Cementation

SKANSKA

Co-op Live (Project Bradford)

Old Coal Workings – Project Completion Report

Revision	Date	Comment
P00	23.12.20	First Issue
P01	02.02.21	Final
P02	04.02.21	Revised
C01	05.02.21	Issue
C02	24.02.21	Revised
C03	03.03.21	Final
C04	04.03.21	Final

Document Number: BRA-CSL-ZZ-ZZ-RP-X-00900

Uniclass Code: PM_60_60_70

Project Manager: *Gavin Clifford*

Project Engineer: Oliver Partington

1.0 EXECUTIVE SUMMARY

Cementation Skanska have been appointed by BAM Construction Limited to undertake grouting works on the site at the Etihad Campus to the North of the Etihad Stadium, West of Alan Turning Way. The works involve grouting of coal seams and existing coal mine workings and revalidation of site remediation works previously completed by others.

The primary objectives of these grouting works are to:

- Reduce the risks and uncertainty associated with the proposed pile design from the former coal seam mining workings.

The grouting works aimed to stabilise historic mine workings for the piling works only, other structures, slabs or excavations have not been considered.

1.1 VALIDATION METHODOLOGY

The site is validated on a design area basis (see **Appendix A**) and handed back to the Contractor on completion of the area identified. The validation methodology has been agreed with the Employer's Engineer.

1.2 PROGRESS

Progress of the Works is as follows: -

Area	Status	Date	Notes/ Comments
A	Pass – Works Complete	26.01.21	
B	Pass – Works Complete	25.01.21	Validation Bore CE 04 did not pressurise within the allowed 1500ltrs. 2400ltrs were injected then pressurised. Additional bores were completed around this location to ensure sufficient grouting.
C	Pass – Works Complete	19.01.21	
D	Pass – Works Complete	19.01.21	
E	Pass – Works Complete	17.12.20	
F	Pass – Works Complete	19.01.21	
G	Pass – Works Complete	17.12.20	
Arena Floor	Pass – Works Complete	27.01.21	

2.0 INTRODUCTION

Cementation Skanska have been appointed by BAM Construction Limited to undertake grouting works on the site at the Etihad Campus to the North of the Etihad Stadium, West of Alan Turning Way. The works involve grouting of coal seams and existing coal mine workings and revalidation of site remediation works previously completed by others.

3.0 OVERVIEW

Works on site commenced 16th November 2020 and were completed 29th January 2021. Where grout holes were accessible, a 21m grid and 7m grid were completed. Where holes were inaccessible due to obstructions, trees and exclusions, inclined holes were installed to target the coal seams. Please see Appendix C for site restrictions.

The grouting has been undertaken on an observational approach and in line with the grouting philosophy (Appendix K). Initially a 21.0m grid was completed across site to understand the ground. This then was reviewed and a 7.0m probing grid was completed where possible.

The grouting records were reviewed with regards to both

- Drilling water flush returns / subsequent grouting
- Grout takes in individual holes and surrounding holes.

The above was then reviewed to determine the requirement for additional holes. Following this review targeted additional probes were drilled on a smaller 3.5m grid to ensure that the old coal workings were sufficiently grouted.

A summary of the works is below.

Holes Completed (No)	646
Grout Injected (m3)	349.7m3
Total Tonnage Used (Dry Weight)	552 ton

Throughout the works the results were reviewed and design areas made available for validation testing once deemed sufficiently grouted. Validation grouting targeted areas with comparative higher grout take to the rest of the site. These were selected by the client's engineer Buro Happold. A total of 21no validation positions were selected following their own review of the grouting records. These areas were drilled and validated. Where validation criteria were not met (1no location) additional bores were drilled and treated to ensure coverage around the validation position.

Whilst undertaking the works 3no locations were identified as potential shaft locations. The investigation, drilling and grouting of these locations is located within **Appendix M**.

4.0 VALIDATION PROCESS AND METHODOLOGY

4.1 PROCESS

The validation process is a testing regime to validate these grouting works through the spot drilling across the site to test and validate works are completed and comply with the methodology identified below.

The validation test will seek to confirm: -

- The old coal workings have been sufficiently grouted for the piling works.

Validation of the site was undertaken incrementally based on the Design Areas within Appendix A with completed and validated areas handed back to the Main Contractor as works progressed. All works have been completed.

4.2 METHODOLOGY

The agreed methodology for the validation process was as follows: -

- Employer's Engineer identifies location and quantity of validation locations required based on drilling records provided within the design area.
- Validation locations are drilled to the indicative target depth (significant seam depth).
- Grout is injected and pressurized to a maximum 30 PSI (200kN/m^2) and held at this pressure for 5 minutes.

4.3 REMEDIAL MEASURES

Should pressure fail to be maintained within the agreed parameters identified within the methodology, additional grout was added to a maximum of 1500 litres and the pressure testing recommenced as above.

At one location (CE 04) the bore continued to fail to maintain pressure, the validation bore was terminated, and further guidance was sought from the Employer's Engineer.

This validation process and methodology was carried out in agreement with the Employer's Engineer.

5.0 PROGRESS OVERVIEW

The status of Design Areas validated is as follows: -

Area	Status	Date	Notes/ Comments
A	Pass – Works Complete	26.01.21	
B	Pass – Works Complete	25.01.21	Validation Bore CE 04 did not pressurise within the allowed 1500ltrs. 2400ltrs were injected then pressurised. Additional bores were completed around this location to ensure sufficient grouting.
C	Pass – Works Complete	19.01.21	
D	Pass – Works Complete	19.01.21	
E	Pass – Works Complete	17.12.20	
F	Pass – Works Complete	19.01.21	
G	Pass – Works Complete	17.12.20	
Arena Floor	Pass – Works Complete	27.01.21	

6.0 CONCLUSION

The grouting works have been completed in accordance with the agreed philosophy. The validation works have been completed and confirmed suitability of the grouting operation for it's intended purpose. There will be an element of risk for areas which have not been directly drilled or accessible for both vertical and inclined drilling across the entire site. The grouting undertaken relates to the piling works only and no other works or structures on the site. All areas are now validated, and the works are complete.

- Design Areas are identified within **Appendix A**.
- A copy of the Validation Record Logs is included within **Appendix B**.
- Site drawing is contained in **Appendix C**.
- Detailed Validation Record is contained in **Appendix D**.
- Drilling logs for works attached in **Appendix E – (Sent under separate cover)**
- Drilling and Grouting Summary Table attached in **Appendix F – (Sent under separate cover)**
- Grout Take Drawing attached in **Appendix G – (Sent under separate cover)**
- Grout take heat Map attached in **Appendix H (Sent under separate cover)**
- Cube Register attached in **Appendix I – (Sent under separate cover)**
- Cube Reports attached in **Appendix J – (Sent under separate cover)**
- Grouting Philosophy document attached in **Appendix K - (Sent under separate cover)**
- Geological sections attached in **Appendix L – (Sent under separate cover)**
- Suspected Shaft Locations attached in **Appendix M (sent under separate cover)**

APPENDIX A – DESIGN AREA LAYOUT

APPENDIX B – VALIDATION RECORD LOG

Drilling Records - Key	
Pile Number	Probe location
Redrill	Prob location has been previously drilled
Design Area	Location on site with specific design considerations
BH Reference	Local borehole information to works
Rock Head	Point at which rock head was encountered
Expected Depth	Approximate depth of probing required
Water Returns	FWR – Full Water Return PWR – Part Water Return LWR – Lost Water Return NWR – No Water Return

Note – The grouting logs are drillers' logs only and not engineer's logs and as such are indicative only in terms of strata levels and descriptions of geological strata/material encountered. Where material has been logged as "coal/shale", this is the drillers' description and is likely dark, carboniferous mudstone and given the significant depths this material was logged over, is not considered to be coal seams.

Area A – BU04

22D990 - Drilling Record - Rev 6

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Cementation SKANSKA

Contract Name: Project Bradford

Contract Number: 22D990

Search Pile Number:

Pile Number: BU-04

General Information

Design Area: A

Driller: John Drummond

Spannerman: William Hamilton

Rig: C6 XP – A57217

Start Date: 2021-01-22

Finish Date: 2021-01-22

Drilling Log

Design Area: A

BH Reference: BH19/02A

Rock Head Depth: 14.00

Expected Casing:

Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Mudstone	/	FWR	☐ Yes ☐ No	16.0	17.0
Broken Ground	/	NWR	☐ Yes ☐ No	17.0	23.0
Hard Ground	/	NWR	☐ Yes ☐ No	23.0	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☒ Yes ☐ No

Area A – BD04

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Cementation SKANSKA

Contract Name: Project Bradford

Contract Number: 22D990

Search Pile Number:

Pile Number: BD-04

Re-drill

General Information

Design Area: A

Driller: John Drummond

Spannerman: William Hamilton

Rig: C6 XP – A57217

Start Date: 2021-01-21

Finish Date: 2021-01-21

Drilling Log

Design Area	BH Reference	Rock Head Depth	Expected Casing	Expected Depth
A	BH19/02A	14.50		42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Mudstone	/	FWR	☐ Yes ☐ No	16.0	21.0
Soft Ground	/	PWR	☐ Yes ☐ No	21.0	23.0
Mudstone	/	PWR	☐ Yes ☐ No	23.0	34.0
Soft Ground	/	PWR	☐ Yes ☐ No	34.0	36.0
Mudstone	/	PWR	☐ Yes ☐ No	36.0	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☒ Yes ☐ No

Area A – AW08

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Cementation SKANSKA

Contract Name: Project Bradford

Contract Number: 22D990

Search Pile Number:

Pile Number: AW-08

General Information

Design Area: A

Driller: John Drummond

Spannerman: William Hamilton

Rig: C6 XP – A57217

Start Date: 2021-01-22

Finish Date: 2021-01-22

Drilling Log

Design Area: A

BH Reference: BH19/02A

Rock Head Depth: 17.50

Expected Casing:

Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	18.0
Mudstone	/	FWR	☐ Yes ☐ No	18.0	29.0
Coal	/	FWR	☐ Yes ☐ No	29.0	31.0
Mudstone	/	FWR	☐ Yes ☐ No	31.0	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☒ Yes ☐ No

Area A - AY11

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Cementation
SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: AY-11

General Information

Design Area: A
Driller: David Trower
Spannerman: Richard Lowery
Rig: C6 XP2 – A57221
Start Date: 2021-01-22
Finish Date: 2021-01-22

Drilling Log

Design Area: A
BH Reference: BH19/02A
Rock Head Depth: 15.00
Expected Casing:
Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Mudstone	/	FWR	☐ Yes ☐ No	16.0	16.5
Coal / Shale	/	FWR	☐ Yes ☐ No	16.5	19.5
Mudstone	/	FWR	☐ Yes ☐ No	19.5	25.0
Hard Ground	/	LWR	☐ Yes ☐ No	25.0	27.0
Soft Ground	/	NWR	☐ Yes ☐ No	27.0	29.0
Hard Ground	/	NWR	☐ Yes ☐ No	29.0	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☒ Yes ☐ No

Area B – CE04

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Cementation SKANSKA

Contract Name: Project Bradford

Contract Number: 22D990

Search Pile Number:

Pile Number: CE-04

General Information

Design Area: B

Driller: Billy Rooney

Spannerman: Connor Wilburn

Rig: C6 – A57096

Start Date: 2021-01-21

Finish Date: 2021-01-21

Drilling Log

Design Area: B

BH Reference: BH19/05

Rock Head Depth: 14.00

Expected Casing:

Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	16.0	33.5
Traces of Coal	/	FWR	☐ Yes ☐ No	33.5	34.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	34.0	40.0
Soft Ground	/ Broken Ground	LWR	☐ Yes ☐ No	40.0	42.0
Hard Ground	/	NWR	☐ Yes ☐ No	42.0	43.0
	/		☐ Yes ☐ No	43.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☐ Yes ☒ No

Area B – CN08

22D990 - Drilling Record - Rev 6

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Cementation
SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: CN-08

General Information

Design Area: B
Driller: Billy Rooney
Spannerman: Connor Wilburn
Rig: C6 – A57096
Start Date: 2021-01-22
Finish Date: 2021-01-22

Drilling Log

Design Area: B
BH Reference: BH19/05
Rock Head Depth: 12.50
Expected Casing:
Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	14.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	14.0	36.5
Soft Ground	/	PWR	☐ Yes ☐ No	36.5	37.5
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	37.5	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☐ Yes ☒ No

Area C – AS20

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Cementation SKANSKA

Contract Name: Project Bradford

Contract Number: 22D990

Search Pile Number:

Pile Number: AS-20

General Information

Design Area: C

Driller: David Trower

Spannerman: Richard Lowery

Rig: C6 XP2 – A57221

Start Date: 2021-01-18

Finish Date: 2021-01-18

Drilling Log

Design Area: C

BH Reference: BH19/07C

Rock Head Depth: 14.50

Expected Casing:

Expected Depth: 39.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Mudstone	/	FWR	☐ Yes ☐ No	16.0	25.0
Coal / Shale	/	FWR	☐ Yes ☐ No	25.0	28.0
Mudstone	/	FWR	☐ Yes ☐ No	28.0	39.0
	/		☐ Yes ☐ No	39.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☒ Yes ☐ No

If yes then insert details below....

As20 test pile. Trace of coal 37 metres

Area C – BB14

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Cementation SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: BB-14

General Information

Design Area: C
Driller: David Trower
Spannerman: Richard Lowery
Rig: C6 XP2 – A57221
Start Date: 2021-01-18
Finish Date: 2021-01-18

Drilling Log

Design Area: C
BH Reference: BH19/07C
Rock Head Depth: 14.50
Expected Casing:
Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Mudstone	/	FWR	☐ Yes ☐ No	16.0	16.5
Coal / Shale	/	FWR	☐ Yes ☐ No	16.5	18.5
Mudstone	/	FWR	☐ Yes ☐ No	18.5	24.0
Hard Ground	/	PWR	☐ Yes ☐ No	24.0	39.0
	/		☐ Yes ☐ No	39.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☒ Yes ☐ No

Area D – CA26

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Cementation SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: CA-26

General Information

Design Area: D
Driller: Billy Rooney
Spannerman: Connor Wilburn
Rig: C6 – A57096
Start Date: 2021-01-15
Finish Date: 2021-01-15

Drilling Log

Design Area: D
BH Reference: BH19/11
Rock Head Depth: 13.00
Expected Casing:
Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	14.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	14.0	19.5
Coal / Shale	/	FWR	☐ Yes ☐ No	19.5	20.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	20.0	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☐ Yes ☒ No

Area D – CM14

22D990 - Drilling Record - Rev 6

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Cementation SKANSKA

Contract Name: Project Bradford

Contract Number: 22D990

Search Pile Number:

Pile Number: CM-14

General Information

Design Area: B

Driller: Colin Trower

Spannerman:

Rig: C6 – A57097

Start Date: 2021-01-18

Finish Date: 2021-01-18

Drilling Log

Design Area: B

BH Reference: BH19/05

Rock Head Depth: 11.00

Expected Casing:

Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	12.0
Mudstone	/	FWR	☐ Yes ■ No	12.0	29.0
Coal / Shale	/	FWR	☐ Yes ■ No	29.0	30.0
Mudstone	/	FWR	☐ Yes ■ No	30.0	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☐ Yes ■ No

Area E – AU30

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Cementation
SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: AU-30

General Information

Design Area: E
Driller: Billy Rooney
Spannerman: Connor Wilburn
Rig: C6 – A57096
Start Date: 2020-12-17
Finish Date: 2020-12-17

Drilling Log

Design Area: E
BH Reference: BH19/09
Rock Head Depth: 14.00
Expected Casing:
Expected Depth: 45.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	16.0	27.0
Traces of Coal	/ Siltstone	FWR	☐ Yes ☐ No	27.0	28.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	28.0	36.5
Soft Ground	/ Broken Ground	LWR	☐ Yes ☐ No	36.5	37.5
Hard Ground	/	NWR	☐ Yes ☐ No	37.5	38.5
	/		☐ Yes ☐ No	38.5	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☒ Yes ☐ No

If yes then insert details below....

Lost water didn't reach target depth

Area E – BC32

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Cementation
SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: BC-32

General Information

Design Area: E
Driller: Billy Rooney
Spannerman: Connor Wilburn
Rig: C6 – A57096
Start Date: 2021-01-18
Finish Date: 2021-01-18

Drilling Log

Design Area: E
BH Reference: BH19/09
Rock Head Depth: 13.50
Expected Casing:
Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Traces of Coal	/	FWR	☐ Yes ☐ No	16.0	17.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	17.0	29.5
Soft Ground	/	LWR	☐ Yes ☐ No	29.5	30.5
Hard Ground	/	NWR	☐ Yes ☐ No	30.5	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☐ Yes ☒ No

Area F – BM40

22D990 - Drilling Record - Rev 6

Page 1

Cementation SKANSKA

Contract Name: Project Bradford

Contract Number: 22D990

Search Pile Number:

Pile Number: BM-40

General Information

Design Area: F | Driller: Billy Rooney | Spannerman: Connor Wilburn | Rig: C6 – A57096

Start Date: 2021-01-14 | Finish Date: 2021-01-14

Drilling Log

Design Area: F | BH Reference: BH19/15 | Rock Head Depth: 13.50 | Expected Casing: | Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	14.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	14.0	21.5
Coal / Shale	/	FWR	☐ Yes ☐ No	21.5	22.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	22.0	37.0
Soft Ground	/	PWR	☐ Yes ☐ No	37.0	38.5
Hard Ground	/	PWR	☐ Yes ☐ No	38.5	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☐ Yes ☒ No

Area F – BW42

22D990 - Drilling Record - Rev 6 Page 1

Cementation SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: BW-42

General Information

Design Area: F
Driller: Allen Devine
Spannerman: Adam Riley
Rig: C6 XP – A57216
Start Date: 2021-01-15
Finish Date: 2021-01-15

Drilling Log

Design Area: F
BH Reference: BH19/15
Rock Head Depth: 14.00
Expected Casing:
Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Sandstone	/	FWR	☐ Yes ■ No	16.0	28.0
Coal	/	FWR	☐ Yes ■ No	28.0	30.0
Sandstone	/	FWR	☐ Yes ■ No	30.0	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ■ Yes ☐ No

If yes then insert details below....

Test Hole

Area F – CH32

22D990 - Drilling Record - Rev 6 Page 1

Cementation SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: CH-32

General Information

Design Area: F
Driller: Billy Rooney
Spannerman: Connor Wilburn
Rig: C6 – A57096
Start Date: 2021-01-18
Finish Date: 2021-01-18

Drilling Log

Design Area: F
BH Reference: BH19/15
Rock Head Depth: 13.00
Expected Casing:
Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	14.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	14.0	16.5
Soft Ground	/	PWR	☐ Yes ☐ No	16.5	18.0
Mudstone	/ Siltstone	PWR	☐ Yes ☐ No	18.0	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☐ Yes ☒ No

Area G – AZ36

22D990 - Drilling Record - Rev 6 **Page 1**

Cementation SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: AZ-36

General Information

Design Area: G
Driller: Billy Rooney
Spanneman: Connor Wilburn
Rig: C8 – A57096
Start Date: 2020-12-17
Finish Date: 2020-12-17

Drilling Log

Design Area: G
BH Reference: BH19/13
Rock Head Depth: 13.50
Expected Casing:
Expected Depth: 45.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	16.0	19.0
Traces of Coal	/ Siltstone	FWR	☐ Yes ☐ No	19.0	21.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	21.0	32.0
Traces of Coal	/ Siltstone	FWR	☐ Yes ☐ No	32.0	32.5
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	32.5	46.0
	/		☐ Yes ☐ No	46.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☐ Yes ☒ No

Area G – AN36

22D990 - Drilling Record - Rev 6

Page 1

Cementation
SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: AN-36

General Information

Design Area: G
Driller: Billy Rooney
Spannerman: Connor Wilburn
Rig: C6 – A57096
Start Date: 2020-12-17
Finish Date: 2020-12-17

Drilling Log

Design Area: G
BH Reference: BH19/13
Rock Head Depth: 14.00
Expected Casing:
Expected Depth: 45.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	16.0	18.0
Traces of Coal	/ Siltstone	FWR	☐ Yes ☐ No	18.0	19.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	19.0	31.0
Traces of Coal	/ Siltstone	FWR	☐ Yes ☐ No	31.0	32.0
Mudstone	/ Siltstone	FWR	☐ Yes ☐ No	32.0	44.0
Soft Ground	/ Broken Ground	LWR	☐ Yes ☐ No	44.0	45.5
Hard Ground	/	NWR	☐ Yes ☐ No	45.5	46.5
	/		☐ Yes ☐ No	46.5	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☐ Yes ☒ No

Arena – BK15

22D990 - Drilling Record - Rev 6

Page 1

Cementation SKANSKA

Contract Name: Project Bradford

Contract Number: 22D990

Search Pile Number:

Pile Number: BK-15

General Information

Design Area:

Driller: David Trower

Spannerman: Connor Wilburn

Rig: C6 XP – A57217

Start Date: 2021-01-22

Finish Date: 2021-02-02

Drilling Log

Design Area:

BH Reference:

Rock Head Depth: 14.00

Expected Casing:

Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	15.0
Mudstone	/	FWR	☐ Yes ☐ No	15.0	30.0
Soft Ground	/	LWR	☐ Yes ☐ No	30.0	33.0
Hard Ground	/	NWR	☐ Yes ☐ No	33.0	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☐ Yes ☒ No

Arena – BX 15

22D990 - Drilling Record - Rev 6 Page 1

Cementation
SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: BX-15

General Information

Design Area:
Driller: Billy Rooney
Spannerman: Connor Wilburn
Rig: C6 – A57096
Start Date: 2021-01-21
Finish Date: 2021-02-02

Drilling Log

Design Area:
BH Reference:
Rock Head Depth: 14.50
Expected Casing:
Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Mudstone	/	FWR	☐ Yes ☐ No	16.0	19.5
Broken Ground	/ Soft Ground	LWR	☐ Yes ☐ No	19.5	22.5
Hard Ground	/	NWR	☐ Yes ☐ No	22.5	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☒ Yes ☐ No

If yes then insert details below....

Validation Hole.

Arena – BF25

22D990 - Drilling Record - Rev 6 Page 1

Cementation SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: BF-25

General Information

Design Area:
Driller: David Trower
Spannerman: Connor Wilburn
Rig: C6 XP2 – A57221
Start Date: 2021-01-25
Finish Date: 2021-02-02

Drilling Log

Design Area:
BH Reference:
Rock Head Depth: 14.00
Expected Casing:
Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	16.0
Mudstone	/	FWR	☐ Yes ■ No	16.0	22.0
Soft Ground	/	LWR	☐ Yes ■ No	22.0	25.0
Hard Ground	/	NWR	☐ Yes ☐ No	25.0	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ■ Yes ☐ No

If yes then insert details below....

Validation Hole.

Arena – BU26

22D990 - Drilling Record - Rev 6

Page 1

Cementation
SKANSKA

Contract Name: Project Bradford
Contract Number: 22D990
Search Pile Number:
Pile Number: BU-26

General Information

Design Area:
Driller: Billy Rooney
Spannerman: Connor Wilburn
Rig: C6 – A57096
Start Date: 2021-01-22
Finish Date: 2021-02-02

Drilling Log

Design Area:
BH Reference:
Rock Head Depth: 12.50
Expected Casing:
Expected Depth: 42.00

Type of Strata	Specific Strata (if able to identify)	Water Returns	Fractured?	Depth to Top	Depth
Cased	/	FWR		0.0	14.0
Mudstone	/	FWR	☐ Yes ☐ No	14.0	26.0
Broken Ground	/ Soft Ground	LWR	☐ Yes ☐ No	26.0	29.0
Hard Ground	/	NWR	☐ Yes ☐ No	29.0	42.0
	/		☐ Yes ☐ No	42.0	
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		
	/		☐ Yes ☐ No		

Productivity

	Hours	Comments/Details
Breakdowns	0	
Obstructions	0	
Standing	0	

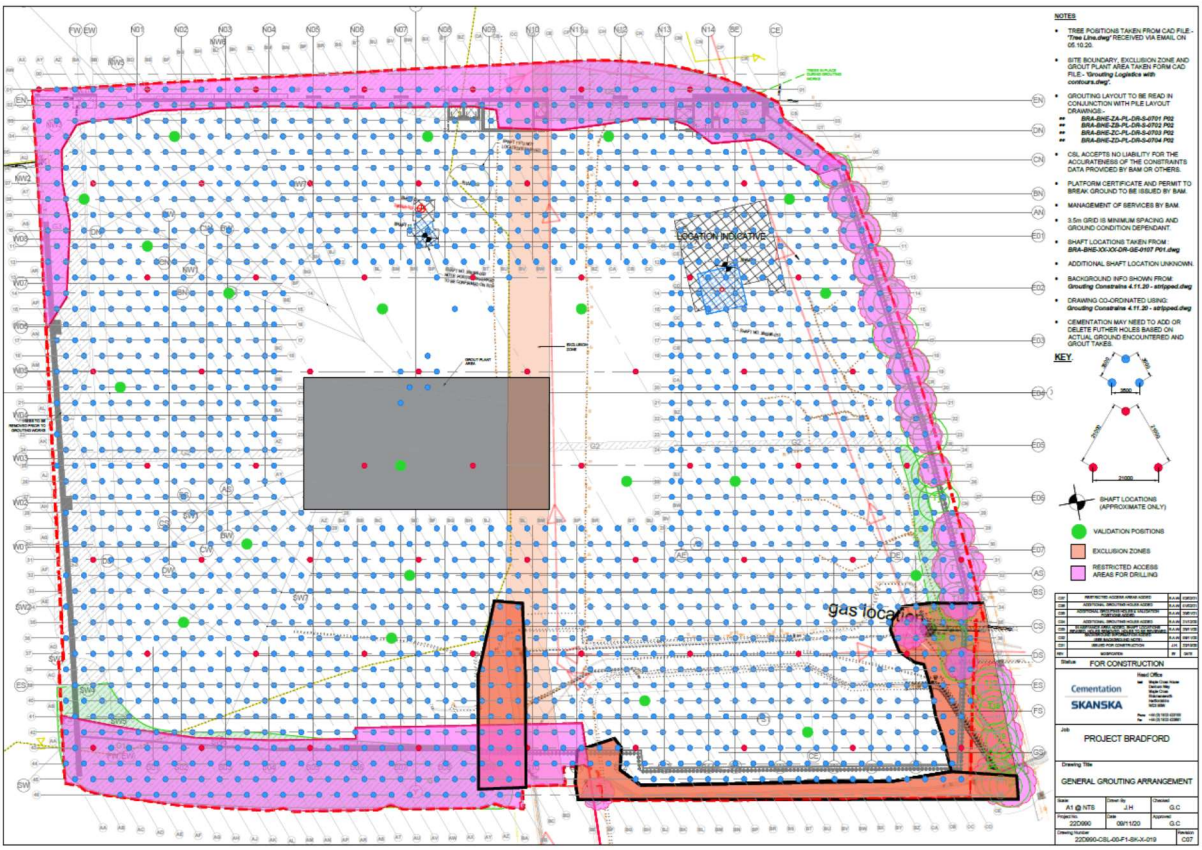
Other Details

Underground Services / Gas, Water emissions / Voids or Suspected Workings / Settlement of Ground Heave? ☒ Yes ☐ No

If yes then insert details below....

Validation Hole.

APPENDIX C – Site Drawing



Cementation
SKANSKA

APPENDIX D – Detailed Validation Record

Validation Record									
Area	Date Offered	Date Validated	Grid Reference	Grout Qty (ltr)	Grout Pressure (PSI)	Pressure Duration (mins)	Witnessed by	Notes/ Comments	Status
A	25.01.21	27.01.21	BU 04	200	30	5	Martin Werner BAM	- Lost water 17.0m - Hard Ground 23.0 – 42.0m - Passed on the first pressurization.	Pass
A	25.01.21	26.01.21	BD 04	300	30	5	Martin Werner BAM	- Part water loss from 21.0m - Drilled down to the seam and grouted with minimal grout injection. - Passed on the first pressurization.	Pass
A	25.01.21	25.01.21	AW 08	300	30	5	Martin Werner BAM	- Full water return - Drilled down to the seam and grouted with minimal grout injection. - Passed on the first pressurization.	Pass
A	25.01.21	26.01.21	AY 11	300	30	5	Martin Werner BAM	- Lost water 25.0m BGL - Drilled down to the seam and grouted with minimal grout injection. - Passed on the first pressurization.	Pass
B	18.01.21	25.01.21	CE 04	2400	30	5	Martin Werner BAM	- Lost Water 40.0m BGL - Day 1 injected - Day 2 injected 300 and pressurized - Due to high volume injected 4no additional bores on the 3.5m grid were completed around this location to ensure sufficient grout injection. -	Pass

Area	Date Offered	Date Validated	Grid Reference	Grout Qty (ltr)	Grout Pressure (PSI)	Pressure Duration (mins)	Witnessed by	-	Notes/ Comments	Status
B	18.01.21	25.01.21	CN 08	500	30	5	Martin Werner BAM	-	Full water return - Drilled down to the seam and grouted with minimal grout injection. - Passed on the first pressurization.	Pass
C	18.01.21	18.01.21	AS 20	100	30	5	J.Hobkirk Buro Happold	-	Full water return - Drilled down to the seam and grouted with minimal grout injection. - Passed on the first pressurization.	Pass
C	18.01.21	18.01.21	BB 14	200	30	5	J.Hobkirk Buro Happold	-	Part water return at 24.0m - Drilled down to the seam and grouted with minimal grout injection. - Passed on the first pressurization.	Pass
D	18.01.21	18.01.21	CA 26	100	30	5	J.Hobkirk Buro Happold	-	Full water return - Drilled down to the seam and grouted with minimal grout injection. - Passed on the first pressurization.	Pass
D	18.01.21	18.01.21	CM 14	100	30	5	J.Hobkirk Buro Happold	-	Full water return - Drilled down to the seam and grouted with minimal grout injection. - Passed on the first pressurization.	Pass
E	17.12.20	17.12.20	AU30	900	30	5	J.Hobkirk Buro Happold	-	Lost water at 37.5m at the seam. - Grouted with Medium grout injection. - Passed on the third pressurization. - Suspected faulty Gauge as line pressure did not drop and when replaced pass on first pressurization. - Incorrect target depth recorded, should have been circa 40.0m.	Pass
E	18.01.21	18.01.21	BC 32	200	30	5	J.Hobkirk Buro Happold	-	Originally BD 32 however this was grouted before position received. Lost water 29.5m BGL - Drilled down to the seam and grouted with minimal grout injection. - Passed on the first pressurization.	Pass

Area	Date Offered	Date Validated	Grid Reference	Grout Qty (ltr)	Grout Pressure (PSI)	Pressure Duration (mins)	Witnessed by	-	Notes/ Comments	Status
F	18.01.21	18.01.21	BM 40	200	30	5	J.Hobkirk Buro Happold	-	Part water return from 37.0m BGL Drilled down to the seam and grouted with minimal grout injection. Passed on the first pressurization.	Pass
F	18.01.21	18.01.21	BW 42	100	30	5	J.Hobkirk Buro Happold	-	Full water return Drilled down to the seam and grouted with minimal grout injection. Passed on the first pressurization.	Pass
F	18.01.21	18.01.21	CH 32	200	30	5	J.Hobkirk Buro Happold	-	Part water return from 16.0m BGL Drilled down to the seam and grouted with minimal grout injection. Passed on the first pressurization	Pass
G	17.12.20	17.12.20	AZ36	100	30	5	J.Hobkirk Buro Happold	-	Full water return Drilled down to the seam and grouted with minimal grout injection. Passed on the first pressurization.	Pass
G	17.12.20	17.12.20	AN36	200	30	5	J.Hobkirk Buro Happold	-	Lost water at 44.0m at the seam. Grouted with minimal grout injection. Passed ion the first pressurization.	Pass
Arena	18.01.21	26.01.21	BK 15	1000	30	5	Martin Werner BAM	-	Lost water at 30.0m BGL. Passed ion the first pressurization.	Pass
Arena	18.01.21	25.01.21	BX 15	500	30	5	Martin Werner BAM	-	Lost water at19.5m BGL. Passed ion the first pressurization.	Pass
Arena	18.01.21	27.01.21	BF 25	500	30	5	Martin Werner BAM	-	Lost water at22.0m BGL. Passed ion the first pressurization.	Pass
Arena	18.01.21	26.01.21	BU 26	500	30	5	Martin Werner BAM	-	Lost water at 26.0m BGL. Passed ion the first pressurization.	Pass

Cementation

SKANSKA

APPENDIX E - Drilling logs (sent under separate cover)

Drilling Records - Key	
Pile Number	Probe location
Redrill	Prob location has been previously drilled
Design Area	Location on site with specific design considerations
BH Reference	Local borehole information to works
Rock Head	Point at which rock head was encountered
Expected Depth	Approximate depth of probing required
Water Returns	FWR – Full Water Return PWR – Part Water Return LWR – Lost Water Return NWR – No Water Return

Note – The grouting logs are drillers' logs only and not engineer's logs and as such are indicative only in terms of strata levels and descriptions of geological strata/material encountered. Where material has been logged as "coal/shale", this is the drillers' description and is likely dark, carboniferous mudstone and given the significant depths this material was logged over, is not considered to be coal seams.

APPENDIX F - Drilling and Grouting Summary Table (sent under separate cover)

APPENDIX G - Grout Take Drawing (sent under separate cover)

APPENDIX H – Grout Take Heat Map (sent under separate cover)

APPENDIX I - Cube Register (sent under separate cover)

APPENDIX J - Cube Reports (sent under separate cover)

Appendix K – Grouting Philosophy Document (sent under separate cover)

Appendix L – Geological Sections (sent under separate cover)

Appendix M – Suspected Shaft Locations (sent under separate cover)