

SLADEN ASSOCIATES

**Specification for Treatment of
Shallow Mineworkings
Proposed New Industrial Unit
Brookhouses Industrial Estate
Cheadle
Staffordshire**

Prepared for

Vulcan Refractories Ltd

March 2023

Job No: 22 2521-2

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1.0 GENERAL SPECIFICATION

1.1 GENERAL DESCRIPTION OF THE WORKS

All Permanent and Temporary Works in connection with the stabilisation of underground mine workings and suspected mine shafts at the site.

1.2 METHOD STATEMENT

At the commencement of the Contract, the Contractor should provide a detailed method statement. This should include a programme giving full details of both type and quantity of all the plant he proposes to use, the order of carrying out the work, the detailed and dimensioned layout of the works, site specific risk assessment and any further information required in the various subsections below.

1.3 GENERAL REQUIREMENTS

1.3.1 BRITISH STANDARD SPECIFICATIONS

All materials and workmanship should be in general accordance with the appropriate British Standards current at the time of tender, including those listed in this Specification, except that where the requirements of British Standards are in conflict with this Specification, the latter should take precedence.

1.3.2 DEFINITIONS

In this Specification the terms 'approved', 'approval' and 'required' mean 'approved by the Engineer', 'approval of the Engineer' and 'required by the Engineer' respectively. The Engineer will mean Sladen Associates, or other appointed by the Client.

1.3.3 PROGRESS REPORT

The Contractor should submit to the Engineer on the first day of each week, or at such longer periods as the Engineer may from time to time direct, a progress report showing the current rate of progress and progress during the previous period on all important items of each section of the Works.

1.3.4 RESPONSIBILITY FOR THE EXECUTION AND PERFORMANCE

The design, execution and performance of the ground treatment shall be the responsibility of the Contractor who should, nonetheless, satisfy the Engineer that all treated ground has attained the required degree of improvement.

1.3.5 PERSONNEL AND RELEVANT EXPERIENCE

Prior to commencement of the Works, the Contractor should provide a list of key personnel he proposes to employ for each phase of the works, together with a resume of their experience and qualification. The list of key personnel should include the name of the full-time Contractors Agent.

1.3.6 MATERIALS

Sources of supply

The sources of supply of materials should be approved by the Engineer and should not be changed without prior approval of the Engineer in writing.

Goods and materials used in the execution of this Contract should, where possible, have been produced in the United Kingdom, the British Commonwealth or the European Union. Where a specification issued by the British Standards Institute is current at the date of the

tender and is appropriate, goods and materials used in the execution of this Contract should be in accordance with the specification.

Rejected materials

Rejected Material should be removed promptly from the Site.

1.3.7 SUITABILITY OF EQUIPMENT

The Contractor should satisfy the Engineer regarding the suitability, efficiency and adequacy of the equipment to be employed. The Contractor should state the type and number of rigs he intends to use.

1.3.8 SETTING OUT

The Contractor shall be responsible for all setting out on the site, including all borehole positions. The Contractor shall be responsible for providing adequate protection of any survey points.

The Contractor should provide and maintain bench marks throughout the duration of the Works.

Following completion of the Works, the Contractor shall provide to the Engineer a drawing showing the positions of all boreholes and any other works. The drawing shall be related to the National Ordnance Survey Grid Coordinates and to Ordnance Datum.

1.3.9 TOLERANCES

All treatment points should be located to the tolerances given in the Specification.

1.3.10 PROGRAMME

The Contractor should inform the Engineer at regular mutually agreed intervals of the forward programme of ground works.

1.3.11 SERVICES

The Contractor shall be responsible for ensuring that no damage is caused to service installations. If during the execution of the work damage is, or is likely to be, caused to mains, services or adjacent structures, the Contractor should inform the Engineer of his proposals for avoidance or repair of such damage. The Contractor should arrange the sequence and timing of the Works to ensure that damage does not occur to treated ground by any subsequent work.

1.3.12 SITE FACILITIES

Proper sanitary accommodation and washing facilities with an efficient water supply should be provided and the Contractor should make all necessary arrangements, for the use of the land required.

1.3.13 SITE CLEANLINESS AND MAKING GOOD WORKING AREAS

The Contractor should confine his operations to the minimum area of ground required for proper execution of the works and access thereto.

1.3.14 SITE ELECTRICITY SUPPLY

The Contractor should provide a suitable electricity supply to suit his requirements.

1.3.15 SITE WATER SUPPLY

The Contractor should be responsible for locating a suitable water supply and for providing and paying for all temporary plumbing and connection of the water supply to site. Where a suitable water supply is not available in the locality, the Contractor should make arrangements for carrying and storing water in quantities as necessary for the Works. All costs incurred in this respect shall be borne by the Contractor. The Contractor is responsible for its sensible use and for the care and the maintenance of his pipework from the supply point.

1.3.16 CONTROL OF NUISANCE

General

The Contractor should during the course of the Contract take every precaution to prevent nuisance in the form of noise, dust and water from occurring. In organising the operations to be carried out within the site, the Contractor should take into consideration the nuisance effect of his proposals and employ means to reduce such effects as necessary.

Dust and Water

All stored materials, such as pulverised fuel ash, etc., should be sheeted or treated such that no nuisance is caused by wind borne dust as a result of this operation. In this regard it may be necessary to erect dust tents for the storage of materials.

Noise Control

The Contractor should employ the best means to minimise noise and vibration produced by his operations and should have regard to the recommendations in BS 5228, Noise Control on Construction and Demolition sites - see Appendix A. The Contractor should comply in particular with the following requirements: -

- i) All vehicles and mechanical plant used for the purpose of the Works should be fitted with effective exhaust silencers and should be maintained in good efficient working order.
- ii) All compressors should be 'sound reduced' models fitted with properly lined sealed acoustic covers which should be kept closed whenever the machines are in use, and all ancillary pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers.
- iii) Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum.
- iv) All items of stationary plant, e.g. generators, pumps, etc., should be housed in acoustic enclosures when in operation.

The Contractor should ensure that all steps are taken to limit noise to a level compatible with the particular environment.

1.3.17 HIGHWAYS TO BE KEPT CLEAN

No debris or material resulting from the works should be allowed to fall onto any public highway.

1.3.18 LIGHTING

Where works are permitted in hours of darkness all adequate flood lighting at working locations should be provided for the execution of the works.

1.3.19 SITE SECURITY

The Contractor should provide adequate site security to protect plant, equipment and offices during the hours of working and non-working.

1.3.20 WATER SPRAY

The Contractor should take all precautions and measures by way of screening and/or suppression to minimise the amount of water spray in all areas on the site. In particular this should be applicable to drilling works adjacent to any work being carried out by other Contractors and in areas adjacent to or within road or railway networks.

1.3.21 WATER AND SLURRIES

The Contractor shall be responsible for all waters and slurries produced and used on site while conducting his drilling and grouting operations. The Contractor will also be responsible for the safe and controlled discharge of all waters and slurries produced on site. It is however unlikely that permission to discharge into existing sewer systems will be given and the Contractor should find alternative methods of disposal.

1.3.22 SITE CLEARANCE

On completion of the treatment to the satisfaction of the Engineer, the Contractor should remove from the site all plant and unwanted material.

1.4 SITE CONTROL AND SAFETY

1.4.1 COSHH AND TRANSFER OF WASTE

The Contractor should carry out comprehensive environmental controls during the works. The Contractor should submit to the Engineer, such environmental information pertaining to the methods of construction. The Contractor is reminded that he is required to provide his own COSHH assessment tailored to his purpose and method of working.

1.4.2 GENERAL

It should be assumed that all materials encountered in boreholes and trial excavations at the site are potentially contaminated, hence workers should operate with care at all times. Workers may be affected by contaminants via skin contact, ingestion of contaminated material and the inhalation of gasses such as hydrogen sulphide and hydrogen cyanide. All site personnel and visitors should be made aware of the contamination hazards and health and safety procedures involved to ensure safe operation.

1.4.3 SAFETY POLICY

The Contractor should provide written details of his safety policy and procedures to be adopted on site prior to the commencement of site works. The procedures should comply with all prevailing legislation and in any case must include the following as a minimum:

- (a) Suitable protective clothing should be worn at all times. As a minimum this should include overalls, boots, gloves and safety helmets. Dust masks and suitable eye protection should be available on site at all times for use as required.
- (b) The Contractor should provide and maintain on site for the duration of the works, a satisfactory first aid kit to include an eye bath and a supply of clean water.
- (c) The Contractor should provide and maintain adequate washing and toilet facilities to the satisfaction of the Engineer.
- (d) The Contractor should ensure that all activities involving hand/mouth contact such as eating and smoking are restricted to designated areas where hygiene facilities are provided.
- (e) Should conditions dictate, the Contractor should provide equipment to minimise the production of dust by the wetting of access roads and excavated materials.

1.4.4 LEGISLATION

The Contractor shall allow for all necessary measures and precautions. The legislation to be complied with should include the following non exhaustive guide, any subsequent amendments and any other applicable legislation:

- 1. The Health and Safety at Work Act, etc., 1974.
- 2. The Control of Substances Hazardous to Health Regulations 2002.
- 3. Noise and Statutory Nuisance Act 1993.
- 4. The Control of Noise at Work Regulations 2005.
- 5. Environmental Act 1995.
- 6. Environmental Protection Act 1990.
- 7. Factories Act 1961 Section 127 and other subsequent Health and Safety Regulations.
- 8. Mines and Quarries Act 1954.

1.4.5 DUST

Dust prevention techniques should be such that no apparent dust cloud is maintained for significant periods of time.

Work practices should, therefore, be designed to keep dust production to a level that is as low as is reasonably achievable. When unpredictable levels are inadvertently produced, site workers should be provided with readily available filter masks and eye protection for use during such periods.

1.4.6 WELFARE AND HYGIENE

i) All site personnel should be provided with adequate protective clothing to include the following non-exclusive list:

- Suitable overalls
- Safety Wellington/Boots
- Hard Hat
- Suitable Gloves

ii) Washing facilities should be provided.

iii) Operators should observe safety policy and strict hygiene procedures.

iv) First aid equipment should be provided in accordance with the requirement for the general construction regulation.

v) A telephone or approved radio link should be available in order that emergency services can be contacted.

vi) The Contractor should provide details of emergency procedures. Emergency services should be informed of site operations prior to commencement.

1.4.7 DOCUMENTATION

All site operations should be monitored and a record kept.

1.4.8 INFORMATION, INSTRUCTION, TRAINING AND SUPERVISION

All site personnel should be fully briefed verbally on the hazards associated with the material to be handled, method of work, first aid and emergency procedures, welfare and hygiene, monitoring, control measures in place and general site protocol. The Contractor should ensure that the above is documented and confirmed in writing to the Engineer.

Further verbal or written instructions should be issued as appropriate and records of these should be kept. The Contractor should provide evidence that he has sufficient management systems in place to ensure the workforce comply with a safe system of work.

1.4.9 MONITORING OF GASES

The Contractor should arrange for the monitoring of Methane, Carbon Dioxide, Carbon Monoxide, Hydrogen Sulphide and Oxygen that may be present in boreholes or excavations. Until such time that a borehole can be deemed to be safe from such gas naked lights should not be permitted within 10m of any boreholes. All gas testing and subsequent standing time associated with this shall be deemed to be included within the drilling rates submitted. When odours are perceived or identified all drilling or excavation should cease in the locality until adequate testing has been carried out and it is confirmed by the testing that it is safe to continue.

1.4.10 GENERAL SITE PROTOCOL

i) A documented procedure should exist to ensure that the Contractor's agent and the Engineer are informed of any unknown materials which are encountered during the works.

ii) The site should be secured to restrict access, as far as it is reasonably practicable, at the end of each working day.

iii) No eating, drinking or smoking should be allowed anywhere on site apart from in the designated areas.

1.4.11 DRILLING OPERATIONS

Drilling rig stability and operative safety should have specific consideration. The Contractor should satisfy himself that the arrangements for general drilling will be effective and offer a high degree of safety to the personnel.

1.4.12 DRILLING IN THE VICINITY OF BURIED CABLES, GAS MAINS, PIPES AND SEWERS ETC.

No drilling should be undertaken at any position until:

- (a) The appropriate statutory bodies have delineated the position of such buried cables, gas mains etc. and the Contractor has satisfied himself of their position.
- (b) Where there is no accurate information available with regard to such utilities the best possible means should be adopted to located them. In such circumstances no borehole should be situated closer than 5 metres to the conjectured position of the utility.
- (c) Any means of delineation should be such that mischievous or wilful alteration can either not be made or such alteration will be obvious to the Contractor.
- (d) Where delineation is dependant upon surveyors or similar markers, a competent surveyor should confirm any delineation made.

1.4.13 VISITORS

All visitors should report to a reception at the site offices and be provided with appropriate site protection and site supervision during any visit to the work place.

2.0 MINE STABILISATION WORKS

2.1 GENERAL REQUIREMENTS FOR MINE STABILISATION WORKS

2.1.1 DESCRIPTION

The works include the design and construction of measures to stabilise abandoned coal mine workings beneath proposed structures on the site. The area requiring treatment is shown on the proposed Borehole Layout Plan for Mine Stabilisation Works, drawing SA-23-2521-2. The mine stabilisation works should be carried out by means of grout injection through boreholes drilled into the abandoned mine workings zone. Depth of boreholes will be as agreed with the Engineer. It is anticipated that the boreholes will be drilled to a maximum depth of 15 m below the existing ground level, decreasing in depth to the east. It is proposed to drill and treat a total of 88 primary and centre boreholes. If grout take in any of these primary or centre boreholes exceeds 5 T, then additional tertiary boreholes should be drilled and treated.

2.1.2 METHOD STATEMENT

At the commencement of the Contract, the Contractor should provide a detailed method statement. This should include full details of his proposed plant and equipment utilisation along with his general methodology with regard to the following specific operations and restrictions:

- 1) Drilling methodology including methods to maintain an open borehole and overcoming problems that may be encountered by interconnection of boreholes and broken ground associated with void migration.
- 2) Number, phasing and type of drill rigs.
- 3) Drilling flush.
- 4) Grouting methodology including techniques to be adopted to maintain open boreholes, insertion of grout tremie pipes and methods of overcoming underground water pressures.
- 5) Avoidance and protection of services.
- 6) Avoidance and protection of public.
- 7) Site security.
- 8) Grout plant requirements and set up areas.
- 9) Methodology for control and storage of materials on site and the capacity of grout mixing and injection plant.

2.2 LAYOUT OF BOREHOLES

The grout stabilisation is required below all structures and should extent to at least 3m beyond the plan footprint of all structures.

The proposed layout of boreholes, on a basic 6 m grid with centre holes, is indicated on the borehole layout plan.

Where non vertical boreholes need to be used because of surface access restrictions etc. the locations shown on the layout drawing should be the hole location at the base of the target seam.

2.3 NAKED LIGHTS

The following safety precautions should apply when drilling.

- (i) Naked lights or smoking should not be permitted within 15 metres of any borehole unless it is full to the top with mud, water or grout.

- (ii) If the hole is to be cased, screw jointed pipes should be used.
- (iii) The Contractor should maintain on site apparatus for checking the presence of methane in the atmosphere and should record any emissions of gas from boreholes.

2.4 DRILLING AND PRESSURE GROUTING PROCEDURE

2.4.1 METHOD OF DRILLING

Boreholes drilled for the purpose of pressure grouting should be drilled by rotary or rotary-percussive techniques employing water flush only. All boreholes should be drilled to a line within 5 degrees of the design line and the Contractor should provide means of demonstrating that the required borehole line has been achieved.

2.4.2 DIAMETER OF BOREHOLE

The minimum diameter of borings should be 50 mm for grout infill and 75 mm for curtain wall boreholes. Where an exploratory hole is to be of such depth that boring to the full depth at the minimum diameter is likely to be impossible, or where obstructions are expected the Contractor should begin boring at such greater diameter as he may choose.

2.4.3 CASING TO ROCKHEAD

When each borehole has been drilled to rockhead, drilling should not continue further until a metal casing of appropriate diameter has been securely placed into the rockhead to prevent the loss of grout into the materials above rockhead during subsequent grouting operations and to allow for the grout to be pressurised. Drilling should subsequently proceed to the final depth of the borehole.

2.4.4 DEPTH OF BOREHOLES

All holes should be drilled to not less than 1.0 m below the pavement of the lowest seam to be treated at that location, or through the seat earth.

2.4.5 PLUMBING OF BOREHOLES

Immediately prior to grouting any borehole the Contractor should check by plumbing or by other approved techniques that no collapse has occurred within the borehole after the drill rods have been withdrawn and that the hole is open to the design depth.

2.4.6 REDRILLING OF BOREHOLES

Grouting should commence via flexible tubing, or a series of metal rods having a minimum internal diameter of 25mm placed to the base of the borehole or at such other depth required by the design. Where it is realised that the tubing or rods cannot be placed to the specified depth, the tubing or rods should be withdrawn and the obstruction removed by re-drilling to the specified depth with casing, if necessary. It should be anticipated that significant mine workings and void migration may be encountered on this site.

2.4.7 GROUTING TUBES

When the tubing or rods have been placed to the depth specified, and checked for blockages, a T-connection pipe of approved design should be attached to the top of the tubing or rods. The connection pipe should have a free outlet available in order that grout flow may be checked and a pressure meter calibrated in units not greater than 50kN/m² (7psi) up to at least 1050 kN/m² (150 psi.) but not exceeding 2100 kN/m² (300 psi.) must be permanently attached at the inlet during the grouting operations.

2.4.8 GROUT MIX

- (1) The grout mix to be injected into each borehole normally should have an initial composition by weight of not less than 1 part sulphate resisting cement to 10 parts pulverised fuel ash (P.F.A.). Should the acceptance of such grout exceed 10 tonnes the Contractor may continue injection with a revised mix which may include sand. A typical upper limit with regard

to sand would be 5:5:1 (sand:PFA:Cement), which would still enable satisfactory pumping of the grout.

(2) The minimum amount of water should be added to the dry grout mix to render it of a workable consistency. High bleed grouts should be avoided, with a target value of less than 5% and the mix should be kept agitated within the mixing tub to reduce any risk of separation. The mixes should produce cubes with crushing strengths of not less than 0.7MN/m^2 and typically 1 to 2MN/m^2 .

(3) A 150 mm concrete test cube should be cast from the grout mix once every couple of working days (i.e. Monday, Wednesday & Friday) and initially cured on site, whilst the works are in progress. The cubes should be tested after 28 days, with all testing to be carried out by a testing authority approved by the Engineer.

2.4.9 GROUT MATERIALS

(1) The cement shall consist of sulphate resisting Portland Cement complying with BS 12/BS 4027 or Portland blast-furnace cement complying with BS 146.

(2) The sand should comply with BS 882. It should be of a size and grading, suitable for use with the Contractors plant.

(3) The pulverised fuel ash should be conditioned hopper ash or dry powder ash to BS389:Part 2.

(4) The water to be used for grouting should be clear and free from organic or other deleterious substances. If possible, it should be supplied by the local Water Authority. Where other source is to be used, the Contractor should arrange for tests of the water to be carried out in accordance with BS 3148.

2.4.10 STORAGE OF MATERIALS

(1) Cement should be stored on a raised platform and should be protected by a waterproof covering.

(2) The sequence of deliveries should be recorded so that the cement can be used in rotation. A complete record of the removals and deliveries of cement should be maintained.

(3) Pulverised Fuel Ash and sand should be kept free from contact with deleterious matter. All materials should be stored in stock piles adequately separated from each other. The Contractor should in his method statement state his anticipated source of materials and likely requirements for daily stockpiling of materials.

(4) The Contractor should ensure that an adequate supply of tested and approved materials are ready for use at all times during grouting operations.

2.4.11 GROUTING EQUIPMENT AND PRESSURE

(1) The arrangements for preparing the grout should be such that an uninterrupted supply is available at the point of injection.

(2) The grout should be mixed in a high speed high shearing action grout mixer. From the mixing tank it should pass to a holding tank where it should be kept in a continuously agitated state until delivered.

(3) The grout pump should be a variable pressure ram type pump or other approved pump, capable of delivering a continuous supply of grout of varying consistency at pressures of up to 1.0 bar at the point of injection. The operating pressure should be maintained generally at 0.1 bar (10KN/m^2) per one metre depth of temporary casing installed within the borehole.

(4) All valves in the grout ranges should be of the ball type for ease of cleaning.

2.4.12 GROUTING PROCEDURE

(1) The specified grout mix should be injected under the aforementioned conditions until either grout overflow occurs at the surface or the specified pressure is recorded on the pressure meter attached to the T-connection pipe. When this pressure is reached the outlet

tap should be temporarily opened to ensure that pressure has not been incurred by line blockage.

- (2) If during the operation described above grout overflows at the surface (via the temporary casing), at a similar rate to that being injected, the flexible tube or metal rods should be withdrawn completely and the borehole pressurised as described below.
- (3) If alternatively, the stipulated pressure is reached on the pressure gauge attached to the T-connection pipe, and this is not caused by line blockage and no further materials can be injected at this pressure, the injection pipe/tube should be partially withdrawn until the pressure falls and grout injection should be recommenced. If the stipulated pressure is again realised this procedure of gradual withdrawal of the grout pipe/tube is to be repeated (hereafter referred to as stage grouting) until grout returns to the surface via the casing. Only when grout appears at the surface in similar quantities to that being injected should the grout pipe/tube be completely withdrawn from the borehole and the pressurisation process specified below be carried out.
- (4) Should it become apparent that any grout injection pipe/tube has become blocked (indicated by a constant back pressure on the pressure gauge attached to the T-connection pipe, and zero flow of grout) the grout injection pipe/tube should be removed and only replaced when the blockage has been cleared.
- (5) Immediately the grout pipes/tubes are withdrawn the T-connection should be attached to the top of the metal casing originally inserted into the borehole to rockhead and further grout should be injected until the specified pressure is recorded on the pressure meter attached to the T-connection pipe/tubes. When this second pressure is reached the outlet pipe should again be temporarily opened to ensure line blockage has not occurred. When the specified pressure has been maintained such that no further grout can be injected at that pressure, the T-connection pipe should be removed and the metal casing immediately withdrawn. If on disconnecting the T-connection pipe, an appreciable back flow of grout occurs, a cap should be screwed onto the casing until sufficient setting time has elapsed for the grout flow to cease and yet allow the casing to be withdrawn.

2.4.13 BACKFILLING BOREHOLES

Upon completion of the pressure grouting procedure, and following the subsequent withdrawal of the borehole casing, the Contractor should ensure that each borehole is backfilled to the surface with grout. In the event that settlement of such backfill grout subsequently occurs, the Contractor should return to these borehole locations to top up the grout level. Only in exceptional circumstances - for example where unacceptably high quantities of grout might flow into loosely filled ground - should this requirement be relaxed.

In instances of high grout acceptance the Contractor should bulk backfill with pea gravel, followed by topping up with grout.

2.4.14 ABANDONED CASING

The Contractor should make every attempt to recover all casing used in the drilling operations. However, if this becomes impractical then any abandoned casings must be filled with P.F.A./cement grout and cut at least 2 metres below ground level. The positions of such abandoned casings should be recorded.

2.4.15 DRILLING AND GROUTING SEQUENCE

- 1) The boreholes should be drilled in a sequence and to depths required by the design. Grout should be injected into the boreholes in an order and with grout mixes as required by the design. The boreholes should be drilled and grouted in a systematic manner. Interconnection of boreholes may be anticipated and in this regard it may be necessary to restrict grouting in the proximity of drilling operations to avoid difficulties in the grouting operations.
- 2) The grouting should where possible commence at the lowest point of the seam to be treated and progress up dip.

- 3) The Contractor should take all reasonable steps to ensure that any uplift consequent upon the grouting should be completely obviated and that no disturbance to adjacent structures should occur.
- 4) The Contractor should attempt to inject grout into each borehole irrespective of whether or not a cavity or old mineworking is suspected. Care should be taken to ensure that grout is not injected into Made Ground, superficial deposits or pipes, drains, cable ducts, etc.
- 5) Where large voids are encountered in the 'downdip' zone of the proposed treatment area it may be necessary to drill and form a grout curtain prior to the main infill drilling. Where large voids are located the injection of pea gravel may be required. In these instances to avoid excess pressure causing the grout/pea gravel cone to slump, the injection should be stopped as soon as practicable after the cone has reached the roof of the void and has formed good interlock. When the perimeter hole grout has set sufficiently hard, the hole should be filled to the surface with grout and injected.
- 6) In general the procedure will involve the drilling of primary grout injection boreholes initially on a 6m square grid with centres. Where possible the sequence will commence at the down dip end of the geological structure and continue up dip. Where grout acceptance in any primary borehole exceeds 5 tonnes then additional secondary boreholes on a 3m grid around the primary hole locations shall be drilled and grouted.

2.4.16 DAILY RECORD

- 1) The Contractor should keep both a Daily Drilling Record and a Daily Grouting Record for each borehole, while work proceeds at that borehole.
- 2) The Daily Drilling Record should record the following information:-
 - (a) Job name and location.
 - (b) Borehole reference number.
 - (c) Date.
 - (d) Contractor's name.
 - (e) Plant in use, crew members, and hours worked.
 - (f) Method of drilling and flushing medium.
 - (g) Type of bit used.
 - (h) Diameter and depths of all casing used.
 - (i) Depth and diameter of borehole at beginning and end of each working day or shift.
 - (j) Depth to each change of stratum.
 - (k) Description of each stratum.
 - (l) Depths at which groundwater is encountered.
 - (m) The depths at which samples were taken.
 - (n) Details of any loose ground or voids penetrated.
 - (o) Details of any loss of flushing medium.
 - (p) Details of time spent in overcoming obstructions.
 - (q) Details of services or drains located.
 - (r) Details of any emission of gas, water, foul air, etc.
 - (s) Details of any settlement or ground heave adjacent to boreholes.
 - (t) Daily and cumulative quantities of drilling.
- 3) The Daily Grouting Record should record the following information.
 - (a) Job name and location.

- (b) Borehole reference number.
 - (c) Date.
 - (d) Contractor's name.
 - (e) Plant in use, crew members and hours worked.
 - (f) Details of plumbing of the depth of borehole.
 - (g) Details of quantity of grout constituents injected into each borehole.
 - (h) Total daily and cumulative quantities of each constituent of grout mixes.
 - (i) Details of the grouting pressures recorded, and corresponding depths.
 - (j) Details of casing abandoned in boreholes with appropriate reference numbers.
- 4) Particular attention should be paid to recording the depths of cavities or suspected old mine workings and to recording the loss of water during drilling.
- 5) The Daily Records of Materials and Plant Received should show in particular each day's quantities by weight of each type of material and cumulative quantities. The Contractor should submit to the Engineer with the Daily Records copies of receipts or invoices for all materials delivered and should keep them on site until the work is complete.

3.0 PROBE DRILLING AND SHAFT TREATMENT

3.1 EXPLORATORY OPEN-HOLE DRILLING PROCEDURE TO LOCATE MINE SHAFT (IF REQUIRED)

3.1.1 ORIENTATION OF BOREHOLES

The boreholes shall be drilled vertically and shall be maintained within 5 degrees of the vertical throughout their entire length.

3.1.2 DRILLING FLUSH AND BOREHOLE DIAMETER

The drilling fluid shall be clean water, air or mist. The borehole diameter shall not be less than 50mm and the drill bit shall be of a design that produces the required open-hole samples.

3.1.3 LOSS OF FLUSH

If at any time, whilst drilling is in progress, the flushing medium fails to return to the surface, drilling shall only proceed where it is possible to identify the level of rockhead by the determination of 'hard' rock drilling from 'soft' superficial deposit drilling. If this is not possible and material cuttings borne by the flushing medium are required for the identification of rockhead level then casing must be inserted into the borehole to restore the flush circulation. If at any stage during the drilling the insertion of casing fails to re-instate the flow of the flush to the surface, the Contractor shall stop drilling and contact the Engineer for further instruction.

3.1.4 DEPTH OF BOREHOLES

All probe boreholes will be drilled to a depth of 1.5 metres below rockhead. Where a borehole does not encounter rockhead at the expected level, and continues to prove 'soft' drilling or otherwise to a depth of 5.0 metres below previously proved rockhead level, the Engineer should be informed immediately. No shaft drilling is to take place until a shaft platform can be established.

3.1.5 BOREHOLE GRID

The boreholes shall be drilled on a grid to be established and numbered by the Engineer. This grid will be centred on the 'best plot' location of the shaft position. The Contractor shall commence probe drilling at the shaft location and then drill boreholes at increasing distances from the shaft position until the shaft is located or further instructions are received from the Engineer. In the event that the entire grid is drilled without encountering the shaft, additional boreholes may be required to extend the grid or drill a secondary 'centre borehole' grid to an appropriate distance around the best plot position of the shaft.

3.1.6 SEALING OF BOREHOLES

On completion, to the approval of the Engineer, each borehole shall be carefully sealed with cement slurry and drill cuttings or sand from the bottom upwards so as to prevent any collapse of the borehole and/or surface disturbance at or in the vicinity of the borehole.

3.1.7 SAMPLING OF SUPERFICIAL DEPOSITS

Where directed by the Engineer, the Contractor, when drilling through superficial deposits shall provide disturbed samples at two metre intervals and at each change in strata, or as otherwise directed by the Engineer.

3.1.8 SAMPLE STORAGE AND OWNERSHIP

Disturbed samples from individual boreholes shall be presented and stored collectively on site and made available for inspection by the Engineer. All samples shall become the property of the Employer and shall not be removed from site by the Contractor other than at the Engineers instruction. It may be required for samples to be kept for three months after completion of site works and they shall be discarded only on the instructions of the Engineer.

3.1.9 DRILLING RECORDS

- (1) The Contractor shall keep a written record, in a form approved by the Engineer, while work proceeds at a borehole.
- (2) Drilling Records shall record the following information:
 - (a) Job name and location.
 - (b) Borehole reference number.
 - (c) Date.
 - (d) Contractor's name.
 - (e) Plant in use, crew members and hours worked.
 - (f) Method of drilling and flushing medium.
 - (g) Type of bit used.
 - (h) Diameter and depths of all casing used.
 - (i) Depth and diameter of borehole at beginning and end of each working day or shift.
 - (j) Depth to each change of stratum.
 - (k) Description of each stratum.
 - (l) Depths at which groundwater is encountered.
 - (m) The depths at which samples were taken.
 - (n) Details of any loose ground or voids penetrated.
 - (o) Details of any loss of flushing medium.
 - (p) Details of time spent in overcoming obstructions.
 - (q) Details of services or drains located.
 - (r) Details of any emission of gas, water, foul air, etc.
 - (s) Details of backfilling of holes.
- (3) The details of the strata shall be based on the driller's interpretation of the drilling returns and shall note any major colour or stratum changes and the hardness of the strata (as estimated from the rate of penetration). Generally the strata description shall be confined to simple terminology such as made ground, sand, gravel, mudstones, sandstones, shale, coal, etc., with their appropriate colour and degree of hardness.
- (4) The Contractor shall give written instructions to his site staff defining the nature of the log required for each exploratory hole. Copies of all such instructions shall be forwarded to the Engineer for his information and comment.
- (5) Particular attention shall be paid to recording the depths of cavities or suspected old mine workings and to recording the loss of flushing medium during drilling.

3.2 DRILLING AND PRESSURE GROUTING PROCEDURE FOR ABANDONED MINE SHAFTS AND ADITS

3.2.1 SHAFT BOREHOLES

The boreholes shall be drilled by rotary methods employing water flush techniques unless otherwise agreed to by the Engineer. Initially, a vertical borehole of minimum 72 mm diameter will be drilled commencing at the centre of the shaft. Drilling will then continue until solid strata are reached at the base of the shaft. It is proposed that the subsequent grouting of the shaft is to be carried out via the drill string. The minimum internal diameter of the drill string shall be not less than 35 mm and external casing will not be necessary unless it is required to insert pea gravel. If a cavity is located within the shaft the Engineer may require it to be infilled with pea gravel in which case the Contractor will be required to insert casing of minimum 100 mm

diameter to the upper limit of the cavity to facilitate the placing of the pea gravel into the cavity. The casing must then remain in place until the base of the shaft is proved by the drilling. During the drilling the Contractor shall carry out regular checks and any necessary adjustment to the drilling rig to ensure that the drill is vertical. When the drilling encounters solid strata at the presumed base of the shaft, boring will continue into rockhead for a distance of at least 5 metres or as specified by the Engineer.

3.2.2 GROUTING TUBES

Grouting can then proceed via the drill string. Any casing may at this stage be withdrawn but the drill string must remain at the borehole base. A triple outlet, 1-connection pipe will be attached to the top of the drill string, via a coupling of approved design. The connection pipe will be of such design that a free outlet is available to check the flow of grout and that a pressure meter, calibrated up to at least 1,750 kPa (250 p.s.i.) is permanently attached at the inlet location. It is anticipated that pressure in the region of 700 kPa (100 p.s.i.) to 1,000 kPa (150 p.s.i.) will be required.

3.2.3 GROUTING PROCEDURE

Grouting will continue via the drill string, previously placed to the base of the borehole until a pressure to be stipulated by the Engineer has been recorded and maintained at the pressure meter, attached to the I-connection pipe, or until grout overflow at the surface occurs. The drill rig will be of such design that up to 3 metres (10 feet) lengths can be withdrawn, disconnected and the T-connection re-connected at the top of the borehole. When the stipulated pressure has been maintained and further grouting at that level is not possible without generating greater pressure, the Contractor will withdraw the drill string up to 3 metres (10 feet). Further grouting will then proceed and further withdrawal up the shaft shall not be carried out at this or any subsequent stage or level until the stipulated pressure has been recorded and maintained at that stage or level. This procedure will continue until the shaft has been pressure grouted to the surface or near surface, to the satisfaction of the Engineer. Following completion of treatment, a probe hole should be drilled through the centre of the treated area to the base of the shaft and two to half depth to confirm the effectiveness of the treatment.

3.2.4 GROUT MIX

The grout mix will be of composition 10 parts pulverised fuel ash to 1 part cement by weight, or as otherwise specified by the Engineer. The Contractor may be required to include sand in the grout mix. The grain size and consistency of any materials used for grouting must be approved by the Engineer and only the minimum quantity of water shall be used so as to render the grout workable. The consistency and slump nature of the mix must be approved by the Engineer. The mixing and pumping plant used shall be such that constant agitation of the grout is possible and the Contractor must specify in writing the method of controlling, metering and pumping the amount of material to be used when submitting the completed tender documents.

3.2.5 RECOVERY OF MATERIALS

The Contractor is expected to recover from each borehole, metal rods, connections and casings used in the operations, and it will be necessary for the Contractor to indemnify the Employer against any claims for loss of such items.

3.2.6 DRILLING PLATFORM

The Contractor's particular attention is drawn to the possibility of the collapse of fill material into the shaft, or of the shaft itself whilst drilling and/or grouting operation are being carried out. During the drilling and treatment of the shaft, the drilling equipment shall be supported on and secured to a suitable platform such that in the event of a collapse the drilling rig remains supported over the shaft. When assessing the platform requirements, the Contractor shall consider whether the platform itself could become dislodged by a collapse and in such a case shall make provision for the platform to be secured to suitable anchorages so as to prevent such an occurrence. Subsequent to the shaft being located no drilling is to take place at any suspected old mine shaft until the Contractor is satisfied that the appropriate platforming and anchoring systems have been established. It is recommended that all personnel involved in

the drilling and treatment of a shaft should wear appropriate safety harnesses secured at a safe distance from the shaft.

3.2.7 SHAFT CAPPING

3.2.7.1 Concrete Caps

If the depth to rockhead at the shaft locations is anticipated to be less than about 4 m, a reinforced concrete cap should be constructed over each of the shafts. Cap details for each shaft should be as follows:

- Minimum plan dimensions 4.2 m by 4.2 m, centred on shaft centre.
- Minimum thickness 450 mm
- Base reinforcement minimum 25 mm High Yield Bars at maximum 200 mm spacing in both directions
- Top reinforcement minimum 25 mm High Yield Bars at maximum 200 mm spacing in both directions
- Minimum cover to steel 75 mm
- Concrete minimum cube strength 40 MPa
- Concrete to comply with requirements for DS-3/AC-4 conditions as per BRE Special Digest 1 (2005)
- Concrete slump to be 25 to 75 mm and compacted using vibratory compactor as approved by the engineer.
- Curing procedures (to be approved by the Engineer) should be such as to ensure that concrete remains damp until placement of backfill.
- Cap to be founded in weathered Coal Measures strata at a minimum depth of 2 m to underside.

4No 150 mm concrete test cubes should be cast from each batch mix and cured adjacent to the shaft caps. Two of the cubes to be tested after 7 days and the remaining two after 28 days. All testing to be carried out by a testing authority approved by the Engineer.

3.2.7.2 Grouted Caps

If the depth of fill materials at suspected shaft locations is likely greater than about 5 metres, a grout cap will be formed at rockhead, rather than a conventional reinforced concrete cap. The grout cap should consist of boreholes drilled on a 2 m grid within 6 m radius circle of the shaft centre, i.e. 29 number boreholes. Boreholes should penetrate 4 m into the coal measures. Grouting should take place generally to 4 m above the coal measures, i.e. about an 8 m depth of cap. The same grout mix specification should apply as Section 2.48 above. If the grout take exceeds 5 tonnes for any one stage, the Engineer should be informed immediately. The addition of sand should be at the Engineer's discretion.

A further five secondary holes should be drilled and grouted not less than 12 hours after the initial grouting.

3.3 FILLING OF OPEN MINE SHAFTS/WELLS (IF REQUIRED)

3.3.1 FILLING

Materials used for filling shall be picked up from a remote stockpile and placed in the shaft or well using a mechanical grab or bucket attached to a machine with a horizontal reach of not less than 5 metres. Direct tipping into the shaft or well will not be permitted.

3.3.2 FILL MATERIALS

The Engineer will inspect and approve the materials used to backfill an open shaft or well. These should be Rock Fill - which shall be quarry run or surface ripped materials free from soil and other organic matter and shall not include more than 10% passing a 40 mm square or more than 5% larger than 300 mm and shall include adequate proportions of intermediate sizes so that a well graded material is obtained.

3.3.3 REMOVAL OF SURFACE WATER

Any water displaced during the filling operations should be disposed of by the Contractor but subject to any special provisions laid down by the relevant Statutory Undertaking.

3.3.4 PLUMBING OF SHAFT / WELL

Prior to the filling operation commencing, the shaft or well will be plumbed to its base to determine its depth. During the filling operation plumbing shall be carried out at regular intervals, to be specified by the Engineer, in order that the level of the fill material can be monitored and related to the volume of the material tipped down the shaft or well. This procedure is to enable any continuous settlement of the fill material, or any 'bridging' of the material to be detected.

3.3.5 SAFETY HARNESES

Any person situated within the immediate zone of influence of the shaft or well, shall wear approved safety harnesses suitably anchored at a safe distance.

APPENDIX A NOISE CONTROL

The Contractor should comply with the general recommendations set out in BS5228:Part 1:1984 and Part 4:1986, "Noise Control on Construction and Open Sites", together with the specific requirements described in the following table:

Period	Hours	Noise level in Leq dB (A)	Period of hours over which Leq is applicable	Peak Noise measured in dB(A)
Monday to Friday	0800 - 1800	75	12	85
	1800 - 0800	50	4	55
Saturdays	0800 - 1300	75	5	85
	1300 - 1800	60	8	65
	1800 - 0800	50	4	55
	0900 - 1600	60	4	65
	1600 - 0800	50	4	55

Total Noise Levels at One Metre from the Facade of Nearest Occupied Dwelling