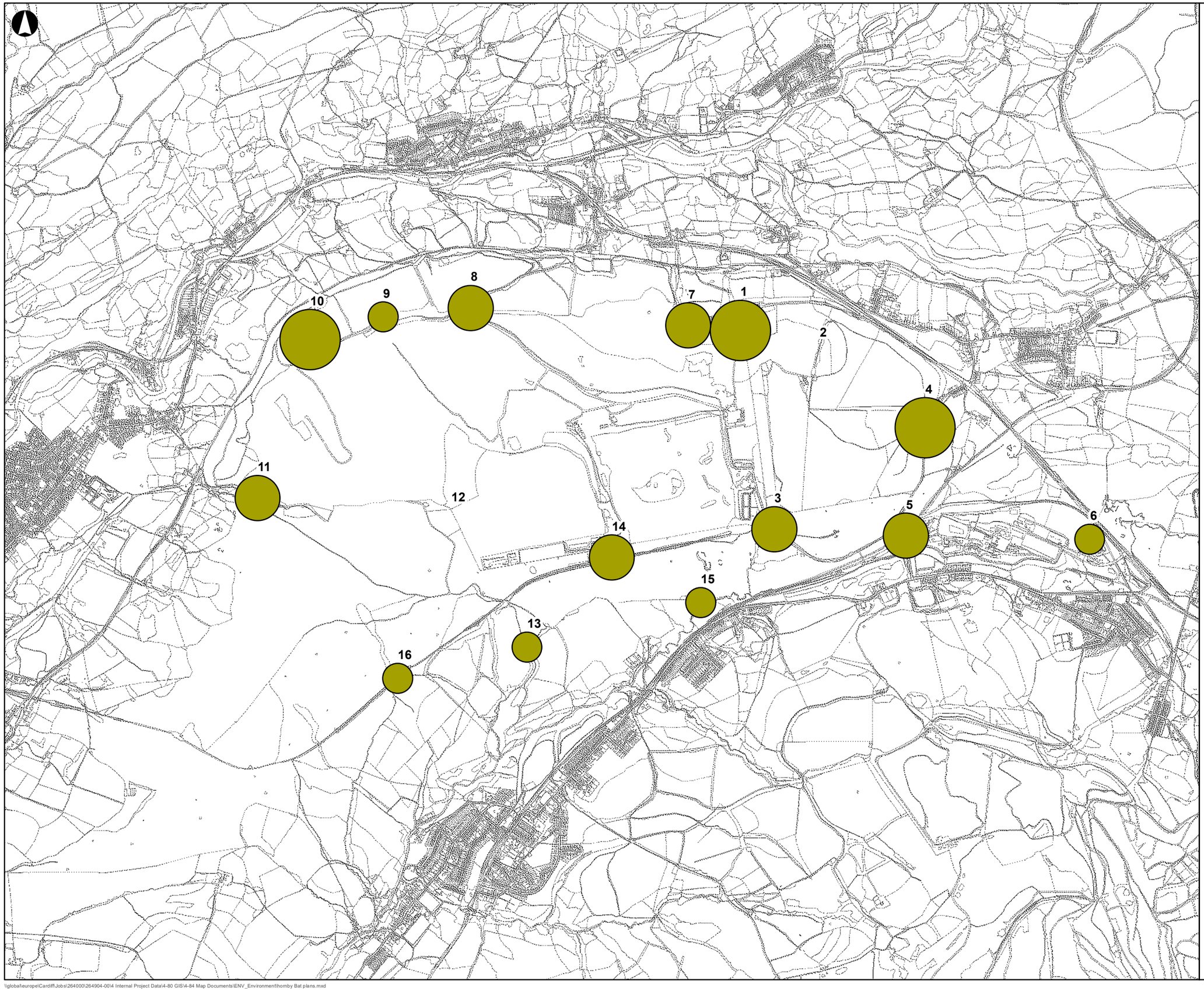

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Legend

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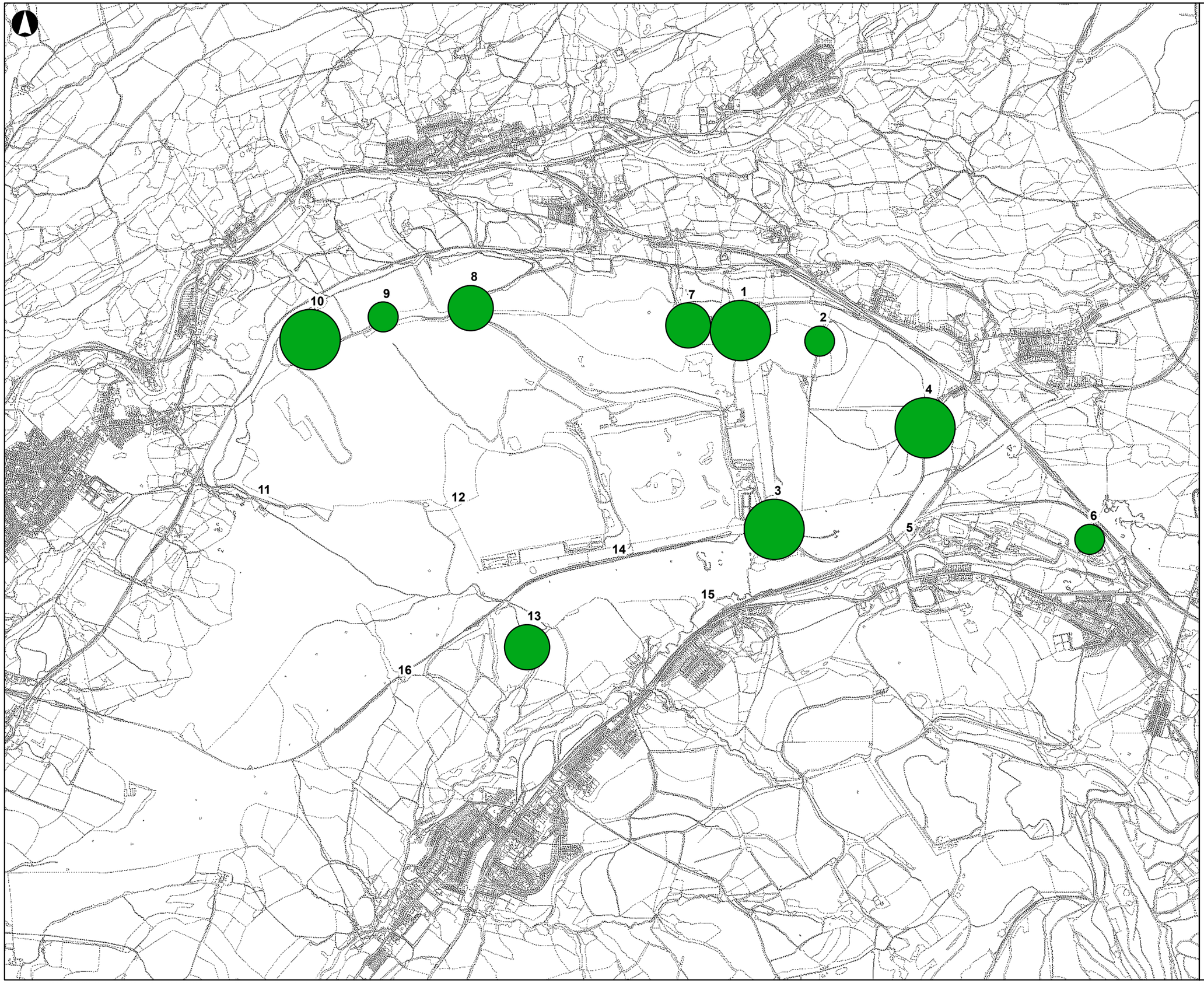

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October Bat Activity Index

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Appendix 7O

Habitat Classification and Evaluation

Appendix 7O: Habitat Classification and Evaluation

Habitat classification, notable plants and evaluation.

Vegetation type	Summary of vegetation community descriptions	NVC category (most closely aligned)	Notable vascular plants	Evaluation (conservation significance)
Semi-natural broad-leaved woodland	Small examples of W11 upland oak woodland, and W9 upland mixed ash woodland present near site perimeter.	W11	-	These are Section 7 habitats / UK BAP habitats and include small remnants of ancient woodland. SINC guidance states that, the following should be considered for selection: All ancient woodlands as recorded in the Ancient Woodland Inventories, apart from those felled and replanted with non-native species which have also entirely lost their ancient features such as characteristic ground flora semi-natural woodlands, of whatever size, which support an assemblage of ancient woodland indicator species · all semi-natural beech and yew woodlands all semi-natural upland woodlands all semi-

Vegetation type	Summary of vegetation community descriptions	NVC category (most closely aligned)	Notable vascular plants	Evaluation (conservation significance)
				natural wet woodlands planted / re-planted wet woodland with semi-natural ground flora or other areas of interest such as ditches, pools and marshy areas.
Plantation and scrub woodland	Relatively young habitats with limited botanical diversity.	W21 / W6	Sherard's downy rose (or a possible hybrid of it), several non-native invasive Cotoneaster species, particularly hollyberry cotoneaster, and Bird cherry (probably planted).	-
Conifer plantation	Relatively young and even-aged, with only a sparse ground flora. The large population of Common Wintergreen is of importance in a county context.	Unclassified	Common wintergreen.	Powys LBAP habitat. Common wintergreen is a 'Primary' species, therefore qualifying the habitat as SINC quality.
Acid grassland – unimproved (in mosaic with dry heathland)	Patchily distributed through much of the Study Area and mainly represented by U1 and U4 grassland, sometimes forming mosaics with other vegetation. Most of the acid grassland is relatively species-	U1 / U4	-	Not a priority habitat or habitat of principal importance (since this refers to lowland habitats only). SINC guidance states that all areas of unimproved acid

Vegetation type	Summary of vegetation community descriptions	NVC category (most closely aligned)	Notable vascular plants	Evaluation (conservation significance)
	poor and in a heavily-grazed state.			grassland should be considered for selection as a SINC.
Semi-improved acid grassland	Many extensive examples, especially on well-drained slopes associated with former mining activity. Including some areas with high densities of ant-hills.	U4 / U5	-	Not a priority habitat or habitat of principal importance (since this refers to lowland habitats only). SINC guidance states that all areas of unimproved acid grassland should be considered for selection, where they support a relatively high diversity of indicator species.
Neutral grassland	Mostly limited to small patches and roadside strips, mainly MG5 and MG1 but very variable in species diversity.	MG5	-	SINC guidance states that all examples of MG5 grassland should be considered for selection as a SINC. S7 / UK BAP lowland meadow which includes meadow / pasture in non-agricultural settings such as roadside verges. Lowland meadows is also a Powys LBAP habitat.

Vegetation type	Summary of vegetation community descriptions	NVC category (most closely aligned)	Notable vascular plants	Evaluation (conservation significance)
Sparse grassland on coal spoil and Washery sidings / short perennial	Many variations on U1 grassland. There is a full spectrum of cover and diversity from almost bare spoil to very high diversity vegetation which includes locally uncommon species.	Unclassified	Small cudweed, viviparous fescue, brown sedge, bee orchid and eye bright	Small cudweed, viviparous fescue, brown sedge, bee orchid and eyebright are 'Contributory' species, and viviparous fescue is a 'Primary' species, therefore qualifying the habitat as SINC quality.
Dry heath / Dry heath and acid mosaic	The Study Area supports very few examples of heath with >25% cover by dwarf shrub species that would qualify as the S7 habitat 'upland heathland'. The largest area is in the restoration area in the centre of the site, which supports H1 heath. Heath is mostly only present as mosaic component amongst acid grassland on former colliery slopes.	H1	-	Small number of areas with S7 upland heathland / UK BAP Dwarf shrub heath SINC guidance states that all examples of unmodified dry heathland should be considered for selection as a SINC. Examples of degraded heathland secondary heathland and grass heath mixtures which meet the designation as acid grassland or which have at least 10% dwarf shrub heath.
Wet heath / marshy grassland mosaic	Only a few small examples present, and mostly M25 mire, grading into other habitat mosaics. All that were seen	M25	-	S7 and UK BAP. SINC guidance states that all examples of unmodified wet heath and wet grass heath,

Vegetation type	Summary of vegetation community descriptions	NVC category (most closely aligned)	Notable vascular plants	Evaluation (conservation significance)
	support a good range of species.			should be considered for selection as a SINC.
Sphagnum-rich bog vegetation	Only a few small areas are present, but they all support uncommon plants and all occur in association with other diverse marshy grassland and heath.	M6	Royal fern.	SINC guidance states that all examples of undegraded bog habitat, and degraded bog habitats which still show some remaining distinctive features, should be considered for selection as a SINC. Royal fern is a 'Contributory' species, in the SINC guidance.
Marshy grassland	Several relatively large areas are present that are dominated by Purple Moor-grass (M25 mire) and rush pasture (M23 mire). The most diverse would qualify as the S7 habitat 'Purple Moor-grass and rush pastures'. An extensive area of diverse, minerotrophic M23 / M24 marshy grassland is present in wet fields with coal spoil north of the Washery.	M25 (species poor – where ungrazed), M23. M22, U4, MG10	In species rich areas - the flower-rich sward includes a number of locally uncommon species, such as marsh lousewort and brookweed.	Species rich examples qualify as S7 habitat 'Purple Moor-grass and rush pastures'. Only occurs in the Washery. SINC guidance states that species rich examples of M23 and M25 should be considered for selection as a SINC. Brookweed is a 'Contributory' species in the SINC guidance. Only present in the Washery.

Vegetation type	Summary of vegetation community descriptions	NVC category (most closely aligned)	Notable vascular plants	Evaluation (conservation significance)
	A high proportion of marshy grassland on recently restored farmland is species poor MG10 rush pasture with negligible value.			
Flush vegetation	Several small M23 flushes are present; mostly at the margins of the grazed upland areas. They support a diverse sward with locally uncommon plant species.	M23	Several locally uncommon species were found in association with flushes, including ivy-leaved bellflower, whorled caraway and bog pimpernel (although no quadrats included the ivy-leaved bellflower).	SINC guidance states that all examples of individual neutral, basic or acid flushes of any size, providing they are not grossly modified by agricultural improvement.
Swamp	Several areas of swamp vegetation are present, but they are mostly too small to qualify as priority habitat. Only one small area of S4 reedbed is present, but this is relatively small and species-poor.	S3, S7, S12 and S4	-	SINC guidance states that all examples of reedbed and other tall swamps should be considered for selection as a SINC. UK BAP / S7 habitat
Ponds	There is an extensive network of ponds within the site. They are of man-made origin but support a variety of vegetation types, including several locally	Affinities with M23, S19, M29, M6 and OV35 and A24.	Floating bur-reed, lesser bulrush, and spiked water-milfoil.	UKBAP / S7 habitat. SINC guidance states that all examples of lakes and ponds which have largely unmodified, semi-natural beds and banks, good water quality and or

Vegetation type	Summary of vegetation community descriptions	NVC category (most closely aligned)	Notable vascular plants	Evaluation (conservation significance)
	rare plant species such as floating bur-reed.			which support good aquatic, emergent or bankside plant communities. Ponds are modified but some support aquatic plant communities. Floating bur-reed and lesser bulrush are 'Contributory' species, and spiked water-milfoil is a 'Primary' species, therefore qualifying the habitat as SINC quality.
Ditches	There are a range of ditch types within the site. Most are small with a limited wetland flora. Several larger ones support a more diverse flora.	Variation of M23, S12, S19, and OV28	-	-
River and streams	The Afon Dulais is the only river within the study area. It has a natural channel profile with a naturally meandering course and is bordered by diverse wetland vegetation and therefore meets the wildlife sites qualifying criteria.	M23 / M27	-	SINC habitat. UKBAP / S7 habitat. Powys LBAP habitat.

Vegetation type	Summary of vegetation community descriptions	NVC category (most closely aligned)	Notable vascular plants	Evaluation (conservation significance)
	A number of tributaries of the Afon Dulais, Llech and tawe are presen within the Site.			

Appendix 7P

Soil Sampling Technical Note

Celtic Energy Limited
9 Beddau Way
Castlegate Business Park
Caerphilly CF83 2AX

Tel: 029 2076 0990

28th April 2020

TECHNICAL NOTE – Nant Helen - Investigation of Soils within Planted Ancient Woodland Site.

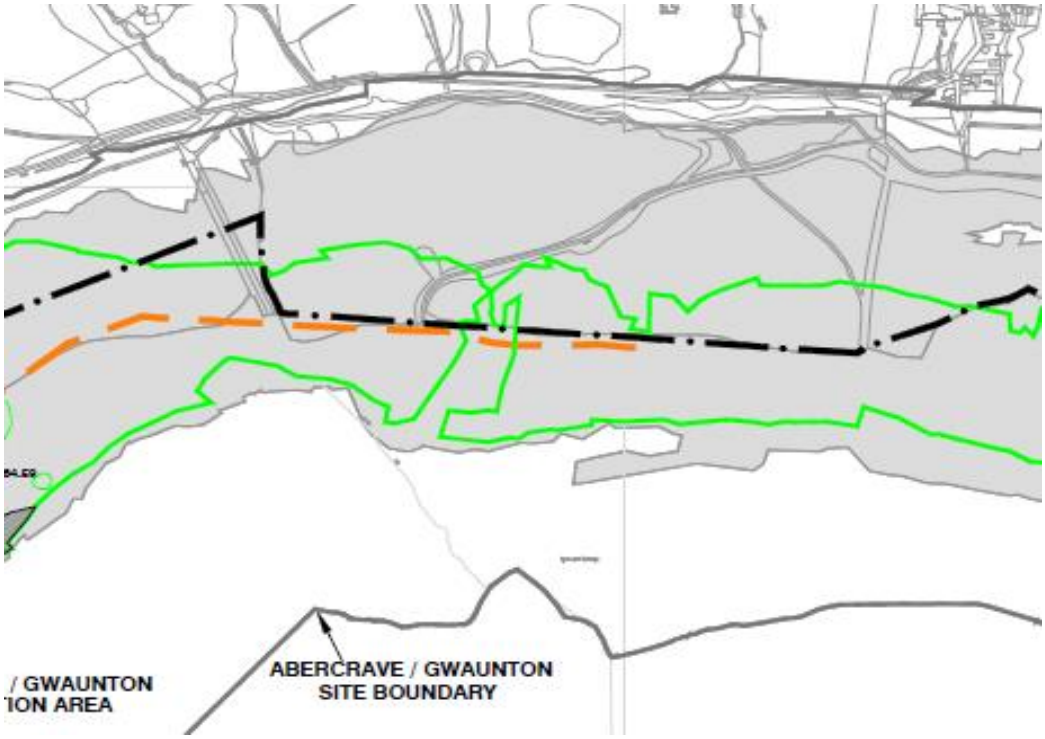
Dr R N Humphries CBiol CSci FRSB FBSSS FIQ

Natural Resources Manager

Background

A Planted Ancient Woodland Site (PAWS) was reported in the draft NANT HELEN COMPLEMENTARY RESTORATION EARTHWORKS EIA (Section 7.14.4) as occurring within the proposed location of an embankment to be built (see EIA Figure 7.4).

The PAWS and the proposed embankment are located within the excavation area of the former Abercrave / Gwaunton surface mine with the mined area no longer having any coal (the grey shadowed fill in the following extract from Figure 14.01 (Celtic Energy, Nant Helen Remainder EIA, 2011)).

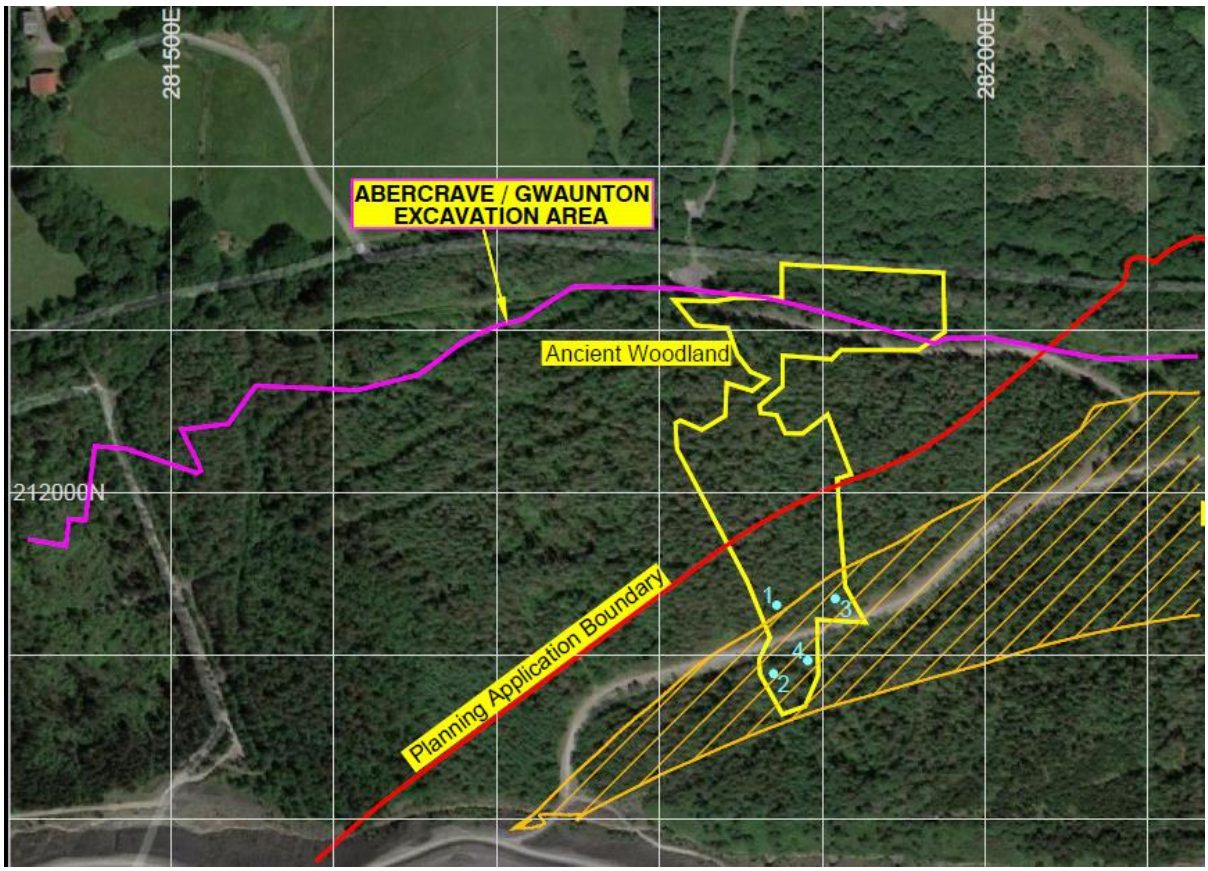


This is compelling evidence that the current plantation is likely to be on backfilled material following mining and extending over the area recorded as a PAWS, rather than as implied, the plantation replacing semi-natural woodland on the in situ woodland soils.

To solve the inconsistency between the recorded 'PAWS' and the mining records, the soils within the area of the 'PAWS' affected by the proposed raising of the embankment were examined to determine if they were backfilled 'spoil' or in situ woodland soils.

Method

The location and extent of the 'PAWS' (yellow line) within the application area (red line) and intersections with the proposed embankment works (orange hatch) on ground were marked using a GPS surveying system (see aerial image below). The purple line is the northern most extent of the surface mined land. Four representative locations (light blue and numbered) within the 'PAWS' and with safe access for a mini-tracked excavator were identified (see below).



Soil pits to a depth of about 1m were dug to expose the soil profile and provide material for examination. The features of the soil profile were recorded using standard soil survey descriptions (Hodgson, 1974). Photographs of each Pit are provided at the end of this Note.

Findings

At all four locations, the soil pits were within the European larch plantation where the ground had been deep 'forestry' ploughed to create parallel 0.3-0.5m high planting ridges at about 2.5m spacing. The pits were dug in the furrows between two ridges.

All four soil pits comprised backfilled Carboniferous Shale material. Soil Pits 1 and 2, and particularly Pit 2, had burnt colliery shale indicating an origin as 'above ground' deposited colliery waste. The predominantly clay profiles of Pits 3 and 4 were likely to be surfaced mined overburden.

Soil Pit 1 – 281872 E 211931 N

Depth cm	Description	Horizon
0-1	Moss/Litter	L
1-3	Dark Brown Humi c/ Stone Free	H
3-10	Clay Loam / 90% Grit / Grey Shale	Ah
10-70	80% Boulders & 20% Small Stones / Grey Shale	C

Soil Pit 2 – 281870 E 211889 N

Depth cm	Description	Horizon
0-1	Moss/Litter	L
1-3	Dark Brown Humic / Stone Free	H
3-10	Heavy Clay Loam / Stone Free / Grey Shale	Ah
10-90	Heavy Clay Loam/Clay / 40% Large Stones / Grey Shale	C

Soil Pit 3 – 281908 E 211935 N

Depth cm	Description	Horizon
0-1	Moss/Litter	L
1-3	Dark Brown Humic / Stone Free	H
3-10	Sandy Clay Loam / Stone Free / Grey Shale	Ah
10-70	Clay Loam / 20% Large Stones / Grey Shale + 30% Red Burnt Shale	C

Soil Pit 4 281891 E 211897 N

Depth cm	Description	Horizon
0-1	Moss/Litter	L
1-3	Dark Brown Humic / Stone Free	H
3-20	Heavy Clay Loam / Stone Free / Grey Shale	Ah
20-90	Heavy Clay Loam/Clay / 50% Large Stones / Grey Shale	C

There was no evidence of buried natural soil layers due to the forestry ploughing resulting in soil inversion in any of the Pits.

Conclusion

Clearly the original ancient woodland within the area now denoted as PAWS was surface mined during the extensive Abercrave / Gwaunton scheme. The in situ woodland soils were most likely disposed of within the progressive workings, as was the general practice into the early 1990s. Hence, the status of the ancient woodland site is more accurately referred to as having been 'destroyed'. The planting of the current conifer plantation after the backfilling of the surface mine workings could

give the impression that it is a PAWS, whereas it is simply a plantation on a destroyed ancient woodland site.

Reference

Hodgson J M, 1974. Technical Monograph nNo. 5: Soil Survey Field Handbook. Soil Survey, Harpenden.



Soil Pit 1



Soil Pit 2



Soil Pit 3



Soil Pit 4

Appendix 7Q

Habitat Regulations Assessment Report

Welsh Government

Global Rail Centre of Excellence

Habitat Regulations Assessment (HRA) Report

Issue 7 July 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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			Prepared by	Checked by	Approved by
		Name	Claire Pooley		
		Signature			
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			Prepared by	Checked by	Approved by
		Name	Pippa Wood	Claire Pooley	Paul Clack
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		Filename			
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Appendices

Appendix A
Habitats Regulations Assessment Process

1 Introduction

Ove Arup & Partners Ltd (Arup) was commissioned by Welsh Government to undertake a range of consultancy services in relation to the proposed railway test facility known as the Global Rail Centre of Excellence (the Project). A site location plan and red line boundary is provided in Figure 1.

The Welsh Government has developed a concept for a Global Centre of Rail Excellence (GCRE) in Wales. GCRE would be a modern, purpose-built rail testing and R&D facility for the UK. This initiative offers a unique opportunity to provide a centre of excellence for UK rolling stock and infrastructure testing, R&D, high capacity warm storage, maintenance and decommissioning.

The proposed site is currently being mined by Celtic Energy, who will cease extraction operations in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and agreements with Powys County Borough Council (PCBC) and Neath Port Talbot County Borough Council (NPTCBC)[1]. This includes Section 106 planning obligations and planning conditions that need to be discharged.

Celtic Energy has submitted a revised restoration strategy for approval (under Section 73 application under the Town and Country Planning Act 1990) which would change the existing approved restoration scheme (for planning application ref 18/1070/REM). The purpose of the variation is to allow for a '*flexible and adaptable landform for a variety of uses on restoration including agriculture, nature conservation, leisure, tourism and some industrial uses*'[2].

One such revised restoration proposal was for the use of the site for the Welsh Government's proposal to develop a rail testing and storage facility GCRE at this site together with the adjacent Onllwyn Washery.

A separate planning application (reference no. 20/0738/FUL) and associated Environmental Impact Assessment (EIA) and Habitat Regulation Assessment (HRA) was produced by Arup, on behalf of Celtic Energy and submitted to PCBC and NPTCBC on the 12th May 2020, in relation to the Nant Helen Complementary Earthworks for the provision of GCRE[3] (for which there is subject to a resolution to grant planning permission).

This HRA will accompany an outline planning application and EIA for the GCRE Project, submitted to PCBC and NPTCBC, who will therefore be the competent authorities, in accordance with Regulation 63 of the Habitat Regulations. The information provided here to inform a Habitats Regulations Assessment (HRA4), does not repeat the HRA completed in relation to the Nant Helen Complementary

[1] The site straddles two Local Authorities – Powys County Borough Council (PCBC) and Neath Port Talbot County Borough Council (NPTCBC).
[2] Celtic Energy s73 application for variation of condition 45 of planning application 18/1070/REM – further addendum to original environmental statement and supporting information submitted under planning reference 18/1070/REM including revised LVIA.
[3] Celtic Energy Nant Helen Complementary Earthworks EIA application 20/0738/FUL.
[4] Hereafter referred to as HRA.

Earthworks but assesses the construction and operation of the proposed GCRE project.

Furthermore, the assessment considers the ‘Future Baseline’, which is also described in the accompanying ecology Chapter within the associated EIA. The Future Baseline considers the site at the time of the GCRE Project commencing, including new habitats which will be created as part of the Nant Helen Complementary Earthworks Project in addition to the ecological receptors, which will be retained and protected (and enhanced), and those in the washery.

1.1 Purpose of this Document

This document has been prepared by Arup on behalf of our client, to provide information to inform a HRA report for the project in compliance with the requirements of the Conservation of Habitats and Species Regulations 2017 (as amended); hereafter referred to as the 'Habitats Regulations'.

The formal assessment required by the Regulations will be undertaken by Planning Departments of PCC and NPTCBC in the process of determining the applications in their role as Competent Authority.

1.2 The HRA Process

Regulation 63 of the Habitats Regulations requires a competent authority to make an 'Appropriate Assessment' of the implications of the plan or project for that site in view of its conservation objectives, before deciding to undertake or give consent for a plan or project which (a) is likely to have a significant effect on an International Site (either alone or in combination with other plans or project), and (b) is not directly connected with or necessary to the management of that site. In light of the conclusions of the assessment, the competent authority may proceed with or consent to the plan or project only after having ascertained that it will not adversely affect the integrity of the International Site.

All plans and projects should identify any likely significant effects early in the plan/project making process and then either alter the plan/project to avoid them or introduce mitigation measures to the point where no adverse effects remain. The 'competent authority' shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned, and if appropriate having obtained the opinion of the general public.

The assessment of a project under the Habitats Regulations can be split into several sections as shown in Appendix A; however, there are effectively four stages to the assessment as described below.

Stage 1 is the assessment of the likelihood of a plan or project having a significant effect on an International Site or its features. If a likely significant effect cannot be rules out this is the trigger for the need for an Appropriate Assessment as set out in Regulation 63(1).

The Appropriate Assessment (Stage 2) is the detailed consideration of the potential effects of the plan or project in relation to the conservation objectives for the International Site(s) to determine if there is likely to be an adverse effect on the integrity of the site (i.e. an effect that would compromise the site meeting its conservation objectives). Providing it can be demonstrated that with appropriate mitigation measures the plan or project would not give rise to an adverse effect on the integrity of an International Site, the plan or project can proceed.

Where this cannot be demonstrated or there is uncertainty, the assessment would then need to consider if there were any other alternatives to the plan or project (Stage 3) that would not give rise to adverse effects on the integrity of the International Site.

If there are no alternatives, Stage 4 would then consider if there are any Imperative Reasons of Overriding Public Interest (IROPI), only at this stage can Compensatory Measures be considered.

1.3 Consideration of Mitigation

With regards to recent case law (Coillte vs People Over Wind[5]) the inclusion of mitigation during Stage 1 is no longer considered appropriate. Mitigation, as considered by the Centre Européen de Coopération Juridique (CECJ) in regard to the case law[2], is interpreted to mean measures that are intended to avoid or reduce the harmful effects of the envisaged project on the site concerned.

Consequently, any project where a likely significant effect on an International Site cannot be ruled out and where avoidance and mitigation is applicable will need to progress to Stage 2 Appropriate Assessment.

1.4 Structure of this Report

This report uses the following structure:

- Section 2 provides information on the proposed works (the 'proposed development') including the environmental baseline and a brief description of the development;
- Section 3 provides information on the data and methodology used in the assessment;
- Section 4 provides information on the European Sites that are considered within the assessment;
- Section 5 provides a screening assessment for the potential pathways for effects; and
- Section 6 provides a conclusion.

[5] People over Wind, Case C323/17 European Court of Justice, 12th April 2018.

2 Project Description

The Welsh Government is proposing to develop a rail testing, maintenance, research and development and storage facility, known as the Global Centre of Rail Excellence (GCRE) at the site of the Onllwyn Washery and Nant Helen Open

The site for the proposed development is approximately 475 ha and the project boundary is considered in this assessment as the footprint of the development (as shown in Figure 1) and is hereafter referred to as the 'Site'.

The proposed development includes the following components listed:

- Large railroad test loop (outer loop) - Electrified high speed outer rail testing loop (6.9 km) which would extend around the perimeter of the site to enable the testing of moderate and higher-speed passenger trains up to a maximum 110 mph.
- High tonnage infrastructure test loop (inner loop) - Electrified low speed inner rail testing loop (4.5 km) for testing rail infrastructure. This will include track systems, civil structures, ancillary lineside equipment, signalling, power and telecommunications equipment. Trains will be able to run up to a line speed of 40 mph
- An operations and control centre/office and separate staff accommodation - A multi-storey control building from which testing activities would be managed. Separate staff accommodation which would also act as a general hub for site personnel.
- Research and development centre - The centre would provide opportunities for research, development, education and training / conference facilities including laboratory space.
- 4-road rolling stock maintenance shed - For trains undergoing testing at the facility. Capacity for 2no. 400 m trains and 2no. 230m trains simultaneously with provision of headshunt road at shed rear for increased operational flexibility. Internal provision of light and heavy maintenance roads.
- Warm and Cold Storage sidings - Sets of storage roads for the medium-long term storage of the Angel Trains fleets. Storage capacity for up to 400 vehicles with connections to shore supply units located incrementally along sidings.
- Carriage wash and Controlled Emission Toilet (CET) spine facility- A carriage wash facility to service trains up to 400 m including a (CET) point with canopy to control wash equipment, water and cleaning materials.
- Site Access - Access to the external highway network is proposed to be taken from existing junctions of the A4109 Wembley Avenue with Onllwyn Road, the A4221 Celtic Energy – Nant Helen access road, and the A4221 Washery and Distribution centre access which will be used by HGVs only.
- Decommissioning facility - This is a facility which allow for the decommissioning of rolling stock.

- Associated development - Across the site associated development would include access routes, staff car parking, drainage, lighting, mobile and land based communications 'hyper connectivity', CCTV, fencing (including acoustic mitigation as required), Neath and Brecon Branch Line connection and signalling upgrade.

A full description of the proposed development is given in Chapter 3: Project description of the EIA.

2.1 Environmental Baseline

As described above, this HRA will consider the Future Baseline, which comprises the site subject to earthworks and habitat restoration (in accordance with the Nant Helen Complementary Earthworks planning application (reference no. 20/0738/FUL) and the further restoration works in accordance with a separate planning application (reference no. 19/1899/REM), to restore parts of the Nant Helen site post mining operations. For the purposes of this assessment, it is assumed that the earthworks and restoration works will have been approved and commenced / completed at the time of the GCRE Project commencing.

The future baseline therefore includes new habitats which will be created as part of the Nant Helen Complementary Earthworks Project in addition to the ecological receptors, which will be retained and protected (and enhanced), and those in the washery (not previously included in the Nant Helen Complementary Earthworks application but now form part of the GCRE Project site).

The Future Baseline will comprise the earthworks (including cutting and embankments) and associated infrastructure such as drainage and habitat restoration. The latter comprises the approved habitat restoration plan, required as part of a planning application by Celtic Energy to mitigate for mining activities on the Nant Helen site, and the habitat creation and enhancement plan which was submitted with the Nant Helen Complementary Earthworks application as mitigation for habitats affected by the earthworks.

The Future Baseline will therefore exclude habitats which will be lost as a result of the Nant Helen Complementary Earthworks Project, and which has been assessed within the separate ecology Chapter[6]. However, it will include the enhanced retained habitats and newly created habitats as set out in the Nant Helen Complementary Earthworks habitat creation and enhancement plan, and shown in Figure 3.

In summary the habitat creation and enhancement plan include the creation of a habitat mosaic with the newly created landform, and retained adjacent habitats. Habitats will include acid grassland, enclosed pasture and broadleaved woodland, heathland, peatland-mire complex, wetland and lichen / fungi rich habitats. The diversity of habitats created will encourage the growth and establishment of increased species numbers and diversity including notable flora which occurs in the adjacent, retained habitats. Further enhancements will be facilitated through

[6] Arup (2020) Nant Helen Complementary Earthworks Environmental Statement: Ecology Chapter

the long-term management of habitats such as conifer and broadleaved woodland, acid and marshy grassland in addition to wetland habitats.

The Future Baseline will also include additional land unaffected by the Nant Helen Complementary Earthworks (and which is also detailed in the existing baseline). In particular, land in the washery which occurs within the GCRE Project boundary, but was excluded from the Nant Helen Complementary Earthworks Project boundary. In addition, all the ecological receptors which are retained as part of the Nant Helen Complementary Earthworks Project, and which remain in the zone of influence (ZOI) of the GCRE Project will be included within the future baseline i.e. protected sites, habitats and species; which with the incorporation of mitigation as part of the Nant Helen Complementary, will continue to occur in the site, and adjacent areas. More information on these ecological receptors is detailed in the GCRE ecology ES chapter[6].

3 Guidance and Methodology

This section sets out the guidance and evidence base used in assessing the potential effects of the proposed works.

3.1 Guidance and Policy

This information has been informed by the following guidance and policy documents:

- Planning Policy Wales - Technical Advice Note (TAN) 5: Nature Conservation and Planning[7];
- The Planning Series: 16 – Habitats Regulations Assessment. National Assembly for Wales 2017[8];
- Assessment of plans and projects significantly affecting Natura 2000 sites, European Commission 2001[9];
- Managing Natura 2000 sites, European Commission 2000[10]; and
- The Habitats Regulations Assessment Handbook, May 2019 edition, UK: DTA Publications Limited[11].

These documents and publications are intended to improve understanding of how projects are regulated under the Habitats Directive.

3.2 Desk Study Information

In addition to the guidance noted above, the following websites were used to gather information on the European Protected Sites;

- Natural Resources Wales (NRW) website[12];
- MAGIC (Multi-Agency Geographic Information for the Countryside) website[13], and;
- Joint Nature Conservation Committee (JNCC)[14].

[7] Welsh Government. (2009). Planning Policy Wales - Technical Advice Note 5: Nature Conservation and Planning. Cardiff: Welsh Government.
[8] Research Briefing: The Planning Series: 16 – Habitats Regulations Assessment. December 2017. National Assembly for Wales.
[9] Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC. (2001) European Commission.
[10] Managing Natura 2000 sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/CEE. (2000). European Commission.
[11] Tyldesley & Chapman, 2017. The Habitats Regulations Assessment Handbook, January 2017 Edition, UK: DTA Publications Limited.
[12] http://naturalresources.wales/guidance-and-advice/environmental-topics/wildlife-and-biodiversity/find-protected-areas-of-land-and-seas/designated-sites/?lang=en
[13] https://magic.defra.gov.uk/
[14] https://jncc.gov.uk/our-work/special-areas-of-conservation-overview/

The Core Management Plans for European Sites, and Regulation 35 information[15] containing advice on European Sites were also obtained and have been used to inform this assessment.

These documents provide the main elements of NRW's management plan for European Sites along with the Conservation Objectives for the qualifying features. The qualifying features will be considered to be in Favourable Conservation Status only when the conservation objectives are being met. These objectives therefore provide an indication of the type of effects which could affect the features of European Site. An effect which could affect the ability of a site or feature meet its objective could be considered to be an adverse effect on the integrity of the European Site concerned.

3.3 Habitats Regulations Assessment Methodology

3.3.1 Identifying sites

In order to understand the potential implications for European Sites from the proposed project it is necessary to identify those sites that are located close to the project or are linked by pathways, such as hydrological connections.

All European Sites within 10 km and all Special Areas of Conservation (SACs) designated for the presence of marsh fritillary *Euphydryas aurinia* within 10-15 km and for the presence of Annex II bat species within 15-30 km of the project were identified using Geographic Information System data from datasets downloaded from the JNCC and NRW.

3.3.2 Understanding qualifying interests and conservation objectives

For each of the sites identified, the qualifying features were established and the conservation objectives for each feature were obtained. Information was also sought to understand the potential vulnerability of the features to any effects that might arise from the project.

3.3.3 Identification of the potential effects of the project

Any potential pathways for effect on European Sites resulting from the project were identified prior to consideration of best practice procedures (for example, Guidelines for Pollution Prevention[16] and Construction Industry Research and Information Association (CIRIA) guidance) or the integration of any mitigation measures.

[15] http://naturalresources.wales/guidance-and-advice/environmental-topics/wildlife-and-biodiversity/find-protected-areas-of-land-and-seas/advice-for-developers-and-marine-planners/?lang=en
[16] http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/

3.3.4 Identification of plans or projects considered for in-combination effects

An ‘in-combination’ assessment is required where the project may have an effect on a European site, but on its own the effects would not be significant. The potential effects of the project should be considered in-combination with other plans or projects that similarly may have an effect, but where on their own those effects would not be significant. The combined effects may therefore become significant.

Details of other plans and projects which are currently proposed or consented within the vicinity of the European Sites identified were obtained to inform the in-combination assessment of the proposed project.

3.3.5 Consideration of the significance of potential effects

The significance of potential effects was assessed in the absence of avoidance or other mitigation measures other than those which are standard construction practices such as pollution control or those incorporated into the scheme. The assessment has been made with awareness of the conservation objectives for the features of the European Sites, although as stated in the relevant guidance the assessment of the project against the conservation objectives is not required until the Appropriate Assessment stage of the HRA process.

In the assessment of the significance of effects, professional judgement was applied using the following criteria, as often insufficient information about the elements and interests is available:

- The vulnerability/sensitivity of the receiving environment/features of interest;
- When the risk of effects is likely to occur (e.g. construction and/or operation);
- The likely geographical extent of the effects; and
- Likelihood of significant effects (e.g. those above negligible in magnitude) occurring based on previous experience with similar elements, where available.

Where there was not enough information about the risk of qualifying interest being present, or of the risk of effects, the assessment used the precautionary principle to inform the judgement. This principle means that the conservation objectives should prevail where there is uncertainty or that harmful effects will be assumed in the absence of evidence to the contrary.

3.4 Limitations

Information provided by third parties, including publicly available information and databases, is considered correct at the time of publication. Due to the dynamic nature of the environment, conditions may change in the period between the preparation of this report, and the construction and operation of the project.

The HRA has been undertaken in as detailed a way as possible, using available data sources. However, the conclusions drawn from this is necessarily limited by

the age, type, coverage and availability of data. Any uncertainties and the limitations of the assessment process are acknowledged and highlighted. Recommendations for mitigation measures to address the potential adverse effects on International Site integrity identified by this report are also based on the information available at the time of the assessment.

4 European Sites Potentially Affected by the Proposal

A 10 km search area is considered sufficient to identify any potential impacts on the majority of European sites, except sites which have mobile qualifying features (and which may have ranges that extend beyond 10 km).

The European Sites identified within 10 km of the proposed works are as follows (distances and direction are measured as a straight line from the Project location to the European Site):

- Coedydd Nedd a Mellte SAC: approximately 2.9 km south-east; and
- Cwm Cadlan SAC: approximately 9.5 km east.

In addition, a search was undertaken of European Sites designated for marsh fritillary, within 10-15 km of the project, since this species is known to range up to 15 km from its primary habitat (and due to records of this species being present in vicinity of the site). European Sites designated for marsh fritillary are detailed below.

- Blaen Cynon SAC: 4 compartments, with the closest being approximately 9.2 km east.

In addition, a search was undertaken of European Sites designated for Annex II bat species within 15-30 km of the project, since some species of bats are known to range up to 30 km from roost site locations. No bat SACs are within 30 km of the project.

Figure 2 shows the location of the project in relation to European Sites within 15 km of the project. The features for which these Sites are designated are summarised in Table 1.

Table 1 Qualifying Features of the European Sites identified within 10 km, 10-1 5 km for marsh fritillary SAC and 15-30 km for bat SACs.

Site	Qualifying Features	Importance	Conservation Objectives Summary	Vulnerability
Coedydd Nedd a Mellte SAC	*Tilio-Acerion* forests of slopes, screes and ravines. Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles.	Tilio-Acerion forests of slopes, screes and ravines for which the area is considered to support a significant presence. Old sessile oak woods with Ilex and Blechnum in the British Isles for which this is considered to be one of the best areas in the United Kingdom.	• Upland ash woodland will occupy at least 18 ha of the total site area. • The canopy should be predominantly ash and the following trees will be common in the woodland. • Ferns will be common ground flora species. • Although they may be present in the canopy in small quantities, sycamore and beech should not become dominant at the expense of ash. • Introduced invasive species will be absent and any conifers seeding in from adjoining plantations will be removed whilst at the seedling/sapling stage. • Damage to the ground flora and soil erosion due to public pressure will be at a minimum. • All factors affecting the achievement of these conditions are under control.	Livestock grazing, non-native species, woodland management, Access and Visitor management and human and grazing induced bare ground.
Cwm Cadlan SAC	Molinia meadows on calcareous, peaty or clayey-silt-laden soils	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) for which this is considered to	• Fen-meadow will occupy at least 26 ha of a total area of marshy grassland habitat which itself will cover at least 42 ha. • The remainder of the site will mainly consist of other semi-natural habitat, including alkaline fen. • Typical fen-meadow plants will be common.	Human induced changes in hydraulic conditions, air pollution, air-borne pollutants, problematic native species, biocenotic evolution,

Site	Qualifying Features	Importance	Conservation Objectives Summary	Vulnerability
	(*Molinion caeruleae*). Alkaline fens.	be one of the best areas in the United Kingdom. Alkaline fens for which this is considered to be one of the best areas in the United Kingdom.	• Plants indicating agricultural modification or alteration to hydrology and drying of soils will be absent or present at only low cover. • Although rushes are frequent, the more bulky species will not exceed 33% cover. • Bare ground will generally not exceed 5% cover and vegetation litter 25%. • Dense scrub will be largely absent from the fen-meadow, but it is probably desirable for invertebrates and birds to have a sparse scattering of shrubs or trees. • All factors affecting the achievement of these conditions are under control. • Alkaline Fen will occupy about 11 ha or more. • The remainder of the site will mainly consist of other semi-natural habitat including fenmeadow. • Typical alkaline fen plants will be common. • Plants indicating agricultural modification or alteration of hydrology and drying of soils will be absent or present only at low cover. • Although rushes are frequent, the more bulky species will not exceed 33% cover. • Bare ground will generally not exceed 5% cover and vegetation litter 10 %. • Scrub species will be largely absent from the alkaline fen. • At selected springheads, water should flow in all but the most severe drought conditions. • All factors affecting the achievement of these conditions are under control.	succession, fertilisation and grazing.

Site	Qualifying Features	Importance	Conservation Objectives Summary	Vulnerability
Blaen Cynon SAC	Marsh fritillary butterfly (*Euphydryas aurinia*)	*Eurodryas aurinia* which this is considered to be one of the best areas in the United Kingdom.	The site will contribute towards supporting a sustainable metapopulation of the marsh fritillary in the Penderyn/Hirwaun area. This will require a minimum of 50 ha of suitable habitat, of which at least 10 ha must be in good condition, although not all is expected to be found within the SAC. Some will be on nearby land within a radius of about 2km. • The population will be viable in the long term, acknowledging the extreme population fluctuations of the species. • A minimum of 30% of the total site area will be grassland suitable for supporting marsh fritillary. (As the total area of the SAC is 66.62 ha, 30% represents approximately 20 ha.) • At least 40% of the suitable habitat (approximately 8 ha) must be in optimal condition for breeding marsh fritillary. • Suitable marsh fritillary habitat is defined as stands of grassland where *Succisa pratensis* is present and where scrub more than 1 metre tall covers no more than 10% of the stands. • Optimal marsh fritillary breeding habitat will be characterised by grassland where the vegetation height is 10-20 cm, with abundant purple moor-grass *Molinia caerulea*, frequent “large-leaved” devil’s-bit scabious *Succisa pratensis* suitable for marsh fritillaries to lay their eggs and only occasional scrub. In peak years, a density of 200 larval webs per hectare of optimal habitat will be found across the site.	Owner objectives, weather conditions, parasites.

4.1 Identification of Other Plans and Projects

In July 2020, planning applications[17] were searched for within 500 m of the proposed works and within the last year. These are included below:

- Land At And Surrounding Nant Helen Open Cast Coal Site Powys And Onllwyn Distribution Centre, Neath Port Talbot. Ref. No: 20/0738/FUL Validated: Fri 15 May 2020 | Status: Pending Consideration: *Construction of complementary restoration earthworks to create 2 looped landform platforms (part in cutting and part on embankment) with associated drainage infrastructure and areas of landscaping and habitat creation to create a flexible and adaptable area of land that could be used for a variety of uses including agriculture, nature conservation, leisure, tourism and industrial, research and development/business uses (potentially including a proposed rail testing, research and development and storage facility). (Cross-boundary application, see Neath Port Talbot CC Application ref. P2020/0362)*

- Ref. No: 19/1899/REM | Validated: Mon 11 Nov 2019 | Status: Unknown: *Section 73 application to vary condition 45 of planning permission 18/1070/REM in relation to restoration scheme. Nant Helen Surface Mine Coelbren Neath Powys*

- Ref. No: 20/0325/HH | Validated: Fri 06 Mar 2020 | Status: Pending Consideration: Erection of an extension, 2 Moorside Villas Onllwyn Road Coelbren Neath SA10 9NR

- Request for scoping opinion (under Regulation 14 of the Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017 in respect of a proposed application for a rail testing and storage facility, known as the Global Centre of Rail Excellence (GCRE), and incorporating:- a Rolling Stock and Infrastructure Testing Facility (consisting of two test tracks of loop configuration, one 4.5km, inside a larger loop of 6.9km in length), New buildings including Test Platform/Station, Control Building, Research and Development Centre, Rolling Stock Maintenance Shed, Decommissioning facility and Rail Sidings, Winch-propelled facility for testing of track and track systems, Carriage Wash facility, plus ancillary development including land reformation, landscaping, infrastructure works and access (affecting land within Neath Port Talbot and Powys County Council administrative boundaries). Land at and surrounding the Nant Helen open cast coal site, Powys and Onllwyn distribution centre, SA10 9NN. Pending decision.

- P/2018/0524: Outline-proposed replacement dwelling (some matters reserved), Glendale. A building has been proposed for demolition.

[17] https://pa.powys.gov.uk/online-applications and https://www.npt.gov.uk/1617 [accessed 20.11.2019]

Ecological surveys have been undertaken and no protected species have been found using the building.

- 19/1520/HH: Erection of a single storey side extension at Tynypant farm caehopkin Abercrave, SA9 1UE. Pending decision.
- 19/0625/AGR: Erection of an agricultural building at Tynypant farm Caehopkin Abercrave, SA9 1UE.

5 Screening Assessment

5.1 Screening of European Sites

The European Sites identified in Section 4 have been screened out of the following assessment. These Sites include:

- Coedydd Nedd a Mellte SAC;
- Cwm Cadland SAC; and
- Blaen Cynon SAC.

5.2 Justification for Screening Out European Sites

5.2.1 Coedydd Nedd a Mellte SAC

Coedydd Nedd a Mellte SAC's closest compartment is 2.9 km from the project. The SAC is designated for its important woodland habitat. Potential effects on the SAC are limited to 1) water quality effects: pollutants (fuel, chemical spills, dust and vehicle emissions) from construction or during operation of GCRE or high sediment load in surface water runoff from construction areas; and 2) air quality effects during both construction and operation: increases in levels of nitrogen oxides (NOx), sulphur dioxide (SO2) and ammonia (NH3), which can be absorbed directly[18] or indirectly i.e. through deposition, which affects the soil pH or causes nutrient enrichment of the soil.

The SAC is not hydrologically connected to the Project area, and therefore there is no pathway for effects from changes in water quality. Due to the distance/spatial separation of the SAC from the proposed works it is considered that any changes in air quality would not result in any effects.

No mitigation is required to be integrated into the Outline Construction Method Statement to avoid, reduce or cancel effects on the Coedydd Nedd a Mellte SAC.

5.2.2 Cwm Cadlan SAC

Cwm Cadlan SAC's closest point is 9.5 km from the proposed works. The SAC is designated for its important *Molinia* meadows and alkaline fen habitat. Potential effects on the SAC are limited to 1) water quality effects: pollutants (fuel, chemical spills, dust and vehicle emissions) from construction or during operation of GCRE or high sediment load in surface water runoff from construction areas; and 2) air quality effects during both construction and operation: increases in levels of nitrogen oxides (NOx), sulphur dioxide (SO2) and ammonia (NH3), which can be absorbed directly or indirectly i.e. through deposition, which affects the soil pH or causes nutrient enrichment of the soil.

[18] The relevant assessment benchmark for pollutant concentrations 'in the air' is referred to as a critical level.

The SAC is not hydrologically connected to the Project area, and therefore there is no pathway for effects from changes in water quality. Due to the distance/spatial separation of the SAC from the proposed works it is considered that any changes in air quality would not result in any effects.

No mitigation is required to be integrated into the Outline Construction Method Statement to avoid, reduce or cancel effects on the Cwm Cadlan SAC.

5.2.3 Blaen Cynon SAC

The closest compartment of Blaen Cynon is located 9.2 km from the Site. It is designated for its population of marsh fritillary; a species which exists in metapopulations and are known to range up to 15 km from its primary habitat[19]. Marsh fritillary are also known to be present in the Wildlife Trust Nature Reserve west of the Site (approximately 1.5 km).

Potential effects could occur to this species, if they were to occur within any habitats of the Site or adjacent habitats. Although purple moor grass and rush pasture that supports the larval foodplant devil's-bit scabious *Succisa pratensis*, the habitat often used by this species, is present within and adjacent to the Site, invertebrate surveys[20] found no evidence of marsh fritillary using habitats within the Site. In addition, surveys assessed the habitat present as being largely unsuitable for this species (due to being in poor condition as a result of agricultural improvement and overgrazing and having little or no growth of the larval food plant).

Therefore, it is considered unlikely that any metapopulations of marsh fritillary, associated with either the Wildlife Trust Reserve or Blaen Cynon SAC, would occur within the Site. Furthermore, although there would be a loss of habitat within the Site, this would be a very small proportion of what is available within the wider area.

Potential impacts on the Wildlife Trust Reserve, were scoped out in the Ecology Chapter of the Environmental Impact Assessment for the Nant Helen Complementary Earthworks project[21], due to the distance of the Reserve from the works.

Furthermore, the future baseline of the GCRE Project has already considered the loss of habitat and habitat creation and enhancement proposed through the Nant Helen Complementary Earthworks project. As such, the potential construction impact is greatly reduced and considered to have no likely effect on the habitats associated with the marsh fritillary within the suitable habitat in the wider area in relation to the GCRE Project.

No mitigation is required to be integrated into the Outline Construction Method Statement to avoid, reduce or cancel effects on the Blaen Cynon SAC.

[19] Warren M.S. 1994. The UK status and suspected metapopulation structure of a threatened European butterfly, the marsh fritillary Eurodryas aurinia. Biol. Conserv. 67: 239–249.
[20] Further ecological details provided in the: Nant Helen Invertebrate Report; Arup (2019) prepared for Celtic Energy.
[21] Nant Helen Environmental Impact Assessment, Arup (2019), prepared for Celtic Energy.

Operational effects on the Blaen Cynon SAC are also considered to be unlikely, due to the distance at which marsh fritillary presence has been recorded (namely within the Wildlife Trust Nature Reserve) and their assumed absence from the Site.

Butterfly, however, are known to one of the most common group of insects that are adversely affected by vehicle collision[22]. For this reason, the habitat and creation and enhancement proposed for both the Nant Helen Complementary Earthworks project and the GCRE Project have ensured that habitats within the test loops will not be designed specifically to encourage marsh fritillary, through avoiding the planting of the larval foodplant devil's-bit scabious within or around the test loops. Therefore ensuring steppingstone habitats are not provided for this species within the Site, and links to any SAC populations. The continued absence of marsh fritillary from the site will also ensure there is no collision risk with operation trains within the Nant Helen site.

This considered, alongside the current assumed absence of this species within the site, operational effects on the Blaen Cynon SAC marsh fritillary butterfly population are unlikely.

No mitigation is required to be integrated into the operation of GCRE to avoid, reduce or cancel effects on the Blaen Cynon SAC.

5.3 In-Combination Assessment

No effects are anticipated from the proposed improvement works alone; as such, there cannot be an in-combination effect with other plans and projects. It is therefore reasonable to conclude that the application will not have a likely significant effect in-combination with other plans and projects.

[22] Skórka, Piotr & Lenda, Magdalena & Moroń, Dawid & Kalarus, Konrad & Tryjanowski, Piotr. (2013). Factors affecting road mortality and the suitability of road verges for butterflies. Biological Conservation. 159. 148–157. 10.1016/j.biocon.2012.12.028.

6 Conclusion

Based on results presented above, it is reasonable to conclude that there are **no effects**, either alone or in-combination with other plans and projects, resulting from the proposed improvement works.

Given the conclusion that the proposal is not likely to have a significant effect on European Sites, nor are mitigation measures proposed to avoid, reduce or cancel potential effects, the requirement to complete a Stage 2: Appropriate Assessment has not been triggered.

As a consequence, the proposed works are not considered to be contrary to the provisions of Regulation 63 of the Conservation of Habitats and Species Regulations 2017 (as amended).

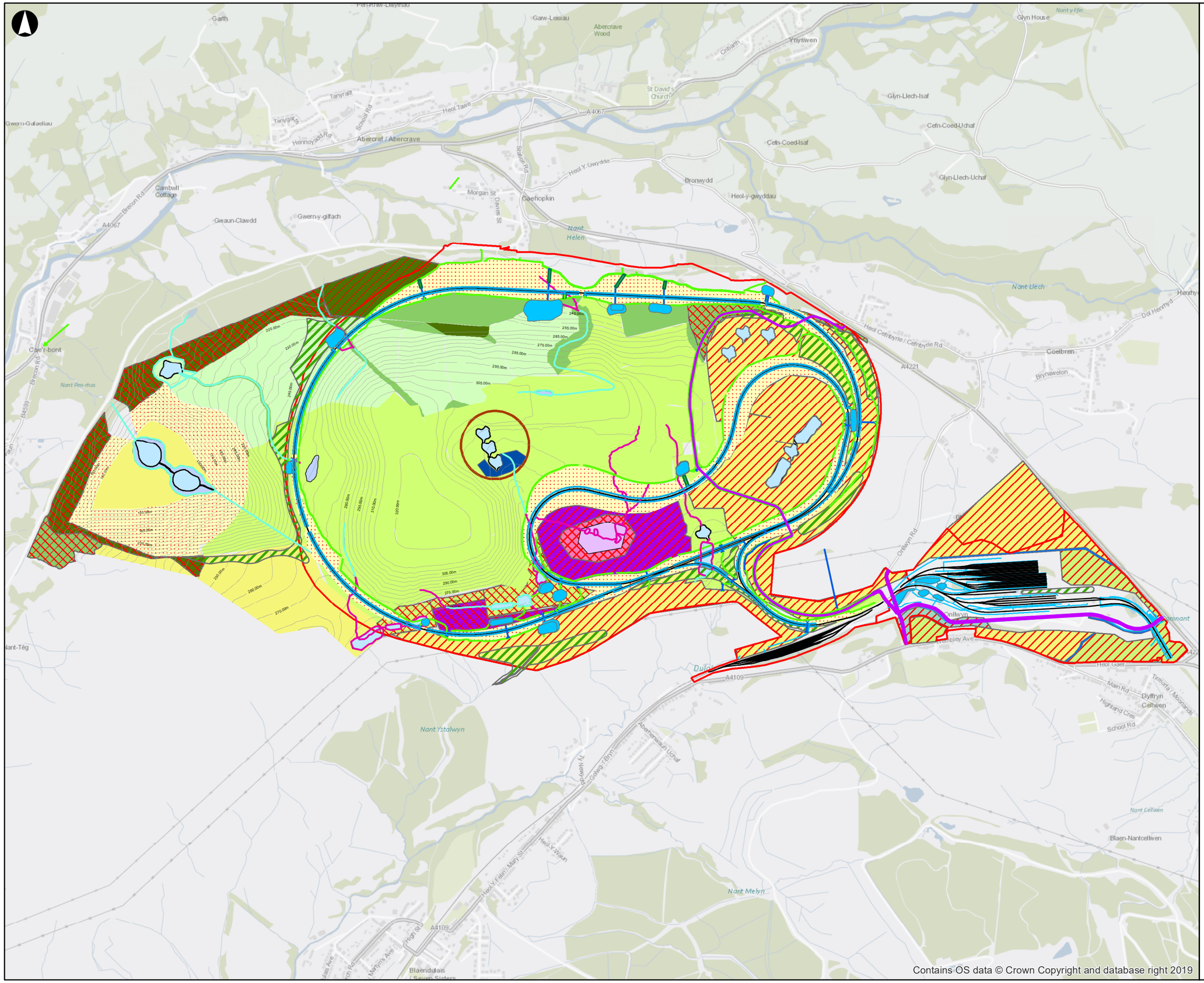
Figures

Figure 1: Site Location

Figure 2: International Statutory Designated Sites

Figure 3: Habitat Creation and Restoration Plan

A3



Legend

- Planning Development Boundary
- Site Layout Plan
- Access Road
- EXISTING WATERCOURSE
- MIXED WOODLAND POTENTIAL FOR ENHANCEMENT
- ACID GRASSLAND POTENTIAL FOR ENHANCEMENT
- MARSHY GRASSLAND POTENTIAL FOR ENHANCEMENT
- PEATLAND
- WET HEATH
- HEATH EXISTING
- INOCULATED HEATH/ACID GRASSLAND
- ACID GRASSLAND
- ACID GRASSLAND EXISTING
- ACID GRASSLAND LICHEN HEATH
- BROADLEAF WOODLAND
- BROADLEAF WOODLAND EXISTING
- CONIFEROUS WOODLAND
- CONIFEROUS WOODLAND MANAGED FOR BROADLEAVED WOODLAND
- CONIFEROUS WOODLAND EXISTING
- ENCLOSED PASTURE
- HEATH/ACID GRASSLAND EXISTING
- MARSHY GRASSLAND
- POTENTIAL SPHAGNUM-RICH / FEN-MIRE
- POND
- WETLAND
- Landscape Mitigation
- Restoration Watercourse
- Restoration Watercourse to be removed/discontinued
- Proposed Cut Off Ditch
- Proposed Carrier Drain
- Proposed Culvert
- Proposed Filter Drain
- Proposed Ponds

Issue	Date	By	Chkd	Appd
P01.3	2020-08-04	KSJ	CP	RE

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HABITAT CREATION AND ENHANCEMENT

Scale at A3

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Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
Figure 7.9	**P01.3**

\\global\europe\Cardiff\Jobs\264000\264904-00\4 Internal Project Data\4-80 GIS\4-84 Map Documents\ENV_Environment\Environmental Statement\Ecology\GCRE_264904_ES_7_9_HabitatCreationAndEnhancement_P01_2_KJ.mxd

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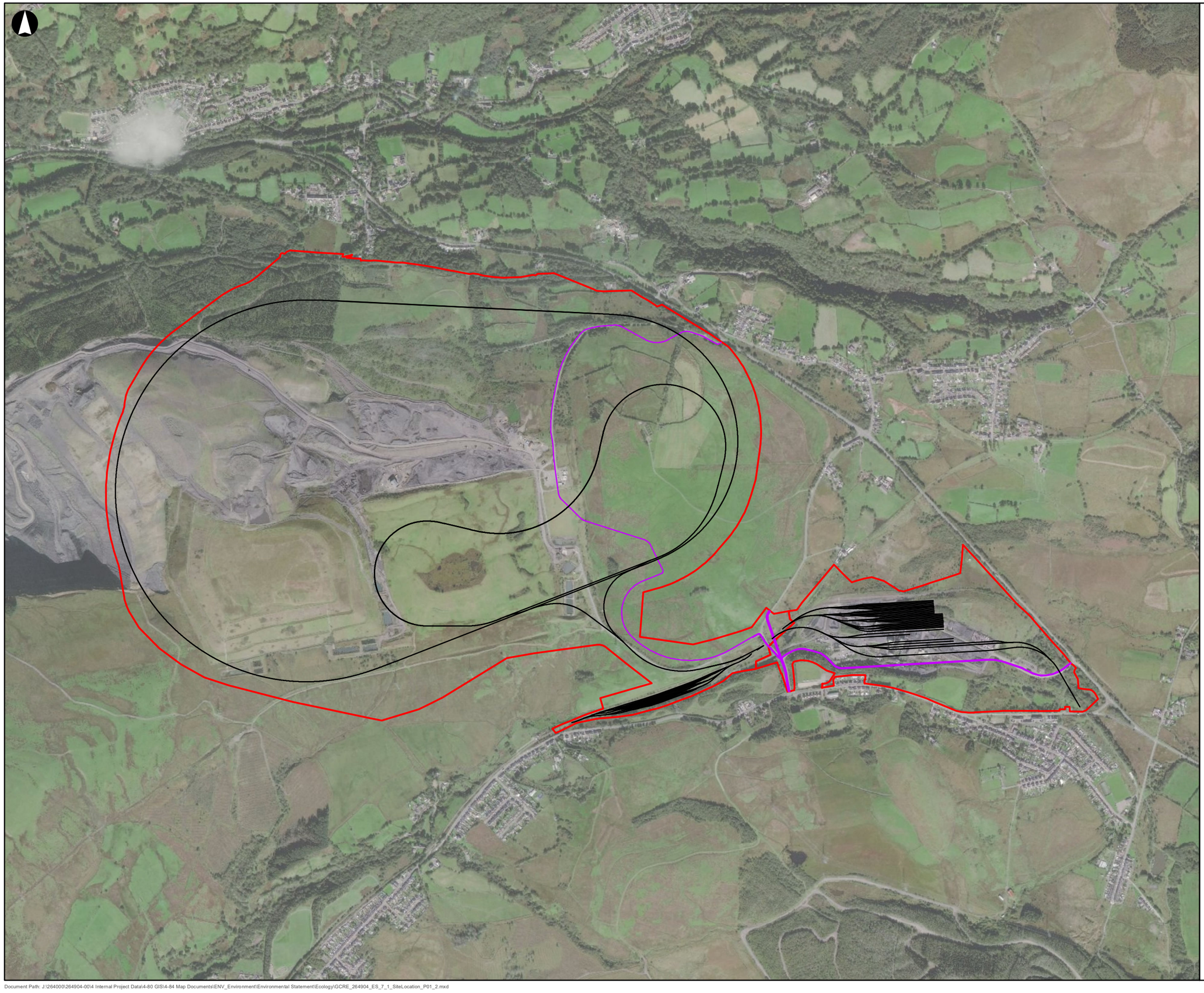
A3



Legend

- Planning Development Boundary
- Site Layout Plan
- Proposed Access Road

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Issue	Date	By	Chkd	Appd
P01.3	2020-08-05	KD	CP	NH

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SITE LOCATION

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Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
Figure 7.1	**P01.3**

Document Path: J:\264000\264904-00\4 Internal Project Data\4-80 GIS\4-84 Map Documents\ENV_Environment\Environmental Statement\Ecology\GCRE_264904_ES_7_1_SiteLocation_P01_2.mxd

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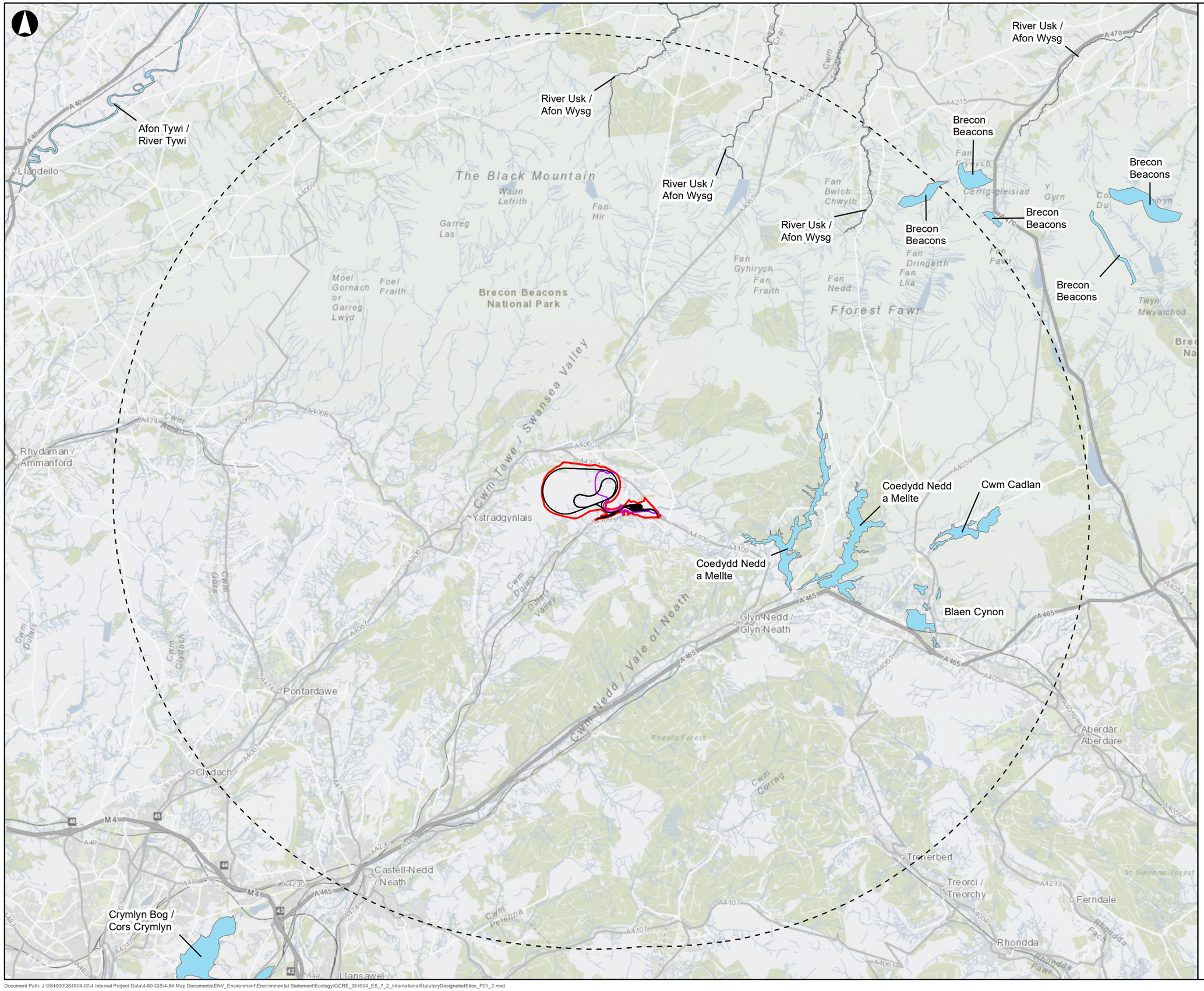

Legend

- Planning Development Boundary
- Site Layout Plan
- Proposed Access Road
- Study Area - 15km Buffer
- Special Area of Conservation (SAC)

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Figure Title

INTERNATIONAL STATUTORY DESIGNATED SITES

Scale at A3

1:125,000

Job No	Drawing Status
264904	**For Issue**

Drawing No	Issue
Figure 7.2	**P01.3**

Document Path: J:\264000\264904-00\4 Internal Project Data\4-80 GIS\4-84 Map Documents\ENV_Environment\Environmental Statement\Ecology\GCRE_264904_ES_7_2_InternationalStatutoryDesignatedSites_P01_2.mxd

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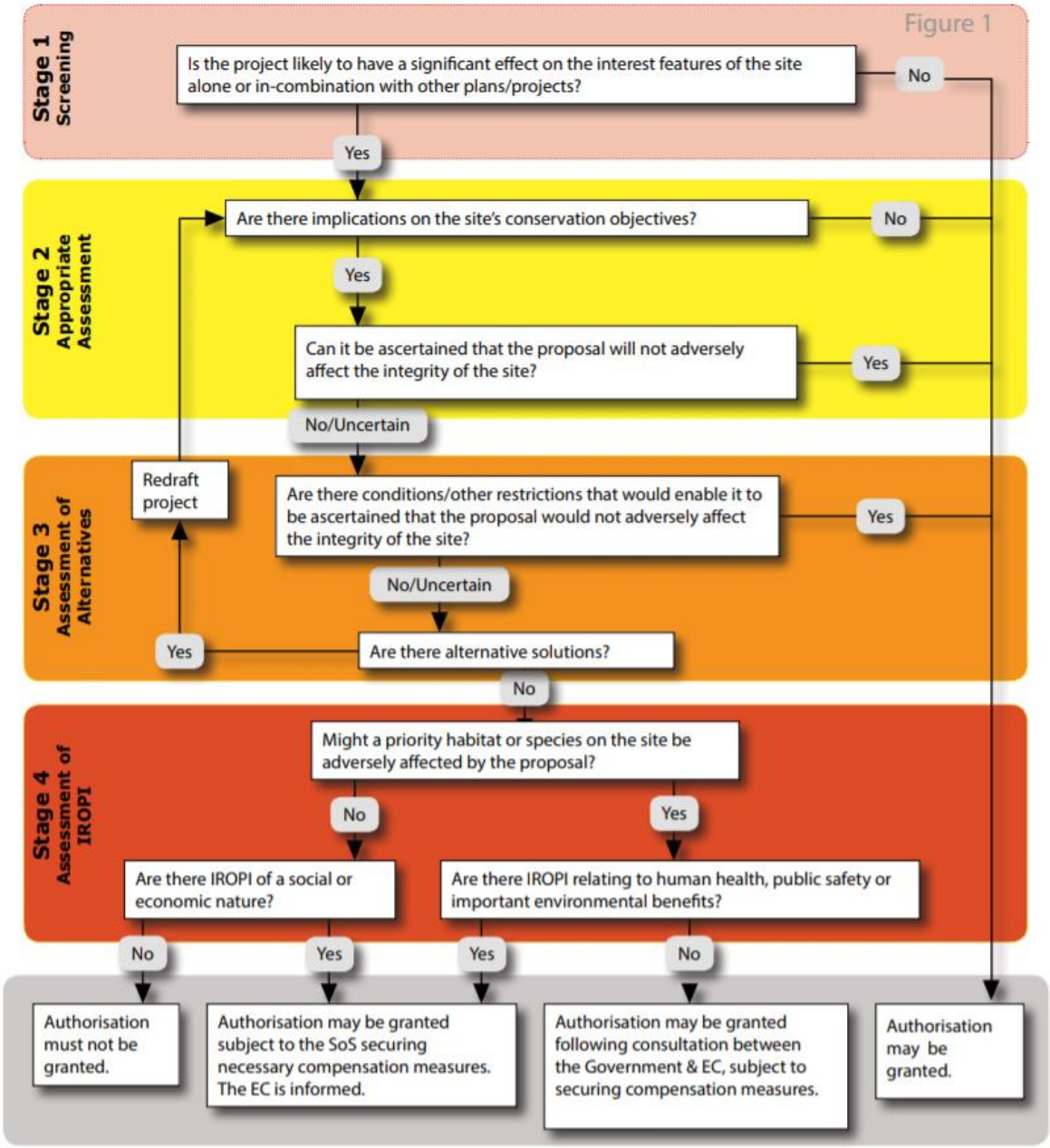
Appendix A

Habitats Regulations Assessment Process

A1 Habitat Regulations Assessment Process



Copied from: The Planning Inspectorate, 2017. Habitat Regulations Assessment relevant to nationally significant infrastructure projects. Version 8, November

Appendix 7R

Evaluation of Impacts on
Important Ecological Receptors

Appendix 7R Evaluation of Impacts on Important Ecological Receptors

Evaluation of impacts on IEF, where impacts are likely to occur on the future baseline. The significance of effects presented in the right-hand columns, both adverse and beneficial, is determined by both using the CIEEM EcIA methodology.

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
Future Baseline								
Designated sites								
Designated National Sites - Nant Llech and Gors Llyn SSSI	National	Habitat degradation	Habitat degradation	Significant	Implementation of standard air and water quality pollution control measures during site clearance, construction	N	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					and operation. Details to be provided within CEMP / EPP and long term management / monitoring plan.			
Ancient woodland	County	Habitat degradation / disturbance	Habitat degradation / disturbance	Significant	Implementation of standard air and water quality pollution control measures during site clearance, construction and operation. Details to be provided within CEMP / EPP and long	N	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					term management / monitoring plan. Protection of ancient woodland during construction / operation through establishment of buffer zones and use of fencing. Details to be provided within EPP, CEMP and EMMP.			
Notable Habitats								

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
Mosaic of habitats in the Washery: marshy grassland, species rich grassland, heathland and standing water.	County	Habitat loss and habitat degradation / disturbance	Habitat degradation and disturbance	Significant	Small-scale habitat creation within the Washery. Establishment of short including swales etc, and species rich acid grassland on railway embankments. Retained marshy grassland and species rich grassland within the wahsrey to be enhanced through management. Habitats will be subject to long term monitoring. Implementation of standard air and water	N	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					quality pollution control measures during site clearance, construction and operation. Details to be provided within CEMP, EMMP and EPP. Protection of adjacent habitats during construction and operation through establishment of buffer zones and use of fencing. Details to be provided within EPP and EMMP.			

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
Mosaic of retained and newly created habitats in Nant helen: marshy grassland, heathland, and peatland – bog habitats	County	Habitat degradation / disturbance and habitat fragmentation	Habitat degradation / disturbance and habitat fragmentation.	Significant	Re-siting of proposed new waterbodies within the Nant Helen site, to avoid impacts from the road. Implementation of standard air and water quality pollution control measures during site clearance, construction and operation. Details to be provided within CEMP, EMMP and EPP. Protection of adjacent habitats during	N	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					construction and operation through establishment of buffer zones and use of fencing. Details to be provided within EPP and EMMP. Habitats will be subject to long term management and monitoring.			
Species								

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
Fungi	County / local	Habitat loss and habitat degradation / disturbance	Habitat degradation / disturbance	Significant	Implementation of standard air and water quality pollution control measures during site clearance, construction and operation. Protection of fungi-rich habitats adjacent to clearance / construction activities. Establishment of short, species rich grassland on railway embankments, and where possible small scale habitat creation in the Washery through the re-	Y	Significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					use of coal spoil and or other suitable substrate. Habitats will be subject to long term management including scrub control, and monitoring.			
Invertebrates	County	Habitat loss, and habitat disturbance / degradation	Habitat degradation / disturbance, and harm / mortality	Significant	Avoidance of use of devils bit scabious in planting scheme for Nant Helen restoration. Implementation of standard air and water quality pollution control measures during site clearance, construction	Y	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					and operation. Protection of adjacent retained habitats during construction and operation. Small-scale habitat creation within the Washery. Establishment of short, species rich grassland on railway embankments. Habitats will be subject to long term management and monitoring. Opportunities to be sought for additional			

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					habitat provision on green / brown roofs within the Washery.			
Amphibians	Local	Habitat loss, habitat degradation, habitat fragmentation and harm / mortality	Habitat degradation, and harm / mortality	Not significant	Implementation of standard air and water quality pollution control measures during site clearance, construction and operation. Protection of adjacent retained habitats during construction and operation. Sensitive clearance of vegetation (in accordance	N	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					with reptile clearance methods). Small-scale habitat creation within the Washery. Establishment of short, species rich grassland on railway embankments. Habitats will be subject to long term management and monitoring. Opportunities for additional habitat provision in SuDS. Any reptile refugia created			

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					would also be suitable for amphibians.			
Reptiles	Local	Habitat loss, degradation, habitat fragmentation and harm / mortality	Habitat degradation, and harm / mortality	Not significant	Implementation of standard air and water quality pollution control measures during site clearance, construction and operation. Protection of adjacent retained habitats during construction and operation.	N	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					Sensitive clearance of vegetation, and reptile translocation programme. Small-scale habitat creation within the Washery. Establishment of short, species rich grassland on railway embankments. Habitats will be subject to long term management and monitoring. Opportunities for additional habitat provision through			

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					creation of reptile refugia.			
Birds (Breeding and Wintering)	Local	Habitat loss, degradation, disturbance and harm / mortality	Habitat degradation, disturbance and harm / mortality.	Not significant	Implementation of standard air and water quality pollution control measures during site clearance, construction and operation. Protection of adjacent retained habitats during construction and operation. Sensitive clearance of vegetation and pre-clearance checks for	Y	Not significant	Not Significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					nesting birds, ensuring suitable buffers provided to protect any nesting birds from disturbance where necessary. Small-scale habitat creation within the Washery. Establishment of short, species rich grassland on railway embankments. Habitats will be subject to long term management and monitoring.			

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					Barn owl box to be provided >3 km from the Site. Opportunities for additional habitat provision through creation of bird boxes on buildings and trees within / adjacent to the Site.			
Badger	Local	Habitat loss, degradation, disturbance, habitat fragmentation	Habitat degradation, disturbance	Not significant	Sensitive clearance of vegetation and pre-clearance checks for badgers.	N	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
		and harm / mortality	and harm / mortality		Closure of badger setts under licence, in accordance with approved method statement. Mitigation during construction and operation comprising sensitive lighting and limiting construction vehicles to low speeds. In addition, there will be the provision of ramps in open excavations where necessary, during construction.			

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					Opportunities for providing connectivity beneath tracks, through appropriate culvert provision.			
Otter	Local	Habitat loss, degradation, disturbance, habitat fragementation and harm / mortality	Habitat degradation, disturbance, harm / mortality	Not significant	Implementation of standard air and water quality pollution control measures during site clearance, construction and operation. Protection of adjacent retained habitats during construction and operation.	N	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					Sensitive clearance of vegetation and pre-clearance checks for otter. Mitigation during construction and operation comprising sensitive lighting and limiting construction vehicles to low speeds. In addition, there will be the provision of ramps in open excavations where necessary, during construction.			

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					Creation and enhancement of habitat mosaic post construction, providing good connectivity. Management to maintain and enhance habitats through management and monitoring plan Provision of habitat connectivity beneath tracks, through installation of culverts suitable for otter. Landscaping implemented which			

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					directs otters through culverts. Opportunities for additional habitat provision through creation of otter holt within the Site or adjacent habitats.			
Bats (roosting and foraging / commuting)	Local / County	Habitat loss, fragmentation, disturbance, harm / mortality	Disturbance and harm / mortality	Significant	Implementation of standard air and water quality pollution control measures during site clearance, construction and operation. Protection of adjacent retained	Y	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					habitats during construction and operation. Sensitive clearance of vegetation and pre-clearance checks for bats in trees with low potential. Mitigation during construction comprising implementation of sensitive lighting scheme. Creation and enhancement of habitat			

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					mosaic post construction, providing good connectivity. Management to maintain and enhance habitats through management and monitoring plan Provision of habitat connectivity beneath tracks, through installation of culverts suitable for bats. Landscaping implemented which directs bats through culverts.			

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					Opportunities for additional habitat provision through creation of bat boxes on buildings and trees within / adjacent to the Site.			
Notable mammal species	Local	Habitat loss, habitat disturbance / degradation and harm / mortality	Habitat degradation / disturbance and harm / mortality	Not significant	Implementation of standard air and water quality pollution control measures during site clearance, construction and operation. Protection of adjacent retained habitats during	N	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					construction and operation. Mitigation during construction comprising sensitive lighting, provision of ramps in open excavations where necessary and limiting construction vehicles to low speeds. Sensitive lighting in place during operation.			

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					Creation and enhancement of habitat mosaic post construction, providing good connectivity. Management to maintain and enhance habitats through management and monitoring plan.			
Invasive Non Native species (INNS)	Local	Disturbance	Disturbance		Production of INNS management plan, and implementation during site clearance and construction.	Y	Not significant	Not significant

Important Ecological Receptors	Value of receptor	Potential impact during construction	Potential impact during operation	Significant of potential impact without mitigation	Mitigation and enhancement measures	Monitoring required (Y / N)	Short term (<10 years) significance of potential impact further to implementation of mitigation including enhancements	Long term (>20-30 years) significance of potential impact further to implementation of mitigation including enhancements
					Management to maintain absence of INNS through management and monitoring plan.			

Appendix 8A

Historic Environment Baseline Assessment

Welsh Government

Global Centre of Rail Excellence

Historic Environment Baseline

Issue PO1 | 16 September 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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Document Verification 1

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Appendix A: Historic Environment Baseline Assessment

A1 Introduction

A1.1 Background to the project

A1.1.1 This is an assessment of the cultural heritage baseline of the proposed scheme and should be read in conjunction with Chapter 8 of the Environmental Statement. Its purpose is to:

- summarise the known archaeology, built heritage and historic landscapes of the site and its surrounding area;
- identify previously unrecorded heritage assets from a variety of desk-based sources and walkover survey;
- make an assessment of the archaeological potential of the site; and
- describe the value of heritage assets potentially impacted by the proposed scheme, including the contribution made to their value by their setting if relevant.

A1.2 Consultation

A1.2.1 The methodology for this baseline assessment was submitted as a Written Scheme of Investigation to Clywd Powys Archaeological Trust (CPAT) and Glamorgan-Gwent Archaeological Trust (GGAT). Further details of consultation carried out for the proposed scheme can be found in Chapter 8 of the Environmental Statement.

A2 Methodology

A2.1.1 The Chartered Institute for Archaeologists (CIfA) guidance on historic environment desk-based assessments (DBA) states that "where the project is carried out within the planning process, the report should contain sufficient objective data to enable 'an informed and reasonable decision to be made' including a decision to require further evaluation of the site"

A2.1.2 These data are used to inform our understanding of the presence and significance of known heritage assets, and the potential and significance of previously unknown heritage assets. A professional judgement based on the requirements of the assessment, the nature of the site and the impact the proposed scheme has on it, has led to several scales being used to define the study area. Firstly, in order to allow full consideration of the potential implications of the development on the setting of heritage assets, a 5km outer study area buffered from the site boundary has been used to identify those heritage assets most likely to be sensitive to changes in their setting (World Heritage Sites, Grade I and II* Listed Buildings and Historic Parks and Gardens and Scheduled Monuments). A smaller inner study area of 3km from the boundary of the site has been used to identify Historic Landscape Areas, Grade II Listed Buildings and Grade II Historic Parks and Gardens.

A2.1.3 The site is located on Mynydd y Drum, a long ridge dividing the Swansea Valley to the north from the Dulais Valley to the south. Its landscape context, which will have constrained the types of land use in the past, has an upland character different to the valleys to the north and south. This, in addition to the density of known non-designated heritage assets within and around the site, has informed the decision to use a study area of 500m buffered from the site boundary for the assessment of non-designated heritage assets. This will be used to inform an assessment of the archaeological potential of the site.

A2.1.4 Baseline data has been collected from the following sources:

- Cadw datasets of designated heritage assets;
- National Monuments Record of Wales dataset held by RCAHMW for archaeological sites and events (license no. RCPL2/3/64/166);
- Historic Environment Record (HER) data held by GGAT (ref: 5923) and CPAT (ref: E6427);
- Welsh Government LANDMAP, LiDAR data and historical aerial photographs;
- Historic maps, documents and local history publications (the collections of Ystradgynlais Library, Glamorgan Archives, West Glamorgan Archives, Powys County Archives Office and the National Library of Wales were consulted);

- Historic Ordnance Survey mapping;
- Online sources; and
- Site walkover survey (19.09.2019 and 15.11.2019) to identify any visibly surviving archaeological remains within the site and to inform the discussion of the landscape context of the site and the potential for impacts resulting from changes to the setting of heritage assets across the study area.

A2.1.5 Heritage asset information was compiled into a gazetteer which is included in Section A8A8. Each heritage asset was given a number with the prefix CH[1], corresponding to a label on Figures 8.1-8.2. Where multiple references applied to the same heritage asset they were grouped together to allow greater legibility of the figures.

A2.1.6 The potential for hitherto unknown buried archaeology is based on currently known archaeological remains from the study area alongside knowledge of the wider area, past land use and consideration of the topography and location of the site in relation to typical remains from a particular period. Potential can be negligible to high with the criteria given in Table A-1.

Table A.1 Archaeological Potential

Potential	**Definition**
High	Known archaeological remains of the period within the site area, or an abundance of remains of the period within the near vicinity.
Medium	A number of archaeological remains of the period are present in the vicinity or wider area, and/or the topography or location of the site would be typical for remains of that period.
Low	Few sites of a specific period are known in the wider area, or where the topography of the site is unlikely to contain remains of that period. Or where no archaeological records of a certain period are present, but the location of the site is one that would be considered suitable or typical for remains of that period to exist.
Negligible	Where there is no evidence for archaeological remains of a certain period to be present and the location/topography is most unlikely to contain remains of that period, or where a site area has already been totally disturbed.

[1] Due to the linked nature of the Nant Helen Complementary Earthworks application and the GCRE application a shared baseline was initially developed. Due to the differences in the study area, the small number of heritage assets added to the GCRE application baseline have been given an individual number starting from CH200.

A3 Archaeological and Historic Background

A3.1 Time periods

A3.1.1 The archaeological and built heritage of the study area, as defined is discussed below. The historical periods used are based on the chronology for Wales available from the Forum on Information Standards in Heritage (FISH)[2].

Table A.2 Time periods

Period name	Date range
Palaeolithic	From the earliest appearance of humans in the British Isles to the end of the last Ice Age around 8,500 years BC.
Mesolithic	8,500 – 4000 BC
Neolithic	4,000 – 2,200 BC
Bronze Age	2,200 – 700 BC
Iron Age	700 BC – AD 43
Roman	AD 43 - 410
Early medieval	AD410 - 1086
Medieval	AD 1086 - 1536
Post-Medieval	AD 1536 – 1899
Modern	AD 1900 - present

A3.2 Geology and Topography

A3.2.1 The site is located to the south of the Black Mountains in Wales on Mynydd y Drum, a long ridge dividing the Swansea Valley to the north from the Dulais Valley to the south. The summit of the hill is c1km south-west of the site at c297m AOD. Much of the eastern part of the hill, including most of the area within the site, has been opencast mined. Nant Helen coal mine currently includes an area of retained overburden in the south-west of the site and an open pit to the its eastern area transformed by opencast mining at the Nant-Helen Coal mine which, at the time of writing, included areas of retained overburden and an open pit to the north-west. The base case for this

[2] FISH (no date) *Chronology* [RCHAMW data link]. Available at: http://www.heritage-standards.org.uk/chronology/

assessment is the restored opencast mine, including two rings of earthwork cuttings and embankments.

A3.2.2 The underlying bedrock geology of the site is made up of the South Wales Middle and Lower Coal Measures formations, which formed in the Carboniferous period around 300 million years ago[3]. In the lower lying parts of the site the coal measures are overlain with glacial till, with a smaller area of peat formerly in the centre of the site (within an area subsequently removed by opencast-mining).

A3.2.3 The geology of the site has been an important influence in its historical development. Throughout the post-medieval period there was small-scale mining and quarrying, eventually leading to the larger scale extraction required from the end of the 19th century to power the nearby ironworks. In the last few decades the majority of the site has been subjected to opencast mining, dramatically altering the topography and below ground make-up of the site.

A3.3 Prehistoric

A3.3.1 There are seven heritage assets of prehistoric date within the site, including findspots, burial mounds and a settlement site, most of which were investigated prior to the opencast mining of the site. Within the 500m study area there are three further prehistoric heritage assets, one of which is a Scheduled Monument. Out of the 21 Scheduled Monuments located in the wider 5km study area, seven are also prehistoric in date.

A3.3.2 There is limited evidence from the Palaeolithic period in Wales as a whole, with the last glaciation appearing to have removed the majority of evidence from this time [4]. The earliest clearly datable evidence from within the 500m study area dates to the Neolithic. However, a Mesolithic chert implement (CPAT: 5307) was found c.870m north of the site in Abercrave close to the River Tawe suggesting, if tentatively, that Mesolithic hunter-gatherers may have been active in this river valley. Further evidence of this comes from pollen extracted and analysed from peat deposits in the central part of the site, now removed by mining, which suggests that woodland was being deliberately burnt during the Mesolithic, potentially to create clearings for hunting.[5]. Prior to the opencast mining of the site, a flint flake was found during the excavation of a Bronze Age barrow (CH020), which may also be of Mesolithic date.[6]

[3] British Geological Survey (2018) *Geoindex Onshore.* Available at: http://www.bgs.ac.uk/GeoIndex/home.html.
[4] RFAW (2004) A Research Framework for the Archaeology of Wales: Palaeolithic and Mesolithic. Available at: https://www.archaeoleg.org.uk/paleo.html.
[5] Dorling, P. and Chambers, F.M. (1990) 'Field Survey, Excavation and Pollen Analysis at Mynydd y Drum, Ystradgynlais, Powys, 1983 and 1987', in *Bulletin of the Board of Celtic Studies* 37, pp215-246; CH036.
[6] Dorling and Chambers (1990) p230.

A3.3.3 One Neolithic artefact has been found within the site, a stone axe head found in an area which has been subsequently opencast (CH033). There is considerable debate about the purpose of Neolithic stone axes making it difficult to establish what the presence of it might mean in the context of the site. While they may have had a functional purpose, associated with the clearance of land for the spread of farming, the activity which characterises the transition to the Neolithic, stone axes may also have had a ritual function with scholars noting the potentially unnecessary amounts of effort going into their production and trade. It has been variously suggested that polishing the axes made them less likely to break, brought out their colours making their source more apparent, or that their transformation itself was a symbolic act.[7] The stone axe was found on higher ground, but may not be in its original context given the heavily quarried and mined history of this landscape. What it does indicate, however, like the Mesolithic chert implement, is that there were people in this area in the Mesolithic and Neolithic periods, although the potential for further discovery of archaeological remains of these periods within the site is limited by extensive later industrial land use.

A3.3.4 The majority of prehistoric archaeological evidence within the study area dates to the Bronze Age. Environmental samples were taken from an area of peat in the central part of the site prior to opencast mining. Analysis of the samples indicated that the landscape had been largely cleared of forest by the Bronze Age and was an open environment of heath and hazel scrub (CH036). This is the trend across the wider region, with pollen evidence from the Brecon Beacons showing a similar pattern of tree felling opening up the landscape for prehistoric farmers.[8] The climate would have been warmer during the Bronze Age than it is now and the upland peat bogs which are now prevalent had not yet formed making the type of landscape that the site is located in suitable for farming and habitation.[9] There is no definitive domestic evidence of Bronze Age date, although a settlement site of potentially prehistoric date was recorded prior to opencast mining, including a possible hut site and sections of boundary banks as well as clearance cairns (CH040). There is, however, considerable evidence for ritual and burial activity. Within the study area four Bronze Age cairns have been identified, although one only tentatively. These form part of a larger alignment of cairns along the ridge of Mynydd y Drum, with three further cairns located outside the study area (GGAT:00535-7w). The most westerly cairn within the study area, Bryn Llechwen, is a Scheduled Monument (CH002) and is located at the end of a slight plateau with views in all directions.

[7] Cummings, V. (2002) 'Experiencing texture and transformation in the British Neolithic', in *Oxford Journal of Archaeology* 21 (3), pp249-261; p257.
[8] BBNPA (2012) *Brecon Beacons National Park Landscape Character Assessment*. Fiona Syfe Associates Ltd.
[9] Jenkins, G.H. (2007) *A Concise History of Wales*, Cambridge: Cambridge University Press.

A3.3.5 Two further cairns in this alignment were located within the site and were excavated prior to their destruction by opencast mining. The first of these, Carn Goch, had formerly been designated as a Scheduled Monument (CH020). Excavation revealed that it had been damaged by hole digging but an original cairn diameter of 15m was established, made up of large stones in the lower levels, with smaller stones in the upper part encircled by a wall or large stones. While no burials were found there was a flint scatter and rim sherds from two pottery vessels. The second cairn (CH038) was a similar size and revealed evidence of an internal structure, although no burials were found. A further possible cairn, also within the site, was located slightly to the north of the alignment of other cairns (CH035), its identification made difficult by its reuse as a modern sheepfold. As with CH020 and CH038 it has also now been destroyed by opencast mining.

A3.3.6 Other Bronze Age evidence includes the findspot of a socketed axe found during drainage in the north-western part of the site in 1955 (CH028). This was found within the site boundary but, as it is a findspot, will not be affected by development. Another Bronze Age artefact, a socketed spearhead, was found c.220m south of the site boundary, close to Dyffryn Cellwen (CH205). Within the larger 5km study area, however, there are several important Bronze Age sites. These include a stone row, comprising seven standing stones (CH081), a standing stone (CH090), a stone circle (CH091) and two further cairns (CH096-7). The site is a long ridge between two rivers, with much higher slopes rising to the north and south. These Bronze Age sites, all designated as Scheduled Monuments, look out over an expansive open landscape. With the palaeoenvironmental evidence (CH036) suggesting this was a landscape of open heathlands, the Bronze Age people who built and used these ritual sites would have experienced long views from them and it is likely that these views, and their setting on the hill slopes, was important to how they were understood.

A3.3.7 Towards the end of the prehistoric period, in the Iron Age, the site lay in the north-western part of land held by the Silures tribe, although their main centre is thought to have been at Caerwent, c.68km to the south-east.[10] While there is no known evidence from the Iron Age within the site or its immediate vicinity, a hillfort (CH088) and hut circle (CH089) are located c.4km and c.3km north-east respectively, indicating that the wider area continued to be occupied during this period.

A3.4 Roman

A3.4.1 While there is no evidence from the Roman period within the site itself, there is considerable evidence for Roman activity to the east

[10] Kessler, P. (2007) *Prehistoric Britain: Pre-Roman Britain 55 BC- AD 10*. Available at: http://www.historyfiles.co.uk/FeaturesBritain/BritishMapAD10.htm (Accessed: 20 December 2018).

where a Roman Fort, marching camp and section of road are known. The Roman military conquest of the territories of the Silures had been accomplished by the end of the AD 70s and the establishment of Roman control was accompanied by the construction of forts and roads throughout the region.[11] Located c.500m to the east of the site is a Roman marching camp, most likely dating to AD74-78 (CH084). A little further north is Coelbren Roman Fort (CH083), which was a medium sized auxiliary fort dating from c.AD75. Excavation of the fort showed that it had a standard layout of timber buildings in the interior. It was abandoned c.AD 140-150.

A3.4.2 During the period of Roman occupation and rule in Wales military power was underpinned by logistical infrastructure[12]. Roads were established across the country, connecting fortresses, auxiliary forts and marching camps. One of these roads connected Neath to Y Gaer (near Brecon) and entered and exited Colbren Roman Fort from its south and eastern gates. A section of the road to the north-east of the fort is still extant, with parts of the original road surface still visible in places. It is a Scheduled Monument (CH082). While the road, known as Sarn Helen, only survives in places it is believed to have run to the along the ridge of Hirfynydd, where another Scheduled Monument, a Roman signal station, is located (CH094).

A3.5 Early Medieval

A3.5.1 The early medieval period is considered one of the most significant in the history of Wales, the 'heroic age' when the Welsh identity and language were being formed.[13] Historic records indicate that this was a time of considerable political struggle and change, with internal conflicts between the multiple kingdoms coinciding with external threats from the Anglo-Saxons and the Vikings. In many ways, however, there was continuity from the preceding Roman era.[14] The site lay either at the southern extent of the kingdom of Brycheiniog or at the northern boundaries of the kingdom of Glywysing.[15]

A3.5.2 There are no early medieval heritage assets within the site itself but a fragment of the shaft of a cross-slab was found c.350m south of the site, near Onllwyn (CH003). The carved stone shows part of a figure praying. Another inscribed stone was found in Colbren (CPAT:683), just beyond the study area, c.515m east of the site. It was found near the current chapel, which is 18th century but may have replaced an earlier predecessor. Two further carved stone fragments were found at

[11] Sherman, A. and Evans, E. (2004) *Roman Roads in Southeast Wales: Desk-based assessment with recommendations for fieldwork*. Swansea: GGAT, p4.
[12] Jenkins, G.H. (2007) A Concise History of Wales, Cambridge: Cambridge University Press
[13] Edwards, N., Lane, A., Bapty, I. and Redknap, M. (2005) Early Medieval Wales: A Framework for Archaeological Research. Available at: https://www.archaeoleg.org.uk/pdf/earlymed/VERSION%2001%20EARLY%20MEDIEVAL.pdf; and Jenkins, G.H. (2007) A Concise History of Wales, Cambridge: Cambridge University Press.
[14] Walker, D. (1990) Medieval Wales. Cambridge: Cambridge University Press.
[15] Jenkins, G.H. (2007) A Concise History of Wales, Cambridge: Cambridge University Press.

Ystradgynlais Church, beyond the study area, and it is also possible that there was an early medieval church site there. While these discoveries of inscribed stones are not accompanied by other evidence for early medieval settlement within the study area, they indicate that the area was occupied in the early medieval period and that it is likely that there was at least one church. The carved stones were found in the valleys and it is unlikely that the upland area of the site was used for anything other than pasture during this time.

A3.6 Medieval

A3.6.1 The Norman Conquest led to the former Welsh territories becoming Marcher lordships which operated largely independently from the king in England. Alongside the castles and church architecture that accompanied this change, the Normans also brought with them their manorial system, characterised by cultivation in common fields with marginal upland areas becoming common pasture. [16] Just beyond the site, to the west, there is the record of a large rounded platform, possibly the site of a domestic dwelling now believed to have been removed by opencast mining (CH019). Other evidence of medieval rural settlement in the area includes a possible seasonal hafod (summer pasture) dwelling at Coed Ddu (CH095), an early 15th century hall house (CH079), and one of three possible sites for Blaendulais, a monastic grange known from documentary sources (CH201).

A3.7 Post-Medieval

A3.7.1 The Act of Union of 1536 joined Wales to England and replaced the previous marcher lordships with 13 shires, including Breconshire and Glamorgan, the site being located on the border between the two. [17] Outside of the political changes this brought about, the end of the medieval period had also seen increased temperatures which once again opened upland areas for settlement and agriculture.[18] From the beginning of the post-medieval period onwards an increasing number of buildings survive, providing evidence of settlement patterns and the economy.[19] An important source of information about the development of the area during the post-medieval and modern periods are historic maps, with many of the structures, industrial works and buildings shown on them included within the HERs. Other features, including those identified from walkover and LiDAR survey

[16] Davies, M. (1967) 'Medieval to Modern Times: The Changing Landscape', in Davies, M. (ed) Brecon Beacons National Park Guide No.5. London: Her Majesty's Stationery Office, pp39-48.
[17] Jenkins, G.H. (2007) A Concise History of Wales, Cambridge: Cambridge University Press
[18] Davidson, A., Davies, W. and Gray, M. (2017) A Research Framework for he Archaeology of Wales: Medieval. Available at: https://www.archaeoleg.org.uk/pdf/review2017/medreview2017.pdf.
[19] CPAT (1994) Windows on the Past: a review of the first 20 years of discovery by CPAT. Available at: http://www.cpat.org.uk/cpat/past/window.htm.

(discussed below) that are not included within the HER have been added to the gazetteer.

A3.7.2 The majority (86) of heritage assets within the study area date to the post-medieval period. These relate to post-medieval farming, industry and settlement. Prior to the large-scale industrial development of the region in the 19th century the site would have been used as upland pasture and subsistence agriculture, with much of Mynydd y Drum remaining as common land to this day. Upland areas, such as those within the site, were used for sheep farming, breeding rabbits and the harvesting of natural resources such as fern, gorse and kindling[20]. Within the study area there are a number of heritage assets which reflect the agricultural practices and the houses of those who worked the land, including traces of ruined dwellings (CH019, CH037, CH207), enclosures, banks and clearance cairns (CH045-47 and CH049) and sheepfolds (CH024, CH041-2 and CH044). Many of those within the site were recorded in advance of opencast mining and no longer survive.

A3.7.3 While the first major coal mining and industrial works did not begin until the later 18th century, there was small scale coal extraction within the study area from a much earlier date. Bell pits and small depressions and scoops created by small-scale opencast mining (CH039, CH1063) have been recorded, indicating that the coal here was being exploited prior to the opening of the large collieries. Iron had been smelted at Ynysgedwyn Colliery (CH085, c1.15km west of the site) as early as the 16th century but the local coal is anthracite, a difficult fuel to burn[21]. It was at Ynysgedwyn, in 1838, that anthracite was first used for iron smelting[22], an innovation which was to lead to the dramatic industrialisation of the study area in the 19th century. Late 19th century mapping (see A3.10) shows many traces of earlier industrial activity, including old quarries, old coal levels and disused ironstone pits. Through the historic maps a succession of collieries, tramways and railways can be identified, illustrating the evolution of the study area as it came to be one of the world's leading iron processing areas and known as the 'iron cradle'[23].

A3.7.4 There are several post-medieval collieries located within the site and the 500m study area (CH026, CH030, CH062, CH064, CH066), many of which had associated buildings, tramroads and other infrastructure. This is in addition to numerous shafts, airshafts and levels shown on 19th century maps (CH014-6, CH022-3) and physical evidence of mining recorded archaeologically (CH034, CH039, CH063). The other major industry in the area was ironworking and there are several

[20] Leighton, D.K. and Silvester, R.J., (2003) 'Upland Archaeology in the Medieval and Post-Medieval Periods', in Browne, D. and Hughes, S., (eds.) The Archaeology of the Welsh Uplands. Aberystwyth: RCAHMW
[21] Ley, L. (2005*) The Iron Cradle. Ystradgynlais and the Upper Swansea Valley*. Glamorgan Press, Neath.
[22] *Ibid.*
[23] *Ibid.*, p10.

ironworks within the study area (CH008, CH077 and CH092). Related to ironworking there are ironstone quarries (CH009 and CH058), limestone quarries, a lime kiln (CH202), and the tramways to bring the limestone to the ironworks (CH087 and CH204).

A3.7.5 The extractive industries located within the site required connections to the ironworks and other industries in the area, which made the transport infrastructure which developed across the site so significant. The Swansea Canal had been built to the north-west of the site at the end of the 18th century[24]. The canal connected Swansea to Abercraf, allowing coal and other resources to be transported along the Swansea Valley to the docks at Swansea.[25] The Brecon Forest Tramroads were built to the north-east of the site in the early decades of the 19th century, connecting the limestone quarries in the Brecon Beacon to the Upper Swansea Valley.[26]

A3.7.6 Within the site runs the Ystradgynlais Tramroad, or 'Claypon's Extension', which is a Scheduled Monument (CH001). It was built in the 1830s to link the Brecon Forest Tramroad and the Swansea Canal with Drum Colliery and the ironworks at Ynscedwyn and it is shown on the 1844 tithe map as a single black line crossing 'Drim Common'.[27] Both the Brecon Forest Tramroad and the Ystradgynlais extension were a hybrid between the earlier horse drawn mineral railways and the later locomotive railways.[28] The Brecon Forest Tramroad was the work of the Scottish entrepreneur John Christie, taken on by his creditor Joseph Claypon following Christie's bankruptcy.[29] Branch lines were later added to the Ystradgynlais extension, connecting it to the new collieries at Onllwyn (CH066)and the Banwen ironworks (CH092).[30]

A3.7.7 Further development of the transport infrastructure of the area came with the opening of the railways. Two lines run close to the site, with the Dulais Mineral Railway, later the Neath and Brecon Railway (CH055), to the south and the Swansea Vale Junction Railway to the north (CH050). The Dulais Mineral Railway was incorporated in 1862, built to connect the collieries in the valley. The Swansea Vale Junction Railway was built by the same company to connect the Dulais Valley Mineral Railway to the Midland Railway operated line in the Swansea Valley[31]. The northern boundary of the site, now a

[24] *Ibid.*
[25] Hadfield, C. (1967) The Canals of South Wales and the Border. Newton Abbot: David and Charles.
[26] Hughes, S. (1990) The Brecon Forest Tramroads. Aberystwyth: RCAHMW.
[27] Hughes, S. (1990), p23; Williams, W., Williams, H, and Martin, T.L. (1844) *Map of the parish of Ystradgunlais in the County of Brecon* (Map). Available at: https://places.library.wales/viewer/4623747#?cv=0&h=2514&c=0&m=0&s=0&xywh=-6049%2C12134%2C36736%2C13889. Cannot be reproduced due to copyright restrictions.
[28] Hughes (1990), p9
[29] Hughes (1990)., p23
[30] Hughes (1990), p23
[31] Welsh Railways Research Circle (no date) *Neath and Brecon Railway (and related lines).* Available at: http://wrrc.org.uk/n&brc.php.

Sustrans bicycle trail, runs along the route of the Swansea Vale Junction Railway, which later became the Neath and Brecon Railway.

A3.7.8 With the growth of the industries in the Swansea and Dulais Valleys there was also rapid settlement growth, with villages growing in the valley to the north and south of the site, served by chapels and schools. Several listed buildings within the study area form part of these settlements. Further north, on the edge of the Brecon Beacons, the large country house of Craig-y-Nos (CH099) was built in the mid-19th century, its expense bankrupting Rhys Davies Powell who had commissioned it. In 1879 it was bought by the opera singer Adelina Patti who had a theatre (CH100) built and a large extension and gardens added. Both the country house and its gardens are designated Grade II*, as a Listed Building and Registered Park and Garden respectively. The theatre is a Grade I Listed Building.

A3.8 Modern

A3.8.1 There are 12 heritage assets of modern date located within the study area. These include the Nant Helen opencast coal mine (CH048) and the Onllwyn Washery to the south of it (CH061), both within the site. The washery was built in 1932 to service local drift mines. It has continued in use, serving the Nant Helen mine and Derlwyn mine, with the coal delivered by road. Earlier 20th century evidence of coal mining, from the Ordnance Survey 6":mile map of 1914, is also present within the site (CH025 and CH073). Several trackways and covered shafts were also identified during walkover survey which may also be modern in date (CH068-9) and areas of spoil were identified from historic maps (CH065). In Onllwyn there is an early 20th century Independent chapel (CH060) and a miners' welfare (CH052), both built to serve the mining community of the village. Two further churches, a corrugated iron church (CH210) and an independent chapel (CH206) are located in Dyffryn Cellwen. The war memorial in Seven Sisters is also a listed building (CH113).

A3.9 Unknown

A3.9.1 There are two records features of unknown date from the HER data - a clearance cairn (CH018) and a circular feature thought likely to be a quarry (CH203). Additionally, several raised trackways were identified in the northern part of the site during walkover survey (CH071). While these are undated, they are considered to be most likely to be modern in date, as they are not shown on historic mapping and cross areas of late 19th and early 20th century mine workings which would be expected to have removed earlier features.

A3.10 Cartographic and Remote Sensing

A3.10.1 In addition to collecting data on recorded archaeological remains and historic buildings, further research has been carried out to identify any

further potential heritage assets. This has included a review of historic maps, LiDAR imagery and historic aerial photographs. Heritage assets identified have been included within the gazetteer. As the majority of the site has been subjected to opencast coal mining in the latter part of the 20th century, this section, while describing the site as a whole, is particularly focused on areas outside of the opencast mine.

A3.10.2 The earliest published map of Wales is Humphrey Llwyd's 1601 map *Cambriae Typus*, on which can be seen the mountains of the Brecon Beacons and the rivers flowing from them.[32] The lowland and coastal towns that are shown on this map are all at some considerable distance from the site, with the nearest being Swansea.

A3.10.3 The site is shown on the 1844 tithe map of the parish of Ystradgynalis (spelt 'Ystradgunlais'). The map and accompanying apportionment for the area of the site shows the majority of the site as featureless area marked as 'Drum Common'[33]. Around the edges of the site the tithe map shows enclosed fields and areas of woodland, predominantly marked as being pasture where this is noted.[34] The field names are predominantly descriptive, translating as 'tree field', 'hill field', 'rough' or 'gorse'. Occasionally there is some more specific indication of landuse, such as 'hay grass' or, in the case of one field in the north of the site, 'mine workings'. Claypon's Extension (CH001) is shown as a black line crossing the common.

A3.10.4 The 1st edition Ordnance Survey 6":mile map of Brecknockshire, surveyed in 1876-7[35], shows the traces of considerable earlier industrial activity within the area of the site, including old quarries, old coal levels and disused ironstone pits. The line of Claypon's Extension (CH001), marked as 'old tramway' crosses Mynydd y Drum, which is shown as an area of rough or heathy pasture interspersed with smaller areas of marsh and gorse. In the northern part of the site, where opencast mining has not taken place, the 1st edition map shows an area of small enclosed fields beyond the northern edge of the open common. One of the field boundaries shown still remains today (CH075). An 'old quarry' (CH070) is shown in the centre of this area. This feature is no longer extant. Running from east to west across the area is a trackway – this feature is still extant and was recorded during the walkover survey (CH071). The southern part

[32] NLW (2018*) Cambriae Typus*. [Digital version of Llwyd's 1601 map held by NLW, not available for commercial reproduction] Available at: https://viewer.library.wales/1446318#?c=0&m=0&s=0&cv=0&xywh=3846%2C3656%2C2711%2C2812.

[33] Williams, W., Williams, H, and Martin, T.L. (1844) Map of the parish of Ystradgunlais in the County of Brecon (Map). Available at: https://places.library.wales/viewer/4623747#?cv=0&h=2514&c=0&m=0&s=0&xywh=-6049%2C12134%2C36736%2C13889. Cannot be reproduced due to copyright restrictions.

[34] Williams, W., Williams, H, and Martin, T.L. (1844) Map of the parish of Ystradgunlais in the County of Brecon (Apportionment). Available at: https://places.library.wales/viewer/4552186#?cv=49&h=2514&c=0&m=0&s=0&xywh=-4220%2C-1%2C14199%2C4856.

[35] Historic Ordnance Survey maps are appended to Chapter 6: Ground Conditions.

of the site, where the washery is located today, was close to the Onllwyn Colliery (CH066) which is shown immediately to the south of the site boundary on the 1st edition map. 'Old quarries' associated with the colliery are also labelled (CH009). The Dulais Valley Mineral Railway (CH055), which crosses through the southern part of the site, is shown, in addition to a mineral railway branch which is still in use as part of the washery site. However, with the exception of the mineral railway, much of the land in the south-eastern part of the site is shown as being marshy and undeveloped.

A3.10.5 The 2nd edition Ordnance Survey 6":mile map (1903), which was surveyed in 1896, shows the increasing size of the mining settlements located beyond the limits of the site, particularly Seven Sisters. The existing collieries show further expansion and new collieries had opened. The northern part of the site, the area where opencast mining has not taken place, had also seen industrial expansion. An area of 'old levels (CH075) linked to the trainline in the north by an 'old tramway' (CH070) are shown, both features having been opened/built and gone out of use between the 1st and 2nd edition maps. Onwllyn Station (CH005) had been built on the Dulais Valley Mineral Railway, and the map shows a public house located next to it. Onllwyn Colliery (CH066) is shown as having large areas of spoil radiating out from it and into the southern part of the site.

A3.10.6 The Ordnance Survey 6": mile map of 1914 shows further development of the northern part of the site. Glynllech Colliery (CH025) had been opened, with a tramway linking it to the railway. A second drift mine is shown to the north-west of the colliery, also with an associated tramway (CH073).

A3.10.7 The area of the site is covered by a 1945 vertical aerial photograph (see A9) which show the majority of the site as an open upland area, crossed by Claypon's Extension (CH001) and with numerous small mine workings along its northern edge. Within the smaller area not subsequently opencast mined, numerous small pits and shafts can be seen, several of which are associated with large spoil tips. In the south-eastern part of the site the expansion of Onllwyn Colliery is clear, with much of the area covered by tips fed by aerial ropeways and with several buildings, including one labelled as a brickworks, forming part of the colliery complex. This has subsequently been redeveloped as the Onllwyn Washery, with the spoil tips either removed or reprofiled to an extent that they are no longer dominant landscape features. Lidar imagery of the washery site (see A9) shows areas of raised ground likely to be the result of reprofiling.

A3.10.8 Review of the Welsh Government's 50cm LiDAR data for the northern part of the site in combination with walkover survey (see below) has allowed the survival of these features to be determined. The quarry in the northern part of the site, shown on the 1st edition map, is no longer extant, presumably having been infilled and weathered down (CH070). Of the three tramways (CH072, CH025 and

CH073) only a small section of the one associated with Glynllech Colliery has any traces visible on the LiDAR data. No evidence of any of them was observed during the walkover survey. The drift mine, shown on the Ordnance Survey map of 1914 (CH073) is visible on the LiDAR imagery as a slight depression. Further, two small depressions on the LiDAR data which do not correspond with any mapped features, were identified as covered mine shafts, or air shafts, during walkover survey (CH68-9).

A3.11 Walkover Survey

A3.11.1 Walkover Survey was carried out across the site with particular attention paid to the southern area around Claypon's Extension and the northern area not previously subjected to opencast mining.

A3.11.2 Much of the site is formed of the active opencast mine and areas of restored fields. Claypon's Extension (CH001) is visible as an earthwork across the southern area of the site, mostly running immediately north of a modern trackway although the trackway crosses it at its eastern end (Photograph 8.1). No other previously unrecorded archaeological remains were identified in the southern part of the site.

A3.11.3 The northern part of the site comprises a series of small enclosed fields, much of which had considerable undergrowth obscuring possible archaeological remains. North of the site boundary tips associated with Glynnlech Colliery were visible, just to the south of the former railway line where the colliery tramway would have ended (Photograph 8.5).

A3.11.4 A historic field boundary was identified dividing two of the fields. This boundary matches one shown on the 1st edition Ordnance Survey map of 1877 and appeared to be of some antiquity (Photograph 8.2). It was formed of a raised bank with trees growing along it and frequent stones protruding from its surface suggesting it might at one point have had a stone wall.

A3.11.5 A raised bank running from east to west across the area was noted, along with two others connecting perpendicularly to it (CH071, Photograph 8.6). These can also be seen on the LiDAR data. The one shown in Photograph 8.6 runs from east to west and corresponds to a trackway shown on the Ordnance Survey 6":mile map of 1877 and later maps. The other banks, which connect with this, may be later as they do not correspond with any features shown on historic mapping. Indeed, comparison with the maps indicates that they would, if pre-dating the end of the 19th century, have been substantially disturbed by quarrying and mining. It is, therefore, most likely that these are relatively recent modern trackways used by the farmers who graze livestock in these fields.

A3.11.6 Although no traces of Glynnlech Colliery (CH025) or the drift mine (CH073) could be seen during the walkover, two covered shafts were identified (CH68-9, Photograph 8.3). These correspond with small depressions visible on the LiDAR but not to any features on historic maps. They are likely to be air shafts or mine shafts relating to the late post-medieval or early 20th century mining of this area.

A3.12 Archaeological Potential

A3.12.1 The archaeological potential of the site has been significantly affected by the large-scale opencast mining that has taken place within it. Within areas affected by opencast mining there is no potential for the survival of archaeological remains. Indeed, one of the reasons the archaeological and historical background of the site can be so well understood is due to extensive archaeological work carried out prior to this mining. The remaining areas of the site have had a mixture of past land uses, including extensive post-medieval and early 20th century mining and quarrying. Further, the base case for this assessment is the Nant Helen Complementary Earthworks scheme, which includes large cuttings and earthwork embankments running in an inner and outer loops. In the area of the earthworks themselves, it is assumed that all archaeological remains will either have been removed or are too deeply buried (ie below mine mining features) to be affected by the proposed scheme. There remains archaeological potential in the wider working area around them.

A3.12.2 Drawing on the baseline evidence the site can be broadly divided into the following areas:

- Area A: land where 20th century opencast mining has taken place;
- Area B: the area of the Nant Helen Complementary Earthworks scheme;
- Area C: area in the north of the site where intensive 19th century extraction is known to have taken place but which has not, subsequently, been opencast or affected by the Nant Helen Complementary Earthworks; and
- Area D: the area of the Onllwyn Washery and associate rail and road infrastructure.

A3.12.3 An assessment has been made of the archaeological potential of the different areas of the site based on the presence of known heritage assets and the most likely effects on survival from more recent land use. The potential is described from negligible to high, the definitions of which can be found in Table A-1. The three areas are shown on Figure 8.4.

Area A

A3.12.4 There is **negligible** archaeological potential for all periods as a result of the opencast mining that has taken place in this area.

Area B

A3.12.5 Within the footprint of the earthworks, both cuttings and embankments, there is **negligible** archaeological potential for all periods as a result of the construction of the Nant Helen Complementary Earthworks scheme. However, any areas which have not been subjected to topsoil stripping or other groundworks, especially in the southern part of the area which is crossed by the Tramroad at Ystradgnlais (CH001) there remains a **high** potential for 19th century and modern features associated with historic mining and quarrying.

Area C

A3.12.6 Area C is a small parcel of land in the north of the site. There is evidence of intensive 19th century extractive industry, including coal mining and quarrying and it is beyond the limits of the 20th century opencast mining and the Nant Helen Complementary Earthworks scheme. Analysis of historic mapping, LiDAR imagery, aerial photographs and walkover survey has identified several late 19th century and early 20th century heritage assets within this area. This includes the site of Glynllech Colliery (CH022), a field boundary (CH074), a late 19th century tramway (CH072) drift mine (CH073) and mine shaft/air shaft (CH069)

A3.12.7 The area is marshy and is likely to have been unsuitable for settlement in the past. While no peat has been identified in this area it is possible that peat deposits survive, which could have palaeoenvironmental potential. There is a **moderate** potential for palaeoenvironmental remains. However, given the marshy nature of the area and the known agricultural land use from the post-medieval period onwards, there is a **low** potential for archaeological remains predating the end of the post-medieval period. There are known post-medieval and modern heritage assets and there is a **high** potential for further buried remains of these features.

Area D

A3.12.8 Area D is in the south of the site and includes the area around Onllwyn Washery (CH061) with a narrower stretch of land along the Dulais Valley Mineral Railway, CH055). The 25”:mile Ordnance Survey map of 1876 shows that a large part of the area was marshy, labelling is as Gors Llwyn, which translates as boggy shrub. The railway line crosses the site through this area, serving Onllwyn Colliery (CH066), other industrial facilities in the area, and the

emerging settlement of Onllwyn itself. Onllwyn station (CH005) was located in the eastern part of the area, as well as several features relating to the railways and tramways built to connect to the industries of the area (CH010, CH011 and CH059).

A3.12.9 It is likely that the construction and operation of the washery site (CH061) will have removed most evidence of earlier features, which themselves would have been unlikely to predate the late 19th century due to the extensive nature of industrial activity in the area. It is possible that some remains of the railway station and structures associated with it or with Onllwyn Colliery may survive, although there is no evidence of these above ground. Thus, there is a **negligible** archaeological potential within the footprint of the washery in Area D. There is a **moderate** potential for late 19th century or early 20th century features in the remainder of the area.

A3.13 Historic Landscape

A3.13.1 There are no registered historic landscapes within the site or study area. However, although undesignated, the historic landscape of the site and its surroundings still possess heritage value. The Historic Landscape LANDMAP assessment includes 11 areas across the site and its immediate surroundings. The historic areas range between those dominated by opencast mining, areas of woodland, open upland moorland, areas of enclosed fields and the industrial and urban areas in the valleys. These are described in detail in Table A-3 and are shown on Figure 8.3. The LANDMAP assessment includes an assessment of the value of each Historic Landscape area, based on a combination of the integrity, survival, condition, rarity and potential (for future study, educational or tourist use)[36].

A3.13.2 Almost all of the site is within the Onllwyn historic landscape area – which includes both modern and historic extraction. It has been evaluated as of low value. To the north-west is an area of 20th century conifer woodland, some of which is on restored mining land. It is also of low value.

A3.13.3 To the south-west, and partially within the site, is Twyn Eithinog, an area of marginal land divided into two historic landscape areas. The northern part of it is of moderate value, but the southern part, due to the presence of prehistoric cairns and the scheduled 19th century tramroad, has been evaluated as outstanding.

A3.13.4 To the south, east and north of the site are the settlements of Ystradgynlais, Abercraf, Coelbren, Seven Sisters, Onllwyn and Banwen, represented by three historic landscape areas. The southernmost of the site is within the Crynant and Seven Sisters Urban

[36] Cyfoeth Naturiol Cymru Natural Resources Wales (2016) *LANDMAP Methodology Historic Landscape*. Available at: https://cdn.naturalresources.wales/media/677812/historic-landscape-landmap-methodology-2016.pdf?mode=pad&rnd=131471903450000000

Corridor historic landscape. Between the settlements there are areas of irregular fields (Dulais Valley NE and NW) and an area of generally unenclosed moorland (Banwaen Tor-y-Betal). The site itself occupies the higher ground between the two valleys that these settlements are located in.

A3.13.5 The final area is Dyffryn Tawe, an area of irregular fields to the north-east of the site containing both prehistoric and post-medieval features which contribute to its high value. While a part of this area extends into the north of the site, this part within the site has been restored following opencast mining.

Table A-3: Historic Landscape

Name	**Dominant Landscape Pattern**	**Description**	**Evaluation**
Onllwyn	Extractive	Area of opencast coal mining opening in the later 20th century and still operating. A prehistoric settlement with burial cairns has been completely destroyed by the mining. Much or area worked out and reinstated.	Low
Nant Pen-rhos	Woodland	20th-century conifer woodland on steeply-sloping hillside, including some reclaimed land in former mining areas.	Low
Twyn Eithinog (N)	Marginal Land	Open moorland parts of which are crossed by a dismantled 19th century tramroad and by modern electricity power lines.	Moderate
Twyn Eithinog (S)	Marginal Land	Rhos Common is situated on the upland of Twyn Eithinog and Mynydd y Drum with the Dulais Valley snaking away to the south and the upland Massif of the Brecon Beacons stretching away to the north. The Rhos Common aspect area is situated on the cusp of the Unitary Authority boundary, which dissects Mynydd y Drum and Twyn Eithinog, in effect this creates two areas of unenclosed upland moor. This area has been assessed as outstanding on two counts:1/the important survival of prehistoric funerary landscape represented by the extensive cairn grouping on the southern slope of Mynydd y Drum and 2/the survival of extensive remains of Claypon's Extension to the Brecon Forest Tramroad, an early industrial railway of considerable historic importance (as evidenced by its scheduled status).	Outstanding

Name	Dominant Landscape Pattern	Description	Evaluation
Ystradgynlais /Abercraf	Settlement	Ynyscedwyn iron works dates from the late 17th century and was the first iron works to use anthracite as a fuel; an innovation quickly followed by iron works centred on Abercraf in the north of the area. The, now conjoined, settlements of Ystradgynlais and Abercraf are included in this area and the two settlements have extensive mining and iron working remains and workers housing. Only let down by its poor condition.	High
Crynant & Seven Sisters Urban Corridor	Other built environment	This aspect area consists of a narrow communications corridor linking Aberdulais and Crynant with Severn Sisters, Onllwyn and Banwen. The settlements of Crynant and Severn Sisters were little more than small hamlets, centred on collieries such as Severn Sisters and Maes-mawr, developing along the route of the Neath and Brecon Railway by the late 19th century. The south of the aspect area generally retains a rural character of an irregular fieldscape; whilst the northern part of the aspect area is more unsettled with disused and contemporary industrial workings dominating a greater part of the landscape. This area has been assessed as being of high value, representing a reasonably well-preserved example of an industrial communications/settlement corridor. During the late 19th-early 20th century the collieries at Seven Sisters and Cefncoed near Crynant represented some of the most important anthracite collieries in the South Wales Coalfield; the extensive remains of the Cefncoed Colliery (now a museum) eloquently attest to this remarkable period of industrial growth.	High
Coelbren	Settlement	Small modern industrial settlement with post medieval origins, but little significant historic content.	Low
Dyffryn Tawe	Irregular fieldscapes	Landscape of small irregular fields, scattered farmsteads and cottages of post-medieval and probably earlier origin along bottom and sides of the Tawe valley, with residual areas of ancient broadleaved woodland along watercourses and along steeper slopes.	High

Name	Dominant Landscape Pattern	Description	Evaluation
		Nucleated settlement is largely confined to the linear roadside settlement at Pen-y-cae, of late 19th-century origin. The area is crossed by the course of the dismantled Neath & Brecon Railway, the Brecon Forest Tramroad and various other tramways. Distinctive systems of mixed regular and irregular fields in the Tawe Valley. Numerous farms and houses and industrial remains. Scattered prehistoric remains. An eclectic but significant combination.	
Dulais Valley NW	Irregular Fieldscapes	Discontinuous area of similar landscape character and historical identity to the Dulais Valley. The Dulais Valley aspect area is defined as the extent of enclosure flanking the Crynant and Severn Sisters industrial communication corridor. The aspect area is characterised by a heavily industrialised, irregular, agricultural fieldscape. The irregular fieldscape in this area has survived in a reasonably well-preserved state, with relatively little disturbance by industrial activity, in contrast to other parts of the Dulais Valley (with the exception of modern opencast mining to the W of	Moderate
Dulais Valley NE	Irregular Fieldscapes	Discontinuous area of similar landscape character and historical identity to the Dulais Valley. The Dulais Valley aspect area is defined as the extent of enclosure flanking the Crynant and Severn Sisters industrial communication corridor. The aspect area is characterised by a heavily industrialised, irregular, agricultural fieldscape. This area has been assessed as moderate, reflecting the fact that modern opencast mining and dense modern forestry plantation has significantly disrupted the coherence of the upland fieldscape and reduced the value of the archaeological resource.	Moderate
Banwaen Tor-y-Betal	Other fieldscapes	Large area of generally unenclosed moorland following the south side of the Afon Pyrddin valley from the Vale of Neath to the Crynant and Severn Sisters urban corridor. This area has been assessed as being of outstanding value, representing a landscape of considerable significance in historical and archaeological terms, dominated by	Outstanding

Name	Dominant Landscape Pattern	Description	Evaluation
		extensive and well-preserved remains of Roman military occupation (Coelbren Fort.	

A4 Value and Setting

A4.1.1 The following heritage assets have been identified in the Environmental Statement as being potentially impacted by the proposed scheme either because they are within the site or the ZTV, or otherwise identified as potentially being affected (by noise or other non-visual changes to setting). This section considers the heritage value of each individually. Where the potential impact would arise from a change to their setting (i.e. for heritage assets located within the ZTV or otherwise identified as being potentially affected) this includes a discussion of the nature of their setting and the contribution made to their value by their setting. Where it is concluded that the asset's setting does not contribute to their value, or that the setting does not extend to the site, these will not be assessed further for potential impacts in the Environmental Statement.

The Tramroad at Ystradgynlais (CH001)

A4.1.2 The Tramroad at Ystradgynlais, known as Claypon's Extension, was built in 1832-7 as an extension to the Brecon Forest Tramroad. It is 6.44km long and links the ironworks at Ynyscedwyn with limestone quarries and the Swansea Canal. The tramroad has historical value as one of the first 'hybrid' railways, combining horse-drawn elements and an engine driven incline. The well-preserved earthwork remains (Photograph 8.1a-b) are designated as a Scheduled Monument and have evidential value in addition to their historical value. It is of **high value.**

1.1.1 As part of the construction of the Nant Helen Complementary Earthworks (the base case), a 450m section of the Scheduled Monument will have been permanently buried by an earthwork embankment. This will have the result of visually severing the line of the tramway, although physical effects on the fabric of the monument will be kept to a minimum. However, the result of the construction of the new embankment will have led to a loss of legibility for the monument. As an industrial feature of at least national, if not international significance, it remains as a **high value** asset. Its setting, within the base case scenario, is formed by a restored mining landscape where much of the evidence of the historic industries it was built to connect erased by time and more recent extraction. However, the overall topography of its surroundings and the remaining industrial features, many of which are designated, which it connects to mean that its setting makes a positive contribution to its value.

Bryn Llechwen Ring Cairn (CH002)

A4.1.3 The Bryn Llechwen ring cairn is the fourth (moving from west to east) of a chain of seven Bronze Age cairns along the Mynydd y Drum ridgeline. Due to the opencast mining of the eastern part of the hill, the

three easternmost cairns do not survive and are not part of the setting of Bryn Llechwen.

1.1.2 The cairn is located c130m west of the site boundary and directly overlooks the site meaning that there is the potential for it to be affected by the proposed scheme. There are long views from the cairn over the surrounding landscape – it is located on the end of a ridge of high ground with views across the valleys to the north and south towards the ridgelines which form a larger bowl-like landscape, with the Brecon Beacons closing off views to the north-east. These views are important to how the cairn is understood as a ritual monument and part of a chain of interconnected, and intervisible, cairns along Mynydd y Drum. However, views directly west of the cairn will, using the base case scenario, overlook the restored landscape of the Nant Helen mine, including the earthwork embankment of the outer loop. The base case scenario was considered to have a temporary adverse effect on the asset, resulting from the increased noise, lighting and appearance of construction activities appearing a short distance from the cairn. However, the previous views, which looked directly over the large square 'hill' of retained overburden (Photograph 8.4) associated to the mine, was already considered to have an adverse effect on the significance of the ring cairn.

A4.1.4 Bryn Llechwen ring cairn is a heritage asset of **high value**, possessing evidential value due to the potential for burial remains and with a setting which contributes to this value.

Dulais Valley Mineral Railway (CH055)

A4.1.5 The Dulais Valley Mineral Railway is an extant railway line which crosses the site just north of the Onllwyn Washery (CH061). It was built in the 19th century and has historically served the numerous coal mines and furnaces in the region. Onllwyn Station (CH005) has been demolished. The railway line is a heritage asset of **negligible** value.

Railway bridge bases (CH010, CH011 and CH059)

A4.1.6 Several railway bridge bases or structures relating to former underbridges which carried the Brecon Forest Tramroad across the River Dulais are recorded in the southern part of the site. Several of the records may relate to the same features, as there is some uncertainty over locations. It is understood that the majority of these features have been removed, but possible bridge bases are recorded to survive beneath the modern road bridge immediately west of the Onllwyn Washery. While these structures are associated with the historically significant Brecon Forest tramroad, their fragmentary condition and mostly illegible context has diminshed their individual historic interest. They are not designated and are of **low** value.

Onllwyn Washery (CH061)

A4.1.7 The Onllwyn Washery is an extant complex of buildings and facilities which serve the Nant Helen Opencast mine and the Derlwyn Colliery (coal delivered by road for the latter). It was originally built in the 1930s but has been substantially remodelled over the years. It is of **negligible** heritage value.

Trackway and Tramway (CH071-CH072)

A4.1.8 A series of raised trackways were identified during walkover survey and mapped using LiDAR imagery. One, running from east to west, corresponds with a track present on the 1st edition Ordnance Survey 6":mile map of 1877. However, the others are not shown on historic maps and appear to run through areas of 20th century mining spoil, suggesting that they are of mid-20th century date or later. The majority of the trackways will have been removed as part of the base case construction of the Nant Helen Complementary Earthworks. However, the southern extent of one of the trackways extends into Area C, which is outside of the earthworks consruction area. The trackway has some limited evidential interest as part of the mining, and potentially agricultural, historic landscape of the site. It is of **negligible** value.

A4.1.9 A tramway is shown as 'old tramway' on the 2nd edition Ordnance Survey 6":mile map of 1903. It is not shown on earlier maps suggesting that it was built and abandoned in the last decades of the 19th century. It likely connected the coal levels and shafts to the south with the railway line to the north. No evidence of the tramway could be found on the walkover survey and there are no traces of it on the LiDAR imagery of the site. However, it is possible that below ground remains could survive, although the northern extent of it will have removed as part of the construction of the base case earthworks. Any remains in Area C, if present, would be of **negligible** value.

Area of mine shafts and spoil tips (CH075, CH0043 and CH0069)

A4.1.10 Area of mine shafts and spoil tips identified from a combination of historic Ordnance Survey maps and a 1945 aerial photograph. Walkover survey indicates that all above ground earthworks associated have been removed or weathered down. Any surviving traces of the spoil tips or below ground features associated with the mine shafts would be of **negligible** value.

Glynllech Colliery (CH025)

A4.1.11 Glynnlech Colliery was established in the early years of the 20th century and is visible on historic Ordnance Survey maps and an aerial photograph of 1945. The site of the colliery has been cleared, although

there are likely to be extensive below ground remains within Area C. As the remains of a modern industrial site, this has **negligible** value.

Hen Noyadd (CH079)

A4.1.12 This is an aqueduct of the Swansea Canal and has historical and evidential value as part of the group of heritage assets related to the canal – an important work of engineering which was vital to the industrial development of the area. Its setting is formed by the River Tawe and the canal, which have a functional relationship with the aqueduct. Longer views away from the aqueduct are largely screened by trees and the buildings of the settlement of Ystalyfera. Its canal and river setting make a positive contribution to its value and the aqueduct is a heritage asset of **high** value.

A4.1.13 15th century house located at the head of the Swansea Canal near Ystradgynlais. The house is primarily of evidential value; renovation works have revealed late medieval window glass indicating that it was a building of relatively high status, and it is a rare survival of an early building in this region. While it is located within the area of potential visibility from the proposed scheme, its setting is formed by an area of 20th century residential development and does not contribute to its value. It is a heritage asset of **high** value.

Lamb & Flag Cottages and adjacent pound (CH080, CH108-110)

A4.1.14 Group of four listed buildings which represent the remains of what was a small settlement at the beginning of the 19th century. The buildings include two cottages which were formerly one large building, possibly an inn (CH080 and CH108), a 19th century animal pound for keeping stray animals found on common land (CH109) and outbuildings (CH110). The outbuildings and pound are partially included as designated buildings because of their group value with the cottages. They have historical interest as a remnant of a small industrial and agricultural settlement which predates the intensive industrial expansion of the area in the mid-late 19th century. The setting of the buildings includes the river running to the north and a small area of historic enclosed fields which surround them. This setting makes a positive contribution to their value as it is related to their evidential value as a small historic settlement. Views to the south and east, towards the site, are mostly screened by woodland and the site is outside of the buildings' immediate setting, not contributing to their value. The buildings are of **high** value.

Canal Aqueduct over the River Twrch, Ystalyfera (CH093)

A4.1.15 This is an aqueduct of the Swansea Canal and has historical and evidential value as part of the group of heritage assets related to the canal – an important work of engineering which was vital to the industrial development of the area. Its setting is formed by the River Tawe and the canal, which have a functional relationship with the aqueduct. Longer views away from the aqueduct are largely screened by trees and the buildings of the settlement of Ystalyfera. Its canal and river setting make a positive contribution to its value and the aqueduct is a heritage asset of **high** value.

Group of Roman sites at Coelbren (CH082-4)

A4.1.16 Group of three Scheduled Monuments of Roman date at Coelbren, including a section of Roman road (CH082), Coelbren Roman fort (CH083) and a marching camp (CH084). These three sites have considerable archaeological value. Their setting of these archaeological sites is an area of enclosed fields of pasture. This setting does not contribute to the value of the Roman remains. The three Scheduled Monuments are all of **high** value.

Pillow Mounds at Pant Mawr (CH086)

A4.1.17 Area of post-medieval pillow mounds, used for the farming of rabbits, which have evidential and historical value. They are located in an area of forestry plantation restricting all views. As a result their setting does not contribute to their value. They are of **high** value.

Abercrave Ironworks (CH077)

A4.1.18 Remains of buildings related to a 19th century ironworks, which are of both evidential and historical value. Abercrave was an important site in the development of anthracite fuelled iron smelting. The site of the ironworks is now mostly covered by mature trees and, although it is located in an area with theoretical visibility of the site, views towards it do not contribute to the ironwork's value. The ironworks is of **high** value.

Cribarth Limestone Quarries and Tramroads (CH087)

A4.1.19 This Scheduled Monument is a large expanse of post-medieval limestone quarry workings located high on a ridgeline north of the site. It was connected to the Swansea Canal by tramroads and remains of some of these are included within the scheduled area. The quarries are of historical value as a key part of the industrial landscape, providing limestone for the ironworks at the base of the valley. Their hilltop location was a matter of resources rather than views, although

there are panoramic views over the valley and the area of the site. Their setting contributes to their value through the visual connections to the other aspects of the historic landscape which survive, including particularly the Swansea Canal. The area of the site was a part of this historic landscape, mined extensively for fuel for the same ironworks served by the quarries. However, modern opencast mining of the site has removed almost all traces of this historic landscape and it does not add value to the quarries. The quarries and tramroads are of **high** value.

Craif-y-Rhiwarth, Hillfort (CH088)

1.1.3 Hillfort, probably of Iron Age date, located on high limestone cliffs with extensive views over the Tawe valley. The hillfort has evidential value, with a surviving stone rampart and high potential for further buried archaeological remains. The setting of the hillfort is central to its value – it was deliberately sited to take advantage of both the commanding views and the defensible position. It commands views across the valley to the north and south, including across the area of the site, and these views make a positive contribution to its value. The base case of the Nant Helen Complementary Earthworks will be visible within the views from the hillfort. During construction and the first year post completion (until the grass is established, allowing the earthworks to blend into the surrounding landscape), the increased activity on the hillside, especially the restored areas east of the current void, will temporarily have an impact on the asset (minor adverse significance of effect) The hillfort is an asset of **high** value.

Dorwen Standing Stone and Lorfa Stone Circle (CH090 and CH091)

A4.1.20 Two prehistoric monuments, both thought to be Bronze Age in date, located in the open upland landscape of the Black Mountain's southern slopes. Both monuments have wide arcs of views across the Tawe valley to the south, although the standing stone (CH090) has clearer views to the south-west than towards the site in the south-east. Both monuments are likely to have been deliberately sited, their setting an integral part of how they would have been experienced and understood by their builders. As such, their setting makes a positive contribution to their value. During construction, the base case earthworks would be visible from these two monuments. However, the distance from the monuments to the site and the breadth of their views minimises the impact on them by the works. As a result, there was considered to only be a temporary minor adverse significance of effect. They are both monuments of **high** value.

Hirfynydd Roman Earthwork (CH094)

A4.1.21 Roman signal station, located on the high ridge of Hirfyndd on the line of Sarn Helen, the Roman road which connects to the fort at Coelbren (CH083). The signal station has evidential value due to its potential for buried archaeological remains alongside the well-preserved earthwork remains. Its setting on the high ridge allows for expansive views to the north and north-west across the Tawe valley. However, views towards the site are limited due to the presence of forestry plantation immediately to the north-west of the earthwork remains. Thus, although located within the ZTV, views towards the site do not contribute to the value of the signal station. The earthworks are of **high** value.

Coed Ddu house platforms and enclosure (CH095)

A4.1.22 Remains of a small medieval or post-medieval upland settlement, presumed to be a seasonal hafod site associated with summer grazing The remains are located on the west-facing slopes of Hirfynydd with views across the valley to the north. Its setting on the high and open hillside makes a positive contribution to its value, reflecting its purpose in relations to seasonal transhumance farming. While there are views towards the site, the contribution made by the setting to the assets value does not extend that far. The remains have evidential value due to the survival of archaeological remains and, further, have historical value as a surviving feature of a mostly vanished form of farming in the region. It is of **high** value.

Coed Ddu ring cairn (CH096)

A4.1.23 Ring cairn, most likely of Bronze Age data, possessing evidential value for the potential for surviving archaeological remains. The setting of the cairn is classic for its type, located on a high hillside with sweeping views over the valley below. The main views are to the north-west although it is within the ZTV for the proposed scheme, which is located c.4km to the north-east. During construction, the base case earthworks would be visible from the carin. However, the distance from the monument to the site and the breadth of the views from it minimises the impact on it by the works. As a result, there was considered to only be a temporary minor adverse significance of effect. It is of **high** value.

Carn Cornel Round Cairn (CH097)

A4.1.24 Two Bronze Age burial cairns located on the top of a high ridge with views in all directions. The cairns have evidential value for the potential for surviving archaeological remains and their setting on the top of the ridge makes a positive contribution to their value. During construction, the base case earthworks would be visible from these

two monuments. However, the distance from the monuments to the site and the breadth of their views minimises the impact on them by the works. As a result, there was considered to only be a temporary minor adverse significance of effect. They are of **high** value.

Sardis Independent Chapel and attached schoolroom (CH102)

A4.1.25 19th century chapel and attached 20th century school room in Ystradgynlais. The chapel was designed by the Rev Thomas Thomas, a noted Welsh chapel architect and it is well preserved with internal features and furniture also surviving. It possesses historical value; reflecting the importance of non-conformist religion in the region and the contribution made by the chapels in the education and social lives of the community. It also has aesthetic value, derived through its surviving interior painted woodwork, carved pulpit and architectural form. Although partially within the ZTV, views towards the site are screened by trees along the river immediately south of the chapel. Further, while the chapel's setting within Ystradgynlais contributes to its value by making its context within the community legible, longer views towards the site are not important to the building's value. It is of **high** value.

Cae'r Lan Castle (CH111)

A4.1.26 Cae'r Lan Castle is an early 19th century inn, now a house, built next to the Swansea Canal. It has historic interest through its association with the Swansea Canal and the setting of the building, located a short distance from the canal, makes a positive contribution to its value. It is surrounded by deciduous trees which mostly screen view towards the site. While views may be possible in winter, the contribution made by the setting of the building is much more localised, relating to the close proximity of canal and former inn.

A4.1.27 Remains of a small medieval or post-medieval upland settlement, presumed to be a seasonal hafod site associated with summer grazing The remains are located on the west-facing slopes of Hirfynydd with views across the valley to the north. Its setting on the high and open hillside makes a positive contribution to its value, reflecting its purpose in relations to seasonal transhumance farming. While there are views towards the site, the contribution made by the setting to the assets value does not extend that far. The remains have evidential value due to the survival of archaeological remains and, further, have historical value as a surviving feature of a mostly vanished form of farming in the region. It is of **high** value.

Historic Landscape Areas

A4.1.28 There are no designated historic landscape areas in the site or the study area. However, the LANDMAP Historic Landscapes assessment grants an outstanding evaluation to the southern part of Twyn Eithinog, a stretch of commons to the north of Onllwyn and Seven Sisters. This, alongside the historic landscapes of Twyn Eithinog (N), Ystradgynalis/Abercraf, the Crynant & Seven Sisters Urban Corridor and Dyffryn Tawe, which were given a moderate or high evaluation, possess historical and evidential value. The evaluations are not equivalent to the heritage value terms used in this assessment and none of these landscapes have merited designation on the Register of Historic Landscapes of Outstanding or Special Historic Interest. Those with an evaluation of moderate-outstanding are of **low** value. Those given a low evaluation are of **negligible** value.

1.1.4 The base case included large scale earthworks and restoration work within the site. The site occupies a large area within the Onllwyn historic landscape area, which is an area of modern coal mining of negligible value. The construction of the base case earthworks will have altered the physical appearance and form of the historic landscape area but its characteristics would still be broadly legible. As a result, this was considered as a permanent negligible adverse significance of effect.

1.1.5 Nant Pen-Rhos is an area of 20th century conifer woodland which extends into the north-western part of the site. This part is an area of restored mining land. It is of negligible value. The base case will have resulted in a change to the legibility of the landscape, through the construction of the new embankment through the eastern part of the woodland, resulting in a permanent negligible adverse significance of effect.

1.1.6 The north and south areas of Twyn Eithinog are an expanse of marginal upland stretching across Mynydd y Drum to the west of the site. They are of low value. The base case will have extended into the easternmost parts of the two areas, truncating the edges of the historic landscapes but not otherwise affecting their legibility. This was considered to a permanent minor adverse significance of effect.

Unaffected Assets

A4.1.29 There are a number of heritage assets identified which are within the site but which will not be affected by the proposed scheme. This includes features identified from historic mapping or other archaeological surveys but which have subsequently been removed by opencast mining (CH014-6, CH020, CH024, CH028, CH030-1, CH033-8, CH040-7, CH049). Further assets (CHCH064, CH068, CH070 and CH073-4) are considered to have been removed, or covered to the point of being impervious to the proposed scheme, as part of the base case of the Nant Helen Complementary Earthworks.

Others include Onwllyn Station (CH005), which was demolished in the latter part of the 20th century and the point location for the settlement of Abercraf (CH017), which is within the site but reflects an area of settlement to the north. As these assets are not affected by the proposed scheme they have not been considered further in this assessment.

A4.1.30 From the assessments of value and setting in the section above, the following heritage assets have been scoped out of further assessment in relation to impacts arising from changes to their setting:

- Hen Noyadd (CH079);
- Lamb & Flag Cottages and adjacent buildings (CH080, CH108-110);
- Canal Aqueduct over the River Twrch, Ystalyfera (CH093);
- Group of Roman sites at Coelbren (CH082-4);
- Pillow Mounds at Pant Mawr (CH086);
- Abercrave Ironworks (CH077);
- Cribarth Limestone Quarries and Tramroads (CH087);
- Hirfyndd Roman Earthwork (CH094);
- Coed Ddu house platforms and enclosure (CH095);
- Sardis Independent Chapel and attached schoolroom (CH102);
- Cae'r Lan Castle (CH111).

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A6 Abbreviations

CIfA: Chartered Institute for Archaeologists

CPAT: Clywd Powys Archaeological Trust

DBA: Desk-Based Assessment

FISH: Forum on Information Standards in Heritage

HER: Historic Environment Record

GGAT: Glamorgan-Gwent Archaeological Trust

NLW: National Library of Wales

NMRW: National Monuments Record of Wales

OS: Ordnance Survey

RCAHMW: Royal Commission of Ancient and Historical Monuments of Wales

ZTV: Zone of Theoretical Visibility

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A8 Gazetteer

Heritage Assets within 500m study area

#	ID reference	Asset name	Designation	Description	Period
CH001	GM399, CPAT: 19335, 21068, 21081 RCHAMW: 34628-9, 80115, 80119, 80122, 80124, 80129-35, 80145 80159	Tramroad at Ystradgynlais	Scheduled Monument	The monument comprises the remains of the well preserved tramroad at Ystradgynlais. It was built c. 1832-7 as a 6.44km link line to the Brecon Forest Tramroad to enable limestone to be brought directly down to the Ynyscedwyn Ironworks. The proprietor was Joseph Claypon and the engineer's contractors were John and Robert Brunton. The whole length remains an impressive monument - the track runs through large cuttings and over impressive stretches of embankment on the expanse of Mynydd y Drum. At the canal end, Brunton's Incline, 1.2km long rising through 210m is among the most impressive tramroad inclines surviving in south Wales. The squared rubble masonry engine house and cable tunnel runs are located at NGR SN8013 0942.	Post-Medieval
CH002	BR327 CPAT: 682, RCHAMW: 304746	Bryn Llechwen ring cairn	Scheduled Monument	The monument comprises the remains of a ring cairn, probably dating to the Bronze Age (c.2300 BC - 800 BC) and situated within enclosed rough pasture on the ENE end of a prominent plateau. The ring cairn remains largely undisturbed and is situated in a classic location, with wide views all around. It is also tilted slightly towards the NE.	Bronze Age
CH003	GGAT: 00934w	Early Christian monument on Cefn Hirfynydd, Coelbren	Non-designated	Fragment of shaft of probable disc-headed slab-cross, showing part of a full-length figure in a posture of prayer. Found on Cefn Hirfynydd, but now in Swansea Museum.	Early Medieval
CH004	GGAT: 02223w	Findspot, Tynewydd Farm	Non-designated	Polished stone axe found during ploughing in 1932	Neolithic
CH005	GGAT: 02818.6w; RCAHMW: 34838	Onllwyn Station	Non-designated	Onllwyn Station Neath and Brecon railway. Not present on maps after 1987 and no evidence of survival on site.	Post-Medieval

#	ID reference	Asset name	Designation	Description	Period
CH006	GGAT: 02818.7w	Abercrave Station	Non-designated	Abercrave Station Neath and Brecon Railway	Post-Medieval
CH007	GGAT: 05816w, RCAHMW: 80156	Limekiln, Onllwyn	Non-designated	This is a calcining kiln which is part of the Onllwyn Ironworks.	Post-Medieval
CH008	GGAT: 05957w, RCHAMW: 80144, 80163	Onllwyn Iron works	Non-designated	The Onllwyn Ironworks was constructed in the Dulais Valley in the early 1840s, and initially its two furnaces used locally available anthracite coal as fuel. No features associated with the Onllwyn Ironworks are considered to survive as the remains were removed by opencast operations by the late 1970s.	Post-Medieval
CH009	GGAT: 06250w	Onllwyn Colliery Quarries	Non-designated	Old quarries associated with Onllwyn Colliery visible on 1st edition OS map (1878)	Post-Medieval
CH010	GGAT: 08085w	Railway bridge base, Drym Power Station, Dulais Valley	Non-designated	Bridge base.	Post-Medieval
CH011	GGAT: 08086w, RCAHMW: 80164-5	Possible railway bridge, Drym Power Station, Dulais Valley	Non-designated	Remains of a possible bridge over the railway track. RCHAMW records a location for a mid or early 19th century bridge crossing the eastern Brecon Forest tramroad branch to the Onllwyn Colliery, located under the line of the later road bridge. This may be the same feature, but both points are included on Figure 8.2.	Post-Medieval
CH012	GGAT: 08281w	Drym Power Station, Dulais Valley	Non-designated	Houses first recorded in 1st edition of OS map. No longer standing.	Post-Medieval
CH013	GGAT: 08282w	Former school, Drym Power Station, Dulais Valley	Non-designated	School that first appeared on 1878 1st edition OS map. No longer extant. Found during desk-based assessment of proposed Drym Power Station.	Post-Medieval
CH014	RCAHMW: 80149	Cwm Mawr Coal Level	Non-designated	Coal level attached to a branch of the Brecon Forest Tramroad constructed in the mid-1820s, recorded on the Ordnance Survey drawings.	Post-Medieval

#	ID reference	Asset name	Designation	Description	Period
CH015	RCAHMW: 80152	Drum Colliery Level 2	Non-designated	Coal level. Site thought likely to have been destroyed by opencast coal mining.	Post-Medieval
CH016	RCAHMW: 80141	Drum Colliery Shaft 2	Non-designated	Nineteenth-century coal shaft on Mynydd Y Drum, by the Afon Dulais. No longer visible but it may survive as a capped structure.	Post-Medieval
CH017	CPAT: 15945	Abercraf	Non-designated	Settlement of Abercraf. The name means 'the mouth of [the] river Craf' although no such watercourse is shown on modern maps. Alternatively, 'Aber' can mean a small stream and 'craf' may refer to the wild garlic on its banks. The initial growth of the settlement was associated with the development of coal mining, which began here in the second half of the 18th century. Abercraf lay within the ecclesiastical parish of Ystradgynlais and is now in the modern community of the same name.	Post-Medieval
CH018	CPAT: 6189	Bryn Llechwen Cairn II	Non-designated	Clearance cairn of unknown date.	Unknown
CH019	CPAT: 6188	Bryn Llechwen House Platform	Non-designated	Medieval or post-medieval house platform. HER states that the site is presumed to have been destroyed by opencast working since site recorded in 1990 but it is not within the area of known opencast mining at Nant Helen so it is possible it is still extant.	Medieval/Post-Medieval
CH020	CPAT: 681, 12379 RCAHMW: 304745	Carn Goch Cairn	Non-designated	Bronze Age round barrow. One of two cairns lying about 280 m above O.D. on Mynydd y Drum. Both were excavated by the Clwyd-Powys Archaeological Trust in 1983 and 1987 in advance of their total destruction through opencast coal extraction. This carin had been robbed out and damaged by hole digging. Excavation suggested an original diameter of about 15 m the lower layers, which included stones up to 0.75 in diameter, were of both angular rounded stones, the upper part was of stones 0.15-0.2 m across, more uniform in size and appearance. The cairn lay upon stony bedrock, largely bereft of soil or vegetation. Cairn-building had been preceded by several irregular scoops excavated into the bedrock. The original cairn mass was encircled by an almost continuous length of walling, (about 17 long by up	Bronze Age

#	ID reference	Asset name	Designation	Description	Period
				to 0.3 m high. No clear indications of a Bronze Age burial were recorded from the centre of the cairn. However, a flint scatter from the N.W. sector of the excavated area indicated prehistoric activity. Rim sherds representing two pottery vessels were also located from outside the cairn. Some were undecorated and too fragmentary to assist useful identification others were considered to have belonged to the Deverel-Rimbury tradition. Possibly Mesolithic punch-struck blade from the (presumed) Bronze Age cairn of Garn Coch.	
CH021	CPAT: 21087	Cefn Yr Erw House	Non-designated	Post-medieval house of early 18th century date.	Post-Medieval
CH022 (multiple points)	CPAT: 23707-8, 125380, 125385-6, 127025, 127057-8 127062, 127065, 127067, 127069, 127072-4. RCAHMW: 80108, 80147, 80151, 53, 54, 55 80157-8, 80166-67-68	Mining Levels	Non-designated	Post-medieval levels known from historic mapping. Shown as individual points but with the CH022 label for clarity on Figure 8.2.	Post-Medieval
CH023 (multiple points)	CPAT: 125381, 127071, 23704, 23705, 127066, 127063 RCAHMW: 80140, 42-3, 80162, 80169	Mine shafts	Non-designated	Post-medieval mine shafts known from historic mapping. Shown as individual points but with the CH023 label for clarity on Figure 8.2.	Post-Medieval

#	ID reference	Asset name	Designation	Description	Period
CH024	CPAT: 23730	Coelbren Sheepfold	Non-designated	Post-medieval sheep fold. Within the area of Nant Helen opencast mine so assumed to have been removed.	Post-Medieval
CH025	CPAT: 125362	Glynllech Colliery	Non-designated	Colliery first noted on the 1914 OS map. Examination of Lidar imagery, aerial photographs from 1945 and walkover survey have allowed this to be enhanced with a polygon for the purposes of this report. The shafts and a trial mine were located to the south of the complex, linked by a tramway to the Neath and Brecon Railway line (CH050). The only evidence on the surface is a small spoil heap next to the railway line, although the LiDAR imagery shows that the north-eastern end of the tramway has not been fully erased, although this is not visible through the current undergrowth on site.	Modern
CH026	CPAT: 127084, 127075-83, RCHAMW: 80107, 80109-10	Gwaun-y-clawdd Colliery	Non-designated	Post-medieval colliery noted on OS 1st edition 25":mile map of 1878. HER includes records of eight buildings and a tramway. Inclines on the tramway (RCAHMW: 80107, 80109-10) is also shown on Figure 8.2.	Post-Medieval
CH027	CPAT: 127085	Gwaun-y-clawdd, house	Non-designated	Post-medieval house noted on OS 1st edition 25":mile map of 1878. In the area of the Nant Helen opencast mine so assumed to no longer survive.	Post-Medieval
CH028	CPAT: 17965, 680	Hen Hevadd Find	Non-designated	Bronze Age socketed axe found during drainage work in 1955.	Bronze Age
CH029	CPAT: 21086	Heol Y Gwyddan House	Non-designated	Post-medieval long house, probably later 17th century with a modernised front.	Post-Medieval
CH030	127095, 127087-4	International Anthracite Colliery	Non-designated	Colliery noted on OS 1st edition 25":mile map of 1878, including six buildings, an engine house and a reservoir. Located within the area of the Nant Helen opencast mine and is assumed to no longer survive.	Post-Medieval
CH031	CPAT: 127086	Llwyn-llafrod, building	Non-designated	Building shown on OS 1st edition 25":mile map of 1878. Located within the area of the Nant Helen opencast mine and is assumed to no longer survive.	Post-Medieval
CH032	CPAT: 125361	Melin-Llech, mill complex	Non-designated	Post-medieval mill, shown on OS 1st edition 25":mile map of 1878.	Post-Medieval

#	ID reference	Asset name	Designation	Description	Period
CH033	CPAT: 44881	Mynydd y Drum find	Non-designated	Findspot of Neolithic stone axe head.	Neolithic
CH034	CPAT: 38565	Mynydd y Drum bell pits	Non-designated	Post-medieval bell-pits (mining) probably 18th or 19th century. Identified on aerial photographs but since removed by opencast coal extraction.	Post-Medieval
CH035	CPAT: 4592	Mynydd y Drum Cairn	Non-designated	Possible cairn site occupied by modern sheepfold – site now destroyed by opencast workings.	Bronze Age (unconfirmed)
CH036	CPAT: 58788	Mynydd y Drum environmental site	Non-designated	Environmental sampling in 1987 showed that the cairns in the area had been constructed in an open environment of heath/hazel scrubland. Located within the area of the Nant Helen opencast mine and is assumed to no longer survive.	NA
CH037	CPAT: 6187	Mynydd y Drum House Platform	Non-designated	House platform of post-medieval date, recorded before opencast working which has destroyed the site.	Post-Medieval
CH038	CPAT: 6186	Mynydd y Drum Ring Cairn	Non-designated	One of two ring cairns excavated by CPAT in advance of opencast mining. Excavation showed it to be 15.5m by 16m external diameter enclosing a central area 8.7m diameter and composed of a single layer of stone. A stakehole and two shallow scoops in central area. Charcoal from one scoop. Partially infilled.	Bronze Age
CH039	CPAT: 38566-7	Mynydd y Drum scoops	Non-designated	Two small scoops indicative of small scale post-medieval coal mining. Both individually shown on Figure 8.2.	Post-Medieval
CH040	CPAT: 12495	Mynydd y Drum settlement	Non-designated	Fieldwork prior to opencast mining recorded a series of clearance features of indeterminate age, potentially prehistoric. These included a possible hut site, a platform, eight clearance cairns, two lengths of boundary bank. Located within the area of the Nant Helen opencast mine and is assumed to no longer survive.	Prehistoric
CH041	CPAT: 9770	Mynydd y Drum Sheepfold I	Non-designated	Derelict post-medieval sheepfold, recorded in advance of opencast mining.	Post-Medieval
CH042	CPAT: 23729	Mynydd y Drum Sheepfold II	Non-designated	Sheepfold, identified from historic mapping. Now destroyed by opencast mining.	Post-Medieval

#	ID reference	Asset name	Designation	Description	Period
CH043	CPAT: 6190	Mynydd y Drum Tramway	Non-designated	Curving linear bank thought to be a post-medieval or modern tramway or trackway associated with the extraction of peat or coal. Excavated in advance of opencast mining revealing it to be a cobbled path bordered on each side by larger kerb stones. Iron horse shoe, iron nails and a piece of slag were found.	Post-Medieval
CH044	CPAT: 23728	Mynydd y Drum, sheepfold I	Non-designated	Post-medieval sheepfold recorded from historic mapping	Post-Medieval
CH045	CPAT: 6176	Nant Helen Bank	Non-designated	Linear bank, possibly a field bank or clearance feature. Excavation, prior to destruction by opencast mining, revealed it was built of stone and turf. Although two flints were found it had clearly been laid over peat and is unlikely to be prehistoric.	Post-Medieval
CH046	CPAT: 6184-6185	Nant Helen Banks II and III	Non-designated	Linear banks, possibly field bank or clearance feature. Destroyed by opencast working. Both shown on Figure 8.2.	Post-Medieval
CH047	CPAT: 12496, 6174-5, 6177-82	Nant Helen clearance cairns	Non-designated	Cluster of eight clearance cairns. Total excavation of two found neither cultural nor environmental evidence. Likely to be post-medieval in date. Now destroyed by opencast working.	Post-Medieval
CH048	CPAT: 19249, RCHAMW: 410795	Nant Helen coal mine	Non-designated	Modern open cast coal mine.	Modern
CH049	CPAT: 5947, 6183	Nant Helen Enclosure I and II	Non-designated	Enclosures of house sites. Partially excavated in 1987 in advance of opencast working. No dating evidence but thought likely to be post-medieval. Both enclosures shown on Figure 8.2.	Post-Medieval
CH050	CPAT: 125363, 34789 GGAT: 02818.0w	Swansea Vale Railway (Neath and Brecon)	Non-designated	Swansea Vale Railway, later the Neath and Brecon Railway	Post-Medieval
CH051	CPAT: 19023	Pen Twyn Helen House	Non-designated	Post-medieval house – appears to be of mid-19th century date but probably originally of one storey and attic and late 17th century.	Post-Medieval
CH052	RCHAMW: 414833	Ollwyn Miners' Welfare	Non-designated	Onllwyn Miner's Welfare opened in 1955 and provided a cinema and public hall. The Welfare Hall was part of the overall miners' welfare scheme which	Modern

#	ID reference	Asset name	Designation	Description	Period
				included the football field, bowling green, tennis courts, children's play area and sport's pavilion.	
CH053	RCAHMW: 407798, 407800	Front Row and Back Row, Onllwyn	Non-designated	Two rows of worker's housing, now demolished	Post-Medieval
CH054	RCAHMW: 80170	Price's Row, Coelbren	Non-designated	Price's Row is a terrace of housing built by the railway contractor John Dickson in the 1860s when he was working on the Neath & Brecon Railway and housed the navvies. The terrace is situated on land sandwiched between two branches of the Brecon Forest Tramroad, which Dickson had bought in 1865. The terrace was originally known as 'Dicksons' Row'	Post-Medieval
CH055	GGAT: 02817.0w	Dulais Valley Mineral Railway	Non-designated	Mineral railway from Neath travelling up the Dulais Valley	Post-Medieval
CH056	RCAHMW: 80171	Coelbren Junction	Non-designated	Junction of the mainline of the Brecon Forest Tramroad and Claypon's Extension Tramroad, now sited beneath a public road adjacent to a large opencast area.	Post-Medieval
CH057	RCAHMW: 80172	Banwen Ironworks, Trans point	Non-designated	Former transhipment siding from the 1840s Banwen Ironworks edge-railway to the Brecon Forest Tramroad. The site shows no other obvious features beside those of the later (1860s) railway formation.	Post-Medieval
CH058	RCAHMW: 80173	Coelbren Iron-Ore Quarry	Non-designated	Iron-ore quarry opened in the 1840s to serve the Banwen Ironworks, with a railway connection. Various tips, quarry faces and line formations survive.	Post-Medieval
CH059	RCAHMW: 80146, 80160	River Dulais underbridge	Non-designated	Two railway underbridges on the eastern Brecon Forest Tramroad branch to Onllwyn Colliery, carrying the line over the River Dulais. There are no visible remains.	Post-Medieval

#	ID reference	Asset name	Designation	Description	Period
CH060	RCAHMW: 13351, 9488	Onllwyn Independent Chapel	Non-designated	Onllwyn Independent Chapel was built between 1900 -1948 and replaced an earlier chapel of the same name.	Modern
CH061	RCHAMW: 306037	Onllwyn Washery	Non-designated	The washery was built to service local drift mines in 1932. It has been substantially altered since, and was re-equipped in 1950. It services two opencast sites: Nant Helen & Derlwyn- coal delivered by road.	Modern
CH062	RCHAMW: 80136, 80137, 80139	Drum Colliery and associated railway branch line	Non-designated	19th century colliery, now largely obscured. Railway branch built by 1826 but site largely re-levelled. Both the site of the colliery and the railway branch line are shown on Figure 8.2.	Post-Medieval
CH063	RCAHMW: 80148, 80150	Mynydd-y-drum coal patches	Non-designated	Slight depressions marking site of nineteenth-century opencast with tips to the side.	Post-Medieval
CH064	Historic Maps	Dulais Anthracite Colliery	Non-designated	A colliery at this location is first shown on the Ordnance Survey 6":mile map of 1905, labelled as 'Drym Colliery'. It was linked by tramway to several old levels and old shafts so is likely to have come into operation in the late 19th century. The Ordnance Survey 25":mile map of 1912 shows the colliery labelled as the Dulais Anthracite Colliery, which by that time had numerous sidings to connect it to the Neath and Brecon Railway Line. The colliery is shown as being disused by the Ordnance Survey 6":mile map of 1953 (surveyed 1948).	Post-Medieval/ Modern
CH065	Historic Maps and Aerial photographs	Spoil heap	Non-designated	Linear spoil heap seen on 1945 aerial photograph (REF). The Ordnance Survey 6":mile map of 1953 (surveyed 1948) shows this tip as being linked to Seven Sisters colliery to the south by an aerial ropeway. The area is now covered by woodland.	Modern
CH066	RCAHMW: 80161, 80169	Onllwyn Colliery	Non-designated	Nineteenth-century coal shaft and drift.	Post-Medieval

#	ID reference	Asset name	Designation	Description	Period
CH067	RCAHMW: 97303	Siloh Calvinistic Methodist Chapel, Onllwyn	Non-designated	Post-medieval chapel, now demolished.	Post-Medieval
CH068	Walkover Survey, LiDAR and aerial photographs	Mine shaft/air shaft	Non-designated	Covered shaft, noted on walkover survey and visible on LiDAR data. Does not correspond with any historically mapped shafts or drifts so may be an air shaft. Corresponds with a small depression visible on 1945 aerial photograph suggesting a 20th century date.	Modern
CH069	Walkover Survey, LiDAR and aerial photographs	Mine shaft/air shaft	Non-designated	Covered shaft, noted on walkover survey and visible on LiDAR data. Within an area of visible spoil heaps on the 1945 aerial photo but does not correspond with any historically mapped shafts or drifts. Likely to post-date the clearance of the spoil heaps shown on 1945 aerial photograph.	Modern
CH070	Historic Maps, aerial photograph and LiDAR	Quarry	Non-designated	Old quarry shown on 1st ed 1877 6 inch map. Area now restored and quarry remains not visible during walkover survey.	Post-Medieval
CH071	Walkover Survey	Trackway and LiDAR	Non-designated	Several trackways identified during walkover survey. One, running east-west across the area, corresponds with a possible track shown on the Ordnance Survey 6":mile map of 1877 and later maps. The others, which connect with this, may be later as they do not correspond with any shown on historic mapping.	Post-Medieval/ Modern
CH072	Historic Maps	Tramway	Non-designated	Old Tramway marked on OS map of 1903 and connecting to the 'old levels' shown to the south (CH075). Not shown on later maps and no evidence visible on LiDAR or walkover.	Post-Medieval
CH073	Historic Maps	Drift Mine	Non-designated	Drift shown on OS 1914 map. Shaft, spoil heap and tramway shown on map, visible on lidar. Not visible on walkover survey as area covered with scrub woodland, although LiDAR indicates a slight depression.	Modern
CH074	Walkover Survey	Field boundary	Non-designated	Historic banked field boundary with a line of trees identified during walkover survey, and visible on historic maps.	Post-Medieval

#	ID reference	Asset name	Designation	Description	Period
CH075	Historic Maps, Aerial Photograph	Mine	Non-designated	Area of mine shafts and spoil shown on the OS 1903 and later maps and visible on 1945 aerial photograph. Likely to be extension of CPAT HER record of mapped mining levels (CH022)	Post-Medieval
CH201	GGAT: 00910w, RCAHMW: 18045	Blaendulais Grange: possible site at Rhyd-y-Pwllau	Non-designated	Medieval grange. Blaendulais Grange was a grange of Neath Abbey known from documentary sources (extent of 1296) only; it has not been located accurately. GGAT:910w represents one of three possible sites.	Medieval
CH202	GGAT: 05316w	Possible kiln shed opposite Bryngolau, Coelbren	Non-designated	A lime shed located to the south of Tonyfildre Farm along Camnant Road, 300m away from Coelbren Roman Fort defences. Aligned NE-SW and approximately 50m long by 10m wide.	Post-Medieval
CH203	GGAT: 05672w	Rhyd-y-pwllau quarry	Non-designated	A circular feature to the south of Rhyd-y-pwllau farm, showing on CPE/UK/1997 frames 4396-7. Field visit showed that it was a quarry	Unknown
CH204	GGAT: 07065w	Railway	Non-designated	A disused railway. This ran from the mine workings, east of the site, to the Neath and Brecon Railway to the northwest. The railway was constructed in order to transport raw materials to the Melincwrt furnace at Neath, a job previously undertaken by horses. The exact date of its closure and its exact location is currently uncertain, but it was still shown on the Ordnance survey map of 1963.	Post-Medieval
CH205	PAS: 30078	Findspot: Bronze Age spearhead	Non-designated	Findspot of Bronze Age socketed spearhead of copper alloy (PAS ref: NMGW-E80BA5)	Bronze Age
CH206	RCAHMW: 13352	Bryn Seion Independent Chapel, Onllwyn	Non-designated	Bryn Seion Independent Chapel was built before 1948 and converted for residential use in 1988.	Post-Medieval/ Modern

#	ID reference	Asset name	Designation	Description	Period
CH207	RCHAMW: 19865	Rhyd-y-Pwllau	Non-designated	The now-demolished Rhyd-y-pwllau was a single-storey cottage with attached byre	Post-Medieval
CH208	RCHAMW: 97304	Calfaria Baptist Chapel, Dyffryn Cellwen	Non-designated	Baptist chapel.	Post-Medieval
CH209	RCAHMW: 13456	Noddfa Wesleyan Methodist Chapel, Dyffryn Cellwen	Non-designated	Early 19th century Methodist Chapel.	Post-Medieval
CH210	RCAHMW: 13435	St David's Church, Dyffryn Cellwen	Non-designated	St David's church is a rectangular corrugated iron structure built in 1925 as a branch Church and dedicated to St David.	Modern

Designated heritage assets within the outer 3km and 5km study areas

#	ID Reference	Asset name	Designation	Description	Period
CH076	BR201, CPAT: 30475, RCAHMW: 275622, 33371-2 LB: 17922, CPAT: 42188, RCAHMW: 25714	Lefel Fawr Coal Adit, Yard House and Pont-Y-Yard Bridge	Scheduled Monument and two Listed Buildings (Grade II)	The Scheduled Monument consists of a well-preserved example of a rock-cut coal level of late 18th century date. The mine was opened in 1796 and was initially intended to become a boat-level, forming an underground branch of the Swansea Canal. The level is disused but is the route of a stream draining from underground. The entrance is covered by a metal grill. Yard House was the manager's house and office for the Lefel Fawr colliery. This was established around 1800, following the opening of the Swansea Canal, by the Abercrave Colliery Co of Daniel Harper. The adjacent Yard Bridge or Pont-y-Yard was built by Daniel Harper c1824 to replace a timber bridge carrying a tramroad from the colliery to the Swansea Canal. Yard	Post-Medieval

#	ID Reference	Asset name	Designation	Description	Period
	LB: 7468, CPAT: 30472			House was built around this date. A plan of 1840 shows it as the Lefel Fawr colliery office. The half near the tramroad was the office, with a weighbridge and a stable adjoining. The further side contained the manager's house. No other colliery office and managers' house of the early nineteenth century is known to exist in Wales. It is listed as a rare surviving example of an early colliery office, and for group value with the listed Yard Bridge and Scheduled Lefel Fawr adit entrance (BR201). Pont-y-Yard Bridge is a former tramway bridge of c1823-4 across the Tawe, now providing road access to Yard House. The bridge was built for Daniel Harper of the British Iron & Coal Co. (later Abercrave Colliery Co.) for a coal tramroad down from the Level Fawr colliery. The original intention was for the bridge to be an aqueduct so that coal could be loaded onto boats and sent to the Swansea Canal across the valley. Instead the coal was brought to The Yard, the wide open space by the river, and thence transhipped to the canal.	
CH077	BR222	Abercrave Ironworks	Scheduled Monument	The monument comprises the remains of several buildings, including a blast furnace, coke oven and leat and an open excavated area related to the production of iron. Abercrave Ironworks was the first works built specifically to smelt iron using anthracite fuel and was opened in 1824 by Daniel Harper. The use of anthracite in iron smelting was only achieved in 1837, with the work of David Thomas at nearby Ynyscedwyn and the Abercrave Ironworks proved a failure, closing in 1829. It operated again between 1855 and 1861, but was unused subsequently. The ironworks was situated next to the terminus of the Swansea Canal and tramroad to Cribarth quarries. A diversion from the canal's feeder supplied a waterwheel powering the works, measuring 10.6m in diameter. The remains include the stone revetment of a charging area, plateway, leat leading to the stone wheelpit, circular furnace base, two large bears of solidified iron and the tramroad embankment.	Post-Medieval
CH078	LB: 6610, CPAT: 20868, RCHAMW: 31177	Circular cow-house at Gwaunclawdd	Listed Building Grade II*	Circular cow-house, early C19, consisting of a 2-storey inner core for storing and preparing feed flanked by 2 curved lean-tos for stock almost surrounding the inner core except for opposed access passages that allowed hay to be loaded into loft of the core, whence it could be dropped into the base, to be	Post-Medieval

#	ID Reference	Asset name	Designation	Description	Period
				distributed via 4 doorways each side to the feed-passages of the lean-tos. This building type was promoted in the United States and advocated in the agricultural press in Britain (cf Annals of Agriculture 1798 p 502) but very few were ever built, this apparently the only one in Wales. Graded at II* as probably the only example of a circular cow-house in Wales, the design illustrating the contemporary interest in improving animal husbandry.	
CH079	6605	Hen Noyadd	Listed Building Grade II	House of early C15 origin, largely rebuilt in C17 and altered in C19 and restored in 1986. Late medieval work includes the basement of the whole building, and the walls of the upper end, with medieval windows restored on the basis of evidence found. The house was at the head of the Swansea Canal, extended from Ystradgynlais to Hen Neuadd in 1794. In poor repair in 1863, it was renovated for Morgan Morgan (d 1889) agent of the British Iron & Coal Co, who converted the basement to dairies, and added outbuildings. He also built cottages nearby at Trefleming and Tanyrallt. Morgan later moved to Craig-y-nos Castle, which he sold to Adelina Patti. The collapse of the upper part of the C17 main chimney during works brought to light broken fragments of late medieval windows. Included as rare late medieval to C17 house, carefully restored. Associated barn (RCHAMW: 405917)	Medieval
CH080	6607	12 Lamb & Flag Cottages	Listed Building Grade II	Terraced house, painted render with slate close eaved roofs and square rendered end stack to original range. In 1801, when Thomas Malkin passed, Pentre'r Lamb was a settlement of two inns and a few houses with a small mine by the river, near the canal-head of the Swansea Canal. No 10, the former Lamb and Flag Inn, and No 12 may have been originally part of one large house or inn. No 12 has been carefully restored and extended in matching style c2000. Included with No 10 as remnant of a small rural industrial/agricultural settlement illustrative of the early industrial history of the region.	Post-Medieval
CH081	BR072	Saith Maen	Scheduled Monument	The monument comprises the remains of a stone row, which probably dates to the Bronze Age (c. 2300 - 800 BC). The site comprises an impressive row of 7 standing stones aligned N/S in an area of shake holes on an east-facing slope overlooking the Tawe Valley at 350m AOD.	Bronze Age

#	ID Reference	Asset name	Designation	Description	Period
CH082	BR074	Section of Road NE of Coelbren Fort	Scheduled Monument	The monument consists of the remains of a road, dating to the Roman period (1st to 5th century AD). This scheduled area forms part of Sarn Helen which leads NE from Coelbren Roman Fort (GM146), and is 1.3km in length. The road comprises a slightly raised level platform with a slight scarp on its eastern side and a ditch along the western side. The surface of the road is largely turf covered, although the stone of the original road surface can be seen in places along its length. An old field wall runs along the western side of the road for much of its length.	Roman
CH083	GM146	Coelbren Fort	Scheduled Monument	The monument consists of the remains of a medium-sized auxiliary fort dating from c. AD 75 (Roman period). It is located on the Roman road from Neath to Brecon. It is best preserved on the west side where surrounding bank and two outer ditches are clearly visible. Excavations revealed a standard layout, with timber buildings inside. To the south are the remains of a probably earlier large marching camp (GM343). Roads can be traced leading to the south and east of the fort. The fort was abandoned AD 140-50.	Roman
CH084	GM343	Roman Marching Camp South East of Coelbren Fort	Scheduled Monument	The monument comprises the remains of a Roman marching camp, probably constructed during the period of Roman conquest (AD74-78). The large embanked enclosure is typically playing-card shaped and occupies part of a broad low ridge which rises to approximately 230m OD. The camp is bounded on all sides except the east by the marshy valleys of the Camnant and Afon Pyrddin. The crest of the ridge runs almost due west from the south-east corner so that most of the interior of the camp falls gently to the north and overlooks the neighbouring Roman fort at Coelbren. The marching camp and fort are about 180m apart. The rampart can be detected almost throughout the circuit, and the rounded corners (except the south-west) remain recognisable; but all details of the entrances have been destroyed.	Roman
CH085	BR198, LB: 25952 CPAT: 19333	Ynysgedwyn Colliery, Fan House	Scheduled Monument and Listed Building (Grade II)	The monument consists of the remains of a Guibal Fanhouse that was built to ventilate the Ynysgedwyn Colliery in the late 19th century. The development of mechanical ventilation in coal mines was crucial to the improvement of safety and the extension of working potential during the late 19th century. The Guibal Fan was one of the earliest to come into general use and was the most	Post-Medieval

#	ID Reference	Asset name	Designation	Description	Period
	RCAHMW: 33733			successful, with nearly 200 installed within 14 years of it being patented in 1862. This is the only known Guibal Fanhouse to survive in Wales and one of only four surviving in the UK as a whole. The site is currently in a ruinous condition	
CH086	BR173	Pillow Mounds at Pant Mawr	Scheduled Monument	The monument consists of the remains of a series of pillow mounds, pillow-shaped, flat topped rectangular mounds often surrounded by a shallow ditch used to farm rabbits. The site consists of at least 80 pillow mounds located within a walled enclosure. The pillow mounds are between 20m and 140m long, around 4m wide and up to 1.2m high and surrounded by ditches averaging 1.5m wide and 0.3m deep. A series of dry stone lined pits are also located on the site, possibly for use as rabbit traps, while a series of quadrilateral dry stone walled enclosures, measuring 18m long by 12m wide and containing pits may represent rabbit breeding pens.	Post-Medieval
CH087	BR237	Cribarth Limestone Quarries and Tramroads	Scheduled Monument	The monument comprises the remains of quarry workings dating from the industrial period. The quarries worked limestone and silica sand and were connected with the Swansea Canal by tramroad. The remains include quarry, tip, limekiln, boundary and tramroad features. There is a dense network of tramroads within the quarries, one unfinished tramroad of the 1820s provides some of the best evidence in Wales of the construction process of such features. The main period of activity at the quarries was connected with the provision of flux and silica firebricks for the boom in the anthracite iron industry of the upper Swansea Valley from 1837 to about 1860.	Post-Medieval
CH088	BR246	Craig-y-Rhiwarth Hillfort	Scheduled Monument	The monument comprises the remains of a hillfort, which probably dates to the Iron Age period (c. 800 BC - AD 74, the Roman conquest of Wales). Craig y Rhiwarth is a small univallate hillfort located in a naturally defensive position on high limestone cliffs offering extensive views over the Afon Tawe valley. The hillfort is surrounded by a single stone rampart which survives to a height of 0.5m. A modern field wall has been constructed across it on the N side. There are three breaks in the surviving stretch of rampart, all of which have modern tracks running through them and it is unclear which entrance is original.	Iron Age

#	ID Reference	Asset name	Designation	Description	Period
CH089	BR256	Hut Circle West of Saith Maen	Scheduled Monument	The monument comprises the remains of a hut circle that probably dates to the Iron Age or Romano-British period (c. 800 BC - AD 400). The hut circle constructed in a sheltered position at the bottom of a deep natural shake hole. It has an internal diameter of 3.2m, is bounded by well constructed coursed stone walls 0.6m wide and standing up to 0.6m in height. The hut has a well defined west facing entrance marked by two large boulders.	Iron Age
CH090	BR333	Dorwen standing stone	Scheduled Monument	The monument comprises a fine standing stone, probably dating to the Bronze Age (c.2300 BC - 800 BC) and situated within open moorland on the SW-facing slopes of the ridge above and to the E of Afon Twrch, in the foothills of the Black Mountain. The standing stone measures 1.2m in height, 0.9m in thickness from ENE to WSW by 0.7m in width. The stone is a striking block of weathered limestone and boasts fine views around the SW arc. Several packing stones are visible around its base.	Bronze Age
CH091	BR388	Lorfa Stone Circle	Scheduled Monument	The monument comprises the remains of a fine stone circle, probably dating to the Bronze Age (c.2300 BC - 800 BC) and situated on the SSW end of the gently rounded Lorfa ridge on the S facing slopes of the Black Mountain. The stone circle boasts fine views around the whole SSE and measures about 10m in diameter. The stone circle contains at least 20 stones in total, comprising several prominent stones and many smaller stones; although the circle is broken in parts (on the E and SSW), more stones may be hidden under the turf. A large quartzitic boulder is situated about 50m to the NNE and may represent an outlier; and a small but well-preserved hut circle is situated about 50m to the SW.	Bronze Age
CH092	GM420	Remains of Blast Furnaces at Banwen	Scheduled Monument	The monument comprises the remains of an ironworks. Founded in 1838, the ironworks proved to be short-lived and unsuccessful. As a result, the works at Banwen remained small scale and representative of a relatively rare single phase development. The complex of stone-built buildings includes two substantially intact blast furnaces with their associated charging platform, the engine house and the site of the chimney. The two furnaces are constructed of roughly coursed large grey stone with archways on all four sides with pecked detailing to the quoins. While the site was in use, material to charge the	Post-Medieval

#	ID Reference	Asset name	Designation	Description	Period
				furnaces would be weighed at the weighbridge (un-scheduled), then brought to the edge of the charging platform (which exploits a slight natural cliff) and taken over a bridge onto the tops of the furnaces. Power for the forced draught (blast) was provided by a steam engine located in the engine house.	
CH093	GM396, LB:25953 80809	Canal Aqueduct over the River Twrch, Ystalyfera	Scheduled Monument and Listed Building GII*	The monument consists of the remains of an aqueduct, dating to the industrial period. As well as being a Scheduled Monument it is included as a Grade II* Listed Building as the principal surviving engineered structure of the Swansea Canal. This is the largest of the aqueducts which carried part of the original Swansea Canal, and it spans the Afon Twrch. The fast flowing nature of the river necessitated a weir to be built below the aqueduct to protect the piers and also to serve as a feeder. The total span of the aqueduct, which is built entirely of stone, is 21m. The canal itself is recorded as GGAT:01046.0w.	Post-Medieval
CH094	GM274	Hirfynydd Roman Earthwork	Scheduled Monument	The monument comprises the remains of a signal station dating to the Roman period (AD74 - AD410). The signal station sits at 451m above OD on a broad mountain ridge with a superb outlook in all directions, extending as far as the Preseli Mountains in Pembrokeshire. The station stands on the line of the Roman road over Hirfynydd and consists of an approximately square earthwork measuring (between the crests of the rampart) 19.5m from north-west to south-east by 18.3m. The defences comprise a low, spread bank 1.8m-3.7m wide, with rounded corners and an external ditch. Internally, the bank is nowhere more than 0.3m high; externally it is 0.3m high along the south-east and south-west sides, 0.6m along the other two sides, and 0.9m at the west angle. The single entrance lay at the middle of the south-east side, facing the road. The ditch is 2.7-3.1m wide and at the entrance is interrupted by a causeway about 3.7m wide. There are no signs of any internal structures. A deep trench to the north of the site appears to be a quarry hollow.	Roman
CH095	GM593	Coed Ddu house platforms and enclosure	Scheduled Monument	The monument comprises the remains of two house platforms and a large enclosure, all probably dating to the medieval or post-medieval periods and situated within enclosed moorland on the west-facing slopes of Hirfynydd, above and to the north-east of Crynant. The settlement presumably represents the remains of seasonal hafotai, the platforms once boasting buildings	Medieval/ Post-Medieval

#	ID Reference	Asset name	Designation	Description	Period
				associated with summer grazing - perhaps a dwelling house and barn (respectively represented by the main house platform and that associated with the enclosure). There are historical references to a monastic grange at Crynant, belonging to the Abbey at Neath - it is possible that this enclosure (typical of an upland monastic grange) and its associated house platforms represent the surviving remains of the Crynant Grange (RCAHMW 1982).	
CH096	GM592	Coed Ddu ring cairn	Scheduled Monument	The monument comprises the remains of a ring cairn, probably dating to the Bronze Age (c.2300 BC - 800 BC) and is situated within enclosed unimproved pasture on the west-facing slopes of Hirfynydd, above and to the north-east of Crynan. The ring cairn is situated in a classic location, with wide views all around and particularly to the north-west - except to the rear, where it is overlooked by higher ground. Several large slabs (one set upright) are situated immediately to the south of the cairn, forming a semi-circle perhaps 11m in diameter; these footings may represent the surviving elements of the kerb remaining from a further cairn, now robbed of its stone.	Prehistoric, probably Bronze Age
CH097	GM275	Carn Cornel Round Cairn	Scheduled Monument	The monument comprises the remains two burial cairns, probably dating to the Bronze Age (c. 2300 - 800 BC). Cairn A - A large mound of stones, 20.4m long from east to west by 17.7m wide and 0.9m high. The base of the mound may be partially natural, and the actual cairns appears to have been circular and about 15.2m in diameter.	Bronze Age
CH098	23080	Godre'r Rhos Independent Chapel and vestry	Listed Building GII*	Independent chapel in isolated site approached across a stream. Built in 1855-6, replacing one of 1754 founded by the Rev Henry Thomas, notable Independent minister. Henry Thomas was initially associated with the Calvinistic Methodist cause, and was given a house in which to preach by his father-in-law, Jenkin David of Crynant: Howel Harris was a frequent visitor. By c 1752, Thomas had abandoned the Methodists, after briefly siding with Harris after the latter's split with Daniel Rowland in 1750, and was ordained as an Independent minister.	Post-Medieval
CH099	7491	Craig-y-nos	Listed Building GII*	Large castellated country house in Scottish baronial style. Sited to maximise views of surrounding mountains, the front courtyard opening onto mountain	Post-Medieval

#	ID Reference	Asset name	Designation	Description	Period
				road to W and E frontage overlooking the River Tawe and the mountain ranges beyond. Incorporated into the wall of one of the buildings fronting the S courtyard is a mullioned window and blocked arched doorway, evidence of the C16- C17 predecessor of the C19 development. The elaborate mid C19 Scottish baronial style house which fronts the main courtyard and is the core of Craig-y-nos was originally called Bryn Melin and was built by T H Wyatt for Rhys Davies Powell in 1841-3. This extravagance bankrupted Powell and the estate was sold to the Morgan Morgans, a branch of the Tredegar family. In 1879 the property was bought by world-famous opera singer Adelina Patti. In 1890 she had built a theatre at NE (see separate entry for history) and in 1891 a large extension to N in pink Crai stone to provide additional spacious reception rooms and accommodation for guests and changing rooms for the theatre; a clock tower was also built adjacent to the theatre, the clock mechanism dated 1884. Further enrichments included a pavilion which was built as part of a Winter Garden development at the far SE corner of the building and was moved and re-erected at Victoria Park,Swansea, in 1920, and a large glass conservatory with attached aviary facing the garden to E accessed off the S courtyard and from the breakfast room. The railway station on the Brecon Neath line at nearby Penwyllt was remodelled for her and re-named Craig-y-nos; she also had her own railway carriage complete with piano and solid silver bath. The building later was first used as a hospital during the Great War, the room layout mainly unaltered though a lift later replaced the central staircase. Ward wings were built in place of the Winter Garden pavilion. Subsequently the house reverted to private ownership, and is currently mainly used for private functions and in association with opera performances. Patti commissioned William Barron (1800-1891) to lay out the gardens E of the Castle. These descended beneath the main frontage in an unusual stepped terrace to the river where a rocky water garden was constructed with summerhouse (restored). On the plateau either side of the house were the walled winter gardens to S and walled kitchen garden to N with game larder and glass houses; fishponds and boating lake beyond, also rose garden, croquet and tennis courts, and paddock. A network of paths	

#	ID Reference	Asset name	Designation	Description	Period
				allowed Patti and her visitors to enjoy the formal gardens and the wilder meadows, woodland and mountain scenery.	
CH100	7492	Theatre at Craig-y-nos	Listed Building GI	Theatre was constructed in 1890 by Bucknall and Jennings of Swansea with decoration by the famous London plasterers Jackson and Sons of Kensington, part of a large extension to a mid C19 mansion built for the famous opera singer Adelina Patti following her acquisition of the property in 1879 (see history of Craig-y-nos for more details). Plan is a small version of the Bayreuth theatre and seats 150. Stage retains side flats of painted garden scenery by Steinhardt and curtain drop by Hawes Craven depicting Madame Patti as Semiramide. At the opening in 1891 Madame Patti performed extracts of La Traviata and Faust. Originally there was a balcony along the back (S).	Post-Medieval
CH101	PO16	Craig-y-Nos Castle and Country Park	Historic Parks and Gardens Grade II*	Gardens designed by William Barron in the late-19th century.	Post-Medieval
CH102	23032	Sardis Independent Chapel and attached schoolroom	Listed Building Grade II	Independent chapel of 1860-1 designed by the Rev Thomas Thomas. Schoolroom adjoining of 1926. Included as a well-designed and well-preserved chapel by one of the leading Welsh chapel architects, and with notable painted-grained interior woodwork, and unusual curved pulpit.	Post-Medieval
CH103	25946	,74, Heol Giedd, Cwm Giedd, Swansea,, SA9 1LS	Listed Building Grade II	One of a terraced row of five mid to later C19 cottages, marked on 1877 OS map. The best surviving range of such cottages in the region. The development of Ystradgynlais and the surrounding valleys was by the building of short terraces on existing roads, initially for workers in the limestone quarries, later for colliery workers. These houses are probably associated with stone quarrying.	Post-Medieval
CH104	25947	,76, Heol Giedd, Cwm Giedd, Swansea,, SA9 1LS	Listed Building Grade II	One of a terraced row of five mid to later C19 cottages, marked on 1877 OS map. The best surviving range of such cottages in the region. The development of Ystradgynlais and the surrounding valleys was by the building of short terraces on existing roads, initially for workers in the limestone	Post-Medieval

#	ID Reference	Asset name	Designation	Description	Period
				quarries, later for colliery workers. These houses are probably associated with stone quarrying.	
CH105	25948	,78, Heol Giedd, Cwm Giedd, Swansea,, SA9 1LS	Listed Building Grade II	One of a terraced row of five mid to later C19 cottages, marked on 1877 OS map. The best surviving range of such cottages in the region. The development of Ystradgynlais and the surrounding valleys was by the building of short terraces on existing roads, initially for workers in the limestone quarries, later for colliery workers. These houses are probably associated with stone quarrying.	Post-Medieval
CH106	25949	,80, Heol Giedd, Cwm Giedd, Swansea,, SA9 1LS	Listed Building Grade II	One of a terraced row of five mid to later C19 cottages, marked on 1877 OS map. The best surviving range of such cottages in the region. The development of Ystradgynlais and the surrounding valleys was by the building of short terraces on existing roads, initially for workers in the limestone quarries, later for colliery workers. These houses are probably associated with stone quarrying.	Post-Medieval
CH107	25950	,82, Heol Giedd, Cwm Giedd, Swansea,, SA9 1LS	Listed Building Grade II	One of a terraced row of five mid to later C19 cottages, marked on 1877 OS map. The best surviving range of such cottages in the region. The development of Ystradgynlais and the surrounding valleys was by the building of short terraces on existing roads, initially for workers in the limestone quarries, later for colliery workers. These houses are probably associated with stone quarrying.	Post-Medieval
CH108	6606	10 Lamb & Flag Cottages	Listed Building Grade II	House, former inn, late C18 origins, much altered. In 1801, when Thomas Malkin passed, Pentre'r Lamb was a settlement of two inns and a few houses with a small mine by the river, near the canal-head of the Swansea Canal. The Lamb and Flag Inn and the adjacent No 12, once Lamb and Flag farmhouse may have been originally part of one large house or inn. Included despite alterations as remnant of a small rural industrial/agricultural settlement illustrative of the early industrial history of the region.	Post-Medieval

#	ID Reference	Asset name	Designation	Description	Period
CH109	6608	The Pound	Listed Building Grade II	Pound for stray animals removed from common land, probably early to mid C19. Included as a well-built C19 animal pound and for group value with adjacent listed buildings.	Post-Medieval
CH110	6609	Outbuildings opposite Lamb & Flag Cottages	Listed Building Grade II	Outbuildings of former Lamb & Flag Farm which was the end house of the terraced row opposite. A lofted stable and carthouse added to a slightly earlier lofted cow-house. Probably early C19. Included for group value with the pound and Nos 10 and 12 Lamb and Flag Cottages opposite.	Post-Medieval
CH111	7544	Caer'r Lan Castle	Listed Building Grade II	Inn, now house, built for the former Swansea Canal c 1800 and extended in later C19. In use as an inn until c1990. Included as a substantial late Georgian house with unusual Victorian and finely detailed cast-iron large porch, and for connection with the Swansea Canal.	Post-Medieval
CH112	82048	Circular pigsty at Blaendulais Farm	Listed Building Grade II	Late C18 or early C19 corbelled pigsty. The date range for this style of pigsty in Glamorgan is uncertain, but they are noted as early as 1796 by travellers and the latest dated example is 1856 in Gwent. Included as a very rare and unusual example of a disappearing building type using and ancient form of construction.	Post-Medieval
CH113	82050	The War Memorial	Listed Building Grade II	War Memorial of 1921 of white marble soldier on granite plinth, said to have been designed by a local man and similar to examples by E. Jones of Llanybydder found across S and W Wales. War memorial, white marble soldier in uniform with cap and reversed rifle. Standing on tall pedestal of grey granite with moulded cornice, tapered shaft, moulded plinth and square base. Inscription on front of cornice '1914-18' with 'This memorial is erected in memory of the men of this place who died in their country's service during the Great War and whose names are inscribed hereon' on pedestal shaft and 34 names below. Also on front of plinth is 'Greater love hath no man than this; that a man lay down his life for his friends'. On right side of cornice is inscribed 'Yn ang of ni chant fod' with a further 32 names on shaft below. On left side of cornice is '1939-45' with 15 names on shaft below. Included for its special historic interest as a carved marble village war memorial in a prominent position.	Modern

#	ID Reference	Asset name	Designation	Description	Period
CH200	11867	Church of Saint Cadoc	Listed Building GII*	Anglican parish church originally a C17 chapel of ease to Cadoxton, rebuilt in 1808-9 for the Williams family of Aberpergwm and extended with chancel in 1836-41, the chancel apparently designed around two fine medieval effigies said to have been purchased in France. There were further works by J.B. Fowler of Cardiff in 1883, and his may be the C17 style ogee-traceried windows in red sandstone. The bellcote apparently modelled on C14 originals, e.g. Betws (Glamorgan) and Chilthorne Domer (Somerset), has been replaced in late C20. The two nave porches were originally one for men the other for women, the S porch now a vestry. The E window contains four stained glass panels which have been identified as originating from the cloister of Steinfield Abbey, Germany, built between 1499 and 1517 and glazed c.1530. The panels were removed in the late C18 and eventually sold to John Christopher Hampp, a German immigrant who lived in Norwich and imported continental glass at the beginning of the C19. It is unknown when the panels were installed at St Cadoc's but may belong to the 1808-9 rebuilding.	Post-Medieval

A9 Photographs

8.1a



8.1b



8.2



8.3



Photograph 8.1a-b: Claypon's Extension (CH001) looking east
Photograph 8.2: Field boundary (CH075), looking north.
Photograph 8.3: Covered shaft, looking south-east (CH69)

8.4



8.5



8.6



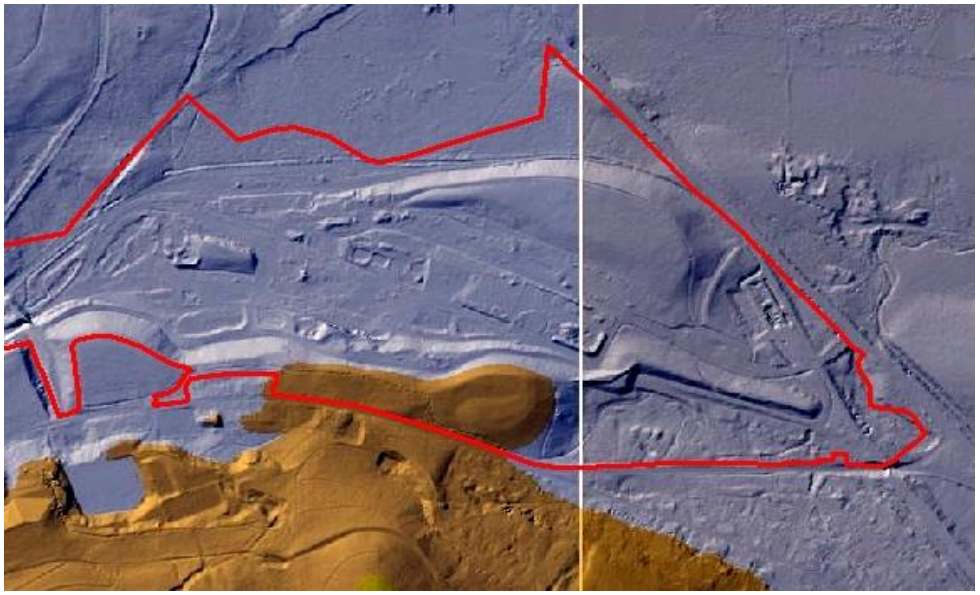
Photograph 8.4: Bryn Llechwen ring cairn (CH002): View from cairn, looking east

Photograph 8.5: Spoil associated with Glynllech Colliery (CH025) (looking north)

Photograph 8.6: Trackway (CH071), looking east

8.7





Photograph 8.7: View of the Onllwyn Washery site (CH061). View from publicly accessible road looking east
Right: Lidar imagery of the washery site (Welsh Government 2m lidar, contains public sector information licensed under the Open Government License v2.0)



Aerial photograph of the site in 1945. Contains public sector information licensed under the Open Government Licence v2.0.

Appendix 9A

Assessment Methodology

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9A1 Assessing the Sensitivity of Landscape Receptors to Change

This study assigns a degree of sensitivity to landscape features and to each Landscape Character Area identified through baseline studies.

The sensitivity of landscape receptors to change is assigned by combining judgements of the value of the receptor and their susceptibility to the type of change or development being proposed, as outlined in *Guidelines for Landscape and Visual Impact Assessment* (GLVIA), (Third Edition, 2013)[1].

9A1.1 Value

Reviewing existing designated landscapes forms the starting point for assigning value to landscape character areas.

In a policy context, the usual basis for recognising certain important landscapes is via application of local or national landscape designations. A landscape can nonetheless be valued by different communities for many different reasons without any formal designation.

The assessment of landscape value is based on judgements about the physical state of the landscape (quality/condition) and about its intactness from visual, functional and biodiversity perspectives. It also reflects the state of repair of individual features and elements that make up the character in any one place.

Value may be: **High, Medium or Low**

9A1.2 Susceptibility to Change

Susceptibility refers to the degree to which a particular landscape feature or character area is able to accommodate the changes proposed by a development without significant effects to its components or overall character.

Susceptibility is assigned to landscape receptors based on ‘ability of the landscape receptor (whether it be the overall character or quality/condition of a particular landscape type or area, or an individual element and/or feature, or a particular aesthetic and perceptual aspect) to accommodate the proposed development without undue consequences for the maintenance of the baseline situation and/or the achievement of landscape planning policies and strategies’ (GLVIA3).

Susceptibility may be: **High, Medium or Low**

[1] Landscape Institute and I. E. M. A (2013) *Guidelines for Landscape and Environmental Impact Assessment*

9A1.3 Sensitivity

Sensitivity is assigned by combining the value and susceptibility assigned to landscape character areas.

The criteria to define each sensitivity rating are shown in Table 1 below.

Table 1: Landscape Sensitivity

Sensitivity	**Typical Criteria**
High	Landscapes which by nature of their character would be unable to accommodate change of the type proposed. High sensitivity landscapes are typically: - highly valued landscapes, likely to be covered by international, national or regional designations; - of high quality with distinctive elements and features that make positive contribution to character and sense of place; - containing features recognised through use, perception or historic and cultural associations; - likely to contain features and elements that are rare and consequently irreplaceable.
Medium	Landscapes which by nature of their character would have the ability, to some extent, to accommodate change of the type proposed. Medium sensitivity landscapes are typically: - locally valued landscape, likely to be covered by local designations or recognised through non-statutory local publications. - comprising commonplace elements and features creating generally unremarkable character but with some sense of place; - containing some features recognised through use, perception or historic and cultural associations; - likely to contain some features and elements that could not be replaced.
Low	Landscapes which by nature of their character would be able to accommodate change of the type proposed. Low sensitivity landscapes are typically: - undesignated landscapes of low value and often eroded; - comprised of some features that are discordant, derelict or in decline;

Sensitivity	Typical Criteria
	- containing few, if any, features of value through use, perception or historic and cultural associations; - containing few, if any, features and elements that could not be replaced.

9A2 Assessing the Magnitude of Change to Landscape receptors

This study compares the overall character of the existing landscape with the changes that result from the proposed development. It quantifies the degree of change in terms of size or scale, geographical extent of the change and its duration and reversibility.

The magnitude of change to the current (baseline) landscape environment depends on a combination of factors as outlined within GLVIA3:

Size or Scale

Judgments for the size or scale of change in the landscape take account of the following:

- the extent of existing landscape elements that will be lost, the proportion of the total extent that this represents and the contribution of that element to the character of the landscape;
- the degree to which aesthetic or perceptual aspects of the landscape are altered either by removal of existing components of the landscape or by addition of new ones;
- whether the effect changes the key characteristics of the landscape, which are critical to its distinctive character.

Geographical Extent

- The area over which the landscape effects will be felt. In general, effects may have an influence at the following scales:
-
- at site level, within the development site itself;
- at the level of the immediate setting of the site;
- at the scale of the landscape type or character area within which the proposal lies;
- on a larger scale, influencing several landscape types or character areas.

The magnitude of the change to existing landscape character and features is assessed in accordance with the criteria set out in Table 2. These criteria can be applied to both positive and negative impacts.

Table 2: Magnitude of Change to the Landscape

Magnitude of Change	Typical Criteria
High (Adverse)	The proposed development will result in dominant deterioration due to: - total loss or large-scale damage to existing character; - total loss or large-scale damage to distinctive features and elements; - introduction of conspicuous features and elements that are incongruous.
Medium (Adverse)	The proposed development will result in noticeable deterioration due to: - partial loss or noticeable damage to existing character; - partial loss or noticeable damage to distinctive features and elements; - introduction of noticeable features and elements that are incongruous.
Low (Adverse)	The proposed development will result in slight deterioration due to: - perceptible loss or damage to existing character; - perceptible loss or damage to distinctive features and elements; - introduction of features and elements that are incongruous.
Negligible (Adverse)	Any deterioration to existing character, features and elements or the introduction of incongruous features and elements is barely noticeable.
No Change	No noticeable loss, damage or alteration to character or features or elements.
Negligible (Beneficial)	Any enhancements to existing character, features and elements or the introduction of characteristic features and elements is barely noticeable.
Low (Beneficial)	The proposed development will result in slight enhancements due to: - perceptible restoration of existing character; - perceptible restoration of distinctive features and elements; - removal of features and elements that are incongruous; - introduction of perceptible features and elements that are characteristic of the area.
Medium (Beneficial)	The proposed development will result in noticeable enhancements due to: - partial restoration of existing character; - partial restoration of distinctive features and elements; - removal of features and elements that are incongruous; - introduction of noticeable features and elements that are characteristic of the area.
High (Beneficial)	The proposed development will result in dominant enhancements due to: - large-scale restoration of existing character; - large-scale restoration of distinctive features and elements; - removal of features and elements that are incongruous; - introduction of conspicuous features and elements that are characteristic of the area.

9A3 Assessing the Sensitivity of Visual Receptors to Change

This study assigns a degree of sensitivity to visual receptors identified through baseline studies.

The sensitivity of visual receptors to change is assigned by combining judgements of the value of the view and the receptors susceptibility to the type of change or development being proposed.

9A3.1 Value

Value is assigned to a view based on indicators such as appearance in guidebooks or tourist maps, or the provision of facilities or interpretation boards. Views may also hold value due to references in literature or art. Views associated with heritage assets or visitor attractions, or recognised through planning designations, also hold higher value.

Beyond recognised or published views, value may be held due to the nature or rarity of a particular type of view. Clear explanations are included where these instances occur.

Value may be: **High, Medium or Low**

9A3.2 Susceptibility to Change

Susceptibility is assigned to visual receptors based on 'the occupation or activity of people experiencing the view at particular locations and the extent to which their attention or interest may therefore be focused on the views and the visual amenity they experience at particular locations' (GLVIA3).

Susceptibility may be: **High, Medium or Low**

9A3.3 Sensitivity

Sensitivity is assigned by combining the value and susceptibility assigned to visual receptors.

The typical criteria to define each sensitivity rating are shown in Table 3 below.

Table 3: Visual Sensitivity

Sensitivity	**Typical Criteria**
High	Views from within internationally or nationally designated high-quality landscapes (National Parks, AONB, Areas of Great Landscape Value). Views from well used public rights of way often known to and used by people from beyond the local area where the attractive nature of the countryside is the main factor in the enjoyment of the experience, such as National Trails, Long Distance Routes or National Cycle Routes. Views from residential properties.

Sensitivity	Typical Criteria
Medium	Views from non-designated but locally important landscapes, outdoor sports or recreation (where the landscape is not a significant factor in the enjoyment of the sport). Views from locally valued public rights of way often passing through rural landscapes. Views from passenger trains, or people within cars on local roads.
Low	Views from within non-designated but potentially locally valued landscapes. Views from less well used public rights of way which pass through less attractive landscapes or townscapes and are not used specifically for enjoyment of the scenery. Views from motorways, main roads, or business premises where the receptors attention is not focused on the surrounding landscape.

9A4 Assessing the Magnitude of Change to Visual Receptors

The visual assessment compares the quality of the existing view with that which would result from the construction of the scheme and then verbally quantifies the degree of change.

The magnitude of change to the current (baseline) visual environment depends on a combination of factors:

- The size and scale of change in the view;
- The proximity of the viewpoint to visible elements of the development;
- The extent and composition of the view (e.g. degree of existing screening, partial, glimpsed or unobstructed views, fleeting or constant nature of view);
- The degree of contrast or integration of proposed elements with the existing or remaining features or characteristics of the receiving landscape that may detract from or add to its amenity; and
- The relative direct or oblique angle of the view in relation to the receptor.

Table 4: Visual Magnitude of Change

Magnitude of Change	**Typical Criteria**
High (Adverse)	The proposed development will contrast with, or largely alter, key features or characteristics of the views, resulting in a dominant deterioration of the view. These changes to open and direct views are likely to be irreversible or only partly reversible. New elements will occupy a large proportion of the view.
Medium (Adverse)	The proposed development will be noticeable and will result in deterioration of the view. The change will be medium in scale and contrast with the view.
Low (Adverse)	The proposed development will result in slight, often temporary and reversible deteriorations to the view that are small in scale or do not overtly contrast with the key features or characteristics of the view. Views will be largely unchanged despite perceptible differences.
Negligible (Adverse)	Minimal alteration to the features or characteristics of the existing view such that the development will result in barely discernible deterioration to the existing view.
No Change	No part of the project, or work or activity associated with it, is discernible.
Negligible (Beneficial)	Minimal alteration to the features or characteristics of the existing view such that the development will result in barely discernible enhancement to the existing view.
Low (Beneficial)	The proposed development will result in slight enhancements to the view that are small in scale. Views will be largely unchanged despite perceptible differences.
Medium (Beneficial)	The proposed development will be noticeable and will result in enhancement of the view. The change will be medium in scale.
High (Beneficial)	The proposed development will contrast with or largely alter key features or characteristics of the views resulting in a dominant enhancement of the view. New elements will occupy a large proportion of the view.

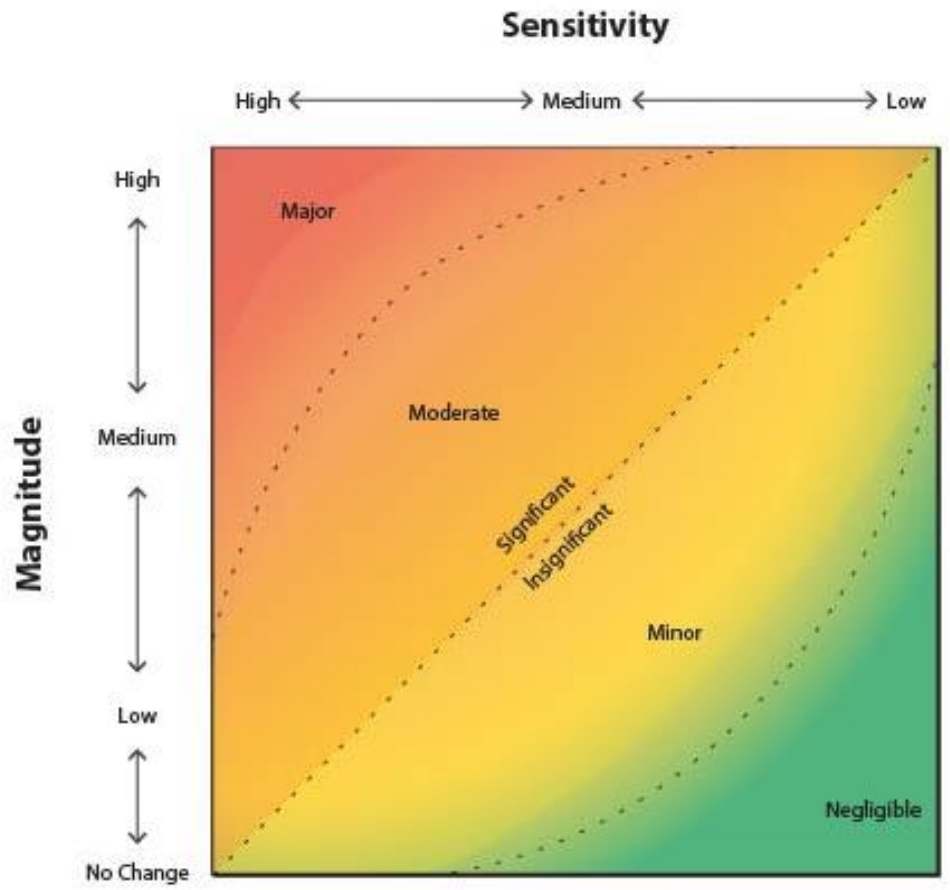
9A5 Assessment of Significance

The significance of effect is a result of the combined Magnitude of Change and Sensitivity of the receptor. The reversibility and duration of the effect are taken into consideration when determining the overall significance of effect which is based on professional judgment. Typical definitions for the significance of effect are shown in Table 5 below. Illustration 1 shows the parameters within which significance of effect is determined.

Table 5: Significance of Effect Definitions

Significance of Effect	**Definition**
Major	These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to experience dominant damaging or beneficial changes of medium to high magnitude leading to long term irreversible loss or enhancement. However, a high magnitude of change to a site or feature of local importance may also enter this category. The proposed development will cause substantial degradation or enhancement of the landscape character/landscape features/existing views. These effects are key factors in the decision-making process.
Moderate	These effects are generally, but not exclusively, associated with sites or features of regional or local importance that are likely to experience damaging or beneficial changes of low to high magnitude, often leading to reversible long or medium-term loss or enhancement of resource integrity. The proposed development will cause noticeable degradation or enhancement of the landscape character/elements/existing views. These effects are material factors in the decision-making process. These effects are important in influencing the subsequent design of the project.
Minor	The proposed development will cause degradation or enhancements of low to medium magnitude to landscape character elements/existing views of local importance. These adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process but are used in optimising the design of the project.
Negligible	The proposed development will cause barely perceptible degradation or enhancement of the landscape character/elements/ existing views.
Neutral	Beneficial and adverse effects on the same receptor balance each other out, such that there is no overall beneficial or adverse effect

Illustration 1: Determining Significance of Effect



9A6 Approach to Cumulative Effects

Cumulative effects are 'the additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together' (SNH, 2012: 4)

Appendix 9B

LANDMAP - Aspect Area Analysis

Contents

B1 Landscape Character – LANDMAP Analysis 1

B1 Landscape Character – LANDMAP Analysis

This Appendix provides a breakdown of LANDMAP[1] aspect areas that form the constituent parts of the landscape character areas identified for this assessment. The value derived from the pre-existing evaluation of aspect areas was used to help inform the assignment of the overall value to each character area.

Banwen Uplands

Aspect	Aspect Area No.	Value
Geological Landscapes	BRCKNGL884	Outstanding
	BRCKNGL670	Outstanding
	NPTGL018	High
	NPTGL019	Outstanding
Landscape Habitats	NPTLH021	Outstanding
	NPTLH022	High
	NPTLH023	Low
	NPTLH024	High
	NPTLH096	Moderate
	BRCKNLH335	High
	BRCKNLH456	High
Historic Landscape	BRCKNHL735	High
	BRCKNHL604	Low
	NPTHL019	Outstanding
	NPTHL072	High
Cultural Landscape	BRCKNCL847	Outstanding
	NPTCL045	High
	NPTCL026	Outstanding
Visual and Sensory	BRCKNVS436	Moderate
	NPTVS970	Moderate

Black Mountain Southern Fringe

Aspect	Aspect Area No.	Value
Geological Landscapes	CRMRTGL293	Moderate
	CRMRTGL263	Moderate
	CRMRTGL292	Outstanding
Landscape Habitats	CRMRTLH039	High
	CRMRTLH029	Outstanding
Historic Landscape	CRMRTHL39602	Outstanding
	CRMRTHL39601	High
	CRMRTHL39600	Outstanding

[1] Natural Resources Wales (2019). *Natural Resources Wales / LANDMAP - the Welsh landscape baseline.* [online]

Cultural Landscape	CRMRTCL060	Low
Visual and Sensory	CRMRTVS008	Moderate

Bryn Henllys Reclaimed Open Cast

Aspect	Aspect Area No.	Value
Geological Landscapes	BRCKNGL773	Outstanding
Landscape Habitats	BRCKNLH456	High
	BRCKNLH101	Low
	BRCKNLH777	High
Historic Landscape	BRCKNHL753	Low
Cultural Landscape	BRCKNCL847	Outstanding
	BRCKNCL957	Outstanding
Visual and Sensory	BRCKNVS365	Low

Coelbren Settlements

Aspect	Aspect Area No.	Value
Geological Landscapes	BRCKNGL670	Outstanding
Landscape Habitats	BRCKNLH456	High
	BRCKNLH335	High
Historic Landscape	BRCKNHL604	Moderate
	BRCKNHL735	High
	BRCKNHL826	Low
Cultural Landscape	BRCKNCL847	Outstanding
	BRCKNCL501	High
Visual and Sensory	BRCKNVS436	Moderate

Cwm Twrch

Aspect	Aspect Area No.	Value
Geological Landscapes	NPTGL013	Moderate
	NPTGL010	High
Landscape Habitats	NPTLH013	High
	NPTLH004	Moderate
	NPTLH078	Low
Historic Landscape	NPTHL041	High
	NPTCL044	High

Cultural Landscape	NPTCL043	High
Visual and Sensory	NPTVS344	Moderate

Fforest Fawr

Aspect	Aspect Area No.	Value
Geological Landscapes	BRCKNGL383	Outstanding
	BRCKNGL852	Outstanding
	BRCKNGL436	Outstanding
	BRCKNGL884	Outstanding
	BRCKNGL966	Outstanding
Landscape Habitats	BRCKNLH816	High
	BRCKNLH456	High
	BRCKNLH128	Outstanding
	BRCKNLH338	High
	BRCKNLH779	Moderate
	BRCKNLH584	High
	BRCKNLH745	Outstanding
Historic Landscape	BRCKNHL825	Outstanding
	BRCKNHL766	High
	BRCKNHL461	Moderate
	BRCKNHL202	Moderate
	BRCKNHL735	High
Cultural Landscape	BRCKNCL501	High
	BRCKNCL839	Outstanding
	BRCKNCL977	Outstanding
Visual and Sensory	BRCKNVS922	Moderate
	BRCKNVS185	Moderate
	BRCKNVS230	Outstanding
	BRCKNVS955	Outstanding

Head of Dulais Valley

Aspect	Aspect Area No.	Value
Geological Landscapes	NPTGL016	Moderate
	NPTGL018	High
Landscape Habitats	NPTLH022	High
	BRCKNLH501	Low
	BRCKNLH335	High
	NPTLH015	High
	NPTLH017	Moderate
	NPTLH080	Low
	NPTLH020	Low
	NPTLH095	Low

	NPTLH096	Moderate
	NPTLH022	High
Historic Landscape	NPTHL076	Moderate
	NPTHL046	High
	NPTHL075	Moderate
	BRCKNHL826	Low
	BRCKNHL735	High
	NPTHL027	Outstanding
	NPTHL019	Outstanding
Cultural Landscape	NPTCL037	Outstanding
	NPTCL045	High
	BRCKNCL847	Outstanding
Visual and Sensory	NPTVS846	High
	NPTVS215	Low
	NPTVS661	Low
	BRCKNVS926	Low
	NPTVS400	Low
	BRCKNVS436	Moderate
	NPTVS357	Moderate

Hirfynydd

Aspect	Aspect Area No.	Value
Geological Landscapes	NPTGL008	Moderate
	NPTGL015	High
	NPTGL017	Moderate
	NPTGL016	Moderate
	NPTGL018	High
Landscape Habitats	NPTLH096	Moderate
	NPTLH019	Moderate
	NPTLH094	Low
	NPTLH020	Low
	NPTLH018	Low
	NPTLH095	Low
	NPTLH024	High
Historic Landscape	NPTHL075	Moderate
	NPTHL027	Outstanding
	NPTHL048	Moderate
	NPTHL072	High
	NPTHL042	Outstanding
	NPTHL019	Outstanding
Cultural Landscape	NPTCL045	High
	NPTCL047	Outstanding
Visual and Sensory	NPTVS751	Moderate
	NPTVS357	Moderate

Mynydd Allt y grug

Aspect	Aspect Area No.	Value
Geological Landscapes	NPTGL010	High
Landscape Habitats	NPTLH005	Moderate
	NPTLH013	High
	NPTLH092	Low
Historic Landscape	NPTHL063	Moderate
	NPTHL041	High
Cultural Landscape	NPTCL044	High
Visual and Sensory	NPTVS581	Moderate
	NPTVS541	High

Mynydd Marchywel

Aspect	Aspect Area No.	Value
Geological Landscapes	NPTGL008	Moderate
	NPTGL007	Moderate
Landscape Habitats	NPTLH014	Moderate
	NPTLH093	Moderate
	NPTLH030	Moderate
	NPTLH017	Moderate
	NPTLH036	Moderate
	NPTLH015	High
Historic Landscape	NPTHL040	Outstanding
	NPTHL028	High
	NPTHL074	Moderate
Cultural Landscape	NPTCL045	High
Visual and Sensory	NPTVS359	Moderate
	NPTVS581	Moderate
	NPTVS751	Moderate

Dulais Valley

Aspect	Aspect Area No.	Value
Geological Landscapes	NPTGL016	Moderate
	NPTGL015	High
	NPTGL008	Moderate
Landscape Habitats	NPTLH093	Moderate
	NPTLH030	Moderate
	NPTLH036	Moderate
	NPTLH015	High
	NPTLH031	High
	NPTLH017	Moderate
	NPTLH019	Moderate

	NPTLH018	Low
Historic Landscape	NPTHL048	Moderate
	NPTHL046	High
	NPTHL074	Moderate
	NPTHL028	High
	NPTHL020	Moderate
	NPTHL076	Moderate
	NPTHL075	Moderate
Cultural Landscape	NPTCL045	High
	NPTCL038	Outstanding
	NPTCL024	High
Visual and Sensory	NPTVS846	High
	NPTVS661	Low
	NPTVS215	Low

Mynydd Uchaf Mynydd Garth Cefn Gwrhyd

Aspect	Aspect Area No.	Value
Geological Landscapes	NPTGL010	High
	NPTGL009	Moderate
	NPTGL013	Moderate
	CRMRTGL263	Moderate
	CRMRTGL293	Moderate
Landscape Habitats	NPTLH003	High
	NPTLH008	High
	NPTLH013	High
	CRMRTLH039	High
	NPTLH077	Low
Historic Landscape	NPTHL064	High
	NPTHL041	High
	CRMRTHL39589	Outstanding
Cultural Landscape	NPTCL044	High
	NPTCL043	High
	CRMRTCL060	Low
Visual and Sensory	NPTVS188	High
	NPTVS149	Low
	CRMRTVS008	Moderate

Nant Helen Reclaimed Uplands

Aspect	Aspect Area No.	Value
Geological Landscapes	NPTGL018	High
	NPTGL016	Moderate
Landscape Habitats	BRCKNLH501	Low
	BRCKNLH975	High
	BRCKNLH567	Moderate

	NPTLH020	Low
	NPTLH095	Low
	NPTLH016	Moderate
Historic Landscape	BRCKNHL008	Moderate
	BRCKNHL826	Low
	NPTHL059	Outstanding
Cultural Landscape	BRCKNCL847	Outstanding
	NPTCL045	High
Visual and Sensory	BRCKNVS007	Moderate
	BRCKNVS926	Low
	NPTVS640	Moderate
	NPTVS661	Low

Slopes of Cefn Gwrhyd Cwm Egel

Aspect	Aspect Area No.	Value
Geological Landscapes	NPTGL013	Moderate
	NPTGL010	High
	NPTGL009	Moderate
Landscape Habitats	NPTLH003	High
	NPTLH091	Low
	NPTLH013	High
	NPTLH008	High
	NPTLH006	High
	NPTLH092	Low
Historic Landscape	NPTHL041	High
Cultural Landscape	NPTCL044	High
Visual and Sensory	NPTVS541	High

Swansea Valley

Aspect	Aspect Area No.	Value
Geological Landscapes	NPTGL013	Moderate
	NPTGL010	High
	NPTGL009	Moderate
	NPTGL010	High
	NPTGL005	Moderate
	NPTGL006	Moderate
	NPTGL008	Moderate
	NPTGL014	High
Landscape Habitats	NPTLH078	Low
	NPTLH011	High
	NPTLH014	Moderate
	NPTLH036	Moderate
Historic Landscape	NPTHL044	High
	NPTHL040	Outstanding

Cultural Landscape	NPTCL045	High
	NPTCL039	High
	NPTCL042	High
	NPTCL040	Low
Visual and Sensory	NPTVS458	Moderate
	NPTVS286	Moderate

Swansea Valley Urban Settlement

Aspect	Aspect Area No.	Value
Geological Landscapes	BRCKNGL151	Moderate
	BRCKNGL149	Moderate
	BRCKNGL773	Outstanding
	NPTGL014	High
	NPTGL010	High
	BRCKNGL670	Outstanding
	CRMRTGL293	Moderate
	CRMRTGL292	Outstanding
Landscape Habitats	NPTLH013	High
	NPTLH078	Low
	NPTLH011	High
	BRCKNLH808	Low
	NPTLH004	Moderate
	BRCKNLH456	High
	CRMRTLH039	High
Historic Landscape	NPTHL044	High
	NPTHL041	High
	NPTLH063	Moderate
	BRCKNHL124	High
	BRCKNHL735	High
	BRCKNHL622	Low
Cultural Landscape	NPTCL039	High
	NPTCL044	High
	BRCKNCL965	High
	BRCKNCL847	Outstanding
	CRMRTCL060	Low
Visual and Sensory	BRCKNVS005	Low
	NPTVS184	Low

Upland Settlements

Aspect	Aspect Area No.	Value
Geological Landscapes	CRMRTGL293	Moderate
	CRMRTGL263	Moderate
	NPTGL013	Moderate
	CRMRTLH039	High

Landscape Habitats	NPTLH013	High
	NPTLH077	Low
Historic Landscape	CRMRTHL002	Moderate
	NPTHL041	High
	CRMRTHL001	Moderate
Cultural Landscape	CRMRTCL586	Outstanding
	CRMRTCL060	Low
	NPTCL043	High
	NPTCL044	High
Visual and Sensory	CRMRTVS008	Moderate
	CRMRTVS005	Low
	NPTVS149	Low
	NPTVS215	Low

Waterfall Country and Southern Valleys

Aspect	Aspect Area No.	Value
Geological Landscapes	BRCKNGL773	Outstanding
	BRCKNGL955	Outstanding
	BRCKNGL670	Outstanding
	BRCKNGL151	Moderate
	BRCKNGL672	High
	BRCKNGL436	Outstanding
	BRCKNGL383	Outstanding
	BRCKNGL200	Outstanding
	BRCKNGL852	Outstanding
	BRCKNGL884	Outstanding
	BRCKNGL149	Moderate
Landscape Habitats	BRCKNLH567	Moderate
	BRCKNLH456	High
	BRCKNLH808	Low
	CRMRTLH039	High
	BRCKNLH101	Low
	BRCKNLH777	High
	BRCKNLH254	High
	BRCKNLH479	Outstanding
	BRCKNLH520	High
	BRCKNLH128	Outstanding
	BRCKNLH584	High
	BRCKNLH779	Moderate
	BRCKNLH335	High
	BRCKNLH330	High
	BRCKNLH797	Outstanding
	BRCKNLH776	High
	BRCKNLH156	Outstanding
	BRCKNLH929	Moderate
	BRCKNLH338	High

	BRCKNLH745	Outstanding
Historic Landscape	BRCKNHL735	High
	BRCKNHL124	High
	BRCKNHL753	Low
	BRCKNHL132	Low
	BRCKNHL622	Low
	BRCKNHL852	Low
	BRCKNHL595	High
	BRCKNHL105	Low
	BRCKNHL433	Outstanding
	BRCKNHL825	Outstanding
	BRCKNHL766	High
	BRCKNHL314	Low
	BRCKNHL202	Moderate
	BRCKNHL461	Moderate
	BRCKNHL798	High
	BRCKNHL830	Outstanding
	BRCKNHL271	Moderate
	CYNONHL150	Outstanding
Cultural Landscape	BRCKNCL847	Outstanding
	BRCKNCL957	Outstanding
	BRCKNCL501	High
	BRCKNCL113	Outstanding
	BRCKNCL839	Outstanding
Visual and Sensory	BRCKNVS436	Moderate
	BRCKNVS811	High
	BRCKNVS597	Moderate
	BRCKNVS876	Outstanding

Wooded Tawe Valley

Aspect	Aspect Area No.	Value
Geological Landscapes	BRCKNGL670	Outstanding
	BRCKNGL151	Moderate
	BRCKNGL149	Moderate
Landscape Habitats	BRCKNLH808	Low
	BRCKNLH456	High
	BRCKNLH975	High
	BRCKNLH567	Moderate
	BRCKNLH335	High
Historic Landscape	BRCKNHL002	Moderate
	BRCKNHL397	Low
	BRCKNHL124	High
	BRCKNHL248	High
	BRCKNHL761	Low
	BRCKNHL735	High
	BRCKNHL826	Low

Cultural Landscape	BRCKNCL847	Outstanding
	BRCKNCL965	High
	BRCKNCL501	High
Visual and Sensory	BRCKNVS436	Moderate

Y Mynydd Du

Aspect	Aspect Area No.	Value
Geological Landscapes	CRMRTGL293	Moderate
	CRMRTGL296	High
	CRMRTGL292	Outstanding
	CRMRTGL300	High
	CRMRTGL272	High
	BRCKNGL773	Outstanding
	BRCKNGL447	High
	BRCKNGL955	Outstanding
	BRCKNGL672	High
	BRCKNGL149	Moderate
	BRCKNGL200	Outstanding
	BRCKNGL852	Outstanding
Landscape Habitats	CRMRTLH029	Outstanding
	CRMRTLH039	High
	BRCKNLH456	High
	BRCKNLH777	High
	BRCKNLH693	High
	BRCKNLH479	Outstanding
	BRCKNLH254	High
Historic Landscape	CRMRTHL40294	Outstanding
	BRCKNHL540	Moderate
	CRMRTHL39602	Outstanding
	CRMRTHL39601	High
	CRMRTHL39600	Outstanding
	CRMRTHL40293	Outstanding
	BRCKNHL735	High
	BRCKNHL595	High
	BRCKNHL623	Outstanding
Cultural Landscape	CRMRTCL586	Outstanding
	BRCKNCL957	Outstanding
	BRCKNCL113	Outstanding
	BRCKNCL839	Outstanding
	BRCKNCL501	High
Visual and Sensory	CRMRTVS008	Moderate
	CRMRTVS016	Outstanding
	BRCKNVS118	Outstanding
	BRCKNVS363	Outstanding
	CRMRTVS015	Outstanding

Appendix 9C

Baseline Environment

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C1 Baseline Environment - Landscape

Banwen Uplands LCA

A landscape defined by its broad upland valley landform and including areas of woodland, open upland and pastoral fields divided by hedgerows and linear woodlands.

The Inter Valley Road dissects the character area running north-west to south-east. Views outwards from the road are confined to the northern extent of the character area which results in stronger ties with the contextual landscape to the north which includes the Brecon Beacons National Park.

Settlement is limited to scattered houses focused along the A4109 Inter Valley Road and Roman Road / Camnant Road A large solar farm is situated to the South of the character area.

Past mining operation is evident to the west of the character area where the pastoral field pattern is less complex, and boundaries clearly differ to the overgrown and well treed boundaries north-east of the Inter Valley Road.

The character area extends to the edge of the national park boundary to the north where the Afon Pyrddin lies. This is an important upland river and woodland system designated as the Caeau Ton-Y-Fildre biological SSSI. The area also contains BAP priority habitats.

Key Features/Characteristics

- Inter Valley Road
- Important habitats towards the northern boundary of the character area. Caeau Ton-Y-Fildre SSSI

The Banwen Uplands LCA's value is a result of its complex landscape pattern and important habitats to the north of the character area. Evidence of a landscape in a state of repair exists to the south of the Inter Valley Road but is not at the detriment to its overall character. The Inter Valley Road provides open, long-distance views to the north.

Value: **High**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Value: **High**

Black Mountain Southern Fringe LCA

A landscape defined by the sloping hillside running down from the Black Mountains. The area is characterised by a mix of open upland and small-scale pasture with dense, treed hedgerow boundaries lying between the Afon Twrch valley and the settlements around Cwmllynfell. The character area comprises the transition between the flatter lower lying landform near the settled areas in the valley and the mountainous Brecon Beacons to the north. The landscape pattern of small-medium scale pasture fields located nearest to the settlements on lower-lying ground directly contrasts with the open moorland to the north.

The wooded Afon Twrch valley lies to the south-east.

Past mining activity is evident within the LCA resulting in incongruous areas and the evident loss of landscape complexity.

Key Features/Characteristics

- Pattern formed by small-medium scale fields
- Transition landform

The Black Mountain Southern Fringe LCA's value is a result of its lack of complexity and evidence of previous mining activity.

Value: **Medium**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Value: **Medium**

Bryn Henllys Reclaimed Open Cast LCA

A landscape defined by its past use as an open cast mining site and current land use as grazed pasture.

A large number of public right of ways (PRoWs) cross the site and provide access to the adjacent national park from settlements on the valley floor.

Key Features/Characteristics

- Open character
- Public access due to large number of PRoWs
- Long-distance panoramic views available from higher ground

The Bryn Henllys Reclaimed Open Cast Site LCA's value is a result of its recreational access and access to the adjacent national park. Past mining activity is evident across the LCA and has resulted in areas that are distinguishable from the

surrounding landscape comprising more complex field patterns and mature vegetation.

Value: **Low**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Value: **Low**

Coelbren Settlement LCA

A settlement developed around the historic mining industry evident by the defunct railway junction of the Neath and Brecon Railway and Swansea Vale Railway.

The historic core of the settlement is along Station Road and The Prices Arms pub, which stood adjacent Coelbren Station, stands as a relic of the former industry. The village has expanded as linear development predominantly along Cefnbyrle Road and Heol Eglwys.

The LCA includes small-scale fields between Cefnbyrle Road and the disused Neath and Brecon Railway and Swansea Vale Railway junction.

Key Features/Characteristics

- Prices Arms pub, Coelbren Church
- Disused Neath and Brecon Railway and Swansea Vale Railway

The Coelbren Settlement LCA's value is a result of the historic and cultural associations. Beyond this it is a settlement typology that occurs frequently within the wider landscape.

Value: **Low**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Value: **Low**

Cwm Twrch LCA

A landscape defined by its upland valley landform and land use for grazing.

Fields are contained by overgrown hedgerows and deciduous tree cover. A belt of woodland runs along the north-eastern edge of the character area which contains Ancient Semi-Natural Woodland and creates a buffer between the adjacent built

form. There is evidence of previous mining activity where the enclosed agricultural pattern becomes more open and larger in scale with significantly less vegetation along boundaries.

Views within the character area are confined by tree cover and topography.

Key Features/Characteristics

- Enclosed fields with overgrown hedges
- Valley landform
- Woodland belt along north-eastern edge including Ancient Semi-Natural Woodland

The Cwm Twrch LCA's value is a result of its importance as a buffer to the adjacent built form. Past mining activity is evident across the LCA and has scarred the landscape resulting in it being clearly distinguishable from the surrounding landscape.

Value: **Medium**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Value: **Medium**

Dulais Valley LCA

A landscape defined by the River Dulais and associated wooded valley landform. The land-use comprises predominantly post-medieval enclosed pastoral fields with treed field boundaries. The linear settlement of Crynant which stretches along the A4109 is situated on the valley floor at the centre of the character area. The Neath and Brecon railway runs along elevated topography on the eastern side of the valley.

Key Features/Characteristics

- Valley landform
- River Dulais
- Enclosed pastoral land with treed field boundaries.
- A4109
- Neath and Brecon Railway
- Crynant

The Dulais Valley LCA's value is a result of its recognition within Neath Port Talbot 'LDP Policy EN2: Special Landscape Areas' as 'SLA2 (EN2/2) Dulais Valley'. The SLA is identified as a high-quality landscape that comprises:

- wide, rolling, pastoral valley with significantly treed field boundaries;
- tranquillity as a key feature due to the undeveloped upper ridge areas;
- prehistory evidence such as: important Romain remains, open cast and forestry;
- examples of the importance of the mining industry in the area such as the Cefn Coed Colliery Museum.

Value: **High**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Value: **High**

Fforest Fawr LCA

A landscape defined by its upland open moorland used for grazing. The LCA contains some coniferous forestry blocks to the south.

Very few settlements contribute to the overall remoteness and tranquillity which is experienced away from the main roads that provide direct access to the LCA.

The LCA is largely covered by open access land allowing opportunities for recreational use and the Beacons Way runs through the south-western extent of the area.

Key Features/Characteristics

- Remoteness
- Peace and tranquillity
- Dark skies
- The Beacons Way
- High proportion of open access land

The Fforest Fawr LCA's value is a result of; its designated status as it falls within the Brecon Beacons National Park boundary; its special qualities; its remoteness; peace and tranquillity and recreational value.

Value: **High**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Value: **High**

Head of Dulais Valley LCA

Landscape defined by the linear mining settlements associated with mining industry of the Dulais Valley. The settlements include Seven Sisters, Onllwyn, Dyffryn Cellwen and Banwen following the A4109 along the Dulais river valley. Seven Sisters Miners Welfare and Onllwyn Welfare Hall are indicators of communities with strong connections to the mining industry.

The Neath and Brecon rail corridor also follows the valley and terminates at the coal washery at the north-eastern extent of the LCA. The low level of the railway line, sitting below the A4109, makes it barely perceptible.

The southern valley slope comprises restored surface coal mining which is now sparsely vegetated, open grasslands and narrow woodland belts associated with tributaries of the Dulais river. The river itself is perceptible only by its associated linear woodland.

Perception of the LCA is influenced by the views towards the surrounding landscapes of the Nant Helen opencast site, Brecon Beacons National Park and Hirfynydd.

Key Features/Characteristics

- A4109 along the Dulais river valley
- Sparsely vegetated, restored coal mine valley slope to the south
- Linear settlements typical of mining industry
- Neath and Brecon Railway corridor and washery
- Seven Sisters Miners Welfare and Onllwyn Welfare Hall

The Head of Dulais Valley LCA's value is a result of its strong connection to its industrial past and present.

Value: **Medium**

Future baseline:

The adjacent Nant Helen Opencast Site will have been restored, changing the context of the Head of Dulais Valley LCA and also a small area of the LCA itself, to the west of the coal washery.

Within the LCA, the restoration will include the Nant Helen Complementary Restoration Earthworks, which will introduce an engineered embankment west of Onllwyn Road and north of the existing mineral railway line. The embankment will follow an existing track to the north-west, that forms the boundary of the LCA. Restoration works within the adjacent Nant Helen Reclaimed Uplands LCA will substantially change that LCA, including the reprofiling of the distinctive overburden mound. This will be re-graded to provide a less 'engineered' land form, however the Nant Helen Complementary Restoration Earthworks will introduce new engineered land forms around the overburden mound and deep

cuttings to the south-east. These earthworks will result in disturbance to the landscape adjacent to Head of Dulais Valley LCA, that will influence perception of the both this LCA and the Nant Helen Reclaimed Uplands LCA.

Future Key Features/Characteristics

There will be no change to the key features/characteristics of the LCA.

The restoration works will be a minor change to Head of Dulais Valley LCA, with the embankment earthworks being typical of the receiving landscape. The minor changes to the Head of Dulais Valley LCA and changes to its contextual landscape would not result in sufficient enhancement or degradation of its key features or characteristics to result in a change to the overall value of the LCA.

Value: **Medium**

Hirfynydd LCA

A landscape is defined by the landform of Hirfynydd and the dominant land cover of coniferous woodland plantation. The area has a remote character due to the absence of dwellings or settlements. A Roman Road crosses the ridgeline that runs north-east to south-east and offers public access and long-distance views to the north and north-west by way of Byway 28/39.N.Hi/1. Wind turbines on the north-eastern edge are a notable feature of the landscape.

Key Features/Characteristics

- Roman Road that follows the ridgeline from north-east to south-west
- Wind Turbines on north-eastern edge.
- Large proportion of coniferous woodland plantation
- Elevated topography (Hirfynydd hill)

The Hirfynydd LCA's value is a result of its tranquillity and remoteness. Past and present human activity through mining is evident though not widely visible throughout the LCA. The western extent of the character area is formed by the Dulais Valley side which is recognised within Neath Port Talbot 'LDP Policy EN2: Special Landscape Areas' as 'SLA2 (EN2/2) Dulais Valley' as it reinforces the visual context of the SLA.

Value: **Medium**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Value: **Medium**

Mynydd Allt y Grug LCA

A landscape defined by its significant landform which rises above the Tawe valley, comprising exposed rock and scree, and heathland. The elevated landform forms a dominant feature from the surrounding landscape and is accessible by path to designated common land. The character area provides views across the Tawe Valley.

Key Features/Characteristics

- Exposed rock and scree cover
- Heathland
- Views across Tawe Valley

The Mynydd Allt y Grug LCA's value is a result of its prominence within the surrounding landscape and internationally important dry heath habitats.

Value: **Medium**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Value: **Medium**

Mynydd Marchywel LCA

A landscape defined by a high proportion of coniferous plantation on elevated topography. Much of the woodland along the eastern and western boundary of the character area is designated as Restored Ancient Woodland, Semi-Natural Ancient Woodland or Plantation on Ancient Woodland Site. A ridgeline runs north to south and forms the partitioning higher ground between the Dulais valley to the east and Swansea valley to the west.

There are a number of PRoWs that cross the character area and allow recreational users to take advantage of long-distance views. The character area also comprises large areas of open access land to the north and south.

The northern extent of the character area is formed by Varteg Hill which rises above the Swansea Valley forming a dominant feature within the surrounding landscape, pylons that cross the landform and a wireless mast that stands atop are highly visible due to their elevated position.

A lack of developments and roads gives the character area a remote and tranquil character.

Key Features/Characteristics

- High proportion of coniferous plantation

- Remoteness and tranquillity
- Elevated landform and distinctive Varteg Hill
- Pylons and wireless mast that are highly visible

Mynydd Marchywel LCA's value is a result of its dominance within the surrounding landscape and valued recreational routes with long distance views, and its remoteness and tranquillity.

Value: **Medium**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Value: **Medium**

Mynydd Uchaf, Mynydd Garth & Cefn Gwrhyd LCA

A landscape defined by its plateau landform and land cover of rough grasses, which are managed by sheep grazing.

The area contains no settlements and is accessible by minor roads and tracks which contribute to its overall sense of remoteness. PRoWs provide recreational access to the common land which offers panoramic views across the surrounding landscape.

The Gwrhyd Welsh Independent Church built in 1856 is a significant local landmark and cultural feature within the LCA.

Key Features/Characteristics

- Open character
- Common Land
- Panoramic views
- Grazed landcover
- Gwrhyd Welsh Independent Church

The Mynydd Uchaf, Mynydd garth & Cefn Gwrhyd LCAs value is a result of its important habitats and sense of remoteness as well as its opportunity for recreational and scenic qualities including panoramic views of the surrounding landscape.

Value: **High**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and

introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Value: **High**

Nant Helen Reclaimed Uplands LCA

A landscape defined by past and present mining activity. Present mining activity dominates the north and eastern extents of the character area and there is evidence of previous mining activity to the south.

Areas of upland moorland with predominantly rough grassland and bracken landcover and further areas of marsh and grassland. Large areas are used for grazing.

The overburden mound associated with the mining activity stands as a prominent and evidently man-made feature visible from the wider landscape.

A number of PRoWs cross the character area, many of which are temporarily suspended through the mining site. Mining activity within the character area is a detractor from its use for recreational purposes.

Pylons run from east to west along the southern extent of the character area and contribute to the overall large-scale industrial character.

The Ystradgynlais Scheduled Monument Tramroad is further evidence of the industrial history of the character area and the importance of mining in the historical development of the wider landscape.

Key Features/Characteristics

- Past and present mining activity
- Overburden mound
- Open character
- Marsh and grassland landcover
- Tramroad at Ystradgynlais Scheduled Monument

The Nant Helen Reclaimed Uplands LCA's value is a result of detractors due to the current mining activity. Recreational opportunities are limited due to mining activity and routes that remain open are at the detriment of noise, and unattractive nature of the current mining activity. Features of this activity such as the overburden mound are incongruous with the surrounding landscape. The mining industry has been crucial to the development of the surrounding landscape and the Tramroad at Ystradgynlais stands as a relic of the local history of the area.

Value: **Low**

Future baseline:

The Nant Helen Restoration and Nant Helen Complementary Restoration Earthworks will directly affect the eastern half of the LCA.

The restoration includes the reprofiling of the distinctive overburden mound. This will be re-graded to provide a less 'engineered' land form and will reduce the height of the mound. The western opencast area will be reformed, with ponds and marshy grassland habitat created. The northern and eastern opencast areas will be restored to pasture with linear woodlands associated with watercourses. Elsewhere will be restored to the acid grassland currently on site.

The Nant Helen Complementary Restoration Earthworks will introduce new engineered landforms across the eastern extent of the LCA. This will include embankments to the north and south, deep cuttings to the east and a shallower cutting to the west. The southern embankment will cross the disused historic tram road (Scheduled Monument), severing the associated footpath. The earthworks will also cross numerus other PRoW, restricting access across the LCA.

The restored Nant Helen Reclaimed Uplands LCA will remove adverse features of the existing landscape, particularly the engineered and dominating form of the overburden mound, however the Nant Helen Complementary Restoration Earthworks will introduce new engineered landforms.

Future Key Features/Characteristics

- Past mining activity
- Open character
- Established marsh and grassland landcover
- Newly restored marsh, acid grassland and enclosed pasture
- Tramroad at Ystradgynlais Scheduled Monument

The value of the Nant Helen Reclaimed LCA will not change as a result of future changes due to the Nant Helen Restoration and Nant Helen Complementary Restoration Earthworks. It is anticipated that there would be the loss/degradation of some key features such as previously restored habitats, recreational access may be further limited due to the severance of PRoWs and engineered landforms would be present across the eastern extent of the LCA. However, the restoration would result in the loss of mining activity from the LCA and the reduction and reprofiling of the overburden mound to a more naturalistic appearance. The newly restored areas would not be sufficiently established within the first 3 years to increase the overall value of the LCA.

Value: **Low**

Slopes of Cefn Gwrhyd & Cwm Egel LCA

A landscape defined by grazed pasture and deciduous tree cover along riparian corridors within the sheltered confines of the valley landform.

Grazed pasture fields boundaries are formed by hedgerows on lower ground and stone walls on higher ground.

The character area contains extensive areas of SSSI including Gwrhyd Meadows and Coed Cwm Du. The wooded valley of Cwm Du contains Ancient Semi-Natural Woodland with the largest areas to the south of the character area.

There is only one minor road which passes through the area providing access to the scattered farmsteads across the landscape. Limited access contributes to the sense of remoteness and tranquillity within this settled landscape.

Key Features/Characteristics

- Grazed pasture
- Field boundaries formed by hedgerow and stone walls
- Scattered farmsteads
- Remoteness and tranquillity
- SSSIs
- Ancient Semi-Natural Woodland

The Slopes of Cefn Gwrhyd & Cwm Egel LCAs value is a result of its important habitats, scenic rural character and its sense of remoteness and tranquillity.

Value: **Medium**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Swansea Valley LCA

A landscape defined by the Swansea Valley landform and the meandering River Tawe that runs through a mosaic of pasture and woodland. The southern valley side is predominantly covered with deciduous woodland. North of the river the area comprises pasture fields with well treed boundaries.

Key Features/Characteristics

- Meandering River Tawe.
- Deciduous woodland
- Mosaic of pasture fields

The Swansea Valley LCAs value is a result of its picturesque valley landform and function as a habitat corridor.

Value: **Medium**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and

introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Swansea Valley Settlements LCA

An area defined by the Swansea Valley and linear settlements that have established along the valley, coinciding with the transport corridors of A4068, A4067 and B4599. The character area comprises the settlements of Ystalyfera, Gurnos, Ystradgynlais, Penrhos, Cwm-twrch Isaf, Cwmgiedd and Glan-rhyd. The boundaries of these settlements are difficult to define due to their linear integrated nature which is driven primarily by landform but also the transport corridors that have established over time. The older cores of these settlements are located above the floodplain while newer development spreads across the valley floor. Newer developments are generally built of materials that do not reflect the vernacular.

The settlements are nestled within the valley landform, with valley sides forming the backdrop and extent of available views outwards. There is a range of housing types across the settlements, but housing density is generally quite high and consist of many examples of rows of terraces.

The housing density and enclosed nature of the character area changes where the valley widens at the Afon Twch and River Tawe confluence. A culmination of sports centres, a rugby club and employment land use results in a more open, larger-scale character with more green space.

The Swansea canal provides a recreational route through the character area and persist as a relic of the industrial history of the area.

Key Features/Characteristics

- Linear settlements of Ystalyfera, Gurnos, Ystradgynlais, Penrhos, Cwm-twrch Isaf, Cwmgiedd and Glan-rhyd
- Transport corridors of A4067, A4068 and B4599
- Enclosed, relatively high density urban character
- Historic relics of the industrial history of the area such as Swansea Canal that is now used for recreation

Swansea Valley Settlements LCA's value is a result of its sense of place and community built around the industrial history of the area.

Value: **Medium**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Upland Settlements LCA

A landscape defined by the settlements of Ystradowen and Cwmllynfell that are situated on the uplands above the Afon Cwch valley.

Settlements are linear in nature and strung out along the A4068. The key defining feature that defines these settlements as a separate character area from Swansea Valley Settlements is the more exposed character due to the location on elevated topography and views that are afforded as a result.

Key Features/Characteristics

- A4068
- Exposed character and views of surrounding landscape
- Linear settlements

The Upland Settlement LCA's value is a result of its sense of place and community that is a continuation of that within the Swansea Valley Settlements LCA. The LCA has a more exposed nature with residents afforded long-distance views.

Value: **Medium**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Waterfall Country and Southern Valleys LCA

A landscape defined by its enclosed character comprising streams, spectacular waterfalls and ancient woodland.

The LCA includes the villages of Ystradfellte, Penderyn and Glyntawe which are located on the valley floor. Land use is predominantly pastoral agriculture with extensive areas of forestry to the south-east. Higher areas are more open and less complex in composition.

Southern part of the LCA have inter-visibility with land beyond the National Park boundary. Recreational opportunities include caving, canoeing cycling and walking and are mostly related to the rivers streams and waterfalls within the area. A number of PRoWs re located on higher ground and offer views out from the LCA.

Key Features/Characteristics

- Recreational opportunities
- Complex geology
- Complex pastoral field patterns

- Rivers and multiple waterfalls
- Peace and tranquillity

The Waterfall and Southern Valleys LCA's value is a result of its designated status as it falls within the Brecon Beacons National Park boundary; its combination of rivers, waterfalls, woodland and complex textures due to historic pastoral field patterns and geology; and its special qualities including peace and tranquillity. The LCA also contains important natural heritage features and a strong sense of time-depth.

Value: **High**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

Wooded Tawe Valley LCA

A landscape defined by the wooded River Tawe valley. The landscape comprises a high proportion of woodland cover and enclosed pastoral fields with dense, treed boundaries. Areas of Restored Ancient Woodland, Semi-Natural Ancient Woodland and Plantation on Ancient Woodland Sites are scattered across the character area and contribute to the overall enclosed character of the LCA. A4067 and A4221 road corridors are also lined by woodland, reducing their influence on the LCA.

Settlements are predominantly associated with the road corridors and include Abercraf, Caehopkin and Caerbont. Abercraf is situated on the northern valley slope with views across the wooded valley. It is the largest settlement, containing multiple community resources. Caehopkin is situated on the opposite, southern valley slope and has a small-scale, enclosed character due to the surrounding topography and woodland cover which limits the distance of available views. Caerbont- lies on the valley floor, alongside the River Tawe, with residential development to the west of the A4067 and Caerbont Enterprise Park to the east.

Key Features/Characteristics

- Ancient woodlands
- River Tawe
- A4067 and A4221
- Settlements of Caeerbont, Abercraf and Caehopkin
- Listed buildings at Gwaunclawdd

Wooded Tawe Valley LCA's value is a result of its distinctive, heavily wooded, valley landform. Development is relatively small-scale and surrounded by woodland that reduces its influence on the wider LCA. The River Tawe is well

vegetated throughout the character area and the dense vegetation alongside transport corridors compliments this.

Value: **Medium**

Future baseline:

The Nant Helen Restoration and Nant Helen Complementary Restoration Earthworks will directly affect an area of plantation woodland and pastoral fields bordered by mature hedgerows and belts of broadleaf woodland on the southern boundary of the LCA.

The Nant Helen Complementary Restoration Earthworks will introduce an embankment through a large area of the plantation woodland. Large areas of mature broadleaf woodland also removed for the embankment contribute to the LCA's woodland valley side character.

The embankment will also cross National Cycle Network Route 43 that connects to the Celtic Trail. The cycle route will be diverted through existing semi-mature woodland, c.80m north of the affected section of the route.

The Restoration of Nant Helen Opencast Site will include infilling of the opencast mining void and the reprofiling of the distinctive overburden mound to provide a less 'engineered' land form and reduced height. The infilled void will be restored to include ponds and marshy grassland habitat creation. The northern and eastern opencast areas will be restored to pasture with linear woodlands associated with watercourses.

The Restoration of Nant Helen Opencast Site will be beneficial to Wooded Tawe Valley LCA in removing detrimental features from the landscape adjacent to the LCA. However, the Nant Helen Complementary Restoration Earthworks will result in the loss of mature woodland that is the defining characteristic of the LCA. The loss of broadleaf woodland in Nant Helen Reclaimed Uplands LCA and the associated introduction of engineered landforms will be change to the landscape context.

Within the first year, mitigation planting proposed as part of the Nant Helen Complementary Restoration Earthworks will not be sufficiently established to reinstate the wooded character in the small area of the LCA affected by the development.

Future Key Features/Characteristics

There will be no change to the key features/characteristics of the LCA.

Changes to the LCA and adjacent LCA due to the Nant Helen Restoration and Nant Helen Complementary Restoration Earthworks will not alter the overall value of the character area.

Value: **Medium**

Y Mynydd Du LCA

A landscape defined by its open, exposed character with few trees or settlements. The character areas openness and lack of development contribute to its overall sense of remoteness and tranquillity.

The LCA is prominent in views from roads and settlements to the south of the national park. The edges of the LCA accommodate spectacular long-distance views across the surrounding lowlands.

Key Features/Characteristics

- Openness
- Peace and tranquillity
- Spectacular long-distance views to the south
- Recreational value and accessibility

The Y Mynydd Du LCA's value is a result of its designated status as it falls within the Brecon Beacons National Park boundary; its special qualities; its remoteness and tranquillity; ample opportunities for recreation for all and its scenic qualities and spectacular views outwards.

Value: **High**

Future Baseline:

The Implementation of Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration will result in the loss of some mining activity and introduction of engineered landform into the contextual landscape. The change will not alter the overall character or affect the value of the LCA.

C2 Baseline Environment – Visual

Viewpoint 1 - View from Ystradgynlais Bridleway 61

View south-east from Ystradgynlais Bridleway 61 within the Brecon Beacons National Park. This viewpoint represents views experienced by recreational receptors.

Baseline Description

The foreground is open grassland on the lower slopes of Cefn Mawr. Scrub and overgrown hedgerow boundaries filter the view of Cae-Mawr, beyond which is the linear woodland that follows the Afon Giedd.

In the middle ground to the north is the open, upper slopes of Dorwen ar Giedd. The Swansea valley is not visible to the south due to the topography but is visible to the north-east. The Nant Helen opencast mine site and Mynydd y Drum fills the middle ground, with the overburden mound breaking the horizon. The broadleaf

and plantation woodland of the southern valley side blend with the foreground woodland, and contrasts with the open grassland above. The active opencast site is clearly visible, with steep terraces and wide access tracks highlighted by the movement of multiple excavation vehicles. The wide access track to the summit is also visible.

The ridge line of Hirfynydd, c.8km away, forms the horizon, with a wind turbine near Nant Hir Colliery visible beyond the overburden mound.

The value of the view is a result of the presence of the opencast mine which is a large-scale detractor despite its distance from the viewpoint.

Value: **Medium**

Future Baseline:

The restored Nant Helen opencast site and Mynydd y Drum will fill the middle ground. The broadleaf and plantation woodland of the southern valley side blend with the foreground woodland, and contrasts with the open grassland above. The restoration works will result in the reduced height of the overburden mound and create a similar land cover to that of the foreground of the view. The lower slopes of the site will include enclosed pasture, with linear broadleaf woodland planting associated with new field boundaries and watercourses. Large ponds and marshy grassland will be visible to the south-east above the tree line. The upper slopes will be restored to open grassland.

An engineered embankment that is part of the Nant Helen Complementary Restoration Earthworks will be visible above the foreground trees and across open fields on the southern Swansea Valley side to the east. Shallow cuttings and a small embankment will be barely perceptible between the reprofiled overburden mound and the ponds.

The value of the view is a result of the restoration of the opencast mine to create landforms and land cover that complements the surrounding landscape pattern. The engineered gradient of the earthworks will be incongruous within the restored landscape but comprise a small proportion of the view and will be less intrusive than the previous mining activity.

Value: **High**

Viewpoint 2 - View from Ystradgynlais Footpath 64

View south from Ystradgynlais Footpath 64 within the Brecon Beacons National Park. This viewpoint represents views experienced by recreational receptors near the local high point, at c. 295m A.O.D.

Baseline Description

The foreground is open, rough, grazed land that drops steeply down the Swansea Valley side to the south. Small woodland copses c.200-350m away filter views east and west.

The floor of the Swansea Valley is visible to the south-east and south-west, the foreground topography slightly restricting the view directly south. Caehopkin and the A4221 lie to the east, with Caerbont and Ystradgynlais to the south-west. The surrounding mature woodlands screen the road and reduce the influence of the settlements, providing an overall semi-rural view.

The northern Swansea Valley slopes are a mix of pastoral fields with strongly wooded boundaries and broadleaf and plantation woodland.

Above the woodland, a restored area of former opencast mining forms a distinctive near horizon, crossed by a wide operational site access track near the summit. The upper terraces of the active opencast mine are visible just below this horizon, with plantation coniferous woodland screening part of the area.

Very long-distance views are available to the Brecon Beacons National Park to the east, Hirfynydd and Maesgwyn Wind Farm to the south, and along the Swansea Valley to the west. The densely wooded valley contrasts with the open hilltops on either side.

The value of the view is a result of its location within the national park which is recognised for its recreational value. In addition, despite the presence of the opencast mining site, the availability of very long-distance views across different landscape types (wooded valleys, national park, mountain ranges) contributes to the value of this viewpoint.

Value: **High**

Future Baseline:

To the south-east, an engineered embankment that is part of the Nant Helen Complementary Restoration Earthworks will be visible crossing the open grassland on the southern valley side, the gradient contrasting with the surrounding hillside. The embankment will be screened by mature plantation woodland west of this. Newly planted belts of broadleaf woodland (following watercourses and forming new field boundaries) will be visible as part of the Nant Helen Restoration on higher slopes above the embankment. These newly planted areas will be noticeable from the surrounding established vegetation during the first three years.

A shallow cutting and smaller embankment will be just visible to the south-west due to the elevation of the viewpoint. Large ponds and marshy grassland habitat creation will be visible west of the cutting.

The near horizon will be formed by the restored opencast sites, with open grassland land cover much like the surrounding landscape.

The value of the view is a result of its location within the national park which is recognised for its recreational value. In addition, despite the presence of the engineered landforms, the availability of very long-distance views across different landscape types (wooded valleys, national park, mountain ranges) contributes to the value of this viewpoint.

Value: **High**

Viewpoint 3 - View from Trig point on Cribarth

View south from the Trig Point on Cribarth. This viewpoint represents views experienced by recreational receptors.

Baseline Description

The foreground comprises open grassland and exposed rock on the southern slopes of Cribarth, that drop steeply down to the Swansea Valley to the east and south.

The middle ground comprises the heavily wooded Swansea Valley and properties within Caehopkin and Coelbren are visible on the southern valley side, surrounded by mature woodlands. The valley side comprises a mix of small-scale pasture fields with well treed boundaries, and broadleaf and plantation woodland.

The distinctive, engineered form of the overburden mound from the opencast mining forms the backdrop to the plantation woodland to the south-west, and the area of active opencast mining is also visible.

Long-distance views are available to the south, with Hirfynydd and Mynydd Marchywel forming notable, well-wooded landforms.

The value of the view is a result of its location at the trig point that marks the highest point of the Cribarth ridge, within the national park which is recognised for its recreational value.

Value: **High**

Future Baseline:

To the south-east, an engineered embankment that is part of the Nant Helen Complementary Restoration Earthworks will be visible crossing the open grassland on the southern Swansea Valley side, the gradient contrasting with the surrounding hillside. The embankment will be partially screened by mature plantation woodland west of this. Newly planted belts of broadleaf woodland (following watercourses and forming new field boundaries) will be visible as part of the Nant Helen Restoration on higher slopes above the embankment. These newly planted areas will be noticeable from the surrounding established vegetation during the first three years.

A shallow cutting and smaller embankment will be just visible to the south-west due to the elevation of the viewpoint. Large ponds and marshy grassland habitat creation will be visible west of the cutting, partially screened by plantation woodland. To the south-east, another cutting will be perceptible close to the A4221.

The near horizon will be formed by the restored opencast sites, with open grassland land cover much like the surrounding landscape.

The value of the view is a result of its location at the trig point that marks the highest point of the Cribarth ridge, within the national park which is recognised for its recreational value.

Value: **High**

Viewpoint 4 - View from Ogof Ffynnon Ddu NNR

View south-west from dismantled Neath & Brecon Railway line (Open Country), within Ogof Ffynnon Ddu National Nature Reserve. This viewpoint represents views experienced by recreational receptors. The Beacons Way is located to the north-east from this viewpoint however views are largely screened by topography.

Baseline Description

The foreground comprises the undulating rocky moorland within the nature reserve. Views south-west are slightly restricted by the adjacent topography. The view south includes woodland near Penycae.

The hillside slopes to the west and the middle ground comprises the north-eastern extent of the Nant Helen opencast site, lying between the Swansea Valley and the Nant Llech valley. Coelbren is visible to the south and Ceahopkin to the south-west. Visible Site features include the broadleaf and plantation woodlands, and the open fields above Caehopkin on the northern edge, pastoral fields with mature hedgerow and tree boundaries above Coelbren, and the track from the main site access to the Site's main compound, visible on the horizon, passing behind properties along Heol Y Gwydde and Cefnbyrle Road. The western end of the washery site is also visible. The distinctive engineered gradient of the overburden mound is visible on the horizon.

Long distance views include Hirfynydd and turbines within Maesgwyn Wind Farm to the south, Mynydd Marchwel, Cribarth and Mynydd Allt-y-grug to the south-west.

The value of the view is a result of its multiple levels of recreational value, including being within Ogof Ffynnon Ddu National Nature Reserve and the national park, and being a popular recreational destination for caving.

Value: **High**

Future Baseline:

Visible Site features will include the Nant Helen Complementary Restoration Earthworks and Nant Helen Restoration. A large embankment will be visible above the plantation woodland and crossing the open fields above Caehopkin and the pastoral fields above Colebren to the south-west. The engineered gradient of this embankment will contrast with the surrounding landscape and cut through areas of mature woodland. The earthworks will transition to cutting behind Coelbren. A smaller embankment east of the washery will also be perceptible.

The value of the view is a result of its multiple levels of recreational value, including being within Ogof Ffynnon Ddu National Nature Reserve and the national park, and being a popular recreational destination for caving. Whilst the engineered landform will detract from the scenic quality across a small section of the view, the overall value will not change.

Value: **High**

Viewpoint 5 - View from western edge Ynyswen

View south from western edge of Ynswen. This viewpoint represents views experienced by residential receptors.

Baseline Description

The foreground comprises the property boundaries of bungalows along Cribarth in Ynswen, and two-storey properties off the A4067 on lower ground to the south-west. St David's Church Abercraf is visible above the roofline.

The topography falls to the south, to the wooded Swansea Valley. The valley is filtered by mature trees along the A4067 and associated street lighting is visible in front of this. The southern valley slope comprises small-scale pasture with mature field boundaries, and farmsteads on and below Heol Y Gwydde are scattered across the valley side. To the south-west, the open field and coniferous plantation and broadleaf woodlands above Caehopkin are visible on the southern Swansea Valley side.

The horizon is formed by restored opencast mining land, including the distinctive engineered gradient of the overburden mound. Active opencast mining activity is only perceptible at the top of the plantation woodland.

The value of the view is a result of detracting, modern features in the foreground. However, the viewpoint is within the Brecon Beacons National Park and predominantly attractive landscape features are visible from the Cribarth properties.

Value: **Medium**

Future Baseline:

Earthworks associated with the Nant Helen Complementary Restoration Earthworks will be visible to the south and south-west. A large embankment with engineered gradients will be visible above broadleaf woodland on the southern Swansea Valley side, visible above the two-storey property in the foreground. The embankment will cross the fields above Caehopkin and the farmsteads on Heol Y Gwydde, partially screened by intervening topography and woodland. The earthworks transition to cutting directly south of the viewpoint, behind properties (the cluster of buildings visible above the foreground hedgerow) on Heol Y Gwydde. The restored land cover south of the earthworks will comprise enclosed pasture with newly planted belts of broadleaf woodland forming field boundaries.

The horizon will be formed by opencast mining land, partially reprofiled and restored to grassland.

Incongruous engineered landforms will detract from the overall scenic quality of the view. However, the viewpoint is within the Brecon Beacons National Park and predominantly attractive landscape features are visible from the Cribarth properties. The value is therefore Medium.

Value: **Medium**

Viewpoint 6 - View from Tanygarth, Abercraf

View south from Tanygarth, Abercraf. This viewpoint represents views experienced by residential receptors.

Baseline Description

The foreground comprises two-storey and bungalow properties within an estate development in Abercraf.

The middle ground comprises dense woodland along the River Tawe and small-scale pasture fields with well treed mature field boundaries on the southern slope of the Swansea Valley. The valley side above this is covered by coniferous woodland plantation on the northern edge of the Nant Helen opencast site and breaks the horizon to the south-east.

To the south, the horizon is formed by the restored opencast mine landform. The engineered gradient of the overburden mound is visible to the south-east.

The value of the view is a result of its frequency within the surrounding landscape and visibility of housing and street lighting to which the elevated topography forms the backdrop.

Value: **Low**

Future Baseline:

Valley side coniferous planting will partially screen an embankment that is part of the Nant Helen Complementary Restoration Earthworks, which will just be visible at the eastern end of the plantation, where it crosses open fields.

To the south, the horizon will be formed by the restored opencast mine landform that comprises enclosed pasture with newly planted belts of linear broadleaf woodland creating new field boundaries or following watercourses. The horizon will be formed by open grassland.

The value of the view is a result of its frequency within the surrounding landscape and visibility of housing and street lighting to which the elevated topography and engineered landforms form the backdrop.

Value: **Low**

Viewpoint 7 - View from Pen-Rhiwfawr

View east from Gwrhyd Road, Pen-Rhiwfawr, on the north-eastern lower slopes of Mynydd Uchaf. This viewpoint represents views experienced by residential receptors.

Baseline Description

The foreground comprises the junction of Gwrhyd Road and Pen-Y-Rhiw. The landform rises steeply to the west and falls away to the east. A stone wall and a stone barn are attractive, rural features. To the south-east, some of the residential properties within Pen-Rhiwfawr are visible, some of which face south-east.

In the middle ground to the east, the view is across the densely wooded Afon Twrch and Nant Gwys valleys and small-scale fields with treed boundaries that lie between the valleys. The Celtic Minor Golf Club house is a recognisable feature but the course itself blends well with the surrounding landscape due to the mature trees. Properties on higher ground within Ystradgynlais and Penrhos are visible, whilst the majority of the settlements are screened due to the valley landform and intervening woodland belts.

In longer distance views, the distinctive engineered slopes of the overburden mound within Nant Helen Opencast Mining Site is visible directly east and breaks the horizon. The active opencast mine is clearly visible directly below this, with its terraced sides and excavation vehicle movements. The slopes of Mynydd y Drum lie to the south-east, crossed by a pylon line. To the north-east, the densely wooded lower slopes of the southern Swansea Valley side blends with woodland further along the valley. Cribarth forms the northern valley side. To the south-east, Hirfynydd and its transmitter, pylons and wind turbines, breaks the horizon, with the Brecon Beacons beyond.

Long distance views to the moorlands and large areas of forestry plantation within the Brecon Beacons National Park to the north-east.

The value is a result of the elevated, panoramic and long-distance views towards the national park that will be available to the residential receptors without the detracting roadside elements from the viewpoint location.

Value: **Medium**

Future Baseline:

The opencast mine will be filled in and restored to include two large ponds surrounded by marshy grassland and heath which will be perceptible only at this distance. The overburden mound will be reduced in height and restored to a less ‘engineered’ landform. The summit will be restored to open grassland, with the lower slopes on the southern valley side restored to enclosed pasture with narrow belts of newly planted broadleaf woodland along watercourses. Coniferous plantation woodland towards the top of the Site will have been cleared for the Nant Helen Complementary Restoration Earthworks. These earthworks will include a small embankment near the top of the existing opencast area but will otherwise be in cutting and therefore barely perceptible.

The value is a result of the elevated, panoramic and long-distance views towards the national park that will be available to the residential receptors without the detracting roadside elements from the viewpoint location. The changes to a small area within the distance will not affect the value.

Value: **Medium**

Viewpoint 8 - View from Ystradgnlais Footpath 4

View east from Ystradgynlais Footpath 4. This viewpoint represents views experienced by recreational receptors.

Baseline Description

The foreground comprises grazed grassland on the lower Swansea Valley slopes that falls away from the viewpoint towards the valley floor. Mature trees on the edges of woodland to the east and south-east partially screen the valley floor.

The middle ground comprises the settlement of Ystradgynlais on the valley floor. The River Tawe is distinguishable by the dense woodland along its corridor that partially screens the housing. The wooded valley is visible to the north-east, with views south-east blocked by foreground boundary vegetation.

Long-distance views to the north-east include Cefn-garth and the distinctive Cribarth, the wooded Nant Cyw valley and extend beyond the coniferous Giedd Forest to the upland moorland within the Brecon Beacons National Park. To the east, Mynydd y Drum forms the horizon beyond Ystradgynlais, within wooded lower slopes and open moorland above, and pylons crossing near the summit. The terraces and excavation vehicle movements within Nant Helen Opencast mine are clearly visible to the east, partially screened by coniferous plantation woodland on the lower valley slopes, and the distinctive restored overburden mound forms the near horizon. Longer-distance views are available beyond Mynydd Drum towards Hirfynydd to the south-east.

The view's value is a result of the concentration of dense, modern development of Ystradgynlais along with the opencast mine and overburden mound at the centre of the view. While there are long, panoramic views towards the national park, these are commonplace within the surrounding landscape.

Value: **Low**

Future Baseline:

The opencast mine will be partially filled in and restored to include two large ponds surrounded by marshy grassland and heath. The overburden mound will be reduced in height and restored to a less 'engineered' landform. The summit will be restored to open grassland, with the lower slopes on the southern valley side restored to enclosed pasture with newly planted narrow belts of broadleaf woodland planting along watercourses. It is not anticipated that the height difference will extend the length of views to the east.Coniferous plantation woodland towards the top of the site will have been cleared for the Nant Helen Complementary Restoration Earthworks. These earthworks will include an embankment near the top of the existing opencast area but will otherwise be in cutting and therefore barely perceptible.

Whilst mining activity will be absent from the view. The view's value is also as a result of the concentration of dense, modern development of Ystradgynlais. While there are long, panoramic views towards the national park, these are commonplace within the surrounding landscape. The value will not change.

Value: **Low**

Viewpoint 9 - View from NCNR 43

View south from National Cycle Network Route 43 which largely follows the historic line of the Neath & Brecon Railway. This viewpoint represents views experienced by recreational receptors.

Views from NCR43 are predominantly enclosed by dense, semi-mature vegetation along its route, south of Caehopkin. The view is from an open section of the NCR.

Baseline Description

The NCR runs north-south in the foreground, through a gated access. To the east and west, views are filtered by tall vegetation.

The bend in the cycleway route provides a gap in the vegetation that allows a view towards an area of restored opencast mine. in the middle ground. The land cover is open grassland with scattered scrub, with the edge of coniferous plantation woodland visible to the south-west. A watercourse that runs down the hillside is distinguishable by the dip in the land to the south.

The rising topography foreshortens the view to c. 600m, with the horizon at c.245m A.O.D. A large area of scrub including scattered coniferous trees covers the higher ground to the horizon.

The view is recognisably that of a restored landscape but reflects the character of the surrounding moorland landscapes.

The value of the view is a result of being on National Cycle Route 43 and being one of few locations on the route from which there are views to the surrounding landscape.

Value: **Medium**

Future Baseline:

The Nant Helen Complementary Restoration Earthworks will cross the open grassland on embankment. The toe of the embankment will cross the cycleway route in the foreground, removing the majority of foreground vegetation beyond the gate. The cycleway will continue directly west following the toe of the embankment. An area of coniferous plantation woodland on the lower slopes to the south-west will also have been removed for the embankment. Above the embankment, the Nant Helen Restoration will change the scrub land cover to enclosed pasture and there will be belts of newly planted broadleaf woodland up the hillside to the south-east, following the watercourse.

The value of the view will be low as a result of it closely following engineered form and providing little scenic quality.

Value: **Low**

Viewpoint 10 - View from Station Road, Coelbren

View south-west from Station Road, Coelbren and western end of Tawe-Uchaf Footpath 1. This viewpoint represents views experienced by residential receptors.

Baseline Description

The foreground comprises residential properties and The Prices Arms Pub on Station Road which have south facing windows. Pasture fields on the southern side of Station Road are bounded by post and wire fences. The Neath & Brecon Railway had a junction immediately south of the viewpoint (known as Coelbren Junction) and mature trees mark the boundaries of the northernmost line in the foreground, and the other branch is distinguishable by the curved fence line on the ground below.

In the middle ground to the south-east, properties at Dyffryn Cellwen are visible. The Coal Washery is visible, partially screened by trees and woodland that follows the A4221, with the house at Blaen-Y-Waun, on the edge of the disused railway line, visible beyond the roadside trees. Coniferous woodland alongside the A4221 screens long distance views across a section of the view to the south-west.

Hirfynydd forms the backdrop to the settlements and Coal Washery to the south and south-east. To the south-west, Mynydd Marchyw is visible, and pylons break the horizon. The distinctive engineered gradient of the overburden mound at the Nant Helen opencast site forms the horizon to the east, along with the restored eastern slopes of the site including hedgerow boundaries.

Despite the presence of heritage features and some long-distance views, the value of the view is a result of its frequency within the surrounding landscape and visibility of industrial scale features.

Value: **Low**

Future Baseline:

Restoration of the Site will include the reprofiling of the overburden mound to reduce its height and create a less ‘engineered’ landform. The Nant Helen Complementary Restoration Earthworks will be just visible to the west, with a large embankment crossing the fields to the north-west. The earthworks then comprise two cuttings to the west, one closer to the horizon than the other. Due to the elevation of the viewpoint, the cuttings will be perceptible only as breaks in the land cover and landscape pattern, with views along the lower cutting screened by the coniferous woodland along the A4221. This woodland will also partially screen the minor embankment earthworks west of the Coal Washery.

There will be no change to the value of the view as a result of the Nant Helen Restoration and Nant Helen Complementary Restoration Earthworks.

Value: **Low**

Viewpoint 11 - View from Tawe-Uchaf Footpath 5

View south-west from Tawe-Uchaf Footpath 5. This viewpoint is representative of views experienced by recreational receptors.

Baseline Description

The foreground comprises fenced, grazed grassland and moorland. Mature field boundary trees partially filter views to the south-west and west.

The middle ground comprises coniferous plantation woodland south of Nant y Bryn to the south. Further away, the settlements of Banwen and Dyffryn Cellwen are visible, to the south, on the lower slopes of Hirfynydd, west of Roman Road. The coal washery, with large-scale buildings sitting on terraces, is visible to the south-west. These developed areas sit below open grassland and areas of predominantly coniferous plantation woodland on Hirfynydd, the ridgeline of which forms a near horizon and includes the Maesgwyn Wind Farm, with turbines breaking the horizon. Also to the south-west, closer properties within Coelbren,a nd Dol Henrhyd road, are visible below the level of the viewpoint and partially filtered by mature trees in the foreground. To the west, the landform falls away from the viewpoint towards mature woodland alongside Nant Llech.

To the west, a near horizon is formed by the Site and the distinctive landform of the overburden mound. Hedgerow enclosed pastures are visible below this, and buildings within the Site compound. An area of active opencast mining is perceptible, specifically the wide access tracks to the summit. A pylon line crosses the view between Hirfynydd and the Site, breaking the horizon to the south and south-west.

Long-distance views are available beyond the lower slopes of Hirfynydd to the south, to Mynydd Marchywel to the south-west, and to the Brecon Beacons to the west.

The value of the view is a result of its location within the national park which is recognised for its recreational value.

Value: **High**

Future Baseline:

Restoration of the Site will include the reprofiling of the overburden mound to reduce its height and create a less ‘engineered’ landform. It is not anticipated that this will change the extent of the view. The Nant Helen Complementary Restoration Earthworks will be just visible to the south-west, with large cuttings crossing the hedgerow-bound fields below the overburden mound. The lower cutting will be perceptible as a wide break in the land cover and landscape pattern, above the properties in Coelbren. Foreground trees will filter their visibility. Views along the lower cutting will be available to the south-west, above Dol Henrhyd. Foreground trees will screen earthworks between this and the Coal Washery.

The value of the view is a result of its location within the national park which is recognised for its recreational value. The value will not change due to the changes as a result of the Nant Helen Restoration and Nant Helen Complementary Restoration earthworks.

Value: **High**

Viewpoint 12 - View from Ystradfellte Byway 74

View from Ystradfellte Restricted Byway 74. This viewpoint represents views experienced by recreational receptors.

Baseline Description

The foreground comprises the byway that follows the Sarn Helen Roman Road and runs through grazed grassland and scrub.

The settlement of Banwen is visible to the south and Dyffyn Cellwen and the coal washery site are visible to the south-west across grazed pasture land. Coniferous woodland plantation limits the distance of available view to the west and north-west.

To the south, the view comprises Hirfynydd which is covered by woodland plantation and wind turbines that break the horizon. Long-distance views towards Mynydd Marchywel are available, with pylons breaking the horizon and overhead lines crossing the view. To the west, pylons break the horizon and the overburden mound at Nant Helen forms a prominent feature within the view due to its steep engineered form. Mining activity to the north of the overburden mound is perceptible, though mostly screened by coniferous woodland plantation within the middle ground.

The value of the view is a result of its location within the national park which is recognised for its recreational value.

Value: **High**

Future Baseline:

Restoration of the site will include the reprofiling of the overburden mound to reduce its height and create a less ‘engineered’ landform. The Nant Helen Complementary Restoration Earthworks will be visible to the south-west with cuttings crossing the hedgerow-bound fields below the overburden mound. The lower cutting will be perceptible as a wide break in the land cover and landscape pattern. Cutting and a small section of embankment will be perceptible further into the distance to the south of the reformed overburden mound.

The value will remain due to its location within the national park which is recognised got its recreational value.

Value: **High**

Viewpoint 13 - View from School Road, Ystalyfera

View north-east from School Road, Ystalyfera. This viewpoint is representative of views experienced by residential receptors.

Baseline Description

The foreground comprises the entrance to Ysgol Gynradd Y Wern Primary School on School Road and properties with east facing windows.

Beyond the gated entrance to a property off School Road, roofs of further properties with east facing windows are visible. To the south-east, Wernwood Road follows the landform to towards further properties within Ystalyfera, situated on the valley floor.

To the south-east, Varteg Hill forms the backdrop to the view. To the north-east, the overburden mound at the opencast mining site stands as a prominent feature that forms the horizon. Mining activity is perceptible, though partially filtered by intervening vegetation and woodland at the perimeter of the mining site.

The value of the view is a result of its frequency within the surrounding landscape and perceptibility of mining activity.

Value: **Low**

Future Baseline:

Restoration of the site will include the reprofiling of the overburden mound to reduce its height and create a less 'engineered' landform. The outer loop cutting of the Nant Helen Complementary Restoration Earthworks will be perceptible as well as loss of mining activity from the void which will be replaced by ponds and marshy grassland habitat creation.

The value will not change due to the changes being barely perceptible and having little impact on the overall scenic quality of the view. Similar views are commonplace within the surrounding landscape.

Value: **Low**

Viewpoint 14 - View from Ystradgynlais Footpath 10

View north-east from Ystradgynlais Footpath 10. This viewpoint is representative of views experienced by recreational receptors.

Baseline Description

The foreground comprises upland grazed grassland with a track that runs east to west.

The middle ground is dominated by the engineered form of the overburden mound from the opencast mining site which forms the horizon to the north-east. Opencast mining activity is visible within the void to the north. To the east, pylons and overhead lines are visible and break the horizon.

In the long distance to the north, the northern Dulais valley slope is formed by pasture fields with well treed boundaries, and the Black Mountain forms the backdrop. Long distance views are available to the east, beyond the pylons, towards large areas of woodland plantation. The wooded slopes of Hirfynydd are located to the south-west and limits the distance of the available view, with wind turbines breaking the horizon.

The value of the view is a result of its proximity to large-scale mining activity and features such as pylons. The viewpoint does provide long-distance panoramic views.

Value: **Medium**

Future Baseline:

Restoration of the site will include the reprofiling of the overburden mound to reduce its height and create a less 'engineered' landform. Shallow cuttings will be perceptible to the west of the reprofiled overburden mound as well as an embankment to the north of the reprofiled mound. The ground cover will be reinstated as acid grassland across the visible areas of the restoration. To the north, the void will be partially filled, and the visible areas will be replaced by acid grassland.

The value of the view will not change. Whilst mining activity will be absent from the view and the landform will appear less 'engineered'. The value assigned to the view is primarily based upon long-distance panoramic nature of the views available.

Value: **Medium**

Viewpoint 15 - View from Tawe-Uchaf Footpath 49

Viewpoint 15 was included as part of the Nant Helen Complementary Restoration Earthworks LVIA. It is assumed that public access to this footpath/viewpoint will not be provided and it has therefore not been included in this assessment.

Viewpoint 16 - View from properties on A4109

View north / north-west from properties on the A1049. This viewpoint is representative of views experienced by residential receptors.

Baseline Description

The foreground is dominated by the road but a gap in roadside vegetation allows a clear view across the minor valley.

The middle ground comprises the northern valley slope of a minor watercourse that runs alongside the road. Residential properties of Tynewydd, surrounded by predominantly coniferous garden trees that partially screen the landscape beyond. Elsewhere, the landscape is open, rough grazing land, typical of the surrounding landscape, crossed east to west by two pylon lines that break the horizon.

The background is dominated by an overburden mound within the partially restored open cast mining landscape. Its engineered gradient landform contrasts with the surrounding, gentler slopes. The topography results in the horizon being relatively close to the viewpoint but there are much longer views towards hilltops within the Brecon Beacons National Park to the north-east and Mynydd

Marchywel to the south-west. A small area of open cast mining spoil is visible beyond the overburden mound to the north.

The value of the view is a result of its frequency within the surrounding landscape for residential receptors. The view contains large-scale industrial activity and smaller scale enclosed features.

Value: **Low**

Future Baseline:

Restoration of the site will include the reprofiling of the overburden mound to reduce its height and create a less 'engineered' landform. A small embankment, part of the Nant Helen Complementary Restoration Earthworks, will be visible to the north-west in front of the reprofiled overburden mound. The restoration works visible will comprise acid grassland visible across the view.

The changes as a result of the Nant Helen Restoration and Nant Helen Complementary Restoration Earthworks will result in the landforms appearing slightly less engineered. The view remains frequent within the surrounding landscape and the value will therefore not change.

Value: **Low**

Viewpoint 17 - View from Onllwyn Cemetery

View west from Onllwyn, Cemetery. This viewpoint is representative of visitors to the cemetery.

Baseline Description

The foreground comprises the entrance road to the cemetery and grass verges with a bench located near the bus stop and commemorative stone to the north.

The A4109 Onllwyn Road runs east to west and is lined by vegetation on either side. Mature vegetation on the southern side of the road forms the boundary to the cemetery. Views to the south-west are filtered by mature vegetation. Pylons cross the view from south-east to north-west and break the horizon.

Longer-distance views are available to the east and comprise rising landform with grazed grassland cover. The distinctive tiered overburden mound forms a prominent landform within the view.

The value of the view is a result of its relatively enclosed nature due to overgrown vegetation.

Value: **Low**

Future Baseline:

Restoration of the site will include the reprofiling of the overburden mound to reduce its height and create a less 'engineered' landform visible beyond the pylons. To the north-west, cuttings, part of the Nant Helen Complementary

Restoration Earthworks, will be perceptible as breaks in vegetation and acid grassland land cover.

The view will remain enclosed due to surrounding vegetation and will have noticeable industrial features and engineered landforms. Therefore, the value will not change.

Value: **Low**

Viewpoint 18 - View from Sarn Helen Roman Road

View north from Sarn Helen Roman Road and Byway 28/39.N.Hi/1, along the ridge of Hirfynydd. This viewpoint is representative of recreational users of the footpath.

Baseline Description

The foreground comprises the Sarn Helen Roman Road and coniferous woodland plantation on the slopes of Hirfynydd.

The landform falls away from the viewpoint to the Dulais Valley floor where properties at Seven Sisters are visible along the A4109. The Dulais Valley slope rises beyond Seven Sisters towards the prominent opencast overburden mound. Pylons are visible running east to west along the southern boundary of the mound and grassland with small areas of scrub forms the main land cover in this direction. Opencast mining works are visible at the northern edge of the overburden mound. To the north, the access track to the mining site compound buildings is visible. Coelbren is visible to the north-east across views of coniferous woodland plantation.

The viewpoint offers panoramic, long distance views to a horizon formed by the Brecon Beacons National Park.

The value of the view is a result of its location on the Sarn Helen Roman Road which follows a ridgeline, with panoramic, long distance views.

Value: **High**

Future Baseline:

Restoration of the site will include the reprofiling of the overburden mound to reduce its height and create a less ‘engineered’ landform. The Nant Helen Complementary Restoration Earthworks will be visible as a small embankment to the north-west and cuttings to the north. Cutting will be perceptible as breqaks in scrubby vegetation but grassed slopes will integrate with the surrounding restored acid grassland land cover. Panoramic, long distance views will remain available from the Sarn Helen Roman Road and therefore the value of the view will not change.

Value: **High**

Appendix 9D

Assessment Tables

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A1 Assessment Table – Effects from Construction (Landscape)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
Banwen Uplands LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Industrial remnants (the washery and Neath and Brecon railway), infrastructure routes (A4221 and A4109) and urban features (pylons, street lighting, solar farms) are typical of the wider contextual landscape, particularly to the west due to Onllwyn, Ytradgynlais and wind turbines at Hirfynydd. The susceptibility to change is therefore Low. There are no direct impacts to the LCA. There would be a slight increased perception of impacts resulting from large-scale infrastructure operations within the contextual landscape to the north-west of the character area. These impacts would result in the perceptible disturbance of newly restored areas within an adjacent LCA, with works taking place on and around the engineered landforms implemented as part of the Nant Helen Complementary Restoration Earthworks. The perceptibility of these changes would be minimal and concentrated closer to the less tranquil areas of the LCA which are closer to urban settlements, existing rail infrastructure (the washery and Neath and Brecon railway) and busy roads such as the A4221 and A4109. The magnitude of change would therefore be Negligible	Medium	Negligible (Adverse)	Negligible (Adverse)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	(Adverse) for this Medium sensitivity receptor. The significance of effect would be Negligible (Adverse)			
Black Mountain Southern Fringe LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Large-scale activity (mining west of Cwmllynfell), urban settlements (Cwmllynfell and Ystradgynlais) and infrastructure (A4068 and A4067) exist within the wider contextual landscape. The susceptibility to change is therefore Low. There are no direct impacts to the LCA. There would be slightly increased perception of large-scale activity within the wider contextual landscape mainly due to construction works for the outer rail track including laying of track bed and erection of overhead line equipment. The LCA lies in close proximity to mining activity and urban settlement and is located approximately 5.6km from the Project.	Medium	Negligible (Adverse)	Negligible (Adverse)
Bryn Henllys Reclaimed Open Cast LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The existing contextual landscape of the LCA contains mining activity (west of Cwmllynfell), urban settlements (Cwmllynfell, Cwm-twrch Isaf and Ystradgynlais) and road infrastructure (A4068 and A4607). The susceptibility to change is therefore Low. There are no direct impacts to the LCA. There would be slightly increased perception of large-scale activity within the contextual landscape mainly due to construction of the outer and inner rail tracks	Low	Negligible (Adverse)	Negligible (Adverse)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	including laying of track bed and erection of OLE. Large-scale operations, movement and development are characteristic of the LCAs contextual landscape.			
Coelbren Settlement LCA	The LCA has some capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The existing contextual landscape contains existing rail infrastructure related to previous mining activity. The LCA is also urban and therefore contains features such as roads, lighting, signage and buildings. The susceptibility to change is therefore Low. There are no direct impacts to the LCA. Construction works associated with the outer and inner rail track including; laying of track bed and track; and erection of overhead line equipment would result in perceptible disturbance to restored areas within the contextual landscape. Construction activity at the location of the washery would be perceptible as development of a defunct industrial area within the LCA's wider landscape and would not affect its overall character.	Low	Low (Adverse)	Minor (Adverse)
Cwm Twrch LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Urban settlements (Cwm-twrch Isaf, Ystalyfera and Cwmllynfell) and road infrastructure (A4068 and Rhiwfawr Road) are existing features of the contextual landscape. The susceptibility to change is therefore Low. There are no direct impacts to the LCA. The contextual landscape comprises urbans settlements and road infrastructure. There would be	Medium	Negligible (Adverse)	Negligible (Adverse)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	slightly increased large-scale activity within the wider landscape due to construction works associated with the western extent of the outer track of the Project. This includes, laying of the track bed and track and erection of overhead line equipment.			
Dulais Valley LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The existing contextual landscape comprises, large scale forestry activity (Hirfynydd), urban settlements (Neath, Seven Sisters and Ystradgynlais) and infrastructure (A4221). The susceptibility to change is therefore Low. There are no direct impacts to the LCA. Construction of the outer and inner rail track including; laying of track bed and track; and erection of overhead line equipment would result in perceptible disturbance to restored areas within the contextual landscape. Construction works at the washery site would be perceptible as development of a defunct industrial area within the LCA contextual landscape and would not affect its overall character. Increased large-scale activity would be perceptible, with potential minor impacts upon tranquillity but would be localised to the northernmost extent of the LCA.	Medium	Negligible (Adverse)	Negligible (Adverse)
Fforest Fawr LCA	The LCA is susceptible to indirect changes that would affect its sense of remoteness, peacefulness and tranquillity, which are; recognised special qualities of the national park; identified within the aims and	High	Negligible (Adverse)	Minor (Adverse)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	objectives of *A Management Plan for the Brecon Beacons National Park 2015-2020*[1]; and recognised within both the national park's landscape character assessment and within LANDMAP. The LCA is also susceptible to urban or large-scale features that would change the perception of the wider landscape and the LCA itself. The susceptibility to change is therefore Medium. There are no direct impacts to the LCA. Construction works associated with the outer and inner rail track including; laying the track bed and track; and erection of overhead line equipment would result in the perceptible disturbance to newly restored areas of the wider landscape. Construction activity at the washery site would not be a substantial change to the baseline landscape. Construction activity and disturbance of restored areas within the contextual landscape, and the potential impacts to the sense of tranquillity experienced within the LCA, are limited to a small geographical extent of the LCA which is approximately 1.8km away from the Site at its closest point. It is anticipated that the construction of the Project would be visible at a much greater distance from within the LCA however, perception of the construction works and impacts to peacefulness and tranquillity would be limited by distance and by the Project forming only a small component within expansive views. Impacts on peace and tranquillity are limited to the edge of the LCA			

[1] Brecon Beacons National Park *A Management Plan for the Brecon Beacons National Park 2015-2020*

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	where these qualities are already slightly reduced due to existing development and infrastructure.			
Head of Dulais Valley LCA	The LCA is able to accommodate the Project without effects upon its overall integrity. The character of the LCA and development of the settlement is a direct result of local industry and the LCA contains rail infrastructure (Neath and Brecon Railway and washery), road infrastructure (A4109) and urban development (Seven Sisters and Onllwyn). The susceptibility to change is therefore Low. Works within the LCA would include the construction of sidings along the existing Neath and Brecon Railway corridor to the west of the washery site. Further works would include the construction of sidings, storage sheds, control centre building and a research and development centre at the location of the washery. Construction of the track bed and track and the erection of overhead line equipment across a short embankment connecting the sidings to the outer rail track will be direct impacts to a small area of the LCA north of Onllwyn Road. Construction works within the LCA are located close to areas of existing infrastructure such as the Neath and Brecon rail corridor and large-scale industrial activity at the washery.	Medium	Low (Adverse)	Minor (Adverse)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
Hirfynydd LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Large scale operations (mining) and man-made features (forestry) are characteristic of the LCA. The contextual landscape contains urban settlements (Crynant, Seven Sisters, Onllwyn) and main roads (A4109 and A4221). The susceptibility to change is therefore Low. There are no direct impacts to the LCA. Construction works associated with the outer and inner rail track including; laying of track bed and track; and erection of overhead line equipment would result in perceptible disturbance to restored areas within the contextual landscape. Perceptible construction works activity at the washery site would be characteristic of the existing wider landscape and would not affect the LCA's overall character.	Medium	Low (Adverse)	Minor (Adverse)
Mynydd Allt y grug LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The LCAs contextual landscape comprises urban settlement (Ystalyfera, Cilmaengwyn and Ystradgynlais) and road infrastructure (A4067) within the valley. The susceptibility to change is therefore Low. There are no direct impacts to the LCA. The character area's varied contextual landscape comprises urban settlements, main roads and mountainous regions. Construction works including laying of the track bed and track and erection of overhead line equipment at the western extent of the outer rail track would result in a barely perceptible	Medium	Negligible (Adverse)	Negligible (Adverse)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	disturbance to a restored area within an already varied contextual landscape.			
Mynydd Marchywel LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The LCAs contextual landscape comprises urban settlement (Neath, Rhos, Crynant, Ystalyfera and Ystradgynlais) and road infrastructure (A4109 and B4599) within the surrounding valleys. The susceptibility to change is therefore Low. There are no direct impacts to the LCA. The contextual landscape of the LCA comprises urban settlement and main roads. The LCAs sense of remoteness and tranquillity is as a result of the stark contrast to its surrounding urban development (Neath to the south-west and Ystradgynlais to the north). Changes to the sense of remoteness and tranquillity due to the construction of the outer rail track would be barely perceptible when considering the activity within the surrounding contextual landscape. Construction activity is located approximately 4km from the most northerly point of the LCA.	Medium	Negligible (Adverse)	Negligible (Adverse)
Mynydd Uchaf, Mynydd Garth & Cefn Gwrhyd LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Large-scale activity (mining west of Cwmllynfell) exists within the wider contextual landscape. The susceptibility to change is therefore Low. There are no direct impacts to the LCA. The landscape character area has a varied contextual landscape that comprises; mining in close	Medium	Negligible (Adverse)	Negligible (Adverse)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	proximity; valley landforms; mountainous regions; urban settlements; infrastructure corridors. The slightly increased perception of activity due to the laying of the track bed and track and erection of overhead line equipment on the outer track of the Project would result in a barely perceptible change to the contextual landscape of the LCA.			
Nant Helen Reclaimed Uplands LCA	The LCA has some capacity to accommodate the Project without affecting its overall integrity due to the development taking place on engineered landforms within he restored landscape. The LCA also contains existing urban features such as electricity pylons and is surrounded by urban development (Ystradgynlais and Seven Sisters) and road infrastructure (A4109, A4221 and A4067). It is susceptible to the removal of restored features and urbanisation. The susceptibility to change is therefore Medium. The construction of the outer and inner rail tracks would take place within the LCA. Two rail tracks would be constructed on the existing Nant Helen Complementary Earthworks development. This rail infrastructure would tie into the Neath and Brecon Railway to the south and further associated sidings and buildings located at the washery. Construction includes the laying of the track bed and rail track and erection of overhead line equipment. To the south, where the rail tracks connect with the sidings at the washery, construction would include 2 platforms 230m in length and an associated station building. Works within the adjacent Head of Dulais Valley LCA would include the construction of maintenance and storage sheds, research and development centre and a multi-storey control centre building as well	Medium	Medium (Adverse)	Moderate (Adverse)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	as rail sidings for up to 400 vehicles. These works would be at the location of the washery and would not directly impact on the LCA but would contribute to the overall sense of scale of construction works taking place. Whilst the removal of previously restored areas of the LCA is not anticipated, the construction works within and adjacent to the LCA would introduce large-scale construction activity to the restored landscape. Evidence of historic mining activity and urbanising features including pylons, overhead lines and engineered landforms are characteristic of the LCA. Due to the activity being introduced to approximately half of the LCA but concentrated to the engineered earthworks and not relating in removal of mature vegetation/habitats the magnitude of change would be Medium (Adverse) for this Medium sensitivity receptor. The significance of effect on the Nant Helen Reclaimed Uplands LCA would therefore be **M**oderate (Adverse).			
Slopes of Cefn Gwrhyd & Cwm Egel LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Large-scale activity (mining west of Cwmllynfell), urban settlement (Ystalyfera, and Pontardawe) and road infrastructure (A4068, B4599 and A474) exists within the wider contextual landscape. The susceptibility to change is therefore Low. There are no direct impacts to the LCA. The landscape character area has a varied contextual landscape that comprises; mining; valley landforms; mountainous regions; urban settlements; and infrastructure corridors. The LCAs sense of remoteness and tranquillity is owed to	Medium	Negligible (Adverse)	Negligible (Adverse)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	the valley topography within which the enclosed grazed pasture lies. The slightly increased perception of activity within the contextual landscape due to the laying of the track bed and track and the erection of overhead line equipment at the western edge of the outer rail track would result in the barely perceptible change.			
Swansea Valley LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The LCA is a result of its valley topography, urbanised areas form the contextual landscape to the north-east (Ystradgynlais) and south-west (Pontardawe). The susceptibility to change is therefore Low. There are no direct or indirect impacts to the LCA. The area of development is located well beyond the extents of the LCA which has an overall enclosed character due to the steep valley sides. Construction activity would result in no change to the LCA.	Medium	No Change	Neutral
Swansea Valley Settlements LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The urban character of the area and history of mining activity within the surrounding landscape means it can accommodate indirect changes within the contextual landscape as long as changes do not result in the removal or degradation of key/valuable landscape features. The susceptibility to change is therefore Low. There are no direct impacts to the LCA. Large-scale operations such as mining have been commonplace within the surrounding landscape and	Medium	Negligible (Adverse)	Negligible (Adverse)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	urban settlement has developed due to industry. There would be a slight increased perception of activity within the contextual landscape and the perceived disturbance to a newly restored landscape due to the laying of the track bed and track and erection of overhead line equipment at the western extent of the outer rail track. Due to the enclosed character of the LCA effects would be barely perceptible.			
Upland Settlements	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Large-scale activity (mining west of Cwmllynfell) and road infrastructure (A4068) exists within the wider contextual landscape. The susceptibility to change is therefore Low. There are no direct impacts to the LCA. The construction of the Project would result in perceptible disturbance of a newly restored area within the contextual landscape. These effects would be barely perceptible due to distance.	Medium	Negligible (Adverse)	Negligible (Adverse)
Waterfall Country and Southern Valleys LCA	The LCA is susceptible to changes that would affect its sense of remoteness, peacefulness and tranquillity, which are; recognised special qualities of the national park; identified within the aims and objectives of *A Management Plan for the Brecon Beacons National Park 2015-2020*[2]; and recognised within both the national park's	High	Negligible (Adverse)	Minor (Adverse)

[2] Brecon Beacons National Park *A Management Plan for the Brecon Beacons National Park 2015-2020*

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	landscape character assessment and within LANDMAP. The LCA is also susceptible to the introduction of incongruous features into the contextual landscape. The susceptibility to change is therefore Medium. There are no direct impacts to the LCA. Construction activity within 350m of the LCA's southern boundary would be visible from limited elevated locations within the character area. Construction works include the laying of the track bed and track and the erection of overhead line equipment across engineered earthworks. Construction activity within the contextual landscape would result in perceptible disturbance of a newly restored landscape. Indirect impacts would be limited to elevated locations within the western extent of the LCA which is already influenced by adjacent urban development and road infrastructure. Perception of the majority of the LCA and its key characteristics would not change.			
Wooded Tawe Valley LCA	The character area is susceptible to changes that would result in an increased sense of urbanisation and loss of its natural character. The susceptibility to change is therefore Medium. Construction works on the outer rail track of the Project including the laying of track bed and track and the erection of overhead line equipment would result in the perceptible disturbance of a newly restored landscape beyond the northern embankment woodland	Medium	Low (Adverse)	Minor (Adverse)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	planting implemented as part of the Nant Helen Complementary Restoration Earthworks. The introduction of construction activity would result in the perceptible spread of urban development further up the valley slopes and away from the existing developed areas located on the valley floor. This would only affect a small proportion of the overall LCA to the north-east.			
Y Mynydd Du LCA	The LCA is susceptible to indirect changes that would affect its sense of peace and tranquillity, which are; recognised special qualities of the national park; identified within the aims and objectives of *A Management Plan for the Brecon Beacons National Park 2015-2020*[3]; and recognised within both the national park's landscape character assessment and within LANDMAP. The LCA is also susceptible to the introduction of incongruous features into the contextual landscape. The susceptibility to change is therefore Medium. There are no direct impacts to the LCA. The construction works including the laying of track bed and track and the erection of overhead line equipment along the earthworks implemented as part of the Nant Helen Complementary Restoration Earthworks would result in the perceptible disturbance of a newly restored area within the contextual landscape. Impacts would be limited to a small proportion	High	Low (Adverse)	Minor (Adverse)

[3] Brecon Beacons National Park *A Management Plan for the Brecon Beacons National Park 2015-2020*

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	of the overall LCA at its southern extent, near existing urban features that currently reduce the sense of peace and tranquillity at the LCA's boundary. It is anticipated that the construction works would be visible at a much greater distance from within the LCA, however the impacts to peacefulness and tranquillity and perceived disturbance to the contextual landscape would be barely perceptible at these greater distances.			

A2 Assessment Table – Effects from Operation (Landscape)

Landscape Character Area	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
Banwen Uplands LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Industrial remnants (the washery and Neath and Brecon railway), infrastructure routes (A4221 and A4109) and urban features (pylons, street lighting, solar farms) are typical of the wider contextual landscape, particularly to the west due to Onllwyn, Ytradgynlais and wind turbines at Hirfynydd. The susceptibility to change is therefore Low. **Year 1** There are no direct impacts to the LCA. There would be an increase in urban features adjacent to the north-west extent of the character area due to the redevelopment of the coal washery site which would contain more buildings which would be bigger in footprint and height. Train movement at the eastern edge of the outer track in shallow cutting and across a small section of embankment would contribute to the impacts, introducing rail infrastructure and activity to the adjacent landscape. Changes would affect a small proportion of the LCA and be concentrated close to the less tranquil areas of the LCA, already influenced by urban settlements, existing rail infrastructure (the washery and Neath and Brecon Railway) and busy roads such as the A4221 and A4109. The magnitude of change would therefore	Medium	**Year 1** Low (Adverse) **Year 15** Low (Adverse)	**Year 1** Minor (Adverse) **Year 15** Minor (Adverse)

	be Low (Adverse) for this Medium sensitivity receptor. The significance of effect would be Minor (Adverse) **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of movement/activity within the contextual landscape. The changes would be minimal, and the magnitude of change would therefore remain Low (Adverse). The significance of effect would remain Minor (Adverse).			
Black Mountain Southern Fringe LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Large-scale activity (mining west of Cwmllynfell), urban settlements (Cwmllynfell and Ystradgynlais) and infrastructure (A4068 and A4067) exist within the wider contextual landscape. The susceptibility to change is therefore Low. **Year 1** There are no direct impacts to the LCA. There would be a slightly increased perception of activity within the wider contextual landscape due to moving trains on the outer rail track. The LCA lies in close proximity to existing large-scale activity, urban settlement and road infrastructure and is located approximately 5.6km from the Project. The magnitude of change would therefore be Negligible (Adverse) for this Medium sensitivity receptor. The significance of effect would be Negligible (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of movement/activity within the contextual landscape. The changes would be	Medium	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)

	minimal due to the distance of the LCA from the Project and the magnitude of change would therefore remain Negligible (adverse). The significance of effect would remain Negligible (adverse).			
Bryn Henllys Reclaimed Open Cast LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The existing contextual landscape of the LCA contains mining activity (west of Cwmllynfell), urban settlements (Cwmllynfell, Cwm-twrch Isaf and Ystradgynlais) and road infrastructure (A4068 and A4607). The susceptibility to change is therefore Low. **Year 1** There are no direct impacts to the LCA. There would be slightly increased perception of large-scale activity and urbanisation within the wider landscape mainly due to the movement and noise from the trains and rail infrastructure features on the outer rail track. Movement and development are characteristic of the LCAs existing contextual landscape and the Project is located approximately 4.3km from the edge of the LCA. The magnitude of change would therefore be Negligible (adverse) for this Low sensitivity receptor. The significance of effect would-be Negligible (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of movement/activity within the contextual landscape. The changes would be minimal due to the distance of the LCA from the Project and the magnitude of change would therefore remain Negligible (Adverse). The significance of effect would remain Negligible (Adverse).	Low	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)

Coelbren Settlement LCA	The LCA has some capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The existing contextual landscape contains existing rail infrastructure related to previous mining activity. The LCA is also urban and therefore contains features such as roads, lighting, signage and buildings. The susceptibility to change is therefore Low. **Year 1**he Project would result in increased activity at the washery site due to introduction and operation of new sidings, storage sheds, multi-storey control centre building and a research and development centre. There would be an increase in activity and the defunct coal washery buildings/machinery would be replaced with more substantial structures. There are no direct impacts to the LCA. To the west of the LCA, there would be an increase in urban features within the restored landscape including train movements, overhead line equipment, fencing and signals on the outer and inner rail track. There would be substantial changes to the contextual landscape that would not substantially alter the LCA itself which owes its character to its linear development and historic links to mining industry. The magnitude of change would therefore be Low (Adverse) for this Low sensitivity receptors. The significance of effect would be Minor (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of movement/activity within the contextual landscape. The changes would be minimal, and the magnitude of change would therefore remain Low (Adverse). The significance of effect would remain Minor (Adverse).	Low	**Year 1** Low (Adverse) **Year 15** Low (Adverse)	**Year 1** Minor (Adverse) **Year 15** Minor (Adverse)

Cwm Twrch LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Urban settlements (Cwm-twrch Isaf, Ystalyfera and Cwmllynfell) and road infrastructure (A4068 and Rhiwfawr Road) are existing features of the contextual landscape. The susceptibility to change is therefore Low. **Year 1** There are no direct impacts to the LCA. The contextual landscape comprises urban settlements and road infrastructure. There would be an increase of urban elements in the surrounding landscape due to train movements and rail infrastructure features such as overhead line equipment, fencing and signals. Changes to the surrounding landscape would affect the eastern extent of the LCA only and the Project is located approximately 4.2km from the edge of the LCA. The magnitude of change would therefore be Negligible (Adverse) for this Medium sensitivity receptor. The significance of effect would be Negligible (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of movement/activity within the contextual landscape. The changes would be minimal due to the distance of the LCA from the Project and the magnitude of change would therefore remain Negligible (Adverse). The significance of effect would remain Negligible (Adverse).	Medium	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)
Dulais Valley LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The existing contextual landscape comprises, large scale forestry activity (Hirfynydd), urban settlements	Medium	**Year 1**	**Year 1**

	(Neath, Seven Sisters and Ystradgynlais) and infrastructure (A4221). The susceptibility to change is therefore Low. **Year 1** There are no direct impacts to the LCA. The introduction of passing trains and rail infrastructure elements such as; overhead line equipment, fencing and signals; and platforms and an associated station building would contribute to the perceptible urbanisation of a restored area of the surrounding landscape. These urbanising features would be located on engineered landforms implemented as part of the Nant Helen Complementary Restoration Earthworks. The introduction of additional sidings and buildings at the location of the washery are not anticipated to affect the character of the LCA due to it being a minor change to the pre-existing land cover outside of the LCA. Indirect impacts to the LCA would be limited to the north-eastern extent of the LCA where the levels of tranquillity are already lower due to the proximity of developed areas including Severn Sisters and Onllwyn and existing road infrastructure. The changes to the contextual landscape will affect the northern extent of the LCA which is a small proportion of the overall LCA. The magnitude of change would therefore be Low (Adverse) for this Medium sensitivity receptor. The significance of effect would be Minor (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of movement/activity within the contextual landscape. The changes would be minimal, and the magnitude of change would therefore remain Low (Adverse). The significance of effect would remain Minor (Adverse).		Low (Adverse) **Year 15** Low (Adverse)	Minor (Adverse) **Year 15** Minor (Adverse)

Fforest Fawr LCA	The LCA is susceptible to indirect changes that would affect its sense of remoteness, peacefulness and tranquillity, which are; recognised special qualities of the national park; identified within the aims and objectives of *A Management Plan for the Brecon Beacons National Park 2015-2020*[4]; and recognised within both the national park's landscape character assessment and within LANDMAP. The LCA is also susceptible to urban or large-scale features that would change the perception of the wider landscape and the LCA itself. The susceptibility to change is therefore Medium. **Year 1** There are no direct impacts to the LCA. Train movement and urban rail infrastructure including overhead line equipment, signals and fencing on the inner and outer rail tracks would contribute to the introduction of activity within a newly restored landscape albeit with some engineered landforms. Whilst urban and rail features would be introduced to a restored, upland landscape, it is the speed and frequency of train movement around the site that would have the greatest impact to the sense of remoteness, peace and tranquillity experienced within the LCA. The greatest impact on sense of remoteness, peace and tranquillity would be experienced at the south-western edge of the LCA where these qualities are already lessened by the proximity to existing development and infrastructure. It is anticipated that the Project would be perceptible at a much greater distance from within the LCA however, the impacts to peacefulness and tranquillity would be limited by distance and by the Project forming only a small component within an expansive surrounding landscape. The magnitude of change would therefore be	High	**Year 1** Low (Adverse) **Year 15** Negligible (Adverse)	**Year 1** Minor (Adverse) **Year 15** Negligible (Adverse)

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	Low (Adverse) for this High sensitivity receptor. The significance of effect would be Minor (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and would reduce the perceptibility of movement/activity within the contextual landscape. Planting implemented as part of the Nant Helen Complementary Restoration Earthworks and landscape mitigation planting at the north-eastern extent of the Project would re-establish the wooded valley side that forms part of the contextual landscape. Due to the reduced perceptibility of the Project the magnitude of change would reduce to Negligible (Adverse). The significance of effect would be Negligible (Adverse).			
Head of Dulais Valley LCA	The LCA is able to accommodate the Project without effects upon its overall integrity. The character of the LCA and development of the settlement is a direct result of local industry and the LCA contains rail infrastructure (Neath and Brecon Railway and washery), road infrastructure (A4109) and urban development (Seven Sisters and Onllwyn). The susceptibility to change is therefore Low. **Year 1** Changes within the LCA would include sidings along the existing Neath and Brecon Railway corridor to the west of the washery and the introduction of; sidings for up to 400 vehicles; storage sheds; multi-storey control centre building and research and development centre at the location of the washery. The new features within the LCA are closely related to the existing rail infrastructure and the sidings and new buildings at the washery would be perceived as redevelopment and restarting of activity at a defunct area rather	Medium	**Year 1** Low (Adverse) **Year 15** Low (Adverse)	**Year 1** Minor (Adverse) **Year 15** Minor (Adverse)

	than the introduction of new different activity that would be out of character with the LCA. The introduction of rail infrastructure in the adjacent LCA would include; overhead line equipment, signals and fencing on engineered landforms; 230m platforms and a station building at the intersection between the rail tracks and the connecting branch line; and the introduction of fast-moving trains. These features would contribute to the urbanisation of the LCA and the adjacent, newly restored landscape, alongside existing pylons and the Neath and Brecon Railway corridor. The impacts on the LCA predominantly result from the impacts to the restored adjacent landscape. The magnitude of change would therefore be Low (Adverse) for this Medium sensitivity receptor. The significance of effect would be Minor (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation around along the branch line and around station building within the landscape adjacent the LCA would reduce the perceptibility of the Project. The reduction in perceptibility would be slight only and there would be no change within the LCA itself. The magnitude of change would therefore remain Low (Adverse). The significance of effect would be Minor (Adverse).			
Hirfynydd LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Large scale operations (mining) and man-made features (forestry) are characteristic of the LCA. The contextual landscape contains urban settlements (Crynant, Seven Sisters, Onllwyn) and main roads (A4109 and A4221). The susceptibility to change is therefore Low. There are no direct impacts to the LCA. Changes to the wider landscape context would be the introduction of rail infrastructure and urban elements including	Medium	**Year 1** Low (Adverse) **Year 15**	**Year 1** Minor (Adverse) **Year 15**

	overhead line equipment and train movements which would be a perceptible change to the newly restored landscape to the north of the LCA. Development at the washery site would not impact upon the LCA's character as it would be barely perceptible. Effects would be limited to the northern extent of the LCA or from the ridgeline that runs north-east to south-west. The magnitude of change would therefore be Low (Adverse) for this Medium sensitivity receptor. The significance of effect would be Minor (Adverse). **Year 15 – (with established mitigation planting)** Established landscape mitigation planting along the branch line would partially screen the rail infrastructure and integrate the station platforms and station building into the landscape. Planting at the south-western extent of the Project following the shallow watercourse valley would partially screen trains and rail infrastructure on embankment. Due to the decreased perceptibility of the Project within the contextual landscape the magnitude of change would reduce to Negligible (Adverse). The significance of effect would be Negligible (Adverse).		Negligible (Adverse)	Negligible (Adverse)
Mynydd Allt y grug LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The LCAs contextual landscape comprises urban settlement (Ystalyfera, Cilmaengwyn and Ystradgynlais) and road infrastructure (A4067) within the valley. The susceptibility to change is therefore Low. **Year 1** There are no direct impacts to the LCA. The character area's varied contextual landscape comprises urban settlements, main roads and mountainous regions. The	Medium	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)

	Project would result in the introduction of urbanising features within a recently restored area of the contextual landscape. The increase in urbanising features and perception of urban features due to fast moving trains would be limited to a relatively small area within the expansive surrounding landscape. The magnitude of change would therefore be Negligible (Adverse) for this Medium sensitivity receptor. The significance of effect would be Negligible (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of movement/activity within the contextual landscape. The changes would be minimal due to the distance of the LCA from the Project and the magnitude of change would therefore remain Negligible (Adverse). The significance of effect would remain Negligible (Adverse).			
Mynydd Marchywel LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The LCAs contextual landscape comprises urban settlement (Neath, Rhos, Crynant, Ystalyfera and Ystradgynlais) and road infrastructure (A4109 and B4599) within the surrounding valleys. The susceptibility to change is therefore Low. **Year 1** There are no direct impacts to the LCA. The contextual landscape of the LCA comprises urban settlement and main roads. The LCA's sense of remoteness and tranquillity is as a result of the stark contrast to its surrounding urban development (Neath to the south-west and Ystradgynlais to the north).	Medium	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)

	There would be a perceptible change to the contextual landscape due to an increase in activity including fast moving trains within a newly restored area. Changes to the sense of remoteness and tranquillity due to the introduction of urbanising features and operation of the rail testing facility within the surrounding landscape would be slight and affect only the northern extent of the LCA. The magnitude of change would therefore be Negligible (Adverse) for this Medium sensitivity receptor. The significance of effect would be Negligible (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of movement/activity within the contextual landscape. The changes would be minimal, and the magnitude of change would therefore remain Negligible (Adverse). The significance of effect would remain Negligible (Adverse).			
Mynydd Uchaf, Mynydd Garth & Cefn Gwrhyd LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Large-scale activity (mining west of Cwmllynfell) exists within the wider contextual landscape. The susceptibility to change is therefore Low. **Year 1** There are no direct impacts to the LCA. The landscape character area has a varied contextual landscape that comprises; mining in close proximity; valley landforms; mountainous regions; urban settlements; infrastructure corridors. The operational Project would result in urbanising features within a newly restored area of the contextual landscape. Fast moving trains would contribute to the disturbance of the newly restored area.	Medium	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)

	The contextual landscape surrounding the LCA is varied and effects would be barely perceptible due to the distance (approximately 6.8km) from the Project. **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of movement/activity within the contextual landscape. The changes would be minimal due to the distance of the LCA from the Project and the magnitude of change would therefore remain Negligible (Adverse). The significance of effect would remain Negligible (Adverse).			
Nant Helen Reclaimed Uplands LCA	The LCA has some capacity to accommodate the Project without affecting its overall integrity due to the development taking place on engineered landforms within he restored landscape. The LCA also contains existing urban features such as pylons and is surrounded by urban development (Ystradgynlais and Seven Sisters) and road infrastructure (A4109, A4221 and A4067). It is susceptible to the removal of restored features and urbanisation. The susceptibility to change is therefore Medium. **Year 1** The Project would introduce urban features including; overhead line equipment, signals and fencing; two platforms and a station building to the north-eastern extent of the LCA. The rail tracks would tie into the Neath and Brecon Railway and further associated sidings and buildings located at the washery. The urbanising features would sit on the engineered earthworks within the newly reprofiled and restored landscape. Changes within the contextual landscape are closely related to the existing Neath and Brecon Railway corridor and the washery site and would not impact the LCA.	Medium	**Year 1** Medium (Adverse) **Year 15** Medium (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Moderate (Adverse)

	The introduction of new urbanising features and large-scale activity and noise across a large proportion of the LCA, whilst not anticipated to result in loss or degradation of key features, would result in a substantial change to the newly restored landscape. The scale of the new features and prominent position on elevated topography would result in a Medium (Adverse) magnitude of change. The significance of effect would therefore be Moderate (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting will reduce the perceptibility of the Project from within the rest of the LCA to the south-west. The planting on the north-eastern edge of the site combined with established planting implemented as part of the Nant Helen Complementary Restoration Earthworks will re-establish the wooded valley character just north of the LCA. Although the perceptibility of the Project will be decreased across the south-western extent of the project the Project will remain a substantial change to the LCA and therefore the magnitude of change would remain Medium (Adverse). The significance of effect would be Moderate (Adverse).			
Slopes of Cefn Gwrhyd & Cwm Egel LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Large-scale activity (mining west of Cwmllynfell), urban settlement (Ystalyfera, and Pontardawe) and road infrastructure (A4068, B4599 and A474) exists within the wider contextual landscape. The susceptibility to change is therefore Low. **Year 1** There are no direct impacts to the LCA. The landscape character area has a varied contextual landscape that comprises; mining; valley landforms; mountainous regions; urban settlements; and infrastructure corridors. The LCAs sense of	Medium	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)

	remoteness and tranquillity is owed to the valley topography. There would be an increased perception of activity and urbanising features within the contextual landscape including overhead line equipment, signals and fencing and the operation of the testing facility including fast moving trains. It is anticipated that any perception of a loss of sense of remoteness and tranquillity would be slight and would only be experienced at the eastern extent of the LCA due to the moving trains at the western extent of the outer rail track (approximately 5km from the edge of the LCA). The magnitude of change would therefore be Negligible (Adverse) for this Medium sensitivity receptor. The significance of effect would be Negligible (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of movement/activity within the contextual landscape. The changes would be minimal due to the distance of the LCA from the Project and the magnitude of change would therefore remain Negligible (Adverse). The significance of effect would remain Negligible (Adverse).			
Swansea Valley LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The LCA is a result of its valley topography, urbanised areas form the contextual landscape to the north-east (Ystradgynlais) and south-west (Pontardawe). The susceptibility to change is therefore Low. **Year 1** There are no direct or indirect impacts to the LCA. The area of development is located well beyond the extents of the LCA which has an overall enclosed	Medium	**Year 1** No Change **Year 15** No Change	**Year 1** Neutral **Year 15** Neutral

	character due to the steep valley sides. Operational activity would result in no change to the LCA. **Year 15 – (with established mitigation planting)** There is no change to the LCA at year 1 and therefore mitigation planting would not alter the magnitude of change at year 15.			
Swansea Valley Settlements LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. The urban character of the area and activity within the surrounding landscape means it can accommodate indirect changes within the contextual landscape as long as changes do not result in the removal or degradation of key/valuable landscape features. The susceptibility to change is therefore Low. **Year 1** There are no direct impacts to the LCA. Activity within the surrounding landscape and urban settlement has developed due to industry. There would be a slight increased perception of urbanisation of the contextual landscape due to the introduction of rail infrastructure and the movement of trains. The perceived urbanisation of the surrounding landscape would affect only a small proportion of the overall contextual landscape that is formed by mountainous regions between the valleys. The magnitude of change would therefore be Low (Adverse) for this Medium sensitivity receptor. The significance of effect would be Minor (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of	Medium	**Year 1** Low (Adverse) **Year 15** Low (Adverse)	**Year 1** Minor (Adverse) **Year 15** Minor (Adverse)

	movement/activity within the contextual landscape. The changes would be minimal, and the magnitude of change would therefore remain Low (Adverse). The significance of effect would remain Minor (Adverse).			
Upland Settlements LCA	The LCA has the capacity to accommodate the Project within its contextual landscape without effects to its overall integrity. Large-scale activity (mining west of Cwmllynfell) and road infrastructure (A4068) exists within the wider contextual landscape. The susceptibility to change is therefore Low. **Year 1** There are no direct impacts to the LCA. The construction of the Project would introduce urban features and regular train movements to the contextual landscape. These changes would be barely perceptible due to distance (approximately 6km from the LCA). The magnitude of change would therefore be Negligible (Adverse) for this Medium sensitivity receptor. The significance of effect would be Negligible (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and slightly reduce the perceptibility of movement/activity within the contextual landscape. The changes would be minimal due to the distance of the LCA from the Project and the magnitude of change would therefore remain Negligible (Adverse). The significance of effect would remain Negligible (Adverse).	Medium	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)	**Year 1** Negligible (Adverse) **Year 15** Negligible (Adverse)
Waterfall Country and Southern Valleys LCA	The LCA is susceptible to changes that would affect its sense of remoteness, peacefulness and tranquillity, which are; recognised special qualities of the national park; identified within the aims and objectives of *A Management Plan*	High	**Year 1** Low (Adverse)	**Year 1** Minor (Adverse)

	for the Brecon Beacons National Park 2015-2020[5]; and recognised within both the national park's landscape character assessment and within LANDMAP. The LCA is also susceptible to the introduction of incongruous features into the contextual landscape. The susceptibility to change is therefore Medium. **Year 1** There are no direct impacts to the LCA. Urbanising features including overhead line equipment, signals and fencing along the northern extent of the Project would be perceptible within the contextual landscape. The presence of overhead line equipment, signals and fencing within a recently restored area of the contextual landscape would contribute to a sense of urbanisation of the surrounding landscape and the loss of peacefulness and tranquillity from the LCA. These effects are however limited to the western extent of the character area and would be experienced at the edges of the LCA where peacefulness and tranquillity is already reduced due to proximity to urban development and existing infrastructure. **Year 15 – (with established mitigation planting)** Established landscape mitigation planting at the north-eastern and western extents of the Project combined with established planting implemented as part of the Nant Helen Complementary Restoration earthworks would provide screening of rail infrastructure and passing trains and would reduce the perceptibility of the Project within the LCAs surrounding landscape. The planting on the northern embankment would reinstate he wooded valley character of the LCAs		**Year 15** Negligible (Adverse)	**Year 15** Negligible (Adverse)

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	surrounding landscape. The magnitude of change would therefore reduce to Negligible (Adverse). The significance of effect would be Negligible (Adverse).			
Wooded Tawe Valley LCA	The LCA is susceptible to changes that would result in an increased sense of urbanisation and loss of its natural character. The susceptibility to change is therefore Medium. **Year 1** The presence of rail infrastructure elements such as overhead line equipment, signals and fencing on the outer track of the Project would introduce urban and rail infrastructure features to the newly restored adjacent landscape. There are direct impacts on a small area of the LCA where the Project is on the embankment that passes through the plantation woodland, introducing track bed, overhead line equipment and train movements to the highest areas on the valley slope. These changes would continue on the embankment in the adjacent LCA, where the grassland land cover would allow the project, particularly train movements, to influence the surrounding landscape. The LCA's valley topography would limit the influence of the project on the LCA, however the project features contrast with the infrastructure within the LCA and would be a substantial change to the character of the adjacent landscape. Mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would provide a buffer between the LCA and the operational scheme but would not be sufficiently established within its first three years to screen the Project. Due to the introduction of rail infrastructure up the valley slope and the contrast with its otherwise wooded character and limited development beyond the valley floor, the magnitude of change would therefore be Medium (Adverse) for this	Medium	**Year 1** Medium (Adverse) **Year 15** Low (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Minor (Adverse)

	Medium sensitivity receptor. The significance of effect would be Moderate (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would reinstate the wooded valley character on the southern side of the Swansea valley. The planting would provide screening of rail infrastructure and passing trains reducing the perceptibility of the Project from the rest of the LCA. The magnitude of change would therefore reduce to Low (Adverse). The significance of effect would be Minor (Adverse).			
Y Mynydd Du LCA	The LCA is susceptible to indirect changes that would affect its sense of peace and tranquillity, which are; recognised special qualities of the national park; identified within the aims and objectives of *A Management Plan for the Brecon Beacons National Park 2015-2020*[6]; and recognised within both the national park's landscape character assessment and within LANDMAP. The LCA is also susceptible to the introduction of incongruous features into the contextual landscape. The susceptibility to change is therefore Medium. **Year 1** There are no direct impacts to the LCA. The operational scheme would introduce urban features into a recently restored landscape which forms part of the LCA's contextual landscape. These features include the fencing, signals and overhead line equipment on the outer rail track which would affect the southern extent of the LCA.	High	**Year 1** Medium (Adverse) **Year 15** Low (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Minor (Adverse)

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	Passing trains halfway up the valley slope would impact upon the sense of peace and tranquillity at the southern extent of the LCA. It is anticipated that the Project would be perceptible at a greater distance from within the LCA however this would form part of much wider vistas where settlements, road and rail infrastructure also form constituent parts of the surrounding landscape. The magnitude of change would be Medium (Adverse) for this High sensitivity receptor. The significance of effect would therefore be Moderate (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would help the proposed scheme to integrate into the surrounding landscape and would reduce the perceptibility of movement/activity within the contextual landscape. Planting implemented as part of the Nant Helen Complementary Restoration Earthworks would re-establish the wooded valley side that forms part of the contextual landscape. Woodland planting at the western extent of the Project would screen rail infrastructure and passing trains and would integrate the Project through its connection with surrounding mature woodland. Due to the reduced perceptibility of the Project and the reinstatement of character within the LCAs wider surrounding landscape, the magnitude of change would reduce to Low (Adverse). The significance of effect would be Minor (Adverse).			

A3 Assessment Table – Effects from Construction (Visual)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
1 - View from Ystradgynlais Bridleway 61	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography. Construction activity would be visible within 3.5km of the viewpoint. Receptors would have views of construction works on the northern embankment and the shallow cuttings at the western edge of the Project. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of a vehicle maintenance access route alongside the track. Construction works would be confined to the engineered landforms implemented as part of the Nant Helen Complementary Restoration Earthworks. Broadleaf woodland planting implemented as part of the Nant Helen Complementary Restoration earthworks would provide some filtering of works at grade on the northern embankment. Due to the introduction of construction activity across an open upland landscape across which restored features from the Nant Helen restoration works, such as vegetation would not yet have established, the magnitude of change would be Medium (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Moderate (Adverse).	High	Medium (Adverse)	Moderate (Adverse)
2 - View from Ystradgynlais Footpath 64	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography.	High	Medium (Adverse)	Moderate (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	Construction activity would be visible within 1.7km of the viewpoint. Receptors would have views of construction works on the northern embankment of the Project. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of vehicle access route alongside the track. Construction works would be confined to the engineered landforms implemented as part of the Nant Helen Complementary Restoration Earthworks. Broadleaf woodland implemented as part of the Nant Helen Complementary Restoration earthworks would provide some filtering of works that are at grade with the embankment. However, due to the elevated position of the viewpoint, the majority of the works including construction vehicles and erection of infrastructure elements would remain visible. Due to the construction works visible across a wide section of the view and the perceived disturbance within restored areas of the view the magnitude of change would be Medium (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Moderate (Adverse).			
3 - View from Trig point on Cribarth	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography. Construction activity would be visible within 2km of the viewpoint. Receptors would have views of construction works on the northern embankment as well as some works visible on the cutting at the eastern edge of the Project. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of	High	High (Adverse)	Major (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	signals, fencing and acoustic barriers; and construction of vehicle access route alongside the track. Works would also be visible, further into the distance at the location of the washery and would include demolition of existing sheds and construction of; sidings for up to 400 vehicles; multi-storey control building; research and development centre; and maintenance/storage shed for rolling stock. Receptors views would be dominated by the construction works associated with the outer rail track on the northern embankment. The establishing planting on the northern embankment implemented as part of the Nant Helen Complementary Restoration Earthworks would not filter views of construction due to the receptors' elevated position above the Project. The works at the washery would take place within a less prominent area of the view and where activity is already a feature of the view. Although 2km from the viewpoint, construction works would be taking place within a prominent, open upland area within the view. Works would be incongruous with the restored landscape and a large proportion of the Project would be visible, the magnitude of change would therefore be High (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Major (Adverse).			
4 - View from Ogof Ffynnon Ddu NNR	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography. Construction activity would be visible within 4km of the viewpoint. Receptors would have views of construction works on the northern embankment as well as some works visible on the cutting at the eastern edge of the Project. It is also anticipated that some	High	Medium (Adverse)	Moderate (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	works may be perceptible on the inner track in deep cutting. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of vehicle access route alongside the track. The majority of works taking place at the location of the washery would be screened by the topography in the middle ground but demolition of existing sheds and construction of taller structures including the multi-storey control building or works at the eastern edge of the washery would be perceptible. Mitigation broadleaf woodland planting on the northern embankment implemented as part of the Nant Helen Complementary Restoration Earthworks would provide partial visual filtering of works at grade with the top of the embankment. Construction vehicles and taller features such as fencing, overhead line equipment and signals would remain visible throughout the construction period. Due to the construction works taking place on a prominent landform in the direction of the longer distance views, the magnitude of change would be Medium (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Moderate (Adverse).			
5 - View from western edge Ynyswen	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. Construction activity would be visible within 1km of the viewpoint. Receptors would have views of construction works on the northern embankment. These works would include; the laying of track bed and rail track; erection of overhead line equipment;	High	High (Adverse)	Major (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	erection of signals, fencing and acoustic barriers; and construction of a vehicle access route alongside the track. Mitigation broadleaf woodland planting on the northern embankment implemented as part of the Nant Helen Complementary Restoration Earthworks would partially filter views of construction activity due to receptors viewing the Project from lower ground. It is anticipated that construction vehicles and overhead line equipment would be clearly visible above intervening mitigation vegetation across the embankment. Due to the works being visible across the view above existing mature and establishing vegetation and the introduction of activity into an otherwise rural backdrop the magnitude of change would be High (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Major (Adverse).			
6 - View from Tanygarth, Abercraf	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. Construction activity would be visible within 1km of the viewpoint. Receptors would have views of the construction works on the northern embankment and cuttings at the north-western edge of the Project. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of the vehicle maintenance access route alongside the track. Mitigation broadleaf woodland planting on the northern embankment implemented as part of the Nant Helen Complementary Restoration Earthworks would partially filter views of construction activity to the east that would be visible between property roof	Medium	Low (Adverse)	Minor (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	tops. It is anticipated that the erection of overhead line equipment and the movement from construction vehicles would still be visible. To the south-east, existing mature coniferous plantation woodland would provide screening of construction on the embankment through the woodland, it is anticipated that works in cutting across the open acid grassland would be largely screened though still perceptible. Due to the filtering and partial screening provided by Nant Helen Complementary Restoration Earthworks mitigation planting, existing mature vegetation and the works occurring in cutting, the magnitude of change would be Low (Adverse) for these Medium sensitivity receptors. The significance of effect would therefore be Minor (Adverse).			
7 - View from Pen-Rhiwfawr	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. Construction activity would be visible within 7km of the viewpoint. Receptors would have views of the construction works on the shallow cutting at the western edge of the Project. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of vehicle access route alongside the track. These works would be visible across a small proportion of the wide view. The works would also be taking place at a great distance from the receptors and would not break the skyline. It is anticipated that the movement, scale and colour of construction plant would likely draw attention to the works.	High	Negligible (Adverse)	Minor (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	Due to the distance and relatively small section of the view affected the magnitude of change would be Negligible (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Minor (Adverse).			
8 - View from Ystradgnlais Footpath 4	Recreational receptors have a High susceptibility as their attention is concentrated on surrounding views. Construction activity would be visible within 3.1km of the viewpoint. Receptors would have views of the construction works on the shallow cutting at the western edge of the Project. It is anticipated that works on the northern embankment would also be perceptible. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of vehicle maintenance access route alongside the track. Construction works would extend urban activity and features into the open, upland hillside above the woodland, adding to the existing development in the view. The magnitude of change would be Medium (Adverse) for these Medium sensitivity receptors. The significance of effect would therefore be Moderate (Adverse).	Medium	Medium (Adverse)	Moderate (Adverse)
9 - View from NCNR 43	Recreational receptors have a High susceptibility to change as their attention is concentrated on surrounding views.	Medium	Medium (Adverse)	Moderate (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	Receptors would have close range views of the construction work on the northern embankment. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of a vehicle maintenance access route alongside the track. Mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would partially filter the construction works at ground level on the top of the embankment, however due to the close proximity of works it is anticipated that the majority of works would be clearly visible. The introduction of construction activity at close range above the viewpoint into a view that comprises engineered landform, but no urban features or activity would result in a Medium (Adverse) magnitude of change for these Medium sensitivity receptors. The significance of effect would therefore be Moderate (Adverse).			
10 - View from Station Road, Coelbren	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. Construction would be visible within 600m of the viewpoint. To the south, works would be visible at the location of the washery, including demolition of existing buildings/equipment and the construction of; sidings for up to 400 vehicles; multi-storey control building; research and development centre; and maintenance/storage sheds for rolling stock. It is anticipated that cranes used for construction and the taller buildings would be visible at this location above intervening vegetation within field boundaries and alongside the A4221 within the middle ground.	Medium	Medium (Adverse)	Moderate (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	To the west, receptors would have views of construction on the shallow outer track cuttings at the eastern extent of the Project. It is also anticipated that construction works within the deeper cuttings of the inner track would be perceptible. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of vehicle maintenance access route alongside the track. These works would be visible just above mature vegetation and below the horizon. Due to the increased large-scale activity at the washery, in close proximity to receptors, and the introduction of activity and urban elements on the grassed cuttings to the west, the magnitude of change would be Medium (Adverse) for these Medium sensitivity receptors. The significance of effect would therefore be Moderate (Adverse).			
11 - View from Tawe-Uchaf Footpath 5	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography. Construction activity would be visible within 1.7km of the viewpoint. Receptors would have views of construction on the shallow outer track cuttings at the eastern extent of the Project. It is also anticipated that construction works within the deeper cuttings of the inner track would be perceptible. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of vehicle maintenance access route alongside the track. Further construction works would be visible at the location of the washery and would include demolition of existing buildings/equipment and the construction of; sidings for up to 400 vehicles; multi-storey control building; research and development centre; and	High	Low (Adverse)	Minor (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	maintenance/storage sheds for rolling stock. These works would be visible within the middle ground below the A4109 to the south-west. Construction activity would be visible within grassed cuttings as well as construction at the washery which would extend further east than existing buildings/equipment at its location. These areas form a relatively small part of wider views which contain existing urban features including pylons, settlements and wind turbines. The magnitude of change would be Low (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Minor (Adverse).			
12 - View from Ystradfellte Byway 74	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography. Construction would be visible within 1.8km of the viewpoint. Receptors would have views of construction on the shallow outer track cuttings at the eastern extent of the Project. It is also anticipated that construction works within the deeper cuttings of the inner track would be perceptible. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of vehicle maintenance access route alongside the track. Further works at the location of the washery would be visible including the demolition of existing buildings/equipment and construction of; sidings for up to 400 vehicles; multi-storey control building; research and development centre; and maintenance/storage sheds for rolling stock. Due to the lack of vegetation north-east of the washery site these works will be clearly visible, whilst works closer to Onllwyn will be screened by topography.	High	Medium (Adverse)	Moderate (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	Due to the lack of intervening vegetation and therefore the clear visibility of construction works at the washery and on earthworks to the west, the magnitude of change would be Medium (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Moderate (Adverse).			
13 - View from School Road, Ystalyfera	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. Construction activity would be visible within 5.5km of the viewpoint. Receptors would have views of the construction works on the northern embankment and shallow cuttings at the north-western extent of the Project. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of a vehicle maintenance access route alongside the track. It is anticipated that existing conifer plantation and the mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would provide some filtering of works on the northern embankment. Works on the shallow cutting at the western edge of the Project would be visible due to a lack of intervening vegetation and the elevated position. Due to the construction works being below the horizon and forming only a small part of the view with movement and urban features characteristic of the foreground and middle ground, the magnitude of change would be Low (Adverse) for these Medium sensitivity receptors. The significance of effect would therefore be Minor (Adverse).	Medium	Low (Adverse)	Minor (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
14 - View from Ystradgynlais Footpath 10	Recreational receptors have a High susceptibility as their attention is concentrated on surrounding views. Construction activity would be visible within 400m of the viewpoint. Receptors would have views of construction works on the shallow cuttings at the western edge of the Project as well works on the slight embankment and cutting earthworks running parallel to the pylons to the east. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of a vehicle maintenance access route alongside the track. Views of construction works at the location of the washery would also be available, beyond the existing pylons and power lines. These works would be difficult to distinguish, due to distance and construction works within the foreground and middle ground but would include demolition of existing sheds and construction of; sidings for up to 400 vehicles; multi-storey control building; research and development centre; and maintenance/storage sheds for rolling stock. The view includes existing urban features such as pylons, wind turbines, settlements and road infrastructure in the middle to long distance to the east However, the construction works within a restored upland landscape would be incongruous. Expansive long-distance view to the north-west would be retained and therefore the magnitude of change would be Medium (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Moderate (Adverse).	High	Medium (Adverse)	Moderate (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
15 - View from Tawe-Uchaf Footpath 49	Viewpoint 15 was included as part of the Nant Helen Complementary Restoration Earthworks LVIA. It is assumed that public access to this footpath/viewpoint would not be provided and it has therefore not been included in this assessment.	N/A	N/A	N/A
16 - View from properties on A4109	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. Construction would be visible within 500m of the viewpoint. Receptors would have direct views of construction on the outer rail track embankment and shallow cutting at the southern edge of the Project. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of a vehicle maintenance access route alongside the track. There would be large-scale construction activity within the open, elevated landscape in the view, however there are existing urban features within the foreground and middle ground including; the Neath and Brecon Railway; street lighting; pylons; and engineered landforms (Nant Helen Complementary Restoration Earthworks). The magnitude of change would therefore be Medium (Adverse) for these Medium sensitivity receptors. The significance of effect would therefore be Moderate (Adverse).	Medium	Medium (Adverse)	Moderate (Adverse)
17 - View from Onllwyn Cemetery	Visitors to the cemetery have a High susceptibility to change. Construction activity would be visible within 250m of the viewpoint. Receptors would have views of construction works on the embankment and shallow cutting to the west beyond the existing pylons. It is anticipated that works on the inner rail track cutting	Medium	Low (Adverse)	Minor (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	would be perceptible to the north-west though filtered by existing vegetation alongside the A4109. Works on the earthworks implemented as part of the Nant Helen Complementary Restoration Earthworks would include the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of a vehicle maintenance access route alongside the track. Due to the works being visible within the context of existing urban features such as the main road and pylons, the magnitude of change would be Low (Adverse) for these Medium sensitivity receptors. The significance of effect would therefore be Minor (Adverse).			
18 - View from Sarn Helen Roman Road	Recreational receptors have a High susceptibility as their attention is concentrated on surrounding views. Construction would be visible within 2.7km of the viewpoint. Due to the elevation of the viewpoint, receptors would have views of the construction works on the cutting and embankment that form the southern extent of the outer rail track. Works would also be perceptible within the deeper cuttings that form the inner rail track. These works would include; the laying of track bed and rail track; erection of overhead line equipment; erection of signals, fencing and acoustic barriers; and construction of vehicle maintenance access route alongside the track. At the intersection of the rail tracks and the connecting branch line to the Neath and Brecon Railway, works would also include the construction of rail platforms and a station building.	High	Medium (Adverse)	Moderate (Adverse)

Viewpoint No.	Assessment	Sensitivity	Magnitude of Change	Significance of Effect
	Construction of rail infrastructure across a small section of the branch line which follows the existing vehicular access between the coal washery, and the central site compound would be visible. To the north, construction works at the washery site would be perceptible, including the demolition of existing buildings/equipment and construction of; sidings for up to 400 vehicles; multi-storey control centre building; research and development centre; and maintenance/storage sheds for rolling stock. It is anticipated that cranes and construction of taller elements including the multi-storey control building would be more clearly visible in this area, above the topography. Due to the elevated view down onto construction works across a wide section of the available view, the magnitude of change would be Medium (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Moderate (Adverse).			

A4 Assessment Table – Effects from Operation (Visual)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
1 - View from Ystradgynlais Bridleway 61	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography. **Year 1** The Project would be visible within 2km of the viewpoint. Receptors would have views of rail infrastructure on the northern embankment and shallow cuttings at the western edge of the Project. This would include; overhead line equipment; signals, fencing and acoustic barriers. When in use, passing trains would highlight the location of the track and introduce fast movement into a rural upland landscape view. Infrequent maintenance vehicle operations will also be visible alongside the track. Broadleaf woodland implemented as part of the Nant Helen Complementary Restoration earthworks would be perceptible but would only provide minimal filtering of rail infrastructure and train movements at grade with the embankment due to its size. The Project will be visible across a small section of the view. However, due to the introduction of urbanising features into a prominent, open upland landscape and the introduction of fast movement into an otherwise rural view, the magnitude of change would be Medium (Adverse) for these High	High	**Year 1** Medium (Adverse) **Year 15** Low (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	sensitivity receptors. The significance of effect would therefore be Moderate (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would provide a greater level of filtering of train movements and overhead line equipment and visually integrate the Project with existing surrounding woodland on the valley slopes. It is anticipated that mitigation planting on the western extent of the Project outside the outer rail track would provide screening of passing trains. Overhead line equipment may remain visible above the tree canopies due to the location of planting away from the cutting edge down the hillside. The additional screening provided by mitigation planting implemented as part of the Project and the Nant Helen Complementary Restoration Earthworks would reduce the overall perceptibility of the Project and restore the overall character of the view. Whilst some woodland will be visible further up the side of Mynydd y Drum contrasting with the open upland landscape, woodland will tie in with existing coniferous plantation and the change will only affect a small proportion of the overall view. The magnitude of change will therefore be Low (Adverse). The significance of effect would be Minor (Adverse).			

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
2 - View from Ystradgynlais Footpath 64	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography. **Year 1** Receptors would have elevated views onto rail infrastructure on the northern embankment of the Project. This would include; overhead line equipment; signals, fencing and acoustic barriers. During operation, fast train movement would be introduced into the open landscape across the view. The scale and linearity of the infrastructure would contrast with the winding A4221. Broadleaf woodland implemented as part of the Nant Helen Complementary Restoration earthworks would be perceptible but would only provide minimal filtering of infrastructure elements and trains at grade with the embankment. Due to the elevated position of the viewpoint, fast train movement would be visible above acoustic fencing and change the rural character of the view. Infrequent maintenance vehicle operations would also be visible alongside the track. Due to the introduction of urbanising features into a rural open landscape view and visibility of features across a wide section of the view, the magnitude of change would be High (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Major (Adverse). **Year 15 – (with established mitigation planting)**	High	**Year 1** High (Adverse) **Year 15** Medium (Adverse)	**Year 1** Major (Adverse) **Year 15** Moderate (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	Established mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would provide screening of acoustic barriers and train movements on the northern embankment. It is anticipated that overhead line equipment would remain visible above tree canopies but would be difficult to distinguish as they do not break the horizon. Mitigation planting at the western extent of the Project would integrate with existing coniferous plantation, it is however anticipated that glimpsed views would be available of passing trains as they transition from embankment to cutting. Due to the reduced visibility of rail infrastructure and integration of mitigation planting with surrounding woodland cover the magnitude of change would reduce to Medium (Adverse). The significance of effect would be Moderate (Adverse).			
3 - View from Trig point on Cribarth	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography. **Year 1** Receptors would have elevated views of rail infrastructure on the northern embankment as well as some taller features visible on the cutting at the eastern edge of the Project. This would include; overhead line equipment; signals, fencing and acoustic barriers. The view would be dominated by rail infrastructure on the outer rail track on the northern embankment. The planting on the northern embankment implemented as part of the Nant Helen Complementary Restoration	High	**Year 1** High (Adverse) **Year 15** Medium (Adverse)	**Year 1** Major (Adverse) **Year 15** Moderate (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	Earthworks would not provide any filtering of views of infrastructure features or passing trains due to the receptors elevated position above the Project. Facilities at the location of the washery would also be visible including; sidings for up to 400 vehicles; multi-storey control building; research and development centre; and maintenance/storage shed for rolling stock. The visibility of these features would not result in a substantial change to the character of the view as they would be located on the site of existing development however the scale of the facilities would contrast with nearby small-scale settlements. Due to the prominence and close proximity of the Project which would be visible across the restored upland landscape and would contrast with the rural charter of the view, the magnitude of change would be High (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Major (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would provide partial screening of the rail infrastructure and passing trains on the northern embankment. It is anticipated that overhead line equipment would remain visible above canopies due to the elevated position of the receptor looking down onto the Project. Mitigation planting at the eastern extent of the Project between the inner and outer rail track and would provide partial screening of trains as they transition			

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	between the northern embankment and the cuttings at the eastern extent of the Project. It is anticipated that glimpsed views of trains would remain visible. Mitigation planting would provide screening of trains across a large proportion of the view and would integrate the scheme with the adjacent wooded valley. Due to the elevated position of the receptor and the close proximity of the Project rail infrastructure would remain visible above tree canopies. The magnitude of change would therefore reduce to Medium (Adverse). The significance of effect would remain Moderate (Adverse).			
4 - View from Ogof Ffynnon Ddu NNR	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography. **Year 1** Receptors would have views of rail infrastructure on the northern embankment as well as some taller features on the cutting at the eastern edge of the Project and the deeper cutting that forms the inner rail track. This would include; overhead line equipment; signals, fencing and acoustic barriers. The majority of facilities at the location of the washery would be screened by the topography. It is anticipated that the increased scale of operations at this location would be perceptible and some taller structures such as the multi-storey control building or buildings/sheds at the eastern edge of the washery would be visible.	High	**Year 1** High (Adverse) **Year 15** Low (Adverse)	**Year 1** Major (Adverse) **Year 15** Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	Mitigation planting on the northern embankment implemented as part of the Nant Helen Complementary Restoration Earthworks would provide partial filtering of infrastructure features at grade with the top of the embankment. Taller features such as overhead line equipment, signals, fencing and passing trains and maintenance vehicles would all remain visible across this section. Due to the introduction of urbanising rail infrastructure to a rural landscape and prominent landform that dominates the middle ground of the view, the magnitude of change would be High (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Major (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would provide screening of passing trains on the northern embankment. It is anticipated that overhead line equipment would remain visible above the tree canopies but would be difficult to distinguish as they would not break the horizon and due to the distance of the receptor from the Project. Tree planting would visually integrate with surrounding wooded landcover on the valley slopes. Tree planting alongside the buildings at the coal washery would not screen any of the buildings but would provide a soft buffer and help integrate the structures within the surrounding landscape. Due to the screening provided by mitigation planting and therefore the reduced perceptibility of the Project within the view, the magnitude of change			

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	would reduce to Low (Adverse). The significance of effect would be Minor (Adverse).			
5 - View from western edge Ynyswen	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. **Year 1** Receptors would have views of rail infrastructure on the northern embankment. This would include; overhead line equipment; signals, fencing and acoustic barriers. Mitigation planting on the northern embankment implemented as part of the Nant Helen Complementary Restoration Earthworks would partially filter views of infrastructure elements (at grade with the top of the embankment) due to the lower elevation of the viewpoint. It is anticipated that taller features such as overhead line equipment, signals and passing trains and maintenance vehicles would remain visible. Due to the rail infrastructure being visible across the full width of the view across the hillside, and the introduction of movement and urbanising features to a rural view, the magnitude of change would be High (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Major (Adverse). **Year 15 – (with established mitigation planting)**	High	**Year 1** High (Adverse) **Year 15** Low (Adverse)	**Year 1** Major (Adverse) **Year 15** Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	Established mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would provide screening of train movements across the northern embankment and would visually integrate with existing woodland on the lower hillside slopes. It is anticipated that the viewing position of receptors on lower ground would increase the effectiveness of planting as a visual screen. Overhead line equipment would remain visible above the tree canopies but would not break the horizon. There would be reduced visibility of trains and associated infrastructure across the view and woodland would be sufficiently established to visually integrate with mature woodland on the hillside. It is anticipated that the Project would remain perceptible due to overhead line equipment. The magnitude of change would therefore reduce to Low (Adverse). The significance of effect would be Minor (adverse).			
6 - View from Tanygarth, Abercraf	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. **Year 1** Receptors would have views of rail infrastructure on the northern embankment and the cutting at the north-western edge of the Project. This would include; overhead line equipment; signals, fencing and acoustic barriers. Mitigation planting on the northern embankment implemented as part of the Nant Helen Complementary Restoration Earthworks would be perceptible but would only filter rail infrastructure features at grade with the top of the	Medium	**Year 1** Medium (Adverse) **Year 15** Low (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	embankment. Fast moving trains would be visible between property roof tops to the east. To the south, existing mature coniferous plantation would provide screening of rail infrastructure and passing trains on embankment through the woodland. The Project would emerge above the woodland in shallow cutting and rail infrastructure and fast-moving trains would be visible across a short section of the view. The Project will introduce urbanising features across the middle ground of the view, between the rooftops and the horizon. Existing mature coniferous woodland would screen the scheme across a large portion of the view, leaving rail infrastructure and trains visible across short sections of the view to the south and south-east. The magnitude of change will be Medium (Adverse) for these Medium sensitivity receptors. The significance of effect would therefore be Moderate (Adverse) **Year 15 – (with established mitigation planting)** Established mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would provide screening of passing trains along the northern embankment. It is anticipated that woodland at the western edge of the Project would screen trains as they transition between the northern embankment and cuttings at the western extent of the Project. Overhead line equipment would remain visible above the tree canopies across a short section of the view.			

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	Due to the reduced visibility of the Project, and the screening of fast movement from the backdrop of the view, the magnitude of change would reduce to Low (Adverse). The significance of effect would be Minor (Adverse).			
7 - View from Pen-Rhiwfawr	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. **Year 1** Rail infrastructure on the shallow cutting at the western edge of the Project would be perceptible to receptors. This would include; overhead line equipment; signals, fencing and acoustic barriers. Passing trains would introduce movement across an open, rural upland landscape and highlight other Project features. The project would introduce incongruous urbanising features across the hillside of Mynydd y Drum but would constitute a small proportion of much wider views. Built project features would be perceptible, however, train movements would result in noticeable change to the rural character of the view. The magnitude of change would be Medium (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Moderate (Adverse) **Year 15 – (with established mitigation planting)**	High	**Year 1** Medium (Adverse) **Year 15** Low (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	Mitigation planting to the west of the outer rail track would provide screening of passing trains on the shallow cuttings. It is anticipated that overhead line equipment would remain visible above tree canopies but would not be clearly distinguishable due to the distance of the receptor from the Project. Due to the screening of fast movement from the long-distance view, the magnitude of change would reduce to Low (Adverse). The significance of effect would be Minor (Adverse).			
8 - View from Ystradgnlais Footpath 4	Recreational receptors have a High susceptibility as their attention is concentrated on surrounding views. **Year 1** Receptors would have views of rail infrastructure on the shallow cutting at the western edge of the Project. It is anticipated that a small section of the rail infrastructure on the northern embankment would also be perceptible. This would include; overhead line equipment; signals, fencing and acoustic barriers. The Project would introduce fast-moving trains and visible urbanising features on the hillside, separated by mature woodland from settlements in the valley. This would affect the composition of the view by increasing the proportion of development within the valley. Rail infrastructure would be clearly visible, contrasting with the landscape of ponds and marshy grassland to the west of the Project. Despite existing settlement being a feature of the view, due to the elevation and perceived	Medium	**Year 1** Medium (Adverse) **Year 15** Low (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	increase of developed areas within the valley, the magnitude of change would be Medium (Adverse) for these Medium sensitivity receptors. The significance of effect would therefore be Moderate (Adverse). **Year 15 – (with established mitigation planting)** Mitigation planting on the hillside of Mynydd y Drum on the western side of the outer rail track, would provide screening of passing trains. It is anticipated that overhead line equipment would remain visible above tree canopies but would not break the horizon and would therefore be difficult to distinguish. Due to the reduced perceptibility of the Project and therefore development within the valley, the magnitude of change would reduce to Low (Adverse). The significance of effect would be Minor (Adverse).			
9 - View from NCNR 43	Recreational receptors have a High susceptibility to change as their attention is concentrated on surrounding views. **Year 1** Mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would provide a filter between receptors travelling along the cycle route and the rail infrastructure. Receptors would have filtered views of the rail infrastructure on the northern embankment. This would include; overhead line equipment; signals, fencing and acoustic barriers and fast-moving trains.	Medium	**Year 1** Medium (Adverse) **Year 15** Medium (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Moderate (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	The introduction of rail infrastructure, close to receptors would result in a less tranquil experience for receptors using the cycle route who would have transient views of the Project. The magnitude of change would be Medium (Adverse) for these Medium sensitivity receptors. The significance of effect would therefore be Moderate (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting implemented as part of the Nant Helen Complementary Restoration Earthworks would screen rail infrastructure across the northern embankment and would alter the receptors experience from a corridor with woodland belts and glimpsed views out to a cycle route which would become a densely wooded enclosed corridor with limited views outwards. Due to the close proximity of the railway, passing trains would remain perceptible and would intermittently affect the sense of tranquillity experienced by cycle route users. The magnitude of change would therefore remain Medium (Adverse). The significance of effect would be Moderate (Adverse).			
10 - View from Station Road, Coelbren	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. **Year 1** Receptors would have views of rail infrastructure on the shallow outer track cutting at the north-eastern extent of the Project. It is also anticipated that	Medium	**Year 1** Medium (Adverse) **Year 15**	**Year 1** Moderate (Adverse) **Year 15**

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	taller features within some areas of the deeper cuttings of the inner track would be perceptible. These features would include; overhead line equipment; signals, fencing and acoustic barriers; and moving trains. The majority of cuttings are deep enough to completely screen rail infrastructure and therefore these would be visible across short sections of the view. To the south, facilities at the location of the washery, including; sidings for up to 400 vehicles; multi-storey control building; research and development centre; and maintenance/storage sheds for rolling stock would be visible and would result in an increased scale of development beyond the intervening vegetation along the A4221 and within middle-ground field boundaries. Due to the increased amount and size of buildings at the washery, in close proximity to receptors, and the introduction of urbanising features to a restored area of the landscape to the west, the magnitude of change would be Medium (Adverse) for these Medium sensitivity receptors. The significance of effect would therefore be Moderate (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting on the eastern side of the outer rail track would provide screening of trains and rail infrastructure features within the shallowest parts of the cuttings to the west. To the south, tree planting alongside the multi-storey control building; research and development centre; and maintenance/storage sheds for rolling stock would not screen the buildings but would provide soft buffer to lessen the visual intrusion of the structures.		Low (Adverse)	Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	Due to the screening of the Project to the west and the reduced perceptibility of buildings at the washery site the magnitude of change would reduce to Low (Adverse). The significance of effect would be reduced to Minor (Adverse).			
11 - View from Tawe-Uchaf Footpath 5	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography. **Year 1** Receptors would have views of taller rail infrastructure features within the shallowest areas of inner track cuttings. This would include; overhead line equipment; signals, fencing and acoustic barriers; and moving trains. Trains travelling at high speeds would contribute to the receptors' awareness of the Project within a restored area of the view. Facilities associated with the Project rail infrastructure including; sidings for up to 400 vehicles; multi-storey control building; research and development centre; and maintenance/storage sheds for rolling stock would be visible to the south at the location of the washery. The western half of the site would be screened by intervening vegetation and topography however, the introduction of buildings further east would result in increased scale of development within the view. Rail infrastructure features and moving trains will only be visible across short sections of the view to the west however, due to the increased scale of development and visibility of sidings and buildings at the washery the	High	**Year 1** Medium (Adverse) **Year 15** Low (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	magnitude of change would be Medium (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Moderate (Adverse). **Year 15 – (with established mitigation planting)** Established mitigation planting would screen passing trains and rail infrastructure on the outer rail track and shallow areas of the inner rail track to the west. Buildings at the site of the washery including the multi-storey control building; research and development centre; and maintenance/storage sheds for rolling stock would remain visible however mitigation planting alongside the buildings would provide a soft buffer to the structures. Due to the reduced perceptibility of rail infrastructure to the west and the reduced dominance of buildings at the washery site, the magnitude of change would reduce to Low (Adverse). The significance of effect would be Minor (Adverse).			
12 - View from Ystradfellte Byway 74	Recreational receptors within the national park have a High susceptibility as their attention is concentrated on available views outwards from elevated topography. **Year 1** Receptors would have views of rail infrastructure within the shallowest areas of the inner track cuttings at the eastern extent of the Project. It is anticipated	High	**Year 1** Medium (Adverse) **Year 15** Low (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	that taller features including; overhead line equipment; signals, fencing and acoustic barriers; and fast-moving trains would be visible. It is anticipated that topography would screen the majority of the branch line connecting the outer tracks to the washery. However, the platforms and station building would be visible and indicate the location of rail infrastructure. Facilities associated with the Project rail infrastructure including; sidings for up to 400 vehicles; multi-storey control building; research and development centre; and maintenance/storage sheds for rolling stock would be visible at the location of the washery and would result in an increased scale of development The sidings and buildings would be clearly visible due to the location on a small exposed plateau and a lack of intervening vegetation. The Project would result in an increase in the scale of development at the washery site and would introduce new urbanising features to the view to the west. These changes would contribute to the urbanisation of a view that already comprises development associated with rail infrastructure and urbanising features such as urban settlement and pylons. The magnitude of change would therefore be Medium (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Moderate (Adverse). **Year 15 – (with established mitigation planting)** Mitigation planting outside the outer rail track at the south-eastern extent of the Project would screen rail infrastructure and passing trains on cuttings. Established planting around the platforms and station building would integrate			

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	the structures within the surrounding landscape, it is still anticipated that the station building would remain visible above the tree canopies. Buildings at the washery site including multi-storey control building; research and development centre; and maintenance/storage sheds for rolling stock would remain visible however tree planting alongside the buildings would help the structures to integrate with their vegetated surroundings. Due to the reduced visibility of the Project and integration through mitigation planting the magnitude of change would reduce to Low (Adverse). The significance of effect would be reduced to Minor (Adverse).			
13 - View from School Road, Ystalyfera	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. **Year 1** Receptors would have views of rail infrastructure on the shallow cuttings at the north-western extent of the Project. This would include; overhead line equipment; signals, fencing and acoustic barriers. Passing trains would be clearly visible across the shallow cuttings due to the positioning on a prominent landform (the slopes of Mynydd y Drum) with no intervening vegetation. Due to the introduction of rail infrastructure features and fast train movement which would be incongruous with the restored landscape and rural hillside setting of the view, the magnitude of change would be Medium (Adverse) for	Medium	**Year 1** Medium (Adverse) **Year 15** Low (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	these Medium sensitivity receptors. The significance of effect would therefore be Moderate (Adverse). **Year 15 – (with established mitigation planting)** Mitigation planting on the side of Mynydd y Drum at the western extent of the Project would provide screening of passing trains. It is anticipated that overhead line equipment would remain visible above tree canopies but would not break the horizon and would therefore be difficult to distinguish. Due to the screening of train movement and the reduced perceptibility of the Project the magnitude of change would therefore reduce to Low (Adverse). The significance of effect would be reduced to Minor (Adverse).			
14 - View from Ystradgynlais Footpath 10	Recreational receptors have a High susceptibility as their attention is concentrated on surrounding views. **Year 1** Receptors would have views of rail infrastructure within the shallowest areas of the cuttings at the western edge of the Project as well as elevated views across works on the slight embankment and cuttings running parallel to the pylons to the east. This would include; overhead line equipment; signals, fencing and acoustic barriers. The close proximity of the rail infrastructure features, and fast-moving trains would introduce development and activity to the rural upland view, affecting the perception of the immediate view and views to the Brecon Beacon	High	**Year 1** High (Adverse) **Year 15** High (Adverse)	**Year 1** Major (Adverse) **Year 15** Major (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	National Park to the north. The introduction of rail infrastructure would widen the existing corridor of urban features comprising pylons, urban settlement, and road and rail infrastructure. Facilities associated with the rail testing tracks would be visible beyond the pylons and power lines at the location of the washery. This would include; sidings for up to 400 vehicles; multi-storey control building; research and development centre; and maintenance/storage sheds for rolling stock. The introduction of buildings and sidings would increase the scale of development at the location of the washery, however intervening features including rail infrastructure and existing pylons and the distance of the buildings would make the change difficult to distinguish. The magnitude of change would therefore be High (Adverse) for these High sensitivity receptors. The significance of effect would be Major (Adverse). **Year 15 – (with established mitigation planting)** Mitigation planting at the western extent of the Project would partially screen rail infrastructure and passing trains across shallow cuttings. The scheme would remain visible across embankments and cutting running parallel to the pylons to the east. Due to the close proximity of receptors to the Project and the upland character that offers open views the magnitude of change would remain High (Adverse). The significance of effect would remain Major (Adverse).			

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
15 - View from Tawe-Uchaf Footpath 49	Viewpoint 15 was included as part of the Nant Helen Complementary Restoration Earthworks LVIA. It is assumed that public access to this footpath/viewpoint would not be provided and it has therefore not been included in this assessment.	N/A	N/A	N/A
16 - View from properties on A4109	Residential receptors have a High susceptibility to change due to the permanence and static nature of views. **Year 1** Receptors would have direct views of rail infrastructure on the outer rail track small embankment and shallow cutting at the southern edge of the Project. This would include; overhead line equipment; signals, fencing and acoustic barriers. It is anticipated that taller features would also be visible within the shallowest areas of the cuttings that form the inner rail track. The introduction of rail infrastructure and passing trains would alter the character of the views and widen the infrastructure corridor that currently comprises the A4109, Neath and Brecon Railway and pylons that all span the view. The changes as a result of the Project would introduce urban features and fast movement into an open restored area of the landscape that forms the backdrop to foreground views of the A4109. The magnitude of change would be Medium (Adverse) for these Medium sensitivity receptors. The significance of effect would therefore remain Moderate (Adverse).	Medium	**Year 1** Medium (Adverse) **Year 15** Low (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	Year 15 – (with established mitigation planting) Belts of woodland planting to the south of the outer rail track would screen the majority of the rail infrastructure. It is anticipated that overhead line equipment (approx. 9m tall) would remain visible above the tree canopies. Train movement would be screened across the view. The reduced visibility of the scheme would result in the restoration of the backdrop to the view as a restored landscape with some urban detractors. The mitigation planting would be slightly incongruous with the open upland landscape but would integrate with existing plantation woodland at a similar elevation. Dues to the reduced visibility of the Project the magnitude of change would reduce to Low (Adverse). The significance of effect would reduce to Minor (Adverse).			
17 - View from Onllwyn Cemetery	Visitors to the cemetery have a High susceptibility to change. **Year 1** Receptors would have views of rail infrastructure on the embankment and shallow cutting to the west beyond the existing pylons. It is anticipated that rail infrastructure in the shallowest areas of the inner rail track cutting would be perceptible to the north-west though filtered by existing vegetation alongside the A4109. This would include; overhead line equipment; signals, fencing and acoustic barriers.	Medium	**Year 1** Low (Adverse) **Year 15** Negligible (Adverse)	**Year 1** Minor (Adverse) **Year 15** Negligible (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	Filtered views of 230m single-face platforms and an associated station building would be available beyond the vegetation alongside the A4109. Passing trains would also be clearly visible across the embankment and shallow cuttings in addition to the existing movement from traffic on the A4109. The existing view includes urbanising features such as pylons and street lighting along the main road. Due to the dominance of these features in the existing view, and the screening provided by roadside vegetation, the magnitude of change would therefore be Low (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Minor (Adverse). **Year 15 – (with established mitigation planting)** It is anticipated that overhead line equipment would remain visible above the established belts of woodland planting to the south of the outer rail track. Glimpsed views of fast train movements would remain available across a small proportion of the view towards the restored overburden mound. Woodland planting surrounding the platforms and associated station building beyond the A4109 would help to integrate the structures with the surrounding landscape and provide additional filtering of views in combination with the A4109 roadside vegetation. The increased woodland would result in change to the view but would provide screening of the majority of the Project. Due to the reduced visibility of the Project across the view, the magnitude of change would reduce to Negligible			

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	(Adverse) for these High sensitivity receptors. The significance of effect would be Negligible (Adverse).			
18 - View from Sarn Helen Roman Road	Recreational receptors have a High susceptibility as their attention is concentrated on surrounding views. **Year 1** Receptors would have views of rail platforms and associated station building at the intersection of the rail tracks and the connecting branch line to the Neath and Brecon Railway. The branch line connecting to the Neath and Brecon Railway would be visible across a small section before being screened by topography. Due to the elevation of the viewpoint, receptors would also have views of the rail infrastructure on the cutting and embankment that form the southern extent of the outer rail track. Taller rail features would also be perceptible within the shallowest areas of the inner rail track cuttings. This would include; overhead line equipment; signals, fencing and acoustic barriers. To the north it is anticipated that facilities at the location of the washery would be perceptible. This would include; sidings for up to 400 vehicles; multi-storey control building; research and development centre; and maintenance/storage sheds for rolling stock. It is anticipated that the taller structures would be visible and the increased number of units at this location would increase the scale of the development in the view.	High	**Year 1** Medium (Adverse) **Year 15** Low (Adverse)	**Year 1** Moderate (Adverse) **Year 15** Minor (Adverse)

Viewpoint No.	Comments	Sensitivity	Magnitude of Change	Significance of Effect
	Passing trains would be clearly visible across the earthworks implemented as part of the Nant Helen Complementary Restoration Earthworks and would add movement across a wide section of the view. The project would introduce transport infrastructure and urbanising features across an open restored landscape in an elevated view, the Project would not break the horizon and long-distance open views would be retained, the magnitude of change would therefore be Medium (Adverse) for these High sensitivity receptors. The significance of effect would therefore be Moderate (Adverse). **Year 15 – (with established mitigation planting)** Mitigation planting to the south of the outer rail track and planting alongside the branch line earthworks would provide screening of passing trains across a large proportion of the view. It is anticipated that overhead line equipment would remain visible above the tree canopies. There would be no change to the visibility of facilities at the location of the washery. Due to the reduced visibility of train movement across a large portion of the view and the integration of platforms and station building due to established woodland the magnitude of change would reduce to Low (Adverse). The significance of effect would be Minor (Adverse).			

Appendix 10A

Noise Survey and Baseline

Contents

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A1 Introduction

An environmental noise survey has been undertaken to determine the existing noise climate in and around the site. This appendix details the baseline noise survey and results.

A1.1 Noise survey receptor locations

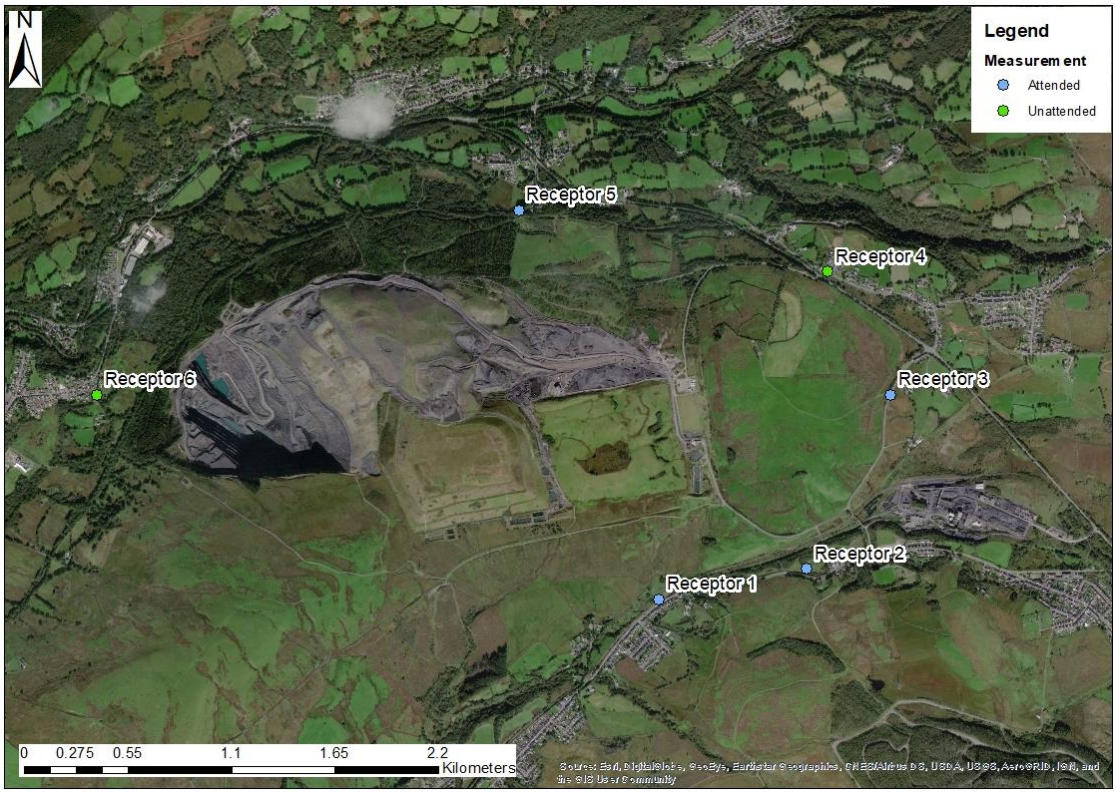


Figure 1: Noise survey locations

A1.2 Instrumentation

The sound level meters and microphones are Class 1 conforming to BS EN 61672-1:2013. All equipment is calibrated annually according to international standards, together with traceable records. Calibration certificates can be provided upon request. Onsite calibration checks were conducted and no drift in noise levels recorded. The monitoring equipment used is described in Table 1.

Table 1: Noise survey instrumentation

Description	Serial Number	Item Type
NOR 140 SLM Kit A (AAcW)	1403425	SLM
NOR Microphone 1225 (Nor 140 Kit A)	98510	Microphones
NOR Preamp 1209 (Nor 140 Kit A)	12578	Miscellaneous
Nor 1251 Calibrator	33849	Calibrator

A1.3 Measurement Methodology

At each location L_{Aeq}, L_{A10}, L_{A90}, L_{Amax} metric values were measured. All broadband measurements were A-weighted and used a fast time constant (0.125s).

The sound level meter was mounted on a tripod with the microphone set approximately at 1.2m-1.5m above local ground level. All measurements were taken under acoustically free-field conditions, except where otherwise stated. A windshield was fitted to the microphone.

A1.4 Summary of measured noise levels

Table 2: Summary of measured baseline noise levels during noise surveys

Noise Survey Location	Assessment locations at which this survey location is used in the noise assessments	Noise level, $L_{Aeq,T}$		
		Daytime (0700-1900)	Evening (1900-2300)	Night-time (2300-0700)
1	R8, R10	48	47	33
2	R7, R9, R12, R13	49	51	44
3	R6	56	56	34
4	R4, R5	51	42	43
5	R1, R2, R3, R11	46	41	38
6	None	Baseline noise levels monitored at this location were cut short by equipment failure and the noise climate contaminated by domestic noise. A repeat survey here was planned but due to the Covid-related lockdown it was not possible to carry this out. The construction and operational noise assessments, however, demonstrate that regardless of baseline noise levels, the noise from the scheme will not produce any likely significant effects.		

A1.5 Attended Measurements

A1.5.1 Location 1

Location Description:
Location 1 is at the southern end of the proposed site looking north towards the site. This is a gentle slopping up area to the east. Dips down to the north to a stream then a steep incline after the stream to the north onto the proposed site.

Environment and Observations:





Measurement Duration:
Thu 05/03/2020 13:50
to
Fri 06/03/2020 03:46

Weather Conditions:
Wind Speed: 0-3.2MPS
Wind Direction: N
Summary: 8Deg C down to -3Deg C
Very low cloud all day clearing at night.

Personnel: 2

Additional Comments:
At this location traffic dominates the area followed by a gentle trickle from the lower stream.

Table 3: Summary of averaged sound pressure levels at noise survey location 1

Period	Sound Pressure Level, dB(A) (re 20 µPa)			
	L_{90}	L_{eq}	L_{10}	L_{max}
Day (07:00-19:00)	37	48	52	65 - 66
Evening (19:00-23:00)	32	47	50	62 - 66
Night (23:00-07:00)	29	33	34	50 - 59

Table 4: Detail of measured sound pressure levels at location 1

Date	Time [hh:mm:ss]		Sound Pressure Level, dB(A) (re 20 µPa)				Comments
	Start	Duration	L_{90}	L_{eq}	L_{10}	L_{max}	
Day							
05/03/2020	13:50	00:15:00	37.9	47.6	51.0	66.2	To the left of houses and north of railway. Constant dog barking. Dominant source traffic on the main road to the south.

Date	Time [hh:mm:ss]		Sound Pressure Level, dB(A) (re 20 µPa)				Comments
	Start	Duration	L_{90}	L_{eq}	L_{10}	L_{max}	
05/03/2020	15:27	00:15:00	35.9	49.1	53.6	64.9	As above
Evening							
05/03/2020	20:42	00:10:00	31.5	45.3	48.2	62.1	Traffic is main noise source along with the stream
05/03/2020	21:55	00:10:00	33.3	48.3	51.3	65.9	As above
Night							
06/03/2020	02:26	00:10:00	29.7	31.1	31.4	50.3	Distant dogs barking along with running stream
06/03/2020	03:36	00:10:00	28.0	34.6	37.3	59.4	1 car per min. Getting colder dominant sound is a small river then owls. Hooting then distant traffic

A1.5.2 Location 2

Location Description:

Location 2 was moved 250 metres to the west away from traveller's accommodation. It is at the southern end of the proposed site looking north towards the site. This is a gentle slopping up area to the east.

Measurement Duration:
Thu 05/03/2020 13:27
to
Fri 06/03/2020 03:31

Weather Conditions:
Wind Speed: 1.2 m/s
Wind Direction: N
Summary: 8Deg C down to -3Deg C
Very low cloud all day clearing at night.

Personnel: 2

Additional Comments:
Dominated by road traffic noise at this location. When traffic is not present, crackle of the pylons above was noticeable.

Environment and Observations:





Table 5: Summary of averaged sound pressure levels at noise survey location 2

Period	Sound Pressure Level, dB(A) (re 20 µPa)			
	L_{90}	L_{eq}	L_{10}	L_{max}
Day (07:00-19:00)	41	49	53	62-64
Evening (19:00-23:00)	26	51	56	66-67
Night (23:00-07:00)	33	46	45	52-67

Table 6: Detail of measured sound pressure levels at location 2

Date	Time [hh:mm:ss]		Sound Pressure Level, dB(A) (re 20 µPa)				Comments
	Start	Duration	L_{90}	L_{eq}	L_{10}	L_{max}	
Day							
05/03/2020	13:27	00:15:00	42.4	49.6	53.3	62.0	Most dominant sound is a road to south along with earth movers on proposed site.
05/03/2020	15:06	00:15:00	39.8	49.1	53.0	63.7	Dominant sound is traffic to the south
Evening							

Date	Time [hh:mm:ss]		Sound Pressure Level, dB(A) (re 20 µPa)				Comments
	Start	Duration	L_{90}	L_{eq}	L_{10}	L_{max}	
05/03/2020	20:27	00:10:00	26.5	52.4	57.1	66.0	Traffic to the south along with pylons about 60m away
05/03/2020	21:39	00:10:00	24.5	50.0	54.8	67.3	5 car passages during this time. Dominant sound traffic followed by crackling pylon sound + wildlife
Night							
06/03/2020	02:11	00:10:00	31.1	35.6	37.6	52.3	Frozen ground buzzing + cracking from pylon. Dogs barking at traveller accommodation
06/03/2020	03:21	00:10:00	34.0	46.2	44.9	66.6	Sound from pylon is dominant sound then distant traffic.

A1.5.3 Location 3

Location Description:

Environment and Observations:

Measurement Duration:
Thu 05/03/2020 12:56
to
Fri 06/03/2020 03:14

Weather Conditions:
Wind Speed: 0 1.2 m/s
Wind Direction: N
Summary: 8Deg C down to -3Deg C
Very low cloud all day clearing at night.

Personnel: 2

Additional Comments:
Dominated by road traffic noise.





Table 7: Summary of averaged sound pressure levels at noise survey location 3

Period	Sound Pressure Level, dB(A) (re 20 µPa)			
	L_{90}	L_{eq}	L_{10}	L_{max}
Day (07:00-19:00)	40	56	54	69-82
Evening (19:00-23:00)	28	58	48	73-75
Night (23:00-07:00)	24	34	35	59-62

Table 8: Detail of measured sound pressure levels at location 3

Date	Time [hh:mm:ss]		Sound Pressure Level, dB(A) (re 20 µPa)				Comments
	Start	Duration	L_{90}	L_{eq}	L_{10}	L_{max}	
Day							
05/03/2020	12:56	00:15:00	42.1	57.9	56.1	81.7	Dominant sound is A4221. Noise from people departing hostel.
05/03/2020	14:43	00:15:00	37.1	50.1	51.4	69.4	Road traffic from A4221
Evening							
05/03/2020	20:09	00:10:00	26.9	51.8	50.4	74.6	As above
05/03/2020	21:21	00:10:00	28.0	57.8	47.8	72.6	As above
Night							
06/03/2020	01:54	00:10:00	23.5	34.7	38.6	61.6	Distant traffic and flowing water
06/03/2020	03:04	00:10:00	24.5	32.2	31.4	58.9	As above

A2.1.4 Location 5

Location Description:
Location 5 is north of the proposed site. Main road A4221 north of location.

Measurement Duration:
Thu 05/03/2020 12:32
to
Fri 06/03/2020 03:46

Weather Conditions:
Wind Speed: 2.4 m/s
Wind Direction: N
Summary: 8Deg C down to -3Deg C
Very low cloud all day clearing at night.

Personnel: 2

Additional Comments:
Road traffic noise from A421 dominates.

Environment and Observations:



Table 9: Summary of averaged sound pressure levels at noise survey location 5

Period	Sound Pressure Level, dB(A) (re 20 µPa)			
	L90	Leq	L10	Lmax
Day (07:00-19:00)	42	47	48	65-68
Evening (19:00-23:00)	38	42	44	60-66
Night (23:00-07:00)	35	39	42	50-55

Table 10: Detail of measured sound pressure levels at location 5

Date	Time [hh:mm:ss]		Sound Pressure Level, dB(A) (re 20 µPa)				Comments
	Start	Duration	L_{90}	L_{eq}	L_{10}	L_{max}	
Day							
05/03/2020	12:32	00:15:00	43.3	47.6	48.9	67.5	Dominant source is road traffic noise from A4221.
05/03/2020	14:21	00:15:00	41.5	45.0	47.1	64.8	As above
Evening							
05/03/2020	19:48	00:10:00	39.1	42.6	44.6	65.6	Distant traffic to the north
05/03/2020	21:02	00:10:00	36.2	40.0	42.7	59.7	As above
Night							
06/03/2020	01:36	00:10:00	34.9	38.2	40.4	50.4	Distant traffic, running water and wildlife
06/03/2020	02:46	00:10:00	34.0	38.5	41.8	55.4	As above

A1.6 Unattended measurements

A1.6.1 Location 4

Location Description:

Environment and Observations:



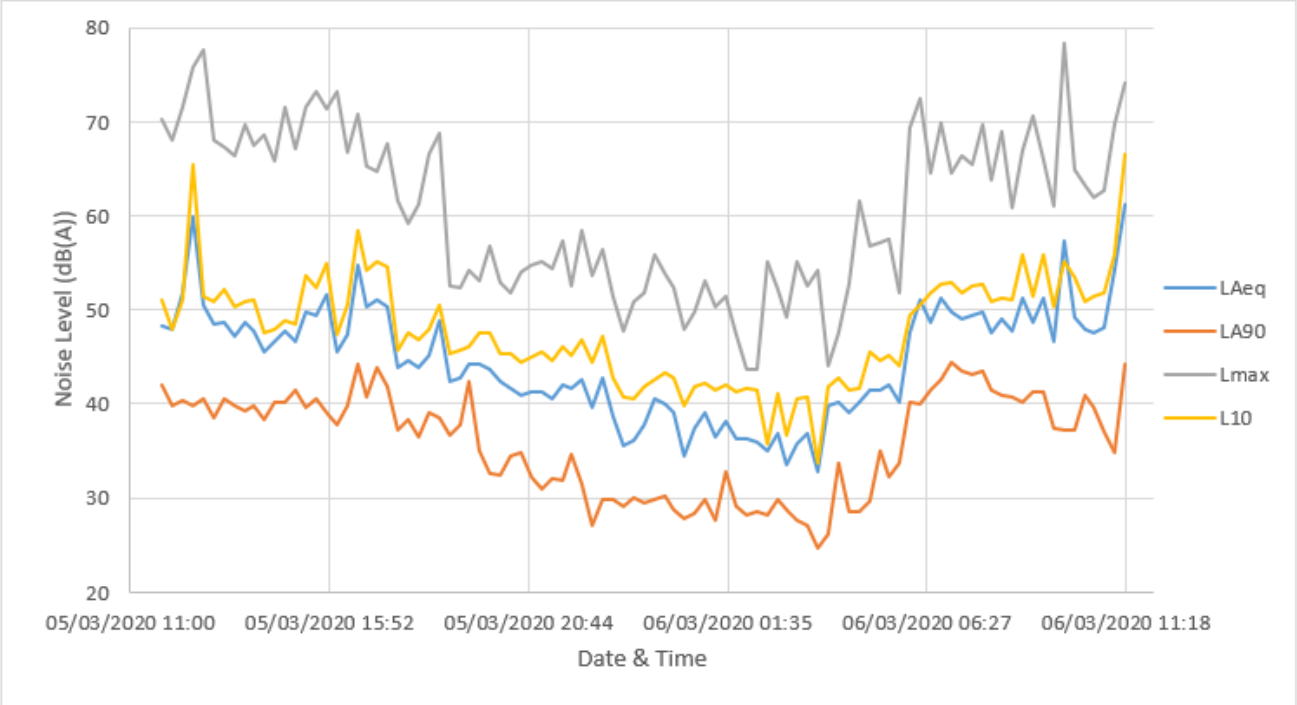
Measurement Duration:
Thu 05/03/2020 12:03
to
Fri 06/03/2020 11:03

Logging Interval:
00:15:00

Weather Conditions:

Additional Comments:

Figure 2: Noise level time history for the unattended measurement at location 4



A1.6.2 Location 6

Location Description:

Environment and Observations:



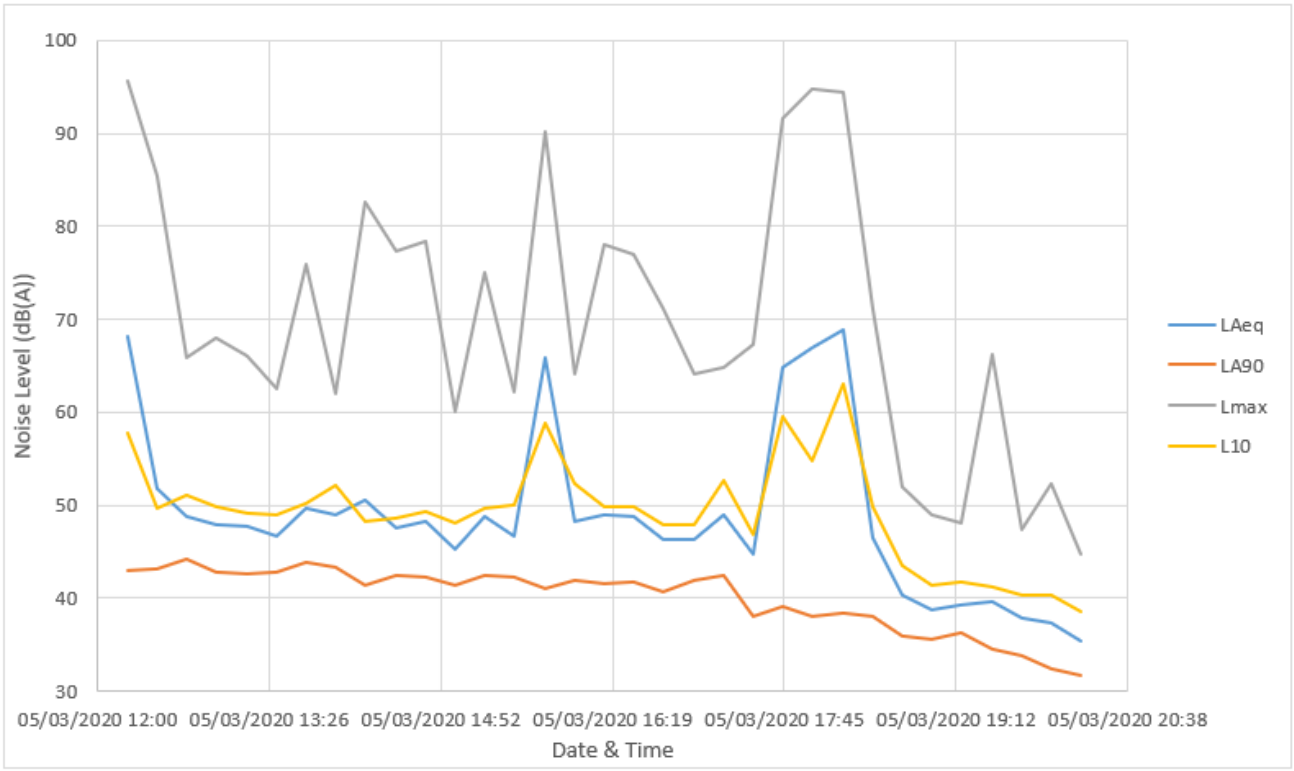
Measurement Duration:
Thu 05/03/2020 12:15
to
Fri 06/03/2020 20:15

Logging Interval:
00:15:00

Weather Conditions:

Additional Comments:

Figure 3: Noise level time history for the unattended measurement at location 6



Appendix 10B

Policy, assessment criteria and consultation

B1 Overall policy review

National and Regional Policy

1.1.1 Planning Policy Wales Edition 9[1] describes the planning development policies of the Welsh Government. Chapter 13 of the policy 'Minimising and Managing Environmental Risks and Pollution' sets out the policy objectives with regard to noise from new development. Paragraph 13.13.1 states the policy objectives:

'Noise can affect people's health and well-being and have a direct impact on wildlife and local amenity. Noise levels provide an indicator of local environmental quality. The objective of a policy for noise is to minimise emissions and reduce ambient noise levels to an acceptable standard. Noise Action Plans, drawn up by the Welsh Ministers in relation to Wales under the Environmental Noise Directive, and the Wales Regulations, aim to prevent and reduce environmental noise where necessary and preserve environmental noise quality where it is good. They are a planning consideration in the use and development of land.'

1.1.2 With regard to the assessment of noise associated with development, paragraph 13.15.1 states the following:

'Noise can be a material planning consideration, for example in proposals to use or develop land near an existing source of noise or where a proposed new development is likely to generate noise. Local planning authorities should make a careful assessment of likely noise levels and have regard to any relevant Noise Action Plan before determining such planning applications and in some circumstances, it will be necessary for a technical noise assessment to be provided by the developer.'

1.1.3 Paragraph 13.15.2 provides guidance on noise generation near protected areas:

'Special consideration is required where noise-generating development is likely to affect a protected species, or is proposed in or near statutorily designated areas, including urban 'quiet areas' designated in Noise Action Plans. The effect of noise on the enjoyment of other areas of landscape, wildlife and historic value should also be taken into account.'

1.1.4 TAN 11[2] provides technical guidance on noise generating development including transportation projects. In relation to highway projects TAN 11 makes reference to the Noise Insulation Regulations as described above.

[1] Planning Policy Wales Edition 9 (Welsh Government, 2016)
[2] Planning Guidance (Wales) Technical Advice Note 11 (Welsh Assembly Government, 1997)

1.1.5 The Well-being of Future Generations (Wales) Act 2015[3] has a number of well-being goals to achieve through implementing sustainable development. Changes in noise levels can have an impact on the health of habitat and humans, as such the goals to create 'a resilient Wales' and 'a healthier Wales' are applicable.

1.1.6 The 'Noise and soundscape action plan'[4] for Wales 2018-2023 was produced by the Welsh Government in response to the requirement set out in the Environmental Noise (Wales) Regulations (as mentioned above).

1.1.7 The noise and soundscape action plan defines priority areas[5] (NAPPA), proximity areas[6] and quiet areas. The relevant datasets and reports have been reviewed and no priority areas or quiet areas have been identified within the study area. No quiet area is identified within the close proximity to the proposed scheme.

Local Planning Policy

Powys County Council (PCC)

1.1.8 Powys Local Development Plan 2011-2026[7] (as amended in September 2017[8], adopted in January 2020[9]) policies relevant to noise include:

1.1.9 Policy DM15 – Design and Resources

The amenities enjoyed by the occupants or users of nearby or proposed properties shall not be unacceptably affected by levels of noise…

Neath Port Talbot County Borough Council (NPTCBC)

1.1.10 Neath Port Talbot County Borough Council Local Development Plan 201-2066 (adopted in January 2016)[10] relevant to noise include:

1.1.11 Policy EN8 Pollution and Land Stability

[3] Well-being of Future Generations (Wales) Act 2015 (Welsh Assembly Government, 2015)
[4] Noise and soundscape action plan for Wales 2018-2023 (Welsh Government, 2018)
[5] These are defined in the Noise and Soundscape Action Plan as "areas where people's homes are exposed to a day-evening-night noise level exceeding 73 dB according to the 2017 noise maps, or where people live alongside concrete trunk roads"
[6] These are defined in the Noise and Soundscape Action Plan as "Priority areas highlighting situations such as those where noise levels at all the highly exposed residential properties have effectively been calculated within 7.5 metres of the noise source"
[7] Powys Local Development Plan 2011-2026, Strategic Environmental Assessment Environmental Report, Deposit Draft (Incorporating Focused Changes and Further Focussed Changes), October 2016
[8] Powys Local Development Plan 2011-2026, Strategic Environmental Assessment Environmental Report Addendum, Composite Version incorporating Matters Arising Changes, September 2017
[9] Powys Local Development Plan (2011-2026), Supplementary Planning Guidance, Residential Design, Adopted January 2020
[10] Neath Port Talbot County Borough Council Local Development Plan 201-2066 (adopted in January 2016)

1.1.12 *'...potentially noisy proposals should not be located close to sensitive uses (such as hospitals, schools and housing) ...unless it can be shown that adverse effects can be dealt with through mitigation measures incorporated into the design.'*

Legislation

1.1.13 The Environmental Noise (Wales) Regulations 2006[11] (as amended 2009[12]) provide the mechanism for enacting the requirements of Directive 2002/49/EC[13] of the European Parliament (the Environmental Noise Directive) in Welsh law.

B1.1 Policy and criteria specifically relevant to Construction noise & vibration

1.1.14 The Environmental Protection Act[14] describes the duty of the Local Authority to take steps to abate any noise impact, including that from a construction site, deemed to be causing a statutory nuisance. Noise is outlined in Part III of the Act in relation to noise as a nuisance or that is prejudicial to health.

1.1.15 The Control of Pollution Act[15] gives the Local Authority powers to serve a notice to the developer requiring the control of site noise under Section 60 of the Act. This may include specific controls to restrict certain activities identified as causing particular problems. Conditions regarding hours of operation will generally be specified and noise and vibration limits at certain locations may be applied in some cases. All requirements must adhere to established guidance and be consistent with best practicable means to control noise only as far as is necessary to prevent undue disturbance.

1.1.16 The British Standard BS 5228 Code of Practice for noise and vibration on construction and open sites – Part 1[16] and Part 2[17] provide guidance on the assessment and control of noise and vibration from construction activities. Part 1 of the Standard contains detailed information on noise reduction measures and promotes the 'best practicable means' approach to control noise and vibration to minimise the impact on local residents and construction workers. Part 2 of the Standard provides criteria for vibration with regard to perception and

[11] The Environmental Noise (Wales) Regulations (National Assembly for Wales, 2006)
[12] The Environmental Noise (Wales) (Amendment) Regulations (National Assembly for Wales, 2009)
[13] Directive 2002/49/EC of the European Parliament and of the Council (The European Parliament and the Council of the European Union, 2002)
[14] Environmental Protection Act 1990, Chapter 43 (HMSO, 1990)
[15] Control of Pollution Act 1974, Chapter 40 (HMSO, 1974)
[16] BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise (British Standards Institution, 2014)
[17] BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration (British Standards Institution, 2014)

disturbance to residents and the onset of potential cosmetic or structural damage to buildings.

1.1.17 The threshold for determining significant effects from construction noise has been set according to the time of day that they occur and the prevailing ambient noise levels. For the residential receptors, potential significant effects maybe be identified where construction noise exceeds the appropriate ABC threshold associated with the ambient noise level (EIA significance criteria derived using the ABC method in Annex E of BS 5228-1 which is described in Table 1).

Table 1: Threshold of potential significant effect at dwellings according to ABC method in BS 5228 Part 1

Assessment category and threshold value period	**Threshold value, dB**		
	Category A	Category B	Category C
Night-time (23:00 – 07:00)	45	50	55
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
Other: Weekday evenings (19:00 – 23:00) Saturdays (13:00 – 23:00) Sundays (07:00 – 23:00)	55	60	65
Category A: threshold value to use when ambient noise levels (rounded to the nearest 5dB) are less than these values. Category B: threshold value to use when ambient noise levels (rounded to the nearest 5dB) are the same as Category A values. Category C: threshold value to use when ambient noise levels (rounded to the nearest 5dB) are higher than Category A values.			

1.1.18 For non-residential receptors, any significant effects have been evaluated on a receptor-by-receptor basis using appropriate guidance criteria to establish likely effects where appropriate for the particular use receptor. For example, BS 8233[18] would be referred to for guidance on internal noise levels within a particular building use.

1.1.19 The final assessment of EIA significance is determined by evaluating the construction noise thresholds along with other factors including the expected length of any exceedance of the ABC method criteria.

B1.2 Traffic noise effects

1.1.20 Changes in noise due to increases in road traffic noise – both during construction and operational phases - between the baseline and the assessment case has been determined to be a potentially significant

[18] British Standards Institution (2014); BS 8233 Guidance on sound insulation and noise reduction for buildings

effect where the change would be greater than 3dB. The overall assessment of significance is based on this noise change and other parameters.

B1.3 Policy and criteria specifically relevant to Operational noise & vibration

External noise levels

1.1.21 The World Health Organization (WHO) provides guidance in respect to community noise and recommends for outdoor living areas a criterion of 50 $dBL_{Aeq,T}$ "to protect the majority of people from being moderately annoyed…" and 55 $dBL_{Aeq,T}$ "to protect the majority of people from being seriously annoyed…" during the daytime.

1.1.22 The new WHO 'Environmental noise guidelines for the European Region' 2018[19] identifies the latest research on health issues (carried out between 1999 and 2015), which relates adverse health impacts to various sources of noise, including road transportation noise. However, it should be noted that these new WHO guidelines align well with the recently published PPW 10 policy (Section 6) which also addresses and takes account of the 'negative impacts' that undesirable noise can have on public health, and strongly supports the importance when considering high priority NAPPA locations and also provision of 'Tranquil Areas'.

Internal noise levels

1.1.23 The primary guide used for criteria on internal noise levels – specifically in living areas and bedrooms – is from BS 8233. The criteria used for the operational assessment are set out in the main chapter.

B2 Scoping and Consultation

Scoping

1.1.24 A formal scoping assessment was undertaken to set out the proposed assessment methodology and submitted to Powys County Council (PCC) and Neath Port Talbot County Borough Council (NPTCBC). The following response to the noise and vibration section was provided by PCC:

"They are satisfied with the proposed assessments in respect of noise and air quality."

1.1.25 and NPTCBC:

[19] World Health Organisation, Environmental Noise Guidelines for the Europe Region (World Health Organisation, 2018)

"The proposal in relation to noise and vibration at this stage is vague, but reference is made within the document that prior to undertaking the various assessments that will be required for such a large proposal, the applicant will consult with the LA's. I am pleased to see this, as it will be at this stage the detail can be discussed and methodologies agreed."

1.1.26 A further informal consultation was carried out with PCC, who confirmed that the proposed survey specification detailing survey locations, duration of measurements (logged and attended) were acceptable.

Appendix 10C

Operational and construction noise assessment detail, assumptions and limitations

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J1 Construction noise assessment

J1.1 Introduction

This note summarises the results of the outline construction noise assessment of the Global Centre for Rail Excellence. The outline assessment of effects from construction on noise sensitive receptors has been carried out using the ABC method from Annex E of BS 5228-1.[1]

J1.2 Limitations and assumptions

The predicted level of noise from construction depends on the particular items of plant used. At this stage in the programme, a fully detailed schedule of construction equipment is not available. A representative schedule has been prepared by the engineering specialists developing the design, based on their experience. This is considered to be a reasonable, illustrative scenario for the purpose of this assessment.

The following assumptions have been made:

- For each construction stage, the shortest distance to each receptor that is likely to occur was used, as a reasonable worst case.
- All activities associated with each construction stage were assumed to take place simultaneously.
- All ground between the location of each construction stage and the noise sensitive receptors was assumed to be soft (acoustically absorptive).
- There was assumed to be no screening between the converter station and noise sensitive receptors.
- All background noise levels were assumed to be less than 65dB(A), i.e. this would relate to the most sensitive BS 5228 ABC category (category A) for all receptors.
- It was assumed that all works take place during the daytime (07:00 – 19:00 Monday – Friday, 07:00 – 13:00 Saturday).
- Assumed activities for the calculation, alongside the estimated durations and the corresponding equipment are shown in

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
Demolition of existing	4 – 6	Excavator with breaker	1	50	118
		Excavator with pulveriser	1	50	104

[1] BS 5228-1:2009+A1:2014 and BS 5228 Part 2 Code of Practice for Noise and Vibration Control on Open Construction Sites

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
washery site and site establishment		Wheeled mobile crane	1	50	98
		Articulated dump truck	2	20	109
		Tracked crusher	1	50	110
		Tracked excavator	2	50	104
		Handheld pneumatic breaker	1	50	111
		Dozer	1	30	106
		Telehandler	2	80	99
		Vibratory roller	1	30	105
Construction of 12no. warm storage sidings, including track, walkways, shore supply units and lighting	8 – 10	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106
		Articulated dump truck	2	50	109
		Ballast train / hoppers	1	20	108
		Tracked excavator	2	50	104
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99
		Mobile telescopic crane (rail-mounted)	1	50	99
Construction of electrical infrastructure – Primary DNO MV intake room and customer MV room. 2no. further substations. Connection to electric network.	6 – 8	Telehandler	2	50	99
		Mobile telescopic crane	1	20	99
		Concrete mixer truck & pump	1	20	103
		Tracked excavator	2	70	104
Internal highways and hardstanding work	2 – 4	Dozer	1	50	106
		Articulated dump truck	2	20	109
		Vibratory roller	1	50	105
		Road planer	1	20	110
		Asphalt paver	1	40	105
		Tracked excavator	2	70	104
		Telehandler	2	80	99
Construction of track system for Infrastructure Test Track, including	4 – 6	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106
		Articulated dump truck	2	50	109

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
vehicle access route, fencing and rail access track		Ballast train / hoppers	1	20	108
		Tracked excavator	2	50	104
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99
		Mobile telescopic crane (rail-mounted)	1	50	99
Neath and Brecon Branch line trackwork	1 – 2	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106
		Articulated dump truck	2	50	109
		Ballast train / hoppers	1	20	108
		Tracked excavator	2	50	104
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99
		Mobile telescopic crane (rail-mounted)	1	50	99
OLE installation on test track and onto selected sidings. Discrete activities (foundation works, column erection, boom and registration installation, wiring)	4 – 6	Concrete pump and mixer truck	1	20	103
		Tracked drilling / piling rig	2	50	110
		Wheeled mobile crane	2	50	98
		Tracked excavator	2	50	104
		MEWP RRV	2	50	95
		High output wiring system	2	20	109
		Road rail excavator crane	2	50	106
Construction of rail crossings; 2 no. bridge crossings	9 – 12	Mobile Crane	4	70	99
		Tracked Excavator	2	30	104
		Concrete mixed truck and pump	2	30	103
		Articulated dump truck	2	30	109
		Poker Vibrator	2	30	97
		Rotary Bored piling rig	1	20	111
		Disk Cutter	2	50	108
Additional electrical infrastructure. 3no. substations.	2 – 4	Telehandler	2	50	99
		Mobile telescopic crane	1	20	99
		Concrete mixer truck & pump	1	20	103
		Tracked excavator	2	70	104
Rolling Stock Maintenance	12 – 18	Wheeled excavator	2	50	105
		Lorry with lifting boom	1	10	105

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
Shed construction, including full-internal fit-out		Wheeled mobile crane	2	50	98
		Articulated dump truck	2	50	109
		Concrete pump and mixer truck	2	40	103
		Mobile telescoping crane	2	50	99
		Poker vibrator	2	20	97
		Rotary bored piling rig	1	20	111
		Telehandler	2	80	99
Construction of track system for Rolling Stock Test Track, including vehicle access route, fencing and rail access track. (Assumes single-track loop)	6 – 8	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106
		Articulated dump truck	2	50	109
		Ballast train / hoppers	1	20	108
		Tracked excavator	2	50	104
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99
		Mobile telescopic crane (rail-mounted)	1	50	99
OLE installation on test track and on roads connecting to maintenance shed. Discrete activities (foundation works, column erection, boom and registration installation, wiring)	9 – 12	Concrete pump and mixer truck	1	20	103
		Tracked drilling / piling rig	2	50	110
		Wheeled mobile crane	2	50	98
		Tracked excavator	2	50	104
		MEWP RRV	2	50	95
		High output wiring system	2	20	109
		Road rail excavator crane	2	50	106
Construction of carriagewash	4 – 6	Articulated dump truck	1	50	109
		Concrete pump and mixer truck	1	40	103
		Mobile telescoping crane	1	50	99
		Poker vibrator	1	20	97
		Rotary bored piling rig	1	20	111
		Telehandler	1	80	99
		Tracked excavator	1	80	104
Construction of warm storage sidings, including	8 – 10	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
track, walkways, shore supply units and lighting.		Articulated dump truck	2	50	109
		Ballast train / hoppers	1	20	108
		Tracked excavator	2	50	104
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99
		Mobile telescopic crane (rail-mounted)	1	50	99
Internal highways and hardstanding works	8 – 10	Dozer	1	50	106
		Articulated dump truck	2	20	109
		Vibratory roller	1	50	105
		Road planer	1	20	110
		Asphalt paver	1	40	105
		Tracked excavator	2	70	104
		Telehandler	2	80	99
Construction of rail crossings; 1no. bridge crossings	6 – 9	Mobile Crane	2	70	99
		Tracked Excavator	1	30	104
		Concrete mixed truck and pump	1	30	103
		Articulated dump truck	1	30	109
		Poker Vibrator	1	30	97
		Rotary Bored piling rig	1	20	111
		Disk Cutter	1	50	108
Research & Development Centre construction	2 – 4	Wheeled excavator	1	50	105
		Lorry with lifting boom	1	10	105
		Articulated dump truck	1	50	109
		Concrete pump and mixer truck	1	40	103
		Mobile telescoping crane	1	50	99
		Poker vibrator	1	20	97
		Rotary bored piling rig	1	20	111
		Telehandler	1	80	99
Station Testing facilities and laboratories	6 – 8	Wheeled excavator	1	50	105
		Lorry with lifting boom	1	10	105
		Articulated dump truck	1	50	109
		Concrete pump and mixer truck	1	40	103
		Mobile telescoping crane	1	50	99
		Poker vibrator	1	20	97
		Rotary bored piling rig	1	20	111
		Telehandler	1	80	99
Rolling stock decommissioning facility	6 – 8	Articulated dump truck	1	50	109
		Concrete pump and mixer truck	1	70	103
		Mobile telescoping crane	1	50	99
		Poker vibrator	1	20	97

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
		Rotary bored piling rig	1	20	111
		Telehandler	1	80	99
		Tracked excavator	1	80	104
Construction of warm storage sidings, including track, walkways, shore supply units and lighting	8 – 10	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106
		Articulated dump truck	2	50	109
		Ballast train / hoppers	1	20	108
		Tracked excavator	2	50	104
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99
		Mobile telescopic crane (rail-mounted)	1	50	99

- :

Table 1: Assumed construction activities and plant items

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
Demolition of existing washery site and site establishment	4 – 6	Excavator with breaker	1	50	118
		Excavator with pulveriser	1	50	104
		Wheeled mobile crane	1	50	98
		Articulated dump truck	2	20	109
		Tracked crusher	1	50	110
		Tracked excavator	2	50	104
		Handheld pneumatic breaker	1	50	111
		Dozer	1	30	106
		Telehandler	2	80	99
		Vibratory roller	1	30	105
Construction of 12no. warm storage sidings, including track,	8 – 10	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106
		Articulated dump truck	2	50	109

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
walkways, shore supply units and lighting		Ballast train / hoppers	1	20	108
		Tracked excavator	2	50	104
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99
		Mobile telescopic crane (rail-mounted)	1	50	99
Construction of electrical infrastructure – Primary DNO MV intake room and customer MV room. 2no. further substations. Connection to electric network.	6 – 8	Telehandler	2	50	99
		Mobile telescopic crane	1	20	99
		Concrete mixer truck & pump	1	20	103
		Tracked excavator	2	70	104
Internal highways and hardstanding work	2 – 4	Dozer	1	50	106
		Articulated dump truck	2	20	109
		Vibratory roller	1	50	105
		Road planer	1	20	110
		Asphalt paver	1	40	105
		Tracked excavator	2	70	104
		Telehandler	2	80	99
Construction of track system for Infrastructure Test Track, including vehicle access route, fencing and rail access track	4 – 6	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106
		Articulated dump truck	2	50	109
		Ballast train / hoppers	1	20	108
		Tracked excavator	2	50	104
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99
		Mobile telescopic crane (rail-mounted)	1	50	99
Neath and Brecon Branch line trackwork	1 – 2	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106
		Articulated dump truck	2	50	109
		Ballast train / hoppers	1	20	108
		Tracked excavator	2	50	104

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99
		Mobile telescopic crane (rail-mounted)	1	50	99
OLE installation on test track and onto selected sidings. Discrete activities (foundation works, column erection, boom and registration installation, wiring)	4 – 6	Concrete pump and mixer truck	1	20	103
		Tracked drilling / piling rig	2	50	110
		Wheeled mobile crane	2	50	98
		Tracked excavator	2	50	104
		MEWP RRV	2	50	95
		High output wiring system	2	20	109
		Road rail excavator crane	2	50	106
Construction of rail crossings; 2 no. bridge crossings	9 – 12	Mobile Crane	4	70	99
		Tracked Excavator	2	30	104
		Concrete mixed truck and pump	2	30	103
		Articulated dump truck	2	30	109
		Poker Vibrator	2	30	97
		Rotary Bored piling rig	1	20	111
		Disk Cutter	2	50	108
Additional electrical infrastructure. 3no. substations.	2 – 4	Telehandler	2	50	99
		Mobile telescopic crane	1	20	99
		Concrete mixer truck & pump	1	20	103
		Tracked excavator	2	70	104
Rolling Stock Maintenance Shed construction, including full-internal fit-out	12 – 18	Wheeled excavator	2	50	105
		Lorry with lifting boom	1	10	105
		Wheeled mobile crane	2	50	98
		Articulated dump truck	2	50	109
		Concrete pump and mixer truck	2	40	103
		Mobile telescoping crane	2	50	99
		Poker vibrator	2	20	97
		Rotary bored piling rig	1	20	111
		Telehandler	2	80	99
Construction of track system for Rolling Stock Test Track, including vehicle access	6 – 8	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106
		Articulated dump truck	2	50	109
		Ballast train / hoppers	1	20	108

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
route, fencing and rail access track. (Assumes single-track loop)		Tracked excavator	2	50	104
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99
		Mobile telescopic crane (rail-mounted)	1	50	99
OLE installation on test track and on roads connecting to maintenance shed. Discrete activities (foundation works, column erection, boom and registration installation, wiring)	9 – 12	Concrete pump and mixer truck	1	20	103
		Tracked drilling / piling rig	2	50	110
		Wheeled mobile crane	2	50	98
		Tracked excavator	2	50	104
		MEWP RRV	2	50	95
		High output wiring system	2	20	109
		Road rail excavator crane	2	50	106
Construction of carriagewash	4 – 6	Articulated dump truck	1	50	109
		Concrete pump and mixer truck	1	40	103
		Mobile telescoping crane	1	50	99
		Poker vibrator	1	20	97
		Rotary bored piling rig	1	20	111
		Telehandler	1	80	99
		Tracked excavator	1	80	104
Construction of warm storage sidings, including track, walkways, shore supply units and lighting.	8 – 10	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106
		Articulated dump truck	2	50	109
		Ballast train / hoppers	1	20	108
		Tracked excavator	2	50	104
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99
		Mobile telescopic crane (rail-mounted)	1	50	99
Internal highways and hardstanding works	8 – 10	Dozer	1	50	106
		Articulated dump truck	2	20	109
		Vibratory roller	1	50	105
		Road planer	1	20	110
		Asphalt paver	1	40	105
		Tracked excavator	2	70	104

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
		Telehandler	2	80	99
Construction of rail crossings; 1no. bridge crossings	6 – 9	Mobile Crane	2	70	99
		Tracked Excavator	1	30	104
		Concrete mixed truck and pump	1	30	103
		Articulated dump truck	1	30	109
		Poker Vibrator	1	30	97
		Rotary Bored piling rig	1	20	111
		Disk Cutter	1	50	108
Research & Development Centre construction	2 – 4	Wheeled excavator	1	50	105
		Lorry with lifting boom	1	10	105
		Articulated dump truck	1	50	109
		Concrete pump and mixer truck	1	40	103
		Mobile telescoping crane	1	50	99
		Poker vibrator	1	20	97
		Rotary bored piling rig	1	20	111
		Telehandler	1	80	99
Station Testing facilities and laboratories	6 – 8	Wheeled excavator	1	50	105
		Lorry with lifting boom	1	10	105
		Articulated dump truck	1	50	109
		Concrete pump and mixer truck	1	40	103
		Mobile telescoping crane	1	50	99
		Poker vibrator	1	20	97
		Rotary bored piling rig	1	20	111
		Telehandler	1	80	99
Rolling stock decommissioning facility	6 – 8	Articulated dump truck	1	50	109
		Concrete pump and mixer truck	1	70	103
		Mobile telescoping crane	1	50	99
		Poker vibrator	1	20	97
		Rotary bored piling rig	1	20	111
		Telehandler	1	80	99
		Tracked excavator	1	80	104
Construction of warm storage sidings, including track, walkways, shore supply units and lighting	8 – 10	Handheld welder	2	20	101
		Handheld angle grinder	2	20	108
		Tamper	1	20	91
		Hydraulic vibratory compactor	1	20	106
		Articulated dump truck	2	50	109
		Ballast train / hoppers	1	20	108
		Tracked excavator	2	50	104
		Concrete mixer truck & pump	1	20	103
		Telehandler	2	80	99

Construction stage / activity	Estimated Construction Time (months)	Equipment	Number of items	% of day in operation	Lw (dB(A)) per item
		Mobile telescopic crane (rail-mounted)	1	50	99

J1.3 Results

Results for each construction stage are given in

Construction stage / activity	Predicted noise level (dB LAeq) Receptor												
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
Demolition of existing washery site + site establishment	26	32	33	37	40	47	67	39	53	35	35	61	57
Construction of warm storage sidings	21	27	28	32	35	42	52	33	44	30	30	46	41
Construction of electrical infrastructure	15	21	22	27	29	36	47	27	38	24	24	41	36
Internal highways + hardstanding work	19	25	26	30	32	39	46	29	38	27	27	49	46
Construction of track system - infrastructure test track + delta junction	27	35	37	47	49	46	47	43	56	40	41	39	34
Neath and Brecon Branch line trackwork	21	27	28	32	34	40	49	36	53	32	30	40	35
OLE installation	28	36	38	48	50	47	48	43	56	41	42	40	35
Additional electrical infrastructure	15	21	22	26	28	35	49	27	38	24	24	43	36
Rolling stock maintenance shed construction	20	25	27	30	33	39	51	31	40	28	28	52	47
Construction of track system - rolling stock test track	34	54	53	58	55	47	38	43	41	42	55	34	31
OLE installation	35	55	54	59	56	48	39	44	41	43	56	35	32

Construction stage / activity	Predicted noise level (dB LAeq) Receptor												
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
Construction of carriagewash	17	23	24	28	30	36	47	28	37	26	25	51	41
Construction of warm storage sidings	20	26	28	32	34	41	55	32	43	29	29	48	42
R&D centre construction	17	22	23	27	29	34	41	27	34	24	25	48	44
Station testing facilities + laboratories	17	22	23	27	29	34	40	27	34	24	24	47	45
Rolling stock decommissioning facility	18	23	24	28	31	37	47	29	37	26	26	47	40
Construction of warm storage sidings	23	28	29	31	33	37	44	52	57	40	30	37	33

. As is highlighted, the ABC method threshold value is predicted to be exceeded (by 2 dB over the 65dB criterion) at receptor R7 during the demolition of the buildings/structures on the existing washery site. A short-term noise impact is therefore predicted at receptor R7 for this construction stage. For all other receptors and construction stages the noise levels are predicted to be less than the threshold value, with a comfortable margin.

Table 2: Predicted construction noise levels per stage/activity

Construction stage / activity	Predicted noise level (dB LAeq) Receptor												
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
Demolition of existing washery site + site establishment	26	32	33	37	40	47	67	39	53	35	35	61	57
Construction of warm storage sidings	21	27	28	32	35	42	52	33	44	30	30	46	41
Construction of electrical infrastructure	15	21	22	27	29	36	47	27	38	24	24	41	36
Internal highways + hardstanding work	19	25	26	30	32	39	46	29	38	27	27	49	46
Construction of track system - infrastructure test track + delta junction	27	35	37	47	49	46	47	43	56	40	41	39	34

Construction stage / activity	Predicted noise level (dB LAeq) Receptor												
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
Neath and Brecon Branch line trackwork	21	27	28	32	34	40	49	36	53	32	30	40	35
OLE installation	28	36	38	48	50	47	48	43	56	41	42	40	35
Additional electrical infrastructure	15	21	22	26	28	35	49	27	38	24	24	43	36
Rolling stock maintenance shed construction	20	25	27	30	33	39	51	31	40	28	28	52	47
Construction of track system - rolling stock test track	34	54	53	58	55	47	38	43	41	42	55	34	31
OLE installation	35	55	54	59	56	48	39	44	41	43	56	35	32
Construction of carriagewash	17	23	24	28	30	36	47	28	37	26	25	51	41
Construction of warm storage sidings	20	26	28	32	34	41	55	32	43	29	29	48	42
R&D centre construction	17	22	23	27	29	34	41	27	34	24	25	48	44
Station testing facilities + laboratories	17	22	23	27	29	34	40	27	34	24	24	47	45
Rolling stock decommissioning facility	18	23	24	28	31	37	47	29	37	26	26	47	40
Construction of warm storage sidings	23	28	29	31	33	37	44	52	57	40	30	37	33

J2 Operational Noise Assessment

J2.1 Introduction

The main body of the operational noise assessment text is included in the main ES chapter. This appendix gives any details not included in the main text.

J2.2 Calculation methods used

The Calculation of Rail Noise (CRN 1996) methodology was used to predict noise from the test tracks.

For the washery facility, slow moving trains were represented with line sources with source noise levels verified against measured data made at similar facilities. Predictions were made using ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation.*

J2.3 Assumptions

The assumptions for the assessment are as follows:

Scheme element	Assumption title	Assumption detail	Comments
Rolling Stock test track	Train speeds	110mph except eastern curve where 85mph is assumed	Curvature of the eastern curve limits speeds to 85mph
	Rolling stock Calculation of Rail Noise (CRN) train correction used	8dB	This value is typical of modern electric or diesel trains
	Number of days per week assumed operation (average across a year)	Day: 5 days Evening: 3 days Nights: 2 days	
	Average number of laps per day assumed in calculations	Day: 175 Evening: 35 Night: 50	
	Number of carriages per train assumed	12	
High tonnage infrastructure test track	Train speeds	40mph	
	Rolling stock Calculation of Rail Noise (CRN) train correction used	Locomotives: +15 for loco power; +8 for loco rolling. +8 for wagons	
	Number of days per week assumed	Day: 7 days	

Scheme element	Assumption title	Assumption detail	Comments
	operation (average across a year)	Evening: 3 days Nights: 2 days	
	Average number of laps per day assumed in calculations	Day: 170 Evening: 25 Night: 35	
	Number of carriages per train assumed	40 wagons hauled by 2 locomotives	
Washery facility	Assumptions listed in main chapter		

J3 Traffic noise

Table 3 shows the traffic flow changes predicted as a result of the scheme. No increases of greater than 3dB are identified during either the construction or operational phases.

Table 3: Traffic noise assessment for both construction and operational phases

Link	Description	Direction	Annual Average Weekday Traffic (AAWT) values			Increase in noise levels from roads during construction, dB(A)	Increase in noise levels from roads during operation, dB(A)
			Without scheme, 2022	During construction, 2024	During operation, 2031		
A4067 North	North of A4221/ Junction 1	Northbound	2,207	2,265	2,389	0.2	0.3
		Southbound	2,276	2,334	2,462	0.2	0.3
A4067 South	South of A4221/ Junction 1	Northbound	3,945	3,961	4,188	0.0	0.3
		Southbound	4,100	4,123	4,359	0.0	0.3
A4221	West of Washery Access/ Junction 2	Eastbound	1,940	1,939	2,050	0.1	0.2
		Westbound	2,007	2,012	2,127	0.1	0.3
A4221	East of Washery Access (between junction 2&3)	Eastbound	1,974	1,980	2,078	0.1	0.2
		Westbound	2,008	2,038	2,139	0.2	0.3
A4109	North of Onllwyn/ Junction 4	Northbound	1,011	1,025	1,083	0.1	0.3
		Southbound	980	991	1,047	0.0	0.3
A4109	South of Onllwyn/ Junction 4	Northbound	1,328	1,425	1,502	0.5	0.5
		Southbound	1,331	1,426	1,503	0.5	0.5
Onllwyn Road	West of A4109/ Junction 4	Eastbound	538	626	658	1.2	0.9
		Westbound	504	591	621	1.3	0.9
A4109	North of Glynneath/ West of Junction 5	Eastbound	3,056	3,087	3,248	0.1	0.3
		Westbound	3,061	3,113	3,274	0.2	0.3
A4109	West of A465 (between junction 5&6)	Eastbound	3,436	3,500	3,681	0.1	0.3
		Westbound	3,604	3,683	3,873	0.2	0.3

Appendix 11A

WFD Strategy

WFD Screening Assessment

WFD/01

Final | 24 July 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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1 Introduction

Ove Arup & Partners has been commissioned by Welsh Government to undertake a preliminary Water Framework Directive (WFD) assessment to assess the environmental impacts of the Global Centre of Rail Excellence. This preliminary assessment is to support the outline planning application submitted to Powys County Council (PCC) and Neath Port Talbot County Borough Council (NPTCBC) for those works.

The Welsh Government is proposing to develop a rail testing, maintenance, research, development and storage facility, known as the Global Centre of Rail Excellence (GCRE) at the site of the Onllwyn Washery and Nant Helen Open Cast mine at which coaling operations are coming to an end and final site restoration by Celtic Energy is consented.

The site for the proposed development is approximately 475ha and includes the following components listed below and represented on Figure 1.1.

The proposed works are to include the following:

- Large railroad test track (outer track);
- High tonnage infrastructure test track (inner track);
- Site access;
- Associated development; and
- The washery site comprising:
    - An operations and control centre/office;
    - Research and development centre;
    - 4-road rolling stock maintenance shed;
    - Storage siding for medium-long term storage;
    - Carriage wash and CET spine facility;
    - Decommissioning facility;
    - Stationary testing facility; and
    - Associated development.

1.1 WFD Background

The WFD has been in force since 2000 and is currently the largest and most influential piece of European Union (EU) legislation relating to the water environment. All new (and current on-going) activities in the water environment need to be guided by the requirements of the WFD. In Wales, Natural Resources Wales (NRW) is the Competent Authority for implementing WFD.

This WFD assessment aims to determine the effects of the proposed scheme on ecological quality and potential. The assessment will identify any potential

impacts that could cause deterioration in the status of a water body or that could prevent the water body from meeting its WFD objectives.

The Directive requires that Environmental Objectives be set for all surface and ground waters in England and Wales to enable them to achieve Good Status (or Good Ecological Potential for Heavily Modified and Artificial Water Bodies) by a defined date. These Environmental Objectives are listed below:

• Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters;

• Aim to achieve at least good status for all water bodies by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve good status by 2021 or 2027;

• Meet the requirements of Water Framework Directive Protected Areas;

• Promote sustainable use of water as a natural resource;

• Conserve habitats and species that depend directly on water;

• Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;

• Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and

• Contribute to mitigating the effects of floods and droughts.

The Directive was transposed into law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. The framework for delivering this Directive is through the River Basin Management Plans (RBMPs). There are three River Basin Districts (RBD) that cover Wales: Dee, Severn and Western Wales. NRW is responsible for drawing up the RBMPs for Dee and Western Wales river basin districts. The responsibility for the RBMP for Severn is shared between NRW and Environment Agency. Each RBD has been characterised into smaller management units known as Water Bodies. These include all river, lake, groundwater, coastal, and transitional waters located within that RBD.

The Ecological Status or Potential of each water body in the RBD is established on the basis of specific criteria and boundaries defined against biological, physicochemical, and hydromorphological Quality Elements, and is ultimately determined by whichever of these elements is poorer.

The scheme is located in the Western Wales RBD. The RBMP details the Environmental Objectives, alongside the specific actions which are necessary to enable each water body in the RBD to meet these objectives.

1.2 Project Background

The project site is within the Dulais Valley located within Powys and Neath Port Talbot, with the Brecon Beacons National Park Authority boundary immediately to the north. Nearby settlements include Onllwyn, Seven Sisters, Ystradgynlais,

Caehopkin, Abercrave or Coelbren. The site is predominantly brownfield land that has been heavily worked by open cast mining. Much of the site has been revegetated.

The proposed site is currently being mined by Celtic Energy, who will cease extraction operations in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and agreements with PCC. Celtic Energy has submitted a revised restoration strategy for approval (under Section 73 application under the Town and Country Planning Act 1990) which would change the existing approved restoration scheme (for planning application ref 18/1070/REM). The purpose of the variation is to allow for a '*flexible and adaptable landform for a variety of uses on restoration including agriculture, nature conservation, leisure, tourism and some industrial uses*'[1].

The revised restoration proposal looks to provide a flexible landform that can be used or adapted for a diverse set of future uses, including: traditional agriculture, woodland and nature conservation uses, to amenity, leisure and tourism.

In April 2020, Celtic Energy submitted two planning applications reference 20/0738/FUL (Powys) and P/2020/0362 (Neath Port Talbot) for a complementary earthworks scheme to provide a comprehensive, flexible and adaptable landform across the entire site that could support a wide range of future uses which included the GCRE, establishing the earthworks formation and associated drainage and landscaping for two of the key components of the rail testing facility, namely the high speed and infrastructure test loops and rail line connections.

2 Project Details

The proposed project includes rail testing, maintenance, research, development and storage facility, known as the Global Centre of Rail Excellence (GCRE). Table 1 outlines the main details of the proposed works.

Table 1: Details of the proposed project.

Project Details	
Applicant name	Welsh Government
Application reference number (where applicable)	n/a
Description of activities	• Large railroad test track (outer track); • High tonnage infrastructure test track (inner track); • Site access; • Associated development; and • The washery site comprising:

[1] Celtic Energy s73 application for variation of condition 45 of planning application 18/1070/REM – further addendum to original environmental statement and supporting information submitted under planning reference 18/1070/REM including revised LVIA.

	• An operations and control centre/office; • Research and development centre; • 4-road rolling stock maintenance shed; • Storage siding for medium-long term storage; • Carriage wash and CET spine facility; • Site access; • Decommissioning facility; and • Stationary testing facility.
Location of activity (central point XY coordinates or national grid reference)	SN825113
Footprint of activity (ha)	475
Timings of activity (including start and finish dates)	Approximately 42 weeks including site preparation and landscaping. Start and finish dates tbc.
Relevant supporting documents	Hydrology and Flooding ES chapter Drainage Strategy

3 Baseline Information

3.1 Zone of Influence

The Water Framework Directive Cycle 2 (2018) information[2] shows that the site is located between four WFD river water body catchments. These include:

- Tawe - Confluence with Nant Llech to Confluence with Giedd (ID GB110059032170)
- Nant Llech - Headwaters to confluence with Tawe (ID GB110059032240)
- Pyrddin – Headwaters to confluence with Nedd Fechan (ID GB110058032400)
- Dulais - Headwaters to confluence with River Neath (ID GB110058032430)

All four WFD river water bodies are classified as being at **Good** status, and as such Good Status Objectives are not relevant.

The site falls within one groundwater body, Tawe - Swansea Carboniferous Coal Measures (GB41002G201000), which has an overall status of **Poor**.

The location of the project site and associated surface water features is shown in ES Figure 11.1.

[2] Water Watch Wales, Cycle 2 (2018), Available at: https://nrw.maps.arcgis.com/apps/webappviewer/index.html?id=4ef6ea25c5984c939636714dbfce25f3

A general site walkover was conducted on 28th November 2018 to support this work. Most of the watercourses on the site itself are artificial ditches part of the water drainage system for the mine site. The whole area has been mined at some point during the last 50 years.

3.2 Surface Water

3.2.1 Tawe – Confluence with Nant Llech to Confluence with Giedd

The Tawe - Confluence with Nant Llech to Confluence with Giedd water body (ID GB110059032170) is achieving overall **Good** status (Table 2), with both ecological status and chemical status classified as **Good**. Biological quality elements such as invertebrates are at **Good** status, whereas fish, macrophytes and diatoms are **High**. Supporting physico-chemical elements are achieving **High** status, other than ammonia which has a status of **Good**. As a result, physico-chemical status is **Good**.

Table 2 Summary of WFD status for Tawe – Confluence with Nant Llech to Confluence with Giedd

Macrophytes and phytobenthos combined	
Diatoms	
Hydromorphological Supporting Elements	
Hydrological regime	
Morphology	

3.2.2 Nant Llech - Headwaters to confluence with Tawe

The Nant Llech - Headwaters to confluence with Tawe water body (ID GB110059032240) is achieving overall **Good** status (Table 3), with both ecological and chemical status also **Good**. Biological status is **Good**, with elements such as fish and macrophytes at **Good** status, whereas invertebrates and diatoms are **High**. Physico-chemical status is classified as **High**.

Table 3 Summary of WFD status for Nant Llech – Headwater to confluence with Tawe.

Invertebrates	
Fish	
Macrophytes and phytobenthos combined	
Diatoms	
Physico-chemical elements	
Ammonia	High
Dissolved oxygen	High
pH	High
Phosphate	High

Temperature	High
Hydromorphological Supporting Elements	
Hydrological regime	High
Morphology	
	Not assessed

3.2.3 Pyrddin – Headwaters to confluence with Nedd Fechan

The Pyrddin – Headwaters to confluence with Nedd Fechan water body (ID GB110058032400) is achieveing overall **Good** status (Table 4). Biological status is Good, with all quality elements attaining **Good** status. Physio-chemical elements achieved **High** status and hydromorphological elements are **Not High**.

Table 4 Summary of WFD status for Pyrddin – Headwaters to confluence with Nedd Fechan

OVERALL STATUS	**Good**
ECOLOGICAL STATUS	**Good**
Biological Quality Elements	**Good**
Invertebrates	Good
Fish	Good
Macrophytes and phytobenthos combined	Good
Diatoms	Good
Physico-chemical elements	**High**
Ammonia	High
Dissolved oxygen	High
pH	High
Phosphate	High
Temperature	High
Hydromorphological Supporting Elements	**Not High**
Hydrological regime	High
Morphology	Good
Specific Pollutants	**Not Assessed**
CHEMICAL STATUS	**Good**

3.2.4 Dulais - Headwaters to confluence with River Neath

The Dulais - water body (ID GB110058032430) is achieving overall **Good** status (Table 5). Biological status is **Good**, with invertebrates at **High** status, whereas fish, macrophytes and diatoms are **Good**. Physico-chemical status is classified as **High**.

Table 5 Summary of WFD status for Dulais – Headwaters to confluence with River Neath

OVERALL STATUS	**Good**
ECOLOGICAL STATUS	**Good**
Biological Quality Elements	**Good**
Invertebrates	High
Fish	Good
Macrophytes and phytobenthos combined	Good

Diatoms	Good
Physico-chemical elements	**High**
Ammonia	High
Dissolved oxygen	High
pH	High
Phosphate	High
Temperature	High
Hydromorphological Supporting Elements	**Not High**
Hydrological regime	Not High
Morphology	Good
Specific Pollutants	**Not assessed**
CHEMICAL STATUS	**Good**

3.3 Groundwater

The scheme is located within the Swansea Carboniferous Coal Measures groundwater body (ID GB41002G201000). The overall status for the groundwater body is **Poor**, driven by a **Poor** chemical status, likely associated with a legacy of coal mining activities in the region (Table 6). Natural Resources Wales has designated that it is technically infeasible to reach 'good' status at this waterbody by 2021 due to coal minewater[3].

The site is topographically located on high ground, which suggests that the water table may be relatively low in relation to the ground surface. The ground condition assessment desk study has identified level of 70 to 120 metres below ground level in the area based on online available data.

Table 6 Summary of WFD groundwater body status

Quality Element	**Status**
OVERALL STATUS	Poor
Quantitative	Good
Chemical	Poor

3.4 Protected Sites

There are no Natura 2000 Sites located within the WFD surface water body catchments. There is a Special Area of Conservation (SAC) located approximately 5 miles east of the site, which falls within the the Swansea Carboniferous Coal Measures groundwater body. However, the features in this protected area are all related to supporting surface habitats and are separated by a topographic water divide, so it not relevant for this assessment.

[3] Natural Resources Wales (2015) Consultation on updating the River Basin Management Plan: River Basin Management Planning Overall Annex.

4 Screening

4.1 Proposed Activities

Activities that may result in an impact on WFD quality elements may take place during construction and/or operation of the proposed development. Details of the expected activities, whether they have been screened in/out of further assessment, along with an explanation for the screening decision, are provided in Table 7.

The design and construction information are currently at an outline stage and is subject to change. This assessment should be revisited during the detailed design and construction of the scheme to ensure these activities remain compliant with the objectives of the WFD.

4.1.1 Construction Activities

Key activities construction activities will include temporary dewatering to allow construction of below ground elements and excavation works. A desk study ground condition assessment has been completed, and a site investigation will be undertaken. The ground condition assessment has identified that as the site has been impacted by both sub-surface and surface coal mining activities, potential ground contamination resulting from such activities is likely. Potential contaminants associated with coal mining activities typically include various metals, metalloids, sulphates, PAHs, TPHs and asbestos. The site investigation will confirm the presence and nature of any contamination. Dewatering activities and excavation works in a contaminated ground setting pose a risk to both groundwater and surface water. Although the risk may be limited to a certain extent by the potentially low water level in relation to the high ground setting of the site, appropriate method statements and mitigation will be required once site investigations have been undertaken and the nature of the risk is better understood.

Additional risks related to the construction activities could include risks arising from works in or near watercourses, which could be increased by sediment mobilisation from and discharge of site runoff, and accidental spillage of pollutants. These risks should be managed by ensuring that there is an appropriate Construction Environmental Management Plan in place to ensure that there are no negative impacts to WFD quality elements.

4.1.2 Operational Activities

Activities that could pose a risk to WFD quality elements during operation include discharge of surface water via SuDS to the four WFD catchments identified in Section 3.2. If an insufficient level of treatment is provided and not managed, discharges may be of an acceptable quality and have the potential to adversely impact the status of WFD elements.

Discharge of foul water generated on site has the potential to impact quality elements through release into the water environment or sewerage network. Potential impacts can occur if discharge infrastructure is not of sufficient capacity or is not correctly maintained and managed.

Additional activities that could pose a risk to WFD quality elements include accidental spillage of pollutants entering surface watercourses or seepage into groundwater bodies (e.g. fuel spills from trains on testing track and in facilities within the washery site or vehicles on development roads and car park).

Table 7 Screening of proposed activities against WFD objectives

Proposed Activity	Potential impacts and mitigation measures	Screen In/Out of further assessment
Construction (Temporary) Activities		
Temporary dewatering to allow construction of below-ground elements	Temporary dewatering poses a risk to surface and groundwater due to risks of soil contamination. Desktop reviews suggests that due to the relatively low groundwater level on site, any dewatering required will not significantly impact surface or groundwater. The risk would be mitigated provided there is an appropriate CEMP in place to ensure there are no negative impacts of WFD quality elements.	Out
Works in or near to watercourses (e.g. open cut installation of new pipe beneath watercourse)	Potential impacts from activities affecting watercourses that are part of the tributary network of the river WFD water bodies. This risk would be mitigated provided there is an appropriate CEMP in place to ensure there are no negative impacts of WFD quality elements.	Out
Sediment mobilisation from site runoff	Potential impacts from excess sediment affecting watercourses that are part of the tributary network of the river WFD water bodies. This risk would be mitigated provided there is an appropriate CEMP in place to ensure there are no negative impacts of WFD quality elements.	Out
Discharge of site runoff	Potential impacts from discharge affecting watercourses that are part of the tributary network of the river WFD water bodies. This risk would be mitigated provided there is an appropriate CEMP in place to ensure there are no negative impacts of WFD quality elements.	Out
Accidental spillage of pollutants (e.g. fuel leakage from storage or plant)	Potential impacts from pollutants affecting watercourses that are part of the tributary network of the river WFD water bodies. This risk would be mitigated provided there is an appropriate CEMP in place to ensure there are no negative impacts of WFD quality elements.	Out
Excavation works (e.g. the digging of trial or borrow pits)	Excavation poses a risk to surface and groundwater due to risks of soil contamination. This risk would be mitigated provided there is an appropriate CEMP in place to ensure there are no negative impacts of WFD quality elements.	Out
Operational (Permanent) Activities		
Discharge of surface water via SuDS to the surrounding four WFD catchments	Surface water drainage across the site has the potential to create a pollution pathway for contamination (e.g. run off from car park or carriage washing facility) to enter the surrounding WFD catchments. SAB consent is being sought which includes the incorporation of Sustainable Drainage Systems (SuDS). The drainage strategy for the proposed development describes how surface water will pass through the SuDS features including swales and attenuation ponds. The features would remove pollutants to an acceptable level, in line with the 'Simple Index Approach' which is the recognised method of assessing water quality within Welsh Governments Statutory Standards for SuDS.	Out

	Following the implementation of SuDS there are not expected to be permanent impacts on the status or future potential of WFD quality elements.	
Discharge of foul water generated on site to the surrounding WFD catchments or existing sewer network	Foul water drainage across the site has the potential to create a pollution pathway for contaminants to enter the wider water environment. The site would seek to connect to the wider foul drainage network, operated by Dwr Cymru Welsh Water. A foul water drainage strategy has been developed for the site. This will follow relevant guidelines which will ensure pollutants from the sewerage do not enter the wider water environment. Following the relevant constraints, this activity is anticipated to not result in a decline in any WFD quality elements or prevent them from attaining Good status or potential in the future.	Out
Accidental spillage of pollutants from trains on testing track into groundwater bodies	The proposed development comprises a testing track for trains. Trains are sources of accidental spills as a result of fuel leaks on the testing track. For groundwater bodies, accidental spills can directly infiltrate at source or infiltrate through surface water drainage features. The likelihood of spills is low as trains will not be stationed and be constantly moving. Accidental spills on the tracks will be collected in the track drainage in the form of train ballasts preventing direct infiltration at source. However, there is potential for seepage into groundwater through the surface water drainage features (swales) connecting to the track drainage. Further detailed risk assessment should be undertaken as part of detailed design when more information is available to confirm the appropriate treatment and design.	In
Accidental spillage of pollutants from trains on testing track into surface water bodies	The proposed development comprises a testing track for trains. Trains are sources of accidental spills as a result of fuel leaks on the testing track. For surface watercourses, accidental spills have the potential to run off into surface watercourses. The likelihood of spills is low as trains will not be stationed and be constantly moving. Accidental spills on the tracks will be collected in the track drainage in the form of train ballasts and connect into the site drainage comprising a treatment train of SuDS features. Further detailed risk assessment should be undertaken as part of detailed design more information is available to confirm the appropriate treatment and design.	In
Accidental spillage of pollutants from vehicles on development roads and car park into groundwater bodies	Vehicles are sources of accidental spills as a result of fuel leaks on the roads and car park. For groundwater bodies, accidental spills can directly infiltrate at source or infiltrate through surface water drainage features. The likelihood of spills is low as there will be low traffic on the roads and within the car park and collisions are not expected. Direct infiltration at source is unlikely due to the impermeable nature of the development roads and car park. However, there is potential for seepage into groundwater through the surface water drainage features (swales) connecting to the roads and car park. Further detailed risk assessment should be undertaken as part of detailed design when more information is available to confirm the appropriate treatment and design.	In

Accidental spillage of pollutants from vehicles on development roads and car park into surface water bodies	Vehicles are sources of accidental spills as a result of fuel leaks on the roads and car park. For surface waters, accidental spills have the have the potential to run off into surface watercourses. The likelihood of spills is low as there will be low traffic on the roads and within the car park and collisions are not expected. The treatment train of SuDS features is considered sufficient to manage the impacts associated with accidental spills and it is not anticipated that accidental spills will result in a decline in any WFD quality element or prevent them from attaining Good status or potential in the future.	Out
Discharge of effluent from the individual facilities within the washery site into groundwater bodies	The washery site is comprised of facilities that will discharge effluent containing hydrocarbons, oils, sediment and other pollutants washed off the trains and spilt during activities such as refuelling. Pollution can infiltrate directly at source or infiltrate through surface water features during periods of low flow. Some facilities within the washery site are known to present a risk of pollution therefore these facilities will be equipped with specific drainage systems to intercept pollutants. Effluent leaving these facilities will be of an acceptable standard and will discharge into the wider site drainage design. Further detailed risk assessment should be undertaken as part of detailed design when more information is available to confirm the appropriate treatment and design.	In
Discharge of effluent from the individual facilities within the washery site into surface water bodies	The washery site is comprised of facilities that will discharge effluent containing hydrocarbons, oils, sediment and other pollutants washed off the trains and spilt. The facilities within the washery site present a greater risk of pollution than the testing track therefore each individual facility within the washery site will be equipped with a specific drainage system including measures for intercepting contaminants in the effluent released. The specific drainage systems connect into the site drainage system which, when combined, are considered sufficient to manage impacts and it is not anticipated that accidental spills will result in a decline in any WFD quality elements or prevent them attaining Good status or potential in the future.	Out

5 Summary

The proposed project comprises facilities for rail testing, maintenance, research, development and storage known as GCRE.

The site is located on high ground between four WFD river water body catchments, ‘Tawe – Conf with Nant Llech to Conf with Giedd’, ‘Nant Llech – Headwaters to confluence with Tawe’, ‘Pyrddin - Headwaters to confluence with Nedd Fechan’ and ‘Dulais - Headwaters to confluence with River Neath’. All four water bodies are classified as being of **Good** status.

The site is located within the Tawe - Swansea Carboniferous Coal Measures WFD groundwater body, which has an overall status of **Poor**, driven by a **Poor** chemical status, likely associated with a legacy of coal mining activities in the region.

The scope of the detailed assessment is based upon the activities identified as potentially posing a risk to WFD quality elements in the screening assessment. The study area extends to the surface and ground waterbodies within the zone of influence.

Based on the screening assessment, several activities have the potential to impact WFD quality elements and have been screened in for more detailed assessment. The activities that are screened in for further assessment include:

- Accidental spillage of pollutants from trains on testing track into groundwater bodies; and
- Accidental spillage of pollutants from vehicles on development roads and car park into groundwater bodies.

The full WFD assessment will be completed at detailed design.

Appendix 11B

Drainage Strategy

Welsh Government

Global Centre of Rail Excellence

Drainage Strategy Report

Rev 1 | 9 September 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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Appendices

Appendix A

Restoration and Existing Topography Drawing

Appendix B

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Appendix C

Celtic Energy Restoration Drainage Proposals

Appendix D

Hydrological Calculations Technical Note

Appendix E

GCRE Nant Helen
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Appendix F

Washery Site Drawings

Appendix G

DCWW Pre planning Response

1 Project Overview

The Nant Helen site to the north of Onllwyn is an open cast mine owned and operated by Celtic Energy. The mining operations currently being undertaken will cease in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and the agreements with Powys County Council (PCC). The Nant Helen Complementary Earthworks restoration scheme for the site has been approved through the Planning process.

Following discussions with both PCC and Neath Port Talbot County Borough Council (NPTCBC), the local authorities have expressed a desire to develop restoration proposals for the Nant Helen site which will create long term, sustainable jobs.

The approved Nant Helen Complementary Earthworks Scheme provides a flexible landform that can be used or adapted for a diverse set of future uses. One use for the site is for industrial purposes, in particular the Welsh Government's (WG) proposal to develop a rail testing and storage facility, known as the Global Centre of Rail Excellence (GCRE). This also includes developing the adjacent Onllwyn Washery into a rail maintenance and research facility.

The GCRE development will comprise of two tracks on sleepers set into a ballast track foundation, associated Overhead Line Equipment (OLE) to support electric trains and all required supporting infrastructure. This will be located on the 17.5m wide flat plateaus provided by the Complementary Earthworks. An access track will also be located adjacent to the track.

A new private access road is proposed to replace the existing which connects Onllwyn Road and the A4221. This will be diverted from its original route where necessary to suit the development, bridging over the cuttings.

The existing coal washery site is proposed to be redeveloped to a rail maintenance facility and research centre. The proposals currently comprise of numerous track sidings and buildings required to support the facility. The storm and foul discharge will need to be managed as the maintenance facility works will produce trade effluent which will need to be disposed of in a suitable agreed manner.

This drainage strategy is written to cover the requirements of the GCRE infrastructure, the diverted private road and the redevelopment of the Washery. New storm drainage infrastructure will be required to serve the GCRE development , however the general principle for the Nant Helen site is to retain all storm drainage features associated with the Nant Helen Complementary Earthworks drainage strategy where possible, and either amend or relocate to suit the GCRE requirements. The proposed road and rail maintenance facility, which have not been covered in the Nant Helen Complementary Earthworks drainage strategy, will require a new storm drainage provision with green infrastructure solutions, examples include swales, ditches and attenuation ponds.

2 The Site

2.1 Site Location and Description

The Nant Helen site is currently an open cast coal mine, owned and operated by Celtic Energy. The quarrying works being undertaken are nearing completion for the site. Following completion, the land is to be restored in accordance with the proposed restoration scheme which has been prepared separately by Celtic Energy. This will also include the construction of earthworks cuttings and embankments, with associated drainage features, as per the Complementary Earthworks scheme.

The site is located at approximate National Grid reference 283000, 210000. The area encompassed within the Nant Helen site planning application boundary is approximately 416ha. The existing Washery site is approximately 49ha. The Nant Helen and Washery Site locations can be seen in Figure 1.

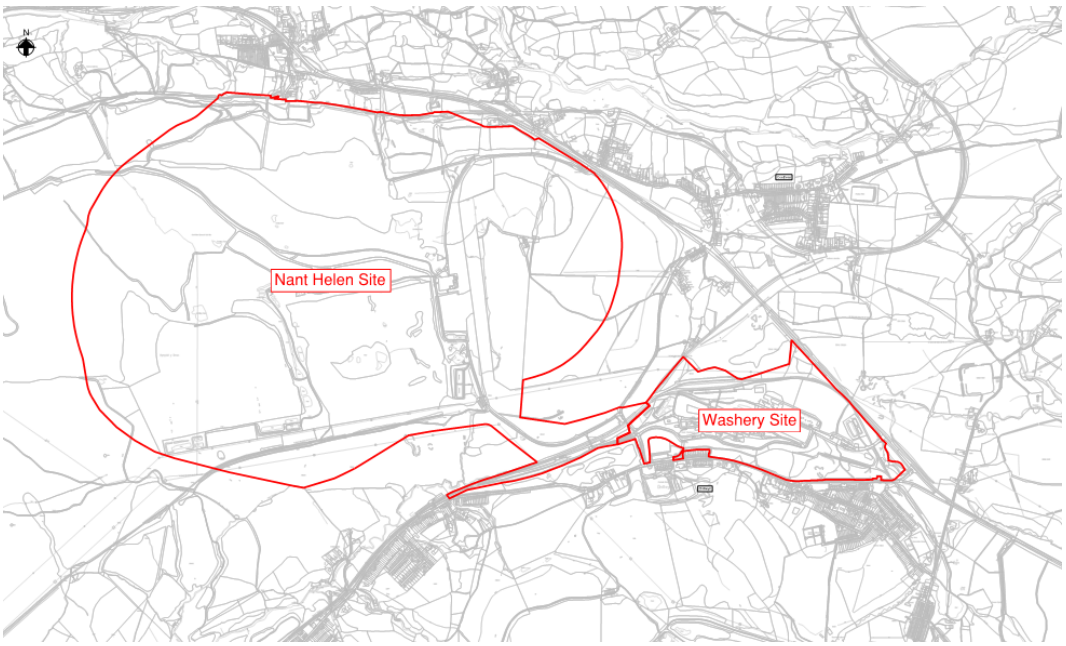


Figure 1: Site Location on OS Mapping (red – planning application boundary)

The site is proposed to be developed into a rail testing and storage facility, named the Global Centre of Rail Excellence (GCRE). Utilising the earthworks platforms provided by the Complementary Earthworks scheme, the testing track on the Nant Helen site development will comprise of two tracks on sleepers set into a ballast track foundation, associated Overhead Line Equipment (OLE) to support electric trains and an access track. The plateaus provided in the Contemporary Earthworks are anticipated to be sufficiently wide to contain the proposed works. Local earthworks reprofiling may be required to tie the works into the Complementarity Earthworks scheme.

The existing private track that runs through the site connecting Onllwyn Road and the A4221 will be diverted from its original route to suit the Complementary Earthworks development, bridging over the cuttings where necessary.

The Nant Helen site is located on the border between Neath Port Talbot and Powys, south of Caehopkin and north of Onllwyn. The site is bounded at the east by the A4221 highway and Onllwyn Road. The northern boundary of the site is formed by the Sustrans Cycle Route 43 and the southern boundary by an existing rail corridor. There are numerous engineered and natural ditches located within and around the site.

Adjacent to the Nant Helen site is the existing Coal Washery. This is currently a working coal washing facility and the proposal is to develop this into a rail maintenance facility comprising of numerous rail sidings and associated buildings to operate the maintenance facility. This will require both storm and foul drainage, including trade effluent provision.

On the rail approach to the Washery from the south west, prior to the proposed GCRE track connecting point, additional sidings are proposed. The existing rail track running from the south west through Seven Sisters terminates within the Washery site, and generally follows the line of the A4109 with the road to the south.

The Washery site is bounded by Wembley Avenue to the south and the A4221 to the east. There is a positive storm and foul network associated with the Washery as well as a local natural ditch network surrounding the site.

The River Dulais runs in a south westerly direction down the valley, predominantly to the north of the existing rail track. Tributaries to the river connect underneath the track in numerous locations. As the track approaches the Washery, the tributaries closely follow and run parallel to the track.

2.2 Site Topography

2.2.1 Nant Helen Site

The Nant Helen site is located around a ridgeline which runs from east to west on the site. To the north of this ridge, the land slopes down at a moderate gradient to the Sustrans cycle route. Similarly, the land south of the ridge falls at a moderate gradient to the rail line. The ridgeline finishes within the site extent to the east and small portion at the eastern extent of the site slopes down towards the A4221.

Owing to the opencast mining operations which take place on the western area of the site, the topography within the site changes due to the large scale earthworks taking place and the movement of earthworks material.

Celtic Energy have provided their proposed restoration contours which cover a portion of the site. The proposals broadly represent the existing topography described above, although the ridge line contained within the restoration proposals has been shifted to the north and a flat plateau is proposed at the ridgeline.

Where the proposed development is within the extent of the restoration scheme, the restoration levels have been applied as the baseline for the proposed drainage and earthworks. Outside of the restoration extent, 2m resolution LIDAR data has been applied for the baseline model.

A drawing has been produced which shows the topography of the site on this basis and can be seen in Appendix A.

2.2.2 Washery Site

The Washery site is located at the base of the hill with the brow being just south of the site boundary. The site high point (255m AOD) is located just east of centre on the southern site boundary and is on the downslope of the hills northern face. As the hill continues to fall, there is a slight plateau set at approximately 240m AOD located north east of the site high point where the land gently slopes away towards the site boundary in all directions.

North of the site the elevation starts to rise which has produced a local flat valley at approximately 230m AOD north of the site boundary.

The Washery development itself has also altered the natural topography, reprofiling areas to suit the development needs, namely larger gentle graded plateaus for the rail sidings and operations. In general, the overall direction of the natural contours has been retained with the western portion of the site sloping to the River Dulais to the west and the eastern portion of the site sloping east towards the A4221. The existing topography can be seen on CG2502 and CG2503 in Appendix F.

2.3 Published Flood Risk Maps

The Flood Risk maps hosted on the Natural Resources Wales (NRW) web portal have been checked for the site. These are detailed in the following subsections.

2.3.1 Development Advice Maps

The Development Advice Map (DAM) has been consulted to determine whether the site is located within a surface water flood zone. The map shows that the proposed development within the Nant Helen site is located entirely within Zone A, which is considered to be at little or no risk of fluvial or tidal/coastal flooding. An extract from the DAM can be seen in Figure 2.

The DAM shows the Washery site to be predominantly in Flood Zone A, an extract can be found in Figure 3. A small section on the eastern boundary is located in Zone C2 however this position correlates to an existing watercourse and no development is planned in this area.

As such, a Flood Consequence Assessment will not be required.



Figure 2: Long term flood risk Development Advice Map for the Nant Helen site. Yellow – Zone B, Blue – Zone C2

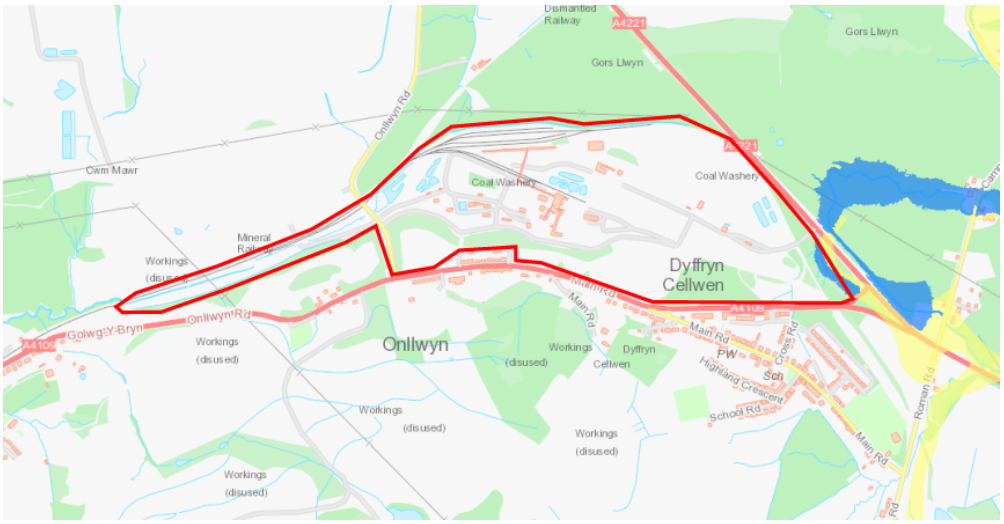


Figure 3 - Long term flood risk Development Advice Map for the Washery site. Yellow – Zone B, Blue – Zone C2

2.3.2 Fluvial, Reservoir, Coastal and Surface Water Flooding

Owing to the location and elevation of the site, there is no risk from Fluvial, Reservoir or Coastal Flooding.

The surface water flood maps show a number of areas within the Nant Helen GCRE site at low, medium and high risk of surface water flooding. These are generally centred around the numerous water features and ponds, see Figure 4.

The surface water flood map for the Washery site can be seen in Figure 5. The land directly to the north of the Washery site is subject to low, medium and high

surface water flood risk however, development is not currently planned for this area. There are some areas of surface water flooding risk on the Washery site which are to be expected as these largely correlate to existing surface water channels and ponds.

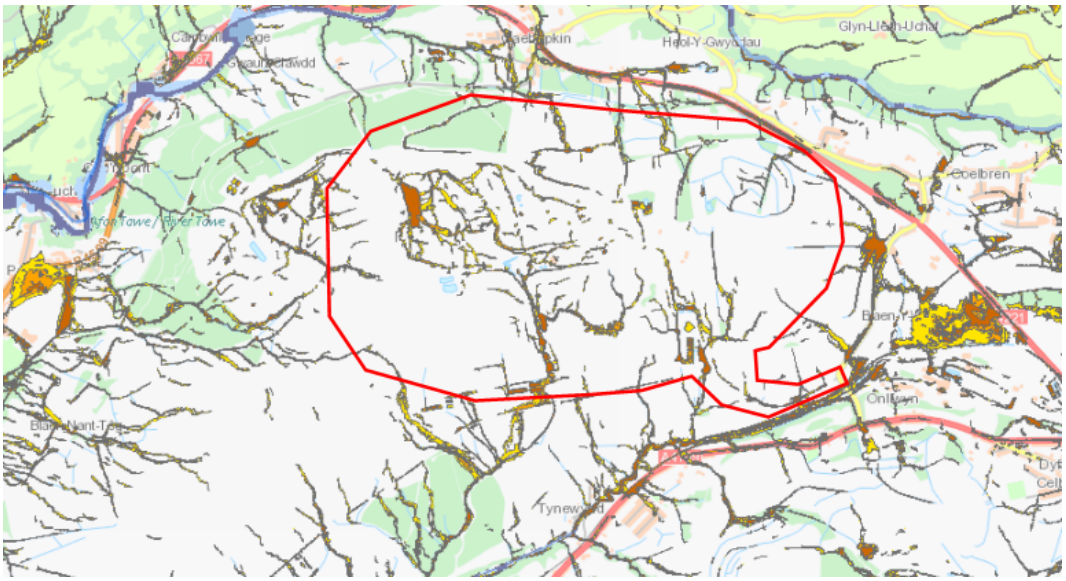


Figure 4 - Fluvial, coastal, reservoir and surface water flood risk map based on the NRW Long Term Flood Risk Maps for the Nant Helen Site (yellow and orange – surface water flooding, blue – fluvial flooding).



Figure 5 - Fluvial, coastal, reservoir and surface water flood risk map based on the NRW Long Term Flood Risk Maps for the Washeries Site (yellow and orange – surface water flooding, blue – fluvial flooding).

3 Existing Hydrology

For the analysis of the existing hydrology, the site has been split into two sections. The Nant Helen section which corresponds to Complementary Earthworks site boundary and the Washery site area.

3.1 The Nant Helen site

The proposed works to develop the Nant Helen site for the proposed GCRE use has been considered in the catchment analysis undertaken for the Complementary Earthworks Scheme.

The drainage catchments for the proposed GCRE works will remain the same as those proposed for the Complementary Earthworks. These have been summarised in the sections below.

3.1.1 Rainfall Runoff Catchments

As described in Section 2.2, the Nant Helen site encompasses a central ridgeline. This ridgeline forms the boundary between three overarching catchments. Stormwater runoff from these catchments is ultimately conveyed to three major watercourses:

- The River Tawe, to the north of the site
- The River Dulais, to the south-west of the site
- The Afon Pyrddin, to the east of the site

Within the site, these larger catchments are separated into a number of smaller sub-catchments which are served by ditches and small watercourses. These serve as tributaries, conveying the runoff from the site to the major watercourses.

Unusually, for this site there are two different catchment scenarios to consider. The first are the natural catchment areas that were present prior to the mining operations on the site (referred to as the “Original Catchments”). The second is the catchments modified as part of the Complementary Earthworks scheme, (referred to as the “Restoration Catchments”).

3.1.2 Original Catchment Boundaries

The original catchment information for the site has been provided by Celtic Energy. This information was extracted and digitized from the Flood Estimation Handbook (FEH) 1999.

To validate these catchment boundaries, a visual comparison was undertaken with the catchment data available on the FEH Online portal. The boundaries for the sub-catchments were shown to be visually similar. The shapefile for the overarching River Tawe, River Dulais and Afon Pyrddin catchments was also downloaded and compared. The ridgeline for the site demarcating the catchment boundaries matched the information provided by Celtic Energy.

A drawing showing the original catchments has been provided in Appendix B. Table 1 below provides a summary of the existing catchments. For ease of reference, the catchment names used by Celtic Energy have been applied for the proposals.

3.1.3 Restoration Catchments

The catchments and associated discharge rates based on the restoration earthwork proposals have been provided by Celtic Energy. These are contained within Appendix C. This information highlights that the majority of the proposed catchments will have reduced discharge rates compared to the original discharge rates.

During discussions with Celtic Energy, it was highlighted that the reduction to discharge rates for the River Tawe catchments has been provided to alleviate historical flooding issues in downstream tributaries. This was mainly achieved by shifting the ridgeline north and consequently reducing the contributing catchment areas. Attenuation ponds have also been proposed in some catchments to further restrict stormwater runoff.

A reduction in discharge rate has also been provided in the restoration scheme for the River Dulais catchments. However, this is not provided to alleviate downstream flooding but due to the presence of existing settlement ponds which have been incorporated into the restoration proposals as proposed attenuation features.

3.1.4 Summary of Rainfall Runoff Catchments

Based on the above, the original catchment areas should be compared to the proposed catchment areas to ensure the natural runoff regime for the site is replicated.

However, for the River Tawe catchments only, the reduction in peak discharge rates proposed by the restoration scheme will be applied to the proposals to avoid reducing the betterment provided.

3.1.5 Greenfield Runoff Rate

A hydrological analysis has been undertaken for the three major catchments to determine the Greenfield Runoff Rate (GRR). The IH124, ReFH2.2 and FEH Statistical methods have been applied and compared to calculate the GRR for the 1:1, 1:30 and 1:100-year rainfall events.

Of these methods, ReFH2.2 was selected as the most appropriate as it is a widely accepted method for plot-scale sites and uses the updated FEH13 DDF curves. It also demonstrated a better correlation with the observed QMED at river monitoring station 58008, located downstream in the River Dulais at Cilfrew.

The GRR for each catchment was therefore calculated to be the values as shown in Table 1 below. For further details of the assumptions, calculations and conclusions, refer to the Hydrology Calculations technical note in Appendix D.

Table 1 – Greenfield Runoff Rate for the site calculated using the ReFH2.2 summer profile

Catchment	Greenfield Runoff Rate (l/sec)		
	1:1 year	1:30 year	1:100 year
River Tawe	17.8	42.2	53.0
River Dulais	19.8	46.3	57.9
Afon Pyrddin	16.9	40.5	51.0

3.2 Washery Site

3.2.1 Rainfall runoff catchments and Existing Drainage

The existing coal washery development has introduced surface water channels and site reprofiling which have impacted the natural catchments. A ridgeline is present to the east of the existing coal stores which divides the site into two catchments as shown on CG2502 and CG2503 in Appendix F. The area to the west of the ridgeline falls towards to the River Dulais to the west of the site. The area to the east of the ridgeline falls towards the A4221 and lies within the Afon Pyrddin catchment.

The topography indicates that overland flow enters the Washery site from the higher ground from the south. Surface water management information provided by Celtic Energy, show that perimeter surface water ditches intercept the flow and convey it to the River Dulais to the west and a tributary to the Afon Pyrddin to the east.

Within the eastern Afon Pyrddin Catchment, the watercourses and surface water channels converge and cross the A4221 adjacent to the Washery site access entrance from the A4221. It is thought that a culvert is present in this location to convey the flow underneath the highway, but this has not been confirmed.

Directly north of the site is a flat area shown to be at risk to surface water flooding on the NRW flood maps. The natural contours imply that this northern area drains towards the River Dulais tributaries via perimeter surface water channels around the existing Washery.

An existing surface water management strategy has been provided by Celtic Energy who currently operate the coal washery. The information, reproduced on CG2502 and CG2503 in Appendix F, shows there to be multiple surface water ditches, piped networks, ponds and settlement lagoons for the management of surface water runoff on the existing site. These all primarily outfall to the River Dulais to the west, with a small portion of access track and storage areas outfalling to the Afon Pyrddin tributary to the east. The existing ponds are also currently being used for the treatment of washery process water which is discharged to the River Dulais under an existing discharge consent. The discharge consent limits the runoff to a maximum 100l/sec and no more than 5000m^3 per day.

Two settlement lagoons are shown on the eastern boundary however, these lagoons are not shown as in use on the surface water management information provided by Celtic Energy.

The proposed section of track connecting the Washery site to the test track on Nant Helen site also lies within the River Dulais catchment.

3.2.2 Greenfield runoff rate

The Greenfield runoff rates for the River Dulais and Afon Pyrddin catchments have been used as calculated for the Nant Helen catchment in Section 3.1.5.

For further details of the assumptions, calculations and conclusions, refer to the Hydrology Calculations technical note in Appendix D.

Table 2 - Greenfield Runoff Rates for the Washery site catchments

Catchment	Greenfield Runoff Rate (l/sec)		
	1:1 year	1:30 year	1:100 year
River Dulais	19.8	46.3	57.9
Afon Pyrddin	16.9	40.5	51.0

4 Proposed Stormwater Drainage

4.1 Introduction

The Nant Helen Complementary Earthwork Scheme provides a 17.5m wide plateau to facilitate the infrastructure for the GCRE scheme. As such, the Complementary Earthworks Scheme considered the impact of the cuttings and embankments on the existing drainage catchments and flow paths whilst making an allowance for the drainage requirements of the proposed GCRE scheme.

The GCRE rail and access track will require a dedicated storm water drainage system. This infrastructure will be located on the 17.5m flat plateaus created by the Complementary Earthworks. The track drainage will replace the ditches proposed on the plateaus however, the outfall locations and overarching strategy will remain the same as that detailed in the Complementary Earthworks Drainage Strategy report.

The private access road realignment though the GCRE site will also require a dedicated storm drainage system.

The development of the Washery site will require a surface water network to serve the maintenance facilitiy including buildings, track sidings, storage areas and general infrastructure. Any new track infrastructure including the connecting track to the Nant Helen site and the proposed sidings on the approach to the Washery, will also require drainage provision.

This section outlines the drainage strategy for each catchment area on both the Nant Helen and Washery sites and the proposed attenuation and conveyance features.

The proposed drainage drawings for the Nant Helen site can be found in Appendix E and the Washery site in Appendix F.

4.2 Schedule 3 of the Flood and Water Management Act

Schedule 3 of the Flood and Water Management Act 2010 establishes SABs (SuDS Approving Body) in local authorities. Since the 7th January 2019, developments greater than 100m^2 or developments containing more than one building will be required to submit a SAB application. This application requires developers to utilise Sustainable Drainage Systems (SuDS) in their surface water management for a development.

SuDS aim to manage rainfall on site using methods that mimic natural processes, by making use of the landscape and vegetation to control the flow, volume and quality of the surface water runoff. In addition, SuDS also provide amenity benefits by providing aesthetically pleasing and natural landscapes, and biodiversity benefits by creating habitats for wildlife and vegetated areas.

The Welsh Government's Statutory Standards for Sustainable Drainage Systems contains six standards, which details the requirements for the surface water drainage. The standards are as follows:

S1. Runoff destination

S2. Hydraulic control

S3. Water quality

S4. Amenity

S5. Biodiversity

S6. Construction, operation and maintenance

These form a set of principles which must be considered in the design of the SuDS features in order to obtain approval by the SAB.

4.3 S1 - Runoff Destination

The Welsh Government's SuDS Standard S1 provides a discharge hierarchy for surface water from developments, as well as exemption criteria for each level that must be met before the next level can be considered. The discharge hierarchy is shown below:

- Level 1: Surface water runoff is collected for use;
- Level 2: Surface water runoff is infiltrated to ground;
- Level 3: Surface water runoff is discharged to a surface water body;
- Level 4: Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system;
- Level 5: Surface water runoff is discharged to a combined sewer.

The aim of this is to encourage developments to use runoff as a resource and ensure that runoff is sustainably managed to avoid any negative impacts from the development, such as increased flood risk.

4.3.1 Level 1 - Collected for Use

The GCRE track infrastructure does not require non-potable water to be used therefore this does not provide a viable discharge point for the site.

There is an opportunity in the proposed rail maintenance facility to utilise harvested rainwater, particularly for lavatories, and this should be adopted where possible. The frequency of use of these facilities compared to the site area however will mean that only a small proportion of the total volume of rainfall and runoff can be reused. Additionally, rainwater harvesting tanks may be already full after successive storms and not be sufficient to cater for larger return period events. Therefore, rainwater harvesting is not considered a suitable primary outfall for the surface water strategy.

4.3.2 Level 2 - Infiltrate to Ground

For the Nant Helen site much of the current area has been previously open casted, whilst other areas have remained unaffected. Both the natural and restored ground are within material of low permeability. Therefore, infiltration is not a viable outfall source for the site.

Soakaway tests have not yet been undertaken for the Washery site at this stage, however it is anticipated that the ground material will be similar to the Nant Helen site, and soakaways are likely to not be viable. Open source British Geological Survey (BGS) superficial records indicate peat to be present in the area. This further indicates that the use of a soakaway solution as the primary outfall would not be feasible.

Additionally, the large presence of water bodies and surface water channels indicate that the ground is of low permeability, this should be confirmed through soakaway testing in future design stages.

However, some infiltration is likely to occur and may be suitable to provide infiltration of the first 5mm of rainfall and prevent discharge in small return period events. This is discussed further under Standard S2 - Hydraulic Control.

4.3.3 Level 3 - Discharge to a Surface Water Body

There are a number of existing ditches and watercourses within the Nant Helen site extents as well as drainage features associated with the Complementary Earthworks scheme to convey and attenuate the flow. These form the pathways for surface water runoff to communicate to the downstream watercourses. As such, it is proposed to outfall runoff from the site to the receiving watercourses using these existing features, albeit with some ditches/swales relocated to suit the proposed works.

The existing Washery works discharge into lagoon features on the western boundary which capture runoff and attenuate/treat it before outfalling to the River Dulais to the west. It is also assumed that the lagoons on the eastern side boundary perform a similar function and attenuate/treat flow before outfalling into an Afon Pyrddin tributary to the east, however this has not been confirmed. For the maintenance facility, it is proposed that storm runoff is directed to the eastern and western boundary and discharged into the same receiving watercourses as the existing works, mimicking the current hydraulic regime.

Discharging to a waterbody will provide the runoff destination for all the sites, as such, Level 4 and 5 have not been considered.

4.4 S2 - Hydraulic Control

Standard S2 details the requirements for hydraulic runoff from the site. The existing GRR for the Nant Helen site including the original and restoration catchment areas and the Washery site have been assessed and compared in Section 3 of this report.

4.4.1 Nant Helen Site

The proposed test track and rail infrastructure are contained on the 17.5m plateaus created by the Complementary Earthworks. The attenuation features proposed for the Complementary Earthworks, described in the Complementary Earthworks Drainage Strategy Report, have been designed to accommodate the GCRE proposals and as such will retained and utilised for the proposed scheme. The hydraulic control measures and attenuation ponds have been designed to control additional impermeable area, above that of the natural catchments, for storm events up to and including the 1 in 100 year return period event including a 40% allowance for climate change. The attenuation requirements for the GCRE Nant Helen site are shown on drawings CG3050 to CG3053 in Appendix E.

The proposed catchment and discharge rates for the GCRE Nant Helen site in comparison to the original catchment areas is summarised in Table 3.

Table 3 - Summary of the original and proposed catchment areas and discharge rates for the GCRE Nant Helen for the 1:100-year event.

Catchment	Original Catchment Area (ha)	Proposed Catchment Area (including track area) (ha)	Original 1:100 year Discharge Rate (m^3/s)	Proposed 1:100 year Discharge Rate (m^3/s)
1B	9.5	0.0	0.5	0.0
1C	7.5	3.0	0.4	0.2
1D	55.2	25.4	2.9	1.3
1E	39.6	41.0	2.1	1.9
1F	42.3	44.3	2.2	2.1
1G	36.2	16.4	1.9	0.3
1H	24.6	8.3	1.3	0.4
1I	0.0	26.3	0.0	1.4
River Tawe	**214.9**	**164.7**	**10.9**	**7.7**
2A	33.0	28.8	1.9	1.7
2B	55.7	115.3	3.2	3.2
2C	77.6	72.7	4.5	4.2
River Dulais	**166.2**	**216.8**	**9.6**	**9.1**
3A	34.8	34.4	1.8	1.7
Afon Pyrddin	**34.8**	**34.4**	**1.8**	**1.7**
Total	**415.9**	**415.9**	**22.3**	**18.5**

For the River Tawe catchment, the reduction in contributing area coupled with the reduction in discharge rates proposed as part of the restoration scheme results in a

total 30% reduction in peak flow to the River Tawe, which includes a 40% allowance for climate change for future impermeable areas.

Conversely, the River Dulais Catchment has an overall increase in impermeable area, particularly attributed to Catchment 2B. To mitigate the associated increase in site runoff, a series of ponds have been proposed within the catchment to attenuate stormwater to the original peak discharge rate.

The Afon Pyrddin also has a small increase in catchment area, resulting in the flows being attenuated to match the original discharge rate.

A portion of the impermeable area of GCRE track connecting the testing loops to the mainline has not been accounted for in the Complementary Earthworks Scheme drainage. Attenuation and hydraulic control for the additional 4.1ha of impermeable area will be provided adjacent to the existing railway to the south and detailed further in Section 4.4.2.

The GCRE track, ballast and access track along the 17.5m plateau will require its own dedicated drainage features which will outfall into the Complementary Earthworks drainage features or for the connecting track to the Washery, a dedicated attenuation feature before the receiving watercourse.

The realigned access road could be drained through swales running adjacent to the highway which then connect to the Complementary Earthworks drainage and outfall into the relevant catchment. As the road is being aligned and similar cross section installed, there is no change in the impermeable area.

4.4.2 Washery Site

It is anticipated that the earthworks and levels for the proposed maintenance facility will not differ significantly from those of the existing Washery due to the need to tie into the existing rail infrastructure. Additionally, much of the area previously supported additional rail sidings and infrastructure in its former historic use. Earthworks modelling will be undertaken in further design stages however, it is not expected for the proposed gross drainage catchment areas to differ markedly from the existing.

Increases in impermeable area are expected due to the positive drainage of additional rail track, hardstanding areas, buildings and access tracks. It is proposed to attenuate the flows to the greenfield rates outlined in Section 3 prior to outfalling into the existing watercourses. Similarly, to the Nant Helen Site, attenuation and hydraulic control will be provided for storm events up to and including the 1 in 100 year return period event plus a 40% allowance for climate change.

The proposed sidings on the approach to the Washery site will require surface water network and attenuation due to an increase in impermeable area.

As discussed in Section 3.2, areas to the south and north of the existing Washery's area are thought to produce overland surface water runoff towards the Washery site. As per the current hydraulic regime, the cut off ditches that currently intercept the overland flow will be maintained to convey the flow to the existing

watercourses. This minimises the risk of surface water flooding for the development from the upper natural catchments. Attenuation of such flows are not proposed as the runoff is from green areas only.

The attenuation requirements for the Washery site are shown on drawings CG2504 to CG2505 in Appendix F and summarised in Table 4.

Table 4 - Washery's Site Attenuation Volume Estimates

Area	Catchment Ref	Imp. Area (ha)	100 yr GRR (l/s)	Estimated Attenuation Vol. m^3
Maintenance facility	2D	15.72	910.2	7830
West Approach Sidings	2E	3.70	214.2	2130
Eastern Sidings	3B	1.05	60.8	600
Main loop Connection	2C	4.10	237.4	2340
Access Track	2C	1.70	98.4	970

4.4.3 Drainage Features

To facilitate conveyance of flow around the Nant Helen and Washery site, a number of drainage features are proposed. These are detailed briefly in the following subsections.

For the location of these drainage features, refer to drawings CG3050 to CG3053 in Appendix E and CG2504 to CG2505 in Appendix F.

4.4.3.1 Rail track drainage

Rail track drainage will be provided in the rail ballast in the form of perforated pipe filter drains. The surface water runoff within the 17.5m plateaus will be directed into the filter drains which will run parallel to the rail track. An indicative arrangement of the plateaus can be found on CG3024 in Appendix E. Drainage of the cuttings will also be provided by the filter drains.

For the Nant Helen site, the longitudinal gradient of the track is such that the low points are aligned with the embankment sections of the Complementary Earthworks. This allows the track drainage to connect to either cut off ditches or cascades located at the base of the embankments.

Track drainage will also be provided for the rail network in the Washery site. Similarly, to the test track, filter drainage will be used to drain the track ballast running parallel to the track. The filter drains will then discharge into ditches and ponds at appropriate locations downstream.

4.4.3.2 Swales/ Cut-off Ditches

In the Nant Helen site, to collect and convey runoff from the base of embankments and top of cuttings, cut-off ditches have been proposed. These will capture sheet runoff from upland areas and convey them to the low points within the catchments.

Swales and cut off ditches will be used to capture runoff from the realigned private access road with runoff directed to the ditch network associated with the Complementary Earthworks.

Within the Washery site, swales and cut off ditches will be used to convey flow from the track filter drainage and proposed buildings to the attenuation features. The gentle site gradients and linear nature of the rail maintenance facility lends itself for the use of swales as an effective and sustainable drainage solution.

Three types of ditch profile are currently proposed:

- In areas of low flow, low velocity and shallow longitudinal gradients (less than 1 in 35), grass lined channels will be used. These will generally be towards the start of the ditches where runoff will be less concentrated.
- Where higher flows are anticipated or for longitudinal gradients steeper than 1 in 35, stone bedded channels will be proposed. This will provide channels with long-term stabilisation and erosion protection. The stone size will be determined based on the anticipated flows in the ditch.
- Finally, at longitudinal gradients steeper than 1:12 or where flow would become supercritical (Froude number > 1), the ditches will be rock reinforced bedded on a concrete bed. Longitudinally, these would be stepped with slight ponding on each step to dissipate energy from the water.

4.4.3.3 Culverts

Water collected by cut-off ditches at the base of the embankments on the Nant Helen site will need to be conveyed under the plateau at discreet low points. To do this, a number of culverts will be installed as part of the scheme.

Culverts should be designed in accordance with CIRIA C689 - "C*ulvert Design and Operation Guide*". Culverts should be sized to accommodate flows from the 1:100-year event including a 40% allowance for climate change.

At the inlet and outlet for the culverts, a headwall will be required. These are likely to be precast or in-situ concrete headwalls. However, for smaller diameter culverts alternative soft engineered options may be considered.

The outfall from the Washery site is anticipated to connect to the River Dulais tributary upstream of the culvert under Onllwyn Road.

Culverts may also be required in and around the development to maintain the natural flow paths and existing surface water channels which may be severed by proposed rail and access road infrastructure.

4.4.3.4 Cascades

At a number of locations on the Nant Helen site, the cut-off ditches are required to flow down the side of the proposed engineered slopes. To do this, cascade features will be required.

These will be designed to have sufficient capacity for the 1:100-year event (+40% climate change) and dissipate energy from the flow as required.

4.4.3.5 Attenuation Ponds

The attenuation ponds specified in the Complementary Earthworks will be retained for the proposed GCRE development. The existing lagoons on the Washery site will be removed, where required, to allow for the new track infrastructure however, new attenuation ponds are proposed. Ponds will also be required for the new track sidings and the track connecting the Nant Helen site to the Washery.

All ponds have been sized for the various catchments as described in Section 4.4. A 300mm freeboard will be provided above the highest water level for each pond.

The attenuation ponds will be lined to provide a permanent wet base and increase the amenity and biodiversity value to the scheme. An access track has also been provided around the Nant Helen ponds to provide an area for inspection and maintenance.

Access to all ponds will be required to facilitate inspection and maintenance.

Hydraulic control will be provided on the pond outfalls to attenuate the discharge rate to the GRR.

4.4.4 Further Considerations

For the Nant Helen site, the GCRE infrastructure is predominantly permeable. An impermeable access track is being introduced however runoff from this track is being slowed as it percolates through the ballast. Generally, stormwater falling on the catchment will infiltrate and evapotranspirate at the same rate it does in the existing case. Therefore, it is not proposed to review the Complementary Earthworks proposals to reduce discharge from the site for rainfall events less than 5mm.

This will also be the case for the relocated private road which will be served by vegetated cut off ditches and swales offering interception.

The proposed maintenance facility on the Washery site will have a number of impermeable surfaces, including the access roads and associated buildings. Interception of the first 5mm of rainfall will be required for these areas. It is anticipated that this will be provided by the swales, ditches and green infrastructure for the scheme. Further consideration of this element will be required during subsequent design stages.

For each sub-catchment, the runoff rate will be controlled to the GRR to mitigate any increase in flood risk and prevent morphological and ecological damage downstream. For the River Tawe catchments, the betterment provided as part of the restoration scheme has been incorporated into the proposals, resulting in an overall reduction from the GRR.

Volumetric control will also need to be considered for each catchment based on the potential future impermeable area. This will be achieved through long-term storage areas discharging at a reduced discharge rate within the attenuation ponds.

4.5 S3 - Water Quality

The Welsh Standard S3 covers the necessary water quality requirements for a scheme.

During construction, it is likely that silts will be mobilised by rainfall which if uncontrolled will be conveyed to the downstream watercourses. Celtic Energy have noted this and propose to use a combination of settlement ponds and Siltbusters to capture silt during the earthworks. This will be detailed in the Contractor's method statements.

Following completion of the earthworks, the engineered slopes will be grass seeded. Once the roots have taken, the site will be effectively green and therefore no dedicated treatment train is required at this stage. However, it is noted that the grass lined channels and attenuation ponds will provide water quality benefits for the scheme.

The predominant mechanism for potential surface water pollution is anticipated to be derived from the mobilisation of contaminants from the rail network during storm events, particularly in the siding areas where carriages may be stationary for some time. Appropriate stages of treatment, often referred to as 'treatment trains' will be required to ensure adequate pollution mitigation is provided.

The current proposed treatment train, in order, consists of; trackside filter drains, ditches/swales and attenuation/bio retention ponds prior to discharge into the natural watercourses. For the maintenance facility area, sediment/oil forebays may be required upstream of the ponds to capture and contain any potential contaminants which have not been treated by the upstream networks.

Additionally, specific maintenance areas such as carriage washing and fuel handling areas etc, may require their own dedicated pollution control systems prior to connecting into the wider surface water network.

4.6 S4 - Amenity

The Welsh Standard S4 states that the surface water management systems should maximise amenity benefits.

The proposed use of grass lined ditches will provide a more natural looking drainage on the site which will be visually appealing. Similarly, the ponds can be shaped to look visually appealing and provide provision for additional flora, fauna and wildlife habitats.

4.7 S5 - Biodiversity

Standard S5 requires that surface water management systems also maximise biodiversity benefits.

The use of grass lined ditches and attenuation ponds will provide a diverse range of habitats for flora and fauna.

4.8 S6 - Construction, Operation and Maintenance

Standard S6 requires that the proposed surface water drainage systems are designed such that they can be constructed, operated and maintained easily, safely and cost effectively for the whole design life of the systems. They should also aim to minimise the use of natural resources and embedded carbon.

The Complementary Earthworks scheme will be completed before the GCRE scheme is installed which will provide suitable access to all areas. Utilising the drainage installed as part of those works will minimise the amount of work required and therefore natural resources.

The use of green features will also assist in offsetting carbon and the nature of the ballast will offer a filtering effect and to a degree keep contaminants within the ballast rather than discharging them into the watercourse.

The drainage proposals minimise the requirement for hard engineering solutions by utilising ditches for conveyance and attenuation ponds for storage. Stone for the ditches will likely be from site won material rather than being imported.

An access track has been provided around each of the attenuation ponds to facilitate an area for inspection and maintenance. To provide access to each pond, a proposed maintenance access track route has been determined around the GCRE, this is shown in drawing CG3075 in Appendix E.

5 Foul Drainage

No existing or proposed foul drainage is currently required for the Nant Helen Site. The existing Washery site is served by foul drainage and the proposed maintenance and research facilities will require foul drainage provision as detailed in the following sections.

5.1 Existing Foul Drainage

Asset record information obtained from Dŵr Cymru Welsh Water (DCWW) show a public 150mm foul sewer enters the western portion of the Washery site from the north. The records show the sewer converts to a 230mm diameter combined drain within the site before exiting the site. After the public combined network that serves Onllwyn connects to this combined network it continues in a south westerly direction down the valley.

Information provided by Celtic Energy shows an existing private foul drainage network present in the Washery site. The network collects flows from various buildings before heading in a westerly direction and outfalling to the existing 230mm diameter combined sewer.

Celtic Energy have advised that trade effluent is not currently discharged from the site into the DCWW foul or combined network.

5.2 Proposed Foul Drainage

Foul drainage will be generated from the site from staff facilities such as canteens, toilets and welfare facilities. Based on a staff population of 118, the estimate submitted in the economic business case, the proposed peak flow is estimated to be 1.87 l/s.

A pre planning application was made to DCWW to ascertain if sufficient capacity exists within the local network to facilitate the proposed development based on the above peak flow. DCWW have subsequently advised that sufficient capacity exists within the combined sewer to cater for the development. Therefore, it is proposed to convey the foul drainage from the development to the existing connection to the DCWW combined sewer. The pre planning response letter can be found in Appendix G.

5.3 Proposed Trade Effluent

It is anticipated that the maintenance facility works will also produce trade effluent from train carriage washing facilities. The quantity and flow rates for such facilities are currently unknown at this stage of the scheme. As part of the pre planning application to DCWW, it was highlighted that discharge of pre-treated carriage wash may require a connection to the DCWW network. DCWW have advised in the pre planning response that a discharge consent would be required.

Should an agreement on the discharge of trade effluent to the DCWW sewer not be reached with DCWW, storage and removal of trade effluent may be required.

6 Conclusion

The surface water drainage strategy has been considered in accordance with the Welsh Government's Statutory Standards for Sustainable Drainage Systems. Consideration has been given to the proposed runoff destination, hydraulic control, water quality, amenity and biodiversity for the scheme.

The proposed Nant Helen rail testing tracks will be located on the 17.5m earthworks plateaus provided by the previously submitted Nant Helen Complementary Earthworks Scheme.

The drainage strategy for the Complementary Earthworks considered and made allowance for the proposed GCRE development. Minor changes have been proposed which include; the replacement of the drainage on the earthworks plateaus for dedicated track drainage, additional drainage for the rail link between the testing loops and the existing mainline and the drainage for the GCRE access road.

The Complementary Earthworks Scheme will result in modifications to the original catchment and restoration catchment areas. For each sub-catchment, to ensure the runoff rate from the site is not increased, the catchment areas for the original and proposed catchments were compared. Where the proposed catchment is larger, flows have been attenuated to the GRR for the smaller catchment area. In addition to this, for the River Tawe catchments, the betterments to the GRR proposed in the Celtic Energy Restoration Plan have been adopted. Further details are contained with the previously submitted Complementary Earthworks Drainage Strategy Report. Attenuation and flow control will be provided to GRR for storm events up to and including the 1 in 100 year return period event including a 40% allowance for climate change.

Rail maintenance and research facilities are proposed on the site of the existing Onllwyn Coal Washery. The existing surface water catchments and drainage strategy have been evaluated and used to inform the proposed strategy. It is proposed to control, treat and convey the surface water from the proposed impermeable areas to the GRR prior to discharging to existing watercourses. The majority of the site is proposed to outfall west into the River Dulais mimicking the existing hydraulic regime. The eastern portion of the site is proposed to outfall to a tributary for the Afon Pyrddin to the east. Attenuation and flow control will be provided for storm events up to and including the 1 in 100 year return period event including a 40% allowance for climate change.

The principles of the stormwater conveyance have been discussed. The rail track will be primarily drained by filter drains within the ballast. Elsewhere, the stormwater runoff will be captured and conveyed within the catchments utilising engineered cut-off ditches, swales, culverts, cascades and attenuation ponds. The sequential drainage elements will provide treatment of the storm water prior to discharging to existing watercourses. The ditches and attenuation ponds will also

provide both amenity and biodiversity value by blending into the natural landscape and providing a contrast between dry and wet areas.

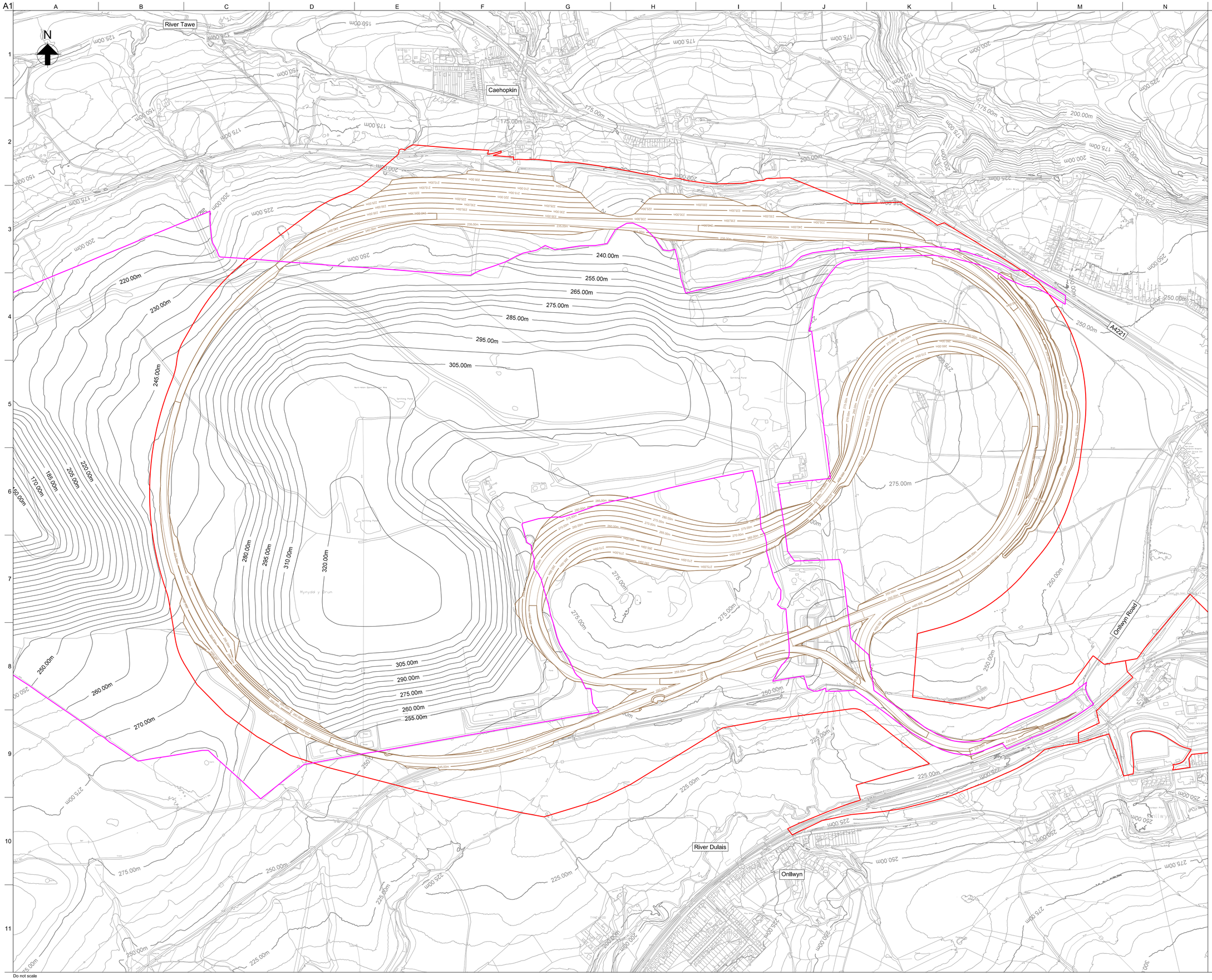
The proposed rail maintenance facility at the Washery site will require a foul drainage connection for the site buildings. Based on an occupancy of 118 staff and estimated peak flow of 1.87 l/s, DCWW have confirmed that sufficient capacity exists within the existing connection to the combined sewer to facilitate the proposed development.

Carriage washing facilities will generate trade effluent which will need to be disposed of accordingly. The discharge of trade effluent to the combined DCWW sewer would require a trade discharge agreement with DCWW. Should an agreement on the discharge of trade effluent to the DCWW sewer not be reached with DCWW, storage and removal of trade effluent may be required.

Appendix A

Restoration and Existing Topography Drawing

A1



Legend

- Planning Application Boundary
- Restoration Works Boundary
- 285.000m — Restoration Topography
- 285.000m — Existing Topography
- 285.000m — Complimentary Earthworks Plateaus

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. Levels shown within the Restoration Works Boundary are based on the restoration scheme proposed by Celtic Energy and provided to Arup on 17/10/2019. No responsibility is taken for the accuracy of this information.

3. Levels outside the Restoration Contour Boundary are based on 2m resolution LIDAR data. No responsibility is taken for the accuracy of this information.

4.Slight discrepancies between LIDAR data and restoration proposals to be reviewed once topographical survey is undertaken on site.

J:\264000\264904-00\4 Internal Project Data\4-30 Drawings\4-31 Issue drawings\Drainage Submission\CG3000.dgn

Issue	Date	By	Chkd	Appd
P01	17/07/20	DO	IA	JS
Issued for Planning				

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Client
Welsh Government

Job Title
Global Centre for Rail Excellence

Drawing Title
Existing Site Plan, Restoration Topography and Planning Boundary

Scale at A1 1:5000

Discipline Infrastructure

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3000**	**P01**

Do not scale

© Arup

Appendix B

Nant Helen Original and Proposed Catchment Boundaries Drawing

A1

River Tawe

Caehopkin

Catchment 1E: 39.6 ha

Catchment 1F: 42.3 ha

Catchment 1G: 36.2 ha

Catchment 1H: 24.6 ha

Catchment 1D: 55.2 ha

Catchment 3A: 34.8 ha

Catchment 1C: 7.5 ha

Catchment 1B: 9.5 ha

Catchment 2A: 33.0 ha

Catchment 2B: 55.7 ha

Catchment 2C: 77.6 ha

A4221

Onllwyn Road

River Dulais

Onllwyn

Legend

- Planning Application Boundary
- 285.000m — Existing and Restoration Topography
- Existing Watercourse
- Engineered Site Restoration Watercourse (Proposed)
- Surface Runoff Direction
- Catchment Boundary

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. Levels within the Restoration Works Extent are based on the restoration scheme proposed by Celtic Energy and provided to Arup on 17/10/2019. No responsibility is taken for the accuracy of this information.

3. Levels outside the Restoration Scheme Extents are based on 2m resolution LIDAR data. No responsibility is taken for the accuracy of this information.

4.Slight discrepancies between LIDAR data and restoration proposals to be reviewed once topographical survey is undertaken on site.

J:\264000\264904-00\4 Internal Project Data\4-30 Drawings\4-31 Issue drawings\Drainage Submission\CG3005.dgn

Issue	Date	By	Chkd	Appd
P01	17/07/20	DO	IA	JS
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Client
Welsh Government

Job Title
Global Centre for Rail Excellence

Drawing Title
Existing and Restoration Topography Flow Paths

Scale at A1 1:5000

Discipline Infrastructure

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3005**	**P01**

Do not scale

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Appendix C

Celtic Energy Restoration
Drainage Proposals

CELTIC ENERGY LTD

NANT HELEN REMAINDER SURFACE COAL MINE SITE

Condition 45: Restoration of Watercourses – Design Statement Revision C

1.0 Introduction

The overall site restoration strategy was established through the original planning consent, to which reference has been made in developing these proposals to restore the watercourses affected by the site workings. The site covers the head of the local catchment areas, with the larger part of the site draining towards the north to the Afon Tawe and the southern part of the site draining towards the south to the Dulais. A very small triangle of land to the east drains towards the Afon Pyrddin.

A restoration scheme has been submitted under condition 45 of the current Planning Permission and the restoration of the watercourses is specifically referenced in part g) to enhance biodiversity and in part i) to create attenuation ponds, water features, wetlands and reed beds to achieve maximum ecological diversification.

2.0 Design Principles

The restoration of the watercourses has been designed to incorporate attenuation ponds, wetlands and rush-lined channel beds in accordance with the submitted scheme. These water features will slow down and reduce surface water flows away from the site and re-connect the restored on-site watercourses to the existing downstream watercourses that were severed by the site operations.

Wherever gentler gradients permit, the watercourses will be clay-lined and planted with rushes; wetlands are located into the proposed landscape where possible. The gradients along some of the watercourses are steep and for slopes in excess of 1 in 12 the channel beds will need to be reinforced with rock. These sections will be stepped and formed with back-fall areas to provide small pools and to help slow the flows.

In between the more gentle and steep gradients the watercourse beds will be lined with loose stone/gravel. The size of the gravel beds that will be required for stability have been determined by calculation and typical details of each of the three types of construction are included on the watercourse restoration drawings.

Of the total length of new watercourses, an estimated 17% will be rush-lined, 53% formed with stone/gravel beds and 30% will need to be reinforced with rock. Natural materials will be sourced from the site as much as possible for use in the construction of the new watercourses.

Reference has been made to the original planning application documents to compare the original surface water run-off from the site and the long-term surface run-off resulting from the restoration proposals. Preliminary designs have been undertaken for the proposed

on-site water features to act as attenuation ponds and reduce the surface water run-off from the site to lower flow rates than were experienced before the site was brought into operation. The principle of reducing the flows away from the site also serves to reduce possible flood risk in the downstream receiving watercourses including the main rivers, the Afon Tawe and the Dulais.

A summary comparison table of the pre- and post-operational surface water run-off rates to each of the original catchment areas follows, together with a second table showing the results of the preliminary attenuation assessments. Calculations for each watercourse and the associated attenuation assessments are included as separate attachments.

3.0 Q_{100} Off-Site Flow Comparisons

Original Site Catchment	Original Q_{100} Site Run-off (cumec)	Proposed Watercourse	Proposed Q_{100} Site Run-off (cumec)	Difference in Flows Off-site (Percentage)
1a	0.310	Site run-off	0.268	-14%
1b	3.000	Site run-off	0.251	-92%
1c	3.600	A	1.080	-70%
1d	4.200	C	1.522	-64%
1e	1.480	E	1.066	-28%
1f	1.010	Site run-off	0.967	-4%
1g	1.090	D	0.441	-60%
2a	1.330	H	0.397	-70%
2b	1.620	G1 and G2	0.819	-49%
2c	0.830	F	0.216	-74%

4.0 Preliminary Q_{100} Attenuation Assessments

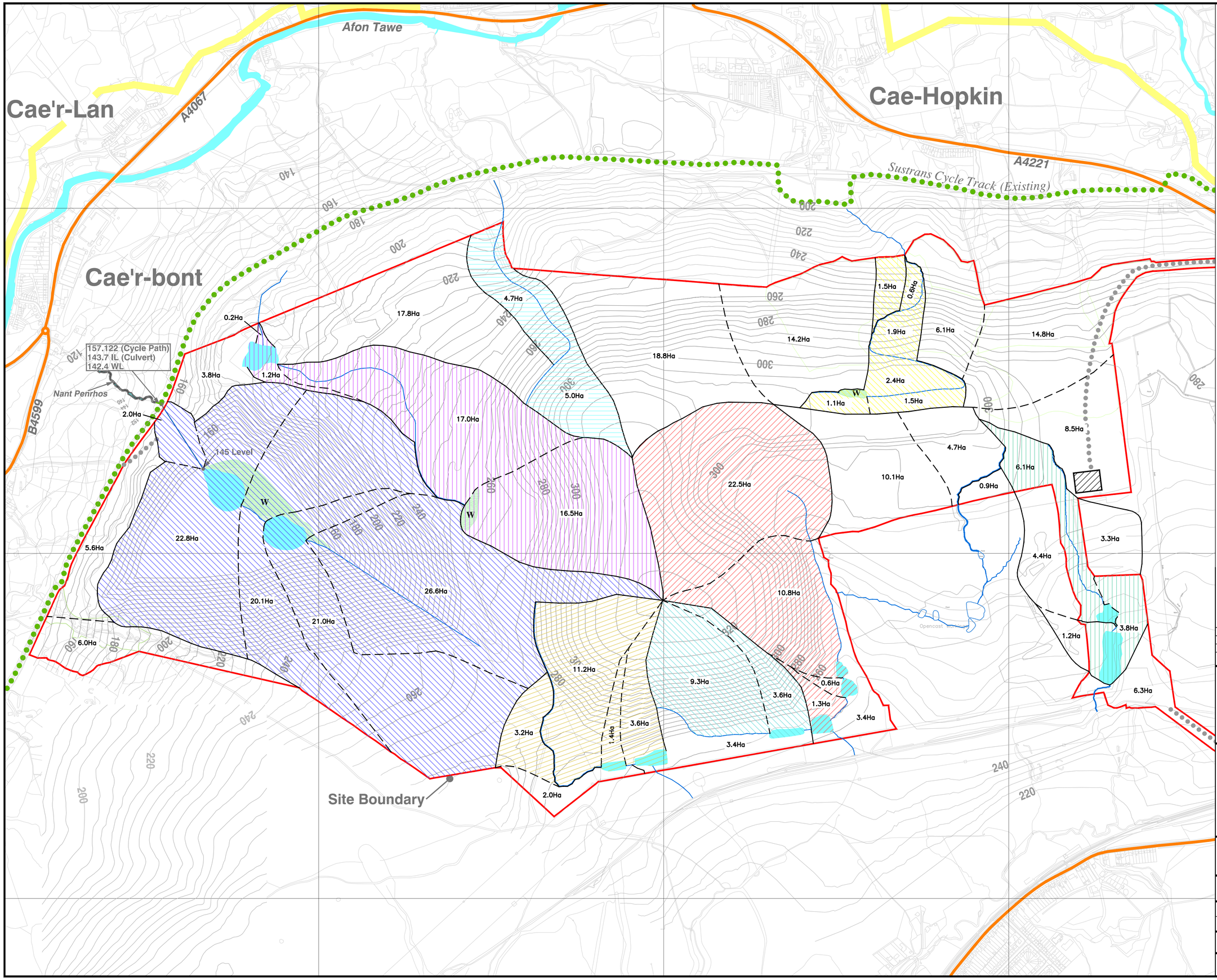
Attenuation Pond	Flow Control Structure (m)	Maximum Q_{100} Attenuation Volume (cum)	Maximum Q_{100} Water Level Variations (m)	Maximum Q_{100} Outflow (cumec)
A1 UPPER	1.000	4528	0.495	0.594
A2 LOWER	1.000	6477	0.615	0.820
C	1.400	2534	0.443	0.704
F UPPER	1.000	716	0.313	0.299
F LOWER	1.000	1974	0.252	0.216
G1 UPPER	1.100	1037	0.910	1.627
G1 LOWER	0.700	1758	0.896	1.011
G2 UPPER	0.300	1229	0.570	0.220
G2 LOWER	0.550	2597	0.914	0.819
H UPPER	1.000	801	0.481	0.568
H LOWER	1.000	1213	0.379	0.397

5.0 Condition 45 Drawings

2363-D01-C Proposed Restoration Water Features
2363-D02-C Restoration Watercourses Catchment Plan
2363-D04-C Watercourse A Longitudinal Section
2363-D05-C Watercourse C Longitudinal Section
2363-D06-C Watercourse D Longitudinal Section
2363-D07-B Watercourse E Longitudinal Section
2363-D08-B Watercourse F Longitudinal Section
2363-D09-B Watercourse G1 Longitudinal Section
2363-D10-B Watercourse G2 Longitudinal Section
2363-D11-B Watercourse H Longitudinal Section
2363-D12-B Restoration Watercourse Details
2363-D13-C Water Features and Landscape

6.0 Condition 45 Calculations

2363-C01-C Restoration Watercourse A
2363-C02-C Restoration Watercourse C
2363-C03-C Restoration Watercourse D
2363-C04-B Restoration Watercourse E
2363-C05-B Restoration Watercourse F
2363-C06-B Restoration Watercourse G1
2363-C07-B Restoration Watercourse G2
2363-C08-B Restoration Watercourse H
2363-C09-C Site Run-off to Areas 1a, 1b, 1c, 1d, 1e and 1f



KEY

- SITE BOUNDARY
- WATERCOURSE A CATCHMENT AREA
- WATERCOURSE C CATCHMENT AREA
- WATERCOURSE D CATCHMENT AREA
- WATERCOURSE E CATCHMENT AREA
- WATERCOURSE F CATCHMENT AREA
- WATERCOURSE G1 CATCHMENT AREA
- WATERCOURSE G2 CATCHMENT AREA
- WATERCOURSE H CATCHMENT AREA

Revision Details		By	Date
C	WESTERN PONDS AMENDED		30.09.19
B	RESTORATION CONTOURS AMENDED		23.11.18
A	FIRST ISSUE FOR PLANNING AUTHORITY		19.08.16

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Project

NANT HELEN RESTORATION

Title

RESTORATION WATERCOURSES CATCHMENT PLAN

Scale at A1: 1:5000

Drawn | Date: 29 Jun 2016

Checked | Date

Project No: 2363

Drawing No: D02–C

Afon Tawe

Cae'r-Lan

A4067

Cae-Hopkin

NANT HELEN

A4221

Sustrans Cycle Track (Existing)

Cae'r-bont

157.122 (Cycle Path)
143.7 IL (Culvert)
142.4 WL

Nant Penrhos

B4599

145 Level

W

Site Boundary

Opencast Workings

DULAIS

DRAFT

KEY

- SITE BOUNDARY
- WATERCOURSE
- RUSH–LINED WATERCOURSE
- STONE BED WATERCOURSE
- ROCK REINFORCED WATERCOURSE
- POND
- WETLAND
- HARDSTANDING
- CYCLE ROUTE
- RETAINED ACCESS

	Revision Details	By	Date
C	WESTERN PONDS AMENDED		30.09.19
B	RESTORATION CONTOURS AMENDED		23.11.18
A	FIRST ISSUE FOR PLANNING AUTHORITY		19.8.16

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Project

NANT HELEN
RESTORATION

Title

PROPOSED RESTORATION
WATER FEATURES

Scale at A1
1:5000

Drawn — Date 6 Jul 2016
Checked — Date

Project No: 2363

Drawing No: D01–C

Appendix D

Hydrological Calculations
Technical Note

Technical Note

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Project title	Nant Helen Complementary Restoration Earthworks	Job number	264904
cc		File reference	
Prepared by	Rob Varley	Date	04 December 2019
Subject	Nant Helen Complementary Restoration Earthworks - Hydrological Assessment		

1 Introduction

The Nant Helen site to the north of Onllwyn is an open cast mine owned and operated by Celtic Energy. The mining operations currently being undertaken will cease in 2021, at which point Celtic Energy will be required to restore the land in accordance with regulatory requirements and the agreements with Powys County Council (PCC). A restoration scheme for the site has been submitted for approval through the Planning process.

Following discussions with both PCC and Neath Port Talbot County Borough Council (NPTCBC), the local authorities have expressed a desire to develop restoration proposals for the Nant Helen site which will create long term, sustainable jobs.

As such, the Nant Helen Complementary Earthworks Scheme looks to provide a flexible landform that can be used or adapted for a diverse set of future uses. This could range from the traditional agriculture, woodland and nature conservation purposes, to amenity, leisure and tourism uses.

Other potential uses for the site could also include industrial purposes such as the Welsh Government's (WG) proposal to develop a rail testing and storage facility, known as the Global Centre of Rail Excellence (GCRE) at this site together with the adjacent Onllwyn Washery.

For the proposed scheme, an earthworks plateau is proposed that can be adapted for all the above purposes. Consideration has been given to providing suitable longitudinal gradients and track radii should the GRCE project proceed. It is proposed that the construction of this earthworks plateau will be undertaken in tandem with the restoration scheme for the site.

A planning application has been prepared for the Nant Helen Complementary Earthworks. A separate planning application will be submitted at a future date to cover any additional infrastructure required to bring the site to its selected future use.

This technical note details the hydrological calculations undertaken to determine the Greenfield Runoff Rate (GRR) for the scheme.

2 Overview of site

2.1 Site Description

The Nant Helen Complementary Earthworks Scheme consists of an inner and an outer track loop. The outer track loop encompasses a ridgeline running from east to west across the centre of the site. This ridgeline forms the catchment boundary for three adjacent watercourses:

- The River Tawe, located to the north of the site (River Tawe Catchment)
- The River Dulais, located to the south of the site (River Dulais Catchment)
- The Afon Pyrddin, located to the east of the site (Afon Pyrddin Catchment)

The extent of each of these catchments relative to the planning boundary has been shown in Appendix A. The total area within the Planning boundary is approximately 416ha.

Stormwater runoff from the site is conveyed via a number of smaller streams and ditches, which discharge into the major watercourses as tributaries. A number of these tributaries have been severed during the open cast mining operations that have taken place on the site.

As part of the Celtic Energy restoration scheme, these tributaries and associated catchment areas are proposed to be reinstated. However, the proposed restoration scheme highlights that the discharge rate from these catchments will be attenuated to discharge rates significantly less than the calculated Greenfield Runoff Rate (GRR) . This was queried during a meeting with Celtic Energy, where it was established that a number of tributaries within the River Tawe Catchment have experienced fluvial flooding issues in the past. Therefore, the proposed discharge from the reinstated catchments had been reduced from the GRR to help alleviate these downstream flooding issues.

This note has been prepared to establish the GRR for the site, and as such the restoration scheme is not considered. However, these reductions to the GRR for the River Tawe catchment have been adopted as discussed in the overarching drainage strategy report for the scheme.

2.2 Site Catchment Descriptors

The descriptors for the three catchments were obtained from the FEH Online Service. The catchments selected were the smallest catchments that included the largest possible portion of the study site, so the catchment descriptors were are site-specific as possible. This meant that to represent the River Tawe and River Dulais Catchments, a smaller tributary was selected to minimise the inclusion of adjacent areas and therefore obtain catchment descriptors representative of the site.

The purchased descriptors were subsequently compared (Table 1), and the below findings noted:

- The FARL index demonstrates that the watercourses are not controlled upstream of the site by lakes or reservoirs.

- The FPEXT descriptor shows that a larger proportion of the Afon Pyrddin catchment would be inundated during a 1:100-year flooding event, although the value is still relatively small.

- The Base Flow Index (BFIHOST) is relatively similar for all catchments, but slightly higher for the Afon Pyrddin catchment.

- The Standard Average Annual Rainfall 1961-1990 (SAAR6190) is similar between the three sites.

- The urban extent is higher for the Afon Pyrddin catchment as the catchment area encompasses a portion of the village of Coelbren.

- The descriptor SPRHOST indicates that the soil within all catchments has a relatively low permeability.

Table 1 - Comparison of the River Tawe, River Dulais and Afon Pyrddin Catchment Descriptors

Catchment Descriptor	River Tawe Catchment	River Dulais Catchment	Afon Pyrddin Catchment
AREA (km^2)	0.54	1.04	0.61
FARL	1	1	1
FPEXT	0.0092	0.0241	0.0776
BFIHOST	0.306	0.286	0.319
SAAR6190 (mm)	1775	1826	1789
SPRHOST (%)	50.86	52.90	44.77
URBEXT2000	0.000	0.000	0.0245

3 Hydrological Assessment

To design the cut off ditches, culverts, cascades and attenuation volumes required for the scheme, the GRR for the 1, 30 and 100-year return period events is required.

To calculate these, a hydrological analysis has been undertaken on the River Dulais, Afon Pyrddin and River Tawe Catchments. Although each of these catchments have been separated into a number of sub-catchments serving individual tributaries, these would be too small to analyse individually. Therefore, an analysis has been undertaken on each overarching catchment and the results will be applied to each sub-catchment area.

Three calculation methods have been used to derive this rate, the FEH Statistical, ReFH rainfall-runoff (Version 2.2) and IH124 methods. The parameters used and results from each analysis are detailed in the sections below.

Refer to Section 4 for a summary of the results.

3.1 River Dulais Catchment

3.1.1 IH124 Method

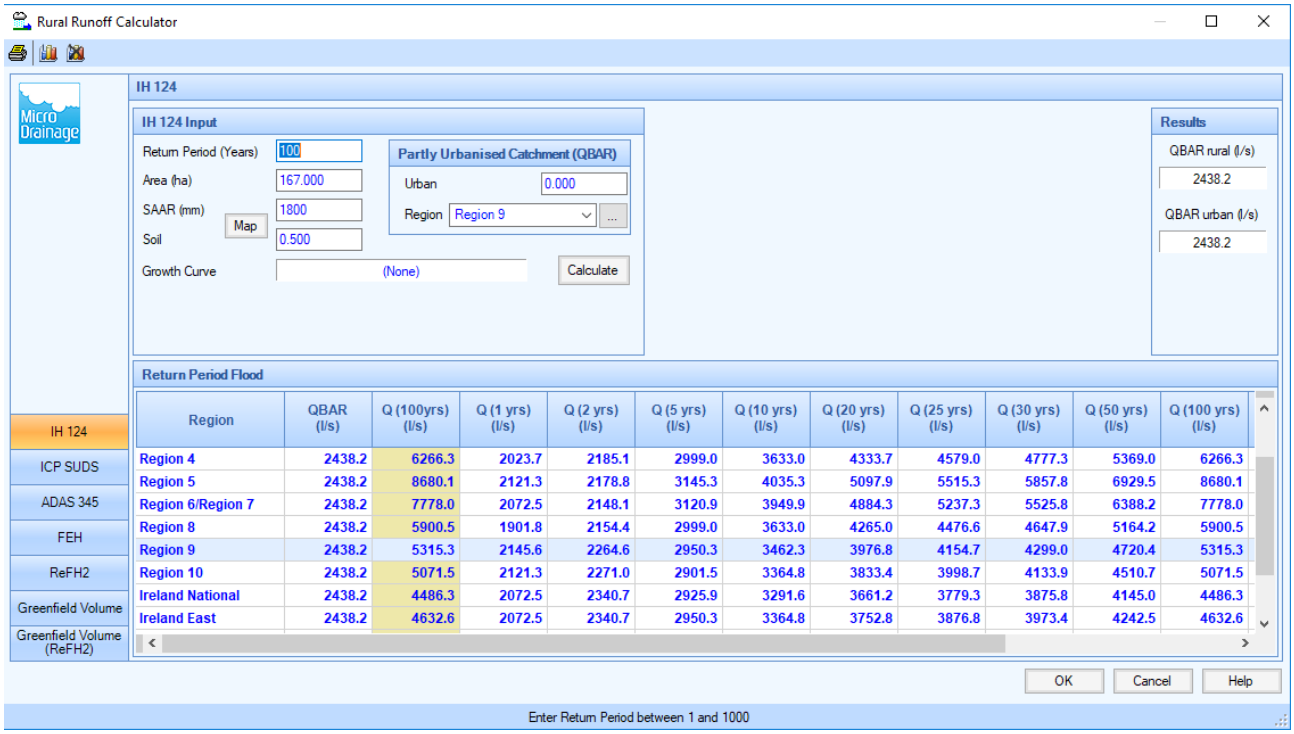
To undertake the IH124 Method, the source control module within Microdrainage was applied.

The point SAAR value of 1800mm was applied using the interactive map within the microdrainage software. This value of 1800mm is between the values obtained for the three catchments, which demonstrates this will be a good representative of the average SAAR value for the site.

The area of the River Dulais catchment contained within the planning application boundary was measured to be 167Ha. This area was applied within the software to determine the peak GRR for the total site. The peak GRR has been calculated for the 1 year, 30 year and 100-year return period events and was subsequently scaled by the area to give the GRR per hectare:

- 1:1 year rainfall event – 12.8l/s/ha
- 1:30 year rainfall event – 25.7l/s/ha
- 1:100 year rainfall event – 31.8l/s/ha

Refer to *Figure 1: IH124 Calculation undertaken within Microdrainage for the River Dulais Catchment*Figure 1 for the Microdrainage summary of results.



Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (2 yrs) (l/s)	Q (5 yrs) (l/s)	Q (10 yrs) (l/s)	Q (20 yrs) (l/s)	Q (25 yrs) (l/s)	Q (30 yrs) (l/s)	Q (50 yrs) (l/s)	Q (100 yrs) (l/s)
Region 4	2438.2	6266.3	2023.7	2185.1	2999.0	3633.0	4333.7	4579.0	4777.3	5369.0	6266.3
Region 5	2438.2	8680.1	2121.3	2178.8	3145.3	4035.3	5097.9	5515.3	5857.8	6929.5	8680.1
Region 6/Region 7	2438.2	7778.0	2072.5	2148.1	3120.9	3949.9	4884.3	5237.3	5525.8	6388.2	7778.0
Region 8	2438.2	5900.5	1901.8	2154.4	2999.0	3633.0	4265.0	4476.6	4647.9	5164.2	5900.5
Region 9	2438.2	5315.3	2145.6	2264.6	2950.3	3462.3	3976.8	4154.7	4299.0	4720.4	5315.3
Region 10	2438.2	5071.5	2121.3	2271.0	2901.5	3364.8	3833.4	3998.7	4133.9	4510.7	5071.5
Ireland National	2438.2	4486.3	2072.5	2340.7	2925.9	3291.6	3661.2	3779.3	3875.8	4145.0	4486.3
Ireland East	2438.2	4632.6	2072.5	2340.7	2950.3	3364.8	3752.8	3876.8	3973.4	4242.5	4632.6

Figure 1: IH124 Calculation undertaken within Microdrainage for the River Dulais Catchment

3.1.2 ReFH Version 2.2

The catchment descriptors purchased from the FEH Online service were imported into the ReFH2 software (version 2.2). Within the software, the FEH13 DDF rainfall model was applied as this updated method removes the need to derive an alpha correctional factor. This factor was used to modify the initial soil moisture content (C_{ini}) of the model and was often derived using results from the FEH Statistical Method.

By removing the alpha factor, the peak flows estimated by the ReFH2 method are independent of those generated using the FEH Statistical Method, resulting in improved decision making and higher flexibility when selecting the appropriate GRR (ReFH2 Technical Report).

The default storm duration recommended by ReFH2 was used to calculate the GRR. This corresponded to the 2 hour 54 minute storm event. A timestep of 6 minutes was applied.

The 1, 30 and 100-year peak flow outputs were scaled by the subject catchment area to obtain GRR per hectare and are shown in Table 2 below. Both the winter and summer seasonal values have been provided:

Table 2 – Derived GRR from the ReFH2 Analysis for the River Dulais		
Return Period	**Winter (l/s/ha)**	**Summer (l/s/ha)**
1:1 Year	18.4	19.8
QMED	20.7	22.4
1:30 Year	42.2	46.3
1:100 Year	52.7	57.9

The proposed scheme predominantly involves sizing cut-off ditches, culverts, cascades and attenuation features which are suitable for conveying and attenuating predominantly undeveloped land. It is important that the critical storm event is used to size these features to ensure they have sufficient capacity. Since the GRR was calculated to be higher for the summer seasonality, these values will be applied in the design, to ensure adequate sizing of proposed drainage features.

3.1.3 FEH Statistical Method

To undertake the FEH Statistical analysis, the WINFAP4 software was used. Within the software, the latest version of the HiFlows UK data set was applied (version 8), to ensure the latest available station data was utilised.

DEFRA/EA Science Report SC090031 provides guidance and best practice on estimating peak flows and hydrographs for small catchments. The report recommends that for ungauged catchments, the QMED obtained from catchment descriptors should be modified using data transfer from a local donor station with annual maxima data.

The use of a geographically close catchment prevents introducing uncertainties from local flooding factors that may not be contained within catchment descriptors. The QMED adjustment factor in the data transfer equation is moderated based on distance between catchment centroids, so only geographically close stations will have a larger influence.

Using the WINFAP Donor Adjustment method provided a list of the ten closest catchments, and selected the nearest 6 of these by default:

- Station 58008: Dulais at Cilfrew
- Station 59001: Tawe @ Ynystanglws
- Station 58002: Neath @ Resolven
- Station 58006: Mellte @ Pontneddfechan
- Station 60009: Sawdde @ Felin-Y-Cwm
- Station 58012: Afan @ Marcroft Weir

A review of the catchment descriptors for these donor sites was undertaken. Stations 59001, 60009 and 58012 were all removed due to the difference of the SPRHOST, BFIHOST and AREA with the subject catchment. Station 58002 was also removed due to the large AREA difference and the noted combined effect on observed flows from reservoirs, water abstraction and effluent returns.

The donor catchments used for the QMED adjustment were therefore:

- Station 58008: Dulais at Cilfrew
- Station 58006: Mellte @ Pontneddfechan

Station 58006 provided the closest correlation with the target sites catchment descriptors. Station 58008 also provided a good correlation and is downstream of the site in the River Dulais. Given this station includes the area within the site catchment, it is likely to give a reasonable representation of the QMED adjustment required. It was noted that the observed flows for both stations are affected by effluent, but since they are suitable for QMED this was deemed to be acceptable.

A comparison of QMED was undertaken between the calculated value using catchment descriptors and the measured value observed from annual maxima data. This comparison is shown in Table 3 below.

Table 3 – Comparison of calculated and observed QMED values for donor sites

Station	Observed QMED (m3/s)	Calculated QMED (m3/s)	Difference ($QMED_{calc}/QMED_{obs}$)
River Dulais (From FEH Online)	N/A	2.4	N/A
58008 (Dulais @ Cilfrew)	56.4	46.9	1.20
58006 (Mellte @ Pentneddfechan)	87.4	75.3	1.16

The use of data transfer from these donor sites results in an uplift of the GRR from 23.0 l/s/ha (using the QMED catchment descriptor equation) to 25.7 l/s/ha.

The default pooling group contained 16 stations with a total of 515 years of data. This pooling group had a standardised test value (H2) of 1.36, indicating that the pooling group was possibly heterogeneous and a review of the group was optional.

A review of the pooling group was undertaken and the following stations removed:

- Station 49005 – Bollingey Stream at Bollingey Cocks Bridge. Rationale: Short records, only 8 years. Different seasonality of flooding. Negative L-kurtosis. High BFIHOST (0.627) compared to target site. High discordancy value of 2.803.
- Station 69047 – Roch @ Littleborough. Rationale: Low FARL value (0.890)

It was also noted that Station 45816 (Haddeo at Upton) had a steeper growth curve than other stations and a high BFIHOST (0.590). However, a review of the site showed that it has had two relatively large annual maxima events during its recording period. These signify extreme events which have occurred and offer an important contribution to the pooled growth curve. Therefore, it was decided that this station should be included within the group.

The resulting pooling group consisted of 14 stations with a total of 466 years of data. One station was added to achieve the required 500 years:

- Station 21017 – Ettrick Water @ Brockhoperig

This brings the total years of data within the group to 507 years. The modifications to the pooling group resulted in a reduced H2 value of 1.10. The group therefore remained possibly heterogeneous, but there were no obvious justifications to make further amendments.

The goodness of fit test was used which recommended the Generalised Logistic fit. This was applied to produce peak flow estimates for the QMED, 30 and 100-year return period events. These were then scaled by the catchment area to determine the GRR.

The modified pooling group was used to produce peak flow estimate for the QMED, 30 and 100 year return period events. These were then scaled by the catchment area to determine the GRR.

The derived Greenfield Runoff Rate is shown below:

- QMED (1:2 year) rainfall event – 25.7 l/s/ha
- 1:30 year rainfall event – 52.2 l/s/ha
- 1:100 year rainfall event – 67.9 l/s/ha

3.2 Afon Pyrddin Catchment

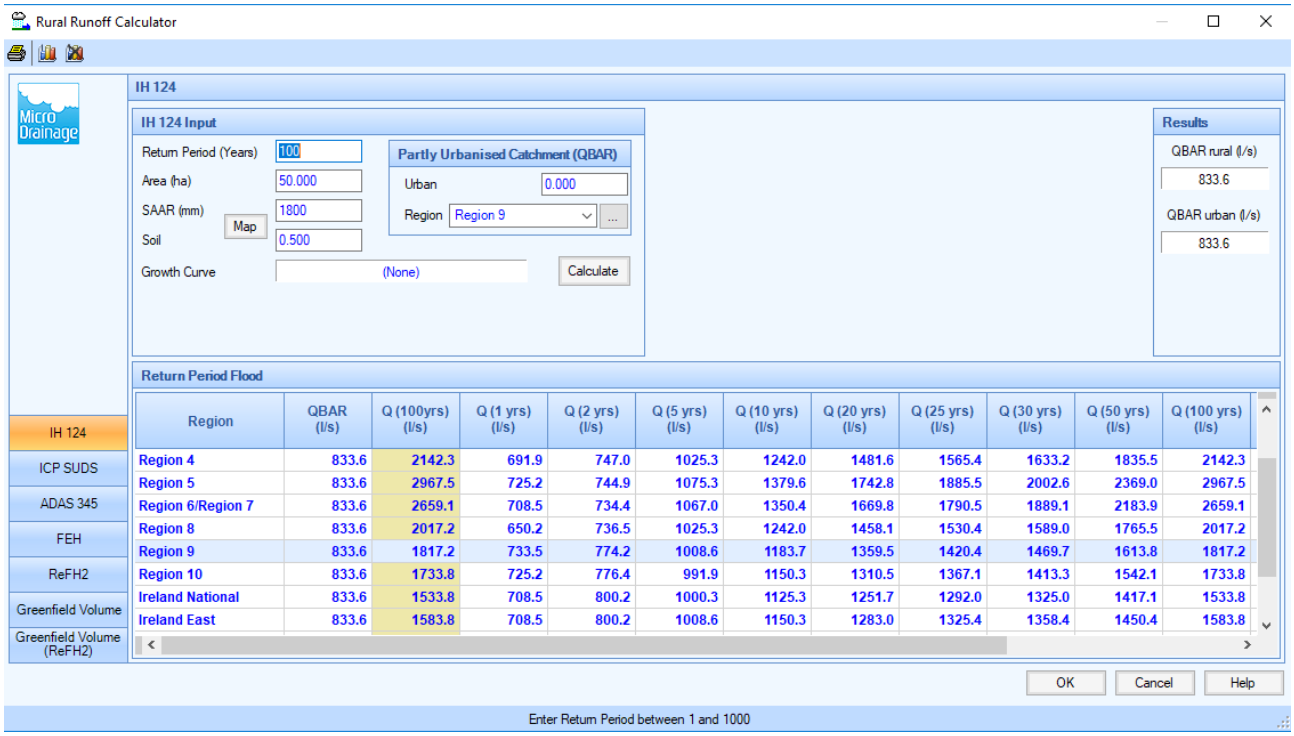
3.2.1 IH124 Method

The IH124 Method was applied within Microdrainage as described for the River Dulais catchment (see Section 3.1.1). The area of the Afon Pyrddin catchment within the planning application boundary was measured to be 33Ha. The point SAAR value of 1800mm was applied.

As the IH124 method was derived for sites over 50ha, it is common practice to undertake the calculation based on an area of 50ha and then linearly interpolate this down for the catchment area. This has been shown in Table 4 below. The results from Microdrainage are shown in Figure 2:

Table 4 – Derived GRR from the IH124 Analysis for the Afon Pyrddin

Return Period	Total GRR for 50ha (l/s)	Scaled Catchment (33ha) GRR (l/s)	GRR per ha (l/s/ha)
1:1 Year	733.5	484.1	14.7
1:30 Year	1469.7	970.0	29.4
1:100 Year	1817.2	1199.4	36.3



Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (2 yrs) (l/s)	Q (5 yrs) (l/s)	Q (10 yrs) (l/s)	Q (20 yrs) (l/s)	Q (25 yrs) (l/s)	Q (30 yrs) (l/s)	Q (50 yrs) (l/s)	Q (100 yrs) (l/s)
Region 4	833.6	2142.3	691.9	747.0	1025.3	1242.0	1481.6	1565.4	1633.2	1835.5	2142.3
Region 5	833.6	2967.5	725.2	744.9	1075.3	1379.6	1742.8	1885.5	2002.6	2369.0	2967.5
Region 6/Region 7	833.6	2659.1	708.5	734.4	1067.0	1350.4	1669.8	1790.5	1889.1	2183.9	2659.1
Region 8	833.6	2017.2	650.2	736.5	1025.3	1242.0	1458.1	1530.4	1589.0	1765.5	2017.2
Region 9	833.6	1817.2	733.5	774.2	1008.6	1183.7	1359.5	1420.4	1469.7	1613.8	1817.2
Region 10	833.6	1733.8	725.2	776.4	991.9	1150.3	1310.5	1367.1	1413.3	1542.1	1733.8
Ireland National	833.6	1533.8	708.5	800.2	1000.3	1125.3	1251.7	1292.0	1325.0	1417.1	1533.8
Ireland East	833.6	1583.8	708.5	800.2	1008.6	1150.3	1283.0	1325.4	1358.4	1450.4	1583.8

Figure 2: *IH124 Calculation undertaken within Microdrainage for the Afon Pyrddin Catchment*

3.2.2 ReFH Version 2.2

The ReFH2 method was applied as described for the River Dulais catchment (see section 3.1.2). Catchment descriptors were exported from FEH Online and analysed for both winter and summer seasonality. The default recommended storm duration of 2 hours, 42 minutes with 6-minute intervals was used.

The 1, 30 and 100-year peak flows from the analysis were scaled by the subject catchment area to obtain GRR per hectare estimates. These are shown in Table 5 below.

Table 5 - Derived GRR using the ReFH2 Analysis for the Afon Pyrddin

Return Period	Winter Seasonality (l/s/ha)	Summer Seasonality (l/s/ha)
1:1 Year	15.6	16.9
QMED	17.5	19.2
1:30 Year	36.6	40.5
1:100 Year	45.9	51.0

As with the River Dulais catchment, the summer seasonality has been applied due to the proposed use of the GRR to size culverts and ditches from predominantly undeveloped areas.

3.2.3 FEH Statistical Method

As per the River Dulais analysis, the latest HiFlows UK data set was used (version 8).

The data transfer method from donor catchments was used to estimate QMED. Applying the donor adjustment method within the WINFAP software provided a list of the ten geographically closest catchments, selecting the closest six of these by default. These are listed below in order of proximity, as well as whether they were included for data transfer:

- Station 58008: Dulais at Cilfrew - Included
- Station 58002: Neath @ Resolven – Discounted
- Station 59001: Tawe @ Ynystanglws – Discounted
- Station 58006: Mellte @ Pontneddfechan - Included
- Station 57017: Rhondda Fawr @ Tynewydd – Discounted
- Station 58012: Afan @ Marcroft Weir - Discounted

The catchment descriptors for these are shown in Table 4 below. Stations 58002 and 59001 were discounted owing to the significantly larger catchment area (more than 200 times larger than the target catchment). Station 58012 was discounted as it has a significantly higher BFIHOST value than the target site. Station 57017 was discounted owing to its much higher SAAR value than the target site.

The two remaining donor catchments are larger than the subject site but are similar from a hydrological perspective. For the selected donor site, a comparison was undertaken between QMED calculated using catchment descriptors and the measured values observed from annual maxima data. This comparison is shown in Table 6 below.

Table 6 – Comparison of calculated and observed QMED values for Afon Pyrddin donor sites

Station	Observed QMED (m3/s)	Calculated QMED (m3/s)	Difference ($QMED_{calc}/QMED_{obs}$)
River Dulais (From FEH Online)	N/A	2.388	N/A
58008 (Dulais @ Cilfrew)	56.3	46.9	1.20
58006 (Mellte @ Pentneddfechan)	87.4	75.3	1.16

The data transfer from the selected donor sites resulted in an uplift to the QMED value from 1.399m^3/s to 1.551m^3/s.

The default pooling group consisted of 14 stations with a total of 516 years of data. This pooling group had a standardised test value (H2) of 1.48, indicating that it was possibly heterogeneous and a review of the group was optional.

A review of the pooling group was subsequently undertaken and the following stations removed:

- Station 69047 – Roch at Littleborough: Low FARL value (0.890) relative to target catchment (1.000).

- Station 47022 – Tory Brook at Newnham Park: Low FARL value (0.942) relative to target catchment (1.000).
- Station 27073 – Brompton Beck at Snainton Ings: High FPEXT (0.2373) and BFIHOST (0.887) compared to the target site (0.0776 and 0.319 respectively).

The resulting pooling group consisted of 11 stations with a total of 416 years of data. Two stations were added to achieve the required 500 years:

- Station 46005 – East Dart @ Bellever
- Station 21017 – Ettrick Water @ Brockhoperig

This brings the total data within the group to 511 years. The modifications to the pooling group resulted in a reduced H2 value of 1.29. This means it remains possibly heterogeneous, however there are no obvious justifications to make further changes.

The goodness of fit test was used which recommended the Generalised Logistic fit. This was applied to produce peak flow estimates for the QMED, 30 and 100-year return period events. These were then scaled by the catchment area to determine the GRR.

The derived Greenfield Runoff Rate is shown below:

- QMED (1:2 year)– 25.3 l/s/ha
- 1:30 year– 52.0 l/s/ha
- 1:100 year– 68.6 l/s/ha

3.3 River Tawe Catchment

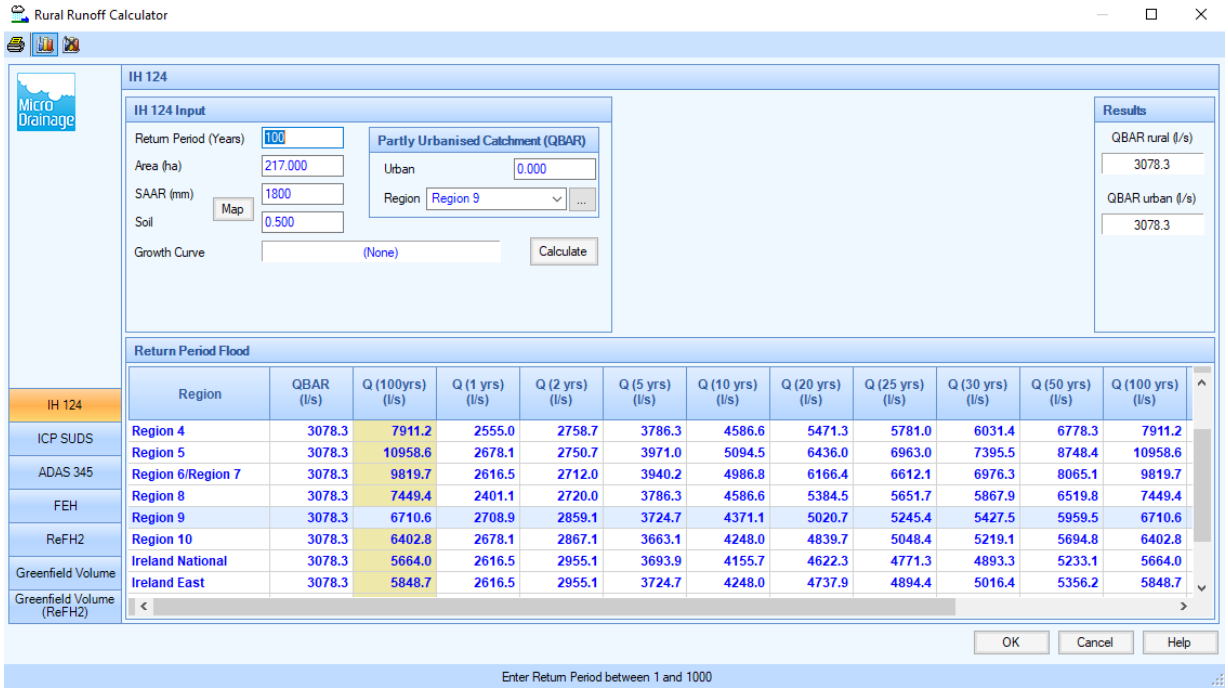
3.3.1 IH 124 Method

The IH124 Method was applied within Microdrainage as described for the River Dulais catchment.

The area of the River Tawe catchment contained within the planning application boundary was measured to be 217Ha. This area was applied within the software to determine the peak GRR for the total site. The peak GRR was been calculated for the 1 year, 30 year and 100-year return period events and was subsequently scaled by the area to give the GRR per hectare:

- 1:1 year rainfall event – 12.4l/s/ha
- 1:30 year rainfall event – 25.0l/s/ha
- 1:100 year rainfall event – 30.9l/s/ha

The results from the Microdrainage analysis are shown in Figure 3.



Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (2 yrs) (l/s)	Q (5 yrs) (l/s)	Q (10 yrs) (l/s)	Q (20 yrs) (l/s)	Q (25 yrs) (l/s)	Q (30 yrs) (l/s)	Q (50 yrs) (l/s)	Q (100 yrs) (l/s)
Region 4	3078.3	7911.2	2555.0	2758.7	3786.3	4586.6	5471.3	5781.0	6031.4	6778.3	7911.2
Region 5	3078.3	10958.6	2678.1	2750.7	3971.0	5094.5	6436.0	6963.0	7395.5	8748.4	10958.6
Region 6/Region 7	3078.3	9819.7	2616.5	2712.0	3940.2	4986.8	6166.4	6612.1	6976.3	8065.1	9819.7
Region 8	3078.3	7449.4	2401.1	2720.0	3786.3	4586.6	5384.5	5651.7	5867.9	6519.8	7449.4
Region 9	3078.3	6710.6	2708.9	2859.1	3724.7	4371.1	5020.7	5245.4	5427.5	5959.5	6710.6
Region 10	3078.3	6402.8	2678.1	2867.1	3663.1	4248.0	4839.7	5048.4	5219.1	5694.8	6402.8
Ireland National	3078.3	5664.0	2616.5	2955.1	3693.9	4155.7	4622.3	4771.3	4893.3	5233.1	5664.0
Ireland East	3078.3	5848.7	2616.5	2955.1	3724.7	4248.0	4737.9	4894.4	5016.4	5356.2	5848.7

Figure 3: IH124 Calculation undertaken within Microdrainage for the River Tawe Catchment

3.3.2 ReFH2

Similarly, the ReFH2 method was applied as described for the River Dulais catchment (see section 3.1.2). The default recommended storm duration of 2 hours, 42 minutes with a 6-minute time step was used to calculate the GRR.

The 1, 30 and 100-year peak flows from the analysis were scaled by the subject catchment area to obtain GRR per hectare estimates. These are shown in Table 7 below.

Table 7 - Derived GRR using the ReFH2 Analysis for the River Tawe

Return Period	Winter Seasonality (l/s/ha)	Summer Seasonality (l/s/ha)
1:1 Year	16.3	17.8
QMED	18.5	20.2
1:30 Year	38.0	42.2
1:100 Year	47.6	53.0

As with the other catchments, the larger summer seasonality values will be adopted.

3.3.3 FEH Statistical Assessment – Pooled Analysis

Reviewing the FEH Statistical Method for the Afon Pyrddin and River Dulais catchments highlighted that the pooling groups and donor stations were very similar for the two catchments, resulting in very similar discharge rates.

The catchment descriptors between the River Tawe and River Dulais/Afon Pyrddin are very similar. As such, it is presumed that an FEH pooled analysis would result in very similar results for the River Tawe Catchment. As such, the values derived from the River Dulais catchment have been adopted for the scheme.

4 Conclusion

4.1 Results and Comparison

A hydrological study of the River Tawe, River Dulais and Afon Pyrddin catchments have been undertaken using the IH124, ReFH2 and FEH Statistical methods. The statistical method was not undertaken for the River Tawe catchment due to the similarities between the catchment descriptors, and as such the outputs from the River Dulais catchment have been adopted for the River Tawe. A summary of the results has been included in Table 8:

Table 8 – Summary of Hydrological Analysis for the GCRE Project

Catchment	Return Period (yr)	IH124 Peak Flows (l/s/ha)	ReFH2 Peak Flows (l/s/ha)	WINFAP Peak Flows (l/s/ha)
River Tawe	1	12.4	17.8	N/A
River Dulais		12.8	19.8	N/A
Afon Pyrrdin		14.7	16.9	N/A
River Tawe	QMED (2 year)	N/A	20.2	25.7
River Dulais		N/A	22.4	25.7
Afon Pyrrdin		N/A	19.2	25.3
River Tawe	30	25.0	42.2	52.2
River Dulais		25.7	46.3	52.2
Afon Pyrrdin		29.4	40.5	52.0
River Tawe	100	30.9	53.0	67.9
River Dulais		31.8	57.9	67.9
Afon Pyrrdin		36.3	51.0	68.6

The results of the IH124 method are shown to correlate well between the three catchments. However, this is due to the only variable within the equation within the three catchments being the catchment area. The IH124 QBAR equation contains a factor of $(0.01 \times AREA)^{0.89}$. Therefore, a larger area such as the River Tawe catchment will have a reduced discharge rate when compared to a smaller area such as the Afon Pyrddin catchment.

The GRR estimate provided using the FEH Statistical and ReFH2 methods are significantly higher than the estimate provided by the IH 124 method. IH124 is a relatively coarse method based on regional growth curves, which utilises no site-specific information. In addition to this, NRW Guidance Note GN008 provides a preference for the FEH Statistical and ReFH2 methods. Given this, the results of the IH124 method has been discounted.

The ReFH2 discharge rates show a reasonable correlation between the three catchments. The results from the WINFAP4 method show a better correlation, with less than 1 l/s/ha difference between the two catchments. This is due to the similarity between the pooling groups, initial QMED estimate from catchment descriptors and the suitable donor catchments based on Geographical distance. Therefore, the closer correlation of the FEH method does not in this instance indicate that it is more accurate. There is a large difference between the results generated by the two methods, particularly when comparing the QMED values.

As mentioned previously, there is a station downstream in the River Dulais. The QMED value measured from this station is 56.4m^3/s, which equates to 13.1 l/s/ha. As this is downstream and serves a larger area, a larger GRR would be expected when analysing a smaller area owing to the longer time of concentration and catchment losses through infiltration and evapotranspiration. However, the values estimated using the WINFAP method are almost double the observed QMED, which is significantly higher than would be expected.

The WINFAP method uses a catchment descriptor equation to estimate QMED which was derived from regression analysis and based on observed information from gauging stations. However, most of the gauged catchments used to compare the equations are between 50km^2 and 500km^2, whilst the target catchments are 1km^2 or less. A smaller area used within the derived FEH QMED equation results in higher peak flow rates, which explains why using this method would result in a significantly higher QMED value. Owing to the small catchment sizes, it is likely that this equation is overestimating QMED.

ReFH2.2 is widely accepted for use on plot-scale sites, as it uses sire specific catchment descriptors with updated FEH13 DDF curves. ReFH2.2 is also used on the plot scale, which is more appropriate for the catchment sizes being reviewed. Given the smaller catchment areas, since the ReFH2 provides a reasonably consistent GRR for the catchments that is slightly higher than the observed downstream QMED in the River Dulais, this method has been chosen as the preferred method.

Therefore, it is recommended that the GRR applied to the Nant Helen Complementary Earthworks scheme should be as shown in Table 9:

Table 9 – GRR to be Applied for the Nant Helen Complementary Earthworks Scheme

Catchment	Return Period (yr)	ReFH2 Peak Flows (l/s/ha)
River Tawe	1	17.8
River Dulais		19.8
Afon Pyrrdin		16.9
River Tawe	30	42.2
River Dulais		46.3
Afon Pyrrdin		40.5
River Tawe	100	53.0
River Dulais		57.9
Afon Pyrrdin		51.0

Technical Note

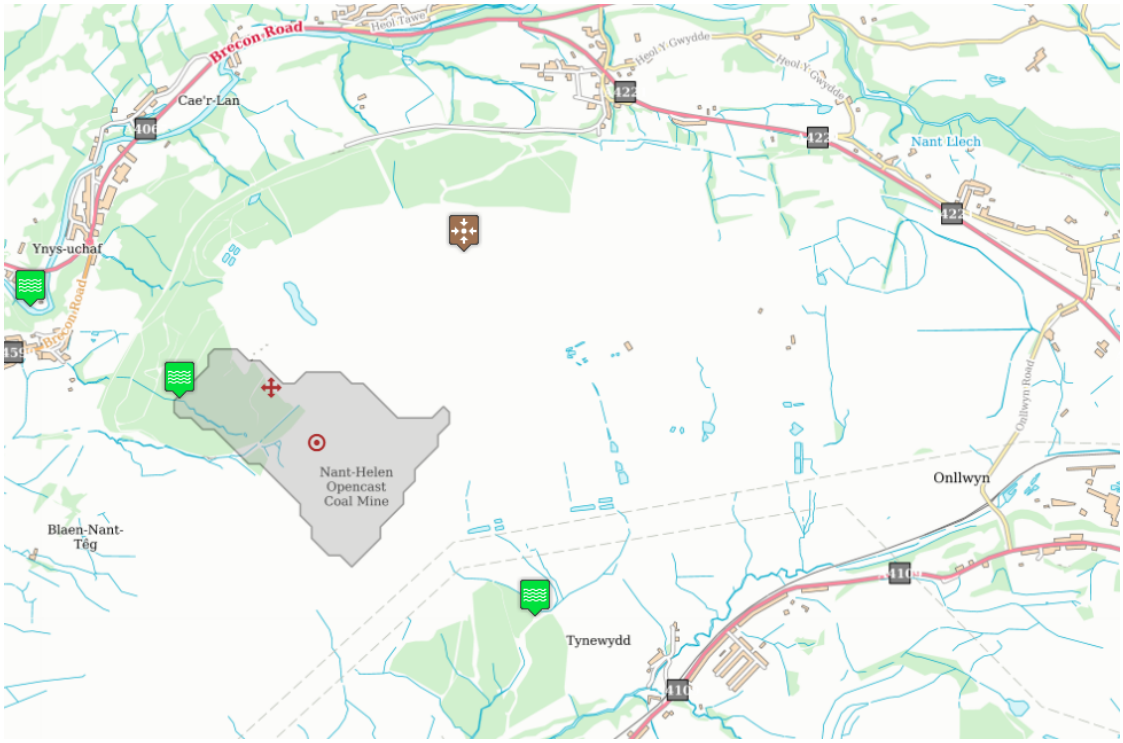
264904 04 December 2019

DOCUMENT CHECKING (not mandatory for File Note)

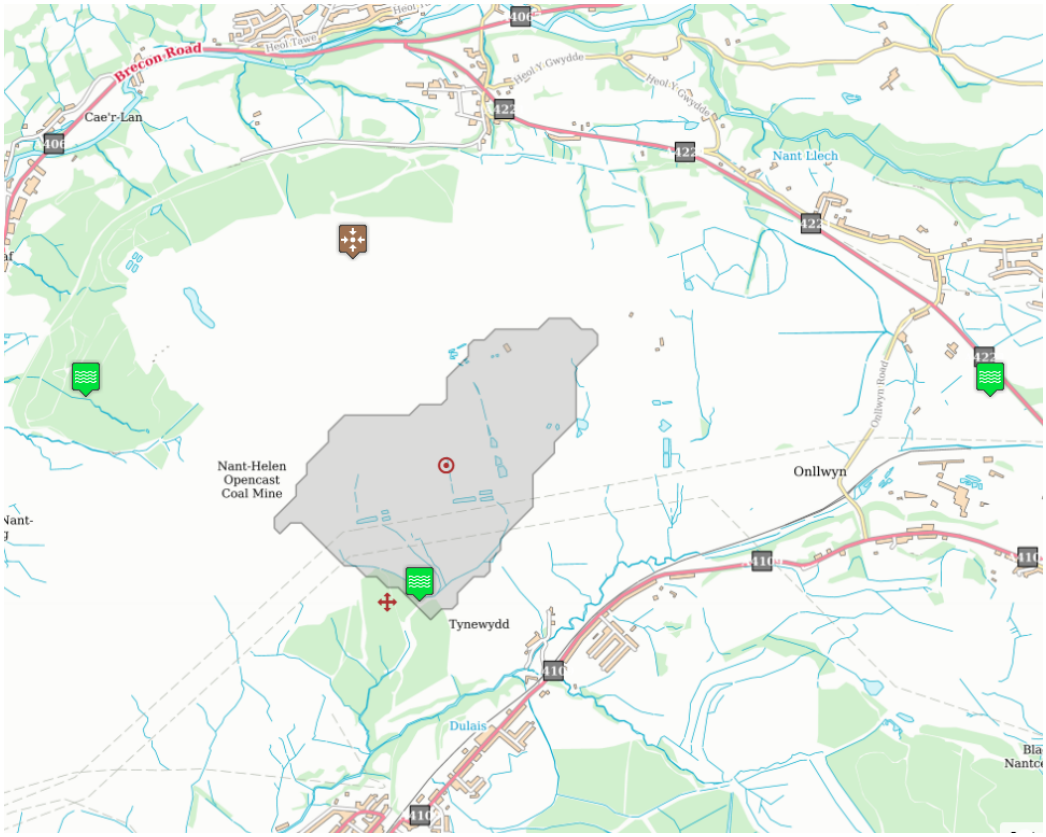
	Prepared by	Checked by	Approved by
Name	Rob Varley	Miguel Piedra	John Smith
Signature			

Appendix A – FEH Catchment Downloads

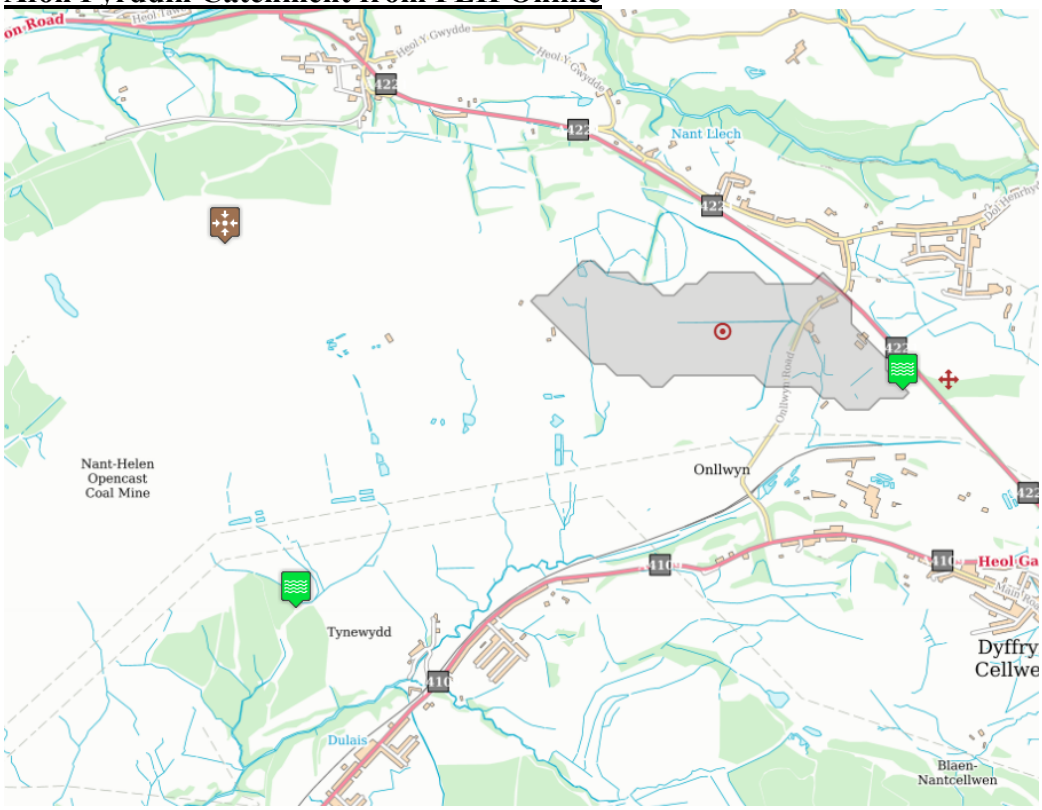
River Tawe Catchment from FEH Online



River Dulais Catchment from FEH Online



Afon Pyrddin Catchment from FEH Online



Appendix E

GCRE Nant Helen

Proposed Drainage Drawings

A1

River Tawe

Caehopkin

A4221

Onllwyn Road

River Dulais

Onllwyn

N

Legend

- Planning Application Boundary
- Existing National Grid Overhead Line
- Existing DCWW Storm Sewer
- Existing DCWW Foul Sewer
- Existing DCWW Combined Sewer
- Existing Water Main
- Existing BT
- Existing WPD Service Line
- Existing WPD PL
- Existing WPD LV
- Existing WPD 132kV HV
- Existing WPD 33kv HV
- Existing WPD 11kV HV

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. The utility information shown has been taken from Statutory Record plans. No responsibility is taken for the accuracy of this information.

3. The location and alignment of utilities may vary from that shown. Statutory plans received may not be complete and as such unchartered services could be present. An overhead and a buried services survey should be undertaken during future design stages to confirm utility alignment.

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Issue	Date	By	Chkd	Appd
P01	17/07/20	DO	IA	JS
	Issued for Planning			

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Client
Welsh Government

Job Title
Global Centre for Rail Excellence

Drawing Title
Existing Utilities

Scale at A1 1:5000

Discipline Infrastructure

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3010**	**P01**

Do not scale

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Legend

- Planning Application Boundary
- 285.00m — Proposed Finished Level Contours
- Proposed Cutting Zone
- Proposed Embankment Zone

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. For typical sections across the proposed track, refer to drawing CG3024.

3. For proposed drainage, refer to drawings CG3050 to CG3053.

4. Where proposed earthworks are within the proposed restoration boundary, the restoration contours have been used as the existing ground level. Elsewhere, the 2m LIDAR data has been used as the baseline ground level. For existing topography, refer to drawing CG3000.

5. Proposed embankments to have permitted side slopes of 1 in 3. Proposed cuttings within superficial deposits and restored ground to have permitted side slopes of 1 in 2.5. Where cuttings are located within rock areas, a steeper side slope of 1 in 1 has been provided.

6. All slopes to be seeded.

Keyplan



Issue	Date	By	Chkd	Appd
P01	17/07/20	DO	IA	JS

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Drawing Title
Proposed Finished Levels
Sheet 1 of 4

Scale at A1 1:2500

Discipline Infrastructure

Drawing Status
For Information

Job No	Drawing No	Issue
264904	CG3020	P01

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A1

For continuation see Drawing CG3020

For continuation see Drawing CG3023

Coelbren

Celtic Energy Offices

A4221

Legend

- Planning Application Boundary
- 285.00m — Proposed Finished Level Contours
- Proposed Cutting Zone
- Proposed Embankment Zone

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. For typical sections across the proposed track, refer to drawing CG3024.

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6. All slopes to be seeded.

Keyplan



Issue	Date	By	Chkd	Appd
P01	17/07/20	DO	IA	JS

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Drawing Title
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Sheet 2 of 4

Scale at A1 1:2500

Discipline Infrastructure

Drawing Status

Job No	Drawing No	Issue
264904	CG3021	P01

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A1

N

For continuation see Drawing CG3020

For continuation see Drawing CG3020

For continuation see Drawing CG3023

For continuation see Drawing CG3023

Mynydd y Drum

Nant Ystalwyn

Legend

- Planning Application Boundary
- 285.00m — Proposed Finished Level Contours
- Proposed Cutting Zone
- Proposed Embankment Zone

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. For typical sections across the proposed track, refer to drawing CG3024.

3. For proposed drainage, refer to drawings CG3050 to CG3053.

4. Where proposed earthworks are within the proposed restoration boundary, the restoration contours have been used as the existing ground level. Elsewhere, the 2m LIDAR data has been used as the baseline ground level. For existing topography, refer to drawing CG3000.

5. Proposed embankments to have permitted side slopes of 1 in 3. Proposed cuttings within superficial deposits and restored ground to have permitted side slopes of 1 in 2.5. Where cuttings are located within rock areas, a steeper side slope of 1 in 1 has been provided.

6. All slopes to be seeded.

Keyplan



Issue	Date	By	Chkd	Appd
P01	17/07/20	DO	IA	JS

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Drawing Title
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Sheet 3 of 4

Scale at A1 1:2500

Discipline Infrastructure

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3022**	**P01**

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Do not scale

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A1

N

For continuation see Drawing CG3021

For continuation see Drawing CG3022

For continuation see Drawing CG1032

Celtic Energy Offices

River Dulais

Onllwyn

Onllwyn Road

Mineral Railway

Legend

- Planning Application Boundary
- 285.00m — Proposed Finished Level Contours
- Proposed Cutting Zone
- Proposed Embankment Zone

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. For typical sections across the proposed track, refer to drawing CG3024.

3. For proposed drainage, refer to drawings CG3050 to CG3053.

4. Where proposed earthworks are within the proposed restoration boundary, the restoration contours have been used as the existing ground level. Elsewhere, the 2m LIDAR data has been used as the baseline ground level. For existing topography, refer to drawing CG3000.

5. Proposed embankments to have permitted side slopes of 1 in 3. Proposed cuttings within superficial deposits and restored ground to have permitted side slopes of 1 in 2.5. Where cuttings are located within rock areas, a steeper side slope of 1 in 1 has been provided.

6. All slopes to be seeded.

Keyplan



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Proposed Finished Levels
Sheet 4 of 4

Scale at A1 1:2500

Discipline Infrastructure

Drawing Status

Job No	Drawing No	Issue
264904	CG3023	P01

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Do not scale

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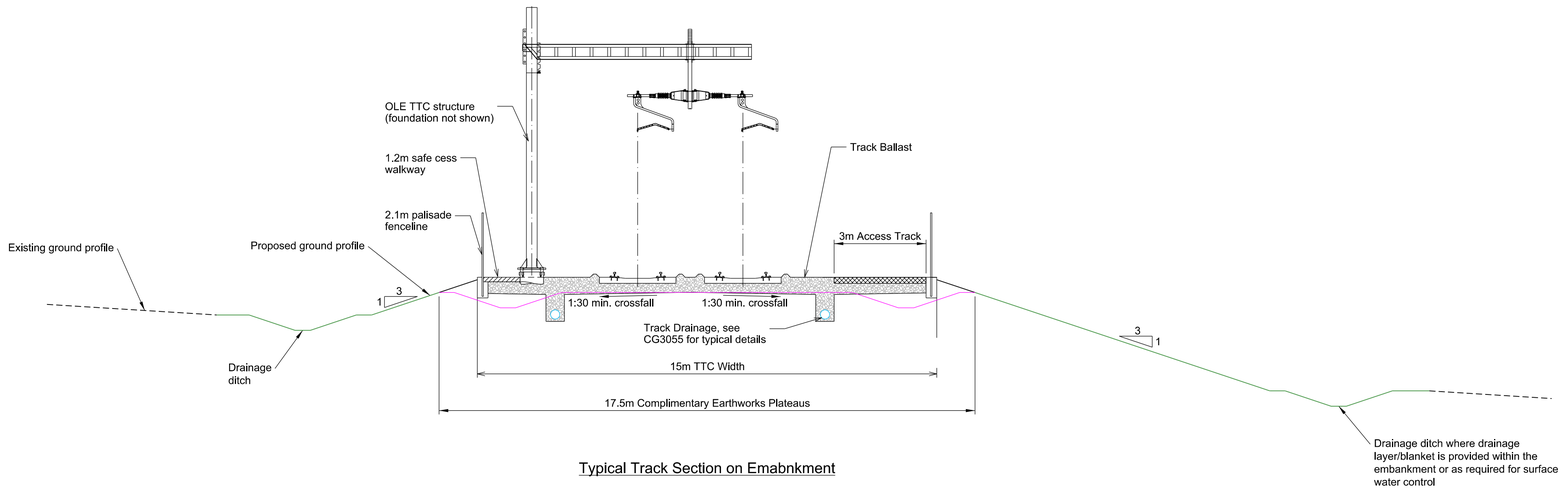
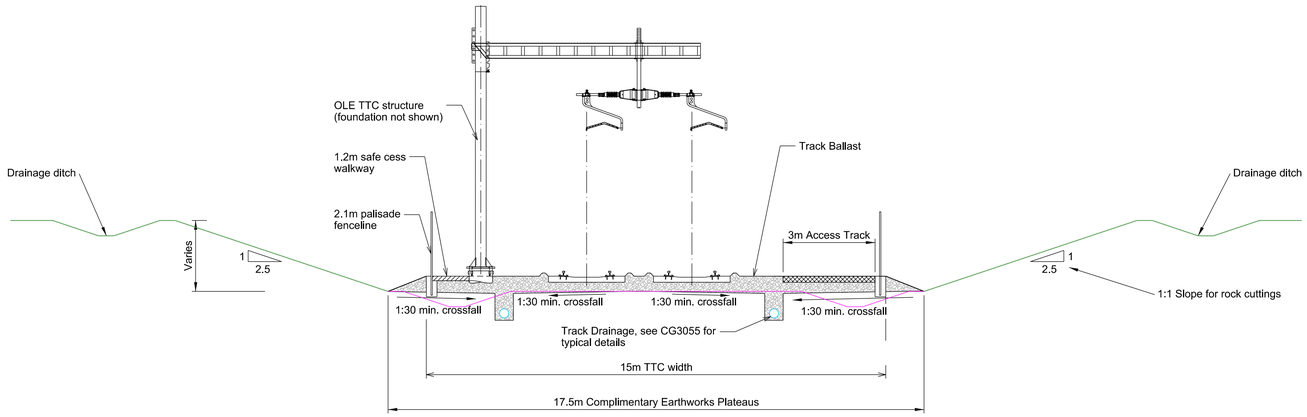


Typical Track Section on Emabnkment

Scale 1:100



Typical Track Section in Cutting

Scale 1:100

Legend

- Access Track
- Ballast
- Cess Walkway
- Track Drainage
- Existing Complimentary Earthworks Ground Profile to be modified
- Existing Complimentary Earthworks Ground Profile to be retained

Notes

1. Earthworks plateau and cut-fill areas based on a 15m required width for TTC track arrangement and ancillary elements.

2. Width of track formation and depth of construction buildup for Access Road/ Access Walkway is indicative.

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Drawing Title
Proposed Track Embankment and Cuttings Cross Sections

Scale at A1: As Shown

Discipline: Civils

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3024**	**P01**

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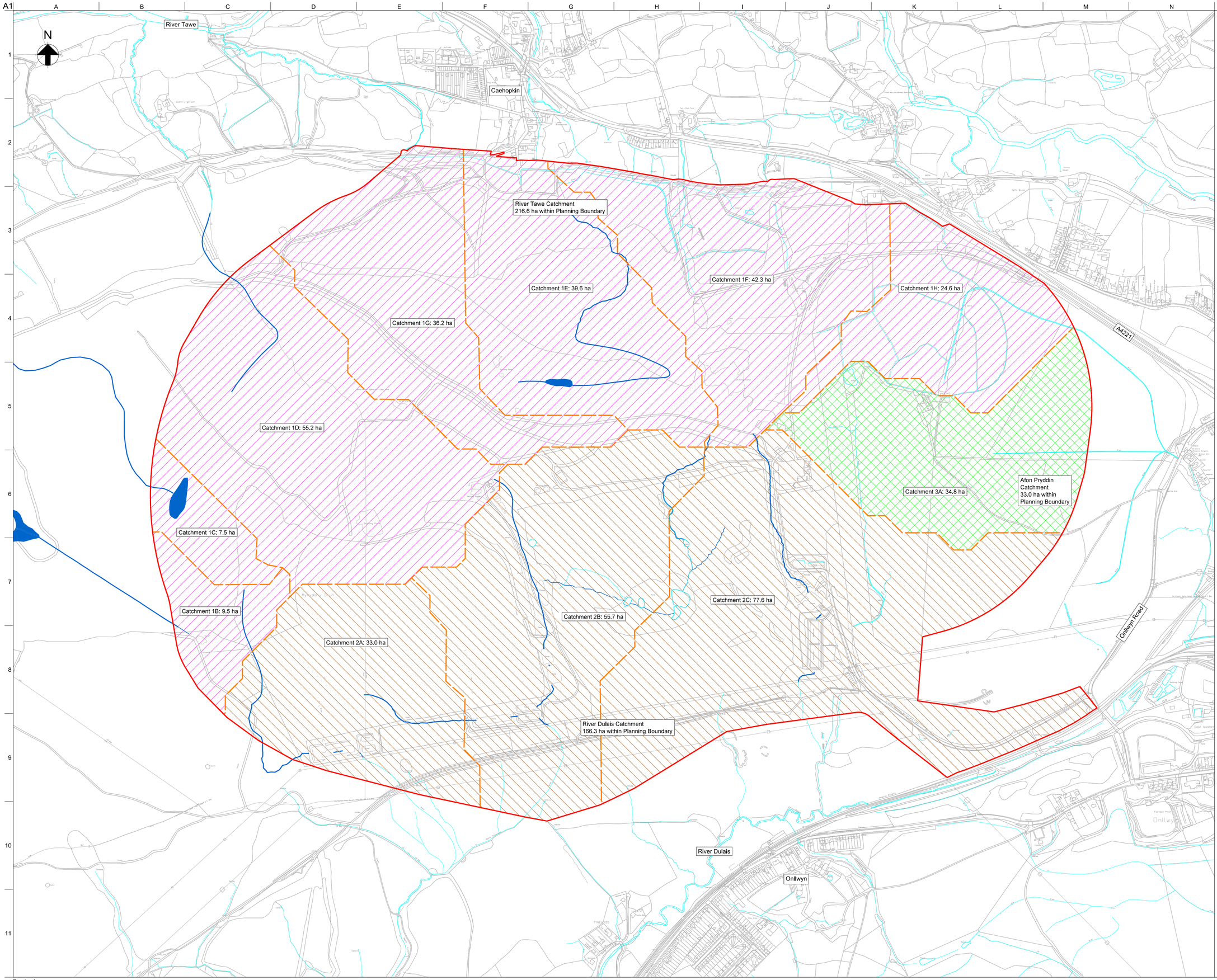

Legend

- Planning Application Boundary
- River Tawe Catchment
- River Dulais Catchment
- Afon Pryddin Catchment
- Existing Watercourses
- Restoration Watercourses
- Tributary Catchments
- Proposed Carrier Drain
- Proposed Filter Drain

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. The overarching catchment boundaries shown have been downloaded from the FEH Online Service. These were preferred over catchments derived from the Lidar model due to the open cast mining works undertaken on the site.

3. Tributary catchments are based on the existing catchments prepared by the restoration works and compared to the online catchments using the FEH Online Tool.

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Drawing Title
Existing Drainage Catchments

Scale at A1 1:5000

Discipline Infrastructure

Drawing Status
For Information

Job No	Drawing No	Issue
264904	CG3040	P01

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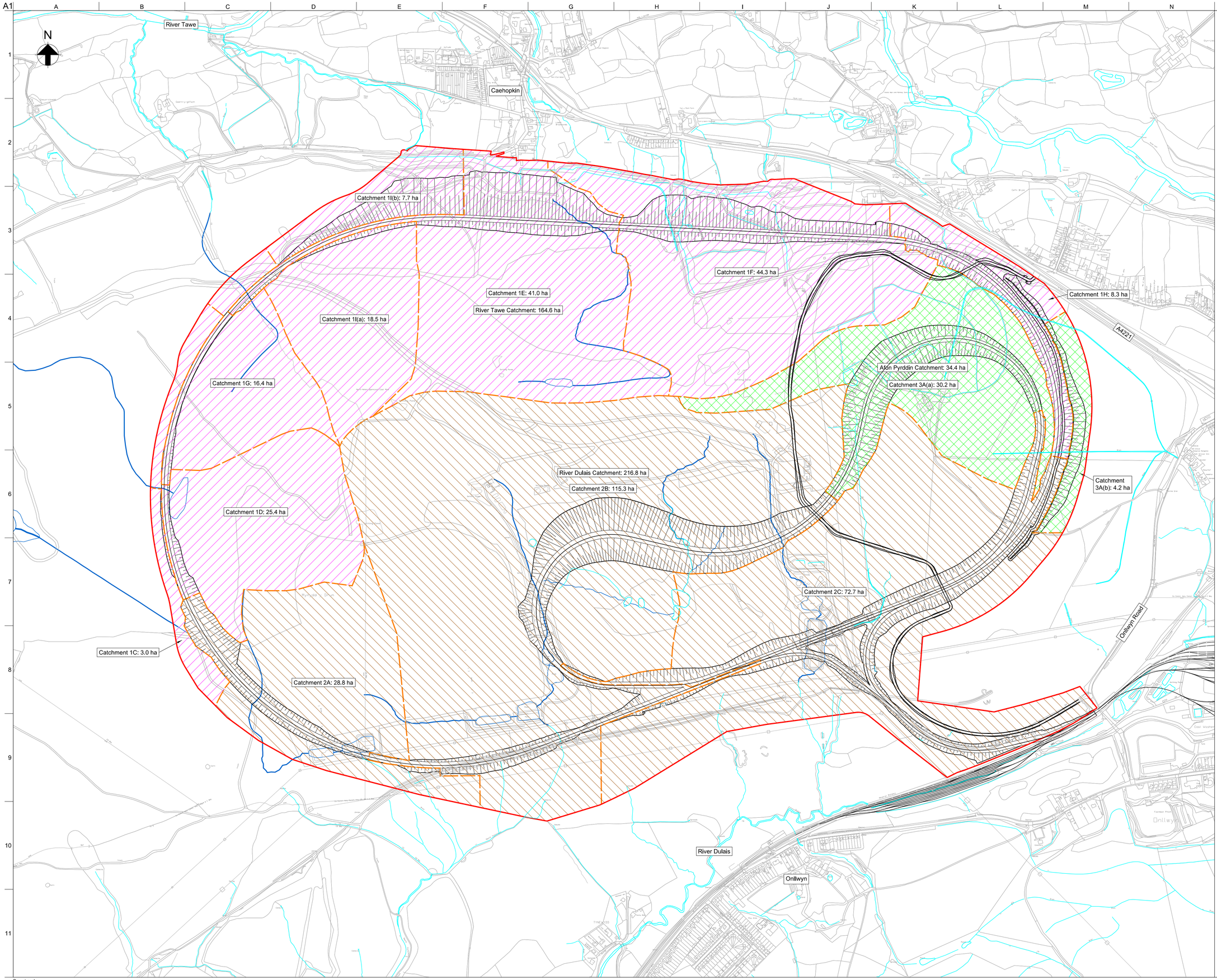
A1



Legend

- Planning Application Boundary
- River Tawe Catchment
- River Dulais Catchment
- Afon Pryddin Catchment
- Proposed Catchment Boundary
- Existing Watercourse
- Restoration Watercourses

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. The catchment boundaries shown have been downloaded from the FEH Online Service.

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Drawing Title
Proposed Drainage Catchment Overview

Scale at A1 1:5000

Discipline Infrastructure

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3041**	**P01**

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A1

N

Catchment 1E outfall to existing ditch

Catchment 1I(b)

Pond 1E
Volume = 3550m³
IL = 225.0m
Depth = 2.0m

Catchment 1G outfall to existing ditch

Pond 1G
Volume = 2600m³
IL = 238.0m
Depth = 2.0m

Catchment 1E

Catchment 1I(a)

Catchment 1G

Catchment 1D

Catchment outfall to existing ditch

Pond 1D
Volume = 380m³
IL = 248.0m
Depth = 1.5m

Catchment 2B

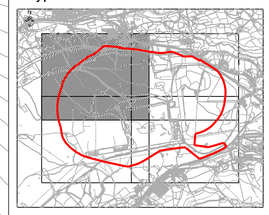
Legend

- Planning Application Boundary
- Existing Watercourse
- Restoration Watercourse
- Restoration Watercourse to be Removed / Discontinued
- Restoration Watercourse to be Diverted
- Proposed Catchment
- Proposed Cut Off Ditch
- Proposed Pond
- Proposed Carrier Drain
- Proposed Filter Drain
- Proposed Culvert
- Proposed Carrier Drain
- Proposed Filter Drain

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.
2. This drawing is for planning purposes only and is to be read in conjunction with the Drainage Strategy report.
3. For cut-off ditch typical details, refer to drawing CG3055.
4. The diameter of culverts and sizing of headwall structures is to be determined during subsequent design stages.
5. Existing watercourses that will be removed as part of the site restoration works have not been shown for clarity.
7. The restoration watercourses have been shown based on the current restoration proposals for the site. Should the track earthworks be undertaken at the same time as the restoration earthworks, the restoration watercourses shown as to be removed will not be installed.
8. The attenuation ponds shown are indicative based on the sizing determined from hydraulic calculations as discussed in the Drainage Strategy report. The depth and profile may change in subsequent design stages to accommodate topography and improve aesthetics.

Keyplan



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Drawing Title
Proposed Drainage
Sheet 1 of 4

Scale at A1 1:2500

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Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3050**	**P01**

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A1

N

Catchment 1F outfall to existing ditch

Pond 1E
Volume = 3550m³
IL = 225.0m
Depth = 2.0m

Pond 1F-A
Volume = 1500m³
IL = 227.0m
Depth = 2.0m

Pond 1F-B
Volume = 2100m³
IL = 231.5m
Depth = 2.0m

Catchment 1E

Catchment 1F

Catchment 1H outfall to existing ditch

Pond 1H
Volume = 740m³
IL = 231.5m
Depth = 1.5m

Catchment 1H outfall to existing ditch

Catchment 1H

Existing watercourses within track loop extents to be removed

Catchment 3A(a)

Pond 3A
Volume = 1000m³
IL = 252.9m
Depth = 1.8m

Catchment 3A(b)

Catchment 3A outfall to existing ditch

Pond 2E-A
Volume = 3500m³
IL = 280.0m
Depth = 2.0m

Catchment 2B

Catchment 2C

Legend

- Planning Application Boundary
- Existing Watercourse
- Restoration Watercourse
- Restoration Watercourse to be Removed / Discontinued
- Restoration Watercourse to be Diverted
- Proposed Catchment
- Proposed Cut Off Ditch
- Proposed Pond
- Proposed Carrier Drain
- Proposed Filter Drain
- Proposed Culvert
- Proposed Carrier Drain
- Proposed Filter Drain

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.
2. This drawing is for planning purposes only and is to be read in conjunction with the Drainage Strategy report.
3. For cut-off ditch typical details, refer to drawing CG3055.
4. The diameter of culverts and sizing of headwall structures is to be determined during subsequent design stages.
5. Existing watercourses that will be removed as part of the site restoration works have not been shown for clarity.
7. The restoration watercourses have been shown based on the current restoration proposals for the site. Should the track earthworks be undertaken at the same time as the restoration earthworks, the restoration watercourses shown as to be removed will not be installed.
8. The attenuation ponds shown are indicative based on the sizing determined from hydraulic calculations as discussed in the Drainage Strategy report. The depth and profile may change in subsequent design stages to accommodate topography and improve aesthetics.

Keyplan



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Proposed Drainage
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Discipline Infrastructure

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3051**	**P01**

Do not scale

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A1

N

Catchment 1C outfall to existing ditch

Pond 1D
Volume = 380m³
IL = 248.0m
Depth = 1.5m

Catchment 1D

Catchment 1C

Catchment 2A

Catchment 2B

Pond 2A
Volume = 580m³
IL = 253.0m
Depth = 2.0m

Attenuation ponds installed as part of the restoration scheme

Pond 2B-1
Volume = 2700m³
IL = 248.0m
Depth = 2.0m

Pond 2B-2
Volume = 2400m³
IL = 241.0m
Depth = 2.0m

Pond 2B-4
Volume = 2400m³
IL = 248.0m
Depth = 2.0m

Pond 2B-5
Volume = 4700m³
IL = 239.0m
Depth = 2.0m

Catchment 2B outfall to existing ditch

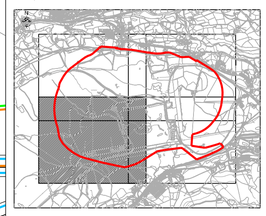
Legend

- Planning Application Boundary
- Existing Watercourse
- Restoration Watercourse
- Restoration Watercourse to be Removed / Discontinued
- Restoration Watercourse to be Diverted
- Proposed Catchment
- Proposed Cut Off Ditch
- Proposed Pond
- Proposed Carrier Drain
- Proposed Filter Drain
- Proposed Culvert
- Proposed Carrier Drain
- Proposed Filter Drain

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.
2. This drawing is for planning purposes only and is to be read in conjunction with the Drainage Strategy report.
3. For cut-off ditch typical details, refer to drawing CG3055.
4. The diameter of culverts and sizing of headwall structures is to be determined during subsequent design stages.
5. Existing watercourses that will be removed as part of the site restoration works have not been shown for clarity.
7. The restoration watercourses have been shown based on the current restoration proposals for the site. Should the track earthworks be undertaken at the same time as the restoration earthworks, the restoration watercourses shown as to be removed will not be installed.
8. The attenuation ponds shown are indicative based on the sizing determined from hydraulic calculations as discussed in the Drainage Strategy report. The depth and profile may change in subsequent design stages to accommodate topography and improve aesthetics.

Keyplan



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Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3052**	**P01**

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A1

N

Catchment 2B

Catchment 3A(b)

Catchment 2C

Pond 2B-3
Volume = 3500m³
IL = 280.0m
Depth = 2.0m

Pond 3A
Volume = 1000m³
IL = 252.9m
Depth = 1.8m

Existing watercourses within track loop extents to be removed

Catchment 3A(b) outfall to existing ditch

Pond 2B-1
Volume = 2700m³
IL = 248.0m
Depth = 2.0m

Pond 2B-4
Volume = 2400m³
IL = 250.5m
Depth = 2.0m

Pond 2B-5
Volume = 4700m³
IL = 239.0m
Depth = 2.0m

Catchment 2C outfall to existing ditch

Catchment 2C outfall to existing ditch

Assumed line of existing watercourse based on LiDAR information

Catchment 2C outfall to proposed Washery drainage (not shown) see CG2004 for details.

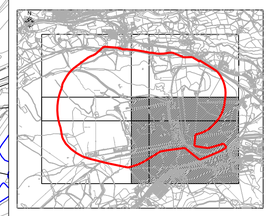
Legend

- Planning Application Boundary
- Existing Watercourse
- Restoration Watercourse
- Restoration Watercourse to be Removed / Discontinued
- Restoration Watercourse to be Diverted
- Proposed Catchment
- Proposed Cut Off Ditch
- Proposed Pond
- Proposed Carrier Drain
- Proposed Filter Drain
- Proposed Culvert
- Proposed Carrier Drain
- Proposed Filter Drain

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.
2. This drawing is for planning purposes only and is to be read in conjunction with the Drainage Strategy report.
3. For cut-off ditch typical details, refer to drawing CG3055.
4. The diameter of culverts and sizing of headwall structures is to be determined during subsequent design stages.
5. Existing watercourses that will be removed as part of the site restoration works have not been shown for clarity.
7. The restoration watercourses have been shown based on the current restoration proposals for the site. Should the track earthworks be undertaken at the same time as the restoration earthworks, the restoration watercourses shown as to be removed will not be installed.
8. The attenuation ponds shown are indicative based on the sizing determined from hydraulic calculations as discussed in the Drainage Strategy report. The depth and profile may change in subsequent design stages to accommodate topography and improve aesthetics.

Keyplan



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Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3053**	**P01**

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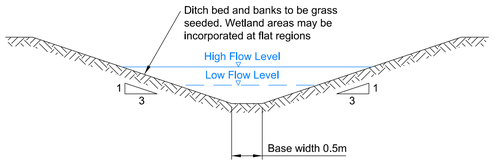
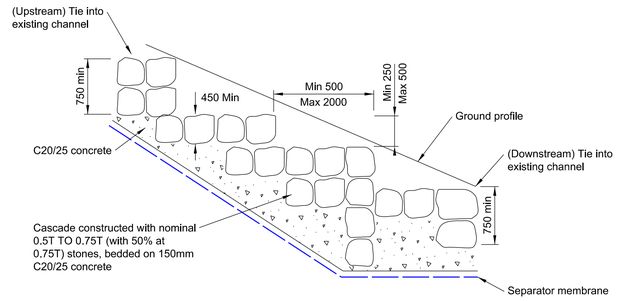
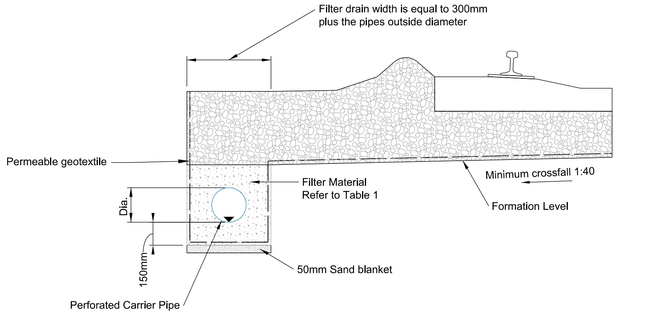


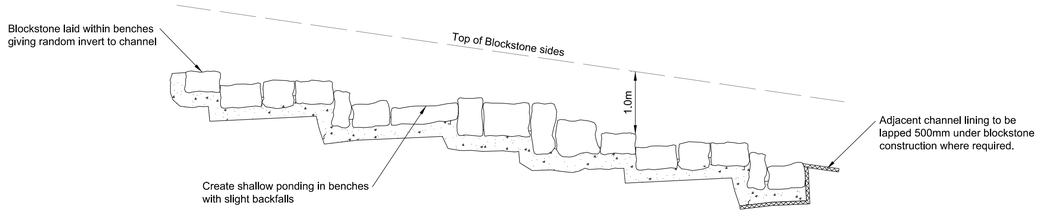
Typical Section - Grass Lined Channel (See Note 4)
N.T.S



Typical Cascade Detail
N.T.S



Example Filter / Track Drainage
NTS

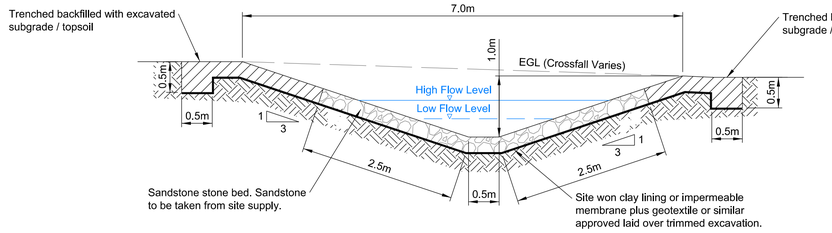


Typical Longitudinal Section - Rock Reinforced Ditch
N.T.S

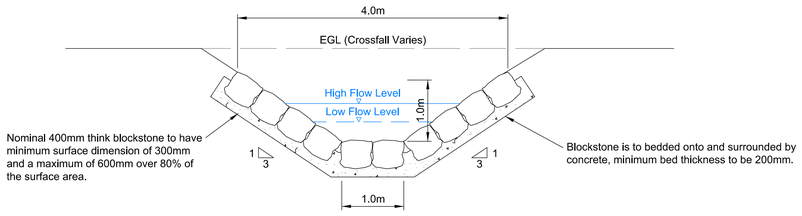
Pipe Nominal Size (DN)	Aggregate to BS 12620
140 to 400	10, 14 or 20mm Nominal Single Size Or 14 to 5mm Graded Or 20 to 5mm Graded
> 400	10, 14 or 20mm Nominal Single Size Or 14 to 5mm Graded Or 20 to 5mm Graded Or 40 to 5mm Graded

OR IN ACCORDANCE WITH PIPE MANUFACTERS BEDDING SPECIFICATION

Table 1 - Example Requirements For Pipe Bedding And Filter Details



Typical Section - Stone Bedded Ditch (See Note 4)
N.T.S



Detail C - Rock Reinforced Ditch (See Note 4)
N.T.S

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. This drawing is for planning purposes only and is to be read in conjunction with the Drainage Strategy report.

3. For drainage plans, refer to CG3050 to CG3053.

4. Grass lined channels to be used in areas of shallow longitudinal gradient, low flow and low velocity. Stone lined channels to be used in locations of medium longitudinal gradient and medium flow and veloicity. Rock reinforced channels to be used in high velocity areas steeper than 1:12.

5. Details shown for information only, subject to detailed design.

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Job Title
Global Centre for Rail Excellence

Drawing Title
Typical Channel and Pond Details

Scale at A1: As Shown

Discipline: Civils

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3055**	**P01**

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Do not scale

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A1

River Tawe

Caehopkin

Proposed underpass through track embankment

Proposed bridge over track cutting

A4221

Proposed bridge over track cutting

Proposed bridge over track cutting

Onllwyn Road

Proposed underpass through track embankment

River Dulais

Onllwyn

Legend

- Planning Application Boundary
- Proposed Attenuation Pond
- Existing Access Track to be retained Asphalt Surface
- Proposed Access Track Asphalt Surface
- Existing Access Track to be retained Gravel/unbound surface
- Proposed Access Track Gravel/unbound surface

Notes

1. Access tracks shown are to facilitate attenuation pond access and maintenance.
2. Access routes to be typically 3m wide.
3. Access track locations shown indicatively and subject to further design.

J:\264000\264904-00\4 Internal Project Data\4-30 Drawings\4-31 Issue drawings\Drainage Submission\CG3075.dgn

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Job Title
Global Centre for Rail Excellence

Drawing Title
Maintenance Access Routes

Scale at A1 1:5000

Discipline Infrastructure

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG3075**	**P01**

Do not scale

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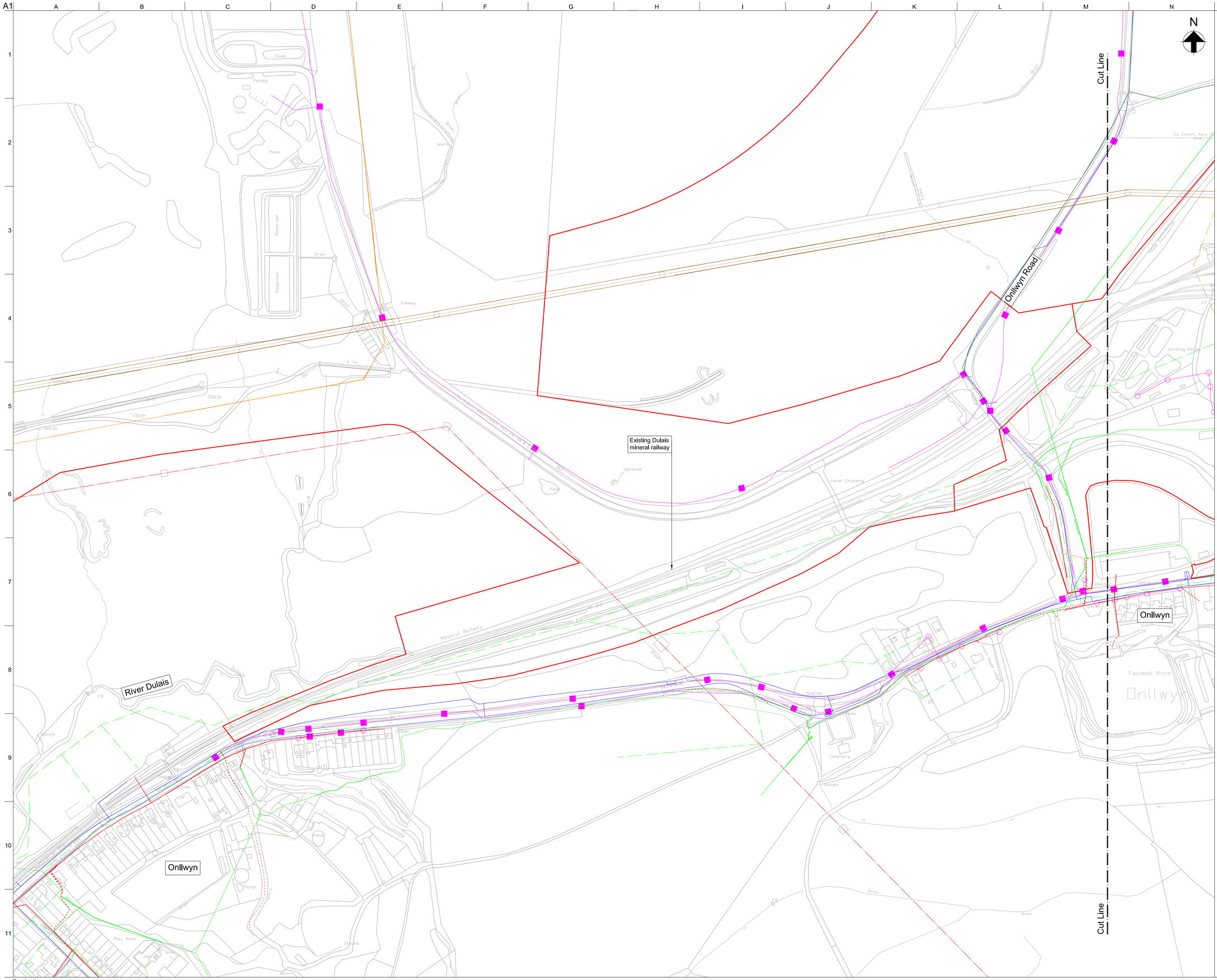
Appendix F

Washery Site Drawings


Existing Dulais mineral railway
Onllwyn Road
Cut Line
River Dulais
Onllwyn
Onllwyn
Cut Line
Mineral Railway
Pond
Pond
Tank
Reservoir
Reservoir
Drain
Weir
Subway
Concrete
Spreads
Level Crossing
Tracks
Shelter
Cemetery
Travellers Pit
Settling Ponds
Football Pitch
Onllwyn
Play Area
Issues
Pond
Pond
Pond

A1

Cut Line

Onllwyn Road

Existing Onllywn Coal Washery.

Private Washery drainage not shown. Refer to CG2503-2504

Onllwyn

Dyffryn Cellwen

Cut Line

Gors Llwyn

Coal Washerly

Onllwyn

Dyffryn Cellwen

N

Legend

- Planning Application Boundary
- Existing National Grid Overhead Line
- Existing DCWW Storm Sewer
- Existing DCWW Foul Sewer
- Existing DCWW Combined Sewer
- Existing Water Main
- Existing BT
- Existing WPD Service Line
- Existing WPD PL
- Existing WPD LV
- Existing WPD 132kV HV
- Existing WPD 33kv HV
- Existing WPD 11kV HV

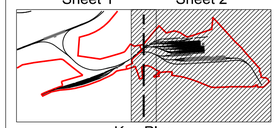
Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. The utility information shown has been taken from Statutory Record plans. No responsibility is taken for the accuracy of this information.

3. The location and alignment of utilities may vary from that shown. Statutory plans received may not be complete and as such unchartered services could be present. An overhead and a buried services survey should be undertaken during future design stages to confirm utility alignment.

Sheet 1 Sheet 2



Key Plan

Issue	Date	By	Chkd	Appd
P01	17/07/20	DO	IA	JS

Issued for Planning

ARUP

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Client
Welsh Government

Job Title
Global Centre for Rail Excellence

Drawing Title
Washery Site
Existing Site and Utilities
Sheet 2 of 2

Scale at A1 1:2000

Discipline Civil

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG2501**	**P01**

J:\264000\264904-00\4 Internal Project Data\4-30 Drawings\4-31 Issue drawings\Drainage Submission\CG2501.dgn

Do not scale

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A1

Existing Washery Surface Water Connection point to River Dulais, including a discharge consent of treated process water from the washery.

River Dulais Catchment 25.43 ha

Onllwyn Road

Cut Line

Onllwyn

River Dulais

Onllwyn

Cut Line

N

Legend

- Planning Application Boundary
- Existing Watercourse
- Existing Ridgeline
- Existing Catchment
- Existing Storm Drainage
- Existing Private Foul Drainage
- Existing DCWW Combined Sewer

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. Existing catchments shown have been derived from the topography information from from LiDAR survey. Existing catchments are shown for the washerys site only and do not present whole river catchments.

3. Existing Wahsery drainage shown traced from information provided by Celtic Energy.

4. Existing watercourses as defined by the Ordinance Survey information shown.

5. Existing DCWW combined sewer traced from asset information provided by DCWW.

Sheet 1 Sheet 2

Key Plan

Issue	Date	By	Chkd	Appd
P01	17/07/20	DO	IA	JS

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Job Title
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Drawing Title
Washery Site
Existing Catchments and Drainage
Sheet 1 of 2

Scale at A1 1:2000

Discipline Civil

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG2502**	**P01**

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A1

Existing Washerys Foul drainage network connection to existing DCWW combined sewer.

Area of existing washery in the River Dulais Catchment 30 ha

Area of existing washery in the Afon Pyrddin Catchment = 18.5 ha

Afon Pryddin Tributary

Onllwyn Road

Onllwyn

Dyffryn Cellwen

Cut Line

Cut Line

N

Legend

- Planning Application Boundary
- Existing Watercourse
- Existing Ridgeline
- Existing Catchment
- Existing Storm Drainage
- Existing Private Foul Drainage
- Existing DCWW Combined Sewer

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

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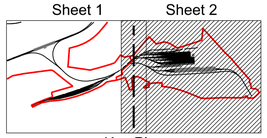
Sheet 1 Sheet 2



Key Plan

Issue	Date	By	Chkd	Appd
P01	17/07/20	DO	IA	JS
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Client
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Job Title
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Drawing Title
Washery Site
Existing Catchments and Drainage
Sheet 2 of 2

Scale at A1 1:2000

Discipline Civil

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG2503**	**P01**

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A1

Re-aligned flows from the run-off of greenfield areas north of the washery site to be conveyed to the River Dulais to maintain the existing hydrological regime.

Attenuation Ponds for catchment 2D
Total Attenuation Volume = 7830m3

Catchment 2D outfall to the River Dulais at the same location as the surface water outfall from the former washerys.

Proposed realigned access track

Unattenuated track drainage connection from main loop Catchment 2C and realigned access track. See drawing connection CG3053 for catchment details.

Proposed main loop rail connection.

Catchment 2E

Re-aligned flows from the run-off of greenfield areas to be conveyed to the River Dulais to maintain the existing hydrological regime.

Attenuation Pond 2E
Attenuation Volume = 5410m3
Attenuation for Catchment 2E and 2C track drainage and 2C access track

Proposed rail sidings on the site of former sidings.

Attenaution pond outfall to the River Dulais

Design of track sidings to be coordinated with the River Dulais, watercourse diversion and multiple culverts may be required.

Cut Line

Onllwyn Road

River Dulais

Onllwyn

Onllwyn

Cut Line

N

Legend

- Planning Application Boundary
- Existing Watercourse
- Proposed Catchment
- Proposed Cut Off Ditch/Swale
- Proposed Filter Drain
- Proposed Culvert
- Proposed Carrier Drain
- Proposed Foul Drain
- Proposed Attenuation Pond Forebay
- Proposed Attenuation Pond
- Existing DCWW Drainage Network

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.
2. This drawing is for planning purposes only and is to be read in conjunction with the Drainage Strategy report.
3. For cut-off ditch typical details, refer to drawing CG2506.
4. The diameter of culverts and sizing of headwall structures are to be determined during subsequent design stages.
5. The attenuation ponds shown are indicative based upon the principles discussed in the drainage strategy report.
6. Foul drainage shown indicatively and strategy subject to agreement with DCWW. Foul strategy shown does not allow for trade effluent which, if required, is subject subject to discussion with DCWW and subsequently not shown.

Sheet 1 Sheet 2

Key Plan

Issue	Date	By	Chkd	Appd
P01	17/07/20	DO	IA	JS

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Client
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Project Title
Global Centre for Rail Excellence

Drawing Title
Washery Site
Proposed Drainage
Sheet 1 of 2

Scale at A1 1:2000 | Role

Suitability Civil

Job No **For Information** | Rev

Drawing No **264904 CG2504 P01**

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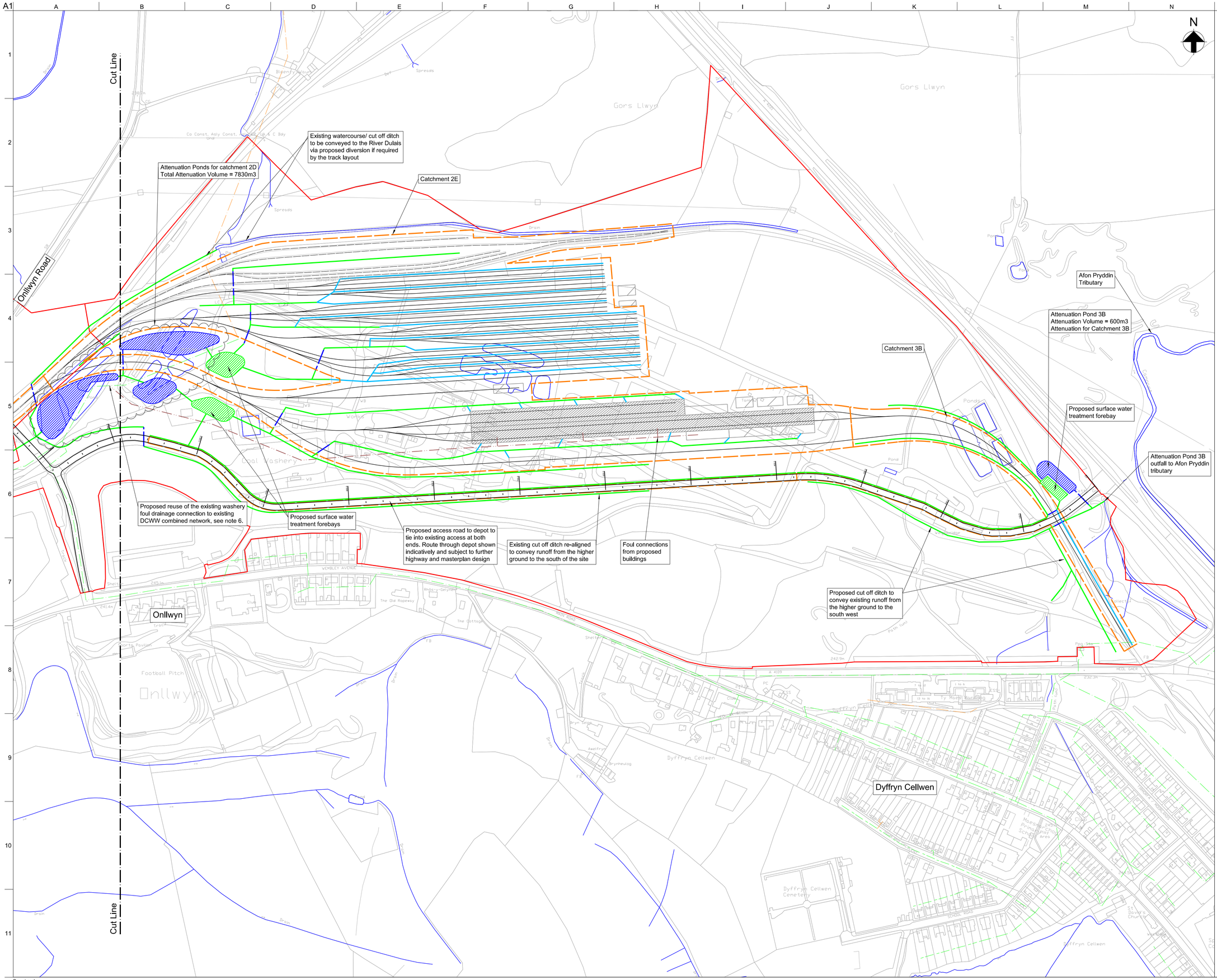

Legend

- Planning Application Boundary
- Existing Watercourse
- Proposed Catchment
- Proposed Cut Off Ditch/Swale
- Proposed Filter Drain
- Proposed Culvert
- Proposed Carrier Drain
- Proposed Foul Drain
- Proposed Attenuation Pond Forebay
- Proposed Attenuation Pond
- Existing DCWW Drainage Network

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.
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3. For cut-off ditch typical details, refer to drawing CG2506.
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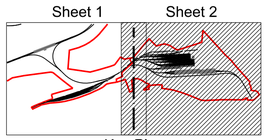

Key Plan

Issue	Date	By	Chkd	Appd
P01	17/07/20	DO	IA	JS

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Job Title
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Drawing Title
Washery Site
Proposed Drainage
Sheet 2 of 2

Scale at A1 1:2000

Discipline Civil

Drawing Status
For Information

Job No	Drawing No	Issue
264904	CG2505	P01

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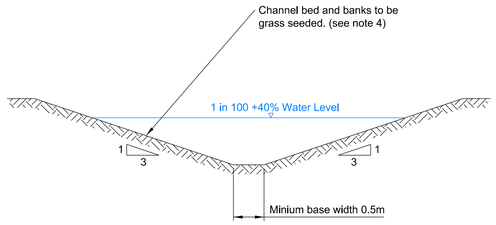
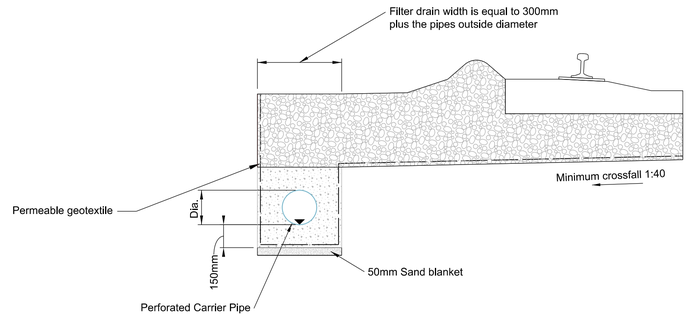


Typical Section - Cut off Ditch and Swale Channel
N.T.S



Example Filter / Track Drainage
NTS

Pipe Nominal Size (DN)	Aggregate to BS 12620
140 to 400	10, 14 or 20mm Nominal Single Size Or 14 to 5mm Graded Or 20 to 5mm Graded
> 400	10, 14 or 20mm Nominal Single Size Or 14 to 5mm Graded Or 20 to 5mm Graded Or 40 to 5mm Graded

OR IN ACCORDANCE WITH PIPE MANUFACTERS BEDDING SPECIFICATION

Table 1 - Example Requirements For Pipe Bedding And Filter Details

Notes

1. All dimensions are in metres unless noted otherwise. All elevations are in metres Above Ordnance Datum (AOD). Do not scale.

2. This drawing is for planning purposes only and is to be read in conjunction with the Drainage Strategy report.

3. For drainage plans, refer to CG2504 and CG2505.

4. Channel subject to detailed design, additional erosion control may be required for higher velocity flows.

5. Details shown for information only, subject to detailed design.

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Client
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Job Title
Global Centre for Rail Excellence

Drawing Title
Washery Site
Typical Drainage Details

Scale at A1: As Shown

Discipline: Civils

Drawing Status
For Information

Job No	Drawing No	Issue
264904	**CG2506**	**P01**

J:\264000\264904-00\4 Internal Project Data\4-30 Drawings\4-31 Issue drawings\Drainage Submission\CG2506.dgn

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Appendix G

DCWW Pre planning Response

Dŵr Cymru
Welsh Water

Developer Services
PO Box 3146
Cardiff
CF30 0EH

Tel: +44 (0)800 917 2652
Fax: +44 (0)2920 740472
E.mail: developer.services@dwrcymru.com

Gwasanaethau Datblygu
Blwch Post 3146
Caerdydd
CF30 0EH

Ffôn: +44 (0)800 917 2652
Ffacs: +44 (0)2920 740472
E.bost: developer.services@dwrcymru.com

Mr David Owen
Arup
Cardiff
CF10 4QP

Date: 19/06/2020
Our Ref: PPA0004933

Dear Mr Owen

Grid Ref: 284848 210504
Site Address: Onllwyn, Neath Port Talbot
Development: Global Centre for Rail Excellence

I refer to your pre-planning enquiry received relating to the above site, seeking our views on the capacity of our network of assets and infrastructure to accommodate your proposed development. Having reviewed the details submitted I can provide the following comments which should be taken into account within any future planning application for the development.

APPRAISAL

Firstly, we note that the proposal relates to the 'Global Centre for Rail Excellence' at Onllwyn, Neath Port Talbot and acknowledge that the site comprises of a potential windfall development with no allocated status in the Local Development Plan (LDP). Accordingly, whilst it does not appear an assessment has been previously undertaken of the public sewerage system, we offer the following comments as part of our appraisal of this development.

Please note, notwithstanding the following assessment, we would advise there is also a mandatory requirement to undertake pre-application consultation with all 'Specialist Consultees', including Dwr Cymru Welsh Water as the statutory water and sewerage undertaker, in accordance with Schedule 4 of Town & Country Planning (Development Management Procedure) (Wales) (Amendment) Order 2016. As a major development, you will be statutorily required to consult Welsh Water and a substantive response will be issued within 28 days from the date of the notice as per the requirements of Article 2E.

Public Sewerage Network

The proposed development site is located in the immediate vicinity of a predominantly combined public sewerage system which drains to Crynant Wastewater Treatment Works (WwTW). The site also lies in proximity to a foul water public sewer, located approximately 0.6km to the north, that drains to Ystradgynlais WwTW.

glas
Glas Cymru Cyfyngedig

Welsh Water is owned by Glas Cymru – a 'not-for-profit' company.
Mae Dŵr Cymru yn eiddo i Glas Cymru – cwmni 'nid-er-elw'.

We welcome correspondence in Welsh and English

Dŵr Cymru Cyf, a limited company registered in Wales no 2366777. Registered office: Pentwyn Road, Nelson, Treharris, Mid Glamorgan CF46 6LY

Rydym yn croesawu gohebiaeth yn y Gymraeg neu yn Saesneg

Dŵr Cymru Cyf, cwmni cyfyngedig wedi'i gofrestru yng Nghymru rhif 2366777. Swyddfa gofrestredig: Heol Pentwyn Nelson, Treharris, Morgannwg Ganol CF46 6LY.

This site is crossed by public sewers with their approximate position being marked on the attached Statutory Public Sewer Record. In accordance with the Water Industry Act 1991, Dwr Cymru Welsh Water requires access to its apparatus at all times in order to carry out maintenance and repairs. No part of any building will be permitted within the protection zone of the public sewers measured 3 metres either side of the centreline. Our strong recommendation is that your site layout takes into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application. Further information regarding Asset Protection is provided in the attached Advice & Guidance note.

You are also advised that some public sewers and lateral drains may not be recorded on our maps of public sewers because they were originally privately owned and were transferred into public ownership by nature of the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011. The presence of such assets may affect the proposal. In order to assist you may contact Dwr Cymru Welsh Water on 0800 085 3968 to establish the location and status of the apparatus in and around your site. Please be mindful that under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

Surface Water Drainage

As of 7th January 2019, this proposed development is subject to Schedule 3 of the Flood and Water Management Act 2010. The development therefore requires approval of Sustainable Drainage Systems (SuDS) features, in accordance with the 'Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems'. As highlighted in these standards, the developer is required to explore and fully exhaust all surface water drainage options in accordance with a hierarchy which states that discharge to a combined sewer shall only be made as a last resort. Disposal should be made through the hierarchical approach, preferring infiltration and, where infiltration is not possible, disposal to a surface water drainage body in liaison with the Land Drainage Authority and/or Natural Resources Wales.

It is therefore recommended that the developer consult with Neath Port Talbot County Borough Council, as the determining SuDS Approval Body (SAB), in relation to their proposals for SuDS features. Please note, DCWW is a statutory consultee to the SAB application process and will provide comments to any SuDS proposals by response to SAB consultation. Please refer to further detailed advice relating to surface water management included in our attached Advice & Guidance note. In addition, please note that no highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system.

Foul Water Drainage – Sewerage Network

We have considered the impact of foul flows generated by the proposed development, as confirmed on the accompanying ‘Proposed Site Location Plan’ (Drawing No. SK001), and concluded that flows can be accommodated within the public sewerage system. We advise that the flows can connect to the existing combined sewer crossing the development site.

Should a planning application be submitted for this development we will seek to control these points of communication via appropriate planning conditions and therefore recommend that any drainage layout or strategy submitted as part of your application takes this into account. However, should you wish for an alternative connection point to be considered please provide further information to us in the form of a drainage strategy, preferably in advance of a planning application being submitted.

You may need to apply to Dwr Cymru Welsh Water for any connection to the public sewer under Section 106 of the Water industry Act 1991. However, if the connection to the public sewer network is either via a lateral drain (i.e. a drain which extends beyond the connecting property boundary) or via a new sewer (i.e. serves more than one property), it is now a mandatory requirement to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). The design of the sewers and lateral drains must also conform to the Welsh Ministers Standards for Foul Sewers and Lateral Drains, and conform with the publication "Sewers for Adoption"- 7th Edition. Further information can be obtained via the Developer Services pages of www.dwrcymru.com.

Notwithstanding the above, if the development will give rise to a new discharge (or alter an existing discharge) of trade effluent, directly or indirectly to the public sewerage system, then a Discharge Consent under Section 118 of the Water Industry Act 1991 is required from Dwr Cymru / Welsh Water. Please note that the issuing of a Discharge Consent is independent of the planning process and a consent may be refused although planning permission is granted.

SEWAGE TREATMENT

No problems are envisaged with the Wastewater Treatment Works for the treatment of domestic discharges from this site

WATER SUPPLY

A water supply can be made available to service this proposed development and facilitated via an existing connection at NGR-284571, 210338. Alternatively, the developer may be required to contribute, under Sections 40 – 41 of the Water Industry Act 1991, towards the provision of new off-site and/or on-site watermains and associated infrastructure. The cost of providing new on-site watermains can be calculated upon the receipt of detailed site layout plans which should be sent to the above address.

The proposed development is crossed by a trunk watermain and an abandoned distribution watermain the approximate positions being shown on the attached plan. Dwr Cymru Welsh Water as Statutory Undertaker has statutory powers to access our apparatus at all times. It may be possible for this watermain to be diverted under Section 185 of the Water Industry Act 1991, the cost of which will be re-charged to the developer. The developer must consult Dwr Cymru Welsh Water before any development commences on site.

I trust the above information is helpful and will assist you in forming water and drainage strategies that should accompany any future planning application.

Please note that our response is based on the information provided in your enquiry and should the information change we reserve the right to make a new representation. Should you have any queries or wish to discuss any aspect of our response please do not hesitate to contact our dedicated team of planning officers, either on 0800 917 2652 or via email at **developer.services@dwrcymru.com**

Please quote our reference number in all communications and correspondence.

Yours faithfully,



Owain George
Planning Liaison Manager
Developer Services

ENC. Sewer plan
Water plan
Pre Planning notes

***Please Note** that demands upon the water and sewerage systems change continually; consequently the information given above should be regarded as reliable for a maximum period of 12 months from the date of this letter.*

Appendix 13A

Health Baseline

Contents

A1 Health baseline 1

A1.1 Introduction 1
A1.2 Population profile 1
A1.3 Deprivation 3
A1.4 Health and wellbeing 3
A1.5 Employment and income 6

A2 Health literature review 7

A2.1 Introduction 7
A2.2 Healthcare services and and community facilities 7
A2.3 Open space and nature 8
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A2.5 Transport and connectivity 14
A2.6 Community safety 16
A2.7 Employment and income 17
A2.8 Social capital cohesion 19

A1 Health baseline

A1.1 Introduction

A1.1.1 This appendix sets out the health baseline used to determine the overall health and wellbeing of the population that interacts with the proposed development.

A1.1.2 Data related to population, health and wellbeing is provided at a variety of scales. Where possible, the lowest scale is used. The following study areas are therefore used throughout the baseline:

- Local authority level: Powys and Neath Port Talbot (NPT);
- Ward level: Aber Craf and Tawe Uchaf (Powys) and Onllywyn and Seven Sisters (NPT);
- Lower Super Output Area (LSOA)[1]:

  Aber Craf – W01000426

  Aberdualis – W0100887

  Crynant – W0100918

  Onllywn – W01000944

  Seven Sisters – W0100965

  Tawe-Uchaf – W0100496

  Ynyscedwyn – W0100502

  Ystradgynlais 1 – W0100504

  Ystradgynlais 2 – W0100505

  The proposed development is within the Aber Craf and Tawe-Uchaf LSOAs.

A1.2 Population profile

A1.1.3 ONS mid-year population estimates (2018)[2] show that at the local authority level, NPT has a population of 142,906 and Powys has a population of 132,447. Both areas have high elderly populations, with 21% of NPT and 27% of Powys aged 65 and over, compared with 18% of Wales.

A1.1.4 **Error! Reference source not found.** sets out the population profile for each Lower Super Output Area (LSOA**Error! Bookmark not defined.**)

[1] LSOA is the smallest geographical scale data is available at, including Census data, based on the population size of an area. The minimum population is 1000 and the mean is 1500.
[2] Office for National Statistics (ONS), 2018. Mid-year population estimates. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates

showing similar trends at the county and national level. Notably, Tawe-Uchaf and Ynyscedwyn have relatively high elderly populations and less 0-15 year olds.

Table 1: Age profile

LSOA	Total pop	Age breakdown		
		0-15	16-64	65+
Aber Craf	1,451	18%	57%	25%
Aberdualis	2,388	23%	61%	16%
Crynant	1,926	16%	61%	22%
Onllwyn	1,197	21%	56%	23%
Seven Sisters	2,088	18%	60%	22%
Tawe-Uchaf	1,971	14%	57%	28%
Ynyscedwyn	2,047	14%	54%	32%
Ystradgynlais 1	1,401	14%	60%	26%
Ystradgynlais 2	1,175	21%	60%	19%

A1.1.5 In terms of population density**Error! Bookmark not defined.**, NPT's density of 324 people per km^2 is above the Welsh average of 151. Powys has a density significantly below the national average with only 26 people per km^2.

Ethnicity

A1.1.6 The table below sets out the ethnicity from the 2011 Census, showing that almost all residents in the areas surrounding the proposed development identify as white ethnicity[3].

Table 2: Ethnicity

	White	Mixed	Asian	Black	Other
Aber Craf	99.5%	0.3%	0.1%	0.1%	0.0%
Aberdualis	98.5%	0.6%	0.8%	0.0%	0.0%
Crynant	99.3%	0.2%	0.3%	0.3%	0.0%
Onllwyn	99.3%	0.5%	0.0%	0.1%	0.1%
Seven Sisters	99.2%	0.5%	0.3%	0.0%	0.0%
Tawe-Uchaf	98.9%	0.4%	0.7%	0.0%	0.0%
Ynyscedwyn	98.4%	0.6%	0.7%	0.2%	0.0%
Ystradgynlais 1	97.6%	1.0%	1.3%	0.0%	0.1%
Ystradgynlais 2	98.5%	0.5%	0.9%	0.1%	0.0%

[3] Office for National Statistics (ONS), 2011. 2011 Census – ethnicity. Available at: https://www.nomisweb.co.uk/census/2011

A1.3 Deprivation

A1.1.7 The Welsh Index of Multiple Deprivation (2019) (WIMD)[4] provides a measure of relative deprivation at the small area level based on Lower Super Output Area (LSOA). The WIMD is currently made up of eight separate types (domains) of deprivation: income, employment, health, education, access to services, community safety, physical environment and housing. These domains are combined to also provide an indication of overall deprivation.

A1.1.8 **Error! Reference source not found.** sets out the IMD score and rank for each LSOA in the study area. This shows that generally the areas in proximity to the proposed development are not very deprived, with exception of Ystradgynlais 1 which is considered to be one the most deprived areas in Wales.

Table 3: WIMD 2019 - overall deprivation

LSOA	WIMD Score[1]	WIMD Rank[2]
Aber Craf	950	4
Aberdualis	735	4
Crynant	1206	5
Onllywn	508	3
Seven Sisters	552	3
Tawe-Uchaf	847	4
Ynyscedwyn	1198	5
Ystradgynlais 1	117	1
Ystradgynlais 2	821	4

[1]Where 1 is most deprived and 1909 is the least deprived

[2]Where 1 is most deprived 10% of LSOAs and 5 is the least deprived 50%

A1.4 Health and wellbeing

A1.1.9 The following section sets out the health and wellbeing status of the population. WIMD and census data is provided at smaller geographical levels, but the majority of information presented is at the local authority level (NPT and Powys) and is not available at the more granular level of LSOA data.

Mortality

A1.1.10 **Error! Reference source not found.** shows the life expectancy and healthy life expectancy at the local authority and national level[5]. It

[4] Welsh Index of Multiple Deprivation, 2019. Available at: https://wimd.gov.wales/explore?lang=en#domain=overall&&z=8&lat=52.4137&lng=-4.2000

[5] Public Health Wales Observatory, 2015-2017 data. *Life expectancy and healthy life expectancy*. Available at: https://public.tableau.com/profile/publichealthwalesobservatory

shows that in general Powys has an above-average life expectancy and healthy life expectancy compared to the national average, whilst NPT is below average.

Table 4: Life expectancy and healthy life expectancy

	Life expectancy		Healthy life expectancy	
	Males	**Females**	**Males**	**Females**
NPT	77.0	80.9	60.7	58.9
Powys	79.6	84.2	66.4	68.9
Wales	78.3	82.3	61.4	62.0

A1.1.11 The actual death count and death rates for each local authority and nationally are show **Error! Reference source not found.**[6].

Table 5: Death rates and count

	Rate	Deaths
Powys	905.9	1,594
NPT	1,150.30	1594
Wales	1,035.60	33,247

Health deprivation

A1.1.12 The health deprivation domain measures the lack of good health, using seven indicators such as long term illnesses, death rates, birth weights and obesity levels. **Error! Reference source not found.** shows Ystradgynlais 1 is one of the most deprived areas of Wales in terms of health deprivation, whereas the other LSOAs are considered to be relatively healthy.

Table 6: WIMD 2019 - health deprivation

LSOA	WIMD Score[1]	WIMD Rank[2]
Aber Craf	616	4
Aberdualis	700	4
Crynant	948	4
Onllywn	398	3
Seven Sisters	432	3
Tawe-Uchaf	955	4
Ynyscedwyn	895	4
Ystradgynlais 1	105	1
Ystradgynlais 2	711	4

[6] NHS Wales. Health maps, 2017 data. Available at: https://www.healthmapswales.wales.nhs.uk/IAS/dataviews/report/multiple?reportId=60&viewId=138&geoTypeId=107,108,109,110

LSOA	WIMD Score[1]	WIMD Rank[2]
[1]Where 1 is most deprived and 1909 is the least deprived [2]Where 1 is most deprived 10% of LSOAs and 5 is the least deprived 50%		

Self-evaluation of health status

A1.1.13 As shown in **Error! Reference source not found.**, an above-average proportion of Powys residents consider their health to be 'Good or Very Good'[7], whereas the health status of NPT residents is below the Welsh Average.

Table 7: Self-rated health

	"Good or Very Good"	"Fair"	"Bad or Very Bad"
Powys	75.1	18.5	6.5
Neath Port Talbot	68.1	21.4	10.5
Wales	71.20	19.54	9.26

A1.1.14 Looking specifically at different age groups, 78.2% of working age adults in Powys identified their health as 'Good or Very Good' compared with 71.7% in NPT and 76.0% across Wales. For older people, this percentage significantly drops with only 61.0% in Powys and 53.7% in NPT identifying their health as 'Good or Very Good', compared with 56.1% nationally.

Healthy lifestyles

A1.1.15 The Public Health Wales Observatory identifies that approximately 18% of children ages 11 to 16 are considered to be physically active, and both Powys and NPT have the same percentage as this national average[8]. For adults, Powys has a much higher rate of physical activity, with 64% of adults considered to be physically active (defined as 150 minutes or more of physical activity in a week), compared with 53.1% nationally[9]. NPT however is below average, with only 48.4% of adults considered to be physically active.

[7] StatsWales, 2019. National Survey for Wales *General health and illness*. Available at: https://statswales.gov.wales/Catalogue/National-Survey-for-Wales/Population-Health/Adult-general-health-and-illness/genhealthillness-by-localauthorityhealthboard

[8] Public Health Wales Observatory, 2017/18 data. *Physical activity in adolescents.* Available at: https://public.tableau.com/profile/publichealthwalesobservatory

[9] Public Health Wales Observatory, 2016/17 – 2018/19 data. *Physical activity in adults.* Available at: https://public.tableau.com/profile/publichealthwalesobservatory

Community cohesion

A1.1.16 Public health data shows that NPT had higher levels of loneliness, with 18.9% of the population felling lonely, compared with 13.0% in Powys and 16.7% in Wales[10].

A1.1.17 Results from the National Survey for Wales (2018/19) show that both Powys and NPT had above-average sense of community in the local authorities, with 58.5% and 53.6% respectively, compared with 52.2% nationally**Error! Bookmark not defined.**.

A1.5 Employment and income

A1.1.18 **Error! Reference source not found.** sets out the employment and income deprivation levels. The employment domain considers four indicators including the number of people applying for different Government benefits or allowances, whereas the income domain assess the proportion of people below a defined level of income.

A1.1.19 In line with the domains discussed above, the area around the proposed development is not particularly deprived, with exception to the Ystradgynlais 1 LSOA which is deprived in terms of both employment and income.

Table 8: WIMD 2019 – employment and income deprivation

	Employment deprivation		**Income deprivation**	
LSOA	**WIMD Score[1]**	**WIMD Rank[2]**	**WIMD Score[1]**	**WIMD Rank[2]**
Aber Craf	616	4	1007	5
Aberdualis	700	4	727	4
Crynant	948	4	1067	5
Onllywn	398	3	586	4
Seven Sisters	432	3	622	4
Tawe-Uchaf	955	4	928	4
Ynyscedwyn	895	4	1153	5
Ystradgynlais 1	105	1	147	1
Ystradgynlais 2	711	4	915	4

[1]Where 1 is most deprived and 1909 is the least deprived
[2]Where 1 is most deprived 10% of LSOAs and 5 is the least deprived 50%

A1.1.20 Further baseline information in relation to employment and income is provided in the Socio-economics chapter (Chapter 12).

[10] Public Health Wales Observatory, 2016/17 data. *Loneliness.* Available at: https://public.tableau.com/profile/publichealthwalesobservatory

A2 Health literature review

A2.1 Introduction

This appendix summarises a literature review of publicly available research and evidence relating to the health determinants considered in the health and wellbeing assessment of the proposed development.

It has been used to inform the assessment of impacts on health determinants arising from the proposed development and the potential significant effects on population health as a result.

A2.2 Healthcare services and and community facilities

A1.1.21 Access to services and community facilities can affect health and wellbeing directly, through access to treatment and care, or access to fresh food retailers, and indirectly through issues such as access to social networks. It has been found that access to public services and social infrastructure such as health, education and community facilities has a direct positive effect on human health[11].

A1.1.22 Recent evidence[12] has stated that the accessibility of local shops, community services and healthcare facilities may be affected by:

- effects on the capacity of existing services;
- physical accessibility (i.e. distances travelled and transport connections);
- social and/or cultural access (i.e. communication issues); and
- separation imposed by a new piece of physical infrastructure.

A1.1.23 Research has suggested that 'access to local shops, post offices, places of entertainment and community activity all contribute to well-being'[13]. It has been estimated that 5% of adults in Great Britain reported feeling a sense of isolation due to difficulties accessing local shops and services[14.] Furthermore, the same research also reported that over a fifth of adults reported that they knew someone who felt a sense of isolation due to difficulties accessing local shops and services.

A1.1.24 Access to healthcare services is affected by the accessibility of transport modes, availability of financial support for those on low incomes and the location of healthcare services[14]. Groups impacted by disability and of certain ages can also experience even greater barriers to health and social care services[15]. Access to healthcare is important

11 HUDU (2013). HUDU Planning for Health. Rapid Health Impact Assessment Tool. (NHS) London Healthy Urban Development Unit

12 Quigley, R. and Thornley, L., 2011, Literature Review on Community Cohesion and Community Severance: Definitions and Indicators for Transport Planning and Monitoring, Report to New Zealand Transport Agency, Quigley and Watts Ltd

13 Harding, T., 1997, A Life Worth Living: the Independence and Inclusion of Older People, London: Help the Aged, cited in Randall, C., 2012, Measuring National Well-being – Where we Live,2012, Office for National Statistics

14 Randall, C., 2012, Measuring National Well-being - Where we Live – 2012, Office for National Statistics

15 Hamer, L., 2004, Improving patient access to health services: a national review and case studies of current approaches, Health Development Agency

for communities as healthcare offers information, screening, prevention and treatments. Restricted access to healthcare prevents patients gaining necessary treatments and information.

A1.1.25 Access to social infrastructure including leisure and cultural facilities is a determinant of health and wellbeing. According to research 'leisure activities can have a positive effect on people's physical, social, emotional and cognitive health through prevention, coping (adjustment, remediation, diversion), and transcendence'[16]. People participate in cultural activities for a number of reasons including personal growth and development, to learn new skills, enjoyment and entertainment and as a 'means of creative expression', or 'to meet new people' and to 'pass on cultural traditions'[17].

A2.3 Open space and nature

A1.1.26 Numerous studies have found links between health and wellbeing and access to green space. A systematic review of observational evidence has shown an association between long-term exposure to green space and cognition (intellect and cognisance) over the life course[18]. The association is seen cross-sectionally in both adults and children.

A1.1.27 A review of the literature examining the association between access to green space and the mental wellbeing of children concluded that access to green spaces promoted attention and memory, fostered supportive social groups and self-discipline and improved symptoms of ADHD[19].

A1.1.28 A review by O'Brien et al. (2010) for the Forestry Commission[20] found that the proximity, size and amount of green space available to people in urban environments influenced physical and mental health outcomes. The review identified the key health benefits of green space as:

- 'Long and short term physical benefits associated with obesity, life expectancy, heart rate and blood pressure;
- Attention and cognitive benefits associated with restoration, mood and self-esteem;
- Physical activity benefits associated with the use of greenspace;
- Self-reported benefits in terms of health and life satisfaction; and

16 Caldwell, L.L. (2005) Leisure and health: Why is leisure therapeutic?

17 New Zealand Government, 2007, Social Report: Leisure and Recreation, Ministry of Social Development, New Zealand Government

18 Keijezer, C et al (2016), L*ong-term Green Space Exposure and Cognition Across the Life Course: A Systematic Review. Current Environmental Health Reports* Vol 3(4): 468-477

19 McCormick, R. (2017) *Does Access to Green Space Impact the Mental Well-being of Children: A Systematic Review*. Vol 37 pages 3-7

20 O'Brien, L., Williams, K. and Stewart, A. (2010), *Urban health and health inequalities and the role of urban forestry in Britain: A review*, The Research Agency of the Forest Commission

- Community cohesion benefits through social contact fostered by greenspace.'

A1.1.29 The review suggests various mechanisms for the beneficial effects of green space including 'providing a space that promotes social interaction and inclusion, reducing social annoyances and crime' and 'reducing stress and restoring cognitive function and capacity to function with the demands of life'.

A1.1.30 An evidence review by Natural England[21] showed that access to natural environments promotes physical activity including walking, gardening and children's play. The review shows evidence that people with poorer health tend to benefit more from physical activity in natural environments. In addition, a systematic review of physical activity and green spaces concluded that, compared with indoor activities, physical activity in natural environments is associated with greater feelings of revitalisation, increased energy and positive engagement, and decreases in tension, confusion, anger and depression.[22]

A1.1.31 Research conducted by Maas et al. in 2006[23] has suggested that there is a positive association between the proportion of green space in a residential area and the perceived general health of residents, and that this relationship is strongest for lower socio-economic groups.

A1.1.32 A literature review by Croucher et al. in 2007 for Greenspace Scotland[24] found a positive relationship between green space and general health, and also identified that 'the attractiveness or quality of greenspace is an important determination of green space use'. The review also identified links to mental health, stating that 'studies consistently show a relationship between levels of stress and access to urban green spaces' and identified 'activity and exercise, natural daylight, stimulation of the senses and aesthetic experience' as potential factors in reducing stress. Similarly, Wood et al (2017) found that there was a positive relationship between access to green spaces and mental wellbeing, including in places with a nature focus and spaces designed for recreational and sporting activity[25].

A1.1.33 A systematic review of the impact of green space on biodiversity and health found that, while reported effects of green space were

21 Natural England Access to Evidence Information Note EIN019. (2016) Links between natural environments and physical activity: evidence briefing.

22 Thompson Coon J., et al (2011) Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors? A Systematic Review. Environmental Science & Technology 45: 1761

23 Maas, J., Verheij, R., Groenewegen, P., de Vries, S. and Spreeuwenberg, P. (2006), *Green space, urbanity and health: how strong is the relation?* Journal of epidemiology and community health

24 Croucher, K., Myers, L., and Bretherton, J. (2007), *The links between greenspace and health: a critical literature review*, Greenspace Scotland

25 Wood. L et al (2017), Public green spaces and positive mental health – investigating the relationship between access, quantity and types of parks and mental wellbeing. Health and Place 48:63-71

overwhelmingly positive, 22% of the papers examined identified either no effect or negative effects[26].

A1.1.34 A UK study by Houlden et al.[27] in 2019 was undertaken to test whether the amount of greenspace within a radius of individuals' homes was associated with mental wellbeing, testing the UK government guideline that greenspace should be available within 300m of homes. Findings showed that an increase in one hectare of greenspace within 300m of residents was associated with a statistically significant increase in life satisfaction, worth and happiness.

A1.1.35 Research into the effects of the visual and aesthetic environment on wellbeing is mainly focused on the psychological effects of 'natural' versus 'man-made' or urban views. In general, evidence shows a preference for views of natural over man-made scenes. These links are often tied in with other, related issues such as opportunities for exercise and contact with nature.

A2.4 Neighbourhood quality (air quality, noise and visual amenity)

Landscape and visual

A1.1.36 There is evidence of links between health outcomes and the physical characteristics of neighbourhoods. In 2013, a Position Statement by the Landscape Institute[28] looked at evidence linking the quality of places with health and wellbeing across a range of environmental, social and lifestyle determinants. This document cites evidence to suggest that health and wellbeing are influenced positively by factors such as the attractiveness, noise and other pollution, and the perceived safety of the environment. Similarly, a report by Cubbin et *al.* 2008 for the Commission to Build a Healthier America[29] identified links between health outcomes and the physical characteristics of neighbourhoods, including issues such as air quality, safety and traffic, alongside a range of social and neighbourhood service characteristics.

A1.1.37 A literature review of over 120 studies[30] identified a set of pathways that link landscape and health. The study found that: 'Landscapes have the potential to promote mental well-being through attention restoration, stress reduction, and the evocation of positive emotions; physical well-being through the promotion of physical activity in daily

26 Lai, H., et al. (2019) The impact of green space and biodiversity on health. The ecological society of America 17:7, doi: https://doi.org/10.1002/fee.2077

27 Houlden V. et al (2019) A spatial analysis of proximate greenspace and mental wellbeing in London. Applied Geography 109:102036

28 Landscape Institute (2013), *Public Health and Landscape – Creating healthy places,* https://www.landscapeinstitute.org/PDF/Contribute/PublicHealthandLandscape_CreatingHealthyPlaces_FINAL.pdf.

29 Cubbin, C., Pedregon, V., Egerter, S. and Braveman, P. (2008), *Where we live matters for our health: Neighbourhoods and health*, Commission to build a Healthier America

30 Abraham, A., Sommerhalder, K. and Abel, T. (2010), *Landscape and well-being: a scoping study on the health-promoting impact of outdoor environments*, International Journal of Public Health

life as well as leisure time and through walkable environments; and social well-being through social integration, social engagement and participation, and through social support and security.'

A1.1.38 Another study by Seresinhe *et al.* in 2015[31] sought to quantify the relationship between environmental aesthetics and human health by comparing geographic data against self-rated health. This found that *'inhabitants of more scenic environments report better health, across urban, suburban and rural areas, even when taking core socioeconomic indicators of deprivation into account, such as income, employment and access to services.'*

Air quality

A1.1.39 The WHO recognises outdoor air pollution as a major environmental health problem for all countries, including high-income countries.[32]There is a wealth of evidence showing the association of nitrogen dioxide and particulate matter on poor health outcomes. Epidemiological studies have shown that long-term exposure to air pollution (over years or a lifetime) reduces life expectancy, due to cardiovascular and respiratory diseases and lung cancer. Short-term exposure (over hours or days) to increased levels of air pollution can also have a range of health effects, including effects on lung function, asthma, as well as increases in respiratory and cardiovascular hospital admissions, and mortality[33]. Additionally, outdoor air pollution can influence productivity and contribute to social costs such as increasing days off work and school due to restricted health.[34]

A1.1.40 A Public Health England review[35] of interventions to improve outdoor air quality and public health found clear evidence that air pollution is the largest environmental risk to the health of the public in the UK. The review found that:

- It is estimated that between 28,000 and 36,000 deaths each year are attributed to humanmade air pollution
- There is a close association with cardiovascular and respiratory disease, including lung cancer
- There is emerging evidence that other organs may also be affected, with possible effects on dementia, low birth weight and diabetes.

31 Seresinhe, C., Preis, T. and Moat, H. (2015), *Quantifying the Impact of Scenic Environments on Health*, Scientific Reports

32 WHO Topic Sheet. (2018) Ambient (outdoor) air quality and health. https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

33 Public Health England (2018). Guidance: Health Matters: air pollution. https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution

34 IOM Working for a Healthier Future. Scotland's Environment (2015) Air Quality, Health, Wellbeing and Behaviour, https://www.environment.gov.scot/media/1133/iom-seweb-aq-health-behaviour-review.pdf

35 Public Health England (2019), Review of interventions to improve outdoor air quality and public health. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/795185/Review_of_interventions_to_improve_air_quality.pdf

- It concluded that the most impactful interventions would be those that reduce emissions of air pollution at source.

A1.1.41 Evidence on the links between road traffic emissions and health is well established, based on numerous research studies. A WHO report in 2000 suggested that about 36,000–129,000 adult deaths a year are brought forward due to long-term exposure to air pollution generated by traffic in European cities. The main health damaging pollutants released as emissions from road traffic are Particulate Matter (PM1036) and nitrogen dioxide (NO2).

A1.1.42 PM10, which is an important pollutant with regard to health effects, comprises atmospheric particles that are less than 10μm in diameter. Road transport is a major source of PM10, which is emitted from the combustion of vehicle fuels. There is growing evidence that smaller respirable particulate matter may be more relevant to health than larger particles. Recent studies[37] have found that ultra-fine particles (less than 0.1 μm) have been associated with stronger effects on the lung function and symptoms in asthmatics than either PM10 or PM2.5.

A1.1.43 According to the Lancet Commission on pollution and health[38] children are at high risk of pollution related disease and even extremely low-dose exposures to pollutants during windows of vulnerability in utero and in early infancy can result in disease, disability, and death in childhood and across their lifespan. Research has shown that exposure to PM affects children's lung development, including reversible deficits in lung function as well as chronically reduced lung growth rate and a deficit in long-term lung function.

A1.1.44 Whilst there is no clear evidence of a safe level of exposure below which there is no risk of adverse health effects, there is sufficient evidence available to demonstrate that the adverse effects of air pollution on health outcomes is widely accepted. There is consensus that lowering levels of NO2 and particulate matter will bring additional health benefits. Therefore, the evidence is judged to be strong.

A1.1.45 Defra commissioned a study in 2006 to review recent research evidence on links between air quality and social deprivation in the UK[39]. The analysis for England showed that there is a tendency for higher relative mean annual concentrations of nitrogen dioxide (NO2) and particulate matter (PM10) in the most deprived areas of the country. This distribution can largely be explained by the high urban concentrations driven by road transport sources, and the higher

36 Particulate Matter up to 10 micrometers in size

37 World Health Organization. (2000) Transport, environment and health. WHO Regional Publications, European Series. No.89

38 Landrigan, P.J., et al (2018), The Lancet Commission on pollution and health, The Lancet 391:462-512

39 Defra, Netcen, Department for Communities and Local Government, National Statistics. Air Quality and Social Deprivation in the UK: an environmental inequalities analysis - Final Report to Department of Environment, Food and Rural Affairs AEAT/ENV/R/2170, June 2006

proportion of deprived communities in urban areas. If exceedences of National Air Quality Standards are considered, the correlation between poor air quality and deprivation is stronger, showing that when the most polluted areas are considered, the greatest burden is on the most deprived communities, and very little on the least deprived.

Noise environment

A1.1.46 According to the WHO[40], 'excessive noise seriously harms human health and interferes with people's daily activities at school, at work, at home and during leisure time. It can disturb sleep, cause cardiovascular and psychophysiological effects, reduce performance and provoke annoyance responses and changes in social behaviour'.

A1.1.47 A literature review by van Kamp and Davies in 2013[41] looked at 62 papers published from April 2006 to April 2011, which included the impact of environmental noise on the health of vulnerable people, including primary school children, young adolescents, preschool children, the elderly, and children with autism, asthma and attention deficit hyperactivity disorder. This found that, while vulnerable groups of people may be more at risk from exposure to environmental noise than healthy adults, there is comparatively little research focusing on the adverse health effects of noise on vulnerable people.

A1.1.48 A European Commission publication in 2015[42] cited evidence that 'living in a quiet area has a positive impact on health. A study assessed quality of life for people living in quiet and noisy locations and found that those who lived in quiet locations – particularly in rural areas – had a better quality of life'.

A1.1.49 The recently published 2018 WHO guidelines on Environmental Noise for the European Region[43] undertook a series of systematic reviews synthesising exposure and associated impacts on health in order to develop a set of guidelines on how to protect human health. Recommendations were formulated based on the strength of evidence from various noise sources which are road traffic noise, railway noise, aircraft noise, wind turbine noise and leisure noise. The systematic reviews concluded that there was evidence for an association of railway noise and road traffic noise on cardiovascular disease (CVD), sleep disturbance, annoyance, and cognitive impairment, with suggestive but weaker evidence (often due to lack of studies) for effects on mental health and birth weight.

40 World Health Organization (2017), Noise, http://www.euro.who.int/en/health-topics/environment-and-health/noise.

41 van Kamp, I. and Davies, H. (2013), *Noise and health in vulnerable groups: A review*, Noise and Health

42 European Commission, Science for Environment Policy, Thematic issues: Noise impacts on health (2015), http://ec.europa.eu/environment/integration/research/newsalert/pdf/47si.pdf.

43 World Health Organisation Regional Office for Europe (2018) Environmental Noise Guidelines for the European Region. http://www.euro.who.int/__data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf

A1.1.50 Based on the evidence reviews, the 2018 WHO guidelines set a recommended level for railway noise exposure to protect health of 54dB Lden and 44dB Lnight; for road noise the recommended levels are 53dB Lden and 45dB Lnight. However, the WHO states that recommended levels are not LOAEL (Lowest Observed Adverse Effect Level) values and there is currently no policy requirement to implement these values in the UK.

A2.5 Transport and connectivity

A1.1.51 There is a large body of evidence linking physical activity with improved physical and mental health. The WHO[44] defines physical activity as 'any bodily movement produced by skeletal muscles that requires energy expenditure' and states that 'physical activity has significant health benefits and contributes to prevent non-communicable diseases'.

A1.1.52 These benefits are identified as reduced risk of hypertension, coronary heart disease, stroke, diabetes, breast and colon cancer, depression and the risk of falls, improved bone and functional health, and weight control. The WHO also states that 'beyond exercise, any other physical activity that is done during leisure time, for transport to get to and from places, or as part of a person's work, has a health benefit. Further, both moderate- and vigorous-intensity physical activity improve health.'

A1.1.53 The positive effects of physical activity on physical health was summarised in a recent Department of Health report[45] which suggests that 'Regular physical activity can reduce the risk of many chronic conditions including coronary heart disease, stroke, type 2 diabetes, cancer, obesity, mental health problems and musculoskeletal conditions. Even relatively small increases in physical activity are associated with some protection against chronic diseases and an improved quality of life.'

A1.1.54 It has been shown that 'physical activity improves health throughout the life course – from childhood through to older age'[46]. The health benefits of physical exercise occur across virtually the full range of diseases, and when this is combined with the prevalence of inactivity among the public, it 'makes physical activity one of the main contemporary public health issues'.

44 World Health Organization, Physical activity (2017), http://www.who.int/mediacentre/factsheets/fs385/en/.

45 CMO (2011) Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers, Department of Health, Physical Activity, Health Improvement and Protection.

46 Harding, T., (1997), A Life Worth Living: the Independence and Inclusion of Older People, London: Help the Aged, cited in Beaumont, J., 2011, Measuring National Well-being, Discussion paper on domains and measures, Faculty of Public Health, Office for National Statistics

A1.1.55 Positive mental health effects associated with physical exercise have been highlighted in evidence reviews by Cave et al[47], Sport England[48] and AEA Technology[49]. Mental health effects cited include improvements in people with generalised anxiety disorders including phobias, panic attacks, and stress disorders.

A1.1.56 A 2013 literature review focused on the health benefits of active travel by Saunders et al. determined that, although there is no clear evidence in the effectiveness of active travel in reducing obesity, there has been a rise in the prevalence of obesity which has occurred in parallel with a decline in active travel in the past 30-40 years. Data from a report by the National Obesity Observatory in 2011 suggests a number of factors impact active travel including access to fitness facilities, distance to destinations, land use, urban walkability scores, safety, availability of equipment and the provision of footpaths.

A1.1.57 A study undertaken in 2017 by the University of the West of England[50], examined the impacts of commuting on the wellbeing of over 26,000 employed people in England between 2009/10 and 2014/15 as part of 'The Commuting and Wellbeing Study'. The study found that for every extra minute of commute time, job satisfaction and leisure time reduced and stress was increased.

A1.1.58 Vernon et al. in 2014[51] suggest that road safety inventions can also help to encourage physical activity by creating a safer physical road environment and reducing the level of danger posed to vulnerable road users. Vernon et al also noted that that 'road safety has a much wider impact on health than just preventing injuries. This is because some forms of travel (i.e., walking and cycling), and the provision for them, bring more health benefits for individuals and society than others. However, the way that people travel is influenced by concerns about actual or perceived safety; effective intervention to reduce road danger can encourage more people to travel by these active, health-promoting modes.'

A1.1.59 More recent research[52] found that people living in walkable neighbourhoods tend to be more physically active and less likely to be obese.

A1.1.60 Accessibility and the provision of public services such as health, education and community facilities have been found to have a direct

47 Cave. B, Curtis. S, Aviles. M, and Coutts. A, (2001). 'Health Impact Assessment for Regeneration Projects. Volume II Selected evidence base'. East London and City Health Action Zone.

48 Sport England. (2007). 'Active Design. Promoting opportunities for sport and physical activity through good design'. Supported by CABE, DH and DCMS. Sport England.

49 AEA Technology, (2000). 'Informing transport health impact assessment in London'. Commissioned by NHS Executive, London.

50 Chatterjee, K., Clark, B., Martin, A. & Davis, A. (2017). *The Commuting and Wellbeing Study: Understanding the Impact of Commuting on People's Lives*. UWE Bristol, UK. https://travelbehaviour.files.wordpress.com/2017/10/caw-summaryreport-onlineedition.pdf

51 Vernon, D. (2014), *Road Safety and Public Health*, Royal Society for the Prevention of Accidents (RoSPA)

52 Booth GL, Creatore MI, Luo J, et al. Neighbourhood walkability and the incidence of diabetes: an inverse probability of treatment weighting analysis. J Epidemiol Community Health Published Online First: 29 January 2019

positive effect on human health[53]. Accessibility for local residents to community facilities can play a significant role in promoting or discouraging physical activity. The key influential characteristics of an accessible community noted by Dannenberg et al[54] included proximity of recreation facilities, housing density, street design and accommodation for safe pedestrian, bicycle, and wheelchair use.

A2.6 Community safety

A1.1.61 A literature review by Lorenc et *al.* BMC literature review[55] included 40 studies to review and synthesize qualitative evidence from the UK on fear of crime and the environment. The review found that, while environmental factors may influence fear of crime, including visibility and signs of neglect, factors in the local social environment appear to be more important as drivers of fear of crime.

A1.1.62 The Department for Communities and Local Government's 2008 Place Survey[56] showed that personal safety and low levels of crime are highly valued; respondents were asked to identify up to 5 priorities for a good place to live, and 61% identified low levels of crime as a priority. A study by Stafford et al. in 2007 in the American Journal of Public Health[57] found evidence to suggest that fear of crime was a contributory factor in some adverse health outcomes. The study suggested that fear of crime can impact mental health by increasing anxiety and decreasing trust and community participation, and has been linked to reducing people's willingness to participate in physical activity[58].

A1.1.63 In 2012, Lorenc et al.[59] highlighted that crime and fear of crime have a substantial impact on health but the pathways are often indirect and mediated by environmental factors. For example, the built environment may affect wellbeing by increasing fear of crime due to poor design or quality.

A1.1.64 A US literature review of studies of older people's health outcomes in relation to neighbourhood safety identified 32 studies on health status and health behaviours in relation to crime and safety.[60] A systematic review of 22 longitudinal cohort studies of childhood obesity and

53 HUDU (2013). HUDU Planning for Health. Rapid Health Impact Assessment Tool. (NHS) London Healthy Urban Development Unit

54 Dannenberg A.L, Jackson R.J, Frumkin H, Schieber R.A, Pratt M, Kochtitzky C and Tildon H. N (2003) The Impact of Community Design and Land-Use Choices on Public Health: A Scientific Research agenda. American Journal of Public Health 93

55 Lorenc, T., Petticrew, M., Whitehead, M., Neary, D., Clayton, S., Wright, K., Thomson, H., Cummins, S., Sowden, A. and Renton, A. (2013), *Fear of crime and the environment: systematic review of UK qualitative evidence*, BMC Public Health

56 Department for Communities and Local Government, Place Survey (2008), http://webarchive.nationalarchives.gov.uk/20120919132719/http:/www.communities.gov.uk/documents/statistics/pdf/1326142.pdf.

57 Stafford, M., Chandola, T. and Marmot, M. (2007), *Association Between Fear of Crime and Mental Health and Physical Functioning*, American Journal of Public Health

58 Jackson, J. and Stafford, M. (2009), *Public health and fear of crime*, British Journal of Criminology Advance

59 Lorenc, T., Clayton, S., Neary, D., Whitehead, M., Petticrew, M., Thomson, H., Cummins, S., Sowden, A. and Renton, A. (2012), *Crime, fear of crime, environment, and mental health and wellbeing: mapping review of theories and causal pathways*, Health Place

60 J. Won et al (2016) *Neighbourhood safety factors associated with older adults' health-related outcomes: A systematic literature review*. Social Science and Medicine 165: 177-186

physical activity[61], found that children were less likely to undertake physical activity if living in an unsafe environment.

A2.7 Employment and income

A1.1.65 There is a large body of evidence linking employment and income levels with health. The World Health Organization (WHO) identifies a list of health determinants[62] that combine to affect the health of individuals and communities. Included in this list is: *'income and social status - higher income and social status are linked to better health. The greater the gap between the richest and poorest people, the greater the differences in health'.*

A1.1.66 The Marmot Review, published in 2010[63], was commissioned by the Department of Health to investigate health inequalities in England and focused on correlations between health and wellbeing and the socio-economic status of communities. The report identified six evidence-based policy objectives to reduce health inequalities, one of which was to create fair employment and good work for all. The Review stated that *'being in good employment is protective of health. Conversely, unemployment contributes to poor health'*. This study also identifies links between educational attainment and physical and mental health.

A1.1.67 Much of the literature relating to unemployment and health outcomes is focused on the increased likelihood of poor health in low income groups, often referred to as the social gradient in health. For example, a large-scale study by Wapner in 2015[64] showed that disadvantaged adolescents reported lower levels of physical activity and higher levels of bodily aches and pains, sleeplessness and emotional difficulties, such as nervousness and irritability, than more advantaged teenagers. In addition, a Spanish study undertaken in 2015[65] found that the impact of unemployment, particularly long-term unemployment, had a negative impact on self-reported health and mental health.

A1.1.68 A study by Clark and Lepinteur[66] in 2019 explored the causes and consequences of early-adult unemployment. Findings showed that past unemployment can negatively impact on life satisfaction later in life. A Policy Brief for the LEAD Centre[67] presented evidence to suggest a

61 R. An et al (2017*) Influence of Neighbourhood Safety on Childhood Obesity: A Systematic Review and Meta-analysis of Longitudinal Studies.* Obesity Reviews. Nov;18(11):1289-1309

62 World Health Organization (2017), *Health Impact Assessment - The determinants of health*, http://www.who.int/hia/evidence/doh/en/.

63 Marmot, M., Allen, J., Goldblatt, P., Boyce, T., McNeish D., Grady, M. and Geddes, I. (2010), *Fair society, healthy lives: Strategic review of health inequalities in England post-2010*, The Marmot Review

64 Wapner, J. (2015), *Money is driving a wedge in teen health*, Scientific American

65 R.M. Urbanos-Garrido and B.G.Lopez-Valcarcel (2015) *The influence of economic crisis on the association between unemployment and health: an empirical analysis for Spain.* The European Journal of Health Economics. Vol 16(2) 175-184.

66 Clark, AE and Lepinteur, A (2019), The Causes and Consequences of Early-Adult Unemployment: Evidence from Cohort Data, Paris School of Economics, Working Paper 2019:29

67 N. Goodman (2015). *The Impact of Employment on the Health Status and Health Care Costs of Working-age People with Disabilities. Lead Centre Policy Brief.* http://www.leadcenter.org/system/files/resource/downloadable_version/impact_of_employment_health_status_health_care_costs_0.pdf

positive correlation between employment and health for working age people with disabilities.

A1.1.69 A review of longitudinal study literature by Reche et al.[68] in 2019 suggested that the direct association between income and self-rated health is small. Most studies of this topic have used cross-sectional data and only considered self-rated health as the decisive factor. Moreover, the study was unable to find a statistically significant link between income and morbidity.

A1.1.70 A wide range of mechanisms for the health benefits of employment, as well as the negative effects of unemployment, have been suggested. For example, a study by Olesen *et al.* in 2013[69] cites numerous references indicating that the health benefits of employment *'are believed to reflect a combination of material (e.g., income and the resulting access to resources) and psychological outcomes, such as social role and status, access to social networks and support, and a sense of purpose/achievement'* and that *'in contrast, excluded individuals experience a set of multiple, and often entrenched, disadvantages including limited social support and networks, inadequate financial resources, and poor employment and health'*. A literature review by Kim *et al.*. in 2015[70] identified higher incidence of poor self-rated health, mental illness, physical complaints such as coronary heart disease, and higher all-cause mortality in unemployed people compared with those in employment.

A1.1.71 There is a large body of evidence linking education, employment and income levels with health. The WHO identifies a list of health determinants[71] that combine to affect the health of individuals and communities. Included in this list is: *'education – low education levels are linked with poor health, more stress and lower self-confidence'.*

A1.1.72 The majority of evidence linking education with health outcomes looks at educational attainment in the context of broader socio-demographic status. An evidence review by the Joseph Rowntree Foundation[72] states that improved qualifications can lead to better wages and employment, providing greater access to the health benefits associated with good and secure employment. A University of London report by Feinstein et *al.* in 2008[73] on the social and personal benefits of learning states that *'people with better qualifications are more likely to have healthy lifestyles, to be fitter and slimmer – and such*

68 Reche E., Konig, H-H., and Hajek, A. *Income, Self-Rated Health, and Morbidity: A Systematic Review of Longitudinal Studies*. International Journal of Environmental Research and Public Health. Vol 16:2884; doi:10.3390/ijerph16162884.

69 Olesen, S., Butterworth, P., Leach, L., Kelaher, M. & Pirkis, J. (2013), *Mental health affects future employment- as job loss affects mental health: findings from a longitudinal population study*, BMC Public Health

70 Kim, T. and Knesbeck, O. (2015), *Is an insecure job better for health than no job at all? A systematic review of studies investigating the health-related risks of both job insecurity and unemployment,* BMC Public Health

71 World Health Organization (2017), *Health Impact Assessment- The determinants of health*, http://www.who.int/hia/evidence/doh/en/.

72 Rowntree, J. (2014), *Reducing Poverty in the UK: A collection of evidence reviews*, Joseph Rowntree Foundation

73 Vorhaus, J., Duckworth, K.,Budge, D. and Feinstein, L. (2008), *The Social and personal benefits of learning: A summary of key research findings*, Centre for Research on the Wider Benefits of Learning, Institute of Education, University of London, London

health advantages can be transferred to the next generation at the earliest age'.

A1.1.73 An evidence review by the Economic and Social Research Council [74] suggests that the level of education a person has correlates with positive life outcomes including health and wellbeing.

A2.8 Social capital cohesion

A1.1.74 A 2014 Office for National Statistics (ONS) paper, Measuring Social Capital[75], provides the following definition of social capital: 'In general terms, social capital represents social connections and all the benefits they generate. The benefits for people having these social connections can occur either at an individual level (for example, through family support) or at a wider collective level (for example, through volunteering). Social capital is also associated with values such as tolerance, solidarity or trust. These are beneficial to society and are important for people to be able to cooperate.'

A1.1.75 The ONS has looked at social capital as part of its Measuring National Well-being (MNW) programme. This programme identifies four aspects of social capital, based on work undertaken by Scrivens et al. in 2013 for the Organisation for Economic Co-operation and Development (OECD)[76]. These aspects are:

- personal relationships;
- social network support;
- civic engagement and trust; and
- cooperative norms.

A1.1.76 The 2014 ONS paper includes a review of academic studies on social capital and its effects on health. The evidence suggests that social capital makes a positive contribution to a range of well-being aspects such as personal well-being, health and crime rates, and that these benefits occur at individual, community, regional and national level. In the same paper, the ONS cites evidence to suggest that *'people with a good range and frequency of social contact report higher levels of life satisfaction and happiness, but also better mental health. However, people with poorer health, particularly mental health, have been reported to have significantly smaller social networks. Personal relationships are important for individual well-being but can also have positive outcomes for firms and organisations, and at a community level'*. The evidence also suggests that *'more socially*

74 Economic and Social Research Council. Evidence Briefing: The wellbeing effect of education. July 2014. https://esrc.ukri.org/files/news-events-and-publications/evidence-briefings/the-wellbeing-effect-of-education/

75 Siegler, V. and Office for National Statistics (2014), *Measuring Social Capital*, Office for National Statistics

76 Scrivens, K. and Smith, C. (2013), *Four interpretations of social capital: an agenda for measurement*, OEDC

isolated people are more at risk of risky behaviours such as smoking, drinking, physical inactivity and poor diet'.

A1.1.77 Social capital can also be defined as benefits that emerge from social networks, where individuals have good access to information, services and support[77]. The same study suggests that cultural and socioeconomic aspects can act as a barrier to social capital. For example, some types of social capital may only be beneficial to those who have access to them through sufficient economic capital, such as expensive sports clubs.

A1.1.78 A systematic review of systematic reviews[78] on social capital and multiple health outcomes carried out in 2019 showed that there is good evidence to suggest a positive correlation between social capital and mental and physical health, and that social capital contributes to lower mortality. On the other hand, the review also found numerous non-significant or negative relationships between social capital and health. The review also analysed social capital interventions and found that their efficacy remained unclear. The analysis showed that it is difficult to assess whether an increase in health outcome is due to an increase in social capital, which limits the ability to understand whether and how social capital interventions can improve health.

A1.1.79 A study by Nieminen et al. in 2013 published in BMC Public Health[79] identified associations between health behaviours and social capital. For example, in Sweden lower trust in communities and families led to increased alcohol consumption; in England strong social support networks were associated with increased healthy eating; and in Finland those with higher social participation and networks exhibited healthier behaviours. A study by McPherson et al. in 2014 published in BMC Psychology[80] found that 'social capital can affect the norms and attitudes that influence health behaviours. It can be generated at a family and community level and can influence mental health and behaviour from a young age'.

77 Uphoff, E., Pickett, K., Cabieses, B., Small, N. and Wright, J. (2013), *A systematic review of the relationships between social capital and socioeconomic inequalities in health: a contribution to understanding the psychosocial pathway of health inequalities,* International Journal for Equity in Health

78 Ehsan, A., et al. (2019), *Social capital and health: A systematic review of systematic reviews,* SSM Population Health, doi:10.1016/j.ssmph.2019.100425

79 Nieminen, T., Prattala, R., Martelin, T., Harkanen, T., Hyyppa, M., Alanen, E. and Koskinen, S. (2013), *Social capital, health behaviours and health: a population-based associational study,* BMC Public Health

80 McPhI'erson, K., Kerr, S., McGee, E., Morgan, A., Cheater, F., McLean, J. and Egan, J. (2014), *The association between social capital and mental health and behavioural problems in children and adolescents: an integrative systematic review,* BMC Psychology

Appendix 14A

Construction Dust Assessment Methodology and Assessment

Welsh Government

Global Centre of Rail Excellence

Air Quality Appendix

Air quality

Issue | 18 August 2020

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 264904

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Table 3: Sensitivity of the area to human health impacts
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Table 5: Risk of dust impacts

14 Air quality appendix

14.1 Air quality assessment methodology and baseline

Methodology for construction dust risk assessment

14.1.1 The impacts of construction and associated air quality effects upon locally sensitive receptors from demolition, earthworks, trackout and construction activities have been assessed using the qualitative approach guidance prescribed by the Institute of Air Quality Management (IAQM)[1].

14.1.2 An 'impact' is described as a change in pollutant concentrations or dust deposition, while an 'effect' is described as the consequence of an impact. The main impacts that may arise during demolition and construction of the proposed development are:

- dust deposition, resulting in the soiling of surfaces;
- visible dust plumes;
- elevated PM10 concentrations as a result of dust generating activities at the proposed development; and
- an increase in NO2 and PM10 concentrations due to exhaust emissions from non-road mobile machinery and vehicles accessing the proposed development.

14.1.3 The IAQM guidance[1] considers the potential for dust emissions from activities such as demolition of existing structures, earthworks, construction of new structures and trackout. Earthworks refer to the processes of soil stripping, ground levelling, excavation and land capping, while trackout is the transport of dust and dirt from the proposed development onto the public road network where it may be deposited and then re-suspended by vehicles using the network. This arises when vehicles leave the site with dust materials, which may then spill onto the road, or when they travel over muddy ground on site and then transfer dust and dirt onto the road network.

14.1.4 There are five steps in the assessment process described in the IAQM guidance[1]. These are summarised in Diagram 1 and are further outlined in the paragraphs below.

[1] IAQM (2016), Guidance on the Assessment of Dust from Demolition and Construction (Version 1.1)

Step 1: Need for assessment

14.1.5 The first step is the initial screening for the need for a detailed assessment. According to the IAQM guidance, an assessment is required where there are sensitive receptors within 350m of the proposed development boundary (or 50m where there are ecological receptors) and/or within 50m of the route(s) used by the construction vehicles on the public highway and up to 500m from the proposed development entrance(s).

Step 2: Assess the risk of dust impacts

14.1.6 This step is split into three sections as follows:

- 2A – define the potential dust emission magnitude;
- 2B – define the sensitivity of the area; and
- 2C – define the risk of impacts.

14.1.7 Each of the dust-generating activities is prescribed a dust emission magnitude depending on the scale and nature of the works (Step 2A) based on the criteria shown in Table 1.

14.1.8 The sensitivity of the surrounding area is then determined (Step 2B) for each dust effect from the above dust-generating activities, based on the proximity and number of receptors, their sensitivity to dust, the local PM_{10} background concentrations and any other site-specific factors.

14.1.9 Table 2 to Table 4 shows the criteria for defining the sensitivity of the area to different dust effects.

14.1.10 The overall risk of the impacts for each activity is then determined (Step 2C) prior to the application of any mitigation measures (Table 5) and an overall risk for the proposed development derived.

Step 3: Determine the site-specific mitigation

14.1.11 Once each of the activities is assigned a risk rating, appropriate mitigation measures are identified. Where the risk is negligible, no mitigation measures beyond those required by legislation are necessary.

Step 4: Determine any significant residual effects

14.1.12 Once the risk of dust impacts has been determined and the appropriate dust mitigation measures identified, the final step is to determine whether there are any residual significant effects. The IAQM guidance[1] notes that it is anticipated that with the implementation of effective site-specific mitigation measures, the environmental effect will not be significant in most cases.

Step 5: Prepare a dust assessment report

14.1.13 The last step of the assessment is the preparation of a Dust Assessment Report which forms part of the EIA.

Diagram 1: IAQM dust assessment methodology

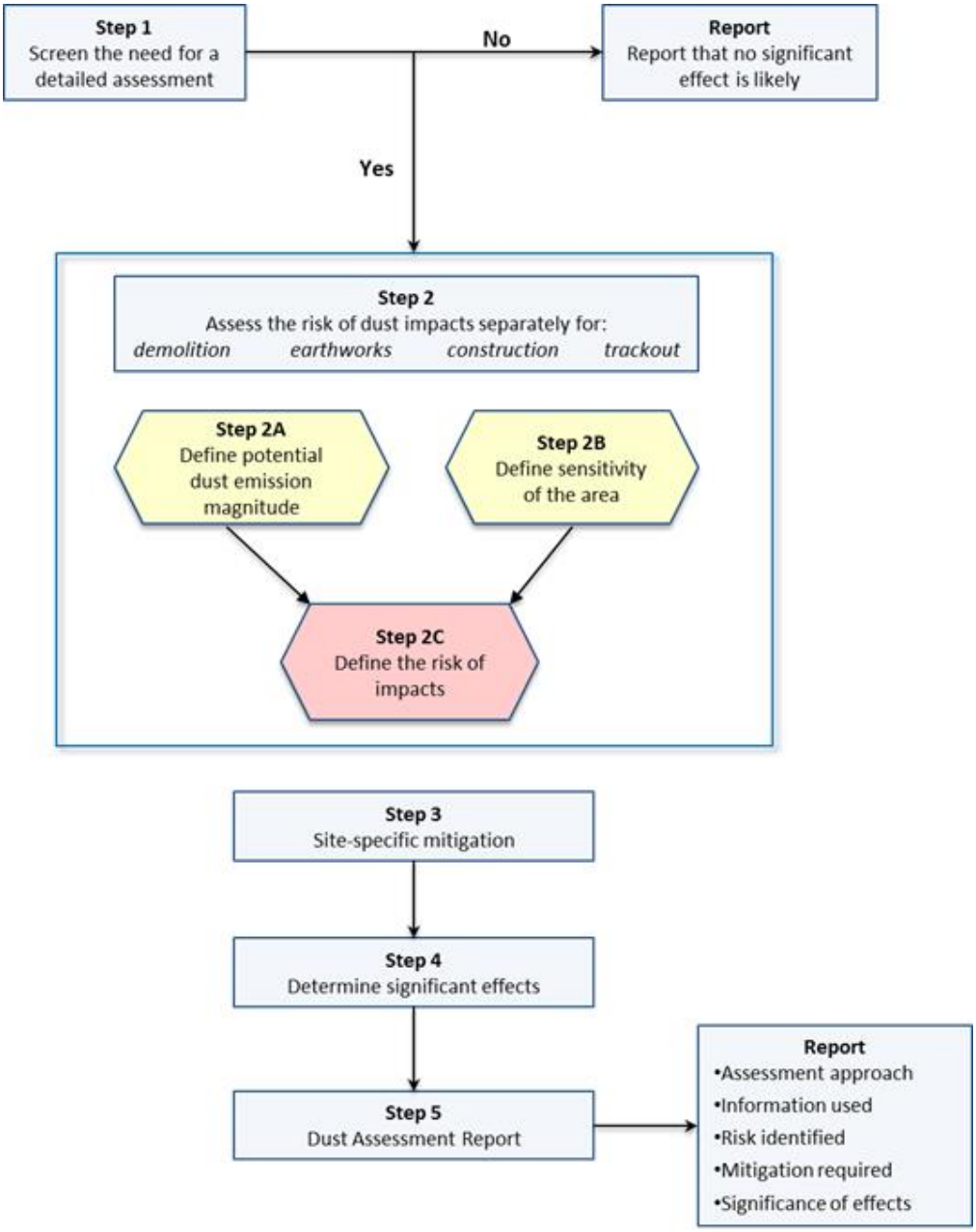


Table 1: Dust emission magnitude

Dust emission magnitude		
Small	**Medium**	**Large**
Demolition		
• total building volume <20,000m^3; • construction material with low potential for dust release (e.g. metal cladding or timber); • demolition activities <10m above ground; and • demolition during wetter months.	• total building volume 20,000 – 50,000m^3; • potentially dusty construction material; and • demolition activities 10 – 20m above ground level.	• total building volume >50,000m^3; • potentially dusty construction material (e.g. concrete); • on-site crushing and screening; and • demolition activities >20m above ground level.
Earthworks		
• total site area <2,500m^2 • soil type with large grain size (e.g. sand); • <5 heavy earth moving vehicles active at any one time; • formation of bunds <4m in height; • total material moved <10,000 tonnes; and • earthworks during wetter months.	• total site area 2,500m^2 – 10,000m^2 • moderately dusty soil type (e.g. silt); • 5 – 10 heavy earth moving vehicles active at any one time; • formation of bunds 4 – 8m in height; and • total material moved 20,000 – 100,000 tonnes.	• total site area >10,000m^2; • potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size); • >10 heavy earth moving vehicles active at any one time; • formation of bunds >8m in height; and • total material moved >100,000 tonnes.
Construction		
• total building volume <25,000m^3; and • construction material with low potential for dust release (e.g. metal cladding or timber).	• total building volume 25,000 – 100,000m^3; • potentially dusty construction material (e.g. concrete); and • on-site concrete batching.	• total building volume >100,000m^3; • on-site concrete batching; and • sandblasting.
Trackout		
• <10 Heavy duty vehicle (HDV) (>3.5t) outward movements in any one day; • surface material with low potential for dust release; and • unpaved road length <50m.	• 10 – 50 HDV (>3.5t) outward movements in any one day; • moderately dusty surface material (e.g. high clay content); and • unpaved road length 50 – 100m.	• >50 HDV (>3.5t) outward movements in any one day; • potentially dusty surface material (e.g. high clay content); and • unpaved road length >100m.

Table 2: Sensitivity of the area to dust soiling effects

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		< 20	< 50	< 100	< 350
High	> 100	High	High	Medium	Low
	10 – 100	High	Medium	Low	Low
	< 10	Medium	Low	Low	Low
Medium	> 1	Medium	Low	Low	Low
Low	> 1	Low	Low	Low	Low

Table 3: Sensitivity of the area to human health impacts

Background PM_{10} concentrations (annual mean)	Number of receptors	Distance from the source (m)				
		< 20	< 50	< 100	< 200	< 350
High receptor sensitivity						
> 32µg/m^3	> 100	High	High	High	Medium	Low
	10 – 100			Medium	Low	
	< 10		Medium	Low		
28 – 32µg/m^3	> 100	High	High	Medium	Low	Low
	10 – 100		Medium	Low		
	< 10					
24 – 28µg/m^3	> 100	High	Medium	Low	Low	Low
	10 – 100					
	< 10	Medium	Low			
< 24µg/m^3	> 100	Medium	Low	Low	Low	Low
	10 – 100	Low				
	< 10					
Medium receptor sensitivity						
> 32µg/m^3	> 10	High	Medium	Low	Low	Low
	< 10	Medium	Low			
28 – 32µg/m^3	> 10	Medium	Low	Low	Low	Low
	< 10	Low				
24 – 28µg/m^3	> 10	Low	Low	Low	Low	Low
	< 10					
< 24µg/m^3	> 10	Low	Low	Low	Low	Low
	< 10					
Low receptor sensitivity						
–	> 1	Low	Low	Low	Low	Low

Table 4: Sensitivity of the area to ecological impacts

Receptor sensitivity	Distance from the source (m)	
	< 20	< 50
High	High	Medium
Medium	Medium	Low

Low	Low	Low

Table 5: Risk of dust impacts

Sensitivity of area	**Dust emission magnitude**		
	Large	**Medium**	**Small**
Demolition			
High	High risk site	Medium risk site	Medium risk site
Medium	High risk site	Medium risk site	Low risk site
Low	Medium risk site	Low risk site	Negligible
Earthworks			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Medium risk site	Low risk site
Low	Low risk site	Low risk site	Negligible
Construction			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Medium risk site	Low risk site
Low	Low risk site	Low risk site	Negligible
Trackout			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Low risk site	Negligible
Low	Low risk site	Low risk site	Negligible

Appendix 15A

GHG Assessment

Global Centre of Rail Excellence (GCRE)

Summary

ARUP

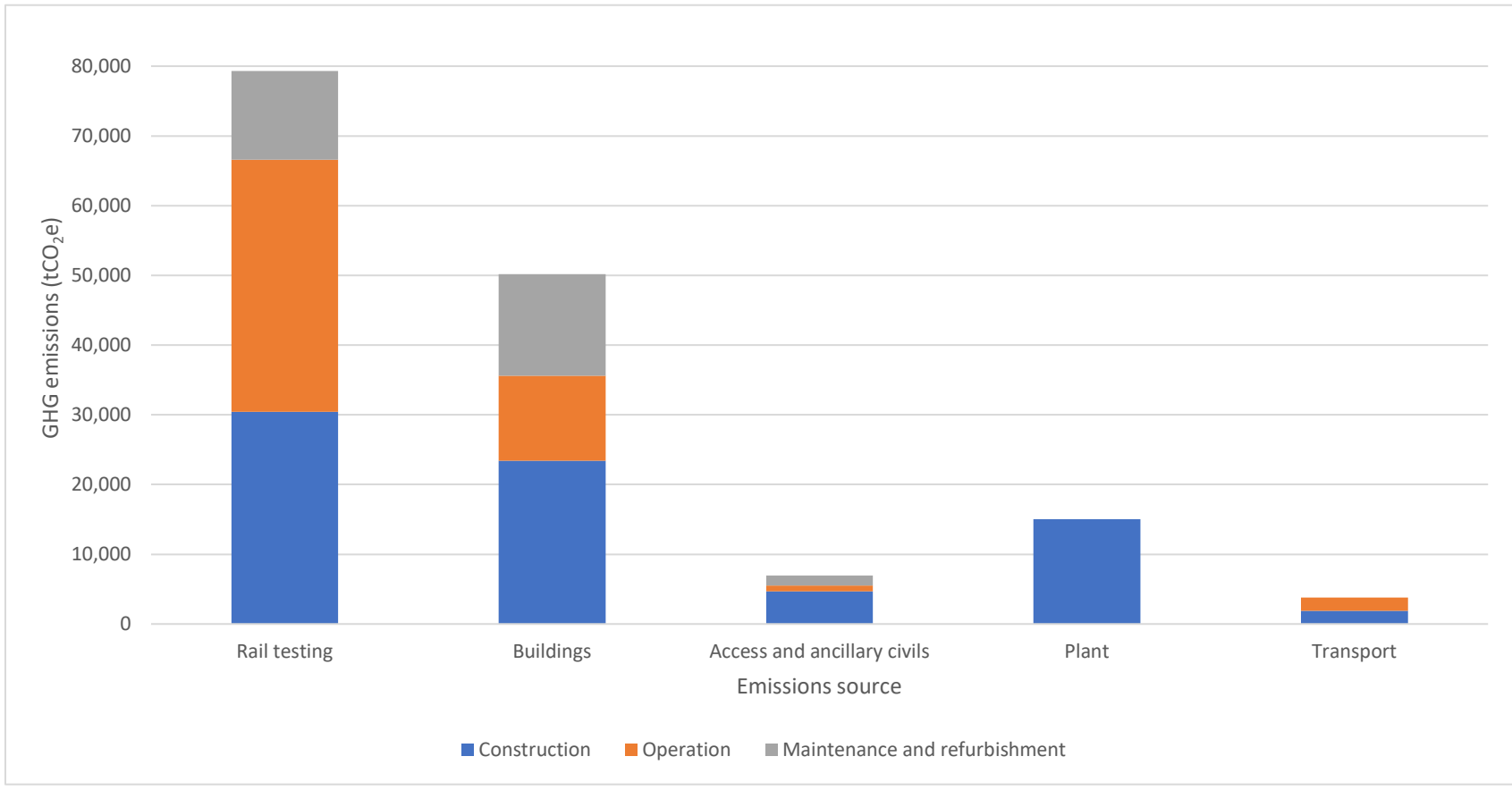
Emissions source	Emissions over appraisal period (kgCO2e)	Emissions over appraisal period (tCO2e)	Annual emissions in opening year (kgCO2e)	Annual emissions in opening year, 2023 (tCO2e)	% Emissions over appraisal period
Stage A - Construction					
Rail testing infrastructure	30,429,695	30,430			20%
Buildings	23,422,230	23,422			15%
Access and ancillary civils	4,694,518	4,695			3%
Plant	15,030,447	15,030			10%
Transport	1,917,458	1,917			1%
Stage B - Operation					
Buildings	12,191,199	12,191			8%
Access and ancillary civils	801,512	802	137,336	137	1%
Transport	1,886,316	1,886	13,228	13	1%
Rolling Stock Testing (operational 2024)	13,192,827	13,193	0	0	8%
Infrastructure Testing (operational 2023)	22,978,703	22,979	1,075,376	1,075	15%
Stage B - Maintenance and refurbishment					
Rail testing infrastructure	12,712,383	12,712			8%
Buildings	14,559,697	14,560			9%
Access and ancillary civils	1,463,676	1,464			1%
Total	155,280,661	155,281	1,225,940	1,226	
Construction total	75,494,347	75,494			49%
Operation total	51,050,557	51,051			33%
Maintenance total	28,735,757	28,736			19%
		36,172			
		79,786			

Global Centre of Rail Excellence (GCRE)

Summary chart

ARUP

	Rail testing	Buildings	Access and ancillary civils	Plant	Transport
Construction	30,430	23,422	4,695	15,030	1,917
Operation	36,172	12,191	802	0	1,886
Maintenance and refurbishment	12,712	14,560	1,464	0	0



Global Centre of Rail Excellence (GCRE)

Buildings A1-B7

Phase	Asset	Benchmark name	Source	Units	Area (m2)	Quantity (nr)	Total area	Benchmark (kgCO2e/m^2)	A1-A5 kgCO2e	WLC kgCO2e	B1-B5 kgCO2e	B6-B7 kgCO2e	Proxy	Source
Phase I	Modular buildings (Shunters cabin)	Small medium light industrial	RICS 2012	kgCO2e	30	13	390	435	169,650	360,957	104,678	86,630	Warehouse	RICS 2017
	Substation	Utilities compond	RICS 2012	kgCO2e	88	2	176	395	69,520	147,915	42,895	35,500	Warehouse	RICS 2017
	Staff facilities (replaced in Phase 2)	Small medium light industrial	RICS 2012	kgCO2e	120	1	120	435	52,200	111,064	32,209	26,655	Warehouse	RICS 2017
	Infrastructure Testing R&D Centre (relocated in Ph	Low-rise offices	RICS 2012	kgCO2e	240	1	240	925	222,000	634,286	202,971	209,314	Office	RICS 2017
Phase II	Carriagewash equipment and associated plantroom	Other industrial/utilities/specialist uses	RICS 2012	kgCO2e	430	1	430	545	234,350	498,617	144,599	119,668	Warehouse	RICS 2017
	Rolling stock maintenance shed 1	Other industrial/utilities/specialist uses	RICS 2012	kgCO2e	14398	1	14398	545	7,846,910	16,695,553	4,841,710	4,006,933	Warehouse	RICS 2017
	Rolling stock maintenance shed 2	Other industrial/utilities/specialist uses	RICS 2012	kgCO2e	25040	1	25040	545	13,646,800	29,035,745	8,420,366	6,968,579	Warehouse	RICS 2017
	Signalling control centre	Low-rise offices	RICS 2012	kgCO2e	300	1	300	925	277,500	792,857	253,714	261,643	Office	RICS 2017
	Staff accommodation	Live work unit	RICS 2012	kgCO2e	300	1	300	515	154,500	302,941	54,529	93,912	Residential	RICS 2017
Phase III	Decommissioning shed	Other industrial/utilities/specialist uses	RICS 2012	kgCO2e	350	1	350	545	190,750	405,851	117,697	97,404	Warehouse	RICS 2017
	Static testing structures	Other industrial/utilities/specialist uses	RICS 2012	kgCO2e	500	1	500	545	272,500	579,787	168,138	139,149	Warehouse	RICS 2017
	Modular building (Shunters cabin)	Small medium light industrial	RICS 2012	kgCO2e	30	1	30	435	13,050	27,766	8,052	6,664	Warehouse	RICS 2017
	Research and Development Centre	Other industrial/utilities/specialist uses	RICS 2012	kgCO2e	500	1	500	545	272,500	579,787	168,138	139,149	Warehouse	RICS 2017
Total					**42326**				**23,422,230**	**50,173,127**	**14,559,697**	**12,191,199**		RICS 2017
							42774							

Stage(s)	Office	Warehouse	Residential
A1-A5	0.35	0.47	0.51
B1-B5	0.32	0.29	0.18
B6-B7	0.33	0.24	0.31
RICS 2017 Figure 1 data			

Ancillary civil works*					
A1-A3		A4			
Floor area (m2)	42774	Mass (tonnes)	1026.576		
10% (m2)	4277.4	Source location	Swansea/F		
Thickness (m)**	0.1	Distance travelled (k	25		
Volume (m3)	427.74	tonne.km	25664.4		
Concrete density	2400	Freight mode	Rail/road	90%	10%
Mass (kg)	1026576	Conversion factors	Rail/road	0.03333	0.129087
Concrete EF (kgCO2e/kg)	0.103	Freight kgCO2e	Rail/road	769.855	331.2937
Emissions kgCO2e	105737.328	Total A4 kgCO2e	1101.149		

*Ancillary civil works calculated as 10% of main hardstanding area as advised by Chris Justice (approved by Phill Harris)
**0.1 m thick concrete used as fair assumption for buildings ancillary hardstanding, e.g. walkways etc.

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Source: Chris Justice (Chris.Justice@arup.com)

Source: ..\..\Transport\2020_07_03 Traffic Flows.xlsx
Source: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020

Buildings info source: Chris Justice (Chris.Justice@arup.com)

Buildings carbon benchmarks source: https://www.igbc.ie/wp-content/uploads/2015/02/ Figure 6: Embodied carbon benchmark values (sourced from Atkins Carbon Critical Masterplanning Tool. Reproduced with permission from Atkins))

WLC breakdown source: https://www.rics.org/globalassets/rics-website/me Figure 1: Total whole life carbon emissions breakdown for different building types



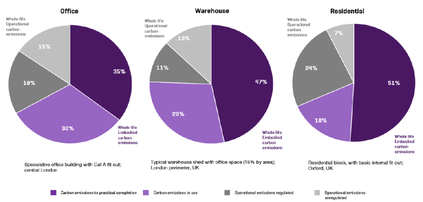

Figure 1: Total whole life carbon emissions breakdown for different building types © Sturgis Carbon Profiling

Global Centre of Rail Excellence (GCRE)

Substations A1-A4

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A1-A3

Asset	Area (m2)	Quantity (nr)
Substation	88	3

By cost (pg. 14): https://www.nation *'We are on track to meet our 2017/18 carbon intensity target by reducing capital carbon intensity from a baseline of 188tCO2/£m to 138tCO2/£m, exceeding our target of a 10 per cent reduction'*

Cost of electrical equipment from: Eòghann macLachlainn (Eoghann.MacLachlainn@arup.com) and Carl Thomas (carl.thomas@se.com)

Electrical Equipment Descritpion			Cost, £
Phase 1 - Equipment	MV SS	MV Panel (4ways)	50,000
		MV Ring Main Unit (Site)	10,000
		MV Ring Main Unit (Test L	10,000
	SS1	MV Ring Main Unit	10,000
		MV Panel (4ways)	50,000
		SS1-Tx1 (250kVA)	10,000
		SS1-Tx2 (3MVA)	25,000
		LV Panel Board	10,000
	SS5	MV Ring Main Unit	10,000
		MV Panel (4ways)	50,000
		SS5-Tx1 (500kVA)	13,000
		SS5-Tx2 (2.5MVA)	22,000
		LV Panel Board	12,000
Phase 2 - Equipment	SS2	MV Ring Main Unit	10,000
		MV Panel (4ways)	50,000
		SS2-Tx1 (500kVA)	13,000
		SS2-Tx2 (2.5MVA)	22,000
		LV Panel Board	12,000
	SS3	MV Ring Main Unit	10,000
		MV Panel (4ways)	50,000
		SS3-Tx1 (800kVA)	16,000
		SS3-Tx2 (2MVA)	20,000
		LV Panel Board	15,000
	SS4	SS4-Tx1 (1MVA)	20,000
		LV Panel Board	20,000
Total			540,000

tCO2/£m	kgCO2/£
138	0.138

kgCO2 = 74,520

Material quantity of structure (based on drawing on RHS)

Reinforced concrete (assumed 75kg rebar per m3 concrete)

Component	CS Area (mm2	CS Area m2
2 x large walls	9650000	9.65
1 x short ceiling	3325000	3.325
1 x floor	10900000	10.9
4 x small walls	5390000	5.39
1 x small outer wall	1925000	1.925
1 x long ceiling	7575000	7.575
Total	38765000	38.765

Depth (m) 4

Volume (m3) 155.06

Mass concrete

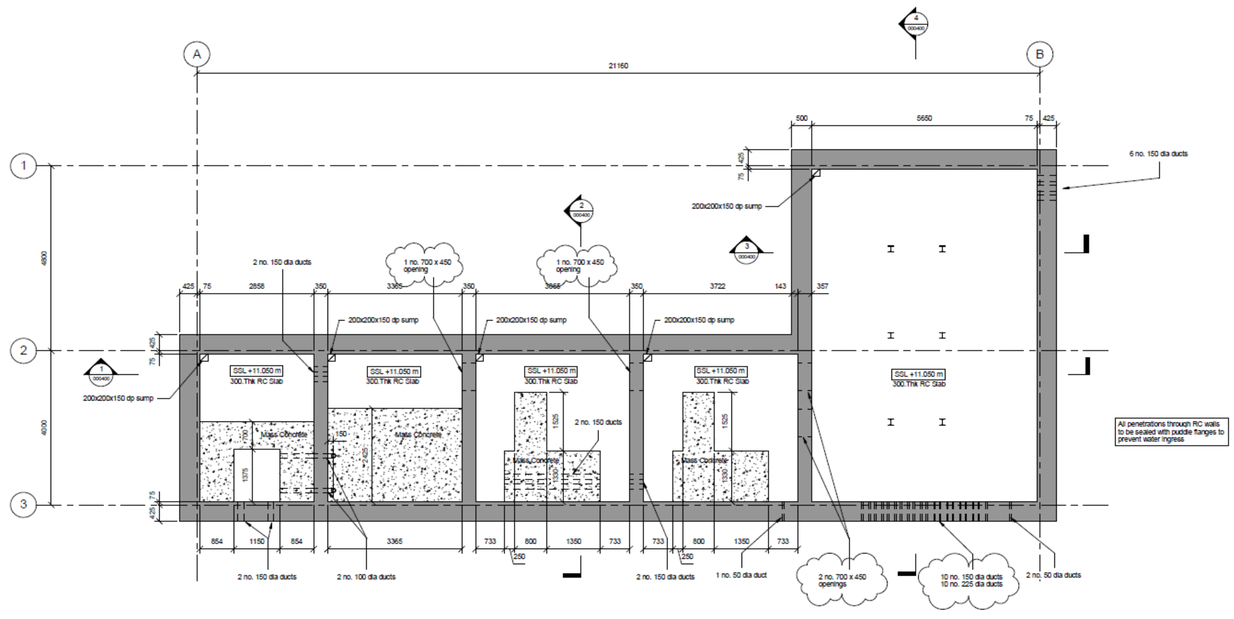
Component	CS area (mm2	CS area (m2)
1	4349100	4.3491
2	8160125	8.160125
3	4412000	4.412
4	4412000	4.412
Total	21333225	21.333225

Depth (m) 4

Volume (m3) 85.3329

Material	Volume (m3)	Density (kg m3)	Weight (kg)	Emission factor (kgCO2e/kg)	Emissions (kgCO2e)	Source
Concrete - General (with 75kg rebar per m3 concrete)	155.06	2300	356,638	0.16075	57,330	ICE v2.0
Concrete - General	85.3329	2400	204,799	0.103	21,094	ICE v2.0
Total					**78,424**	

A1-A3 substation emissions (kgCO2e): 309,792



REINFORCED CONCRETE - Modification Factors			
For reinforcement add this value to the appropriate concrete coefficient for each 100 kg of rebar per m3 of concrete	**1.04**	**0.077**	Add for each 100 kg steel rebar per m3 concrete. Use multiple of this value, i.e. for 150 kg steel use a factor of 1.5 times these values.
EXAMPLE: Reinforced RC 25/30 MPa (with 110 kg per m^3 concrete)	**1.92 MJ/kg (0.78 + 1.04 * 1.1)**	**0.198 kgCO2/kg (0.113 + 0.077 * 1.1)**	with 110 kg rebar per m3 concrete

A4

Material	Weight (kg)	Weight (tonnes)	Source location	Distance (km)	tonne.km	Freight mode 1	Freight mode 2	Percentage split		Conversion factor 1	Conversion factor 2	Freight mode 1 kgCO2e	Freight mode 2 kgCO2e	Total A4 kgCO2e
Concrete - General	204,799	204.79896	Swansea/Pe	25	5119.974	Rail	Road	90%	10%	0.03333	0.129087	153.5839	66.09213	219.676
Reinforced concrete	356,638	356.638	Swansea/M	40	14265.52	Road	N/A	100%	0%	0.129087	0	1841.491	0	1841.491
Total														2061.167

Freight mode: ..\..\Transport\2020_07_03 Traffic Flows.xlsx

Conversion factors (I https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020

Material source local Chris Justice (Chris.Justice@arup.com)

A1-A4 substation emissions (kgCO2e): 311,853

Global Centre of Rail Excellence (GCRE)

Misc. Assets A1-A3

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Quantities from: Chris Justice (Chris.Justice@arup.com)

Assumptions:
Duel-loop track assumed over single-loop track for rolling stock testing as a worst-case scenario for emissions.

Summaries of RSSB export by construction phase

Phase I-III

	Steel - General	Nylon 66	Rubber - General	Soil - General (Rammed Soil)	Concrete - General	Steel - Plate	Granite - General - Lower	Concrete - Reinforced - For each 25kg rebar	Aggregates and Sand - Typical UK Mix	HDPE - Pipe	Steel - Bar and Rod - Virgin	Steel - Section - Virgin	Concrete - 1:2:4 Cement:Sand:Aggregate - Average UK Additions	Concrete - 32/40 MPa - Average UK Additions	Aluminium - Cast Products	Concrete - Precast Concrete Paving	Insulation - Mineral Wool	Total kg CO2e
Track	6,643,345	180,655	198,019	3,992,841	7,011,538	2,180	1,185,735	19,731	346,099	4,201,611	0	0	0	0	0	0	0	23,781,755
OLE	0	0	0	0	138,432	0	0	0	0	0	32,708	547,232	0	0	0	0	0	718,372
Rail cable trough	0	0	0	0	0	0	0	0	4,819	0	62,225	0	83,529	0	0	0	0	150,573
Fencing	4,490,356	0	0	0	0	0	0	0	0	0	0	0	0	238,998	0	0	0	4,729,354
Lighting bollards	0	0	0	0	768	0	0	0	0	0	0	0	0	0	60,720	0	0	61,488
Platform	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	379,500	0	379,500
Acoustic barrier	259,147	0	0	0	0	0	0	0	0	0	0	0	0	1,698	0	0	38,016	298,861
																		30,119,903
Total kgCO2e	11,392,848	180,655	198,019	3,992,841	7,150,737	2,180	1,185,735	19,731	350,918	4,201,611	94,933	547,232	83,529	240,696	60,720	379,500	38,016	30,119,903
Emissions factor (kgCO2e/kg)	1.46	6.5	2.85	0.024	0.103	2.46	0.006	0.018	0.00747	2.52	2.77	3.03	0.115	0.138	13.2	0.132	1.28	
Density (kg/m3)	7800	1140	1500	1460	2400	7800	2880	2400	2240	970	7800	7800	2400	2400	2700	2500	140	
Volume (m3)	1,000	24	46	113,951	28,927	0	68,619	457	20,972	1,719	4	23	303	727	2	1,150	212	
Mass (kg)	7,803,321	27,793	69,480	166,368,384	69,424,636	886	########	1,096,176	46,976,988	1,667,306	34,272	180,605	726,336	1,744,177	4,600	2,875,000	29,700	

	Mass (kg)				
	Steel - General	Concrete - 32/40 MPa - Average UK Additions	Concrete - General	Aluminium - Cast Products	Insulation - Mineral Wool
Fencing	3075586.27	1731873.15			
Lighting bollards			7452	4600	
Acoustic barrier	177498.0269	12303.9			29700

Phase I

	Steel - General	Nylon 66	Rubber - General	Soil - General (Rammed Soil)	Concrete - General	Steel - Plate	Granite - General - Lower	Concrete - Reinforced - For each 25kg rebar	Aggregates and Sand - Typical UK Mix	HDPE - Pipe	Steel - Bar and Rod - Virgin	Steel - Section - Virgin	Concrete - 1:2:4 Cement:Sand:Aggregate - Average UK Additions	Concrete - 32/40 MPa - Average UK Additions	Aluminium - Cast Products
Track	1,773,727	44,425	48,634	1,161,938	457,195	620	415,440	6,617	116,070	1,409,077	0	0	0	0	0
OLE	0	0	0	0	59,328	0	0	0	0	0	14,018	234,528	0	0	0
Rail cable trough	0	0	0	0	0	0	0	0	1,673	0	21,606	0	29,003	0	0
Fencing	1,347,055	0	0	0	0	0	0	0	0	0	0	0	0	71,697	0
Lighting bollards	0	0	0	0	267	0	0	0	0	0	0	0	0	0	21,120
Total kgCO2e	3,120,782	44,425	48,634	1,161,938	516,790	620	415,440	6,617	117,743	1,409,077	35,624	234,528	29,003	71,697	21,120
Emissions factor (kgCO2e/kg)	1.46	6.5	2.85	0.024	0.103	2.46	0.006	0.018	0.00747	2.52	2.77	3.03	0.115	0.138	13.2
Density (kg/m3)	7800	1140	1500	1460	2400	7800	2880	2400	2240	970	7800	7800	2400	2400	2700
Volume (m3)	274	6	11	33,160	2,091	0	24,042	153	7,037	576	2	10	105	216	1
Mass (kg)	2,137,522	6,835	17,064	48,414,080	5,017,376	252	########	367,620	15,762,126	559,157	12,861	77,402	252,200	519,542	1,600

Phase II

	Soil - General (Rammed Soil)	Steel - General	Nylon 66	Steel - Plate	Granite - General - Lower	Concrete - General	Rubber - General	Concrete - Reinforced - For each 25kg rebar	Aggregates and Sand - Typical UK Mix	HDPE - Pipe	Concrete - Precast Concrete Paving	Steel - Bar and Rod - Virgin	Steel - Section - Virgin	Concrete - 1:2:4 Cement:Sand:Aggregate - Average UK Additions	Concrete - 32/40 MPa - Average UK Additions	Aluminium - Cast Products	Insulation - Mineral Wool
Track	2,302,750	4,172,615	95,931	1,560	649,125	4,848,241	104,857	13,114	230,029	2,792,534	0	0	0	0	0	0	0
OLE	0	0	0	0	0	79,104	0	0	0	0	0	18,690	312,704	0	0	0	0
Rail cable trough	0	0	0	0	0	0	0	0	1,472	0	0	19,013	0	25,523	0	0	0
Fencing	0	3,143,301	0	0	0	0	0	0	0	0	0	0	0	0	167,302	0	0
Lighting bollards	0	0	0	0	0	234	0	0	0	0	0	0	0	0	0	18,480	0
Platform	0	0	0	0	0	0	0	0	0	0	379,500	0	0	0	0	0	0
Acoustic barrier	0	259,147	0	0	0	0	0	0	0	0	0	0	0	1,698	0	0	38,016
Total kgCO2e	2,302,750	7,575,062	95,931	1,560	649,125	4,927,579	104,857	13,114	231,502	2,792,534	379,500	37,704	312,704	25,523	169,000	18,480	38,016
Emissions factor (kgCO2e/kg)	0.024	1.46	6.5	2.46	0.006	0.103	2.85	0.018	0.00747	2.52	0.132	2.77	3.03	0.115	0.138	13.2	1.28
Density (kg/m3)	7800	1140	1500	1460	2400	7800	2880	2400	2240	970	7800	7800	2400	2400	2700	2500	140
Volume (m3)	12,301	4,551	10	0	45,078	6,133	13	304	13,835	1,142	369	2	43	92	454	1	212
Mass (kg)	95,947,904	5,188,399	14,759	634	108,187,500	########	36,792	728,556	30,990,862	1,108,148	2,875,000	13,611	103,203	221,936	1,224,635	1,400	29,700

Phase III

	Soil - General (Rammed Soil)	Granite - General - Lower	Concrete - General	Steel - General	Nylon 66	Rubber - General	Steel - Bar and Rod - Virgin	Concrete - 1:2:4 Cement:Sand:Aggregate - Average UK Additions	Aggregates and Sand - Typical UK Mix	Aluminium - Cast Products
Track	528,154	121,170	1,706,102	697,004	40,300	44,528	0	0	0	0
Rail cable trough	0	0	0	0	0	0	21,606	29,003	1,673	0
Lighting bollards	0	0	267	0	0	0	0	0	0	21,120
Total kgCO2e	528,154	121,170	1,706,369	697,004	40,300	44,528	21,606	29,003	1,673	21,120
Emissions factor (kgCO2e/kg)	0.024	0.006	0.103	1.46	6.5	2.85	2.77	0.115	0.00747	13.2
Density (kg/m3)	7800	2400	7800	1140	1500	2880	7800	2400	2240	2500
Volume (m3)	2821.333333	8414.58333	2123.93487	418.7719298	4.13333333	5.425	1	105.08333	100	0.64
Mass (kg)	22006400	20195000	16566692	477400	6200	15624	7800	252200	224000	1600

Global Centre of Rail Excellence (GCRE)

Misc. Assets A4

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Basis of calculations:
Material source locati Chris Justice (Chris.Justice@arup.com)
Freight mode: ___\

Global Centre of Rail Excellence (GCRE)

Civils A1-A4

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Basis and assumptions:
Fully flexible pavement structure based on A40 Low Carbon side roads
Access road chainage from drainage designs: ..\..\..\4-30 ..\..\..\4-30 Drawings\4-31 Issue drawings\Drainage Submission\PDFs\CG3053.pdf

Maintenance road and track dimensions from BoQ: Chris Justice (Chris.Justice@arup.com)
Road resurfacing, cess, retaining walls & crossings from: John Smith (John.Smith@arup.com)
RC: kg rebar per m3 concrete from: Peter Richardson (Peter.Richardson@arup.com)

A1-A3

Access

Phase	Asset	Length (m)	Width (m)	Area (m2)	Pavement type	Pavement layer	Material (ICEv3 Reference)	Density (kg m^3)	Thickness (mm)	Thickness (m)	Volume (m^3)	Weight (kg)	Emission factor (kgCO2-e/kg)	Emissions (kgCO2-e)
Phase II	Access road	2852	7.3	20819.6	Fully flexible	TSCS	Asphalt, 5% binder content	2100	200	0.2	4,164	8,744,232	0.05420	473,937
						Binder course								
						Base								
						Subbase	Aggregates and Sand - Typical UK Mix	2,240	320	0.32	6,662	14,923,489	0.00747	111,478
						Total			520	0.52				585,416
	Rolling stock maintenance road 1	115	10	1150	Fully flexible	TSCS	Asphalt, 5% binder content	2100	200	0.2	230	483,000	0.05420	26,179
						Binder course								
						Base								
						Subbase	Aggregates and Sand - Typical UK Mix	2,240	320	0.32	368	824,320	0.00747	6,158
						Total			520	0.52				32,336
	Rolling stock maintenance road 2	115	10	1150	Fully flexible	TSCS	Asphalt, 5% binder content	2100	200	0.2	230	483,000	0.05420	26,179
						Binder course								
						Base								
						Subbase	Aggregates and Sand - Typical UK Mix	2,240	320	0.32	368	824,320	0.00747	6,158
						Total			520	0.52				32,336
	Rolling stock maintenance road 3	200	10	2000	Fully flexible	TSCS	Asphalt, 5% binder content	2100	200	0.2	400	840,000	0.05420	45,528
						Binder course								
						Base								
						Subbase	Aggregates and Sand - Typical UK Mix	2,240	320	0.32	640	1,433,600	0.00747	10,709
						Total			520	0.52				56,237
	Rolling stock maintenance road 4	200	10	2000	Fully flexible	TSCS	Asphalt, 5% binder content	2100	200	0.2	400	840,000	0.05420	45,528
						Binder course								
						Base								
						Subbase	Aggregates and Sand - Typical UK Mix	2,240	320	0.32	640	1,433,600	0.00747	10,709
						Total			520	0.52				56,237
	Resurface existing road	900	7.3	6570	Fully flexible	TSCS	Asphalt, 5% binder content	2100	40	0.04	263	551,880	0.05420	29,912
	Cess access track	24600	3	73800	N/A	Subbase	Aggregates and Sand - Typical UK Mix	2,240	300	0.3	22,140	49,593,600	0.00747	370,464
	Total	**3482**	**47.3**											**1,162,938**

Ancillary civil works		
Pavement area (m2)	164,699	
10% (m2)	16,470	
Thickness (m)	0.15	**0.15 m depth assumed
Volume (m3)	2470.479	
Asphalt, 5% binder content	2100	
Mass (kg)	5,188,006	
Asphalt EF (kgCO2e/kg)	0.05420	
Emissions kgCO2e	**281,190**	

*Ancillary civil works calculated as 10% of main hardstanding area as advised by Chris Justice (approved by Phill Harris)

Concrete - general emissions factor	0.103

Carbon factors	
ICE v.3	Asphalt, 5% binder content
ICE v.3	Aggregates and Sand - Typical UK Mix
ICE v.2	Concrete - General (with 200kg rebar per m3 concrete)

Retaining walls & rail crossings

Phase	Asset					Volume (m3)	Material	Density (kg m3)	Weight (kg)	Emission factor (kgCO2e/kg)	Emissions (kgCO2e)	Source
Phase II	Retaining wall 1					500	Concrete - General (with 200kg rebar per m	2300	1,150,000	0.257	295,550	ICE v2.0
	Retaining wall 2					360	Concrete - General (with 200kg rebar per m	2300	828,000	0.257	212,796	ICE v2.0
	Retaining wall 3					360	Concrete - General (with 200kg rebar per m	2300	828,000	0.257	212,796	ICE v2.0
	Total								2,806,000		721,142	
	Rail crossing 1					1300	Concrete - General (with 200kg rebar per m	2300	2,990,000	0.257	768,430	ICE v2.0
	Rail crossing 2					1300	Concrete - General (with 200kg rebar per m	2300	2,990,000	0.257	768,430	ICE v2.0
	Rail crossing 3					1500	Concrete - General (with 200kg rebar per m	2300	3,450,000	0.257	886,650	ICE v2.0
	Total								9,430,000		2,423,510	
	Grand total								12,236,000		**3,144,652**	

REINFORCED CONCRETE - Modification Factors			
For reinforcement add this value to the appropriate concrete coefficient for each 100 kg of rebar per m3 of concrete	**1.04**	**0.077**	Add for each 100 kg steel rebar per m3 concrete. Use multiple of this value, i.e. for 150 kg steel use a factor of 1.5 times these values.
EXAMPLE: Reinforced RC 25/30 MPa (with 110 kg per m^3 concrete)	**1.92 MJ/kg (0.78 + 1.04 * 1.1)**	**0.198 kgCO2/kg (0.113 + 0.077 * 1.1)**	with 110 kg rebar per m3 concrete

A4

Phase	Material	Weight (kg)	Weight (tonnes)		Source location	Distance (km)	tonne.km	Freight mode 1	Freight mode 2	Percentage split		Conversion factor 1	Conversion factor 2	Freight mode 1 kgCO2e	Freight mode 2 kgCO2e	Total A4 kgCO2e
Phase II	Asphalt, 5% binder content	17,130,118	17130.118		Penderyn	22	376862.5938	Road	N/A	100%	0%	0.129086853	0	48648.006	0	48,648
	Aggregates and Sand - Typical UK Mix	69,032,929	69032.929		Swansea, Porta	25	1725823.232	Rail	Road	90%	10%	0.03333	0.12908685	51769.519	22278.1089	74,048
	Concrete - General (with 200kg rebar per m3 concrete)	12236000	12236		Swansea/Mert	40	489440	Road	N/A	1	0	0.129086853	0	63180.269	0	63,180
	Total															**185,876**

Freight mode: ..\..\Transport\2020_07_03 Traffic Flows.xlsx

Conversion factors (R https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020

Material source locati Chris Justice (Chris.Justice@arup.com)

Total emissions from civil works (kgCO2e) 4,774,656

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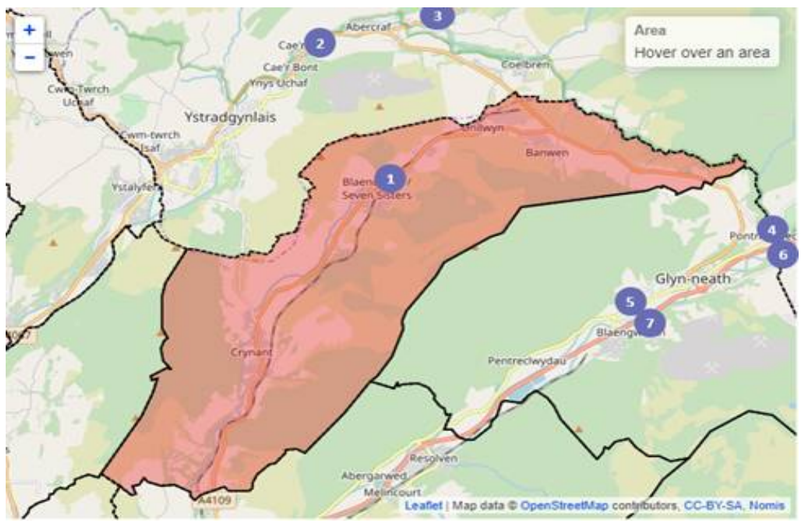
Basis of calculation

Source: Socio-economics chapter (workforce numbers) and Transport Assessment
Based on construction duration estimates provided by Chris Justice (Chris.Justice@arup.com)
Assume multiple construction activities can be undertaken simultaneously

Assumptions (based on those used in Transport Assessment)

Assume each commuting construction worker drives to work in a light goods vehicle (small diesel engine car)
2 people per vehicle
Distances based on method used in Transport Assessment (distribution as below)

Worker start location	Distribution of workers	Distance (km) to and from site
1	62%	12
2	5%	10.4
3	20%	10
4	1%	24.4
5	5%	22.6
6	7%	24.4
7	0%	22.6



Phases	Construction period (months)	Construction period (days)	No of workers	Distance travelled (km)
Phase I	18	548	80	285,623
Phase II	24	730	244	1,161,533
Phase III	12	365	244	580,767
			Total distance	2,027,923 km

	Km	kgCO2e		
Small diesel car	1	0.13721	Source:	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020

Total emissions **278,251** kgCO2e

Global Centre of Rail Excellence (GCRE)

Plant A5

ARUP

Power rating sources: https://shop.bsigroup.com/ProductDetail?pid=000000000030258086
ICES (1998) The Reference Manual for Construction Plant

Plant type	Power rating, kW (SB 5228-1:2009)	Proxy value where actual plant not available
Excavator with breaker	121	
Excavator with pulveriser	147	
Wheeled mobile crane	275	
Articulated dump truck	194	
Tracked crusher	172	
Tracked excavator	250	
Dozer	200	
Telehandler	90	Wheeled excavator
Vibratory roller	98	
Handheld angle grinder	2.3	
Tamper	1.1	
Hydraulic vibratory compactor	250	
Concrete mixer truck & pump	167	
Mobile telescopic crane (rail-mo	610	
Mobile telescopic crane	610	
Road planer	185	
Asphalt paver	112	
Concrete pump and mixer truck	171	
Tracked drilling / piling rig	104	
MEWP RRV	35	Lifting platform
Road rail excavator crane	610	
Wheeled excavator	90	
Lorry with lifting boom	50	
Concrete pump and mixer truck	171	
Poker vibrator	2.2	
Rotary bored piling rig	164	Oscillatory bored piling rig (ICES 1998)

Activity	Country	Unit	Year	kg CO2e
Electricity g	Electricity:	kWh	2019	0.2556
DEFRA 2019:				

Plant hours per week: 85 As per project description
Small and handheld plant excluded

Source: Based on construction duration estimates provided by Chris Justice (Chris.Justice@arup.com)

Construction Phase	Construction Activities	Estimated Construction Time	Estimated Construction Time (weeks, assume worst case)	Plant Type	No. plant	% on-time	% on time	Total use (hours)	kWhr	kgCO2e
Phase 1	Demolition of existing washery site and site establishment.	4 – 6 months	24	Excavator with breaker	1	50	50%	1020	123420	31546.152
			24	Excavator with pulveriser	1	50	50%	1020	149940	38324.664
			24	Wheeled mobile crane	1	50	50%	1020	280500	71695.8
			24	Articulated dump truck	2	20	20%	816	158304	40462.5024
			24	Tracked crusher	1	50	50%	1020	175440	44842.464
			24	Tracked excavator	2	50	50%	2040	510000	130356
			24	Dozer	1	30	30%	612	122400	31285.44
			24	Telehandler	2	80	80%	3264	293760	75085.056
			24	Vibratory roller	1	30	30%	612	59976	15329.8656
			40	Handheld angle grinder	2	20	20%	1360	3128	799.5168
			40	Tamper	1	20	20%	680	748	191.1888
			40	Hydraulic vibratory compactor	1	20	20%	680	170000	43452
			40	Articulated dump truck	2	50	50%	3400	659600	168593.76
			40	Tracked excavator	2	50	50%	3400	850000	217260
			40	Concrete mixer truck & pump	1	20	20%	680	113560	29025.936
			40	Telehandler	2	80	80%	5440	489600	125141.76
			40	Mobile telescopic crane (rail-m	1	50	50%	1700	1037000	265057.2
	Construction of electrical infrastructure – Primary DNO MV	6 – 8 months	32	Telehandler	2	50	50%	2720	244800	62570.88
			32	Mobile telescopic crane	1	20	20%	544	331840	84818.304
			32	Concrete mixer truck & pump	1	20	20%	544	90848	23220.7488
			32	Tracked excavator	2	70	70%	3808	952000	243331.2
	Internal highways and hardstanding work	2 – 4 months	16	Dozer	1	50	50%	680	136000	34761.6
			16	Articulated dump truck	2	20	20%	544	105536	26975.0016
			16	Vibratory roller	1	50	50%	680	66640	17033.184
			16	Road planer	1	20	20%	272	50320	12861.792
			16	Asphalt paver	1	40	40%	544	60928	15573.1968
			16	Tracked excavator	2	70	70%	1904	476000	121665.6
			16	Telehandler	2	80	80%	2176	195840	50056.704
			24	Handheld angle grinder	2	20	20%	816	1876.8	479.71008
			24	Tamper	1	20	20%	408	448.8	114.71328
			24	Hydraulic vibratory compactor	1	20	20%	408	102000	26071.2
			24	Articulated dump truck	2	50	50%	2040	395760	101156.256
			24	Tracked excavator	2	50	50%	2040	510000	130356
			24	Concrete mixer truck & pump	1	20	20%	408	68136	17415.5616
			24	Telehandler	2	80	80%	3264	293760	75085.056
			24	Mobile telescopic crane (rail-m	1	50	50%	1020	622200	159034.32
			8	Handheld angle grinder	2	20	20%	272	625.6	159.90336
			8	Tamper	1	20	20%	136	149.6	38.23776
			8	Hydraulic vibratory compactor	1	20	20%	136	34000	8690.4
			8	Articulated dump truck	2	50	50%	680	131920	33718.752
			8	Tracked excavator	2	50	50%	680	170000	43452
			8	Concrete mixer truck & pump	1	20	20%	136	22712	5805.1872
			8	Telehandler	2	80	80%	1088	97920	25028.352
			8	Mobile telescopic crane (rail-m	1	50	50%	340	207400	53011.44
	OLE installation on test track and onto selected sidings. Discrete activities (foundation	4 – 6 months	24	Concrete pump and mixer truc	1	20	20%	408	69768	17832.7008
			24	Tracked drilling / piling rig	2	50	50%	2040	212160	54228.096
			24	Wheeled mobile crane	2	50	50%	2040	561000	143391.6
			24	Tracked excavator	2	50	50%	2040	510000	130356
			24	MEWP RRV	2	50	50%	2040	71400	18249.84
			24	Road rail excavator crane	2	50	50%	2040	1244400	318068.64
	Construction of rail crossings; 2 no. bridge crossings	9 – 12 months	48	Mobile telescopic crane	4	70	70%	11424	6968640	1781184.384
			48	Tracked excavator	2	30	30%	2448	612000	156427.2
			48	Concrete pump and mixer truc	2	30	30%	2448	418608	106996.2048
			48	Articulated dump truck	2	30	30%	2448	479912	121387.5072
			48	Poker vibrator	2	30	30%	2448	5385.6	1376.55936
			48	Rotary bored piling rig	1	20	20%	816	133824	34205.4144
Phase 2	Additional electrical infrastructure. 3no. substations.	2 – 4 months	16	Telehandler	2	50	50%	1360	122400	31285.44
			16	Mobile telescopic crane	1	20	20%	272	165920	42409.152
			16	Concrete mixer truck & pump	1	20	20%	272	45424	11610.3744
			16	Tracked excavator	2	70	70%	1904	476000	121665.6
	Rolling Stock Maintenance Shed construction, including full-internal fit-out	12 – 18 months	72	Wheeled excavator	2	50	50%	6120	550800	140784.48
			72	Lorry with lifting boom	1	10	10%	612	30600	7821.36
			72	Wheeled mobile crane	2	50	50%	6120	1683000	430174.8
			72	Articulated dump truck	2	50	50%	6120	1187280	303468.768
			72	Concrete pump and mixer truc	2	40	40%	4896	837216	213992.4096
			72	Mobile telescopic crane	2	50	50%	6120	3733200	954205.92
			72	Poker vibrator	2	20	20%	2448	5385.6	1376.55936
			72	Rotary bored piling rig	1	20	20%	1224	200736	51308.1216
			72	Telehandler	2	80	80%	9792	881280	225255.168
			32	Handheld angle grinder	2	20	20%	1088	2502.4	639.61344
			32	Tamper	1	20	20%	544	598.4	152.95104
			32	Hydraulic vibratory compactor	1	20	20%	544	136000	34761.6
			32	Articulated dump truck	2	50	50%	2720	527680	134875.008
			32	Tracked excavator	2	50	50%	2720	680000	173808
			32	Concrete mixer truck & pump	1	20	20%	544	90848	23220.7488
			32	Telehandler	2	80	80%	4352	391680	100113.408
			32	Mobile telescopic crane (rail-m	1	50	50%	1360	829600	212045.76
	OLE installation on test track and on roads connecting to maintenance shed. Discrete	9 – 12 months	48	Concrete pump and mixer truc	1	20	20%	816	139536	35665.4016
			48	Tracked drilling / piling rig	2	50	50%	4080	424320	108456.192
			48	Wheeled mobile crane	2	50	50%	4080	1122000	286783.2
			48	Tracked excavator	2	50	50%	4080	1020000	260712
			48	MEWP RRV	2	50	50%	4080	142800	36499.68
			48	Road rail excavator crane	2	50	50%	4080	2488800	636137.28
	Construction of carriagewash	4 – 6 months	24	Articulated dump truck	1	50	50%	1020	197880	50578.128
			24	Concrete pump and mixer truc	1	40	40%	816	139536	35665.4016
			24	Mobile telescopic crane	1	50	50%	1020	622200	159034.32
			24	Poker vibrator	1	20	20%	408	897.6	229.42656
			24	Rotary bored piling rig	1	20	20%	408	66912	17102.7072
			24	Telehandler	1	80	80%	1632	146880	37542.528
			24	Tracked excavator	1	80	80%	1632	408000	104284.8
			40	Handheld angle grinder	2	20	20%	1360	3128	799.5168
			40	Tamper	1	20	20%	680	748	191.1888
			40	Hydraulic vibratory compactor	1	20	20%	680	170000	43452
			40	Articulated dump truck	2	50	50%	3400	659600	168593.76
			40	Tracked excavator	2	50	50%	3400	850000	217260
			40	Concrete mixer truck & pump	1	20	20%	680	113560	29025.936
			40	Telehandler	2	80	80%	5440	489600	125141.76
			40	Mobile telescopic crane (rail-m	1	50	50%	1700	1037000	265057.2
	Acoustic Barrier Construction*									
	Internal highways and hardstanding works	8 – 10 months	40	Dozer	1	50	50%	1700	340000	86904
			40	Articulated dump truck	2	20	20%	1360	263840	67437.504
			40	Vibratory roller	1	50	50%	1700	166600	42582.96
			40	Road planer	1	20	20%	680	125800	32154.48
			40	Asphalt paver	1	40	40%	1360	152320	38932.992
			40	Tracked excavator	2	70	70%	4760	1190000	304164
			40	Telehandler	2	80	80%	5440	489600	125141.76
	Construction of rail crossings; 1no. bridge crossings	6 – 9 months	36	Mobile telescopic crane	2	70	70%	4284	2613240	667944.144
			36	Tracked excavator	1	30	30%	918	229500	58660.2
			36	Concrete pump and mixer truc	1	30	30%	918	156978	40123.5768
			36	Articulated dump truck	1	30	30%	918	178092	45520.3152
			36	Poker vibrator	1	30	30%	918	2019.6	516.20976
			36	Rotary bored piling rig	1	20	20%	612	100368	25654.0608
Phase 3	Research & Development Centre construction	2 – 4 months	16	Wheeled excavator	1	50	50%	680	61200	15642.72
			16	Lorry with lifting boom	1	10	10%	136	6800	1738.08
			16	Articulated dump truck	1	50	50%	680	131920	33718.752
			16	Concrete pump and mixer truc	1	40	40%	544	93024	23776.9344
			16	Mobile telescopic crane	1	50	50%	680	414800	106022.88
			16	Poker vibrator	1	20	20%	272	598.4	152.95104
			16	Rotary bored piling rig	1	20	20%	272	44608	11401.8048
			16	Telehandler	1	80	80%	1088	97920	25028.352
	Station Testing facilities and laboratories	6 – 8 months	32	Wheeled excavator	1	50	50%	1360	122400	31285.44
			32	Lorry with lifting boom	1	10	10%	272	13600	3476.16
			32	Articulated dump truck	1	50	50%	1360	263840	67437.504
			32	Concrete pump and mixer truc	1	40	40%	1088	186048	47553.8688
			32	Mobile telescopic crane	1	50	50%	1360	829600	212045.76
			32	Poker vibrator	1	20	20%	544	1196.8	305.90208
			32	Rotary bored piling rig	1	20	20%	544	89216	22803.6096
			32	Telehandler	1	80	80%	2176	195840	50056.704
	Rolling stock decommissioning facility	6 – 8 months	32	Articulated dump truck	1	50	50%	1360	263840	67437.504
			32	Concrete pump and mixer truc	1	70	70%	1904	325584	83219.2704
			32	Mobile telescopic crane	1	50	50%	1360	829600	212045.76
			32	Poker vibrator	1	20	20%	544	1196.8	305.90208
			32	Rotary bored piling rig	1	20	20%	544	89216	22803.6096
			32	Telehandler	1	80	80%	2176	195840	50056.704
			32	Tracked excavator	1	80	80%	2176	544000	139046.4
			40	Handheld angle grinder	2	20	20%	1360	3128	799.5168
			40	Tamper	1	20	20%	680	748	191.1888
			40	Hydraulic vibratory compactor	1	20	20%	680	170000	43452
			40	Articulated dump truck	2	50	50%	3400	659600	168593.76
			40	Tracked excavator	2	50	50%	3400	850000	217260
			40	Concrete mixer truck & pump	1	20	20%	680	113560	29025.936
			40	Telehandler	2	80	80%	5440	489600	125141.76
			40	Mobile telescopic crane (rail-m	1	50	50%	1700	1037000	265057.2

Total	15,030,447

*No available information on acoustic barrier construction at time of assessment therefore excluded from the calculation
Exclusion justified under Section 5.5.2 Cut off rules of IEMA guidance 'Assessing Greenhouse Gas Emissions and Evaluating their Significance.' Available at https://www.iaia.org/pdf/wab/EIA%20Guide_GHG%20Assessment%20and%20Significance_IEMA_16May17.pdf

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Source: \\Global\Europe\Bristol\Jobs\264xxx\264904-11\4.40_Calculations\Costing\2020-04-21 GCRE Updated Phased Costing.xlsx

Design life 60

Assets requiring replacement within the 60-year lifecycle:

No construction programme available for maintenance and refurbishments at the time of the assessment so A5 emissions are excluded from the calculation

Exclusion of A5 justified under Section 5.5.2 Cut off rules of IEMA guidance 'Assessing Greenhouse Gas Emissions and Evaluating their Significance.' Available at https://www.iaia.org/pdf/wab/EIA%20Guide_GHG%20Assessment%20and%20Significance_IEMA_16May17.pdf

Asset	Life (years)	A1-A3	A4	No. of replacements	B2-B5 kgCO2e
Substations	25	309,792	2,061	2.4	748,447
Palisade fencing	25	4,729,354	6,308	2.4	11,365,589
Lighting bollards	25	61,488	25	2.4	147,629
Acoustic barriers	30	298,861	313	2	598,348
Access roads	20	94,787	4,967	3	299,262
Cess access track	25	370,464	53,196	2.4	1,016,785
Total					**14,176,059**

A4

	Material	Mass (kg)	Mass (tonnes)	Distance (km)	tonne.km	Freight mode 1	Freight mode 2	Percentage split		Conversion factor 1	Conversion factor 2	A4 kgCO2e
	Steel - General	3075586.3	3075.586	25	76889.65676	Rail	Road	80%	20%	0.03333	0.129086853	4,035
Fencing	Concrete - 32/40 MPa	1731873.2	1731.873	25	43296.82875	Rail	Road	80%	20%	0.03333	0.129086853	2,272
	Concrete - General	7452	7.452	25	186.3	Rail	Road	80%	20%	0.03333	0.129086853	10
Lighting bollards	Aluminium - Cast Prod	4600	4.6	25	115	Road	N/A	100%	0%	0.129086853	0	15
	Steel - General	177498.03	177.498	25	4437.450672	Rail	Road	80%	20%	0.03333	0.129086853	233
	Concrete - 32/40 MPa	12303.9	12.3039	25	307.5975	Rail	Road	80%	20%	0.03333	0.129086853	16
Acoustic barrier	Insulation - Mineral W	29700	29.7	50	1485	Rail	Road	90%	10%	0.03333	0.129086853	64
Access road	Asphalt, 5% binder con	1748846.4	1748.846	22	38474.6208	Road	N/A	100%	0%	0.129086853	0	4,967
Cess access track	Aggregates and Sand -	49593600	49593.6	25	1239840	Rail	Road	90%	10%	0.03333	0.129086853	53,196

Civils A1-A3 (Assume replace top 40mm of access track, replace whole cess track)

Asset	Length (m)	Width (m)	Area (m2)	Material (ICEv3 Reference)	Density (kg m3)	Thickness (mm)	Thickness (m)	Volume (m3)	Weight (kg)	Emission factor (kgCO2-e/kg)	Emissions (kgCO2-e)
Access road	2852	7.3	20819.6	Asphalt, 5% binder c	2100	40	0.04	832.784	1748846.4	0.0542	94,787
Cess access track	24600	3	73800	Aggregates and San	2240	300	0.3	22140	49593600	0.00747	370,464

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Operational hours per day: 12 https://catalogues.rssb.co.uk/rgs/standards/GIGN7621%20Iss%201.pdf
Sidings area taken from: ..\..\..\4-80 GIS\4-84 Map Documents\ENV_Environment\Environmental Statement\Intro\GCRE_264904_ES_1_1_SiteLayout_P01_2.mxd

Operational hours per day: 12

Lighting areas	Measure	Units	Light intensity (W/m2)	kWh/unit	kWh
Sidings	71,600	m2	3	13.1	941,468
Hardstanding associated with access (car parks)	16,470	m2	2	8.8	144,375
Hardstanding associated with buildings (walkways)	4,277	m2	3	13.1	56,244
Access roads	3,752	m	8	35.1	131,560

Reference: Energy benchmarks based on Arup experience, adopted as per Llanelli Wellness Centre Carbon Assessment

	kgCO2e:			
Operational year	Sidings	Car parks	Walkways	Access roads
1	101,518	15,568	6,065	14,186
2	94,604	14,508	5,652	13,220
3	95,543	14,652	5,708	13,351
4	89,528	13,729	5,348	12,511
5	95,478	14,642	5,704	13,342
6	90,413	13,865	5,401	12,634
7	83,279	12,771	4,975	11,637
8	75,083	11,514	4,485	10,492
9	66,065	10,131	3,947	9,232
10	55,584	8,524	3,321	7,767
11	51,531	7,902	3,078	7,201
12	44,791	6,869	2,676	6,259
13	37,093	5,688	2,216	5,183
14	37,093	5,688	2,216	5,183
15	37,093	5,688	2,216	5,183
16	37,093	5,688	2,216	5,183
17	37,093	5,688	2,216	5,183
18	37,093	5,688	2,216	5,183
19	35,887	5,503	2,144	5,015
20	34,681	5,318	2,072	4,846
21	33,475	5,133	2,000	4,678
22	32,269	4,949	1,928	4,509
23	31,063	4,764	1,856	4,341
24	29,858	4,579	1,784	4,172
25	28,652	4,394	1,712	4,004
26	27,446	4,209	1,640	3,835
27	26,240	4,024	1,568	3,667
28	25,034	3,839	1,496	3,498
29	25,034	3,839	1,496	3,498
30	25,034	3,839	1,496	3,498
31	25,034	3,839	1,496	3,498
32	25,034	3,839	1,496	3,498
33	25,034	3,839	1,496	3,498
34	25,034	3,839	1,496	3,498
35	25,034	3,839	1,496	3,498
36	25,034	3,839	1,496	3,498
37	25,034	3,839	1,496	3,498
38	25,034	3,839	1,496	3,498
39	25,034	3,839	1,496	3,498
40	25,034	3,839	1,496	3,498
41	25,034	3,839	1,496	3,498
42	25,034	3,839	1,496	3,498
43	25,034	3,839	1,496	3,498
44	25,034	3,839	1,496	3,498
45	25,034	3,839	1,496	3,498
46	25,034	3,839	1,496	3,498
47	25,034	3,839	1,496	3,498
48	25,034	3,839	1,496	3,498
49	25,034	3,839	1,496	3,498
50	25,034	3,839	1,496	3,498
51	25,034	3,839	1,496	3,498
52	25,034	3,839	1,496	3,498
53	25,034	3,839	1,496	3,498
54	25,034	3,839	1,496	3,498
55	25,034	3,839	1,496	3,498
56	25,034	3,839	1,496	3,498
57	25,034	3,839	1,496	3,498
58	25,034	3,839	1,496	3,498
59	25,034	3,839	1,496	3,498
60	25,034	3,839	1,496	3,498
Total:	**########**	**348,362**	**135,710**	**317,441**

Emissions from lighting over design life (kgCO2e): **########**

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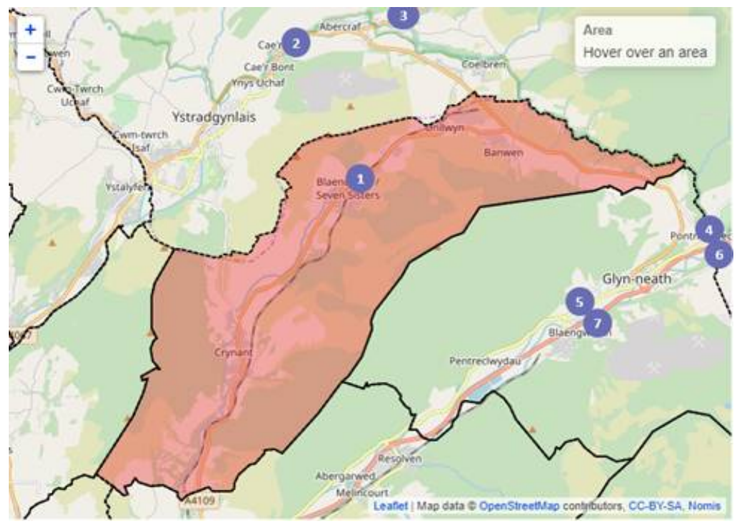
Basis of calculation
Source: OBC (workforce numbers) and Transport Assessment
Local traffic (that unrelated to GCRE) is not affected by the operation of GCRE
OBC - 'In respect of the Core Activities, it is considered that the site could support in the region of 50 to 90 permanent jobs'

Assumptions (based on those used in Transport Assessment)
Assume each commuting employee drives to work in a small diesel engine car/van
1 person per vehicle
Distances based on method used in Transport Assessment (distribution as below, construction and operation split assumed the same)

Further assumptions
Workers travelling to site as a result of indirect employment excluded from assessment (as visits to site are variable and difficult to anticipate)
Rolling Stock testing operational 252 days per year (see Rolling stock testing B6 tab)
Infrastructure testing operational 105 days (see Infrastructure testing B6 tab)
Each shift lasts 12 hrs
90 employees used as worse-case scenario

Worker start location	Distribution of workers	Distance (km) to and from site
1	62%	12
2	5%	10.4
3	20%	10
4	1%	24.4
5	5%	22.6
6	7%	24.4
7	0%	22.6



Phase	Year	Operational year	No. of permanent employees	No. of working days	Distance travelled	Gallons of fuel	Litres of fuel	kgCO2e
Phase I	2023	1	90	105	123,247	1,202	5,466	13,228
Phase II	2024	2	90	252	295,793	2,886	13,119	31,747
Phase III	2025	3	90	252	295,793	2,886	13,119	31,747
Phase III	2026	4	90	252	295,793	2,886	13,119	31,747
Phase III	2027	5	90	252	295,793	2,886	13,119	31,747
Phase III	2028	6	90	252	295,793	2,886	13,119	31,747
Phase III	2029	7	90	252	295,793	2,886	13,119	31,747
Phase III	2030	8	90	252	295,793	2,886	13,119	31,747
Phase III	2031	9	90	252	295,793	2,886	13,119	31,747
Phase III	2032	10	90	252	295,793	2,886	13,119	31,747
Phase III	2033	11	90	252	295,793	2,886	13,119	31,747
Phase III	2034	12	90	252	295,793	2,886	13,119	31,747
Phase III	2035	13	90	252	295,793	2,886	13,119	31,747
Phase III	2036	14	90	252	295,793	2,886	13,119	31,747
Phase III	2037	15	90	252	295,793	2,886	13,119	31,747
Phase III	2038	16	90	252	295,793	2,886	13,119	31,747
Phase III	2039	17	90	252	295,793	2,886	13,119	31,747
Phase III	2040	18	90	252	295,793	2,886	13,119	31,747
Phase III	2041	19	90	252	295,793	2,886	13,119	31,747
Phase III	2042	20	90	252	295,793	2,886	13,119	31,747
Phase III	2043	21	90	252	295,793	2,886	13,119	31,747
Phase III	2044	22	90	252	295,793	2,886	13,119	31,747
Phase III	2045	23	90	252	295,793	2,886	13,119	31,747
Phase III	2046	24	90	252	295,793	2,886	13,119	31,747
Phase III	2047	25	90	252	295,793	2,886	13,119	31,747
Phase III	2048	26	90	252	295,793	2,886	13,119	31,747
Phase III	2049	27	90	252	295,793	2,886	13,119	31,747
Phase III	2050	28	90	252	295,793	2,886	13,119	31,747
Phase III	2051	29	90	252	295,793	2,886	13,119	31,747
Phase III	2052	30	90	252	295,793	2,886	13,119	31,747
Phase III	2053	31	90	252	295,793	2,886	13,119	31,747
Phase III	2054	32	90	252	295,793	2,886	13,119	31,747
Phase III	2055	33	90	252	295,793	2,886	13,119	31,747
Phase III	2056	34	90	252	295,793	2,886	13,119	31,747
Phase III	2057	35	90	252	295,793	2,886	13,119	31,747
Phase III	2058	36	90	252	295,793	2,886	13,119	31,747
Phase III	2059	37	90	252	295,793	2,886	13,119	31,747
Phase III	2060	38	90	252	295,793	2,886	13,119	31,747
Phase III	2061	39	90	252	295,793	2,886	13,119	31,747
Phase III	2062	40	90	252	295,793	2,886	13,119	31,747
Phase III	2063	41	90	252	295,793	2,886	13,119	31,747
Phase III	2064	42	90	252	295,793	2,886	13,119	31,747
Phase III	2065	43	90	252	295,793	2,886	13,119	31,747
Phase III	2066	44	90	252	295,793	2,886	13,119	31,747
Phase III	2067	45	90	252	295,793	2,886	13,119	31,747
Phase III	2068	46	90	252	295,793	2,886	13,119	31,747
Phase III	2069	47	90	252	295,793	2,886	13,119	31,747
Phase III	2070	48	90	252	295,793	2,886	13,119	31,747
Phase III	2071	49	90	252	295,793	2,886	13,119	31,747
Phase III	2072	50	90	252	295,793	2,886	13,119	31,747
Phase III	2073	51	90	252	295,793	2,886	13,119	31,747
Phase III	2074	52	90	252	295,793	2,886	13,119	31,747
Phase III	2075	53	90	252	295,793	2,886	13,119	31,747
Phase III	2076	54	90	252	295,793	2,886	13,119	31,747
Phase III	2077	55	90	252	295,793	2,886	13,119	31,747
Phase III	2078	56	90	252	295,793	2,886	13,119	31,747
Phase III	2079	57	90	252	295,793	2,886	13,119	31,747
Phase III	2080	58	90	252	295,793	2,886	13,119	31,747
Phase III	2081	59	90	252	295,793	2,886	13,119	31,747
Phase III	2082	60	90	252	295,793	2,886	13,119	31,747

Total CO2e 1,886,316

Small diesel vans average 63.7 MPG = 102.5 KMPG
https://vanfueldata.vehicle-certification-agency.gov.uk/download.aspx

1 gallon = 4.546 litres

Global Centre of Rail Excellence (GCRE)

Rolling Stock Testing B6

ARUP

Assumptions (as per project description)

Fuel proportions for first two years stated as 70% e-, 20% H, 10% diesel

Have assumed 10% diesel over first 5 years of design life. Diesel usage is de-scoped after 5 operational years, with equal electic and hydrogen take-up

60 year design life

Rolling Stock testing operational during the daytime for seven days per week, for four evenings each week and for two nights per week = 116 hours a week = 6,048 hours a year (252 days)

Daytime (defined as 0700-1900), evening (1900-2300) and night-time (2300-0700)

Further assumptions

'Over 80% of journeys per km use electrified rail' (https://www.rssb.co.uk/en/Research-and-Technology/Sustainability/Decarbonisation/Decarbonisation-our-final-report-to-the-Rail-Minister)

Conversions:

kWh to kgCO2e https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Electricity/diesel power usage, train kms: https://dataportal.orr.gov.uk/

Electric train

Passenger train	Traction electricity usage (million kWh)	Train kms (million kms)	Electrified train kms (million km)	Electric kms (%)
2018-19	3,976.0	530.3	424.2	80%

kWh/train-km	9.4

Diesel train

Passenger train	Diesel usage (million litres)	Train kms (million kms)	Diesel train kms (million kms)	Diesel kms (%)
2018-19	469.3	530.3	106.1	20%

litre/train-km	4.4

H2 consumption (k 0.48 From Figure 6 of: References\Study on the use of fuel cells and hydrogen in the railway environment_final.pdf

kg H2 to kgCO2e: https://www.industry.gov.au/sites/default/files/2019-11/australias-national-hydrogen-strategy.pdf

kgCO2e / kgH2: 0

Assume 'green' / 100% recycled hydrogen. Assumed that hydrogen fuel would also be zero carbon at the point of use.

Rolling stock testing

Year operation 2024 Average speed (112.654 Average speed (mp 70

Appraisal perio 60 Vehicle-km per 567776.16 Operational hours 5040

Year	Operational year	Operational hours	Vehicle/fuel proportion			Energy consumption			Emissions (kgCO2e)		
			Electric	Hydrogen	Diesel	Electric (kWh)	Hydrogen (kg)	Diesel (litres)	Electric	Hydrogen	Diesel
2023	1	0	70%	20%	10%	0	0	0	0	0	0
2024	2	5040	70%	20%	10%	3,724,949	54,507	251,221	374,304	0	607,952
2025	3	5040	70%	20%	10%	3,724,949	54,507	251,221	378,021	0	607,952
2026	4	5040	70%	20%	10%	3,724,949	54,507	251,221	354,222	0	607,952
2027	5	5040	70%	20%	10%	3,724,949	54,507	251,221	377,761	0	607,952
2028	6	5040	70%	20%	10%	3,724,949	54,507	251,221	357,724	0	607,952
2029	7	5040	75%	25%	0%	3,991,017	68,133	0	353,031	0	0
2030	8	5040	75%	25%	0%	3,991,017	68,133	0	318,288	0	0
2031	9	5040	75%	25%	0%	3,991,017	68,133	0	280,059	0	0
2032	10	5040	75%	25%	0%	3,991,017	68,133	0	235,627	0	0
2033	11	5040	75%	25%	0%	3,991,017	68,133	0	218,445	0	0
2034	12	5040	75%	25%	0%	3,991,017	68,133	0	189,877	0	0
2035	13	5040	75%	25%	0%	3,991,017	68,133	0	157,242	0	0
2036	14	5040	75%	25%	0%	3,991,017	68,133	0	157,242	0	0
2037	15	5040	75%	25%	0%	3,991,017	68,133	0	157,242	0	0
2038	16	5040	75%	25%	0%	3,991,017	68,133	0	157,242	0	0
2039	17	5040	75%	25%	0%	3,991,017	68,133	0	157,242	0	0
2040	18	5040	75%	25%	0%	3,991,017	68,133	0	157,242	0	0
2041	19	5040	75%	25%	0%	3,991,017	68,133	0	152,130	0	0
2042	20	5040	75%	25%	0%	3,991,017	68,133	0	147,018	0	0
2043	21	5040	75%	25%	0%	3,991,017	68,133	0	141,906	0	0
2044	22	5040	75%	25%	0%	3,991,017	68,133	0	136,794	0	0
2045	23	5040	75%	25%	0%	3,991,017	68,133	0	131,682	0	0
2046	24	5040	75%	25%	0%	3,991,017	68,133	0	126,570	0	0
2047	25	5040	75%	25%	0%	3,991,017	68,133	0	121,458	0	0
2048	26	5040	75%	25%	0%	3,991,017	68,133	0	116,346	0	0
2049	27	5040	75%	25%	0%	3,991,017	68,133	0	111,234	0	0
2050	28	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2051	29	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2052	30	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2053	31	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2054	32	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2055	33	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2056	34	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2057	35	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2058	36	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2059	37	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2060	38	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2061	39	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2062	40	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2063	41	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2064	42	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2065	43	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2066	44	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2067	45	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2068	46	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2069	47	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2070	48	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2071	49	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2072	50	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2073	51	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2074	52	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2075	53	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2076	54	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2077	55	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2078	56	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2079	57	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2080	58	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2081	59	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
2082	60	5040	75%	25%	0%	3,991,017	68,133	0	106,123	0	0
								Total:	**9,067,993**	**0**	**3,039,759**

Combined total: 12,107,752

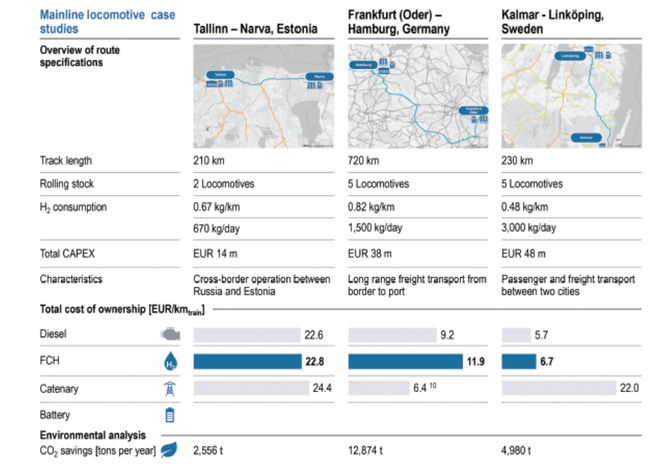


Figure 6: Overview of the Mainline Locomotives case studies including economic and environmental results(10).

Emissions intensity of production

Production technology	Emissions (kg CO_{2-e}/kg hydrogen)[vi]
Electrolysis – Australian grid electricity[vii]	40.5
Electrolysis – 100% renewable electricity	0
Coal gasification, no CCS[viii]	12.7 – 16.8
Coal gasification + CCS – best case[ix]	0.71
Steam methane reforming (SMR), no CCS[x]	8.5
SMR + CCS – best case[xi]	0.76

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Infrastructure testing B6

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Assumptions (based on project description)

Infrastructure testing operational 105 days / 2520 hours per year
60 year design life
Likely to mostly be powered electrically (25kV OLE) but potentially could be some diesel / bi-mode stock and potentially some hydrogen trains in the future.

Further assumptions

Electric freight vehicles are 4% of the total fleet (based on the fact that diesel freight trains produce 96% of total rail freight carbon emissions - see para. 6.23 of https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/901692/conversion-factors-2020-methodology.pdf). Expected to be within 5% margin of error.
'Only a small percentage of rail freight (around 5 per cent) is currently powered by electric traction' - Rail Freight Strategy 2016 (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/552492/rail-freight-strategy.pdf)

Electricity usage, train kms: https://dataportal.orr.gov.uk/

	Traction electricity usage (million kWh)	Freight train kms (million kms)	Electrified frieght train kms (million km)	Electric kms (%)
2018-19	74.9	33.6	1.3	4%

kWh/train-km	55.7

Infrastructure testing

Year operational:	2023	Average speed (	40
Appraisal period:	60	Average speed (	64.3738

Year	Operational	Operational	Distance (km)	kWh	kgCO2e
2023	1	2520	162,222	9,031,513	973,859
2024	2	2520	162,222	9,031,513	907,537
2025	3	2520	162,222	9,031,513	916,549
2026	4	2520	162,222	9,031,513	858,847
2027	5	2520	162,222	9,031,513	915,920
2028	6	2520	162,222	9,031,513	867,337
2029	7	2520	162,222	9,031,513	798,896
2030	8	2520	162,222	9,031,513	720,272
2031	9	2520	162,222	9,031,513	633,763
2032	10	2520	162,222	9,031,513	533,215
2033	11	2520	162,222	9,031,513	494,333
2034	12	2520	162,222	9,031,513	429,684
2035	13	2520	162,222	9,031,513	355,832
2036	14	2520	162,222	9,031,513	355,832
2037	15	2520	162,222	9,031,513	355,832
2038	16	2520	162,222	9,031,513	355,832
2039	17	2520	162,222	9,031,513	355,832
2040	18	2520	162,222	9,031,513	355,832
2041	19	2520	162,222	9,031,513	344,264
2042	20	2520	162,222	9,031,513	332,696
2043	21	2520	162,222	9,031,513	321,128
2044	22	2520	162,222	9,031,513	309,560
2045	23	2520	162,222	9,031,513	297,991
2046	24	2520	162,222	9,031,513	286,423
2047	25	2520	162,222	9,031,513	274,855
2048	26	2520	162,222	9,031,513	263,287
2049	27	2520	162,222	9,031,513	251,719
2050	28	2520	162,222	9,031,513	240,151
2051	29	2520	162,222	9,031,513	240,151
2052	30	2520	162,222	9,031,513	240,151
2053	31	2520	162,222	9,031,513	240,151
2054	32	2520	162,222	9,031,513	240,151
2055	33	2520	162,222	9,031,513	240,151
2056	34	2520	162,222	9,031,513	240,151
2057	35	2520	162,222	9,031,513	240,151
2058	36	2520	162,222	9,031,513	240,151
2059	37	2520	162,222	9,031,513	240,151
2060	38	2520	162,222	9,031,513	240,151
2061	39	2520	162,222	9,031,513	240,151
2062	40	2520	162,222	9,031,513	240,151
2063	41	2520	162,222	9,031,513	240,151
2064	42	2520	162,222	9,031,513	240,151
2065	43	2520	162,222	9,031,513	240,151
2066	44	2520	162,222	9,031,513	240,151
2067	45	2520	162,222	9,031,513	240,151
2068	46	2520	162,222	9,031,513	240,151
2069	47	2520	162,222	9,031,513	240,151
2070	48	2520	162,222	9,031,513	240,151
2071	49	2520	162,222	9,031,513	240,151
2072	50	2520	162,222	9,031,513	240,151
2073	51	2520	162,222	9,031,513	240,151
2074	52	2520	162,222	9,031,513	240,151
2075	53	2520	162,222	9,031,513	240,151
2076	54	2520	162,222	9,031,513	240,151
2077	55	2520	162,222	9,031,513	240,151
2078	56	2520	162,222	9,031,513	240,151
2079	57	2520	162,222	9,031,513	240,151
2080	58	2520	162,222	9,031,513	240,151
2081	59	2520	162,222	9,031,513	240,151
2082	60	2520	162,222	9,031,513	240,151

Total:	21,792,111

Habitat loss and creatoion for GCRE
Construction will result in some habitat loss, although this will be limited to areas of development including temporary works which require clearance within the washery area only
Areas within the Nant Helen site will have been cleared as part of the Nant Helen Complementary Earthworks project
The areas within the washery area which would require clearance to facilitate development, largely comprise buildings or other man made habitats associated with the current operations of the washery.
The operation of the Site as a rail testing, maintenance, research, development and storage facility will result in no further habitat loss
Opportunities exist within the washery for small-scale habitat creation, to mitigate for habitat loss, in addition to enhancements of the retained marshy grassland and acid grassland - heathland within the washery.
Embankments created around the tracks, will provide additional area for the establishment of grassland, and lichen / heathland communities.
Management and monitoring of any created / enhanced habitats will be crucial to ensure that the intended mitigation for this Project is implemented.
Source: Ecology chapter

Notes on the chapter
The ecology chapter states that opportunities exist for habitat creation as above, however, no indication of scale is given

Cut off
It is anticipated that the impact of habitat loss/creation as part of the GCRE project will be negligible and most habitat loss/creation will form part of future baseline (i.e. be included within the Nant Helen scope)
These activities are not expected to significantly change the result of the quantification and are excluded at this time
Guidance c https://www.iaia.org/pdf/wab/EIA%20Guide_GHG%20Assessment%20and%20Significance_IEMA_16May17.pdf

The emissions intensity of electricity will (and assumed to) decrease over time as per the table below

Table 1: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Year	Grid average		
	Consumption-based		
	Domestic	Commercial/ Public sector	Industrial
2010	0.501	0.492	0.483
2011	0.485	0.476	0.467
2012	0.532	0.523	0.513
2013	0.495	0.486	0.477
2014	0.441	0.433	0.425
2015	0.369	0.363	0.356
2016	0.291	0.285	0.280
2017	0.247	0.243	0.238
2018	0.180	0.177	0.174
2019	0.146	0.143	0.141
2020	0.141	0.138	0.135
2021	0.115	0.113	0.111
2022	0.107	0.105	0.103
2023	0.112	0.110	0.108
2024	0.104	0.102	0.100
2025	0.105	0.103	0.101
2026	0.099	0.097	0.095
2027	0.105	0.103	0.101
2028	0.100	0.098	0.096
2029	0.092	0.090	0.088
2030	0.083	0.081	0.080
2031	0.073	0.072	0.070
2032	0.061	0.060	0.059
2033	0.057	0.056	0.055
2034	0.049	0.048	0.048
2035	0.041	0.040	0.039
2036	0.041	0.040	0.039
2037	0.041	0.040	0.039
2038	0.041	0.040	0.039
2039	0.041	0.040	0.039
2040	0.041	0.040	0.039
2041	0.040	0.039	0.038
2042	0.038	0.038	0.037
2043	0.037	0.036	0.036
2044	0.036	0.035	0.034
2045	0.034	0.034	0.033
2046	0.033	0.032	0.032
2047	0.032	0.031	0.030
2048	0.030	0.030	0.029
2049	0.029	0.028	0.028
2050	0.028	0.027	0.027
2051	0.028	0.027	0.027
2052	0.028	0.027	0.027
2053	0.028	0.027	0.027
2054	0.028	0.027	0.027
2055	0.028	0.027	0.027
2056	0.028	0.027	0.027
2057	0.028	0.027	0.027
2058	0.028	0.027	0.027
2059	0.028	0.027	0.027
2060	0.028	0.027	0.027
2061	0.028	0.027	0.027
2062	0.028	0.027	0.027
2063	0.028	0.027	0.027
2064	0.028	0.027	0.027
2065	0.028	0.027	0.027
2066	0.028	0.027	0.027
2067	0.028	0.027	0.027
2068	0.028	0.027	0.027

2069	0.028	0.027	0.027
2070	0.028	0.027	0.027
2071	0.028	0.027	0.027
2072	0.028	0.027	0.027
2073	0.028	0.027	0.027
2074	0.028	0.027	0.027
2075	0.028	0.027	0.027
2076	0.028	0.027	0.027
2077	0.028	0.027	0.027
2078	0.028	0.027	0.027
2079	0.028	0.027	0.027
2080	0.028	0.027	0.027
2081	0.028	0.027	0.027
2082	0.028	0.027	0.027
2083	0.028	0.027	0.027
2084	0.028	0.027	0.027
2085	0.028	0.027	0.027
2086	0.028	0.027	0.027
2087	0.028	0.027	0.027
2088	0.028	0.027	0.027
2089	0.028	0.027	0.027
2090	0.028	0.027	0.027
2091	0.028	0.027	0.027
2092	0.028	0.027	0.027
2093	0.028	0.027	0.027
2094	0.028	0.027	0.027
2095	0.028	0.027	0.027
2096	0.028	0.027	0.027
2097	0.028	0.027	0.027
2098	0.028	0.027	0.027
2099	0.028	0.027	0.027
2100	0.028	0.027	0.027

Source: Department for Transport
https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
Table 2b: Converting road and rail fuels to CO2e (emissions factors), kgCO2e/litre

Year	Diesel
2010	2.562
2011	2.567
2012	2.609
2013	2.597
2014	2.601
2015	2.601
2016	2.602
2017	2.556
2018	2.511
2019	2.465
2020	2.420
2021	2.420
2022	2.420
2023	2.420
2024	2.420
2025	2.420
2026	2.420
2027	2.420
2028	2.420
2029	2.420
2030	2.420
2031	2.420
2032	2.420
2033	2.420
2034	2.420
2035	2.420
2036	2.420
2037	2.420
2038	2.420
2039	2.420
2040	2.420
2041	2.420
2042	2.420
2043	2.420
2044	2.420
2045	2.420
2046	2.420
2047	2.420
2048	2.420
2049	2.420
2050	2.420
2051	2.420
2052	2.420
2053	2.420
2054	2.420
2055	2.420
2056	2.420
2057	2.420
2058	2.420
2059	2.420
2060	2.420
2061	2.420
2062	2.420
2063	2.420
2064	2.420
2065	2.420
2066	2.420
2067	2.420

2068	2.420
2069	2.420
2070	2.420
2071	2.420
2072	2.420
2073	2.420
2074	2.420
2075	2.420
2076	2.420
2077	2.420
2078	2.420
2079	2.420
2080	2.420
2081	2.420
2082	2.420
2083	2.420
2084	2.420
2085	2.420
2086	2.420
2087	2.420
2088	2.420
2089	2.420
2090	2.420
2091	2.420
2092	2.420
2093	2.420
2094	2.420
2095	2.420
2096	2.420
2097	2.420
2098	2.420
2099	2.420
2100	2.420

Phase 1 – Infrastructure Testing (operational 2023):

- Infrastructure test track with 25kV overhead line electrification. Bi-directional rail access from N&B branch line.
- 12 full-length stabling roads.
- 1 shunters cabin (probably a portacabin with basic amenities) from which the shunter will move around the facility opening / closing hand points to enable train movements.
- Staff facilities – modular site cabin buildings with mess facilities, changing rooms, storage, IT.
- Infrastructure testing R&D facility – modular site cabin buildings with advanced IT for monitoring of infrastructure tests.
- External storage space – concrete hardstanding area with vehicle access for storage of materials & equipment for testing.

Phase 2 – Rolling Stock Testing (operational 2024):

- Rolling stock test track with 25kV overhead line (and potential 3rd rail DC) electrification. Bi-directional rail access from N&B branch line.
- 12 full-length stabling roads.
- Rolling stock maintenance shed. 2 roads at 400m length, 2 roads at 250m length. Internal and external storage spaces.
- Carriagewash.
- Improved (permanent) staff facilities. Those introduced in phase 1 will be removed. Provision of overnight accommodation, in addition to all previous functions.
- Upgrade of all points to electric points.
- Central control centre – panel from which all train movements are controlled. Points are changed electronically.
- Infrastructure testing R&D facility – relocated to location shown on final plan. [3] on phasing sketches.

Phase 3 – Aspirational inclusions (operational 2025):

- Rolling stock R&D / education facility.
- Stationary testing facilities and associated laboratories.
- Rolling stock maintenance & decommissioning facility.
- 10 'through' sidings, south of the N&B branch line (the phasing of this conflicts with what is shown in the email you sent across. It was later re-shuffled for the through sidings to be the last constructed).

Source: ..\..\..\4-70 Technical Notes\Rail\EIA Rail Information.docx

Appendix 15B

CCR Assessment

Climate change risk assessment

Project

Timeframes

Data from climate predictions

Examples in Grey

Risk ID	Climate hazard	Trend or Likelihood of Climate Hazard	Potential Climate Change Impact	Potential Climate Change Risk to Scheme	Construction/Operation Stage	Asset type	Existing or embedded mitigation measure	Result of mitigation measure on resilience	Hazard Impact			Uncertainty Level		Level of Uncertainty	Proposed additional resilience measure (only if Risk Rating = 'High' (4) or 'Very high' (5))	Reference documenting relevant mitigation
									Likelihood	Consequence	Risk rating	CC Projection	CC effect on asset			
1	High temperatures		Rising temperatures impact building performance	Increased temperatures leads to increased HVAC system power demand and increased energy consumption to cool buildings.	Operation	Buildings	Expected temperature increase is within operational range of systems designed to current standards for 20-year design life of HVAC system. Energy efficient systems to be selected.	A level of resileicene reached through maintenance of system and regular replacement	Unlikely	Minor	Very Low	Low	Low	**Low**		
2	High temperatures		Rising temperatures impact building performance	Increased temperatures and extreme heat events lead to reduced thermal performance of buildings and reduce thermal comfort of occupants	Operation	Buildings	Expected temperature increase is within operational range of systems designed to current standards for 20-year design life of HVAC system.	A level of resileicene reached through maintenance of system and regular replacement	Likely	Minor	Medium	Low	Medium	**Low**		
3	High temperatures		Rising temperatures impact materials performance	Increased temperatures lead to accelerated degradation of building facade materials	Operation	Buildings	Design of external building materials to current standards, monitored and maintained as per standard maintenance procedures.	A level of resileicene reached through maintenance of asset	Unlikely	Minor	Very Low	Low	Medium	**Low**		
4	High temperatures		Rising temperatures impact equipment performance	Extreme heat events lead to failure of sensitive equipment at high temperatures	Construction and Operation	Buildings	Sensitive equipment to be located in temperature-controlled areas of buildings. Building design to meet guidance in Health Technical Memoranda.	Resilience achieved through design decisions.	Unlikely	Moderate	Low	Low	Medium	**Low**		
5	High temperatures		Rising temperatures effecting road surface	Extreme heat events lead to damage to road surface through deformation of asphalt	Operation	Traffic and transport	Road construction to current standards, monitored as per standard maintenance procedures.	A level of resileicene reached through maintenance of asset	Unlikely	Minor	Very Low	Low	Medium	**Low**		
6	High temperatures		Rising temperatures impact building useage	Opportunity: Increased temperatures lead to increased outdoor recreation opportunities for development occupants	Operation	Public realm										
7	High temperatures		Rising temperatures impact materials performance	Increased temperatures lead to accelerated degradation of materials in outdoor facilities and pavements	Operation	Public realm	Faculties and pavement construction to current standards, monitored as per standard maintenance procedures.	A level of resileicene reached through maintenance of asset	Unlikely	Minor	Very Low	Low	Medium	**Low**		
8	High temperatures		Rising temperatures impact equipment performance	Extreme heat events lead to overheating of overhead electricity transmission lines	Operation	Utilities	Expected temperature increase is within operational range of transmission lines.	Resilience already accounted for.	Unlikely	Minor	Very Low	Low	High	**Medium**		
9	High temperatures		Increased number of hot days may lead to shrinkage of soil and drying out of vegetation	Extended periods of hot days may lead to a risk of spontaneous grassland fires, causing bulding damage	Operation	Buildings			Very unlikely	Major	Low	Medium	Medium	**Medium**		
10	High temperatures		Increased number of hot days may lead to shrinkage of soil and drying out of vegetation	Extended periods of hot days may lead to a risk of spontaneous grassland fires, affecting safety to public.	Operation	Public realm			Very unlikely	Major	Low	Medium	Medium	**Medium**		
11	Low temperatures		Rising temperatures impact building performance	Opportunity: Fewer frost days leads to decreased energy consumption to heat buildings	Operation	Buildings										
12	Low temperatures		Rising temperatures impact building performance	Opportunity: Fewer frost days leads to improved thermal comfort of building occupants	Operation	Buildings										
13	High precipitation		Increase in number of wet days may cause building damage	Extreme rainfall events lead to localised flooding, causing damage to building structure, internal fit-out, and equipment and pumps	Construction and Operation	Buildings	Masterplan design is based on detailed flood risk assessment which incorporates projected climate change.	Resilience achieved through design decisions.	Unlikely	Moderate	Low	Low	Medium	**Low**		
14	High precipitation		Increased rainfall provides a water supply to building	Opportunity: Extreme rainfall events lead to opportunity for rainwater harvesting	Operation	Buildings										
15	High precipitation		Increased rainfall may cause flooding risk from river and groundwater sources	Extreme rainfall events lead to localised flooding of roads and transport infrastructure, causing disruption to services and traffic	Operation	Traffic and transport	Masterplan design is based on detailed flood risk assessment which incorporates projected climate change.	Resilience achieved through design decisions.	As likely as not	Moderate	Medium	Low	Low	**Low**		
16	High precipitation		Increased rainfall may damage road suface	Extreme rainfall events causing damage to road surface (increased stripping rate, likelihood of potholing from moisture entering cracks in surface)	Operation	Traffic and transport	Road construction to current standards, monitored and maintained as per standard procedures. Resurfacing to occur within 10 - 20 years.	Resilience achieved through monitoring and maintenance of asset	Likely	Minor	Medium	Low	Medium	**Low**		
17	High precipitation		Increased rainfall may cause flooding risk from river and groundwater sources	Extreme rainfall events lead to localised flooding in public realm, causing disruption to users	Operation	Public realm	Masterplan design is based on detailed flood risk assessment which incorporates projected climate change.	Resilience achieved through design decisions.	Unlikely	Minor	Very Low	Low	Low	**Low**		
18	High precipitation		Increased rainfall can cause flooding	Increased rainfall and flooding effects can damage internal building contents.	Operation	Buildings	Masterplan design is based on detailed flood risk assessment which incorporates projected climate change.	Resilience achieved through design decisions.	Unlikely	Moderate	Low	Medium	Medium	**Medium**		
19	High temperatures		Increased rainfall can cause sea level rising	Extreme rainfall can cause coastal and inland flooding through rising sea levels. This leads to flooding effects and more coastal salt spray causing corrosion.	Operation	Buildings			Unlikely	Minor	Very Low	Medium	High	**High**	https://www.labcowarranty.co.uk/blog/oh-we-do-like-to-build-beside-the-seaside/	
20	High precipitation		Increased rainfall may cause flooding risk from river and groundwater sources	Extreme rainfall events lead to localised flooding of infrastructure, causing disruption to services	Construction and Operation	Utilities	Masterplan design is based on detailed flood risk assessment which incorporates projected climate change.	Resilience achieved through design decisions.	Unlikely	Moderate	Low	Low	Medium	**Low**		
21	High precipitation		Increased rainfall may cause flooding risk from river and groundwater sources	Extreme rainfall events lead to sewer flooding and resulting effects	Construction and Operation	Utilities	Masterplan design is based on detailed flood risk assessment which incorporates projected climate change.	Resilience achieved through design decisions.	Unlikely	Moderate	Low	Low	Medium	**Low**		
22	High precipitation		Increased rainfall effecting soil moisure levels	Increased average rainfall and extreme rainfall events lead to increased soil moisture levels, causing landslip and damage to utilities	Operation	Utilities	Design and construction of utilities to current standards, monitored as per standard maintenance procedures.	A level of resileicene reached through maintenance of asset	Unlikely	Moderate	Low	Low	High	**Medium**		
23	High precipitation		Increased rainfall may cause debris and sediment run-off	Extreme rainfall events leading to debris and sediment runoff, causing blockage to drainage systems. Blockage may result in flooding and resulting effects.	Construction and Operation	Utilities	Masterplan design is based on detailed flood risk assessment which incorporates projected climate change.	Resilience achieved through design decisions.	Unlikely	Moderate	Low	Low	Medium	**Low**		
24	Low precipitation		Decreased rainfall may increase soil shrinkage	Decreased average rainfall leads to drier soil conditions and soil shrinkage, causing damage to building foundation and possible ground movement.	Operation	Buildings	Shrinkage and dessication considered in foundation design however risk is low due to granular soils in local area.	Resilience achieved through design decisions.	Unlikely	Moderate	Low	Low	High	**Medium**		
25	Low precipitation		Extended dry weather can lead to increased desiccation of soil	Dry spells lead to desiccation of soils, causing reduced slope stability and potential earthworks failure following subsequent rainfall events	Construction and Operation	Buildings	Shrinkage and dessication considered in foundation design however risk is low due to granular soils in local area.	Resilience achieved through design decisions.	Unlikely	Moderate	Low	Low	Medium	**Low**		
26	Low precipitation		Decreased rainfall can reduce water supply to building	Decreased average rainfall and dry spells lead to disruption to water supply to building	Operation	Buildings	Buildings connected to mains water supply. Capacity checks have been undertaken with utilities to confirm capacity within network.	Resilience already accounted for.	Very unlikely	Minor	Very Low	Low	High	**Medium**		
27	Low precipitation		Decreased rainfall can reduce water supply to building	Decreased average rainfall leads to increased reliance on mains water for landscape irrigation during summer	Operation	Public realm	Landscape Management Plan includes procedures for irrigation during establishment and ongoing maintenance.	A level of resileicene e reached through maintenance of asset	Likely	Minor	Medium	Low	High	**Medium**		
28	Low precipitation		Decreased rainfall can reduce water supply to building	Decreased average rainfall leads to loss of vegetation during summer	Operation	Public realm	Landscape Management Plan includes procedures for irrigation during establishment and ongoing maintenance.	A level of resileicene e reached through maintenance of asset	Likely	Moderate	Medium	Low	Medium	**Low**		
29	Low precipitation		Decreased rainfall may increase soil shrinkage	Decreased average rainfall leads to drier soil conditions and soil shrinkage, causing damage to underground service infrastructure	Operation	Utilities	Shinkage and dessication considered in service infrastructure and foundation design however risk is low due to granular soils in local area.	Resilience achieved through design decisions.	Very unlikely	Moderate	Low	Low	Medium	**Low**		
30	Low precipitation		Increased number of dry days may lead to shrinkage of soil and drying out of vegetation	Extended periods of dry days may lead to a risk of spontaneous grassland fires, causing bulding damage	Operation	Buildings			Very unlikely	Major	Low	Medium	Medium	**Medium**		
31	Low precipitation		Increased number of dry days may lead to shrinkage of soil and drying out of vegetation	Extended periods of dry days may lead to a risk of spontaneous grassland fires, affecting safety to public.	Operation	Public realm			Very unlikely	Major	Low	Medium	Medium	**Medium**		
32	Extreme winds		Increased stress due to extreme wind	High winds lead to increased stress and damage to buildings, especially material fixtures, claddings and fasteners	Operation	Buildings	Current standards include sufficient allowance for changes in wind patterns	Resilience already accounted for in design standards	Very unlikely	Minor	Very Low	Medium	Medium	**Medium**		
33	Extreme winds		High winds can cause damage to vegetation	High winds lead to damage to vegetation and trees	Operation	Public realm	Site is exposed and strong winds currently occur, layout of buildings considers mitigation of wind impacts through creation of microclimates.	Resilience achieved through design decisions.	Likely	Minor	Medium	Medium	Medium	**Medium**		
34	Extreme winds		Increased stress due to extreme wind	High winds lead to increased stress and damage to above ground utility infrastructure	Operation	Utilities	Current standards include sufficient allowance for changes in wind patterns.	Resilience already accounted for in design standards	Very unlikely	Moderate	Low	Medium	Medium	**Medium**		

35	Extreme winds		High winds can cause greater movement of dust in the air	High winds leads to movement of dust from construction, which can harm the health of construction workers and the public.	Construction	Public realm			Very unlikely	Moderate	Low	High	Medium	**High**		
36	Lightning		Lightening effects can cause damage to vegetation	Increased lighting strikes lead to more frequent damage to trees	Operation	Public realm			Unlikely	Minor	Very Low	High	Medium	**High**		
37	Lightning		Lightening effects can cause damage to utilities	Increased lighting strikes lead to more frequent damage to above ground utility infrastructure, including overhead electricity transmission lines	Operation	Utilities	Considered in standard design of above ground utilities.	Resilience achieved through design decisions.	Very unlikely	Moderate	Low	High	Medium	**High**		
38	Lightning		Lightening effects can cause bulding damage	Increased lighting strikes lead to more damage, especially roofs, guttering and windows.	Operation	Buildings			Very unlikely	Moderate	Low	High	Medium	**High**		
39	Humidity		Higher temperatures means air can carry more water vapour, causing more humidity.	Increased humidity through warmer air causes mould, condensation and decreased thermal performance of buildings.	Operation	Buildings			As likely as not	Moderate	Medium	Medium	High	**High**		

Climate change risk assessment

Project

Timeframes

change these

Data from climate predictions

Examples in Grey

Risk ID	Climate hazard	Trend or Likelihood of Climate Hazard	Potential Climate Change Impact	Potential Climate Change Risk to Scheme	Construction/Operation Stage	Asset type	Existing or embedded mitigation measure	Result of mitigation measure on resilience	Hazard Impact			Uncertainty Level		Level of Uncertainty	Proposed additional resilience measure (only if Risk Rating = 'High' (4) or 'Very high' (5))	Reference documenting relevant mitigation
									Likelihood	Consequence	Risk rating	CC Projection	CC effect on asset			
1	High temperatures		Increased number of hot days may increase impact to staff	Increased heat stress for staff, particularly for outdoor construction and maintenance workers.	Construction and Operation	H&S	To be incorporated within proposed maintenance regimes. These can be reviewed regularly to ensure H&S requirements within Highways England are met	Resilience achieved through monitoring and maintenance of asset	Unlikely	Minor	Very Low	Low	Medium	**Low**		
2	High temperatures		Increased number of hot days may cause thermal expansion.	Increased risk of thermal expansion joints being pushed beyond their design capability, presenting a direct risk of damage to structures and assets (e.g. concrete joints).	Operation	Structures	TBC		Very unlikely	Major	Low	Low	Medium	**Low**		The need to increase design temperature ranges for bridge expansion joints to be further explored
3	High temperatures		Increased number of hot days may lead to shrinkage of soil and drying out of vegetation.	Extended periods of hot, dry weather may lead to a risk of spontaneous grassland fires in vicinity of the route, affecting safety on the road.	Operation	Road Surface	Risk to be sufficiently mitigated through standard emergency procedures	Resilience achieved through standard measures already in place	Unlikely	Moderate	Low	Medium	High	**High**		
4	High temperatures		Increase in number of hot days may impact the road surface increasing the danger to road users.	Asphalt surface may exhibit permanent deformation in long periods of hot, sunny conditions.	Operation	Road Surface	This risk will be managed through the selection of suitable road surface material as well as through the proposed maintenance regimes for road surface.	Resilience achieved through design and maintenance	Likely	Minor	Medium	Medium	High	**High**		Potential to use asphalt with different specifications relating to temperature may be explored
5	High temperatures		Increase in number of hot days may impact the road surface increasing the danger to road users.	High temperatures increase the risk of surfacing rutting leading to water ponding in the ruts. Higher temperatures also increase the risk of reduced skid resistance due to fatting and chipping embedment. This increase the risk of vehicle accidents.	Operation	Road Surface	This risk will be managed through the selection of suitable road surface material as well as through the proposed maintenance regimes for road surface.	Resilience achieved through design and maintenance	Unlikely	Major	Medium	Medium	Medium	**Medium**		
6	High temperatures		Increased number of hot days may impact the bitumen binder hardening rate.	Inability to flex under traffic loads. Increased risk of road surface cracking and fretting with age.	Operation	Road Surface	This risk will be managed through the proposed maintenance regimes.	Resilience achieved through maintenance of the asset	As likely as not	Minor	Low	Medium	High	**High**		
7	High temperatures		Increased number of hot days may impact the bitumen binder hardening rate.	Risk of being unable to lay road surface layers in hot weather.	Construction	Road Surface	Risk to be mitigated by following procedures detailed in the outline EMP	Resilience achieved through management plan monitoring environmental impacts	Unlikely	Minor	Very Low	Low	Medium	**Low**		
8	High temperatures		Increased impact of diesel spills.	Decreased viscosity in head leads to greater spreading of diesel in a smaller timeframe. Higher temperatures and increased number of hot, dry days increase the likelihood of ignition of this diesel leading to road and forest fires.	Operation	Road Surface	Risk to be sufficiently mitigated through proposed maintenance procedures	Resilience achieved through maintenance of the asset	Unlikely	Major	Medium	Medium	High	**High**		
9	High temperatures		Increased summer temperatures may impact on performance of electrical equipment.	Reduced efficiency and lifespan of LED luminaires.	Operation	Electrical Equipment	The impacts associated with increased ambient temperature to be absorbed within current maintenance procedures. Design life 100,000hours (~25 years).	Resilience already accounted for.	As likely as not	Minor	Low	Low	Medium	**Low**		
10	Low temperatures		Impact of extreme cold weather on equipment and infrastructure.	Change of risk of freeze-thaw occurring to road infrastructure and structures. (The mark against noise barriers is only applicable if not in the form of bunds- still not decided)	Operation	Structures	To be mitigated by an appropriate choice of concrete mix.	Resilience achieved through design	As likely as not	Minor	Low	Medium	High	**High**		
11	Low temperatures		Impact of extreme cold weather on staff health.	Possible negative health implications for staff.	Construction and Operation	H&S	For construction: to be mitigated as described in the outline EMP. For operation: To be incorporated within proposed maintenance regimes. These can be reviewed regularly to ensure H&S requirements within Highways England are met	Resilience achieved through maintenance	Very unlikely	Minor	Very Low	Medium	Low	**Low**		
12	Low temperatures		Impact of extreme cold weather on equipment and infrastructure.	General risk of freezing of electrical equipment.	Operation	Electrical Equipment	Accounted for in the choice of appropriate electrical equipment	Resilience achieved through design	Very unlikely	Minor	Very Low	Medium	Medium	**Medium**		
13	Low temperatures		Potential decrease in ice on road surfaces from reduced cold days.	Opportunity: Reduced grit/salt used during winter, reducing deterioration of pavement.	Operation	Road Surface	Number of frost days is projected to decrease. However, cold spells are expected to be more severe and so it is recommended that preparedness levels remain unchanged									
14	Low temperatures		Increase in ice on road surfaces.	Increased risk of skidding for road users due to ice/snow on road - safety concerns + damage to road infrastructure.	Operation	Road Surface	It is recommended that preparedness levels remain unchanged.	Resilience achieved through current methods in place.	Very unlikely	Major	Low	Medium	Low	**Low**		
15	Low temperatures		Increase in ice on road surfaces.	Increase in slips trips and falls and construction /maintenance worker injury.	Construction and Operation	H&S	For construction: to be mitigated as described in the outline EMP. For operation: To be incorporated within proposed maintenance regimes. These can be reviewed regularly to ensure H&S requirements within Highways England are met	Resilience achieved through maintenance	Very unlikely	Minor	Very Low	Medium	Low	**Low**		
16	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Flooding of road surface.	Operation	Drainage	Attenuation ponds designed for 1/100 year event +20% for climate change (check performed for 40% increase) Climate change allowance in critical drainage areas increased to +40%	Resilience achieved through design	Very unlikely	Major	Low	Low	High	**Medium**		
17	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Flooding of access roads and/or road infrastructure.	Operation	Drainage	Attenuation ponds designed for 1/100 year event +20% for climate change (check performed for 40% increase) Climate change allowance in critical drainage areas increased to +40%	Resilience achieved through design	Very unlikely	Major	Low	Low	High	**Medium**		
18	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Increase risk of sewage overflow in floodwater causing damage and impacting health of maintenance workers.	Operation	Drainage	Attenuation ponds designed for 1/100 year event +20% for climate change (check performed for 40% increase) Climate change allowance in critical drainage areas increased to +40%	Resilience achieved through design	Very unlikely	Moderate	Low	Medium	High	**High**		
19	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Increased risk of scouring of culverts.	Operation	Drainage	Attenuation ponds designed for 1/100 year event +20% for climate change (check performed for 40% increase) Climate change allowance in critical drainage areas increased to +40%	Resilience achieved through design	Unlikely	Minor	Very Low	Medium	Medium	**Medium**		
20	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Flooding causing damage to fibre optic cables running near to site.	Operation	Drainage	Attenuation ponds designed for 1/100 year event +20% for climate change (check performed for 40% increase) Climate change allowance in critical drainage areas increased to +40%	Resilience achieved through design	Very unlikely	Minimal	Very Low	Medium	High	**High**		
21	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Increased pore water pressure in embankments/cuttings.	Construction and Operation	Earthworks	To be mitigated through drainage design Risk likely to be absorbed by conservative assumptions made during design	Resilience achieved through design	Very unlikely	Catastrophic	Medium	Low	Medium	**Low**		
22	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Increased erosion at toe of embankment.	Operation	Earthworks	To be mitigated through drainage design Risk likely to be absorbed by conservative assumptions made during design	Resilience achieved through design	Unlikely	Catastrophic	Medium	Low	Medium	**Low**		
23	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Water ingress to critical construction equipment.	Construction	Drainage	Drainage on site to be suitably managed, as specified within the outline EMP	Resilience achieved through management plan monitoring environmental impacts	Very unlikely	Minor	Very Low	Low	Low	**Low**		
24	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Water ingress to signalling, lighting and other operational electrical equipment.	Operation	Electrical Equipment	Water tight cables housed in plastic ducts. No water ingress to underground cables.	Resilience achieved through design	Very unlikely	Minor	Very Low	Low	Low	**Low**		
25	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Change in ground water level affecting earth pressures and foundation settlement causing possible large ground movement.	Operation	Drainage	To be mitigated through drainage design Risk likely to be absorbed by conservative assumptions made during design	Resilience achieved through design	Very unlikely	Catastrophic	Medium	Low	Medium	**Low**		
26	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Increased risk of debris deposit from water seeping up to the surface through the pavement e.g. calcium sulphate leading to reduced skid resistance.	Operation	Road Surface	Weather and weather effects on traffic considered within pavement design	Resilience achieved through design	Unlikely	Moderate	Low	Low	Low	**Low**		
27	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Construction site flooding during construction phase, excavations flooded and site roads impassable. Safety risk of slips, trips and falls to construction workers.	Construction	Drainage	Drainage on site to be suitably managed, as specified within the outline EMP. H&S procedures to be further specified within the outline EMP	Resilience achieved through management plan monitoring environmental impacts	Unlikely	Moderate	Low	Low	Low	**Low**		
28	High precipitation		Increased risk of flooding from river/streams, surface and groundwater sources.	Increased ground water level in winter may lead to flooding of underpasses.	Operation	Drainage	To be mitigated through drainage design	Resilience achieved through design	Unlikely	Minor	Very Low	Low	Medium	**Low**		
29	High precipitation		Increased soil moisture levels.	Increased risk of earthworks failure and landslides. Exacerbated by variance between high and low precipitation events and soil moisture levels. (The mark against noise barriers assumes that they are in the form of bunds).	Construction and Operation	Earthworks	To be mitigated through geotechnical and drainage design Risk likely to be absorbed by conservative assumptions made during design	Resilience achieved through design	Unlikely	Catastrophic	Medium	Low	Medium	**Low**		

30	High precipitation		Increase likelihood of debris and sediment run-off.	Reduced capacity of attenuation ponds due to sediment build-up.	Operation	Drainage	Risk to be mitigated through the monitoring and maintenance procedures specified for the relevant attenuation ponds.	Resilience achieved through monitoring and maintenance of asset	As likely as not	Minor	Low	Medium	Medium	**Medium**		
31	High precipitation		Increase likelihood of debris and sediment run-off.	Increased risk of debris washing into drainage gulleys, blocking them. A blockage may result in flooding and resulting effects.	Operation	Drainage	Mitigated through drainage design and monitoring and maintenance procedures proposed for drainage systems	Resilience achieved through design and monitoring and maintenance of asset	Unlikely	Major	Medium	Medium	Medium	**Medium**		
32	High precipitation		Increase in number of wet days may impact the damage to road surface	Increase stripping rate of the road surfaces	Operation	Road Surface	This risk will be managed through the proposed maintenance regimes for road surface.	Resilience achieved through maintenance	Unlikely	Minor	Very Low	Medium	High	**High**		
33	High precipitation		Increase in number of wet days may impact the damage to road surface	Wetter surface may lead to reduced skid resistance	Operation	Road Surface	This risk will be managed through the selection of suitable road surface material as well as through the proposed maintenance regimes for road surface.	Resilience achieved through design and monitoring and maintenance of asset	Unlikely	Major	Medium	Low	Low	**Low**		
34	High precipitation		Increase in number of wet days may impact the damage to road surface	Increased likelihood of potholing, rutting and cracking from moisture entering and remaining in road surfaces.	Operation	Road Surface	This risk will be managed through the proposed maintenance regimes for road surface.	Resilience achieved through maintenance	Likely	Minor	Medium	Low	Low	**Low**		
35	High precipitation		Increased flow of groundwater	Increased flow of groundwater causing accelerated weathering effects, weakening the embankment	Operation	Earthworks	Risk likely to be absorbed by conservative assumptions made during design	Resilience achieved through design	Very unlikely	Major	Low	Medium	High	**High**		
36	Low precipitation		Increased risk of soil shrinkage around foundations of structures.	Potential risk of soil shrinkage impacting foundations, including signal gantries, lighting pylons, bridges, other structures. Possible ground movement (check differential settlement due to different types of foundations)	Operation	Earthworks	to be confirmed Risk likely to be absorbed by conservative assumptions made during design	Resilience achieved through design	Very unlikely	Major	Low	Medium	Medium	**Medium**		
37	Low precipitation		Dry weather for extended periods of time could lead to increased desiccation of soils.	Reduced slope stability and potential earthworks failure during or immediately after summer storm events falling on desiccated soils. (The mark against noise barriers assumes that they are in the form of bunds).	Construction and Operation	Earthworks	to be confirmed Risk likely to be absorbed by conservative assumptions made during design	Resilience achieved through design	Unlikely	Catastrophic	Medium	Medium	Medium	**Medium**		
38	Low precipitation		Dry weather for extended periods of time could lead to increased desiccation of soils.	Earthing and thermal/electrical conductivity issues for high voltage or dynamically loaded cables - in typical ground conditions (i.e. near surface geology and subsoil), ground resistance and electrical and thermal conductivity of earthing arrays and high voltage cables are controlled by a range of factors including the presence of moisture (% water saturation) and temperature. As ground moisture decreases, conductivity also decreases and ground 'resistance' therefore increases.	Operation	Earthworks	High voltage cables largely overhead - suspended on pylon.	Resilience achieved through current methods in place.	Very unlikely	Minor	Very Low	Low	Medium	**Low**		
39	Low precipitation		Reduced inflow into attenuation ponds.	Anaerobic conditions may occur, risking die back of sediment collecting species, reducing attenuation pools functional capacity.	Operation	Drainage	Risk to be mitigated through the monitoring and maintenance procedures specified for the relevant attenuation ponds.	Resilience achieved through monitoring and maintenance of asset	As likely as not	Minor	Low	Medium	High	**High**		
40	Extreme winds		Risk of windborne debris due to extreme winds.	Possible blockage of drainage systems due to obstructions and debris from domestic or third party objects.	Operation	Drainage	Mitigated through drainage design and monitoring and maintenance procedures proposed for drainage systems	Resilience achieved through design and monitoring and maintenance of asset	Very unlikely	Minor	Very Low	Medium	Medium	**Medium**		
41	Extreme winds		Risk of windborne debris due to extreme winds.	Increased risk of wind-blown debris on the road, affecting road safety.	Operation	Road Surface	To be mitigated through appropriate design for barriers (incl noise barriers), lighting columns and landscape	Resilience achieved through design	Unlikely	Major	Medium	High	Medium	**High**		
42	Extreme winds		Increase wind impacting construction activity.	Increase risk of wind interference with construction equipment and workers, particularly with temporary equipment.	Construction		to be mitigated as described in the outline EMP.	Resilience achieved through management plan monitoring environmental impacts	Unlikely	Major	Medium	High	High	**High**		
43	Extreme winds		Increased stress on proposed scheme infrastructure due to extreme winds.	Failure of or damage to assets as a result of changes in extreme winds.	Operation	Structures	Risk sufficiently mitigated within current design standards (structures, lighting columns, noise barriers)	Resilience achieved through current methods in place.	Unlikely	Major	Medium	High	Medium	**High**		
44	Extreme winds		Increased stress on electrical equipment due to extreme winds.	Failure of or damage to assets as a result of changes in extreme winds.	Operation	Electrical Equipment	Risk sufficiently mitigated within current design standards	Resilience achieved through current methods in place.	Unlikely	Moderate	Low	High	Medium	**High**		
45	Lightning		Increased risk of lightning strikes.	Indirect/ direct damage to roadside equipment lightning strikes damaging trees and vehicles.	Operation	Electrical Equipment	Surge protection only available for the LED luminaires locally, no plan for surge protection to the main electrical installation.	Resilience achieved through design	Unlikely	Moderate	Low	High	Medium	**High**		

Climate change risk assessment

Project

Timeframes

change these

Data from climate predictions

Examples in Grey

Risk ID	Climate hazard	Trend or Likelihood of Climate Hazard	Potential Climate Change Impact	Potential Climate Change Risk to Scheme	Construction/Operation Stage	Asset type	Existing or embedded mitigation measure	Result of mitigation measure on resilience	Hazard Impact			Uncertainty Level		Level of Uncertainty	Proposed additional resilience measure (only if Risk Rating = 'High' (4) or 'Very high' (5))	Reference documenting relevant mitigation
									Likelihood	Consequence	Risk rating	CC Projection	CC effect on asset			
1	High temperatures		Increased number of extremely hot days	Rail buckling and/or associated misalignment problems.	Operation	Rail Infrastructure	The design shall take into account climate change requirements for specific structure types including effects of increase in temperature. Further more heat watchmen will be deployed to look for risk signs and imposing restrictions. In addition, track is more likely to buckle when the ballast has been recently disturbed and so restrictions placed on track work in hot weather. Climate change allowances are also considered for steel material selection. Maintenence and monitoring measures will also be put in place with particular focus on preventing derailment due to a track fault.	Resilience achieved through design and monitoring and maintenance of asset	Very unlikely	Catastrophic	Medium	Low	Medium	**Low**		
2	High temperatures		Increased number of extremely hot days	Increased heat stress for passengers and staff on trains	Operation	Human Factors	*Trains will be air conditioned - but this is not being considered as part of the Hybrid Bill*		Unlikely	Minimal	Very Low	Low	Medium	**Low**		
3	High temperatures		Increased number of extremely hot days	Increased heat stress for staff, particularly for outdoor maintenance workers.	Construction and Operation	Human Factors	Risk for staff working indoors is mitigated by Buildings being designed to BREEAM "Excellent Rating" which includes appropriate climate change measures. During construction principle contractors being aware of and taking appropriate measures during extreme weather events.	Resilience achieved through management and monitoring	Unlikely	Minor	Very Low	Low	Medium	**Low**		
4	High temperatures		Increased number of extremely hot days	Increased heat stress for staff, particularly outdoor construction workers.	Operation	Human Factors	Risk of heat stress to staff during construction is mitigated by principle contractors being aware of and taking appropriate measures during extreme weather events. Plus H&S standards.	Resilience achieved through management and monitoring	Unlikely	Minor	Very Low	Low	Medium	**Low**		
5	High temperatures		Increased number of extremely hot days	Overhead line equipment (OLE) including overhead lines (OHL) and traction distribution sites (ATFS, ATS) may fail to operate properly under extreme heat resulting in a reduction in electrical loading capability, fail to operature properly or be damaged.	Operation	Mechanical & Electrical Equipment	Risk of overheating of OLE and OHL is mitigated by design to be resilient to CC using existing design standards.	Resilience achieved through current design methods in place.	Unlikely	Moderate	Low	Medium	Medium	**Medium**		
6	High temperatures		Increased number of extremely hot days	Increased risk of thermal expansion joints being pushed beyond their design capability, presenting a direct risk of damage to bridge structures and indirect of damage of other assets dependent on bridge .	Operation	Rail Infrastructure	The standard requires that climate change is incorporated in to bridge design, which consider a maximum shade air temperature of 40 degrees Celsius with an annual probability of being exceeded p of 0.0063, equivalent to 120 years design life.	Resilience achieved through design and monitoring and maintenance of asset	Unlikely	Major	Medium	Low	Medium	**Low**		
7	High temperatures		Increased number of extremely hot days	Impact of extreme hot weather could lead to increase in auxiliary power demand (cooling) on trains resulting in increase demands on traction power system above design basis, leading to impact on train mechanical performance and journey times and overloading of electrical equipment, cabling and conductors.	Operation	Mechanical & Electrical Equipment	*To be considered and addressed in future design stages*		As likely as not	Minor	Low	Medium	Medium	**Medium**		
8	High temperatures		Increasured number of extremely hot days may lead to shrinkage of soil and drying out of vegetation, especially in conjunction with decreases in groundwater level.	Planting failures may occur due to drought.	Operation		Removal of planting has deterimental impact on stability of embankments. Mitigated against in embankment standard. Constraints are also placed on high-water demand plants. Plant selection also takes into account CC. Furthermore green bridges will have appropriate measures put in place to ensure water retention accounting for climate change.	Resilience achieved through design and monitoring and maintenance of asset	Unlikely	Minimal	Very Low	Low	Medium	**Low**		
9	High temperatures		Increasured number of extremely hot days may lead to shrinkage of soil and drying out of vegetation, especially in conjunction with decreases in groundwater level.	Extended periods of hot days may lead to a risk of spontaneous grassland fires in vicinity of the route.	Operation	Rail Infrastructure	The risk of grassland fires in the Midlands:North West of England is very low. Therefore there are no explicit resilience measures put in place. However lineside vegetation species will be selected to be resilient to drought and appropriately managed and maintained.	Resilience achieved through selection in design	Very unlikely	Minor	Very Low	Medium	High	**High**		
10	Low temperatures		Impact of extreme cold weather on line equipment and infrastructure.	Overhead line equipment (OLE) including overhead lines (OHL) or aerial busbars/connections of outdoor switchgear at traction power distribution sites (ATFS, ATS etc) may fail may fail due to snow overloading. Also sensitive electronic equipment (protection, control etc) and mechanical 'operating mechanisms/moving parts/motors/solenoids' may fail to operate correctly due to low temperatures or freezing.	Operation	Mechanical & Electrical Equipment	Low temperature risks to OLE/OHL mitigated by X, Y, Z.... Asset is dessigned to be resilient to CC using existing design standards.	Resilience achieved through design	Unlikely	Moderate	Low	Low	Medium	**Low**		
11	Low temperatures		Impacts of extreme cold on train relability and operation.	Reliability of trains may reduce at low temperatures due to: Failure of train horns due to ice/snow accretion, Failure of sliding doors, couplers and pneumatic devices due to ice, snow and ice accretion reduces effectiveness of brakes, traction motor failures due to snow and/or water ingress, damage from snow and/or ice accretions being dislodged at speed. Freight trains more susceptible.	Operation	Rail Infrastructure	*Rolling stock not being considered as part of the Hybrid Bill*		Unlikely	Minor	Very Low	Low	Medium	**Low**		
12	Low temperatures		Impact of extreme cold weather on staff and passenger health.	Possible negative health implications for passengers and staff, disruption to service operation	Operation	Human Factors	tbc		Unlikely	Minimal	Very Low	Low	Medium	**Low**		
13	Low temperatures		Impact of extreme cold weather on staff health.	Possible negative health implications for staff, disruption to construction	Construction	Human Factors	Risk of heat stress to staff during construction is mitigated by principle contractors being aware of and taking appropriate measures during extreme weather events.	Resilience achieved through management and monitoring	Unlikely	Minimal	Very Low	Low	Medium	**Low**		
14	Low temperatures		Overall prevalance of cold conditions and snowfall, but cold weather events have the potential to be more extreme.	General risk of freezing of mechanical and electrical equipment	Operation	Mechanical & Electrical Equipment	Risk of mechanical and electrical equipment is mitigated through the Infrastructure maintenance strategy which includes preventative measures.	Resilience achieved through maintenance	Unlikely	Minimal	Very Low	Medium	Medium	**Medium**		
15	Low temperatures		Overall prevalance of cold conditions and snowfall, but cold weather events have the potential to be more extreme.	Increase risk of rail breaks due to extreme cold conditions.	Operation	Rail Infrastructure	The design shall take into account Climate change allowances for steel material selection. Maintenence and monitoring measures will also be put in place with particular focus on preventing derailment due to a track fault.	Resilience achieved through design and monitoring and maintenance of asset	Very unlikely	Catastrophic	Medium	Medium	Medium	**Medium**		
16	Low temperatures		Overall prevalance of cold conditions and snowfall, but cold weather events have the potential to be more extreme.	Impact of extreme cold weather could lead to increase in auxiliary power demand (heating) on trains resulting in increase demands on traction power system above design basis, leading to impact on train mechanical performance and journey times and overloading of electrical equipment, cabling and conductors.	Operation	Mechanical & Electrical Equipment	*To be considered and addressed in future design stages*		As likely as not	Minor	Low	Medium	Medium	**Medium**		
17	High precipitation		Increased risk of flooding from river, surface and groundwater sources.	Flooding of track.	Operation	Rail Infrastructure	Rail line is designed to an appropriate extreme rainfall event (1 in 100 + climate change) with additional freeboard allowance (1m). This will protect the railway infrastructure from floodwater ensuring that the line will remain operational or can restart without delay. Drainage will also include additional allowance for climate change. During operation regular maintenence strategies will be put in place to ensure continual operation of infrastructure.	Resilience achieved through design and maintenance	Unlikely	Major	Medium	Low	Low	**Low**		
18	High precipitation		Increased risk of flooding from river, surface and groundwater sources.	Flooding of tunnel portals	Operation	Rail Infrastructure			Unlikely	Major	Medium	Low	Medium	**Low**		
19	High precipitation		Increased risk of flooding from river, surface and groundwater sources.	Flooding of access roads and/or road infrastructure linked to HS2, such as access routes for HS2 staff and neighbouring landowners.	Operation	Rail Infrastructure	Access and maintenance routes are designed to 1 in 100 year + CC	Resilience achieved through design	Unlikely	Moderate	Low	Low	Medium	**Low**		
20	High precipitation		Increased risk of flooding from river, surface and groundwater sources.	Water ingress to critical equipment, including traction power distribution sites (ATFS, ATS), leading to signalling or other electronic equipment failures, requiring switchoff or, possibly causing damage.	Operation	Mechanical & Electrical Equipment	Automatic Transformer (Feeder) Stations (ATF(F)S) are essential in delivering traction power supply to the route. Where practical, ATFS/ATS will be located outside of EA flood zones. Where not practical, ATFS/ATSs will be located at flood level with sufficient freeboard. Tunnel Portals shall be protected by raising the entrance by 300mm above the 1 in 1000 year flood level from all sources without the need for intervention (passive provision).	Resilience achieved through design	Unlikely	Major	Medium	Low	Medium	**Low**		
21	High precipitation		Increased risk of flooding from river, surface and groundwater sources.	Construction site flooding during construction phase, excavations flooded and site roads impassable. Safety risk of slips, trips and falls to construction workers.	Construction	Human Factors	Flood risk during construction is mitigated by contractors paying due notice of extreme weather events and there impacts. Measures on site will also be put in place to prevent flooding.	Resilience achieved through monitoring	Unlikely	Minor	Very Low	Medium	Medium	**Medium**		
22	High precipitation		Increased risk of flooding from river, surface and groundwater sources.	Increased risk of scouring of bridge piers and abutments during periods of peak river flow.	Operation	Rail Infrastructure	Scouring risk is reduced through use of reinforced concrete to strengthen structure of abutments and piers. A remaining operational risk will remain as a result of scouring of river beds during peak river flow.	Resilience achieved through design	Unlikely	Major	Medium	Medium	Medium	**Medium**		

23	High precipitation		Increased soil moisture levels.	Increased risk of earthworks failure and landslides. Exacerbated by variance between high and low precipitation events and soil moisture levels.	Operation	Earthworks	Risk of earthworks failure mitigated by drainage design to be resilient to 1/1000 year event and be designed to a 1/100year + CC event. This is coupled with appropriate material and planting selction to ensure embankment stability as well as continued maintenence of embankments and drainage.	Resilience achieved through design and maintenance	Unlikely	Major	Medium	Low	Medium	**Low**		
24	Low precipitation		Increased risk of soil shrinkage around foundations of structures.	Movement of OHL equipment due to soil shrinkage.	Operation	Earthworks	Risk of earthworks shrinkage mitigated by appropriate material and planting selction to ensure embankment stability as well as continued maintenence of embankments and drainage.	Resilience achieved through design and maintenance	Very unlikely	Major	Low	Medium	Medium	**Medium**		
25	Low precipitation		Dry weather for extended periods of time could lead to increased dessication of soils.	Lowered slope stability and potential earthworks failure during or immediately after summer storm events falling on dessicated soils.	Operation	Earthworks	Risk of lowered slope stability is mitigated by limiting the gradient of slopes as well as appropriate material and planting selction to ensure embankment stability as well as continued maintenence of embankments and drainage. Planting will be to appropriate depths to prevent desication of soils.	Resilience achieved through design and maintenance	Unlikely	Major	Medium	Medium	Medium	**Medium**		
26	Low precipitation		Dry weather for extended periods of time could lead to increased dessication of soils.	Earthing and thermal/electrical conductivity issues for high voltage or dynamically loaded cables - in typical ground conditions (i.e. near surface geology and subsoil), ground resistance and electrical and thermal conductivity of earthing arrays and high voltage cables are controlled by a range of factors including the presence of moisture (% water saturation) and temperature. As ground moisture decreases, conductivity also decreases and ground 'resistance' therefore increases.	Operation	Earthworks	Thermal / electrical conductivity risks mitigated by protection of earthworks against any accelerated degredation. Appropriate maintenance of earthworks also enables the train service to operate under all environmental conditions thoughout their life cycle.	Resilience achieved through maintenance	Very unlikely	Moderate	Low	Medium	Medium	**Medium**		
27	Low precipitation		Dry weather for extended periods of time could lead to increased dessication of soils.	Impact on the effectiveness of earthing systems of traction power distribution sites (ATFS, ATS etc), leading to possibility of dangerous Earth Potential Rise and touch voltages. Similarly on effectiveness of OCS foundation earthing leading to possibility of dangerous trackside touch voltages.	Operation	Earthworks	Thermal / electrical conductivity risks mitigated by protection of earthworks against any accelerated degredation. Appropriate maintenance of earthworks also enables the train service to operate under all environmental conditions thoughout their life cycle.	Resilience achieved through maintenance	Very unlikely	Major	Low	Medium	High	**High**		
28	Extreme winds		Risk of windborne debris due to extreme winds.	Possible blockage of railway drainage systems due to obstructions and debris from domestic or third party objects, as well as potentially landing on track and causing damage to OHL.	Operation	Drainage	Appropriate monioring and inspections will be carried out with increased inspections and remote monitoring for high risk areas. Specific tree will be avoided within the HS2 line side boundary to minimise the risk associated with leaf fall and high winds. Debris can be carried by watercourses during floods. Flood Risk TN details that a min of 600mm above the 1/100 plus CC should apply to the lowest part of the bridge soffit levels to account for this.	Resilience achieved through design selection and monitoring and maintenance of asset	Unlikely	Minor	Very Low	Medium	Medium	**Medium**		
29	Extreme winds		Increased stress on trees due to extreme winds leads to risk of trees/branches falling and changes to leaf fall patterns. Exacerbated by other factors e.g. seasonal precipitation and temperature patterns.	Obstructions and debris on track and damage to OHL from fallen trees / branches.	Operation	Rail Infrastructure	Appropriate monioring and inspections will be carried out with increased inspections and remote monitoring for high risk areas. Specific tree will be avoided within the HS2 line side boundary to minimise the risk associated with leaf fall and high winds.	Resilience achieved through design selection and monitoring and maintenance of asset	Unlikely	Minor	Very Low	Medium	Medium	**Medium**		
30	Extreme winds		Increased stress on trees due to extreme winds leads to risk of trees/branches falling and changes to leaf fall patterns. Exacerbated by other factors e.g. seasonal precipitation and temperature patterns.	Increased disruption from autumn leaf fall or changed temporal patterns of leaf fall.	Operation	Rail Infrastructure	Appropriate monioring and inspections will be carried out with increased inspections and remote monitoring for high risk areas. Specific tree will be avoided within the HS2 line side boundary to minimise the risk associated with leaf fall and high winds.	Resilience achieved through design selection and monitoring and maintenance of asset	Very unlikely	Minor	Very Low	Medium	High	**High**		
31	Extreme winds		Increased stress on trees due to extreme winds leads to risk of trees/branches falling and changes to leaf fall patterns. Exacerbated by other factors e.g. seasonal precipitation and temperature patterns.	Wind interference with construction equipment and workers, particularly with temporary equipment.	Construction	Mechanical & Electrical Equipment	Changes to long-term seasonal averages are not considered to be as significant by 2020s and therefore specific resilience measures to address these changes are not required during the construction phase.	Resilience measures not required	Very unlikely	Minimal	Very Low	High	High	**High**		
32	Extreme winds		Increased stress on Proposed Scheme infrastructure due to extreme winds.	Failure of or damage to parts of structure or infrastructure as a result of changes in extreme winds. Noise barriers and fencing are likely to be most at risk.	Operation	Rail Infrastructure	Has liarsay any relevant wind loading sensitivity structures in Phase 2a are deemed not to be sensitive to wind loading as there are no slender/suspension bridge type of structures. Also inputs of HS2 without clearly defined earthworks	Resilience measures not required	Very unlikely	Minor	Very Low	Medium	Medium	**Medium**		
33	Extreme winds		Increased stress on Proposed Scheme infrastructure due to extreme winds.	Failure of or damage to electrical and mechanical equipment including aerial busbars/connections of outdoor switchgear at traction power distribution sites (ATFS, ATS etc) may fail or be damaged	Operation	Mechanical & Electrical Equipment	Due to the high uncertainty in projection of wind events assets will be designed to existing standards, as climate change is unlikely to increase the peak high wind event.	Current resilience measures sufficient	Unlikely	Minor	Very Low	High	High	**High**		
34	Lightning		Increased risk of lightning strikes.	Indirect damage to buildings, structures, lineside equipment and equipment and cabling traction power distribution sites from lightning strikes damaging trees.	Operation	Rail Infrastructure	Risk of damage to assets is partially mitigated by if vegetation should be struck by lightning trees should not fall onto route of train. This is the primary risk for this hazard.		Very unlikely	Moderate	Low	High	Medium	**High**		
35	Lightning		Increased risk of lightning strikes.	Direct damage to buildings, structures, lineside equipment and equipment and cabling traction power distribution sites from lightning strikes.	Operation	Rail Infrastructure	To be addressed during further design stages.	Resilience achieved through design and maintenance	Unlikely	Moderate	Low	High	Medium	**High**		
36	Lightning		Increased risk of lightning strikes.	Safety risk to construction equipment and workers.	Construction	Human Factors	Risk of safety risk to construction workers due to lightning is mitigated by lead contractors taking appropriate measures to manage extreme weather events		Very unlikely	Major	Low	High	Medium	**High**		
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Climate change risk assessment

Project

Timeframes

Data from climate predictions

change these

Examples in Grey

Risk ID	Climate hazard	Trend or Likelihood of Climate Hazard	Potential Climate Change Impact	Potential Climate Change Risk to Scheme	Construction/Operation Stage	Asset type	Existing or embedded mitigation measure	Result of mitigation measure on resilience	Hazard Impact			Uncertainty Level		Level of Uncertainty	Proposed additional resilience measure (only if Risk Rating = 'High' (4) or 'Very high' (5))	Reference documenting relevant mitigation
									Likelihood	Consequence	Risk rating	CC Projection	CC effect on asset			
1	High temperatures		Increased number of extremely hot days.	Increased heat stress for passengers and staff during operation of the airport; negative impacts on passenger experience.	Operation	Airport Operation	Building air conditioning systems; introduction of new technologies to reduce manual handling activities, onsite medical and occupational health facilities (see risk ID CCA 24).	Resilience achieved through equipment selection and monitoring	Unlikely	Minor	Very Low	Low	Medium	**Low**	No additional resilience measures required.	
2	High temperatures		Increased number of extremely hot days.	Sensitive electronic equipment and mechanical operating mechanisms may fail to operate correctly due to high temperatures.	Operation	Electronic Equipment	No current measures identified relating to resilience of electronic and mechanical systems to prolonged periods of high temperatures.		Very unlikely	Major	Low	Low	High	**Medium**	Recommend that STAL review and ensure robustness of electronic and mechanical systems to future temperature changes.	
3	High temperatures		Increased number of extremely hot days.	Possible increase in number of days outside the normally acceptable range of conditions for cooling systems.	Operation	Electronic Equipment	HVAC systems and controls, building management system, temporary spot cooling (fans) if needed, monitoring of temperatures in buildings (see risk ID CCA26).	Resilience achieved through equipment selection and monitoring	Very unlikely	Minor	Very Low	Low	Medium	**Low**	Recommend that STAL review temperature thresholds for cooling systems to ensure effective and efficient provision of cooling with increased passengers and higher temperatures in future.	
4	High temperatures		Increased number of extremely hot days.	Flashpoint of aviation fuel exceeded on hot days, leading to delays in re-fuelling procedures.	Operation	Flights	Airside fuelling operations in line with Civil Aviation Publication (CAP) 748[i] (see risk ID CCA19).	Current resilience method sufficient	Unlikely	Moderate	Low	Low	Low	**Low**	No additional resilience measures required.	
5	High temperatures		Increased number of extremely hot days.	Possible increase in occurrence of days outside the acceptable range of temperatures affects aircraft and their utilisation schedule, due to air pressure changes affecting maximum take-off weight capacity.	Operation	Flights	Measures relating to allowances in maximum take-off weight and maximum plane operating temperature are usually set by airline operators; recommend STAL review these.		Unlikely	Moderate	Low	Low	Medium	**Low**	Recommend that STAL collaboratively review airline operators' allowances for maximum take-off weight and maximum plane operating temperatures to determine they are within tolerance of extreme hot day occurrences.	
6	Low temperatures		Extreme cold weather.	Sensitive electronic equipment and mechanical operating mechanisms may fail to operate correctly due to low temperatures or freezing	Operation	Electronic Equipment	Annual review of winter response and contingency plans, regular inspections and rapid maintenance response (see risk ID CCA09).	Resilience achieved through monitoring	Unlikely	Catastrophic	Medium	Low	Medium	**Low**	No additional resilience measures required.	
7	Low temperatures		Extreme cold weather.	Reliability of journeys may reduce at low temperatures due to cracking of pavement surfaces and snow/ice accretion on aircraft and runways/airfield pavements causing delays.	Operation	Airport Infrastructure	Annual review of winter response, snow contingency plans, de-icing procedures; new snow clearing equipment purchased in 2015/16 (see risk ID CCA09).	Resilience achieved through monitoring and emergency planning	Unlikely	Moderate	Low	Low	Medium	**Low**	No additional resilience measures required.	
8	Low temperatures		Extreme cold weather.	Possible negative health implications for passengers and staff, disruption to service operation.	Operation	Airport Operation	Disruption contingency plans, diversification of surface access toward public transport, HVAC systems and controls, onsite medical staff (see risk IDs CCA12 and CCA26).	Resilience achieved through monitoring and emergency planning	Unlikely	Minor	Very Low	Low	Low	**Low**	No additional resilience measures required.	
9	Low temperatures		Extreme cold weather.	Possible increase in number of days outside the normally acceptable range of conditions for heating systems and increased risk of HVAC failure.	Operation	Electronic Equipment	Annual review of winter response and contingency plans, regular inspections and rapid maintenance response (see risk ID CCA09). HVAC systems and controls, building management system, monitoring of temperatures in buildings (see risk ID CCA26).	Resilience achieved through monitoring and emergency planning	Unlikely	Minor	Very Low	Low	Low	**Low**	No additional resilience measures required.	
10	High precipitation		Increased frequency of flooding from river, surface and groundwater sources.	Flooding of infrastructure during operation: inundation of airfield, airport building basements and sub-structures, utility cables/tunnels	Operation	Airport Infrastructure	A Flood Risk Assessment is currently being carried out in accordance with Climate Change Adaptation Progress Report2 (see risk ID CCA15). The results are reported in an Appendix to the ES.		Very unlikely	Catastrophic	Medium	Low	Medium	**Low**	Continue to monitor extreme precipitation events on airport infrastructure including balancing pond system. Action plan to be put in place where capacity of balancing pond system is exceeded.	
11	High precipitation		Increased frequency of flooding from river, surface and groundwater sources.	Flash flooding, erosion/scouring of embankment areas, ground destabilisation and possible weakening of foundations.	Construction and Operation	Earthworks	A Flood Risk Assessment is currently being carried out in accordance with Climate Change Adaptation Progress Report2 (see risk ID CCA15). The results are reported in an Appendix to the ES.		Very unlikely	Catastrophic	Medium	Low	Medium	**Low**	Continue to monitor extreme precipitation events on airport infrastructure including balancing pond system. Action plan to be put in place where capacity of balancing pond system is exceeded.	
12	High precipitation		Increased frequency of flooding from river, surface and groundwater sources.	Flooding of infrastructure connecting to the airport during operation: inundation of access roads and railways. Effects of infrastructure interdependencies.	Operation	Airport Infrastructure	Interdependencies not currently addressed in CCARP.		As likely as not	Minor	Low	Low	Medium	**Low**	Recommend risk assessment of interdependencies as suggested by CCC4.	
13	High precipitation		Increased soil moisture levels.	Increased intensity of rainfall may increase risk of earthworks failure and landslides, saturation of sub-grade pavement layers and degradation.	Construction and Operation	Earthworks	Regular inspections, rapid maintenance response, regular surface relaying (see risk ID CCA25). Increased monitoring including weather warnings, emergency contingencies for areas affected by flooding and water ingress, ongoing monitoring and modelling dialogue with Environment Agency and Affinity Water (see risk ID CCA16).	Resilience achieved through monitoring and emergency planning	Unlikely	Catastrophic	Medium	Low	Medium	**Low**	No additional resilience measures required.	
14	Low precipitation		Increased risk of soil shrinkage around foundation of structures.	Movement of shallow foundations.	Construction and Operation	Earthworks	Regular inspections, rapid maintenance response, regular surface relaying (see risk ID CCA25). Increased monitoring including weather warnings.	Resilience achieved through monitoring and emergency planning	Very unlikely	Catastrophic	Medium	Low	Medium	**Low**	No additional resilience measures required.	
15	Low precipitation		Increased desiccation of soils.	Increased slope stability, but potential earthworks failure after summer storm events on desiccation-cracked soils.	Construction and Operation	Earthworks	Regular inspections, rapid maintenance response, regular surface relaying, surfaces defined by detailed design standards based on current best practice (see risk ID CCA25).	Resilience achieved through monitoring and emergency planning	Unlikely	Catastrophic	Medium	Low	Medium	**Low**	No additional resilience measures required.	
16	Extreme winds		Risk of windborne debris due to strong winds.	Possible debris on runways and other airport infrastructure causing delays (foreign object debris).	Operation	Airport Infrastructure	Regular inspection and contingency plans (see risk ID CCA14).		Unlikely	Moderate	Low	Low	Low	**Low**	No additional resilience measures required.	
17	Extreme winds		Risk of windborne debris due to strong winds.	Vegetation fall due to strong winds leading to road and rail disruption	Operation	Airport Infrastructure	Regular inspection and contingency plans (see risk ID CCA14). Interdependencies not currently addressed in CCARP.	Resilience achieved through monitoring and emergency planning	Unlikely	Moderate	Low	Low	Medium	**Low**	Recommend risk assessment of interdependencies as suggested by CCC4.	
18	Extreme winds		Increased stress on infrastructure and assets due to strong winds.	Failure or damage to parts of structure or infrastructure as a result of changes in strong winds and gustiness.	Operation	Airport Infrastructure	Reparation programme, electrical resilience strategy under development, design standards, regular inspections and maintenance as needed, operational guidance for airside staff in strong winds (see risk IDs CCA04 and CCA14).	Resilience achieved through monitoring and maintenance	Unlikely	Major	Medium	Low	Medium	**Low**	No additional resilience measures required.	
19	Extreme winds		Increased stress on infrastructure and assets due to strong winds.	Change to prevailing wind direction and vortex effect may affect runway utilisation and schedules according to traffic flow sequencing and delay recovery to the flight schedule, including landing movement rates, interference with aircraft landing and take-offs.	Operation	Flights	Air Traffic Control procedures e.g. separation distances, contingency plans for disruption (see risk IDs CCA05 and CCA06).	Current resilience measures in place, with emegency planning	Very unlikely	Major	Low	Medium	High	**High**	No additional resilience measures required.	
20	Extreme winds		Cross-wind speeds exceed limits for take-off and landing.	Aircrafts not permitted to land or take off, causing delays.	Operation	Flights	Air Traffic Control procedures e.g. separation distances, contingency plans for disruption (see risk IDs CCA05 and CCA06).	Current resilience measures in place, with emegency planning	Likely	Moderate	Medium	Low	Low	**Low**	Check cross-wind speed limits with airline operators and assess risks using historical and projections data.	
21	Lightning		Increased risk of lightning strikes.	Indirect and direct damage to buildings, infrastructure, aircraft, equipment from lightning strikes.	Operation	Airport Infrastructure	Suspension of refuelling, dual feed electricity supply, monitoring and weather warnings, electrical resilience strategy under development, power outage contingencies (see risk ID CCA07).	Resilience achieved through monitoring and maintenance	Very unlikely	Major	Low	Medium	Medium	**Medium**	No additional resilience measures required.	
22	Lightning		Increased risk of lightning strikes.	Suspension of activities on the ramp by ground handling agents, delaying the service and turnaround times for aircraft and stressing terminal/gatehouses.	Operation	Flights	Suspension of refuelling, dual feed electricity supply, monitoring and weather warnings, electrical resilience strategy under development, power outage contingencies (see risk ID CCA07).	Resilience achieved through monitoring and maintenance	Unlikely	Major	Medium	Medium	Medium	**Medium**	Recommend close monitoring of lightning and thunderstorm events.	
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Likelihood Rating

Level	Descriptor	Description
A	**Very unlikely**	Event only occurs in exceptional circumstances and would not be expected to occur in the lifetime of the development
B	**Unlikely**	Based on the current design, engineering and maintenance standards, the event is not excpected to occur more than once during the lifetime of the development
C	**As likely as not**	Event may occur at least once during the lifetime of the development
D	**Likely**	Event is expected to occur several times during the lifetime of the development
E	**Very likely**	Event is expected to occur many times during the lifetime of the development

Consequence Rating

Level	Descriptor	Disruption	Public Perception
1	**Minimal**	Minpr service disruption within a single day <30 mins	Short-term adverse local stakeholder reaction
2	**Minor**	Minor service disruption for multiple days or delays up to 2h on a single day.	Adverse local media reports over sustained period; localised stakeholder concern.
3	**Moderate**	Service delays of up to 2h for multiple days or major delays (>2h) in a single day	Significant local and /or regional reports including social media. National media interest creating public concern
4	**Major**	Service closed for 1 day or major delays for multiple days	Negative national reporting and public disputes with key stakeholders, utility companies or other government agencies such as the Environment Agency.
5	**Catastrophic**	Service closed for multiple days	Extensive and prolonged negative reporting nationally and or public disputes with key stakeholders.

Risk Rating

	1	2
	Minimal	**Minor**

Likelihood	A	Very Likely	Medium	Medium
	B	Likely	Low	Medium
	C	As Likely as Not	Low	Low
	D	Unlikely	Very Low	Very Low
	E	Very unlikely	Very Low	Very Low

Level of Uncertainty

Uncertainity Level - Climate Change Predicition

Level	Descriptor	Consequence
A	Low	>66% probability of climate change hazard occuring
B	Medium	33-66% probability of climate change hazard occuring
C	High	<33% probability of climate change hazard occuring

Uncertainity Level - Effect of Climate Change on Asset

Level	Descriptor	Consequence
1	Low	Climate Change event expected to impact scheme as described.
2	Medium	Climate Change event may impact scheme as described.
3	High	Climate Change event not expected to impact scheme as described.

			Uncertainty Level - Effects of Climate Change	
			1	2
Uncerainty Level - Climate Change Prediction			Low	Medium
	A	Low	Low	Low
	B	Medium	Low	Medium
	C	High	Medium	High

Financial	Safety	Damage
Insignificant financial loss.	Minor harm or near miss -no adverse human health effects or complaints.	No damage to assets
Additional operational costs. Minor financial loss.	Lost time injury or medical treatment, short term impact on persons affected	No permanent damage. Some minor restoration work required.
Moderate financial loss.	Long-term injury or illness, porlonged hospitalisation or inability to work	Widespread damage and loss of service. Damage recoverable by maintenance and minor repair. Partial loss of local infrastructure.
Major financial loss.	Single fatality/ multiple long-term injuries-emergency response	Extensive damage requiring extensive repair.
Significantly high financial loss.	Multiple fatalities - emergency response	Permanent damage and/or loss of service Retreat and translocation of development.

Consequence

3	4	5
Moderate	**Major**	**Catastrophic**

High	Very High	Very High
Medium	Very High	Very High
Medium	High	High
Low	Medium	Medium
Low	Low	Medium

on Asset

3

High

Medium
High
High

Take highest

Climate change risk identification

Project

Risk identification - resilience assessment		
	Mixed-use development Road Rail Airport	
Climate hazard + likelihood of changes	*High temperatures*	Increase in mean daily temperatures in the summer and winter, increase in the number of hot days (days when daily mean temperature is >25°C) and increased insolation
	Low temperatures	Decrease in the number of frost days (days when daily minimum temperature <0°C)
	High precipitation	Increase in mean daily rainfall in the winter, increase in the number of days with heavy rain
	Low precipitation	Decrease in mean daily rainfall in the summer, increase in the annual number of dry spells
	Extreme winds	Increase in extreme wind events
	Lightning	Increase in the number of lighting days, particularly in Autumn
	Humidity	
	Insolation	

Construction	Operation	Construction and Operation	
Asset type			
Buildings	Traffic and transport	Public realm	Utilities
Structures	Drainage	Road Surface	Electrical Equipment
Drainage	Earthworks	Rail Infrastructure	Human Factors
Airport Infrastructure	Electronic Equipment	Flights	Airport Operation

H&S

Mechanical &
Electrical Equipment

Earthworks

Earthworks

Appendix 15C

ICCI Assessment

Version 1.0 February 2019

User note for in-combination climate impacts (ICCI) spreadsheet

File:

ICCI user note for technical specialists and EIA coordinators.pdf

Location:

\\Global.arup.com\london\ATG\Jobs\Climate Change Group Data\06- Technical\EIA ICCI and CCR tools\ICCI\Master ICCI tool\

How to assess ICCIs using this spreadsheet:

1. Navigate to the relevant technical discipline tab at the bottom of the spreadsheet;
2. Review the list of potential impacts that have been identified from previous EIAs for your topic, in the context of the future baseline climate (defined by the climate change team) and the Proposed Development, and delete those not relevant;
3. Add any additional potential impacts to the bottom of the spreadsheet and email the climate change team details of this so that the master spreadsheet can be updated;
4. Brainstorm additional mitigation measures to address any impacts that you believe may be significant via workshops, other projects, etc.
5. Consider if the new mitigation measures proposed would reduce the significance of the remaining significant impacts. If they do, then delete the effect. The spreadsheet could be used as an appendix to the technical chapter.
6. Write a short summary paragraph in your chapter acknowledging that ICCIs were assessed. This should list all impacts that are considered to be significant.

Note: Example sentences have been provided for grey tabs. ICCIs for these topic areas have not been assessed in previous EIAs. This is a work in progress and we welcome any thoughts for developing the content in this spreadsheet.

Agriculture, forestry and soils

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
Soils	Disruption to soil, including removal and reinstatement	Construction		Drier/drought conditions	The quality and capability of soils if effected, potential risk to harvest and increased risk of soil erosion	No	Drier/drought conditions may reduce the quality of the soils and make it more difficult to reinstate soils to their previous condition	Not Significant	To mitigate the permanent effect from construction plus climate change impact there is the potential for the creation of deeper soil profiles or more moisture retentive textures to mitigate longer term drought effects on restored soils. The current good practice is to separate different soil types during the restoration process, however this measure may not be sufficient following any potential CC impacts. To combat this, soil types could be mixed during the restoration process. Future measures and monitoring: Soil moisture and texture to be monitored. A land/soil management guidance document could be produced and provided to aid with management of the soil.
				Increase in frequency and intensity of heavy rainfall events/ flooding	Increased loss of soil	No	For areas already affected by flooding it is unlikely that increased flooding will enhance soil erosion because good practice techniques are in place for handling the soil during construction. In additon, mitigation measures are already in place; including the creation of suitable well-drained landforms, installation of field drains and borrow pits to minimise any potential flood risk. The potential for soil loss in areas subject to new flood risk is likely however the soils have been designed to retain more water and therefore soil erosion from potential flood risk is considered to be low	Not Significant	Potential for land/soil management guidance document to be produced and provided to landowners/farmers when they retain ownership of the land following the 5 year after care period
				Increase in frequency and intensity of heavy rainfall events/ flooding	Increase area of lower qualit	No	The potential for soil quality in areas with medium to poor quality land that is subject to new flood risk is likely. Wetter soils may be less biologically active therefore reducing soil quality and functionality	Not Significant	Potential need for creation / installation of measures to mitigate areas subject to new flood risk. A land/soil management guidance document could be produced and provided to aid with management of the soil on poor/medium land quality when handed back to farmers/landowners.

				Increase in frequency and intensity of heavy rainfall events/ flooding	Increased erosion	No	Increased erosion risk is likely due to more intense rainfall. It is of low consequence on land, which will remain in HS2 ownership following the 5yr aftercare period, because HS2 have produced a proposed planting strategy. However, there is a high consequence on land handed back to farmers, following the 5yr aftercare period. As a result no long term mitigation measures are to be enforced on this land and it may therefore more subject to increased erosion	Not Significant	No addition mitigation measures required because the HS2 Landscape maintenance, management and monitoring plan TS provides details on how manage the soil in the longer term. Potential for land/soil management guidance document to be produced and provided to landowners/farmers when they retain ownership of the land following the 5 year after care period
				Increased wind speed	Increased loss of soil	No	There is considerable uncertainty in projecting wind changes, from wind speed to wind direction, and studies show statistically insignificant variation in wind speed. If wind speeds were to increase then there would not be a significant impact with regard to soil erosion because of the mitigation measures in place i.e. planting and monitoring strategy	Not Significant	Potential for land/soil management guidance document to be produced and provided to landowners/farmers when they retain ownership of the land following the 5 year after care period
Forests	Permanent effects on areas of woodland Need to discuss temporary and permanent effects	Construction		Drier/drought conditions	Loss of trees	No	It is unlikely that drought conditions will increase the loss of trees during the construction works because any damaged and/or diseased trees, which are more susceptible to incidents of drought, will be replaced with new forest stands as part of the Ecology Site Management Plan	Not Significant	No additional mititgation measures are required because ecological resilience has been built into the existing mitigation measures for the design of new; and reinstatement of existing, woodlands
				Hotter and wetter conditions	Longer growing season - changes in tree growth. Certain species will flourish/suffer in particular locations, fast growing species will become more dominent	No	It is unlikely that drought conditions will increase the loss of trees during the construction works because any damaged and/or diseased trees, which are more susceptible to incidents of drought, will be replaced with new forest stands as part of the Ecology Site Management Plan	Not Significant	No additional mititgation measures are required because ecological resilience has been built into the existing mitigation measures for the design of new; and reinstatement of existing, woodlands

	Permanent effects on areas of woodland Need to discuss temporary and permanent effects	Construction		Increased wind speed	Risk of tree loss and consequent exposure of soils to surface water erosion	No	There is considerable uncertainty in projecting wind changes, from wind speed to wind direction, and studies show statistically insignificant variation in wind speed. Mitigation measures include planting native species which are pre-adapted to warmer conditions and therefore are more resilient to potential changes in wind reducing the potential for tree or habitat losses	Not Significant	No additional mititgation measures are required because ecological resilience has been built into the existing mitigation measures for the design of new; and reinstatement of existing, woodlands
	Permanent effects on areas of woodland	Operation		Drier/drought conditions	Loss of trees	No	N/A - no in-combination CC impact.	Not Significant	
				Hotter and wetter conditions	Longer growing season - benefit tree growth	No	N/A - no in-combination CC impact.	Not Significant	
Irrigation and water supply systems	Disruption to soil, including removal and reinstatement	Construction		Drier/drought conditions	Greater need for irrigation, potential risk to harvest, affects effectiveness of	No	Mitigation measures in place	Not Significant	No additional mitigation measures required
Drainage systems	Loss of, or disruption to drainage systems	Construction		Drier/drought conditions	Dry soils damage drainage systems	No	Mitigation measures in place	Not Significant	No additional mitigation measures required
				Increase in frequency and intensity of heavy rainfall events/ flooding	Increased need to drain lower lying areas of land, failure of drainage system could lead to flooding	No	It is unlikely that increased frquency or intensity of heavy rainfall events will cause the drainage systems to fail because HS2 critical assets have been designed with an embedded climate change allowance to account for changes in rainfall and therefore potential flooding of drainage systems is considered to be low	Not Significant	No additional mitigation measures required because a climate change allowance has already been embedded into the design of drainage systems
	Land required temporarily from holdings	Construction		Increased wind speed	Increase spread of weeds and invasive species	No	There is considerable uncertainty in projecting wind changes, from wind speed to wind direction, and studies show statistically insignificant variation in wind speed. If wind speeds are likely to increase, the Ecology TS sets out mitigation measures to limit the spread of weeds and invasive species	Not Significant	No additional mitigation measures required, as ecological resilience has been embedded into existing mitigation measures
				Variation in temperature and rainfall patterns	Alters optimum growing conditions	No	There is likely to be changes in temperate and ranfaill patterns during constructino works. The design of suitable well-drained landforms, installation of field drains and borrow pits will minimise the increased potential of erosion or saturation of soils which and therefore not affect optimum growing conditions	Not Significant	No additional mitigation measures required because assets will be designed with embedded climate change allowances

Agricultural land	Quality of reinstated agricultural land may be affected	Construction		Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Increase the susceptibility of agricultural land	No	Reinstatement of soil back to agricultural land may become more vulnerable to extreme events therefore disrupting the soil structure	Not Significant	Design suitable well-drained landforms, and install field drains and borrow pits to manage the additional flood risk from extreme weather events To manage the in combination drought risk deeper soil profiles or more moisture retentive textures should be used to mitigate longer term drought effects on restored soils Additional measures: Potential for land/soil management guidance document for farmers when they retain ownership of the land following the 5yr after care period
	Propensity of land to harbour noxious weeds	Operation		Increased wind speed	Increase spread of weeds and invasive species	No	There is considerable uncertainty in projecting wind changes, from wind speed to wind direction, and studies show statistically insignificant variation in wind speed. If wind speeds are likely to increase, the Ecology TS sets out mitigation measures to limit the spread of weeds and invasive species	Not Significant	No additional mitigation measures required, as ecological resilience has been embedded into existing mitigation measures

Air Quality

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
Atmosphere, people, ecology and communities	Increase dust and air pollutants from construction works will have temporary local effects Increase in NO2, NOx and particulate matter from construction vehicles and changes in the volume, composition and location of traffic on the highway network during construction works - if we identify siginifcant affects then monitoring will be required during construction	Construction	Construction dust mitigation for *high* risk schemes will be put in place. This can be seen in the Air quality chapter.	Hotter and drier/drought conditions	Exacerbate dust generation and concentrations of certain air pollutants.	No	It is unlikely that hotter and drier/drought conditions will exacerbate dust generations and concentrations of air pollutants because there are sufficient mitigation measures in the air quality chapter to limit the generation and dispersion of construction dust.	Not Significant	No further mitigation measures required Future measures/monitoring: Construction related dust monitoring requirements are covered by the air quality chapter/CMP.
				Increase in frequency and intensity of heavy rainfall events/ flooding	Suppress dust movement.	No	It is likely that heavy rainfall events/flooding will become more frequent in future therefore suppressing dust movement and reducing the amount of dust in the	Not Significant	No further mitigation measures required Future measures/monitoring: Construction related dust monitoring requirements are
				Increased wind speed	Could influence dispersion of poll	No	There is considerable uncertainty in projecting wind changes, from wind speed to wind direction, and studies show statistically insignificant variation in wind speed. Construction dust mitigation outlined in the air quality chapter will mitigate any further impacts due to climate change impacts.	Not Significant	No further mitigation measures required Future measures/monitoring: Construction related dust monitoring requirements are covered by the air quality chapter/CMP.
	Impacts from the operation of the Proposed Scheme could arise from vehicle emissions due to changes in the volume, composition and distribution of traffic in the area.	Operation	None	Hotter and drier/drought conditions	Increased concentration of air pollutants such as ozone and NOx.	No	Hotter and drier conditions are likely in the future however vehicle emissions are predicted to reduce significantly and therefore the	Not Significant	No further mitigation measures required
				Increase in frequency and intensity of heavy rainfall events/ flooding	Increase in frequency and intensity of heavy rainfall events/flooding – decreased concentration of air pollutants	No	Increased rainfall and flooding is likely in the future. This will have a beneficial impact on air quality.	Not Significant	No further mitigation measures required
				Increased wind speed	Could influence local pollutant lev	No	There is considerable uncertainty in projecting wind changes, from wind speed to wind direction, and studies show statistically insignificant	Not Significant	No further mitigation measures required
	Impacts from the construction of the Proposed Scheme could arise from vehicle exhaust emissions associated with construction related traffic	Construction		Increased wind speed	Could influence local pollutant lev	No	No conclusive projections relating to wind patterns areavailable, however, it is unlikely that there will be major changes to the spread of pollutants.The consequences are uncertain; however, it is unlikely that	Not Significant	No further mitigation measures required

Community

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
Residential property	Isolation - Isolation of residential properties from other properties and infrastructure. This could be physical e.g. islanding or isolation of resource or psychological	Construction		Increase in frequency and intensity of heavy rainfall events/ flooding	Exacerbate isolation of properties	No	An increase in extreme weather events is likely. There are sufficient mitigation measures in place.	Not Significant	No additional mitigation measures required
	In-combination effects - combination of significant residual effects, such as noise, vibration, construction dust, poor air quality and visual intrusion. During construction, significant noise, visual and HGV effects will result in in-combination effects on the community.	Construction		Increased temperatures and occurrence of heat waves	Negative effect to thermal comfort - may increase need to open windows increasing effect of noise for example	No	A temperature increase is likely. The in combination impact of climate change with noise effects is not significant. Relevant mitigation measures are proposed by the noise topic.	Not Significant	No additional mitigation measures required
				Drier/drought conditions	Could lead to loss of vegetation and defoliation, drought tolerant trees may become more prevalent (therefore also changing landscape character), wetlands may disappear.	No	Drier/drought conditions are likely which could cause these effects. Incombination with climate change, these effects are not significant. Relevant mitigation measures are also proposed by the Landscape and visual topic.	Not Significant	No additional mitigation measures required
				Hotter and wetter conditions	Could lead to an increase in pests and diseases and could lead to a longer growing season	No	Hotter and wetter conditions are likely. Incombination with climate change, these effects are not significant. Relevant mitigation measeures are also proposed by the Landscape and visual topic.	Not Significant	No additional mitigation measures required
	In-combination effects - combination of significant residual effects, such as noise, vibration, poor air quality and visual intrusion	Operation		Increased temperatures and occurrence of heat waves	Negative effect to thermal comfort - may increase need to open windows increasing effect of noise for example	No	A temperature increase is likely. There are sufficient mitigation measures in place.	Not Significant	No additional mitigation measures required Future measures and monitoring: There are no area-specific community monitoring requirements during operation of the Proposed Scheme. Any area-specific operational monitoring requiremtns in relation to air quality effects, noise and vibration effects, traffic effects and visual effects that have contributed to the in-combination assessments are described in the relevant topic chapters.
Community and recreational facilities	Isolation - Isolation of community infrastructure from other properties and infrastructure. Physical/psychological.	Construction		Increase in frequency and intensity of heavy rainfall events/ flooding	Exacerbate isolation of facilities	No	An increases in the number of extreme weather events is likely. There are sufficient mitigation measures in place.	Not Significant	No additional mitigation measures required
	In-combination effects - combination of significant residual effects, such as noise, vibration, construction dust, poor air quality and visual intrusion. During construction, significant noise, visual and HGV effects will result in in-combination effects on the community.	Construction		Increased temperatures and occurrence of heat waves	Negative effect to thermal comfort - may increase need to open windows increasing effect of noise for example	No	A temperature increase is likely. There are sufficient mitigation measures in place.	Not Significant	No additional mitigation measures required
	In-combination effects - combination of significant residual effects, such as noise, vibration, construction dust, poor air quality and visual intrusion	Operation		Increased temperatures and occurrence of heat waves	Negative effect to thermal comfort - may increase need to open windows increasing effect of noise for example	No	A temperature increase is likely.There are sufficient mitigation measures in place.	Not Significant	No additional mitigation measures required Future measures and monitoring: There are no area-specific community monitoring requirements during operation of the Proposed Scheme. Any area-specific operational monitoring requiremtns in relation to air quality effects, noise and vibration effects, traffic effects and visual effects that have contributed to the in-combination assessments are described in the relevant topic chapters.
	Land take - open space and PROW lost due to land required for construction (temporary loss) or operation of the Proposed scheme (permanent loss).	Construction		Drier/drought conditions	Exacerbate loss of grassland	No	A temperature increase and increases in the number of extreme weather events is likely. In combination with HS2 this could increase pressure on remaining areas of open space.	Not Significant	Refer to landscape and Ecology strategies for replacing vegetation in open spaces

Open space and public rights of way (PROW)	Land take - open space and PROW lost due to land required for construction (temporary loss) or operation of the Proposed scheme (permanent loss). In-combination effects - combination of significant residual effects, such as noise, vibration, construction dust, poor air quality and visual intrusion. During construction, significant	Construction		Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Impact quality and patterns of use of open spaces/green spaces	No	An increase in extreme weather events is likely. In combination with HS2 this could increase pressure on remaining areas of open space.	Not Significant	Refer to landscape and Ecology strategies for replacing vegetation in open spaces Ecological resilience and technical standard and planting strategy
	In-combination effects - combination of significant residual effects, such as noise, vibration, construction dust, poor air quality, visual intrusion and traffic and transport.	Operation		Drier/drought conditions	Exacerbate loss of grassland	No	A temperature increase is likely. There are sufficient mitigation measures in place during operation	Not Significant	No additional mitigation measures required Future measures and monitoring: There are no area-specific community monitoring requirements during operation of the Proposed Scheme. Any area-specific operational monitoring requiremtns in relation to air quality effects, noise and vibration effects, traffic effects and visual effects that have contributed to the in-combination assessments are described in the relevant topic chapters.
				Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Impact quality and patterns of use of open spaces/green spaces	No	An increase in the number of extreme weather events is likely. There are sufficient mitigation measures in place during operation	Not Significant	No additional mitigation measures required Future measures and monitoring: There are no area-specific community monitoring requirements during operation of the Proposed Scheme. Any area-specific operational monitoring requiremtns in relation to air quality effects, noise and vibration effects, traffic effects and visual effects that have contributed to the in-combination assessments are described in the relevant topic chapters.

GHG									
Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	**Effects of Proposed Scheme on receptors/resources identified by environmental topic**	**Each effect should be identified as occuring during construction or operation by environmental topic**	**Existing/ embedded mitigation measures**	**Potential climate change hazards impacting on resources/receptors**	**In-combination climate change impact**	**Can this change the significance given existing/embedded mitigation measures**	**Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures**	**Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change**	**Topic Specific Reference**
Atmosphere	GHG emissions resulting from construction works including energy, transport and new materials for the construction of the proposed scheme. This can relate to any works, including earthworks, infrastructure, structures and buildings	Construction		Increase in frequency of extreme weather events e.g. drought flooding heatwaves	Loss of material due to extreme weather such as high temperatures, drought, flooding, can damage material during construction. Thus, more material required and more GHG associated with this.	No			
	Energy needed to maintain necessary environmental conditions for suitable materials storage	Operation		Increase in frequency of extreme weather events e.g. drought flooding heatwaves	Variation in temperatures may require more or less energy to maintain env conditions depending on season, and may affect GHG emissions	No			
	Carbon emissions resulting from activities related to any works and new materials for the maintenance, repair, replacement, and refurbishment of the Proposed scheme during the use stage. This can relate to earthworks and assets e.g. infrastructure	Operation		Variation in temperature and rainfall patterns	Weathering of material due to extreme weather may cause additional material requirements, therefore more maintenance, repair and replacement and GHG emissions	No			
	Carbon emissions resulting from the i)energy used by the proposed scheme's infrastructure ii)building integrated systems (e.g.fans, pumps, lights)	Operation		Increased temperatures	Increased summer cooling demand in buildings etc	No			
	Carbon emissions from water provision required to enable operation. Includes all water used and its treatment (pre/post use) during the normal operations of the proposed scheme.	Operation		Hotter and drier conditions in summer	Less water available in drought for water provision and treatment and thus emergency plan needed	No			

**Example sentence to include in your topic chapter:
This assessment may be affected by a potential change in GHGs brought about by climate change. However, it is unlikely to have a material impact on the carbon assessment and therefore, unlikely to increase the significance of any residual effects.

Daylight and sunlight									
Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	**Effects of Proposed Scheme on receptors/resources identified by environmental topic**	**Each effect should be identified as occuring during construction or operation by environmental topic**	**Existing/ embedded mitigation measures**	**Potential climate change hazards impacting on resources/receptors**	**In-combination climate change impact**	**Can this change the significance given existing/embedded mitigation measures**	**Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures**	**Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change**	**Topic Specific Reference**
n/a						No			

**Example sentence to include in your topic chapter

This assessment may be affected by a potential change in cloud cover brought about by climate change. However, significant uncertainty exists regarding future projections of cloud cover and therefore, no potential in-combination climate impacts have been identified that are thought to increase the significance of any residual effects.

Ecology and Biodiversity

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
Habitats and wildlife species	Disruption to breeding, feeding and migration patterns of species Decline of species populations Permanent loss, removal, degradation of habitats	Construction	Recommending native species for the local area including drought tolerant species Millennium green developed on a flood plain and the flooding here is maunally managed. This has been incorporated into the assessment. Increasing green corridors and recommending species which are naturally able to adapt.	Drier/drought conditions	Low flows and decrease in water levels – enhanced opportunity for species to adapt and move more freely	No	Drier drought conditions are more likely in future and therefore lower water levels will increase species migration and adaption because the Proposed Scheme is located xxx which will limit habitat fragmentation.	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and mitigation measures for the Proposed Scheme
				Increased wind speed	Increased tree loss, habitat loss and/or fragmentation.	No	There is considerable uncertainty in projecting wind changes, from wind speed to wind direction, and studies show statistically insignificant variation in wind speed.	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and mitigation measures for the
				Increase in frequency and intensity of heavy rainfall events/ flooding	Habitat loss	No	It is likely that the intensity and frequency of rainfall events would increase, however, the likelihood of this causing further habitat loss	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and
				Variation in temperature and rainfall patterns	Exceed thresholds for certain habitats and species	No	Temperature changes could cause some species to exceed thresholds. Plant species will be recommended which are able to naturally adapt making this an unlikely	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and mitigation measures for the
				Drier/drought conditions	Leads to low flows and decreases in water levels, habitat loss and/or fragmentation	No	Drier/drought conditions are unlikely to cause habitat fragmentation or increase habitat loss because the ecological design for	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and
				Increased wind speed	Increased tree loss, habitat loss and/or fragmentation, and reduction in woodland blocks.	No	There is considerable uncertainty in projecting wind changes, to wind speed and direction, and studies show statistically insignificant variation in wind speed. Mitigation measures include planting native	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and mitigation measures for the Proposed Scheme
				Variation in temperature and rainfall patterns	Exceed thresholds for certain habitats and species. Could change the growing season of species. Changes in precipitation patterns may have an effect on pollution caused by runoff	No	Temperature changes could cause some species to exceed thresholds. Plant species will be recommended which are able to naturally adapt making this an unlikely	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and mitigation measures for the
				Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Increased frequency and intensity of storm events lead to destruction of trees and affect nesting birds by disturbance and reduce availability of nesting habitat.	No	Increased levels of damage due to storms are expected to occur. Potential impacts to habitat are not expected to be permanent	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and mitigation measures for the Proposed Scheme Future measures and monitoring: Ecological monitoring for habitats and species will be carried out in line with the Ecological monitoring strategy. This strategy is routewide and will monitor the effectiveness of and maintain the ecological conditions based on the mitigation measures provided in the Ecology Chapter.
		Operation		Increase in frequency and intensity of heavy rainfall events/ flooding	Extreme rainfall events lead to flooding and disturbance and destruction of habitat. Flooding may affect riparian mammals i.e. water vole and otter – potentially reducing suitability of habitat to shelter/breed and also making it more likely that animals would need to cross roads as they move through waterbodies/connecting estuary – therefore increasing risk of mortality from collisions.	No	It is likely that the intensity and frequency of rainfall events would increase, however, the likelihood of this causing fragmentation, disturbance and destruction of habitat is low. This would not change the significance of the ecological effect and thus the ICCI consequence is low. Millennium Green evolved on a flood plain so the species are	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and mitigation measures for the Proposed Scheme Future measures and monitoring: Ecological monitoring for habitats
				Hotter and drier/drought conditions	Hot and dry (drought-like) conditions lead to habitat degradation, including potentially drying out of waterbodies and therefore making less suitable for otter/water vole.	No	Projected temperature increases and precipitation changes are expected to be within the tolerance of local habitats. Potential impacts to habitat are not expected impact the viable locations of vulnerable species	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and mitigation measures for the Proposed Scheme Future measures and monitoring: Ecological monitoring for habitats and species will be carried out in line with the Ecological monitoring strategy. This strategy is routewide and will monitor the effectiveness of and maintain the ecological conditions based on the mitigation measures provided in the Ecology Chapter.
				Increased temperatures and occurrence of heat waves	Increased temperature may change the suitability of habitat conditions, potential for increase in spread of non-native species if native species/plants can't survive.	No	Projected temperature increases and precipitation changes are expected to be within the tolerance of local habitats. Potential impacts to habitat are not expected impact the viable locations of vulnerable species	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and mitigation measures for the Proposed Scheme Future measures and monitoring: Ecological monitoring for habitats and species will be carried out in line with the Ecological monitoring strategy. This strategy is routewide and will monitor the effectiveness of and maintain the ecological conditions based on the mitigation measures provided in the Ecology Chapter.

				Increase in frequency and intensity of heavy rainfall events/ flooding	Damaging habitats and increasing habitat fragmentation. Increased winter rainfall combined with increase airborne pollutants may result in increased acid rain. Damage to wildlife: Acid rain- damage to trees, soils, water bodies,	No	Low likelihood of flooding in the local area. Further mitigated through robust drainage design, incorporating climate change considerations. The effect of any potential flooding and resulting habitat fragmentation is not expected to be large or long-lasting	Not Significant	No additional mitigation measures required. Ecological resilience is embedded within the design and mitigation measures for the Proposed Scheme Future measures and monitoring:

Electromagnetic interference									
Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	**Effects of Proposed Scheme on receptors/resources identified by environmental topic**	**Each effect should be identified as occuring during construction or operation by environmental**	**Existing/ embedded mitigation measures**	**Potential climate change hazards impacting on resources/receptors**	**In-combination climate change impact**	**Can this change the significance given existing/embedded mitigation**	**Justification of Likelihood/Consequence of in-combination climate change impacts given**	**Additional mitigation measures to address significant effects on the ability of resources and**	**Topic Specific Reference**
n/a						No			

**Example sentence to include in your topic chapter
No potential in-combination climate change impacts have been identified for this project.

Environmental wind									
Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	**Effects of Proposed Scheme on receptors/resources identified by environmental topic**	**Each effect should be identified as occuring during construction or operation by environmental topic**	**Existing/ embedded mitigation measures**	**Potential climate change hazards impacting on resources/receptors**	**In-combination climate change impact**	**Can this change the significance given existing/embedded mitigation measures**	**Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded**	**Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change**	**Topic Specific Reference**
n/a						No			
Pedestrians, cyclists, vehicles	usability of spaces, base	Operation	trees/screens/canopies	Changes in wind rose - speed and direction					
This assessment may be affected by a potential change in environmental wind brought about by climate change. However, significant uncertainty exists regarding future projections of wind spe				Effect on mitigation - resilience of planted trees					

Land Quality

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
People	Potential impact on human health on-site and off-site (direct contact, ingestion, inhalation of dusts and vapours from contaminated soils and groundwater and inhalation of ground gases).	Construction		Increased temperatures and occurrence of heat waves	May enhance landfill gas production, but this may be ameliorated by lower moisture content associated with dry weather.	No	The construction phase is expected to have a neutral to minor beneficial effect on the receptors overall (although there may be temporary worsening during the construction phase, occasionally leading to temporary minor to moderate adverse effects) and is not considered to be significant in relation to potential land contamination. Existing mitigation measures are also in place (see column 3).	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.
				Increased temperatures and occurrence of heat waves	May cause increased volatility of organic compounds (VOC) causing unpleasant odours locally.	No	The construction phase is expected to have a neutral to minor beneficial effect on the receptors overall (although there may be temporary worsening during the construction phase, occasionally leading to temporary minor to moderate adverse effects) and is not considered to be significant in relation to potential land contamination. Existing mitigation measures are also in place (see column 3).	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.
				Increased wind speed	Wind-blown dusts.	No	The construction phase is expected to have a neutral to minor beneficial effect on the receptors overall (although there may be temporary worsening during the construction phase, occasionally leading to temporary minor to moderate adverse effects) and is not considered to be significant in relation to potential land contamination. Existing mitigation measures are also in place (see column 3).	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.
	Users of the Proposed Scheme (i.e. rail passengers) are at all routine times within a controlled environment (i.e. within trains), and have, therefore, been scoped out of the assessment.	Operation		Increased temperatures and occurrence of heat waves	May enhance landfill gas production, but this may be ameliorated by lower moisture content associated with dry weather.	No	Users of the Proposed Scheme have been scoped out. Sufficient mitigation measures are in place to prevent harm in the case of unexpected incidents.	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.
				Increased temperatures and occurrence of heat waves	May cause increased volatility of organic compounds (VOC) causing unpleasant odours locally.	No	Users of the Proposed Scheme have been scoped out and low consequence because mitigation measures are in place to prevent harm in the case of unexpected incidents.	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.
				Increased wind speed	Wind-blown dusts.	No	Users of the Proposed Scheme have been scoped out. Sufficient mitigation measures are in place to prevent harm in the case of unexpected incidents.	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.
Ground and surface water	Potential impact on groundwater quality (leaching, vertical and lateral migration from soils and water), and on surface water quality (lateral migration through groundwater, direct run-off from site).	Construction		Increase in frequency and intensity of heavy rainfall events/ flooding	May cause and increased risk of run-off of sediments.	No	The construction phase is expected to have a neutral to minor beneficial effect on the receptors overall (although there may be temporary worsening during the construction phase, occasionally leading to temporary minor to moderate adverse effects) and is not considered to be significant in relation to potential land contamination. Existing mitigation measures are also in place (see column 3).	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.

	The operation of the trains may give rise to minor contamination through leakage of hydraulic or lubricating oils. An auto-transformer station can, in principle, be a source of contamination through accidental discharge or leaks of coolant.	Operation		Increase in frequency and intensity of heavy rainfall events/ flooding	May cause an increased risk of run-off of sediments.	No	Soil is unlikely to be a significant contaminant to ground and surface water receptors and mitigation measures in place to protect ground and surface water from sediment runoff during heavy rainfall events or flooding.	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.
Built and natural environment	Potential impact on property receptors on-site and off-site (direct contact with soils and water, exposure to explosive gases).	Construction		Increased wind speed	Wind-blown dusts.	No	The construction phase is expected to have a neutral to minor beneficial effect on the receptors overall (although there may be temporary worsening during the construction phase, occasionally leading to temporary minor to moderate adverse effects) and is not considered to be significant in relation to potential land contamination. Existing mitigation measures are also in place (see column 3).	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.
				Increase in frequency and intensity of heavy rainfall events/ flooding	May cause an increased risk of run-off of sediments.	No	The construction phase is expected to have a neutral to minor beneficial effect on the receptors overall (although there may be temporary worsening during the construction phase, occasionally leading to temporary minor to moderate adverse effects) and is not considered to be significant in relation to potential land contamination. Existing mitigation measures are also in place (see column 3).	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.
				Increased temperatures and occurrence of heat waves	May enhance landfill gas production, but this may be ameliorated by lower moisture content associated with dry weather.	No	The construction phase is expected to have a neutral to minor beneficial effect on the receptors overall (although there may be temporary worsening during the construction phase, occasionally leading to temporary minor to moderate adverse effects) and is not considered to be significant in relation to potential land contamination. Existing mitigation measures are also in place (see column 3).	Not Significant	
				Increased temperatures and occurrence of heat waves	May cause an increased volatility of organic compounds (VOC) causing unpleasant odours locally.	No	The construction phase is expected to have a neutral to minor beneficial effect on the receptors overall (although there may be temporary worsening during the construction phase, occasionally leading to temporary minor to moderate adverse effects) and is not considered to be significant in relation to potential land contamination. Existing mitigation measures are also in place (see column 3).	Not Significant	
	The operation of the trains may give rise to minor contamination through leakage of hydraulic or lubricating oils. An auto-transformer station can, in principle, be a source of contamination through accidental discharge or leaks of coolant.	Operation		Increase in frequency and intensity of heavy rainfall events/ flooding	Lead to an increased risk of run-off of sediments.	No	Soil is unlikely to be a significant contaminant to ground and surface water receptors and mitigation measures in place to protect ground and surface water from sediment runoff during heavy rainfall events or flooding.	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.
Mining and mineral sites	There may be a temporary sterilisation of the resource during construction works. There may be permanent sterilisation of resources (i.e. direct excavation, severance, isolation of resource).	Construction		Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	May exacerbate isolation of resource.	No	The construction phase is expected to have a neutral to minor beneficial effect on the receptors overall (although there may be temporary worsening during the construction phase, occasionally leading to temporary minor to moderate adverse effects) and is not considered to be significant in relation to potential land contamination. Existing mitigation measures are also in place (see column 3).	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures and monitoring: Requirements for monitoring will be determined as part of the site investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process.
	Any effects arising during operation are expected to be adequately mitigated by the application of good practice in terms of materials handling and railway operation, and are not considered further.	Operation			n/a	No	n/a	Not Significant	

Health

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
People and Communities	Neighbourhood quality; life, mental health and wellbeing of residents i.e. visual and noise impacts, loss of property, disturbance from construction traffic. Housing.	Construction		Changes in humidity and increase in temperature	Greater number of people sleeping with windows open, may alter propagation characteristics of sound through air.	No	It is unlikely that changes in humidity and hotter temperatures will increase noise levels in the local area during construction works because mitigation measures include control of noise and vibration at source, by using quiet and low vibration equipment; and screening, by constructing perimeter hoarding or use of temporary stockpiles.	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures: continue to engage with the owners and occupiers of sensitive receptors directly affected by the Proposed Scheme to develop mitigation measures that will reduce or avoid impacts.
	Neighbourhood quality; life, mental health and wellbeing of residents i.e. visual and noise impacts, loss of property, disturbance from construction traffic. Access to services, health and social care; including direct and indirect impacts of services and community facilities and reduced access from changes in journey times. Access to green space and physical activity. Social capital; including changes in community connectivity from road diversions, creation of barriers between communities, direct impacts on community facilities and impacts to construction workforce. Housing.	Construction		Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	May create stress for people.	No	It is unlikely that an increase in the frequency of extreme weather events will create additional stress for people because the extreme weather events clause in the CoCP1 states that programme management, environmental control and impact mitigation measures will be influenced and informed by a short to medium-range weather forecasting service; therefore ensuring the Proposed Scheme is resilient against extreme weather which will result in negligible stress to local residents.	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures: continue to engage with the owners and occupiers of sensitive receptors directly affected by the Proposed Scheme to develop mitigation measures that will reduce or avoid impacts.
	Neighbourhood quality; life, mental health and wellbeing of residents i.e. visual and noise impacts, loss of property, disturbance from construction traffic. Access to services, health and social care; including direct and indirect impacts of services and community facilities and reduced access from changes in journey times. Access to green space and physical activity.	Construction		Hotter and drier/drought conditions	May exacerbate loss of grassland/green space, reduced health and wellbeing of communities.	No	It is unlikely that an increase in the frequency of extreme weather events will create additional stress for people because the extreme weather events clause in the CoCP1 states that programme management, environmental control and impact mitigation measures will be influenced and informed by a short to medium-range weather forecasting service; therefore ensuring the Proposed Scheme is resilient against extreme weather which will result in negligible stress to local residents. The CoCP in addition to other mitigation measures will mitigate the advers effects on sensitive and valued landscape features and characteristics, therefore, providing green spaces that can adapt to changes in climate conditions.	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures: continue to engage with the owners and occupiers of sensitive receptors directly affected by the Proposed Scheme to develop mitigation measures that will reduce or avoid impacts.
	Health effects from noise	Operation		Changes in humidity and increase in temperature	Greater number of people sleeping with windows open, may alter propagation characteristics of sound through air.	No	It is unlikely that changes in humidity and hotter temperatures will increase noise levels in the local area during construction works because mitigation measures such as noise barriers will be constructed. HS2 Ltd is also committed to providing trains that are quieter than the relevant current European Union specifications. Due to sufficient mitigation measures, and HS2 Ltd's commitment to providing trains that are quieter than the relevant current European Union specifications there sould be no increased risk to health from the Proposed scheme in combination with changes in humidity and increase in temperature.	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures: continue to engage with the owners and occupiers of sensitive receptors directly affected by the Proposed Scheme to develop mitigation measures that will reduce or avoid impacts.
	Health effects from noise Possible impact on health of altered landscape due to changed perception of local environment.	Operation		Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	May create stress for people.	No	Whilst it is likely that the frequency of extreme weather events will increase over the operational period of the Proposed Scheme, it is unlikely that increased flooding will create additional stress for local residents because of the climate change allowance built into the design of critical infrastructure assets. The climate change allowance built into the design of critical infrastructure assets will minimise the impacts of flooding events and therefore reduce the potential stress on people during these events.	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures: continue to engage with the owners and occupiers of sensitive receptors directly affected by the Proposed Scheme to develop mitigation measures that will reduce or avoid impacts.

	Possible impact on health of altered landscape due to changed perception of local environment.	Operation		Hotter and drier/drought conditions	Might affect the effectiveness of landscape planting	No	It is unlikely that hotter and drier/drought conditions will cause stress to plants because species will be chosen based on their ability to adapt to climate change and ability to cope with changes in soil moisture conditions to minimise the impact of drought.	Not Significant	No additional measures required as there are sufficient mitigation measures in place. Future measures: continue to engage with the owners and occupiers of sensitive receptors directly affected by the Proposed Scheme to develop mitigation measures that will reduce or avoid impacts.
Older People	Vulnerability to fluctuations in temperature (heat waves or extended cold periods)	Operation		Increased temperatures and occurrence of heat waves	Extreme heat events to cause increased morbidity and mortality in elderly residents (note also potential opportunity: reduction in excess winter deaths)	No	Statistically heatwave events increase the morbidity and mortality rate, however there are few extreme heat days predicted. Additional fatalities are classified as a major consequence	Not Significant	
Residents and users of the site facilities	Access to healthcare services and other social infrastructure (including education)	Operation		Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Increased frequency and intensity of storm events lead to temporary isolation from services due to flooding and other infrastructure failure	No	Storm events expected to increase in frequency and intensity, however extensive flood mitigation has been incorporated into design of infrastructure. Inability to access facilities will limit the beneficial impact of the LWLV.	Not Significant	
	Access to open space and nature Accessibility and active travel	Operation		Hotter and drier/drought conditions	Opportunity: Increased temperatures lead to increased outdoor recreation, walking and cycling opportunities for development occupants	No		Not Significant	
				Increase in frequency and intensity of heavy rainfall events/ flooding	Increased frequency and intensity of storm events lead to reduced opportunity for occupants and local residents to access and enjoy open space and nature, reduced suitability of conditions for active travel options	No	Storm events expected to increase in frequency and intensity.	Not Significant	

Cultural Heritage

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
Historic buildings	Temporary/permanent disruption to historic landscape setting	Construction		Increased wind speed	There could be an impact on the designed landscape due to trees lost from variation in wind patterns	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. There are sufficient mitigation measures in place.	Not Significant	Incombination impact is unlikely and sufficient mitigation measures in place, no additional mitigation measures required.
				Hotter and wetter conditions	This can lead to an increase in the growing season which will lead to an increase rate of growth of vegetation. The landscape setting will therefore be either postively or negatively affected.	No	An increase in temperatures and frequency and intensity of rainfall is likely, however, this will lead to a positive impact. The potential increased rate of growth is beneficial to reducing impacts on the setting of assets.	Not Significant	Positive impact, therefore, no additional mitigation measures required
	Temporary/permanent disruption to historic landscape setting	Operation		Hotter and wetter conditions	This can lead to an increase in the growing season which will lead to an increase rate of growth of vegetation. The landscape setting will therefore be either postively or negatively affected.	No	An increase in temperatures and frequency and intensity of rainfall is likely. The potential increased rate of growth is negative as this could disrupt the view of historic buildings. however most of the historic buildings will be located around public squares which are paved or on roads and therefore will the risk will be low consequence.	Not Significant	No additional mitigation measures required
				Drier/drought conditions	This could exacerbate the risks of ground settlement and threaten the foundations of any buildings.	No	It is likely that there will be an increase in drought conditions however there is sufficient mitigation in place to preserve records of any historic buildings and there is a strategy in place to deal with basements.	Not Significant	No additional mitigation measures required
	Temporary/permanent disruption to designed landscape			Increased wind speed	There could be an impact on the designed landscape due to trees lost from variation in wind patterns	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. There are sufficient mitigation measures in place.	Not Significant	No additional mitigation measures required
				Hotter and wetter conditions	This can lead to an increase in the growing season which will lead to an increase rate of growth of vegetation. The landscape setting will therefore be either postively or negatively affected.	No	An increase in temperatures and frequency and intensity of rainfall is likely. The potential increased rate of growth is negative as this could disrupt the view of historic buildings. Find out if there is a management plan in place to maintain the vegetation	Not Significant	No additional mitigation measures required
Palaeo-environmental sites and remains	Complete/partial removal of palaeo-environmental remains Potential temporary adverse effects on landscape settings (local flora and fauna, including protected species)	Construction		Increase in frequency and intensity of heavy rainfall events/ flooding	Changes to water courses	No	Flash flooding could cause diversions to water courses and, therefore, cause drying out to palaeo-environmental sites. Given the location and condition of remains is unknown it is uncertain how likely and significant this impact might be.	Not Significant	No additional mitigation measures required
	Complete/partial removal of palaeo-environmental remains	Construction		Increase in frequency and intensity of heavy rainfall events/ flooding	Stabilising of palaeoenvironment	No	It is likely that there will be an increase in the frequency and intensity of heavy rainfall and extreme rainfall events such as flooding. However, this could have a positive impact.	Not Significant	No additional mitigation measures required
				Drier/drought conditions	Drying out of waterlogged remains.	No	Potentially significant in-combination effect with insufficient mitigation. It is currently unknown what palaeo-environmental sites and remains exist and so it is uncertain how significant this impact might be.	Not Significant	No additional mitigation measures required
	Potential permanent adverse effects on landscape settings (local flora and fauna, included protected species) Expectation that conservation areas are expected to be permanently significantly affected visually once the Proposed Scheme becomes operational.	Operation		Increase in frequency and intensity of heavy rainfall events/ flooding	Changes to water courses	No	Flash flooding could cause diversions to water courses and, therefore, cause drying out to palaeo-environmental sites. Given the location and condition of remains is unknown it is uncertain how likely and significant this impact	Not Significant	No additional mitigation measures required
				Increased wind speed	Impact on settings due to trees lost	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. There are sufficient mitigation measures in place.	Not Significant	Incombination impact is unlikely and sufficient mitigation measures in place, no additional mitigation measures required.
				Hotter and wetter conditions	Leads to longer growing season – increase rate of growth of vegetation	No	An increase in temperatures and frequency and intensity of rainfall is likely. This will lead to a positive impact. The potential increased rate of growth is beneficial to reducing impacts on the setting of assets.	Not Significant	Positive impact, therefore, no additional mitigation measures required

				Drier/drought conditions	Exacerbate the risks of ground settlement, stability of archaeological site	No	No in-combination effect identified as the scheme will not impact on the stability of the archaeological sites during operation.	Not Significant	No additional mitigation measures required
Designed landscapes	Potential temporary adverse effects on landscape settings (local flora and fauna)	Construction		Increased wind speed	Impact on settings due to trees lost	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. There are sufficient mitigation measures in place.	Not Significant	Incombination impact is unlikely and sufficient mitigation measures in place, no additional mitigation measures required.
				Hotter and wetter conditions	Leads to longer growing season – increase rate of growth of vegetation	No	An increase in temperatures and frequency and intensity of rainfall is likely. This will lead to a positive impact. The potential increased rate of growth is beneficial to reducing	Not Significant	Positive impact, therefore, no additional mitigation measures required
	Significant change in setting	Operation		Increased wind speed	Impact on settings due to trees lost	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. There are sufficient	Not Significant	Incombination impact is unlikely and sufficient mitigation measures in place, no additional mitigation measures required.
	Potential temporary adverse effects on landscape settings (local flora and fauna)	Operation		Hotter and wetter conditions	Leads to longer growing season – increase rate of growth of vegetation	No	An increase in temperatures and frequency and intensity of rainfall is likely. This will lead to a positive impact. The potential increased rate of growth is beneficial to reducing	Not Significant	Positive impact, therefore, no additional mitigation measures required
Buried archaeology	Permanent removal of buried archaeological features due to construction of the Proposed Scheme.	Construction	Keep a record of any buildings which are demolished or burried archeology which is removed due to the construction of the scheme	Increase in frequency and intensity of heavy rainfall events/ flooding	This could exacerbate the risk of ground settlement and threaten any burried remains or lead to water damage of remains.	No	It is likely that there will be an increase in heavy rain conditions however there is sufficien mitigation in place to make a record of any remains which have	Not Significant	No additional mitigation measures required
				Drier/drought conditions	This could lead to drying out of waterlogged remains causing damage.	No	It is likely that there will be an increase in drought conditions however there is sufficient mitigation in place to make a record of any remains which have	Not Significant	No additional mitigation measures required

Major Accidents and Natural Hazards

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
Members of the public and local communities	Spillage or longer term seepage of pollutants into watercourse, potential to affect drinking water	Construction		Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Exacerbate the risk of speading pollutants to watercourses	No	Given the mitigation in place, it is considered that the risks of this effect are ALARP (as low as reasonbly practicable).	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required. Future measures and monitorng: Tunnel design and construction methods includes risk assessment for overlying structures and monitoring or mitigation if subsequently required.
	Collapse of or damage to existing structures	Construction		Increased wind speed	Could cause increased loads on structures leading to collapse	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. Therefore this is not considered an in-combination impact. It is considered that the risk of this impact is mitigated to be ALARP.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required. Future measures and monitorng: Tunnel design and construction methods includes risk assessment for overlying structures and monitoring or mitigation if subsequently required.
	Train derailment or collision causing severe disruption to rail transportation, major accident causing harm to staff/passenger/adjacent receptors. Train derailment or collision - no passengers but potentially carrying flammable fuel. Could cause a diesel spillage	Operation		Increase in frequency and intensity of heavy rainfall events/ flooding	Could increase the likelihood of a train derailment.	No	The system is designed both to reduce the likelihood of a derailment and manage the impact. This risk will be ALARP. Mitigation measures include designing to appropriate environmental parameters including 'designed in' or embedded considerations of climate change.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required. Future measures and monitoring: Real time monitoring and integrated communication for rolling stock will be used.
	Train derailment or collision causing severe disruption to rail transportation or spillage of pollutants.	Operation		Increased wind speed	Could increase the likelihood of a train derailment.	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. Therefore this is not considered an in-combination impact. The system is designed both to reduce the likelihood of a derailment and manage the impact. This risk will be ALARP. Mitigation measures include designing to appropriate environmental parameters including 'designed in' or embedded considerations of climate change.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required. Future measures and monitoring: Real time monitoring and integrated communication for rolling stock will be used.

	Collapse of structures leading to non-train incident - death or injury to members of public, road traffic accident.	Operation		Increased wind speed	Could cause increased loads on structures leading to collapse	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. Therefore this is not considered an in-combination impact. It is considered that the risk of this impact is mitigated to be ALARP. Mitigation measures include designing to appropriate environmental parameters including 'designed in' or embedded considerations of climate change	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required. Future measures and monitoring: Real time monitoring and integrated communication for rolling stock will be used.
	Collapse of embankments	Operation		Increase in frequency and intensity of heavy rainfall events/ flooding	Could cause collapse of embankments	No	It is considered that the risk of this impact is mitigated to be ALARP. Mitigation measures include rail infrastructure designed to accommodate 1 in 100 (1%) annual probability flood plus climate change and remain safe during a 1:1000 (0.1%) annual probability flood. The embankment design will include an allowance for extreme weather and climate change.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required. Future measures and monitoring: Real time monitoring and integrated communication for rolling stock will be used.
	Electric shock due to exposure to live conductor/arcing etc.	Operation		Increased wind speed	Could cause over head line collapse	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. Therefore this is not considered an in-combination impact. It is considered that the risk of this impact is mitigated to be ALARP	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required. Future measures and monitoring: Real time monitoring and integrated communication for rolling stock will be used.
	Collapse of or damage to existing structures	Construction		Increased wind speed	Could cause increased loads on structures leading to collapse	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. Therefore this is not considered an in-combination impact. It is considered that the risk of this impact is mitigated to be ALARP	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required.
Infrastructure and the	Train derailment or collision causing major accident causing	Operation		Increase in frequency and intensity of heavy rainfall events/ flooding	Could increase the likelihood of a train derailment.	No	The system is designed both to reduce the likelihood of a derailment and manage the impact. This risk will be ALARP. Mitigation measures include designing to appropriate environmental parameters including 'designed in' or embedded considerations of climate change.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required.

built environment	harm to adjacent receptors.	Operation		Increased wind speed	Could increase the likelihood of a train derailment.	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. Therefore this is not considered an in-combination impact. The system is designed both to reduce the likelihood of a derailment and manage the impact. This risk will be ALARP. Mitigation measures include designing to appropriate environmental parameters including 'designed in' or embedded considerations of climate change	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required.
	Collapse of structures leading to non-train incident	Operation		Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Could cause increased loads on structures leading to collapse	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. Therefore this is not considered an in-combination impact. It is considered that the risk of this impact is mitigated to be ALARP. Mitigation measures include designing to appropriate environmental parameters including designed in considerations of climate change.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required.
Natural environment (including ecosystems, land and soil quality, air quality, surface and groundwater resources and landscape)	Spillage or longer term seepage of pollutants into watercourse, potential to affect drinking water	Construction		Increase in frequency and intensity of heavy rainfall events/ flooding	Exacerbate the risk of speading pollutants to watercourses	No	Given the mitigation in place, it is considered that the risks of this effect are ALARP (as low as reasonably practicable).	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required.
	Collapse of or damage to existing structures	Construction		Increased wind speed	Could cause increased loads on structures leading to collapse	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. Therefore this is not considered an in-combination impact. It is considered that the risk of this impact is mitigated to be ALARP.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required.
	Train derailment or collision causing major accident causing harm to adjacent receptors. Train derailment or collision - could cause a diesel spillage	Operation		Increase in frequency and intensity of heavy rainfall events/ flooding	Could increase the likelihood of a train derailment.	No	The system is designed both to reduce the likelihood of a derailment and manage the impact. This risk will be ALARP. Mitigation measures include designing to appropriate environmental parameters including 'designed in' or embeddedconsiderations of climate change.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required. Real time monitoring and integrated communication for rolling stock will be used.

	Train derailment or collision causing spillage of pollutants.	Operation		Increased wind speed	Could increase the likelihood of a train derailment.	No	There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. Therefore this is not considered an in-combination impact. The system is designed both to reduce the likelihood of a derailment and manage the impact. This risk will be ALARP. Mitigation measures include designing to appropriate environmental parameters including 'designed in' or embedded considerations of climate change.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required. Real time monitoring and integrated communication for rolling stock will be used.
	Collapse of embankments	Operation		Increase in frequency and intensity of heavy rainfall events/ flooding	Could cause collapse of embankments	No	It is considered that the risk of this impact is mitigated to be ALARP. Mitigation measures include rail infrastructure designed to accommodate 1 in 100 (1%) annual probability flood plus climate change and remain safe during a 1:1000 (0.1%) annual probability flood. The embankment design will include an allowance for extreme weather and climate change.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required.
Historic environment (including archaeology and built heritage)	Collapse of or damage to existing structures	Construction		Increased wind speed	Could cause increased loads on structures leading to collapse	No	It is considered that the risk of this impact is mitigated to be ALARP. In addition, there is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. Therefore this is not considered an in-combination impact.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required.
	Collapse of structures leading to non-train incident	Operation		Increased wind speed	Could cause increased loads on structures leading to collapse	No	It is considered that the risk of this impact is mitigated to be ALARP. Mitigation measures include designing to appropriate environmental parameters including 'designed in' or embedded considerations of climate change. There is considerable uncertainty in projecting wind changes to wind speed and direction and studies show statistically insignificant variation in wind speed. Therefore this is not considered an in-combination impact.	Not Significant	There are sufficient mitigation measures in place, no additional mitigation measures required.

Sound and Noise Vibration

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
Residential properties and community facilities	Airborne noise during construction operations Ground borne vibration Impact on vegetation	Construction	All works will be conducted in accordance with a Construction Environmental Management Plan, to minimise noise impacts.	Changes in humidity and increase in temperature	Greater number of people sleeping with windows open	No	of sound being affected by temperature or humidity because assessment is based on outdoor noise. Windows being open or closed is not factored into the assessment;	Not Significant	No additional mitigation measures required
	Noise due to operation of site and roads post-construction. All noise effects decrease significantly with distance from roads.	Operation	No mitigation practicable.	Changes in humidity and increase in temperature	Greater number of people sleeping with windows open	No	No anticipated effect on propagation of sound being affected by temperature or humidity because assessment is based on outdoor noise. Windows being open or closed is not	Not Significant	No additional mitigation measures required
	Noise due to the operation of mechanical services equipment for the cooling of commercial uses.		Building services noise set by the noise assessment	Changes in humidity and increase in temperature	Increased building services demand to cool the buildings down which may produce more noise.	No	This is currently addressed by the noise limit specified within the noise assessment and therefore if equipment is used a a hgiher duty, the same noise limits applies, therefore would need additional attenuation.	Not Significant	No additional mitigation measures required

Socio-economics

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
Businesses and community organisations	Pubic right of way being severed due to construction could affect access around the site by the public or through the site by employees.	Construction		Hotter and wetter conditions	Increased rate of growth of vegetation.	No	Increased growing season has both positive and negative effects for example, vegetation will be in leaf for longer reducing adverse views, but plant/tree species structure and adaptability may change. Sufficient mitigation measures in place, see Landscape and visual topic assessment for further details.	Not Significant	No additional mitigation measures required
				Increased wind speed	Impact on landscape through potential tree losses.	No	There is considerable uncertainty in projecting wind changes, to wind speed and direction, and studies show statistically insignificant variation in wind speed. Sufficient mitigation measures in place, see Landscape and visual topic assessment for further details.	Not Significant	No additional mitigation measures required
				Drier/drought conditions	Drought tolerant trees may become more prevalent (therefore also changing landscape character)	No	Drier/drought conditions could increase loss of vegetation and defoliation however there are sufficient mitigation measures in place, see Landscape and visual topic assessment for further details.	Not Significant	No additional mitigation measures required
				Increase in frequency and intensity of heavy rainfall events/ flooding	Increased risk of pubic right of way becoming severed by flooding during construction	No	Risk assessed and managed as described in the flood risk assessment, which includes climate change allowances.	Not Significant	No additional mitigation measures required
				Drier/drought conditions	Could lead to loss of vegetation and defoliation	No	Drier/drought conditions could increase loss of vegetation and defoliation however there are sufficient mitigation measures in place, see Landscape and visual topic assessment for further details	Not Significant	No additional mitigation measures required
	Suitability of public space for use by the public may varey in different weather conditions and during different events. Public behaviour and the need for public space changing based on different weather conditions and events	Operation		Hotter and wetter conditions	Leads to a longer growing season – increased rate of growth of vegetation.	No	Increased growing season has both positive and negative effects for example, vegetation will be in leaf for longer reducing adverse views, but plant/tree species structure and adaptability may change. Sufficient mitigation measures in place, see Landscape and visual topic assessment for further details.	Not Significant	No additional mitigation measures required
				Increased wind speed	Impact on landscape through potential tree losses.	No	There is considerable uncertainty in projecting wind changes, to wind speed and direction, and studies show statistically insignificant variation in wind speed. Sufficient mitigation measures in place, see Landscape and visual topic assessment for further details.	Not Significant	No additional mitigation measures required
				Drier/drought conditions	Drought tolerant trees may become more prevalent (therefore also changing landscape character)	No	Could increase loss of vegetation and defoliation however there are sufficient mitigation measures in place, see Landscape and visual topic assessment for further details.	Not Significant	No additional mitigation measures required
				Drier/drought conditions	Could lead to loss of vegetation and defoliation	No	Could increase loss of vegetation and defoliation however there are sufficient mitigation measures in place, see Landscape and visual topic assessment for further details	Not Significant	No additional mitigation measures required
				Increase in frequency and intensity of heavy rainfall events/ flooding	Increased risk of pubic right of way becoming severed by flooding during operation	No	Risk assessed and managed as described in the flood risk assessment, which includes climate change allowances.	Not Significant	No additional mitigation measures required
				Hotter and drier/drought conditions	Increased frequency of hotter and drier conditions in summer may affect suitability of the type of open space eg vegetatoin, amount of shade or shelter in the design. (See landscaping chapter)	No	The Proposed Site will be designed to be suitable for a range of weather conditions. Significance of the effects assessed within the Socio-economics chapter is not affected by this impact, and thus the consequence is low. Vegetation planted will be of a variety of species including drought tolerant species (see more in the landscaping chapter).	Not Significant	No additional mitigation measures required
				Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Could change public behaviour and the pattern of use of public spaces.	No	Significance of the effects assessed within the Socio-economics chapter is not affected by this impact, and thus the consequence is low. The Proposed Site will be designed to be suitable for a range of weather conditions.	Not Significant	No additional mitigation measures required

Landscape and Visual

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
	Presence of construction sites, cranes, compounds etc., vehicle movement and the loss of trees or vegetation could affect the character of the site, the setting of the townscape as well as view from the proposed development of key site lines to the city of York e.g.xxx	Construction		Drier/drought conditions	Could lead to loss of vegetation and defoliation and receptors could become more vulnerable to stress. Could further disrupt views to and from the site.	No	Drier/drought conditions could increase loss of vegetation and defoliation. There are a number of mitigation measures in place to reduce the impacts of this however the in-combinaiton cimate change impact could affect the significance of the effects identified within the townscape and visual assesment and therefore extra mitigation has been suggested to address this and to account for climate change. This means that if the local existing plants and vegetation can not survive there will still be vegetation providing screening.	Not Significant	Potential to include deeper soil profiles or more moisture retentive textures to mitigate longer term drought effects on soils and associated tree species or vegetation. The current good practice is to separate different soil types during the restoration process, however this measure may not be sufficient following any potential CC impacts therefore to combat this, soil types may be mixed to provide greater flexibility for plant and trees species to be more resilient to drought. Future measures and monitoring: Operational monitoring to take place in the form of cross-checking works undertaken with contractor specification documents Soil moisture and texture to be monitored during the 5yr after care period.
				Drier/drought conditions	Drought tolerant trees may become more prevalent (therefore also changing landscape character)	No	Drier/drought conditions could increase loss of vegetation and defoliation . There are a number of mitigation measures in place to reduce the impacts of this; including compliance with the Plant Procurement Strategy which aims to minimise impacts of drought on native tree species; undertake post-construction monitoring and design planting palettes for replacement planting lost during construction to align with soil profiles.	Not Significant	Potential to include deeper soil profiles or more moisture retentive textures to mitigate longer term drought effects on soils and associated tree species or vegetation The current good practice is to separate different soil types during the restoration process, however this measure may not be sufficient following any potential CC impacts therefore to combat this, soil types may be mixed to provide greater flexibility for plant and trees species to be more resilient to drought.
				Drier/drought conditions	Wetlands may disappear (also dependent on elevation and spilt type) and certain soil types may be less readily available.	No	Drier/drought conditions could encourage the drying out of wetlands. There are a number of mitigation measures in place to reduce these potential impacts and therefore the consequence is low; the Ecology chater sets out the design specification, management and monitoring details for wetland ecosystems.	Not Significant	Potential to include deeper soil profiles or more moisture retentive textures to mitigate longer term drought effects on soils and associated tree species or vegetation. The current good practice is to separate different soil types during the restoration process, however this measure may not be sufficient following any potential CC impacts therefore to combat this, soil types may be mixed to provide greater flexibility for plant and trees species to be more resilient to drought.
				Hotter and wetter conditions	Could lead to an increase in pests and diseases, leading to loss of vegetation and defoliation making species more susceptible to external stress	No	Hotter and wetter conditions are likely . Increased risk of pests and diseases is low because traceability studies will be used to minimise risk of spreading diseases during planting	Not Significant	No additional mitigation measures required
				Increase in frequency and intensity of heavy rainfall events/ flooding	Loss of species in certain areas, because soils become water-saturated and can no longer support existing species	No	Heavy rainfall events and flooding are more likley to occur in the future. The loss of species is low because planting palettes will be designed in advance to increase species resilience and adaptability	Not Significant	To further reduce the impact of flood risk on plant/tree species the drainage profile of the soil could be increased.
				Hotter and wetter conditions	Leads to a longer growing season – increased rate of growth of vegetation. Could be a beneficial impact.	No	Longer growing seasons have both positive and negative impacts. Vegetation will be in leaf for longer and reduce adverse views, but it may increase number of leaves on the line, change the trees structural capacity which could increase the stress on trees to external stressors. There are a number of mitigation measures in place including the planting of a wide variety of species including drought tolerant species. This means that if the local existing plants	Not Significant	No additional mitigation measures required
				Increased wind speed	Impact on landscape through potential tree losses. Could further disrupt views to and from the site.	No	There is considerable uncertainty in projecting wind changes, to wind speed and direction, and studies show statistically insignificant variation in wind speed. If wind speed does increase then its more likely to affect more mature, existing trees however the future Tree Survey will assess risks to trees in proximity to construction sites and work in combination with tree protection works to minimise tree damage	Not Significant	No additional mitigation measures required

Landscape character and visual receptors	Existence of new development . Specific elements taken into account in assessing visual impact include the loss of vegetation and landscape features such as ponds, streams, soils, hills, plains	Operation		Drier/drought conditions	Could lead to loss of vegetation and defoliation and receptors could become more vulnerable to stress	No	Drier/drought conditions could increase loss of vegetation and defoliation. There are a number of mitigation measures in place to reduce the impacts of this however the in-combinaiton climate change oimpact could affect the significance of the effects identified within the townscape and visual assesmsnt and therefore extra mitigation has been suggested to address this and to account for climate change. This means that if the local existing plants and vegetation can not survive there will still be vegetation providing screening.	Not Significant	Deeper soil profiles or more moisture retentive textures to mitigate longer term drought effects on soils and associated tree species or vegetation. The current good practice is to separate different soil types during the restoration process, however this measure may not be sufficient following any potential CC impacts therefore to combat this, soil types may be mixed to provide greater flexibility for plant and trees species to be more resilient to drought. Future measures and monitoring: Operational monitoring to take place in the form of cross-checking works undertaken with contractor specification documents Soil moisture and texture to be monitored during the 5yr after care period.
				Drier/drought conditions	Drought tolerant trees may become more prevalent (therefore also changing landscape character)	No	Drier/drought conditions could increase loss of vegetation and defoliation however there are a number of mitigation measures in place to reduce the impacts of this; including compliance with the Plant Procurement Strategy which aims to minimise impacts of drought on native tree species; undertake post-construction monitoring and design planting palettes for replacement planting lost during construction to align with soil profiles.	Not Significant	Deeper soil profiles or more moisture retentive textures to mitigate longer term drought effects on soils and associated tree species or vegetation The current good practice is to separate different soil types during the restoration process, however this measure may not be sufficient following any potential CC impacts therefore to combat this, soil types may be mixed to provide greater flexibility for plant and trees species to be more resilient to drought Future measures and monitoring: Operational monitoring to take place in the form of cross-checking works undertaken with contractor specification documents Soil moisture and texture to be monitored during the 5yr after care period.
				Drier/drought conditions	Wetlands may disappear (also dependent on elevation) and certain soil types may be less readily available.	No	Drier/drought conditions could encourage the drying out of wetlands however there are a number of mitigation measures in place to reduce these potential impacts and therefore the consequence is low; the Ecology chapter sets out the design specification, management and monitoring details for wetland ecosystems.	Not Significant	Deeper soil profiles or more moisture retentive textures to mitigate longer term drought effects on soils and associated tree species or vegetation. The current good practice is to separate different soil types during the restoration process, however this measure may not be sufficient following any potential CC impacts therefore to combat this, soil types may be mixed to provide greater flexibility for plant and trees species to be more resilient to drought. Future measures and monitoring: Operational monitoring to take place in the form of cross-checking works undertaken with contractor specification documents Soil moisture and texture to be monitored during the 5yr after care period.
				Increase in frequency and intensity of heavy rainfall events/ flooding	Loss of species in certain areas, because soils become water-saturated and can no longer support existing species	No	There are a number of mitigation measures in place to reduce the impacts of this; including the planting of a wide variety of species including drought tolerant species. This means that if the local existing plants and vegetation can not survive there will still be vegetation providing screening. The consequence is low because existing mitigation measures will minimise this increased flood risk. Loss of vegetation screening could affect the setting of character areas however it is not thought that this would change the level of effect.	Not Significant	No additional mitigation measures required
				Hotter and wetter conditions	Could lead to an increase in pests and diseases, leading to loss of vegetation and defoliation making species more susceptible to external stress	No	Warmer and wetter conditions are more likley . The increased risk of pests and disease to species is low because of compliance with Plant Procurement Strategy and management of trees during construction works i.e. removing trees that pose a threat/are diseased	Not Significant	No additional mitigation measures required Future measures and monitoring: Management/monitoring of newly planted trees during aftercare period (typically 12-24 months) will help to identify diseased or pest infested trees
				Hotter and wetter conditions	Leads to a longer growing season – increased rate of growth of vegetation.	No	Longer growing seasons have both positive and negative impacts. Vegetation will be in leaf for longer and reduce adverse views, but it may increase number of leaves on the line, change the trees structural capacity which could increase the stress on trees to external stressors. There are a number of mitigation measures in place including the planting of a wide variety of species including drought tolerant species. This means that if the local existing plants and vegetation can not survive there will still be vegetation providing screening.	Not Significant	No additional mitigation measures required Future measures and monitoring: Monitoring of the plant/tree species to be undertaken to identify changes in growth patterns
				Increased wind speed	Loss of valued landscape, opening up new views that were previously shielded, potential for damage to trees from construction making them more vulnerable to high winds	No	There is considerable uncertainty in projecting wind changes, to wind speed and direction, and studies show statistically insignificant variation in wind speed. If wind speed does increase then its more likely to affect more mature, existing trees. There are a number of mitigation measures in place to reduce the impacts of this; including the planting of a wide variety of species including drought tolerant species. This means that if the local existing plants and vegetation can not survive there will still be vegetation providing screening.	Not Significant	No additional mitigation measures required

Traffic and Transport

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
All forms of motorised traffic and transport	Roads: temporary diversions, closures, alternative routes	Construction	Travel plan implemented Improved routes into and around the site provided	Hotter and drier/drought conditions	Variation to public transport methods and time spent outdoors	No	It is likely that drier/drought conditions will increase the time the public spent outdoors. The impact of this could be positive or negative.	Not Significant	No additional mitigation measures required
	Roads: permanent diversions, closures, alternative routes	Operation	Travel plan implemented Improved routes into and around the site provided	Hotter and drier/drought conditions	Variation to public transport methods and time spent outdoors	No	It is likely that drier/drought conditions will increase the time the public spent outdoors. Impact on the traffic assessment could be positive or negative.	Not Significant	No additional mitigation measures required Future measures and monitoring: travel plan?
				Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Variation to public transport methods and time spent outdoors Increased flood risk leading to road closures	No	It is unlikely that an increase in the frequency of extreme events will negatively impact the roads because they have been designed with surface drainage systems that have embbeded climate change allowances to deal with increased flood risk as described in the Water Chapter	Not Significant	No additional mitigation measures required
Pedestrian routes	Footpaths: diversions, closures, alternative routes – temporary and permanent.	Construction	Travel plan implemented Improved routes into and around the site provided	Increase in frequency and intensity of heavy rainfall events/ flooding	Increased flood risk leading to road/footpath closures	No	Increases in rainfall events/flooding is likely. The risk of flooding to PROW is considered to be low because the river levels in this poart of York are manually managed. It is believed that with this mitigation the risk of flooding of PROW along the route is negligible	Not Significant	No additional mitigation measures required Climate change including flood risk has been embedded into design based on the Flood Risk Assessment undertaken by the Water Resources and Flood Risk team, therefore no future measures and monitoring are required.
		Operation	Travel plan implemented Improved routes into and around the site provided	Increase in frequency and intensity of heavy rainfall events/ flooding	Increased flood risk leading to road/footpath closures	No	Increases in rainfall events/flooding is likely. The risk of flooding to PROW is considered to be low because the river levels in this poart of York are manually managed. It is believed that with this mitigation the risk of flooding of PROW along the route is negligible	Not Significant	No additional mitigation measures required Climate change including flood risk has been embedded into design based on the Flood Risk Assessment undertaken by the Water Resources and Flood Risk team, therefore no future measures and monitoring are required.
Cyclists	Cyclists	Construction	Travel plan implemented Improved routes into and around the site provided	Hotter and drier/drought conditions	An increase in hotter and dryer conditions can cause variation in the time spent cycling	No	It is likely that drier/drought conditions will increase the time the public spent outdoors. The impact of	Not Significant	No additional mitigation measures required
		Operation	Travel plan implemented Improved routes into and around the site provided	Hotter and drier/drought conditions	An increase in hotter and dryer conditions can cause variation in the time spent cycling	No	It is likely that drier/drought conditions will increase the time the public spent outdoors. Impact on the traffic assessment could be positive or negative.	Not Significant	No additional mitigation measures required Future measures and monitoring: travel plan?
				Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	An increase in frequency of extreme weather events can cause variation in the time spent cycling	No	It is unlikely that an increase in the frequency of extreme events will negatively impact the roads because they have been designed with surface drainage systems that have embbeded climate change allowances to deal with increased flood risk as described in the Water Chapter	Not Significant	No additional mitigation measures required

Waste and Material Resources

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
Non-hazardous waste landfill	Excavated material - approximately 0 tonnes of chemically unacceptable U1B material to require off-site disposal to non-hazardous landfill. Demolition material and waste – forecast that quantity of demolition waste for off-site disposal would be 7,781 tonnes. Construction waste – approximate quantity of waste that would require off-site disposal to landfill during the overall construction period of 2020 to 2026 would be 41,954 tonnes. Reduction in on-hazardous landfill waste capacity in north yorkshire Excavated material, demolition material and construction waste to require off-site disposal to non-hazardous landfill.	Construction		Hotter and drier/drought conditions	Waste will desiccate instead of decompose.	No	It is unlikely that hotter, drier conditions will lead to waste dessicate insead of decomposing. Temperature change will not affect inert waste.	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.
				Hotter and drier/drought conditions	Increase consumption of beverages, increased frequency of waste collection required.	No	Whilst hotter and drier conditions are likely, there are sufficient mitigation measures in place, including compliance with the EMR requirements. This additional quantity of waste will also be insignificant compared to other waste generated.	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.
				Hotter and wetter conditions	Could affect decomposition and odour production (anaerobic more quickly)	No	It is unlikely that hotter, wetter conditions will lead to odour production. Temperature change will not affect inert waste.	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.
				Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Loss and reduction in quality of available waste and material resources	No	This is not considered a significant in-combination impact. Whilst some waste will be suitable for energy recovery, most waste will be sent to landfill and therefore this loss and reduction in quality of available waste and resources is not affected by the Proposed Scheme.	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.
				Increase in frequency and intensity of heavy rainfall events/ flooding	Impact excavated soils, turn valuable stock pile into waste through contamination	No	It is unlikely that increased frequency of heavy rainfall or flooding will reduce the value of excavated soils during construction. The consequence of any effects officring is low because precipitation change wouldn't affect inert waste.	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.
	Track maintenance waste – quantity that would require off-site disposal to landfill in 2027 will be approximately 119 tonnes. Ancillary infrastructure waste - The quantity of ancillary infrastructure waste that will require off-site disposal to landfill in 2026 will be approximately 27 tonnes.	Operation		Hotter and drier/drought conditions	Could affect decomposition and odour production, however there are limited amout of operational non-hazaradous waste being sent to landfill.	No	Thiis is not considered a significant in-combination impact. Whilst waste will be generated which needs to be disposed of in landfill, the additional odour from this waste will be insignificant.	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.
				Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Loss and reduction in quality of available waste and material resources	No	This is not considered a significant in-combination impact. While waste will be generated and resources needed, the quantities are small during	Not Significant	No additional mitigation measures required Monitoring of waste management
	Ancillary infrastructure waste - The quantity of ancillary infrastructure waste that will require off-site disposal to landfill in 2026 will be approximately 27 tonnes.	Operation		Hotter and drier/drought conditions	Increased frequency of waste collection required, increased consumption of beverages	No	Given there are no stations along the Proposed route and significantly reduced works on site during operation this is not considered to be a significant in-combination impact.	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.
Hazardous waste landfill	Excavated material - approximately 6,306 tonnes will require off-site disposal to landfill Demolition material and waste – forecast that quantity of demolition waster for off-site disposal would be 5,187 tonnes	Construction		Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Loss and reduction in quality of available waste and material resources	No	The likely significant environmental effects associated with the disposal of inert surplus waste has been considered a minor adverse and, therefore, it is not considered that there is a significant in-combination impact.	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.
				Increase in frequency and intensity of heavy rainfall events/ flooding	Impact excavated soils.	No	Tthe likely significant environmental effects associated with the disposal of inert surplus waste has been considered a minor adverse and, therefore, it is not considered that there is a significant in-combination impact.	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.
	Operation FC 11/07/2016 Assume no effect post-construction.	Construction			n/a	No	n/a	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.
Inert Waste	Excavated material - approximately 674,179 tonnes will require off-site disposal to landfill	Construction		Increase in frequency of extreme weather events (e.g. drought, flooding, heat waves)	Loss and reduction in quality of available waste and material resources	No	The likely significant environmental effects associated with the disposal of inert surplus waste has been considered a minor adverse and, therefore, it is not considered that there is a significant in-combination impact.	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.
				Increase in frequency and intensity of heavy rainfall events/ flooding	Impact excavated soils.	No	The likely significant environmental effects associated with the disposal of inert surplus waste has been considered a minor adverse and, therefore, it is not considered that there is a significant in-combination impact.	Not Significant	No additional mitigation measures required Monitoring of waste management activities will be undertaken by xxx.

Water resources and flood risk

Resources/receptors potentially impacted by the Proposed Scheme identified by environmental topic	Effects of Proposed Scheme on receptors/resources identified by environmental topic	Each effect should be identified as occuring during construction or operation by environmental topic	Existing/embedded mitigation measures	Potential climate change hazards impacting on resources/receptors	In-combination climate change impact	Can this change the significance given existing/embedded mitigation measures	Justification of Likelihood/Consequence of in-combination climate change impacts given existing/embedded mitigation measures	Significance of in-combination climate change impacts given existing/embedded mitigation measures	Additional mitigation measures to address significant effects on the ability of resources and receptors to adapt to climate change
Surface water resources	Increased surface water discharge and run off to sewage systems leads to flooding of sewage systems and to discharge of contaminated water to surface water. This may trigger off-site operation of combined sewer overflows downstream of the site. Temporary surface water ponding. Potential indirect impact on traffic movements. Increase in foul flow resulting from the development	Construction		Drier/drought conditions	Reduced rainfall leads to lower flows in watercourses, low river flows, exacerbating effects of pollution.	No	Drought conditions will not lower flows in water courses along the route because climate change mitigation measures have been embedded into the design as per the Flood Risk chapter	Not Significant	No additional mitigation measures required because climate change has already been embedded into exisitng mitigation measures as per the Flood Risk Chapter
				Increase in frequency and intensity of heavy rainfall events/ flooding	Increased flood risk, increased discharge volume, increased surface water run-off	No	Increased frequency and intensity of heavy rainfall events/flooding will not increase flood risk, discharge volumes and surface water runoff because climate change allowances have been provided in Section xx of the Cross-Drainage Chapter which states that a 30% allowance shall be added to design flood return period flows for future climate change	Not Significant	No additional mitigation measures required because climate change has already been embedded into exisitng mitigation measures as per the Flood Risk Chapter
		Operation		Drier/drought conditions	Reduced rainfall leads to lower flows in watercourses, low river flows, exacerbating the effects of spillages and increasing the concentration of pollutants in surface water resources.	No	Mitigation measures will comprise a net increase storage across the route, replacing all ponds that will be removed as part of construction. Natural wetlands act as a buffer against drought.	Not Significant	No additional mitigation measures required because climate change has already been embedded into exisitng mitigation measures as per the Flood Risk Chapter
				Increase in frequency and intensity of heavy rainfall events/ flooding	Increased flood risk, increased run-off, increased discharge volume, increased surface water run-off	No	Structures are to be designed to 1 in 100yr event including a climate change allowance of 30% as described in the Cross-drainage chapter and adherence with NPPF policies will be undertaken to ensure proposed scheme is safe from flooding in future	Not Significant	No additional mitigation measures required because climate change has already been embedded into exisitng mitigation measures as per the Flood Risk and Cross Drainage Chapter
	Increase discharge and run-off from site resulting in increasing flood risk downstream. Impacts on residential receptors, access routes through the site and debris/maretial causing blockages.	Operation	Surface Water discharge rates to be restricted to 70% of existing or 5l./s (whichever is higher) Surface Water to be attenuated on site. System to be designed to retain surface water flooding on site up to 1 in 100 year. Exceedance flow in excess of 1 in 100 years to be directed away from the operational property. Surface Water discharge rates to be Debris Screens to be provided on downstream end of new swales to mitigate the risk of debris entering Holgate Beck A 40% climate change allowance has been added to design flood return period flows to account for future climate change.	Increase in frequency and intensity of heavy rainfall events/ flooding	Increased flood risk, increased run-off, increased discharge volume, increased surface water run-off	No	Potential climate change impacts on flood risk and land drainage during operation works have been mitigated through a 40% climate change allowance has been added to design flood return period flows to account for future climate change, as described in section xx of the xxx chapter. A flood risk assessment has also been completed (ref to chapter). For more detail see the Water resources EIA chapter.	Not Significant	
Ground water resources	Groundwater resources impacted by the construction of tunnels Pollution to groundwater resources Loss of features (i.e. springs) due to the construction of culverts etc. Rediction in total area of permeable zones which will reduce recharge of the aquifer. Flow may be affected by short-term temporary excavations and temporary dewatering	Construction		Increase in frequency and intensity of heavy rainfall events/ flooding	Lower flows in watercourses, reduction in groundwater levels, low river flows and reduced groundwater recharge and levels	No	There are no potential climate change impacts on ground water resources during construction works because of the mitigation measures set out in the Groundwater Protection chapter	Not Significant	No additional mitigation measures required because climate change has already been embedded into exisitng mitigation measures as per the Groundwater Protection Chapter
		Construction	Contractor to programme construction works to minimise the duration of open excavations in so far as practicable.	Drier/drought conditions	Lower flows in watercourses, reduction in groundwater levels, low river flows leading to furrther reduced groundwater recharge and levels.	No		Not Significant	
		Operation	Use of de-silting equipment prior to discharge of surface water off-site.	Drier/drought conditions	Lower flows in watercourses, reduction in groundwater levels, low river flows leading to furrther reduced groundwater recharge and levels.	No		Not Significant	
	Potential for accidental spillages that release contaminants into the water environment	Construction	Use of temporary drainage networks and ditches to intercept overland flow.	Drier/drought conditions	Lower flows in watercourses, reduction in groundwater levels, low river flows leading to furrther reduced groundwater recharge and levels and increasing the concentration of pollutants in groundwater resources.	No		Not Significant	
		Operation	Use of temporary attenuation ponds.	Drier/drought conditions	Lower flows in watercourses, reduction in groundwater levels, low river flows leading to furrther reduced groundwater recharge and levels and increasing the concentration of pollutants in groundwater resources.	No		Not Significant	
		Operation		Hotter and wetter conditions	Lower flows in watercourses, reduction in groundwater levels, low river flows and reduced groundwater recharge and levels	No	Water attenuation schemes for the surrounding environment should provide some extra buffer to groundwater levels, against drought conditions. There will be an increase in net storage across the route because for every pond removed as part of the construction works two smaller ponds will be created. Groundwater therefore recharges locally wherever possible	Not Significant	No additional mitigation measures required because climate change has already been embedded into exisitng mitigation measures as per the Groundwater Protection Chapter
Flood risk and land drainage	Surcharging and flooding leading to exceedance of sewers resulting in combined sewer effluent escaping from the system and flooding on site. Relasing contaminants into the water environment.	Construction		Increase in frequency and intensity of heavy rainfall events/ flooding	Increased fluvial and ground water flood risk.	No	Potential impacts of extreme weather and climate change on flood risk during construction to be mitigated through resilient design guidelines, presented in the Design Guide (TBC)	Not Significant	No additional mitigation measures required because climate change has already been embedded into exisitng mitigation measures as per the Flood Risk and Cross-drainage Chapters
		Operation	New surface water drainage system implemented which will reduce the peak flow discharge from the existing site to the combined sewer creating capacity for the peak foul water discharge. A 40% climate change allowance has been added to design flood return period flows to account for future climate change.	Increase in frequency and intensity of heavy rainfall events/ flooding	Increased flood risk, increased run-off, increased discharge volume, increased surface water run-off	No	Potential climate change impacts on flood risk and land drainage during operation works have been mitigated through a 40% climate change allowance has been added to design flood return period flows to account for future climate change, as described in section xx of the xxx chapter. A flood risk assessment has also been completed (ref to chapter). For more detail see the Water resources EIA chapter.	Not Significant	

	Potential for accidental spillages that release contaminants into the water environment	Operation		Increase in frequency and intensity of heavy rainfall events/ flooding	Increased flood risk, increased run-off, increased discharge volume, increased surface water run-off	No	Structures are to be designed to 1 in 100yr event including a climate change allowance of 30% (see Cross-drainage chapter) and adherence with NPPF policies will be undertaken to ensure proposed scheme is safe from flooding in future section 4 of the Spillage Risk Assessment Water Tecnical Note document states that mitigation measures will be identified to avoid, reduce and offset significant spillage risk and can be	Not Significant	No additional mitigation measures required because climate change has already been embedded into exisitng mitigation measures as per the Flood Risk and Cross-drainage Chapters
	Increase discharge and run-off from site resulting in increasing flood risk downstream. Impacts on residential receptors, access routes through the site and debris/maretial causing blockages.	Operation	Surface Water discharge rates to be restricted to 70% of existing or 5l./s (whichever is higher) Surface Water to be attenuated on site. System to be designed to retain surface water flooding on site up to 1 in 100 year. Exceedance flow in excess of 1 in 100 years to be directed away from the operational property. Surface Water discharge rates to be Debris Screens to be provided on downstream end of new swales to mitigate the risk of debris entering Holgate Beck A 40% climate change allowance has been added to design flood return period flows to account for future climate change.	Increase in frequency and intensity of heavy rainfall events/ flooding	Increased flood risk, increased run-off, increased discharge volume, increased surface water run-off	No	Potential climate change impacts on flood risk and land drainage during operation works have been mitigated through a 40% climate change allowance has been added to design flood return period flows to account for future climate change, as described in section xx of the xxx chapter. A flood risk assessment has also been completed (ref to chapter). For more detail see the Water resources EIA chapter.	Not Significant	