BROWN LEES DEVELOPMENT

MINING HAZARD SITE INVESTIGATION

FACTUAL AND INTERPRETATIVE REPORT

for

ADVANTAGE WEST MIDLANDS

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1.0 INTRODUCTION

IMC Consulting Engineers (IMC) was instructed by Advantage West Midlands (AWM) to carry out a further site investigation of the former Victoria Colliery, Biddulph to investigate the potential for historical mining activity to create hazards for the development of the site.

Previous investigations of the site have included a desk study, environmental site investigation and foundation survey, each of which has been reported on in separate volumes.

Phase I comprised a desk study incorporating a reconnaissance visit and established the site history including mining aspects. The environmental setting was assessed based on regulatory authority records and other sources.

The three part invasive site investigation (Phase II) has consisted of an environmental site investigation, geotechnical study, foundation survey and mining hazard investigation. The objectives of the investigation were :

To test for contamination of soils or groundwater through the excavation of trial pits on an approximate 50m centred grid, logged to BS5930:1999. Samples were collected of soils and groundwater if encountered for contamination testing. Testing involved standard contaminant suites, loss on ignition and leachability. Selection of samples for testing was based on site observations and potential historical contamination.

- To investigate the bearing capacity of the ground along the centre line of the proposed road, by means of in-situ CBR tests.

- To confirm the presence or prior removal of remnant foundations of previous structures on the site by the excavation of trenches. To quantify the volumes of materials requiring demolition and disposal.

- To assess the presence of mining hazards on the site resulting from previous mining activity, including the presence of uncapped shafts, gas emissions, remnant coal close to surface and shallow old mine workings.

- To prepare factual and interpretative reports on these investigations, including recommendations for any necessary remedial works or building specification requirements.

2.0 SITE LOCATION

The site is located to the west of the A527 (Tunstall Road) and to the south of Brown Lees Road, south of Biddulph, Stoke on Trent. It is centred at National Grid Reference 387863 355465, as shown in Figure 1.

The area to the southeast, southwest and south is Adopted Green Belt Land under the City of Stoke-on-Trent Plan 2001, Staffordshire Moorlands Local Plan and the Newcastle-under-Lyme Local Plan.

3.0 SITE HISTORY AND CURRENT CONDITIONS

A detailed discussion of the site history and current conditions is contained in the IMC Desk Study on the site.

3.1 Site History

Industrial activity in connection with coal mining, quarrying, spoil tipping and brick manufacture has been known on the site since before the first map of the area, in 1878. Shafts were sunk to various depths across the site, whilst brick kilns, tanks, reservoirs and other colliery or railway infrastructure were erected, dismantled or demolished and buried over the intervening decades of the 19th and 20th Centuries.

Part of the site was excavated to recover coal from at least three seams by opencast methods commencing in 1988 and ceasing in September 1994.

The settlement of the open cast backfill has been monitored since May 1995 and reported on by SWK at the end of 2000.

3.2 Current Conditions

A site inspection was undertaken on 12 February 2001 and details of the condition of the site at the time of the inspection can be found in the IMC desk study of March 2001.

The site occupies an irregular shaped area, approximately 270m by 570m at its widest points. A track from Tunstall Road, opposite Bemersley Road allows access to the site area.

Considerable preparatory work for the development of the site has taken place since the initial reconnaissance visit in February 2001. The foundations of numerous former structures have been excavated, spoil mounds levelled and inert materials and soils dispersed to other parts of the site to provide appropriate levels for subsequent development works. The northern extent of the site is flat and level with Brownlees Road, although further west, the lands falls away towards the valley bottom. The central part of the site is also flat and formerly included a large spoil mound to the north-eastern extent, again with the land to the west falling towards the valley bottom. Removal of the spoil mound has left a minor depression, level with the junction of Brownlees Road and Tunstall Road. The southern half of the site falls away progressively to the south and west. Much of the former spoil mound has been re-deposited and compacted in the south of the site.

The western half of the site, extending almost the full length from the north, has been rigged with settlement monitoring equipment, which is understood to remain in place and is subject to routine monitoring by SWK. This part of the site is covered with rough grassland on poorly draining heavy clay soil.

The remainder of the site where earth-moving work has taken place is cleared of vegetation, poorly draining and in places heavily rutted. An interceptor ditch extends from north to south through the middle of the site.

4.0 MINING HAZARD INVESTIGATIONS

4.1 Site Investigation Remit

The investigation was intended to address the following requirements:

- To confirm areas where remnant or un-worked coal was within 15 x extraction thickness or seam thickness respectively of the development surface such that a risk of subsidence and gas emission or spontaneous combustion was unacceptable.
- To identify the distribution and condition of shallow coal workings beneath the development areas, recommend methods for their treatment and provide guideline costs for this work.
- To investigate the condition of known shafts on the site in terms of capping and gas venting.
- To investigate the presence and nature of any capping of suspected shafts within the site, including those at the periphery of the opencast excavations.

The field investigations were undertaken between the 12th September and 1st October 2001. All positions were set out by Forkers Ltd site surveyor to avoid disruptions to earth-moving works taking place at the same time.

4.2 Method of Investigation

4.2.1 Remnant Coal and Shallow Coal Workings

Four coal seams are known to exist at shallow depth beneath the site including the Bellringer, Ten Foot, Bowling Alley and Holly Lane, each dipping to the west at approximately 20-25º. Three areas were identified beneath the proposed development area of the site where the coal seams may be within 15 x seam thickness of the development surface and these are shown on Figure 2. The Holly Lane seam is known to lie beneath the Bowling Alley and although the former seam only approaches within 15 x seam thickness of the surface in the extreme east of the site, the potential influence of old workings in this deeper seam on those in the shallower Bowling Alley seam necessitated investigation down to the Holly Lane over the whole area of proposed investigation for the Bowling Alley seam.

Investigation of these areas comprised rotary air-flush drilling by open-hole method to determine seam depth and disposition and to identify zones indicating the presence of old workings (using shallow casing where required to stabilise superficial deposits) followed by geo-logging.

The geo-logging was carried out to confirm the exact depth and thickness of each coal seam and the presence of voids, comprising Natural Gamma, Short and Long-Spaced Gamma and three-arm Caliper.

Rotary spot-coring was then carried out to collect samples of the coal seams for subsequent analysis. Rotary open-hole boreholes were drilled to directly above the target depth determined from previous drilling and logging. A core barrel containing a clear plastic inner sleeve was used to secure the core for delivery to IMC's core store. Following geotechnical logging of the core to identify mining-induced fractures / subsidence and other evidence of old workings, the coal fractions of each core were collected in bulk bags for coal quality analysis.

4.2.2 Presence of known and suspected shafts

Several shafts were known to have been sunk within the curtilage of the site and for development purposes it was necessary to determine the exact location of these and the presence and condition of any shaft capping or vent

The removal or treatment of various of these has been recorded on mining records lodged with the Coal Authority, whilst the reminder appear only as shaft locations with no further information.

Where these shafts were clearly within the opencast excavation, no action was deemed necessary. Where shafts were shown within the un-excavated development area, these were exposed using a tracked excavator. One suspected shaft was outside of the development area but within influencing distance of the boundary and was excavated, whilst a second shaft was sufficiently far from the development area that no investigation was required.

Finally, a shaft into the Bellringer seam was within the development area but either within or beside the opencast excavation, dependent upon the exact location of the latter. According to mining records, those shafts encountered within the 'cut' were treated either by removal or capping according to NCB standards. Hence, depending on the exact location of the boundary of the 'cut', either the shaft would or would not have been treated / removed. Therefore a series of six rotary open-holes was drilled at ten metre intervals, normal to the recorded edge of the opencast void, extending through opencast backfill to rockhead, to provide a depth profile for the opencast excavation batter.

5.0 REMNANT COAL AND SHALLOW COAL WORKINGS INVESTIGATION

5.1 Bellringer seam

Three rotary open-holes (B#1 – B#3) were drilled within the target zone defined as 15 x seam thickness and marked in green on Figure 2. Coal returns were obtained from each borehole and no voiding was apparent from drilling rates or loss of air-flush.

Geo-logging confirmed the depths to coal as illustrated in the Bellringer composite logs provided in Appendix A and collated in Table 1. The Bellringer was found in two holes to be 1.30 m although only 0.55 m thick in B#2 on account of erosion (Basset Edge). The lower leaf, some 0.6 – 0.8 beneath the main seam was found to vary between 0.5 – 0.9 m in thickness.

Both coal seams were successfully cored intact to full thickness (B#1a).

The seam outcrops within the development area beneath approximately 5.5 m of colliery spoil and a further 1.8 m of sand and gravel deposits. The precise thickness and elevations of made ground, superficials and rockhead are given for each of the main seams in Table 4.

5.2 Ten Foot seam

Three rotary open-holes (10foot#1 – 10foot#3) were drilled within the target zone defined as 15 x seam thickness and marked in green on Figure 2. The Ten Foot seam was found to be not present in borehole 10foot#1, being entirely outcropped at this location. Coal returns and broken ground were observed from the remaining boreholes indicating some working of the seam. A second leaf was encountered in each borehole, which may comprise the lower part of the same seam but with a particularly wide dirt parting. This is referred to as the sub-Ten Foot seam.

Geo-logging confirmed the depths to coal as illustrated in the Ten Foot composite logs provided in Appendix A and collated in Table 2. The upper leaf of the Ten Foot was found to be between 0.5 – 1.0 m in thickness, whilst the lower leaf was between 0.24 – 1.1 m thick, separated by a mudstone band between 0.17 – 1.1 m thick.

Both coal seams were successfully cored intact to full thickness (10foot#2a).

The seam outcrops within the development area beneath approximately 6.5 – 8.0 m of opencast backfill consisting of variably weathered colliery spoil. The precise thickness and elevations of made ground and rockhead are given for each of the main seams in Table 4.

5.3 Bowling Alley & Holly Lane seams

Six open-hole rotary boreholes (BA#1 - #4, #6 & #7) were drilled through the Bowling Alley seam to the Holly Lane seam beneath. The outcrop onsite of the Bowling Alley seam was proved by its absence in the eastern-most borehole (BA#4) where superficial deposits of boulder clay extended to 8.5m. The seam was encountered in all other open-hole boreholes as given in Table 2 except BA#2. No coal seam nor evidence of broken ground was identified from drilling observations in this borehole. The Bowling Alley seam beneath the site is 1.1 - 1.3m thick.

The Holly Lane seam was encountered in all boreholes except BA#1 and comprised a main seam 1.2 – 1.3m thick with a further 0.3m thick leaf 1.7 – 1.8m beneath the floor.

Borehole BA#5 was spot cored for the coal seams but due to unforeseen variations in the local geology, the seams were deeper than anticipated. Consequently, a further borehole was drilled, BA#5a and both seams were then successfully spot cored.

Geo-logging was carried out in all boreholes as illustrated by the composite logs provided in Appendix A and collated in Table 2. However, due to the presence and depth of workings in the Bowling Alley seam it was not possible to geo log beyond approximately 44 m BGL.

Contaminated groundwater was detected during the drilling of BA#2. It was not possible to sample the water at the time of the investigation and thus a standpipe was installed to 6 mBGL to permit subsequent collection of water samples. The findings of the analysis of such samples will follow the issue of this report.

6.0 REMNANT COAL

6.1 Coal Distribution

Coal was found close to outcrop in each of the three areas investigated. However, substantial overburden was present in all areas comprising mainly colliery spoil, but also sand and gravel and in places red shale. The risk of spontaneous combustion of shallow coal or of the risk of gas emission from shallow seams is considered negligible where the depth of burial is greater than 15 x seam thickness. Due to the thickness of overburden cover, the areas where coal may need to be removed prior to development have been reduced from the original estimate to that illustrated on Figure 5.

Coal recovery: average seam thickness, area where coal needs to be removed, % loss due to shallow old workings

6.2 Coal Quality

Samples of each of the four principal coal seams encountered beneath the site and retrieved by means of coring were sent for analysis to TES Bretby. The upper and lower leaves of the Bellringer were analysed separately, whilst only the upper leaf of the Ten Foot and Bowling Alley seams were sent for analysis. Samples were analysed for calorific value (CV), moisture, ash, sulphur, chlorine, volatile matter and fixed carbon contents.

The results of these analyses are provided in Appendix B and presented graphically in Figure 4. The CV exceeds 26000 kJ/kg in both Bellringer leaves and the Bowling Alley whilst the Ten Foot and Holly Lane seams achieve 22644 and 23261 kJ/kg respectively. Volatiles range between 27.2 – 32.4 %, whilst Sulphur content is highest in the Ten Foot (1.66%), followed by the Bowling Alley and lower leaf of the Bellringer, with lowest values in the upper leaf of the Bellringer (0.74%).

7.0 SHALLOW COAL WORKINGS

7.1 Bellringer

No workings were detected in this seam either during drilling and coring or by subsequent geophysical logging. Whilst this does not preclude the possibility of undetected old workings, the probability of their existence is considered to be low.

7.2 Ten Foot

This seam was found from geo-logging and drilling evidence to be worked in each borehole that encountered the seam including the cored borehole. Recompacted fragments of broken coal and mudstone were recovered in the core and interpreted as resting on the former floor of the workings. Neither the distribution of the workings nor their character can be accurately determined from the drilling data, although it is likely that they would be extensive to have been encountered in each borehole.

7.3 Bowling Alley

Collapsed workings were encountered in four of the six open-hole boreholes and evidence of stowage of workings was observed in the cored borehole BA#5A. The seam was inadvertently drilled out in BA#5 before it could be cored and was found to outcrop to the west of BA#4. Intact coal was encountered in BA#3, reflecting the proximity of this borehole to the outcrop position.

The drilling, coring and geo-logging evidence indicates that whilst no voids were detected, old workings are likely to be pervasive beneath the site within this coal seam.

7.4 Holly Lane

Old workings were detected in one borehole, BA#7, by geo-logging, in the southern extent of the target zone, although no voiding was apparent. The seam was not encountered in BA#1, BA#2 and BA#5 and it is suggested that the seam is faulted out in the northern part of the site. Intact coal was drilled and geo-logged in the remaining boreholes, BA#3, BA#4 and BA#6. Workings are likely to be less pervasive in this seam due to the greater depth and distance from outcrop and this is reflected in the low incidence of workings detected during the investigation.

7.5 Remedial works

Ground stabilisation would be required prior to development of the site within those areas found to be affected by old workings within the underlying seams, but only where such workings are within 15 x ‘extraction thickness’ of the surface.

The drilling and logging indicates that pervasive shallow old workings are present within the Ten Foot and Bowling Alley seams. Figure 6 indicates the extent of those areas where the worked seams are within 15 x extraction thickness of the current surface, assuming an extraction thickness of X.X m (XX%) and X.X m (XX%) within the Ten Foot and Bowling Alley seams respectively.

The preferred method of stabilising collapsed shallow old workings is by grout injection. A weak cementitious grout is injected into the collapse zone by means of closely spaced unlined boreholes. The efficacy of the grout injection is demonstrated by drilling additional proving holes within the previously grouted areas and monitoring the grout take of these latter boreholes.

In order to treat the areas indicated in Figure 6 as requiring stabilisation, a grout hole pattern on a 6 metre grid is recommended. If subsequent proving holes reveal the need for additional grouting, the grid spacing would be closed to 3 metres.

Outline costs for this method of treatment involving the drilling of approximately XX boreholes (6 metre grid) and XX proving holes in both areas to be grouted, together with the injection of XX tonnes of grout (equating to an assumed porosity of X%) have been obtained. The cost of the above programme is indicated to be approximately £XX,XXX.

8.0 PRESENCE OF KNOWN AND SUSPECTED SHAFTS

Seventeen shafts were either known from recent mining records, or suspected from markings on older plans, to exist within the site or within influencing distance of the site, See Figure 3. Of these, eight were known to have been located within the opencasted area and either treated by capping at the base of the opencast excavation or removed entirely, See Table 5.

Five shafts were either known or suspected to have existed within the development area of the site, four to the east of the opencast excavation and one at the southern edge of the 'cut'.

A further four shafts were either known or suspected to have existed, two south of the development area and two on the north east side of Brownlees Road beside the northern part of the development area. These latter shafts provided concern over the accuracy of their positions and the possibility of their existence within the site.

The investigation for shafts #1 and #2 (according to the numbering indicated in Table 5 and on Figure XX) comprised excavation to natural ground across a rectangular area bordering the north eastern edge of the site. No traces of any shafts were found within this area indicating that the shafts, if existent, must lie across the road from the site, outside of influencing distance of the development.

Reliable Mining records indicate that shafts #3 - #8, #12 and #13 lay within the opencasted area. Shafts #5 - #7 were only shallow and were thus completely removed during opencast excavations, whilst the remaining shafts were exposed and capped according to prevailing NCB practices, as given in Table 5.

The investigation for shafts #9 - #11, #14 and #16 comprised excavation to natural ground to prove the absence of disturbance.

Shaft #9 comprised a brick-lined culvert extending south-eastwards; this was removed along its entire course.

Shaft #10 comprised a mass-concrete reinforced manhole chamber extending down to a 150 mm diameter clay-ware sewer orientated approximately east-west and exhibiting no perceptible flow. This structure was removed.

Shaft #11 was indicated from mining records as having been capped and the concrete cap was located XX m beneath the current ground surface. The cap comprised a XX mm thick concrete plinth X m square (the cap was not broken to reveal any reinforcement), with three rusted iron pipes extending from the central area. These pipes appeared to be remnant grout pipes for stabilising the upper section of the filled shaft and surplus grout was apparent around the pipes and the top of the shaft cap.

A second shaft cap was encountered at the location for shaft #14 at XX m below current ground level. The cap extended 8 m square and approximately 750 mm in depth (although two of the cap sides were not formed) with a central rectangular port, presumably for the introduction of shaft fill and / or the injection of grout. Records indicated that the cap ahd been set at ground level and evidence of an original ground at the level of the top of the cap was provided by a thin tarmac surface above a compacted sub-base

Excavation to natural ground (XX m depth) at the indicative location, and to X m radially, of shaft #16 revealed no evidence of the former presence of a shaft at this location.

All excavations were subsequently backfilled with colliery spoil which was replaced in 300 mm layers and compacted with a hydraulic vibro-compactor.

The indicative position for shaft #17 fell outside of influencing distance of the development area and thus no investigative work was carried out.

9.0 CONCLUSIONS

shallow workings

drilling and grouting

capping

coal extraction

monitoring of contamination

10.0 RECOMMENDATIONS

TABLES

Table 1: Bellringer Seam Intersections

BH Number	Surface Elevation	Bellringer seam			Bellringer (lower leaf)			Parting Thick	Comments
		Top	Bottom	Thick	Top	Bottom	Thick		
B#1		9.90 ( )	11.20 ( )	1.30	11.95 ( )	12.50 ( )	0.55	0.75	Seams intact
B#2		7.30 ( )	7.85 ( )	0.55	8.58 ( )	9.40 ( )	0.88	0.73	Part of top leaf eroded
B#3		15.80 ( )	17.10 ( )	1.30	17.68 ( )	18.40 ( )	0.72	0.58	Seams intact
B#1a (cored)		9.63 ( )	10.93 ( )	1.30	11.72 ( )	12.37 ( )	0.65	0.79	Core only (no geolog)

(Figures in parentheses are reduced levels)

Table 2: Ten Foot Seam Intersections

BH Number	Surface Elevatn	Ten Foot seam			Sub-Ten Foot seam			Parting Thick	Comments
		Top	Bottom	Thick	Top	Bottom	Thick		
10'#1	202.98	N/P			9.00 (193.98)	9.55 (193.43)	0.55	N/A	Main leaf outcropped
10'#2	201.79	24.40 (177.39)	25.15 (176.64)	0.75	26.25 (175.54)	26.80 (174.99)	1.10	1.10	Worked
10'#3	198.22	20.30 (177.92	20.80 (177.42)	0.50	21.50 (176.72)	22.00 (176.22)	0.50	0.70	Worked
10'#2a (cored)	(201.79)	23.59 (178.20)	24.59 (177.20)	1.00	24.76 (177.03)	25.00 (176.79)	0.24	(0.17)	'sub-ten foot' data = additional ten foot seam

(N/P = Not Present; N/A = Not Applicable; figures in parentheses are reduced levels)

Table 3: Bowling Alley / Holly Lane Seam Intersections

BH Number	Surface Elevatn	Bowling Alley seam			Holly Lane seam			Parting Thick	Comments
		Top	Bottom	Thick	Top	Bottom	Thick		
BA#1	202.12	c.44.0	c.45.4	c.1.4	N/P			N/A	BA worked
BA#2	202.49	23.10	24.30	1.20	35.10	36.30	1.20	10.80	BA worked ?
BA#3	202.78	12.20	13.90	1.60	23.90	25.30	1.40	10.00	
BA#4	202.13	N/P			12.60	13.90	1.30	N/A	
BA#6	203.10	9.80	11.05	1.25	21.80	23.30	1.50	10.75	BA worked ?
BA#7	204.76	27.80	28.95	1.15	39.95	40.40	0.45	11.00	BA & HL worked
BA#5 (cored)		26.65	27.60	0.95 (E-log)	37.60 ?	39.73 ?	Not known	10.00	BA worked (poor core recovery)
BA#5a (cored)		27.30	28.30	1.00 (Core)	37.72	39.00	1.28	9.42	BA (?) & HL worked

(N/P = Not Present; N/A = Not Applicable; figures in parentheses are reduced levels)

Table 4: Rockhead Elevations

BH	Grid Reference		Ground level	Top of			Rockhead	Comments
	Easting	Northing		Layer 1	Layer 2	Layer 3		
B#1	1196.161	1186.268		CS/Slag	5.5 S&G		8.5	Based on returns
B#1a				CS/Slag	5.5 S&G			Based on returns
B#2	1195.950	1160.507		CS/Slag	5.5 S&G		7.3	Based on returns
B#3	1180.714	1162.294		CS/Slag	5.0 S&G		9.6	
10'#1	1245.114	1319.495	202.98	Backfill			7.8 (195.2)	
10'#2a	1194.489	1318.420	201.79	Backfill			8.0 (193.8)	Inferred from 10'#2d
10'#2d				Backfill			8.0	G'ist not present
10'#3	1234.195	1241.784	198.22	Backfill			6.5 (191.7)	
BA#1	1117.792	1652.785	202.12	CS	4.0 BC		5.5 (196.6)	
BA#2	1201.491	1572.820	202.49	CS			6.5 (196.0)	
BA#3	1247.807	1555.070	202.78	CS			9.0 (193.1)	
BA#4	1285.507	1539.472	202.13	CS	3.0 BC		8.5 (193.6)	
BA#5	1232.846	1527.109		Red Ash	2.5 CS	4.0 BC	5.0	
BA#5a				Red Ash	2.5 CS	4.0 BC	6.0	
BA#6	1285.507	1498.056	203.10	CS	3.0 S&G	8.0 BC	9.8 (193.3)	
BA#7	1274.082	1432.072	204.76	CS			2.0 (202.8)	

(CS = Colliery Spoil; S&G = Sand and Gravel; BC = Boulder Clay)

Table 5: Shaft Information

Shaft	Name	Grid Reference		Location	Plans	Records	Actions
No.		Easting	Northing				
1				North of BL road			Cleared to NG
2							
3	Havelock Pumping			Within centre of opencast		Capped at base of opencast	None
4	Havelock				1878, 1899, 1925, 1937, 1955, 1976		
5						Removed by opencast	
6							
7							
8	Victoria				1878, 1899, 1925, 1937, 1955	Capped at base of opencast	
9				Centre of develop--ment area			Cleared to NG
10							
11	"No.3"				1878, 1899	Capped	Exposed & confirmed
12	"No.7"			Within centre of opencast		Cap at 185.8	None
13					1878	Cap at 168.5m	
14	Salisbury			Southern half of DA	1899, 1925, 1937, 1955, 1976	Cap at original ground level	Exposed & confirmed
15				Southern edge of opencast			Drilled & confirmed within opencast
16				Southern half of DA			Cleared to NG
17				South of DA			None

(BL = Brownlees; NG = Natural Ground; DA = Development Area)

FIGURES

APPENDICES

APPENDIX A

Bellringer Composite Logs

APPENDIX B

Ten Foot Composite Logs

APPENDIX C

Bowling Alley / Holly Lane Composite Logs

APPENDIC D

Drillers' Logs

APPENDIX E

Coal Quality Analyses