VICTORIA COLLIERY

BIDDULPH STAFFORDSHIRE

GROUND STABILISATION
GROUTING REPORT

FOR
ADVANTAGE WEST MIDLANDS

REF: D5249/H
FEB 2002

VICTORIA COLLIERY, BIDDULPH, STAFFORDSHIRE.
GROUND STABILISATION REPORT.

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1 INTRODUCTION

IMC Consulting Engineers Ltd (IMC) were engaged by Advantage West Midlands to supervise the ground stabilisation works at the former Victoria Colliery, Biddulph, Staffordshire. The works incorporated drilling and grouting operations in 2 specified treatment areas, the Ten Foot seam area and the Bowling Alley seam area, and included the grouting and capping of any disused mine shafts encountered. A plan showing the proposed grouting scheme, referenced D5249/20, is included at Appendix 1.

The treatment works were to be carried out in accordance with the contract document specifications for "stabilisation of shallow mine workings" included at Appendix 5. Any unrecorded mine shafts to be treated in accordance with the contract document specifications for "the treatment of old disused mine shafts" included at Appendix 6.

Forkers Limited were awarded the contract and prior to drilling operations commencing the treatment areas were marked out as per drawing D5249/20 and services verified by the contractor's engineer.

2 DRILLING AND GROUTING

Work commenced on site on Monday 10th December 2001, with an initial 3 drilling rigs working in the Ten Foot seam treatment area. The grouting plant was established adjacent to the site offices near the site access point on Brown Lees road. The grouting plant comprised of a 30 tonne cement hopper with a screw feed delivery to the two mixing pans. Water was provided via a 50mm metered standpipe connected to a fire hydrant on Brown Lees road delivering into two tanks holding some 13,000 litres and 26,000 litres respectively. Steel road haulage containers were used to form a boundary to the PFA stockpile to limit spread and dust problems. The PFA was loaded into the mixing pans using a CAT910 rubber tyred loading shovel. The grout, a mix of PFA and cement on a 9/1 ratio, was mixed with water in the two mixing tanks to give a water solids ratio of 0.4. The grout was then pumped, using 2 Gardner Denver pumps, to the grouting areas via 50mm rigid plastic piping. From the end of the main grouting line a flexible pipe was connected to tremmie tubes for insertion into the borehole casing. Each individual borehole had grout injected as per the specification detailed at Appendix 5. The amount of grout pumped into each hole was recorded from the meter on the grout pump. Sample grout test cubes were taken on a daily basis for subsequent testing after both 7 and 28 days.

The drilling was undertaken using JCB814 rigs with 70mm rock bits incorporating a water flushing system. Temporary 100mm surface casing was initially driven through made ground and superficial deposits and into rock head. The rigs drilled open holes to the specified coal seam horizon, recording the encountered strata, any loss of flush and soft or broken ground. If total loss of flush occurred at a level below rock head, drilling continued to the coal seam horizon with the rate of penetration monitored.

The agreed stabilisation method was to establish a curtain wall along the three deep sides of each area on a 3 metre spacing. The area was then to be infilled incorporating a 6 metre grid. Proving holes were to be drilled to check the amount of residual grout take.

2.1 TEN FOOT AREA

2.1.1 Drilling

Drilling commenced using 3 drill rigs on 10th December 2001 with all rigs drilling to establish the western curtain wall. On 12th December 2001, a rig moved to establish the curtain wall adjacent to Tunstall road. On 14th December 2001 the Tunstall road curtain wall was completed and the rig moved to the Bowling Alley area, a second rig moved from the west curtain wall to start the Ten Foot 6 metre in-fill grid. The west curtain wall was completed on 20th December 2001. The line of the north curtain wall was established some 6 metres south of the limit of coaling line as shown on the former Brown Lees opencast site completion plan. The north curtain wall was completed on 7th January 2002 and the rig moved to the 6 metre in-fill grid. The 2 drill rigs continued to drill the in-fill grid working eastwards to establish the location of the seam outcrop. The in-fill grid was completed on 17th January 2002. The location of the previously capped Salisbury Shaft was marked out and probe drilling carried out to prove its location. The location of in-fill holes in the vicinity of the shaft was adjusted so as to avoid the shaft cap. A previously unrecorded mine shaft was encountered in borehole K37 and details of its treatment are at section 2.3 below.

Drilling records show that in this area rock head was overlain by some 7 to 8 metres of made ground. Some 60% of boreholes were recorded as encountering solid coal with 40% encountering either soft ground or loss of flush indicating old mine workings. The mine workings appeared to be totally collapsed as no voids were recorded.

2.1.2 Grouting

Grouting commenced on 13th December 2001 and was carried out as per the specification detailed at Appendix 5. The average grout take for the curtain wall holes was 0.6 tonnes. Of the 116 curtain wall holes 10 took 1 tonne or more of grout. The average grout take for the infill holes was 0.5 tonnes. Proving holes were drilled to check the effectiveness of the grouting at the areas of highest grout take. The average grout take for the proving holes was 0.25 tonnes. Grouting works were completed on 23rd January 2002.

A summary of the Ten Foot area drilling and grouting is at Appendix 2 below.

2.2 BOWLING ALLEY AREA

2.2.1 Drilling

Drilling commenced using 1 drill rig on 14th December 2001 establishing the western curtain wall. On 3rd January 2002, a second rig moved to site drilling to establish the curtain wall adjacent to Tunstall road. The Tunstall road curtain wall was completed on 8th January 2002 and the rig moved to the Bowling Alley area 6 metre in-fill grid. On 10th January 2002 the western curtain wall was completed and the rig moved onto the northern curtain wall adjacent to Brown Lees road. At the western end of the northern curtain wall the rig was standing on a red shale tip some 2 metres above the general ground level. The red shale tip was bounded to the north by a 2 metre retaining wall, being the edge of the footpath on Brown Lees road. The north curtain wall was established some 2 metres south of the wall in order to protect its stability. Drilling along the north curtain wall was completed on 14th January 2002 and the rig moved onto the Bowling Alley 6 metre in-fill grid. On Friday 18th January 2002 a third rig became available from the Ten Foot area and also moved onto the in-fill grid. The three rigs worked in a general easterly direction to prove the location of the seam outcrop completing the grid on 22nd January 2002. Proving holes were drilled between 22nd January 2002 and 23rd January 2002.

Drilling records show that in this area rock head was overlain by some 6 metres of made ground. Some 80% of boreholes were recorded as encountering solid coal with 20% encountering either soft ground or loss of flush indicating old mine workings. The mine workings appeared to be totally collapsed as no voids were recorded.

2.2.2 Grouting

Grouting commenced on 19th December 2001 and was carried out as per the specification detailed at Appendix 5. The average grout take for the curtain wall holes was 0.5 tonnes, however borehole CW5 took some 8.5 tonnes. The log for this hole shows that fractured ground, with loss of flush, was encountered some 2 metres below rock head, this being some 20 metres above the coal horizon. It is likely that the higher grout take for this hole was at an horizon well above the coal seam due to the presence of broken ground of undetermined nature. Proving holes were drilled in the immediate vicinity of borehole CW5 to check for both any extension to the area of broken ground and to ensure that the grout had completely stabilised the area. Borehole A/B5, some

1.5 metres east of CW5, although not recorded as having encountered any broken ground had a grout take of 1.5 tonnes. Further proving holes were drilled in the immediate vicinity, however, no further broken ground or high grout takes were recorded.

Omitting borehole CW5, the average grout take for the curtain wall was 0.45 tonnes. The average grout take for the in-fill holes was 0.21 tonnes and the average for the proving holes was 0.18 tonnes.

Grouting works were completed in the Bowling Alley seam area on 23rd January 2002.

A summary of the Bowling Alley area drilling and grouting is at Appendix 3 below.

2.3 DISUSED MINE SHAFT

On 10th January 2001, during the drilling of the in-fill 6 metre grid in the Ten Foot area, borehole K37 recorded soft drilling all the way down to the seam horizon indicating the presence of an unrecorded mine shaft. The method of investigation and treatment was then carried out as per the specification detailed at Appendix 6. A safety drilling platform was installed and on 11th January 2002 a series of 14 probe holes were drilled on a 0.75 metre grid to prove the existence of the shaft and to determine its likely diameter. Some 9 of the 14 probe holes encountered rock head at the average depth for the Ten Foot seam area of around 8.0 metres. The remaining 5 holes encountered the shaft, 2 drilled 24 metres in soft material to the seam horizon to prove the likely depth, and 3 drilled to 12 metres to prove the absence of rock-head. From examination of the probe drilling it was determined that the shaft was some 2.2 metres in diameter and some 24 metres deep. A plan, referenced D5249/H/S1, showing the probe holes is included at Appendix 4 below.

The shaft location, determined by Forker's engineer: E1210.26 N1288.32 L200.4, relative to the site local grid.

On 18th January 2001 a borehole was drilled down the centre of the shaft encountering soft material to a depth of 24.5 metres and steel casing installed. Once hard rock had been encountered the borehole continued for a further 5.5 metres in rock to prove the base of the shaft. Grout was then injected into the shaft on a PFA to cement ratio of 9:1 as per the specification. Once the required pressure was achieved the amount of grout take was recorded and a 2 metre section of casing removed. This process was repeated up to rock head with a total grout take of some 16 tonnes. On 21st January a proving hole was drilled into the shaft and the grouting process repeated with a recorded grout take of some 2 tonnes.

The design for the concrete shaft cap was produced by IMC Consulting Engineers and a plan referenced D5249/23 showing that specification is at Appendix 4 below.

Due to the depth of made ground at the site of the shaft the specification required a grout cap to be formed to ensure stability beneath the proposed concrete cap. On 21st January 2002 drilling commenced on a 1 metre grid some 5 metres square to form the grout cap. Each hole was drilled to prove rock head and steel casing installed. Grout was injected until the required pressure achieved, 2 metres of casing withdrawn and the

process repeated until grout appeared at the surface. The grout cap was completed on 23rd January 2002 having taken some 6 tonnes of grout.

On 25th January 2002 the excavation work to install the concrete shaft cap was carried out to form a cap some 4.4 metres square with a base level of 197.00 and a minimum thickness of 0.6 metres. Once the excavation was completed the volume of concrete required to fill the void to the required thickness of 0.6 metres was calculated as 15 cubic metres. A layer of Visqueen was installed at the base of the excavation with at least 1 metre extending up the sides. The steel reinforcement was installed as per the specification and the concrete poured, vibrated and test cubes taken. On 28th January the excavation was back filled in 300mm layers using a vibro roller to compact the material. Concrete cube test results confirmed compliance with the specification included at Appendix 6.

Details of the drilling, grouting and capping of the shaft are at Appendix 4.

3.0 SUMMARY

IMC Consulting Engineers Ltd (IMC) were engaged by Advantage West Midlands to supervise the ground stabilisation works at the former Victoria Colliery, Biddulph, Staffordshire.

The works required drilling and grouting operations in 2 specified treatment areas, the Ten Foot seam area and the Bowling Alley seam area as shown on the proposed grouting scheme plan, referenced D5249/20 included at Appendix 1.

Following tender appraisal Forkers Limited were awarded the contract and moved onto site on 10th December 2001.

Drilling commenced in the Ten Foot seam area on 10th December 2001 and was completed on 17th January 2002. Grouting started in the Ten Foot seam area on 13th December 2001 and was completed on 23rd January 2002. A summary of the Ten Foot seam area treatment is at Appendix 2.

Drilling commenced in the Bowling Alley seam area on 14th December 2001 and was completed on 23rd January 2002. Grouting started in the Bowling Alley seam area on 19th December 2001 and was completed on 23rd January 2002. A summary of the Bowling Alley seam area treatment is at Appendix 3.

A disused mine shaft was discovered in the Ten Foot seam area on 10th January 2002. Proving holes to determine its depth and diameter were drilled on 11th January 2002. The shaft was grouted on 18th January 2002 and a grout cap formed on 21st January 2002. A concrete cap was installed on 25th January 2002. A summary of the shaft treatment is at Appendix 4.

All ground stabilisation and shaft treatment works were supervised by IMC Consulting Engineers and were carried out to the required specification as detailed at Appendices 5 and 6, and were completed on 25th January 2002.

APPENDIX 1

Plan showing Proposed Grouting Scheme
Referenced D5249/20

APPENDIX 2

Summary of daily Drilling and Grouting
Ten Foot seam area

APPENDIX 3

Summary of daily Drilling and Grouting
Bowling Alley seam area

APPENDIX 4

Summary of Drilling and Grouting
Disused Mine Shaft

APPENDIX 5

Drilling and Grouting Specification
(Extract from Contract Documents, D5249H, Nov 2001)
(Sections B and C)

APPENDIX 6

Shaft Treatment Specification
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