

# Trinity Academy, Barnsley

## Specification for Stabilisation of Shallow Coal Mine Workings

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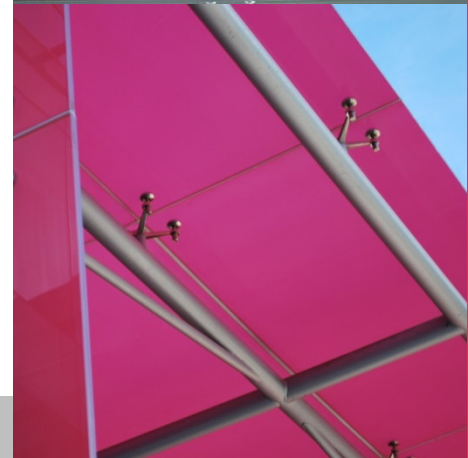
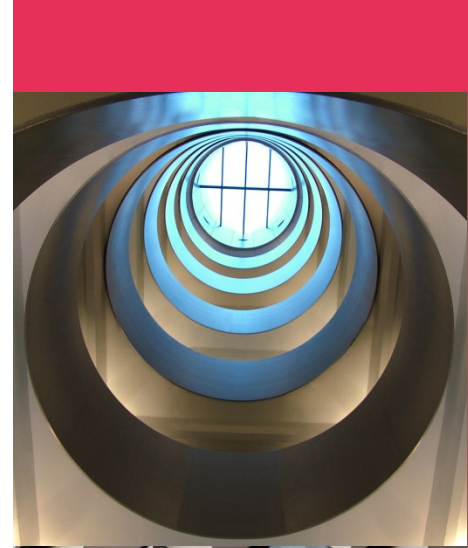
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Rev	Description	Issued by	Checked	Date
V01	First Issue - DRAFT	BC	ML	22/10/2021
C01	Tender Issue	PW	PW	08/11/2022
C02	Include information for playing field to the west of the main school development.	RS	PW	14/11/2022

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## 1.0 Preliminaries

This report should be read in conjunction with the following documents.

- 1) Waterman Infrastructure & Environment (2020) Geo-Environmental Assessment Report for Trinity Academy, Barnsley (report no. WIE7125-100-R-8.1.3-Geoenv)
- 2) Waterman Infrastructure & Environment (2020) Coal Mining Risk Assessment for Trinity Academy, Barnsley (report no. WIE7125-100-R-7.1.3-CMRA)
- 3) Curtins (2022) Phase 2 Ground Investigation (Report no. 079532-CUR-XX-XX-T-GE-00002-P01\_Phase 2 GI)
- 4) Curtins (2022) Coal Mining Ground Movement Assessment (Report no. 079532.301-CUR-XX-XX-T-GE-00003-P01).
- 5) Trinity Academy, Barnsley, Supplemental Ground Investigation, reference 079532-CUR-XX-XX-T-GE-00005, revision C01 dated 19 October 2022.
- 6) Trinity Academy, Barnsley, Strategy for Grout Stabilisation of Shallow Coal Mine Workings and Mine Entries, reference 079532-CUR-00-XX-RP-GE-3002 revision C02 dated 14 November 2022.

All work shall be carried with due reference to,

CIRIA Report "C514 Grouting for Ground Engineering"

BS 5930:2015 'Code of Practice for Ground Investigations'

ENV 1997-1:1994 Eurocode 7: Geotechnical Design – Part 1: General Rules and BS EN 12715:2000 Execution of Special Geotechnical Work – Grouting

CIRIA Special Publication 32 "Construction over abandoned mine workings"

CIRIA C758D "Abandoned Mine Workings Manual"

Coal Authority document "Guidance on managing the risk of hazardous gases when drilling or piling near coal"

British Drilling Association document "Health & Safety Manual for Land Drilling 2015: A Code of Safe Drilling Practice".

In this Specification the term "Engineer" shall refer to the authorised representative of the Client (such as Curtins). The term "Contractor" shall refer to the specialist Contractor tendering for the location and treatment of disused mine shaft(s) and/or adit(s) and/or shallow workings. The term "Client" shall refer to Bowmer and Kirkland. It is understood that Bowmer and Kirkland will be the Principal Contractor.

The Contractor shall also allow for the Clients and Principal Contractors requirements as included within the tender invitation.

Before submitting their tender, the Contractor shall visit the site. The tender shall include any costs likely to be incurred in traversing the site with plant and materials and setting up at the work/drilling locations.

Safe access to the site will be arranged by the Principal Contractor.

The Contractor shall note in their tender the necessity for removal of overhead wires or any other items likely to increase the cost of the work.

Any points not so noted and itemised, or cost details not included, shall be deemed to be covered in the tender figure.

The Contractor shall comply in all respects with local byelaws with particular regard to noise, smoke, and parking for off-loading, etc.

The Contractor shall state in their tender the type and number of machines and drilling rigs they intend to use on site and their method of operation.

The conditions likely to be met on site shall be determined by the Contractor and it shall be their responsibility to provide suitable plant to cope with the ground conditions and changes in level. The cost of standing time caused by failure or inadequacy of plant shall not be recoverable under the contract.

At the time of tendering the Contractor shall clearly state in detail, including size and amounts, the working or storage areas, water, power, access, labour, or any other items they will require to be provided.

Any item not so noted shall be assumed to be covered in the tender figure.

The Contractor shall state in their tender the amount of notice they require before beginning work. Any costs incurred by delays in beginning operations shall be borne by the Contractor.

Sufficient insurance cover against damage to persons or property shall be arranged by the Contractor and dated prior to the commencement on site by the Contractor and shall be maintained to cover the full period of the Contractor's legal liability.

The Contractor shall provide and erect adequate fencing around all excavations, work locations and shafts once they have been located.

The Contractor shall carry out the works in a safe and competent manner and shall comply with the appropriate safety Regulations applicable to the site and nature of the ground encountered.

All safety procedures relevant to grouting works in stable ground conditions are to be adhered to and emergency procedures outlined within risk assessment and method statements prepared by the Contractor for dealing with the unlikely event of unstable ground conditions.

The Contractor will allow in their tender and be responsible for applying for and obtaining a permit for the works from the Coal Authority in a timely manner to suite the programme.

One recorded mine shaft is present within the playing field identified as requiring a grout treatment and concrete cap at rockhead. However, if additional shafts are encountered, the Contractor shall be responsible for arranging, where necessary, for the Coal Authority Surveying Branch to visit the site in the event that an unrecorded mine shaft has been located and that it has been securely fenced and to make the necessary tests and arrangements for noxious gases.

The Contractor must allow a sum in their tender to cover the full cost of any standing involved while waiting for the Coal Authority to visit the site to determine that a mine shaft has been found, and to test for noxious gases.

The contractor shall include for the provision of noxious gas detection equipment and equipment required on site to comply with the Coal Authority safety requirements for the duration of the contract.

The Contractor will be provided with all information available concerning services under the site by the Client. In some cases, it may be necessary, at the discretion of the Contractor, to begin boring or excavations with a hand excavation to avoid service or drainage runs. Any damage to such services or drains under the site shall be the responsibility of the Contractor and they shall ensure at the time of tendering that, should precautions be necessary, they are included in the tender.

The Contractor shall provide the Engineer with two copies (one paper, one electronic .xls format) of a boring record detailing items required by the Engineer, for every hole bored, as the work proceeds. They shall also give the Engineer sufficient notice to enable them to check and agree the length of penetration of each hole bored.

No conditions requested by the Contractor with their tender shall override any clause in this Specification.

Should a Contractor require modification to any clause they shall apply in writing to the Engineer before submitting their tender.

On completion of the work the Contractor shall remove from site all unwanted materials and plant. The Contractor shall be responsible for removing from the site all effluent, unused or waste material arising from grouting operations to a suitably licensed disposal facility.

The Contractor shall dispose of all excavated material to the satisfaction of the Engineer and to a suitably licensed disposal facility. The Contractor shall be responsible for backfilling boreholes and excavations on completion of the work. The site when vacated shall be in a similar condition to its condition before commencement of work.

The Contractor shall be responsible for all setting out and location of grout holes.

If required by the Engineer, the Contractor shall provide an Engineer or Engineering Geologist on site, competent and sufficiently experienced to advise on the conduct of the investigation.

A plan has been produced by Van Elle which covers the main school area and a portion of the playing field where the synthetic pitch is to be situated. Drawing number is 212914VE Rev. E dated 25/10/2021.

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It is likely that this plan will require updating prior to the works beginning. In this drawing there 615 No. 3m spaced holes for the proposed buildings and 622 No. 6m spaced holes for the external hardstanding and synthetic playing pitch areas. This drawing is included in the appendices.

Unless advised otherwise by the Client, the Contractor shall fulfil the duties required of them as Principal Contractor under CDM 2015 Regulations.

Nothing in this specification should be taken as an instruction to adopt working methods which contravene the CDM Regulations, and all contractor/sub-contractors etc., are responsible for ensuring safe procedures which comply with the Regulations.

## 2.0 Materials

Test certificates for materials showing compliance with the British Standard along with source of manufacture should be forwarded to the Engineer for record purposes before orders are placed.

The use of materials or techniques not covered by the British Standard or excluded from the specification clauses will not be permitted unless by prior written agreement with the Engineer.

Water shall be from the mains supply or other source approved by the Engineer. The water supply connection is the responsibility of the Contractor.

Sand shall generally comply with BS EN 12620:2013 and be of a grading suitable for use in the Contractor's plant and approved by the Engineer.

Pea gravel shall comply with BS EN 12620:2013, grading approved by the Engineer.

Bulk material, excluding mixing water, shall be paid for by weight, except that there shall be no payment for the excess weight if the moisture content exceeds 10% by weight of the dried material as determined in accordance with BS 1881.

Pulverised Fuel Ash (PFA) for use in grouts shall comply with BS 3892. Its source of supply shall be to the approval of the Engineer, and certificates of compliance with BS 3892 shall be provided by the Contractor to the Engineer for all the material used.

Alternatives to PFA shall be agreed with the Engineer in advance of works commencing.

Portland cement/PFA grout shall comply with the requirements of BS EN 197-1:2011.

Proprietary grouts shall be of a type approved for the purpose by the Manufacturer and the Engineer and used strictly in accordance with the Manufacturer's instructions. The constituent materials including catalysts, additives and admixtures shall be notified to the Engineer immediately upon request.

Cement for sand and cement grouts shall be Sulphate Resisting Portland Cement to BS4027; cement for use with PFA shall be Ordinary Portland Cement (OPC) to BS EN 197-1:2011.

Sand and cement grouts shall be made with an approved super-plasticiser. Sand grading shall be determined by the Contractor, for approval by the Engineer, to achieve the required performance.

Materials shall be stored so as to prevent contamination and deterioration. Cement shall be kept in a dry location and the delivery sequence recorded to ensure that cement is used in rotation.

If and where end tipping is deemed a viable and safe methodology for the filling of open voids, the selection and use of granular bulk filling materials shall be subject to the approval of the Engineer.



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## 3.0 Grouting Plant

The Contractor shall submit to the Supervising Engineer, for comment, details of the proposed method of mixing, batching, and pumping of grout to the injection points, together with the means of monitoring grouting pressures and the quantities injected.

The materials shall be introduced into the mixer via approved weight batching equipment. (Bearing in mind the low strength requirements, volume batching may be acceptable on occasion, with the approval of the Supervising Engineer).

The grout mixer shall be capable of producing a homogeneous mix, all particles being thoroughly wetted without segregation occurring.

Any grout which has started to gel shall be discarded; the addition of extra water or the "working up" of gelled grout shall not be permitted.

## 4.0 Grout Mixes

Before work commences, the Contractor shall propose to the Supervising Engineer a selection of grout mixes likely to prove satisfactory for the conditions. (Alternatively, the Supervising Engineer may specify the mixes). The Contractor shall prepare cubes, of an agreed size, representative of the mixes agreed, and shall arrange for them to be tested by crushing at 14 and 28 days in accordance with BS 1881. The testing shall be carried out by an independent laboratory if directed by the Supervising Engineer. Where time permits, the results of the tests shall be furnished to the Supervising Engineer prior to commencement of grouting operations.

The Contractor shall provide the Engineer with the proposed grouting mixture and be able to demonstrate, in line with this specification, that the design will meet the minimum strength and flow requirements of this Specification.

The following mixes (proportions by weight) are listed for general guidance:

- i) **Primary grouting positions or; perimeter curtain wall grouting:** cavities less than 500 mm high:
  - Cement : PFA = 1:12
  - Cement : PFA : Sand = 1:10:2 (sand can be added where grout consumption or spread should be limited).
  - The cement content should not be less than 75 kg/m<sup>3</sup> in dry or unsaturated conditions. In waterlogged workings, the minimum cement content may be raised to 100 kg/m<sup>3</sup> to allow for dilution effects.
- ii) **Primary grouting positions or; perimeter curtain wall; or mine entry grouting:** for large or interconnecting cavities exceeding 500 mm high (a pea gravel infilling is recommended to limit grout travel within the area of consolidation):
  - Cement : PFA : Sand = 1:6:1
  - The cement content should not be less than 100 kg/m<sup>3</sup> in dry or unsaturated conditions. In waterlogged workings, the minimum cement content may be raised to 125 kg/m<sup>3</sup>. (Admixtures, such as bentonite, may be incorporated to limit the spread of the grouting during injection). The grout is injected while pea gravel is fed simultaneously through
- iii) **Secondary grouting positions or; infill grouting**
  - Cement: PFA = 1:12 to 1:20
  - The cement content should not be less than 50 kg/m<sup>3</sup> of mixed volume in dry or unsaturated conditions. In waterlogged workings, the minimum cement content may be raised to 75 kg/m<sup>3</sup>.

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The adjustment and installation of grouts shall be the sole responsibility of the Contractor who shall nevertheless satisfy the Engineer that the mix proportions are in accordance with this Specification, or with the approved variations, and meet the minimum strength and flow requirements of this Specification.

## 5.0 Grout Properties and Testing

Water to cement and PFA ratios shall generally be in the range 0.40 to 0.45 (including the moisture in the aggregates), the mixes envisaged should produce pump able grout with lucidity readings of between 300 to 600 mm. The Contractor shall check the lucidity of the grout on site during operations by means of a flow meter.

High bleed grouts shall be avoided, and the bleed capacity shall be limited to 5% maximum.

Bleed capacity shall be measured in a clear plastic or glass graduated cylinder which has an internal diameter not less than 50 mm, with a volume of approximately 1,000 ml. After placing the grout, a cover shall be placed over the cylinder to avoid evaporation. Bleed capacity shall be read at hourly intervals. For neat cement grout, readings shall continue for not less than 3 hours, and for not less than 6 hours for fly ash/cement grouts.

For strength testing, the Contractor shall make one set of six test cubes per week of an agreed size and taken from the grouting, at surface positions throughout operations or as when directed by the Engineer. The cubes shall be marked, handled, stored, and tested in accordance with BS 1881 to confirm the projected 14- and 28-day strengths of the grout. The mixes shall produce cubes with crushing strengths of not less than 1.0 N/mm<sup>2</sup> (1MPa) at 28 days.

The actual proportions to be used initially for the various grouts shall be determined by the Contractor for approval by the Engineer, according to the conditions met in drilling and the results of any cube testing or trial grouting carried out before commencement of the main works.

Grout viscosity at the time of injection shall be such as to achieve full penetration of all voids encountered, subject to achieving a satisfactory gel with minimum bleeding and shrinkage within three hours of injection.

If the Supervising Engineer considers the results of the tests indicate that a change of mix proportions is required, the Contractor shall make such modifications as the Engineer may direct. If required by the Engineer, the testing shall be carried out by an independent laboratory which shall provide certified records of the results. The contract shall specify the extent of testing and allow a provisional sum for such.

## 6.0 Drilling and Grouting Procedures

### 6.1 Drill Procedures

All holes, including any which strike mineral pillars, to be used for the injection of grout, shall be drilled by rotary or rotary percussive techniques down to the pavement of the old workings and a minimum of 1.0 m beyond into competent bedrock. The drilling system and flushing medium to be used shall be approved by the Engineer and Coal Authority. The minimum diameter of holes shall be 70 mm unless otherwise specified by the Engineer.

The holes shall be cased through superficial deposits down to the rock-head, and if directed by the Engineer, down through the rock strata. The holes shall be kept open until grout injection into the workings and rock is complete.

Where a hole proves abortive because it becomes obstructed, or because of the Contractor's failure to progress the hole, it shall be re-drilled at a larger diameter and re-cased, or a new hole drilled and cased at the contractor's expense.

Holes for any perimeter curtain walls, if required, shall be spaced at maximum 3.00 m intervals. Where cavities exceeding 500 mm are found, grout hole centres are to be reduced to not greater than 1.50 m centres until clear of the area of void or as directed by the engineer.

### 6.2 Grouting Procedures

The Contractor shall stabilise by grouting all worked seams, voids and cavities as shown on the Coal Authority drawings (abandonment plans provided in the CMRA) or as directed by the Engineer. The Contractor should satisfy themselves that all shallow workings within influencing depth to the proposed development have been recorded and treated.

The Contractor shall be responsible for ensuring that the grouting has completely stabilised all voids, cavities, worked seams, adits, or shafts, encountered in the boreholes.

Immediately prior to grouting each hole, the contractor shall check that it is unobstructed to the required depth to receive the tubing or pipes for grout. Obstructions shall be dealt with as described above.

Grout shall be tremied into position down each hole via an approved T-connection and flexible tubing, or series of steel tubes, placed to the base of the hole or to such other depth as specified by the Engineer. Provision shall be made for monitoring the pressure of the grout and the quantity being delivered in the line.

The grout shall be injected at the approved rates until either a limiting pressure of 10 kN/m<sup>2</sup> per m overburden or a maximum of 200 kN/m<sup>2</sup> is reached, or grout appears near the point of injection, when the hole shall be deemed complete. If one of these criteria is reached quickly, the grout tube or pipes shall be lifted to check that a local obstruction is not preventing the flow of the grout into the strata.

Grout shall be injected using a grout tube carried below rock head level. The Contractor shall seal the tube against the surrounding ground as necessary to develop the required pressures, with a bentonite slurry or mechanical packer.

### **6.3 'Excessive' Grout Take**

If pressure is not achieved or grout has not appeared at the point of injection after 15 tonnes of grout materials have been placed, the grout tube or pipe shall be removed from the hole and injection suspended. After a period of at least 12 h, up to a further 10 tonnes of materials shall be injected. If there is still no result, injection shall again be suspended for at least 12 h and the process shall be repeated with further quantities of 5 tonnes. If the hole is still accepting grout after a total of 25 tonnes of materials have been injected without any sign of the hole being completed, the Contractor shall consult the Engineer to determine whether the injection is to be continued or other measures are required.

When holes have been cased through rock, grout injection shall continue at gauge pressures to be approved by the Engineer, subject to the maximum of 10 kN/m<sup>2</sup> per m of overburden with an upper limit of 200 kN/m<sup>2</sup> whatever the depth, as the casing is withdrawn.

Care shall be taken to ensure that uplift pressures are not allowed to develop under any adjacent building or structure, including services, during grout injections. Where nearby buildings or structures might be affected by the grouting operations, the Contractor shall employ special supervision, and unless otherwise specified by the Engineer, shall monitor ground levels by precise levelling at intervals, both prior to and during operations.

### **6.4 Perimeter Curtain Wall**

Work shall commence at the deepest point of the workings, and in the upper seam if more than one is present and progress up to the shallower parts where the final perimeter holes shall be left un-grouted until infill grouting is almost complete. If applicable, the lower seams shall be similarly treated in descending order.

The grout mixes shall be as specified or directed by the Engineer. In grouting the curtain wall, to avoid excess pressure causing the cone to slump, the flow should be stopped as soon as the cone has reached the roof of the seam and has formed a good interlock.

When the perimeter curtain grout has set sufficiently hard, the hole, if required, shall be filled to the surface with grout injected at pressures to be approved by the Engineer, subject to a maximum of 10 kN/m<sup>2</sup> per m of overburden with an upper limit of 200 kN/m<sup>2</sup>, whatever the depth of the hole. The same procedure shall apply if the hole is cased through rock, grout injection continuing as the casing is withdrawn.

## **6.5 Infilling**

The grouting of infill holes shall proceed systematically from the deepest point of the workings, care being taken to ensure that the perimeter curtain wall is sufficiently far in advance. In no case shall infill holes be grouted until at least 6 hours have elapsed since the curtain wall grouting was completed and is at least three rows in advance of primary infilling.

Injection shall be carried out as described under general procedure, but immediately the grout tubes, or pipes, are withdrawn, the T-connection shall be attached to the top of the casing lining the hole down to rockhead, and further grout shall be injected up to the specified pressures.

## **6.6 Primary, Secondary and Tertiary Holes**

Where development proposals dictate, e.g., multiple small units, the adoption of grouting arrays can be approached on a plot-by-plot basis (including roadways and driveways where necessary). Primary grout holes shall be positioned on no less than a 6 m by 6 m grid with secondary and tertiary grout holes adopted subject to the levels of grout take within the primary grout holes the requirement for which is to be at the discretion of the Engineer.

Both primary, secondary, and tertiary grout holes shall approach in the same manner as perimeter curtain wall holes described previously in Section 4.0 and Section 6.4.

For tendering purposes, the Contractor is to allow for 25% of Secondary holes which would be located centrally in the grid of four Primary holes (orthogonally spaced at 3m to the 6m spacing alignment of the primary holes).

## **6.7 Reporting / Certification**

The Contractor shall issue a Certificate of completion for the treatment work itemising.

- the depth and position of each hole drilled,
- the condition of seams, shafts or cavities encountered,
- the quantity and type of grout injected, measured as tonnes of dry material,
- the quantity and type of other filling material used,
- any information related to underground workings bearing on future building development on the site, and stating the site is stabilised and fit for the proposed development, subject to suitable foundation design.

The client / employer will advise the contractor of any warranties required.

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## 7.0 Testing

The Contractor shall test the consolidated ground for permeability and strength.

Permeability by grout acceptance testing shall be checked by drilling test holes and injecting grout at pressures appropriate to the depth, all in accordance with the requirements for infill grouting. The Engineer will advise upon test positions however as a minimum allowance shall be made for test positions at a rate of 2% of total holes drilled or 6 locations whichever is the greater. If the quantities of grout accepted are excessive, further holes should be drilled and grouted.

After testing, holes shall be completed in accordance with the requirements for grouting infill holes.

Where deemed appropriate by the Engineer, the strength of consolidated ground shall be tested by taking sample cores either in newly drilled and cased holes or in re-drilled existing holes. When the samples have been taken, the hole shall be filled up with grout injected in accordance with the requirements for infill grouting.



## 8.0 Materials

The Contractor shall prepare and keep available for inspection site plans showing the positions and surface levels of all holes, and sections through the rows of holes to show the results of the Works, in particular the information included in the Daily Drilling Records (see below 20 items inclusive), together with the total amounts of grout injected. All levels should be given with reference to a datum to be determined.

Daily drilling records should be provided for each hole and should preferably contain the following information:

- Job title and location
- Hole reference number
- Date
- Contractor's name
- Plant in use, crew members and hours worked
- Method of boring or drilling, flushing medium and type of drill bit used
- Type, diameter, and depth of casing used.
- Diameter and depth of hole at the beginning and end of each working day or shift.
- Loss of any flushing medium during drilling
- Standing time, with reason, or time lost overcoming obstructions
- Details of underground services located
- Details of any settlement or ground heave
- Daily and cumulative length drilled
- Depth to each major change of stratum
- Description, with identification, of the stratum and whether it is intact or broken
- Depths at which groundwater is encountered
- Depths at which any samples are taken
- Details of any voids or suspended workings
- Details of any emissions of gas, water etc
- Depth of completed hole

Daily grouting records shall be provided for each hole and shall contain the following information:

- Job title and location
- Hole reference number
- Date
- Contractor's name
- Plant in use, crew members, and hours worked

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- Details of type of injection and grout-line dimensions (e.g., tremie injection through 25mm diameter line)
  - Type of grout mix and volumetric quantity injected
  - Grout pressures recorded, with the corresponding depths
  - Details of casing abandoned.

All records should be provided to the engineer in both paper and electronic (.xlsx) formats.

On completion of the works, a factual report detailing the works undertaken, the results of validation test holes, and a summary of all information should be provided to the engineer.

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