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KRONOSPAN HIGH BAY WAREHOUSE SPECIFICATION FOR GROUND INVESTIGATION

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Description **Ground Investigation Specification**

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1 FORM OF CONTRACT

Not Included.

2 FORM OF TENDER

Not Included.

3 SPECIFICATION

Specification

The Specification shall be the *UK Specification for Ground Investigation, 2nd Edition* published by ICE Publishing, with information, amendments and additions as described in the Schedules:

Schedule 1. Information and site-specific requirements

Schedule 2. Exploratory holes

Schedule 3. Investigation Supervisor's facilities

Schedule 4. Specification amendments

Schedule 5. Specification additions

Additional Terms of Reference are listed in Schedule 5.1

Schedule 1 Information

S1.1 Name of Contract

Kronospan High Bay Warehouse

S1.2 Investigation Supervisor

Simon Miller of Ramboll UK, 2nd Floor, The Exchange, St. John Street, Chester, CH1 1DA

The Conditions of Contract shall be as specified by Client.

S1.3 Description of Site

The site is located in the Kronospan factory in Chirk, Wales. The centre of the site can be located by National Grid Reference SJ 28671 38394. A plan of the site showing the location is presented as Figure 1.

Previous ground investigation reports completed within the Kronospan factory site have provided a general understanding of the site. The main observations from the current site works and findings from the previous ground investigations are summarised below:

- The anticipated geological sequence at the site consists of the following: Made Ground (0-3.5mbgl), Granular Alluvium (3.5-5.5mbgl), Cohesive Alluvium (5.5mbgl-17.5mbgl), Glacio-Fluvial (17.5mbgl-20.3mbgl) and Glacial Till (20.3mbgl-NP).
- The cohesive Alluvium stratum is described as soft.
- Ground water levels are anticipated to be very close to the existing ground level.

The GI Contractor will need to coordinate with the Client to ensure access to the proposed borehole locations. It is recommended that the GI Contractor visits the site during the tender period/prior to quotation to determine site conditions and to verify the suitability of all access routes, height restrictions and security provision present on the site.

S1.4 Main Works Proposed and Purpose of this Contract

This investigation shall be the main investigation. The purpose of the investigation is to assess the nature and extent of ground and groundwater conditions to inform design.

The development of the site shall comprise:

- A new high bay warehouse.
- Modifications to the existing portal frame shed
- New base for the 3rd sprinkler tank
- Associated drainage works

Existing ground investigation information will be used to supplement the proposed ground investigation. The proposed ground investigation is primarily focused on informing the foundation design for the high bay warehouse.

S1.5 Scope of Investigation

The investigation shall comprise:

- 3 no. light cable percussive boreholes to a depth of 35.0mbgl
- 5 no. dynamic windowless sample holes up to 6m bgl
- In-situ testing;
- Installation of monitoring wells
- Gas and groundwater monitoring;
- Geotechnical and contamination laboratory testing; and
- Provision of borehole logs, laboratory test results and factual ground investigation report.

The exploratory hole details are summarised in Schedule 2.

The specific objectives for the site investigation as identified in the desk study are detailed in Table 1.

Table 1: Ground Investigation Objectives

Objective	Proposed Method
Confirm the geological sequence underlying the site	Cable percussion boreholes and window sample holes
Assess geotechnical and chemical properties of geological strata	In-situ and laboratory tests
Confirm groundwater conditions	Groundwater measurements during investigation

The following Schedules are not required for this investigation:

- S1.10 (Rotary drilling)
- S1.11 (Pitting and trenching)
- S1.13 (Probing and cone penetration testing)
- S1.14 (Geophysical testing)

The associated Bills C, D, F and G are not required.

S1.6 Geology and Ground Conditions

The following general assessment of the geology and ground conditions at the site has been inferred from available information, including Sheet 121 of the British Geological Survey, 1:50000, Solid and Drift edition. No assurance is given to the accuracy of this assessment.

The expected geology of the site comprises Made Ground overlying Alluvial granular and cohesive deposits further underlain by Fluvio-Glacial and Glacial Till material. This is summarised in Table 2.

The Made Ground potentially contains contaminants and appropriate drilling techniques should be adopted to mitigate further contamination and/or cross-contamination.

Table 2: Summary of Anticipated Geology

Stratum	Estimated Thickness (m)	Typical Description
Made Ground	3.50m	Clayey sandy GRAVEL To clayey gravelly SAND with Cobbles
Alluvium (Granular)	2.0m	Medium dense clayey gravelly SAND
Alluvium (Cohesive)	12.0m	Soft grey silty CLAY with sand lenses
Fluvio-Glacial	4.0m	Medium Dense to very dense clayey sandy GRAVEL with occasional cobbles.
Glacial Till	NP	Very stiff to hard gravelly sandy CLAY with occasional cobble.

The groundwater level is estimated at or just below the existing ground level.

S1.7 Schedule of drawing(s) and documents

The following drawings and documents are provided:

Title	Reference	Notes
Site Location Plan	Figure 1	
Exploratory Hole Location Plan	Figure 2	Actual GI locations to be agreed between Kronospan, contractor and RUK prior to start of works.
Schematic Drawing of a Standpipe Installation	Figure 3	

The Client has the services and utilities drawings that can be supplied upon request by the GI contractor. The GI Contractor is required to undertake a statutory service and utilities search prior to commencement on site to satisfy themselves it is safe to advance the boreholes.

Previous ground investigations in connection with the site and surrounding area are available and can be obtained from the Client.

S1.8 General Requirements (Specification Section 3) Particular Restrictions / Relaxations

Contract specific restrictions/relaxations are detailed in the following schedules.

The work on site shall not commence until the Client is satisfied that a suitable and sufficient Health and Safety Plan/Construction Phase Plan, complying with the current CDM Regulations, has been produced for the works.

- S1.8.1 Quality management system** (Clause 3.3)
Quality management to BS EN ISO 9001, BS EN ISO 14001 and BS OHSAS 18001 is required,

unless otherwise specified by the Client.

S1.8.2	Professional attendance	(Clause 3.5.2) The GI Contractor shall provide Professional Attendance to perform those tasks detailed in Specification Note for Guidance 3.5.2 which are relevant to this investigation. Proposed personnel shall be suitably qualified, with at least three years' experience. The GI Contractor shall provide CVs and detail the number, names and experience details of the proposed staff and the times which each member of staff is anticipated to spend at the site. Bill of Quantities Item A7 shall be used to detail the GI Contractor's expected Professional Attendance. As a minimum, the GI Contractor shall provide a suitably qualified person whilst mobilizing to site and demobilizing from site.
S1.8.3	Provision of ground practitioners and other personnel	(Clauses 3.6.1 and 3.6.2) Drilling staff qualifications shall be provided within the Tender Return. The Contractor is to prepare the specified factual part of the Ground Investigation Report. The Contractor's expected staff times for report compilation, preparation and checking are to be included in Bill of Quantities Item A7
S1.8.4	Hazardous ground, land affected by contamination and notifiable and invasive weeds	(Clauses 3.7.1 and 3.22) A contamination assessment has not been completed as part of the preparation of this specification. There is the potential for the Made Ground materials present at the surface to be contaminated.
S1.8.5	Additional information on services not shown on Contract drawings	(Clause 3.7.2) The GI contractor shall liaise with the Client in regard to the locations of underground services and utilities at site.
S1.8.6	Known suspected mine workings, mineral extractions, etc.	(Clause 3.7.3) No known workings.
S1.8.7	Protected species	(Clause 3.7.4) No known protected species.
S1.8.8	Archaeological remains	(Clause 3.7.5) No known archaeological remains.
S1.8.9	Security of site	(Clause 3.11) The GI contractor shall consult with the Client regarding site security.
S1.8.10	Traffic management measures	(Clause 3.12) Not required.
S1.8.11	Restricted working hours	(Clause 3.13) The GI contractor shall consult with the Client

		regarding working hours.
S1.8.12	Trainee site operatives	(Clause 3.14.1) As specified.
S1.8.13	Contamination avoidance and/or aquifer protection measures required	(Clauses 3.15.2 and 3.15.3) Ground protection sheets shall be used at each exploratory hole location to prevent cross contamination. All equipment should be cleaned between exploratory holes where contamination is encountered or suspected to prevent cross contamination. In addition, suitable investigation techniques shall be employed within exploratory holes to prevent causing vertical cross contamination. The GI Contractor shall be responsible for disposal of excess material in accordance with waste management regulations and schedule S5.9 of this specification. The GI Contractor shall supply their chain of custody records for the disposal of all materials off site as part of their factual report. If any signs (visual and/or olfactory) of significant contamination are encountered, particularly Non-Aqueous Phase Liquid (NAPL), the Contractor shall inform the Investigation Supervisor immediately. It is anticipated that the GI Contractor shall advance casing from the existing ground surface, through the Made Ground materials and Granular Alluvium and embed it 1.0m into the Cohesive Alluvium deposits. A seal of bentonite of a minimum 2.0m to be placed at the base of the larger diameter casing prior to proceeding at a reduced diameter.
S1.8.14	Maximum period for boring, pitting or trenching through hard material, hard stratum or obstruction	(Clauses 2.8, 4.3 and 6.4) If unexpected or hard ground conditions are encountered then the Investigation Supervisor shall be informed. Chiselling shall not proceed for longer than one hour without instruction from the Investigation Supervisor. NB – Existing concrete ground slab at site will require coring.
S1.8.15	Reinstatement requirements	(Clause 3.16) As specified.
S1.8.16	Hygiene facilities required	(Clauses 2.20 and 3.16.1) As specified.
S1.8.17	Unavoidable damage to be reinstated by Contractor	(Clause 3.16.1) Not applicable.
S1.8.18	Accuracy of exploratory hole locations	(Clauses 3.19 and 3.20) The accuracy of the exploratory hole locations shall be as specified.

The GI Contractor shall survey the top of all exploratory locations using Ordnance Survey (OS) benchmark. OS datum used shall be Newlyn.

The GI Contractor shall determine the coordinates of all exploratory holes with reference to the UK OS National Grid.

S1.8.19 Photography requirements

(Clause 3.25)

Photographs should be taken in accordance with the specification and as follows:

- Exploratory hole location prior to commencement of works
- Exploratory hole location following completion of works

S1.8.20 Notice to the Investigation Supervisor

The Investigation Supervisor shall be given at least 48 hours (h) notice of the commencement of work on site.

The GI Contractor shall inform the Investigation Supervisor in each and every instance where standing time exceeds 30 minutes.

S1.8.21 Additional Items

The site is within a working factory and the GI contractor shall consult with the client regarding management of the work schedule and work areas. Position of the borehole shall be agreed with the Client.

S1.9 Percussive Boring (Specification Section 4) Particular Restrictions / Relaxations

Contract specific restrictions/relaxations, are detailed in the following schedules.

S1.9.1 Permitted methods and restrictions

(Clauses 4.1 to 4.4)

The GI Contractor shall be responsible for selecting the appropriate casing at the start of boring/drilling to account for any necessary reduction in casing size to achieve the minimum diameter required at the base of the borehole. Necessary precautions shall be taken to prevent fuel spillage entering the ground or groundwater.

The GI contractor shall adopt appropriate drilling techniques when advancing boreholes through the soft Cohesive Alluvium deposits to minimise disturbance to the material and ensure U100/UT100 samples are representative.

Whenever water is added to the borehole, the depth at which it is added together with the volume added shall be recorded on the driller's daily logs. Only the minimum amount of clean water shall be added to the boreholes to aid boring.

S1.9.2 Backfilling

(Clause 4.5)

Boreholes not requiring monitoring standpipes to be installed shall be backfilled with soil arisings or bentonite pellets to level with the structural soil

layers. Reinstatement of the structural soil shall be on a like-for-like basis. Reinstatement of the concrete ground slab shall be agreed with the client.

- S1.9.3 Dynamic sampling** (Clause 4.6)
Not required.

S1.10 Rotary Drilling (Specification Section 5) Particular Restrictions / Relaxations

Not required.

S1.11 Pitting and Trenching (Specification Section 6) Particular Restrictions / Relaxations

Contract specific restrictions/relaxations, are detailed in the following schedules.

- S1.11.1 Indirect detection of buried services and inspection pits** (Clauses 3.8.3 and 6.1)
Prior to the commencement of each hand excavated pit a services check, including the use of a Cable Avoidance Tool, shall be carried out in order to check for any unmarked or unknown services.
All hand excavated trial pits will require logging and sampling by the Contractor's engineer as per Section 6 of the Thomas Telford Specification for Ground Investigation. Records of foundations are to be fully sketched and dimensioned along with photographic records.
For specific requirements of each exploratory hole location refer to Schedule S2.

S1.12 Sampling and Monitoring During Intrusive Investigation (Specification Section 7) Particular Restrictions / Relaxations

Contract specific restrictions/relaxations, are detailed in the following schedules.

- S1.12.1 Address for delivery of selected geotechnical samples** (Clause 7.6.1)
Not required
- S1.12.2 Retention and disposal of geotechnical samples** (Clause 7.6.2)
As specified.
- S1.12.3 Frequency of sampling for geotechnical purposes** (Clauses 7.6.3 to 7.6.11)
Within boreholes: as follows:
Inspection pits
Small or bulk disturbed samples (as appropriate) should be undertaken at each change in soil type or consistency or at 0.5m intervals, whichever is the more frequent.
Fine soils
Small disturbed and bulk disturbed samples shall be taken in each change in stratum.

Alternating open tube samples and SPT shall be undertaken from 0.3m below the base of the inspection pit at 1.0m intervals to 5.5m bgl. Thereafter, alternating open tube and SPT shall be undertaken at 1.5m intervals.

Soil from the cutting shoe of an open tube or the split barrel SPT shall be retained as a small disturbed sample. Bulk disturbed samples should be taken over the depth range of open tube samples or SPTs.

Coarse soils

Bulk disturbed samples shall be taken at each change in stratum. Where solid cone SPTs are undertaken, a bulk disturbed sample shall be taken over the range of the test.

S1.12.4	Open tube and piston sample diameters	(Clause 7.6.5) As specified.
S1.12.5	Retention of cutting shoe samples	(Clause 7.6.5) As specified.
S1.12.6	Delft and Mostap sampling	(Clause 7.6.12) Not required
S1.12.7	Groundwater level measurements during exploratory hole construction	(Clause 7.7) As specified.
S1.12.8	Special geotechnical sampling	(Clause 7.8) Not required.
S1.12.9	Address for delivery of selected samples	(Clause 7.9.2) Not required.
S1.12.10	Retention and disposal of contamination/WAC samples	(Clause 7.9.3) Not required.
S1.12.11	Frequency of sampling for environmental testing	(Clause 7.9.4) Samples for contamination testing shall be recovered from exploratory holes to the base of the made ground or changes in horizon, unless specified by the Engineer. Where window sampling has been undertaken using plastic liners then the liners should be split and sub sampled to obtain samples at the relevant depths. At each location samples shall comprise the following subject to confirmation by the Contractor with the laboratory: • Plastic tub (minimum 500 ml volume) • Amber glass jar (minimum 500 ml volume) Assuming uniform ground conditions, contamination samples shall be taken at the following depths below ground level: • Ground level to 0.20m • 0.50m

- 1.00m

and then every meter to the base of any made ground.

Samples shall be taken at 0.5 m and then at 1.5m-2.0 m into the underlying natural soils. However, if there is any visual or olfactory evidence of contamination in these soils, samples of this material shall also be undertaken.

Where there are changes in strata or any visual or olfactory evidence of contamination, then either the spacing shall be amended to take account of this or additional samples shall be recovered.

Samples shall be representative of the materials and/or contamination encountered. When areas of contaminated materials are identified, either by visual or olfactory means, additional samples of individual areas of contamination shall be recovered. It is anticipated that no more than three sets of soil samples shall be required for contamination testing from in-situ glacial till deposits.

However, where there is material at the location of a geotechnical sample that shows evidence of particular contamination, a sample for contamination testing shall be recovered and the relevant geotechnical samples shall be recovered as soon as possible thereafter.

S1.12.12 Sampling method

(Clause 7.9.5)

To be under the supervision of an environmental specialist or ground engineer experienced at obtaining contamination samples.

All containers for samples intended for contamination testing shall be provided by the contaminated land/chemical analysis laboratory (see S1.20 Particular Laboratory Testing Requirements). The Contractor shall arrange for sample containers to either be delivered to the site or delivered to him for onward transportation to the site.

Preservation of samples

Sample containers for contaminated materials shall be provided with necessary preservatives by the laboratory to undertake the analysis. The sample containers and preservatives shall reflect the anticipated contamination and determinants. Sample analysis for both inorganic and organic parameters is anticipated. The Contractor shall liaise with the analytical laboratory to ensure that the correct sample containers or bottles are used in each exploratory hole.

Storage of samples

Samples for analysis of contamination shall be stored as follows:

Immediately after sampling all samples of Made Ground, contaminated or potentially contaminated

materials shall be labelled and stored in temperature-controlled facilities at 4°C +/- 2°C in the dark. Storage facilities shall be located at all exploratory holes where sampling is taking place.

All samples shall be stored at 4°C +/- 2°C in the dark at all stages of intermediate transport to the laboratory and all stages of storage.

The contaminated land laboratory will provide storage facilities for the samples (generally cool boxes and cool packs). The cool packs will not be frozen on receipt. It will be the Contractors responsibility to ensure that cool packs are frozen in preparation for sampling and for ensuring that all cool boxes have frozen cool packs. The Contractor shall ensure there is a sufficient supply of frozen packs to meet this requirement.

The samples shall be packed in the cool boxes with a minimum of three ice packs, all frozen. Any remaining void shall be filled with insulating material to be agreed with the Project Manager or the Engineer.

Samples shall be transported to the contaminated land laboratory within 24 hours of sampling. Delivery of samples to the contaminated land laboratory will be the responsibility of the Contractor.

If it is necessary to store samples on site beyond the end of the working day then this shall only be undertaken using temperature controlled facilities capable of maintaining a temperature of 4°C +/- 2°C for extended periods. The Contractor is required to make an allowance for these facilities

Storage on site beyond the end of the working day using cool boxes is not acceptable. In any event, all samples shall reach the contaminated land laboratory within 24 hours of sampling.

In accordance with BS10175:2011+A2:2017, the Contractor shall prepare a sample report for each sample. Copies of the sample reports shall be maintained on site, a copy of all sample reports shall be passed to the Engineer at the end of each working day.

Chain of custody forms

All samples shall be accompanied by Chain of Custody forms copies of which shall be forwarded to the Engineer. Chain of custody forms shall be forwarded to the Engineer within 24 hours of sampling both paper and excel versions.

S1.12.13 Headspace testing

(Clause 7.9.8)

The Contractor shall arrange for a portable monitor to detect volatile organic vapour. This shall be photo ionisation detector (PID) or equivalent which shall have maximum lower detection limit of 1 ppm and shall be available onsite at all times during the Investigation. Where arisings are to be monitored, this shall comprise

headspace testing.

Routine monitoring for volatile vapours shall be required at all exploratory hole locations shown in Schedule 2. As a minimum, monitoring will be required on every soil sample and every 1.00 m from ground level to the base of the hole and shall include soils and rock cores where olfactory evidence of contamination is encountered during the site works. The Contractor shall record the peak result for each sample screened.

The requirement for monitoring for volatile and/or flammable gases as detailed does not relieve the Contractor of any requirement to monitor for the presence of gases or vapours to comply with Health & Safety requirements.

The methodology of screening and results from the Site Operations will need to be detailed by the Contractor in the Factual Ground Investigation Report.

Copies of calibration certificates for all monitors used onsite shall be provided to the Engineer at the start of the Site Operations.

S1.12.14	Specific requirements for chemical samples	Not Required
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S1.13	Probing and Cone Penetration Testing (Specification Section 8) Particular Restrictions / Relaxations
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Not required.

S1.14	Geophysical Testing (Specification Section 9) Particular Restrictions / Relaxations
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Not required

S1.15	In-situ Testing (Specification Section 10) Particular Restrictions / Relaxations
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Contract specific restrictions/relaxations, are detailed in the following schedules.

S1.15.1	Tests in accordance with British Standards	(Clause 10.3) Required in-situ tests are as follows: • SPTs in percussion/rotary boreholes at depth intervals/frequencies specified in Schedule S1.12.3
S1.15.2	Hand penetrometer and hand vane for shear strength	(Clause 10.4.1) Not required.
S1.15.3	Self-boring pressuremeter and high-pressure dilatometer testing and reporting	(Clause 10.5.1) Not required.

S1.15.4	Driven or push-in pressuremeter testing and reporting requirements.	(Clause 10.5.2) Not required.
S1.15.5	Menard pressuremeter tests	(Clause 10.5.3) Not required.
S1.15.6	Soil infiltration test	(Clause 10.6) Not required.
S1.15.7	Special in-situ testing and reporting requirements	(Clause 10.7) Not required.
S1.15.8	Interface probes	(Clause 10.8) Before any water samples are recovered, and following monitoring for gas / volatile vapours, wells shall be checked for the presence of Light Non-Aqueous Phase Liquids (LNAPLs) and Dense Non-Aqueous Liquids (DNAPLs) using an interface meter or similar approved method. The thickness of any free product layer shall be recorded and included in the factual report. Probes shall be thoroughly cleaned between monitoring wells.
S1.15.9	Contamination screening tests	(Clause 10.9) The Contractor shall arrange for a portable monitor to detect volatile organic vapour. This shall be photo ionisation detector (PID) or equivalent which shall have maximum lower detection limit of 1ppm and shall be available onsite at all times during the Investigation. Where arisings are to be monitored, this shall comprise headspace testing. Routine monitoring for volatile vapours shall be required at all exploratory hole locations shown in Schedule S2. As a minimum, monitoring will be required on every soil sample and every 1.0 m from ground level to the base of the hole and shall include soils and rock cores where olfactory evidence of contamination is encountered during the site works. The Contractor shall record the peak result for each sample screened. The requirement for monitoring for volatile and/or flammable gases as detailed does not relieve the Contractor of any requirement to monitor for the presence of gases or vapours to comply with Health & Safety requirements. The methodology of screening and results from the Site Operations will need to be detailed by the Contractor in the Factual Ground Investigation Report. Copies of calibration certificates for all monitors used onsite shall be provided to the Engineer at the start of the Site Operations.
S1.15.10	Metal detection	(Clause 10.10)

Not required.

S1.16	Instrumentation (Specification Section 11) Particular Restrictions / Relaxations	
	Contract specific restrictions/relaxations, are detailed in the following schedules.	
S1.16.1	Protective covers for installations	(Clause 11.2) Flush covers are required for the installation with heavy duty covers suitable for the location (highways standard).
S1.16.2	Protective fencing	(Clause 11.3) Not required.
S1.16.3	Standpipe and standpipe piezometer installations	(Clauses 11.4.1 and 11.4.2) The installation details for each exploratory hole shall be agreed with the Investigation Supervisor at the completion of drilling. Standpipe piezometer installations in cable percussion boreholes to be based on slotted 38 mm (window sample holes) 50mm diameter (boreholes) uPVC or HDPE pipe. All standpipes shall be installed with a 300 to 500 µm seamless geotextile wrap around slotted sections of the installation and set in a sand or gravel backfill. The installation of piezometers and standpipes shall generally comprise the arrangement as detailed in drawings AI.1 of the Specification for Ground Investigation, which are reproduced in Figures 3. Actual installation depths of response zones and seals to be determined by the Investigation supervisor. These installations are to be used for groundwater monitoring and sampling.
S1.16.4	Other piezometer installations	(Clause 11.4.3) Not required.
S1.16.5	Development of standpipes and standpipe piezometers	(Clause 11.4.5) All groundwater monitoring wells shall be developed by the Contractor in accordance with Section 8.3.3.3 and 8.3.3.4 of the BS10175:2011. The Contractor shall provide details of the method for well development and the disposal of arisings in his method statement.
S1.16.6	Ground gas standpipes	(Clause 11.5) The installation details shall be agreed with the Engineer at the completion of drilling. Standpipes are to be installed at depths to be advised by the Engineer in boreholes as described in schedule S2. These installations are also to be used for groundwater monitoring and sampling.
S1.16.7	Inclinometer	(Clause 11.6)

	installations	Not required.
S1.16.8	Slip indicators	(Clause 11.7) Not required.
S1.16.9	Extensometers and settlement gauges	(Clause 11.8) Not required.
S1.16.10	Settlement monuments	(Clause 11.9) Not required.
S1.16.11	Removal of installations	(Clause 11.10) Not required.
S1.16.12	Other instrumentation	(Clause 11.11) Not required.

S1.17 Installation Monitoring and Sampling (Specification Section 12) Particular Restrictions / Relaxations

Contract specific restrictions/relaxations, are detailed in the following schedules.

S1.17.1	Groundwater level readings in installations	(Clause 12.2) Groundwater levels are to be taken in accordance with the specification during the ground gas monitoring rounds in all combined groundwater/ground gas standpipes.
S1.17.2	Groundwater sampling from installations	(Clause 12.3.1) Groundwater samples will be required from each installed hole. Collection of water samples shall be undertaken in accordance with the requirements of BS10175:2011 and BS6068. Sampling will take place no sooner than seven days post completion of the site works and well development as part of the first round of groundwater level monitoring. Where wells are combined gas and groundwater monitoring points, the Contractor shall ensure that they take account of the requirements for gas monitoring prior to undertaking groundwater sampling. Before any samples are recovered, and following monitoring for volatile vapours, wells shall be checked for the presence of Light Non-Aqueous Phase Liquids (LNAPLs) using an interface meter or similar approved method. The thickness of any free product layer shall be recorded. Sampling may be undertaken using the purging equipment. Samples shall be contained in suitable containers provided by the analytical laboratory to meet the chemical testing requirements outlined in Section L of the Bill of Quantities (including rate only items) which will include plastic bottle/s and glass amber jar/s – Contractor to confirm requirement for

sample containers with the laboratory. Unless otherwise instructed, sample containers shall be completely filled without overflowing with the samples such that no air space remains. Overflowing from the sample container shall be minimised to prevent loss of any light non-aqueous phase contaminants. Samples vials for volatile organic compounds shall not be provided with an air gap.

Fixatives suitable for the analytical requirements specified by the laboratory shall be included in sample jars as appropriate.

The method of sampling used must ensure that no cross contamination between wells is allowed to occur. The Contractor is required to provide dedicated sampling equipment for each monitoring well where water sampling is required unless specified by the Engineer. This dedicated equipment can be used for purging and sampling and shall remain in the well on completion of sampling.

The Contractor shall wash all equipment between monitoring wells which has been used in groundwater. The Contractor shall make provision for supplying clean water free of contamination for cleaning purposes and for collecting and disposing of any contaminated wash water. The Contractor shall ensure that the washing of equipment to prevent cross contamination does not result in any additional contamination of soils or groundwater.

The Contractor shall ensure that all water samples are undertaken in accordance with the requirements of BS10175:2001 and BS6068.

S1.17.3 Purging/micro-purging

(Clause 12.3.2)

The Contractor shall provide details of the method for well purging and groundwater sampling in their method statement.

S1.17.4 Ground gas monitoring

(Clause 12.4)

Monitoring is required in all combined groundwater/ground gas standpipes on completion of the fieldwork and comprise four rounds of monitoring over a one month period.

The Contractor shall provide details of the equipment to be used and be able to demonstrate that the equipment has been calibrated in accordance with the manufacturer's requirements. This information shall be provided as part of the tender return.

The Contractor shall provide the following information at each monitoring well location:

- Record weather conditions atmospheric pressure (via analyser) and make a note of general wind strength (this can affect flow rate) and borehole I.D.
- Record condition of borehole and well

installation, i.e. if tap is open, well damaged/ vandalised.

- Record differential pressure and flow rate peak and steady state for 1 minute. Ensure monitor is zeroed before opening well tap.
- Record peak and steady state gas concentrations. Gases concentrations required are methane, carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide.
- Record water level and depth to base of well using dip meter.
- Record any free product using an interface probe.

The Contractor shall ensure that well caps and taps are in good working order and replace, securing well and locking.

Gas monitoring shall commence no sooner than 7 days following well installation.

Calibration Certificates for gas monitoring equipment shall be included in the report.

S1.17.5	Sampling from ground gas installations	(Clause 12.5) Not required.
S1.17.6	Other monitoring	(Clause 12.8) Not required.
S1.17.7	Sampling and testing of surface water bodies	(Clause 12.9) Not required.

S1.18 Daily Records (Specification Section 13) Particular Restrictions / Relaxations

Contract specific restrictions/relaxations, are detailed in the following schedules.

S1.18.1	Information for daily records	(Clause 13.1) As specified.
S1.18.2	Special in-situ tests and instrumentation records	(Clause 13.4) As specified.

S1.19 Geotechnical Laboratory Testing (Specification Section 14) Particular Restrictions / Relaxations

Contract specific restrictions/relaxations, are detailed in the following schedules.

S1.19.1	Investigation Supervisor or Contractor to schedule testing	(Clause 14.1.1) The testing shall be scheduled by the Investigation Supervisor on receipt of draft exploratory hole records and blank laboratory test schedules.
S1.19.2	Tests required	(Clause 14.1.2)

The testing required will be dependent upon the ground conditions encountered. However, the following tests are anticipated to be required:

- Moisture content determinations
- Atterberg limits determinations
- Particle size distribution
- Consolidation Tests
- Unconsolidated, undrained triaxial tests

S1.19.3	Specifications for test not covered by BS1377 and options under BS1377	(Clauses 14.2.1 and 14.4) Laboratory test certificates for the unconsolidated, undrained triaxial tests shall be supplied with stress-strain curves.
S1.19.4	UKAS accreditation to be adopted	(Clause 14.3) As specified.
S1.19.5	Rock testing requirements	(Clause 14.5) Not required.
S1.19.6	Chemical testing for aggressive ground / groundwater for concrete	(Clause 14.6) Suite D (Brownfield site - pyrite present)
S1.19.7	Laboratory testing on site	(Clause 14.7) Not required.
S1.19.8	Special laboratory testing	(Clause 14.8) Not required.

S1.20 Geoenvironmental Laboratory Testing (Specification Section 15) Particular Restrictions / Relaxations

S1.20.1	Investigation Supervisor or Contractor to schedule testing	(Clause 15.1) The testing shall be scheduled by the Investigation Supervisor on receipt of draft exploratory hole records and blank laboratory test schedules. These shall be provided via email within 48 hours of completion of the exploratory hole to minimise the delay between sampling and testing. Draft information shall include details of strata encountered and any observations indicating the possible presence of contamination.
S1.20.2	Accreditation required	(Clause 15.2) MCERTS where available (for soils), otherwise UKAS.
S1.20.3	Outsourcing of Chemical laboratory testing	See Chemical Testing Suites detailed in Appendix C. The chemical analysis shall be undertaken by: Element (formerly Exova Jones Environmental Laboratory) Unit 3 Deeside Point Zone 3

Deeside Industrial Park
 Flintshire
 CH5 2UA
 T: +44 (0)1244 833780

It will be the responsibility of the Contractor to ensure that the samples are delivered to the nominated laboratory for chemical analysis within 24 hours of sampling.

S1.20.4 Contractor communication with chemical testing laboratory

The Contractor shall liaise with the analytical laboratory specified in S1.20.4 to obtain the relevant sample containers for chemical testing outlined in S1.1.1. **The Contractor will be responsible for paying laboratory invoices and liaising with the laboratory regarding scheduling and results.** Schedules for chemical testing shall be provided to the Contractor by Ramboll.

S1.21 Reporting (Specification Section 16) Particular Restrictions / Relaxations

Contract specific restrictions/relaxations, are detailed in the following schedules.

S1.21.1 Form of exploratory hole logs

(Clauses 16.1 and 16.2.1)

In accordance with BS5930:2015.

Preliminary / draft borehole logs shall be submitted within 48 hours after completion of each exploratory hole to allow for chemical test scheduling.

S1.21.2 Information on exploratory hole logs

(Clause 16.2.2)

As specified.

S1.21.3 Variations to final digital data supply requirements

(Clause 16.5.1)

Extent of data

All data collected during the investigation in accordance with the codes and standards used for the contract are to be transferred in electronic format.

The format of the digital data files shall comply with the Association of Geotechnical and Geoenvironmental Specialists (AGS) publication 'Electronic Transfer of Geotechnical and Geoenvironmental Data' Edition 4.0.4 (February 2017), known as AGS4.

The Contractor shall provide all field and laboratory data in both digital and PDF format. This shall include all data from sub-contractors.

The AGS data and associated files shall be complete and identical to the data provided in the PDF version of the Factual Report. To ensure the

AGS4 data provided is identical to the PDF copy version, both the PDF and digital versions of the data must be generated from the same source software. The preferred approach is to use database software specifically intended for this purpose.

The units of measurement and abbreviations within the data file should match those presented in the AGS publication unless otherwise stated below.

Transfer file

AGS Format data shall be issued as a single '.ags' file. However, subject to the agreement of Ramboll, separate '.ags' files may be permitted in the following cases:

- Separate field and laboratory data for preliminary issue.
- CPT and other in situ data as separate files for each test where the data files are large.

The associated files that are required to complete the factual data submission shall be provided and referenced in the associated file (FILE_FSET) fields. When these are submitted the Contractor shall provide AGS Format data and associated files within single and identifiable submissions.

Draft data is that which is represented by the Draft Factual Report.

The digital data provided by the Contractor with the Final Factual Report is required to be complete and a total replacement of any previous Preliminary and Draft data submissions.

In addition to the PDF copies of the Factual Report, the Contractor shall provide a Report with a digital copy of the fields, laboratory data and associated files which are specified in the Contract to be in digital form. This report shall consist of a disk(s), or other agreed transmission medium, containing the digital data and associated files and paper copies of any data or drawings not included in digital form.

Submission of data shall be by email to the address(es) given in Schedule 1.21.13. Where data files are too large for practical transmission by email, alternative methods of transmittal shall be agreed with the Engineer.

Files shall not be compressed (zipped) without the agreement of Ramboll.

All issues of data, including draft/preliminary, shall be accompanied by an issue record that shall

include the following information:

- The heading 'AGS Format Data'
- The project name
- The project identification (PROJ_ID)
- The unique issue sequence number (TRAN_ISNO)
- The date of issue to the data receiver (TRAN_DATE)
- The name of the data provider issuing the transmission media (TRAN_PROD)
- The name of the data receiver to whom the transmission media was issued (TRAN_RECV)
- That the transfer file has been checked for viruses etc prior to Issue (TRAN_REM)
- A general description of the data transferred and/or a file listing for associated files
- The status of the data (Preliminary, Draft or Final)

This information is also included in the TRAN group.

For each AGS Format data set, including all associated files, the index will detail:

- The file name including the file extension
- The date and time the file was created
- The file size in bytes/kilobytes/megabytes as appropriate
- A general description of the data contained in each file and/or a file listing for associated files.

All data shall be checked by the Contractor and the data originator (i.e. the laboratory) for AGS Format errors and integrity prior to issue using AGS checking software. A list of AGS compatible software is available from the AGS website but KeyAGS, developed by Keynetix, is recommended. All files shall be checked for viruses etc. prior to issue.

Schedule for submission of data

The electronic data is to be submitted in accordance with Table S.1.21.3A below.

Table S1.21.3A

Data Status	Timing
Field data (if required)	Within two days of completion of hole/fieldwork
Preliminary data (if required)	Weekly updates
Draft data	With issue of Draft Factual Report
Final data	With issue of Final Factual Report

Associated files

The associated files to be included in the AGS data submission are as per Table S1.21.3B below.

Table S1.21.3B

File (Clause)	Group	File Format
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Photographs (Cl. 5.8, & 6.12)	FILE	JPG
Drawings (Cl. 16.4)	FILE	AutoCAD DXF or DWG

S1.21.4	Preliminary digital data	(Clause 16.5.3) As per clause S1.21.3. Preliminary digital photos shall be provided for approval in accordance with Clause 3.25 of the Specification.
S1.21.5	Type(s) of report required	(Clause 16.6) Factual Ground Investigation Report.
S1.21.6	Electronic report requirements	(Clause 16.6.3) Hard copies of the report are not required. As specified and with the following requirements: • all photographs (jpeg, tiff or other format agreed by the Investigation Supervisor); • as built exploratory hole location plan (dwg, dxf or other format agreed by the Investigation Supervisor); • testing results (excel, AGS or other format agreed by the Investigation Supervisor); • x,y,z coordinates of all exploratory holes in electronic format (text, csv files or excel spreadsheets are acceptable); • all factual ground investigation data (AGS format).
S1.21.7	Format and contents of Desk Study Report	(Clause 16.7) Not required.
S1.21.8	Contents of Ground Investigation Report (or specified part thereof)	(Clause 16.8) The GI contractor shall provide a factual ground investigation report with borehole logs, a borehole location plan and the laboratory test certificates. The information to be reported shall be as specified along with the following additional information: 1. Calibration certificates for equipment used. 2. Copies of field records and reports.
S1.21.9	Contents of Geotechnical Design Report (or specified part thereof)	(Clause 16.9) Not required.
S1.21.10	Times for supply of electronic information	(Clause 16.10.1) Preliminary AGS data shall be submitted within 48hrs of completion of the site operations.
S1.21.11	Electronic information transmission media	(Clause 16.10.2) Preliminary information: email Final information: email

S1.21.12 Report approval

(Clause 16.11)

An electronic copy of the draft reportable information shall be forwarded to the Investigation Supervisor for approval prior to the issue of the final report.

One electronic copy of the draft Factual Ground Investigation Report required for submission 2 weeks after the completion of site work. This shall not be locked or otherwise protected, to allow for mark-up.

Once the Engineer's comments on the draft Factual Ground Investigation Report are received by the Contractor, one electronic copy of the final Ground Investigation Report and digital data shall be issued within 2 weeks.

Schedule 2 Exploratory Holes (Locations to be agreed between Kronospan, the GI contractor and RUK prior to the start of the ground investigation)

Hole ID	Type	Anticipated depth (m bgl) *	Easting (m)	Northing (m)	Inspection Pit	Made Ground Expected	Installation required	Recovery for geotechnical testing	Recovery for contamination testing	Remarks
BH101	RC	35			✓	✓	✓	✓	✓	To define ground conditions and geotechnical parameters and investigate potential contamination
BH102	CP	35			✓	✓	✓	✓	✓	
BH103	CP	35			✓	✓	✓	✓	✓	
WS101	WS	6			✓	✓	✓		✓	
WS102	WS	6			✓	✓	✓		✓	
WS103	WS	6			✓	✓	✓		✓	
WS104	WS	6			✓	✓	✓		✓	
WS105	WS	6			✓	✓	✓		✓	

CP = cable percussion

WS = windowless sampler

Schedule 3 Investigation Supervisor's Facilities

S3.1	Accommodation	Not required
S3.2	Furnishings	Not required
S3.3	Services	Not required
S3.4	Equipment	Not required
S3.5	Transport	Not required
S3.6	Personal Protective Equipment for Investigator supervisor	Not required

Schedule 4 Specification Amendments

The following clauses are amended:

[illegible]

Schedule 5 Specification Additions

The following clauses are added to the specification:

5.1	Additional Terms of Reference	
5.1.1	Additional Terms of Reference	Unless stated otherwise, additional Terms of Reference for the works shall include but not be limited to: • Guidance Notes for the Safe Drilling of Landfills and Contaminated Land published by the British Drilling Association (1992); • Eurocode 7, Geotechnical design Part 1: General Rules - BS EN 1997-1:2004; • Eurocode 7, Geotechnical design Part 2: Ground investigation and testing - BS EN 1997-2:2007; • Code of Practice for Ground Investigation – BS 5930:2015; • Methods of test for Soils for Civil Engineering Purposes – BS1377; • Foundations, Code of Practice – BS8004; • Guidance Notes for the Safe Investigation by Drilling of Landfills and Contaminated Land published by the (ICE) Site Investigation Steering Group (1993); • Investigation of Potentially Contaminated Sites – Code of Practice. BS 10175:2011+A1:2013; • Guidelines for Combined Geo-environmental and Geotechnical Investigation published by AGS (2000); • Technical Aspects of Site Investigations. Vol. I and II. Technical Report P5-065/TR published by Environment Agency (2000).
5.2	Safety, Health and Environment	
5.2.1	Working in contaminated ground	The GI Contractor shall ensure that all reasonable precautions are taken to protect his employees, the employees of his sub-contractors and the general public against possible chemical or physical hazards in accordance with the Health and Safety at Work Act (1974), the Work at Height Regulations 2005, the Construction (Design and Management) Regulations 2015 and any other relevant legislation and codes of practice including the ICE Guidelines for the Safe Drilling of Landfills and Contaminated Land 1993. The Contractor's employees shall be properly trained and supervised in investigating contaminated ground.
5.2.1	Health and safety plan	The GI Contractor shall submit to the Investigation Supervisor a document describing the arrangements for ensuring health and safety of all personnel engaged prior to the start of the site works. This shall include arrangements for ensuring the health and safety of persons not employed by the Contractor, e.g. employees of sub-contractors, members of the public, residents, and any others who may be affected by the works.

5.3 Construction (Design and Management) Regulations, 2015		
5.3.1	Principle	The Contractor shall be the Principal Contractor for the duration of the fieldwork unless otherwise informed.
5.3.2	Pre-construction information	A Pre-Construction Information document prepared by the Client, in accordance with Appendix 2 of the CDM 2015 L153 Guidance will be supplied as part of tender documents with a Designers risk assessment provided in Appendix E. The Principal Contractor will be required to consider and apply the information contained therein in developing the Construction Phase Health & Safety Plan.
5.3.3	Construction phase health & safety plan	The Principal Contractor will be required to prepare a Construction Phase Health and Safety Plan (CPHSP) for the works. This shall be submitted to the Client prior to works beginning. Works must not start unless instructions to commence are provided by the Client / Employer. The plan shall be supplemented with Safety Method Statements and Risk Assessments for the works being undertaken. Where the works are extensive the safety method statements & risk assessments for the initial works will require to be provided, with a list of safety method statements & risk assessments submitted for future works beyond the initial works. At least five days shall be allowed in the programme for approval of the document. Guidance for the preparation of the Construction Phase Health & Safety Plan is contained in Appendix 3 of the CDM 2015 L153 Guidance.
5.3.4	Method statement and risk assessment	The Contractor shall provide a Method Statement & Risk Assessment covering the site works.
5.3.5	Asbestos	The Contractor shall provide details of the procedure to be adopted for encountering asbestos or asbestos containing materials, in the event that these should be identified during the course of the works.
5.4 Pollution Control		
5.4.1	General requirements	The Contractor shall take all necessary precautions to prevent the pollution and/or discolouration of the ground, groundwater, watercourses or ponds resulting from his operations on or adjacent to the site. No discharge to controlled waters shall be permitted without previous consent by the Investigation Supervisor. Where discharge is required the Contractor shall submit a method he intends to adopt and temporary works he proposes to construct and licences that he will obtain. The

5.4.2	Additional measures	Contractor shall acquire and maintain all relevant licences and ensure proper control and treatment of all discharges, either solid or liquid. The Contractor shall ensure as a minimum that: • fuel or lubricating oil stored in bulk on site are kept as far as reasonably possible from any watercourse and that such stores are surrounded with effective bunds capable of holding 110% of the full contents of the store; • all equipment using fuel is located as far away as possible from any watercourse. Any fuel transfer shall be via a fully closed system and spill kits shall be provided. • no discharge or seepage of cement slurry, drilling fluids and cuttings to any controlled waters will occur. In the event of a controlled water-body being polluted as a result of his works, the Contractor shall be responsible for taking immediate action to prevent the pollution spreading, and inform the Environment Agency and Investigation Supervisor immediately.
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5.5	Waste Management	
5.5.1	General Waste Management requirements	The GI contractor shall consult with the Principal Contractor regarding the removal and disposal of excess arisings from exploratory boreholes. The site shall be left in a clean and tidy state to the satisfaction of the Principal Contractor. This shall include obtaining a skip for the storage of waste materials on site. The GI Contractor shall allow for the classification and disposal of any contaminated arisings from the works to a suitably licensed disposal facility.
5.5.2	Disposal of material off-site	Should any material be removed off-site the Contractor shall comply with all applicable Waste Management and Duty of Care regulations. The following documentation must be completed, held on site in a designated file for the removal of waste and a copy provided to the Investigation Supervisor on completion of the works: • Chemical test certificates and classification of material in accordance with the European Waste Catalogue (EWC); • Waste Transfer Notes (Controlled Waste) including EWC classification; • Consignment Notes (Hazardous/Special Waste); • Licences of waste carrier and receiving facility.

ANNEX 1: BILL OF QUANTITIES FOR GROUND INVESTIGATION

Preamble

1. In this Bill of Quantities the sub-headings and item description identify the work covered by the respective items. The exact nature and extent of the work to be performed shall be ascertained by reference to the Conditions of Contract, the Specification and the Schedules and Appendices to the Specification as appropriate. The rates and prices entered in the Bill of Quantities shall be deemed to be the full inclusive value of then work covered by the several items, including the following unless stated otherwise:
 - a) Contract management and superintendence, labour and all costs in connection therewith;
 - b) the supply of materials, goods, storage, facilities and services, and all costs in connection therewith, including wastage and delivery to site;
 - c) plant and all costs in connection therewith;
 - d) fixing, erecting and installing or placing of materials and goods in position;
 - e) all temporary works;
 - f) all general obligations, requirements, liabilities and risks involved in the execution of the investigation as set forth or implied in the documents on which the tender is based;
 - g) establishment charges, overheads and profit;
 - h) bringing plant and sampling and in-situ testing and monitoring equipment to the site of each exploratory hole; erecting dismantling and removing on completion;
 - i) on completion, removal of all equipment and services from site and disposal of arisings.
2. Unless identified as Not Required, all items in Section A of the Bill of Quantities (general items, and provisional services and additional items), and all items in subsequent sections against which quantities are entered shall be priced.
3. If lump-sum items are not required by the Contractor, this shall be stated against the rate item in the Bill of Quantities and £0.00 entered in the amount. Where rates are not priced they shall have £0.00 placed against them and £0.00 entered in the amount.
4. When full or part-time professional attendance on site is required in accordance with Clause 3.5.2, this shall normally be paid for under Item A7 of the Bill of Quantities.

Unless otherwise detailed in Schedule S1.8.2, the on-site professional attendance services provided by the technical staff shall comprise the technical supervision of site activities, site liaison, logistics logging, in-situ testing and sampling, photography and the preparation of daily records and preliminary logs (except where any of the above activities are carried out by site operatives and boring/drilling operatives).

When individuals are not carrying out their specific duties are otherwise away from the site then daily rates will not apply and these costs will be deemed to be covered under general items.
5. The rate entered under Item A3 shall include for the provision of any additional PPE, ground surface protection measures, additional welfare and hygiene facilities and plant and equipment decontamination facilities required as a direct result of the contamination of hazard(s) detailed in Schedule S1.8.4 and/or S1.8.6.
6. The Item for photographs shall allow for the standing time of associated plant and supply of negatives, enprints and bound volume or electronic equivalents.

7. Rates for moving plant and equipment to the site of each exploratory hole shall allow for the formation of access routes, and making good avoidable damage to access routes and working areas on completion as required by the Contract.
8. The rates for moving rotary drilling plant to the site of each hole shall include for setting up over a previously formed borehole, including for any additional costs arising from pulling casings left in the ground or providing temporary casings
9. Payment for forming exploratory holes shall be based on:
 - a) full thickness of strata investigated and described in accordance with the Specification;
 - b) depths measured from ground level;
 - c) depth measured from the original ground level where an inspection pit has been excavated;
 - d) that part of a drill hole below the bottom of a borehole where a drill hole has been ordered to continue from the bottom of a borehole;
 - e) core recovery of at least 90% in any core run, unless the Investigation Supervisor is satisfied it cannot be achieved;
 - f) volume calculated as measured length multiplied by measured depth multiplied by specified width for trial and observation trenches.
10. Rates for forming exploratory holes shall allow for:
 - a) temporary casing installation, where necessary, and removal;
 - b) dealing with surface water;
 - c) backfilling with arisings;
 - d) taking information and supply of daily record for the works carried out by site operatives;
 - e) additional site supervision of non-qualified operatives.
11. Rates for aquifer protection measures shall allow for the measures detailed in section S1.8.13.
12. Standing time shall be measured as the duration of time for which plant, equipment and personnel are standing on the instruction of the Investigation Supervisor or in accordance with the specification.

Standing time shall be paid for interruption of the formation of exploratory holes to record groundwater entry in accordance with Clause 7.7. The rates for standing time shall include for:

 - a) plant equipment and personnel;
 - b) consequential costs;
 - c) changes in the programme of working;
 - d) recording information and preparing daily report.
13. The rates for daily provision of dynamic sampling and probing, hand augering and pitting and trenching crews and equipment at locations as directed by the Investigation Supervisor shall allow for compliance with the requirements of the Contract, including preparation of records (unless the Investigation Supervisor takes responsibility for the logging and preparation of records).

The rates for dynamic sampling Items B15 to B17 and B19 shall include for the provision of liners.
14. The rates for sampling shall allow for the standing time of associated plant. The rates for sampling shall also include for the costs of the sample containers and transport and storage of the samples up to the specified time limits.

The rate for taking U100 or UT100 sample does not include for recovery of a sample from the cutting shoe.

The rates for each of Items E14.1 to E15.3 shall include for all necessary containers and collected samples for an individual determination of the specified contamination or WAC suite.

15. The rates for in-situ testing shall allow for the standing time of associated plant and for the interpretation and presentation of the results on preliminary logs/exploratory hole logs or on separate agreed report forms using the same dates of presentation as the exploratory hole to which they refer.

In the case of the self-boring pressuremeter, high pressure dilatometer or Menard pressuremeter, the rates shall also allow for the mutual standing of the respective boring/drilling plant and specialist testing equipment and crews during the combined process.

Where in-situ testing is paid for on an hourly basis, the time measured shall be the actual time taken to carry out the test in accordance with the Investigation Supervisor's instruction and/or the Specification but excluding the time taken to erect and dismantle test equipment where this is itemised separately.

The rate for carrying out an SPT (whether using split spoon or solid cone), does not include for the recovery of associated sample.

16. The rates for cone penetration test Items F15 and F21 shall allow for the provision of daily records and for the interpretation and presentation of the results on agreed report forms/exploratory hole logs in accordance with BS1377 and Schedules 1.13.3 or 1.13.4.

For the seismic cone, the recorded and presented data shall include the specified CPT data recorded between seismic test depths.

The rates for dynamic probing shall allow for undertaking and reporting torque measurements at the prescribed vertical intervals.

17. The rates for installation of instruments shall allow for:

- a) clearing and keeping the hole free of unwanted materials;
- b) all costs associated with equipment, installation, specified seals, surround and backfill materials excluding backfill below the instrument and surface terminal if appropriate;
- c) Proving correct functioning;
- d) Delays due to installations including setting time for grout;
- e) Recording information and preparing daily record and additional reports.

18. The rates for monitoring and sampling of installations during the fieldwork period shall allow for:

- a) Purging and dealing with disposal of recovered water
- b) All costs associated with consumables and provision of data recording equipment to site
- c) Proving correct calibration and recalibration
- d) Recording information, preparing, updating and submitting additional reports successively and at the completion of monitoring, including notification of any unexpected readings and/or variation in readings
- e) Delays due to interruptions of other site activities.

The rates for recording of water level, ground gas or other monitoring measurement shall allow for notices of re-entry to the Investigation Supervisor, owners or occupiers affected by the location or access route.

19. The rates for laboratory testing shall include for:

- a) The supply of a copy of the preliminary test results to the Investigation Supervisor
- b) Notification of available test samples, failed tests and/or deviating samples (e.g. samples not correctly preserved)
- c) The cost of determining a parameter (e.g. moisture content or density), where that parameter forms part of the information to be reported for the specified test (e.g. undrained shear strength, consolidation test, or unconfined compressive strength)
- d) The disposal of samples in accordance with the relevant regulations.

20. The provisional sum, Item A6, for the off-site disposal of contaminated waste shall include for temporary storage and for organising the transport and disposal by a suitably licenced waste disposal contractor. Payment shall be made only against receipted invoices.

The costs of laboratory testing to determine the nature of the waste shall be covered by laboratory testing rates for tests actually completed and to an agreed schedule. Those sums shall be offset against the Provisional sum Item A6.

21. Appendix A to the Bill of Quantities (Rates for Ground Practitioners and other Personnel) shall be priced. The rates given will be used by the Investigation Supervisor to make an initial estimate of costs, where applicable, of employing the Contractor's staff in accordance with Clauses 3.5.2, 3.6.1 and/or 3.6.2 of the Specification.
22. Items for the supply of the master and copies of the Desk Study Report, Ground Investigation Report and/or Geotechnical Design Report shall include for the printing and supply of the specified number of draft and final copies (Specification Clause 16.11 and Schedule S1.21.12). All other duties in compiling, preparing and checking the draft and final reports shall normally be paid for either under Item A7 of the Bill of Quantities or using the rates given under Appendix A.
23. Units of measurement: the following abbreviations shall be used for the units of measurements:
- Millimetres: mm
 - Metre: m
 - Kilometres: km
 - Square millimetres: mm²
 - Square metre: m²
 - Cubic metre: m³
 - Square metre per day: ²/day
 - Linear meter: lin.m
 - Kilogramme: kg
 - Tonne: t
 - Sum: sum
 - Number: nr
 - Hour: h
 - Week: wk
 - Vehicle week: v.wk
 - Item: item
 - Day: day
 - Specimen day: sp.day
 - Person day: p.day

Bill of Quantities

The following pages constitute the Bill of Quantities.

A General Items, Provisional Services and Additional Items

Number	Item Descriptions	Unit	Quantity	Rate	Amount (£)
A1	Offices and stores for the Contractor	sum	1		
A2	Establish on site all plant, equipment and services for a Green Category site	sum	1		
A3	Extra over Item A2 for a Yellow Category site	sum	1		
A4	Maintain on site all site safety equipment for a Yellow Category site (including PPE)	week	2		
A5	Decontamination of equipment during and at end of intrusive investigation for a Yellow Category site	sum	1		
A6.1	Appropriate storage, transport and off-site disposal of contaminated arisings and any PPE equipment, excluding laboratory testing	provisional sum	1		
A6.2	WAC testing	nr			
A7	Provide professional attendance in accordance with Clause 3.5.2				
A7.1	Provide Technician	p.day			
A7.2	Provide Graduate Ground Engineer	p.day			
A7.3	Provide Experienced Ground Engineer	p.day	15		
A7.4	Provide Registered Ground Engineering Professional	p.day			
A7.5	Provide Registered Ground Engineering Specialist	p.day			
A7.6	Provide Registered Ground Engineering Advisor	p.day			
A8	Establish the location and elevation of the ground at each exploratory hole	sum	1		
A9	Preparation of Health and Safety documentation and Safety Risk Assessment	sum	1		
A10	Facilities for the Investigation Supervisor	sum			
A11	Vehicle(s) for the Investigation Supervisor	v.week			
A12	Fuel for vehicle for the Investigation Supervisor	provisional sum			
A13	Investigation Supervisor's telephone and facsimile charges	provisional sum			
A14	Deliver selected cores and samples to the specified address	provisional sum			
A15	Special testing and sampling required by Investigation Supervisor	provisional sum			
A16	Traffic safety and management	provisional sum			
A17	One master copy of the Desk Study Report	sum			
A18	Additional copies of the Desk Study Report	nr			
A19	One master copy of the ground investigation data (borehole logs, borehole location plan, laboratory test certificates) (or specified part thereof)	sum	1		
A20	Additional copies of the Ground Investigation Report (or specified part thereof)	nr			
A21	Electronic copy of ground investigation data (borehole logs, borehole location plan, laboratory test certificates) (or specified part thereof)	sum	1		
A22	One master copy of the Geotechnical Design report (or specified part thereof)	sum			
A23	Additional copies of the Geotechnical Design Report (or specified part thereof)	nr			
A24	Electronic copy of Geotechnical Design Report (or specified part thereof)	sum			
A25	Digital data in AGS transfer format	sum	1		
A26	Hard-copy photographs	nr			
A27	Photographic volume	nr			
Contract specific additional bill items					-
Total Section A carried to summary					

B Percussion Boring

Number	Item Descriptions	Unit	Quantity	Rate	Amount (£)
B1.1	Move boring plant and equipment to the site of each exploratory hole and set up	nr	3		
B1.2	Move cut-down boring plant and equipment to the site of each exploratory hole and set up	nr			
B2	Extra over Item B1 for setting up on a slope of a gradient greater than 20%	nr			
B3	Break out surface obstruction where present at exploratory hole	h	r/o		
B4.1	Advance borehole between existing ground level and 10m depth	m	30		
B4.2	As Item B4.1 but for cut-down rig	m			
B5.1	As Item B4 but between 10 and 20m depth	m	30		
B5.2	As Item B5.1 but for cut-down rig	m			
B6.1	As Item B4 but between 20 and 30m depth	m	30		
B6.2	As Item B6.1 but for cut-down rig	m			
B7	As Item B4 but between 30 and 40m depth	m	15		
B8	As Item B4 but between 40 and 50m depth	m			
B9	Advance borehole through hard stratum or obstruction	h			
B10	Provide aquifer protection measures at a single aquiclude/aquifer boundary or cross-contamination control measures at a single soil boundary in a borehole	nr	3		
B11	Backfill borehole with cement/bentonite grout or bentonite pellets	m	r/o		
B12	Standing time for borehole plant, equipment and crew	h	r/o		
Dynamic sampling					-
B19	Provision of dynamic sampling equipment and crew for sampling as directed by the Investigation Supervisor; maximum depth 6m (to include hand dug pits to 1.2m)	day	3		
B20	Backfill dynamic sampling hole with cement/bentonite grout or bentonite pellets	m	R/O		
Contract specific additional bill items					-
Total Section B carried to summary					

C Rotary Drilling

Number	Item Descriptions	Unit	Quantity	Rate	
	Hand augering				-
C1	Bring hand auger equipment to the position of each exploratory hole	nr			
C2	Bore with hand auger from existing ground level to 2m depth	m			
C3	As Item C2 but between 2 and 4m depth	m			
C4	Standing time for hand auger equipment and crew	h			
C5	Provision of hand augering equipment and crew for augering as directed by the Investigation Supervisor; maximum depth 4m	day			
C6	Backfill hand auger hole with cement/bentonite grout or bentonite pellets	m			
	Continuous flight and hollow- stem flight augering				-
C7	Move mechanical augering plant and equipment to the site of each exploratory hole and set up	nr			
C8	Extra over Item C7 for setting up on a slope of gradient greater than 20%	nr			
C9	Break out surface obstruction where present at auger hole	h			
C10	Standing time for rotary auger equipment and crew	h			
C11	Auger in materials other than hard strata at the specified diameter between existing ground level and 10m depth	m			
C12	As Item C11 but between 10 and 20m depth	m			
C13	As Item C11 but between 20 and 30m depth	m			
C14	Backfill auger hole with cement/bentonite grout or bentonite pellets	m			
	Rotary drilling with and without core recovery				-
C15	Move rotary drilling plant and equipment to the site of the site of each exploratory drillhole and set up	nr			
C16	Extra over Item C15 for setting up on a slope of gradient greater than 20%	nr			
C17	Extra over Item C15 for setting up drilling plant for inclined drillhole	nr			
C18	Break out surface obstructions where present at exploratory drillhole	h			
C19	Standing time for rotary drilling plant, equipment and crew	h			
C20	Provide aquifer protection measures at a single aquiclude/aquifer boundary in a drillhole	nr			
	Drilling without cores				-
C21	Rotary drill in materials other than hard strata at the specified diameter from which cores are not required, between existing ground level and 10m depth	m			
C22	As Item C21 but between 10 and 20m depth	m			
C23	As Item C21 but between 20 and 30m depth	m			
C24	As Item C21 but between 30 and 40m depth	m			
C25	As Item C21 but between 40 and 50m depth	m			
C26	Extra over Items C21 to C25 for inclined rotary drillhole	m			
C27	Rotary drill in hard strata at the specified diameter, from which cores are not required, between existing ground level and 10m depth	m			
C28	As Item C27 but between 10 and 20m depth	m			
C29	As Item C27 but between 20 and 30m depth	m			
C30	As Item C27 but between 30 and 40m depth	m			
C31	As Item C27 but between 40 and 50m depth	m			

Number	Item Descriptions	Unit	Quantity	Rate	
C32	Extra over Items C27 to C31 for inclined drillhole	m			
C33	Backfill rotary drillhole with cement/bentonite grout or bentonite pellets	m			
Drilling to obtain cores					-
C34	Rotary drill in materials other than hard strata to obtain cores of the specified diameters between existing ground level and 10m depth	m			
C35	As Item C34 but between 10 and 20m depth	m			
C36	As Item C34 but between 20 and 30m depth	m			
C37	As Item C34 but between 30 and 40m depth	m			
C38	As Item C34 but between 40 and 50m depth	m			
C39	Extra over Items C34 to C38 for use of semi-rigid core liner	m			
C40	Extra over Items C34 to C38 for coring inclined rotary drillhole	m			
C41	Rotary drill in hard strata to obtain cores of the specified diameter between existing ground level and 10m depth	m			
C42	As Item C41 but between 10 and 20m depth	m			
C43	As Item C41 but between 20 and 30m depth	m			
C44	As Item C41 but between 30 and 40m depth	m			
C45	As Item C41 but between 40 and 50m depth	m			
C46	Extra over Items C41 to C45 for use of semi-rigid core liner	m			
C47	Extra over Items C41 to C45 for coring inclined rotary drillhole	m			
C48	Backfill rotary drillhole with cement/bentonite grout or bentonite pellets	m			
C49	Core box to be retained by Client	nr			
Rotary percussive drilling					-
C50	Move rotary percussive drilling plant and equipment to the site of each drill hole and set up	nr			
C51	Extra over Item C50 for setting up on a slope of gradient greater than 20%	nr			
C52	Rotary percussive drill at the specified diameter in any material between existing ground level and 10m depth	m			
C53	As Item C52 but between 10 and 20m depth	m			
C54	As Item C52 but between 20 and 30m depth	m			
C55	As Item C52 but between 30 and 40m depth	m			
C56	As Item C52 but between 40 and 50m depth	m			
C57	Standing time for rotary percussive drilling plant, equipment and crew	h			
C58	Backfill rotary percussive drillhole with cement/bentonite grout or bentonite pellets	m			
Resonance (sonic) drilling					-
C59	Move sonic drilling plant and equipment to the site of each exploratory drillhole and setup	nr			
C60	Extra over Item C59 for setting up on a slope of gradient greater than 20%	nr			
C61	Extra over Item C59 for setting up sonic drilling plant for inclined drillhole	nr			
C62	Break out surface obstructions where present at exploratory drillhole	h			
C63	Standing time for sonic drilling plant, equipment and crew	h			
Sonic drilling without cores					-
C64	Sonic drill in materials other than hard strata at the specified diameter, from which cores are not required, between existing ground level and 10m depth	m			
C65	As Item C64 but between 10 and 20m depth	m			

Number	Item Descriptions	Unit	Quantity	Rate	
C66	As Item C64 but between 20 and 30m depth	m			
C67	As Item C64 but between 30 and 40m depth	m			
C68	As Item C64 but between 40 and 50m depth	m			
C69	Extra over Items C64 to C68 for inclined sonic drillhole	m			
C70	Sonic drill in hard strata at the specified diameter, from which cores are not required, between existing ground level and 10m depth	m			
C71	As Item C70 but between 10 and 20m depth	m			
C72	As Item C70 but between 20 and 30m depth	m			
C73	As Item C70 but between 30 and 40m depth	m			
C74	As Item C70 but between 40 and 50m depth	m			
C75	Extra over Items C70 to C74 for inclined sonic drillhole	m			
C76	Backfill sonic drillhole with cement/bentonite grout or bentonite pellets	m			
<u>Sonic drilling to obtain cores</u>					-
C77	Sonic drill in materials other than hard strata to obtain cores of the specified diameter between existing ground level and 10m depth	m			
C78	As Item C77 but between 10 and 20m depth	m			
C79	As Item C77 but between 20 and 30m depth	m			
C80	As Item C77 but between 30 and 40m depth	m			
C81	As Item C77 but between 40 and 50m depth	m			
C82	Extra over Items C77 to C81 for use of semi-rigid core liner	m			
C83	Extra over Items C77 to C81 for coring inclined sonic drillhole	m			
C84	Sonic drill in hard strata to obtain cores of the specified diameter between existing ground level and 10m depth	m			
C85	As Item C84 but between 10 and 20m depth	m			
C86	As Item C84 but between 20 and 30m depth	m			
C87	As Item C84 but between 30 and 40m depth	m			
C88	As Item C84 but between 40 and 50m depth	m			
C89	Extra over Items C77 to C81 for use of semi-rigid core liner	m			
C90	Extra over Items C77 to C81 for coring inclined sonic drillhole	m			
C91	Backfill sonic drillhole with cement/bentonite grout or bentonite pellets	m			
<u>Contract specific additional bill items</u>					-
Total Section C carried to summary					

D Pitting and Trenching

Number	Item Descriptions	Unit	Quantity	Rate	Amount (£)
Inspection pits					
D1	Excavate inspection pit by hand to 1.2m depth	nr	3		
D2	Extra over Item D1 for breaking out surface obstructions	h			
Trial pits and trenches					
D3	Move equipment to the site of each trial pit or trench of not greater than 4.5m depth	nr			
D4	Extra over Item D3 for setting up on a slope of gradient greater than 20%	nr			
D5	Extra over Item D3 for trial pit or trench between 4.5 and 6.0m	nr			
D6.1	Excavate trial pit between existing ground level and 3.0m depth	m			
D6.2	Extra over Item D3 for hand excavation	m			
D7	As Item D6 but between 3.0 and 4.5m depth	m			
D8	As Item D6 but between 4.5 and 6.0m depth	m			
D9	Excavate trial trench between existing ground level and 3.0m depth	m ³			
D10	As Item D9 but between 3.0 and 4.5m depth	m ³			
D11	As Item D9 but between 4.5 and 6.0m depth	m ³			
D12	Extra over Items D6 to D11 inclusive for breaking out hard material or surface obstructions	h			
D13.1	Standing time for excavation plant, equipment and crew for machine dug trial pit or trench	h			
D13.2	Standing time for excavation equipment and crew for hand dug trial pit or trench	h			
Observation pits and trenches					
D14	Move equipment to the site of each observation pit or trench of not greater than 4.5m depth	nr			
D15	Extra over Item D14 for setting up on slope of gradient greater than 20%	nr			
D16	Extra over Item D14 for observation pit or trench between 4.5 and 6.0m depth	nr			
D17	Excavate observation pit between ground level and 3.0m depth	nr			
D18	As Item D17 but between 3.0 and 4.5m depth	m			
D19	As Item D17 but between 4.5 and 6.0m depth	m			
D20	Extra over Item D17 for hand excavation	m			
D21	Excavate observation trench between existing ground level and 3.0m depth	m ³			
D22	As Item D21 but between 3.0 and 4.5m depth	m ³			
D23	As Item D21 but between 4.5 and 6.0m depth	m ³			
D24	Extra over Item D21 for hand excavation	h			
D25	Extra over Items D17 to D19 and D21 to D23 for breaking out hard strata or obstructions	h			
D26	Extra over Items D17 and D21 for breaking out hard strata or obstructions by hand	h			
D27	Standing time for excavation plant, equipment and crew for machine dug observation pit or trench	h			
D28	Standing time for excavation plant, equipment and crew for hand dug observation pit or trench	h			
Daily provision of pitting crew and equipment					
D29	Provision of excavation plant equipment and crew for machine dug trial pits or trenches as directed by the Investigation Supervisor; maximum depth 3.0m	day			

Number	Item Descriptions	Unit	Quantity	Rate	
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D30	As Item D29 but between 3.0 and 4.5m depth	day			
D31	As item D29 but between 4.5 and 6.0m depth	day			
D32	Provision of excavation plant, equipment and crew for machine dug observation pit or trench as directed by the Investigation Supervisor; maximum depth 3.0m	day			
D33	As Item D32 but between 3.0 and 4.5m depth	day			
D34	As Item D32 but between 4.5 and 6.0m depth	day			
D35	As Item D32 but for hand excavation	day			
D36	Extra over Items D32 to D34 for breaking out hard strata or obstructions	day			
General -					
D37	Bring pump to position of each exploratory pit or trench	nr			
D38	Pump water from pit or trench	h			
D39	Extra over Item D38 for temporary storage, treatment and disposal of contaminated water	provisional sum			
D40	Leave open observation pit or trench (including H&S provisions for securing pit or trench)	m ² /day			
D41	Leave open trial pit or trench (including H&S provisions for securing pit or trench)	m ² /day			
Contract specific additional bill items -					
D51	Provision of concrete equipment and personnel	sum	1		
D52	Concrete coring through surface obstructions to allow for hand dug inspection pits and drilling at required commencement diameter to achieve target depths.	nr	8		
Total Section D carried to summary					

E Sampling and Monitoring During Intrusive Investigation

Number	Item Descriptions	Unit	Quantity	Rate	Amount (£)
<u>Samples for geotechnical purposes</u>					-
E1	Small disturbed sample	nr	100		
E2	Bulk disturbed sample	nr	50		
E3	Large bulk disturbed sample	nr	10		
E4.1	Open-tube sample using thick-walled (OS-TK/W) sampler	nr	30		
E4.2	Open-tube sample using thin-walled (OS-T/W) sampler	nr			
E5	Piston sample	nr			
E6	Groundwater sample	nr			
E7	Ground gas sample	nr			
E8.1	Rotary core sub-sample (including cutting, preparation and protecting)	nr			
E8.2	Diamond Drill core sub-sample (including cutting, preparation and protecting)	nr			
<u>Continuous or semi-continuous sampling</u>					-
E9	Move Delft continuous or Mostap semi-continuous sampling plant and equipment to the site of each exploratory hole and set up	nr			
E10	Extra over Item E9 for setting up on a slope of gradient greater than 20%	nr			
E11	Break out surface obstruction where present at exploratory hole	h			
E12	Advance sampler between existing ground level and 10m depth	m			
E13	As Item E12 but between 10 and 20m depth	m			
<u>Containers for contamination assessment and WAC testing</u>					-
E14.1	Provision of containers and collection of samples for contamination Suite E (S1.20.3)	nr	50		
E14.2	Provision of containers and collection of sample for contamination Suite F (S1.20.3)	nr	8		
E14.3	Provision of containers and collection of samples for contamination Suite G (S1.20.3)	nr			
E15.1	Provision of containers and collection of samples for WAC Suite H (S1.20.5)	nr			
E15.2	Provision of containers and collection of samples for WAC Suite W (S1.20.5)	nr			
E15.3	Provision of containers and collection of samples for WAC Suite J (S1.20.5)	nr			
<u>Contract specific additional bill items</u>					-
Total Section E carried to summary					

G Geophysical Testing

Number	Item Descriptions	Unit	Quantity	Rate	Amount (£)
	<u>Land-based mapping techniques</u>				-
G1	Collect and process conductivity, magnetic or gravimetric data	lin.m			
G2	Collect and process microgravity data at each measuring station	nr			
	<u>Land-based profiling techniques</u>				-
G3	Collect and process resistivity, seismic or ground-probing radar data	lin.m			
	<u>Land-based borehole techniques</u>				-
G4	Move down-hole logging equipment to the site of each exploratory hole and set up	nr			
G5	Carry out down-hole calliper, natural gamma, resistivity (where hole is uncased), fluid temperature, conductivity and fluid flow logging	m			
	<u>Overwater</u>				-
G6	Collect and process echo sounding, side-scan sonar, magnetic conductivity, seismic reflection, seismic refraction, resistivity imaging or ground-probing radar data	day			
	<u>Contract specific additional bill items</u>				-
Total Section G carried to summary					

H In-situ Testing

Number	Item Descriptions	Unit	Quantity	Rate	Amount (£)
H1	Standard penetration test in borehole	nr	45		
H2	Standard penetration test in rotary drillhole	nr			
H3	In situ density testing	nr			
H3.1	Small pouring cylinder method	nr			
H3.2	Large pouring cylinder method	nr			
H3.3	Water replacement method	nr			
H3.4	Core cutter method	nr			
H3.5	Nuclear method	day			
H4	California Bearing Ratio test	nr			
H5	Vane shear strength test in borehole	nr			
H6	Penetration vane test, penetration from ground level	nr			
H7	Hand penetrometer test (set of 3 readings)	nr			
H8	Hand vane test (set of 3 readings)	nr			
Other tests					-
H9	Apparent resistivity of soil	nr			
H10	Redox potential	nr			
Permeability testing					-
H11	Set up and dismantle variable head permeability test in borehole	nr			
H12	Set up and dismantle constant head permeability test in borehole	nr			
H13	Carry out permeability test in borehole	h			
H14	Set up and dismantle variable head permeability test in standpipe/ standpipe piezometer	nr			
H15	Set up and dismantle constant head permeability test in standpipe/drillhole	nr			
H16	Carry out permeability test in standpipe/standpipe piezometer	h			
H17	Set up and dismantle variable head permeability test in rotary drillhole	nr			
H18	Set up and dismantle constant head permeability test in rotary drillhole	nr			
H19	Carry out permeability test in rotary drillhole	h			
H20	Set up and dismantle single packer permeability test	nr			
H21	Set up and dismantle double packer permeability test	nr			
H22	Carry out single packer permeability test	h			
H23	Carry out double packer permeability test	h			
Self-boring pressuremeter					-
H24	Move and set up self-boring pressuremeter and exploratory hole-forming equipment to site of each exploratory hole	nr			
H25	Extra over Item H24 for setting up on slope of gradient greater than 20%	nr			
H26	Advance exploratory hole to pressuremeter test location between ground level and 10m depth	m			
H27	As Item H26 but between 10 and 20m depth	m			
H28	As Item H26 but between 20 and 30m depth	m			
H29	Advance exploratory hole through hard stratum or obstruction	h			
H30	Self-bore to form test pocket between ground level and 10m depth	m			

Number	Item Descriptions	Unit	Quantity	Rate	
H31	As Item H30 but between 10 and 20m depth	m			
H32	As Item H30 but between 20 and 30m depth	m			
H33	Carry out pressuremeter test, provision of data and report, test duration not exceeding 1.5 hours	nr			
H34	Extra over Item H33 for test duration in excess of 1.5 hours	h			
H35	Carry out additional calibrations as instructed by the Investigation Supervisor				
H35.1	Displacement transducers	nr			
H35.2	Pore pressure transducers	nr			
H35.3	Total pressure transducers	nr			
H35.4	Membrane stiffness	nr			
H36	Carry out membrane compression calibrations as instructed by the Investigation Supervisor	nr			
H37	Backfill exploratory hole for pressuremeter with cement/bentonite grout	m			
H38	Standing time for self-boring pressuremeter and crew	h			
High pressure dilatometer					-
H39	Move and set up high-pressure dilatometer and exploratory hole-forming equipment to site of each exploratory hole	nr			
H40	Extra over Item H39 for setting up on a slope of gradient greater than 20%	nr			
H41	Advance exploratory hole to dilatometer test depth between ground level and 10m depth	m			
H42	As Item H41 but between 10 and 20m depth	m			
H43	As Item H41 but between 20 and 30m depth	m			
H44	Advance exploratory hole through hard stratum and obstruction	h			
H45	Rotary core to form dilatometer test pocket between ground level and 10m depth	m			
H46	As Item H45 but between 10 and 20m depth	m			
H47	As Item H45 but between 20 and 30m depth	m			
H48	Carry out dilatometer test, provision of data and report, test duration not exceeding 1.5 hours	nr			
H49	Extra over Item H48 for test duration in excess of 1.5 hours	h			
H50	Carry out additional calibrations as instructed by the Investigation Supervisor				
H50.1	Displacement Transducers	nr			
H50.2	Total Pressure Transducers	nr			
H50.3	Membrane stiffness	nr			
H51	Carry out membrane compression calibrations as instructed by the Investigation Supervisor	nr			
H52	Backfill exploratory hole for high-pressure dilatometer with cement/bentonite grout	m			
H53	Standing time for dilatometer equipment and crew	h			
Driven or push-in pressuremeter					-
H54	Move and set up pressuremeter and exploratory hole-forming equipment to site of each exploratory hole	nr			
H55	Extra Item H54 for setting up on a slope of gradient greater than 20%	nr			
H56	Advance exploratory hole through hard stratum or obstruction between ground level and 10m depth	m			
H57	As Item H56 but between 10 and 20m depth	m			
H58	As Item H56 but between 20 and 30m depth	m			

Number	Item Descriptions	Unit	Quantity	Rate	
H59	Advance exploratory hole through hard stratum or obstruction between ground level and 10m depth	h			
H60	Install pressuremeter at base of exploratory hole between ground level and 10m depth	m			
H61	As Item H60 but between 10 and 20m depth	m			
H62	As Item H60 but between 20 and 30m depth	m			
H63	Carry out pressuremeter test, provision of data and report, test duration not exceeding 1.5 hours	nr			
H64	Extra over Item H63 for test duration in excess of 1.5 hours	h			
H65	Carry out additional calibrations as instructed by the Investigation Supervisor				
H65.1	Displacement transducers	nr			
H65.2	Pore pressure transducers	nr			
H65.3	Total pressure transducers	nr			
H65.4	Membrane stiffness	nr			
H66	Carry out membrane compression calibrations as instructed by the Investigation Supervisor	nr			
H67	Backfill exploratory for pressuremeter with cement/bentonite grout	m			
H68	Standing time for driven or push-in self boring pressuremeter and crew	h			
Menard pressuremeter					-
H69	Move and set up pressuremeter and exploratory hole-forming equipment to site of each exploratory hole	nr			
H70	Extra over Item H69 for setting up on a slope of gradient greater than 20%	nr			
H71	Advance exploratory hole to pressuremeter test location between ground level and 10m depth	m			
H72	As Item H71 but between 10 and 20m depth	m			
H73	As Item H71 but between 20 and 30m depth	m			
H74	Advance exploratory hole through hard stratum	h			
H75	Rotary core to form pressuremeter test pocket between ground level and 10m depth	m			
H76	As Item H75 but between 10 and 20m depth	m			
H77	As Item H75 but between 20 and 30m depth	m			
H78	Carry out Menard pressuremeter test	nr			
H79	Backfill exploratory hole for pressuremeter with cement/bentonite grout	m			
H80	Standing time for Menard pressuremeter crew	h			
Soil infiltration test					-
H81	Provide equipment and carry out set of 3 infiltration tests at selected location up to 1 day, including hire of excavation equipment	nr			
H82	Extra over Item H81 for additional days	day			
H83	Calculation of infiltration rate for each tested location	nr			
Miscellaneous site testing					-
H84	Reading of free product level in borehole using an interface probe	nr			
H85	Provide contamination screening test kits per sample	nr			
H86	Carry out headspace testing by PID	sum	1		
Contract specific additional bill items					-
Total Section H carried to summary					

I Instrumentation

Number	Item Descriptions	Unit	Quantity	Rate	Amount (£)
<u>Standpipes and piezometers</u>					
11	Backfill exploratory hole with cement/bentonite grout below standpipe or standpipe piezometer	m			
12	Provide and install standpipe (19mm)	m			
13	Provide and install standpipe piezometer (19mm)	m			
14	Provide and install standpipe piezometer (50mm)	m	105		
15	Provide and install standpipe piezometer (38mm) – dynamic sampler	m	30		
16	Provide and install ground gas monitoring standpipe (19mm)	m			
17	Provide and install ground gas monitoring standpipe (50mm)	m			
18	Provide and install ground gas monitoring standpipe (75mm)	m			
19	Provide and install headworks for ground gas monitoring standpipe, standpipe or standpipe piezometer	nr			
I10	Provide and install protective cover (flush)	nr	8		
I11	Provide and install protective cover (raised)	nr			
I12	Extra over Item I10 for heavy duty cover in highways	nr	8		
I13	Supply and erect protective fencing around standpipe or piezometer installation	nr			
I14	Supply and erect 1.5m high marker post	nr			
I15	Standpipe and piezometer development				
I15.1	Supply equipment and personnel to carry out development by surging	nr			
I15.2	Develop standpipe or piezometer by surging	h			
I15.3	As Item I15.1 but by airlift pumping	nr			
I15.4	As Item I15.2 but by airlift pumping	h			
I15.5	As Item I15.1 but by over pumping	nr	8		
I15.6	As Item I15.2 but by overpumping	nr	8		
I15.7	As Item I15.1 but by jetting	nr			
I15.8	As Item I15.2 but by jetting	h			
I15.9	Disposal of development water, not including chemical testing	Provisional sum	1		
<u>Inclinometer</u>					
I16	Supply and install inclinometer tubing in exploratory hole, not including hole formation	m			
I17	Hire of inclinometer readout unit	day			
I18	Carry out base set of inclinometer readings per installation and installation report	h			
I19	Provide and install protective cover (flush)	nr			
I20	Provide and install protective cover (raised)	nr			
<u>Slip indicators</u>					
I21	Supply and install slip indicators in exploratory hole, including brass probe and not including hole formation	m			
I22	Provide and install protective cover (flush)	nr			
I23	Provide and install protective cover (raised)	nr			
<u>Contract specific additional bill items</u>					
Total Section I carried to summary					

J Installation Monitoring and Sampling

Number	Item Descriptions	Unit	Quantity	Rate	Amount (£)
<u>During fieldwork period</u>					
					-
J1	Reading of water level in standpipe or standpipe piezometer during fieldwork period	nr	incl		
J2	Ground gas measurement in gas monitoring standpipe during fieldwork period	nr			
J3	Set of inclinometer readings (as defined in Specification Clause 11.6.5 or Schedule S1.16.7) per installation during fieldwork period and report results	nr			
J4	Check for ground slippage in slip indicator installation during fieldwork period	nr			
J5	Water sample from standpipe or standpipe piezometer during fieldwork period, including purging or micro-purging up to 3.0 hours	nr			
J6	Extra over Item J5 for purging or micro-purging in excess of 3.0 hours	h			
J7	Ground gas sample from gas monitoring standpipe during fieldwork period	nr			
J8	Reading of free product level in standpipe using an interface probe during fieldwork period	nr			
<u>Post fieldwork period</u>					
					-
J9	Return visit to site following completion of fieldwork to take readings in, or recover samples from installations	nr	4		
J10	Extra over Item J9 for reading of water level in standpipe or standpipe piezometer during return visit	nr	Incl		
J11	Extra over Item J9 for ground gas measurement in ground gas monitoring standpipe during return visit (per round – all wells)	nr	4		
J12	Extra over Item J9 for set of inclinometer readings (as defined in Specification Clause 11.6.5 or Schedule S1.16.7) per installation during return visit to site	nr			
J13	Extra over Item J9 to check ground slippage in slip indicator installation during return visit to site	nr			
J14	Extra over Item J9 for water sample from standpipe or standpipe piezometer during return visit to site, including purging or micro-purging up to 3.0 hours (per round - all wells)	nr	1		
J15	Extra over Item J14 for purging or micro-purging in excess of 3.0 hours	h			
J16	Extra over Item J9 for ground gas sample for gas monitoring standpipe during return visit to site	nr			
J17	Extra over Item J9 for reading of free product level in standpipe using an interface probe during return visit to site (per round – all wells)	nr	4		
<u>Surface water body sampling and testing</u>					
					-
J18	Surface water body sample taken during fieldwork period	nr			
J19	Surface water body sample taken during return visit to site	nr			
J20	Determination of dissolved oxygen, conductivity, pH and temperature of surface water body during fieldwork period	nr			
J21	Determination of dissolved oxygen, conductivity, pH and temperature of surface water body during return visit to site	nr			
<u>Contract specific additional bill items</u>					
					-
Total Section J carried to summary					

K Geotechnical Laboratory Testing

Number	Item Descriptions	Unit	Quantity	Rate	Amount (£)
K1	<u>Classification</u>				
					-
K1.1	Moisture content	nr	30		
K1.2	Liquid limit, plastic limit and plasticity index	nr	15		
K1.3	Volumetric shrinkage	nr			
K1.4	Linear shrinkage	nr			
K1.5	Density by linear measurement	nr			
K1.6	Density by immersion in water or water displacement	nr			
K1.7	Dry density and saturation moisture content for chalk	nr			
K1.8	Particle density by gas jar or pycnometer	nr			
K1.9	Particle size distribution by wet sieving	nr	15		
K1.10	Particle size distribution by dry sieving	nr			
K1.11	Sedimentation by pipette	nr			
K1.12	Sedimentation by hydrometer	nr	15		
K2	<u>Chemical and electrochemical</u>				
					-
K2.1	Organic matter content	nr			
K2.2	Mass loss on ignition	nr			
K2.3	Sulphate content of acid extract from soil	nr			
K2.4	Sulphate content of water extract from soil	nr			
K2.5	Sulphate content of groundwater	nr			
K2.6	Carbonate content by rapid titration	nr			
K2.7	Carbonate content by gravimetric method	nr			
K2.8	Water soluble chloride content	nr			
K2.9	Acid soluble chloride content	nr			
K2.10	Total sulphur content	nr			
K2.11	Total dissolved solids	nr			
K2.12	pH value	nr			
K2.13	Resistivity	nr			
K2.14	Redox potential	nr			
K3	<u>Compaction related</u>				
					-
K3.1	Dry density/moisture content relationship using 2.5kg rammer	nr			
K3.2	Dry density/moisture content relationship using 4.5 kg rammer	nr			
K3.3	Dry density/moisture content relationship using vibrating rammer	nr			
K3.4	Extra over Items K3.1, K3.2 and K3.3 for use of CBR mould	nr			
K3.5	Maximum and minimum dry density for granular soils	nr			
K3.6	Moisture Condition Value at natural moisture content	nr			
K3.7	Moisture Condition Value/moisture content relationship	nr			
K3.8	Chalk crushing value	nr			
K3.9	California Bearing Ratio on re-compacted disturbed sample	nr			
K3.10	Extra over Item K3.9 for soaking	nr			

Number	Item Descriptions	Unit	Quantity	Rate	
K4	<u>Compressibility, permeability and durability</u>				
K4.1	One-dimensional consolidation properties, test period 5 days	nr	r/o		
K4.2	Extra over Item K4.1 for test period in excess of 5 days	day	r/o		
K4.3	Measurement of swelling pressure, test period 2 days	nr			
K4.4	Measurement of swelling, test period 2 days	nr			
K4.5	Measurement of settlement on saturation, test period 1 day	nr			
K4.6	Extra over Items K4.3 to K4.5, for test period in excess of 2 or 1 days (s)	nr			
K4.7	Permeability by constant head method	nr			
K4.8	Dispersibility by pinhole method	nr			
K4.9	Dispersibility by crumb method	nr			
K4.10	Dispersibility by dispersion method	nr			
K4.11	Frost heave of soil	nr			
K5	<u>Consolidation and permeability in hydraulic cells</u>				
K5.1	Consolidation properties of a 76mm diameter specimen using a hydraulic cell, test period 4 days	nr			
K5.2	As Item K5.1 but using a 100mm diameter specimen	nr	r/o		
K5.3	As Item K5.1 but using a 150mm diameter specimen	nr			
K5.4	As Item K5.1 but using a 250mm diameter specimen	nr			
K5.5	Extra over Items K5.1 to K5.4 for test period in excess of 4 days	day	r/o		
K5.6	Permeability of a 76mm diameter specimen in hydraulic consolidation cell	nr			
K5.7	As Item K5.6 but using a 100m diameter specimen	nr			
K5.8	As Item K5.6 but using a 150m diameter specimen	nr			
K5.9	As Item K5.6 but using a 250m diameter specimen	nr			
K5.10	Extra over Items K5.6 to K5.9 for test period in excess of 4 days	nr			
K5.11	Isotropic consolidation properties in a triaxial cell, test period 4 days	nr			
K5.12	Extra over Item 5.11 for test periods in excess of 4 days	day			
K5.13	Permeability in a triaxial cell, test period 4 days	nr			
K5.14	Extra over Item K5.13 for test period in excess of 4 days	day			
K6	<u>Shear strength (total stress)</u>				
K6.1	Shear strength by the laboratory vane method (set of 3)	nr			
K6.2	Shear strength by hand vane (set of 3)	nr			
K6.3	Shear strength by hand penetrometer (set of 3)	nr			
K6.4	Shear strength of a set of three 60mm x 60mm square specimens by direct shear, test duration not exceeding 1 day per specimen	nr			
K6.5	Extra over Item K6.4 for test durations in excess of 1 day per specimen	sp.day			
K6.6	Shear strength of a single 300mm x 300m square specimen by direct shear, test duration not exceeding 1 day	nr			
K6.7	Extra over Item K6.6 for test durations in excess of 1 day	day			
K6.8	Residual shear strength of a set of three 60mm x 60mm square specimens by direct shear, test duration not exceeding 4 days per specimen	nr			
K6.9	Extra over Item K6.8 for test durations in excess of 4 days per specimen	sp.day			

Number	Item Descriptions	Unit	Quantity	Rate	
K6.10	Residual shear strength of a 300mm square specimen by direct shear, test duration not exceeding 4 days	nr			
K6.11	Extra over Item K6.10 for test duration in excess of 4 days	day			
K6.12	Residual shear strength using a small ring shear apparatus at three normal pressures, test duration not exceeding 4 days	nr			
K6.13	Extra over Item K6.12 for test duration in excess of 4 days	day			
K6.14	Unconfined compressive strength of 38mm diameter specimen	nr			
K6.15	Undrained shear strength of a set of three 38mm diameter specimens in triaxial compression without the measurement of pore pressure	nr			
K6.16	Undrained strength of a single 100mm diameter specimen in triaxial compression without the measurement of pore pressure (with stress/strain curves on laboratory certificates)	nr	15		
K6.17	Undrained shear strength of single 100mm diameter specimen in triaxial compression with multi-stage loading and without measurement of pore pressure	nr			
K7	<u>Shear strength (effective stress)</u>				-
K7.1	Consolidated undrained triaxial compression test with measurement of pore pressure (set of three 38mm specimens) test duration not exceeding 4 days per specimen	nr			
K7.2	As Item K7.1 but single-stage or multi-stage test using 100mm diameter specimen	nr	r/o		
K7.3	Consolidated drained triaxial compression test with measurement of volume change (set of three 38mm specimens), test duration not exceeding 4 days per specimen	nr			
K7.4	As Item K7.3 but single-stage or multi-stage test using 100 mm diameter specimen, test duration not exceeding 4 days	nr			
K7.5	Extra over Items K7.1 and K7.3 for test duration in excess of 4 days	sp.day			
K7.6	Extra over Items K7.2 and K7.4 for test duration in excess of 4 days	day	r/o		
K8	<u>Rock testing</u>				-
K8.1	Natural water content of rock sample	nr			
K8.2	Porosity/density using saturation and calliper techniques	nr			
K8.3	Porosity/density using saturation and buoyancy	nr			
K8.4	Slake durability index	nr			
K8.5	Soundness by magnesium sulphate	nr			
K8.6	Magnesium sulphate test	nr			
K8.7	Shore scleroscope	nr			
K8.8	Schmidt rebound hardness	nr			
K8.9	Resistance to fragmentation	nr			
K8.10	Aggregate abrasion value	nr			
K8.11	Polished stone value	nr			
K8.12	Aggregate frost heave	nr			
K8.13	Resistance to freezing and thawing	nr			
K8.14	Uniaxial compressive strength	nr			
K8.15	Deformability in uniaxial compression	nr			
K8.16	Indirect tensile strength by Brazilian test	nr			
K8.17	Undrained triaxial compression without measurements of porewater pressure	nr			

Number	Item Descriptions	Unit	Quantity	Rate	
K8.18	Undrained triaxial compression with measurement of porewater pressure	nr			
K8.19	Direct shear strength of a single specimen	nr			
K8.20	Swelling pressure test	nr			
K8.21	Measurement of point load strength index of rock specimen (set of ten individual determinations)	nr			
K8.22	Single measurement of point load strength on irregular rock lump or core sample (either axial or diametral test)	nr			
K9	<u>Ground/groundwater aggressivity</u>				-
K9.1	Suite A (Greenfield site - pyrite absent Schedule 1.19.6)	nr			
K9.2	Suite B (Greenfield site - pyrite present Schedule 1.19.6)	nr			
K9.3	Suite C (Brownfield site - pyrite absent Schedule 1.19.6)	nr			
K9.4	Suite D (Brownfield site - pyrite present Schedule 1.19.6)	nr	15		
	<u>Contract specific additional bill items</u>				-
Total Section K carried to summary					

L Geo-environmental Laboratory Testing

Number	Item Descriptions	Unit	Quantity	Rate	Amount (£)
L1	<u>Contamination testing</u>				-
L1.1	Suite E (Soil samples Schedule S1.20.3)	nr	20		
L1.2	Suite F (Water samples Schedule S1.20.3)	nr	8		
L1.3	Suite G (Gas samples Schedule S1.20.3)	nr			
L2	<u>Waste acceptance criteria testing</u>				-
L2.1	Suite H (Inert waste landfill Schedule S1.20.5)	nr			
L2.2	Suite I (Stable, non-reactive hazardous waste in non hazardous waste landfill Schedule S1.20.5)	nr			
L2.3	Suite J (Hazardous waste landfill Schedule S1.20.5)	nr			
L2.4	Comprehensive Waste Acceptance Criteria Testing	nr	3		
	<u>Contract specific additional bill items</u>				-
L3	Chemical testing – Soils				
L3.1	Asbestos screen (presence and ID)	nr	12		
L3.2	Asbestos quantification ACM & Fibre bundles (lower limit of quantification <0.001% wt/wt)	nr	5		
L3.3	Speciated Semi-Volatile Organic Compounds (SVOCs) + TICs (LoD <0.1 mg/kg)	nr	8		
L3.4	Speciated Volatile Organic Compounds (VOCs) + TICs (LoD <0.01 mg/kg)	nr	8		
L3.5	Polychlorinated Biphenyls (PCBs) – EC7+WHO12 (speciated)	nr	R/O		
L3.6	Formaldehyde	nr	12		
L4	Chemical testing – Water				
L4.2	Speciated Semi-Volatile Organic Compounds (SVOCs) + TICs (LoD <1 µg/l)	nr	5		
L4.3	Speciated Volatile Organic Compounds (VOCs) + TICs (LoD <1 µg/l)	nr	5		
L4.4	Formaldehyde	nr	8		
L5	Chemical Testing - Soil Leachate				
L5.1	Soil leachate preparation (BS EN 12457 10:1)	nr	R/O		
L5.2	Suite F	nr	R/O		
Total Section L carried to summary					

Summary of Bill of Quantities

Section	Title	Amount (£)
A	General items, provisional services and additional items	
B	Percussion boring	
C	Rotary drilling	
D	Pitting and trenching	
E	Sampling and monitoring	
F	Probing and cone penetration testing	
G	Geophysical testing	
H	In situ testing	
I	Instrumentation	
J	Installation monitoring and sampling	
K	Geotechnical laboratory testing	
L	Geoenvironmental laboratory testing	
Total tender		

FIGURES

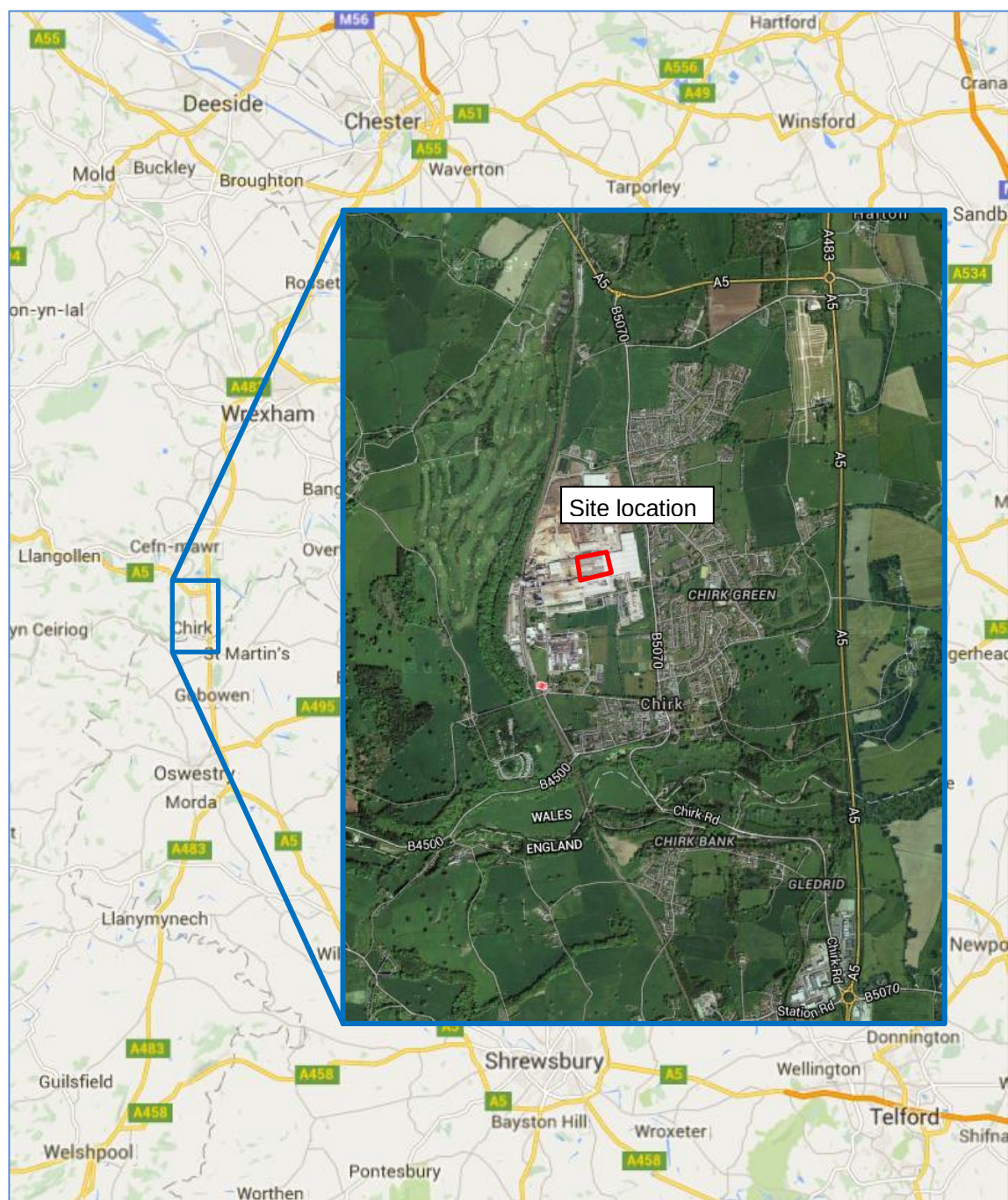


Figure 1 Site Location Plan (Google Maps, accessed by James Wherrett on 16/05/2017, <https://www.google.co.uk/maps>)

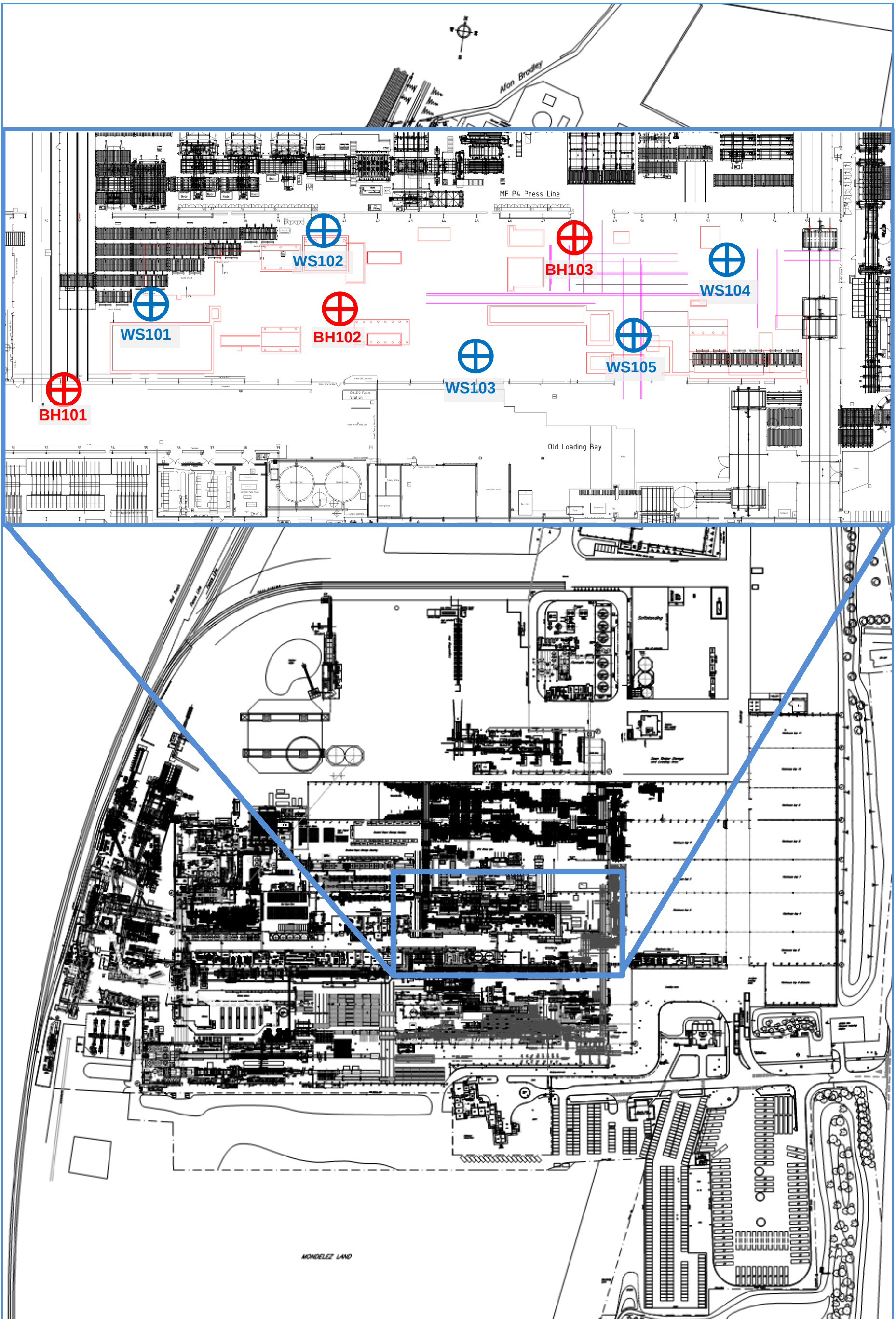


Figure 2 Proposed Exploratory Hole Location Plan – actual locations to be agreed prior to start of the ground investigation between the GI contractor, Kronospan and RUK.

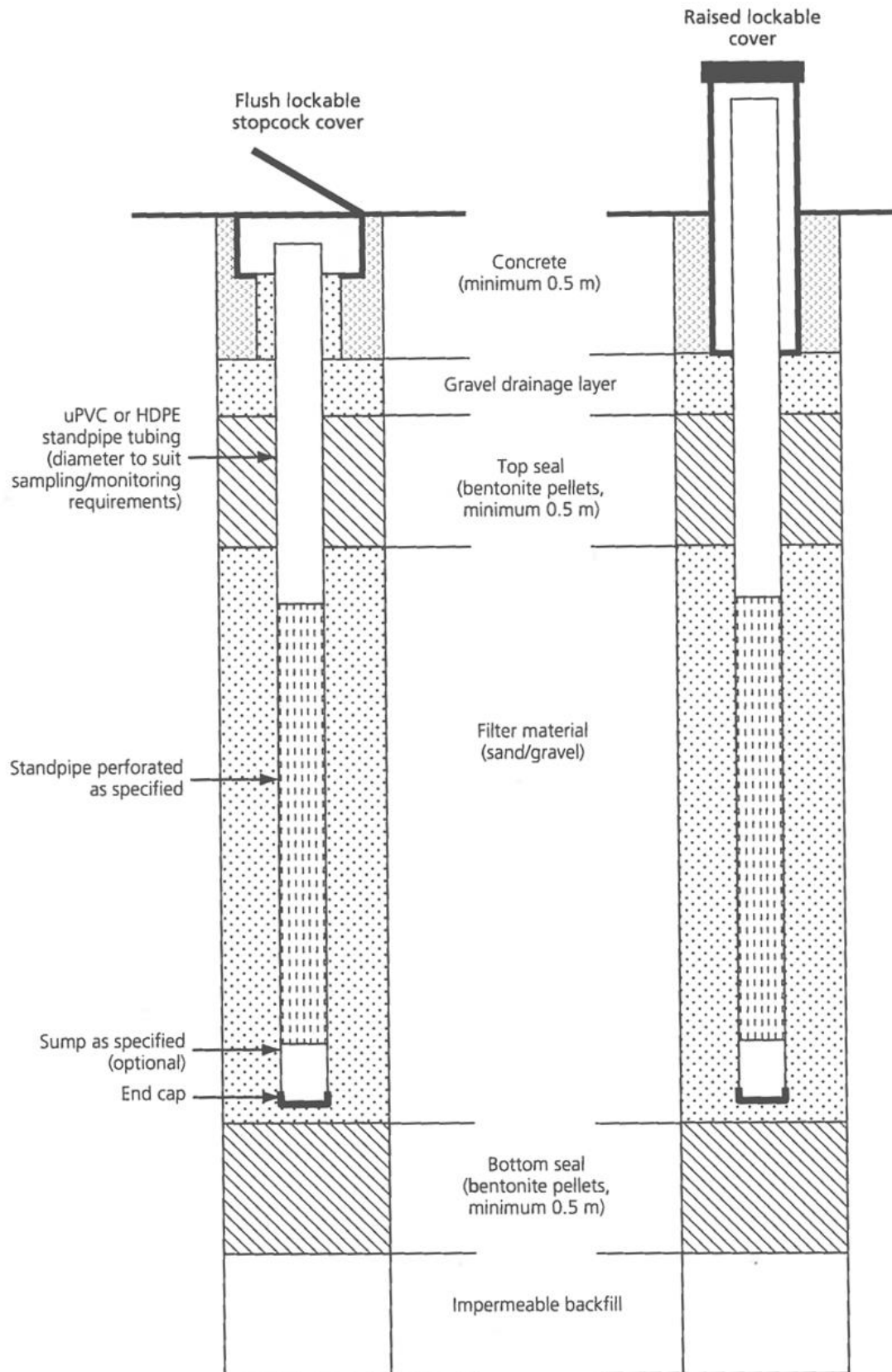


Figure 3: Schematic Drawing of a Standpipe Installation

(Drawing A1.1 of UK Specification for Ground Investigation)

APPENDICES

Appendix A**RATES FOR GROUND PRACTITIONERS AND OTHER
PERSONNEL**

Rates shall be entered for the various grades of staff listed, who will be employed by agreement with the Investigation Supervisor to provide advice or assistance during the course of the investigation and/or the preparation of the Ground Investigation Report and/or Geotechnical Design Report all in accordance with Specification Clauses 3.6.1 and 3.6.2 and Schedule S1.8.3

These services exclude the contract management, superintendence and technical direction require under the Conditions of Contract and the requirements of Specification Clauses 3.5.1 which are to be included in the general rates and prices of the main Bill of Quantities (see Cause 1 of the Preamble to the Bill of Quantities).

Item	Item description	Unit	Rate
1	Technician	h	
2	Graduate ground engineer	h	
3	Experienced ground engineer	h	
4	Registered Ground Engineering Professional	h	
5	Registered Ground Engineering Specialist	h	
6	Registered Ground Engineering Advisor	h	
7	Expenses incurred by staff n site visits or who are resident by agreement with the Investigation Supervisor	day	
8	Fare per kilometer ¹ from Contractor's premises and return for Items 1, 2 and 3	km ¹	
9	As above, but for Items 4, 5 and 6	km ¹	
10	All other expenses incurred in conjunction with a site visit where a return journey is made on the same day for Items 1, 2 and 3	visit	
11	As above, but for Items 4, 5 and 6	visit	
12	All other expenses incurred in connection with visit where and overnight stay is necessary for Items 1, 2 and 3	overnight	
13	As above, but for Items 4, 5 and 6	overnight	

1. Where considered appropriate, 'mile' may be used.

Estimate of costs under Appendix A to the Bill of Quantities where the provision of the Contractor's staff for work in accordance with Specification Causes 3.5.2, 3.6.1 and 3.6.2 cannot be adequately specified at tender **(to be assessed by the Investigation Supervisor)**:

£

Appendix B LONG-TERM SAMPLE STORAGE

Rates shall be entered for:

Item	Item description	Unit	Rate/month
Geotechnical Samples			
1	Dynamic (windowless) samples	nr	NA
2	Rotary drilling core in core box	nr	NA
3	Rotary drilling core sub-samples	nr	NA
4	Bulk samples	nr	
5	Large bulk samples	nr	
6	Open-tube samples (thick-walled sampler)	nr	NA
7	Open-tube samples (thin-walled sampler)	nr	
8	Disturbed samples	nr	
9	Groundwater samples	nr	NA
10	Delft samples	nr	NA
11	Mostap samples	nr	NA
12	Piston samples	nr	NA
Contamination Samples			
13	Soil samples in plastic tubs	nr	NA
14	Soil samples in glass containers	nr	NA
15	Groundwater samples	nr	NA
16	Gas samples	nr	NA

Where samples comprise more than one container, the rate entered shall be per container.

Estimates of costs under Appendix B to the Bill of Quantities for long term storage of samples where required in Schedules S1.12.2 and S1.12.10 **(to be assessed by Investigation Supervisor)**:

£

Appendix C CHEMICAL TEST REQUIREMENTS

SCHEDULE 1.19.6 (Derived from BRE Special Digest SD1)**CHEMICAL TESTS ON POTENTIALLY AGGRESSIVE GROUND/GROUNDWATER****SUITE A: Greenfield Site (pyrite absent)**

Sample Type	Determinand	Recommended Test Method	Test Method Specified/Offered ¹
Soil	pH in 2.5:1 water/soil extract	BR 279 Elecrometric	
		BS 1377 Part 3, Method 9	
	SO ₄ in 2:1 Water/soil extract	BR 279 Gravimetric method, cation exchange or iron chromatography	
		BS 1377 Part 3, Method 5.3+5.5	
		TRL 447 Test 1	
Groundwater	pH	BR 279 Elecrometric	
		BS 1377 Part 3, Method 9	
	SO ₄	BR 279 Gravimetric method, cation exchange or iron chromatography	
		BS 1377 Part 3, Method 5.4+5.5	
		Commercial lab in-house procedure: determination of sulphur by ICP-AES ²	

1. Contractor to detail method(s) offered.

2. ICP-AES: Inductively Coupled Plasma Atomic Emission Spectroscopy

SCHEDULE 1.19.6 (Derived from BRE Special Digest SD1)**CHEMICAL TESTS ON POTENTIALLY AGGRESSIVE GROUND/GROUNDWATER**

SUITE D: Brownfield Site (pyrite present)			
Sample Type	Determinand	Recommended Test Method	Test Method Specified/Offered ¹
Soil	pH in 2.5:1 water/soil extract	BR 279 Elecrometric	
		BS 1377 Part 3, Method 9	
	SO ₄ in 2:1 water/soil extract	BR 279 Gravimetric method, cation exchange or iron chromatography	
		BS 1377 Part 3, Method 5.3+5.5	
		TRL 447 Test 1	
	Acid Soluble SO ₄	BR 279 Gravimetric method	
		BS 1377 Part 3, Method 5.2+5.5	
		TRL 447 Test 2	
	Total Sulphur	BR 279 Ignition in Oxygen	
		TRL 447 Test 4A	
		TRL 447 Test 4B	
	Mg (only required if water soluble SO ₄ >3000mg/l)	BR 279 AAS ² method	
		Commercial lab in-house procedure: variant of BR279 using ICP-AES ³	
Groundwater	NO ₃ in 2:1 water/soil extract (only required if pH>5.5)	BR 279	
	Cl in 2:1 water/soil extract (only required if pH>5.5)	BR 279	
		BS 1377 Part 3, Method 7.2	
	pH	BR 279 Elecrometric	
		BS 1377 Part 3, Method 9	
	SO ₄	BR 279 Gravimetric method, cation exchange or iron chromatography	
		BS 1377 Part 3, Method 5.4+5.5	
		Commercial lab in-house procedure: determination of sulphur by ICP-AES ³	
	Mg (only required if water soluble SO ₄ ≥3000mg/l)	BR 279 AAS ² method	
		Commercial lab in-house procedure: Mg in solution using ICP-AES	
	NO ₃ (only required if pH>5.5)	BR 279	
	Cl (only required if pH>5.5)	BR 279	
		BS 1377 Part 3, Method 7.2	

1. Either Project Manager to specify or Contractor to detail method(s) offered.

2. AAS: Atomic Absorption Spectrometry

3. ICP-AES: Inductively Coupled Plasma Atomic Emission Spectroscopy

SCHEDULE 1.20.3**CHEMICAL LABORATORY TESTING FOR CONTAMINATION****Nominated test laboratory?** Element (Deeside)**Required testing turn-around times?** 10 days maximum**SUITE E: Soil Samples**

Determinand	Required Lower Limit of Detection	Test Method (if specific method required)	Accreditation Required
Arsenic			
Antimony			
Barium			
Boron			
Cadmium			
Chromium VI			
Chromium III			
Copper			
Lead			
Mercury			
Nickel			
Zinc			
Selenium			
Vanadium			
pH			
Water Soluble Sulphate			
Total Organic Carbon			
USEPA Speciated 16 Polyaromatic Hydrocarbons (PAHs)			
Petroleum Hydrocarbons – speciated TPHCWG			

SCHEDULE 1.20.3**CHEMICAL LABORATORY TESTING FOR CONTAMINATION****Nominated test laboratory?** Element (Deeside)**Required testing turn-around times?** 10 days maximum**SUITE F: Water Samples**

Determinand	Required Lower Limit of Detection	Test Method (if specific method required)	Accreditation Required
Arsenic			
Antimony			
Barium			
Boron			
Cadmium			
Chromium III			
Chromium VI			
Copper			
Lead			
Mercury			
Nickel			
Zinc			
Selenium			
Vanadium			
pH			
Total Organic Carbon			
USEPA Speciated 16 PAHs			
Petroleum Hydrocarbons – speciated TPHCWG			
Ammoniacal Nitrogen (as N)			
Electrical Conductivity			
Hardness			
Sulphate			

Appendix D DESIGNERS RISK ASSESSMENT

Risk Assessment (Residual risks outside the standard risks identified by a competent GI Contractor)

Activity / Element		Design Item Giving Rise to Risk ²	Consequence of Item Giving Rise to Risk	Risk Estimation ³ (Residual Evaluation ⁶)				Design Action to Mitigate/Reduce Risk	Residual Risks - risks that cannot be designed out or those remaining following risk assessment	Action By	Status
				Probability Rating	Severity Rating	Significant Risk (>3)	Control / Influence ⁵				
Item N ^o	Cat ¹			a ⁴	b ⁴	a x b					
1	C/P	Operational factory. The site is very busy with machinery and personnel moving around.	Delays to works schedule to access areas of the site. Personnel hit by equipment.	2 (1)	2 (2)	4 (2)	I	Designer to review the GI contractor RAMS prior to work starting at site to check all risks have been considered and mitigated.	Actual works area is unsafe and borehole cannot be advanced.	NA	Open
2	C/P	Underground and overhead services.	Injury to personnel. Delays to programme. Damage to the CP rig.	2 (1)	2 (2)	4 (2)	I	Designer to review the GI contractor RAMS prior to work starting at site to check proposed location of boreholes against known services Specify in the Spec that services search required at site prior to starting work.	Services not identified during or before works are encountered and damaged.	NA	Open
3	P	Boreholes refused on cobbles / gravels.	Cannot assess founding stratum.	2 (1)	1 (1)	2 (1)	C	Adopted Cable percussion borehole which is considered most likely to penetrate stratum.	Borehole refuses on gravel / cobble layer.	NA	Open

1 (C) CDM / (P) Project / (E) Environmental

2 Hazard consideration - harm to human health, construction, cost, project developments, breach of legislation/regulations or the natural environment

3 Option - No numerical risk estimation is required for CDM risks
4 Scoring (3) High / (2) Med / (1) Low

5 (Ramboll) Ramboll control / (I) Ramboll Influence

6 Subject to implementation of Ramboll management action

7 Live/Close