BACK TO THE FUTURE: A NEW UK ROOM AND PILLAR COAL MINE

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Abstract

On 19th June 2014, provisional Planning Permission was granted to New Crofton Co-operative Colliery (NCCC) by Wakefield Metropolitan Borough Council for the development of a new underground drift mine to extract, process, stock and sell 4.9 million tonnes of coal over a period of 20 years. This was confirmed together with the Section 106 Agreement in May 2015. Currently, the funding is in place, and it is expected that a contract for sale of the coal will be in place early in 2016. It is hoped that excavation will begin in the summer of 2016. This paper describes the geology, mining method, mine development and environmental aspects of the project with an update on works progress, correct to December 2015.

The Colliery is located on the site of a former coal stocking and rail loading yard, in an area of extensive underground and opencast workings. The plan area of the surface and underground development is 174ha. Four Sharlston seams will be worked at three levels; Top, Muck and Low together, and Yard. The depth of workings is limited to a minimum of 45m below surface by mining regulations, and will reach a depth of ~150m. The reserves have been calculated based on existing BGS borehole data and previous extensive drilling by British Coal Opencast. The coaling area is fault bounded to the south and east, with a number of other significant faults crossing the site, including a complex graben structure. Generally the seams dip between 2° and 4° to the north east, but steepen in the vicinity of faults.

Access to the seams will be via two drifts (5.5m wide by 2.2m high) driven at a grade of 25% (1v:4h) from the surface. Extraction of the coal will be by room (6m wide) and pillar (10m square), which gives good roof support properties and is predicted to produce zero subsidence at the surface. This design gives a potential recovery of 63%, but 55% has been assumed for operational and financial reasons. A continuous miner will be used to extract the coal, with three coal scoops transporting the coal to an underground feeder-breaker, which will feed a run-of-mine conveyor taking the coal to the surface. Mine stability will be ensured using a twin-arm roof bolter. Some of the seams have dirt partings, and so will need to be washed at the surface. Waste material will be sent back underground, and the Environmental Impact Assessment has shown that the location, scale and mode of operation of the colliery means there is unlikely to be any significant environmental impact. Over 85% of the coal will be sent to power stations by rail, with up to 15% being screened for use in heritage steam and domestic markets.

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Introduction

The UK's continued dependence on coal for electricity generation is shown by the data for 2014 given in Figure 1. Although this is reducing (coal represented 41% in 2013), the construction and development of alternative energy sources is such that there will continue to be a need for coal for many years to come. Since 2003, coal imports have exceeded production in the UK, and since 2006, more coal in the UK has been produced from surface mining than from deep mines (Figure 2). In December 2015, the last remaining deep coal mine in the UK; Kellingley Colliery in North Yorkshire closed.

New Crofton Co-operative Colliery (NCCC) is designed to recover 4.9 million tonnes of coal over a period of approximately 20 years, by means of a new underground drift mine in the Yorkshire coalfield. The planning application was submitted to Wakefield Metropolitan Borough Council on 18th November 2013, and provisional planning permission was granted just seven months later on 19th June 2014. The Section 106 Legal Agreement was finally signed in May 2015. This was in large part due to the significant community engagement

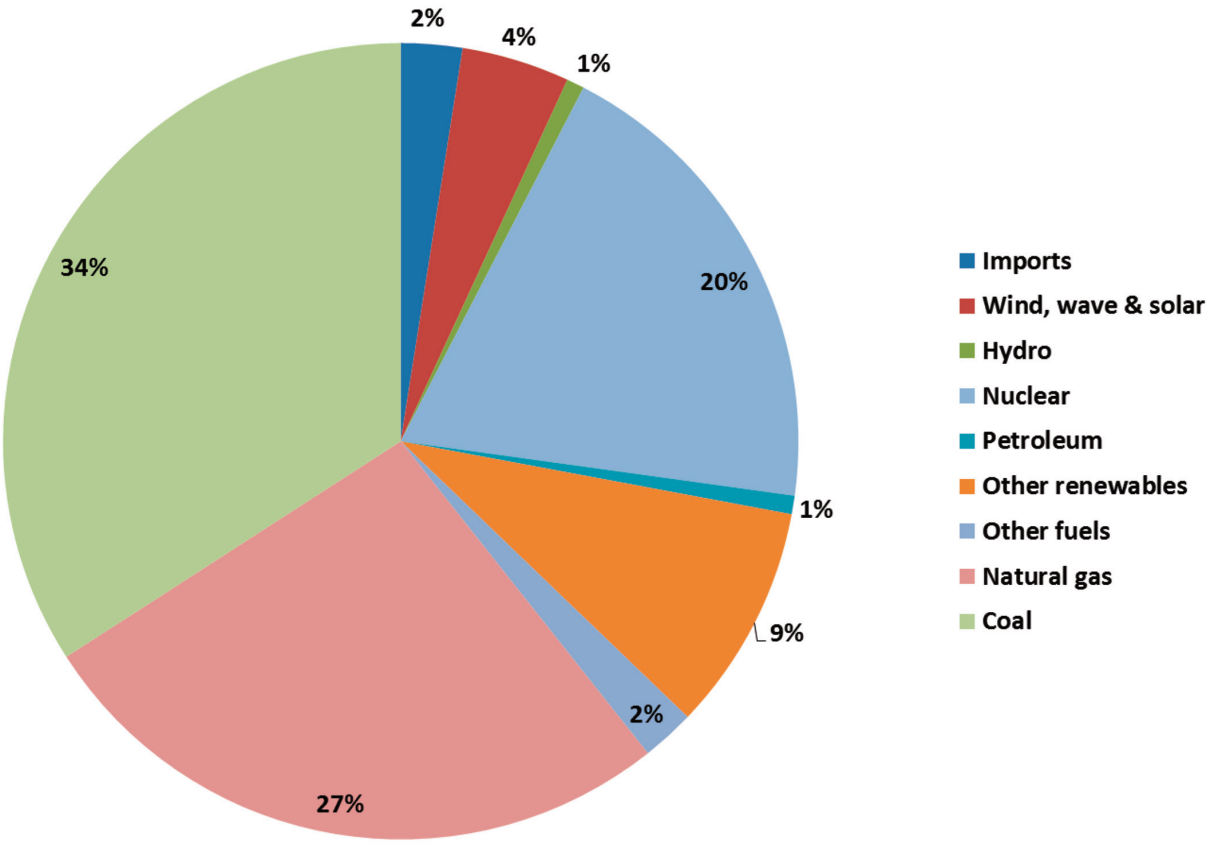

Figure 1. *Relative proportion of UK electricity generation by fuel type. Data from DECC, 2014.*

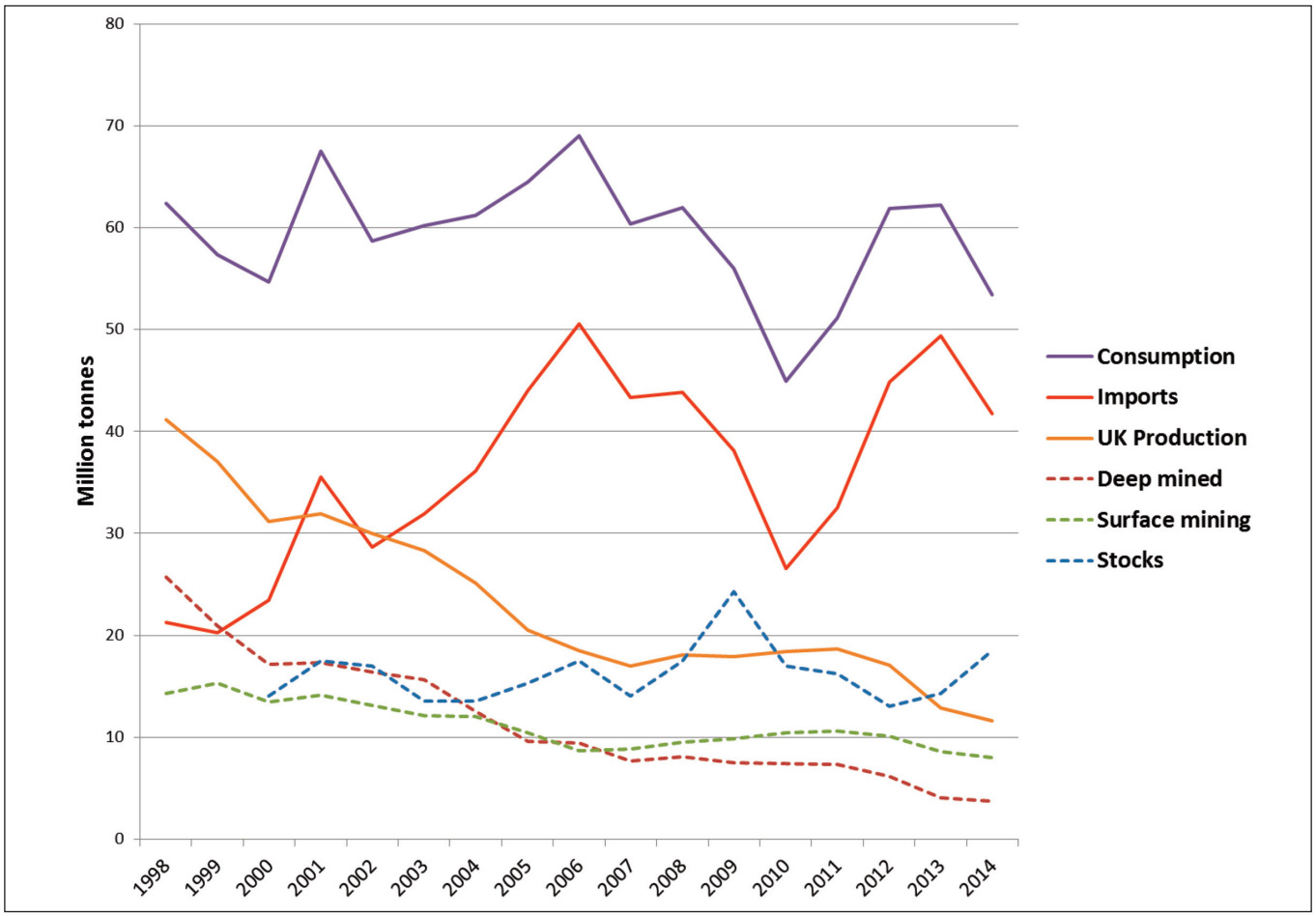

Figure 2. *UK Coal statistics, 1998 – 2012. Data from DECC, 2014.*

which had taken place prior to the formal submission of the application, and the fact that NCCC has been established as a workers' co-operative which truly seeks to be part of the coalfield community in which it is situated

Mine Location And Coal Quality

The mine lies approximately 7km south-east of the centre of Wakefield in West Yorkshire, which places it in the heart of an historic coal mining community, with a number of former underground and opencast mines in close proximity. The site lies immediately adjacent to the Wakefield-Doncaster section of the main Leeds to London rail line.

A lease is in place to take control of the land (within the blue line of Figure 3) for the duration of the mine operation and restoration period. The red line on Figure 3 shows the land which will actually be used at the surface (including the access route from Santingley Road) and the green dashed line indicates the colliery curtilage.

The surrounding area is mainly agricultural, with the closest properties being 550m to the north-west in New Crofton (visible at the top of Figure 3). To the south of the site is mature woodland and the remnants of the former mineral railway lines and embankments, which all help to screen the site.

Within the colliery curtilage lie sidings, signals and points which are part of a previous coal loading depot, which served a number of local opencast sites. Everything is still in working order and will be used to send 85% of the coal to the coal-fired power stations in the Yorkshire and Lower Trent areas. The remaining 10 – 15% of the coal will be dispatched by road as domestic heating and steam heritage fuel. Table 1 gives a summary of the coal quality parameters for each of the Sharlston seams.

Seam	Moisture (%)	Ash (%)	Sulfur (%)	Chlorine (%)	Net CV (kJ/kg)
Sharlston Top	13.1	9.7	1.50	0.041	24,490
Sharlston Muck	13.9	20.6	2.64	0.039	20,740
Sharlston Low	13.1	11.1	2.04	0.044	24,360
Sharlston Yard	13.1	6.1	1.55	0.041	26,400

Table 1. *Coal quality values for the different seams*

Mine Geology

The mining area (purple line in Figure 4) is approximately 174 hectares, and is bounded by faults to the south and south-east, by the railway line to the north and the old Anglers Opencast Coal site to the west (shown on Figure 4 by a cross hatch, that identifies infilled ground). The four Sharlston seams will be worked at three levels; the Top (~1.2m average thickness), the Muck and Low together (~1.2m and ~1.42m average thickness' respectively), and the Yard (~0.82m average thickness). These sit near the top of the Pennine Middle Coal Measures (MCM) Formation, at the base of the Bolsovian (Westphalian C) Substage, within the Pennsylvanian Epoch (Upper Carboniferous /

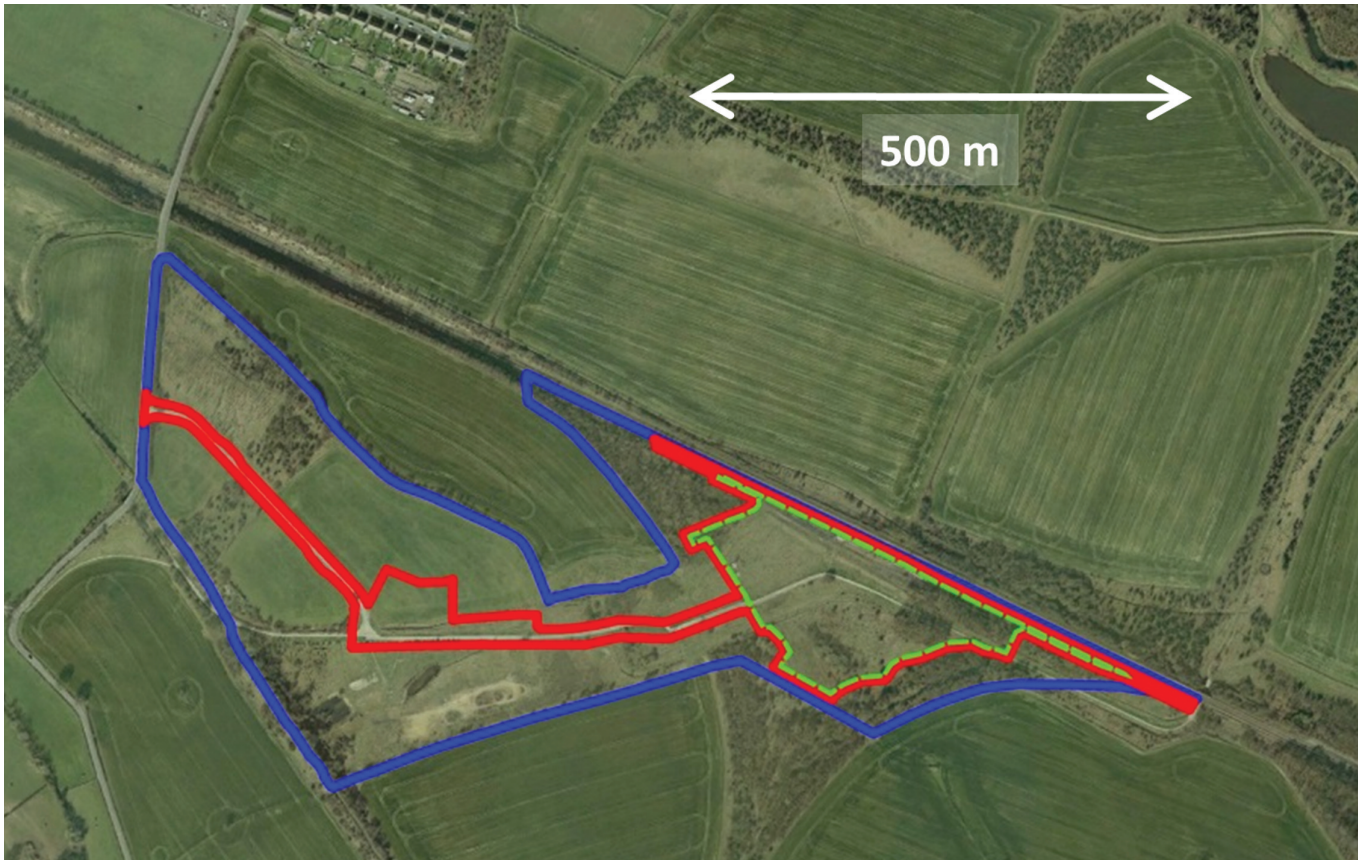

Figure 3. *Surface site boundary lines. Blue line: Lease area, red line: land that will be used at the surface, green dashed line: colliery curtilage.*

Silesian). The MCM comprise sequences of the productive coal seams, seatearths, mudstones, siltstones and sandstones. (On Figure 4 the dark grey colour in and around the coal take area shows the general MCM strata and the green units are significant sandstones within the MCM. South of the major Ryhill Fault which downthrows (*c*.120m) to the south east, Upper Coal Measure (UCM) strata is presented at surface. The UCM have fewer productive coal seams than the MCM and a greater abundance of sandstones. The pale orange colour south of the Ryhill Fault on Figure 4 shows the UCM strata. Sandstones within the UCM are shown in orange. Figure 5 shows the generalised section produced by the British Geological Survey (BGS), together with the old National Coal Board (NCB) vertical section, modified with site specific data. The coal seams range in thickness from 0.7 to 1.6m and some are split into two or more leaves. The Sharlston Thin is too thin to be able to extract.

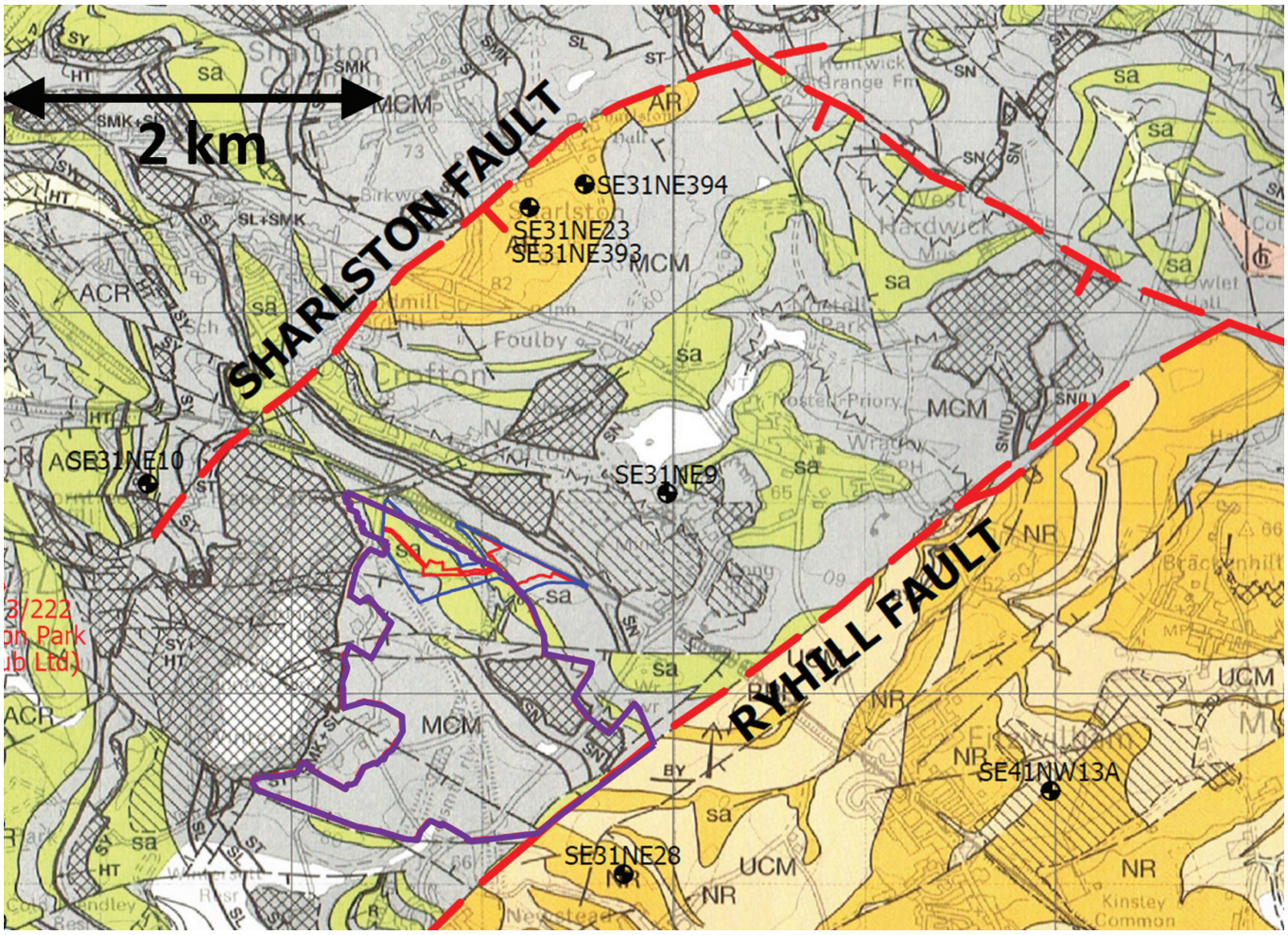

Figure 4. *Mine take area (purple line) and the local geology (the site's surface lease is shown by the blue line). Base geological map 1:50,000 BGS Sheet 78.*

The calculated reserves are primarily based on borehole data collected by the British Coal Opencast Executive (BCOE) when they were starting to plan for an opencast site in the area, which they never fully developed, deciding instead to work a small area near the surface as the Moorhouse Open Cast Coal Site (OCCS) (shown on Figure 4 as a cross hatched (infilled) area within the coal take boundary). Data from 650 BCOE boreholes (over the northern part of the coal take area) has been supplemented by data gained during the excavation of Moorhouse OCCS. As these boreholes were drilled in an active coal mining area, they were all fully grouted upon completion, in compliance with BCOE policy at the time. This was to guard against possible issues arising should the coal be worked by underground methods in the future.

Figure 6 shows the coal take area (inside the green line) and demonstrates how well the northern domain is served by boreholes. The central and southern domains on the other hand need further drilling to confirm the structure, although there is enough information to be confident the coal is there: from seam contours of the Shafton seam taken in the Moorhouse OCCS, as well as abandonment plans from all relevant seams and the Winter seam which was extensively worked at depth beneath the proposed workings. The drilling will be carried out while the northern area is being extracted.

The geological model is indicated by the cross-sections in Figures 7 and 8, based on the section lines shown in blue on Figure 6. The coaling area is fault bounded to the south and east, with a number of other significant faults crossing the site, including a complex graben structure shown in Figures 6 and 7 between the central and northern domains. Generally the seams dip between 2° and 4° to the north east, but steepen in the vicinity of faults.

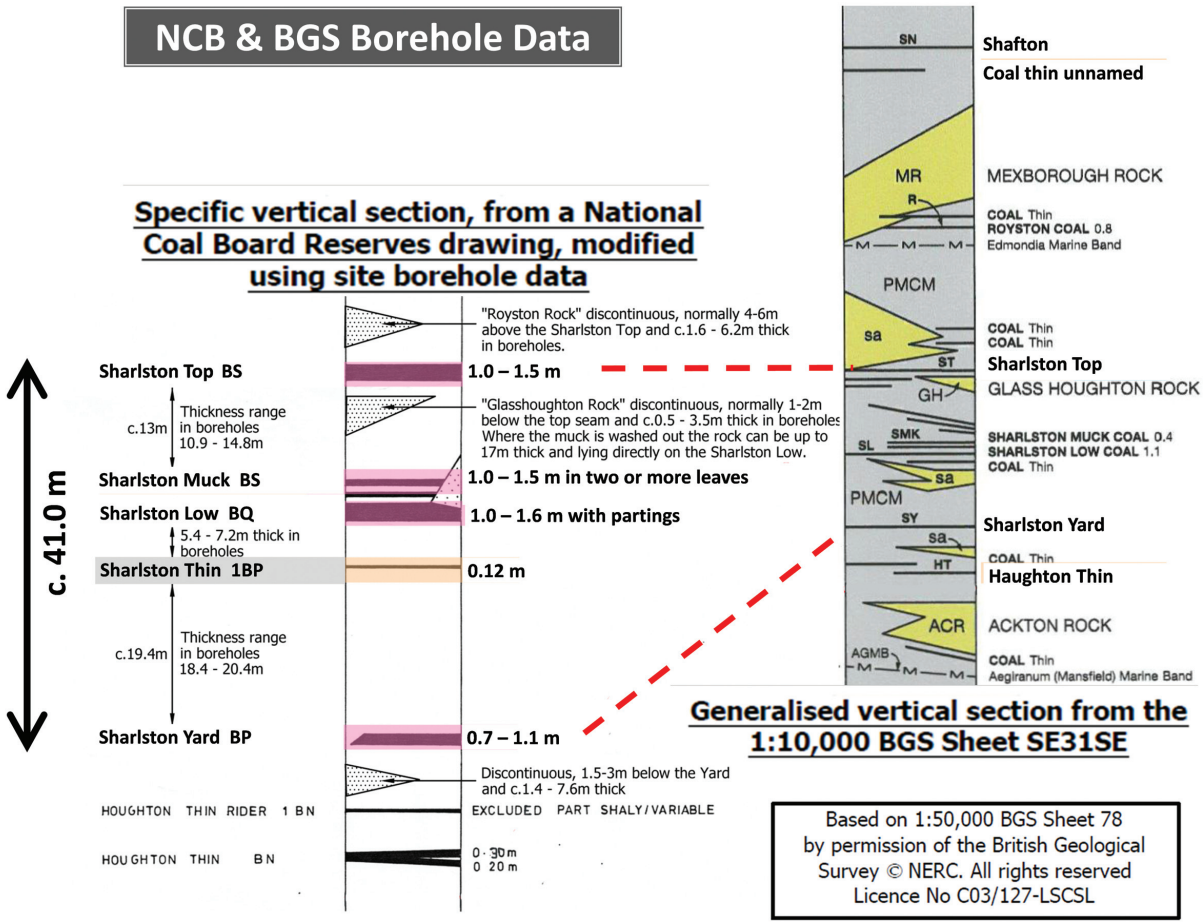

Figure 5. *Generalised and specific vertical sections through the relevant seams (highlighted in pink/purple).*

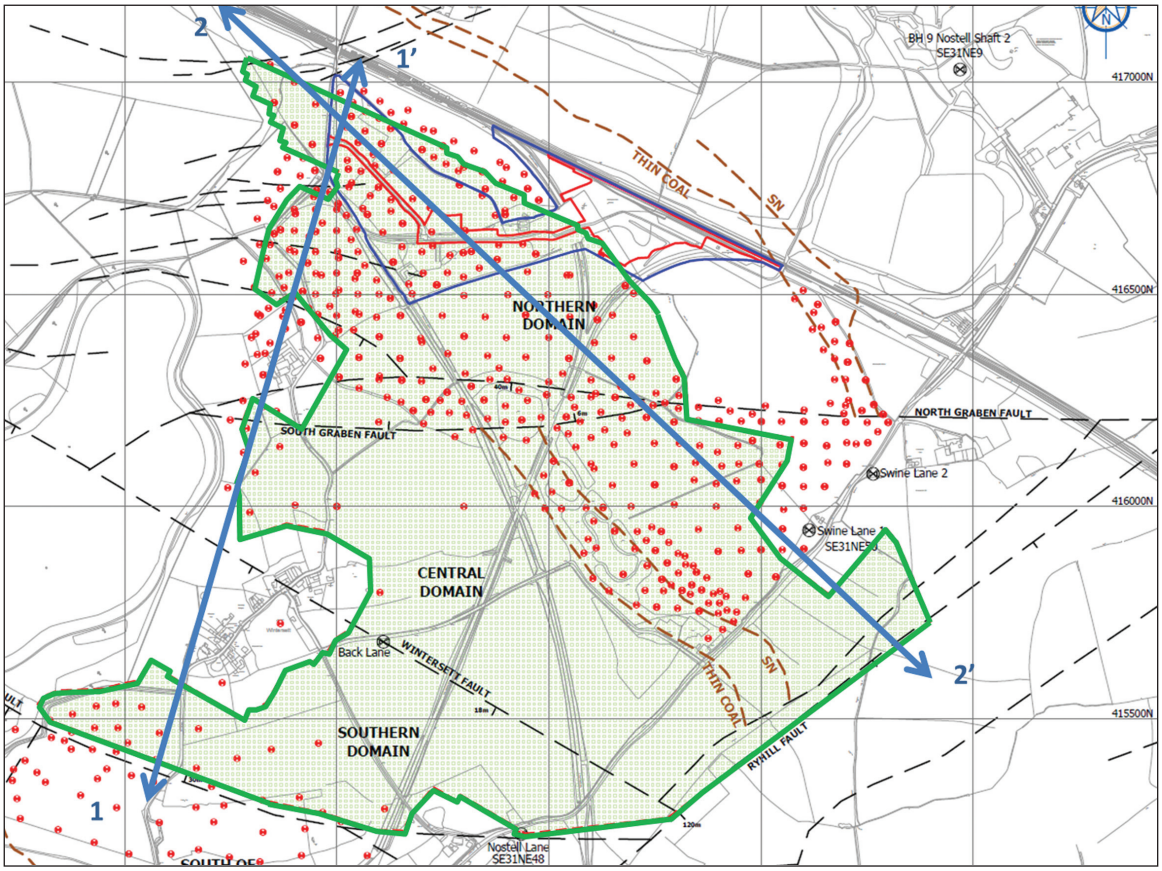

Figure 6. *BCOE boreholes (red dots), cross-section lines (blue double-headed arrows) and the coal take boundary (green solid line). Faults are shown as dark grey dashed lines and coal outcrops as brown dashed lines. Moorhouse OCCS is not shown on this figure.*

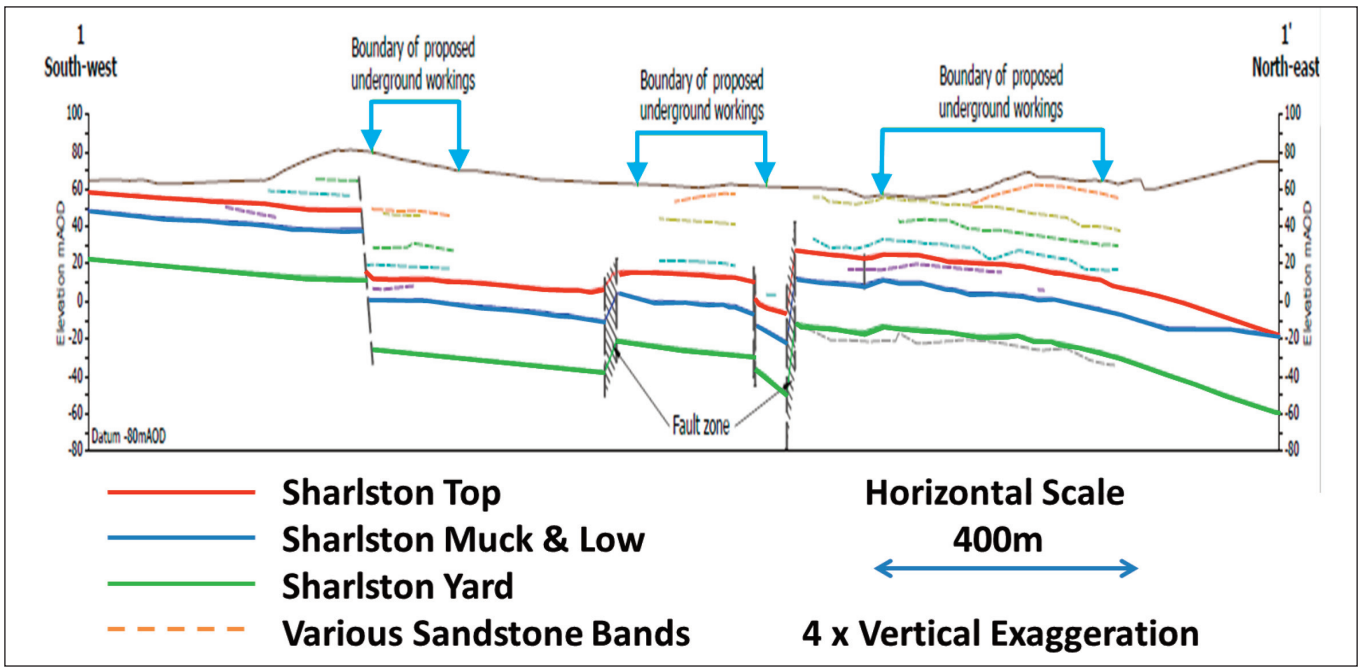

Figure 7. *Cross-section along the line shown in blue and marked 1-1' on Figure 6.*

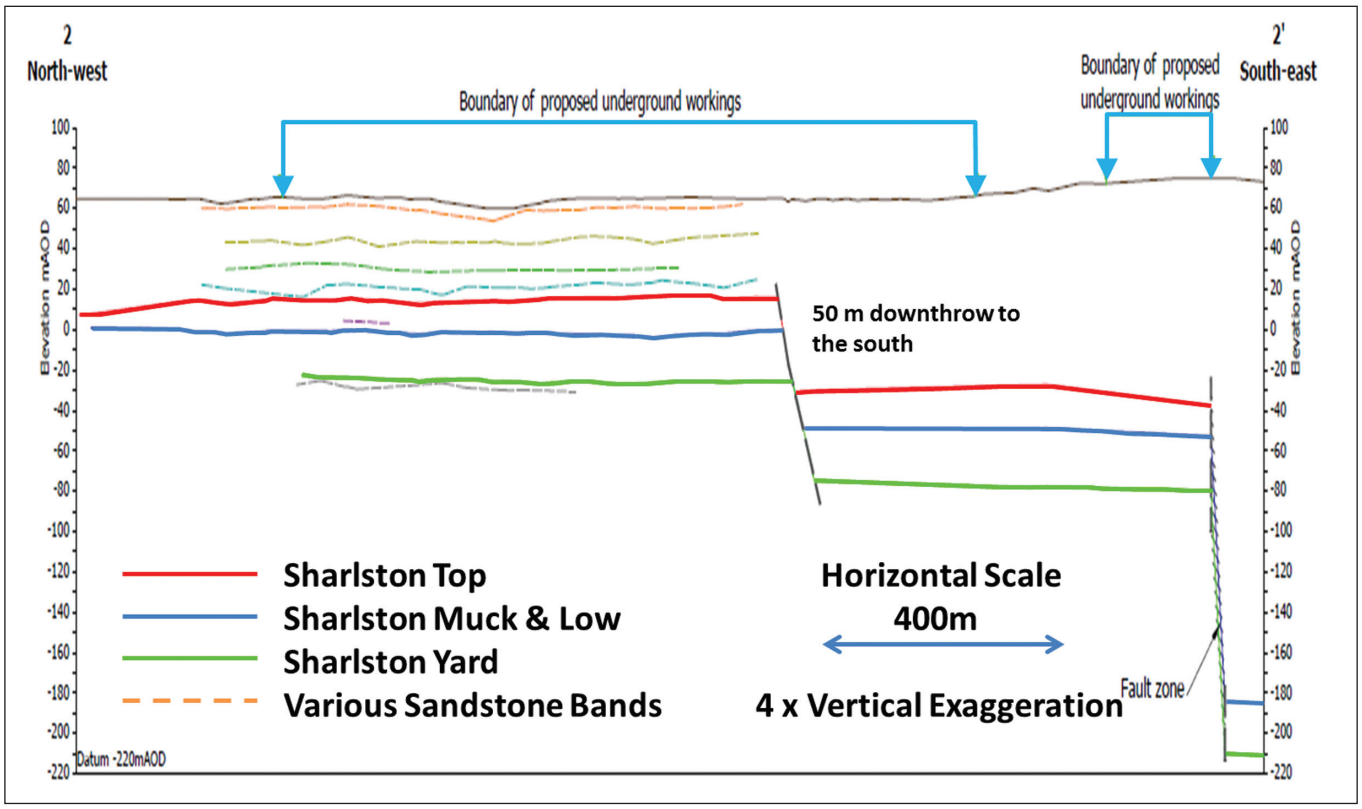

Figure 8. *Cross-section along the line shown in blue and marked 2-2' on Figure 6.*

Mining Method

Coal extraction will take place between 45m and 155m below the surface, and access to the seams will be by two parallel drifts, 5.5m wide and 2.2m high, with a 1 in 4 (25%) decline (Figure 9). The upcast drift will contain the conveyor and will have two coal bunkers cut into the rock above it. These will be able to load onto a conveyor located above the run-of-mine conveyor, in order to load straight into the rail wagons when appropriate.

A continuous miner will be used to load coal scoops to transport the coal to a feeder-breaker, which in turn feeds the coal onto the conveyor system to be taken to the surface. The room and pillar (pillar and stall) method is shown in Figure 10, although at NCCC the pillars will be square rather than rectangular, and the mine will use coal scoops rather than the shuttle cars shown.

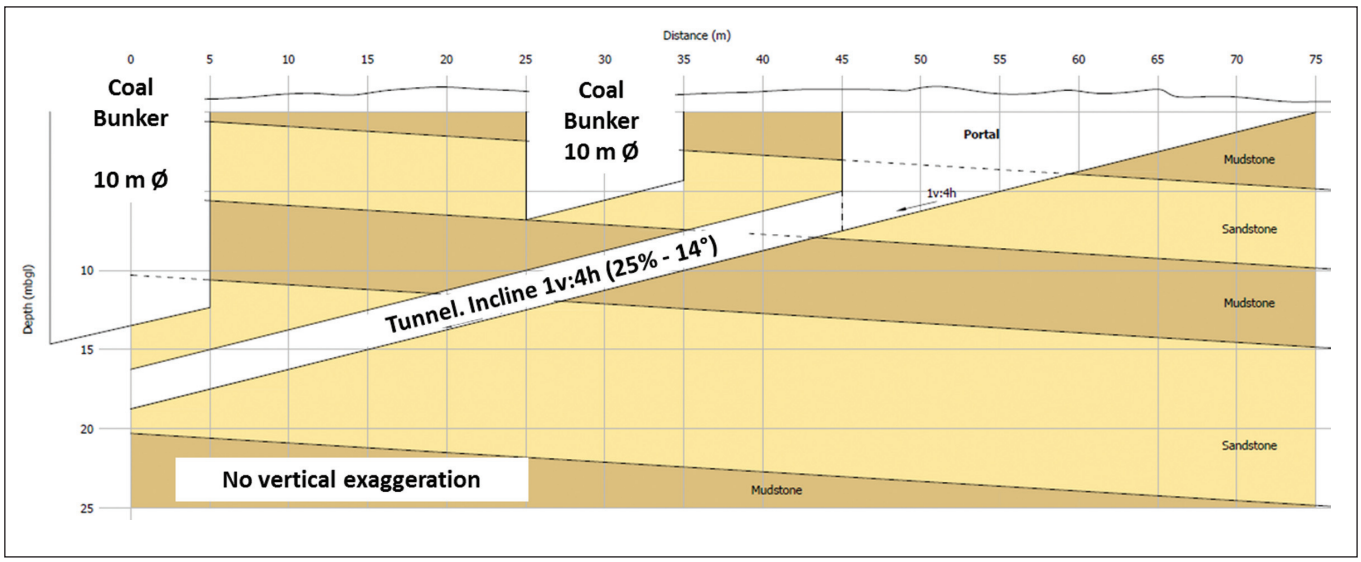

Figure 9. *Drift, and bunkers at the surface.*

The coal pillars are an integral part of the roof support system, and with the addition of the roof bolts, ensure the safety of the operators. The pillars will be 10m square, and the roadways will be 6m wide. This allows a theoretical recovery of around 63%, but the recoverable reserves have been estimated at 55%, to take account of losses and reduced extraction in certain areas.

The continuous miner will have a minimum cutting height of 0.9m (maximum 2.3m), and a cutting width of 3.4m. It will therefore be able to cut the road widths (6m) in two cuts, advancing each cut the appropriate distance, before withdrawing to work on another room. This will allow the twin-arm roof bolter to enter and insert a number of roof bolts to help secure the roof. A low

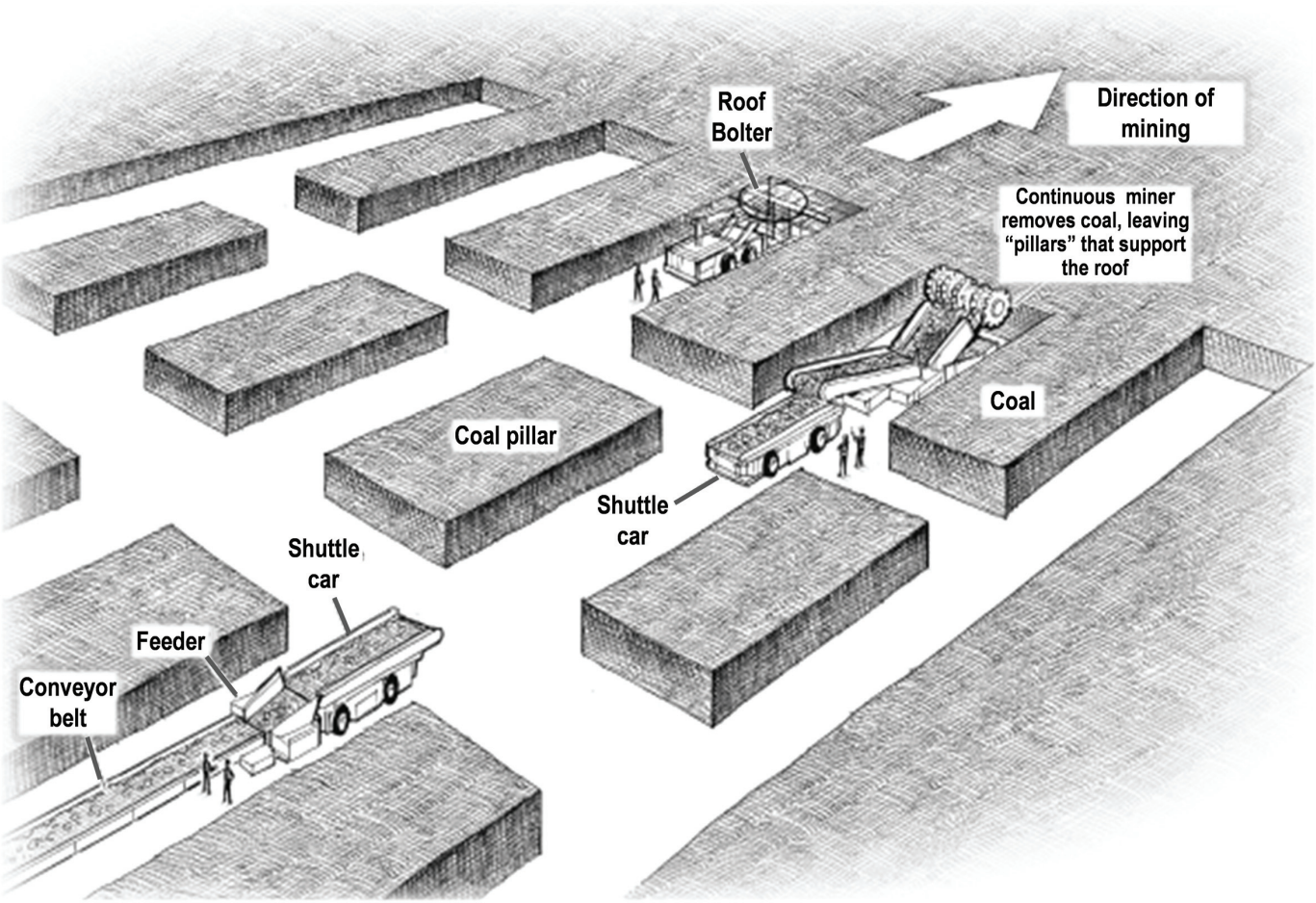

Figure 10. *Schematic view of Room and Pillar mining (source unknown)*

profile roof bolter is only 0.82m high, and can operate in as little as 0.89m. The roof bolts are used to ensure the integrity of the roof and to prevent spalling.

The dimensions of the pillars and roads will ensure that each pillar supports a sufficient area of rock mass above it to ensure the safety of the workforce, with a significant margin of safety. A 100m² pillar has been shown to support at least 256m² of rock above it in these conditions (HSE, 2000).

Mine Plan And Develpoment

Figure 11 shows the configuration of rooms and pillars in the Northern Area of the Sharlston Top seam, which will take about 10 months to extract.

The development roads driven within the coal seams will be five-room entry, with two of the roads excavated to a height of 2.2m (i.e. thicker than the coal seam), to give space for the conveyor as well as to allow a ventilation circuit to be established along these oversized roads. The feeder-breaker will be repositioned at various times to shorten the distance the coal scoops have to travel, with the conveyor being lengthened behind it. This will continue until the full length of each development drive has been reached, which will vary within the mine. Once this has been achieved, the equipment will start to work into the main seven-room entry panels shown.

It is clear from Figure 12 that every effort has been made to reduce the possibility subsidence related issues at the surface. It shows the development of the Sharlston Top seam in the southern area, with no mining underneath the local villages and farms. In addition, recovery is reduced below potentially sensitive areas such as the roads, by either not removing any coal or reducing the number of rooms, thus reducing even further the possibility of any subsidence in these areas.

Environmental Aspects

The seams with dirt partings will need to be washed at the surface, and all waste material will be hydraulically stowed in the previously mined out areas. The detailed Environmental Impact Assessment (EIA), submitted as part of the planning application showed that the location, scale and mode of operation of the colliery means there is unlikely to be any significant environmental impact.

Figure 13 shows the site layout and illustrates a couple of interesting issues. Firstly NCCC have to deal with protected Great Crested Newts, which will involve creating a new habitat and then trapping and relocating them to their new home. Secondly, there is a permissive

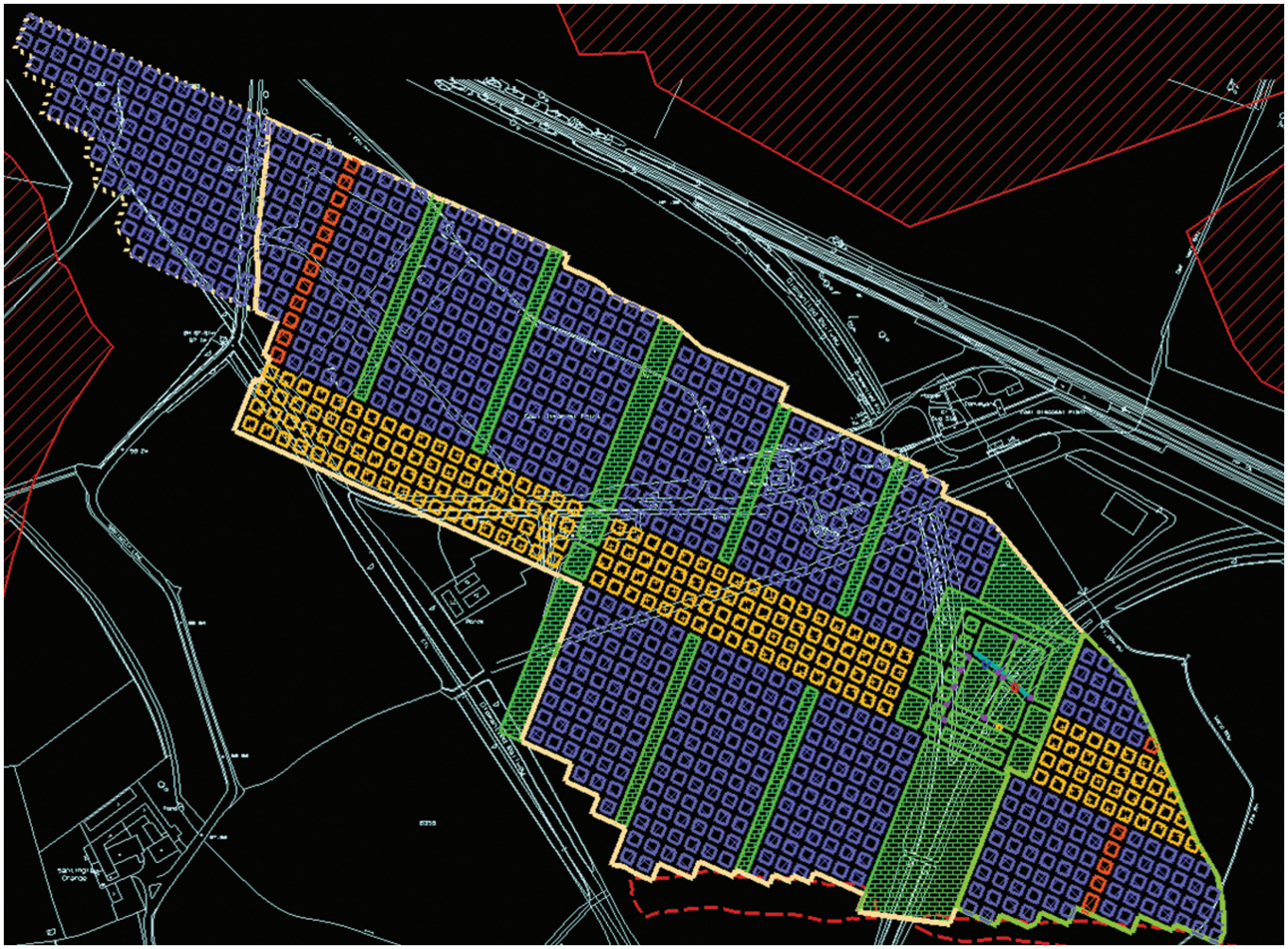

Figure 11. *Room and pillar configuration for the Sharlston Top (highest) seam. (The yellow pillars are in the development drives, the blue pillars are in the production drives, and the shaded green areas are where solid coal is left).*

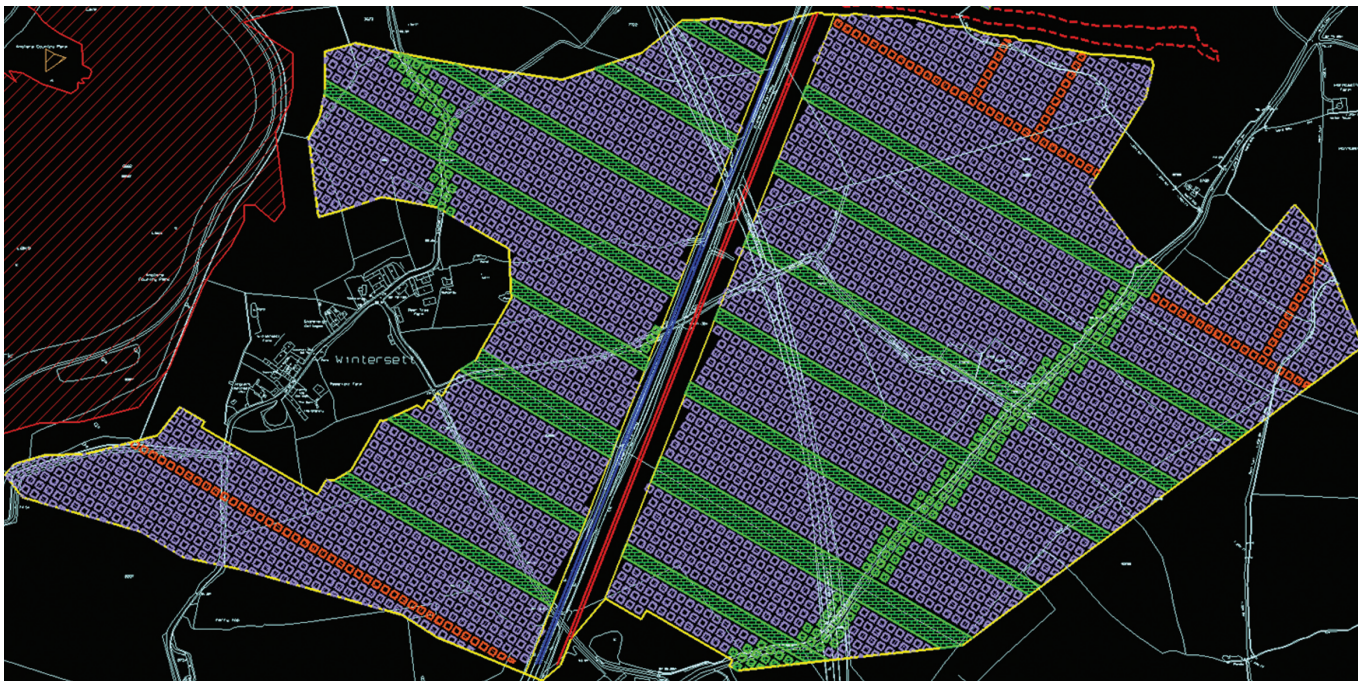

Figure 12. *Sharlston Top seam, southern area. (The blue pillars are in the production drives, and the shaded green areas are where solid coal is left. Additional coal may be left where pillars are green and are red, or these areas may be left solid).*

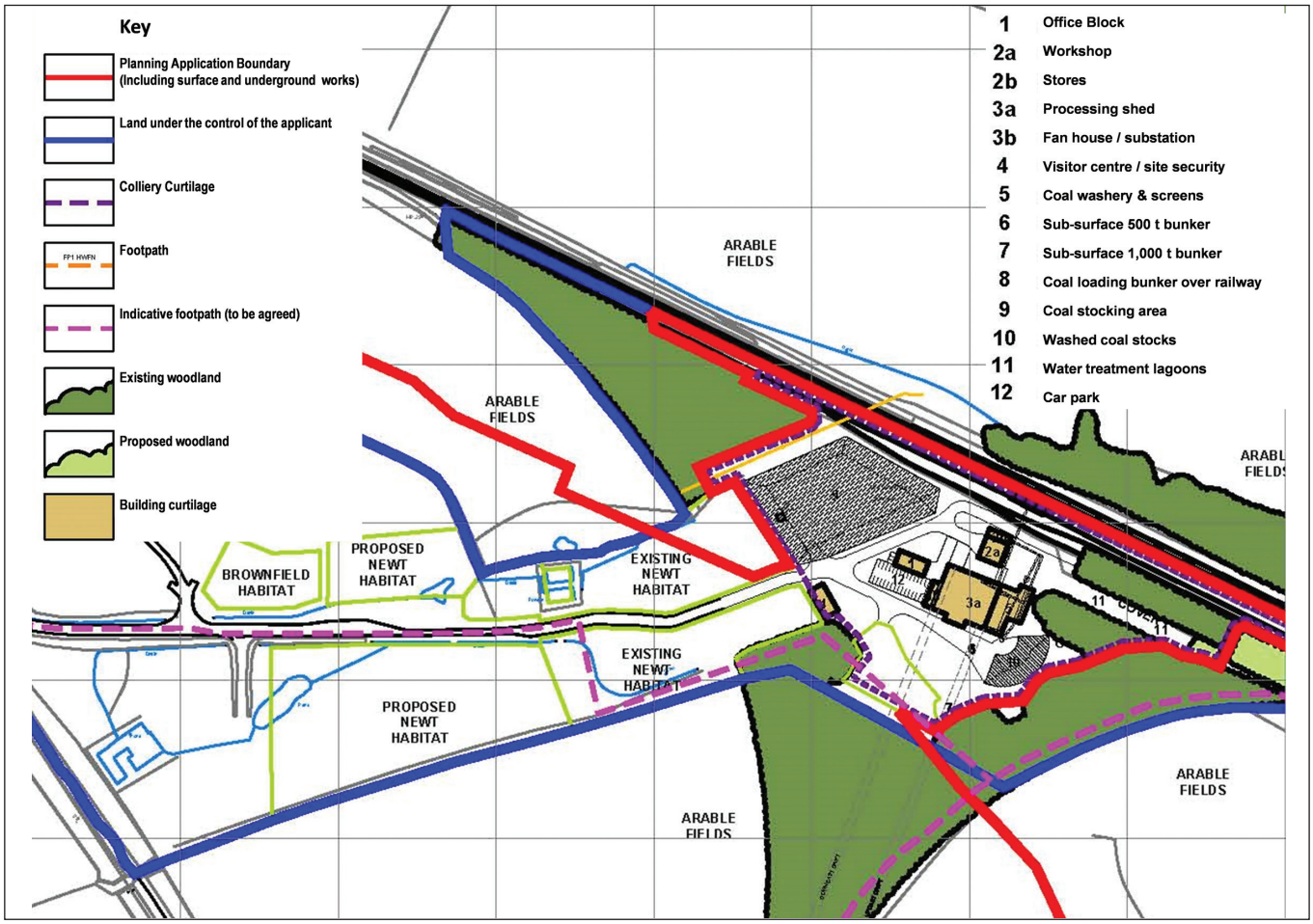

Figure 13. *Site layout showing existing newt habitats and path routes.*

bridlepath which crosses the land, which is part of an existing Section 106 agreement stating that this is due to become a public right of way. All parties have agreed to a variation on the agreement such that the path will not become a right-of-way until after operations have completed. In the meantime, there will be a suitable diversion to the existing permissive path.

Developments During 2015

It was initially hoped that the mine would be in operation in early 2015. However, the raising of sufficient funds to ensure financial security during the early stages of the project was harder than anticipated. By the end of 2015, NCCC had secured the required funding through a mix of loans from social investors such as Social and Sustainable Capital, as well as asset finance deals on pieces of equipment. Understandably, the social investors did not want to release their loans until there was a contract in place to sell the coal. This caused some delay as the power generators did not require new contracts until early 2016, because they had stocked up when the UK government doubled the Carbon Price Support rates of the Climate Change Levy in April 2015.

This was also a contributing factor to the early closure of Hatfield Colliery near Doncaster, and although NCCC would have preferred Hatfield to stay open, they have been able to acquire a lot of their "scrapped" mining and workshop equipment. This was made possible by the early loan of funds raised through a Community Share Offer organised by Coalfield Community Investment Society, who are supporting NCCC as their first project. Over 50 investors purchased more than £175,000 in shares, of which £165,000 has so far been loaned to NCCC to enable purchase of 2nd hand equipment.

At the time of writing (December 2015), the fencing around the colliery curtilage has been erected, and the work to divert the permissive bridlepath has commenced. The correct procedures have been put in place to ensure the ground is checked for Great Crested Newts prior to construction work, and relocated if found.

Conclusions

At a time when the last deep mine in the UK closed on 18th December 2015, this paper shows the feasibility of opening a new coal mine to produce over 200,000 tonnes of coal a year for 20 years. The Founding Members of the co-operative believe that, despite the recent announcement by the government that they wish to see all coal-fired power stations closed by 2025, there is still a future for UK produced coal. This project will create 50 high-quality sustainable jobs in the area and enable investment into other co-operative ventures totalling tens of millions of pounds, which could potentially include other new coal mines.

Acknowledgments

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