CONTAMINATED LAND REMEDIATION STRATEGY AND VERIFICATION PLAN

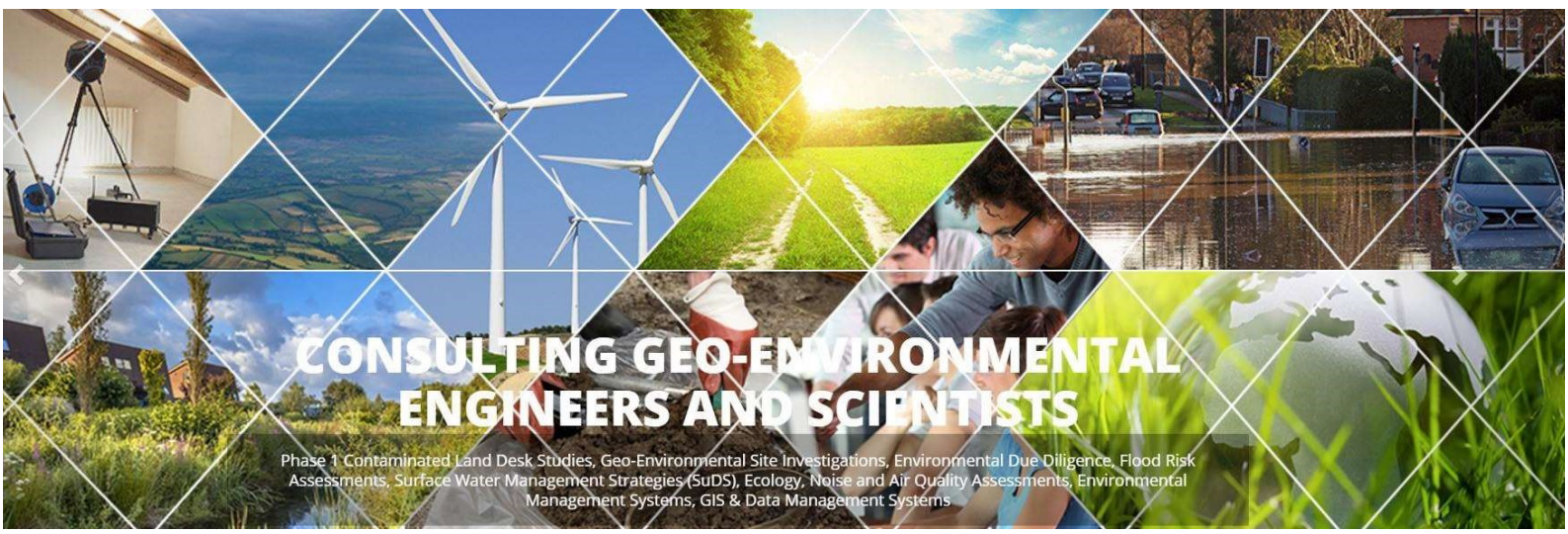
Site Address
Windmill Meadow
Windmill Road
Towersey
OX9 3QQ

Client
Gillian Probets

Report Reference
REM-2022-000017

Prepared by
STM Environmental Consultants Ltd

Date
14/07/2022



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CONTAMINATED LAND RISK ASSESSMENT
Remediation Strategy and Verification Plan

Site Address	Windmill Meadow Windmill Road Towersey OX9 3QQ
Site Coordinates	473330, 205747
Prepared for	Gillian Probets
Version No	1.0
STM Reference	REM-2022-000017
Date	14/07/2022
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Report Authorised By	Simon Makoni (BSc, MSc Env. Eng.) **Director**

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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.

4. INTRODUCTION

STM Environmental Consultants Ltd. (STM) were commissioned by Gillian Probets (Client) to undertake a prepare a Remediation Strategy and Verification Plan for a site located at Windmill Meadow, Windmill Road, Towersey, OX9 3QQ (Site).

The study is required to support planning permission P19/S0606/FUL for the conversion of part of the existing stables and barn into residential use, providing a 1-bedroom dwelling. Comments from the Contaminated Land Officer at South Oxfordshire & Vale of White Horse District Councils and proposed development plans are available in Appendix 1 and Appendix 2 respectively.

This document sets out the Remediation Strategy and Verification Plan for the site. It should be read in combination with the Phase 1 Desk Study Report (Ref: PH1-2019-000040) which was produced for the site by STM in May 2019 and the Phase 2 Site Investigation report (Ref: PH2-2022-000026) also produced by STM in June 2022.

5. BACKGROUND

5.1 Summary of Phase 1 Desk Study

The Phase 1 Desk Study produced for the site by STM in May 2019 indicated that the site has been subject to past potentially contaminative land uses (PCLUs) including Stables while off site PCLUs include a Sewage Works. A conceptual risk site model was constructed and a qualitative risk assessment carried out. This identified potentially significant Potential Pollutant Linkages with respect to human health and property receptors.

Additionally, it was noted that a search of the BGS Radon dataset indicates that the property lies in an area with 3 – 5% chance of being affected by naturally occurring Radon gas. Therefore, Radon protective measures are necessary.

The Desk Study recommended that an intrusive site investigation be carried out with the objective of determining the presence and extent of any soil contamination at the site.

5.2 Summary of Phase 2 Intrusive Site Investigation

The site investigation work was carried out on the 28th of April 2022. A total of 12no. boreholes (BH01 – BH12) were excavated to a maximum depth of 1 mbgl using a dynamic windowless sampler rig. The strata encountered generally consisted of Made Ground comprising sandy gravelly Silt and Clay which was encountered to depths between 0.15 – 0.5 mbgl and to a maximum depth of 0.9 mbgl in BH10. This was underlain by Clay to the base of the boreholes.

Visual indications of contamination of the Made Ground were observed (i.e. fragments of brick, concrete and cinder blocks) generally across the site. No significant odours were recorded during the investigation. Elevated PID readings were recorded during the site investigation in locations BH03 – BH09 with a maximum reading of 422 ppm in BH08.

2no. of the boreholes (BH03 and BH07) were installed as groundwater, ground gas and vapour monitoring wells. 3no. rounds of ground gas monitoring were undertaken over 3 weeks.

A total of 18no. soil samples were collected from depths ranging between 0.2 – 0.9 mbgl and submitted to a UKAS/MCERTS accredited laboratory for analysis of Heavy Metals, TPH, BTEX, PAHs, Pesticides and Asbestos. Additionally, 4no. samples were analysed for Microbial Soil Sample Analysis (Coliforms, E. Coli and Streptococci).

A Generic Quantitative Risk Assessment was carried out where the results of the soil sample analysis were compared to Generic Assessment Criteria (GAC) for a residential housing with home-grown produce land use scenario. Results of the soil Bacteriological sample analysis

indicate elevated concentrations of Coliforms and Enterococci in 2no. of the 4no. samples analysed.

Ground gas monitoring did not identify any concentrations of Methane or Carbon Dioxide. A Gas Screening Value of 0.0026 l/hr was calculated using the results of the monitoring which indicates that the site should be classified as Wilson and Card "Characteristic Situation 1 (CS1 – Very Low Gas Risk) meaning that gas protection measures are not required. However, given that the site lies within an area with 3 – 5% chance of being affected by naturally occurring Radon gas, Radon protective measures are necessary.

5.3 Reassessment of Potential Pollutant Linkages

The Potential Pollutant Linkages (PPLs) identified as being plausible in Phase 1 were as follows:

- Risk of direct contact (ingestion and absorption) with and inhalation of contaminants to on-site human health receptors (PPL1a)
- Risk of injury/death of on-site human health receptors as a result of explosion due to accumulation of ground gas from on and off-site sources in confined spaces within on-site dwellings (PPL1b)
- Risk of direct contact with (ingestion and absorption) and inhalation of contaminants to off-site human health receptors as a result of on-site contaminants migrating off-site (PPL2a)
- Risk of injury/death to off-site human health receptors as a result of explosion due to migration of on-site ground gas and subsequent accumulation in confined spaces in off-site buildings. (PPL2b)
- Risk of derogation of groundwater quality resulting from the migration of on-site contaminants into the underlying aquifer (PPL3)
- Risk of derogation of surface water quality resulting from the migration and entry of on-site contaminants into the surface water receptor (PPL4)
- Risk of derogation of ecological quality resulting from the migration and entry of on-site contaminants to the ecological receptor during development and after completion (PPL5)
- Risk of damage to buildings and services from on-site contaminants (PPL6a)
- Risk of damage to property as a result of explosion due to accumulation of ground gas from on and off-site sources in confined spaces within buildings (PPL6b)

Of these, the Desk Study concluded that PPL1a and PPL6a had the potential to be significant.

The Conceptual Risk Model for the site was reassessed incorporating the results of the site investigation. Potentially Significant Potential Pollutant Linkages were considered to exist with respect to human health receptors due to the elevated Bacteriological contaminants that were identified in the area of BH03. These were concerned with the risk of human health receptors (construction workers and future occupiers) being exposed to the contamination identified while undertaking groundworks and recreational activities in gardens. The table below presents the results of the re-assessment.

Given the findings of the site investigation, it was recommended that remedial measures are undertaken. However, the only location in which contamination was identified within the red line boundary which will be covered in soft landscaping is BH03. Therefore, remediation was recommended only in the area of BH03 in order to break the Potential Pollutant Linkages identified and to render the site suitable for the proposed residential end use.

Table 1: Results of Qualitative and Quantitative Risk Assessments

CRITERIA	POTENTIAL POLLUTANT LINKAGES								
	PPL1a	**PPL1b**	**PPL2a**	**PPL2b**	**PPL3**	**PPL4**	**PPL5**	**PPL6a**	**PPL6b**
POTENTIAL SOURCES	**Potential Contaminants Associated with Site Use as a Stables and Offsite Land Uses as a Sewage Works:** i.e. Acids & Alkalis, Asbestos, Chlorinated & Non-Chlorinated Solvents, Fuels & Fuel Oils, Hazardous Gases – Methane, Carbon Dioxide & Hydrogen Sulphide, Heavy Metals Organic & Inorganic Compounds, Pathogens, Pesticides & Insecticides and Treatment Chemicals.								
POTENTIAL RECEPTORS	**Onsite Humans**	**Onsite Humans**	**Offsite Humans**	**Offsite Humans**	**Groundwater** Secondary (Undifferentiated) Aquifer	**Surface Water** None	**Ecology** None	**Property/ Services**	**Property/ Services**
POTENTIAL PATHWAYS	Direct Contact/ Inhalation	Explosive Ground Gases	Direct Contact/ Inhalation	Explosive Ground Gases	Leaching	Leaching/ Migration	Direct Contact/ Inhalation	Direct Contact/ Corrosion	Explosive Ground Gases
SEVERITY	Major (4)	Major (4)	Major (4)	Major (4)	Moderate (3)	Moderate (3)	Moderate (3)	Moderate (3)	Moderate (3)
LIKELIHOOD	Possible (3)	Improbable (1)	Improbable (1)	Improbable (1)	Improbable (1)	Improbable (1)	Improbable (1)	Improbable (1)	Improbable (1)
RISK	Moderate (12)	Low (4)	Low (4)	Low (4)	Very Low (3)	Very Low (3)	Very Low (3)	Very Low (3)	Very Low (3)
POTENTIALLY SIGNIFCANT?	**YES**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

6. REMEDIATION STRATEGY

This section outlines the remedial strategy that will be implemented as part of the development.

6.1 Objectives

The Remediation Strategy and Verification Plan sets out the proposed remedial works to be undertaken at the Site to support its future development for a proposed residential with private gardens end use.

The objective of the Remediation Strategy is to break the identified PPLs thus ensuring that the site is suitable for the proposed end use.

In order for land to be considered contaminated, there must be a contaminant (or source), a receptor and a pathway (via which the contaminant can reach the receptor) present at the site. When these three components are identified at a site, a *pollutant linkage* is said to exist.

Pollutant Linkage (PL) = Contaminant –> Pathway -> Receptor

The PPL can be broken through either the removal of the Source, the Pathway or the Receptor. As the receptor cannot be removed in this scenario (the site is proposed for use as a residential dwelling), either the Source or the Pathway will need to be removed.

6.2 Remedial Options Appraisal

An appraisal of the potential remedial options available to severe the PPLs identified with respect to end users was carried out. The results are summarised in table below.

Table 2: Remedial Options Appraisal

PPL	Pathway	Remedial Option No.	Description	Feasible?	Recommended?	Comments
PPL1a	Direct Contact in private gardens and other areas of soft landscaping Direct Contact pathway involves exposure to contaminants via direct ingestion of soil and dust; consumption of home-grown produce and dermal contact Inhalation of dust (indoor and outdoor)	1	Excavation and removal of all contaminated soils from the site	Not Feasible	No	Too expensive and time consuming.
		2	Encapsulation of contaminated areas under hardstanding (i.e. driveways, car parks and buildings)	Feasible	**Yes**	This will be possible in some areas but not across the entire site as it may compromise the surface water drainage strategy for the site due to the resulting increase in run-off rates.
		3	Installation of a clean cover system	Feasible	No	Raising the ground levels by the required amounts would likely be impracticable for the development. Also, most of the contamination would be left in-situ resulting in little or no reduction of the potential impact on groundwater and surface water receptors.
		4	Installation of an engineered capping system - excavation and removal of 600mm of the contaminated Made Ground and replacement with clean fill.	Feasible	**Yes**	This option would involve the excavation and removal of 600mm of the contaminated Made Ground in a 2 - 3m radius of location of BH03 (depending on visual signs of contamination observed during the excavation) and replacement with clean topsoil.
		5	Onsite remediation of contaminated soils	Feasible	No	Although it is feasible, and the most sustainable of the available options, it would be time consuming and would likely not be completed within the timescales of the project.
	Inhalation of Radon	6	Installation of Radon protection measures	Feasible	**Yes**	Combined damp proof and Radon membrane is recommended.

6.3 Proposed Remedial Options

The proposed remedial measures will comprise all of the following:

- **Remedial Option 2 –** encapsulation of contaminated areas under hardstanding or buildings;
- **Remedial Option 4 –** installation of an engineered capping system in the area of BH03;
- **Remedial Option 6 –** installation of Radon protection measures.

6.4 Remediation Methodology

6.4.1 Encapsulation of Contaminated Areas Under Buildings and Driveway/Car Parking area

Much of the area of the site will comprise driveways/car parking and the building footprint, and as such will encapsulated much of the contaminated made ground at the site. This means that it cannot be accessed via the direct contact pathway. This is shown in the proposed plans in Appendix 2.

6.4.2 Installation of Engineered Capping Layer in the area of BH03

Made Ground within a 2 – 3m radius surrounding sampling location BH03 will be manually excavated to a maximum depth 600mm (depending on visual signs of contamination observed during the excavation). The Made Ground will be removed and taken to a licenced disposal facility by a licenced waste transport carrier. The soils removed from the excavated areas will be replaced with clean, imported, verified fill materials. The clean fill will consist of a 200mm thick sub-base (i.e. MOT Type 1 or 2) layer and 400mm topsoil.

6.4.3 Installation of Radon Protection Measures

A Radon protection membrane will be installed by appropriately certified and experienced installers and will be verified by an independent verifier.

6.5 Health and Safety

The following measures will be undertaken as a minimum for the protection of the health and safety of site workers:

- Provision of appropriate Personal Protective Equipment (PPE) including protective clothing, footwear, gloves and dust masks to all groundworkers on-site. These should not be removed from site, and advice should be given on when and how they are to be used;
- Minimising the amount of dust and mud generated on-site;
- Good practices relating to personal hygiene (i.e. washing and changing procedures) should be adhered to on-site, i.e. food and drink should only be consumed within designated areas on the site and smoking should be prohibited in all working areas.
- Provision of welfare facilities on the site;
- Health and Safety Inductions and daily briefings.

All site works will be carried out in accordance with Health and Safety Executive regulations and guidelines and the Contractor's Construction Health and Safety Plan. Particular should be made to the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Development of Contaminated Land".

6.6 Watching Brief and Discovery Strategy

It is recommended that a "watching brief" is kept at all times during the development. Should any unexpected contamination be encountered then the discovery strategy outlined below should be followed.

- Works should be halted if any suspicious ground conditions are identified by groundworkers;
- The Contractor should assess the need for any immediate health and safety or environmental management control measures. If control measures are considered to be required, they should be implemented;
- The Contractor should notify the Client's Environmental Consultant and the Local Planning Authority;
- The Environmental Consultant should attend the site to record the extent of 'contamination' and if necessary, to collect samples.
- If remedial action is considered necessary then the proposed works should be agreed with the Local Planning Authority prior to implementation;
- Once remediation is complete, the Environmental Consultant should collate evidence of work carried out for inclusion in a Remediation Verification Report which should be submitted to the Local Planning Authority.

7. VERIFICATION STRATEGY

A Remediation Verification Report written by a competent environmental consultant will be submitted and will provide a complete record of the works that have been carried out on the site. The verification reports will as a minimum contain the following:

- Plans showing locations of remediated (i.e. excavated) areas and photographic evidence (e.g. excavations with thickness measurements, filling of imported soils, finished levels etc) of the works undertaken.
- Soil certificates confirming the source of the imported material and that it is suitable for use on a residential site;
- Imported Soil Laboratory Test Certificates for full suite of potential contaminants (i.e. heavy metals, PAH, asbestos etc..) at a density of either 1 sample per garden in private gardens or 1 sample per 50m^3;
- Waste Transfer Notes and Soil Importation Certificates including volume of soil transported in each truck;
- Details, including photographic evidence of the installation of the Radon protection;
- An updated risk assessment for the site, taking into account the works that have been implemented and any uncertainties and limitations that were encountered.

8. CONCLUSIONS

It is considered that the proposed remedial measures will be sufficient to break the identified PPL and render the site suitable for the proposed use.

9. APPENDICES

9.1 Appendix 1 – Planning Permission Decision Notice

APPLICATION WEB COMMENTS FORM

Information available for public inspection and available on our website

Location : Windmill Meadow Windmill Road Towersey OX9 3QQ
Proposal : Conversion of part of the existing stables and barn into residential use, providing a 1 bedroom dwelling.
Application Reference : P19/S0606/FUL - 4

Please complete

Your name :	Contaminated Land
Your address :	(South Oxfordshire & Vale of White Horse District Councils)
Date :	15 March 2019

Use the space below for your comments

Thank you for consulting the Environmental Protection Service regarding this planning application.

I have reviewed the application from a contaminated land perspective. Colleagues will respond separately with any air quality or general environmental protection comments. I am unable to comment at present as no appropriate contamination assessment has been submitted with the application.

The planning application site has formerly been used as agricultural land. Potentially there are a range of contaminants that could be present on former agricultural land. This is particularly true of areas used as farmyards which may have contained a variety of buildings such as barns and workshops, and which could have been put to a number of uses including vehicle maintenance, chemical storage, metal working and fuel storage. Aside from the presence of made ground there are a number of chemicals that could have been used and possibly leaked or been spilled particularly in farmyard areas. Chemicals typically stored and used include agricultural pesticides, herbicides, fungicides and fuel. Disposal of waste on or in the land may also have occurred through fly tipping or unlicensed disposal of waste. Asbestos containing materials may be present on or in farmyard buildings such as barns that can have cement asbestos roofing.

The proposed residential development is regarded as a particularly sensitive use to any land contamination. For this reason, the developer should conduct adequate contaminated land investigations to ensure that the land is safe and

suitable for the intended use.

Risks associated with agricultural land â¿¿farmyardsâ¿¿ can remain difficult to quantify until there has been sampling and chemical analysis of the soils contained within the development area. This will help to determine the suitability of the site for the proposed development and whether any measures are needed to mitigate against any risks. Investigations are typically restricted to areas that will form garden grounds unless a specific source of potential contamination is identified in the preliminary risk assessment that could pose a risk to the development or the environment.

To ensure that any land contamination is addressed I would recommend that a contaminated land preliminary risk assessment consultants report is submitted in support of the application. Chemical analysis of soils at the development site may well be required following completion of this report and it may expedite understanding of any land contamination risks to undertake this testing at the same time as the preliminary risk assessment.

Regards

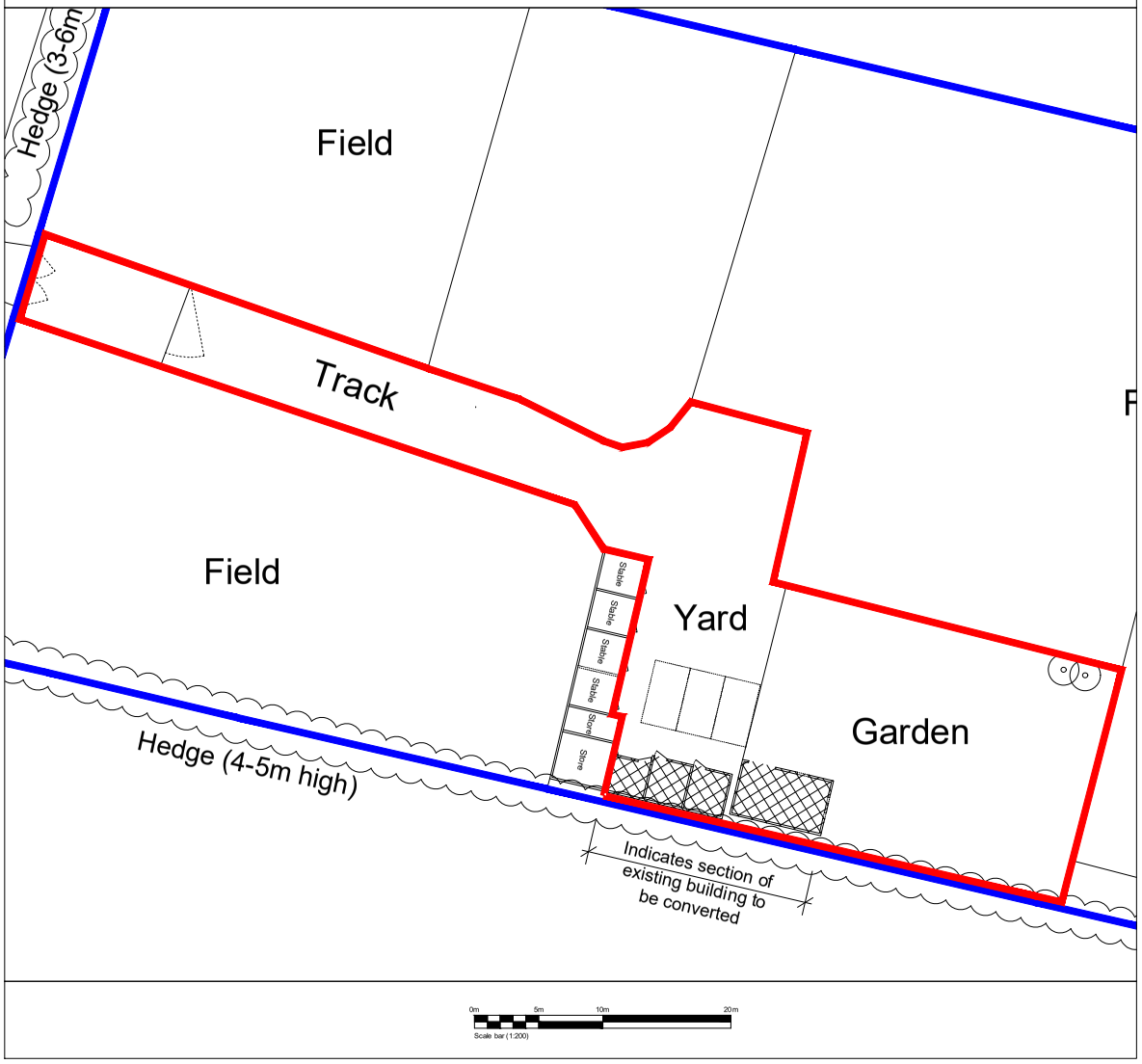
Darren Detheridge
Environmental Protection Officer

9.2 Appendix 2 - Proposed Development Plans

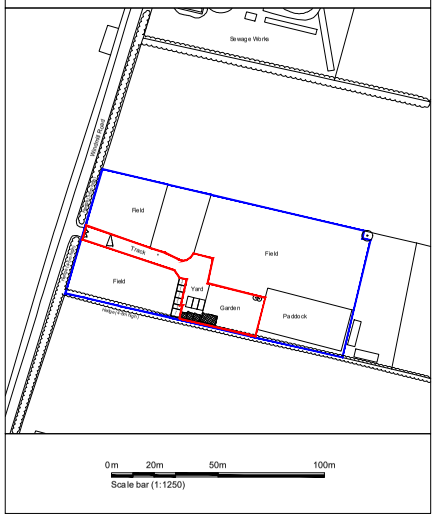
NOTES:

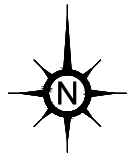
ANY DISCREPANCIES IN DRAWINGS OR DETAILS TO BE REPORTED TO BENJAMIN HILL DESIGNS LTD FOR CLARIFICATION

Site Plan



Location Plan





REV.	DATE	REVISION DESCRIPTION

BH DESIGNS

CLIENT:

Mrs Gillian Probets

PROJECT:

Windmill Meadow,
Windmill Road,
Towersey,
Oxfordshire,
OX9 3QQ

TITLE: PROPOSED - Location and Site Plan

PROJECT No:	DRAWING No:	ISSUE
BHD-0055	P1	-

STATUS:	Planning	SCALE:	1:200
DRN. N.H.	CHK –	DATE Feb 2019	1:1250

SHEET SIZE: A1

NOTES:

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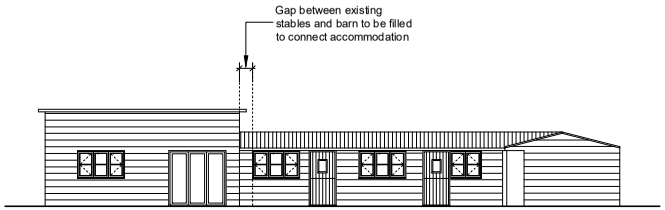

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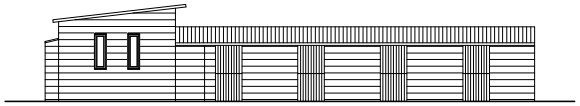

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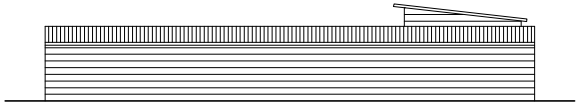

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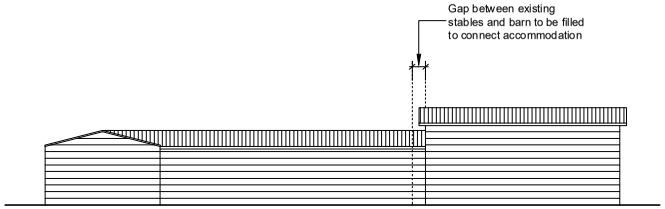

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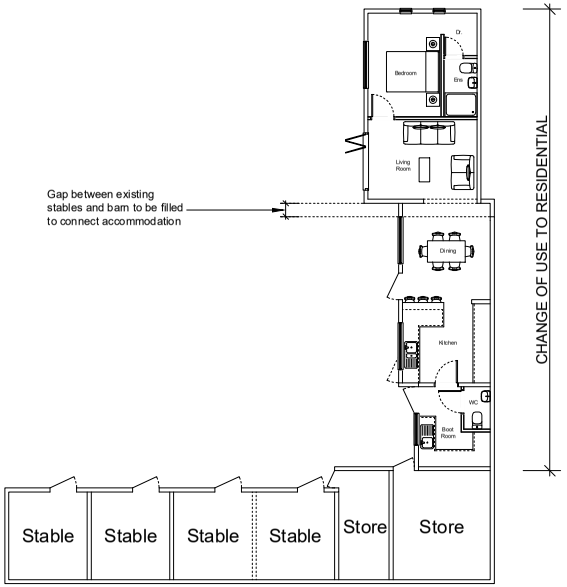

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REV.	DATE	REVISION DESCRIPTION
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BH DESIGNS

CLIENT:

Mrs Gillian Probets

PROJECT:

Windmill Meadow,
Windmill Road,
Towersey,
Oxfordshire,
OX9 3QQ

TITLE:

PROPOSED - Plans and Elevations

PROJECT No:	DRAWING No:	ISSUE
BHD-0055	P2	–

STATUS:	Planning				SCALE:
DRN.	N.H.	CHK	–	DATE Feb 2019	1:100

SHEET SIZE - A1