



*Geotechnical and Geo-environmental Consultants*

## **REMEDIATION METHOD STATEMENT**

**BARN AT DUCK END FARM  
GREEN ROAD  
LINDSELL  
DUNMOW  
CM6 3QH**

**Reference Number 3293/Rpt 2v1  
July 2023**

Prepared for

Duck End Farm Limited  
Duck End Lane  
Lindsell  
Dunmow  
CM6 3QM

By

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Client	Duck End Farm Limited
	Duck End Lane Lindsell Dunmow CM6 3QM
Report Title	Remediation Method Statement: Barn at Duck End Farm, Green Road, Lindsell, Dunmow, CM6 3QH
Reference Number	3293/Rpt 2v1
Date	July 2023

Approved By	Philip Miles BSc, MSc, C Geol (Director)
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## **1 INTRODUCTION**

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### **1.1 Background**

Brown 2 Green Associates Ltd have been commissioned by Duck End Farm Limited to prepare a Remediation Method Statement for the redevelopment as residential of the site of two barns at Duck End Farm, Green Road, Lindsell, Dunmow, CM6 3QH. The site is located at National Grid Reference 564060, 228880. The site location is presented in Figure 1.

A Phase 1 Desk Study and Phase 2 combined geotechnical and Geo-environmental Site Investigation was undertaken by Brown 2 Green Associates Ltd. The investigation identified a requirement for remediation. This report presents the remediation strategy to be adopted at the site.

### **1.2 Proposed Development**

It is proposed to redevelop the site for residential usage consisting of a detached house with a private garden. The proposed development is shown on drawing number 5757/03 prepared by Andrew Stevenson Associates. The proposed development layout is presented in Appendix I.

### **1.3 Objectives**

This document provides details of the requirements for remediation. The objectives of the remediation are to:

- Break the pollutant linkages that were identified as being active during the site investigation works.
- Render the site suitable for the intended end use as a residential development with private gardens.
- Render the site incapable of determination as contaminated land under Part 2A

### **1.4 Sources of Information**

Background information relating to the site was acquired and referenced from the following sources:

A Phase 1 Desk Study was previously completed by Resource and Environmental Consultants Ltd. The findings of the Desk Study are presented in the report titled:

- Prepared by Brown 2 Green Associates Limited; Geo-environmental and Geotechnical Desk Study and Site Investigation Report: Barn at Duck End Farm, Green Road, Lindsell, Dunmow, CM6 3QH; dated July 2023; Report Reference: 3293/Rpt 1 v1.

During the preparation of this report consideration has been made to the findings of the previous work. These reports should be read in conjunction with this report.

### **1.5 Limitations and Constraints of the Study**

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## 2 SITE LOCATION AND SETTING

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This section presents a summary of the site location and setting. A detailed description can be found in the previous report.

### 2.1 Site Location

The site is in a rural area at the eastern end of Duck End Farm Lane. The site location is presented in Figure 1.

The subject parcel of land is irregular in shape and covers 0.33 hectares. At the time of the site walk-over the site was being used as a farmyard. The site contains two interconnected barns. The larger barn that occupies the majority of the northern part of the site is constructed of corrugated metal sheeting, with a roof of corrugated cement sheeting suspected to contain asbestos. The floor is constructed of concrete. The barn is used for the stored or a tractor, a telehandler, domestic items, wood, building materials, a disused tank that would formally have been used for the storage of oil/diesel and general scrap metal and other dry waste. Adjacent to the eastern external wall there is an empty above ground storage tank with a dispensing pump and a grain drying unit. The tank is constructed of metal and sited on stanchions. The tank would have been used for the storage of diesel to refuel farm machinery. The ground beneath the tank is unpaved. No staining or evidence of fuel spillage was noted.

The second barn is located in the north-west corner of the site. This barn is constructed of brick with a corrugated cement roof suspected to contain asbestos. At the time of the site visit, this barn was empty.

The ground surrounding the barns is unpaved, except along the norther end of the site, where the hardstanding provides access to the barns. In the open area south of the barns, there is a stockpile of wood chippings that is partly overgrown.

### 2.2 Historic Land Use

The Desk Study identified that the site has been used as a farmyard from as early as 1872. A backfilled pond was noted.

### 2.3 Geology and Hydrogeology

The British Geological Survey mapping indicates that the site is underlain by the following geology:

Drift/Solid	Geological Unit	Description
Drift/Superficial	Lowestoft Formation	Diamicton
Solid	London Clay Formation	Blue-grey clay

The Superficial Deposits are classified as a Secondary (Undifferentiated) Aquifer. The solid geology is classified as an unproductive aquifer.

The combined groundwater vulnerability for the site is classified as medium with an intermediate pollutant speed.

There are no licenced groundwater abstraction points within 1km radius of the site. The site is in a Zone III Source Protection Zones.

## **2.4 Hydrology**

The Ordnance Survey Water Network Lines indicates the nearest surface water feature is the Daisley Brook located 197m to the south-east.

There are no licensed surface water abstraction points within 500m radius of the site.

The database indicates that the site does not lie in a fluvial or tidal floodplain.

### **3 SUMMARY OF RESULTS OF INVESTIGATION**

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#### **3.1 Ground Conditions**

##### **Top Soil/Disturbed Ground/Made Ground**

The boreholes indicate that the site outside of the footprint of the existing barns is underlain by up to 1.1m of top soil/disturbed natural soil or made ground. In WS1, 0.2m of top soil was recorded, which was underlain by 1.0m of made ground consisting of laminated slightly silty, slightly sandy, slightly gravelly clay with occasional fragments of brick. This is suspected to be soil that has been used to backfill the former pond.

In WS2 a 0.05m thick layer of ash/burnt wood with metal and plastic was identified within the made/disturbed ground. The disturbed ground consists of dark brown, silty, slightly sandy and slightly gravelly clay with gravel of flint and rare brick fragments.

Within WS3, WS4, the made ground consist of top soil over disturbed natural soil with rare brick fragments.

In WS5 only 0.1m of made ground was identified consist of a dark brown slightly silty, slightly sandy, silty gravelly clay with occasional ash fragments.

In WS6 located within the footprint of the barn, the concrete floor slab is underlain by 0.1m of yellow brown sand sub-base over disturbed natural soil.

##### **Natural Soil**

The made ground is underlain by brown with mottled orange brown and brown and blue grey mottled, slightly silty, slightly sandy slightly gravelly clay. The gravels being fine to coarse and occasional cobbles of chalk with occasional flint., fine to coarse sand to the depth of the boreholes.

##### **Visual and Olfactory Evidence of Contamination**

No visual or olfactory evidence of contamination was identified.

##### **Groundwater Conditions**

During the drilling groundwater all boreholes were dry.

It should be noted that groundwater levels can fluctuate seasonally and therefore, may be encountered at higher or lower elevations than those recorded in this site investigation.

#### **3.2 Contamination Assessment**

The contaminated land risk assessments identified the following:

The Tier I Human Health Risk Assessment has identified concentrations of individual PAHs at levels above the generic assessment criteria with made ground that has been used to backfill a pond that was formally located on the site. As this part of the site will become the rear garden of the proposed house, pollution pathways will be created. It is therefore considered that the concentrations will pose an unacceptable level of risk to human health of future site users. The concentrations will not pose an unacceptable level of risk to neighbours or construction workers.



The Tier I Controlled Water Risk Assessment has determined that there are no unacceptable concentrations of potential contaminants within the underlying soils that would pose a potential risk to controlled waters.

The risk assessment for bio-genic ground gas concluded that there is no risk from ground gas.

The risk assessment in respect to the future planting and towards sensitive ecological receptors identified that the determinants at the site would not pose a potential risk.

The risk assessment in respect to water supply infrastructure identified that the determinants at the site would not pose a potential risk to the integrity of PE or PVC pipework.

In light of the results of the site investigation, and the results of the chemical analysis and the risk screening assessment presented in the previous reports, a Conceptual Model showing the identified pollution linkages was developed. The Conceptual Model is presented below.

<b>Source</b>	<b>Potential migration pathway</b>	<b>Potential Receptors</b>	<b>Discussion, Remedial or Precautionary Measures and Mitigating Factors</b>
PAHs identified in the made ground used to backfill the pond	Soil and dust ingestion	Future residents	Remove contaminated backfill and placement of a minimum of 600mm of clean soil.

## **4 REMEDIATION STRATEGY**

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The results of the site investigation have confirmed that the level of contamination at the site has the potential to pose a risk to end users and the environment and that there are active pollution linkages present. Remediation will be required to render the site suitable for the intended end use. The aim of the remediation is to break pollutant linkages that are present and thus mitigate the identified risks to acceptable levels. An appraisal of the remediation options concludes that source removal and pathway interruption are the most appropriate techniques to be adopted.

Following the consideration of the remedial options and objectives it is considered that remediation can be achieved by implementation of the following key elements:

- Removal of contaminated made ground from extent of backfilled pond;
- Backfilling of excavated area with chemically and geotechnically suitable soils;
- Verification testing of the works undertaken.

### **4.1 Remediation Action**

#### **4.1.1 Removal of Contaminated Made Ground**

The site investigation identified that the made ground used to backfill the pond contained concentrations of PAHs at levels that would pose a n unacceptable level of risk to human health. The thickness of the made ground identified was 1.1m thick.

The made ground that has been used to backfill the pond should be excavated and removed. The excavation will be taken to either the base of the made ground where the thickness of made ground is less than 600mm below finished garden level, or, to a maximum depth of 600mm below finished garden level where the made ground extends to a depth greater than 600mm below finished garden levels.

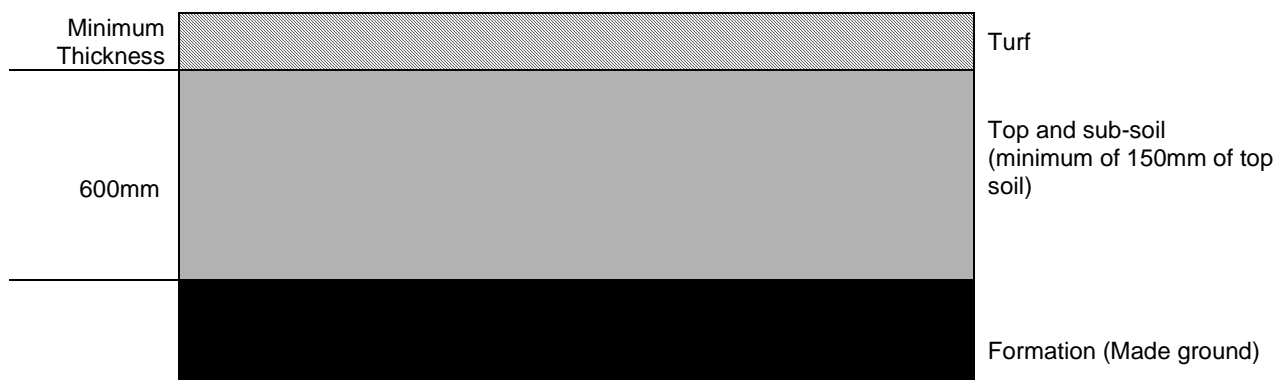
The approximate extent of the area that requires excavation is presented in Figure 2. The final extent of the area excavated should be based on visual inspection and the results of the verification sampling.

All excavated soil generated by the remediation will be classified as waste. The soil will be disposed of to a suitable waste disposal facility, treatment facility or other suitable route to enable the soil to be re-used.

#### **4.1.2 Reinstatement**

Prior to reinstatement verification sampling to provide confirmation that all contaminated soil has bene removed should be undertaken. Details are provided in Section 4.2.

Following the verification should any contaminated made ground still be present in the base of the excavated area a cover system will be placed. If all contaminated made ground has been removed, a cover system will not be required. Details of the cover system are presented below:



The soils imported to make up the capping layer should be of a standard suitable for a residential end use. The soils must be physically suitable for the intended use and be free from deleterious materials such as glass, plastic, wood, paper etc. It is recommended that topsoil should generally comply with the requirements of the specification for multigrade topsoil as given in BS 3882: 2015 or to the satisfaction of the landscape architect. All top and sub-soil that is used for the capping layer must conform to the chemical specification detailed in Appendix II.

As the investigation has identified the natural soil beneath the site is clean and suitable for reuse. Made ground and top soil can be reused providing it conformed to the requirements of the chemical specification.

## 4.2 Verification

Within the area that required remediation the following verification will be undertaken by a contaminated land consultant immediately following the excavation of the contaminated made ground and before the reinstatement of the area:

- A detailed inspection of the area will be completed to determine if all the made ground has been removed.
- Soils samples will be obtained from the sides and the base of the excavation. A minimum of 1 sample will be obtained from each side face between GL and 600mm below finished ground level and one sample will be obtained from the base.
- Samples will be submitted to a UKAS/MCERT accredited laboratory and analysed for Speciated polycyclic aromatic hydrocarbons (PAHs). The following verification criteria will be adopted.

	1% Soil Organic Matter	2.5% Soil Organic Matter	6% Soil Organic Matter
Naphthalene**	2.3	5.6	13
Acenaphthylene **	170	420	920
Acenaphthene **	210	510	1100
Fluorene **	170	400	860
Phenanthrene **	95	220	440
Anthracene**	2400	5400	11000
Fluoranthene**	280	560	890
Pyrene**	620	1200	2000
Benz(a)anthracene**	7.2	11	13
Chrysene**	15	22	27

Benzo(b)fluoranthene**	2.6	3.3	3.7
Benzo(k)fluoranthene**	77	93	100
Benzo(a)pyrene**	2.2	2.7	3.0
Indeno(123-cd)pyrene**	27	36	41
Dibenzo(a,h)anthracene**	0.24	0.28	0.3
Benzo(ghi)perylene**	320	340	350

Following the reinstatement of the area the following verification will be undertaken.

- Excavation of a trial pit to the base of the placed soil to confirm thickness has been placed. A minimum of two trial pits will be excavated.
- Verification samples of the placed soil will be obtained for laboratory analysis. A minimum of two samples will be obtained, assuming all the soil is obtained from the same source. Should soil be obtained from more than one source a minimum of three samples per source will be obtained. Should top and sub-soil be placed a sample will be obtained from each type of material.
- Samples will be submitted to a UKAS/MCERT accredited laboratory and analysed for the determinants presented in Appendix II.
- The following verification criteria will be adopted:

If contaminated made ground is still present in the base of the excavated area and minimum of 600mm of clean soil within the capping layer must be present. If the contaminated made ground has been removed no specified thickness is required.

All soil used for the capping layer or to backfill the excavated area must conform to the chemical specification detailed in Appendix II.

### 4.3 Reporting

On completion of the remediation a verification report will be prepared. The verification report will present the following information:

- Site observations and photographs, including plan showing the location of all photographs.
- Chemical analysis of verification samples and imported soils.
- Waste transfer notes.

### 4.4 Remediation Programme

Due to the time of remediation works required, the works will be undertaken as part of the construction phase.

### 4.5 Unforeseen Contamination

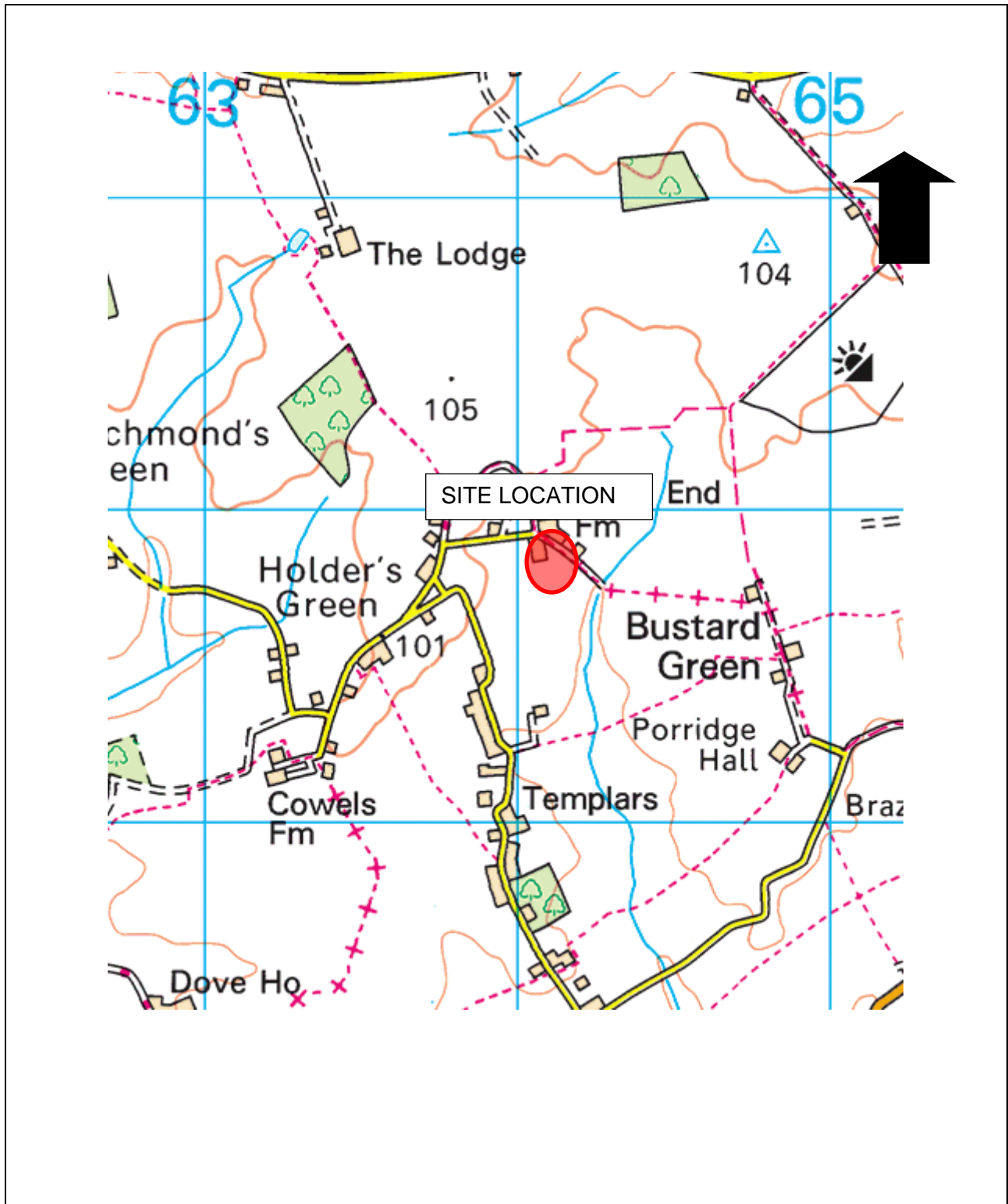
During the construction works, should any evidence of unforeseen visual or olfactory contamination not revealed during the site investigation, underground storage tanks or other underground structures be identified, contact should be made with a suitable qualified Geo-environmental Consultant. Following inspection, suitable action will be taken to assess any risk from contamination.

This may include additional investigation or sampling. If contamination is identified contact will be made with the Contaminated Land Officer at the local council and all relevant information submitted.


#### **4.6 Post Development Maintenance/Monitoring**

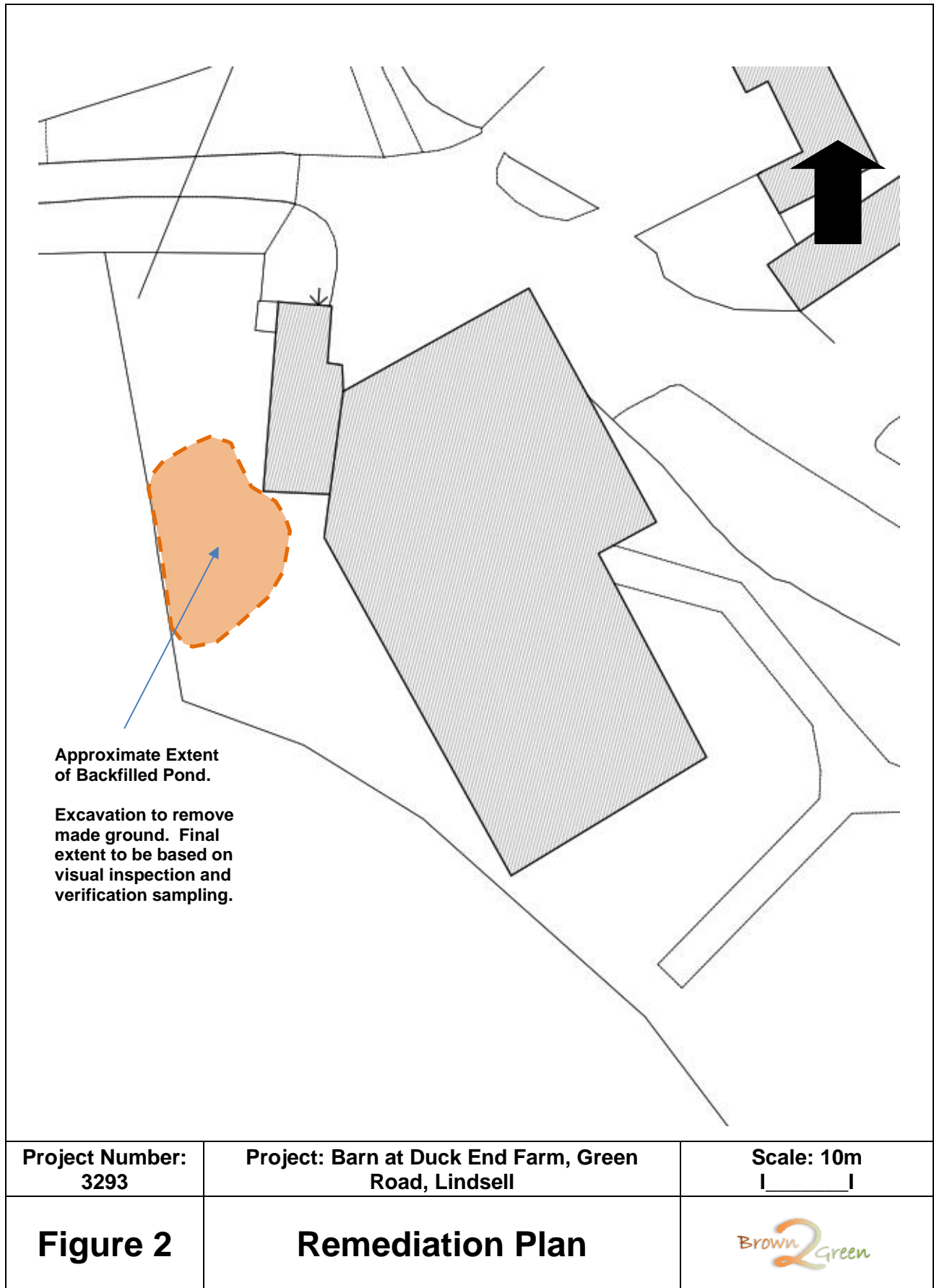
No post development maintenance or monitoring of the remediation measures are required.

## **FIGURES**



Based on an Ordnance Survey map with permission of HMSO. Crown copy right reserved. Licence number 100053399

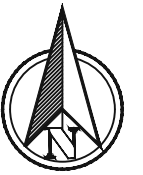
<b>Project Number:</b> 3293	<b>Project:</b> Barn at Duck End Farm, Green Road, Lindsell	<b>Scale:</b> NTS
<b>Figure 1</b>	<b>Site Location Plan</b>	





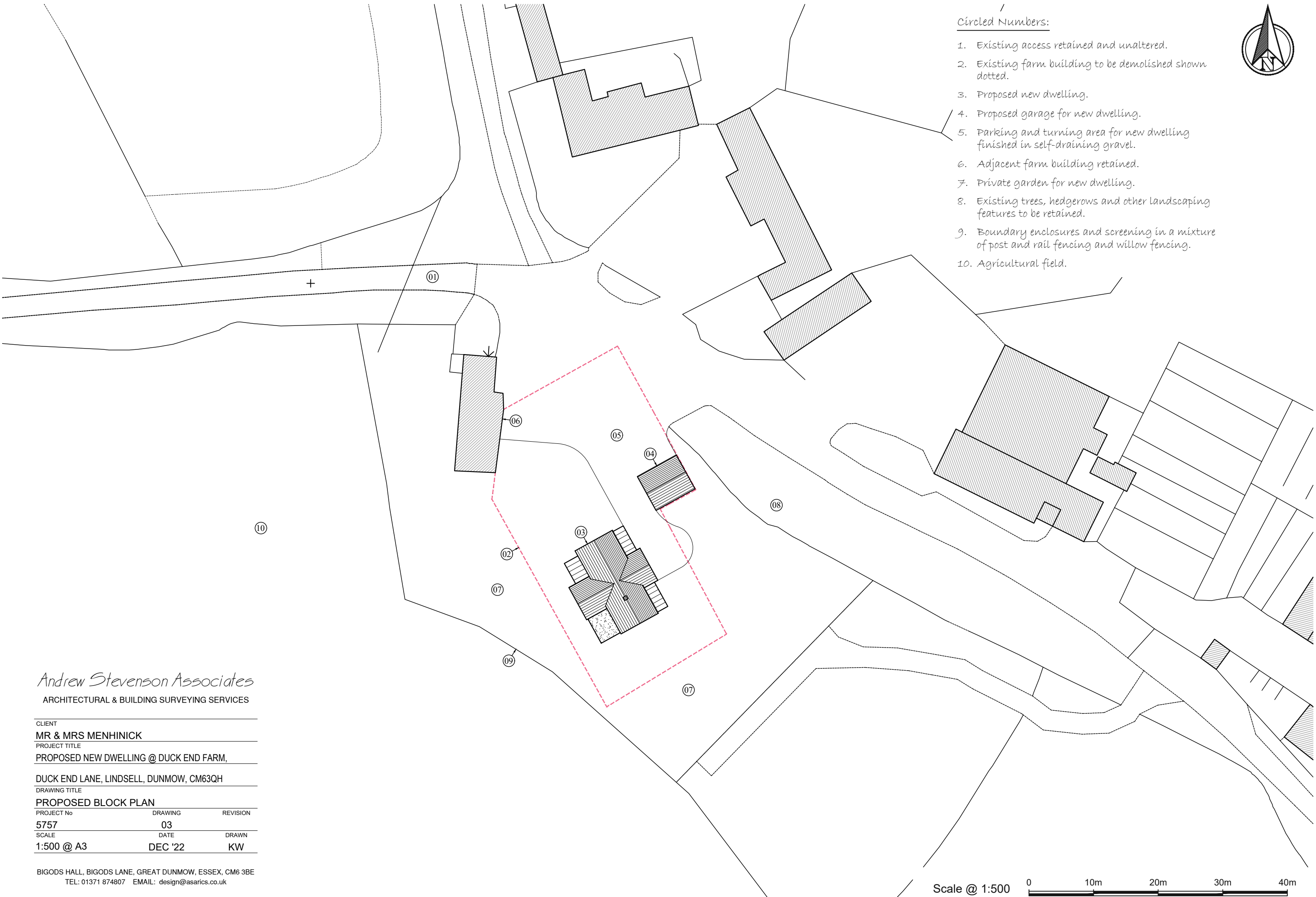
## **APPENDICES**

**APPENDIX I**  
**PROPOSED DEVELOPMENT PLAN**



Circled Numbers:

1. Existing access retained and unaltered.
2. Existing farm building to be demolished shown dotted.
3. Proposed new dwelling.
4. Proposed garage for new dwelling.
5. Parking and turning area for new dwelling finished in self-draining gravel.
6. Adjacent farm building retained.
7. Private garden for new dwelling.
8. Existing trees, hedgerows and other landscaping features to be retained.
9. Boundary enclosures and screening in a mixture of post and rail fencing and willow fencing.
10. Agricultural field.



*Andrew Stevenson Associates*  
ARCHITECTURAL & BUILDING SURVEYING SERVICES

CLIENT  
**MR & MRS MENHINICK**  
PROJECT TITLE  
**PROPOSED NEW DWELLING @ DUCK END FARM,**

**DUCK END LANE, LINDSELL, DUNMOW, CM63QH**  
DRAWING TITLE  
**PROPOSED BLOCK PLAN**

PROJECT No	DRAWING	REVISION
5757	03	
SCALE	DATE	DRAWN
1:500 @ A3	DEC '22	KW

BIGODS HALL, BIGODS LANE, GREAT DUNMOW, ESSEX, CM6 3BE  
TEL: 01371 874807 EMAIL: design@asarics.co.uk

Scale @ 1:500

**APPENDIX II**

**CHEMICAL SPECIFICATION FOR TOP AND SUB SOIL**

Determinant	Maximum Concentration (mg/kg)		
Arsenic **	37		
Cadmium**	11		
Chromium**	910		
Lead***	200		
Mercury**	40		
Nickel****	75		
Selenium**	250		
Vanadium**	410		
Copper ****	200		
Zinc ****	300		
Asbestos	None detected		
pH	5 - 10		
	1% Soil Organic Matter	2.5% Soil Organic Matter	6% Soil Organic Matter
<b>Polycyclic Aromatic Hydrocarbons</b>			
Naphthalene**	2.3	5.6	13
Acenaphthylene **	170	420	920
Acenaphthene **	210	510	1100
Fluorene **	170	400	860
Phenanthrene **	95	220	440
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Benzo(a)pyrene**	2.2	2.7	3.0
Indeno(123-cd)pyrene**	27	36	41
Dibenzo(a,h)anthracene**	0.24	0.28	0.3
Benzo(ghi)perylene**	320	340	350
<b>Total Petroleum Hydrocarbons Aliphatic</b>			
TPH C <sub>5</sub> -C <sub>6</sub> **	42	78	160
TPH C <sub>6</sub> -C <sub>8</sub> **	100	230	530
TPH C <sub>8</sub> -C <sub>10</sub> **	27	65	150
TPH C <sub>10</sub> -C <sub>12</sub> **	130	330	760
TPH C <sub>12</sub> -C <sub>16</sub> **	1100	2400	4300
TPH C <sub>16</sub> -C <sub>35</sub> **	65000	92000	110000
<b>Total Petroleum Hydrocarbons Aromatic</b>			
TPH C <sub>5</sub> -C <sub>6</sub> **	70	140	300
TPH C <sub>6</sub> -C <sub>8</sub> **	130	290	660
TPH C <sub>8</sub> -C <sub>10</sub> **	34	83	190
TPH C <sub>10</sub> -C <sub>12</sub> **	74	180	380
TPH C <sub>12</sub> -C <sub>16</sub> **	140	330	660
TPH C <sub>16</sub> -C <sub>21</sub> **	260	540	930
TPH C <sub>21</sub> -C <sub>35</sub> **	1100	1500	1700
No visual or olfactory evidence of hydrocarbons			

**Source of Values**

- \* - Soil guideline value, DEFRA/Environment Agency
- \*\* - Tier 1 GAC are based on Nathanail, C. P., McCaffrey, C., Gillett, A. G., Ogden, R. C. and Nathanail, J. F. 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham. **Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3086.**
- \*\*\* - Category 4 Screening Level.
- \*\*\*\* - BS 3882 British Standards Specification for Top Soil.
- \*\*\*\*\* - B2G level to ensure no visible or olfactory evidence.