

Viking CCS Pipeline

**Environmental
Statement Volume IV –
Appendix 6-6: Aquatic
Ecology Report**

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1 Introduction

1.1 Background

1.1.1 AECOM was commissioned by Harbour Energy in 2022 to complete aquatic ecological surveys to inform the Viking Carbon Capture and Storage (CCS) Pipeline, hereafter referred to as the 'Proposed Development'.

1.1.2 This report describes the approach and findings of aquatic ecology surveys undertaken to inform the Environmental Statement for the Proposed Development. The terms of reference used to describe the Proposed Development in this report are consistent with those defined within the main chapters of the Environmental Statement (ES) Volume II (*Application Document 6.2*). The Proposed Development Site Boundary illustrates the provisional outer limits of the Proposed Development. It comprises both the temporary and permanent land take required for construction and operation of the Proposed Development for which powers are sought through the DCO.

Site Location and Development Proposals

1.1.3 The Proposed Development is located in the Yorkshire and Humber and East Midlands regions of England. The Proposed Development comprises approximately 55.5 km of buried pipeline, which would enable carbon dioxide (CO₂) captured by emitters in Immingham to be transported to Theddlethorpe, for onward transportation and storage offshore. Full details of the Proposed Development are provided in *ES Volume II Chapter 3: Description of the Proposed Development (Application Document 6.2.3)*. The location of the Proposed Development is also shown in Figure 3-1 within *ES Volume III (Application Document 6.3)*.

Aims and Objectives

1.1.4 The purpose of this report is to present the approach and findings of the desk study and the aquatic ecology field studies undertaken in December 2022 and Spring 2023 to inform the Environmental Impact Assessment (EIA) presented in the ES.

Legislation

1.1.5 This assessment has been undertaken within the context of the following relevant legislative instruments, planning policies and guidance documents:

- The Conservation of Habitats and Species Regulations 2017 ("the Habitats Regulations") (**Ref 1**);
- Water Environment (Water Framework Directive ('WFD')) (England and Wales) Regulations 2017 (**Ref 2**);
- Wildlife and Countryside Act 1981 (as amended) (the 'WCA') (**Ref 3**);
- Natural Environment and Rural Communities Act (2006), Section 41 of which provides a list of habitats and species of principal importance for nature conservation in England (**Ref 4**);
- Salmon and Freshwater Fisheries Act 1975 (Ref 5);
- The Eels (England and Wales) Regulations 2009 (Ref 6);
- The Invasive Alien Species (Enforcement and Permitting) Order 2019 (Ref 7); and
- UK Post-2010 Biodiversity Framework (Ref 8).

2 Methodology

2.1 Desk Study

2.1.1 A desk-based review of Water Framework Directive (WFD) information and aquatic ecology receptors was undertaken for all watercourses and ditches that could potentially be impacted, where information was available. This included a review of:

- Current WFD status using the Environment Agency (EA) Catchment Data Explorer website (**Ref 9**);
- Environment Agency ecological survey data from the last ten years using the Environment Agency Ecology and Fish Data Explorer (**Ref 10**);
- Records of relevant Statutory Designated sites, Non-Statutory Designated sites, legally protected and/or notable species, as well as invasive species (INNS), sourced from Great Lincolnshire Nature Partnership (GLNP); and
- Records commercially available on the National Biodiversity Network NBN Atlas (**Ref 11**).

2.2 Field Surveys

2.2.1 A total of 145 crossing points of watercourses and ditches were identified as part of the Viking CCS Pipeline (**Table 1**).

2.2.2 Subsequently, watercourses and ditches that will be impacted by way of open-cut crossings along the Viking CCS pipeline were identified, based on the currently available design and crossing schedule, a copy of which is included within *ES Volume IV Appendix 3.2 Crossing Schedule (Application Document 6.4.3.2)*. A total of 87 open-cut watercourse and ditch crossings were identified along the route of the Proposed Development (**Table 1**). It should be noted that the pipeline route section presented in column 1 of **Table 1** matches the pipeline route split into five sections as detailed throughout the Environmental Statement (ES). This is to assist in describing baseline conditions present across the length of the pipeline route.

2.2.3 A targeted approach was taken to select locations for aquatic ecological surveys informed by the identification of likely or potential impacts, and this was based on connectivity to other water bodies, including WFD water bodies where potential impacts may be of greater significance. Where impacts to watercourses and ditches were avoided by the selection of auger boring or Horizontal Directional Drilling (HDD) as the crossing method, specific aquatic ecological surveys were scoped out.

Table 1: Watercourse and Ditch Crossing Points and Survey Locations

Route Section	Purple Route Name of Crossing	Crossing ID	OSGB36 Eastings	OSGB36 Northings	Crossing type	Walkover site	Macroinvertebrate site
1	Drain (part of PLX001P)	DX001P	517321.76	416500.44	Auger Bore		No
1	Drain	DX001AP	517361.15	416463.50	Open cut		No
1	Drain	RVX001GP (formerly DX002P)	517622.77	416286.45	Open cut		Yes
1	Habrough drain	DX003P	517713.24	416208.19	Open cut		Yes
1	Habrough drain	DX004P	517526.14	416022.14	Open cut	Yes	Yes
1	Drain	DX005P	517431.29	415710.41	HDD		No
1	Drain	DX005AP	517263.60	415644.94	HDD		No
1	Drain	DX006AP	516914.36	415508.58	HDD		No
1	Drain in trees	DX006P	516943.06	415723.44	HDD		No
1	Drain	DX007P	516864.46	415623.36	HDD	Yes	Yes
1	Drain	DX008P	516308.62	414925.44	Open cut	Yes	Yes
1	Drain	DX008AP	516374.34	414871.91	Open cut		No
1	Drain (Part of RDX008P)	DX009P	516438.31	414340.78	Auger Bore		No
1	Drain (Part of RDX008P)	DX009AP	516437.91	414328.90	Auger Bore	No	No
1	Drain (part of RDX009P)	DX010P	516609.53	413924.00	Auger Bore		No
1	Drain (part of RDX009P)	DX011P	516598.68	413876.11	Auger Bore		No
1	Drain	DX012P	516879.94	413730.44	Open cut		No
1	Drain (field drain)	DX013P	517144.99	413487.35	Open cut		No
1	Drain (part of RDX010P)	DX014P	517280.16	413284.36	Auger Bore		No
2	Drain (part of RDX010P)	DX015P	517291.52	413277.22	Auger Bore		No

Route Section	Purple Route Name of Crossing	Crossing ID	OSGB36 Eastings	OSGB36 Northings	Crossing type	Walkover site	Macroinvertebrate site
2	Drain	DX016P	517173.35	412630.43	Open cut		No
2	Drain	DX017P	517228.59	412517.85	Open cut	Yes	Yes
2	Drain (field drain)	DX018P	517670.01	411845.38	Open cut		No
2	Drain (field drain)	DX019P	517971.66	411621.18	Open cut		No
2	North Beck Drain	RVX001AP (formerly DX020P)	518217.02	410920.16	HDD		Yes
2	Drain (field drain)	DX021P	518095.27	411318.22	Open cut		No
2	North Beck Drain	DX022P	518172.48	411026.20	HDD		No
2	North Beck Drain	DX023P	518281.41	410766.89	HDD		No
2	Drain	DX023AP	518892.53	409695.90	Auger Bore		
2	Drain	DX023BP	519014.32	409355.80	Open cut		No
2	Drain	DX023CP	519019.48	409340.58	Open cut		No
2	Drain	DX023DP	519115.64	409069.11	Auger Bore		No
2	Old Fleet Drain	DX024P	519122.15	409061.14	Auger Bore		No
2	Drain	DX025P	519536.07	408369.82	Open cut		No
2	Drain (field drain)	DX026P	519468.37	408156.37	Open cut		No
2	Drain (part of RDX014P)	DX027P	519386.28	407728.00	Auger Bore		No
2	Drain	DX028P	519672.53	406338.30	Open cut	Yes	No
2	Drain (field drain)	DX029P	519981.06	405809.53	Open cut		No
2	Drain (field drain)	DX029AP	520022.55	405724.66	Open cut		No
3	Drain (field drain)	DX030P	521205.26	404645.83	Open cut		No
3	Drain (field drain)	DX031P	521452.96	404605.44	Open cut		No

Route Section	Purple Route Name of Crossing	Crossing ID	OSGB36 Eastings	OSGB36 Northings	Crossing type	Walkover site	Macroinvertebrate site
3	Drain (field drain)	DX032P	521611.86	404398.09	Open cut		No
3	Welbeck Spring (drain)	RVX001BP (formerly DX033P)	522139.42	404134.12	Auger Bore	Yes	Yes
3	Drain (field drain)	DX034P	522275.54	403706.40	Open cut	Yes	No
3	Drain (part of RDX020P)	DX034AP	522771.13	402806.66	Auger Bore	No	No
3	Drain (in trees)	DX035P	523380.03	402496.95	Open cut	Yes	Yes
3	Drain (in trees)	DX035AP	523399.94	402503.13	Open cut		No
3	Waithe Beck (in trees)	RXV001CP (formerly DX036P)	524277.79	402046.42	Auger Bore		No
3	Waithe Beck (in trees)	RVX001DP	524103.51	402029.70	HDD		No
3	Drain	DX037P	525229.63	401263.00	Open cut		Yes
3	Drain (in trees)	DX038P	525375.51	401260.40	Open cut	Yes	Yes
3	Drain	DX038AP	525634.02	401327.47	Open cut		No
3	Drain (meandering stream)	DX039P	526122.89	400677.21	Auger Bore		No
3	Water Channel/Pond	DX039AP	526239.31	400272.63	Open cut		No
3	Drain (field drain)	DX040P	526327.98	400116.26	Open cut		No
3	Drain (field drain)	DX041P	526470.56	399726.46	Open cut		No
3	Drain	DX042P	525789.42	398754.73	Open cut	Yes	Yes
3	Drain (field drain)	DX043P	526331.60	398152.62	Open cut		No
3	Drain (field drain)	DX044P	526683.69	397761.61	Open cut		No
3	Drain (field drain)	DX045P	526687.96	397756.86	Open cut		No
3	Drain (field drain)	DX045AP	527091.45	397567.82	Open cut		No
3	Bond Croft Drain (& RDX025)	DX046P	527614.30	397682.76	Auger Bore		No

Route Section	Purple Route Name of Crossing	Crossing ID	OSGB36 Eastings	OSGB36 Northings	Crossing type	Walkover site	Macroinvertebrate site
3	Unlisted Drain	DX046AP	528030.10	397516.88	Auger Bore		No
3	Drain (with RDX027P)	DX047P	528470.07	397258.34	Auger Bore		No
3	Drain (field drain)	DX048P	528674.63	397166.60	Open cut		No
3	Drain	DX049P	529000.69	397020.89	Open cut		No
3	Drain	DX049AP	529254.74	396828.68	Auger Bore		No
4	Drain	DX050P	529262.12	396830.76	Open cut		Yes
4	Drain	DX051P	529509.12	396693.06	HDD		No
4	Drain (field drain)	DX052P	529809.96	396466.04	Open cut		No
4	Drain (field drain)	DX053P	529915.56	396386.36	Open cut		No
4	Drain (field drain)	DX054P	530146.47	396212.12	Open cut		No
4	Drain	DX055P	530493.32	395909.70	Auger Bore		No
4	Drain (field drain)	DX056P	530861.62	395535.02	Open cut		No
4	Drain	DX057P	531327.79	395214.72	Open cut		No
4	Drain	DX058P	531476.86	395066.12	Auger Bore		No
4	Drain (field drain)	DX059P	531886.04	394646.49	Open cut		Yes
4	Drain (field drain)	DX060P	532000.53	394511.16	Open cut		No
4	Drain (field drain)	DX069AP	532130.31	394357.64	Open cut		No
4	Stream	DX061P	532297.18	394160.52	Open cut		Yes
4	Poulton Drain	RVX001EP (formerly DX062P)	532649.10	393510.87	Auger Bore		No
4	Drain	DX063P	532727.92	393124.59	Auger Bore		No
4	unlisted drain	DX063AP	533069.97	392797.04	Open cut		No

Route Section	Purple Route Name of Crossing	Crossing ID	OSGB36 Eastings	OSGB36 Northings	Crossing type	Walkover site	Macroinvertebrate site
4	Drain	DX064P	533373.26	392526.80	Auger Bore		No
4	Yarburgh Beck	RVX001FP (formerly DX065P)	533757.01	391949.75	Auger Bore		No
4	Stream	DX066P	534230.51	391247.61	Open cut	Yes	Yes
4	Drain (field drain)	DX067P	534849.12	390560.24	Open cut		Yes
4	Drain (field drain)	DX068P	535208.74	390546.33	Open cut		Yes
4	River Ludd	RVX001P	536188.87	390299.49	HDD		No
4	Drain (part of RDX036)	DX069P	536649.20	389891.81	Auger Bore		No
4	Drain (part of RDX037)	DX071P	537528.64	389604.20	Auger Bore		No
4	Drain (part of RDX038)	DX072P	537601.43	389560.20	Auger Bore		No
4	Drain	DX073P	538287.04	389985.43	Open cut	Yes	Yes
4	Drain (part of RDX039P)	DX074AP	539067.18	390536.82	Auger Bore		No
4	Harrowsea Drain	DX074P	539160.00	390561.75	Open cut	Yes	Yes
4	Drain (field drain)	DX075P	539653.67	389945.05	Open cut	Yes	Yes
4	Greyfleet Drain	RVX003AP (formerly DX076P)	539802.27	389759.42	HDD		No
4	Drain	DX077P	539990.24	389526.27	Auger Bore		No
4	Drain (part of RDX041P)	DX077AP	540001.07	389515.28	Auger Bore		No
4	Drain	DX078AP	540370.58	389140.1401	Open cut		No
4	Drain (field drain)	DX078P	540378.32	389132.27	Open cut		Yes
4	Drain (field drain)	DX079P	540708.45	389027.20	Open cut		No
4	Drain	DX080P	541329.21	388534.60	HDD		No
5	Drain (field drain)	DX081P	541341.49	388519.34	HDD		No

Route Section	Purple Route Name of Crossing	Crossing ID	OSGB36 Eastings	OSGB36 Northings	Crossing type	Walkover site	Macroinvertebrate site
5	Drain (field drain)	DX082P	541443.33	388392.78	Open cut		Yes
5	Meandering Drain	DX083P	541520.41	388120.97	Auger Bore		No
5	Drain (field drain)	DX083AP	541693.11	387962.61	Open cut		No
5	Drain beside TX007	DX084P	541810.62	387865.14	Open cut		No
5	Drain beside TX007	DX085P	541818.43	387858.66	Open cut		No
5	Drain (field drain)	DX086P	541996.99	387706.29	Open cut		No
5	Drain (field drain)	DX087P	542092.22	387649.87	Open cut		No
5	Head Dike Drain	DX088P	542206.86	387520.02	Auger Bore		No
5	Long Eau (drain)	RVX002P	542372.78	387392.96	HDD		No
5	Drain	DX089P	542527.36	387094.96	Auger Bore		No
5	The Cut Drain	DX089AP (formerly RVX003P)	542931.39	386921.27	Open cut		Yes
5	Drain (field Drain)	DX090P	542955.09	386892.37	Open cut		No
5	Drain (field Drain)	DX090AP	543367.86	386388.99	Open cut		No
5	Two Mile Bank Drain	DX090BP (formerly RVX004P)	543393.77	386357.39	Open cut		Yes
5	Drain	DX091P	543623.10	386197.20	Open cut	Yes	Yes
5	Drain	DX092P	543914.10	386387.21	Open cut	Yes	Yes
5	Gayton North Fen Drain	DX093P	544200.35	386284.21	Open cut		Yes
5	Unlisted Drain	DX093AP	544336.06	386353.04	Open cut		No
5	Drain	DX094P	544507.91	386482.80	Open cut		Yes
5	Drain	DX095P	544705.92	386632.30	HDD		Dry
5	New Gayton Engine Drain	DX095AP (formerly RVX005P)	544838.82	386732.65	Open cut		Yes

Route Section	Purple Route Name of Crossing	Crossing ID	OSGB36 Eastings	OSGB36 Northings	Crossing type	Walkover site	Macroinvertebrate site
5	Drain	DX096P	545140.89	386960.71	Open cut		Yes
5	Drain	DX097P	545197.82	387003.70	Open cut		No
5	Old Engine Drain	DX097AP (formerly RVX006P)	545731.85	387250.24	HDD		No
5	Great Eau	RVX007P	545781.01	387272.16	HDD		No
5	Drain	DX098P	545814.51	387287.09	HDD		No
5	Drain	DX099P	546190.18	387454.56	Auger Bore		No
5	Drain	DX100P	546238.11	387475.93	Open cut		No
5	Drain (field drain)	DX101P	546357.97	387534.30	Open cut		No
5	Drain (field drain)	DX102P	546478.53	387593.95	Open cut		No
5	Drain (field drain)	DX103P	546550.04	387629.34	Open cut		No
5	Drain (field drain)	DX104P	546623.70	387665.79	Open cut		No
5	Drain (field drain)	DX105P	546741.17	387723.92	Open cut		No
5	Drain (field drain)	DX105AP	546800.00	387753.03	Open cut		No
5	Drain	DX106P	546937.39	387821.02	Auger Bore		No
5	Drain	DX107P	546955.35	387829.916	Auger Bore		No
5	Drain (field drain)	DX108P	547124.04	387843.49	Open cut		Yes
5	Drain	DX109P	547471.20	387814.47	Open cut		Yes
5	Drain	DX110P	547599.42	387772.60	Open cut		Yes
5	Drain (part of RDX046)	DX111P	547759.19	387753.95	Auger Bore		No
5	Drain (part of RDX046P)	DX111BP	547782.09	387752.26	Auger Bore		No
5	The Cut (drain)	DX111AP (formerly RVX008P)	548224.04	387572.89	Auger Bore		No

Route Section	Purple Route Name of Crossing	Crossing ID	OSGB36 Eastings	OSGB36 Northings	Crossing type	Walkover site	Macroinvertebrate site
5	The Cut (drain)	DX111APa (formerly RVX008P)	548223.90	387581.81	Auger Bore		No
5	Drain (field drain)	DX112P	548258.54	387572.04	Auger Bore		Yes
5	Drain (field drain)	DX112Pa	548258.64	387581.70	Auger Bore		No
5	Drain (field drain)	DX113P	548284.21	387571.40	Open cut		Yes
5	Drain (field drain)	DX113Pa	548283.25	387581.61	Auger Bore		No
5	Drain (field drain)	DX114P	548473.90	387566.71	Open cut		Yes
5	Drain (field drain)	DX114Pa	548500.33	387520.03	Open cut		No

Aquatic Ecology Walkover Survey

2.2.4 Aquatic walkover scoping surveys were carried out in December 2022. Walkover site locations are presented in **Table 2** below.

Aquatic Macroinvertebrate Survey

2.2.5 Aquatic macroinvertebrate samples were collected to identify the conservation value of aquatic macroinvertebrate communities, to record the presence of any notable/protected species or invasive non-native species (INNS), and to provide an indication of water and habitat quality.

2.2.6 Of the 87 open-cut sites, 41 sites were selected for macroinvertebrate sampling (see **Table 2**). Minor, isolated drains that were not connected other water bodies were scoped out of surveys. Of the 41 sites selected for survey, eight sites were dry when visited. Therefore, a total of 33 macroinvertebrate samples were collected.

Table 2: Final Aquatic Ecological Survey Locations

Crossing Ref	NGR	Survey Date	Survey Type	Site Description
RVX001GP	TA 17627 16282	16/04/2022	Aquatic macroinvertebrate survey	Very shaded, shallow ditch. Moderately turbid water with average flow <10 cm/s. 2 m average width, 10 cm average depth. 100% ditch habitat. 100% silt substrate
DX003P	TA 17713 16208	10/03/2023	Aquatic macroinvertebrate survey	Realigned drainage channel. Slightly turbid water with average flow <10 cm/s. 2 m average width, 20 cm average depth. 100% ditch habitat. 100% silt substrate
DX004P	TA 17525 16019	14/12/2022 16/03/2023	Aquatic walkover Aquatic macroinvertebrate Survey	Overgrown ditch with ochre present throughout the stretch surveyed. Slightly turbid water with average flow <10 cm/s. 1.5 m average width, 10 cm average depth. 100% ditch habitat. 100% silt substrate
DX005P-Harbrough Drain	TA 17395 15965	12/10/2023 16/10/2023	Aquatic walkover Aquatic macroinvertebrate survey	Ditch lightly shaded, channel has been realigned and deepened. Slightly turbid water with average flow 10-25 cm/s, 2.5 m average width, 20 cm average depth. 100% ditch habitat. 100% silt substrate
DX007P	TA 16867 15626	12/12/2022 15/03/2023	Aquatic walkover	Realigned and deepened ditch. Slightly turbid water with average flow <10 cm/s. 2 m

Crossing Ref	NGR	Survey Date	Survey Type	Site Description
			Aquatic macroinvertebrate survey	average width, 40 cm average depth. 100% ditch habitat. 100% silt substrate
DX008P	TA 16309 14924	13/12/2022 15/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Steep-sided drain, channel has been realigned and deepened. Slightly turbid water with average flow <10 cm/s. 0.5 m average width, 20 cm average depth. 100% ditch habitat. 100% silt substrate
DX017P	TA 17230 12515	13/12/2022 15/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Steep-sided ditch with good macrophyte cover. Realigned channel. Clear water with average flow <10 cm/s. 1 m average width, 15 cm average depth. 100% ditch habitat. 100% silt substrate
RVX001AP	TA 18095 11318	15/03/2023	Aquatic macroinvertebrate survey	Dry at time of survey, sample not collected
DX028P	TA 19648 06307	13/12/2022	Aquatic walkover	Dry at time of survey, sample not collected
RVX001BP- Wellbeck Spring	TA 22075 04084	13/12/2022 15/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Spring running into a steep-sided, realigned and deepened channel. Clear water with average flow <10 cm/s. 1 m average width, 15 cm average depth. 100% ditch habitat. 100% silt substrate
DX034P	TA22271 03707	14/12/2022	Aquatic walkover	Dry in winter, did not return in spring
DX035P	TA 23389 02999	13/12/2023 15/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Small, realigned drainage ditch. Slightly turbid water with average flow <10 cm/s. 1 m average width, 15 cm average depth. 100% ditch habitat. 100% silt substrate
DX037P	TA 25227 01264	14/03/2023	Aquatic macroinvertebrate survey	Small, realigned stream. Slightly turbid water with average flow 1-25 cm/s. 0.3 m average width, 15 cm average depth. 100% ditch habitat. 100% clay substrate

Crossing Ref	NGR	Survey Date	Survey Type	Site Description
DX038P	TA 25377 01260	15/12/2022 14/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Realigned stream. Highly turbid water with average flow 25-50 cm/s. 1 m average width, 20 cm average depth. 100% run habitat. 100% clay substrate
DX042P	TF 25789 98754	15/12/2022 14/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Very small, shallow field drain (w. 10cm). Slightly turbid water with average flow 10-25 cm/s. 0.10 m average width, 5 cm average depth. 100% ditch habitat. 100% silt substrate
DX050P	TF 29522 96706	14/03/2023	Aquatic Habitat Appraisal	Field drain that has been realigned and dredged, Clear water with average flow 25-50 cm/s. 0.5 m average width, 10 cm average depth. 100% run habitat. 80% clay, 15% gravel and 5% pebble substrate
DX059P	TF 31887 94644	14/03/2023	Aquatic Habitat Appraisal	Field drain that has been realigned and dredged. Slightly turbid water with average flow 25-50 cm/s. 1 m average width, 15 cm average depth. 100% ditch habitat. 100% silt substrate
DX061P	TF 32284 94175	14/03/2023	Aquatic Habitat Appraisal	Small arable field drain that has been realigned and deepened. Slightly turbid water with average flow 10-25 cm/s. 0.8 m average width, 15 cm average depth. 100% silt habitat. 100% silt substrate
DX066P	TF34232 91244	15/12/2022 10/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Small arable field drain with reprofiled banks. Slightly turbid water with average flow 10-25 cm/s. 0.5 m average width, 40 cm average depth. 100% ditch habitat. 95% clay substrate with 5% silt
DX067P	TF 34846 60364	10/03/2023	Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Slightly turbid water with average flow 25-50 cm/s. 1 m average width, 30 cm average depth. 100% ditch

Crossing Ref	NGR	Survey Date	Survey Type	Site Description
				habitat. 90% clay substrate with 10% silt
DX068P	TF 35808 90546	10/03/2023	Aquatic macroinvertebrate survey	Dry at time of survey, sample not collected
DX073P	TF 38287 89985	14/12/2022 09/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Slightly turbid water with average flow <10 cm/s. 0.5 m average width, 20 cm average depth. 100% ditch habitat. 95% clay substrate with 5% silt
DX074P	TF 39158 90566	14/12/2022 09/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Clear water with average flow 10-25 cm/s. 1 m average width, 5 cm average depth. 100% ditch habitat. 80% clay substrate with 10% gravel, 5% silt and 5% sand
DX075P	TA 39672 89963	14/12/2023 09/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Very shallow and mostly dry at time of survey. Highly turbid water with average flow <10 cm/s. 0.5 m average width, <5 cm average depth. 100% ditch habitat. 90% clay substrate with 10% silt
RV003AP	TF 39828 89781	14/12/2022 09/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Clear water with average flow 10-25 cm/s. 1 m average width, 35 cm average depth. 100% ditch habitat. 80% clay substrate with 10% gravel, 5% sand and 5% silt
DX078P	TF 40381 89133	09/03/2023	Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Clear water with average flow <10 cm/s. 0.5 m average width, 10 cm average depth. 100% ditch habitat. 95% clay substrate with 5% silt

Crossing Ref	NGR	Survey Date	Survey Type	Site Description
DX082P	TF 41448 88393	03/03/2023	Aquatic macroinvertebrate survey	Dry at time of survey, sample not collected
DX089AP	TF 42931 86921	18/05/2023	Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Highly turbid water with average flow <10cm/s. 3 m average width, 35 cm average depth. 100% ditch habitat. 100% silt substrate
DX091P	TF 43624 86198	14/12/2022 06/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Clear water with average flow <10 cm/s. 1 m average width, 10 cm average depth. 100% ditch habitat. 50% clay and 50% silt substrate
DX090BP	TF 43391 86360	18/05/2023	Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Slightly turbid water with average flow <10 cm/s. 2 m average width, 10 cm average depth. 100% ditch habitat. 50% clay and 50% silt substrate
DX092P	TF 43917 86389	14/12/2022 06/03/2023	Aquatic walkover Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Clear water with average flow <10 cm/s. 0.5 m average width, 10 cm average depth. 100% ditch habitat. 80% clay and 20% silt substrate
DX093P	TF 44203 86282	18/05/2023	Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Slightly water with average flow <10 cm/s. 1.5 m average width, 30 cm average depth. 100% ditch habitat. 100% silt substrate
DX094P	TF 44303 86492	08/03/2023	Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Moderately turbid water with average flow <10 cm/s. 1 m average width, 40

Crossing Ref	NGR	Survey Date	Survey Type	Site Description
				cm average depth. 100% ditch habitat. 50% clay and 50% silt substrate
DX095P	TF 44698 86648	08/03/2023	Aquatic macroinvertebrate survey	Dry at time of survey, sample not collected
DX096P	TF 45122 86987	08/03/2023	Aquatic macroinvertebrate survey	Dry at time of survey, sample not collected
DX108P	TF 47125 87843	07/03/2023	Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Clear water with average flow <10 cm/s. 0.5 m average width, 10 cm average depth. 100% ditch habitat. 80% clay and 20% silt substrate
DX109P	TF 47461 87816	07/03/2023	Aquatic macroinvertebrate survey	Dry at time of survey, sample not collected
DX110P	TF 45799 87774	18/03/2023	Aquatic macroinvertebrate survey	Field drain that has been realigned and the banks reprofiled. Slightly turbid water with average flow <10 cm/s. 2 m average width, 30 cm average depth. 100% ditch habitat. 10% sand and 90% silt substrate
DX112P	TF48260 87572	17/03/2023	Aquatic macroinvertebrate survey	Dry at time of survey, sample not collected
DX113P	TA 48281 87571	17/03/2023	Aquatic macroinvertebrate survey	Small, realigned field drain. Moderately turbid water with average flow <10 cm/s. 0.5 m average width, 10 cm average depth. 100% ditch habitat. 100% silt substrate
DX114P	TA 48475 87566	17/03/2023	Aquatic macroinvertebrate survey	Small, realigned field drain. Moderately turbid water with average flow <10 cm/s. 1 m average width, 10 cm average depth. 100% ditch habitat. 100% silt substrate

Crossing Ref	NGR	Survey Date	Survey Type	Site Description
DX095AP	TF 44827 86751	08/03/2023	Aquatic macroinvertebrate survey	Small, realigned channel. Moderately turbid water with average flow <10 cm/s. 3.5 m average width, 50 cm average depth. 100% ditch habitat. 80% clay and 20% silt substrate

2.2.7 The macroinvertebrate survey method followed the aquatic macroinvertebrate sampling procedures standardised by the EA (Ref 19), which conforms to BS EN ISO 10870:2012 Water Quality – Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters. The method allowed characterisation of aquatic macroinvertebrate communities and were used to determine whether rare or notable species or communities were present. The samples were taken using a standard Freshwater Biological Association (FBA) pattern pond net (mesh size: 1mm). The habitats present were sampled through a combination of kick sampling and sweep sampling for three minutes followed by a one-minute hand search of larger substrates in accordance with the standard methods. The samples collected were subsequently preserved in Industrial Methylated Spirit (IMS) for laboratory processing.

2.2.8 In-situ measurements of temperature, dissolved oxygen, electrical conductivity, and pH were determined using a calibrated YSI probe.

2.2.9 Each of the samples collected was sorted and analysed in a laboratory by suitably qualified and experienced aquatic ecologists. Lists of the aquatic macroinvertebrate taxa present were produced in line with EA guidance (Ref 18). The aquatic macroinvertebrate samples were identified to ‘mixed taxon level’ using stereomicroscopes. Most groups were identified to species level (where practicable), with the exception of the following:

- Mites (Hydracarina) which were identified to order;
- Worms (Oligochaeta) which were identified to sub-class;
- Marsh beetles (Scirtidae) which were identified to family;
- Butterfly / moth larvae (Lepidoptera), which were identified to order;
- Springtails (Collembola) which were identified to order;
- Truefly larvae, which were identified to the maximum resolution possible; and
- Immature or damaged specimens, which were identified to the maximum resolution possible on a case-by-case basis.

2.2.10 The survey data was then used to calculate the following metrics (see Section 3.3) that can be used to inform an assessment of relative nature conservation value, sensitivity to sedimentation, flow regime and organic enrichment.

Community Conservation Index (CCI)

2.2.11 A Community Conservation Index (CCI) (Ref 14) was calculated for each site as detailed in Annex B. The CCI classifies many groups of aquatic macroinvertebrates according to their

scarcity and nature conservation value in England as understood at the time that the classification was developed.

- 2.2.12 Species scores range from 1 to 10, with one being very common and 10 being Endangered (see Annex B). Since its initial publication, in some cases the references used in the CCI classification to define scarcity and value have been superseded by more recent assessments. Due to this, the author has provided AECOM with updated species scores to take account of this new information (Ref 15). These updated scores have been used within this assessment.
- 2.2.13 The overall CCI derived provides an indication of the conservation value of the community sampled, based on a combination of the rarity of the different aquatic macroinvertebrate taxa present and overall community richness, as shown in Annex B. As indicated above, in some cases expert judgment may be needed to moderate these assessments with reference to current information on status and distribution.

Whalley, Hawkes, Paisley & Trigg (WHPT) Index

- 2.2.14 The aquatic macroinvertebrate data were analysed to generate Whalley, Hawkes, Paisley & Trigg (WHPT) Average Score Per Taxon (ASPT), and Number of scoring taxa (NTAXA) values which provides an indication of the ecological quality in the watercourse (WFD-UKTAG, 2021). This assigns numerical value to taxa according to their sensitivity to organic pollution. The average of the values for each taxon in a sample, known as 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 Annex C).
- 2.2.15 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, as described in this report.

Proportion of Sediment-sensitive Invertebrates (PSI) Index

- 2.2.16 Calculations were also made to determine the proportion of sediment sensitive aquatic macroinvertebrates present using the Proportion of Sediment-sensitive Invertebrates (PSI) index (Ref 17). Using this approach, individual taxa of aquatic macroinvertebrate are assigned a Fine Sediment Sensitivity Rating (FSSR) ranging from A to D, as detailed in Annex D.
- 2.2.17 The PSI score for each aquatic macroinvertebrate sample was derived from individual species scores and abundances. The derived PSI score corresponds to the percentage of fine sediment-sensitive taxa present in a sample and ranges from 0 to 100, where low scores correspond to watercourses with high fine sediment cover. The PSI score therefore provides an indication of the extent to which watercourses are influenced by fine sediments, and therefore by inference the potential sensitivity of the associated aquatic macroinvertebrate community to changes in silt load and deposition.

Lotic-invertebrate Index for Flow Evaluation (LIFE)

- 2.2.18 Lotic-invertebrate Index for Flow Evaluation (LIFE) indices were also calculated (Ref 16). This is an index that links benthic macroinvertebrate data to flow regimes prevailing in UK

waters. Flow scores have been allocated to various aquatic macroinvertebrates based on species/family abundance and ecological association with different flows.

2.2.19 The overall LIFE score for a site is calculated as the sum of the individual scores divided by the number of scoring species/families, as detailed in Annex E. LIFE scores increase with current velocity, with scores <6.00 generally indicating sluggish or still water conditions and scores >7.5 indicating fast flows. LIFE allows the mean flow preference of macroinvertebrates colonising a site to be determined so that effect of habitat changes such as sediment accumulation can be monitored.

River Invertebrate Classification Tool (RICT)

2.2.20 RICT¹ predicts the WHPT-ASPT and NTAXA scores for the surveyed locations based on the Reach location, altitude, alkalinity, slope, discharge category, distance from source, channel dimensions and substrate composition. The predicted scores are then compared to actual scores and the output is an Ecological Quality Ratio (EQR). The EQR can be translated into a WFD classification (High, Good, Moderate, Poor, or Bad).

2.2.21 However, RICT analysis was not suitable for the samples collected as the sites being mostly small ditches for which RICT would not have any comparable data to make an accurate assessment.

3 Results

3.1 Desk Study

Water Framework Directive Status

Becks Northern Operational Catchment

North Beck Drain Water Body

3.1.1 North Beck Drain² (WFD Water body ID: GB104029067575) is a heavily modified river flowing northeast between Immingham and Stallingborough before feeding the Humber estuary.

3.1.2 The North Beck Drain Water Body is currently classified as having Moderate Ecological Status, remaining unchanged since 2013. Biological quality elements and physico-chemical quality elements have not been assessed since 2015 and 2014, respectively. This lack of data may be impacting the overall ecological status of the water body. Furthermore, hydrological supporting elements have deteriorated since 2015 where the hydrological regime deteriorated from 'supports good' in 2013, 2014 and 2015, to 'does not support good' in 2016 and 2019. Finally, the chemical assessment status of North Beck Drain has declined from Good in 2016 to Fail in 2019. This could be attributed to the assessment of priority hazardous substances which failed in 2019 but did not require assessment in previous years.

3.1.3 The overall objective for the water body is to improve the overall water body status to Good by 2027. An additional objective is to improve the surface elements (surface water) to Good

¹ River Invertebrate Classification Tool (RICT)

² North Beck Drain Water Body: <https://environment.data.gov.uk/catchment-planning/Water body/GB104029067575>

status by 2027. The Environment Agency states disproportionate burdens for achieving both objectives.

Laceby Beck / River Freshney Catchment (to N Sea) Water Body

- 3.1.4 Laceby Beck is a heavily modified river flowing northeast where it becomes the River Freshney before flowing through Grimsby and feeding the Humber Estuary. This is a WFD water body (WFD Laceby Beck / River Freshney Catchment (to N Sea) Water Body: ID GB104029067530³), which had Bad Ecological Status under the 2019 classification. Drivers behind this status include bad grading for biological quality elements such as fish, and failures in chemical testing for compounds such as priority hazardous substances including Mercury and its compounds and Polybrominated diphenyl ethers (PBDE).
- 3.1.5 The Laceby Beck / River Freshney Catchment (to N Sea) Water Body is currently classified as having Bad Ecological status, deteriorating from Poor Ecological status in 2016. Despite this, Laceby Beck has previously received Bad ecological status from 2013 to 2015. Furthermore, hydrological supporting elements such as the hydrological regime have consistently been recorded as 'does not support good' since the beginning of Cycle 1 in 2009. Despite failing the chemical assessment in 2019, Laceby Beck has previously received a Good status in 2015 and 2016. This deterioration could be attributed to the introduction of testing for Mercury and its Compounds and Polybrominated diphenyl ethers (PBDE) which had not previously been tested for, and for which both failed their assessments in 2019.
- 3.1.6 The overall objective for the water body is to improve the overall Ecological Status to Moderate by 2027, specifically targeting fish, the hydrological regime and supporting elements (surface water). The Environment Agency states disproportionate burdens and insufficient technical solutions for achieving these objectives.

Waithe Beck lower catchment (to Tetney Lock) Water Body

- 3.1.7 Waithe Beck lower catchment (to Tetney Lock) Water Body (WFD water body ID: GB104029062100⁴) is a heavily modified water body flowing east from Hatcliffe to Tetney Lock.
- 3.1.8 The water body is currently classified by the EA as having Moderate Ecological Status. The quality elements preventing the water body from achieving Good status are macrophytes, mitigation measures assessment and priority hazardous substances. The reasons for not achieving Good status (RNAG) have been assessed as physical modification and flow. Measures have been delivered to address priority hazardous substances and are currently awaiting recovery.
- 3.1.9 The objectives for this water body are to improve the overall ecological quality status and mitigation measures assessment status to Good by 2027 (low confidence), however the EA states this is disproportionately expensive with disproportionate burdens. Priority hazardous substances status is to be increased to Good by 2063 through recovery by natural conditions.

³ Laceby Beck / River Freshney Catchment (to N Sea) Water Body: <https://environment.data.gov.uk/catchment-planning/Water body/GB104029067530>

⁴ Waithe Beck lower catchment (to Tetney Lock) Water Body: <https://environment.data.gov.uk/catchment-planning/Water body/GB104029062100>

Poulton Drain Catchment (trib of Louth Canal)

- 3.1.10 Poulton Drain Catchment (trib of Louth Canal) (WFD water body ID: GB104029062010⁵) is a heavily modified water body which drains into the Louth Canal east of Covenham St Mary.
- 3.1.11 The water body is currently classified by the EA as having Moderate Ecological Status. The quality elements preventing the water body from achieving Good status are invertebrates, mitigation measures assessment and priority hazardous substances. The RNAG have been assessed as physical modification and changes in flow due to land drainage. Measures have been delivered to address priority hazardous substances and are currently awaiting recovery.
- 3.1.12 The objectives for this water body are to increase the status of invertebrates and mitigation measures assessment to Good by 2027 (low confidence), however the EA states this is disproportionately expensive with disproportionate burdens. Priority hazardous substances status is to be increased to Good by 2063 through recovery by natural conditions.

Black Dyke Catchment (trib of Louth Canal)

- 3.1.13 Black Dyke Catchment (trib of Louth Canal) Water Body (WFD water body ID: GB104029062000⁶) is a heavily modified water body flowing east from Fotherby and discharging into the Louth Canal at North End.
- 3.1.14 The water body is currently classified by the EA as having Moderate Ecological Status. The quality elements preventing the water body from achieving Good status are fish, invertebrates, macrophytes, mitigation measures assessment and priority hazardous substances. The RNAG have been assessed as physical modification and changes in flow due to land drainage. Measures have been delivered to address priority hazardous substances and are currently awaiting recovery.
- 3.1.15 The objectives for this water body are to increase the status of fish to moderate and invertebrates and mitigation measures assessment to Good by 2027 (low confidence), however the EA states this is disproportionately expensive with disproportionate burdens. Priority hazardous substances status is to be increased to Good by 2063 through recovery by natural conditions.

Louth Canal

- 3.1.16 Louth Canal Water Body (WFD ID: GB104029061990⁷) is a heavily modified water body flowing north from Louth to Tetney Lock.
- 3.1.17 The water body is currently classified by the EA as having Poor Ecological Status. The quality elements preventing the water body from achieving Good status are fish, invertebrates, macrophytes and phytobenthos combined, hydrological regime, mitigation measures assessment and priority hazardous substances. The RNAG have been assessed as diffuse source pollution from urban development and poor livestock management, point source pollution from sewage discharge, physical medication for land drainage, and the presence of the invasive non-native American signal crayfish. Measures have been delivered to address priority hazardous substances and are currently awaiting recovery.
- 3.1.18 The objectives for this water body are to increase the status of fish, macrophytes and phytobenthos combined and mitigation measures assessment to Good by 2027 (low

⁵ Poulton Drain Catchment (trib of Louth Canal) Water Body: [https://environment.data.gov.uk/catchment-planning/Water body/GB104029062010](https://environment.data.gov.uk/catchment-planning/Water%20body/GB104029062010)

⁶ Black Dyke Catchment (trib of Louth Canal) Water Body: [https://environment.data.gov.uk/catchment-planning/Water body/GB104029062000](https://environment.data.gov.uk/catchment-planning/Water%20body/GB104029062000)

⁷ Louth Canal Water Body: [https://environment.data.gov.uk/catchment-planning/Water body/GB104029061990](https://environment.data.gov.uk/catchment-planning/Water%20body/GB104029061990)

confidence), however the EA states this is disproportionately expensive with disproportionate burdens. Priority hazardous substances status is to be increased to Good by 2063 through recovery by natural conditions, however the EA states this is technically infeasible.

Steeping and Eaus Operational Catchment

South Dike and Grayfleet Drain

3.1.19 South Dike and Grayfleet Drain Water Body is a heavily modified WFD water body (WFD water body ID: GB105029061680⁸) located near Saltfleet.

3.1.20 The water body is currently classified by the EA as having Moderate Ecological Status. The quality elements preventing the water body from achieving Good status are invertebrates, macrophytes, mitigation measures assessment and priority hazardous substances. The RNAG have been assessed as physical modification for land drainage and natural conditions. Measures have been delivered to address priority hazardous substances and are currently awaiting recovery.

3.1.21 The objectives for this water body are to increase the status of invertebrates to Good by 2027 (low confidence), however the EA states this is technically infeasible as the cause of the adverse impact is unknown. Mitigation measures assessment is to be increased to Good by 2027 (low confidence), however the EA states this is disproportionately expensive with disproportionate burdens. Priority hazardous substances status is to be increased to Good by 2063 through recovery by natural conditions.

Long Eau

3.1.22 Long Eau Water Body (WFD water body ID: GB105029061670⁹) is a heavily modified water body which flows northeast from Legbourne and joins the Great Eau water body at Great Eau.

3.1.23 The water body is currently classified by the EA as having Moderate Ecological Status. The quality elements preventing the water body from achieving Good status are fish, macrophytes, dissolved oxygen, phosphate, mitigation measures assessment and priority hazardous substances. The RNAG have been assessed as diffuse source pollution from poor livestock, nutrient and soil management, point source pollution from sewage discharge, and physical modification due to land drainage and urbanisation (transport). Measures have been delivered to address priority hazardous substances and are currently awaiting recovery.

3.1.24 The objectives for this water body are to increase the status of fish, dissolved oxygen, phosphate, and mitigation measures assessment to Good by 2027 (low confidence), however the EA states this is disproportionately expensive with disproportionate burdens. Priority hazardous substances status is to be increased to Good by 2063 through recovery by natural conditions.

Great Eau (downstream of South Thoresby)

3.1.25 Great Eau (downstream of South Thoresby) Water Body (WFD water body ID: GB105029061660¹⁰) is a heavily modified water body which flows northeast from South Thoresby and discharges into coastal waters at Saltfleet.

⁸ South Dike and Grayfleet Drain Water Body: <https://environment.data.gov.uk/catchment-planning/Water body/GB105029061680>

⁹ Long Eau Water Body: <https://environment.data.gov.uk/catchment-planning/Water body/GB105029061670>

¹⁰ Great Eau (downstream of South Thoresby) Water Body: <https://environment.data.gov.uk/catchment-planning/Water body/GB105029061660>

- 3.1.26 The water body is currently classified by the EA as having Poor Ecological Status. The quality elements preventing the water body from achieving Good status are fish, macrophytes and phytobenthos combined, hydrological regime, mitigation measures assessment and priority hazardous substances. The RNAG have been assessed as diffuse source pollution from poor soil, nutrient and livestock management, point source pollution from trade/industry discharge, physical modification including barriers to fish, and the presence of the invasive non-native American signal crayfish. Measures have been delivered to address priority hazardous substances and are currently awaiting recovery.
- 3.1.27 The objectives for this water body are to increase the status of fish, macrophytes and phytobenthos combined and mitigation measures assessment to Good by 2027 (low confidence), however the EA states this is disproportionately expensive with disproportionate burdens. Priority hazardous substances status is to be increased to Good by 2063 through recovery by natural conditions.

3.2 Designated Sites and Notable Habitats

- 3.2.1 Statutory and non-Statutory designated sites within 10 km of the DCO Site Boundary were provided by GLNP. A total of nine statutory designated sites of interest to freshwater aquatic ecology were identified within 10km of the DCO Site Boundary and are listed in **Table 3** below.

Table 3: Statutory Designated Sites of Aquatic Ecology Interest within 10km of the DCO Site Boundary

Designation	Name	Reasons for Designation (of interest to Aquatic Ecology)	Central NGR	Distance from DCO Site Boundary (km)
Ramsar	Humber Estuary	Designated for habitats including dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons. The site is largely designated for its significance for grey seal, natterjack toad, and waterfowl. (JNCC, 2008).	TA 23803 14883	Within section 5 of the DCO Site Boundary
SSSI	Saltfleetby - Theddlethorpe Dunes	Includes flats, dunes, salt and freshwater marsh support an exceptionally rich flora and fauna. There are outstanding assemblages of vascular plants, invertebrates and breeding birds and it is the most north-easterly breeding site in Britain for the Natterjack Toad.	TF481908	Within section 5 of the DCO Site Boundary
SAC	Humber Estuary	Habitats that are a primary reason for selection of this site:	TA 23289 15455	1.5 km north-east of Section

Designation	Name	Reasons for Designation (of interest to Aquatic Ecology)	Central NGR	Distance from DCO Site Boundary (km)
		<p>Estuaries and mudflats and sandflats not covered by seawater at low tide. Habitats present as a qualifying feature, but not a primary reason for selection of this site: coastal lagoons.</p> <p>Species present as a qualifying feature, but not a primary reason for site selection: sea lamprey <i>Petromyzon marinus</i>, river lamprey <i>Lampetra fluviatilis</i>, and grey seal <i>Halichoerus grypus</i>.</p>		1 at the closest point
SSSI	Humber Estuary	The Humber Estuary supports nationally important habitats including intertidal mudflats and sandflats, coastal saltmarsh and associated saline lagoons, sand dunes and standing waters. It is also nationally important for a breeding colony of grey seal, river lamprey and sea lamprey, a vascular plant assemblage and an invertebrate assemblage.	TA 23204 15509	1.5 km north-east of Section 1 at the closest point
SSSI	North Killingholme Haven Pits	Large saline lagoons which provide roosting and feeding grounds for waterfowl. Nine species of specialist lagoonal species are recorded from the pits include the polychaete worm <i>Alkmaria romijni</i> .	TA 16606 19738	2.5 km north of Section 1
SSSI	Tetney Blow Wells	Tetney Blow Wells consists of reedbeds together with base-rich fern and swamp vegetation associated with the calcareous water of four large artesian springs.	TA 32070 00713	4.00 km south-east of Section 3
SSSI	Sea Bank Clay Pits	A series of isolated flooded clay workings of varying size, depth and topography which now support uncommon aquatic plant community characteristic of the slightly brackish,	TF 54647 76523	8 km south-east of Section 5

Designation	Name	Reasons for Designation (of interest to Aquatic Ecology)	Central NGR	Distance from DCO Site Boundary (km)
		eutrophic (nutrient-rich) water in addition to extensive reedbeds and a rich marginal wetland flora.		
SSSI	Swaby Valley	This glacial overflow valley supports two habitats now scarce in Lincolnshire - floristically diverse, lime-rich marsh and unimproved chalk turf. The marsh borders a stream bisecting the valley floor and the interest of the grassland is increased by the terraced nature of the slopes. Designated for botanical interest.	TF 39178 77650	9.0 km south of Section 5
SSSI	Calceby Marsh	An outstanding example of a base-rich marsh.	TF 39806 77251	9.5 km south of Section

3.2.2 A total of 16 non-Statutory designated sites of interest to freshwater aquatic ecology were identified within 10km of the DCO Site Boundary and are listed in **Table 4** below.

Table 4: Non-Statutory Designated Sites of Aquatic Ecology Interest within 10km of the DCO Site Boundary

ID	Designation	Reason for designation	Name	Central NGR	Distance from DCO Site Boundary (km)
LGS848	Local Geological Site (LGS)	No further information available	Welbeck Spring	TA 22009 04040	-
LWS123	LWS	Watercourse – no further information available.	Buck Beck East	TA 29574 06135	1.5 km east of Section 2
LWS414	LWS	Designated for its species rich neutral grassland	Homestead Park Pond	TA 17983 15536	0.5 km south-east of Section 1
LWS658	LWS	Designated for its wetland habitat.	River Freshney Headwaters	TA 22233 05345	Within Section 3 of the DCO Site Boundary

ID	Designation	Reason for designation	Name	Central NGR	Distance from DCO Site Boundary (km)
LWS666	LWS	Designated for its standing water with botanical interest.	Rosper Road Pools	TA 17501 17006	0.05 km east of Section 1
LWS747	LWS	Designated for its standing water with botanical interest	Stallingborough Meadows East	TA 20025 11691	1.5 km east of Section 2
LWS832	LWS	Designated for its standing water and mosaic of standing water, neutral grassland and flowing water.	Waithe Beck East	TA 24789 01821	Within Section 3 of the DCO Site Boundary
SNCI3602	Site of Nature Conservation Interest (SNCI)	Designated for its woodland, wet woodland, running water, and habitat mosaic.	Great Eau	TF 44020 84485	Within Section 5 of the DCO Site Boundary
SNCI3728	SNCI	Designated for its wetland with a biodiverse species assemblage and habitat mosaic.	Long Eau, East	TF 43942 88182	Within Section 5 of the DCO Site Boundary
SNCI3729	SNCI	Designated for its running water with biodiverse species	Long Eau, West	TF 41220 86601	0.5 km south-west of Section 5

ID	Designation	Reason for designation	Name	Central NGR	Distance from DCO Site Boundary (km)
		assemblage and its wetland with a biodiverse species assemblage.			
LWS1102	LWS	Designated for its running water with biodiverse species assemblage and its wetland with a biodiverse species assemblage.	Long Eau, West	TF 40797 86228	1 km south-west of Section 5
LWS1121	LWS	Designated for its woodland, wet woodland, running water, and habitat mosaic.	Great Eau	TF 44312 84942	Within Section 5 of the DCO Site Boundary
LWS4747	LWS	Designated for its wetland with a biodiverse species assemblage and habitat mosaic.	Long Eau, East	TF 44142 88304	1 km north-east of Section 5
LWS4769	LWS	Designated for its species rich neutral grassland, running or standing water with botanical interest and its botanically	Manby Wetlands	TF 40721 86305	1.5 km west of Section 4

ID	Designation	Reason for designation	Name	Central NGR	Distance from DCO Site Boundary (km)
		interesting wetland areas.			
LWS4770	LWS	Wetland habitats – no further information available.	Great Carlton Wetlands	TF 40982 86377	1 km west of Section 5
1006128	National Nature Reserve (NNR)	The reserve contains tidal sand and mudflats, salt and freshwater marshes and sand dunes.	Saltfleetby-Theddlethorpe Dunes	TF 480910	0.50 km north of Section 5

3.3 Notable Species

3.3.1 Historic records of fish, macroinvertebrate and aquatic macrophyte species are available from the Environment Agency through their routine monitoring programme. Details of relevant EA monitoring sites within the last 10 years are summarised in **Table 5** below. Sites have been included if they are located on water bodies or their tributaries which are being crossed through open cutting.

Table 5: Relevant EA Monitoring Sites within 10 years. From north to south

Site name (ID)	Site National Grid Reference	WFD water body ID	Distance to nearest open cut crossing point	Year last surveyed	Group monitored
Habrough Marsh Drain (202771)	TA16606156 57	GB10402906 7570	0.3 km upstream of crossing point on Habrough Marsh Drain	2021	Macrophytes
Lincs Chalk Stream Project – Laceby Acres (46203)	TA22700079 00	GB10402906 7530	6.5 km downstream of crossing point on Laceby Beck	2014	Fish

Site name (ID)	Site National Grid Reference	WFD water body ID	Distance to nearest open cut crossing point	Year last surveyed	Group monitored
Lacey Beck (160406)	TA2230005000	GB104029067530	2 km downstream of crossing point on Lacey Beck	2012	Macroinvertebrates
U/s A18 (Chalk Stream Proj) (61963)	TA2295402496	GB104029062100	0.7 km upstream of crossing point on trib. Of Waithe Beck	2014	Fish
Brigsley (6754)	TA2520001500	GB104029062100	0.5 km upstream of 2 x crossing points on ditches connected to Waithe Beck	2018	Fish
Waithe Beck (55395)	TA2524701658	GB104029062100	0.5 km upstream of 2 x crossing points on ditches connected to Waithe Beck	2022	Inverts
Old Fleet Drain (202293)	TF3001799309	GB104029062080	4.5 km downstream of crossing point on ditch connected to Old Fleet Drain	2022	Macroinvertebrates
Black Dyke (160390)	TF3507592720	GB104029062000	2.6 km upstream of crossing point on trib of Black Dyke	2014	Macroinvertebrates
Black Dyke (160617)	TF3509892712	GB104029062000	2.6 km upstream of crossing point on trib of Black Dyke	2019	Inverts
Grayfleet Drain (202457)	TF4248190396	GB105029061680	2.6 km downstream of crossing point on trib of Grayfleet Drain	2022	Macroinvertebrates
Gayton Engine (6611)	TF4570088000	GB105029061660	1.7 – 2.2 km downstream of 5 x crossing points on ditches connected to Old Engine Drain	2018	Fish
Theddlethorpe (6662)	TF4690088100	GB105029061660	0.7 – 1.2 km upstream of 2 x crossing points on ditches connected to The Cut	2015	Fish

3.3.2 Fish records from the Environment Agency data that are relevant to the Proposed Development are presented in **Table 6** below.

Table 6: Environment Agency Fish Survey Data

EA Site ID	EA site grid references	Water body	Relevance to Proposed Development	Route Section	Brown trout (<i>Salmo trutta</i>)	Bullhead (<i>Cottus gobio</i>)	European eel (<i>Anguilla 31ucius31a</i>)	Lamprey (<i>Lampetra fluvitilis</i>)	Stone Loach (<i>Barbatula barbatula</i>)	Dace (<i>Leuciscus leuciscus</i>)	Gudgeon (<i>Gobio gobio</i>)	Rudd (<i>Scardinius erythrophthalmus</i>)	Roach (<i>Rutilus rutilus</i>)	3 spined stickleback (<i>Gasterosteus aculeatus</i>)	Pike (<i>Esox 31ucius</i>)	Perch-Perca <i>fluviatilis</i>
Laceby Acres (EA 6642)	TA 22716 07913	Laceby Beck	10km downstream of RVX001BP (Auger-Bore crossing)	2	Present	Present								Present		
Thorganby (EA 6756)	TF 20937 97586	Waithe Beck	DX035P (open-cut crossing) has potential to be connected to Waithe Beck 7km downstream of EA Site but mapping does not currently show a connection	3	Present		Present									

EA Site ID	EA site grid references	Water body	Relevance to Proposed Development	Route Section	Brown trout (<i>Salmo trutta</i>)	Bullhead (<i>Cottus gobio</i>)	European eel (<i>Anguilla 31ucius31a</i>)	Lamprey (<i>Lampetra fluvitilis</i>)	Stone Loach (<i>Barbatula barbatula</i>)	Dace (<i>Leuciscus leuciscus</i>)	Gudgeon (<i>Gobio gobio</i>)	Rudd (<i>Scardinius erythrophthalmus</i>)	Roach (<i>Rutilus rutilus</i>)	3 spined stickleback (<i>Gasterosteus aculeatus</i>)	Pike (<i>Esox 31ucius</i>)	Perch-Perca <i>fluviatilis</i>
Brigsley (EA 6754)	TA 25251 01640	Waithe Beck	RVX001CP, a HDD crossing is 1km upstream of this EA site. DX037P and DX038P (both open cut crossings) connected to a drain that has potential to enter Waithe Beck at TA25353 01581 but mapping currently does not show connection	3	Present		Present		Present	Present						
Waithe (EA 55395)	TA 29144 00855	Waite Beck	No open cut sites in the vicinity of this site. RVX001CP, a HDD crossing is located c. 7km upstream of this EA location.	3	Present	Present	Present		Present	Present						Present

EA Site ID	EA site grid references	Water body	Relevance to Proposed Development	Route Section	Brown trout (<i>Salmo trutta</i>)	Bullhead (<i>Cottus gobio</i>)	European eel (<i>Anguilla 31ucius31a</i>)	Lamprey (<i>Lampetra fluvitilis</i>)	Stone Loach (<i>Barbatula barbatula</i>)	Dace (<i>Leuciscus leuciscus</i>)	Gudgeon (<i>Gobio gobio</i>)	Rudd (<i>Scardinius erythrophthalmus</i>)	Roach (<i>Rutilus rutilus</i>)	3 spined stickleback (<i>Gasterosteus aculeatus</i>)	Pike (<i>Esox 31ucius</i>)	Perch-Perca fluviatillis
Alvingham High Bridge (EA 6653)	TF 37453 92134	Louth Canal	CNX001P (HDD crossing) is 2km east of this EA site	4	Present		Present		Present	Present	Present		Present	Present		
Little Carton Mill (EA 53043)	TF 40125 85379	The Beck	Outside Study Area but is connected to Long Eau	5			Present	Present						Present		
Walk Farm (EA 6649)	TF 42296 86984	Long Eau	EA site is 1km upstream of RVXOO2P (HDD crossing)	5			Present									
Three Bridges No1 (EA 6651)	TF 43700 88100	Long Eau	EA site is 2km downstream of RVX007P (HDD crossing)	5			Present		Present	Present		Present	Present		Present	
Gayton Engine (EA 6754)	TF 45794 88002	Long Eau	RVX007P (HDD crossing) is 1km upstream of this EA site	5			Present							Present	Present	

3.3.3 Records of protected and invasive aquatic species from the Gloucestershire Local Nature Partnership (GLNP) are presented in **Table 7** below.

Table 7: Aquatic Protected and Invasive species identified by Gloucestershire Local Nature Partnership within 2km of the DCO Site Boundary

Species	Total Number of Records	Most recent record	Distance to closest open cut crossing	Location of closest record	National Grid Reference
Protected					
Brown trout <i>Salmo trutta</i>	18	2018	0.5 km	Waithe Beck	TA 22954 02496
European eel <i>Anguilla anguilla</i>	52	2019	0.5 km	Waithe Beck	TA 25200 01500
Invasive Non-Native Species (INNS)					
Canadian waterweed <i>Elodea canadensis</i>	29	2018	2.0 km	Lacey Beck	TA 22300 05000
Curly waterweed <i>Lagarosiphon major</i>	2	2012	0.5 km	Glebe Farm	TA1615
Crustacean <i>Crangonyx pseudogracilis/floridanus</i>	31	2017	0.5 km	Habrough Marsh Drain	TA 16000 15800
Gammarid <i>Gammarus tigrinus</i>	3	2012	2.0 km	Lacey Beck	TA 22300 05000
Giant hogweed <i>Heracleum mantegazzianum</i>	2	2019	0.5 km	Tributary of The Cut	TF4788
Himalayan balsam <i>Impatiens glandulifera</i>	37	2019	2.0 km	Lacey Beck	TA 22300 05000
Japanese knotweed <i>Reynoutria japonica</i>	2	2015	1.5 km	Louth Canal	TF3589
New Zealand Pigmyweed <i>Crassula helmsii</i>	2	2017	1.5 km	Gayton North Fen Drain	TF4385
Nuttall's waterweed <i>Elodea nuttallii</i>	35	2020	2.0 km	Lacey Beck	TA 22300 05000
Rainbow trout <i>Oncorhynchus mykiss</i>	1	2015	1 km	River Lud	TF355898

Species	Total Number of Records	Most recent record	Distance to closest open cut crossing	Location of closest record	National Grid Reference
Water fern <i>Azolla filiculoides</i>	1	2012	2.5 km	Mablethorpe	TF5086

3.3.4 A summary of protected notable fish species and their relevant designations from Environment Agency and GLNP datasets is presented in **Table 8** below. However, it is also worth noting that all fish species are protected by the Salmon and Fisheries Act (1975) (Ref 5).

Table 8: Protected Fish Species identified during the Desk Study, with Relevant Designations

Fish species	Habitats Directive (Appendix)	Eels regulations	S41 SPI / UKBAP priority species	Location	Most recent year
Brown trout <i>Salmo trutta</i>			Y	Brigsley (EA 6754) U/s A18 (Chalk Stream Proj) (EA 61963) Waithe Beck; Louth Canal (GLNP)	2018 2014 2018
Bullhead <i>Cottus gobio</i>	II		Y	Waithe Beck (EA 55395) River Lud	2018 2015
European eel <i>Anguilla anguilla</i>		Y	Y	Gayton Engine Drain (EA 6611) Brigsley (EA 6754) Waithe Beck; Louth Canal; New Gayton Engine Drain; Gayton North Fen Drain (GLNP) Long Eau (EA Three Bridges Survey 153489)	2018 2018 2019 2018
River Lamprey	II		Y	Little Carton Mill (EA 53043)	2018

3.4 Aquatic Macroinvertebrate Survey

Macroinvertebrate Results

- 3.4.1 A total of 33 aquatic macroinvertebrate samples were collected. The biological metrics results are presented in **Table 9**: along with any notable or invasive species found in the samples.

Table 9: Aquatic Macroinvertebrate Metric Results

Route section	Crossing metric	NTAXA (WHPT)	WHPT Score	ASPT (WHPT)	WHPT-ASPT interpretation	PSI Score (species)	PSI Score (species)-interpretation	LIFE Score	LIFE Score interpretation	CCI Score	CCI Score interpretation	Total number of taxa	Notable species
1	RVX001GP	9	30.5	3.39	Poor, Polluted or Impacted	0.00	Heavily Sedimented	5.75	Low sensitivity to reduced flows	11.3	Fairly High conservation value	13	The snail <i>Aplexa hypnorum</i> – CCI 5 'Local' Conservation Status. The non-native but naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
1	DX003P	16	61.0	3.81	Poor, Polluted or Impacted	4.00	Heavily Sedimented	6.22	Low sensitivity to reduced flows	4.0	Low conservation value	24	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i> and the crustacean 'shrimp' <i>Crangonyx pseudogracilis/f lordanus</i>
1	DX004P	10	39.0	3.90	Poor, Polluted or Impacted	0.00	Heavily Sedimented	5.43	Low sensitivity to reduced flows	5.6	Moderate conservation value	17	The invasive crustacean 'shrimp' <i>Crangonyx pseudogracilis/f lordanus</i>
1	DX005P	18	74.5	4.14	Poor, Polluted or Impacted	3.45	Heavily Sedimented	6.08	Low sensitivity to reduced flows	3.5	Low conservation value	28	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
1	DX007P	11	35.7	3.25	Poor, Polluted or Impacted	0.00	Heavily Sedimented	5.63	Low sensitivity to reduced flows	5.6	Moderate conservation value	21	N/A

Route section	Crossing metric	NTAXA (WHPT)	WHPT Score	ASPT (WHPT)	WHPT-ASPT interpretation	PSI Score (species)	PSI Score (species)-interpretation	LIFE Score	LIFE Score interpretation	CCI Score	CCI Score interpretation	Total number of taxa	Notable species
1	DX008P	19	82.8	4.36	Moderate, Moderately impacted	7.69	Heavily Sedimented	5.67	Low sensitivity to reduced flows	4.9	Low conservation value	32	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
2	DX017P	15	59.8	3.99	Poor, Polluted or Impacted	3.70	Heavily Sedimented	5.83	Low sensitivity to reduced flows	5.8	Moderate conservation value	26	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
3	RVX001BP	11	42.6	3.87	Poor, Polluted or Impacted	0.00	Heavily Sedimented	5.14	Low sensitivity to reduced flows	10.7	Fairly High conservation value	19	The lesser water boatman <i>Corixa panzeri</i> – CCI 5 and the non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
3	DX035P	9	36.6	4.07	Poor, Polluted or Impacted	7.69	Heavily Sedimented	5.00	Low sensitivity to reduced flows	7.5	Moderate conservation value	15	N/A
3	DX037P	17	78.0	4.59	Moderate, Moderately impacted	4.00	Heavily Sedimented	6.00	Low sensitivity to reduced flows	4.5	Low conservation value	24	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
3	DX038P	12	45.5	3.79	Poor, Polluted or Impacted	6.25	Heavily Sedimented	6.17	Low sensitivity to reduced flows	6.6	Moderate conservation value	17	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>

Route section	Crossing metric	NTAXA (WHPT)	WHPT Score	ASPT (WHPT)	WHPT-ASPT interpretation	PSI Score (species)	PSI Score (species)-interpretation	LIFE Score	LIFE Score interpretation	CCI Score	CCI Score interpretation	Total number of taxa	Notable species
3	DX042P	8	33.2	4.15	Poor, Polluted or Impacted	14.29	Heavily Sedimented	6.50	Moderate sensitivity to reduced flows	5.3	Moderate conservation value	11	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
4	DX050P	13	54.3	4.18	Moderate, Moderately impacted	12.50	Heavily Sedimented	5.80	Low sensitivity to reduced flows	6.0	Moderate conservation value	22	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
4	DX059P	13	53.7	4.13	Moderate, Moderately impacted	16.67	Heavily Sedimented	5.40	Low sensitivity to reduced flows	6.0	Moderate conservation value	24	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
4	DX061P	8	36.8	4.60	Moderate, Moderately impacted	0.00	Heavily Sedimented	6.00	Low sensitivity to reduced flows	1.0	Low conservation value	12	N/A
4	DX066P	14	60.4	4.31	Moderate, Moderately impacted	11.11	Heavily Sedimented	5.60	Low sensitivity to reduced flows	1.3	Low conservation value	22	N/A
4	DX067P	11	44.4	4.04	Poor, Polluted or Impacted	23.08	Sedimented	6.00	Low sensitivity to reduced flows	4.5	Low conservation value	15	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
4	DX073P	12	41.9	3.49	Poor, Polluted or Impacted	0.00	Heavily Sedimented	5.40	Low sensitivity to reduced flows	6.6	Moderate conservation value	19	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
4	DX074P	15	56.6	3.77	Poor, Polluted or Impacted	11.76	Heavily Sedimented	6.43	Low sensitivity to reduced flows	1.2	Low conservation value	23	The non-native but now naturalised

Route section	Crossing metric	NTAXA (WHPT)	WHPT Score	ASPT (WHPT)	WHPT-ASPT interpretation	PSI Score (species)	PSI Score (species)-interpretation	LIFE Score	LIFE Score interpretation	CCI Score	CCI Score interpretation	Total number of taxa	Notable species
													New Zealand mud snail <i>Potamopyrgus antipodarum</i>
4	DX075P	6	21.8	3.63	Poor, Polluted or Impacted	0.00	Heavily Sedimented	5.50	Low sensitivity to reduced flows	6.0	Moderate conservation value	13	N/A
4	DX076P	22	97.5	4.43	Moderate, Moderately impacted	23.30	Sedimented	6.60	Moderate sensitivity to reduced flows	4.3	Low conservation value	43	The invasive crustacean 'shrimp' <i>Crangonyx pseudogracilis/f lordanus</i>
4	DX078P	19	86.5	4.55	Moderate, Moderately impacted	12.00	Heavily Sedimented	5.89	Low sensitivity to reduced flows	10.0	Fairly High conservation value	30	<i>Gammarus fossarum</i> -CCI 5 'Local' conservation status and the non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i>
5	DX089AP	18	77.3	4.29	Moderate, moderately impacted	5.71	Heavily Sedimented	6.2	Low sensitivity to reduced flows	9.3	Moderate conservation flow	33	The snail <i>Bithynia leachii</i> -CCI 5 and the invasive crustacean 'shrimp' <i>Crangonyx pseudogracilis/f lordanus</i>
5	DX091P	9	36.1	4.01	Poor, Polluted or Impacted	0.00	Heavily Sedimented	0.00	Low sensitivity to reduced flows	0.0	Low conservation value	11	The invasive crustacean 'shrimp' <i>Crangonyx pseudogracilis/f lordanus</i>

Route section	Crossing metric	NTAXA (WHPT)	WHPT Score	ASPT (WHPT)	WHPT-ASPT interpretation	PSI Score (species)	PSI Score (species)-interpretation	LIFE Score	LIFE Score interpretation	CCI Score	CCI Score interpretation	Total number of taxa	Notable species
5	DX090BP	22	93.4	4.25	Moderate, moderately impacted	2.33	Heavily Sedimented	6.1	Low sensitivity to reduced flows	4.7	Low conservation value	42	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i> and the crustacean 'shrimp' <i>Crangonyx pseudogracilis/f lordanus</i> . A single crayfish specimen from the family Astacide was present but was unable to be identified due to size.
5	DX092P	9	36.1	4.01	Poor, Polluted or Impacted	0.00	Heavily Sedimented	5.75	Low sensitivity to reduced flows	1.0	Low conservation value	13	N/A
5	DX093P	20.0	74.7	3.74	Poor, polluted or impacted	0.00	Heavily Sedimented	5.9	Low sensitivity to reduced flows	8.9	Moderate conservation value	42	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i> and the crustacean 'shrimp' <i>Crangonyx pseudogracilis/f lordanus</i>
5	DX094P	9	32.2	3.58	Poor, Polluted or Impacted	7.14	Heavily Sedimented	5.00	Low sensitivity to reduced flows	1.0	Low conservation value	11	The invasive crustacean 'shrimp' <i>Crangonyx pseudogracilis/f lordanus</i>

Route section	Crossing metric	NTAXA (WHPT)	WHPT Score	ASPT (WHPT)	WHPT-ASPT interpretation	PSI Score (species)	PSI Score (species)-interpretation	LIFE Score	LIFE Score interpretation	CCI Score	CCI Score interpretation	Total number of taxa	Notable species
5	DX108P	22	88.2	4.01	Poor, Polluted or Impacted	0.00	Heavily Sedimented	0.00	Low sensitivity to reduced flows	0.0	Low conservation value	6	N/A
5	DX110P	23	86.8	3.77	Poor, polluted or impacted	0.00	Heavily Sedimented	5.9	Low sensitivity to reduced flows	4.9	Low conservation value	47	The non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i> and the crustacean 'shrimp' <i>Crangonyx pseudogracilis/floridanus</i> .
5	DX113P	10	45.0	4.56	Moderate, Moderately impacted	0.00	Heavily Sedimented	0.00	Low sensitivity to reduced flows	0.0	Moderate conservation value	17	The invasive crustacean 'shrimp' <i>Crangonyx pseudogracilis/floridanus</i>
5	DX114P	16	74.3	4.64	Moderate, Moderately impacted	11.10	Heavily Sedimented	6.00	Low sensitivity to reduced flows	9.2	Moderate conservation value	21	Leech <i>Dina lineata</i> -CCI 6 'regionally Notable' conservation status, the non-native but now naturalised New Zealand mud snail <i>Potamopyrgus antipodarum</i> and the crustacean 'shrimp' <i>Crangonyx pseudogracilis/floridanus</i>
5	DX095AP	22	88.2	4.01	Poor, Polluted or Impacted	0.00	Heavily Sedimented	5.89	Low sensitivity to reduced flows	3.8	Low conservation value	35	The non-native but now naturalised New Zealand mud snail

Route section	Crossing metric	NTAXA (WHPT)	WHPT Score	ASPT (WHPT)	WHPT-ASPT interpretation	PSI Score (species)	PSI Score (species)-interpretation	LIFE Score	LIFE Score interpretation	CCI Score	CCI Score interpretation	Total number of taxa	Notable species
													<i>Potamopyrgus antipodarum</i> and the crustacean 'shrimp' <i>Crangonyx pseudogracilis/floridanus</i>

Route Section 1

RVX001GP

- 3.4.2 Macroinvertebrate diversity was low within the sample collected with 13 taxa recorded, dominated by Diptera (the non-biting midge larvae Chironomidae), snails and worms.
- 3.4.3 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 3.4) and is consistent with the 'heavily sedimented' PSI score (5.75). The community at this site had 'low sensitivity' to reduced flows and was of 'fairly high' conservation value owing to the presence of the snail *Aplexa hypnorum*, with a Conservation Score of 5 which indicates 'Local' Conservation Status.
- 3.4.4 The non-native but naturalised New Zealand mud snail *Potamopyrgus antipodarum* was also present in this sample. This species is now considered naturalised.

DX003P

- 3.4.5 Of moderate diversity with 24 taxa recorded, macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails and hoglouse *Asellus aquaticus*.
- 3.4.6 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score 3.81) and had a 'heavily sedimented' PSI score (4.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.
- 3.4.7 The non-native but naturalised New Zealand mud snail was also present in this sample. This species is now considered naturalised.
- 3.4.8 There were no notable species recorded.

DX004P

- 3.4.9 This site had moderate diversity with 17 taxa recorded; macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails and hoglouse *Asellus aquaticus*. There were also some beetle species present such as *Helophorus grandis* and the cased-caddisfly larvae *Glyptotaelius pellucidus* from the family Limnephilidae. The snail *Anisus leucostoma* was also recorded here which had a conservation value that was Occasional (species which occur in up to 10 % of all samples from similar habitats).
- 3.4.10 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 3.90) and had a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.
- 3.4.11 The non-native but naturalised crustacean 'shrimp' *Crangonyx pseudogracillis/floridanus* was recorded in this sample.
- 3.4.12 There were no notable species recorded.

DX005P

- 3.4.13 This site had moderate diversity with 28 taxa recorded; macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails and hoglouse *Asellus aquaticus*. There were also some beetle species, true bugs from the Corixidae family (*Sigara falleni*), the alderfly larva *Sialis lutaria*, and the cased caddisfly larvae *Limnephilus lunatus* and *L. marmoratus* from the family Limnephilidae.

3.4.14 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 4.14) and had a 'heavily sedimented' PSI score (3.45). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low' conservation value'.

3.4.15 The non-native but naturalised New Zealand mud snail was present in this sample.

3.4.16 There were no notable species recorded.

DX007P

3.4.17 Moderate diversity with 21 taxa recorded; macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails and hoglouse. There was also the leech *Trocheta subviridus* from the family Erpobdellidae, true bugs from the Corixidae family (*Sigara* sp.), the alderfly larva *Sialis lutaria*, and the cased caddisfly larva *L. lunatus* from the family Limnephilidae.

3.4.18 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 3.25) and had a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate' conservation value'.

3.4.19 The non-native but naturalised New Zealand mud snail was present in this sample.

3.4.20 There were no notable species recorded.

DX008P

3.4.21 This was a diverse site with 32 taxa recorded, macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails and mussels, and crustaceans; the hoglouse *Asellus aquaticus* and the shrimp *Gammarus pulex/fossarum* agg. Also present were dragonflies (unidentified species of Libellulidae), beetles *Hydroporus nigrita* and *Anacaena globulus* from the family Hydrophilidae and the cased caddisfly larva *L. lunatus*.

3.4.22 Biological water quality was 'moderate, moderately impacted' (ASPT-WHPT score of 4.36) and had a 'heavily sedimented' PSI score (7.69). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low' conservation value'.

3.4.23 The non-native but naturalised New Zealand mud snail was present in this sample.

3.4.24 There were no notable species recorded.

Route Section 2

DX017P

3.4.25 This site was moderately diverse with 26 taxa recorded. Macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails and worms. The mayfly *Cloeon dipterum* from the family Baetidae, the beetle *A. globulus* from the family Hydrophilidae as well as the cased caddis-fly larva *L. lunatus* and *L. auricula* were also present. The snail *Anisus leucostoma* was also recorded here, which has a conservation value of Occasional (species which occur in up to 10 % of all samples from similar habitats).

3.4.26 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 3.99) and had a 'heavily sedimented' PSI score (3.70). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.

3.4.27 The non-native but naturalised New Zealand mud snail was present in this sample.

3.4.28 There were no notable species recorded.

Route Section 3

RVX001BP

3.4.29 A moderately diverse site with 19 taxa recorded, macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails and the mayfly *Cloeon dipterum* from the family Baetidae. The water boatman *Sigara lateralis* from the family Corixidae, the dragonfly family Libellulidae and beetle larvae from the family Dytiscidae were also present in abundance. Another species of water boatman, *Corixa panzeri* was also recorded here, which has a conservation value of 'Local' (Conservation Score 5). However, there are no statutory designations for this species.

3.4.30 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 3.87) and had a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'fairly high conservation value'.

3.4.31 The non-native but naturalised New Zealand mud snail was present in this sample.

DC035P

3.4.32 With a low diversity with 15 taxa recorded, macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails, worms and Ostracoda. Small numbers of beetle larvae from the families Dytiscidae and Scirtidae were also present. The snail *A. leucostoma* was also recorded here, which has a conservation value of 'Occasional' (species which occur in up to 10 % of all samples from similar habitats).

3.4.33 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 4.07) and had a 'heavily sedimented' PSI score (7.69). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'fairly high conservation value'.

3.4.34 There were no notable or non-native species recorded.

DX037P

3.4.35 This was a low diversity site with 17 taxa recorded. Macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails, and the stonefly larva *Nemoura cinerea* from the family Nemouridae. Beetle larva from the family Dytiscidae were also present and an adult beetle *A. globulus* from the family Hydrophilidae was also present.

3.4.36 Biological water quality was 'moderate, moderately impacted' (ASPT-WHPT score of 4.59), with a 'heavily sedimented' PSI score (4.0). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low conservation value'.

3.4.37 The non-native but non-invasive New Zealand mud snail was present in this sample in large numbers.

3.4.38 There were no notable species recorded.

DX038P

3.4.39 A moderately diverse site with 24 taxa recorded, macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails, and worms. Beetle

larva from the family Dytiscidae and an adult beetle *Helophorus grandis* from the family Helophoridae was also present along with a species from the cased caddisfly family Limnephilidae, *L. centralis*.

3.4.40 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 3.79), with a 'heavily sedimented' PSI score (6.25). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.

3.4.41 The non-native but naturalised New Zealand mud snail was present in this sample.

3.4.42 There were no notable species recorded.

DX042P

3.4.43 This was a low diversity site with 11 taxa recorded; macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails, and worms. Two species from the cased caddisfly family Limnephilidae, *L. auricula* and *Micropterna lateralis* and the beetle *A. globulus* from the family Hydrophilidae were also present.

3.4.44 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 4.15), with a 'heavily sedimented' PSI score (14.29). The macroinvertebrate community at this site had 'moderate sensitivity to reduced flows' and was of 'moderate conservation value'.

3.4.45 The non-native but naturalised New Zealand mud snail was present in this sample.

3.4.46 There were no notable species recorded.

Route Section 4

DX050P

3.4.47 A moderately diverse site with 22 taxa recorded, macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails, and worms. Three species from the cased-caddisfly family Limnephilidae, *L. auricula*, *L. centralis* and *L. lunatus* were present along with the beetle *A. globulus* from the family Hydrophilidae.

3.4.48 Biological water quality was 'moderate, moderately impacted' (ASPT-WHPT score of 4.18), with a heavily sedimented 'PSI score (12.50). The macroinvertebrate community at this site had 'moderate sensitivity to reduced flows' and was of 'moderate conservation value'.

3.4.49 The non-native but naturalised New Zealand mud snail was present in this sample.

3.4.50 There were no notable species recorded.

DX059P

3.4.51 A low diversity site with 11 taxa recorded, macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae) and the black fly larvae Simuliidae), snails, and worms. Two species from the cased-caddisfly family Limnephilidae, *L. auricula* and *L. lunatus*, with some beetle larvae/unidentifiable adults from the families Haliplidae, Dytiscidae, Hydrophilidae and Dryopsidae.

3.4.52 Biological water quality was 'moderate or moderately impacted' (ASPT-WHPT score of 4.13), with a 'heavily sedimented' PSI score (16.67). The macroinvertebrate community at this site had 'moderate sensitivity to reduced flows' and was of 'moderate conservation value'.

3.4.53 The non-native but naturalised New Zealand mud snail was present in this sample.

3.4.54 There were no notable species recorded.

DX061P

3.4.55 This was a low diversity site with 12 taxa recorded; macroinvertebrate community was dominated by the hoglouse *A. aquaticus*, beetle larvae from the family Dytiscidae, and Diptera (non-biting midge larvae Chironomidae). Small numbers of cased-caddisfly larvae from the family Limnephilidae and true-fly larvae from the family Simuliidae were also present.

3.4.56 Biological water quality was 'moderate or moderately impacted' (ASPT-WHPT score of 4.60), with a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low conservation value'.

3.4.57 There were no notable or invasive species recorded.

DX066P

3.4.58 A moderately diverse site with 23 taxa recorded, macroinvertebrate community was dominated by snails and worms. Larvae from the cased-caddisfly family Limnephilidae with some species of *L. lunatus* were present along with Diptera (non-biting midge larvae Chironomidae). Beetles from two different families were also present, larvae from the family Dytiscidae and *Hydrochus sp.* and *Laccobius sp.* from the family Hydrophilidae were present in this sample.

3.4.59 Biological water quality was 'moderate or moderately impacted' (ASPT-WHPT score of 4.31), with a 'heavily sedimented' PSI score (11.11). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low conservation value'.

3.4.60 There were no notable or invasive species recorded.

DX067P

3.4.61 This was a moderately diverse site with 15 taxa recorded. Macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), blackfly larvae from the family Simuliidae, and pill clams (*Pisidium sp.*). Two species from the cased caddisfly family Limnephilidae, *L. auricula* and *L. lunatus* and some beetle larvae from the family Dytiscidae were also present.

3.4.62 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 4.04), with a 'sedimented' PSI score (23.08). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low conservation value'.

3.4.63 The non-native but naturalised New Zealand mud snail was present in this sample.

3.4.64 There were no notable species recorded.

DX073P

3.4.65 A moderately diverse site with 19 taxa recorded, macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), the hoglouse *Asellus aquaticus* and the snail *A. leucostoma* from the family Planorbidae. *A. leucostoma* has a conservation value that is 'Occasional' (species which occur in up to 10 % of all samples)

from similar habitats)'. *L.centralis* from the cased caddisfly family Limnephilidae and some beetle larvae, *Hydroporus sp.*, from the family Dytiscidae were also present.

3.4.66 Biological water quality was 'poor, polluted or impacted (ASPT-WHPT score of 3.49), with a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.

3.4.67 The non-native but naturalised New Zealand mud snail was present in this sample.

3.4.68 There were no notable species recorded.

DX074P

3.4.69 This was a moderately diverse site with 23 taxa recorded. Macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails and limpets. Four species of snail were present: *Radix balthica*, *Valvata cristata*, *Valvata piscinalis*, and *Bithynia tentaculata*. Beetles from the families Haliplidae and Dryopidae were also present.

3.4.70 Biological water quality was 'poor, polluted or impacted (ASPT-WHPT score of 3.77), with a 'heavily sedimented' PSI score (11.76). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low conservation value'.

3.4.71 The non-native but naturalised New Zealand mud snail was present in this sample.

3.4.72 There were no notable species recorded.

DX075P

3.4.73 Of low diversity site with 13 taxa recorded, macroinvertebrate community was dominated snails, worms and Diptera (non-biting midge larvae Chironomidae). Larvae of cased-caddisfly *L. auriculara* from the Limnephilidae family Limnephilidae were present along with beetles *Hydrochus sp.* and *Anacaena globulus*.

3.4.74 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 3.63), with a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.

3.4.75 There were no notable or invasive species recorded.

DX076P

3.4.76 This was a highly diverse site with 43 taxa recorded. The macroinvertebrate community was composed of snails, worms, leeches, crustaceans, mayfly larvae, beetles, cased-caddisfly larvae and Diptera larva. Larvae from two mayfly families were present in this sample: *Baetis rhodani/atlanticus* and *C. dipterum* from the family Baetidae and *Ephemera Danica* from the family Ephemeridae.

3.4.77 Biological water quality was 'moderate, moderately impacted (ASPT-WHPT score of 4.43), with a 'sedimented' PSI score (22.30). The macroinvertebrate community at this site had 'moderate sensitivity to reduced flows' and was of 'low conservation value'.

3.4.78 The non-native but naturalised crustacean *Crangonyx pseudogracillis/floridanus* was present at this site.

DX078P

- 3.4.79 A moderately diverse site with 30 taxa recorded, macroinvertebrate community was dominated by Diptera (non-biting midge larvae Chironomidae), snails and worms. Other taxa were present in lower numbers such as the dragonfly family Libellulidae (specimens too small to speciate) and the water boatman *Sigara sp.* from the family Corixidae. The shrimp *Gammarus fossarum* from the family Gammaridae was found in this sample which had a conservation value of 'Local' (CCI 5).
- 3.4.80 Biological water quality was 'moderate or moderately impacted (ASPT-WHPT score of 4.55) and had a 'heavily sedimented' PSI score (12.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'fairly high conservation value'.
- 3.4.81 The non-native but naturalised New Zealand mud snail was present in this sample.

Route Section 5

DX089AP

- 3.4.82 This was a moderately diverse site with 33 taxa recorded. Macroinvertebrate community was dominated by snails, beetles (species from the families Haliplidae, Dytiscidae, Hydrophilidae and Dryopidae) and Diptera larva. Other taxa were present in lower numbers such mayfly species from the families Baetidae and Caenidae. The snail *Bithynia leachii* from the family Bithynidae was found in this sample which had a conservation value that was of 'Local' (CCI 5).
- 3.4.83 Biological water quality was 'moderate or moderately impacted (ASPT-WHPT score of 4.29), with a 'heavily sedimented' PSI score (12.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.
- 3.4.84 The non-native but naturalised New Zealand mud snail and *Crangonyx pseudogracillis/floridianus* were present in this sample.
- 3.4.85 There were no notable species recorded.

DX090BP

- 3.4.86 A moderately diverse site with 42 taxa recorded, macroinvertebrate community was dominated by snails, crustaceans and Diptera larva. Other taxa were present in lower numbers such as the leech *Erpobdella octoculata* from the family Erpobdellidae and mayfly species from the families Baetidae and Caenidae. There were also dragonfly and damselfly larvae from the families Libellulidae and Coenagrionidae respectively. However, specimens were too small or damaged and could not be identified to species level.
- 3.4.87 Biological water quality was 'moderate or moderately impacted (ASPT-WHPT score of 4.25), with a 'heavily sedimented' PSI score (2.33). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low conservation value'.
- 3.4.88 The non-native but naturalised New Zealand mud snail and crustacean *C. pseudogracillis/floridianus* were present in this sample.
- 3.4.89 A single specimen of crayfish Astacidae was recorded at this site; however, it was too small to be identified further. There are no records of white-clawed crayfish *Austropotamobius pallipes* within 10 km, and the nearest record of American signal crayfish *Pacifastacus leniusculus* is approximately 9 km to the south. Therefore, this is considered to be the latter species. American signal crayfish is an invasive non-native species listed under Schedule 9 of the WCA 1981; refer to Section 4.

DX091P

- 3.4.90 This was a low diversity site with 11 taxa recorded. The macroinvertebrate community was dominated by snails, worms and beetle larvae from the family Scirtidae.
- 3.4.91 Biological water quality was 'poor, polluted or impacted (ASPT-WHPT score of 4.01), with a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low conservation value'.
- 3.4.92 The non-native crustacean *Crangonyx pseudogracillis/floridanus* was present at this site.
- 3.4.93 There were no notable species recorded.

DX092P

- 3.4.94 A low diversity site with 13 taxa recorded, macroinvertebrate community was dominated by snails, worms, beetle larvae from the family Scirtidae and mosquito larvae from the family Culicidae.
- 3.4.95 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 4.01) and had a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.
- 3.4.96 There were no notable or invasive species recorded.

DX093P

- 3.4.97 A moderately diverse site with 42 taxa recorded, macroinvertebrate community was dominated by snails, crustacea and Diptera larva. Low numbers of other taxa were recorded such as mayfly species Cloeon dipterum from the family Baetidae, the damselfly larvae Ischnura elegans from the family Coenagrionidae and beetles from the families Dytiscidae and Haliplidae.
- 3.4.98 Biological water quality was 'poor, polluted or impacted (ASPT-WHPT score of 3.74), with a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.
- 3.4.99 The non-native but naturalised New Zealand mud snail and crustacean 'shrimp' *C. pseudogracillis/floridianus* were present at this site.
- 3.4.100 There were no notable species recorded.

DX094P

- 3.4.101 This was a low diversity site with 11 taxa recorded. The macroinvertebrate community was dominated by snails, worms and the hoglouse *A. aquaticus*. There were also low numbers of *Hydroporus* sp. beetles from the family Dytiscidae and beetle larvae from the family Hydrophilidae.
- 3.4.102 Biological water quality was 'poor, polluted or impacted (ASPT-WHPT score of 3.58), with a 'heavily sedimented' PSI score (7.14). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low conservation value'.
- 3.4.103 The non-native crustacean *Crangonyx pseudogracillis/floridanus* was present at this site.

DX108P

3.4.104 Of extremely low diversity site with only six taxa recorded, macroinvertebrate community at this site was mostly composed of the snail *Stagnicola sp.* from the family Lymnaeidae, the hoglouse *A. aquaticus* and beetle larvae from the family Scirtidae.

3.4.105 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 4.01), with a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.

3.4.106 There were no notable or invasive species recorded.

DX113P

3.4.107 A moderately diverse site with 47 taxa recorded, macroinvertebrate community was dominated by snails, crustaceans, mayfly larvae (*C. dipterum*) and Diptera larva. Other taxa were present in lower numbers such as the true bug *Notonecta sp.* from the family Notonectidae, beetles from the families Haliplidae, Dytiscidae and Hydrophilidae and alderfly larva *Sialis lutaria* from the family Sialidae .

3.4.108 Biological water quality was 'poor, polluted or impacted' (ASPT-WHPT score of 3.77), with a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low conservation value'.

3.4.109 The non-native New Zealand mud snail and 'shrimp' *C. pseudogracillis/floridanus* were present at this site.

DX113P

3.4.110 This was a low diversity site with 17 taxa recorded. The macroinvertebrate community was dominated by worms and beetle larvae from the family Scirtidae There were also two species from the cased-caddisfly Limnephilidae family: *L. auricula* and *Glyphotaelius pellucidus* and adult beetle species *A. globulus* from the family Hydrophilidae.

3.4.111 Biological water quality was 'moderate, moderately polluted' (ASPT-WHPT score of 4.56), with a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.

3.4.112 The non-native but naturalised crustacean *Crangonyx pseudogracillis/floridanus* was present at this site.

3.4.113 There were no notable species recorded.

DX114P

3.4.114 This was a moderately diverse site with 21 taxa recorded. The macroinvertebrate community was mostly dominated by snails with multiple other taxa present in similarly low numbers such as the hoglouse *A. aquaticus* and the flatworm *Polycelis sp.* Three families of beetle were found at this site: *Hydroporus palustris* from the family Dytiscidae, *A. globulus* from the family Hydrophilidae and larvae from the family Scirtidae.

3.4.115 Biological water quality was 'moderate, moderately polluted' (ASPT-WHPT score of 4.64), with a 'heavily sedimented' PSI score (11.10). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'moderate conservation value'.

3.4.116 The leech, *Dina lineata* from the family Erpobdellidae was present in this sample. This species has a CCI score of 6 which makes it a Regionally Notable species; however, there are no statutory designations for this species.

3.4.117 The non-native but naturalised New Zealand mud snail and the 'shrimp' *C. pseudogracillis/floridanus* were also present at this site.

DX095AP

3.4.118 This was a diverse site with 35 taxa recorded. Macroinvertebrate community was dominated by snails (many species across different families), worms and mayfly larvae (*Caenis horaria* from the family Caenidae). There were also damselflies (*Ischnura elegans* and *Coenagrion* sp. from the family Coenagrionidae) and dragonfly larva from the family Libellulidae.

3.4.119 Biological water quality was 'poor, polluted or impacted (ASPT-WHPT score of 4.01), with a 'heavily sedimented' PSI score (0.00). The macroinvertebrate community at this site had 'low sensitivity to reduced flows' and was of 'low conservation value'.

3.4.120 The non-native New Zealand mud snail and crustacean 'shrimp' *C. pseudogracillis/floridianus* were present in this sample.

3.4.121 There were no further notable species recorded.

4 Discussion and Recommendations

4.1 Protected and notable species

Aquatic Macroinvertebrates

4.1.1 No protected or notable species were found during the desk study.

4.1.2 The only notable species found in macroinvertebrate field surveys was the leech *Dina lineata* from the family Erpobdellidae, which had a CCI score of 6 (Regionally Notable). This species was recorded in a sample from the drain at crossing point DX114P which is potentially to be open cut. However, there are no statutory designations associated with this species.

Aquatic Macrophytes

4.1.3 No notable or protected species of macrophytes were recorded during the desk study. However, several invasive non-native macrophyte species were recorded within 2 km; see below.

4.1.4 No field surveys were carried out for aquatic macrophytes.

Fish

4.1.5 Using open-source Environment Agency Ecology and Fish data explorer and data sought from the Greater Lincolnshire Nature Partnership, a number of notable fish species were found to be present in the Study Area during the desk study. No field surveys were carried out for fish species.

- 4.1.6 On Laceby Beck (EA site ID 6642), Brown trout *Salmo trutta* and bullhead *Cottus gobio* were found to be present at EA monitoring site 6642. The EA site is c. 10 km downstream of crossing point RVX001BP, which is an Auger-Bore crossing. All fish species are protected under The Salmon and Freshwater Fisheries Act (1975), which aims to protect all migratory and freshwater fish stocks from activities that could result in direct mortality, barriers to migration, and degradation of habitats. Brown trout is a species of principal importance (SPI) under Section 41 (S41) of the NERC Act 2006, and bullhead is a UKBAP priority species.
- 4.1.7 For the Louth Canal, data from the EA data explorer showed Brown trout and European eel to be present approximately 2 km to the west of crossing point CNX001P. European eel is categorised as critically endangered (Jacoby and Gollock, 2014) after a decline in stocks since the 1980s (Wirth and Bernatchez, 2003) and is protected under the Eels (England and Wales) Regulations 2009 (The Regulations). European eels are a SPI under S41 of the NERC Act 2006.
- 4.1.8 Brown trout and European eel were also present on Waithe Beck water body. There are currently no proposed open-cut crossings on Waithe Beck but there are three open cut crossing points, DX035P, DX037P and DX038P that are in very close proximity to Waithe Beck on minor tributaries. HDD crossing point RVX001CP on Waithe Beck is 1 km and 7 km upstream from EA survey locations that recorded brown trout and European eel (Brigsley and Waithe respectively).
- 4.1.9 European eels and river lamprey were also found in The Beck water body. The Beck does not have any proposed crossings, but it is connected to Long Eau which has a number of proposed closed crossings on it. There is potential for species present in The Beck to migrate within Long Eau due to the connectivity of these water bodies.
- 4.1.10 European eels were also present at three different EA locations on Long Eau, these were 1km upstream of crossings RVX002P (HDD crossing), and 1km upstream and 2km downstream of RVX007P (HDD crossing).

4.2 Invasive Non-Native Species (INNS)

INNS Aquatic macroinvertebrates

- 4.2.1 A crayfish specimen, considered to be American signal crayfish *Pacifastacus leniusculus*, was found at site DX090BP Two Mile Bank Drain. There are no records of the protected white-clawed crayfish within 10 km, and a single record of American signal crayfish approximately 9 km to the south. American signal crayfish is listed as an INNS in Schedule 9 of the WCA 1981, and therefore it is an offence to release or otherwise cause it to spread in the wild. In addition, the signal crayfish carries the fungal disease crayfish plague, which if spread can decimate populations of the protected native white-clawed crayfish. Therefore, biosecurity precautions would need to be put in place to prevent the spread of both signal crayfish and crayfish plague.
- 4.2.2 During the desk study, a non-native 'shrimp', *Gammarus tigrinus* was recorded in Laceby Beck. This species is now considered naturalised.
- 4.2.3 The non-native but naturalised New Zealand Mud snail *Potamopyrgus antipodarum* was recorded in aquatic macroinvertebrate samples from the following open-cut crossings: RVX001GP, DX003P, DX005P, DX008P, DX017P, RVX001BP, DX037P, DX038P, DX042P, DX050P, DX059P, DX067P, DX073P, DX074P, DX078P, DX114P and DX095AP.

4.2.4 The non-native but naturalised Amphipod ‘shrimp’, *Crangonyx pseudogracillis/floridanus* was recorded in aquatic macroinvertebrate samples from the following open-cut crossings; DX003P (Habrough Drain), DX004P (Habrough Drain), DX076P, DX091P, DX094P, DX113P, DX114P and DX095AP. *Crangonyx pseudogracillis* was first introduced to the UK in the 1930’s and is now naturalised, widespread and common in many areas as well. Until recently it was the only non-native species of this genus known to be present in the UK. However, in 2017 a related non-native species *Crangonyx floridanus* was identified in the UK for the first time (Mauvisseau *et al.*, 2018) but it may have been overlooked previously. The identification features available to distinguish the two species are slight and it is often not possible to place samples to species using routine laboratory identification techniques. Given this, records of *Crangonyx* are treated in an aggregated sense within this report are recorded as *Crangonyx pseudogracillis/floridanus*.

4.2.5 Both New Zealand mud snail and *Crangonyx pseudogracillis/floridanus* are now considered naturalised and there are no statutory constraints regarding their potential spread.

INNS Macrophytes

4.2.6 A number of invasive aquatic and riparian macrophytes were recorded during the desk study (**Table 7**). Records of Canadian pondweed, Himalayan Balsam and Nuttall’s waterweed were found on Laceby beck. Records of Giant hogweed were found on Tributary of The Cut, Japanese knotweed was found on Louth Canal. New Zealand pigmyweed on Grayton Fen Drain and water fern on Mablethorpe.

4.2.7 Himalayan balsam *Impatiens glandulifera*, Japanese knotweed *Reynoutria japonica*, Canadian pondweed *Elodea canadensis*, giant hogweed *Heracleum mantegazzianum*, New Zealand pigmyweed *Crassula helmsii*, and water fern *Azolla filiculoides* are listed in Schedule 9 of the WCA 1981. Therefore, it is an offence to release or otherwise cause them to grow in the wild, and biosecurity measures would need to be implemented to minimise the risk of their spread.

4.2.8 Nuttall’s waterweed *Elodea nuttallii* is listed in The Invasive Alien Species (Enforcement and Permitting) Order 2019, and as such it is an offence to plant or otherwise cause to grow in the wild. Therefore, biosecurity measures would need to be implemented to minimise the risk of its spread.

4.2.9 Field surveys for aquatic macrophytes were not part of this assessment but during the aquatic macroinvertebrate surveys, Canadian waterweed was found to be present at open-cut crossing point DX007P.

Fish

4.2.10 The non-native fish, Rainbow trout, was recorded in the desk study in the River Lud 1km upstream from HDD crossing point RVX001P. There are no statutory constraints to the spread of this species.

4.3 Conclusion

4.3.1 A number of protected fish species were recorded in the desk study on water bodies that are within the Study Area and are on the crossing schedule. For water bodies that will potentially be crossed using HDD or Auger-Bore methods, drilling should be at a depth that is deep enough to avoid vibration and noise impacts on fish species, otherwise recommendations will be made to avoid the migratory and spawning seasons of these species.

- 4.3.2 For invasive species, regardless of the construction technique, biosecurity measures would be implemented to prevent the spread of invasive species and water-borne diseases.

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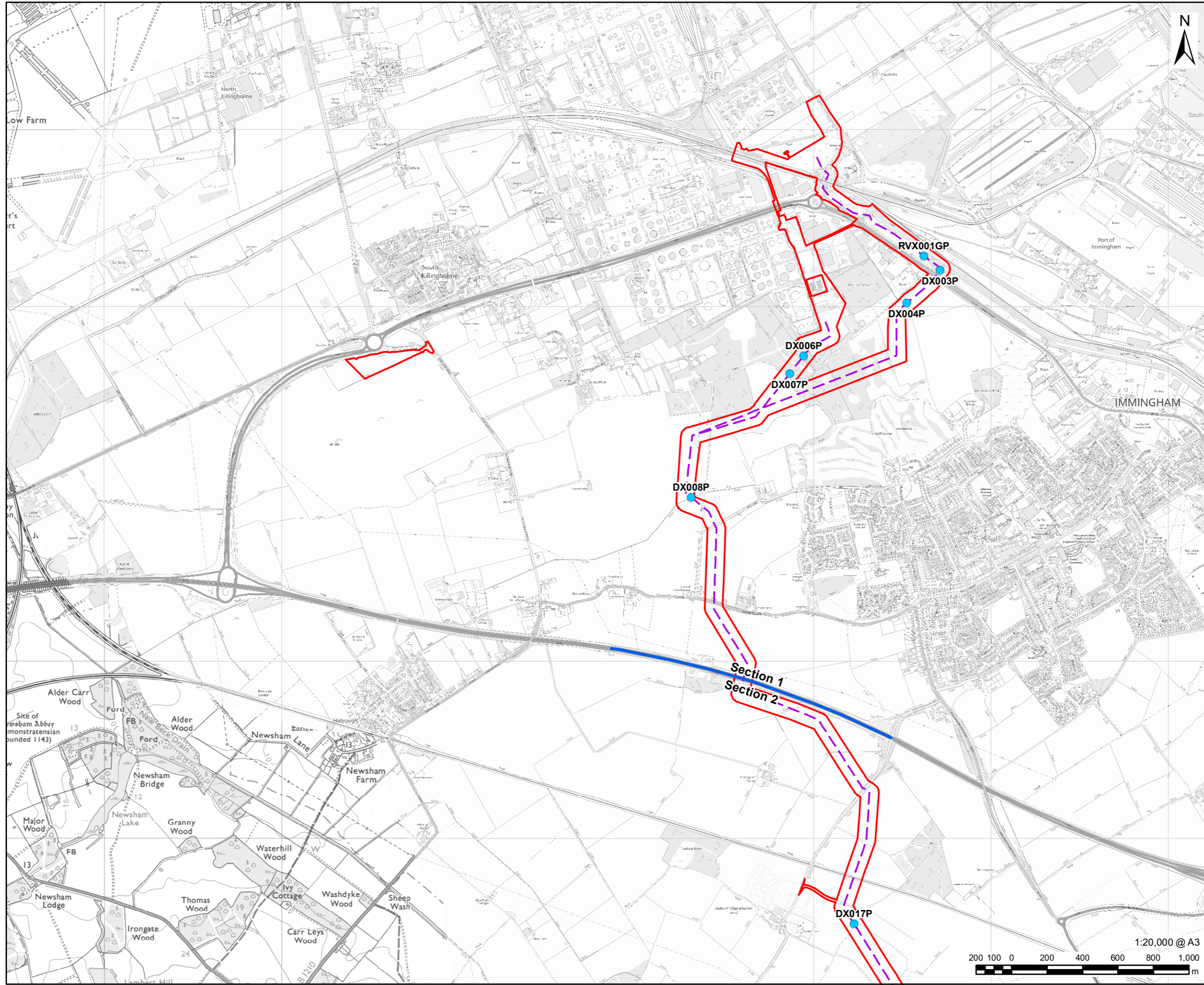
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Annex A Aquatic Survey Locations

Figure 1: Aquatic Macroinvertebrate Survey Locations



- LEGEND**
- ▭ DCO Site Boundary
 - ▬ Route Section Break
 - ▬ Preferred Pipeline Route (Indicative)
 - Aquatic Macroinvertebrate Survey Location

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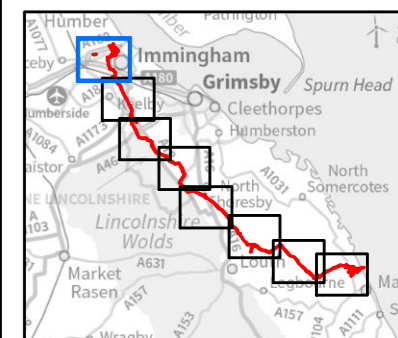
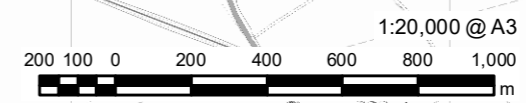


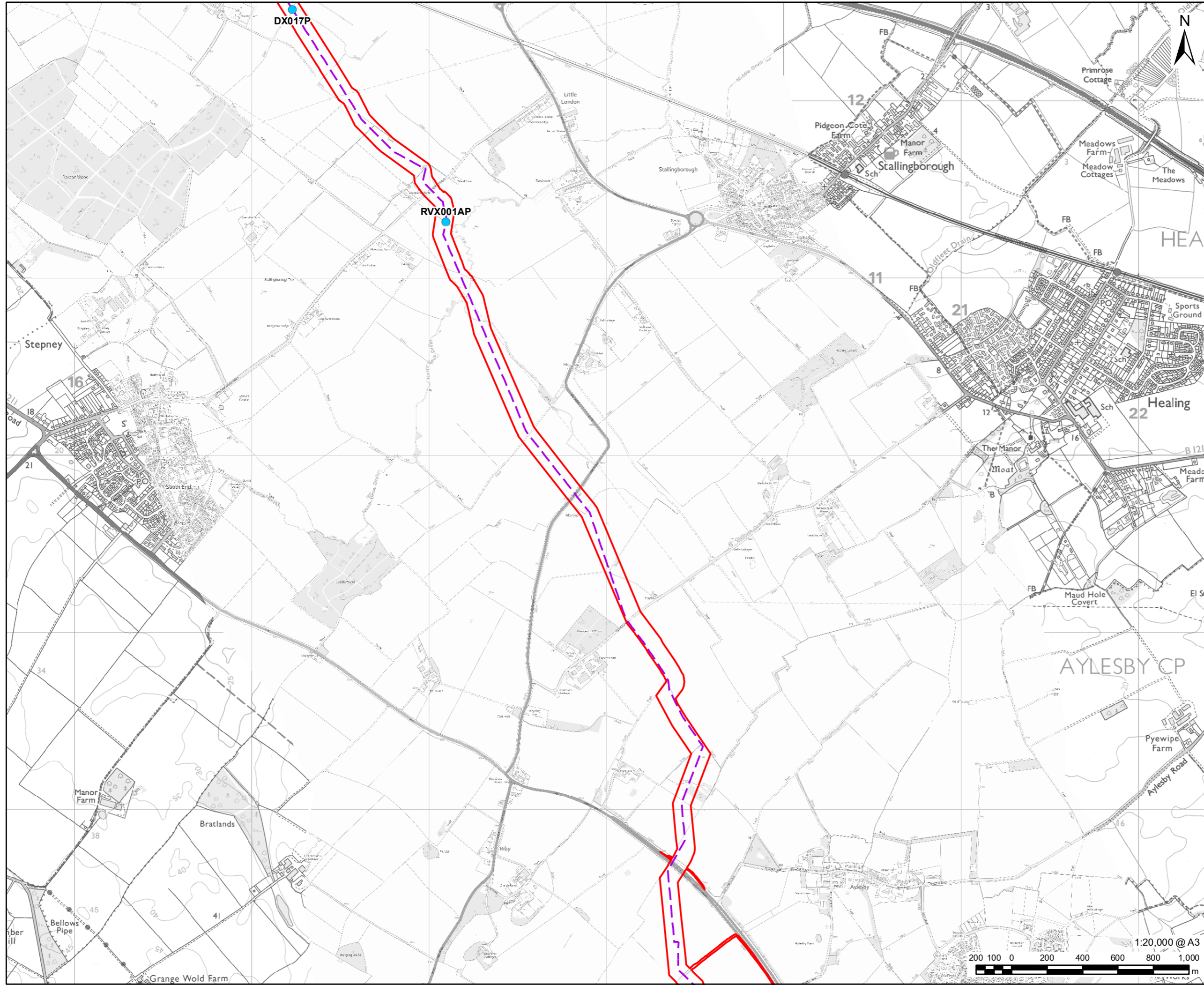
FIGURE TITLE
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Aquatic macroinvertebrate Survey Locations

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- LEGEND**
- DCO Site Boundary
 - Preferred Pipeline Route (Indicative)
 - Aquatic Macroinvertebrate Survey Location

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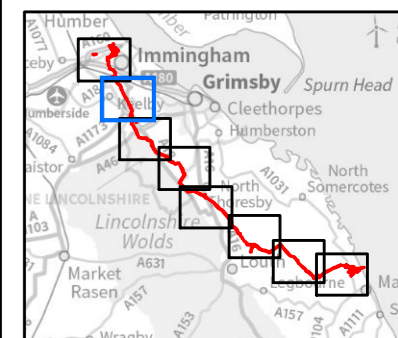
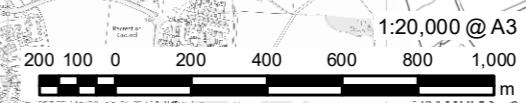
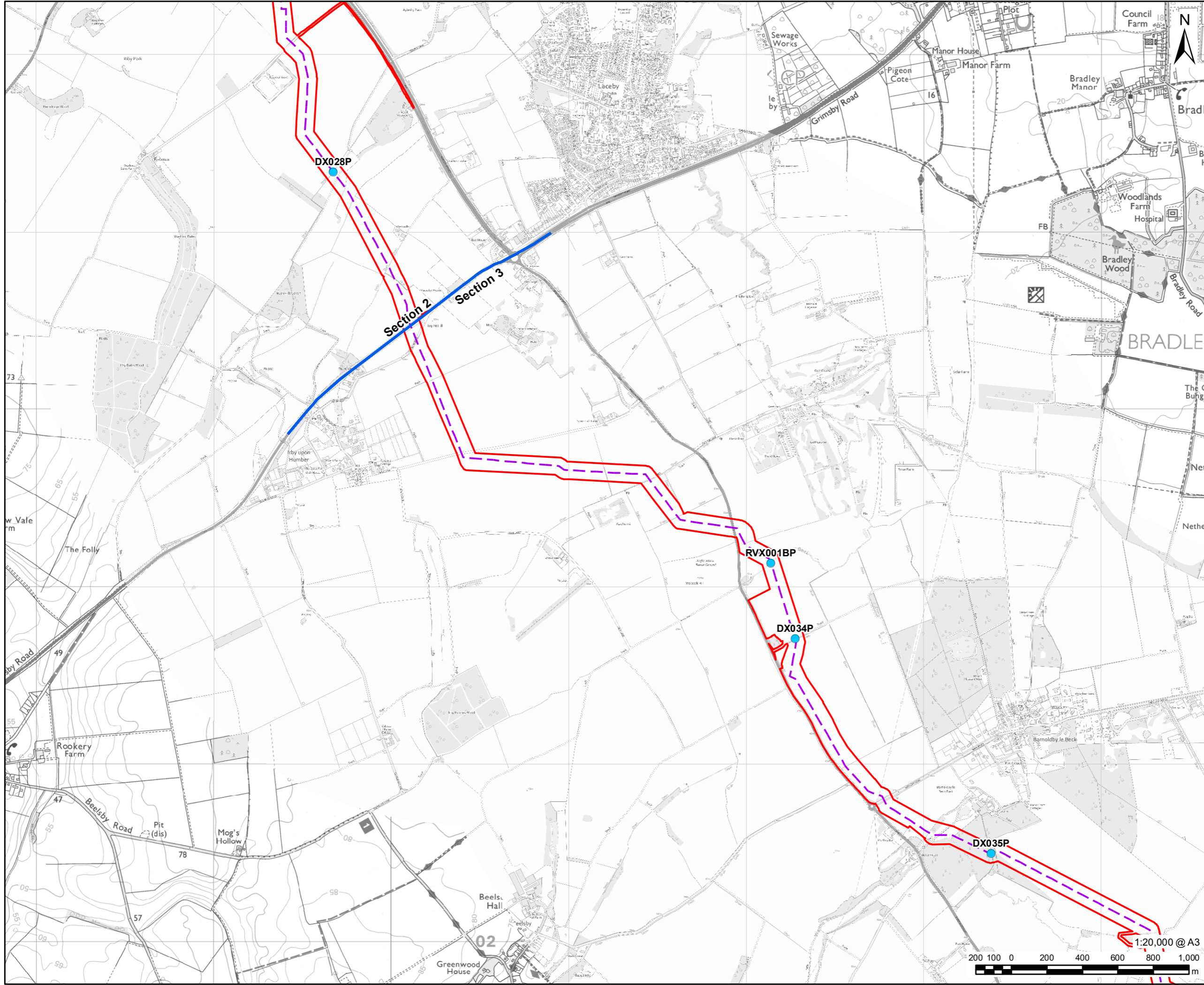


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VikingCCS

AECOM

PROJECT
Viking CCS Pipeline

LEGEND

- DCO Site Boundary
- Route Section Break
- Preferred Pipeline Route (Indicative)
- Aquatic Macroinvertebrate Survey Location

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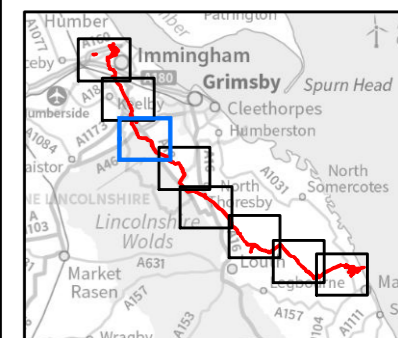
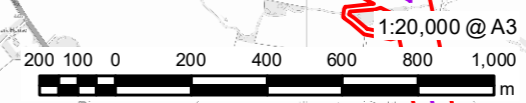


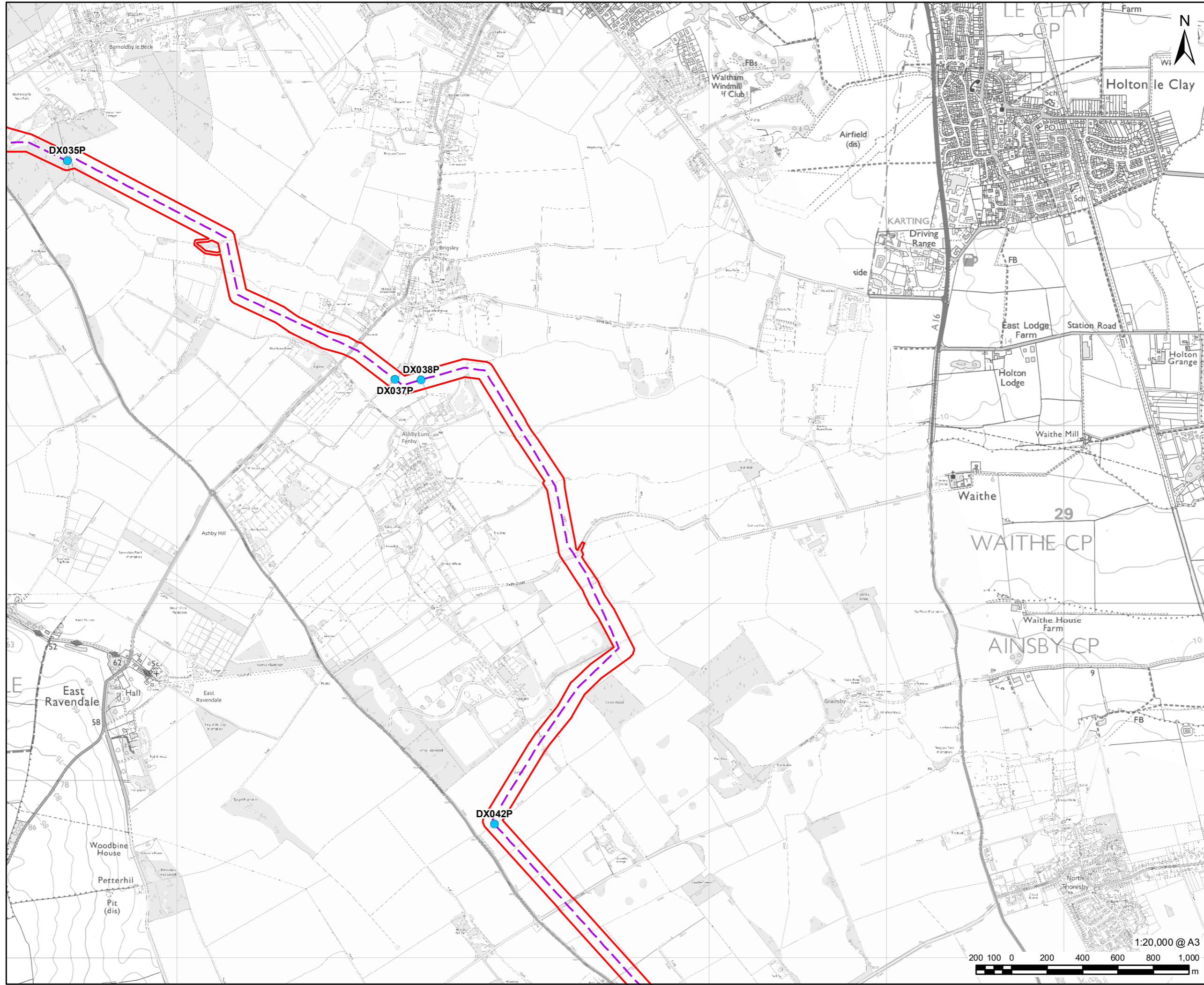
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- LEGEND**
- DCO Site Boundary
 - Preferred Pipeline Route (Indicative)
 - Aquatic Macroinvertebrate Survey Location

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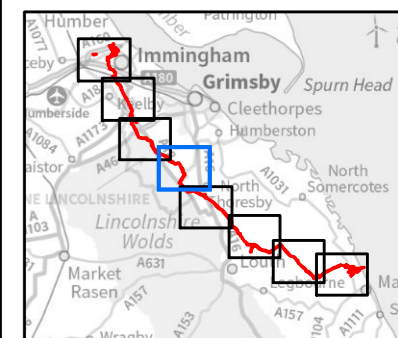
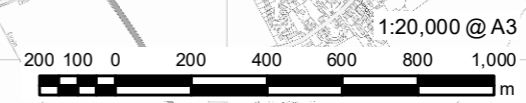
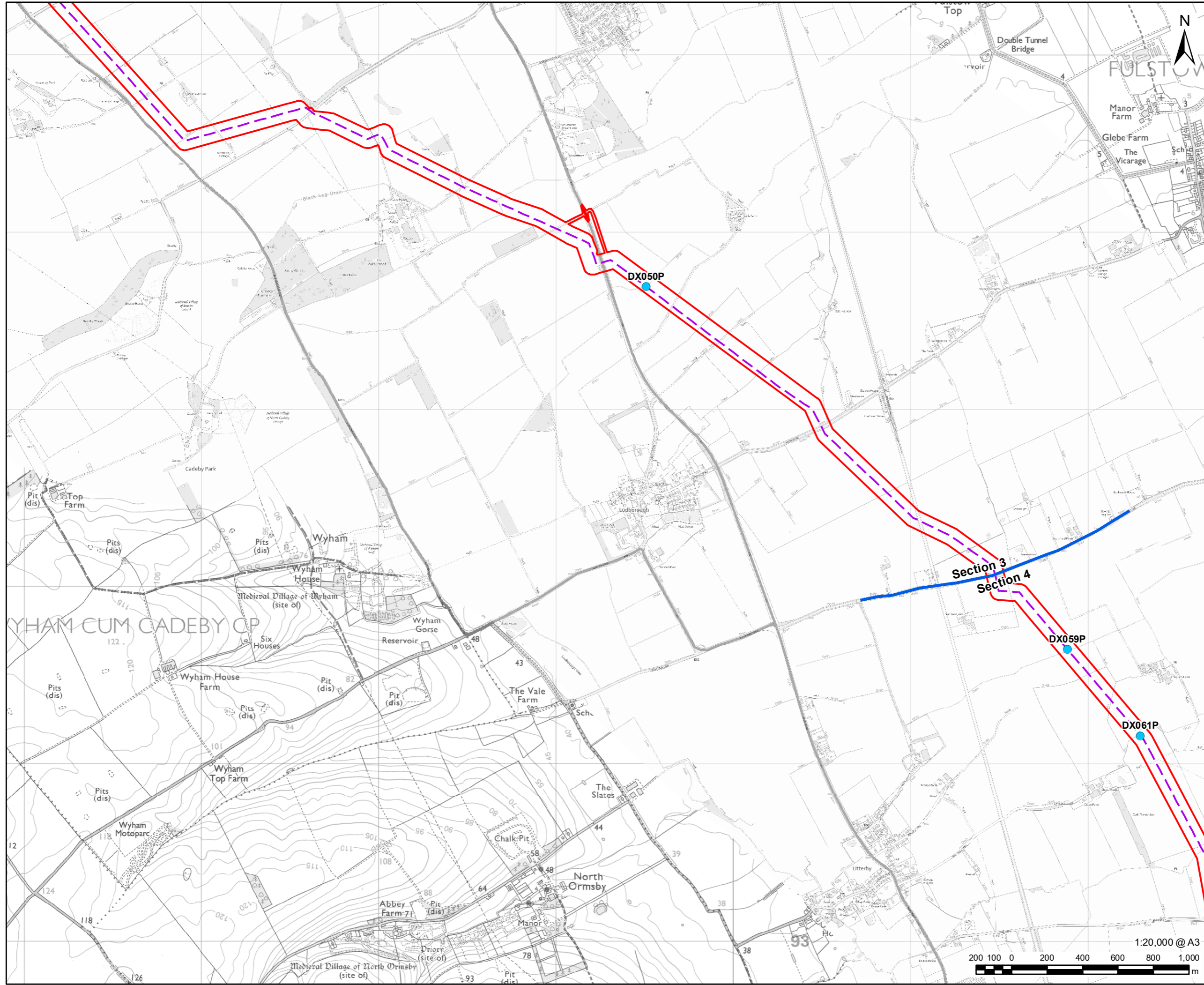


FIGURE TITLE
Figure 1 (4 of 8)
Aquatic macroinvertebrate Survey Locations

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LEGEND

- DCO Site Boundary
- Route Section Break
- Preferred Pipeline Route (Indicative)
- Aquatic Macroinvertebrate Survey Location

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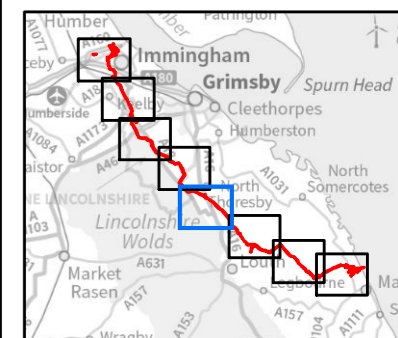
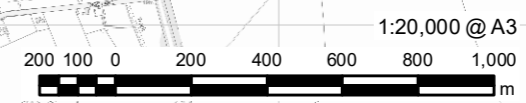
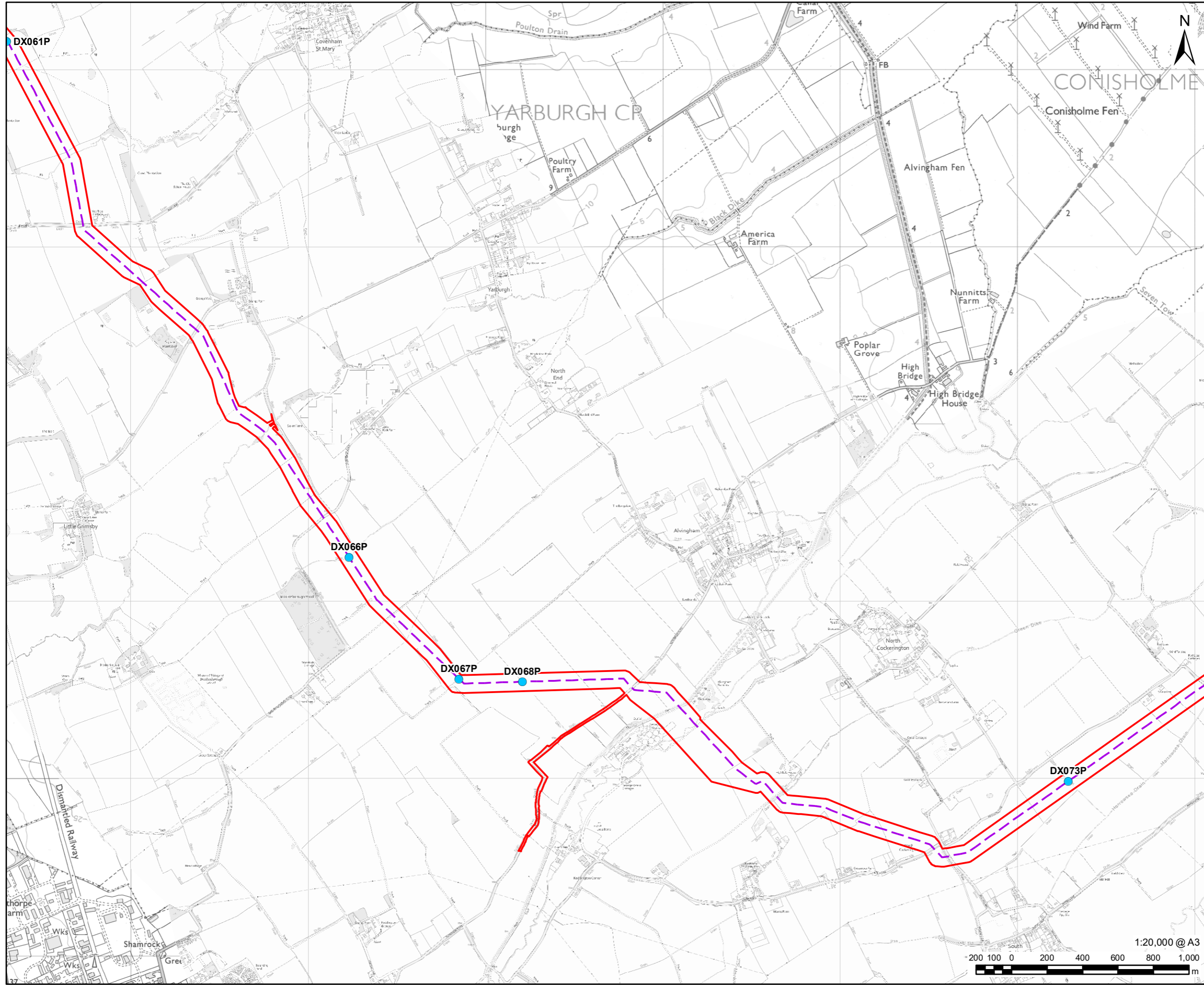


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Aquatic macroinvertebrate Survey Locations

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- LEGEND
- DCO Site Boundary
 - Preferred Pipeline Route (Indicative)
 - Aquatic Macroinvertebrate Survey Location

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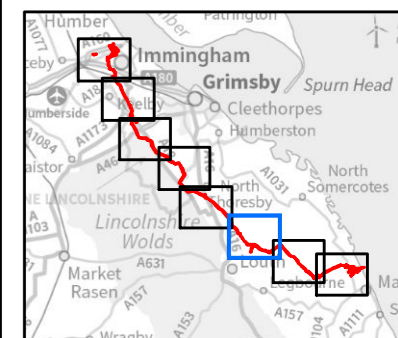
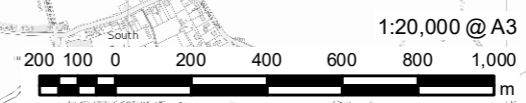
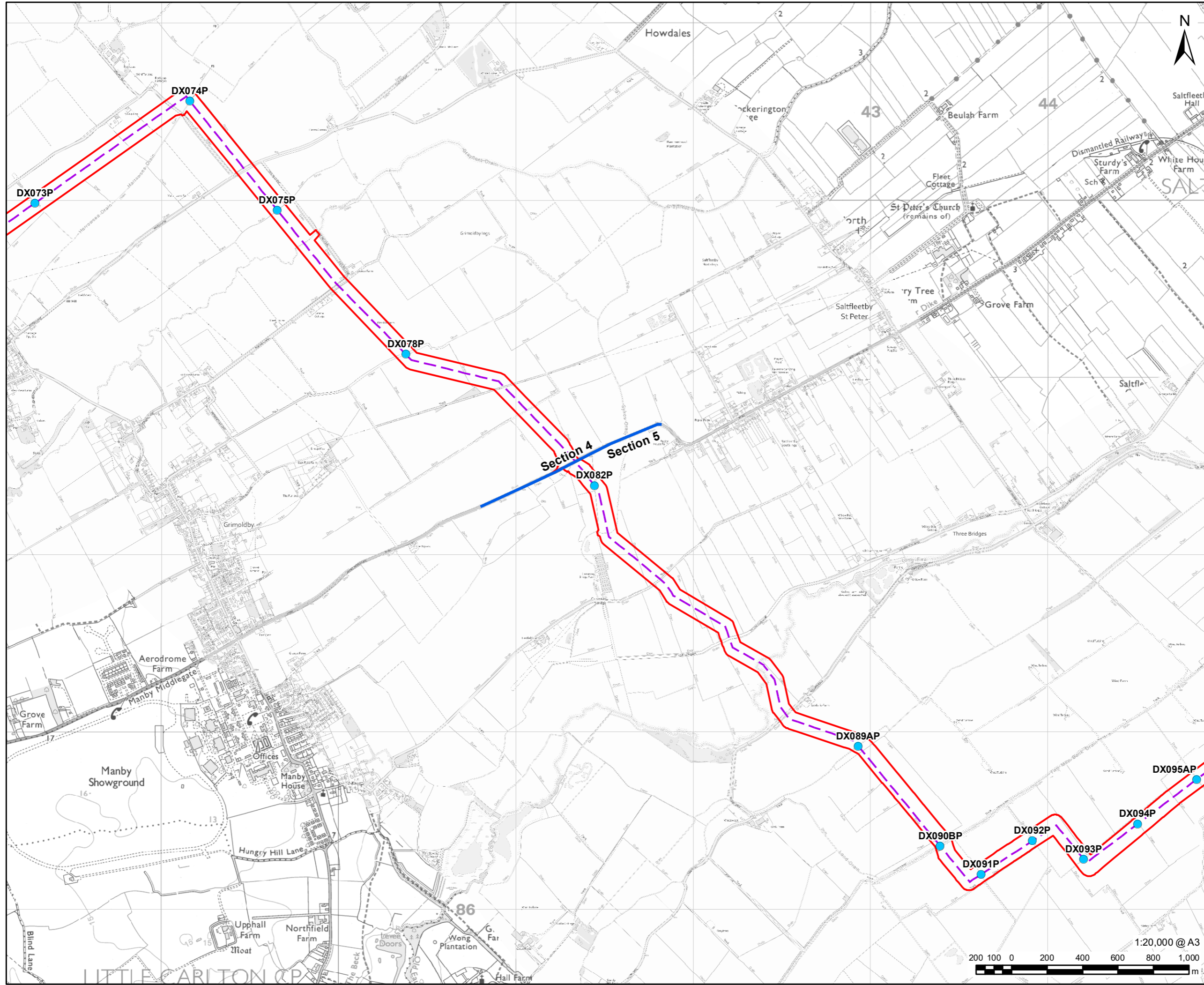


FIGURE TITLE
Figure 1 (6 of 8)
 Aquatic macroinvertebrate Survey Locations



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LEGEND

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- Preferred Pipeline Route (Indicative)
- Aquatic Macroinvertebrate Survey Location

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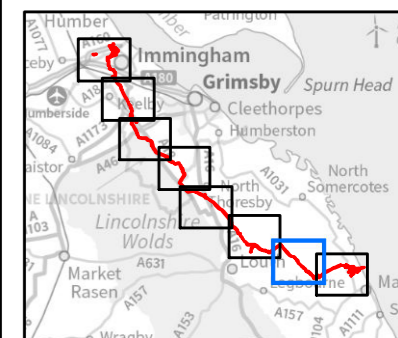


FIGURE TITLE

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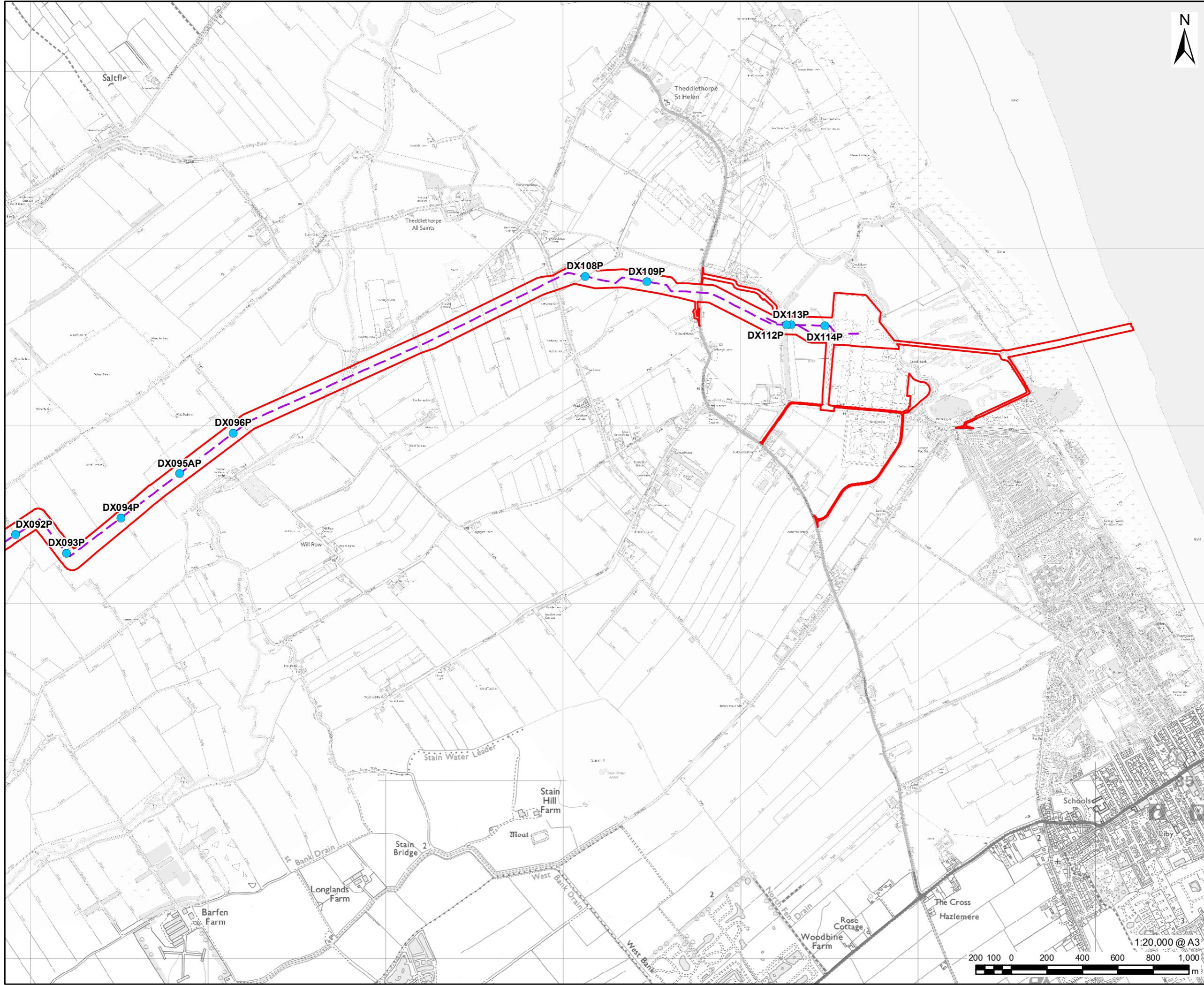
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- LEGEND**
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 - - - Preferred Pipeline Route (Indicative)
 - Aquatic Macroinvertebrate Survey Location

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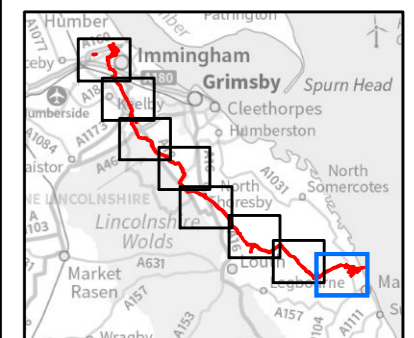


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Annex B Community Conservation Index (CCI)

5.1.1 The Community Conservation Index (Chadd & Extence, 2004) allows a classification of the nature conservation value associated with a macroinvertebrate community. The CCI score for one sample is derived from individual Conservation Scores (CS), assigned to some species of aquatic macroinvertebrates and relating closely to the available published Red Data Books (Bratton, 1990, 1991; Shirt, 1987). Conservation Scores assigned to individual species vary from 1 to 10, as detailed on the **Table A1** below. The derived CCI scores generally vary from 0 to > 20, as detailed in the **Table A2** below. **Table A2** below provides a guide to interpreting CCI scores.

Table A1: Conservation Scores from the Community Conservation Index (from Chadd & Extence, 2004)

Conservation Score	Relation to Red Data Books
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)

Table A2: General guide to CCI scores (from Chadd & Extence, 2004)

CCI Score	Description	Interpretation
0 to 5.0	Sites supporting only common species and/or 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 taxon 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 and/or a community of very high taxon richness	Very high conservation value

Annex C Whalley, Hawkes, Paisley & Trigg (WHPT) Metric

- 5.1.2 There are approximately 4,000 species of aquatic macroinvertebrates in the British Isles. To simplify the analysis of the samples and the data, individual species are not identified but only the major types (taxa), mostly at the family taxonomic level. A key piece of information is the number of different taxa at a site. A fall in the number of taxa indicates ecological damage, including pollution (organic, toxic and physical pollution such as siltation, and damage to habitats or the river channel).
- 5.1.3 The WHPT scoring system (WFD-UKTAG, 2021) is based upon the sensitivity of macroinvertebrate families to organic pollution. It replaces the Biological Monitoring Working Party (BMWP) system (Hawkes, 1997) previously used in the UK.
- 5.1.4 The WHPT system assigns a numerical value to about 100 different taxa (known as the WHPT-scoring taxa) according to their sensitivity to organic pollution. In addition to the presence of macroinvertebrate taxa at a sampling site, as in the BMWP scoring system, the WHPT system also uses another type of information, this being the abundances of different scoring taxa.
- 5.1.5 Taxa abundances are classified in four categories (Class 1: 1 to 10 individuals, Class 2: 11 to 100 individuals, Class 3: 101 to 1,000 individuals, and Class 4: > 1,000 individuals). A score (Pressure Sensitivity Scores (PSs)) is then assigned to each taxa, depending on the taxa sensitivity and abundances recorded.
- 5.1.6 The total WHPT score for a sample corresponds to the sum of PSs of scoring taxa recorded. The Average Score Per Taxon (ASPT) values are calculated as the Sum PSs divided by the number of scoring taxa (NTAXA). As such, three metrics are calculated:
- WHPT score;
 - NTAXA; and
 - ASPT.
- 5.1.7 Some animals are more susceptible to organic pollution than others, and the presence of sensitive species indicates good water quality. This fact is taken into account by the WHPT metrics.
- 5.1.8 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. However, 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 because they are unable to support many of the high-scoring taxa associated with fast flowing habitat. WHPT scores and ASPT for different types of watercourses 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.

Annex D Proportion of Sediment-sensitive Invertebrates (PSI)

5.1.9 The Proportion of Sediment-sensitive Invertebrates (PSI) index allows an assessment of the extent to which a water body is composed of, or covered by, fine sediments. This follows the method stated in Extence et al., 2013. Under this system, individual species of aquatic macroinvertebrates are assigned a Fine Sediment Sensitivity Rating (FSSR) as detailed in **Table A3**, and abundance rating as detailed in **Table A4**. The PSI score for the aquatic macroinvertebrate sample is then derived from the individual species scores and abundances, as detailed in **Table A5**. The PSI score corresponds to the percentage of fine sediment-sensitive taxa present in a sample and ranges from 0 to 100, with low scores corresponding to water bodies with high fine sediment cover.

Table A3: Fine Sediment Sensitivity Rating (FSSR) groups used to derive PSI scores

FSSR group	Description
A	Highly sensitive
B	Moderately insensitive
C	Moderately insensitive
D	Highly insensitive

Table A4: Abundance categories used to derive PSI scores

FSSR group	Abundance			
	1-9	10-99	100-999	>999
A	2	3	4	5
B	2	3	4	5
C	1	2	3	4
D	1	2	3	4

Table A5: Interpretation of PSI scores

PSI	Description
81-100	Minimally sedimented
61-80	Slightly sedimented
41-60	Moderately sedimented
21-40	Sedimented
0-20	Heavily sedimented

Annex E Lotic-Invertebrate Index of Flow Evaluation (LIFE)

5.1.10 The Lotic-Invertebrate Index for Flow Evaluation (LIFE) provides an assessment of the impact of variable flows on benthic macroinvertebrate communities. Under the assessment, individual species of aquatic macroinvertebrates are assigned to a flow group varying from I to VI, as detailed on the **Table A6** below. The LIFE score for a macroinvertebrate sample is then derived (mean of individual scores) from individual species scores and abundances, as detailed on the **Table A8** below. LIFE scores for a macroinvertebrate sample ranges from 1 to 12, where highest scores describe communities adapted to rapid flows.

Table A6: Flow groups used to derive LIFE scores (from Extence et al., 1999)

LIFE score Group	Description	Mean current velocity
I	Taxa primarily associated with rapid flows	Typically > 100 cm.s-1
II	Taxa primarily associated with moderate to fast flows	Typically 20 to 100 cm.s-1
III	Taxa primarily associated with slow or sluggish flows	Typically < 20 cm.s-1
IV	Taxa primarily associated with (usually slow) and standing waters	
V	Taxa primarily associated with standing waters	
VI	Taxa frequently associated with drying or drought impacted sites	

Table A7: Abundance categories used to derive LIFE scores (from Extence et al., 1999)

Abundance category	Description
A	1 to 9
B	10 to 99
C	100 to 999
D	1000 to 9999
E	> 10000

Table A8: A guide to interpreting LIFE scores (from Extence et al., 1999)

Flow groups	Abundance categories			
	A	B	C	D/E
I	9	10	11	12
II	8	9	10	11

Flow groups	Abundance categories			
	A	B	C	D/E
III	7	7	7	7
IV	6	5	4	3
V	5	4	3	2
VI	4	3	2	1

Annex F Macroinvertebrate Laboratory Analysis Data

Table A10: Route 1 Macroinvertebrate Laboratory Analysis Results

Family	Species	DX00 2P	DX00 3P	DX00 4P	DX00 5P	DX00 7P	DX00 8P
Planariidae	<i>Polycelis nigra / tenuis</i>		1				1
Dugesiidae	<i>Dugesia lugubris/polychroa</i>	1					
Lymnaeidae	Lymnaeidae (juvenile / damaged)						20
Lymnaeidae	<i>Galba truncatula</i>						25
Lymnaeidae	<i>Stagnicola sp.</i>						3
Lymnaeidae	<i>Lymnaea stagnalis</i>				1		
Lymnaeidae	<i>Radix balthica</i>						1
Hydrobiidae	<i>Potamopyrgus antipodarum</i>	1	20		8		23
Physidae	Physidae (juvenile / damaged)		1		30		
Physidae	<i>Aplexa hypnorum</i>	4					
Physidae	<i>Physa fontinalis</i>		1		5		
Physidae	<i>Physella sp.</i>		1				
Planorbidae	<i>Anisus sp.</i>			15			3
Planorbidae	<i>Anisus vortex</i>			6			
Planorbidae	<i>Anisus leucostoma</i>			2		1	4
Planorbidae	<i>Gyraulus albus</i>				3		
Planorbidae	<i>Armiger crista</i>					1	
Sphaeriidae	Sphaeriidae (juvenile / damaged)	2				30	
Sphaeriidae	<i>Pisidium sp.</i>		35		25	10	27
Oligochaeta	Oligochaeta	20		6	6	10	
Glossiphoniidae	Glossiphoniidae (juvenile / damaged)				1		
Glossiphoniidae	<i>Theromyzon tessulatum</i>		1				
Glossiphoniidae	<i>Glossiphonia complanata</i>		2				
Glossiphoniidae	<i>Helobdella stagnalis</i>					1	

Family	Species	DX00 2P	DX00 3P	DX00 4P	DX00 5P	DX00 7P	DX00 8P
Erpobdellidae	<i>Trocheta subviridis</i>					1	
Hydracarina	Hydracarina	1					1
Oribatei	<i>Oribatei</i>	1					
Ostracoda		1	1			1	
Gammaridae	<i>Gammarus sp.</i>		5				
Gammaridae	<i>Gammarus pulex/fossarum agg.</i>						47
Gammaridae	<i>Gammarus pulex</i>						1
Crangonyctidae	<i>Crangonyx sp. (floridanus/pseudogr acilis)</i>		1	3			
Asellidae	Asellidae					3	3
Asellidae	<i>Asellus aquaticus</i>	1	40	18	8	65	22
Baetidae	<i>Cloeon dipterum</i>				3		
Leptophlebiidae	<i>Paraleptophlebia sp.</i>						2
Coenagrionidae	Coenagrionidae (juvenile / damaged)				5		
Libellulidae	Libellulidae (juvenile / damaged)						10
Corixidae	Corixidae (nymph / damaged)					1	
Corixidae	<i>Sigara sp.</i>		7		10	1	
Corixidae	<i>Sigara falleni</i>				1		
Haliplidae	<i>Haliplus lineaticollis</i>		1				
Dytiscidae	Dytiscidae (larvae / damaged)			7			6
Dytiscidae	<i>Hydroporus nigrita</i>						1
Dytiscidae	<i>Hydroporus palustris</i>					1	
Hydrophilidae	Hydrophilidae (larvae / damaged)						1
Hydrophilidae	<i>Helophorus grandis</i>			2	1		
Hydrophilidae	<i>Hydrobius fuscipes</i>			1			
Hydrophilidae	<i>Anacaena globulus</i>				1		1
Hydrophilidae	<i>Anacaena limbata</i>			1			
Hydraenidae	<i>Hydraena sp.</i>				1		

Family	Species	DX00 2P	DX00 3P	DX00 4P	DX00 5P	DX00 7P	DX00 8P
Dryopidae	<i>Dryops sp.</i>				1		
Scirtidae	Scirtidae (larvae / damaged)	1		3			
Sialidae	<i>Sialis lutaria</i>		1		5	3	
Limnephilidae	Limnephilidae (juvenile / damaged)		2		1	2	28
Limnephilidae	<i>Limnephilus marmoratus</i>				1		
Limnephilidae	<i>Limnephilus lunatus</i>				1	5	7
Limnephilidae	<i>Glyptotaelius pellucidus</i>		1	1			
Chironomidae	Tanypodinae		4		20	55	41
Chironomidae	Orthoclaadiinae		4	13	12	48	91
Chironomidae	Chironomini	20		2	2	4	
Chironomidae	Tanytarsini		4		2	59	33
Chironomidae	Prodiamesinae		25		12	7	
Simuliidae	Simuliidae (damaged / juvenile)						39
Psychodidae			7		2		6
Empididae							1
Ceratopogonidae			1				14
Stratiomyidae	Stratiomyidae		1				1
Culicidae	Culicidae	5		10			1
Lepidoptera				1			
Collembola		1			1		3
Unidentified Diptera				1			

Table A11: Route section 2 Macroinvertebrate laboratory analysis results

Family	Species	DX017P
Planariidae	<i>Polycelis nigra / tenuis</i>	3
Planariidae	<i>Polycelis felina</i>	1
Lymnaeidae	<i>Galba truncatula</i>	4
Lymnaeidae	<i>Radix balthica</i>	7
Hydrobiidae	<i>Potamopyrgus antipodarum</i>	64
Planorbidae	<i>Anisus sp.</i>	3
Planorbidae	<i>Anisus leucostoma</i>	1
Oligochaeta	Oligochaeta	100
Oribatei	<i>Oribatei</i>	1
Asellidae	Asellidae	1
Asellidae	<i>Asellus aquaticus</i>	5
Asellidae	<i>Asellus meridianus</i>	3
Baetidae	<i>Cloeon dipterum</i>	1
Dytiscidae	Dytiscidae (larvae / damaged)	18
Hydrophilidae	<i>Anacaena globulus</i>	2
Hydraenidae	<i>Hydraena sp.</i>	1
Limnephilidae	Limnephilidae (juvenile / damaged)	20
Limnephilidae	<i>Limnephilus lunatus</i>	6
Limnephilidae	<i>Limnephilus auricula</i>	1
Chironomidae	Tanypodinae	14
Chironomidae	Orthoclaadiinae	162
Simuliidae	Simuliidae (damaged / juvenile)	33
Psychodidae		10
Culicidae	Culicidae	1

Family	Species	DX017P
Collembola		1
Unidentified Diptera		1

Table A12: Route Section 3 Macroinvertebrate Laboratory Analysis Results

Family	Species	DX033 P	DX035 P	DX037 P	DX038 P	DX042 P
Lymnaeidae	Lymnaeidae (juvenile / damaged)	20				
Lymnaeidae	<i>Galba truncatula</i>			4		
Lymnaeidae	<i>Stagnicola sp.</i>		3		5	
Lymnaeidae	<i>Radix balthica</i>	50	1			
Hydrobiidae	<i>Potamopyrgus antipodarum</i>	30		300	50	10
Physidae	<i>Physella sp.</i>			20		
Planorbidae	<i>Anisus sp.</i>	2				
Planorbidae	<i>Anisus leucostoma</i>	15	2			
Sphaeriidae	Sphaeriidae (juvenile / damaged)			50		30
Sphaeriidae	<i>Pisidium sp.</i>		80	850	50	
Oligochaeta	Oligochaeta		30	2	40	2
Erpobdellidae	Erpobdellidae (juvenile / damaged)			1	1	
Oribatei	<i>Oribatei</i>		1	1		
Ostracoda			20	2	30	
Gammaridae	<i>Gammarus pulex</i>			3		
Asellidae	Asellidae	1				
Asellidae	<i>Asellus aquaticus</i>	1		4	1	
Baetidae	<i>Cloeon dipterum</i>	50				
Nemouridae	<i>Nemoura sp.</i>			15		
Nemouridae	<i>Nemoura cinerea</i>			45		

Family	Species	DX033 P	DX035 P	DX037 P	DX038 P	DX042 P
Libellulidae	Libellulidae (juvenile / damaged)	10				
Corixidae	Corixidae (nymph / damaged)	1				
Corixidae	<i>Corixa panzeri</i>	1				
Corixidae	<i>Sigara lateralis</i>	18				
Dytiscidae	Dytiscidae (larvae / damaged)	16	6	20	6	4
Dytiscidae	<i>Agabus guttatus</i>				1	
Hydrophilidae	Hydrophilidae (larvae / damaged)					1
Hydrophilidae	<i>Helophorus grandis</i>				1	
Hydrophilidae	<i>Anacaena globulus</i>			2		8
Scirtidae	Scirtidae (larvae / damaged)		3			
Limnephilidae	Limnephilidae (juvenile / damaged)	20	1			
Limnephilidae	<i>Limnephilus lunatus</i>			1		
Limnephilidae	<i>Limnephilus centralis</i>				1	
Limnephilidae	<i>Limnephilus auricula</i>					2
Limnephilidae	<i>Glyphotaelius pellucidus</i>			4		
Limnephilidae	<i>Micropterna lateralis</i>					1
Chironomidae	Chironomidae (damaged / pupa)				15	
Chironomidae	Tanypodinae	15	2	40	15	
Chironomidae	Orthocladiinae	2	10	50	60	3
Chironomidae	Chironomini	6	4			
Chironomidae	Tanytarsini	4	10	50	60	

Family	Species	DX033 P	DX035 P	DX037 P	DX038 P	DX042 P
Tipulidae	<i>Tipula sp.</i>		1			
Simuliidae	Simuliidae (damaged / juvenile)			250		
Psychodidae				6		9
Empididae				1		
Ceratopogonidae				1	2	
Stratiomyidae	Stratiomyidae				2	
Culicidae	Culicidae	1				
Collembola						2

Table A13: Route Section 4 Macroinvertebrate Laboratory Analysis Results

Family	Species	DX050 P	DX059 P	DX061 P	DX066 P	DX067 P	DX073 P	DX074 P	DX075 P	DX076 P	DX078 P
Dendrocoelidae	<i>Dendrocoelum lacteum</i>									2	
Dugesiidae	Dugesiidae (juvenile / damaged)									3	
Lymnaeidae	Lymnaeidae (juvenile / damaged)		1				2	5		2	
Lymnaeidae	<i>Galba truncatula</i>	1	105								2
Lymnaeidae	<i>Stagnicola sp.</i>										1
Lymnaeidae	<i>Radix balthica</i>				8			2		2	
Valvatidae	<i>Valvata cristata</i>						1	1			
Valvatidae	<i>Valvata piscinalis</i>							2			
Hydrobiidae	<i>Potamopyrgus antipodarum</i>	70	1			1	2	1			107
Bithyniidae	<i>Bithynia tentaculata</i>							1		1	
Succineidae	<i>Succinea sp.</i>		5								
Planorbidae	Planorbidae (juvenile / damaged)										2

Family	Species	DX050 P	DX059 P	DX061 P	DX066 P	DX067 P	DX073 P	DX074 P	DX075 P	DX076 P	DX078 P
Planorbidae	<i>Anisus leucostoma</i>						23				2
Sphaeriidae	Sphaeriidae (juvenile / damaged)	40			10		1	6	10		31
Sphaeriidae	<i>Sphaerium sp.</i>									2	
Sphaeriidae	<i>Pisidium sp.</i>	5			2	40		4	6	63	23
Oligochaeta	Oligochaeta	10	1		20	2	5	151	10	75	60
Erpobdellidae	Erpobdellidae (juvenile / damaged)						1				
Erpobdellidae	<i>Erpobdella sp.</i>	5								2	
Piscicolidae	<i>Piscicola geometra</i>									1	
Hydracarina	Hydracarina					1				9	
Oribatei	<i>Oribatei</i>					3	2		1		
Ostracoda			6		6		5	6		3	20
Copepoda				1							
Gammaridae	Gammaridae	1									
Gammaridae	<i>Gammarus sp.</i>				4					3	12
Gammaridae	<i>Gammarus pulex</i>	2									9

Family	Species	DX050 P	DX059 P	DX061 P	DX066 P	DX067 P	DX073 P	DX074 P	DX075 P	DX076 P	DX078 P
Gammaridae	<i>Gammarus fossarum</i>										9
Asellidae	<i>Asellus aquaticus</i>			5	1	1	24	2		43	7
Baetidae	Baetidae (juvenile / damaged)		1								
Baetidae	<i>Baetis sp.</i>		1					1		9	
Baetidae	<i>Baetis rhodani / atlanticus</i>		1			1				3	
Baetidae	<i>Cloeon dipterum</i>									1	
Ephemeridae	<i>Ephemera sp.</i>									7	
Ephemeridae	<i>Ephemera danica</i>									1	
Libellulidae	Libellulidae (juvenile / damaged)		5								4
Corixidae	<i>Sigara sp.</i>										3
Corixidae	<i>Sigara lateralis</i>				1						
Haliplidae	Haliplidae (larvae / damaged)		5					2		1	1
Dytiscidae	Dytiscidae (larvae / damaged)	2	7	7	1	2	8				2
Hydrophilidae	Hydrophilidae (larvae / damaged)		2	1							

Family	Species	DX050 P	DX059 P	DX061 P	DX066 P	DX067 P	DX073 P	DX074 P	DX075 P	DX076 P	DX078 P
Hydrophilidae	<i>Hydrochus sp.</i>				1						
Hydrophilidae	<i>Helophorus sp.</i>								2		
Hydrophilidae	<i>Anacaena globulus</i>	2							1		1
Hydrophilidae	<i>Laccobius sp.</i>				2						
Hydraenidae	<i>Limnebius truncatellus</i>										1
Dryopidae	Dryopidae (larvae / damaged)							1			
Scirtidae	Scirtidae (larvae / damaged)		1								
Elmidae	<i>Elmis aena</i>									8	
Elmidae	<i>Oulimnius sp.</i>									3	
Elmidae	<i>Oulimnius tuberculatus</i>									1	
Curculionidae	Curculionidae			2							
Limnephilidae	Limnephilidae (juvenile / damaged)	3	22	1	11		3	1		45	2
Limnephilidae	<i>Limnephilus sp.</i>									1	
Limnephilidae	<i>Limnephilus lunatus</i>	1	10		8	4				6	3

Family	Species	DX050 P	DX059 P	DX061 P	DX066 P	DX067 P	DX073 P	DX074 P	DX075 P	DX076 P	DX078 P
Limnephilidae	<i>Limnephilus centralis</i>	1					2				
Limnephilidae	<i>Limnephilus auricula</i>	1	1			1			1		
Chironomidae	Chironomidae (damaged / pupea)	16									
Chironomidae	Tanypodinae	39	100		8		18	143		7	40
Chironomidae	Orthoclaadiinae	335	115	5	43	50	30	11	7	148	39
Chironomidae	Chironomini						99	29	6	3	
Chironomidae	Tanytarsini		14		47		3	103		14	2
Chironomidae	Prodiamesinae				4					3	
Pediciidae	<i>Dicranota</i> sp.									1	
Limoniidae	Limoniidae										5
Simuliidae	Simuliidae (damaged / juvenile)	46	186	4	5					46	2
Simuliidae	<i>Simulium</i> sp.	3			2	150				2	
Simuliidae	<i>Simulium lundstromi</i>									1	
Psychodidae		4	6	2	1	3	1	1	13	7	
Empididae		7			4					1	1

Family	Species	DX050 P	DX059 P	DX061 P	DX066 P	DX067 P	DX073 P	DX074 P	DX075 P	DX076 P	DX078 P
Ceratopogonidae				5				14		7	39
Stratiomyidae	Stratiomyidae				1	1					
Dolichopodidae								1			
Lepidoptera			1	3						1	
Collembola		1	1	1	2		3	1	8	1	1
Unidentified Diptera						1			1		
Unidentified Tricladida									1	2	1

Table A14: Route Section 5 Macroinvertebrate Laboratory Analysis Results

Family	Species	DX089 P	DX090 P	DX091 P	DX092 P	DX093 P	DX094 P	DX108 P	DX110 P	DX113 P	DX114 P	RVX00 5P
Dendrocoelid ae	<i>Dendrocoelum lacteum</i>								2			
Planariidae	<i>Polycelis sp.</i>	2				1			3	1	1	
Dugesiidae	<i>Dugesia lugubris/polychroa</i>		1			1						
Lymnaeidae	Lymnaeidae (juvenile / damaged)		210			3			129			
Lymnaeidae	<i>Stagnicola sp.</i>						3	7			2	
Lymnaeidae	<i>Lymnaea stagnalis</i>		2									
Lymnaeidae	<i>Radix balthica</i>		5	1								3
Valvatidae	<i>Valvata piscinalis</i>	59				9						1
Hydrobiidae	<i>Potamopyrgus antipodarum</i>		151			844			2		110	5
Bithyniidae	<i>Bithynia sp.</i>								1			
Bithyniidae	<i>Bithynia tentaculata</i>	8	6			7			8			6
Bithyniidae	<i>Bithynia leachi</i>	1				2						
Physidae	<i>Physa fontinalis</i>								1			1
Succineidae	<i>Succinea sp.</i>	2									1	
Planorbidae	Planorbidae (juvenile / damaged)		1			3	2		28			

Family	Species	DX089 P	DX090 P	DX091 P	DX092 P	DX093 P	DX094 P	DX108 P	DX110 P	DX113 P	DX114 P	RVX00 5P
Planorbidae	<i>Planorbarius corneus</i>		1			1						1
Planorbidae	<i>Planorbis sp.</i>		6				2		2			
Planorbidae	<i>Planorbis carinatus</i>								2			1
Planorbidae	<i>Planorbis planorbis</i>					5			18			
Planorbidae	<i>Anisus sp.</i>											4
Planorbidae	<i>Anisus vortex</i>	1	1		3	8	2		59			1
Planorbidae	<i>Gyraulus albus</i>	1	5									20
Planorbidae	<i>Armiger crista</i>					10						
Planorbidae	<i>Bathyomphalus contortus</i>								4			
Planorbidae	<i>Hippeutis complanatus</i>					1						
Anyclidae	<i>Ancylus fluviatilis</i>										1	
Sphaeriidae	Sphaeriidae (juvenile / damaged)	4				4			1			
Sphaeriidae	<i>Sphaerium sp.</i>											2
Sphaeriidae	<i>Sphaerium corneum</i>					2						
Sphaeriidae	<i>Pisidium sp.</i>	2	8	1					16			20
Sphaeriidae	<i>Pisidium amnicum</i>		3									

Family	Species	DX089 P	DX090 P	DX091 P	DX092 P	DX093 P	DX094 P	DX108 P	DX110 P	DX113 P	DX114 P	RVX00 5P
Oligochaeta	Oligochaeta	7	6		2	3	8		27	10	3	40
Glossiphoniidae	<i>Glossiphonia complanata</i>								3			
Erpobdellidae	<i>Erpobdella sp.</i>				1							
Erpobdellidae	<i>Erpobdella octoculata</i>		2						1			
Erpobdellidae	<i>Dina lineata</i>										2	
Hydracarina	Hydracarina	2	3		1	1			2			
Oribatei	<i>Oribatei</i>			1						1		
Ostracoda			9		1				15			20
Copepoda									35	4		
Cladocera			1						50			
Gammaridae	<i>Gammarus sp.</i>						3					
Crangonyctidae	<i>Crangonyx sp. (floridanus/pseudogr acilis)</i>	1	10	2		23	8		3	10	2	10
Astacidae	Astacidae (juvenile / damaged)		1									
Asellidae	Asellidae				1	6			38			
Asellidae	<i>Asellus aquaticus</i>	1		40	2	21	25	50	48	5	7	4

Family	Species	DX089 P	DX090 P	DX091 P	DX092 P	DX093 P	DX094 P	DX108 P	DX110 P	DX113 P	DX114 P	RVX00 5P
Baetidae	Baetidae (juvenile / damaged)		2			1			5			
Baetidae	<i>Baetis sp.</i>	1										
Baetidae	<i>Centroptilum luteolum</i>	3										
Baetidae	<i>Cloeon dipterum</i>	1	2			15			131			6
Caenidae	<i>Caenis horaria</i>	3	20									40
Coenagrionid ae	Coenagrionidae (juvenile / damaged)		3			5						10
Coenagrionid ae	<i>Ischnura elegans</i>					5						2
Coenagrionid ae	<i>Coenagrion sp.</i>					2						1
Libellulidae	Libellulidae (juvenile / damaged)		1									1
Libellulidae	<i>Sympetrum sp.</i>					1			6			
Corixidae	Corixidae (nymph / damaged)	9	5			1						
Corixidae	<i>Callicorixa praeusta</i>											1
Corixidae	<i>Sigara sp.</i>		1			1						1
Corixidae	<i>Sigara dorsalis</i>					1						1

Family	Species	DX089 P	DX090 P	DX091 P	DX092 P	DX093 P	DX094 P	DX108 P	DX110 P	DX113 P	DX114 P	RVX00 5P
Notonectidae	Notonectidae (nymph / damaged)					4						
Notonectidae	<i>Notonecta sp.</i>								2			
Notonectidae	<i>Notonecta glauca</i>											1
Haliplidae	Haliplidae (larvae / damaged)		30						5			
Haliplidae	<i>Haliplus sp.</i>	18										
Haliplidae	<i>Haliplus flavicollis</i>		1									
Haliplidae	<i>Haliplus lineaticollis</i>	2	1			1			1			
Haliplidae	<i>Haliplus ruficollis</i> group	4				3						
Dytiscidae	Dytiscidae (larvae / damaged)	2	5			3			6	2	3	
Dytiscidae	<i>Laccophilus minutus</i>	1										
Dytiscidae	<i>Hydroporus sp.</i>						2					
Dytiscidae	<i>Hydroporus palustris</i>	1									2	1
Dytiscidae	<i>Graptodytes pictus</i>	5	1			1			1			
Hydrophilidae	Hydrophilidae (larvae / damaged)						1		1			
Hydrophilidae	<i>Helophorus sp.</i>									1		

Family	Species	DX089 P	DX090 P	DX091 P	DX092 P	DX093 P	DX094 P	DX108 P	DX110 P	DX113 P	DX114 P	RVX00 5P
Hydrophilidae	<i>Hydrobius fuscipes</i>				1							
Hydrophilidae	<i>Anacaena globulus</i>		1					3	1	5	12	
Hydrophilidae	<i>Laccobius sp.</i>	1										
Hydrophilidae	<i>Enochrus testaceus</i>								1			
Dryopidae	Dryopidae (larvae / damaged)	1										
Scirtidae	Scirtidae (larvae / damaged)			400	108			80		100	2	1
Curculionidae	Curculionidae		3	1								
Sialidae	<i>Sialis lutaria</i>								1			6
Limnephilidae	Limnephilidae (juvenile / damaged)			4	1						6	
Limnephilidae	<i>Limnephilus sp.</i>									4	6	
Limnephilidae	<i>Limnephilus auricula</i>									8		
Limnephilidae	<i>Glyphotaelius pellucidus</i>									1		
Leptoceridae	<i>Athripsodes aterrimus</i>											1
Leptoceridae	<i>Mystacides sp.</i>					1						
Leptoceridae	<i>Triaenodes bicolor</i>					1			1			

Family	Species	DX089 P	DX090 P	DX091 P	DX092 P	DX093 P	DX094 P	DX108 P	DX110 P	DX113 P	DX114 P	RVX00 5P
Leptoceridae	<i>Oecetis lacustris</i>	2										
Chironomidae	Chironomidae (damaged / pupae)		20			5			7			
Chironomidae	Tanypodinae		4			25	1		7		1	10
Chironomidae	Orthoclaadiinae	47	8	10	14	11			6	8	3	10
Chironomidae	Chironomini	1	4			2			2			10
Chironomidae	Tanytarsini	4				70						40
Tipulidae	<i>Tipula sp.</i>		3									
Limoniidae	Limoniidae									1	1	
Ceratopogonidae		9	7						1			1
Culicidae	Culicidae			30	57			1			1	
Dolichopodidae											1	
Collembola				1	1				1	1		
Microturbellaria									2			
Unidentified Diptera						1		1		1	1	
Unidentified Tricladida									3		1	

