XLINKS' MOROCCO-UK POWER PROJECT

Environmental Statement

Volume 2, Appendix 1.10: Aquatic Invertebrate Monitoring of Watercourses to be Crossed

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Prepared by:

Lee Knight

Prepared for:

Xlinks 1 Limited

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Glossary

Term	Meaning
Alverdiscott Substation Site	The National Grid Electricity Transmission substation site within which the Alverdiscott Substation sits.
Converter Site	The Converter Site is proposed to be located to the immediate west of the existing Alverdiscott Substation site in north Devon. The Converter Site would contain two converter stations (known as Bipole 1 and Bipole 2) and associated infrastructure, buildings and landscaping.
Environmental Impact Assessment	The process of identifying and assessing the significant effects likely to arise from a Proposed Development. This requires consideration of the likely changes to the environment, where these arise as a consequence of a Proposed Development, through comparison with the existing and Proposed projected future baseline conditions.
Environmental Statement	The document presenting the results of the Environmental Impact Assessment process.
HVDC Cables	The High Voltage Direct Current cables which would bring electricity to the converter stations from its generation source.
Landfall	The proposed area in which the offshore cables make landfall in the United Kingdom (come on shore) and the transitional area between the offshore cabling and the onshore cabling. This term applies to the entire landfall area at Cornborough Range, Devon, between Mean Low Water Springs and the transition joint bay inclusive of all construction works, including the offshore and onshore cable routes, and landfall compound(s).
Onshore HVDC Cable Corridor	The proposed corridor within which the onshore High Voltage Direct Current cables will be located.
Proposed Development	The element of Xlinks' Morocco-UK Power Project within the UK. The Proposed Development covers all works required to construct and operate the offshore cables (from the UK Exclusive Economic Zone to Landfall), Landfall, onshore Direct Current and Alternating Current cables, converter stations, and highways improvements.
Xlinks' Morocco UK Power Project (the 'Project')	The overall scheme from Morocco to the national grid, including all onshore and offshore elements of the transmission network and the generation site in Morocco (referred to as the 'Project').

Acronyms

Acronym	Meaning
ASPT	Average Score Per Taxon
BMWP	Biological Monitoring Working Party
CCI	Community Conservation Index
CIEEM	Chartered Institute of Ecology and Environmental Management
D/S	Downstream
HVDC	High Voltage Direct Current
N-Taxa	Number of BMWP scoring taxa
U/S	Upstream
WHPT	Whalley Hawkes Paisley Trigg

Units

Units	Meaning
km	Kilometre
ha	Hectares
m	Metres

1 AQUATIC INVERTEBRATE MONITORING OF WATERCOURSES TO BE CROSSED

1.1 Introduction

1.1.1 This document forms Volume 2, Appendix 1.10: Aquatic Invertebrate Monitoring of Watercourses to be Crossed of the Environmental Statement (ES) prepared for the United Kingdom (UK) elements of the Xlinks Morocco-UK Power Project (the 'Project'). For ease of reference, the UK elements of the Project are referred to as the 'Proposed Development, which is the focus of the Environmental Statement (ES). The ES presents the findings of the Environmental Impact Assessment process for the Proposed Development.

1.1.2 This document provides the results of survey for aquatic invertebrate surveys undertaken to inform Volume 2, Chapter 1: Onshore Ecology and Nature Conservation of the ES.

1.1.3 The desk study and site-surveys were designed to determine the presence or likely absence of protected and notable aquatic macroinvertebrate species, and to determine the aquatic invertebrate diversity of each relevant waterbody or watercourse.

1.2 Site Location

1.2.1 The Onshore Infrastructure Area is located in north Devon and includes the Landfall, Onshore HVDC Cable Corridor, HVAC Cable Corridors and Converter Site. The Onshore HVDC Cable Corridor is approximately 14.5 km in length and the Converter Site is approximately 39.5 ha. The HVAC Cable Corridors are situated within the boundaries of the Converter Site and Alverdiscott Substation Site.

1.2.2 The Onshore HVDC Cable Corridor passes through a mixture of pastoral and arable farm land, with fields bounded by Devon hedgerows, and occasionally crossing small watercourses in wooded valleys. The route also crosses the tidal Torridge estuary.

1.2.3 The Onshore Infrastructure Area is presented in Volume 2, Figure 1.1 of the ES (see Volume 2, Figures).

1.3 Study Area

1.3.1 The onshore ecology and nature conservation study area is detailed within Volume 2, Chapter 1: Onshore Ecology and Nature Conservation of the ES. The study area includes the following.

- Locally designated sites, including Local Nature Reserves and Local Wildlife Sites, and less mobile species located within 2 km of the Onshore Infrastructure Area.
- Nationally designated sites, including Sites of Special Scientific Interest and National Nature Reserves, and records of particularly mobile protected or

otherwise notable species (e.g. bats and otters) located within 5 km of the Onshore Infrastructure Area.

- Internationally designated sites located within 12 km of the Onshore Infrastructure Area.

1.3.2 The onshore ecology and nature conservation study area is presented in Volume 2, Figure 1.1 of the ES (see Volume 2, Figures).

1.4 Survey Area

1.4.1 The survey area is defined as the area within which each survey has been undertaken and is based on species or site-specific guidance on the extent of survey required. The survey area for the aquatic invertebrate monitoring included those watercourses that are crossed by or immediately adjacent to the Onshore Infrastructure Area.

1.5 Methodology

Data sources

1.5.1 Reference has been made to the publicly-accessible ES for the Atlantic Array Offshore Wind Farm project which was applied for in 2013 but not completed and which followed a similar cable route from the Landfall to the Alverdiscott Substation Site. Reference to the Atlantic Array project also allows a level of ground-truthing to ensure that there is some consistency between what was identified in 2013 and what is being identified now.

1.5.2 As part of both the former and current projects, a suite of ecological impact assessments were carried out along the proposed cable route and as the route crosses several small watercourses, surveys were required of the aquatic macro-invertebrate communities within them to assess their importance and determine the presence of any species of conservation value prior to works commencing. Eleven watercourses were thus investigated during October 2010 and May 2011 and are reported by RPS (2013).

Overview

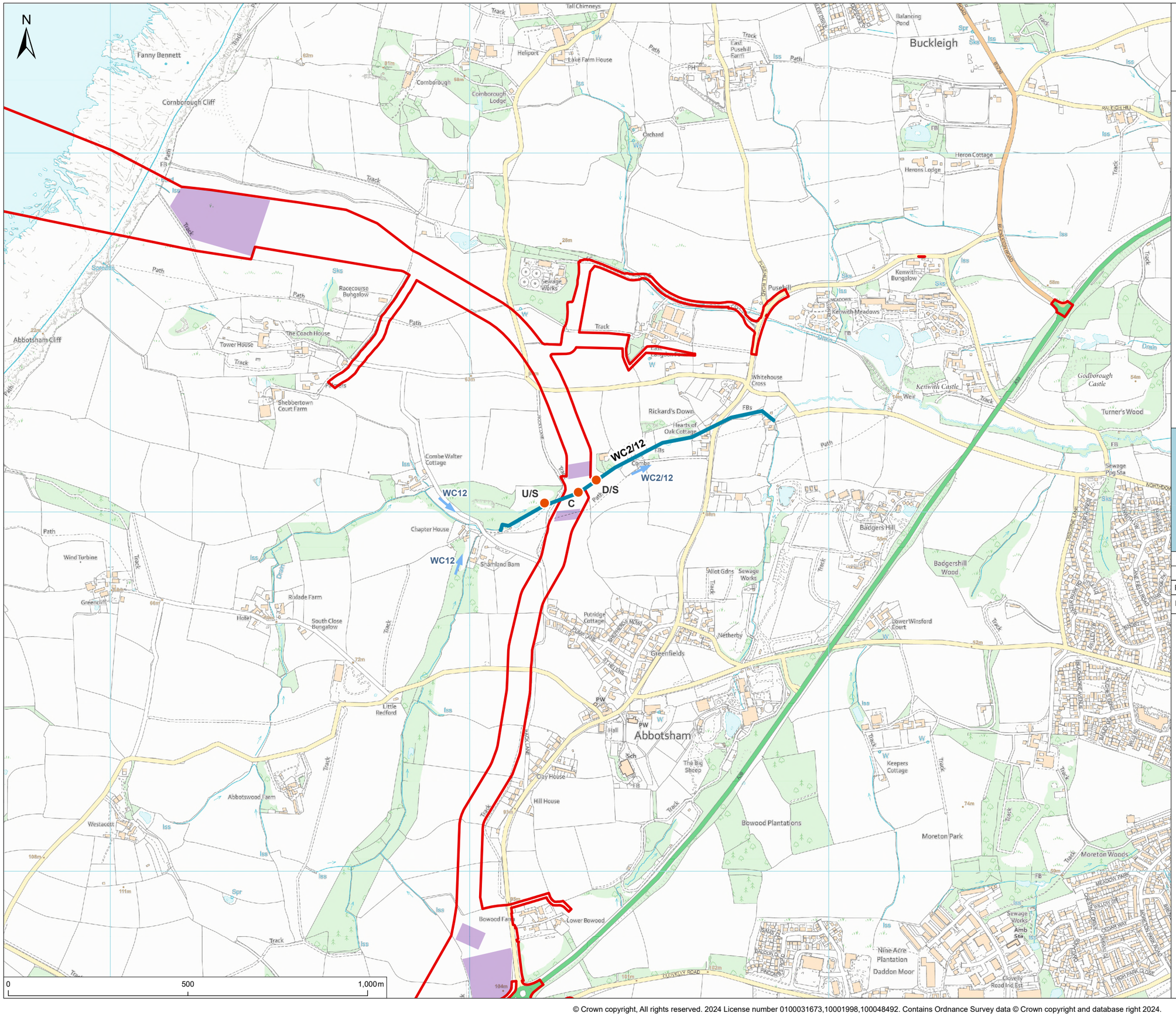
1.5.3 An initial investigation of watercourses along the route of the Xlinks cable was undertaken during September 2022 (see **Annex F**). Six small first order streams were identified as being either directly crossed by the route or close to the proposed works, such that they might be potentially impacted as a result of the Proposed Development. Due to a prolonged dry summer and low flows in 2022, two of the streams held insufficient water for sampling, and only on two of the streams was it possible to sample three sites, as specified in the adopted method below.

1.5.4 Owing to the iterative design process of the Proposed Development, further aquatic invertebrate surveys were conducted in 2024. A desk study indicated the following watercourses that would be crossed by the cable or are close to the Converter Site.

- Kenwith Stream at Rickard's Down to the east of Combe Walker and Chaltaborough, identified as WC2/12 in the 2022 survey report.

- Small ditch to the south of the A39, west of the Abbotsham Cross roundabout, identified as WC17 in the 2022 survey.
- Stream flowing through Littleham Wood into a watercourse feeding the western end of Jennetts Reservoir. The Onshore HVDC Cable Corridor does not cross the stream directly, but its source is located at the bottom of a slope just to the north of the route, such that it could potentially be impacted by run-off during excavations. This is referred to as WC18.
- Stream to the east of Robin Hill Farm that flows northwards into the western end of Jennetts Reservoir. This is referred to as WC19.
- Small stream that rises to the west of Lower Dunn Farm. As with WC19, the Onshore HVDC Cable Corridor does not directly cross this watercourse, but its source is located just to the north of the route. This is referred to as WC20.
- Stream to the east of Lower Dunn Farm that flows northwards into Jennets Reservoir, identified as WC5 in previous surveys.
- Stream south of Higher Huxhill that flows south eastwards along the boundary of the Converter Site to join WC10 (see below), the combined flow then joins a third tributary (identified as WC9 in previous surveys), forming the headwaters of the Huntshaw Water. Identified as WC16 in the 2022 survey.
- A second tributary of the Huntshaw Water which flows along the eastern boundary of Alverdiscott Substation Site, before combining with WC16. Identified as WC10 in the 2022 survey.

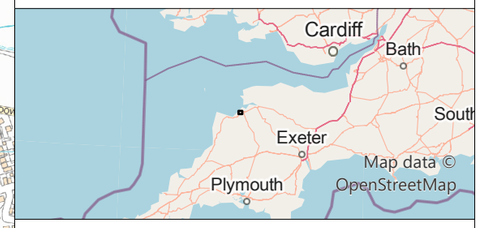
1.5.5 The locations of the streams and sampling sites on them are illustrated in **Figure 1.1** to **Figure 1.3** below.



Notes
1. This plan is scaled at paper size A3. If received electronically it is the recipients responsibility to print to the correct scale. Only written dimensions should be used.

Legend

- Order Limits
- Temporary construction compounds
- Watercourses
- Direction of flow
- Sampling locations



Rev	Description	By	CB	Date
P01	FINAL	AC	MB	31.10.24

Xlinks

Client: Xlinks 1 Limited

Project: Xlinks' Morocco-UK Power Project

Title: The Locations of Sampling Sites on WC2/12

Status: FINAL

Scale @ A3: 1:10,000

Date Created: Nov 2024

Figure Number: **1.1**

Rev: **P01**

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N

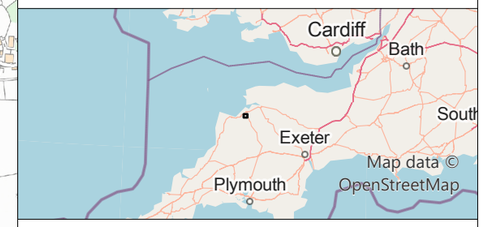
WC5
D/S
C
U/S
WC20
D/S
WC19
D/S
C
WC18
D/S
WC19
WC5

0 500 1,000m

Notes
1. This plan is scaled at paper size A3. If received electronically it is the recipients responsibility to print to the correct scale. Only written dimensions should be used.

Legend

- Order Limits
- Temporary construction compounds
- Watercourses
- Direction of flow
- Sampling locations



P01	FINAL	AC	MB	31.10.24
Rev	Description	By	CB	Date

Xlinks

Client: Xlinks 1 Limited

Project: Xlinks' Morocco-UK Power Project

Title: The Locations of Sampling Sites on WC18, WC19, WC20 and WC5

Status: FINAL

Scale @ A3: 1:10,000

Date Created: Nov 2024

Figure Number: **1.2**

Rev: **P01**

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N

WC16
WC10
WC9
D/S
D/S
Cleave Solar Farm
Cleave Solar Farm
Cleave Solar Farm
Gas Gov
CG
ESS
El Dist Sta
Woodtown
Webbery Cross
Webbery Cross Cottage
on site of Mansion
North Meadow Cope
Webbery Garden Cottage
Webbery House
Webbery Wood
Bulworthy Forest House
Bulworthy Common
Bulworthy Farm
Rice Mill Cottage
Longland Copse
Deepy Park
Stony Cross
East Webbery Cottage
Twelve Acre Copse
Westclose Copse
Northclose Copse
Bartridge Farm
Temple Haven
Woodtown House
Woodtown Lodge
Coach House
Longstone House
Path
Track
Gammaton Barton
Higher Kingdon Barn
Gammaton Reservoirs
Tarka Swims
Moorland Cottage
Gammaton Lodge
Gammaton House
Milestone Cottage
Lower Kingdon
Higher Huxhill
Wind Turbine
Haddacott Moor
Haddacott Cottage
Haddacott Cross
Brownscombe Farm
Garnacott Farm
Claw Copse
Higher Guscott Farmhouse
Huntshaw Water Farm
Guscott
Huntshaw
Pillhead
West Webbery
Souther Down Wood
Ppg Sta
Furze Ball

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Notes
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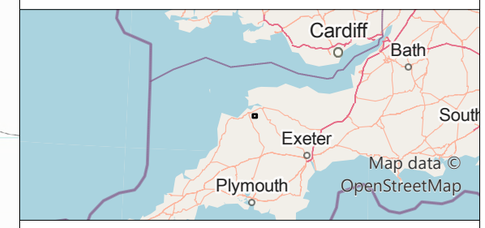
Legend

- Order Limits
- Temporary construction compounds
- Watercourses
- Direction of flow
- Sampling locations



Rev	Description	By	CB	Date
P01	FINAL	AC	MB	31.10.24

Client: Xlinks 1 Limited

Project: Xlinks' Morocco-UK Power Project

Title: The Locations of Sampling Sites on WC10 and WC16

Status: FINAL

Scale @ A3: 1:10,000

Date Created: Nov 2024

Figure Number: **1.3**

Rev: **P01**

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Field Survey

1.5.6 The survey of the watercourses took place on 1 October 2024, after a period of prolonged rain. On each watercourse, it was proposed to select three sites for aquatic invertebrate sampling:

- one at the location of the proposed Onshore HVDC Cable Corridor (the central site); and
- two further sampling sites, within approximately 50 m upstream and downstream of the central site.

1.5.7 The central site would potentially be destroyed during the installation of the Onshore HVDC Cable Corridor but the data from the survey would provide a baseline assessment of the communities present before works commenced. The other two sites would provide potential monitoring sites should this be required during the construction process, with the upstream site providing a control against which the downstream site could be compared.

1.5.8 As streams WC18 and WC20 will not be crossed by the Onshore HVDC Cable Corridor but rise close to it, a single downstream site on each was deemed sufficient for aquatic invertebrate sampling. Whilst the Onshore HVDC Cable Corridor does cross the headwaters of stream WC19 above the location of the central site, the watercourse is very small and flows within a deep, heavily overgrown channel, thus sampling was limited to downstream and central sites only.

1.5.9 Streams WC10 and WC16 are not crossed by the Onshore HVDC Cable Corridor, but both watercourses flow along the boundary of the Converter Site and in the vicinity of Alverdiscott Substation Site. Downstream sites only were sampled on each watercourse, just upstream of their confluence to the south of Alverdiscott Substation Site.

1.5.10 The Onshore HVDC Cable Corridor will cross the source of WC17, which was a small agricultural ditch flowing within a deep channel beneath a dense hedgerow. This same location was also investigated in 2022, when only a few very shallow, isolated pools were present in the channel and no sampling was undertaken. Whilst more flow was evident in the channel in October 2024, the stream was still very small and coupled with the dense growth of the adjacent hedgerow, sampling would have been impractical.

1.5.11 The locations of the watercourses and sampling sites on them are illustrated in **Figure 1.1** to **Figure 1.3. Annex A** lists the environmental data for the sites, including descriptions of their locations, grid references, substrate composition and any flora present in the wetted channel. Site photographs are provided in **Annex B**.

1.5.12 Each of the sites was sampled using the standard protocol employed by the Environment Agency for sampling lotic watercourses (detailed in Environment Agency internal document No. 018_08 (2017), which has now superseded the more detailed BT001 (Murray-Bligh, 1999)). This protocol involved a timed period of three minutes of active net sampling (the time being apportioned to each habitat according to the proportion of the site that it covered), accompanied by a one minute search.

1.5.13 The net sampling was carried out using a Freshwater Biological Association pattern pond net, fitted with a 1 mm mesh collecting bag and involved a combination of kick sampling and sweeping the net through marginal vegetation.

1.5.14 This was accompanied by manual investigation of submerged coarse woody debris and larger stones for attached organisms (e.g. the river limpet (*Ancylus fluviatilis*)) and searches of the water surface for surface-dwelling animals (e.g. the whirligig beetle *Orectochilus villosus*), for a timed period of one minute in total at each site.

1.5.15 After collection, the samples were preserved on-site, in a solution of 90% Industrial Methylated Spirits (IMS or Denatured Ethanol B), 5% water and 5% glycerol for transportation to the laboratory and subsequent analysis.

1.6 Sample Analysis and Data Evaluation

1.6.1 The analysis of the samples followed standard Environment Agency procedures (as outlined in Environment Agency internal document No. 024_08 (2014) and BT001). Taxa were identified to the lowest possible taxonomic level, with the exception of the taxonomically difficult groups: Oligochaeta (segmented worms) and Chironomidae (non-biting midge larvae). Other Diptera larvae were identified to the lowest level possible due to larval maturity and available identification keys.

1.6.2 In the 2010 and 2011 Atlantic Array cable route surveys Biological Monitoring Working Party (BMWP), N-Taxa (number of BMWP scoring taxa) and Average Score Per Taxon (ASPT) scores were calculated for each sample to provide an assessment of the ecological water quality at each site. The BWMP index has since been superseded by the Whalley Hawkes Paisley Trigg (WHPT) index, which is now used by the Environment Agency and the other UK environmental monitoring agencies for the classification of rivers according to the European Water Framework Directive (WFD, 2000/60/EC) (see **Annex D** for further details of the BMWP and WHPT indices). In order to provide some comparison with previous data, both WHPT and BMWP indices were calculated for the data in the current survey.

1.6.3 The conservation value of the invertebrate communities at each sampling site was assessed using a community-based classification developed by the Environment Agency (Chadd and Extence, 2004). The Community Conservation Index (CCI) empirically assesses the conservation value of a given site using the entire invertebrate community rather than undue emphasis on the presence of a few scarce species. An explanation of the terms used, along with the formula for calculating the index is given in **Annex E**. The conservation values for individual species used in this report are those cited by Chadd and Extence (2004).

1.7 Site-specific Surveys

Results

1.7.1 **Table 1.1** below lists the WHPT, BMWP and CCI indices for each of the sites on the seven watercourses.

Table 1.1: Results of the site-specific survey

WATERCOURSE	WC2/12 Kenwith Stream			WC5 Lower Dunn Farm Stream East			WC10 Stream east of Sub-station	WC 16 Stream south of Sub-station	WC 18 Littleham Wood Stream	WC19 Robin Hill Farm Stream	WC20 Lower Dunn Farm Stream West
Sample Location	Downstream (D/S)	Central	Upstream (U/S)	D/S	Central	U/S	D/S	D/S	D/S	D/S	Central
BMWP	77	59	60	76	90	80	94	97	76	55	72
N-TAXA	16	13	14	14	17	14	17	16	13	11	13
ASPT	4.81	4.54	4.29	5.43	5.29	5.71	5.53	6.06	5.85	5	5.54
WHPT	91.8	68.18	69.86	85.26	108.87	90.45	104.76	101.28	98.7	67.98	86.7
WHPT N-TAXA	17	14	14	14	19	15	18	16	15	11	15
WHPT ASPT	5.4	4.87	4.99	6.09	5.73	6.03	5.82	6.33	6.58	6.18	5.78
Average Conservation Score	1.92	1.56	1.8	1.89	2.25	2.13	2.18	2.45	2.63	2.29	2
Community Score	3	3	3	3	3	3	3	3	3	3	3
Community Conservation Index	5.76	4.68	5.4	5.67	6.75	6.39	6.54	7.35	7.89	6.87	6
Conservation Status	Moderate	Low	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

1.2 Taxa lists for each of the five sampled watercourses are presented in **Annex C**, with summaries of the aquatic invertebrate communities below.

WC2/12: Kenwith Stream

1.7.1 The headwaters of this stream include the two watercourses referred to as WC2 and WC12 in the Atlantic Array survey report (RPS, 2013), both of which unite at Chaltaborough and then flow eastwards to Kenwith Castle, where the stream is joined by another tributary, before flowing through the Kenwith Valley to enter the Torridge Estuary between Bideford and Northam. The Onshore HVDC Cable Corridor crosses the stream at the same location as that surveyed in 2022, thus sampling was repeated at the same three sites, with the central sampling site located at SS 4230 2705. The stream is very small at this location, on average 2 m wide and 5 cm deep, with a predominately cobble and pebble substrate. Occasional marginal stands of brooklime (*Veronica beccabunga*) and fool's watercress (*Apium nodiflorum*) were present at the less shaded central and downstream sites respectively.

1.7.2 Whilst more diverse than those recorded in 2022, when flows were much reduced compared to 2024, the invertebrate communities at all three sites were of fairly low diversity, dominated by *Gammarus* amphipods and representative of such small headwater streams: the caddis *Diplectrona felix* in particular being typical of the habitat. As in all the streams in the survey, the low diversity is more an indication of the nature of the watercourses surveyed, rather than any detrimental impacts, given that pollution-sensitive taxa such as *Leuctra* stonefly and *Ecdyonurus* mayfly nymphs were sporadically present at various sites. All of the watercourses in the survey were very small first order streams either within or close to their headwaters, with restricted meso-habitat diversity and liable to either dry out completely or have very low flows in the summer months, further curtailing the diversity of their aquatic invertebrate communities. Although there are some potentially rare headwater specialist species amongst the aquatic invertebrates, such species were not recorded during the survey and the rather low diversity of all the assemblages led to them being of only moderate conservation value.

WC 5: Lower Dunn Farm Stream East

1.7.3 This is one of several watercourses (including WC18, 19 and 20) feeding into Jennets Reservoir to the south of Bideford. The stream lays within a small, wooded valley and has previously been sampled at various locations slightly further upstream of the 2024 survey. The downstream site was located at SS 4418 2442, adjacent to an old decoy pond. The whole stream channel was heavily shaded by tress and overhanging bankside vegetation, such that in-channel vegetation was largely absent. The substrate was primarily composed of pebbles and cobbles, with gravel more prevalent at the upstream site. The channel was 1 m wide with an average water depth of just 3 cm.

1.7.4 Aquatic invertebrate diversity was low, with the communities dominated by *Gammarus* amphipods, representative of the habitat and fairly similar in composition to those recorded further upstream in 2022.

WC 10: Stream to east of substation and WC16: Stream to south of sub-station

1.7.5 Both of these watercourses are not crossed by the Onshore HVDC Cable Corridor but flow along the boundaries of the Converter Site and the Alverdiscott Substation Site. They both unite at SS 50215 2492 and then flow for approximately 100 m to the southwest, where they are joined by a third tributary, Higher Kingdon Stream (WC9 in previous surveys), forming the headwaters of the Huntshaw Water. In 2022, WC 16 was just a muddy trickle, with insufficient water for sampling. WC10 also contained very little flow, mostly supplied via a spring culverted beneath the sub-station and was sampled just upstream of the confluence of the two watercourses.

1.7.6 In October 2024, both streams had considerably greater flow than in 2022 and were sampled just upstream of the confluence where their flows combine, in the case of WC10 at the same location as in 2022. The aquatic invertebrate communities at both sampling sites were similar in composition, representative of the habitat, and of moderate conservation value. The community at WC 10 was notably more diverse than that recorded in 2022, testament to the increased flow in the stream in October 2024.

WC 18: Littleham Wood Stream and WC20: Lower Dunn Farm Stream West

1.7.7 Both of these watercourses are not crossed by the Onshore HVDC Cable Corridor but have their sources in steep, wooded valleys just to the north, thus could potentially be impacted by run-off during excavation works. Neither stream had been previously surveyed. Downstream sites only were sampled on each and both streams were very small at these locations, on average 0.6 m wide with 3 cm to 4 cm of water. As with the other headwater streams in the survey, their aquatic invertebrate faun was rather restricted in diversity and of moderate conservation value.

WC19: Robin Hill Farm Stream

1.7.8 This stream was not sampled in previous surveys. This watercourse will be cut by the Onshore HVDC Cable Corridor, but due to its very small nature and difficulty of access upstream of the central site, only a central and downstream site were sampled. At both locations the stream channel was very small, on average 0.7 m wide and 5 cm deep, with a mostly pebble and gravel substrate. Both sampling sites had aquatic invertebrate communities of low diversity, dominated by Gammarus and of moderate conservation value.

1.8 Summary

1.8.1 All of the watercourses surveyed were very small headwater or first order streams with restricted aquatic invertebrate diversity. The communities were fairly similar in composition between the different streams and representative of the habitat, with the caddis *Diplectrona felix* and *Plectrocnemia geniculata* in particular being typical small stream species. The low diversity of the assemblages is more an indication of the nature of the watercourses surveyed, rather than any detrimental impacts, given that pollution-sensitive taxa such as *Leuctra* stonefly and

Ecdyonurus mayfly nymphs were sporadically present at various sites. Such small streams, in mostly heavily shaded, wooded valleys have little in the way of in-channel vegetation to improve meso-habitat heterogeneity and frequently either dry out completely or experience significantly reduced flows in the summer, as evident during the previous survey of September 2022 (see **Annex F**), which incorporated some of the same watercourses and sampling sites. Such an ephemeral flow regime can further curtail the development of diverse aquatic communities.

1.8.2 Although there are some potentially rare headwater invertebrates, limited to the habitat, no such species were recorded during the survey and overall the assemblages were of moderate (low at the WC 2/12 central site) conservation value.

1.9 References

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Walley, W.J. and Hawkes, H.A. (1996). A computer-based reappraisal of the Biological Monitoring Working Party scores using data from the 1990 river quality survey of England and Wales. Water Research, 30 (9): 2086-2094.

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Annex A: Sampling site environmental data

SITE	WC2 / 12 D/S	WC2 / 12 Central	WC2 / 12 U/S	WC5 D/S	WC5 Central	WC5 U/S
WATERCOURSE	Rickard's Down Stream	Rickard's Down Stream	Rickard's Down Stream	Lower Dunn Farm Stream East	Lower Dunn Farm Stream East	Lower Dunn Farm Stream East
LOCATION	50m Downstream central site, 30 m downstream boundary	20m Upstream boundary	75 m Upstream central site, 50m upstream boundary and ford	Adjacent to top end of decoy pond	60m Upstream downstream site, by large ash and game pen	75 m Upstream central site
NGR	SS 42353 27089	SS 42303 27055	SS 42209 27025	SS 44177 24421	SS 44240 24389	SS 44313 24330
WIDTH (m)	2	1.9	1.9	1	1	0.9
AVERAGE DEPTH (cm)	5	4	6	5	3	2
SUBSTRATE (% cover)						
Silt	Marginal / overlying	1	<1	1	3	2
Clay	2	0	0	0	0	0
Sand	1	2	<1	2	2	2
Gravel	12	15	9	17	40	35
Pebbles	50	47	45	45	35	41
Cobbles	35	35	45	35	20	20

SITE	WC2 / 12 D/S	WC2 / 12 Central	WC2 / 12 U/S	WC5 D/S	WC5 Central	WC5 U/S
Rock pavement	3	<1	2	0	0	0
FLOW	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
SHADING	Heavy	Medium	Heavy	Heavy	Heavy	Heavy
MACROPHYTE COVER (%)	1	1	0	0	0	0
MACROPHYTE SPECIES	*Apium nodiflorum*	*Verronica Beccabunga*	**	**	**	**
BRYOPHYTE COVER (%)	<1	<1	<1	0	0	0
BRYOPHYTE SPECIES	*Conocephalum conicum*	*Platyhypnidium riparoides*	*Platyhypnidium riparoides*	**	**	**
ALGAL COVER (%)	5	5	2	3	3	3
ALGAL SPECIES	Benthic diatoms	Benthic diatoms	Benthic diatoms	Benthic diatoms	Benthic diatoms	Benthic diatoms

SITE	WC10 D/S	WC16 D/S	WC 18 D/S	WC 19 D/S	WC 19 Central	WC 20 D/S
WATERCOURSE	Stream to east of sub-station	Stream to south of sub-station	Littleham Wood Stream	Robin Hill Farm Stream	Robin Hill Farm Stream	Lower Dunn Farm Stream West
LOCATION	5 m Upstream confluence with WC16	5 m Upstream confluence with WC10, immediately upstream gate	5 m Downstream bedrock cascade, downstream confluence of three spring heads	30 m Downstream field boundary	10 m Upstream field gate	25 m Downstream confluence of two spring heads
NGR	SS 50216 24925	SS50214 24920	SS 43255 24066	SS 43811 24230	SS 43802 24129	SS 43921 24214
WIDTH (m)	1.6	1.25	0.5	0.8	0.5	0.7
AVERAGE DEPTH (cm)	9	4	4	7	3	3
SUBSTRATE (% cover)						
Silt	5	0	5	1	2	3
Clay	0	0	0	0	0	0
Sand	5	<1	1	4	3	5
Gravel	45	30	30	25	30	50
Pebbles	30	35	34	40	40	27
Cobbles	15	35	30	30	25	15
Rock pavement			5	0	1	0

SITE	WC10 D/S	WC16 D/S	WC 18 D/S	WC 19 D/S	WC 19 Central	WC 20 D/S
FLOW	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
SHADING	Heavy	Heavy	Medium	Heavy	Heavy	Heavy
MACROPHYTE COVER (%)	0	0	0	0	0	0
MACROPHYTE SPECIES	**	**	**	**	**	**
BRYOPHYTE COVER (%)	0	0	3	0	<1	1
BRYOPHYTE SPECIES	**	**	*Conocephalum conicum*	**	*Platyhypnidium riparoides*	*Platyhypnidium riparoides*
ALGAL COVER (%)	10	3	3	5	3	3
ALGAL SPECIES	Benthic diatoms	Benthic diatoms	Benthic diatoms	Benthic diatoms	Benthic diatoms	Benthic diatoms

Annex B: Site photographs

WC2/12: Rickard's Down Stream, downstream site (left); central site (right)

WC2/12: Rickard's Down Stream, upstream site (left); WC5: Lower Dunn Farm Stream East, downstream site (right)

WC5: Lower Dunn Farm Stream East, central site (left); upstream site (right)

WC10: Stream east of sub-station, downstream site (left); WC16: Stream south of sub-station, downstream site (right)

WC18: Littleham Wood Stream, downstream site (left); WC20: Lower Dunn Farm Stream West, downstream site (right)

WC19: Robin Hill Farm Stream, downstream site (left); central site (right)

Annex C: Aquatic invertebrate taxa lists

WC2/12: Rickard's Down Stream

	Downstream		Central		Upstream	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
TRICLADIDA						
PLANARIIDAE						
Polycelis felina	4	0.99	3	0.53	2	0.38
OLIGOCHAETA						
Eiseniella tetraedra	1	0.25				
Oligochaeta (other sp.)	14	3.47	8	1.43	2	0.38
HIRUDINEA						
GLOSSIPHONIIDAE						
Glossiphonia complanata			1	0.18		
ERPOBDELLIDAE						
Trocheta subviridis	5	1.24	7	1.25	2	0.38
GASTROPODA						
PLANORBIDAE						
Ancylus fluviatilis	1	0.25				
HYDROBIDAE						
Potamopyrgus antipodarum	16	3.97	12	2.14	65	12.29
BIVALVIA						
SPHAERIIDAE						
Euglesa sp.					1	0.19
CRUSTACEA						
ASELLIDAE						

	Downstream		Central		Upstream	
TAXA	Nos.	Relative Abundance	Nos.	Relative Abundance	Nos.	Relative Abundance
Asellus aquaticus	15	3.72			9	1.70
GAMMARIDAE						
Gammarus pulex	10	2.48			6	1.13
Gammarus pulex / fossarum	223	55.33	499	88.95	344	65.03
PLECOPTERA						
LEUCTRIDAE						
Leuctra fusca	11	2.73	5	0.89	34	6.43
Leuctra sp.			3	0.53	4	0.76
EPHEMEROPTERA						
BAETIDAE						
Baetis rhodani / atlanticus	7	1.74	2	0.36		
TRICHOPTERA						
RHYACOPHILIDAE						
Rhyacophila dorsalis	2	0.50				
GLOSSOSMATIDAE						
Agapetus fuscipes			1	0.18		
POLYCENTROPODIDAE						
Plectrocnemia sp.	1	0.25				
HYDROPSYCHIDAE						
Diplectrona felix	2	0.50			14	2.65
DIPTERA						
CHIRONOMIDAE						

	Downstream		Central		Upstream	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
Chironomidae spp.	26	6.45	4	0.71	33	6.24
PSYCHODIDAE						
Pericoma sp.			2	0.36		
DIXIDAE						
Dixa nebulosa	2	0.50				
SIMULIIDAE						
Simulium sp.	2	0.50	1	0.18		
COLEOPTERA						
ELMIDAE						
Elmis aenea	25	6.20	4	0.71	7	1.32
Limnius volckmari	5	1.24				
HYDRAENIDAE						
Hydraena gracilis					3	0.57
SCIRTIDAE						
Elodes sp. (larvae)	31	7.69	9	1.60	2	0.38
Nos. Identified Taxa	**19**		**14**		**14**	
Total Nos. of Invertebrates	**403**		**561**		**529**	
BMWP	**77**		**59**		**60**	
N-TAXA	**16**		**13**		**14**	
ASPT	**4.81**		**4.54**		**4.29**	
WHPT	**91.8**		**68.18**		**69.86**	
N-TAXA	**17**		**14**		**14**	

	Downstream		Central		Upstream	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
ASPT	**5.4**		**4.87**		**4.99**	
Average Conservation Score	**1.92**		**1.56**		**1.8**	
Community Score	**3**		**3**		**3**	
Community Conservation Index	**5.76**		**4.68**		**5.4**	
Conservation Status	**Moderate**		**Low**		**Moderate**	

WC5: Lower Dunn Farm Stream East

	Downstream		Central		Upstream	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
TRICLADIDA						
PLANARIIDAE						
Polycelis felina	6	1.95	7	1.93	1	0.59
OLIGOCHAETA						
Oligochaeta sp.	5	1.62	13	3.59	4	2.35
GASTROPODA						
PLANORBIDAE						
Ancylus fluviatilis					2	1.18
HYDROBIDAE						
Potamopyrgus antipodarum	1	0.32	21	5.80		
CRUSTACEA						
GAMMARIDAE						
Gammarus pulex	6	1.95				

	Downstream		Central		Upstream	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
Gammarus pulex / fossarum	144	46.75	145	40.06	110	64.71
PLECOPTERA						
LEUCTRIDAE						
Leuctra fusca	10	3.25	6	1.66	1	0.59
EPHEMEROPTERA						
HEPTAGENIIDAE						
Ecdyonurus sp.	1	0.32			4	2.35
BAETIDAE						
Baetis muticus			6	1.66		
Baetis rhodani / atlanticus	1	0.32				
TRICHOPTERA						
RHYACOPHILIDAE						
Rhyacophila sp. (pupa)			1	0.28		
PHILOPOTAMIDAE						
Philopotamus montanus	10	3.25				
Wormaldia occipitalis	36	11.69	34	9.39	11	6.47
POLYCENTROPODIDAE						
Plectrocnemia conspersa	2	0.65	11	3.04		
Plectrocnemia geniculata			3	0.83		
Plectrocnemia sp.	3	0.97	12	3.31		
HYDROPSYCHIDAE						
Diplectrona felix	15	4.87	8	2.21	3	1.76

	Downstream		Central		Upstream	
TAXA	Nos.	Relative Abundance	Nos.	Relative Abundance	Nos.	Relative Abundance
LIMNEPHILIDAE						
Limnephilidae sp. (indet.)			2	0.55	1	0.59
DIPTERA						
CHIRONOMIDAE						
Chironomidae spp.	57	18.51	60	16.57	3	1.76
CERATOPOGONIDAE						
Palpomyia / Bezzia			1	0.28		
DIXIDAE						
Dixa maculata / nubilipennis			3	0.83	6	3.53
PEDICIIDAE						
Pedicia sp.	1	0.32	3	0.83	2	1.18
Dicranota sp.			1	0.28		
LIMONIIDAE						
Eloeophila sp.	1	0.32	2	0.55		
TIPULIDAE						
Tipula maxima	1	0.32				
Tipula montium			3	0.83		
SIMULIIDAE						
Simulium cryophilum			1	0.28		
Simulium lundstromi					1	0.59
Simulium sp.	1	0.32	6	1.66		
COLEOPTERA						

	Downstream		Central		Upstream	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
ELMIDAE						
Elmis aenea					1	0.59
Limnius volckmari			1	0.28		
DYTISCIDAE						
Hydroporus tesselatus			1	0.28		
SCIRTIDAE						
Elodes sp. (larvae)	7	2.27	10	2.76	20	11.76
Nos. Identified Taxa	**17**		**23**		**15**	
Total Nos. of Invertebrates	**308**		**362**		**170**	
BMWP	**76**		**90**		**80**	
N-TAXA	**14**		**17**		**14**	
ASPT	**5.43**		**5.29**		**5.71**	
WHPT	**85.26**		**108.87**		**90.45**	
N-TAXA	**14**		**19**		**15**	
ASPT	**6.09**		**5.73**		**6.03**	
Average Conservation Score	**1.89**		**2.25**		**2.13**	
Community Score	**3**		**3**		**3**	
Community Conservation Index	**5.67**		**6.75**		**6.39**	
Conservation Status	**Moderate**		**Moderate**		**Moderate**	

WC10: Stream east of electrical sub-station; WC 16 Stream south of sub-station; WC18 Littleham Wood Stream

	WC 10: Stream east of Sub-station, Downstream		WC 16: Stream south of Sub-station, Downstream		WC18: Littleham Wood Stream, Downstream	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
TRICLADIDA						
PLANARIIDAE						
Polycelis felina			3	1.58		
OLIGOCHAETA						
Oligochaeta sp.	1	1.20				
HIRUDINEA						
GLOSSIPHONIIDAE						
Glossiphonia complanata	2	2.41				
ERPOBDELLIDAE						
Trocheta subviridis	5	6.02	1	0.53		
GASTROPODA						
PLANORBIDAE						
Ancylus fluviatilis			2	1.05		
HYDROBIDAE						
Potamopyrgus antipodarum	5	6.02	4	2.11	4	0.74
BIVALVIA						
SPHAERIIDAE						
Euglesa sp.					1	0.18
CRUSTACEA						
GAMMARIDAE						

	WC 10: Stream east of Sub-station, Downstream		WC 16: Stream south of Sub-station, Downstream		WC18: Littleham Wood Stream, Downstream	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
Gammarus pulex / fossarum	29	34.94	101	53.16	311	57.17
ANISOPTERA						
CORDULEGASTRIDAE						
Cordulegaster boltonii					7	1.29
PLECOPTERA						
NEMOURIDAE						
Nemoura sp.	1	1.20			2	0.37
LEUCTRIDAE						
Leuctra fusca	1	1.20	5	2.63		
Leuctra sp.	1	1.20	1	0.53		
EPHEMEROPTERA						
HEPTAGENIIDAE						
Ecdyonurus sp.	1	1.20	5			
TRICHOPTERA						
PHILOPOTAMIDAE						
Wormaldia occipitalis			6	3.16	1	0.18
POLYCENTROPODIDAE						
Plectrocnemia conspersa	3	3.61			1	0.18
Plectrocnemia sp.	4	4.82	2	1.05	3	0.55
HYDROPSYCHIDAE						
Diplectrona felix	1	1.20	7	3.68	6	1.10

	WC 10: Stream east of Sub-station, Downstream		WC 16: Stream south of Sub-station, Downstream		WC18: Littleham Wood Stream, Downstream	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
ODONTOCERIDAE						
Odontocerum albicorne					1	0.18
SERICOSTOMATIDAE						
Sericostoma personatum	1	1.20				
LEPIDOSTOMATIDAE						
Cruoecia irrorata			1	0.53		
LIMNEPHILIDAE						
Chaetopteryx villosa			1	0.53		0.00
Limnephilidae sp. (indet.)	1	1.20	2	1.05	1	
DIPTERA						
CHIRONOMIDAE						
Chironomidae spp.	16	19.28	8	4.21	170	31.25
CERATOPOGONIDAE						
Palpomyia / Bezzia	1	1.20				
PTYCHOPTERIDAE						
Ptychoptera lacustris					7	1.29
Ptychoptera sp.					21	3.86
DIXIDAE						
Dixa maculata / nubilipennis					3	0.55
PEDICIIDAE						
Pedicia sp.			2	1.05		

	WC 10: Stream east of Sub-station, Downstream		WC 16: Stream south of Sub-station, Downstream		WC18: Littleham Wood Stream, Downstream	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
Dicranota sp.			1	0.53		
TIPULIDAE						
Tipula montium	1	1.20				
Tipula montium gp.			1	0.53		
SIMULIIDAE						
Simulium lundstromi	1	1.20				
Simulium cryophilum			4	2.11	1	0.18
Simulium sp.	6	7.23	24	12.63	2	0.37
COLEOPTERA						
DYTISCIDAE						
Platambus maculatus	1	1.20				
GYRINIDAE						
Orectochilus villosus	1	1.20				
SCIRTIDAE						
Elodes sp. (larvae)			9	4.74	2	0.37
Nos. Identified Taxa	**18**		**18**		**16**	
Total Nos. of Invertebrates	**83**		**190**		**544**	
BMWP	**94**		**97**		**76**	
N-TAXA	**17**		**16**		**13**	
ASPT	**5.53**		**6.06**		**5.85**	
WHPT	**104.76**		**101.28**		**98.7**	

	WC 10: Stream east of Sub-station, Downstream		WC 16: Stream south of Sub-station, Downstream		WC18: Littleham Wood Stream, Downstream	
TAXA	Nos.	Relative Abundance	Nos.	Relative Abundance	Nos.	Relative Abundance
N-TAXA	18		16		15	
ASPT	5.82		6.33		6.58	
Average Conservation Score	2.18		2.45		2.63	
Community Score	3		3		3	
Community Conservation Index	6.54		7.35		7.89	
Conservation Status	Moderate		Moderate		Moderate	

WC19: Robin Hill Farm Stream; WC20: Lower Dunn Farm Stream West

	WC 19: Robin Hill Farm Stream				WC20: Lower Dunn Farm Stream West	
	Downstream		Central		Downstream	
TAXA	Nos.	Relative Abundance	Nos.	Relative Abundance	Nos.	Relative Abundance
TRICLADIDA						
PLANARIIDAE						
Polycelis felina			10	1.90		
OLIGOCHAETA						
Eiseniella tetraedra	2	1.18			1	1.23
Oligochaeta (other sp.)	1	0.59			3	3.70
GASTROPODA						
HYDROBIDAE						
Potamopyrgus antipodarum	10	5.88	5	0.95	4	4.94
CRUSTACEA						
GAMMARIDAE						
Gammarus pulex / fossarum	82	48.24	338	64.14	65	80.25
ANISOPTERA						
CORDULEGASTRIDAE						
Cordulegaster boltonii	1	0.59				
PLECOPTERA						
NEMOURIDAE						
Nemoura sp.			1	0.19		
LEUCTRIDAE						
Leuctra fusca			1	0.19		

	WC 19: Robin Hill Farm Stream				WC20: Lower Dunn Farm Stream West	
	Downstream		Central		Downstream	
TAXA	Nos.	Relative Abundance	Nos.	Relative Abundance	Nos.	Relative Abundance
TRICHOPTERA						
PHILOPOTAMIDAE						
Wormaldia occipitalis	1	0.59				
POLYCENTROPODIDAE						
Plectrocnemia geniculata	6	3.53	4	0.76		
Plectrocnemia sp.	3	1.76	11	2.09		
HYDROPSYCHIDAE						
Diplectrona felix	18	10.59	3	0.57	1	1.23
LIMNEPHILIDAE						
Chaetopteryx villosa			1	0.19		
Limnephilidae sp. (indet.)			2	0.38	2	2.47
DIPTERA						
CHIRONOMIDAE						
Chironomidae spp.	26	15.29	46	8.73	1	1.23
PSYCHODIDAE						
Tonnoiriella pulchra			2	0.38		
DIXIDAE						
Dixa maculata / nubilipennis			6	1.14	1	1.23
PEDICIIDAE						
Pedicia sp.	3	1.76	1	0.19		
Dicranota sp.					1	1.23

	WC 19: Robin Hill Farm Stream				WC20: Lower Dunn Farm Stream West	
	Downstream		Central		Downstream	
TAXA	Nos.	Relative Abundance	Nos.	Relative Abundance	Nos.	Relative Abundance
TIPULIDAE						
Tipula maxima					1	1.23
Tipula montium gp.			1	0.19		
COLEOPTERA						
ELMIDAE						
Elmis aenea			3	0.57		
HYDROPHILIDAE						
Anacaena globulus	1	0.59			1	1.23
DYTISCIDAE						
Agabus sp. (larva)			1	0.19		
SCIRTIDAE						
Elodes sp. (larvae)	16	9.41	91	17.27		
Nos. Identified Taxa	**12**		**16**		**11**	
Total Nos. of Invertebrates	**170**		**527**		**81**	
BMWP	**55**		**72**		**34**	
N-TAXA	**11**		**13**		**8**	
ASPT	**5**		**5.54**		**4.25**	
WHPT	**67.98**		**86.7**		**43.29**	
N-TAXA	**11**		**15**		**9**	
ASPT	**6.18**		**5.78**		**4.81**	
Average Conservation Score	**2.29**		**2**		**1.75**	

	WC 19: Robin Hill Farm Stream				WC20: Lower Dunn Farm Stream West	
	Downstream		Central		Downstream	
TAXA	Nos.	Relative Abundance	Nos.	Relative Abundance	Nos.	Relative Abundance
Community Score	3		3		3	
Community Conservation Index	6.87		6		5.25	
Conservation Status	Moderate		Moderate		Moderate	

Annex D: WHPT and BMWP indices

A.1.1 Prior to 2015, the BMWP (Biological Monitoring Working Party) scoring system was used by the UK environmental agencies to provide an ecological classification of rivers and streams. This scoring system assigned a value of one to ten to certain invertebrate families, according to their degree of sensitivity to the effects of organic pollution, with the more sensitive families scoring the higher values. The BMWP scores for all the taxa in a sample are then totalled to provide an overall BMWP score for the sample. The ASPT (Average Score Per Taxon) is calculated by dividing the BMWP score by the number of taxa used to calculate it. This is arguably the most useful score for comparing between samples as it reduces the distorting effect of single / small numbers of very high or low-scoring taxa occurring at a sample site.

A.1.2 The BMWP system was in use from the late 1980s up to 2015 and by this time had long been in need of updating to better reflect current, better-informed information on the ecology and pollution tolerance of various aquatic invertebrate taxa. Under the initial BMWP system values were allocated to individual taxa based on expert judgement. Comprehensive information is now available from standardised river surveys undertaken across the UK by the Environment Agency, the Environment and Heritage Service for Northern Ireland and the Scottish Environmental Protection Agency. This data enabled Walley and Hawkes (1996, 1997) to carry out an analysis of the results and derive new values for each family and also to incorporate several families not previously included in the BMWP system. Combined with further refinement, this led to the development of the WHPT (Walley Hawkes Paisley Trigg) index, which is now being used by the UK regulatory agencies. This is calculated in a similar manner to the BMWP with WHPT N-TAXA and WHPT ASPT values also derived during the process. The main difference is that the WHPT values for each family can also be used to take into account that family's abundance within a sample of aquatic invertebrates, a factor that was noticeably lacking in the old BMWP system.

A.1.3 The numbers of individuals in each family are given a log abundance value based on the categories shown in **Apx Table 1**.

Apx Table 1: Abundance categories

Abundance Category	Numerical Abundance
AB1	1-9
AB2	10-99
AB3	100-999
AB4	>1000

A.1.4 A WHPT value is then assigned to each family according to its abundance in a sample; for example, for Asellidae based on presence only the WHPT score is: 2.8; AB1: 4; AB2: 2.3; AB3: 0.8 and AB4: -1.6, reflecting the fact that hoglice are an important natural component of the biota of many watercourses but when present in very high numbers are bio-indicators of organic pollution. WHPT values are assigned in this way to all families in a sample and then totalled, with the ASPT derived as in the BMWP system above.

A.1.5 Both the BMWP and WHPT scoring systems are designed for use with lotic sites and are only applicable to samples of invertebrates collected using the Environment Agency's standard methods. Although, primarily designed to detect the effects of organic pollution, both systems can also respond to the effects of toxic pollution and physical disturbance.

Annex E: Community Conservation Assessment Index (CCI)

A.1.1 The Community Conservation Index (Chadd & Extence, 2004) was initially developed in 1995 by biologists in the NRA (National Rivers Authority) Anglian region and was reviewed in October 2004 after a ten year trial period. The CCI has advantages over other conservation assessment schemes, such as the species rarity score in that it takes into account the overall diversity of an invertebrate community and includes species that nationally might be uncommon but are not sufficiently scarce to warrant any conservation status. However, the scheme is already in need of up-dating as the conservation status of several species has changed in light of current knowledge. Chadd and Extence (2004) state that the scores can be adapted to local circumstances and changing designations but the scores from the original paper have been used in this report in order to avoid discrepancies and confusion.

A.1.2 Conservation Scores of between 1 and 10 have been assigned to each species of aquatic macro-invertebrate based on their rarity. Most of the individual species in a sample are allocated a score

A.1.3 The Community Score is based on the BMWP-score or the species in the sample with the highest conservation score: the Community Score for a site is based on whichever indicates the highest score.

Apx Table 2: Conservation scores used for the CCI (CS)

Conservation Score	Definition
10	Red Data Book Category (RDB)1, endangered
9	RDB2, vulnerable
8	RDB3, rare
7	Notable (but not RDB status) or regionally very notable
6	Regionally notable
5	Local
4	Occasional (species not in categories 10 - 5, which occur in up to 10% of all samples from similar habitats)
3	Frequent (species not in categories 10 - 5, which occur in 10 - 25% of all samples from similar habitats)
2	Common (species not in categories 10 - 5, which occur in 25 - 50% of all samples from similar habitats)
1	Very Common (species not in categories 10 - 5, which occur in 50 - 100% of all samples from similar habitats)

A.1.4 Categories 10 - 5 are recognised national designations developed by the Joint Nature Conservation Committee.

Apx Table 3: Community scores used with the CCI (CoS)

Community Score	BMWP	Highest Conservation Score
15	>301	10
12	251 - 350	9
10	201 - 250	8
7	151 - 200	7
5	101 - 150	5 or 6
3	51 - 100	3 or 4
1	1 - 50	1 or 2
0	0	scoring species absent

A.1.5 The CCI for a site is the product of the Community Score and the average Conservation Score. It is calculated by dividing the sum of the individual species scores (CS) by the number of species (n) then multiplying the resulting product by the community score (CoS) described above:

$$CCI = (\sum CS \div n) \times CoS$$

A.1.6 This gives a numerical index from which the conservation value of a site is derived (see numerical ranges below):

- 0.0 to 5.0 – sites supporting only common species and/or a community of low taxon richness. LOW CONSERVATION VALUE
- 5.0 to 10.0 – sites supporting at least one species of restricted distribution and/or a community of moderate species richness. MODERATE CONSERVATION VALUE
- 10.0 to 15.0 – sites supporting at least one uncommon species, or several species of restricted distribution and/or a community of high taxon richness. FAIRLY HIGH CONSERVATION VALUE
- 15.0 to 20.0 – sites supporting several uncommon species, at least one of which may be nationally rare and/or a community of high taxon richness. HIGH CONSERVATION VALUE
- >20.0 – sites supporting several rarities, including species of national importance, or at least one extreme rarity (e.g. taxa included in the British RDBs) and/or a community of very high taxon richness. VERY HIGH CONSERVATION VALUE

Annex F: 2022 Aquatic Invertebrate Monitoring Survey

XLINKS' MOROCCO-UK POWER PROJECT

Environmental Statement

Volume 2, Appendix 1.10, Annex F: 2022 Aquatic Invertebrate Survey Results

Document Number: 6.2.1.10

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APFP Regulations: 5(2)(a)

November 2024

For Issue

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Prepared by:

RPS

Prepared for:

Xlinks 1 Limited

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1 2022 AQUATIC INVERTEBRATE SURVEY RESULTS

1.1 Introduction

Purpose and Scope of this Report

1.1.1 This document forms Annex F of Volume 2, Appendix 1.10 of the Environmental Statement (ES) prepared for the United Kingdom (UK) elements of the Xlinks Morocco-UK Power Project (the 'Project'). For ease of reference, the UK elements of the Project are referred to as the 'Proposed Development', which is the focus of the Environmental Statement (ES). The ES presents the findings of the Environmental Impact Assessment (EIA) process for the Proposed Development.

1.1.2 This document presents the results of the aquatic invertebrate monitoring that was carried on watercourses to be crossed by the Proposed Development, which was undertaken in November 2022. The surveys and report have been undertaken by a recognised invertebrate specialist based in Devon.

1.2 Methodology

Data Sources

1.2.1 Reference has been made to the publicly-accessible ES for the Atlantic Array Offshore Wind Farm project which was applied for in 2013 but not completed and which followed a similar cable route from the Landfall to the Alverdiscott Substation Site. Reference to the Atlantic Array project also allows a level of ground-truthing to ensure that there is some consistency between what was identified in 2013 and what is being identified now.

1.2.2 As part of both the former and current projects, a suite of ecological impact assessments were carried out along the proposed cable route and as the route crosses several small watercourses, surveys were required of the aquatic macro-invertebrate communities within them to assess their importance and determine the presence of any species of conservation value prior to works commencing.

1.2.3 During the Atlantic Array Project, eleven small watercourses were identified as being either crossed by the cable route, or close to the construction area for new electricity distribution and converter stations, which might potentially be impacted by the planned works. These watercourses were investigated during October 2010 and May 2011. At the time of the 2010 survey, four of the watercourses were dry, thus seven were sampled for aquatic invertebrates. In May 2011, due to slight changes in the cable route, fewer watercourses would potentially be impacted, although several new ones were added to the list. A total of six watercourses were investigated of which two were dry and four were sampled. The results of these earlier surveys are reported in Knight (2010), Knight (2011) and RPS (2013).

Study Area

1.2.4 The onshore ecology and nature conservation study area is detailed within Volume 2, Chapter 1: Onshore Ecology and Nature Conservation of the ES. The study area includes the following.

- Locally designated sites, including Local Nature Reserves and Local Wildlife Sites, and less mobile species located within 2 km of the Onshore Infrastructure Area.
- Nationally designated sites, including Sites of Special Scientific Interest and National Nature Reserves, and records of particularly mobile protected or otherwise notable species (e.g. bats and otters) located within 5 km of the Onshore Infrastructure Area.
- Internationally designated sites located within 12 km of the Onshore Infrastructure Area.

1.2.5 The onshore ecology and nature conservation study area is presented in Volume 2, Figure 1.1 of the ES (see Volume 2, Figures).

Survey Area

1.2.6 The Proposed Development varies slightly from the previous proposed routes, but a desk study indicated the following watercourses that would be crossed by the Onshore HVDC Cable Corridor or are close to the converter stations.

- Stream on Rickard's Down to the east of Combe Walker and Chaltaborough, into which two watercourses (WC) identified as WC2 and WC12 in previous surveys flow, referred to as WC2/12 in this report.
- Small ditch to the south of the A39, west of the Abbotsham Cross roundabout, herein referred to as WC17.
- Stream to the east of Lower Dunn Farm that flows northwards into Jennets Reservoir, identified as WC5 in previous surveys.
- Stream that rises to the west of Gammaton and flows westwards into the River Torridge at Hadlow, herein referred to as WC15.
- Stream south of Higher Huxhill that flows south eastwards along the boundary of the Converter Station site into WC9, herein referred to as WC16.
- Headwater tributary of the Huntshaw water that rises east of Higher Kingdon Farm and will be crossed by the Onshore HVDC Cable Corridor east of Lower Kingdon Farm, identified as WC9 in previous surveys.
- Tributary of WC9 which flows along the eastern boundary of the Alverdiscott Substation Site, identified as WC10 in previous surveys.

1.2.7 The locations of the streams and sampling sites on them are illustrated in **Figure 1.1** to **Figure 1.3** below. .

N

U/S

C

D/S

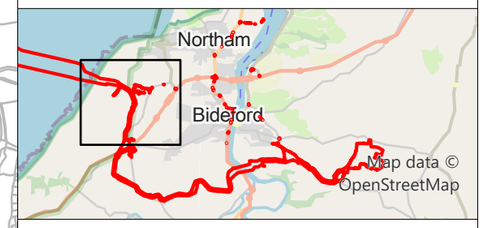
WC2 WC12
WC2/12

0 500 1,000m

Notes
1. This plan is scaled at paper size A3. If received electronically it is the recipients responsibility to print to the correct scale. Only written dimensions should be used.

Legend

- Order Limits
- Converter Site
- Construction Compound
- Sample Sites C: Central Site, U/S: Upstream Site, D/S: Downstream Site



Rev	Description	By	CB	Date
P01	FINAL	SHB	MB	16.10.24

Client: Xlinks 1 Limited

Project: Xlinks' Morocco-UK Power Project

Title: Aquatic Invertebrate Monitoring of Watercourses to be Crossed

Status: FINAL

Scale @ A3: 1:10,000

Date Created: Nov 2024

Figure Number: **1**

Rev: **P01**

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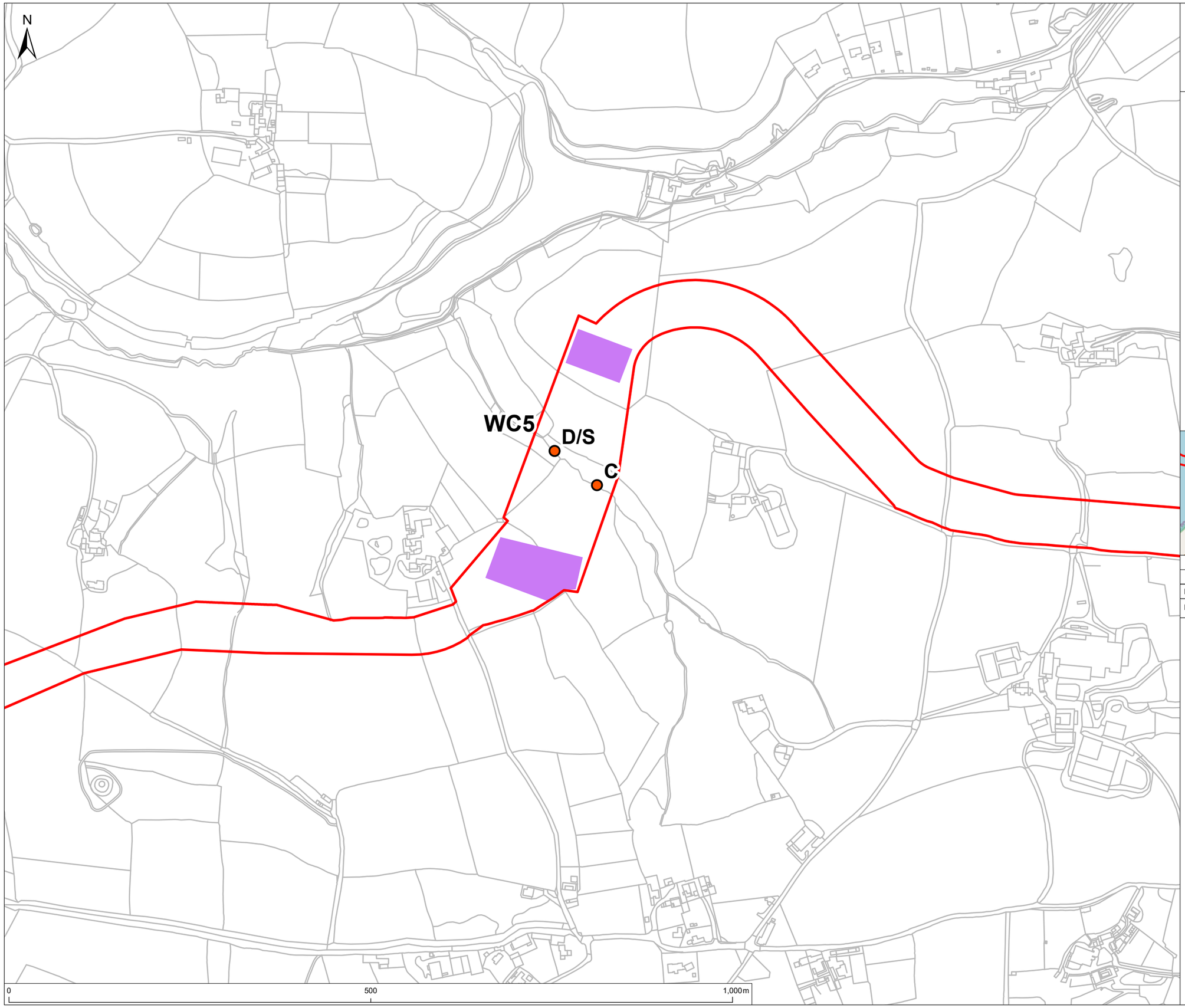

Notes
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Legend

- Order Limits
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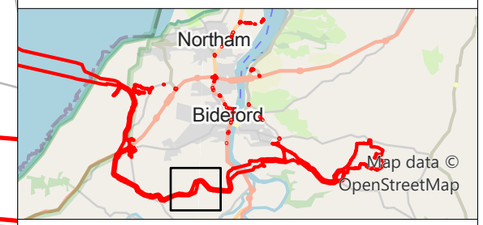

Rev	Description	By	CB	Date
P01	FINAL	SHB	MB	16.10.24

Client: Xlinks 1 Limited

Project: Xlinks' Morocco-UK Power Project

Title: Aquatic Invertebrate Monitoring of Watercourses to be Crossed

Status	Scale @ A3	Date Created
FINAL	1:5,000	Nov 2024

Figure Number: **2**

Rev: **P01**

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N

WC9 WC10

D/S

U/S

C

WC9 WC14

D/S

D/S

C

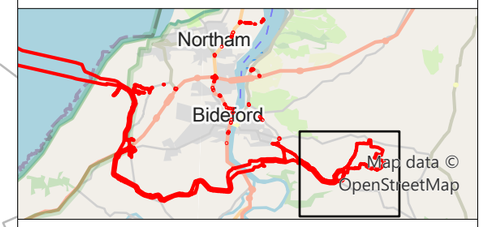
WC15

0 500 1,000m

Notes
1. This plan is scaled at paper size A3. If received electronically it is the recipients responsibility to print to the correct scale. Only written dimensions should be used.

Legend

- Order Limits
- Converter Site
- Construction Compound
- Sample Sites C: Central Site, U/S: Upstream Site, D/S: Downstream Site



Rev	Description	By	CB	Date
P01	FINAL	SHB	MB	16.10.24

Xlinks

Client: Xlinks 1 Limited

Project: Xlinks' Morocco-UK Power Project

Title: Aquatic Invertebrate Monitoring of Watercourses to be Crossed

Status: FINAL

Scale @ A3: 1:10,000

Date Created: Nov 2024

Figure Number: **3**

Rev: **P01**

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1.3 Materials and Methods

Field Survey

1.3.1 The survey of the watercourses took place on 12 to 13 September 2022. On each watercourse, it was proposed to select three sites for aquatic invertebrate sampling:

- one at the location of the Onshore HVDC Cable Corridor (the central site); and
- two further sites, within approximately 50 m upstream and downstream of the central site.

1.3.2 The central site would potentially be destroyed during the installation of the Onshore HVDC Cable Corridor but the data from the survey would provide a baseline assessment of the communities present before works commenced. The other two sites would provide potential monitoring sites should this be required during the construction process, with the upstream site providing a control against which the downstream site could be compared.

1.3.3 Despite some rain in the weeks preceding the survey, a prolonged very dry summer meant that water levels in many of the watercourses were extremely low, such that it was only possible on two of the watercourses, WC9 and 2/12, to sample three sites.

1.3.4 The Onshore HVDC Cable Corridor will cross the source of WC17, which was a small agricultural ditch laying within a deep channel beneath a dense hedgerow. Only a few very shallow, isolated pools were present in the channel and no sampling was undertaken.

1.3.5 At WC5, above the central site most of the flow in the channel originated from a land drain and upstream of this there was barely a trickle in the channel, limiting the survey to central and downstream sites only. A similar situation was also evident at WC15, where the channel was very narrow, with insufficient water for sampling above the central site.

1.3.6 WC16 consisted of a muddy trickle, with insufficient water for sampling. At WC10 most of the flow originated from a land drain, with just a trickle of water in the channel above, thus it was only possible to sample a downstream site, just upstream of the stream's confluence with WC9.

1.3.7 The locations of the watercourses and sampling sites on them are illustrated in **Figure 1.1** to **Figure 1.3** below. **Annex A** lists the environmental data for the sites, including descriptions of their locations, grid references, substrate composition and any flora present in the wetted channel. Site photographs are provided in **Annex B.**

1.3.8 Each of the sites were sampled using the standard protocol employed by the Environment Agency for sampling lotic watercourses (detailed in Environment Agency internal document No. 018_08 (2017), which has now superseded the more detailed BT001 (Murray-Bligh, 1999)). This protocol involved a timed period of three minutes of active net sampling (the time being apportioned to each habitat according to the proportion of the site that it covered), accompanied by a one-minute search.

1.3.9 The net sampling was carried out using a Freshwater Biological Association pattern pond net, fitted with a 1 mm mesh collecting bag and involved a

combination of kick sampling and sweeping the net through marginal vegetation. This was accompanied by manual investigation of submerged coarse woody debris and larger stones for attached organisms (e.g. the river limpet (*Ancylus fluviatilis*)) and searches of the water surface for surface-dwelling animals (e.g. the whirligig beetle *Gyrinus substriatus*), for a timed period of one minute in total at each site.

1.3.10 After collection, the samples were preserved on-site, in a solution of 90% Industrial Methylated Spirits (IMS or Denatured Ethanol B), 5% water and 5% glycerol for transportation to the laboratory and subsequent analysis.

Sample Analysis and Data Evaluation

1.3.11 The analysis of the samples followed standard Environment Agency procedures (as outlined in Environment Agency internal document No. 024_08 (2014) and BT001). Taxa were identified to the lowest possible taxonomic level, with the exception of the taxonomically difficult groups: Oligochaeta (segmented worms) and Chironomidae (non-biting midge larvae). Other Diptera larvae were identified to the lowest level possible due to larval maturity and available identification keys.

1.3.12 In the previous cable route surveys Biological Monitoring Working Party (BMWP), N-Taxa (number of BMWP scoring taxa) and ASPT (Average Score Per Taxon) scores were calculated for each sample to provide an assessment of the ecological water quality at each site. The BWMP index has since been superseded by the WHPT (Whalley Hawkes Paisley Trigg) index, which is now used by the Environment Agency and the other UK environmental monitoring agencies for the classification of rivers according to the European Water Framework Directive (WFD, 2000/60/EC) (see **Annex D** for further details of the BMWP and WHPT indices). In order to provide some comparison with previous data, specifically relating to watercourses WC5, WC9 and WC10, both WHPT and BMWP indices were calculated for the data in the current survey.

1.3.13 The conservation value of the invertebrate communities at each site was assessed using a community-based classification developed by the Environment Agency (Chadd and Extence, 2004). The Community Conservation Index (CCI) empirically assesses the conservation value of a given site using the entire invertebrate community rather than undue emphasis on the presence of a few scarce species. An explanation of the terms used, along with the formula for calculating the index is given in **Annex E**. The conservation values for individual species used in this report are those cited by Chadd and Extence (2004).

Accurate Lifespan of Ecological Data

1.3.14 The majority of ecological data remain valid for only short periods due to the inherently transient nature of the subject. The survey results contained in this report are considered accurate for two years, assuming no significant considerable changes to the site conditions.

1.3.15 Site specific surveys used to inform Volume 2, Chapter 1: Onshore Ecology and Nature Conservation of the ES were undertaken between 2021 and 2024. CIEEMs Advice Note: On the lifespan of ecological reports and surveys (CIEEM, 2019) recommends that surveys exceeding three years in age are likely to require updating, whilst surveys undertaken between 18 months and three years prior to application may require site visits pre-construction to review the validity of survey findings. Therefore, in accordance with CIEEM guidance, site specific surveys

undertaken over 18 months prior to the submission will be updated, where required (following a site review to confirm the validity of survey findings by a suitably qualified ecologist).

1.4 Results

1.4.1 **Table 1.1** below lists the WHPT, BMWP and CCI indices for each of the sites on the five watercourses.

Table 1.1: WHPT, BMWP and CCI indices across the watercourses

Watercourse	WC2/12 Rickard's Down			WC5 lower Dunn Farm	
Sample Location	1: D/S	2: CENT.	3: U/S	1: D/S	2: CENT.
BMWP	26	19	58	82	63
N-TAXA	7	5	12	14	13
ASPT	3.71	3.8	4.83	5.86	4.85
WHPT	42.03	35.92	73.5	108.63	91.12
WHPT N-TAXA	9	8	14	17	17
WHPT ASPT	4.67	4.49	5.25	6.39	5.36
Average conservation score	1	1.33	1.56	1.8	1.86
Community score	1	1	3	3	3
Community conservation index	1	1.33	4.68	5.4	5.58
Conservation status	Low	Low	Low	Moderate	Moderate

Watercourse	WC9 Higher Kingdon			WC10 Sub-station	WC15 Gammaton	
Sample Location	1: D/S	2: CENT.	3: U/S	1: D/S	1: D/S	2: CENT.
BMWP	96	86	88	23	52	49
N-TAXA	16	15	16	5	11	10
ASPT	6	5.73	5.5	4.6	4.73	4.9
WHPT	105.06	115.14	106.78	26.7	63.36	65.16
WHPT N-TAXA	17	19	19	6	12	12
WHPT ASPT	6.18	6.06	5.62	4.45	5.28	5.43
Average conservation score	1.82	2.1	2.15	1	2.67	2.67
Community score	3	5	5	1	3	3
Community conservation index	5.46	10.5	10.75	1	8.01	8.01
Conservation status	Moderate	Fairly High	Fairly High	Low	Moderate	Moderate

1.4.2 Taxa lists for each of the five sampled watercourses are presented in **Annex C**, with summaries of the aquatic invertebrate communities below.

WC2/12: Rickard's Down Stream

1.4.3 The headwaters of this stream include the two watercourses referred to as WC2 and WC12 in the previous cable corridor surveys, both of which unite at Chaltaborough and then flow eastwards to Kenwith Castle, where the stream is joined by another tributary, before flowing through the Kenwith Valley to enter the Torridge Estuary between Bideford and Northam. The central sampling site was located at SS 4230 2705, where the upper part of the surveyed reach flows through pasture, before entering woodland further downstream. Water levels in the channel were very low, with the wetted channel averaging just 1 m in width and a depth of 3 cm. It was evident that during wetter months the channel would be considerably wider and deeper. Vegetation was sparse with just a few stands of brooklime (*Veronica beccabunga*) and fool's watercress (*Apium nodiflorum*) at the central site. The substrate was a mixture of cobbles, pebbles and gravel, with the former dominant at the upstream and downstream sites and gravel at the central.

1.4.4 Both aquatic invertebrate numbers and diversity were low and considerably less than those recorded for WC2, further upstream, in 2010 and 2011. The species recorded were typical of such small, stony stream and the communities were dominated by *Gammarus* amphipods. As with all the small streams in this survey, many of which were likely to have been dry at the height of the summer, it was believed that the low diversity was due to the extremely low water levels, accompanied by difficulties in effectively sampling such shallow water. No uncommon species were recorded and the communities at all three sites were assessed as being of low conservation value.

WC 5: Lower Dunn Farm Stream

1.4.5 Previously sampled further upstream on its headwaters, this is one of several watercourses feeding into Jennets Reservoir to the south of Bideford. The stream lays within a small, wooded valley and water levels were very low, such that it was not possible to sample above the central site at SS 4430 2435.

1.4.6 The wetted channel was on average 0.5 to 0.75 m wide with just 2 cm of water, making netting difficult, and a substrate of predominately cobbles and pebbles. Channel vegetation was virtually absent and restricted to benthic diatoms and marginal patches of bryophytes above the current water level.

1.4.7 Invertebrate diversity was poor at both sites, with the communities dominated by chironomid larvae, *Gammarus* amphipods and the hydrobiid snail *Potamopyrgus antipodarum.* Several sensitive taxa were present suggesting that the poor diversity was more an indication of the drought conditions rather than water quality issues. The composition of the assemblages was similar to that recorded on the headwaters in 2010 and 2011, with no uncommon species and of moderate conservation interest.

WC 9: Higher Kingdon Stream

1.4.8 WC 9 is a headwater tributary of the Huntshaw Water, which flows into the River Torridge south of Weare Giffard. The stream rises in a small wood to the east of Higher Kingdon and flows eastwards, along the southern boundary of Alverdiscott Substation Site to join another stream (WC10) which flows along the eastern boundary of Alverdiscott Substation Site. The combined waters then flow

southwards, to be joined by the flow from a second tributary (referred to as WC14 in previous surveys) and then on to the confluence with the Huntshaw Water at Fairoak.

1.4.9 In the current survey, WC9 was sampled downstream of the confluence of WC10, with the central site located at SS 4999 2453. At this point the stream flows through a wooded valley and is heavily shaded by the surrounding trees, such that in-channel vegetation was virtually absent, limited to a few stands of hemlock water-dropwort (*Oenanthe crocoata*) at the central site. The wetted channel width was on average 2 m, with very low water levels on average 4 cm deep, and substrates of predominately cobbles and pebbles at the lower sites, and gravel at the upstream.

1.4.10 Diversity was similar to that recorded in the 2010 survey but lower than that of 2011, both conducted on the upper reaches, above the confluence of WC10. However, the communities recorded at WC9 were still the most diverse in the current survey. The assemblages were dominated by *Gammarus* and chironomid larvae. Taxa sensitive to organic pollution were present and again it was believed that the low diversity was more a result of the very low water levels, rather than water quality issues in the catchment. Conservation interest varied from moderate at the downstream site to fairly high at the other two locations.

1.4.11 Single larvae of the caddis species *Hydatophylax infumatus* were recorded at the central and upstream sites and were the only species of note within the communities. *Hydatophylax infumatus* feeds on decaying submerged wood and is a widespread species of streams and rivers, although never found frequently due to the cryptic habits of its adults and larvae. Formerly regarded as a Local Species (Wallace, 1991) it has since been given a status of Nationally Scarce in a more recent review (Wallace, 2016). Due to its rarer status, allocated since Chadd and Exetnce (2004), it is thus more likely that the communities at the central and upstream sites are of 'high' conservation interest.

1.4.12 Bullheads (*Cottus gobio*) were also recorded on the lower part of the stream during invertebrate sampling.

WC 10: Stream to east of Substation

1.4.13 WC10 is a small headwater tributary of WC9 that rises to the southwest of Stony Cross and was sampled in autumn 2010, approximately 100 m upstream of its confluence with WC9. As with all the watercourses in the current survey water levels were very low, such that only a downstream site, just upstream of the confluence at SS 5022 2493 could be sampled. Approximately 30 m upstream of this location most of the flow in the channel comes from a land drain discharging into the watercourse and above this point the flow was just a muddy trickle. At the sampling site the wetted channel was 0.75 m wide with an average depth of 4 cm and a predominately gravel substrate.

1.4.14 Invertebrate diversity was very low, much less than that recoded previously, overwhelmingly dominated by *Gammarus*, and of low conservation value.

WC 15: Gammaton Stream

1.4.15 A small, heavily shaded stream within a wooded valley, with very low water levels in a channel 0.35 to 0.5 m wide with an average depth of 2 cm. Above the central site (at SS 4867 2426) the water was even shallower and impossible to sample.

The substrate was predominately pebbles and gravel with in-channel vegetation limited to a few patches of the moss *Platyhypnidium riparoides* at the downstream site.

1.4.16 Aquatic invertebrate diversity was low, of moderate conservation interest, and the assemblages dominated by *Gammarus* and Chironomidae.

1.5 Conclusions

1.5.1 The watercourses surveyed had low aquatic invertebrate diversity, with assemblages dominated by Gammarus amphipods and chironomid larvae, and were mostly of low to moderate conservation interest.

1.5.2 The most diverse stream was WC9, which was slightly larger than the others in the survey and was sampled at locations further down the catchment than in the previous cable route appraisals. However, even here aquatic invertebrate diversity was somewhat restricted and lower than expected for a watercourse of this nature. The Nationally Scarce caddis *Hydatophylax infumatus* was recorded at the central and upstream sites. Although the CCI index indicated assemblages of moderate conservation interest at the upstream site and fairly high interest at the central and downstream sites, it was felt that in light of the elevation of the conservation status of *H. infumatus* from Local to Nationally Scarce, a designation of high conservation interest for the two lower sites was more appropriate.

1.5.3 Due to a very prolonged period of dry, hot weather in the preceding months, water levels in all the watercourses were very low, such that it was only possible to sample three sites on WC9 and 2/12, with flow in the upper channels of the others reduced to a trickle. Whilst restricted diversity is a naturally occurring phenomenon on such small headwater streams, the assemblages were still less diverse than to be expected for watercourses of this nature and, where previously surveyed in 2010 and 2011, the communities were of lower diversity than the historical data, which was collected from sampling sites further up the catchments than in the current survey. It was believed that the extremely low water levels were the limiting factor engendering the low diversity of the communities, rather than water quality issues on the catchments. It was likely that many of the streams had only just begun to flow again in the weeks preceding the survey and had probably been dry at the height of the summer. Thus, the survey was in fact documenting the steady re-colonisation of the watercourses by invertebrates from refugia either lower down the catchments or within the hyporheic zone beneath the stream beds. Should the watercourses be sampled during their typical follow regime then diversities within them would probably be much higher and more representative of that documented in previous surveys conducted as part of the Atlantic Array cable route appraisal in autumn 2010 and spring 2011.

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Annex A: Sampling Site Environmental Data

ANNEX A: Sampling site environmental data

SITE	**WC2 / 12 D/S**	**WC2 / 12 Central**	**WC2 / 12 U/S**	**WC5 D/S**	**WC5 Central**
WATERCOURSE	Rickard's Down Stream	Rickard's Down Stream	Rickard's Down Stream	Lower Dunn Farm Stream	Lower Dunn Farm Stream
LOCATION	50m Downstream central site, 30m downstream boundary	20m Upstream boundary	75m Upstream central site, 50m upstream boundary and ford	60m Downstream central site, adjacent to large ash and game pen	40m Upstream boundary on LHB
NGR	SS 4234 2708	SS 4230 2705	SS 4221 2702	SS 4424 2437	SS 4430 2435
WIDTH (m)	1.9	0.75	1.1	0.75	0.5
AVERAGE DEPTH (cm)	3	3	5	3	1
SUBSTRATE (% cover)					
Silt	2	5	marginal / overlying	Overlying	Marginal / overlying
Clay	1	0	0	0	0
Sand	2	5	<1	<1	2
Gravel	15	50	5	10	28
Pebbles	45	25	35	40	50
Cobbles	35	20	60	50	20
FLOW	Moderate	Moderate	Moderate	Slow	Slow
SHADING	Heavy	Heavy	Heavy	Heavy	Heavy
MACROPHYTE COVER (%)	0	10	0	0	0
MACROPHYTE SPECIES	**	*Verronica Beccabunga, Apium nodiflorum*	**	**	**
BRYOPHYTE COVER (%)	0	0	0	0	0
BRYOPHYTE SPECIES	**	**	**	**	**
ALGAL COVER (%)	3	5	3	3	3
ALGAL TAXA	Benthic diatoms	Benthic diatoms	Benthic diatoms	Benthic diatoms	Benthic diatoms

SITE	**WC9 D/S**	**WC9 Central**	**WC9 U/S**	**WC10 D/S**	**WC15 D/S**	**WC15 Central**
WATERCOURSE	Higher Kingdon Stream	Higher Kingdon Stream	Higher Kingdon Stream	Stream to east of sub-station	Gammaton Stream	Gammaton Stream
LOCATION	70m Downstream central site, 10m downstream boundary on RHB	50m Downstream boundary on LHB	87m Upstream central site, 37m upstream boundary on RHB	5m Upstream confluence with WC9	50m Downstream central site, 40m downstream boundary on LHB	10m Upstream boundary on LHB
NGR	SS 4998 2447	SS 4999 2453	SS 5002 2559	SS 5022 2493	SS 4863 2425	SS 4867 2426
WIDTH (m)	2	2.6	1.35	0.75	0.35	0.5
AVERAGE DEPTH (cm)	4	3	6	3	2	2
SUBSTRATE (% cover)						
Silt	Marginal / overlying	Marginal / overlying	10	12	7	3
Clay	0	0	0	0	3	0
Sand	1	1	2	3	2	2
Gravel	9	35	65	65	55	50
Pebbles	50	50	20	10	20	25
Cobbles	40	14	3	10	13	20
FLOW	Moderate	Moderate	Moderate	Slow	Slow	Slow
SHADING	Heavy	Heavy	Heavy	Heavy	Heavy	Heavy
MACROPHYTE COVER (%)	0	<1	0	0	0	0
MACROPHYTE SPECIES	**	*Oenanthe crocoata*	**	**	**	**
BRYOPHYTE COVER (%)	0	0	0	0	<1	0
BRYOPHYTE SPECIES	**	**	**	**	*Platyhypnidium riparoides*	**
ALGAL COVER (%)	5	5	10	5	3	3
ALGAL TAXA	Benthic diatoms	Benthic diatoms	Benthic diatoms	Benthic diatoms	Benthic diatoms	Benthic diatoms

Annex B: Site Photographs

ANNEX B: Site photographs

WC2/12: Rickard's Down Stream, downstream site (left) and central site (right)

WC2/12: Rickard's Down Stream, upstream site

WC5: Lower Dunn Farm Stream, downstream site (left) and central site (right)

WC9: Higher Kingdon Stream, downstream site (left) and central site (right)

Left: WC9: Higher Kingdon Stream, upstream site. Right WC10: Stream to east of sub-station, downstream site

WC15: Gammaton Stream, downstream site (left) and central site (right)

Annex C: Aquatic Invertebrate Taxa Lists

ANNEX C: Aquatic invertebrate taxa lists

WC2/12: Rickard's Down Stream

	SAMPLE 1, D/S		SAMPLE 2, CENTRAL		SAMPLE 3, U/S	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
TRICLADIDA						
PLANARIIDAE						
Polycelis felina					25	5.83
OLIGOCHAETA						
Oligochaeta spp.	9	13.64			34	7.93
HIRUDINEA						
ERPOBDELLIDAE						
Trocheta subviridis					3	0.70
GASTROPODA						
PLANORBIDAE						
Ancylus fluviatilis	1	1.52				
HYDROBIDAE						
Potamopyrgus antipodarum	5	7.58	10	16.39	6	1.40
BIVALVIA						
SPHAERIIDAE						
Pisidium sp.			1	1.64		0.00
CRUSTACEA						
ASELLIDAE						
Asellus aquaticus	4	6.06			6	1.40
GAMMARIDAE						
Gammarus pulex / fossarum	15	22.73	11	18.03	319	74.36
PLECOPTERA						
LEUCTRIDAE						
Leuctra fusca					2	0.47
Leuctra sp.					3	0.70
EPHEMEROPTERA						
EPHEMERIDAE						
Ephemera danica					1	0.23
DIPTERA						
CHIRONOMIDAE						
Chironomidae spp.	28	42.42	30	49.18	21	4.90
CERATOPOGONIDAE						
Palpomyia / Bezzia gp.	1	1.52	2	3.28	2	0.47
PTYCHOPTERIDAE						
Ptychoptera sp.	1	1.52				
TABANIDAE						
Chrysops sp.			1	1.64		
PSYCHODIDAE						
Pericoma sp.			5	8.20	1	0.23
COLEOPTERA						
ELMIDAE						
Elmis aenea					2	0.47
Oulimnius sp. (larva)					1	0.23
DYTISCIDAE						

Hydroporus tesselatus			1	1.64		
HYDRAENIDAE						
Hydraena gracilis					2	0.47
SCIRTIDAE						
Elodes sp. (larvae)	2	3.03			1	0.23
Nos. Identified Taxa	**9**		**8**		**15**	
Total Nos. of Invertebrates	**66**		**61**		**429**	
BMWP	**26**		**19**		**58**	
N-TAXA	**7**		**5**		**12**	
ASPT	**3.71**		**3.8**		**4.83**	
WHPT	**42.03**		**35.92**		**73.5**	
N-TAXA	**9**		**8**		**14**	
ASPT	**4.67**		**4.49**		**5.25**	
Average Conservation Score	**1**		**1.33**		**1.56**	
Community Score	**1**		**1**		**3**	
Community Conservation Index	**1**		**1.33**		**4.68**	
Conservation Status	**Low**		**Low**		**Low**	

WC5: Lower Dunn Farm Stream

	SAMPLE 1, D/S		**SAMPLE 2, CENTRAL**	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
TRICLADIDA				
PLANARIIDAE				
Polycelis felina	3	0.32	17	2.45
OLIGOCHAETA				
Oligochaeta spp.			7	1.01
GASTROPODA				
HYDROBIDAE				
Potamopyrgus antipodarum	124	13.07	75	10.79
BIVALVIA				
SPHAERIIDAE				
Pisidium casertanum	1	0.11		
Pisidium sp.	6	0.63	3	0.43
CRUSTACEA				
ASELLIDAE				
Asellus aquaticus	7	0.74		
GAMMARIDAE				
Gammarus pulex / fossarum	272	28.66	321	46.19
ANISOPTERA				
CORDULEGASTRIDAE				
Cordulegaster boltonii	1	0.11		
PLECOPTERA				
LEUCTRIDAE				
Leuctra sp.	2	0.21	3	0.43
NEMOURIDAE				
Nemurella picteti			1	0.14
EPHEMEROPTERA				
BAETIDAE				

Baetis muticus			1	0.14
TRICHOPTERA				
POLYCENTROPODIDAE				
Plectrocnemia conspersa	6	0.63	3	0.43
Plectrocnemia sp.	3	0.32	3	0.43
SERICOSTOMATIDAE				
Sericostoma personatum	2	0.21		
ODONTOCERIDAE				
Odontocerum albicorne	1	0.11		
DIPTERA				
CHIRONOMIDAE				
Chironomidae spp.	485	51.11	208	29.93
CERATOPOGONIDAE				
Palpomyia / Bezzia gp.	1	0.11	3	0.43
PTYCHOPTERIDAE				
Ptychoptera sp.	2	0.21	33	4.75
PEDICIIDAE				
Dicranota sp.	1	0.11	3	0.43
Pedicia sp.			1	0.14
LIMONIIDAE				
Eloeophila sp.			1	0.14
PSYCHODIDAE				
Pericoma sp.			1	0.14
DIXIDAE				
Dixa maculata / nubilipennis	1	0.11	3	0.43
COLEOPTERA				
GYRINIDAE				
Gyrinus substriatus	10	1.05		
DYTISCIDAE				
Hydroporus tesselatus			3	0.43
SCIRTIDAE				
Elodes sp. (larvae)	21	2.21	5	0.72
Nos. Identified Taxa	**17**		**19**	
Total Nos. of Invertebrates	**949**		**695**	
BMWP	**82**		**63**	
N-TAXA	**14**		**13**	
ASPT	**5.86**		**4.85**	
WHPT	**108.63**		**91.12**	
N-TAXA	**17**		**17**	
ASPT	**6.39**		**5.36**	
Average Conservation Score	**1.8**		**1.86**	
Community Score	**3**		**3**	
Community Conservation Index	**5.4**		**5.58**	
Conservation Status	**Moderate**		**Moderate**	

WC9: Higher Kingdon Stream

	SAMPLE 1, D/S		SAMPLE 2, CENTRAL		SAMPLE 3, U/S	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
TRICLADIDA						
PLANARIIDAE						
Polycelis felina	2	0.85			4	1.19
OLIGOCHAETA						
Oligochaeta spp.	2	0.85	6	1.53	3	0.90
HIRUDINEA						
ERPOBDELLIDAE						
Trocheta subviridis	1	0.43				
GLOSSIPHONIIDAE						
Glossiphonia complanata					1	0.30
GASTROPODA						
PLANORBIDAE						
Ancylus fluviatilis			1	0.26		
HYDROBIDAE						
Potamopyrgus antipodarum	7	2.98	1	0.26	59	17.61
BIVALVIA						
SPHAERIIDAE						
Pisidium subtruncatum					1	0.30
Pisidium sp.					1	0.30
CRUSTACEA						
GAMMARIDAE						
Gammarus pulex / fossarum	73	31.06	253	64.54	49	14.63
ANISOPTERA						
CORDULEGASTRIDAE						
Cordulegaster boltonii					3	0.90
PLECOPTERA						
LEUCTRIDAE						
Leuctra fusca	27	11.49	10	2.55	8	2.39
Leuctra sp.	17	7.23	14	3.57	5	1.49
NEMOURIDAE						
Nemoura sp.	1	0.43				
EPHEMEROPTERA						
LEPTOPHLEBIIDAE						
Habrophlebia fusca	2	0.85				
BAETIDAE						
Baetis muticus			1	0.26		
HEPTAGENIIDAE						
Ecdyonurus torrentis	1	0.43				
Ecdyonurus sp.	6	2.55	2	0.51		
TRICHOPTERA						
POLYCENTROPODIDAE						
Plectrocnemia conspersa			1	0.26		
Plectrocnemia sp.	1	0.43				
SERICOSTOMATIDAE						
Sericostoma personatum	3	1.28			3	0.90
ODONTOCERIDAE						
Odontocerum albicorne			1	0.26	1	0.30

LIMNEPHILIDAE						
Hydatophylax infumatus			1	0.26	1	0.30
Limnephilidae sp.	2	0.85			5	1.49
DIPTERA						
CHIRONOMIDAE						
Chironomidae spp.	75	31.91	55	14.03	153	45.67
CERATOPOGONIDAE						
Palpomyia / Bezzia gp.			1	0.26	11	3.28
PTYCHOPTERIDAE						
Ptychoptera sp.			12	3.06		
EMPIDIDAE						
Hemerodromia sp. (pupa)			1	0.26		
Clinocerinae sp. (pupa)	1	0.43				
PEDICIIDAE						
Dicranota sp.					5	1.49
Pedicia sp.			1	0.26	2	0.60
CULICIDAE						
Anopheles claviger					1	0.30
TIPULIDAE						
Tipula maxima			1	0.26		
DIXIDAE						
Dixa nebulosa			1	0.26	1	0.30
Dixa maculata / nubilipennis			5	1.28		
COLEOPTERA						
ELMIDAE						
Elmis aenea	1	0.43	4	1.02	4	1.19
Limnius volckmari	1	0.43				
DYTISCIDAE						
Platambus maculatus	3	1.28	1	0.26	4	1.19
SCIRTIDAE						
Elodes sp. (larvae)	9	3.83	19	4.85	10	2.99
Nos. Identified Taxa	**18**		**21**		**20**	
Total Nos. of Invertebrates	**235**		**392**		**335**	
BMWP	**96**		**86**		**88**	
N-TAXA	**16**		**15**		**16**	
ASPT	**6**		**5.73**		**5.5**	
WHPT	**105.06**		**115.14**		**106.78**	
N-TAXA	**17**		**19**		**19**	
ASPT	**6.18**		**6.06**		**5.62**	
Average Conservation Score	**1.82**		**2.1**		**2.15**	
Community Score	**3**		**5**		**5**	
Community Conservation Index	**5.46**		**10.5**		**10.75**	
Conservation Status	**Moderate**		**Fairly High**		**Fairly High**	

WC10: Stream to east of electrical sub-station

	SAMPLE 1, D/S	
TAXA	**Nos.**	**Relative Abundance**
CRUSTACEA		

GAMMARIDAE		
Gammarus pulex / fossarum	454	74.79
DIPTERA		
CHIRONOMIDAE		
Chironomidae spp.	146	24.05
CERATOPOGONIDAE		
Palpomyia / Bezzia gp.	2	0.33
PEDICIIDAE		
Pedicia sp.	1	0.16
COLEOPTERA		
ELMIDAE		
Elmis aenea	1	0.16
SCIRTIDAE		
Elodes sp. (larvae)	3	0.49
Nos. Identified Taxa	**6**	
Total Nos. of Invertebrates	**607**	
BMWP	**23**	
N-TAXA	**5**	
ASPT	**4.6**	
WHPT	**26.7**	
N-TAXA	**6**	
ASPT	**4.45**	
Average Conservation Score	**1**	
Community Score	**1**	
Community Conservation Index	**1**	
Conservation Status	**Low**	

WC15: Gammaton Stream

	SAMPLE 1, D/S		SAMPLE 2, CENTRAL	
TAXA	**Nos.**	**Relative Abundance**	**Nos.**	**Relative Abundance**
TRICLADIDA				
PLANARIIDAE				
Polycelis felina	1	0.28	1	0.37
OLIGOCHAETA				
Oligochaeta spp.	1	0.28		
GASTROPODA				
HYDROBIDAE				
Potamopyrgus antipodarum			3	1.12
BIVALVIA				
SPHAERIIDAE				
Pisidium sp.	1	0.28	2	0.75
CRUSTACEA				
GAMMARIDAE				
Gammarus pulex / fossarum	143	39.50	135	50.56
ANISOPTERA				
CORDULEGASTRIDAE				
Cordulegaster boltonii	3	0.83	9	3.37
TRICHOPTERA				

POLYCENTROPODIDAE				
Plectrocnemia conspersa	5	1.38	2	0.75
Plectrocnemia sp.	2	0.55	1	0.37
HYDROPSYCHIDAE				
Diplectrona felix	1	0.28		
DIPTERA				
CHIRONOMIDAE				
Chironomidae spp.	179	49.45	103	38.58
PTYCHOPTERIDAE				
Ptychoptera sp.	15	4.14	1	0.37
PEDICIIDAE				
Dicranota sp.			4	1.50
DIXIDAE				
Dixa maculata / nubilipennis			1	0.37
COLEOPTERA				
DYTISCIDAE				
Hydroporus tesselatus	3	0.83	1	0.37
SCIRTIDAE				
Elodes sp. (larvae)	7	1.93	4	1.50
Nos. Identified Taxa	**12**		**112**	
Total Nos. of Invertebrates	**362**		**267**	
BMWP	**52**		**49**	
N-TAXA	**11**		**10**	
ASPT	**4.73**		**4.9**	
WHPT	**63.36**		**65.16**	
N-TAXA	**12**		**12**	
ASPT	**5.28**		**5.43**	
Average Conservation Score	**2.67**		**2.67**	
Community Score	**3**		**3**	
Community Conservation Index	**8.01**		**8.01**	
Conservation Status	**Moderate**		**Moderate**	

Annex D: WHPT and BMWP Indices

ANNEX D: WHPT and BMWP indices

Prior to 2015, the BMWP (Biological Monitoring Working Party) scoring system was used by the UK environmental agencies to provide an ecological classification of rivers and streams. This scoring system assigned a value of one to ten to certain invertebrate families, according to their degree of sensitivity to the effects of organic pollution, with the more sensitive families scoring the higher values. The BMWP scores for all the taxa in a sample are then totalled to provide an overall BMWP score for the sample. The ASPT (Average Score Per Taxon) is calculated by dividing the BMWP score by the number of taxa used to calculate it. This is arguably the most useful score for comparing between samples as it reduces the distorting effect of single / small numbers of very high or low-scoring taxa occurring at a sample site.

The BMWP system was in use from the late 1980s up to 2015 and by this time had long been in need of updating to better reflect current, better-informed information on the ecology and pollution tolerance of various aquatic invertebrate taxa. Under the initial BMWP system values were allocated to individual taxa based on expert judgement. Comprehensive information is now available from standardised river surveys undertaken across the UK by the Environment Agency, the Environment and Heritage Service for Northern Ireland and the Scottish Environmental Protection Agency. This data enabled Walley and Hawkes (1996, 1997) to carry out an analysis of the results and derive new values for each family and also to incorporate several families not previously included in the BMWP system. Combined with further refinement, this led to the development of the WHPT (Walley Hawkes Paisley Trigg) index, which is now being used by the UK regulatory agencies. This is calculated in a similar manner to the BMWP with WHPT N-TAXA and WHPT ASPT values also derived during the process. The main difference is that the WHPT values for each family can also be used to take into account that family's abundance within a sample of aquatic invertebrates, a factor that was noticeably lacking in the old BMWP system.

The numbers of individuals in each family are given a log abundance value based on the following:

Abundance Category	Numerical Abundance
AB1	1-9
AB2	10-99
AB3	100-999
AB4	>1000

A WHPT value is then assigned to each family according to its abundance in a sample; for example, for Asellidae based on presence only the WHPT score is: 2.8; AB1: 4; AB2: 2.3; AB3: 0.8 and AB4: -1.6, reflecting the fact that hoglice are an important natural component of the biota of many watercourses but when present in very high numbers are bio-indicators of organic pollution. WHPT values are assigned in this way to all families in a sample and then totalled, with the ASPT derived as in the BMWP system above.

Both the BMWP and WHPT scoring systems are designed for use with lotic sites and are only applicable to samples of invertebrates collected using the Environment Agency's standard methods. Although, primarily designed to detect the effects of organic pollution, both systems can also respond to the effects of toxic pollution and physical disturbance.

Annex E: Community Conservation Assessment Index (CCI)

ANNEX E: Community Conservation Assessment Index (CCI)

The Community Conservation Index (Chadd & Extence, 2004) was initially developed in 1995 by biologists in the NRA (National Rivers Authority) Anglian region and was reviewed in October 2004 after a ten year trial period. The CCI has advantages over other conservation assessment schemes, such as the species rarity score in that it takes into account the overall diversity of an invertebrate community and includes species that nationally might be uncommon but are not sufficiently scarce to warrant any conservation status. However, the scheme is already in need of up-dating as the conservation status of several species has changed in light of current knowledge. Chadd and Extence (2004) state that the scores can be adapted to local circumstances and changing designations but the scores from the original paper have been used in this report in order to avoid discrepancies and confusion.

Conservation Scores of between 1 and 10 have been assigned to each species of aquatic macro-invertebrate based on their rarity. Most of the individual species in a sample are allocated a score

The Community Score is based on the BMWP-score or the species in the sample with the highest conservation score: the Community Score for a site is based on whichever indicates the highest score.

Conservation scores used for the CCI (CS)

Conservation Score	Definition
10	Red Data Book Category (RDB)1, endangered
9	RDB2, vulnerable
8	RDB3, rare
7	Notable (but not RDB status) or regionally very notable
6	Regionally notable
5	Local
4	Occasional (species not in categories 10 - 5, which occur in up to 10% of all samples from similar habitats)
3	Frequent (species not in categories 10 - 5, which occur in 10 - 25% of all samples from similar habitats)
2	Common (species not in categories 10 - 5, which occur in 25 - 50% of all samples from similar habitats)
1	Very Common (species not in categories 10 - 5, which occur in 50 - 100% of all samples from similar habitats)

Categories 10 - 5 are recognised national designations developed by JNCC.

Community scores used with the CCI (CoS)

Community Score	BMWP	Highest Conservation Score
15	>301	10
12	251 - 350	9
10	201 - 250	8
7	151 - 200	7
5	101 - 150	5 or 6
3	51 - 100	3 or 4
1	1 - 50	1 or 2
0	0	scoring species absent

The CCI for a site is the product of the Community Score and the average Conservation Score. It is calculated by dividing the sum of the individual species scores (CS) by the number of species (n) then multiplying the resulting product by the community score (CoS) described above:

$$CCI = (\sum CS \div n) \text{ X } CoS$$

This gives a numerical index from which the conservation value of a site is derived (see numerical ranges below)

0.0 to 5.0 – sites supporting only common species and/or a community of low taxon richness. LOW CONSERVATION VALUE

5.0 to 10.0 – sites supporting at least one species of restricted distribution and/or a community of moderate species richness. MODERATE CONSERVATION VALUE

10.0 to 15.0 – sites supporting at least one uncommon species, or several species of restricted distribution and/or a community of high taxon richness. FAIRLY HIGH CONSERVATION VALUE

15.0 to 20.0 – sites supporting several uncommon species, at least one of which may be nationally rare and/or a community of high taxon richness. HIGH CONSERVATION VALUE

>20.0 – sites supporting several rarities, including species of national importance, or at least one extreme rarity (e.g. taxa included in the British RDBs) and/or a community of very high taxon richness. VERY HIGH CONSERVATION VALUE