SUPPLEMENTARY SITE INVESTIGATION
MOTORSPORTS CENTRE, LAND NORTH OF WATER LANE
ANGMERING, WEST SUSSEX
GLEESON STRATEGIC LAND / RYDON HOMES
SI-19495-21-62
FEBRUARY 2021

IDOM

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SECTION 1 INTRODUCTION

1.1 Rydon Homes (Rydon) and Gleeson Strategic Land (Gleeson) propose to develop an area of land located to the north of Water Lane in Angmering, West Sussex for residential development purposes. IDOM Merebrook Limited (IDOM) has been commissioned by Rydon / Gleeson to undertake supplementary site investigation works in an area of the site known as the Motorsports Centre in order to fill gaps in the earlier data in order to facilitate obtaining a fixed price for remediation.

1.2 The Motorsports Centre is located at National Grid Reference $^{5}07730$, $^{1}05370$ and at approximate post code BN16 4EJ.

1.3 Desk-based and intrusive investigation and interpretative reporting have been undertaken previously on the site by IDOM Merebrook and the reader is referred to these reports for full details:

i. *Geo-environmental Assessment: Land North of Water Lane, Angmering* (ref: GEA-19495B-17-318 Rev A) dated February 2018; and

ii. Letter Report *Land North of Water Lane, Angmering – Supplementary Site Investigation* (ref: L-19495-2.4.2-19-S593-DCE) dated 21 November 2019.

1.4 This report has been prepared for Rydon / Gleeson for the sole purpose described above and no extended duty of care to any third party is implied or offered. Third parties making reference to the report should consult Rydon / Gleeson and IDOM as to the extent to which the findings may be appropriate for their use.

SECTION 2 SUPPLEMENTARY SITE INVESTIGATION RATIONALE

2.1 INTRODUCTION

2.1.1 A supplementary site investigation rationale has been devised in order to fill gaps in data from the earlier investigation, chiefly where access was limited previously. Priority contaminants were identified as polyaromatic hydrocarbons and asbestos based of previous data and also petroleum hydrocarbons given the history as a motorsports centre. A precautionary broad suite of potential contaminants has been retained.

2.1.2 The site investigation also focuses on the type and amount of anthropogenic materials in the made ground which may impact future remediation and materials processing.

2.2 SITE INVESTIGATION METHODS

2.2.1 An intrusive investigation was carried out by IDOM on 1 to 5 February 2021 and comprised the following scope of work:

i. 17 shallow windowless sample probe holes (MWS301 to MWS316) to a depth of 4.3 m bgl; and

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ii. 43 machine-dug trial holes (MTP301 to MTP343) to a depth of 3.5 m bgl.

2.2.2 Exploratory hole locations are indicated on drawing 19495-304-007 in Appendix 1. Logging of exploratory holes was undertaken by a IDOM Officer. Exploratory hole logs are contained in Appendix 3. A photographic record is presented in Appendix 2.

2.2.3 A tracked windowless sampling rig was used to advance MWS301-316. This comprised a rig-mounted drop hammer to drive a hollow steel barrel into the ground. The barrel is recovered along with a removable plastic sleeve, which lines the barrel and holds a core of soil which is retracted for logging and sampling. Whilst geotechnical assessment is outside the scope of these works, SPTs were performed at approximate 1 m intervals in all windowless sample holes for future reference.

2.2.4 Representative soil samples were taken from various depths and strata to assess the contaminative status of the site. Soil samples were submitted to an MCERTS/ UKAS accredited laboratory for chemical analysis of a broad suite of potential contaminants. The results are provided in Appendix 4.

SECTION 3 GROUND CONDITIONS

3.1 SURFACE GROUND CONDITIONS

3.1.1 The general surface ground conditions on the site comprised the following:

i. Gravel and asphalt road planings;

ii. Asphalt hardstanding;

iii. Grassed topsoil; and

iv. Weeds/brambles over reworked clays.

3.1.2 Made ground inclusions such as bricks, concrete, asphalt, and tyres were found present at the surface of many locations during the investigation.

3.2 SUB-SURFACE GROUND CONDITIONS

3.2.1 British Geological Survey (BGS) mapping data suggests an absence of superficial drift deposits for the majority of the site. Superficial deposits (Head) are expected to be present in northern and southern sections of the site. Bedrock of London Clay Formation underlies the entire site.

3.2.2 A summary of the ground conditions encountered is presented in Table 1, whilst a more detailed assessment of the strata is contained in the following sections of the report.

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Table 1: Summary of Sub-surface Ground Conditions

STRATA	DEPTH TO TOP RANGE (m bgl)	THICKNESS RANGE (m)
Made Ground	0-0.3	0.3-1.2
Made Ground (bunds)	0	1.3 to >3.2
Drift (Head deposits)	0.3-1.6	0.2-1.9
Solid (London Clay)	0.3-2.8	Not proven

3.2.3 Made Ground

3.2.3.1 Made ground was encountered in each exploratory hole during the investigation.

3.2.3.2 The general made ground encountered in the raceway comprised reworked orangish brown gravelly clays with inclusions of asphalt planings, brick, some concrete, metal and wood up to 1.3 m below ground level (bgl). At MTP301 a small piece of fragmented asbestos cement was identified 0.4 m bgl. Analysis of a bulk sample of the material confirms that it contains chrysotile asbestos.



MTP302: Made ground arisings in the raceway area.

3.2.3.3 In areas excavated into stone (within the yard/workshop front and in the entrance road to site) generally the made ground comprised compacted road gravel planings with occasional brick inclusions. Location MWS315 and 316 and MTP309, 310, 317

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and 318 were advanced through asphalt hardstanding underlain by mixed made ground gravels with inclusions of concrete and brick. MTP318, MWS315 and MWS316 were identified to have a hydrocarbon odour beneath the asphalt. Location MTP319, (close to workshop) also identified a hydrocarbon odour in the upper strata overlying successive concrete slab boulders. Made ground encountered in these areas was shallow.



MTP343: Showing trial hole location and arisings.

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MTP318: Trial hole.



MTP319: Trial hole.

3.2.3.4 25 No. of the trial holes were advanced through banked/bunded areas. The depth and extent of these bunds was not achieved in all locations due to machine

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constraints and potential services underlying the mounded materials in the northern and western sections. Each bunded area is referenced and summarised in Figure 1 below.

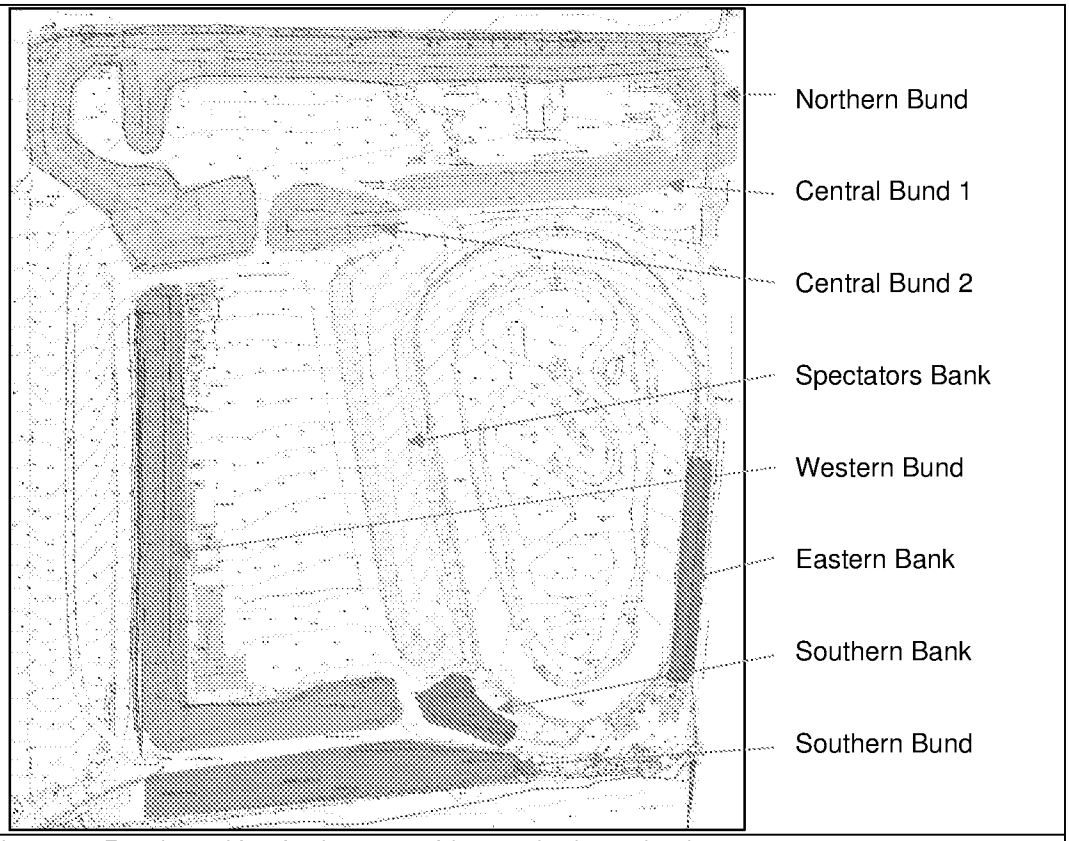


Figure 1: Bunds and banked areas subject to the investigation.

3.2.4 Northern Bund

3.2.4.1 Generally comprised orangish brown reworked gravelly clay with regular inclusions of concrete (cobbles and boulders), asphalt and brick. Metal rebar and other scrap metal materials were also identified. Tyres were identified within the bund and following conversations with the landowner, a buried tyre wall is anticipated on the eastern side of the bund where former racing tracks have previously existed. In one location (MTP332) dark stained clay with a hydrocarbon odour was identified within a localised patch on the bund. Aside from this localised staining, the composition of the bund was consistent throughout.

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MTP329: Arisings (including tyres).



MTP322: Dark stained clay arisings.

3.2.4.2 At the time of the investigation damaged asbestos cement sheeting was situated at the top of the bund (close to location MTP332).

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3.2.4.3 The actual depth of the bund was not achieved during the investigation due to underlying electrical services beneath the bund.

3.2.5 Central Bund 1

3.2.5.1 Generally comprised mixed reworked gravelly clays combined with topsoil with regular inclusions of brick and concrete. Tyres were found in MTP325 into the embankment and a tyre wall within the bund cannot be discounted due to the location of former racing track.



MTP325: Trial hole including edge of excavated tyre (right).

3.2.6 Central Bund 2

3.2.6.1 Surrounded by walled tyres. Made ground comprises reworked orangish brown gravelly clays with inclusions of brick, concrete (boulders/slabs) and asphalt.

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MTP323: Showing trial hole location (into bund).

3.2.7 Spectators Bank

3.2.7.1 Made ground was described as reworked gravelly clay with inclusions of brick, clinker, concrete, and occasional metal. A slight organic odour was noticed within the reworked ground of the bank. Window sample hole MWS310A was obstructed at 2.7 m bgl by what was presumed to be a rubber tyre.

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MTP316: Arisings.

3.2.8 Western Bund

3.2.8.1 The L-shaped bund on the west of site consisted generally of the same reworked orangish brown gravelly clay with made ground inclusions more frequent in the southern spur section. Made ground elements included concrete (boulders/slabs and cobbles), brick, asphalt, old timber, plastic and metal rebar and wire. Tyres support one side of the embankment of the southern section. Asphalt hardstanding was encountered 2.5 m into the bund (at the base) at location MTP315.

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MTP315: Arisings.



MTP322: Arisings.

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3.2.8.2 Trial holes were restricted in this bund due to live services beneath and within the bund.

3.2.8.3 At the time of the investigation damaged asbestos cement sheeting was situated at the top of the bund behind the workshop building. It was also noted the workshop building had damaged asbestos roofing elements.

3.2.9 Eastern Bank

3.2.9.1 The bank to the east of the raceway was found to have consistent reworked orangish brown gravelly clay with brick and concrete inclusions. A tyre wall was identified from MTP306 in the embankment and is anticipated to follow the perimeter of the racetrack.

3.2.9.2 The extent of the made ground in the eastern bank was not achieved due to constrained machine access.



MTP306: Showing the eastern bank.

3.2.10 Southern Bank

3.2.10.1 Made ground was encountered up to 1.7 m bgl. This made ground includes successive tyres, concrete (boulders and cobbles) and regular brick. A degraded metal barrel lid was encountered 1.0 m bgl. The surrounding soil comprised a matrix of orangish brown gravelly clay.

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3.2.10.2 Asbestos cement debris was encountered within MTP308 at 0.4 m bgl. Analysis of a bulk sample of the material confirms that it contains chrysotile asbestos.



MTP308: Buried tyres.

3.2.11 Southern Bund

3.2.11.1 The southern bund was excavated into from the base. The whole of the northern embankment of the bund was supported by tyre wall. The soil encountered in the bund comprised orangish brown reworked sandy gravelly clay with inclusions of brick, concrete, asphalt, wood, metal, and geotextile pieces. Both locations MTP311 and MTP312 within the southern bund encountered black stained gravels with strong hydrocarbon odour. Oily globules were evident at MTP311.

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MTP311: Dark stained oily strata.

3.2.12 Perched water was only encountered in the made ground at location MTP311 and MTP312. In MWS304 groundwater was encountered within the made ground strata at shallow depth (0.4 m bgl).

3.2.13 Natural Ground

3.2.13.1 Although geological mapping data suggests the absence of superficial drift on site, the natural ground encountered comprised of orangish brown/light brown gravelly clays with chalk and flint gravels (Superficial Drift – Head deposits) and blueish grey gravelly clay (Bedrock – London Clay). The Head superficial drift when identified on site was found to extend from 0.2 m to >0.9 m in thickness.

3.2.13.2 There was no visual or olfactory evidence of contamination identified within the natural ground.

3.2.13.3 Groundwater was encountered in the natural clays ranging from 1.2 – 2.6 m bgl.

3.2.13.4 SPT values achieved during window sampling within the natural strata suggest very soft clays on site with N values of 16 or less.

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SECTION 4 ENVIRONMENTAL ASSESSMENT

4.1 SOIL QUALITY

4.1.1 A total of 50 soil samples were submitted to the laboratory as part of the supplementary investigation for chemical analysis, all samples were from made ground. The laboratory chemical analysis certificates are contained in Appendix 4. The results of the analysis are summarised in Table 2.

4.1.2 An initial screening exercise has been undertaken whereby contaminant concentrations recorded in soils have been assessed against *Suitable for Use Levels* (S4ULs) published in 2015 by LQM/CIEH[1]. These precautionary screening levels are designed to be representative of minimal risk to human health in a number of land use scenarios. In this report S4ULs have been selected for a residential land use where the possibility of consumption of homegrown produce exists and assuming a soil organic matter of 2.5 %. For lead the DEFRA Category 4 Screening Level[2] has been used as this is based on updated toxicological data and a low risk to human health.

4.1.3 An additional set of phytotoxin screening levels have been adopted from 'The Code of Agricultural Practice for the Protection of Soil' Ministry of Agriculture, Fisheries and Food (MAFF), 1993, which are protective of healthy plant growth.

4.1.4 In previous IDOM investigations covering the wider site, a total of 36 soil samples were submitted to the laboratory for chemical analysis from made ground, predominantly from within the motorsports area. The results from these investigations are discussed in conjunction with the data summarised in Table 2 below.

Table 2: Summary of Soils Chemical Analysis Results

CONTAMINANT	No of Tests	MAX ($mg.kg^{-1}$)	MEAN ($mg.kg^{-1}$)	SCREENING LEVEL (SL) ($mg.kg^{-1}$)	No > SL*
HUMAN HEALTH RISK ASSESSMENT					
Asbestos in soil	50			Detected	2
pH	50	10.0	8.4	5 – 9	6
Arsenic	50	15.0	10.8	37	0
Cadmium	50	1.5	0.4	11	0
Chromium (total)	50	71.0	26.9	910	0
Hexavalent Chromium	50	4.0	4.0	6	0

[1] 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 S4UL3100. All rights reserved. Including August 2015 nickel update.

[2] SP1010 *Development of Category 4 Screening Levels Main Report* (Dec 2013) and SP1010 *Policy Companion Document* (Mar 2014).

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CONTAMINANT	No of Tests	MAX (mg.kg^{-1})	MEAN (mg.kg^{-1})	SCREENING LEVEL (SL) (mg.kg^{-1})	No > SL*
Lead	50	440.0	76.9	200	2 (MWS301 and MTP334)
Mercury	50	0.7	0.3	40	0
Nickel	50	44.0	18.9	130	0
Selenium	50	2.1	1.0	250	0
TPH Aliphatic >EC_5 - EC_6	50	0.001	0.001	78	0
TPH Aliphatic >EC_6 - EC_8	50	0.001	0.001	230	0
TPH Aliphatic >EC_8 - EC_{10}	50	0.001	0.001	65	0
TPH Aliphatic >EC_{10} - EC_{12}	50	20.00	2.42	330	0
TPH Aliphatic >EC_{12} - EC_{16}	50	350.00	14.11	2400	0
TPH Aliphatic >EC_{16} - EC_{21}	50	810.00	39.98	92000	0
TPH Aliphatic >EC_{21} - EC_{35}	50	3900.00	202.62	92000	0
TPH Aromatic >EC_5 - EC_7	50	<0.001	<0.001	140	0
TPH Aromatic >EC_7 - EC_8	50	<0.001	<0.001	290	0
TPH Aromatic >EC_8 - EC_{10}	50	<0.001	<0.001	83	0
TPH Aromatic >EC_{10} - EC_{12}	50	15.00	2.16	180	0
TPH Aromatic >EC_{12} - EC_{16}	50	120.00	13.10	330	0
TPH Aromatic >EC_{16} - EC_{21}	50	940.00	77.10	540	1 (MTP336)
TPH Aromatic >EC_{21} - EC_{35}	50	1200.00	147.10	1500	0
Benzene	43	<0.001	<0.001	0.17	0
Toluene	43	<0.001	<0.001	290	0
Ethylbenzene	43	<0.001	<0.001	110	0
Xylene	43	<0.002	<0.002	130	0
Naphthalene	50	6.70	0.48	5.6	2 (MTP336 and MTP311)
Acenaphthylene	50	4.80	0.40	420	0
Acenaphthene	50	21.00	1.25	510	0
Fluorene	50	24.00	1.38	400	0
Phenanthrene	50	140.00	9.44	220	0
Anthracene	50	46.00	2.70	5400	0
Fluoranthene	50	260.00	16.84	560	0
Pyrene	50	210.00	15.20	1200	0
Benzo(a)anthracene	50	100.00	8.71	11	11
Chrysene	50	82.00	6.64	22	3 (MTP335,336 and 303)
Benzo(b)fluoranthene	50	95.00	9.79	3.3	21
Benzo(k)fluoranthene	50	53.00	3.69	93	0
Benzo(a)pyrene	50	89.00	8.05	2.7	21
Indeno(1,2,3-c,d)pyrene	50	43.00	4.35	36	1 (MTP336)
Dibenzo(a,h)anthracene	50	9.30	1.02	0.28	20

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CONTAMINANT	No of Tests	MAX (mg.kg^{-1})	MEAN (mg.kg^{-1})	SCREENING LEVEL (SL) (mg.kg^{-1})	No > SL*
Benzo(g,h,i)perylene	50	47.00	4.68	340	0
Phenol	50	<1.0	<1.0	200	0
PHYTOTOXICITY RISK ASSESSMENT					
Copper	50	160.0	39.7	200	0
Nickel	50	44.0	18.9	110	0
Zinc	50	380.0	109.9	300	1 (MTP319)

Notes: * Number of samples exceeding screening level nd = not detected

4.1.5 Zootoxic Metals (harmful to human health)

4.1.5.1 Two moderate exceedances of lead were identified in at locations (MWS301 and MTP334). These locations were comprised of made ground beside the racetrack and in the northern bund respectively. The average lead concentration was significantly below the adopted screening level. In previous IDOM investigations covering the wider site, two elevated concentrations of lead were detected within samples retrieved from the Motorsports centre from MWS115 at 0.25 m bgl and 0.90 m bgl from an area where the ground level has been raised for motorsport viewing purposes.

4.1.6 Phytotoxic Metals (harmful to plant health)

4.1.6.1 A single slight exceedance of zinc was encountered at MTP319 at 0.1 m bgl. This location was in an area in front of the workshop where storage and breakdown of scrap engines are likely to have taken place. Elevated zinc is anticipated to be localised to this area. Given the marginal and isolated nature of the exceedance, this is not considered to be significant and is not discussed further in this report.

4.1.7 Organic Contaminants

4.1.7.1 Exceedances of the health-based screening level for TPH were identified in one location MTP336, where elevated aromatic TPH C_{16} – C_{21} was identified. This is coincident with a hydrocarbon odour and observations of road planings. Location MTP336 also has elevated concentrations of polycyclic aromatic hydrocarbon (PAH).

4.1.7.2 Elevated PAH was relatively widespread (25 locations in total). Many of these exceedances were in locations close to the workshop or in made ground within which inclusions of road planings had been identified. In many of the locations with exceedances of PAH a hydrocarbon odour was noted.

4.1.7.3 Previous IDOM investigations identified eight exploratory holes impacted by elevated PAH across the site and of these, two locations (MWS108 and MTP201) were also impacted by heavy end aromatic TPH contamination associated with the PAH but without any hydrocarbon odours. These are detailed in Figure 2.

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4.1.7.4 The table below summarises the benzo(a)pyrene exceedances and the made ground observations.

Table 3: Breakdown of benzo(a)pyrene exceedances.

LOCATION	DEPTH (m bgl)	FIELD OBSERVATIONS	BENZO(A)PYRENE (mg/kg)
MTP303	0.5	Reworked orangish brown gravelly clay with brick, plastic, and metal rebar inclusions.	52.0
MTP309	0.4	Greenish brown sandy gravel with brick, concrete and metal rebar inclusions.	2.9
MTP311 (southern bund)	0.6	Black stained gravel with oily globules and a strong hydrocarbon odour.	3.1
MTP312 (southern bund)	1.2	Black stained gravel with a hydrocarbon odour.	7.5
MTP315 (western bund)	0.6	Reworked orangish brown gravelly clay with asphalt inclusions.	3.5
MTP316	0.8	Reworked orangish brown gravelly clay with asphalt inclusions.	28.0
MTP317	0.3	Mixed gravel (type 1/planings) with brick, concrete and ceramic inclusions.	16.0
MTP318	0.5	Dark brown/black gravels. Strong hydrocarbon odour.	21.0
MTP319	0.1	Black stained clayey gravel. Strong hydrocarbon odour.	16.0
MTP325 (central bund 1)	0.5	Reworked brown gravelly clay with inclusions of brick and concrete.	4.4
MTP331 (northern bund)	2.0	Reworked brown gravelly clay with inclusions of brick, concrete.	5.3
MTP333 (northern bund)	2.7	Reworked orangish brown gravelly clay with asphalt, concrete and brick inclusions.	9.8
MTP334 (northern bund)	0.9	Reworked orangish brown gravelly clay with concrete and brick inclusions.	5.3
MTP335	0.2	Mixed gravel with road planings. Hydrocarbon odour.	32.0
MTP336	0.7	Mixed gravel with road planings. Slight hydrocarbon odour.	89.0
MTP341	0.1	Black gravel planings.	14.0
MTP342	0.2	Black gravel planings.	6.7
MWS301	0.6-0.8	Grey reworked gravelly sandy clay with brick inclusions.	21
MWS304	0.9-1.0	Black sandy gravel.	3.8
MWS306	0.3-0.4	Brown gravelly clay with clinker and brick inclusions.	16.0
MWS315	0.1-0.3	Grey gravelly clay with dark stains and a hydrocarbon odour.	9.6

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4.1.7.5 Benzo(a)pyrene concentrations have also been considered in the context of *Category 4 Screening Levels* (C4SLs) for a residential land usage where consumption of homegrown produce may occur. Based on the C4SLs for benzo(a)pyrene criteria, sixteen locations on site are found to have elevated benzo(a)pyrene above the 5 $mg.kg^{-1}$ screening level. This shows that five of the exceedances of benzo(a)pyrene found on site may be considered to sit between low and minimal risk to human health as concentrations are below those considered for C4SLs. These locations are highlighted green in Table 2 above.

4.1.7.6 In general it appears that elevated PAH is related to inclusions in the made ground (such as road planings, clinker *etc.*) rather than being related to fuel spillages.

4.1.8 Inorganic Contaminants

4.1.8.1 Exceedances of the pH screening level were identified within six locations in relation to elevated alkalinity. Concrete/cement material within samples taken from the made ground in these locations are likely to have caused the elevated pH levels and the results are considered unlikely to be representative of the wider soil chemistry.

4.1.8.2 Asbestos fibres in soil were detected in two locations MTP329 (Chrysotile <0.027% by weight) and MWS315 (Amosite <0.001% by weight) at depths of 0.3 m and 0.1-0.2 m bgl respectively. Visible (bulk) asbestos in the form of chrysotile cement debris was identified within two trial pit locations MTP301 and MTP308 both at 0.4 m bgl.

4.1.8.3 Asbestos materials (sheet cement) was identified during the investigation in two locations:

i. On the northern bund (near MTP332); and

ii. On the western bund (behind the workshop).

4.1.8.4 Photographs of asbestos identified on the surface are included in the photograph appendix enclosed in Appendix 2.

4.1.8.5 Previous IDOM investigations highlight the presence of asbestos containing material (ACM) as detected by the laboratory in the soil sample from MWS107 in the Motorsports Centre at 0.90 m bgl which was found to contain insulation lagging (chrysotile fibres). Asbestos was also detected in two locations in the supplementary investigation in MTP203 and MTP204 at depth of 1.5 and 0.5 m bgl, respectively. The asbestos in MTP203 was present as chrysotile (in a visible cement tile fragment), whilst in MTP204 it was present as chrysotile, amosite and crocidolite fibres. These locations are highlighted in Figure 2.

4.1.9 Summary

4.1.9.1 Contamination within the made ground comprises widespread elevated levels PAH which are mostly be associated with asphalt or black gravel planings identified within the made ground. Elevated levels of heavy end TPH were occasionally coincident with the PAH contamination. Asbestos has been identified by lab testing in soils in

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five locations across all the phases of investigation and visible fragments of asbestos have been identified in two locations. Asbestos containing materials were present on the surface at two further locations (northern bund and behind the workshop).

4.1.9.2 No contamination was identified within the natural ground.

4.2 MONITORING

4.2.1 Gas / groundwater monitoring and testing are outside the scope of this investigation and have been appropriately assessed by the earlier reports.

4.3 WASTE CLASSIFICATION, OFF-SITE DISPOSAL OR RE-USE

4.2 Waste classification

4.2.1 It is anticipated that the site will be progressed in a sustainable manner with the aim of retaining soils on site rather than large-scale off-site disposal.

4.2.2 Based on the contaminant concentrations recorded to date, the majority of site soils would be expected to be classified as non-hazardous should they require disposal.

4.2.3 However, the following samples would trigger a hazardous classification for waste purposes due to their hydrocarbon content (using the unknown oils classification mechanism):

i. MWS108 at 0.6 m bgl

ii. TP112 at 0.5 m bgl

iii. MTP201 at 0.1-0.3 m bgl

iv. MTP205 at 1.5 m bgl

v. MTP317 at 0.3 m bgl

vi. MTP318 at 0.5 m bgl

vii. MTP319 at 0.1 m bgl

viii. MTP332 at 2.7 m bgl

ix. MTP335 at 0.2 m bgl

x. MTP336 at 0.7 m bgl.

4.2.4 Visible fragments of asbestos-containing material have also been observed in soil in two locations (MTP301 and MTP308) which would also trigger a hazardous classification. Site clearance should also be cognisant of the presence of asbestos-containing materials on the surface on the northern bund and behind the workshop.

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4.2.5 A single sample submitted for WAC analysis as part of earlier investigations (MWS109 at 0.50 m bgl) indicated that made ground may be classed as inert, subject to confirmation from the landfill operator as the leachable fluoride concentration slightly exceeds inert limits and also subject to the absence of asbestos.

4.2.6 However, more generally, asbestos fibres have been encountered in a small number of locations and this material would be unsuitable for disposal at inert landfill. Asbestos fibre quantification confirms that in the absence of visible asbestos, a non-hazardous classification would apply. Where any visible fragments of asbestos are noted, materials would be classified as mixed waste and potentially hazardous.

4.2.7 It is also the case that elevated concentrations of PAH would also in many samples exceed inert solid WAC criteria.

4.2.8 In general, it is considered that made ground without visible asbestos and where no significant quantities of inclusions of road planings are present would likely be non-hazardous waste.

4.2.9 Natural as-dug soils could be classed as inert waste without the requirement for WAC testing.

4.2.10 WAC testing would be required for made ground soils destined for landfill.

4.2.11 Materials, including waste soils which are not to be retained on site, should be removed and disposed of in accordance with all relevant statues including the *Environmental Protection Act 1990* (as amended), *The Controlled Waste Regulations 2012* (as amended), *The Waste (England and Wales) Regulations 2011* (as amended) , *The Hazardous Waste (England and Wales), Regulations 2005* as amended, *The Waste Management (England and Wales) Regulations 2006*, and *The Environmental Permitting (England and Wales) Regulations 2016* (as amended).

4.2.12 It is a requirement of these regulations that waste sent to landfill should have been subject to measures to reduce the amount of waste, reduce harmful or hazardous properties and facilitate recycling. These requirements may be satisfied by measures such as segregation and screening of wastes to recover suitable fill and material for crushing, segregation of inert materials and putrescible wastes.

4.3 Re-use Considerations

4.3.1 As a sustainable alternative to off-site disposal, it would be advantageous to re-use site-won soils provided the following criteria are met:

i. Use of the material will not create an unacceptable risk of pollution to the environment or harm to human health;

ii. The material must be chemically and geotechnically suitable without further treatment;

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iii. There must be certainty of use within the scheme;

iv. Material should only be used in the quantity necessary for that use.

4.3.2 Provided these criteria are met, the re-use of site-won materials is unlikely to be deemed a waste activity. Production of a *Materials Management Plan* under the industry *CL:AIRE Code of Practice on the Definition of Waste* represents a robust method of demonstrating that the proposed re-use of material meets the criteria and is not liable for landfill tax.

SECTION 5 DISCUSSION

5.1 INTRODUCTION

5.1.1 The recent investigations have been carried out to increase the coverage of the site and provide supplementary data to reduce uncertainties.

5.1.2 This section of the report considers the findings of the recent supplementary investigation in the context of the findings from the earlier phases of investigation. Any cases where a change to the risk assessment or conceptual site model are required are highlighted in this section.

5.2 DISTRIBUTION OF CONTAMINATION

5.2.1 The contamination encountered to date is mainly in the form of occurrences of PAH (and in some cases associated TPH) in made ground likely associated with anthropogenic inclusions. PAH is a product with incomplete combustion and can be found where there are inclusions of tarmac, ash, clinker *etc.* This type of contamination is not particularly mobile in the environment. Exploratory holes with soils impacted by PAH and asbestos are displayed in Figure 2 below.

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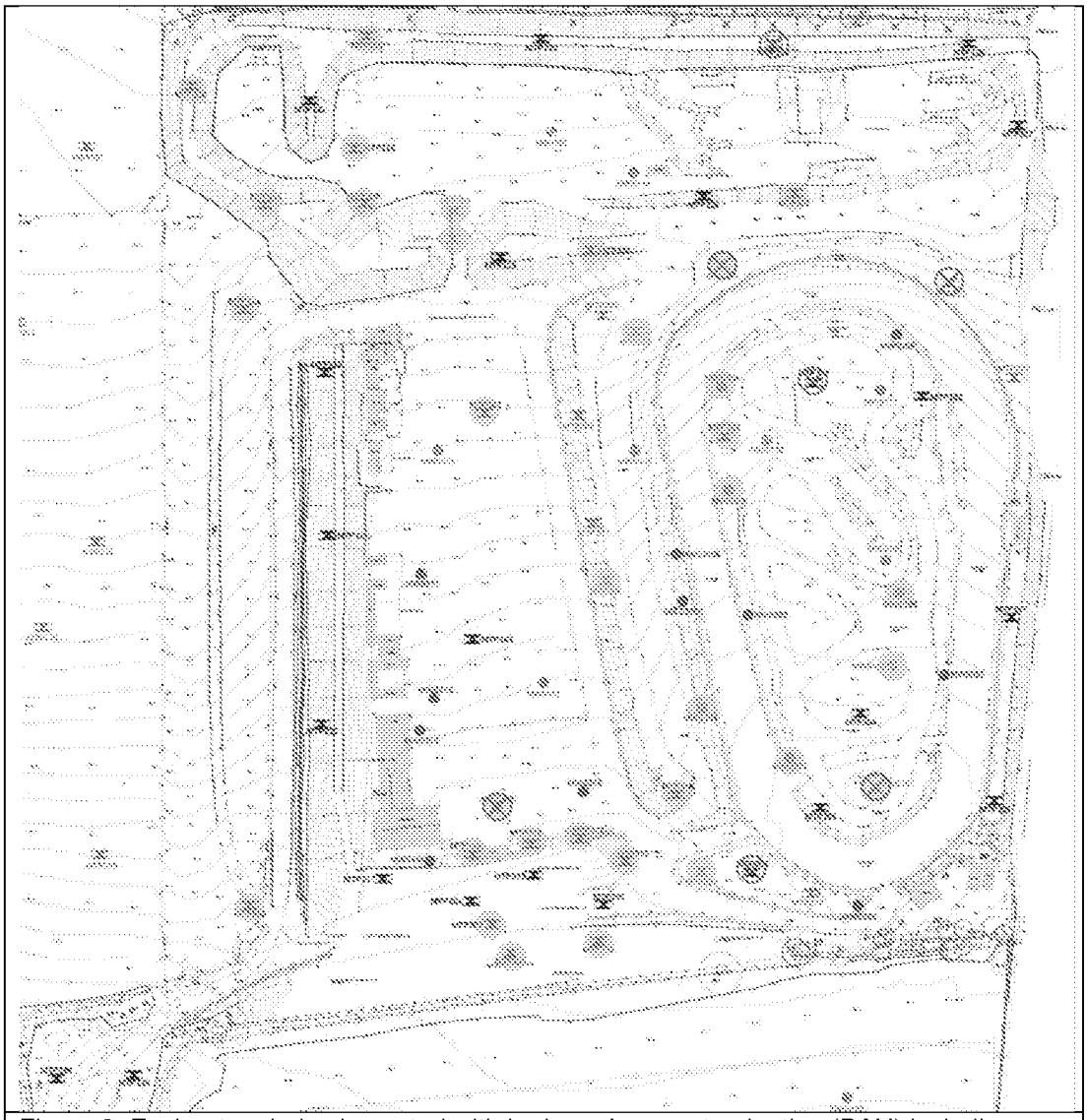


Figure 2: Exploratory holes impacted with hydrocarbon contamination (PAH) including from previous IDOM investigations = ⊗ Asbestos impacted locations = ⊗

5.3 BURIED TYRES

5.3.1 Buried tyres were found in some trial holes during the investigation which will require clearance as part of the site preparation works. Throughout the site, tyre walls are present supporting banks/bunds, however discovery of tyres buried in exploratory hole locations MTP308, MTP325, MTP329 and MWS10A provides evidence of buried tyres within bunds/banks. Figure 3 indicates the locations affected by buried tyres and the potential extent.

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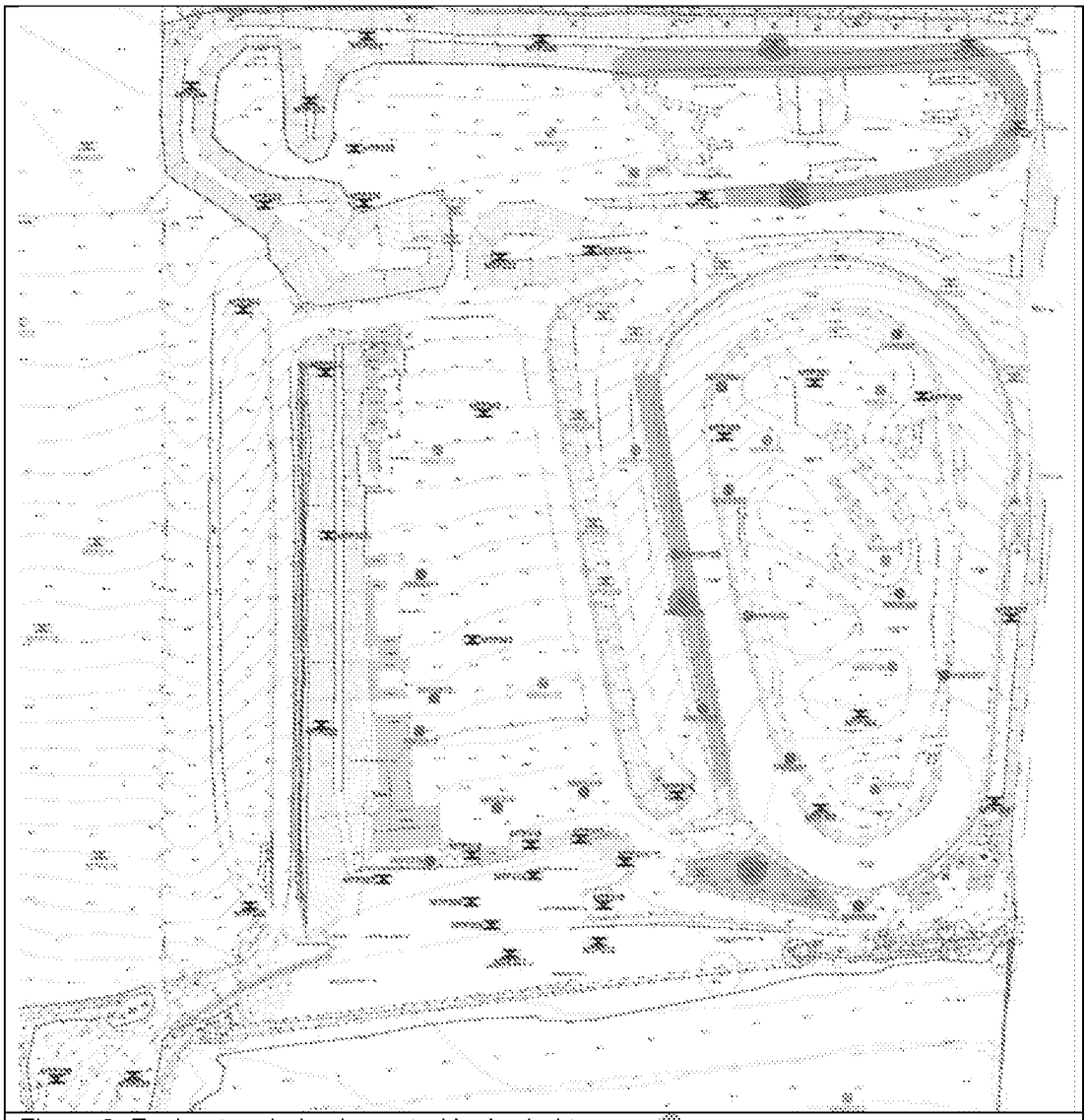


Figure 3: Exploratory holes impacted by buried tyres =
Potential extent of buried tyres/tyre walls not visible at surface =

5.4 CONTAMINATION RISK ASSESSMENT SUMMARY

5.4.1 **Soil Contamination**: In common with the earlier investigations, soil contamination has been identified within the area of the motorsports centre in the form of hydrocarbons associated with anthropogenic inclusions in made ground, which is located primarily in bunded and banked locations. No significant evidence of fuel spillages has been identified by the investigations carried out to date. Consistent with the earlier reports, the risk from the site for current site users is considered to be low. For the future residential receptors, a low to moderate risk is assumed via ingestion and inhalation of soil and soil-derived dust, and via dermal contact.

5.4.2 **Asbestos**: Asbestos-containing soils have been encountered in two locations MTP329 and MWS315 as well as previously MWS107 and MTP204. Visible (bulk)

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asbestos in the form of chrysotile cement debris was identified on site at MTP301 and MTP308 and previously location MTP203. Whilst many of the samples have not detected asbestos, the possibility remains for it to be present in made ground, particularly in the raised bunds. The Low-to-Moderate risk level assigned previously is considered to remain valid.

5.4.3 **Controlled Waters**: Consistent with the earlier reports, limited contamination has been identified in soils, localised to made ground within the area of the Motorsports centre. It is noted that this contamination is not particularly mobile and is a considerable distance from the watercourse along Water Lane therefore the risk to surface waters is considered to be low. No significant risks to groundwater quality are considered to be present.

5.4.4 **Construction Environmental Management**: Potentially, construction workers are initially at the greatest risk from exposure to hazardous contamination due to excavation works and during the handling of materials. As sporadic asbestos contamination has been identified, it will be necessary to implement an Asbestos Management Plan during the works to minimise the potential for fibre release and exposure and to ensure that appropriate management controls are in place.

5.4.5 **Utilities**: Limited contamination with the potential to permeate polymeric services has been identified by this investigation in the vicinity of the Motorsports Centre, however it is recommended that the utility provider is consulted with respect to their requirements for water supply pipes. Utility companies apply strict guideline levels on use of polymeric pipes and may consider all made ground unsuitable for typical plastic pipe materials to be used.

5.5 OUTLINE REMEDIATION STRATEGY

5.5.1 Consistent with the earlier reports, it is considered that large scale remediation of soils is not required at the site. Limited soil remediation (in the form of provision of a clean soil cover system) will be required in the area of the Motorsports Centre due to the lead, TPH, PAH and asbestos identified. This contamination appears to be associated with inclusions within made ground and is not indicative of mobile contamination with the potential to impact the wider environment. It will be acceptable to leave the contamination *in-situ* provided suitable clean soil cover is provided to sensitive areas.

5.5.2 There are numerous bunds present on site which will require reprofiling. In addition, several areas of the site have been found to contain buried tyres which will require removal as part of the reprocessing and preparation of the site for development. If the made ground materials are to remain on site, it is vital that this work is carried out under a Materials Management Plan under the CL:AIRE Code of Practice on the Definition of Waste.

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5.5.3 Zoning the site

5.5.3.1 As the wider development site has distinct historic greenfield and brownfield areas (*i.e.* the motorsports centre), it is recommended that the site is zoned for construction purposes into "clean" and potentially "dirty" areas. There should be no cross over of "dirty" soils into the greenfield area of the site.

5.5.3.2 In due course, it will be necessary for site-won clean topsoils and subsoils from the greenfield area of the site to be re-used in gardens and soft landscaped areas of the plots within the Motorsports Centre.

5.5.4 Watching brief and verification inspections

5.5.4.1 The previous reports recommended that a watching brief should be in place during site clearance for any previously undiscovered petroleum hydrocarbon contamination. The recent intrusive investigations have greatly reduced the likelihood of any such contamination being identified. Nevertheless, a watching brief will still be appropriate for any readily identifiable fuel-type staining or odours. Should any such contamination be identified then delineation and sampling would be required in order determine the risks and any appropriate remedial actions.

5.5.4.2 It is the case that the majority of the contamination on the Motorsports centre is concentrated in the soil which makes up the bunds. A watching brief should be maintained by a suitably qualified contractor during clearance of the bunds for any bulk asbestos materials. Any soils with visible asbestos should be carefully segregated in order to reduce the potential for degradation or spread of the asbestos materials and to reduce ongoing risks. These asbestos impacted soils should be disposed from site. Other made ground would be suitable for retention within the Motorsports area beneath buildings, hardstandings or a clean cover system.

5.5.5 Clean cover system for gardens and landscaped areas

5.5.5.1 Consistent with the earlier reports, the outline remedial strategy comprises the provision of clean soil cover to all soft landscaping within the area of the Motorsports Centre. This may be formed from site-derived natural topsoil/subsoil from the wider greenfield areas of the wider site. The clean cover should comprise 600 mm topsoil and subsoil in private gardens, and 300 mm topsoil and subsoil in communal gardens/public open space.

5.5.5.2 It is noted that outside the area of the Motorsports Centre no specific soil remediation is considered necessary but any visible fragments of deleterious materials should be removed including brick. Generally, it is recommended that suitable topsoil (which can be site-won) is ensured in all soft areas of the wider site to provide a suitable medium for healthy plant growth.

5.5.5.3 It is envisaged that site-derived topsoil from the wider greenfield site will be re-used on site. This is considered to be acceptable in terms of contaminant concentrations. Any material imported for the formation of domestic gardens and landscaped areas

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should be obtained from a validated source and be subject to independent verification inspection and testing.

SECTION 6 CONCLUSIONS

6.1 The recent investigation has provided considerable supplementary data on ground conditions and chemical contamination at the site. The additional data has been used to test the validity of the earlier risk assessment and to reduce uncertainty for contractors scoping the site preparation and remediation works.

6.2 Soil contamination has been identified within the area of the motorsports centre in the form of hydrocarbons (primarily PAHs) associated with anthropogenic inclusions in made ground, which is located principally in bunded and banked locations. Made ground is of limited thickness elsewhere. No significant evidence of fuel spillages has been identified by the investigations carried out to date. Investigations have identified several locations affected by buried types.

6.3 It is considered that the broad risk assessment and outline remedial strategy presented in the earlier *Geo-environmental Assessment* report remain valid in light of the additional data.

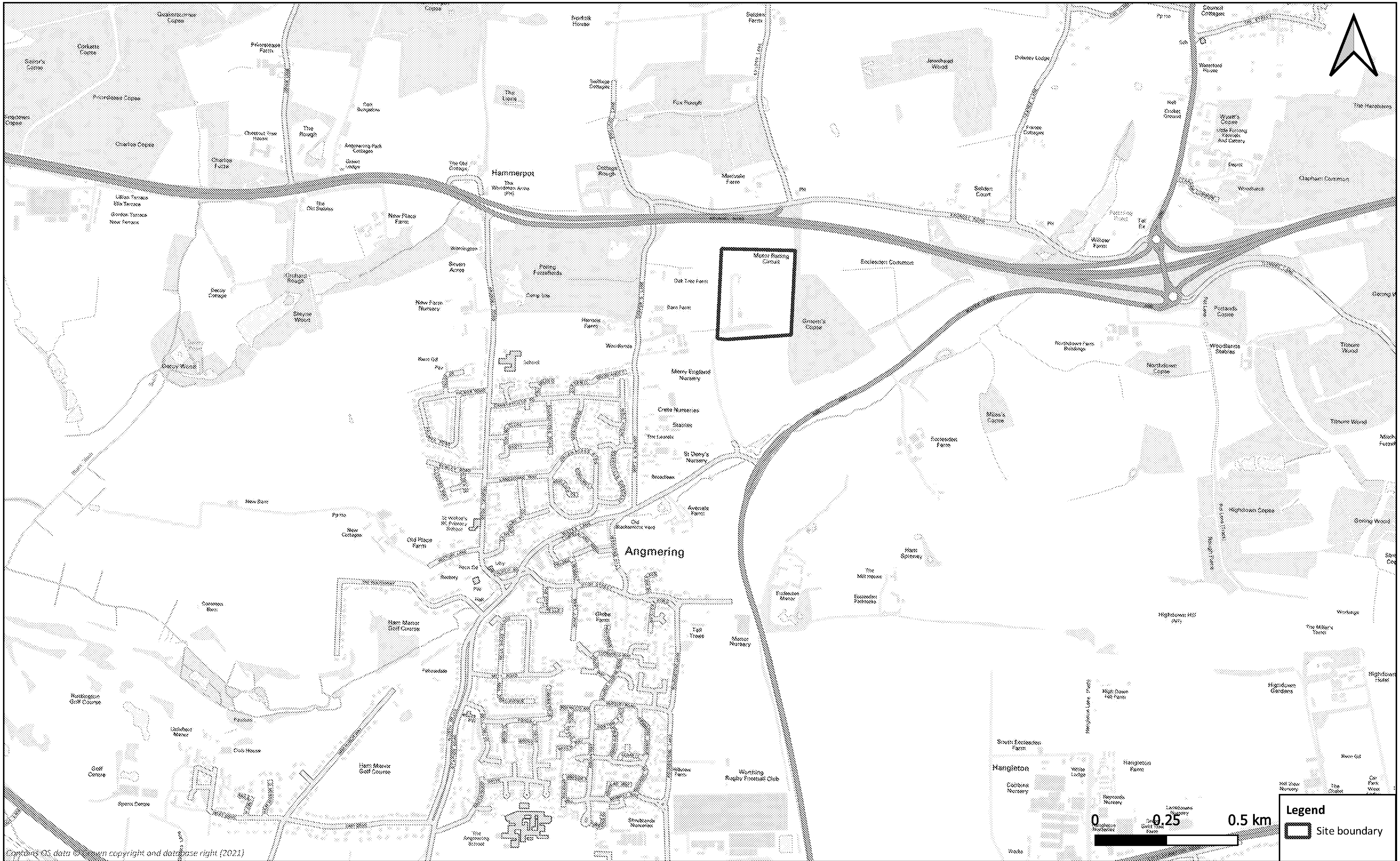
6.4 Provision of a clean soil cover system will be necessary in the area of the Motorsports Centre. This contamination appears to be associated with inclusions within made ground and is not indicative of mobile contamination with the potential to impact the wider environment. It will be acceptable to leave the contamination *in-situ* provided a suitable clean soil cover is provided to sensitive areas. In addition, several areas of the site have been found to contain buried tyres which will require removal as part of the reprocessing and preparation of the site for development.

6.5 A *Detailed Remedial Strategy* is likely to be required by the Local Authority in due course together with a *Materials Management Plan* under the CL:AIRE *Code of Practice on the Definition of Waste* to allow the re-use of made ground materials on site.

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APPENDIX 1 ▪ Drawings

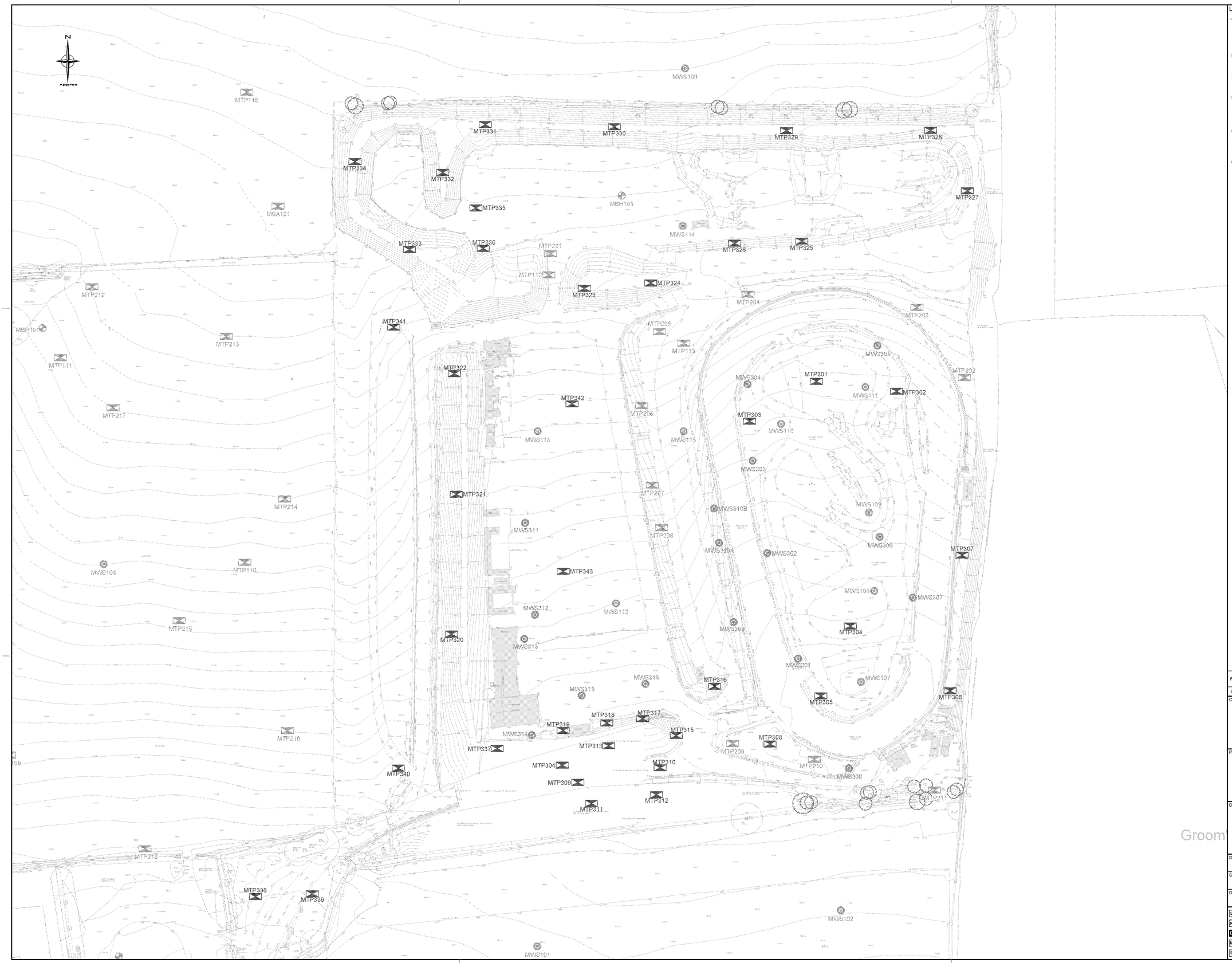
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Client/Project	Map Title	Job no.	Drawing No.	Revision
Land North of Water Lane, Angmering	**Site Location Plan**	19495	001-004	-
		Scale: **1:18655**	Date: JAN/2021	Frame dimensions: A3
		Drawn: RMH	Checked: LH	Approved: LH



Legend

- Site boundary
- MTPref — Merebrook trial pit with location reference
- MWSref — Merebrook window sample with location reference
- MSAref — Merebrook soakage test pit with location reference
- MBH104 — Merebrook cable percussion borehole installed for water level monitoring
- MTPref — Trial pit with location reference
- MWSref — Window sample with location reference
- MTPref — 2021 Trial pit with location reference
- MWSref — 2021 Window sample with location reference

First Issue	16-02-2021	SNC	-
		RH	RH
Issue Details	Dwn	Chd	App'd

Client

Rydon Homes
&
Gleeson Strategic Land

Project

Water Lane,

Angmering

Dwg Title

Approximate Site Investigation Locations

Land to the North of Water Lane

Dwg No. 19495-304-007	Revision -
Scale N.T.S	Date Feb 2021
Frame Dimensions mm (A1) 791 x 544	
Drawn SNC	Checked RH
Approved RH	

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Kent
Derbyshire
Manchester
Stirling

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APPENDIX 2 ▪ Photographic Record

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MTP301: Showing trial hole location



MTP301: Trial hole.

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MTP301: Arisings.



MTP301: Fragment of asbestos (chrysotile) cement.

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MTP302: Showing trial hole location.



MTP302: Trial hole.

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MTP302: Arisings.



MTP303: Showing trial hole location.

ARUN DISTRICT COUNCIL A/90/22/DOC



MTP303: Trial hole.



MTP303: Arisings.

ARUN DISTRICT COUNCIL A/90/22/DOC



MTP304: Showing trial hole location.



MTP304: Trial hole.

ARUN DISTRICT COUNCIL A/90/22/DOC



MTP304: Arisings.



MTP304: Arisings.

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MTP305: Showing trial hole location.



MTP305: Trial hole.



MTP305: Arisings.



MTP305: Arisings.

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MTP306: Showing trial hole location.



MTP306: Trial hole.

ARUN DISTRICT COUNCIL A/90/22/DOC



MTP306: Arisings.



MTP306: Arisings.

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MTP307: Showing trial hole location.



MTP307: Trial hole.

ARUN DISTRICT COUNCIL A/90/22/DOC



MTP307: Arisings.



MTP307: Arisings.

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MTP308: Showing trial hole location.

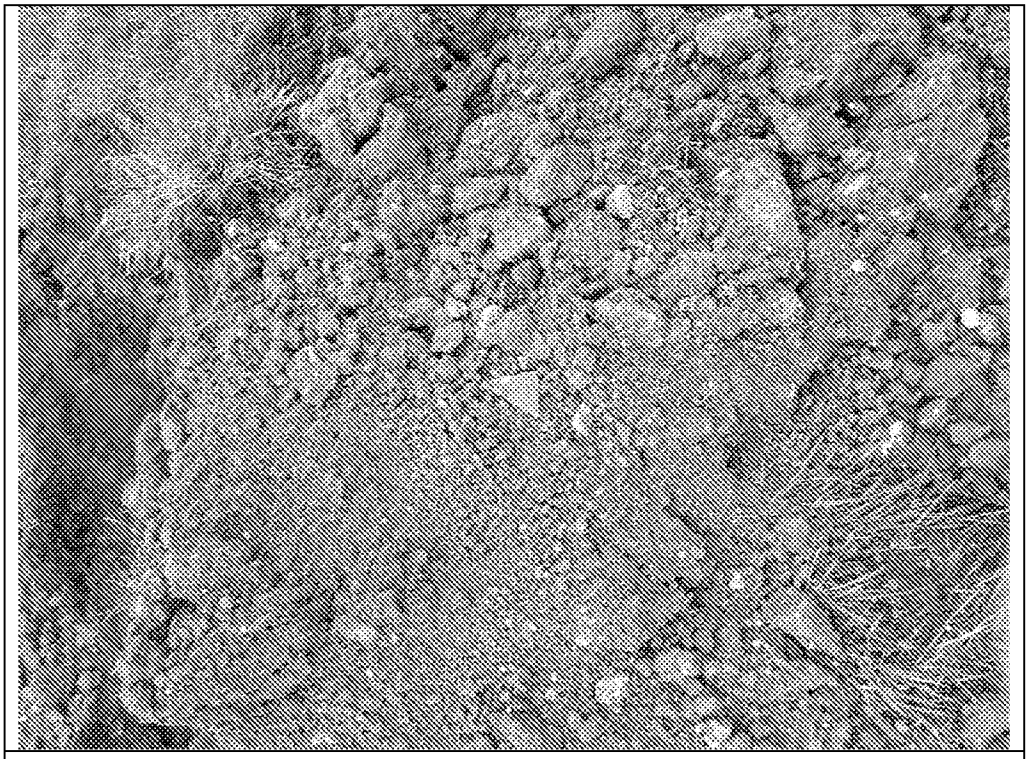


MTP308: Trial hole.

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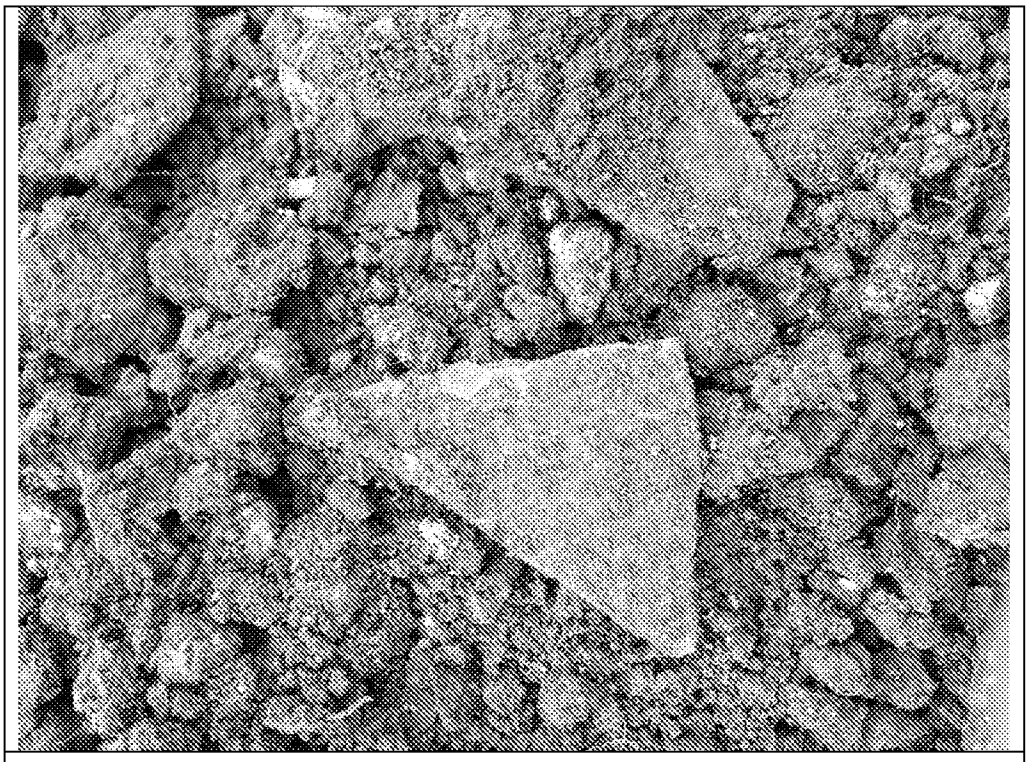


MTP308: Trial hole (showing metal lid)



MTP308: Arisings.

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MTP308: Fragment of asbestos (chrysotile) cement.



MTP308: Arisings with tyres.

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MTP308: Buried tyres.



MTP309: Showing trial hole location.

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