

<b>REPORT TITLE:</b>	<b>REMEDIAL WORKS SUMMARY &amp; VALIDATION</b>
<b>At:</b>	<b>10 &amp; 12 Bangor Street Y Felinheli Gwynedd LL56 4JD</b>
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<b>Project Reference:</b>	<b>07RB239</b>
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## 1 INTRODUCTION

### 1.1 General

Randall & Walsh Associates (RAW Group) were instructed by Quest Gates Ltd to proceed with remedial works and site validation at No's 10 & 12 Bangor Street, Y Felinheli, Gwynedd (Appendix A, Figure 1). Remedial works were required in order to address the release of an unknown quantity of domestic heating oil (kerosene) from the boiler or feed line at No. 10.

The householder of No. 10 moved into the property during January 2005 and during February 2005 the boiler (located against the rear kitchen wall) was removed and the householder noticed contaminated soils in this area. The occupant of No. 12 commented they had noticed hydrocarbon odours since 1998 and had reported it to Gwynedd County Council in 2005.

Due to the elevated concentrations of naphthalene within the ambient air of No. 10 the council recommended the occupants were moved out of the property due to young children living in the property. Whereas the residents of No. 12 remained in occupancy.

Previous reports made available to RAW were: '10 & 12 Bangor Street, Remediation Strategy' by Smith Grant LLP and 'Gwynedd Council Environmental Protection Act (EPA) 1990 Part IIA Section 78E Remediation Notice' dated 7 August 2007. The investigation conducted by Smith Grant LLP identified a potential risk to human health of the residents of No's 10 & 12 Bangor Street, through inhalation of hydrocarbon vapours, with the primary risk driver being naphthalene with a threshold concentration of 2.44µg/m<sup>3</sup>. Further details of the targets for contaminants of concern are presented in the table in section 1.2. Gwynedd County Council (GCC) issued a remediation notice to the owner of No. 10 Bangor Street (Mr Nelmes) under Part IIA of the Environmental Protection Act 1990 and Smith Grant have also provided a remediation strategy document for the site.

### 1.2 Objective

The objective of the remedial works was to mitigate the risks identified in the RAW Spill Investigation Report dated 16<sup>th</sup> November 2007 (primarily risks to human health and also property structures and third party property), thereby restoring residential amenity to the property. The principal objective with respect to addressing the risks posed to human health was to achieve concentrations of hydrocarbons in the ambient air in the properties below the relevant threshold concentrations. The table below confirms the threshold concentrations for the contaminants of concern.

Contaminant of concern	Threshold Concentration µg/m <sup>3</sup>	Threshold Concentration mg/m <sup>3</sup>
Benzene	2.81	0.00281
Toluene	219	0.219
Ethylbenzene	770	0.770
Total Xylenes	185	0.185
<b>Naphthalene</b>	<b>2.44</b>	<b>0.00244</b>
Aromatic C8-C10	200	0.200
Aliphatic C8-C10	1000	1
Aliphatic C10-C12	1000	1
Aliphatic C12-C16	1000	1

This report provides a summary of remedial and validation works undertaken at the property. Supporting information is provided within the appendices.

## **2 CONTAMINANT IMPACT**

Site investigation activities undertaken by RAW Group confirmed the presence of hydrocarbon contamination within the area of the spill origin and along the foundations of the boundary kitchen wall. Evidence of hydrocarbon impact to masonry, specifically within the lime mortar, was identified via penetrative PID testing. The analysis of the ambient air within the kitchens of both properties identified the presence of TPH contamination with a TPH concentration of 2.95mg/m<sup>3</sup> in property No. 12 and 0.76 mg/m<sup>3</sup> in property No. 10. Further details of the RAW investigation works and the air sample results obtained are presented in the RAW report dated 16<sup>th</sup> November 2007.

## **3 REMEDIAL WORKS**

In line with RAW's recommendations, remedial works were undertaken between January and October 2008 and included the following:

- The excavation of the grossly impacted soils at the spill origin and impacted soils within the kitchen of both properties. Within property No. 10 the excavation was advanced to a maximum depth of 0.70mBGL (metres below ground level) and within property No. 12 to a maximum depth of 0.80mBGL. Validation soil samples were collected from the sides of the excavation prior to reinstatement;
- The internal foundations and masonry was treated with a bio-remedial solution which was washed onto the impacted masonry;
- Removal of impacted masonry from the kitchen of No.10 Bangor Street; and
- An SVE system was installed within impacted soils at depth beneath the excavations in both kitchens and at depth externally beneath the spill origin. During the treatment period, additional SVE treatment points were installed into the cavity of the kitchen walls above ground to remove hydrocarbon vapours being emitted from the lime mortar.

Please refer to Figure 2: Remedial works and Figure 3: SVE location points within Appendix A, which depict the area of excavation and the locations of all validation soil samples collected. Details of the works are reported below and photographs showing the remedial works are provided within Appendix C.

### **3.1 Physical Works**

In line with RAW's recommendations, hydrocarbon contaminated soils internally and externally, located adjacent to the foundations of the house at No. 10 and No. 12 Bangor Street, were excavated to a maximum depth of 0.80mBGL to the base of the property foundations.

Following the excavations, the external and internal foundation masonry was treated with a bio-remedial solution to address any residual hydrocarbon contamination impacting the structures. Following the recommendations of the structural engineer, it was recommended that the replacement of the wall was not appropriate given the structural condition of the wall, therefore an SVE system was installed to treat impacted soils and

the cavity wall bounding the two kitchens in-situ which is discussed further in section 3.3 below.

All hydrocarbon contaminated soils were collected from site by a licensed waste contractor for disposal at a suitable waste facility in accordance with good waste management practice and duty of care. Copies of waste transfer documentation are available on request.

### 3.2 Re-instatement

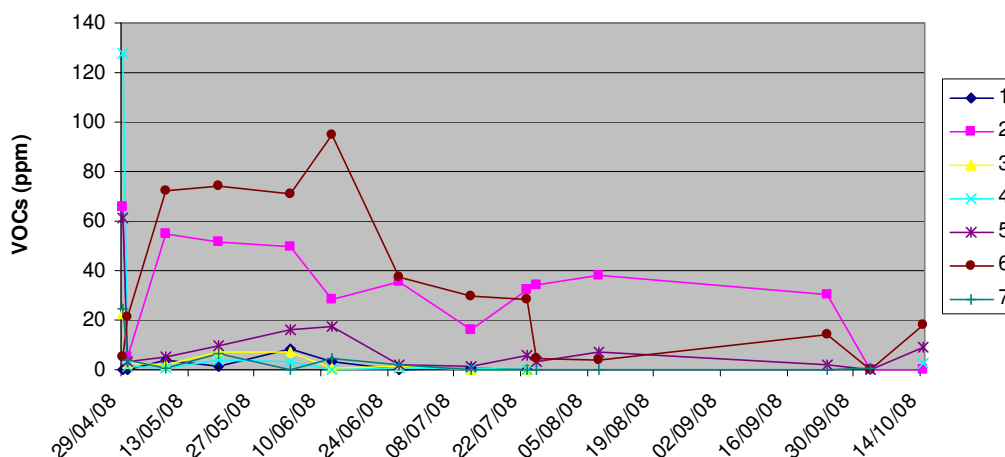
All excavated areas were reinstated to original specification and all fixtures in the kitchen were reinstated to original specification.

### 3.3 Soil Vapour Extraction (SVE) System

RAW installed an SVE system to remediate the soils at the properties using this in-situ technique which comprised of 7 no. vapour extraction points. 3 no. SVE points were located within the soils beneath the kitchen floor of No. 10, and 2 no. SVE points were within the soils below the kitchen of no. 12. A further 2 no. SVE points were located within the rear garden of No. 10 adjacent to the third party property. During the remediation of the soils, a total of 12 no. SVE points were also installed into the cavity wall between the two properties. Figure 3 within Appendix A illustrates the extraction point locations associated with the SVE system. Summary data from the SVE extraction points in the soils and structures are provided in Appendix E.

Graph 1 below provides an illustration of the general reduction in VOC concentrations determined using a MiniRae 2000 Photo-ionisation Detector (PID) calibrated on 100ppm isobutylene, used to obtain measurements from each SVE extraction point in the soils over the treatment period.

**Graph 1: VOC concentrations measured in SVE extraction points 1 -7 within in-situ treated soils**



Graph 1 above and the graphs provided with the summary data sheets in Appendix E confirm the reduction in VOC concentrations during the SVE treatment of the soils and structures at both No.10 and No.12 Bangor Street.

### 3.4 **Internal Air Quality Assessment**

RAW Group mobilised to site on 30<sup>th</sup> October 2008 to collect validation air samples using Tenax thermal desorption tubes. On this occasion samples of the ambient air at both properties were collected over a seven day time period and a return visit was made to site to collect the Tenax thermal desorption tubes on 6<sup>th</sup> November 2008. Final validation air samples were collected using Tenax thermal desorption tubes on the 7<sup>th</sup> April 2009 with air sampling having been undertaken over a two week period to achieve the required detection limits for naphthalene. On both monitoring occasions Tenax thermal desorption tubes were used to collect samples of ambient air within the kitchens and the top of the stairs within both properties. Further details of the sampling and analysis are provided in section 4.2 below.

## 4 **LABORATORY ANALYSIS**

### 4.1 **Soil Analysis**

A total of 8 no. validation soil samples were analysed for speciated Total Petroleum Hydrocarbons (TPH) across the C<sub>6</sub>-C<sub>35</sub> carbon range by GC-FID and the VOCs; benzene, toluene, ethyl-benzene and xylenes (BTEX)) by GC-MS. All soil analysis was performed by Scientific Analysis Laboratories Ltd (SAL) using UKAS and MCERTS approved analytical techniques where available.

All soil samples collected from the site were transported to the laboratory under appropriate preservation and chain-of-custody procedures.

### 4.2 **Air Analysis**

Tenax thermal desorption tubes were used to collect passive (or diffuse) samples of ambient air to assess the concentration of VOCs within the kitchen and upstairs rooms in both properties. The samples were submitted to SAL for analysis. Samples were obtained in general accordance with the method outlined in BS EN1441-2:2004 – "Indoor air quality: Diffusive samplers for the determination of concentrations of gases and vapours – Guide for selection, use and maintenance".

All air samples collected from the site were transported to the laboratory under appropriate preservation and chain-of-custody procedures.

### 4.3 **Quality Assurance / Quality Control**

As part of the RAW Group Quality Assurance/Quality Control (QA/QC) programme, samples were collected to evaluate the integrity (and assess the accuracy) of the sampling and analysis process. The QA/QC samples collected are summarised in the table below:

QA/QC type	Sample Name	Analysis	Purpose
Field duplicate (soil)	QS-1 (V-6 0.8m)	TPH, BTEX	Ensuring a representative sample is collected, evaluating differences in soil heterogeneity and ensuring the integrity of the sampling and analysis process
Field Duplicate (air)	QA-1 (VA-3) QA-1 (VA-7)	Air analysis suite	Ensuring a representative sample is collected and ensuring the integrity of the sampling and analysis process

## **5 RESULTS AND DISCUSSION**

### **5.1 Soil Analytical Results**

Concentrations of TPH and BTEX reported for the soil samples collected from site are presented in Table 1, Appendix B and laboratory reports are provided in Appendix D.

Following the excavation of grossly contaminated soils within the kitchen of the two properties, validation soil samples were collected. The soils returned concentrations below laboratory detection limits with the exception of V-3 at 0.70mBGL and V-4 at 0.70mBGL which recorded TPH concentrations of 5 and 4,400mg/kg respectively. The elevated concentration of 4,400mg/kg was recorded within soils beneath the property's foundations; however, the samples were collected prior to the installation of the SVE system. As indicated in section 3.3 above, upon remediation of the soils using the SVE system, the concentrations of VOCs within the soils were significantly reduced from an average of 44ppm in April 2008 to an average of 7 ppm in October 2008.

### **5.2 Air Analytical Results**

The concentrations of hydrocarbon compounds recorded in the validation air samples collected from site are presented within Appendix B (Tables 2 – 11) and laboratory reports are provided in Appendix D.

All eight of the ambient air samples (VA-1 to VA-8) collected within the kitchens and upstairs of both properties returned no detectable concentrations of the principal contaminant of concern (naphthalene). The final validation air samples collected from both properties in April 2009 confirmed that there were no detectable concentrations of naphthalene in either property above the agreed threshold concentration of 0.00244 mg/m<sup>3</sup>.

Other hydrocarbon compounds were identified in the laboratory analysis undertaken on both validation sampling occasions (including aliphatic TPH C<sub>6</sub>-C<sub>8</sub>, C<sub>8</sub>-C<sub>10</sub>, C<sub>10</sub>-C<sub>12</sub> and C<sub>12</sub>-C<sub>16</sub> xylenes and toluene), however, in all cases the detectable concentrations were below the threshold criteria as outlined in section 1.2 of this report.

### **5.3 Quality Assurance / Quality Control (QA/QC)**

The results of the QA/QC samples are provided in the analytical summary tables section (Appendix B). The validation field duplicate and original soil sample collected (QS-1/V-6 0.8m) both returned BTEX and TPH concentrations below laboratory detection limits.

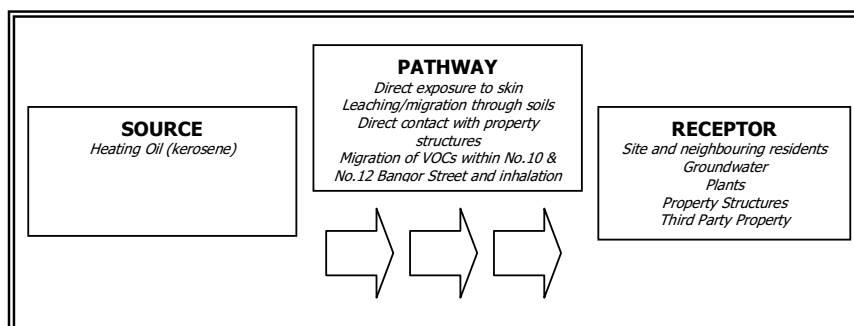
Validation air sample VA-3 and duplicate sample QA-1 both returned similar concentrations of aliphatic TPH C<sub>10</sub>-C<sub>12</sub> and C<sub>12</sub>-C<sub>16</sub> found in the ambient air of the property. During the final validation air sampling round in April 2009, parent sample VA-7 and duplicate sample QA-1 both returned similar concentrations of aliphatic TPH C<sub>8</sub>-C<sub>10</sub>, C<sub>10</sub>-C<sub>12</sub> and C<sub>12</sub>-C<sub>16</sub>.

Copies of all analytical results including the results of the QA/QC sampling can be found in the appended laboratory reports (Appendix D).

## 6 QUALITATIVE RISK ASSESSMENT

### 6.1 Risk Assessment

This section provides an assessment of the risks associated with the residual contamination identified at site. In line with current guidelines, this takes the form of a qualitative source – pathway – receptor assessment which enables the construction of a conceptual site model. The conceptual site model is a simplification of reality, which aims to identify the key processes that affect the contaminant transport behaviour. Within a qualitative risk assessment context it is simply an identification of the potential contaminants sources, pathways and receptors.



If any one of these elements is missing then it is considered that there is no significant risk associated with the contamination and the site cannot be determined as being contaminated land.

Following completion of the initial intrusive investigation the potential source-pathway-receptor linkages have been identified as shown below:



	Contaminant Source	Pathway	Receptors	Pre-Remediation Qualitative Risk	Comments	Post Remediation Qualitative Risk
1	Hydrocarbons in soils (kerosene)	Direct contact with contaminated soils	Site Residents	Medium	Removal of grossly contaminated soils and remediation of impacted soils and masonry has reduced the risk to site residents to low.	Low
2	Volatile hydrocarbons (VOCs including naphthalene)	Inhalation of vapours emitted from impacted materials.	Current and future users of the site	High	Removal of grossly contaminated soils and treatment of masonry has removed the contaminant source reducing the risk to current and future site users to low. Validation air sampling has demonstrated the efficacy of the remediation at both properties reducing naphthalene concentrations to below the agreed threshold criteria.	Low
3	Hydrocarbons in soils (kerosene)	Migration of contaminants through soils to groundwater	Groundwater	Medium	Removal of grossly contaminated soils and validation of the excavation has confirmed removal of impacted soils and reduced the risk to groundwater to low.	Low
4	Hydrocarbons in soils (kerosene)	Direct contact with contaminated soils	Property structure	High	Removal of grossly contaminated soils and remediation of impacted soils and structures has reduced the risks to property structures to low.	Low
5	Hydrocarbons in soils (kerosene)	Migration of contaminants through soils	Off-site receptors, third party property	Medium to high	The oil spill originated at no. 10 and was found to impact the property of no. 12. The removal and in-situ treatment of grossly contaminated soils has reduced the risk to third party property to low.	Low
6	Hydrocarbons in soils (kerosene)	Migration of contaminants through soils to groundwater	Plants	Medium to High	Removal of grossly contaminated soils and remediation of impacted soils removed the risk to plants to low.	Low

The above source-pathway-receptor assessment indicates that the remedial works have been successful in eliminating the potential risks to the identified receptors. In summary following completion of remedial works and validation the risks have been identified as follows:

- Low risk to human health of occupants;
- Low risk to groundwater;
- Low risk to property structures;
- Low risk to third party property; and
- Low risk to plants.

The validation works undertaken at the property have demonstrated that the concentrations of the contaminants of concern including naphthalene have been reduced to concentrations below the agreed threshold criteria as set out in Section 1.2 of this report.

## 6.2 Explanation of the Risk Classification

A qualitative risk classification is provided for all of the identified pollutant linkages and these are explained as outlined in the following table.

Classification	Interpretation
High	The nature of the contaminant source, the pathway and the vulnerability of the receptors are such that with little or no mitigation works undertaken it is considered highly likely that a significant risk exists to site users, buildings, services and environmental receptors both on and off site. Further investigation and assessment is required in order to quantify the risks posed to the receptor.
Medium-High	The nature of the contaminant source, the pathway and the vulnerability of the receptors are such that with little or no mitigation works undertaken it is considered likely that a significant risk exists to site users, buildings, services or environmental receptors both on and off site. Further investigation and assessment is required in order to quantify the risks posed to the receptor.
Medium	The nature of the contaminant source, the pathway and the vulnerability of the receptors are such that with little or no mitigation works undertaken it is considered likely that a risk exists to site users, buildings, services and environmental receptors both on and off site. Further investigation and assessment is required in order to quantify the risks posed to the receptor.
Low-Medium	The nature of the contaminant source, the pathway and the vulnerability of the receptors are such that with little or no mitigation works undertaken it is considered possible that a risk exists to site users, buildings, services and environmental receptors both on and off site. Some further investigation and assessment is required in order to quantify the risks posed to the receptor.
Low	Owing to the absence of any identifiable source, pathway, or the lack of any vulnerable receptor, it is considered unlikely that any risk exists to site users, buildings, services and environmental receptors both on and off site. No further investigation or assessment is required.

## 7 CONCLUSIONS

RAW Group were instructed to undertake and validate remedial works at no. 10 and no. 12 Bangor Street, Y Felinheli, Gwynedd, further to the release of an unknown quantity of kerosene from No. 10 first reported to Gwynedd Council in 2005.

Remedial works undertaken by RAW Group consisted of the excavation and disposal of contaminated soils within the kitchens of No. 10 and No. 12. The exposed foundations and masonry were treated with a bio-remedial solution. A soil vapour extraction (SVE) system was installed in the residually contaminated soils at both properties to remove hydrocarbon vapours from the soils at depth beneath both kitchens. The SVE system was also installed into the cavity wall above ground between the two kitchens to remove hydrocarbon vapours being emitted from residually impacted lime mortar.

All of the ambient air samples collected by RAW within the kitchens and upstairs of both properties returned no detectable concentrations of the principal contaminant of concern (naphthalene). The final validation air samples collected from both properties in April 2009 confirmed that there were no detectable concentrations of naphthalene in either property above the agreed threshold concentration of 0.00244 mg/m<sup>3</sup>. Other hydrocarbon compounds were identified in the laboratory analysis undertaken on both validation sampling occasions, however, in all cases the detectable concentrations were below the threshold criteria required by Gwynedd County Council. Therefore validation air sampling has confirmed that naphthalene and other hydrocarbon compounds related to the kerosene release are no longer considered to pose a significant risk to human health at either no. 10 and no. 12 Bangor Street.

On completion of the remedial works, RAW consider that the risks posed to surrounding environmental receptors, property structures, third party property and the health of the occupants, attributable to the spill have been reduced to acceptable levels.

## **8 RECOMMENDATIONS**

RAW Group is satisfied that remedial works undertaken on this site meet the objectives outlined in Section 1.2, reducing the risks posed to building structures, health and safety of the residents and potential surrounding environmental receptors to an acceptable level, thereby restoring residential amenity to the property. It is therefore considered that no further works are required on this site at this time.

## **9 GLOSSARY**

<b>Carbon range</b>	<i>Grouping of hydrocarbons between a minimum and maximum number, applied to the carbon atoms in the chain linked together in the hydrocarbon molecule (e.g C<sub>8</sub>-C<sub>35</sub>).</i>
<b>Controlled Waters</b>	<i>(as defined by Water Resources Act 1991, Part III, Section 104) All rivers, canals, lakes, groundwaters, estuaries and coastal waters to three nautical miles from the shore.</i>
<b>Hydrocarbon</b>	<i>Hydrocarbons are compounds that contain hydrogen and carbon. The nature of which, either gas or liquid is distinguished by molecular structure (number of carbon and hydrogen atoms in each molecule).</i>
<b>Laboratory detection limits</b>	<i>Minimum levels detectable using the designated laboratory techniques.</i>
<b>Migration/migrated</b>	<i>Flow of contamination from one place to another.</i>
<b>Pathway</b>	<i>A route along which a particle of water, substance or contaminant moves through the environment.</i>
<b>QA/QC</b>	<i>Quality assurance and quality control procedures.</i>
<b>Receptor</b>	<i>An entity/organism or a controlled water that is being or could be harmed by a potential pollutant.</i>
<b>Borehole</b>	<i>Hole drilled or augered into the ground to obtain information on the soils or aquifers to delineate contamination and obtain groundwater samples.</i>
<b>Source</b>	<i>Origin of any contamination.</i>
<b>TPH</b>	<i>Total Petroleum Hydrocarbons.</i>
<b>UKAS</b>	<i>United Kingdom Accreditation Service.</i>
<b>MCERTS</b>	<i>Monitoring certification scheme requested by the Environment Agency</i>

## **10    *LIMITATIONS***

The samples collected and conclusions reported herein are merely believed broadly representative of the observed site conditions at the time of collection. Whilst every attempt is made to adequately characterise site conditions, no warranty can be supplied for the contents of this report as a result of laboratory analysis performed by subcontractors, variations in heterogeneous or variable subsurface features, contaminant distributions or as a result of unencountered details. Environmental Site Assessments are by their nature an inexact science and all care should be taken in any interpretation of any aspect of the findings contained herein.

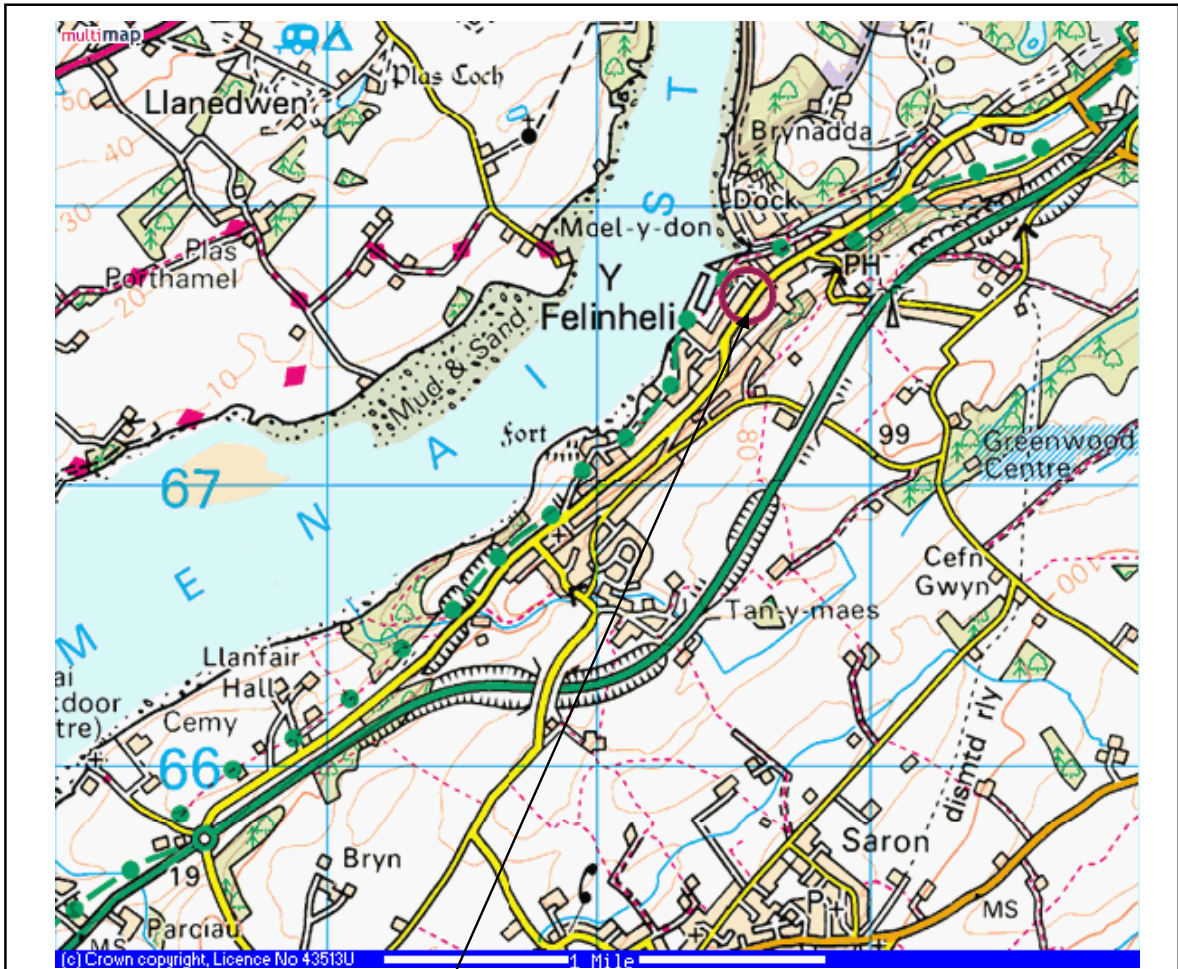
The assessment undertaken considers only those areas within the boundaries of the sites concerned. Care should be taken with evaluating any remedial requirements or costs and the existence or presence of off-site contaminant impact may need to be further considered. In addition, the investigation only considers those potential subsurface contaminants evaluated in this investigation.

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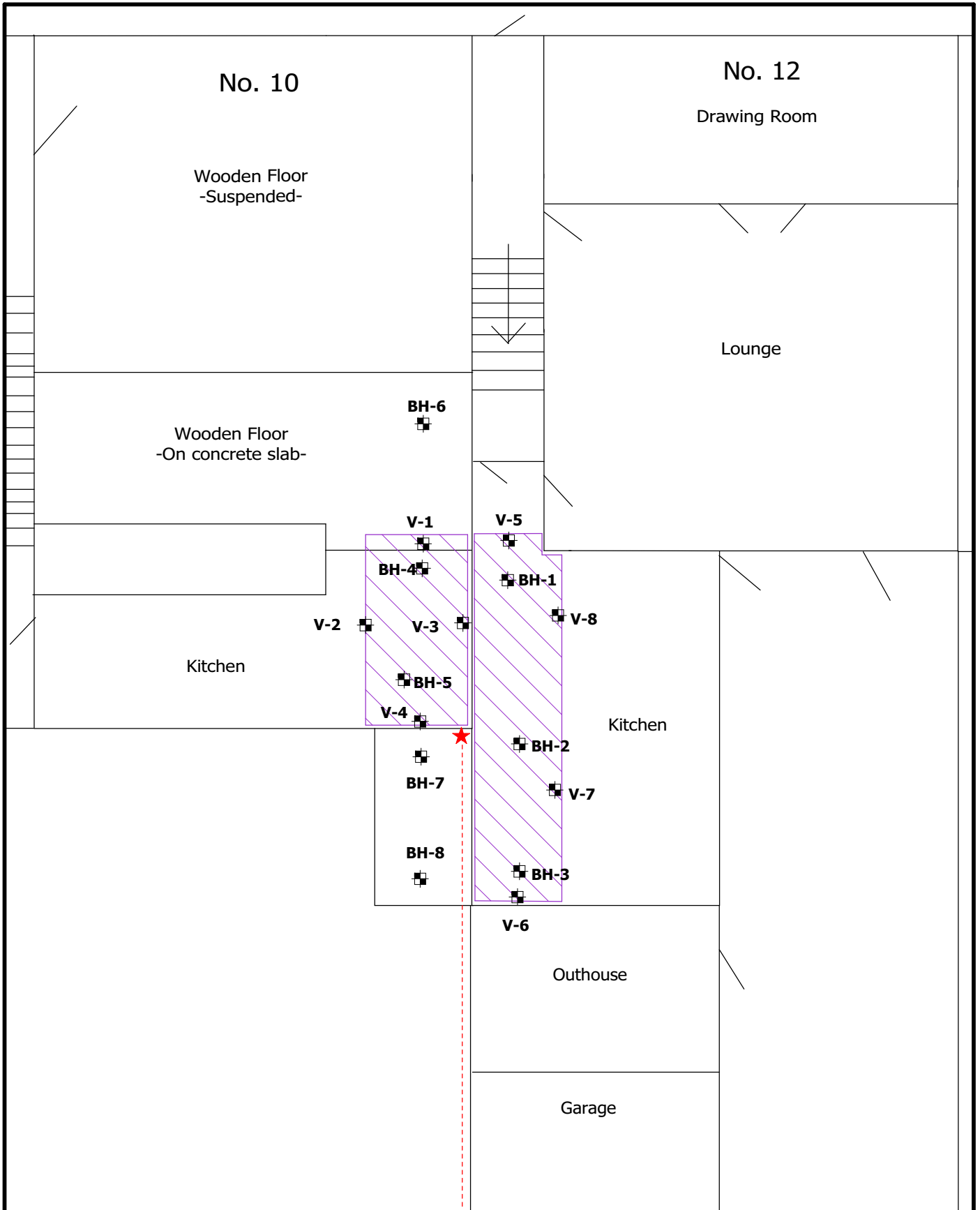
***APPENDIX A  
FIGURES AND PLANS***



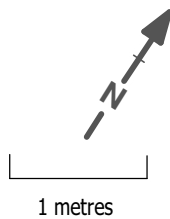
Approximate Location of Site



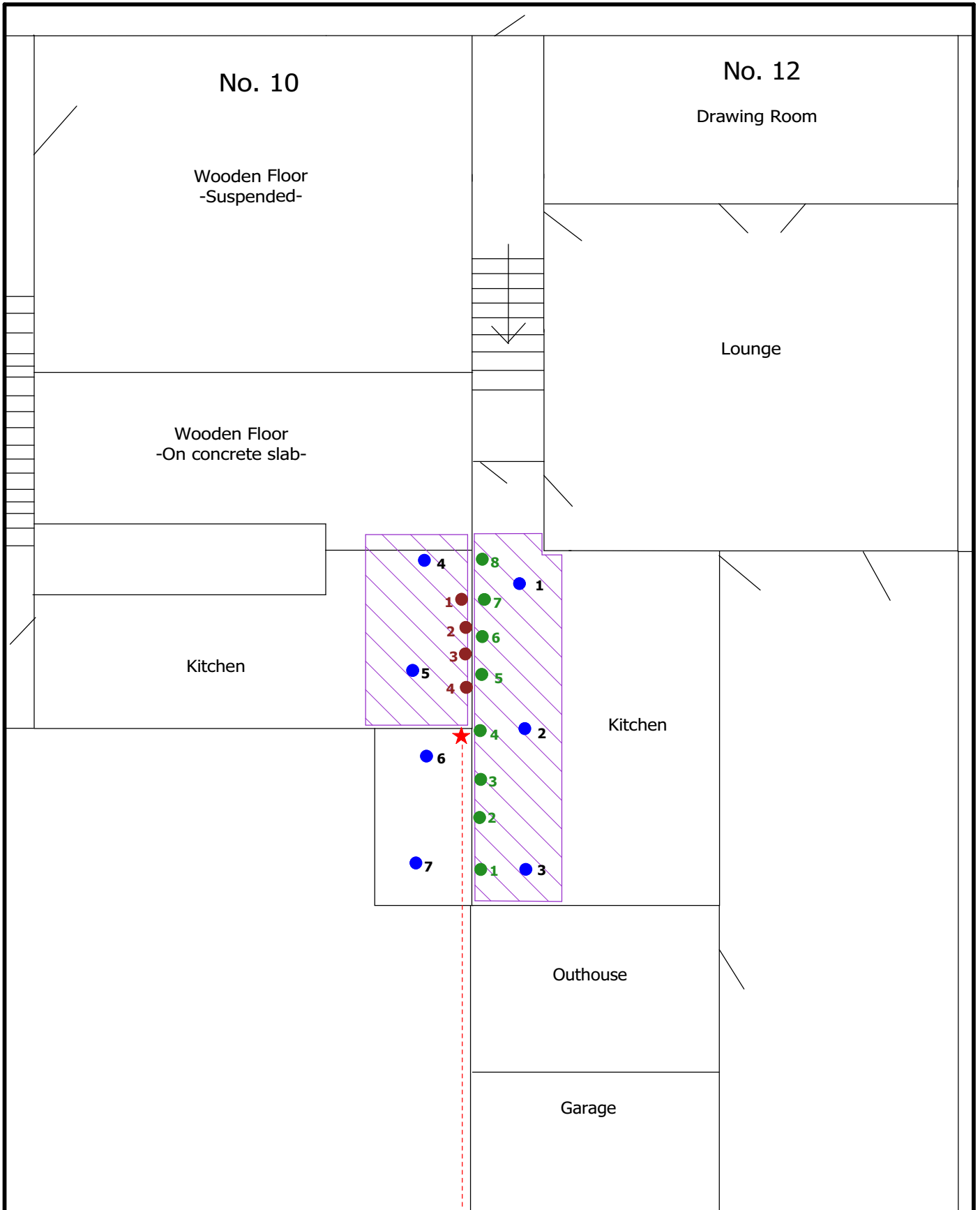
Remedial Works & Validation 10 & 12 Bangor St. Y Felinheli RAW Ref: 07RB239	
FIGURE 1: Site vicinity plan	Version: 1
APPROXIMATE SCALE: As shown Drawn By: CS    Checked By: AK	S:RAW/Projects/07RB239/Vicmap



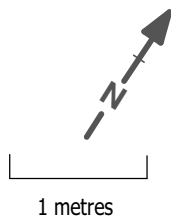
Legend	
	Spill Origin
	Location of Oil Feed Line
	Excavated area
	<b>BH-9</b> Borehole location
	<b>V-8</b> Validation sample location



Remedial Works & Validation 10 & 12 Bangor Street Y Felinheli RAW Ref: 07RB239	
Figure 2: Remedial Works	Version 1
Approximate Scale: As Shown Drawn by: CS Checked by: AK	S:RAW/Projects/07RB239/fig2plan



Legend	
★	Spill Origin
---	Location of Oil Feed Line
●	SVE location points in soils
●	SVE location points in wall of No. 10
●	SVE location points in wall of No. 12
▨	Excavated area



Remedial Works & Validation 10 & 12 Bangor Street Y Felinheli RAW Ref: 07RB239	
Figure 3: SVE Works	Version 1
Approximate Scale: As Shown Drawn by: CS Checked by: AK	S:RAW/Projects/07RB239/fig3plan





***APPENDIX B  
SUMMARY OF ANALYTICAL RESULTS***

**TABLE 1: VALIDATION SOIL ANALYTICAL SUMMARY  
PETROLEUM HYDROCARBONS AND BTEX**

Sample ID and Depth (m)	Date Collected	Benzene mg/kg	Toluene mg/kg	Ethyl-benzene mg/kg	Total Xylenes mg/kg	Petroleum Hydrocarbons						TPH >C <sub>10</sub> -C <sub>25</sub> mg/kg
						>C <sub>7</sub> -C <sub>8</sub> mg/kg	>C <sub>9</sub> -C <sub>10</sub> mg/kg	>C <sub>10</sub> -C <sub>12</sub> mg/kg	>C <sub>12</sub> -C <sub>16</sub> mg/kg	>C <sub>16</sub> -C <sub>21</sub> mg/kg	>C <sub>21</sub> -C <sub>25</sub> mg/kg	
V-1 0.70m	25-Mar-08	ND	ND	ND	ND	ND	ND	ND	1	ND	ND	1
V-2 0.70m	25-Mar-08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
V-3 0.70m	25-Mar-08	ND	ND	ND	ND	ND	1	4	ND	ND	ND	5
V-4 0.70m	25-Mar-08	ND	ND	ND	ND	ND	4	580	3400	310	67	4400
V-5 0.40m	04-Apr-08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
V-6 0.80m	04-Apr-08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
V-7 0.50m	04-Apr-08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OS-1 duplicate of V-6 0.80m		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Method detection limits		0.01	0.01	0.01	0.01	0.1	1	1	1	1	1	1
Lab Methodology		Headspace / GC-MS Solvent Extraction / GC-FID										

NOTES: i) The locations of all soil samples are depicted on the Site Map.  
ii) "ND" denotes sample tested below laboratory method detection limits.  
iii) TPH - Total Petroleum Hydrocarbons

**TABLE 2: AIR ANALYTICAL SUMMARY  
PETROLEUM HYDROCARBONS AND VOCs  
(Tenax tube sampling media)**

Sample Ref	Location and Date	Analyte	Thresholds (mg/m <sup>3</sup> )	Concentration mg/m <sup>3</sup>
VA-1	Property No. 10 Kitchin 30/10/08 to 6/11/08	Benzene	<0.0028	<0.0048
		Ethyl Benzene	<0.770	<0.0043
		Metal/Para-Xylene	<0.185*	<0.0047
		Methyl-tert-Butyl-Ether	N/T	<0.011
		n-butane*†	N/T	<0.023
		n-hexane	N/T	<0.011
		Naphthalene	<0.00244	<0.004
		Ortho-Xylene	<0.185*	<0.0047
		Toluene	<0.219	<0.0045
		C5-C6 aliphatic	N/T	<0.023
		C6-C8 aliphatic	N/T	<0.023
		C8-C10 aliphatic	<1	<0.023
		C10-C12 aliphatic	<1	<0.023
		C12-C16 aliphatic	<1	0.095
		C5-C7 aromatic	N/T	<0.024
		C7-C8 aromatic	N/T	<0.023
		C8-C10 aromatic	<0.2	<0.023
		C10-C12 aromatic	N/T	<0.023
		C12-C16 aromatic	N/T	<0.023

Duration of air sampling 10080 mins  
 Air sampling pump rate N/A cm<sup>3</sup>/min  
 Analysed volume of air N/A litres  
 N/T No Threshold

**TABLE 3: AIR ANALYTICAL SUMMARY  
PETROLEUM HYDROCARBONS AND VOCs  
(Tenax tube sampling media)**

Sample Ref	Location and Date	Analyte	Thresholds (mg/m <sup>3</sup> )	Concentration mg/m <sup>3</sup>
VA-2	Property No. 10 Upstairs 30/10/08 to 6/11/08	Benzene	<0.0028	<0.0048
		Ethyl Benzene	<0.770	<0.0043
		Metal/Para-Xylene	<0.185*	<0.0047
		Methyl/tert-Butyl/Ether	N/T	<0.011
		n-butane*†	N/T	<0.023
		n-hexane	N/T	<0.011
		Naphthalene	<0.00244	<0.004
		Ortho-Xylene	<0.185*	<0.0047
		Toluene	<0.219	<0.0045
		C5-C6 aliphatic	N/T	<0.023
		C6-C8 aliphatic	N/T	<0.023
		C8-C10 aliphatic	<1	<0.023
		C10-C12 aliphatic	<1	<0.023
		C12-C16 aliphatic	<1	0.05
		C5-C7 aromatic	N/T	<0.024
		C7-C8 aromatic	N/T	<0.023
		C8-C10 aromatic	<0.2	<0.023
		C10-C12 aromatic	N/T	<0.023
		C12-C16 aromatic	N/T	<0.023

Duration of air sampling 10080 mins  
 Air sampling pump rate N/A cm<sup>3</sup>/min  
 Analysed volume of air N/A litres  
 N/T No Threshold

**TABLE 4: AIR ANALYTICAL SUMMARY  
PETROLEUM HYDROCARBONS AND VOCs  
(Tenax tube sampling media)**

Sample Ref	Location and Date	Analyte	Thresholds (mg/m <sup>3</sup> )	Concentration mg/m <sup>3</sup>
VA-3	Property No. 12 Kitchin 30/10/08 to 6/11/08	Benzene	<0.0028	<0.0048
		Ethyl Benzene	<0.770	<0.0043
		Metal/Para-Xylene	<0.185*	<0.0047
		Methyl/tert-Butyl-Ether	N/T	<0.011
		n-butane*†	N/T	<0.023
		n-hexane	N/T	<0.011
		Naphthalene	<0.00244	<0.004
		Ortho-Xylene	<0.185*	<0.0047
		Toluene	<0.219	<0.0045
		C5-C6 aliphatic	N/T	<0.023
		C6-C8 aliphatic	N/T	<0.023
		C8-C10 aliphatic	<1	<0.023
		C10-C12 aliphatic	<1	0.036
		C12-C16 aliphatic	<1	0.34
		C5-C7 aromatic	N/T	<0.024
		C7-C8 aromatic	N/T	<0.023
		C8-C10 aromatic	<0.2	<0.023
		C10-C12 aromatic	N/T	<0.023
		C12-C16 aromatic	N/T	<0.023

Duration of air sampling 10080 mins  
 Air sampling pump rate N/A cm<sup>3</sup>/min  
 Analysed volume of air N/A litres  
 N/T No Threshold

**TABLE 5: AIR ANALYTICAL SUMMARY  
PETROLEUM HYDROCARBONS AND VOCs  
(Tenax tube sampling media)**

Sample Ref	Location and Date	Analyte	Thresholds (mg/m <sup>3</sup> )	Concentration mg/m <sup>3</sup>
VA-4	Property No. 12 Upstairs 30/10/08 to 6/11/08	Benzene	<0.0028	<0.0048
		Ethyl Benzene	<0.770	<0.0043
		Metal/Para-Xylene	<0.185*	<0.0047
		Methyl/tert-Butyl/Ether	N/T	<0.011
		n-butane*†	N/T	<0.023
		n-hexane	N/T	<0.011
		Naphthalene	<0.00244	<0.004
		Ortho-Xylene	<0.185*	<0.0047
		Toluene	<0.219	<0.0045
		C5-C6 aliphatic	N/T	<0.023
		C6-C8 aliphatic	N/T	<0.023
		C8-C10 aliphatic	<1	<0.023
		C10-C12 aliphatic	<1	0.023
		C12-C16 aliphatic	<1	0.095
		C5-C7 aromatic	N/T	<0.024
		C7-C8 aromatic	N/T	<0.023
		C8-C10 aromatic	<0.2	<0.023
		C10-C12 aromatic	N/T	<0.023
		C12-C16 aromatic	N/T	<0.023

Duration of air sampling 10080 mins  
 Air sampling pump rate N/A cm<sup>3</sup>/min  
 Analysed volume of air N/A litres  
 N/T No Threshold

**TABLE 6: AIR ANALYTICAL SUMMARY  
PETROLEUM HYDROCARBONS AND VOCs  
(Tenax tube sampling media)**

Sample Ref	Location and Date	Analyte	Thresholds (mg/m <sup>3</sup> )	Concentration mg/m <sup>3</sup>
QA-1	Duplicate property No. 12 kitchen 30/10/08 to 6/11/08	Benzene	<0.0028	<0.0048
		Ethyl Benzene	<0.770	<0.0043
		Metal/Para-Xylene	<0.185*	<0.0047
		Methyl/tert-Butyl-Ether	N/T	<0.011
		n-butane*†	N/T	<0.023
		n-hexane	N/T	<0.011
		Naphthalene	<0.00244	<0.004
		Ortho-Xylene	<0.185*	<0.0047
		Toluene	<0.219	<0.0045
		C5-C6 aliphatic	N/T	<0.023
		C6-C8 aliphatic	N/T	<0.023
		C8-C10 aliphatic	<1	<0.023
		C10-C12 aliphatic	<1	0.041
		C12-C16 aliphatic	<1	0.36
		C5-C7 aromatic	N/T	<0.024
		C7-C8 aromatic	N/T	<0.023
		C8-C10 aromatic	<0.2	<0.023
		C10-C12 aromatic	N/T	<0.023
		C12-C16 aromatic	N/T	<0.023

Duration of air sampling 10080 mins  
 Air sampling pump rate N/A cm<sup>3</sup>/min  
 Analysed volume of air N/A litres  
 N/T No Threshold

**TABLE 7: AIR ANALYTICAL SUMMARY  
PETROLEUM HYDROCARBONS AND VOCs  
(Tenax tube sampling media)**

Sample Ref	Location and Date	Analyte	Thresholds (mg/m <sup>3</sup> )	Concentration mg/m <sup>3</sup>
VA-5	No. 10 Kitchen 24/03/09 to 07/04/09	Benzene	<0.0028	<0.0024
		Ethyl Benzene	<0.770	<0.0022
		Metal/Para-Xylene	<0.185*	<0.0024
		Methyl-tert-Butyl-Ether	N/T	<0.0056
		n-butane*†	N/T	<0.023
		n-hexane	N/T	<0.011
		Naphthalene	<0.00244	<0.0020
		Ortho-Xylene	<0.185*	<0.0024
		Toluene	<0.219	<0.0023
		C5-C6 aliphatic	N/T	<0.011
		C6-C8 aliphatic	N/T	<0.11
		C8-C10 aliphatic	<1	<0.11
		C10-C12 aliphatic	<1	0.018
		C12-C16 aliphatic	<1	0.062
		C5-C7 aromatic	N/T	<0.012
		C7-C8 aromatic	N/T	<0.011
		C8-C10 aromatic	<0.2	<0.011
		C10-C12 aromatic	N/T	<0.011
		C12-C16 aromatic	N/T	<0.011

Duration of air sampling 20160 mins  
 Air sampling pump rate N/A cm<sup>3</sup>/min  
 Analysed volume of air N/A litres  
 N/T No Threshold



**TABLE 8: AIR ANALYTICAL SUMMARY  
PETROLEUM HYDROCARBONS AND VOCs  
(Tenax tube sampling media)**

Sample Ref	Location and Date	Analyte	Thresholds (mg/m <sup>3</sup> )	Concentration mg/m <sup>3</sup>
VA-6	No. 10 Landing	Benzene	<0.0028	<0.0024
	24/03/09 to 07/04/09	Ethyl Benzene	<0.770	<0.0022
		Meta/Para-Xylene	<0.185*	<0.0024
		Methyl-tert-Butyl-Ether	N/T	<0.0056
		n-butane*†	N/T	<0.023
		n-hexane	N/T	<0.011
		Naphthalene	<0.00244	<0.0020
		Ortho-Xylene	<0.185*	<0.0024
		Toluene	<0.219	0.0023
		C5-C6 aliphatic	N/T	<0.011
		C6-C8 aliphatic	N/T	<0.11
		C8-C10 aliphatic	<1	<0.11
		C10-C12 aliphatic	<1	<0.11
		C12-C16 aliphatic	<1	0.024
		C5-C7 aromatic	N/T	<0.012
		C7-C8 aromatic	N/T	<0.011
		C8-C10 aromatic	<0.2	<0.011
		C10-C12 aromatic	N/T	<0.011
		C12-C16 aromatic	N/T	<0.011

Duration of air sampling 20160 mins  
 Air sampling pump rate N/A cm<sup>3</sup>/min  
 Analysed volume of air N/A litres  
 N/T No Threshold

**TABLE 9: AIR ANALYTICAL SUMMARY  
PETROLEUM HYDROCARBONS AND VOCs  
(Tenax tube sampling media)**

Sample Ref	Location and Date	Analyte	Thresholds (mg/m <sup>3</sup> )	Concentration mg/m <sup>3</sup>
VA-7	No. 12 Klichen	Benzene	<0.0028	<0.0024
	24/03/09 to 07/04/09	Ethyl Benzene	<0.770	<0.0022
		Metal/Para-Xylene	<0.185*	0.003
		Methyl-tert-Butyl-Ether	N/T	<0.0056
		n-butane*†	N/T	<0.023
		n-hexane	N/T	<0.011
		Naphthalene	<0.00244	<0.0020
		Ortho-Xylene	<0.185*	<0.0024
		Toluene	<0.219	0.003
		C5-C6 aliphatic	N/T	<0.011
		C6-C8 aliphatic	N/T	0.018
		C8-C10 aliphatic	<1	0.035
		C10-C12 aliphatic	<1	0.14
		C12-C16 aliphatic	<1	0.048
		C5-C7 aromatic	N/T	<0.012
		C7-C8 aromatic	N/T	<0.011
		C8-C10 aromatic	<0.2	<0.011
		C10-C12 aromatic	N/T	<0.011
		C12-C16 aromatic	N/T	<0.011

Duration of air sampling 20160 mins  
 Air sampling pump rate N/A cm<sup>3</sup>/min  
 Analysed volume of air N/A litres  
 N/T No Threshold

**TABLE 10: AIR ANALYTICAL SUMMARY  
PETROLEUM HYDROCARBONS AND VOCs  
(Tenax tube sampling media)**

Sample Ref	Location and Date	Analyte	Thresholds (mg/m <sup>3</sup> )	Concentration mg/m <sup>3</sup>
VA-8	No. 12 Landing	Benzene	<0.0028	<0.0024
	24/03/09 to 07/04/09	Ethyl Benzene	<0.770	<0.0022
		Meta/Para-Xylene	<0.185*	<0.0024
		Methyl-tert-Butyl-Ether	N/T	<0.0056
		n-butane*†	N/T	<0.023
		n-hexane	N/T	<0.011
		Naphthalene	<0.00244	<0.0020
		Ortho-Xylene	<0.185*	<0.0024
		Toluene	<0.219	0.0043
		C5-C6 aliphatic	N/T	<0.011
		C6-C8 aliphatic	N/T	<0.011
		C8-C10 aliphatic	<1	0.033
		C10-C12 aliphatic	<1	0.14
		C12-C16 aliphatic	<1	0.065
		C5-C7 aromatic	N/T	<0.012
		C7-C8 aromatic	N/T	<0.011
		C8-C10 aromatic	<0.2	<0.011
		C10-C12 aromatic	N/T	<0.011
		C12-C16 aromatic	N/T	<0.011

Duration of air sampling 20160 mins  
 Air sampling pump rate N/A cm<sup>3</sup>/min  
 Analysed volume of air N/A litres  
 N/T No Threshold

**TABLE 11: AIR ANALYTICAL SUMMARY  
PETROLEUM HYDROCARBONS AND VOCs  
(Tenax tube sampling media)**

Sample Ref	Location and Date	Analyte	Thresholds (mg/m <sup>3</sup> )	Concentration mg/m <sup>3</sup>
QA-1	Duplicate property No. 12 kitchen 24/03/09 to 07/04/09	Benzene	<0.0028	<0.0024
		Ethyl Benzene	<0.770	<0.0022
		Meta/Para-Xylene	<0.185*	0.003
		Methyl-tert-Butyl-Ether	N/T	<0.0056
		n-butane*†	N/T	<0.023
		n-hexane	N/T	<0.011
		Naphthalene	<0.00244	<0.0020
		Ortho-Xylene	<0.185*	<0.0024
		Toluene	<0.219	0.003
		C5-C6 aliphatic	N/T	<0.011
		C6-C8 aliphatic	N/T	<0.011
		C8-C10 aliphatic	<1	0.033
		C10-C12 aliphatic	<1	0.12
		C12-C16 aliphatic	<1	0.056
		C5-C7 aromatic	N/T	<0.012
		C7-C8 aromatic	N/T	<0.011
		C8-C10 aromatic	<0.2	<0.011
		C10-C12 aromatic	N/T	<0.011
		C12-C16 aromatic	N/T	<0.011

Duration of air sampling 20160 mins  
 Air sampling pump rate N/A cm<sup>3</sup>/min  
 Analysed volume of air N/A litres  
 N/T No Threshold



***APPENDIX C***  
***PHOTOGRAPHS***



Randall and Walsh Associates Limited  
1<sup>st</sup> Floor Offices  
Michael Ward  
Lynstock Way  
Lostock  
Bolton  
BL6 4SA

Client: QuestGates Ltd

Project: 10 & 12 BANGOR STREET  
Y FELINHILI  
GWYNEDD

Project No. 07RB239



**Photograph 2:** The excavated floor in the kitchen of No. 12 to remove impacted soils to foundation level.



**Photograph 4:** Two SVE points installed in the soils within the kitchen of No.10.



**Photograph 1:** The excavated floor in the kitchen of No. 10 to remove impacted soils to foundation level.



**Photograph 3:** View of the exterior SVE system to treat soils beneath the ground.



**Photograph 5:** View of the SVE points installed into the soils within the kitchen of No. 12.



**Photograph 7:** View of the SVE system installed into the wall within property No. 12.



**Photograph 6:** View of the SVE system installed into the wall within property No. 10.



**Photograph 8:** View of the reinstated kitchen floor and wall in property No.10.



**Randall and Walsh Associates Limited**  
 1<sup>st</sup> Floor Offices  
 Michael Ward  
 Lynstock Way  
 Lostock  
 Bolton  
 BL6 4SA

**Client:** QuestGates Ltd

**Project:** 10 & 12 BANGOR STREET  
 Y FELINHELI  
 GWYNEDD

**Project No. 07RB239**



***APPENDIX D  
LABORATORY ANALYTICAL REPORTS***



# Scientific Analysis Laboratories

## Certificate of Analysis

**Report Number:** 128204-1

**Date of Report:** 04-Apr-2008

**Client:** RAW Consulting,  
1st Floor Offices,  
Michael Ward,  
Lynstock Way,  
Lostock,  
Bolton.  
BL6 4SA

**Client Contact:** Mr David Turner  
**Client Job Reference:** 07RB239  
**Client Site Reference:** Nelmes y Felinheli  
**Client Purchase Order:** 9907393

**Date Job Received at SAL:** 27-Mar-2008  
**Date Analysis Started:** 31-Mar-2008  
**Date Analysis Completed:** 03-Apr-2008

The results reported relate to samples received at the laboratory  
Opinions and interpretations expressed herein are outside the scope of UKAS or MCERTS accreditation  
This report should not be reproduced except in full without the written approval of the laboratory  
Tests covered by this certificate were conducted in accordance with SAL SOPs

Key to symbols used in this report:

W: Analysis was sub-contracted and performed at another SAL Laboratory

S: Analysis was sub-contracted

N: Analysis is not UKAS accredited

U: Analysis is UKAS accredited

M: Analysis is MCERTS accredited

Report checked  
and authorised by:

Mr Ross Walker  
Assistant Customer Services Manager



1549  
Group



1549

### Index to caveats used in this report

Value	Description
AR	As Received
A105	Assisted dried at 105C
13	Results have been blank corrected.

#### Notes:

Fill samples are outside the scope of our accreditation. Results are UKAS only

<b>SAL Reference:</b> 128204									
<b>Project Site:</b> Nelmes y Felinheli									
<b>Customer Reference:</b> 07RB239									
<b>Soil</b>		Analysed as Soil							
<b>MCERTS Preparation</b>									
<b>SAL Reference</b>		128204 001	128204 002	128204 003	128204 004	128204 005			
<b>Customer Sample Reference</b>		V-1	V-2	V-3	V-4	BH-1			
<b>Test Sample</b>		AR	AR	AR	AR	AR			
<b>Type</b>		Clay	Clay	Clay	Clay	Clay			
<b>Date Sampled</b>		25-MAR-2008	25-MAR-2008	25-MAR-2008	25-MAR-2008	25-MAR-2008			
<b>Depth</b>		0.7	0.7	0.7	0.7	1.8			
<b>Determinand</b>	<b>Technique</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>					
Moisture @ 105 C	Grav (1 Dec) (105 C)	0.1	%	N	12	11	12	9.1	14

<b>SAL Reference:</b> 128204									
<b>Project Site:</b> Nelmes y Felinheli									
<b>Customer Reference:</b> 07RB239									
<b>Soil</b>		Analysed as Soil							
<b>MCERTS Preparation</b>									
<b>SAL Reference</b>		128204 006	128204 007	128204 008	128204 009	128204 010			
<b>Customer Sample Reference</b>		BH-1	BH-1	BH-2	BH-2	BH-3			
<b>Test Sample</b>		AR	AR	AR	AR	AR			
<b>Type</b>		Sand	Sand	Clay	Fill	Clay			
<b>Date Sampled</b>		25-MAR-2008	25-MAR-2008	25-MAR-2008	25-MAR-2008	25-MAR-2008			
<b>Depth</b>		2.5	3.4	0.9	3.3	0.9			
<b>Determinand</b>	<b>Technique</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>					
Moisture @ 105 C	Grav (1 Dec) (105 C)	0.1	%	N	13	11	14	11	12

<b>SAL Reference:</b> 128204									
<b>Project Site:</b> Nelmes y Felinheli									
<b>Customer Reference:</b> 07RB239									
<b>Soil</b>		Analysed as Soil							
<b>MCERTS Preparation</b>									
<b>SAL Reference</b>		128204 011	128204 012	128204 013					
<b>Customer Sample Reference</b>		BH-3	BH-4	BH-4					
<b>Test Sample</b>		AR	AR	AR					
<b>Type</b>		Fill	Clay	Fill					
<b>Date Sampled</b>		25-MAR-2008	25-MAR-2008	25-MAR-2008					
<b>Depth</b>		2.3	0.9	2.1					
<b>Determinand</b>	<b>Technique</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>					
Moisture @ 105 C	Grav (1 Dec) (105 C)	0.1	%	N	6.4	12	7.7		

<b>SAL Reference:</b> 128204									
<b>Project Site:</b> Nelmes y Felinheli									
<b>Customer Reference:</b> 07RB239									
<b>Soil</b>		Analysed as Soil							
<b>BTEX (MCERTS)</b>									
<b>SAL Reference</b>			<b>128204 001</b>	<b>128204 002</b>	<b>128204 003</b>	<b>128204 004</b>	<b>128204 005</b>		
<b>Customer Sample Reference</b>			<b>V-1</b>	<b>V-2</b>	<b>V-3</b>	<b>V-4</b>	<b>BH-1</b>		
<b>Test Sample</b>			<b>A105</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>		
<b>Type</b>			<b>Clay</b>	<b>Clay</b>	<b>Clay</b>	<b>Clay</b>	<b>Clay</b>		
<b>Date Sampled</b>			<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>		
<b>Depth</b>			<b>0.7</b>	<b>0.7</b>	<b>0.7</b>	<b>0.7</b>	<b>1.8</b>		
<b>Determinand</b>	<b>Technique</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>					
Benzene	GC/MS(Head Space)(MCERTS)	10	µg/kg	M	<10	<10	<10	<10	<10
EthylBenzene	GC/MS(Head Space)(MCERTS)	10	µg/kg	M	<10	<10	<10	<10	<10
Meta/Para-Xylene	GC/MS(Head Space)(MCERTS)	10	µg/kg	M	<10	<10	<10	<10	<10
Ortho-Xylene	GC/MS(Head Space)(MCERTS)	10	µg/kg	M	<10	<10	<10	<10	<10
Toluene	GC/MS(Head Space)(MCERTS)	10	µg/kg	M	<sup>(13)</sup> <10	<sup>(13)</sup> <10	<sup>(13)</sup> <10	<sup>(13)</sup> <10	<sup>(13)</sup> <10

<b>SAL Reference:</b> 128204									
<b>Project Site:</b> Nelmes y Felinheli									
<b>Customer Reference:</b> 07RB239									
<b>Soil</b>		Analysed as Soil							
<b>BTEX (MCERTS)</b>									
<b>SAL Reference</b>			<b>128204 006</b>	<b>128204 007</b>	<b>128204 008</b>	<b>128204 010</b>	<b>128204 012</b>		
<b>Customer Sample Reference</b>			<b>BH-1</b>	<b>BH-1</b>	<b>BH-2</b>	<b>BH-3</b>	<b>BH-4</b>		
<b>Test Sample</b>			<b>A105</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>		
<b>Type</b>			<b>Sand</b>	<b>Sand</b>	<b>Clay</b>	<b>Clay</b>	<b>Clay</b>		
<b>Date Sampled</b>			<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>		
<b>Depth</b>			<b>2.5</b>	<b>3.4</b>	<b>0.9</b>	<b>0.9</b>	<b>0.9</b>		
<b>Determinand</b>	<b>Technique</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>					
Benzene	GC/MS(Head Space)(MCERTS)	10	µg/kg	M	<10	<10	<10	<10	<10
EthylBenzene	GC/MS(Head Space)(MCERTS)	10	µg/kg	M	<10	<10	<10	<10	<10
Meta/Para-Xylene	GC/MS(Head Space)(MCERTS)	10	µg/kg	M	<10	<10	<10	<10	<10
Ortho-Xylene	GC/MS(Head Space)(MCERTS)	10	µg/kg	M	<10	<10	<10	<10	<10
Toluene	GC/MS(Head Space)(MCERTS)	10	µg/kg	M	<sup>(13)</sup> <10	<sup>(13)</sup> <10	<sup>(13)</sup> <10	<sup>(13)</sup> <10	<sup>(13)</sup> <10

**SAL Reference:** 128204  
**Project Site:** Nelmes y Felinheli  
**Customer Reference:** 07RB239

**Soil**                      Analysed as Soil  
**BTEX (UKAS)**

<b>SAL Reference</b>	<b>128204 009</b>	<b>128204 011</b>	<b>128204 013</b>
<b>Customer Sample Reference</b>	<b>BH-2</b>	<b>BH-3</b>	<b>BH-4</b>
<b>Test Sample</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>
<b>Type</b>	<b>Fill</b>	<b>Fill</b>	<b>Fill</b>
<b>Date Sampled</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>
<b>Depth</b>	<b>3.3</b>	<b>2.3</b>	<b>2.1</b>

<b>Determinand</b>	<b>Technique</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>			
Benzene	GC/MS(Head Space)(MCERTS)	10	µg/kg	U	<10	<10	<10
EthylBenzene	GC/MS(Head Space)(MCERTS)	10	µg/kg	U	<b>200</b>	<10	<10
Meta/Para-Xylene	GC/MS(Head Space)(MCERTS)	10	µg/kg	U	<b>1000</b>	<10	<10
Ortho-Xylene	GC/MS(Head Space)(MCERTS)	10	µg/kg	U	<b>1700</b>	<10	<10
Toluene	GC/MS(Head Space)(MCERTS)	10	µg/kg	U	<sup>(13)</sup> <b>10</b>	<10	<10

**SAL Reference:** 128204  
**Project Site:** Nelmes y Felinheli  
**Customer Reference:** 07RB239

**Soil**                      Analysed as Soil  
**TPH (MCERTS)**

<b>SAL Reference</b>	<b>128204 001</b>	<b>128204 002</b>	<b>128204 003</b>	<b>128204 004</b>	<b>128204 005</b>
<b>Customer Sample Reference</b>	<b>V-1</b>	<b>V-2</b>	<b>V-3</b>	<b>V-4</b>	<b>BH-1</b>
<b>Test Sample</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>
<b>Type</b>	<b>Clay</b>	<b>Clay</b>	<b>Clay</b>	<b>Clay</b>	<b>Clay</b>
<b>Date Sampled</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>
<b>Depth</b>	<b>0.7</b>	<b>0.7</b>	<b>0.7</b>	<b>0.7</b>	<b>1.8</b>

<b>Determinand</b>	<b>Technique</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>					
Total Petroleum Hydrocarbons (C6-C8)	GC/MS (Headspace)	0.1	mg/kg	N	<0.1	<0.1	<0.1	<0.1	<0.1
Total Petroleum Hydrocarbons (C8-C10)	GC/FID	1	mg/kg	U	<1	<1	<1	<b>4</b>	<1
Total Petroleum Hydrocarbons (C10-C12)	GC/FID	1	mg/kg	U	<1	<1	<b>1</b>	<b>580</b>	<1
Total Petroleum Hydrocarbons (C12-C16)	GC/FID	1	mg/kg	U	<b>1</b>	<1	<b>4</b>	<b>3400</b>	<b>1</b>
Total Petroleum Hydrocarbons (C16-C21)	GC/FID	1	mg/kg	U	<1	<1	<1	<b>310</b>	<1
Total Petroleum Hydrocarbons (C21-C35)	GC/FID	1	mg/kg	U	<sup>(13)</sup> <1	<sup>(13)</sup> <1	<sup>(13)</sup> <1	<sup>(13)</sup> <b>67</b>	<sup>(13)</sup> <1
Total Petroleum Hydrocarbons	GC/FID	1	mg/kg	M	<b>1</b>	<1	<b>5</b>	<b>4400</b>	<b>1</b>

**SAL Reference:** 128204  
**Project Site:** Nelmes y Felinheli  
**Customer Reference:** 07RB239

**Soil**                      Analysed as Soil  
**TPH (MCERTS)**

<b>SAL Reference</b>	<b>128204 006</b>	<b>128204 007</b>	<b>128204 008</b>	<b>128204 010</b>	<b>128204 012</b>
<b>Customer Sample Reference</b>	<b>BH-1</b>	<b>BH-1</b>	<b>BH-2</b>	<b>BH-3</b>	<b>BH-4</b>
<b>Test Sample</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>
<b>Type</b>	<b>Sand</b>	<b>Sand</b>	<b>Clay</b>	<b>Clay</b>	<b>Clay</b>
<b>Date Sampled</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>
<b>Depth</b>	<b>2.5</b>	<b>3.4</b>	<b>0.9</b>	<b>0.9</b>	<b>0.9</b>

<b>Determinand</b>	<b>Technique</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>					
Total Petroleum Hydrocarbons (C6-C8)	GC/MS (Headspace)	0.1	mg/kg	N	<0.1	<0.1	<0.1	<0.1	<0.1
Total Petroleum Hydrocarbons (C8-C10)	GC/FID	1	mg/kg	U	<1	<1	<b>130</b>	<b>2</b>	<1
Total Petroleum Hydrocarbons (C10-C12)	GC/FID	1	mg/kg	U	<1	<1	<b>1900</b>	<b>24</b>	<b>2</b>
Total Petroleum Hydrocarbons (C12-C16)	GC/FID	1	mg/kg	U	<b>2</b>	<1	<b>8800</b>	<b>79</b>	<b>12</b>
Total Petroleum Hydrocarbons (C16-C21)	GC/FID	1	mg/kg	U	<1	<1	<b>560</b>	<b>7</b>	<b>1</b>
Total Petroleum Hydrocarbons (C21-C35)	GC/FID	1	mg/kg	U	<sup>(13)</sup> <1	<sup>(13)</sup> <1	<b>31</b>	<b>2</b>	<b>6</b>
Total Petroleum Hydrocarbons	GC/FID	1	mg/kg	M	<b>2</b>	<1	<b>11000</b>	<b>110</b>	<b>21</b>

**SAL Reference:** 128204  
**Project Site:** Nelmes y Felinheli  
**Customer Reference:** 07RB239

**Soil**                      Analysed as Soil  
**TPH (UKAS)**

<b>SAL Reference</b>	<b>128204 009</b>	<b>128204 011</b>	<b>128204 013</b>
<b>Customer Sample Reference</b>	<b>BH-2</b>	<b>BH-3</b>	<b>BH-4</b>
<b>Test Sample</b>	<b>A105</b>	<b>A105</b>	<b>A105</b>
<b>Type</b>	<b>Fill</b>	<b>Fill</b>	<b>Fill</b>
<b>Date Sampled</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>	<b>25-MAR-2008</b>
<b>Depth</b>	<b>3.3</b>	<b>2.3</b>	<b>2.1</b>

<b>Determinand</b>	<b>Technique</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>			
Total Petroleum Hydrocarbons (C6-C8)	GC/MS (Headspace)	0.1	mg/kg	N	<0.1	<0.1	<0.1
Total Petroleum Hydrocarbons (C8-C10)	GC/FID	1	mg/kg	U	<b>520</b>	<1	<1
Total Petroleum Hydrocarbons (C10-C12)	GC/FID	1	mg/kg	U	<b>1800</b>	<b>1</b>	<1
Total Petroleum Hydrocarbons (C12-C16)	GC/FID	1	mg/kg	U	<b>3900</b>	<b>8</b>	<b>2</b>
Total Petroleum Hydrocarbons (C16-C21)	GC/FID	1	mg/kg	U	<b>190</b>	<b>2</b>	<1
Total Petroleum Hydrocarbons (C21-C35)	GC/FID	1	mg/kg	U	<b>16</b>	<b>7</b>	(13) <1
Total Petroleum Hydrocarbons	GC/FID	1.0	mg/kg	U	<b>6300</b>	<b>18</b>	<b>2.0</b>



# Scientific Analysis Laboratories

## Certificate of Analysis

**Report Number:** 148175-1

**Date of Report:** 14-Nov-08

**Client:** RAW  
1st Floor Offices  
Michael Ward  
Lynstock Way  
Lostock  
Bolton  
BL6 4SA

**Client Contact:** Mr David Turner  
**Client Job Reference:** 07RB239-I  
**Project Site:** Nelmes Felinheli

**Date Job Received at SAL:** 7-Nov-08  
**Date Analysis Started:** 11-Nov-08

The results reported relate to samples received at the laboratory  
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation  
This report should not be reproduced except in full without the written approval of the laboratory  
Tests covered by this certificate were conducted in accordance with SAL SOPs

### Key to symbols used on this report:

W: Analysis was performed at another SAL laboratory  
S: Analysis was subcontracted  
N: Analysis is not UKAS accredited  
U: Analysis is UKAS accredited

**Report written by:** Saber Chaudhry  
Senior Analyst

**Report checked and authorised by:** Sarah Cooke  
Analyst



Report Number: 148175-1  
 Client Job Reference: 07RB239-I  
 Project Site: Neimes Feinheli

<b>SAL Ref.</b>	148175 001	148175 002	148175 003	148175 004	148175 005
<b>Client Ref.</b>	VA-1	VA-2	VA-3	VA-4	QA-1
<b>Type</b>	Tube (Tenax)	Tube (Tenax)	Tube (Tenax)	Tube (Tenax)	Tube (Tenax)

Determinand	Method	Units	LOD	Symbol
Benzene	GC/MS	ng/tube	20	U
Ethylbenzene	GC/MS	ng/tube	20	U
m+p Xylene	GC/MS	ng/tube	20	U
Methyl-tert-Butyl Ether	GC/MS	ng/tube	50	N
n-Butane	GC/MS	ng/tube	100	N
n-Hexane	GC/MS	ng/tube	50	N
Naphthalene	GC/MS	ng/tube	20	U
o Xylene	GC/MS	ng/tube	20	U
Toluene	GC/MS	ng/tube	20	U
TPH (C5 - C6 aliphatic)	GC/MS	ng/tube	100	N
TPH (C6-C8 aliphatic)	GC/MS	ng/tube	100	N
TPH (C8-C10 aliphatic)	GC/MS	ng/tube	100	N
TPH (C10-C12 aliphatic)	GC/MS	ng/tube	100	N
TPH (C12-C16 aliphatic)	GC/MS	ng/tube	100	N
TPH (C5 - C7 aromatic)	GC/MS	ng/tube	100	N
TPH (C7-C8 aromatic)	GC/MS	ng/tube	100	N
TPH (C8-C10 aromatic)	GC/MS	ng/tube	100	N
TPH (C10-C12 aromatic)	GC/MS	ng/tube	100	N
TPH (C12-C16 aromatic)	GC/MS	ng/tube	100	N

Report Number: 148175-1  
 Client Job Reference: 07RB239-I  
 Project Site: Neimes Feinheili

<b>SAL Ref.</b>	148175 001	148175 002	148175 003	148175 004	148175 005
<b>Client Ref.</b>	VA-1	VA-2	VA-3	VA-4	QA-1
<b>Time(min)</b>	10080	10080	10080	10080	10080
<b>Type</b>	Tube (Tenax)	Tube (Tenax)	Tube (Tenax)	Tube (Tenax)	Tube (Tenax)

Determinand	Method	Units	LOD	Symbol
Benzene	GC/MS	mg/m3		N
Ethylbenzene	GC/MS	mg/m3		N
m+p Xylene	GC/MS	mg/m3		N
Methyl-tert-Butyl Ether	GC/MS	mg/m3		N
n-Butane	GC/MS	mg/m3		N
n-Hexane	GC/MS	mg/m3		N
Naphthalene	GC/MS	mg/m3		N
o Xylene	GC/MS	mg/m3		N
Toluene	GC/MS	mg/m3		N
TPH (C5 - C6 aliphatic)	GC/MS	mg/m3		N
TPH (C6-C8 aliphatic)	GC/MS	mg/m3		N
TPH (C8-C10 aliphatic)	GC/MS	mg/m3		N
TPH (C10-C12 aliphatic)	GC/MS	mg/m3		N
TPH (C12-C16 aliphatic)	GC/MS	mg/m3		N
TPH (C5 - C7 aromatic)	GC/MS	mg/m3		N
TPH (C7-C8 aromatic)	GC/MS	mg/m3		N
TPH (C8-C10 aromatic)	GC/MS	mg/m3		N
TPH (C10-C12 aromatic)	GC/MS	mg/m3		N
TPH (C12-C16 aromatic)	GC/MS	mg/m3		N



# Scientific Analysis Laboratories

## Certificate of Analysis

Scientific Analysis Laboratories is a limited company registered in England and Wales (No 2514788) whose address is at Hadfield House, Hadfield Street, Manchester M16 9FE

Hadfield House  
Hadfield Street  
Cornbrook  
Manchester  
M16 9FE  
Tel : 0161 874 2400  
Fax : 0161 874 2404

**Report Number:** Supplement to 161752-1

**Date of Report:** 16-Apr-2009

**Customer:** RAW  
1st Floor Offices  
Michael Ward  
Lynstock Way  
Lostock  
Bolton  
BL6 4SA

**Customer Contact:** Ms Catherine Shannon

**Customer Job Reference:** 07RB239

**Customer Purchase Order:** 9913340

**Customer Site Reference:** Felinheli

**Date Job Received at SAL:** 09-Apr-2009

**Date Analysis Started:** 09-Apr-2009

**Date Analysis Completed:** 16-Apr-2009

The results reported relate to samples received in the laboratory  
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation  
This report should not be reproduced except in full without the written approval of the laboratory  
Tests covered by this certificate were conducted in accordance with SAL SOPs



1549

Report checked  
and authorised by :  
Mr Nicholas Moore  
Project Manager

Issued by :

## Index to symbols used in this report

Value	Description
AR	As Received
U	Analysis is UKAS accredited
N	Analysis is not accredited

## Notes

Supplement issued to report correct calcs.



SAL Reference: 161752

Project Site: Felinheli

Customer Reference: 07RB239

Tube (Tenax) Analyzed as Tube (Tenax)  
Suite A

SAL Reference					161752 001	161752 002	161752 003	161752 004	161752 005
Customer Sample Reference					QA-1	VA-5	VA-6	VA-7	VA-8
Test Sample					AR	AR	AR	AR	AR
Sampling Time (min)					20160	20160	20160	20160	20160
Determinand	Method	LOD	Units	Symbol					
Benzene	GC/MS (TD)	20	ng	U	<20	<20	<20	<20	<20
	C	C	mg/m3		<0.0024	<0.0024	<0.0024	<0.0024	<0.0024
	C	C	ppm		<0.00076	<0.00076	<0.00076	<0.00076	<0.00076
EthylBenzene	GC/MS (TD)	20	ng	U	<20	<20	<20	<20	<20
	C	C	mg/m3		<0.0022	<0.0022	<0.0022	<0.0022	<0.0022
	C	C	ppm		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Meta/Para-Xylene	GC/MS (TD)	20	ng	U	25	<20	<20	25	<20
	C	C	mg/m3		0.0030	<0.0024	<0.0024	0.0030	<0.0024
	C	C	ppm		0.00023	<0.00018	<0.00018	0.00023	<0.00018
Methyl-tert-Butyl Ether	GC/MS (TD)	50	ng	N	<50	<50	<50	<50	<50
	C	C	mg/m3		<0.0056	<0.0056	<0.0056	<0.0056	<0.0056
	C	C	ppm		<0.0016	<0.0016	<0.0016	<0.0016	<0.0016
n-butane	GC/MS (TD)	100	ng	N	<100	<100	<100	<100	<100
n-hexane	GC/MS (TD)	50	ng	N	<50	<50	<50	<50	<50
Naphthalene	GC/MS (TD)	20	ng	U	<20	<20	<20	<20	<20
	C	C	mg/m3		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	C	C	ppm		<0.00039	<0.00039	<0.00039	<0.00039	<0.00039
Ortho-Xylene	GC/MS (TD)	20	ng	U	<20	<20	<20	<20	<20
	C	C	mg/m3		<0.0024	<0.0024	<0.0024	<0.0024	<0.0024
	C	C	ppm		<0.00054	<0.00054	<0.00054	<0.00054	<0.00054
Toluene	GC/MS (TD)	20	ng	U	27	<20	20	27	38
	C	C	mg/m3		0.0030	<0.0023	0.0023	0.0030	0.0043
	C	C	ppm		0.00081	<0.00060	0.00060	0.00081	0.0011
Total Petroleum Hydrocarbons (C10-C12 aliphatic)	GC/MS (TD)	100	ng	N	1100	160	<100	1200	1200
	C	C	mg/m3		0.12	0.018	<0.011	0.14	0.14
	C	C	ppm		0.033	0.0048	<0.0030	0.036	0.036
Total Petroleum Hydrocarbons (C10-C12 aromatic)	GC/MS (TD)	100	ng	N	<100	<100	<100	<100	<100
	C	C	mg/m3		<0.011	<0.011	<0.011	<0.011	<0.011
	C	C	ppm		<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Total Petroleum Hydrocarbons (C12-C16 aliphatic)	GC/MS (TD)	100	ng	N	500	550	210	430	580
	C	C	mg/m3		0.056	0.062	0.024	0.048	0.065
	C	C	ppm		0.015	0.016	0.0063	0.013	0.017
Total Petroleum Hydrocarbons (C12-C16 aromatic)	GC/MS (TD)	100	ng	N	<100	<100	<100	<100	<100
	C	C	mg/m3		<0.011	<0.011	<0.011	<0.011	<0.011
	C	C	ppm		<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Total Petroleum Hydrocarbons (C5 - C6 aliphatic)	GC/MS (TD)	100	ng	N	<100	<100	<100	<100	<100
	C	C	mg/m3		<0.011	<0.011	<0.011	<0.011	<0.011
	C	C	ppm		<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Total Petroleum Hydrocarbons (C5-C7 aromatic)	GC/MS (TD)	100	ng	N	<100	<100	<100	<100	<100
	C	C	mg/m3		<0.012	<0.012	<0.012	<0.012	<0.012
	C	C	ppm		<0.0038	<0.0038	<0.0038	<0.0038	<0.0038
Total Petroleum Hydrocarbons (C6-C8 aliphatic)	GC/MS (TD)	100	ng	N	<100	<100	<100	160	<100
	C	C	mg/m3		<0.011	<0.011	<0.011	0.018	<0.011
	C	C	ppm		<0.0030	<0.0030	<0.0030	0.0048	<0.0030
Total Petroleum Hydrocarbons (C7-C8 aromatic)	GC/MS (TD)	100	ng	N	<100	<100	<100	<100	<100
	C	C	mg/m3		<0.011	<0.011	<0.011	<0.011	<0.011
	C	C	ppm		<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Total Petroleum Hydrocarbons (C8-C10 aliphatic)	GC/MS (TD)	100	ng	N	290	<100	<100	310	290
	C	C	mg/m3		0.033	<0.011	<0.011	0.035	0.033
	C	C	ppm		0.0087	<0.0030	<0.0030	0.0093	0.0087
Total Petroleum Hydrocarbons (C8-C10 aromatic)	GC/MS (TD)	100	ng	N	<100	<100	<100	<100	<100
	C	C	mg/m3		<0.011	<0.011	<0.011	<0.011	<0.011
	C	C	ppm		<0.0030	<0.0030	<0.0030	<0.0030	<0.0030



***APPENDIX E  
SVE MONITORING SUMMARY SHEETS***

## SVE MONITORING REPORT

Project Name: Nelmes - Y Felinheli  
 Project Number: 07RB239  
 Project Manager: Dave Turner  
 Project Engineer: Kevin Downes  
 Date of Installation: 29/04/2008

SVE Point	DATE							
	29/04/2008		30/04/2008		08/05/2008		19/05/2008	
	PID	mb	PID	mb	PID	mb	PID	mb
1	0.3	0	0.3	0	3.9	5	1.2	5
2	65.5	7	5.4	7	54.8	5	51.4	5
3	22.8	7	2.9	7	2	5	7	5
4	128	10	1.5	10	0.8	5	3.8	5
5	61.4	7	3.2	7	5.4	5	9.4	5
6	5.4	5	21.5	5	72.4	5	74.5	5
7	24.2	5	3.7	5	0.6	5	6.5	5

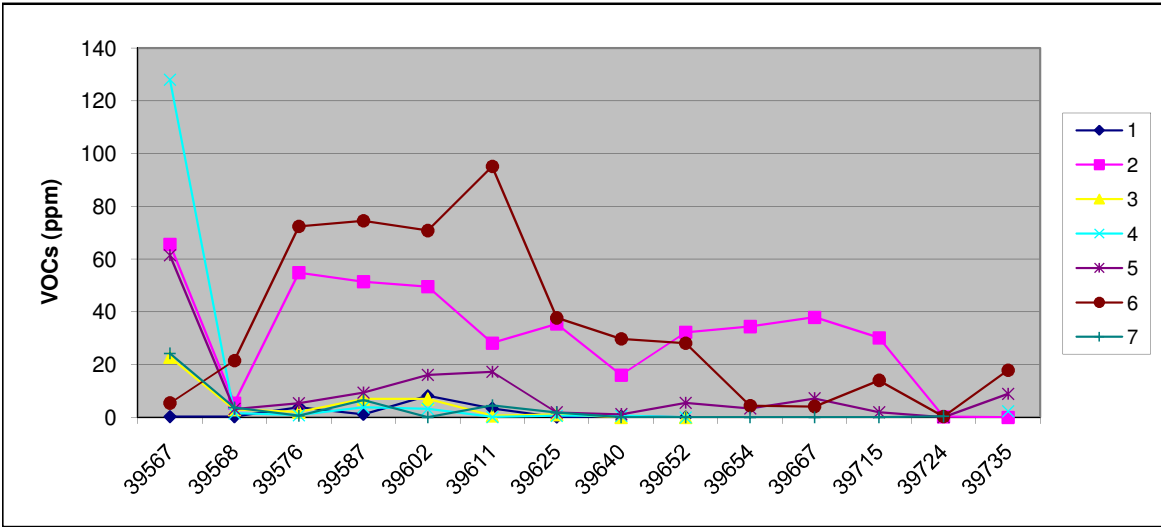
SVE Point	DATE							
	03/06/2008		12/06/2008		26/06/2008		11/07/2008	
	PID	mb	PID	mb	PID	mb	PID	mb
1	8.2	5	3.4	5	0.1	0	0.4	0
2	49.5	5	28.1	5	35.4	10	16	5
3	7	5	0.6	5	1.1	10	0	0
4	3.2	5	0.1	5	0.6	10	0.6	0
5	16.1	5	17.3	5	1.9	10	1.2	10
6	70.8	5	95.1	5	37.7	10	29.7	10
7	0	5	4.5	5	1.8	10	0	0

SVE Point	DATE							
	23/07/2008		25/07/2008		07/08/2008		24/09/2008	
	PID	mb	PID	mb	PID	mb	PID	mb
1	0.1	0						
2	32.2	10	34.4	10	37.9	10	30.1	5
3	0	0						
4	0	off						
5	5.5	5	3.4	5	7.2	5	2	5
6	28.1	10	4.4	10	4.1	5	14	5
7	0	off	0	0	0		0	off

SVE Point	DATE							
	03/10/2008		14/10/2008					
	PID	mb	PID	mb	PID	mb	PID	mb
1								
2	0.2		0					
3								
4			2.3					



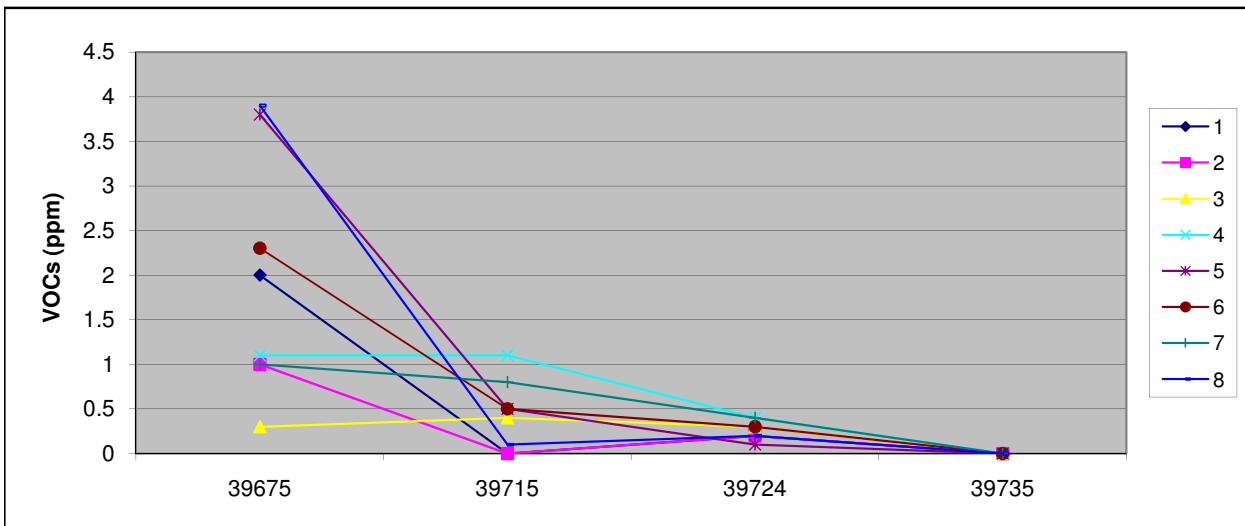
5	0.1		8.9				
6	0.3		17.8				
7	0.4						



## SVE MONITORING REPORT

Project Name:	Nelmes - Y Felinheli
Project Number:	07RB239
Project Manager:	Dave Turner
Project Engineer:	Kevin Downes
Date of Installation:	15/08/2008

SVE Point	DATE							
	15/08/2008		24/09/2008		03/10/2008		14/10/2008	
1	2	0.5	0	0.5	0.2	off	0	off
2	1	0.5	0	0.5	0.2	off	0	off
3	0.3	0.5	0.4	0.5	0.3	off	0	off
4	1.1	0.5	1.1	0.5	0.4	off	0	off
5	3.8	0.5	0.5	0.5	0.1	off	0	off
6	2.3	0.5	0.5	0.5	0.3	off	0	off
7	1	0.5	0.8	0.5	0.4	off	0	off
8	3.9	0.5	0.1	0.5	0.2	off	0	off



### SVE MONITORING REPORT

Project Name: Nelmes - Y Felinheli  
 Project Number: 07RB239  
 Project Manager: Dave Turner  
 Project Engineer: Kevin Downes  
 Date of Installation: 29/04/2008

SVE Point	DATE							
	24/09/2008		03/10/2008		14/10/2008		23/10/2008	
1	0	5	0	off	0	off	0	off
2	1.6	5	0.4	off	0	off	0	off
3	0.4	5	0.6	off	0	off	0	off
4	1.3	5	0.7	off	0	off	0	off

