



**BROWNFIELD  
SOLUTIONS LTD**

GEO-ENVIRONMENTAL ENGINEERING EXCELLENCE

## DOMIS CONSTRUCTION LTD

BRWRY, Manchester

Site Investigation Proposal

NHA/C5313/11937

March 2023

## PROJECT QUALITY CONTROL DATA SHEET

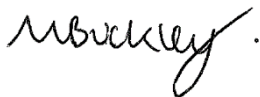
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## DRAWINGS

| Drawing Number              | Rev | Title                                   |
|-----------------------------|-----|-----------------------------------------|
| A2943 200                   | R16 | Dutton Street Floor Plan                |
| BRW-REN-ZZ-00-DR-S-01-01100 | P01 | Site Wide Ground Floor Plan             |
| C5313/01                    | -   | Site Location Plan                      |
| C5313/02                    | -   | Proposed Exploratory Hole Location Plan |

## APPENDICES

| Appendix   | Title                        |
|------------|------------------------------|
| Appendix A | BSL Methodology and Guidance |

## 1.0 INTRODUCTION

### 1.1 Context

This report describes a scoping exercise for a Site Investigation proposal carried out by Brownfield Solutions Limited (BSL) for Domis Construction Limited, for the proposed redevelopment of the car park located off Dutton Street, Manchester, M3 1LD and details the requirements from a land quality perspective to satisfy the relevant planning conditions. The site investigation and subsequent report to be undertaken will be in general accordance with the following guidance:

- Environment Agency guidance - Land Contamination: Risk Management (LCRM).
- BS 10175:2011+A2:2017 Investigation of Potentially Contaminated Sites.
- BS5930: 2015+A1:2020 Code of Practice for Ground Investigations.
- BS EN 1997-1:2004+A1:2013 Eurocode 7. Geotechnical design. General rules plus UK National Annex.
- BS EN 1997-2:2007 Eurocode 7 Geotechnical design. Ground investigation and testing plus UK National Annex.

By following the above guidance, it will ensure that any significant contaminated land related issues are picked up through this report, any proposed future site investigations and the development. Any proposed future site investigation will be undertaken through obtaining good coverage and adequate grid spacing as outlined within the above guidance and any significant sources of contamination identified through the Desk Study Assessment report will be targeted for investigation.

### 1.2 Proposed Development

This Site Investigation Proposal report has been prepared pursuant to Condition 7a of planning permission ref. 118831/FO/2018, granted by Manchester City Council on 19<sup>th</sup> January 2018 at Former Boddingtons Brewery Site, Dutton Street, Manchester, M3 1LE (the Site). Permission was granted for the Erection of two buildings (a part 17, part 12 storey building and a part 26, part 23 storey building) to form 556 residential units (Use Class C3a) together with the creation of 3490 sqm of commercial floor space (Use Classes A1, A2, A3, B1 and D1) with associated landscaping, access and other associated works, as shown on drawing refs. A2943 200 and BRW-REN-ZZ-00-DR-S-01100-P01 provided to BSL by the client. This report has been prepared and submitted on behalf of Domis Construction Limited, the developers.

Condition 7a relating to the Site Investigation Proposal details the following:

*“Notwithstanding the phase 1 desk based ground conditions report prepared by Wardell Armstrong stamped as received by the City Council, as Local Planning Authority, on the 19 January 2018, (a) before each relevant phase of development as detailed in Condition 2 hereby approved commences, the following information shall be submitted for approval in writing by the City Council, as Local Planning Authority:*

- *Submission of detailed site investigation proposals;*
- *Submission of details of liaison with a UXO specialist to complete a detailed threat assessment of the risk of UXO prior to any intrusive site investigation works and site development;*
- *Submission of an updated site investigation and risk assessment report;*
- *Asbestos management report;*
- *Submission of a remediation strategy.*

*The development of that phase shall then be carried out in accordance with the approved details.”*

### 1.3 Limitations

This assessment has been prepared in accordance with the relevant current legislative framework, guidance and risk assessment methodology as outlined in Appendix A. BSL is not liable for any subsequent changes in the guidance and legislation.

This assessment has been based on the proposed planning layouts provided. Any subsequent change to the planning layout may have an impact on the validity of recommendations made within this report. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

The site plans enclosed in this report should not be scaled off. Any site boundary line depicted on plans does not imply legal ownership of land.

Any recommendations made in this report should be confirmed with the Regulatory Authorities prior to implementation to ensure compliance.

## 2.0 PREVIOUS REPORTING

### 2.1 Wardell Armstrong - Phase 1 Contaminated Land Assessment (11 January 2018)

Wardell Armstrong were instructed by Prosperity Capital Partners Ltd to undertake a Phase I Contaminated Land Assessment, to support a full planning application for commercial and residential development for the area (reference LO10517 R006.01, dated 11 January 2018). A summary of the relevant points from the report is presented below:

- The site has had a significant industrial past, including a brewery and print works, timber yard, iron works, at works, box works, eight chimneys, a carriage works, waterproof clothing factory, engineering works, cotton works, garage, cabinet makers, motor repair works and car parking. A number of tanks have been recorded within the site boundary historically.
- The site is indicated to be underlain by Devensian till Secondary Aquifer (Undifferentiated). The deeper solid geology is indicated to be the Chester Pebble Beds Formation (Principal Aquifer).
- An active groundwater abstraction license was recorded onsite (SJ89NW3264) operated by Interbrew UK Ltd for drinking, cooking, sanitary and washing purposes as well as brewery processes.
- The site does not lie within a Source Protection Zone.
- The nearest watercourse is the River Irk circa 171m east of the site.
- The risk from mining is considered to be low.
- The site is located in a Zone 1 floodplain. A small area across the western portion of the site is within a Zone 2 floodplain.
- The development end use risk is low (commercial) to medium (high-rise residential).
- The overall risk to human health is considered to be low to moderate, with a moderate to high risk from asbestos.
- The risk to controlled waters is low to moderate.
- The risk from ground gas is moderate/low and no radon protection measures are required.
- Recommendations included:
  - Drilling and testing of soil, groundwater and ground gas to target potential sources of contamination within the outside of the current buildings;
  - A quantitative risk assessment to determine if significant contamination is present; and
  - If significant contamination is identified, calculation of site specific remedial targets, liaison with the regulators and remediation.
  - Testing of potential fly tipped asbestos containing material.
  - Confirmation as to whether the abstraction boreholes onsite were effectively decommissioned.
- Assessment and recommendations based on the above, including requirements for further work, if necessary.

### 2.2 Geotechnical & Environmental Associates (GEA) – Desk Study and Ground Investigation Report (June 2019)

A summary of the relevant points from GEA Desk Study and Ground Investigation Report (ref. J18242, dated June 2019) is presented below:

#### *Desk Study*

- Historical mapping from 1787 and 1794 suggests the potential presence of a spring in the middle of the site which flowed towards a brewery directly to the south of the site.
- A smithy was recorded onsite. Mapping from 1850 shows lakes and a canal to the north of the site have been infilled and built upon. Two large reservoirs are present in the middle of the site.
- The Ardwick Fault is shown to lie parallel to Dutton Street roughly along the western edge of the site with its downthrow being east of the fault.
- The main sources of contamination recorded are from infilling of the onsite reservoirs, warehousing and industrial usage including the carriage works, garage, engineering works, smithy and iron works. The

number of chimneys indicate a high possibility of ash and clinker, along with oil and fuel contamination and asbestos. The brewery is unlikely to have been a source of significant contamination given the construction of the substantial floor slabs across its entirety. The infilled reservoirs present a possible risk from ground gas. The offsite infilled lake and canal which took place >150 years ago is likely to have a negligible ground gas generation potential.

- A moderate risk associated with contamination at the site is considered to exist.

#### *Site Investigation*

- The following site investigation was undertaken at the site:
  - 7No. cable percussive boreholes advanced to a maximum depth of 23.7m bgl;
  - 1No. rotary open borehole advanced to a maximum depth of 5.0m bgl;
  - 7No. rotary core boreholes follow on to a maximum depth of 30.0m bgl;
  - 2No. boreholes advanced using a combination of rotary open-holing and coring methods;
  - 6No. combined gas and groundwater monitoring standpipes, to depths of between 2.00m and 4.00m bgl, and four subsequent monitoring visits over a four-month period;
  - 9No. mechanically excavated trial pits advanced to a maximum depth of 2.80m bgl;
  - 2No. manually excavated trial pits to a maximum depth of 1.00m bgl;
- Obstructions were encountered within BH2 and BH7 due to high density rebar. BH7 was attempted four times, but was hampered by the rebar, the fourth location identified what appeared to be an uncharted culvert discharging foul water. TP1, TP4, and TP8 in the area all revealed concrete boulders with high density reinforcement. TP8 was abandoned at 0.70m due to a concrete slab which could not be progressed through with a breaker.
- The site is split into three levels, Area A being the highest in the east, to Area C which is the lowest in the west. In Area A made ground was recorded to between 1.00m and 1.80m in thickness in the south, and 2.60m and 3.30m in thickness in the north. BH08 in the west of the area recorded made ground up to 8.00m bgl. Hydrocarbon staining was recorded in BH4 at 0.50m bgl within an ashy layer of made ground.
- Area B recorded made ground down to between 1.70m and 4.45m bgl based on borehole data and presented a clear ash and brick fill layer with hydrocarbon staining within TP6 between 0.40m and 0.50m which was similar to that encountered within BH4 at 0.50m bgl.
- Area C recorded made ground to a maximum depth of 1.70m, dense made ground / reinforced concrete obstructions limited much progress within the central portion of the area. A potential culvert is present in this area.
- Below the made ground Glacial deposits comprising interbedded sands/gravels and clay but general conditions encountered between 11.20m and 24.00m comprising gravelly sandy clay with gravel / sand encountered to depths between 11.60m and 15.50m bgl.
- Depth to bedrock was variable across the site. In Area A between 11.20m and 26.80m bgl, in Area B at 8.30m bgl and in Area C at 5.60m bgl. Sandstone was proven to a maximum depth of 30m bgl, with between 3m and 7m of core obtained from each hole – an average of ~4.5m per borehole.
- Groundwater monitoring suggests groundwater between 1.52m and 10.31m bgl. Groundwater flow generally towards the southwest from between 30m AOD and 32m AOD in Area A down to 25.24m AOD in Area C and towards the River Irwell.
- Soils recorded elevated concentrations of arsenic (<220mg/kg), lead (<1400mg/kg), TPH (<3500mg/kg), naphthalene (<6.5mg/kg), and benzo(a)pyrene (<3.3mg/kg). Asbestos was recorded in TP8 and TP10 at 1.00m bgl, and BH6 and BH7 at 0.50m and 0.80m, respectively. Concentrations varied between <0.001% and 0.021%.
- 5No. gas monitoring rounds revealed methane between 3.8% and 4.1% in BH3. A maximum carbon dioxide concentration of 1.6% was recorded and a maximum positive flow rate of 0.5l/hr.

### 3.0 PROPOSED PHASE II GROUND INVESTIGATION

#### 3.1 Context and Objectives

The objectives of the proposed site investigation and subsequent Geo-Environmental Assessment Report are to determine the site's geo-environmental setting and ground conditions, highlighting potential risks and areas of concern that may govern the development under the current planning regime. This assessment is also intended to fulfil the requirements of a Ground Investigation Report (GIR) as detailed in BS EN 1997-2:2007.

Following the Phase I Contaminated Land Assessment by Wardell Armstrong and the Desk Study and Ground Investigation Report by GEA referenced above, a detailed intrusive investigation is proposed to confirm the preliminary CSM and risk assessment findings and meet any objectives that had not been satisfied. The main investigation will be undertaken using window sampling, cable percussive boreholes, rotary coring, trial pitting, gas and groundwater monitoring, laboratory chemical and geotechnical testing, with reporting on the findings.

The Phase II Ground Investigation and Geo-Environmental Assessment Report will be undertaken pursuant to Condition 7a detailed in Section 1.2 above.

#### 3.2 Coverage and Method of Site Investigation

The proposed exploratory hole positions are shown on the appended Proposed Exploratory Hole Location Plan (ref. C5313\_02). Indicative locations from this historic site investigation by GEA are also presented for reference.

Due to the nature of the development, the following scope of site investigation is proposed:

- 
- Provision of Health and Safety documentation in accordance with CDM 2015 regulations.
  - Provision of welfare facilities.
  - Service/utility clearance survey utilising EM and GPR techniques.
  - UXO Engineer supervision.
  - One day of concrete coring for Area C.
  - One days of trial pitting with a 22 ton tracked machine to undertaken 2No. slip trenches and 2No. well excavations up to 5.00m bgl:
  - One day of trial pitting with a JCB 3CX to undertake 1No. well excavations to 4.00m bgl and up to 5No. trial pits.
  - 9 No. cable percussive boreholes to bedrock, recorded to be between 6.70m bgl and 23.70m bgl with in-situ testing.
  - 9 No. p size rotary coring with liner (water flush/air mist flush) to follow on from cable percussive boreholes to obtain between 10m and 15m of competent core. The holes might require deepening if core recovery is poor.
  - 7 No. installations to allow for future monitoring (3No. shallow installations, 4No. deep installations within the rotary boreholes).
  - One day of windowless sampling to drill approximately 6 No. holes to 5.00m bgl with in-situ testing.
  - PID monitoring during the site investigation
  - Chemical and geotechnical laboratory testing on soils.
  - Chemical laboratory testing on groundwater.
  - Ground gas and groundwater level monitoring (3 No. visits over 3 No. months).
- 

The above scope of works describes a detailed investigation in accordance with BS 10175 with a grid spacing of 1 exploratory hole location every 17.7m, when combined with the exploratory holes from the GEA report in 2019 presents a grid spacing of 1 exploratory hole location every 13.6m.

| Method                                               | No. | Range Depths<br>(m bgl)      | Hole ID                        | Purpose                                                                                                                                                                                                                                               |
|------------------------------------------------------|-----|------------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Window sample boreholes – Tracked WS rig             | 6   | Up to 5.45m                  | WS101 – WS106                  | Establish general ground conditions on site and provide coverage.<br>Allow Standard Penetration Tests (SPTs) to be carried out. Obtain samples for contamination and geotechnical and testing. Installation of ground gas and water monitoring wells. |
| Trial pitting – JCB 3CX / 21 Tonne Tracked Excavator | 10  | Up to 5.00m                  | TP101 – TP106<br>TT101 – TT105 | Establish general ground conditions and gain good coverage.<br>Undertake 2 slip trenches to locate relic features / culvert. Undertake 3 well excavations.<br>Undertake ~6 trial pits.                                                                |
| Cable percussive boreholes                           | 9   | To bedrock (~6m to 24m bgl)  | BH101 – BH109                  | Assess deeper ground conditions.<br>Allow Standard Penetration Tests (SPTs) to be carried out. Obtain samples for contamination and geotechnical and testing. Installation of ground gas and water monitoring wells.                                  |
| Rotary core hole – Comachio GEO 205                  | 9   | 10.00-15.00m through bedrock | BH101 – BH109                  | P sized rotary core follow on from cable percussive boreholes to obtain rock core for geotechnical testing and parameters for foundation design.                                                                                                      |

Minimally invasive techniques are proposed due to the active nature of the site to minimise damage to hardstanding and to avoid surcharging any of the retaining walls onsite. Where obstructions are encountered exploratory holes will be relocated, time pursuant.

### 3.3 Supervision

The site works would be carried out under the full-time supervision of a qualified and experienced geo-environmental engineer who will set out the locations, obtain samples and log the holes in accordance with BS 5930, BS EN 14688 and BS EN 14689.

### 3.4 Testing

During the drilling and excavation of the exploratory holes, representative samples will be taken at regular intervals to assist in the identification of the soils and to allow subsequent laboratory testing. They will be stored and transported in general accordance with BS 10175:2011+A2:2017. As part of the initial assessment for potential contamination of the site, selected samples will be taken for the purpose of chemical contamination testing.

The potential contaminative sources on site were noted to be associated with made ground and historical development, including a timber yard, brewery, motor and iron works. Therefore the following suite of determinands have been chosen to be screened for potential site impacts at a UKAS approved laboratory.

#### *Chemical Analysis (Contamination):*

| Determinands                                                                                                                                                                                                                                | No of Samples |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| BSL Default Soil Suite: Arsenic, Cadmium, Chromium (III), Chromium (VI), Copper, Nickel, Mercury, Lead, Zinc, Selenium, speciated polycyclic hydrocarbons (PAH 16), water soluble sulphate (2:1 Extract), soil organic matter (SOM) and pH. | 14            |
| Petroleum Hydrocarbons (TPH CWG) inc BTEX and MTBE.                                                                                                                                                                                         | 10            |
| Asbestos Screen & ID                                                                                                                                                                                                                        | 14            |
| Volatile Organic Compounds (VOCs) by GC-MS (ex TIC).                                                                                                                                                                                        | 2             |
| Semi Volatile Organic compounds (SVOCs) by GC-MS (exTIC).                                                                                                                                                                                   | 2             |

| Determinands                     | No of Samples |
|----------------------------------|---------------|
| Waste Acceptance Criteria (WAC). | 3             |

#### *Geotechnical Analysis:*

| Determinands                              | No of Samples |
|-------------------------------------------|---------------|
| Quick Undrained Triaxial                  | 4             |
| One-dimensional compression test          | 4             |
| pH & Water Soluble Sulphate (2:1 Extract) | 14            |
| SD1 BRE Full Suite                        | 6             |
| Point Load                                | 33            |
| Unconfined Compressive Strength           | 21            |

The type of testing scheduled may change depending on our findings of the site work, for example, additional sampling, testing and detailed risk assessment will be needed should significant contamination be identified, or should asbestos be identified in soils then additional quantification testing will be required. The requirements will be constantly reviewed.

Further soil sampling will be carried out across the site to enable further testing if deemed necessary.

Should any exceedances of the above contaminants be identified against a residential without plant uptake screening criteria, these will be adequately remediated as outlined within a subsequent Remediation Strategy that will be submitted pursuant to Condition 7a.

In situ geotechnical testing will comprise Standard Penetration Tests (SPTs) to assist with preliminary foundation design.

#### *Groundwater Analysis (Contamination):*

Groundwater sampling has been undertaken at the site historically which concluded that any elevations above the limit of detection were due to the sampling methodology and not representative of the groundwater body, with the exception of BH11 where marginal exceedances of PAHs were recorded. The laboratory certificates present data for BH02 rather than BH11, however, given that BH02 terminated at shallow depth, has no installation and is located adjacent to BH11, we have assumed that this is an error in the sample labelling. No groundwater was encountered as part of the final visit with the exception of BH11, which suggests that a substantial, continuous groundwater body is not present underlying the site.

Should we encounter ground conditions which vary from that encountered in the previous site investigation additional groundwater sampling and analysis will be undertaken. However, at this stage, given the ground conditions present, the level/presence of groundwater and the proposed development comprising building footprint and hardstanding in the vast majority, there is not considered to be a viable source-pathway-receptor linkage.

### 3.5 Monitoring

A potential on-site gas source has been identified associated with the made ground associated with previous developments, as well as historical infilled reservoirs/lakes onsite. Previous site investigation revealed elevated methane within BH03 which requires further assessment to determine the requirement for gas protection measures at the site.

Ground gas and groundwater monitoring standpipes will be installed in seven boreholes, five shallow installs and four deep installs. The standpipes will be constructed in general accordance with the relevant guidance.

Monitoring will also be undertaken of the five installs which are present within the site boundary from the GEA report to support the assessment. Subsequently 3 No. spot monitoring visits will be carried out, along with the installation of 3 No. continuous monitoring GasClam™ devices over a three week period, recording ground gas concentrations at hourly intervals to provide a high resolution data set, following guidance within CL:AIRE TB18. The spot monitoring will be undertaken using a Gas Data GFM436/GA5000 infrared gas meter or with integral electronic flow analyser and an Ion Science Tiger Photo Ionisation Detector (PID).

Measurements of the percentage volume in air (%v/v) of oxygen (O<sub>2</sub>), carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) will be recorded via continuous and spot monitoring in addition to the percentage Lower Explosive Limit (%LEL) of methane (Note: 100% LEL equates to 5% by volume), the atmospheric pressure (mb) and average temperature during the visit (°C). Total volatile organic compounds (TVOCs) will be measured with a Photo Ionisation Detector (PID).

The spot monitoring visits will record peak and steady state conditions prior to deployment and on collection of the GasClam devices. Peak results are those that occur on opening the valve on the borehole tap. Steady state conditions are those that occur a period of -time afterwards when the initial (accumulated) gases have been purged from the borehole.

### 3.6 Reporting

On receipt of all the information, the report will be compiled and would include the factual information obtained during the site investigation, and interpretative reporting including qualitative risk assessment, outline remedial strategy, preliminary foundation, floor slab, drainage and highway recommendations. We will also make recommendations for further work if deemed necessary.

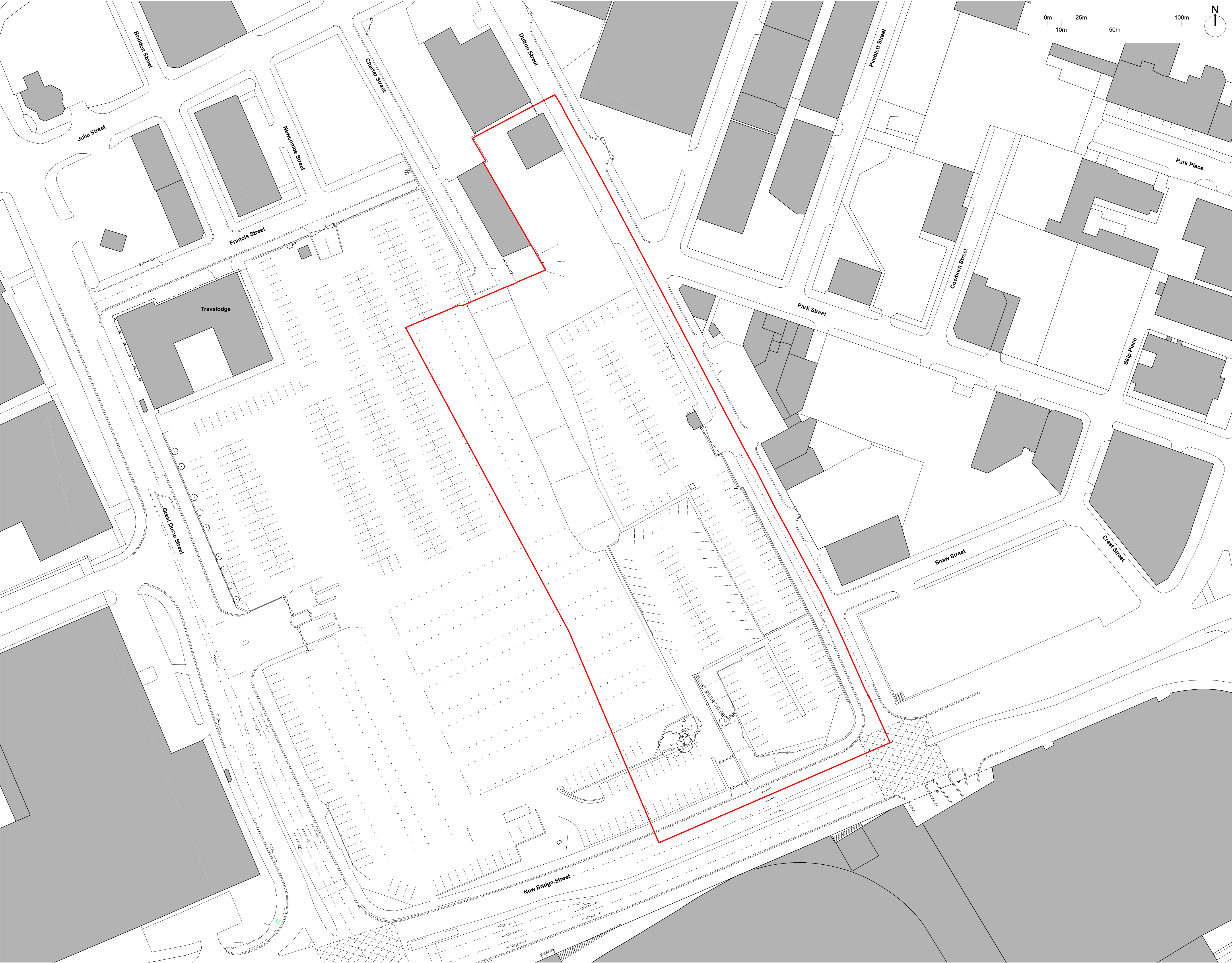
### 3.7 Services

All survey work will conform to the high-level 4 TSA survey approach matrix standard. The utility survey unit will apply electromagnetic, real-time ground probing radar and sonde location techniques to establish the position of all suspected and the majority of buried main external services that exist.

### 3.8 GPR Survey / Abstraction Well Location

During the site investigation, a GPR survey will be undertaken to locate or disprove the presence of suspected historical culverts encountered during the initial site investigation works. To support this, slip trenches will be carried out to confirm the findings. Furthermore, the GPR survey will be undertaken alongside excavations to determine the locations of historic abstraction wells on site associated with the historical Brewery.

## DRAWINGS



General notes

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All levels must be checked on site and refer to Ordnance Datum Newlyn unless alternative Datum given  
All fixings and weathers must be checked on site  
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Drawing notes

Electronic file reference

A2943 100 Site Wide Information

| Status | R:             | Revision | Date | DRN | CHK | CDM |
|--------|----------------|----------|------|-----|-----|-----|
| 1      | Planning Issue | 18/12/17 | AJS  | -   |     |     |

Purpose of information

The purpose of the information on this drawing is for:

|                 |                                     |
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| Planning        | <input checked="" type="checkbox"/> |
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| Comment         | <input type="checkbox"/>            |
| Client approval | <input type="checkbox"/>            |
| Construction    | <input type="checkbox"/>            |

All information on this drawing is not for construction unless it is marked for construction.

Planning application red line

Client

**Prosperity UX Manchester Developments Ltd.**

Project title

**Old Brewery Gardens**

Drawing title

**Red Line Boundary Plan**

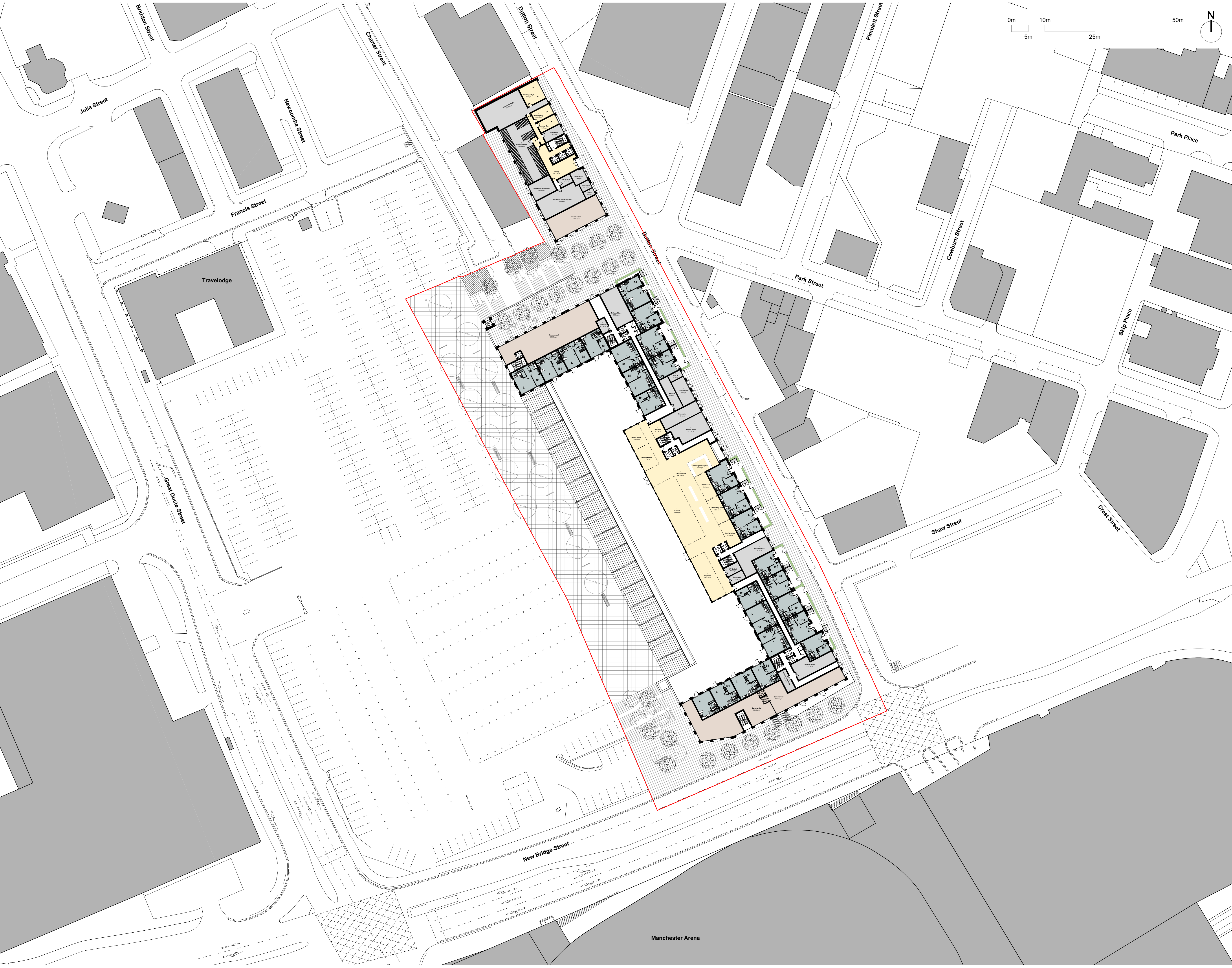
|                  |                      |
|------------------|----------------------|
| Scale @ A1 size  | Date                 |
| <b>1:500</b>     | <b>December 2017</b> |
| Drawing N°       | Status & Revision    |
| <b>A2943 100</b> | <b>R1</b>            |

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Drawing notes

|                           |                |          |     |     |     |
|---------------------------|----------------|----------|-----|-----|-----|
| Electronic file reference |                |          |     |     |     |
| A2943 200 Series Plans    |                |          |     |     |     |
| Status R:                 | Revision       | Date     | DRN | CHK | CDM |
| 16                        | Planning Issue | 06/01/18 | AJS | -   | -   |

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Construction ☐

All information on this drawing is not for construction unless it is marked for construction.

|     |                     |
|-----|---------------------|
| Key |                     |
|     | 1 Bed               |
|     | 2 Bed               |
|     | 3 Bed               |
|     | Residential Amenity |
|     | Commercial          |
|     | Ancillary / Plant   |

Client

**Prosperity UX Manchester Developments Ltd.**

Project title

**Old Brewery Gardens**

Drawing title

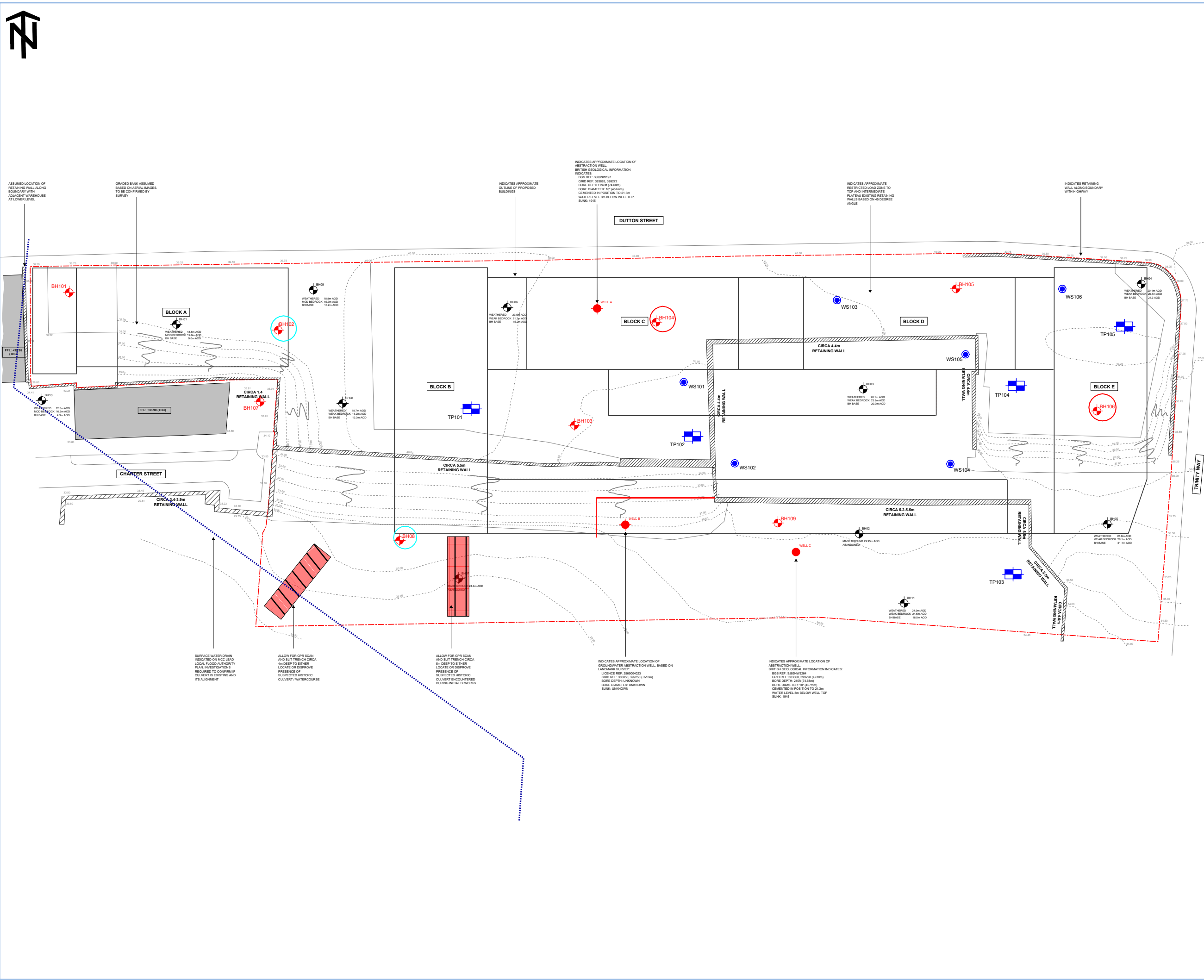
**Dutton Street Floor Plan  
40m Datum**

|                  |                   |
|------------------|-------------------|
| Scale @ A1 size  | Date              |
| <b>1:500</b>     | <b>April 2017</b> |
| Drawing N°       | Status & Revision |
| <b>A2943 200</b> | <b>R16</b>        |

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WSXXX WINDOW SAMPLE BOREHOLE

TPXXX TRIAL PIT

 BHXX INDICATES APPROXIMATE LOCATION OF BOREHOLES UNDERTAKEN IN 2018. REFER TO EXISTING SI REPORT J18242 BY GEA JUNE 2019

**BHXX** INDICATES ADDITIONAL BOREHOLE REQUIRED TO SUPPLEMENT EXISTING SI INFORMATION. NEW BOREHOLES TO BE TAKEN MIN 10m DEEP INTO COMPETANT ROCK

**WELL x**

INDICATES APPROXIMATE LOCATION OF GROUNDWATER ABSTRACTION WELL ASSOCIATED WITH HISTORIC BREWERY. LOCATIONS ACCURATE TO CIRCA 10m. ALLOW FOR GPR SCANNING AND TRENCHING TO LOCATE AND SURVEY WELL LOCATIONS WITHIN SI WORKS SCOPE PLUS OBTAINING ALL INFORMATION REQUIRED FOR ENVIRONMENT AGENCY SIGN OFF ON CAPPING STRATEGY

INDICATES SLIT TRENCHING WORKS TO LOCATE  
OR DISPROVE THE PRESENCE OF SUSPECTED  
HISTORIC CULVERTS ON SITE.

## DUAL WELL INSTALLATION

## SINGLE WELL INSTALLATION

## NOTES

1. ALL DIMENSIONS TO BE CHECKED ON SITE BEFORE COMMENCING WORKS. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ARCHITECT & ENGINEER FOR VERIFICATION. FIGURED DIMENSIONS ONLY ARE TO BE TAKEN FROM THIS DRAWING.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS REPORTS. THIS DRAWING IS COPYRIGHT OF BSL.
3. DRAWING NOT FOR CONSTRUCTION PURPOSES.

| REV | DATE | DESCRIPTION | BY | CKD |
|-----|------|-------------|----|-----|
|     |      |             |    |     |
|     |      |             |    |     |
|     |      |             |    |     |



**BROWNFIELD  
SOLUTIONS LTD**

CLIENT

DOMIS CONSTRUCTION LTD

PROJECT TITLE

## BRWRY, BODDINGTONS

DRAWING TITLE

## PROPOSED EXPLORATORY HOLE PLAN

|                                |                      |                         |                         |
|--------------------------------|----------------------|-------------------------|-------------------------|
| DRAWING No.<br><b>C5313/02</b> | REVISION<br><b>-</b> | SCALE<br><b>NTS</b>     | DATE<br><b>21/03/23</b> |
| DRAWN BY<br><b>JM</b>          |                      | CHECKED BY<br><b>NS</b> |                         |

## **APPENDIX A**

### **BSL Methodology and Guidance**

## **BSL Phase I & II Geo-Environmental Assessment Reports - Methodology and Guidance**

This Appendix provides information on the approaches, methods and guidance used by Brownfield Solutions Ltd in the preparation of this report.

The term 'geo-environmental' is used to describe aspects relating to ground-related environmental issues (such as potential soils and groundwater contamination). The term 'geotechnical' is used to describe aspects relating to the physical nature of the site (such as foundation requirements). It should be noted that this is an integrated investigation and these two main aspects are related, unless otherwise specified within the report.

Phase I reports are written in general accordance with the description of a Preliminary Investigation as defined in BS10175:2011+A2:2017 and are also produced in general accordance with the recommendations for a Tier 1 Preliminary Risk Assessment as described in LCRM guidance

The first stage of the investigation and assessment of a site is the Preliminary Investigation/Tier 1 Preliminary Risk Assessment, often referred to as a Phase 1 Desk Study, comprising a desk study and walk-over survey and collation of desk-based searches, which culminates in the Preliminary Risk Assessment and the development of a preliminary/initial Conceptual Site Model (CSM). From this are identified any potential geotechnical and geo-environmental hazards and the qualitative degree of risk associated with them.

From the geo-environmental perspective, the hazard Identification process uses professional judgement to evaluate all the hazards in terms of possible contaminant linkages (of source-pathway-receptor). Possible contaminant linkages are potentially unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and generic risk assessment as part of Phase II investigations and reports.

The second stage is the Ground Investigation, Generic Risk Assessment and Geotechnical Interpretation. This represents the further assessment mentioned above. The Ground Investigation comprises field work and laboratory testing based on the findings of the Preliminary Risk Assessment, to reduce uncertainty in the geotechnical and geo-environmental hazard identification. This may include an exploratory, a detailed or/and supplementary Investigations as described in BS 10175:2011+A2:2017. Phase II Assessments are produced in general accordance with the recommendations for a Tier 2 Generic Quantitative Risk Assessment as described in LCRM guidance and are also intended to fulfil the requirements of a Ground Investigation Report (GIR) as detailed in BS EN 1997-2:2007.

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## Contaminated Land - Legislative Background

Land contamination can be addressed in several ways, e.g. during planning, under Part 2A, following an incident, during an investigation into environmental damages, or during the application of an environmental permit, or its surrender.

For the planning process the key test is **as a minimum the site cannot be determined as contaminated land**, e.g. there is not significant harm, significant possibility of significant harm to human health or that there is not significant harm to, or the significant possibility that the pollution of controlled waters will occur.

Environmental liabilities and risks have been evaluated in terms of a source -pathway - target relationship in accordance with the approach set out in:

- The 1995 Environment Act.
- The Contaminated Land Statutory Guidance, DEFRA – April 2012.
- The Contaminated Land (England) Regulations 2006.
- The Contaminated Land (England) Amendment Regulations 2012.
- Water Resources Act.
- Water Framework Directive.
- Environmental Damage Regulations.
- Environment Agency (EA) - Land Contamination Risk Management (LCRM) 2019.

Contaminated land is defined within the legislative framework as land which is in such condition by reason of substances in, on or under the land that:

- 1) Significant harm is being caused or there is a significant possibility of such harm being caused.
- 2) Significant pollution of controlled waters is being or is likely to be caused.

The potential for harm is based on the presence of three factors:

**Source** - substances that are potential contaminants or pollutants that may cause harm.

**Pathway** - a potential route by which contaminants can move from the source to the receptor, and the impact of that migration on the source e.g. ;attenuation.

**Receptor** - a receptor that may be harmed, for example the water environment, humans and water, considering the sensitivity of the receptor

Where a source, pathway and target are all present a pollutant linkage exists and there is potential for harm to be caused. The presence of a source does not automatically imply that a contamination problem exists, since contamination must be defined in terms of pollutant linkages and unacceptable risk of harm. The nature and importance of both pathways and receptors are site specific and will vary according to the intended end use of the site, its characteristics and its surroundings.

The key principle which supports the S-P-R approach is 'suitable for use' criteria. This requires remedial action only where contamination is considered to pose unacceptable actual or potential risks to health or the environment and, taking into account the proposed use of the site.

### *Relevant Guidance Documents*

This report has been prepared in accordance with the list of guidance below, however the list is not exhaustive:

- DETR: Circular 02/2000: Environmental Protection Act 1990: Part IIA: Contaminated land. 2012.
  - Environment Agency technical advice to third parties on Pollution of Controlled Waters for Part IIA of the EPA1990, May 2002.
  - BS 10175:2011+A2:2017.
  - Environment Agency (EA) - Land Contamination Risk Management (LCRM). 2019.
-

- Groundwater Protection - <https://www.gov.uk/government/collections/groundwater-protection>.
- UK Technical Advisory Group (UKTAG) - - Water Framework Directive
- Incidents and their classification: the Common Incident Classification Scheme (CICS) – Used by the Environment Agency to classify pollution incidents.

#### *Relevant Legislative Documents*

The following is a non-exhaustive list of legislative framework documents that has been considered in the production of this report:

- The Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (2012).
- The Environment Protection Act (1990).
- The Water Resources Act (1991).
- The Environment Act (1995).
- The Contaminated Land (England) Act (2000).
- The Pollution Prevention and Control (England and Wales) Regulations (2000).
- The Landfill Regulations (England and Wales) Regulations (2002).
- The Landfill (England and Wales) (Amendment) Regulations (2004).
- Contaminated Land (England) Regulations (2012).
- The Environmental Damage (Prevention and Remediation) Regulations (2009).
- Environmental Permitting Regulations (England and Wales) Regulations (2010).
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
- Health and Safety at Work Act.
- National Planning Policy Framework (NPPF)(2021).

#### **Contaminated Land Risk Assessment Approach**

Contaminated Land Risk Assessment is a technique that identifies and considers the associated risk, determines whether the risks are significant and whether action needs to be taken. The four main stages of risk assessment are:

Hazard Identification ➡ Hazard Assessment ➡ Risk Estimation ➡ Risk Evaluation.

LCRM outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. The starting point of the risk assessment is to identify the context of the problem and the objectives of the process. Under LCRM, three tiers of risk assessment exist – Stage/Tier Preliminary Risk Assessment, Stage 2 Generic Quantitative and Stage 3 Detailed Quantitative.

Further information can be found at the below site:

<https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

Formulating and developing a conceptual model for the site is an important requirement of risk assessment, this supports the identification and assessment of pollutant linkages. Development of the conceptual model forms the main part of preliminary risk assessment, and the model is subsequently refined or revised as more information and understanding is obtained through the risk assessment process.

Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, both the likelihood and the consequences of an event must be taken into account when assessing risk.

The risk assessment process needs to take into account the degree of confidence required in decisions. Identification of uncertainties is an essential step in risk assessment.

The likelihood of an event is classified on a four-point system using the following terms and definitions from CIRIA C552, with reference to Incidents and their classification: the Common Incident Classification Scheme

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(CICS), Environmental Protection Act 1990: Part 2A – Contaminated Land Statutory Guidance 2012 and other guidance as appropriate which will be detailed within the main body of the report if applied.

The likelihood of a given receptor being impacted is related to a number of factors, e.g. the geology which could inhibit contaminant migration. For example, a site with a significant thickness of clay between it and a receptor may reduce migration of contamination via the subsurface, which will reduce the likelihood of a given receptor being impacted. The geology or drainage for example could offer a preferential pathway e.g. mines shafts/faults increasing the likelihood and potential magnitude of an impact. The depth of contamination will also affect the exposure pathway, for example petroleum hydrocarbons at depth are unlikely to reach a receptor via dermal contact but could via vapour pathways which will influence the likelihood of an impact being felt e.g. if there are no buildings on site.

The terms and definitions used for the assessment of the likelihood are provided below:

**High likelihood:** There is a pollution linkage and an event appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.

*Examples - Extensive areas with concentrations above saturation limits for mobile contamination e.g. petroleum hydrocarbons within the water table.*

**Likely:** There is a pollution linkage and all the elements are present and in the right place, which means it is probable that an event will occur. Circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term.

*Examples – Localised areas of contaminants with concentrations above saturation limits for mobile contamination e.g. localised petroleum hydrocarbons within the water table; shallow contamination above relevant human health generic assessment criteria is present with little or no hardstanding,*

**Low likelihood:** There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain even over a longer period such event would take place, and is less likely in the short term.

*Examples - A thickness/distance of low permeability deposits preventing contaminant migration to a receptor is present; a site is mostly covered hard standing preventing exposure to soil contamination.*

**Unlikely:** There is a pollution linkage but circumstances are such that it is improbable the event would occur even in the long term.

*Examples – A site is underlain by a substantial thickness of low permeability clays, between the source and potential receptors which will inhibit significantly, but not completely rule out migration to sensitive receptors.*

The severity is also classified using a system based on CIRIA C552, with reference to Incidents and their classification: the Common Incident Classification Scheme (CICS), Environmental Protection Act 1990: Part 2A – Contaminated Land Statutory Guidance 2012 and other guidance as appropriate which will be detailed within the main body of the report, if applied. The terms and definitions are:

**Severe:** Short term (acute) risk to human health likely to result in ‘significant harm’ as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. A short-term risk to a particular ecosystem or organism forming part of that ecosystem (note definition of ecosystem in ‘Draft Circular on Contaminated Land’, DETR 2000);

*Examples – High concentrations of contaminant on surface of recreation area, major spillage of contaminants from site into controlled waters, explosion causing building to collapse.*

**Medium:** Chronic damage to human health (‘significant harm’ as defined in DETR 2000). Pollution of sensitive water resources. A significant change in a particular ecosystem or organism forming part of that ecosystem (note definition of ecosystem in ‘Draft Circular on Contaminated Land’, DETR 2000);

*Examples - Concentrations of contaminants exceed the generic assessment criteria, leaching of contaminants from a site to a Principal or Secondary Aquifer, death of species within a designated nature reserve.*

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**Mild:** Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000). Damage to sensitive buildings, structures, services or the environment.

*Examples – Pollution of non-classified groundwater or damage to buildings rendering it unsafe to occupy.*

**Minor:** harm, not necessarily significant harm, which may result in financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by use of personal protective clothing etc). Easily repairable effects of damage to buildings, structures and services.

*Examples – Presence of contaminants at such concentrations PPE is required during site work, loss of plants in landscaping scheme or discolouration of concrete.*

Once the likelihood and severity have been determined, a risk category can be assigned using the table below.

|             |                | Consequences |              |              |              |
|-------------|----------------|--------------|--------------|--------------|--------------|
|             |                | Severe       | Medium       | Mild         | Minor        |
| Probability | Highly likely  | Very high    | High         | Moderate     | Moderate/low |
|             | Likely         | High         | Moderate     | Moderate/low | Low          |
|             | Low likelihood | Moderate     | Moderate/low | Low          | Very low     |
|             | Unlikely       | Moderate/low | Low          | Very Low     | Very low     |
|             | No Linkage     | Negligible   |              |              |              |

Definitions of the risk categories obtained from the above table are as follows together with an assessment of the further work that might be required:

**Very high:** There is a high probability that severe harm could arise to a designated receptor from an identified hazard or there is evidence that severe harm is currently happening. This risk, if realised, could result in substantial liability. Urgent investigation and remediation are likely to be required.

**High:** Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation is required and remedial works may be necessary in the short term and are likely over the longer term.

**Moderate:** It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it would be more likely to be relatively mild. Investigation is normally required to clarify the risk and determine the liability. Some remedial works may be required in the longer term.

**Low:** It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.

**Very Low:** There is a low possibility that harm could arise to a receptor. In the event of such harm being realised, it is not likely to be severe.

Some linkages may be identified which constitutes a theoretical connection between a source and a receptor, but professional judgement shows them not to be possible for some reason. These are labelled 'no linkage' in the summary table, which give rise to a **negligible** risk category and no further action is required.

## Ground Gas Risk Assessment Guidance

BS8485:2015+A1:2019, BS 8576:2013, CIRIA C665 and CL:AIRE RB17 are the current guidance which gives up-to-date advice on all aspects of ground gas. They outline good practice in investigation, the collection of relevant data and monitoring programmes in a risk-based approach to ground gas contamination.

Within BS8485:2015+A1:2019, BS 8576:2013 and CIRIA C665, two semi-quantitative methods are set out for the assessment of risk:

- 1 For low rise housing with a ventilated under floor void at minimum 150 mm (Boyle and Witherington).
- 2 For all other development types (Wilson and Card).

Both methods use the concept of Gas Screening Values (GSVs) to identify levels of risk. The mitigation and management of potentially unacceptable risk is described with reference to both passive and active systems of gas. Source removal is also discussed as an option. A separate approach is discussed under the RB17 header further below.

The aim of the guidance is for a consistent approach to decision making, particularly relating to the scope of protective design measures on a site-specific basis.

### *Legislative Framework*

BS8485:2015+A1:2019, BS 8576:2013 and CIRIA C665 provides technical guidance, however they also recognise the context into which the guidance has to be employed. Government policy is based upon a “suitable for use approach”, which is relevant to both the current and proposed future use of land. When considering the current use of land, Part IIA of the Environment Protection Act 1990 provides the regulatory regime. The presence of hazardous ground gases could provide the “source” in a “pollutant linkage” which could lead the regulator to determine that considerable harm or there is a significant possibility of such harm being caused. Under such circumstances, the regulator would determine the land to be “contaminated land” under the provisions of the Act, setting out the process of remediation as described in the DETR Circular 02/2000 *Statutory guidance on contaminated land*.

### *Generation Potential of Sources*

BS 8576:2013 Figure 6 provides a basis for assessing the generation potential from sources identified as part of the Phase I Assessment. These are summarised below:

| Generation Potential | Typical Sources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Very Low             | <ul style="list-style-type: none"> <li>Natural carbonate soil and strata, e.g. chalk and limestone.</li> <li>Natural soil strata with a low degradable organic content, e.g. alluvium, peat.</li> <li>In-filled pond less than 15 m diameter, in-filled before 1930s to 1940s.</li> <li>Made ground with low degradable organic content (e.g. up to 5% organic material such as pieces of wood, pieces of paper, rags, etc. with a high proportion of ash and no food or other easily degradable waste).</li> <li>Mine workings shallow or shaft (where there is clear evidence that they are flooded).</li> <li>Inert landfill sites.</li> </ul> |
| Low                  | <ul style="list-style-type: none"> <li>Natural soil strata with a high degradable organic content (DOC).</li> <li>Made ground with total organic carbon (TOC) up to 6% (e.g. dock silt, no food or other easily degradable waste).</li> <li>Foundry sand (includes phenolic binders, rags and wood that decay, albeit at low rates).</li> <li>Landfill 1945 to mid 1960s (see also Moderate below).</li> </ul>                                                                                                                                                                                                                                    |
| Moderate             | <ul style="list-style-type: none"> <li>Sewage sludge.</li> <li>Mine workings – unflooded, more than 50 years since last worked (gas is liberated from coal when mine workings are excavated; this continues for up to about 50 years).</li> <li>Landfill 1945 to mid 1960s (this could also be “low” or, if disturbed, “high”).</li> </ul>                                                                                                                                                                                                                                                                                                        |

| Generation Potential | Typical Sources                                                                                                                                                 |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High                 | <ul style="list-style-type: none"> <li>Landfill mid 1960s to early 1990s.</li> <li>Mine workings – unflooded – less than 50 years since last worked.</li> </ul> |
| Very High            | <ul style="list-style-type: none"> <li>Municipal landfill sites.</li> <li>Landfill early 1990s onward.</li> </ul>                                               |

#### *Frequency and Duration of Monitoring*

The monitoring period for a specific site covers the “worst case” scenario. A “worst case” scenario will typically occur during falling atmospheric pressure and, in particular, weather conditions such as rainfall, frost and dry weather.

The benefits of the additional information and whether it is likely to change the scope of gas protection should be considered, as are the consequences of failing to characterise adequately pollutant linkages. Investigations concerned with soil gas are required to provide monitoring data sufficient to allow prediction of worst case conditions enabling the confident assessment of risk and subsequent design of appropriate gas protection schemes. Monitoring programmes should not be an academic exercise in data collection. CL:AIRE publication TB17 “Ground Gas Monitoring and ‘Worst-Case’ Conditions” provides further guidance.

Below are matrices that will aid in determining an appropriate number of gas monitoring visits and the length of monitoring period.

#### *Typical/idealised periods of monitoring*

|                            |                             | Generation of Potential Source |          |          |           |           |
|----------------------------|-----------------------------|--------------------------------|----------|----------|-----------|-----------|
|                            |                             | Very Low                       | Low      | Moderate | High      | Very High |
| Sensitivity of Development | Low (Commercial)            | 1 month                        | 2 months | 3 months | 6 months  | 12 months |
|                            | Moderate (Apartments)       | 2 months                       | 3 months | 6 months | 12 months | 24 months |
|                            | High (Low rise Residential) | 3 months                       | 6 months | 6 months | 12 months | 24 months |

#### *Typical/idealised frequency of monitoring/Number of Visits Required*

|                            |                             | Gas Generation of Potential Source |     |          |      |           |
|----------------------------|-----------------------------|------------------------------------|-----|----------|------|-----------|
|                            |                             | Very Low                           | Low | Moderate | High | Very High |
| Sensitivity of Development | Low (Commercial)            | 4                                  | 6   | 6        | 12   | 12        |
|                            | Moderate (Apartments)       | 6                                  | 6   | 9        | 12   | 24        |
|                            | High (Low rise Residential) | 6                                  | 9   | 12       | 24   | 24        |

#### **Note**

- NHBC guidance also recommends this period of monitoring (Boyle and Witherington, 2007).
- Generation potential of sources based on descriptions within BS 8576:2013.
- At least two sets of readings should be at low and falling atmospheric pressure (but not restricted to periods below <1000 mb) known as worst case conditions. Historical data can be used as part of the data set (Table 5.5b).

It is recommended that newly installed monitoring wells are left for 24 hours to allow the soil gas to reach equilibrium. It should be recognised, however, that some soil gas regimes could take considerably longer (up to seven days). Interpretation of any initial readings should take this equilibrium process into account.

#### *RB17 Approach*

CL:AIRE RB17 (Card et al 2012) is a pragmatic approach to ground gas risk assessment and was developed because gas concentration, pressure and flow rate measured in a well headspace may not be representative of the conditions in the surrounding formation.

In these low-risk situations, the approach is to use the conceptual site model and the estimation of the likely gas generation from a source to identify where or if gas monitoring is required to better define the risks.

Under this approach, for sites with natural soils only with no credible methane source, then no action is required (no monitoring or gas protection measures) as this represents Characteristic Situation 1 (CS1).

### **Unexploded Ordnance (UXO) Guidance**

Clients have a legal duty under the CDM 2015 Regulations to provide designers and contractors with project-specific health and safety information needed to identify hazards and risks. This includes the possibility of unexploded ordnance (UXO) being encountered on the site. Further details are given in CIRIA report C681.

BSL carry out non-specialist UXO screening exercises by considering any evidence of UK defence activities on or near the site evident from gathered desk study information and the unexploded aerial delivered bomb (UXB) online risk maps produced by Zetica. Other data sources are available, but as a first stage screening exercise the freely available online Zetica maps have been used. The level of risk stated is that determined by Zetica, a company experienced and considered competent in the assessment of UXO.

### **Contaminated Land Screening Values**

In assessing the potential for contamination Brownfield Solutions Limited (BSL) follows UK guidance and current best practice.

#### *General*

The current recommended method for assessing contamination is on the basis of:

#### **Source-Pathway-Receptor**

Where any one of these “pollution linkages” is absent there is deemed to be no risk.

Fundamentally, receptors can be considered as humans (human health) and controlled waters (surface and ground waters).

The purpose of using generic Tier 1 screening levels is to have a simple means of assessing the potential contamination of a site and to inform decisions on whether further investigation is warranted or whether an option to undertake clean up based on the data to hand is cost effective.

#### *Human Health*

Current UK guidance is provided by DEFRA and the Environment Agency (EA). Publications forming part of the guidance include the CLEA Model and toxicological reports collectively referred to as the CLEA Guidance. The CLEA Guidance has included a number of publications which have provided initial screening values for soil contamination based on standard land uses and soil assumptions.

CLEA guidance has gone through a number of revisions over time. Tier 1 generic S4UL values have been published using the CLEA 1.06 Model by CIEH/LQM. These are the third set of generic assessment criteria generated by CIEH and replace the previous two sets of GACs (Generic Assessment Criteria). The revised S4UL values are based on greater knowledge of relevant toxicology and further consideration of exposure frequencies.

C4SL values for six determinands including lead was published by DEFRA/CL:AIRE in December 2014 and they represent a low risk as opposed to minimal risk. These screening values were published by DEFRA for Part 2A use, although with the dual purpose for use under planning. However, S4ULs remain the first reference due to the broader range of end uses and soil organic content.

---

The preference from the EA is that site specific screening levels are used wherever possible. Due to numerous factors it is not always possible to utilise site specific values. In these instances the following data sources are used in the order of preference given below:

- CIEH S4UL values (derived by CIEH/LQM).
- DEFRA/CL:AIRE C4SL's.
- CL:AIRE GAC values.
- Guidance from other European countries.
- Guidance from the outside Europe.

#### *Controlled Waters*

The European Water Framework Directive (WFD) became UK law in December 2003. It was created to ensure that European countries manage their rivers, groundwater and lakes so that they stay healthy for people and for wildlife.

This is achieved by the use of chemical standards for surface waters and groundwater. These values describe concentrations of chemicals that are not expected to cause harm to environmental organisms or human health, provided they are not exceeded. The same chemical may have several standards for different environmental regimes, and for different protection objectives.

Statutory Standards are set in legislation and if exceeded, this constitutes non-compliance with statutory obligations. European Directives are implemented in England and Wales by corresponding statutory instruments (i.e. regulations). The statutory instruments can be the exact same standards as they appear in the Directive or be more stringent.

A number of non-statutory standards also exist, these are set by various organisations (including the EA) for chemicals that are considered to be of concern, but are not covered by any specific legislation.

The chemical standards used in the UK to control impaction of contamination on controlled waters are Environmental Quality Standards (EQS). The EQS's cover a large number of compounds.

Where certain compounds are not covered by the EQS these are commonly compared to the UK Drinking Water Standards (DWS).

#### *Further Assessment*

When screening values are exceeded then further consideration is required. This could include the use of simple measures to break the pollution pathway and mitigate the risk, further additional detailed investigation, including the deriving of site-specific values to better define the risk, and to design appropriate remedial measures.

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## Re-Use Of Waste - Guidance Note

### *Definition of Waste*

The Environment Agency considers waste to be “...any material that is discarded, or intended to be discarded...” This includes any soil from trenches, footing, site strip etc. It is no longer required in its original location, therefore it is considered to be waste.

### *CL:AIRE: Code of Practice*

Where materials are excavated for construction purposes, wherever possible these should be retained on site for engineering purposes if they are suitable for use. This can be implemented under the CL:AIRE “Development Industry Code of Practice for the Definition of Waste” (CL:AIRE DoWCoP), also commonly referred to as a “Materials Management Plan”.

The developer/contractor is advised to complete all works under the DoWCoP.

Potential scenarios where soils may be able to be re-used:

- Material capable of being used in another place on the same site without treatment.
- Material capable of being used in another place on the same site following ex-situ treatment on site.
- Material capable of being used in another development site without treatment (Direct Transfer).
- Material capable of being used in another development site following ex-situ treatment on another site eg Hub site.

The Code of Practice requires 4 No. Factors to be addressed:

- 1) Protection of human health and protection of the environment.
- 2) Suitability of use, without further treatment.
- 3) Certainty of use.
- 4) Quantity of material.

In order to satisfy these requirements the following are required:

- i) Consultation/approval with Local Authority & Environment Agency to confirm they have no objections to the proposed re-use of waste soils, or the risk assessments for the site.
- ii) Risk Assessments to demonstrate that the site does not present an Environmental Hazard.
- iii) Remediation Strategy for contaminated sites (or Design Statement for non-contaminated sites).
- iv) Materials Management Plan (MMP) which details material generated stockpiles and the end use.
- v) Volume calculations.
- vi) Planning permission for the development.
- vii) Contractual details to be clear, regarding who steps in if a contractor goes into administration/liquidation.

The use of the CoP is effectively industry regulated, there is a requirement to appoint an independent Qualified Person (QP) who checks all the requirements have been met and registers the documentation with the Environment Agency. This person must not have had any involvement with the preparing of the risk assessments or remedial strategy on the site.

Soils which require treatment on site (eg bioremediation, stabilisation) will require an Environmental Permit for treatment, together with justification and validation to prove, once treated, this material is suitable for use. Site management procedures need to be in place to ensure that material is tracked through from excavation stockpiling, treatment and remediation processes. Should the process of material tracking be considered non-robust, or not adhered to, this may fail the test whether excavated materials may be considered non-waste.

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## Waste Classification for Soils

### *Introduction*

Waste producers have a duty of care to classify the waste they are producing:

- Before it is collected, disposed of or recovered.
- To identify the controls that apply to the movement of the waste.
- To complete waste documents and records.
- To identify suitably authorised waste management options.
- To prevent harm to people and the environment.

The most sustainable and economic method of dealing with waste soil is usually the retention and re-use on site. Where this is not possible there are three main options for the disposal of soils:

1. Disposal to a permitted waste recycling facility.
2. Re-use on another site (subject to the suitability).
3. Disposal to a landfill site.

The disposal to a permitted facility will be subject to the **specific conditions of the permits for each individual facility** and will vary dependent on location and environmental sensitivity of the receiving site. Re-use on another site will also be subject to the acceptability criteria of that site.

The guidance below relates to disposal to **landfill sites only**.

### *Background for Landfill Disposal*

In July 2005 the United Kingdom implemented the European Directive 1999/31/EC (The Landfill Directive), this introduced the current regime for waste and waste disposal to landfill. The Landfill Directive places controls on waste disposal. These controls include requirements to follow the waste acceptance procedures and criteria that have been agreed by the Council of the European Union and are laid out in Council Decision 2003/33/EC.

Before a waste can be accepted at a landfill site, the landfill **operator** must be satisfied that the waste meets his permit conditions, the waste acceptance procedures (WAP) and waste acceptance criteria (WAC).

If disposal to landfill is the best management option for the waste soils, these procedures **must** be followed or the operator may refuse to accept the waste.

### *Key Points:*

- Not all waste can be landfilled
- Landfills are classified according to whether they can accept hazardous, non-hazardous or inert wastes.
- Wastes can only be accepted at a landfill if they meet the waste acceptance criteria (WAC) for that class of landfill.
- Most wastes must be treated before you can send them to landfill.
- There are formal processes for identifying and checking wastes that must be followed before wastes can be accepted at a landfill site.

### *Classification*

Wastes are listed in the European Waste Catalogue (EWC 2002) and grouped according to generic industry, process or waste types. Wastes within the EWC are either hazardous or non-hazardous. Some of these wastes are hazardous without further assessment (absolute entries) or are 'mirror' entries that require further assessment of their hazardous properties in order to determine whether they are hazardous waste.

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Waste soil has mirror entries on the EWC and as such the first phase of the waste classification process is that of determining if the waste is hazardous or not i.e the hazard assessment. The most common EWC waste codes related to soil are:

|              |                                                                                           |
|--------------|-------------------------------------------------------------------------------------------|
| <b>17 05</b> | <b>soil (including excavated soil from contaminated sites), stones and dredging spoil</b> |
| 17 05 03*    | soil and stones containing dangerous substances                                           |
| 17 05 04     | soil and stones other than those mentioned in 17 05 03                                    |

Soils may contain certain contaminants (eg asbestos, oil,) which have prescribed concentration thresholds, that if breached will render the material hazardous waste. These are based on specific “hazardous properties” which include hazards such as carcinogenicity, flammability and toxicity.

In the first instance the concentrations of plausible contaminants within the soil should be identified and wastes should be **classified based on their total concentrations**.

### Waste Definitions

|                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inert                                | <ul style="list-style-type: none"> <li>Will not undergo any significant physical, chemical or biological transformations.</li> <li>Will not dissolve.</li> <li>Will not burn.</li> <li>Will not physically or chemically react.</li> <li>Will not biodegrade.</li> <li>Will not adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health.</li> <li>Has insignificant total leachability and pollutant content.</li> <li>Produces a leachate with an ecotoxicity that is insignificant (if it produces leachate).</li> </ul> |
| Non-Hazardous                        | Is not inert (see above)<br>Is not hazardous (see below)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Hazardous                            | Soil has hazardous properties as defined in WM3 (Guidance on the classification and assessment of waste (1st edition 2015)- Technical Guidance)                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Stable Non-reactive hazardous waste# | Hazardous waste, the leaching behaviour of which will not change adversely in the long-term, under landfill design conditions or foreseeable accidents either: in the waste alone (for example, by biodegradation), under the impact of long-term ambient conditions (for example, water, air, temperature or mechanical constraints) or by the impact of other wastes (including waste products such as leachate and gas).                                                                                                                                                                                       |

# This option allows hazardous waste that is stable and thus has a low leaching potential to be deposited in cells with a standard of containment consistent with non-hazardous wastes.

### WAC Testing

The purpose of WAC analysis is to confirm that the waste complies with the relevant WAC for the receiving landfill. If the waste has any disposal route other than a landfill site (e.g. recycling facility, incineration etc) the WAC is not relevant. Furthermore, the WAC limits **cannot** be used to make an assessment of whether a waste is hazardous. WAC testing does however define if a non-hazardous waste is suitable for an inert landfill.

| Classification based on Total Concentrations <sup>1</sup> | Non-Hazardous Waste           |                                     | Hazardous Waste                  |                                  |
|-----------------------------------------------------------|-------------------------------|-------------------------------------|----------------------------------|----------------------------------|
|                                                           | Below inert WAC limit values: | Above inert WAC limit values:       | Below hazardous WAC limit values | Above hazardous WAC limit values |
| WAC testing                                               |                               |                                     |                                  |                                  |
| Landfill requirements                                     | INERT landfill                | NON-HAZARDOUS landfill <sup>2</sup> | HAZARDOUS landfill               | PRE-TREATMENT <sup>3</sup>       |

1 Total concentrations are defined as tests results on solids as opposed to leachate (i.e. a liquid).

2 Individual sites may have certain limit values pre-determined in their licence.

3 After pre-treatment the material characteristics may have changed to an extent that allow the soil to be re-classified.

### Hydrocarbons in Soils

WM3 uses the term Oil or Waste Oil to cover hydrocarbons products such as fuel oil, petrol or diesel. These are defined by WM3 as hazardous under an absolute entry in the List of Wastes. However, hydrocarbons in soils are a mixture rather than a pure product and are therefore not absolute entries.

### Known Oils

The simplest scenario is where the identity of the contaminating oil is known or can be identified. If the oil is known the manufacturer's or supplier's REACH compliant safety data sheet for the specific oil can be obtained and the hazard statement codes on that Safety Data Sheet can be used for the hazardous waste assessment.

Where the identity of the oil can only be identified down to a petroleum group level (i.e. the contaminating oil is known to be diesel, but the specific type/brand is unknown), then the classification of that petroleum group should be used in the assessment. The marker compounds associated with that petroleum group may be used to confirm carcinogenicity.

Oils may contain a range of hydrocarbons, so the presence of for instance Diesel Range Organics (DRO) does not enable the assessor to conclude that diesel is present. These hydrocarbons may have arisen from other oils, the laboratory needs to provide an interpretation of the chromatograph to determine if it is consistent with diesel or weathered diesel as a whole.

The concentration of known oils should be determined using a method that as a minimum spans the range in which the carbon numbers for that known oil fall.

### Unknown Oils

Where hydrocarbons are contaminating soils, it is likely that the oil will be unknown or cannot be determined.

WM3 states that:

For contaminated land specific consideration must be given to the following before proceeding;

- The presence of other organic contaminants, for example solvents or coal tar that could be detected as hydrocarbons. Coal Tar is not an oil and is considered separately in WM3 example 2. Where the site history or investigation indicates the presence of hydrocarbons from oil and other sources (e.g. coal tar), and the origin of the hydrocarbons cannot reliably be assigned to either, then a worst case approach of considering the hydrocarbons both as waste oil (in accordance with this example) and from other sources, for example coal tar should be taken.
- The presence of diesel, or weathered diesel, should be specifically considered by the laboratory and where this is confirmed by the hydrocarbon profile the oil should be assessed as a known or identified oil (diesel).

The use of marker compounds is optional; however, it is recommended that where possible the marker compounds should be used. WM3 states:

If the identity of the oil is unknown, and the petroleum group cannot be established, then the oil contaminating the waste can be classified as non-carcinogenic/mutagenic due to the presence of oil if all three of the following criteria are met:

- The waste contains benzo[a]pyrene (BaP) at a concentration of less than 0.01% (1/10,000th) of the TPH concentration (This is the carcinogenic limit specified in table 3.1 of the CLP for BaP)
- This has been determined by an appropriate and representative sampling approach in accordance with the principles set out in Appendix D of WM3, and
- The analysis clearly demonstrates, for example by carbon bands or chromatograph, and the laboratory has reasonably concluded that the hydrocarbons present have not arisen from petrol or diesel.

For example:

| TPH Concentration<br>(mg/kg) | Petrol or Diesel | BaP<br>(mg/kg) | Classification |
|------------------------------|------------------|----------------|----------------|
| 10,000                       | No               | 0.9            | Non- Hazardous |
| 1,000                        | No               | Not available  | Hazardous      |
| 1,000                        | Yes              | Not relevant   | Hazardous      |

## References

1. Environmental Permitting (England and Wales) Regulations 2010 (as amended) (EP Regulations), the Landfill Directive (1999/31/EC) and the subsequent Council Decisions.
2. Environment Agency Environmental Permitting Regulations: "Inert Waste Guidance- Standards and Measures for the Deposit of Inert Waste on Land" 2009.
3. Environment Agency "Waste acceptance at landfills - Guidance on waste acceptance procedures and criteria" Nov 2010.
4. Environment Agency "Guidance on the classification and assessment of waste (Technical Guidance WM3)".
5. Classification, Labelling and Packaging of Substances Regulation (EC 1272/2008) (CLP).
6. Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives
7. 2014/955/EU: Commission Decision of 18 December 2014 amending Decision 2000/532/EC on the list of waste pursuant to Directive 2008/98/EC of the European Parliament
8. Environmental Permitting Guidance The Landfill Directive For the Environmental Permitting (England and Wales) Regulations 2010 Updated March 2010 Version 3.1
9. Classification, Labelling and Packaging of Substances Regulation (EC 1272/2008) (CLP).

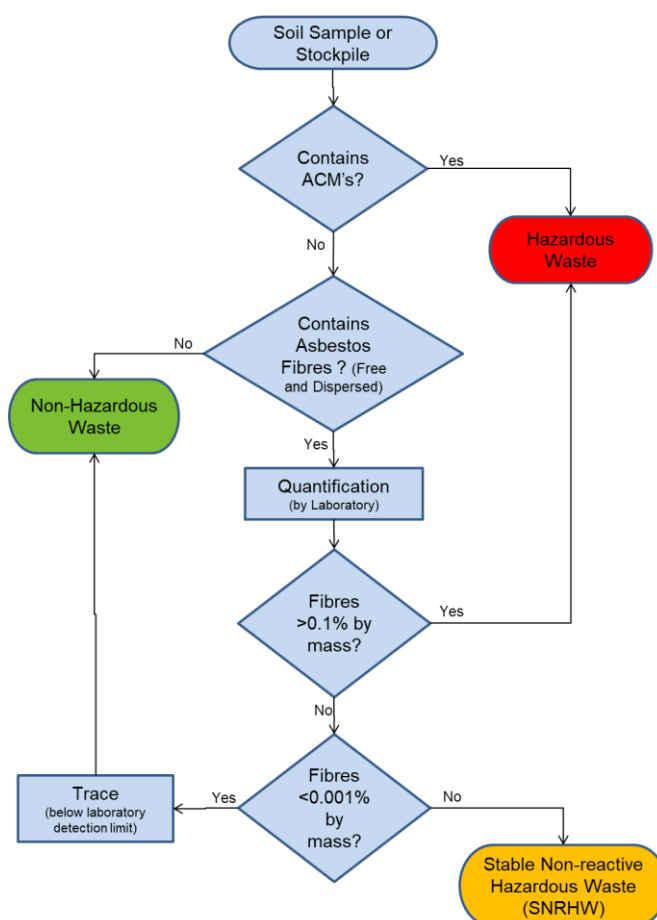
## Additional Asbestos Guidance Notes

### Disposal

The 1st Edition of WM3 "Guidance on the classification and assessment of waste", details the way in which Asbestos is assessed within soils.

The assessment of asbestos containing waste is dependent on whether the asbestos is present as:

- Fibres that are free and dispersed, or
- Identifiable pieces of asbestos containing materials (ACM's)



Identifiable pieces of asbestos are any particle of a size that can be identified as potentially being asbestos by a competent person if examined by the naked eye. The result is that commonly soils with visible ACM's are sorted and the ACM's removed by hand picking and separate disposal.

Asbestos concentrations below 0.001% by mass are below standard laboratory detection limits and are not currently regarded as containing asbestos for the purposes of disposal and may be disposed of to an inert landfill site<sup>1</sup>. These levels are often termed "trace" by laboratories.

Asbestos concentrations between 0.001% and 0.1% are stable non-reactive hazardous waste (SNRHW)<sup>1</sup>. Waste transfer stations where soil recycling takes place may be able to take SNRHW, but are unlikely to take soils containing asbestos above trace concentrations.

The following codes should be assigned to the asbestos waste as appropriate:

|                 |                                                                             |
|-----------------|-----------------------------------------------------------------------------|
| <b>17 06</b>    | <b>Insulation materials and asbestos-containing construction materials</b>  |
| 17 06 01        | Insulation materials containing asbestos                                    |
| 17 06 03        | Other insulation materials consisting of or containing hazardous substances |
| 17 06 04        | Insulation materials other than those mentioned in 17 06 01 and 17 06 03    |
| <b>17 06 05</b> | <b>Construction material containing asbestos</b>                            |

WM3 indicates that 17 06 05 would normally be used in preference to 17 06 01 for the asbestos in asbestos contaminated soil and stones.

Construction materials containing asbestos and "*other suitable materials*" may be landfilled at landfills for non-hazardous waste in accordance with the Landfill Directive without testing.

This means that wastes that are only hazardous because of their asbestos content can be disposed of at landfills for non-hazardous waste in separate landfill cells that only accept asbestos wastes and other suitable materials. The Landfill Directive requires that stable non-reactive hazardous waste shall not be deposited with biodegradable waste (for example organic material, household waste, paper etc..) and must meet the waste acceptance criteria set out in accordance with Annex II.

#### *Construction*

Health and Safety Executive (HSE) guidance on asbestos is not directly related to soil and much of the guidance focuses on the removal of asbestos from buildings. The overarching legislation is the Control of Asbestos Regulation (CAR 2012). However, where work involves (or is likely to involve) contact with asbestos then CAR 2012 requires a risk assessment including whether or not the work is licensed or notifiable non-licensed work and may require an Asbestos Management Plan. Work becomes notifiable if it is considered that the control limit could be exceeded.

Brownfield sites frequently have soils that contain asbestos and the presence of asbestos needs to be considered within the context of construction, particularly in relation to groundworks. The exposure of soils and the use of excavators and plant to move soil around increases the possibility of fibres becoming airborne. However, it is good site practice to not generate dusts and to employ dust suppression on all sites regardless of the presence of asbestos.

The legal control limit for asbestos is 0.1f/ml over a continuous four-hour period. The control limit is not a 'safe' level and exposure from work activities involving asbestos must be reduced to as far below the control limit as possible.

Clearly the higher the concentrations in the soil the greater potential there is for fibres to be released, however IOM publication TM/88/14 "the release of dispersed asbestos fibres from soil" 1988 concludes that:

- Mixtures of asbestos in dry soils with asbestos content as low as 0.001% can produce airborne respirable asbestos concentrations greater than 0.1f/ml in dust clouds where the respirable dust concentrations are less than 5mg/m<sup>3</sup>.
- An action limit is recommended of no higher than 0.001% asbestos in soils above which steps should be taken to minimise exposure to airborne fibres (e.g. by wetting).
- The addition of relatively small quantities (10%) of water can reduce the airborne fibre concentrations by an order of magnitude.

Where asbestos has been identified at concentrations above 0.001% as free and dispersed fibres in the soil precautions need to be adopted. Concentrations below this are considered to be normal background, although good site practice dictates that the generation of dusts should be avoided and therefore any fugitive fibre release from minor concentrations should be kept to a practical minimum.

#### *End Use*

The use of materials containing asbestos and material containing asbestos is prohibited under EU legislation. There is currently a Joint Industry Working Group (JIWG) tasked with producing a Code of Practice for Asbestos in Soil, Made Ground and Construction & Demolition Material that will clarify in due course the position of the various government agencies.

Asbestos containing materials can remain in situ under a suitable cover system which may be hardsurfacing or soft landscaping (with or without hard dig layers and markers).

There is a risk that future maintenance may compromise such systems and details of the presence of asbestos should be kept in the Health and Safety File.

Preliminary publications from JIWG (April 2015) provide guides for decision making in relation to construction.

The re-use of waste soils should be undertaken in accordance with the CL:AIRE Code of Practice and is subject to suitable risk assessments demonstrating low risk. There is nothing that specifically excludes the re-use of soils containing asbestos as fill to raise levels. However, the movement of materials increases the risk of fibres becoming airborne and suitable precautions will be required.

The re-use of soils containing asbestos at concentrations above hazardous waste levels is likely to meet with regulatory opposition. Assuming a suitable strategy could be agreed this would take a considerable amount of time and is only likely to be feasible where there is a long program for implementation.

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## Asbestos in Soil as Free Fibres

| Concentration (by weight) | Waste Disposal |                |     |         | Construction Issues                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | End Use                                                                                                                                                                                                     |                                                                                                                           |
|---------------------------|----------------|----------------|-----|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
|                           | Recyc          | Inert          | SNR | Hazardo |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Suitable for re-use on site                                                                                                                                                                                 | Precautions                                                                                                               |
| Not detected              | √              | √              |     |         | No precautions necessary, however on a brownfield site asbestos not previously identified may be found during works and a statement within the contractors method statement for how they will deal with this unforeseen asbestos would be good practice to ensure compliance with CAR2012.                                                                                                                                                                                                                                                                                                                                             | Yes                                                                                                                                                                                                         | None                                                                                                                      |
| Trace (<0.001%)           |                | √ <sup>2</sup> |     |         | Precautions are unlikely to be required, however a detailed method statement may be required to ensure compliance with CAR2012. Basic asbestos management good practice will be required. Typically precautions would include: <ul style="list-style-type: none"> <li>Ensuring soils do not dry out to become dusty.</li> <li>Site personnel have the risk communicated at induction stage.</li> </ul>                                                                                                                                                                                                                                 | Yes<br>Soils can be re-used under CL:AIRE CoP with the correct precautions in place.                                                                                                                        | Generally clean cover or hardstanding cover required.                                                                     |
| 0.001% – 0.099%           |                |                | √   |         | Contractor needs to produce an Asbestos Management Plan in accordance with CAR2012 as part of their method statement. Typical precautions would include: <ul style="list-style-type: none"> <li>Site personnel have the risk communicated at induction stage.</li> <li>Ensuring personnel have suitable training.</li> <li>Task monitoring to inform PPE requirements.</li> <li>Ensuring soils do not dry out to become dusty and that misting is available during groundworks.</li> <li>Separate stockpiling.</li> <li>Clean haulage routes.</li> </ul>                                                                               | Possibly<br>Soils may be able to be re-used under CL:AIRE CoP, subject to a satisfactory Risk Assessment and regulatory agreement with the correct precautions in place.                                    | Clean cover or hardstanding cover required.                                                                               |
| 0.1+%                     |                |                |     | √       | Contractor needs to produce an Asbestos Management Plan in accordance with CAR2012 as part of their method statement. Typical precautions would include: <ul style="list-style-type: none"> <li>Site personnel have the risk communicated at induction stage.</li> <li>Ensuring personnel have suitable training.</li> <li>Task monitoring to inform PPE requirements.</li> <li>Site wide and or perimeter monitoring.</li> <li>Ensuring soils do not dry out to become dusty and that misting is available during groundworks.</li> <li>Separate stockpiling.</li> <li>Clean haulage routes.</li> <li>Decontamination unit</li> </ul> | Unlikely <sup>3</sup><br>Re-use of soils containing asbestos within an earthworks scheme will involve significant engineering and the<br><br>Risk for generating dusts will be significantly increased with | Clean cover and a hard dig layer. A plan should be in place for future excavations as part of the Health and Safety File. |

| Concentration (by weight) | Waste Disposal |       |     |         | Construction Issues | End Use                           |             |
|---------------------------|----------------|-------|-----|---------|---------------------|-----------------------------------|-------------|
|                           | Recyc          | Inert | SNR | Hazardo |                     | Suitable for re-use on site       | Precautions |
|                           |                |       |     |         |                     | repeated handling and compaction. |             |

1. The standard laboratory detection limit is normally 0.001%. Below 0.001% is trace and currently regarded as not containing asbestos for the purposes of disposal off site. However the waste producer has a duty to fully classify the waste and the presence of trace asbestos should be declared. Consequently it is unlikely that a waste treatment site will take this soil and an inert landfill may make a commercial decision to only take it under some circumstances.
2. The re-use of soils containing asbestos at concentrations above hazardous waste is likely to meet with regulatory opposition. Assuming a suitable strategy could be agreed this would take a considerable amount of time and is only likely to be warranted where there a long program for implementation.

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