



**The Laurels
Dappers Lane
Angmering
West Sussex**

Remediation Strategy

Report Beneficiary:
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Project Reference: P14215

Report Reference: R13936

Document Control			
Issue No.	Status	Issue Date	Notes
1	Final	25 th October 2019	
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TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	SITE CONTEXT AND RISK ASSESSMENT	1
2.1	Site Location	1
2.2	Ground Conditions	1
2.3	Summary of Quantitative Risk Assessment	1
3.	REMEDIATION STRATEGY	2
3.1	Options Appraisal	2
3.2	Proposed Treatment of Existing Contamination	2
3.3	Watching Brief on Development Works	4
4.	VERIFICATION PLAN	4
4.1	Services	4
4.2	Inspection of Stripped Formations and Placement of Geotextile Marker and Geo-Grid (where necessary)	4
4.3	Cover System Depth	5
4.4	Imported Materials	5
5.	POST REMEDIATION RISK ASSESSMENT	7

FIGURES AND APPENDICES

FIGURES

- Figure 1 Site Location Plan
Figure 2 Remedial Works Plan

APPENDIX A

Quantitative Conceptual Model

APPENDIX B

Checklist for Verification Report(s)

1. INTRODUCTION

It is proposed to redevelop a parcel of land located off Dappers Lane, Angmering, West Sussex, for residential use. The development proposals are understood to comprise the construction of 9 No. detached and semi-detached dwellings with associated private gardens, parking and access road.

Ashdown Site Investigation Ltd. previously carried out an intrusive ground investigation and prepared a ground contamination risk assessment¹ to assist development of the site. The report identified complete pollutant linkages to be present and recommended remedial works be carried out to safeguard the end users of the proposed development. The report recommended that remediation proposals should be documented in a separate report.

Ashdown Site Investigation Ltd was subsequently requested to prepare a remediation strategy for the site. The remediation proposals are based upon the conclusions of the contamination risk assessment report and should be read in conjunction with that report. The remediation strategy has been prepared in line with current guidance^{2,3}.

The scope of the works covered by this report, and the terms and conditions under which they were undertaken, were set out within the offer letter Q8994, dated 1st October 2019. The instruction to proceed was received on behalf of the client, Oceanview Developments Ltd.

2. SITE CONTEXT AND RISK ASSESSMENT

2.1 Site Location

The site comprises an approximately 'L' shaped plot of land located at Dappers Lane, Angmering, West Sussex, and is centred on the approximate Ordnance Survey national grid reference TQ 07350 04860. A site location plan is presented as Figure 1.

2.2 Ground Conditions

The majority of the site was surfaced with grass and underlain by a shallow depth of topsoil. Made ground was recorded to depths of between 0.20m and 0.65m below ground level and was underlain by Head Deposits.

2.3 Summary of Quantitative Risk Assessment

The quantitative risk assessment identified the shallow made ground and topsoil currently present on the site to contain asbestos materials and concentrations of lead and PAH compounds considered to pose an unacceptable risk to human health. Concentrations of petroleum hydrocarbons which exceeded the threshold value for the use of PE water supply pipe were also recorded.

The quantitative conceptual model showing complete pollutant linkages in the absence of remediation works for the proposed development is presented in Appendix A.

¹ Ashdown Site Investigation Report ref: R18-13291, 14th November 2018

² Environment Agency Contaminated Land Report 11: Model Procedures for Management of Land Contamination

³ Environment Agency Report Ref: SC030114/R1 "Verification of remediation of land contamination"

3. REMEDIATION STRATEGY

CLR11 recommends that any remedial action proposed for the site should be justified. The requirement for remedial action is considered to be justified due to the identification of complete pollutant linkages.

The remediation works have been developed to meet the technical objectives for the development, the major drivers behind which are:

- To achieve successful remediation within a particular timescale and budget;
- Familiarity with the methodology by the developer/ground worker;
- Confidence that the remediation can be carried out by good technical practices; and
- Likely success of the style of remediation.

3.1 Options Appraisal

The primary driver for remediation at the site is the presence of asbestos and concentrations of lead and PAH compounds within the shallow made ground and topsoil that are considered to pose an unacceptable level of risk to human health in the context of the development. There are no in situ or ex situ remediation techniques available to reduce the concentrations of contaminants within the made ground soils to below that of the published screening values, or which could guarantee removal of all asbestos containing materials within the matrix of the made ground soils.

The method chosen for remediation must be achievable by the groundworker, ideally by using techniques they are familiar with.

Given the very shallow depths of made ground generally recorded on the site, it is considered that the remediation proposals would ideally comprise the complete removal of the contaminant source (the made ground soils) or, where locally the made ground is present to greater depth, the contaminant pathways may be severed through the provision of a cover system in areas where the end users may reasonably be expected to be exposed to the soils or soil derived dust.

3.2 Proposed Treatment of Existing Contamination

3.2.1 *Protection of Human Health*

Within all proposed areas of private garden and/or areas of communal soft landscaping existing topsoil and made ground should be excavated to expose the undisturbed soils below. In the event that localised pockets of deeper made ground are found, these should be excavated to a sufficient depth to allow the placement of a cover system of at least 600mm of verified "clean" soil which must then be underlain by a high visibility geotextile marker and a geo-grid.

Where required, the proposed depth of the cover system represents "two spade depths" to allow for planting of trees, shrubs etc. without residents coming into contact with the contaminated soils remaining at depth.

It is noted that the intrusive works undertaken to date have not proven significant depths of made ground to be present below the canopy area of existing trees, many of which are to be retained within the development. It is therefore anticipated that all made ground will be able to be removed without impacting existing tree roots.

In the event that deeper made ground is found to be present within any tree root zones, further testing and assessment may be necessary to determine whether complete removal is necessary in such areas.

Elsewhere on the site the presence of building cover, roadways and permanent access ways comprising hard cover will also act to sever the contaminant pathways and thereby reduce the risk to end users to an acceptable level.

3.2.2 *Protection of Controlled Waters*

The risk assessment did not identify any unacceptable risks to controlled waters beneath the site and therefore no specific remedial works are considered necessary in this regard.

3.2.3 *Protection of Services*

Unless confirmed otherwise in writing by the water supply company, it should be assumed that barrier pipe is required for all new water supply connections.

All service providers' requirements must be fully adhered to in order to reduce the risk to end users and services to an acceptable level.

Details of any measures required by service providers and confirmation of their implementation should be included within the verification report.

3.2.4 *Protection of Construction Workers*

As a minimum and in accordance with industry best practice, all ground-workers should be issued with the appropriate PPE and should be instructed in safe working methods, particularly in view of the potential for asbestos to be encountered within the made ground soils. Site clearance should be undertaken by a suitably experienced contractor and appropriate working procedures and PPE should be employed to ensure the health and safety of the site operatives.

As a precautionary measure, instructions should be given in the recognition of potentially hazardous materials, including oily and odorous soil and water and discoloured or fibrous substances. Any oil-like substances contacting the skin must be washed off immediately using an appropriate cleanser. Operatives should be warned to avoid contact between hands and mouth before washing. The consumption of food and smoking must be confined to designated clean areas. Suitable welfare (washing) facilities should be provided. These precautions should be taken in addition to anything highlighted by a site-specific risk assessment which should be undertaken by any contractor prior to commencing work.

Particular attention should be paid to minimising dust arising from soils and appropriate precautions in this regard should include damping down of soils when in dry conditions.

All site personnel should be appropriately briefed on what actions to take if evidence of significant contamination is identified or suspected.

3.3 Watching Brief on Development Works

If, during the site clearance and development works, any materials not previously identified by the investigation that are suspected of being 'contaminants' are encountered, then the following procedure should apply:

- All works in that area should cease and the site manager should be informed.
- Advice should be sought from suitably qualified and experienced personnel as to whether any further site inspection, sampling, testing and/or assessment is deemed necessary.
- If required, the conclusions of any assessment and any proposed remedial works (if required) should be agreed by the local authority.
- If necessary, full details of any additional remedial works undertaken should be included in the verification report for the site.

Suspected 'contamination' may take the following form, though it is noted that this list is not exhaustive and site operatives should ask if they are at all unsure of any findings:

- Soil or water looks oily and/or has an oily odour
- Soil or water has a solvent type of odour
- Significant quantities of man-made materials within fill such as paint cans, car parts, glass fragments
- Suspected asbestos containing materials (insulating boards, cement, loose fibres etc.)
- Significant volumes of clinker like or ashy material
- Sand bags, and/or subsurface concrete structures
- Animal carcasses or evidence of animal burial pits

4. VERIFICATION PLAN

A checklist summarising the requirements of the verification report is presented within Appendix B.

Depending on the development programme it may be necessary for interim verification reports to be produced for individual plots or groups of plots, prior to the completion of all development works.

4.1 Services

Confirmation of any service providers' requirements and evidence to demonstrate adherence to them should be included in the verification report.

The contractor should provide photographic evidence to confirm installation of barrier pipe or, if applicable, written confirmation from the local water supply company that other pipework is acceptable.

4.2 Inspection of Stripped Formations and Placement of Geotextile Marker and Geo-Grid (where necessary)

For all areas where remediation works are required (reference Figure 2) the formation level of all garden and soft landscaped areas will be inspected to confirm the removal of existing topsoil and made ground to expose the undisturbed soil below.

R13936

In any areas where locally deeper made ground is present and the cover system is to be provided, inspection should be made to view the presence of the geotextile and geo-grid and to confirm that a sufficient depth is available to place 600mm of cover soils.

A photographic record of all stripped formations will be maintained for inclusion in the verification report.

4.3 Cover System Depth

In any areas where the 600mm cover system is necessary, the final depth of cover soils placed should be confirmed by use of tape measurements made within trial excavations. In areas where the cover system is not required, the depth of any surface dressing (topsoil etc.) will not be measured.

Photographic evidence of the depth of cover soils present will be included in the verification report.

4.4 Imported Materials

Any imported material from a potentially contaminated (e.g. industrial) site should be rejected. It is recommended that chemical testing results are obtained and supplied for comment prior to accepting the soils on site.

Once imported materials have been brought to site they should be stockpiled and protected from cross contamination with any other materials already on site. They will then be inspected, sampled and tested by Ashdown Site Investigation Ltd.

4.4.1 Soils for use in soft covered areas.

The table below summarises the soil screening values⁴ against which any imported soils will be assessed.

Table 1. Calculated soil screening values for imported soils

Contaminant	Screening Value (mg/kg)	Contaminant	Screening Value (mg/kg)
Arsenic	37	Fluorene	170
Cadmium	11	Phenanthrene	95
Chromium	910	Anthracene	2400
Copper	2400	Fluoranthene	280
Lead	200	Pyrene	620
Mercury	40	Benz(a)anthracene	7.2
Nickel	180	Chrysene	15
Selenium	250	Benzo(b)fluoranthene	2.6
Zinc	3700	Benzo(k)fluoranthene	77
Hexavalent Chromium	6	Benzo(a)pyrene	2.2
Water Soluble Boron	290	Indeno(123-cd)pyrene	27
Naphthalene	2.3	Dibenz(ah)anthracene	0.24
Acenaphthylene	170	Benzo(ghi)perylene	320
Acenaphthene	210	Asbestos	None detected

⁴ Comprising 'Suitable For Use Levels' (S4ULs), 'The LQM/CIEH Suitable 4 Use Levels, 2015' and for lead, the Category 4 Screening Level (C4SL), SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Final Project Report, published by DEFRA, 2014.

It is noted that the SSV are only protective of long-term risk to human health and do not necessarily represent suitable concentrations for planting or landscaping. If necessary, a horticulturalist should be consulted in this regard.

All soils must be free from any visual or olfactory evidence of suspected petroleum hydrocarbon contamination and should contain no significant quantity of putrescible material (incl. wood or paper). Along with testing for the contaminants listed above, testing should also be undertaken to confirm the absence of any significant concentrations of petroleum hydrocarbons.

All soils used as surface dressing or as part of the cover system must be free from propagules of aggressive weeds, fragments of glass, bricks, concrete, wire or other potentially hazardous foreign matter and bulk vegetative growth, in order to ensure negligible risk of subsequent weed problems (introduced in the soil) or traumatic injury.

In the event that any individual sample of imported material records concentrations of contaminants above the screening values listed above, the following method of assessment will be undertaken:

- Statistical analysis of the results, along with an assessment of whether any statistical 'outliers' should be removed from the dataset and treated as 'hotspots'. If the data indicates that the majority of the soil mass as a whole may be considered to contain contaminant concentrations below the screening values, then it may be deemed suitable to remain.
- Depending on the findings of the analysis, additional testing (which may include retests of the original sample) may be undertaken along with further analysis of the results to determine if this is representative of a widespread issue, or may be attributed to a smaller part of the site, or batch of imported soils.
- Liaison with the regulators may be undertaken to agree whether or not the materials are to be considered suitable to remain.

Where testing and analysis identify a significant failure and the procedures above do not provide sufficient evidence that the imported materials are suitable to remain, then the imported soils will be removed and replaced with other suitable soils.

5. POST REMEDIATION RISK ASSESSMENT

The remedial works set out in this report are considered to remove or sever the identified pollutant linkages. A post remediation conceptual model is presented in the following table.

Table 2. Post Remediation Conceptual Model for End Users – Potential Pollutant Linkages and Assessment of Risk

Contaminant Source	Remedial Measures	Potential Pathway(s)	Assessment of Risk to Human Health
Elevated concentrations of lead and PAH compounds and potential for localised asbestos contamination within the shallow soils across the site. Concentrations of petroleum hydrocarbons in soils above the screening criteria for use of PE water supply pipe.	Gardens and Soft Landscaped areas Removal of all topsoil/made ground to expose the undisturbed soils below OR Provision of a cover system of 600mm "clean" soil overlying a high visibility geotextile marker and geo-grid.	Pathways severed by remedial measures	No significant pollutant linkages identified.
	Provision of barrier pipe		
	Provision of building cover, parking areas and permanent access ways comprising hard cover	Pathways severed by construction works	

Ashdown Site Investigation Ltd.

FIGURES

- Figure 1 Site Location Plan
- Figure 2 Remedial Works Plan



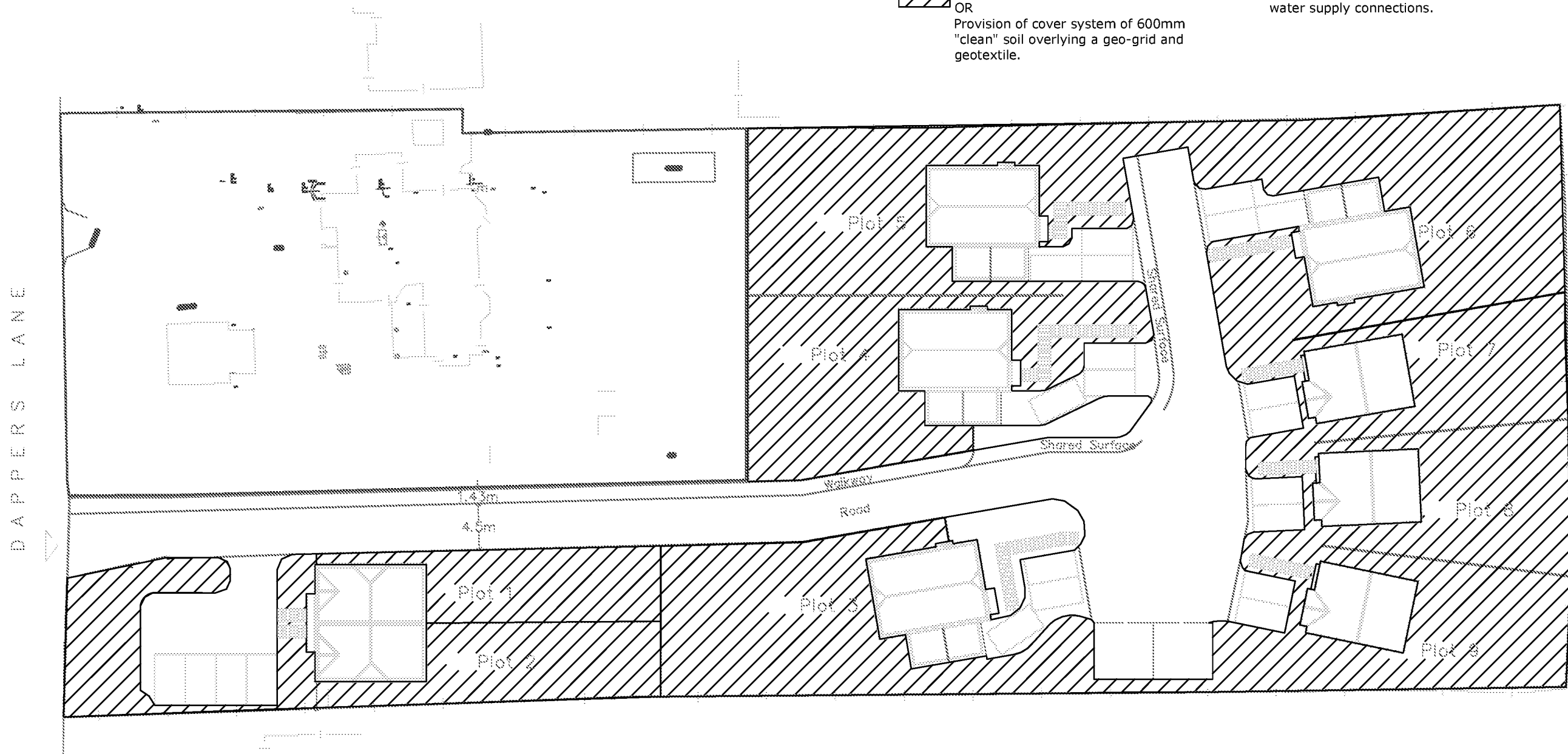
Site Location

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 Areas of garden/soft landscaping. All topsoil/ made ground to be removed to expose the undisturbed soils below.
OR
Provision of cover system of 600mm "clean" soil overlying a geo-grid and geotextile.

Unless confirmed otherwise by the water supply company, it should be assumed that barrier pipe is required for all new water supply connections.



ASHDOWN SITE INVESTIGATION

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Site:

The Laurels
Dappers Lane
Angmering

Report Ref:

P14215

Figure No.

2

Drawing Title

Remedial Works Plan

Scale

NTS

APPENDIX A

Quantitative Conceptual Model

The Laurels, Dappers Lane, Angmering, West Sussex				Quantitative Conceptual Model		R18-13291	
Source	Receptor	Contaminants	Pathway	Complete Linkage Present?	Probability	Consequence	Risk
Elevated concentrations of lead and PAH compounds and potential for localised asbestos contamination within the shallow soils across the site	End Users	Lead, PAH Compounds and Asbestos	Dermal contact with soil and dust (indoor & outdoor)	Yes	P2: Low	C2: Minor	Low
			Ingestion of soil and indoor dust	Yes	P2: Low	C2: Minor	Low
			Consumption of home-grown produce and attached soil	Yes	P2: Low	C2: Minor	Low
			Inhalation of soil dust (indoor and outdoor)	Yes	P2: Low	C2: Minor	Low
			Inhalation of soil vapours	Identified contaminant(s) do not pose a risk via this pathway			N/A
			Inhalation of soil gases/ Risk of explosion	No potential source of ground gases identified			N/A
	End Users (via Water Supply Pipework)		Contamination of incoming services	Identified contaminant(s) do not pose a risk via this pathway			N/A
	Groundwater		Migration to groundwater	No contaminants present at concentrations posing risk to groundwater			N/A
Concentrations of petroleum hydrocarbons in soils above screening criteria for PE water supply pipes	End Users		Dermal contact with soil and dust (indoor & outdoor)	No contaminants present above SSVs			N/A
			Ingestion of soil and indoor dust	No contaminants present above SSVs			N/A
			Consumption of home-grown produce and attached soil	No contaminants present above SSVs			N/A
			Inhalation of soil dust (indoor and outdoor)	No contaminants present above SSVs			N/A
			Inhalation of soil vapours	No contaminants present above SSVs			N/A
			Inhalation of soil gases/ Risk of explosion	No potential source of ground gases identified			N/A
	End Users (via Water Supply Pipework)	Petroleum Hydrocarbons	Contamination of incoming services	Yes	P2: Low	C2: Minor	Low
	Groundwater		Migration to groundwater	No contaminants present at concentrations posing risk to groundwater			N/A

APPENDIX B

Checklist for Verification Report(s)

Item	Tick (☐)
Documentation (Including Photographs) of Stripped Formation	
Documentation (Including Photographs) of Placed Geotextile and Geogrid (where necessary)	
Documentation (Including Photographs) Confirming Depth of Cover Soils (where necessary)	
Laboratory Test Data for Imported Materials (where provided)	
Documentation from Contractor (Including Photographs) of Installed Supply Pipe Material (if barrier pipe)	
Documentation from Water Supply Company	