

Norfolk Vanguard Offshore Wind Farm

Appendix 28.5

Onshore Geophysical Survey Results

Environmental Statement

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Environmental Impact Assessment Environmental Statement

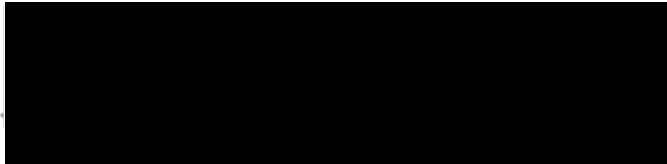
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For and on behalf of Norfolk Vanguard Limited

Approved by: Ruari Lean, Rebecca Sherwood

Signed:



Date: 8th June 2018

NVOW17



PRIORITY ARCHAEOLOGICAL GEOPHYSICAL SURVEY (TERRESTRIAL ARCHAEOLOGY), NORFOLK VANGUARD OFFSHORE WIND FARM

GEOPHYSICAL SURVEY

commissioned by Royal HaskoningDHV UK Ltd
on behalf of Norfolk Vanguard Ltd

April 2018

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PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering approximately 600 hectares, along the onshore cable corridor and associated onshore project area for the Norfolk Vanguard Offshore Wind Farm, in order to provide further information about the archaeological potential of the cable route. This work was focussed on areas identified in the Archaeological Desk-Based (baseline) Assessment (DBA), as potentially containing buried archaeological remains following preliminary analysis of aerial photographs, LiDAR, and Historic Environment Record (HER) data. The survey successfully evaluated 127 Priority Archaeological Geophysical Survey Areas, identifying twenty distinct areas of clear archaeological activity ranging from isolated ring-ditches to extensive areas of settlement and enclosure. Most of these areas were previously known, although some were less extensive than has been identified by the geophysical survey, whilst several others were not known at all. These areas are assessed as being of high archaeological potential. Anomalies at numerous other locations have been interpreted as being of possible archaeological potential, including possible field systems, trackways, isolated ditches and pits. However, the weak, fragmentary nature of these secondary-possible archaeological type anomalies, or an absence of supporting archaeological information (cropmarks or HER data), precludes a more confident interpretation. These anomalies are ascribed a moderate archaeological potential.

Only two definite areas of archaeological activity, in the form of isolated ring-ditches, and relatively few anomalies of possible archaeological potential, have been identified over the White Chalk bedrock and seasonally wet clays in the western half of the cable route, whereas eighteen definite areas of archaeological activity have been identified over the freely-draining loams and Crag Group sands and gravels in the east. Moreover, half of the areas of archaeological activity identified by the survey occur within the easternmost 7km of the approximately 60km cable route. This pattern mirrors the cropmark data and corroborates the results of the DBA. Anomalies due to geological and pedological variation are common throughout all survey areas and linear trend anomalies due to post-medieval agricultural activity (boundary removal, field drains or post-medieval ploughing) are also recorded in virtually all parts of the survey.

CONTENTS

1	INTRODUCTION	1
	1.1 SITE LOCATION, LAND USE AND TOPOGRAPHY	1
	1.2 GEOLOGY AND SOILS	1
2	ARCHAEOLOGICAL BACKGROUND	2
3	AIMS, METHODOLOGY AND PRESENTATION	2
	3.1 MAGNETOMETER SURVEY	2
	3.2 REPORTING	2
4	RESULTS AND DISCUSSION	3
	4.1 FERROUS AND MODERN ANOMALIES	3
	4.2 GEOLOGICAL ANOMALIES	3
	4.3 AGRICULTURAL ANOMALIES	3
	4.4 QUARRYING ANOMALIES	4
	4.5 POSSIBLE ARCHAEOLOGICAL ANOMALIES	4
	4.6 AREAS OF ARCHAEOLOGICAL ACTIVITY	4
	4.7 SUMMARY OF RESULTS	7
5	CONCLUSION	9
6	REFERENCES	10
7	APPENDICES	533
	APPENDIX 1 MAGNETOMETER SURVEY	533
	APPENDIX 2 SURVEY LOCATION INFORMATION	534
	APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE	534
	APPENDIX 4 DATA PROCESSING	534
	APPENDIX 5 DATA REPEATABILITY	534
	APPENDIX 6 OASIS DATA COLLECTION FORM: ENGLAND	537

LIST OF ILLUSTRATIONS

ILLUS 1 Site location	x
ILLUS 2 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 1-9 (1:7,500)	11
ILLUS 3 Interpretation of magnetometer data; PAGSA 1-9 (1:7,500)	13
ILLUS 4 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 10 (1:7,500)	15
ILLUS 5 Interpretation of magnetometer data; PAGSA 10 (1:7,500)	17
ILLUS 6 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 11-13 (1:7,500)	19
ILLUS 7 Interpretation of magnetometer data; PAGSA 11-13 (1:7,500)	21
ILLUS 8 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 14-19 (1:7,500)	23
ILLUS 9 Interpretation of magnetometer data; PAGSA 14-19 (1:7,500)	25
ILLUS 10 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 20-22 (1:7,500)	27
ILLUS 11 Interpretation of magnetometer data; PAGSA 20-22 (1:7,500)	29
ILLUS 12 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 23-24 (1:7,500)	31
ILLUS 13 Interpretation of magnetometer data; PAGSA 23-24 (1:7,500)	33
ILLUS 14 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 25-41 (1:7,500)	35
ILLUS 15 Interpretation of magnetometer data; PAGSA 25-41 (1:7,500)	37
ILLUS 16 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 40b-42 (1:7,500)	39
ILLUS 17 Interpretation of magnetometer data; PAGSA 40b-42 (1:7,500)	41
ILLUS 18 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 43-47 (1:7,500)	43
ILLUS 19 Interpretation of magnetometer data; PAGSA 43-47 (1:7,500)	45
ILLUS 20 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 48-53 (1:7,500)	47
ILLUS 21 Interpretation of magnetometer data; PAGSA 48-53 (1:7,500)	49
ILLUS 22 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 54-59 (1:7,500)	51
ILLUS 23 Interpretation of magnetometer data; PAGSA 54-59 (1:7,500)	53
ILLUS 24 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 60-66 (1:7,500)	55
ILLUS 25 Interpretation of magnetometer data; PAGSA 60-66 (1:7,500)	57
ILLUS 26 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 67-74 (1:7,500)	59
ILLUS 27 Interpretation of magnetometer data; PAGSA 67-74 (1:7,500)	61
ILLUS 28 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 75-86 (1:7,500)	63

ILLUS 29 Interpretation of magnetometer data; PAGSA 75-86 (1:7,500)	65
ILLUS 30 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 87-97 (1:7,500)	67
ILLUS 31 Interpretation of magnetometer data; PAGSA 87-97 (1:7,500)	69
ILLUS 32 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 98-105 (1:7,500)	71
ILLUS 33 Interpretation of magnetometer data; PAGSA 98-105 (1:7,500)	73
ILLUS 34 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 106-110 (1:7,500)	75
ILLUS 35 Interpretation of magnetometer data; PAGSA 106-110 (1:7,500)	77
ILLUS 36 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 111-118 (1:7,500)	79
ILLUS 37 Interpretation of magnetometer data; PAGSA 111-118 (1:7,500)	81
ILLUS 38 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 119-134 (1:7,500)	83
ILLUS 39 Interpretation of magnetometer data; PAGSA 119-134 (1:7,500)	85
ILLUS 40 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 135-146 (1:7,500)	87
ILLUS 41 Interpretation of magnetometer data; PAGSA 135-146 (1:7,500)	89
ILLUS 42 Processed greyscale magnetometer data showing cropmarks, geology and first edition OS mapping (1888-1913); PAGSA 147-166 (1:7,500)	91
ILLUS 43 Interpretation of magnetometer data; PAGSA 147-166 (1:7,500)	93
ILLUS 44 Processed greyscale magnetometer data; PAGSA 10 (1:2,500)	95
ILLUS 45 XY trace plot of minimally processed magnetometer data; PAGSA 10 (1:2,500)	97
ILLUS 46 Interpretation of magnetometer data; PAGSA 10 (1:2,500)	99
ILLUS 47 Processed greyscale magnetometer data; PAGSA 12 (1:2,500)	101
ILLUS 48 XY trace plot of minimally processed magnetometer data; PAGSA 12 (1:2,500)	103
ILLUS 49 Interpretation of magnetometer data; PAGSA 12 (1:2,500)	105
ILLUS 50 Processed greyscale magnetometer data; PAGSA 14-19 (1:2,500)	107
ILLUS 51 XY trace plot of minimally processed magnetometer data; PAGSA 14-19 (1:2,500)	109
ILLUS 52 Interpretation of magnetometer data; PAGSA 14-19 (1:2,500)	111
ILLUS 53 Processed greyscale magnetometer data; PAGSA 20-22 (1:2,500)	113
ILLUS 54 XY trace plot of minimally processed magnetometer data; PAGSA 20-22 (1:2,500)	115
ILLUS 55 Interpretation of magnetometer data; PAGSA 20-22 (1:2,500)	117
ILLUS 56 Processed greyscale magnetometer data; PAGSA 23-24 (1:2,500)	119
ILLUS 57 XY trace plot of minimally processed magnetometer data; PAGSA 23-24 (1:2,500)	121
ILLUS 58 Interpretation of magnetometer data; PAGSA 23-24 (1:2,500)	123
ILLUS 59 Processed greyscale magnetometer data; PAGSA 25-32 (1:2,500)	125

ILLUS 60 XY trace plot of minimally processed magnetometer data; PAGSA 25-32 (1:2,500)	127
ILLUS 61 Interpretation of magnetometer data; PAGSA 25-32 (1:2,500)	129
ILLUS 62 Processed greyscale magnetometer data; PAGSA 32-38b (1:2,500)	131
ILLUS 63 XY trace plot of minimally processed magnetometer data; PAGSA 32-38b (1:2,500)	133
ILLUS 64 Interpretation of magnetometer data; PAGSA 32-38b (1:2,500)	135
ILLUS 65 Processed greyscale magnetometer data; PAGSA 33, 38-39c (1:2,500)	137
ILLUS 66 XY trace plot of minimally processed magnetometer data; PAGSA 33, 38-39c (1:2,500)	139
ILLUS 67 Interpretation of magnetometer data; PAGSA 33, 38-39c (1:2,500)	141
ILLUS 68 Processed greyscale magnetometer data; PAGSA 39-40b (1:2,500)	143
ILLUS 69 XY trace plot of minimally processed magnetometer data; PAGSA 39-40b (1:2,500)	145
ILLUS 70 Interpretation of magnetometer data; PAGSA 39-40b (1:2,500)	147
ILLUS 71 Processed greyscale magnetometer data; PAGSA 40b-41b (1:2,500)	149
ILLUS 72 XY trace plot of minimally processed magnetometer data; PAGSA 40b-41b (1:2,500)	151
ILLUS 73 Interpretation of magnetometer data; PAGSA 40b-41b (1:2,500)	153
ILLUS 74 Processed greyscale magnetometer data; PAGSA 43-44 (1:2,500)	155
ILLUS 75 XY trace plot of minimally processed magnetometer data; PAGSA 43-44 (1:2,500)	157
ILLUS 76 Interpretation of magnetometer data; PAGSA 43-44 (1:2,500)	159
ILLUS 77 Processed greyscale magnetometer data; PAGSA 45-47 (1:2,500)	161
ILLUS 78 XY trace plot of minimally processed magnetometer data; PAGSA 45-47 (1:2,500)	163
ILLUS 79 Interpretation of magnetometer data; PAGSA 45-47 (1:2,500)	165
ILLUS 80 Processed greyscale magnetometer data; PAGSA 48-50 (1:2,500)	167
ILLUS 81 XY trace plot of minimally processed magnetometer data; PAGSA 48-50 (1:2,500)	169
ILLUS 82 Interpretation of magnetometer data; PAGSA 48-50 (1:2,500)	171
ILLUS 83 Processed greyscale magnetometer data; PAGSA 50-53 (1:2,500)	173
ILLUS 84 XY trace plot of minimally processed magnetometer data; PAGSA 50-53 (1:2,500)	175
ILLUS 85 Interpretation of magnetometer data; PAGSA 50-53 (1:2,500)	177
ILLUS 86 Processed greyscale magnetometer data; PAGSA 54 (1:2,500)	179
ILLUS 87 XY trace plot of minimally processed magnetometer data; PAGSA 54 (1:2,500)	181
ILLUS 88 Interpretation of magnetometer data; PAGSA 54 (1:2,500)	183
ILLUS 89 Processed greyscale magnetometer data; PAGSA 55-58 (1:2,500)	185
ILLUS 90 XY trace plot of minimally processed magnetometer data; PAGSA 55-58 (1:2,500)	187

ILLUS 91 Interpretation of magnetometer data; PAGSA 55-58 (1:2,500)	189
ILLUS 92 Processed greyscale magnetometer data; PAGSA 58-60 (1:2,500)	191
ILLUS 93 XY trace plot of minimally processed magnetometer data; PAGSA 58-60 (1:2,500)	193
ILLUS 94 Interpretation of magnetometer data; PAGSA 58-60 (1:2,500)	195
ILLUS 95 Processed greyscale magnetometer data; PAGSA 59-61 (1:2,500)	197
ILLUS 96 XY trace plot of minimally processed magnetometer data; PAGSA 59-61 (1:2,500)	199
ILLUS 97 Interpretation of magnetometer data; PAGSA 59-61 (1:2,500)	201
ILLUS 98 Processed greyscale magnetometer data; PAGSA 62-63 (1:2,500)	203
ILLUS 99 XY trace plot of minimally processed magnetometer data; PAGSA 62-63 (1:2,500)	205
ILLUS 100 Interpretation of magnetometer data; PAGSA 62-63 (1:2,500)	207
ILLUS 101 Processed greyscale magnetometer data; PAGSA 64-65 (1:2,500)	209
ILLUS 102 XY trace plot of minimally processed magnetometer data; PAGSA 64-65 (1:2,500)	211
ILLUS 103 Interpretation of magnetometer data; PAGSA 64-65 (1:2,500)	213
ILLUS 104 Processed greyscale magnetometer data; PAGSA 64-66 (1:2,500)	215
ILLUS 105 XY trace plot of minimally processed magnetometer data; PAGSA 64-66 (1:2,500)	217
ILLUS 106 Interpretation of magnetometer data; PAGSA 64-66 (1:2,500)	219
ILLUS 107 Processed greyscale magnetometer data; PAGSA 67-69 (1:2,500)	221
ILLUS 108 XY trace plot of minimally processed magnetometer data; PAGSA 67-69 (1:2,500)	223
ILLUS 109 Interpretation of magnetometer data; PAGSA 67-69 (1:2,500)	225
ILLUS 110 Processed greyscale magnetometer data; PAGSA 70-74 (1:2,500)	227
ILLUS 111 XY trace plot of minimally processed magnetometer data; PAGSA 70-74 (1:2,500)	229
ILLUS 112 Interpretation of magnetometer data; PAGSA 70-74 (1:2,500)	231
ILLUS 113 Processed greyscale magnetometer data; PAGSA 73b-74 (1:2,500)	233
ILLUS 114 XY trace plot of minimally processed magnetometer data; PAGSA 73b-74 (1:2,500)	235
ILLUS 115 Interpretation of magnetometer data; PAGSA 73b-74 (1:2,500)	237
ILLUS 116 Processed greyscale magnetometer data; PAGSA 75-77 (1:2,500)	239
ILLUS 117 XY trace plot of minimally processed magnetometer data; PAGSA 75-77 (1:2,500)	241
ILLUS 118 Interpretation of magnetometer data; PAGSA 75-77 (1:2,500)	243
ILLUS 119 Processed greyscale magnetometer data; PAGSA 78-81(1:2,500)	245
ILLUS 120 XY trace plot of minimally processed magnetometer data; PAGSA 78-81 (1:2,500)	247
ILLUS 121 Interpretation of magnetometer data; PAGSA 78-81 (1:2,500)	249

ILLUS 122 Processed greyscale magnetometer data; PAGSA 82-85 (1:2,500)	251
ILLUS 123 XY trace plot of minimally processed magnetometer data; PAGSA 82-85 (1:2,500)	253
ILLUS 124 Interpretation of magnetometer data; PAGSA 82-85 (1:2,500)	255
ILLUS 125 Processed greyscale magnetometer data; PAGSA 85-86 (1:2,500)	257
ILLUS 126 XY trace plot of minimally processed magnetometer data; PAGSA 85-86 (1:2,500)	259
ILLUS 127 Interpretation of magnetometer data; PAGSA 85-86 (1:2,500)	261
ILLUS 128 Processed greyscale magnetometer data; PAGSA 87-91 (1:2,500)	263
ILLUS 129 XY trace plot of minimally processed magnetometer data; PAGSA 87-91 (1:2,500)	265
ILLUS 130 Interpretation of magnetometer data; PAGSA 87-91 (1:2,500)	267
ILLUS 131 Processed greyscale magnetometer data; PAGSA 91-94 (1:2,500)	269
ILLUS 132 XY trace plot of minimally processed magnetometer data; PAGSA 91-94 (1:2,500)	271
ILLUS 133 Interpretation of magnetometer data; PAGSA 91-94 (1:2,500)	273
ILLUS 134 Processed greyscale magnetometer data; PAGSA 94-97 (1:2,500)	275
ILLUS 135 XY trace plot of minimally processed magnetometer data; PAGSA 94-97 (1:2,500)	277
ILLUS 136 Interpretation of magnetometer data; PAGSA 94-97 (1:2,500)	279
ILLUS 137 Processed greyscale magnetometer data; PAGSA 98-101 (1:2,500)	281
ILLUS 138 XY trace plot of minimally processed magnetometer data; PAGSA 98-101 (1:2,500)	283
ILLUS 139 Interpretation of magnetometer data; PAGSA 98-101 (1:2,500)	285
ILLUS 140 Processed greyscale magnetometer data; PAGSA 107 (1:2,500)	287
ILLUS 141 XY trace plot of minimally processed magnetometer data; PAGSA 107 (1:2,500)	289
ILLUS 142 Interpretation of magnetometer data; PAGSA 107 (1:2,500)	291
ILLUS 143 Processed greyscale magnetometer data; PAGSA 108-109 (1:2,500)	293
ILLUS 144 XY trace plot of minimally processed magnetometer data; PAGSA 108-109 (1:2,500)	295
ILLUS 145 Interpretation of magnetometer data; PAGSA 108-109 (1:2,500)	297
ILLUS 146 Processed greyscale magnetometer data; PAGSA 110-113 (1:2,500)	299
ILLUS 147 XY trace plot of minimally processed magnetometer data; PAGSA 110-113 (1:2,500)	301
ILLUS 148 Interpretation of magnetometer data; PAGSA 110-113 (1:2,500)	303
ILLUS 149 Processed greyscale magnetometer data; PAGSA 113-115 (1:2,500)	305
ILLUS 150 XY trace plot of minimally processed magnetometer data; PAGSA 113-115 (1:2,500)	307
ILLUS 151 Interpretation of magnetometer data; PAGSA 113-115 (1:2,500)	309
ILLUS 152 Processed greyscale magnetometer data; PAGSA 115-119 (1:2,500)	311

ILLUS 153 XY trace plot of minimally processed magnetometer data; PAGSA 115-119 (1:2,500)	313
ILLUS 154 Interpretation of magnetometer data; PAGSA 115-119 (1:2,500)	315
ILLUS 155 Processed greyscale magnetometer data; PAGSA 119-120 (1:2,500)	317
ILLUS 156 XY trace plot of minimally processed magnetometer data; PAGSA 119-120 (1:2,500)	319
ILLUS 157 Interpretation of magnetometer data; PAGSA 119-120 (1:2,500)	321
ILLUS 158 Processed greyscale magnetometer data; PAGSA 120-122 (1:2,500)	323
ILLUS 159 XY trace plot of minimally processed magnetometer data; PAGSA 120-122 (1:2,500)	325
ILLUS 160 Interpretation of magnetometer data; PAGSA 120-122 (1:2,500)	327
ILLUS 161 Processed greyscale magnetometer data; PAGSA 122-126 (1:2,500)	329
ILLUS 162 XY trace plot of minimally processed magnetometer data; PAGSA 122-126 (1:2,500)	331
ILLUS 163 Interpretation of magnetometer data; PAGSA 122-126 (1:2,500)	333
ILLUS 164 Processed greyscale magnetometer data; PAGSA 126-134 (1:2,500)	335
ILLUS 165 XY trace plot of minimally processed magnetometer data; PAGSA 126-134 (1:2,500)	337
ILLUS 166 Interpretation of magnetometer data; PAGSA 126-134 (1:2,500)	339
ILLUS 167 Processed greyscale magnetometer data; PAGSA 135-138 (1:2,500)	341
ILLUS 168 XY trace plot of minimally processed magnetometer data; PAGSA 135-138 (1:2,500)	343
ILLUS 169 Interpretation of magnetometer data; PAGSA 135-138 (1:2,500)	345
ILLUS 170 Processed greyscale magnetometer data; PAGSA 137-138 (1:2,500)	347
ILLUS 171 XY trace plot of minimally processed magnetometer data; PAGSA 137-138 (1:2,500)	349
ILLUS 172 Interpretation of magnetometer data; PAGSA 137-138 (1:2,500)	351
ILLUS 173 Processed greyscale magnetometer data; PAGSA 139-144 (1:2,500)	353
ILLUS 174 XY trace plot of minimally processed magnetometer data; PAGSA 139-144 (1:2,500)	355
ILLUS 175 Interpretation of magnetometer data; PAGSA 139-144 (1:2,500)	357
ILLUS 176 Processed greyscale magnetometer data; PAGSA 144-145 (1:2,500)	359
ILLUS 177 XY trace plot of minimally processed magnetometer data; PAGSA 144-145 (1:2,500)	361
ILLUS 178 Interpretation of magnetometer data; PAGSA 144-145 (1:2,500)	363
ILLUS 179 Processed greyscale magnetometer data; PAGSA 146-148 (1:2,500)	365
ILLUS 180 XY trace plot of minimally processed magnetometer data; PAGSA 146-148 (1:2,500)	367
ILLUS 181 Interpretation of magnetometer data; PAGSA 146-148 (1:2,500)	369
ILLUS 182 Processed greyscale magnetometer data; PAGSA 148-151 & 156-158 (1:2,500)	371
ILLUS 183 XY trace plot of minimally processed magnetometer data; PAGSA 148-151 & 156-158 (1:2,500)	373

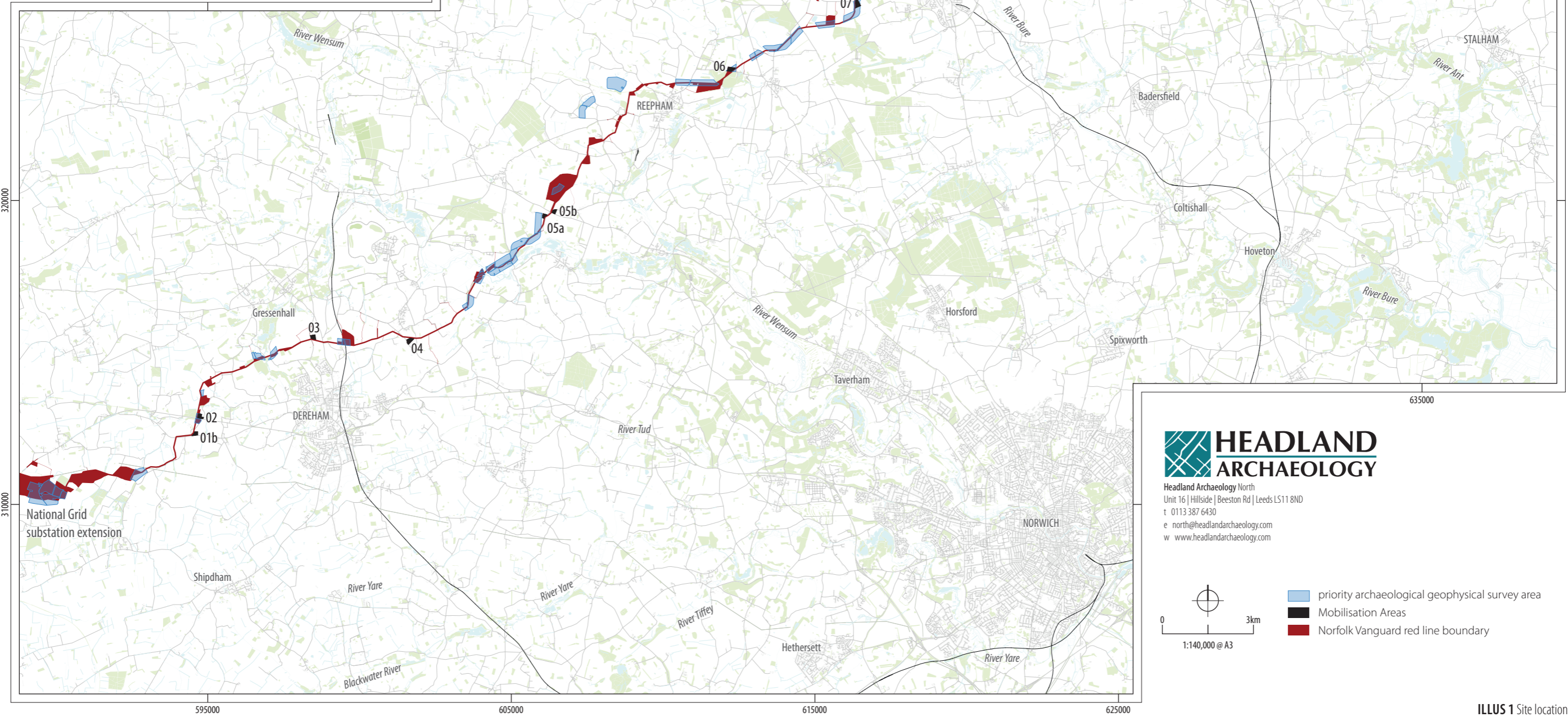
ILLUS 184 Interpretation of magnetometer data; PAGSA 148-151 & 156-158 (1:2,500)	375
ILLUS 185 Processed greyscale magnetometer data; PAGSA 153-155 (1:2,500)	377
ILLUS 186 XY trace plot of minimally processed magnetometer data; PAGSA 153-155 (1:2,500)	379
ILLUS 187 Interpretation of magnetometer data; PAGSA 153-155 (1:2,500)	381
ILLUS 188 Processed greyscale magnetometer data; PAGSA 158-166 (1:2,500)	383
ILLUS 189 XY trace plot of minimally processed magnetometer data; PAGSA 158-166 (1:2,500)	385
ILLUS 190 Interpretation of magnetometer data; PAGSA 158-166 (1:2,500)	387
ILLUS 191 Processed greyscale magnetometer data; PAGSA 164-165 (1:2,500)	389
ILLUS 192 XY trace plot of minimally processed magnetometer data; PAGSA 164-165 (1:2,500)	391
ILLUS 193 Interpretation of magnetometer data; PAGSA 164-165 (1:2,500)	393
ILLUS 194 Processed greyscale magnetometer data; PAGSA 165-166 (1:2,500)	395
ILLUS 195 XY trace plot of minimally processed magnetometer data; PAGSA 165-166 (1:2,500)	397
ILLUS 196 Interpretation of magnetometer data; PAGSA 165-166 (1:2,500)	399
ILLUS 197 Processed greyscale magnetometer data; AAA1 (1:1,000)	401
ILLUS 198 XY trace plot of minimally processed magnetometer data; AAA1 (1:1,000)	403
ILLUS 199 Interpretation of magnetometer data; AAA1 (1:1,000)	405
ILLUS 200 Processed greyscale magnetometer data; AAA2 (1:1,000)	407
ILLUS 201 XY trace plot of minimally processed magnetometer data; AAA2 (1:1,000)	409
ILLUS 202 Interpretation of magnetometer data; AAA2 (1:1,000)	411
ILLUS 203 Processed greyscale magnetometer data; AAA3 (1:1,000)	413
ILLUS 204 XY trace plot of minimally processed magnetometer data; AAA3 (1:1,000)	415
ILLUS 205 Interpretation of magnetometer data; AAA3 (1:1,000)	417
ILLUS 206 Processed greyscale magnetometer data; AAA4 (1:1,000)	419
ILLUS 207 XY trace plot of minimally processed magnetometer data; AAA4 (1:1,000)	421
ILLUS 208 Interpretation of magnetometer data; AAA4 (1:1,000)	423
ILLUS 209 Processed greyscale magnetometer data; AAA5 (1:1,000)	425
ILLUS 210 XY trace plot of minimally processed magnetometer data; AAA5 (1:1,000)	427
ILLUS 211 Interpretation of magnetometer data; AAA5 (1:1,000)	429
ILLUS 212 Processed greyscale magnetometer data; AAA6 (1:1,000)	431
ILLUS 213 XY trace plot of minimally processed magnetometer data; AAA6 (1:1,000)	433
ILLUS 214 Interpretation of magnetometer data; AAA6 (1:1,000)	435

ILLUS 215 Processed greyscale magnetometer data; AAA7 (1:1,000)	437
ILLUS 216 XY trace plot of minimally processed magnetometer data; AAA7 (1:1,000)	439
ILLUS 217 Interpretation of magnetometer data; AAA7 (1:1,000)	441
ILLUS 218 Processed greyscale magnetometer data; AAA8 (1:1,000)	443
ILLUS 219 XY trace plot of minimally processed magnetometer data; AAA8 (1:1,000)	445
ILLUS 220 Interpretation of magnetometer data; AAA8 (1:1,000)	447
ILLUS 221 Processed greyscale magnetometer data; AAA9 (1:1,000)	449
ILLUS 222 XY trace plot of minimally processed magnetometer data; AAA9 (1:1,000)	451
ILLUS 223 Interpretation of magnetometer data; AAA9 (1:1,000)	453
ILLUS 224 Processed greyscale magnetometer data; AAA10 (1:1,000)	455
ILLUS 225 XY trace plot of minimally processed magnetometer data; AAA10 (1:1,000)	457
ILLUS 226 Interpretation of magnetometer data; AAA10 (1:1,000)	459
ILLUS 227 Processed greyscale magnetometer data; AAA11 (1:1,000)	461
ILLUS 228 XY trace plot of minimally processed magnetometer data; AAA11 (1:1,000)	463
ILLUS 229 Interpretation of magnetometer data; AAA11 (1:1,000)	465
ILLUS 230 Processed greyscale magnetometer data; AAA12 (1:1,000)	467
ILLUS 231 XY trace plot of minimally processed magnetometer data; AAA12 (1:1,000)	469
ILLUS 232 Interpretation of magnetometer data; AAA12 (1:1,000)	471
ILLUS 233 Processed greyscale magnetometer data; AAA13 (1:1,000)	473
ILLUS 234 XY trace plot of minimally processed magnetometer data; AAA13 (1:1,000)	475
ILLUS 235 Interpretation of magnetometer data; AAA13 (1:1,000)	477
ILLUS 236 Processed greyscale magnetometer data; AAA14 (1:1,000)	479
ILLUS 237 XY trace plot of minimally processed magnetometer data; AAA14 (1:1,000)	481
ILLUS 238 Interpretation of magnetometer data; AAA14 (1:1,000)	483
ILLUS 239 Processed greyscale magnetometer data; AAA15 (west) (1:1,000)	485
ILLUS 240 XY trace plot of minimally processed magnetometer data; AAA15 (west) (1:1,000)	487
ILLUS 241 Interpretation of magnetometer data; AAA15 (west) (1:1,000)	489
ILLUS 242 Processed greyscale magnetometer data; AAA15 (central) (1:1,000)	491
ILLUS 243 XY trace plot of minimally processed magnetometer data; AAA15 (central) (1:1,000)	493
ILLUS 244 Interpretation of magnetometer data; AAA15 (central) (1:1,000)	495
ILLUS 245 Processed greyscale magnetometer data; AAA15 (east) (1:1,000)	497

ILLUS 246 XY trace plot of minimally processed magnetometer data; AAA15 (east) (1:1,000)	499
ILLUS 247 Interpretation of magnetometer data; AAA15 (east) (1:1,000)	501
ILLUS 248 Processed greyscale magnetometer data; AAA16 (1:1,000)	503
ILLUS 249 XY trace plot of minimally processed magnetometer data; AAA16 (1:1,000)	505
ILLUS 250 Interpretation of magnetometer data; AAA16 (1:1,000)	507
ILLUS 251 Processed greyscale magnetometer data; AAA17 (1:1,000)	509
ILLUS 252 XY trace plot of minimally processed magnetometer data; AAA17 (1:1,000)	511
ILLUS 253 Interpretation of magnetometer data; AAA17 (1:1,000)	513
ILLUS 254 Processed greyscale magnetometer data; AAA18 (1:1,000)	515
ILLUS 255 XY trace plot of minimally processed magnetometer data; AAA18 (1:1,000)	517
ILLUS 256 Interpretation of magnetometer data; AAA18 (1:1,000)	519
ILLUS 257 Processed greyscale magnetometer data; AAA19 (1:1,000)	521
ILLUS 258 XY trace plot of minimally processed magnetometer data; AAA19 (1:1,000)	523
ILLUS 259 Interpretation of magnetometer data; AAA19 (1:1,000)	525
ILLUS 260 Processed greyscale magnetometer data; AAA20 (1:1,000)	527
ILLUS 261 XY trace plot of minimally processed magnetometer data; AAA20 (1:1,000)	529
ILLUS 262 Interpretation of magnetometer data; AAA20 (1:1,000)	531

Priority Archaeological
Geophysical Survey
(Terrestrial Archaeology)
Norfolk Vanguard Offshore Wind Farm
Norfolk

0 200km
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- priority archaeological geophysical survey area
- Mobilisation Areas
- Norfolk Vanguard red line boundary

PRIORITY ARCHAEOLOGICAL GEOPHYSICAL SURVEY (TERRESTRIAL ARCHAEOLOGY), NORFOLK VANGUARD OFFSHORE WIND FARM

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Freddie Scadgell of Royal HaskoningDHV UK Ltd (the Consultant) on behalf of Norfolk Vanguard Ltd, to undertake a geophysical (magnetometer) survey within Priority Archaeological Geophysical Survey Areas (PAGSA) along the onshore cable corridor (and associated onshore project area) for the Norfolk Vanguard Offshore Wind Farm. The survey is required in order to provide information on the archaeological potential of the project, to inform an Environmental Statement being prepared by Royal HaskoningDHV.

The work was undertaken in accordance with a Written Scheme of Investigation (WSI) (Royal HaskoningDHV 2017a), with guidance contained within the National Planning Policy Framework (DCLG 2012) and in line with current best practice (David et al 2008).

The survey was carried out between October 17th 2017 and March 9th 2018.

1.1 SITE LOCATION, LAND USE AND TOPOGRAPHY

The Norfolk Vanguard red line boundary (NVRLB) extends from the National Grid substation extension in the west (centred at TF 8863 1082) to the landfall zone at Happisburgh in the east (centred at TG 3894 3046) and incorporates a new onshore project substation, mobilisation area's (MA's), trenchless crossing zones and other associated infrastructure. The total area identified in the WSI for Priority Archaeological Geophysical Survey equates to approximately 750ha, comprising PAGSAs 1-166 (see Illus 1). Of this, 600ha was available for

survey – the remainder having been deep ploughed or still containing crops and/or wild bird cover, whilst access was not granted in others. During the course of the fieldwork, the NVRLB was revised so that some of the PAGSA's now lie outside the revised onshore project area.

The PAGSA's mostly comprised arable fields that were either fallow having been recently harvested or had been ploughed, harrowed and re-seeded following harvest.

Topographically, the majority of the NVRLB comprises flat agricultural land, interspersed with predominantly small rural settlements, including the towns of North Walsham, Aylsham, Reepham, and Dereham, as well as watercourses, areas of woodland and hedgerows.

1.2 GEOLOGY AND SOILS

The underlying bedrock geology comprises White Chalk in the west and Crag Group (sand and gravel) in the east. This is overlain predominantly by glacial till, interspersed with sheets of glacial sands and gravels. Channels of alluvium, river terrace deposits and glaciofluvial deposits occur alongside several watercourses throughout the onshore project area (NERC 2018).

The soils overlying the White Chalk in the west are classified in the Soilscape 8 and Soilscape 18 associations, characterised as seasonally wet loams and clays with impeded drainage. The soils overlying the Crag Group bedrock in the east are mostly classified in the Soilscape 6 association, characterised as freely draining loams. Loamy and sandy soils with naturally high groundwater and a peaty surface (Soilscape 23 association) occur at several locations along the courses of streams and rivers (Cranfield University 2018).

2 ARCHAEOLOGICAL BACKGROUND

An onshore Archaeological Desk-Based (baseline) Assessment (Royal HaskoningDHV 2017b) has established that the archaeological evidence within the NVRLB reflects a human presence from the earliest evidence of hominin activity in the UK (Happisburgh) to the present day. Analysis of aerial photographic and LiDAR data assessment identified that the onshore project area has a high potential for the discovery of buried archaeological remains. The assessment confirmed the presence of extensive and complex cropmark sites which are indicative of a complex multi-period archaeological landscape dating from earlier prehistoric through to modern periods.

The DBA identified that the cropmark features were more abundant throughout the eastern half of the NVRLB, thought to be due to the ease with which crops respond to soil moisture deficits over the Crag Group sands and gravels. In contrast, cropmarks are less plentiful in the western half of the NVRLB where seasonally wet loams and clays may impede drainage and consequently the appearance of cropmarks caused by buried features, if present.

The DBA concluded that the potential for buried remains to be present within the NVRLB is considered to be high.

3 AIMS, METHODOLOGY AND PRESENTATION

The general aim of the geophysical survey was to gather sufficient information to enable an assessment to be made of the impact of the proposed development on any potential sub-surface archaeological remains within the PAGSAs and to inform further strategies as necessary.

Specifically, the aims were to:

- › undertake an initial programme of targeted detailed magnetometry across those areas identified as Priority;
- › to corroborate, identify and characterise sub-surface anomalies that may have an archaeological origin (including defining the spatial limits of already known or suspected heritage assets);
- › to discount areas within the survey area that are found to have been subject to previous 'modern' disturbance, for example where the geophysical survey data indicate the presence of 'made' or previously heavily disturbed ground;
- › provide an interpretation of all recorded geophysical anomalies in order to inform the design of a scheme-wide programme of archaeological evaluation trial trenching (in this instance this will be an initial informative stage of mitigation, post-consent); and
- › to produce a comprehensive site archive and report that is compliant with all relevant standards, guidance and good practice.

3.1 MAGNETOMETER SURVEY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. Features such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the Earth's magnetic field. In mapping these slight variations, detailed plans of archaeological sites can be obtained as buried features often producing reasonably characteristic anomaly shapes and strengths (Gaffney and Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system is programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses 4m apart. These readings are stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system is linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software has been used to collect and export the data. Terrasurveyor V3.0.32.4 (DWConsulting) software has been used to process and present the data.

3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:140,000. Survey location plans are shown on Illus 2 – Illus 43 inclusive at a scale of 1:7,500 showing the processed greyscale magnetometer data, interpretative illustrations, cropmark data and geology data (NERC 2018) overlying the first edition Ordnance Survey map (1888–1913).

Large-scale fully processed (greyscale) data, minimally processed data (XY traceplot) and accompanying interpretative plots are presented at a scale of 1:2,500 in Illus 44 – Illus 196 inclusive with more detailed plots (1:1,000) of the areas of archaeological activity (AAA) shown in Illus 197 to Illus 262 inclusive.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive. Data processing details are presented in Appendix 4. Data repeatability plots are presented in Appendix 5 whilst a copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 6.

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Royal HaskoningDHV 2017a), as approved by Norfolk County Council Historic Environment Service, guidelines outlined by Historic England (English Heritage 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The illustrations in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All illustrations are presented to most suitably

display and interpret the data from this site based on the experience and knowledge of management and reporting staff.

4 RESULTS AND DISCUSSION

Generally, a variable magnetic background has been recorded throughout the PAGSA's manifesting in the data as a plethora of discrete areas of magnetic enhancement. These are due to localised variations in the depth and composition of the soils and the superficial deposits from which they derive. Areas of variation are also caused by differing agricultural activities and ploughing regimes. Ground conditions were generally good across the PAGSA's and the data quality is correspondingly good throughout. It is therefore assessed that the results provide a reliable indication of the extent of the sub-surface archaeological remains, particularly over the Crag Group sand and gravel bedrock in the east of the NVRLB. The reliability of the results over alluvial and colluvial (Head) deposits, and over glacial sand and gravels is less clear and detection of some soil-filled features may be hampered by low magnetic contrast in the surrounding soils and/or the depth of the superficial deposits. In these instances some isolated and/or low magnitude features, and localised areas of unenclosed settlement, may not manifest in the data at all.

The anomalies identified by the survey fall into a number of categories according to their origin. These are discussed below with those anomalies with modern, agricultural or geological origins discussed first followed by those anomalies of a possible or probable archaeological nature. Thereafter, a brief summary is provided for all of the PAGSA's which, for ease of discussion, is subdivided into sections defined by the thirteen mobilisation areas (MA's; see Illus 1), starting at the Onshore Project Substation and moving eastwards to the Landfall at Happisburgh.

4.1 FERROUS AND MODERN ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris is common on most sites, often being present as a consequence of manuring or tipping/infilling. Throughout the PAGSA's, there is no obvious clustering to these ferrous anomalies which might indicate an archaeological origin. Far more probable is that the 'spike' responses are likely caused by the random distribution of ferrous debris in the upper soil horizons.

Several high magnitude dipolar linear anomalies have been identified across the PAGSA's, such as those in Area 33 (see Illus 65–67) and Area 54 (see Illus 86–88). These are caused by buried service pipes.

Localised areas of magnetic disturbance within Areas 10 (see Illus 44–46), 20 and 22 (see Illus 53–55), 36 (see Illus 62–64), 51 and 52 (see Illus 83–85), 77 (see Illus 116–118), and 137 (see Illus 167–169) locate ponds which are depicted on the 1888–1913 six inch Ordnance Survey map. The disturbance is caused by magnetic objects (brick, tile, iron etc.) within the material used to infill the features.

Two former buildings, shown on the 1888–1913 six inch Ordnance Survey map, manifest in the south of Area 10 (see Illus 44–46) and the north of Area 27 (see Illus 59–61) as amorphous areas of magnetic disturbance. The disturbance is caused by the spreading of demolition material within the topsoil.

The band of ferrous anomalies aligned east/west in the north of Area 65 (see Illus 101–103) corresponds to the route of a former railway shown on the 1888–1913 six inch Ordnance Survey map. The anomalies probably locate the buried remains of the former ballast.

Magnetic disturbance around the area edges is due to ferrous material within or close to the adjacent field boundaries and is of no archaeological interest.

4.2 GEOLOGICAL ANOMALIES

Geological anomalies are identified throughout the NVRLB. These are mostly due to changes in the depth and composition of the topsoil (or the superficial deposits from which the upper soil horizons are derived), or the accumulation of topsoil along the breaks in, or bottom of, slopes. These anomalies can either manifest as broad areas of amorphous but enhanced magnetic response, such as those identified in Area 14–16 (see Illus 50–52) or Area 127–130 (see Illus 164–166), faint linear or curvilinear trend anomalies, such as those in Area 165–166 (see Illus 194–196), a generally more magnetic background, such as that exhibited in Area 118–119 (see Illus 152–154) or an area of quite distinct discrete anomalies in a general magnetically quiet background such as those in Area 10 (see Illus 44–46). It should be noted, however, that it may be difficult or impossible to identify any archaeological responses where geological anomalies are particularly dense and/or of a high magnitude.

4.3 AGRICULTURAL ANOMALIES

Analysis of historic cartographic sources (Norfolk County Council 2018) indicates that the pattern of land division throughout the NVRLB has undergone substantial change since the publication of the Enclosure and Tithe maps in the late eighteenth and nineteenth centuries, with the removal of numerous field boundaries to create larger fields. The majority of these former boundaries manifest in the data as linear anomalies (soil-filled ditches) or as linear alignments of ferrous anomalies, which are caused by modern debris within the fill of the ditch or which have accumulated at the former field margins. Linear anomalies of a similar magnitude to the former boundaries, and which are identified parallel with, or at right angles to them, are interpreted as possible former field boundaries, probably locating boundaries removed prior to the publication of the Enclosure and/or Tithe maps.

The more closely-spaced linear anomalies, aligned parallel with the extant field boundaries, are due to modern ploughing. No anomalies have been identified in any of the magnetic datasets which are caused by medieval and/or post medieval ridge and furrow cultivation. Occasionally, linear trend anomalies have been identified which are oblique to the surrounding field boundaries, often being speckled in appearance, such as those in Area 51–52 (see Illus 83–85). These anomalies are characteristic of modern field drains.

The data throughout Area 84 (see Illus 122–124) is dominated by high magnitude magnetic disturbance throughout. Disturbance of this magnitude and distribution is characteristic of the recent spreading of organic waste as soil conditioner. The exact cause of the response is not fully understood but is thought to be caused by the presence of magnetic compounds in the soil created during decomposition processes, and also by frequent ferrous contaminants within the waste material. Against this background it is not possible to clearly distinguish any anomalies which may be of archaeological origin.

4.4 QUARRYING ANOMALIES

Several broad and amorphous areas of high magnitude magnetic enhancement are interpreted as areas of former extraction, such as those in Area 87–88 (see Illus 128–130) and Area 107 (see Illus 140–142). These are not recorded on historic mapping but are characteristic of localised quarrying, the anomalies being due to the magnetic contrast between the materials used to infill the former features and the surrounding soils.

4.5 POSSIBLE ARCHAEOLOGICAL ANOMALIES

Anomalies interpreted as being of possible archaeological origin are caused by soil-filled features such as pits or ditches or by spreads of magnetically enhanced material within the upper soil horizons. Whilst these anomalies do not manifest in any coherent archaeological pattern, they are either located near to areas of known archaeology, or cannot be satisfactorily interpreted as either modern, agricultural or geological in origin. On this basis, these anomalies are interpreted as potentially archaeological in origin.

4.6 AREAS OF ARCHAEOLOGICAL ACTIVITY

Unless specified all the linear anomalies described are likely to be due to soil filled cut features, such as ditches, forming clear patterns of enclosure and land division. With the variable magnetic background it is difficult to confidently discriminate between discrete anomalies which may be due to archaeological features, such as pits, which may be indicative of occupational activity, and those that are probably due to localised geological variation. For this reason, most of the discrete anomalies within enclosures have been ascribed a possible archaeological origin with those outside, except where the responses are particularly broad or high in magnitude, interpreted as of non-archaeological origin.

Twenty distinct areas of archaeological activity (AAA) have been identified, which are discussed below. These range from individual features to extensive areas of settlement or enclosure.

AAA1 (outside of NVRLB)

A clear double ring-ditch has been identified in the north-west of Area 39a, centred on TG 0523 1869 (see Illus 197–199), and corresponding with a circular cropmark which is recorded on the Norfolk HER (NHER 3053) as the central of three likely Bronze Age round barrows. The

outer ring-ditch extends beyond the limit of the PAGSA to the north but can be seen to measure 27m in diameter. The faint concentric inner ring-ditch measures 13m. No anomalies of archaeological potential have been identified to confirm the presence of the southernmost of the cluster of ring-ditches identified by NHER 3053, although a faint circular anomaly in the south-west corner of Area 39a, 150m south of AAA1, may locate a previously unrecorded ring-ditch. All anomalies are outside of the NVRLB.

AAA2 (outside of NVRLB)

A faint ring-ditch is clearly visible 10m south-east of Area 39c, centred on TG 0562 1851 (see Illus 200–202), and corresponding to a circular cropmark which is recorded on the Norfolk HER (NHER 3052) as a probable Bronze Age ring-ditch. The ring-ditch measures 19m in diameter. Low magnitude discrete anomalies within the interior of the ring-ditch may locate pits. Several faint linear anomalies are identified either side of the ring-ditch corresponding to NHER 50642 – cropmark field boundaries of unknown date. These anomalies are caused by soil-filled ditches with those aligned parallel to the adjacent field boundaries interpreted as agricultural in origin, whilst those aligned oblique to the field boundaries are ascribed a possible archaeological origin. All anomalies are outside of the NVRLB.

AAA3 (partly overlaps NVRLB)

AAA3 locates a previously unrecorded possible roadside settlement, identified running north/south along the eastern edge of Area 54, centred on TG 1237 2436 (see Illus 203–205). The area comprises a series of interlinking rectangular enclosures, defined by high magnitude linear anomalies (ditches), within an elevated magnetic background which extends from Park Farm in the north for 250m to the B1145 in the south. Several broad high magnitude anomalies are clearly visible within the complex of ditches, perhaps locating areas of burning.

AAA4 (outside of NVRLB)

High magnitude rectilinear anomalies are clearly visible aligned north-west/south-east along the northern edge of Area 57, centred on TG 1314 2494 (see Illus 206–208), and forming the southern extents of three small enclosures. The anomalies measure 23m north/south and 63m north-west/south-east. They are not recorded as cropmarks although they clearly form the continuation of a rectilinear cropmark which is recorded on the Norfolk HER (HER 21848). Several discrete anomalies in the interior of the enclosures are identified, perhaps locating pits. Anomalies are outside of the NVRLB.

AAA5 (partly overlaps NVRLB)

A clear area of archaeological activity is identified immediately east of Beerhouse Farm, crossing Area 60 and the south of Area 61 (see Illus 209–211), and comprising of at least two rectilinear enclosures either side of an east/west trackway. The anomalies are identified against a particularly variable magnetic background, thought to be due to the underlying sand and gravel superficial deposits. In the south of Area 61 a rectilinear enclosure is clearly visible centred on TG 1444 2541 and corresponding to cropmarks recorded on NHER 22903. Several high magnitude anomalies are identified in the interior of the enclosure, probably being due to settlement activity.

The enclosure is appended to the southern edge of an east/west trackway, defined by parallel linear anomalies (soil-filled ditches), 6-8m apart, and flanking either side of the trackway. The trackway extends westwards for 225m to the western limit of Area 60. Here, a second rectilinear enclosure (almost completely contained within the NVRLB) is identified appended to the northern edge of the trackway, centred on TG 1427 2544, and measuring approximately 48m north/south and 48m east/west. Several discrete anomalies of possible archaeological potential are identified within the interior of the enclosure and to its immediate west.

It is worth considering that against the variable magnetic background across Area 60 and Area 61, low magnitude anomalies which may be archaeological in origin may not be detected by the magnetometer. For this reason, the archaeological potential of this area may be greater than is currently suggested by the geophysical survey.

AAA6 (outside of NVRLB)

AAA6 locates a broad ring-ditch, forming a possible henge monument within the eastern corner of Area 82, centred on TG 2091 2899 (see Illus 212–214). The ring-ditch corresponds to a cropmark, identified amongst a wider cropmark complex on NHER 12772, as a possible Late Neolithic to Early Bronze Age hengiform monument. The anomaly varies in magnitude, fading away altogether in the east, but the outer diameter of the ring-ditch can be seen to measure 33m, with the interior measuring 23m in diameter. A clear gap in the south-west of the ring-ditch locates an entrance or causeway. A second possible entrance/causeway is identified on the opposite north-eastern side of the ring-ditch and a third on the eastern side, although these are less clearly defined. Discrete anomalies within the interior of the ring-ditch may locate pits. Anomalies are outside of the NVRLB.

AAA7 (partly overlaps NVRLB)

A previously unrecorded irregularly-shaped enclosure is clearly identified in the west of Area 88, centred on TG 2227 3038 (see Illus 215–217). The enclosure is aligned approximately north-east/south-west and measures 85m north-east/south-west and 61m north-west/south-east. Several discrete and short linear anomalies are identified throughout the interior of the enclosure, perhaps locating pits, internal divisions and spreads of archaeological material. The broad, amorphous high magnitude anomalies in the south of the enclosure may be caused by localised extraction, the response being due to the magnetically enhanced material used to infill the feature.

Several linear anomalies (soil-filled ditches) are identified surrounding AAA7, most on the same general alignment. These anomalies may form a wider system of land division and enclosure although a definite interpretation cannot be determined within the confines of the PAGSA. For this reason, these anomalies are ascribed a possible archaeological origin.

AAA8 (partly overlaps NVRLB)

High magnitude parallel sinuous anomalies aligned north/south for 215m in the east of Area 91 are thought to locate a buried trackway (see Illus 218–220). The anomalies are caused by soil-filled ditches flanking the trackway. No trackway is shown here on early cartographic sources

(Norfolk County Council 2018), although the Enclosure map shows two former trackways traversing this area on the same alignment, 40m to the east and 95m to the west respectively. At least one rectangular enclosure is discernible appended to the western side of the trackway (located outside of the NVRLB).

AAA9 (partly overlaps NVRLB)

An extensive complex of criss-crossing, high magnitude linear and rectilinear anomalies, forming multiple interlinking enclosures is clearly visible over the glacial superficial deposits in the south and west of Area 93, centred on TG 2305 3046, and extending into the south-west corner of Area 94 (see Illus 221–223). The complex corresponds to cropmarks recorded on the Norfolk HER (NHER 36499) as a possible field system including square enclosures and a ring-ditch. However, the anomalies detected by the geophysical survey are far more extensive, measuring 360m from east to west and 190m from north to south. The complex is aligned approximately north-east/south-west in keeping with the extant field layout and it is likely that some of the linear anomalies are caused by later agricultural activity cutting into the archaeological deposits. However, such is the density of anomalies it is virtually impossible to confidently differentiate between the two. Anomalies of particular note, however, include the high magnitude circular anomaly within the centre of Area 93, centred on TG 2313 3048, on the northern limits of the complex. The anomaly measures 10m in diameter and is surrounded by a negative anomaly which may locate a ring-ditch, as is suggested by the cropmark data. If so, this would suggest that the soil-fill of the ditch is less magnetic than the surrounding soils, perhaps being exaggerated by the presence of extremely high magnitude material within the interior of the ring-ditch. Alternatively, the anomaly may be caused by industrial activity, involving periods of intense burning/heating as is suggested by the XY trace plot (see Illus 222).

AAA10 (partly overlaps NVRLB)

Clear rectilinear anomalies in the south-west corner of Area 122, centred on TG 3256 3092 (see Illus 224–226), correspond to cropmarks recorded on HER 38866 as a probable rectangular Roman enclosure/farmstead. The majority of the enclosure is located beyond the limit of the NVRLB to the south. The survey has identified the northern extent of a double-ditched enclosure which, contrary to the rectangular description on the HER, appears to be trapezoidal in form, the north-western corner turning south-westwards close to Bacton Road. No anomalies of archaeological potential have been identified to the west of the road in Area 121 to suggest any continuation of the enclosure. Within the interior of the enclosure linear anomalies have been identified which are suggestive multi-phase occupation and/or internal divisions, whilst discrete anomalies have been identified which may locate pits.

Approximately 90m north-east of AAA10, several linear and rectilinear anomalies are identified within an area of cropmarks which are recorded on NHER 27242 as a possible Roman field system. Some of the anomalies identified by the survey correspond with the cropmark data although the anomalies are more regular and rectilinear in appearance. This is the area of partial overlap with

the NVRLB, not the double-ditched enclosure, noted above, which is well beyond the NVRLB to the south-west.

AAA11 (partly overlaps NVRLB)

A clear ring-ditch is identified on top of a low rise in the centre of Area 123, centred on TG 3301 3084 (see Illus 227–229), and corresponding to the site of a late medieval or post medieval post mill which was partly excavated in 1962. The survey has accurately located the post mill, confirming and enhancing the cropmarks and HER data. The two causeways which divide the ring-ditch are clearly visible in the north-west and the south, whilst an irregular cross-shaped cropmark within the interior of the ring-ditch manifests as a clear high magnitude anomaly. The anomaly is thought to locate the cross-tree base of the post mill. Four roughly-equidistant discrete anomalies surround the cross-tree base and probably locate post-holes.

To the north of the ring-ditch a broad linear high magnitude anomaly corresponds to a north-east/south-west orientated cropmark which is recorded on NHER 38864 and appears as a road on early cartographic sources (this is the area of partial overlap with the NVRLB). The anomaly is less extensive than is suggested by the cropmarks with no clear continuation beyond the post mill. The anomaly is caused by magnetically enhanced material, such as brick, tile and gravels, within the buried surface of the road.

Numerous faint and fragmentary linear and rectilinear anomalies, locating soil-filled ditches, have been identified throughout Area 123 alignments. All of the anomalies correspond to cropmarks recorded on the HER (NHER 27243/27240/27241/38872) and may form a part of a wider landscape of land division and enclosure.

AAA12 (partly overlaps NVRLB)

AAA12 defines a clear area of archaeological activity in the east of Area 125, centred on TG 3358 3062 (see Illus 230–232), comprising high magnitude linear and rectilinear anomalies forming a rectangular double-ditched enclosure (located predominantly within the NVRLB). The anomalies do not correspond to any specific cropmarks in this part of the field although undated cropmarks are recorded to the immediate west (NHER 38860) and east (NHER 38861) of AAA12. The enclosure is aligned east/west, and measures 26m north/south and at least 40m east/west. Several high magnitude amorphous anomalies are visible in the interior of the enclosure, perhaps locating spreads of enhanced material and almost certainly locating settlement activity. Several linear and rectilinear anomalies have been identified throughout Area 125, mostly aligned east/west and possibly forming part of a wider landscape of land division and enclosure.

AAA13 (partly overlaps NVRLB)

Sinuuous high magnitude parallel anomalies are clearly visible winding north-east/south-west for 375m across Area 128, 129 and 130, centred on TG 3391 3054 (see Illus 233–235). The anomalies are caused by soil-filled ditches flanking a buried trackway. At least two small rectilinear enclosures are visible appended to the southern edge of the trackway (located outside of the NVRLB) perhaps locating areas of localised settlement and enclosure. The data to the north of the trackway is dominated by high magnitude amorphous

anomalies which are caused by the accumulation of Head superficial deposits at the base of low dry valley. These deposits mask part of the trackway and may mask any other anomalies of archaeological potential, if present, within the affected area.

AAA14 (largely outside of NVRLB)

A fragmented irregularly-shaped enclosure is clearly visible against a varied but relatively homogenous magnetic background within the south-west of Area 134 and extending into the east of Area 133, centred on TG 3435 3045 (see Illus 236–238). The anomalies broadly correspond to cropmarks on NHER 38853 (multi-period field boundaries). The extents of the enclosure are clearly defined on all but the south-eastern side where Head superficial deposits are recorded and the anomalies become faint. For this reason, it is possible that the actual extent of the archaeological deposits is greater than that suggested by the geophysical survey. A rectangular annex is identified on the north-western side of the enclosure. Several linear and rectilinear anomalies within the interior of the enclosure probably locate internal features such as pits and ditches.

AAA15 (largely outside of NVRLB)

AAA15 defines an extensive series of ditches, trackways and conjoined enclosures which extend over at least 8ha from The Street in the south-west of Area 137 for 750m to the PAGSA limit in the east of Area 139 (see Illus 239–247). The anomalies are recorded as cropmarks on NHER 21835 and are interpreted as a multi period complex comprising a trackway, enclosures and field system of probable Iron Age to Roman date and further enclosures of medieval to post medieval date. The survey has confirmed and significantly enhanced the archaeological record, in particular confirming that the complex extends at least 215m further east than was previously known.

AAA16 (largely overlaps NVRLB)

Linear and rectilinear anomalies are clearly identified in the north of Area 137, on the southern side of Happisburgh Road centred at TG 3523 3123 (see Illus 248–250) which are suggestive of roadside settlement activity. The anomalies are not recorded as cropmarks although they probably form a continuation of cropmarks which are recorded on the same east/west orientation, 120m to the south-west, as a possible Iron Age/Roman or medieval/post medieval trackway and ditches (NHER 38846). The anomalies extend for 250m and comprise ditched enclosures and several high magnitude broad and amorphous anomalies. A particularly high magnitude anomaly in the south-west of AAA16 is likely to locate an area of heating/burning as is indicated by the characteristic XY-trace response (see Illus 249). This anomaly is likely to locate a kiln or furnace and is caused by the thermoremanent magnetisation of the ground during the firing process.

AAA17 (outside of NVRLB)

AAA17 accurately locates a ring-ditch within the south of Area 151, centred at TG 3721 3023, which is recorded on NHER 38729 as a probable Bronze Age round barrow (see Illus 251–253). The barrow is also recorded as part of a wider group of ten ring-ditches (NHER 55788) thought to form a Bronze Age barrow cemetery. The ring

ditch measures 28m in diameter. Parallel linear anomalies, extending both north and south of the ring-ditch define a trackway, recorded on NHER 38730 as a probable Iron Age to Roman trackway from which extends a regular rectilinear field system. The survey has confirmed the cropmark data and enhanced the archaeological record with the identification of numerous discrete anomalies which may locate pits. Anomalies are outside of the NVRLB, although there may be associated peripheral elements

AAA18 (outside of NVRLB)

A clear area of archaeological activity is identified in the north of Area 158 centred on a clear ring-ditch located at TG 3777 3009 and which is recorded as a cropmark on NHER 38736, a likely Bronze Age round barrow (see Illus 254–256). The barrow is also recorded as part of a wider group of ten ring-ditches (NHER 55788) thought to form a Bronze Age barrow cemetery. The ring-ditch measures 11.5m in diameter. A discrete pit-type anomaly within the south-west of the anomaly is also recorded as a cropmark on the HER and is thought to locate a grave. No definite entrance/causeway is visible although a small gap in the east of the ring-ditch may locate an entrance. On the north-western side of the ring-ditch a rectangular anomaly is visible on a north-east/south-west alignment and appears to respect the ring-ditch. The anomaly is recorded as a cropmark on NHER 38738 and is interpreted as a possible medieval to post medieval trackway. However, the magnetic data does not obviously conform to this interpretation, with the rectangular anomaly clearly terminating at its south-western extent. It is possible that the anomaly locates a boundary feature or funerary monument contemporary with the adjacent ring-ditch.

The ring-ditch is located in the north of a clear rectangular enclosure measuring 70m east/west and 72m north/south. Several high magnitude anomalies located within the interior of the enclosure and to the immediate south/south-west are probably archaeological in origin and may locate pits. Anomalies are outside of the NVRLB, although there may be associated peripheral elements.

AAA19 (partly overlaps NVRLB)

Dense clusters of high magnitude anomalies have been identified either side of Whimpwell Street, on the southern periphery of Happisburgh, centred on TG 3824 3011, and are thought to locate roadside settlement activity (see Illus 257–259). The anomalies are located in a rich archaeological landscape with cropmarks of undated field systems (NHER 36765), undated trackways and ditches (NHER 38769) and a Bronze Age cemetery (NHER 55788) in the immediate locality. The anomalies span Area 159 to Area 162 and cover an area of 270m north/south and 90m east/west. Several conjoined enclosures are clearly visible within the east of Area 160 (located outside of the NVRLB). Numerous high magnitude anomalies in the interior of the enclosures are caused by settlement activity. The anomalies on the eastern side of Whimpwell Street are less-well defined, with no clear enclosures discernible in the data, although the density and magnitude of the anomalies are characteristic of settlement activity. Broader, amorphous high magnitude anomalies on the margins of the settlement may locate areas of localised quarrying and/or industry.

AAA20 (outside of NVRLB)

AAA20 locates a faint ring-ditch within the south of Area 164, centred on TG 3849 3031 (see Illus 260–262), and corresponding to cropmarks recorded on NHER 38774. The ring-ditch is thought to represent a round barrow and is also recorded as part of a wider group of ten ring-ditches (NHER 55788) thought to form a Bronze Age barrow cemetery. Only the northern extent of the ring-ditch has been detected by the survey, the southern extent extending into a field boundary/border at the south of Area 164. It can be seen to measure 23m in diameter. Discrete anomalies within the interior of the ring-ditch may be due to pits.

4.7 SUMMARY OF RESULTS

National Grid substation extension

No area was available for priority archaeological geophysical survey,

National Grid substation extension (east of) to (west of) MA1b

Several linear anomalies throughout Area 10 correspond to cropmarks identified within the DBA as possible post-medieval/modern field boundaries (see Illus 44–46). A broad area of magnetic disturbance in the south of the dataset corresponds to a building which is shown on the first edition OS map (1888–1913). The disturbance is due to the presence of demolition material (brick, tile, iron etc) within the topsoil. Isolated areas of magnetic disturbance in the north of Area 10 are caused by magnetic material used to infill two former ponds. No anomalies of archaeological potential have been identified.

MA1b to (west of) MA2

No area was available for priority archaeological geophysical survey.

MA2 to (west of) MA3

Discrete anomalies of a geological origin are prevalent throughout Area 12 and Area 18-19 (see Illus 47–52), whilst broader, amorphous, high magnitude anomalies dominate Area 14–16. These anomalies are alluvial in origin, being due to the accumulation of silts, sands and gravels on low-lying ground south-west of the adjacent Wendling Beck. Several linear cropmarks have been detected as magnetic anomalies in Area 16 and are thought to locate a former field boundary along with a series of north/south field drains. A faint rectilinear anomaly in the south of Area 14 is ascribed some archaeological potential, although an agricultural origin is also possible. The broad area of magnetic disturbance in the south-west of Area 12 is probably caused by modern tipping/dumping.

MA3 to (west of) MA4

Survey within this section was limited to two areas either side of the Mid-Norfolk Railway (Area 20 and Area 22; see Illus 53–55). Anomalies have been identified which represent three infilled ponds and three former field boundaries, all of which are shown on first edition OS mapping of 1888–1913.

MA4 to (west of) MA5a

A varied magnetic background is detected throughout Area 23 – Area 40b (see Illus 56–73), which reflects the mix of glacial, alluvial and colluvial superficial deposits across these areas. Against this background, numerous anomalies are identified mostly locating geological and pedological variation, modern ploughing trends and former field boundaries. A series of linear anomalies is identified throughout Area 33 (see Illus 65–67), east of the River Wensum, corresponding, in part, with cropmarks recorded on NHER 2999 as a multi-phase cropmark site including medieval and post-medieval field boundaries. These anomalies are ascribed a possible archaeological origin and are thought to locate soil-filled ditches. Two clear ring-ditches are identified as AAA1 and AAA2 in Area 39 and Area 39c respectively, corresponding to cropmarks on the NHER (see Illus 197–202; Sections 4.6.1 and 4.6.2 above). However, two further ring-ditches which are recorded as cropmarks in the middle of Area 39 and the east of Area 40 have not been detected as magnetic anomalies. It is possible that there is locally insufficient magnetic contrast for these ring-ditches to manifest in the data, but given the clear identification of AAA1 and AAA2, it is more likely that the cropmarks are non-archaeological in origin.

No anomalies or archaeological potential have been identified within Area 40b (see Illus 71–73) where cropmarks of post medieval field boundaries are recorded (NHER 3024). It is possible that there is insufficient magnetic contrast in this area for some, low magnitude anomalies to manifest as anomalies in the data. However, a broad band of ferrous anomalies within the south of the area may be of local historical interest. The anomalies are located on the northern side of Lime Kiln Road along which the remains of possible World War Two roadside defences are recorded on NHER 50771. The anomalies may locate associated ferrous detritus within the upper soil horizons.

MA5a to (west of) MA5b

Linear trend anomalies due to modern cultivation and discrete anomalies due to localised pedological variation are identified throughout Area 41b (see Illus 71–73). No anomalies have been identified corresponding to cropmarks of post medieval field boundaries, which are recorded on NHER 3024.

MA5b to (west of) MA6

An area of possible archaeological potential is identified in the west of Area 43 (see Illus 74–76) as a series of faint and fragmented linear and rectilinear anomalies which are thought to be caused by soil-filled ditches. The anomalies cannot be confidently interpreted as agricultural or modern in origin and therefore an archaeological origin cannot be dismissed. It is possible that the anomalies locate a previously unrecorded enclosure.

The only other anomaly of possible archaeological potential within this area is that of an isolated, high magnitude, curvilinear anomaly within the centre of Area 50 (see Illus 80–85). The anomaly is located within a variable magnetic background including a number of low magnitude sinuous trends and it is possible that it is geological in origin, although an archaeological origin should be considered.

No anomalies of archaeological potential have been identified in either Area 45 or Area 47 (see Illus 77–79) adjacent to the site of St Mary's Chapel, Kerdiston (NHER 59757), although Area 46 across the former chapel site was not available for priority archaeological geophysical survey, due to heavy plough conditions.

MA6 to (west of) MA7

Three areas of definite archaeological activity have been clearly located in Area 54 (AAA3 - see Illus 203–205; Section 4.6.3 above), Area 57 (AAA4 - see Illus 206–208; Section 4.6.4 above) and Area 60/61 (AAA5 - see Illus 209–211; Section 4.6.5 above), each being defined by rectilinear anomalies forming a series of one or more enclosures and probably locating settlement activity. The anomalies confirm and enhance the archaeological record identifying considerably more possible and probable archaeology than was previously suggested by the desk-based records and aerial photographic assessment.

MA7 to (west of) MA8

No anomalies of definite archaeological potential have been detected across Area 67 – Area 81 (see Illus 107–121). Besides the ubiquitous discrete geological anomalies and agricultural trends, numerous faint and/or fragmentary linear anomalies have been identified, almost all of which correspond to cropmarks recorded on the NHER, and which are likely to locate soil-filled ditches. The linear anomalies appear on varying alignments and form no coherent pattern. It is possible that they locate a former system of enclosure and land division, although some may be modern in origin, perhaps being due to field drains.

With the exception of a single linear anomaly, a north-west/south-east cropmark complex (NHER 12772) throughout Area 81 (see Illus 119–121) has not been detected by the geophysical survey. It is possible that there is insufficient magnetic contrast in these soils, which are derived from sand and gravel superficial deposits, for some archaeological features, if present, to manifest as magnetic anomalies.

MA8 to (west of) MA9

Immediately east of MA8 a clear ring-ditch is identified as AAA6 (see Illus 212–214) (see Section 4.6.6 above), confirming the cropmark data as recorded on NHER 12772, and interpreted as a possible Late Neolithic to Early Bronze Age hengiform monument.

Fragmented low magnitude sinuous anomalies aligned north-east/south-west across Area 85 (see Illus 122–127) do not correspond to any cropmarks, nor do they correspond to any agricultural, geological or topographical features. It is possible that they locate soil-filled ditches either side of a winding trackway.

A broad area of high archaeological potential is identified across Area 88, Area 91 and Area 93 (see Illus 128–133) comprising AAA7 – AAA9 (see Sections 4.6.7 to 4.6.9 above). The nature and extents of these areas are clearly defined against the variable magnetic background, with the probable settlement complex in Area 93 (AAA9; see Illus 221–223) extending over 3ha to the east of the Kings Beck crossing.

MA9 to (west of) MA10

No area was available for priority archaeological geophysical survey.

MA10 to (west of) MA10a

A variable magnetic background is recorded throughout Area 107–117 (see Illus 140–154) with discrete geological anomalies and modern ploughing trends throughout. No areas of definite archaeological potential are identified across these areas although several anomalies of possible archaeological potential are identified in Area 107–108 on the northern periphery of North Walsham. A cluster of high magnitude anomalies has been identified at the site of a post medieval windmill (NHER 6858) in the north-east of Area 107 (see Illus 140–142). No coherent pattern is visible in the data but the cluster is thought likely to be due to demolition material and possibly to in situ buried remains. The NHER also records cropmarks of a ring-ditch within the centre of Area 107 (NHER 36505). No anomalies have been identified in the immediate vicinity of the recorded cropmark but it is possible that the cropmark relates to a localised area of high magnitude magnetic disturbance 30m to the south-east. The disturbance does not correspond to any features on historic mapping and is thought likely to be modern in origin. The cluster of high magnitude anomalies in the south-west corner of Area 107 is also likely to be modern in origin, probably being due to tipping/dumping although an archaeological origin is possible – the anomalies may be industrial in nature.

The regular network of east/west linear cropmarks (NHER 36504) across Area 108 (see Illus 143–155) has been clearly identified by the survey as a former field system depicted on the first edition OS map (1888–1913). In addition, a further series of east/west linear and rectilinear anomalies is identified in the north of this area which is not shown on any available historical mapping. These anomalies are ascribed as possibly archaeological in origin and may be due to an earlier system of land division.

MA10a to (west of) MA11

Six areas of definite archaeological activity (AAA10 – AAA15- see Illus 224–241), see Sections 4.6.10 to 4.6.15 above, have been clearly identified between MA10a and M11 including two rectilinear anomalies, a late medieval or post medieval post mill, a winding trackway with appended enclosures, a fragmented, irregular enclosure and an extensive area of settlement and enclosure of likely late Iron Age/Roman origin. Two of the areas of archaeological activity were previously unrecorded (AAA12 and AAA13 – see Illus 230–235) whilst the survey has identified that the archaeological features suggested by cropmark complexes within this section are more extensive than was previously recorded.

MA11 to (west of) Landfall zone

Numerous cropmarks are recorded within the eastern sector of the NVRLB, close to Landfall, presenting evidence for a complex multi-period buried archaeological landscape. This evidence has been corroborated by the geophysical survey, which has identified anomalies identifying five clear areas of archaeological activity

(AAA16 – AAA20 – see Illus 242–262), see Sections 4.6.16 to 4.6.20, between Area 137 and Area 164 (see Illus 170–193). The anomalies are suggestive of two previously unrecorded roadside settlements, three ring-ditches (NHER 38729, NHER 38736, NHER 38774) which form part of a wider Bronze Age cemetery (NHER 55788), and a late Iron Age/Roman trackway and associated field system (NHER 38730). Numerous linear anomalies of archaeological potential are identified across this landscape, probably locating ditches which form a part of a wider landscape of land division and enclosure.

Landfall

No areas of clear archaeological activity have been identified at Landfall in the far east of the NVRLB (Area 165 and Area 166; see Illus 188–196). Faint and fragmentary linear anomalies have been identified corresponding to a series of cropmarks which are recorded on NHER 16015 as undated field systems, ditches, trackways, pits and a possible grubenhauser, although no clear pattern is discernible in the data. No anomalies have been identified specifically at the Landfall to confirm the presence of the Bronze Age cemetery, which is recorded across (partially interacting with) this area on NHER 55788.

5 CONCLUSION

The survey has successfully evaluated 127 Priority Archaeological Geophysical Survey Areas, further advancing knowledge of the archaeological potential within the NVRLB and providing evidence for twenty distinct areas of clear archaeological activity ranging from isolated ring-ditches to extensive areas of settlement and enclosure. Most of these areas were previously known, although some were less extensive than has been identified by the geophysical survey, whilst several others were not known at all. These areas are assessed as being of high archaeological potential. Anomalies at numerous other locations have been interpreted as being of possible archaeological potential including possible field systems, trackways, isolated ditches and pits. However, the weak, fragmentary nature of these anomalies, or an absence of supporting archaeological information (cropmarks or HER data) precludes a confident interpretation. These anomalies are ascribed a moderate archaeological potential.

Only two definite areas of archaeological activity, in the form of isolated ring-ditches, and relatively few anomalies of possible archaeological potential, have been identified over the White Chalk bedrock and seasonally wet clays in the western half of the cable route, whereas eighteen definite areas of archaeological activity have been identified over the freely-draining loams and Crag Group sands and gravels in the east. Moreover, half of the areas of archaeological activity identified by the survey are located within the easternmost 7km of the approximately 60km cable route. This pattern mirrors the cropmark data and corroborates the results of the DBA. Anomalies due to geological and pedological variation are common throughout all survey areas, and linear trend anomalies due to post-medieval agricultural activity (boundary removal, field drains or recent or post-medieval ploughing) are also recorded in virtually all parts of the NVRLB.

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