



SPECIFICATION FOR THE STABILISATION OF SHALLOW MINEWORKINGS, UNIT 4 SYMMETRY PARK MERSEYSIDE

TE1163-TE-00-XX-CM-GE-002-V01

VERSION 1.0

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FINAL

Prepared for:

Tritax Symmetry Ltd

Prepared by: Alex Preston

Tier Environmental Ltd

Warrington	London	Manchester	Bromsgrove	Bristol	Sheffield
HQ Telephone 01244 684900			Telephone 01925 818388		
Website: www.tieruk.com			Email: environmental@tieruk.com		
Tier Environmental is a trading name of Tier Environmental Ltd. Registered in England and Wales no 05441804					

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APPENDICES

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1. INTRODUCTION

Tier Environmental was commissioned by Tritax Symmetry Ltd to undertake the following reports to assess the land at the Former Cronton Colliery:

- Phase 1 Preliminary Risk Assessment Report for the Former Cronton Colliery. (Report Ref TE1163PRA1.2 dated 13th August 2020).
- Ground Investigation Report for Symmetry Park Merseyside (Report Ref TE1163GIR1.3 dated 1st December 2021).
- Supplementary Ground Investigation and Coal Mining Risk Assessment Report for Symmetry Park (Report Ref: TE1163-TE-00-XX-RP-GE-003-V01 dated 23rd June 2023)

The Ground Investigation Report recommended a programme of proof drilling together with the provision for grouting beneath the proposed building footprints owing to the presence of shallow coal workings across the entire site area. It is recommended that the proof drilling operations are conducted across each individual unit on a primary grid of 6 m grid, with sufficient extension beyond proposed building footprints and drainage/utilities.

Treatment of shallow mine workings is required to mitigate the potential risk of ground instability. The purpose of this document is to detail the site and geological setting of the site to allow for the development of a suitable programme of grouting at the site and to provide a specification for these works are to take place.

This document has been written in general accordance with the following reference material:

- BS 5930:2020 'Code of Practice for Ground Investigations';
- ENV 1997-1:1994 Eurocode 7: Geotechnical Design – Part 1: General Rules;
- CIRIA C758 Construction Over Abandoned Mine Workings;
- BS EN 12715:2000 Execution of Special Geotechnical Work – Grouting; and,
- CIRIA C514 Grouting for Ground Engineering.

An intrusive investigation was undertaken to assess the risk from historic coal mining activity within the commercial development. The investigations resulted in the following constraints associated with historic coal mining across the site:

- **Low risk** associated with the recorded mineworkings;
- **High risk** of unrecorded shallow mineworkings;
- **Moderate to high risk** of unrecorded mine entries;
- **Low risk** associated with opencast coal workings;
- **Moderate risk** of hazardous ground gases associated with historic coal mineworkings and the presence of coal seams beneath the Site.
- **Moderate risk** of hazardous ground gas in the vicinity of the coal mine entries.

Hazards associated with the drilling of relic coal workings stand to have severe consequences both during, e.g. initiation of collapses or forced migration of mine gases to nearby properties, and after, e.g. preferential pathways for the migration of mine gases, the works are completed and it is therefore recommended that reference is made to British Drilling Association's Code of Safety Drilling Practice.

1.1. Proposed Development

Under current proposals the Unit 4 area is to be developed as a commercial unit with associated roadways and hardstanding.



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Throughout this document the term "Engineer" shall refer to the authorised representative of Tier. The term "Contractor" shall refer to the specialist Contractor tendering for the location and treatment of shallow workings and/or mine shafts, if encountered.



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2. SITE DETAILS AND DESCRIPTION

Table 2.1 Current Site Overview.

Site name	Former Cronton Colliery
Site address	South of Halsnead Farm Livery Stables, Fox's Bank Lane, Cronton, L353SU. A site location plan is included as Drawing No. TE1163GIR1 within Appendix A.
National Grid Reference	SJ 47493 89537
Location description	The Site is located south of the M62 in a predominantly agricultural area. The closest town is Whiston which is 2.3 km North of the Site.
Approximate Site area	50.84ha
Site shape	Irregular with the longest axis in the east to west direction and the shortest axis being in the north to south direction.
General topography and ground levels	The Site is generally undulating with ground levels in the north of the Site ranging from 44m AOD in the east to 24m AOD in the west. The southern area of the site is a plateau at 34m AOD with a steep slope towards the south to 25m AOD. Ground levels in the eastern area of the site generally decrease from 48m AOD to 40m AOD in the west and 34m AOD in the east and south.
Existing structures	There are 3 No. mine gas vent pipes located within the centre of the site (outside of the development area) overlying the 3 No. old mine shafts used by the former colliery. High voltage overhead electricity pylons transect the site east to west.
Site ground surfaces	The northern agricultural section of the site is covered by arable land. The central and southerly sections are comprised of immature woodland, scrubland with exposed colliery spoil surficial gravelled expanses.



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3. GROUND CONDITIONS SUMMARY

Made Ground was encountered from depths between ground level to depths greater than 14.50m bgl. Total Made Ground thickness was highly variable, but it was observed to be thinner in the north of the site. Made Ground generally consisted of colliery spoil amalgamated with some anthropogenic constituents which included brick, rubber, glass, concrete, slag and coal in the south of the Site. In the northern sections of the Site Made Ground was generally composed of reworked topsoil material consisting of sandy silty loam. Some areas within the north contained no Made Ground. Localised areas of demolition rubble were observed within the former footprints of infrastructure related to the colliery. Within the colliery spoil heaps, in the east of the Site very soft grey clayey silt was encountered from between approximately 4.00m bgl and 14.20m bgl. This material is believed to have been excavated from the old colliery settlement ponds and lagoons around the Site and deposited here in 1995.

Materials representative of Till Deposits were encountered across the Site. This stratum was encountered as dark brown and light brown slightly sandy gravelly clay or as a gravelly sand. SPT N values achieved within this unit ranged from 4 to 78, indicative of low to very high strength soils. The base of the Till deposits was proven at 13.40m bgl at its deepest extent across the site or at elevations between 32.20m AOD and 37.95m AOD.

Bedrock across the majority of the site was observed to be strata from the Pennine Middle Coal Measures Formation with the Kinnerton Sandstone Formation encountered within the east of the site. A north-south trending normal fault is shown to separate the two units on BGS geological maps. The weathered Pennine Middle Coal Measures was encountered as a sandy gravelly clay, whilst the weathered Kinnerton Sandstone Formation was encountered as a slightly gravelly silty sand. Both increased in strength or density with depth. The competent rockhead was encountered between 37.94m AOD and 20.82m AOD, the base of these strata was not encountered.

Groundwater observations indicate that there are perched groundwater bodies present locally across the site, within the colliery spoil and locally within the Till Deposits. The minimum groundwater level during monitoring to date is 0.26m bgl (21.80m AOD). Seasonal variations in the groundwater level should be anticipated.

3.1. Coal Seams Encountered

A summary of the encountered intact coal seams encountered during all the known investigations for the Site is given in Table 3.1.

Table 3-1 Summary of Observed Coal Seams

Borehole ID	Depth of Coal Seam (m AOD)	Thickness (m)	Observations
1999 Parkman Investigation			
P1/2	25-24.30	0.70	N/A
P1/3	20.85-20.20	0.35	N/A
P1/4	19.90-19.30	0.60	N/A
P1/7	17.40-17.00	0.40	N/A
P2/2	30.16-28.90	0.26	N/A
P2/5	25-24.50	0.50	N/A
P2/7	27-26	1.00	N/A
2003 Soil Mechanics Investigation			
P1/10	11.98-12.40	0.42	N/A
P1/11	15.40-15.85	0.45	N/A
P4/09	19-19.56	0.56	N/A
P4/10	19.4-20.0	0.60	N/A
2020 Tier Environmental			



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Borehole ID	Depth of Coal Seam (m AOD)	Thickness (m)	Observations
RB101	21.11-21.51	0.40	N/A
	17.11-16.61	0.50	N/A
RB105	4.80-5.00	0.20	N/A
TP126	33.23-32.23	1.00	Black bituminous coal
2023 Tier Environmental			
RB401	27.34-26.34	1.00	N/A
RB403	19.69-18.79	1.10	N/A
RB404	28.91-28.11	0.80	N/A
RB407	6.63-6.03	0.60	N/A
RB409	6.26-5.56	0.70	N/A
	13.96-13.76	0.20	N/A
RB410	17.30-16.10	1.20	N/A
RB412	14.08-13.48	0.60	N/A
RB413	23.91-23.01	0.10	N/A

3.2. Evidence of Mine Workings

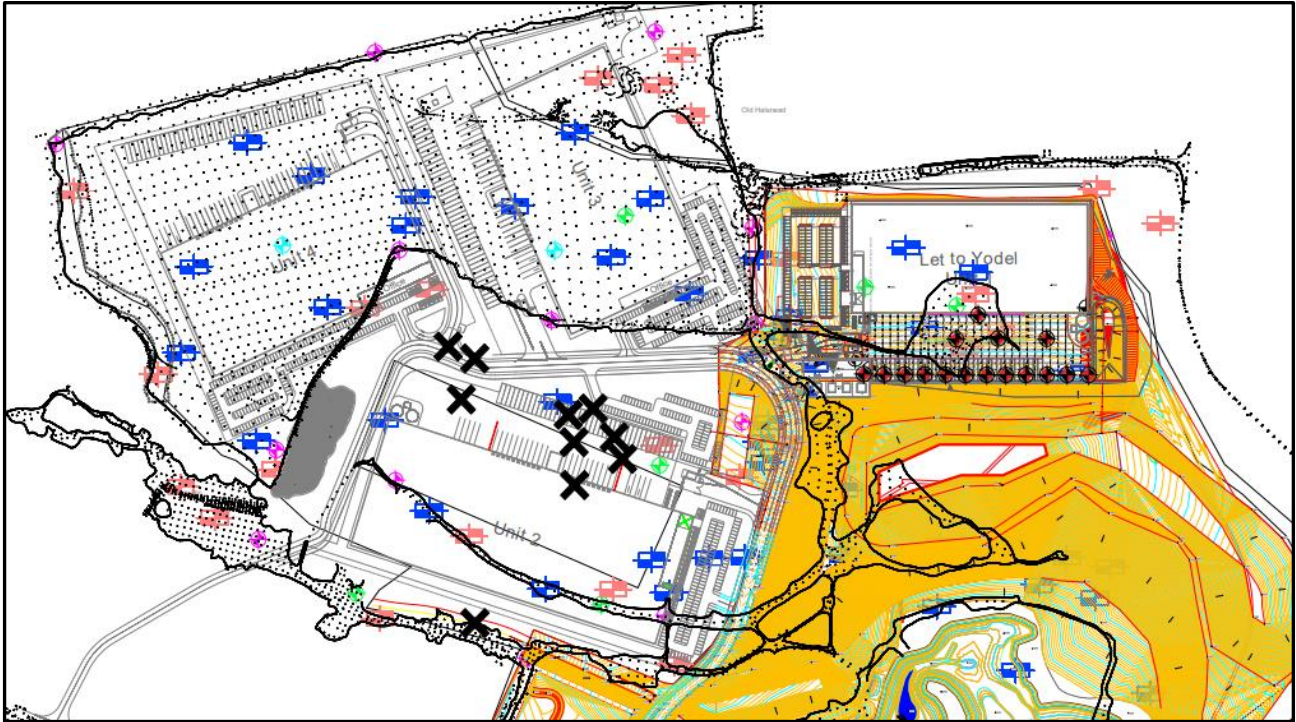
A summary of the evidence of potential shallow mineworkings from known investigations is presented in Table 3.2

Table 3-2 Summary of Mineworkings

Borehole ID	Depth of Coal Seam (m AOD)	Observations
1999 Parkman Investigation		
P1/5	20.10-19.40	Loss of flush
	19.40-17.90	Very loose material
P1/6	22.20-21.00	Change in flush, very dirty returns
P2/1	30.00	Loss of flush
	28.00-27.70	Core barrel drop
	26.00	Borehole caving in
P2/4	30.00-27.00	Void
P2/6	25.00-22.00	Loss of flush
P2/7	26.00-22.00	Mineworkings
P1/10	15.62-16.22	Loss of flush
P2/10	18.00-16.00	No core return
2003 Soil Mechanics Investigation		
P2/13	24.00-25.70	No core return
	13.85-15.00	No core return/ loss of flush
P2/14	6.00-10.00	No core returns/ mineworkings
2023 Tier Environmental Investigation		
RB408	27.60-27.20	Weak, lost 100% flush

Figure 3.1 below highlights the location of the potential mineworkings encountered during all intrusive investigations with an 'X'.

Figure 3-1 Location of encountered mineworkings



3.3. Surface Subsidence

The third-party reports highlight evidence of historic hummocky ground present on site, located west of the mine shafts. This indicates that there was previously some localised subsidence in this area that may be indicative of the presence of bell pits and shallow workings. There was no evidence of surface subsidence encountered during the recent investigations but the likely area of the hummocky ground was covered during the regrading works during the 1990s. These observations may also indicate mounded spoil around bell pits.

Figure 3-2 Historic Aerial Image Showing Potential Hummocky Ground



3.4. Opencast Workings

During all phases of investigations, no evidence of opencast workings have been identified. Localised unrecorded opencast workings may have occurred in the vicinity of the subcrop of the Worsley Four Feet seam.

3.5. Unrecorded Mine Entries

During all phases of investigations, no unrecorded mine shafts have been identified. However, due to the outcropping coal seam, hummocky ground previously identified and the historical extensive coal mining undertaken across the south-western area of the Site, it is considered likely that unrecorded mine entries (bells pits, shafts or adits) are present at the Site.

3.6. Recorded Mineworkings

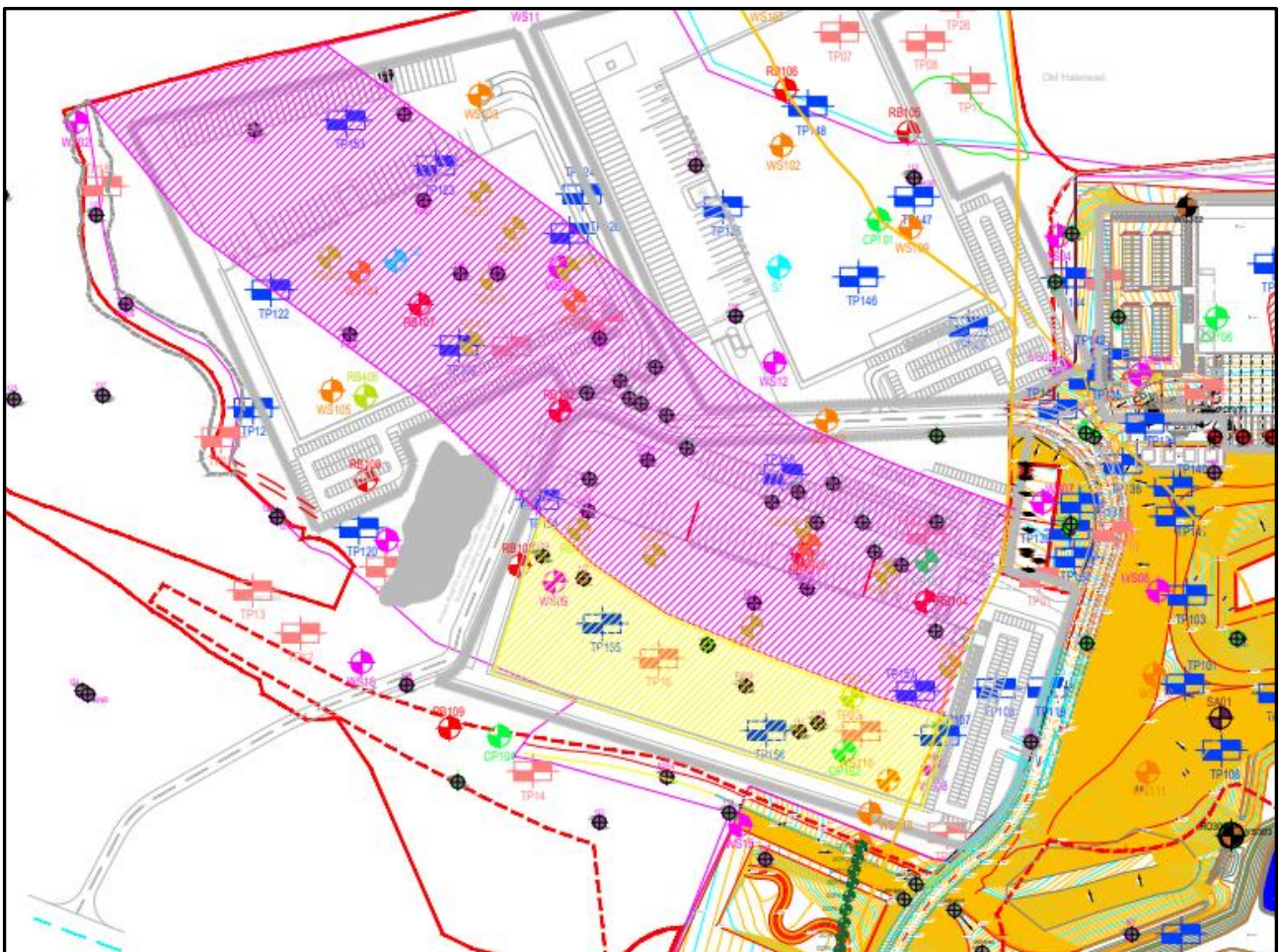
Coal Authority records indicate deeper coal seams (from 85m bgl to 558m bgl) were worked beneath the Site. However, it has been assumed that with the substantial overburden pressure at depths, any consolidation of these workings has already occurred.

CIRIA C758D outlines that void relating to coal extraction are unlikely to migrate more than 10 times seam thickness in bedrock. Whilst this 'rule of thumb' may be considered over-cautious in most circumstances, given the near impossibility in gathering enough data for numerical modeling techniques, it has been decided that it provides a reasonable assurance against surface subsidence at the Site. When applying this method, the seam thickness has only been compared to bedrock cover. In areas where more than one seam is thought to have been extracted, the depth between the seams has been compared to seam thickness. The largest seam thickness abstracted is recorded at 330cm thick; this would mean an adequate overburden of 33m is required. It is therefore considered that the deeper mineworkings do not pose a significant risk to the proposed development.

3.7. Discussion

The Worsley Four Foot coal seam is recorded as dipping towards the south-west with an average dip of 7°. Therefore, the coal seam is present at greater depths in the south and southwest of the Site. It is considered that approximately 100m - 125m south of the inferred seam location that there would be sufficient depth of overburden/bedrock, therefore a low risk of shallow mineworkings affecting the proposed development. As shown on Figure 3.2, the red hatched area represents the parcel of land at greatest risk of surficial subsidence.

Figure 3-3 Location of approximate area at greatest risk from shallow mineworkings



The western area of the Site is considered to be at risk from potentially unrecorded shallow coal mining. Evidence of unrecorded workings was encountered within 11 No. out of 56 No. boreholes undertaken throughout all investigations at the Site. In the central, southern and western areas of the Site, multiple boreholes encountered either broken ground, voids, no core return, flush change, a loss of flush or extremely weak strata, all are indicative of potential historic mineworkings.

Due to the nature of different types of evidence encountered (voids, loss of flush and weak strata) it is presumed that some of the encountered workings are collapsed whilst some are still intact. The presence of collapsed workings is expected given the workings are likely from pre 1900 (>120 years old). It is considered that the risk of unacceptable settlement or collapse is high in these areas. As a precautionary measure to avoid unacceptable total



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and differential settlements affecting the proposed development, it is recommended that the area of shallow mineworkings is stabilised by a series of drilling and grouting. There are no recorded shallow workings, or evidence of unrecorded workings, in the eastern sections of the Site. This area of the Site is underlain by the Kinnerton Sandstone Formation to a maximum proven depth of 20m bgl. It is considered that this section of the Site will not require stabilisation works; **however, proof grouting stabilisation works will be required beneath units 02 and 03.** As the earthworks is progressed an inspection of the Site will be undertaken, to identify any potential unrecorded mine entries.



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4. SCOPE OF WORKS

4.1. Coal Authority Permits

Tier will be responsible for obtaining the relevant Coal Authority permit(s) for the proposed stabilisation works. Reference should be made to the previous permits obtained by Tier (Ref. 20570).

4.2. Grouting Operations

As detailed above, the key elements for consideration as part of the grouting operations are:

- The geology is complex locally with faulting and the site lies within the Lancashire Coalfield;
- The geology dip angles generally vary between 5° and 10° due to folding and possibly secondary faulting;
- **Low risk** associated with the recorded mineworkings;
- **High risk** of unrecorded shallow mineworkings;
- **Moderate to high risk** of unrecorded mine entries;
- **Low risk** associated with opencast coal workings;
- **Moderate risk** of hazardous ground gases associated with historic coal mineworkings and the presence of coal seams beneath the Site.
- **Moderate risk** of hazardous ground gas in the vicinity of the coal mine entries. ; and,
- Proof bulk filling/grouting is required on 6m primary and possible off-set 6m secondary grid and tertiary grid (subject to drilling records and grout takes), underlying the building footprint. A 12m grid will be used in external areas and under roads

Preliminaries

The contractor is to submit site specific Health and Safety Plan, Risk Assessments and Operation Method Statements for the Grouting Operations, including all temporary works details for approval by Tier and the Developer.

Grouting Operations - Shallow Mine Workings (Coal)

The grouting operations will comprise bulk grouting beneath the proposed building footprint Unit 4 and service/utility corridors and are to be undertaken in accordance with the Grouting Specification (Section 5 of this document). At this stage, it is envisaged that the Grouting Programme will broadly comprise:

- Mobilisation to site.
- Installation of safety measures.
- Drilling and proof grouting on a Primary Grid of 6m
- Drilling and grouting of Secondary Grid dependent on findings of Primary Grid.
- Drilling and grouting of a Tertiary Grid dependent on findings of Secondary Grid. This is likely to be localised where grout takes have been excessive, unable to maintain grout pressures and/or uncertainty remains.
- Validation of grouting operations, including testing of the grout.
- Demobilisation from site.



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Proof grouting drill and grout holes are proposed beneath the proposed buildings (Unit 04) as shown on Tier Drawing Ref TE1163-TE-00-XX-DW-GE-029-V02 & TE1163-TE-00-XX-DW-GE-028-V01 within Appendix A. Additional probe and grout boreholes are likely to be required beneath the proposed access roads and proposed services/utility corridors in general accordance with the Grouting Programme outlined above.

The primary holes drilled under the building footprint will be drilled on a 6m grid and the secondary centre holes will be drilled offset to the primary holes on a 3m grid. Drilling and grouting of a tertiary grid may also be required, dependent on findings of the secondary grid. The tertiary grid is likely to be localised where grout takes have been excessive, unable to maintain grout pressures and/or uncertainty remains.

Proof drilling and grouting to a maximum depth of approximately 30m is considered sufficient. As the works progress a review should be undertaken to assess reducing the depth of grouting to shallow depths if possible. Boreholes should be drilled to a minimum of 5m below the shallowest coal seam and a minimum of 20m below rockhead if no coal is present. Borehole depths will be continuously reviewed during the works.

Casing is likely to be required in order to achieve sufficient socket into the bedrock deposits encountered at depths of between of 4m and 10m bgl to ensure that the pressurised grout is injected into the correct strata and not say, into the Made Ground backfill.

The lower limit on the main grouting operations has been set at 30.0m below ground level. However, if a phased programme of works is undertaken within each unit, a reduction in grouting depth may be achievable depending on the findings of the stabilisation works.

Grout compositions and mixes have been designed in order to maintain a sufficient viscosity to infill voids (*bulk grouting*) and limit the potential for progressive collapses to occur within the workings with the strength characteristics of the grout mix a secondary consideration.

Grout will be injected in a bottom-up, ascending stage fashion from the base of the drill hole using a tremie pipe and employing the use of a packer (*if required*) to maintain sufficient injection pressures across each stage. Stages shall initially be set at 1.0m lengths to be increased, up to 2.5m lengths, at the discretion of the Engineer and subject to the findings of the initial drill hole.

However, a top-down grouting system may be more favourable given the number of seams.

Grout pressures shall generally be low with an upper limit of the overburden pressure up to a maximum limit of 200kN/m².

Completion of the on-site grouting operations shall be confirmed once all primary drill holes (and any secondary and tertiary drill/grout holes) have been successfully drilled and grouted together with validation drill holes and a complete pack of drill and grout records have been supplied to the Engineer for approval. Completion of the contract shall be confirmed once the Contractor has submitted their Completion Report to the Engineer and approval of the works has been confirmed.

Grouting Operations - Mine Entries

No recorded mine entries are shown to be present within the Site boundary and no unrecorded mine entries were encountered during the intrusive works. Due to the shallow coal encountered underlying the Site and the presence of extensive underground workings, it is considered likely that further unrecorded shafts and bell pits are potentially present. If a suspected mine entry is encountered, the Engineer should be consulted to fully appraise the Health and Safety risk.

Actions required if and where a mine entry is identified are included within the specification. If or where evidence of a mine entry is encountered, e.g. backfill, voiding or loose ground from shallow depths, the Contractor shall cease operations and inform the Engineer immediately.



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Ground Improvement – Mine Entries

To mitigate the risks from any unrecorded mine entries in the northern external areas of Unit 4, initially boreholes will be drilled and grouted on a 12m grid. Following this during the earthworks rolling dynamic compaction will be utilised, this process will improve approximately 3m of the colliery spoil. This should then identify any unrecorded mine entries at the surface as depressions, as these areas may settle further. This is because although the improvement (compaction / consolidation) is generally limited to 3m in this material as a rule. The energy from the process is felt still beneath this level. Thus if loser materials are present at the base of the colliery spoil these could settle further. Any depressions at the surface will then be treated and compacted further by one of the following methods:

- Rapid Impact Compaction.
- Drill and Grouting.
- Compaction with imported Type 1 stone.

4.3. Reporting

Once completed, the contractor is to submit a completion report for the stabilisation works, including copies of all records detailed in Section 5.6 of the Grouting Specification, and a Warranty for the works completed, exact details to be confirmed with successful Contractor during the appointment process.

4.4. Risk Assessments, Method Statements and Insurance Details

The contractor will be required to supply site specific risk assessments, method statements and insurance details for the stabilisation works.

Recommendations and supporting information provided herein are indicative and the contractor should satisfy themselves of the provision of suitable health and safety measures within their method statements.

Mine Gases

The relic shallow coal mine workings serve as potential repositories for mine gases to accumulate. The mining of coal deposits and subsequent abandoning of the workings may have given rise to the accumulation of carbon dioxide, carbon monoxide, methane and hydrogen sulphide. Notwithstanding the potential presence of mine gases within the workings, the use of water flush within the probe holes and subsequent grout injection will result in only limited displacement of these gases and therefore the risk presented to adjacent sites is considered to be **Low/Moderate**.

The close monitoring of mine gases at the drill site should be undertaken as a matter of course and in accordance with the regulations with the Contractor making allowance for this within their Health and Safety Plan, Risk Assessments and Operation Method Statements. If and where evidence of elevated concentrations of mine gas are recorded at the drill/grout positions, then off-site mitigation/measurement may be considered at the discretion of the Engineer.

Current ground gas regime has been assessed by Tier as part of the recent ground investigation works. Results of that monitoring indicate that, in its current state the site is assessed as CS2 – low risk scenario for which ground gas protection measures are required.

If wells proposed to be maintained are damaged, the Engineer should be informed immediately.



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Utility Mapping

The client is to provide relevant public utility suppliers service plans and/or a scan of the site utilities prior to commencement of any intrusive works.

Thereafter, the Contractor is to allow for confirming that the site is free from live services in the location of the exploratory holes or otherwise by use of appropriate equipment, such as CAT and genny, GPR or other appropriate surveys.



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5. SPECIFICATION

5.1. Preliminaries

- 5.1.1. In this Specification the term "Engineer" shall refer to the authorised representative of Tier. The term "Contractor" shall refer to the specialist Contractor tendering for the location and treatment of shallow workings and/or mine entries, if encountered.
- 5.1.2. All work shall be carried out strictly in accordance with the "Treatment of Disused Mine Shafts and Adits" as issued by the NCB and CIRIA C758 "Construction over abandoned mine workings".
- 5.1.3. Before submitting their tender, the Contractor shall visit the site. The tender shall include any costs likely to be incurred in gaining access to the site with plant and materials including removing fencing and reinstating same at the completion of the work.
- 5.1.4. 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.
- 5.1.5. Any points not so noted and itemised, or cost details not included shall be deemed to be covered in the tender figure.
- 5.1.6. The Contractor shall comply in all respects with local bye-laws with particular regard to noise, smoke and parking for off-loading, etc.
- 5.1.7. The Contractor shall state in their tender the type and number of machines and drilling rigs he intends to use on site and their method of operation.
- 5.1.8. 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.
- 5.1.9. 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 he will require to be provided.
- 5.1.10. Any item not so noted shall be assumed to be covered in the tender figure.
- 5.1.11. The Contractor shall state in their tender the amount of notice he requires before beginning work. Any costs incurred by delays in beginning operations shall be borne by the Contractor.
- 5.1.12. 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.
- 5.1.13. The Contractor shall provide and erect adequate fencing around all excavations and shafts if they have been located. If deemed necessary by the Engineer, the Contractor shall provide a watchman together with all necessary equipment and accommodation on site.
- 5.1.14. 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.



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- 5.1.15. All safety procedures relevant to mine workings are to be adhered to and reference made to precautions to be taken as referred in Coal Authority document "The Treatment of Disused Mine Shafts and Adits".
- 5.1.16. Mine entries may potentially be encountered within the development. If encountered, the Contractor shall be responsible for arranging, where necessary, for a Coal Authority Surveyor to visit the site to determine that a disused mine entry has been located and that it has been securely fenced and to make the necessary tests for noxious gases.
- 5.1.17. 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 entry has been found, and to test for noxious gases.
- 5.1.18. 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 (and permit requirements) for the duration of the contract.
- 5.1.19. The Contractor will be provided with all information available concerning services under the site. In some cases it may be necessary, at the discretion of the Contractor, to begin boring or excavations with a hand excavation to a depth of 1.20 metres, to avoid service or drainage runs. Any damage to such services or drains under the site shall be the responsibility of the Contractor and he shall ensure at the time of tendering that, should precautions be necessary, they are included in the tender.
- 5.1.20. The intrusive investigation indicates a moderate likelihood of mine entries on site within the development area. If encountered, the Contractor must be prepared to have to remove obstructions including old foundations when searching for mine entries and a rate must be included in the tender for clearing any such obstructions.
- 5.1.21. The Contractor shall provide the Engineer with two copies of a boring record detailing items required by the Engineer, for every hole bored, as the work proceeds. He shall also give the Engineer or Clerk of Works sufficient notice to enable them to check and agree the length of penetration of each hole bored.
- 5.1.22. No conditions requested by the Contractor with their tender shall override any clause in this Specification.
- 5.1.23. Should a Contractor require modification to any clause he shall apply in writing to the Engineer before submitting their tender.
- 5.1.24. On completion of the work the Contractor shall remove from site all unwanted materials and plant.
- 5.1.25. 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.
- 5.1.26. The Contractor shall be responsible for all setting out and location of the existing mine entries/workings as per the development layout contained within Appendix A.
- 5.1.27. Unrecorded mine entries are likely to be present based on the ground investigation. However, if encountered the Contractor shall submit with their tender details of the method he proposes to adopt to locate the disused mine shafts and/or adits. Once mine entries are located the Coal Authority will be informed and an agreed upon method of making them safe will be confirmed before any work takes place.
- 5.1.28. Tier are to provide supervision during the grouting works, with attendance based on work load and programme.



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- 5.1.29. A plan will be available to the Contractor showing the extent of the grouting within the commercial development on the site to be treated (TE1163-TE-00-XX-DR-GE-029-V01 - Unit 4 Road grouting plan and TE1163-TE-00-XX-DR-GE-028-V02 – Unit 04 Grouting Plan in Appendix A). The Contractor shall ensure that the proposed treatment works will be adequate in terms of the proposed development.
- 5.1.30. 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.
- 5.1.31. 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.



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5.2. Materials

- 5.2.1. 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.
- 5.2.2. 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.
- 5.2.3. Water shall be from an agreed upon source. Ideally mains supplied or other source approved by the Engineer.
- 5.2.4. 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.
- 5.2.5. Pea gravel shall comply with BS EN 12620:2013, grading and chemical testing approved by the Engineer.
- 5.2.6. 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.
- 5.2.7. Pulverised Fuel Ash (PFA) for use in grouts shall comply with BS EN 450-1:2005 (+A1:2007). Its source of supply shall be to the approval of the Engineer, and certificates of compliance with BS EN 450-1:2005 (+A1:2007) shall be provided by the Contractor to the Engineer for all the material used.
- 5.2.8. Portland cement/PFA grout shall comply with the requirements of BS EN 197-1:2011.
- 5.2.9. 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.
- 5.2.10. Cement for sand and cement grouts shall be Sulphate Resisting Portland Cement to of BS EN 197-4:2011; cement for use with PFA shall be Ordinary Portland Cement (OPC) to BS EN 197-1:2011.
- 5.2.11. Sand and cement grouts shall be made with an approved super-plasticiser. Sand grading shall be determined by the Contractor to achieve the required performance.
- 5.2.12. 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.
- 5.2.13. If and where end tipping is deemed a viable and safe methodology for the filling of open voids, e.g. mine shafts, the selection and use of granular bulk filling materials shall be subject to the approval of the Engineer.



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5.3. Grouting Plant

- 5.3.1. The Contractor shall submit to the 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.
- 5.3.2. 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 Engineer.
- 5.3.3. The grout mixer shall be capable of producing a homogeneous mix, all particles being thoroughly wetted without segregation occurring.
- 5.3.4. 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.

5.4. Grout Mixes

- 5.4.1. Before work commences, the Contractor shall confirm to the Engineer a selection of grout mixes likely to prove satisfactory for the conditions. Alternatively, the Engineer may specify the mixes. The Contractor shall prepare cubes, of an agreed size, representative of the mixes agreed, and he 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 Engineer. Where time permits, the results of the tests shall be furnished to the Engineer prior to commencement of grouting operations.
- 5.4.2. 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 75kg/m³ in dry or unsaturated conditions. In waterlogged workings, the minimum cement content may be raised to 100kg/m³ to allow for dilution effects.

II. **Primary grouting positions, 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 100kg/m³ in dry or unsaturated conditions. In waterlogged workings, the minimum cement content may be raised to 125kg/m³. 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 a hopper, to form a cone of side slope greater than 35 degrees.



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III. Secondary and tertiary grouting positions or infill grouting

- Cement: PFA = 1:12 to 1:20
- The cement content should not be less than 50kg/m³ of mixed volume in dry or unsaturated conditions. In waterlogged workings, the minimum cement content may be raised to 75kg/m³.

5.4.3. The design, 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.

5.4.4. If PFA is not able to be sourced, sand can be used as the component of the grout mix. Ideally use of sand will be limited to working within voids greater than 0.5m thickness. Where sand is proposed in small voids/ broken ground, additional and increased testing using PFA:Cement only mixtures is required. Sand used should be fine grained and grains should be rounded. Grading certificates should be provided by the contractor.



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5.5. Grout Properties and Testing

- 5.5.1. 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 300mm to 600mm when measured in a meter of the 'Concrete' type.
- 5.5.2. High bleed grouts shall be avoided and the bleed capacity shall be limited to 5% maximum.
- 5.5.3. 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 1,000ml. 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.
- 5.5.4. The mixes shall produce cubes with crushing strengths of **not less than 1.0N/mm² (1MPa) at 28 days**.
- 5.5.5. The actual proportions to be used initially for the various grouts shall be determined by the Engineer, according to the conditions met in drilling and the results of any cube testing or trial grouting carried out before work commences.
- 5.5.6. 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.
- 5.5.7. The Contractor shall check the lucidity of the grout on site during operations by means of a flow meter. Bleed capacity after 2 hours shall be monitored by means of a graduated beaker. For strength testing, the Contractor shall make sets of six test cubes of an agreed size and taken from the grouting, at surface positions, 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.
- 5.5.8. If the 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.



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5.6. Drilling and Grouting Procedures

Drill Procedures

- 5.6.1. 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 a minimum of the pavement of the old workings. The drilling system and flushing medium to be used shall be approved by the Engineer. The minimum diameter of holes shall be 50mm unless otherwise specified by the Engineer. When it is impracticable to drill at the minimum diameter for the full depth, the diameter of the holes shall be increased in the upper lengths.
- 5.6.2. 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.
- 5.6.3. 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.

Grouting Procedures

- 5.6.4. The Contractor shall stabilise by grouting all worked seams, voids and cavities as directed by the Engineer. The maximum drill depth anticipated is 30m with a review during the works to potentially reduce the depth as the data set is enhanced and made clearer. Liaisons with Coal Authority will be undertaken to agree this reduction if it arises.
- 5.6.5. The Contractor shall be responsible for ensuring that the grouting has completely stabilised all voids, broken ground, cavities, worked seams, adits or shafts, encountered in the boreholes.
- 5.6.6. 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.
- 5.6.7. 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.
- 5.6.8. The grout shall be injected at the approved rates until either a limiting pressure of 10kN/m² per m overburden or a maximum of 200kN/m² 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.
- 5.6.9. 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.
- 5.6.10. 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 hours, 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 hours and the process shall be repeated with further quantities of 5 tonnes. **If the hole is still accepting grout after a total of 50 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 such as secondary or test holes are required.**



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- 5.6.11. 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 10kN/m² per m of overburden with an upper limit of 200kN/m² whatever the depth, as the casing is withdrawn.
- 5.6.12. Care shall be taken to ensure that uplift pressures are not allowed to develop under any adjacent infrastructure, including the M6 slip road and the proximal National Grid and United Utilities services, during grout injections. Where there is the potential for any nearby infrastructure to 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.

Primary and Secondary Holes

- 5.6.13. Primary grout holes shall be positioned on no less than a 6m by 6m square grid with secondary grout holes adopted at an offset 6m by 6m square grid, 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. Secondary and tertiary holes may be required dependent on grout takes.
- 5.6.14. If grout takes within the secondary holes are excessive or there any doubt, tertiary holes will be drilled as specified by the Engineer.

Reporting / Certification

- 5.6.15. The Contractor shall issue a Certificate and Warranty (exact requirements to be confirmed to successful Contractor) upon completion of the treatment work itemising:
- I. the depth and position of each hole drilled.
 - II. the condition of seams, shafts or cavities encountered.
 - III. the quantity and type of grout injected, measured as tonnes of dry material.
 - IV. the quantity and type of other filling material used.
 - V. 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.
 - VI. Tier to provide a Completion Report in addition to Factual Remedial Works Report from the Contractor.



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5.7. *In Situ* Testing

- 5.7.1. The Contractor should consider the need to test the consolidated ground for permeability and strength.
- 5.7.2. Permeability by grout acceptance testing should 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. If the quantities of grout accepted are excessive, further holes should be drilled and grouted.
- 5.7.3. After testing, holes shall be completed in accordance with the requirements for grouting infill holes.
- 5.7.4. Where deemed appropriate, 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.



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5.8. Records

5.8.1. The Contractor should 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, inclusive of the Daily Drilling Records (see below), together with the total amounts of grout injected. All levels should be given with reference to a datum to be determined.

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

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

5.8.3. Daily grouting records should be provided for each hole and should preferably contain the following information:

- I. Job title and location
- II. Hole reference number
- III. Date
- IV. Contractor's name
- V. Plant in use, crew members, and hours worked
- VI. Details of type of injection and grout-line dimensions (e.g. tremie injection through 25 mm diameter line)
- VII. Type of grout mix and volumetric quantity injected
- VIII. Grout pressures recorded, with the corresponding depths
- IX. Details of casing abandoned.

5.8.4. The Contractor will be required to provide a Warranty for the remedial works undertaken. The exact warranty terms and requirements will be confirmed with the successful Contractor prior to commencement of the works.



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**SPECIFICATION FOR THE STABILISATION OF
SHALLOW MINeworkINGS, UNIT 4 SYMMETRY
PARK MERSEYSIDE**

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7. GLOSSARY OF TERMS

ACEC	Aggressive Chemical Environment for Concrete (classification)
aOD	Above Ordnance Datum
bgl	Below ground level
BGS	British Geological Survey
BRE	Building Research Establishment
CBR	California Bearing Ratio (test)
COMAH	Control of Major Accident Hazards (regulations)
Designated location	Site (and the ecosystem on that site) protected under national or international legislation. A potential ecological receptor to be considered as part of the assessment of land contamination. Example designated locations include SSSIs (q.v.), SACs (q.v.), national nature reserves, Ramsar sites and bird special protection areas.
DQA	Data Quality Assessment
DQO	Data Quality Objective
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EQS	Environmental Quality Standard
GAC	Generic Assessment Criterion
GQA	General Quality Assessment (Environment Agency)
GSV	Gas Screening Value
HCV	Health Criteria Value
IPPC	Integrated Pollution Prevention and Control (regulations)
K _{ow}	Octanol-water partition coefficient
LEL	Lower Explosive Limit
LL	Liquid Limit
LoD	Limit of Detection (analytical)
LoQ	Limit of Quantification (analytical)
Mean Value Test	Statistical test (described in the CIEH Guidance) to estimate the mean value of a normally distributed population of data at a given level of confidence. Normally for contaminated land assessment, the 95th percentile (referred to as the 95%UCL or US95) is applied as a reasonable but conservative estimate of the mean concentration for comparison with the relevant assessment criteria.
Maximum Value Test	Statistical test (described in the CIEH Guidance) to identify whether an elevated concentration within a normally distributed data set forms part of the underlying population from which it has been sampled or whether it is an outlier (such as a localised area of contamination) that merits further consideration.
MC	Moisture Content
NGR	National Grid Reference
NIHHS	Notification of Installations Handling Hazardous Substances (regulations)
OS	Ordnance Survey
PI	Plasticity Index
PID	Photoionisation Detector
PL	Plastic Limit
ppm	Parts per million
ppmv	Parts per million by volume
QA	Quality Assurance
QC	Quality Control
SAC	Special Area of Conservation
SOM	Soil Organic Matter



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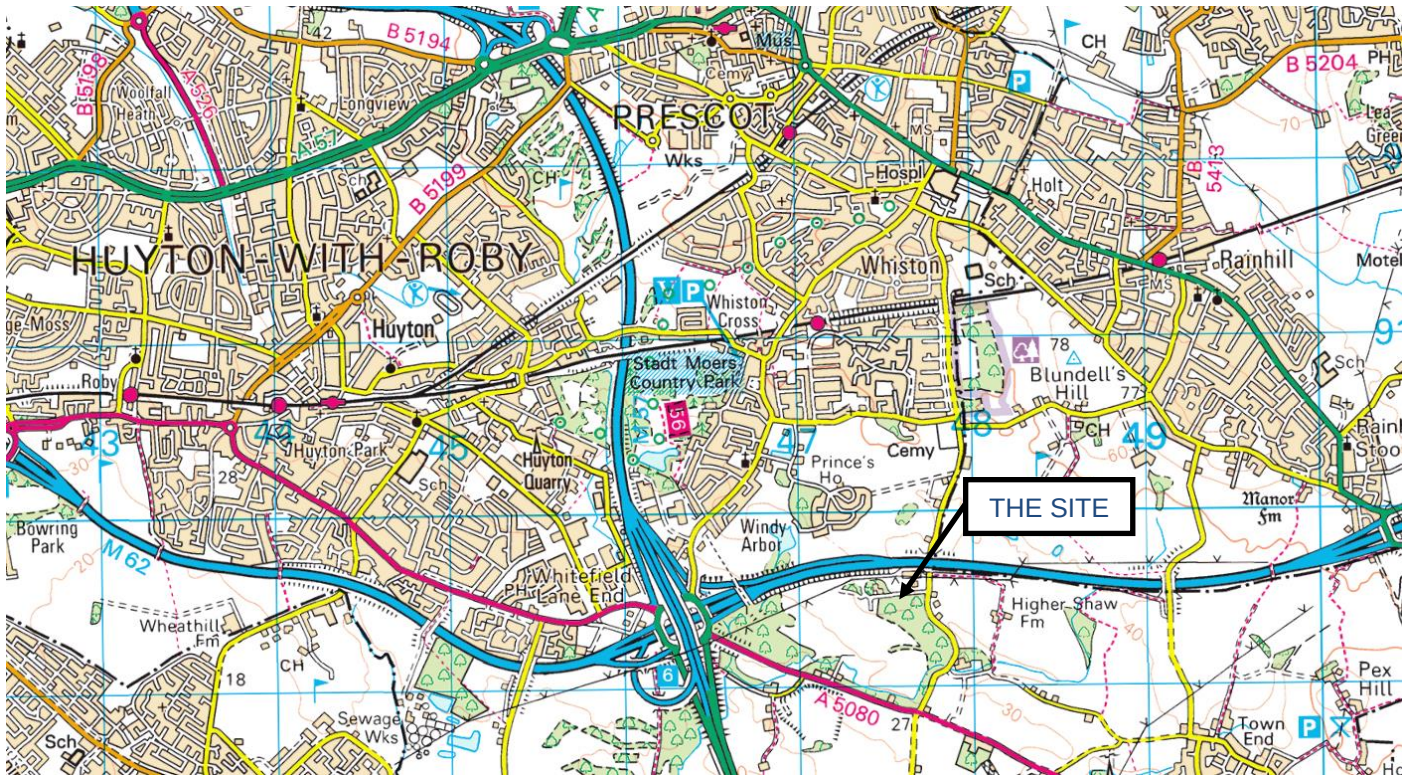
SPT	Standard Penetration Test
SPZ	Source Protection Zone
SSAC	Site-Specific Assessment Criterion
SSSI	Site of Special Scientific Interest
SVOC	Semi-Volatile Organic Compound
TEF	Toxicity Equivalent Factor
TPH	Total Petroleum Hydrocarbons
TWA	Time Weighted Average
US95	95 th percentile estimate of the true mean value of a data population (also known as 95%UCL).
VOC	Volatile Organic Compound

APPENDIX A - DRAWINGS



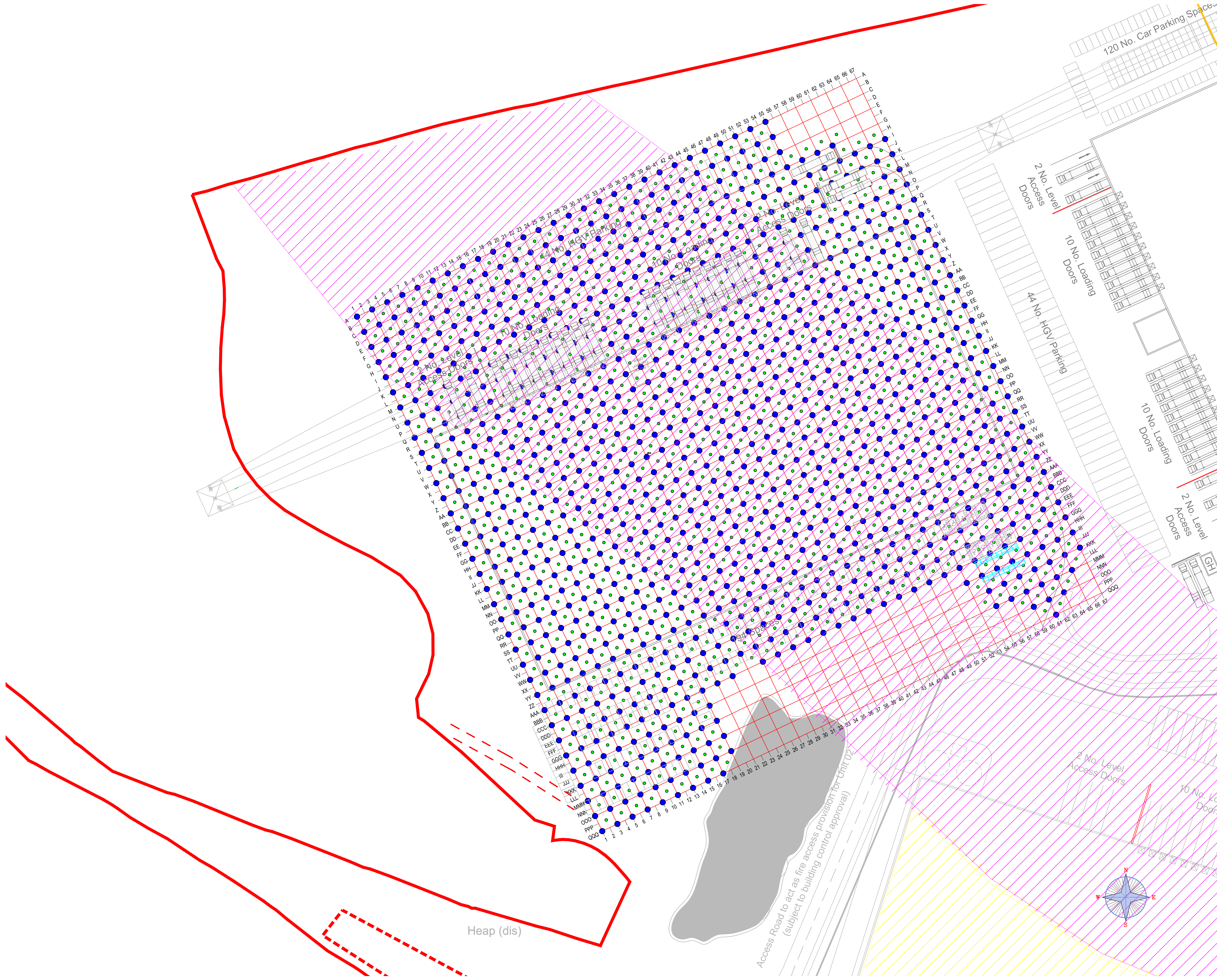
Contract Number	TE1163
Contract	Former Cronton Colliery Site
Client	DB Symmetry

Site Location Plan



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Scale	NTS		
Drawn by	JC	Approved	SL
Drawing Number	TE1163GIR1		



DO NOT SCALE



LEGEND

- Primary Borehole locations
- Secondary Borehole Locations
- AREA THAT REQUIRES STABILISATION BY DRILL AND GROUTING
- AREAS LOCATED WITHIN THE PINK HATCHED AREA UNDERLYING THE BUILDING FOOTPRINT AND DOCKS WILL REQUIRE DRILLING AND GROUTING ON A 6M PRIMARY GRID
- AREAS LOCATED WITHIN THE PINK HATCHED AREA WITH THE REMAINDER OF CONCRETE HARD STANDING AREAS WILL REQUIRE DRILLING AND GROUTING ON A 12M PRIMARY GRID
- SECONDARY AND TERTIARY BOREHOLES MAY BE REQUIRED IN ALL AREAS. THIS WILL BE DEPENDANT ON FINDINGS AND GROUT TAKES
- GROUTING WITHIN THE CAR PARK MAY BE REQUIRED DUE TO THE ANTICIPATED SHALLOW OUTCROP, THIS WILL BE DEPENDANT ON FINDINGS OF STABILISATION IN REMAINDER OF SITE AND REVIEW AFTER CUT

P2	14/02/2024	CS	LEGEND UPDATE	AP	AP
P1	11/12/2023	CS	ISSUED FOR INFORMATION	AP	AP
REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

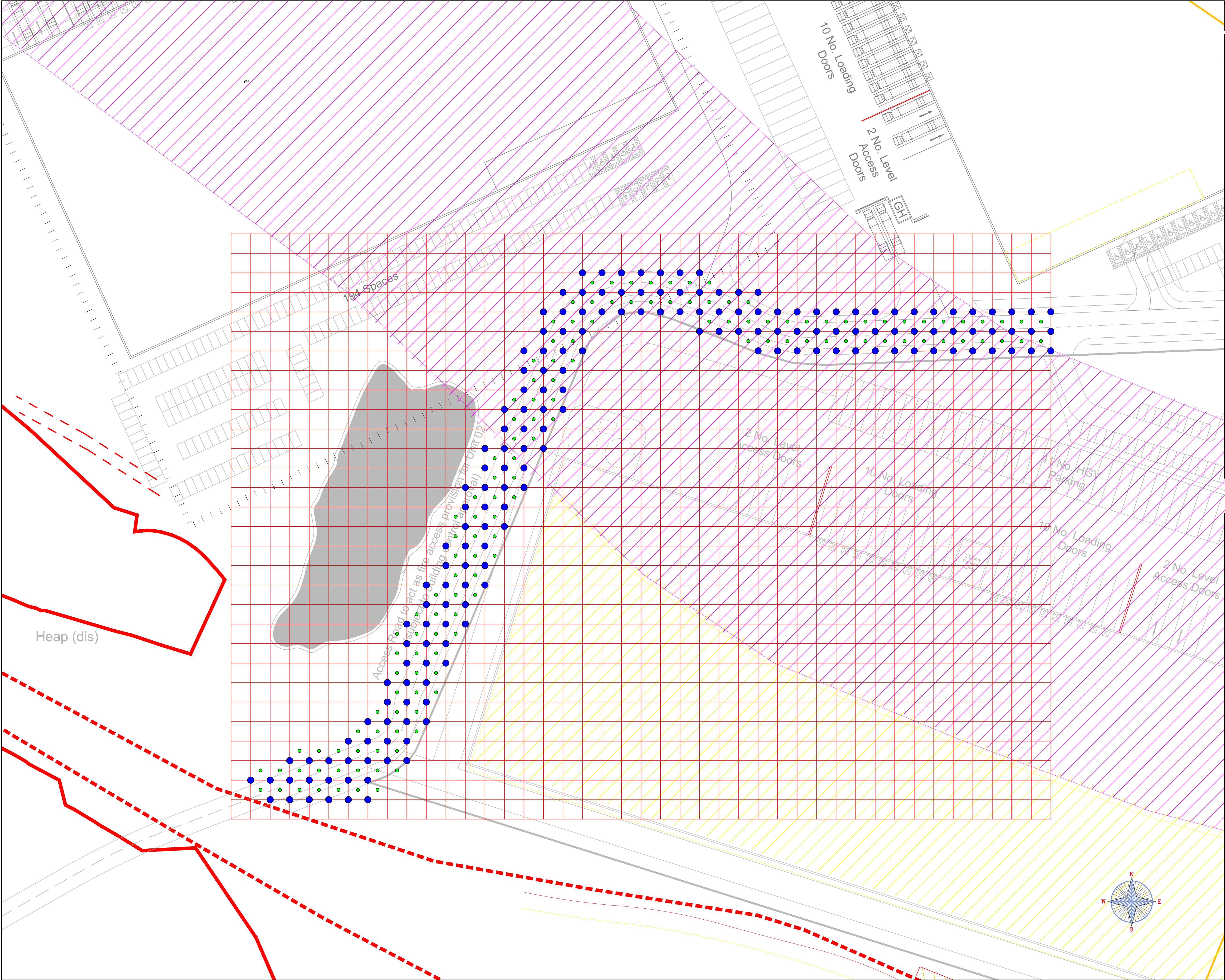
Tier Environmental Ltd.
Chadwick House
Warrington Road
Birchwood
Warrington | WA3 6AE
t: 01925 818388

CLIENT: DB SYMMETRY

PROJECT: FORMER CRONTON COLLIERY

TITLE: UNIT 4 GROUTING PLAN

SCALE: NTS	CHECKED: AP	APPROVED: AP
CAD FILE: -	DESIGN/DRAWN: CS	DATE: 11.12.2023
PROJECT No: TE1163	DRAWING No: TE1163-TE-00-XX-DR-GE-028-V02	REV: p2



DO NOT SCALE



LEGEND

- Primary Borehole locations
- Secondary Borehole Locations

GROUTING UNDER THE ROAD WILL BE
REQUIRED ON A 12M GRID DEPENDANT ON
FINDINGS AND GROUT TAKES

P2	14.02.2024	CS	LEGEND UPDATED	AP	AP
P1	04.01.2024	CS	ISSUED FOR INFORMATION	AP	AP
REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION



Tier Environmental Ltd.
Chadwick House
Warrington Road
Birchwood
Warrington | WA3 6AE
t: 01925 818388

CLIENT:
DB SYMMETRY

PROJECT:
FORMER CRONTON COLLIERY

TITLE:
UNIT 4 ROAD GROUTING PLAN

SCALE ● SIZE:	CHECKED:	APPROVED:
NTS	AP	AP
CAD FILE:	DESIGN/DRAWN:	DATE:
-	CS	04.01.2024
PROJECT No:	DRAWING No:	REV:
TE1163	TE1163-TE-00-XX-DR-GE-029-V02	P2