REMEDIATION STATEMENT
FOR PROPOSED RESIDENTIAL DEVELOPMENT
AT ALTON NURSERIES
LONG BANK
BEWDLEY

CARRIED OUT FOR:

CLIENT: MR CHRIS FLETCHER

DATE: JULY 2019 **REPORT NO:** 1953

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1.0 INTRODUCTION

Ground Investigation Specialists Limited (GIS) have previously submitted an intrusive investigation report (GIS Report No: 1953; dated January 2019) for a proposed residential development at the former Alton Nurseries located at Long Bank, Bewdley.

The contamination testing established the presence of three elements of concern on the site with potential implications for human health and the pollution of controlled waters. Specifically they were all connected to the area of the former coal store and boiler house, and where there were once two above ground fuel storage tanks (ASTs).

i) Hydrocarbon contamination (TPH $>C_{12} - C_{16}$) of the near surface clays. Visual and olfactory evidence of contamination also noted.

ii) Significant hydrocarbon contamination of the groundwater in respect of diesel and heating oil (TPH >C_{10} – C_{44} Aliphatics). A little PAH (anthracene) contamination was also found due to the presence of coal, ash and clinker at the surface in the made ground.

iii) Elevated concentrations of carbon dioxide, attaining a maximum of 9.3% v/v during the period of monitoring.

The recommendations made in the intrusive investigation concerning soil, groundwater and gas contamination and an outline remediation strategy for the site have been reviewed and agreed in principal by Worcestershire Regulatory Services (WRS). On this basis, the following report provides a detailed remediation statement for approval by WRS. It outlines a comprehensive strategy for the treatment of the contamination sources summarised above, with the aim of significantly reducing the risks posed to human health and the wider environment. It should only be read in conjunction with GIS report 1953.

2.0 OBJECTIVES OF THE REMEDIATION WORKS

The objectives of the remediation works are to mitigate the risks posed to human health and controlled waters associated with the hydrocarbon contamination present in the near surface soils and groundwater around the area of the former boiler house and ASTs.

Table 1 (page 4) comprises the revised conceptual site model (CSM) for the proposed residential development at Alton Nurseries.

3.0 SUMMARY OF OPTIONS APPRAISAL

The remedial option considered the most economic and effective involves the excavation and appropriate treatment of the worst of the impacted soils in tandem with the removal of the locally contaminated groundwater. Following confirmation that the excavation is 'free' from hydrocarbon contamination, the excavation will be immediately backfilled in a controlled and engineered manner with a suitable 'clean' low permeability material, which could either be site won or imported. The anticipated lateral extent of the excavation/treatment area is depicted on the Remediation Site Plan included in Section 6.0. The remedial works will require independent validation to ensure the contaminated soil has been removed and to check the suitability of the 'clean' soil.

4.0 DETAILS OF REMEDIAL WORKS TO BE COMPLETED

Table 2 (pages 5 and 6) is a summary of the remedial works to be completed for the site. The anticipated area of treatment is indicated on the Remediation Site Plan included in Section 6.0.

5.0 DETAILS OF VALIDATION OF REMEDIAL OBJECTIVES

Table 3 (page 7) is a summary of the validation of the remedial works to achieve the objectives for the site.

Table 1. CSM for Proposed Residential Development – Alton Nurseries, Bewdley

Location	Source	Pathways	Receptors	Risk
Area in and around old boiler house/coal store and former ASTs	TPH contamination in near surface soils	• Direct ingestion of soil and dust (indoor through tracking back of dust into buildings and outdoor) • Consumption of home grown produce through plant uptake of contaminants and soil attached to home grown produce. • Inhalation of dust and vapour (indoor and outdoor) • Dermal contact (indoor and outdoor)	• Site workers • Building occupants • Neighbours	**Moderate** As long as the TPH contamination remains on site it represents a potential risk to groundworkers and end-users alike.
	TPH & PAH contamination in groundwater	• Migration of contamination through fissures or sandstone bands in Etruria Formation	• Groundwater – likely discharge zone is ditch located on northern boundary which could be connected to unnamed stream issuing c. 140m to the north-west	**Low to Moderate** The contamination could present a potential risk to groundwater quality down gradient. However, this is mitigated by the mostly low permeability of the Etruria Formation. No overlying drift deposits present. Site not located in a Source Protection Zone.
	Carbon dioxide and possible Volatile Organic Compounds (VOCs) contamination	• Generation of ground gases and VOCs on site • Migration through fissures and sandstone bands in Etruria Formation	• Building occupants • Neighbours	**Low** the ground gas contamination could present a potential risk, but following treatment of the TPH contamination identified above, post-remediation monitoring will likely confirm low gas concentrations and no protective measures required in new buildings.

Table 2 : Details of Remedial Works to be completed

Description of Ground Conditions in Work Area	Type, Form and Scale of Contamination	Remediation Methodology	Phasing of Works	Consents and Licenses	Site Management Measures
TPHs within near surface clays and shallow groundwater in area of boiler house and ASTs- BH1 and BH2	In soil TPH $>C_{12}-C_{16}$ = 340 mg/kg in BH1	• Excavation and removal of impacted clay to soil treatment centre in Rowley Regis operated by Provectus Remedation • Validation of removal and clean-up. • Backfill with clean soil	i) Excavation of made ground and clay to anticipated depths of 1.0 – 1.5 m ii) Confirmatory visual inspection and laboratory analysis of validation samples should be used to confirm the removal. iii) Backfill with suitable replacement soil Duration of works approximately 2 weeks.	• Waste Transfer Tickets showing quantities of soil removed from site and transported to treatment centre in Rowley Regis operated by Provectus Remediation.	• Works to be undertaken during normal working hours Mon – Fri • Contractors to wear appropriate PPE and receive appropriate training • Concrete and buried foundations to be broken out where present • Excavation to be undertaken by appropriately sized excavator • Works to be verified by Geoenvironmental Engineer.

Table 2 (contd): Details of remedial works to be completed Cont ..../

Description of Ground Conditions in Work Area	Type, Form and Scale of Contamination	Remediation Methodology	Phasing of Works	Consents and Licences	Site Management Measures
TPHs within near surface clays and shallow groundwater in area of boiler house and ASTs – BH1 and BH2	In groundwater TPH >C_{10} – C_{44} Aliphatics = 2627 µg/L in BH2	• Excavation of contaminated zone for groundwater pumping (see Remediation Site Plan in Section 6.0) • Groundwater to be pumped to tanker and then tested (repeat if required) • Validation of removal and clean – up. • Further risk assessment carried out if required.	i) Excavation of made ground and clay to anticipated depths of 1.0 – 1.5 m. ii) Confirmatory visual inspection and laboratory analysis of validation samples should be used to confirm removal Duration of works approximately 2 weeks	Waste Transfer Ticket(s) showing quantity of groundwater removed from site and destination	• Works to be undertaken during normal working hours Mon – Fri • Contractors to wear appropriate PPE and receive appropriate training • Concrete and buried foundations to be broken out where present • Excavation to be undertaken by appropriately sized excavator • Works to be verified by Geoenvironmental Engineer.
TPHs within near surface clays and shallow groundwater in area of boiler house and ASTs – BH1 and BH2	Potential Carbon Dioxide and Volatile Organic Compounds (VOCs) Vapour Ingress	• Following removal of impacted soils and groundwater and replacement with clean soil, a programme of post-remediation gas monitoring carried out to determine if new houses required specialist gas protection measures.	Following remediation and backfilling of excavation a minimum of two standpipes installed and monitored weekly for six weeks for carbon dioxide and flammable gases. Duration of works approximately 6 weeks	Ground gas risk assessment report provided giving results of monitoring programme and details of gas protection measures (if required).	• Works to be undertaken during normal working hours Mon – Fri • Contractors to wear appropriate PPE and receive appropriate training • Works to be verified by Geoenvironmental Engineer

Table 3 : Details of Validation of Remedial Objectives

Site Area	Sampling Strategy	Use of On-site Observations	Chemical Analysis/Monitoring Data	Proposed Clean-up Standards	Variations from Approvied Remediation Certificate	Phasing of Validation
Area of TPH contamination in and around boiler house and ASTs (BH1 and BH2)	i) Laboratory analysis of validation samples to confirm the removal ii) Analysis of imported soil at source (if applicable) iii) Sampling of imported soil once in place (if applicable)	i) Confirmatory PID detection, visual and odour inspection.	i) Surrounding clay horizon tested for TPH CWG ii) Groundwater tested for PAH (Anthracene) and TPH CWG iii) If deemed necessary to bring soil onto site tested at source and once imported for routine metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn); speciated PAH; banded TPH and asbestos. **NOTE:** CLAY gained from elsewhere on site has been tested and proved to be suitable for re-use – no further testing is required	S4UL/C4SL for residential with home grown produce land use (See Table 4)	If arise confirm action with WRS	No

5.1 Soil Import Criteria

Table C (below) sets out suitable criteria for any soils delivered to site (if required). These values are designed to be protective of human health in a residential end use scenario.

It would be advisable to import soils from a non-recycled natural source. This will minimise the risk of importing materials containing asbestos, or any sharp object (such as glass) that may cause injury.

Table 4 : Soil Import Criteria

Determinand	Units	Import Criteria	Determinand	Units	Import Criteria
Arsenic	mg/kg	37	Anthracene	mg/kg	5400
Cadmium	mg/kg	11	Fluoranthene	mg/kg	560
Chromium	mg/kg	910	Pyrene	mg/kg	1200
Copper	mg/kg	2400	Benzo[a]anthracene	mg/kg	11
Lead	mg/kg	200	Chrysene	mg/kg	22
Mercury	mg/kg	40	Benzo[b]fluoranthene	mg/kg	3.3
Nickel	mg/kg	130	Benzo[k]fluoranthene	mg/kg	93
Selenium	mg/kg	250	Benzo[a]pyrene	mg/kg	2.7
Zinc	mg/kg	3700	Indeno[1,2,3-cd]pyrene	mg/kg	36
pH	pH Units	<5	Dibenzo[a,h]anthracene	mg/kg	0.28
Asbestos	-	Nil	Benzo[g,h,i]perylene	mg/kg	340
			>C_5 – C_7	mg/kg	78
			>C7 – C8	mg/kg	230
Naphthalene	mg/kg	5.6	>C_8 - C_{10}	mg/kg	65
Acenaphthylene	mg/kg	420	>C_{10} - C_{12}	mg/kg	180
Acenaphthene	mg/kg	510	>C_{12} – C_{16}	mg/kg	330
Fluorene	mg/kg	400	>C_{16} – C_{21}	mg/kg	540
Phenanthrene	mg/kg	220	>C_{21} – C_{35}	mg/kg	1500
			>$C3_5$ – C_{44}	mg/kg	1500

All soils to be imported must be verified prior to delivery to site. Once laid on site, testing should be carried out at a ratio of at least 1 test per 250m^3 for natural soils.

5.2 Validation Reporting

Once the contaminated soils and groundwater have been removed, the validatory test results confirmed as acceptable and the excavation backfilled, a final Validation Report will be produced for the approval of Worcestershire Regulatory Services. This will include all laboratory test results and observations, a photographic records of the events and details of all waste and soil transfers.

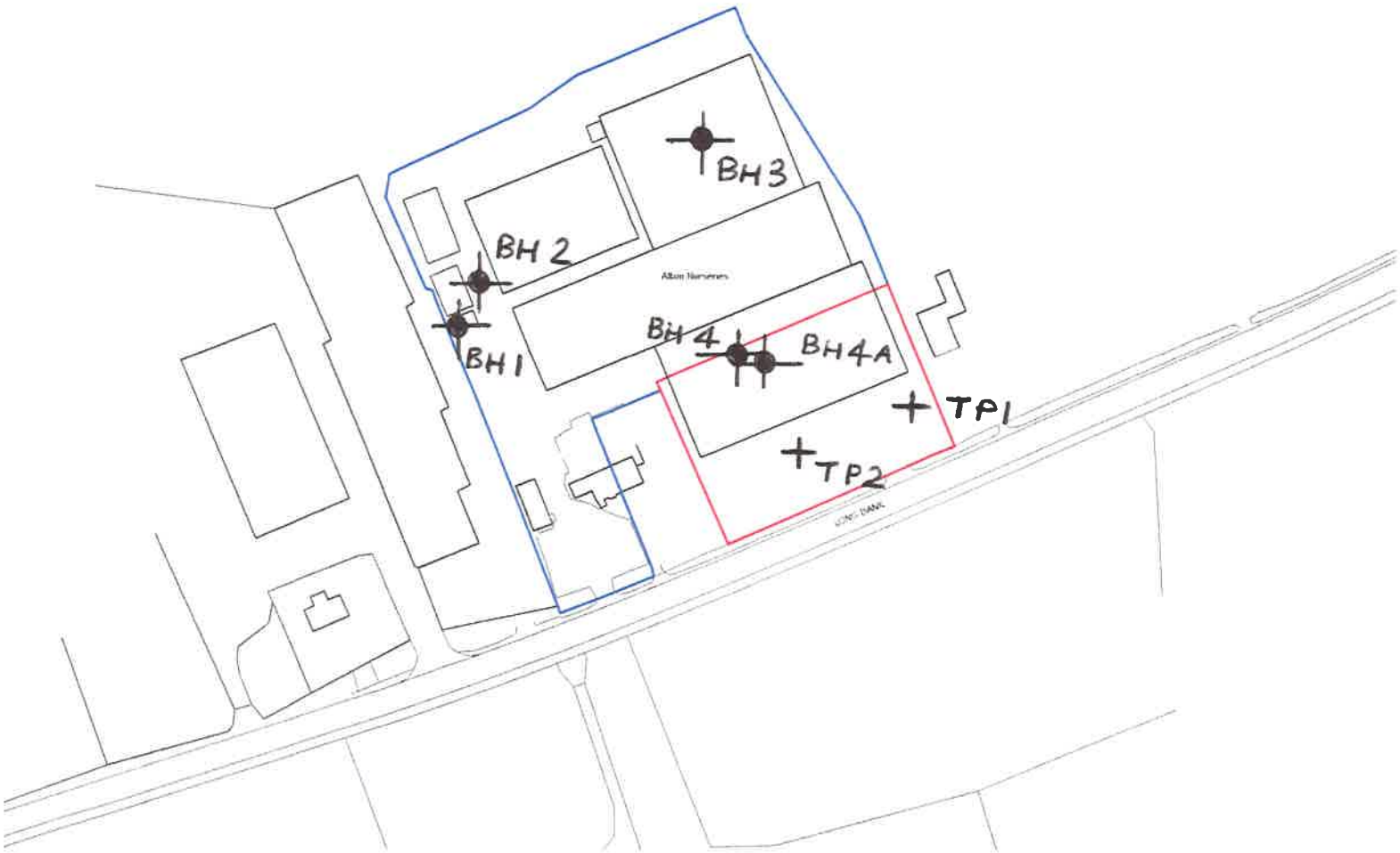
5.3 Additional Considerations

Groundworkers involved in the construction works should wear appropriate PPE at all times (gloves, overalls, boots etc).

Washing facilities should be provided and used prior to eating. Full details of appropriate PPE and facilities are provided in the HSE document ("Protection of Workers and the General Public during Development of Contaminated Land"). No smoking shall be permitted during the remediation works.

H.S. Lister, BSc., C. Geol., C Sci., FGS.
Director
Ground Investigation Specialists Limited

6.0 REMEDIATION SITE PLAN



1:1250 scale SITE LOCATION PLAN

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