

YACHTHAVEN, HAYLING ISLAND

ENVIRONMENTAL STATEMENT

DECEMBER 2011

APPENDIX 8.3

YACHTHAVEN (HAYLING) LTD

Environmental Impact Assessment Contamination Assessment Update Report

October 2011



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Environmental Assessment Services Ltd

APPENDIX 8

CONTAMINATION RISK ASSESSMENT

Update Report

October 2011

1 BACKGROUND

1.1 The site of the proposed development is currently disused industrial land previously used for a boatyard and subsequently for materials, vehicle and plant storage. The levels of much of the site were raised with fill as part of this earlier development.

1.2 It is now intended to restore and redevelop the site partially for residential use, partly for use as a small boatyard with marina for leisure craft. The remainder of the site will be returned to a natural habitat for environmental enhancement.

1.3 As a consequence of:

- The site's previous history and use as a commercial boatyard since the 1930s, wartime use for camouflage paint testing and subsequently for materials and vehicle storage.
- The extensive made ground covering the site.
- The proximity of the site to Chichester Harbour and to environmentally important areas.

It was required that the risk of contamination of the soils should be assessed particularly in respect to:

- The risk to users of the site, particularly within the gardens of the residential development.
- The risk to persons involved during construction, particularly on earthworks.
- The risk of contaminated runoff into the Harbour with its consequent impact on the neighbouring ecologically sensitive areas.

1.4 In view of the above, the site has been subjected to the following site and soils investigations:

- The Contamination Assessment carried out by Environmental Assessment Services Ltd and dated September 2002.
- Desktop Study Report prepared by L R Pimenta dated October 2010.

1.5 Havant Borough Council issued a Scoping Opinion relating to the proposed development on 19 July 2011 in which it stated that:

- The results of the contamination testing of 2002 should be updated with further sampling to establish any changes in the condition of the site over the period.
- The contamination results should be compared against current standards as provided in CLR11 including for the conceptual model.

As a consequence of this, additional trial pits and soil testing was carried out in October 2011 with the results of this testing, and of the previous investigations, assessed against the current standards.

1.6 This report sets out the conclusions for this update study.

2 STUDY OF OCTOBER 2002

2.1 This study followed a comprehensive investigation of the site, which included:

- A review of the development history of the site.
- A site investigation including 73 trial holes and 4 boreholes with the findings logged to provide a record of the soils across the site.
- The taking and the testing of 105 soils and groundwater samples. Landfill gas monitoring was also carried out at the four borehole positions.
- An assessment of the results of the testing against the then current ICRCL standards and recommendations concerning the overall contamination risk at the site and remedial measures required.

2.2 The resulting borehole and trial pit logs and the results of the soil, groundwater and landfill gas testing were given in a report. The report concluded:

- *The site is underlain by a minor aquifer with soils of low vulnerability and is not within a source protection zone. The site is in one of the least hydrogeologically sensitive locations on Hayling Island.*
- *The majority of the site is on filled land, however, the fill appears to have been largely inert soil and construction waste. This type of waste is unlikely to be a source of landfill gas. The Environment Agency has confirmed that there is a former domestic waste landfill to the west of the site at SU 723 017, although this is not within 250 m of the site. The distance and low permeability migration horizon suggests that there should not be any significant risk of gas migration from the former to the site.*

- *The land use of the site as agricultural fields prior to its development in the 1930s is unlikely to have caused any contamination. However, there are significant risks associated with the use of the site since its industrial development. These include the storage of oils and other liquid chemicals, the use of the site as a scrap yard and subsequent fly-tipping.*
- *Further investigation was required prior to consent for redevelopment of the land for residential housing. The further investigation included the analysis of soil and groundwater samples from boreholes and trial pits across the site. Samples were generally taken from the fill and upper natural ground. Samples were then analysed for substances listed in Tables 3 and 4 of ICRCL59/83 plus total petroleum hydrocarbons, molybdenum, asbestos and in accordance with the recommended schedule of further investigation as approved by the Environment Agency.*
- *The analysis of the soil samples revealed sporadic locations of significant contamination with a clearly defined divide. The southern section of the site, incorporating mostly areas of fill, maintained significantly high levels of water soluble boron, down to depths of 1.5 m with two significant pockets of PAH. However, the northern section of the site had significant levels of contamination recorded throughout the site area. The main source of contamination in the northern section was heavy metals in the soil, which were recorded at depths of up to 1 m. In both sections the results exceeded the ICRCL and Soil Value Guideline thresholds for domestic gardens.*
- *An asbestos content survey was carried out on ten surface soil samples at the site. There were no samples containing significant levels of asbestos dust recorded during this survey.*
- *Three groundwater samples were obtained at the site, again these showed no significant contaminating results. These results imply that there are no significant contaminants leaching into or onto the neighbouring SSSI and Ramsar Sites.*
- *There were four gas monitoring boreholes installed at the site during June 2002 and these were subsequently tested for soil gas composition on 16 July 2002, 24 July 2002, 2 August 2002 and 7 September 2002. Boreholes 1 & 2 have consistently shown results of no significant landfill gas concentrations, these being in the northern portion of the site where there was no significant fill over saltmarsh. Borehole 3 shows modest levels of gas concentrations typical of a good grassy soil horizon, whereas borehole 4 has consistently shown minor elevated levels of methane and carbon dioxide after its initial peak value for methane just exceeding the Lower Explosive Limit (LEL) at the first recording. Subsequent readings indicate much reduced levels. Borehole 4 results have no significant landfill gas risk due the distance of the hole from the proposed property developments and the results*

obtained so far indicate that the borehole pierced an isolated pocket of marsh gas originating from the underlying salt marsh. This conclusion is supported by the high levels of oxygen found in all of the results, which indicates that there is no current methane gas production on this site.

- *The results of the site investigations carried out at the Hayling Island Yacht Haven site suggested that the site is significantly contaminated in a way likely to constrain the proposed development or require remediation prior to redevelopment of the site for domestic housing. From the results of the site investigations, it is recommended that the less suitable upper soil be removed and replaced with clean topsoil in the proposed gardens to a depth of 0.6 m. It is advised that the clean soil be placed on a geotextile membrane and capillary break sand layer.*
- *Finally, during site redevelopment extra care should be taken to ensure that no current site contaminants are displaced into the neighbouring SSSI and Ramsar sites. Guidelines should be in place prior to redevelopment commencing and adhered to throughout the construction phase of the site.*

- 2.3 The overall environmental risk for the site was rated as 2, on a scale of 1 to 4, due to the significant contamination potential identified as being associated with the historic industrial land use of the site, reducing to category 1, low, once remediation measures and redevelopment are complete.

3 STUDY OF OCTOBER 2010

- 3.1 This report was commissioned for the purposes of the current planning application and included the following:

- A review of the 2002 report.
- An up-to-date Sitecheck report.
- A walkover survey of the site to assess the current condition and any material changes since 2002.
- An initial site Conceptual Model.

- 3.2 The report on the October 2010 study concluded that:

The level of contamination or gases on the site is not serious enough to warrant major remedial works to be carried out but further testing is recommended.

4 TESTING OF OCTOBER 2011

4.1 Additional samples were obtained from six trial pits adjacent to the 2002 trial pits referenced D33, D11, D21, F20, E25 and G5 in order to give comparative results at these typical positions. The location of these trial pits is shown on the plan attached to the 2002 report. The results of this testing is attached in Appendix A of this report.

4.2 Gas tests were carried out at the four original borehole positions. It is reported that:

The gas measurements were much the same as before and no detectable concentrations of methane were found and the carbon dioxide levels were not significantly above normal background. [see Appendix A]

4.3 No groundwater samples could be recovered, probably due to the recent long period of dry weather.

5 REVIEW OF RESULTS

5.1 **Changes since 2002**

5.1.1 The results of the soil and gas testing are set out in Appendix A. These results are also summarised on Table 5.1 where the results are compared with samples taken at comparable locations in 2002.

5.1.2 The conclusions from this comparison is that there has been no significant change in the contamination in the site over that period. The soil gas readings support the previous view that the elevated readings obtained in 2002 were due to pockets of trapped gas without potential for continued gas generation.

5.2 **Assessment against Current Standards**

5.2.1 The soil sample pH values were found to be generally neutral to alkaline (7.0 – 10.1) with two samples (E25 and F21) giving acid results down to 6.2.

5.2.2 The results of the analysis of the soil samples have been compared with the current CLEA Soil Guideline Values for metals (summarised in Table 5.2 below), and the LQM/CIEH Generic Assessment Criteria Values for Human Health Risk Assessment (2nd edition 2009).

5.2.3 The most sensitive land use for which SGVs are given is residential + plant uptake, which has been used to assess the soil sample results in this case.

TABLE 5.1
Summary of the results of the soil sample analysis for 2001 and 2011
(Samples taken from equivalent positions and depths for comparison)

SUBSTANCE	UNITS	TRIAL PIT No. / DATE / DEPTH (m)											
		D33 2002 d=0.0	D33 2011 d=0.1	D11 2002 d=0.0	D11 2011 d=0.2	D21 2002 d=0.5	D21 2011 d=0.2	F20 2002 d=0.6	F20 2011 d=0.5	E25 2002 d=0.0	E25 2011 d=0.0	G5 2002 d=0.0	G5 2011 d=0.2
Arsenic	mg/kg	10.1	8	20.4	14	12.0	17	8.8	7	8.5	4	10.9	6
Cadmium	mg/kg	<0.5	<0.5	0.8	0.5	0.5	0.7	<0.5	0.6	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	34	14	57	25	23	24	38	13	14	21	19	14
Copper	mg/kg	13	22	1088	25	113	43	13	28	29	17	27	12
Nickel	mg/kg	14	13	191	13	16	14	15	9	9	7	15	11
Lead	mg/kg	26	79	551	51	287	126	33	88	62	35	86	40
Mercury	mg/kg	<0.5	<1	0.8	1	10.5	3.8	<0.5	<1	<0.5	<1	<0.5	<0.5
Selenium	mg/kg	<0.5	<3	<0.5	<3	<0.5	<3	<0.5	<3	0.6	<3	<0.5	<3
Zinc	mg/kg	52	350	2605	89	254	135	43	103	62	44	112	52
Boron (water sol.)	mg/kg	0.5	1.4	0.8	2	0.7	2.2	4.9	<1	14.7	4.8	0.7	<1
PH	value	8.1	7.4	7.9	7.7	8.3	7.9	7.5	7.6	6.4	7.8	7.8	7.8
Total Cyanide	mg/kg	<1	<2	<1	<2	<1	<2	<1	<2	<1	<2	<1	<2
Water soluble Sulphate	g/l	0.07	0.28	0.03	0.05	0.02	0.05	0.01	0.07	0.12	0.20	<0.01	0.13
Sulphide	mg/kg	<2	-	12.8	-	<2	-	<2		<2	-	<2	-
Elemental Sulphur	mg/kg	40	-	310	-	710	-	1010		60	-	140	-
TPH	mg/kg	<5	-	<5	-	-	-	<5		<5	-	<0.5	-
Total PAH	mg/kg	4.4	<1.6	37.5	<1.6	38.3	<1.6	<0.5	20.94	4.1	<1.6	6.4	10.81
Benzene	mg/kg	-	<2	-	<2	-	<2	-	<2	-	<2	-	<2
Toluene	mg/kg	-	<5	-	<5	-	<5	-	<5	-	<5	-	<5
Ethyl Benzene	mg/kg	-	<10	-	<10	-	<10	-	<10	-	<10	-	<10

5.2.4 From comparison of the results in Table 5.1 and in the Appendix with the SGVs given in Table 5.3 and the LQM / CIEH values in Table 5.4, 5.5 and 5.6 it is apparent from the results of the analysis that:

- Site average results as shown in Table 5.2 are within guideline values for a residential land use - except for mercury, which is within guideline values for allotments.
- There is a substantial variation in potential contaminant concentrations across the site but with the exceedences over current guidelines for a residential land use confined to the previously developed eastern part of the site.
- PAH values are within current guidelines for a residential land use and the TPH values in the 2011 testing do not indicate any evidence of significant fuel spillage or leakage.
- An asbestos content survey was carried out on ten surface soil samples at the site. There were no samples containing significant levels of asbestos dust recorded during this survey.
- Three groundwater samples were obtained in 2002 at the site, again these showed no significant contaminating results. These results imply that there are no significant contaminants leaching into or onto the neighbouring SSSI and Ramsar Sites.

TABLE 5.2
Summary of Results from 2001 Study

		Max Recorded	Min Recorded	Site Average
Arsenic	mg/kg	108	6.0	15
Cadmium	mg/kg	2	<0.5	0.6
Chromium	mg/kg	99	11	32
Copper	mg/kg			
Nickel	mg/kg	366	9	29
Lead	mg/kg	3096	25	206
Mercury	mg/kg	217	<0.5	6.6
Selenium	mg/kg	1.1	<0.5	0.6
Zinc	mg/kg	7881	24	386
Boron (water sol.)	mg/kg	12.1	<0.5	1.7
PH	value	10.2	6.4	8.1
Total Cyanide	mg/kg	<1	<1	<1
Water soluble Sulphate	g/l	0.04	0.01	0.02
Sulphide	mg/kg	<2	<2	<2
Elemental Sulphur	mg/kg	1330	<20	316
TPH	mg/kg			
Total PAH	mg/kg	117	<0.5	12.5

TABLE 5.3
Soil Guideline Values (SGV s)

Concentrations in mg/kg dry weight

Substance		Soil Guideline Values (mg/kg dry weight)		
		Land Use		
		Residential	Allotment	Commercial
Arsenic		32	43	640
Cadmium		10	1.8	230
Chromium		130	200	5000
Mercury	Elemental	1	26	26
	Inorganic	170	80	3600
	Methyl	11	8	410
Benzene		0.33	0.07	95
Nickel		130	230	1800
Phenol		420	280	3200 (38000)
Xylene	<i>o</i> -xylene	250	160	2600
	<i>m</i> -xylene	240	180	3500
	<i>p</i> -xylene	230	160	3200
Selenium		350	120	13000
Lead		450	450	750
Toluene		610	120	4400
Ethylbenzene		350	90	2800

TABLE 5.4
The LQM / CIEH Generic Assessment Criteria for Human Health Risk
Assessment (2nd edition) Paul Nathanail *et al* (2009)

	Residential	Allotment	Commercial
Boron	291	45	192000
Cadmium	3	0.53	348
Chromium	4.3	2.1	35
Copper	2330	524	71700
Zinc	3750	618	665000

TABLE 5.5
Petroleum hydrocarbons for the residential land use
at 1%, 2.5% and 6% Soil Organic Matter (SOM)

Residential land use	LQM/CIEH GAC for Petroleum Hydrocarbons (mg kg ⁻¹ DW)		
	1% SOM	2.5% SOM	6% SOM
Aliphatic EC 5-6	30	55	110
Aliphatic EC >6-8	73	160	370
Aliphatic EC >8-10	19	46	110
Aliphatic EC >10-12	93 (48)	230 (118)	540 (283)
Aliphatic EC >12-16	740 (24)	1700 (59)	3000 (142)
Aliphatic EC >16-35	45000 (8.48)	64000 (21)	76000
Aliphatic EC >35-44	45000 (8.48)	64000 (21)	76000
Aromatic EC >5-7 (benzene)	65	130	280
Aromatic EC >7-8 (toluene)	120	270	611
Aromatic EC >8-10	27	65	151
Aromatic EC >10-12	69	160	346
Aromatic EC >12-16	140	310	593
Aromatic EC >16-21	250	480	770
Aromatic EC >21-35	890	1100	1230
Aromatic EC >35-44	890	1100	1230
Aliphatic + Aromatic EC >44-70	1200	1300	1300

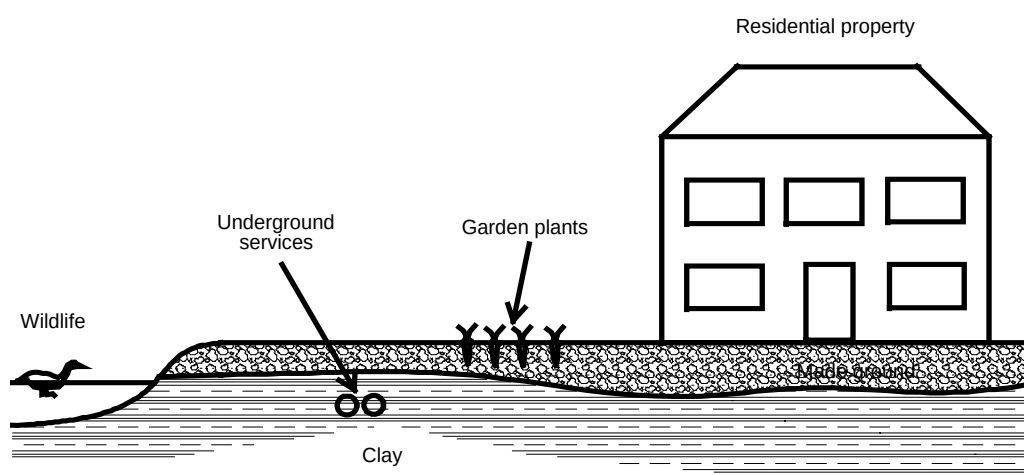
TABLE 5.6
Polycyclic Aromatic Hydrocarbons for residential land use
At 1%, 2.5% and 6% SOM

Residential land use	LQM/CIEH GAC for Polycyclic Aromatic Hydrocarbons		
	1% SOM	2.5% SOM	6% SOM
PAH Congener			
Acenaphthene	210	480	1000
Acenaphthylene	170	400	850
Anthracene	2300	4900	9200
Benz(a)anthracene	3.1	4.7	5.9
Benzo(a)pyrene	0.83	0.94	1.0
Benzo(b)fluoranthene	5.6	6.5	7.0
Benzo(ghi)perylene	44	46	47
Benzo(k)fluoranthene	8.5	9.6	10
Chrysene	6.0	8.0	9.3
Dibenz(ah)anthracene	0.76	0.86	0.90
Fluoranthene	260	460	670
Fluorene	160	380	780
Indeno(123-cd)pyrene	3.2	3.9	4.2
Naphthalene	1.5	3.7	8.7
Phenanthrene	92	200	380
Pyrene	560	1000	1600

6 CONCEPTUAL MODEL AND CONTAMINATION RISK ASSESSMENT

- 6.1 The contamination risk assessment has been prepared in accordance with the recommendations given in the DETR/CIRIA publication “Contaminated Land Risk Assessment – a guide to good practice”. 2001.
- 6.2 For contamination to be significant, there must be three elements present: *Contamination* (a significant concentration of a hazardous substance), a *receptor* (a person potentially at risk from the hazardous substance) and a feasible *pathway* between substance and receptor. See Figure 6.1 below.

FIGURE 6.1
Site Specific Conceptual Model



- 6.3 The model may be applied to four cases:
- Future residents and site users (*receptor*) using the site and the gardens (*pathway*). The receptor assumed to be adults and children.
 - Construction workers (*receptor*) engaged in proposed and future construction on the site (*pathway*) and exposed to contamination. The receptor assumed to be an adult.
 - Impacts on the wider environment and on wildlife (*receptor*). Includes off-site contamination migration (*pathway*), contamination of Chichester Harbour etc.
 - Impacts on buildings and services.

6.4 See summary of conceptual model in Table 6.1 below.

TABLE 6.1
Conceptual Model for Current Conditions

Source		Pathway	Receptor	Risk
Contaminated soil	Contaminated groundwater			
Moderate contamination identified from testing and resulting from previous use of the site.	Testing demonstrates no significant contamination of groundwater	Contact with contaminated soil.	Future site users residential and leisure use.	✓
		Ingestion of or skin contact with contaminated soil or dust.	Maintenance or construction workers engaged in groundworks on the site.	✓
		Contact with contaminated soil.	Building & services	?
		Leeching of site contaminants into groundwater.	Wider environment	✗

Key: ✓ Significant risk ✗ No significant risk ? Uncertain risk

- 6.5 The site, presently vacant following former commercial/industrial use, is to be redeveloped for residential and leisure use with wildlife reserves. Future residents will come into contact with the soil in their gardens and soft landscaped areas. Future site users contact with the underlying soil is unlikely in the marina or boatyard and not very likely in wildlife areas. Construction and maintenance workers required to work in excavated service trenches will have contact with the underlying soil.
- 6.6 No contamination likely to potentially impact on services has been identified. However, the stricter WRAS standards would apply for any new polyethylene water main laid within the site.
- 6.7 Finally during site redevelopment extra care should be taken to ensure that no current site contaminants are displaced into the neighbouring SSSI and Ramsar sites. Guidelines should be in place prior to redevelopment commencing and adhered to throughout the construction phase of the site.
- 6.8 The overall environmental risk for the site is rated according to the risk assessment matrix in Table 6.2 below.

TABLE 6.2
Risk Assessment Matrix

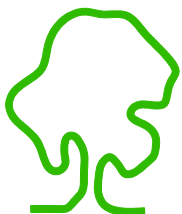
PROBABILITY OF IMPACT	CONTAMINATION POTENTIAL		
	SEVERE	MODERATE OR UNCERTAIN	MINIMAL
High	4	3	2
Medium	3	2	1
Low	2	1	1

- 6.9 In this case the rating would be 2, due to the contamination potential identified as being associated with the historic industrial land use of the site, reducing to 1 (low) once recommended remediation measures (see below) and redevelopment are complete.

7. SUMMARY OF RECOMMENDATIONS

- 7.1 Remove all deposited superficial waste together with demolition waste as part of site clearance. Concrete and brick from demolished buildings, etc., may be crushed and recycled on site for granular fill, road base, etc.
- 7.2 All garden and soft landscaping areas to have the less suitable upper soil (made ground) removed and replaced with clean topsoil from an uncontaminated source to a depth of 0.6 m. The clean topsoil to be placed on a geotextile membrane and capillary breaker sand layer where the underlying ground is not natural undisturbed soil.
- 7.3 The condition of soil exposed during site clearance and in excavations should be monitored during the work and any evidence of significant contamination should be investigated, treated and/or removed from site as necessary.
- 7.4 In the wildlife areas, the superficial waste deposits should be removed and the area should be enhanced with brash and wood piles, south facing soil banks (where practicable) and open compost heaps. Apart from the foregoing suggestions, the wildlife areas should be disturbed as little as possible.





eas ltd

Environmental Assessment Services Ltd

London Road, Hickstead, Haywards Heath, West Sussex RH17 5LZ UK

Phone : +44 (0) 1444 882 552

Fax : +44 (0) 1444 882 553

email : info@easltd.co.uk

web site : www.easltd.co.uk