Title: The potential use of local government planning data for soil contamination analyses.

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Abstract (150 – 200 words)

Contamination information is obtained at considerable expense through site investigations by developers in the UK. This field information is submitted to local government as part of the planning process. Local government, therefore, has a vast resource of site-specific contamination data for developments in their area. These data are focussed on brownfield sites. They are in hard quality format with some data quality issues, particularly for older site investigations. This research presents the results of a study to access and analyse this data. The dataset is evaluated in terms of the information available, its form, quality and the potential use of this information for researchers, regulators and developers. A preliminary analysis of the data is presented in which the main contaminants in the study area were investigated and local anomalies such as elevated lead levels were highlighted. In addition, asbestos was found at low concentrations in 25% of made ground soil samples; a result requiring further study to inform future risk assessment. The potential use of this countrywide dataset is currently limited by the hardcopy format and storage of the dataset. Updating the submission to digital format could result in a vast national resource of brownfield information.

Keywords:

Local government, site investigation, urban regeneration, environment.

1 Introduction

There is a recognised need for new homes to be built in the UK combined with a policy preference to locate these on brownfield land (Department for Communities and Local Government 2015). However, development of brownfield land, particularly for residential use, can be challenging due to the contamination left in the ground by historical land use. The contamination can pose real health risks to new residents and considerable costs are incurred in enabling such sites to be redeveloped for residential use (English Partnerships, 2008). Understanding contamination and focusing resources is vital for the efficient and beneficial development of former brownfield land. The consequences of poor understanding are overly conservative remediation (e.g. £140-£280 million estimated wasted per annum, Defra and WAG (2011)) or conversely exposing residents to potential health risks (e.g. at Corby UK, Verkaik, 2009).

Contamination levels, on any development site, where a potential risk to a receptor is identified, are determined routinely as part of the planning process for Local Government in the UK. National Planning Policy Framework 2019 requires any development to be 'suitable for its proposed use.' To conform with this policy, the local contaminated land officer recommends a number of contaminated land conditions, which are then set by the planning officer for planning applications. These conditions are likely to include a requirement for a desk study, then potentially an intrusive site investigation and risk assessment. If contamination and risk to a vulnerable receptor is identified, then a remediation method statement and verification report are also required (Environment Agency 2004, 2019, British Standard Code of Practice, 2010). The contaminated land officer then reviews all the submitted documentation relating to the planning condition and makes recommendations relating to condition discharge. Through this process each local planning authority in the UK has details on almost all of the site investigations undertaken in their area, since 2000. This information is available on most planning websites, although interrogation of these websites to obtain this information is not straightforward. The information can also be requested from local government under the Environmental Information Regulations (2004).

The only study where this local government data has been used was in Gateshead (Rothwell and Cooke 2015). This work primarily focussed on evaluating the background levels for metal contamination. This study determined that local government data was a useful resource to evaluate local levels of contamination. Site investigation data has been used in an indirect way by a Society of Brownfield Risk Assessment, SoBRA, study (Cole, 2017) which evaluated asbestos data for soils sent to a particular laboratory. This study evaluated the number of positive samples and form of the asbestos, but did not have access to the source of the data, i.e. site and location. Asbestos was found in 20% of 37,000 soil samples.

Further interrogation of this local government dataset could help improve understanding of which contaminants to expect on a particular brownfield sites, their potential location and concentrations. This could inform desk studies and focus the design and resources for future site investigations, risk assessments and remediation plans. It would also help improve national regulatory guidance and improve public confidence regarding living on former industrial/brownfield sites.

The aim of this study is to investigate if it is possible to use the site investigation data from planning applications to improve local understanding of contamination levels on brownfield sites. This will be achieved through a proof of concept study in a local government area in which

- i) Site data is collected from planning databases, extracted and input to a database
- ii) The information itself is analysed in terms of data quality and form
- iii) The potential use of the data is evaluated by a preliminary analysis into key brownfield contaminants in the selected area.

A schematic overview of this study is shown in Figure 1.

Figure 1 Schematic overview of the study

2 Method

The first stage in this research was to select a local government area to study. The selection criteria were based upon the following requirements:

- A representative area, that was not tied to any particular industry
- A readily available information source (reports that can be easily accessed).
- An appropriate number of site investigation reports to enable evaluation of the dataset and statistical analysis.

Based on these criteria together with expert input from environmental health departments and contaminated land officers, led to Thames Ditton, one of the 16 electoral wards within Elmbridge Borough Council being selected for this study.

2.1 Data Collection

Thames Ditton is a suburban village, of 3.3 km², bounded to the north by the River Thames. It lies within the County of Surrey, 20km south west of central London (Figure 2). This area was first developed as a residential area for officials and workers of Hampton Court Palace in the 16th century. It became an area of large rural properties and market gardens until the 1890s, when some industrial development occurred, including a foundry, early car manufacture and steam engines. The area was extensively developed between 1920-1940, becoming a residential suburb of London, with some small, local industries (Elmbridge Borough Council, 2013). It is now an affluent area where available land is prioritised for residential use.

Figure 2 Location of the wards in Elmbridge Borough, high-lighting Thames Ditton

To identify the locations within this ward with site information, the local government database on potentially contaminated sites was interrogated. This is an internal database, maintained as part of the Environmental Protection Act Statutory Guidance, DEFRA 2012. Interrogation of this led to 29 sites being identified, of which 10 had intrusive (Phase 2) site investigation reports. Copies of these reports were publicly available from the Elmbridge Planning website (Elmbridge Borough Council 2019) and were located by site address or planning number. All site investigation reports were scanned copies of hardcopy documents, with extensive appendices of contamination data and geological logs, saved in pdf format. The data, even for the latest reports, was not in an accessible digital format. Obtaining the reports was not always straightforward as site investigation reports can be distributed in a number of different planning applications relating to a site and the discharge of planning conditions. Occasionally the investigation reports had different titles or could be contained in a report with an unrelated title. In addition, many of these reports were very large and sometimes appendices were not scanned or sections were missing. A few reports, generally from site investigations prior to 2012, had not been uploaded on the website and were provided by the council.

For this proof of concept study, all reports were dated post 1996. Table 1 details the information and sites identified.

Table 1 Information available for study area.

Information	Number
Sites on Elmbridge Borough Council database	29
Sites with intrusive site investigation data	10
Date of investigations	1996-2018
Number of boreholes/window samples etc.	111
Number of soil samples tested	140

2.2 Database construction

The site investigation reports contained information relevant to the study in different sections and formats. For example, the past use of a site may have been detailed in a Phase 1 Desk Study, whereas contamination information was detailed in tables of data in a Phase 2 Report within the appendices. Extraction of information was therefore time consuming and a knowledge of local government systems was essential. A database was constructed to contain all the information required in this study. This was based upon the information provided by Ander et al. (2013) and Rothwell and Cooke (2015). Information was subdivided into sections as detailed in Table 2.

Table 2 Format of database and information extracted

Section title	Information required
Metadata	Format and units required for each class in the database
Site Data	Site name Site address Previous site use Current site use Land use classification by Ordnance Survey
Source Data	Planning application number Report Title Consultant Investigation date Laboratory used Laboratory chemical technique listed, including state of sample, e/g/ air dried Laboratory accreditation e.g. MCERTS Limit of detection (LOD) for each chemical
Borehole data	Borehole name Type of borehole/sampling Investigation date Borehole location Final depth of Borehole Made Ground depth Underlying natural soil Contamination information itemised in the log, e.g. ash / clinker
PAH and asbestos data	Sample depth Moisture content Asbestos result Asbestos form Asbestos concentration PAH concentrations: acenaphthene acenaphthylene anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i] perylene, benzo[k] fluoranthene, chrysene, dibenz[a,h]anthracene, fluoranthene, fluorene, indeno[123-cd]pyrene, naphthalene, phenanthrene, and pyrene.
Other chemical data	Sample depth, pH, total cyanide, water soluble sulphate, sulphide, organic matter, total organic carbon, antimony, arsenic, beryllium, water soluble boron, cadmium, chromium, hexavalent chromium, copper, lead, mercury, nickel, selenium, vanadium, zinc and total phenol concentrations.

All the information included in the dataset was entered in its original format. Hence the limit of detection for a chemical analysis, e.g. <0.1 was entered into the database, so that variations in this value and what number to assign could be addressed later within the analyses.

Conventions for input values were set up for no data (-9999) and no information (-1111) and poor quality data was highlighted in the database in amber as a warning and noted.

2.3 The Raw Data

Information from the 10 sites, with intrusive data, was input into the database and is summarised in Table 3. Most of the sites were small developments, with less than 15 sampling points, apart from one large development with 52 sampling locations. Soil samples were analysed for the standard suite of chemical tests including metals, anions and polyaromatic hydrocarbons (PAHs). 75% of the chemical tests were on Made Ground samples.

Table 3 – Summary of information at the 10 sites within the study area

Site No.	Report Year	Site history	No. of boreholes/ window samples	Total No. soil samples	No. samples analysed for metals and anions	No. samples analysed for PAH	No. samples analysed for asbestos
1	2018	Workshop	3	6	6	6	3
2	2018	Storage/garages	6	8	8	4	8
3	2017	Boatyard	15	26	20	22	9
4	2016	Police station	4	6	6	8	4
5	2016	Engineering workshop	6	6	6	6	5
6a	2016	Industrial estate, including cement works	45	45	27	24	36
6b	2011		7	6	6	6	0
7	2011	Hospital	5	10	8	10	0
8	2008	Offices	4	4	4	4	0
9	2004	Railway land	12	16	16	16	16
10	1996	Undeveloped - adjacent to railway.	4	6	6	6	0
Total			111	139	113	112	81

The dataset for the study area was collected over a period of 22 years, by 10 different consultants who had used 8 different analytical laboratories. Consequently, the consistency and quality of data was investigated further.

Two particular issues that were noted were:

- Samples were not uniformly tested for the same chemicals
- There were inconsistencies in the form of sample (dry, wet etc.) tested, particularly for asbestos.

2.4 Chemicals selected

Soil samples on the ten sites were tested for different chemicals. The choice of chemicals selected would have been based upon the consultant's requirements, the conceptual site model (CSM) and the budget. There was a standard core suite of testing, which included arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc and 16 PAHs. Selection of testing for other chemicals was *ad hoc* and is shown in Table 4 together with the date of the investigation. It is interesting to note that asbestos testing has now become routine; there is a greater awareness of the prevalence of this contaminant and the testing method to detect asbestos has been refined.

Table 4 Soil chemical tests selected, in addition to the standard test suite, at each site.

Site	Date	Asbestos	Sulphate	Total cyanide	Organic matter	Total Organic carbon	Antimony	Beryllium	Boron	Chromium VI	Vanadium	Phenol
1	2018	✓		✓		✓				✓		✓
2	2018	✓	✓	✓		✓			✓			✓
3	2017	✓							✓	✓		
4	2016	✓	✓	✓								✓
5	2016	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6a	2016	✓				✓						
6b	2011											
7	2011		✓		✓				✓	✓		✓
8	2008		✓	✓								✓
9	2004	✓	✓	✓				✓	✓		✓	✓
10	1996		✓						✓	✓		✓

2.5 Analytical methods used

The majority of site investigation reports include information from the laboratory on the chemical test procedure and whether this is an approved test, i.e. MCERTS in the UK for Environment Agency approved testing in line with EN ISO/IEC 17025. Not all test procedures are marked as MCERTS and asbestos analysis does not generally have this certification. (A standardised test for asbestos quantification is under review in the UK, (The Standing Committee of Analysts, 2017). This laboratory information also details the form of the sample tested, e.g. as received, wet or air dried. Table 5 shows the information supplied for three example contaminants, lead, benzo(a)pyrene (BaP) and asbestos for each site.

Collecting this test information highlights differences between the testing laboratories over time in terms of the tests applied for chemical analysis and the sample form used. There is more uniformity in the tests used post 2016. This information shows inconsistencies within the dataset, particularly when the sample form and testing method are different. This is a major difference between this dataset and that used in previous UK geochemical mapping studies (BGS and Tellus, Johnson et al. 2005), where a single laboratory and sample collection method was used for the analysis. All test methods, and sample form (when available), were input into the database, so obvious inconsistencies in sampling/testing could be taken into consideration in the analyses.

Table 5 Test information supplied. (- Indicates no information)

Site	Date	Lead	Benzo(a)pyrene		Asbestos screen		
		Test specified	Sample form	Test specified	Sample form	Test specified	Sample form
1	2018	Aqua regia digestion +ICP OES	Dried	Extraction in acetone and hexane GC-MS M	As received	ISO17025 polarising light microscopy and dispersion staining	-
2	2018	Aqua regia digestion +ICP OES	Dried	Extraction in dichloromethane and hexane GC-MS M	-	ISO17025 polarising light microscopy and dispersion staining	-
3	2017	Filtration of sample followed by inductively coupled plasma mass spectrometry ICP-MS	Air dried <37°	Dichloromethane extraction and GCFID	Air dried <37°	Polarised light microscopy and gravimetry UKAS	Air dried <37°
4	2016	Aqua regia ICPMS	-	GCFID method 133	As received	PMAN microscopy	As submitted
5	2016	Aqua regia digestion +ICP OES	Dried	Extraction in acetone and hexane GC-MS M	-	ISO17025 polarising light microscopy and dispersion staining	-
6a	2011	-	-	-	-	NT	NT
6b	2016	-	-	-	-	-	-
7	2011	Aqua regia digestion +ICP OES	Dried	Extraction in dichloromethane and hexane GC-MS M	Dry	NT	NT
8	2008	BS1377 MCERTS	Air dried	NCA PAH	Air dried	NT	NT
9	2004	Iris emission spectrometer ISO not MCerts	Air dried 35°	GCMS - ISO not MCerts, modified USEPA method	Air dried 35°	In house not ISO or MCerts	Wet
10	1996	-	-	-	-	-	-

3 Data Analysis

To evaluate the potential use of intrusive planning data to inform future local developments, an analysis of the contaminants was carried out. To achieve this, the dataset selected was relatively small and localised (10 sites, 139 sample points) and the analysis focused on identifying the key contaminants in that area. Issues investigated were:

- Mean and median for each chemical tested within the study area.
- Distribution of contaminants in the study area
- Contamination level variations with sample depth

For this study, the soil data for the chemicals listed in Table 2 were analysed and key contaminants identified. Asbestos was typically measured as detect or non-detect and was rarely quantified, hence these results are shown separately.

3.1 Contamination levels for the study area

Geochemical data analysis has shown that the use of mean and standard deviation alone to describe the data is generally inappropriate (Reiman 2000). This is due to the data being

heavily skewed and not following a normal distribution. A few high value outliers can impose a significant influence on the resultant mean value, as seen for lead in this study, Figure 3. Therefore, the median is generally accepted as a more appropriate value. Reiman et al. (2005) recommend presenting both mean and median values to assess environmental data. Hence these were evaluated for this study area as shown in Table 6. The results were further divided to separate the Made Ground samples and those within the top 0.5m.

Figure 3 Frequency distribution for concentrations of lead in the top 0.5m of soil.

Table 6 reflects the nature of the data collected. For many contaminants, e.g. cyanide, chromium (hexavalent), mercury and selenium, a high proportion of the data collected was below the limit of detection of the laboratory test. This also applied to many of the PAH results where concentrations were close to or below the limit of detection (LOD) as demonstrated by naphthalene. In these cases, the statistical results were affected by the value allocated to samples below the limit of detection.

Regional mean and median of measured data and analyses, including Tukey and MAD evaluations are used to determine background and threshold levels for contamination in a region (Tukey, 1977, Reiman et al. 2005). These approaches have been applied to grids of regularly sampled data and were not considered applicable to the randomly distributed sites, with different numbers of sampling points, of this study. As each data point has equal value within the analysis, the data is skewed to reflect the information from the site with the greatest number of sampling locations, in this case, site 6. It was considered more appropriate to evaluate the data in its simplest form, i.e. evaluate means and medians for individual sites and then reflect on these values to provide an overall assessment of brownfield sites in the study

Table 6 Mean and median for the sampling points

	Made Ground				Top 0.5m			
	Test No.	LOD %	Concentration (mg/kg)		Test No.	LOD %	Concentration (mg/kg)	
			Mean	Median			Mean	Median
Arsenic	81	1	18.4	14.0	61	2	16.8	15.0
W/S Boron	39	36	0.9	0.7	28	29	1.0	1.0
Cadmium	81	26	1.8	0.6	61	30	2.0	0.7
Chromium	81	0	27.4	20.5	61	0	23.8	20.0
Chromium (hex)	27	100	N/a	N/a	21	100	N/a	N/a
Copper	81	0	507.7	50.5	61	0	540.8	55.0
Lead	81	0	375.0	149.5	61	0	356.3	209.0
Mercury	81	42	0.7	0.4	61	41	0.8	0.6
Nickel	81	0	26.7	19.0	61	0	23.1	18.0
Selenium	81	80	0.6	0.5	61	87	1.2	1.0
Zinc	81	0	453.0	153.0	61	0	440.7	193.0
Total Organic Carbon	22	0	2.5	1.5	24	0	2.2	1.5
Total Cyanide	28	96	N/a	N/a	26	100	N/a	N/a
Naphthalene	76	71	0.15	0.05	59	73	0.11	0.05
Benzo(a)pyrene	76	26	2.50	0.30	59	27	3.18	0.31
Total PAH	82	18	29.46	4.10	62.00	24	30.61	4.08

LOD = Limit of detection

Table 7– Mean and median values of contaminants for samples taken within the top 0.5m.

Concentrations (mg/kg)	Site	1	2	3	4	5	6	7	8	9	10
Arsenic	Mean	13.8	13.8	17.8	16.4	15.0	12.0	26.6	7.6	14.7	45.4
	Median	10.0	13.0	16.5	15.9	15.0	12.0	22.5	8.0	16.0	37.4
Cadmium	Mean	2.1	0.2	8.1	0.6	0.3	1.2	0.8	0.5	0.3	0.6
	Median	1.6	0.2	3.0	0.5	0.4	1.2	0.6	0.5	0.3	0.5
Chromium (total)	Mean	19.6	15.5	21.2	51.2	20.3	11.0	33.8	19.4	20.3	18.0
	Median	18.0	15.5	20.5	45.6	20.0	11.0	35.5	20.0	22.0	16.0
Copper	Mean	92	40	67	62	36	47	3606	72	56	187
	Median	38	40	67	68	38	47	365	46	60	200
Lead	Mean	408	286	530	655	195	305	347	890*	73	521
	Median	392	235	455	489	142	127	410	890*	50	575
Nickel	Mean	22.9	13.5	17.7	20.6	16.0	8.5	37.6	13.2	18.3	47.3
	Median	17.0	13.5	18.0	20.7	16.0	8.5	37.0	15.0	21.0	58.0
Zinc	Mean	429	133	1258	146	220	250	444	54	148	505
	Median	187	116	560	161	249	250	385	42	91	448
Benzo-a-pyrene #	Mean	0.52	0.03	0.88	0.69	1.31	6.75	1.01	0.90	2.41	Not
	Median	0.61	0.03	0.52	0.40	0.50	0.33	1.40	0.90	0.98	tested
Total PAH#	Mean	64.61	14.60	0.80	8.88	5.65	9.80	10.48	43.32	9.20	29.17
	Median	4.03	5.25	0.80	3.00	6.55	9.80	6.20	22.36	10.00	10.20

Red/italics values indicate exceedance of current UK guidance values for residential use with plant uptake

evaluating using 0.5*LOD for values detected below the Limit of Detection (LOD)

* only 1 sample at this depth.

area. Table 7 therefore shows the mean and median values for the main pollutants for the 10 sites for samples taken in the top 0.5m. The values shown in bold/italics indicate exceedance of current UK guidance values for residential use, with plant uptake.

In terms of overall site analysis, an elevated mean and median value indicates that this contaminant may be an issue across the site. An elevated mean, but considerably lower median indicates the data contains outliers or there are isolated hot spots of this contaminant on the site. Hence the results show the following:

- Lead is elevated on most of the sites, with mean and median levels generally considerably exceeding the guidance Category 4 screening level (C4SL) value of 200mg/kg for residential use with plant uptake.
- There are isolated high levels of benzo(a)pyrene on site 6, copper on site 7 and arsenic on site 10.
- Measured levels of the remaining chemicals were found to be considerably below guidance level and for some chemicals, e.g. cyanide, chromium VI, the concentrations found in soil were below the level of detection of the laboratory method.

3.2 *Spatial distribution of data*

Levels of lead and benzo(a)pyrene were shown to be elevated in this study area and consequently their distribution was investigated further. The results for lead and benzo(a)pyrene concentrations for all soil data are shown on a maps outlining the Thames Ditton boundary in Figures 4a, 4b. The development sites were all formerly brownfield sites, hence the levels shown are not representative of soils within Thames Ditton, but show the concentrations found on these particular sites. The maps clearly show that the local authority dataset was not uniformly distributed, but represented where new developments were taking place.

Lead concentrations were found to be high on most sites, with all but one site having levels that exceeded current C4SL guidance for residential use with plant uptake. Benzo(a) pyrene levels were generally below current guidance level (C4SL) on most sites, with concentrations higher on the most northerly site.

3.3 *Sample Depth*

Shallow soils (<0.5m) are those most likely to come into contact with future residents of a site and therefore where risk is generally considered highest. Deeper made ground deposits could however pose risks to site workers and therefore analysis of contamination concentrations for the key contaminants and depth was carried out. Figure 5 shows the distribution of concentration against depth for lead and benzo(a)pyrene.

a)

b)

Figure 4 Spatial distribution of sample (a) lead and (b) BaP concentrations within the study area.

Figure 5 Lead and benzo(a)pyrene concentrations with depth.

The plots show BaP concentrations were highest within the top 0.6m of ground and elevated levels were measured in made ground samples to 1m depth. Apart from 2 outliers, all measured BaP levels were below UK guidance level of 5 mg/kg for residential use with plant uptake. For lead, the elevated measurements were found in the top 0.7m of made ground, though lead concentrations above current C4SL guidance for residential use (200mg/kg) were

found at depths up to 1.5m. These results indicate a probable anthropological source for these contaminants.

3.4 Asbestos Data

Laboratory data for asbestos contamination is initially provided in the form of present or not detected. If detected, information is then provided on the type of the asbestos, such as chrysotile, amosite etc. and sometimes the matrix form, i.e. asbestos cement or fibres. There was insufficient asbestos quantification data to evaluate mean and median concentrations. It was noted that on two sites, deep natural ground samples were analysed for the standard chemical suite, including asbestos. As asbestos does not occur within this natural soil strata, this suggests a lack of understanding at these sites of where asbestos is likely to be found and is a poor use of site investigation resources.

Almost 50% of soils samples were analysed for asbestos (n=67). It was detected on 3 of the 10 sites with a detection rate of approximately 25% in Made ground, with 15 positive detects. This is a small sample to provide any detailed analysis, though the results are summarised in terms of depth of sample and asbestos type in Figure 6. Quantification was carried out on 9 samples, with 6 below the detection limit of 0.001% and 3 samples with concentrations of 0.002-0.11%. All the positive detections were found in samples in the first 0.5m of soil. Most of the asbestos was chrysotile, however a significant proportion of samples were the more carcinogenic amosite.

Figure 6 Type of asbestos found and sample depth.

The results of the analysis of asbestos data, is similar to that produced by Cole 2017 using only analysis data from laboratories. In their study 20% of soil samples tested positive for asbestos compared to 25% in this dataset. The relative percentages of different forms of asbestos also follow the Cole study, with a slightly higher level of amosite detection in this small study. Further analysis of this full local authority dataset would provide additional evidence of the level of asbestos found on development sites to inform regulators and policy makers of this potential hazard.

4 Comparison with other datasets.

To evaluate the local government dataset, the results of this preliminary study were compared with other studies into soil contamination in the UK. These included the national survey, Geochemical Baseline Survey of the Environment (G-BASE) (Johnson 2005), where soil samples were taken every 2km² in Surrey. There was no sampling location within Thames Ditton. Comparisons were therefore made with the G-Base results for the adjacent Greater London area (London Regional Atlas, Ferreira 2017). The mean and median levels for lead contamination in 8 out of 10 of the Thames Ditton sites were higher than those for the G-Base survey for London and the south east (Lark and Scheib et al. 2013) The London Regional Atlas (Ferreira et al. 2017), plots this G-Base data and includes the Thames Ditton area where levels of lead were 71-138mg/kg. This shows the different nature of the sites tested as the G-Base data was from a range of land uses including domestic garden and public open space. The Thames Ditton results were also higher than the mean and median for lead concentrations measured at 64 industrial sites in the G-Base London study of 225mg/kg .

These results indicate that regional spatial modelling on a 2km grid has evaluated substantially lower levels of lead contamination in Thames Ditton than was found on these brownfield sites. The results for the sites in Thames Ditton were also higher than the results for lead found in other urban studies (Belfast and Sheffield, McIlwaine et al. 2016) obtained using G-Base data. This suggests that the anthropological source of lead contamination is localised to a site and shows that onsite measurements can not be replaced by generic regional values.

There are no comparative measurements for BaP in the study area. However, the BaP levels were substantially lower in Thames Ditton than measured in East London (mean 2.37mg/kg, median 1.95 mg/kg) using a G-Base type sampling grid. This Thames Ditton study area also had higher site levels of lead, but lower levels of BaP contamination than the Newcastle studies, obtained from a similar local government dataset (Rothwell and Cooke, 2015, Lowe 2012). These comparisons indicate the relative complexity and potential localised nature of contamination measurements.

5 Discussion and use of this dataset

The data presented is the result of a preliminary study to determine if this local government dataset is a useful resource for academics, developers and regulators. Once in a digitised form the data is very accessible to interrogate for a wide range of chemicals, with differences between sampling techniques and form clearly identified. This study has provided a localised overview of the key contaminants on brownfield sites that can be used to inform new desk studies. The findings of this research were relayed to the contaminated land officer and further investigation into the potential source of the lead contamination and whether it is related to site use or this geographical area is now being investigated. Hence this study has updated knowledge on brownfield sites in this area and led to a requirement for asbestos analysis in soils on all brownfield sites in Elmbridge.

This paper presents a ‘proof of concept’ and hence the results are shown in detail for one local government ward, to demonstrate the potential of this dataset. The same methodology can be applied to different regions to provide a unique view of brownfield contamination in other areas. This has been demonstrated for two additional local government wards in Elmbridge, namely Cobham and Downside and Walton Central, whose locations are also shown on Figure 2. Each ward has a distinct characteristic: Cobham and Downside contains large rural areas whereas Walton Central is a smaller, more urban ward containing a former industrial area and gasworks. The spatial distribution of lead contamination found in site investigations in these wards is shown in Figures 7a, 7b. In Cobham and Downside, the site investigations were predominantly on brownfield sites along a main road, with no investigations in the surrounding rural areas. The data indicates some elevated levels of lead, but at lower concentrations than found in Thames Ditton. In contrast, a high number of elevated levels of lead were found in Walton Central ward, reflecting the more industrial nature of these sites. These results provide a very local view of brownfield contamination: they capture different results for particular local sites and high-light contaminants which may cause concern in an area, e.g. in this example lead. This is of particular value for both local government and potential developers who can then use this information with the confidence that it is actually representative of their local conditions.

5.1 Data acquisition

There is a vast amount of useful data available on planning websites, however accessing the data currently prohibits its extensive use by researchers or within local government. There is no standard format in the UK for these websites and for some it is difficult to obtain large site reports and not all information is available. A few websites do enable searches for sites with a ‘condition discharge’. However, this would include all forms of condition discharge, not just contaminated land types and so filtering of results would then be required. Hence to extract the information, generally prior knowledge of the sites, the address or planning application number is required.

a)

b)

Figure 7 Spatial distribution of sample lead concentrations within (a) Cobham and Downside and (b) Walton Central wards.

Data is currently only available in hard copy format. Hence contamination data and borehole information had to be manually extracted and input. This was laborious and time consuming. The information is obtained and used by consultants in a digital form, but there is currently no requirement for this format to be supplied to local government. Providing digitised data to local government, for example in a standard format such as AGS (Association of Geotechnical and Geoenvironmental Specialists, 2020), would enable the information to be incorporated directly into their local government contaminated land database and actively used. The data could then be available to develop local plans, provided to developers and used to inform local residents.

The dataset has been shown to be varied in terms of quality due to the different consultants, laboratories and testing techniques used. Standard sampling and testing procedures have generally been followed, particularly in more recent investigations, but caution is required in comparing data obtained over a 20 year sampling period. Going forwards a fully standardised approach in terms of sampling protocols and test procedures should be adopted to ensure consistency between datasets.

In 90% of reports there was a lack of surveyed or GPS co-ordinates of sampling locations. This is a data quality issue that should be addressed in all site investigations. The lack of site co-ordinates was not confined to older reports: current practice does not mandate the use GPS on sites to record this information. This should be addressed by the site investigation industry as the technology is readily available. In this study, the site map of survey points was used together with GIS and digital ordnance survey maps, including historical map data to estimate the borehole co-ordinates.

5.2 Future development

The planning data is available nationally but is currently held locally in hard copy in individual authority planning databases. This is a valuable resource and should be pulled into a national database. To enable this, the information needs to be submitted in a digitised format that can easily be imported into the database. This could be similar to the current BGS database of geotechnical borehole logs. The relevant information could then be downloaded and used in desk studies for new developments and urban plans of the contamination found in the vicinity of a site or development zone. It could identify localised contamination hot spots in an area, which can be missed by regional grid measurements on a large resolution scale, as evidenced by this research.

This study has highlighted contamination information that can be extracted from local government planning databases. This dataset also includes information on geotechnical parameters, ecological studies, flooding data, a vast quantity of data that could be mined to provide useful information to developers and researchers. Whilst the form and storage of this information similarly limits the data extraction process, improvements in data digitisation may

facilitate this process. Hence this resource could then be used across a much broader range of planning, policy and research applications.

6 Conclusions

This local government dataset is a vast, untapped resource within the UK, that has been collected at considerable expense by developers. The data is available on planning websites, however, extraction of key information required a knowledge of local government databases and development sites. This research has demonstrated the potential for these data to provide additional information on contamination levels and inform local regulators and developers. The preliminary analysis identified the key contaminants in the study area and highlighted local anomalies that would have been missed by more generic grid-based sampling strategies.

As with any application of discreet location sampling, the end user must be aware of the limitations of the available data, its distribution and accuracy. The current use of this dataset is limited by the lack of digitisation. Recognising this and a requirement for mandatory digitisation would significantly enhance the use and capability of this dataset. The information could be stored nationally in databases of site data and interrogated and used locally and nationally by regulators, developers and policy makers. This concept could be expanded beyond contamination data, to include other parameters contained in planning data such as groundwater or geotechnical information.

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