Geo-Environmental

NON-TECHNICAL SUMMARY

for the land at

ARNOLD'S FIELD, LAUNDERS LANE,

RAINHAM, RM13 9FL

on behalf of

LONDON BOROUGH OF HAVERING COUNCIL

Report:	**NON-TECHNICAL SUMMARY**
Site:	**ARNOLD'S FIELD, LAND WEST OF LAUNDERS LANE, RAINHAM, ESSEX RM13 9FL**
Client:	**LONDON BOROUGH OF HAVERING COUNCIL**
Date:	**20/11/2023**
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Introduction

The London Borough of Havering (LBH) has commissioned Geo-Environmental Services Limited (Geo-Environmental) to undertake an assessment of an area identified by LBH as the Arnolds Field, Launders Lane, Rainham. This Non-Technical Summary should be read in conjunction with the main report (GE21483/GIR/NOV23).

Background

The site comprises a former sand and gravel quarry that was subsequently registered as a landfill with the last waste recorded as being accepted in 1965. The site was licensed to accept inert, commercial, industrial, household and solid sludge waste. The details of the type of restoration works on the site post landfilling are unknown but is assumed that the site was restored with a thin cap of non-landfill materials, e.g. soil or stone. No measures to deal with possible ground gases are understood to have been installed as part of any restoration works.

More recently unauthorised placement of waste materials has occurred on the site. A review of historical photographs indicates that some level of earthworks, materials movements and potential placing of materials occurred between 1999 and 2019. A Freedom of Information (FOI) Request was made by Geo-Environmental to the Environment Agency detailed that between 30,000m^3 and 50,000m^3 of waste material was deposited on site between 2011 and July 2014. This material consisted of mixed household, commercial and industrial material, suspected from a waste transfer station.

It is understood that the site has the tendency to combust periodically, causing smoke and odour issues associated with fires on site.

Investigation Works

The scope of works undertaken by Geo-Environmental, comprised a site walkover in August 2023 and a review of desk study information for the site and an intrusive investigation which was undertaken between the 18th and 22nd September 2023. On-site gas and groundwater monitoring is ongoing and due to complete on the 4th December 2023.

The intrusive investigation included excavation of a series of small trenches (trial pits referred to as TP) to depths of up to 4.50m bgl (metres below ground level) and small diameter boreholes (window sampler boreholes referred to as WS) to depths of up to 5.00m bgl. A plan showing the spread of the investigation positions on site is presented in Figure 1 below:

Figure 1 – Site Investigation Location Plan

Encountered Conditions

The materials encountered comprised Made Ground, i.e. deposited soils/materials, with no investigation locations considered to extend into the natural soils underlying the original landfill on site.

Where soils were encountered these were noted to contain materials such as (but not limited to) brick, concrete, tarmac, coal, clinker and slate, tyres, plastic fragments, plastic bags, cement bags, CD players, cassette tapes, timber, slate, ceramic tiles, textiles, hessian, plastic gloves, glass bottles, cabling, ceramic pipe, plastic bottles, paper, metal bars, bike parts, packing tape, polystyrene, fibreglass, metal car parts, timber sleeper, metals drums and canisters, and Asbestos Containing Material (ACM) and/or suspected ACM.

A generalised summary of the encountered soil conditions encountered in the investigation position locations and depths under is presented in Table 1.

Top (m bgl)	Base (m bgl)	Description	Locations
0.00-2.00	4.50+	**MADE GROUND** Brown silty/clayey/gravelly sometimes ashy SAND. Gravels are fine to coarse brick and concrete, sometimes tarmac. Cobbles and boulders of concrete and brick. Other items included tyres, plastic fragments, plastic bags, cement bags, CD players, cassette tapes, timber, slate, ceramic tiles, textiles, hessian, plastic gloves, glass bottles, cabling, ceramic pipe, plastic bottles, paper, metal bars, bike parts, packing tape and timber sleeper. Suspected bonded Asbestos Containing Material (ACM). Oily odour and sheen Charred plastic Organic odour	TP101, TP102, TP103, TP105, TP106, TP107, TP108, TP109, TP111, TP112, TP113, WS101, WS103, WS104, WS106, WS106a, WS107, WS107a, WS017b WS107c, WS108, WS108a, WS108b, WS109, WS109a, WS109b, WS110 TP105 TP108 TP112
0.00	0.40	**MADE GROUND** Greyish brown ashy gravelly SILT. Gravels are fine to coarse brick with plastic.	TP103, TP104
0.00	0.50	**MADE GROUND:** Surface tipped materials: 70% plastic (mostly plastic bags), 15% textiles, metal, timber and concrete.	TP111
0.05	0.10	**TARMAC**	WS103, TP110
0.40-1.80	5.00+	**MADE GROUND** Brown, grey or black gravelly sandy CLAY. Gravels are fine to coarse brick, concrete, flint and occasional chalk. Cobbles and boulders of brick and concrete. Other items included tiles, metal bucket, metal car parts, polystyrene, timber, glass bottles, fibreglass, plastic, ceramic tiles, clinker, tarmac, hessian, coal, slate, suspected Asbestos Containing Material (ACM). Organic odour Strong hydrocarbon odour Tarry odour	TP104, TP106, TP107, TP110, TP111, TP112, WS101, WS102, WS103, WS104, WS105, WS106, WS106a, WS107c, WS108b, WS109b, WS110 TP106 & TP107 TP110 WS107c
0.80-3.70	3.90+	**MADE GROUND** Domestic waste: often comprising 20% to 85% plastic bag, up to 50% gravelly SAND, gravels are fine to coarse brick and concrete and flint, 5% timber, 5% textiles. Other items included: metal pipes, plastic pipes, rope, metals cans, brick, hessian materials, cladding, cables, ceramics, plastic bottles, shoes, foam, car parts, underlay, and car registration plates, cassettes, paper labels, metal, tree trunk, carpet, metal wire, plastic tray, netting, plastic bucket.	TP101, TP102, TP112

		Hydrocarbon and organic odour Crisps packet best before date 2011	TP101 TP112
1.60	2.00	**MADE GROUND:** Lilac iridescent fine to coarse GRAVELS of concrete and clinker.	TP107

Table 1 Summary of Ground Conditions encountered within the exploratory hole locations

In addition to the conditions encountered above an organic odour was also noted in TP110 between 3.40m and 3.70m bgl. An oily/tarry odour was noted in TP105 (3.20m and 3.30m bgl), TP110 and WS107c, with further organic odours in TP106, TP107 and TP112. Lilac iridescent colouring was observed on samples of concrete and clinker recovered (thought to be connected with some form of combustion waste) in TP107.

Domestic waste materials within the ground, where encountered, contained plastic bags (20%-85%), brick and concrete, timber (5%), textiles (5%). Other items included: metal pipes, plastic pipes, rope, metal cans, brick, hessian materials, cladding, cables, ceramics, plastic bottles, shoes, foam, car parts, underlay and car registration plates, cassettes, paper labels, metal, tree trunk, carpet, metal wire, plastic tray, netting, plastic bucket (TP101, TP102 and TP113).

Surface tipped materials noted while tracking across the site comprised plastic (mostly plastic bags -70%), textiles (15%), metal, timber and concrete and ACMs as well as trommel fines (material that comes from the mechanical treatment of waste).

Some photographs of the materials encountered are presented below:

Suspected Asbestos Containing Materials (ACM) on tracking route between TP103 & TP104

A plan showing some of the key features identified on site is presented in Figure 2 below:

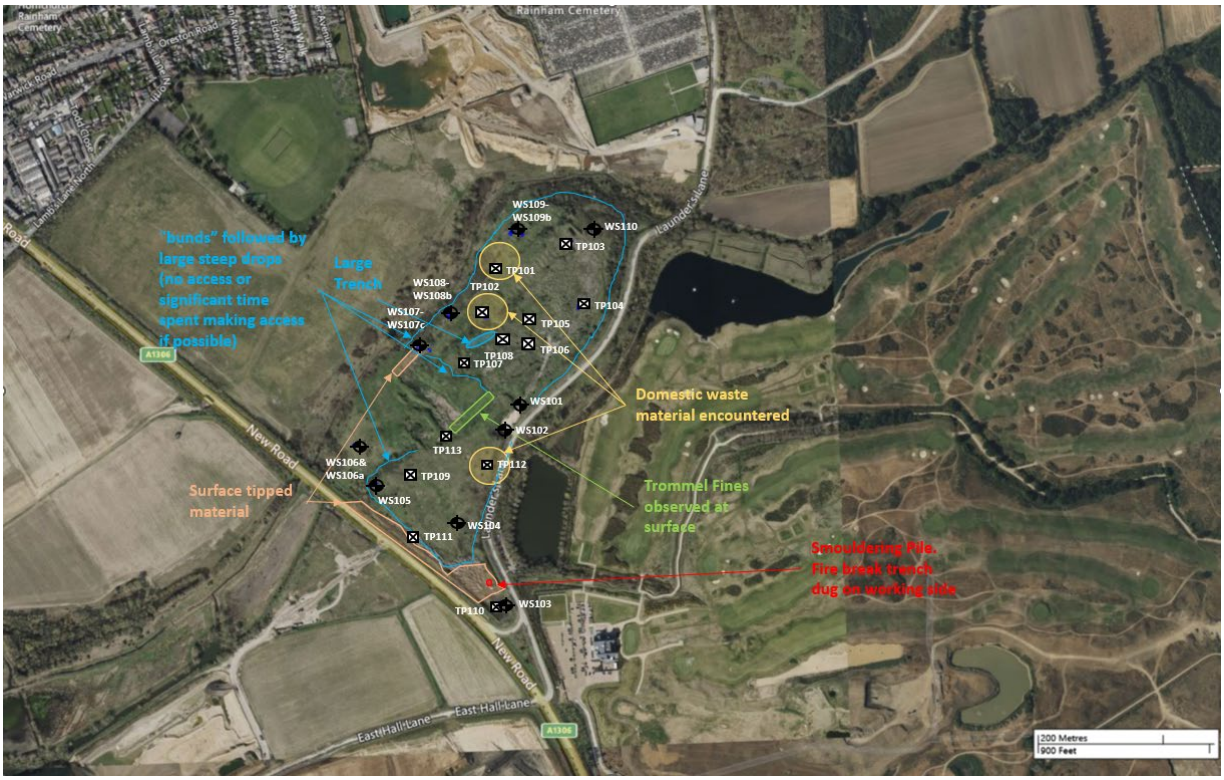

Figure 2 – Key Features Plan

Laboratory Testing

Soil samples were submitted to the geochemical laboratory with a selection of samples analysed for a range of substances as identified from the desk study for the site. Samples were tested for a range including metals, hydrocarbons/organics, volatile and semi-volatile organic compounds, polychlorinated biphenyls (PCBs), inorganics and asbestos.

In term of the assessment of risk from the testing undertaken. the closest possible land use screening criteria given the current vacant use of the site (which comprise a privately owned site, that is not actively open to the public but also is not fully secured/fenced of such that unauthorised access is feasible) is considered to be 'Public open space, park'. As such the results have been compared initially against the acceptable levels for this land use.

A summary of the range of concentrations identified from the soil testing is presented in Table 2. However, exceedances in relation to the Public open spaced end use were only identified in sample results from TP103 and WS107c for organics (PAH), and TP106, TP110 for metals (lead and arsenic) a summary of the exceedances is presented in Table 3 below:

Determinand	Minimum	Maximum	Maximum Sample (mbgl)	Location of the maximum concentration within analysis on site
Arsenic (mg/kg)	12	830	TP110 3.40m	Southern Area (Lower elevation)
Beryllium (mg/kg)	0.69	2	TP104 3.30m	Northern Area (Higher elevation)
Cadmium (mg/kg)	0.2	2.4	TP106 2.20m	Northern Area (Higher elevation)
Chromium (mg/kg)	22	110	TP109 2.5m	Southern Area (Higher elevation)
Copper (mg/kg)	37	4700	TP106 2.20m	Northern Area (Higher elevation)
Lead (mg/kg)	100	4400	TP106 2.20m	Northern Area (Higher elevation)
Mercury (mg/kg)	0.3	210	TP109 2.5m	Southern Area (Higher elevation)
Nickel (mg/kg)	18	49	TP106 2.20m	Northern Area (Higher elevation)
Selenium (mg/kg)	<1	<1	-	-

Determinand	Minimum	Maximum	Maximum Sample (mbgl)	Location of the maximum concentration within analysis on site
Vanadium (mg/kg)	38	100	TP106 2.20m	Northern Area (Higher elevation)
Zinc (mg/kg)	91	2000	TP106 2.20m	Northern Area (Higher elevation)
Hexavalent Chromium	0	0	-	-
Cyanide (mg/kg)	0.1	4.4	TP104 3.30m	Northern Area (Higher elevation)
Boron (mg/kg)	1.1	6.3	WS102 4.70m	Entrance compound (Lower elevation)
Phenol (mg/kg)	1.0	1.1	TP106 2.20m	Northern Area (Higher elevation)
Poly Aromatic Hydrocarbons (PAH) (mg/kg)	0.05	94	TP103 0.75m	Northern Area (Higher elevation)
BTEX (µg/kg)	5	5	-	-
TPH (mg/kg)	0.1	15000	TP110 3.40m	Southern Area (Lower elevation)
VOCs (µg/kg)	<5.0	<5.0	-	-
SVOCs (µg/kg)	<0.05	3.4	TP110 3.50m	Entrance compound (Lower elevation)
PCBs (mg/kg)	<0.001	0.043	TP106 2.20m	Northern Area (Higher elevation)

Table 2: Summary of range of concentration for determinands identified in soil samples analysed from site.

Determinand	Public Open Space (Park) Screening Criteria (mg/kg)*	Samples exceeding criteria (m bgl)	Maximum Value (mg/kg)	Exceedance locations on site
Arsenic	170	TP110 3.40	830	Southern Area (Lower elevation)
Lead	1300	TP106 2.20	4400	Northern Area (Higher elevation)
Benzo(b)fluoranthene	13	TP103 0.75 WS107c 2.30	28	Northern Area (Higher elevation) Western Area (Lower elevation)
Benzo(a)pyrene	11	TP103 0.75 WS107c 2.30	22	Northern Area (Higher elevation) Western Area (Lower elevation)
Dibenzo(ah)anthracene	1.1	TP103 0.75 WS107c 2.30	2.1	Northern Area (Higher elevation) Western Area (Lower elevation)

Note * These represent the acceptable maximum concentrations for this end use

Table 3: Summary of Soil Screening Criteria Exceedances (for a public open space end use)

Asbestos was identified in 9No. of the samples tested comprising a mix of asbestos cement, loose fibrous debris (lagging) and loose fibres, details of which are provided in Table 4 below:

Sample	Material Detected	Total % asbestos in the sample by hand picking/weight. *	Location of the maximum concentration within analysis on site
TP103 0.75m	Asbestos Cement – Chrysotile	-	Northern Area (Higher elevation)
TP104 0.00m	Asbestos Cement – Chrysotile	-	Northern Eastern Area (Higher elevation)
TP105 3.20m	Loose Fibres – Chrysotile	<0.001	Northern Area (Higher elevation)
TP106 0.00-1.80m	Insulation Lagging – Chrysotile, Amosite Asbestos Cement – Chrysotile	-	Northern Area (Higher elevation)
TP106 2.20m	Loose Fibres – Amosite	<0.001	Northern Area (Higher elevation)
TP106 3.00-3.40m	Insulation Lagging – Chrysotile Asbestos Cement – Chrysotile	-	Northern Area (Higher elevation)
TP107 1.80m	Loose Fibrous Debris – Chrysotile	0.034	Central Area (Higher elevation)
TP111 0.60m	Loose Fibres – Amosite	<0.001	Southern Area (Lower elevation)
TP113 3.30m	Loose Fibres – Chrysotile	<0.001	Southern Area (Higher elevation)

Note: * quantification was only undertaken on samples where loose asbestos fibres were identified. Quantification was not undertaken on bulk samples where visible ACM was identified.

Table 4: Summary of Asbestos Positive Identification

Water/leachate samples were taken where sufficient sample was obtainable during the initial monitoring visit (WS102 and WS103) and a third from TP110 during the investigation works. The samples recorded exceedances (potentially mobile substances) in relation to metals (Arsenic) and organics (PAH) in the sample from TP110 at 3.50m bgl and non-metals (Boron and chloride), metals (Mercury) in the sample from WS102 at 3.18m bgl. A summary of the range of

water/leachate concentrations identified is presented in Table 5 for information and where exceedances have been identified these are presented in Table 6 below:

Determinand	Minimum Concentration	Maximum Concentration	Maximum Sample	Location on site
Arsenic (µg/l)	4.14	223	TP110 3.50m bgl	Southern Area (Lower elevation)
Barium (µg/l)	250	430	WS103 3.70m bgl	Eastern Area (Lower elevation)
Beryllium (µg/l)	<0.1	<0.1	-	-
Cadmium (µg/l)	<0.02	0.03	TP110 3.50m bgl	Southern Area (Lower elevation)
Chromium (µg/l)	0.9	1.1	WS102 3.18m bgl	Eastern Area (Lower elevation)
Copper (µg/l)	0.8	3.5	WS103 3.70m bgl	Eastern Area (Lower elevation)
Lead (µg/l)	0.5	7.6	WS102 3.18m bgl	Eastern Area (Lower elevation)
Mercury (µg/l)	<0.05	<0.05	-	-
Nickel (µg/l)	2.5	10	WS102 3.18m bgl	Eastern Area (Lower elevation)
Selenium (µg/l)	<0.6	2.3	TP110 3.50m bgl	Southern Area (Lower elevation)
Vanadium (µg/l)	1.4	6.7	WS102 3.18m bgl	Eastern Area (Lower elevation)
Zinc (µg/l)	3.2	28	WS102 3.18m bgl	Eastern Area (Lower elevation)
Hexavalent Chromium (µg/l)	<0.5	<0.5	-	
Cyanide (µg/l)	<10	430	WS102 3.18m bgl	Eastern Area (Lower elevation)
Ammoniacal Nitrogen as NH3 (µg/l)	11000	47000	TP110 3.50m bgl WS102 3.18m bgl	Southern Area (Lower elevation) Eastern Area (Lower elevation)
Boron (µg/l)	610	4200	WS102 3.18m bgl	Eastern Area (Lower elevation)
Iron (mg/l)	0.14	1.6	TP110 3.50m bgl	Southern Area (Lower elevation)
PAH (µg/l)	<0.01	3.3	TP110 3.50m bgl	Southern Area (Lower elevation)
BTEX (µg/l)	<3.0	<3.0	-	-
TPH (µg/l)	<1.0	1700	TP110 3.50m bgl	Southern Area (Lower elevation)
VOCs (µg/l)	<3.0	<3.0	-	-
SVOCs (µg/l)	<0.01	3.3	TP110 3.50m bgl	Southern Area (Lower elevation)
PCBs (µg/l)	<0.02	<0.02	-	-

Table 5: Summary of determinands identified in water/leachate samples analysed from site

Determinand	Drinking Water Standards	EQS Freshwater	AtRisk Commercial*	Samples exceeding criteria	Maximum Value
Arsenic	10µg/l	50µg/l	-	TP110 3.5m bgl	223 µg/l
Boron	1000µg/l	2000 µg/l	-	WS102 3.18m bgl	4200 µg/l
Mercury	1µg/l	1 µg/l	-	WS102 3.18m bgl	7.6 µg/l
Chloride	250mg/l	250 mg/l	-	WS102 3.18m bgl	440 mg/l
PAH	0.1µg/l	-	-	TP110 3.50m bgl	1.84 µg/l

Note:* No determinands exceeded AtRisk Commercial values for Human Health; Drinking Water Standards relate to permissible concentrations at consumers' taps and are highly conservative in the context of the site, EQS freshwater relation to risk to surface water receptors.

Table 6: Summary of Water Screening Criteria Exceedances

Ground Gases

The spot monitoring undertaken to date has detected the following concentrations of ground gases in monitoring wells on the site:

- Methane in the range of 0.0% to 33.4%
- Carbon dioxide in the range of 0.1% to 30.2%
- Carbon monoxide in the range of 0ppm and 12ppm
- Hydrogen sulphide between 0ppm and 61ppm
- Oxygen in the range 0.1% to 21.9%
- Volatile Organic Compounds (VOCs) between 0.8ppm and 302ppm
- Atmospheric pressure in the range of 991mb to 1020mb
- Borehole flows with recorded steady flows between -0.2 to 0.3 l/hr.

Note: % – percentage based on the volume analysed; ppm – parts per million; l/hr – flow reported as litres per hour; mb - millibars

Assessment is on-going with regards to ground gas.

Conclusions

It is considered that the risk to members of the public from the elevated concentrations of specific determinands could primarily be mitigated through securing the site to prevent unauthorised access to the site.

Further consideration would need to be given to the presence of ACMs identified on the surface and in shallow soils beneath the site, together with seemingly sporadic low concentrations of free fibres identified within the soils. Whilst it is recommended that air monitoring is undertaken on/around the site to inform further assessment of the potential for airborne fibres to be released to the air, where asbestos is bound within cement, or mixed within a soil mass, it is considered that there is negligible potential for fibres to be released.

In terms of the risk to human health, it is considered that the majority of the source-pathway-receptor linkages (with the exception of combustion) can be mitigated via the securing of the site to prevent unauthorised access on the site.

Whilst the gas risk assessment has identified elevated concentrations of gas, no significant flow has been recorded and therefore a risk of migration of ground gases off-site is considered to be low. Methane can be flammable within a specific concentration range and the presence of pockets of methane could potentially exacerbate or sustain fires within the deposited waste. However, without a source of ignition and with no significant flow, the methane would be likely to remain within the waste mass and concentration reduce towards ground surface. Assessment of ground gases is ongoing.

If a capping system could be installed it would prevent any potential for fugitive release of asbestos fibres from the current surface and could also be integrated with possible ground gas mitigation measures, which would further reduce and/or mitigate the source-pathway-receptor linkages identified in relation to the site.