

**APPENDIX 10D: AQUATIC MACROINVERTEBRATE AND MACROPHYTE SURVEY  
REPORT.**

# South Humber Bank Energy Centre

South Marsh Road, Stallingborough, DN41 8BZ

**Appendix 10D: Aquatic Macroinvertebrate and Macrophyte Survey**

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**Applicant: EP SHB Limited**  
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## 1.0 INTRODUCTION

- 1.1 This Appendix of the Environmental Statement (ES) presents the results of aquatic macroinvertebrate and macrophyte (aquatic plant) surveys undertaken for the Proposed Development. The terms of reference used in this report are consistent with those defined within the main chapters of the ES (Volume I).

### **Survey Scope**

- 1.2 Aquatic macroinvertebrate and macrophyte surveys were undertaken on all of the permanent waterbodies present within the Site (two ponds and three ditches, see Annex A) to determine the diversity and biological quality of the communities each waterbody supported, and to understand whether rare or notable species are present. The data also provides a baseline prior to start of construction, allowing the potential impact of the Proposed Development to be monitored and evaluated (if required).

### **Relevant Legislation**

- 1.3 Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) (WCA) affords specific protection to a small number of aquatic macroinvertebrate species and their habitat, while Schedule 8 provides protection to named species of flora (including fungi and lichens). In certain circumstances, licences can be granted to permit some actions prohibited under the Act.
- 1.4 Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 includes a list of habitats and species of principal importance for nature conservation in England which is to be used by decision-makers to guide the implementation of their duties under section 40 of the Act. Decision-makers are required to have regard to the conservation of biodiversity in England when carrying out their normal functions.

## 2.0 SURVEY METHODS

### Desk Study

- 2.1 A desk study was undertaken as part of the scope of works for the Phase 1 Habitat survey and is reported in the Preliminary Ecological Appraisal Report (Appendix 10C in ES Volume III). As part of the desk study, records of notable and protected aquatic macroinvertebrate and macrophyte species were requested from the local ecological records centre (Greater Lincolnshire Nature Partnership) for a search radius of 1 km from the Site boundary, hereafter referred to as the Study Area.

### Aquatic Macroinvertebrate Survey

#### Field Survey Approach

- 2.2 Aquatic macroinvertebrate sampling was carried out on 18<sup>th</sup> June 2018 (covering Ponds 1 and 2, and Ditch 1 and 2) and 17<sup>th</sup> September 2018 (Ditch 3) by two appropriately experienced AECOM aquatic ecologists.
- 2.3 The method used to survey the ditches was based upon the Buglife approach for sampling grazing marsh ditch systems (Palmer *et al.*, 2013). An aggregate aquatic macroinvertebrate sample was collected along a 50 m section of each ditch, sampling a range of habitats in order to obtain representative samples of the taxa present.
- 2.4 The method within the ponds followed the Predictive System for Multimetrics (PSYM) protocols used for ponds (Pond Action, 2002). This method is similar to the sampling method detailed above, as sampling is divided between the number of mesohabitats present at the site (e.g. open water, reed bed etc).
- 2.5 All samples were taken using a standard FBA pattern pond net (mesh size: 1 mm) and were sampled by kick sampling for three minutes followed by a one-minute hand search of larger substrates in accordance with the respective methodologies. The samples collected, were subsequently preserved in 70% v/v Industrial Methylated Spirits (IMS) for laboratory processing.

#### Analysis of Aquatic Macroinvertebrate Samples

- 2.6 Each of the samples collected was sorted and analysed in AECOM's aquatic ecology laboratory by suitably trained and experienced ecologists. Although the Buglife method is based on *in situ* (on-site) identification, laboratory analysis involving low power microscopy is generally considered to provide a more comprehensive and accurate taxa list and was therefore undertaken.
- 2.7 Lists of the aquatic invertebrate taxa present were produced in line with Environment Agency guidance (Environment Agency, 2014). The aquatic invertebrate samples were identified to 'mixed taxon level' using stereo-microscopes. Most groups were identified to species level (where practicable), with the exception of the following:
- bladder snails (*Physella* sp.), which were identified to genus;
  - amber snails (*Succineidae*), which were identified to genus;
  - pea mussels (*Pisidium* species), which were identified to genus;
  - worms (*Oligochaeta*) which were identified to order;
  - Truefly larvae (*Chironomidae*, *Tipulidae*, *Limoniidae*, *Simiidae*, *Ceratopogonidae*, *Culicidae*, *Chaoboridae*, *Ephydriidae*, *Sciomyzidae*), which were identified to the to the maximum resolution specified in the guidance;
  - butterfly/ moth larvae (*Lepidoptera*), which were identified to order; and

- Immature or damaged specimens, which were identified to the maximum resolution possible on a case-by-case basis.

2.8 The survey data were then used to calculate various biotic indices, as set out below, to inform an assessment of relative nature conservation value.

2.9 The Community Conservation Index (CCI) (Chadd & Extence, 2004) was calculated for each waterbody. The CCI classifies many groups of freshwater invertebrates according to their scarcity and nature conservation value in England as understood at the time that the classification was developed. Species scores range from 1 to 10, with 1 being very common and 10 being Endangered (see Table 10D.1). In some cases, the references used in the CCI classification to define scarcity and value have since been superseded by more recent assessments (e.g. Foster et al., 2016, Seddon et al., 2014). The CCI cannot be modified to take account of this more current information, but it has been considered when making the wider assessment of nature conservation value provided in this appendix.

**Table 10D.1: Conservation Scores from the Community Conservation Index**

CONSERVATION SCORE	CONSERVATION STATUS
10	RDB1 (Endangered)
9	RDB2 (Vulnerable)
8	RDB3 (Rare)
7	Notable (but not RDB status)
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 up to >10-25% of all samples from similar habitats)
2	Common (species not in categories 10-5, which occur in up to >25-50% of all samples from similar habitats)
1	Very common (species not in categories 10-5, which occur in up to >50-100 % of all samples from similar habitats)

2.10 The overall CCI provides an indication of the conservation value of the community sampled, based on a combination of the rarity of the different aquatic invertebrate taxa present (as understood when the CCI was developed) and overall community richness, as shown in Table 10D.2 below. As indicated above, in some cases expert judgment may be needed to moderate these assessments with reference to current information on status and distribution.

**Table 10D.2: Community Conservation Index Interpretation Guidance (Chadd & Extence, 2004)**

COMMUNITY CONSERVATION INDEX (CCI)	EXPECTED CONSERVATION VALUE
< 5	Low conservation value
5 to 10	Moderate conservation value
10 to 15	Fairly high conservation value
15 to 20	High conservation value
> 20	Very high conservation value

2.11 The invertebrate data were also analysed to generate Biological Monitoring Working Party (BMWP) scores and Average Score Per Taxon (ASPT) values (Hawkes, 1997). The BMWP system assigns a numerical value to about 80 different taxa (known as the BMWP-scoring families) according to their sensitivity to organic pollution. The average of the values for each taxon in a sample (the ASPT) is a stable and reliable index of organic pollution. Therefore these assessments can indicate to what extent an aquatic macroinvertebrate community is exposed to organic pollution (further information is provided in Appendix 2). It is important to note that these indices can vary between geological regions and habitat types. Ditches for example are unable to support many of the high-scoring taxa associated with fast flowing habitats. Therefore the resultant metrics should be reviewed with an awareness of their potential limitations, and the site-specific context.

Macrophyte Survey

2.12 The surveys were carried out by two experienced AECOM ecologists on 18th June 2018 (encompassing Ponds 1 and 2, and Ditches 1 and 2) and 17th September 2018 (Ditch 3) to record their associated emergent and aquatic flora.

2.13 The survey was carried out by either walking the perimeter or wading within the waterbody and recording all species encountered. Deeper areas were sampled with a grapnel. A list of emergent and aquatic plant species encountered was made for each waterbody and their relative abundance recorded using the DAFOR scale:

- Dominant (>75% cover)
- Abundant (51-75% cover)
- Frequent (26-50% cover)
- Occasional (11-25% cover)
- Rare (1-10% cover)

**Nature Conservation Evaluation Approach**

2.14 An essential prerequisite step to allow ecological impact assessment of the Proposed Development is an evaluation of the relative nature conservation value of the identified ecological features (encompassing nature conservation designations, ecosystems, habitat and species).

2.15 Aquatic macroinvertebrate and macrophyte communities, and the component individual species, can be of nature conservation value for various reasons, and their relative value should always be determined on a case-by-case basis to demonstrate a robust assessment process. Value may relate, for example, to the uniqueness of the assemblage, or to the extent to which species are threatened throughout their range, or



to their rate of decline. The value of these assemblages and species recorded by the survey has been defined with reference to the geographical level at which the feature being assessed is considered to matter (further information is provided in Appendix 10B of the ES, and Table 10D.3 below).

- 2.16 Relevant published national and local guidance and criteria can be used, where available, to inform the assessment of nature conservation value and to assist consistency in evaluation. Relevant guidance and assessment criteria are summarised in Table 10D.3. This summary is not definitive and when appropriate other criteria can inform the decision on relative nature conservation value. For example, the previously described CCI index has been used to inform assessment of nature conservation value.

**Table 10D.3: Geographic Scale used to Define Nature Conservation Value**

<b>GEOGRAPHIC SCALE OF VALUE</b>	<b>DEFINITION</b>	<b>EXAMPLE SUPPORTING GUIDANCE AND ASSESSMENT CRITERIA</b>
International	Europe	Guidelines for the selection of Special Areas of Conservation (SACs) (McLeod <i>et al.</i> 2005)
National	Great Britain/ England	Guidelines for the selection of biological Sites of Special Scientific Interest (SSSIs) (Bainbridge <i>et al.</i> 2013)
Regional	South Humberside	No specific guidance available, professional judgement is to be used. It will encompass features clearly of greater than county value but not of sufficient merit to demonstrate national value.
County	Greater Lincolnshire	Greater Lincolnshire Nature Partnership (GNLP) (GNLP, 2013)
District	Stallingborough	No specific guidance available, professional judgement is to be used.
Local	Below district value	No specific guidance available, professional judgement is to be used.

Limitations

- 2.17 There are no significant limitations to the work undertaken. All surveys were undertaken in favourable weather conditions and within an optimal season for survey.
- 2.18 Given the nature of biological survey it is not possible to be certain that all of the species present in a waterbody will be detected. Not all macroinvertebrate species that colonise waterbodies are present at all times of year and therefore some may be overlooked when surveying in a single season. Other species that may be present at other times of year, sporadically and/or in low numbers may not have been recorded, so ideally samples should be collected in spring and autumn. However, this is not considered a major limitation as standard methods were applied and the data collected are considered representative of the conditions present and appropriate for assessment of value.

## 3.0 SURVEY RESULTS

### Desk Study Results

- 3.1 The desk study did not return any records of notable or protected aquatic macroinvertebrates or macrophytes for the study area.

### Field Survey Results

- 3.2 The aquatic macroinvertebrate species recorded and the associated indices for each waterbody are detailed in Appendix 3. The macrophyte species recorded and their relative abundances are identified within Appendix 4, which also identifies species relevant to the identification of sites of importance for their aquatic plant interest (based on Table 11 and Criteria FW2 and FW3 of GNLP, 2013).
- 3.3 No aquatic macroinvertebrate or macrophyte species recorded within any of the waterbodies receive specific legal protection by way of Schedule 5 or 8 of the Wildlife and Countryside Act respectively, or are listed on Section 41 of the NERC Act as being of principal importance for nature conservation in England.
- 3.4 A summary of the results for each waterbody surveyed is provided below.

#### Pond 1

- 3.5 An oval pond approximately 10 x 20 m in size with a predominantly silt substrate and shallow earth banks and common reed (*Phragmites australis*) around the margins. It is located at National Grid Reference (NGR) TA 2307 1332 (see Annex A) within semi-improved grassland.

#### *Aquatic Macroinvertebrates*

- 3.6 A low diversity of species was recorded (eight species) and the community is considered to be fairly typical of a small standing waterbody, comprising species such as snails and crustaceans. The CCI score was 9.38 indicating that the pond is of moderate conservation value. The majority of the species are of very common to occasional status. The only exception was:
- Water stick insect (*Ranatra linearis*). This is classified as of local status within the CCI. However recent data suggest that it is better known and recorded than historically, as the number of hectads where it has been recorded has tripled when compared to historic data (Cook, 2015).
- 3.7 The biological quality of the pond is moderate/ good (BMWP 64, APST 4.9). It supported two pollution-sensitive macroinvertebrates (the caddisfly *Phryganea* sp., and the dragonfly *Libellula quadrimaculata*) in addition to a range of taxa defined as having moderate tolerance to pollution.

#### *Macrophytes*

- 3.8 Five species of macrophyte were recorded, none of which were rare or notable and the assemblage is considered typical of the habitat conditions. Four are scoring species in GNLP criteria for assessing sites for LWS quality, lesser water-parsnip (*Berula erecta*), rigid hornwort (*Ceratophyllum demersum*), spiked water-milfoil (*Myriophyllum spicatum*) and common reed.

#### Pond 2

- 3.9 An oval pond approximately 15 x 35 m in size, with a predominantly silt substrate, shallow earth banks and common reed around the margins. It is located at NGR TA 2314 1348 (See Annex A) within semi-improved grassland.

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*Aquatic Macroinvertebrates*

- 3.10 A low diversity of species was recorded (six species) and the community is considered to be fairly typical of a small standing waterbody, comprising species such as beetles, bugs, mayflies and damselflies. The CCI score was 4.50 indicating that the pond is of low conservation value. All of the species present were of very common to occasional status.
- 3.11 The biological quality of the pond is moderate (BMWP 53, APST 4.8). It supported a single pollution-sensitive taxon (the caddisfly *Phryganea* sp.), in addition to a range of taxa defined as having moderate tolerance to pollution.

*Macrophytes*

- 3.12 Only two species of macrophyte were recorded. Common reed was present along the margins, with spiked water-milfoil in deeper water. Neither of these species is rare or notable, but both are scoring species in GNLP criteria for assessing sites for LWS quality.

Ditch 1

- 3.13 Ditch 1 is located along a boundary fence adjacent to semi-improved grassland and arable land (NGR TA 2324 1336, See Annex A). It has a wetted width of approximately 1 m, and an average depth of approximately 0.5 m. The substrate was predominately silt. No flow was present at the time of the survey. The majority of the ditch and its associated steep earth banks were dominated by extensive stands of emergent common reed, to the exclusion of other flora.

*Aquatic Macroinvertebrates*

- 3.14 A moderate diversity of aquatic macroinvertebrates was present (19 species). The community is considered fairly typical of a small slow-flowing ditch, with the assemblage dominated by a range of snail, dragonfly and beetle species. The CCI score was 7.8 indicating the ditch is of moderate conservation value. The majority of the species were of very common to frequent status. The only exception was:
- Smooth Ram's Horn snail (*Gyraulus laevis*). This is classified as being of notable status within the CCI, and is Nationally Scarce. Refer to Table 10D.4 for further information on the status of this snail.
- 3.15 The biological quality of the ditch is moderate/ good quality (BMWP 77, APST 4.5). It supported the dragonfly *Sympetrum striolatum* and the caddisfly *Limnephilus lunatus*, both of which are pollution-sensitive taxon, in addition to a range of taxa defined as having moderate tolerance to pollution.

*Macrophytes*

- 3.16 Ten species of macrophyte were present, none of which are rare or notable and the assemblage is considered typical of the habitat conditions. Of these, seven are scoring species in GNLP criteria for assessing sites for LWS quality, water-plantain (*Alisma plantago aquatica*), lesser water parsnip, common water-star wort (*Callitriche stagnalis*), common stonwort (*Chara vulgaris*), small pondweed (*Potamogeton berchtoldii*), ivy-leaved duckweed (*Lemna trisulca*) and common reed.

Ditch 2

- 3.17 Ditch 2 is linear drainage ditch located along a boundary fence adjacent to semi-improved grassland and arable land. It is connected to Ditch 1 (NGR TA 2309 1316, See Annex A). It has a wetted width of approximately 1.5 m, with a typical depth of approximately 0.3 m. The substrate was predominately silt. No flow was present at the

time of the survey. Sections of the ditch were dominated by extensive stands of common reed, to the almost complete exclusion of other flora.

*Aquatic Macroinvertebrates*

- 3.18 A high diversity of aquatic macroinvertebrates was present (31 species), and the community is considered fairly typical of a small slow-flowing ditch. It was dominated by a range of snails, crustaceans, dragonflies, damselflies, caddisflies, bugs and beetles. The CCI score was 8.93, indicating that the ditch is of moderate conservation value. The majority of species were of very common to frequent status. Exceptions were:
- Smooth Ram's Horn snail (*Gyraulus laevis*). This is classified as of notable status within the CCI, and is Nationally Scarce (see Table 10D.4).
  - A diving beetle (*Hygrotus impressopunctatus*). This is classified as of local status within the CCI. This species is commonly found in ponds and ditches within lowland areas and is present throughout England into Scotland's central belt (Foster et al., 2016). As such, it is considered widespread and is not currently threatened.
  - A diving beetle (*Ilybius quadriguttatus*). This is classified as of local status within the CCI and typically occurs in stagnant and well-vegetated lowland waterbodies and it has been recorded throughout England (Foster et al., 2016). As such, it is considered widespread and is not currently threatened.
- 3.19 The biological quality of the ditch is moderate/ good quality (BMWP 86, APST 4.3). It supported a single pollution-sensitive taxon (the dragonfly *Sympetrum striolatum*), in addition to a range of taxa defined as having moderate tolerance to pollution.

*Macrophytes*

- 3.20 Ten species of macrophyte were present, none of which are rare or notable and the assemblage is considered typical of the habitat conditions. Of these, nine are scoring species in GNLP criteria for assessing sites for LWS quality, water-plantain, fool's-water-cress (*Apium nodiflorum*), lesser water-parsnip, various-leaved water-starwort (*Callitriche platycarpa*), common stonewort, ivy-leaved duckweed, spiked water-milfoil, bulrush (*Typha latifolia*) and common reed.

Ditch 3

- 3.21 This is a linear drainage ditch located along a boundary fence adjacent to semi-improved grassland and industrial premises (NGR TA 22988 13514.). It has a wetted width of approximately 2 m, with a silt substrate and vertical banks. No flow was present at the time of the survey.

*Aquatic Macroinvertebrates*

- 3.22 A low diversity of aquatic macroinvertebrate species was present (eight species). The community was fairly typical of small slow-flowing ditch comprising predominantly snails, crustaceans and beetles. The CCI score was 1.29 indicating that the ditch is of low conservation value. All species present were of very common to common status.
- 3.23 The biological quality of the ditch is poor (BMWP 34, APST 4). No pollution sensitive taxa were present, but it did support a range of taxa defined as having a moderate tolerance to pollution (the crustaceans Crangonyctidae, and the beetles Haliplidae, Dytiscidae and Noteridae).

*Macrophytes*

- 3.24 Seven species of macrophyte were present, none was rare or notable and the assemblage is considered typical of the habitat conditions. Of these, three are scoring

species in GNLP criteria for assessing sites for LWS quality: common reed, bulrush and branched bur-reed (*Sparganium erectum*).

**Table 10D.4: Summary of the notable species recorded (Conservation Scores > 6)**

SPECIES	HABITAT AND DISTRIBUTION	CURRENT STATUS
Smooth Ram's Horn snail ( <i>Gyraulus laevis</i> )	This snail species is associated with shallow, slow flowing waters, rivers, lakes and ponds, usually found on weeds but sometimes on muddy bottoms and on stones. It has the ability to colonise new artificial habitats and can be found in gravel pits, reservoirs and fish ponds (Van Damme, 2012)	Nationally Scarce (found in 16 to 100 hectads nationally) (Seddon <i>et al.</i> , 2014). Notable (Conservation Score 6) in the CCI system; no statutory protection. This species is not currently threatened in Great Britain, it is present in 70 hectads but is suffering from adverse habitat loss (Seddon <i>et al.</i> , 2014).

## 4.0 NATURE CONSERVATION EVALUATION

4.1 This section evaluates the aquatic macroinvertebrate and macrophyte species/assemblages present and their relative nature conservation values. The features present are not of international nature conservation importance as the site supports no:

- known endemic species or races; or
- species of European Union concern as listed on Annexes II and IV of the Habitats Directive (Council Directive 92/43/EEC).

### Smooth Ram's Horn Snail

4.2 This was the only notable species recorded during the surveys, being recorded from Ditch 1 and 2. Although this species is regarded as Nationally Scarce, it is found within 70 hectads, which is towards the upper end of this category (the definition is a species which occurs between 16 and 100 hectads). Although habitat loss appears to be the main factor in its decline, it occurs in a range of habitats and is able to colonise new artificial habitats.

4.3 Given the relatively limited extent of the ditch associated with the site, in comparison with the much wider extent of suitable habitats in the local area, they are likely to also support this species, therefore the site population of this species is assessed as having Local nature conservation value.

### Pond 1

4.4 All of the aquatic macroinvertebrate and macrophyte species recorded are common and typical of the habitats present. None are rare, threatened or legally protected. Therefore there are no individual species present that can be considered to be of any more than Local value.

4.5 The pond does not meet the criteria established for the identification of sites of county value for aquatic invertebrates or macrophytes, either in isolation or in combination. The communities present are therefore judged to be of Local value.

### Pond 2

4.6 All of the aquatic macroinvertebrate species and macrophyte recorded are common and typical of the habitats present. None are rare, threatened or legally protected. Therefore there are no individual species present that can be considered to be of any more than Local value.

4.7 The pond does not meet the criteria established for the identification of sites of county value for aquatic invertebrates or macrophytes, either in isolation or in combination. The communities present are therefore judged to be of Local value.

### Ditch 1

4.8 All of the aquatic macroinvertebrate (with the exception of smooth Ram's Horn snail which is assessed separately above) and macrophyte species recorded are common and typical of the habitats present. None are rare, threatened or legally protected. Therefore there are no individual species present that can be considered to be of any more than Local value.

4.9 The ditch does not meet the criteria established for the identification of sites of county value for aquatic invertebrates or macrophytes, either in isolation or in combination. However, as Ditch 1 is linked to Ditch 2 hydrologically, it is likely to have value in terms of the contribution it makes to supporting the nature conservation interest of Ditch 2 (see below). In combination with Ditch 2 it can be considered to have District value.

### **Ditch 2**

- 4.10 All of the aquatic macroinvertebrate (with the exception of smooth Ram's Horn snail which is assessed separately above) and macrophyte species recorded are common and typical of the habitats present. None are rare, threatened or legally protected. Therefore there are no individual species present that can be considered to be of any more than Local value.
- 4.11 The ditch does not meet the criteria established for the identification of sites of county value for aquatic invertebrates or macrophytes, either in isolation or in combination. However, it only just falls short of these criteria and supports diverse assemblages of macroinvertebrates and macrophytes. On this basis, Ditch 2 is considered to be of District value.

### **Ditch 3**

- 4.12 All of the aquatic macroinvertebrate and macrophyte species recorded are common and typical of the habitats present. None are rare, threatened or legally protected. Therefore there are no individual species present that can be considered to be of any more than Local value.
- 4.13 The assemblage present does not meet the criteria established for the identification of sites of county value for aquatic invertebrates or macrophytes, either in isolation or in combination. The communities present are judged to be of Local value.

## 5.0 REFERENCES

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## **ANNEX A: SURVEY AREA AND WATERBODY LOCATIONS**

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

**LEGEND**

- Application Boundary
- E G2.1 - Running water - eutrophic
- J2.1.2 - Intact hedge - species-poor
- A1.1.2 - Broadleaved woodland - plantation
- A2.1 - Scrub - dense/continuous
- B2.2 - Neutral grassland - semi-improved
- F1 - Swamp
- G1 - Standing water
- G1.1 - Standing water - eutrophic
- J1.1 - Cultivated/disturbed land - arable
- J1.2 - Cultivated/disturbed land - amenity grassland
- J2.1.2 - Intact hedge - species-poor
- J3.6 - Buildings & Structures
- J5 - Other Habitat - Hard Standing

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Purpose of Issue  
**ENVIRONMENTAL STATEMENT**

Client  
 EP SHB

Project Title  
**SOUTH HUMBER BANK ENERGY CENTRE**

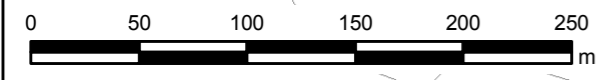
Application Document Ref  
**AQUATIC MACROINVERTEBRATE AND MACROPHYTE SURVEY**

Drawn LC	Checked SD	Approved JA	Date 06/11/2018
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Drawing Ref  
**FIGURE 10D.1**



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## ANNEX B: BIOLOGICAL MONITORING WATERBODY (BMWP) SYSTEM

The BMWP system assigns a numerical value to about 80 different taxa (known as the BMWP-scoring families) according to their sensitivity to organic pollution. The average of the values for each taxon in a sample, known as ASPT (average score per taxon) is a stable and reliable index of organic pollution. Values lower than expected indicate organic pollution.

The most useful way of summarising the biological data was found to be one that combined the number of taxa and the ASPT. The best quality is indicated by a diverse variety of taxa, especially those that are sensitive to pollution. Poorer quality is indicated by a smaller than expected number of taxa, particularly those that are sensitive to pollution. Organic pollution sometimes encourages an increased abundance of the few taxa that can tolerate it.

The biotic scores can be interpreted by following the guidelines in the table below (taken from Armitage et al., 1983; Chapman, 1996; Mason, 2002). However, these categories are for guidance only and it should be remembered that maximum achievable values will vary between geological regions.

For example, pristine lowland streams in East Anglia will always score lower than pristine Welsh mountain streams as they are unable to support many of the high-scoring taxa associated with fast flowing habitat. BMWP scores and ASPT for different types watercourse are dependent on the quality and diversity of habitat, natural water chemistry (associated with geology, distance from source etc.), altitude, gradient, time of year the sample was taken and other factors.

**Table A2: A guide to interpreting BMWP Score and ASPT**

BMWP SCORE	ASPT	INTERPRETATION
0-10	<3.0	Very poor, heavily polluted
11-40	3.0-4.3	Poor, polluted or impacted
41-70	4.3-4.8	Moderate, moderately impacted
71-100	4.8-5.4	Good, clean but slightly impacted
>100	>5.4	Very good, unpolluted, unimpacted

## ANNEX C: AQUATIC MACROINVERTEBRATE SPECIES DATA

BMWP GROUP	SPECIES	BMWP SCORE	CONSERVATION SCORE	POND 1	POND 2	DITCH 1	DITCH 2	DITCH 3
Snails								
Lymnaeidae	Lymnaeidae (juvenile / damaged)	3				1		
Lymnaeidae	Radix sp.	3					15	
Lymnaeidae	<i>Radix balthica</i>	3	1		1	388	452	10
Hydrobiidae	Hydrobia sp.	3					23	
Hydrobiidae	<i>Potamopyrgus antipodarum</i>	3	1	136	1	316	554	
Physidae	Physella sp.	3		82				
Succineidae	Succinea sp.	-				1	9	
Planorbidae	Planorbidae (juvenile / damaged)	3				82		
Planorbidae	Planorbis sp.	3					21	
Planorbidae	<i>Planorbis planorbis</i>	3	1			2	92	40
Planorbidae	<i>Gyraulus laevis</i>	3	6			120	78	
Planorbidae	<i>Armiger crista</i>	3	2			2		
Limpets and mussels								
Sphaeriidae	Pisidium sp.	3				2	11	
Worms								
Oligochaeta		1					1	7
Leeches								
Glossiphoniidae	<i>Helobdella stagnalis</i>	3	1				1	
Erpobdellidae	Erpobdella sp.	3						1
Mites								
Hydracarina		-			2			
Crustaceans								
Ostracoda		-		1				
Copepoda		-				1		

BMWP GROUP	SPECIES	BMWP SCORE	CONSERVATION SCORE	POND 1	POND 2	DITCH 1	DITCH 2	DITCH 3
Cladocera		-		2	2			
Crangonyctidae	<i>Crangonyx pseudogracilis</i>	6	1	8			1	12
Asellidae	<i>Asellus</i> sp.	3					4	
Asellidae	<i>Asellus aquaticus</i>	3	1	135		1	72	25
Mayflies								
Baetidae	Baetidae (juvenile / damaged)	4			212	1		
Baetidae	<i>Cloeon dipterum</i>	4	1	10	100		2	
Damselflies								
Coenagrionidae	Coenagrionidae (juvenile / damaged)	6		2	500	2	16	
Coenagrionidae	<i>Ischnura</i> sp.	6			4			
Coenagrionidae	<i>Ischnura elegans</i>	6	1	3	13		0	
Dragonflies								
Libellulidae	<i>Libellula quadrimaculata</i>	8	4	1				
Libellulidae	<i>Sympetrum</i> sp.	8				23	9	
Libellulidae	<i>Sympetrum striolatum</i>	8	1			42	84	
True bugs								
Gerridae	Gerridae (nymph / damaged)	5		1	9	7		
Gerridae	<i>Gerris</i> sp.	5					4	
Gerridae	<i>Gerris lacustris</i>	5	1			1	2	
Nepidae	<i>Ranatra linearis</i>	5	5	1				
Naucoridae	<i>Ilyocoris cimicoides</i>	5	4		1		1	
Corixidae	Corixidae (nymph / damaged)	5				2		
Corixidae	<i>Hesperocorixa sahlbergi</i>	5	2			2		
Notonectidae	<i>Notonecta</i> sp.	5			1			
Beetles								
Haliplidae	<i>Halipplus</i> sp.	5				13	2	

BMWP GROUP	SPECIES	BMWP SCORE	CONSERVATION SCORE	POND 1	POND 2	DITCH 1	DITCH 2	DITCH 3
Haliplidae	<i>Haliplus flavicollis</i>	5	4			5	2	
Haliplidae	<i>Haliplus lineaticollis</i>	5	1			14	2	1
Haliplidae	Haliplus ruficollis group	5				18	4	1
Dytiscidae	<i>Hygrotus inaequalis</i>	5	2				1	3
Dytiscidae	<i>Hygrotus impressopunctatus</i>	5	5				1	
Dytiscidae	Hydroporus sp.	5				1		
Dytiscidae	<i>Hydroporus palustris</i>	5	1			1	1	
Dytiscidae	<i>Graptodytes pictus</i>	5	3				1	
Dytiscidae	<i>Agabus bipustulatus</i>	5	1			1	3	
Dytiscidae	<i>Agabus nebulosus</i>	5	1			1	1	
Dytiscidae	<i>Agabus paludosus</i>	5	1				1	
Dytiscidae	<i>Agabus sturmii</i>	5	1				2	
Dytiscidae	<i>Ilybius quadriguttatus</i>	5	5				2	
Noteridae	<i>Noterus clavicornis</i>	5	2					1
Hydrophilidae	Hydrophilidae (larvae / damaged)	5				8		
Hydrophilidae	<i>Helophorus brevipalpis</i>	5	1		1		1	
Hydrophilidae	<i>Hydrobius fuscipes</i>	5	1			6	18	
Hydrophilidae	<i>Anacaena globulus</i>	5	1			1	5	
Hydrophilidae	Laccobius sp.	5						1
Hydraenidae	<i>Ochthebius minimus</i>	5	1				1	
Hydraenidae	<i>Hydraena riparia</i>	5	1			1		
Dryopidae	Dyops sp.	5					3	
Alderflies								
Sialidae	Sialidae (juvenile / damaged)	4						
Sialidae	<i>Sialis lutaria</i>	4	1	1			1	
Caddisflies								

BMWP GROUP	SPECIES	BMWP SCORE	CONSERVATION SCORE	POND 1	POND 2	DITCH 1	DITCH 2	DITCH 3
Phryganeidae	Phryganea sp.	10		1	1			
Limnephilidae	Limnephilus sp.	7					18	
Limnephilidae	<i>Limnephilus lunatus</i>	7	1			1	51	
Trueflies								
Chironomidae	Tanypodinae	2		20	16	27	30	
Chironomidae	Orthoclaadiinae	2		14	28			
Chironomidae	Chironomini	2				22	24	
Chironomidae	Tanytarsini	2		5			14	
Tipulidae	Tipula sp.	5		1	1	6		
Limoniidae	Limoniidae	5		3		1		
Limoniidae	Helius sp.	5		2				
Simuliidae	Simulium sp.	5				1		
Ceratopogonidae		-			1			
Culicidae	Culicidae	-			19		1	
Chaoboridae	Chaoborus sp.			1				
Ephydriidae	Setacera sp.	-			24			
Sciomyzidae	Tetanocera sp.	-			1	2	3	
Other Taxa								
Lepidoptera		-						2
Number of scoring families (BMWP)				13	11	17	20	9
Number of non-scoring families (BMWP)				3	6	3	3	1
Total number of families (BMWP)				16	17	20	23	10
BMWP score				64	53	77	86	34
ASPT (BMWP)				4.9	4.8	4.5	4.3	4
CCI Score				9.38	4.50	7.78	8.93	1.29
Total Number of species				8	6	19	31	8



BMWP GROUP	SPECIES	BMWP SCORE	CONSERVATION SCORE	POND 1	POND 2	DITCH 1	DITCH 2	DITCH 3
Total Number of genus / above				13	15	19	18	4

## ANNEX D: MACROPHYTE SPECIES DATA

COMMON NAME	LATIN NAME	POND 1	POND 2	DITCH 1	DITCH 2	DITCH 3
<b>GNLP (2013) scoring freshwater flora</b>						
Water-plantain	<i>Alisma plantago-aquatica</i>			R	R	
Fool's-water-cress	<i>Apium nodiflorum</i>				R	
Lesser water-parsnip	<i>Berula erecta</i>	R		R	R	
Various-leaved Water-starwort	<i>Callitriche platycarpa</i>				R	
Common water-star wort	<i>Callitriche stagnalis</i>			R		
Rigid hornwort	<i>Ceratophyllum demersum</i>	R				
Common stonewort	<i>Chara vulgaris</i>			R	R	
Ivy-leaved duckweed	<i>Lemna trisulca</i>			R	R	
Water mint	<i>Mentha aquatica</i>					
Spiked water-milfoil	<i>Myriophyllum spicatum</i>	R	A		R	
Common reed	<i>Phragmites australis</i>	A	F	D	D	R
Small pondweed	<i>Potamogeton berchtoldii</i>			R		
Branched Bur-reed	<i>Sparganium erectum</i>					O
Bulrush	<i>Typha latifolia</i>				R	F
<b>Other Species</b>						
Sea club-rush	<i>Bolboschoenus maritimus</i>			R		
Great willowherb	<i>Epilobium hirsutum</i>					O
Field horsetail	<i>Equisetum arvense</i>			R		
Hard rush	<i>Juncus inflexus</i>					F
Common duckweed	<i>Lemna minor</i>			R	R	F
Least duckweed	<i>Lemna minuta</i>					F
White water-lily	<i>Nymphaea alba</i>	R				
<b>Negative Indicators (Algae)</b>						
Green filamentous algae		R		R	R	
Green algae	<i>Cladophora</i> sp.			R	R	
An algae	<i>Enteromorpha intestinalis</i>			R		
<b>Total - all species excluding algae</b>		5	2	10	10	7

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<b>Total number of GLBP scoring flora</b>	4	2	7	9	3
<b>Number of scoring species required to meet GNL (2013) criteria for LWS quality based on botanical diversity alone</b>	10				