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Identifying Borehole Geology Projects

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Foreword

This report is the published product of an internal BGS study to identify the originating projects of borehole interpretations in Borehole Geology. In addition, two database tables, Project Codes and Project Index were also created and populated to hold this information, as a result of this analysis. The corporate database currently does not store this data, but it would nevertheless be useful to do for a number of reasons.

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1 Introduction

Over the years, the British Geological Survey (BGS) has amassed a large collection of paper borehole logs from a variety of sources in the UK. This has partly occurred in response to various legal statutes requiring companies to lodge copies of this information with the BGS, as well as resulting from commercial storage contracts and voluntary donations. These hardcopy records, together with other geological and contextual documents, comprise BGS' National Geological Records Centre (NGRC) repository.

Although some of the geological details are confidential, all basic borehole log identifier information, such as borehole name, position relative to the British National Grid (BNG) and start heights, have been routinely, digitally recorded in the Single Onshore Borehole Index BGS.SOBI (SOBI) Oracle database table.

Permitted geological information recorded in the borehole logs have subsequently been utilised to different degrees by BGS, as required on a project-by-project basis. In order to digitally manipulate this information, each log employed, has been coded to an appropriate level of detail as a series of layers, which together comprise a single borehole interpretation, in the Borehole Geology database table BGS.BOREHOLE_GEOLOGY (BoGe).

BoGe layers must include top and base depths, and optionally lithological and stratigraphical information. Supplementary layer details such as colour or hardness information can be separately coded in the BGS.BH_GEOLOGY_PROPERTIES database table, but was not utilised for the present study.

The relationship between these three tables is shown in Figure 1.

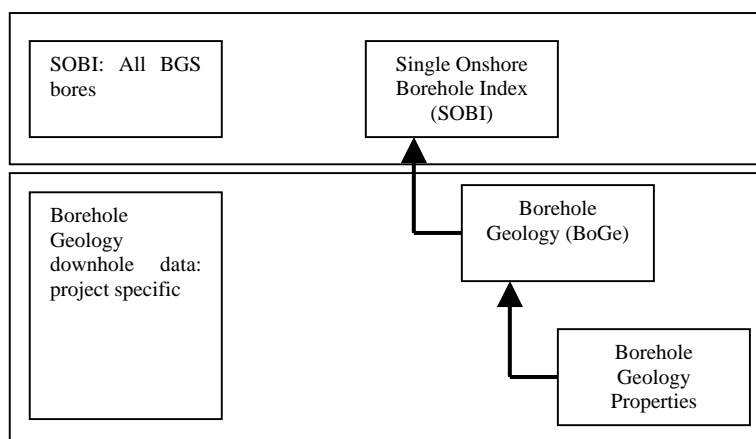


Figure 1: BGS borehole database tables

At present, Borehole Geology does not include a specific column to indicate the project that created it. Although the Content Code column may hold some project information, this column was intended to specify the level of coding such as 'full', 'outline' or 'partial' etc, but in some instances, has been used to indicate a particular project. Older interpretations migrated from a pre-existing database, BLITH, had a column designated to store the project code. When the BLITH data was uploaded to the present system, the project code information was concatenated

with other discontinued column data, into a special BLITH_COMMENTS column in Borehole Geology. A basic summary of Borehole Geology is shown in Figure 1.

Column	Description
QS	Borehole identifier information
RT	
NUMB	
BSUFF	
INTERPRETER	Time and date, originator(s) of entry
USER_ENTERED	
DATE_ENTERED	
DRILLED_DEPTH_TOP	Depth information
DRILLED_DEPTH_BASE	
LITHOLOGY_CODE	Geological details
LITHOSTRAT_CODE	
UNIT_DESCRIPTION	
BASE_BED_CODE	
CONTENT_CODE	Degree of coding, but also some project info
BLITH_HISTORICAL_COMMENTS	Only used to store migrated historical data

Figure 2: Borehole Geology (BoGe) table data columns. Note that not all columns are shown.

The purpose of this study has been to identify the project for which each borehole interpretation was created. This attribution has a number of benefits:

- The user can locate and review all borehole interpretations created by a particular project.
- Individual projects will have had certain standard ways of recording information that can be used, for example, to create uniform 3-D models, which can be made use of, now that all boreholes belonging to a particular project can be easily selected.
- The difference between two adjacent borehole interpretations may be clearly understood, if it is known that they were created by different projects.
- The user can inadvertently avoid calling up interpretations created by projects that are not of interest.
- The list of identified projects can be used to rapidly check the type of information currently held in Borehole Geology.
- Further project details can be assessed, by means of the link to the Projects Database.

This report describes the issues involved in attributing borehole interpretations to projects, outlines the methodology employed to determine project details, and ends with a brief discussion of the success of this exercise, and a list of suggested follow-up work.

2 Data Tables

Two database tables were created for this study to store borehole project information. The purpose of the first table, SDBR.PROJECT_CODES (Project Codes) is to store a list of all borehole interpretations, together with a numerical identifier unique to each individual project. The second table, SDBR.PROJECT_INDEX (Project Index), stores the list of the numerical identifiers used in the first table, but also includes descriptive information, such as the project name and location, together with other optional details. Both tables are further described below.

2.1 THE PROJECT CODES TABLE

Column	Datatype	Nulls?	Index	Description
USER_ENTERED	VARCHAR2(10)	N	PK1	Extracted from the user login
CONTENT_CODE	VARCHAR2(2)	N	PK2	Degree of coding, but also some project info
QS	VARCHAR2(6)	N	PK3	Borehole identifier information
RT	VARCHAR2(2)	N	PK4	
NUMB	VARCHAR2(5)	N	PK5	
BSUFF	VARCHAR2(4)	N	PK6	
BLITH_CODE	VARCHAR2(15)	N		Only used to store migrated historical data
BNG_EASTING*	NUMBER(6,0)	Y		British National Grid co-ordinates
BNG_NORTHING*	NUMBER(7,0)	Y		
PID	NUMBER(5,0)	Y	FK1	Unique project or sub-project identifier

Figure 3: The SDBR.BHG_PROJECT_CODES database table. These columns * are temporary.

The columns QS, RT, NUMB and BSUFF uniquely identify a borehole in the SOBI database, however, more than one person may have coded the same borehole, and indeed, may have done so for several projects. Therefore, the USER_ENTERED and CONTENT_CODE columns are required in order to further define a single borehole interpretation. However, if a user has coded the same borehole using the same content code more than once, perhaps for different projects, then this situation would not have been identified by this study.

There is an INTERPRETER column available in Borehole Geology that might seem a better choice than the USER_ENTERED column, for identifying the person who would know which project had created a particular borehole interpretation. However, users are able to type any user identifier into the INTERPRETER field, whereas USER_ENTERED is a password protected field, required when the data entry application is launched.

The first five columns were populated by querying from Borehole Geology, columns six and seven were derived from SOBI, after converting the co-ordinates from alphanumeric to numerical data, whereas the eighth column, 'PID', short for 'project identifier', was populated by this project.

Only one distinct identifying row containing the primary key columns was inserted for each borehole interpretation, instead of the multiple layers that exist in Borehole Geology.

The location columns BNG_EASTING and BNG_NORTHING marked with an asterisk in Figure 2, were used only to match projects with borehole interpretations, and were later dropped (deleted) at the end of this study, once their function had been completed.

2.2 THE PROJECT INDEX TABLE

Column	Datatype	Nulls?	Index	Description
PID	NUMBER(5,0)	N	PK1	Unique project or sub-project identifier.
CODE	VARCHAR2(20)	Y		Project code, if known.
TASK	VARCHAR2(10)	Y		Task number, if known. Defaults to '01'.
NAME	VARCHAR2(50)	Y		Project or sub-project name.
TYPE	VARCHAR2(40)	Y		Project theme.
LOCATION	VARCHAR2(40)	Y		County, region or area info.
SITE	VARCHAR2(40)	Y		Additional location details.
DESCRIPTION	VARCHAR2(100)	Y		Additional name details.

Figure 4: The SDBR.BHG_PROJECT_INDEX database table

As mentioned above, the PID field provides a unique identifier for each project. A basic project name was entered in the NAME field, and a longer DESCRIPTION field, was used to provide a more comprehensive description. Each project was located to a particular county, or region for Scotland, yet some projects have been listed as nationwide. Further details to assist with locating some of the smaller projects recognized, are listed in the SITE field. If a project code could be determined, this is listed too. The task number is separately listed, and has been defaulted to '01' for older projects that do not have such a designation.

2.3 USING THE OUTPUT TABLES

Project details for a single borehole interpretation, can be determined by linking the second table to the first, using the common project identifier (PID) column. These details have been stored separately from the borehole interpretations, making it easy for users to update or correct project

details, without having to change all project instances in the Project Codes table, and provides a useful summary listing.

The multiple columns and careful description makes the project list easily searchable using different project properties, such as project type or location. Also, the index list can easily be viewed as a whole onscreen, without having to display the associated interpretation data.

The project names entered into the SDBR.PROJECT_INDEX table do not necessarily precisely match the 'official' project title, although programme managers, project workers and the Finance department often refer to the same project by several different names, the project names listed were made as comprehensive as possible to enable easy recognition for all interested parties.

3 Methodology

3.1 DATA MANIPULATION

Having created the two working tables, the unique list of all borehole interpretations from Borehole Geology together with location data from SOBI were inserted into the Project Codes table. This table was then uploaded into MapInfo to create a project Geographical Information System (GIS), composed of separate layers for each of the borehole interpretation selections. The screen displays were then copied into Table 5, in the appendix of this document, and the appropriate project identifier, once determined, was inserted into the PID column, of the project Codes table. As new projects were identified, they were added to the Project Index table and new PIDs allocated.

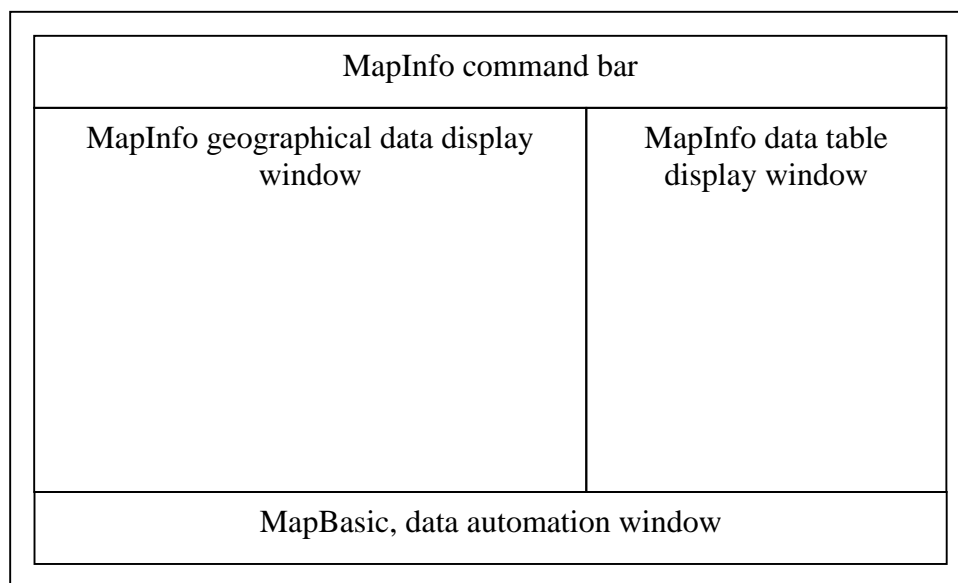


Figure 5: The MapInfo screen layout.

Project identification was accomplished in two different ways, as:

- 1) Interpretations with content codes that directly identify the source project.
- 2) Other interpretations, which require a different approach.

3.2 INTERPRETATIONS WITH PROJECT-SPECIFIC CONTENT CODES

As mentioned in the Introduction, some content codes are directly associated with particular projects, as shown in Table 1, below.

Table 1: Content codes related to specific projects.

Code	Project	Task	Description
CA	E1364S90	01	CILOR coding, subtype A
DV	E1362S96	03	Midland Valley DGSM, solid & drift details
DY	E1276S72	01	Vale of York, detailed logs
G	(not known)	-	Industrial Minerals Assessment Unit
L	E1364S90	01	GeoHazarD
LO	E1340S85	01	LOITH
MS	E1362S96	06	Nottingham-Melton DGSM liths, drift
NA	E1362S96	06	Nottingham Permo-Triass
NM	E1362S96	06	Nottingham-Melton DGSM solid stratigraphy
NS	ERE91900018	01	NDGD Nirex, outline logs
NW	ECF9190008801	01	Manchester-Macclesfield Drift, pilot project
NX	E RE91900018	01	NDGD Nirex, detailed logs
OH	E1289S76	01	Onshore Hydrocarbons and Coal Resources
OV	E1362S96	03	Midland Valley DGSM, outline logs
OY	E1276S72	01	Vale of York, outline logs
TE	E1340S85	03	Thames Estuary
TF	E1584R85	01	Thames Flood Defences
WD	(not used)	-	Wellmaster, interpreted drillers' logs
WM	(not used)	-	Wellmaster, outline & stratigraphy

The remaining content codes indicate the level of coding detail either in terms of the vertical resolution of the layers or the table columns populated. Therefore, these codes could not be used to identify source projects. Non- project-specific content codes are listed in Table 2.

Table 2: Content codes not related to specific projects.

Code	Description
1	All BINDEX fields, full drift lithology, first solid lithology and the remainder categorised as 'ROCK'.
A	'A' record only entered: BH name with comments, giving an explanation of why the borehole was not coded any further.

B	'A' & 'B' records entered; i.e. all BINDEX fields, plus the OD level, OD level accuracy, and the project.
C	Cross-reference data: only either the 'X' or the 'A' form is coded, with the name, registration number and a comment indicating the duplicated bore.
F	Full borehole data: all required fields on 'X' and 'Y' forms or 'A' and 'B' fields completed, plus the lithology for both drift and solid units.
M	Microwritten data entry: same as code 'F', but likely more accurate due to direct computer record transfer.
N	National grid reference data: the 'X' or 'A' form is fully coded, and the 'B' record contains the borehole and NGR only.
P	'X' and 'Y' fields are coded as completely as required, but with only specific horizons of interest, such as coal seams fully coded, the remaining lithological units coded as undifferentiated 'ROCK'.
Q	Quaternary data: all required fields on 'X' and 'Y' or 'A' and 'B' forms, with lithology for all drift units and a single solid unit categorised as 'ROCK'.
R	Rockhead data: 'A' and 'B', or 'X' and 'Y' records entered; i.e. all BINDEX fields, plus the OD level, OD level accuracy, and the project as for code 'B', plus the rockhead position, rockhead depth, the total depth of the bore and reason for not coding any further in the comments field.
S	Solid data only: 'X' and 'Y', or 'A' and 'B' forms completed, a single combined drift unit, the depths of the individual solid units, and the lithostratigraphy if known.
W	Only the 'X' record has been completed.
X	Correct content code not yet determined.

In some cases, an incorrect content code has been employed by the USER_ENTERED, such as using the code 'TE' in locations not in the Thames Estuary project study area. It was therefore always necessary to geographically plot all the interpretations that have project-specific content codes, as a precaution. Any interpretations found to have the wrong content code were further analysed to determine the correct code, or originating project. If the project could not be identified, these boreholes were not processed any further.

3.3 INTERPRETATIONS WITHOUT PROJECT-SPECIFIC CONTENT CODES

Several methods of enquiry were employed to identify this group of interpretations.

Separate queries were plotted using the geographical distribution of British National Grid coordinates of the borehole interpretations for each USER_ENTERED:CONTENT_CODE combination, overlain on a map of the British Isles. The users' actual names, instead of their Oracle logins, were identified from the BGS.META_ORACLE USER table.

A number of boreholes without coordinate data were identified, which were not processed any further by the current project. It is uncertain as to why so many boreholes have been interpreted which are missing this crucial information, although a small number of such omissions could be attributed to operator error. Others may be groups of closely-spaced boreholes derived from site investigation reports, in which the boreholes have not been separately located.

3.3.1 Interpretations with BLITH project codes

A significant number of interpretations have a project code recorded in the BLITH_HISTORICAL_COMMENTS column of Borehole Geology. BLITH was an older version of Borehole Geology, which contained an optional column for the project code.

When the data was migrated to Borehole Geology, this project code data, along with various other columns that would not be separately held in the new table, were concatenated into this single text field. This historical project code data has been very useful to the present study.

For the present project, the BLITH historical project code data was extracted from the concatenated text field in Borehole Geology, into the BLITH_CODE column, in the SDBR.BHG_PROJECTS table.

Sub-selections were made in MapInfo by BLITH project code, and all interpretations having the same code were plotted geographically onscreen to help determine the project name. This was not too difficult for some of the larger or more recent projects, however, several different approaches were still required:

- 1) The BLITH project codes were abbreviations of the full code. Therefore, in some instances, analysis indicated that several full codes contained the same partial BLITH code. An informed choice of which was the most likely match, if any, was then required.
- 2) In other cases, the existence of various projects was known from other external sources, such as scientific papers and by interviewing users. These were matched with project codes by studying the distribution of boreholes and the nature of the coded data.

- 3) Still other interpretations clearly appeared to be associated with certain projects, but had apparently incorrect project codes. In this case, the code was examined to see if it had been mistyped, such as the letter 'O' instead of the number '0', or 'A' instead of 'S', the latter would be because the two letters are adjacent on Qwerty keyboards.
- 4) Lastly, for those interpretations where no project name could be associated with a project code, a new project name was composed, usually with a descriptive geographical basis. These projects commonly only had a few borehole interpretations associated with them, so the BLITH codes may have been mistyped, or they could have been test data.

Some unnamed projects appeared to have more than one distinct population, not just on a geographical basis, but also in terms of how they were coded were given separate PID codes. It appears that in some instances two projects may have used the same code.

3.3.2 Interpretations without BLITH project codes

The table of maps of borehole distributions for each USER_ENTERED:CONTENT_CODE combination was presented to each user who had entered them, if contactable, in order to help identify and delineate separate projects. In addition, a summary of the content of the borehole interpretations was also supplied for each combination, such as the creation date, the lithologies and stratigraphy encountered, as well as an indication of the coding detail.

Sometimes, the person listed was only able to provide limited assistance, because:

- 1) They had merely entered the data without having knowledge of the project generating the interpretation
- 2) Some project details, such as the project code could not be recalled by the original coder
- 3) The person listed as the USER_ENTERED had only been involved in the data uploading or migration, and the original name had been overwritten
- 4) A generic login had been used, which could not be traced to a particular individual or group of users.
- 5) An incorrect or 'borrowed' login had been used.
- 6) The person in question had left the organization.

However, usually the associated interpreter, coder or project manager was able to provide some further information.

From the USER_ENTERED:CONTENT_CODE borehole plots displayed onscreen in MapInfo, the replies obtained from the users were employed to graphically sub-select groups of borehole interpretations identified by the users as belonging to a particular project, using a marquee or polygon screen selection tool.

The tables of selected boreholes displayed onscreen by this process, were then visually checked to see whether any of the borehole interpretations had already been associated with any BLITH project codes. If the BLITH project information matched the information obtained by the user, then it was copied to all the other sub-selected borehole interpretations. If there was a conflict, then further analysis was undertaken, perhaps approaching the user again to try to resolve the situation.

If of course, no BLITH codes had been associated with the selected borehole interpretations, then the interpretations were updated with a unique project identification code for the associated project, and the project details entered into the SDBR.PROJECT_INDEX table.

In some instances, a particular project may have more than one project codes associated with it. This may be because a project may have had more than one funding source, with a different code for each source. Other projects may have more than one code, because a new code was assigned each year as the project continued. To resolve this issue, project leaders were asked to nominate a preferred project code as the primary one to reference, this was usually the Science Budget (SB) code, which was most likely relate more closely to project aims, rather than other more generic or ancillary codes. Otherwise the most recent or commonly used code was selected.

4 Results

This project has been moderately successful. It was not expected at the beginning that so many borehole interpretations could be attributed to the originating project, although about 70% have been matched.

Particular difficulties were encountered with borehole interpretations located in Scotland, where many non-BGS bores were routinely coded on receipt from the supplier, but could not be associated with a single project. There appear to have been many overlapping projects in the Midland Valley, which has caused some particular difficulty.

Conversely in England and Wales, borehole interpretations were only coded up on a needs basis by individual projects. Many of the projects are widely spaced, but in the urban areas, especially those in London are very closely located, and cannot be easily separated. Large ongoing projects such as some of the Nirex and coalfield work seem to have had many generations of sub-projects.

Unfortunately there have been many staff changes since the digital coding of borehole began at BGS, and many people have left or cannot recall a lot of the smaller projects. However, on the whole, there does appear to be a limited number of projects with a fairly discrete geographical spread. The outputs from this work are the present document, and the Oracle tables SDBR.BHG_PROJECT_CODES, and SDBR.BHG_PROJECT_INDEX.

To tidy up, the BNG Easting and Northing columns in the Project Codes table were dropped at the end of this study, as they are of no further use for the proposed upload or population of the Projects database. In addition, borehole interpretations for which no projects could be determined, which were also deleted.

The list of borehole projects stored in the Project Index table, is reproduced in Table 3, which for reasons of space, does not show some of the less important table columns.

Table 3: Borehole Geology projects

PID	CODE	TASK	NAME	LOCATION
1	009V	01	Blackburn House	Lothian
2	05F	01	Various	Scotland
3	05FA	01	Edinburgh southeast	Lothian
4	05FA	01	Glenrothes	Fife
5	09AA	01	Falkirk	Central
6	09AB	01	Hamilton	Strathclyde

7	09AB	01	Wishaw	Strathclyde
8	09AD	01	Wrexham district	Clwyd
9	09AE	01	Oldbury & Blackheath	West Midlands
10	09AF	01	Forth Estuary	Central
11	09AG	01	Cockermouth west	Cumbria
12	09AH	01	Aberdeen	Grampian
13	09AK	01	Chrisswell School	Strathclyde
14	09AK	01	East Linton	Lothian
15	09AL	01	Coatbridge	Strathclyde
16	09AP	01	Kirkcaldy	Fife
17	09AS	01	Stonehaven bypass	Grampian
18	09AV	01	Bathgate	Lothian
19	09AW	01	Morpeth & Bedlington	Tyne & Wear
20	09AX	01	Dunfermline	Fife
21	09AY	01	Blantyre	Strathclyde
22	09CA	01	Livingston, Bo'ness & Queensferry	Lothian
23	09EG	01	Balgonie	Fife
24	09F	01	Glasgow, Erskine, Dumbarton & Port Glasgow	Strathclyde
25	09FA	01	Howgate	Lothian
26	09FW	01	Tayside north	Tayside
27	09FZ	01	Edinburgh south	Lothian
28	09LV	01	Livingston, Linlithgow & Queensferry	Lothian
29	09RB	01	Southampton district	Hampshire
30	09RK	01	Bedworth Sheet	Warwickshire
31	09RM	01	Stoke-On-Trent Sheet	Staffordshire
32	09RR	01	Fuller's earth	England, Wales
33	27FX	01	Sutton	Nottinghamshire
34	5	01	Stewarton School	Strathclyde
35	56EA	01	Glasgow & Edinburgh	Strathclyde; Lothian
36	57	01	Corsehouse Reservoir	Strathclyde
37	61AE	01	Falkland, Markinch & Leslie	Fife
38	70BC	01	Whitesmith & Riverhead	East Sussex; Kent
39	70BV	01	Core coding 1	England; Wales
40	70FO	01	Covehithe	Suffolk
41	71AF	01	Glasgow phase 2	Strathclyde
42	71DD	01	Edinburgh, Livingston & Inverkeithing	Lothian
43	72AB	01	IMAU, Leeming district	North Yorkshire
44	72AB	01	Scotland & Borders	Scotland
45	72AG	01	Nottingham Sheet	Nottingham
46	72F0	01	LOCUS, City, East London & Essex	London
47	72F0	01	LOCUS, Battersea, Hackney, Romford & Rainham	Locus
48	72FL	01	Hitchen Sheet+E102	Hertfordshire
49	72FX	01	GPS, regional ground-level monitoring	London
50	78AB	01	Falkland	Fife

51	78CA	01	Scotland south	Scotland
52	78CB	01	Ardmore ore terminal	Strathclyde
53	81DH	01	Egremont, Whitehaven & Cleator Moor	Cumbria
54	81DM	01	Seascale & Sellafield	Cumbria
55	81JT	01	Egremont & Whitehaven	Cumbria
56	81JY	01	Egremont & Seascale	Cumbria
57	81KW	01	Whitehaven & Cleator Moor	Cumbria
58	83BF	01	Marston Vale	Bedfordshire
59	83DJ	01	Sellafield	Cumbria
60	83SB	01	Rosyth	Fife
61	B	01	Elgin District	Grampian
62	BORE	01	Scotland	Scotland
63	E09AQ	01	Clyde Valley drift	Strathclyde
64	E09AR	01	Motherwell	Strathclyde
65	E1265S71	01	Midland Valley of Scotland 1	Strathclyde; Lothian
66	E1268S72	01	Southeast England	England
67	E1268S72	01	Ipswich Urban	Suffolk
68	E126972	01	Eastern England	England
69	E1275S72	01	West Midlands	West Midlands
70	E1276S72	01	Vale of York & the Humber	North Yorkshire
71	E1289S76	01	Onshore hydrocarbons and coal resources	England
72	E1324S83	01	Manchester Urban	Greater Manchester
73	E1326S83	01	Swansea & Port Talbot	West Glamorgan
74	E1340S85	01	Coastal & estuarine evolution	Nationwide
75	E1340S85	03	Thames Estuary	London
76	E1362S96	03	DGSM, Midland Valley of Scotland	Strathclyde; Lothian
77	E1362S96	06	DGSM, Nottingham & Melton	Nottinghamshire
78	E1362S96	09	DGSM, Sand & gravel resources	Nationwide
79	E1364S90	01	Geohazard	Nationwide
80	E1422R72	01	Tilbury Archaeological Survey	London
81	E1510R72	01	ECC, East Kent	Kent
82	E1584R85	01	Thames flood defences	London
83	E71CBA12	01	Southern Uplands	Dumfries & Galloway; Borders
84	E72DT	01	Huddersfield Sheet	West Yorkshire
85	E72DW	01	Lancashire & Cheshire	Lancashire; Cheshire
86	E72DYA12	01	East Midlands	Warwickshire; Nottinghamshire
87	E72FOA12	01	Great Yarmouth Sheet	Norfolk
88	E72FOA12	01	Lowestoft Sheet	Suffolk
89	E72FZA12	01	London Basin	London
90	E75FED32	01	Wolverhampton Urban	West Midlands
91	E78CDF12	01	Edinburgh district database preparations	Lothian
92	E82DXA12	01	Whitehaven borehole database	Cumbria
93	E83BN005	01	Thames Water Utilities, London southeast	London
94	E83KJ005	01	Sellafield region	Cumbria

95	E88AB007	01	Central & southern Scotland	Scotland
96	ECF7290003509	01	EA, North Downs	Kent; Surrey
97	ECF9190008801	01	EA, Northwest regional drift characterisation	Greater Manchester
98	ERE91900018	01	Nirex, NDGD database	Cumbria
99	ESB700036	01	Leeds Sheet	West Yorkshire
100	ESB71900025	01	Midland Valley terrain evolution	Strathclyde; Lothian
101	ESB71900026	01	Southern Scotland & Northern England	Scotland; England
102	ESB72900126	01	Eastern England	England
103	F	01	Eltham	London
104	FIFE	01	Fife phase 1	Fife
105	MAFJ	01	Stirling west	Central
106	MVAL	01	Midland Valley of Scotland 2+E55	Strathclyde; Lothian
107	N	01	Croydon	London
108	NGIS	01	Douglas, near Lanark	Strathclyde
109	NGRC	01	Edinburgh & Glasgow	Strathclyde; Lothian
110	REFM	01	Midland Valley of Scotland 3	Strathclyde; Lothian
111	SRC	01	Govan	Strathclyde
112	TEST	01	Test data 1	Strathclyde; Lothian
113	U	01	Glasgow northwest	Strathclyde
114		01	IMAU, Sand & gravel etc resources	Nationwide
115		01	Kinross	Tayside
116		01	Test data 2	Nationwide
117		01	Wandsworth district	London
118		01	Lancaster Sheet	Lancashire
119		01	Glasgow phases 1-3	Strathclyde
120		01	Glasgow phase 1	Strathclyde
121		01	EA, Shrewsbury	Shropshire
122		01	Peterborough Sheet	Lincolnshire
123		01	LOCUS, London projects	London
124		01	Ayr	Strathclyde
125		01	Tyne Valley	Tyne & Wear
126		01	Egremont	Cumbria
127		01	Coalville Sheet	Leicestershire
128		01	Bexhill	East Sussex
129		01	Bradford Sheet	West Yorkshire
130		01	Swillington Sheet	West Yorkshire
131		01	Stragglethorpe airfield	Lincolnshire
132		01	Grantham Sheet	Lincolnshire
133		01	NGRC, E82 core coding 2	Nationwide
134		01	Glasgow phases 1 & 2	Strathclyde

5 Further Work

Suggested further issues to be considered are:

- 1) The Project Codes table, is intended to be used to populate a new Project Code (PID) column in Borehole Geology. This new column would enable all new borehole interpretations and the historical borehole interpretations from this study, to be associated with BGS projects.
- 2) Modifications to the Borehole Geology data entry application, so that users must specify a default project code before any boreholes can be coded, would be ensure this information is captured for all new borehole interpretations. The code entered must be selectable only from a list of pre-existing valid project codes, that have already been added, together with other project details, into the Projects Database. Also, users should also be able to change the default project code, so that they can work on a different project without requiring to logout and back in again.
- 3) The facility for users to be easily able to add or remove borehole interpretations to or from a particular project, by means of a graphical interface, if this information is known.
- 4) The Project Index table is intended to be used to populate the Projects Database, but it is recommended this data is used to create a linking table for project codes that need to be either amalgamated in the case of multiple codes used by one project, or split where a project code has been used for more than one project.
- 5) The ability for users to be able to edit the assigned project name, perhaps to make it more meaningful, or change the primary project code, if perhaps another funding code is more relevant to a particular project in the index table should be considered.
- 6) A borehole project index window on the intranet, displaying a list of all identified Borehole Geology projects in one frame, with a map of the UK showing all the project areas in another, would probably be very useful. Users could select a project from either frame, to be then taken to either view further project details or the interpretations stored in Borehole Geology. This would make Borehole Project information more accessible to a wider audience, help geologists to easily see what data is available, and if there is anything of interest to their work.
- 7) The present study will need to be re-run, once the new PID field has been added to Borehole Geology, and the facilities for entering this information have been added to the input application. This is so that borehole interpretations created in the interim can be appropriately ascribed to the originating projects. It would also be a second opportunity to look again at borehole interpretations that could not be sourced back to projects during this first attempt.

Many of these 'self-service' solutions are aimed at enabling users to update and maintain the integrity of future borehole project metadata.

6 Conclusions

At the beginning of the project, there were mixed views about the likely success of this enterprise. However, after resolving a number of technical issues, and analysing the data more closely, it has been shown that the majority of significant projects could be identified, along with the project codes.

Hopefully, this work will enable users to be able to select groups of borehole interpretations, belonging to a particular project, either because it is the region of the country they wish to study, or because the bores were coded to a particular standard. Some borehole projects have focused on a one part of the stratigraphical column; others have just attempted to code all layers to a suitable level of detail.

Many parts of the UK seem to have been exclusive to particular projects. This may be because any missing associated projects were undertaken to the same standard as other, larger projects, and thus may have been amalgamated, or because particular coding projects supplied interpreted logs to other themed projects. Another possibility is that some interpretations may not have been entered, or migrated into Borehole Geology.

To answer these questions, the present study at least provides a starting point for further analysis and investigation.

References

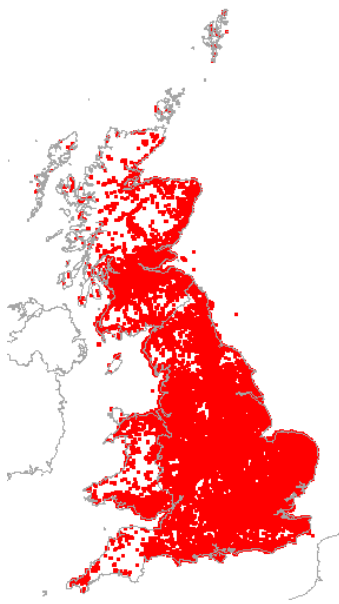


Most of the references listed below are held in the Library of the British Geological Survey at Keyworth, Nottingham. Copies of the references may be purchased from the Library subject to the current copyright legislation.

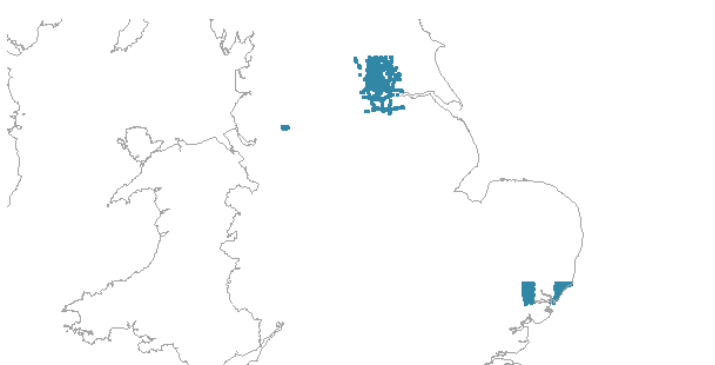
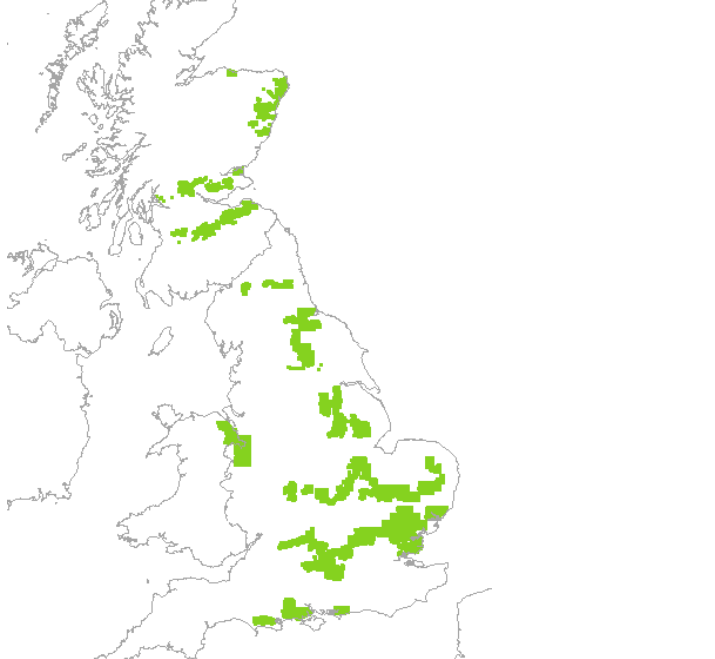
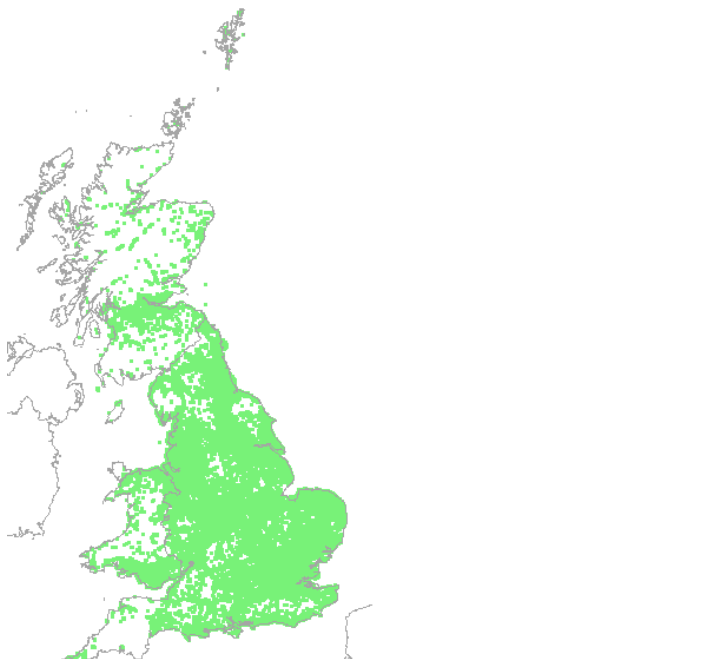
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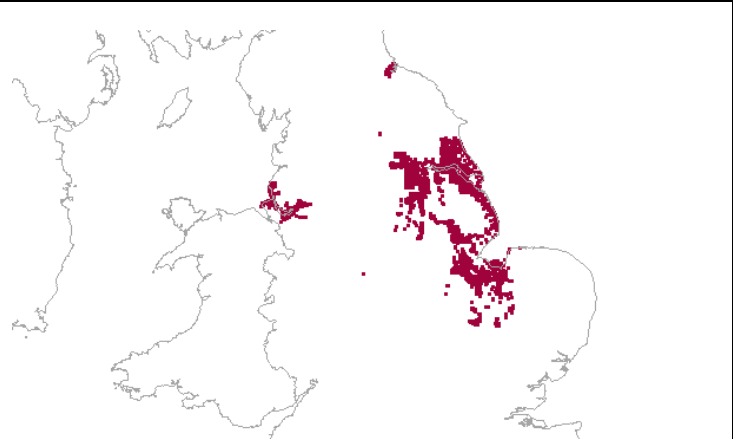
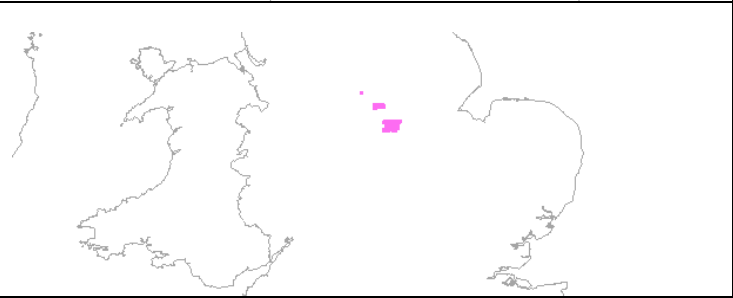
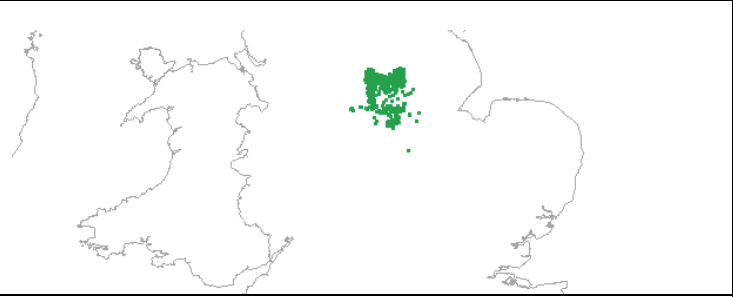
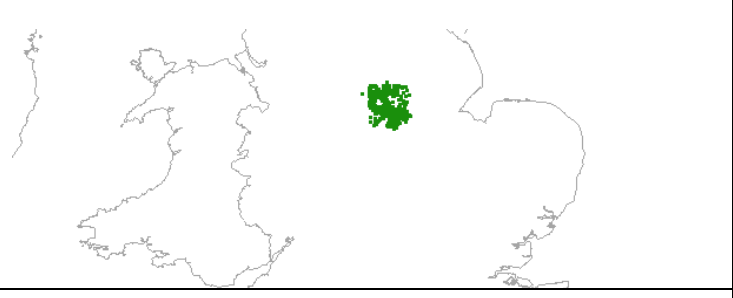


Appendix 1 Boreholes with project-specific content codes


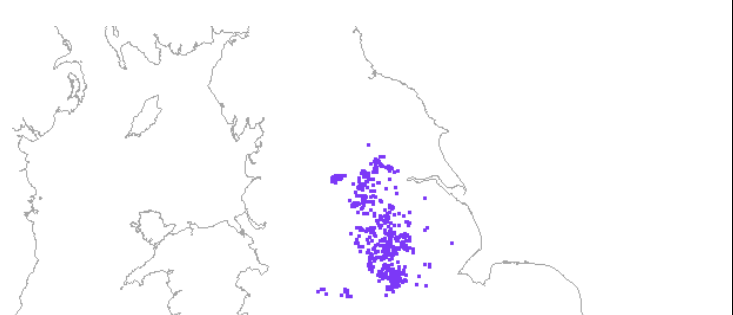
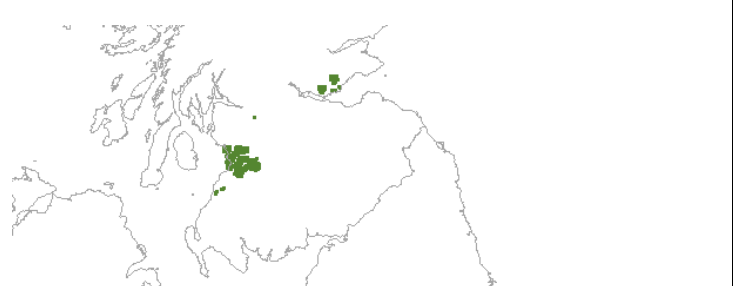
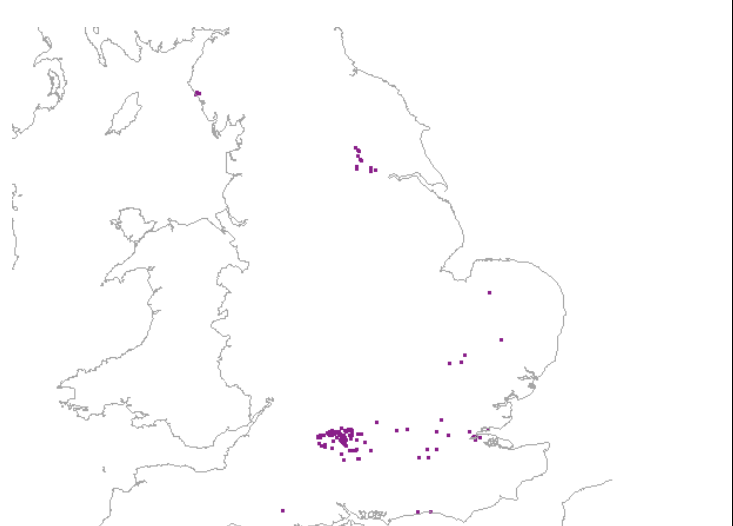
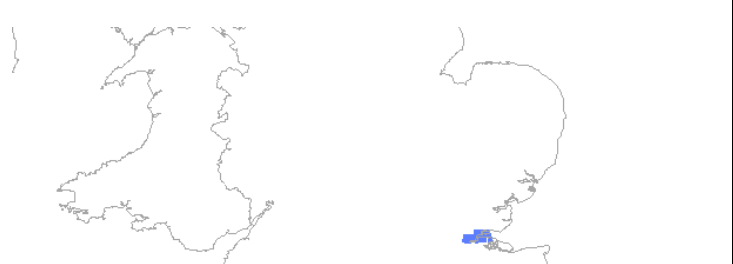
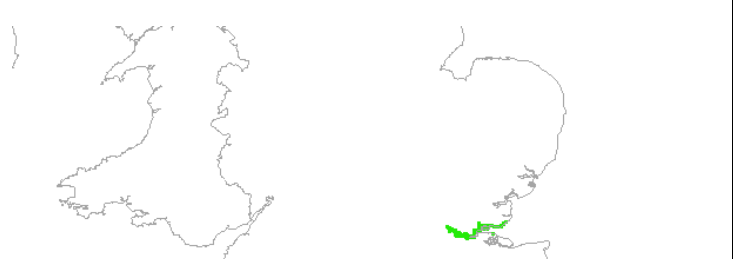
These geographical plots display borehole interpretations classified by content code, where this can be related to a specific project. Other non-specific content code borehole interpretation distributions are plotted in the following section.

Table 4: Distribution of boreholes with project-specific content codes.

Code	Project	No.	Boreholes Coded
All	(All)	547530	
CA	Cilor coding, sub-type A	3582	
DV	Midland Valley DGSM, solid & drift details	18055	

DY	Vale of York, detailed logs	21853	
G	Industrial Minerals Assessment Unit (IMAU)	53511	
L	GeoHazarD	472528	

LO	LOITH	56584	
MS	Nottingham-Melton DGSM liths, drift	4042	
NA	Nottingham Permo-Triass	2873	
NM	Nottingham-Melton DGSM strat, solid (kam ash & dibr = legacy data)	9533	
NS	NDGD Nirex, outline logs	317	
NW	Manchester-Macclesfield Drift, pilot project, PTr > 0.3 m thick	24066	

NX	NDGD Nirex, detailed logs	1602	
OH	Onshore Hydrocarbons and Coal Resources	10955	
OV	Midland Valley DGSM, outline logs	11620	
OY	Vale of York, outline logs	487	
TE	Thames Estuary	10035	
TF	Thames Flood Defences	3885	

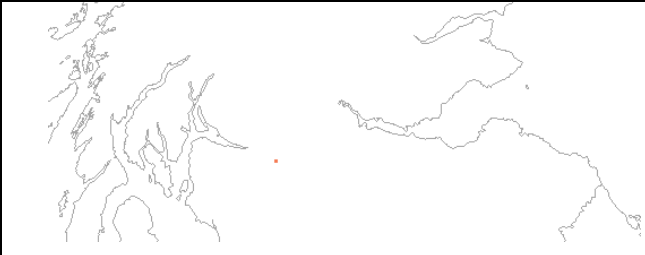


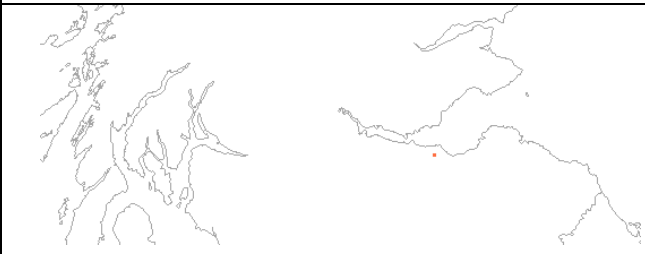
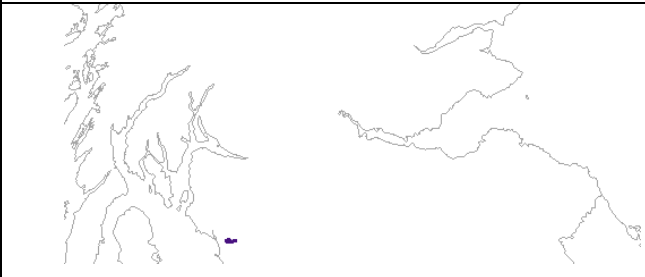
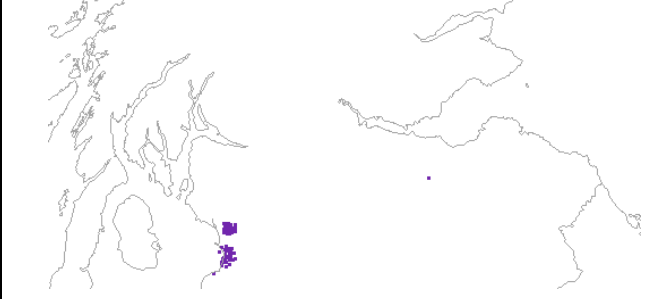
WD	Wellmaster, interpreted drillers' logs	0	Not used
WM	Wellmaster, outline & strat	0	Not used

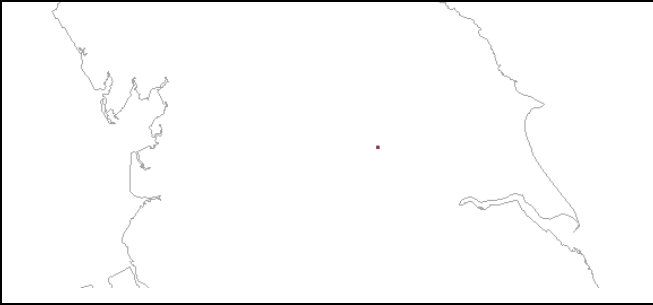
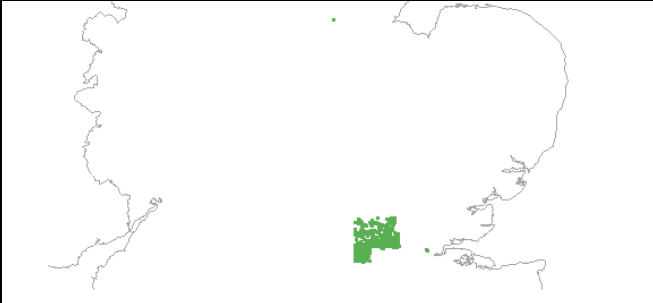
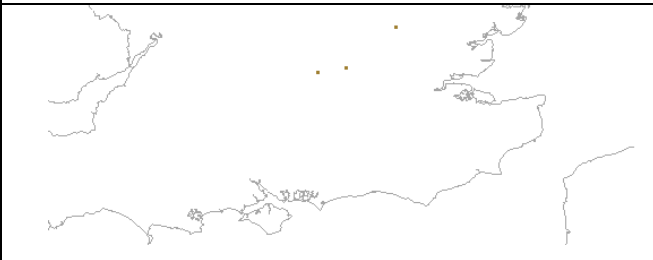
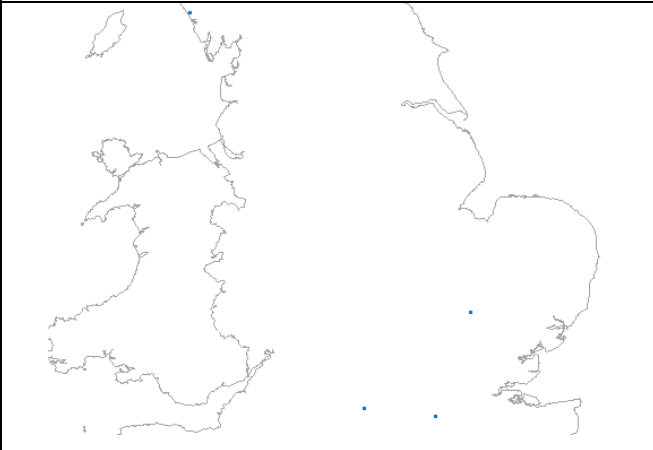
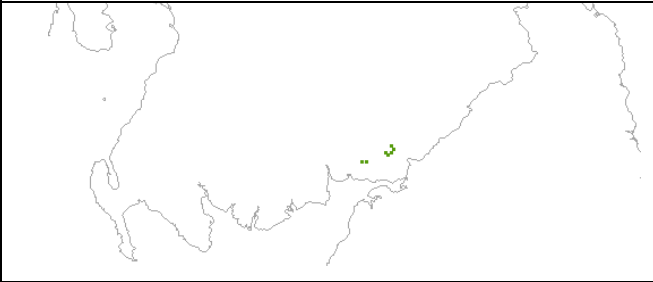
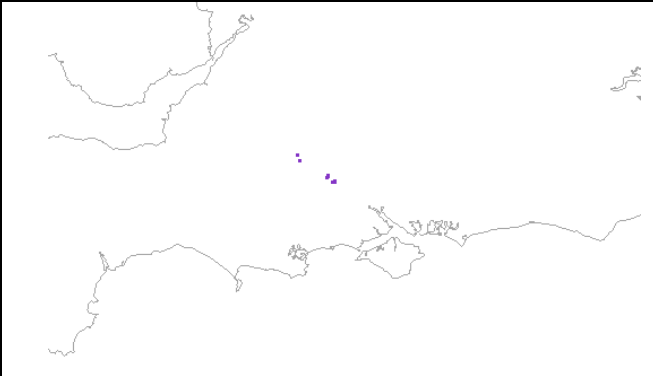
Appendix 2 Other Borehole Project Data

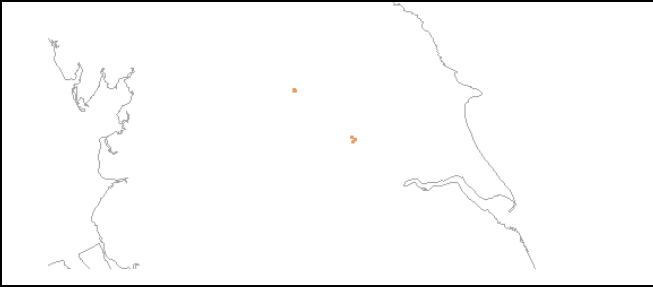
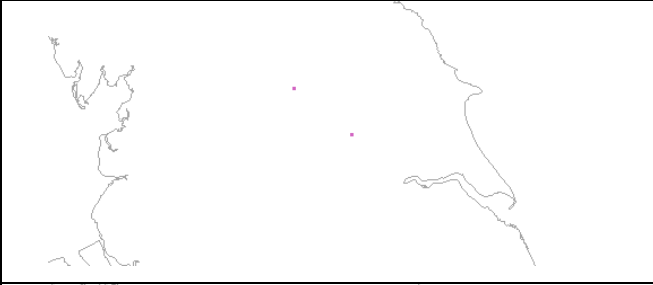
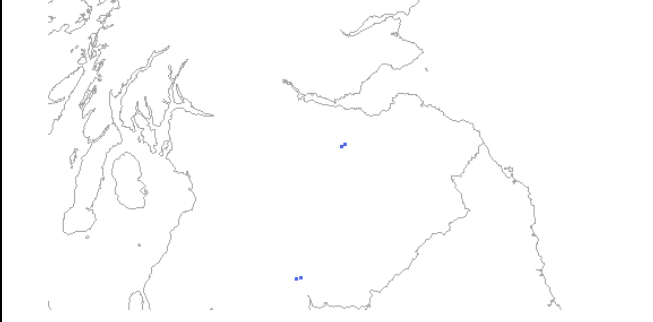
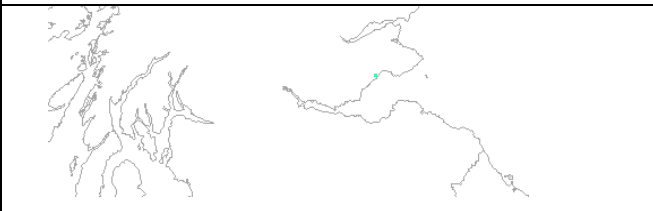
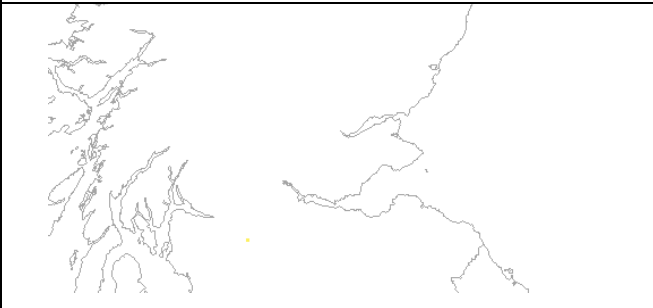
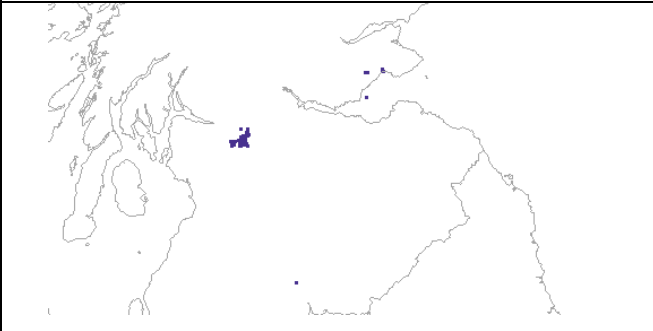
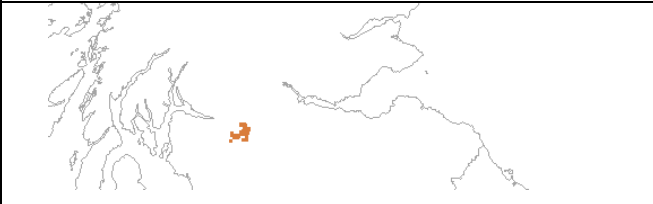
This table of geographical plots of borehole interpretations is subdivided by the login listed in the USER_ENTERED field, and then by non-project specific content code. The coder names were mostly identified from the BGS.META_ORACLE_USER table. For some names, no match was found, but in some cases this could be identified anyway, or determined from other coded information. Not all such users were necessarily associated with the coding or interpretation of boreholes, as discussed in the previous section of this document. Crossed-out names indicate BGS persons who have left the organisation.

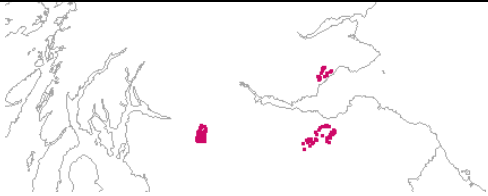

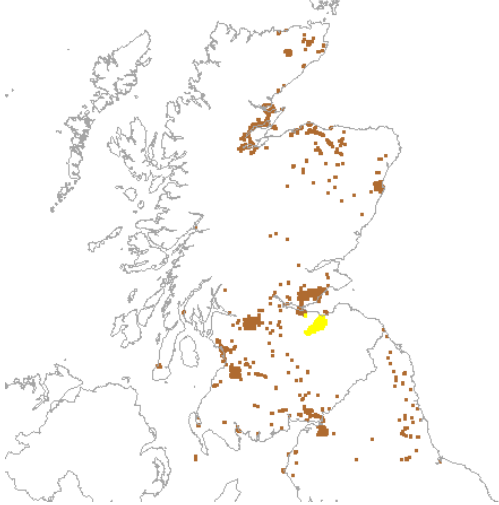
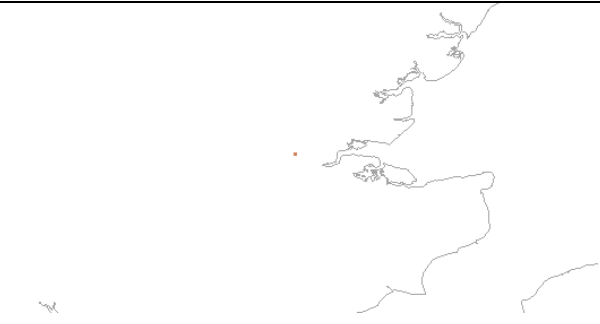


Table 5: Distribution of boreholes by coder, excluding project-specific content codes.


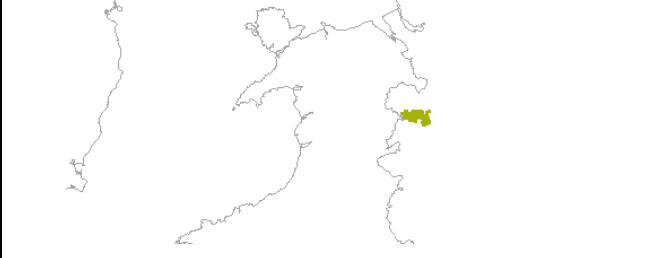


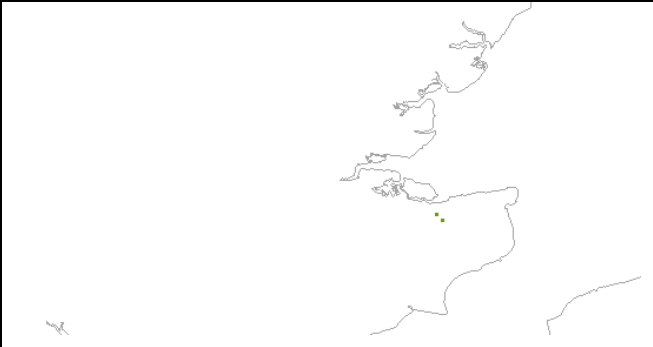

Coder	Id	Cc	No.	Boreholes coded
Alan Weller	AWEL	X	4	
Alison Dunlop	E_EPS2	1	5	
Alison Dunlop	E_EPS2	F	17	
Alison Dunlop	E_EPS2	M	1	

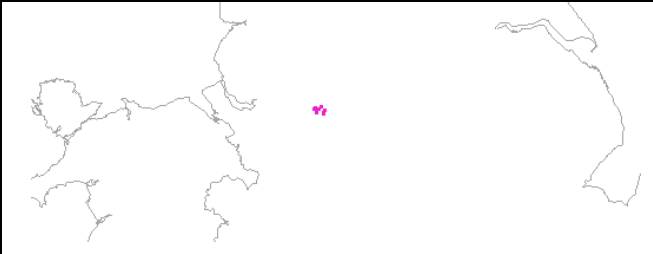


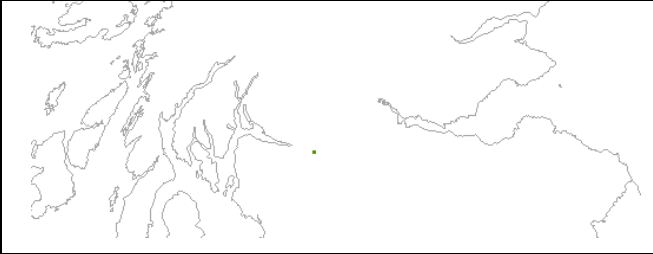


Alison Dunlop	E_EPS2	P	1	
Alison Dunlop	E_EPS2	Q	81	
Alison Dunlop	E_EPS2	R	67	
Alison Dunlop	E_EPS2	X	9	
Alison Monaghan	ALS	R	13	
Alison Monaghan	ALS	X	232	


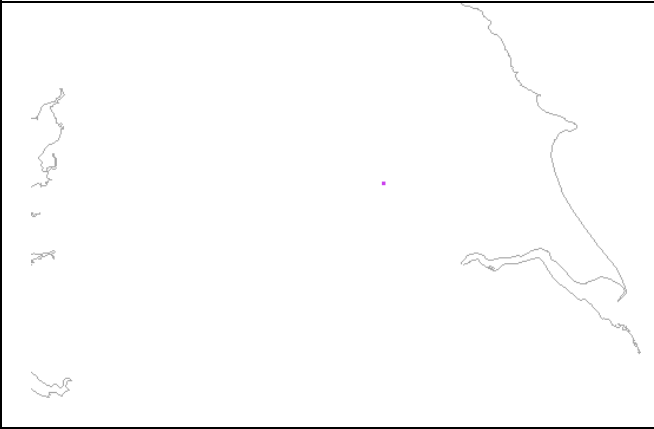
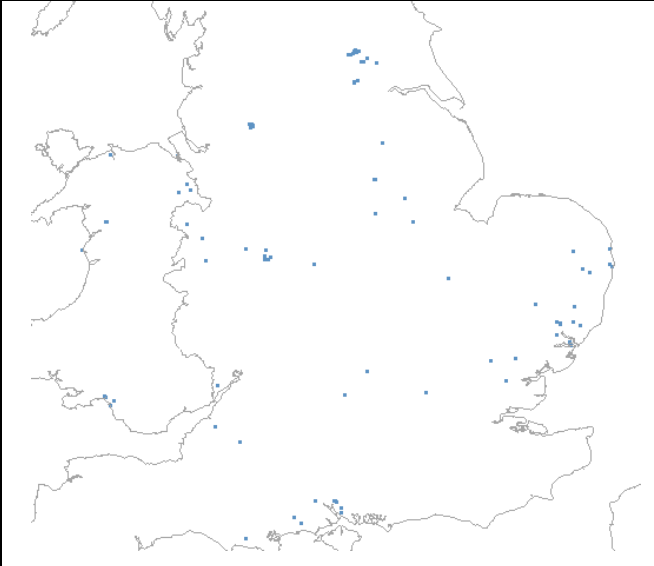
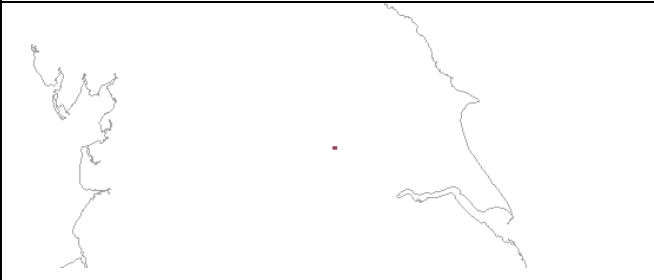
Amanda Richardson	ARICH	X	1	
Amanda West	ARWE	X	2274	
Amit Arora	AARORA	X	3	
Andrew Kingdon	AKI	X	5	
Andrew Macmillan	AAMC	X	9	
Andrew Newell	AJN	X	17	

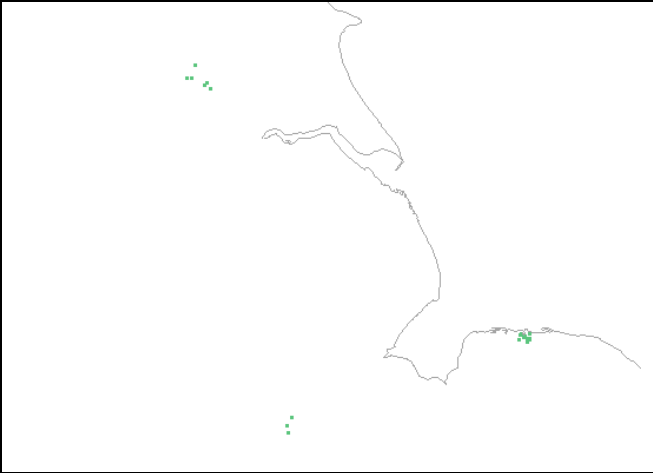
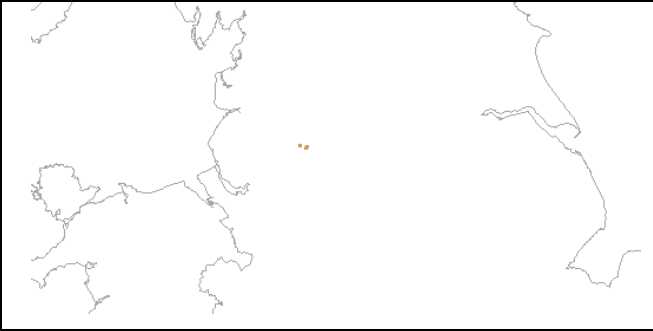
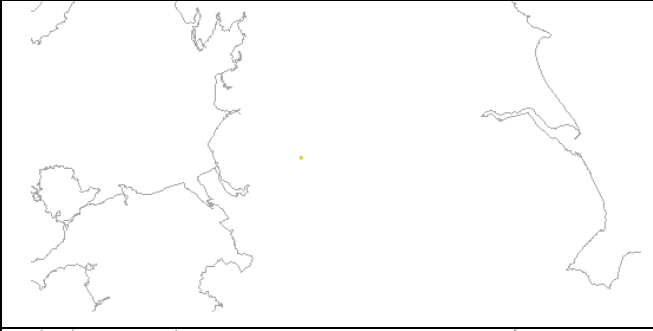
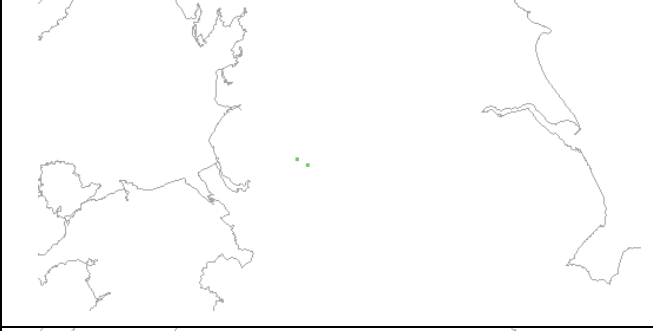
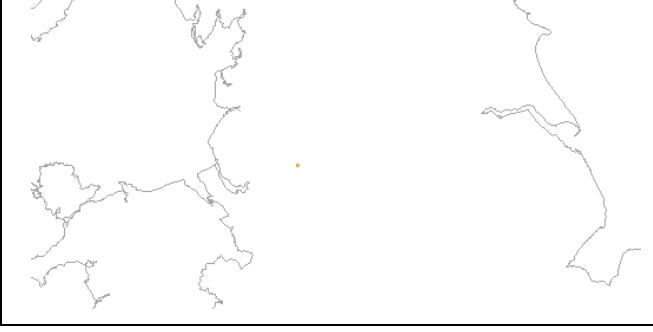
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Anthony Cooper	AHC	X	13	
Anthony Irving	AAMI	1	4	
Anthony Irving	AAMI	B	1	
Anthony Irving	AAMI	C	1	
Anthony Irving	AAMI	F	112	
Anthony Irving	AAMI	M	250	


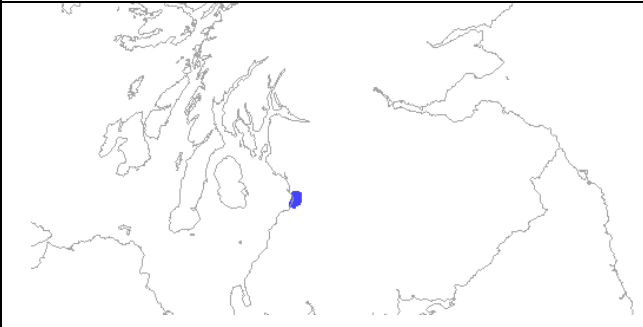
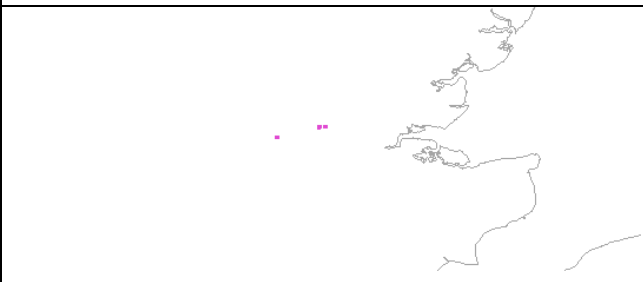
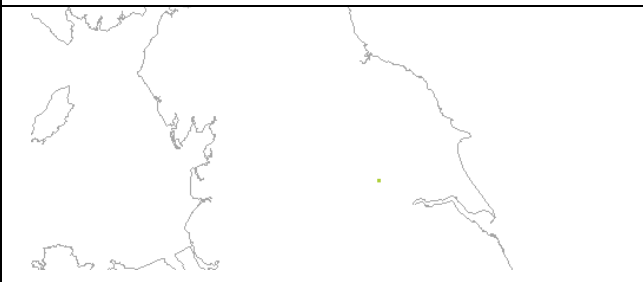
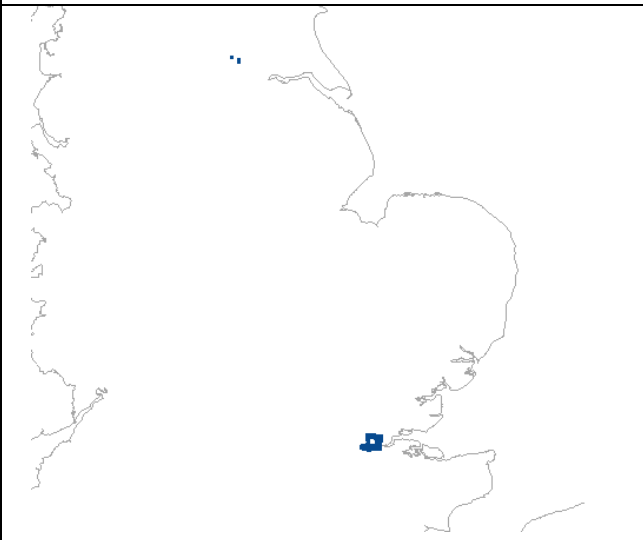
Anthony Irving	AAMI	Q	284	
Anthony Irving	AAMI	R	189	
Anthony Irving	AAMI	X	11559	
Catherine Poulton	CPOULTON	F	1	
Catherine Poulton	CPOULTON	X	1	
Charlotte Vye	CVYE	X	34	


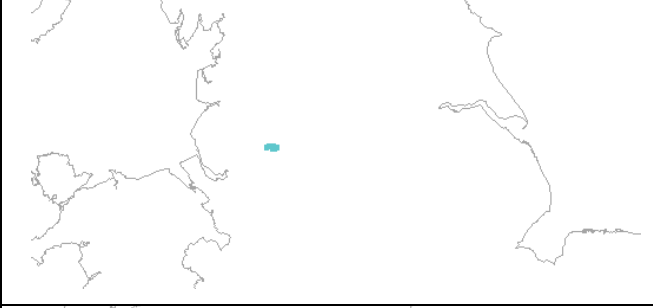
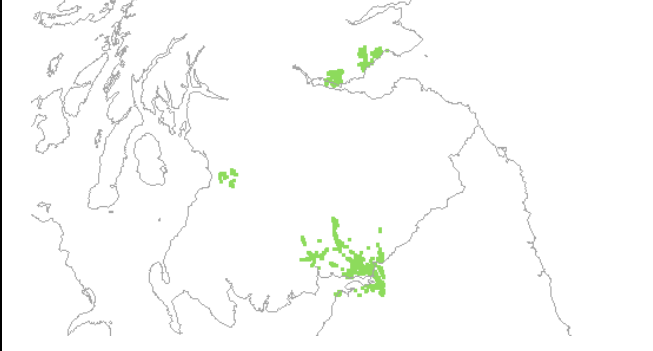
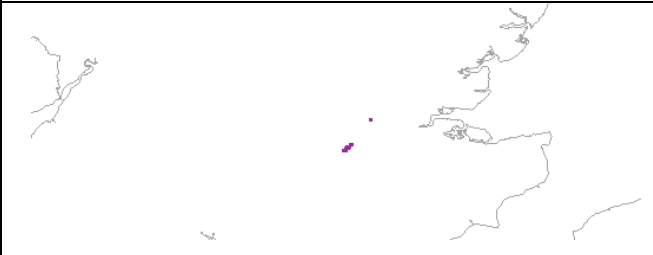

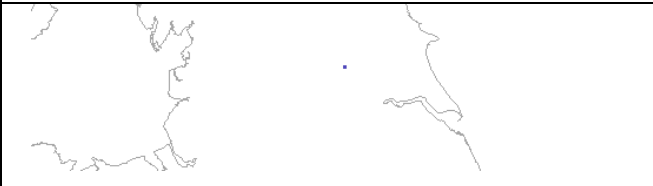
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David Bridge	DMBR	X	308	
David Lawrence	DJDL	P	288	
David Schofield	DIS	X	1121	
Donald Aldiss	DTA	S	2	
Donald Aldiss	DTA	X	306	

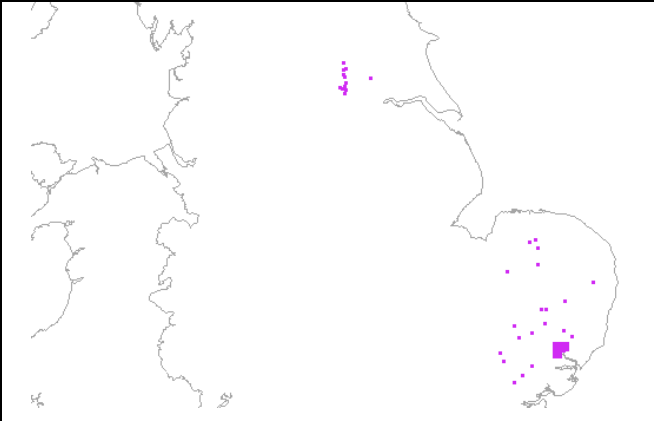


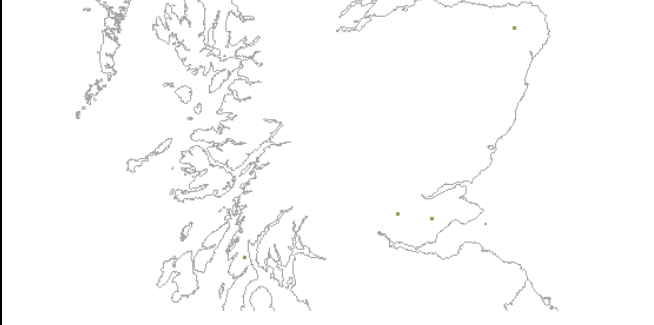
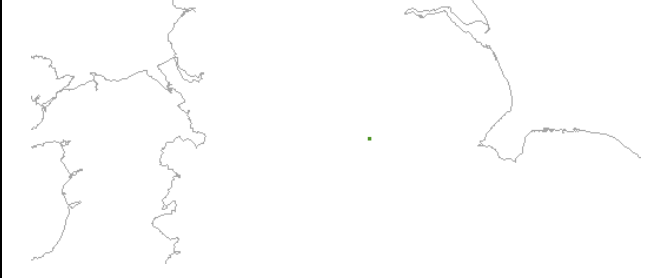

Edward Hough	EH	P	13	
Edward Hough	EH	Q	14	
Edward Hough	EH	X	3506	
Eileen Callaghan	ECAL	F	1	
Eileen Callaghan	ECAL	X	79	
Garry Baker	BHLOAD	M	39	


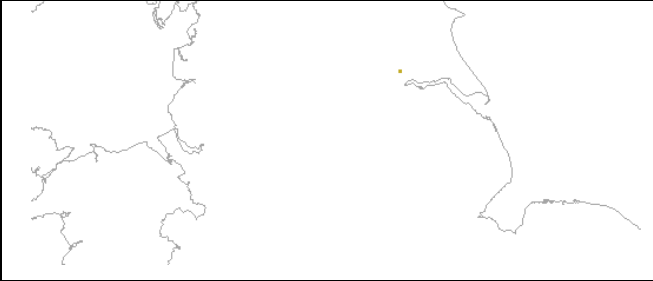
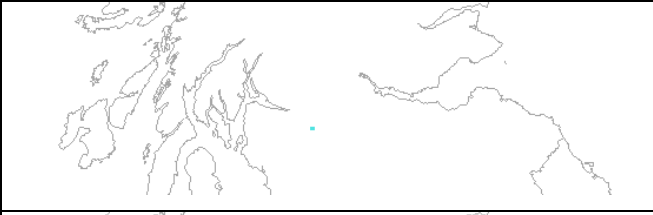

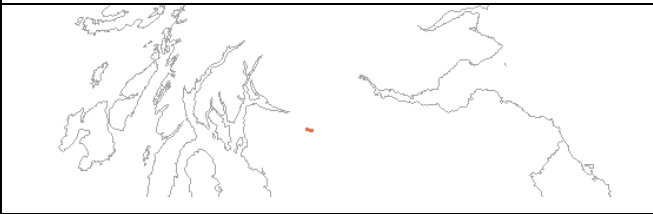
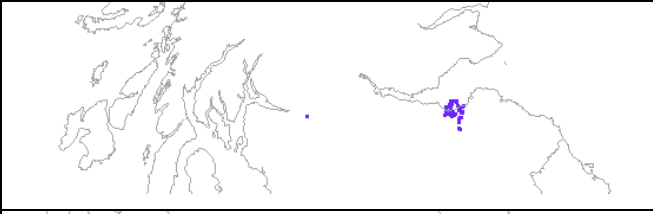


Garry Baker	BHLOAD	X	191	
Helen Burke	HBU	S	1	
Helen Burke	HBU	X	102	
Holger Kessler	HKE	F	9	

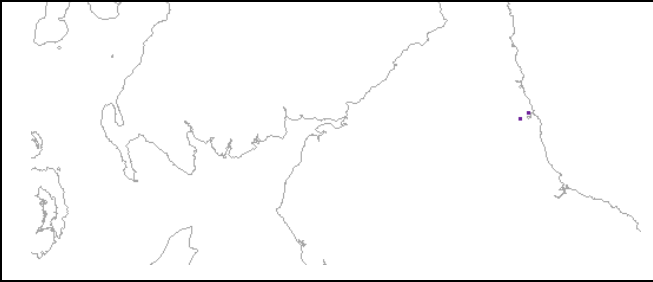
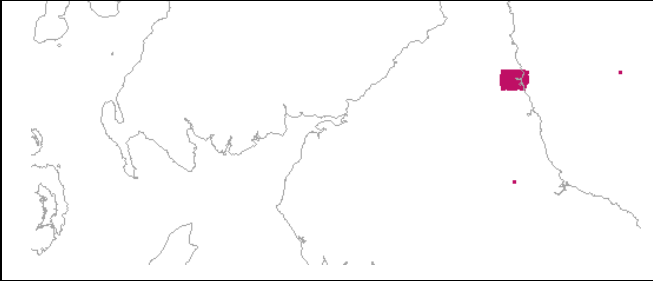

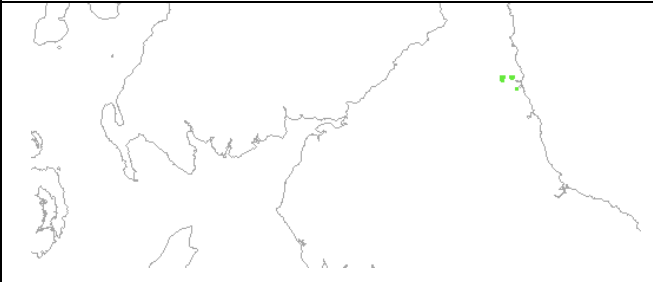
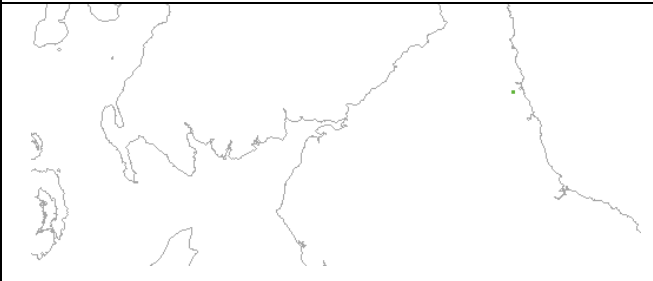

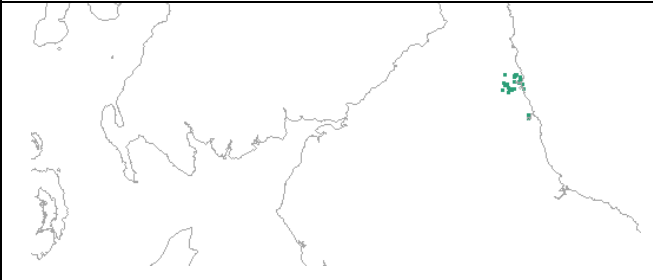
Holger Kessler	HKE	X	32	
James Carty	JCARTY	X	3	
James Woodier	JWOODIER	S	1	
James Woodier	JWOODIER	W	2	
James Woodier	JWOODIER	X	1	

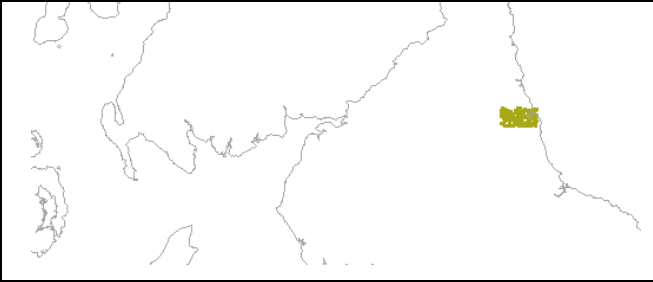
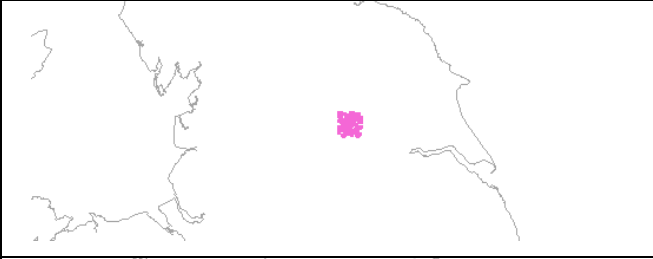
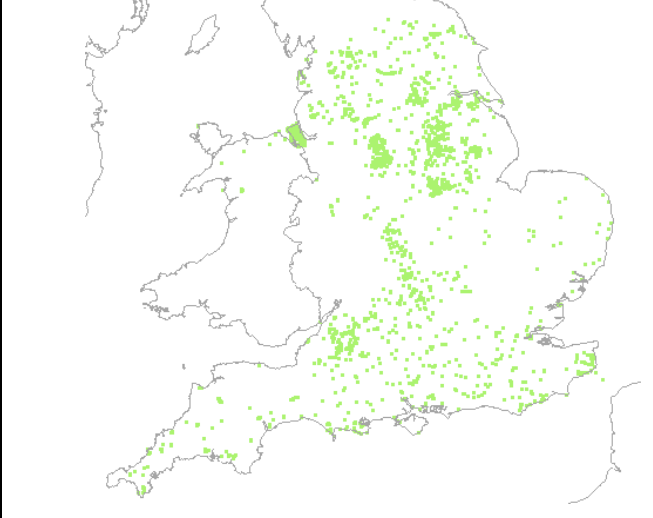
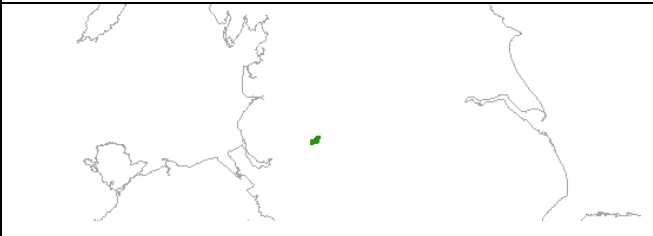
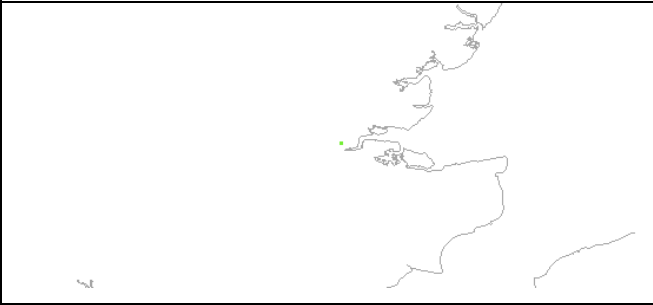

Joanne Venus	JVENUS	X	1	
John Gibson	JRG	R	163	
John Gibson	JRG	X	11	
Jonathan Ford	JFORD	F	1	
Jonathan Ford	JFORD	X	284	

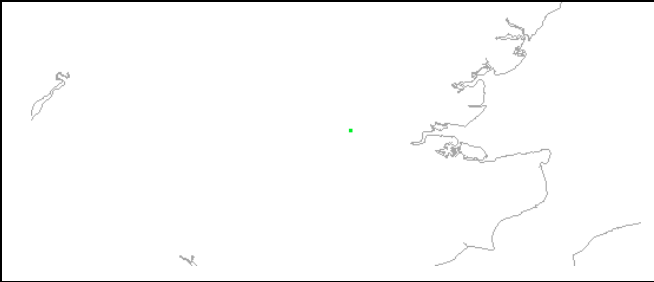
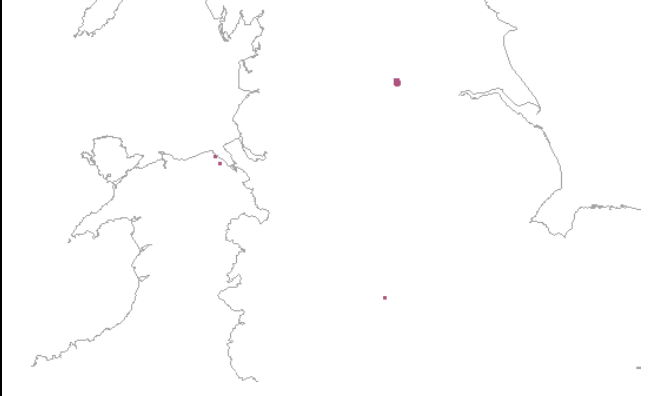

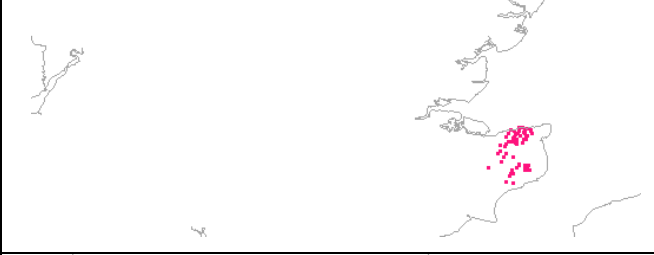
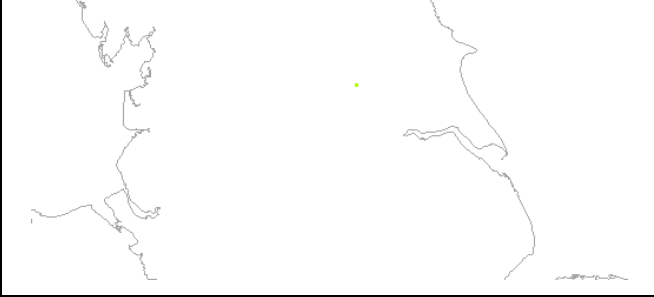
Katrina Cook	KCO	X	1	
Katy Rowlands	KARO	X	130	
Keith Holmes	KAH	X	5028	
Madeleine Samuel	K_MDAS	X	37	
Mark H Shaw	MHSH	F	1	
Mark H Shaw	MHSH	N	1	

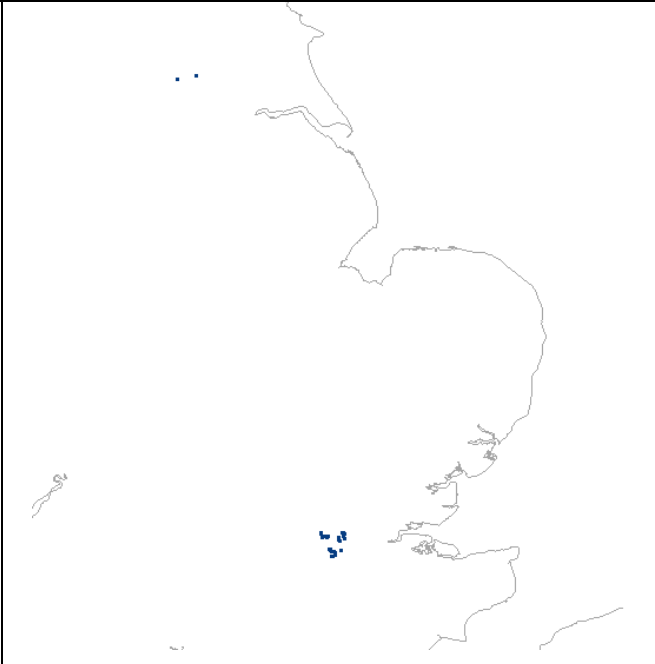
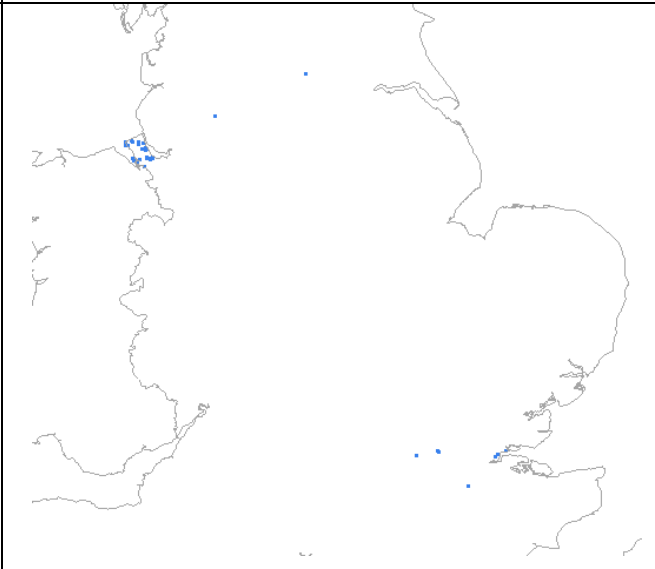

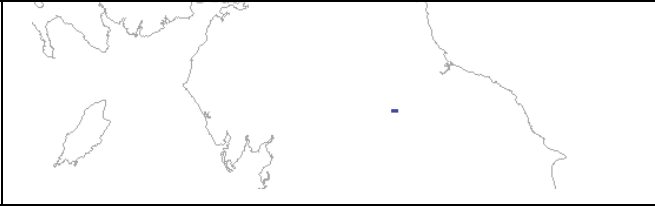
Mark H Shaw	MHSH	X	1024	
Michael Sumbler	MGSU	P	1	
Michael Sumbler	MGSU	X	191	
Neil Halley	DNH	X	6	
Neil Jones	NSJ	M	1	
Neil Jones	NSJ	X	2	

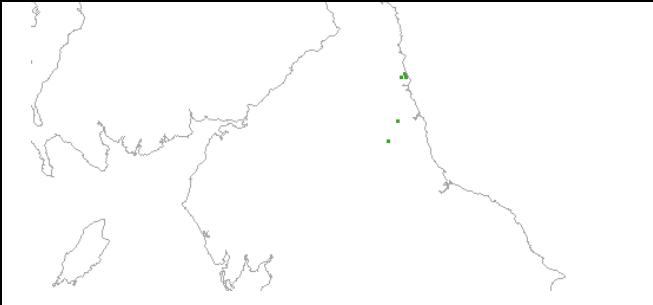

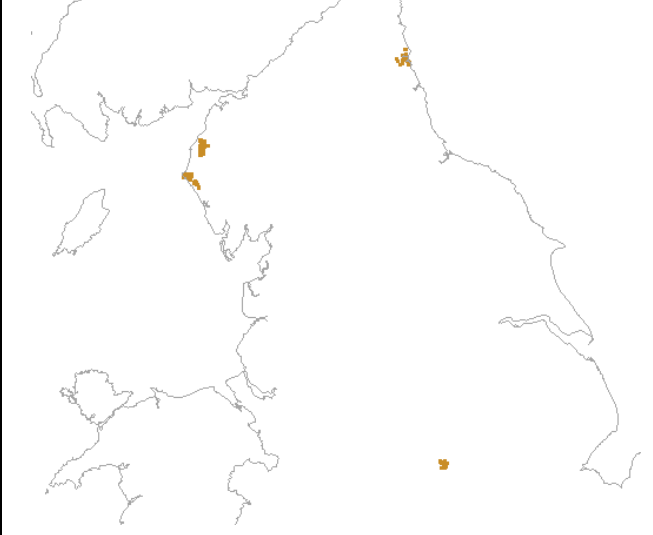


Paul Henney	J	PJHEN	F	2	
Paul Henney	J	PJHEN	X	1	
Peter Halpin		PMHA	M	4	
Peter Halpin		PMHA	P	71	
Peter Halpin		PMHA	Q	3	
Peter Halpin		PMHA	X	55	
Peter Robson		BGS	A	114	
Peter Robson		BGS	B	24	


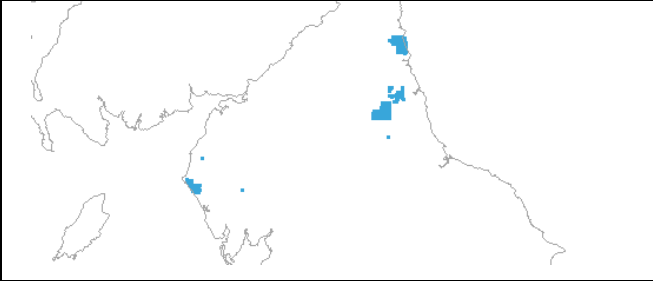

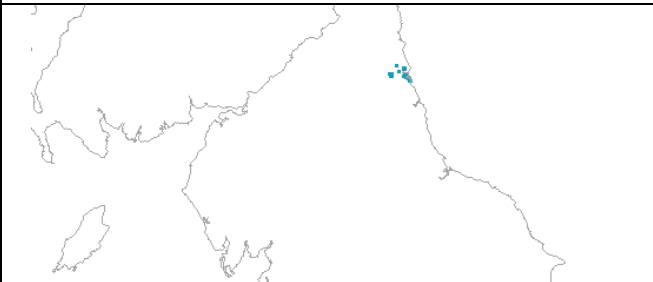
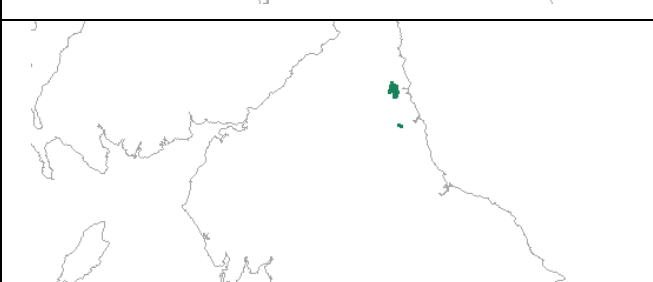
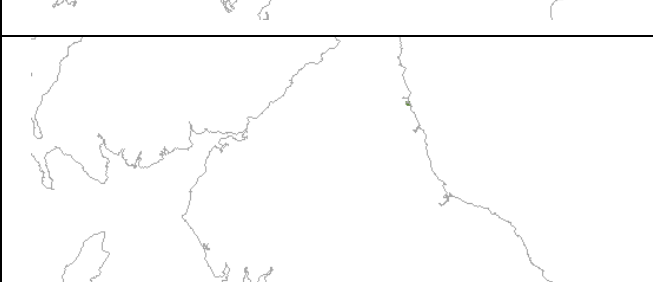
Peter Robson	BGS	C	2	
Peter Robson	BGS	F	1809	
Peter Robson	BGS	N	281	
Peter Robson	BGS	P	17	
Peter Robson	BGS	Q	1	
Peter Robson	BGS	R	5306	
Peter Robson	BGS	S	76	

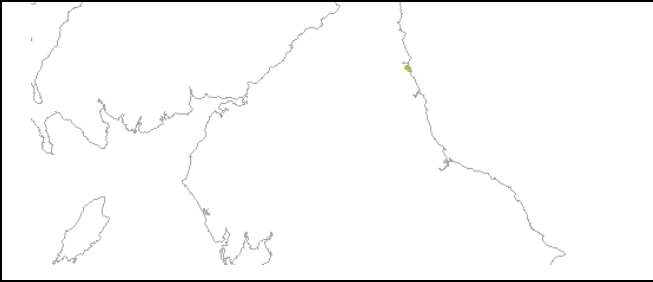
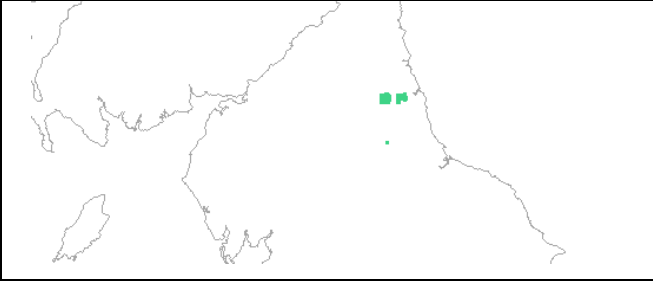
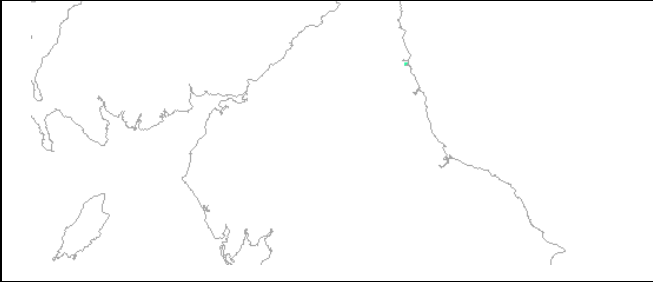
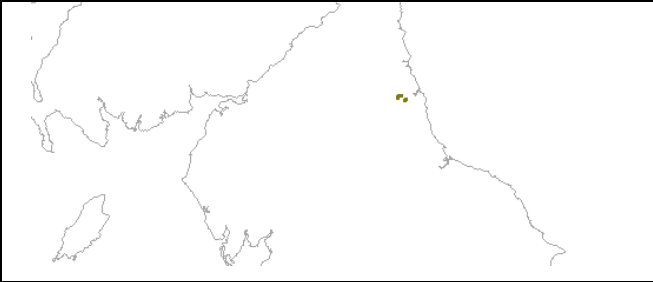
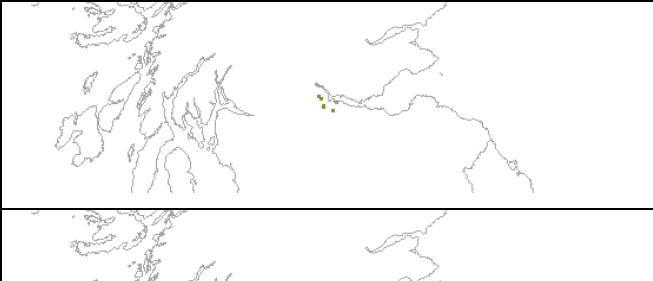

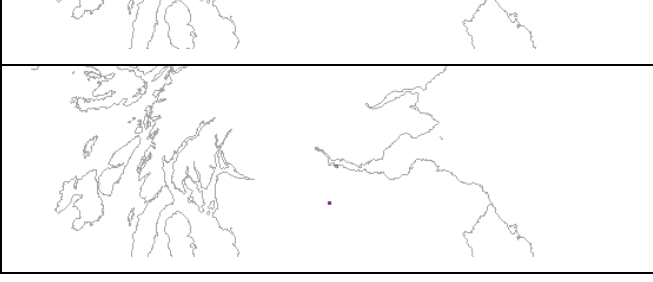

Peter Robson	BGS	X	312	
Peter Robson	PGRO	F	1121	
Peter Robson	PGRO	X	2602	
Richard Ellison	RAEL	X	154	
Ricky Terrington	RTE	X	1	
Roy Fakes	RDF	M	4	

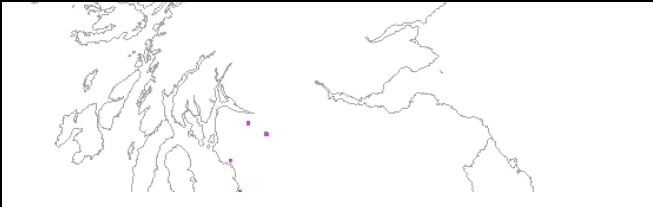
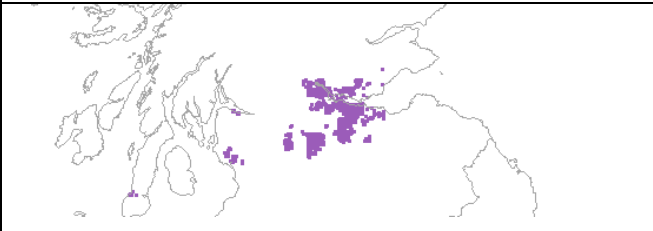
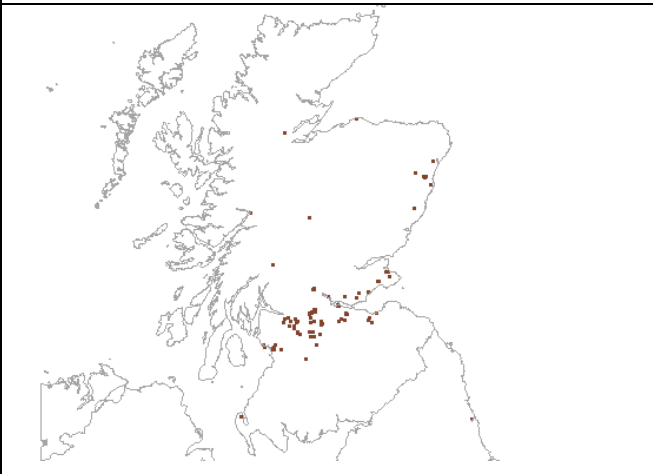
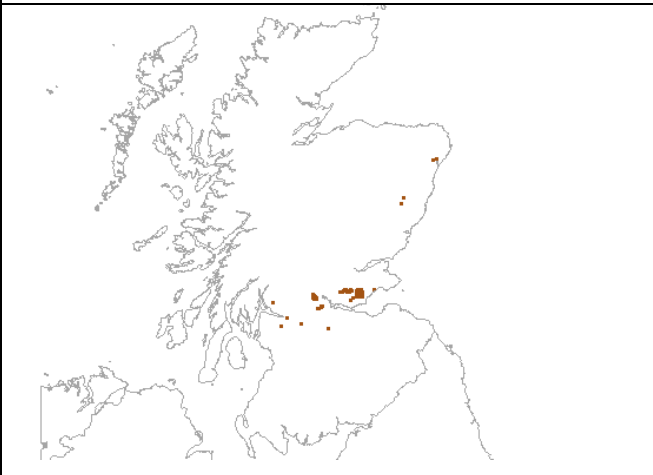
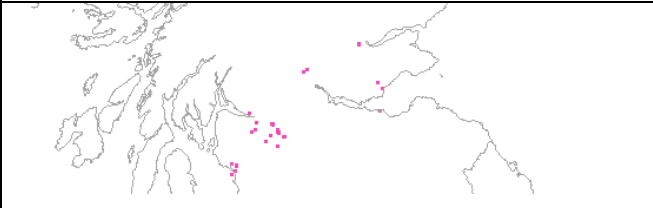
Russell Lawley	RSLAW	F	1	
Russell Lawley	RSLAW	X	15	
Sally Wallwin	SYB	X	2	
Sarah Doran	SDORAN	S	78	
Sarah Doran	SDORAN	X	1	

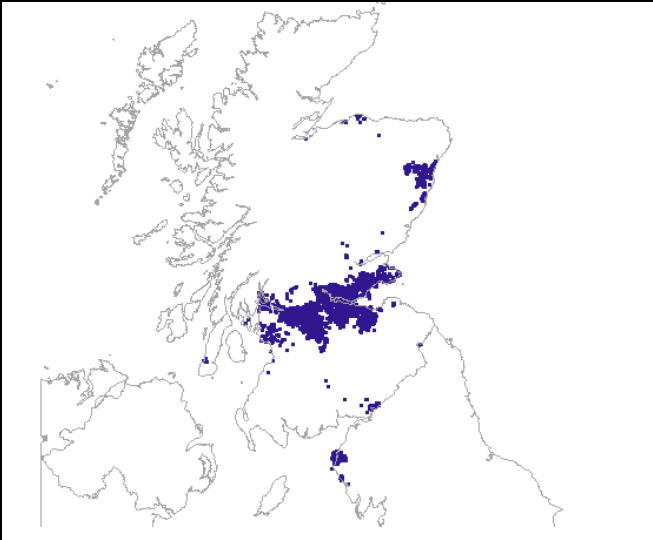
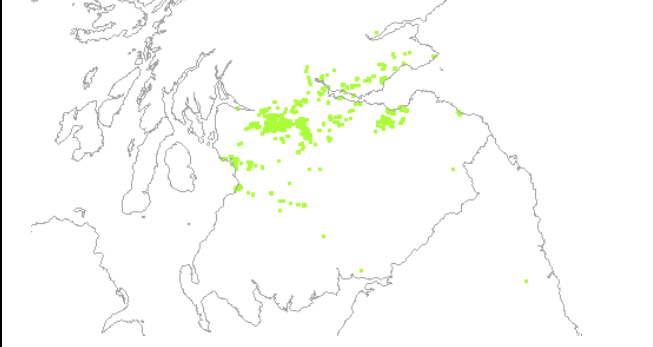
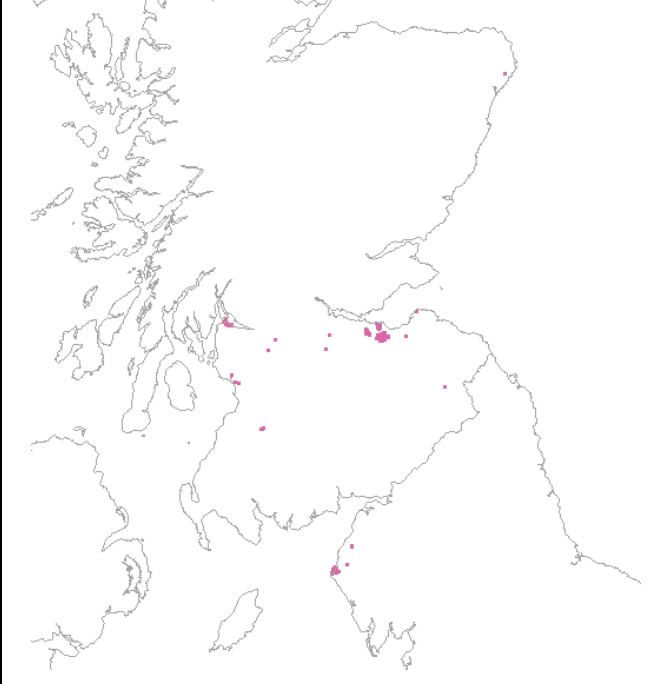
Stephen Brearley	SDBR	F	48	
Stephen Brearley	SDBR	X	41	
Stephen Mathers	SJMA	X	1594	
	AB_WTP	X	2	

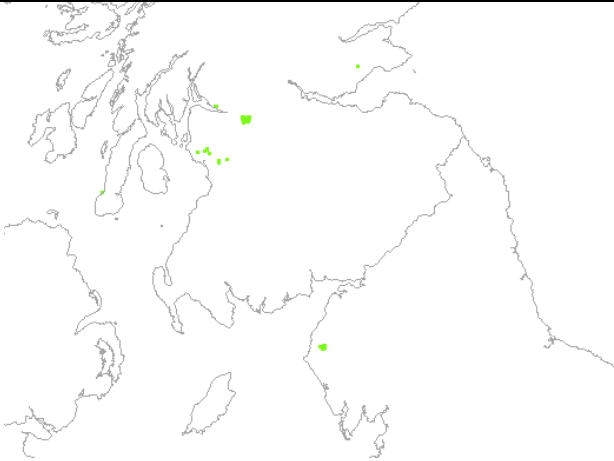
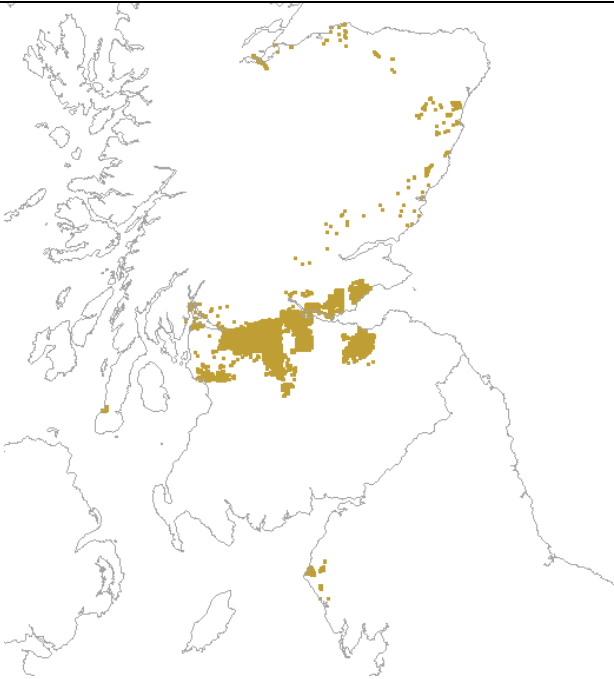
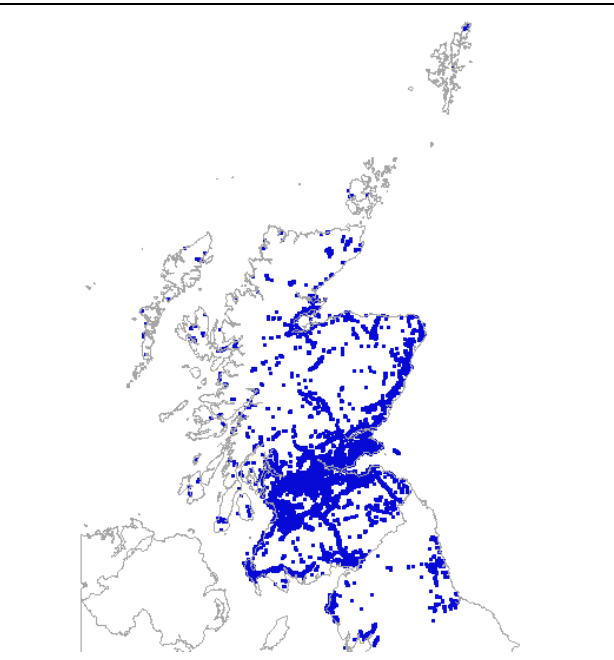
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	EN_BMP_T	C	13	
	EN_BMP_T	F	556	
	EN_BMP_T	N	258	
	EN_BMP_T	P	36	

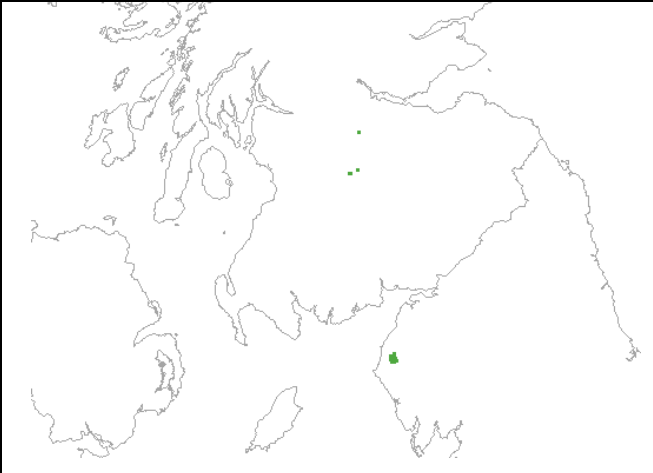
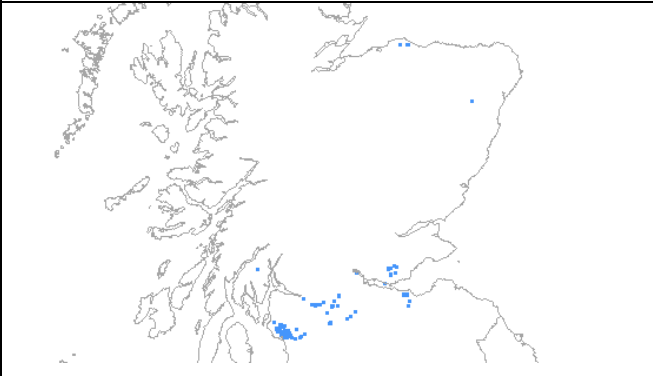
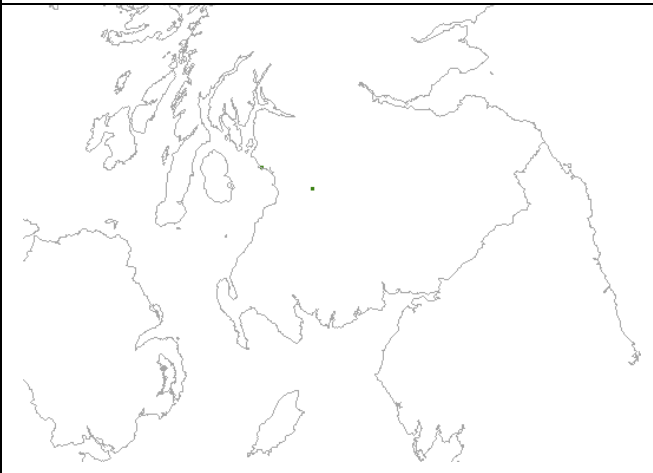
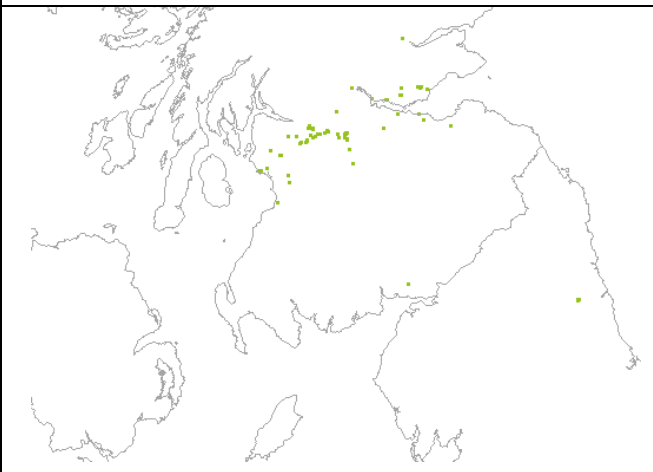
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	EN_BMP_T	R	2225	
	EN_BMP_T	S	82	
	EN_DJDL	A	0	
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	EN_DJDL	F	231	
	EN_DJDL	N	122	
	EN_DJDL	P	9	

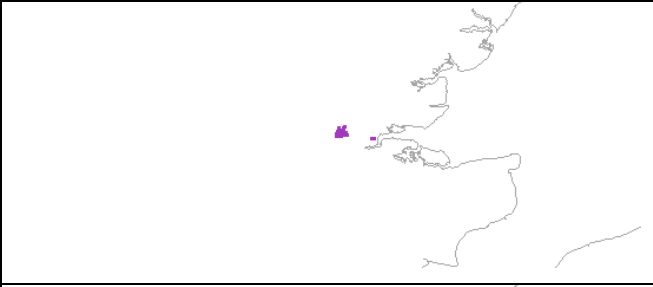
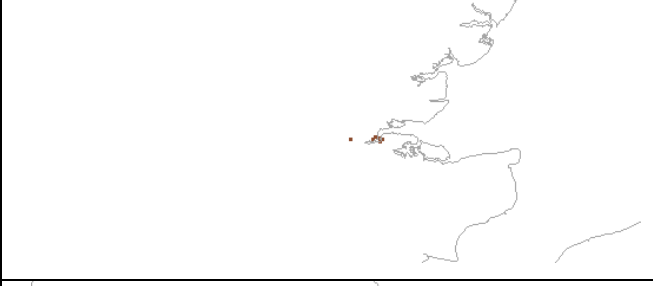
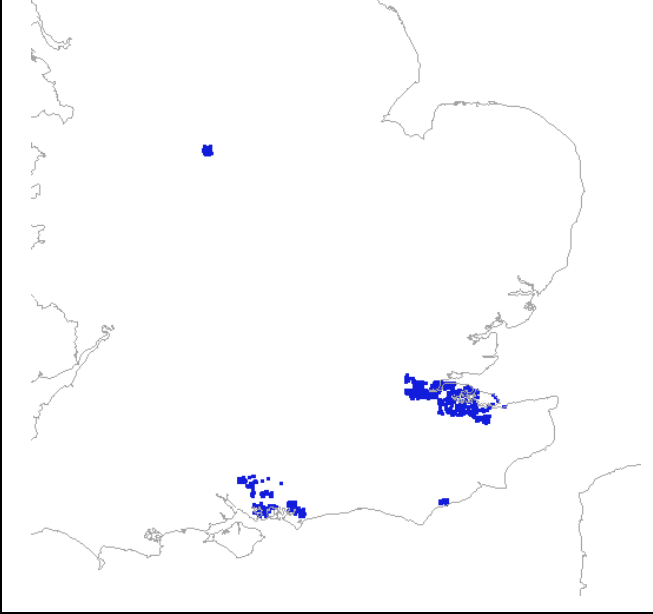
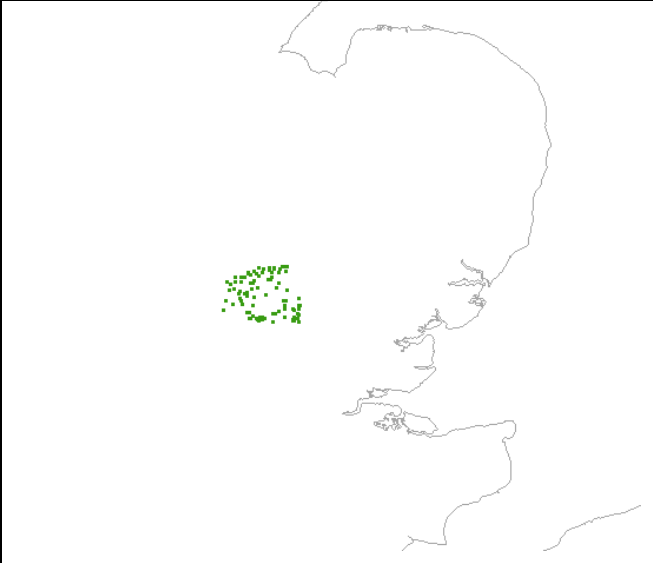
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	EN_DJDL	R	687	
	EN_DJDL	S	1	
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	E_AMA	1	8	
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	E_AMA	Q	5	
	E_AMA	R	2	


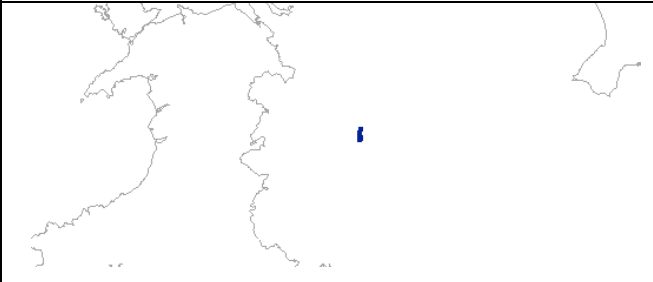
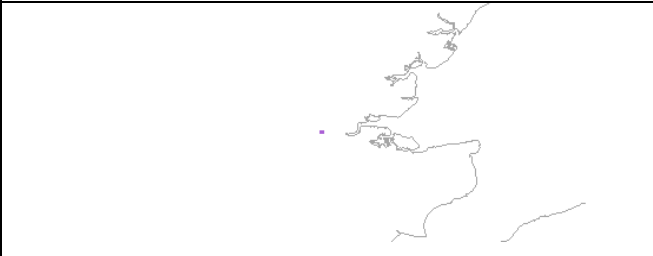
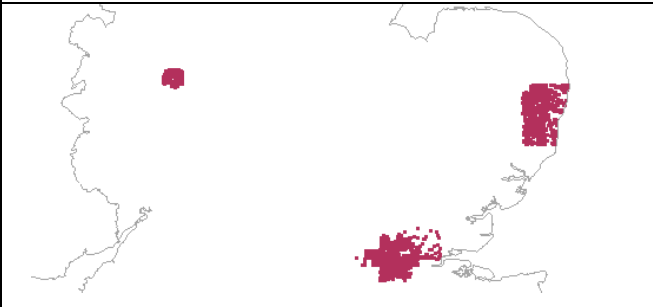
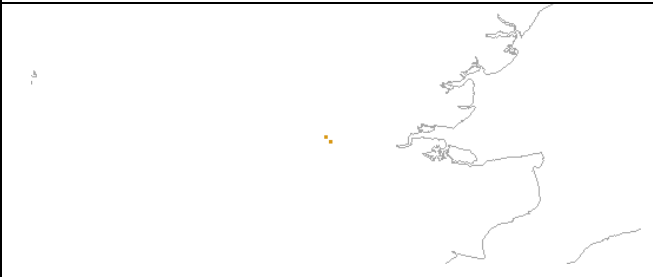
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	E_EPS	A	179	
	E_EPS	B	956	
	E_EPS	C	64	

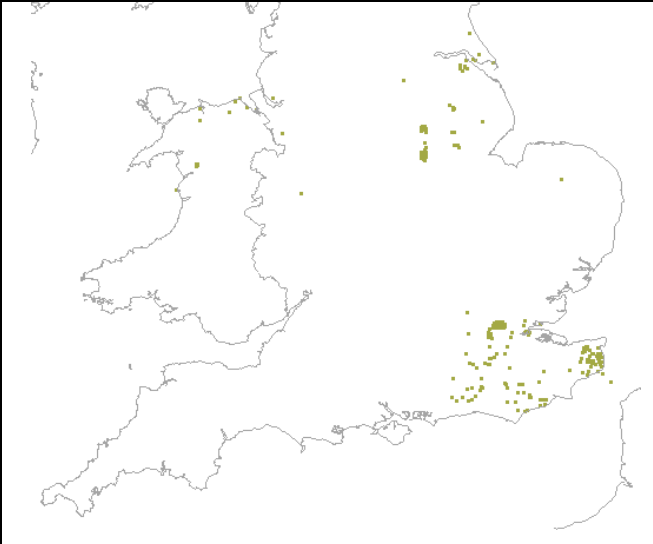


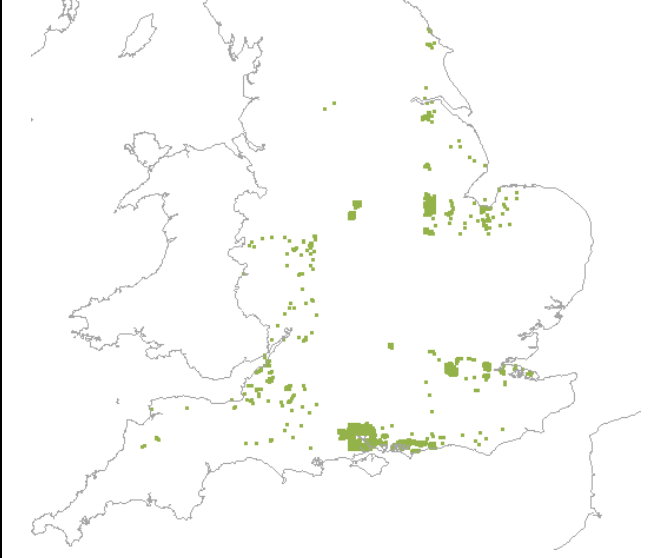
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	E_EPS	N	1247	

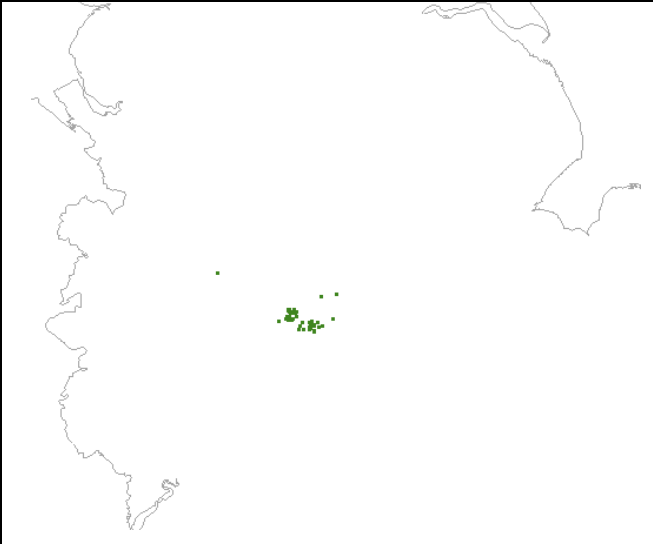
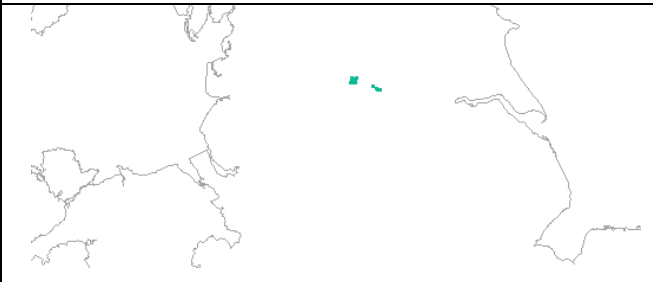
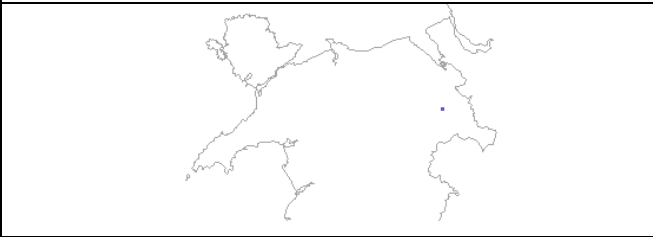
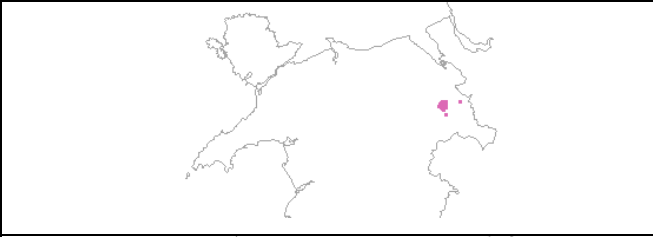
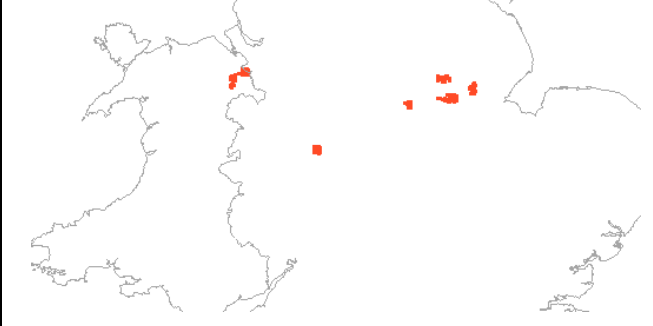

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	E_EPS	Q	28178	
	E_EPS	R	93895	


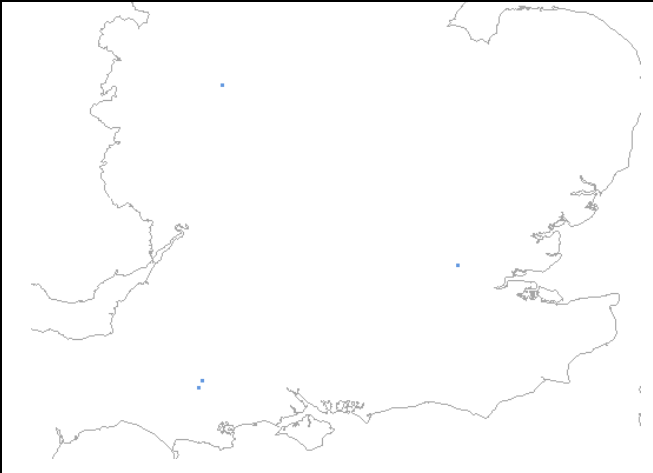

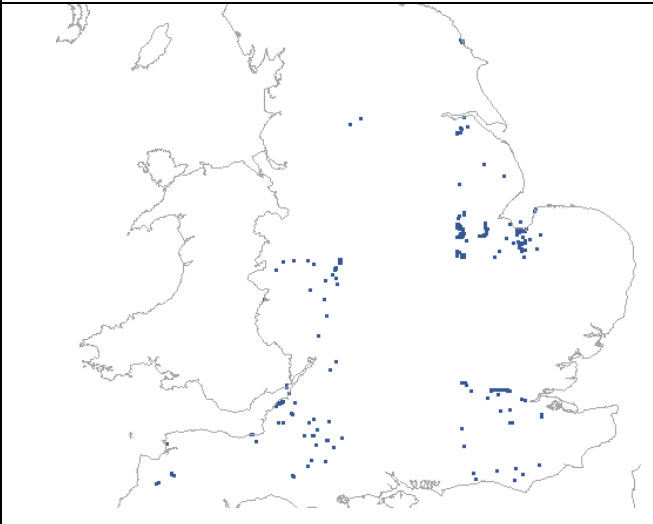

	E_EPS	S	51	
	E_EPS	X	354	
	E_KIGL	M	4	
	E_WJM	M	259	

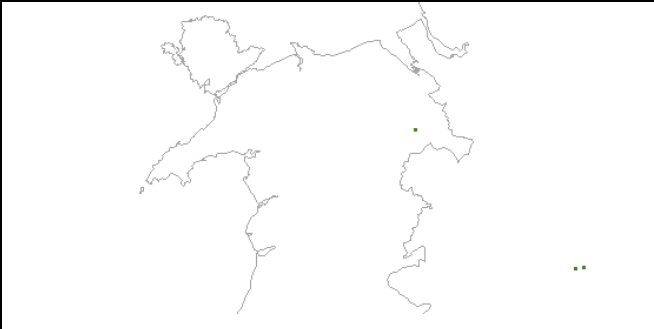
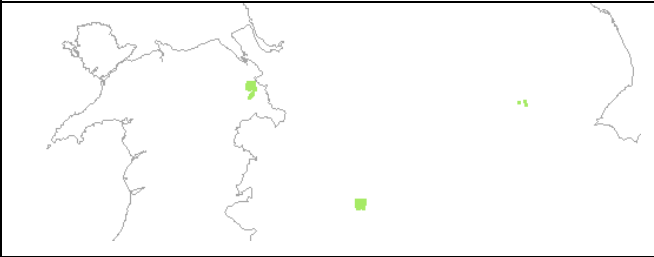



	K_ARS	F	102	
	K_ARS	P	6	
	K_ARS	X	3047	
	K_AS	P	96	

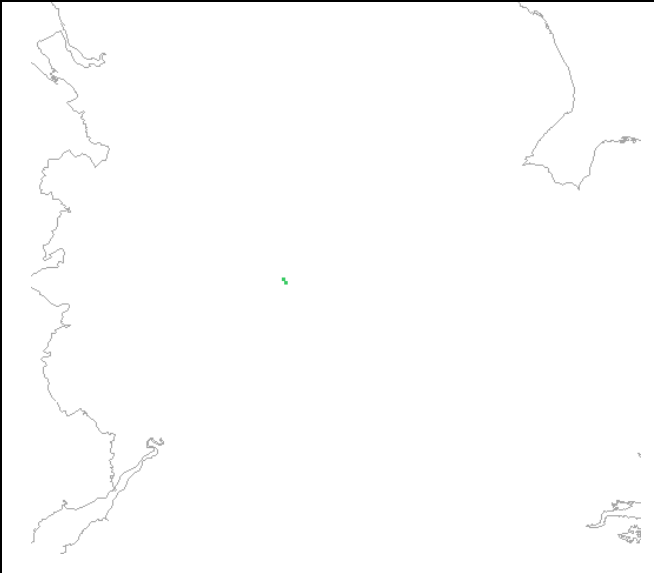
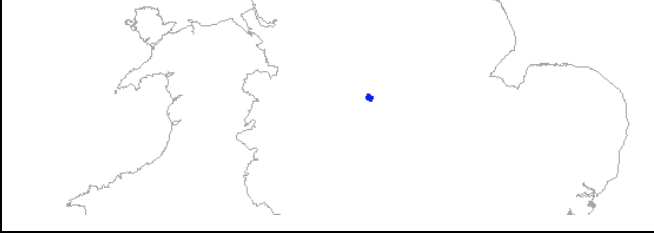
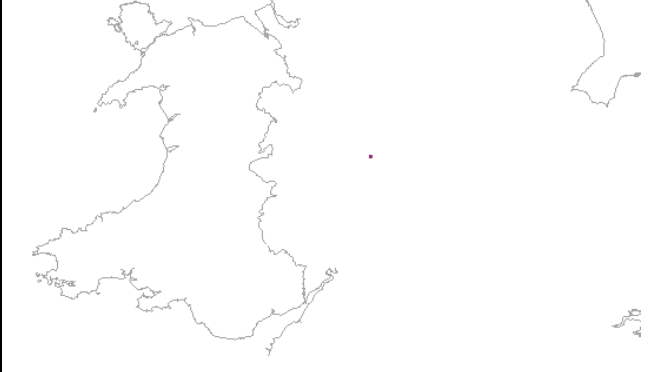
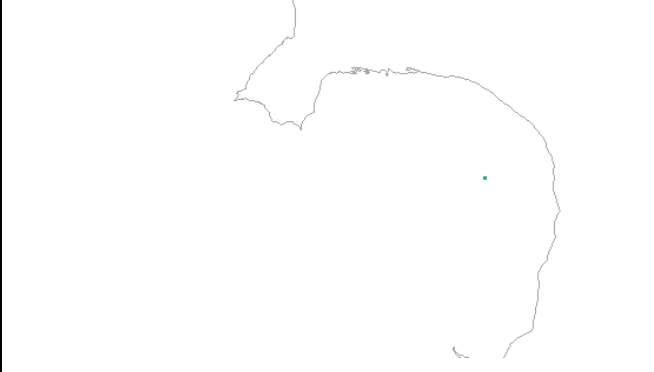
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	K_BORE	A	90	
	K_BORE	B	2	
	K_BORE	F	13400	
	K_BORE	N	2	


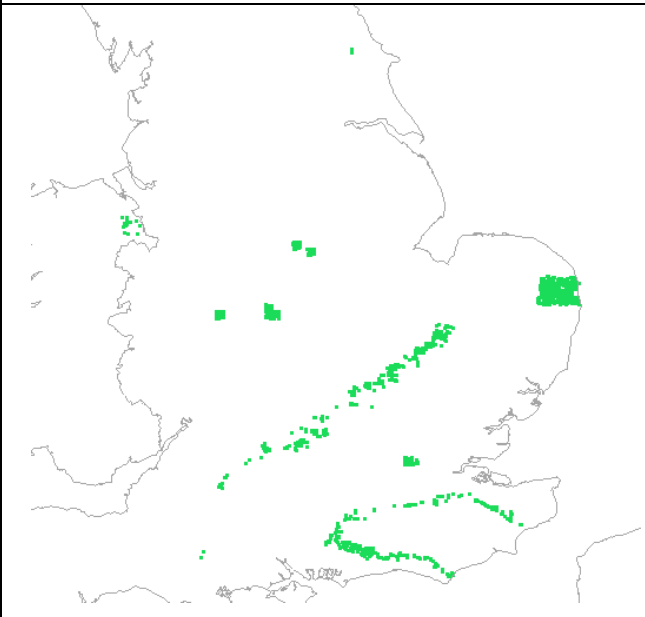
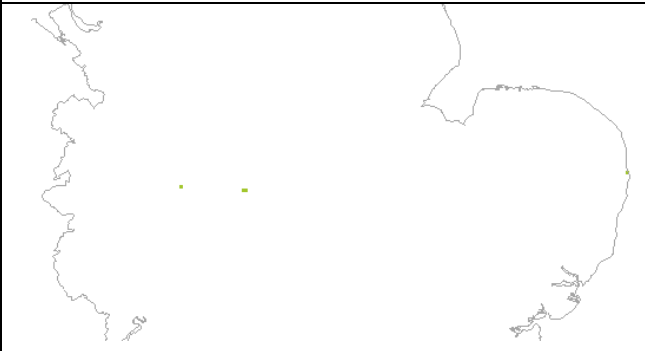
	K_BORE	P	971	
	K_BORE	R	2	
	K_BORE	S	2	
	K_BORE	X	5521	

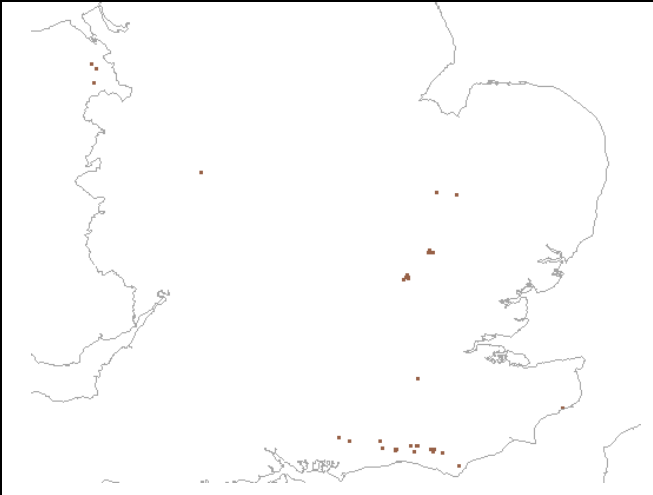
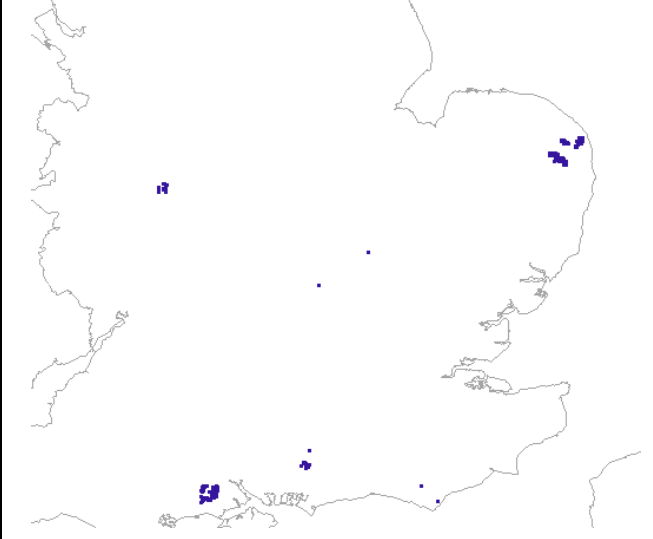
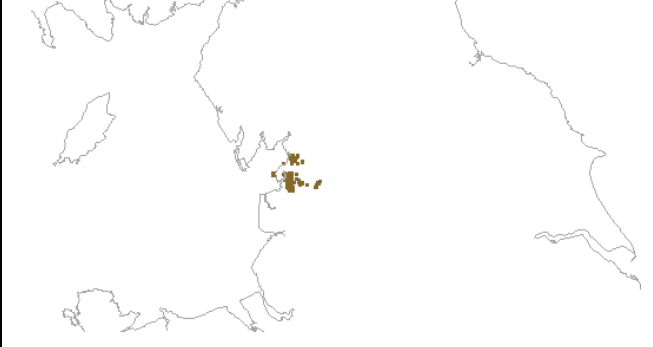

	K_DB	X	93	
	K_DGT_T	X	17	
	K_DJL	A	1	
	K_DJL	B	65	
	K_DJL	F	1043	
	K_DJL	P	843	


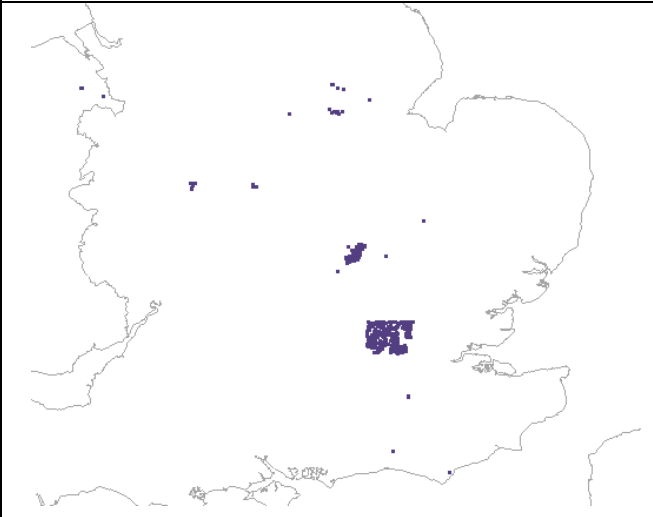
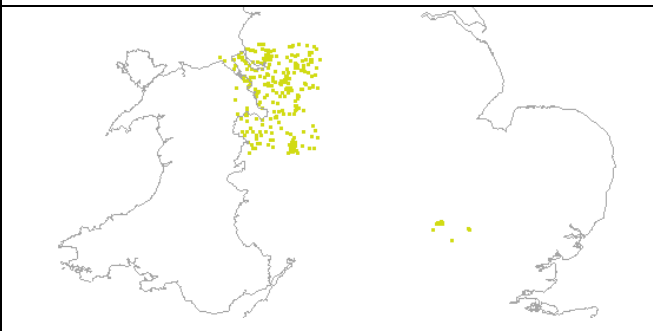
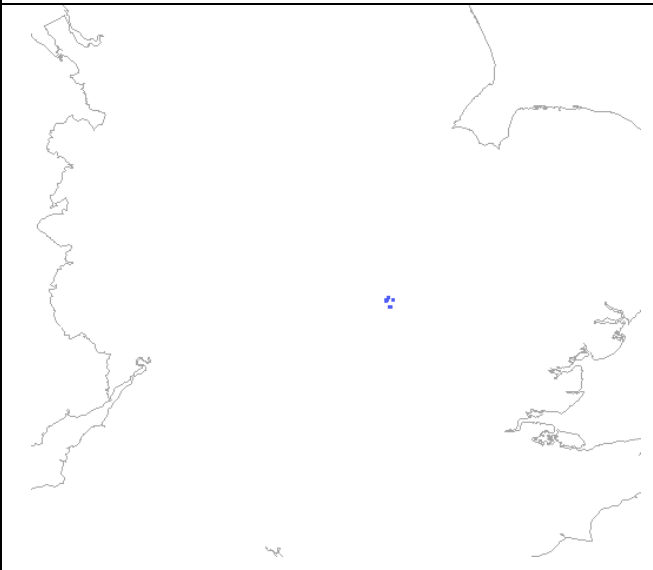
	K_GRAN	X	23	
	K_JLW	F	5	
	K_JLW	P	1	
	K_JLW	X	330	
	K_JRAG	F	56	

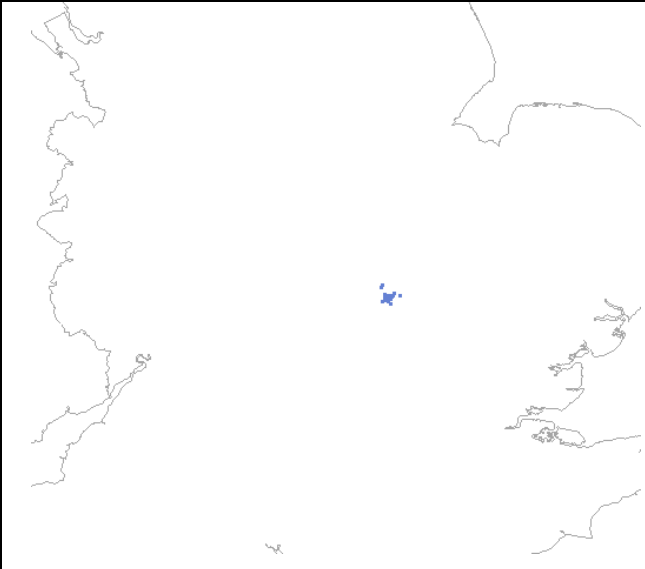
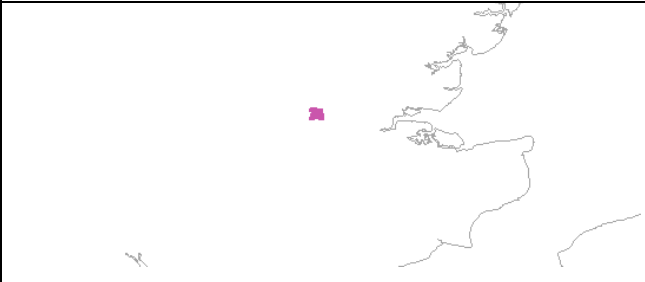
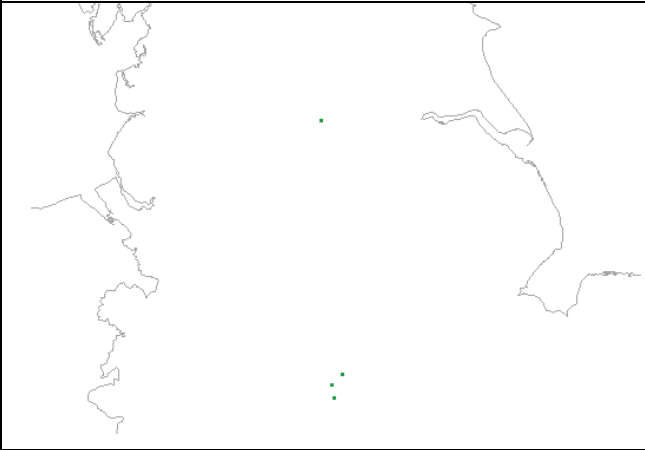
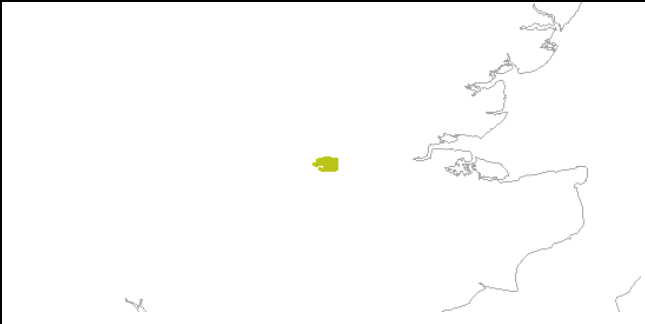
	K_KAH	B	5	
	K_KAH	F	528	
	K_KAH	P	14	
	K_KAH	X	1	
	K_LP	X	2	

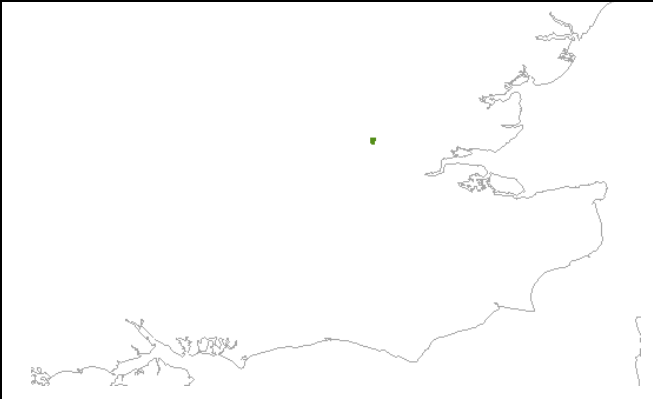
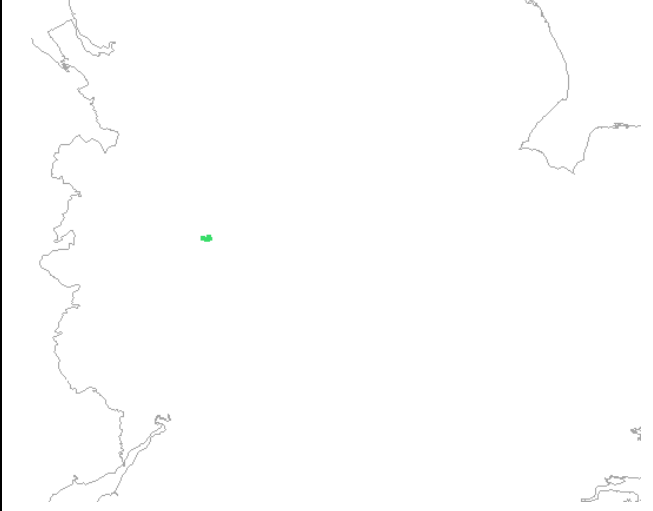


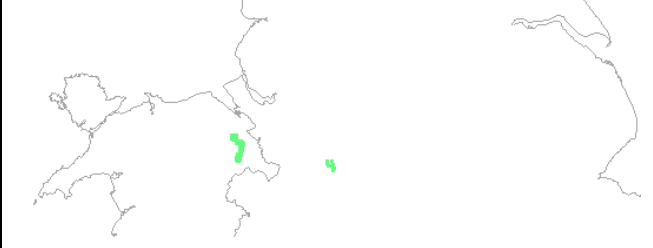
	K_MCC	X	2	
	K_PJM	X	36	
	K_PML	A	2	
	K_PML	B	1	

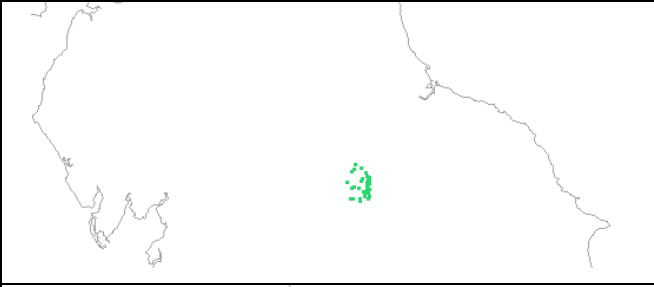
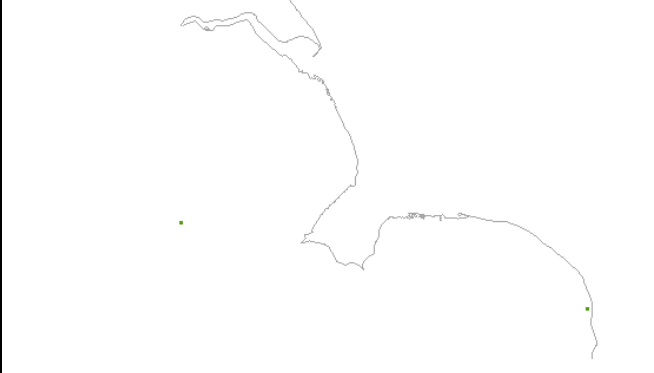
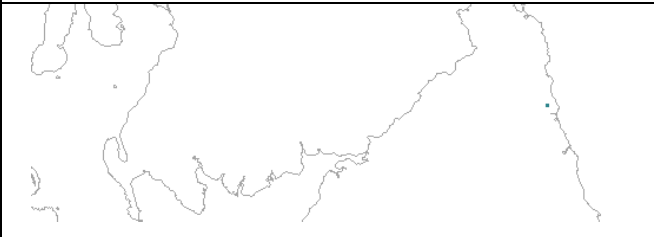
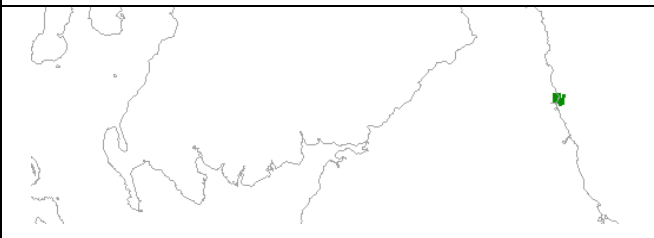
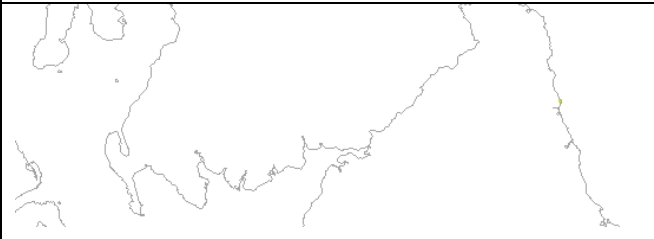
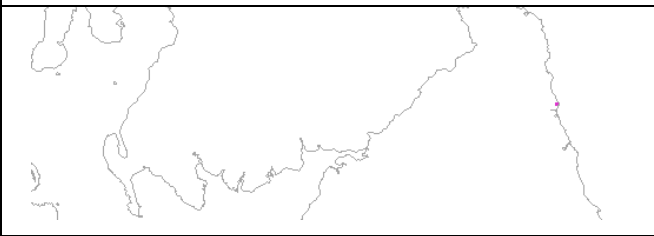
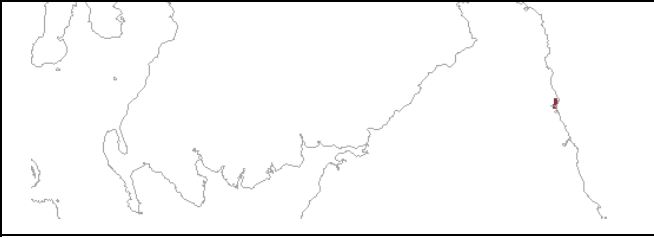
	K_PML	C	3	
	K_PML	F	7191	
	K_PML	N	26	

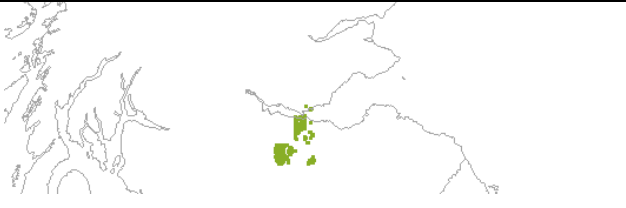
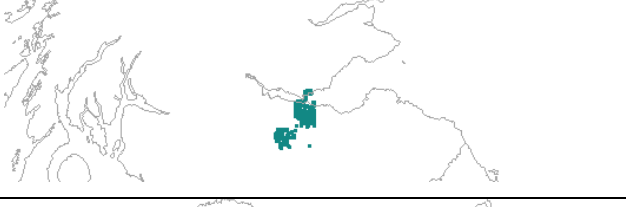

	K_PML	P	42	
	K_PML	X	239	
	K_RGC	X	322	
	K_RJN	A	1	

	K_RJN	C	4	
	K_RJN	F	1305	
	K_RJN	P	318	
	K_RJN	R	18	

	K_RJN	S	40	
	K_RJN	X	229	
	K_RSL	X	9	
	K_TMOSA	X	478	

	K_TMOSB	X	9	
	K_WOLVES	F	58	
	PDB	B	51	
	PDB	F	2062	
	PDB	P	811	

	PDB	Q	44	
	PDB	R	2	
	UNKNOWN	F	1	
	bgs	A	0	
	bgs	F	128	
	bgs	N	1	
	bgs	R	1	
	bgs	S	5	

	e_EPS	1	946	
	e_EPS	A	0	
	e_EPS	F	2517	
	pdb	F	531	
	pdb	P	276	