

WOLVERTON STREET

MANCHESTER

M11 2XX

REMEDIATION STRATEGY



Prepared for:

Cruden Construction Ltd
Hillcrest
Knutsford Road
Grappenhall
Warrington
Cheshire
WA4 3LA

By:

LK Consult Ltd
Eton Business Park
Eton Hill Road
Greater Manchester
M26 2ZS

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LK Consult Ltd

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Prepared By	Dr Paul Quimby	Signature	
Checked By	Chris Hughes	Signature	

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1 INTRODUCTION

1.1 Background

LK Consult Ltd (LKC) has been commissioned by Cruden Construction Ltd to provide a Remediation Strategy for land off Wolverton Street, Manchester (planning reference 108951/FO/2015/N2).

The Remediation Strategy is required to determine the work necessary in order to ensure the site is “suitable for use” for the proposed commercial development with regards to potential contaminated land pollutant linkages.

The site is approximately 1.4ha and centred on NGR 387130E 397425N (Figure 1). The proposed development will be a new warehouse with integral offices (Figure 2).

1.2 Previous Reports

The following reports have previously been undertaken on the site by Sub Surface North West Ltd and should be read in conjunction with this Remediation Strategy:

- ‘Ground Investigation at Ashton Old Road, Manchester for PP Plasma Limited’ by Sub Surface North West Ltd (reference 5637B, dated January 2013).
- ‘Walkover Survey and Desk Study at Ashton Old Road, Manchester for Little Greene Paint Company’ by Sub Surface North West Ltd (reference NW5957, dated November 2014).

1.3 Summary of Previous Work

The site has had a former industrial and residential uses, including an Iron Works, railway sidings and terraced housing.

Site investigation work has included nine cable percussive boreholes (reference BH1 – BH9), eleven trial pits (reference TP1 – TP11) and a significant archaeological excavation in the centre of the site.

Made ground has been identified to depths of between 0.45mbgl and 3.00mbgl and comprises an ashy clay or sand and gravel with concrete and brick.

The made ground is underlain by high strength clay drift deposits encountered between 0.45mbgl and 3.00mbgl and proven to depths of *circa* 14mbgl. The drift deposits are anticipated to be underlain by bedrock beneath the site comprising the northwest – southeast trending Etruria Formation (mudstone, sandstone and conglomerates).

Stones with localised bitumen binder were encountered in Trial Pits TP1 and TP5 to TP11.

Only limited groundwater was encountered at the site with water strikes recorded in 5 out of the 20 exploratory holes.

A total of eleven soil samples and five water samples were analysed. Six gas monitoring visits were undertaken over a period of 13 weeks on the five installed wells.

Elevated benzo(a)pyrene was detected in made ground in one sample at BH8 from 0.5mbgl (40mg/kg). A risk from direct contact ([Pollutant Linkage 1](#)) was noted but mitigated by hardstanding in that area.

A negligible risk was identified from the inhalation of vapours ([Pollutant Linkage 2](#)).

Carbon dioxide was noted above 5%v/v in BH7 and BH8 on 6 occasions (max. 7.8% v/v). However, flow rates were at the limit of detection (<0.1l/hr). The maximum Gas Screening Value (GSV) was 7.8E-03l/hr which characterises the gas regime as Green/CS1, where no gas protection would be required. However, Sub Surface North West Ltd recommended precautionary CS2 / Amber 1 gas protection measures to mitigate a risk from hazardous gas (Pollutant Linkage 3).

A United Utility Risk Assessment may identify the requirement for barrier pipe for potable water supply (Pollutant Linkage 4) based on naphthalene results.

Sub Surface North West Ltd.'s assessment of groundwater samples did not identify a risk to controlled waters. Based on exceedances of selenium and boron a qualitative risk assessment was undertaken considering limited groundwater presence onsite, source and underlying stiff-very stiff clay. It was concluded that the risk to controlled waters (Pollutant Linkage 5) was low and no specific remediation would be required.

1.4 Aims and Objectives

It is anticipated that the works on site will be undertaken with recourse to U1 and T5 waste exemptions due to the likely material re-use onsite.

Considerable relic foundations are present on site which will need to be addressed prior to construction works commencing.

Based on the above, LKC and the earthworks contractor will undertake the following:

- Assess Pollutant Linkages presented by Sub Surface North West Ltd.
- 'Pre-construction' remediation and validation work.
- Watching brief and further considerations for the site.
- 'On-construction' remediation and validation recommendations.
- Validation Completion Report detailing validation of all remedial works.

In order to achieve the aims of the Remediation Strategy, the following objectives will be set:

- Maximise sustainability through the use re-use of existing site-won materials during ground works and development.
- Ensure that the design meets with current environmental and waste legislation.
- Use of appropriate environmental controls during the remediation and development programme.
- Segregate and stockpile differing materials for validation testing and appropriate re-use or offsite disposal.

The site remediation works will also include the treatment / removal / processing of geotechnical constraints to the proposed development including relic foundations and hardstanding. However, this is considered outwith the scope of this Remediation Strategy.

2 FURTHER ASSESSMENT OF POTENTIAL POLLUTANT LINKAGES

2.1 Pollutant Linkage 1 (Direct Contact)

LKC compared results to more current C4SLs and LQM S4ULs criteria. No soil samples were elevated when compared to the 'commercial' values.

LKC considers no specific environmental capping layer is required in any landscaped area.

Due to the undesirable nature of the soil matrix, LKC recommend placing a nominal 150mm of 'clean' topsoil in landscaped areas.

2.2 Pollutant Linkage 2 (Inhalation of Vapours)

Sub Surface North West Ltd considered the risk from the inhalation of vapours to be low due to no significant source identified during the site investigation.

LKC is in agreement that the risk from the inhalation of vapours is low and no specific remediation is required.

2.3 Pollutant Linkage 3 (Inhalation of Hazardous Gas)

Precautionary gas protection measures (CS2/Amber 1) were recommended by Sub Surface North West Ltd, based on carbon dioxide slightly above the nominal 5%v/v threshold in BH7 (3.6%v/v to 6.4%v/v) and BH8 (5.3%v/v to 7.8%v/v).

LKC consider this a precautionary approach.

2.4 Pollutant Linkage 4 (Potable Pipework)

There may be a potential risk to potable pipework, subject to completing a United Utilities Risk Assessment. There may be a requirement for barrier pipe based on naphthalene concentrations compared to very stringent UU criteria.

2.5 Pollutant Linkage 5 (Controlled Waters)

Sub Surface North West Ltd considered the risk to controlled waters to be low due to no significant source or presence of groundwater onsite.

LKC in in agreement that the risk to controlled waters is low and no specific remediation is required.

2.6 Summary of Recommended Remediation and Validation Work

LKC consider the remediation works may be spilt in to the 'pre-construction' (or enabling works) phase and the 'on-construction' (i.e. during the development works) phase.

The following earthworks, remediation and validation required for this site are presented in Table 2-1. More detail of proposed works will be provided in the following Sections.

Phase	PL	Remediation Requirements	Validation Requirements
Pre-Construction	N/A	<u>Excavation and Processing of Made Ground</u> This will include the grubbing out and processing of hardstanding and in-ground relic foundations. Any oversize material will also be processed. Material will be used under roadways, pathways and building footprint.	Chemical validation and testing of any site won material for potential re-use: See Table 5-1. Re-use of material will be under U1 and T5 waste exemptions.
	1,2	<u>Excavation, Segregation and Stockpiling of Made Ground</u> Appropriate site won material will be stockpiled for potential reuse as subsoil to raise levels in the landscaped area. Additionally, suspect material will be quarantined for characterisation prior to possible offsite disposal.	
	4	<u>United Utilities (UU) Risk Assessment</u> UU Potable Water Risk Assessment to be undertaken once the location and depth of potable water pipes are known and following completion the earthworks. It is likely that barrier pipe will be required in some areas of the site if pipes are to be laid in made ground.	To be completed following completion of the remediation earthworks.
On-Construction	All	<u>Earthworks Site Inspections</u> A watching brief should be maintained during earthworks to confirm the ground conditions and identify any unusual ground conditions. <u>Unexpected Contamination</u> If any visual or olfactory evidence of contamination be encountered at the site, further assessment of the material may be required. It is recommended to contact LKC and the Local Authority if any unexpected contamination is identified.	Log of work undertaken including photographs. Details of any sampling undertaken and validation of any potential additional remedial work. Further risk assessment, delineation and remediation of the unexpected contamination may be required during the build phase.
	1	<u>Environmental Cover System</u> No specific remediation is required for landscaped areas. Recommended all soft landscaping has a nominal 150mm cover of topsoil to cover the existing matrix of undesirable material. Landscaping around the compound area will need to be raised and therefore additional 'clean' subsoil will be used	Chemical validation and testing volume of soils: See Table 5-1. Soil samples will be compared to generic assessment criteria for a ' <u>Commercial</u> ' end use (see Appendix A for criteria).
	3	<u>Gas Protection Measures</u> In line with CS2 as per UK guidance ^{1,2} . BS8485 states that a point score of 2.5 is required for a commercial building (Type C). Mitigation will comprise the following: • Cast In-situ ground-bearing floor slab = 0.5 points. • Gas Resistant Membrane (installed as per BS8485 requirements (Table 7)) = 2 points. • Minimum penetration of ground slab by services. • All joints and penetrations to be sealed.	Membrane installation and foundation drawings are presented in Appendix B. Membrane to be used is a Protech Super which is a foil back carbon dioxide and methane resistant membrane (see Appendix C for details). Photographic evidence of membrane installation. Validation of gas protection measures should be in line with CIRIA 735 ³
	4	<u>Installation of Barrier Pipe (if required)</u>	Details of consultation with UU. Evidence of the installation of protective pipework if deemed necessary e.g. delivery notes of pipe material and / or photographs of the installed pipe.

Table 2-1: Further work, remediation and validation requirements

Note: PL = Pollutant Linkage¹ CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665² BSI (2015). "Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for new buildings." BS8485:2015.³ CIRIA (2014). "Good Practice on the Testing and Verification of Protection Systems for Building Against Hazardous Ground Gas". CIRIA C735.

3 SITE WIDE CONSIDERATIONS

3.1 Construction Management Plan and Health and Safety

A Construction Management Plan and Method Statement should be produced which details appropriate Health and Safety measures to be employed during the site works.

Risks to site workers and adjacent receptors from contamination present in the site soils can be easily mitigated by good environmental management of the site during site works. Standard health and safety precautions (as per HSE guidance⁴) should be adopted by all workers involved with site enabling and construction works.

3.2 Materials Management

An appropriate permit will be required to allow processing of recycled aggregate and the deployment notification should be presented to the Local Authority prior to commencement.

Re-use of material should be compliant with appropriate legislation. A U1 Standard Rule Permit (U1 exemption) can be registered and allow up to 5,000 tonnes (approximately 3,000m cube) of non-hazardous material within construction and up to 50,000 tonnes (approximately 25,000m cube) of bitumous and road sub-base in the construction of roads.

A T5 Standard Rule Permit (T5 exemption) allows the screening and recovery of 5,000 tonnes (approximately 3,000m cube) of material, such as concrete or brick for re-use in construction.

Sampling of all re-used / imported material should ensure material is 'suitable for use' and should not be classified as waste (see Table 5-1).

3.3 Stockpile Management

Stockpiled material should be suitably managed. The source of each stockpile should be recorded and appropriate validation testing for the proposed re-use or potential offsite disposal should be undertaken as required. Depending on the nature of the material the potential for dust generation or release of asbestos fibres will be mitigated by dampening down and covering as required.

Material should be segregated by type and source. For example, construction / demolition arisings, site won topsoil and site won subsoil.

A quarantine area for suspect contaminated soils should be established on site. This should comprise a Visqueen (or similar) lined area with a small bund to prevent run off and to minimise the risk of contaminating other areas of the site. The material should also be covered to minimise the generation of vapours, fibres, dust and possible nuisance to adjacent receptors, and to prevent rainwater ingress which may mobilise soluble contaminants.

⁴ HSE (1991). "Protection of Workers and the General Public During Development of Contaminated Land" London HMSO.

3.4 Watching Brief / Unexpected or Gross Contamination

A watching brief will be maintained for evidence of contamination during the remediation earthworks and development works.

If evidence of contamination is identified then works in the area will stop pending further sampling and assessment and the Local Authority will be informed.

Delineation works will be undertaken and this may include collection of appropriate samples for laboratory analysis to further characterise the material and allow a risk assessment to be undertaken or removal of the impacted material to quarantine.

If obvious gross contamination is encountered then impacted soils will be carefully excavated and quarantined (See Section 3.3) pending further testing and assessment.

Soil samples will be taken and analysed for a suite of contaminants, including *inter alia* Soil Organic Matter, VOCs, SVOCs, BTEX, TPHCWG and asbestos.

Soil samples should represent the impacted area and, in order to determine that significantly impacted soils have been removed samples, will be collected from the base and sides of the excavation.

After analysis, quarantined material may be removed offsite to a licensed treatment facility or an assessment made of its potential for treatment and / or retention on site.

3.5 Disposal

If any made ground or natural material is required to be removed from site this should be undertaken under an appropriate duty of care and the results of chemical analysis should be provided to a licensed landfill for confirmation of waste classification.

Waste records such as disposal tickets and waste carrier licences should be provided in the Site Completion Report.

4 PRE-CONSTRUCTION PHASE REMEDIATION WORKS

4.1 Introduction

An outline of the proposed pre-construction remediation earthworks is given in Table 2-1. Soil will be re-used in line with appropriate U1 and T5 waste exemptions as described in Section 3.2.

The recommended remedial works and validation works are outlined in the following Sections.

4.2 Processing of In-Ground Structures, Hardstanding and Oversize

In-ground structures such as relic foundations, relic slabs and hardstanding will be grubbed up and, along with oversize material from the made ground, subjected to segregation, stockpiling and processing for reuse on site below roadways, path and driveways and around the building footprint as a construction or pile mat.

The material generated will comprise an engineered capping material (nominally 6F2 specification). It should be noted the geotechnical remediation and validation works are outwith the scope of this Remediation Strategy.

These works will have suitable control measures to prevent the release of dust.

4.3 Segregation & Stockpiling of Made Ground for Validation / Reuse

Potentially suitable site won material will be stockpiled separately for potential reuse as subsoil and 6F2. Suitably processed material will be stockpiled for potential reuse.

In order to assess the suitability of such materials each stockpile / type of material will be subjected to validation sampling and testing. The sampling suites, requirements and frequencies are summarised in Table 5-1. Validation criteria for subsoil and recycled material, with justification for their use, are outlined in Section 5.2.

The destination of each stockpile / source of material will be denoted and reported.

5 ON-CONSTRUCTION PHASE REMEDIATION WORKS

5.1 Introduction

The scope of the on-construction remedial works will comprise the following:

- The watching brief for contamination during earthworks excavations with details of any unexpected contamination and the further assessment and mitigation steps undertaken.
- Validation of gas protection measures.
- United Utilities risk assessment for potable water pipes and installation of barrier pipes, as required.
- Details of material reuse on site and information on any offsite disposal.
- Validation testing of site won and imported material earmarked for use as topsoil, subsoil or recycled stone.

LKC recommend that the proposed works are prior approved by the regulators (and United Utilities, as required) prior to the commencement of construction works.

Once this strategy is approved, a Remediation Statement will be provided to the site manager which summarises the required remedial works and trigger points for inspections and validation works.

5.2 Gas Membrane Validation

Validation of gas protection measures should be in line with CIRIA 735⁵ for a low gas risk (CS2) and intermediate complexity and low volume. Independent inspection without the need for integrity testing is considered suitable.

Photographic evidence of suitably installed and lapped membrane, as well as particular care around services will be observed.

Due to the size of the structure validation will be undertaken in stages. Once each section of the installation has been validated the slab will be poured.

5.3 Validation of Subsoil, Topsoil and Physical Aggregate Materials

Chemical validation of all site won and any imported soils to be used on site in landscaped areas and site won recycled material to be used for infrastructure should be undertaken. Imported soils should be accompanied by a certificate of analysis and source details as an initial screen.

A summary of the required site won / imported material sampling requirements are presented in Table 5-1.

Ideally, the material should be sampled at source to prevent double handling if soil fails, with confirmatory sampling undertaken on importation to site. However, where this is not possible then material imported should be segregated based on source and soil type with validation samples taken prior to placement in soft landscaped areas to ensure suitability for use.

⁵ CIRIA (2014). "Good Practice on the Testing and Verification of Protection Systems for Building Against Hazardous Ground Gas". CIRIA C735.

Material Type	Source	Suite of Analysis	Sampling Rate
Topsoil	Greenfield	Suite A	1 sample per 50m ³ (minimum of 3 samples per source)
	Brownfield / Unknown / Site Won	Suite B	
Subsoil	Brownfield / Unknown / Site Won	Suite B	1 sample per 250m ³ (minimum of 3 samples per source)
	Site won natural sand / gravel / clay	Suite A	
		First Generation i.e. quarried sand (subsoil) or stone (break layer)	No testing is required. Certification of material provenance is required.
Physical Stone Break Layer and Piling / Building Mat	Recycled Stone (6F2 / Site Won)	Suite B	1 sample per 500m ³ (minimum of 3 samples per source)

Table 5-1: Recommended validation sampling requirements for environmental capping layer soils.

Notes:**Suite A** - Heavy metals, pH, water soluble sulphate, speciated PAH, soil organic matter and asbestos screen.**Suite B** - Heavy metals, pH, water soluble sulphate, speciated PAH, phenol, total and free cyanide, soil organic matter, asbestos screen, banded petroleum hydrocarbons (TPH CWG), BTEX, MTBE.

Remedial targets will be based upon the following hierarchy:

- Category 4 Screening Levels (C4SLs).
- LQM Suitable 4 Use Levels (S4ULs).

New C4SLs have recently been published^{6,7}. The recent change to the contaminated land guidance has changed the evaluation of risk from 'minimal' (referred to as Health Criteria values (HCVs))⁸ used to generate Soil Guideline Values (SGVs) to 'low' (referred to as Lowest Level of Toxicological Concern (LLTCs)). The policy companion document and supporting letter by Defra, dated 3rd September 2014, states that C4SLs *'could be used under the planning regime, as well as within Part 2A'*. Based on these comments LKC considers the justifications and assumptions used to generate 'low' risk are suitable for the planning regime.

Where no C4SLs have been generated LKC will use the LQM S4ULs⁹. Similar assumptions and land uses to C4SLs have been used. However, toxicological information has been based on 'minimal risk' as per previous guidelines and assumptions^{10,11,12,13}.

LKC consider the main risk drivers for PAHs are benzo(a)pyrene (B(a)P) and naphthalene. This is due to B(a)P possibly being a carcinogen and most toxic of the PAHs^{14,15} and naphthalene the most volatile and soluble¹⁶. The new C4SLs indicate B(a)P as a surrogate marker for carcinogenic PAHs, if it falls within appropriate limits, since the risk

⁶ Defra (2014). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Policy Companion Document."

⁷ CL:AIRE (2013). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Final project Report."

⁸ EA (2008). "Human Health Toxicological Assessment of Contaminants in Soils." Science Report – SC050021/SR2.

⁹ LQM (2014). "The LQM/CIEH S4ULs for Human Health Risk Assessment."

¹⁰ EA (2008). "Updated Technical Background to the CLEA Model." Science Report – SC050021/SR3.

¹¹ EA (2008). "Human Health Toxicological Assessment of Contaminants in Soils." Science Report – SC050021/SR2.

¹² EA (2008). "A Review of Body Weight and Height Data used within the Contaminated Land Exposure Assessment Model (CLEA)." Project SC050021/Technical Review 1.

¹³ EA (2009). "Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values." Science report SC050021/SR7.

¹⁴ EA (2002). "Contaminants in Soils: Collation of Toxicological Data and Intake Values for Humans. Benzo[a]pyrene." R&D Publication TOX2.

¹⁵ USEPA (1984). "Health Effects Assessment of Polycyclic Aromatic Hydrocarbons (PAHs). EPA 540/1-86-013."

¹⁶ EA (2003). "Review of the Fate and Transport of Selected Contaminants in the Soil Environment." Draft technical report P5-079/TR1.

from other non-carcinogenic PAHs are considered negligible¹⁷. For B(a)P to be used as a surrogate marker it should follow the profile described by the HPA (2008)¹⁸ and CL:AIRE (2013). Naphthalene will be treated separately using the LQM S4ULs.

The proposed development comprises a commercial end use with areas of soft landscaping. Therefore, the assessment criteria for 'Commercial' will be used for any soil or recycled stone to be used in soft landscaping areas, roads and building footprint.

All criteria have been generated using the CLEA V1.06 model¹⁹ based on 1%, 2.5% and 6% Soil Organic matter (SOM). Where appropriate, results will be compared to the nearest appropriate SOM.

A summary of the generic assessment criteria is provided in Appendix A.

Any soil with visual or olfactory evidence of hydrocarbons or asbestos containing material should be rejected.

In addition, it should be ensured that the matrix of the topsoil is suitable as a growing medium and no undesirable material is present (in line with BS3882²⁰). This should be the responsibility of your designated soil supplier.

Validation testing certificates shall be collated and included in the Validation Completion Report.

5.4 Potable Water Supply Pipes

A UU risk assessment should be completed once the remediation earthworks have been completed and once the pipe routes and depths are known. Sub Surface North West Ltd considered that it is likely that barrier pipe is required.

In the event that barrier pipe is required then the risk assessment should be approved by UU prior to any installation works.

Pipework should be installed in trenches back filled with first generation materials.

For the purposes of the Validation Completion Report, a works notice, delivery notes indicating the source of the first generation backfill material and photographic evidence of this material in the trenches should be collated along with photographs illustrating the installation of barrier pipe.

5.5 Validation Completion Report

A validation completion report detailing the pre-construction and on-construction phase remediation works will be produced which will include:

- Watching brief for contamination during development works and any unexpected contamination and the further assessment and mitigation steps undertaken.
- Photographic evidence of appropriate gas protection measures.
- Installation of the correct water pipe specification and confirmation of the use of first generation trench backfill. As a minimum proof of connection by UU indicates UU are satisfied with the installed potable pipework.

¹⁷ CL:AIRE (2013). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Final project Report."

¹⁸ HPA (2010). "HPA Contaminated Land Information Sheet: Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)." Version 3.

¹⁹ EA (2008). "CLEA Software (Version 1.05) Handbook." Science Report – SC050021/SR4.

²⁰ BS (2015). "Specifications for Topsoil and Requirements for use." BS3882:2015.

- Validation testing of imported or site won subsoil, topsoil and recycled stone materials, as required.
- Waste transfer notes for any disposal.

The aim of the on-construction validation report will be to demonstrate to the Local Authority that the site has been suitably remediated to the extent that the site is suitable for its proposed commercial end use and, in accordance with the National Planning Policy Framework (NPPF)²¹:

- 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.

²¹ DCL (2012). "National Planning Policy Framework." Department of Communities and Local Government. March 2012.

FIGURES

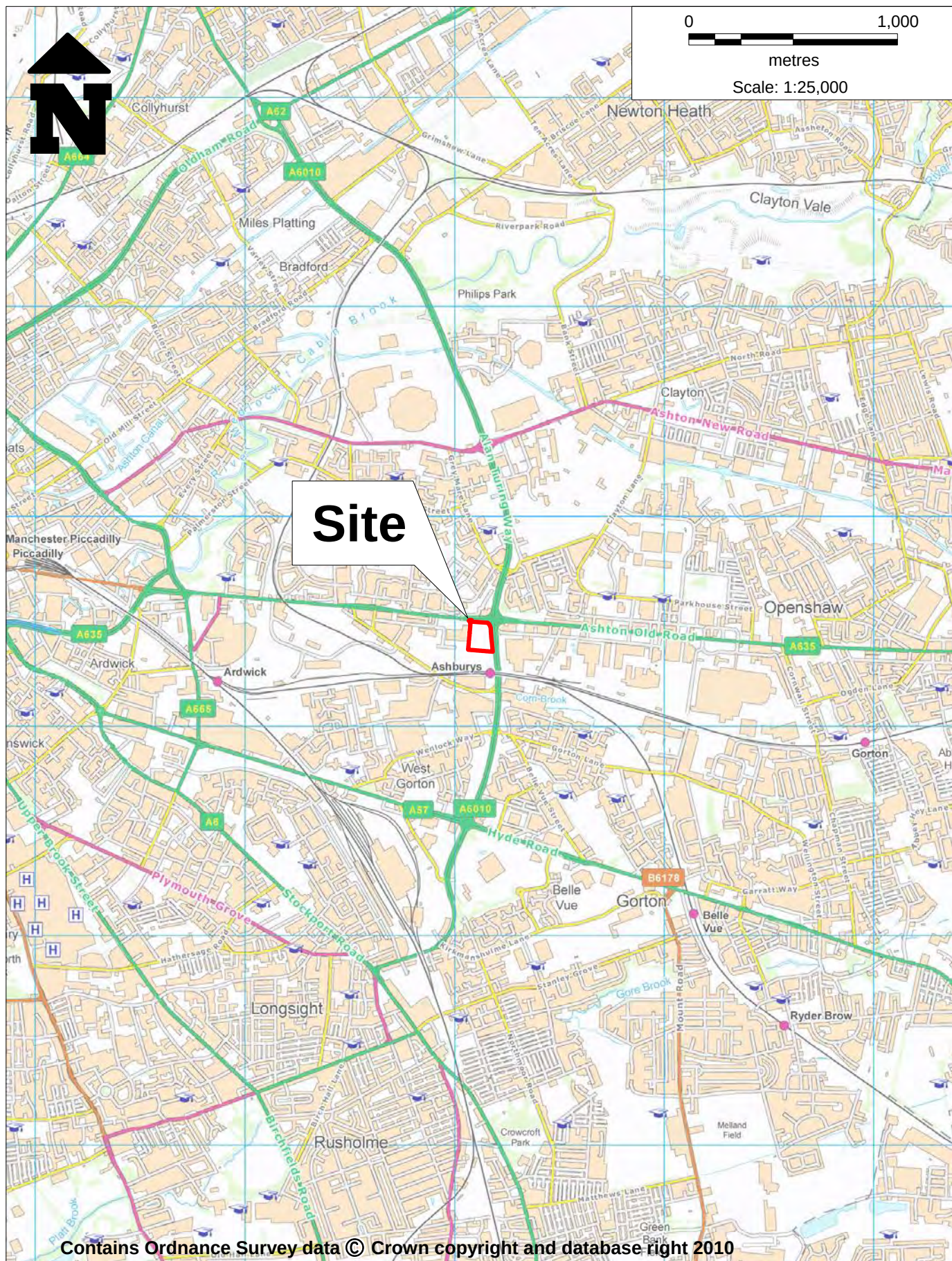


Figure 1: Site Location Plan, Wolverton, Manchester

Drawn: February 2017 Scale: 1:25,000 @ A4 (see scale bar)

- CONCRETE HARD STANDING AREA

175mm THIN CRACK CONCRETE HARD STANDING WITH 1 LAYER AGG. IN TOP MAY BEHAVE DUE TO CONCRETE MIX WITH 4.5 - 5.5% AIR ENTRAINMENT. 150mm THICK 1 MET SUB-BASE. ADVISE REVIEWER FOR SITE DRAINAGE LAYER. REFER TO CAR PARK SPEC FOR FULL DESCRIPTION.

THE CONCRETE SLAB SHOULD NOT BE THINER THAN THE COMPRESSIVE STRENGTH AND ELASTICITY CRITERIA. THIS WILL BE AN IMPROVEMENT TO THE CONCRETE SLAB. CONCRETE SHOULD BE THICKER TO COMPENSATE FOR STRENGTH AND ELASTICITY CRITERIA. ADVISE REVIEWER FOR SITE DRAINAGE LAYER. REFER TO CAR PARK SPEC FOR FULL DESCRIPTION.
- THINNING (VEGETATION) AREA CAR PARK CONSTRUCTION

SURFACE COURSE (TO BE IN 11100-11200)

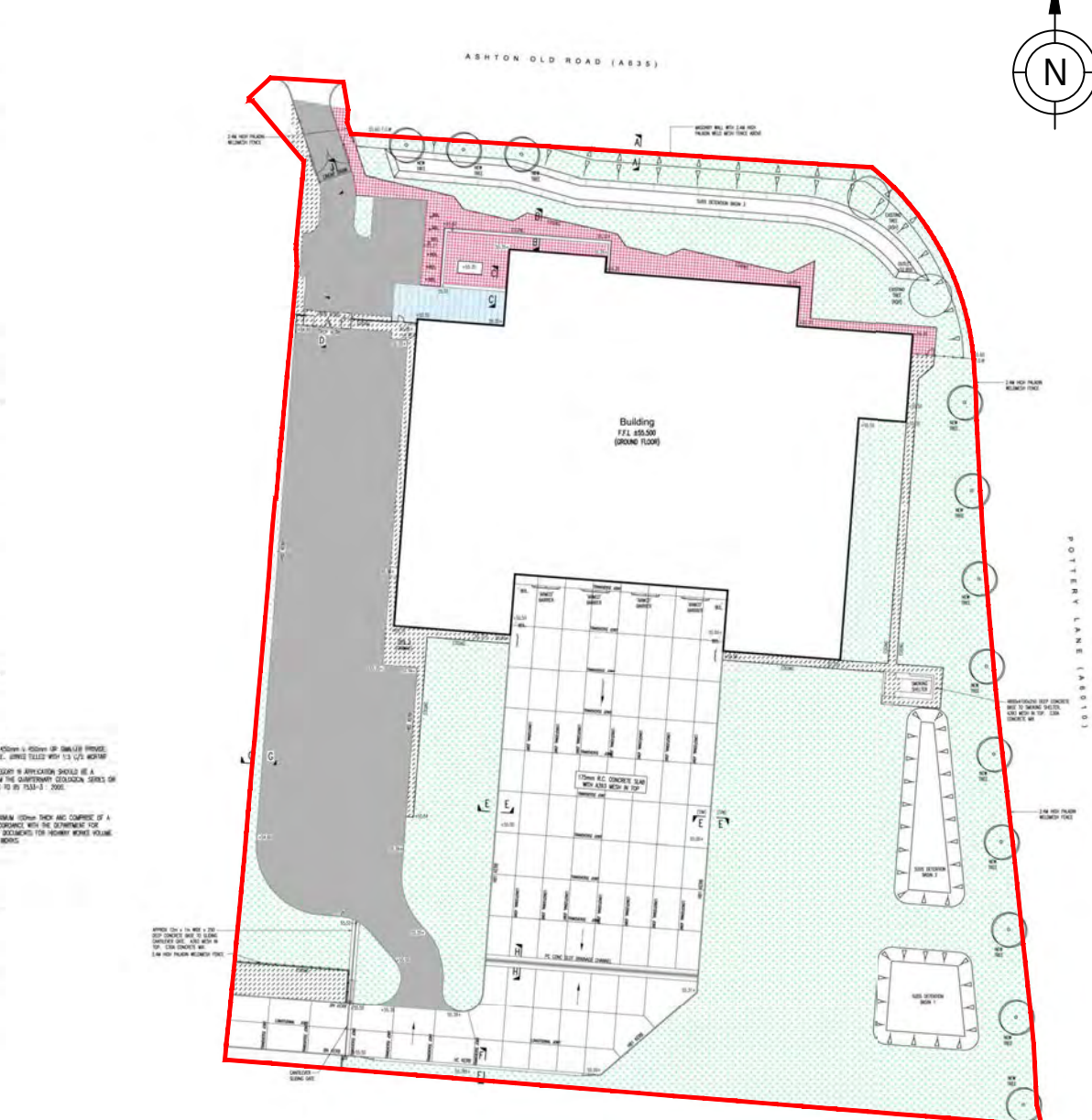
175mm THIN CRACK CONCRETE HARD STANDING WITH 1 LAYER AGG. IN TOP MAY BEHAVE DUE TO CONCRETE MIX WITH 4.5 - 5.5% AIR ENTRAINMENT. 150mm THICK 1 MET SUB-BASE. ADVISE REVIEWER FOR SITE DRAINAGE LAYER. REFER TO CAR PARK SPEC FOR FULL DESCRIPTION.

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- THINNING (VEGETATION) AREA CAR PARK CONSTRUCTION

SURFACE COURSE (TO BE IN 11100-11200)

175mm THIN CRACK CONCRETE HARD STANDING WITH 1 LAYER AGG. IN TOP MAY BEHAVE DUE TO CONCRETE MIX WITH 4.5 - 5.5% AIR ENTRAINMENT. 150mm THICK 1 MET SUB-BASE. ADVISE REVIEWER FOR SITE DRAINAGE LAYER. REFER TO CAR PARK SPEC FOR FULL DESCRIPTION.

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KEY

Site Boundary

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.

LK

CONSULT LIMITED

Client:

Cruden Construction

Site:

Wolverton, Manchester

Title:

Proposed Development Plan

Job No.:

LKC 17 1058

Scale (See Scale Bar):

1:1000 @ A4

Figure:

2

Revision:

Drawn By:

AC

Checked By:

PQ

Drawn:

Feb 2017

APPENDIX A

SOIL VALIDATION CRITERIA

Substance	Residential (with home- grown produce)	Residential (without home- grown produce)	Allotments	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	37 mg/kg	40 mg/kg	49 mg/kg	640 mg/kg	79 mg/kg	170 mg/kg
Benzene	0.87 mg/kg	3.3 mg/kg	0.18 mg/kg	98 mg/kg	140 mg/kg	230 mg/kg
Benzo(a)pyrene	5.0 mg/kg	5.3 mg/kg	5.7 mg/kg	77 mg/kg	10 mg/kg	21 mg/kg
Cadmium	22 mg/kg	150 mg/kg	3.9 mg/kg	410 mg/kg	220 mg/kg	880 mg/kg
Chromium VI	21 mg/kg	21 mg/kg	170 mg/kg	49 mg/kg	21 mg/kg	250 mg/kg
Lead	200 mg/kg	310 mg/kg	80 mg/kg	2300 mg/kg	630 mg/kg	1300 mg/kg

Summary Table for the Generic Assessment Criteria for Human Health Risk Assessment Land Quality Management (LQM) S4ULs.

All GAC are based on sandy loam soils with a pH 7.

		LQM Generic Assessment Criteria (mg/kg) Dry weight soil						
Contaminant		SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Metals	Inorganic Arsenic	6%	37	40	43	640	79	170
	Beryllium	6%	1.7	1.7	35	12	2.2	63
	Boron	6%	290	11,000	45	240,000	21,000	46,000
	Cadmium	6%	11	85	1.9	190	120	532
	Chromium (III)	6%	910	910	18,000	8,600	1,500	33,000
	Chromium (VI)	6%	6.0	6.0	1.8	33	7.7	220
	Copper	6%	2,400	7,100	520	68,000	12,000	44,000
	Elemental Mercury	6%	1.2	1.2	21	58 (25.8) ^{vap}	16	30 (25.8) ^{vap}
	Inorganic Mercury	6%	40	56	19	1,100	120	240
	Methylmercury	6%	11	15	6.0	320	40	68
	Nickel	6%	180	180	230	980	230	3,400
	Selenium	6%	250	430	88	12,000	1,100	1,800
	Vanadium	6%	410	1,200	91	9,000	2,000	5,000
	Zinc	6%	3,700	40,000	620	730,000	81,000	170,000
BTEX Compounds	Benzene	1%	0.087	0.38	0.017	27	72	90
		2.5%	0.17	0.70	0.034	47	72	100
		6%	0.37	1.4	0.075	90	73	110
	Toluene	1%	130	880 (869) ^{vap}	22	56,000 (869) ^{vap}	56,000	87,000 (869) ^{vap}
		2.5%	290	1,900	51	110,000 (1,920) ^{vap}	56,000	95,000 (1,920) ^{vap}
		6%	660	3,900	120	180,000 (4,360) ^{vap}	56,000	100,000 (4,360) ^{vap}
	Ethylbenzene	1%	47	83	16	5,700 (518) ^{vap}	24,000	17,000 (518) ^{vap}
		2.5%	110	190	39	13,000 (1,220) ^{vap}	24,000	22,000 (1,220) ^{vap}
		6%	260	440	91	27,000 (2,840) ^{vap}	25,000	27,000 (2,840) ^{vap}
	o-xylene	1%	60	88	28	6,600 (478) ^{sol}	41,000	17,000 (478) ^{sol}
		2.5%	140	210	67	15,000 (1,120) ^{sol}	42,000	24,000 (1,120) ^{sol}
		6%	330	480	160	33,000 (2,620) ^{sol}	43,000	33,000 (2,620) ^{sol}
	m-xylene	1%	59	82	31	6,200 (625) ^{vap}	41,000	17,000 (625) ^{vap}
		2.5%	140	190	74	14,000 (1,470) ^{vap}	42,000	24,000 (1,470) ^{vap}
		6%	320	450	170	31,000 (3,460) ^{vap}	43,000	32,000 (3,460) ^{vap}
	p-xylene	1%	56	79	29	5,900 (576) ^{sol}	41,000	17,000 (576) ^{sol}
		2.5%	130	180	69	14,000 (1,350) ^{sol}	42,000	23,000 (1,350) ^{sol}
		6%	310	430	160	30,000 (3,170) ^{sol}	43,000	31,000 (3,170) ^{sol}

NOTES

^{sol/vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

f = oral, dermal and inhalation exposures compared to oral HCV.

All GAC are based on sandy loam soils with a pH 7.

All GAC are based on sandy loam soils with a pH 7.		LQM Generic Assessment Criteria (mg/kg) Dry weight soil						
Contaminant		SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthene	1%	210	3,000 (57.1) ^{sol}	34	84,000 (57.0) ^{sol}	15,000	29,000
		2.5%	510	4,700 (141) ^{sol}	85	97,000 (141) ^{sol}	15,000	30,000
		6%	1,100	6,000 (336) ^{sol}	200	100,000	15,000	30,000
	Acenaphthylene	1%	170	2,900 (86.1) ^{sol}	28	83,000 (86.1) ^{sol}	15,000	29,000
		2.5%	420	4,600 (212) ^{sol}	69	97,000 (212) ^{sol}	15,000	30,000
		6%	920	6,000 (506) ^{sol}	160	100,000	15,000	30,000
	Anthracene	1%	2,400	31,000 (1.17) ^{vap}	380	520,000	74,000	150,000
		2.5%	5,400	35,000	950	540,000	74,000	150,000
		6%	11,000	37,000	2,200	540,000	74,000	150,000
	Benz(a)anthracene	1%	7.2	11	2.9	170	29	49
		2.5%	11	14	6.5	170	29	56
		6%	13	15	13	180	29	62
	Benzo(a)pyrene (only)	1%	2.2	3.2	0.97	35	5.7	11
		2.5%	2.7	3.2	2.0	35	5.7	12
		6%	3.0	3.2	3.5	36	5.7	13
	Benzo(b)fluoranthene	1%	2.6	3.9	0.99	44	7.1	13
		2.5%	3.3	4.0	2.1	44	7.2	15
		6%	3.7	4.0	3.9	45	7.2	16
	Benzo(ghi)perylene	1%	320	360	290	3,900	640	1,400
		2.5%	340	360	470	4,000	640	1,500
		6%	350	360	640	4,000	640	1,600
	Benzo(k)fluoranthene	1%	77	110	37	1,200	190	370
		2.5%	93	110	75	1,200	190	410
		6%	100	110	130	1,200	190	440
	Chrysene	1%	15	30	4.1	350	57	93
		2.5%	22	31	9.4	350	57	110
		6%	27	32	19	350	57	120
	Dibenzo(ah)anthracene	1%	0.24	0.31	0.14	3.5	0.57	1.1
		2.5%	0.28	0.32	0.27	3.6	0.58	1.3
		6%	0.3	0.32	0.43	3.6	0.58	1.4
	Fluoranthene	1%	280	1,500	52	23,000	3,100	6,300
		2.5%	560	1,600	130	23,000	3,100	6,300
		6%	890	1,600	290	23,000	3,100	6,400
	Fluorene	1%	170	2,800 (36.0) ^{sol}	27	63,000 (30.9) ^{sol}	9,900	20,000
		2.5%	400	3,800 (76.5) ^{sol}	67	68,000	9,900	20,000
		6%	860	4,500 (183) ^{sol}	160	71,000	9,900	20,000
	Indeno(123-cd)pyrene	1%	27	45	9.5	500	82	150
		2.5%	36	46	21	510	82	170
		6%	41	46	39	510	82	180
	Naphthalene	1%	2.3 ^f	2.3 ^f	4.1 ^f	190 ^f (76.4) ^{sol}	4,900 ^f	1,200 ^f (76.4) ^{sol}
		2.5%	5.6 ^f	5.6 ^f	10 ^f	460 ^f (183) ^{sol}	4,900 ^f	1,900 ^f (183) ^{sol}
		6%	13 ^f	13 ^f	24 ^f	1,100 ^f (432) ^{sol}	4,900 ^f	3,000
	Phenanthrene	1%	95	1,300 (36.0) ^{sol}	15	22,000	3,100	6,200
		2.5%	220	1,500	38	22,000	3,100	6,200
		6%	440	1,500	90	22,000	3,100	6,300
	Pyrene	1%	620	3,700	110	54,000	7,400	15,000
		2.5%	1,200	3,800	270	54,000	7,400	15,000
		6%	2,000	3,800	620	54,000	7,400	15,000
Coal Tar (B(a)P as surrogate marker)	1%	0.79	1.2	0.32	15	2.2	4.4	
	2.5%	0.98	1.2	0.67	15	2.2	4.7	
	6%	1.1	1.2	1.2	15	2.2	4.8	

NOTES

^{sol} / ^{vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

^f = naphthalene is based on comparison of inhalation exposure with TDI_{Inhal} for localised effect.

All GAC are based on sandy loam soils with a pH 7.

LQM Generic Assessment Criteria (mg/kg) Dry weight soil

Contaminant	SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Aliphatic							
EC 5-6	1%	42	42	730	3,200 (304) ^{sol}	570,000(304) ^{sol}	95,000 (304) ^{sol}
EC>6-8	1%	100	100	2,300	7,800 (144) ^{sol}	600,000	150,000 (144) ^{sol}
EC>8-10	1%	27	27	320	2,000 (78) ^{sol}	13,000	14,000 (78) ^{vap}
EC>10-12	1%	130 (48) ^{vap}	130 (48) ^{vap}	2,200	9,700 (48) ^{sol}	13,000	21,000 (48) ^{vap}
EC>12-16	1%	1,100 (24) ^{sol}	1,100 (24) ^{sol}	11,000	59,000 (24) ^{sol}	13,000	25,000 (24) ^{sol}
EC>16-35	1%	65,000 (8.48) ^{f, sol}	65,000 (8.48) ^{f, sol}	260,000 ^f	160,000 ^f	250,000 ^f	450,000 ^f
EC>35-44	1%	65,000 (8.48) ^{f, sol}	65,000 (8.48) ^{f, sol}	260,000 ^f	160,000 ^f	250,000 ^f	450,000 ^f
Aliphatic							
EC 5-6	2.5%	78	78	1,700	5,900 (558) ^{sol}	590,000	130,000 (558) ^{sol}
EC>6-8	2.5%	230	230	5,600	17,000 (322) ^{sol}	610,000	220,000 (322) ^{sol}
EC>8-10	2.5%	65	65	770	4,800 (190) ^{vap}	13,000	18,000 (190) ^{vap}
EC>10-12	2.5%	330 (118) ^{vap}	330 (118) ^{vap}	4,400	23,000 (118) ^{vap}	13,000	23,000 (118) ^{vap}
EC>12-16	2.5%	2,400 (59) ^{sol}	2,400 (59) ^{sol}	13,000	82,000 (59) ^{sol}	13,000	25,000 (59) ^{sol}
EC>16-35	2.5%	92,000 (21) ^{f, sol}	92,000 (21) ^{f, sol}	270,000 ^f	1,700,000 ^f	250,000 ^f	480,000 ^f
EC>35-44	2.5%	92,000 (21) ^{f, sol}	92,000 (21) ^{f, sol}	270,000 ^f	1,700,000 ^f	250,000 ^f	480,000 ^f
Aliphatic							
EC 5-6	6%	160	160	3,900	12,000 (1,150) ^{sol}	600,000	180,000 (1,150) ^{sol}
EC>6-8	6%	530	530	13,000	40,000 (736) ^{sol}	620,000	320,000 (736) ^{sol}
EC>8-10	6%	150	150	1,700	11,000 (451) ^{vap}	13,000	21,000 (451) ^{vap}
EC>10-12	6%	760 (283) ^{vap}	760 (283) ^{vap}	7,300	47,000 (283) ^{vap}	13,000	24,000 (283) ^{vap}
EC>12-16	6%	4,300 (142) ^{sol}	4,400 (142) ^{sol}	13,000	90,000 (142) ^{sol}	13,000	26,000 (142) ^{sol}
EC>16-35	6%	110,000 ^f	110,000 ^f	270,000 ^f	1,800,000 ^f	250,000 ^f	490,000 ^f
EC>35-44	6%	110,000 ^f	110,000 ^f	270,000 ^f	1,800,000 ^f	250,000 ^f	490,000 ^f
Aromatic							
EC5-7(benzene as non-threshold)	1%	70	370	13	26,000 (1,220) ^{sol}	56,000	76,000 (1,220) ^{sol}
EC>7-8(toluene)	1%	130	860	22	56,000 (869) ^{vap}	56,000	87,000 (869) ^{vap}
EC>8-10	1%	34	47	8.6	3,500 (613) ^{vap}	5,000	7,200 (613) ^{vap}
EC>10-12	1%	74	250	13	16,000 (364) ^{sol}	5,000	9,200 (364) ^{sol}
EC>12-16	1%	140	1,800	23	36,000 (169) ^{sol}	5,100	10,000
EC>16-21	1%	260 ^f	1,900 ^f	46 ^f	28,000 ^f	3,800 ^f	7,600 ^f
EC>21-35	1%	1,100 ^f	1,900 ^f	370 ^f	28,000 ^f	3,800 ^f	7,800 ^f
EC>35-44	1%	1,100 ^f	1,900 ^f	370 ^f	28,000 ^f	3,800 ^f	7,800 ^f
Aromatic							
EC5-7(benzene as non-threshold)	2.5%	140	690	27	46,000 (2,260) ^{sol}	56,000	84,000 (2,260) ^{sol}
EC>7-8(toluene)	2.5%	290	1,800	51	110,000 (1,920) ^{sol}	56,000	95,000 (1,920) ^{sol}
EC>8-10	2.5%	83	110	21	8,100 (1,500) ^{vap}	5,000	8,500 (1,500) ^{vap}
EC>10-12	2.5%	180	590	31	28,000 (899) ^{sol}	5,000	9,700 (899) ^{sol}
EC>12-16	2.5%	330	2,300 (419) ^{sol}	57	37,000	5,100	10,000
EC>16-21	2.5%	540 ^f	1,900 ^f	110 ^f	28,000 ^f	3,800 ^f	7,700 ^f
EC>21-35	2.5%	1,500 ^f	1,900 ^f	820 ^f	28,000 ^f	3,800 ^f	7,800 ^f
EC>35-44	2.5%	1,500 ^f	1,900 ^f	820 ^f	28,000 ^f	3,800 ^f	7,800 ^f
Aromatic							
EC5-7(benzene as non-threshold)	6%	300	1,400	57	86,000 (4,710) ^{sol}	56,000	92,000 (4,710) ^{sol}
EC>7-8(toluene)	6%	660	3,900	120	180,000 (4,360) ^{vap}	56,000	100,000 (4,360) ^{vap}
EC>8-10	6%	190	270	51	17,000 (3,580) ^{vap}	5,000	9,300 (3,580) ^{vap}
EC>10-12	6%	380	1,200	4	34,000 (2,150) ^{sol}	5,000	10,000
EC>12-16	6%	660	2,500	130	38,000	5,100	10,000
EC>16-21	6%	930 ^f	1,900 ^f	260 ^f	28,000 ^f	3,800 ^f	7,800 ^f
EC>21-35	6%	1,700 ^f	1,900 ^f	1,600 ^f	28,000 ^f	3,800 ^f	7,900 ^f
EC>35-44	6%	1,700 ^f	1,900 ^f	1,600 ^f	28,000 ^f	3,800 ^f	7,900 ^f
Aliphatic	1%	1,600 ^f	1,900 ^f	1,200 ^f	28,000 ^f	3,800 ^f	7,800 ^f
+Aromatic	2.5%	1,800 ^f	1,900 ^f	2,100 ^f	28,000 ^f	3,800 ^f	7,800 ^f
>EC44	6%	1,900 ^f	1,900 ^f	3,000 ^f	28,000 ^f	3,800 ^f	7,900 ^f

NOTES

^{sol}/^{vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

^f = oral, dermal and inhalation exposures compared to oral HCV.

All GAC are based on sandy loam soils with a pH 7.

		LQM Generic Assessment Criteria (mg/kg) Dry weight soil						
Contaminant		SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Chloalkanes and Alkenes & Explosives	1,2 Dichloroethane (DCA)	1%	7.1E-03	9.2E-03	4.6E-03	0.67	29	21
		2.5%	1.1E-02	1.3E-02	8.3E-03	0.97	29	24
		6%	1.9E-02	2.3E-02	1.6E-02	1.7	29	28
	1,1,1 Trichloroethane (TCA)	1%	8.8	9.0	48	660	140,000	57,000 (1,425) ^{vap}
		2.5%	18	18	110	1,300	140,000	76,000 (2,915) ^{vap}
		6%	39	40	240	3,000	140,000	100,000 (6,392) ^{vap}
	1,1,2,2-Tetrachloroethanes (PCA)	1%	1.6	3.9	0.41	270	1,400	1,800
		2.5%	3.4	8.0	0.89	550	1,400	2,100
		6%	7.5	17	2.0	1,100	1,400	2,300
	1,1,1,2-Tetrachloroethanes (PCA)	1%	1.2	1.5	0.79	110	1,400	1,500
		2.5%	2.8	3.5	1.9	250	1,400	1,800
		6%	6.4	8.2	4.4	560	1,400	2,100
	Tetrachloroethene (PCE)	1%	0.18	0.18	0.65	19	1,400	810 (424) ^{sol}
		2.5%	0.39	0.40	1.5	42	1,400	1,100 (951) ^{sol}
		6%	0.90	0.92	3.6	95	1,400	1,500
	Tetrachloromethane (carbon tetrachloride)	1%	2.6E-02	2.6E-02	0.45	2.9	890	190
		2.5%	5.6E-02	5.6E-02	1.0	6.3	920	270
		6%	0.13	0.13	2.4	14	950	400
	Trichloroethene (TCE)	1%	1.6E-02	1.7E-02	4.1E-02	1.2	120	70
		2.5%	3.4E-02	3.6E-02	9.1E-02	2.6	120	91
		6%	7.5E-02	8.0E-02	0.21	5.7	120	120
	Trichloromethane (chloroform)	1%	0.91	1.2	0.42	99	2,500	2,600
		2.5%	1.7	2.1	0.83	170	2,500	2,800
		6%	3.4	4.2	1.7	350	2,500	3,100
	Chloroethene (vinyl chloride)	1%	6.4E-04	7.7E-04	5.5E-04	5.9E-02	3.5	4.8
		2.5%	8.7E-04	1.0E-03	1.0E-03	7.7E-02	3.5	5.0
		6%	1.4E-03	1.5E-03	1.8E-03	0.12	3.5	5.4
	2,4,6-Trinitrotoluene (TNT)	1%	1.6	65	0.24	1,000	130	260
		2.5%	3.7	66	0.58	1,000	130	270
		6%	8.1	66	1.4	1,000	130	270
	RDX	1%	120	13,000	17	210,000	26,000	49,000 (18.7) ^{sol}
		2.5%	250	13,000	38	210,000	26,000	51,000
		6%	540	13,000	85	210,000	27,000	53,000
	HMX	1%	5.7	6,700	0.86	110,000	13,000	23,000 (0.35) ^{vap}
		2.5%	13	6,700	1.9	110,000	13,000	23,000 (0.39) ^{vap}
		6%	26	6,700	3.9	110,000	13,000	24,000 (0.48) ^{vap}
Pesticides	Aldrin	1%	5.7	7.3	3.2	170	18	30
		2.5%	6.6	7.4	6.1	170	18	31
		6%	7.1	7.5	9.8	170	18	31
	Dieldrin	1%	0.97	7.0	0.17	170	18	30
		2.5%	2.0	7.3	0.41	170	18	30
		6%	3.5	7.4	0.96	170	18	31
	Atrazine	1%	3.3	610	0.5	9,300	1,200	2,300
		2.5%	7.8	620	1.2	9,400	1,200	2,400
		6%	17.4	620	2.7	9,400	1,200	2,400
	Dichlorvos	1%	3.2E-02	6.4	4.9E-03	140	16	26
		2.5%	6.6E-02	6.5	1.0E-02	140	16	26
		6%	0.14	6.6	2.2E-02	140	16	27
	Endosulfans (2 isomers)	1%	7.4	160 (3.0E-03) ^{vap}	1.2	5,600 (3.0E-03) ^{vap}	1,200	2,300
		2.5%	18	280 (7.0E-03) ^{vap}	2.9	7,400 (7.0E-03) ^{vap}	1,200	2,400
		6%	41	410 (1.6E-02) ^{vap}	6.8	8,400 (1.6E-02) ^{vap}	1,200	2,500
	Hexachlorocyclohexane (3 isomers), inc Lindane	1%	8.5E-02	3.7	1.3E-02	65	8.1	15
		2.5%	0.2	3.8	3.2E-02	65	8.1	15
		6%	0.46	3.8	7.7E-02	65	8.1	16

NOTES

^{sol} / ^{vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

All GAC are based on
sandy loam soils with a pH
7.

All GAC are based on sandy loam soils with a pH 7.			LQM Generic Assessment Criteria (mg/kg) Dry weight soil					
Contaminant		SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Chlorobenzenes	Chlorobenzene	1%	0.46	0.46	5.9	56	11,000	1,300 (675) ^{sol}
		2.5%	1.0	1.0	14	130	13,000	2,000 (1,520) ^{sol}
		6%	2.4	2.4	32	290	14,000	2,900
	Dichlorobenzenes (3 isomers)	1%	23	24	94	2,000 (571) ^{sol}	90,000	24,000 (571) ^{sol}
		2.5%	55	57	230	4,800 (1,370) ^{sol}	95,000	36,000 (1,370) ^{sol}
		6%	130	130	540	11,000 (3,240) ^{sol}	98,000	51,000 (3,270) ^{sol}
	Trichlorobenzenes (3 isomers)	1%	2.6	2.6	55	220	15,000	1,700 (318) ^{vap}
		2.5%	6.4	6.4	140	530	17,000	2,600 (786) ^{vap}
		6%	15	15	320	1,300	19,000	4,000 (1,880) ^{vap}
	Tetrachlorobenzenes (3 isomers)	1%	0.66	0.75	0.38	49 (39.4) ^{vap}	78	110 (39) ^{vap}
		2.5%	1.6	1.9	0.90	120 (98.1) ^{vap}	79	120
		6%	3.7	4.3	2.2	240 (235) ^{vap}	79	130
	Pentachlorobenzene	1%	5.8	19	1.2	640 (43.0) ^{sol}	100	190
		2.5%	12	30	3.1	770 (107) ^{sol}	100	190
		6%	22	38	7.0	830	100	190
	Hexachlorobenzene	1%	1.8 (0.20) ^{vap}	4.1 (0.20) ^{vap}	0.47	110 (0.20) ^{vap}	16	30
		2.5%	3.3 (0.50) ^{vap}	5.7 (0.50) ^{vap}	1.1	120	16	30
		6%	4.9	6.7 (1.2) ^{vap}	2.5	120	16	30
Chlorophenol	Chlorophenols (4 congeners)	1%	0.87 ^g	94	0.13 ^g	3,500	620	1,100
		2.5%	2.0	150	0.30	4,000	620	1,100
		6%	4.5	210	0.70	4,300	620	1,100
	Pentachlorophenol	1%	0.22	27 (16.4) ^{vap}	3.0E-02	400	60	110
		2.5%	0.52	29	8.0E-02	400	60	120
		6%	1.2	31	0.19	400	60	120
Others	Carbon Disulphide	1%	0.14	0.14	4.8	11	11,000	1,300
		2.5%	0.29	0.29	10	22	11,000	1,900
		6%	0.62	0.62	23	47	11,000	2,700
	Hexachlorobutadiene	1%	0.29	0.32	0.25	31	25	48
		2.5%	0.7	0.78	0.61	66	25	50
		6%	1.6	1.8	1.4	120	25	51
	Phenol	1%	280	750	66	760 ^{dir} (31,000)	760 ^{dir} (11,000)	760 ^{dir} (8,600)
		2.5%	550	1,300	140	1,500 ^{dir} (35,000)	1,500 ^{dir} (11,000)	1,500 ^{dir} (9,700)
		6%	1,100	2,300	280	3,200 ^{dir} (37,000)	3,200 ^{dir} (11,000)	3,200 ^{dir} (11,000)

NOTES

^{sol / vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

^{dir} = S4uls based on threshold protective of direct skin contact with phenol (brackets long term exposure for illustration purposes).

^g = derived based on 2,3,4,6-tetrachlorophenol.

APPENDIX B

FOUNDATION DRAWINGS

Ref: SEM/877

26th October 2016

Fosroc
Drayton Manor Business Park
Coleshill Road
Tamworth
Staffs
B78 3XN

For the Attention of Mr Gordon Sprouse

Ref: Protech GM Super 871 / Fosroc Proofex Total

Dear Sir,

Further to your recent enquiry, I write to confirm that the product you supply as Proofex Total is our Protech GM Super 871. Protech GM Super is covered by a BBA certificate – number 11/4868.

I trust this meets with your satisfaction, however if you have any further queries please do not hesitate to contact me.

Yours sincerely,



Sue Menmuir
Technical Advisor



t: +44 (0)1250 872 261
f: +44 (0)1250 872 727



contact@proctorgroup.com

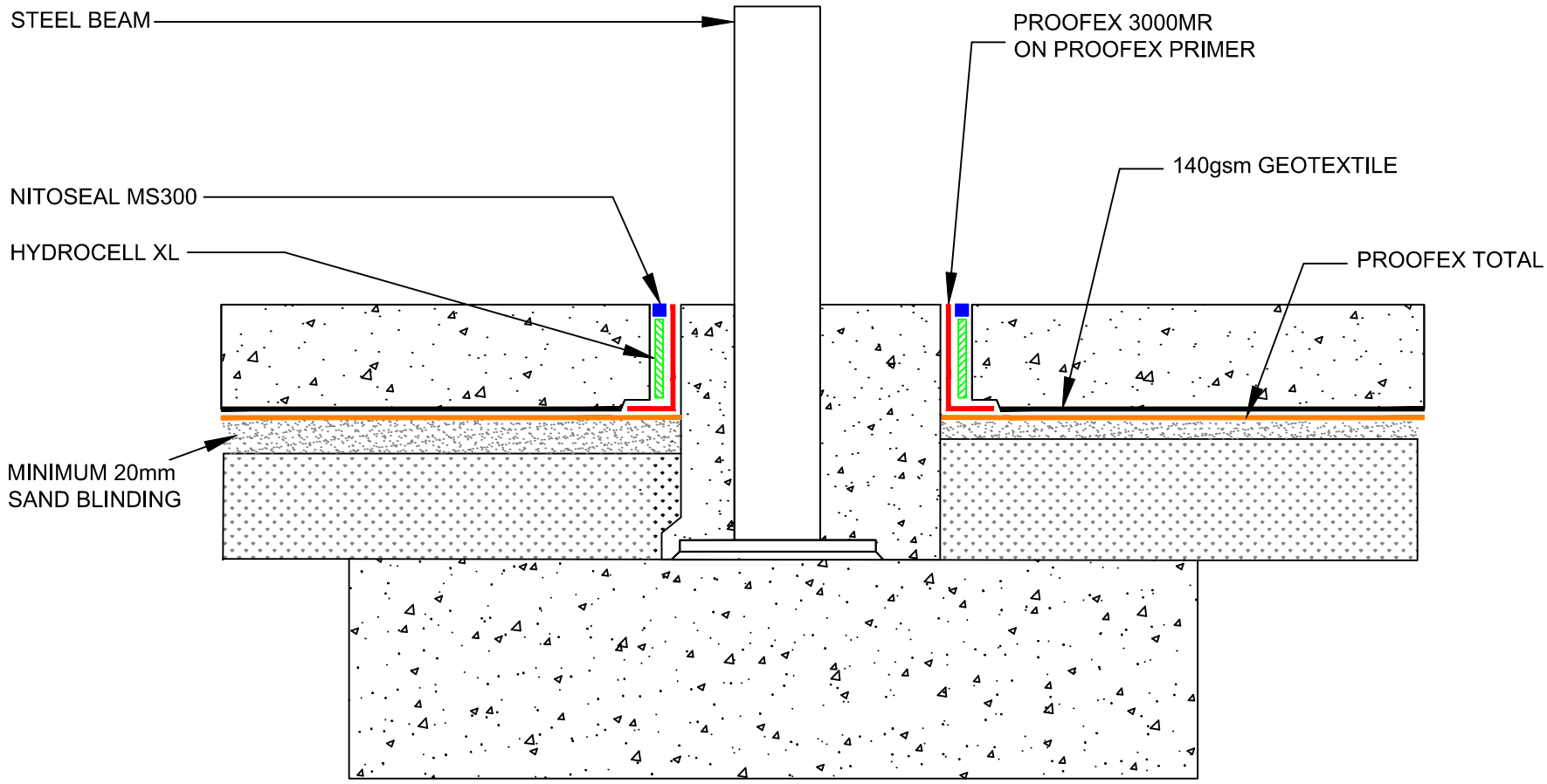


www.proctorgroup.com

The Haugh, Blairgowrie
Perthshire, PH10 7ER

CONSTRUCTION ISSUE

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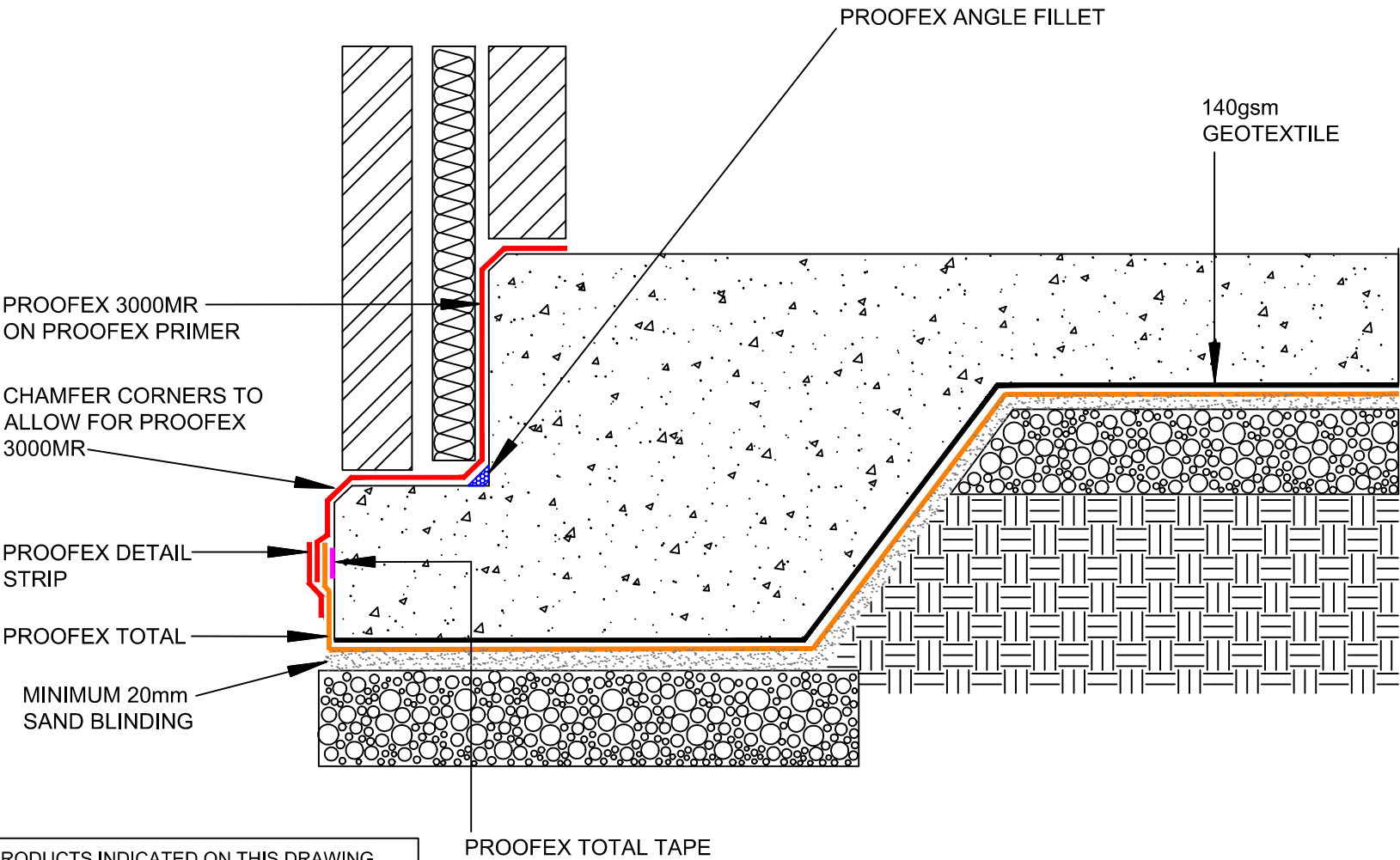
Scale:	NTS
Drawn By:	MW
Date:	22-02-2017
Amendment:	MW
Date:	24-03-2017
TSDO/27822-6b	

LITTLE GREENE PAINT COMPANY
GASPROOFING TO SECTION THROUGH STEEL COLUMN
OPTION 2





FOSROC LIMITED,
Coleshill Road,
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Staffs
B78 3XN
Tel:01827 262222
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Drawn By: MW

Date: 22-02-2017

Amendment: MW

Date: 24-03-2017

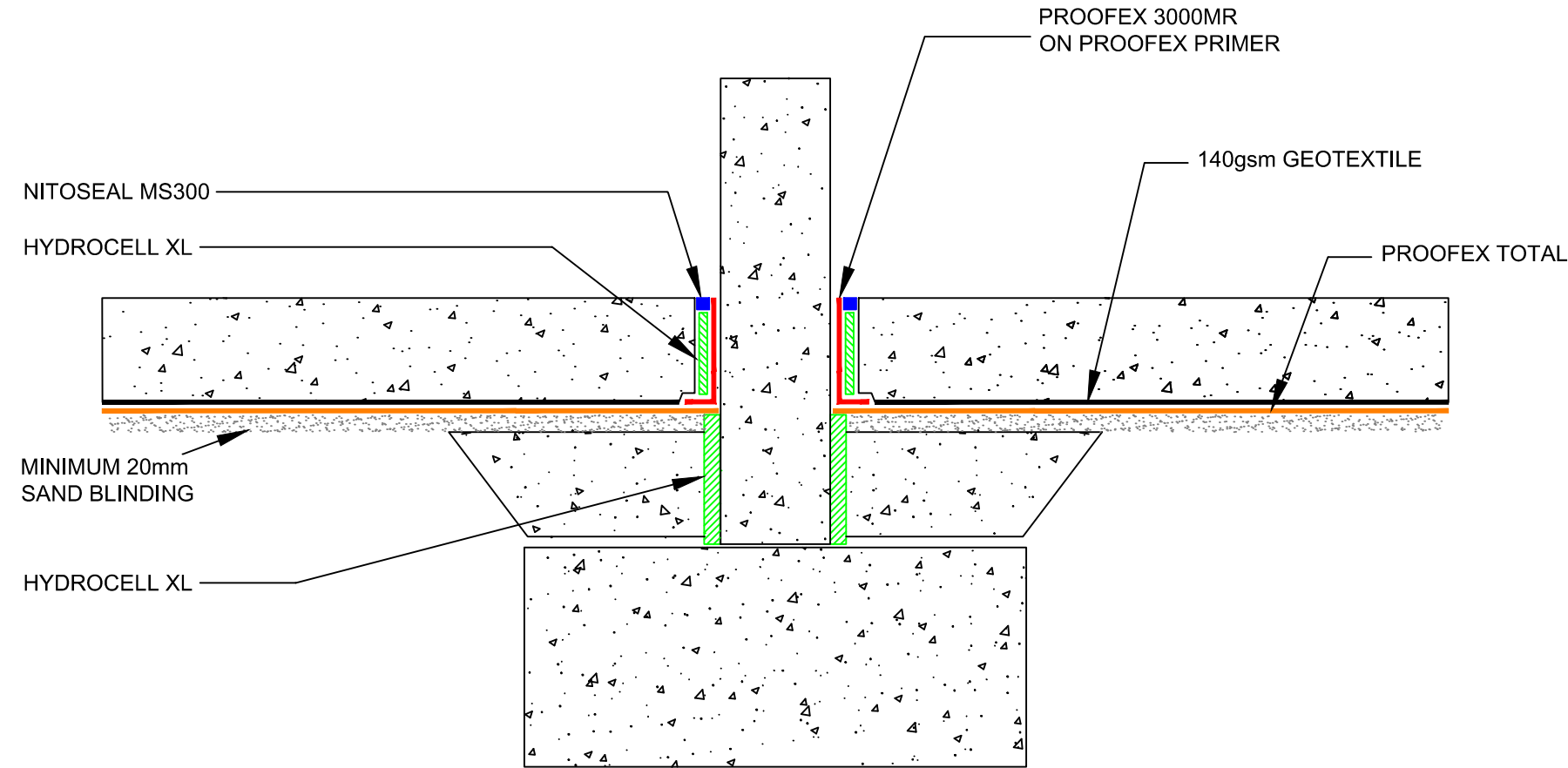
TSDO/27822-5b

LITTLE GREENE PAINT COMPANY

GAS PROOFING TO TYPICAL SECTION THROUGH SLAB EDGE DETAIL - OPTION 2



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B78 3XN
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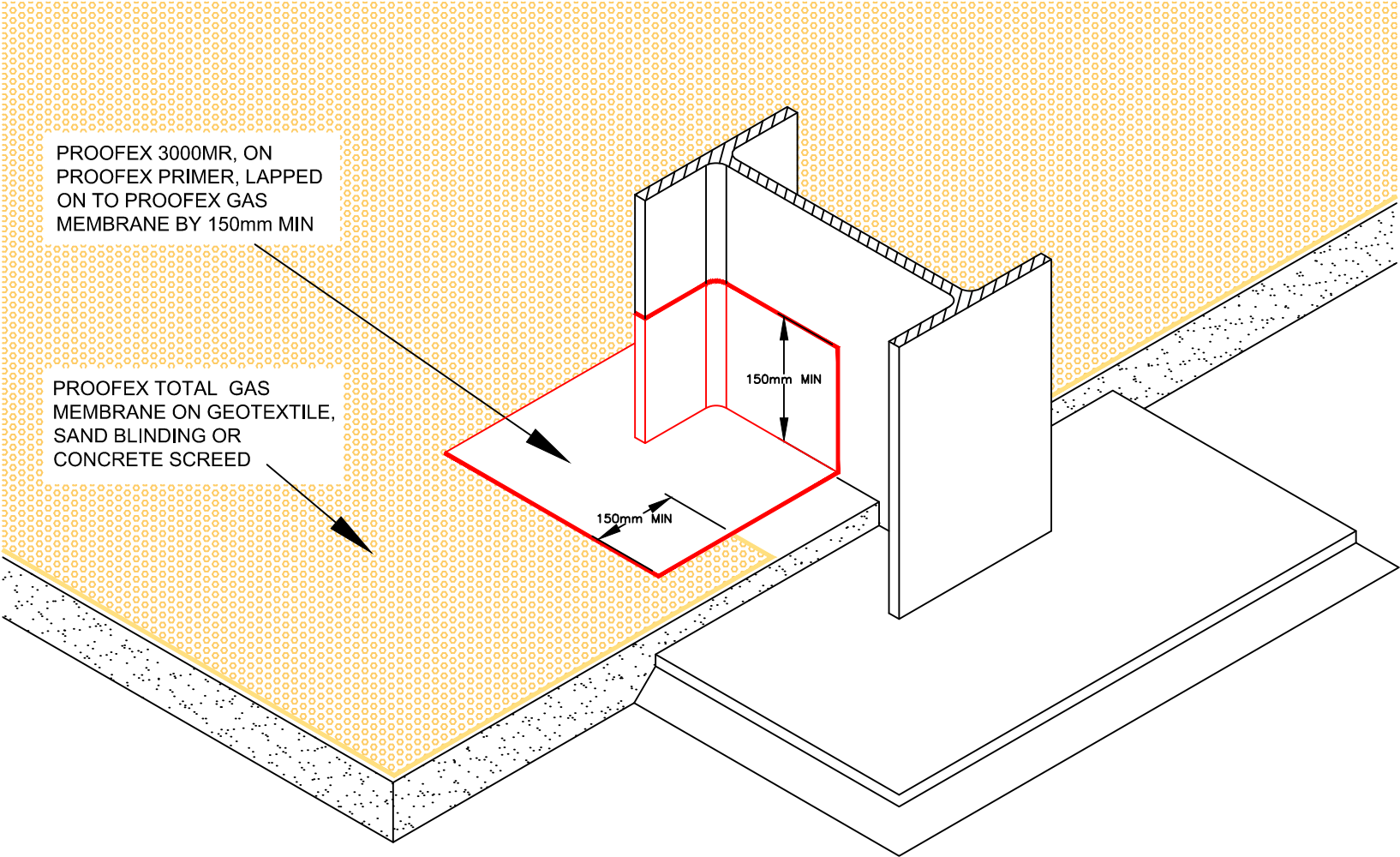
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Amendment:	MW
Date:	24-03-2017
TSDO/27822-4c	

LITTLE GREENE PAINT COMPANY
SECTION DETAIL FOR GAS MEMBRANE TO
COLUMN/GROUND BEAM DETAIL - OPTION 2





GEOTEXTILE PROTECTION OMITTED FOR CLARITY

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Amendment: MW

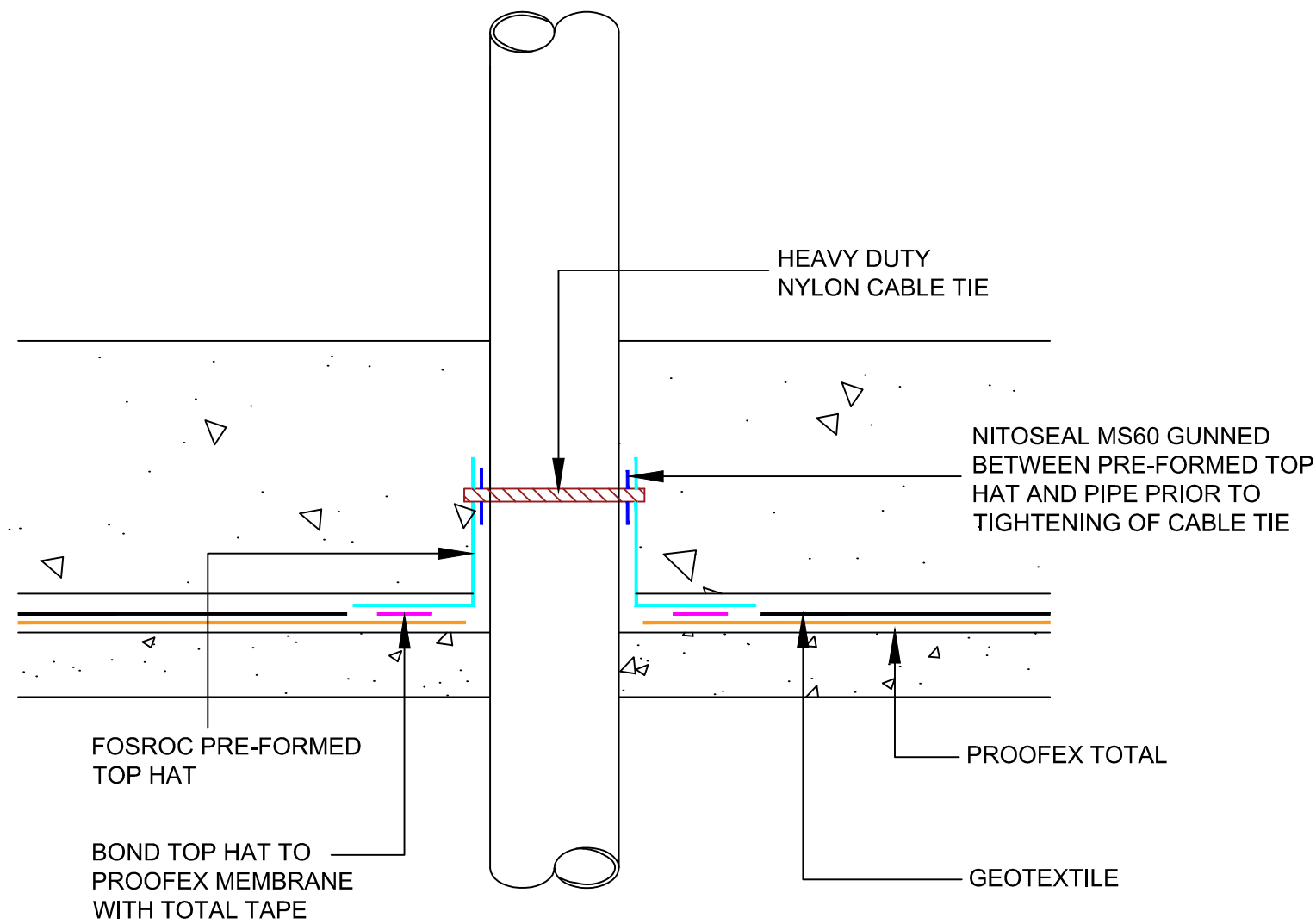
Date: 24-03-2017

TSDO/27822-8a

LITTLE GREENE PAINT COMPANY
GAS PROOFING TO TYPICAL STEEL/CONCRETE COLUMN BASE



 FOSROC LIMITED,
Coleshill Road,
Tamworth,
Staffs
B78 3XN
Tel: 01827 262222
www.fosroc.com



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Date:	24-03-2017
TSDO/27822-7a	





FOSROC LIMITED,
Coleshill Road,
Tamworth,
Staffs
B78 3XN
Tel:01827 262222
www.fosroc.com

APPENDIX C

PROPRIETARY GAS MEMBRANE SPECIFICATION

A Proctor Group Ltd

The Haugh
Blairgowrie
Perthshire PH10 7ER

Tel: 01250 872 261 Fax: 01250 872 727

e-mail: technical@proctorgroup.com

website: www.proctorgroup.com



Agrément Certificate

11/4868

Product Sheet 1

PROTECH GAS RESISTANT DAMP-PROOF MEMBRANES

PROTECH GM SUPER

PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to Protech GM Super, for use as a LDPE gas barrier and damp-proof membrane in solid concrete ground floors not subject to hydrostatic pressure, to protect buildings against, moisture, radon, methane and carbon dioxide from the ground.

AGRÉMENT CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.



KEY FACTORS ASSESSED

Resistance to water and water vapour — the membrane provides an effective barrier to the passage of liquid water and water vapour from the ground (see section 5).

Resistance to underground gases — the membrane is capable of restricting the ingress of radon, methane and carbon dioxide gases into the building (see section 6).

Resistance to puncture — on smooth or blinded surfaces the membrane will accept without damage the limited foot traffic and loads associated with the installation of the system (see section 7).

Durability — under normal service conditions the membrane will remain effective against the ingress of water and water vapour, and will restrict the ingress of radon, methane and carbon dioxide during the lifetime of the concrete slab in which it is installed (see section 12).

The BBA has awarded this Agrément Certificate to the company named above for the product described herein. This product has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 14 November 2011

Simon Wroe
Head of Approvals — Materials

Greg Cooper
Chief Executive

The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

British Board of Agrément
Bucknalls Lane
Garston, Watford
Herts WD25 9BA

©2011

tel: 01923 665300
fax: 01923 665301
e-mail: mail@bba.star.co.uk
website: www.bbacerts.co.uk

Regulations

In the opinion of the BBA, Protech GM Super, if used in accordance with the provisions of this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations:



The Building Regulations 2010 (England and Wales)

Requirement:	C1(2)	Site preparation and resistance to contaminants
Comment:		The product can contribute to a structure satisfying the requirements of this Requirement. See sections 6.1 and 6.2 of this Certificate.
Requirement:	C2(a)	Resistance to moisture
Comment:		The product will enable a floor to meet this Requirement. See sections 5.1 and 5.2 of this Certificate.
Requirement:	Regulation 7	Materials and workmanship
Comment:		The product is an acceptable material. See section 12.1, and the <i>Installation</i> part of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)	Fitness and durability of materials and workmanship
Comment:		The product can contribute to a construction satisfying this Regulation. See section 12.1, and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building standards — construction
Standard:	3.1	Site preparation — harmful and dangerous substances
Standard:	3.2	Site preparation — protection from radon gas
Comment:		The product will enable a floor to satisfy the requirements of these Standards, with reference to clauses 3.1.2 ⁽¹⁾⁽²⁾ , 3.1.6 ⁽¹⁾⁽²⁾ , 3.1.7 ⁽¹⁾⁽²⁾ , 3.1.8 ⁽¹⁾⁽²⁾ , 3.2.1 ⁽²⁾ and 3.2.2 ⁽¹⁾⁽²⁾ . See sections 5.1 and 5.2 of this Certificate.
Standard:	3.4	Moisture from the ground
Comment:		When properly installed in a correctly designed structure, the product forms an effective barrier to the movement of water within the ground-floor slab, enabling compliance with this Standard, with reference to clauses 3.4.2 ⁽¹⁾⁽²⁾ , 3.4.4 ⁽¹⁾⁽²⁾ and 3.4.6 ⁽¹⁾⁽²⁾ . See sections 5.1 and 5.2 of this Certificate.
Standard:	7.1(a)	Statement of sustainability
Comment:		The product can contribute to meeting the relevant requirements of Regulation 9, Standards 1 to 6 and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.
Regulation:	12	Building standards — conversions
Comment:		Comments made in relation to this product under Regulation 9, Standards 1 to 6 also apply to this Regulation, with reference to clause 0.12.1 ⁽¹⁾⁽²⁾ and Schedule 6 ⁽¹⁾⁽²⁾ . (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



The Building Regulations (Northern Ireland) 2000 (as amended)

Regulation:	B2	Fitness of materials and workmanship
Comment:		The product is acceptable. See section 12.1 and the <i>Installation</i> part of this Certificate.
Regulation:	C2(a)	Preparation of site and resistance to dangerous and harmful substances
Comment:		The product can contribute to a structure satisfying the requirements of this Regulation. See sections 6.1 and 6.2 of this Certificate.
Regulation:	C4(a)	Resistance to ground moisture and weather
Comment:		The product will enable a floor to satisfy this Regulation. See sections 5.1 and 5.2 of this Certificate.

Construction (Design and Management) Regulations 2007

Construction (Design and Management) Regulations (Northern Ireland) 2007

Information in this Certificate may assist the client, CDM co-ordinator, designer and contractors to address their obligations under these Regulations.

See section: 2 *Delivery and site handling* (2.1 and 2.2) of this Certificate.

Additional Information

NHBC Standards 2011

NHBC accepts the use of Protech GM Super, when installed and used in accordance with this Certificate, in relation to NHBC Standards, Chapters 4.1 *Land quality — managing ground conditions* and 5.1 *Substructure and ground bearing floors*.

Technical Specification

1 Description

1.1 Protech GM Super is a 0.4 mm thick, LDPE membrane with an integral aluminium foil and polyester scrim reinforcement reinforcing grid. The top surface of the membrane is green and reverse silver.

1.2 The membrane has nominal characteristics of:

Thickness (mm)	0.4
Width (m)	2
Weight (kg·m ⁻²)	0.37
Roll length (m)	50
Methane gas permeability (ms ⁻¹)	$7.799 \times 10^{-12(1)(2)(3)}$

(1) Plain membrane without joints.

(2) For taped joints 2.361×10^{-7} .

(3) For welded joints 6.323×10^{-8} .

1.3 Ancillary products outside the scope of the Certificate available are:

- Protech GM Super Starter Band — perimeter edging strip
- Protech GM double-sided Tape — a cross-linked butyl sealing and bonding strip
- Protech GM Tophats — preformed top hat section for sealing around pipe penetrations in the gas membrane
- Protech SAGM (Self Adhesive Gas Membrane) — aluminium/polyethylene laminate with a modified bitumen adhesive backing. Used to maintain gas membrane continuity on vertical surfaces and around complex penetrations and foundations
- Protech GM Flashing Strip — foil tape used for sealing around column penetrations and for repairs/patching of membranes damaged during installation
- Protech GM Super Corner Units — preformed internal and external sections for detailing of the membrane at perimeter corners, in accordance with BS 8215 : 1991
- Protech GM Primer — primer for preparing substrates prior to the application of Protech SAGM
- Protech GM 3 mm Protection Board — a board for protecting the membrane from mechanical damage and puncture from backfilling
- Protech GM Protection Fleece — a fleece for protecting the membrane from mechanical damage and puncture from backfilling
- Provoid 25 — a passive ventilation system for use where ventilation is required in accordance with design including bespoke pipe and vent layouts.

1.4 Quality control checks are carried out on the incoming materials, during production and on the finished product.

2 Delivery and site handling

2.1 Rolls are wrapped in clear polythene film, marked with a label indicating the product grade and with a warning that the load exceeds 15 kg. The rolls must be stored on their sides.

2.2 Rolls must be stacked laid on their side on a flat surface, kept under cover and protected from sunlight and mechanical damage.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Protech GM Super.

Design Considerations

3 Use

3.1 Protech GM Super is satisfactory for use as a damp-proof membrane under concrete, screed and floor slabs in accordance with CP 102 : 1973, Section 2, and to restrict the ingress of radon, methane and carbon dioxide gases into buildings from landfill and naturally occurring sources.

3.2 Buildings in areas of risk from landfill gas should be constructed in accordance with the recommendations of BRE Report 211 (BR 211 : 2007) *Radon : guidance on protective measures for new dwellings*; BRE Report 212 (BR 212 : 1991) *Construction of new buildings on gas-contaminated land*, BRE Report 414 (BR 414 : 2001) *Protective measures for housing on gas-contaminated land*, CIRIA C665 : 2007 *Assessing risks posed by hazardous ground gases to buildings*, BS 8485 : 2007 and the *Ground Gas Handbook*, 2009.

4 Practicability of installation

The membrane is designed to be installed by a competent general builder, or a contractor, experienced with this type of product.

5 Resistance to water and water vapour



5.1 The membranes including joints provide an effective barrier to the passage of liquid moisture from the ground.

5.2 When installed in accordance with the following documents, the membrane will comply with the minimum sheet thickness detailed in the national Building Regulations.

England and Wales — Approved document C, Requirement C2(a), Section 4.6

Scotland — Mandatory Standard 3.4, clauses 3.4.2, 3.4.4 and 3.4.6

Northern Ireland — Regulation C4(a).

5.3 The membrane is impervious to water and provides a waterproof layer capable of accepting minor structural movements without damage.

6 Resistance to underground gases



6.1 Examination of the results of test data indicate that the product is capable of restricting the ingress of radon, methane and carbon dioxide gases into buildings through the ground-floor slab from naturally occurring sources and/or landfill.

6.2 BRE Reports 211 and 212 recommend 300 µm thick polyethylene sheet as the minimum required thickness for a gas-resistant membrane. It is generally accepted that other materials with comparable or higher gas resistance are suitable, provided they can withstand the construction processes. In the opinion of the BBA, the product meets the criteria.

6.3 When installed in accordance with BRE Report 414 the membrane will be compliant with the recommendations made in CIRIA C665 : 2007, BS 8485 : 2007, BRE Report 211 and *NHBC Standards*. Guidance is given in the *Ground Gas Handbook*, 2009 and the Certificate holder's technical literature.

7 Resistance to puncture

7.1 The membrane can be punctured by sharp objects and care should be taken when handling building materials over the exposed surface.

7.2 On smooth or blinded surfaces the membrane will accept without damage the limited foot traffic and loads associated with the installation of the system.

7.3 Depending on the type of construction, Protech GM 3 mm Protection Board or Protech GM Protection Fleece may be used to minimise the risk of puncture to the membrane.

8 Compatibility with other materials

The membrane contains an aluminium foil interplay which may be subject to corrosion by alkaline conditions if damage to the membrane and exposure occurs. However, under normal circumstances the polyethylene faces of the membrane are compatible with other materials and products typically used in the same area.

9 Underfloor heating

When used in accordance with underfloor heating under normal operating conditions there will be no adverse effect on the membrane; however in other circumstances the Certificate holder's advice should be sought.

10 Effects of temperature

When the membrane is loose-laid and the joints are taped the installation temperature should not be below 5°C.

11 Maintenance

As the product is confined under concrete and has suitable durability (see section 12) maintenance is not required. However, it must be ensured that any damage occurring before enclosure is repaired (see section 1.5).

12 Durability



12.1 Results of artificial ageing tests indicate that a satisfactory retention of physical properties is achieved. The membrane will, in normal circumstances, remain effective against the ingress of water and water vapour and will restrict the ingress of radon, methane and carbon dioxide during the lifetime of the building.

12.2 Long periods of exposure to ultraviolet light will reduce the effectiveness of the membrane.

13 General

13.1 Protech GM Super must be installed and fixed in accordance with the Certificate holder's instructions, the relevant Clauses of CP 102 : 1973, Section 2, and BS 8000-4 : 1989 and section 14 of this Certificate.

13.2 The membrane can be installed in all normal site conditions, provided that the air temperature is not below 5°C to prevent the risk of surface condensation.

14 Procedure

General

14.1 The product should be applied to surfaces that have a smooth finish, ie they should be free from voids, projection and mortar deposits. Surfaces should be dry and free from dust and frost.

14.2 Concrete surfaces should be dense. Vertical surfaces of brickwork and blockwork should be dry and rendered to provide an even surface. Brickwork or unrendered blockwork must be flush pointed to give a smooth surface without sudden changes in level.

14.3 The membrane is rolled out with green side uppermost, ensuring that it is properly aligned. All end and side laps should be a minimum of 150 mm and prepared in accordance with the manufacturer's instructions (see Figure 1).

14.4 Joints are bonded with Protech GM double-sided tape applied 50 mm from the edge of Protech GM Super membrane. When using Protech GM double-sided tape the joints should be pressed down with a stiff brush to ensure that it is well adhered (see Figure 1). Alternatively joints can be hot-air welded.

Figure 1 Application of Protech GM Super



14.5 The surface of the damp-proof membrane to be lapped must be dry and dust free.

14.6 All service penetrations and direction changes should be properly detailed. Protech GM Tophats are available for sealing around pipe entries. Service ducts must be vented to prevent the possibility of gas accumulating in confined spaces.

14.7 When the membrane is to be laid below the concrete slab it should be loose-laid to accommodate any small movement.

14.8 The membrane must extend over the footprint of the building with a stepped damp-proof course separated with a mortar joint.

14.9 The membrane is either covered by a screed or other protective layer as soon as possible after installation. If blockwork is the protection used, care must be taken to avoid damage to the membrane during construction.

14.10 The membrane installation should be subject to third party independent validation in accordance with the *Ground Gas Handbook*, 2009.

15 Repair

Before permanent protection is placed, the membrane area must be inspected for defects. Damage to the product must be repaired using Protech GM Flashing Strip, or if a larger repair is required by using a patch of the membrane and the laps sealed with Protech GM double-sided tape. All patches must extend a minimum of 150 mm from the damaged area. If required by the local authority repair work should be confirmed by an independent validation report, as all gas membrane installation should be subject to third party validation in accordance with *Ground Gas Handbook : 2009, Chapter 9*.

Technical Investigations

16 Tests

An assessment was made of test data in relation to:

- dimensions
- mass per unit area
- tensile strength and elongation at break
- nail tear resistance
- water vapour permeability
- water vapour resistance
- watertightness
- resistance to static loading
- resistance to impact
- heat ageing 70°C for 84 days followed by tensile strength and elongation, nail tear resistance and watertightness
- short term UV ageing, followed by tensile strength and elongation.

Tests on joints

- tensile strength
- heat aged 70°C for 84 days followed by tensile strength.

17 Investigations

17.1 An evaluation was made of the results of the test data on the permeability of radon, methane and carbon dioxide in relation to the product.

17.2 The manufacturing process was evaluated, including methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

17.3 A site visit was conducted to assess practicability of installation.

Bibliography

BS 8000-4 : 1989 *Workmanship on building sites — Code of practice for waterproofing*

BS 8215 : 1991 *Code of practice for design and installation of damp-proof courses in masonry construction*

BS 8485 : 2007 *Code of practice for the characterization and remediation from ground gas in affected areas*

CP 102 : 1973 *Code of practice for protection of buildings against water from the ground*

Conditions of Certification

18 Conditions

18.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page — no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English law.

18.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

18.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

18.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

18.5 In issuing this Certificate, the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- individual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal.

18.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

Eton Business Park, Eton Hill Road,
Manchester M26 2ZS

Tel: 0161 763 7200

The Corn Exchange, Fenwick Street,
Liverpool L2 7QL

Tel: 0151 235 8716

Unit 121, Wright Business Centre,
1 Lonmay Road, Glasgow G33 4EL

Tel: 0141 773 6269

www.thelkgroup.com