JOMAS | ENGINEERING ENVIRONMENTAL LAND REMEDIATION

WE LISTEN, WE PLAN, WE DELIVER

Geotechnical Engineering and Environmental Services across the UK

# REMEDIAL STRATEGY
# AND
# VERIFICATION PLAN

FOR

PROPOSED DEVELOPMENT AT

FORMER SITE OF HPH4,
HYDE PARK,
MILLINGTON ROAD,
HAYES, LONDON,
UB3 4AZ

JOMAS ASSOCIATES LTD
24 Sarum Complex, Salisbury Avenue, Uxbridge, UB8 2RZ
www.jomasassociates.com 0333 305 9054 info@jomasassociates.com

| | |
|---|---|
| **Report Title:** | **Remedial Strategy & Verification Plan for Former site of HPH4, Hyde Park, Millington Road, Hayes, London, UB3 4AZ** |
| **Report Status:** | **Final** |
| **Job No:** | **P3284J2275/CLP** |
| **Date:** | **14 June 2024** |

**QUALITY CONTROL – REVISIONS**

| Version | Date | Issued By | Comment |
|---|---|---|---|
| | | | |
| | | | |

**Prepared by: JOMAS ASSOCIATES LTD For: AITCH GROUP**


| Prepared by | Reviewed by | Approved by |
|---|---|---|
| Clare Prosser BSc (Hons), MSc, FGS | Tom Elbourne BSc (Hons) CGeol CSci FGS, RoGEP - Professional | Simon Pike BSc (Hons), MSc, MIEnvSc |
| Senior Geo-environmental Engineer | | Senior Principal Geo-Environmental Engineer |
| ..... | ..... | ..... |


**Should you have any queries relating to this report, please contact**

**JOMAS ASSOCIATES LTD**

**www.jomasassociates.com**

**0333 305 9054**

**info@jomasassociates.com**

## CONTENTS

Page

# 1 INTRODUCTION

## 1.1 Terms of Reference

1.1.1 Aitch Group ("The Client"), has commissioned Jomas Associates Ltd ('Jomas') to produce a remedial strategy prior to the development of Former site of HPH4, Hyde Park, Millington Road, Hayes, London, UB3 4AZ .

## 1.2 Site Information

1.2.1 The site currently comprises a car park in the east of the site and unoccupied soft landscaping in the west

## 1.3 Proposed Development

1.3.1 The proposed development is to comprise of the construction of a new residential building to consist of approximately 8-9 storeys containing approximately 130 residential units. Communal areas of soft landscaping are anticipated.

## 1.4 Previous Reports

1.4.1 The previous reports that have been utilised by Jomas for the purposes of this document comprise:

- Phase 1 Environmental Assessment for Hyde Park Hayes, Building 4, R1620010949_01_HPH4 _ Ph1, November 2020, Ramboll.
- Groundwater Survey for Hyde Park, Hayes, Building 4, L1700000706JR22_01, November 2020, Ramboll.
- HPH4 Groundwater Contamination Commentary, Ramboll.
- Desk Study/Preliminary Risk Assessment Report for Former Site of HPH4, Hyde Park, 1 Millington Road, Hayes, London, UB3 4AZ, P3284J2275, May 2021, Jomas Associates Ltd.
- Geo-environmental and Geotechnical Assessment (Ground Investigation) Report for Former Site of HPH4, Hyde Park, 1 Millington Road, Hayes, London, UB3 4AZ, P3284J2275, December 2021, Jomas Associates Ltd.
- Detailed Soil Vapour Quantitative Risk Assessment for Former Site of HPH4, Hyde Park, 1 Millington Road, Hayes, London, UB3 4AZ, P3284J2275, February 2022, Jomas Associates Ltd.

## 1.5 Background

1.5.1 Development permission is being granted by London Borough of Hillingdon with a number of conditions relating to various requirements.

1.5.2 Planning Condition 22 of application ref 76655/APP/2021/3039, relates to land contamination matters, as reproduced below. The condition consists of 4No parts.

*Condition 22:*

> (i) The development shall not commence until a scheme to deal with contamination has been submitted to and approved by the Local Planning Authority (LPA). All works which form part of the remediation scheme shall be completed before any part of the development is occupied or brought into use unless the Local Planning Authority

dispenses with any such requirement specifically and in writing. The scheme shall include all of the following measures unless the LPA dispenses with any such requirement specifically and in writing:

a) A site investigation, including where relevant soil, soil gas, surface and groundwater sampling, together with the results of analysis and risk assessment shall be carried out by a suitably qualified and accredited consultant/contractor. The report should also clearly identify all risks, limitations and recommendations for remedial measures to make the site suitable for the proposed use; and

(b) A written method statement providing details of the remediation scheme and how the completion of the remedial works will be verified shall be agreed in writing with the LPA prior to commencement, along with the details of a watching brief to address undiscovered contamination. No deviation shall be made from this scheme without the express agreement of the LPA prior to its implementation.

If during remedial or development works contamination not addressed in the submitted remediation scheme is identified an addendum to the remediation scheme shall be agreed with the LPA prior to implementation; and

(iii) Upon completion of the approved remedial works, this condition will not be discharged until a comprehensive verification report has been submitted to and approved by the LPA. The report shall include the details of the final remediation works and their verification to show that the works for each phase have been carried out in full and in accordance with the approved methodology.

(iv) No contaminated soils or other materials shall be imported to the site. All imported soils for landscaping purposes shall be clean and free of contamination. Before any part of the development is occupied, all imported soils shall be independently tested for chemical contamination, and the results of this testing shall be submitted and approved in writing by the Local Planning Authority. REASON To ensure that risks from land contamination to the future users of the land and neighbouring land are minimised, together with those to controlled waters, property and ecological systems and the development can be carried out safely without unacceptable risks to workers, neighbours and other offsite receptors in accordance with Policies DMEI 11 and DMEI 12 of the Hillingdon Local Plan: Part 2 (2020).

1.5.3 Condition 22 Part (i) a) has been addressed by the above referenced previous reports. The purpose of this report is to satisfy Condition 22 (i) b) by providing a remediation strategy to bring the site into a suitable condition for the proposed end use.

1.5.4 Condition 22 (ii) to (iv) will be addressed by the production of a Verification Report on completion of the works set out within this strategy.

## 1.6 Objectives

1.6.1 The primary objectives of this document are as follows:

- To provide information on the site setting; identify ground conditions and potential environmental risks associated with the development.
- To provide an assessment of various options for remediation.
- To set out the remediation strategy that will provide a site that is suitable for the intended use and addresses any identified unacceptable risks.

- To provide relevant information to address planning conditions relating to contaminated land. A separate verification report will be required following the implementation of the remediation strategy.

1.6.2 The primary remediation objective is the mitigation of the risks associated with asbestos impacted soils and a potential vapour risk from trichloroethene impacting groundwater, identified by previous investigations by Ramboll.

1.6.3 This document provides an assessment of potential remedial strategies and describes the methodology for the proposed remedial action.

1.6.4 The remediation strategy and associated remediation criteria have been developed with reference to previous works carried out at the site. The remediation criteria used to develop the proposed remediation strategy will be used for the proposed verification works.

1.6.5 The Principal Contractor will be responsible for implementing the appropriate methodology and site management procedures to achieve the required outcome and comply with these principles.

1.6.6 The works will be undertaken by experienced personnel and will be managed in accordance with the Contractor's Construction Environmental Management Plan. Detailed construction method statements will be prepared for the impacted soil removal works. Jomas will be employed as Environmental Specialist, to supervise the works and undertake soil sampling and analysis as part of the validation process.

1.6.7 This document should be read in conjunction with the above reports.

## 1.7 Limitations

1.7.1 Jomas Associates Ltd ('Jomas') has prepared this report for the sole use of Aitch Group, in accordance with the generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon by any other party without the explicit written agreement of Jomas. No other third party warranty, expressed or implied, is made as to the professional advice included in this report. This report must be used in its entirety.

1.7.2 This report provides an overview of conclusions drawn from previous investigations, some of which has been conducted by others. Third party information used is assumed to be correct, and Jomas has not validated any of the data provided. Jomas is unable to guarantee the accuracy of the information provided by others.

# 2 LAND CONTAMINATION OVERVIEW

## 2.1 Desk Study Findings (Jomas 2021)

2.1.1 A desk study was produced for the site (Jomas, May 2021), and issued separately. A brief overview of the findings is presented below:

- The historical record of the site indicated that the site remained undeveloped until after World War 2, when the site appears to have been used for storage associated with the adjacent aviation works. From the 1970's until recent demolition circa 2013, the site appears to have been developed with a warehouse.
- The site vicinity underwent significant development in the early part of the 20th century with a gramophone factory 240m north of the site, and an aviation works 90m east during the 1930s. The aviation works appeared to have been redeveloped with industrial warehouses from the 1970s onwards, with more recent commercial developments occurring in the last ten years.
- The British Geological Survey indicated that the site is directly underlain by superficial deposits of the Lynch Hill Gravel Member, underlain by solid deposits of the London Clay Formation. Artificial deposits are reported across the entire site, reported as worked ground (undivided).
- The superficial deposits underlying the site were identified as a Principal Aquifer with the underlying solid deposits identified as Unproductive. A review of the Enviro+Geoinsight Report indicated that there are no source protection zones within 500m of the site.
- There were no potable water abstractions reported within 2km of the site and no surface water features within 1km of the site.
- There were no Environment Agency Zone 2 or 3 floodplains reported within 250m of the site.
- It was recommended that an intrusive investigation be undertaken to clarify potential risks to the identified receptors.

## 2.2 Desk Study Findings (Ramboll 2020)

2.2.1 The report includes observations from a site inspection in 2014 and ad-hoc observations during Ramboll's groundwater monitoring surveys at a wider site area between 2016 and 2020. At that time the site was being used as a contractor's compound associated with development of a nearby site.

2.2.2 A programme of environmental monitoring of groundwater across the Hyde Park Hayes site has been undertaken by Ramboll in support of the discharge of planning conditions associated with the redevelopment of an adjacent site known as HPH5. Two (2) monitoring wells included within the monitoring programme lie within the boundary of the current study site, referred to by Ramboll as HPH4.

2.2.3 A review of historical mapping reached similar conclusions to those identified by Jomas Associates in the Desk Study. However, aerial photography not seen by Jomas indicated that in the post WW2 years, the eastern part of the site appears unsurfaced and in use for storage, potentially associated with off-site aviation works. The western part of site had the appearance of possible allotment gardens.

2.2.4 Ramboll noted that are records of four (4) former landfills within 1km of the subject site. The nearest of these (located 770m south-west at its nearest point) is the Frogsditch Farm landfill site, operated by Hall Aggregates Limited. The landfill was authorised to receive inert construction and demolition waste between 1982 and 1989.

2.2.5 Ramboll identified the following on site potentially contaminative activities:

- Use of the site for warehousing from early 1970's to late 2010's. Potential contaminants would depend on the nature of materials stored in the warehouse; fuels and other hydrocarbons may be present if refuelling activities were undertaken on-site.
- Storage associated with off-site Westland Aircraft Ltd (Fairy Aviation Division) Aeronautical Engineering Works from the 1940s, potentially up to site redevelopment in the early 1970s.

2.2.6 The following potentially contaminative activities were identified as having taken place in the surrounding area:

- Westland Aircraft Ltd (Fairy Aviation Division) Aeronautical Engineering Works from the 1940s, potentially up to site redevelopment in the early 1970s. The Westlands site is indicated to have included fuel storage in underground storage tanks, and the specific location of these tanks is unconfirmed. Potential contaminants would depend on the nature of materials stored and utilised, but could include hydrocarbon fuels and oils, solvents, and metals.
- Gramophone factories from at least the 1910s to the 1990s approximately 170m north of the site. Potential contaminants from the Gramophone Factory could include solvents, hydrocarbons, metals and asbestos.
- Further industrial and commercial land use in the area, including a large unidentified Factory 290m north-west (1960s to 1990s); and a Transport Depot 190m north-west (from 1960s).

2.2.7 Ground conditions from previous investigations at the HPH4 site were reported to comprise:

- Made Ground comprising reworked natural strata with some observations of concrete and brick fragments to depths of between 0.7m (REH01) and 1.8m (BH11) below ground level (bgl).
- Natural strata underlying the made ground comprised dense sandy gravel of flint (Lynch Hill Gravels) with discrete bands of gravelly sand and silty clay (REH01 only) to depths of between 4.5mbgl (BH11) and 4.7mbgl (REH01).
- The London Clay was encountered at the base of the Lynch Hill Gravels in both boreholes on the HPH4 plot.

2.2.8 Environmental assessments of the wider Hyde Park Hayes site and remediation verification reporting for HPH5 (a site located to the east-southeast of HPH4) was undertaken by the consultant Jacobs on behalf of (its client) the former owner of the site (Melfords) in conjunction with the planning process for the construction of HPH5. Long term monitoring of groundwater conditions was requested by the EA in conjunction with the discharge of planning condition No.14 relating to groundwater contamination. Ramboll was commissioned to undertake longer term groundwater monitoring in 2016 to discharge this condition.

2.2.9 The Groundwater Assessment programme comprised eight (8) groundwater monitoring and sampling surveys over the period March 2016 to March 2017, reported and submitted to the

Local Planning Authority (LPA) (ref: RUK16-20878_GWA_2, dated 10th October 2017). The outstanding Planning Condition 14 associated with HPH5 was discharged by the LPA following submission of the Ramboll report.

2.2.10 A subsequent programme of three (3) groundwater monitoring and sampling surveys were subsequently undertaken in 2018 (April, September and December). A further confirmatory survey was undertaken in October 2020.

2.2.11 The findings of the groundwater monitoring were summarised by Ramboll as follows:

- Groundwater depths on the HPH4 plot ranged from 1.46mbgl (BH11, October 2020) to 2.68mbgl (BH11, April 2018).
- Overall, groundwater flow direction was towards the east/north-east across the wider HPH area, which was broadly consistent with the findings of Jacobs' previous assessments and indicating a recharge mound in the vicinity of HPH4 (unsurfaced ground on/off-site to the west). Therefore, groundwater flow was considered to flow away from HPH4 towards the wider HPH site.
- The groundwater system within the Lynch Hill Gravels aquifer was considered to have been demonstrated by long term field monitoring surveys to be moderately dynamic, with seasonal fluctuations in groundwater levels and physio-chemical parameters observed.

2.2.12 Groundwater physico-chemical testing on-site indicated that the groundwater at the wider HPHP site (and specifically HPH4) is oxygenated (>1.5mg/l dissolved $O_2$) and oxidising (>100mV redox potential), which provides a supporting line of evidence for the presence of a local recharge zone. The observed groundwater conditions were not considered to be conducive to microbially-mediated de-chlorination of chlorinated hydrocarbons (natural attenuation).

2.2.13 Contaminants of concern have not been detected in samples from BH11 in any of the groundwater monitoring surveys conducted by Ramboll between March 2016 and December 2018.

2.2.14 Since the installation of REH01 in July 2016, some contaminants, including chlorinated hydrocarbons (specifically trichloroethene and cis-1,2-dichloroethene), have been detected at concentrations exceeding the remedial targets derived by DQRA by SKM. However, since December 2016 only one (1) of seven (7) samples recovered from REH01 (the September 2018 sample) exceeded the remedial target. The latest detected concentration at RE0H1 from the October 2020 sample survey was again below the remedial target and was found to be consistent with the reported declining trend in TCE concentrations at this location since December 2016.

2.2.15 Concentrations of these contaminants have been assessed as having exhibited an overall decreasing trend between August 2016 and December 2018 (despite a moderate increase in detected concentrations in September 2018).

2.2.16 In the absence of observed groundwater conditions conducive to natural attenuation processes, the observed declining concentration in contaminant concentrations was considered likely to be representative of a declining source influenced by dilution and dispersion processes in the groundwater.

2.2.17 Ramboll considered that the HPH4 site area and wider Hyde Park Hayes site benefit from a significant level of environmental assessment which serves to reduce the uncertainty associated with the assessment of the potential for contaminated land to affect future users of HPH4.

2.2.18 According to Ramboll, the site of HPH5 was considered by Jacobs to represent the primary source area for observed chlorinated solvent impacts to groundwater.

2.2.19 Ramboll considered that a robust understanding of the environmental conditions has been established at HPH4. Ramboll considered that a localised contamination impact to groundwater has been identified in one (1) of the two (2) monitoring wells on the HPH4 plot (REH01); however, Ramboll also considered that statistical analysis of the available dataset indicated an overall declining trend in detected concentrations since the installation of the monitoring well in 2016.

2.2.20 Ramboll considered that a Planning Consent for redevelopment of HPH4 would likely include standard contaminated land related Conditions; a requirement for onerous remedial intervention is considered to be unlikely. Ramboll concluded that the Environment Agency has de-prioritised the site and consistently declined to provide comment on the discharging of Planning Conditions relating to groundwater contamination at HPH5.

2.2.21 Using the activities undertaken as part of the HPH5 development as a template, remedial interventions that might be required at HPH4 were considered likely to be limited to:

- Segregation and removal of impacted soils (if any);
- Dewatering of excavations (likely only required if development includes construction of a basement); and
- Inclusion of a vapour impermeable membrane as a precautionary measure to prevent the ingress of any residual volatile compounds present in soil / groundwater into the indoor airspace.

## 2.3 Intrusive Investigation (Ramboll 2020)

2.3.1 A groundwater survey report was completed by Ramboll, dated 9th November 2020.

2.3.2 A further groundwater sampling visit was conducted by Ramboll in October 2020, and included the groundwater monitoring wells BH11 and REH011 present on the HPH4 site.

2.3.3 Trichloroethene was the only chlorinated solvents compound detected above the laboratory method detection limits. A concentration of 26 µg/L was detected in REH011 only, which did not exceed the remedial target of 179 ug/L.

2.3.4 Ramboll's conclusions were unchanged from those presented in their Phase 1 Environmental Assessment.

## 2.4 Intrusive Investigation (Jomas 2021)

2.4.1 The Jomas ground investigation was undertaken in May 2021, and consisted of the following:

- 5No windowless sampler boreholes to a maximum depth of 2mbgl.
- 2No cable percussion boreholes to a maximum depth of 30mbgl.

- Installation of 6No gas and groundwater monitoring wells.

2.4.2 The results of the ground investigation revealed a ground profile comprising a variable thickness of Made Ground, to depths of up to 1.92m, underlain by loose to very dense sandy gravel of the Lynch Hill Gravel Member, to a maximum proven depth of 5.20mbgl, underlain by firm to stiff consistency clay of the London Clay Formation to the base of the boreholes (maximum depth of 30mbgl).

2.4.3 Groundwater strikes were reported at 3.6mbgl and 4.10mbgl respectively within BH1 and BH2, rising to 3.1mbgl and 3.5mbgl in BH1-BH2 respectively. No strike was reported within BH3 although water was added to aid drilling and may have masked a strike.

2.4.4 During return monitoring completed to date, groundwater was encountered at depths of between 1.55m to 2.25mbgl within the Lynch Hill Gravel Member.

## 2.5 Soil Gas Risk Assessment

2.5.1 The site can be considered as Characteristic Situation 1 in terms of the gas screening value when calculated using worst case results. Therefore, formal gas protection methods are not considered necessary.

2.5.2 The risks from vapour inhalation were considered to be negligible based on the results of soil and groundwater samples obtained on site; however, the primary source of potential vapour as identified by Ramboll is considered to originate off-site and therefore a detailed quantitative risk assessment was recommended.

## 2.6 Controlled Waters Risk Assessment

2.6.1 The superficial Lynch Hill Gravel Member deposits underlying the site were identified as a Principal Aquifer with the underlying solid deposits of the London Clay Formation identified as Unproductive. A review of the Enviro+Geoinsight Report indicated that there are no source protection zones within 500m of the site.

2.6.2 Concentrations of nickel were found to exceed environmental water quality standard. It is noted that the EQS is for bioavailable concentrations which is likely to be lower than the total concentration reported. In addition, no environmental receptors have been identified in close proximity to the site, and the concentrations do not exceed the drinking water standard, and are therefore not considered to pose a significant risk to the Principal Aquifer beneath the site.

2.6.3 There were no potable water abstractions reported within 2km of the site and no surface water features within 1km of the site.

2.6.4 Risks to controlled waters from soil are considered negligible.

## 2.7 Human Health Risk Assessment

2.7.1 Following a review of the site investigation reports, the following factors are noted:

- The proposed development comprises residential apartments with communal soft landscaping.
- Following generic risk assessments, no contaminants contained within the testing suite were reported at concentrations in excess of generic assessment criteria for the protection of human health within a “residential without plant uptake” end-use scenario.

- Asbestos in the form of loose chrysotile fibres were detected in a single sample out of 8No analysed in the laboratory.
- Health and Safety measures will be required for the protection of construction workers.

**2.8 Impact to Neighbouring Properties and Buried Services**

2.8.1 Screening of levels of determinands potentially affecting water pipes did not identify any exceedances, therefore upgraded pipework is unlikely to be required.

2.8.2 Requirements for potable water supply pipework should be confirmed with the relevant utility provider at an early stage of the project life cycle.

**2.9 Soil Vapour Detailed Quantitative Risk Assessment (Jomas 2022)**

2.9.1 Site specific vapour phase assessment criteria (VAC) have been derived for the site and used for comparison with vapour samples obtained from the site.

2.9.2 The results of the model indicate that a pollutant linkage via vapour inhalation pathways to end users of the proposed development is unlikely to exist.

2.9.3 None of the samples tested exceeded the derived VAC, however 2No samples were reported within an order of magnitude of the VAC for trichloroethene.

2.9.4 The ground investigation undertaken on site by Jomas Associates did not identify evidence of a significant source of trichloroethene on the site. However, given the historical records of VOC concentrations detected in groundwater at the site, and the detection of concentrations of trichloroethene in the vapour phase in the subsoils within an order of magnitude of the derived VAC, it is recommended that a vapour resistant membrane be installed within the ground floor construction of the development as a precaution.

**2.10 Conceptual Site Model (CSM)**

2.10.1 A review of potential sources Identified During Desk Study, is presented overleaf within an updated CSM.

**Table 2.1: Plausible Pollutants Linkages Summary (Pre-Remediation, as updated for Remediation Strategy)**

| Source | Pathway | Receptor | Relevant Pollutant Linkage | Comment |
|---|---|---|---|---|
| • Warehouse on site from early 1970's to late 2010's – (S1)<br>• Use of site for storage associated with nearby aircraft works - (S2)<br>• Potential for Made Ground associated with previous development operations – on site (S4) | • Ingestion<br>• Inhalation or contact with potentially contaminated dust and vapours | • Future site users<br>• Construction workers<br>• Maintenance workers<br>• Neighbouring site users | **Y** | Asbestos fibres detected on site; remedial measures required. |
| | • Inhalation of vapours | • Future site users<br>• Construction workers<br>• Maintenance workers<br>• Neighbouring site users | **Y** | Remedial measures considered necessary in the form of a vapour resistant membrane. |
| | • Permeation of water pipes and attack on concrete foundations by aggressive soil conditions | • Building structures/services | **N** | Contact should be made with relevant utility providers to confirm if upgraded materials are required. |
| | • Leaching through permeable soils, migration within the vadose zone (i.e., unsaturated soil above the water table) and/or lateral migration within surface water, as a result of cracked hardstanding or via service pipe/corridors and surface water runoff.<br>• Horizontal and vertical migration of contaminants within groundwater | • Controlled waters - Principal aquifer | **N** | No significant risk to controlled waters receptors identified. |
| • Current and previous industrial use –off site (S3)<br>  ○ Gramophone factory 240m NE (from ca 1910)<br>  ○ Gas works 300m north (from ca 1910)<br>  ○ Aviation works 90m east (from ca 1930s)<br>  ○ USTs for fuel storage at adjacent site to the north, and wider within the adjacent former aviation works | • Horizontal and vertical migration of contaminants within groundwater<br>• Inhalation of vapours | • Future site users<br>• Construction workers<br>• Maintenance workers | **Y** | Remedial measures considered necessary in the form of a vapour resistant membrane. |
| • Former brick fields 20m north and 130m north east (S5)<br>• Worked ground on site and in wider site vicinity (S6) | • Accumulation and Migration of Soil Gases (P5) | • Future site users<br>• Construction workers<br>• Maintenance workers | **N** | Characteristic Situation 1, gas protection measures not required, however a vapour resistant membrane is recommended. |

# 3 REMEDIAL OPTIONS APPRAISAL

3.1.1 Soil Screening

- A possible remedial option would be to undertake soil screening, comprising excavation of impacted soils, screening within the site to remove likely contaminative materials, and re-deposition of materials on site. Such an operation may include a variety of screening methodologies, including soil washing etc.
- Any visual asbestos materials may be removed by hand, with extensive dust control measures required during the soil screening operations for the protection of site workers and nearby residents. Asbestos fibres in soil will, however, not be visible for removal.

3.1.2 Excavation and disposal

- Made Ground displaying elevated concentrations of contaminants may be excavated for disposal off site. From a review of chemical testing data, excavations to a depth of the order of 2.0mbgl minimum would be required, with the importation of a respective thickness of certified clean material to restore site level.
- The costs and vehicle movements required for such an operation may render the costs associated with this method prohibitive.

3.1.3 Encapsulation

- In order to sever the identified pathways to the most sensitive receptors (human health), encapsulation of impacted materials below building footprints or areas of hard surfacing may be undertaken. This would have the effect of removing the potential pathways of direct contact and inhalation.
- Asbestos was detected within 1No (WS1 at 1.50mbgl) of the 8No samples tested during the ground investigation. It should be noted that a sample obtained at 0.25m within WS1, did not contain asbestos.
- Although asbestos was not detected elsewhere across the site, the exploratory hole locations were not positioned within the proposed soft landscaped areas and therefore the presence of asbestos within these areas cannot be discounted.
- In areas of soft landscaping, impacted soils can be encapsulated beneath a minimum 450mm thickness of clean imported sub/topsoil placed over a geotextile membrane or marker layer.

3.1.4 Dust control measures will be required during the undertaking of all the remedial options identified above for the protection of site workers.

3.1.5 When issues of cost effectiveness, requirements for vehicle movements etc. are taken into account, it is recommended that encapsulation of impacted soils is adopted as the preferred remedial methodology.

3.1.6 The requirements for the remedial methodology are presented within Section 4 of this report.

# 4 PROPOSED REMEDIATION STRATEGY

## 4.1 Introduction

4.1.1 The proposed remediation scheme serves to address the potential unacceptable risks identified in the context of the proposed redevelopment of the site.

4.1.2 The remedial measures comprise;

- The encapsulation of impacted soils below areas of building footprint or hardstanding.
- Implementation of a vapour resistant membrane within the proposed building footprint.
- A watching brief following demolition and during enabling works.
- Within areas of private and communal soft landscaping, a cover layer comprising a minimum 450mm thickness of clean subsoil/topsoil over a geotextile membrane/marker layer will be utilised.
- Where Made Ground is removed and the base of the Made Ground is encountered at shallower depth than the depth of the proposed clean cover, the depth of clean cover can be limited to the thickness of made ground removed, or thickness required for finished levels.
- Validation testing will be undertaken upon soils imported to site to confirm their suitability for use as a clean capping layer.

## 4.2 Remediation Strategy

Vapour mitigation measures

4.2.1 Following the Soil Vapour Detailed Quantitative Risk Assessment (Jomas, 2022), the results did not show a pollutant linkage via vapour inhalation, however given the historical records of VOC concentrations detected in groundwater at the site, and the detection of concentrations of trichloroethene in the vapour phase in the subsoils within an order of magnitude of the derived VAC, it is recommended that a vapour resistant membrane be installed within the ground floor construction of the development.

4.2.2 As per CIRIA C748/C716 the most common types of VOC membranes include polypropylene and polyethylene.

4.2.3 The membrane should meet the following criteria, as recommended within BS8485.

**Table 4.1: Recommended Gas Protection Measures**

| Protection Measures |
|---|
| Barrier<br>Vapour resistant membrane meeting all of the following criteria:<br>• Sufficiently impervious to VOC's.<br>• Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions.<br>• Sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab). |

| Protection Measures |
|---|
| • Sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc).<br>• Capable, after installation, of providing a complete barrier to the entry of the relevant gas; and<br>• Verified in accordance with CIRIA C748/C716 |

4.2.1 During construction where personnel are required to enter excavations of greater than 1.2m the air quality should be regularly checked prior and during person entry. Appropriate precautions, including but not limited to, venting, PPE and gas alarms should be undertaken.

4.2.2 Any permanent excavations such as manholes, inspection chambers or other void spaces formed beneath the sites ground surface are potential ground gas traps and precautions, as per above, are considered the minimum necessary prior to person entry.

4.2.3 The installation of the ground gas protection measures shall be verified by a competent person in accordance with CIRIA C735.

4.2.4 An example of a product meeting the specification of a suitable vapour membrane is provided in Appendix 1.

Impacted Soils Encapsulation

4.2.5 Following removal of hardstanding etc, any visible asbestos materials are to be removed by a specialist contractor by a hand-picking operation, and double bagged for disposal. Dust control measures will also be required. This may comprise the damping down of excavations. It is noted that asbestos fibres will not be visible to the naked eye.

4.2.6 Where buildings or hardstanding are proposed, no formal remedial works are considered necessary, beyond the hand picking discussed above, and the construction of the building/hardstanding, as this should provide an appropriate barrier to impacted soils. External hardstanding within private areas should be of a construction that discourages possible removal by future occupiers.

4.2.7 Within areas of soft landscaping, soils will be encapsulated below a cover layer of imported clean subsoil/topsoil. This should comprise a minimum 450mm of soil within communal soft landscaped areas, laid over a geotextile membrane/marker layer.

4.2.8 Where topsoil and sub-soil is imported to the site, the soil should be chemically suitable for use. All imported soil should conform to the following chemical specification:

**Table 4.2: Topsoil Requirements**

| Determinand | Unit | Screening Criteria | |
|---|---|---|---|
| Arsenic | mg/kg | S4UL | 37 |
| Boron | mg/kg | S4UL | 290 |
| Cadmium | mg/kg | S4UL | 11 |
| Chromium | mg/kg | S4UL | 910 |
| Lead | mg/kg | C4SL | 200 |
| Mercury | mg/kg | S4UL | 40 |

| Determinand | Unit | Screening Criteria | |
|---|---|---|---|
| Nickel | mg/kg | BS3882 | 110 |
| Selenium | mg/kg | S4UL | 250 |
| Copper | mg/kg | BS3882 | 200 |
| Zinc | mg/kg | BS3882 | 300 |
| Total Cyanide | mg/kg | CLEA v1.06 | 33 |
| Asbestos | % | S4UL | None Detected |
| pH | - | S4UL | 5-9 |
| Naphthalene | mg/kg | S4UL | 2.3 |
| Acenaphthylene | mg/kg | S4UL | 170 |
| Acenaphthene | mg/kg | S4UL | 210 |
| Fluorene | mg/kg | S4UL | 170 |
| Phenanthrene | mg/kg | S4UL | 95 |
| Anthracene | mg/kg | S4UL | 2400 |
| Fluoranthene | mg/kg | S4UL | 280 |
| Pyrene | mg/kg | S4UL | 620 |
| Benzo(a)anthracene | mg/kg | S4UL | 7.2 |
| Chrysene | mg/kg | S4UL | 15 |
| Benzo(b)fluoranthene | mg/kg | S4UL | 2.6 |
| Benzo(k)fluoranthene | mg/kg | S4UL | 77 |
| Benzo(a)pyrene | mg/kg | S4UL | 2.2 |
| Indeno(123-cd)pyrene | mg/kg | S4UL | 27 |
| Dibenzo(ah)anthracene | mg/kg | S4UL | 0.24 |
| Benzo(ghi)perylene | mg/kg | S4UL | 320 |
| TPH $C_5$-$C_6$ | mg/kg | S4UL | 42 |
| TPH $C_6$-$C_8$ | mg/kg | S4UL | 100 |
| TPH $C_8$-$C_{10}$ | mg/kg | S4UL | 27 |
| TPH $C_{10}$-$C_{12}$ | mg/kg | S4UL | 74 |
| TPH $C_{12}$-$C_{16}$ | mg/kg | S4UL | 140 |
| TPH $C_{16}$-$C_{21}$ | mg/kg | S4UL | 260 |
| TPH $C_{21}$-$C_{35}$ | mg/kg | S4UL | 1100 |

### 4.3 Health and Safety / PPE

4.3.1 Excavations will have suitable barriers and access points, with pedestrian routes clearly marked. Appropriate safety signage and instructions will be clearly visible, with accesses to be kept clear of debris, materials and cables.

4.3.2 Operatives will be briefed on sharps protection in order to ensure safety. Clean/dirty rooms will be provided for operatives working within contaminated areas

4.3.3 Standard PPE will be required at all times, namely:

- Hard hat
- Safety spectacles
- Hi-viz waistcoat or jacket
- Gloves
- Boots or shoes with steel toe and midsole protection

4.3.4 Other items may be required as per detailed in the specific method statement, such as:

- Harness
- Dust protection
- Ear protection
- Other specialist equipment

4.3.5 A method statement will be produced by the chosen contractor.

### 4.4 Unexpected Contamination

4.4.1 To accord with best practice if, during the construction of the development, contamination and/or materials not previously identified are found to be present at the site, then no further development (unless otherwise agreed in writing with the Local Planning Authority) shall be carried out until Jomas (or qualified environmental engineer) has been informed, and a suitable strategy implemented to the approval of the engineer and/or the Local Planning Authority.

4.4.2 Examples of such materials include:

- Buried drums, tanks, pipework or containers
- Soil or water with colour or odour
- Non-natural materials and wastes
- Other evidence of contamination, for example iridescent sheens (like oil or diesel) on soil or water.

### 4.5 Operational Standards – Summary

4.5.1 As a minimum, the following standards shall be employed during the full course of this remediation site works:

- All materials subject to excavation and disposal must be tracked throughout and evidence generated to provide an auditable trail.

- Any excavated soils will be stockpiled/stored in a designated area on site, with plastic sheeting placed at ground surface to prevent cross-contamination. The contractor shall be responsible for the removal of spoil from the site.
- Personal protective equipment shall be employed by all site remediation and ground worker personnel in accordance with site specific risk assessments. These are to be completed by all contractors following consideration of the potentially hazardous properties of contaminants within the site.
- A copy of this remediation statement together with all previous geo-environmental assessment reports shall be retained on site for reference during the full course of remediation activities.

# 5 VERIFICATION PLAN

## 5.1 Proposals for Validation & Verification

Cover Layer

5.1.1 A qualified environmental engineer shall undertake the following tasks to monitor the remedial activities described in this statement.

- Following importation of subsoil/topsoil to site, representative samples will be obtained for laboratory testing. It is anticipated that 1No sample will be taken per 50m$^3$ of soil imported, or a minimum of 3No samples (whichever greater).
- The thickness of the clean cover layer and the presence of a geotextile/marker layer will be verified by a series of hand dug pits in areas of soft landscaping, with accompanying photographs.
- These samples shall be sent directly to an MCERTS and UKAS accredited laboratory for testing.
- The results will be screened against the criteria given previously within Table 4.1, which comprise S4UL generic assessment criteria (suitable for use levels for human health risk assessment) published by the Chartered Institute of Environmental Health (CIEH). Where these are not available, other available general assessment criteria (GAC), including the Category 4 Screening Levels (C4UL) published by DEFRA have been used. If these values become out of date, reference shall be made to industry approved superseded values.

Vapour Protection Measures

5.1.2 The vapour protection measures should be independently verified by a suitably qualified specialist with documentation provided for inclusion in the Verification Report.

## 5.2 Remediation Verification/Completion Report

5.2.1 The Remediation Completion Report shall include the following information:

- Summary of all works undertaken.
- Photographic log of the works.
- A full chemical soil analysis results schedule.
- Independent verification of the vapour resistant membrane installation.
- Full details of any further contamination reported during construction works
- Disposal documentation for any spoil or asbestos materials spoil.

## 5.3 Reporting

5.3.1 All activities will be documented (including photographs) to show compliance with the Remediation Strategy. This documentation will be kept on site at all times during the works and updated daily as part of a field record as the works progress, which would be available for regulatory inspection at any time. All documentation would be included in a final verification report to be presented to the Local Authority.

# 6 REFERENCES


- A possible approach for generating site specific assessment criteria for polycyclic aromatic hydrocarbons (draft internal HPA briefing note)
- CL:AIRE (2020) *Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration*
- Environment Agency (2020); Land Contamination Risk Management (LCRM). https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm
- Environment Agency, NHBC & CIEH (2008) *Guidance for the safe development of housing on land affected by contamination*. R & D Publication 66. London: Environment Agency
- Environment Agency Technical Report P45 "Polycyclic Aromatic Hydrocarbons (PAH): Priorities for Environment Quality Standard Development
- LQM/CIEH S4ULs. LQM, 2014
- National Planning Policy Framework. Department for Communities and Local Government, March 2012

## APPENDICES

## APPENDIX 1 – VAPOUR MEMBRANE EXAMPLE

Technical Product Datasheet
Edition: 10/07/2019
Identification no. VBP009


VISQUEEN
ADVANCED BARRIER TECHNOLOGY

# VISQUEEN ULTIMATE VOC BLOK

The ultimate membrane protection against VOCs and Methane

- Market leading membrane with no protection required
- Conforms in full to CIRIA C748 and BS8485:2015
- Excellent VOC & methane barrier resistance
- Utilises Visqueen's unique advanced barrier technology
- Flexible even at low temperatures – limits stress cracking

**Description**

Visqueen Ultimate VOC BLOK is a flexible membrane designed to comply with current guidance on Volatile Organic Compounds (VOCs) and ground gases.

Manufactured using Visqueen's advanced barrier technology and drawing on our extensive knowledge and expertise in gas protection, Visqueen has developed a new flexible barrier membrane suitable in brownfield applications that are affected by aggressive chemicals such as Benzene, Toluene, Ethyl Benzene and Xylene (BTEX). In accordance with BS8485-2015 and C748, VOC BLOK is the only membrane that does not require a protective layer.Manufactured using Visqueen's advanced barrier technology and drawing on our extensive knowledge and expertise in gas protection, Visqueen has developed a new flexible barrier membrane suitable in brownfield applications that are affected by aggressive chemicals such as Benzene, Toluene, Ethyl Benzene and Xylene (BTEX).

The product is available in large roll formats to minimise jointing and quick installation times. The membrane is grey and black and 2.44m x 41m x 1mm (100m²), in single wound roll format and packaged in a blue outer wrap.

The membrane should be installed grey side up.

**Applications**

Visqueen Ultimate VOC BLOK is suitable for the following applications:

- VOC/Hydrocarbon contaminated sites in accordance with CIRIA C748
- Carbon dioxide and methane sites in accordance with BS8485:2015
- Radon affected sites in accordance with BRE211:2015
- Damp protection in accordance with Building Regulations part C

Due to a diverse range of applications and variations in attack chemicals we strongly advise contacting Visqueen's technical department for correct specification – 0333 202 6800

**The innovative Visqueen - Advanced Barrier Technology**

1. An advanced gas barrier structure
2. Superior physical and chemical resistant barrier properties
3. Easy & rapid welding

4. Flexibility for uneven ground contours

5. Good environmental stress crack resistance

Advanced barrier technology utilises Visqueen's extensive manufacturing technical expertise and experience to ensure buildings and occupants are safe from hazardous ground gases and VOCs.

**Specific Approvals/Standards**

- **CIRIA C748** – Guidance on the use of plastic membranes as VOC vapour barriers
- **BS8485:2015** - Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings
- **CE Mark EN13967** - Flexible sheets for waterproofing. Plastic and rubber damp proof sheets including plastic and rubber basement tanking sheet. Definitions and characteristics

**Validated test data and compliance to the latest standards**

CIRIA C748 and BS8485:2015 are the latest and most relevant standards and codes of practice for protecting buildings on contaminated land. These documents ensure any risks are mitigated by using best practice in design and selection of gas membranes. The documents intend to **harmonise test methods and result units** for the industry and to mirror the application in order that the appropriate membrane can be selected.

Visqueen embarked on an extensive testing regime to ensure its membranes are the best in class and comply with the new standards. Visqueen's Ultimate range have all passed the stringent **methane 40ml/m$^2$/day/atm** (ISO15105-1 to BS8485:2015 requirement) threshold and physical property requirements. CIRIA C748 states a VOC membrane must be tested as a minimum to the below challenge chemicals. Visqueen have conducted VOC vapour and chemical resistance testing (including conducting application cocktail testing) to these challenge chemicals below in accordance C748. The actual test results by a 3rd party approved laboratory are shown in the datasheet.

- Benzene
- Toluene
- ethyl benzene
- (m,p, and o) xylenes
- Hexane
- vinyl chloride
- tetrachlororthene (PCE),
- trichloroethene (TCE),
- Naphthalene

**System Components:**

- Visqueen GX Double Sided Bonding Tape
- Visqueen Gas Resistant Lap Tape
- Visqueen Surface DPC Fixing System
- Visqueen GX DPC
- Visqueen GX Top Hat Units
- Visqueen Detailing strip

Note: the membrane can be welded as a preferred alternative to using tapes.

Visqueen Ultimate VOC BLOK and ancillary components must be installed in accordance with the recommendations of CIRIA C748. The membrane is suitable where hydrostatic pressure is present, however in this application the joints must be welded and not taped. The membrane should be installed on a blinded or smooth surface allowing adequate overlap for jointing between the sheets and avoiding bridging (i.e. areas of unsupported membrane). In areas where high levels of unsupported membrane occur it is recommended that Visqueen Ultimate GeoSeal is used.

Visqueen Ultimate VOC BLOK is normally installed below the concrete slab (continued) but can be used above the slab. Please contact Visqueen for further information on foundation types and membrane suitability - 0333 202 6800 Technical Department.

**Tape Joints**

For taped joints, overlap the membranes by at least 150mm and bond together using Visqueen GX Double Sided Jointing tape. Secure the lap using Visqueen Gas Resistant Lap Tape. Punctures to the membrane can only be repaired by

using a patch of the same membrane and lapped at least 150mm beyond the limits of the puncture. Bond and seal the patch using Visqueen GX tape system.

**Welding**

When a welded joint system is being used, punctures to the membrane can only be repaired by welding a patch of membrane with identical thickness and lapped at least 150mm beyond the limits of the puncture. Where this is not possible and the three dimensional shapes are complex it is recommended a preformed unit is used.

**Precaution**

The membrane has been designed to perform in circumstances where linear expansion could occur, however in high temperatures the membrane should be covered immediately after installation.

The membrane should not be taken through any masonry wall. The relevant Visqueen damp proof or gas proof course should be taken through and extended beyond the wall by a minimum of 250mm where it can be jointed to the membrane.

**Service penetrations, corners and junctions**

All service pipe penetrations should be fully sealed using welded membrane or Visqueen GX Preformed Top Hat Units. The base and collar of the preformed unit should be bonded using Visqueen GX Double Sided Jointing Tape and sealed with Visqueen Gas Resistant Lap Tape. The collar should be secured with a mechanical fastening.

To ensure system integrity, all internal and external corners should be provided with either welded corners or Visqueen Preformed Units bonded to the membrane using Visqueen Double Sided Jointing Tape and sealed with Visqueen GR Single Sided Lap Tape. Complex or awkward junctions should be sealed using either welded membrane or Visqueen Detailing Strip.

**Ventilation**

When high levels of ground gases are present in accordance with BS8485:2015 or when the generation of gases still occurs, then an open void beneath the ground floor should be constructed as ventilation beneath the ground floor will dilute and disperse the gases to atmosphere. Open voids are normally restricted to beam and block floors or other precast concrete floor systems. An alternative for providing ventilation to in situ concrete floor slabs is to install a Visqueen Gas Venting System

**Storage and Handling**

Visqueen Ultimate VOC BLOK is classified as non-hazardous when used in accordance with the relevant British Standards. The product is chemically inert and is not affected by acids and alkalis that may be present in the sub-soils. The product should be stored in a warm dry environment and not exposed to long periods of sunlight.

A roll weighs 97 kilos and should be handled with care following on site health and safety procedures.

**Product & Performance Data:**

| Characteristic | Test Method | Units | Criteria | Result |
|---|---|---|---|---|
| Colour | | | | Black/Grey |
| Weight | | kilos | | 97 |
| Length | EN 1848-2 | m | -0/+10% | 41 |
| Width | EN 1848-2 | m | -0/+10% | 2.44 |
| Thickness | EN 1848-2 | mm | +/-10% | 1 |

| BS8485 and C748 physical test results | Test Method | Units | Criteria | Result |
|---|---|---|---|---|
| Puncture | BS EN ISO 12236:2006 | N | MDV | 2850 |
| Impact resistance Method A hard surface | EN12691 | mm | MDV | 750 |
| Impact resistance Method B soft surface | EN12691 | mm | MDV | >2000 |

| | | | | |
|---|---|---|---|---|
| Tensiles Yield strength MD 1 | ASTM D4885-01 | kN/m | MDV | 11.9 |
| Tensiles Yield strength CD 1 | ASTM D4885-01 | kN/m | MDV | 12.7 |
| Elongation @ break MD 1 | ASTM D4885-01 | % | MDV | >500 |
| Elongation @ break CD 1 | ASTM D4885-01 | % | MDV | >501 |
| Tear resistance - trouser method A - MD | BS ISO 34-1 | kN/m | MDV | 79.6 |
| Tear resistance - trouser method A - CD | BS ISO 34-1 | kN/m | MDV | 75.8 |
| Tear resistance - angle method B - MD | BS ISO 34-1 | N | MDV | 128.3 |
| Tear resistance - angle method B - CD | BS ISO 34-1 | N | MDV | 126.9 |

1 - this is at yield and not break as the equipment used was not strong enough to break the membrane

| BS8485:2015 - Methane testing | Test Method | Units | Criteria | Result |
|---|---|---|---|---|
| Methane permeability | ISO 15105-1 | ml/m$^2$/d/atm | <40 | 3.2 |

In order to comply with C748, Visqueen has expressed the test result units by volume (ml) and weight (mg)

| C748 - Permeation vapour tests - 100% concentration | Test Method | Criteria | ml/m$^2$/d | mg/m$^2$/d | mg/m$^2$/hr |
|---|---|---|---|---|---|
| Benzene | ISO 15105-2 | MDV | 0.08 | 67.7 | 2.82 |
| Toluene | ISO 15105-2 | MDV | 0.09 | 75.9 | 3.16 |
| Ethyl benzene | ISO 15105-2 | MDV | 0.11 | 90.7 | 3.78 |
| (m,p xyxlene | ISO 15105-2 | MDV | 0.01 | 6.5 | 0.27 |
| Hexane | ISO 15105-2 | MDV | gas | 2.5 | 0.1 |
| Vinyl chloride | ISO 15105-2 | MDV | 0 | 6.2 | 0.26 |
| Tetrachlororthene (PCE) | ISO 15105-2 | MDV | 0 | 3.1 | 0.13 |
| Trichloroethene (TCE) | ISO 15105-2 | MDV | solid | 0.3 | 0.01 |
| Naphthalene | ISO 15105-2 | MDV | 0.03 | 19.1 | 0.8 |

| C748 - Chemical immersion testing | Test Method | Weight % | Thickness % | Tensiles/elongation |
|---|---|---|---|---|
| Benzene | EN14414 | Pass | Pass | Pass |
| Toluene | EN14414 | Pass | Pass | Pass |
| Ethyl benzene | EN14414 | Pass | Pass | Pass |
| (m,p, and o,) xyxlenes | EN14414 | Pass | Pass | Pass |
| Hexane | EN14414 | Pass | Pass | Pass |
| Vinyl chloride | EN14414 | Pass | Pass | Pass |
| Tetrachlororthene | EN14414 | Pass | Pass | Pass |
| Trichloroethene | EN14414 | Pass | Pass | Pass |
| Naphthalene | EN14414 | Pass | Pass | Pass |

Pass is achieved if the aged membrane is within 25% of the fresh sample.

| CE Mark to EN13967 Type A | Test Method | Units | Criteria | Result |
|---|---|---|---|---|
| Tensile Strength - MD | EN 12311 | N/mm$^2$ | >MDV | 23.6 |
| Tensile Strength - CD | EN 12311 | N/mm$^2$ | >MDV | 22.4 |
| Tensile Elongation - MD | EN 12311 | % | >MDV | 701 |
| Tensile Elongation - CD | EN 12311 | % | >MDV | 706 |
| Joint Strength | EN 12317-2 | N | >MDV | 598 |
| Watertightness 2kPa | EN 1928 | - | Pass/Fail | Pass |
| Resistance to impact | EN 12691 | mm | MDV | 750 |
| DDurability watertightness after heat ageing | EN 1296 | - | Pass/Fail | Pass |
| Durability watertightness against chemicals | EN 1847 | - | Pass/Fail | Pass |
| Resistance to tearing (nail shank) CD | EN 12310-1 | N | MDV | 720 |
| Resistance to tearing (nail shank) MD | EN 12310-1 | N | MDV | 750 |
| Resistance to static loading | EN 12730 | Kg | >MLV | 20 |

| | | | | |
|---|---|---|---|---|
| Water vapour transmission - resistance | EN 1931 | MNs/g | MDV | 2142 |
| Water vapour transmission - permeability | EN 1931 | g/m$^2$/d | MDV | 0.063 |

ULTIMATE GAS MEMBRANES

VISQUEEN

VISQUEEN

ULTIMATE GAS MEMBRANES

VISQUEEN

**About Visqueen**

Visqueen is the market leader in the manufacture and supply of structural waterproofing and gas protection systems. Visqueen offers the complete package – a proven, reliable range backed by a technical support service that goes unmatched in the market - everything you would expect from a reputable and ethical company.

**Complete Range, Complete Solution**

- Structural Waterproofing
- Damp Proof Course
- Damp Proof Membranes
- Gas Protection and Gas Venting
- Vapour Control Layers
- Stormwater Protection

**Download Library**

- Technical Datasheet
- Standard Details
- Technical Service
- Visqueen Gas Protection Brochure
- NBS Clauses
- BBA Certificates
- Material Safety Datasheets
- Specification Guide

**Find your local stockist**

Search our directory of Visqueen specification Specialist Centres to locate your nearest Visqueen Partner.

**Technical support throughout your project**

We are specialists in our field and can help you specify the correct solutions with the necessary performance levels, in accordance with building regulations.

- Nationwide site support team
- Specification advice
- Installation guidance & project sign off
- System design including CAD details

**CPD Seminars and Training Academy**

### Gas Protection CPD

The specification, technical design, and installation of gas protection systems, enabling the sustainable regeneration of brownfield sites.

### Structural Waterproofing CPD

The specification, technical design, and installation of structural waterproofing systems for protection against water and damp ingress in both above and below ground projects.

### Visqueen Training Academy

We are now able to offer exclusive in depth training opportunities on a wide variety of Visqueen products at our Training Academy.

### Visqueen Special Projects

We provide high-level expertise, comprehensive support and experience in all types of waterproofing and gas protection.

VISQUEEN
Part of RPC bpi group
Heanor Gate Road, Heanor, Derbyshire, DE75 7RG
0333 202 6800 enquiries@visqueen.com
www.visqueen.com



VISQUEEN

# POWERBASE® VOC

## VOC and Hydrocarbon Chemical Resistant Barrier Membrane

Industrial Textiles & Plastics Ltd
Revision 1.5
Effective: May 2016

## Technical Data

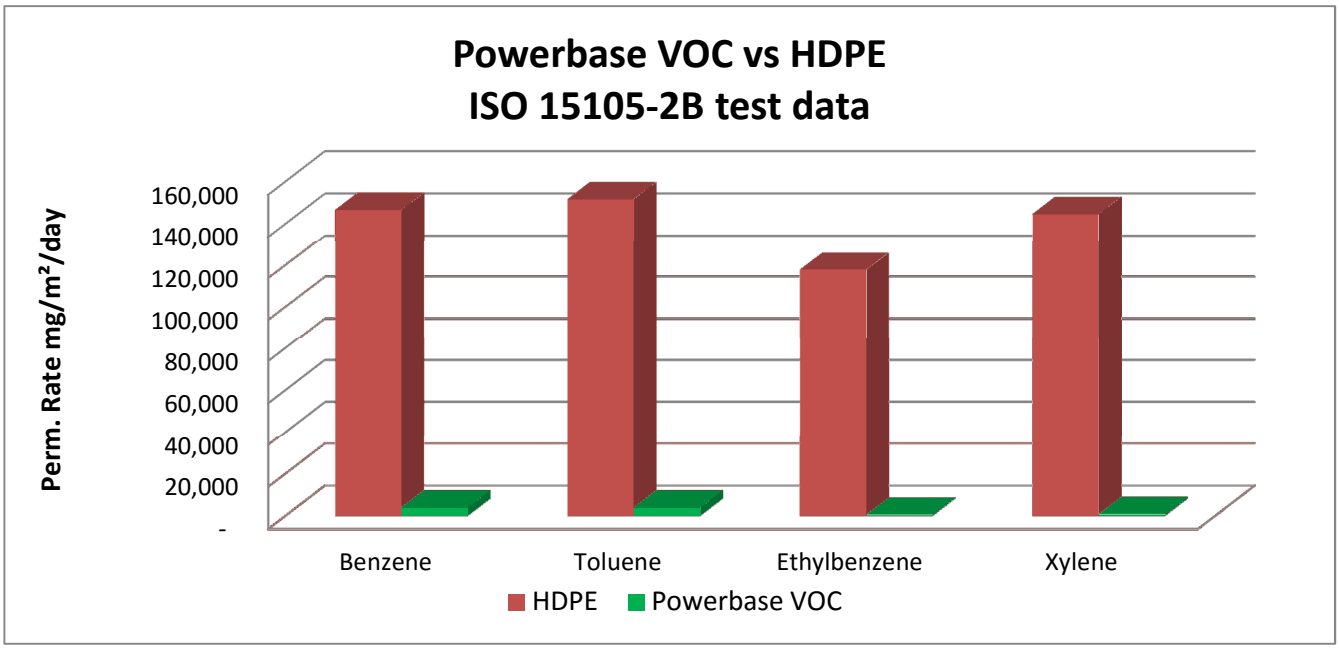
www.itpltd.com

| | | | |
|---|---|---|---|
| **PRODUCT** | **Powerbase® VOC** | **REFERENCE** | **GUNP 3050B** |
| **DESCRIPTION** | Hydrocarbon Resistant barrier membrane with exceptional and proven resistance to hydrocarbons, methane, radon and carbon dioxide. | | |
| **TYPICAL USES** | Covered installations with low level of mechanical constraints, with no risk of puncture or abrasion. Contaminated Land, Brownfield site developments, Environmental protection, Water resources & groundwater protection, Secondary containment; Underground structures. | | |
| **APPLICATION** | Installed using conventional thermal (hot air/wedge) welding equipment or proprietary sealing tapes as detailed in the installation instructions. | | |
| **STORAGE** | Rolls should be stored inside, off the ground, protected from sunlight in cool and dry conditions. | | |
| **COMPOSITION** | Composite membrane comprising protective polymeric layers on both sides of a chemical resistant hydrocarbon barrier inner core. | | |

### BARRIER PERFORMANCE DATA

| CHEMICAL | CAS | STANDARD | UNITS | PERMEATION DATA |
|---|---|---|---|---|
| Benzene | 71-43-2 | ISO 15105-2 | $mg/m^2/day$ | 4,000 |
| Toluene | 108-88-3 | ISO 15105-2 | $mg/m^2/day$ | 4,000 |
| Ethyl Benzene | 100-41-4 | ISO 15105-2 | $mg/m^2/day$ | 500 |
| Xylene | 1330-20-7 | ISO 15105-2 | $mg/m^2/day$ | 800 |
| Radon | 10043-92-2 | | $m^2/s$ | $1.0x10^{-14}$ |
| Methane | 74-82-8 | ISO 15105-2 | $ml/m^2/day/bar$ | 0.140 |
| Carbon Dioxide | 124-38-9 | ISO 15105-1 | $ml/m^2/day/bar$ | 3.010 |
| Water Vapour | 7732-18-5 | DIN 53122 | $g/m^2/day$ | 0.200 |

### PERFORMANCE COMPARISON - POWERBASE VOC vs HDPE




***Powerbase VOC significantly outperforms HDPE***



Industrial Textiles & Plastics Ltd
Stillington Road
Easingwold
York YO61 3FA
United Kingdom

Tel: +44 (0)1347 825200
Fax: +44 (0)1347 825222
www.itpltd.com
technical@itpltd.com

Cert No. 2318/00

# POWERBASE® VOC

## Hydrocarbon and Chemical Resistant Barrier Membrane

## Preliminary Technical Data

www.itpltd.com

| PERFORMANCE | STANDARD | UNITS | VALUES | |
|---|---|---|---|---|
| | | | MD | XD |
| **PHYSICAL PROPERTIES** | | | | |
| Mass | EN 1849-2 | gsm | 475 | |
| Thickness | EN 1849-2 | µm | 500 | |
| Tensile Strength at break | EN 12311-2 | N/50mm | 435 | 430 |
| Elongation at break | | % | 722 | 715 |
| Tear Strength – Elmendorf | ASTM D1922 | g/µm | 7 | 10 |
| Dart drop | ASTM D1709 | g | 1700 | |
| Roll Size | | m | 3.0 x 50 | |
| Packed | | Pallet quantity<br>Roll weight<br>Roll dimensions | 11 rolls<br>71.0 kg<br>20cm dia x 1.5 m | |
| **DURABILITY PROPERTIES** | | | | |
| Temperature Range | | ºC | -40 to +70 | |
| Flame Retardant | BS EN ISO 11925-2 | EN 13501-1 | Class F | |

### Disclaimer of Express and Implied Warranties

**Subject to the limitations, disclaimers and statements as set forth below, Industrial Textiles & Plastics Ltd represents to the Buyer that the product or products delivered to the Buyer conform(s) to the manufacturer's description and specifications attached to or delivered with the product.**

The representation that Industrial Textiles & Plastics Ltd makes to the Buyer that the product or products conform(s) to the manufacturer's description and specifications applies only under such circumstances when the Buyer utilises the product or products as specified and under normal use for which said product was intended. Any alleged nonconformity shall be made in writing to Industrial Textiles & Plastics Ltd. specifically stating and describing any such alleged nonconformity.

The representation by Industrial Textiles & Plastics Ltd that the product or products delivered to the Buyer conform(s) to the manufacturer's description and specification as attached to or delivered with the product is expressly in lieu of all other representations, warranties, expressed or implied, and of all other obligations and liabilities, including consequential damages, on the part of Industrial Textiles & Plastics Ltd. Industrial Textiles & Plastics Ltd neither assumes nor authorises any person to assume for it any other liability in connection with the sale of the product.

The representation of conformity by Industrial Textiles & Plastics Ltd as represented by Industrial Textiles & Plastics Ltd shall in addition to the above be null and void in the event that the product is misused or handled in a negligent manner by Buyer or any third party.

Industrial Textiles & Plastics Ltd shall not be liable for damages or delays, if such occur, on account of defective material or workmanship or delays in shipment, nor will any allowances be granted for any repairs, alterations, work done or expense incurred in connection with any repairs, alterations or replacements except on specific written authority by Industrial Textiles & Plastics Ltd.

Industrial Textiles & Plastics Ltd shall in no way be liable or responsible for injuries or damages to persons or property arising out of the use or operation of the product as herein contemplated, and Buyer hereby agrees to indemnify and save harmless Industrial Textiles & Plastics Ltd from all such liability and responsibility.

Industrial Textiles & Plastics Ltd shall not be liable for any consequential damages for any reason including but not limited to those contemplated herein and whether such consequential damages may have been foreseeable, proximately caused or otherwise occurring.

Due to a policy of continued research & development, Industrial Textiles & Plastics Ltd reserves the right to alter specifications without notice. Products are offered subject to our normal Conditions of Sale, which are available on request.

Samples and specifications are of an illustrative nature and supplied free of charge. They do not form part of any contract or any intended contract with the user. Final determination of the suitability of any information or material for the use contemplated and the manner of use is the sole responsibility of the user and the user must assume all risk and liability in connection therewith.

This disclaimer of Express or Implied Warranties constitutes a significant limitation on the rights and remedies otherwise available to the Buyer, which the Buyer freely and voluntarily acknowledges and accepts as part of the consideration for the contract to purchase the product or products from Industrial Textiles & Plastics Ltd. (201408)

Test results are obtained under laboratory conditions on new material and not under actual usage conditions. Test results only relate to the sample tested. No warranties or assurances of reliability, suitability or fitness for a particular purpose of specimens or data are offered. Assessment of suitability of such material and data for intended use is the sole responsibility of the customer. (201408)



Industrial Textiles & Plastics Ltd
Stillington Road
Easingwold
York YO61 3FA
United Kingdom

Tel: +44 (0)1347 825200
Fax: +44 (0)1347 825222
www.itpltd.com
technical@itpltd.com

Cert No. 2318/00

# PAG HC 400

7 layer Gas barrier , fPE and EVOH, Blue/ Black Colour

| TEST | UNIT | | TEST METHOD |
|---|---|---|---|
| | | | |
| Thickness at 2kPa | mic | 400 ± 5 % | |
| Mass per unit | $g/m^2$ | 376 | EN 1849-2 |
| | | | |
| Tensile Strength at break MD | N/mm | 27 ± 5 % | EN ISO 527/1/3/5 |
| Tensile Strength at break CMD | N/mm | 27 ± 5 % | EN ISO 527/1/3/5 |
| | | | |
| Elongation at beak MD | % | 750 ± 5 % | EN ISO 527/1/3/5 |
| Elongation at beak CMD | % | 850 ± 5 % | EN ISO 527/1/3/5 |
| | | | |
| Tear resistance MD | N | 40 ± 5 % | EN ISO 34-1 |
| Tear resistance CMD | N | 40 ± 5 % | EN ISO 34-1 |
| | | | |
| Puncture resistance | N | 140 ± 5 % | ASTM D4833 |
| | | | |
| $O_2$ Permeability | $ml/m^2$ x day at 1 bar | 5 ± 10 % | ASTM D 1434 |
| | | | |
| Methane Permeation | $cm^3(STP)m^2day^1atm^1$ | < 12 | ISO 15105-1 |
| | | | |
| Width | M | 1.5 | |
| | | | |
| Length | M | 50 | |

1st November 2015

Installation recommendation:

PAG HC 400 should be installed in accordance with current best practice standards NOS COSVR612 & NOS COSVR 613 by suitably experienced and qualified technician.

Tape jointing not recommended.

PAGeotechnical Ltd.
Email: office@pageo.co.uk Web: www.pageo.co.uk

JOMAS | ENGINEERING ENVIRONMENTAL LAND REMEDIATION

## WE LISTEN, WE PLAN, WE DELIVER

Geotechnical Engineering and Environmental Services across the UK

Construction Enquirer Awards – BEST CONSULTANT TO WORK FOR – WINNER

Constructionline Gold Member

SSIP Safety Schemes in Procurement – Acclaim Accreditation

CSCS

CSci Chartered Scientist

National Quality Mark Scheme for Land Contamination Management

The Chartered Institution of Wastes Management

UK RoGEP

silc – Specialist in Land Condition

The Geological Society

IEMA – Transforming the world to sustainability


**JOMAS ASSOCIATES LTD**

**24 Sarum Complex**

**Salisbury Road**

**Uxbridge**

**UB8 2RZ**

**CONTACT US**

**Website:** www.jomasassociates.com

**Tel:** 0333 305 9054

**Email:** info@jomasassociates.com