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GROUND INVESTIGATION REPORT

COLEMANS CATERERS LIMITED / BDN LIMITED

PROPOSED REFURBISHMENT AND EXTENSION

GANDHI'S TEMPLE

SEA ROAD

SOUTH SHIELDS

Project No: 14-804

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Date: 28/04/2015

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Date: 28/04/2015

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Appendices

1.0 Introduction April 2015

As requested by Building Design (Northern) Limited (BDN) of Durham, on behalf of Coleman's Caterers Limited ground investigation works have been carried out at Gandhi's Temple, located off Sea Road, South Shields. The site is accessed from Sea Road and is located adjacent to the beach at South Shields.

The intrusive investigation works comprised a combination of boreholes (Cable Percussive) and manually excavated trial pits, the locations of which can be seen on the Borehole and Trial Pit Location Plan, a copy of which can be seen in Appendix II. It should be noted that this plan is for orientating purposes only, as the positions shown are approximate and the plan is not to a standard scale.

2.0 Site Details

Table 2.1 N = north, S = south, E = east, W = west

Site Name & Address:	Gandhi's Temple, Sea Road, South Shields
OS Grid Reference:	437880, 566966 – representative for the central part of the site
Description of Location:	The site is located at southern end of Sea Road adjacent to the beach and a public house. The site comprises a bandstand with public convenience below (locally known as Gandhi's Temple) and an area of hard landscaping (block paving)
Development Details:	Proposed refurbishment of the bandstand/public convenience and new extension
Site Boundaries:	N = Public House (Sand Dancer), E = Beach/North Sea, S = Hard landscaping with Gypsies Green Stadium beyond, W = Sea Road with recreational ground beyond
Site Setting:	The site is within a public open space

3.0 Scope of Works

Table 3.1

Client:	Coleman's Caterers Limited
Engineers:	Building Design (Northern) Limited
Architects:	Fitz Architects Limited
Site Location plan:	See Appendix I
Layout plans (existing):	See Appendix I
Layout plans (proposed):	None provided at this stage.
Investigation Works:	2 no. manually excavated foundation inspection pits (TP1 & TP2) and 3 no. cable percussive boreholes (CP1 to CP3)
Laboratory Testing:	Geotechnical & Ground Contamination
CLEA Classification:	*Commercial*
Reporting:	Factual & Interpretative
Summary of Site History:	The c.1858 OS plan records the site as forming part the beach/sea front. After which part of the sea front was reclaimed and a mineral railway traversed the site between c.1896 and 1938. The mineral railway was then removed and the bandstand/public convenience constructed some time prior to c.1952.

The information contained in this report is limited to the area of the site, as indicated on the Existing Site Layout Plan shown in Appendix I, and to those areas accessible during the ground investigation. The depths of strata on the record sheets are recorded from current ground levels. Any features and / or issues not specifically mentioned in this report cannot be assumed to have been covered.

4.0 Ground Conditions

For an accurate description of the ground conditions encountered at each investigation position, reference should be made to the borehole and foundation inspection pit record sheets in Appendix II. It should be noted that there is always the possibility of variation in the ground conditions around and between the investigation locations.

4.0 Ground Conditions (Cont'd)

4.1 Soil Profile:-

A summary of the soil profile for this site can be found in Table 4.1 below.

Table 4.1

Type of Strata	Description & General Comments
MADE GROUND:	Made ground ranged in thickness from c.0.60m to c.>2.10m. The made ground comprised block paving and asphalt overlying a sand and concrete sub-base then gravelly sand with occasional brick, coal and ash fragments
DRIFT GEOLOGY: (Marine Beach Deposits)	The drift deposits comprised initially loose to medium dense becoming dense light brown 'fine to medium' blowing SAND, proven to at least 12.00m (Blowing sand is the flowing of (commonly fine) fluidised sand upwards into a length of temporary casing or borehole due to the pressure imbalances)
SOLID GEOLOGY: (Middle Coal Measures)	Not encountered – Anticipated to be present at depths c.≥20m

4.2 Evidence of Ground Contamination:-

During the fieldworks, no hydrocarbon odours or dark staining was noted within the made ground to indicate any heavy or gross contamination. Similarly there was no obvious visual evidence of potential asbestos containing materials at surface or within any of the exploratory boreholes/excavations. However occasional ash deposits were locally noted within CP3.

4.3 Groundwater:-

Water was added to the borehole to aid drilling from c.2.00m and therefore no obvious water strikes could be observed. TP2 was noted to be damp below 2.00m. Therefore groundwater should be assumed to be present at c.2.00m at this stage, based on limited evidence.

4.4 Existing Foundations:-

Manually excavated trial pits were carried out at 2 no. locations in order to determine the foundation type and the immediate underlying strata of the public convenience/bandstand. For an accurate description of the foundation details and ground conditions encountered at these positions, reference should be made to the Foundation Detail Record Sheet in Appendix II. The foundation details identified are summarised in Table 4.2 below.

Table 4.2

Trial pit location	Description & general comments
TP1 (adjacent to gents public convenience entrance)	The existing brick wall was noted to sit directly on top of a 0.60m thick concrete footing which projected 0.08m from the wall. The footing was based within light brown gravelly sand (possibly disturbed). The adjacent c.1.08m high retaining wall which retained 0.79m of soil was based on a 0.20m thick concrete footing with no projection
TP2 (NE elevation of Gandhi's Temple c.0.80m higher than TP1)	The existing brick wall was noted to extend to a depth of c.0.80m below current ground levels with a 0.66m thick concrete footing which projected 0.22m from the wall. The base of the wall was founded within dark brown gravelly sand with occasional brick and coal fragments (MADE GROUND) A 25mm diameter water(?) pipe was noted at a depth of 0.92m, 0.25m from the wall (0.03m from the footing) running parallel to the line of the building. A 150mm vitrified clay drain pipe was noted at 0.96m, exiting the building through a gap in the concrete footing

Taking into account the difference in ground levels (c.0.80m), due to the retaining wall, the basal foundation levels were very similar.

4.0 Ground Conditions (Cont'd)

4.5 Coal Mining Assessment:-

Greater than 20m of drift is anticipated overlying the Carboniferous Middle Coal Measures which comprise interbedded sandstone, mudstone and siltstone with coal seams and marine bands. There are several thin unnamed unproductive coal seams recorded before any significant named coal seams are present. The shallowest named seam is the C Seam (Ryhope Five-Quarter Coal) recorded at >70m depth with a local thickness of 0.80m. This assessment is based on geological plans produced by the BGS and borehole records (NZ36NE157 (67.13m deep) & NZ36NE158 (96.98m deep)) taken from the former Westoe Colliery to the NW of the site, with the Ryhope Five-Quarter coal seam sub-cropping beyond the position of these boreholes. As a result the site is not considered to be at risk from shallow coal mining activities i.e. there are no potential workable coal seams present at less than 30m below rockhead.

5.0 Insitu Testing

5.1 Insitu Standard Penetration Tests:-

Standard penetration tests (SPT's) were carried out within the boreholes with the use of a standard split spoon sampler (S) in order to determine the relative density of the deposits tested. The results are shown as uncorrected 'N' values on the graphic borehole record sheets, adjacent to the appropriate sample level. Where the full penetration depth, including seating blows (450mm), could not be achieved, the bottom sampling depth is indicated as less than 0.45m from the top (start of test), with the actual depth of penetration also being recorded. The results are summarised below:-

- Drift (Marine Beach Deposits) - SPT 'N' values of between 8 and 64 were recorded suggesting loose medium dense, dense and very dense strata.

The SPT tests were adversely affected by blowing sand conditions and should be treated with caution as loose sands below the water table will often 'blow' into the borehole. This results from a head difference between the water level inside the temporary casing and the surrounding soil, leading to sand moving into the casing. This effect may be further enhanced by suction created by the drilling action, which draws more material inwards. The potential outcome is that the temporary casing fills with sand at a faster rate than the drilling operation can remove it, and it can then become difficult to remove the temporary casing.

To minimise the effect of blowing, it was necessary to maintain the water level inside the temporary casing above that of the outside, by adding water from 2.00m until the boreholes were terminated at 12.00m. Bearing this in mind it would be prudent to assume the natural sands are typically loose/medium dense in nature for design purposes.

6.0 Laboratory Testing

All geotechnical testing was carried out in accordance with BS1377:1990: Parts 1-9 unless otherwise stated, at a UKAS accredited laboratory. Ground contamination screening was undertaken by a suitably experienced and qualified laboratory (UKAS and MCERTS accredited, unless otherwise stated).

6.1 Determination of Particle Size Distribution (PSD):-

Representative samples of the made ground and natural deposits were tested in order to determine their particle size distribution, so they might be classified. The results of the tests are represented both graphically and numerically on the PSD results sheets, copies of which can be found in Appendix III and are also summarised Table 6.1 on the following page.

6.0 Laboratory Testing (Cont'd)

6.1 Determination of Particle Size Distribution (PSD) (Cont'd):-

Table 6.1

Position	Depth (m)	Clay/Silt Fraction (%)	Sand Fraction (%) (F/M/C)	Gravel Fraction (%)	Cobble Fraction (%)	Grading Characteristics	Brief Soil Description
CP1	1.50-2.00	3	$97_{(29/67/1)}$	0	0	Poorly graded	Slightly silty fine to medium SAND
CP1	3.50-4.00	4	$95_{(29/65/1)}$	1	0	Poorly graded	Slightly silty slightly gravelly fine to medium SAND
CP1	6.00-6.50	4	$95_{(31/64/0)}$	1	0	Poorly graded	Slightly silty slightly gravelly fine to medium SAND
CP1	9.00-9.50	1	$99_{(21/78/1)}$	0	0	Poorly graded	Slightly silty fine to medium SAND
CP2	2.50-3.00	2	$98_{(29/68/1)}$	0	0	Poorly graded	Slightly silty fine to medium SAND
CP2	4.50-5.00	3	$95_{(33/62/0)}$	0	0	Poorly graded	Slightly silty fine to medium SAND
CP2	7.50-8.00	3	$97_{(37/59/1)}$	0	0	Poorly graded	Slightly silty fine to medium SAND
BH2	10.50-11.00	3	$97_{(59/38/0)}$	0	0	Poorly graded	Slightly silty fine to medium SAND

F=fine sand (0.06mm to 0.2mm), M=medium sand (0.2mm to 0.6mm), C=coarse sand (0.6mm to 2mm)

6.2 Determination of pH & SO_4:-

Representative samples of the made ground materials and drift deposits recovered during the investigation, were tested in order to determine their acidic (pH) and soluble sulphate (SO_4) levels. The results are shown in Table 6.5 below and are also contained within the Chemtech Environmental Limited Analytical Report (Ref no: 54604), a copy of which can be seen in Appendix III. From these results it can be seen that the pH values for the samples of soil tested range from 8.5 up to 8.7 and the amount of soluble sulphate present falls within the negligible range (<500mg/l). Therefore, in accordance with BRE Special Digest 1: 2005, the site can be given a classification of Class DS-1. When considering the nature of the materials tested and assuming mobile groundwater the assessment of the Aggressive Chemical Environment for Concrete (ACEC), is AC-1.

Table 6.2

ACEC = Aggressive Chemical Environment for Concrete site classification

Position	Depth (m)	Soil Type	pH	SO_4(mg/l)	Design SO_4 Class	ACEC Class
CP1	0.70-1.50	Made ground	8.6	70	DS-1	AC-1
CP2	0.70-1.50	Made ground	8.5	241	DS-1	AC-1
CP3	0.20-0.70	Made ground	8.7	40	DS-1	AC-1
CP3	1.50-2.00	Drift deposits	8.7	24	DS-1	AC-1
CP3	3.50-4.00	Drift deposits	8.5	44	DS-1	AC-1
CP3	6.00-6.50	Drift deposits	8.6	40	DS-1	AC-1

No recommendations are given in BRE Special Digest 1: 2005 (3rd Edition) for concrete exposed to seawater (~18000mg/l chloride). Whilst not generally causing chemical attack on concrete, chlorides can lead to degradation of the concrete through a physical mechanism involving crystallisation of chloride salts near the surface of the concrete commonly known as salt weathering. More significantly high chloride concentrations will increase the risk of corrosion of embedded metals (i.e. steel reinforcement). Therefore the recommendations for the protection of steel reinforcement in BS 8500-1 Concrete, should be followed, whilst reference should also be made to BS 6349-1 Maritime Works, General Code of Practice for Materials.

6.3 Contamination Screening/Screening Strategy:-

Representative samples of the made ground recovered from across the site were passed onto Chemtech Environmental of Stanley, Co. Durham, so that soil contamination screening could be carried out. These samples were screened using a standard generic contamination suite (based on the current CLEA SGV listed analytes with historical additions), which is used to assess typical made ground (disturbed natural strata mixed with anthropogenic debris) of an unknown source.

6.0 Laboratory Testing (Cont'd)

6.3 Contamination Screening/Screening Strategy (Cont'd):-

Taking into account the former site development (i.e. a wagonway/mineral railway) and the presence of ash, the samples of made ground were also screened for speciated PAH's (Polycyclic Aromatic Hydrocarbons), speciated TPH's (Total Petroleum Hydrocarbons) and asbestos fibres.

The catalogue of testing results can be found in the Chemtech Analytical Reports (ref nos. 54604 (soil and leachate), attached in Appendix III, and the total analysis carried out to date are summarised below:

6.6.1 Soils:-

- 3 no. soil samples screened using a Generic Soils Suite - based on the current CLEA SGV listed analytes with historical additions and which is used to assess typical made ground, comprising disturbed natural strata mixed with anthropogenic debris, of an unknown source. (Suite comprises; Arsenic, Cadmium, Chromium III, Chromium VI, Copper, Lead, Mercury, Nickel, Selenium, Zinc, Cyanide and asbestos fibres
- 3 no. soil samples screened for Speciated PAH's – based on the current USEPA 16 PAH's.
- 3 no. soil samples screened for Speciated TPH's (8 band split)

6.6.2 Leachate (Soils):-

- 1 no. soil samples screened utilising a Generic Leachate Suite comprising Arsenic, Boron, Cadmium, Chromium Total, Copper, Lead, Mercury, Nickel, Selenium, Zinc, Sulphate, Sulphide & Cyanide
- 1 no. water samples screened for Leachable Speciated PAH's – based on the current USEPA 16 PAH's
- 1 no. water samples screened for Leachable Speciated TPH's (8 band split)

These results have been used to carryout Level 1: Quantitative Human Health and Controlled Waters and are discussed in Section 7.0. These results can also be used for a preliminary assessment for off-site disposal classification.

7.0 Level 1 Ground Contamination Risk Assessment

7.1 Methodology:-

Following completion of the contamination screening undertaken on various samples from this site, Level 1 quantitative ground contamination risk assessments have been undertaken, generally in accordance with CLR11: Model Procedures for the Management of Land Contamination.

This quantitative ground contamination risk assessment uses the current UK practice for assessing the risks from land contamination, which is based on the established *source-pathway-receptor* pollutant linkage methodology and 'suitable for use' approach (Part IIA, EPA 1990 - inserted through Section 57 EA 1995).

Based on the Conceptual Site Model (CSM) for this site (described further in Section 7.2), a site specific screening strategy for the site has been developed (see Section 6.3) and the risks from potential contaminants have been assessed for both human health and controlled waters.

The results of the risk assessments can be found in Sections 7.3 (Human Health) and 7.4 (Controlled Waters). Comments regarding off-site disposal can also be found in Appendix IV.

7.0 Level 1 Ground Contamination Risk Assessment (Cont'd)

7.2 Conceptual Site Model (CSM):-

Taking into account the site history combined with the results of the intrusive investigation works, a Conceptual Site Model (CSM) has been developed for this site, and is represented in Table 7.1 below also summarises the various contaminant *sources*, plausible migration *pathways* and potentially sensitive *receptors* identified for this site, assuming no remediation, additional protection measures and/or removal of the *sources* contamination takes place.

Table 7.1

	Sources (S)
S1	The made ground comprised gravelly sand with occasional brick, coal and ash fragments
S2	Former wagonway/mineral railway (railway land)

	Pathways (P)
P1	Ingestion
P2	Inhalation of indoor / outdoor air
P3	Dermal contact
P4	Migration through existing services
P5	Direct contact with building materials
P6	Infiltration and surface runoff

	Receptors (R)
R1	Human Health (future site users)
R2	Controlled Waters (Secondary A Aquifer)
R3	Building materials *
R4	Adjacent sites
R5	Flora and fauna *

* = Not included in the Human Health & Controlled Waters Risk Assessment

7.2.1 Sources:-

The site is covered by made ground which represents the primary potential source of ground contamination. These materials have been assessed using a standard generic soil suite.

In addition taking into account the previous land use and the nature of the made ground, the samples of made ground have also been screened for appropriate contamination screening as listed in Section 6.3.

7.2.2 Pathways:-

When considering the proposed end use (*Commercial*), and without considering treatment, removal or protection measures, although limited, there are some plausible pathways available for direct contact, dermal contact, ingestion, inhalation, wind (dust / particulate), volatilization, and vertical and lateral transportation below the site, both within the existing structure and externally, where there is no hard cover or vapour barriers present. Within the CLEA Risk Assessment Model for Human Health, there are 3 exposure mediums considered for on site receptors, comprising ingestion of soil containing contaminants, inhalation of contaminated dust/vapours and dermal contact, with up to 10 no. exposure pathways considered, as follows:-

- *1. Ingestion of soil and indoor dust 2. Consumption of homegrown produce and attached soil 3. Dermal contact (indoor) 4. Dermal contact (outdoor) 5. Inhalation of dust (indoor) 6. Inhalation of dust (outdoor) 7. Inhalation of vapour (indoor) 8. Inhalation of vapour (outdoor) 9. Oral background intake 10. Inhalation background intake.*

Where the future site has hardcover and below the structures (which will be c.95% of the site), the majority of these pathways will not be available. In addition, when considering the potential pathways for leachate migration, where either hard cover and/or future surface water drainage systems are present, the potential effects of surface infiltration or contaminated surface water runoff will be greatly reduced. Similarly, when considering the construction workforce, exposure pathways through direct contact, ingestion and dust inhalation will be available during part of the construction process, and therefore adequate PPE should be provided to protect the work force during this period.

7.0 Level 1 Ground Contamination Risk Assessment (Cont'd)

7.2 Conceptual Site Model (CSM)(Cont'd):-

7.2.3 Receptors:-

Within the CLEA Risk Assessment Model for Human Health, the potential receptors are assessed initially on site end use, followed by a delineation of age category (i.e. child or adult), with default settings for *Residential, Allotment* and *Public Open Space (Park)* end uses based on a child aged 0 to 6 years, *Public Open Space (Residential)* based on a child aged 3 to 9 and *Commercial* end uses based upon a working exposure period of up to 49 years (i.e. 16 to 65).

Key generic assumptions for *Residential* and *Public Open Space (Residential)* are based upon a typical residential property, consisting of a two-storey small terraced house, with private garden, and a *Commercial* end use based upon a typical commercial or light industrial property, consisting of a three-storey office building (pre-1970). No buildings are anticipated for *Allotment* or *Public Open Space (Park)* end uses.

Within the CLEA Risk Assessment Model for Human Health there are 6 no. generic end use categories presently in use, as follows;

1) Residential - with home grown produce, 2) Residential - without home grown produce, 3) Allotments, 4) Commercial
5) Public Open Space – Residential, 6) Public Open Space - Park

Therefore, for this Level 1 Risk Assessment, the best fit end use category for this site has been taken as:

4) Commercial

For controlled waters, the underlying drift and solid deposits (Secondary A Aquifers), and the adjacent North Sea to the east represent the primary sensitive receptors, although these are generally considered to be at a low level of risk. In addition the site is not situated within a groundwater Source Protection Zone.

7.3 Level 1 Human Health Risk Assessment (Soils):-

7.3.1 Human Health - Generic Contamination Screening:-

The results of the analysis and risk assessment have been summarised in Table 7.2 below and have identified the following:-

Table 7.2 (1) = LQM S4UL's (Commercial), (2) = C4SL, (3) = ATRISK^{SOIL} SSV, NAD = No Asbestos Detected

Analyte	Critical Conc. (C_C) mg/kg	No. of Samples Screened	Max. Conc. (C_M) recorded	Has C_M exceeded C_C	No. of Samples >C_C
Arsenic	640(1)	3	30	NO	0
Cadmium	190(1)	3	0.9	NO	0
Chromium III	8,600(1)	3	70	NO	0
Chromium VI	33(1)	3	<1	NO	0
Copper	68,000(1)	3	30	NO	0
Lead	2,330(2)	3	67	NO	0
Mercury	1,100(1)	3	<0.5	NO	0
Nickel	980(1)	3	18	NO	0
Selenium	12,000(1)	3	1.5	NO	0
Zinc	730,000(1)	3	108	NO	0
Cyanide	34(3)	3	<2	NO	0
Asbestos	Presence	3	NAD	~	~

- The maximum concentration (C_M) values for all of the generic analytes fall below the chosen critical concentration (C_C) values for this site

7.0 Level 1 Ground Contamination Risk Assessment (Cont'd)

7.3 Level 1 Human Health Risk Assessment (Soils)(Cont'd):-

7.3.1 Human Health - Generic Contamination Screening (Cont'd):-

- No asbestos fibres have been identified
- When considering these results the made ground present on site does not represent a risk to the end users, subsequently no remedial measures will be required

7.3.2 Human Health – Speciated PAH & TPH Screening :-

Table 7.3

Analyte	Critical Conc (C_C) (mg/kg)	No. of Samples Screened	Max. Conc. (C_M) recorded	Has C_M exceeded C_C	No. of Samples > C_C
Speciated PAH					
Acenaphthene	97,000(1)	3	5.46	NO	0
Acenaphthylene	97,000(1)	3	3.18	NO	0
Anthracene	540,000(1)	3	17.47	NO	0
Benzo(a)anthracene	170(1)	3	41.84	NO	0
Benzo(a)pyrene	35(1)	3	34.12	NO	0
Benzo(b)fluoranthene	**44(1)**	**3**	**46.59**	**YES**	**1(CP2)**
Benzo(ghi)perylene	4,000(1)	3	13.40	NO	0
Benzo(k)fluoranthene	1,200(1)	3	18.25	NO	0
Chrysene	350(1)	3	33.37	NO	0
Dibenz(ah)anthracene	**3.6(1)**	**3**	**5.42**	**YES**	**2(CP2 & CP3)**
Fluoranthene	23,000(1)	3	102	NO	0
Fluorene	68,000(1)	3	5.64	NO	0
Indeno(123cd)pyrene	510(1)	3	17.55	NO	0
Naphthalene	460(1)	3	1.26	NO	0
Phenanthrene	22,000(1)	3	83.81	NO	0
Pyrene	54,000(1)	3	74.68	NO	0
Speciated TPH				NO	0
C5-C7	5900(1)	3	<0.1	NO	0
C7-C8	17000(1)	3	<0.1	NO	0
C8-C10	4800(1)	3	<0.1	NO	0
C10-C12	2300(1)	3	7	NO	0
C12-C16	37,000(1)	3	154	NO	0
C16-C21	28,000(1)	3	859	NO	0
C21-C35	28,000(1)	3	1735	NO	0
C35-EC44	28,000(1)	3	314	NO	0

(1) = LQM S4UL's (Commercial – 2.5% SOM) (most conservative Aliphatic or Aromatic fraction), **Bold** = Elevated result

A summary of the results for the Level 1 Risk Assessment based on the results of the soil concentrations for the end users can be seen in Table 7.3 above and have identified the following;

- The C_M values for Benzo(b)fluoranthene and Dibenz(ah)anthracene) slightly exceed the chosen C_C values for this site
- The C_M values for all of the remaining Speciated PAH's and TPH's fall below the chosen C_C values for this site
- Based on these results the site appears to have been impacted by hydrocarbon contamination most likely associated with ashy deposits within the made ground and subsequently remedial measures will be required if areas of soft landscaping are envisaged (i.e. clean cover or localised removal of the made ground)

7.0 Level 1 Ground Contamination Risk Assessment (Cont'd)

7.4 Level 1 Controlled Waters Risk Assessment:-

Leachate screening has been carried out on a single sample of made ground and the results have been used to complete a Level 1 Risk Assessment for the impact on controlled waters. The results have been assessed against appropriate EQS Coastal and Estuarine (saltwater) and Drinking Water Standards and are summarised in Table 7.4 below.

Table 7.4

LEVEL 1	Target Conc. (C_T) (µg/l)	Site Data	
Analyte		Leachate Max Conc (µg/l)	Has max. C_T Value Been Exceeded
Generic Analytes			
Arsenic	**25(1)**	**38.15**	**YES**
Boron	7000(1)	<6	NO
Cadmium	2.5(1)	<0.07	NO
Chromium	15(1)	0.4	NO
Copper	5(1)	1.3	NO
Lead	25(1)	0.6	NO
Mercury	0.3(1)	<0.008	NO
Nickel	30(1)	<0.5	NO
Selenium	10(2)	0.12	NO
Zinc	5000(2)	<1	NO
Cyanide	50(2)	<20	NO
Speciated PAH's			
Acenaphthene	**0.1(3)**	**0.8**	**YES**
Acenaphthylene	**0.1(3)**	**0.2**	**YES**
Anthracene	**0.1(3)**	**0.3**	**YES**
Benzo(a)anthracene	**0.1(3)**	**1.2**	**YES**
Benzo(a)pyrene	0.1(3)	0.1	NO
Benzo(b)fluoranthene	**0.1(3)**	**0.9**	**YES**
Benzo(ghi)perylene	0.1(3)	0.1	NO
Benzo(k)fluoranthene	**0.1(3)**	**0.3**	**YES**
Chrysene	**0.1(3)**	**1.1**	**YES**
Dibenz(ah)anthracene	0.1(3)	<0.1	NO
Fluoranthene	**0.1(3)**	**3.1**	**YES**
Fluorene	**0.1(3)**	**1.1**	**YES**
Indeno(123cd)pyrene	**0.1(3)**	**0.2**	**YES**
Naphthalene	5(1)	<0.1	NO
Phenanthrene	**0.1(3)**	**1.6**	**YES**
Pyrene	**0.1(3)**	**2.4**	**YES**
Speciated TPH's			
C5-C7	10(2)	<1	NO
C7-C8	10(2)	<1	NO
C8-C10	10(2)	<1	NO
C10-C12	10(2)	<1	NO
C12-C16	10(2)	1	NO
C16-C21	10(2)	9	NO
C21-C35	10(2)	3	NO
C35-EC44	10(2)	<1	NO

(1) = EQS Coastal and Estuarine (saltwater), (2) = EQS Drinking water, (3) = Analytical detection limit, **Bold** = Elevated result

7.0 Level 1 Ground Contamination Risk Assessment (Cont'd)

7.4 Level 1 Controlled Waters Risk Assessment (Cont'd):-

A summary of the results for this Level 1 Risk Assessment can be seen in Table 7.4 displayed on the previous page. The results summarised in Table 7.4 have identified the following:

- The C_M values for Arsenic and the majority of the speciated PAH's slightly exceed the C_T values for coastal and estuarine environments taken for this site
- None of the C_M values for any of the generic or remaining speciated organic contaminants (PAH & TPH) screened exceed the C_T values taken for this site
- For controlled waters, the underlying drift and solid deposits (Secondary A Aquifers), and the adjacent North Sea, to the east, represent the primary sensitive receptors for this site. However given the nature of the development, which is envisaged to be predominantly hardcover, these are generally considered to be at a low level of risk as surface infiltration will be greatly reduced
- However, if significant areas of soft landscaping are envisaged then some remedial measures in the form of Detailed Quantitative Risk Assessment (DQRA), removal and/or the installation of appropriate barriers systems may be required

8.0 Conclusions & Recommendations

8.1 Ground Conditions:-

From the information gained during the intrusive ground investigation works made ground materials were recorded to >2.10m depth. There was no evidence of hydrocarbon odours or gross contamination, although limited ash was noted.

The drift deposits (Marine Beach Deposits) comprised initially loose to medium becoming dense fine to medium blowing sand. To minimise the effect of blowing, it was necessary to maintain the water level inside the temporary drill casing above that of the outside, by adding water from c.2.00m depth throughout the drilling works. Taking into account the blowing sand conditions and its effect on the insitu standard penetration tests a loose/medium density should be assumed.

8.2 Groundwater / Trench Stability:-

The sand was noted to become damp at around 2.00m depth within TP2, however any dampness or ingress in the boreholes was masked by the water added to counter the effects of blowing sand, which itself is a function of fluidised sand.

As such it would be prudent allow for the introduction of temporary groundwater control techniques (i.e. sump pumping equipment), in order to take care of any ingresses of groundwater.

For future site works, adequate lateral trench support will be required for all excavations given the granular nature of the made ground and drifts deposits , in order to prevent trench wall collapse or over excavations, as well as to create a safe working environment below a depth of 1.20m, and any excavations on this site should remain open for as short a period as possible, since these materials will be susceptible to deterioration, if left open to the natural elements for any significant period of time.

8.0 Conclusions & Recommendations (Cont'd)

8.3 Existing Foundations:-

Manually excavated trial pits were carried out at 2 no. locations in order to determine the foundation type and the immediate underlying founding strata of the public convenience/bandstand. For an accurate description of the foundation details and ground conditions encountered at these positions, reference should be made to the Foundation Detail Record Sheet in Appendix II. A summary of the existing foundation depths is as follows:-

- TP1 (SE elevation) – Concrete footing, 0.60m thick, based at 0.60m depth
- Retaining wall - Concrete footing, 0.20m thick based at 0.79m depth
- TP2 (NE – elevation) – Concrete footing, 0.66m thick, based at 1.46m

When taking into account the difference in ground levels between the 2 no. trial pit positions (c.0.80m), the basal foundations levels were very similar.

8.4 Foundation Options:-

A combination of traditional shallow strip extended to mass trench fill foundations could be utilised for the proposed extension. Foundations should be stepped and taken down through the full thickness of made ground and based within the natural sand deposits resulting in foundations depths between 1.20m up to c.1.60m. An allowable bearing pressure not exceeding 120kN/m^2 is available for the natural sand deposits.

Significant water ingress and trench stability issues could prove problematic for foundation excavations and therefore appropriate dewatering and trench support should be adopted. An alternative to mass trench fill could be 'concrete filled manhole rings' which would effectively act as a cofferdam and lessen the anticipated groundwater and trench stability problems.

Alternatively ground improvement techniques could be utilised to increase the density and homogenise the shallow soils (made ground and natural sands) and provide a stable bearing medium where bearing pressure typically up to 150kN/m^2 can be achieved. Due to the numerous types of ground improvement techniques it is recommended that the information contained within this report should be passed onto specialist contractors so that they can design and price a suitable scheme. This option could however cause increased disruption (noise and vibration) to adjacent public house.

8.5 Ground Contamination:-

8.5.1 Human Health Risk Assessment:

From the results of the contamination screening carried out on this site and the Level 1 Risk Assessment (Section 7.0), it can be seen that levels of PAH contamination slightly exceed the critical concentrations chosen for this site for a commercial end use. As such remedial measures may be necessary to protect the end users if significant areas of soft landscaping are envisaged.

8.5.2 Controlled Waters:

For controlled waters, the underlying drift and solid deposits (Secondary A Aquifers), and the adjacent North Sea, to the east, represent the primary sensitive receptors for this site. However given the nature of the development, which is envisaged to be predominantly hardcover, these are generally considered to be at a low level of risk. However, if significant areas of soft landscaping are envisaged then some remedial measures in the form of Detailed Quantitative Risk Assessment (DQRA), removal and/or the installation of appropriate barriers systems may be required.

8.0 Conclusions & Recommendations (Cont'd)

8.5 Ground Contamination (Cont'd):-

8.5.3 Concrete Classification and Buried Services:

When considering the risk to building materials, it is recommended that a concrete design class of DS-1 and ACEC class of AC-1 is used for all foundations and buried concrete. In terms of the levels of contamination and the potential risk to plastic service pipes, seals, ducts etc. it would be prudent to contact the relevant utility supplier for their advice/comments.

8.5.4 Ground Gas Risk Assessment:

According to the Environment Agency the southern half of the site and the adjacent Gypsies Green Stadium (sporting venue) to the south is recorded as a historical landfill site, whist according to the British Geological survey this portion of the coastline represents a large area of artificial land, most likely attributable to nearby former colliery activities and partly reclamation of the beach. However there was no evidence of typical landfill site features such as large excavations, etc. on historical plans, although significant earthworks were shown when the stadium was first developed with earth terraces and the like created. Given the age of the earthworks (i.e. pre 1956) and the nature of the made ground noted on site (i.e. no putrescible or biodegradable waste noted) the risk of ground gas production and migration potentially affecting the proposed extension is considered to be negligible.

8.5.5 General Comments:

If during future redevelopment works, any excavated materials are to be removed from this site as a waste and disposed of at a landfill, reference should be made to the notes on off-site disposal within Appendix IV, particularly when assessing the likely classification of these materials prior to disposal.

When considering the risks to the construction workforce, standard PPE should prove adequate protection against the levels of potential contaminants recorded during these investigation works. Similarly, the results can also be used by the Main Contractor / Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations. For further guidance reference should be made to the Health and Safety Executive (HSE) document EH40/2005 Workplace exposure limits.

8.6 General Comments:-

It is also recommended for any new developments, adequate surface drainage should be designed and installed by a competent contractor, in order to prevent surface water 'ponding' or collection, during and post construction, particularly where the existing surface drainage system is disrupted or damaged.

In addition, for deeper excavations, drainage, service runs or the like that may pass close to or beneath any existing or proposed new foundations, these should be undertaken with care and completed prior to the preparation of any new foundations, so as not to allow any loose or granular material to move or 'flow', thus causing settlement to occur to any new foundations based at a higher level.

The site is not considered to be at risk from shallow coal mining activities (See Section 4.5 for further details).

An "observational technique" can be applied to the design and construction of this site, and where ground conditions seem to vary from that indicated from the conceptual ground model derived from works to date, then advice from a suitably qualified Engineering Geologist/Geotechnical Engineer should be sought.

END OF REPORT

GENERAL REFERENCES

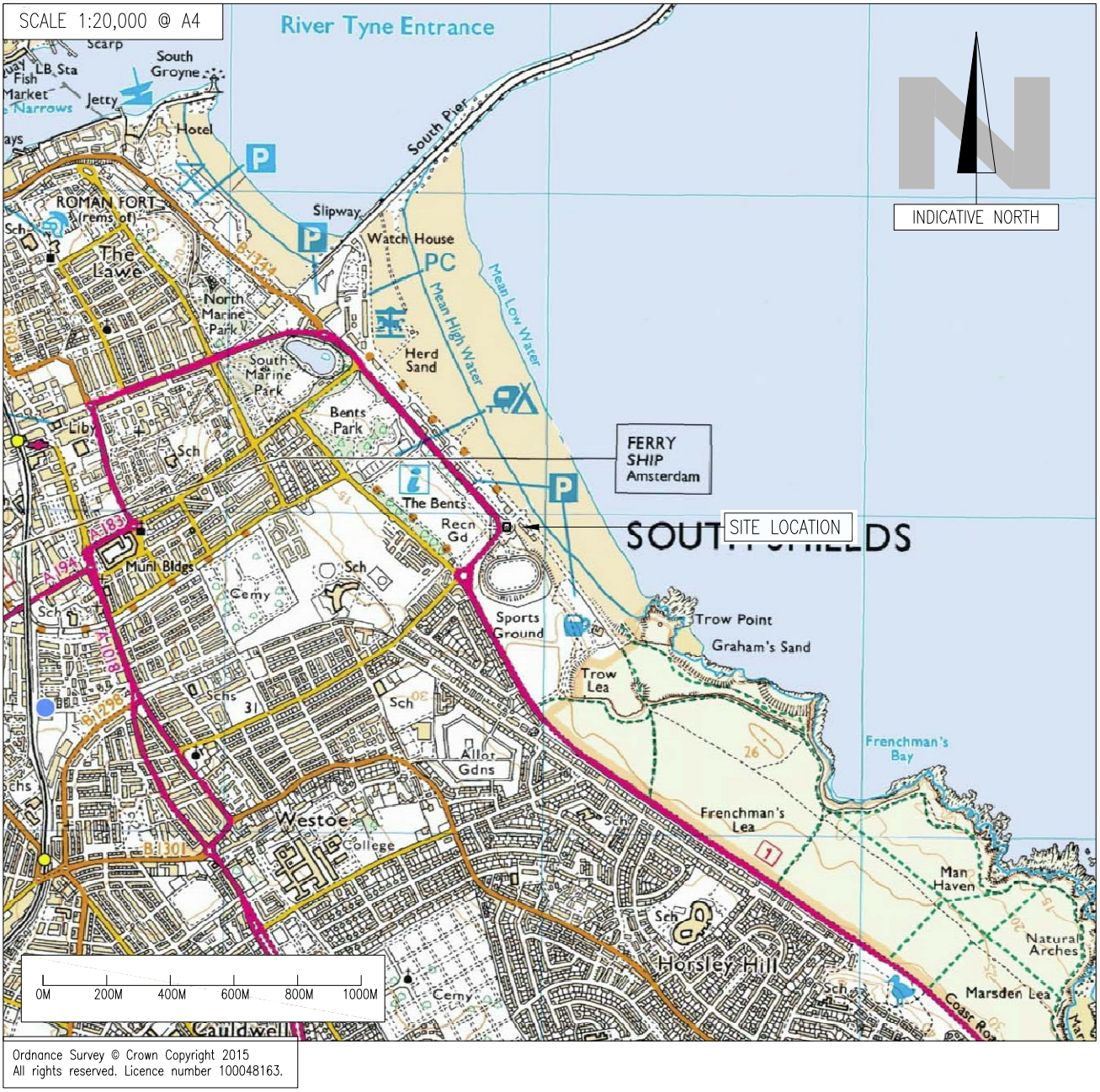
- British Geological Survey: Maps, Reports, Memoirs, etc.
    - Sunderland, Sheet 21, England and Wales, Solid and Drift Edition, 1:50,000 Series.
    - BGS Borehole Record Sheets: NZ36NE157 & NZ36NE158
- DoE. - Contaminated Land Reports, CLR 1-6 1994 & 1995, CLR 7-10 2002, CLR 11 2004.
- BS5930:1999: Code of Practice for Site Investigations
- BS EN 1997-1: 2004: Eurocode 7 - Geotechnical design. Part 1: General rules. British Standards Institution
- BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design. Part 2: Ground investigation and testing British Standards Institution
- BS EN ISO 9001: 2000: Quality Management Systems - requirements. British Standards Institution
- BS EN ISO 14689-1: 2003: Geotechnical investigation and testing - Identification and classification of rock. Identification and description. British Standards Institution. Amended 2007 (Partially supersedes BS 5930:1999)
- BS EN ISO 22476-3: 2005: Geotechnical investigation and testing. Field testing. Standard penetration test. British Standards Institution
- BS EN ISO 14688-1: 2002: Geotechnical investigation and testing. Identification and classification of soil. Identification and description
- BS EN ISO 14688-2: 2004: Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification
- BS10175+A1:2013: British Standard Investigation of Potentially Contaminated Sites
- BS5837: Trees in Relation to Design, Demolition and Construction (2012)
- BRE Special Digest 1 2005: Concrete in Aggressive Ground 3rd Edition
- BS1377: 1990: Parts 1 – 9. Methods of Test for Soils for Civil Engineering Purposes
- Asbestos in soil and made ground: a guide to understanding and managing risks, CIRIA C733, 2014
- Assessing Risks Posed by Hazardous Ground Gases to Buildings, CIRIA C665, 2007
- Methane and Associated Hazards to Construction - CIRIA Reports 149,150,151 & 152
- BS 8485: 2007: Code of Practise for the Characterization and Remediation from Ground Gas in Affected
- BS8576:2013: Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds
- Category 4 Screening Levels (C4SL's) – DEFRA/CL:AIRE
- LQM/CIEH Suitable 4 Use Levels (S4UL's)

APPENDIX I

Location Plan

Aerial Photograph

Existing Site Layout Plan



Client:
TOWN CENTRE SECURITIES LTD

Project Title:	Drawing Title:
Proposed Commercial Development The Merrion Hotel, Wade Lane Leeds, West Yorkshire, LS2 8NH	Location Plan

rev.	date	amendments	drawn	chckd

Job Reference:	Drawing Number:	Revision:
15-058	–	–

Drawn by:	Date:	Scale at A4:
P.D	27.04.15	As Shown

Checked by:	Approved by:	
S.D	S.D	The contractor shall check all dimensions on site before commencement of any works. No dimensions to be scaled off this drawing.

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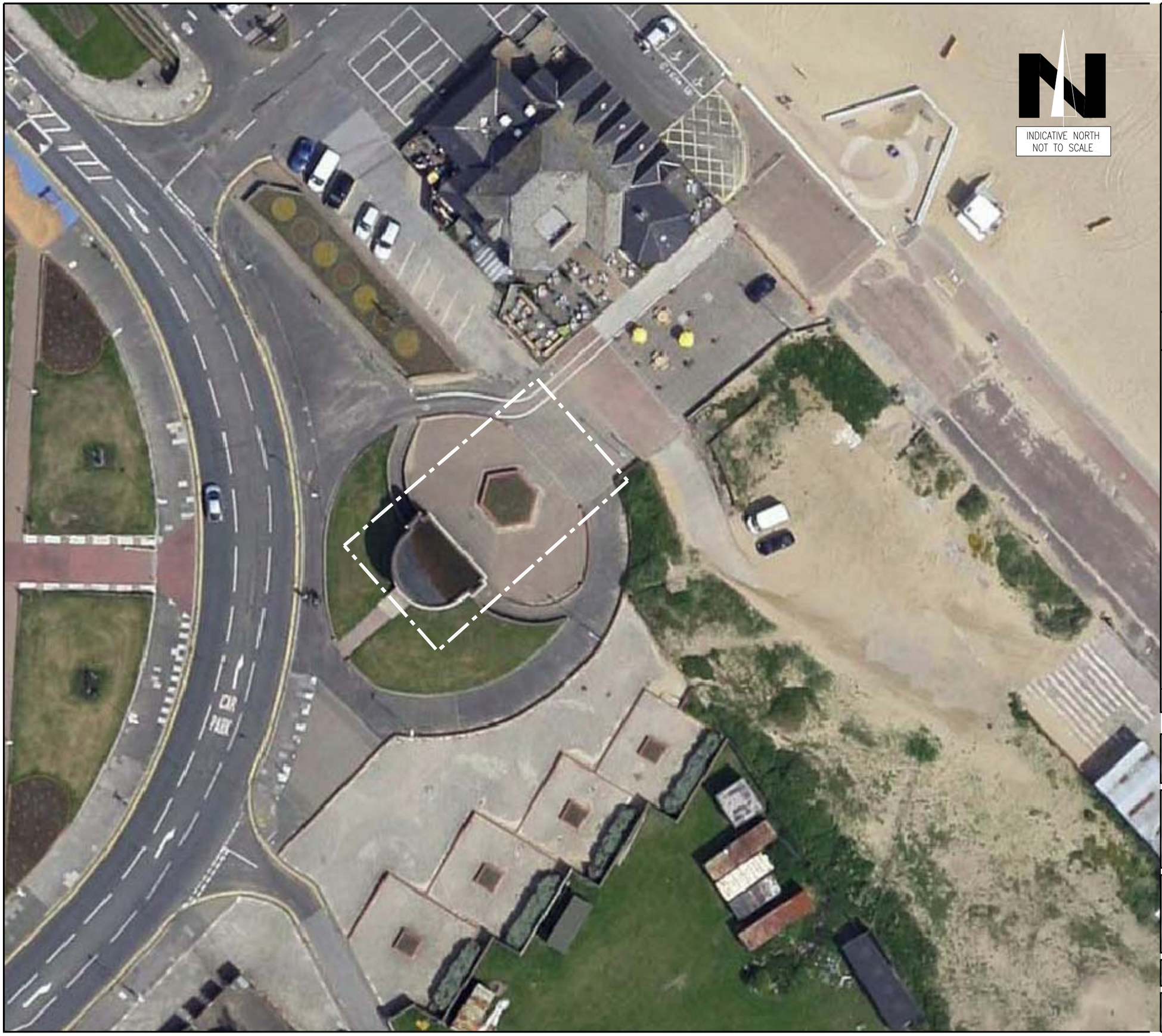

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web: www.arc-environmental.com

LEGEND	
	APPROXIMATE SITE BOUNDARY

rev.	date	amendments	drawn	chckd

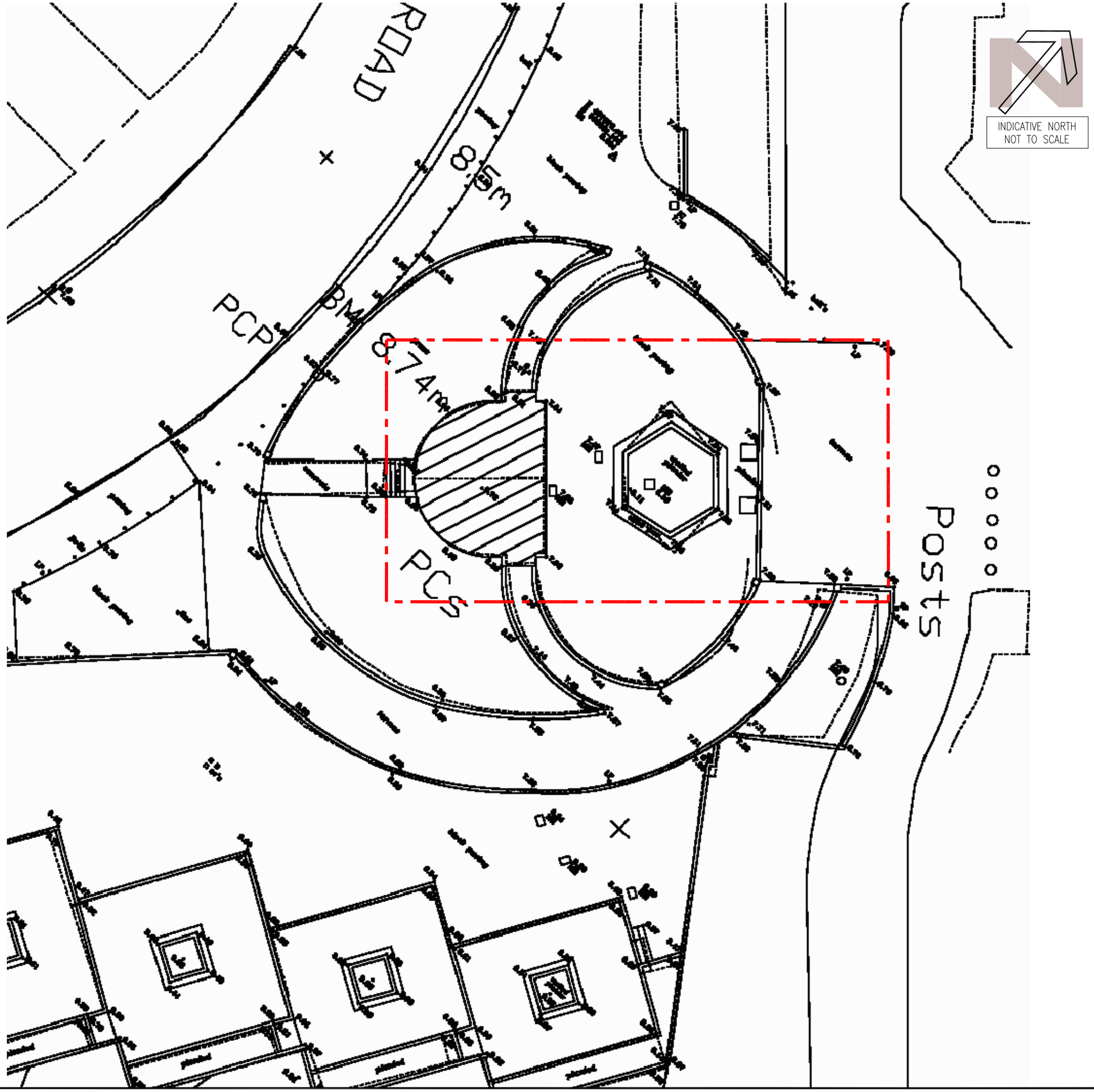
Client:
COLEMANS CATERERS LIMITED / BDN LIMITED

Project Title:
Proposed Refurbishment and Extension
Gandhi's Temple
Sea Road, South Shields

Drawing Title:
Aerial Photograph

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	28.04.15	P.D	J.P.D

Job Ref:	Drg no:	Rev:
14-804	–	–



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LEGEND

-·-	APPROXIMATE SITE BOUNDARY

rev.	date	amendments	drawn	chckd

Client:
COLEMANS CATERERS LIMITED / BDN LIMITED

Project Title:
Proposed Refurbishment and Extension
Gandhi's Temple
Sea Road, South Shields

Drawing Title:
Existing Site Layout Plan

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	28.04.15	P.D	J.P.D

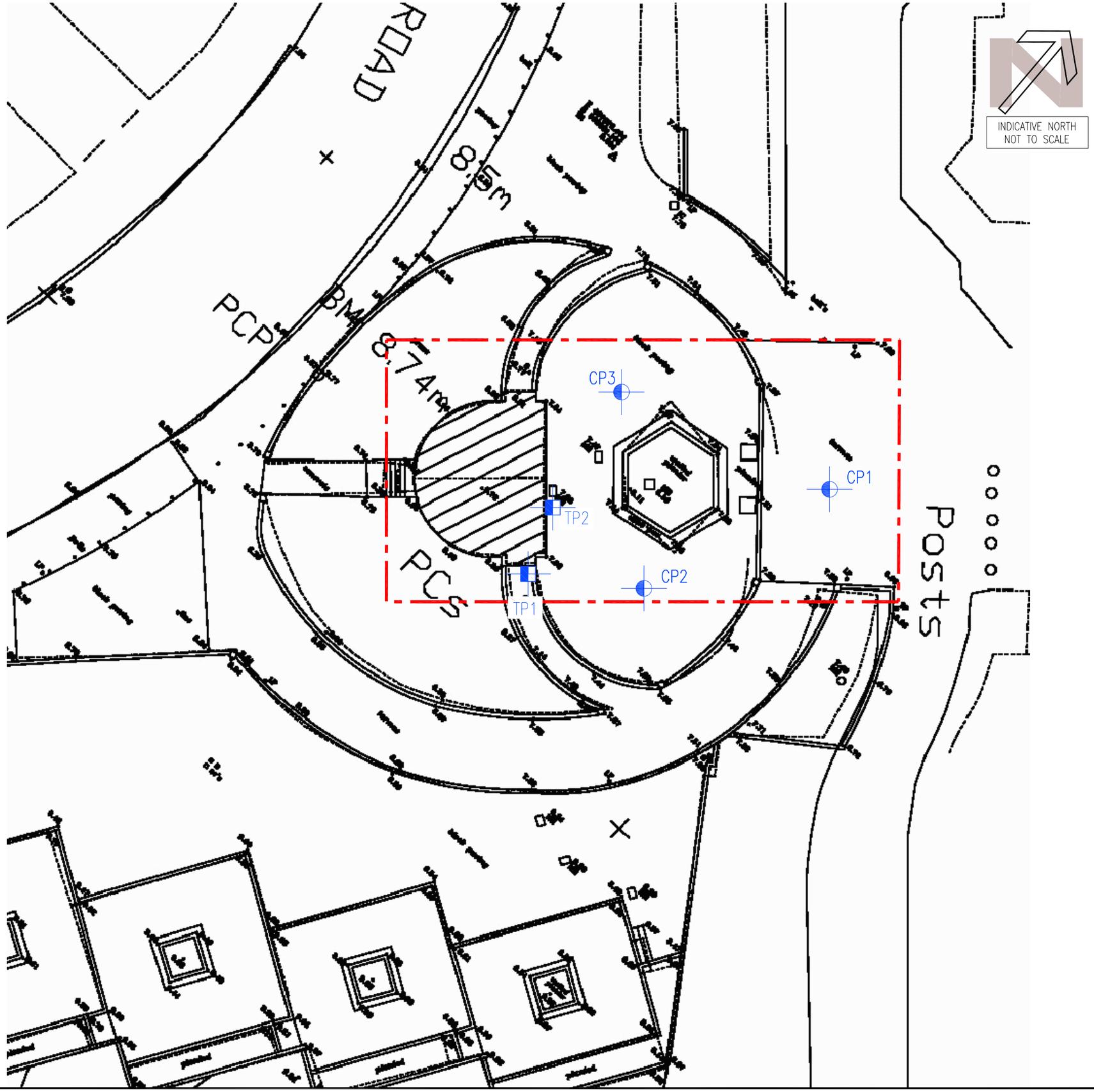
Job Ref:	Drg no:	Rev:
14-804	–	–

APPENDIX II

Borehole & Trial Pit Location Plan

Borehole Record Sheets

Foundation Detail Record Sheets



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LEGEND	
	APPROXIMATE SITE BOUNDARY
	CABLE PERCUSSIVE BOREHOLE POSITION
	MANUALLY EXCAVATED FOUNDATION INSPECTION PIT

rev.	date	amendments	drawn	chckd

Client:
COLEMANS CATERERS LIMITED / BDN LIMITED

Project Title:
Proposed Refurbishment and Extension
Gandhi's Temple
Sea Road, South Shields

Drawing Title:
Borehole and Trial Pit Location Plan

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	28.04.15	P.D	J.P.D

Job Ref:	Drg no:	Rev:
14-804	–	–

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Telephone: 0191 378 6380

BOREHOLE LOG

Project				BOREHOLE No
Gandhis Temple, Sea Road, South Shields				CP1
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14-804	25-02-15			
Contractor				Sheet
Arc Environmental Ltd				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.07	Block paving (MADE GROUND)		
0.20-0.70	B					0.20	Light brown sand sub-base (MADE GROUND)		
0.70-1.50	B/J					(1.40)	Dark brown gravelly sand with occasional fine brick fragments (MADE GROUND)		
						1.60			
1.80-2.00	B						"Medium dense to dense" light brown 'fine' blowing SAND (MARINE BEACH DEPOSITS?)		
1.80-1.95	S	N=11					[SPT's were adversely affected by blowing sand conditions and should be treated with caution]		
2.50-3.00	B								
2.50-2.45	S	N=15							
3.50-4.00	B								
3.50-3.95	S	N=21							
4.50-5.00	B								
4.50-4.95	S	N=28							
6.00-6.45	S	N=34							
6.50-6.50	B					(10.40)			
7.50-8.00	B								
7.50-7.95	S	N=28							
9.00-9.50	B								
9.00-9.45	S	N=51							
10.50-11.00	B								
10.50-10.95	S	64 blows							
11.50-12.00	B								
						12.00			
11.50-11.95	S	58 blows					Note; Blowing sand is the flowing of (commonly fine) fluidised sand upwards into a length of temporary casing or borehole due to pressure imbalances.		

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
25-02-15	00.00	12.00	12.00	150mm	

Chiselling			Water Added	
From	To	Hours	From	To
			2	12

GENERAL REMARKS

DAYWORKS: Service pit 1hr. Reinstate block paving and tidy spoil 1hr

WATER OBSERVATIONS: Water added to aid drilling from 2.00m to 12.00m. No water strikes observed.

All dimensions in metres Scale 1:81.25	Client Building Design (Northern) Ltd	Method/ Plant Used Cable Percussive	Logged By JPD

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St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 0191 378 6380

BOREHOLE LOG

Project				BOREHOLE No
Gandhis Temple, Sea Road, South Shields				CP2
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14-804	25-02-15			
Contractor				Sheet
Arc Environmental Ltd				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.20-0.70	B					0.07	Block paving (MADE GROUND)		
						0.20	Light brown sand sub-base (MADE GROUND)		
0.70-1.50	B/J					(1.40)	Dark brown gravelly sand with occasional fine brick fragments (MADE GROUND)		
						1.60			
1.50-2.00	B						"Medium dense to dense" light brown 'fine' blowing SAND (MARINE BEACH DEPOSITS?)		
1.50-1.95	S	N=12							
2.50-3.00	B						[SPT's were adversely affected by blowing sand conditions and should be treated with caution]		
2.50-2.95	S	N=13							
3.50-4.00	B								
3.50-3.95	S	N=20							
4.50-5.00	B								
4.50-4.95	S	N=24							
6.00-6.50	B								
6.00-6.45	S	N=25				(10.40)			
7.50-8.00	B								
7.50-7.95	S	N=39							
9.00-9.50	B								
9.00-9.45	S	N=43							
10.50-11.00	B								
10.50-10.95	S	N=64							
11.50-12.00	B					12.00			
11.50-11.95	S	N=51					Note; Blowing sand is the flowing of (commonly fine) fluidised sand upwards into a length of temporary casing or borehole due to pressure imbalances.		

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
25-02-15	00.00	12.00	12.00	150mm	

Chiselling			Water Added	
From	To	Hours	From	To
			2	12

GENERAL REMARKS

DAYWORKS: Service pit 1hr. Reinstate block paving and tidy spoil 1hr

WATER OBSERVATIONS: Water added to aid drilling from 2.00m to 12.00m. No water strikes observed.

All dimensions in metres Scale 1:81.25	Client Building Design (Northern) Ltd	Method/ Plant Used Cable Percussive	Logged By JPD

AGS3 UK BH LOGS.GPJ AGS3_ALL.GDT 28/4/15

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Durham, DH7 8PN
Telephone: 0191 378 6380

BOREHOLE LOG

Project				BOREHOLE No
Gandhis Temple, Sea Road, South Shields				CP3
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14-804	26-02-15			
Contractor				Sheet
Arc Environmental Ltd				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.07	Block paving (MADE GROUND)		
0.20-0.70	B/J					0.20	Light brown sand sub-base (MADE GROUND)		
0.80-1.50	B					(1.00)	Dark brown gravelly sand with occasional ash (MADE GROUND)		
						1.20			
1.50-2.00	B						"Loose becoming medium dense to dense" light brown 'fine' blowing SAND (MARINE BEACH DEPOSITS?)		
1.50-1.95	C	N=8					[SPT's were adversely affected by blowing sand conditions and should be treated with caution]		
2.50-2.95	S	N=32							
3.50-4.30	B								
3.50-3.95	S	N=29							
4.50-5.00	B								
4.50-4.95	S	N=32							
6.00-6.50	B								
6.00-6.45	S	N=43				(10.80)			
7.50-8.00	B								
7.50-7.95	S	N=33							
9.00-9.50	B								
9.00-9.45	S	N=58							
10.50-11.00	B								
10.50-10.95	S	N=62							
11.00-11.45	S	N=63							
						12.00			
11.50-12.00	B						Note; Blowing sand is the flowing of (commonly fine) fluidised sand upwards into a length of temporary casing or borehole due to pressure imbalances.		

Boring Progress and Water Observations						Chiselling			Water Added	
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To
26-02-15	00.00	12.00	12.00	150mm					2	12

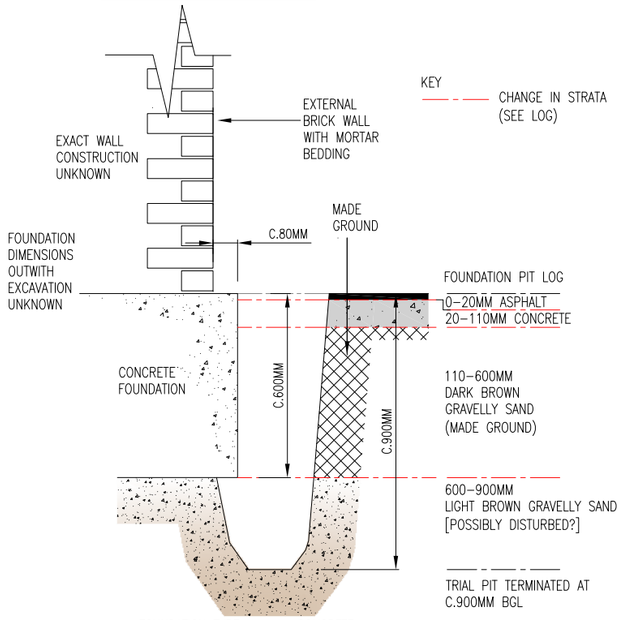
GENERAL REMARKS

DAYWORKS: Service pit 1hr. Reinstate block paving and tidy spoil 1hr

WATER OBSERVATIONS: Water added to aid drilling from 2.00m to 12.00m. No water strikes observed.

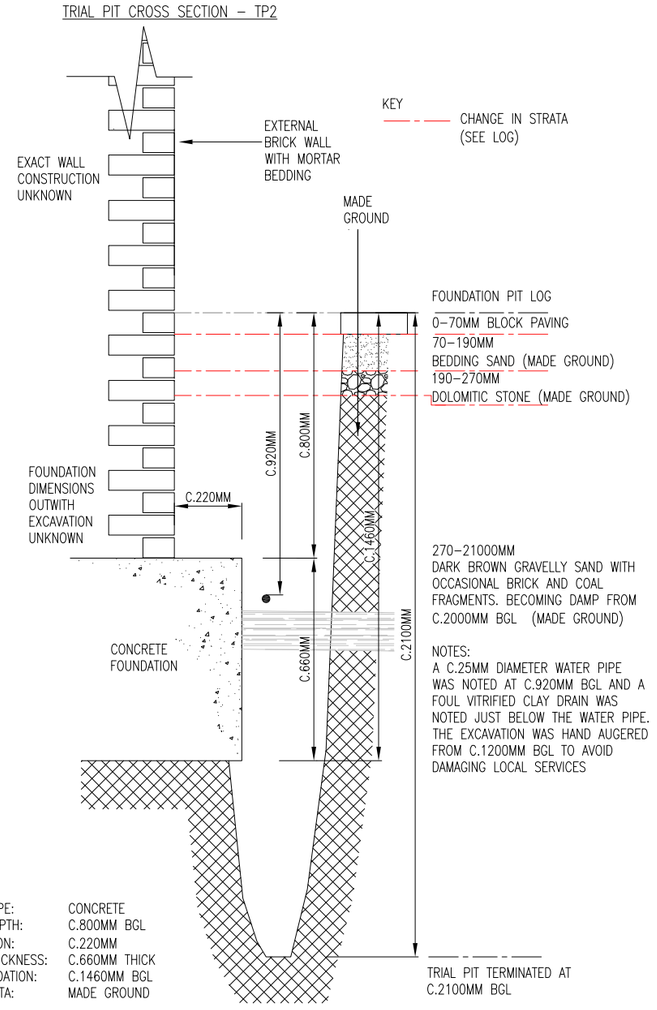
All dimensions in metres Scale 1:81.25	Client Building Design (Northern) Ltd	Method/ Plant Used Cable Percussive	Logged By JPD

TRIAL PIT CROSS SECTION – TP1

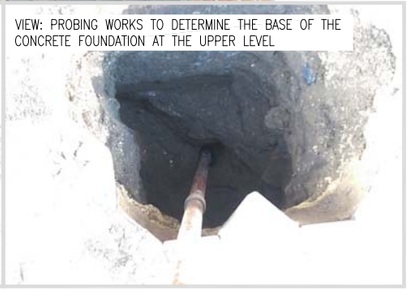


FOUNDATION TYPE:	CONCRETE
FOUNDATION DEPTH:	FROM GROUND LEVEL
STEP/PROJECTION:	C.80MM
FOUNDATION THICKNESS:	C.600MM THICK
BASE OF FOUNDATION:	C.600MM BGL
FOUNDING STRATA:	GRAVELLY SAND MATERIALS

TRIAL PIT CROSS SECTION – TP2



FOUNDATION TYPE:	CONCRETE
FOUNDATION DEPTH:	C.800MM BGL
STEP/PROJECTION:	C.220MM
FOUNDATION THICKNESS:	C.660MM THICK
BASE OF FOUNDATION:	C.1460MM BGL
FOUNDING STRATA:	MADE GROUND



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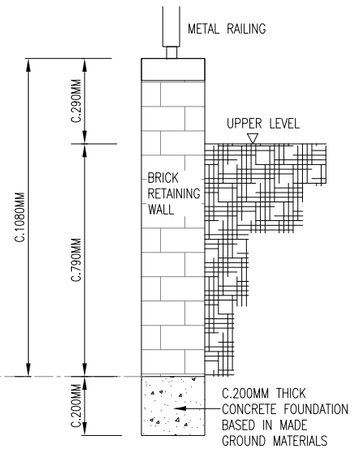
e-mail: admin@arc-environmental.com
web: www.arc-environmental.com

FOR COMPLETENESS A TRIAL PIT WAS CARRIED OUT AGAINST THE BRICK RETAINING WALL ADJACENT TP1. AT THIS LOCATION THE BRICK RETAINING WALL WAS NOTED TO BE BASED ON A C.200MM THICK CONCRETE FOUNDATION BASED DIRECTLY WITHIN THE MADE GROUND MATERIALS (SEE BELOW)



rev.	date	amendments	drawn	chckd

Client:
COLEMANS CATERERS LIMITED / BDN LIMITED

Project Title:
Proposed Refurbishment and Extension
Gandhi's Temple
Sea Road, South Shields

Drawing Title:
Foundation Detail Record Sheet

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	28.04.15	P.D	J.P.D

Job Ref:	Drg no:	Rev:
14–804	–	–

APPENDIX III

Laboratory Testing Results

(Geotechnical & Ground Contamination)

PSL
Professional Soils Laboratory

LABORATORY REPORT

UKAS TESTING
4043

Contract Number: PSL15/1254

Client's Reference: 14-804 Report Date: 20 March 2015

Client Name: Arc Environmental
Solum House
Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham
DH7 8PN

For the attention of: John Ditchburn

Contract Title: Gandis Temple, Sea Road, South Shields

Date Received: 12/03/2015
Date Commenced: 12/03/2015
Date Completed: 20/03/2015

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson (Director)
A Watkins (Director)
M Beastall (Laboratory Manager)

D Lambe (Senior Technician)
S Royle (Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rgunson@prosoils.co.uk
awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Depth m	Description of Sample
BH1			1.50-2.00	Brown slightly silty SAND.
BH1			3.50-4.00	Brown slightly gravelly slightly silty SAND.
BH1			6.00-6.50	Brown slightly gravelly slightly silty SAND.
BH1			9.00-9.50	Brown slightly silty SAND.
BH2			2.50-3.00	Brown slightly silty SAND.
BH2			4.50-5.00	Brown slightly gravelly slightly silty SAND.
BH2			7.50-8.00	Brown slightly silty SAND.
BH2			10.50-11.00	Brown slightly silty SAND.

PSL
Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	20/03/15		20/03/15		20/03/15

GANDIS TEMPLE, SEA ROAD, SOUTH SHIELDS.

Contract No: PSL15/1254

Client Ref: 14-804

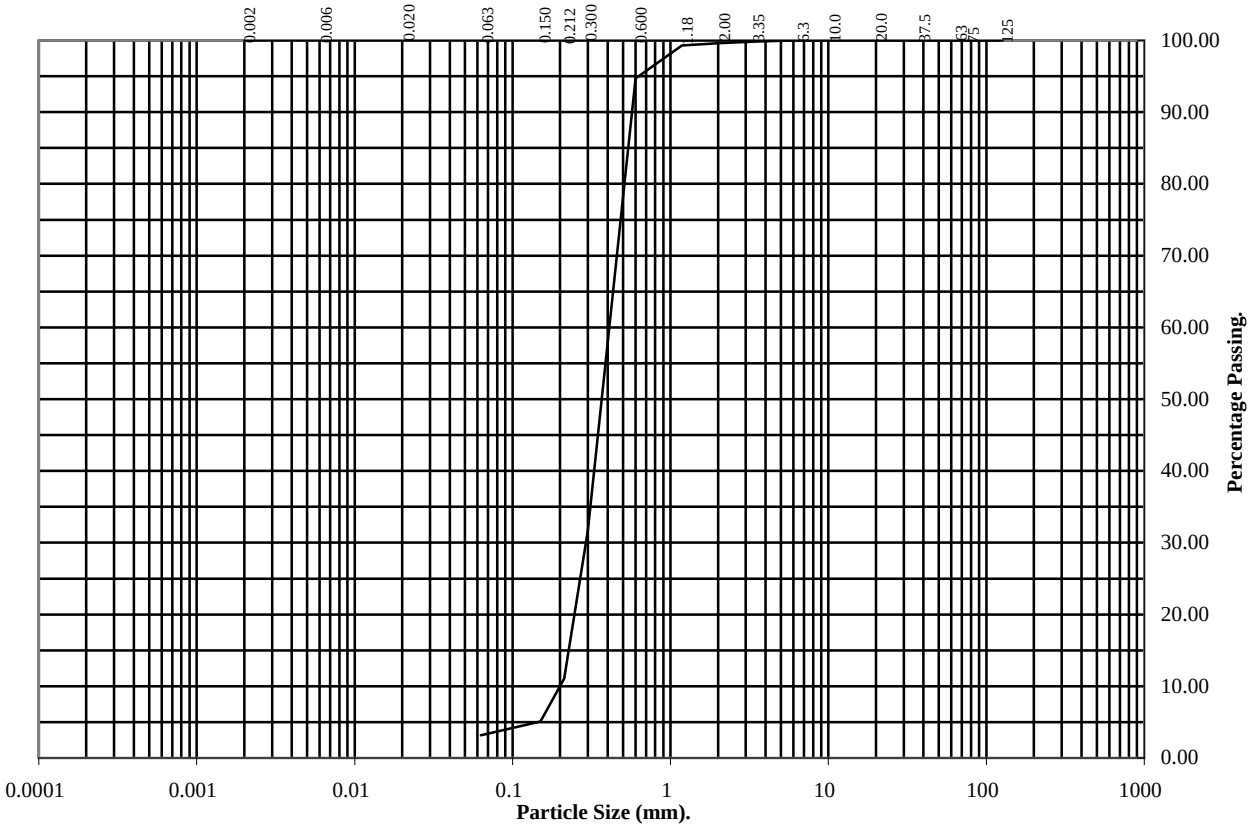
Particle Size Distribution Test

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH1** **Depth (m):** **1.50-2.00**

Sample Number: **Sample Type:**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	99
0.6	95
0.3	32
0.212	11
0.15	5
0.063	3

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	97
Silt / Clay	3

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date
	20/03/15		20/03/15

PSL Professional Soils Laboratory	**GANDIS TEMPLE, SEA ROAD, SOUTH SHIELDS.**	**Contract No.: PSL15/1254**

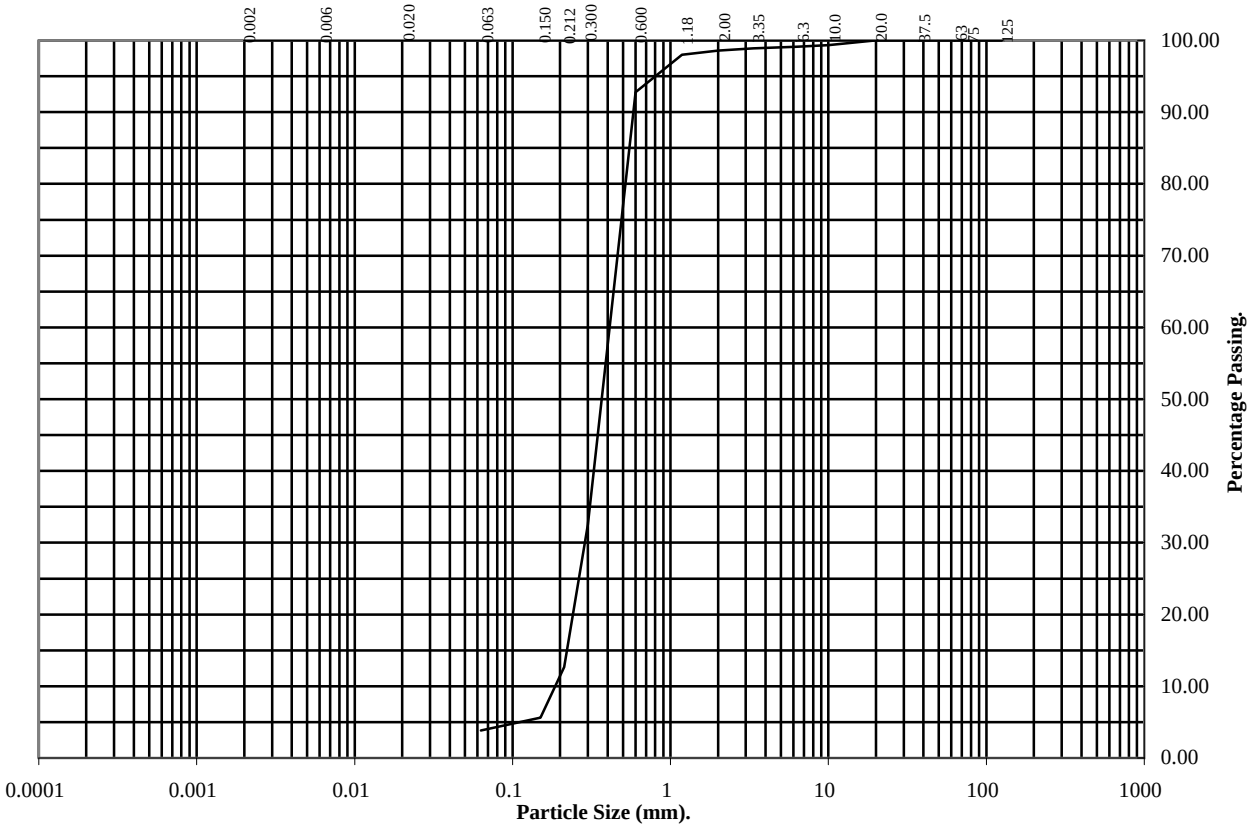
Particle Size Distribution Test

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH1** **Depth (m):** **3.50-4.00**

Sample Number: **Sample Type:**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	99
6.3	99
3.35	99
2	99
1.18	98
0.6	93
0.3	33
0.212	13
0.15	6
0.063	4

Soil Fraction	Total Percentage
Cobbles	0
Gravel	1
Sand	95
Silt / Clay	4

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date
	20/03/15		20/03/15

PSL Professional Soils Laboratory	**GANDIS TEMPLE, SEA ROAD, SOUTH SHIELDS.**	**Contract No.: PSL15/1254**

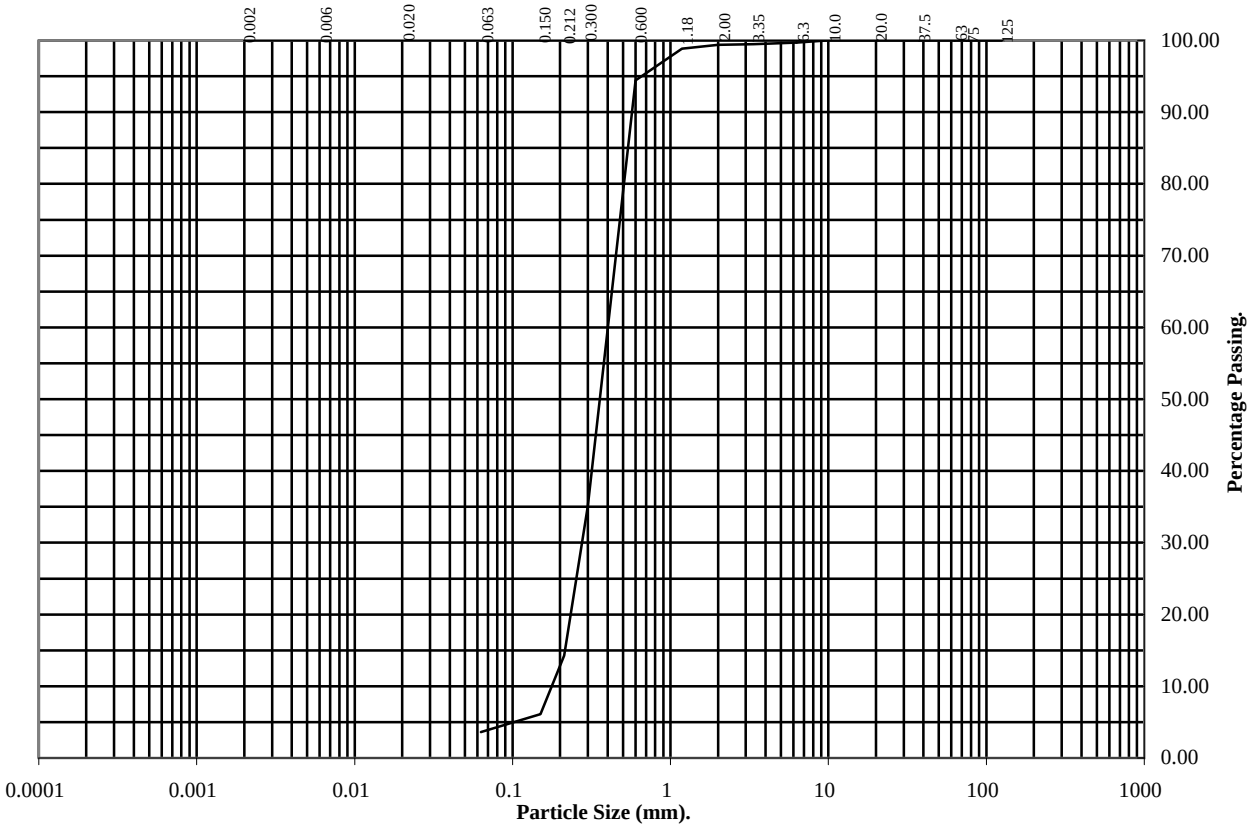
Particle Size Distribution Test

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH1** **Depth (m):** **6.00-6.50**

Sample Number: **Sample Type:**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	99
2	99
1.18	99
0.6	94
0.3	35
0.212	14
0.15	6
0.063	4

Soil Fraction	Total Percentage
Cobbles	0
Gravel	1
Sand	95
Silt / Clay	4

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date
	20/03/15		20/03/15

PSL Professional Soils Laboratory	**GANDIS TEMPLE, SEA ROAD, SOUTH SHIELDS.**	**Contract No.: PSL15/1254**

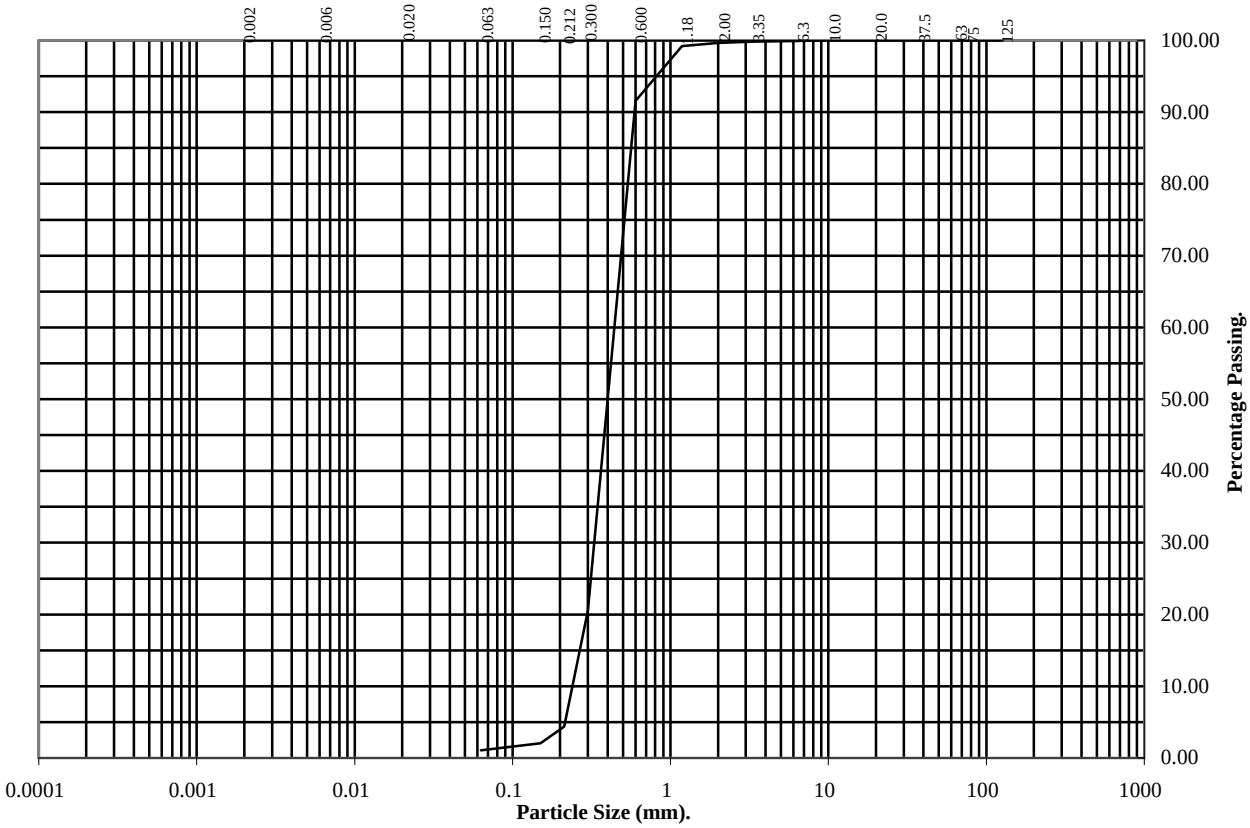
Particle Size Distribution Test

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH1** **Depth (m):** **9.00-9.50**

Sample Number: **Sample Type:**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	99
0.6	92
0.3	21
0.212	4
0.15	2
0.063	1

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	99
Silt / Clay	1

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date
	20/03/15		20/03/15

PSL Professional Soils Laboratory	**GANDIS TEMPLE, SEA ROAD, SOUTH SHIELDS.**	**Contract No.: PSL15/1254**

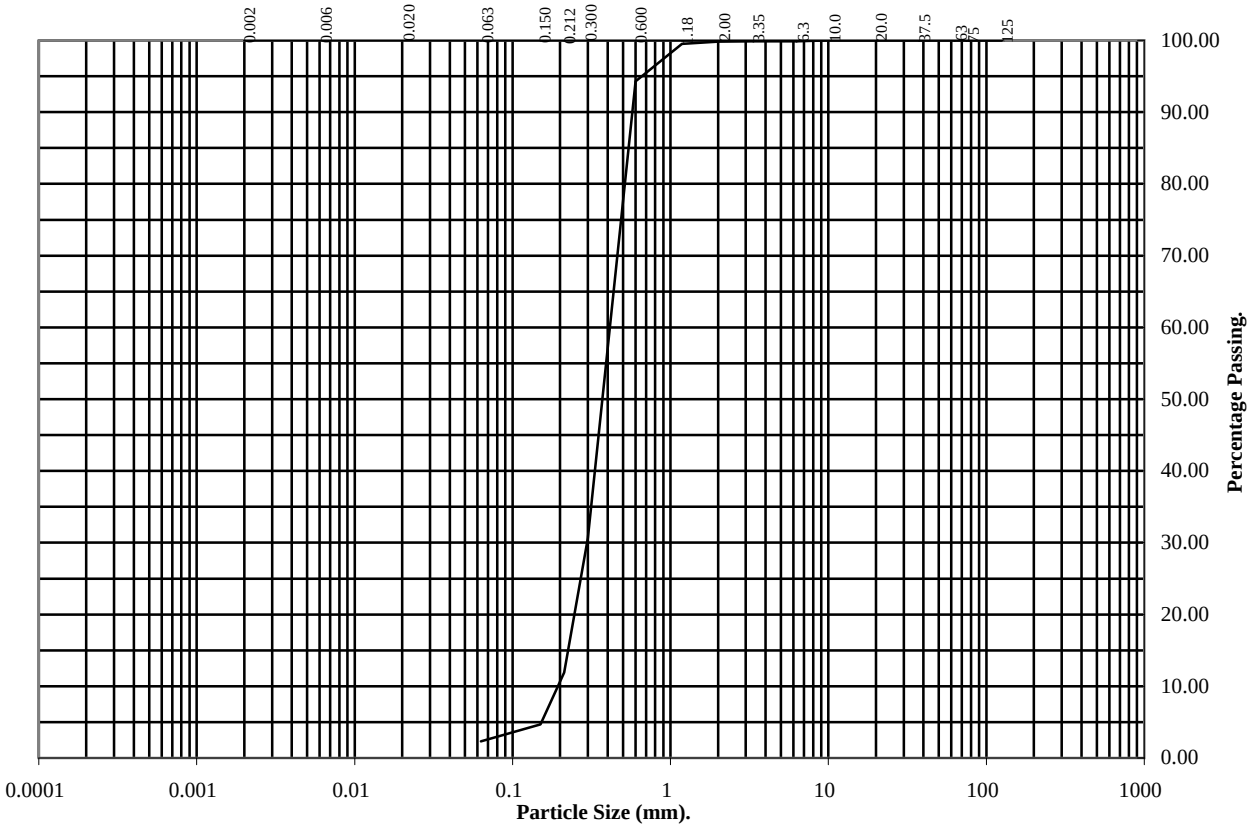
Particle Size Distribution Test

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH2** **Depth (m):** **2.50-3.00**

Sample Number: **Sample Type:**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	99
0.6	94
0.3	31
0.212	12
0.15	5
0.063	2

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	98
Silt / Clay	2

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date
	20/03/15		20/03/15

PSL Professional Soils Laboratory	**GANDIS TEMPLE, SEA ROAD, SOUTH SHIELDS.**	**Contract No.: PSL15/1254**

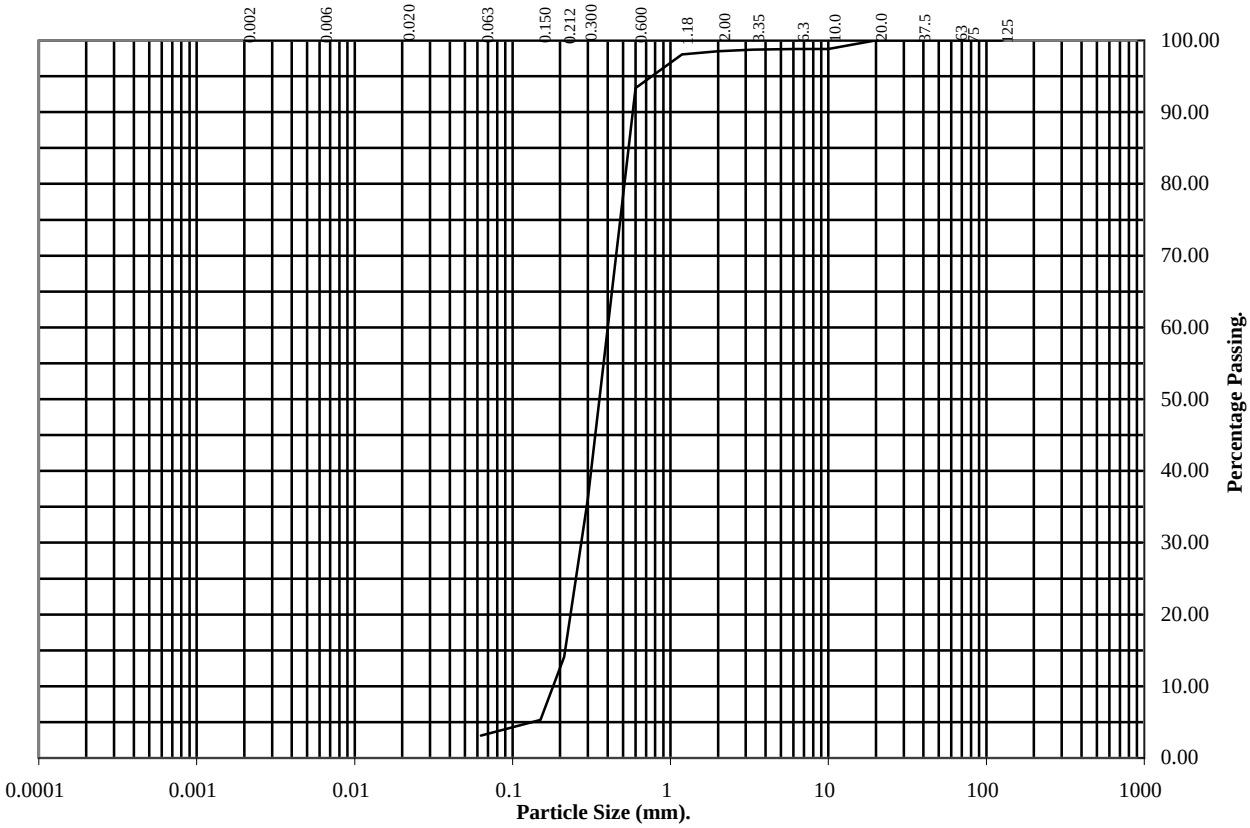
Particle Size Distribution Test

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH2** **Depth (m):** **4.50-5.00**

Sample Number: **Sample Type:**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	99
6.3	99
3.35	99
2	98
1.18	98
0.6	93
0.3	36
0.212	14
0.15	5
0.063	3

Soil Fraction	Total Percentage
Cobbles	0
Gravel	2
Sand	95
Silt / Clay	3

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date
	20/03/15		20/03/15

PSL Professional Soils Laboratory	**GANDIS TEMPLE, SEA ROAD, SOUTH SHIELDS.**	**Contract No.: PSL15/1254**

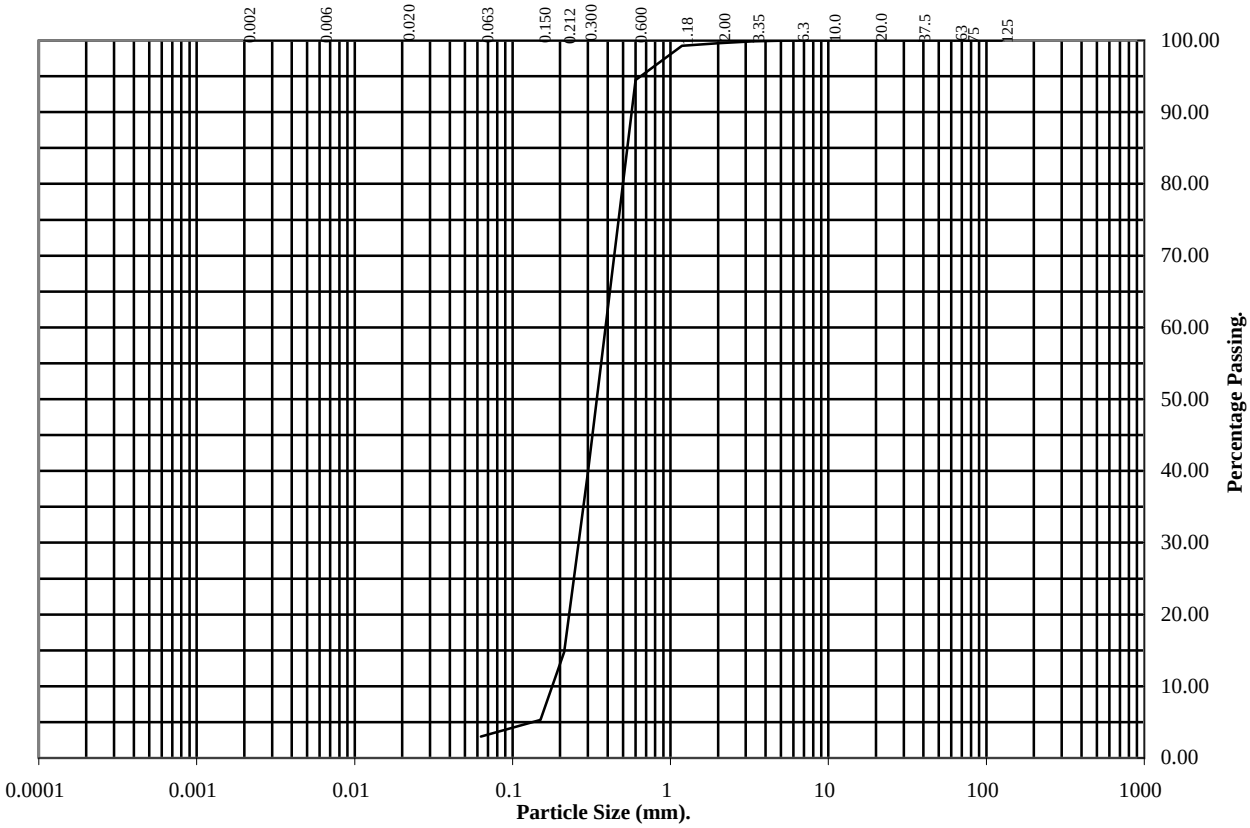
Particle Size Distribution Test

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH2** **Depth (m):** **7.50-8.00**

Sample Number: **Sample Type:**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	99
0.6	94
0.3	40
0.212	15
0.15	5
0.063	3

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	97
Silt / Clay	3

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date
	20/03/15		20/03/15

PSL Professional Soils Laboratory	**GANDIS TEMPLE, SEA ROAD, SOUTH SHIELDS.**	**Contract No.: PSL15/1254**

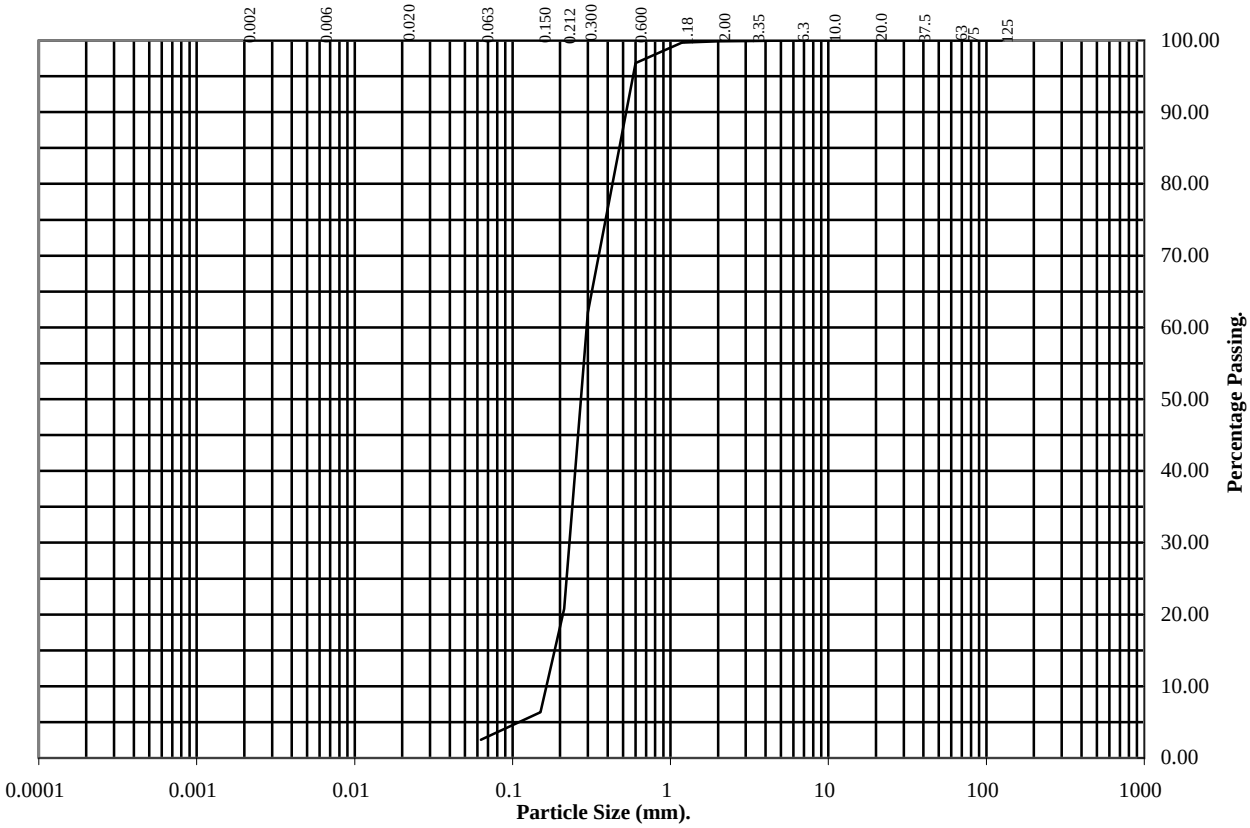
Particle Size Distribution Test

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH2** **Depth (m):** **10.50-11.00**

Sample Number: **Sample Type:**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	100
1.18	100
0.6	97
0.3	62
0.212	21
0.15	6
0.063	3

Soil Fraction	Total Percentage
Cobbles	0
Gravel	0
Sand	97
Silt / Clay	3

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date
	20/03/15		20/03/15

PSL Professional Soils Laboratory	**GANDIS TEMPLE, SEA ROAD, SOUTH SHIELDS.**	**Contract No.: PSL15/1254**

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ANALYTICAL TEST REPORT

Contract no: 54604

Contract name: Gandis Temple, Sea Road, South Shields

Client reference: 14-804

Clients name: ARC Environmental

Clients address: Solum House, Unit 1 Elliott Court
St Johns Road
Meadowfield
DH7 8PN

Samples received: 06 March 2015

Analysis started: 06 March 2015

Analysis completed 12 March 2005

Report issued: 13 March 2015

Notes:
Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, withour prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key:
U UKAS accredited test
M MCERTS & UKAS accredited test
$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing
NAD No Asbestos Detected

Approved by: K Campbell

Karan Campbell Director | John Campbell Director | Dave Bowerbank Customer Services Co-ordinator

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are inclusive of stones.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
54604-1	BH 1	0.70-1.50	Sand with Gravel	-	-	8.5
54604-2	BH 2	0.70-1.50	Sand with Gravel	-	-	10.4
54604-3	BH 3	0.20-0.70	Sand with Gravel	-	-	9.4
54604-4	BH 3	1.50-2.00	Sand with Gravel	-	-	9.1
54604-5	BH 3	3.50-4.00	Sand	-	-	16.8
54604-6	BH 3	6.00-6.50	Sand	-	-	16.5

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SOILS

Lab number			54604-1	54604-2	54604-3	54604-4	54604-5	54604-6
Sample id			BH 1	BH 2	BH 3	BH 3	BH 3	BH 3
Depth (m)			0.70-1.50	0.70-1.50	0.20-0.70	1.50-2.00	3.50-4.00	6.00-6.50
Date sampled			26/02/2015	25/02/2015	25/02/2015	25/02/2015	25/02/2015	25/02/2015
Test	**Method**	**Units**						
Arsenic (total)	CE127 M	mg/kg As	19	30	27	-	-	-
Cadmium (total)	CE127 M	mg/kg Cd	0.9	0.6	0.3	-	-	-
Chromium (total)	CE127 M	mg/kg Cr	50	70	54	-	-	-
Chromium (III)	-	mg/kg CrIII	50	70	54	-	-	-
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	-	-	-
Copper (total)	CE127 M	mg/kg Cu	28	30	30	-	-	-
Lead (total)	CE127 M	mg/kg Pb	58	63	67	-	-	-
Mercury (total)	CE127 M	mg/kg Hg	<0.5	<0.5	<0.5	-	-	-
Nickel (total)	CE127 M	mg/kg Ni	18	16	16	-	-	-
Selenium (total)	CE127 M	mg/kg Se	1.3	1.5	0.7	-	-	-
Zinc (total)	CE127 M	mg/kg Zn	108	93	96	-	-	-
pH	CE004 M	units	8.6	8.5	8.7	8.7	8.5	8.6
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	70	241	40	24	44	40
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	-	-	-
Total Organic Carbon (TOC)	CE072 M	% w/w C	2.04	4.08	2.33	-	-	-
PAH								
Acenaphthene	CE087	mg/kg	1.05	5.46	4.08	-	-	-
Acenaphthylene	CE087	mg/kg	1.13	3.18	3.14	-	-	-
Anthracene	CE087	mg/kg	5.67	17.47	14.37	-	-	-
Benzo(a)anthracene	CE087	mg/kg	15.63	41.84	29.56	-	-	-
Benzo(a)pyrene	CE087	mg/kg	12.80	34.12	24.85	-	-	-
Benzo(b)fluoranthene	CE087	mg/kg	15.93	46.59	35.50	-	-	-
Benzo(ghi)perylene	CE087	mg/kg	5.32	13.40	10.19	-	-	-
Benzo(k)fluoranthene	CE087	mg/kg	6.26	18.25	13.82	-	-	-
Chrysene	CE087	mg/kg	12.13	33.37	24.38	-	-	-
Dibenz(ah)anthracene	CE087	mg/kg	1.97	5.42	4.16	-	-	-
Fluoranthene	CE087	mg/kg	30.79	102.00	71.30	-	-	-
Fluorene	CE087	mg/kg	1.37	5.51	5.64	-	-	-
Indeno(123cd)pyrene	CE087	mg/kg	6.51	17.55	13.11	-	-	-
Naphthalene	CE087	mg/kg	0.33	0.78	1.26	-	-	-
Phenanthrene	CE087	mg/kg	20.69	83.81	49.46	-	-	-
Pyrene	CE087	mg/kg	23.54	74.68	52.76	-	-	-
PAH (total of USEPA 16)	CE087	mg/kg	161	503	358	-	-	-
Benzo(j)fluoranthene	CE087	mg/kg	2.31	5.61	4.02	-	-	-
PAH (total of OIL 8)	CE087	mg/kg	73.60	203	149	-	-	-
TPH								
TPH (C5-C7)	CE067	mg/kg	<0.1	<0.1	<0.1	-	-	-
TPH (C7-C8)	CE067	mg/kg	<0.1	<0.1	<0.1	-	-	-
TPH (C8-C10)	CE067	mg/kg	<0.1	<0.1	<0.1	-	-	-
TPH (C10-C12)	CE033	mg/kg	5	5	7	-	-	-
TPH (C12-C16)	CE033	mg/kg	37	103	154	-	-	-

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SOILS

Lab number			54604-1	54604-2	54604-3	54604-4	54604-5	54604-6
Sample id			BH 1	BH 2	BH 3	BH 3	BH 3	BH 3
Depth (m)			0.70-1.50	0.70-1.50	0.20-0.70	1.50-2.00	3.50-4.00	6.00-6.50
Date sampled			26/02/2015	25/02/2015	25/02/2015	25/02/2015	25/02/2015	25/02/2015
Test	**Method**	**Units**						
TPH (C16-C21)	CE033	mg/kg	207	604	859	-	-	-
TPH (C21-C35)	CE033	mg/kg	616	1672	1735	-	-	-
TPH (C35-C44)	CE033	mg/kg	125	314	252	-	-	-
Subcontracted analysis								
Asbestos	$	-	NAD	NAD	NAD	-	-	-

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LEACHATES

Lab number			54604-3L
Sample id			BH 3
Depth (m)			0.20-0.70
Test	**Method**	**Units**	
Arsenic (dissolved)	CE128 U	µg/l As	38.15
Boron (dissolved)	CE128 U	µg/l B	<6
Cadmium (dissolved)	CE128 U	µg/l Cd	<0.07
Chromium (dissolved)	CE128 U	µg/l Cr	0.4
Copper (dissolved)	CE128 U	µg/l Cu	1.3
Lead (dissolved)	CE128 U	µg/l Pb	0.6
Mercury (dissolved)	CE128 U	µg/l Hg	<0.008
Nickel (dissolved)	CE128 U	µg/l Ni	<0.5
Selenium (dissolved)	CE128 U	µg/l Se	0.12
Zinc (dissolved)	CE128 U	µg/l Zn	<1
pH	CE004 U	units	8.9
Sulphate	CE049 U	mg/l SO_4	13
Cyanide (free)	CE077	µg/l CN	<20
PAH			
Naphthalene	CE087	µg/l	<0.1
Acenaphthylene	CE087	µg/l	0.2
Acenaphthene	CE087	µg/l	0.8
Fluorene	CE087	µg/l	1.1
Phenanthrene	CE087	µg/l	1.6
Anthracene	CE087	µg/l	0.3
Fluoranthene	CE087	µg/l	3.1
Pyrene	CE087	µg/l	2.4
Benzo(a)anthracene	CE087	µg/l	1.2
Chrysene	CE087	µg/l	1.1
Benzo(b)fluoranthene	CE087	µg/l	0.9
Benzo(k)fluoranthene	CE087	µg/l	0.3
Benzo(a)pyrene	CE087	µg/l	0.1
Indeno(123cd)pyrene	CE087	µg/l	0.2
Dibenz(ah)anthracene	CE087	µg/l	<0.1
Benzo(ghi)perylene	CE087	µg/l	0.1
PAH (total of USEPA 16)	CE087	µg/l	13.4
Benzo(j)fluoranthene	CE087	µg/l	0.1
PAH (total of OIL 8)	CE087	µg/l	3.9
TPH			
TPH (C5-C7)	CE067	µg/l	<1
TPH (C7-C8)	CE067	µg/l	<1
TPH (C8-C10)	CE067	µg/l	<1
TPH (C10-C12)	CE052	µg/l	<1
TPH (C12-C16)	CE052	µg/l	1
TPH (C16-C21)	CE052	µg/l	9
TPH (C21-C35)	CE052	µg/l	3

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LEACHATES

Lab number			54604-3L
Sample id			BH 3
Depth (m)			0.20-0.70
Test	**Method**	**Units**	
TPH (C35-C44)	CE052	µg/l	<1

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg As
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	M	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cr
-	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		1	mg/kg CrIII
CE050	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	M	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	M	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO_4
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	Wet		2	mg/kg CN
CE072	Total Organic Carbon (TOC)	Removal of IC by acidification, Carbon Analyser	Dry	M	0.1	% w/w C
CE087	PAH (speciated)	Solvent extraction, GC-MS	Wet		0.01	mg/kg
CE067	TPH (C5-C10) speciation	Headspace GC-FID	Wet		0.1	mg/kg
CE033	TPH (C10-C40) speciation	Solvent extraction, GC-FID	Wet		1	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

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METHOD DETAILS

METHOD	LEACHATES	METHOD SUMMARY	STATUS	LOD	UNITS
CE128	Arsenic (dissolved)	ICP-MS	U	0.06	µg/l As
CE128	Boron (dissolved)	ICP-MS	U	6	µg/l B
CE128	Cadmium (dissolved)	ICP-MS	U	0.07	µg/l Cd
CE128	Chromium (dissolved)	ICP-MS	U	0.2	µg/l Cr
CE128	Copper (dissolved)	ICP-MS	U	0.4	µg/l Cu
CE128	Lead (dissolved)	ICP-MS	U	0.2	µg/l Pb
CE128	Mercury (dissolved)	ICP-MS	U	0.008	µg/l Hg
CE128	Nickel (dissolved)	ICP-MS	U	0.5	µg/l Ni
CE128	Selenium (dissolved)	ICP-MS	U	0.07	µg/l Se
CE128	Zinc (dissolved)	ICP-MS	U	1	µg/l Zn
CE004	pH	Based on BS 1377, pH Meter	U	-	units
CE049	Sulphate	Ion Chromatography	U	10	mg/l SO_4
CE077	Cyanide (free)	Distillation, Colorimetry		20	µg/l CN
CE087	PAH (speciated)	Solvent extraction, GC-MS		0.1	µg/l
CE067	TPH (C5-C10) speciation	Headspace GC-FID		1	µg/l
CE052	TPH (C10-C40) speciation	Solvent extraction, GC-FID		1	µg/l

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
A	Sampling date not provided
B	Sampling time not provided (waters only)
C	Sample exceeded holding time(s)
D	Sample not received in appropriate containers
E	Headspace present in sample container
F	Sample not chemically fixed (where appropriate)
G	Sample not cooled
H	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
54604-1	BH 1	0.70-1.50	N	
54604-2	BH 2	0.70-1.50	N	
54604-3	BH 3	0.20-0.70	N	
54604-3	BH 3	1.50-2.00	N	
54604-3	BH 3	3.50-4.00	N	
54604-3	BH 3	6.00-6.50	N	

APPENDIX IV

Ground Contamination Risk Assessment Data:

Methodology

Notes for Off-site Disposal

Ground Contamination Risk Assessment

Assessment Framework:-

Ground contamination risk assessments are undertaken to identify potential risks from historical and recent land contamination on a given site and enable appropriate risk management actions to be undertaken in accordance with the regulatory context of the site and any future development. There are a range of technical approaches to the assessment of chemical contaminants in the UK, all of which broadly fit within a tiered/phased approach and the current UK approach is set out in the Defra and Environment Agency Publication: CLR 11: Model Procedures for the Management of Land Contamination (*Defra/EA 2004*).

ARC's approach to undertaking ground contamination risk assessments is based on the tiered/phased framework in accordance with CLR11, and for Human Health, the recently updated CLEA (Contaminated Land Exposure Assessment) framework and model for assessing potentially contaminated land in the UK. This framework and model is based primarily on the following publications and software: Science Reports SC050021/SR2 (EA 2008b Human Health toxicological assessment of contaminants in soil) and SC050021/SR3 (Updated technical background to CLEA model – replaces the previous guidance documents CLR9, CLR10 and Briefing notes 1 – 4); Science Report SC050021/SR4 (CLEA Software (version 1.06 beta) handbook) and the new CLEA software (replaces Science Report SC050021/H CLEA UK Handbook (draft) and the CLEA UK Software version 1.0 beta), along with the publication of a review of body weight and height data used within the Contaminated Land Exposure Assessment model (CLEA), Project no. SC050021/Technical Review 1.

At present, the SGV's (Soil Guidance Values) published as part of the previous CLEA UK Handbook (draft) and software (version 1.0 beta), have been withdrawn along with guidance documents CLR7 and CLR8, and replacement of the SGV values, using the updated model and software (version 1.06), is currently ongoing, and the new guidance documents for CLR7 & CLR8 have yet to be published. Currently, Defra and the EA have published TOX and SGV reports for the following select substances: Benzene, Toluene, Ethylbenzene, Xylenes, Arsenic, Cadmium, Mercury, Nickel, Selenium and Phenol. Although updated SGV values have been calculated for the aforementioned analytes, at present for the majority of the potential contaminants, relevant data is yet to be made available for the new model. According to Defra and the EA, the schedule for publication of the remaining reports will depend on various factors, and they anticipate publishing the remaining TOX and SGV reports for Cyanide, Lead, Dioxins, Dioxin-like Polychlorinated Biphenyls and Polycyclic Aromatic Hydrocarbons during the remainder of 2010.

When considering ground contamination risk assessments for Controlled Waters (groundwater and surface waters), ARC follows the EA guidance on Remedial Targets Methodology, Hydrogeological Risk Assessment for Land Contamination, 2006.

Methodology:-

During this transitional period, prior to the publication of all the new SGV values for the above mentioned analytes, ARC consider that the most appropriate methodology for completing a ground contamination risk assessment for soils on this site will be to utilise the recently published SGV values (Benzene, Toluene, Ethylbenzene, Xylenes, Arsenic, Cadmium, Chromium (III & VI), Mercury, Nickel, Selenium and Phenol), combined with the former CLEA model SGV's based on the CLEA UK software and other newly published and recognised GAC's (generic assessment criteria) for the remaining analytes. It is widely recognised by ground contamination risk assessment practitioners that the new CLEA model will generally result in higher SGV and GAC (generic assessment criteria) values for the standard end uses, and consequently continued use of the former CLEA model will result in a slightly more conservative assessment.

For general soil surface contamination, the new SGV value for inorganic Mercury can be compared with chemical analysis for total mercury content, as the concentrations of elemental and methylmercury compounds are likely to be very low, in accordance with Science Report SC050021 / Mercury SGV. In addition, the updated SGV values are based upon a Soil Organic Matter (SOM) content of 6%, in line with the most recent Defra and EA guidance. Once all the relevant data is available, a reassessment of the ground contamination present on this site can be carried out, if felt necessary, as this may result in a reduction in the scope of remediation works (if required). It should be noted that guidance document CLR11: Model Procedures for the Management of Land Contamination has not been withdrawn.

Ground Contamination Risk Assessment (Cont'd)

Methodology (Cont'd):-

ARC ground contamination risk assessments, in accordance with CLR11, are based on the established *source-pathway-receptor* pollutant linkage methodology and 'suitable for use' approach (Part IIA, EPA 1990 - inserted through Section 57 EA 1995), and adopts the tiered/phased approach beginning with a preliminary assessment (also referred to a desk top study). If potential pollutant linkages are identified from the preliminary assessment, for both Human Health and/or Controlled Waters, then Level 1 Quantitative Risk Assessments are appropriate guideline values. For soils these typically comprise soil guideline values (SGV's), generic assessment criteria (GAC) or site specific assessment criteria (SSAC) and for controlled waters, Environmental Quality Standards (EQS) or UK Drinking Water Standards.

Where any Level 1 criteria have been exceeded, various courses of action are available for recommendation, in order to try and 'break' the pollutant linkage by designing into the proposed development works and/or by recommending appropriate remediation works, i.e. removal of source, treatment of contaminants, installation of permanent barriers, etc. and/or by carrying out more detailed site specific quantitative risk assessment (DQRA, i.e. Level 2 or above). Completing further DQRA for any contaminants present, can take into account factors such as the introduction of physical barrier and the actual availability of plausible contaminant migration pathways, as well as site specific data such as the type, properties and characteristics (permeability, porosity, density, etc.) of the soil present on site, groundwater depth and flow, site specific exposure criteria and values, and contaminant retardation, attenuation, dilution and degradation. Similarly, when considering potential risks to off-site receptors, these are considered by assessing the potential risks to on-site receptors, as well as the potential mobility of any contaminants present within either the soils or water/groundwater below this site.

For the purpose of this report, preliminary and level 1 risk assessments consider two main categories of receptor, and these are as follows:

- On site Human Health – (CLEA Model).
- Controlled Waters – (surface water & groundwater) – (EA Remedial Targets Methodology).

When considering the risk to construction workforce, the results of the screening can be used by the Main Contractor/Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations, and when assessing the level of PPE required on site. Similarly, when considering the risks to building materials, again the results of the contamination screening can be used to determine the level of protection that may be required, and reference should be made to the utilities suppliers for their comments.

Level 1 - Human Health:-

Level 1 human health related assessments are based upon the current CLEA Model, with site values assessed against published Soil Guidance Values (SGV's), and where these values are not available against the published CIEM (Chartered Institute of Environmental Health)/LQM Generic Assessment Criteria (GAC), Atkins ATRISKsoil© SSV values and USEPA Region 9 Screening Values (2009). For statistical analysis, the site is assessed to delineate any potentially differing areas of contamination (averaging areas), based on the results of the preliminary investigation as well as the result of any visual, olfactory or analytical evidence following completion of the intrusive investigation works. Following this geographical delineation of the site, where generic or pervasive contaminants are anticipated, for each 'averaging area' under consideration, the results are assessed using the established methods of statistical analysis given in the CL:AIRE Guidance on Comparing Soil Contamination Data with a Critical Concentration (C_C), May 2008. In this case, the results of the sample population are assessed to determine whether they represent a normal or non-normal distribution and the statistical upper confidence limit is (95% percentile – $UCL_{0.95}$) is calculated and then compared with the chosen Level 1 Critical Concentration (C_C) value for the site (i.e. the appropriate SGV, GAC or SSV).

Ground Contamination Risk Assessment (Cont'd)

Methodology (Cont'd):-

Level 1 – Controlled Waters:-

The Level 1 controlled waters risk assessment has been carried out (in accordance with the guidance; Remedial Targets Methodology, Hydrogeological Risk Assessment for Land Contamination, Environment Agency, 2006) by comparing samples of leachate, with the chosen Level 1 Critical Concentration (C_C) value, based on an appropriate water quality standard (EQS, UK Drinking Water, etc.), and which is also taken as the Level 1 Leachate Remedial Target (LTC_1).

The number of samples chosen for screening is determined by assessing the potential risk of contamination reaching a sensitive receptor, i.e. shallow groundwater, nearby surface water feature, etc., based on the results of the preliminary investigation, as well as olfactory, visual, anecdotal and analytical evidence collected during the intrusive investigation works.

Where the potential risk is considered to be low between 0% and c.25% of the samples are targeted for screening, c.25% to c.50% where the risk is considered to be moderate and c.75% to 100% where the risk is considered to be high. This is to ensure that the potential risk is adequately assessed without carrying out unnecessary testing. When considering any 'hot spots' identified, samples are specifically targeted for screening on a sample by sample and analyte by analyte basis.

Notes for Off-Site Disposal

When considering the removal of any materials from this site as a waste, to be disposed of at a landfill, it can be seen that where the uncontaminated natural strata (excluding any 'topsoil' or 'peat' materials) can be kept separate from any made ground or contaminated natural strata, then these materials can be considered as 'inert' and taken to an Inert Landfill Site. Prior to disposal of these 'inert' materials, full WAC screening will need to be undertaken, with the number of samples to be screened dependant upon the volume of material to be disposed of.

Where made ground or contaminated natural strata is to be removed off site as a 'waste', a preliminary classification assessment, regarding off-site disposal, can be made utilising the contamination soils screening undertaken as part of the Level 1 Risk Assessment for Human Health. If there is sufficient screening to classify these materials as Non-Hazardous, then they can be disposed of at a Non-Hazardous Landfill. If insufficient preliminary screening has been undertaken to carryout the classification assessment, then further preliminary soils screening should be undertaken, where required.

If the results of the preliminary classification assessment indicate that the materials to be removed from site as a 'waste' should be classified as Hazardous Waste, then prior to disposal, full WAC screening should be completed so that these materials can be classified as either Stable Non-Reactive Hazardous Waste or Hazardous Waste, and disposed of at a suitable waste disposal facility.

If possible, removal of materials from site as a 'waste' should be kept to a minimum, however, if materials have to be removed to accommodate finished ground levels etc., it is recommended that the volume to be disposed of is calculated, as the amount of additional screening required, including any full WAC screening, will be dependant upon the volume of material to be disposed of.