

# **Contaminated Land Inspection Report Review**

GAS WORKS At SANDY LANE, HILGAY, NORFOLK

January 2018

Reference no. s115100001852

Alex Grimmer
Senior Environmental Protection Officer

Reviewed by

Fabia Pollard
Scientific Officer

Approved by

Dave Robson
Environmental Health Manager

# Please Note:

This report is the property of and confidential to Borough Council of King's Lynn and West Norfolk and its use by and disclosure to any other person without the expressed prior consent of the council is strictly prohibited.

Borough Council of King's Lynn and West Norfolk King's Court Chapel Street King's Lynn Norfolk PE30 1EX

Tel: 01553 616200

Email: environmentalquality@west-norfolk.gov.uk

# Contents

Executive Summary	1
1 Introduction	
2 Desk Study Information	
Location	
Previous investigation	
Revision to the Toxicological Data	
Input parameters for CLEA v1.071	
Results of the CLEA risk assessment model	
5 Outcome of Revised Detailed Quantitative Risk Assessment	
Conclusion	
Part 2A status	
Further Action	
Appendices	
Appendix A: CLEA Risk Assessment model for the Revised Detailed	
Quantitative Risk Assessment (With inhalation and ingestion)	7
Appendix B: CLEA Risk Assessment model for the Revised Detailed	
Quantitative Risk Assessment (Without ingestion and inhalation)	10
Appendix C: Risk Assessment Methodology	
, appoints, or it is a resolution in the file and a serious in the serious of the serious in the	0 .

# **Executive Summary**

The Borough Council of King's Lynn and West Norfolk (BCKLWN) has a statutory duty to inspect its district for potentially contaminated land under Part 2A of the Environmental Protection Act 1990. The Borough Council's Part 2A inspection strategy identified Gas House, Hilgay (the site) as being of high priority due to the presence of a former country house gas works and potentially sensitive receptors.

Given the former site usage, an assessment of the site has been undertaken to assess the potential for harm to human health, property, ground/surface water and designated environmental receptors under Part 2A.

To gather information of the site's history a preliminary risk assessment and desk study were carried out by the Environmental Quality Team. From the evidence gathered during the desk study of the site history and a site walkover, the following can be stated: The site was historically a gas works associated with Wood Hall and took place during late 1900s. The site's present use is a residential property. During the desk study a plausible linkage was identified for the risk to human health. No plausible linkage was identified for property, controlled waters or the environment.

The site has been subject to a previous investigation under Part 2A of the Environmental Protection Act. During the site investigation elevated levels of organic and inorganic contamination were detected. After a detailed quantitative risk assessment it was determined that the site did not pose a significant risk to human health.

Following recent changes to the toxicological data for some of the contaminants of concern encountered a review of the earlier risk assessment has been undertaken. This report comprises that review.

The previous site investigation reported elevated levels of lead, arsenic and some polycyclic aromatic hydrocarbons. A reassessment of the recorded levels has been carried out using the revised risk assessment model CLEA v1.071 to calculate site specific assessment criteria. One result from one soil sample recorded levels of lead which were potentially a risk to human health. This sample was from 0.5 to 0.6 m below ground level. This is not considered to be a plausible exposure pathway via ingestion or inhalation. However, for completeness the risk assessment model was adjusted to take account of the sample depth. The recalculated site specific assessment criteria indicated that the levels of lead present at 0.5 - 0.6m do not pose a significant risk to human health.

Therefore a low risk to human health has been assigned to the site for its present usage. If the circumstances to the site change a further assessment of the risk posed to human health would be required.

Plausible source pathway receptor linkages were identified from the contaminated land risk assessment. A LOW risk to human health was assessed from contamination. As the risk posed is low, the site would be classified as Category 4 as set out in the Statutory Guidance. Therefore the site is not considered to be contaminated land under Part 2A of the Environmental Protection Act 1990.

#### 1 Introduction

This report details a review of information and risk summary about land at Gas House, Sandy Lane Hilgay and provides a conclusion on the risk to human health, property, groundwater and the wider environment.

The Contaminated Land Statutory Guidance (DEFRA, 2012) suggests that where the authority has ceased its inspection and assessment of land as there is little or no evidence to suggest that it is contaminated land the authority should issue a written statement to that effect.

# 2 Desk Study Information

## Location

The site's location is shown in Appendix B. The grid reference for the centre of the site is 562763, 297620. The nearest postcode is PE38 0JY.

# Previous investigation

The site has been subject to a number of investigations which should be read in conjunction with this report. Table 1 below lists the reports used in compiling this written statement.

Table 1 Documents used in this report

Reference	Date	Author		Title
s115100001852	December	Α	J	Preliminary Site
	2012	Grimmer		Assessment
s115100001852DQRA	May 2013	Α	J	Detailed Risk
	-	Grimmer		Assessment of a Former
				Country House Gas
				Works

## Overview of the previous investigations

The site is a tied cottage which is part of Wood Hall Farm and was used as a country house gas works. The gas works operated from approximately the late 19<sup>th</sup> century until some point before 1945. The Country House Gas Works was a small scale installation, which was located in the garden of a residential dwelling (Gas House), which is rented to adult workers. The Preliminary Site Assessment concluded that a site investigation would be required to assess the potential for contamination to be present on the site from the identified pollution linkage (Human Health).

A site investigation was undertaken with the permission of the site owner on 27<sup>th</sup> February 2013. The site investigation included the excavation of four boreholes, one in the centre of the former gasometer and three around its perimeter. The soils excavated from the boreholes was logged and representative soil samples were taken and dispatched to a UKAS accredited laboratory for analysis for analytes which are associated with gas works as described in the Preliminary Site Assessment.

The chemical analysis recorded elevated values of Arsenic, Lead and some species of PAHs when compared to Generic Assessment Criteria. A detailed quantitative risk assessment (DQRA) of the above contaminants of concern was undertaken using CLEA v1.06 and the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK). The DQRA returned results which indicated that no significant risk existed to the human health.

# Revision to the Toxicological Data

Since 2013 new toxicological data has been released, which has changed some of the risk factors associated with undertaking DQRAs. The documents which detail the revisions to the risk assessment are the LQM/CIEH S4ULs for Human Health Risk Assessment developed by Land Quality Management and the Chartered Institute of Environmental Health and the C4SLs presented in the SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination developed by Contaminated Land: Applications in Real Environments.

The chemical data from the site investigation has been compared to Generic Assessment Criteria (GAC) within the S4ULs and C4SIs. The analytes which exceeded the relevant GACs has been presented in tables 1 and 2 below.

**Table 2 Metal Exceedances** 

Analyte	GAC mg/kg	Min/Max	No.	of
		recorded	exceedances	
Arsenic	37 <sub>1</sub>	13/47	1/5	
Lead	2001	270/1,700	5/5	
1). C4SI s selected as the m	ost appropriate le	vel for assessing s	ignificant risk	

**Table 3 Polycyclic Aromatic Hydrocarbon Exceedances** 

Analyte	GAC mg/kg	Min/Max	No.	of
		recorded	exceedances	
Benzo(a)anthracene	7.22	0.45/11	1/5	
Benzo(b)fluoranthene	2.6 <sub>2</sub>	0.85/8.8	2/5	
Benzo(a)pyrene	51	0.87/8.2	1/5	
Dibenzo(a, h)anthrocene	0.242	<0.1/1.6	3/5	

<sup>1).</sup> C4SLs selected as the most appropriate level for assessing significant risk.

Following the assessment of the chemical data against the GACs several exceedances were noted. Therefore a Detailed Quantitative Risk Assessment was undertaken to further assess the risk posed by the identified contamination. The risk assessment package CLEA v1.071 was considered to be the most appropriate risk assessment package to be used as this is the contains the most up to date toxicological data

<sup>2)</sup> S4ULs selected as values do not exist in the C4SL.

# Input parameters for CLEA v1.071.

Contact was made with the site owner who provided information regarding the situation on site, i.e. the number of people who are living on the site, their age and sex etc. Therefore the following parameters have been adopted for this assessment.

- The occupants are all male.
- They are over the age of 16.
- The garden is not used for growing vegetables.

#### Results of the CLEA risk assessment model

An initial risk assessment was undertaken using the above receptor information. The results are presented below compared against the derived site specific assessment criteria (SSAC). Risk assessment output is presented in Appendix A.

**Table 4 Metal Exceedances** 

Analyte	SSAC mg/kg	Min/Max	No.	of
		recorded	exceedances	
Arsenic	237 <sub>1</sub>	13/47	0/5	
Lead	8641	270/1,700	1/5	
1). CLEA v 1.071				

**Table 5 Polycyclic Aromatic Hydrocarbon Exceedances** 

Table 3 Tolycyclic Albinatic I	Tydrocarbon Exce	-uarices		
Analyte	SSAC mg/kg	Min/Max	No.	of
		recorded	exceedances	
Benzo(a)anthracene	107 <sub>1</sub>	0.45/11	0/5	
Benzo(b)fluoranthene	26.9 <sub>1</sub>	0.85/8.8	0/5	
Benzo(a)pyrene	28.9 <sub>1</sub>	0.87/8.2	0/5	
Dibenzo(a, h)anthrocene	2.14. <sub>1</sub>	<0.1/1.6	0/5	
1). CLEA v 1.071				

One result of the chemical analysis indicated an exceedance of the calculated SSAC. This related to one value of lead which was from a sample taken from between 0.3 to 0.5m below ground level (bgl). As the sample was from between 0.3 and 0.5m bgl it is considered that the inhalation and ingestion pathways are not applicable to this sample and do not represent a risk to human health. A revised site specific assessment criteria was calculated to reflect the assumption that ingestion and inhalation are not relevant exposure pathways. Risk assessment output is presented in Appendix B.

**Table 6 Metal Exceedances** 

Analyte	SSAC mg/kg	Min/Max	No.	of
		recorded	exceedances	
Lead	209,000 <sub>1</sub>	270/1,700	0/5	
1). CLEA v 1.071				

The revised site specific assessment criteria indicate that the levels of contamination encountered on site do not pose a significant risk to human health.

#### 5 Outcome of Revised Detailed Quantitative Risk Assessment

#### Conclusion

A plausible source pathway receptor linkage was identified in the previous reports for human health and was initially assessed during the Detailed Quantitative Risk Assessment which concluded that no significant risk was present.

This risk assessment revised the detailed quantitative risk assessment (DQRA) in light of recent revisions in toxicological data for the identified contaminants of concern. The outcome of the DQRA was that there was no significant risk to the only identified potential linkage (human health). As the risk posed is low, the site would be classified as Category 4 for human health as set out in the Statutory Guidance (Appendix C contains categorisations)

#### Part 2A status

Statutory Guidance states that 'If the authority considers there is little reason to consider that the land might pose an unacceptable risk, inspection activities should stop at that point.' In such cases the authority should issue a written statement to that effect. This report forms that written statement.

On the basis of its assessment, the authority has concluded that the land does not meet the definition of contaminated land under Part 2A and is not considered contaminated land.

#### **Further Action**

This assessment is based on the site's current use and is valid providing no changes are made to the soil or vegetation cover material, to surface water conditions or to the site's use.

No further assessment of the site is considered necessary under Part 2A unless additional information is discovered or if changes are made to the site.

# Appendices

Appendix A: CLEA Risk Assessment model for the Revised Detailed Quantitative Risk Assessment (With inhalation and ingestion)

Environment Agency

CLEA Software Version 1.071 Page 1 of 11

Report generated 10-Nov-1

Report title Hilgay Country House Gas Works

Created by Alex Grimmer at BCKLWN

RESULTS

		Assessn	nent Criterion	(mg kg <sup>-1</sup> )	Rati	o of ADE to	HCV combined	Saturation Limit (mg kg <sup>-1</sup> )	50% Oral	ruie? Inhal	Top Two applied?	Greenvegeta	Root vegetabl	Tubervegetabl	Herbaceous fruit	Shrub fruit	1000 Hu
Arsenic (( Lead (C4 Benz[a]ar	C4SL adult) SL adult) ithracene	8.64E+02	8.08E+02 NR 2.62E+02	NR NR NR	1.00 1.00 1.00	0.29 NR 0.41	NR NR NR	NR NR 1.03E+01 (sol)	No No No	No No No	Yes Yes Yes	Yes Yes No	No No	No Yes No	No No	No Y	es No No
Benzo(b)f Benzo(a);	luoranthene oyrene (C4SL adult) njanthracene	2.69E+01 2.89E+01 2.14E+00	7.99E+01 6.33E+01	NR NR NR	1.00 1.00 1.00	0.34 0.46 0.34	NR NR NR	7.29E+00 (sol) 5.46E+00 (vap) 2.36E-02 (vap)	No No No	No No No	Yes Yes	No No	No Yes No	No Yes No	No No No	No N	No No
		2.142.400	CAP LYOU		1.00	0.04		Zunaria (mpl)		140							
															=		
															_		$\exists$
														_	=		$\exists$
												<u> </u>	_	_	<b>=</b>		$\exists$

CLEA Software Version 1.071		Repo	rt generated	10-Nov-17	7			Page 3 of 1	1							_
Environment Againty										4 pejdte	petables	sek	2 Approach	h to Produ		
		ment Criterion		Rati	o of ADE to	$\overline{}$	Saturation Limit (mg kg <sup>1</sup> )	II	rule?	₹ 2	e v	otvegetat	Serve(	paceo	Shrub fruit	e frui
	onal	inhalation	combined	oral	inhalation	combined		Oral	Inhal	<u>۾</u>	8	B.	ž	훈	5	18
21		-	$\vdash$			$\vdash$		╟──		<b>├</b> ─						
23	+	-	-			$\vdash$		╟──		<del> </del>						
22 23 24 25 26 27 27 28										t —						
25										T —		_			_	
26								11		T —					_	
27								1		T —					_	
28										T						
29 30																
30								11		11						

CLEA Software Version 1.07	1					Rep	ort generated	ı		10-Nov-17							Page 4 of 1	1
Environment Agency	;	Soil Dis	tributio	n							Modia	2 Concentr	ations					
	Sorbed	Dissolved	anode).	Total	Soll	Salgas	Indoor Dust	Outdoor dust at 0.8m	Outdoor dust at 1.8m	Indoor Vapour	Outdoor vapourat 8.8m	Outdoor vapourat 1.8m	Green v og diables	Root v agetables	Tuber v og diables	Herbacecus	Shubfult	Tree fruit
	%	%	%	*	mg kg <sup>-1</sup>	mg m <sup>ra</sup>	mg kg <sup>-1</sup>	mg m <sup>a</sup>	mg m²	mg m²	mg m²	mg m²	mg kg <sup>1</sup> FW	mg kg <sup>1</sup> PW	mg kgi¹FW	mg kg <sup>1</sup> FW	mg kg <sup>1</sup> FW	mg kg <sup>-1</sup> PW
1 Americ (C4SL adult)	29.9	0.1	0.0	100.0	2.37E+02	NR	1.19E+02	1.01E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	NA.	NA.	NA	NA
2 Lead (C4SL adult)	100.0	0.0	0.0	100.0	8.64E+02	NR	4.32E+02	3.68E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	NA.	NA.	NA.	NA
3 Berz[s]anthracene	100.0	0.0	0.0	100.0	1.07E+02	1.25E-03	5.35E+01	4.55E-08	0.00E+00	5.95E-07	1.61E-07	0.00E+00	NA	NA.	NA.	NA.	NA.	NA
4 Benzo[b]fluoranthene	100.0	0.0	0.0	100.0	2.69E+01	1.51E-05	1.35E+01	1.15E-08	0.00E+00	8.48E-09	3.30E-08	0.00E+00	NA	NA	NA.	NA.	NA	NA
5 Benzo(a)pyrene (C4SL adult)	100.0	0.0	0.0	100.0	2.89E+01	1.13E-05	1.44E+01	1.23E-08	0.00E+00	6.50E-09	3.21E-08	0.00E+00	NA	NA	NA	NA	NA	NA
6 Dibera[sh]anthracene	100.0	0.0	0.0	100.0	2.14E+00	1.78E-06	1.07E+00	9.11E-10	0.00E+00	9.52E-10	1.91E-09	0.00E+00	NA	NA	NA.	NA	NA	NA
7	T		Г															
8	-		${}^{-}$															
9	-		-															
10	-		${}^{-}$															
11	$T^-$																	
12																		
13																		
9 10 11 12 13 14 15 16 17 18 19																		
15																		
16																		
17																		
18																		
19																		
20	1						ı	l						l .		l .		

CLEA Software Version 1.0	71					Repo	ort generated			10-Nov-17							Page 5 of 1	
Environment Agency		Soil Dist	tributio	n							Modia	Concentra	tions					
	Sorbed	Dissolved	Vapour	Total	Soll	Soilgas	Indoor Dust	Outdoor dust at 0.5m	Outdoor dust at 1.8m	Indoor Vapour	Outdoor vapourat 0.8m	Outdoor vapourat 1.8m	Green v og drabies	Root vegetables	Tuber vegetables	Herbacecus	Shrub fruit	Tree fruit
	%	%	%	%	mg kg*1	mg m <sup>a</sup>	mg kg*1	mg m <sup>ra</sup>	mg m²	mg m²	mg m²	mg m²	mg kg <sup>1</sup> FW	mg kg <sup>1</sup> FW	mg kgi 1 FW	mg kg <sup>-1</sup> FW	mg kg <sup>-1</sup> FW	mg kg <sup>1</sup> FW
21 22 23 24																		
22																		
23																		
24																		
25																		
26	П																	-
27	Г																	$\Box$
28	г																	-
29	${}^{-}$																	$\overline{}$
30	$\Gamma^{-}$																	$\overline{}$

CLEA Software Version 1.071					Rep	ort generated	10-Nov-17					Page 6	of 11		
Environment Agency		Avora	ge Daily Ex	rposure (m	g kg <sup>1</sup> bw o	day ¹)				Dist	ribution by	Pathwa	y (%)		
	Direct sol inguition	Consumption of homegraen produce and attached soll	Direct soll ingestion	Consumption of homegraen produce and stacked soll	Dermal contact with a oil and dust	Malason of dust	bhalaten of vapour (Indeer)	Phalaton of vapour (outboor)	Bi digroun d (oral)	Budground (mhala lon )					
1 Arsenic (C4SL adult)	2.87E-04	0.00E+00	1.30E-05	1.11E-06	0.00E+00	0.00E+00	0.00E+00	95.65	0.00	4.35	0.00	0.00	0.00	0.00	0.00
2 Lead (C4SL adult)	6.27E-04	0.00E+00	0.00E+00	2.60E-06	0.00E+00	0.00E+00	0.00E+00	99.59	0.00	0.00	0.41	0.00	0.00	0.00	0.00
3 Berz[a]anthracene	1.30E-04	0.00E+00	2.55E-05	5.03E-07	1.10E-07	7.24E-07	1.33E-07	83.55	0.00	16.45	0.00	0.00	0.00	0.00	0.00
4 Beruro[b]fluoranthene	3.26E-05	0.00E+00	6.42E-06	1.27E-07	1.57E-09	1.33E-06	1.57E-07	83.55	0.00	16.45	0.00	0.00	0.00	0.00	0.00
5 Benzo(a)pyrene (C4SL adult)	3.50E-05	0.00E+00	6.89E-06	1.36E-07	1.21E-09	0.00E+00	0.00E+00	83.25	0.00	16.40	0.32	0.00	0.00	0.00	0.00
6 Dibera[sh]anthracene	2.59E-06	0.00E+00	5.10E-07	1.01E-08	176E-10	4.83E-07	3.98E-07	83.55	0.00	16.45	0.00	0.00	0.00	0.00	0.00
7															
8															$\Box$
9	-					-					-			$\vdash$	$\overline{}$
10 11 12														$\vdash$	$\overline{}$
11															$\Box$
12															
13															
14															
15															
16															
17															
18															
19															
20															

LEA Software Version 1.071	1				Repo	ort generated	10-Nov-17					Page 7	of 11		
Environment Agency		Avera	go Daily Ex	posure (m	g kg <sup>-1</sup> bw d	iay ¹)				Dis	tribution b	y Pathw	ay (%)		
	Direct and Ingestion	Consumption of homegown produce and attached soil	Dermi contact with a of and dust	who letten of dust	Phalation of vapour	lla diground (oral)	Budground (inhalaton)	Direct soil ingo ation	Consumption of hamegrawn produce	Dermi contact with soil and dust	Interlation of dust	who belon of vapour (Indox)	Interior of vapour (outdoor)	Badground(orn)	Badgound (Inhabition)
21 22 23 24 25															
22															
23															
24															
25															
26															
27															
28															${}^{-}$
29															${}$
30															-

CLEA Software Version 1.071					Rapo	rt generated	10-Nov-1	17							Page 8	of 11
Environment Agency		Oral Health Charley also	1	(ugkg ' BW day')	Oral MosenDaily Intake (agday)	Phalaton Mean Dally Intake (p.g.d.g. <sup>1</sup> )	Alterator partition could derit (K_a) (cm² cm²)	Coeffdent of Diffusion in Air (गर्ने व ')	Coeffdent of Diffusion in Water (of a")	log K <sub>++</sub> (om² g²)	log K <sub>er</sub> (dimensioniem)	Dermi Absorption Fraction (dimensionle as)	Solit bidust temport factor (gg 1 DW)	Sub-autace soil to indoor air correction tudor (dimensionie as)	Relative blowuliability via soil Ingestion (unifiess)	Point ve bloaval ability vin dust inhal all on (unidom)
1 Araenic (C4SL adult)	D	0.3	₽	0.0038	NR	NR	NR	NR	NR	NR	NR	0.03	0.5	- 1	-	1
2 Lead (C4SL adult)	ID	0.63	NR	0	NR	NR	NR	NR	NR	NR	NR	0	0.5	1	0.6	0.64
3 Benzjajanthracene	D	0.155	ID	0.0015	0.06	0.011	3.16E-05	4.60E-06	3.80E-10	4.89	5.91	0.13	0.5	1	1	1
4 Benzo[b]fluorenthene	D	0.039	ID	0.00038	0.11	0.013	2.05E-06	4.36E-06	3.62E-10	5.02	6.08	0.13	0.5	1	1	1
5 Benzo(a)pyrene (C4SL adult)	D	0.042	ID	0.0003	NR	NR	1.76E-06	4.38E-06	3.67E-10	5.11	6.18	0.13	0.5	1	- 1	1
6 Diberz[sh]anthracene	ID	0.0031	ID	0.00003	0.04	0.033	5.40E-06	4.08E-06	3.40E-10	5.27	6.38	0.13	0.5	1	1	1
7																
8																
9	-				-										-	-
10																
11 12																
12																
13																
14																
15																
16																
17																
18 19																
19																
20																

CLEA Software Version	1.071			Rapo	rt generated	10-Nov-1	17							Page 9 o	af 11
Environment Agency		inging "BW day")	bha kiticn Health Criteria Viabe 0g/tgi18W day↑	Ond Mean Daily Intakes (ppd-y <sup>*</sup> )	Inha bation Mean Daily Into to (pgday <sup>1</sup> )	Alreator partition coefficient (K_) (ceff cert)	Coefficient of DRN ston in Air (m² s²)	Coefficient of Office and nWater (m² s²)	log K <sub>++</sub> (am² g")	log K <sub>er</sub> (dimensionie as)	Dermi Absorption Fraction (dineraloriem)	Solib dust temport tactor (95° DW)	Sub-autice soil to indoor at correction to dor (dimensionie as)	Relative blooms ability viscoli Ingestion (unifees)	Restive board atility deduct inhalaton (unitem)
21 22 23 24 25															
22															
23															
24															
25															
26	$\neg \neg$														
26 27	$\neg$														
28	$\neg$														$\Box$
29 30	$\top$														
30	$\neg$		$\neg$												$\overline{}$

CLEA Software Version 1.071				Report generated	110 Nov 17				Page 10 of 11
CLEA GOINAITE VEISION 1.071				Helport generalis.	10-1404-17				rage to or it
Environment Againty	(an $^{\circ}g^{\circ}$ )	(ly) executionally,	Water solubility (mg.L.")	(b.k.b.p bet concentration batter for green vegetables (ng g <sup>2</sup> plant DM or IM basis over ng g <sup>2</sup> DM solt	Solitopher concentration bacterior root vergebiles of plees DW or IW beats over mg g* DW solit	So to polant companies on the control taken vages been trop of plant DM or PM basis owering of DM and ()	So bits of best concentration that is the best of the best of the best best best best over the gr (if DM or IM) bests over try gr (if DM or IM)	(b i-b g last concentration better for a limb bit it (mg g' j' aim I DM or PM basts over ng g' DM s of it	So but plant concentration but by the set full from g' plant UM or PM bada over ng g' CM soll
1 Araenic (C4SL adult)	5.00E+02	NR	1.25E+06	0.00043 fer	0.0004 fw	0.00023 🖦	0.00033 fer	0.0002 te	0.0011 🖦
2 Lead (C4SL adult)	1.00E+03	NR	2.96E+05	0.00419 fer	0.00402 🖦	0.00731 🖢	0.00074 fer	0.00020 fw	0.00022 fer
3 Benz[a]anfinacene	2.70E+03	1.24E-06	3.80E-03	model	model	model	model	model	model
4 Berzo[b]fluoranthene	3.64E+03	6.34E-08	2.00E-03	model	model	model	model	model	model
5 Benzo(alpyrene (C4SL adult)	4.48E+03	2.00E-08	3.80E-03	0.00041 fw	0.00178 🖦	0.00088 iw	0.00050 fw	0.00000 fer	0.00004 fer
6 Diberujah janthracene	6.48E+03	1.66E-10	6.00E-04	model	model	model	model	model	model
7									
8	$\top$								
9	$\top$								
10									
11									
12									
13									
14									
15									
16									
17		L							
18									
19	+	<b>—</b>							
20									

CLEA Software Version 1.07	71			Report generated	10-Nov-17				Page 11 of 11	
En-ironment Agency	do be a war are the contident (an g i)	Autour pressure (Pig	Water actuality (mg L')	Boilto-plant concentration factor for give a wegstables drog g <sup>2</sup> plant DW or PW basis over mg g <sup>2</sup> DW soll)	Sobie-phercencerinalen Sectoriorend vegelebbe Brg gipkent DW or PW basis over mg giDM soll)	So to polari concentration bases for both wayshabse (mg g 'plan LDV or PW bada overing g'DN solt)	10 to polari concentration between the technologies that (ing g' hant UM or MI basis over eng g' DM soli	to be polari concentration between the struct built (mg g ' plant DM or PW bada over mg g' DM solit	its its plant concentration before for the hist (mg g' jelant IM or PW bada over mg g' DM a of it	
21										1
22										ı
23										ı
24										ı
25										1
26										1
22 23 24 25 26 27										
28										ı
30										ı
30										1

Appendix B: CLEA Risk Assessment model for the Revised Detailed Quantitative Risk Assessment (Without ingestion and inhalation)

Environment Agency

CLEA Software Version 1.071 Page 1 of 11

Report generated 10-Nov-1

Report title Hilgay Country House Gas Works

Created by Alax Grimmer at BCKLWN

RESULTS

LIT\_10166 lead CLEA Software Version 1.071 Report generated 10-Nov-17 Page 2 of 11 Environment Agency Ratio of ADE to HCV Assessment Criterion (mg kg<sup>-1</sup>) 1 Load (C4SL adult)
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20 1.00 NR 2.09E+05 NR

LEA Software Version 1.071		Repo	rt generated	10-Nov-1	7			Page 3 of	11							
Environment Agency											ı					
Applicy												Apply Top	2 Арргово	h to Produ	ce Group	P
										£	w					
											差	-8	å	草		ı
											envegeta	ootvegetab	v egetabl	ceous	-	Ι.
	Assess	ment Criterion	(mg kg <sup>-1</sup> )	Rat	io of ADE to	HCV		509	L rule?	2	2	9	2	8	를	13
	onal	inhalation	combined	onal	in ballation	combined	Saturation Limit (mg kg <sup>3</sup> )	Oral	Inhal	8	8	o to	pagn	ê	Shrub fruit	Tree fruit
24		***********	CONTIGUE		***************************************			Chai		ĭ	Ø	Œ	F	Í	9	F
21 22 23 24 25	_	_	$\vdash$			$\vdash$		$\vdash$				—			—	-
23															=	
24		_				$\vdash$				_					_	_
25	-	├	$\vdash$		-	$\vdash$		<b>⊢</b>								
26 27		├	$\vdash$	<b> </b>		$\vdash$		$\vdash$	+							-
28	-	-	$\vdash$	<b>-</b>	-	$\vdash$		-	+							
29		_	$\vdash$			$\vdash$		-	_							
30															_	_

CLEA Software Version 1.07	1					Repo	ort generated			10-Nov-17							Page 4 of 1	1
Environment Agency		Soil Dis	tributio	n							Modia	2 Concentr	ations					
	Sorbed	Dissolved	.modey	Total	Sall	Salgas	Indoor Dust	Outdoor dust at 0.5m	Outdoor dust at 1.8m	Indoor Vapour	Outdoor vapourat 8.8m	Outdoor v apourat 1.6m	seichtber men D	Root v agetables	Tuber v og dables	Herbsoous	Shubinit	Tree fruit
	%	%	%	%	mg kg <sup>-1</sup>	mg m <sup>ra</sup>	mg kg <sup>-1</sup>	mg m <sup>ra</sup>	mg m <sup>a</sup>	mg m²	mg m <sup>ra</sup>	mg m²	mg kg <sup>1</sup> FW	mg kg <sup>1</sup> PW	mg kg <sup>1</sup> FW	mg kg <sup>1</sup> FW	mg kg <sup>1</sup> FW	mg kg <sup>-1</sup> FW
1 Lead (C4SL adult)	100.0	0.0	0.0	100.0	2.09E+05	NR	1.05E+05	8.91E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA.	NA	NA.	NA.	NA.	NA.
2 3 4 5																		
3			-															-
4																		
5			г															$\overline{}$
6			-															$\overline{}$
7	-		-															-
8	-		-	_														-
9	-	_	⊢	-														$\vdash$
10	$\vdash$		$\vdash$	$\vdash$												-		-
11																		$\overline{}$
12																		
13																		
14																		
9 10 11 12 13 14 15 16 17 18 19 20																		
16																		
17																		
18																		
19																		
20																		

CLEA Software Version 1.0	71					Rep	ort generated			10-Nov-17							Page 5 of 11	
Environment Agency		Soil Dis	tributio	n							Modia	Concentra	tions					
	Sorbed	Dissolved	Vapour	Total	Soll	Soligas	Indoor Dust	Outdoor dust at 0.5m	Outdoor dust at 1.8m	Indoor Vapour	Outdoor v apourat 0.8m	Outdoor vapourat 1.8m	Green v og dables	Root vegetables	Tuber vapatables	Herbacecus fruit	Shubfruit	Tree fruit
	%	%	%	*	mg kg <sup>-1</sup>	mg m <sup>a</sup>	mg kg*1	mg m <sup>o</sup>	mg m²	mg m²	mg m²	mg m²	mg kg <sup>1</sup> FW	mg kg <sup>1</sup> FW	mg kg <sup>1</sup> FW	mg kg <sup>-1</sup> FW	mg kg <sup>-1</sup> FW	mg kgʻ¹FW
21																		
22 23 24 25																		
23																		
24																		
25																		
26	Т																$\overline{}$	$\Box$
27	Т																	
28	T		Г															
29	$\mathbf{T}$		${}^{-}$															-
30	$\mathbf{I}$																	$\overline{}$

CLEA Software Version 1.071					Repo	ort generated	10-Nov-17					Page 6	of 11		
Environment Agency		Avora	ge Daily Ex	posure (m	g kg¹bw d	iay ¹)				Dist	ribution by	Pathwa	y (%)		
	Direct sol ingestion	Consumption of homegrown produce and attached soil	Dermil contact with soil and dust	theiston of dust	Inha lation of vapour	(jusy) purodip (g	(Independ	Direct soll ingestion	Consumption of homegraen produce and attached soll	Dermal contact with a cil and dust	Hhalation of dust	brimistion of vapour (Indext)	Hhalation of vapour (outboor)	Bi diground (oral)	(inhala for )
1 Lead (C4SL adult)	0.00E+00	0.00E+00	0.00E+00	6.30E-04	0.00E+00	0.00E+00	0.00E+00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00
2															$\Box$
3															
4															
5															$\Box$
6															$\neg$
2 3 4 5 6 7 8 9 10 11 12 13 14															$\Box$
8															$\Box$
9													-		-
10													_		$\overline{}$
11															
12															
13															
14															
15															
16 17															
17															
18 19															
19															
20															

CLEA Software Version 1.07	71				Rep	ort generated	10-Nov-17					Page 7	of 11		
Environment Agency		Avera	ge Daily Ex	posure (m	g kg <sup>-1</sup> bw o	day ¹)				Dist	tribution b	y Pathwa	ay (%)		
	Drected Ingestion	Consumption of homegrown produce and attached soil	Dermi contact with soll and dust	who lation of dust	traition of vapour	Badground(ora)	Consumption of hamegrawn produce	Dermi cortactwith soll and dest	Halelon of dust	White lation of vapour (Indoor)	bhalation of vapour (outdoor)	Badground (orn)	(inhalation)		
21 22 23 24 25							(uojajauji) punodojajij								
22															
23															
24															
25															
26															
27															
28															
30															$\Box$
30															-

CLEA Software Version 1.071					Repo	t generated	10-Nov-1	17							Page 8	of 11
Ensironment Agency		Opping 'BW day')	1	(yaka' 'BW day')	One labour Douge Interior Ougstay ?)	Phalation Mean Dally Intake (p.g.d.gl. <sup>1</sup> )	Alternate partition coefficient (%), (cm² cm²)	Coefficient of Diffusion in Air (m <sup>2</sup> a <sup>1</sup> )	Coefficient of Diffusion in Water (of a")	log K <sub>++</sub> (am <sup>2</sup> g <sup>1</sup> )	log K <sub>er</sub> (dimeratoriem)	Dermit Absorption Fraction (dimensionle as)	Solit bid ust temport factor (ggl * DW)	Sub-authorized to indoor air correction to dor (dimensionib as)	Rastve Howell still y vissoil Ingestion (unifiess)	Point to blow all ability via dust brhad all on (unifie m.)
1 Lead (C4SL adult)	₽	0.63	NR	0	NR	NR	NR	NR	NR	NR	NR	0	0.5	- 1	0.6	0.64
2 3 4 5 6																
3	$\perp$									_		$\vdash$				$\overline{}$
4	$\vdash$		-							<b>—</b>		-			-	$\vdash$
5																
6																
7																
8																
9																
10																
8 9 110 111 112 113 114 115 115 115 118 119 220																
12																
13																
14																
15																
16																
17																
18	$\vdash$		$\overline{}$									$\vdash$			$\vdash$	
19																
20																

CLEA Software Version 1.0	071				Repo	rt generated	10-Nov-1	7							Page 9	of 11
Environment Agency		One Health Charley also Lights' IIV day')		Oppig' BW day")	Ond Mean Daily Intake (ppday <sup>1</sup> )	Inha bitton Mean Dody Into le (pgday <sup>1</sup> )	Alterator partition coefficient (V <sub>m</sub> ) (ceff cert)	Coachtain at of Diffu sion in Air (m² s²)	Coeficient of Diffusion in Water (m² a¹)	log K <sub>++</sub> (am <sup>2</sup> g <sup>2</sup> )	log K <sub>e</sub> (dimensionie as)	Dermi Absorption Fraction (dinensioniem)	Solit bidust tanapart factor (sgl*DW)	Sub-autices of to indoor air correction to dor (dimensionis as)	Relative bloomatable y vanoil ingestion (unitees)	Restive Houval atility via dust inhal alon (uni fe m.)
21 22 23 24 25																
22	$\perp$															
23	ـــــ															-
24	—		_							-						-
25																
26																
27	П															
28	${}^{-}$		Г													
29	T															$\Box$
30	т															

CLEA Software Version 1.071	Report generated 10-Nov-17 Page 1					Page 10 of 11			
Environment Agancy	(an g)	(ig) extend and and and	Water solu billy (mg L <sup>2</sup> )	So bits of best concentration the best of green wagestald see they girlant DM or NW basis over mg gir DM and	Boltis-plant concentration bacteriorized vegetables in g gipter by or MV beats over mg g <sup>2</sup> DM sol)	(the big last concentral on bacter for tuber vegetables (troy of plant IDV or PV bad a over my of DM soll)	(b) in the concentration by the concentration of a family of the concentration of a family of the concentration of a family of the concentration of the conc	So is to gluet concentration before should be it. Ong of James IDM or PW bads overing of IDM soil.	So be glast concentration theory of period of the foliation of the foliati
1 Lead (C4SL adult)	1.00E+03	NR	2.96E+05	0.00419 🖦	0.00402 🚾	0.00731 🖢	0.00074 fe	0.00020 fer	0.00022 fer
2 3 4 5 6 7	<del></del>								
3									
-	-								
	-								
	─								
8									
9									
10									
11	─								
12 13	+								
13	-								
15	-			<b>.</b>		<b>!</b>	<b>!</b>		
46	+			<b>-</b>		<b>-</b>	<b>-</b>		
16 17	-	-		<b>-</b>					
18	-	-							
19	-			-		-	-	<del>                                     </del>	
20	-	<b>-</b>	<del>                                     </del>	<b>-</b>		<b>-</b>	<b>-</b>		
a									

CLEA Software Version 1.07	1			Report generated	10-Nov-17				Page 11 of 11	_
Environment Agentay	(an 'g')	Napour pressure (Pig	Water actuality (mg L*)	Roll-to-plant concentration factor for give a wegetables (mg g <sup>-1</sup> plant DW or PW basis over mg g <sup>-1</sup> DW sall)	ibe Noplant concentration hact not not no gotables in g g <sup>2</sup> plant DW or PW basis over mg g <sup>2</sup> DW axil	Set be polari concentration bases for sides vegetables (mg g 'plant DM or PWbada overing g' DM set)	So to polanticanomentation back for hard-scopular full (ing g <sup>1</sup> famt DM or MI basis over eng g <sup>1</sup> DM soli	to be polaricomountation better for aimude built (mg g' plant DM or PMbada over ng g' DM solik	Ob the plant concentration factor for time that (mg g', plant DM or PM basis over mg g', DM soil)	
21										
22										
23 24 25										
24										
26										
27										
28										
29										
30										

# Appendix C: Risk Assessment Methodology

The Model Procedures for the Management of Land Contamination (CLR11<sup>1</sup>) provide the technical framework for applying a risk management process when dealing with contaminated land.

The Borough Council's Contaminated Land Strategy has identified priority sites based on mapping and documentary information. The Contaminated Land Inspection Report collates all the existing information on the site and develops a conceptual site model to identify and assess potential pollutant linkages and to estimate risk.

The risk assessment process focuses on whether there is an unacceptable risk, which will depend on the circumstances of the site and the context of the decision. The Council has used a process adapted from CIRIA C552, Contaminated Land Risk Assessment, a guide to good practice<sup>2</sup> to produce the conceptual site model and estimate the risk of harm to defined receptors. This involves the consideration of the probability, nature and extent of exposure and the severity and extent of the effects of the contamination hazard should exposure occur.

The probability of an event can be classified as follows:

- Highly likely: The event appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution;
- Likely: It is probable that an event will occur, or circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term;
- Low likelihood: Circumstances are possible under which an event could occur, but it is not certain even in the long term that an event would occur and it is less likely in the short term;
- Unlikely: Circumstances are such that it is improbable the event would occur even in the long term.

The severity of the hazard can be classified as follows:

- High: Short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short term risk to an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Contaminated Land Statutory Guidance, April 2012');
- Medium: Chronic damage to human health ('significant harm' as defined in 'Contaminated Land Statutory Guidance, April 2012'), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Contaminated Land Statutory Guidance, April 2012');

<sup>1</sup> https://www.gov.uk/guidance/land-contamination-risk-management

<sup>&</sup>lt;sup>2</sup> https://www.brebookshop.com/samples/142102.pdf

• Low: Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Contaminated Land Statutory Guidance, April 2012'). Damage to sensitive buildings, structures or the environment.

Once the probability of an event occurring and hazard severity has been classified, a risk category can be assigned from the table below:

		Hazard				
		High	Medium	Low		
ility	High Probability	Very High Risk	High Risk	Moderate Risk		
Probability	Likely	High Risk	Moderate Risk	Moderate/Low Risk		
Pr	Low Probability	Moderate risk	Moderate/Low Risk	Low Risk		
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk		

Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening  This risk, if realised, is likely to result in a substantial liability.  Urgent investigation (if not undertaken already) and remediation are likely to be required.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard.  Realisation of the risk is likely to present a substantial liability.  Urgent investigation (if not undertaken already) if required to clarify the risk and to determine the potential liability. Some remedial work may be required in the longer term.
Moderate risk	It's possible that harm could arise to a designated receptor from an identified hazard. However, it is relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that harm would be relatively mild.
Moderate/Low risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, if any harm were to occur it is more likely that harm would be relatively mild.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is unlikely to be severe.

# Determination of contaminated land Contaminated Land Statutory Guidance, April 2012

# **Human Health**

Category			
1	The local authority should assume that a significant possibility of significant harm exists in any case where it considers there is an unacceptably high probability, supported by robust science-based evidence that significant harm would occur if no action is taken to stop it. For the purposes of this Guidance, these are referred to as "Category 1: Human Health" cases.  Land should be deemed to be a Category 1: Human Health case where:		
	(a) The authority is aware that similar land or situations are known, or are strongly suspected on the basis of robust evidence, to have caused such harm before in the United Kingdom or elsewhere; or		
	(b) The authority is aware that similar degrees of exposure (via any medium) to the contaminant(s) in question are known, or strongly suspected on the basis of robust evidence, to have caused such harm before in the United Kingdom or elsewhere;		
	(c) The authority considers that significant harm may already have been caused by contaminants in, on or under the land, and that there is an unacceptable risk that it might continue or occur again if no action is taken. Among other things, the authority may decide to determine the land on these grounds if it considers that it is likely that significant harm is being caused, but it considers either: (i) that there is insufficient evidence to be sure of meeting the "balance of probability" test for demonstrating that significant harm is being caused; or (ii) that the time needed to demonstrate such a level of probability would cause unreasonable delay, cost, or disruption and stress to affected people particularly in cases involving residential properties.		
2	Land should be placed into Category 2 if the authority concludes, on the basis that there is a strong case for considering that the risks from the land are of sufficient concern, that the land poses a significant possibility of significant harm, with all that this might involve and having regard to Section 1. Category 2 may include land where there is little or no direct evidence that similar land, situations or levels of exposure have caused harm before, but nonetheless the authority considers on the basis of the available evidence, including expert opinion, that there is a strong case for taking action under Part 2A on a precautionary basis.		
3	Land should be placed into Category 3 if the authority concludes that the strong case described in 4.25(a) does not exist, and therefore the legal test for significant possibility of significant harm is not met. Category 3 may include land where the risks are not low, but nonetheless the authority considers that regulatory intervention under Part 2A is not warranted. This recognises that placing land in Category 3 would not stop others, such as the owner or occupier of the land, from taking action to reduce risks outside of the Part 2A regime if they choose. The authority should consider making available the results of its inspection and risk assessment to the owners/occupiers of Category 3 land.		

#### **Human Health**

# **Category**

- The local authority should consider that the following types of land should be placed into Category 4: Human Health:
  - (a) Land where no relevant contaminant linkage has been established.
  - (b) Land where there are only normal levels of contaminants in soil, as explained in Section 3 of this Guidance.
  - (c) Land that has been excluded from the need for further inspection and assessment because contaminant levels do not exceed relevant generic assessment criteria in accordance with Section 3 of this Guidance, or relevant technical tools or advice that may be developed in accordance with paragraph 3.30 of this Guidance.
  - (d) Land where estimated levels of exposure to contaminants in soil are likely to form only a small proportion of what a receptor might be exposed to anyway through other sources of environmental exposure (e.g. in relation to average estimated national levels of exposure to substances commonly found in the environment, to which receptors are likely to be exposed in the normal course of their lives).