Southern Testing
Environmental & Geotechnical

ST Consult
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Remediation Strategy and Verification Plan



Project Name: Tesco, Wrexham

Location: Tesco Crescent Road, Wrexham

Client: Glanville Group

Project ID: JN1246 - MS

Report Date: 11 September 2024

Report Issue: 1

SUMMARY

The site is part of Tesco car park off Crescent Road, in Wrexham, which extends 0.22 Ha. This comprises an operational car park bounded by fencing, with hedgerows and semi-mature trees.

It is proposed to redevelop the site with a McDonald's with associated car park, soft landscaping and Drive-Thru.

A desk study was carried out and indicates that the site has a history as a field until the construction of the car park on site by 2003. The surrounding area has undergone significant development, including a large sand extraction pit along the north-eastern boundary of the site.

Geological records indicate that the site geology consists of Glaciofluvial Sheet Deposits (Secondary A aquifer) over Salop Formation (Secondary A Aquifer). The site is not located within a Source Protection Zone (SPZ).

Two Phases of investigation have been carried out.

The soils encountered comprised MADE GROUND (-0.5/2.2m), overlying medium-dense fine SAND (-5m+), with loose very clayey SAND bands encountered at times.

Groundwater was not encountered in any of the exploratory holes during the investigation or during the monitoring period.

No contamination has been identified in the soils on site, which concurs with the site history and the observations made during the investigation. As the site is a car park covered in hardstanding a growing medium will be needed in the new areas of soft landscaping.

The gas monitoring confirmed CS2 conditions and therefore a gas protection score of 2.5 is required for the commercial building proposed. This should also include basic radon protection. Protecta-Line pipes will be installed as a precaution on a Brownfield site.

A Remediation Strategy comprising provision of basic gas and radon protection is recommended, with verification of the clean cover in soft landscaping areas to provide a growing medium and the installation. The monitoring wells should also be decommissioned in line with industry guidance.

A Verification Plan and Discovery Strategy are also included.

The contamination screening values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based upon them. Their validity should be confirmed at the time of site development.

The recommendations contained in this report are made in respect of the particular development proposals as described in the report and may not be appropriate to alternative development schemes.

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The findings and opinions conveyed via this report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Limited believes are reliable. Nevertheless, Southern Testing Laboratories Limited cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

This report should be considered in its entirety and Southern Testing Laboratories Ltd accepts no responsibility for and excludes liability in respect of any omission or alteration made by others, and any use of the report for any purpose other than that for which it was produced.

Author	Morgan Howcutt BSc FGS	
Check / Review	Joe Kelly BSc PhD DIC	

For and on behalf of Southern Testing Laboratories Limited

DOCUMENT HISTORY AND STATUS

Issue No	Date	Purpose or Status	Author	Check / Review
01	11/09/2024	Remediation Strategy and Verification Plan	MH	JK

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A INTRODUCTION

1 Authority

This Verification document was requested in an email from Hylton George, of Glanville, dated 27th July 2024.

2 Location

The site is located off Crescent Road, approximately 1km to the north-east of Wrexham Town Centre. The approximate National Grid Reference of the site is SJ 341 504. The site location is indicated on Figure 1 within Appendix A.

3 Proposed Construction

It is proposed to develop the 0.25 ha site with a McDonald's restaurant with associated car park and Drive-Thru architect drawing 7611-SA-8903-SK33 (see Appendix A).

For the purposes of the contamination risk assessment, the proposed development land use is classified as Commercial/Industrial CLEA Model Ref [1] / C4SL Report Ref [2].

The gas sensitivity of the proposed development is therefore rated as Low CIRIA C665 Ref [3].

4 Scope

This report presents our Remediation Options Appraisal, Remediation Strategy, and Verification Plan for the proposed remedial works at the site.

As with any site there may be differences in soil conditions between exploratory hole positions.

The findings and opinions conveyed via this investigation report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Limited believes are reliable. Nevertheless, Southern Testing Laboratories Limited cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

This report has been prepared for the sole internal use and reliance of Glanville Group. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Southern Testing Laboratories Limited. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

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B BACKGROUND INFORMATION

5 Site Investigation Works

The site has been the subject of a series of site investigation reports, as listed below.

Ref	Date	Author	Title / Ref No	Subject
1	May 2019	ST Consult	JN1246	Phase I and II Investigation
2	July 2024	ST Consult	JN1246	Phase III Geotechnical investigation

These reports provide good coverage and characterisation of the site and information derived from these reports is discussed below. The reader is referred to the original reports for supporting detail if needed. These reports are referred to below by the number given in the left hand column of the above table.

6 Site History

The desk study (1), indicates that the site has a history of being an agricultural use, before it became part of a Tesco car park by 2003.

7 Relevant Pollutant Linkages

The Phase II site investigation and risk assessment carried out (1) only identified the following Relevant Pollutant Linkage for the site. The Phase III investigation (2) was limited to geotechnical investigation, although a single natural sample was analysed as part of the soakage testing and this confirmed the material was free from contamination.

Contaminant / Source	Pathways	Receptor
Land Gas and Radon	Inhalation	Future Users

A minor Land gas and radon risk has been identified; as such, basic protection measures should be installed.

In addition, although no organic contamination has been identified on site, due to the Brownfield nature and depth of Made Ground encountered, Protecta-Line Pipes will be installed as a precaution. A growing medium will need to be provided in area of planting, so the topsoil imported for this purpose will require verification to confirm that it is free from contamination.

A discovery strategy will also need to be put in place in order to mitigate the risk of any thus far undetected sources of contamination that may come to light during the course of the proposed development works. This is discussed in more detail below.

C REMEDIAL OBJECTIVES AND OPTIONS

8 Remedial Objectives

On the basis of the investigations carried out to-date, and the proposed redevelopment works to be undertaken on-site, the remediation objectives are as follows:

- Install basic gas protection methods to mitigate the risk from land gas and radon gas risk. This corresponds to a gas protection score of 2.5, in terms of the land gas risk, assuming a commercial/public building classification, and appropriate protection systems will need to allow for this (a mixture of ventilation and gas membrane).

9 Options Appraisal

9.1 A Carbon Dioxide and Methane Ground Gas Risk

The phase II investigation identified land gas. The complete removal of Made Ground from site is unsustainable and unnecessary, therefore the provision of basic gas protection measures is the most suitable remediation option.

Basic land gas protection measures will be required within the new restaurant due to the land gas risk identified, to mitigate the minor risk to the restaurant workers and customers. Ground gas Characteristic Situation 2 applies to the site, subject to regulatory agreement. The gas protection measures are presented in plans in Appendix C. This will require independent validation by a specialist contractor.

9.2 Radon

Basic radon protection measures are also required. There are no other options to mitigate this geological risk.

D REMEDIATION STRATEGY

10 Remediation Methods

The Remediation Strategy will comprise the following:

1. The monitoring wells should be decommissioned in line with industry and regulatory guidance (see below and Appendix D).
2. Provide a growing medium over the made ground to mitigate the contamination risk, a minimum of 300mm of certified clean subsoil and topsoil within areas of soft landscaping.
3. The contractors should, however, be provided with the contamination results for their own health and safety review.
4. The site falls within CS2 conditions. This corresponds to a gas protection score of 2.5, assuming a commercial/public building classification, and appropriate protection systems will need to allow for this (a mixture of ventilation and gas membrane).
5. Basic Radon protection measures will be required.
6. A discovery strategy needs to be put in place to deal with any other contamination that comes to light during the development work.

11 Assessment Criteria

The following assessment criteria values will be used in the verification process:

Although no specific remediation is necessary in terms of the risk to human health, there will be areas of soft landscaping and planting on site. As there is no suitable source of topsoil on site, certified clean topsoil will need to be imported for these areas. This exercise will need to be validated and documented.

Any soils that are imported shall be free from deleterious materials, weeds and contamination. Chemical analyses of soil should comply with the most conservative screening criteria i.e. that of a proposed residential end use with the potential for the consumption of home-grown produce, as per the recommendations of the local authority. The screening values for this end use are presented within the table within Appendix B. These contamination screening values are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.

Greenfield / Manufactured Soils = [Minimum 3 or 1 per 250m3] (whichever is greater): Chemical testing suite - Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn); PAH (16 USEPA speciation); TPH (Aliphatic / Aromatic Split) and Asbestos.

Brownfield / Site won Soils = [Minimum 6 or 1 per 100m3] (whichever is greater): Chemical testing suite - as above and any additional analysis dependant on the history of the donor site.

E VERIFICATION PLAN

12 Data Collection

Location	Data	Responsible Party
Restaurant Building	Installation	Main or Specialist contactor
	Inspection and Validation	Specialist contactor
Decommissioning Monitoring Wells	The monitoring wells on site, WLS1-3, need to be decommissioned in line with industry/regulatory guidance (See below and Appendix D)	Main Contractor
Soft landscaped/planting areas	Reducing levels (if required) and laying membrane Post placement check of thickness Post placement soil samples Consignment Notes	Main Contractor Southern Testing Southern Testing Main Contractor

13 Reporting

Following the completion of the remediation works, a final verification report will be produced by ST Consult. The remediation and validation process at McDonald's sites is well established. The contractor is provided with a copy of the various phases of report, and this Remediation Method Statement, so is aware of the data that is required. Discussions will also be held with the groundworker to confirm this. Photographs of the Protecta-Line pipes installation are taken by the groundworker for inclusion in the report. The groundworker will also supply pictures confirming the decommissioning of the gas monitoring wells. The areas of planting will need to be validated in terms of the depth and quality of topsoil imported.

A separate validation report will be provided by Membrane Testing Solutions for the gas and radon protection measures installed as detailed in Appendix C.

14 Decommissioning Monitoring Wells

There are 3 monitoring wells on site, as shown on Figure 2 in Appendix A. These need to be decommissioned in line with guidance as outlined the EA document appended (Good Practice for decommissioning redundant boreholes and wells – see Appendix D). The proposal is to backfill these with low permeability material (cement, concrete or bentonite grout).

15 Discovery Strategy

As with any site, areas of contamination not identified during site investigation works may come to light in the course of redevelopment. Accordingly, a discovery strategy will be adopted to ensure that any hitherto unknown contamination is identified and dealt with in an appropriate manner, as follows:

- A close watch will be maintained during all demolition and excavation works.
- In the event that unexpected or malodorous soils or liquids are encountered, excavation work shall cease in the affected area.
- The affected area shall be made safe and fenced off to prevent unauthorised access.
- The Site Manager shall notify ST Consult of the discovery, who will attend site to inspect the suspect materials, provide advice and take samples as necessary. Within ST Consult. Dr Joe Kelly shall be the first point of contact (01604500023).
- The Site Manager shall notify Blackpool Council of the discovery. The contact will be the contaminated land officer.

Any suspect excavated soil will be stockpiled separately on polythene sheeting, covered, and tested before being removed.

16 General Guidance

In general terms, the workforce and general public should be protected from contact with contaminated material. There is a range of relevant documents published by the Health and Safety Executive, and organisations such as CIRIA, and the BRE.

Some soils will require removal from site and disposal to suitably licensed landfills. Different guidelines and charges will apply to different waste classifications. As waste producers, the Developer holds responsibilities under the various governing regulations, including:-

- Ensuring that waste is characterised in accordance with current Technical Guidance.
- Ensuring that waste is disposed of at a facility appropriately licensed to receive the waste as classified.
- Keeping accurate records of all waste classification, transfer and a disposal log including information such as:
    - Date, Waste Classification, Carrier's Registration Number, Transfer Note Number, Ultimate Destination.
- Submitting full copies of those records for inclusion in validation/closure reports.

Maintaining those records for potential future regulatory inspection.

REFERENCES

[1] Environment Agency, “Updated technical background to the CLEA model,” 2009.

[2] Contaminated Land: Applications in Real Environments (CL:AIRE), “Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination,” 2014.

[3] CIRIA, “C665 Assessing risks posed by hazardous ground gases to buildings,” 2007.

[4] C. Nathanail, C. McCaffrey, A. Gillett and R. &. N. J. Ogden, “The LQM/CIEH S4ULs for Human Health Risk Assessment,” Land Quality Press, Nottingham, 2015.

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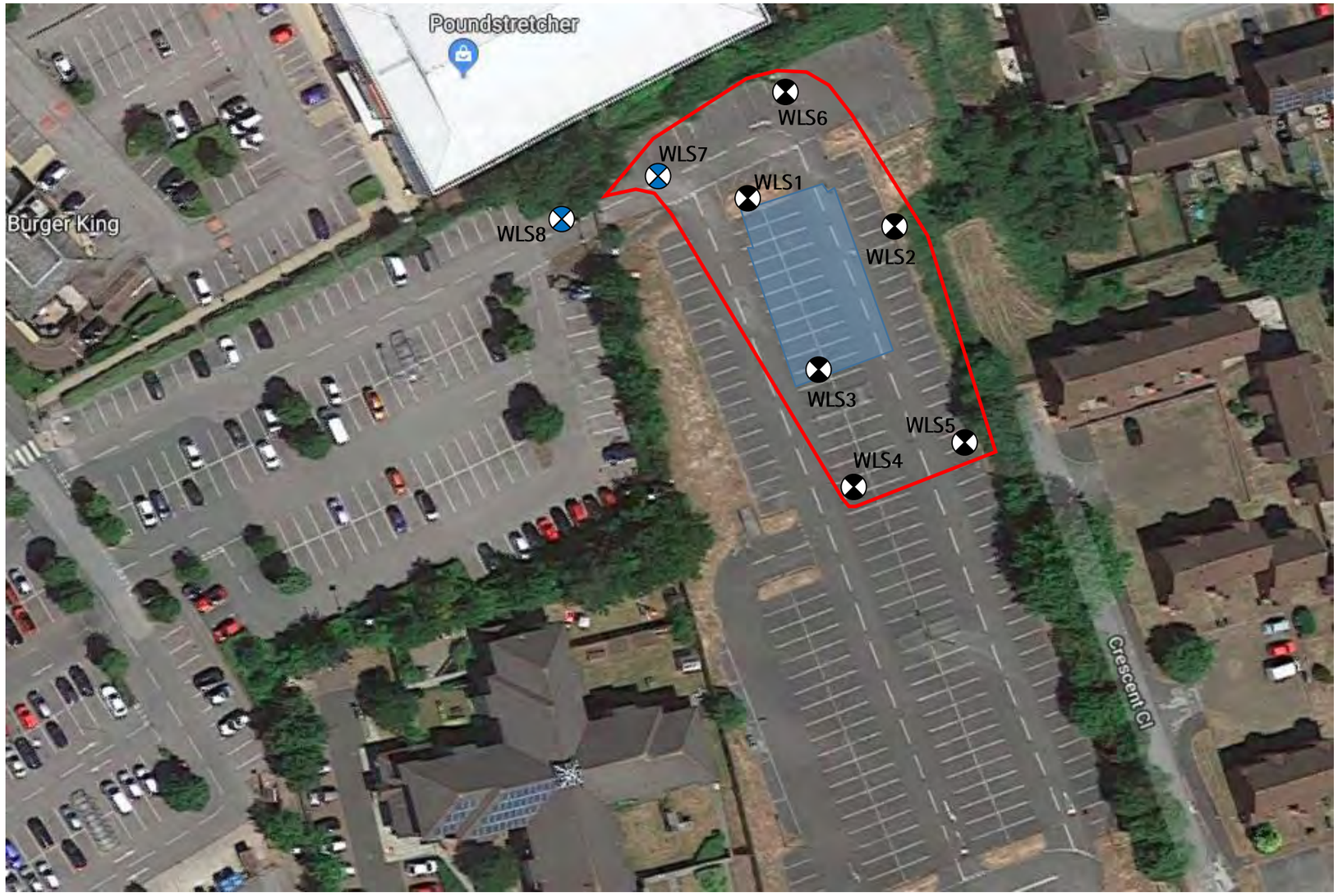


APPENDIX A

Site Plans



A



N

Proposed Building Location

Site Boundary

Windowless Sampler Borehole

Road Core and Windowless Sampler Borehole

NB: Positions of Boreholes and/or Trial Pits are only indicative unless dimensioned

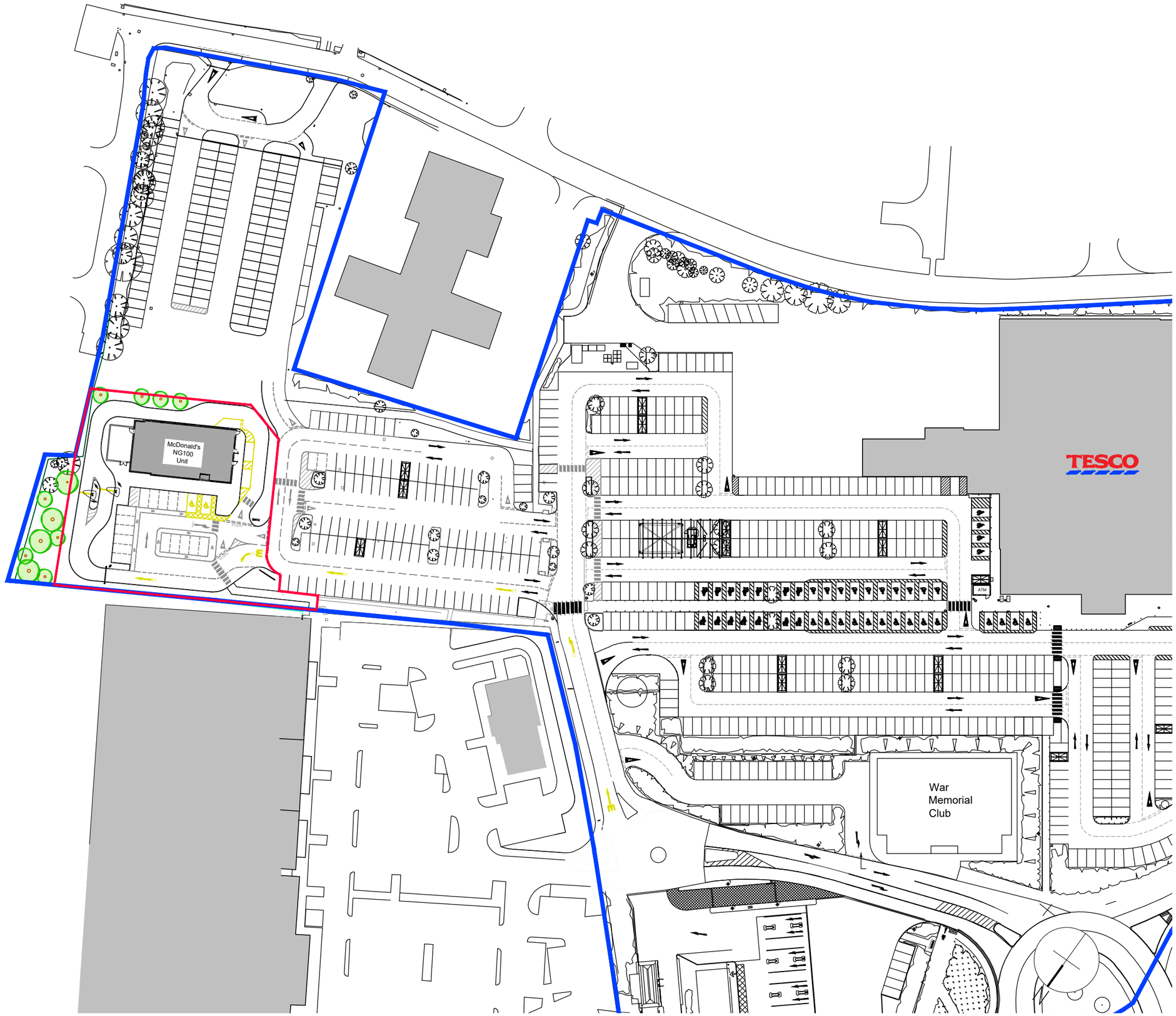
Site: McDonalds Wrexham		STL:JN1246	Fig No:1
Date: 08 April 2019		Final Siteplan	
Southern Testing	Southern Testing: Keeble House, Stuart Way, East Grinstead, West Sussex RH19 4QA ST Consult: Twigden Barns, Brixworth Road, Creaton, Northampton NN6 8NN	ST Consult	

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email: scurrs@scurr.co.uk
www.scurr.co.uk
architects ⊠ designers ⊠ project managers

Notes:
All drawings to be read in conjunction with all other drawings as noted on issue sheet.

Tesco Boundary (as per Existing Tesco Site Plan REF: 3433pg##)

Proposed McDonald's Demise = 0.69 Acres



REV.	DATE.	DRAWING REVISIONS.	BY.	CHECKED

GENERAL NOTES:
All works are to be undertaken in accordance with the Building Regulations and the latest British Standards.
All proprietary materials and products are to be used strictly in accordance with the manufacturer's recommendations.
All dimensions to be checked on site prior to construction.
All risks assessed to comply with the designer's responsibility under the Construction (Design Management) Regulations 2015.

PROPOSED DEVELOPMENT AT
Tesco, Crescent Road
WREXHAM LL13 8HF

STORE No :-
ST XXXX

ON BEHALF OF :-
McDonald's Restaurants Ltd

DRAWING TITLE :-
Site Feasibility Plan
NG100 Unit
Side by Side CODs

DRAWN BY	CHECKED BY	DRAWING No.
DM	-	7611-SA-8903-SK33
SCALE & SIZE	DATE	
1:1000@A3	NOV 2023	

NG100

Scurr Architects
85 Southdown Road
Harpenden
Hertfordshire
AL5 1PR
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architects ⊠ designers ⊠ project managers

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APPENDIX B

Verification Criteria



B

Contaminant Screening Values for Imported Soils

Contaminant	Units	Proposed Land Use					
		Residential with home grown produce consumption	Residential without home grown produce consumption	Open Space * (Residential)	Open Space * (Park)	Allotments	Commercial / Industrial
Arsenic (As) [2]	mg/kg	37	40	79	170	43	640
Cadmium (Cd) [2]	mg/kg	11	85	120	555	1.9	190
Trivalent Chromium (CrIII) [2]	mg/kg	910	910	1,500	33,000	18,000	8600
Hexavalent Chromium (CrVI) [2]	mg/kg	6	6	7.7	220	1.8	33
Lead (Pb) [3]	mg/kg	200	310	630	1300	80	2330
Mercury (Hg) [1,2,7]	mg/kg	7.6-11	9.2-15	40	68-71	6.0	29-320
Selenium (Se) [2]	mg/kg	250	430	1,100	1,800	88	12,000
Nickel (Ni) [2,4]	mg/kg			pH <6.0 pH 6.0 – 7.0 pH >7.0	60 75 110		
Copper (Cu) [2,4]	mg/kg			pH <6.0 pH 6.0 – 7.0 pH >7.0	100 135 200		
Zinc (Zn) [2,4]	mg/kg			pH <6.0 pH 6.0 – 7.0 pH >7.0	200 200 300		
Phenol [1,2]	mg/kg	120-380	440-1200	440-1300	440-1300	23-83	440-1300
Benzo[a]pyrene [1,5]	mg/kg	1.7-2.4	2.6	4.9	10	0.67-2.7	36
Naphthalene [1,2]	mg/kg	2.3-13	2.3-13	77-430+	77-430+	4.1-24	77-430+
Total Cyanide (CN) [6]	mg/kg	/	/	/	/	/	/
Free Cyanide [6]	mg/kg	/	/	/	/	/	/
Complex Cyanides [6]	mg/kg	/	/	/	/	/	/
Thiocyanate [6]	mg/kg	/	/	/	/	/	/

Notes:

* Open Space levels calculated on the basis of the exposure modelling developed in the C4SL research.

+ Screening values constrained to saturation limit. Higher values may be acceptable on a site specific basis.

[1] Where ranges of values are given for organic contaminants the screening value is dependent on the Soil +Organic Matter.

[2] LQM/CIEH S4UL (2014). Copyright Land Quality Management Ltd. reproduced with permission; Publication Number S4UL 3116. All rights reserved.

[3] C4SL (DEFRA 2014).

[4] Copper, Zinc and Nickel may have phototoxic effects at the given concentrations. Alternative criteria should be adopted for importation of Topsoil or other soils for cultivation. BS3882:2015 and BS8601:2013 suggest values of 200 to 300mg/kg for Zn, 100 to 200mg/kg for Cu, and 60 to 110mg/kg for Ni, for topsoil and subsoil, depending on pH.

[5] Based on the Surrogate Marker approach and modelled using the modified exposure parameters of C4SL but retaining 'minimal risk' HCV.

[6] Screening criteria derived on a site specific basis if test results indicate.

[7] S4UL for Methyl Mercury, higher concentrations may be tolerable if inorganic mercury is the only species present. Lower concentrations apply for elemental Mercury.

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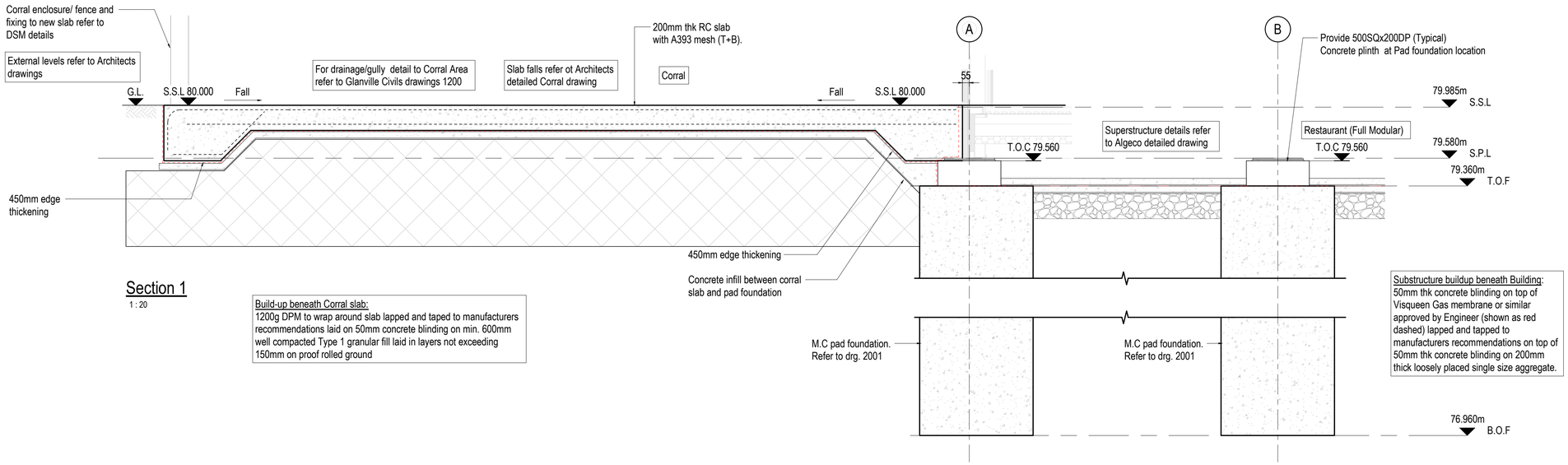


APPENDIX C

Gas & Radon Protection Details

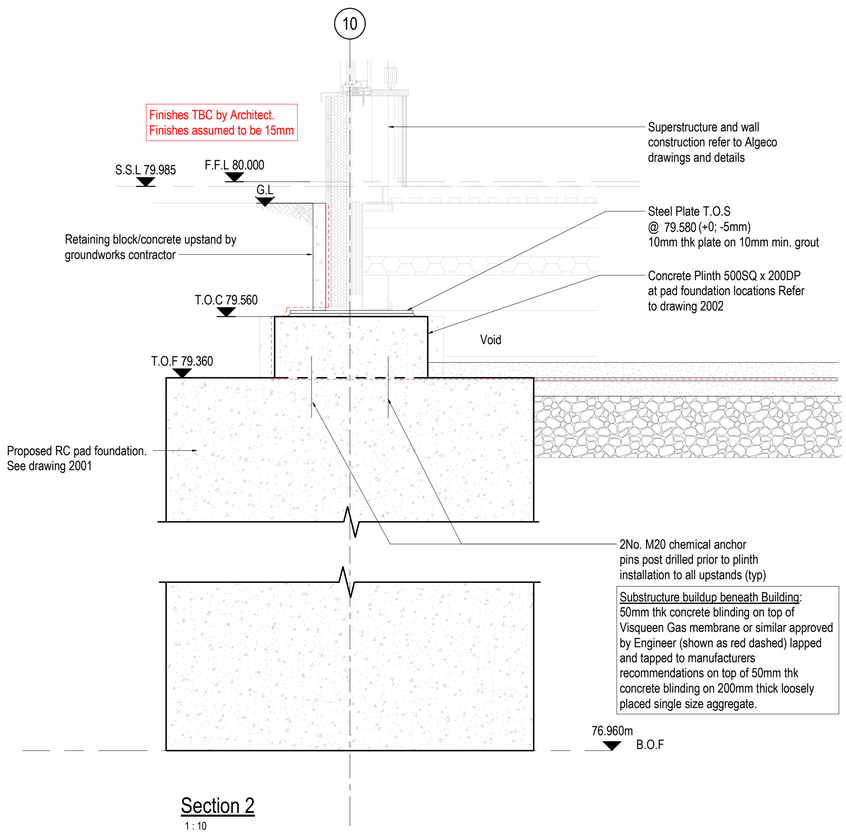


C

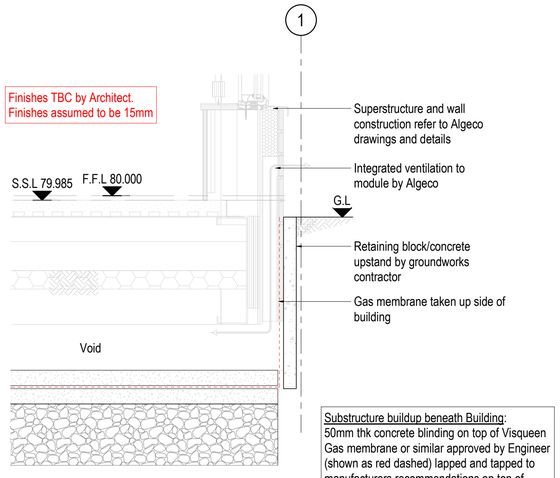


Section 1
1 : 20

Build-up beneath Corral slab:
1200g DPM to wrap around slab lapped and taped to manufacturers recommendations laid on 50mm concrete blinding on min. 600mm well compacted Type 1 granular fill laid in layers not exceeding 150mm on proof rolled ground



Section 2
1 : 10



Section 3
1 : 10

General Notes

1. This drawing must not be scaled; work to figured dimensions only.
2. This drawing is to be read in conjunction with all relevant drawings, documents and specifications. any discrepancies between information shown on this and any other drawing shall be reported to the engineer immediately.
3. This drawing is to be read in conjunction with all relevant drawings, documents and specifications. any discrepancies between information shown on this and any other drawing shall be reported to the engineer immediately.
4. Typically for setting out refer to Architects drawings.

All grids, levels, dimensions and storey heights T.B.C by Architects/Algeco prior to commencement of works on site

Abbreviation Key:
F.F.L - Finished Floor Level
S.S.L - Structural Floor Level
S.P.L - Steel Plate Level

F.F.L	80.000
S.S.L	79.985
S.P.L	79.580

For notes refer to drawing 2000

Basic radon protection required

Gas Protection - CS2

Building Type: Algeco NG100 ECO

Rev.	Description	Date	By	Chkd
I1	For Information	05.09.2024	P.S.	R.A.

Glanville
Survey > Plan > Engineer
Civil Engineering · Highways Engineering · Structural Engineering · Building Surveying · Transport Planning · Geomatics
Hertfordshire | Oxfordshire | Cambridgeshire | Bristol

Client : McDonald's RESTAURANT

Project :
Crescent Road
Wrexham ST2543

Title :
Sections & Details

Engineer : R.A. Date : 06/19/24
Director : J.F. Scale : As indicated @ A1
Status : FOR INFORMATION

Drawing No. 4240121_ SK01
Rev : i1

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APPENDIX D

Barrier Pipe Details

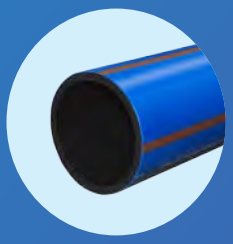


D

Product data sheet

Protecta-Line pipe

A multi-layered PE pipe with an embedded aluminium barrier layer. It is designed to safely transport drinking water in land which is contaminated or has the potential to be contaminated in the future.



Range / pressure rating

OD (mm)	SDR	Pressure rating	Material
25	11	12.5 bar	PE80
32			
63	11	16 bar	PE100
90 to 180	11	16 bar	PE100
	17	10 bar	PE100
225 to 630	11	16 bar	PE100
	17	10 bar	PE100

Colours

Material	Description	Colour
PE80	Black core and light blue outer with brown stripes.	
PE100	Black core and dark blue outer with brown stripes.	

Pipe diameter ≤ 180mm pipe has four brown stripes; > 180mm pipe has eight brown stripes.

Standards / approvals

The Water Supply Regulation 31/33	**BS EN 12201-2**	**WRAS Approved**	**BS 8588**

Certification

WRAS APPROVED PRODUCT **1606501 1511343 1505514 1302025**	**BS EN 12201-2 KM 508224**	**BS 8588 KM 695717**

Lengths

Pipes ≤ 180mm in diameter are available in coiled lengths of 25m, 50m or 100m.

Pipes 63mm – 630mm in diameter are also available in straight lengths of 6 or 12m.

Other lengths may be produced at customer's request.

Aliaxis UK - St. Peter's Road, Huntingdon, PE29 7DA, United Kingdom
Sales/Technical: +44 (0)1480 442600
customerservice@aliaxis.com

Product data sheet

Protecta-Line pipe

Markings

As a minimum requirement, the following information is marked indelibly and linearly at intervals along the pipe:

- Manufacturers identification: **GPS**
- System: **Protecta-Line**
- Pipe composition: **PE Pipe with AL Barrier**
- Standard and pipe type:: **BS 8588 TYPE A**
- Material designation: **PE100 or PE80**
- Nominal size: **180mm (example)**
- SDR value: **Water**
- Continuous pressure rating at 20°C **10 bar (example)**

The pipes are marked with the following three times per metre:

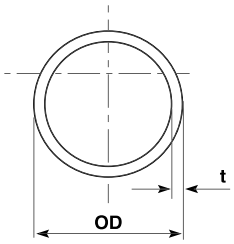
- Application: **Water**

Batch number format

8 Digit Code	Extruder Number 1 & 2	Shift Number 3 & 4	Week Number 5 & 6	Year 7 & 8
	01-23	01 - 14	01 - 52	01-99

Pipe dimensions – water applications (BS EN 12201-2)

Size* (mm)	SDR	Mix OD (mm)	Max OD (mm)	Mean Bore (mm)	Min t (mm)	Max t (mm)	Approx Weight (kg/m)
25	11	26.2	27.4	20.0	3.0	3.7	0.3
32	11	33.3	34.5	26.0	3.7	4.4	0.4
63	11	64.3	65.6	50.9	6.5	7.6	1.3
90	11	92.2	93.5	72.9	9.3	10.7	2.6
	17	92.2	93.5	78.8	6.5	7.5	1.9
110	11	112.2	113.5	89.2	11.1	12.7	3.7
	17	112.2	113.5	96.3	7.7	8.8	2.7
125	11	127.2	128.5	101.2	12.5	14.2	4.7
	17	127.2	128.5	109.6	8.5	9.8	3.4
160	11	163.2	165.1	130.4	15.8	17.9	7.6
	17	163.2	165.1	141.1	10.7	12.4	5.4
180	11	183.3	185.4	146.8	17.6	20.0	9.5
	17	183.3	185.4	158.8	11.9	13.7	6.8
225	11	227.3	229.5	182.5	21.7	24.4	14.5
	17	227.3	229.5	197.4	14.6	16.6	10.3
250	11	252.3	254.9	203	23.9	26.8	17.7
	17	252.3	254.9	219.6	16.0	18.3	12.4
280	11	282.3	285.1	227.4	26.6	29.8	22.0
	17	282.3	285.1	245.9	17.8	20.1	15.4
315	11	317.3	320.2	255.7	29.8	33.3	27.6
	17	317.3	320.2	276.6	19.9	22.4	19.3
355	11	357.3	360.6	288.3	33.4	37.3	34.8
	17	357.3	360.6	311.6	22.3	25.1	24.3
400	11	402.3	405.8	324.8	37.5	41.8	43.9
	17	402.3	405.8	351.3	24.9	27.9	30.4
450	11	452.3	456.1	365.4	42.1	46.8	55.3
	17	452.3	456.1	395.2	27.9	31.2	38.2
500	11	502.3	506.4	406	46.6	51.8	67.9
	17	502.3	506.4	439.0	30.9	34.5	46.9
560	11	562.3	566.8	454.9	52.0	57.7	84.7
	17	562.3	566.8	491.8	34.4	38.4	58.4
630	11	632.3	637.2	511.6	58.4	64.8	106.9
	17	632.3	637.2	553.2	38.6	43.0	73.6



* The size is the nominal core pipe outside diameter. Other diameters, SDRs and lengths can be made subject to a minimum order value.

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APPENDIX E

Well Commissioning Guidance



E

Good practice for decommissioning redundant boreholes and wells

October 2012

What's the purpose of this guidance?

Redundant boreholes and wells must be dealt with appropriately to make them safe and secure, and also to ensure they don't cause groundwater pollution or loss of water supplies. This guidance focuses on groundwater protection aspects but there are many other important factors owners and developers need to consider when designing and carrying out decommissioning works. These will be site specific, depending on the situation and intended afteruse. For example, boreholes near landfills or other sources of soil gas may require an opening to the air to prevent the build-up of noxious, explosive or flammable gas. Therefore, you should seek expert site-specific advice.

Legal framework

The Environment Agency (EA) has a duty to promote the sustainable use of water and to ensure it is protected from pollution. The Environmental Permitting (England and Wales) Regulations 2010 require the EA to take all necessary measures to prevent input of so called hazardous substances (for example pesticides) and limit the input of other non-hazardous pollutants (such as nitrate) into groundwater*, including for example contaminated run-off directly entering groundwater via an uncapped borehole.

**Groundwater is defined as water that is below the surface of the ground in the saturated zone and is in direct contact with the ground or subsoil.*

Why is it important to decommission properly?

Boreholes and wells are constructed for a variety of purposes including water supply, de-watering excavations, collecting geological information, investigating or sampling soils and groundwater and, increasingly, for ground source heating and cooling and geothermal (non-carbon) energy production. Many old water wells and boreholes are redundant as most properties are now connected to a mains water supply.

Improperly abandoned boreholes and wells can provide preferential pathways for groundwater or contaminant movement. This may result in the contamination of groundwater, the mixing of groundwaters of variable quality from different aquifers, or contribute to the loss of aquifer yield and water pressure (referred to as the potentiometric or piezometric head) as groundwater flows out of the system. This can threaten the availability and quality of groundwater resources for other users and potentially have an impacts on wetlands. Abandoned boreholes and wells can also present a physical hazard to people and property.

Artesian boreholes (where groundwater at depth in a 'confined aquifer' is at sufficient pressure to cause water to discharge either at the ground surface or into another overlying aquifer without any pumping) can be particularly problematic. They require special attention to prevent uncontrolled discharge of groundwater or cross-contamination of different aquifer units.

Therefore, site owners need to ensure that redundant boreholes and wells are made both safe and structurally stable, and also backfilled or sealed to prevent groundwater pollution and flow of water

between different aquifer units. This is particularly important where other potable groundwater supplies are at risk.

However, in certain circumstances they may be adapted for use as a groundwater monitoring facility. **You must not use wells or boreholes as soakaways for foul or surface water drainage** because they provide a direct discharge route into groundwater and, as such, pose a risk of groundwater pollution.
This is prohibited by the Environmental Permitting (England & Wales) Regulations 2010.

Firstly, what are the construction details?

When considering how best to backfill and seal a borehole or well, or whether it could be adapted for monitoring purposes – you should first obtain information on the geological strata encountered by the borehole and how it was constructed (including depth, diameter and casing details). These can usually be obtained from site records or the original driller's log; the British Geological Survey holds the national water well archive and other borehole databases.

Is the site suitable for groundwater monitoring?

There are many good reasons for collecting groundwater samples or measuring groundwater levels; the information can, for example, help to validate the success of any remedial works being undertaken on a contaminated land site. Therefore, before decommissioning a borehole you should consider whether you wish to retain it as a monitoring facility. If it is to fulfil part of a planning condition or other legal monitoring requirement you may wish to discuss the details of how you do this with the Environment Agency.

If not, it is still worth contacting us via our National Customer Contact Centre (NCCC) to check whether we would be interested in incorporating it into our strategic groundwater level or quality monitoring networks.

If the borehole is not going to be converted then it should be abandoned using the guidelines below and the British Geological Survey should be informed.

Decommissioning

Each situation is different in terms of its location, geological setting, borehole construction, dimensions, hazards and, very importantly, intended site afteruse. Therefore the most appropriate abandonment procedure will vary from site to site. It is strongly recommended that you engage the services of a proficient well contractor with a good knowledge of the local geology and well abandonment procedures. For large boreholes and wells you may need to seek engineering advice. (**Note that structural aspects are outside the scope of this guidance.**)

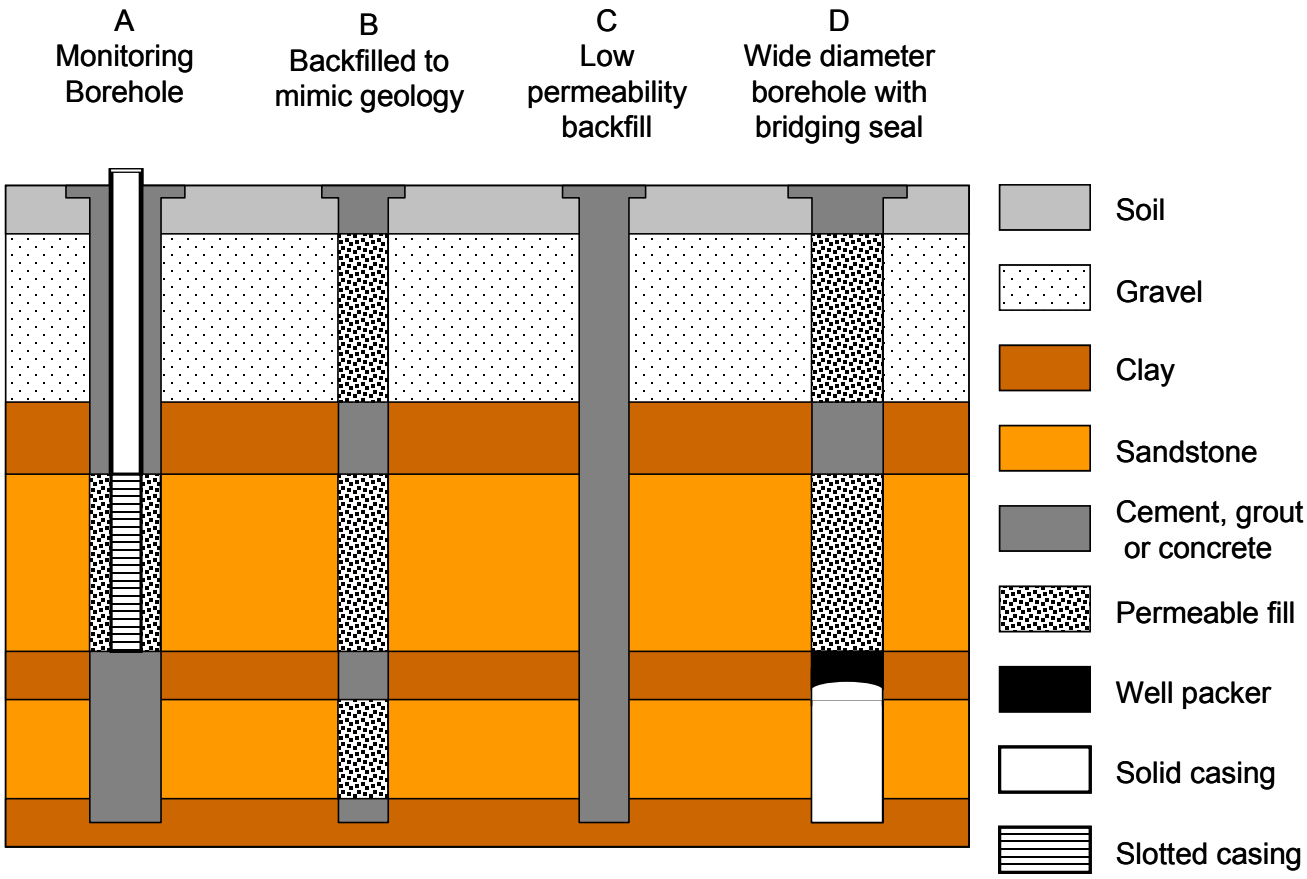


Figure 1: Schematic options (B–D) for decommissioning wells and boreholes

Step 1 - Defining the objectives

When planning the decommissioning works, in addition to any site specific afteruse considerations, the method should address the following objectives:

- Remove the hazard of an open hole (safety issues).
- Prevent the borehole acting as a conduit for contamination of groundwater.
- Prevent the mixing of contaminated and uncontaminated groundwater from different aquifers.
- Prevent the flow of groundwater from one geological horizon to another.
- Prevent the wastage of groundwater from the overflow of artesian boreholes.

Step 2 - Removing headworks and casing

It is crucial to ensure that the borehole or well is free from all obstructions that may interfere with the sealing of the hole. In particular, the pump and pipework should be removed, together with any other infrastructure (dip tubes etc).

The condition of any borehole casing and grout must be examined to ascertain whether its retention in the hole would prejudice any of the objectives of the abandonment. For many holes, examination of the casing from the ground surface will be adequate. However, deep boreholes may require the use of closed-circuit television (CCTV) to examine the casing at depth.

Where the casing has corroded or broken, or the grouting has failed, depending on the setting it may be necessary to remove those materials to prevent any flow of groundwater around the outside of the borehole. However, this is not without its own risks since removal of the well casing can result in collapse of the borehole walls (particularly in unconsolidated materials) and possible subsidence at ground level. If the well casing needs to be removed, a specialist well contractor can advise on appropriate techniques and associated risks.

Step 3 - Backfilling

General considerations

For most purposes the ground should be restored as closely as possible to its pre-drilled condition. The borehole or well should be backfilled with clean (washed), uncontaminated materials so that the permeability of the selected materials are similar to the properties of the geological strata against which they are placed. The backfilled borehole will then mimic the surrounding natural strata and groundwater flow and quality will be protected.

Restoration will require a variety of materials to be used so that permeable aggregates (for example pea gravel and sand) are positioned adjacent to aquifer horizons, whilst low permeability materials (usually clay, bentonite cement grout, or concrete) are positioned adjacent to low permeability horizons (see Fig. 1(B)). Alternatively, the entire borehole or well can be backfilled with low permeability

materials that will prevent significant vertical or horizontal movement of groundwater through or along the borehole (see Fig. 1(C)).

The backfill materials must be clean, inert and non-polluting. Suitable materials include pea gravel, sand, shingle, concrete, bentonite, cement grout and uncontaminated rock. There are also a range of recycled products, like crushed glass, on the market that are designed for use in boreholes

IMPORTANT - Never use backfill materials that can cause pollution.

You should also consider the geochemical environment into which these materials will be placed, as the behaviour of materials may change under different environmental conditions (for example, iron-rich sands may contaminate the aquifer; phenol contamination may prevent bentonite grouts curing).

Aggregates (pea gravel, shingle, sand etc) should be selected such that they have a grain size that allows easy delivery into the borehole and should be introduced in a controlled manner to ensure that accidental 'bridging' does not occur within the borehole. Concrete and grouts that are introduced in a liquid form should be introduced through an appropriate delivery pipe (e.g. tremie pipe), to ensure that voids do not form. **Note**: It is good practice to monitor the volume of backfill material that is being emplaced, compared to that calculated at the design stage, to check if bridging within the borehole, or loss to the formation is occurring.

Boreholes that penetrate highly fissured aquifers, such as some limestones and gypsum bearing units, present additional problems. Liquid grouts (particularly those injected under pressure), or fine-grained aggregates (e.g. sand) may be transported out of the borehole into the body of the aquifer through fissures. Careful monitoring of the process is required if these techniques are used, and in these cases it may be more appropriate to use coarser aggregates such as gravel as a backfill.

Deep and large diameter boreholes/wells

When dealing with very deep or large diameter boreholes and wells (note, this does not apply to mine shafts), the volume of the hole may be considerable. In such circumstances it may be appropriate to adopt an alternative approach to completely backfilling the void, as long as this will not prejudice any of the design objectives.

Provided that the long-term structural stability of the borehole can be demonstrated, it may be possible to place a permanent bridging seal within the borehole and then to infill above this level using the approach summarised above (see Fig. 1(D)). The bridging seal should ideally be positioned below the lowest aquifer horizon. However, where this is not possible, it is important that the open borehole beneath the bridging seal penetrates no more than a single aquifer unit, thereby preventing the flow of groundwater between different aquifers.

The material commonly used as a bridging seal is cement, although a combination of a mechanical plug (packer) and cement can be used. Cement seals must be allowed to set (cure) in place before backfilling is continued and completed.

Again, this is a specialist area of work that requires high standards of design and workmanship to ensure an effective permanent seal is achieved.

Artesian boreholes

For artesian boreholes, the decommissioning process should aim to confine the groundwater to the aquifer from which it came – in order to prevent loss of confining pressure and the loss of water resources to the surface or other formations.

The first step is to control the artesian flow. There are a number of ways to accomplish this depending, in part, on the water pressure in the confined aquifer and the depth to which the water level must be lowered. These include:

- Pumping the borehole to produce the necessary drawdown.
- Pumping nearby boreholes.
- Extending the casing above ground level beyond the elevation to which water will rise in the borehole. (the potentiometric or piezometric surface).
- Introducing dense, non-polluting fluids into the borehole.
- Introducing a pre-cast plug at an appropriate level within the hole.
- Using an inflatable packer and pressure grouting the void space below it.

In aquifers that have large seasonal fluctuations in water level, decommissioning artesian boreholes is likely to be easiest in late summer, when groundwater levels and artesian flows are at their lowest.

The importance of the potential pathways in and around the casing should also be considered.

Decommissioning artesian boreholes is a specialist job and requires expert advice.

Step 4 - Sealing the top of the borehole

The backfilled borehole/well should be completed with an impermeable plug and cap to prevent entry of potentially contaminated surface run-off or other liquids. The top two metres should be filled with cement, concrete or bentonite grout. A concrete cap of suitable strength, with a diameter at least one metre greater than the width of the backfilled borehole (see Fig. 2), should then be installed. The exact finished depth of this cap will depend on the setting and planned afteruse of the site. It should be at least 2 metres below plough depth in agricultural areas and at least 1 metre below formation level for sites proposed for redevelopment. Never build structures directly onto well caps or linings.

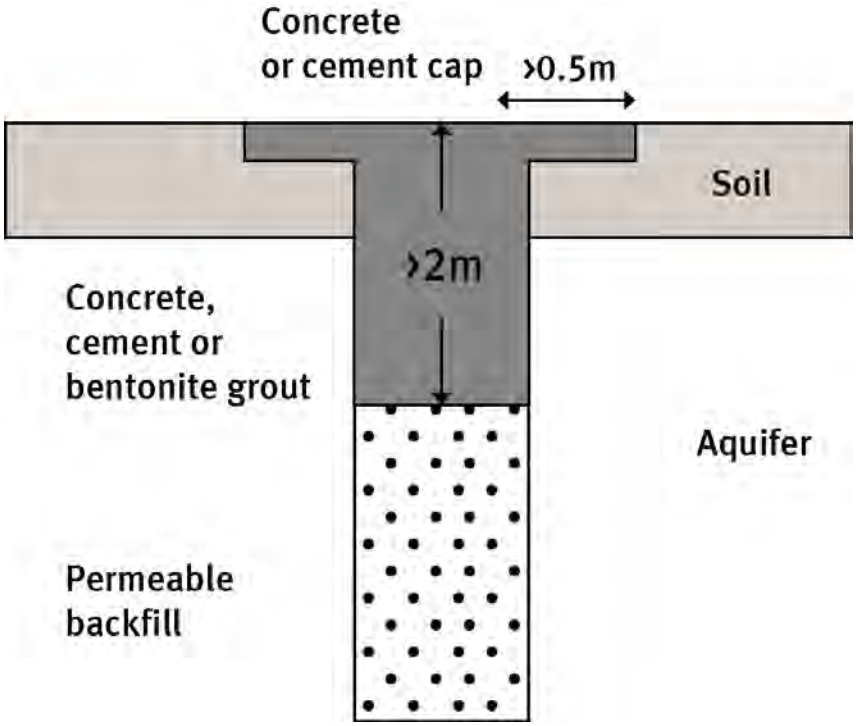


Figure 2: Schematic diagram for borehole seal and cap

Step 5 - Recording details and informing others

You should keep an accurate record of the abandonment details for future reference, including:

- The reasons for abandonment (for example water quality problems).
- Measurement of groundwater level prior to backfilling.
- The depth and position of each layer of backfilling and sealing materials.
- The type and quantity of backfilling and sealing materials used.
- Any changes made to the borehole/well during the abandonment (for example casing removal).
- Any problems encountered during the abandonment procedure.

The location of abandoned borehole and wells should be clearly marked on site records This is essential where any part of the well has not been filled.

It is also very good practice to mark or deeply inscribe well caps with the word "WELL". Even if done crudely it can avoid considerable risk, delay or uncertainty in the event of the structure being discovered during excavation by others in the future, who may not otherwise know what the feature is.

Always notify the Environment Agency and British Geological Survey of the abandoned well location and structure.

Conversion to soakaways

Wells and boreholes should not be converted to soakaways, as these allow the direct discharge of pollutants into groundwater without any potential for attenuation, and will often result in groundwater pollution. The direct discharge of hazardous substances to groundwater, via a borehole, is effectively prohibited by the Environmental Permitting (England & Wales) Regulations 2010, and the pollution risk from any direct discharge of non-hazardous pollutants, such as sewage effluent, is so great as to make it highly unlikely to be acceptable.

Further advice and guidance

It is recommended that the advice of a specialist well contractor should always be sought, Details can be obtained from:

- **The British Drilling Association**. Wayside, London End, Upper Boddington, Daventry, Northamptonshire, NN11 6DP. Tel: 01327 264 622, email: office@britishdrillingassociation.co.uk

The Environment Agency cannot provide an advisory service on decommissioning individual boreholes and wells but your local Groundwater & Contaminated Land team may have some generic advice to help you; and would appreciate a copy of your abandonment details. They can be contacted via our National Customer Contact Centre (NCCC)

- **Environment Agency NCCC** Tel: 03708 506 506

The British Geological Survey are the national custodian of water well records in addition to other borehole records and geological information. They may have a record of the borehole or well you are dealing with, and will be interested in the abandonment details

- **British Geological Survey. National Geosciences Data Centre (NGDC)**, Keyworth, Nottingham, NG12 5GG. Tel: 0115 936 3143.

Useful references

- Environment Agency GP3 (Groundwater Protection Principles and Practice) http://www.environment-agency.gov.uk/research/library/publications/40741.aspx
- American Society for Test and Materials (ASTM) D5299 - 99(2005) Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities
- Driscoll, F.G., 1986. Groundwater and Wells. Second Edition, Johnson Division.

Note: *This guidance supersedes the document ' Good practice for decommissioning redundant boreholes and wells' produced by our former National Groundwater and Contaminated Land Centre*

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