Eastwood & Partners
CONSULTING ENGINEERS

Eastwood & Partners, St Andrew's House, 23 Kingfield Road, Sheffield, S11 9AS
Tel: 0114 255 4554 Fax: 0114 255 4330 mail@eastwoodandpartners.com www.eastwoodandpartners.com

Mr P Allan
T.A.D. Architects
Smithy Wood House
Smithy Wood Crescent
Sheffield
S8 0NU

KRP/AJK/SAE/43632-002

10 July 2019

Dear Peter,

Kendray Hospital Car Park, Barnsley

We are writing to formally report the findings of our recent site investigation.

The Site

The approximately 0.1 hectare site is located south of Doncaster Road, within the north east of the existing Kendray Hospital site in Barnsley, South Yorkshire. The site lies around 1.8 km south east of Barnsley Town Centre. The site is roughly rectangular in shape and is centred around grid reference 436241 405682.

The site currently comprises an area of temporary parking, formed of plastic matting overlying vegetation, in the north eastern corner of the wider Kendray Hospital site. Flowerbeds line the northern and southern areas of the parking area, and mature trees approximately 10 m in height are present at the northern boundary. The remainder of the hospital grounds are present to the west and south.

A live BT cable and surface water drains are known to cross the eastern corner of the site, with electric cables for street lighting running along the southern boundary.

Desktop Information

History of the Site and Surrounding Area

Historical maps have been reviewed from online sources for the site and surrounding area.

The first available historical map, dated 1852, shows the site to comprise fields, with a sandstone quarry (Oaks Quarry) present on the opposite side of Doncaster Road, approximately 10 m from the site. Subsequent maps show the quarry to extend further

northwards, with Oaks Colliery shown approximately 400 m north of the site, adjacent to a railway line which branches into the colliery and quarry.

Kendray Hospital (infectious diseases) is shown as roughly in the centre of the wider hospital site from 1892, with a small quarried area also present at the north western corner of the wider hospital site. Pinder Oaks Colliery (disused) is shown around 500 m west of the site, with a brickworks shown around 400 m north west of the site.

By 1906 the hospital buildings to the south west of the site have expanded around the original hospital building, although the site still remains undeveloped.

The layout remains the same until the 1930s, when housing is constructed immediately north east and east of the site, a school is built immediately west of the wider hospital site, Oaks Quarry is shown as disused, and Old Oaks Colliery is renamed Barnsley Main Colliery. The colliery is now significantly bigger, and includes coke ovens. Houses are constructed to the south of the wider hospital site during the 1950s.

The 1961 historical map shows the hospital buildings to expand further southwards, and factories and works have been added in the wider area to the north west of the site. By the late 1970s and early 1980s, Barnsley Main Colliery is no longer present to the north of the site, with most of its former area shown as a tip (disused), presumed to comprise colliery spoil, although the main winding house remains to the present day. The former quarry to the north of the site is also shown to be covered by a similar disused tip, also presumed to comprise colliery spoil. The map dated 1978 – 1993 shows the former railway branch to Barnsley Colliery to have been dismantled, and several depots and works buildings to be present in the colliery's former footprint. A smaller colliery, named Barrow Colliery, remains 750 m north of the site on this map. The hospital is now shown as a similar layout as the current day.

In recent years, it is understood plastic matting has been placed over the grassed area of the site to create a temporary car park.

Geology, Hydrology and Hydrogeology

The geological map, Sheet SE 30NE (1:10,000 scale), shows the underlying geology to comprise the Oaks Rock formation of sandstone, annotated to be 'flaggy and false bedded'. The strata are shown to be dipping to the east at approximately 4˚.

No superficial deposits are recorded to cover the site, and no faults or other lines of weakness are shown to affect the site.

The bedrock underlying the site is recorded as being a Secondary A aquifer. This is defined as comprising permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

The site is not recorded to be within a Groundwater Source Protection Zone.

The nearest surface water feature is presumed to be a drain located approximately 140 m north west of the site.

Coal Mining

Several coal mines have historically been present in the surrounding area, including Oaks Colliery around 400 m north and Barnsley Main Colliery, shown to be around 700 m north east on the geological map.

However, the closest seam shown to outcrop on the geological map is the Newhill Coal, at approximately 540 m west of the site. At this distance and with a dip angle of 4˚, the Newhill Coal is expected at a depth of 37.76 m beneath the site.

This is confirmed by the Coal Authority interactive map viewer which also shows the site not to be within a 'development high risk area', and 'probable shallow workings' are not shown beneath the site.

Since the site is proposed to be developed with a car park, a Coal Mining investigation is not considered necessary. If the site is to be redeveloped with buildings in the future, a further Coal Mining Risk Assessment will need to be undertaken.

Discharge Consents

There are no discharge consents within 250 m of the site.

Flooding

The site is within a Flood Zone 1, according to government Flood Map for Planning data. Flood zone 1 is defined as land property in flood zone 1 have a low probability of flooding.

Ground Gas

According to Public Health England data, the site is shown to have a maximum radon potential of 1 to 3 % radon. However, since the proposed development of the site comprises an open car park, accumulation of radon gas will not pose a significant risk to future site users, and therefore radon precautions are not relevant.

Several infilled quarries and other features are present in the surrounding area, including the quarry to the north of the site which is recorded as a historic landfill site. Such features may pose a risk of ground gas generation. However, since the site is to be developed with a car park with no enclosed areas, ground gas is not considered to pose a significant risk to future site users. Ground gas monitoring and/or gas precaution measures are therefore not considered necessary.

If the site is to be redeveloped in future, the radon and ground gas risk to future developments will need to be reconsidered.

Outline Conceptual Model

The following table details the possible sources and associated contaminants of concern, pathways and receptors, potentially present:

Source	Potential Contaminants	Pathway
• Heavy metals/metalloids and polycyclic aromatic hydrocarbons (PAHs) from atmospheric fallout of surrounding industry/former collieries in near surface material	• Ingestion, inhalation, direct contact • Migration through ground	• Site workers, future residents • Secondary A aquifer
• Use as temporary car parking	• Total Petroleum Hydrocarbons and PAHs	• Site workers, future residents • Secondary A aquifer
• Sulphates in natural ground	• Direct contact	• Below ground concrete

Ground Investigation

The site works were undertaken on 25 April 2019. Initially, one hand pit, referenced HP1, was excavated in order to ascertain the depth location and direction of the live BT cable crossing the site. Three trial pits, referenced TP1 to TP3, were then excavated across the site using a JCB 3CX style mechanical backhoe excavator. The pits were positioned to give good site coverage.

The hand pit was excavated to 0.65 m at which point the BT cable was located. The three trial pits were excavated to depths of between 1.2 m and 1.3 m below ground level (bgl).

A fourth proposed trial pit in the north of the site was abandoned due to the proximity of tree roots.

Infiltration testing was also undertaken within TP1, referenced TP1/SA1.

Copies of the trial pit and soakaway logs are enclosed and their locations are shown on the Exploratory Hole Location Plan, drawing number 43632/001, also enclosed.

Three samples of topsoil and three samples of natural ground were dispatched for chemical testing. Soil samples were taken in 500 g plastic tubs and 250 ml amber glass jars and were analysed at Chemtest Limited using MCERTs accredited methodologies where available. The results are discussed below and copies of the test certificates are enclosed.

Ground Conditions

Topsoil was encountered across the site to depths of between 0.2 m and 0.3 m bgl, described as slightly clayey slightly gravelly sand.

Within HP1, natural orange brown clayey gravelly sand was encountered beneath the topsoil, with the western wall of the pit (over the BT cable) appearing darker in colour, likely to comprise reworked material.

Beneath the topsoil, the same orange brown clayey gravelly sand was encountered in TP1 and TP3 to depths of 0.4 m and 1 m bgl respectively, with a low cobble content of sandstone recorded in TP3. Natural sandy gravel with a medium to high cobble content of sandstone was recorded from beneath the topsoil to a depth of 0.8 m bgl within TP2, and from 0.4 m to 1.2 m in TP1.

Cobbles of sandstone were encountered from 0.8 m and 1 m bgl in TP2 and TP3 respectively, over medium strong to strong sandstone bedrock at the base of the pit, preventing further excavation.

Groundwater was not required within any of the exploratory holes.

No visual or olfactory evidence of contamination was encountered.

Geotechnical Appraisal

The site is proposed to be developed with a surfaced car park, and therefore recommendations for foundations and ground slabs have not been included.

Sandstone bedrock was encountered at 1.3 m bgl, which, depending on the nature, may pose as an obstruction for any future redevelopment.

It should be noted that the sides of any excavations may be unstable, particularly if oversize material or where shallow groundwater is present.

For the proposed hard surfacing, it can be assumed that a CBR value well in excess of 3% will be provided by the existing soils, assuming that the current topsoil will be removed. The formation should be proof rolled, however, and any soft spots should be excavated and replaced with well compacted granular material. An aggregate sub-base layer should be placed in thin, well compacted layers, prior to placing the hard surfacing, which is expected ot comprise asphalt.

Infiltration Testing

One infiltration pit was excavated, with three tests undertaken. The infiltration calculations are appended to this report, and are summarised below:

- Test 1 drained within 27 minutes, giving an Average Infiltration Rate of 130 ($x10^{-6}$) and a BR365 Soil Infiltration Rate of 180 ($x10^{-6}$);
- Test 2 drained within 31 minutes, giving an Average Infiltration Rate of 120 ($x10^{-6}$) and a BR365 Soil Infiltration Rate of 100 ($x10^{-6}$);
- Test 3 drained within 41 minutes, giving an Average Infiltration Rate of 100 ($x10^{-6}$) and a BR365 Soil Infiltration Rate of 73 ($x10^{-6}$).

Soakaways are therefore considered to be a suitable form of surface water drainage.

Contamination Appraisal

Chemical Testing

Three samples of topsoil and three samples of natural ground were dispatched for chemical testing. The site is proposed to be redeveloped with a car park, and so assessment criteria relating to commercial end use have been used, due to the short length of time site users are expected to interact with the site. The results (Chemtest reports 19-14329 and 19-14337) are appended to this report, along with the relevant Table of Assessment Values.

Three samples of topsoil underwent testing for heavy metals/metalloids, PAH compounds and screening for asbestos, with one of these samples also tested for Total Organic Carbon (TOC). Three samples of natural ground underwent testing for heavy metals/metalloids, PAH compounds, water soluble and acid soluble sulphates, sulphur and pH, with one of these samples also tested for TOC.

In addition, one sample of natural ground underwent inert waste acceptance criteria (WAC) testing.

No visual or olfactory evidence of hydrocarbons was noted both at the surface of the site and within the exploratory holes, and therefore testing for Total Petroleum Hydrocarbons (TPH) was not deemed necessary.

No visual or olfactory evidence of other contamination was observed within the intrusive investigation.

Chemical Test Results

None of the samples of topsoil, or natural ground were found to exceed any of the respective assessment criteria for human health for any metals/metalloids or PAH contaminants. Asbestos was not recorded in the topsoil.

None of the samples of topsoil or natural ground were found to exceed the assessment criteria for phytotoxicity to plants.

The results from the samples of natural ground indicate that the water soluble sulphate concentrations were all <10 mg/l, compared with the upper limit of Design Sulphate Class 1 of 500 mg/l. The concentrations of total potential sulphate calculated are all between 0.03% and 0.09% compared with an upper design limit of 0.24% for class DS-1. The pH of the natural ground samples were all between 6.5 and 8.0.

Based on these results, the natural ground and made ground would be assigned a Design Sulphate Class of DS-1 and Aggressive Chemical Environment for Concrete (ACEC) Class of AC-1.

Waste Acceptance Criteria (WAC) Testing

Spoil from excavations on the site may need to be disposed of off-site, and therefore one sample of the natural ground, from TP01/SA01 at 0.3 m bgl, was submitted for a full inert WAC suite. The results are appended (Chemtest Report 19-14337).

The results indicate that the natural ground is suitable for disposal in as inert waste.

The Environment Agency caveats the guidance in that the final decision as to whether a material can be accepted into any given landfill site will always lie with the receiving tip, and therefore it is recommended that a landfill site is identified prior to starting works, in order that the operator can be approached and given the chance to consider the results of the testing carried out. Options such as reusing the soils on site should be considered, and prioritised wherever possible.

Risk Assessment

The chemical test results have not identified any significant pollutant linkages. Therefore, significant risks to end users of the site are unlikely to be presented, and remedial measures are not considered to be necessary.

Conclusion

Elevated concentrations of contaminants above the relevant human health guidelines have not been identified within the topsoil and natural ground. The topsoil is considered suitable for reuse on site.

If offsite disposal of material is required, it is likely the natural ground will be suitable for disposal in as inert waste.

Any unusual, brightly coloured, ashy or odorous material, or material suspected of containing asbestos, encountered during construction should be brought to the attention of the site staff and investigated.

Significantly elevated concentrations phytotoxic contaminants have not been identified within the materials tested therefore plant growth is not considered to be at significant risk of phytotoxicity.

Significantly elevated concentrations of contaminants were not identified in either topsoil or natural ground. Therefore the risk to controlled waters from materials on site is considered to be negligible.

DS-1 AC-1, i.e. none, sulphate precautions are required for concrete in contact with the natural ground.

The above conclusions are based on the assumption that the site will be developed with a car park. If this is not the case, or if the site is to be redeveloped for other uses in the future, it is likely additional investigation, including further chemical and geotechnical testing, will be required.

We trust that this meets with your approval, however if you have any comments or queries please do not hesitate to contact us.

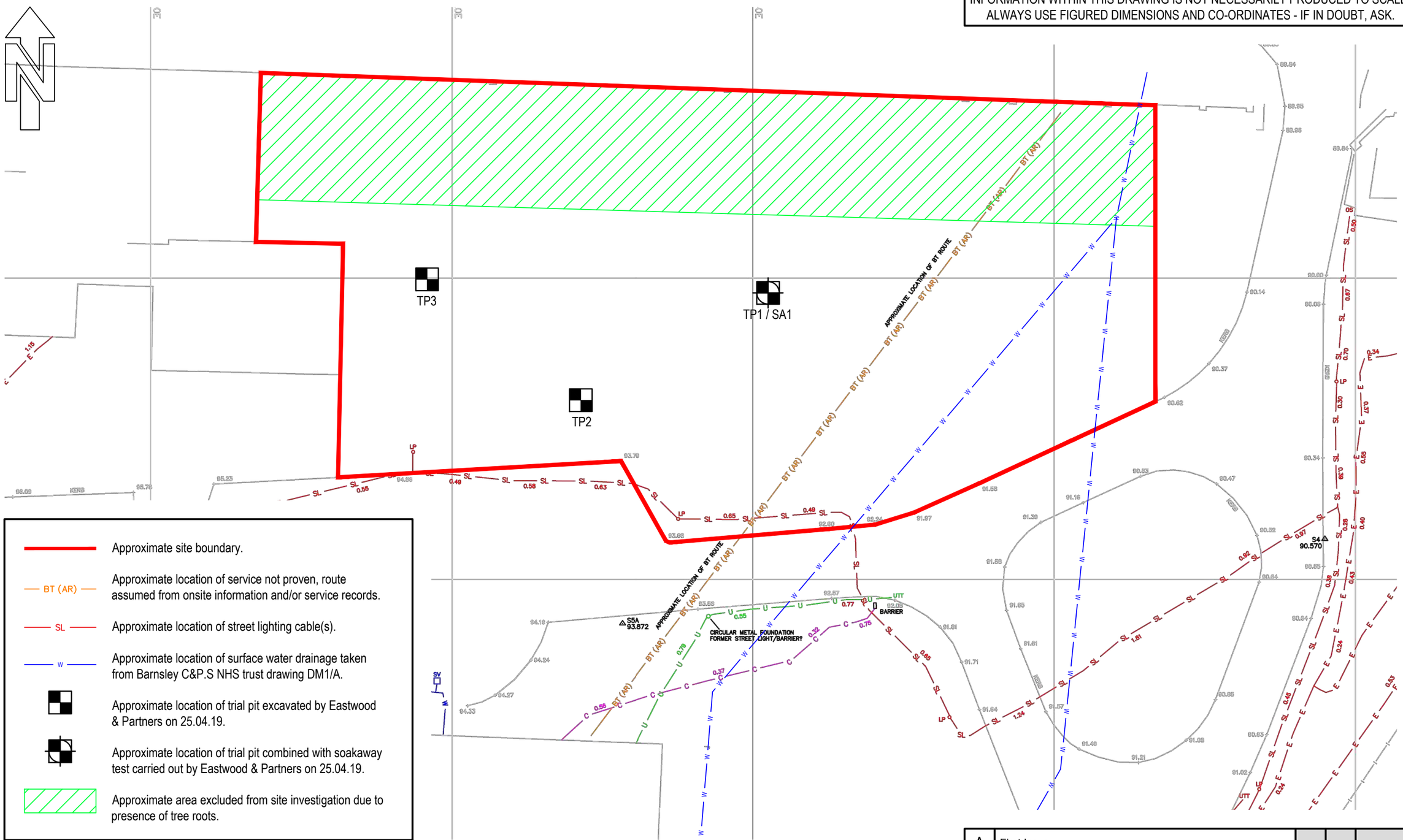
Yours sincerely



Andrew Kerslake
Associate

Enc Exploratory Hole Location Plan – Drawing 43632/001
Trial Pit Logs HP1, TP1 – TP3
Infiltration results
Chemical Test Results – Chemtest Report No. 19-14329 and 19-14337
Assessment Values

INFORMATION WITHIN THIS DRAWING IS NOT NECESSARILY PRODUCED TO SCALE.
ALWAYS USE FIGURED DIMENSIONS AND CO-ORDINATES - IF IN DOUBT, ASK.



- Approximate site boundary.
- BT (AR) — Approximate location of service not proven, route assumed from onsite information and/or service records.
- SL — Approximate location of street lighting cable(s).
- W — Approximate location of surface water drainage taken from Barnsley C&P.S NHS trust drawing DM1/A.
- Approximate location of trial pit excavated by Eastwood & Partners on 25.04.19.
- Approximate location of trial pit combined with soakaway test carried out by Eastwood & Partners on 25.04.19.
- Approximate area excluded from site investigation due to presence of tree roots.

REV	DESCRIPTION	SIG	CHK	DATE
A	First Issue.			

Eastwood & Partners
CONSULTING ENGINEERS
St. Andrew's House
23 Kingfield Road
Sheffield
S11 9AS
Tel 0114 255 4554
Fax 0114 255 4330
mail@eastwoodandpartners.com
www.eastwoodandpartners.com

TAD ARCHITECTS

KENDRAY HOSPITAL, BARNSLEY

EXPLORATORY HOLE LOCATION PLAN

SCALE WHEN PLOTTED AT A3	DRAWING STATUS
1:250	INFORMATION

DRAWN	CHECKED	DATE	DRAWING NUMBER	REV
RH	SAE	24.05.19	43632/001	A

Eastwood&Partners
CONSULTING ENGINEERS

TrialPit No
HP1
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Kendray Hospital	43632	Level:	25/04/2019
Location: Barnsley		Dimensions: m	Scale 1:25
Client: TAD Architects		Depth: 0.65m m	Logged SAE

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.20			TOPSOIL: Grass over compacted dark brown slightly clayey slightly gravelly SAND with frequent roots and rootlets. Gravel is fine to coarse angular to subangular of sandstone with occasional limestone.
			0.65			Orange brown clayey gravelly SAND. Gravel is fine to coarse angular to subangular of sandstone. Material is darker in colour (likely reworked) in western wall of pit.
						Trialpit Complete at 0.650m

Remarks: 1. Hand pit excavated in order to find BT cable, found at 0.65 m bgl. 2. No groundwater encountered.

Stability: Stable

Eastwood&Partners
CONSULTING ENGINEERS

TrialPit No
TP1/SA1
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Kendray Hospital	43632	Level:	25/04/2019
Location: Barnsley		Dimensions: 1.70m, 0.67m, Depth: 1.20m	Scale 1:25
Client: TAD Architects			Logged SAE

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.10	D					TOPSOIL: Grass over dark brown slightly clayey slightly gravelly SAND with frequent roots and rootlets. Gravel is fine to coarse angular to subangular of sandstone with rare clay pottery piece.
0.30	D		0.25			Orange brown clayey gravelly SAND, with low cobble content of sandstone. Gravel is fine to coarse angular to subangular of sandstone. occasional rots and rootlets near surface of stratum.
			0.40			Brownish orange sandy GRAVEL of fine to coarse angular to subangular sandstone, with medium to high cobble content of sandstone.
			1.20			Trialpit Complete at 1.200m

Remarks: 1. No groundwater encountered.

Stability: Stable

Eastwood&Partners
CONSULTING ENGINEERS

TrialPit No
TP2
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Kendray Hospital	43632	Level:	25/04/2019
Location: Barnsley		Dimensions: m	Scale 1:25
Client: TAD Architects		Depth: 1.30m m	Logged SAE

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.10	D					TOPSOIL: Grass over dark brown slightly clayey slightly gravelly SAND with frequent roots and rootlets. Gravel is fine to coarse angular to subangular of sandstone with occasional limestone and brick.
			0.30			Brownish orange sandy GRAVEL of fine to coarse angular to subangular sandstone, with medium to high cobble content of sandstone.
			0.80			Brownish orange sandy gravelly COBBLES of sandstone. Gravel is medium to coarse angular to subangular of sandstone.
			1.25			Medium strong to strong brownish orange SANDSTONE.
			1.30			Trialpit Complete at 1.300m

Remarks: 1. No groundwater encountered. 2. Solid at base

Stability: Stable

Eastwood&Partners
CONSULTING ENGINEERS

TrialPit No
TP3
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Date
Kendray Hospital	43632	Level:	25/04/2019
Location: Barnsley		Dimensions: m	Scale 1:25
Client: TAD Architects		Depth: 1.30m m	Logged SAE

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.10	D					TOPSOIL: Grass over dark brown slightly clayey slightly gravelly SAND with frequent roots and rootlets. Gravel is fine to coarse angular to subangular of sandstone with rare brick and glass.
			0.30			
0.40	D					Orange brown slightly clayey gravelly SAND with low cobble content. Gravel is fine to coase angular to subangular of sandstone, cobble content increases with depth.
0.60	D					
			1.00			Brownish orange sandy gravelly COBBLES of sandstone. Gravel is medium to coarse angular to subangular of sandstone.
			1.25			Medium strong to strong brownish orange SANDSTONE.
			1.30			Trialpit Complete at 1.300m

Remarks: 1. No groundwater encountered. 2. Solid at base

Stability: Stable

PROJECT:	Kendray Hospital, Barnsley	Job No. 43632	Date 25.04.19
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared SAE	Checked AJK

Test No. **TP1/SA1 - Test 1**

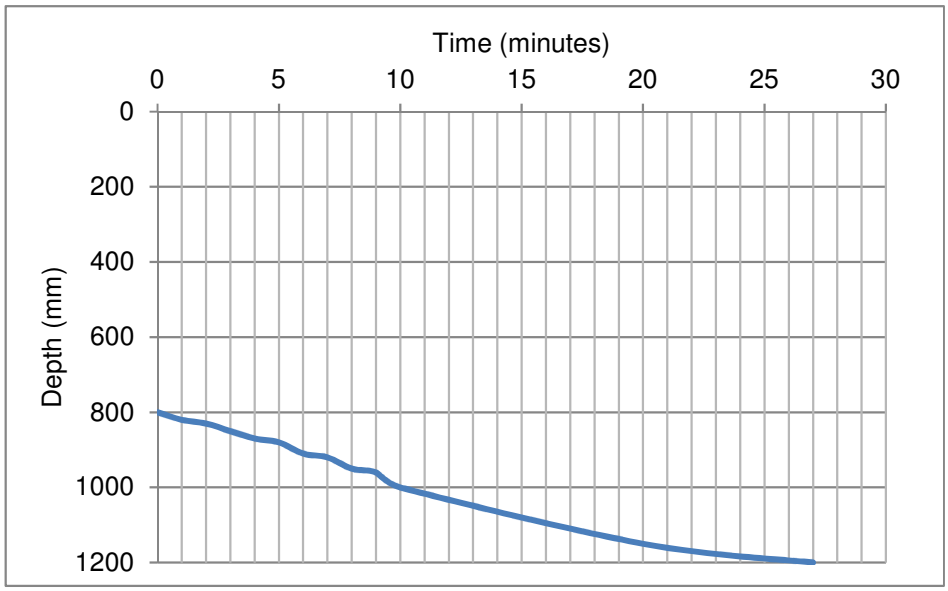
Test Pit Dimensions

Length = **1700** mm
Width = **670** mm
Depth = **1200** mm (Total depth)

Plan area = **1.139** m²

Approximate time to discharge water into the hole: **120** Seconds
Depth to water after completion of pumping: **800** mm

Time (min)	Depth (mm)
0	**800**
1	**820**
2	**830**
3	**850**
4	**870**
5	**880**
6	**910**
7	**920**
8	**950**
9	**960**
10	**1000**
20	**1150**
27	**1200**



Depth (m)	Description
0-0.25	TOPSOIL: Grass over dark brown slightly clayey slightly gravelly SAND.
0.25-0.4	Orange brown clayey gravelly SAND, with low cobble content of sandstone.
0.4-1.2	Brownish orange sandy GRAVEL of fine to coarse angular to subangular sandstone, with medium to high cobble content of sandstone.

PROJECT:	Kendray Hospital, Barnsley	Job No. 43632	Date 25.04.19
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared SAE	Checked AJK

Test No. TP1/SA1 - Test 1

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} x t_{p75-25}}$$

Where:

V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **800** mm
Start time = **0** min

Average water depth: **200** mm

Change in water depth: **400** mm

Final parameters

Depth to water = **1200** mm
End time = **27** min

Time interval: **27** min

Effective Storage Volume of Water in the Trial Pit = **0.4556** m³
75% Effective Depth = **900** mm from ground level
25% Effective Depth = **1100** mm from ground level
Time at 75% Effective Depth = **6** minutes
Time at 25% Effective Depth = **16** minutes

V_{p75-25} = **0.23** m³

a_{p50} = **2.09** m²

t_{p75-25} = **600** sec

f = **1.8E-04 m/sec**

Average Soakaway Rate = **2.8E-04** m³/sec
Average soakaway area = **2.09** m² (sides + base)

BR365 Soil Infiltration Rate = 1.8E-04 m/sec
Average Infiltration Rate = 1.3E-04 m/sec

PROJECT:	Kendray Hospital, Barnsley	Job No. 43632	Date 25.04.19
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared SAE	Checked AJK

Test No. **TP1/SA1- Test 2**

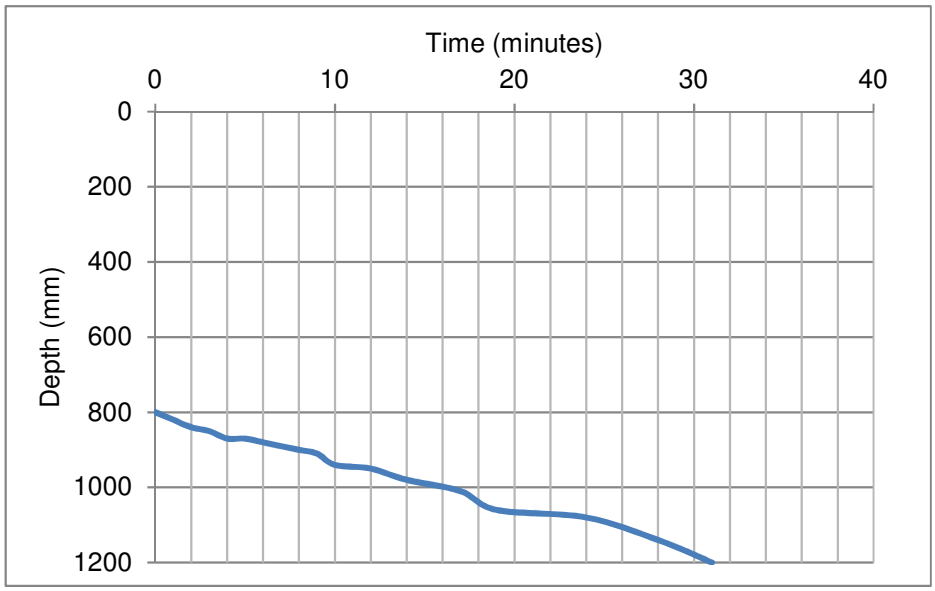
Test Pit Dimensions

Length = **1700** mm
Width = **670** mm
Depth = **1200** mm (Total depth)

Plan area = **1.139** m²

Approximate time to discharge water into the hole: **120** Seconds
Depth to water after completion of pumping: **800** mm

Time (min)	Depth (mm)
0	**800**
1	**820**
2	**840**
3	**850**
4	**870**
5	**870**
6	**880**
7	**890**
8	**900**
9	**910**
10	**940**
12	**950**
14	**980**
17	**1010**
19	**1060**
24	**1080**
28	**1140**
31	**1200**



Depth (m)	Description
0-0.25	TOPSOIL: Grass over dark brown slightly clayey slightly gravelly SAND.
0.25-0.4	Orange brown clayey gravelly SAND, with low cobble content of sandstone.
0.4-1.2	Brownish orange sandy GRAVEL of fine to coarse angular to subangular sandstone, with medium to high cobble content of sandstone.

PROJECT:	Kendray Hospital, Barnsley	Job No. 43632	Date 25.04.19
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared SAE	Checked AJK

Test No. TP1/SA1- Test 2

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} x t_{p75-25}}$$

Where:

V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **800** mm
Start time = **0** min

Average water depth: **200** mm

Change in water depth: **400** mm

Final parameters

Depth to water = **1200** mm
End time = **31** min

Time interval: **31** min

Effective Storage Volume of Water in the Trial Pit = **0.4556** m³
75% Effective Depth = **900** mm from ground level
25% Effective Depth = **1100** mm from ground level
Time at 75% Effective Depth = **8** minutes
Time at 25% Effective Depth = **26** minutes

V_{p75-25} = **0.23** m³

a_{p50} = **2.09** m²

t_{p75-25} = **1080** sec

f = **1.0E-04 m/sec**

Average Soakaway Rate = **2.4E-04** m³/sec
Average soakaway area = **2.09** m² (sides + base)

BR365 Soil Infiltration Rate = 1.0E-04 m/sec
Average Infiltration Rate = 1.2E-04 m/sec

PROJECT:	Kendray Hospital, Barnsley	Job No. 43632	Date 25.04.19
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared SAE	Checked AJK

Test No. **TP1/SA1 - Test 3**

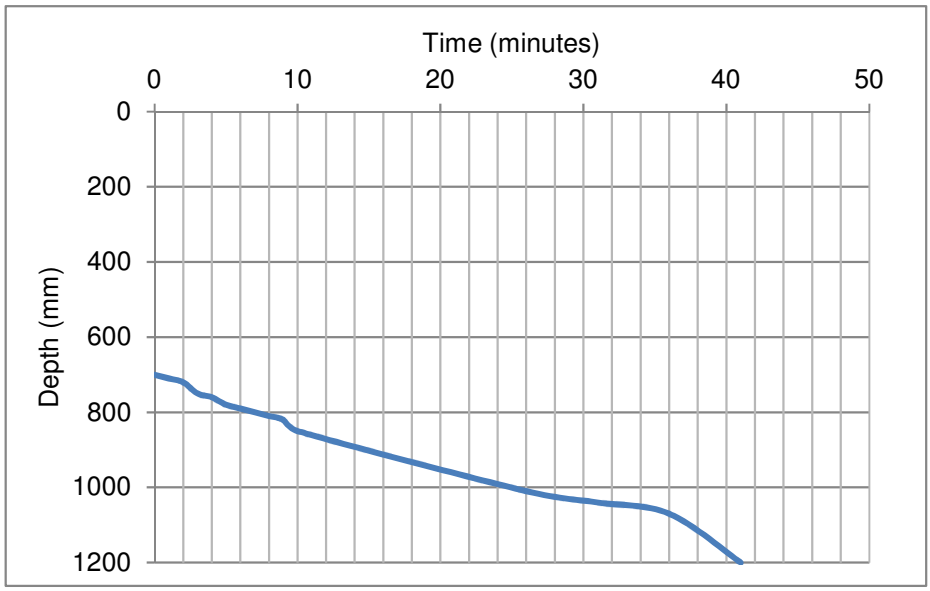
Test Pit Dimensions

Length = **1700** mm
Width = **670** mm
Depth = **1200** mm (Total depth)

Plan area = **1.139** m²

Approximate time to discharge water into the hole: **240** Seconds
Depth to water after completion of pumping: **700** mm

Time (min)	Depth (mm)
0	**700**
1	**710**
2	**720**
3	**750**
4	**760**
5	**780**
6	**790**
7	**800**
8	**810**
9	**820**
10	**850**
26	**1010**
31	**1040**
36	**1070**
41	**1200**



Depth (m)	Description
0-0.25	TOPSOIL: Grass over dark brown slightly clayey slightly gravelly SAND.
0.25-0.4	Orange brown clayey gravelly SAND, with low cobble content of sandstone.
0.4-1.2	Brownish orange sandy GRAVEL of fine to coarse angular to subangular sandstone, with medium to high cobble content of sandstone.

PROJECT:	Kendray Hospital, Barnsley	Job No. 43632	Date 25.04.19
SUBJECT:	Infiltration Test Results and Calculation of Infiltration Rates	Prepared SAE	Checked AJK

Test No. TP1/SA1 - Test 3

Soil Infiltration Rate in Accordance with BR365

$$f = \frac{V_{p75-25}}{a_{p50} x t_{p75-25}}$$

Where:

V_{p75-25} is the effective storage volume of water in the trial pit between 75% and 25% effective depth;

a_{p50} is the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} is the time for the water level to fall from 75% to 25% effective depth

Initial parameters

Depth to water = **700** mm
Start time = **0** min

Average water depth: **250** mm

Change in water depth: **500** mm

Final parameters

Depth to water = **1200** mm
End time = **41** min

Time interval: **41** min

Effective Storage Volume of Water in the Trial Pit = **0.5695** m³
75% Effective Depth = **825** mm from ground level
25% Effective Depth = **1075** mm from ground level
Time at 75% Effective Depth = **9** minutes
Time at 25% Effective Depth = **37** minutes

V_{p75-25} = **0.28** m³

a_{p50} = **2.32** m²

t_{p75-25} = **1680** sec

f = **7.3E-05 m/sec**

Average Soakaway Rate = **2.3E-04** m³/sec
Average soakaway area = **2.32** m² (sides + base)

BR365 Soil Infiltration Rate = 7.3E-05 m/sec
Average Infiltration Rate = 1.0E-04 m/sec

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	19-14329-1
Initial Date of Issue:	03-May-2019
Client	Eastwood & Partners
Client Address:	St. Andrews House 23 Kingfield Road Sheffield South Yorkshire S11 9AS
Contact(s):	Geo Stefani Ellis
Project	43632 Kendray Hospital

Quotation No.:		**Date Received:**	29-Apr-2019
Order No.:	43632/AJK/SAE	**Date Instructed:**	29-Apr-2019
No. of Samples:	6		
Turnaround (Wkdays):	5	**Results Due:**	03-May-2019
Date Approved:	03-May-2019		

Approved By:



Details: Martin Dyer, Laboratory Manager

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 43632 Kendray Hospital

Client: Eastwood & Partners				**Chemtest Job No.:**	19-14329	19-14329	19-14329	19-14329	19-14329	19-14329
Quotation No.:				**Chemtest Sample ID.:**	817237	817238	817239	817240	817241	817242
				Sample Location:	TP01/SA01	TP02	TP03	TP01/SA01	TP03	TP03
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.10	0.10	0.10	0.30	0.40	0.60
				Date Sampled:	25-Apr-2019	25-Apr-2019	25-Apr-2019	25-Apr-2019	25-Apr-2019	25-Apr-2019
				Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY			
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
ACM Type	U	2192		N/A	-	-	-			
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected			
ACM Detection Stage	U	2192		N/A	-	-	-			
Moisture	N	2030	%	0.020	11	11	14	12	8.6	8.1
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown,
Other Material	N	2040		N/A	StonesRoots20 %	stones	stones	Stones,	Stones	Stones
Soil Texture	N	2040		N/A	Sand,	Sand,	Sand,	Sand,	Sand,	Sand
pH	M	2010		N/A	8.1	6.3	7.2	6.5	7.8	8.0
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010				< 0.010	< 0.010	< 0.010
Total Sulphur	M	2175	%	0.010				0.030	< 0.010	< 0.010
Sulphate (Acid Soluble)	M	2430	%	0.010				0.029	< 0.010	< 0.010
Arsenic	M	2450	mg/kg	1.0	23	22	33	13	8.6	7.1
Cadmium	M	2450	mg/kg	0.10	0.35	0.26	0.33	0.13	< 0.10	< 0.10
Chromium	M	2450	mg/kg	1.0	15	15	16	11	11	9.0
Copper	M	2450	mg/kg	0.50	36	36	38	21	11	8.6
Mercury	M	2450	mg/kg	0.10	0.13	0.11	0.33	< 0.10	< 0.10	< 0.10
Nickel	M	2450	mg/kg	0.50	19	21	31	15	18	15
Lead	M	2450	mg/kg	0.50	87	53	250	41	32	22
Selenium	M	2450	mg/kg	0.20	1.1	1.3	1.3	0.95	0.48	0.45
Zinc	M	2450	mg/kg	0.50	67	61	89	37	24	17
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Organic Carbon	M	2625	%	0.20			8.1		0.74	
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10	2.0	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	0.60	< 0.10	< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	0.26	< 0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10	0.19	< 0.10	< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	0.39	0.23	5.8	0.13	< 0.10	< 0.10
Anthracene	M	2800	mg/kg	0.10	0.11	< 0.10	1.4	< 0.10	< 0.10	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	0.80	0.49	4.9	0.24	< 0.10	< 0.10
Pyrene	M	2800	mg/kg	0.10	0.77	0.40	4.0	0.21	< 0.10	< 0.10
Benzo[a]anthracene	M	2800	mg/kg	0.10	0.26	0.11	2.0	< 0.10	< 0.10	< 0.10
Chrysene	M	2800	mg/kg	0.10	0.36	0.17	2.2	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	0.53	< 0.10	2.1	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	0.10	< 0.10	0.90	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	0.23	< 0.10	1.6	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	0.16	< 0.10	0.90	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	0.17	< 0.10	< 0.10	< 0.10

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 43632 Kendray Hospital

Client: Eastwood & Partners										
Quotation No.:			**Chemtest Job No.:**		19-14329	19-14329	19-14329	19-14329	19-14329	19-14329
			Chemtest Sample ID.:		817237	817238	817239	817240	817241	817242
			Sample Location:		TP01/SA01	TP02	TP03	TP01/SA01	TP03	TP03
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.10	0.10	0.10	0.30	0.40	0.60
			Date Sampled:		25-Apr-2019	25-Apr-2019	25-Apr-2019	25-Apr-2019	25-Apr-2019	25-Apr-2019
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY			
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	0.23	< 0.10	0.95	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	3.9	< 2.0	30	< 2.0	< 2.0	< 2.0

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING
2183

Final Report

Report No.:	19-14337-1
Initial Date of Issue:	08-May-2019
Client	Eastwood & Partners
Client Address:	St. Andrews House 23 Kingfield Road Sheffield South Yorkshire S11 9AS
Contact(s):	Geo Stefani Ellis
Project	43632 Kendray Hospital

Quotation No.:		**Date Received:**	29-Apr-2019
Order No.:	43632/AJK/SAE	**Date Instructed:**	29-Apr-2019
No. of Samples:	1		
Turnaround (Wkdays):	7	**Results Due:**	08-May-2019
Date Approved:	08-May-2019		

Approved By:



Details: Glynn Harvey, Laboratory Manager

Results - 2 Stage WAC

Project: 43632 Kendray Hospital

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-14337								
Chemtest Sample ID:	817268								
Sample Ref:							**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:									
Sample Location:	TP01/SA01								
Top Depth(m):	0.30								
Bottom Depth(m):									
Sampling Date:	25-Apr-2019								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			1.1	3	5	6
Loss On Ignition	2610	U	%			3.7	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			4.8	100	--	--
pH	2010	U				8.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.0090	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.0062	0.0081	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	0.0011	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0013	< 0.0010	< 0.050	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	0.0041	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	0.0015	< 0.010	0.013	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.0010	< 0.50	< 0.50	4	50	200
Chloride	1220	U	1.4	7.6	< 10	67	800	15000	25000
Fluoride	1220	U	0.19	0.48	< 1.0	4.4	10	150	500
Sulphate	1220	U	3.9	4.9	< 10	48	1000	20000	50000
Total Dissolved Solids	1020	N	32	55	63	520	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	26	19	51	200	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	10

Leachate Test Information	
Leachant volume 1st extract/l	0.330
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.240

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Contaminant	Intended Land Use				
	Commercial/Industrial End Use (mg/kg)				
	Human Health	Phytoxicity			
		pH 5.0-5.5	pH 5.5-6.0	pH 6.0-6.5	pH >7.0
Arsenic	640	50			
Cadmium	190	3			
Chromium (III)	8600	400			
Chromium (VI)	33	-			
Lead	1100-6000	300			
Mercury	25.8	1			
Nickel	980	50	60	75	110
Selenium	12,000				
Copper	68,000	80	100	135	200
Zinc	730,000	200	200	200	300

Notes:

The assessment concentrations for arsenic, cadmium, chromium (III), chromium (VI), copper, nickel, mercury, selenium and zinc are taken from 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. These are also all based on a sandy loam soil and 6% soil organic matter.

The assessment concentration for lead is the Category 4 Screening Level produced by Contaminated Land; Applications in Real Environments (CL:AIRE) and outlined in Appendix H of their report SP1010.

The threshold value is not intended to be applied to individual sample results where materials are similar, as the levels of contaminants will have a natural variability across the site. The modified mean value should instead be compared with the threshold value.

The assessment values for phytotoxicity are levels at which plant growth is thought to be affected. These are taken from the maximum permissible and advisable concentrations in soil after application of soil sludge given in the '*The Code of Good Agricultural Practice for the Protection of Soil*', MAFF, 1998.

Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3153. All rights reserved.

Prepared	KDL	Checked	ECM	Date	24.04.15	Job No	43632

E•P
Eastwood&Partners
CONSULTING ENGINEERS
St Andrew's House
23 Kingfield Road
Sheffield
S11 9AS
Tel: (0114) 2554554 Fax: (0114) 2554330

KENDRAY HOSPITAL CAR PARK EXTENSION

ASSESSMENT CRITERIA – COMMERCIAL

Organic Compounds	Intended Land Use Commercial (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Naphthalene	190 (76.4)[sol]	460 (183) [sol]	1100 (432) [sol]
Acenaphthene	84000 (57.0) [sol]	97000 (141) [sol]	100000
Acenaphthylene	83000 (86.1) [sol]	97000 (212) [sol]	100000
Fluorene	63000 (30.9) [sol]	68000	71000
Phenanthrene	22000	22000	23000
Anthracene	520000	540000	540000
Fluoranthene	23000	23000	23000
Pyrene	54000	54000	54000
Benzo(a)anthracene	170	170	180
Chrysene	350	350	350
Benzo(b)fluoranthene	44	44	45
Benzo(k)fluoranthene	1200	1200	1200
Benzo(a)pyrene	35	35	36
Dibenz(a,h)anthracene	3.5	3.6	3.6
Indeno(1,2,3-cd)pyrene	500	510	510
Benzo(g,h,i)perylene	3900	4000	4000
Phenol	760	1500	3200
Benzene	27	47	90
Toluene	56000 (869)[vap]	110000 (1920)[vap]	180000 (4360)[vap]
Ethylbenzene	5700 (518) [vap]	13000 (1220) [vap]	27000 (2840) [vap]
o-Xylene	6600 (478) [sol]	15000 (1120) [sol]	33000 (2620) [sol]
m-Xylene	6200 (625) [vap]	14000 (1470) [vap]	31000 (3460) [vap]
p-Xylene	5900 (576) [sol]	14000 (1350) [sol]	30000 (3170) [sol]

[sol] = S4ULs presented exceeds the solubility saturation limit, which is presented in brackets.

[vap] = S4ULs presented exceeds the vapour saturation limit, which is presented in brackets.

The assessment criteria for the sixteen polycyclic aromatic hydrocarbon (PAH) species covered under the USEPA test have been taken from 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.. These are also all based on a sandy loam soil and 6% soil organic matter. This is also the case for phenol at 1% and 2.5% SOM. These are also all based on a sandy loam soil.

The assessment values for phenol (6% SOM) and the BTEX compounds are the Soil Guideline Values derived by DEFRA and Environment Agency using the '*Contaminated Land Exposure Assessment'* model. These are outlined in the Environment Agency's Science Report series SC050021.

Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3153. All rights reserved.

Prepared	KDL	Checked	ECM	Date	24.04.15	Job No	43632

E•P
Eastwood&Partners
CONSULTING ENGINEERS
St Andrew's House
23 Kingfield Road
Sheffield
S11 9AS
Tel: (0114) 2554554 Fax: (0114) 2554330

KENDRAY HOSPITAL CAR PARK EXTENSION

ASSESSMENT CRITERIA – COMMERCIAL

TPH Fraction	Intended Land Use Commercial (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Aliphatic EC 5-6	3200 (304)[sol]	5900 (558)[sol]	12000 (1150)[sol]
Aliphatic EC >6-8	7800 (144)[sol]	17000 (322)[sol]	40000 (736)[sol]
Aliphatic EC >8-10	2000 (78)[sol]	4800 (190)[vap]	11000 (451)[vap]
Aliphatic EC >10-12	9700 (48)[sol]	23000 (118)[vap]	47000 (283)[vap]
Aliphatic EC >12-16	59000 (24)[sol]	82000 (59)[sol]	90000 (142)[sol]
Aliphatic EC >16-35	1,600,000	1,700,000	1,800,000
Aliphatic EC >35-44	1,600,000	1,700,000	1,800,000
Aromatic EC 5-7 (benzene)	26000 (1220)[sol]	46000 (2260)[sol]	86000 (4710)[sol]
Aromatic EC >7-8 (toluene)	56000 (869)[vap]	110000 (1920) [sol]	180000 (4360)[vap]
Aromatic EC>8-10	3500 (613)[vap]	8100 (1500)[vap]	17000 (3580)[vap]
Aromatic EC >10-12	16000 (364)[sol]	28000 (899)[sol]	34000 (2150)[sol]
Aromatic EC >12-16	36000 (169)[sol]	37000	38000
Aromatic EC >16-21	28000	28000	28000
Aromatic EC >21-35	28000	28000	28000
Aromatic EC >35-44	28000	28000	28000
Aliphatic + Aromatic EC >44-70	28000	28000	28000

[sol] = S4ULs presented exceeds the solubility saturation limit, which is presented in brackets.
[vap] = S4ULs presented exceeds the vapour saturation limit, which is presented in brackets.

The assessment criteria for each of the petroleum hydrocarbon fractions have been taken from 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.. These are also all based on a sandy loam soil.

Within the Environment Agency Science Report P5-080/TR3, Askari, K. & Pollard, S., 2005 *'The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils'* it is stated that the assessment values should not be considered individually; instead the potential additive effects should be calculated. This is achieved by calculating an individual Hazard Quotient (HQ) for each fraction. The HQ is the proportion of the assessment concentration represented by the recorded concentration. The HQs are then added together to form a Hazard Index (HI) and where this exceeds unity a potential significant risk to human health may exist.

Where only a TPH screen is undertaken, the assessment value used should be taken as the most onerous value given for individual carbon bands, as described above. This should be the assessment for Aliphatic band EC>8-10, assuming a SOM value of 1%. The assessment value should therefore be taken as 2,100 mg/kg.

Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3153. All rights reserved.

Prepared	KDL	Checked	ECM	Date	24.04.15	Job No	43632

E•P
Eastwood&Partners
CONSULTING ENGINEERS
St Andrew's House
23 Kingfield Road
Sheffield
S11 9AS
Tel: (0114) 2554554 Fax: (0114) 2554330

KENDRAY HOSPITAL CAR PARK EXTENSION

ASSESSMENT CRITERIA – COMMERCIAL