St James Group Ltd

# Former Royal Mail Depot, London Road, Twickenham - Metropolitan Open Land (MOL)

## Supplementary Geoenvironmental Site Investigation

25024-R06 (00)

FEBRUARY 2015

# RSK GENERAL NOTES

**Project No.:** 25024-R06 (00)

**Title:** Supplementary Geoenvironmental Site Investigation: Former Royal Mail Depot, London Road, Twickenham – Metropolitan Open Land (MOL)

**Client:** St James Group Ltd

**Date:** 17th February 2015

**Office:** RSK Environment Limited, 18 Frogmore Road, Hemel Hempstead, Herts, HP3 9RT

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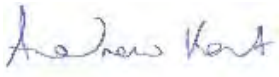
| Signature |  | Signature |  |
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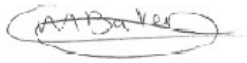
| Signature |  | Signature |  |
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# 1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by the St James Group Ltd (the 'client') to carry out a Supplementary Geoenvironmental Site Investigation of open land adjacent to the former Royal Mail Depot Redevelopment, Twickenham. The site area, as detailed in **Figure 2**, is from here-on in referred to as the Municipal Open Land or MOL.

It is understood that the MOL, which is currently heavily overgrown, is due to undergo localised clearance works to facilitate the construction of a footpath around the perimeter of the site, ahead of being transferred to the ownership of the London Borough of Richmond-upon-Thames.

This report is subject to the RSK service constraints given in **Appendix A**.

## 1.1 Objective and aims

The purpose of this report is to assess the contamination status of the site with a view to identifying any future liabilities and the associated requirement for mitigation measures.

## 1.2 Scope

The scope of the investigation and layout of this report has been designed with consideration of CLR11 (Environment Agency, 2004a) and BS 10175: 2011 (BSI, 2011) and guidance on land contamination reports issued by the Environment Agency (EA) (2010a). A summary of this legislation is presented as **Appendix B**.

The project was carried out to an agreed brief as set out in RSK's proposal (reference: 25024-02AK Quo (Rev 1), dated 31st October 2014). The scope of works for the assessment included:

- A review of RSK's previous works conducted within the footprint of the MOL;
- A supplementary investigation consisting of:
    - Ten shallow drive-in sampler boreholes;
    - installation of seven monitoring wells using continuous flight-auger boreholes (CFA);
    - Excavation of two shallow hand dug inspection pits through existing soils bunds;
    - Groundwater and surface water sampling from the River Crane;
    - Subsequent groundwater and ground gas monitoring;
    - Laboratory analysis of selected soil and groundwater samples;
- Development of a refined conceptual site model followed by generic quantitative risk assessment (GQRA) to assess complete pollutant linkages that may require the implementation of mitigation measures;

- Identification of outline mitigation measures for complete pollutant linkages or recommendations for further work; and
- Preparation of a factual and interpretative report with recommendations for further works (i.e. undertake a remedial options appraisal to identify appropriate mitigation measures/produce a remedial implementation and verification plan) and/or remediation as necessary.

## 1.3 Existing reports

RSK have previously conducted a Contamination Assessment Report for the wider Royal Mail Depot website, which included limited intrusive investigation works within eastern areas of the MOL (owing to the remainder of the MOL being heavily overgrown), as detailed in RSK Report Ref: 25024-01 (00), dated, April 2012.

Pertinent information from this report has been detailed in **Section 3**.

## 1.4 Limitations

The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows may vary from those reported due to seasonal, or other, effects.

# 2 THE SITE

## 2.1 Site location and description

The site, which is located at National Grid Reference 515701E, 173548N as shown in **Figure 1**, currently comprises an area sensibly level, heavily vegetated open space extending over an area of approximately 2.8 hectares.

At the time of conducting the investigation works reported herein, narrow strips of vegetation had been cleared along the northern and southern site boundaries in order to provide access to the desired borehole locations. The reminder of the site was heavily overgrown containing mature deciduous trees together with impenetrable shrubs and brambles extending to a height of approximately 2.0m.

Where the site was accessible, the presence of brick and concrete rubble was evident in several locations together with a 2.0m high bund measuring approximately 3.0m wide by 10.0m long in southern central areas. In two locations, discarded sleepers and track sections were noted in the undergrowth.

Railways sidings are located along the southern boundary of the site with the canalised River Crane running along the northern boundary. Land to the immediate east of the site is occupied by an active construction site whilst allotments/gardens are present to the west.

The area around the site comprises a mixture of commercial/industrial land, together with residential dwellings as detailed in **Table 1**.

**Table 1: Site setting**

| | |
|---|---|
| **To the north:** | River Crane, with residential housing and open land beyond |
| **To the east:** | Active residential construction site with the London Road and Twickenham railway station beyond |
| **To the south:** | Railway lines and sidings with occasional residential properties and unidentified commercial properties beyond |
| **To the west:** | Allotment gardens and open land |

## 2.2 Proposed development

The MOL is due to undergo localised clearance works to facilitate the construction of a footpath running around the perimeter of the site linking in to the ongoing development on the east and open land to the west of the site.

The footpath will comprise a 3.0m wide gravel path with a 1.0m wide maintained grass strip along either side of the path. Beyond this 1.0m wide buffer strip, it is proposed to leave the remainder of the MOL untouched and therefore in its current overgrown condition.

The proposed footpath layout is contained in **Figure 3**.

# 3 PREVIOUS INVESTIGATION WORKS

## 3.1 Introduction

RSK has previously undertakes a Contamination Assessment of the wider Royal Mail Depot development site (Report Ref. 25024-01, dated April 2012).

The assessment included a Preliminary Risk Assessment (PRA) of the existing residential development site and MOL footprint, together with an intrusive investigation of residential development area and eastern edge of the MOL. The remainder of the MOL could not be accessed owing to the overgrown nature of the site

Pertinent information from this report is outlined in the following sections, with details on the MOL ground conditions and associated chemical testing results incorporated into the supplementary assessment contained in **Sections 5** and **6**.

## 3.2 Ground conditions

### 3.2.1 Geology

The published geological map for the area (South London, Sheet 270) indicates the site to be underlain by the Kempton Park Gravel Formation (River Terrace Deposits) with the London Clay Formation at depth.

Given the site setting, with the River Crane running along the northern site boundary, Alluvial deposits should also be anticipated on site. Made ground deposits, attributable to historical use of the site as railway sidings, are also likely to be present.

### 3.2.2 Landfills

No landfills, either active of historical, waste treatment or disposal sites are present within a 500m radius of the site. The nearest identified landfill is located approximately 600m north of the site at Twickenham Trading Estate, and was authorised to accept inert waste between 1946 and 1963.

## 3.3 Hydrogeology and hydrology

### 3.3.1 Hydrogeology

Given the geological sequence underlying the site, the hydrogeology of the area is likely to be characterised by the presence of a shallow unconfined aquifer within the Kempton Park Gravel Formation, perched upon the underlying London Clay Formation.

### 3.3.2 Groundwater vulnerability

Reference to Environment Agency web-based information indicates that the superficial Kempton Park Gravel Formation has been designated as a Principal Aquifer whilst the underlying London Clay Formation is designated an Unproductive Strata. This reflects the predominantly cohesive nature of the geological London Clay Formation, which acts

as an aquiclude, thereby restricting the downwards migration of shallow groundwater (and mobile contaminants, if present) to deeper groundwater resources. However, the presence of low permeability clay at relatively shallow depths beneath the site, whilst restricting downwards migration, may increase the potential for lateral migration of perched groundwater and therefore mobile contamination, if present.

### 3.3.3 Groundwater source protection zones

Reference to Environment Agency web-based information indicates the site is not located within a currently designated Groundwater Source Protection Zone.

### 3.3.4 Surface watercourses

The River Crane is located to the immediate north of the site flowing along the site boundary in an easterly direction though a concrete lined channel.

Reference to historical map records has revealed that the watercourse previously meandered through the northern part of the site during the late 1800's prior to be canalised to follow its present day course. As such, groundwater in the shallow aquifer beneath the site is unlikely to be in hydraulic continuity with the river.

Notwithstanding the above, it should be noted that as part of the adjoining residential development (located hydraulically down-gradient of the site) the Environment Agency is seeking to gain ecological improvement of the watercourse via opening of the concrete channel and local naturalisation of the riverbanks. The potential for such works to result in the establishment of hydraulic continuity between groundwater beneath the site and the River Crane should be noted.

## 3.4 History of site and surrounding area

The history of the site and surrounding area has been assessed by means of a review of available Ordnance Survey maps (contained in shown in RSK's preceding Contamination Assessment Report as contained **Appendix L**), with a summary of pertinent information contained in **Table 2**.

**Table 2: Summary of historical development**

| Year | Land use/feature on site | Land use/features in the vicinity of site (of relevance to the assessment) |
|---|---|---|
| 1880 | No details given | Adjacent to the site in the east is a series of orchards. Beyond the orchards (approximately 150m from the site) is a Brewery (numerous buildings are present). |
| 1869 | No details given | Adjacent orchards in the east have now been removed and replaced with a St Mark's Nursery with a number of greenhouse. |
| 1896 | The River Crane is shown to meander in an open channel traversing north-western and central areas of the site.<br>Railway tracks and sidings are shown to be present across the site area, together with associated buildings, predominantly in the west and east, together with a spherical feature (possible turntable) located in southern areas | Running along the southern boundary of the site are railway tracks and sidings.<br>Numerous residential properties are located 50m south of the site.<br>Open land dominates the surrounding area of the site along with orchards present (60m northeast) and housing (60m south).<br>70m south of the site are allotment gardens.<br>240m southwest of the site is a small gravel pit. |
| 1920 | As above | The allotment gardens located 70m south of the site have been replaced with a school.<br>Sewage works are located approximately 200m west of the site. |
| 1934-1959 | River Crane shown to run through re-aligned channel along northern boundary. | The Brewery located in the east has been demolished and replaced with an extensive structures identified as 'Corporation Depot'.<br>The nursery (adjacent to the site in the east) is still identified, although it appears that the associated river inlet is in the process of being backfilled. This appears to be associated with the canalisation River Crane, which appears to be complete in an aerial photograph dated 1946.<br>Twickenham Station has been constructed to the east of the site, on the opposite side of London Road.<br>Adjacent to the site in the east (associated with the nursery) is an area of worked ground.<br>Garage and works area located approximately 170m southeast of the site.<br>The aerial photography dated 1948 shows that allotment gardens are located adjacent to the site in the west. |

| Year | Land use/feature on site | Land use/features in the vicinity of site (of relevance to the assessment) |
|---|---|---|
| 1967 | As above. | The ‘Corporation Depot’ is now labelled as ‘Sorting office’.<br>The nursery is no longer identified, with the majority of associated structures removed. This area is now partially incorporated into sorting office. |
| 1970s to 1990s | Former railway and sidings across the site are no longer present. | As above. |
| Notes: At the time of writing, it is noted that the depot located adjacent to the site in the east, has now been demolished associated with the ongoing construction of multi-storey flats as part of St James Group redevelopment. | | |

## 3.5 Initial conceptual model

The information summarised above has been used to compile an initial conceptual model. The identified sources of potential contamination, associated contaminants and receptors have been considered with plausible pathways that may link them. The resulting potential pollutant linkages are considered with risk classification estimated in accordance with information in **Appendix C**.

### 3.5.1 Summary of potential contaminant sources

Potential sources and contaminants of concern are summarised in **Table 3**.

**Table 3: Potential sources and types of contamination**

| Potential sources | Contaminants of concern |
|---|---|
| **On-site** | |
| In filled watercourse / made ground (includes historic channel of River Crane and inlet supplying brewery and any associated Alluvial deposits) | Unknown fill material (but potentially including heavy metals, ash, clinker, sulphates, PAHs, asbestos etc.). Possible soil gases including methane and carbon dioxide. |
| Railway lines / sidings and associated structures, e.g. turntable | Fuel oils, lubricating oils, heavy metals, PAHs, PCBs, ethylene glycol, ash, sulphate, herbicides and asbestos. |
| **Off-site** | |
| Railway land present to the south of the site | Fuel oils, lubricating oils, heavy metals, PAHs, PCBs, ethylene glycol, ash, sulphate, herbicides and asbestos. |
| Brewery and Depot (Royal Mail sorting depot) to the east of the site (1880 to 2013). | Coal and ash, fuel oils, lubricating oils, heavy metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), chlorinated and other organic solvents, sulphates, asbestos, etc. |

On-site sources of potential contamination have been identified in the form of made ground and the infilled river channel in northern areas together with historical use of the site as railway land, with associated tracks and sidings.

Off-site sources of potential contamination relate to the former brewery and Royal Mail depot to the east of the site together with the presence of railway land to the immediate south of the site.

### 3.5.2 Sensitive receptors

Sensitive receptors at this site include:

- Future site visitors;
- Adjacent site users/occupants;

- Vegetation;
- Groundwater beneath the site within the Kempton Park Gravel Formation; and
- Surface watercourses (the River Crane).

### 3.5.3 Summary of plausible pathways

The plausible pathways for the migration of contamination are summarised below:

- Direct contact (soil, dust ingestion, dermal contact, dust and fibre inhalation);
- Ground gas and soil gas inhalation;
- Root uptake; and
- Vertical and lateral migration including leaching.

### 3.5.4 Potentially complete pollutant linkages

The outline conceptual model and an estimate of the risk associated with each linkage is summarised in **Table 4** on the following page. The risk classification has been undertaken in accordance with CIRIA C552 (Rudland et al., 2001), a summary of which is included in **Appendix C**.

#### *3.5.4.1 Summary*

The potential pollutant linkages with a risk of moderate or above that may drive site investigation works are:

- Risk to future site users from any identified made ground,/Alluvium (in-filled historical channel of the River Crane) via direct contact (dermal contact, ingestion and inhalation) pathways;
- Risk to adjacent site users from any identified made ground/Alluvium (in-filled historical channel of the River Crane) via inhalation pathways; and
- Risk to groundwater (Principal aquifer) from any identified made ground/Alluvium (in-filled historical channel of the River Crane) via vertical/lateral migration.

**Table 4: Risk estimation for potentially complete pollutant linkages**

| Potential Contaminant | Potential receptor | Possible pathway | Severity | Likelihood | Risk and justification |
|---|---|---|---|---|---|
| **On-site sources** | | | | | |
| In filled watercourse / made ground (includes historic channel of River Crane and inlet supplying brewery and any associated Alluvial deposits)<br><br>Railway lines / sidings and associated structures, e.g. turntable | Future site visitors | Direct contact (dermal contact, ingestion and inhalation) | Medium | Unlikely | Low: Any potential contamination identified poses a risk to future site visitors. However, site users are likely to be transient and intermittent in nature and with visits being for a short duration |
| | Adjacent site users | Inhalation of ground gases, vapours and asbestos fibres | Medium | Unlikely | Low: Pathways for the migration of ground gases between any identified source and sensitive receptors are unlikely to exist. Where the inhalation of fibres is concerned, the presence and intended retention of significant vegetation would impede their liberation, if present. |
| | Vegetation | Root uptake | Mild | Likely | Moderate/low: Sensitive vegetation may be susceptible to contamination where present |
| | Groundwater | Vertical/lateral migration | Medium | Low likelihood | Moderate/low: The principal aquifer within the granular Kempton Park Gravel Formation is in direct contact with made ground deposits, therefore a risk to groundwater/aquifer via vertical migration maybe present depending on the extent of any contamination and associated leaching potential. |
| | Surface watercourse (The River Crane) | Lateral migration | Medium | Low likelihood | Moderate/low: Any potential contamination may pose a risk to the River Crane although the presence of a canalised channel along the site boundary would act to limit the risk. |

Notes: It is noted that, the former brewery and depot (former Royal Mail sorting office) located adjacent to the site in the east, have been removed with the site currently undergoing development with residential properties. As such, these off-site sources have not been detailed within the conceptual site model as any contamination on these sites would have been identified and addressed as part of the ongoing redevelopment works.

# 4 SUPPLEMENTARY SITE INVESTIGATION METHODOLOGY

Supplementary intrusive works were conducted across the MOL on the 28th November and the 2nd and 3rd December 2014 to confirm the potential pollutant linkages identified in the outline conceptual model.

These works supplemented an earlier investigation conducted across eastern sections of the MOL in August 2012. Relevant information from the 2012 investigation has been included in the following sections.

## 4.1 Sampling strategy and methodology

The techniques adopted for the investigation have been chosen considering the anticipated ground conditions, existing land use and the redevelopment proposals.

The intrusive works comprised the following:

- The drilling of ten drive-in sampler boreholes in 2012, designated PH1 to PH10, to a maximum depth of 2.0mbgl together with associated sampling;
- The drilling of ten additional drive-in sampler boreholes in 2014, designated WS204, WS206 to WS207, WS209 to WS210 and WS212 to WS216, to a maximum depth of 3.0mbgl with associated sampling;
- The drilling of seven continuous flight auger (CFA) boreholes in 2014, designated WS201 to WS203, WS205, WS208, WS211 and WS217 for the installation of groundwater and ground gas monitoring wells to a maximum of 5.0mbgl; and
- The excavation of two hand dug inspection pits through existing soils bunds;

The investigation and the soil descriptions were carried out in general accordance with 'BS 5930:1999. Code of Practice for Site Investigations' (BSI, 1999). The relevant exploratory hole records are presented in **Appendix D**.

The locations of the intrusive investigations are shown in **Figure 2**. The investigation points, as agreed with the London Borough of Richmond-upon-Thames, were located approximately by reference to physical features present on the site at the time of investigation. The ground levels at the borehole locations have not been determined.

## 4.2 Soil sampling, in-situ testing and laboratory analysis

Selected samples were placed in polythene bags for headspace screening with a photo-ionisation detector (PID) fitted with a 10.2eV bulb.

### 4.2.1 Soil laboratory testing

A programme of chemical testing was carried out on selected samples taken from various strata encountered within the exploratory holes.

Samples were stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination. All analysis was undertaken by UKAS and MCERTS certified laboratories. The samples were transported to the laboratory in chilled boxes.

The testing rationale is presented in **Table 5** with the laboratory results included in **Appendix F**.

**Table 5: Scheduled analysis – soils**

| Location and sample depth (m bgl) | Analyte |
|---|---|
| PH1 to PH5, PH9 and PH10 at depths ranging between 0.25m and 0.5m<br>WS201 to WS217, SH1 and SH2 at various depths ranging between ground level and 1.0m | Polycyclic Aromatic Hydrocarbons (PAH's), Total Petroleum Hydrocarbons (TPHCWG), pH, heavy metals, total sulphate |
| WS201 to WS217, SH1 and SH2 at various depths ranging between ground level and 1.0m | Asbestos Screen |
| | Soil Organic Matter |
| WS201, WS205, WS206, WS209, WS213 at depths ranging between 0.3m and 0.5m | Altrazine and Simazine herbicides |
| WS214 @ 0.6m<br>WS215 @ 0.5m | Asbestos quantification |
| WS214 @ 0.6m<br>WS205 @ 0.3m and 0.6m<br>WS217 @ 0.4m<br>WS216 @ 0.2m | Leachate Preparation and leachable metals |

### 4.2.2 Groundwater monitoring

Depths to groundwater encountered during the intrusive investigation were recorded during the progression of the exploratory holes.

In addition, standing groundwater levels were also monitored using an electronic dip meter during three subsequent visits (conducted on 15th and 22nd December 2014 and the 13th January 2015).

The groundwater monitoring data is included in **Appendix E**.

### 4.2.3 Groundwater developing, sampling and analysis

Subsequent to the installation of groundwater monitoring wells the installations were developed at least one week before sampling. Groundwater samples were obtained from boreholes WS201, WS202, WS203 and WS205.

Groundwater samples were retrieved using a United States Environment Protection Agency (USEPA) approved low-flow purging and sampling methodology. The low-flow method relies on moving groundwater through the well screen at approximately the same rate as it flows through the geological formation. This results in a significant reduction in the volume of water extracted before sampling and significantly reduces the amount of disturbance of the water in the monitoring well during purging and sampling. Drawdown levels in the monitoring well and water quality indicator parameters (pH, temperature, electrical conductivity, redox potential and dissolved oxygen) are monitored during low-flow purging and sampling, with stabilisation indicating that purging is complete and sampling can begin. As the flow rate used for purging, in most cases, is the same or only slightly higher than the flow rate used for sampling, and because purging and sampling are conducted as one continuous operation in the field, the process is referred to as low-flow purging and sampling.

The groundwater samples were collected in containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box to minimise volatilisation. Samples were transported directly to the testing laboratory under chain of custody documentation. The rationale for groundwater analysis is presented in **Table 6** with the laboratory results included in **Appendix H**.

**Table 6: Scheduled analysis – groundwater**

| Location | Analyte | Rationale |
|---|---|---|
| WS201, WS202, WS203 and WS205 | Polycyclic Aromatic Hydrocarbons (PAH's), Total Petroleum Hydrocarbons (TPHCWG), Metals, pH, alkalinity, EC, NH4, Cl, SO4, tCN and $H_2S$ | To assess the contamination status of shallow groundwater |

### 4.2.4 Surface water sampling

Two surface water samples were collected from the adjacent River Crane at locations directly upstream (to the west) and downstream (to the east) of the site.

The groundwater samples were collected in containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box to minimise volatilisation. Samples were transported directly to the testing laboratory under chain of custody documentation. The rationale for groundwater analysis is presented in **Table 7** with the laboratory results included in **Appendix G**.

**Table 7: Scheduled analysis – surface water**

| Location | Analyte | Rationale |
|---|---|---|
| Water 1 (River Crane upstream) and Water 2 (River Crane downstream) | Polycyclic Aromatic Hydrocarbons (PAH's), Total Petroleum Hydrocarbons (TPHCWG), Metals, pH, alkalinity, EC, NH4, Cl, SO4, tCN and $H_2S$, TOC, COD and BOD | To assess the contamination status of the surface water in the River Crane |

### 4.2.5 Ground gas monitoring

In line with the conceptual model three ground gas monitoring rounds have been undertaken. This included periods of low and/or falling atmospheric pressures and after/during rainfall. Monitoring was undertaken on the 15th and 22nd December 2014 and the 13th January 2015

An infrared gas meter was used to measure gas flow, concentrations of carbon dioxide ($CO_2$), methane ($CH_4$) and oxygen ($O_2$) in percentage by volume, while hydrogen sulphide ($H_2S$) and carbon monoxide (CO) were recorded in parts per million. Initial and steady state concentrations were recorded.

The atmospheric pressure before and during monitoring, together with the weather conditions, was recorded.

All monitoring results together with the temporal conditions are contained within **Appendix E** and discussed in **Section 5.2**.

# 5 GROUND CONDITIONS

The results of the intrusive investigation and subsequent laboratory analysis and monitoring undertaken are detailed below. The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, list of samples taken, field observations of soil and groundwater and details of monitoring well installations are included on the exploratory hole records presented in **Appendix D**.

## 5.1 Soil

The exploratory holes revealed that the site is underlain by a variable thickness of made ground and/or imported topsoil overlying the Kempton Park Gravel Formation and the London Clay Formation at depth. Alluvial deposits were also encountered in northern areas of the site. These findings appear to confirm the stratigraphical succession described within the initial conceptual model.

For the purpose of discussion, the ground conditions are summarised in **Table 8** and the strata discussed in subsequent subsections.

**Table 8: General succession of strata encountered**

| Strata | Exploratory holes encountered | Depth to top of stratum m bgl | Thickness (m) |
|---|---|---|---|
| Made ground | All exploratory holes | Ground level | 0.3m to 1.3m |
| Alluvium | WS202-WS206, WS208, WS217 | 0.4mbgl to 1.0mbgl | 0.8m to 1.3m |
| Kempton Park Gravels | All exploratory holes apart from WS2013 | 0.3mbgl to 1.9mbgl | 0.5m confirmed to 2.4m |
| London Clay Formation | WS201-WS203, WS205, WS208, WS211 and WS217 | 2.7mbgl to 3.6mbgl | Confirmed to 5.0mbgl |

### 5.1.1 Made ground

Made ground was encountered in all exploratory holes extending from ground level to depths ranging between 0.80m and 1.80m with the maximum depth encountered in WS201, advanced in the east of the site.

The stratum comprised a localised upper horizon of imported topsoil (encountered in WS201, WS203, WS205, WS207, WS208, WS211, WS213 and WS215 to WS217, typically overlying a dark brown clayey sand with inclusions of gravel and anthropogenic materials.

Where present, the imported topsoil typically comprised a friable blackish brown sandy clay/sandy silt with occasional to frequent rootlets. The stratum typically extended to depths in the order of 0.2m to 0.4m with a maximum depth of 1.0m recorded WS201.

The underlying made ground was predominantly granular in nature comprising of a clayey sand albeit with subordinate pockets of sandy clay. Anthropogenic materials including glass, mortar, concrete, ash, brick, clinker, chalk, slate, metal and ceramic tile were encountered throughout the stratum.

In several locations, notably WS206, WS208 and WS215, the presence of concrete slabs, typically 0.2-0.3m thick, were encountered at or just beneath the existing ground surface.

With the exception of the identified anthropogenic materials, no visual or olfactory evidence of contamination was encountered on site.

### 5.1.2 Alluvium

Alluvium was encountered beneath the made ground in WS202 to WS206, WS208 and WS217, generally located along the northern edge of the site in close proximity to the existing or former course of the River Crane.

The stratum, which generally comprised firm to stiff (locally soft) brown mottled orange silty clay with occasional inclusions of sand and flint gravel extended to depths ranging between 1.60mbgl and 1.80mbgl.

No visual or olfactory evidence of contamination was encountered within the stratum.

### 5.1.3 Kempton Park Gravels

The Kempton Park Gravel Formation was encountered within all exploratory holes except WS213, which terminated within deep made ground deposits.

The stratum was typically encountered at depths ranging between 0.30mbgl and 1.90mbgl (beneath either made ground or Alluvium) extending to depths ranging between 1.0mbgl and 3.60mbgl.

The stratum was predominantly granular in nature, and generally comprised of an orange/brown/grey sandy gravel with varied inclusions of clay and silt or gravelly sand.

Subordinate cohesive strata were encountered in PH4 to PH10, WS203, WS207, WS209 to WS212, and WS214 to WS16, inter-bedded with the granular portion of the stratum. These cohesive strata generally comprised firm to stiff (locally soft) light greyish brown mottled orange/brown sandy gravelly clay.

No visual or olfactory evidence of contamination was encountered within the stratum.

### 5.1.4 London Clay Formation

The London Clay Formation was encountered directly beneath the Kempton Park Gravels (within all boreholes that fully penetrated the overlying gravels) at depths ranging between 2.70mbgl and 3.60mbgl. The stratum extended to the full depth of the investigation at 5.0mbgl.

The London Clay Formation generally comprised a firm to stiff fissured greyish brown (locally blue/gray) silty clay.

### 5.1.5 Groundwater

Groundwater was encountered within WS201, WS202, WS203 and WS205 at depths ranging between 1.80mbgl and 2.0mbgl.

Subsequent monitoring visits encountered groundwater between 2.10mbgl and 4.90mbgl and therefore predominantly within the Kempton Park Gravel Formation. A summary of groundwater levels during subsequent monitoring visits is presented in **Table 9**.

It should be noted that groundwater levels might fluctuate for a number of reasons including seasonal. Ongoing monitoring would be required to establish both the full range of conditions and any trends in groundwater levels.

## 5.2 Ground gas regime

The results of the ground gas monitoring and testing conducted on site are present in full in **Appendix E**. The minimum and maximum results are summarised in **Table 9**.

**Table 9: Summary of ground gas monitoring results**

| Location | Number of monitoring visits | Methane (%) | Carbon dioxide (%) | Oxygen (%) | Flow rate (l/hr) | Water level (m b TOC) | Atmospheric pressure (mbar) |
|---|---|---|---|---|---|---|---|
| WS201 | 3 | <0.1 to 0.2 | 0.1 to 0.9 | 19.6 to 21.9 | -0.2 to 0 | 2.22 to 2.27 | 999 to 1019 |
| WS202 | 3 | <0.1 to 0.2 | 0.1 to 7.4 | 9.1 to 21.9 | -0.1 to 0 | 2.10 to 2.19 | 999 to 1019 |
| WS203 | 3 | <0.1 to 0.2 | 0.1 to 7.1 | 13.7 to 21.4 | -0.1 to 0 | 2.36 to 2.37 | 999 to 1019 |
| WS205 | 3 | <0.1 to 0.1 | 0.1 to 2.4 | 18.3 to 21.5 | -0.1 to 0 | 2.53 to 2.62 | 999 to 1018 |
| WS208 | 3 | <0.1 to 0.1 | 0.1 to 4.9 | 15.1 to 21.6 | -0.1 to 0 | 3.36 to 4.9 | 998 to 1018 |
| WS211 | 3 | <0.1 to 0.1 | 0.1 to 4.9 | 15.6 to 21.4 | -0.1 to 0.1 | Dry | 998 to 1018 |
| WS217 | 3 | <0.1 to 0.1 | 0.1 to 2.4 | 18.7 to 21.5 | -0.1 to 0 | Dry | 998 to 1018 |

## 5.3 Refinement of the initial conceptual site model

The ground conditions encountered during the intrusive investigation generally confirm those predicted within the initial conceptual model. Therefore, refinement of the initial conceptual site model is not considered necessary.

# 6 QUANTITATIVE RISK ASSESSMENT

In line with CLR11 (EA, 2004a), there are two stages of quantitative risk assessment, generic and detailed. The GQRA comprises the comparison of soil, groundwater, soil gas and ground gas results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results or following statistical analysis depending upon the sampling procedure that was adopted.

## 6.1 Linkages for assessment

**Section 5.3** presents the refined conceptual model which identified the linkages that required assessment after the findings of the site investigation had been considered. These linkages together with the method of assessment are presented in **Table 10**.

**Table 10: Linkages for generic quantitative risk assessment**

| Potentially relevant pollutant linkage | Assessment method |
|---|---|
| 1. Direct contact with impacted soil by future residents | The assessment has predominantly been undertaken by means of a direct comparison of the laboratory results against Generic Assessment Criteria (GAC) derived for a residential with communal soft landscaping end land use scenario as contained in **Appendix I**. Given that, the site is subject to minor redevelopment including clearing of overgrown vegetation and re-landscaping to open land. This GAC is considered the most appropriate from of assessment, albeit very conservative. In addition to the above, where exceedances of the identified GAC's have been recorded, these have been further assessed by means of comparison against C4SL's published by DEFRA. |
| 2. Inhalation exposure of future residents to asbestos fibres | Qualitative assessment based on the asbestos minerals present, their form, concentration, location and the nature of the proposed development. |
| 3. Uptake of contaminants by vegetation potentially impacting plant growth | Comparison of soil data to GAC in **Appendix J**. |
| 4. Leaching of soil contaminants and dissolved phase migration to Principal aquifer and the River Crane | Comparison of leachate data to lowest of those recorded in Table 1 of Appendix K for a Principal Aquifer owing to linkages identified relating to both a Principal Aquifer and a river (upon which the GAC for Principal aquifer are based). |
| 5. Migration of contaminants to wider secondary aquifer body | Comparison of groundwater data to GAC in Table 1 of **Appendix K** for a Principal Aquifer. |

## 6.2 Methodology and results

The findings of the exploratory site investigation have been assessed in relation to the future proposed development.

During the combined investigation works, chemical analysis have been performed on a total of twenty-eight soil samples comprising samples of the imported topsoil and underlying made ground. Twenty-six of the samples were retrieved from the shallow boreholes advanced across the site with two samples analysed from hand-dug inspection pits advanced though a linear soil bund located in the east of the site.

All soil samples scheduled for laboratory testing were also inspected visually on receipt at the laboratory for the presence of materials potential containing asbestos, e.g. fragments of asbestos-cement products.

The full chemical testing results are presented within **Appendices F** to **H**. The results have been assessed with respect to human health, vegetation and controlled waters in the following sections. The methodology and results of the GQRA are presented for each relevant pollutant linkage in turn.

### 6.2.1 Direct contact with impacted soil by future residents

Since both targeted (soil samples retrieved from the linear soil bund in the east of the site) and non-targeted soil samples were obtained during the site investigation, the results of these have been evaluated in the following subsections.

#### *6.2.1.1 Assessment of non-targeted samples*

Non-targeted samples were retrieved across the majority of the site with the notable exception of the two samples analysed from the linear soil bund in the east of the site.

The laboratory testing results for these samples have been initially compared directly against the Generic Assessment Criteria (GAC) for residential development with communal soft landscaping presented in **Appendix I**. The comparison of testing against the adopted GAC's are summarised within **Table 11** based upon an average Soil Organic Matter (SOM) of 6%. Only those determinants where exceedances have been reported are included within the table.

**Table 11: Chemical testing data summary table for human health (non-targeted samples)**

| Determinant | No. of samples tested | GAC (mg/kg) | No of exceedances | Maximum concentration (mg/kg) | |
|---|---|---|---|---|---|
| | | | | Value | Location / depth |
| **General made ground** | | | | | |
| Lead | 24 | 300 | 11 | 2040 | WS205 @ 0.2m |
| Benzo(a)pyrene | 24 | 1.0 | 9 | 5.76 | WS203 @ 0.3m |
| Benzo(a)anthracene | 24 | 6.1 | 1 | 7.46 | WS212 @ 0.5m |

| Determinant | No. of samples tested | GAC (mg/kg) | No of exceedances | Maximum concentration (mg/kg) | |
|---|---|---|---|---|---|
| | | | | Value | Location / depth |
| **Imported topsoil overlying general made ground** | | | | | |
| Lead | 2 | 300 | 1 | 3400 | WS216 @ 0.2m |
| Benzo(a)pyrene | 2 | 1.0 | 1 | 1.29 | WS216 @ 0.2m |

On the basis of the above assessment, it can be seen that samples of both the general made ground and imported topsoil have recorded elevated concentrations of Lead, Benzo(a)pyrene and Benzo(a)anthracene with respect to the identified GAC's.

Where justified by the conceptual model, Category 4 Screening Level (C4SL) values for public open spaces have been used as a second level of assessment of the identified compounds. The C4SLs were issued by DEFRA in March 2014, and are intended for use as a technical tool for defining which land is suitable for use, definitely not contaminated land, and therefore requiring no further assessment with respect to Part 2a.

C4SLs provide a more pragmatic approach than SGVs / GACs, and yet are still strongly precautionary. C4SLs have been developed using the CLEA model, which is the same framework used for the development of the SGVs / GACs; however, C4SL's have been derived using a newly termed 'Low Level of Toxicological Concern (LLTC)' which represents an intake of low concern that remains suitably protective of health, instead of the minimal risk Health Criteria Values (HCV) which have been used in the development of the SGV / GACs. The C4SLs also take into account a number of updated exposure parameters which have been selected following several stakeholder engagement workshops.

Where the recorded concentrations of Lead are concerned, the maximum-recorded concentrations in both the general made ground and imported topsoil still exceed the relevant C4SL of 1,300mg/kg (for a public open space scenario). Comparison of the Benzo(a)pyrene concentrations indicate that the maximum values identified in both the general made ground and imported topsoil are below corresponding C4SL of 21.0mg/kg (for a public open space scenario). C4SL's are not in placed for Benzo(a)anthracene.

To assess the testing results further, statistical analysis of the results has been conducted in accordance with *Guidance on Comparing Soil Contamination Data with a Critical Concentration* (CIEH and CL:AIRE, 2008).

Statistical analysis is utilised to establish whether the land is suitable for the proposed use under the land use planning system by attempting to answer a key question. For a site being developed the key question is: '*can we confidently say that the level of contamination on this land is low relative to some appropriate measure of risk?*' More specifically, this is expressed as '*Is there sufficient evidence that the true mean concentration of the contaminant (μ) is less than the critical concentration ($C_c$)?*', where the critical concentration could be the GAC or a site-specific assessment criterion

(SSAC). The true mean ($\mu$) is unknown and therefore a conservative estimate, termed the upper confidence limit (UCL), of this value is derived from the data. The UCL is then compared against the GAC.

In statistical terms the question above is handled through the use of a formal hypothesis – the null hypothesis and the alternate hypothesis. The statistical tests are structured to show (with a defined level of confidence, in this case 95%) which of the two hypothesies is most likely to be true, by determining whether the null hypothesis can be rejected.

For consideration under the planning regime, the null ($H_0$) and alternative ($H_1$) hypotheses are presented in **Table 12**.

**Table 12: Null and alternative hypotheses**

| Hypothesis | Equation | Description |
|---|---|---|
| Null ($H_0$) | $\mu \geq C_c$ | The true mean concentration is equal to, or greater than, the critical concentration |
| Alternative ($H_1$) | $\mu < C_c$ | The true mean concentration is less than the critical concentration |

Therefore, if the null hypothesis is accepted for a certain contaminant it can be concluded that its concentration is high relative to the critical concentration, which in the case of this assessment is taken to be the GAC/SSAC and as such the whole site may be classed as being contaminated by a particular substance.

In addition, the statistical guidance provides an outlier test (Grubbs' test) that has been used within this assessment for the identification of 'outliers' or 'hotspots'. The 'outlier' test is conducted before undertaking statistical analysis (and 'outliers' may be removed from the dataset) but **only** where the conceptual model supports this.

The statistical tests applied to the dataset are selected based on whether the data is normally or non-normally distributed. The distribution of the dataset has been assessed using the Shapiro-Wilks normality test. Where the dataset has been found to be normally distributed the one sample t-test is undertaken. Where data has been found to be non-normally distributed Chebyshev's theorem is utilised.

The datasets being considered for assessment are detailed in **Table 13**.

**Table 13: Datasets considered for statistical assessment**

| Dataset | Dataset Size | Rationale |
|---|---|---|
| Dataset 1 – General made ground deposits | 24 | Non-targeted samples |
| Dataset 2 – Imported topsoil deposits overlying the general made ground | 2 | |
| It is noted that targeted samples have not been included within the datasets. | | |

Based upon the above, an insufficient number of samples have been analysed from dataset 2 (imported topsoil) to conduct statistical analysis. As such, the direct comparison contained in **Table 11** will be utilised for assessment purposes together with the follow-on comments relating to C4SL thresholds.

For dataset 1 (general made ground deposits) outliers have been indentified using Grubb's outlier test. A summary of the identified outliers and their subsequent assessment is provided in **Table 14**.

**Table 14: Summary of outliers**

| Outliers | Assessment of outlier (determinant) | Removed from dataset? | Rationale |
|---|---|---|---|
| WS212 @ 0.5m | Benzo(a)anthracene | No | Material not dissimilar to other made ground; result considered to reflect heterogeneous nature of made ground |

The normality of the statistical distribution of the datasets has been tested and appropriate statistical tests carried out. The results of the assessment is summarised in **Table 15** on the following page.

**Table 15: Summary of statistical assessment – dataset 1 (general made ground)**

| Determinant | No of samples in dataset | Percentage non-detect | Normality | Test used | Mean mg/kg | Cc* mg/kg | UCL mg/kg | Reject H0? (% confidence level) |
|---|---|---|---|---|---|---|---|---|
| Lead | 24 | 0 | Normal | One sample t-test | 488 | 1300 | 1001 | **Yes** (98% confidence level) Upper confidence level is lower that the critical concentration |
| Benzo(a)pyrene | 24 | 0 | Not normal | Chebyshev's theorem | 1.41 | 21.00 | 3.04 | **Yes** (100% confidence level) Upper confidence level is lower that the critical concentration |
| Benzo(a)anthracene | 24 | 0 | Not normal | Chebyshev's theorem | 1.45 | 6.20 | 3.23 | **Yes** (99% confidence level) Upper confidence level is lower that the critical concentration |

Note: * Cc = critical concentration

The results of the statistical assessment have revealed that the recorded concentrations of Lead, Benzo(a)pyrene and Benzo(a)anthracene have all returned upper confidence limits that pass the corresponding assessment criterion (C4SL's for Lead and Benzo(a)pyrene and GAC's for Benzo(a)anthracene). In each instance, the statistical assessment has returned a confidence limit in excess of 95%.

On this basis the unacceptable risk to end users of the site are not anticipated to exist with respect to the concentrations of chemical determinants recorded within the general made ground.

Where samples of the imported topsoil are concerned, an elevated concentration of Lead has been recorded in WS216 at a depth of 0.2m. On this basis, either further risk assessment of remediation will be required to break the identified pollutant linkages.

#### *6.2.1.2 Assessment of Targeted samples (soil bunds)*

Two targeted soil samples (SH1 and SH2) were analysed from the existing soil bund in the east of the site.

The laboratory testing results for these samples have initially been compared directly against the Generic Assessment Criteria (GAC) for residential development with communal soft landscaping presented in **Appendix I**.

Against these criteria, a marginally elevated concentration of Benzo(a)pyrene has been recorded in sample SH1 returning a concentrations of 1.84mg/kg with respect to an assessment criterion of 1.0mg/kg. Comparison of this concentrations against the corresponding Benzo(a)pyrene C4SL of 21.0mg/kg reveals that concentration of Benzo(a)pyrene recorded in samples SH1 does not give cause for concern.

### 6.2.2 Inhalation exposure of future residents to asbestos fibres

The laboratory screening for asbestos identified detectable asbestos containing materials and/or fibres within two samples of made ground analysed from WS214 at a depth of 0.6mbgl and in WS215 at a depth of 0.5mbgl.

These samples were then further analysed with the sample from WS214 returning the presence of Chrysotile board at a concentration of 0.169% weight/weight whilst the sample from WS216 confirmed the presence of Chrysotile loose fibres at a concentration of <0.001% weight/weight.

On this basis, either further risk assessment of remediation will be required to break the identified pollutant linkages.

### 6.2.3 Uptake of contaminants by vegetation potentially inhibiting plant growth

Samples of the near surface soils, have been used to undertake an assessment for the phytotoxic metals; Zinc, Copper, Nickel, Lead, Cadmium and Mercury.

The direct comparison of testing results against the adopted GAC (presented in **Appendix J**) is summarised in **Table** 16. Only those determinants where exceedances have been reported are included within the table.

**Table 16: chemical testing data summary table for phytotoxic effects**

| Determinant | No. of samples tested | GAC (mg/kg) | No of exceedances | Maximum concentration (mg/kg) | |
|---|---|---|---|---|---|
| | | | | Value | Location / depth |
| Lead | 28 | 300 | 12 | 3400 | WS216 @ 0.2m |
| Mercury | 28 | 1 | 8 | 2.38 | WS212 @ 0.5m |
| Zinc | 28 | 300 | 4 | 1900 | WS214 @ 0.6m |

The results indicate that a relevant pollutant linkage may exist associated with plant phytotoxic effects.

However, given the development proposals, with minimal surface disruption outside of the footpath footprint, and the relatively healthy nature of the existing vegetation, the risks associated with plant phytotoxicity are unlikely to be realised unless additional planting of sensitive vegetation (i.e. grass or shrubs) is proposed.

### 6.2.4 Leaching of contaminants to groundwater in principal aquifer and subsequent migration to surface watercourse

Leachability tests have been conducted on the five samples of made ground returning the highest concentrations of heavy metals. The results, as contained in Appendix F, have been compared against the adopted GAC (presented in **Appendix K**) and summarised in **Table 17**. Only those determinants where exceedances have been reported are included within the table.

**Table 17: summary of soil leachate results with respect to controlled waters**

| Determinant | No. of samples tested | Freshwater GAC (µ/l)* | No of exceedances | Maximum concentration (µ/l) | |
|---|---|---|---|---|---|
| | | | | Value | Location / depth |
| Lead | 5 | 7.2 | 5 | 347 | WS205 @ 0.3m |
| Copper | 5 | 28 | 1 | 31 | WS205 @ 0.3m |
| Zinc | 5 | 125 | 2 | 422 | WS214 @ 0.6m |
| * Threshold values are based on hardness ranges, 100-<200mg/l $CaCO_3$ for Cadmium and >250 mg/l $CaCO_3$ for Copper and Zinc. | | | | | |

Based on the assessment above, **Table 17** indicates exceedances of the GAC for Lead, Copper and Zinc implying that complete pollutant linkage associated with the leaching of contaminants may exist.

However, given the aggressive nature of the leachability testing and depth of the unsaturated zone, the recorded concentrations of these compounds are not considered to pose an unacceptable risk to controlled waters.

### 6.2.5 Migration of dissolved phase contaminants to adjacent surface watercourse

Analytical testing results for surface water samples retrieved from the River Crane are contained in **Appendix G**. The analytical results have been compared directly against the adopted GAC (presented in **Appendix G**) and summarised in **Table 18**. Only those determinants where exceedances have been reported are included within the table.

**Table 18: summary of surface water results with respect to controlled waters**

| Determinant | No. of samples tested | Freshwater GAC | No of exceedances | Maximum concentration | |
|---|---|---|---|---|---|
| | | | | Value | Location / depth |
| Ammonical Nitrogen | 2 | 0.3mg/l | 2 | 0.55mg/l<br>1.44mg/l | Water 1<br>Water 2 |
| Benzo(a)anthracene | 2 | 0.018µg/l | 1 | 0.08 µg/l | Water 1 |
| Benzo(a)pyrene | 2 | 0.05µg/l | 1 | 0.08µg/l | Water 1 |
| Benzo(b)fluoranthene | 2 | 0.03µg/l | 1 | 0.10µg/l | Water 1 |
| Benzo(ghi)perylene | 2 | 0.002µg/l | 1 | 0.06µg/l | Water 1 |
| Benzo(k)fluoranthene | 2 | 0.03µg/l | 1 | 0.03µg/l | Water 1 |
| Chrysene | 2 | 0.01µg/l | 2 | 0.11µg/l<br>0.02µg/l | Water 1<br>Water 2 |
| Dibenzo(ah)anthracene | 2 | 0.01µg/l | 1 | 0.01µg/l | Water 1 |
| Fluoranthene | 2 | 0.1µg/l | 1 | 0.14µg/l | Water 1 |
| Indeno(123-cd)pyrene | 2 | 0.002µg/l | 1 | 0.05µg/l | Water 1 |

As can be seen from **Table 18**, a number of marginally elevated concentrations of several inorganic compounds have been recorded within the sample referenced as 'Water 1' (sampled upstream of the site) together with an elevated concentration of Ammonical Nitrogen.

Within the down-gradient sample (Water 2) marginal exceedances were only recorded for two compounds, namely Chrysene and Ammonical Nitrogen.

Given the absence of the compounds identified up-stream of the site, and the decrease in the concentration of Chrysene recorded in the down-gradient sample, the site is not considered to have a detrimental impact upon surface water quality within the adjacent River Crane.

### 6.2.6 Migration of dissolved phase contaminants to wider secondary aquifer body

Analytical testing results for groundwater samples retrieved from WS201, WS202, WS203 and WS205 are contained in **Appendix H**. The analytical results have been compared directly against the adopted GAC (presented in **Appendix K**).

The testing results have revealed that one groundwater sample from WS201 returned a marginally elevated concentration of Mercury, recording a concentration of 0.12µg/l with

respect to the assessment criterion of 0.05µg/l. No other determinants were identified in excess of the relevant GAC.

Whilst a marginally elevated concentration of Mercury was recorded in WS201, shallow soil testing in this area, including leachability testing, has not identified a source of mercury within the unsaturated zone. When combined with the absence of elevated concentrations of Mercury in the surrounding groundwater samples and adjacent surface water samples, the recorded concentration of Mercury is not considered to give cause for concern. As such, pollutant linkages relating to contaminants in the dissolved phase are considered incomplete.

### 6.2.7 Ground gas

The development proposals do not include for the placement of any structures or deep excavations or similar with the potential create of a feasible scenario under which sensitive receptors would be exposed to ground gases.

As such, an assessment of the ground gas concentrations summarised in **Table 9** has not been completed.

# 7 CONCLUSIONS AND RECOMMENDATIONS

## 7.1 Conclusions

The results of the GQRA indicate that pollutant linkages relating to end users of the site are likely to be present in localised areas relating to the presence of elevated concentrations of Lead, most notably in the vicinity of WS216, associated with topsoil deposits at a depth of 0.2mbgl.

Whilst the assessment of general made ground deposits initially encountered the presence of elevated concentrations of Lead, Benzo(a)pyrene and Benzo(a)anthracene, further assessment by means of statistical assessment and comparison of the results against C4SL's (for public open spaces) have revealed that unacceptable risk to end users of the site are not anticipated to exist. The same is true for samples of the existing soil bunds where testing initially recorded a marginally elevated concentration of Benzo(a)pyrene, albeit below the corresponding C4SL for public open spaces.

The laboratory screening for asbestos identified detectable asbestos containing materials and/or fibres within two samples of made ground analysed from WS214 at a depth of 0.6mbgl and in WS215 at a depth of 0.5mbgl. Both samples have been confirmed to contain Chrysotile fibres or board materials at concentrations ranging between <0.001% and 0.169% weight/weight. On this basis, either further risk assessment of remediation will be required to break the identified pollutant linkages.

The assessment of potential phytotoxicity effects has identified the presence of elevated concentrations of Lead, Mercury and Zinc. However, given the development proposals, with minimal surface disruption outside of the footpath footprint, and the relatively healthy nature of the existing vegetation, the risks associated with plant phytotoxicity are unlikely to be realised unless additional planting of sensitive vegetation (i.e. grass or shrubs) is proposed.

An assessment of the potential for leachable contaminants to migrate into the underlying aquifer has revealed the presence of leachable concentrations of Lead, Copper and Zinc implying that complete pollutant linkage associated with the leaching of contaminants may exist. However, given the aggressive nature of the leachability testing and depth of the unsaturated zone, the recorded concentrations of these compounds are not considered to pose an unacceptable risk to controlled waters. In addition, the absence of these compounds within the underlying groundwater would support his assessment suggesting that contaminants are not leaching from the unsaturated zone into the underlying groundwater body.

Assessment of surface water quality within the neighbouring River Crane has revealed a number of marginally elevated concentrations of several inorganic compounds, together with Ammonical Nitrogen, in a sample analysed from an upstream stretch of the River.

Within the down-gradient sample, marginal exceedances were only recorded for two compounds, namely Chrysene and Ammonical Nitrogen. With the recorded concentration of Chrysene having reduced markedly from that recorded upstream of the

site. As such, the site is not considered to have a detrimental impact upon surface water quality within the adjacent River Crane.

Analytical testing of groundwater samples has identified a marginally elevated concentration of Mercury in WS201. No other determinants were identified in excess of the relevant GAC. Given the absence of elevated concentrations of Mercury within the near surface soils (and associated leachability testing) together with groundwater samples and adjacent surface water samples, the recorded concentration of Mercury is not considered to give cause for concern. As such, pollutant linkages relating to contaminants in the dissolved phase are considered incomplete.

The development proposals do not include for the placement of any structures or deep excavations or similar with the potential create of a feasible scenario under which sensitive receptors would be exposed to ground gases.

## 7.2 Recommendations

Potentially complete pollutant linkages have been identified with respect to end users of the site. These are attributable to an elevated concentration of Lead in WS216 and the presence of Asbestos containing materials in WS214 and WS215. Remedial measures will be necessary in these areas of the site in order to break the pollutant linkages.

Essentially this will need to comprise the targeted excavation of impacted soils within these three areas for disposal off-site at an appropriately licensed facility. Given the nature of the contamination source, with asbestos fibres and board noted in WS214 and WS215, appropriate mitigation measures will need to be put in place to protect workers and neighbouring resident during the implementation of the works.

Potentially complete pollutant linkages have been identified with respect to plant phytotoxicity effects. Whilst existing vegetation does not appear so show significant signs of distress, appropriate measures will need to be put in place where new areas of soft landscaping/planting are proposed (such as along the flanks of the proposed footpath).

It is possible that ground works could encounter different conditions from those revealed by the site investigation, including the presence of additional asbestos containing materials. It is therefore recommended that the ground works be monitored for previously undetected suspect materials and if found appropriate additional testing and advice is sought.

It is recommended that the Local Authority be contacted at an early stage to seek their views on the remediation of contamination on the site. As part of this process a detailed Remediation Method Statement may need to be prepared and submitted to the Local Authority and Environment Agency for their approval.

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# FIGURES


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Client: ST JAMES GROUP

Project Title: FORMER ROYAL MAIL DEPOT TWICKENHAM

Drawing Title: SITE LOCATION MAP

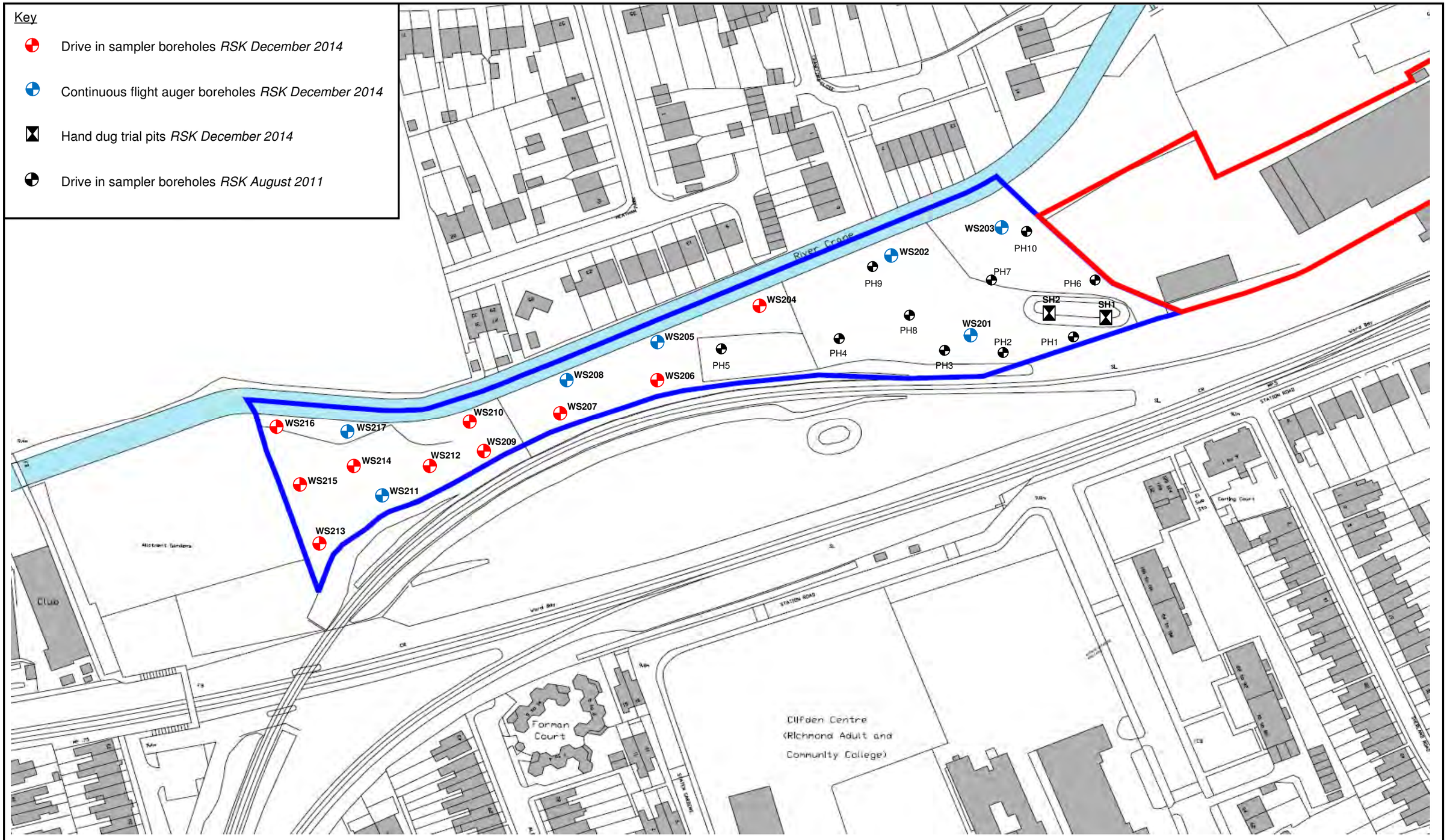
| Rev | Drawn | Date | Checked | Date | Approved | Date |
|---|---|---|---|---|---|---|
| P1 | RS | 12.09.11 | CJL | 12.09.11 | CJL | 12.09.11 |

| Dimensions | Scale | Original Size |
|---|---|---|
| m | 1:50,000 | A4 |

| Project Number | Drawing File | Drawing Number |
|---|---|---|
| 25024-1 (00) | 25024 - Fig 1 SLP.dwg | FIGURE 1 |

Key

- Drive in sampler boreholes *RSK December 2014*
- Continuous flight auger boreholes *RSK December 2014*
- Hand dug trial pits *RSK December 2014*
- Drive in sampler boreholes *RSK August 2011*




| | | | | | |
|---|---|---|---|---|---|
| RSK | **Exploratory Hole Location Plan** | Client: | St James | Figure No: | 2 |
| | | Site: | Twickenham Sorting Office - MOL | Job No: | 25024-06 |
| | | Scale: | - | Source: | - |


| | | | | | |
|---|---|---|---|---|---|
| RSK | **Proposed Development Plan** | Client: | St James | Figure No: | 3 |
| | | Site: | Twickenham Sorting Office - MOL | Job No: | 25024-06 |
| | | Scale: | - | Source: | - |

# APPENDIX A
# SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for the St James Group Ltd (the "client") in accordance with the terms of a contract between RSK and the "client", dated the 31st October 2014. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

**3.** Unless otherwise agreed in writing the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (boreholes, trial pits etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

# APPENDIX B
# SUMMARY OF LEGISLATION AND POLICY RELATING TO CONTAMINATED LAND

Part IIA of the Environmental Protection Act 1990 (EPA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, formed the basis for the current regulatory framework and the statutory regime for the identification and remediation of contaminated land. Part IIA of the EPA 1990 defines contaminated land as 'any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused'. Controlled waters are considered to include all groundwater, inland waters and estuaries.

In August 2006, the Contaminated Land (England) Regulations 2006 (SI 2006/1380) were implemented, which extended the statutory regime to include Part IIA of the EPA as originally introduced on 1 April 2000, together with changes intended chiefly to address land that is contaminated by virtue of radioactivity. These have been replaced subsequently by the Contaminated Land (England) (Amendment) Regulations 2012, which now exclude land that is contaminated by virtue of radioactivity.

The intention of Part IIA of the EPA is to deal with contaminated land issues that are considered to cause significant harm on land that is not undergoing development (see Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012). This document replaces Annex III of Defra Circular 01/2006, published in September 2006 (the remainder of this document is now obsolete).

## Water Framework Directive (WFD)

The Water Framework Directive 2000/60/EC is designed to:

- enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands that depend on the aquatic ecosystems
- promote the sustainable use of water
- reduce pollution of water, especially by 'priority' and 'priority hazardous' substances
- ensure progressive reduction of groundwater pollution.

The WFD requires a management plan for each river basin be developed every six years.

## Groundwater Directive (GWD)

The 1980 Groundwater Directive 80/68/EEC and the 2006 Groundwater Daughter Directive 2006/118/EC of the WFD are the main European legislation in place to protect groundwater. The 1980 Directive is due to be repealed in December 2013. The European legislation has been transposed into national legislation by regulations and directions to the Environment Agency.

## Environmental Permitting Regulations (EPR)

The Environmental Permitting (England and Wales) Regulations 2010 provide a single regulatory framework that streamlines and integrates waste management licensing, pollution prevention and control, water discharge consenting, groundwater authorisations, and radioactive substances regulation. Schedule 22, paragraph 6 of EPR 2010 states: 'the regulator must, in exercising its relevant functions, take all necessary measures - (a) to prevent the input of any hazardous substance to groundwater; and (b) to limit the input of non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution of groundwater.'

## Water Resources Act (WRA)

The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 updated the Water Resources Act 1991, which introduced the offence of causing or knowingly permitting pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so.

## Priority Substances Directive (PSD)

The Priority Substances Directive 2008/105/EC is a 'Daughter' Directive of the WFD, which sets out a priority list of substances posing a threat to or via the aquatic environment. The PSD establishes environmental quality standards for priority substances, which have been set at concentrations that are safe for the aquatic environment and for human health. In addition, there is a further aim of reducing (or eliminating) pollution of surface water (rivers, lakes, estuaries and coastal waters) by pollutants on the list. The WFD requires that countries establish a list of dangerous substances that are being discharged and EQS for them. In England and Wales, this list is provided in the River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. In order to achieve the objectives of the WFD, classification schemes are used to describe where the water environment is of good quality and where it may require improvement.

## Planning Policy

Contaminated land is often dealt with through planning because of land redevelopment. This approach was documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use. PPS23 was withdrawn early in 2012 and has been replaced by much reduced guidance within the National Planning Policy Framework (NPPF).

The new framework has only limited guidance on contaminated land, as follows:

- *"planning policies and decisions should also ensure that:*
    - *the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;*

- *after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
- *adequate site investigation information, prepared by a competent person, is presented".*

# APPENDIX C
# RISK ASSESSMENT METHODOLOGY

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. Under CLR11, three stages of risk assessment exist: preliminary, generic quantitative and detailed quantitative. An outline conceptual model should be formed at the preliminary risk assessment stage that collates all the existing information pertaining to a site in text, tabular or diagrammatic form. The outline conceptual model identifies potentially complete (termed possible) pollutant linkages (contaminant–pathway–receptor) and is used as the basis for the design of the site investigation. The outline conceptual model is updated as further information becomes available, for example as a result of the site investigation.

Production of a conceptual model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, both the likelihood and the consequences of an event must be taken into account when assessing risk. RSK has adopted guidance provided in CIRIA C552 for use in the production of conceptual models.

The likelihood of an event can be classified on a four-point system using the following terms and definitions based on CIRIA C552:

- 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 can be classified using a similar system also based on CIRIA C552. The terms and definitions relating to severity are:

- severe: 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 ‘Draft Circular on Contaminated Land’, DETR 2000)
- medium: chronic damage to human health (‘significant harm’ as defined in ‘Draft Circular on Contaminated Land’, DETR 2000), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem
- mild: pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services (‘significant harm’ as defined in ‘Draft Circular on Contaminated Land’, DETR 2000). Damage to sensitive buildings, structures or the environment

- minor: harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

Once the probability of an event occurring and its consequences have been classified, a risk category can be assigned according to the table below.

| | | Consequences | | | |
|---|---|---|---|---|---|
| | | **Severe** | **Medium** | **Mild** | **Minor** |
| **Probability** | **Highly likely** | Very high | High | Moderate | Moderate/low |
| | **Likely** | High | Moderate | Moderate/low | Low |
| | **Low likelihood** | Moderate | Moderate/low | Low | Very low |
| | **Unlikely** | Moderate/low | Low | Very low | Very low |

Definitions of these risk categories are as follows together with an assessment of the further work that may be required:

- Very high: there is a high probability that severe harm could occur or there is evidence that severe harm is currently happening. This risk, if realised, could result in substantial liability; urgent investigation and remediation are likely to be required.
- High: harm is likely to occur. Realisation of the risk is likely to present a substantial liability. Urgent investigation is required. Remedial works may be necessary in the short term and are likely over the long term.
- Moderate: it is possible that harm could arise, but it is unlikely that the harm would be severe and it is more likely that the harm would be relatively mild. Investigation is normally required to clarify the risk and determine the liability. Some remedial works may be required in the longer term.
- Low: it is possible that harm could occur, but it is likely that if realised this harm would at worst normally be mild.
- Very low: there is a low possibility that harm could occur and if realised the harm is unlikely to be severe.

# APPENDIX D
# EXPLORATORY HOLE RECORDS

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Former Royal Mail Depot, Twickenham** | **St James Group** | **PH1** |

| Contract Ref: | Start: **23.08.11** | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **23.08.11** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | MADE GROUND: TOPSOIL comprising very dark brown slightly organic slightly clayey sand with ash, clinker, occasional fine to medium sub-rounded gravel, roots and rootlets. | (0.30) 0.30 | |
| | | | | | | | POSSIBLE MADE GROUND: Brown slightly clayey gravelly sand and flint fragments. Gravel is fine to coarse angular to sub-rounded with roots and rootlets. | (0.30) 0.60 | |
| | | | | | | | Light brown mottled orange brown sandy clayey GRAVEL with flint cobbles and fragments, roots and rootlets.<br>(KEMPTON PARK GRAVEL) | (0.40) 1.00 | |
| | | | | | | | Window sample hole terminated at 1.0 m depth. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **MB** | **CLarkin** | AGS |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Former Royal Mail Depot, Twickenham** | **St James Group** | **PH2** |

| Contract Ref: | Start: **23.08.11** | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **23.08.11** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | MADE GROUND: TOPSOIL comprising very dark brown slightly organic slightly clayey sand with ash, clinker, occasional fine to medium sub-rounded gravel, roots and rootlets. | 0.20 | |
| | | | | | | | POSSIBLE MADE GROUND: Brown slightly clayey gravelly sand and flint fragments. Gravel is fine to coarse angular to subrounded with roots and rootlets. | (0.40)<br>0.60 | |
| | | | | | | | Light brown mottled orange brown sandy clayey GRAVEL with flint cobbles and fragments, roots and rootlets.<br>(KEMPTON PARK GRAVEL) | (0.40)<br>1.00 | |
| | | | | | | | Window sample hole terminated at 1.0 m depth. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **MB** | **CLarkin** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Former Royal Mail Depot, Twickenham** | **St James Group** | **PH3** |

| Contract Ref: | Start: **23.08.11** | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **23.08.11** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | MADE GROUND: TOPSOIL comprising dark brown slightly organic clayey sand with ash, clinker and fine to coarse sub-angular to sub-rounded gravel. | (0.45)<br>0.45 | |
| | | | | | | | Brown to light brown slightly clayey SAND with occasional fine to medium sub-angular to sub-rounded gravel.<br>(KEMPTON PARK GRAVEL) | (0.55)<br>1.00 | |
| | | | | | | | Light brown very sandy clayey GRAVEL, gravel is fine to coarse sub-angular to sub-rounded fragments of flint, roots and rootlets.<br>(KEMPTON PARK GRAVEL) | (0.55)<br>1.55 | |
| | | | | | | | Window sample hole terminated at 1.55 m depth. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **MB** | **CLarkin** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Former Royal Mail Depot, Twickenham** | **St James Group** | **PH4** |

| Contract Ref: | Start: **23.08.11** | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **23.08.11** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | MADE GROUND: TOPSOIL comprising dark brown slightly organic clayey sand with ash, clinker and fine to coarse sub-angular to sub-rounded gravel. | (0.50)<br>0.50 | |
| | | | | | | | Brown to light brown slightly clayey dense SAND with flint fragments and fine to coarse angular to sub-rounded gravel with roots and rootlets. (KEMPTON PARK GRAVEL) | (0.50)<br>1.00 | |
| | | | | | | | Light brown very sandy CLAY with frequent fine to coarse gravel and fragments of flint, roots and rootlets. (KEMPTON PARK GRAVEL) | (0.40)<br>1.40 | |
| | | | | | | | Light brownish grey clayey SAND AND GRAVEL. (KEMPTON PARK GRAVEL) | (0.40)<br>1.80 | |
| | | | | | | | Window sample hole terminated at 1.8 m depth. | | |

| Drilling Progress and Water Observations | | | | | |
|---|---|---|---|---|---|
| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **MB** | **CLarkin** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Former Royal Mail Depot, Twickenham** | **St James Group** | **PH5** |

| Contract Ref: | Start: **23.08.11** | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **23.08.11** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | MADE GROUND: TOPSOIL comprising very dark brown slightly organic clayey sand. | (0.50)<br>0.50 | |
| | | | | | | | Brown sandy CLAY with pockets of brownish orange sand with occasional fine to medium sub-angular to sub-rounded gravel.<br>(KEMPTON PARK GRAVEL) | (0.50)<br>1.00 | |
| | | | | | | | Light grey brown becoming light grey sandy CLAY with flint cobbles recovered as fragments.<br>(KEMPTON PARK GRAVEL) | (0.60)<br>1.60 | |
| | | | | | | | Window sample hole terminated at 1.6 m depth. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **MB** | **CLarkin** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Former Royal Mail Depot, Twickenham** | **St James Group** | **PH6** |

| Contract Ref: | Start: **23.08.11** | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **23.08.11** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | MADE GROUND: TOPSOIL comprising very dark brown slightly organic clayey sand. | 0.25 | |
| | | | | | | | MADE GROUND: Brick. | 0.30 | |
| | | | | | | | Light greyish brown slightly clayey SAND. (KEMPTON PARK GRAVEL) | (0.30) 0.60 | |
| | | | | | | | Light yellow brown mottled orange brown sandy CLAY with pockets of brownish orange sand with fine to coarse gravel and flint fragments. (KEMPTON PARK GRAVEL) | (0.30) 0.90 | |
| | | | | | | | No recovery. | 1.00 | ZCL |
| | | | | | | | Light brownish grey slightly sandy clayey GRAVEL with flint fragments and cobbles. (KEMPTON PARK GRAVEL) | (0.30) 1.30 | |
| | | | | | | | Light grey sandy CLAY with flint cobbles recovered as fragments. (KEMPTON PARK GRAVEL) | (0.70) 2.00 | |
| | | | | | | | Window sample hole terminated at 2.0 m depth. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **MB** | **CLarkin** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Former Royal Mail Depot, Twickenham** | **St James Group** | **PH7** |

| Contract Ref: | Start: **23.08.11** | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **23.08.11** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | MADE GROUND: TOPSOIL comprising of very dark brown slightly organic slightly clayey sand with ash, clinker occasional fine to medium sub-rounded gravel, roots and rootlets. | 0.25 | |
| | | | | | | | MADE GROUND: Dark brown clayey sand with ash, clinker and metal fragments. | (0.55) | |
| | | | | | | | | 0.80 | |
| | | | | | | | No recovery | 1.00 | ZCL |
| | | | | | | | Light brownish grey slightly sandy clayey GRAVEL with flint fragments and cobbles. (KEMPTON PARK GRAVEL) | (0.30) | |
| | | | | | | | | 1.30 | |
| | | | | | | | Light grey sandy CLAY with flint cobbles recovered as fragments. (KEMPTON PARK GRAVEL) | (0.70) | |
| | | | | | | | | 2.00 | |
| | | | | | | | Window sample hole terminated at 2.0 m depth. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **MB** | **CLarkin** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Former Royal Mail Depot, Twickenham** | **St James Group** | **PH8** |

| Contract Ref: | Start: **23.08.11** | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **23.08.11** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | MADE GROUND: TOPSOIL comprising very dark brown slightly organic clayey sand. | 0.25 | |
| | | | | | | | MADE GROUND: Brick. | 0.30 | |
| | | | | | | | Light greyish brown slightly clayey SAND. (KEMPTON PARK GRAVEL) | (0.30) 0.60 | |
| | | | | | | | Light yellowish brown mottled orange brown sandy CLAY with pockets of brown sand with fine to coarse gravel including flint fragments. (KEMPTON PARK GRAVEL) | (0.30) 0.90 | |
| | | | | | | | No recovery. | 1.00 | ZCL |
| | | | | | | | Light brownish grey slightly sandy clayey GRAVEL with flint fragments and cobbles. (KEMPTON PARK GRAVEL) | (0.30) 1.30 | |
| | | | | | | | Light grey sandy CLAY with flint cobbles recovered as fragments. (KEMPTON PARK GRAVEL) | (0.70) 2.00 | |
| | | | | | | | Window sample hole terminated at 2.0 m depth. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **MB** | **CLarkin** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Former Royal Mail Depot, Twickenham** | **St James Group** | **PH9** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **23.08.11** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | MADE GROUND: TOPSOIL comprising very dark brown clayey sand with occasional ash and roots. | (0.50) 0.50 | |
| | | | | | | | Light yellowish brown mottled orange brown sandy CLAY with pockets of sand and fine to coarse gravel including flint fragments. (KEMPTON PARK GRAVEL) | (0.50) 1.00 | |
| | | | | | | | Light brownish grey slightly sandy clayey GRAVEL with flint fragments and cobbles. (KEMPTON PARK GRAVEL) | (0.30) 1.30 | |
| | | | | | | | Light grey sandy CLAY with flint cobbles recovered as fragments. (KEMPTON PARK GRAVEL) | (0.35) 1.65 | |
| | | | | | | | Window sample hole terminated at 1.65 m depth. | | |

| Drilling Progress and Water Observations | | | | | |
|---|---|---|---|---|---|
| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **MB** | **CLarkin** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Former Royal Mail Depot, Twickenham** | **St James Group** | **PH10** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **23.08.11** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | MADE GROUND: TOPSOIL comprising very dark brown clayey sand with occasional ash and roots. | (0.50)<br>0.50 | |
| | | | | | | | Light yellowish brown mottled orange brown sandy CLAY with pockets of sand and fine to coarse gravel including flint fragments.<br>(KEMPTON PARK GRAVEL) | (0.50)<br>1.00 | |
| | | | | | | | Light brownish grey slightly sandy clayey GRAVEL with flint fragments and cobbles.<br>(KEMPTON PARK GRAVEL) | (0.30)<br>1.30 | |
| | | | | | | | Light grey sandy CLAY with flint cobbles recovered as fragments.<br>(KEMPTON PARK GRAVEL) | (0.35)<br>1.65 | |
| | | | | | | | Window sample hole terminated at 1.65 m depth. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **MB** | **CLarkin** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS201** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** | **---** | **---** | **1** of **1** |
| | End: **02.12.14** | | | |

| Progress | Samples / Tests | | | | Water | Backfill & Instrumentation | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.10<br>0.10 | ES1 | ES<br>PID | Tub/J/VL<br>0.4ppm | | | Friable dark brown silty slightly sandy slightly gravelly CLAY with frequent to occasional roots and rootlets. Sand is fine to coarse. Gravel is rare subrounded fine to medium flint. (IMPORTED TOPSOIL) | (1.00) | |
| | 0.30<br>0.30 | ES2 | ES<br>PID | Tub/J/VL<br>3.3ppm | | | | 1.00 | |
| | | | | | | | MADE GROUND: Yellowish brown clayey sandy GRAVEL. Sand is fine to coarse. Gravel is subangular medium to coarse mortar, concrete and flint. | (0.80) | |
| | | | | | | | | 1.80 | |
| | 2.00 | D1 | D | | 1 | | Orangish brown gravelly fine to coarse SAND. Gravel is subrounded fine to medium flint. (KEMPTON PARK GRAVEL) | (1.60) | |
| | 3.40 | D2 | D | | | | | 3.40 | |
| | | | | | | | Firm to stiff fissured dark grey silty CLAY. (LONDON CLAY FORMATION) | (0.60) | |
| | | | | | | | | 4.00 | |
| | | | | | | | Terminated at 4.00m. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | - | | 2.00 |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **CD** | **VMacfarlane** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS202** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** | **---** | **---** | **1** of **2** |
| | End: **02.12.14** | | | |

| Progress | Samples / Tests | | | | Water | Backfill & Instru-mentation | Description of Strata | Depth (Thick ness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.30<br>0.30 | ES1 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Friable dark brown silty slightly sandy slightly gravelly CLAY with occasional roots and rootlets. Gravel is subangular fine to medium ash and brick. | (0.50)<br>0.50 | |
| | 0.60<br>0.60 | ES2 | ES<br>PID | Tub/J/VL<br>0.1ppm | | | Stiff light grey mottled orange silty CLAY with rare to very rare roots.<br>(ALLUVIUM)<br>. . . at 0.50 to 0.55m rare to occasional inclusions of subrounded flint | | |
| | 1.00<br>1.00 | ES3 | ES<br>PID | Tub/J/VL<br>0.3ppm | | | | (1.30)<br>1.80 | |
| | | | | | 1 | | Yellowish brown gravelly fine to coarse SAND. Gravel is subrounded fine to medium flint.<br>(KEMPTON PARK GRAVEL) | (0.90)<br>2.70 | |
| | 2.30 | D1 | D | | | | | | |
| | 3.00 | D2 | D | | | | Firm to stiff fissured greyish brown silty CLAY.<br>(LONDON CLAY FORMATION) | (2.30) | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | - | | 2.00 |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **CD** | **VMacfarlane** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS202** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** End: **02.12.14** | **---** | **---** | **2** of **2** |

| Progress | Samples / Tests | | | | Water | Backfill & Instrumentation | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | Firm to stiff fissured greyish brown silty CLAY. (LONDON CLAY FORMATION) *(stratum copied from 2.70m from previous sheet)* | 5.00 | |
| | | | | | | | Terminated at 5.00m. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **CD** | **VMacfarlane** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS203** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** End: **02.12.14** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill & Instrumentation | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.30<br>0.30 | ES1 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | Dark brown friable silty slightly sandy CLAY with occasional roots, rootlets and plant material. (IMPORTED TOPSOIL) | 0.10<br>(0.30) | |
| | 0.50<br>0.50 | ES2 | ES<br>PID | Tub/J/VL<br>0.4ppm | | | MADE GROUND: Dark brown silty slightly sandy slightly gravelly CLAY with rare rootlets. Sand is fine to coarse. Gravel is subangular fine to medium flint, brick, ash and clinker. | 0.40 | |
| | 1.00 | ES3 | ES | Tub/J/VL | | | Firm to stiff light brown mottled orange silty CLAY with rare black subrounded fine flint gravel. (ALLUVIUM) | (1.20)<br>1.60 | |
| | | | | | 1 | | Brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse flint. (KEMPTON PARK GRAVEL) | (1.30)<br>2.90 | |
| | 3.00-4.00 | D1 | D | | | | Firm to stiff fissured light greyish brown silty CLAY. (LONDON CLAY FORMATION) | (1.10)<br>4.00 | |
| | | | | | | | Terminated at 4.00m. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | - | | 1.80 |

## General Remarks

1. Kempton Park Gravel poorly recovered and mixed with the alluvium and London Clay Formation.

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **CD** | **VMacfarlane** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS204** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **02.12.14** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.30<br>0.30 | ES1 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | Black organic sandy SILT with roots and vegetation. Sand is fine to coarse (IMPORTED TOPSOIL) | 0.10 | |
| | | | | | | | MADE GROUND: Black silty gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse flint, brick, glass, clinker and occasional roots. | (0.40) | |
| | 0.50<br>0.50 | ES2 | ES<br>PID | Tub/J/VL<br>0.3ppm | | | | 0.50 | |
| | | | | | | | Dark brown very sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse flint with rare roots. (ALLUVIUM) | 0.55 | |
| | 1.30 | D1 | D | | | | Firm dark grey mottled orangish brown slightly gravelly CLAY. (ALLUVIUM) | (1.15) | |
| | | | | | | | | 1.70 | |
| | | | | | | | Brownish grey sandy GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse flint. (KEMPTON PARK GRAVEL) | (0.50) | |
| | | | | | | | | 2.20 | |
| | 2.50 | D2 | D | | | | Orangish brown slightly gravelly fine to coarse SAND. Gravel is subangular to rounded fine to medium flint. (KEMPTON PARK GRAVEL) | (0.70) | |
| | | | | | | | | 2.90 | |
| | | | | | | | Terminated at 2.90m. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **KDS** | **CBrill-Edwards** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS205** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** | **---** | **---** | **1** of **1** |
| | End: **02.12.14** | | | |

| Progress | Samples / Tests | | | | Water | Backfill & Instrumentation | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.30<br>0.30 | ES1 | ES<br>PID | Tub/J/VL<br>0.2ppm | | | Friable dark brown silty slightly sandy CLAY with occasional fine roots and rootlets with occasional plant matter.(IMPORTED TOPSOIL) | 0.10 | |
| | 0.60<br>0.60 | ES2 | ES<br>PID | Tub/J/VL<br>0.2ppm | | | MADE GROUND: Dark brown silty slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to medium flint, brick, mortar, ash and clinker. | (0.60) | |
| | 1.00<br>1.00 | ES3 | ES<br>PID | Tub/J/VL<br>0.2ppm | | | Firm to stiff light brown slightly mottled orange silty CLAY.<br>(ALLUVIUM) | 0.70<br>(1.20) | |
| | 2.00 | D1 | D | | 1 | | Yellowish brown clayey slightly gravelly fine to coarse SAND. Gravel is subrounded fine to medium flints.<br>(KEMPTON PARK GRAVEL) | 1.90<br>(0.90) | |
| | 3.00-4.00 | D2 | D | | | | Firm to stiff fissured greyish brown silty CLAY.<br>(LONDON CLAY FORMATION) | 2.80<br>(1.20) | |
| | | | | | | | Terminated at 4.00m. | 4.00 | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | - | | 2.00 |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **CD** | **VMacfarlane** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS206** |

| Contract Ref: | Start: **02.12.14** | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **02.12.14** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.20<br>0.20 | ES1 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Concrete | 0.10 | |
| | | | | | | | MADE GROUND: Dark grey clayey very gravelly fine to coarse SAND. Gravel is subangular fine to cobble sized concrete and with occasional roots. | (0.30) | |
| | | | | | | | | 0.40 | |
| | 0.50<br>0.50 | ES2 | ES<br>PID | Tub/J/VL<br>0.4ppm | | | Black very sandy gravelly SILT with rare roots. Sand is fine to coarse. Gravel is subangular to rounded fine to medium flint.<br>(ALLUVIUM) | 0.60 | |
| | | | | | | | Soft light brown slightly sandy silty CLAY with occasional roots.<br>(ALLUVIUM) | (0.60) | |
| | | | | | | | | 1.20 | |
| | 1.50 | D1 | D | | | | Soft to firm grey mottled orange brown locally sandy silty CLAY. Sand is fine to coarse.<br>(ALLUVIUM) | (0.50) | |
| | | | | | | | | 1.70 | |
| | | | | | | | Brown slightly gravelly locally clayey moderately coarse SAND. Gravel is angular to subrounded fine to coarse flint.<br>(KEMPTON PARK GRAVEL) | (0.30) | |
| | | | | | | | | 2.00 | |
| | 2.50 | D2 | D | | | | Light brown very gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse flint.<br>(KEMPTON PARK GRAVEL) | (1.00) | |
| | | | | | | | | 3.00 | |
| | | | | | | | Terminated at 3.00m. | | |

| Drilling Progress and Water Observations | | | | | |
|---|---|---|---|---|---|
| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **KDS** | **CBrill-Edwards** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS207** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **02.12.14** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.20<br>0.20 | ES1 | ES<br>PID | Tub/J/VL<br>0.7ppm | | | Black sandy SILT with frequent rootlets. Sand is fine to coarse. (IMPORTED TOPSOIL) | 0.10 | |
| | | | | | | | MADE GROUND: Grey sandy GRAVEL. Sand is coarse. Gravel is subangular to angular fine to coarse concrete. | (0.30)<br>0.40 | |
| | 0.50<br>0.50 | ES2 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Black slightly silty gravelly fine to coarse SAND. Gravel is angular to subrounded fine to coarse clinker, ash and flint with rare medium sized brick and flint. | 0.60 | |
| | | | | | | | Dark brown silty gravelly fine to coarse SAND. Gravel is angular to subrounded fine to medium flint frequent roots and rootlets.<br>(KEMPTON PARK GRAVEL) | (0.55)<br>1.15 | |
| | 1.50 | D1 | D | | | | Stiff brown mottled orange brown sandy slightly gravelly CLAY.<br>(KEMPTON PARK GRAVEL) | (1.85)<br>3.00 | |
| | | | | | | | Terminated at 3.00m. | | |

| Drilling Progress and Water Observations | | | | | |
|---|---|---|---|---|---|
| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **KDS** | **CBrill-Edwards** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS208** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** End: **02.12.14** | **---** | **---** | **1** of **2** |

| Progress | Samples / Tests | | | | Water | Backfill & Instrumentation | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.00-0.10<br>0.00 | ES1 | ES<br>PID | Tub<br>1.0ppm | | | Friable dark brown blackish brown slightly sandy CLAY with frequent rootlets and roots. Plant material and an organic odour. (IMPORTED TOPSOIL) | 0.10<br>0.17 | |
| | | | | | | | MADE GROUND: Concrete recovered as subangular coarse concrete fragments. | (0.43) | |
| | 0.40<br>0.40 | ES2 | ES<br>PID | Tub/J/VL<br>0.6ppm | | | MADE GROUND: Brown clayey gravelly fine to coarse SAND with rare rootlets. Gravel is subangular fine cobble sized flint, slate, brick and mortar. | 0.60 | |
| | 0.80-1.00<br>0.80 | ES3 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with rare rootlets. Sand is fine. Gravel is subangular fine to medium flint, chalk, brick and ash. | (0.40) | |
| | 1.00 | D2 | D | | | | Brown sandy very gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium flint. (ALLUVIUM) | 1.00<br>(0.80) | |
| | 1.90 | D3 | D | | | | Brown clayey sandy GRAVEL. Sand is fine to coarse. Gravel is subrounded fine to medium flint. (KEMPTON PARK GRAVEL) | 1.80<br>(1.80) | |
| | 3.00-4.00 | D4 | D | | | | | 3.60 | |
| | | | | | | | Firm to stiff grey silty CLAY. (LONDON CLAY FORMATION) | (1.40) | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **CD** | **VMacfarlane** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS208** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** | **---** | **---** | **2** of **2** |
| | End: **02.12.14** | | | |

| Progress | Samples / Tests | | | | Water | Backfill & Instru-mentation | Description of Strata | Depth (Thick ness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | Firm to stiff grey silty CLAY.<br>(LONDON CLAY FORMATION)<br>*(stratum copied from 3.60m from previous sheet)* | | |
| | | | | | | | | 5.00 | |
| | | | | | | | Terminated at 5.00m. | | |

| Drilling Progress and Water Observations | | | | | |
|---|---|---|---|---|---|
| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **CD** | **VMacfarlane** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS209** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **02.12.14** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.30<br>0.30 | ES1 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Dark brown mottled black sandy slightly gravelly CLAY with rare roots. Sand is fine to coarse. Gravel is subangular medium to coarse concrete, glass, clinker, flint and brick. | (0.60)<br>0.60 | |
| | 0.80<br>0.80 | ES2 | ES<br>PID | Tub/J/VL<br>0.4ppm | | | Light brown silty slightly gravelly fine to coarse SAND with occasional rootlets. Gravel is subrounded fine to medium of flint.<br>(KEMPTON PARK GRAVEL) | (0.70)<br>1.30 | |
| | 1.60 | D1 | D | | | | Stiff grey mottled orangish brown slightly gravelly CLAY. Gravel is subrounded fine to medium flint.<br>(KEMPTON PARK GRAVEL) | (1.20)<br>2.50 | |
| | | | | | | | Brown sandy GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse flint.<br>(KEMPTON PARK GRAVEL) | (0.50)<br>3.00 | |
| | | | | | | | Fine orange fine to coarse SAND.<br>(KEMPTON PARK GRAVEL)<br>Terminated at 3.00m. | | |

| Drilling Progress and Water Observations | | | | | |
|---|---|---|---|---|---|
| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **KDS** | **CBrill-Edwards** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS211** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** | **---** | **---** | **1** of **1** |
| | End: **02.12.14** | | | |

| Progress | Samples / Tests | | | | Water | Backfill & Instrumentation | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.00-0.10 | ES1 | ES | Tub | | | Friable dark blackish brown slightly sandy slightly gravelly CLAY with occasional rootlets. Sand is fine to coarse. Gravel is subrounded fine to medium flint. (IMPORTED TOPSOIL) | 0.10 | |
| | 0.00 | | PID | 1.1ppm | | | | (0.50) | |
| | 0.40 | ES2 | ES | Tub/J/VL | | | MADE GROUND: Black slightly clayey grey sandy GRAVEL. Sand is fine to coarse. Gravel is subangular fine to coarse flint, ash, clinker, brick and chalk. | 0.60 | |
| | 0.40 | | PID | 0.0ppm | | | | | |
| | 0.60 | | PID | 0.2ppm | | | MADE GROUND: Firm greyish brown mottled orange slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium flint and rare brick and ash. | 0.70 | |
| | 0.65 | ES3 | ES | Tub/J/VL | | | Firm orangish brown silty slightly sandy CLAY. Sand is fine to coarse. (KEMPTON PARK GRAVEL) | (0.90) | |
| | 1.00 | ES3 | ES | Tub/J/VL | | | | | |
| | 1.00 | | PID | 0.4ppm | | | | 1.60 | |
| | 1.80 | D1 | D | | | | Orangish brown very clayey slightly sandy GRAVEL. Sand is fine t coarse. Gravel is subrounded fine to medium flint. (KEMPTON PARK GRAVEL) | (1.50) | |
| | 3.00-4.00 | D2 | D | | | | | 3.10 | |
| | | | | | | | Firm to stiff fissured brownish grey silty CLAY. (LONDON CLAY FORMATION) | (0.90) | |
| | | | | | | | | 4.00 | |
| | | | | | | | Terminated at 4.00m. | | |

| Drilling Progress and Water Observations | | | | | |
|---|---|---|---|---|---|
| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **CD** | **VMacfarlane** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS212** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** | **---** | **---** | **1** of **1** |
| | End: **02.12.14** | | | |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.30<br>0.30 | ES1 | ES<br>PID | Tub/J/VL<br>0.6ppm | | | MADE GROUND: Black slightly gravelly CLAY. Gravel is subangular to rounded fine to medium brick, concrete, ash and occasional rootlets. | (0.35)<br>0.35 | |
| | 0.50<br>0.50 | ES2 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Soft to firm brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded to subangular fine to medium flint, ash and brick fragments. | 0.45<br>0.55 | |
| | | | | | | | MADE GROUND: Black gravelly fine to coarse SAND. Gravel is subangular fine to coarse ash concrete and clinker. | | |
| | | | | | | | Soft to firm brown mottled redish brown silty slightly gravelly CLAY. Gravel is subrounded to rounded fine to coarse flint.<br>(KEMPTON PARK GRAVEL) | (0.85)<br>1.40 | |
| | | | | | | | Brown clayey very sandy GRAVEL. Sand is fine to coarse. Gravel is subrounded fine to coarse flint.<br>(KEMPTON PARK GRAVEL) | (0.40)<br>1.80 | |
| | | | | | | | Terminated at 1.80m. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **KDS** | **CBrill-Edwards** | AGS |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS213** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** | **---** | **---** | **1** of **1** |
| | End: **02.12.14** | | | |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | | | | | | | Brown fine to coarse SAND with frequent roots. (IMPORTED TOPSOIL) | 0.20 | |
| | 0.30<br>0.30 | ES1 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Brown Subangular to angular fine to coarse GRAVEL of flint, concrete and with occasional brick and ceramic. | 0.40 | |
| | 0.50<br>0.50 | ES2 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Black sandy GRAVEL with pockets of stiff brown very sandy gravelly SILT. Sand is fine to coarse. Gravel is subangular fine to medium brick and flint. | (1.10) | |
| | 0.80<br>0.80 | ES3 | ES<br>PID | Tub/J/VL<br>0.8ppm | | | | 1.50 | |
| | | | | | | | Terminated at 1.50m. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **KDS** | **CBrill-Edwards** | AGS |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS214** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** | **---** | **---** | **1** of **1** |
| | End: **02.12.14** | | | |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.60<br>0.60 | ES1 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Dark grey silty very gravelly fine to coarse SAND. Gravel is angular to subrounded fine to coarse flint, slate, ceramic, concrete, sheet of metal and rootlets. | 0.20 | |
| | | | | | | | MADE GROUND: Black slightly silty very sandy GRAVEL with rare subangular cobble sized concrete Sand is fine to coarse. Gravel is angular fine to coarse slate. | (0.40)<br>0.60 | |
| | | | | | | | Zone core loss. | (0.90)<br>1.50 | ZCL |
| | | | | | | | Brown clayey sandy GRAVEL. Sand is fine to coarse. Gravel is angular fine to coarse flint. (KEMPTON PARK GRAVEL) | (0.40)<br>1.90 | |
| | 1.90 | D1 | D | | | | Brown very sandy CLAY. Sand is fine to coarse. (KEMPTON PARK GRAVEL) | (0.40)<br>2.30 | |
| | 2.70 | D2 | D | | | | Brown very gravelly SAND. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse flint. (KEMPTON PARK GRAVEL) | (0.70)<br>3.00 | |
| | | | | | | | Terminated at 3.00m. | | |

| Drilling Progress and Water Observations | | | | | |
|---|---|---|---|---|---|
| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **KDS** | **CBrill-Edwards** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS215** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **02.12.14** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.30<br>0.30 | ES1 | ES<br>PID | Tub/J/VL<br>0.9ppm | | | Brown fine to coarse SAND with frequent roots (IMPORTED TOPSOIL) | 0.20 | |
| | | | | | | | MADE GROUND: Concrete | 0.40 | |
| | 0.50<br>0.50 | ES2 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Dark brownish black silty gravelly fine to coarse SAND. Gravel is subangular to rounded fine to medium clinker, flint and concrete. | 0.60 | |
| | 0.80<br>0.80 | ES3 | ES<br>PID | Tub/J/VL<br>0.7ppm | | | Brown silty gravelly fine to coarse SAND. Gravel is subangular to rounded fine to coarse flint. (KEMPTON PARK GRAVEL) | (0.90)<br>1.50 | |
| | 1.50 | D1 | D | | | | Brown mottled black sandy very gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse flint. (KEMPTON PARK GRAVEL) | (0.70)<br>2.20 | |
| | 2.00 | D2 | D | | | | | | |
| | 2.30 | D3 | D | | | | Light brown gravelly fine to coarse SAND. Gavel is subrounded fine to coarse flint. (KEMPTON PARK GRAVEL) | 2.40 | |
| | | | | | | | Terminated at 2.40m. | | |

Drilling Progress and Water Observations

| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
|---|---|---|---|---|---|
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **KDS** | **CBrill-Edwards** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS216** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | End: **02.12.14** | **---** | **---** | **1** of **1** |

| Progress | Samples / Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.20<br>0.20 | ES1 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | Brown fine to coarse SAND with frequent roots (IMPORTED TOPSOIL) | (0.30)<br>0.30 | |
| | | | | | | | MADE GROUND: Dark blackish brown silty fine to coarse SAND with rare ceramic tile and organic matter. | 0.50 | |
| | 0.50<br>0.50 | ES2 | ES<br>PID | Tub/J/VL<br>0.9ppm | | | Brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse flint.<br>(KEMPTON PARK GRAVEL) | (0.50)<br>1.00 | |
| | 0.80<br>0.80 | ES3 | ES<br>PID | Tub/J/VL<br>0.8ppm | | | Brown silty gravelly fine to coarse SAND. Gravel is subangular to rounded fine to coarse flint.<br>(KEMPTON PARK GRAVEL) | (0.50)<br>1.50 | |
| | | | | | | | Brown slightly silty sandy GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flint.<br>(KEMPTON PARK GRAVEL) | 1.70 | |
| | | | | | | | Terminated at 1.70m. | | |

| Drilling Progress and Water Observations | | | | | |
|---|---|---|---|---|---|
| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **KDS** | **CBrill-Edwards** | |

# WINDOW SAMPLE LOG

| Contract: | Client: | Window Sample: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS217** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** | **---** | **---** | **1** of **1** |
| | End: **02.12.14** | | | |

| Progress | Samples / Tests | | | | Water | Backfill & Instru-mentation | Description of Strata | Depth (Thick ness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|---|
| Window Run | Depth | No | Type | Results | | | | | |
| | 0.40<br>0.40 | ES1 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | Friable dark blackish brown slightly sandy CLAY with occasional rootlets and roots. Sand is fine to coarse. (IMPORTED TOPSOIL) | 0.10 | |
| | | | | | | | MADE GROUND: Black slightly clayey very sandy GRAVEL. Sand is fine to coarse. Gravel is subangular fine to medium flint, ash, clinker and rare brick. | (0.60) | |
| | 0.80<br>0.80 | ES2 | ES<br>PID | Tub/J/VL<br>1.4ppm | | | | 0.70 | |
| | 1.00 | D1 | D | | | | Firm orangish brown silty slightly sandy slightly gravelly CLAY with rare rootlets. (ALLUVIUM) | (1.10) | |
| | 2.00 | D2 | D | | | | | 1.80 | |
| | | | | | | | Yellowish brown slightly gravelly fine to coarse SAND. (KEMPTON PARK GRAVEL) | (0.90) | |
| | 3.00-4.00 | D3 | D | | | | | 2.70 | |
| | | | | | | | Firm to stiff fissured greyish brown silty CLAY. (LONDON CLAY FORMATION) | (1.30) | |
| | | | | | | | | 4.00 | |
| | | | | | | | Terminated at 4.00m. | | |

| Drilling Progress and Water Observations | | | | | |
|---|---|---|---|---|---|
| Date | Time | Borehole Depth (m) | Casing Depth (m) | Borehole Diameter (mm) | Water Depth (m) |
| | | | | | |

## General Remarks

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Drilled By: | Logged By: | Checked By: |
|---|---|---|---|---|
| **Tracked window sampling** | **Archway Competitor** | **CD** | **VMacfarlane** | |

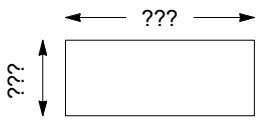
# TRIAL PIT LOG

| Contract: | Client: | Trial Pit: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **SH1** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **28.11.14** | **---** | **---** | **1** of **1** |
| | End: **28.11.14** | | | |

| Samples and In-situ Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|
| Depth | No | Type | Results | | | | | |
| 0.00<br>0.00 | ES1 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Dark brown friable slightly sandy slightly gravelly CLAY with frequent rootlets and a weak organic odour. Sand is fine to coarse. Gravel is subrounded to subangular fine to coarse flint and rare glass. | 0.00 | |

Plan (Not to Scale)




## General Remarks

1. Sample was taken from the soil heap for contamination testing.

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Logged By: | Checked By: |
|---|---|---|---|
| **Hand dug** | **Hand tools** | **VMacfarlane** | |

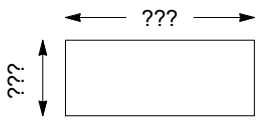
# TRIAL PIT LOG

| Contract: | Client: | Trial Pit: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **SH2** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **28.11.14** | **---** | **---** | **1** of **1** |
| | End: **28.11.14** | | | |

| Samples and In-situ Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|
| Depth | No | Type | Results | | | | | |
| 0.00<br>0.00 | ES1 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | MADE GROUND: Dark brown friable slightly sandy slightly gravelly CLAY with frequent rootlets and a weak organic odour. Sand is fine to coarse. Gravel is subrounded to subangular fine to coarse flint and rare glass. | 0.00 | |

Plan (Not to Scale)




## General Remarks

1. Sample was taken from the soil heap for contamination testing.

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Logged By: | Checked By: |
|---|---|---|---|
| **Hand dug** | **Hand tools** | **VMacfarlane** | |

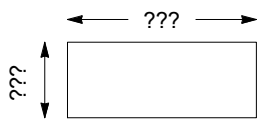
# TRIAL PIT LOG

| Contract: | Client: | Trial Pit: |
|---|---|---|
| **Twickenham Sorting Office MOL** | **St James Group Ltd** | **WS210** |

| Contract Ref: | Start: | Ground Level: | Co-ordinates: | Sheet: |
|---|---|---|---|---|
| **25024** | **02.12.14** | **---** | **---** | **1** of **1** |
| | End: **02.12.14** | | | |

| Samples and In-situ Tests | | | | Water | Backfill | Description of Strata | Depth (Thickness) | Material Graphic Legend |
|---|---|---|---|---|---|---|---|---|
| Depth | No | Type | Results | | | | | |
| 0.30<br>0.30 | ES1 | ES<br>PID | Tub/J/VL<br>0.3ppm | | | MADE GROUND: Blackish brown silty gravelly fine to coarse SAND with occasional roots. Gravel is angular to subrounded fine to coarse concrete metal glass ceramic and flint. | (0.50)<br>0.50 | |
| 0.50<br>0.50 | ES2 | ES<br>PID | Tub/J/VL<br>0.0ppm | | | Greyish brown slightly silty gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to medium flint.<br>(KEMPTON PARK GRAVEL) | (0.30)<br>0.80 | |
| 0.90 | D1 | D | | | | Grey mottled brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to medium flint.<br>(KEMPTON PARK GRAVEL) | 1.00 | |
| | | | | | | Terminated at 1.00m. | | |

Plan (Not to Scale)




## General Remarks

1. Hand dug trail pit was performed in this area due to access constraints.

All dimensions in metres | Scale: **1:25**

| Method Used: | Plant Used: | Logged By: | Checked By: |
|---|---|---|---|
| **Hand dug** | **Hand tools** | **CBrill-Edwards** | |

# APPENDIX E
# GROUND GAS MONITORING DATA

# IN-SITU GAS MONITORING RESULTS

| [Pressures] | Previous | During | Start | End | Equipment Used & Remarks |
|---|---|---|---|---|---|
| Round 1 | - | - | - | - | |
| Round 2 | - | - | - | - | |
| Round 3 | - | - | - | - | |

| Exploratory Position ID | Monitoring Round | Measured Installation Depth (mbgl) | Date & Time of Monitoring (elapsed time) | Borehole Pressure (mb) | Atmos Pressure (mb) | Gas Flow (l/hr) | Water Depth (mbgl) | Carbon Dioxide (% / vol) | Methane (% / vol) | Oxygen (% / vol) | LEL (%) | Carbon Monoxide (ppm) | Hydrogen Sulphide (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS201 | 1 | 3.42 | 15/12/2014 | 1010 | 1010 | 0.0 | 2.26 | 0.1 | 0.1 | 21.5 | 1.0 | 0.0 | 0.0 | |
| WS201 | 1 | --- | 15 secs | - | - | 0.0 | - | 0.3 | 0.1 | 21.1 | 1.0 | 0.0 | 0.0 | |
| WS201 | 1 | --- | 30 secs | - | - | 0.0 | - | 0.3 | 0.1 | 21.0 | 1.0 | 0.0 | 0.0 | |
| WS201 | 1 | --- | 60 secs | - | - | 0.0 | - | 0.3 | 0.1 | 21.0 | 1.0 | 0.0 | 0.0 | |
| WS201 | 1 | --- | 90 secs | - | - | 0.0 | - | 0.3 | 0.1 | 20.9 | 1.0 | 0.0 | 0.0 | |
| WS201 | 1 | --- | 120 secs | - | - | 0.0 | - | 0.3 | 0.1 | 20.9 | 1.0 | 0.0 | 0.0 | |
| WS201 | 1 | --- | 180 secs | - | - | 0.0 | - | 0.3 | 0.1 | 20.8 | 1.0 | 0.0 | 0.0 | |
| WS201 | 1 | --- | 240 secs | - | - | 0.0 | - | 0.4 | 0.1 | 20.7 | 1.0 | 0.0 | 0.0 | |
| WS201 | 1 | --- | 300 secs | - | - | 0.0 | - | 0.4 | 0.1 | 20.7 | 1.0 | 0.0 | 0.0 | |
| WS201 | 1 | --- | 360 secs | - | - | 0.0 | - | 0.4 | 0.1 | 20.7 | 1.0 | 0.0 | 0.0 | |
| WS201 | 1 | --- | 420 secs | - | - | 0.0 | - | 0.4 | 0.1 | 20.7 | 1.0 | 0.0 | 0.0 | |
| WS201 | 2 | 3.42 | 22/12/2014 | 1019 | 1019 | 0.0 | 2.27 | 0.1 | 0.0 | 20.1 | 0.0 | 0.0 | 0.0 | |
| WS201 | 2 | --- | 15 secs | - | - | 0.0 | - | 0.4 | 0.0 | 19.9 | 0.0 | 0.0 | 0.0 | |
| WS201 | 2 | --- | 30 secs | - | - | 0.0 | - | 0.4 | 0.0 | 19.7 | 0.0 | 0.0 | 0.0 | |
| WS201 | 2 | --- | 60 secs | - | - | 0.0 | - | 0.4 | 0.0 | 19.6 | 0.0 | 0.0 | 0.0 | |
| WS201 | 2 | --- | 90 secs | - | - | 0.0 | - | 0.4 | 0.0 | 19.7 | 0.0 | 0.0 | 0.0 | |
| WS201 | 2 | --- | 120 secs | - | - | 0.0 | - | 0.4 | 0.0 | 19.6 | 0.0 | 0.0 | 0.0 | |
| WS201 | 2 | --- | 180 secs | - | - | 0.0 | - | 0.4 | 0.0 | 19.7 | 0.0 | 0.0 | 0.0 | |

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

RSK Environment Ltd
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Hertfordshire
HP3 9RT

| Compiled By | Date | Checked By | Date | Contract Ref: |
|---|---|---|---|---|
| V. Macfarlane | 15/01/15 | | | 25024 |

Contract: **Twickenham Sorting Office MOL**



AGS

# IN-SITU GAS MONITORING RESULTS

| Exploratory Position ID | Monitoring Round | Installation Depth (mbgl) | Date & Time of Monitoring (elapsed time) | Borehole Pressure (mb) | Atmos Pressure (mb) | Gas Flow (l/hr) | Water Depth (mbgl) | Carbon Dioxide (% / vol) | Methane (% / vol) | Oxygen (% / vol) | LEL (%) | Carbon Monoxide (ppm) | Hydrogen Sulphide (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS201 | 2 | --- | 240 secs | - | - | 0.0 | - | 0.4 | 0.0 | 19.7 | 0.0 | 0.0 | 0.0 | |
| WS201 | 2 | --- | 300 secs | - | - | 0.0 | - | 0.4 | 0.0 | 19.7 | 0.0 | 0.0 | 0.0 | |
| WS201 | 2 | --- | 360 secs | - | - | 0.0 | - | 0.4 | 0.0 | 19.7 | 0.0 | 0.0 | 0.0 | |
| WS201 | 2 | --- | 420 secs | - | - | 0.0 | - | 0.4 | 0.0 | 19.7 | 0.0 | 0.0 | 0.0 | |
| WS201 | 3 | 3.42 | 13/01/2015 | 999 | 999 | -0.2 | 2.22 | 0.1 | 0.2 | 21.9 | 3.0 | 0.0 | 0.0 | |
| WS201 | 3 | --- | 15 secs | - | - | -0.1 | - | 0.5 | 0.2 | 21.4 | 3.0 | 0.0 | 0.0 | |
| WS201 | 3 | --- | 30 secs | - | - | -0.2 | - | 0.5 | 0.2 | 21.3 | 3.0 | 0.0 | 0.0 | |
| WS201 | 3 | --- | 60 secs | - | - | -0.2 | - | 0.5 | 0.2 | 21.2 | 3.0 | 0.0 | 0.0 | |
| WS201 | 3 | --- | 90 secs | - | - | -0.2 | - | 0.5 | 0.2 | 21.2 | 3.0 | 0.0 | 0.0 | |
| WS201 | 3 | --- | 120 secs | - | - | -0.2 | - | 0.5 | 0.2 | 21.1 | 3.0 | 0.0 | 0.0 | |
| WS201 | 3 | --- | 180 secs | - | - | -0.2 | - | 0.5 | 0.2 | 20.4 | 3.0 | 0.0 | 0.0 | |
| WS201 | 3 | --- | 240 secs | - | - | -0.2 | - | 0.8 | 0.2 | 20.4 | 3.0 | 0.0 | 0.0 | |
| WS201 | 3 | --- | 300 secs | - | - | -0.2 | - | 0.9 | 0.2 | 20.3 | 3.0 | 0.0 | 0.0 | |
| WS201 | 3 | --- | 360 secs | - | - | -0.2 | - | 0.8 | 0.2 | 20.3 | 3.0 | 0.0 | 0.0 | |
| WS201 | 3 | --- | 420 secs | - | - | -0.2 | - | 0.8 | 0.2 | 20.3 | 3.0 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | | |
| WS202 | 1 | 4.70 | 15/12/2014 | 1010 | 1010 | 0.0 | 2.20 | 0.2 | 0.1 | 21.6 | 1.0 | 0.0 | 0.0 | |
| WS202 | 1 | --- | 15 secs | - | - | 0.0 | - | 3.7 | 0.1 | 17.5 | 1.0 | 0.0 | 0.0 | |
| WS202 | 1 | --- | 30 secs | - | - | -0.1 | - | 3.8 | 0.1 | 15.3 | 1.0 | 0.0 | 0.0 | |
| WS202 | 1 | --- | 60 secs | - | - | -0.1 | - | 3.8 | 0.1 | 15.0 | 1.0 | 0.0 | 0.0 | |
| WS202 | 1 | --- | 90 secs | - | - | -0.1 | - | 3.9 | 0.1 | 14.8 | 1.0 | 0.0 | 0.0 | |
| WS202 | 1 | --- | 120 secs | - | - | -0.1 | - | 4.2 | 0.1 | 14.1 | 1.0 | 0.0 | 0.0 | |
| WS202 | 1 | --- | 180 secs | - | - | -0.1 | - | 4.8 | 0.1 | 12.7 | 1.0 | 0.0 | 0.0 | |
| WS202 | 1 | --- | 240 secs | - | - | -0.1 | - | 6.2 | 0.1 | 10.4 | 1.0 | 0.0 | 0.0 | |
| WS202 | 1 | --- | 300 secs | - | - | -0.1 | - | 7.1 | 0.1 | 9.1 | 1.0 | 0.0 | 0.0 | |

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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| V. Macfarlane | 15/01/15 | | | 25024 |

Contract: **Twickenham Sorting Office MOL**



AGS

# IN-SITU GAS MONITORING RESULTS

| Exploratory Position ID | Monitoring Round | Installation Depth (mbgl) | Date & Time of Monitoring (elapsed time) | Borehole Pressure (mb) | Atmos Pressure (mb) | Gas Flow (l/hr) | Water Depth (mbgl) | Carbon Dioxide (% / vol) | Methane (% / vol) | Oxygen (% / vol) | LEL (%) | Carbon Monoxide (ppm) | Hydrogen Sulphide (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS202 | 1 | --- | 360 secs | - | - | -0.1 | - | 7.2 | 0.1 | 9.1 | 1.0 | 0.0 | 0.0 | |
| WS202 | 1 | --- | 420 secs | - | - | -0.1 | - | 7.4 | 0.1 | 8.7 | 1.0 | 0.0 | 0.0 | |
| WS202 | 2 | 4.00 | 22/12/2014 | 1019 | 1019 | 0.0 | 2.10 | 0.1 | 0.0 | 20.1 | 0.0 | 0.0 | 0.0 | |
| WS202 | 2 | --- | 15 secs | - | - | 0.0 | - | 4.1 | 0.0 | 17.7 | 0.0 | 0.0 | 0.0 | |
| WS202 | 2 | --- | 30 secs | - | - | 0.0 | - | 4.4 | 0.0 | 15.4 | 0.0 | 0.0 | 0.0 | |
| WS202 | 2 | --- | 60 secs | - | - | 0.0 | - | 4.5 | 0.0 | 15.2 | 0.0 | 0.0 | 0.0 | |
| WS202 | 2 | --- | 90 secs | - | - | 0.0 | - | 4.5 | 0.0 | 15.0 | 0.0 | 0.0 | 0.0 | |
| WS202 | 2 | --- | 120 secs | - | - | 0.0 | - | 4.5 | 0.0 | 15.0 | 0.0 | 0.0 | 0.0 | |
| WS202 | 2 | --- | 180 secs | - | - | 0.0 | - | 4.9 | 0.0 | 13.6 | 0.0 | 0.0 | 0.0 | |
| WS202 | 2 | --- | 240 secs | - | - | 0.0 | - | 6.4 | 0.0 | 10.4 | 0.0 | 0.0 | 0.0 | |
| WS202 | 2 | --- | 300 secs | - | - | 0.0 | - | 7.1 | 0.0 | 9.3 | 0.0 | 0.0 | 0.0 | |
| WS202 | 2 | --- | 360 secs | - | - | 0.0 | - | 7.2 | 0.0 | 9.1 | 0.0 | 0.0 | 0.0 | |
| WS202 | 2 | --- | 420 secs | - | - | 0.0 | - | 7.0 | 0.0 | 9.4 | 0.0 | 0.0 | 0.0 | |
| WS202 | 3 | 4.74 | 13/01/2015 | 999 | 999 | -0.1 | 2.19 | 0.1 | 0.2 | 21.9 | 3.0 | 0.0 | 0.0 | |
| WS202 | 3 | --- | 15 secs | - | - | -0.1 | - | 4.2 | 0.1 | 17.9 | 2.0 | 0.0 | 0.0 | |
| WS202 | 3 | --- | 30 secs | - | - | -0.1 | - | 4.3 | 0.1 | 14.8 | 2.0 | 0.0 | 0.0 | |
| WS202 | 3 | --- | 60 secs | - | - | -0.1 | - | 4.4 | 0.2 | 14.3 | 3.0 | 0.0 | 0.0 | |
| WS202 | 3 | --- | 90 secs | - | - | -0.1 | - | 4.5 | 0.2 | 14.1 | 3.0 | 0.0 | 0.0 | |
| WS202 | 3 | --- | 120 secs | - | - | -0.1 | - | 4.8 | 0.2 | 13.7 | 3.0 | 0.0 | 0.0 | |
| WS202 | 3 | --- | 180 secs | - | - | -0.1 | - | 5.9 | 0.2 | 11.7 | 3.0 | 0.0 | 0.0 | |
| WS202 | 3 | --- | 240 secs | - | - | -0.1 | - | 6.8 | 0.2 | 10.1 | 3.0 | 0.0 | 0.0 | |
| WS202 | 3 | --- | 300 secs | - | - | -0.1 | - | 7.0 | 0.2 | 9.9 | 3.0 | 0.0 | 0.0 | |
| WS202 | 3 | --- | 360 secs | - | - | -0.1 | - | 7.0 | 0.2 | 9.9 | 3.0 | 0.0 | 0.0 | |
| WS202 | 3 | --- | 420 secs | - | - | -0.1 | - | 7.1 | 0.2 | 9.8 | 3.0 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | | |

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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| V. Macfarlane | 15/01/15 | | | 25024 |

Contract: **Twickenham Sorting Office MOL**



AGS

# IN-SITU GAS MONITORING RESULTS

| Exploratory Position ID | Monitoring Round | Installation Depth (mbgl) | Date & Time of Monitoring (elapsed time) | Borehole Pressure (mb) | Atmos Pressure (mb) | Gas Flow (l/hr) | Water Depth (mbgl) | Carbon Dioxide (% / vol) | Methane (% / vol) | Oxygen (% / vol) | LEL (%) | Carbon Monoxide (ppm) | Hydrogen Sulphide (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS203 | 1 | 4.00 | 15/12/2014 | 1010 | 1010 | 0.0 | 2.37 | 0.1 | 0.1 | 21.4 | 1.0 | 0.0 | 0.0 | |
| WS203 | 1 | --- | 15 secs | - | - | 0.0 | - | 1.5 | 0.1 | 20.1 | 1.0 | 0.0 | 0.0 | |
| WS203 | 1 | --- | 30 secs | - | - | 0.0 | - | 1.5 | 0.1 | 20.0 | 1.0 | 0.0 | 0.0 | |
| WS203 | 1 | --- | 60 secs | - | - | 0.0 | - | 1.5 | 0.1 | 20.0 | 1.0 | 0.0 | 0.0 | |
| WS203 | 1 | --- | 90 secs | - | - | 0.0 | - | 1.6 | 0.1 | 19.9 | 1.0 | 0.0 | 0.0 | |
| WS203 | 1 | --- | 120 secs | - | - | 0.0 | - | 2.0 | 0.1 | 19.4 | 1.0 | 0.0 | 0.0 | |
| WS203 | 1 | --- | 180 secs | - | - | 0.0 | - | 3.6 | 0.1 | 17.7 | 1.0 | 0.0 | 0.0 | |
| WS203 | 1 | --- | 240 secs | - | - | 0.0 | - | 5.9 | 0.1 | 15.2 | 1.0 | 0.0 | 0.0 | |
| WS203 | 1 | --- | 300 secs | - | - | 0.0 | - | 6.1 | 0.1 | 15.1 | 1.0 | 0.0 | 0.0 | |
| WS203 | 1 | --- | 360 secs | - | - | 0.0 | - | 5.8 | 0.1 | 15.3 | 1.0 | 0.0 | 0.0 | |
| WS203 | 1 | --- | 420 secs | - | - | 0.0 | - | 5.6 | 0.1 | 15.6 | 1.0 | 0.0 | 0.0 | |
| WS203 | 2 | 4.07 | 22/12/2014 | 1019 | 1019 | 0.0 | 2.36 | 0.3 | 0.0 | 20.0 | 0.0 | 0.0 | 0.0 | |
| WS203 | 2 | --- | 15 secs | - | - | 0.0 | - | 1.6 | 0.0 | 18.8 | 0.0 | 0.0 | 0.0 | |
| WS203 | 2 | --- | 30 secs | - | - | 0.0 | - | 1.6 | 0.0 | 18.8 | 0.0 | 0.0 | 0.0 | |
| WS203 | 2 | --- | 60 secs | - | - | 0.0 | - | 1.6 | 0.0 | 18.7 | 0.0 | 0.0 | 0.0 | |
| WS203 | 2 | --- | 90 secs | - | - | 0.0 | - | 1.5 | 0.0 | 18.8 | 0.0 | 0.0 | 0.0 | |
| WS203 | 2 | --- | 120 secs | - | - | 0.0 | - | 1.5 | 0.0 | 18.9 | 0.0 | 0.0 | 0.0 | |
| WS203 | 2 | --- | 180 secs | - | - | 0.0 | - | 1.8 | 0.0 | 18.7 | 0.0 | 0.0 | 0.0 | |
| WS203 | 2 | --- | 240 secs | - | - | 0.0 | - | 2.2 | 0.0 | 18.4 | 0.0 | 0.0 | 0.0 | |
| WS203 | 2 | --- | 300 secs | - | - | 0.0 | - | 2.5 | 0.0 | 18.2 | 0.0 | 0.0 | 0.0 | |
| WS203 | 2 | --- | 360 secs | - | - | 0.0 | - | 2.4 | 0.0 | 18.2 | 0.0 | 0.0 | 0.0 | |
| WS203 | 2 | --- | 420 secs | - | - | 0.0 | - | 2.2 | 0.0 | 18.4 | 0.0 | 0.0 | 0.0 | |
| WS203 | 3 | 3.99 | 13/01/2015 | 999 | 999 | -0.1 | 2.37 | 0.1 | 0.1 | 21.2 | 2.0 | 0.0 | 0.0 | |
| WS203 | 3 | --- | 15 secs | - | - | -0.1 | - | 2.0 | 0.2 | 20.0 | 3.0 | 0.0 | 0.0 | |
| WS203 | 3 | --- | 30 secs | - | - | -0.1 | - | 2.0 | 0.2 | 19.2 | 3.0 | 0.0 | 0.0 | |

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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Contract: **Twickenham Sorting Office MOL**



AGS

# IN-SITU GAS MONITORING RESULTS

| Exploratory Position ID | Monitoring Round | Installation Depth (mbgl) | Date & Time of Monitoring (elapsed time) | Borehole Pressure (mb) | Atmos Pressure (mb) | Gas Flow (l/hr) | Water Depth (mbgl) | Carbon Dioxide (% / vol) | Methane (% / vol) | Oxygen (% / vol) | LEL (%) | Carbon Monoxide (ppm) | Hydrogen Sulphide (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS203 | 3 | --- | 60 secs | - | - | -0.1 | - | 2.1 | 0.2 | 19.0 | 3.0 | 0.0 | 0.0 | |
| WS203 | 3 | --- | 90 secs | - | - | -0.1 | - | 2.1 | 0.2 | 18.9 | 3.0 | 0.0 | 0.0 | |
| WS203 | 3 | --- | 120 secs | - | - | -0.1 | - | 2.9 | 0.2 | 18.2 | 3.0 | 0.0 | 0.0 | |
| WS203 | 3 | --- | 180 secs | - | - | -0.1 | - | 3.0 | 0.1 | 17.4 | 3.0 | 0.0 | 0.0 | |
| WS203 | 3 | --- | 240 secs | - | - | -0.1 | - | 6.9 | 0.2 | 13.9 | 3.0 | 0.0 | 0.0 | |
| WS203 | 3 | --- | 300 secs | - | - | -0.1 | - | 7.1 | 0.1 | 13.7 | 3.0 | 0.0 | 0.0 | |
| WS203 | 3 | --- | 360 secs | - | - | -0.1 | - | 7.0 | 0.2 | 13.8 | 3.0 | 0.0 | 0.0 | |
| WS203 | 3 | --- | 420 secs | - | - | -0.1 | - | 6.8 | 0.2 | 14.0 | 3.0 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | | |
| WS205 | 1 | 3.96 | 15/12/2014 | 1009 | 1009 | 0.0 | 2.62 | 0.1 | 0.1 | 21.5 | 1.0 | 0.0 | 0.0 | |
| WS205 | 1 | --- | 15 secs | - | - | 0.0 | - | 1.5 | 0.1 | 20.1 | 1.0 | 0.0 | 0.0 | |
| WS205 | 1 | --- | 30 secs | - | - | 0.0 | - | 1.5 | 0.1 | 19.9 | 1.0 | 0.0 | 0.0 | |
| WS205 | 1 | --- | 60 secs | - | - | 0.0 | - | 1.5 | 0.1 | 19.9 | 1.0 | 0.0 | 0.0 | |
| WS205 | 1 | --- | 90 secs | - | - | 0.0 | - | 1.5 | 0.1 | 19.8 | 1.0 | 0.0 | 0.0 | |
| WS205 | 1 | --- | 120 secs | - | - | 0.0 | - | 1.6 | 0.1 | 19.6 | 1.0 | 0.0 | 0.0 | |
| WS205 | 1 | --- | 180 secs | - | - | 0.0 | - | 1.9 | 0.1 | 19.0 | 1.0 | 0.0 | 0.0 | |
| WS205 | 1 | --- | 240 secs | - | - | 0.0 | - | 2.1 | 0.1 | 18.5 | 1.0 | 0.0 | 0.0 | |
| WS205 | 1 | --- | 300 secs | - | - | 0.0 | - | 2.1 | 0.1 | 18.5 | 1.0 | 0.0 | 0.0 | |
| WS205 | 1 | --- | 360 secs | - | - | 0.0 | - | 2.1 | 0.1 | 18.6 | 1.0 | 0.0 | 0.0 | |
| WS205 | 1 | --- | 420 secs | - | - | 0.0 | - | 2.0 | 0.1 | 18.7 | 1.0 | 0.0 | 0.0 | |
| WS205 | 2 | 3.96 | 22/12/2014 | 1018 | 1018 | 0.0 | 2.57 | 0.2 | 0.0 | 20.2 | 0.0 | 0.0 | 0.0 | |
| WS205 | 2 | --- | 15 secs | - | - | 0.0 | - | 1.9 | 0.0 | 19.4 | 0.0 | 0.0 | 0.0 | |
| WS205 | 2 | --- | 30 secs | - | - | 0.0 | - | 2.0 | 0.0 | 18.7 | 0.0 | 0.0 | 0.0 | |
| WS205 | 2 | --- | 60 secs | - | - | 0.0 | - | 2.0 | 0.0 | 18.6 | 0.0 | 0.0 | 0.0 | |
| WS205 | 2 | --- | 90 secs | - | - | 0.0 | - | 2.0 | 0.0 | 18.7 | 0.0 | 0.0 | 0.0 | |

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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Contract: **Twickenham Sorting Office MOL**

# IN-SITU GAS MONITORING RESULTS

| Exploratory Position ID | Monitoring Round | Installation Depth (mbgl) | Date & Time of Monitoring (elapsed time) | Borehole Pressure (mb) | Atmos Pressure (mb) | Gas Flow (l/hr) | Water Depth (mbgl) | Carbon Dioxide (% / vol) | Methane (% / vol) | Oxygen (% / vol) | LEL (%) | Carbon Monoxide (ppm) | Hydrogen Sulphide (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS205 | 2 | --- | 120 secs | - | - | 0.0 | - | 2.0 | 0.0 | 18.8 | 0.0 | 0.0 | 0.0 | |
| WS205 | 2 | --- | 180 secs | - | - | 0.0 | - | 2.1 | 0.0 | 18.7 | 0.0 | 0.0 | 0.0 | |
| WS205 | 2 | --- | 240 secs | - | - | 0.0 | - | 2.3 | 0.0 | 18.5 | 0.0 | 0.0 | 0.0 | |
| WS205 | 2 | --- | 300 secs | - | - | 0.0 | - | 2.4 | 0.0 | 18.3 | 0.0 | 0.0 | 0.0 | |
| WS205 | 2 | --- | 360 secs | - | - | 0.0 | - | 2.3 | 0.0 | 18.5 | 0.0 | 0.0 | 0.0 | |
| WS205 | 2 | --- | 420 secs | - | - | 0.0 | - | 2.3 | 0.0 | 18.5 | 0.0 | 0.0 | 0.0 | |
| WS205 | 3 | 4.00 | 13/01/2015 | 999 | 999 | -0.1 | 2.53 | 0.1 | 0.1 | 21.3 | 2.0 | 0.0 | 0.0 | |
| WS205 | 3 | --- | 15 secs | - | - | -0.1 | - | 1.2 | 0.1 | 21.0 | 2.0 | 0.0 | 0.0 | |
| WS205 | 3 | --- | 30 secs | - | - | -0.1 | - | 1.2 | 0.1 | 20.8 | 2.0 | 0.0 | 0.0 | |
| WS205 | 3 | --- | 60 secs | - | - | -0.1 | - | 1.2 | 0.1 | 20.7 | 2.0 | 0.0 | 0.0 | |
| WS205 | 3 | --- | 90 secs | - | - | -0.1 | - | 1.3 | 0.1 | 20.5 | 2.0 | 0.0 | 0.0 | |
| WS205 | 3 | --- | 120 secs | - | - | -0.1 | - | 1.3 | 0.1 | 20.4 | 2.0 | 0.0 | 0.0 | |
| WS205 | 3 | --- | 180 secs | - | - | -0.1 | - | 1.5 | 0.1 | 19.8 | 2.0 | 0.0 | 0.0 | |
| WS205 | 3 | --- | 240 secs | - | - | -0.1 | - | 1.7 | 0.1 | 19.3 | 2.0 | 0.0 | 0.0 | |
| WS205 | 3 | --- | 300 secs | - | - | -0.1 | - | 1.9 | 0.1 | 19.0 | 2.0 | 0.0 | 0.0 | |
| WS205 | 3 | --- | 360 secs | - | - | -0.1 | - | 1.9 | 0.1 | 19.0 | 2.0 | 0.0 | 0.0 | |
| WS205 | 3 | --- | 420 secs | - | - | -0.1 | - | 1.9 | 0.1 | 19.0 | 2.0 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | | |
| WS208 | 1 | 5.03 | 15/12/2014 | 1009 | 1009 | 0.0 | 4.90 | 0.1 | 0.1 | 21.6 | 1.0 | 0.0 | 0.0 | |
| WS208 | 1 | --- | 15 secs | - | - | 0.0 | - | 2.9 | 0.1 | 20.1 | 1.0 | 0.0 | 0.0 | |
| WS208 | 1 | --- | 30 secs | - | - | 0.0 | - | 3.1 | 0.1 | 19.2 | 1.0 | 0.0 | 0.0 | |
| WS208 | 1 | --- | 60 secs | - | - | 0.0 | - | 3.1 | 0.1 | 19.0 | 1.0 | 0.0 | 0.0 | |
| WS208 | 1 | --- | 90 secs | - | - | 0.0 | - | 3.1 | 0.1 | 19.1 | 1.0 | 0.0 | 0.0 | |
| WS208 | 1 | --- | 120 secs | - | - | 0.0 | - | 3.1 | 0.1 | 19.1 | 1.0 | 0.0 | 0.0 | |
| WS208 | 1 | --- | 180 secs | - | - | 0.0 | - | 3.3 | 0.1 | 18.9 | 1.0 | 0.0 | 0.0 | |

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

RSK Environment Ltd
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

| Compiled By | Date | Checked By | Date | Contract Ref: |
|---|---|---|---|---|
| V. Macfarlane | 15/01/15 | | | 25024 |

Contract: **Twickenham Sorting Office MOL**



AGS

# IN-SITU GAS MONITORING RESULTS

| Exploratory Position ID | Monitoring Round | Installation Depth (mbgl) | Date & Time of Monitoring (elapsed time) | Borehole Pressure (mb) | Atmos Pressure (mb) | Gas Flow (l/hr) | Water Depth (mbgl) | Carbon Dioxide (% / vol) | Methane (% / vol) | Oxygen (% / vol) | LEL (%) | Carbon Monoxide (ppm) | Hydrogen Sulphide (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS208 | 1 | --- | 240 secs | - | - | 0.0 | - | 3.6 | 0.1 | 18.2 | 1.0 | 0.0 | 0.0 | |
| WS208 | 1 | --- | 300 secs | - | - | 0.0 | - | 3.8 | 0.1 | 17.9 | 1.0 | 0.0 | 0.0 | |
| WS208 | 1 | --- | 360 secs | - | - | 0.0 | - | 3.9 | 0.1 | 17.7 | 1.0 | 0.0 | 0.0 | |
| WS208 | 1 | --- | 420 secs | - | - | 0.0 | - | 4.0 | 0.1 | 17.6 | 1.0 | 0.0 | 0.0 | |
| WS208 | 2 | 5.03 | 22/12/2014 | 1018 | 1018 | 0.0 | 4.76 | 0.2 | 0.0 | 20.2 | 0.0 | 0.0 | 0.0 | |
| WS208 | 2 | --- | 15 secs | - | - | 0.0 | - | 4.3 | 0.0 | 16.5 | 0.0 | 0.0 | 0.0 | |
| WS208 | 2 | --- | 30 secs | - | - | 0.0 | - | 4.5 | 0.0 | 15.9 | 0.0 | 0.0 | 0.0 | |
| WS208 | 2 | --- | 60 secs | - | - | 0.0 | - | 4.5 | 0.0 | 15.7 | 0.0 | 0.0 | 0.0 | |
| WS208 | 2 | --- | 90 secs | - | - | 0.0 | - | 4.5 | 0.0 | 15.6 | 0.0 | 0.0 | 0.0 | |
| WS208 | 2 | --- | 120 secs | - | - | 0.0 | - | 4.5 | 0.0 | 15.6 | 0.0 | 0.0 | 0.0 | |
| WS208 | 2 | --- | 180 secs | - | - | 0.0 | - | 4.7 | 0.0 | 15.4 | 0.0 | 0.0 | 0.0 | |
| WS208 | 2 | --- | 240 secs | - | - | 0.0 | - | 4.8 | 0.0 | 15.3 | 0.0 | 0.0 | 0.0 | |
| WS208 | 2 | --- | 300 secs | - | - | 0.0 | - | 4.9 | 0.0 | 15.1 | 0.0 | 0.0 | 0.0 | |
| WS208 | 2 | --- | 360 secs | - | - | 0.0 | - | 4.9 | 0.0 | 15.1 | 0.0 | 0.0 | 0.0 | |
| WS208 | 2 | --- | 420 secs | - | - | 0.0 | - | 4.9 | 0.0 | 15.1 | 0.0 | 0.0 | 0.0 | |
| WS208 | 3 | 5.06 | 13/01/2015 | 998 | 998 | -0.1 | 3.36 | 0.1 | 0.1 | 21.4 | 2.0 | 0.0 | 0.0 | |
| WS208 | 3 | --- | 15 secs | - | - | -0.1 | - | 4.2 | 0.1 | 17.2 | 2.0 | 0.0 | 0.0 | |
| WS208 | 3 | --- | 30 secs | - | - | -0.1 | - | 4.3 | 0.1 | 16.8 | 2.0 | 0.0 | 0.0 | |
| WS208 | 3 | --- | 60 secs | - | - | -0.1 | - | 4.3 | 0.1 | 16.6 | 2.0 | 0.0 | 0.0 | |
| WS208 | 3 | --- | 90 secs | - | - | -0.1 | - | 4.3 | 0.1 | 16.7 | 2.0 | 0.0 | 0.0 | |
| WS208 | 3 | --- | 120 secs | - | - | -0.1 | - | 4.3 | 0.1 | 17.2 | 2.0 | 0.0 | 0.0 | |
| WS208 | 3 | --- | 180 secs | - | - | -0.1 | - | 4.4 | 0.1 | 17.9 | 2.0 | 0.0 | 0.0 | |
| WS208 | 3 | --- | 240 secs | - | - | -0.1 | - | 4.5 | 0.1 | 17.8 | 2.0 | 0.0 | 0.0 | |
| WS208 | 3 | --- | 300 secs | - | - | -0.1 | - | 4.5 | 0.1 | 17.6 | 2.0 | 0.0 | 0.0 | |
| WS208 | 3 | --- | 360 secs | - | - | -0.1 | - | 4.5 | 0.1 | 17.5 | 2.0 | 0.0 | 0.0 | |

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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Hertfordshire
HP3 9RT

| Compiled By | Date | Checked By | Date | Contract Ref: |
|---|---|---|---|---|
| V. Macfarlane | 15/01/15 | | | 25024 |

Contract: **Twickenham Sorting Office MOL**



AGS

# IN-SITU GAS MONITORING RESULTS

| Exploratory Position ID | Monitoring Round | Installation Depth (mbgl) | Date & Time of Monitoring (elapsed time) | Borehole Pressure (mb) | Atmos Pressure (mb) | Gas Flow (l/hr) | Water Depth (mbgl) | Carbon Dioxide (% / vol) | Methane (% / vol) | Oxygen (% / vol) | LEL (%) | Carbon Monoxide (ppm) | Hydrogen Sulphide (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS208 | 3 | --- | 420 secs | - | - | -0.1 | - | 4.6 | 0.1 | 17.3 | 2.0 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | | |
| WS211 | 1 | 4.09 | 15/12/2014 | 1009 | 1009 | 0.0 | DRY | 0.1 | 0.1 | 21.4 | 1.0 | 0.0 | 0.0 | |
| WS211 | 1 | --- | 15 secs | - | - | 0.1 | - | 2.4 | 0.1 | 20.2 | 1.0 | 0.0 | 0.0 | |
| WS211 | 1 | --- | 30 secs | - | - | 0.0 | - | 2.4 | 0.1 | 19.3 | 1.0 | 0.0 | 0.0 | |
| WS211 | 1 | --- | 60 secs | - | - | 0.0 | - | 2.4 | 0.1 | 19.3 | 1.0 | 0.0 | 0.0 | |
| WS211 | 1 | --- | 90 secs | - | - | 0.0 | - | 2.4 | 0.1 | 19.3 | 1.0 | 0.0 | 0.0 | |
| WS211 | 1 | --- | 120 secs | - | - | 0.0 | - | 2.5 | 0.1 | 19.3 | 1.0 | 0.0 | 0.0 | |
| WS211 | 1 | --- | 180 secs | - | - | 0.0 | - | 2.8 | 0.1 | 19.0 | 1.0 | 0.0 | 0.0 | |
| WS211 | 1 | --- | 240 secs | - | - | 0.0 | - | 3.3 | 0.1 | 18.5 | 1.0 | 0.0 | 0.0 | |
| WS211 | 1 | --- | 300 secs | - | - | 0.0 | - | 3.2 | 0.1 | 18.5 | 1.0 | 0.0 | 0.0 | |
| WS211 | 1 | --- | 360 secs | - | - | 0.0 | - | 3.2 | 0.1 | 18.6 | 1.0 | 0.0 | 0.0 | |
| WS211 | 1 | --- | 420 secs | - | - | 0.0 | - | 3.1 | 0.1 | 18.7 | 1.0 | 0.0 | 0.0 | |
| WS211 | 2 | 4.09 | 22/12/2014 | 1018 | 1018 | 0.0 | DRY | 0.3 | 0.0 | 20.1 | 0.0 | 0.0 | 0.0 | |
| WS211 | 2 | --- | 15 secs | - | - | 0.0 | - | 3.4 | 0.0 | 18.5 | 0.0 | 0.0 | 0.0 | |
| WS211 | 2 | --- | 30 secs | - | - | 0.0 | - | 3.4 | 0.0 | 17.2 | 0.0 | 0.0 | 0.0 | |
| WS211 | 2 | --- | 60 secs | - | - | 0.0 | - | 3.5 | 0.0 | 16.9 | 0.0 | 0.0 | 0.0 | |
| WS211 | 2 | --- | 90 secs | - | - | 0.0 | - | 3.6 | 0.0 | 16.9 | 0.0 | 0.0 | 0.0 | |
| WS211 | 2 | --- | 120 secs | - | - | 0.0 | - | 3.7 | 0.0 | 16.8 | 0.0 | 0.0 | 0.0 | |
| WS211 | 2 | --- | 180 secs | - | - | 0.0 | - | 4.2 | 0.0 | 16.6 | 0.0 | 0.0 | 0.0 | |
| WS211 | 2 | --- | 240 secs | - | - | 0.0 | - | 4.7 | 0.0 | 15.8 | 0.0 | 0.0 | 0.0 | |
| WS211 | 2 | --- | 300 secs | - | - | 0.0 | - | 4.9 | 0.0 | 15.7 | 0.0 | 0.0 | 0.0 | |
| WS211 | 2 | --- | 360 secs | - | - | 0.0 | - | 4.9 | 0.0 | 15.6 | 0.0 | 0.0 | 0.0 | |
| WS211 | 2 | --- | 420 secs | - | - | 0.0 | - | 4.9 | 0.0 | 15.6 | 0.0 | 0.0 | 0.0 | |
| WS211 | 3 | 4.12 | 13/01/2015 | 998 | 998 | -0.1 | 4.04 | 0.1 | 0.1 | 21.2 | 2.0 | 0.0 | 0.0 | |

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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| Compiled By | Date | Checked By | Date | Contract Ref: |
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| V. Macfarlane | 15/01/15 | | | 25024 |

Contract: **Twickenham Sorting Office MOL**



AGS

# IN-SITU GAS MONITORING RESULTS

| Exploratory Position ID | Monitoring Round | Installation Depth (mbgl) | Date & Time of Monitoring (elapsed time) | Borehole Pressure (mb) | Atmos Pressure (mb) | Gas Flow (l/hr) | Water Depth (mbgl) | Carbon Dioxide (% / vol) | Methane (% / vol) | Oxygen (% / vol) | LEL (%) | Carbon Monoxide (ppm) | Hydrogen Sulphide (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS211 | 3 | --- | 15 secs | - | - | -0.1 | - | 3.6 | 0.1 | 19.7 | 2.0 | 0.0 | 0.0 | |
| WS211 | 3 | --- | 30 secs | - | - | -0.1 | - | 3.7 | 0.1 | 19.7 | 2.0 | 0.0 | 0.0 | |
| WS211 | 3 | --- | 60 secs | - | - | -0.1 | - | 3.7 | 0.1 | 17.8 | 2.0 | 0.0 | 0.0 | |
| WS211 | 3 | --- | 90 secs | - | - | -0.1 | - | 3.8 | 0.1 | 17.8 | 2.0 | 0.0 | 0.0 | |
| WS211 | 3 | --- | 120 secs | - | - | -0.1 | - | 4.1 | 0.1 | 17.8 | 2.0 | 0.0 | 0.0 | |
| WS211 | 3 | --- | 180 secs | - | - | -0.1 | - | 4.3 | 0.1 | 17.1 | 2.0 | 0.0 | 0.0 | |
| WS211 | 3 | --- | 240 secs | - | - | -0.1 | - | 4.3 | 0.1 | 17.6 | 2.0 | 0.0 | 0.0 | |
| WS211 | 3 | --- | 300 secs | - | - | -0.1 | - | 4.3 | 0.1 | 17.7 | 2.0 | 0.0 | 0.0 | |
| WS211 | 3 | --- | 360 secs | - | - | -0.1 | - | 4.3 | 0.1 | 17.7 | 2.0 | 0.0 | 0.0 | |
| WS211 | 3 | --- | 420 secs | - | - | -0.1 | - | 4.3 | 0.1 | 17.8 | 2.0 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | | |
| WS217 | 1 | 3.97 | 15/12/2014 | 1009 | 1009 | 0.0 | DRY | 0.1 | 0.1 | 21.5 | 1.0 | 0.0 | 0.0 | |
| WS217 | 1 | --- | 15 secs | - | - | 0.0 | - | 1.7 | 0.1 | 21.5 | 1.0 | 0.0 | 0.0 | |
| WS217 | 1 | --- | 30 secs | - | - | 0.0 | - | 1.8 | 0.1 | 20.4 | 1.0 | 0.0 | 0.0 | |
| WS217 | 1 | --- | 60 secs | - | - | 0.0 | - | 1.8 | 0.1 | 20.3 | 1.0 | 0.0 | 0.0 | |
| WS217 | 1 | --- | 90 secs | - | - | 0.0 | - | 1.8 | 0.1 | 20.3 | 1.0 | 0.0 | 0.0 | |
| WS217 | 1 | --- | 120 secs | - | - | 0.0 | - | 1.8 | 0.1 | 20.3 | 1.0 | 0.0 | 0.0 | |
| WS217 | 1 | --- | 180 secs | - | - | 0.0 | - | 2.0 | 0.1 | 20.1 | 1.0 | 0.0 | 0.0 | |
| WS217 | 1 | --- | 240 secs | - | - | 0.0 | - | 2.3 | 0.1 | 19.9 | 1.0 | 0.0 | 0.0 | |
| WS217 | 1 | --- | 300 secs | - | - | 0.0 | - | 2.3 | 0.1 | 19.9 | 1.0 | 0.0 | 0.0 | |
| WS217 | 1 | --- | 360 secs | - | - | 0.0 | - | 2.2 | 0.1 | 19.9 | 1.0 | 0.0 | 0.0 | |
| WS217 | 1 | --- | 420 secs | - | - | 0.0 | - | 2.1 | 0.1 | 19.9 | 1.0 | 0.0 | 0.0 | |
| WS217 | 2 | 4.00 | 22/12/2014 | 1018 | 1018 | 0.0 | DRY | 0.5 | 0.0 | 20.0 | 0.0 | 0.0 | 0.0 | |
| WS217 | 2 | --- | 15 secs | - | - | 0.0 | - | 1.7 | 0.0 | 19.4 | 0.0 | 0.0 | 0.0 | |
| WS217 | 2 | --- | 30 secs | - | - | 0.0 | - | 1.8 | 0.0 | 19.0 | 0.0 | 0.0 | 0.0 | |

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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| V. Macfarlane | 15/01/15 | | | 25024 |

Contract: **Twickenham Sorting Office MOL**



AGS

# IN-SITU GAS MONITORING RESULTS

| Exploratory Position ID | Monitoring Round | Installation Depth (mbgl) | Date & Time of Monitoring (elapsed time) | Borehole Pressure (mb) | Atmos Pressure (mb) | Gas Flow (l/hr) | Water Depth (mbgl) | Carbon Dioxide (% / vol) | Methane (% / vol) | Oxygen (% / vol) | LEL (%) | Carbon Monoxide (ppm) | Hydrogen Sulphide (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS217 | 2 | --- | 60 secs | - | - | 0.0 | - | 1.8 | 0.0 | 19.0 | 0.0 | 0.0 | 0.0 | |
| WS217 | 2 | --- | 90 secs | - | - | 0.0 | - | 1.8 | 0.0 | 19.0 | 0.0 | 0.0 | 0.0 | |
| WS217 | 2 | --- | 120 secs | - | - | 0.0 | - | 1.8 | 0.0 | 19.0 | 0.0 | 0.0 | 0.0 | |
| WS217 | 2 | --- | 180 secs | - | - | 0.0 | - | 2.0 | 0.0 | 18.9 | 0.0 | 0.0 | 0.0 | |
| WS217 | 2 | --- | 240 secs | - | - | 0.0 | - | 2.3 | 0.0 | 18.7 | 0.0 | 0.0 | 0.0 | |
| WS217 | 2 | --- | 300 secs | - | - | 0.0 | - | 2.4 | 0.0 | 18.7 | 0.0 | 0.0 | 0.0 | |
| WS217 | 2 | --- | 360 secs | - | - | 0.0 | - | 2.4 | 0.0 | 18.7 | 0.0 | 0.0 | 0.0 | |
| WS217 | 2 | --- | 420 secs | - | - | 0.0 | - | 2.4 | 0.0 | 18.7 | 0.0 | 0.0 | 0.0 | |
| WS217 | 3 | 4.06 | 13/01/2015 | 998 | 998 | -0.1 | DRY | 0.1 | 0.1 | 20.2 | 2.0 | 0.0 | 0.0 | |
| WS217 | 3 | --- | 15 secs | - | - | -0.1 | - | 1.7 | 0.1 | 20.2 | 2.0 | 0.0 | 0.0 | |
| WS217 | 3 | --- | 30 secs | - | - | -0.1 | - | 1.7 | 0.1 | 20.1 | 2.0 | 0.0 | 0.0 | |
| WS217 | 3 | --- | 60 secs | - | - | -0.1 | - | 1.8 | 0.1 | 20.1 | 2.0 | 0.0 | 0.0 | |
| WS217 | 3 | --- | 90 secs | - | - | -0.1 | - | 1.8 | 0.1 | 20.0 | 2.0 | 0.0 | 0.0 | |
| WS217 | 3 | --- | 120 secs | - | - | -0.1 | - | 1.9 | 0.1 | 20.0 | 2.0 | 0.0 | 0.0 | |
| WS217 | 3 | --- | 180 secs | - | - | -0.1 | - | 2.0 | 0.1 | 19.9 | 2.0 | 0.0 | 0.0 | |
| WS217 | 3 | --- | 240 secs | - | - | -0.1 | - | 2.1 | 0.1 | 19.7 | 2.0 | 0.0 | 0.0 | |
| WS217 | 3 | --- | 300 secs | - | - | -0.1 | - | 2.2 | 0.1 | 19.7 | 2.0 | 0.0 | 0.0 | |
| WS217 | 3 | --- | 360 secs | - | - | -0.1 | - | 2.1 | 0.1 | 19.8 | 2.0 | 0.0 | 0.0 | |
| WS217 | 3 | --- | 420 secs | - | - | -0.1 | - | 2.1 | 0.1 | 19.8 | 2.0 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | | |

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

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| Compiled By | Date | Checked By | Date | Contract Ref: |
|---|---|---|---|---|
| V. Macfarlane | 15/01/15 | | | 25024 |

Contract: **Twickenham Sorting Office MOL**



AGS

# Groundwater Sampling Data Form

| | | | | |
|---|---|---|---|---|
| Project Information | Project Name: | Twickenham | | |
| | Project Number: | 25024 | | |
| | Sampling Date: | 22-Dec | Sampled by: | VM |
| | Weather: | Dry/cloudy | | |
| | Well Notes - e.g. Condition, Access, Safety: | | | |

| | | | | | |
|---|---|---|---|---|---|
| Monitoring Information | Water Quality Meter Used: | | Water Level Meter Used (as applicable): | Interface Probe: | |
| | | | | Dip Meter: | |
| | Water Quality Meter Last Calibrated: | Dissolved Oxygen: | | pH, ORP, Specific Conductivity: | |

| Typical Parameter Stabilisation Criteria for Low-Flow Sampling | |
|---|---|
| Dissolved Oxygen (D.O.) | 0.3 mg/l |
| Specific Conductivity (Sp.Cond) | 3% |
| p.H | 0.1 unit |
| Oxygen Reduction Potential (ORP) | 10mV |
| * For REDOX correction, see separate guidance | |

| Well Location | WS205 |
|---|---|
| Well Diameter (mm) | 42 |
| Well Material | PVC |
| Static Water Level (mTOC) | 2.57 |
| LNAPL Present? | Y / N ■ |
| LNAPL Level (mTOC) | |
| Well Headspace Reading (PID/FID) | |
| Purge Method | Low Flow / Other: |
| Sampling Method | Peristaltic ■ Other: / Bladder |
| Pump Intake Depth (mTOC) | 3.07 |
| Well Depth (mTOC) | 3.96 |
| DNAPL Present? | Y / N ■ |
| DNAPL Level (mTOC) | |

| Purge Start Time | | | | | | Depth to Water (mTOC) | Corr. REDOX (mV)* | Notes / Flow (ml/min) |
|---|---|---|---|---|---|---|---|---|
| Time (HH:mm) | Temp (oC) | Sp.Cond (µS/cm) | D.O. (mg/l) | pH (units) | ORP (mV) | | | |
| 13:00 | 11.7 | | | 7.03 | 89.8 | 2.57 | | 400/1 |
| 13:03 | 11.6 | 760 | 5.21 | 6.86 | 91.5 | | | |
| 13:06 | 11.5 | 760 | 5.56 | 6.83 | 87.4 | | | |
| 13:09 | 11.5 | 760 | 5.54 | 6.81 | 88.8 | | | |
| 13:12 | 11.5 | 759 | 5.4 | 6.81 | 89.2 | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

| | |
|---|---|
| Sampling Notes (e.g. oil/colour/odour), Reasons if not monitored | |
| Sample Containers Obtained | Yes |
| Sample Collection Time | 13:15 |

| Well Location | WS202 |
|---|---|
| Well Diameter (mm) | 42 |
| Well Material | PVC |
| Static Water Level (mTOC) | 2.12 |
| LNAPL Present? | Y / N ■ |
| LNAPL Level (mTOC) | |
| Well Headspace Reading (PID/FID) | |
| Purge Method | Low Flow / Other: |
| Sampling Method | Peristaltic ■ Other: / Bladder |
| Pump Intake Depth (mTOC) | |
| Well Depth (mTOC) | |
| DNAPL Present? | Y / N ■ |
| DNAPL Level (mTOC) | |

| Purge Start Time | | | | | | Depth to Water (mTOC) | Corr. REDOX (mV)* | Notes / Flow (ml/min) |
|---|---|---|---|---|---|---|---|---|
| Time (HH:mm) | Temp (oC) | Sp.Cond (µS/cm) | D.O. (mg/l) | pH (units) | ORP (mV) | | | |
| 11:03 | 11.8 | | | 6.81 | 147.5 | 2.62 | | 400/1 |
| 11:06 | 11.7 | 782 | 5.42 | 6.75 | 144.9 | | | |
| 11:09 | 11.7 | 779 | 5.57 | 6.74 | 142.8 | | | |
| 11:12 | 11.7 | 777 | 5.8 | 6.73 | 141.2 | | | |
| 11:15 | 11.7 | 776 | 6.21 | 6.73 | 139.9 | | | |
| 11:18 | 11.7 | 775 | 6.67 | 6.73 | 138.4 | | | |
| 11:21 | 11.7 | 774 | 6.96 | 6.73 | 136.9 | | | |
| 11:24 | 11.7 | 774 | 6.87 | 6.72 | 135.7 | | | |
| 11:27 | 11.7 | 773 | 6.55 | 6.72 | 135.1 | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

| | |
|---|---|
| Sampling Notes (e.g. oil/colour/odour), Reasons if not monitored | |
| Sample Containers Obtained | Yes |
| Sample Collection Time | 11:30 |

mTOC = Metres below top of casing level. Record if measurements are taken to an alternate datum (e.g. ground level)

| Well Location | WS203 |
|---|---|
| Well Diameter (mm) | 42 |
| Well Material | PVC |
| Static Water Level (mTOC) | 2.36 |
| LNAPL Present? | Y / N ■ |
| LNAPL Level (mTOC) | |
| Well Headspace Reading (PID/FID) | |
| Purge Method | Low Flow / Other: |
| Sampling Method | Peristaltic ■ / Other: / Bladder |
| Pump Intake Depth (mTOC) | 2.86 |
| Well Depth (mTOC) | |
| DNAPL Present? | Y / N |
| DNAPL Level (mTOC) | |

| Purge Start Time | | | | | | Depth to Water (mTOC) | Corr. REDOX (mV)* | Notes / Flow (ml/min) |
|---|---|---|---|---|---|---|---|---|
| Time (HH:mm) | Temp (oC) | Sp.Cond (µS/cm) | D.O. (mg/l) | pH (units) | ORP (mV) | | | |
| 12:00 | 12.1 | | | 6.74 | 138.8 | 2.86 | | 400/1 |
| 12:03 | 12.1 | 894 | 5.4 | 6.7 | 113.4 | | | |
| 12:06 | 12 | 893 | 3.71 | 6.7 | 97 | | | |
| 12:09 | 12.1 | 894 | 2.93 | 6.7 | 82 | | | |
| 12:12 | 12.1 | 894 | 2.25 | 6.7 | 68.8 | | | |
| 12:15 | 12.1 | 895 | 1.95 | 6.7 | 63.3 | | | |
| 12:18 | 12.1 | 897 | 1.7 | 6.7 | 57.2 | | | |
| 12:21 | 12.1 | 897 | 1.55 | 6.7 | 52.6 | | | |
| 12:24 | 12.1 | 898 | 1.43 | 6.7 | 48.5 | | | |
| 12:27 | 12.1 | 898 | 1.28 | 6.7 | 44.7 | | | |
| | | | | | | | | |
| | | | | | | | | |

| Sampling Notes (e.g. oil/colour/odour), Reasons if not monitored | |
|---|---|
| Sample Containers Obtained | Yes |
| Sample Collection Time | 12:30 |

| Well Location | WS201 |
|---|---|
| Well Diameter (mm) | 42 |
| Well Material | PVC |
| Static Water Level (mTOC) | 3.42 |
| LNAPL Present? | Y / N ■ |
| LNAPL Level (mTOC) | 2.27 |
| Well Headspace Reading (PID/FID) | |
| Purge Method | Low Flow / Other: |
| Sampling Method | Peristaltic ■ / Other: / Bladder |
| Pump Intake Depth (mTOC) | 2.77 |
| Well Depth (mTOC) | |
| DNAPL Present? | Y / N ■ |
| DNAPL Level (mTOC) | |

| Purge Start Time | | | | | | Depth to Water (mTOC) | Corr. REDOX (mV)* | Notes / Flow (ml/min) |
|---|---|---|---|---|---|---|---|---|
| Time (HH:mm) | Temp (oC) | Sp.Cond (µS/cm) | D.O. (mg/l) | pH (units) | ORP (mV) | | | |
| 09:50 | 12.5 | | | 7.5 | | 2.77 | | 400/1 |
| 09:53 | 12.6 | 718 | 5.32 | 7.25 | 158.9 | | | |
| 09:56 | 12.6 | 710 | 5.82 | 7.23 | 157 | | | |
| 09:59 | 12.6 | 705 | 6.19 | 7.22 | 155.7 | | | |
| 10:02 | 12.6 | 702 | 6.3 | 7.22 | 154.7 | | | |
| 10:05 | 12.6 | 700 | 6.41 | 7.21 | 153.4 | | | |
| 10:08 | 12.6 | 698 | 6.51 | 7.21 | 152.2 | | | |
| 10:11 | 12.6 | 698 | 6.56 | 7.2 | 151.3 | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

| Sampling Notes (e.g. oil/colour/odour), Reasons if not monitored | |
|---|---|
| Sample Containers Obtained | Yes |
| Sample Collection Time | 10:38 |

# APPENDIX F
# LABORATORY CERTIFICATES FOR SOIL ANALYSIS

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

# FINAL ANALYTICAL TEST REPORT

**Envirolab Job Number:** 11/03771
**Issue Number:** 1 **Date:** 12 September, 2011

**Client:** RSK STATS Hemel Hempstead
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

**Project Manager:** Christopher Larkin
**Project Name:** Twickenham (Twix)
**Project Ref:** 25024
**Order No:** Not specified
**Date Samples Received:** 25/08/11
**Date Instructions Received:** 25/08/11
**Date Analysis Completed:** 12/09/11

**Prepared by:**

Melanie Marshall
Laboratory Coordinator

**Approved by:**

Liz McDermott
Project Coordinator

Notes - Soil analysis
All results are reported as dry weight (<40°C).
Stones >10mm are removed from the sample prior to analysis and results corrected where appropriate.

Notes - General
For soil samples subscript A indicates analysis performed on the sample as received, D indicates analysis performed on dried & crushed sample.
Superscript M indicates method accredited to MCERTS.

Predominant Matrix Codes - 1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.
Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our MCERTS accreditation.
Secondary Matrix Codes - A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.
IS indicates Insufficient sample for analysis. NDP indicates No Determination Possible. NFI indicates No Fibres Identified.
Superscript # indicates method accredited to ISO 17025.
Accreditation for TPH (C6-C40) applies to the range C6-C36 only.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.

MCERTS
UKAS TESTING 1247

**Envirolab Job Number: 11/03771**

**Client Project Name: Twickenham (Twix)**

**Client Project Ref: 25024**

| Lab Sample ID | 11/03771/1 | 11/03771/2 | 11/03771/3 | 11/03771/4 | 11/03771/5 | 11/03771/6 | 11/03771/7 | | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | PH1 | PH2 | PH3 | PH4 | PH5 | PH9 | PH10 | | | |
| Depth to Top | 0.30 | 0.40 | 0.40 | 0.50 | 0.50 | 0.45 | 0.25 | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | | | | | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | |
| Sample Matrix Code | 4AE | 7 | 6AE | 4AE | 5E | 5AE | 4AE | | | |
| $pH_D$ M# | 7.84 | 7.13 | 8.18 | 7.33 | 6.74 | 7.03 | 7.65 | | pH | A-T-031s |
| Sulphate (water sol 2:1)$_D$ M# | <0.01 | 0.05 | 0.02 | <0.01 | 0.03 | 0.02 | <0.01 | | g/l | A-T-026s |
| Sulphate (acid soluble)$_D$ M# | <200 | 290 | <200 | 270 | 300 | <200 | 480 | | mg/kg | A-T-028 |
| Arsenic$_D$ M# | 7 | 9 | 8 | 6 | 3 | 8 | 9 | | mg/kg | A-T-024 |
| Cadmium$_D$ M# | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | mg/kg | A-T-024 |
| Copper$_D$ M# | 6 | 8 | 27 | 23 | 17 | 8 | 34 | | mg/kg | A-T-024 |
| Chromium$_D$ M# | 19 | 17 | 16 | 14 | 48 | 15 | 18 | | mg/kg | A-T-024 |
| Chromium (hexavalent) Dep$_D$ | - | - | - | - | <1 | - | - | | mg/kg | A-T-040s |
| Lead$_D$ M# | 10 | 49 | 32 | 365 | 22 | 12 | 189 | | mg/kg | A-T-024 |
| Mercury$_D$ | <0.17 | <0.17 | <0.17 | 0.34 | 0.17 | <0.17 | 0.46 | | mg/kg | A-T-024 |
| Nickel$_D$ M# | 15 | 17 | 27 | 12 | 22 | 15 | 15 | | mg/kg | A-T-024 |
| Selenium$_D$ M# | <1 | <1 | <1 | <1 | 2 | <1 | <1 | | mg/kg | A-T-024 |
| Zinc$_D$ M# | 32 | 23 | 37 | 43 | 77 | 21 | 133 | | mg/kg | A-T-024 |

**Envirolab Job Number: 11/03771**

**Client Project Name: Twickenham (Twix)**

**Client Project Ref: 25024**

| Lab Sample ID | 11/03771/1 | 11/03771/2 | 11/03771/3 | 11/03771/4 | 11/03771/5 | 11/03771/6 | 11/03771/7 | | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | PH1 | PH2 | PH3 | PH4 | PH5 | PH9 | PH10 | | | |
| Depth to Top | 0.30 | 0.40 | 0.40 | 0.50 | 0.50 | 0.45 | 0.25 | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | | | | | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | |
| Sample Matrix Code | 4AE | 7 | 6AE | 4AE | 5E | 5AE | 4AE | | | |
| **TPH CWG** | | | | | | | | | | |
| Ali >C5-C6$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| Ali >C6-C8$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| Ali >C8-C10$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| Ali >C10-C12$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | mg/kg | A-T-023s |
| Ali >C12-C16$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | mg/kg | A-T-023s |
| Ali >C16-C21$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | mg/kg | A-T-023s |
| Ali >C21-C35$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | mg/kg | A-T-023s |
| Total Aliphatics$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | mg/kg | A-T-022+23s |
| Aro >C5-C7$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| Aro >C7-C8$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| Aro >C8-C9$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| Aro >C9-C10$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| Aro >C10-C12$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | mg/kg | A-T-023s |
| Aro >C12-C16$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 5.5 | | mg/kg | A-T-023s |
| Aro >C16-C21$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 19.0 | | mg/kg | A-T-023s |
| Aro >C21-C35$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 76.8 | | mg/kg | A-T-023s |
| Total Aromatics$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 102 | | mg/kg | A-T-022+23s |
| TPH (Ali & Aro)$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 102 | | mg/kg | A-T-022+23s |
| | | | | | | | | | | |
| BTEX - Benzene$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| BTEX - Toluene$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| BTEX - Ethyl Benzene$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| BTEX - m & p Xylene$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| BTEX - o Xylene$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| MTBE$_A$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | mg/kg | A-T-022s |
| | | | | | | | | | | |

Envirolab Job Number: 11/03771

Client Project Name: Twickenham (Twix)

Client Project Ref: 25024

| Lab Sample ID | 11/03771/1 | 11/03771/2 | 11/03771/3 | 11/03771/4 | 11/03771/5 | 11/03771/6 | 11/03771/7 | | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | PH1 | PH2 | PH3 | PH4 | PH5 | PH9 | PH10 | | | |
| Depth to Top | 0.30 | 0.40 | 0.40 | 0.50 | 0.50 | 0.45 | 0.25 | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | | | | | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | Soil | | | |
| Sample Matrix Code | 4AE | 7 | 6AE | 4AE | 5E | 5AE | 4AE | | | |
| PAH 16 | | | | | | | | | | |
| Acenapthene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | | mg/kg | A-T-019s |
| Acenapthylene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.06 | | mg/kg | A-T-019s |
| Anthracene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.09 | | mg/kg | A-T-019s |
| Benzo(a)anthracene$_A^\#$ | <0.01 | 0.03 | 0.14 | 0.14 | <0.01 | 0.02 | 0.95 | | mg/kg | A-T-019s |
| Benzo(a)pyrene$_A^\#$ | <0.01 | <0.01 | 0.11 | 0.15 | <0.01 | 0.02 | 0.96 | | mg/kg | A-T-019s |
| Benzo(b)fluoranthene$_A$ | <0.01 | 0.03 | 0.19 | 0.22 | <0.01 | 0.07 | 1.29 | | mg/kg | A-T-019s |
| Benzo(ghi)perylene$_A^\#$ | <0.01 | <0.01 | 0.12 | 0.17 | <0.01 | <0.01 | 1.09 | | mg/kg | A-T-019s |
| Benzo(k)fluoranthene$_A$ | <0.01 | <0.01 | 0.04 | <0.01 | <0.01 | <0.01 | 0.16 | | mg/kg | A-T-019s |
| Chrysene$_A^\#$ | <0.01 | 0.09 | 0.31 | 0.32 | <0.01 | 0.10 | 1.79 | | mg/kg | A-T-019s |
| Dibenzo(ah)anthracene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.07 | | mg/kg | A-T-019s |
| Fluoranthene$_A^\#$ | <0.01 | 0.08 | 0.24 | 0.25 | <0.01 | 0.07 | 1.95 | | mg/kg | A-T-019s |
| Fluorene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | | mg/kg | A-T-019s |
| Indeno(123-cd)pyrene$_A^\#$ | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 | <0.01 | 0.48 | | mg/kg | A-T-019s |
| Napthalene$_A^\#$ | <0.01 | <0.01 | 0.02 | <0.01 | <0.01 | <0.01 | 0.09 | | mg/kg | A-T-019s |
| Phenanthrene$_A^\#$ | <0.01 | 0.01 | 0.10 | 0.10 | <0.01 | 0.03 | 0.93 | | mg/kg | A-T-019s |
| Pyrene$_A^\#$ | <0.01 | 0.06 | 0.23 | 0.22 | <0.01 | 0.09 | 1.73 | | mg/kg | A-T-019s |
| Total PAH$_A$ | <0.01 | 0.30 | 1.52 | 1.59 | <0.01 | 0.42 | 11.7 | | mg/kg | A-T-019s |

Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

# FINAL ANALYTICAL TEST REPORT

## SUPPLEMENT TO TEST REPORT 14/06836/1

**Envirolab Job Number:** 14/06836
**Issue Number:** 2 **Date:** 15 January, 2015

**Client:**
RSK Environment Ltd Hemel
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

**Project Manager:** Andrew Kent/Nigel Austin/Verity Macfarlane
**Project Name:** Twickenham MOL
**Project Ref:** 25024
**Order No:** N/A
**Date Samples Received:** 08/12/14
**Date Instructions Received:** 08/12/14
**Date Analysis Completed:** 15/01/15

**Prepared by:**
Melanie Marshall
Laboratory Coordinator

**Approved by:**
Iain Haslock
Analytical Consultant

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/1 | 14/06836/2 | 14/06836/3 | 14/06836/4 | 14/06836/5 | 14/06836/6 | 14/06836/7 | 14/06836/8 | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS213 | WS209 | WS206 | WS205 | WS201 | WS202 | WS203 | WS208 | | |
| Depth to Top | 0.50 | 0.30 | 0.20 | 0.60 | 0.30 | 0.30 | 0.30 | 0.80 | | |
| Depth To Bottom | | | | | | | | 1.00 | | |
| Date Sampled | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Solid | Soil - ES | Soil - ES | Soil - ES | | |
| MCERTS Sample Matrix Code | 4ABE | 4AE | 4AE | 6AE | 7 | 6AE | 6AE | 6AE | | |
| % Stones >10mm$_A^{\#}$ | 5.3 | 12.9 | 36.8 | 2.1 | 14.3 | 8.4 | 3.5 | 9.1 | % w/w | A-T-044 |
| Organic matter$_D^{M\#}$ | 65.7 | - | 4.2 | - | 2.8 | - | 9.2 | - | % w/w | A-T-032 OM |
| Arsenic$_D^{M\#}$ | 19 | 17 | 6 | 16 | 7 | 13 | 14 | 11 | mg/kg | A-T-024s |
| Cadmium$_D^{M\#}$ | 1.4 | 0.5 | <0.5 | 0.6 | <0.5 | 0.5 | 0.8 | <0.5 | mg/kg | A-T-024s |
| Copper$_D^{M\#}$ | 114 | 33 | 18 | 72 | 21 | 55 | 74 | 55 | mg/kg | A-T-024s |
| Chromium$_D^{M\#}$ | 13 | 11 | 10 | 23 | 21 | 27 | 26 | 23 | mg/kg | A-T-024s |
| Lead$_D^{M\#}$ | 1500 | 927 | 337 | 2040 | 81 | 244 | 257 | 304 | mg/kg | A-T-024s |
| Mercury$_D$ | 1.93 | 0.30 | <0.17 | 1.67 | 0.41 | 1.81 | 0.76 | 0.79 | mg/kg | A-T-024s |
| Nickel$_D^{M\#}$ | 32 | 15 | 12 | 24 | 19 | 21 | 23 | 19 | mg/kg | A-T-024s |
| Selenium$_D^{M\#}$ | <1 | <1 | <1 | 2 | <1 | <1 | 2 | <1 | mg/kg | A-T-024s |
| Zinc$_D^{M\#}$ | 921 | 53 | 160 | 263 | 83 | 141 | 166 | 73 | mg/kg | A-T-024s |

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/1 | 14/06836/2 | 14/06836/3 | 14/06836/4 | 14/06836/5 | 14/06836/6 | 14/06836/7 | 14/06836/8 | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS213 | WS209 | WS206 | WS205 | WS201 | WS202 | WS203 | WS208 | | |
| Depth to Top | 0.50 | 0.30 | 0.20 | 0.60 | 0.30 | 0.30 | 0.30 | 0.80 | | |
| Depth To Bottom | | | | | | | | 1.00 | | |
| Date Sampled | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Solid | Soil - ES | Soil - ES | Soil - ES | | |
| MCERTS Sample Matrix Code | 4ABE | 4AE | 4AE | 6AE | 7 | 6AE | 6AE | 6AE | | |
| Leachate Prep BS EN 12457-1 (2:1)$_A$ | | | | | | | | | | A-T-046 |
| Arsenic (leachable)$_A^{\#}$ | - | - | - | 8 | - | - | - | - | µg/l | A-T-025w |
| Cadmium (leachable)$_A^{\#}$ | - | - | - | <1 | - | - | - | - | µg/l | A-T-025w |
| Copper (leachable)$_A^{\#}$ | - | - | - | 22 | - | - | - | - | µg/l | A-T-025w |
| Chromium (leachable)$_A^{\#}$ | - | - | - | 4 | - | - | - | - | µg/l | A-T-025w |
| Lead (leachable)$_A^{\#}$ | - | - | - | 321 | - | - | - | - | µg/l | A-T-025w |
| Mercury (leachable)$_A^{\#}$ | - | - | - | <0.1 | - | - | - | - | µg/l | A-T-025w |
| Nickel (leachable)$_A^{\#}$ | - | - | - | 6 | - | - | - | - | µg/l | A-T-025w |
| Selenium (leachable)$_A^{\#}$ | - | - | - | <1 | - | - | - | - | µg/l | A-T-025w |
| Zinc (leachable)$_A^{\#}$ | - | - | - | 43 | - | - | - | - | µg/l | A-T-025w |
| | | | | | | | | | | |
| Asbestos in Soil (inc. matrix) | | | | | | | | | | |
| Asbestos in soil$_D^{\#}$ | NAD | NAD | NAD | NAD | NAD | NAD | NAD | NAD | | A-T-045 |
| Asbestos ACM - Suitable for Water Absorption Test?$_D$ | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | | Gravimetry |
| | | | | | | | | | | |
| At+Sim Herbicides | | | | | | | | | | |
| Atrazine | <50 | <50 | <50 | <50 | <50 | - | - | - | µg/kg | Subcon |
| Simazine | <50 | <50 | <50 | <50 | <50 | - | - | - | µg/kg | Subcon |

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/1 | 14/06836/2 | 14/06836/3 | 14/06836/4 | 14/06836/5 | 14/06836/6 | 14/06836/7 | 14/06836/8 | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS213 | WS209 | WS206 | WS205 | WS201 | WS202 | WS203 | WS208 | | |
| Depth to Top | 0.50 | 0.30 | 0.20 | 0.60 | 0.30 | 0.30 | 0.30 | 0.80 | | |
| Depth To Bottom | | | | | | | | 1.00 | | |
| Date Sampled | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Solid | Soil - ES | Soil - ES | Soil - ES | | |
| MCERTS Sample Matrix Code | 4ABE | 4AE | 4AE | 6AE | 7 | 6AE | 6AE | 6AE | | |
| **PAH 16** | | | | | | | | | | |
| Acenaphthene$_A^{M\#}$ | 0.01 | <0.01 | 0.04 | 0.04 | 0.02 | 0.04 | 0.34 | <0.01 | mg/kg | A-T-019s |
| Acenaphthylene$_A^{M\#}$ | 0.02 | <0.01 | 0.04 | 0.11 | 0.05 | 0.08 | 0.18 | <0.01 | mg/kg | A-T-019s |
| Anthracene$_A^{M\#}$ | 0.06 | <0.02 | 0.08 | 0.33 | 0.08 | 0.29 | 1.03 | 0.06 | mg/kg | A-T-019s |
| Benzo(a)anthracene$_A^{M\#}$ | 0.48 | 0.06 | 0.56 | 2.29 | 0.59 | 2.54 | 6.06 | 0.42 | mg/kg | A-T-019s |
| Benzo(a)pyrene$_A^{M\#}$ | 0.45 | 0.05 | 0.62 | 2.54 | 0.63 | 2.63 | 5.76 | 0.48 | mg/kg | A-T-019s |
| Benzo(b)fluoranthene$_A^{M\#}$ | 0.62 | 0.08 | 0.82 | 3.20 | 0.94 | 0.89 | 6.87 | 0.53 | mg/kg | A-T-019s |
| Benzo(ghi)perylene$_A^{M\#}$ | 0.27 | <0.05 | 0.39 | 1.56 | 0.44 | 1.51 | 3.41 | 0.23 | mg/kg | A-T-019s |
| Benzo(k)fluoranthene$_A^{M\#}$ | 0.21 | <0.07 | 0.29 | 1.12 | 0.29 | 1.12 | 2.42 | 0.30 | mg/kg | A-T-019s |
| Chrysene$_A^{M\#}$ | 0.58 | 0.07 | 0.68 | 2.53 | 0.78 | 2.75 | 6.31 | 0.55 | mg/kg | A-T-019s |
| Dibenzo(ah)anthracene$_A^{M\#}$ | 0.07 | <0.04 | 0.09 | 0.39 | 0.09 | 0.38 | 0.86 | 0.07 | mg/kg | A-T-019s |
| Fluoranthene$_A^{M\#}$ | 0.92 | 0.10 | 1.25 | 3.70 | 1.18 | 4.74 | 12.5 | 0.75 | mg/kg | A-T-019s |
| Fluorene$_A^{M\#}$ | 0.02 | <0.01 | 0.04 | 0.06 | 0.02 | 0.06 | 0.30 | 0.01 | mg/kg | A-T-019s |
| Indeno(123-cd)pyrene$_A^{M\#}$ | 0.30 | 0.04 | 0.42 | 1.71 | 0.45 | 1.69 | 3.63 | 0.23 | mg/kg | A-T-019s |
| Naphthalene$_A^{M\#}$ | <0.03 | <0.03 | 0.04 | 0.07 | <0.03 | 0.03 | 0.08 | <0.03 | mg/kg | A-T-019s |
| Phenanthrene$_A^{M\#}$ | 0.44 | 0.05 | 0.52 | 1.11 | 0.33 | 1.44 | 5.37 | 0.30 | mg/kg | A-T-019s |
| Pyrene$_A^{M\#}$ | 0.75 | 0.08 | 1.02 | 3.03 | 1.12 | 3.97 | 10.7 | 0.67 | mg/kg | A-T-019s |
| PAH (total 16)$_A^{M\#}$ | 5.18 | 0.53 | 6.89 | 23.8 | 6.99 | 24.1 | 65.8 | 4.62 | mg/kg | A-T-019s |

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/1 | 14/06836/2 | 14/06836/3 | 14/06836/4 | 14/06836/5 | 14/06836/6 | 14/06836/7 | 14/06836/8 | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS213 | WS209 | WS206 | WS205 | WS201 | WS202 | WS203 | WS208 | | |
| Depth to Top | 0.50 | 0.30 | 0.20 | 0.60 | 0.30 | 0.30 | 0.30 | 0.80 | | |
| Depth To Bottom | | | | | | | | 1.00 | | |
| Date Sampled | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Solid | Soil - ES | Soil - ES | Soil - ES | | |
| MCERTS Sample Matrix Code | 4ABE | 4AE | 4AE | 6AE | 7 | 6AE | 6AE | 6AE | | |
| TPH CWG | | | | | | | | | | |
| Ali >C5-C6$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Ali >C6-C8$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Ali >C8-C10$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Ali >C10-C12$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-023s |
| Ali >C12-C16$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | 1.5 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-023s |
| Ali >C16-C21$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | 5.3 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-023s |
| Ali >C21-C35$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | 0.9 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-023s |
| Total Aliphatics$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | 7.8 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-022+23s |
| Aro >C5-C7$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Aro >C7-C8$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Aro >C8-C9$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Aro >C9-C10$_A^\#$ | <0.01 | <0.01 | 0.31 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Aro >C10-C12$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-023s |
| Aro >C12-C16$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | 0.6 | <0.1 | 0.4 | <0.1 | mg/kg | A-T-023s |
| Aro >C16-C21$_A^\#$ | 1.8 | <0.1 | 0.4 | 1.3 | 1.3 | 1.2 | 9.1 | <0.1 | mg/kg | A-T-023s |
| Aro >C21-C35$_A^\#$ | 1.4 | <0.1 | 0.4 | 2.5 | 1.0 | 2.0 | 13.4 | <0.1 | mg/kg | A-T-023s |
| Total Aromatics$_A$ | 3.2 | <0.1 | 1.1 | 3.8 | 2.9 | 3.3 | 22.9 | <0.1 | mg/kg | A-T-022+23s |
| TPH (Ali & Aro)$_A$ | 3.2 | <0.1 | 1.1 | 3.8 | 10.6 | 3.3 | 22.9 | <0.1 | mg/kg | A-T-022+23s |
| BTEX - Benzene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| BTEX - Toluene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| BTEX - Ethyl Benzene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| BTEX - m & p Xylene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| BTEX - o Xylene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| MTBE$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/9 | 14/06836/10 | 14/06836/11 | 14/06836/12 | 14/06836/13 | 14/06836/14 | 14/06836/15 | 14/06836/16 | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS211 | WS217 | WS204 | WS210 | WS214 | WS215 | WS212 | WS207 | | |
| Depth to Top | 0.40 | 0.40 | 0.30 | 0.50 | 0.60 | 0.50 | 0.50 | 0.50 | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 03-Dec-14 | 03-Dec-14 | 03-Dec-14 | 03-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Solid | | |
| MCERTS Sample Matrix Code | 4A | 4AE | 4ABE | 4AE | 4AE | 4AE | 4AE | 7 | | |
| % Stones >10mm$_A^{\#}$ | 17.5 | 4.5 | 15.4 | 21.4 | <0.1 | <0.1 | 16.9 | <0.1 | % w/w | A-T-044 |
| Organic matter$_D^{M\#}$ | 57.3 | - | 17.5 | - | 9.8 | - | 42.0 | - | % w/w | A-T-032 OM |
| Arsenic$_D^{M\#}$ | 10 | 19 | 15 | 11 | 11 | 9 | 6 | 5 | mg/kg | A-T-024s |
| Cadmium$_D^{M\#}$ | <0.5 | 1.2 | 0.6 | 0.6 | 1.3 | <0.5 | <0.5 | <0.5 | mg/kg | A-T-024s |
| Copper$_D^{M\#}$ | 136 | 57 | 141 | 30 | 37 | 35 | 99 | 11 | mg/kg | A-T-024s |
| Chromium$_D^{M\#}$ | 11 | 14 | 24 | 15 | 14 | 13 | 56 | 30 | mg/kg | A-T-024s |
| Lead$_D^{M\#}$ | 386 | 824 | 257 | 625 | 1100 | 188 | 164 | 40 | mg/kg | A-T-024s |
| Mercury$_D$ | 0.46 | 0.33 | 1.04 | 0.34 | <0.17 | 0.36 | 2.38 | 0.38 | mg/kg | A-T-024s |
| Nickel$_D^{M\#}$ | 40 | 27 | 41 | 17 | 20 | 13 | 42 | 17 | mg/kg | A-T-024s |
| Selenium$_D^{M\#}$ | <1 | <1 | <1 | <1 | 1 | <1 | <1 | <1 | mg/kg | A-T-024s |
| Zinc$_D^{M\#}$ | 125 | 521 | 133 | 210 | 1900 | 66 | 136 | 24 | mg/kg | A-T-024s |

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/9 | 14/06836/10 | 14/06836/11 | 14/06836/12 | 14/06836/13 | 14/06836/14 | 14/06836/15 | 14/06836/16 | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS211 | WS217 | WS204 | WS210 | WS214 | WS215 | WS212 | WS207 | | |
| Depth to Top | 0.40 | 0.40 | 0.30 | 0.50 | 0.60 | 0.50 | 0.50 | 0.50 | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 03-Dec-14 | 03-Dec-14 | 03-Dec-14 | 03-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Solid | | |
| MCERTS Sample Matrix Code | 4A | 4AE | 4ABE | 4AE | 4AE | 4AE | 4AE | 7 | | |
| Leachate Prep BS EN 12457-1 (2:1)$_A$ | | | | | | | | | | A-T-046 |
| Arsenic (leachable)$_A^{\#}$ | - | 2 | - | - | <1 | - | - | - | µg/l | A-T-025w |
| Cadmium (leachable)$_A^{\#}$ | - | <1 | - | - | <1 | - | - | - | µg/l | A-T-025w |
| Copper (leachable)$_A^{\#}$ | - | 20 | - | - | 3 | - | - | - | µg/l | A-T-025w |
| Chromium (leachable)$_A^{\#}$ | - | <1 | - | - | <1 | - | - | - | µg/l | A-T-025w |
| Lead (leachable)$_A^{\#}$ | - | 281 | - | - | 12 | - | - | - | µg/l | A-T-025w |
| Mercury (leachable)$_A^{\#}$ | - | <0.1 | - | - | <0.1 | - | - | - | µg/l | A-T-025w |
| Nickel (leachable)$_A^{\#}$ | - | 7 | - | - | 3 | - | - | - | µg/l | A-T-025w |
| Selenium (leachable)$_A^{\#}$ | - | <1 | - | - | <1 | - | - | - | µg/l | A-T-025w |
| Zinc (leachable)$_A^{\#}$ | - | 249 | - | - | 422 | - | - | - | µg/l | A-T-025w |
| | | | | | | | | | | |
| **Asbestos in Soil % Composition (Hand Picking & Weighing)** | | | | | | | | | | |
| Asbestos in soil % composition (hand picking and weighing)$_D$ | - | - | - | - | 0.169 | <0.001 | - | - | % w/w | A-T-054 |
| | | | | | | | | | | |
| **Asbestos in Soil (inc. matrix)** | | | | | | | | | | |
| Asbestos in soil$_D^{\#}$ | NAD | NAD | NAD | NAD | Chrysotile | Chrysotile | NAD | NAD | | A-T-045 |
| Asbestos Matrix (visual)$_D$ | - | - | - | - | Board | - | - | - | | A-T-045 |
| Asbestos Matrix (microscope)$_D$ | - | - | - | - | - | Loose Fibres | - | - | | A-T-045 |
| Asbestos ACM - Suitable for Water Absorption Test?$_D$ | N/A | N/A | N/A | N/A | NO | N/A | N/A | N/A | | Gravimetry |

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/9 | 14/06836/10 | 14/06836/11 | 14/06836/12 | 14/06836/13 | 14/06836/14 | 14/06836/15 | 14/06836/16 | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS211 | WS217 | WS204 | WS210 | WS214 | WS215 | WS212 | WS207 | | |
| Depth to Top | 0.40 | 0.40 | 0.30 | 0.50 | 0.60 | 0.50 | 0.50 | 0.50 | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 03-Dec-14 | 03-Dec-14 | 03-Dec-14 | 03-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Solid | | |
| MCERTS Sample Matrix Code | 4A | 4AE | 4ABE | 4AE | 4AE | 4AE | 4AE | 7 | | |
| **PAH 16** | | | | | | | | | | |
| Acenaphthene$_A^{M\#}$ | <0.01 | 0.18 | 0.02 | 0.04 | <0.01 | <0.01 | 2.45 | 0.02 | mg/kg | A-T-019s |
| Acenaphthylene$_A^{M\#}$ | 0.02 | 0.31 | 0.03 | 0.17 | <0.01 | <0.01 | 0.04 | 0.12 | mg/kg | A-T-019s |
| Anthracene$_A^{M\#}$ | 0.03 | 0.77 | 0.09 | 0.20 | <0.02 | <0.02 | 3.75 | 0.37 | mg/kg | A-T-019s |
| Benzo(a)anthracene$_A^{M\#}$ | 0.23 | 4.46 | 0.76 | 1.45 | 0.12 | 0.17 | 7.46 | 1.89 | mg/kg | A-T-019s |
| Benzo(a)pyrene$_A^{M\#}$ | 0.28 | 5.67 | 0.70 | 1.39 | 0.11 | 0.16 | 5.30 | 2.33 | mg/kg | A-T-019s |
| Benzo(b)fluoranthene$_A^{M\#}$ | 0.43 | 7.18 | 1.27 | 1.91 | 0.17 | 0.23 | 7.08 | 2.68 | mg/kg | A-T-019s |
| Benzo(ghi)perylene$_A^{M\#}$ | 0.14 | 3.05 | 0.41 | 0.88 | 0.08 | 0.11 | 2.43 | 1.60 | mg/kg | A-T-019s |
| Benzo(k)fluoranthene$_A^{M\#}$ | 0.14 | 2.47 | 0.44 | 0.60 | <0.07 | <0.07 | 2.36 | 0.89 | mg/kg | A-T-019s |
| Chrysene$_A^{M\#}$ | 0.31 | 5.60 | 0.92 | 1.69 | 0.14 | 0.19 | 7.31 | 1.93 | mg/kg | A-T-019s |
| Dibenzo(ah)anthracene$_A^{M\#}$ | <0.04 | 0.77 | 0.11 | 0.20 | <0.04 | <0.04 | 0.75 | 0.35 | mg/kg | A-T-019s |
| Fluoranthene$_A^{M\#}$ | 0.43 | 11.1 | 1.25 | 3.03 | 0.27 | 0.30 | 19 | 3.14 | mg/kg | A-T-019s |
| Fluorene$_A^{M\#}$ | <0.01 | 0.20 | 0.02 | 0.06 | <0.01 | <0.01 | 2.20 | 0.04 | mg/kg | A-T-019s |
| Indeno(123-cd)pyrene$_A^{M\#}$ | 0.15 | 3.49 | 0.47 | 0.91 | 0.08 | 0.11 | 2.73 | 1.63 | mg/kg | A-T-019s |
| Naphthalene$_A^{M\#}$ | <0.03 | 0.11 | 0.04 | 0.04 | <0.03 | <0.03 | 3.15 | <0.03 | mg/kg | A-T-019s |
| Phenanthrene$_A^{M\#}$ | 0.13 | 5.90 | 0.38 | 1.06 | 0.18 | 0.13 | 21.6 | 0.70 | mg/kg | A-T-019s |
| Pyrene$_A^{M\#}$ | 0.52 | 9.27 | 1.11 | 2.74 | 0.21 | 0.25 | 15 | 2.81 | mg/kg | A-T-019s |
| PAH (total 16)$_A^{M\#}$ | 2.80 | 60.5 | 8.02 | 16.4 | 1.35 | 1.66 | 103 | 20.5 | mg/kg | A-T-019s |

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/9 | 14/06836/10 | 14/06836/11 | 14/06836/12 | 14/06836/13 | 14/06836/14 | 14/06836/15 | 14/06836/16 | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS211 | WS217 | WS204 | WS210 | WS214 | WS215 | WS212 | WS207 | | |
| Depth to Top | 0.40 | 0.40 | 0.30 | 0.50 | 0.60 | 0.50 | 0.50 | 0.50 | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 03-Dec-14 | 03-Dec-14 | 03-Dec-14 | 03-Dec-14 | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 03-Dec-14 | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Soil - ES | Solid | | |
| MCERTS Sample Matrix Code | 4A | 4AE | 4ABE | 4AE | 4AE | 4AE | 4AE | 7 | | |
| TPH CWG | | | | | | | | | | |
| Ali >C5-C6$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Ali >C6-C8$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Ali >C8-C10$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Ali >C10-C12$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-023s |
| Ali >C12-C16$_A^\#$ | <0.1 | 0.8 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-023s |
| Ali >C16-C21$_A^\#$ | <0.1 | 1.8 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-023s |
| Ali >C21-C35$_A^\#$ | <0.1 | 6.0 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-023s |
| Total Aliphatics$_A$ | <0.1 | 8.6 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-022+23s |
| Aro >C5-C7$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Aro >C7-C8$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Aro >C8-C9$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| Aro >C9-C10$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.07 | mg/kg | A-T-022s |
| Aro >C10-C12$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-023s |
| Aro >C12-C16$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | mg/kg | A-T-023s |
| Aro >C16-C21$_A^\#$ | <0.1 | 11.6 | <0.1 | 4.2 | <0.1 | <0.1 | 4.1 | 0.2 | mg/kg | A-T-023s |
| Aro >C21-C35$_A^\#$ | <0.1 | 20.2 | <0.1 | 5.4 | <0.1 | <0.1 | 7.4 | 1.0 | mg/kg | A-T-023s |
| Total Aromatics$_A$ | <0.1 | 31.8 | <0.1 | 9.6 | <0.1 | <0.1 | 11.6 | 1.3 | mg/kg | A-T-022+23s |
| TPH (Ali & Aro)$_A$ | <0.1 | 40.4 | <0.1 | 9.6 | <0.1 | <0.1 | 11.6 | 1.3 | mg/kg | A-T-022+23s |
| BTEX - Benzene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| BTEX - Toluene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| BTEX - Ethyl Benzene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| BTEX - m & p Xylene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| BTEX - o Xylene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |
| MTBE$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | mg/kg | A-T-022s |

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/17 | 14/06836/18 | 14/06836/19 | 14/06836/20 | 14/06836/21 | | | | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | Surface | Surface | | | | | |
| Client Sample ID | WS216 | WS213 | WS205 | SH1 | SH2 | | | | | |
| Depth to Top | 0.20 | 0.30 | 0.30 | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 28-Nov-14 | 28-Nov-14 | | | | | |
| Sample Type | Soil - ES | Solid | Soil - ES | Soil - ES | Soil - ES | | | | | |
| MCERTS Sample Matrix Code | 4AE | 7 | 6AE | 4AE | 4AE | | | | | |
| % Stones >10mm$_A^{\#}$ | 17.1 | <0.1 | 12.0 | 33.2 | <0.1 | | | | % w/w | A-T-044 |
| Organic matter$_D^{M\#}$ | 20.0 | - | - | - | 67.9 | | | | % w/w | A-T-032 OM |
| Arsenic$_D^{M\#}$ | 18 | 4 | 14 | 11 | 18 | | | | mg/kg | A-T-024s |
| Cadmium$_D^{M\#}$ | 0.7 | <0.5 | 0.6 | <0.5 | 0.6 | | | | mg/kg | A-T-024s |
| Copper$_D^{M\#}$ | 90 | 12 | 66 | 49 | 65 | | | | mg/kg | A-T-024s |
| Chromium$_D^{M\#}$ | 19 | 16 | 25 | 15 | 12 | | | | mg/kg | A-T-024s |
| Lead$_D^{M\#}$ | 3400 | 105 | 1740 | 261 | 136 | | | | mg/kg | A-T-024s |
| Mercury$_D$ | 1.04 | 0.41 | 1.12 | 0.19 | 1.06 | | | | mg/kg | A-T-024s |
| Nickel$_D^{M\#}$ | 26 | 11 | 26 | 16 | 34 | | | | mg/kg | A-T-024s |
| Selenium$_D^{M\#}$ | <1 | <1 | <1 | 1 | 2 | | | | mg/kg | A-T-024s |
| Zinc$_D^{M\#}$ | 355 | 36 | 270 | 64 | 84 | | | | mg/kg | A-T-024s |

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/17 | 14/06836/18 | 14/06836/19 | 14/06836/20 | 14/06836/21 | | | | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | Surface | Surface | | | | | |
| Client Sample ID | WS216 | WS213 | WS205 | SH1 | SH2 | | | | | |
| Depth to Top | 0.20 | 0.30 | 0.30 | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 28-Nov-14 | 28-Nov-14 | | | | | |
| Sample Type | Soil - ES | Solid | Soil - ES | Soil - ES | Soil - ES | | | | | |
| MCERTS Sample Matrix Code | 4AE | 7 | 6AE | 4AE | 4AE | | | | | |
| Leachate Prep BS EN 12457-1 (2:1)$_A$ | | | | | | | | | | A-T-046 |
| Arsenic (leachable)$_A^\#$ | 9 | - | 12 | - | - | | | | µg/l | A-T-025w |
| Cadmium (leachable)$_A^\#$ | <1 | - | <1 | - | - | | | | µg/l | A-T-025w |
| Copper (leachable)$_A^\#$ | 12 | - | 31 | - | - | | | | µg/l | A-T-025w |
| Chromium (leachable)$_A^\#$ | <1 | - | <1 | - | - | | | | µg/l | A-T-025w |
| Lead (leachable)$_A^\#$ | 302 | - | 347 | - | - | | | | µg/l | A-T-025w |
| Mercury (leachable)$_A^\#$ | <0.1 | - | <0.1 | - | - | | | | µg/l | A-T-025w |
| Nickel (leachable)$_A^\#$ | <1 | - | 5 | - | - | | | | µg/l | A-T-025w |
| Selenium (leachable)$_A^\#$ | <1 | - | <1 | - | - | | | | µg/l | A-T-025w |
| Zinc (leachable)$_A^\#$ | 13 | - | 101 | - | - | | | | µg/l | A-T-025w |
| | | | | | | | | | | |
| Asbestos in Soil (inc. matrix) | | | | | | | | | | |
| Asbestos in soil$_D^\#$ | NAD | NAD | NAD | NAD | NAD | | | | | A-T-045 |
| Asbestos ACM - Suitable for Water Absorption Test?$_D$ | N/A | N/A | N/A | N/A | N/A | | | | | Gravimetry |

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/17 | 14/06836/18 | 14/06836/19 | 14/06836/20 | 14/06836/21 | | | | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | Surface | Surface | | | | | |
| Client Sample ID | WS216 | WS213 | WS205 | SH1 | SH2 | | | | | |
| Depth to Top | 0.20 | 0.30 | 0.30 | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 28-Nov-14 | 28-Nov-14 | | | | | |
| Sample Type | Soil - ES | Solid | Soil - ES | Soil - ES | Soil - ES | | | | | |
| MCERTS Sample Matrix Code | 4AE | 7 | 6AE | 4AE | 4AE | | | | | |
| **PAH 16** | | | | | | | | | | |
| Acenaphthene$_A^{M\#}$ | 0.02 | 0.14 | 0.02 | 0.06 | <0.01 | | | | mg/kg | A-T-019s |
| Acenaphthylene$_A^{M\#}$ | 0.06 | 0.11 | 0.07 | 0.19 | 0.02 | | | | mg/kg | A-T-019s |
| Anthracene$_A^{M\#}$ | 0.10 | 0.96 | 0.27 | 0.32 | 0.05 | | | | mg/kg | A-T-019s |
| Benzo(a)anthracene$_A^{M\#}$ | 1.14 | 2.49 | 2.10 | 2.09 | 0.39 | | | | mg/kg | A-T-019s |
| Benzo(a)pyrene$_A^{M\#}$ | 1.29 | 1.90 | 2.17 | 1.84 | 0.41 | | | | mg/kg | A-T-019s |
| Benzo(b)fluoranthene$_A^{M\#}$ | 1.62 | 2.57 | 2.83 | 2.86 | 0.70 | | | | mg/kg | A-T-019s |
| Benzo(ghi)perylene$_A^{M\#}$ | 0.87 | 1.15 | 1.24 | 1.10 | 0.30 | | | | mg/kg | A-T-019s |
| Benzo(k)fluoranthene$_A^{M\#}$ | 0.55 | 0.87 | 0.95 | 0.89 | 0.21 | | | | mg/kg | A-T-019s |
| Chrysene$_A^{M\#}$ | 1.26 | 2.62 | 2.22 | 2.59 | 0.54 | | | | mg/kg | A-T-019s |
| Dibenzo(ah)anthracene$_A^{M\#}$ | 0.21 | 0.25 | 0.34 | 0.29 | 0.09 | | | | mg/kg | A-T-019s |
| Fluoranthene$_A^{M\#}$ | 2.08 | 6.23 | 3.40 | 4.88 | 0.71 | | | | mg/kg | A-T-019s |
| Fluorene$_A^{M\#}$ | 0.03 | 0.37 | 0.04 | 0.11 | 0.01 | | | | mg/kg | A-T-019s |
| Indeno(123-cd)pyrene$_A^{M\#}$ | 0.91 | 1.24 | 1.45 | 1.20 | 0.32 | | | | mg/kg | A-T-019s |
| Naphthalene$_A^{M\#}$ | 0.04 | 0.04 | <0.03 | 0.11 | 0.05 | | | | mg/kg | A-T-019s |
| Phenanthrene$_A^{M\#}$ | 0.62 | 5.59 | 1.08 | 2.02 | 0.29 | | | | mg/kg | A-T-019s |
| Pyrene$_A^{M\#}$ | 1.72 | 4.85 | 2.73 | 4.53 | 0.63 | | | | mg/kg | A-T-019s |
| PAH (total 16)$_A^{M\#}$ | 12.5 | 31.4 | 20.9 | 25.1 | 4.73 | | | | mg/kg | A-T-019s |

**Envirolab Job Number: 14/06836**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 14/06836/17 | 14/06836/18 | 14/06836/19 | 14/06836/20 | 14/06836/21 | | | | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | Surface | Surface | | | | | |
| Client Sample ID | WS216 | WS213 | WS205 | SH1 | SH2 | | | | | |
| Depth to Top | 0.20 | 0.30 | 0.30 | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 02-Dec-14 | 02-Dec-14 | 02-Dec-14 | 28-Nov-14 | 28-Nov-14 | | | | | |
| Sample Type | Soil - ES | Solid | Soil - ES | Soil - ES | Soil - ES | | | | | |
| MCERTS Sample Matrix Code | 4AE | 7 | 6AE | 4AE | 4AE | | | | | |
| TPH CWG | | | | | | | | | | |
| Ali >C5-C6$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |
| Ali >C6-C8$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |
| Ali >C8-C10$_A^\#$ | <0.01 | <0.01 | <0.01 | 0.02 | 0.09 | | | | mg/kg | A-T-022s |
| Ali >C10-C12$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | mg/kg | A-T-023s |
| Ali >C12-C16$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | mg/kg | A-T-023s |
| Ali >C16-C21$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | mg/kg | A-T-023s |
| Ali >C21-C35$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | mg/kg | A-T-023s |
| Total Aliphatics$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | mg/kg | A-T-022+23s |
| Aro >C5-C7$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |
| Aro >C7-C8$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |
| Aro >C8-C9$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |
| Aro >C9-C10$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |
| Aro >C10-C12$_A^\#$ | <0.1 | <0.1 | <0.1 | <0.1 | 0.9 | | | | mg/kg | A-T-023s |
| Aro >C12-C16$_A^\#$ | <0.1 | <0.1 | <0.1 | 0.5 | 2.9 | | | | mg/kg | A-T-023s |
| Aro >C16-C21$_A^\#$ | 1.0 | 16.6 | 0.7 | 7.0 | 0.7 | | | | mg/kg | A-T-023s |
| Aro >C21-C35$_A^\#$ | 1.9 | 16.6 | 1.6 | 15.8 | 0.2 | | | | mg/kg | A-T-023s |
| Total Aromatics$_A$ | 2.9 | 33.2 | 2.3 | 23.3 | 4.8 | | | | mg/kg | A-T-022+23s |
| TPH (Ali & Aro)$_A$ | 2.9 | 33.2 | 2.3 | 23.4 | 4.8 | | | | mg/kg | A-T-022+23s |
| BTEX - Benzene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |
| BTEX - Toluene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |
| BTEX - Ethyl Benzene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |
| BTEX - m & p Xylene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |
| BTEX - o Xylene$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |
| MTBE$_A^\#$ | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | A-T-022s |

## REPORT NOTES

**Notes - Soil chemical analysis**
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones >10mm are removed or excluded from the sample prior to analysis and reported results corrected to a whole sample basis. For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis.

**Notes - General**
This report shall not be reproduced, except in full, without written approval from Envirolab.
Subscript "A" indicates analysis performed on the sample as received. "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve, unless asbestos is found to be present in which case all analysis is performed on the sample as received.
All analysis is performed on the dried and crushed sample for samples with Matrix Code 7 and this supercedes any "A" subscripts.
All analysis is performed on the sample as received for soil samples from outside the European Union and this supercedes any "D" subscripts.
Superscript "M" indicates method accredited to MCERTS.
If results are in italic font they are associated with an AQC failure. These are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

**TPH analysis of water by method A-T-007**
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

**Asbestos in soil**
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if present as discrete fibres/fragments. Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified a being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

**Predominant Matrix Codes:**
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.
Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations.

**Secondary Matrix Codes:**
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

IS indicates Insufficient sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Analytical results reflect the quality of the sample at the time of analysis only. Opinions and interpretations expressed are outside the scope of our accreditation.

Please contact us if you need any further information.

# APPENDIX G
# LABORATORY CERTIFICATES FOR SURFACE WATER ANALYSIS

Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

# FINAL ANALYTICAL TEST REPORT

**Envirolab Job Number:** 15/00291
**Issue Number:** 1 **Date:** 03 February, 2015

**Client:** RSK Environment Ltd Hemel
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

**Project Manager:** Nigel Austin/Verity Macfarlane
**Project Name:** Twickenham MOL
**Project Ref:** 25024
**Order No:** N/A
**Date Samples Received:** 22/01/15
**Date Instructions Received:** 22/01/15
**Date Analysis Completed:** 31/01/15

**Prepared by:**

Georgia King
Administrative Assistant

**Approved by:**

Iain Haslock
Analytical Consultant

UKAS TESTING
1247

**Envirolab Job Number: 15/00291**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 15/00291/1 | 15/00291/2 | | | | | | | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | Surface | Surface | | | | | | | | |
| Client Sample ID | Water 1 | Water 2 | | | | | | | | |
| Depth to Top | | | | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 20-Jan-15 | 20-Jan-15 | | | | | | | | |
| Sample Type | Water - EW | Water - EW | | | | | | | | |
| MCERTS Sample Matrix Code | N/A | N/A | | | | | | | | |
| pH (w)$_A^\#$ | 7.80 | 7.80 | | | | | | | pH | A-T-031w |
| Electrical conductivity @ 20degC (w)$_A^\#$ | 784 | 791 | | | | | | | µs/cm | A-T-037w |
| COD (settled)$_A^\#$ | 39 | 40 | | | | | | | mg/l | A-T-034w |
| BOD (settled, 5 day)$_A$ | 1 | 2 | | | | | | | mg/l | A-T-048 |
| Alkalinity (total) (w) Colorimetry$_A^\#$ | 228 | 233 | | | | | | | mg/l Ca CO3 | A-T-038w |
| Ammoniacal nitrogen (w)$_A^\#$ | 0.55 | 1.44 | | | | | | | mg/l | A-T-033w |
| Chloride (w)$_A^\#$ | 78.38 | 81.48 | | | | | | | mg/l | A-T-026w |
| Sulphate (w)$_A^\#$ | 107 | 106 | | | | | | | mg/l | A-T-026w |
| Cyanide (total) (w)$_A^\#$ | <0.005 | <0.005 | | | | | | | mg/l | A-T-042wTCN |
| Sulphide (w)$_A$ | <0.1 | <0.1 | | | | | | | mg/l | A-T-S2-w |
| DOC (w)$_A^\#$ | 6.6 | 7.3 | | | | | | | mg/l | A-T-032w |
| Arsenic (dissolved)$_A^\#$ | <1 | <1 | | | | | | | µg/l | A-T-025w |
| Cadmium (dissolved)$_A^\#$ | <1 | <1 | | | | | | | µg/l | A-T-025w |
| Copper (dissolved)$_A^\#$ | 4 | 4 | | | | | | | µg/l | A-T-025w |
| Chromium (dissolved)$_A^\#$ | <1 | <1 | | | | | | | µg/l | A-T-025w |
| Lead (dissolved)$_A^\#$ | <1 | <1 | | | | | | | µg/l | A-T-025w |
| Mercury (dissolved)$_A^\#$ | <0.1 | <0.1 | | | | | | | µg/l | A-T-025w |
| Nickel (dissolved)$_A^\#$ | 3 | 3 | | | | | | | µg/l | A-T-025w |
| Selenium (dissolved)$_A^\#$ | <1 | <1 | | | | | | | µg/l | A-T-025w |
| Zinc (dissolved)$_A^\#$ | 14 | 15 | | | | | | | µg/l | A-T-025w |

**Envirolab Job Number: 15/00291**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 15/00291/1 | 15/00291/2 | | | | | | | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | Surface | Surface | | | | | | | | |
| Client Sample ID | Water 1 | Water 2 | | | | | | | | |
| Depth to Top | | | | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 20-Jan-15 | 20-Jan-15 | | | | | | | | |
| Sample Type | Water - EW | Water - EW | | | | | | | | |
| MCERTS Sample Matrix Code | N/A | N/A | | | | | | | | |
| Ali >C5-C6 $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| Ali >C6-C8 $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| Ali >C8-C10 $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| Ali >C10-C12 $(w)_A^{\#}$ | <5 | <5 | | | | | | | µg/l | A-T-023w |
| Ali >C12-C16 $(w)_A^{\#}$ | <5 | <5 | | | | | | | µg/l | A-T-023w |
| Ali >C16-C21 $(w)_A^{\#}$ | <5 | <5 | | | | | | | µg/l | A-T-023w |
| Ali >C21-C35 $(w)_A^{\#}$ | <5 | <5 | | | | | | | µg/l | A-T-023w |
| Total Aliphatics $(w)_A$ | <5 | <5 | | | | | | | µg/l | A-T-023w |
| Aro >C5-C7 $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| Aro >C7-C8 $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| Aro >C8-C9 $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| Aro >C9-C10 $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| Aro >C10-C12 $(w)_A^{\#}$ | <5 | <5 | | | | | | | µg/l | A-T-023w |
| Aro >C12-C16 $(w)_A^{\#}$ | <5 | <5 | | | | | | | µg/l | A-T-023w |
| Aro >C16-C21 $(w)_A^{\#}$ | <5 | <5 | | | | | | | µg/l | A-T-023w |
| Aro >C21-C35 $(w)_A^{\#}$ | <5 | <5 | | | | | | | µg/l | A-T-023w |
| Total Aromatics $(w)_A$ | <5 | <5 | | | | | | | µg/l | A-T-023w |
| TPH (Ali & Aro) $(w)_A$ | <5 | <5 | | | | | | | µg/l | A-T-023w |
| BTEX - Benzene $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| BTEX - Toluene $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| BTEX - Ethyl Benzene $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| BTEX - m & p Xylene $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| BTEX - o Xylene $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |
| MTBE $(w)_A^{\#}$ | <1 | <1 | | | | | | | µg/l | A-T-022w |

**Envirolab Job Number: 15/00291**

**Client Project Name: Twickenham MOL**

**Client Project Ref: 25024**

| Lab Sample ID | 15/00291/1 | 15/00291/2 | | | | | | | Units | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | Surface | Surface | | | | | | | | |
| Client Sample ID | Water 1 | Water 2 | | | | | | | | |
| Depth to Top | | | | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 20-Jan-15 | 20-Jan-15 | | | | | | | | |
| Sample Type | Water - EW | Water - EW | | | | | | | | |
| MCERTS Sample Matrix Code | N/A | N/A | | | | | | | | |
| **PAH 16MS (w)** | | | | | | | | | | |
| Acenaphthene $(w)_A^{\#}$ | <0.01 | 0.01 | | | | | | | µg/l | A-T-019w |
| Acenaphthylene $(w)_A^{\#}$ | 0.01 | <0.01 | | | | | | | µg/l | A-T-019w |
| Anthracene $(w)_A^{\#}$ | <0.01 | <0.01 | | | | | | | µg/l | A-T-019w |
| Benzo(a)anthracene $(w)_A^{\#}$ | 0.08 | <0.01 | | | | | | | µg/l | A-T-019w |
| Benzo(a)pyrene $(w)_A^{\#}$ | 0.08 | <0.01 | | | | | | | µg/l | A-T-019w |
| Benzo(b)fluoranthene $(w)_A^{\#}$ | 0.10 | 0.01 | | | | | | | µg/l | A-T-019w |
| Benzo(ghi)perylene $(w)_A^{\#}$ | 0.06 | <0.01 | | | | | | | µg/l | A-T-019w |
| Benzo(k)fluoranthene $(w)_A^{\#}$ | 0.03 | <0.01 | | | | | | | µg/l | A-T-019w |
| Chrysene $(w)_A^{\#}$ | 0.11 | 0.02 | | | | | | | µg/l | A-T-019w |
| Dibenzo(ah)anthracene $(w)_A^{\#}$ | 0.01 | <0.01 | | | | | | | µg/l | A-T-019w |
| Fluoranthene $(w)_A^{\#}$ | 0.14 | 0.02 | | | | | | | µg/l | A-T-019w |
| Fluorene $(w)_A^{\#}$ | <0.01 | <0.01 | | | | | | | µg/l | A-T-019w |
| Indeno(123-cd)pyrene $(w)_A^{\#}$ | 0.05 | <0.01 | | | | | | | µg/l | A-T-019w |
| Naphthalene $(w)_A^{\#}$ | <0.01 | <0.01 | | | | | | | µg/l | A-T-019w |
| Phenanthrene $(w)_A^{\#}$ | 0.05 | <0.01 | | | | | | | µg/l | A-T-019w |
| Pyrene $(w)_A^{\#}$ | 0.16 | 0.04 | | | | | | | µg/l | A-T-019w |
| PAH (total 16) $(w)_A^{\#}$ | 0.88 | 0.10 | | | | | | | µg/l | A-T-019w |

## REPORT NOTES

**Notes - Soil chemical analysis**
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones >10mm are removed or excluded from the sample prior to analysis and reported results corrected to a whole sample basis. For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis.

**Notes - General**
This report shall not be reproduced, except in full, without written approval from Envirolab.
Subscript "A" indicates analysis performed on the sample as received. "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve, unless asbestos is found to be present in which case all analysis is performed on the sample as received.
All analysis is performed on the dried and crushed sample for samples with Matrix Code 7 and this supercedes any "A" subscripts.
All analysis is performed on the sample as received for soil samples from outside the European Union and this supercedes any "D" subscripts.
Superscript "M" indicates method accredited to MCERTS.
If results are in italic font they are associated with an AQC failure. These are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

**TPH analysis of water by method A-T-007**
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

**Asbestos in soil**
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if present as discrete fibres/fragments. Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified a being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

**Predominant Matrix Codes:**
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.
Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations.

**Secondary Matrix Codes:**
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

IS indicates Insufficient sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Analytical results reflect the quality of the sample at the time of analysis only. Opinions and interpretations expressed are outside the scope of our accreditation.

Please contact us if you need any further information.

# APPENDIX H
# LABORATORY CERTIFICATES FOR GROUNDWATER ANALYSIS

**Andrew Kent**
RSK Stats Ltd
18
Frogmore Road
Hemel Hempstead
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HP3 9RT

**t:** 01442 437500
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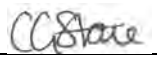
**e:** reception@i2analytical.com

# Analytical Report Number : 14-65025

| | | | |
|---|---|---|---|
| **Project / Site name:** | Tickenham Sorting Office -MOL | **Samples received on:** | 22/12/2014 |
| **Your job number:** | 25024 | **Samples instructed on:** | 22/12/2014 |
| **Your order number:** | | **Analysis completed by:** | 08/01/2015 |
| **Report Issue Number:** | 1 | **Report issued on:** | 08/01/2015 |
| **Samples Analysed:** | 4 water samples | | |

**Signed:** 

Dr Claire Stone
Quality Manager
**For & on behalf of i2 Analytical Ltd.**

**Signed:** 

Emma Winter
Assistant Reporting Manager
**For & on behalf of i2 Analytical Ltd.**

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

| | |
|---|---|
| soils | - 4 weeks from reporting |
| leachates | - 2 weeks from reporting |
| waters | - 2 weeks from reporting |
| asbestos | - 6 months from reporting |

Excel copies of reports are only valid when accompanied by this PDF certificate.

Sampling date indicates that recommended time for holding samples prior to analysis for pH and BTEX has been exceeded. The results for such parameters may be invalid and should be interpreted with care.

**Analytical Report Number: 14-65025**

**Project / Site name: Tickenham Sorting Office -MOL**

| Lab Sample Number | | | | 404446 | 404447 | 404448 | 404449 | |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | WS201 | WS202 | WS203 | WS205 | |
| Sample Number | | | | None Supplied | None Supplied | None Supplied | None Supplied | |
| Depth (m) | | | | None Supplied | None Supplied | None Supplied | None Supplied | |
| Date Sampled | | | | 22/12/2014 | 22/12/2014 | 22/12/2014 | 22/12/2014 | |
| Time Taken | | | | None Supplied | None Supplied | None Supplied | None Supplied | |
| **Analytical Parameter (Water Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| **General Inorganics** | | | | | | | | |
| pH | pH Units | N/A | ISO 17025 | 7.3 | 7.4 | 7.3 | 7.3 | |
| Electrical Conductivity | µS/cm | 10 | NONE | 710 | 770 | 900 | 780 | |
| Total Cyanide | µg/l | 10 | ISO 17025 | < 10 | < 10 | < 10 | < 10 | |
| Sulphate as $SO_4$ | µg/l | 45 | ISO 17025 | 51700 | 106000 | 99200 | 112000 | |
| Sulphide | µg/l | 5 | NONE | < 5.0 | < 5.0 | < 5.0 | < 5.0 | |
| Chloride | mg/l | 0.15 | ISO 17025 | 36 | 63 | 54 | 54 | |
| Ammoniacal Nitrogen as N | µg/l | 15 | ISO 17025 | 51 | < 15 | < 15 | < 15 | |
| Alkalinity | mg/l | 3 | ISO 17025 | 270 | 200 | 280 | 210 | |
| **Speciated PAHs** | | | | | | | | |
| Naphthalene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Acenaphthylene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Acenaphthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Fluorene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Phenanthrene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Anthracene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Fluoranthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Pyrene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Benzo(a)anthracene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Chrysene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Benzo(b)fluoranthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Benzo(k)fluoranthene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Benzo(a)pyrene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Indeno(1,2,3-cd)pyrene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Dibenz(a,h)anthracene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| Benzo(ghi)perylene | µg/l | 0.01 | ISO 17025 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | |
| **Total PAH** | | | | | | | | |
| Total EPA-16 PAHs | µg/l | 0.2 | ISO 17025 | < 0.20 | < 0.20 | < 0.20 | < 0.20 | |
| **Heavy Metals / Metalloids** | | | | | | | | |
| Arsenic (dissolved) | µg/l | 0.15 | ISO 17025 | 0.49 | 0.59 | 0.75 | 0.49 | |
| Cadmium (dissolved) | µg/l | 0.02 | ISO 17025 | 0.02 | 0.09 | 0.03 | < 0.02 | |
| Chromium (dissolved) | µg/l | 0.2 | ISO 17025 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | |
| Copper (dissolved) | µg/l | 0.5 | ISO 17025 | 14 | 11 | 12 | 11 | |
| Lead (dissolved) | µg/l | 0.2 | ISO 17025 | < 0.2 | 0.6 | < 0.2 | < 0.2 | |
| Mercury (dissolved) | µg/l | 0.05 | ISO 17025 | 0.12 | < 0.05 | < 0.05 | < 0.05 | |
| Nickel (dissolved) | µg/l | 0.5 | ISO 17025 | 6.3 | 7.6 | 9.2 | 4.3 | |
| Selenium (dissolved) | µg/l | 0.6 | ISO 17025 | 2.1 | 5.0 | 2.2 | 7.2 | |
| Zinc (dissolved) | µg/l | 0.5 | ISO 17025 | < 0.5 | 1.1 | 1.3 | 1.0 | |

**Analytical Report Number: 14-65025**

**Project / Site name: Tickenham Sorting Office -MOL**

| Lab Sample Number | | | | 404446 | 404447 | 404448 | 404449 | |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | WS201 | WS202 | WS203 | WS205 | |
| Sample Number | | | | None Supplied | None Supplied | None Supplied | None Supplied | |
| Depth (m) | | | | None Supplied | None Supplied | None Supplied | None Supplied | |
| Date Sampled | | | | 22/12/2014 | 22/12/2014 | 22/12/2014 | 22/12/2014 | |
| Time Taken | | | | None Supplied | None Supplied | None Supplied | None Supplied | |
| **Analytical Parameter (Water Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| **Monoaromatics** | | | | | | | | |
| Benzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | |
| Toluene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | |
| Ethylbenzene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | |
| p & m-xylene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | |
| o-xylene | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | |
| MTBE (Methyl Tertiary Butyl Ether) | µg/l | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | |
| **Petroleum Hydrocarbons** | | | | | | | | |
| TPH-CWG - Aliphatic >C5 - C6 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aliphatic >C6 - C8 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aliphatic >C8 - C10 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aliphatic >C10 - C12 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aliphatic >C12 - C16 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aliphatic >C16 - C21 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aliphatic >C21 - C35 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| **TPH-CWG - Aliphatic (C5 - C35)** | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aromatic >C5 - C7 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aromatic >C7 - C8 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aromatic >C8 - C10 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aromatic >C10 - C12 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aromatic >C12 - C16 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aromatic >C16 - C21 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| TPH-CWG - Aromatic >C21 - C35 | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |
| **TPH-CWG - Aromatic (C5 - C35)** | µg/l | 10 | NONE | < 10 | < 10 | < 10 | < 10 | |

U/S = Unsuitable Sample  I/S = Insufficient Sample

**Analytical Report Number : 14-65025**

**Project / Site name: Tickenham Sorting Office -MOL**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)**

| Analytical Test Name | Analytical Method Description | Analytical Method Reference | Method number | Wet / Dry Analysis | Accreditation Status |
|---|---|---|---|---|---|
| Alkalinity in Water | Determination of Alkalinity by discreet analyser (colorimetry). Accredited matrices: SW, PW, GW. | In house method based on MEWAM & USEPA Method 310.2. | L082-PL | W | ISO 17025 |
| Ammoniacal Nitrogen as N in water | Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method. Accredited matrices SW, GW, PW. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton | L082-PL | W | ISO 17025 |
| BTEX and MTBE in water | Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW | In-house method based on USEPA8260 | L073W-PL | W | ISO 17025 |
| Chloride in water | Determination of Chloride in water by Gallery Discrete Analyser based on reaction with mercury (II) thiocyanate and acid solution with iron (III) nitrate to form a red/brown iron (III) thiocyanate complex; followed by spectrophotometrice measurementat a wavelenght of 480 nm. | Methods for the Examination of Water and Associated Materials Chloride in Waters, Sewage and Effluents 1981.ISBN 0117516260 Accredited matrices: SW, PW, GW. | L082 B | W | ISO 17025 |
| Electrical conductivity of water | Determination of electrical conductivity in water by electrometric measurement. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton | L031-PL | W | NONE |
| Metals in water by ICP-MS (dissolved) | Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW. | In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil"" | L012-PL | W | ISO 17025 |
| pH in water | Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW | In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests | L005-PL | W | ISO 17025 |
| Speciated EPA-16 PAHs in water | Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW | In-house method based on USEPA 8270 | L070-UK | W | ISO 17025 |
| Sulphate in water | Determination of sulphate in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW | In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil. | L039-PL | W | ISO 17025 |
| Sulphide in water | Determination of sulphide in water by ion selective electrode. | In-house method | L010-PL | W | NONE |
| Total cyanide in water | Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar) | L080-PL | W | ISO 17025 |
| TPHCWG (Waters) | Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation. | In-house method | L070-UK | W | NONE |

**For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**
**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.**
**Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.**

# APPENDIX I
# HUMAN HEALTH GENERIC ASSESSMENT CRITERIA

# Generic assessment criteria (GAC) for human health: residential scenario – communal soft landscaping

The human health generic assessment criteria (GAC) have been developed during a period of regulatory review and updating of the Contaminated Land Exposure Assessment (CLEA) project. Therefore, the Environment Agency (EA) is in the process of publishing updated reports relating to the CLEA project and the GAC presented in this document may change to reflect these updates. This issue was prepared following the publication of soil guideline value (SGV) reports and associated publications[(1)] for mercury, selenium, benzene, toluene, ethylbenzene and xylene in March 2009, arsenic and nickel in May 2009, cadmium and phenol in June 2009, dioxins, furans and dioxin-like polychlorinated biphenyls (PCBs) in September 2009. It was also produced following publication of GAC by LQM[(6)]. Where available, the published soil guideline values (SGV)[(1)] were used as the GAC. The GAC for lead is discussed separately below owing to it not being derived using the same approach as other compounds.

## Lead GAC derivation

The Environment Agency SGV and Tox reports for lead were withdrawn in 2009. In addition, the provisional tolerable weekly intake data published in the Netherlands were withdrawn in 2010 owing to concerns that they were not suitably protective of human health. The withdrawn SGVs were based on a target blood lead concentration of 10µg/dl. In the absence of current guidelines many consultants continue to use the withdrawn SGV. However, as this is not considered sufficiently protective of human health, after attendance at the SOBRA summer workshop June 2011, RSK has revised its GAC and is currently undertaking a review of recent toxicological developments that will be used to refine this GAC further in the coming months. In the meantime, RSK has undertaken sensitivity analysis using the Society of Environmental Geochemistry and Health (SEGH) equation and the CLEA model to produce an interim GAC value. The results are summarised below:

- Using CLEA with the former provisional tolerable weekly intake (PTWI) (25 µg/kg bw), assuming 100% lead is bioavailable, produces a GAC of 212 mg/kg
- Using CLEA with the former PTWI, assuming 50% lead is bioavailable, produces a GAC of 478 mg/kg
- Using the SEGH equation amended for a blood target concentration of 5.6 µg/dl (equal to the LOAEL for IQ defects) gives a negative GAC number unless other factors such as child background blood concentration or delta are amended. Without undertaking further research into these numbers, RSK can present sensitivity analysis to demonstrate the sensitivity of these input parameters but cannot justify one parameter over another. The results are:
    - GAC between 39mg/kg and 99mg/kg if the value of delta (the slope or response of blood Pb versus soil and dust Pb relationship) only is amended from 5 to 2µg/dl/1000µg/g. The value of 2 was chosen as it is within the reasonable range quoted in the former SGV report
    - GAC between 244mg/kg and 610mg/kg if the geometric mean of blood lead concentration in young children is reduced from 3.4µg/dl to 2µg/dl. This decrease has been simulated on the basis that blood concentrations are likely to decrease over time across the UK owing to a ban on lead in petrol, lead within paint used internally and water pipe replacement. This decrease is considered reasonable as the site is a new development so lead-based paints will not be used internally and lead water supply pipelines will be absent.

Therefore, given the results above RSK proposes to use a GAC of **300mg/kg** for a residential end use. This value is broadly in the middle of the range of sensitivity modelling results quoted above when background mean blood lead concentrations in children are reduced to reflect a new development. The value is also broadly in the middle of the range of sensitivity modelling results for a range of bioavailability of lead between 50% and 100%. This number is considered reasonably protective of human health while being practical for use.

## GAC derivation for other metals and organic compounds

*Model selection*

Soil assessment criteria (SAC) were calculated using CLEA v1.06 and the supporting UK guidance[1–6]. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 1.3b model. RSK has updated the inputs within RBCA to reflect the UK guidance[1–5]. The SAC and GrAC collectively are termed GAC.

*Conceptual model*

In accordance with EA Science Report SC050021/SR3[3], the residential with communal soft landscaping scenario considers risks to a female child between the ages of 0 and 6 years old. In accordance with Box 3.1, SR3, the pathways considered for production of the SAC in the residential with communal soft landscaping scenario are:

- direct soil and dust ingestion
- dermal contact with soil and indoor dust
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents while indoors. Figure 2 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air. Within RBCA, the solubility limit of the determinant restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. While the same restriction is not built into the CLEA model, the CLEA model output cells are flagged red where the soil saturation limit has been exceeded.

An assumption used in the CLEA model is that of simple linear partitioning of a chemical in the soil, between the sorbed, dissolved and vapour phase[4]. The upper boundaries of this partitioning are represented by the aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous-based or the vapour-based saturation limits. Where model output cells are flagged red the soil or vapour saturation has been exceeded and further consideration of the SAC to be used within the assessment is required. One approach that could be adopted is to use the 'modelled' solubility saturation limit or vapour saturation limit of the compound as the SAC. However, as stated within the CLEA

handbook[4] this is likely not to be practical in many cases because of the subsequent very low solubility/vapour saturation limits and, in any case, is highly conservative. Unless free-phase product is present, concentrations of the chemical are unlikely to be present at sufficient concentration to result in an exceedance of the health criteria value (HCV).

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH[6] whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets. Therefore, when using the SAC to screen laboratory analysis the assessor should take note if a given SAC has a corresponding solubility or vapour saturation limit (in brackets) and subsequently incorporate this information within the screening analytical discussion. If further assessment is required following this process then an additional approach can be utilised as detailed within Section 4.12 of the CLEA model handbook[4], which explains how to calculate an effective assessment criterion manually.

*Input selection*

Chemical data was obtained from EA Report SC050021/SR7[5] and the health criteria values (HCV) from the UK TOX[1] reports where available. For total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH), toxicological and specific chemical parameters were obtained from the LQM/CIEH report[6]. Similarly, toxicological and specific chemical parameters for the volatile organic compound 1,2,4-trimethylbenzene were obtained from EIC/AGS/CL:AIRE[7].

For TPH, aromatic hydrocarbons $C_5$–$C_8$ were not modelled as benzene and toluene are being modelled separately. The aromatic $C_8$–$C_9$ hydrocarbon fraction comprises ethylbenzene, xylene and styrene. As ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for this band have been taken from styrene.

Owing to the lack of UK-specific data, default information in the RBCA model was used to evaluate methyl tertiary butyl ether (MTBE). No published UK data was available for 1,3,5-trimethylbenzene, so information was obtained from the RBCA model. RBCA uses toxicity data for the inhalation pathway in different units to the CLEA model and cannot consider separately the mean daily intake (MDI), occupancy periods or breathing rates. Therefore, the HCV in RBCA was amended to take account of:

- amendments to the MDI using Table 3.4 of SR2[2]
- a child weighing 13.3kg (average of 0–6 year old female in accordance with Table 4.6 of SR3[3]) and breathing 11.85$m^3$ (average daily inhalation rate for a 0–6-year old female in accordance with Table 4.14 of SR3[3]
- The 50% rule (for petroleum hydrocarbons, trimethylbenzenes and MTBE)[2] where MDI data is not available but background exposure is considered important in the overall exposure.

*Physical parameters*

For the residential with communal soft landscaping scenario, the CLEA default building is a small two-storey terrace house with concrete ground-bearing slab. SR3[3] notes this residential building

type to be the most conservative in terms of protection from vapour intrusion. The building parameters are outlined in Table 3.

The parameters for a sandy loam soil type were used in line with SR3[3]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this parameter, RSK has produced an additional set of SAC for an SOM of 1% and 2.5%.

For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater.

*GAC*

The SAC were produced using the input parameters in Tables 1 to 3 and the GrAC using the input parameters in Table 4. The GAC by pathway are presented in Table 5 and the combined GAC presented in Table 6.

**Figure 1: Conceptual model for CLEA residential scenario – with communal soft landscaping**

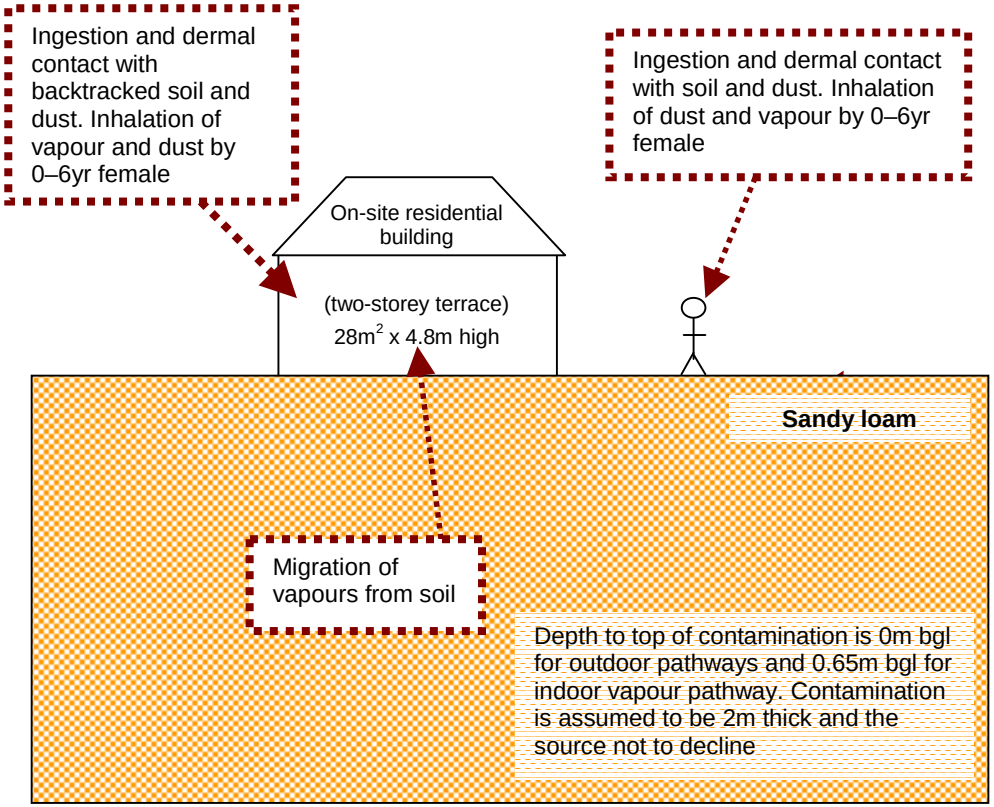



**Table 1: Exposure assessment parameters for residential scenario – with communal soft landscaping – inputs for CLEA model**

| Parameter | Value | Justification |
|---|---|---|
| Land use | Residential without homegrown produce | Chosen land use |
| Receptor | Female Child | Taken as female child exposed over 6 years from 0 to 6 years, Box 3.1, SR3[3] |
| Building | Small terraced house | Key generic assumption given in Box 3.1, SR3[3]. Two-storey small terraced house chosen, as the most conservative residential building type in terms of protection from vapour intrusion (Section 3.2.6, report SC050021/SR3[3]). Table 3 presents building-specific input data |
| Soil type | Sandy loam | Most common UK soil type (Section 4.3.1, Table 4.4, SR3[3]). Table 4 presents soil-specific input data |
| Start age class (AC) | 1 | Range of AC corresponding to key generic assumption that the critical receptor is a young female child aged 0–6 years. From Box 3.1, SR3[3]. Data specific to the receptor is presented in Table 2 |
| End AC | 6 | |
| SOM (%) | 6 | Representative of sandy loam according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[8] |
| | 1 | To provide SAC for sites where SOM < 6% as often observed by RSK |
| | 2.5 | |
| pH | 7 | Model default |

**Table 2: Residential with communal soft landscaping – land use and receptor data for CLEA model**

| Parameter | Unit | Age class | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| Exposure frequency (EF) (soil and dust ingestion) | day $yr^{-1}$ | 180 | 365 | 365 | 365 | 365 | 365 |
| EF (skin contact, indoor) | day $yr^{-1}$ | 180 | 365 | 365 | 365 | 365 | 365 |
| EF (skin contact, outdoor) | day $yr^{-1}$ | 180 | 365 | 365 | 365 | 365 | 365 |
| EF (inhalation of dust and vapour, indoor) | day $yr^{-1}$ | 365 | 365 | 365 | 365 | 365 | 365 |
| EF (inhalation of dust and vapour, outdoor) | day $yr^{-1}$ | 365 | 365 | 365 | 365 | 365 | 365 |
| **Justification** | | Table 3.1, SR3[3] | | | | | |
| Occupancy period (indoor) | hr $day^{-1}$ | 23 | 23 | 23 | 23 | 19 | 19 |
| Occupancy period (outdoor) | hr $day^{-1}$ | 1 | 1 | 1 | 1 | 1 | 1 |
| Justification | | Table 3.2, SR3[3] | | | | | |
| Soil ingestion rate | g/day | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| **Justification** | | Table 6.2, SR3[3] | | | | | |
| Soil to skin adherence factor – (indoor) | mg soil/$cm^2$ skin | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| Soil to skin adherence factor – (outdoor) | mg soil/$cm^2$ skin | 1 | 1 | 1 | 1 | 1 | 1 |
| **Justification** | | Table 8.1, SR3[3] | | | | | |
| Body weight | kg | 5.6 | 9.8 | 12.7 | 15.1 | 16.9 | 19.7 |
| Body height | m | 0.7 | 0.8 | 0.9 | 0.9 | 1 | 1.1 |
| Justification | | Table 4.6, SR3[3] | | | | | |
| Inhalation Rate | $m^3$ $day^{-1}$ | 8.5 | 13.3 | 12.7 | 12.2 | 12.2 | 12.2 |
| Justification | | Table 4.14, SR3[3] | | | | | |
| Max exposed skin fraction (indoor) | $m^2$ $m^{-2}$ | 0.32 | 0.33 | 0.32 | 0.35 | 0.35 | 0.33 |
| Max exposed skin fraction (outdoor) | $m^2$ $m^{-2}$ | 0.26 | 0.26 | 0.25 | 0.28 | 0.28 | 0.26 |
| Justification | | Table 4.8, SR3[3] | | | | | |

Note: for **cadmium**, the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1–18. This is because the $TDI_{oral}$ and $TDI_{inh}$ are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not only in childhood but averaged over a longer time period. See the Environment Agency Science report SC050021 / TOX 3[1] and Science Report SC050021/Cadmium SGV[1] for the full AC1-18 Land use Data suite.

**Table 3: Residential with communal soft landscaping – soil, air and building specific inputs for CLEA model**

| Parameter | Unit | Value | Justification |
|---|---|---|---|
| **Soil properties for sandy loam** | | | |
| Porosity, total | $cm^3\ cm^{-3}$ | 0.53 | Default soil type is sandy loam, Section 4.3.1, SR3[3]<br>Parameters for sandy loam from Table 4.4, SR3[3] |
| Porosity, air filled | $cm^3\ cm^{-3}$ | 0.20 | |
| Porosity, water filled | $cm^3\ cm^{-3}$ | 0.33 | |
| Residual soil water content | $cm^3\ cm^{-3}$ | 0.12 | |
| Saturated hydraulic conductivity | $cm\ s^{-1}$ | 0.00356 | |
| Van Genuchten shape parameter (*m*) | - | 0.3201 | |
| Bulk density | $g\ cm^{-3}$ | 1.21 | |
| Threshold value of wind speed at 10m | $m\ s^{-1}$ | 7.2 | Default value taken from Section 9.2.2, SR3[3] |
| Empirical function ($F_x$) for dust model | - | 1.22 | Value taken from Section 9.2.2, SR3[3] |
| Ambient soil temperature | K | 283 | Annual average soil temperature of UK surface soils. Section 4.3.1, SR3[3] |
| **Air dispersion model** | | | |
| Mean annual wind speed (10m) | $m\ s^{-1}$ | 5.0 | Default value taken from Section 9.2.2, SR3[3] |
| Air dispersion factor at height of 0.8m | $g\ m^{-2}\ s^{-1}$ per $kg\ m^{-3}$ | 2400 | From Table 9.1, SR3[3]. Values for a 0.01ha site, appropriate to a residential land use in Newcastle (representative city for UK, section 9.2.1, SR3[3]) |
| Fraction of site with hard or vegetative cover | $m^2\ m^{-2}$ | 0.75 | Section 3.2.6, SR3[3] for residential land use |
| **Building properties for house with ground-bearing floor slab** | | | |
| Building footprint | $m^2$ | 28 | From Table 3.3 and 4.21, SR3[3] |
| Living space air exchange rate | $hr^{-1}$ | 0.50 | |
| Living space height (above ground) | m | 4.8 | |
| Living space height (below ground) | m | 0.0 | Assumed no basement |
| Pressure difference (soil to enclosed space) | Pa | 3.1 | From Table 3.3 and 4.21, SR3[3] |
| Foundation thickness | m | 0.15 | |

| Parameter | Unit | Value | Justification |
|---|---|---|---|
| Floor crack area | $cm^2$ | 423 | |
| Dust loading factor | $\mu g\ m^{-3}$ | 50 | Default value for a residential site taken from Section 9.3, SR3[3] |
| **Vapour model** | | | |
| Default soil gas ingress rate | $cm^3\ s^{-1}$ | 25 | Generic flow rate, Section 10.3, SR3[3] |
| Depth to top of source (beneath building for indoor exposure) | cm | 50 | Section 3.2.6, SR3[3] states source is 50cm below building or 65cm below ground surface |
| Depth to top of source (outdoors) | cm | 0 | Section 10.2, SR3[3] assumes impact from 0-1m for outdoor inhalation pathway |
| Thickness of contaminant layer | cm | 200 | Model default for indoor air, Section 4.9, SR4[4] |
| Time average period for surface emissions | years | 6 | Time period of a 0–6 year old, Box 3.5, SR3[3] |
| User-defined effective air permeability | $cm^2$ | 3.05E-08 | Calculated for sandy loam using equations in Appendix 1, SR3[3] |

**Figure 2: GrAC conceptual model for RBCA residential with communal soft landscaping scenario**

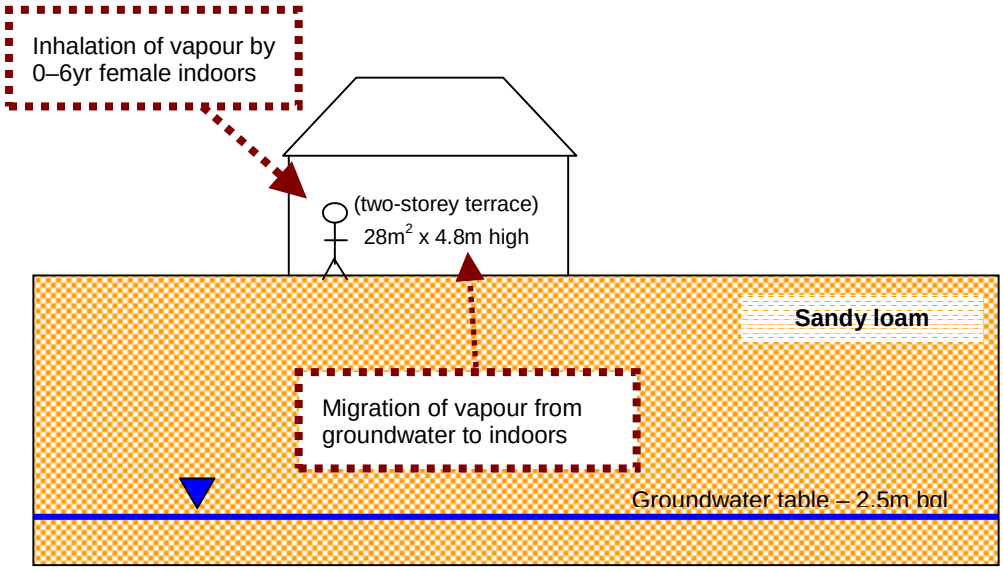



**Table 4: Residential with communal soft landscaping – RBCA inputs**

| Parameter | Unit | Value | Justification |
|---|---|---|---|
| **Receptor** | | | |
| Averaging time | Years | 6 | From Box 3.1, SR3[3] |
| Receptor weight | kg | 13.3 | Average of CLEA 0-6 year old female data, Table 4.6, SR3[3] |
| Exposure duration | Years | 6 | From Box 3.1, report , SR3[3] |
| Exposure frequency | Days/yr | 350 | Weighted using occupancy period of 23 hours per day for 365 days of the year |
| **Soil type – sandy loam** | | | |
| Total porosity | - | 0.53 | CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3[3] |
| Volumetric water content | - | 0.33 | |
| Volumetric air content | - | 0.20 | |
| Dry bulk density | g $cm^{-3}$ | 1.21 | |
| Vertical hydraulic conductivity | cm $s^{-1}$ | 3.56E-3 | CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3] |
| Vapour permeability | $m^2$ | 3.05E-12 | Calculated for sandy loam using equations in Appendix 1, SR3[3] |

| Parameter | Unit | Value | Justification |
|---|---|---|---|
| Capillary zone thickness | m | 0.1 | Professional judgement |
| **Building** | | | |
| Building volume/ area ratio | m | 4.8 | Table 3.3, SR3[3] |
| Foundation area | $m^2$ | 28 | |
| Foundation perimeter | m | 22 | Calculated assuming building measures 7m x 4m to give 28$m^2$ foundation area |
| Building air exchange rate | $d^{-1}$ | 12 | Table 3.3, SR3[3] |
| Depth to bottom of foundation slab | m | 0.15 | |
| Foundation thickness | m | 0.15 | |
| Foundation crack fraction | - | 0.0151 | Calculated from floor crack area of 423 $cm^2$ and building footprint of 28$m^2$ in Table 4.21, SR3[3] |
| Volumetric water content of cracks | - | 0.33 | Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Parameters for sandy loam from Table 4.4, SR3[3] |
| Volumetric air content of cracks | - | 0.2 | |
| Indoor/outdoor differential pressure | Pa | 3.1 | From Table 3.3, SR3[3] |

## References


1. Environment Agency (2009), 'Science Report SC050021/benzene SGV, toluene SGV, ethylbenzene SGV, xylene SGV, mercury SGV, selenium SGV, nickel SGV, arsenic SGV, cadmium SGV, phenol SGV, dioxins, furans and dioxin like PCBs SGVs', 'Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin- like PCBs', and 'Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin- like PCBs', March 2009, May 2009 and September 2009.

2. Environment Agency (2009), *Human health toxicological assessment of contaminants in soil. Science Report – Final SC050021/SR2*, January (Bristol: Environment Agency).

3. Environment Agency (2009), *Science Report – SC050021/SR3. Updated technical background to the CLEA model* (Bristol: Environment Agency).

4. Environment Agency (2009), Contaminated Land Exposure Assessment (CLEA) software, version 1.06.

5. Environment Agency (2008), *Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values* (Bristol: Environment Agency).

6. Chartered Institute for Environmental Health and Land Quality Management (2009), 'The LQM/CIEH Generic Assessment Criteria for Human Health', second edition.

7. CL:AIRE (2009), *Soil Generic Assessment Criteria for Human Health Risk Assessment* (London: CL:AIRE).

8. Changes made to the CLEA framework documents after the three-month evaluation period in 2008, released January 2009 by the Environment Agency.

**GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH COMMUNAL SOFT LANDSCAPING**

**Table 5**

**Human Health Generic Assessment Criteria by Pathway for Residential Scenario With Communal Soft Lanscaping**

| Compound | Notes | GrAC (mg/l) | SAC Appropriate to Pathway SOM 1% (mg/kg) | | | Soil Saturation Limit (mg/kg) | SAC Appropriate to Pathway SOM 2.5% (mg/kg) | | | Soil Saturation Limit (mg/kg) | SAC Appropriate to Pathway SOM 6% (mg/kg) | | | Soil Saturation Limit (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Oral | Inhalation | Combined | | Oral | Inhalation | Combined | | Oral | Inhalation | Combined | |
| **Metals** | | | | | | | | | | | | | | |
| Arsenic | (c) | - | 3.50E+01 | 8.50E+01 | - | NR | 3.50E+01 | 8.50E+01 | - | NR | 3.50E+01 | 8.50E+01 | - | NR |
| Cadmium | | - | 1.21E+02 | 1.85E+02 | 8.49E+01 | NR | 1.21E+02 | 1.85E+02 | 8.49E+01 | NR | 1.21E+02 | 1.85E+02 | 8.49E+01 | NR |
| Chromium (III) -oxide | | - | 1.98E+04 | 3.55E+03 | 3.01E+03 | NR | 1.98E+04 | 3.55E+03 | 3.01E+03 | NR | 1.98E+04 | 3.55E+03 | 3.01E+03 | NR |
| Chromium (VI) - hexavalent | | - | 8.40E+01 | 4.25E+00 | 4.12E+00 | NR | 8.40E+01 | 4.25E+00 | 4.12E+00 | NR | 8.40E+01 | 4.25E+00 | 4.12E+00 | NR |
| Copper | | - | 1.08E+04 | 1.04E+04 | 6.20E+03 | NR | 1.08E+04 | 1.04E+04 | 6.20E+03 | NR | 1.08E+04 | 1.04E+04 | 6.20E+03 | NR |
| Lead | (a) | - | 3.00E+02 | - | - | NR | 3.00E+02 | - | - | | 3.00E+02 | - | - | NR |
| Elemental Mercury ($Hg^0$) | (d) | 9.40E-03 | - | 1.70E-01 | - | 4.31E+00 | - | 4.24E-01 | - | 1.07E+01 | - | 1.02E+00 | - | 2.58E+01 |
| Inorganic Mercury ($Hg^{2+}$) | | - | 2.62E+02 | 2.55E+03 | 2.38E+02 | NR | 2.62E+02 | 2.55E+03 | 2.38E+02 | NR | 2.62E+02 | 2.55E+03 | 2.38E+02 | NR |
| Methyl Mercury ($Hg^{4+}$) | | 2.00E+01 | 1.80E+01 | 1.59E+01 | 8.43E+00 | 7.33E+01 | 1.80E+01 | 1.59E+01 | 1.13E+01 | 1.42E+02 | 1.80E+01 | 6.53E+01 | 1.41E+01 | 3.04E+02 |
| Nickel | (d) | - | 7.86E+02 | 1.27E+02 | - | NR | 7.86E+02 | 1.27E+02 | - | NR | 7.86E+02 | 1.27E+02 | - | NR |
| Selenium | (c) | - | 5.95E+02 | - | - | NR | 5.95E+02 | - | - | NR | 5.95E+02 | - | - | NR |
| Zinc | (c) | - | 4.05E+04 | 2.55E+07 | - | NR | 4.05E+04 | 2.55E+07 | - | NR | 4.05E+04 | 2.55E+07 | - | NR |
| Cyanide | | - | 7.69E+02 | 1.15E+02 | 1.06E+02 | NR | 7.69E+02 | 1.15E+02 | 1.06E+02 | NR | 7.69E+02 | 1.15E+02 | 1.06E+02 | NR |
| **Volatile Organic Compounds** | | | | | | | | | | | | | | |
| Benzene | | 7.00E+00 | 2.58E+01 | 2.69E-01 | 2.66E-01 | 1.22E+03 | 2.58E+01 | 4.99E-01 | 4.90E-01 | 2.26E+03 | 2.58E+01 | 1.04E+00 | 9.98E-01 | 4.71E+03 |
| Toluene | | 1.90E+03 | 1.98E+04 | 6.26E+02 | 6.07E+02 | 8.69E+02 | 1.98E+04 | 1.38E+03 | 1.29E+03 | 1.92E+03 | 1.98E+04 | 3.14E+03 | 2.71E+03 | 4.36E+03 |
| Ethylbenzene | | 2.60E+02 | 8.88E+03 | 1.70E+02 | 1.67E+02 | 5.18E+02 | 8.88E+03 | 3.98E+02 | 3.81E+02 | 1.22E+03 | 8.88E+03 | 9.32E+02 | 8.43E+02 | 2.84E+03 |
| Xylene - m | | 8.40E+01 | 1.60E+04 | 5.56E+01 | 5.54E+01 | 6.25E+02 | 1.60E+04 | 1.31E+02 | 1.30E+02 | 1.47E+03 | 1.60E+04 | 3.07E+02 | 3.02E+02 | 3.46E+03 |
| Xylene - o | | 1.00E+02 | 1.60E+04 | 5.98E+01 | 5.95E+01 | 4.78E+02 | 1.60E+04 | 1.40E+02 | 1.39E+02 | 1.12E+03 | 1.60E+04 | 3.27E+02 | 3.21E+02 | 2.62E+03 |
| Xylene - p | | 8.70E+01 | 1.60E+04 | 5.34E+01 | 5.33E+01 | 5.76E+02 | 1.60E+04 | 1.26E+02 | 1.25E+02 | 1.35E+03 | 1.60E+04 | 2.94E+02 | 2.88E+02 | 3.17E+03 |
| Total xylene | | 8.40E+01 | 1.60E+04 | 5.56E+01 | 5.54E+01 | 6.25E+02 | 1.60E+04 | 1.31E+02 | 1.30E+02 | 1.47E+03 | 1.60E+04 | 3.07E+02 | 3.02E+02 | 3.46E+03 |
| Methyl tertiary butyl ether (MTBE) | | 2.20E+03 | 4.45E+02 | 1.84E+02 | 1.61E+02 | 1.66E+04 | 4.45E+02 | 2.40E+02 | 2.00E+02 | 2.16E+04 | 4.45E+02 | 3.70E+02 | 2.68E+02 | 3.34E+04 |
| Trichloroethene | | 1.80E+00 | 4.63E+02 | 1.10E-01 | 1.10E-01 | 1.54E+03 | 4.63E+02 | 2.30E-01 | 2.30E-01 | 3.22E+03 | 4.63E+02 | 5.11E-01 | 5.11E-01 | 7.14E+03 |
| Tetrachloroethene | | 3.60E+00 | 1.20E+03 | 1.03E+00 | 1.03E+00 | 4.24E+02 | 1.20E+03 | 2.30E+00 | 2.30E+00 | 9.51E+02 | 1.20E+03 | 5.28E+00 | 5.26E+00 | 2.18E+03 |
| 1,1,1-Trichloroethane | | 2.60E+01 | 5.34E+04 | 6.33E+00 | 6.33E+00 | 1.43E+03 | 5.34E+04 | 1.29E+01 | 1.29E+01 | 2.92E+03 | 5.34E+04 | 2.84E+01 | 2.84E+01 | 6.39E+03 |
| 1,1,1,2-Tetrachloroethane | | 1.40E+01 | 5.07E+02 | 1.08E+00 | 1.08E+00 | 2.60E+03 | 5.07E+02 | 2.50E+00 | 2.49E+00 | 6.02E+03 | 5.07E+02 | 5.83E+00 | 5.76E+00 | 1.40E+04 |
| 1,1,2,2-Tetrachloroethane | | 1.40E+01 | 5.07E+02 | 2.76E+00 | 2.74E+00 | 2.67E+03 | 5.07E+02 | 5.65E+00 | 5.58E+00 | 5.46E+03 | 5.07E+02 | 1.24E+01 | 1.21E+01 | 1.20E+04 |
| Carbon tetrachloride | | 5.50E-02 | 1.25E+02 | 1.81E-02 | 1.81E-02 | 1.52E+03 | 1.25E+02 | 3.97E-02 | 3.96E-02 | 3.32E+03 | 1.25E+02 | 8.99E-02 | 8.99E-02 | 7.54E+03 |
| 1,2-Dichloroethane | | 3.00E-01 | 1.07E+01 | 6.46E-03 | 6.46E-03 | 3.41E+03 | 1.07E+01 | 9.32E-03 | 9.31E-03 | 4.91E+03 | 1.07E+01 | 1.60E-02 | 1.60E-02 | 8.43E+03 |
| Vinyl chloride | | 1.90E-02 | 1.25E+00 | 5.43E-04 | 5.43E-04 | 1.36E+03 | 1.25E+00 | 7.02E-04 | 7.02E-04 | 1.76E+03 | 1.25E+00 | 1.07E-03 | 1.07E-03 | 2.69E+03 |
| 1,2,4-Trimethylbenzene | | 7.50E-02 | - | 4.08E-01 | - | 5.57E+02 | - | 9.91E-01 | - | 1.36E+03 | - | 2.33E+00 | - | 3.25E+03 |
| 1,3,5-Trimethylbenzene | | 4.70E-02 | 1.28E+03 | 4.60E-01 | 4.60E-01 | 9.47E+01 | 1.28E+03 | 1.10E+00 | 1.10E+00 | 2.26E+02 | 1.28E+03 | 2.59E+00 | 2.58E+00 | 5.33E+02 |
| **Semi-Volatile Organic Compounds** | | | | | | | | | | | | | | |
| Acenaphthene | | 3.20E+00 | 4.85E+03 | 3.46E+03 | 2.02E+03 | 5.70E+01 | 4.85E+03 | 8.54E+03 | 3.09E+03 | 1.41E+02 | 4.85E+03 | 2.30E+04 | 3.91E+03 | 3.36E+02 |
| Acenaphthylene | | 4.20E+00 | 4.85E+03 | 3.27E+03 | 1.95E+03 | 8.61E+01 | 4.85E+03 | 8.03E+03 | 3.02E+03 | 2.12E+02 | 4.85E+03 | 1.91E+04 | 3.87E+03 | 5.06E+02 |
| Anthracene | | 2.10E-02 | 2.43E+04 | 1.08E+05 | 1.98E+04 | 1.17E+00 | 2.43E+04 | 2.65E+05 | 2.22E+04 | 2.91E+00 | 2.43E+04 | 6.15E+05 | 2.33E+04 | 6.96E+00 |
| Benzo(a)anthracene | | 3.80E-03 | 1.12E+01 | 5.55E+00 | 3.71E+00 | 1.71E+00 | 1.12E+01 | 9.83E+00 | 5.23E+00 | 4.28E+00 | 1.12E+01 | 1.41E+01 | 6.22E+00 | 1.03E+01 |
| Benzo(b)fluoranthene | | 2.00E-03 | 1.15E+00 | 1.79E+01 | 6.99E+00 | 1.22E+00 | 1.15E+01 | 1.97E+01 | 7.25E+00 | 3.04E+00 | 1.15E+01 | 2.05E+01 | 7.36E+00 | 7.29E+00 |
| Benzo(g,h,i)perylene | | 2.60E-04 | 7.35E+01 | 1.27E+02 | 4.66E+01 | 1.54E-02 | 7.35E+01 | 1.32E+02 | 4.72E+01 | 3.85E-02 | 7.35E+01 | 1.34E+02 | 4.75E+01 | 9.23E-02 |
| Benzo(k)fluoranthene | | 8.00E-04 | 1.62E+01 | 2.66E+01 | 1.01E+01 | 6.87E-01 | 1.62E+01 | 2.83E+01 | 1.03E+01 | 1.72E+00 | 1.62E+01 | 2.91E+01 | 1.04E+01 | 4.12E+00 |
| Chrysene | | 2.00E-03 | 1.62E+01 | 1.95E+01 | 8.84E+00 | 4.40E-01 | 1.62E+01 | 2.45E+01 | 9.74E+00 | 1.10E+00 | 1.62E+01 | 2.72E+01 | 1.01E+01 | 2.64E+00 |
| Dibenzo(a,h)anthracene | | 6.00E-04 | 1.46E+00 | 2.13E+00 | 8.65E-01 | 3.93E-03 | 1.46E+00 | 2.42E+00 | 9.09E-01 | 9.82E-03 | 1.46E+00 | 2.56E+00 | 9.28E-01 | 2.36E-02 |
| Fluoranthene | | 2.30E-01 | 1.01E+03 | 2.69E+04 | 9.72E+02 | 1.89E+01 | 1.01E+03 | 6.23E+04 | 9.93E+02 | 4.73E+01 | 1.01E+03 | 1.28E+05 | 1.00E+03 | 1.13E+02 |
| Fluorene | | 1.90E+00 | 3.23E+03 | 4.35E+03 | 1.85E+03 | 3.09E+01 | 3.23E+03 | 1.07E+04 | 2.48E+03 | 7.65E+01 | 3.23E+03 | 2.54E+04 | 2.87E+03 | 1.83E+02 |
| Indeno(1,2,3-cd)pyrene | | 2.00E-04 | 6.95E+00 | 1.04E+01 | 4.17E+00 | 6.13E-02 | 6.95E+00 | 1.17E+01 | 4.35E+00 | 1.53E-01 | 6.95E+00 | 1.22E+01 | 4.43E+00 | 3.68E-01 |
| Phenanthrene | | 5.30E-01 | 1.00E+03 | 5.04E+03 | 8.37E+02 | 3.60E+01 | 1.00E+03 | 1.23E+04 | 9.28E+02 | 8.96E+01 | 1.00E+03 | 2.86E+04 | 9.70E+02 | 2.14E+02 |
| Pyrene | | 1.30E-01 | 2.42E+03 | 6.18E+04 | 2.33E+03 | 2.20E+00 | 2.42E+03 | 1.44E+05 | 2.38E+03 | 5.49E+00 | 2.42E+03 | 2.97E+05 | 2.40E+03 | 1.32E+01 |
| Benzo(a)pyrene | | 3.80E-03 | 1.62E+00 | 2.62E+00 | 1.00E+00 | 9.11E-01 | 1.62E+00 | 2.81E+00 | 1.03E+00 | 2.28E+00 | 1.62E+00 | 2.90E+00 | 1.04E+00 | 5.46E+00 |
| Naphthalene | | 1.90E+01 | 1.58E+03 | 1.64E+00 | 1.64E+00 | 7.64E+01 | 1.58E+03 | 3.93E+00 | 3.92E+00 | 1.83E+02 | 1.58E+03 | 9.27E+00 | 9.22E+00 | 4.32E+02 |
| Phenol | | - | 9.17E+04 | 3.11E+02 | 3.10E+02 | 4.16E+04 | 9.17E+04 | 4.20E+02 | 4.18E+02 | 8.15E+04 | 9.17E+04 | 5.21E+02 | 5.19E+02 | 1.74E+05 |

**GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH COMMUNAL SOFT LANDSCAPING**

**Table 5**

**Human Health Generic Assessment Criteria by Pathway for Residential Scenario With Communal Soft Lanscaping**

| Compound | Notes | GrAC (mg/l) | SAC Appropriate to Pathway SOM 1% (mg/kg) | | | Soil Saturation Limit (mg/kg) | SAC Appropriate to Pathway SOM 2.5% (mg/kg) | | | Soil Saturation Limit (mg/kg) | SAC Appropriate to Pathway SOM 6% (mg/kg) | | | Soil Saturation Limit (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Oral | Inhalation | Combined | | Oral | Inhalation | Combined | | Oral | Inhalation | Combined | |
| **Total Petroleum Hydrocarbons** | | | | | | | | | | | | | | |
| Aliphatic hydrocarbons $EC_5$-$EC_6$ | | 1.00E+01 | 2.23E+05 | 2.98E+01 | 2.98E+01 | 3.04E+02 | 2.23E+05 | 5.47E+01 | 5.47E+01 | 5.58E+02 | 2.23E+05 | 1.13E+02 | 1.13E+02 | 1.15E+03 |
| Aliphatic hydrocarbons >$EC_6$-$EC_8$ | | 5.40E+00 | 2.23E+05 | 7.27E+01 | 7.27E+01 | 1.44E+02 | 2.23E+05 | 1.62E+02 | 1.62E+02 | 3.22E+02 | 2.23E+05 | 3.72E+02 | 3.71E+02 | 7.36E+02 |
| Aliphatic hydrocarbons >$EC_8$-$EC_{10}$ | | 2.30E-01 | 4.45E+03 | 1.89E+01 | 1.88E+01 | 7.77E+01 | 4.45E+03 | 4.60E+01 | 4.59E+01 | 1.90E+02 | 4.45E+03 | 1.09E+02 | 1.09E+02 | 4.51E+02 |
| Aliphatic hydrocarbons >$EC_{10}$-$EC_{12}$ | | 3.00E-02 | 4.45E+03 | 9.34E+01 | 9.29E+01 | 4.75E+01 | 4.45E+03 | 2.32E+02 | 2.29E+02 | 1.18E+02 | 4.45E+03 | 5.57E+02 | 5.38E+02 | 2.83E+02 |
| Aliphatic hydrocarbons >$EC_{12}$-$EC_{16}$ | | 8.00E-04 | 4.45E+03 | 7.82E+02 | 7.45E+02 | 2.37E+01 | 4.45E+03 | 1.95E+03 | 1.69E+03 | 5.91E+01 | 4.45E+03 | 4.68E+03 | 3.04E+03 | 1.42E+02 |
| Aliphatic hydrocarbons >$EC_{16}$-$EC_{35}$ | (c) | - | 4.53E+04 | - | - | 8.48E+00 | 6.41E+04 | - | - | 2.12E+01 | 7.66E+04 | - | - | 5.09E+01 |
| Aliphatic hydrocarbons >$EC_{35}$-$EC_{44}$ | (c) | - | 4.53E+04 | - | - | 8.48E+00 | 6.41E+04 | - | - | 2.12E+01 | 7.66E+04 | - | - | 5.09E+01 |
| Aromatic hydrocarbons >$EC_5$-$EC_7$ | | - | 1.98E+04 | 2.66E+02 | 2.63E+02 | 1.22E+03 | 1.98E+04 | 4.95E+02 | 4.83E+02 | 2.26E+03 | 1.98E+04 | 1.03E+03 | 9.78E+02 | 4.71E+03 |
| Aromatic hydrocarbons >$EC_7$-$EC_8$ | | - | 1.98E+04 | 6.26E+02 | 6.07E+02 | 8.69E+02 | 1.98E+04 | 1.38E+03 | 1.29E+03 | 1.92E+03 | 1.98E+04 | 3.14E+03 | 2.71E+03 | 4.36E+03 |
| Aromatic hydrocarbons >$EC_8$-$EC_9$ (styrene) | | 7.40E+00 | 5.34E+03 | 2.65E+02 | 2.61E+02 | 6.20E+02 | 5.34E+03 | 6.47E+02 | 6.27E+02 | 1.52E+03 | 5.34E+03 | 1.54E+03 | 1.41E+03 | 3.61E+03 |
| Aromatic hydrocarbons >$EC_9$-$EC_{10}$ | | 7.40E+00 | 1.78E+03 | 3.33E+01 | 3.32E+01 | 6.13E+02 | 1.78E+03 | 8.16E+01 | 8.07E+01 | 1.50E+03 | 1.78E+03 | 1.94E+02 | 1.89E+02 | 3.58E+03 |
| Aromatic hydrocarbons >$EC_{10}$-$EC_{12}$ | | 2.50E+01 | 1.78E+03 | 1.82E+02 | 1.77E+02 | 3.64E+02 | 1.78E+03 | 4.48E+02 | 4.17E+02 | 8.99E+02 | 1.78E+03 | 1.07E+03 | 8.66E+02 | 2.15E+03 |
| Aromatic hydrocarbons >$EC_{12}$-$EC_{16}$ | | 5.80E+00 | 1.78E+03 | 2.00E+03 | 1.25E+03 | 1.69E+02 | 1.78E+03 | 4.96E+03 | 1.59E+03 | 4.19E+02 | 1.78E+03 | 1.18E+04 | 1.71E+03 | 1.00E+03 |
| Aromatic hydrocarbons >$EC_{16}$-$EC_{21}$ | (c) | - | 1.29E+03 | - | - | 5.37E+01 | 1.31E+03 | - | - | 1.34E+02 | 1.32E+03 | - | - | 3.21E+02 |
| Aromatic hydrocarbons >$EC_{21}$-$EC_{35}$ | (c) | - | 1.33E+03 | - | - | 4.83E+00 | 1.33E+03 | - | - | 1.21E+01 | 1.33E+03 | - | - | 2.90E+01 |
| Aromatic hydrocarbons >$EC_{35}$-$EC_{44}$ | (c) | - | 1.33E+03 | - | - | 4.83E+00 | 1.33E+03 | - | - | 1.21E+01 | 1.33E+03 | - | - | 2.90E+01 |

**Notes:**

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - the compound is not volatile and therefore a soil saturation limit not calculated within CLEA

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%. This shading has also been used for the RBCA output where the theoretical solubility limit has been exceeded. The SAC has been set as the model calculated SAC with the saturation limits shown in brackets.

Calculated SAC exceeds soil saturation limit but will not effect the SAC significantly since the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cellls have also been hatched red.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3

(a) Sensitivity analysis undertaken on SEGH equation and CLEA model, considered reasonable in absence of UK specific data

(b) GAC taken from the Environment Agency SGV reports published 2009.

(c) SAC for selenium, aliphatic and aromatic hydrocarbons >EC16 do not include inhalation pathway owing to absence of toxicity data. SAC for arsenic is only based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report.

(d) SAC for elemental mercury, chromium VI and nickel are based on the inhalation pathway only owing to an absence of toxicity for elemental mercury, in accordance with the SGV report for nickel and LQM report for chromium VI.

**Table 6**
**Human health generic assessment criteria for residential with communal soft landscaping**

| Compound | GrAC for groundwater (mg/l) | SAC for soil SOM 1% (mg/kg) | SAC for soil SOM 2.5% (mg/kg) | SAC for soil SOM 6% (mg/kg) |
|---|---|---|---|---|
| **Metals** | | | | |
| Arsenic | - | 35 | 35 | 35 |
| Cadmium | - | 85 | 85 | 85 |
| Chromium (III) - oxide | - | 3,000 | 3,000 | 3,000 |
| Chromium (VI) - hexavalent | - | 4.3 | 4.3 | 4.3 |
| Copper | - | 6,200 | 6,200 | 6,200 |
| Lead | - | 300 | 300 | 300 |
| Elemental Mercury (Hg0) | 0.0094 | 0.17 | 0.42 | 1.0 |
| Inorganic Mercury (Hg2+) | - | 240 | 240 | 240 |
| Methyl Mercury (Hg4+) | 20 | 8.4 | 11 | 14 |
| Nickel | - | 130 | 130 | 130 |
| Selenium | - | 600 | 600 | 600 |
| Zinc | - | 41,000 | 41,000 | 41,000 |
| Cyanide | - | 110 | 110 | 110 |
| **Volatile organic compounds** | | | | |
| Benzene | 7 | 0.27 | 0.49 | 1.0 |
| Toluene | 1,900 | 610 | 1,289 | 2,700 |
| Ethylbenzene | 260 | 170 | 381 | 840 |
| Xylene - m | 84 | 55 | 130 | 300 |
| Xylene - o | 100 | 60 | 139 | 320 |
| Xylene - p | 87 | 53 | 125 | 290 |
| Total xylene | 84 | 55 | 130 | 300 |
| Methyl tertiary butyl ether (MTBE) | 2,200 | 160 | 199.55 | 270 |
| Trichloroethene | 1.8 | 0.11 | 0.2 | 0.51 |
| Tetrachloroethene | 3.6 | 1.0 | 2.3 | 5.3 |
| 1,1,1-Trichloroethane | 26 | 6.3 | 12.9 | 28 |
| 1,1,1,2-Tetrachloroethane | 14 | 1.1 | 2.5 | 5.8 |
| 1,1,2,2-Tetrachloroethane | 14 | 2.7 | 5.58 | 12 |
| Carbon tetrachloride | 0.055 | 0.02 | 0.040 | 0.09 |
| 1,2-Dichloroethane | 0.30 | 0.006 | 0.0093 | 0.02 |
| Vinyl chloride | 0.019 | 0.0005 | 0.0007 | 0.001 |
| 1,2,4-Trimethylbenzene | 0.075 | 0.4 | 0.99 | 2.3 |
| 1,3,5-Trimethylbenzene | 0.047 | 0.5 | 1.10 | 2.6 |
| **Semi-volatile organic compounds** | | | | |
| Acenaphthene | 3.2 | 2,000 (57) | 3,100 (141) | 3,900 (340) |
| Acenaphthylene | 4.2 | 2,000 (86) | 3,000 (212) | 3,900 (510) |
| Anthracene | 0.021 | 20,000 (1.2) | 22,000 | 23,000 |
| Benzo(a)anthracene | 0.004 | 3.7 | 5.2 | 6.2 |
| Benzo(b)fluoranthene | 0.002 | 7.0 | 7.3 | 7.4 |
| Benzo(g,h,i)perylene | 0.0003 | 47 | 47 | 48 |
| Benzo(k)fluoranthene | 0.0008 | 10 | 10 | 10 |
| Chrysene | 0.002 | 8.8 | 9.7 | 10 |
| Dibenzo(a,h)anthracene | 0.0006 | 0.87 | 0.91 | 0.93 |
| Fluoranthene | 0.23 | 970 | 993 | 1,000 |
| Fluorene | 1.9 | 1,900 (31) | 2,500 (77) | 2,900 (180) |
| Indeno(1,2,3-cd)pyrene | 0.0002 | 4.2 | 4.4 | 4.4 |
| Phenanthrene | 0.53 | 840 (36) | 930 | 970 |
| Pyrene | 0.13 | 2,300 | 2,400 | 2,400 |
| Benzo(a)pyrene | 0.004 | 1.0 | 1.0 | 1.0 |
| Naphthalene | 19 | 1.6 | 3.9 | 9.2 |
| Phenol | - | 310 | 420 | 520 |
| **Total petroleum hydrocarbons** | | | | |
| Aliphatic hydrocarbons $EC_5$–$EC_6$ | 10 | 30 | 55 | 110 |
| Aliphatic hydrocarbons >$EC_6$–$EC_8$ | 5.4 | 73 | 160 | 370 |
| Aliphatic hydrocarbons >$EC_8$–$EC_{10}$ | 0.23 | 19 | 46 | 110 |
| Aliphatic hydrocarbons >$EC_{10}$–$EC_{12}$ | 0.03 | 93 (48) | 230 (118) | 540 (280) |
| Aliphatic hydrocarbons >$EC_{12}$–$EC_{16}$ | 0.0008 | 746 (24) | 1,700 (59) | 3,000 (140) |
| Aliphatic hydrocarbons >$EC_{16}$–$EC_{35}$ | - | 45,000 | 64,000 (21) | 77,000 |
| Aliphatic hydrocarbons >$EC_{35}$–$EC_{44}$ | - | 45,000 | 64,000 (21) | 77,000 |
| Aromatic hydrocarbons >$EC_8$–$EC_9$ (styrene) | 7.4 | 260 | 627 | 1,400 |
| Aromatic hydrocarbons >$EC_9$–$EC_{10}$ | 7.4 | 33 | 81 | 190 |
| Aromatic hydrocarbons >$EC_{10}$–$EC_{12}$ | 25 | 180 | 417 | 870 |
| Aromatic hydrocarbons >$EC_{12}$–$EC_{16}$ | 5.8 | 1,300 (170) | 1,600 (419) | 1,700 |
| Aromatic hydrocarbons >$EC_{16}$–$EC_{21}$ | - | 1,300 | 1,300 | 1,300 |
| Aromatic hydrocarbons >$EC_{21}$–$EC_{35}$ | - | 1,300 | 1,300 | 1,300 |
| Aromatic hydrocarbons >$EC_{35}$–$EC_{44}$ | - | 1,300 | 1,300 | 1,300 |

**Notes:**

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway or an absence of toxicological data.

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58; 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

The SAC has been set as the model calculated SAC with the saturation limit shown in brackets. For consistency where the GrAC exceeds the solubility limit, GrSV has been set at the solubility limit. These are highly conservative as concentrations of the chemical are very unlikely to be at sufficient concentration to result in an exceedance of the health criteria value at the point of exposure (i.e. indoor air) provided free-phase product is absent.

# APPENDIX J
# GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

# APPENDIX J
# GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

Several compounds can inhibit plant growth; hence it is important to have generic assessment criteria (GAC) to promote healthy plant growth. In the absence of other published GAC, the GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural fields.

The Council of European Communities Sewage Sludge Directive (86/278/EEC) dated 1986, has been transposed into UK law by Statutory Instrument No. 1263, The Sludge (use in Agriculture) Regulations 1989 (Public Health England, Wales and Scotland), as ammended in 1990 and The Sludge (use in Agriculture) Regulations (Northern Ireland) SR No, 245, 1990. In addition the Department of Environment (DoE) produced a Code of Practice (CoP) (Updated 2nd Edition) in 2006 which provided guidance on the application of sewage sludge on agricultural land (however the status of this document is unclear as it is on the archive section of the Defra website).

The directive seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to "***prevent harmful effects on soil, vegetation, animals and man".*** To this end, it prohibits the use of untreated sludge on agricultural land unless it is injected or incorporated into the soil. Treated sludge is defined as having undergone "biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use". To provide protection against potential health risks from residual pathogens, sludge must not be applied to soil in which fruit and vegetable crops are growing, or less than ten months before fruit and vegetable crops are to be harvested. Grazing animals must not be allowed access to grassland or forage land less than three weeks after the application of sludge.

The specified limits of concentrations of selected elements in soil are presented in Table 4 of the updated 2nd Edition of the DoE Code of Practice and are designed to protect plant growth. It is noted that these values are more stringent than the values set in current UK regulations. However since they were ammended following recommendations from the Independent Scientific Committee in 1993. (MAFF/DOE 1993). The GAC are presented in Table 1.

**Table 1: Generic assessment criteria**

| Determinant | Generic assessment criteria (mg/kg) | | | |
|---|---|---|---|---|
| | pH 5.0 < 5.5 | pH 5.5 < 6.0 | pH 6.0 < 7.0 | pH >7.0 |
| Zinc | 200 | 200 | 200 | 300 |
| Copper | 80 | 100 | 135 | 200 |
| Nickel | 50 | 60 | 75 | 110 |
| Lead | 300 | 300 | 300 | 300 |
| Cadmium | 3 | 3 | 3 | 3 |
| Mercury | 1 | 1 | 1 | 1 |
| Note: Only compounds with assessment criteria documented within the Directive 86/278/EEC have been included, although criteria for 5 additional compounds have been presented within the 2006 CoP. | | | | |

# APPENDIX K
# GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

# APPENDIX K
# GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

The water environment in England and Wales is protected under a number of regulatory regimes, many regulated by the Environment Agency. The Environment Agency is consulted where there may be a risk that pollution of 'controlled waters' may occur or may have occurred in the past. Controlled waters are coastal waters, inland freshwaters and groundwaters. The EU Water Framework Directive (WFD) (2000/60/EC) is implemented via various regulations and guidance, covering aspects of groundwater, surface water and drinking water supply policy. The regulations mainly apply to England and Wales, therefore if you are working on a site in Scotland or Northern Ireland, please review the equivalent legislation and guidance provided by the Scottish Environmental Protection Agency (SEPA) or the Northern Ireland Environment Agency (NIEA).

The main objectives of the protection and remediation of groundwater under threat from land contamination are set out in the Environment Agency's Groundwater Protection: Principles and Practice (GP3) series of documents(1). When assessing risks to groundwater the following need to be taken into consideration:

- Where pollutants have not yet entered groundwater, all necessary and reasonable measures must be taken to:
    - *Prevent the input of hazardous substances into groundwater (see description of hazardous substances below)*
    - *Limit the entry of other (non-hazardous) pollutants into groundwater so as to avoid pollution, and to avoid deterioration of the status of groundwater bodies or sustained, upward trends in pollutant concentration*
- Where hazardous substances or non-hazardous pollutants have already entered groundwater, the priority is to:
    - *Minimise further entry of hazardous substances and non-hazardous pollutants into groundwater*
    - *Take necessary and reasonable measures to limit the pollution of groundwater or impact on the status of the groundwater body from the future expansion of a contaminant 'plume', if necessary by actively reducing its extent.*

**Definitions**

**Hazardous Substances** are defined in the Water Framework Directive 2000/60/EC as 'substances or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern. All List 1 substances under the old Groundwater Directive (80/68/EEC) are hazardous substances, all radioactive substances are hazardous substances.

**Non-hazardous Substances** are defined as 'substances capable of causing pollution that have not been classified as hazardous substances'. The non-hazardous list of pollutants does not simply replace the old WFD List II but includes a wider range.

For the current list of classified substances please visit the UKTAG website www.wfduk.org./jagdag/

When assessing the risks to surface waters, various standards apply, including Environmental Quality Standards which are protective of the water ecology[14].

The Water Supply (Water Quality) Regulations[2,3] are the primary source for assessing water bodies which may be used for public water supplies. There are also Private Water Supply Regulations which may be applicable in some cases.

This appendix presents the generic assessment criteria (GAC) that RSK considers are suitable for assessing risks to controlled waters.

The RSK GAC for controlled waters are presented in Table 1. In line with the Environment Agency's (2006b) Remedial Targets Methodology, the GAC for controlled waters are termed 'target concentrations'.

The target concentration can be derived by several means with consideration to:

- whether the substance is classified as hazardous or non-hazardous by the EU under the Water Framework Directive (2000/60/EC) and Groundwater Daughter Directive (2006/118/EC) implemented though the Environmental Permitting Regulations 2010
- background concentrations in the aquifer
- published guidance such as Environmental Quality Standards that are protective of ecology or The Water Supply (Water Quality) Regulations 2010 that are protective of drinking water
- Minimum Reporting Values (or method detection limits if MRV are not provided).

**Table 1: Target concentrations for Controlled Waters**

**Analytes in bold are hazardous**, *analytes in italics are non hazardous*, analytes in plain text are unclassified; according to JAGDAG Determination List June 2010

Target Concentrations shaded in GREEN are Statutory Values ORANGE are Non-Statutory Values

| Determinant | Target concentrations (mg/l) | | | |
|---|---|---|---|---|
| | Minimum Reporting Value | UK Drinking Water Standard or Best Equivalent | Environmental Quality Standard or Best Equivalent | |
| | | | Freshwater | Transitional (estuaries) and Coastal Waters |
| **Metals** | | | | |
| **Arsenic** | - | 0.01[(2)] | 0.05[(13a)] | 0.025[(13a)] |
| **Cadmium** | 0.0001[(4)] | 0.005[(2)] | ≤0.00008, 0.00008, 0.00009, 0.00015, 0.00025 [(13b)] | 0.0002[(13c)] |
| Chromium (total) | - | 0.05[(2)] | Use values for chromium III and VI | |
| Chromium (III) | - | Use value for total chromium | 0.0047 [(13a)] | 0.032[(13c)] |
| Chromium (VI) | | | 0.0034 [(13a)] | 0.0006[(13a)] |
| *Copper* | - | 2.0[(2)] | 0.001, 0.006, 0.01, 0.028[(13e)] | 0.005[(13a)] |
| Lead | - | 0.025 (before 25/12/2013), 0.01 (after 25/12/2013)[(2)] | 0.0072[(13c)] | 0.0072[(13c)] |
| **Mercury** | 0.00001[(4)] | 0.001[(2)] | 0.00005[(13c)] | 0.00005[(13c)] |

| Determinant | Target concentrations (mg/l) | | | |
|---|---|---|---|---|
| | Minimum Reporting Value | UK Drinking Water Standard or Best Equivalent | Environmental Quality Standard or Best Equivalent | |
| | | | Freshwater | Transitional (estuaries) and Coastal Waters |
| Nickel | - | 0.02[2] | 0.02[13c] | 0.02[13c] |
| Selenium | - | 0.01[2] | - | - |
| *Zinc* | - | 5[3] | 0.008, 0.05, 0.075, 0.125 [13e] | 0.04[13a] |
| **Chlorinated solvents** | | | | |
| **Trichloroethene** | 0.0001[4] | 0.01[2] | 0.01[13c] | 0.01[13c] |
| **Tetrachloroethene** | 0.0001[4] | 0.01[2] | 0.01[13c] | 0.01[13c] |
| **1,1,1-Trichloroethane** | 0.0001[4] | - | 0.1[13c] | 0.1[13c] |
| **1,1,2-Trichloroethane** | 0.0001[4] | - | 0.4[13c] | 0.3[13c] |
| **Carbon tetrachloride (Tetrachloromethane)** | 0.0001[4] | 0.003[2] | 0.012[13c] | 0.012[13c] |
| **1,2-Dichloroethane** | 0.001[4] | 0.003[2] | 0.01[13c] | 0.01[13c] |
| **Vinyl chloride (Chloroethene)** | - | 0.0005[2] | - | - |
| **Trihalomethanes** | - | 0.1[2, 5] | - | - |
| **Chloroform (Trichloromethane)** (one of the trihalomethanes included above) | 0.0001[4] | 0.1[2, 5] | 0.0025[13c] | 0.0025[13c] |
| **Polycyclic aromatic hydrocarbons** | | | | |
| **Acenaphthene** | - | - | 0.0058[10] | |
| **Acenaphthylene** | - | - | 0.0058[10] | |
| **Anthracene** | - | - | 0.0001[13c] | 0.0001[13c] |

| Determinant | Target concentrations (mg/l) | | | |
|---|---|---|---|---|
| | Minimum Reporting Value | UK Drinking Water Standard or Best Equivalent | Environmental Quality Standard or Best Equivalent | |
| | | | Freshwater | Transitional (estuaries) and Coastal Waters |
| Benzo(a)anthracene | - | - | 0.000018[10] | |
| **Benzo(b)fluoranthene** | - | 0.0001[2] | 0.00003[13f] | 0.00003[13f] |
| **Benzo(k)fluoranthene** | - | | | |
| **Benzo(g,h,i)perylene** | - | | 0.000002[13g] | 0.000002[13g] |
| **Indeno(1,2,3-cd)pyrene** | - | | | |
| Chrysene | - | - | 0.00001[10] | |
| Dibenzo(a,h)anthracene | - | - | 0.00001[10] | |
| **Fluoranthene** | - | - | 0.0001[13c] | 0.0001[13c] |
| Fluorene | - | - | 0.0021[10] | |
| Phenanthrene | - | - | 0.003[10] | |
| Pyrene | - | - | 0.00004[10] | |
| **Benzo(a)pyrene** | - | 0.00001[2] | 0.00005[13c] | 0.00005[13c] |
| **Naphthalene** | - | - | 0.0024[13c] | 0.0012[13c] |
| **Petroleum hydrocarbons** | | | | |
| **Total petroleum hydrocarbons** | - | 0.01[3] | 0.01[3, 11] | |
| **Benzene** | 0.001[4] | 0.001[2] | 0.01[13c] | 0.008[13c |
| **Toluene** | 0.004[4] | 0.7[9] | 0.05[13a] | 0.04[13a] |
| **Ethylbenzene** | - | 0.3[9] | 0.02[12] | 0.02[12] |
| **Xylene** | 0.003[4] | 0.5[9] | 0.03[13c] | 0.03[13c] |

| Determinant | Target concentrations (mg/l) | | | |
|---|---|---|---|---|
| | Minimum Reporting Value | UK Drinking Water Standard or Best Equivalent | Environmental Quality Standard or Best Equivalent | |
| | | | Freshwater | Transitional (estuaries) and Coastal Waters |
| *Methyl tertiary butyl ether* | - | 0.015[7] | | |
| **Pesticides and herbicides** | | | | |
| **Aldrin** | 0.000003[4] | 0.00003[2] | 0.00001[13d] | 0.000005[13d] |
| **Dieldrin** | 0.003[4] | 0.00003[2] | | |
| **Endrin** | 0.000003[4] | 0.0006[9] | | |
| **Isodrin** | 0.000003[4] | - | | |
| **Heptachlor** | - | 0.00003[2] | | |
| Heptachlor epoxide | - | 0.00003[2] | | |
| Other pesticides | - | 0.0001[2] | | |
| **Total pesticides** | - | 0.0005[2] | | |
| **Total DDT** | 0.000004[4] | 0.001[9] | 0.000025[13c] | 0.000025[13c] |
| **Azinphos – methyl** | 0.000001[4] | - | 0.00001[1] | |
| Cyfluthrin | 0.0001[4] | - | 0.000001[14] | |
| **Demeton** | 0.00005[4] | - | 0.0005[14 | |
| **Dichlorvos** | - | - | 0.000001[13c] | 0.00004[13c] |
| **Dimethoate** | 0.00001[4] | - | 0.00048[13a] | 0.00048[13a] |
| **Endosulphan** | 0.000005[4] | - | 0.000005[13c] | 0.0000005[13c] |
| **Fenitrothion** | 0.000001[4] | - | 0.00001[13c] | 0.00001[13c] |
| Flucofuron | 0.0001[4] | - | 0.001[14] | |

| Determinant | Target concentrations (mg/l) | | | |
|---|---|---|---|---|
| | Minimum Reporting Value | UK Drinking Water Standard or Best Equivalent | Environmental Quality Standard or Best Equivalent | |
| | | | Freshwater | Transitional (estuaries) and Coastal Waters |
| **Malathion** | 0.000001[4] | - | 0.00001[13c] | 0.00002[13c] |
| **Mevinphos** | 0.000005[4] | - | 0.00002[14] | - |
| **Omethoate** | 0.0001[4] | - | 0.00001[14] | |
| PCSDs (cyfluthrin, sulcofuron, flucofuron and **permethrin**) | - | - | 0.00005[15] | |
| **Permethrin** | 0.000001[4] | - | 0.00001[13a] | 0.00001[13] |
| Sulcofuron | 0.0001[4] | - | 0.025[8,14] | |
| **Triazaphos** | 0.0001[4] | - | 0.000005[8] | |
| **Atrazine** | 0.00003[4] | - | 0.0006[13c] | 0.0006[13c] |
| **Simazine** | 0.00003[4] | - | 0.001[13c] | 0.001[13c] |
| *Bentazone* | 0.1[4] | - | 0.5[13c] | 0.5[13a] |
| **Linuron** | 0.0001[4] | - | 0.0005[13a] | 0.0005[13a] |
| Mecoprop | 0.00004[4] | - | 0.018[13a] | 0.018[13a] |
| **Trifluralin** | 0.00001[4] | - | 0.00003[13c] | 0.00003[13c] |
| **Miscellaneous** | | | | |
| Cyanide (Hydrogen cyanide) | - | 0.05[2] | 0.001[13a] | 0.001[13a] |
| Phenol | 0.0005[4] | - | 0.0077[13a] | 0.0077[13a] |
| Sodium | - | 200[2] | - | |
| Chloride | - | 250[2] | 250[6,14] | - |

| Determinant | Target concentrations (mg/l) | | | |
|---|---|---|---|---|
| | Minimum Reporting Value | UK Drinking Water Standard or Best Equivalent | Environmental Quality Standard or Best Equivalent | |
| | | | Freshwater | Transitional (estuaries) and Coastal Waters |
| Ammonium (as $NH_4^+$) | - | 0.5[2] | 0.3[13a] | |
| *Ammonia ($NH_3$)* | - | - | 0.025[15] | 0.021[13a] |
| Sulphate | - | 250[2] | 400[6,14] | - |
| Iron | - | 0.20[2] | 1[13a] | 1[13a] |
| Manganese | - | 0.05[2] | 0.03[6,14] | No EQS required [12] |
| *Aluminium* | - | 0.2[2] | - | |
| Nitrate (as $NO_3$) | - | 50[2] | - | |
| Nitrite (as $NO_2$) | - | 0.1[2] | 0.01[15] | - |

**Analytes in bold are hazardous**, *analytes in italics are non hazardous*, analytes in plain text are unclassified;
according to JAGDAG Determination List June 2010

**Notes:**

1. Environment Agency. Groundwater Protection: Principles and Policy (GP3). Part 1 – 4. Part 4 and 5 under consultation.
2. Statutory Instrument 2000 No. 3184. The Water Supply (Water Quality) Regulations 2000, as amended by SI 2001/2885, SI 2002/2469, SI 2005/2035, SI 2007/2734 and SI 2010/991 (applying from April 20 2010)
3. Statutory Instrument 1989 No. 1147. The Water Supply (Water Quality) Regulations 1989, as amended.
4. Minimum reporting values listed in Annex (j) of Horizontal Guidance Note H1 (H1 Environmental Risk Assessment Framework, Environment Agency, April 2010 v2.0). Note target concentration for xylenes is 0.003mg/l each for o-xylene and m/p xylene.
5. Statutory Instrument 2000 No. 3184. The Water Supply (Water Quality) Regulations 2000 – sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane.
6. Proposed list of EQS for implementation of the Dangerous Substances Directive (76/464.EEC).
7. Environment Agency MTBE guidance, 2006.
8. Freshwater Environmental Quality Standards: The Water Framework Directive 200/60/EC.
9. WHO (2004) guidelines for drinking-water quality.
10. WRc plc (2002), R&D Technical Report P45. Where predicted no-effect concentration is below the laboratory method detection limit (LMDL) for chrysene, dibenzo(a,h)anthracene and fluoranthene, the target concentration has been set at the LMDL of 0.00001mg/l.
11. Please note this is a very conservative value. If necessary please refer to EA, 2009. *Petroleum hydrocarbons in Groundwater Supplementary Guidance for Hydrogeological Risk Assessment, which* provides advice on risk rankings of TPH CWG fractions. It may be possible to eliminate low risk fractions and/or those not detected above LMDL from concern.
12. Environment Agency Chemical Standards Database (May 2011). http://evidence.environment-agency.gov.uk/ChemicalStandards/home.aspx
13. The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010.
    - 13a. Annual mean concentration (mg/l) for 'Good' standard.
    - 13b. Applies to hardness ranges of <40mg/l $CaCO_3$, 40–<50mg/l $CaCO_3$, 50–<100mg/l $CaCO_3$, 100–<200mg/l $CaCO_3$ and >/=200mg/l $CaCO_3$. The target concentrations included in Table 1 are listed in order of increasing calcium carbonate concentrations.
    - 13c Annual Average EQS (surface waters).
    - 13d. Sum of aldrin, dieldrin, endrin and isodrin.
    - 13e. Applies to hardness ranges of 0–50mg/l $CaCO_3$, 50–100mg/l $CaCO_3$, 100–250mg/l $CaCO_3$ and >250mg/l $CaCO_3$. The target concentrations included in Table 1 are listed in order of increasing calcium carbonate concentrations; applies to annual mean concentration (mg/l) of $CaCO_3$. Applies to annual mean concentration of metal (mg/l) for 'Good' standard.

13f. Sum of benzo(b)fluoranthene and benzo(k)fluoranthene.

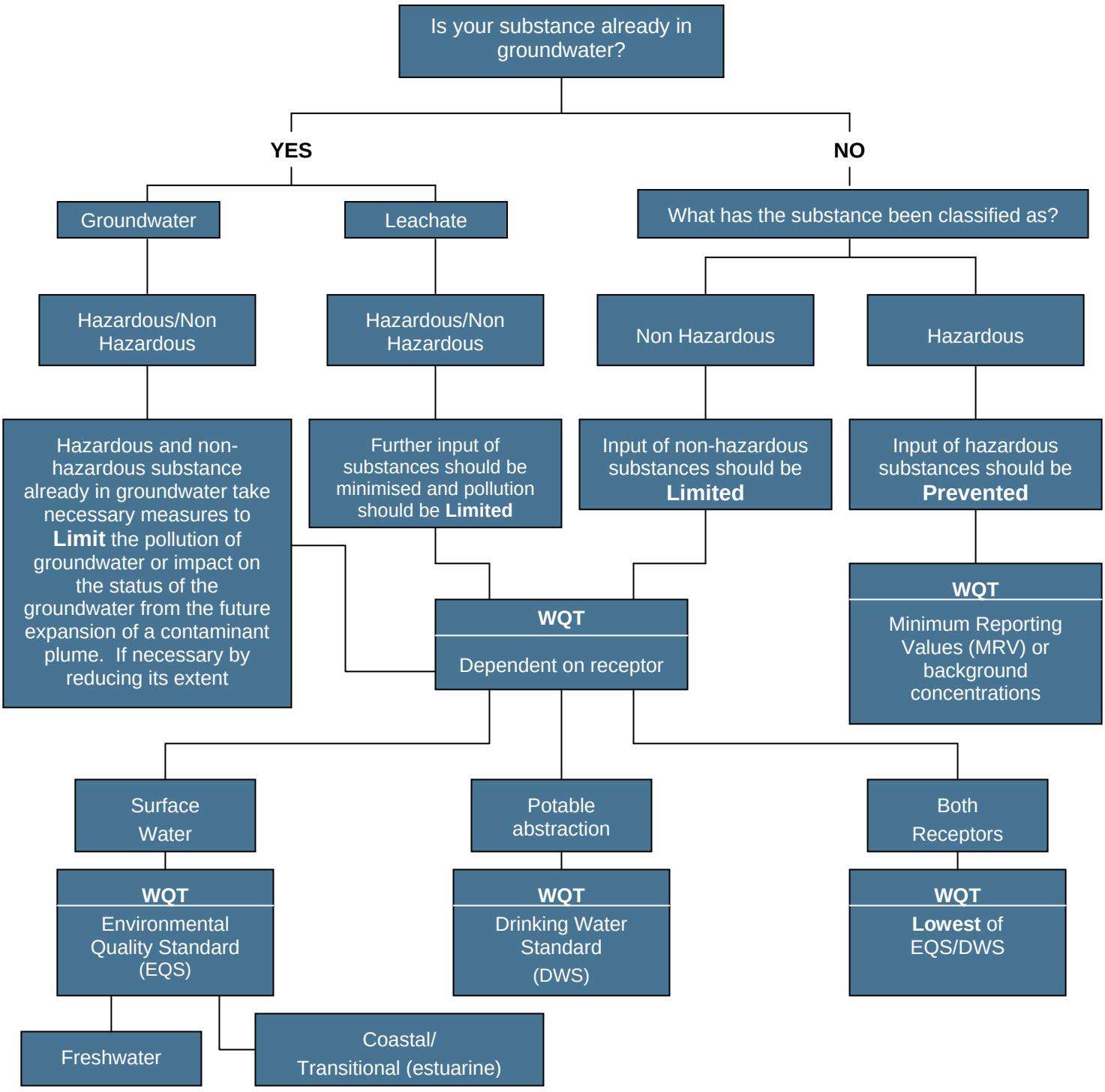
13g. Sum of benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene.

14. Council Directive on Pollution Caused by Certain Dangerous Substances Discharged into the Aquatic Environment of the Community (Dangerous Substances Directive) - List II Substances. Council Directive 76/464/EEC and Surface Waters (Dangerous Substances) (Classification) Regulations 1998

15. Council Directive on the Quality of Fresh Waters Needing Protection or Improvement in Order to Support Fish Life (Freshwater Fish Directive). Surface Waters (Fishlife) (Classification) Regulations 1997.

Note: '-' A target concentration is not available.

# FLOW CHART TO ASSIST WITH SELECTION OF TARGET CONCENTRATIONS




WQT = Water Quality Target

When leachate is being assessed the 'compliance point' is the groundwater body. Therefore dilution within the groundwater body may be applied with caution before comparing with the WQT.

When directly assessing a receptor, e.g., a river, the appropriate WQT should be selected.

# APPENDIX L
# PREVIOUS SITE INVESTIGATION REPORTS