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Phase 3 Remediation Options Appraisal

21 March 2023

La Rose Homes Limited
Land adjacent to Charnwood, 259 High Road, Whaplode, Spalding, PE12 6TG

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1. Introduction

The following document is a Phase 3 Remediation Options Appraisal carried out by Oakshire Environmental, and includes details of the site, environmental setting, contaminant linkages and an evaluation of risk.

1.1 Project Overview

The client's proposed project involves erection of a dwelling and detached garage on land adjacent to Charnwood, 259 High Road, Whaplode, Spalding, PE12 6TG. Following the identification of contaminant linkages at the site, remediation has been recommended. Oakshire Environmental have carried out a Phase 3 Remediation Options Appraisal, as described below.

1.2 Purpose of Investigation

The objectives of the Phase 3 Remediation Options Appraisal were to:

- Assess the nature and extent of contamination risk at the site.
- Identify suitable remediation and gas mitigation option(s).
- Outline a strategy for the implementation of suitable remediation and gas mitigation option(s).
- Determine the requirement or scope of further investigations.

1.3 Scope of Work

- Assessed the nature and extent of contamination risk, identified as part of previous investigations.
- Identified initial feasible options for remediation and gas mitigation at the site, including assessment of potential constraints and generic remediation objectives, based on the costs involved and the practicality of their application. Remediation methods to be considered include civil engineering, biological, chemical, physical and thermal methods.
- Conducted a detailed evaluation of remediation and gas mitigation options, including development of site-specific remediation objectives, in order to determine which are most appropriate for the site.
- Outlined a strategy for the implementation of suitable remediation and gas mitigation option(s).
- Recommended remediation and gas mitigation option(s) have been assessed to determine the scope of required verification work at the site.
- Supporting appendix includes photographs, maps and plans of the site.
- Options Appraisal has been carried out by professional Environmental Consultants, with BSc (Hons) in Environmental Science or above, in accordance with the Environment Agency's Land Contamination: Risk Management (LCRM) guidelines as updated from Environment Agency's Model Procedures for the Management of Land Contamination (CLR11) framework.

1.4 Limitations

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This report excludes consideration of potential hazards arising from any activities at the site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities. Oakshire Environmental does not warrant or guarantee that the site is free of hazardous or potentially hazardous materials or conditions. It should be noted that this report has been produced for environmental purposes only.

2. Site

The following section provides a description of the site, location and previous investigations, utilising information obtained from the client and publicly available sources.

2.1 Site Description and Location

The site is located on land adjacent to Charnwood, 259 High Road, Whaplode, Spalding, PE12 6TG, and is comprised of an approximately 0.03ha soft landscaped area, formerly the private garden of the adjacent dwelling.

The site is bordered by residential dwellings and gardens to the east, south and west and High Road to the north. No Environmentally Sensitive Sites, Ecological Protection Zones, Ramsar Sites or Special Areas of Conservation were identified on or within 250m of the proposed development, in addition, no Conservation Areas, Listed Buildings or Scheduled Ancient Monuments were identified on or within 50m of the proposed development.

National Grid Reference: 532471, 324298

2.2 Previous Investigations

A Phase 1 Desk Study Report was carried out by STM Environmental Consultants in May 2022. This assessment considered there to be a moderate to risk to future occupiers, visitors and construction workers and a low to moderate risk to buildings and services from potential contaminants associated with the site history and potential made ground as well as adjacent uses such as orchards, corn mill, landfill, petrol station and infilled ground. The assessment recommended that an intrusive site investigation is undertaken with the objective of determining the presence and extent of any soil contamination at the site.

Based on the findings of the Phase 1 Preliminary Risk Assessment, Oakshire Environmental carried out a Phase 2 Intrusive Site Investigation including sampling of soil and made ground at the site. This assessment identified made ground comprising brick fragments at depths of between 0.6m and 1.5m and soil conditions were comprised of sandy clay, silty clay and sand.

Lead contamination was identified in made ground material at a depth of 1m (sample S05). It was noted that the depth of this contamination and the absence of contamination in a shallower sample taken from this location suggests that the pathway may be limited.

Mercury concentration also exceeded the residential screening value in the same sample, however, it should be noted that this is based on the ‘worst-case’ screening value for Elemental Mercury and it is considered unlikely that any Mercury present in the soil would exist in this form.

Further assessment of the risk to the proposed development from the ingress of ground gases was also carried out as part of this assessment and concluded that the impermeable underlying geology, comprising cohesive soils, will inhibit the migration of ground gases to the site. The low organic matter content and limited quantity of identified made ground at the site suggests that this will also not present a credible risk from ground gas production through the degradation of putrescible material.

A GeoEnvironmental Desk Study, carried out by Goldfitch Environmental Ltd in July 2017 for a development located 156m east of the site, and a subsequent letter to the council concluded that the risk to the development from off-site landfill could be dismissed due to the local geology inhibiting the migration of ground gas. A precautionary approach was approved by Environmental Protection and the installation of a 1200 gauge LDPE membrane was recommended.

The Phase 2 Intrusive Site Investigation, therefore, concluded that remediation is necessary.

As per the recommendations of the Phase 2 Intrusive Site Investigation, Oakshire Environmental has carried out a Phase 3 Remediation Options Appraisal to include an assessment of the feasible remediation options available.

3. Remediation Options

The Environment Agency's Land Contamination: Risk Management guidance for the development of an options appraisal requires the initial identification of feasible options for remediation at a site, based on the costs involved and the practicality of their application. There are a number of remediation methods available including civil engineering, biological, chemical, physical and thermal methods. Some methods may not be appropriate to a particular site as some can only be used on certain types of media and some may not be cost effective. Other site-specific constraints such as time and access can also determine the feasibility of a particular remediation option. The following section outlines the generic remediation objectives for the site, taking into account potential constraints, and includes a selection of feasible remediation options.

3.1 Site Context and Objectives

The site forms the private garden of the adjacent dwelling and contaminated made ground has been identified on the site at a depth of 1m along with a potential off-site ground gas source. The client's proposed project involves the erection of a dwelling and detached garage to include associated access, parking and landscaping. This report, therefore, considers the feasibility of developing the site for continued residential use.

3.2 Potential Constraints

Given the size of the site and the current access provisions, there will not be significant limitations with regards to space or access for machinery and vehicles required to carry out remediation work. There are sensitive human receptors bordering the site and the site is currently in use as a residential garden so there are also sensitive receptors on site. The on-site contamination is not expected to be ongoing so there are no specific time constraints with regards the implementation of remediation, however, it would be prudent to implement remediation as soon as reasonably practicable given its current use as a private garden.

3.3 Generic Remediation Objectives

The following table outlines the generic objectives of remediation at the site.

Table 1: Summary of Generic Objectives

Remediation Objective	Objective Type
Enable the site to be redeveloped for residential end use	General
Enable development of a remediation strategy that meets regulatory requirements	Management
Enable development of a remediation strategy that meets the developers' requirements	Management
Avoid unacceptable environmental impacts from implementation of remediation strategy	Management
Avoid long term monitoring requirements	Management

3.4 Feasible Remediation Options

Contamination risk from inorganic contaminants has been identified in made ground beneath topsoil, therefore, a number of remediation options have been discounted as they are inappropriate for the site and the identified contamination risk.

Soil flushing, soil washing, and hydraulic binders are likely to be too costly and unnecessarily extensive for the site given the relatively localised contamination and minimal material expected to require remediation. Groundwater is not likely to be impacted due to the low solubility of the identified contaminants and the low permeability of the underlying geology at the site. Similarly, due to the distance to surface waters, impacts to this receptor are considered to be unlikely. Remediation of groundwater and surface water is, therefore, not considered necessary.

Therefore, the following remediation options are considered appropriate for the site and will be subject to a more detailed evaluation in the following section.

Table 2: Summary of Feasible Remediation Options

Remediation Option	Method	Linkage Element Addressed
Excavation and Disposal	Civil Engineering	Source Management
Containment - Cover System	Civil Engineering	Pathway Interruption
Membrane	Barriers (in buildings)	Pathway Interruption
Passive Venting	Dilution and Dispersion	Pathway Interruption

4. Evaluation of Remediation Options

Following the identification of feasible remediation options, a detailed evaluation of options, including development of site-specific remediation objectives, is required to determine which option(s) are most appropriate for the site.

Table 3: Summary of Site-Specific Objectives

Remediation Objective	Objective Type	Evaluation Criteria
Enable the site to be redeveloped for residential end use without risk to human health	General/Technical	Concentrations of Heavy Metals in shallow soils on site to be below relevant screening values after remediation and the ingress of ground gases into the building to be negligible
Enable development of a remediation strategy that meets regulatory requirements	Management	Remediation strategy to be agreed with Local Authority and carried out in accordance with relevant regulations
Enable development of a remediation strategy that meets the developers' requirements	Management	Remediation strategy to be agreed with developer
Avoid unacceptable environmental impacts from implementation of remediation strategy	Management	Compliance with regulations on the control of noise, dust odour, traffic and generation of waste
Utilise remediation option with a proven track record	Management	Selected option to have proven success on sites with similar contamination issues
Avoid long term monitoring requirements	Management	No site-specific evaluation criteria

4.1 Excavation and Off-Site Disposal and Containment

Excavation and off-site disposal of soil and made ground should be carried out in the proposed garden area at the south of the site and containment should then be carried out, through placement of clean material, to interrupt the contamination pathway, protect against residual contamination risk and re-instate site levels. Site-won material from the north of the site, following excavations for the proposed driveway and garage can be used as cover to minimise the volume of waste requiring disposal.

Excavation should be carried out to a depth that would allow the required clean cover to be placed to a minimum depth of 0.6m. This would allow an adequate depth for the growth of plants and soil mixing is unlikely to exceed this depth in a residential garden. Excavation and clean cover are not considered necessary in areas where the site will be covered by hardstanding or the building footprint as there will be no contaminant pathway in these areas.

Results of soil testing from the Intrusive Site Investigation suggest that sampled material from the site would be classified as Non-Hazardous, with an EWC code of 17 05 04, for off-site disposal to landfill or treatment facility.

This remediation option meets all the relevant objectives outlined in this report and is appropriate for the site. Excavation and off-site disposal and containment is likely to be the most cost-effective feasible remediation option and would be most cost effective if conducted alongside the proposed development at the site. There are not likely to be excessive environmental nuisances, such as noise and dust, in addition, excavation and containment are very common remediation techniques, successfully used on multiple sites with similar contamination issues, and is not likely to need extensive post-remediation verification work.

4.2 Membrane and Passive Venting

Due to the presence of historical off-site landfill, gas mitigation measures are recommended. Given the low permeability ground conditions, the risk is likely to be low and pre-emptive gas mitigation measures would be more practical and less costly than carrying out extensive gas monitoring. Ground gas concentrations and flows at the site are unlikely to exceed an Amber 1 (Characteristic Situation 2) classification based on NHBC guidance. Therefore, in order to address the risk of ground gas permeation into the proposed dwelling, a reinforced concrete cast in-situ floor slab with a 1200 gauge damp proof membrane (DPM) should be installed along with an open void below for underfloor venting.

Alternatively, a pre-cast concrete slab or block and beam floor can be installed with a 2000 gauge DPM and an open void below, from which ground gas can be ventilated. In either method, the void will provide good protection against ground gas ingress and when designed and constructed correctly it will dilute any gas being emitted from the ground to acceptable levels.

Of concern is whether the membrane can withstand the construction process because, once torn or damaged, the membrane will cease to operate as an effective barrier. Adequate quality control during the laying of the membrane is extremely important so the membrane should be protected. This is particularly important for the membrane below the raft.

It should be noted that, regardless of any other remediation options selected, gas mitigation measures will need to be incorporated into the development.

5. Recommendations

Based on the detailed evaluation of feasible remediation options in this report, the most appropriate remediation option is considered to be via source management and pathway interruption by way of excavation and off-site disposal of contaminated soil and made ground and containment through the placement of a clean cover layer. The details regarding this remediation are outlined below.

5.1 Remediation Strategy

Soil and made ground from the proposed garden at the south of the site should be excavated and disposed of off-site. There is no minimum requirement for excavations provided that they allow for the placement of the required thickness of clean cover, therefore, this will be dictated by the existing and proposed ground levels across the site. Results of laboratory testing suggest that soil from the site is classified as Non-Hazardous and should be disposed of accordingly, however, Waste Acceptance Criteria (WAC) testing may also be required for materials that are to be disposed of to landfill. Excavations should be carried out by a suitability qualified groundworks contractor and a photographic record of the excavation works should be kept, including the base and faces of each excavation.

A cover layer of clean material should then be placed to a minimum depth of 0.6m at the south of the site in the proposed rear garden area. This material can be imported from off-site or site-won material from the north of the site can be used, provided this can be shown to be free from made ground material. Where imported material is used, this should comprise a combination of 0.45m of subsoil and 0.15m of topsoil to reduce costs and improve drainage, however, this will be at the discretion of the client. It is important that cover soil is placed in its intended area straight away or quarantined on a polythene sheet or similar protective membrane to ensure that cross-contamination does not occur, and all excavation should be carried out prior to the placement of clean cover.

Imported subsoil and topsoil to be utilised as cover material must be shown to be uncontaminated and subsoil must be compliant with British Standard 8601:2013, while topsoil will need to comply with British Standard 3882:2015. Photographic evidence of the depth of cover is required to verify that the required depth of cover has been implemented.

To mitigate the risk from ground gas permeation into the dwelling, subfloor ventilation will be provided via an open void at least 150mm deep and will be ventilated through periscope vents and/or straight through vents in the external walls. Airbricks should be installed where possible on all side of the building with a minimum ventilation to the void of 1500mm^2/m of wall on two opposite sides to provide adequate dilution of gas. In most cases this means that vents should be positioned at 2m maximum centres along the external walls and not more than 450mm from corners. This can implemented with either a reinforced concrete cast in-situ floor slab, pre-cast concrete slab or a block and beam design.

In order to further mitigate the risk of ground gas ingress into the dwelling, a polyethylene, LDPE or modified bitumen/LDPE layer should be installed above a cast in-situ concrete floor slab, pre-cast concrete slab or a block and beam design. The minimum recommended standard of membrane for a cast in-situ floor slab is 1200 gauge while a pre-cast concrete slab or block and beam floor will require a 2000 gauge membrane. A single membrane should satisfy both the requirements of a damp proofing course and gas protection and any screed and insulation should then be laid on top of the membrane.

The gas membrane will span the cavity and be supported over the cavity with concrete fill or foamed plastics inserts and be continuous across the internal walls. All laps or joints in the membrane must be fully sealed where sitting within a wall, not just sealed either side of a wall. Joint sealing is typically via double-sided, self-adhesive synthetic rubber strip sealants. Many manufacturers recommend double-sided butyl tape and additional jointing tape used for securing laps and joints. A minimum 150mm lap is recommended. If service penetrations can’t be avoided, prefabricated “top hat” sections are a good means of sealing the barrier around pipe entries. The gas-resistant membrane will be protected until the screed is laid, for example with boarding, and material used as a damp-proof course will comply with the relevant British Standards or British Board of Agreement (BBA) certificate for damp-proof courses.

5.2 Further Investigation

Following the implementation of remediation, verification will be required, to ensure remediation has been successful and the site is safe for its proposed use and should include the following.

Consignment notes should be kept for waste material disposed of off-site to show that this has been sent to an appropriate licenced facility by a licenced waste carrier.

Where imported material is used as cover, this will be classified as 'greenfield' or 'manufactured' soil and 3 x samples should be taken from cover soil and analysed for Metals (As,Be,Cd,Co,Cu,Fe,Hg,Pb, Ni,Mn,Se,V,Zn), Chromium (III & VI), PAHs (16 USEPA speciation), pH, Organic Matter and Asbestos in a UKAS accredited laboratory. This will provide a sample frequency of approximately 1 sample per 12m^3 as a minimum sample size of 3 is required by YALPAG Technical Guidance.

Where site-won soil is used as cover, this will be classified as 'brownfield' or 'screened' soil and YALPAG Technical Guidance recommends a minimum of 6 samples, however, based on previous test results and the volume of cover soil required, 3 samples is considered to be sufficient. As a result, 3 x samples should be taken from cover soil and analysed for Metals (As,Be,Cd,Co,Cu,Fe,Hg,Pb, Ni,Mn,Se,V,Zn), Chromium (III & VI), PAHs (16 USEPA speciation), TPH (CWG banded), pH, Organic Matter and Asbestos in a UKAS accredited laboratory.

Samples can be collected from stockpiled soil prior to placement or in-situ cover soil after placement. If cover soil is to be stockpiled prior to placement, it should be appropriately quarantined on a polythene sheet or similar protective membrane to avoid contamination prior to placement. Cover soil may be delivered in bags and these are considered to be an appropriate means of quarantine. Alternatively, cover soil can be placed immediately upon arrival at the site.

Ground conditions encountered at the site during the sampling process should be noted, with photographic evidence taken throughout. This information will be used to inform recommendations and conclusions. Results of laboratory testing should be assessed with reference to LQM/CIEH Suitable 4 Use Levels (S4ULs) and CL:AIRE Category 4 Screening Levels (C4SLs), to assess the risk to human health and the environment.

The installation of the sub-floor void and membrane beneath the dwelling will be verified through a visual inspection in accordance with CIRIA C735 and YALPAG Technical Guidance.

A supporting appendix should be produced including photographic evidence of the depth of clean cover, using a tape measure or staff, the construction of the sub-floor void and installation of the membrane to verify that the required depth of cover has been implemented and the membrane has been appropriately installed.

The findings of this validation assessment should be used to update the Conceptual Site Model, produced as part of the Phase 2 Intrusive Site Investigation, to identify contaminant linkages at the site and determine the efficacy of remediation and the requirement for any further investigations or remediation work.

6. References

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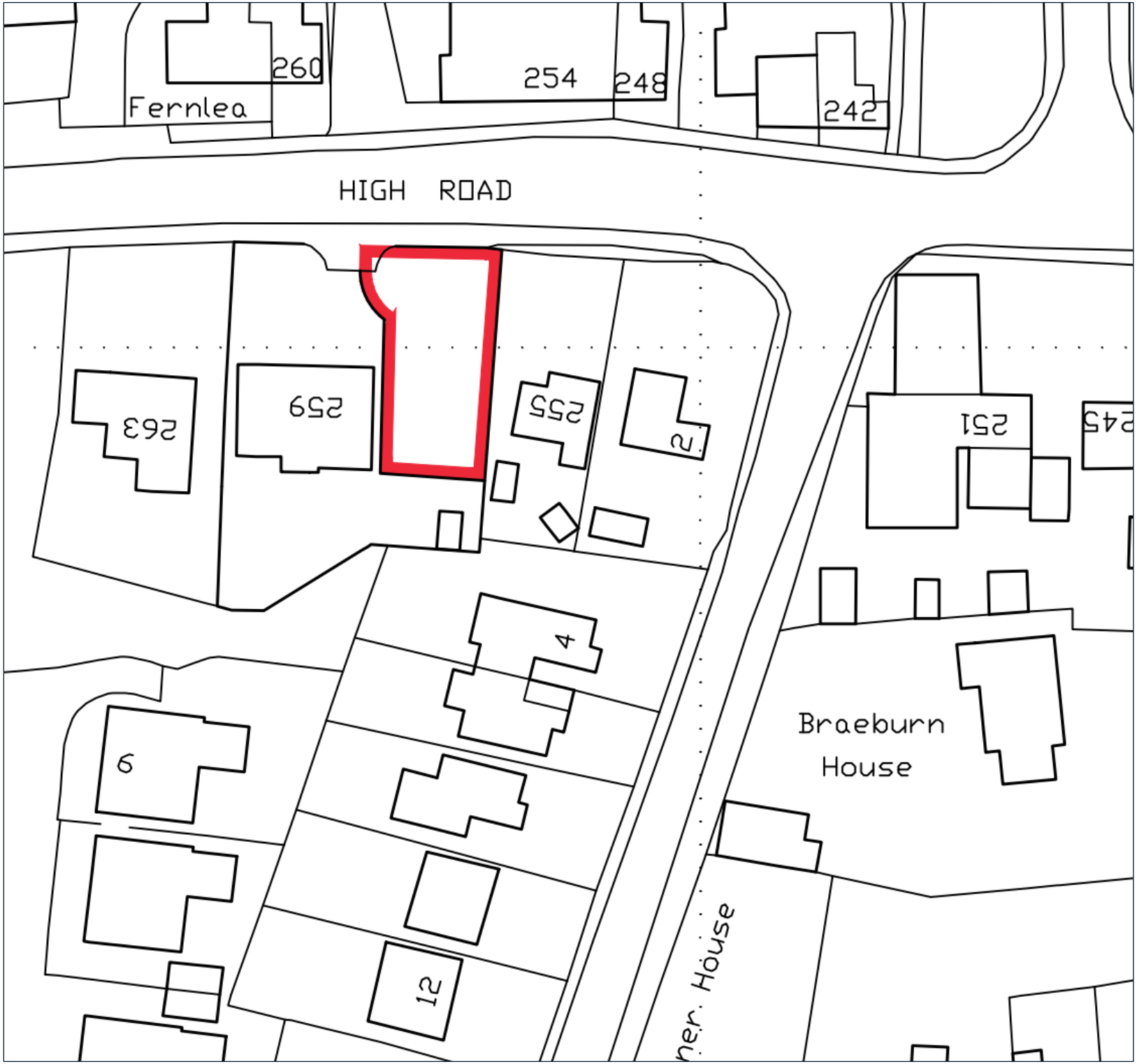
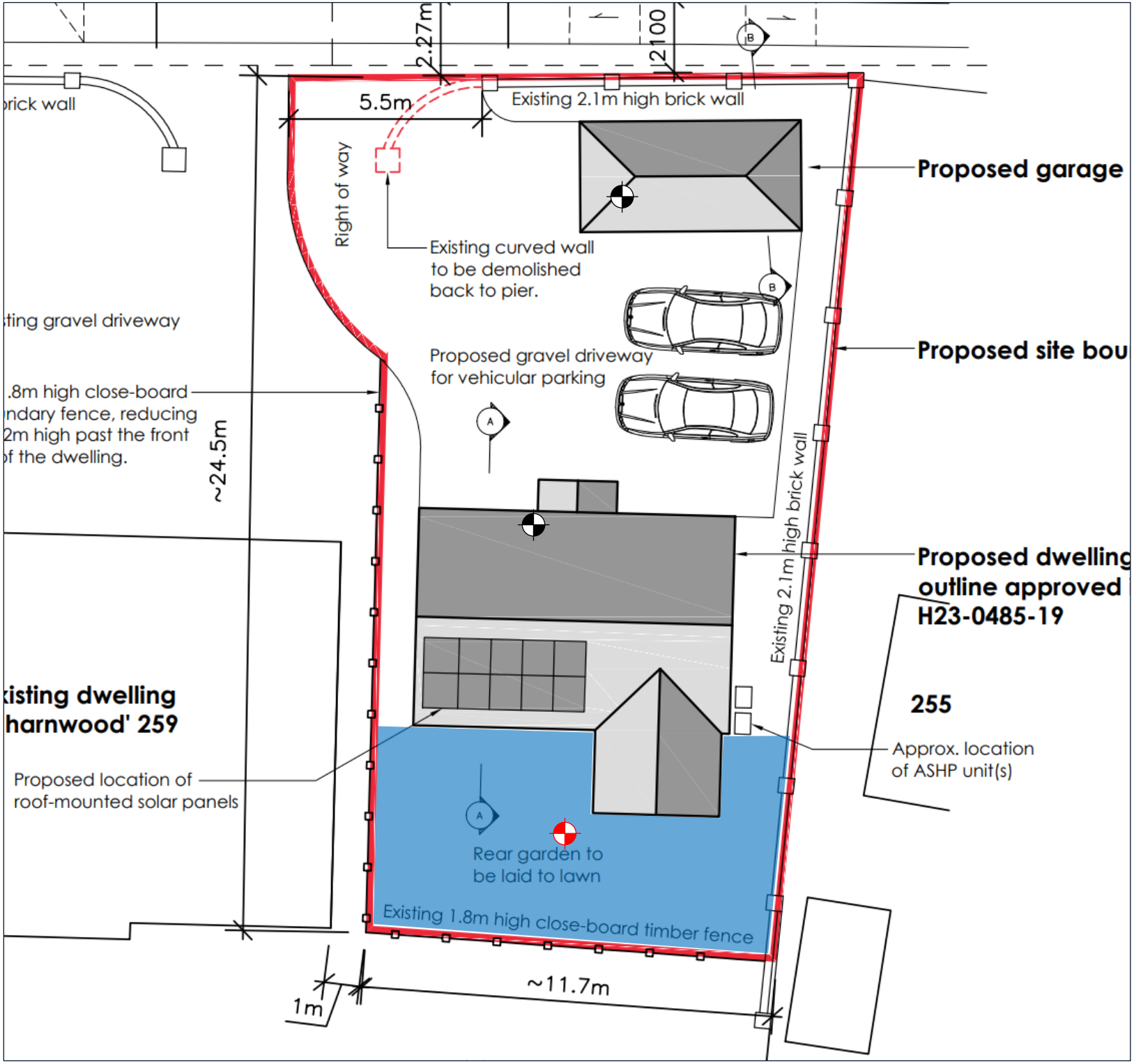


Appendix - Site Maps & Plans	
Description	
Site location plan	
Sources	
GAS Architecture	
Key	
	Site boundary
▲	North



Appendix - Site Maps & Plans	
Description	
Proposed site plan showing sample locations and extent of clean cover required	
Sources	
GAS Architecture	
Key	
	Site boundary
	Sample location
	Lead contamination identified
	Extent of clean cover recommended
▲	North