Development of a Methodology for Estimating Methane Emissions from Abandoned Coal Mines in the UK

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DEVELOPMENT OF A METHODOLOGY FOR
ESTIMATING METHANE EMISSIONS FROM
ABANDONED COAL MINES IN THE UK

May 2005

Reference: REPORT/D5559/SK/May 2005/EMISSIONS/V3			
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File Ref: I:\Projects D0000 to D9699\D5559 DEFRA			

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EXECUTIVE SUMMARY

- The principal aim of the project was to produce a verifiable methodology for generating accurate and reliable estimates of methane emissions from abandoned mines in the UK, to be considered for inclusion in the UK greenhouse gas inventory.

- The prime drivers for methane emission from abandoned mines are displacement by rising mine waters and the rate of emission of methane from the coal seams in the strata disturbed by mining. Rising mine water also serves to isolate methane reserves by cutting them off by flooding. The UK coalfields have been modelled to obtain estimates of water inflow and methane reserves within the coalfields. Measurements have also been made on methane emissions from mines, either from vents or from more general diffuse emissions from the surface. The general methodology has been to seek a relationship between the measured methane flows and parameters relating to the water and gas in the underlying abandoned workings.

- Critical information was required for completion of this project. The main source of data on coal mine workings was the Coal Authority Mining Records Database System (MRDS), which provides data, *inter alia*, on the location, area and seam of all known workings in the UK in an electronic form. Mine water level data was obtained principally from Coal Authority measurements at shafts, boreholes pumping stations and discharge points, but data was also obtained from private coal producers and coal mine methane operators. Seam gas content data were obtained principally from a gas content database, established during the previous three decades using data from exploration boreholes and underground sampling. Geological maps and memoirs of the British Geological Survey (BGS) were used to identify seam sequences (with MRDS data), surface cover and aquifers overlying the mine workings.

- Water level data from open shafts and boreholes indicates that water recovery after mine abandonment follows a predictable exponential curve similar to the recovery in any aquifer following pumping. This allows the future inflow rate of water into a mine to be calculated for use in the controlled pumping of mine water or to estimate the potential surface discharge rate. In this project, the data have been used to model the flooding of mines and the effect of cutting off methane from abandoned mine workings. To allow a detailed assessment of mine water recovery, and hence methane emissions over time, some coalfields required sub-division. A total of 34 coalfield areas were assessed divided into 142 areas for calculation.

- Mine water recovery has only been monitored in a few coalfields in the UK. To determine the impact of mine water recovery on total UK methane emissions between 1990 and 2004, an assessment of mine water levels in all abandoned UK coal mines was essential. Data from the MRDS were used to identify the residual mine volumes for each modelled area as a function of depth; usually divided into volumes within 10m intervals. Water can enter mines via mine entries from aquifers and the surface, although strata water enters a mine laterally through the strata by permeable flow, the rate of water flow decreasing as the water level rises. The rate of water inflow into the mine was modelled using a permeability function that decreases the inflow of the workings into the mine depending on the volume of the workings that remain unflooded.

- Results of the mine water recovery modelling fall in to four broad categories:
  - Category 1. Areas where mine water has fully recovered, but workings remain above the recovered water level (82 areas).
  - Category 2. Areas where mine water has fully recovered, with no mine workings above the water level (13 areas)
  - Category 3. Areas where mine water is continuing to recover (31 areas)
  - Category 4. Areas where mine water recovery is controlled by pumping (16 areas)

  Category three and four type recoveries contain the majority of mines closed in the 1990's.

- Methane from abandoned mines originates in the coal seams within the strata disturbed by the mining process. In the UK coal seams generally contain methane produced during coalification, at values from close to zero to $20m^3$/tonne. During mining the seams release gas into the workings, and continue to do so for many years albeit at a much lower rate. Methane from abandoned mines escapes to atmosphere either through installed vents, designed to prevent the build up of pressure, or in a diffuse manner through old mine entries, broken strata, faults etc.

- Vents at 16 locations around England were monitored from November 2002 to December 2004. The sites were chosen to provide a cross section of the types of abandoned mines found in the UK. Sites were sampled with workings at shallow, intermediate and deep levels and those where water levels had recovered and those where water was still rising. Methane flows ranged from zero to 153 litres per second (l/s), with over half the sites having flows less than 20 l/s.

- Levels of diffuse emissions were made using long term gas samplers taking atmospheric samples over a period of a month. The sampling and measurement using very accurate tunable diode lasers was carried out by the Centre for Ecology and Hydrology (CEH) Edinburgh. As with the vent monitoring, sites were chosen to reflect a range of underlying mine conditions, although sites were chosen not to be close to gas vents.

- Average measured enhancements lay between zero and almost 2,000ppb (parts per billion) above the national background of 2,017ppb. However, at sites where no other potential source of gas was present the maximum enhancement was about 1,300ppb. At these sites methane emissions were estimated at up to 360 tonnes methane per year. By using estimates of the surface area from which the emission might derive, flux estimates were calculated of up to 69 tonnes methane per square kilometre per year ($t\ km^{-2}y^{-1}$), with a mean of 10.5 $t\ km^{-2}y^{-1}$ and a standard deviation of 22 $t\ km^{-2}y^{-1}$. Multiplying the average flux value by the area of shallow workings provides an estimate of 37 kilotonne per year ($kt\ y^{-1}$) for the emission from shallow workings. However, the large standard deviation of the flux, suggests this value should be treated with caution.

- Methane reserve modelling was used to determine the potential source size of methane in abandoned workings. For major coalfields and those where detailed information was available, a full method of calculation was used. This method calculates a degassing area around workings, calculates the total gas in place before mining and subtracts an estimate of the methane released during mining. Only unflooded seams are assumed to contribute towards flow, so combination of the gas reserve model and water level data from the water model enables calculation of a methane reserve against time. For minor coalfields (representing, in total, less than 10% of the total UK gas reserve) the relationship between gas reserves and water level, established for the major coalfields, was used to provide an estimate of gas reserve using known or estimated water levels.

- The estimate of reserves in 1990 is 10.0 billion m^3 methane. Due to the pattern of colliery closure during the early 1990's the estimate of reserves associated with closed mines first rose to 19.5 billion m^3 methane in 1993 then fell, due to mine flooding, to 8.6 billion m^3 methane in 2004.

- No suitable relationship was found between vent methane flow data and the water flow in the underlying abandoned workings. However, vent methane flow data did show an increase with the size of the underlying methane reserve in the abandoned workings. Flux data from the diffuse monitoring was converted into flows by multiplying by the area of underlying workings. These flows also showed an increase with underlying gas reserve. The data was scattered in both sets, but the gradients of regression lines through the flux data was within 11% of the vent flow data. Consequently the two data sets were combined and a regression provided a gradient equivalent to an emission of 0.74% of the underlying gas reserve per year.

- The 0.74% of reserve per year has been applied to the methane reserve over time to produce emission figures for each year from 1990 to 2004. As seen in Table E1 and Figure E1 the results reflect the trends in methane reserve with time, showing an initial increase from 52 kt y^{-1} in 1990 to 101 kt y^{-1} in 1993, followed by a decrease to 45 kt y^{-1} in 2004.

Table E1 Estimated Total UK Methane Emissions from Abandoned Mines 1990 to 2004

Date	Methane Emission Estimate (kt per year)
1990	52
1991	57
1992	83
1993	101
1994	91
1995	96
1996	83
1997	87
1998	76
1999	70
2000	69
2001	59
2002	58
2003	54
2004	45

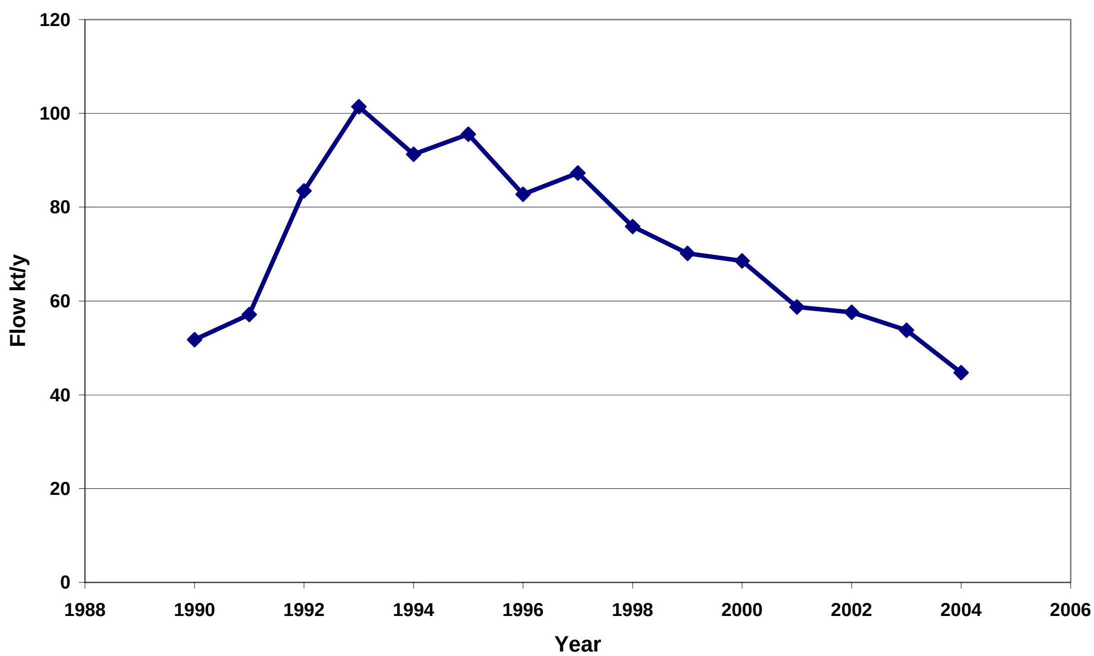

Figure E1 Plot of Estimated Methane Emissions from Abandoned Mines 1990 to 2004

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Development of a Methodology for Estimating Methane Emissions from Abandoned Coal Mines in the UK

1. INTRODUCTION

1.1 Report Request

Following an Invitation to Tender issued in June 2002, IMC presented a proposal to DEFRA in July 2002. An amendment of that proposal was accepted and a contract issued on 20th August 2002. The work was to be carried out by IMC with the Centre for Ecology and Hydrology (CEH), Edinburgh acting as sub-contractors on part of the contract.

1.2 Aims of work

The Terms of Reference set out the aims of the project in Section 3. The principal aim was to "produce a verifiable methodology for generating accurate and reliable estimates of methane emissions from abandoned coal mines in the UK, to be considered for inclusion in the UK greenhouse gas inventory."

The aim was divided into five sub-tasks:

1. Establish a database of abandoned mines in the UK.
2. Stratify the database by dividing abandoned mines into representative types, using depth of workings and the water conditions as parameters; and ensuring suitable sites for measurement purposes fall within the allocated divisions.
3. Measure emissions and linked meteorological data at representative sites including emissions from vents (where present) and diffuse emissions.
4. For representative types of mine within the database establish a mathematical model of methane emissions as a function of time since mine closure.
5. Calculate annual methane emission estimates from 1990 with the model and database.

2. GENERAL METHODOLOGY

A relationship between measured methane emissions and parameters related to the abandoned mine workings was sought.

Methane is produced during the operation of coal mines from both the mined seam and from the seams above and below the workings which are disturbed by the mining process. Following mining, the worked seam ceases to contribute significantly to gas production, due to its removal in large part. However, the seams within the strata which were disturbed by mining continue to produce methane at a low rate. The more extensive the workings, the greater quantity of coal disturbed and the higher the initial methane content of the coal, the greater the potential for methane emission from the abandoned mine. These factors can be combined to provide a gas reserve or an estimate of the quantity of methane left remaining in place from those seams likely to emit gas.

However, rising mine waters may modify the rate of emission of methane from the abandoned mine in two primary ways. The first is by displacing methane from the void. The second is by flooding workings and cutting off the flow of gas from the submerged seams.

Prime drivers for the flow of methane are likely to be water displacement and the rate of emission of methane from all the disturbed coal seams. Once a relationship was found for known sites, the relationship could be extended to all abandoned coal mines to provide an estimate of UK coal mine methane emissions.

To this end, methane emissions from abandoned mines were measured at a number of representative sites. The two methods used were methane flow measurements on vents and atmospheric concentration measurements. The abandoned mines in the UK coalfields were also modelled to calculate parameters such as water inflow rates, water level and the coal bed methane in place above the water level.

3. SOURCES OF DATA

There are four categories of data available for the development of a methodology for estimating methane emissions from abandoned coal mines. These are the mine workings plans; mine water information; mine gas data; and the geology of the mining areas. Some data on isolated mines or small areas of mining were obtained from reports prepared for bodies such as the Coal Authority and the Association of Coal Mine Methane Operators (ACCMO); a full list of reports is contained in Appendix A. Most data for this study were obtained from the Coal Authority records or current coal mine and coal mine methane operations.

3.1 Coal Mine Workings Plans

The plans of mine workings are required to determine:

- The area, depth and interconnection of all mine workings
  - to allow the coalfields to be subdivided into isolated and/or semi-isolated blocks
  - to assess their interaction with the unworked coal, and hence determine the variation in the potential methane reserve as mine workings flood
- The residual mining void
  - used with rate of water inflow and pumping data to determine the rate of mine water recovery over time
- The area of shallow mine workings
  - to determine where mine methane may naturally vent to surface as mine workings flood
- The positions of intermediate and deep shafts
  - to determine where methane may vent to surface other than from shallow workings

The main source of mine plan data was the Coal Authority Mining Records Database System (MRDS). For all the major coalfields where mine water recovery was the key controlling factor of methane emissions over time IMC/WYG used its previously developed system to interrogate MRDS and produce a grid plan of each worked seam. Depth and thickness of coal interaction was recorded for each grid square. The size of the grid varied according to the detail required and extended vertically in both the worked and unworked coal horizons.

In the smaller, older mining areas where mining was abandoned many years ago and mine water had recovered, only the area of workings was able to be determined from the MRDS data. In these cases no detailed assessment was feasible for the workings in each individual seam due to the lack of data.

Table 3.1 lists the coalfields where full MRDS data was used, those where only the area of the workings was determined and those where data was derived from existing mine water and mine gas reports. Appendix B shows maps of the coalfield areas and the names used in this report.

Some areas of very small, old areas of shallow coal workings were not included in the assessment due to their size and absence of data. These areas were unlikely to be significant in terms of gas reserves because their areas were small and gas contents likely to be very low. These areas included Brora, Padstow, Machrihanish and Cononbie.

Table 3.1 Coalfield Areas and Source of Mine Workings Data

Coal Field Area	Detailed MRDS Data	Outline MRDS Data	Previous Report
Central Scotland (West)	✓		
Central Scotland (East)		✓	
Central Ayrshire	✓		
Central Fife	✓		
East Fife			✓
Mid Lothian	✓		
East Lothian		✓	
Clackmannan and NE Stirling		✓	
North Ayrshire		✓	
South Ayrshire		✓	
Sanquhar	✓		
Cumbria	✓		
North East England	✓		
Blenkinsop		✓	
Scremeston		✓	
SE Lancashire	✓		
NE Lancashire		✓	
Cheshire		✓	
Yorkshire	✓		
Nottinghamshire	✓		
Warwickshire		✓	
North Wales		✓	
Coalbrookdale		✓	
N. Staffordshire		✓	
S. Staffordshire		✓	
S. Derbyshire			✓
S Wales	✓		
Bristol and Somerset		✓	
Forest of Dean		✓	
Leicestershire		✓	
Pembrokeshire		✓	
Shrewsbury		✓	
Wyre Forest		✓	
Kent		✓	

3.2 Mine Water Data

Mine water data are required to determine the rate of flooding of mine workings. The rate of mine water recovery is determined by the rate of water inflow into the residual mining void, it can also be monitored at open mine shafts or by means of boreholes drilled into mine workings. The principal source of monitoring data is from the Coal Authority inherited liability sites. Other data have come from private coal producers and coal mine methane operators.

In many areas mine water recovery is controlled by mine water pumping stations. Mine water pumping at abandoned mines was originally to protect operational mines from an inrush of water; a few pumping stations in South Yorkshire and North Nottinghamshire operated by UK Coal still carry out this function. The remainder of the mine water pumping stations are to either prevent contamination of surface water courses from surface outflow or to prevent contamination of aquifers. A list of all the Coal Authority monitoring sites and pumping sites is in Appendix C. Section 5 contains typical examples of monitored mine water recovery data in UK coalfields.

Where there is no monitoring of mine water levels in abandoned mines, recovery can be calculated based on either known mine water inflow data or by calculating an inflow based on the area of the mine workings (see section 5).

Water pumping data from active mines were also obtained even though emissions from active mines are not included in the estimates reported in this study. These data were required because active mines may be interconnected with the abandoned workings being controlled by pumping at the active mine (eg Ellington / Lynemouth).

Surface mine water discharges may occur where mine water levels have fully recovered. Most of the major mine water discharges are monitored by the Coal Authority. However, data on surface mine water discharges is also held by the Environment Agency (EA), the Scottish Environmental Protection Agency and occasionally by local authorities. Once surface water discharges occur, the water level will cease to rise as further water inflow into the mine will flow out via the discharge. Consequently, the start of the surface mine water discharges in an area have been used to assess those areas where mine water recovered prior to and since 1990. Surface levels of the mine water discharges in an area are used to determine the volume of unsaturated workings remaining in an abandoned mine that in turn determines the potential methane reserve that remains.

Data on the ground water levels in the Permo-Triassic aquifers overlaying mine workings were obtained principally from the Environment Agency with some data from water abstractors such as Northumbrian Water in the North East. This data is required for the modelling of the mine water recovery.

3.3 Mine Gas Data

In addition to monitoring data collected specifically for this report, mine gas emission data comes from three main sources, namely operational coal mines, coal mine methane abstractors and the Coal Authority monitoring database.

Seam gas content data used in the calculations of gas reserves largely comes from the British Coal Gas Content Database. This database contains gas content measurements made on coal seam samples obtained from over 400 exploration boreholes in the UK coalfields between the 1970’s and 1990’s.

As methane in abandoned mines comes from the coal seams within the surrounding strata which have been disturbed by mining, the seam gas content data is fundamental to any calculation of methane quantities in underground coal mines. As such is it a key factor used in the gas reserve modelling calculations described in this report.

Methane monitoring data has been obtained from direct measurements on vents into abandoned mine workings and also from measurements on enhancements to the general background in mining areas. These data have been used as the base emissions to be scaled up to the national level.

Monitoring data, which has not been obtained directly under this project, has been used to identify vents where methane emissions occur. Data from operational coal mines and methane abstractors has been used to identify the areas where methane emissions are controlled.

3.4 Geology of the Mining Areas

The geology of the mining areas was principally taken from the British Geological Survey (BGS) 1/10,000 and 1/50,000 plans showing solid and drift (superficial) deposits. Details of the worked and unworked coal seam thickness and intervals were taken from a combination of data on the Coal Authority MRDS system, BGS geological memoirs and shaft and borehole records held by the Coal Authority and BGS.

The data was used to determine the succession of strata including all seams in the section which might be affected by mining activity. The geological data was also used to identify geology which would affect the flow of water into the mine. In particular this involved identification of overlying aquifers and minor aquifers within or below the workings which could increase water flow, and impermeable superficial deposits which would retard the flow of water.

4. MINE WATER RECOVERY

Water level data from open shafts and boreholes indicates that water recovery after mine abandonment follows a predictable exponential curve similar to the recovery in any pumped aquifer. Forward projection of mine water recovery curves is routinely used to determine when mine workings will flood or when surface discharges of mine water will occur. The mine water recovery curve can also be used to calculate the rate of water inflow during recovery if the residual mine volume is known. As the water level in the mine increases, the head between the level of the source of the water and the level of the water in the mine decreases, causing the water inflow rate to slow, again following predictable exponential tends. This allows the future inflow rate of water into a mine to be calculated for use in the controlled pumping of mine water or to estimate the potential surface discharge rate. Where water inflow rates have been calculated, based either on recovery or from mine water pumping data, a correlation has been demonstrated between inflow rates and the area of workings. Using this correlation, water inflow rates can be estimated at those mines with no water level monitoring and / or no data on the pumping rates during the operation of the mine. This inflow data can then be used to determine the flooding of the mine over time which in turn can be used to calculate the displacement of methane from the mine, and the methane reserve that remains accessible to the unflooded areas of the mine.

4.1 Sub-Division of the Coalfield Areas

To allow a more detailed assessment of mine water recovery and hence methane emissions over time some of the coalfields required further sub-division. The decision for sub-division of the coalfield areas used in this report was based on the following:-

- No sub-division was made where the coalfield areas are small and either mine water recovery had occurred prior to 1990 or the coalfield was believed to be recovering as a single unit.

- The coalfield was sub-divided where the areas are large and are known or likely to be areas of workings with different water levels and/or rates of mine water recovery.

The coalfield areas where sub-divisions were made are the following:-

- Central Scotland (West)
- Central Ayrshire
- Central Fife
- Midlothian
- Cumbria
- North East England
- South East Lancashire
- Yorkshire
- Nottinghamshire

- South Wales
- Coalbrookdale
- Blenkinsop
- South Staffordshire
- North Staffordshire
- North East Lancashire
- Warwickshire

The method of sub-division of the above coalfield areas was based on one or more of the following factors:-

- Known or suspected hydraulic isolation of a block of mine workings due to the existence of an extensive area of un-worked coal or a major fault between mining blocks.

- Known or suspected restricted hydraulic connection between blocks of workings due to dams in underground roadways, the level of a known underground connection or the collapse of roadways and/or mine workings.

Lateral sub-division of coalfields into geographic areas occurs in most cases. In addition, where distinct and hydraulically unconnected coal workings exist, coalfields have also been sub-divided vertically; these sub-divisions are generally referred to as upper and lower workings and occur mainly in Scotland and South Wales. The reasons for the distribution of the workings lies in the different coal seam development across the country. In some cases, only the Productive Coal Measures (the Middle and Lower Coal Measures in the Carboniferous system) contain mineable seams. In other cases the some seams are also well developed in the Upper Coal Measures or in the Limestone group in the Namurian, below the Productive Coal Measures.

Most of the coalfield sub-divisions in this work were based on previous reports on mine water or mine gas; these reports are listed in Appendix A. Where no previous reports existed, the sub-divisions were based on either existing mine water and mine gas monitoring data or, where there was no monitoring data available, on the geology and mine workings plans of the coalfield.

Four abandoned, isolated mines situated at depth below saturated aquifers in the Kent coalfield were not assessed for mine water recovery or methane emissions. All four collieries were closed between 1969 and 1989 and the shafts filled and capped. No assessment was made because the workings were either fully saturated prior to 1990 or there was considered, because of the sealing of the shafts, to be no pathway for mine gases to migrate to surface. There has been no report of any mine gases migrating to surface from these collieries.

The 34 coalfield areas and those coalfields with sub-divisions used in this report are shown in Appendix B and listed in Table 4.1. The total number of mining areas listed in the table assessed in this report for mine water recovery and methane emission is 142.

Table 4.1 The Coalfield Areas and Sub-Divisions Used in the Report

AREA AND ZONE	CATE-GORY	AREA AND ZONE	CATE-GORY	AREA AND ZONE	CATE-GORY
CENTRAL SCOTLAND		**NOTTINGHAM**		**CUMBRIA**	
Zone 1	1	Zone 1A	1	Zone 1	1
Zone 2	1	Zone 1Bs	3	Zone 2	3
Zone 3	1	Zone 1Bd	3	Zone 3	1
Zone 4	2	Zone 1C	4	Zone 4	1
Zone 5	2	Zone 2	4	Zone 5	1
CENTRAL AYRSHIRE		Zone 3 a	3	Zone 6	1
1. NEW CUMNOCK	1	Zone 3 b	4	Zone 7	1
2. DALMELLINGTON	1	Zone 4	3	Zone 8	1
3. PATNA	2	Zone 5	3	Zone 9	1
4. PRESTWICK	1				
5. KILLOCK/ BARONY	3	**NORTH EAST**		**BLENKINSOP**	
6. WHITE HILL	1	Zone 1	4	BLENKINSOP (Zone 1)	3
7. KAMES	1	Zone 2	4	HALTWHISTLE (Zone 2)	1
8. BERRY HILL	2	Zone 3	1	LAMBLEY (Zone 3)	1
CENTRAL FIFE		Zone 4A	3		
Zone 1	1	Zone 5	4	**COALBROOKDALE**	
Zone 2	1	Zone 6	4	GRANVILLE (Zone 1)	1
Zone 3	1	Zone 7	4	SHIFNAL (Zone 2)	1
Zone 4	1	Zone 8	4		
Zone 5	1	Zone 8a	3	**SOUTH STAFFORDSHIRE**	
MID LOTHAIN		Zone 9	4	LEA HALL (Zone 1)	2
Zone 1 Upper	1	Zone 9a	3	MID CANNOCK (Zone 2)	4
Zone 1 Lower	3	Zone 10	3	WALSALL WOOD (Zone 3)	1
Zone 1A Upper/ Lower	1	Zone 11	3	BAGGERIDGE (Zone 4)	1
Zone 2A	1	Zone 12	2	PARKLANE (Zone 5)	1
Zone 2B	1	Zone 13	1		
		Zone 14, 15	1	**NORTH STAFFORDSHIRE**	
SANQUHAR		Zone 16	1	HEM HEATH (Zone 5)	3
SANQUHAR	3	Zone 17	1	FLORENCE (Zone 5)	3
		Zone 18	1	SILVERDALE (Zone 1)	4
SOUTH EAST LANCASHIRE				CHATTERLEY WHITFIELD (Zone 2)	1
Zone 1	3	**SOUTH WALES**		OLDFIELD (Zone 3)	1
Zone 2	3	Zone 1	2	FOXFIELD (Zone 4)	1
Zone 3	2	Zone 2	1		
Zone 4	3	Zone 3	2	**WARWICKSHIRE**	
Zone 5	3	Zone 4	1	BIRCH COPPICE (Zone 1)	3
Zone 6	1	Zone 5	1	COVENTRY (Zone 2 & 3)	3
Zone 7	1	Zone 6	2		
Zone 8	1	Zone 7	2		
		Zone 8	1	**OTHERS**	
YORKSHIRE		Zone 9	1	BRISTOL AND SOMERSET	1
Zone 1	1	Zone 10	1	CENTRAL COALFIELD EAST	1
Zone 2	1			CHESHIRE	1
Zone 3 Deep	2	Zone 1	1	CLACKMANNAN & N.E. STIRLING	1
Zone 3 Shallow	3	Zone 2	1	DOUGLAS	2
Zone 4	3	Zone 3	1	EAST FIFE	4
Zone 5	3	Zone 4	1	EAST LOTHAIN	4
Zone 6 (Shallow)	4	Zone 5	1	FOREST OF DEAN	1
Zone 6a (Deep)	4	Zone 6	1	LEICESTERSHIRE	1
Zone 7	3	Zone 7	1	NORTH AYRSHIRE	1
Zone 8	3	Zone 8	3	NORTH WALES	1
Zone 9	1	Zone 9	3	PEMBROKESHIRE	1
Zone 10	1	Zone 10	1	SCREMERSTON	1
				SHREWSBURY	1
		NORTH EAST LANCASHIRE		SOUTH AYRSHIRE	1
		Zone 9	1	SOUTH DERBYSHIRE	3
Reserve Calculation Method:		Zone 10	1	WYRE FOREST	1
Fully Modelled	n*	Zone 11	1		
Estimated from Water Level	n*	Zone 12	1		
		Zone 13	1		
		Zone 14	1		

* category of mine water recovery as detailed in section 5.2

4.2 Existing Mine Water Recovery Data

The monitoring of the recovery of mine water in UK coalfields is principally the responsibility of the Coal Authority. Some mine water level information is obtained by private mining companies and coal mine methane abstractors.

There are currently 653 sites monitored by the Coal Authority for mine water and mine gas and 21 active mine water pumping stations that control mine water levels, which are listed in Appendix C. Appendix C does not contain the Coal Authority sites which are not relevant to mine water or mine gas. “Eastings” and “Northings” in the Appendix refer to the 6-figure National Grid Co-ordinates of the location of the sites. The water level monitoring sites are not evenly distributed between the coalfields, resulting in many coalfields with no monitoring of recovery. However, this is mainly because in these coalfields. mine water has recovered and the mine water discharges are monitored.

Appendix D lists the sites where there are recorded surface gravity discharges of mine water indicating recovery of mine water.

5. MINE WATER RECOVERY MODELLING

Mine water recovery is the major factor controlling the reduction in methane emissions from abandoned coal mines over time. As indicated in the previous section monitoring of mine water recovery in abandoned UK coal mines has only been carried out in recent years and only in a few coalfields. To determine the impact of mine water recovery on total UK methane emissions between 1990 and 2004, an assessment of mine water levels in all abandoned UK coal mines is essential.

5.1 Methodology

The water inflow to a mine comes from two sources: either permeable Coal Measures strata and/or major aquifers hydraulically connected via mine entries or shallow workings. Work carried out previously by IMC/WYG has shown that mine water recovery can be modelled using estimated mine water inflows based on the average permeability of Coal Measures strata and a residual mining void calculated from the mine workings plans[1] Water is taken to enter the workings laterally along the bedding of the strata, through an interaction zone extending 30m above and below the level of the seam extraction. The interaction area is the area of a vertical surface of height 60m, running around the perimeter of all the coal workings, through which the water is assumed to enter the workings. The average permeability is calculated from a known or deduced flow and the head of water.

Where mine entries or workings are adjacent to or pass through major aquifers, the inflow of water is restricted either by impermeable linings to mine entries or by leaving large intact pillars of low permeability Coal Measures strata. Consequently, flows from aquifers are relatively small. It follows therefore, that the bulk of the water flowing into both active and abandoned mine workings is due to water flowing through the Coal Measures strata into the workings and is hence controlled by the permeability of the strata.

The permeability of different types of strata within the Coal Measures ranges from approximately 10^{-6} to 10^{-10} ms^{-1}; this explains why some mine workings are reported ‘dry’ while others have significant inflow of water. Appendix E contains the average permeabilities used in the minewater modelling for the different mining zones. The permeabilities used in the calculations for the modelled coalfields are largely in the range 10^{-7} m/s to 10^{-9} m/s. If a large area of multi-seam mine workings is studied the total mine water inflow can be averaged and the inflow related to the area of the workings. Work carried out in South East Lancashire, North East England and Scotland[1] has shown that the average

[1] Whitworth, K.R. Mine Water Hydrology and Geochemistry, Geological Society, London, Special publications, 198, 61-73. 2002

permeability for the Coal Measures of 10^{-7} and 10^{-9} ms^{-1} is determined using the total interaction area around mine working and mine water pumping data.

Using the average permeability and the interaction area of the mine workings an average initial inflow can be calculated for these mine workings. This initial inflow will decrease as piezometric head difference between the water in the mine workings and in the Coal Measures decreases. However the rate of change of flow with time will also change with the level of the water, because the workings through which the water enters are not distributed evenly through the strata. Monitored mine water level data when plotted against time produce recovery curves of an exponential form. Therefore, to simplify the modelling of mine water recovery for the very large areas in this report, the water inflow has been scaled to be proportional to the volume of unflooded workings. Using this method a plot of remaining void against time produces an exponential recovery curve which makes allowance for the variable distribution of workings and also allows for a reduction in flow with head.

In those coalfield areas modelled for the mine water recovery, the initial interpretation was carried out using an average permeability, the interaction area of the workings and a linear flow reduction based on the minimum and maximum depth of workings within the mining area. Where the maximum elevation with the mining block was greater than the minimum surface elevation of an area or greater than the level of a known connection to an adjacent mining area on outflow or overflow point was incorporated into the model. If the mine water level in an area is controlled by pumping, this is also shown as an overflow, but with no flow to the adjacent block(s).

Once the initial modelling of each mining zone is completed, the mine water recovery curve is checked, where possible, against the known information on mine water from water level monitoring sites or surface discharges etc. Where mine water recovery curves are monitored, the Coal Measure permeability used in the model can be altered to get the best fit with the monitored data. The average permeabilities used for the various modelled coalfields or sub-divisions of the coalfields are in Appendix E.

An alternative method of calibrating the modelled mine water recovery curve to monitored data is by adjusting the residual mine volume. The residual mine volume is the void in the ground that remains after subsidence has taken effect. If no collapse of the strata took place following mining, then the residual mine volume would be equal to the volume of coal and rock extracted. However, because the ground does collapse and the overlying strata settles down (subsides) the volume left in the interstices between the collapsed rock is much less than the volume extracted. To calculate the residual void, British Coal used a general value of 10% of the extraction thickness for areas of total extraction (the Consolidation Factor). However, based on recorded inflows and known rates of recovery, consolidation factors of up to 20% of the extraction thickness have been required to make the modelled recovery match the observed data. The larger consolidation factor is particularly noticeable in the Coal Measures in North East England and Scotland where there is a higher proportion of sandstone strata in the Coal Measures. The sandstones break into larger blocks and have their own porosity, both factors that will increase the void that has to be re-saturated.

The principal steps undertaken to model the mine water recovery and the potential methane reserve were:

1. **Process raw data:** MRSDS data from the Coal Authority were plotted using specially written AutoCAD subroutines. The areas of mine workings were defined as 2D and 3D polygons. AutoCAD was also used to calculate the area of the individual workings and the data saved as a comma separated text file. The individual mining polygons were identified by a unique MRSDS ID number that was plotted at the centre of the polygon.

2. **Divide into mining areas:** Individual mining areas were defined within AutoCAD as closed polylines and a second subroutine was run to export all mining area MRSDS ID's from within the mining area. These data were then exported as a separate text file.

3. **Collect data into mining areas:** The text files generated in steps 1 and 2 were then sorted and the data for the individual mining areas extracted. This data consisted of the MRSDS ID

number, Easting (of ID), Northing (of ID), maximum mining level, minimum mining level, average level, area, thickness.

4. **Calculate volume of mine workings:** The extracted data were then imported into Microsoft Excel and the total volume of workings within discrete vertical intervals calculated. For the purposes of the model, the volumes of workings were calculated at 10 m vertical intervals and the following formulae used

   Volume of workings (m^3) = polygon area (m^2) x extraction thickness (m) x consolidation factor

5. **Calculate rate of water inflow:** The water inflow into the mine was calculated using a permeability function that decreases the inflow of water into the mine depending on the volume of workings that remain unsaturated. The function could be varied depending on the nature of the geological sequence and mining setting in order that the model represented known mine water levels within the mining areas.

6. **Calculate water recovery:** By dividing the inflow rate of water into the volume of workings within the vertical intervals a time function for the filling of the individual set of mine workings could be assessed. These data were then collated to provide a time function for the rising mine water within an individual mining area.

5.2 Results of Mine Water Recovery Modelling

The mine water recovery modelling is principally designed to allow calculation of the potential methane reserve remaining within a mined area at any given time during recovery of mine water (see Section 9). The mine water modelling also provides the volume of mine gases displaced by the mine water inflow from the mine workings by water over time.

The results of the mine water recovery modelling fall into four broad categories:

1 Areas where mine water has fully recovered prior to or since 1990, but there remain mine workings and unworked coal above the recovered mine water level.

2 Areas where mine water has fully recovered prior to or since 1990 and there are no mine workings above the recovered mine water level.

3 Areas where mine water is continuing to recover.

4 Areas where mine water recovery is controlled by the pumping of mine water either to protect existing mines or to prevent contamination of an aquifer or a surface water course.

Category one areas in the UK will always contain a small methane reserve due to the low gas contents of coal seams at shallow depths; this reserve can only increase if mine water levels are reduced by pumping. Category two mines contain no methane reserves; unless mine water levels are reduced by pumping there will remain no methane reserves. Category three mines are characterised by a reducing methane reserve. In category four mines the methane reserve could increase or decrease depending on the level at which mine water is controlled by pumping.

Table 4.1, which lists each of the coalfield areas and sub-divisions considered in this report also includes the category into which each area falls. Of the 142 coalfield areas and sub-divisions assessed in this report, 82 fall into category one, 13 in category two, 31 in category three and 16 in category four. For future projection of mine water recovery and methane emissions, coalfield areas in categories three and four would require assessment. Most of the category three and four type recoveries are in the major coalfields that were abandoned in the early 1990's. These are principally Yorkshire, Nottinghamshire, South East Lancashire, and North East England.

Examples of the four types of recovery as defined above are shown in Figures 5.1 to 5.4.

5.2.1 Category One

Category one areas mainly consist of older, shallow workings where the coal seams outcropped at the surface. The initial workings would be accessed via shallow shafts or adits and mine water would be drained initially by gravity from horizontal roadways or soughs and later by pumping from shafts. The mine waters in category one areas have fully recovered and flooded the mine workings up to the level of the lowest mine entry where a mine water discharge has occurred.

Figure 5.1 shows Zone 17 in the North East England Coalfield as an example of a category one mining area. Mine water was discharged to surface in this area prior to 1990 from Throckley Colliery on the North bank of the River Tyne. The level of the discharge is 15 m above ordnance datum (AOD). The level of the discharge of mine water has left extensive areas of gas filled shallow mine workings that will continue to have a small methane potential.

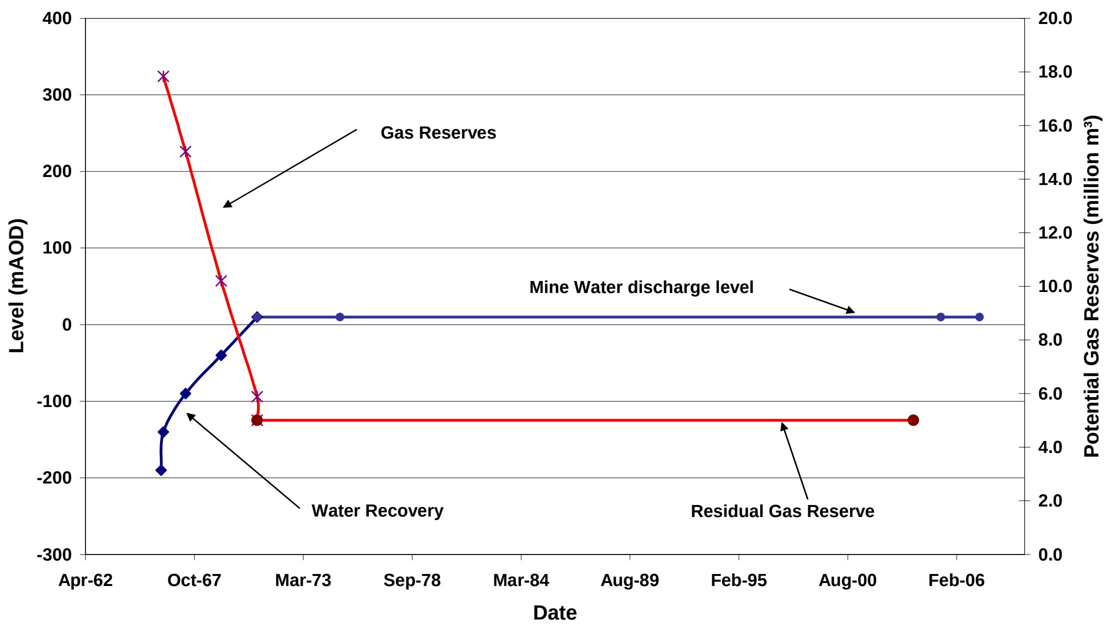


Figure 5.1 Gas Reserves and Water Recovery, Zone 17 North East England

5.2.2 Category Two

Few mining areas currently fall into Category two because in general the mine workings are deeper and have only been abandoned in recent years. For the workings to be totally saturated they are usually at depth beneath non-coal bearing strata, which is often an aquifer. In consequence, water levels rise to above the level of the coal bearing strata. Since most mining areas with deep workings and a surface aquifer are still recovering they fall into Categories three or four. Figure 5.2 shows Zone 12 in North East England as an example of a Category two mining area. Mine workings were abandoned in 1968 and recovered to a point where the piezometric heads in the mine workings and the overlying Permian aquifer are equal. In this area there are no methane emissions.

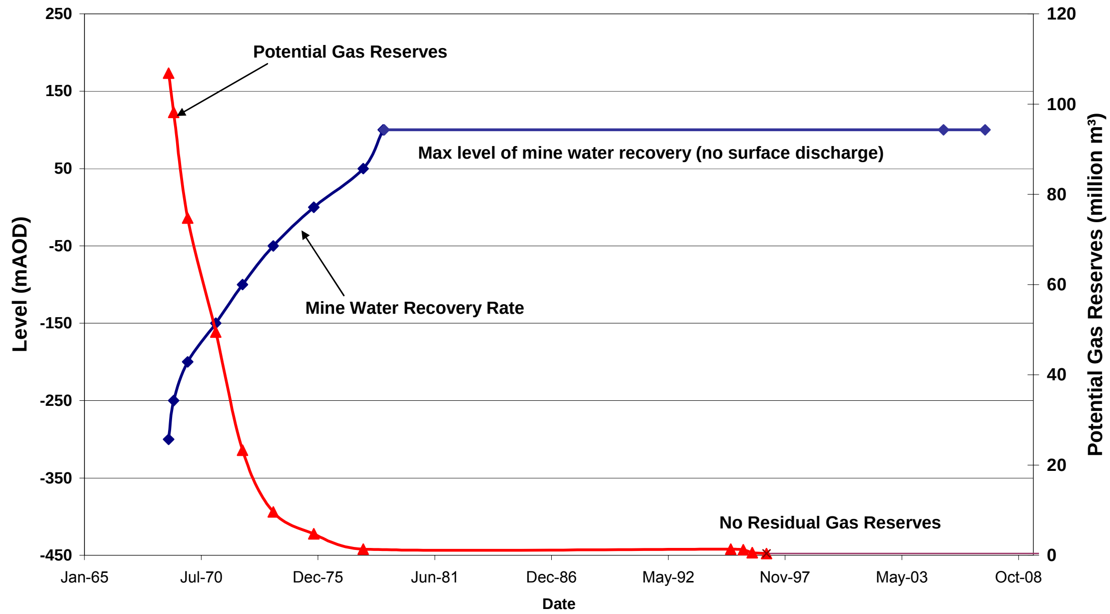


Figure 5.2 Gas Reserves and Water Recovery, Zone 12 North East England

5.2.3 Category Three

Areas in Category three are responsible for the majority of UK coal mine methane emissions. Mining areas in Category three will naturally pass into Categories one, two or four as mine waters recover or are controlled by mine water pumping. All mines closing in the future will initially fall into Category three.

The 31 areas in Category three are mainly in Yorkshire (5), Nottinghamshire (5), Lancashire (4) and the North East (5). A typical example of a Category three mining area is Zone 4 in Nottinghamshire. Mine waters are still at depth following the recent closure of the last coal mine in the area (Calverton 2002). Figure 5.3 shows the modelled recovery continuing for a number of years with a gradually reducing amount of potential methane reserves. Areas such as Zone 4 in Nottinghamshire will at some point in the future require mine water pumping to prevent pollution of the overlying Permo-Triassic aquifer and surface discharges.

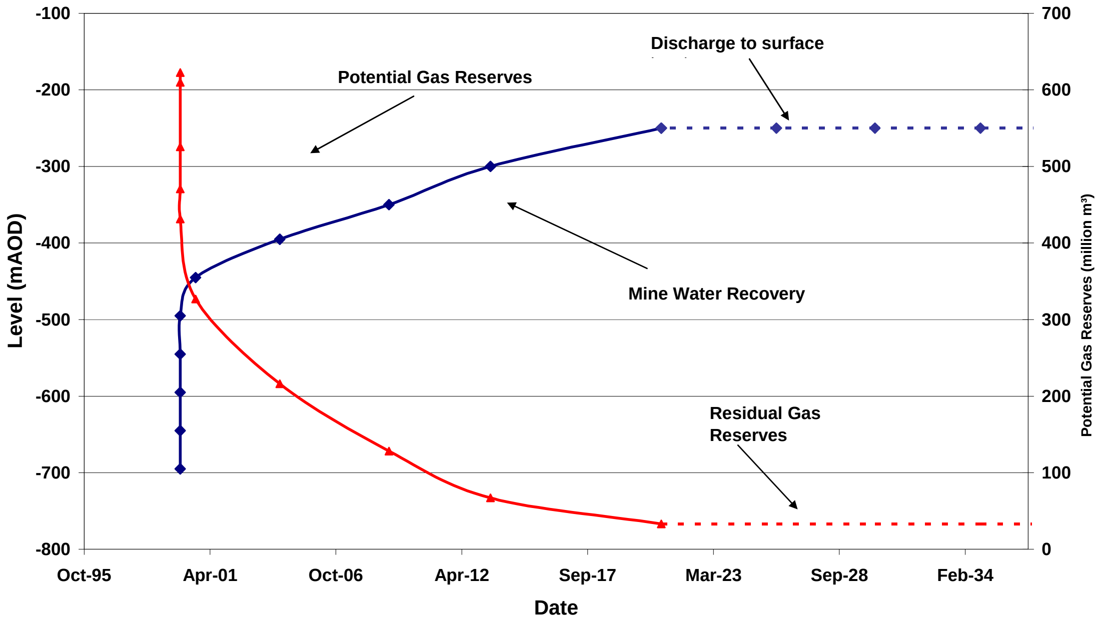


Figure 5.3 Gas Reserves and Water Recovery, Zone 4 Nottinghamshire

5.2.4 Category Four

There are currently 16 mining areas where mine water pumping controls the water level, leaving the mine workings above the water level with a methane potential. As the long-term aims for mine water pumping are to pump as little contaminated mine water as possible to prevent surface discharges or contamination of aquifers, mine water levels are kept as near surface as possible. Hence potential methane reserves in these areas are generally low. The number of pumped mine water areas will increase as remaining mines close and as more mine water treatment schemes are put in place by the Coal Authority.

Figure 5.4 shows Zone 6 in North East England as a typical example of an area where mine waters are currently controlled by pumping, and will be for the foreseeable future. Kibblesworth mine water pumping station controls mine water levels to prevent discharges of mine water into the River Tyne and the low lying areas around Newcastle and Gateshead.

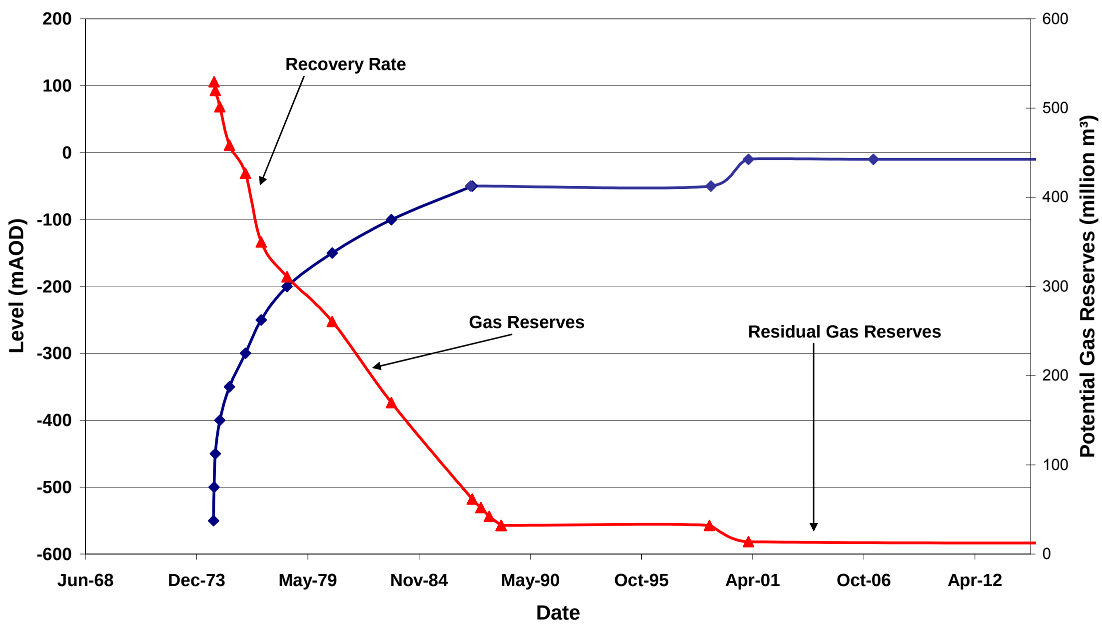


Figure 5.4 Gas Reserves and Water Recovery, Zone 6 North East England

6. METHANE IN MINES

6.1 Introduction

The methane in abandoned mines comes mainly from the coal seams within the strata, although some may come from other porous strata. Coal seams are plant remains that have been subjected to high heats and pressures, due to burial at depth, for millions of years. Coal seams vary in thickness from thin leaves of coal up to seams of a few metres and represent only a few percent of the total strata thickness of the Coal Measures in the UK. Between the coal seams are other strata, such as mudstones, siltstones and sandstones of variable thickness.

As the plant material is transformed into coal, becoming richer in carbon, methane is released as a by-product of the process. The quantities of methane generated in the process are far greater than the gas holding capacities of the coal seams, so the bulk of the gas evolved was lost to the atmosphere during periods when the permeability of the strata was sufficient to allow flow of the gas.

In their virgin state coal seams contain methane as a major constituent as well as other gases such as ethane, propane and carbon dioxide in smaller quantities. In the mining industry, the flammable gas from coal is commonly referred to as firedamp. The gas content of coal seams tends to increase with depth; with the rate of increase varying across the country. In UK coals, gas content varies between zero at the top of the Coal Measures (whether that represents the present ground surface, in exposed coalfields, or a geological unconformity such as the base of the Permian) and approximately 20 m^3/t.

The methane (and most other gases) within coal are adsorbed. Adsorption is the process by which gases are held on surfaces by weak intermolecular forces. Coal seams have a porous structure; the pores having a very high internal surface area. This high internal surface area allows large quantities of gas to be held within coal. Free gas is also present within the pores of the coal which is in dynamic equilibrium with the gas in the adsorbed state.

The permeability of coal seams in the UK is generally low, except in some limited areas of tectonic disturbance. As a result, gas remains locked within the coal seams until the permeability of the coal is increased by fracture. In the present context, the main source of fracture is due to mining operations. When coal seams are mined the gas is released from the mined seam due to the cutting operations. In room and pillar mining where the disturbance of other strata is limited, the gas released comes predominantly from the mined seam. However, during longwall mining, the strata above the worked seam is allowed to collapse behind the advancing coal face, inducing disturbance in the strata above and below the worked seam. Where coal seams lie within the zone of disturbance, fractures will be induced within the seams, allowing gas to be released, providing there is sufficient fracture connectivity to the working area.

The gas found in abandoned coal mines is that which is still being emitted from the coal seams which were disturbed by the mining operations. The rate of release is far slower than the rate of release during mining operations.

Gas released from abandoned mines can be split into two main categories. The first is the emission from vents installed into the abandoned mines to prevent the build up of pressure of gas within the mines. The second is the emission from old shafts, adits and fractures in the strata above workings.

6.2 Methane Emissions from Abandoned Mines

Methane may escape from abandoned mines either at well defined locations such as vents or by more diffuse paths. Vents have either been installed in the shafts during the closure operations or created by drilling into the underlying workings. Pressure can build up from the natural degassing of the coal, but more often as a result of rising mine waters compressing the gas within the mine void. Vents are usually installed to reduce the risk of emission of mine gases to the surface in places where they may represent a hazard. The emission from vents can be measured by monitoring the flow velocity and concentration of the gas within the vent. If the mine workings are connected to the surface by other leakage paths such as old shafts and fractures, then gas can escape to the surface.

Emissions from other leakage paths are more difficult to determine. They usually originate from shallower workings, although the gas may migrate from connected deeper workings. Gas may also migrate from geological structures such as permeable sandstone beds or from older poorly sealed shafts into deeper workings. Where the shallow workings have good connections to the surface a vent may reduce, but is unlikely to eliminate, other emissions as the relative resistance to flow from the vent is unlikely to be very low compared to that of the natural leakage paths. These more diffuse emissions can therefore occur over wide areas and the measurement of the flows has been problematical.

Where the workings are well connected to the surface, either by a vent or other low resistance connection, the pressure within the mine is similar to atmospheric pressure. In this case the rate of gas flow may be effected by changes in barometric pressure. In a process often referred to as "breathing", gas will flow out of the mine while the atmospheric pressure is below that of the mine gas pressure; on rising barometric pressure air flows into the mine. In the case where the connection to the workings is restricted, the gas pressure from degasification always remains significantly above atmospheric and hence the flow from the mine is always positive and depends less on the variation in atmospheric pressure. A range of conditions exist between these two cases and consequently rates of flow from abandoned mines show a wide range of dependence on barometric pressure.

7. MONITORING OF METHANE AT SURFACE VENTS

7.1 Identification of vents

Vents were monitored at 16 locations around England from November 2002 to December 2004 for this project. The sites were chosen to provide a cross section of the types of abandoned mines found in the UK. Sites were sampled with workings at shallow, intermediate and deep levels and those whose water levels had recovered and those which were still rising. Table 7.1 lists the sites monitored showing the name of the vent the category of mine, county, site number used by the Coal Authority and the National Grid Reference given as Eastings and Northings. Some sites were visited twice for validation purposes.

Table 7.1 Monitored Vent Sites

Site	Type	Region	Site No.	Eastings	Northings
Bearmouth	RS	Cumbria	12	297400	517200
Howgill	RS	Cumbria	41	297300	516800
Harrington	RS	Cumbria	181	298900	521600
Dawdon	R	Durham	24	443500	547900
Rawdon	NRI	East Midlands	65	431400	316400
Renishaw Park	NRS	East Midlands	105	443800	377500
Kirkby*	NRI	East Midlands	113	450400	357300
Calverton*	NRD	East Midlands	520	460300	350000
Parkside	NRD	Lancashire	103	359900	394700
Cronton	NRI	Lancashire	150	347400	389200
Askern*	NRD	North Yorkshire	8	455800	413800
Horbury*	NRI	North Yorkshire	286	430600	418400
Hartley Bank	NRI	North Yorkshire	559	427800	417300
Hall Drift	NRS	Northumbria	48	432300	577100
Roughwood	NRS	South Yorkshire	89	440700	394700
Hem Heath*	NRD	West Midlands	182	388600	341500

NR = Not Recovered, R = Recovered
S = Shallow, I = Intermediate, D = Deep
* Measured Twice

7.2 Method of measurement

Gas flow rate through the vent was obtained either directly by measuring the flow velocity with a probe or indirectly by measuring pressure drop.

A small anemometer installed through a hole in the side of the vent was the primary means to continuously measure the gas velocity in the vent. However, these anemometers have a lower velocity limit of about 0.7 m/s, which means that gaps appear in the data, when the velocity falls below this velocity. The anemometers will read velocity in both directions although the flow direction is not indicated. However, the flow direction was inferred from the differential pressure between the vent and the atmosphere and the changes in barometric pressure. Where the pressure in the vent was higher than outside, the flow was necessarily out of the vent and vice versa. Also, where barometric pressure is falling the velocity is most likely to be positive.

The pressure differential between the inside and outside of the vent was measured continuously. Pressure differential data was used in cases where the velocity was too low for the anemometer, or to calculate flows where there were gaps in the anemometer data. A pressure differential between the inside of the vent pipe and the atmosphere is caused by the resistance to flow of the pipe itself and the flame trap usually fitted to vents carrying methane. Flows, under the conditions pertaining in vents, are proportional to the square root of the pressure differential. Where flow data were available, the square of the flow was plotted against the measured differential pressure to obtain a calibration between the two, thereby allowing flows to be calculated from pressure readings, where direct flow measurements were unavailable.

Spot calibration measurements were made routinely on visits to the vents, which took place at about fortnightly intervals. Spot measurements of differential pressure were made with an accurate meter (DPM) and spot measurements of flow were made with a hot wire anemometer. A hot wire anemometer relies upon the rate of heat dissipation from a wire into the gas stream. The reading therefore varies with the thermal properties of the gas. Previous tests by IMC established calibrations of actual against indicated flow for methane and carbon dioxide using a hot wire anemometer of the same type as used here. The hot wire anemometer readings were adjusted using these factors to account for gas composition of the gas in the vent. These corrected hot wire anemometer readings were found to correspond closely with the velocities measured with the vane anemometer, where available.

In a few cases the flow levels were so low that even differential pressure measurements were swamped by signal noise from sources such as the wind blowing across a vent. In these cases the only data were spot measurements made on site at the times of the visits. Table 7.2 indicates for each site whether continuously monitored data were used in the calculations or whether only spot measurement data were available.

Monitoring at each site continued for at least one month.

7.3 Results

The average methane flow for the period of measurement was calculated taking into account changes in both flow rate and methane concentration using the following simple calculation.

$$F_m = \frac{\sum_i^n f_i \cdot c_i}{n}$$

Where F_m is the average flow of methane, f_i and c_i the individual readings of vent flow and methane concentration and n the number of those pairs of measurements.

Table 7.2 shows the flows calculated at the vents monitored. The sites were chosen to provide a wide range of expected emissions in order to provide as broad a range of values for comparison with the properties of the underlying abandoned mines. As expected, the results do show a very wide range of emissions

Some of the vents in Table 7.2, such as Calverton and Kirkby have been grouped together, because they are both connected into the same zone modelled for mine water and methane. The table shows the total average flow for each grouping and the individual flows which make up the total. Table 7.2 also shows the range of flows and methane concentrations measured.

The penultimate column of Table 7.2 indicates whether continuous monitoring was installed on the vents. Most vents were monitored continuously apart from Parkside and Cronton where spot measurements were made on one vent while another gassier vent was continuously monitored. The flow at Florence was also taken as a spot measurement; the flow compared with those measured within an hour at Hem Heath.

The final column of Table 7.2 indicates the method used to calculate flow. Only at Horbury did the vane anemometer provide continuous data throughout the test. Where anemometer data was not complete, the anemometer data was calibrated against the differential pressure measurement. The calibration was then used to calculate flows from the differential pressure measurements.

As described earlier, where vane anemometer and differential data was absent, due to low intrinsic flows at the vents, flows were calculated using the spot measurements made on visits to the site. Of the 15 vents where spot readings were used to calculate flow, six contained no methane. At Florence the spot flow measurement made was similar to that measured at the vents at the Hem Heath shaft at a similar time. The average flow was therefore assumed to be the same as one of those vents.

Table 7.2 Flows Measured at Vents

Site	Region	No. of Vents	Average Methane Flow (l/s)	Split Flows	CH_4 Flow Range (l/s)		CH_4 Conc. (%)		Type of Monitoring	Flow Calculated Using
					Maximum	Minimum	Maximum	Minimum		
Bearmouth	Cumbria	1	4.3	0.0	0.0	0.0	0.0	0.0	Continuous	Spot DPM and hot wire
Howgill		1		0.0	0.0	0.0	0.0	0.0	Continuous	Spot DPM and hot wire
Harrington		1		4.3	7.3	1.5	92.0	60.0	Continuous	Spot DPM and hot wire
Dawdon	North East	1	0.0	0.0	0.0	0.0	0.0	0.0	Continuous	Spot DPM and hot wire
Rawdon	Leicestershire	1	0.1	0.1	0.3	0.0	29.5	0.0	Continuous	Spot DPM and hot wire
Renishaw Park	Derbyshire	1	0.0	0.0	0.0	0.0	0.0	0.0	Continuous	Spot DPM and hot wire
Calverton	Nottinghamshire	1	16.9	14.3	65.4	0.0	39.0	0.0	Continuous	Vane flow with Differential pressure
Kirkby		1		2.7	20.7	0.0	8.1	0.0	Continuous	Vane flow with Differential pressure
Parkside 1	Lancashire	1	11.5	9.5	13.5	4.4	93.0	93.0	Continuous	Spot DPM and hot wire
Parkside 2		1		2.0	2.3	1.9	21.0	10.0	Spot values	Spot DPM and hot wire
Cronton 1	Lancashire	1	4.1	0.91	1.8	0.0	34.0	0.0	Continuous	Spot DPM and hot wire
Cronton 2		1		0.02	0.0	0.0	3.8	1.1	Spot values	Spot DPM and hot wire
Cronton 3		1		3.14	4.1	2.6	83.0	82.0	Continuous	Spot DPM and hot wire
Askern 1	Yorkshire	1	127.8	74.8	174.5	0.0	73.0	0.0	Continuous	Vane flow with Differential pressure
Askern 2		1		53.0	103.3	0.0	70.0	0.0	Continuous	Vane flow with Differential pressure
Horbury	Yorkshire	1	30.8	29.4	38.8	20.6	92.0	91.0	Continuous	Only Anemometer data
Hartley Bank		1		1.4	1.8	1.3	92.0	91.0	Continuous	Spot DPM and hot wire
Hall Drift BHs	North East	1	0.0	0.0	0.0	0.0	0.0	0.0	Continuous	Spot DPM and hot wire
Roughwood	Yorkshire	1	5.0	5.0	5.0	0.0	11.1	0.0	Continuous	Spot DPM and hot wire
Hem Heath No. 1	Staffordshire	2	152.6	62.2	184.5	0.0	46.6	0.0	Continuous	Vane flow with Differential pressure
Hem Heath Drift		1		59.4	150.1	9.8	58.9	34.0	Continuous	Vane flow with Differential pressure
Florence		1		31.1					Spot Measurement	Spot DPM and hot wire

- Of the three vents measured in Cumbria, only that at Harrington contained any methane, the others contained only low levels of blackdamp (air which is depleted in oxygen and enriched in carbon dioxide). Figure 7.1 shows the gas composition measurements for Bearmouth, which is typical for sites connected to shallow workings. This clearly illustrates the phenomenon of "breathing" where higher levels of carbon dioxide and reduced levels of oxygen are measured during periods of falling barometric pressure.

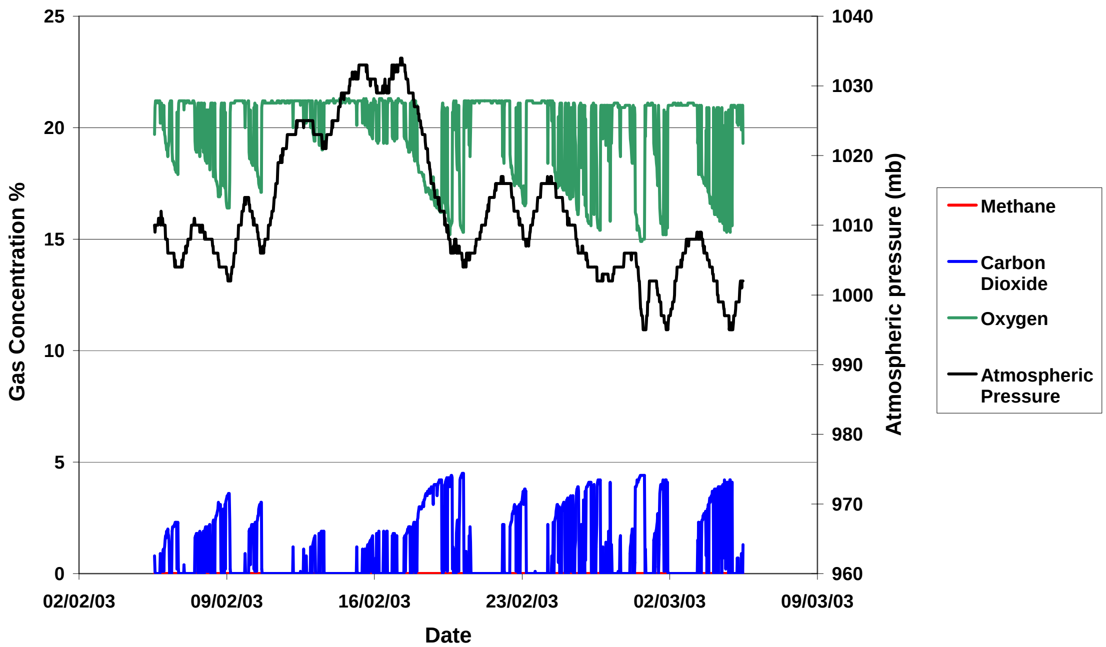


Figure 7.1 Composition of Gas Measured in Bearmouth Vent

- Dawdon and Hall Drift, two vents in the North East, contained no methane and only low levels of carbon dioxide (below 1%).

- Rawdon vent in Leicestershire, contained both methane and carbon dioxide. The concentration of methane was relatively high during monitoring, although the flows were low.

- Renishaw Park during the period monitored contained no methane and total flows measured were zero. Because no flow was discernible, monitoring at Renishaw Park was stopped after two weeks .

- At both Calverton and Kirkby the vents showed significant flows. Methane concentrations at Kirkby were no higher than 5% while those at Calverton reached 30-40%. Both Calverton and Kirkby had concentrations of carbon dioxide up to 15%; the gas composition varying with changes in barometric pressure. Figure 7.2 shows the flows of methane and carbon dioxide at Calverton, illustrating the changes in flow with pressure and the presence of a significant proportion of carbon dioxide in the mine atmosphere.

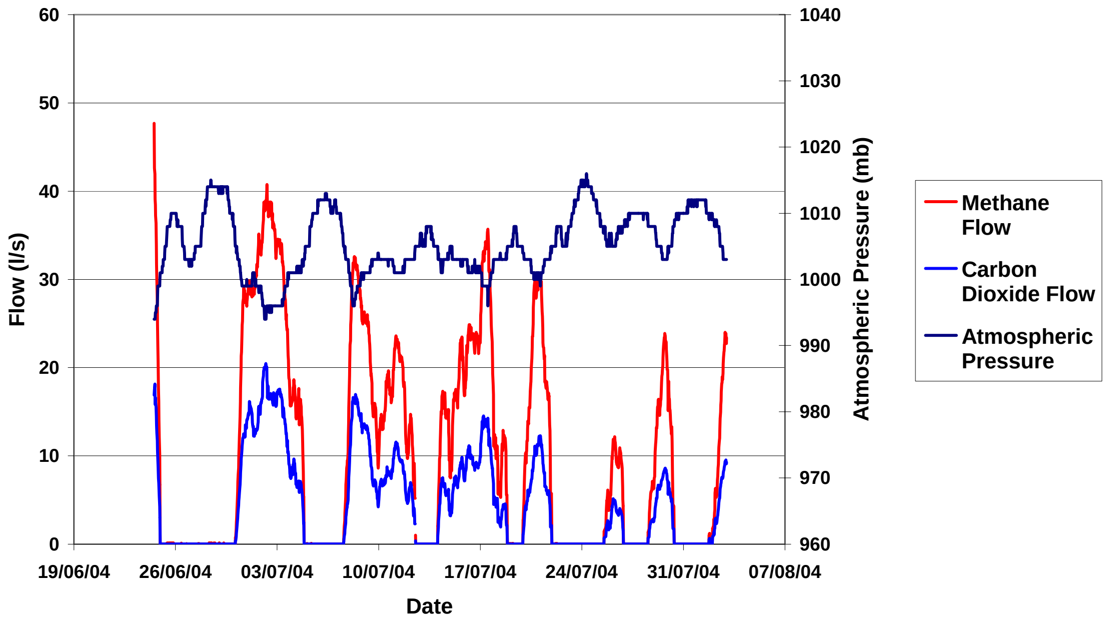


Figure 7.2 Flows of Methane and Carbon Dioxide at Calverton Vent

- Parkside is an abandoned mine with two vents. The spot measurements taken at No. 2 shaft showed a variation in concentration of both methane and carbon dioxide with barometric pressure. However, Parkside No. 1 shaft concentrations stay constant, containing little to no carbon dioxide and high concentrations of methane.

- The Cronton site contains three vents and most of the methane flow comes from the No. 3 shaft. This shaft contained high concentrations of methane and high levels of blackdamp constantly during the time of monitoring.

- Askern in Yorkshire has high flows of both methane and carbon dioxide which vary with barometric pressure.

- Horbury and Hartley Bank contained high levels of methane at all times when monitored. Figure 7.3 shows that there is little variation in methane flow from the vent at Horbury. The concentration of carbon dioxide was low and did not vary during the monitoring period.

- Hall Drift is a venting site included to represent many sites in the North East where methane flows are very low.

- Roughwood vent, also in Yorkshire, has flows of carbon dioxide and methane that vary with barometric pressure. The flow of 5 l/s stated in the table has been taken as a worst case, given the limited data.

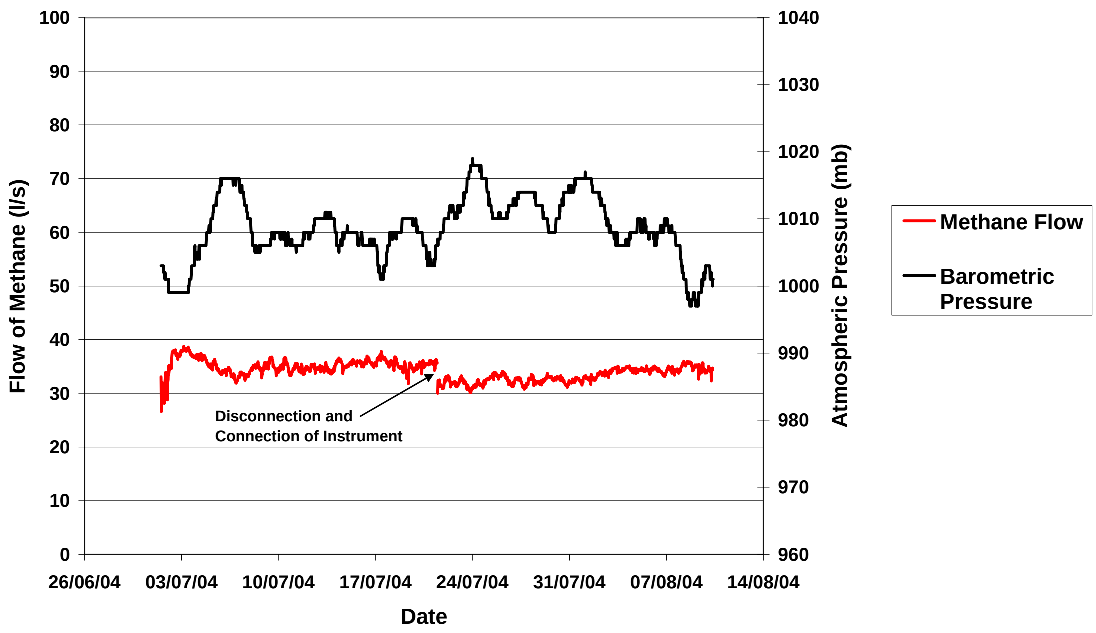


Figure 7.3 Methane Flow at Horbury Vent

- Hem Heath in Staffordshire is a site that consists of three vents. An allowance has also been made in the figures from emissions from Florence colliery, which is connected to Hem Heath. The main vent is No. 1 shaft where the methane and carbon dioxide levels vary with barometric pressure, but reach relatively high concentrations. Figure 7.4 and Figure 7.5 show the gas concentrations and methane flow at the Hem Heath No.1 Shaft vent. The figures clearly show both the strong influence of barometric pressure on the emission and the wide range of flows and gas concentrations found. The data illustrates the need for continuous measurement of concentrations and flows in order to provide average emission values. The drift vent contained concentrations of methane between 35% and 60% with levels of carbon dioxide of about 5% during the time monitored. The third shaft showed no sign of methane or carbon dioxide and flows were very low, even during periods of falling barometric pressure.

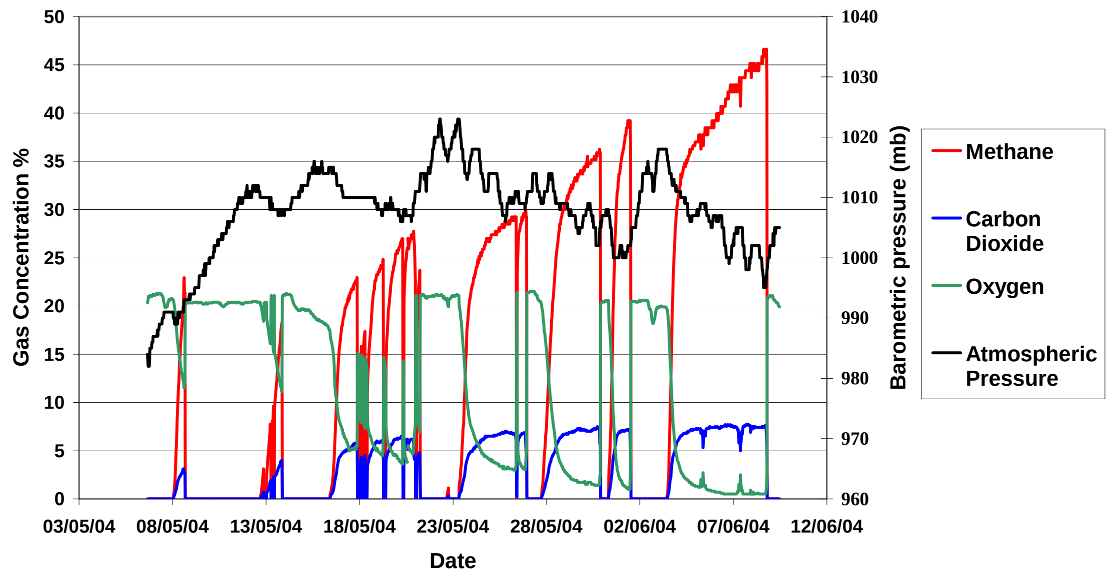


Figure 7.4 Gas Concentrations at Hem Heath No.1 Shaft

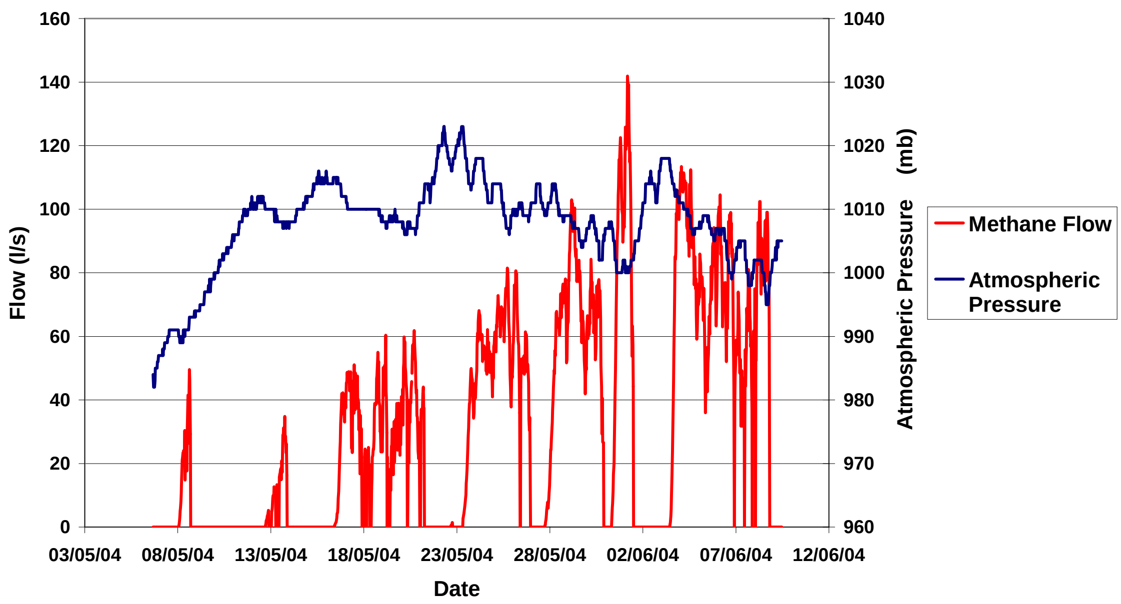


Figure 7.5 Methane Flows at Hem Heath No.1 Shaft Vent

8. MONITORING OF DIFFUSE METHANE EMISSIONS

8.1 Introduction

As described in Section 6, emissions from abandoned mines do not only occur from mine vents, but also as uncontrolled diffuse emissions from old mine entries, fractured ground etc. To obtain data on emissions from this source, a specialised data collection system was required. The Centre for Ecology and Hydrology Edinburgh (CEH) has experience and specialist equipment for measuring very low concentrations of atmospheric gases. Consequently, under this study, CEH were sub-contracted to provide a means to quantify these diffuse flows of methane.

The data on the diffuse emissions was required to provide a complementary data set to the vent flow data. The method used was to measure increases in the background methane concentration and, from these data, calculate estimates of the fluxes (flows per unit area) which would produce those increases in concentration.

To obtain fluxes CEH required data from IMC on the locations of the likely sources of the gas and an estimate of a representative source area from which the methane arose.

The fluxes calculated were used in two ways.

- To obtain an average of the fluxes and then scale up over the area of workings to obtain an estimate of total emission; described in this section.
- To use the flux estimate to calculate emission from the underlying modelled zone of the abandoned mineworkings and relate this to the properties of the modelled zone; described in section 9.

In addition to the long term monitoring of atmospheric methane concentrations, CEH also carried out a field trial to attempt to identify the location of a diffuse emission source using portable detection equipment. A description and results of the trial can be found in Appendix F.

8.2 Measurement activities

8.2.1 Monthly methane sampling in mine areas from December 2002 to November 2003

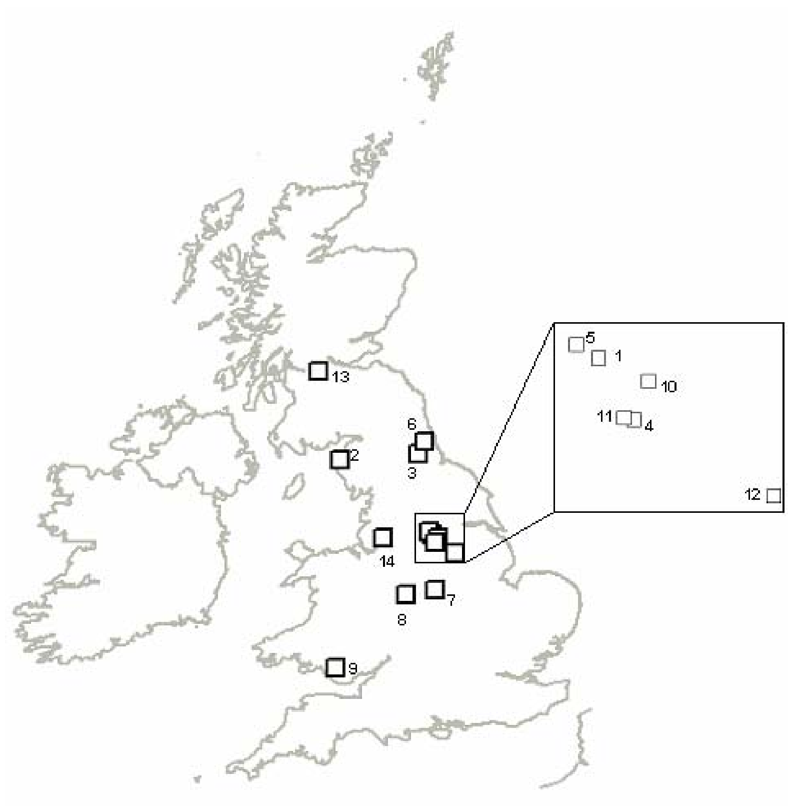
Atmospheric methane concentrations were measured monthly to obtain locally representative results for the site and the type of mine and to estimate diffuse emissions. The approach was to make measurements at sites not immediately affected by vent emissions, and then to scale up to the national level on an area basis.

8.2.1.1 The sites

Sampling started at the first seven sites listed in Table 8.1 on the 10-12 December 2002, 3 sites were installed in February 2003, and a further 4 sites in May 2003. The staging of installation was due to difficulties of finding suitable locations where there were residents who were willing to allow sampling on their property and participate in the sampling. The location of the sites are also shown in Figure 8.1.

Table 8.1 Locations of atmospheric methane measurements

Site name	Grid Reference		Start date	Number of monthly samples
	Eastings (m)	Northings (m)		
Smithies, Barnsley	**435360**	**408070**	**Dec-02**	**5**
Victoria School	**299900**	**528200**	**Dec-02**	**11**
Crook, Durham	**416100**	**536280**	**Dec-02**	**10**
Carhouse Pumping Station	**442400**	**393900**	**Dec-02**	**12**
Caphouse Colliery, Woolley	**430950**	**411160**	**Dec-02**	**9**
Kibblesworth Pumping Station	**424300**	**556250**	**Dec-02**	**9**
The Sycamores, Coleorton	**440400**	**316900**	**Dec-02**	**12**
Mid Cannock	**398500**	**309500**	**Feb-03**	**7**
Nant-y-Moel	**293600**	**192200**	**Feb-03**	**10**
Bolton on Dearne	**445300**	**402700**	**Feb-03**	**5**
Kimberworth Park	**440400**	**394300**	**May-03**	**5**
Bevercotes	**470100**	**376300**	**May-03**	**2**
Chryston	**268200**	**670100**	**May-03**	**7**
West Leigh	**364480**	**401610**	**May-03**	**7**



1. Smithies, Barnsley
2. Victoria School
3. Crook, Durham
4. Carhouse Pumping Station
5. Caphouse Colliery, Woolley
6. Kibblesworth Pumping Station
7. The Sycamores, Coleorton
8. Mid Cannock Pumping Station
9. Nant-y-Moel
10. Bolton on Dearne
11. Kimberworth Park
12. Bevercotes
13. Chryston
14. West Leigh

Figure 8.1 Sites where methane concentration was measured monthly

8.2.1.2 Data collection

The air sample collection system (Figure 8.2) was developed by CEH for the DEFRA project MANE (DEFRA project code cc0251). Air samples were collected by continuously pumping air, over one month periods, into a large aluminium foil bag contained in a cardboard box (50x25x35 cm). The small grey pump (right picture, on top of box) transfers air from the sample inlet at a height of 1.5 m outside of a building (left picture). The flow rate of the pumps was about 0.5 ml/min

The sample bags were checked for gas permeability and contamination during storage. The effects of both variables were negligible, with changes in methane concentrations of less than 0.5% over a 2-months period.

Filled sample bags were returned to CEH at the end of each month and were analysed for methane concentrations by tunable laser spectroscopy. Absolute concentrations were calculated using standard concentrations of 1821.3 ppb of methane.

Figure 8.2 Pictures of the Air Sample Collection Equipment

8.2.1.3 Measurement Results

Monthly measured methane concentrations at the sampled sites are tabulated in Table 8.2. Table 8.3 lists the average and standard deviation of the measurements made at each site and the number of samples taken. Three monthly readings were identified as outliers within the data due to measurements which were not representative of normal conditions. The values for August and September 2003 were removed from further calculations as the larger values were due to increased emissions from the shaft due to altered water levels elsewhere. A change in pump rate re-established the normal levels of methane emission. The other data removed is that for October 2003 for West Leigh, where the reading is over three times grater than any other measurement. It was possible that this reading was due to methane from a landfill, which is usually located up-wind of the monitoring site and was therefore excluded.

Table 8.2 Methane concentration measured on a monthly basis (Units ppb)

	Site name	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03
1	Smithies, Barnsley		2,410	2,342	2,257	2,359	2,225						
2	Victoria School	3,527		3,876	3,354	3,639	4,481	4,231	4,529	3,696	4,279	3,512	4,773
3	Crook, Durham	2,013	1,944	2,079	2,057	2,013	1,991	1,991		2,016	2,061	1,978	
4	Carhouse Pumping Station	2,565	2,732	2,732	2,818	2,573	2,522	2,804	3,144	13,098*	5,252*	3,073	2,445
5	Caphouse Colliery, Woolley	2,246		2,315	2,214	2,110	1,981		2,019	2,075	2,063	2,039	
6	Kibblesworth Pumping Station	2,156		2,336	4,006	3,129	2,461	4,180	4,443		3,753		2,763
7	The Sycamores, Coleorton	2,032	1,987	2,065	2,024	2,018	1,898	2,011	2,055	2,070	2,079	2,107	1,983
8	Mid Cannock Pumping Station			2,963	2,132	2,892	2,357	2,434	2,170			2450	
9	Nant-y-Moel			2,047	2,176	2,069	2,208	2,235	2,189	2,134	2,086	2,057	2,082
10	Bolton on Dearne			2,342	2,259	2,037	2,048	2,070					
11	Kimberworth Park						2,065			2,057	2,130	2,078	2,062
12	Bevercotes						2,022	2,036					
13	Chryston						3,023	3,130	3,384	3,213	3,311	4,074	3,207
14	West Leigh						4,235	3,328	4,680	2,123	2,506	16,571*	4,967

* Identified as outliers (IMC Group)

Table 8.3 Basic statistics on monthly methane concentrations (without outliers) from Dec 02-Nov 03

Site	Annual Mean	Standard deviation	No of observations
1	2,319	76	5
2	3,991	485	11
3	2,014	41	10
4	2,741	230	10
5	2,118	114	9
6	3,247	867	9
7	2,027	56	12
8	2,485	326	7
9	2,128	69	10
10	2,151	140	5
11	2,079	30	5
12	2,029	10	2
13	3,335	346	7
14	3,640	1,173	6

8.3 Analysis, Results and Discussion

The concentrations do not show a clear seasonal pattern. However, methane concentrations were consistently larger than the national network average at several sites. The average annual concentration of methane (national network average) was 2,017 ppb and was measured at 33 sites in grassland, arable and urban areas from March 2002 to March 2003 (unpublished report to DEFRA, June 2003, DEFRA Contract Number CC0251, New Methods to Quantify Agricultural Nitrous Oxide Emissions). For the urban sites of this network average annual concentration was 2,133 ppb methane. Meteorology/Climate appears to have a significant influence on emissions. For example, the urban methane emissions were higher in 2003, a hot dry summer, than in 2002. To determine the repeatability of the measurements, some sample bags were measured when received and again one month later. In 80% of the samples, the concentration varied less than 3ppb between the two measurements.

8.3.1 Source Strengths and Fluxes from Monthly Measurements

The model SCAIL (Simple Calculation of Ammonia Impact Limits) was employed to estimate the source strength of methane escaping from the abandoned mines from the monthly measurements. The SCAIL model estimates source strength from an inversion of Gaussian plume equations using measured concentrations. A dispersion model (Local Atmospheric Dispersion and Deposition - LADD) was used to parameterise the model SCAIL.

The magnitude of estimated source strength is dependent on the SCAIL input parameters:

1. Distance of emission source to point of interest (here measurement site) in metres. The model is designed for local-scale modelling. Distances above about 1km are probably too large. Distances below 100m would also usually be taken to be too close. However, the SCAIL model has been used for shorter distances, in lieu of an alternative, in order to obtain an estimate of emissions on the justification that the model reduces the source strength with proximity to the source.

2. Direction of emission source to point of interest (measurement site) in degrees. The direction input is linked to the mean annual UK wind rose, providing the probability of wind coming from a particular direction as well as the wind speed.
    - Distance and direction of sources was identified by IMC Group for some sites. For sites where no single nearby source was evident, a direction of 225 degrees (most common wind direction in the UK) and a distance of 100m was used as a default.

3. Concentration enhancement over background (ppb). The magnitude of the enhancement depends on the chosen background.
    - Option 1: A UK wide mean annual background derived from measurements of the national network (sites in grassland, arable and urban areas) from March 2002-March 2003.
    - Option 2: A site-specific enhancement (5km grid square) as modelled by FRAME (**F**ine **R**esolution **Am**monia **E**xchange, a Lagrangian trajectory model) using the UK methane emission inventory as well as network concentration measurements. This enhancement can then be added to the mean annual “clean air” Shetland Island background (year 2000) of 1830ppb to obtain the “Frame-modelled background”.

    Using the national network background is appropriate when assuming all sites are located in a similar environment of methane concentration levels, however if that is not the case, using a “local” background level will be more appropriate. Since some monthly monitored sites are located near other methane sources (other than methane from abandoned mines), the second option is likely to produce better source strength estimates. Two sites which illustrate this difference are Victoria School situated in a rural coastal setting in Cumbria (FRAME modelled background of 1889ppb) and West Leigh, a site in Lancashire, an urban setting with several methane sources (landfills) in a 5 mile radius (FRAME modelled background of 2048ppb).

As with all modelling exercises, the use of sensible data and parameter input into a model is crucial to producing good results. Data held by IMC Group suggests the following distances and directions for the sites in question:

- Crook: Mine gas venting site 200m South West of measurement site
- Carhouse Pumping Station: Pumping Shaft 20m South of measurement site

- Caphouse Colliery, Woolley: Pumping Shaft 10m South of measurement site
- Kibblesworth Pumping Station: Pumping Shaft 5m North of measurement site
- Mid Cannock Pumping Station: mine water site 50m North of monitoring site
- Bevercotes: nearest shaft 1km away – too great a distance for SCAIL

The enhancements and estimated source strengths are presented below in Table 8.4 and Table 8.5.

Table 8.4 Concentrations and Enhancements above different background values (Units ppb)

A	B	C	D	E	F	G
	Conc. measured at sites	"Background" values		Enhancement values		Difference between National Network and Frame Modelled
Sites	Annual Mean	Frame Modelled *	UK wide National Network**	Above Frame Modelled	Above National Network	
Smithies, Barnsley	2,319	2,043	2,017	276	302	-26
Victoria School	3,991	1,889	2,017	2,102	1,974	128
Crook, Durham	2,014	1,950	2,017	64	-3	67
Carhouse Pumping Station	2,741	2,054	2,017	687	724	-37
Caphouse Colliery, Woolley	2,118	2,047	2,017	71	101	-30
Kibblesworth Pumping Station	3,247	2,028	2,017	1,219	1,230	-11
The Sycamores, Coleorton	2,027	2,068	2,017	-41	10	-51
Mid Cannock Pumping Station	2,485	1,981	2,017	505	468	36
Nant-y-Moel (Wales)	2,128	1,930	2,017	198	111	87
Bolton on Dearne	2,151	2,049	2,017	102	134	-32
Kimberworth Park	2,079	2,054	2,017	25	62	-37
Bevercotes	2,029	1,975	2,017	55	12	42
Chryston	3,335	2,293	2,017	1,041	1,318	-276
West Leigh	3,640	2,048	2,017	1,592	1,623	-31

*** Frame enhancement +Shetland Background (1830ppb)**

****National Network Mean Mar 02-Mar03**

Table 8.5 SCAIL modelling and source strengths

Sites	H	I	J	K	L	M
	Settings in SCAIL		Source Strength (t CH_4 per year)		Difference in source strength	
	Distance from source [m]	Direction to source [degrees]	National BG	Frame modelled BG	Absolute (t CH_4 per year)	% change
Smithies, Barnsley	100	225	105.5	96.5	-9.0	-9
Victoria School	100	225	690.5	735.3	44.8	6
Crook, Durham	200	225	-3.3	79.6	82.9	104
Carhouse Pumping Station	20	180	17.6	16.7	-0.9	-5
Caphouse Colliery, Woolley	10	180	0.7	0.5	-0.2	-42
Kibblesworth Pumping Station	5	0	3.4	3.3	0.0	-1
The Sycamores, Coleorton	100	225	3.7	-14.3	-17.9	126
Mid Cannock Pumping Station	50	0	86.9	93.6	6.7	7
Nant-y-Moel (Wales)	100	225	38.9	69.3	30.4	44
Bolton on Dearne	100	225	47.0	35.8	-11.1	-31
Kimberworth Park	100	225	21.5	8.7	-12.8	-148
Bevercotes	1,000	180	387.4	1,701.2	1313.8	77
Chryston	100	225	460.9	364.3	-96.7	-27
West Leigh	100	225	567.8	556.9	-10.9	-2

Explanatory Notes on Columns A to M (Tables 8.4 and 8.5)

A. Name of 14 sites, monitored between two and 12 months each (see Table 8.2 for details).
B. Annual mean concentration (ppb) measured at the sites, excluding Aug 03 and Sept 03 at Carhouse and Oct 03 at West Leigh (outliers).
C. Background-value-Frame-modelled: This uses the Frame modelled enhancement plus the Shetland Island mean annual background value (yr 2000) of 1,830 ppb. The Frame enhancement is obtained by using available emission and concentration measurement data. The Background-value–Frame-modelled provides background values on a 5km grid across the UK that reflects on the presence/absence of local sources, such as landfills, agricultural sources etc.
D. Enhancement at site above the national network value (2,017 ppb), excluding outliers.
E. Background-value-National-Network: This is a UK annual mean, derived from the UK national network for the period Mar 02-Mar 03 (2,017 ppb).
F. Enhancement at site above the Frame-modelled-background value, excluding outliers.
G. Absolute difference (ppb) in background levels, provided for comparison with enhancement levels as indicator of underlying uncertainty.
H. Distance (m) of measurement site to nearest assumed or known source. Input parameter in SCAIL model.
I. Direction of measurement site to source (degrees). Input parameter in SCAIL model; related to wind speed and probability of wind coming from given direction.
J. Source Strength of methane (t CH_4 year^{-1}) calculated using SCAIL with concentration enhancements in Column E (enhancement above the national network value (2,017 ppb), excluding outliers).

K. Source Strength of methane (t CH_4 year^{-1}) calculated using SCAIL with concentration enhancements in Column F (enhancement above the Frame-modelled-background value, excluding outliers).
L. Absolute change in source strength based on source strength calculated with enhancement above national network value and source strength calculated with enhancement above Frame modelled value
M. % Change/difference in source strength based on source strength calculated with enhancement above national network value and source strength calculated with enhancement above Frame modelled value

The modelling produces a range of source strengths, the best estimate source strength are the ones using the Frame modelled background, because they make allowance for background changes with geographical location.

The total source strength from the selected 13 sites adds up to 2.05 kt CH_4 per year (excluding Bevercotes). Bevercotes has been excluded from this sum, because it is known to be well sealed and the large deduced source strength is due to the large distance to the potential source, rather than any significant enhancement of background methane enhancement.

Having established annual source strengths (t CH_4 yr^{-1}) for each of the mines/sites, information on the surface emission area was used to estimate an annual flux (t CH_4 km^{-2} yr^{-1}). Surface emission areas data were provided by IMC Group which are listed in Table 8.6. These areas (with 1km^2 as the smallest area used in calculations) were then used to calculate a minimum and maximum flux estimate for each site (Table 8.7).

Table 8.6 Surface emission areas and mine types

	Site	Type	Description	Surface emission area
1	Barnsley	1	Concentrated emission from small area, long flow path to source	Max 1 km^2
2	Victoria School	6	Natural methane emission	Max 1 km^2
3	Crook	3	Dispersed emission from large area, short flow path	Large 5 - 10 km^2
4	Carhouse	2	Pumping station and dispersed emission, moderate sized area	Large 5 - 10 km^2
5	Woolley	2	Pumping station and dispersed emission, moderate sized area	Large 5 - 10 km^2
6	Kibblesworth	2	Pumping station and dispersed emission, moderate sized area	Large 5 - 10 km^2
7	Sycamores	3	Dispersed emission from large area, short flow path	Large 5 - 10 km^2
8	Mid Cannock	2	Pumping station and dispersed emission, moderate sized area	Large 5 - 10 km^2
9	Nant-y-Moel	4	Gas vents and dispersed emission from small area	Large 5 - 10 km^2
10	Bolton-on-Dearne	1	Concentrated emission from small area, long flow path to source	Max 1 km^2
11	Kimberworth	4	Gas vents and dispersed emission moderate sized area	Large 5 - 10 km^2
12	Bevercotes	5	Sealed isolated vent through Permo Trias	Sealed shaft
13	Chryston	4	Gas vents and dispersed emission from small area	Large 5 - 10 km^2
14	West Leigh	1	Concentrated emission from small area, long flow path to source	Max 5 km^2

Table 8.7 Emission fluxes (t CH_4 km^{-2} yr^{-1})

	Source Strength (t CH_4 yr^{-1})		Surface Emission Areas		FLUX (t CH_4 km^{-2} yr^{-1})			
	National BG	Frame predicted BG			National Background		Frame predicted BG	
Sites	(column J in Table 8.5)	(column K in Table 8.5)	Min Area (km^2)	Max Area (km^2)	Max Flux	Min Flux	Max Flux	Min Flux
Barnsley,Smithies	105.5	96.5	1	1	105.5	105.5	96.5	96.5
Victoria School	690.5	735.3	1	1	690.5	690.5	735.3	735.3
Crook, Durham	-3.3	79.6	5	10	-0.7	-0.3	15.9	8.0
Carhouse Pumping Station	17.6	16.7	5	10	3.5	1.8	3.3	1.7
Caphouse Colliery, Woolley	0.7	0.5	5	10	0.1	0.1	0.1	0.0
Kibblesworth Pumping Station	3.4	3.3	5	10	0.7	0.3	0.7	0.3
The Sycamores, Coleorton	3.7	-14.3	5	10	0.7	0.4	-2.9	-1.4
Mid Cannock Pumping Station	86.9	93.6	5	10	17.4	8.7	18.7	9.4
Nant-y-Moel (Wales)	38.9	69.3	5	10	7.8	3.9	13.9	6.9
Bolton on Dearne	47.0	35.8	1	1	47.0	47.0	35.8	35.8
Kimberworth Park	21.5	8.7	5	10	4.3	2.2	1.7	0.9
Bevercotes	387.4	1,701.2	Sealed shaft					
Chryston	460.9	364.3	5	10	92.2	46.1	72.9	36.4
West Leigh	567.8	556.9	1	5	567.8	113.6	556.9	111.4

An average of the maximum and mean fluxes for each site has then been calculated for both the National Network background and the Frame background cases. These are listed in Table 8.8. The columns marked ± contain the differences of the mean from the maximum and minimum values. Consequently a value of zero in this column means that only one value has been provided for the area, not that the reading is anymore accurate than the others.

Table 8.8 Mean emission fluxes and indication of range

	Mean FLUX (t CH_4 km^{-2} yr^{-1})			
	National Background		Frame predicted Background	
Sites	**Mean**	**±**	**Mean**	**±**
Barnsley,Smithies	**105.5**	**0.0**	**96.5**	**0.0**
Victoria School	**690.5**	**0.0**	**735.3**	**0.0**
Crook, Durham	**-0.5**	**-0.2**	**11.9**	**4.0**
Carhouse Pumping Station	**2.6**	**0.9**	**2.5**	**0.8**
Caphouse Colliery, Woolley	**0.1**	**0.0**	**0.1**	**0.0**
Kibblesworth Pumping Station	**0.5**	**0.2**	**0.5**	**0.2**
The Sycamores, Coleorton	**0.5**	**0.2**	**-2.1**	**-0.7**
Mid Cannock Pumping Station	**13.0**	**4.3**	**14.0**	**4.7**
Nant-y-Moel (Wales)	**5.8**	**1.9**	**10.4**	**3.5**
Bolton on Dearne	**47.0**	**0.0**	**35.8**	**0.0**
Kimberworth Park	**3.2**	**1.1**	**1.3**	**0.4**
Bevercotes	**Sealed shaft**			
Chryston	**69.1**	**23.0**	**54.6**	**18.2**
West Leigh	**340.7**	**227.1**	**334.1**	**222.7**

8.4 Scaling up to obtain UK Budget Estimates

This section attempts to make an estimate of the emission from shallow workings to the surface, based on the flux rates calculated in section 8.3. The basic principle is to estimate an average flux and multiply it by the total area of shallow workings.

Data on unflooded working areas of abandoned mines in the UK provided by IMC Group estimated 3579 km^2 of shallow working area, 1055 km^2 of intermediate and 20 km^2 of deep working area. (Shallow is –100m AOD and above, Intermediate is –100m AOD to –400m AOD and Deep is –400m AOD and below).

Suitable sites were selected to calculate average dispersed flows/flux and some sites were not included in the analysis. Reasons for exclusion were largely based on the unrepresentative nature of the sites. Before monitoring took place, some sites were identified as sampling points due to a perception that gas was likely to be found there. Following monitoring, it was felt that at some of these sites, because of the high levels of emission, the gas was being fed in from more distant sources over a larger area and so were excluded. Sampling over a wider area might have identified whether a real problem existed at these sites. Other reasons for exclusion included non-coal sources of methane as being possible or likely for the elevations in background levels and, at Bevercotes, a sealed shaft was suspected might release methane, but was subsequently considered to be fully sealed.

Five of the fourteen sites were excluded from the analysis for the following reasons:

- 1. Barnsley, Smithies – methane originates in area away from emission points, long and restricted flow paths
- 2. Victoria School – which is a site of natural methane emissions
- 10. Bolton-on-Dearne – methane originates in areas away from emission points, long and restricted flow paths
- 12. Bevercote/Gamston Aviation – sealed shaft
- 14. West Leigh/ Newton Westpark – long and restricted flow paths, possible local landfill.

Table 8.9 Extrapolation to annual total UK shallow abandoned mines' emission budget

Sites	National Network BG		Frame predicted BG		Units
	Mean Flux	±	Mean Flux	±	
Crook, Durham	-0.5	-0.2	11.9	4.0	t CH_4 km^{-2}
Carhouse Pumping Station	2.6	0.9	2.5	0.8	t CH_4 km^{-2}
Caphouse Colliery, Woolley	0.1	0.0	0.1	0.0	t CH_4 km^{-2}
Kibblesworth Pumping Station	0.5	0.2	0.5	0.2	t CH_4 km^{-2}
The Sycamores, Coleorton	0.5	0.2	-2.1	-0.7	t CH_4 km^{-2}
Mid Cannock Pumping Station	13.0	4.3	14.0	4.7	t CH_4 km^{-2}
Nant-y-Moel (Wales)	5.8	1.9	10.4	3.5	t CH_4 km^{-2}
Kimberworth Park	3.2	1.1	1.3	0.4	t CH_4 km^{-2}
Chryston	69.1	23.0	54.6	18.2	t CH_4 km^{-2}
Mean of values	10.5	3.5	10.4	3.5	t CH_4 km^{-2} yr^{-1}
Standard deviation	22.4		17.6		kt CH_4 yr^{-1}
Area (shallow only)	3,579		3,579		km^2
UK budget shallow workings (average)	37.6		37.2		kt CH_4 yr^{-1}
UK budget shallow workings (standard deviation)	80.1		62.9		kt CH_4 yr^{-1}

The columns headed mean flux contain the mean fluxes listed in Table 8.8. The row marked "mean of values" contains figures which are the arithmetic means of the numbers above them in the table. The mean values of the mean flux columns can be seen to be heavily weighted by the measurement made at Chryston. The means of the ± columns are simply the means of the individual values and do not represent a real measure of the variability of the derived average flux for all the sites. The measure of the variability is included in the table as the standard deviation of the mean fluxes columns. The standard deviation is significantly larger than the mean derived flux. The reason for the large variability of methane fluxes is most likely due to large differences in the quantities of methane available in the abandoned mines below the sites.

A total flux from shallow workings may be obtained by multiplying the area of shallow workings in the UK by the estimated mean flux of methane from shallow workings. The area of shallow workings is included in the table together with the product of the area with the mean derived flux. Using this method, the methane emissions estimate from shallow abandoned mines in the UK is 37 kt methane per year based on the FRAME data. However, the large error associated with this value means that the deduced methane emission figure of 37 kt/y for shallow workings should be treated with caution. It seems difficult to see how the error can be reduced, when using a method which averages values which vary significantly for real reasons.

A method of scaling up is required which takes into account the magnitude of the underlying methane source strength to compensate for the variability. Section 9 will describe the method of calculating the size of the underlying gas source. Section 10 will reconsider the data in this section in light of those underlying gas quantities.

9. METHANE RESERVE MODELLING

9.1 Introduction

This section deals with the calculation of the quantities of methane left within the coal in abandoned coal mines. The coal seams are the source of the methane which is emitted at surface and hence the quantity of gas within the mines will have an impact on the quantity released at the surface. The quantity of gas, or gas reserve, is calculated by:

1. Identifying the coal which has been disturbed by mining,
2. Estimating the methane content of the various parts of the coal, using the original gas content and making allowance for reductions due to mining processes,
3. Summing the gas across all the coal disturbed.

This quantity is then reduced over time to reflect rising mine waters cutting off the coal seams from the voids within the mine.

9.2 Methodology for Calculating Gas Reserves

This section will consider the calculation of gas reserves for the two cases of:

1. Major coalfields and sites with detailed information
2. Minor coalfields.

For Case one calculations, a full method is used which employs all mine working data, strata sections and gas content data. These areas are those identified in Table 3.1 as having detailed MRSDS Data available.

Case two includes two main categories. The first category covers recovered small areas of old workings, possibly made up of small isolated areas, limited data and uncertain gas contents. The second category covers areas of workings where there has been recovery over the period in question, which has been modelled, data is less reliable. The coalfield areas correspond with those identified in Table 3.1 as having outline MRSDS data or relying on a previous report. An exception to this is the modelling of Hem Heath and Florence in North Staffordshire, which required modelling in more detail for comparison with vent flow measurements made at the site. These sites were treated as with case one coalfields.

A simpler method was used to estimate the reserve for the Case two calculations. This method was based on a relationship between water level and gas reserve derived from the modelling of Case one areas.

9.2.1 The major coalfields (case 1)

The modelling of the gas reserves requires the gas content to be provided as a function of position and depth. The assessment of gas reserves uses a method similar to that developed by British Coal to estimate the gas content reduction due to previous mining operations (Appendix G). All unmined coal seams lying within 150m above and 40m below workings are identified as those which may have lost gas due to mining operations. Seams outside these limits are assumed to have insufficient connectivity to the mine to allow gas flow, although in reality some may have been internally disrupted by the disturbance of the strata. The fact that seams may have enhanced permeability outside the zone of connectivity has been shown from gas flows obtained when drilling gas drainage holes from the surface into the strata above workings. Enhanced gas flows have also been recorded when mining seams which have been previously overworked but not degassed by those workings.

Gas contents are calculated for the coal seams prior to mining from the British Coal gas content database. The database contains the grid co-ordinates of the boreholes and the depths, methane and ethane contents of all the samples taken from each borehole, stored in the form of ASCII files. Data can be selected from the ASCII files and processed by Excel macros to provide graphs of gas content as a function of depth within a specified geographical area.

The plotted data shows that gas content in the UK Coal Measures generally increases with depth. A best fit curve was applied to the scatter of gas content data; the type of curve, whether exponential, linear or constant, depends on the form and scatter of the data. For seven major coalfields and at Hem Heath/Florence collieries a linear model of gas content increasing with depth was fitted. Figure 9.1 shows an example of a linear increase in gas content with depth derived from data in the vicinity of Hem Heath and Florence collieries. Depending upon the consistency of the gas content/depth gradient across a coalfield, either a single value has been used for the whole coalfield, or separate gradients derived for different part of the coalfield. At Hem Heath, the area of the workings are not overlain by Trias so would be expected to fall to zero close to the surface. The regression line in Figure 9.1 intercepts the depth axis at about 120m below surface. The line could have been forced through the origin to make it conform with expectations, but as the workings are at depth, it was considered best to adhere more closely with the measured data.

For the Cumbrian coalfield, data was taken from boreholes in the Canonbie coalfield, which is the closest associated coalfield for which data is available. (Canonbie has not been included in the assessment due to the very limited recorded workings in the area.) The data indicated an increase in gas content with depth (Figure 9.2), but a linear fit through the data suggested gas contents of about 2.5m^3/t at surface, whereas they would be expected to fall to zero. A curve of some form was therefore required to model a reducing rate of increase of gas content with depth, and an exponential function was fitted to the data. The curve is suitable for seams at greater depths, but an exponential fit will not easily go through the origin. Consequently, the lower section of the curve was replaced by a linear section to bring the gas content to zero at the surface. The linear section was required to enable calculation of gas contents at the shallow depths required in this area.

In the Central Fife coalfield there was insufficient data to derive an increase of gas content with depth, so a fixed value was used. In the Midlothian coalfield a fixed value was used for the shallow workings and a gas content gradient used for the deeper workings. In the South Wales coalfields the gas content data showed a wide consistency over a very wide range of depths. Figure 9.3 shows gas content data from boreholes in the Cynheidre area. The figure shows that gas contents of between 15 m^3/t and 18 m^3/t were measured in boreholes at depths between 160m and 840m, although data from some boreholes indicate a drop off in gas content at shallower depths. Gas content measurements from across South Wales show that seams below the Red/Abergorky seams generally have a steady gas content. Above the Red seam, the gas contents decrease significantly with depth although the rate of decrease is not certain. For modelling purposes a fixed gas content was used for seams including and below the Red/Abergorky. For seams above the Red/Abergorky, the gas contents decrease linearly with depth, to zero at surface. Where the Red/Abergorky is at less than 50m depth the gas content decreases from the gas content pertaining at 50m to zero at surface. Gas contents in South Wales show a general increase from East to West and South to North. To model this variation, a fixed gas content was estimated for each 5km square across the coalfield.

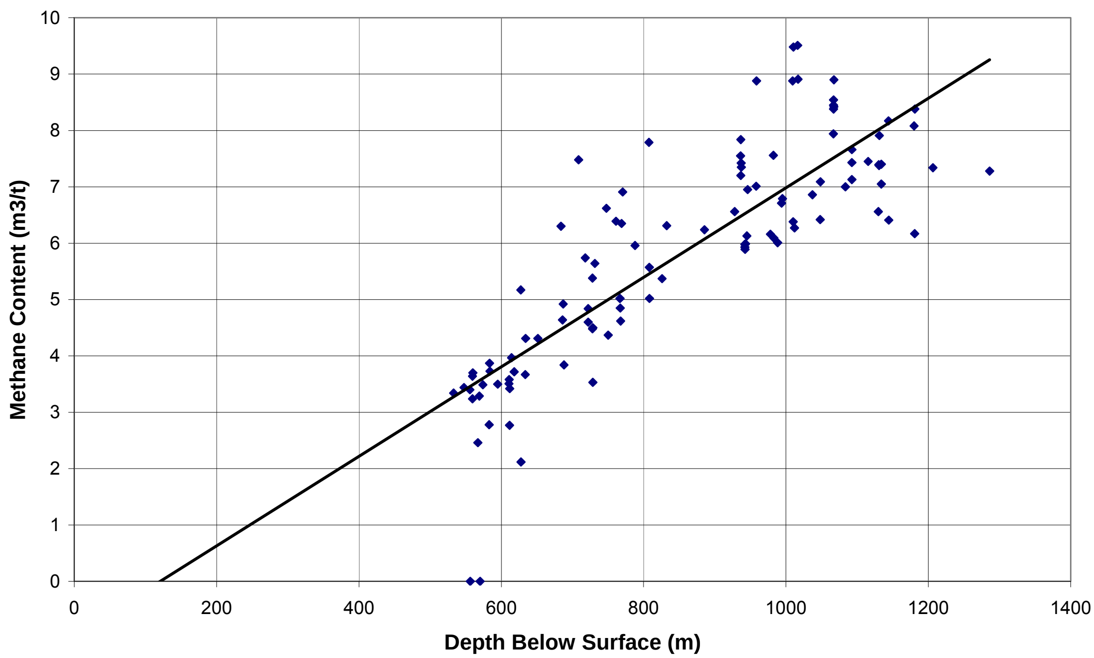


Figure 9.1 Increase in gas content with depth at Hem Heath and Florence collieries.

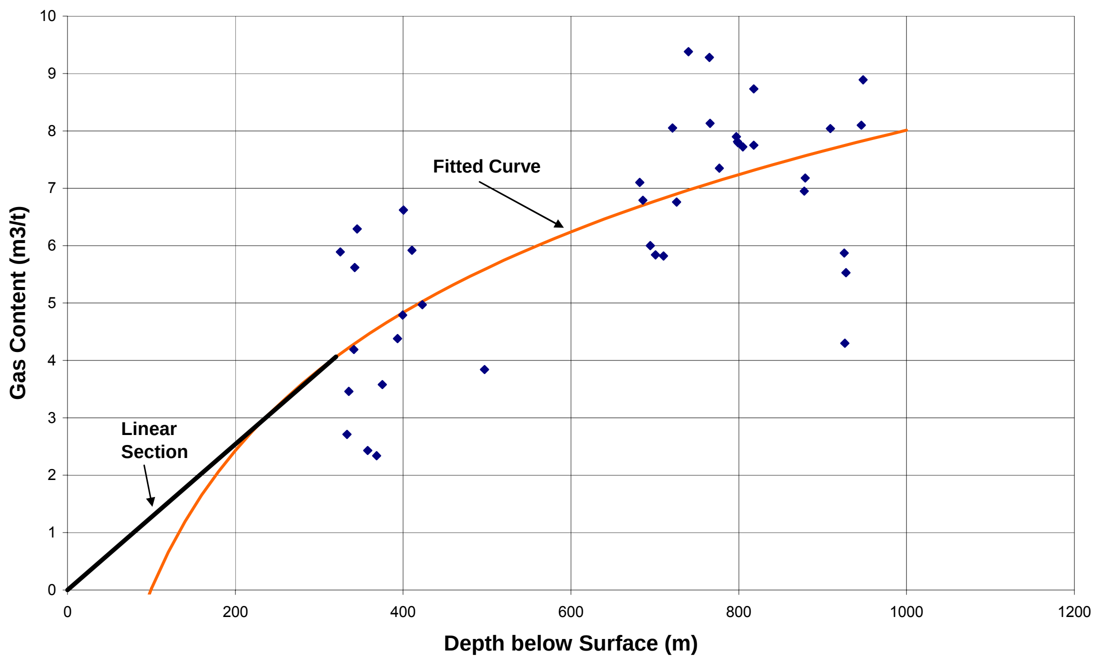


Figure 9.2 Increase in gas content with depth in Canonbie Coalfield, used for Cumbria.

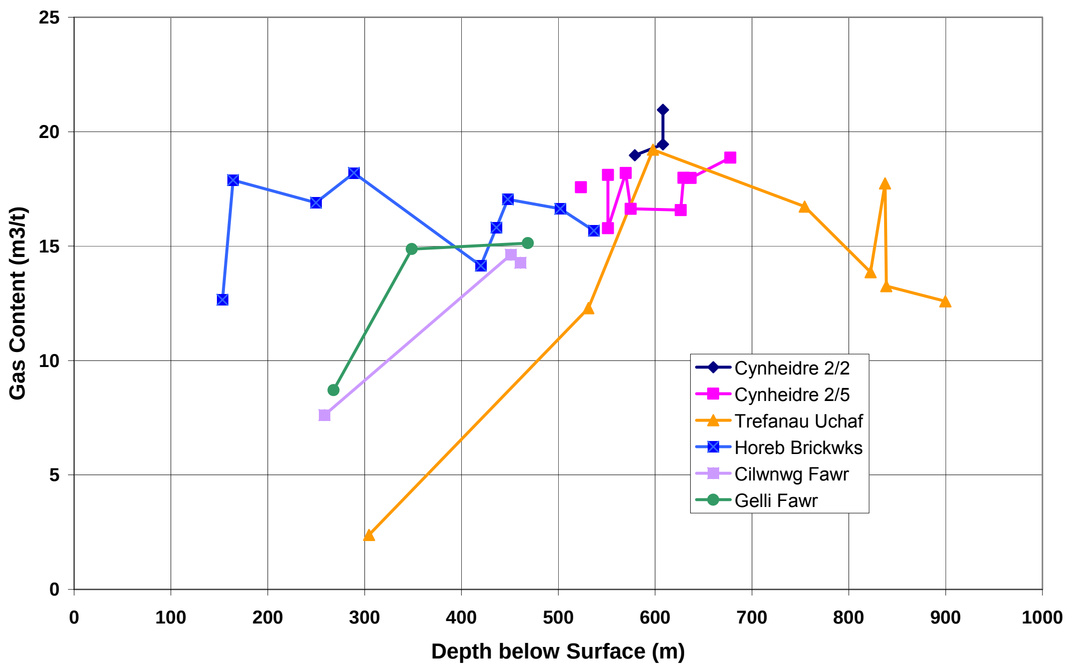


Figure 9.3 Gas content data for boreholes in the Cynheidre Area, South Wales.

Gas contents are reduced to account for mining using a similar method as firedamp prediction (Appendix G). The effect of each seam mined is cumulative; the gas reserve is calculated by summing the quantity of gas remaining within all the coal seams affected by mining. A Schematic diagram illustrating the process is shown in Figure 9.4. The figure shows three worked seams within the stratigraphic section. The columns at the bottom indicate quantities of methane. The left hand column represents the total quantity of gas in the section within 150m above the highest worked seam and 40m below the lowest worked seam, before the seams were worked. This is therefore the potential maximum of gas available. The actual gas reserve which is accessible is, however, zero.

In mining seam A, the gas contents of seams above and below the worked seam are reduced as indicated by the line adjacent to the strata section. However, the action of mining also provides pathways for the gas to flow and hence the nominal accessible gas reserve increases. Extraction of seams B and C further reduce the gas contents, but the increase in the size of the accessible zone, due to ground disturbance, increases the size of the accessible gas reserves. As further seams are mined, the gas reserve may decrease as the effect of decrease in gas content starts to exceed the effect of increasing the degassing zone. The quantity of gas remaining following mining is therefore a complex value, depending on the distribution of workings through the strata section. A plan of workings at different levels provides a complex patchwork of combinations of mined seams, each combination representing a different degassing history and residual gas.

The method was originally developed to calculate the reserve for an individual colliery using graphical methods, identifying the combination of workings, by eye. However, for larger collieries and larger numbers of seams mined it became necessary to develop a computerised method, a version of which has been used in this project and is described below.

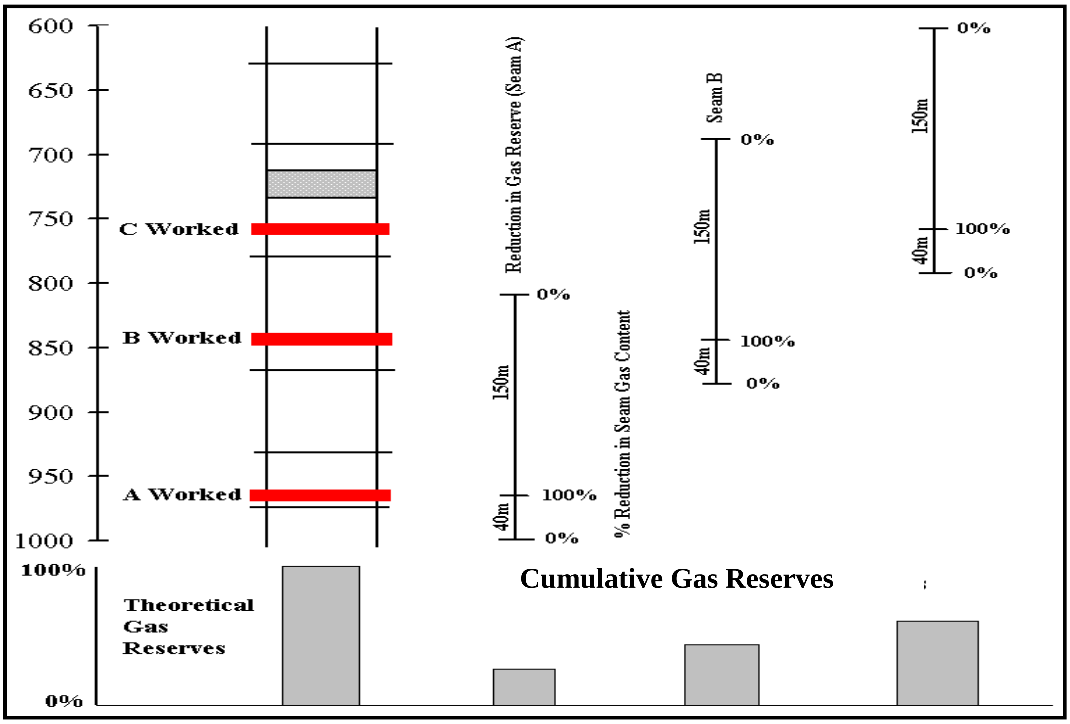


Figure 9.4 Schematic diagram of the effect of worked seams on the gas reserves.

The potential mine gas reserves present within the mining area were calculated from the exported MRSDS database (see Section 5.1). The average levels of the MRSDS polygons were plotted on an Easting and Northing grid. The grid used was either 250m or 500m, the choice determined by the area of the workings, as large areas using a 250m grid would create models too large to be run on the computers. The polygons plotted on the grid were used to establish a "layered" grid of Eastings and Northings so that individual areas of mine workings were stacked vertically above each other within cells. That is, each seam was represented by a grid, with each grid superimposed upon the other. A cell consisted of one grid square projected down through all the seams. A macro was then used to calculate from the layered data set, a "seam code" for each individual cell. The code would have one code letter for each worked seam within the mine, whether or not the seam was worked in that particular cell. If a cell was worked in that cell it would be allocated a value "W", if unworked "U" and if flooded "F". For example, if there were four seams within the mine then a seam code for a cell could be UWUW (i.e. within the cell, the first and fourth seam were un-worked and the second and fourth worked). As the model was run over time the cells' code would change as seams became flooded, for example, the code last example code would change to UWUF as the fourth seam was flooded.

The seam code is then used to calculate the individual potential gas reserves for that particular cell. The interaction between the worked seam and other seams present within the standard stratigraphy for the mine area is calculated and this is used to assess the amount of gas that could be available to a single set of workings. The process is the same as set out in Appendix G. Having identified which seams are mined within each cell (those with a "W"), the gas contents of the coal seams within the stratigraphic section are reduced to allow for the effect of mining in each seam cumulatively. Flooded seams are taken not to contribute to the total. The following equation describes how the gas reserve is calculate.

$$R = \rho \times a^2 \times \sum_{i=1}^{l} \sum_{j=1}^{m} \sum_{k=1}^{n} t_k \times q_{ijk}$$

Where R is the reserve, ρ is the density of coal (tonne/m^3), i and j represent the grid position and k the seam number. t_k the thickness of seam k (m) and q_{ijk} is the methane content of cell ij within seam k (m^3/tonne). a is the grid spacing used in the model, measured in metres.

The process is also repeated at regular vertical intervals to model the recovery of mine water.

The potential gas reserves are calculated by the model at different water levels. The water models also provide the change in water level with time. By combining these two data sets to eliminate water level, the potential gas reserve as a function of time is obtained. These gas reserve against time relationships were used to calculate gas reserves for each of the modelled coalfields for each year between 1990 and 2004.

9.2.2 Minor coalfields (case 2)

The coalfields modelled as described in section 9.2.1 contain more than 90% of the coal mine methane reserves in the UK. The other coalfields, necessarily represent a small proportion of the whole reserves and have more limited data available. As a result, it was not considered that the major effort to estimate the reserves by the methods described in section 9.2.1 was justified. A simpler method, using a relationship derived from data calculated using the full method, was used to estimate the methane reserve from the depth to water below surface.

A value of gas reserve density, to indicate the relative gassiness of a site, was calculated for each modelled zone at different water depths. The reserve density was calculated by dividing the total reserve in the modelled area by the footprint area of the workings in the area. Figure 9.5 shows the calculated gas reserve density plotted against the water level, both derived from the gas and water modelling exercises for the major coalfields. The results are scattered, but show a clear trend of increasing reserve with depth to water. The result is expected since the lower the water level, the more coal is likely to remain above the water, and the greater the gas reserve is likely to be.

A regression line through the data intercepts the depth axis at 135m below surface. However, with depths to water in many of the recovered coalfields within a few tens of metres of surface, a regression line, shown in Figure 9.5, was forced through the origin to enable calculation of gas reserves close to the surface. A curve could have been fitted to the data to increase the gradient with increasing depth. However, the scatter on the data does not seem to justify more than a simple linear fit and water levels in the minor coalfields are almost all less than 100m below the surface.

Forcing the line through the origin necessarily skews it at smaller depths towards higher gas reserves. However, if the line is used to calculate gas reserves from water level, it will tend to produce an overestimate and hence err on the side of caution.

For coalfields where water levels were rising in the period 1990 to present, water levels were derived either from measured water levels or from estimates based on general relationships for all the years in the interval. For mines whose water levels were known to have recovered, a single water level was used for each, based on known outflow levels.

In order to calculate the gas reserves for the smaller coalfields a value for gas reserve density was calculated by multiplying the water level in the coalfield by the line gradient of 27,114 $m^3/km^2/m$. This reserve density figure was then converted into a gas reserve by multiplying by the footprint area of the workings in the coalfield. The results of the calculations are listed in the lower sections of Appendix H.

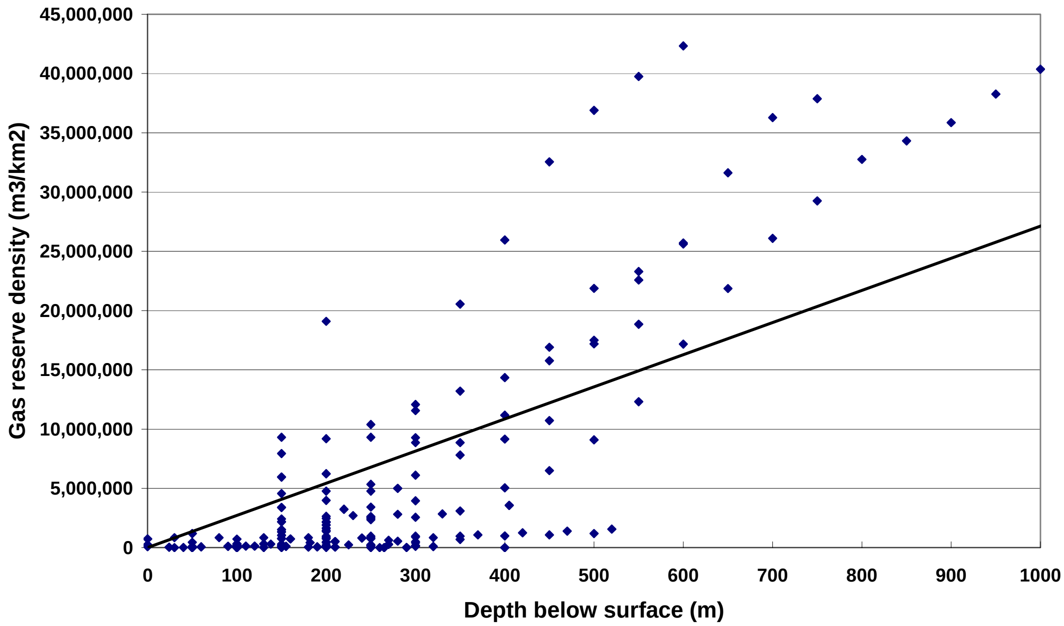


Figure 9.5 Plot of water level below surface against gas reserve density for modelled areas

9.3 Results

The reserves for each year and each coalfield and zone are listed in Appendix H. The totals of the reserves between 1990 and 2004 are shown in Table 9.1 and Figure 9.2.

The 1990 estimate of reserves is 10.0 billion m^3 methane. Due to the pattern of colliery closure during the early 1990's the estimate of reserves associated with closed mines first rises to 19.5 billion m^3 methane in 1993 then falls, due to mine flooding, to 8.6 billion m^3 methane in 2004. The annual reserves have excluded those areas where active extraction of gas has taken place during the year; the assumption being that those areas would be under suction and hence would release no methane to the atmosphere.

Table 9.1 Estimated Total UK Methane Reserves in Abandoned Coal Mines 1990 to 2004

Year	Reserve (million m^3)
1990	9,975
1991	10,999
1992	16,083
1993	19,541
1994	17,588
1995	18,409
1996	15,942
1997	16,815
1998	14,620
1999	13,513
2000	13,211
2001	11,311
2002	11,089
2003	10,347
2004	8,598

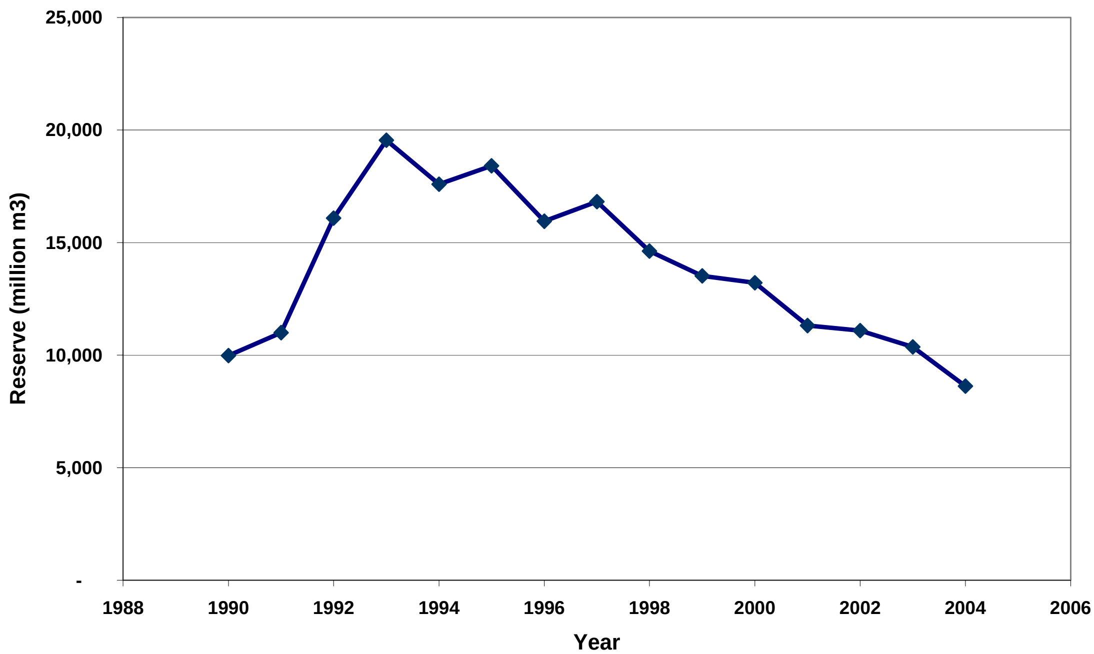


Figure 9.6 Estimated Total UK Methane Reserve in Abandoned Coal Mines 1990 to 2004

10. METHODOLOGY FOR ESTIMATING UK EMISSIONS

The rate of methane emission from abandoned mines is assumed to be linked to the size of the methane reserve in the mine. Although the processes controlling the emissions from abandoned mine are complex, it is considered that both the quantity of coal able to release gas and the gas content of the coal are the major factors in the overall rate of release of the gas. The gas content is linked directly to the pressure of methane in the coal and hence the potential rate of release. The quantity of coal represents a scaling factor on the rate of release of methane per unit weight of coal. The product of these two properties is the gas reserve, as indicated in section 9.2.1.

Rate of flow of mine water was also considered as a factor which might control the emission of gas since it displaces the mine atmosphere as it fills the mine. However, because the gas emission from the coal seams may sometimes be greater than the water flow or the water flow may be displacing low concentrations of methane, there were reasons to suspect that it would not provide a full answer.

10.1 Modelling using vent emission data

Table 10.1 shows data on vent flows and reserves in the underlying zone of mine workings above water level and the water flow into those workings.

Table 10.1 Measured Vent Flows and the Gas Reserve of Underlying Mine Workings

Site	Region	Reserve (m^3)	Methane Flow (l/s)	Flow (kt/y)	Water Flow (l/s)
Bearmouth Howgill Harrington	Cumbria	13,996,192	4.3	0.09	26.4
Dawdon	North East	0	0.0	0.00	0.0
Rawdon	Leicestershire	105,000,000	0.1	0.00	
Renishaw Park	Derbyshire	174,259,434	0.0	0.00	0.0
Calverton Kirkby	Nottinghamshire	298,993,468	16.9	0.37	164.1
Parkside	Lancashire	179,613,941	11.5	0.25	2.6
Cronton	Lancashire	2,820,528	4.1	0.09	3.5
Askern	Yorkshire	520,000,000	127.8	2.82	1.5
Horbury Hartley Bank	Yorkshire	211,090,347	54.7	1.21	108.4
Hall Drift BHs	North East	3,221,192	0.0	0.00	0.0
Roughwood	Yorkshire	27,678,040	5.0	0.11	85.3
Hem Heath	Staffordshire	192,841,487	152.6	3.37	16.4

Figure 10.1 shows that the gas flow from vents has no definite trend when plotted against the water flow. However, Figure 10.2 indicates a trend of increasing emission with increasing gas reserve; three curves (representing high, medium and low emitters) have been fitted through the scattered data. The gradient of the lines represents a value of specific emission, that is, a flow per unit gas reserve.

The upper line represents a regression through the three largest emitters (Askern, Hem Heath and Horbury) to provide an indication of the emission from gassy and more recently closed mines. Hem Heath includes an allowance of emission from a vent at Florence Colliery vent - the two collieries representing an isolated (in terms of gas) unit of collieries. Askern is also an isolated unit which makes these two points more controlled than some others where emission from other points may be possible. Collieries, immediately following closure, may show higher rates of emission in relation to the reserves, due to the presence of recently disturbed coal seams. However, in terms of obtaining representative relationships between emission and reserve across the UK coalfields, it is unlikely that collieries closed at the same time or earlier than these three will show higher specific emission. Because there will be many very old collieries which are likely to have lower levels of specific emission, it is very unlikely that any representative specific emission, which might be applied to all abandoned mine workings, would approach the specific emission of the three collieries.

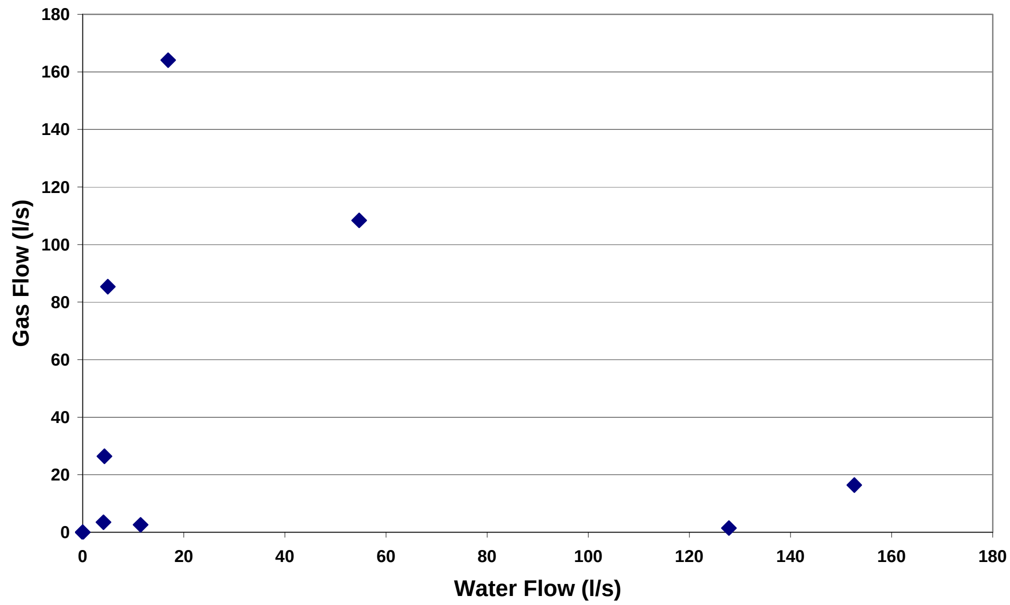


Figure 10.1 Vent Flow data Plotted Against Underlying Water Flow

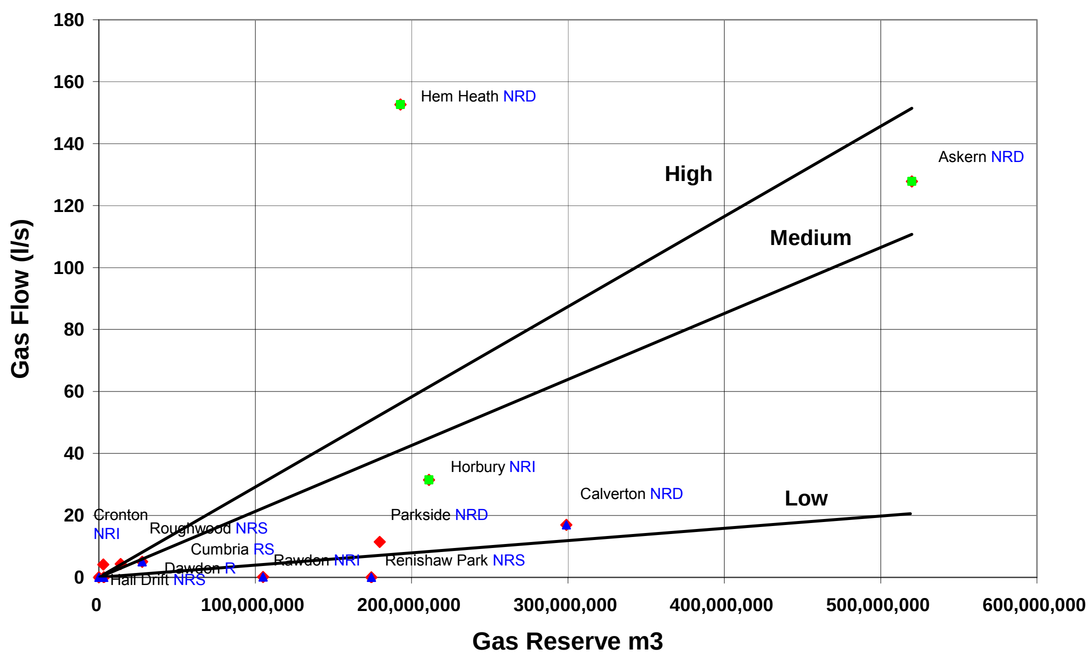


Figure 10.2 Plot of Vent Flows Against Underlying Gas Reserve

The lower line represents a regression through the rest of the data excluding sites where the gas in the mine is at pressure (the exclusions are Harrington, Parkside and Cronton). In these cases the vents are assumed to be the only place from which gas is emitted. This line is regarded as representing a low emission case and probably not representative of the overall emission.

The middle line is a regression for all the data with no exclusions and gives a specific emission of 2.128×10^{-7} l/s per m^3 between emission and reserve.

The regression lines in Figure 10.2 allows the determination of realistic upper and lower limits on the overall UK abandoned mine methane emission based on the reserves in place. The data shows that, for example, Hem Heath cannot be considered representative of all coalfields in the UK and that a representative curve is likely to lie between the high and low lines. The method chosen uses the average line.

10.2 Modelling using diffuse methane measurement data

To obtain a level of confidence in the relationship between emission and gas reserve, the flux data were reanalysed to provide emissions data for comparison with the underlying gas reserves. Section 8.2.1 contained calculations of methane flux based on long term atmospheric sampling for 14 sites. Methane emission flows were calculated by multiplying the flux (t CH_4 km^{-2} y^{-1}) by the footprint area (km^2) of the workings in the modelled zone. Values of flux based on the National Network background and the FRAME predicted background were used for each location to provide an indication of variability. Table 10.2 includes the calculated flow in litres per second and the corresponding underlying methane reserves for those sites where reserves were modelled. The data from Barnsley, Bolton-on-Dearne and West Leigh were also included in the calculations, and were found to not appear anomalous when compared to the size of the underlying reserve. This finding further emphasises the difficulties associated with attempting to obtain average emission rates from a range of sources with a high degree of variability. Those sites where the reserves were deduced from water level were not included due to the higher uncertainty in those reserves. The reserves and emissions from the vent sites have also been repeated here in this table for ease of comparison.

Figure 10.3 (linear scale) and Figure 10.4 (log-log scale) show that the flux based data and vent flow data are fairly consistent. The 99% confidence limits of the regression are also shown in Figure 10.3, which shows that the general gradient of the line appears to lie within tight limits, although there is a degree of scatter in the data.

The gradient of the regression line for all the points (vent estimate and flux estimate) is included in Table 10.3 together with the gradients of the regressions for the separate sets of data. It may be seen from Table 10.3 that the gradients for the different data sets are very close. It is proposed to apply the gradient, derived using all data points, to the gas reserve estimates to provide a sensible estimate of emissions from abandoned mines. The gradient is equivalent to an emission of 0.74% of the reserve per annum.

Table 10.2 Estimated Diffuse Emissions from Underlying Gas Reserves Based on Long Term Sampling Measurements

Site	Gas Reserve (million m^3)	Methane Flow (l/s)		
		Vents	Network	Frame
Barnsley	1,796.0		167	152
Crook	17.8		-4	84
Carhouse	28.0		3	3
Woolley	29.4		0	0
Kibblesworth	11.0		2	2
Nant-y-Moel	6.5		2	3
Bolton-on-Dearne	1,796.0		737	561
Kimberworth	27.7		12	5
Chryston	13.5		19	15
West Leigh	1,367.0		380	373
Bearmouth Howgill Harrington	14.0	4		
Dawdon	0	0		
Rawdon	105.0	0		
Renishaw Park	174.3	0		
Calverton Kirkby	290.0	17		
Parkside	179.6	12		
Cronton	2.8	4.0		
Askern	520.0	128		
Horbury Hartley Bank	211.1	55		
Hall Drift BHs	3.2	0		
Roughwood	27.7	5		
Hem Heath	192.8	153		

Table 10.3 Gradients of Regression Lines for Flow/Reserve Correlations

Source of Data	Gradient (l/s per m^3)
Vent measurements and long term sampling	2.358×10^{-7}
Vent Measurements	2.128×10^{-7}
Long term Sampling	2.365×10^{-7}

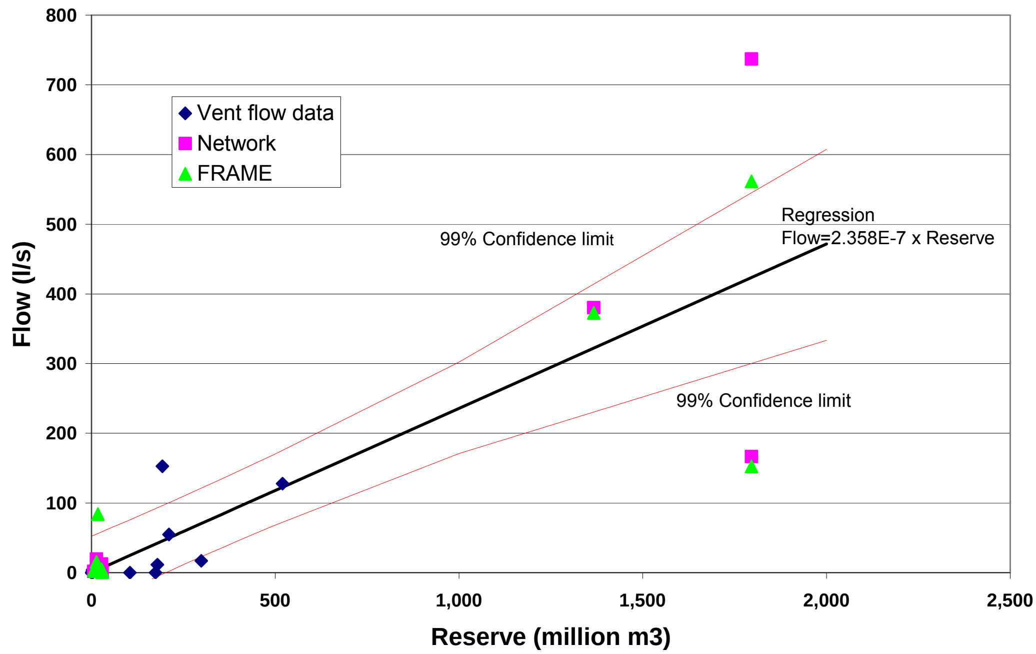


Figure 10.3 Plot of Vent and Diffuse Emission Flows Against Gas Reserve

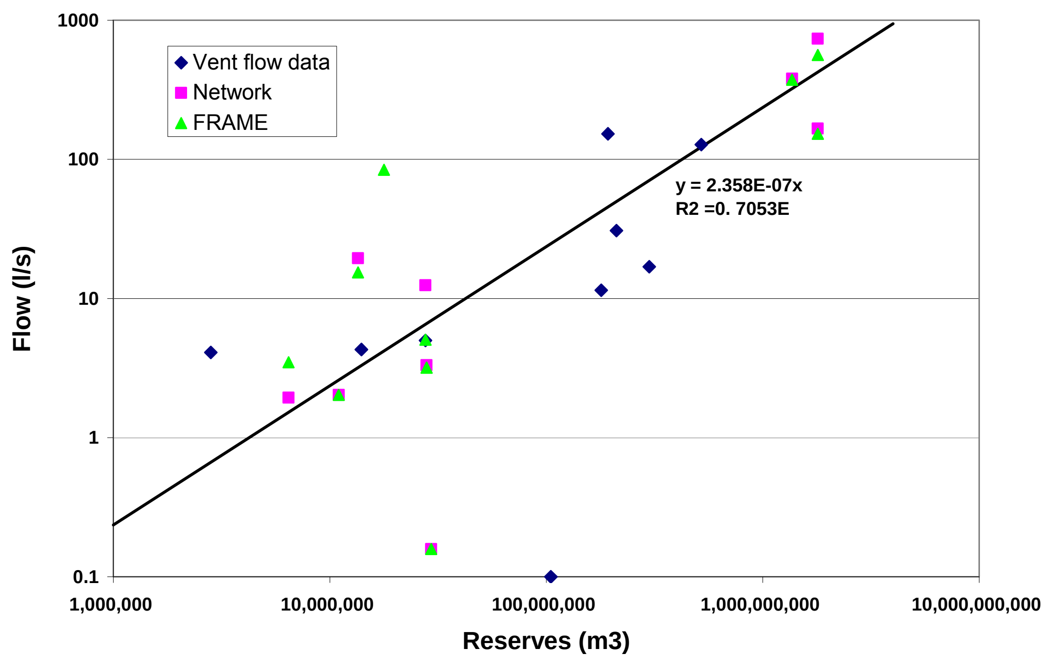


Figure 10.4 Log Plot of Vent and Diffuse Emission Flows Against Gas Reserve

11. RESULTS

The emissions for 1990 to 2004 have been estimated assuming the 0.74% of reserve per annum figure applied to the total reserve calculations for 1990 to 2004 listed in Table 9.1. The results are listed in Table 11.2 and plotted in Figure 11.1.

Table 11.2 Estimated Total UK Methane Emissions from Abandoned Mines 1990 to 2004

Date	Methane Emission Estimate (kt per year)
1990	52
1991	57
1992	83
1993	101
1994	91
1995	96
1996	83
1997	87
1998	76
1999	70
2000	69
2001	59
2002	58
2003	54
2004	45

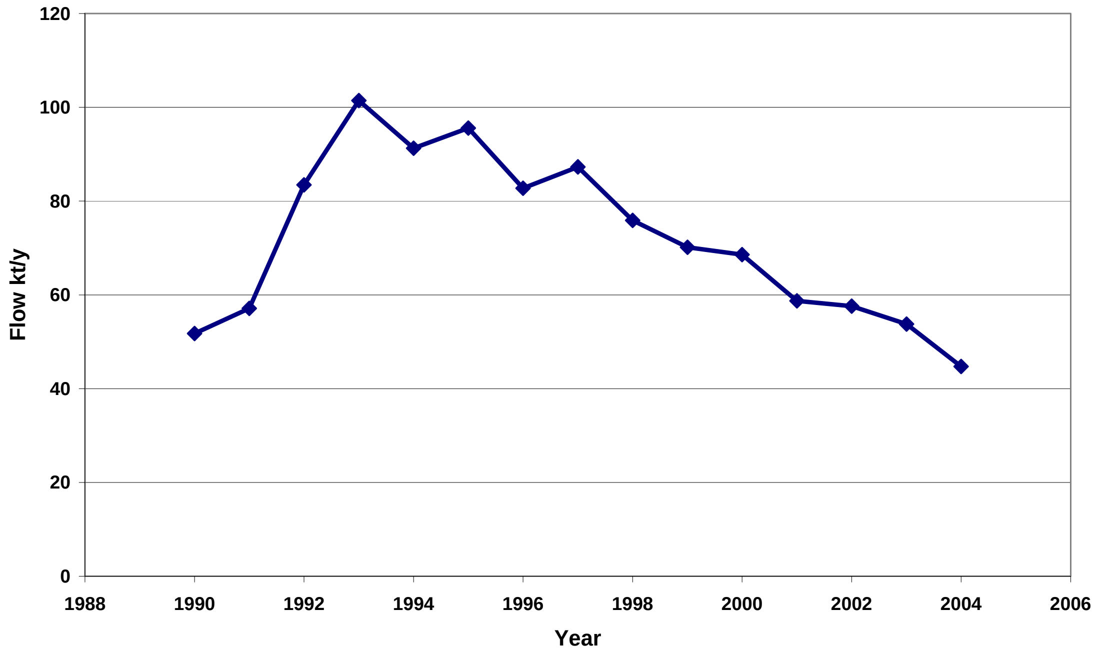


Figure 11.1 Plot of Estimated Methane Emissions from Abandoned Mines 1990 to 2004

The trend in emissions follows that of the methane reserve in showing show an initial estimated emission of 52kt/year in 1990 rising to 101kt/year in 1993 due to the closure of collieries during the early 1990's. Subsequently the estimated emission reduces gradually to 45kt/year in 2004. In recent years, commercial enterprises actively pumped methane from some abandoned mine areas. No flows have been included for those areas during the years in which extraction was taking place.

No allowance has been made for the potentially higher emissions from collieries just after closure because of the lack of measured data. The uncertainty in extrapolating existing data back to 1990 is considered too high. It is recommended that data should be obtained from newly closed collieries to provide direct measurements to improve future estimates of methane emission.

The measurements of flow covered a full range of types of abandoned mines from deep to shallow and from filling with water to fully recovered. However, significant methane flows were measured at eight of the twelve zones investigated. Similarly, ten out of the fourteen sampled using long term samplers showed methane enhancements of over 100ppb. In contrast, surveys of vents in 1999 for the Coal Authority found 32 vents where a flow greater than 1 l/s was found and methane was present. A similar survey in 2003 found 24 vents where a flow greater than 1 l/s was found and methane was present. A total of 91 vents were sampled in 1999 and 51 in 2003, indicating that only 35% and 47% of vents respectively contained measurable flows of methane. The vents chosen for sampling were identified as those where flows might be expected, so the normal percentage of all vents which release any significant methane are even lower. As a result, the sampling of vents has been skewed towards the gassier vents compared with the actual population. This skew is unavoidable without sampling very many sites with no measurable methane flows. Accordingly the correlation between methane flow and methane reserve will tend to produce a larger gradient than would be the case if the sampling reflected fully the distribution of methane flows throughout all the vents.

12. CONCLUSIONS

1. A method for estimating methane emissions from abandoned coal mines in the UK has been developed.

2. Sixteen vents into abandoned mines have been monitored for flow; the vents were connected into 12 modelled mining areas which showed a range of flows from 0 l/s to 153 l/s.

3. Methane enhancement above natural background levels from zero to 98% were determined from the 14 sites monitored over a year above abandoned mine areas

4. Calculated flux for the low level concentration enhancements ranged from zero to 69 tonnes methane per square kilometre year (t CH_4 km^{-2} yr^{-1}) with an average of 10.5 t CH_4 km^{-2} yr^{-1}. The average flux multiplied by the area of shallow workings in the coalfields gives a UK total of 37 kt CH_4 yr^{-1}.

5. The 1990 estimate of reserves is 10.0 billion m^3 methane. Due to the pattern of colliery closure during the early 1990's the estimate of reserves associated with closed mines rises to 19.5 billion m^3 methane in 1993, but then falls, due to mine flooding, to 8.6 billion m^3 methane in 2004.

6. The flow of methane from mine vents showed poor correlation with the rate of water rise in the underlying mine workings, indicating that displacement of gas by water was not the dominant parameter in control of methane emissions.

7. A plot of methane flow from vents against underlying methane reserve suggested a general relationship between the two, with a gradient of 2.128×10^{-7} l/s per m^3.

8. The fluxes from the low level gas monitoring sites were converted into methane flows by multiplying by the area of the underlying mine workings. When the methane flow data was plotted against the underlying methane reserve the relationship was found to be in general agreement with the vent methane flows.

9. Using combined flow data from vents and low level monitoring data against methane reserve indicated a relationship between the two, with a gradient of 2.358×10^{-7} l/s per m^3. This gradient is equivalent to an emission of 0.74% of the methane reserve per annum.

10. The estimated methane emissions in 1990 were 52kt/year; these peaked at 101kt/year in 1993 and have subsequently dropped to 45kt/year in 2004. This peak is due to the closure of collieries during the early 1990's.

13. RECOMMENDATIONS

The calculation of methane emissions from abandoned mines will require updating annually to take into account the changing conditions within the coalfields and the effect of closure of operating collieries.

14. ACKNOWLEDGEMENTS

We wish to thank the site operators for their invaluable help in collecting and posting the sample boxes used in the low level methane monitoring. We also wish to thank David Fowler and his team from CEH Edinburgh for their contribution in the assessment of diffuse emission of methane to surface including the other contributing authors: Ute Skiba, Eiko Nemitz, Daniela Famulari, Mark Theobald, Ivan Simmons, Robert Storeton-West, Chiara di Marco, Tom Murray, Jennifer Muller and Ken Hargreaves. We also thank Jim Penman and Steve Cornelius for their patience and their helpful comments.

APPENDIX A

REPORTS USED AS SOURCE DATA FOR STUDY

Title	Client	Date
Assessment of Gas Reserves Accessible from Annesley Colliery	Midlands Mining Limited	1999
Annesley Bentinck Colliery Water Management Report	Midlands Mining Limited	1998
Assessment of Gas Reserves Accessible from Steetley Venting Site	Independent Energy Limited	1998
Report on Mine Water Recovery Modelling and Potential Coal Mine Methane Reserves in South Derbyshire	Alkane Energy UK Limited	2002
Report on South Derbyshire Coalfield including PEDL 61	Alkane Energy UK Limited	2001
South Derbyshire Minewater Study and Gas Risk Assessment	Coal Authority/Environment Agency	2001
Report on Potential Void Space Resulting from Longwall Coal Extraction	Alkane Energy Limited	2002
A Reconnaissance Study into the Potential for Gob Gas and Coal Bed Methane from Mining Induced Zones in Licence Area EXL 276	Evergreen Resources (UK) Ltd (submitted by IMC Geophysics)	1999
Assessment of Potential Recoverable Gas Reserves from Abandoned Mineworkings at Cronton	Evergreen Resources (UK) Ltd (submitted by IMC Geophysics)	2001
Assessment of Potential Recoverable Gas Reserves from Abandoned Mineworkings at Sutton manor	Evergreen Resources (UK) Ltd (submitted by IMC Geophysics)	2002
A Reconnaissance Study into the Potential for Gob Gas and Coal Bed Methane from Mining Induced Zones in Licence Area EXL 208	Evergreen Resources (UK) Ltd (submitted by IMC Geophysics)	1999
A Reconnaissance Study into the Potential for Gob Gas in EXL 212	Evergreen Resources (UK) Ltd (submitted by IMC Geophysics)	2003
An Assessment of the Potential for Coal Bed Methane in Licence Areas PEDL 056 and PEDL 040	Midlands Mining Holdings Ltd (UK) Ltd (submitted by IMC Geophysics)	2000
Report on a Water level Survey in Askern Shafts	Independent Energy (UK) Ltd (submitted by IMC Geophysics)	2000
A Mine Gas Reconnaissance Study of the Cheshire Basin and North Staffordshire	Independent Energy (UK) Ltd (submitted by IMC Geophysics)	1999
A Reconnaissance Study into the Potential for Coal Bed Methane in the Vicinity of PEDL 78	Strata Gas plc (submitted by IMC Geophysics)	2001
Coal Bed Methane Potential of Abandoned Mineworkings at Granville in PEDL 78	Strata Gas plc (submitted by IMC Geophysics)	2001
A Reconnaissance Study into the Potential for Gob Gas and Coal Bed Methane from Mining Induced Zones in Licence Area EXL 204	Evergreen Resources (UK) Ltd (submitted by IMC Geophysics)	1999
An Appraisal of the Potential for Coal Mine Methane in PEDL 73	Evergreen Resources (UK) Ltd (submitted by IMC Geophysics)	2002
Potential for Gob Gas and Coal Bed Methane from Mining Induced Zones in Licence Areas EXL 203 and EXL 281	Evergreen Resources (UK) Ltd (submitted by IMC Geophysics)	1999
Assessment of Potential Recoverable Gas Reserves from Abandoned Mineworkings at Askern	Independent Energy (UK) Ltd (submitted by IMC Geophysics)	2000
A Reconnaissance Study into Gob Gas in EXL 288	Independent Energy (UK) Ltd (submitted by IMC Geophysics)	1998

Title	Client	Date
An Assessment of the Potential for Coal Mine Methane in PEDL 93	Strata Gas plc (submitted by IMC Geophysics)	2002
Cessation of Mine Water Pumping and the Implications for Water Resources at Parkside Colliery, Newton-le-Willows, Merseyside.	The National Rivers Authority	1994
Report on the Test Pumping for Minewater Control at Deerplay, Lancashire	Coal Authority	2000
North Staffordshire Coalfield Rising Minewater Study (Northern Section)	Coal Authority/Environment Agency	1999
North Staffordshire Coalfield Rising Minewater Study (Northern Section) Progress Report	Coal Authority/Environment Agency	1999
A report on the Potential Circumstances Relating to Mine Water Following the Planned Closure of Silverdale Colliery	Coal Authority	1998
Report into the Emission of Methane Gas at Victoria Road School, Workington	Coal Authority	1998
Coal Mine Methane and Coal Bed Methane Potential in PEDL 102, Cumbria	Alkane Energy UK Ltd	2003
Leicestershire Coalfield Groundwater Study, Interim Report on Monitoring Boreholes and Water Issues	Coal Authority/Environment Agency	2000
Report on Minewater Recovery in the Leicestershire Coalfield	Coal Authority	1999
Hem Heath Colliery Closure Water Report	Coal Authority	1997
Report on Mid Cannock Minewater Recovery Test	Coal Authority	1996
Report on Mid Cannock Minewater Recovery Test 2	Coal Authority	1996
Report on the Geology and Hydrogeology of Hem Heath Shafts and Surface Drift	Coal Authority	1996
Report on Mining Connections at Hickleton Colliery	Octagon Energy	1996
Preliminary Report. Yorkshire Minewater Monitoring Boreholes (a) Townend Farm, Greasborough, Rotherham; (b) Upper Haugh Cricket Club, Rotherham; (c) Lundwood, Barnsley	Coal Authority	2001
Yorkshire Minewater Recovery and Gas Emission Risk Assessment	Coal Authority	2000
Detailed Mine Water Study of Areas 4 and 5 of the Yorkshire Coalfield	Coal Authority	2002
Maltby/Rossington Minewater and Mine Gas Study – Final Report	RJB (Written by JMC mining Services Ltd)	2001
Rising Waters in the Scottish Coalfields, Preliminary Report	Coal Authority	2000
Report on the Mining, Minewater Recovery and CMM Reserves in the Cardowan Area	Alkane Energy UK Ltd	2002
East Fife Mine Water Risk assessment	Coal Authority	2004
East Fife Mine Water and GasRisk assessment	Coal Authority	2002
Report on Frances Pump Test	Coal Authority	2001
Report on the Mining and Geology in the vicinity of the Gas Emission at Barcardine Avenue, Chryston	Coal Authority	1996
Central Ayrshire Minewater Rebound Study	Coal Authority	2001
Blindwells Minewater Study Report	Coal Authority	2000
Recovery of Groundwaters in South East Northumberland	Report by British Coal Corporation	1994?
Options for the Control of Mine Water East of the River Wear	Coal Authority	2002
West of Wear Gas Risk Assessment	Coal Authority	2001

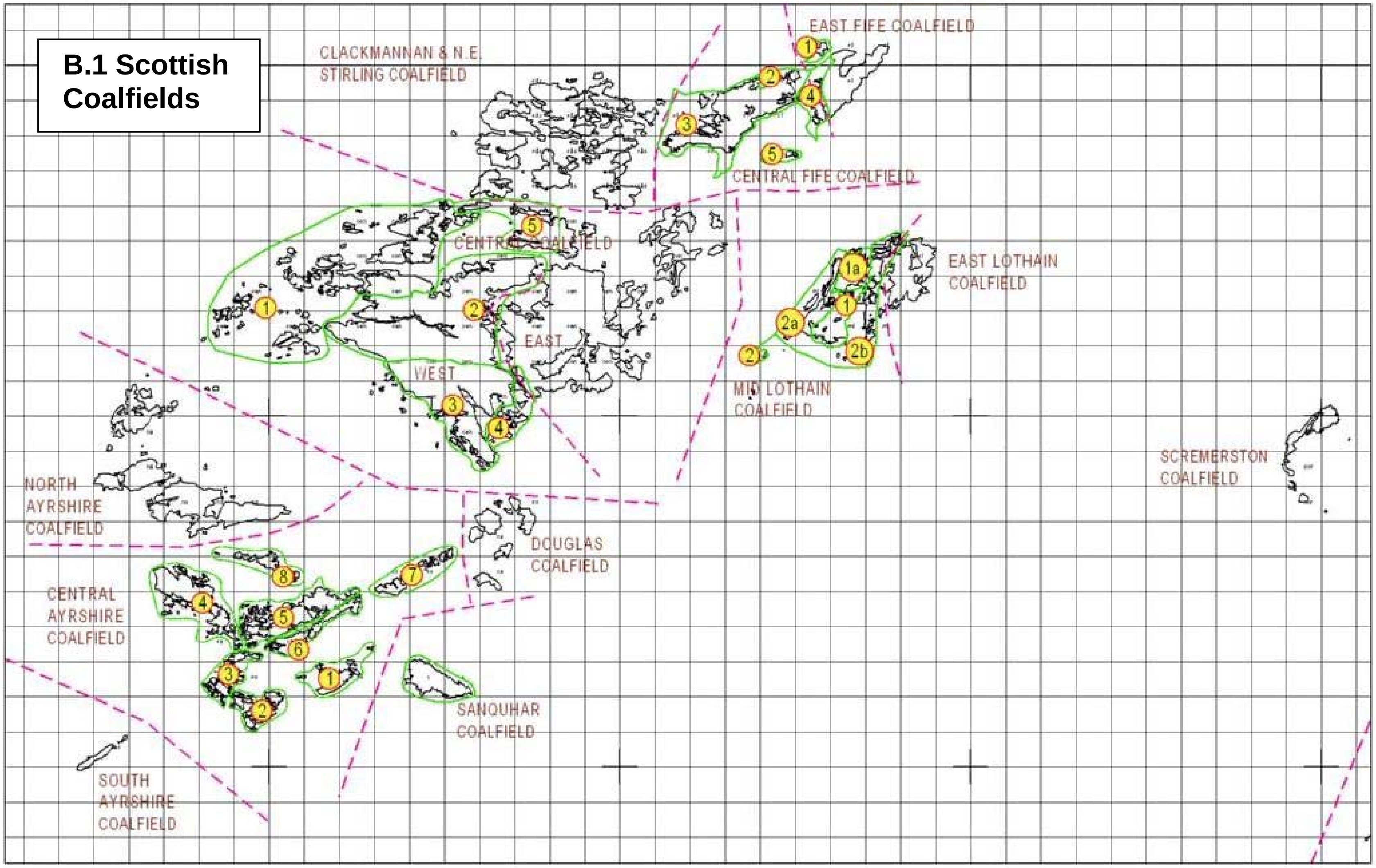
Title	Client	Date
The Mining, Mine Water Recovery and Coal Mine Methane Reserves in the Westoe Wearmouth Area	Alkane Energy UK Ltd	2002
Northumberland Rising Minewater Study	Coal Authority	1996
Report on the Risk of Surface mine Gas Emissions and Minewater Recovery North East England	Coal Authority	1999
Report on the Proposed Minewater Recovery in the Durham Coalfield, West of the River Wear	Coal Authority	1996

APPENDIX B

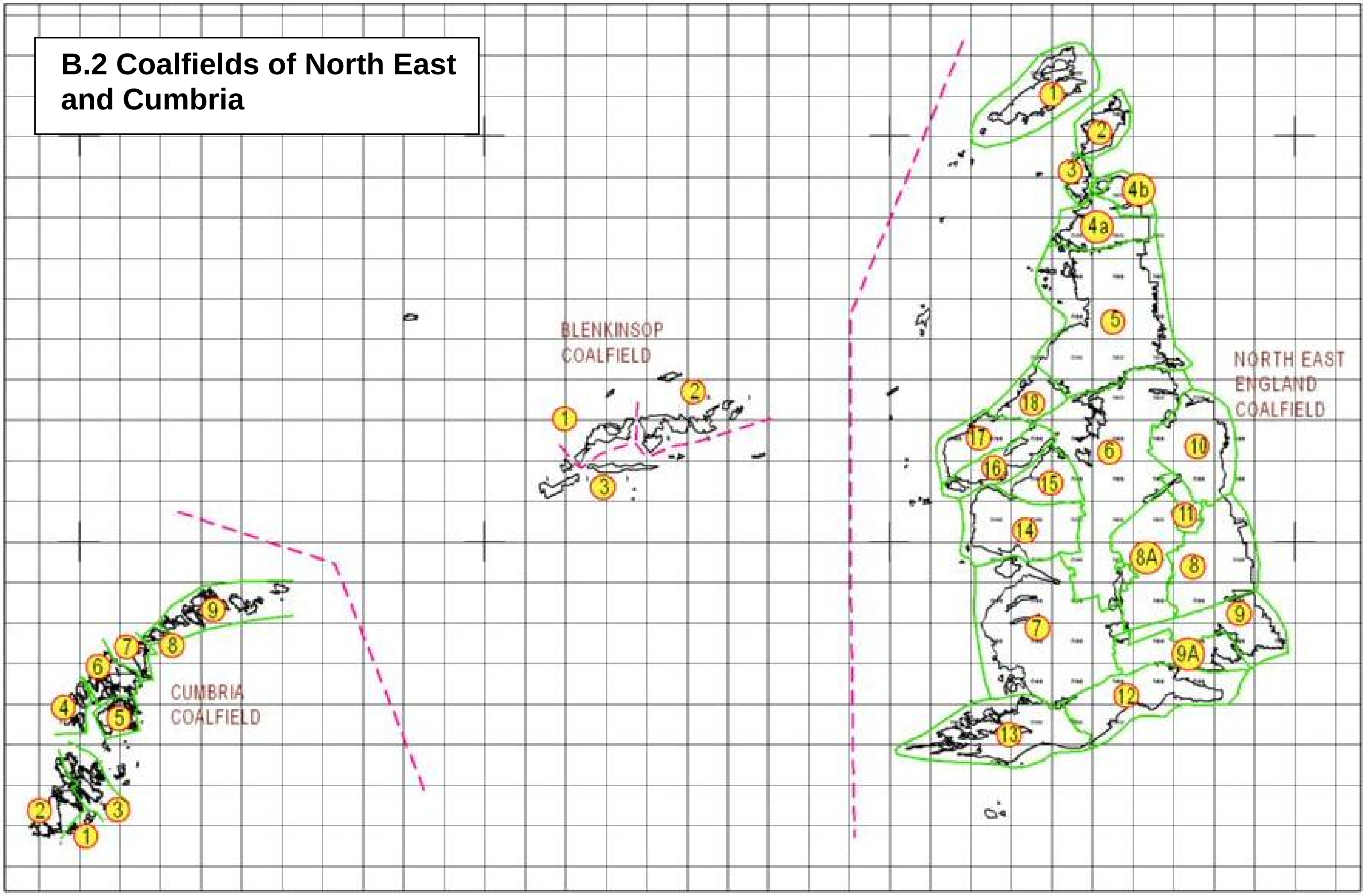
MAPS OF COALFIELD AREAS AND ZONES

B.1 Scottish Coalfields
B.2 Coalfields of North East and Cumbria
B.3 Coalfields of Northern England, North Midlands and North Wales
B.4 Coalfields of the South Midlands
B.5 Coalfields of South Wales and South West
B.6 Kent Coalfield

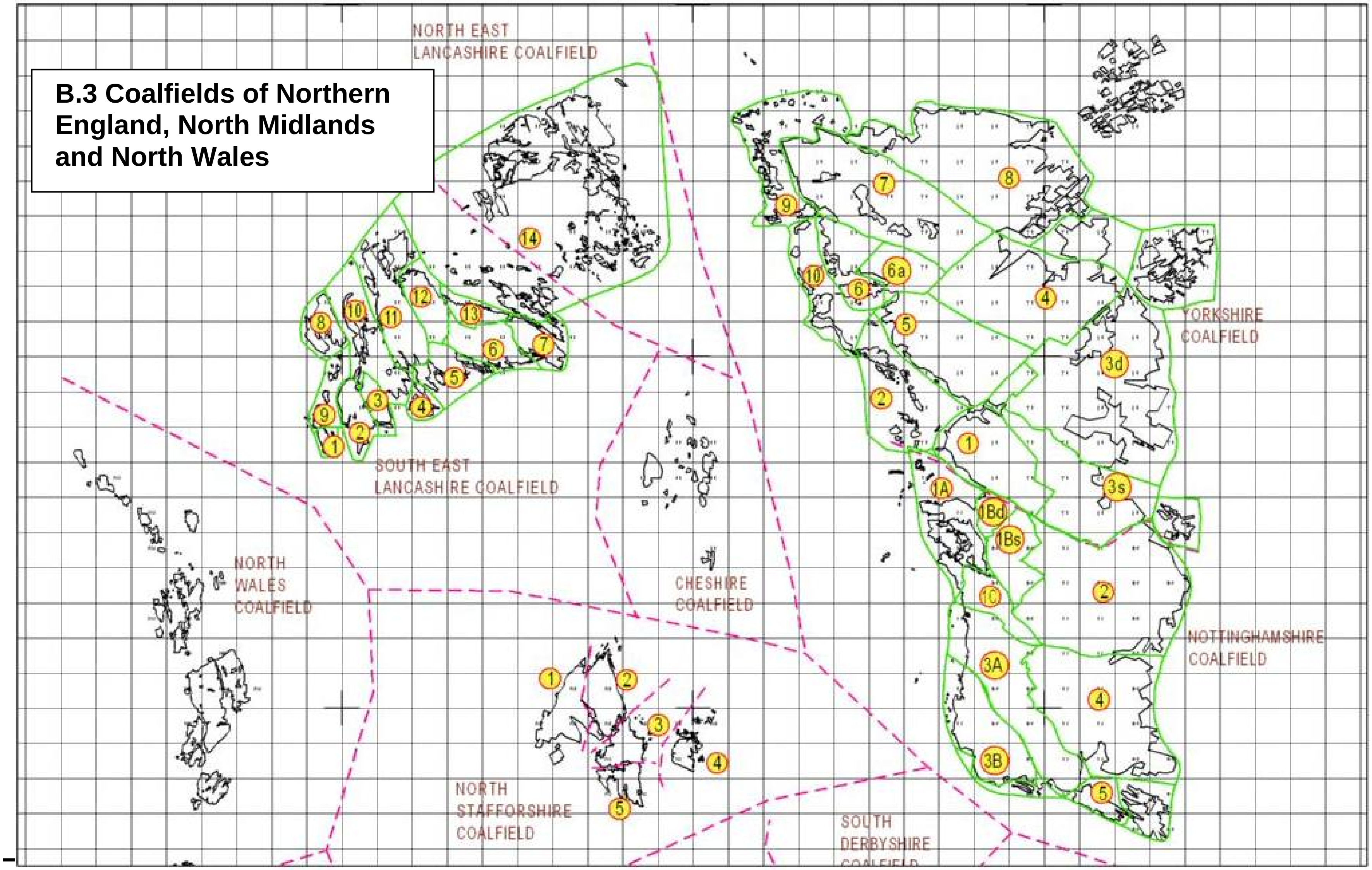
All coalfields shown with 5km grid squares

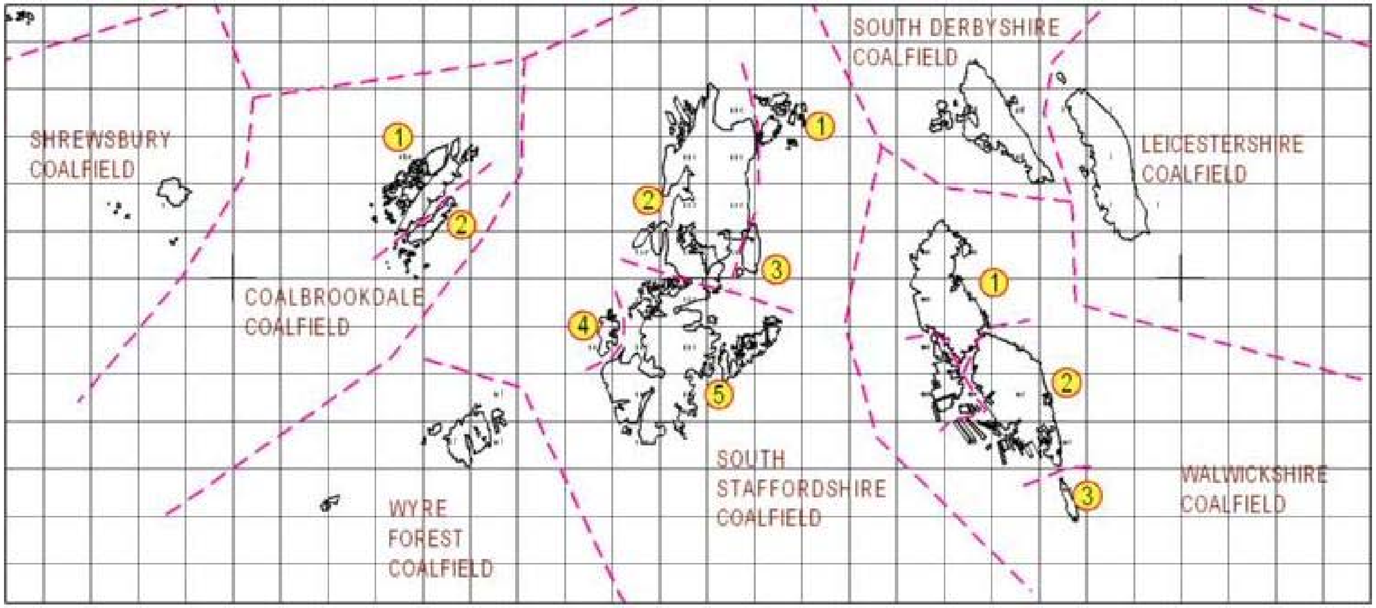

B.1 Scottish Coalfields
CLACKMANNAN & N.E. STIRLING COALFIELD
EAST FIFE COALFIELD
CENTRAL FIFE COALFIELD
CENTRAL COALFIELD
EAST
WEST
EAST LOTHAIN COALFIELD
MID LOTHAIN COALFIELD
SCREMERSTON COALFIELD
NORTH AYRSHIRE COALFIELD
DOUGLAS COALFIELD
CENTRAL AYRSHIRE COALFIELD
SANQUHAR COALFIELD
SOUTH AYRSHIRE COALFIELD

B.2 Coalfields of North East and Cumbria



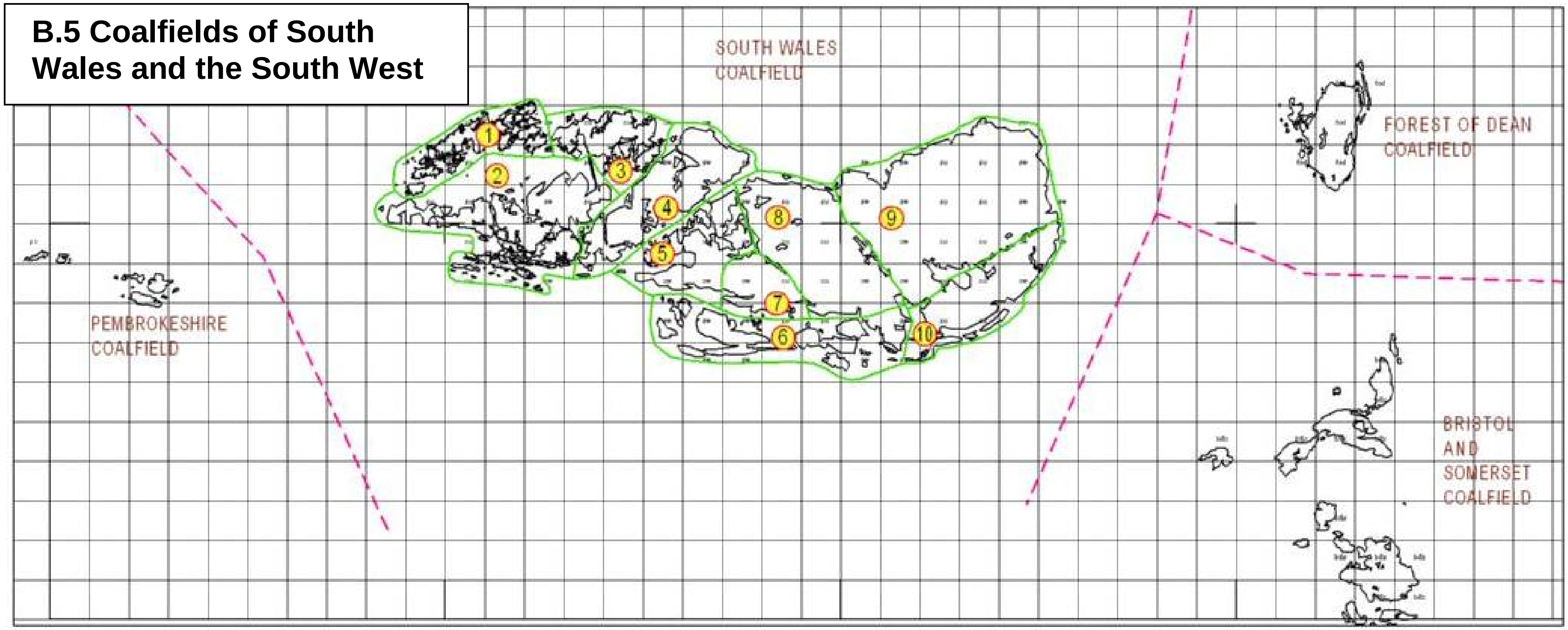
B.3 Coalfields of Northern England, North Midlands and North Wales



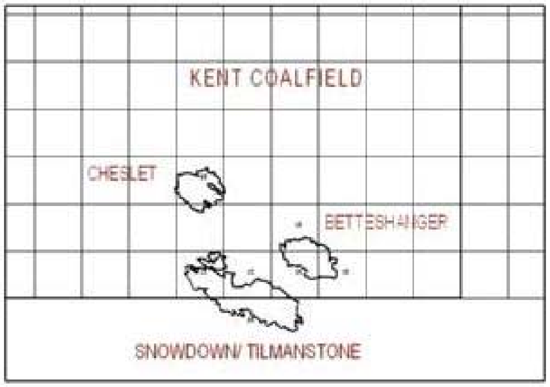


B.4 Coalfields of the South Midlands

B.5 Coalfields of South Wales and the South West



B.6 Kent Coalfield



APPENDIX C

LIST OF COAL AUTHORITY MONITORING SITES AND PUMPING SITES

Site No	Site Title	Site Sub No	Site Sub Title	Region	Eastings	Northings
2	GLAN ROAD	2.1	SHAFT	SOUTH WALES	299400	202800
2	GLAN ROAD	2.2	VENT	SOUTH WALES	299400	202800
3	ALEXANDRA	3.1	DRIFT	YORKSHIRE	424000	414800
3	ALEXANDRA	3.2	NO.19 SHAFT	YORKSHIRE	424000	414800
3	ALEXANDRA	3.3	NO.18 SHAFT	YORKSHIRE	424000	414800
4	ALLERTON BYWATER	4.1	NO.1 SILKSTONE SHAFT	YORKSHIRE	442200	427800
4	ALLERTON BYWATER	4.2	NO.2 FLOCKTON SHAFT	YORKSHIRE	442200	427800
4	ALLERTON BYWATER	4.4	DRIFT INCLINED B/H	YORKSHIRE	442200	427800
5	ARKWRIGHT	5.1	NO.1 ADIT LARGE B/H	NOTTINGHAMSHIRE	442800	370500
5	ARKWRIGHT	5.2	NO.1 ADIT SMALL B/H	NOTTINGHAMSHIRE	442800	370500
6	ASHINGTON	6.1	CARL NO.1 UC EAST SHAFT	NORTH EAST ENGLAND	426400	588400
6	ASHINGTON	6.2	CARL NO.2 DC WEST SHAFT	NORTH EAST ENGLAND	426400	588400
7	ASHTONS FIELD	7.1	NO.2 SHAFT	SOUTH EAST LANCASHIRE	372900	404400
8	ASKERN	8.1	NO.1 SHAFT	YORKSHIRE	455800	413800
8	ASKERN	8.2	NO.2 SHAFT	YORKSHIRE	455800	413800
9	BOILEY LANE	9.1	2ND WATERLOO B/H	NOTTINGHAMSHIRE	445200	379800
10	BARNSLEY MAIN	10.1	NO.4 SHAFT	YORKSHIRE	436600	406200
10	BARNSLEY MAIN	10.2	DRIFT B/H	YORKSHIRE	436600	406200
11	BATES	11.1	NO.2 SHAFT	NORTH EAST ENGLAND	430400	582300
11	BATES	11.2	NO.3 SHAFT	NORTH EAST ENGLAND	430400	582300
11	BATES	11.3	LAGOONS	NORTH EAST ENGLAND	430400	582300
11	BATES	11.4	REED BEDS	NORTH EAST ENGLAND	430400	582300
11	BATES	11.5	DISCHARGE	NORTH EAST ENGLAND	430400	582300
12	BEARMOUTH ADIT	12.1	VENT	CUMBRIA	297400	517200
13	CEFN COED	13.1	NO.1 UC SHAFT	SOUTH WALES	278400	203300
13	CEFN COED	13.2	NO.2 DC SHAFT	SOUTH WALES	278400	203300
14	BEDLINGTON 'A' / 'B'	14.1	A' SHAFT	NORTH EAST ENGLAND	427300	582900
14	BEDLINGTON 'A' / 'B'	14.2	B' SHAFT NORTH CAP	NORTH EAST ENGLAND	427300	582900
14	BEDLINGTON 'A' / 'B'	14.3	B' SHAFT SOUTH CAP	NORTH EAST ENGLAND	427300	582900
15	BRADGATE	15.1	DRIFT	YORKSHIRE	441000	393700
16	BRANDON 'A'	16.1	SHAFT	NORTH EAST ENGLAND	424500	539900
17	BOLDON	17.1	NO.1 SHAFT	NORTH EAST ENGLAND	434700	562000
17	BOLDON	17.2	NO.2 SHAFT	NORTH EAST ENGLAND	434700	562000
18	BULLCLIFFE WOOD	18.1	HAIGH MOOR INTAKE DRIFT	YORKSHIRE	429000	414700
19	CHATERSHEUGH	19.1	NO.1 SHAFT	NORTH EAST ENGLAND	430800	553400
19	CHATERSHEUGH	19.2	NO.2 SHAFT	NORTH EAST ENGLAND	430800	553400
19	CHATERSHEUGH	19.3	NO.3 SHAFT	NORTH EAST ENGLAND	430800	553400
20	CHATTERLEY WHITFIELD	20.1	HESKETH NO.1 VENT	NORTH STAFFORDSHIRE	388500	353400
20	CHATTERLEY WHITFIELD	20.2	HESKETH NO.2 VENT	NORTH STAFFORDSHIRE	388500	353400
21	CHESTER SOUTH MOOR	21.1	UC PUMPING SHAFT	NORTH EAST ENGLAND	426700	549200
21	CHESTER SOUTH MOOR	21.2	DISCHARGE	NORTH EAST ENGLAND	427200	549300
22	CHOPPINGTON 'A'	22.1	SHAFT	NORTH EAST ENGLAND	424900	584100

23	COLLINS GREEN	23.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	355600	394300
23	COLLINS GREEN	23.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	355600	394300
23	COLLINS GREEN	23.3	NO.3 SHAFT	SOUTH EAST LANCASHIRE	355600	394300
23	COLLINS GREEN	23.4	NO.4 SHAFT	SOUTH EAST LANCASHIRE	355600	394300
24	DAWDON	24.1	THERESA SHAFT	NORTH EAST ENGLAND	443500	547900
24	DAWDON	24.2	CASTLEREAGH SHAFT	NORTH EAST ENGLAND	443500	547900
24	DAWDON	24.3	BEACH ADIT	NORTH EAST ENGLAND	443500	547900
25	DALQUHARRAN	25.1	NO.1 INTAKE MINE	DOUGLAS	126600	601700
25	DALQUHARRAN	25.2	MAIN DISCHARGE	DOUGLAS	126600	601700
25	DALQUHARRAN	25.3	REED BEDS & DISCHARGE	DOUGLAS	126600	601700
26	DEEP DUFFRYN	26.1	NO.1 FLUE PIT	SOUTH WALES	304700	199400
27	DENBY GRANGE	27.1	NO.1 WINDING SHAFT	YORKSHIRE	426900	415400
27	DENBY GRANGE	27.2	NO.3 OLD HARDS SHAFT	YORKSHIRE	426900	415400
27	DENBY GRANGE	27.3	NO.2 UC SHAFT	YORKSHIRE	426900	415400
28	DODWORTH	28.1	WHINMOOR DRIFT B/H	YORKSHIRE	431400	405700
29	DUKE OF BRIDGEWATERS CANALS	29.1	EAST TUNNEL	SOUTH EAST LANCASHIRE	374700	400700
29	DUKE OF BRIDGEWATERS CANALS	29.2	WEST TUNNEL	SOUTH EAST LANCASHIRE	374700	400700
29	DUKE OF BRIDGEWATERS CANALS	29.3	RAW MINEWATER	SOUTH EAST LANCASHIRE	374700	400700
29	DUKE OF BRIDGEWATERS CANALS	29.4	TREATMENT SCHEME	SOUTH EAST LANCASHIRE	374700	400700
29	DUKE OF BRIDGEWATERS CANALS	29.5	CLEAN WATER	SOUTH EAST LANCASHIRE	374700	400700
29	DUKE OF BRIDGEWATERS CANALS	29.6	CONSENTED DISCHARGE	SOUTH EAST LANCASHIRE	374700	400700
30	NORTH JUNCTION NO.1	30.1	TOP HARD BOREHOLE	NOTTINGHAMSHIRE	442500	371500
30	ARKWRIGHT BOREHOLES	30.2	TOP HARD (SEALED)	NOTTINGHAMSHIRE	#VALUE!	#VALUE!
31	ELLESMERE	31.1	BOREHOLE	SOUTH EAST LANCASHIRE	373300	403200
31	ELLESMERE	31.2	AIR SHAFT	SOUTH EAST LANCASHIRE	373300	403200
32	ENGINE	32.1	SHAFT	CUMBRIA	297100	517300
33	ETON GARAGE	33.1	GREEN LANE SHAFT (NO.12 PIT)		377700	407100
34	GOLBORNE	34.1	BOREHOLE	SOUTH EAST LANCASHIRE	360400	398500
35	GREGORY SPRINGS	35.1	WATER LEVEL	YORKSHIRE	420600	418900
36	GRIMETHORPE	36.1	NO.1 SHAFT	YORKSHIRE	440800	408500
37	HICKLETON MAIN	37.1	NO.2 SHAFT	YORKSHIRE	446400	405300
38	HIGHAM	38.1	SHAFT	YORKSHIRE	430800	407100
39	HOPE	39.1	PUMPING SHAFT	YORKSHIRE	424600	416200
39	HOPE	39.2	TREATMENT SCHEME	YORKSHIRE	424500	416500
39	HOPE	39.3	DISCHARGE	YORKSHIRE	424500	416500
40	HORDEN	40.1	SOUTH SHAFT	NORTH EAST ENGLAND	444200	542000
40	HORDEN	40.2	NORTH SHAFT	NORTH EAST ENGLAND	444200	542000
40	HORDEN	40.3	TREATMENT PLANT	NORTH EAST ENGLAND	444200	542000
40	HORDEN	40.4	TREATED DISCHARGE	NORTH EAST ENGLAND	444200	542000
41	HOWGILL	41.1	ADIT	CUMBRIA	297300	516800
42	HAMSTERLEY JOHN	42.1	SHAFT	NORTH EAST ENGLAND	412800	556700
42	HAMSTERLEY JOHN	42.2	UPSTREAM DISCHARGE	NORTH EAST ENGLAND	412800	556700
42	HAMSTERLEY JOHN	42.3	DOWNSTREAM DISCHARGE	NORTH EAST ENGLAND	413100	556700
43	KIBBLESWORTH	43.1	GLAMIS PUMPING SHAFT	NORTH EAST ENGLAND	424300	556300
43	KIBBLESWORTH	43.2	DISCHARGE	NORTH EAST ENGLAND	425900	556800
44	KIMBLESWORTH	44.1	NO.3 PUMPING SHAFT	NORTH EAST ENGLAND	426100	546900
44	KIMBLESWORTH	44.2	NO.2 SHAFT	NORTH EAST ENGLAND	426100	546900
44	KIMBLESWORTH	44.3	DISCHARGE	NORTH EAST ENGLAND	426400	547200
45	LADYSMITH	45.1	SHAFT	NORTH EAST ENGLAND	419400	525500
46	LEPTON EDGE	46.1	SHAFT	YORKSHIRE	421300	415400

47	LEA HALL	47.1	NO.1 SHAFT	SOUTH STAFFORDSHIRE	405700	316900
47	LEA HALL	47.2	NO.2 SHAFT	SOUTH STAFFORDSHIRE	405700	316900
47	LEA HALL	47.3	REMOTE VENT (NO.1)	SOUTH STAFFORDSHIRE	405700	316900
48	HALL FARM DRIFT	48.1	BOREHOLES	NORTH EAST ENGLAND	432300	577100
49	LUMLEY 6TH	49.1	PUMPING SHAFT	NORTH EAST ENGLAND	431000	550600
49	LUMLEY 6TH	49.2	DISCHARGE	NORTH EAST ENGLAND	431000	550900
50	MID CANNOCK	50.1	PUMPING BOREHOLE	SOUTH STAFFORDSHIRE	398700	309600
50	MID CANNOCK	50.2	DISCHARGE	SOUTH STAFFORDSHIRE	398900	309700
51	MONK BRETTON	51.1	NO.1 SHAFT VENT	YORKSHIRE	437400	408300
51	MONK BRETTON	51.2	BARNSLEY BOREHOLE VENT	YORKSHIRE	437400	408300
51	MONK BRETTON	51.3	BARNSLEY BOREHOLE	YORKSHIRE	437400	408300
51	MONK BRETTON	51.4	MELTONFIELD BOREHOLE	YORKSHIRE	437400	408300
52	DEARNE VALLEY	52.1	MOOR LANE SHAFT	YORKSHIRE	443200	407500
53	MOSBOROUGH	53.1	A3 BOREHOLE	YORKSHIRE	443700	380700
53	MOSBOROUGH	53.2	A8 BOREHOLE	YORKSHIRE	443700	380700
53	MOSBOROUGH	53.3	A15 BOREHOLE	YORKSHIRE	443700	380700
54	NEWCRAIGHALL	54.1	NO.3 SHAFT	MID LOTHIAN	331600	671900
55	NEW DELAVAL	55.1	FORSTER SHAFT	NORTH EAST ENGLAND	429100	580200
56	NICHOLSONS	56.1	PUMPING SHAFT	NORTH EAST ENGLAND	432800	548300
56	NICHOLSONS	56.2	DISCHARGE	NORTH EAST ENGLAND	432600	548700
57	NORTH SEATON	57.1	DC SHAFT	NORTH EAST ENGLAND	429100	585900
58	OAKTHORPE BUNGALOW	58.1	MAIN COAL B/H	LEICESTERSHIRE	432500	313500
59	SOUTH BRANCEPETH	59.1	BROCKWELL DC PUMPING SHAFT	NORTH EAST ENGLAND	422900	535700
59	SOUTH BRANCEPETH	59.2	DISCHARGE	NORTH EAST ENGLAND	423100	535200
60	PARK	60.1	NO.1 SHAFT	SOUTH WALES	294400	195600
60	PARK	60.2	NO.2 SHAFT	SOUTH WALES	294400	195600
60	PARK	60.3	NO.1 SHAFT REMOTE VENT (SOUTH)	SOUTH WALES	294400	195600
60	PARK	60.4	NO.2 SHAFT REMOTE VENT (NORTH)	SOUTH WALES	294400	195600
61	PARK HILL	61.1	NO.3 SHAFT	YORKSHIRE	435200	421800
62	PARSONAGE	62.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	365100	400600
62	PARSONAGE	62.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	365100	400600
63	PEGSWOOD	63.1	DRIFT BOREHOLES	NORTH EAST ENGLAND	421800	587500
64	PENTREMAWR NO.4	64.1	INTAKE DRIFT	SOUTH WALES	249500	210600
64	PENTREMAWR NO.4	64.2	RETURN DRIFT	SOUTH WALES	249500	210600
65	RAWDON	65.1	MAIN SHAFT	SOUTH DERBYSHIRE	431400	316400
66	RIDLEY DRIFT	66.1	BOREHOLE	NORTH EAST ENGLAND	426400	577900
67	SANDHOLE	67.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	375300	402500
67	SANDHOLE	67.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	375300	402500
67	SANDHOLE	67.3	NO.3 SHAFT	SOUTH EAST LANCASHIRE	375300	402500
67	SANDHOLE	67.4	NO.4 SHAFT	SOUTH EAST LANCASHIRE	375300	402500
68	SEATON DELAVAL	68.1	EAST SHAFT	NORTH EAST ENGLAND	429900	576400
68	SEATON DELAVAL	68.2	WEST SHAFT	NORTH EAST ENGLAND	429900	576400
69	SHANKLEA	69.1	VILLAGE NO.1 DRIFT B/H'S	NORTH EAST ENGLAND	426600	577300
70	SHERBURN HILL	70.1	EAST PUMPING PIT	NORTH EAST ENGLAND	433500	542500
70	SHERBURN HILL	70.2	WEST PIT	NORTH EAST ENGLAND	433500	542500
70	SHERBURN HILL	70.3	DISCHARGE	NORTH EAST ENGLAND	433500	542800
71	SHIREBROOK	71.1	JUBILEE DRIFT	NOTTINGHAMSHIRE	452800	367300
72	SPRINGWOOD	72.1	SHAFT	YORKSHIRE	427100	412800
73	STEETLEY	73.1	SHAFT	NOTTINGHAMSHIRE	455200	378600
74	STRAFFORD	74.1	OLD PUMPING SHAFT	YORKSHIRE	432300	404300

74	STRAFFORD	74.2	SILKSTONE SHAFT	YORKSHIRE	432300	404300
74	STRAFFORD	74.3	FLOCKTON SHAFT	YORKSHIRE	432300	404300
74	STRAFFORD	74.4	PARKGATE SHAFT	YORKSHIRE	432300	404300
74	STRAFFORD	74.5	WHINMOOR SHAFT	YORKSHIRE	432300	404300
74	STRAFFORD	74.6	STAINBOROUGH DISCHARGE	YORKSHIRE	432300	404300
75	TREETON	75.1	DRIFT	YORKSHIRE	443600	387800
76	USHAW MOOR	76.1	NO.1 SHAFT	NORTH EAST ENGLAND	422000	542800
76	USHAW MOOR	76.2	DISCHARGE	NORTH EAST ENGLAND	422000	542400
77	VALLEYFIELD	77.1	NO.2 SHAFT	CLACKMANNAN & NE STIRLING	300900	686100
78	VINOVIUM	78.1	PUMPING SHAFT	NORTH EAST ENGLAND	421000	532400
78	VINOVIUM	78.2	DISCHARGE	NORTH EAST ENGLAND	420900	532500
79	WELLINGTON	79.1	NO.3 DUKE SHAFT	CUMBRIA	296700	518200
79	WELLINGTON	79.2	CANDLESTICK VENT	CUMBRIA	296700	518200
80	WESTERN	80.1	NO.2 SHAFT / NO.1 VENT	SOUTH WALES	293700	192600
80	WESTERN	80.2	NO.2 SHAFT / NO.2 VENT	SOUTH WALES	293700	192600
81	WHARNCLIFFE SILKSTONE	81.1	NO.4 SHAFT	YORKSHIRE	433800	399600
82	WHEATSHEAF	82.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	378700	402000
83	WOOLLEY	83.1	NO.2 PUMPING SHAFT	YORKSHIRE	431200	411300
83	WOOLLEY	83.2	CONCRETE/EARTH PONDS	YORKSHIRE	431200	411300
83	WOOLLEY	83.3	REED BEDS	YORKSHIRE	431200	411300
83	WOOLLEY	83.4	REEDBED DISCHARGE	YORKSHIRE	430600	411400
84	NORTH EAST	84.1	GRAVITY DISCHARGES	DISCHARGES	#VALUE!	#VALUE!
85	EASINGTON	85.1	SOUTH SHAFT	NORTH EAST ENGLAND	443600	544500
85	EASINGTON	85.2	BEACH ADIT	NORTH EAST ENGLAND	444500	544600
86	HAWTHORN	86.1	SHAFT	NORTH EAST ENGLAND	438700	545900
87	REDBROOK	87.1	OLD SHAFT	YORKSHIRE	432700	407900
88	ROTHWELL	88.1	DRIFT BOREHOLE	YORKSHIRE	434900	429700
89	ROUGHWOOD	89.1	DRIFT BOREHOLE	YORKSHIRE	440700	394700
90	SEAHAM	90.1	NO.3 SHAFT	NORTH EAST ENGLAND	440900	549600
91	SKIERS SPRING	91.1	NO.1 SHAFT	YORKSHIRE	436600	399300
91	SKIERS SPRING	91.2	TPI SHAFT	YORKSHIRE	436600	399300
92	TANKERSLEY	92.1	NO.1 SHAFT	YORKSHIRE	433600	398900
92	TANKERSLEY	92.2	NO.2 SHAFT	YORKSHIRE	433600	398900
93	VANE TEMPEST	93.1	VANE SHAFT	NORTH EAST ENGLAND	442400	550100
94	WEARMOUTH	94.1	B SHAFT	NORTH EAST ENGLAND	439300	558000
94	WEARMOUTH	94.2	C SHAFT REMOTE VENT	NORTH EAST ENGLAND	439300	558000
94	WEARMOUTH	94.3	D SHAFT REMOTE VENT	NORTH EAST ENGLAND	439300	558000
95	WESTOE	95.1	CROWN SHAFT	NORTH EAST ENGLAND	437400	566900
96	WALES	96.1	GRAVITY DISCHARGES	DISCHARGES	#VALUE!	#VALUE!
97	HAZLEGREAVE	97.1	DRIFT	YORKSHIRE	425000	417300
98	BIRKACRE	98.1	NO.1 SHAFT		357000	414900
98	BIRKACRE	98.2	NO.2 SHAFT		357000	414900
98	BIRKACRE	98.3	DRYBONES SHAFT		357500	414600
99	BOLSOVER	99.1	NO.3 SHAFT	NOTTINGHAMSHIRE	446200	371000
100	LLANOVER	100.1	SHAFT	SOUTH WALES	317900	200800
100	LLANOVER	100.2	WATER ADIT	SOUTH WALES	317800	200800
101	MAINDY	101.1	NORTH STACK	SOUTH WALES	296700	195200
101	MAINDY	101.2	SOUTH STACK	SOUTH WALES	296700	195200
101	MAINDY	101.3	NORTH SHAFT : NO.1 VENT	SOUTH WALES	296700	195200
101	MAINDY	101.4	NORTH SHAFT : NO.2 VENT	SOUTH WALES	296700	195200

101	MAINDY	101.5	SOUTH SHAFT : NO.3 VENT	SOUTH WALES	296700	195200
101	MAINDY	101.6	SOUTH SHAFT : NO.4 VENT	SOUTH WALES	296700	195200
102	MARKHAM	102.1	NO.3 SHAFT / NO.1 VENT	NOTTINGHAMSHIRE	445000	371900
102	MARKHAM	102.2	NO.3 SHAFT / NO.2 VENT	NOTTINGHAMSHIRE	445000	371900
102	MARKHAM	102.3	NO.3 SHAFT / NO.3 VENT	NOTTINGHAMSHIRE	445000	371900
102	MARKHAM	102.4	NO.3 SHAFT / NO.4 VENT	NOTTINGHAMSHIRE	445000	371900
102	MARKHAM	102.5	NO.2 SHAFT	NOTTINGHAMSHIRE	445000	371900
103	PARKSIDE	103.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	359900	394700
103	PARKSIDE	103.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	359900	394700
104	WALSALL WOOD	104.1	SHAFT	SOUTH STAFFORDSHIRE	404600	304200
105	RENISHAW PARK	105.1	NO.1 SHAFT	NOTTINGHAMSHIRE	443800	377500
106	ECKINGTON HORNTHORPE	106.1	BOREHOLE	NOTTINGHAMSHIRE	442200	378700
107	ECKINGTON BARRATT	107.1	BOREHOLE	NOTTINGHAMSHIRE	442900	378800
107	ECKINGTON BARRATT	107.2	VENT	NOTTINGHAMSHIRE	442900	378800
108	FLATTS FAN	108.1	DRIFT BOREHOLE	NOTTINGHAMSHIRE	443700	378800
109	FURNACE HILL	109.2	DEEP SOFT B/H	NOTTINGHAMSHIRE	443200	377400
110	CAMPBELL	110.1	SHAFT	NOTTINGHAMSHIRE	441100	375800
111	HOLLINGWOOD	111.1	SHAFT CAP VENT	NOTTINGHAMSHIRE	441500	374600
111	HOLLINGWOOD	111.2	UNDER CAP VENT	NOTTINGHAMSHIRE	441500	374600
112	LOSCOE GRANGE	112.1	NO.1 FLAP	NOTTINGHAMSHIRE	442500	347500
112	LOSCOE GRANGE	112.2	VENT	NOTTINGHAMSHIRE	442500	347500
112	LOSCOE GRANGE	112.3	NO.2 FLAP	NOTTINGHAMSHIRE	442500	347500
113	KIRKBY	113.1	TUPTON DRIFT BOREHOLE	NOTTINGHAMSHIRE	450400	357300
113	KIRKBY	113.2	HIGH MAIN DRIFT	NOTTINGHAMSHIRE	450400	357300
114	NORTHWOOD	114.1	DRIFT BOREHOLE	NORTH EAST ENGLAND	423700	594200
114	NORTHWOOD	114.2	DRIFT ENTRANCE	NORTH EAST ENGLAND	423700	594200
115	RAMSEY HOUSE (FERNEY BEDS)	115.1	FIELD BOREHOLE	NORTH EAST ENGLAND	425600	593800
115	RAMSEY HOUSE (FERNEY BEDS)	115.2	HOUSE VENT	NORTH EAST ENGLAND	425600	593800
115	RAMSEY HOUSE (FERNEY BEDS)	115.3	SHAFT VENT	NORTH EAST ENGLAND	425600	593800
116	MAESYFFYNON (BLAENGWAWR)	116.1	BOREHOLE	SOUTH WALES	300600	202000
117	YORKS / MIDLANDS	117.1	GRAVITY DISCHARGES	DISCHARGES	#VALUE!	#VALUE!
118	NOSTELL	118.1	DRIFT BOREHOLE	YORKSHIRE	440100	416900
119	HIGHMOOR	119.1	CLOWNE BOREHOLE	NOTTINGHAMSHIRE	447100	379800
120	DERRY GROVE	120.1	BOREHOLE	YORKSHIRE	445300	405200
120	DERRY GROVE	120.2	DISCHARGE	YORKSHIRE	445300	405200
121	GOLDTHORPE	121.1	BELLA DRIFT	YORKSHIRE	447100	404400
122	KIVETON PARK	122.1	NO.2 SHAFT / NO.1 VENT	YORKSHIRE	449200	382700
122	KIVETON PARK	122.2	NO.2 SHAFT / NO.2 VENT	YORKSHIRE	449200	382700
123	HODROYD	123.1	NO.1 SHAFT	YORKSHIRE	440800	410700
123	HODROYD	123.2	NO.2 SHAFT	YORKSHIRE	440800	410700
124	NEWTOWN	124.1	NO.2 SHAFT	SOUTH EAST LANCASHIRE	378100	402800
125	WINGATE GRANGE	125.1	NO.1 LADY SHAFT	NORTH EAST ENGLAND	439800	537400
125	WINGATE GRANGE	125.2	NO.2 LORD SHAFT	NORTH EAST ENGLAND	439800	537400
126	NORTH WEST	126.1	GRAVITY DISCHARGES	DISCHARGES	#VALUE!	#VALUE!
127	ALBERT DITCH	127.1	POST 1	SOUTH EAST LANCASHIRE	363200	401200
127	ALBERT DITCH	127.2	POST 2	SOUTH EAST LANCASHIRE	363200	401200
127	ALBERT DITCH	127.3	POST 3	SOUTH EAST LANCASHIRE	363200	401200
127	ALBERT DITCH	127.4	POST 4	SOUTH EAST LANCASHIRE	363200	401200
128	DOWHAIL	128.1	ADIT MANHOLE		127400	602200
128	DOWHAIL	128.2	LEVEL MANHOLES		127400	602200

128	DOWHAIL	128.3	DISCHARGE		127400	602200
129	TREDEGAR YARD LEVEL	129.1	ADIT	SOUTH WALES	314200	209200
129	TREDEGAR YARD LEVEL	129.2	DISCHARGE	SOUTH WALES	314200	209200
130	HUDSONS ROUGH	130.1	NO.1 VENT	YORKSHIRE	440500	394500
130	HUDSONS ROUGH	130.2	NO.2 VENT	YORKSHIRE	440500	394500
131	SPEEDWELL	131.1	SHAFT	WARWICKSHIRE	426600	298600
132	PEGSWOOD CTW	132.1	DRIFT B/H	NORTH EAST ENGLAND	422200	587400
132	PEGSWOOD CTW	132.2	MAIN VENT	NORTH EAST ENGLAND	422200	587400
132	PEGSWOOD CTW	132.3	MAIN VENT BEND	NORTH EAST ENGLAND	422200	587400
132	PEGSWOOD CTW	132.4	1 CTW STOP COCK	NORTH EAST ENGLAND	422200	587400
132	PEGSWOOD CTW	132.5	2 CTW STOP COCK	NORTH EAST ENGLAND	422200	587400
132	PEGSWOOD CTW	132.6	LAWN	NORTH EAST ENGLAND	422200	587400
133	ORMONDE	133.1	NO.2 ADIT	NOTTINGHAMSHIRE	443400	348200
134	BERTHLWYD DRIFT	134.1	ADIT MANHOLE	SOUTH WALES	256100	196000
134	BERTHLWYD DRIFT	134.2	DISCHARGE	SOUTH WALES	256100	196000
135	POLKEMMET	135.1	NO.1 SHAFT + TREATMENT	EAST CENTRAL SCOTLAND	293300	664000
135	POLKEMMET	135.2	LAGOONS + REED BED	EAST CENTRAL SCOTLAND	293300	664000
135	POLKEMMET	135.3	DISCHARGE	EAST CENTRAL SCOTLAND	293300	664000
136	CHURCH STREET,BOLTON ON DEARNE	136.1	WATER SERVICES	YORKSHIRE	445600	402400
137	CAE COPYN LEVEL (BROADOAK)	137.1	DRIFT B/H	SOUTH WALES	257300	198300
138	ABERNANT (SIRHOWY)	138.1	SOUTH SHAFT	SOUTH WALES	317500	201400
139	BRITANNIA	139.1	NORTH SHAFT	SOUTH WALES	315700	198000
139	BRITANNIA	139.2	SOUTH SHAFT	SOUTH WALES	315700	198000
140	SCOTLAND	140.1	GRAVITY DISCHARGES	DISCHARGES	#VALUE!	#VALUE!
141	RINGLEY	141.1	BUILDINGS PIT	SOUTH EAST LANCASHIRE	376900	405200
142	RIDDOCHHILL	142.1	NO.1 SHAFT	EAST CENTRAL SCOTLAND	297700	666400
143	WHELDALE	143.1	NO.1 DC WEST SHAFT	YORKSHIRE	444200	426200
143	WHELDALE	143.2	NO.2 UC EAST SHAFT	YORKSHIRE	444200	426200
144	COALBURN (AUCHLOCHAN NO.8)	144.1	NO.8 SHAFT / NO.1 VENT	DOUGLAS	280900	634900
144	COALBURN (AUCHLOCHAN NO.8)	144.2	NO.8 SHAFT / NO.2 VENT	DOUGLAS	280900	634900
145	DRUMMAU ROAD DRIFT	145.1	ADIT MANHOLE	SOUTH WALES	272900	197500
145	DRUMMAU ROAD DRIFT	145.2	DISCHARGE	SOUTH WALES	272900	197500
146	FRYSTON	146.1	NO.1 SHAFT	YORKSHIRE	445600	427100
146	FRYSTON	146.2	NO.2 SHAFT	YORKSHIRE	445600	427100
147	WOOD PIT	147.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	357200	396500
147	WOOD PIT	147.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	357200	396500
147	WOOD PIT	147.3	NO.3 SHAFT	SOUTH EAST LANCASHIRE	357200	396500
148	BOLD	148.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	354800	393500
148	BOLD	148.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	354800	393500
148	BOLD	148.3	NO.3 SHAFT	SOUTH EAST LANCASHIRE	354800	393500
149	SUTTON MANOR	149.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	352100	390700
149	SUTTON MANOR	149.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	352100	390700
149	SUTTON MANOR	149.3	NO.3 SHAFT	SOUTH EAST LANCASHIRE	352100	390700
150	CRONTON	150.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	347400	389200
150	CRONTON	150.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	347400	389200
150	CRONTON	150.3	NO.3 SHAFT	SOUTH EAST LANCASHIRE	347400	389200
151	PENDLETON OLD NO.6	151.1	SHAFT	SOUTH EAST LANCASHIRE	380500	400700
152	ASTLEY GREEN	152.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	370500	400000
152	ASTLEY GREEN	152.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	370500	400000
153	WET EARTH	153.1	DC SHAFT	SOUTH EAST LANCASHIRE	377500	404200

153	WET EARTH	153.2	UC SHAFT	SOUTH EAST LANCASHIRE	377500	404200
154	HAPTON VALLEY	154.1	SURFACE DRIFT	NORTH EAST LANCASHIRE	381100	431300
154	HAPTON VALLEY	154.2	DISCHARGE	NORTH EAST LANCASHIRE	381100	431300
155	BRERETON	155.1	NO.2 SHAFT	SOUTH STAFFORDSHIRE	404500	315100
156	BLAENANT OLD LEVEL	156.1	ADIT	SOUTH WALES	279600	204900
156	BLAENANT OLD LEVEL	156.2	DISCHARGE	SOUTH WALES	279600	204900
157	DARE	157.1	NO.4 SHAFT	SOUTH WALES	295100	196000
158	RHOS	158.1	AIR SHAFT	SOUTH WALES	313300	198700
159	CYNHEIDRE	159.1	NO.3 SHAFT	SOUTH WALES	252900	210500
159	CYNHEIDRE	159.2	NO.4 SHAFT	SOUTH WALES	252900	210500
160	FLORENCE	160.1	NO.1 SHAFT	NORTH STAFFORDSHIRE	391600	341700
160	FLORENCE	160.2	NO.2 SHAFT	NORTH STAFFORDSHIRE	391600	341700
160	FLORENCE	160.3	NO.3 SHAFT	NORTH STAFFORDSHIRE	391600	341700
160	FLORENCE	160.4	BOREHOLE	NORTH STAFFORDSHIRE	391600	341700
161	BICKERSHAW	161.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	363500	399800
161	BICKERSHAW	161.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	363500	399800
161	BICKERSHAW	161.3	NO.3 SHAFT	SOUTH EAST LANCASHIRE	363500	399800
161	BICKERSHAW	161.4	NO.4 SHAFT	SOUTH EAST LANCASHIRE	363500	399800
161	BICKERSHAW	161.5	NO.5 SHAFT	SOUTH EAST LANCASHIRE	363500	399800
162	SILVERHILL	162.1	NO.1 SHAFT	NOTTINGHAMSHIRE	447300	361700
162	SILVERHILL	162.2	NO.2 SHAFT	NOTTINGHAMSHIRE	447300	361700
162	SILVERHILL	162.3	COOPERS SHAFT	NOTTINGHAMSHIRE	447300	361700
163	FRANCES	163.1	SHAFT	EAST FIFE	331200	693800
163	FRANCES	163.2	TREATMENT STATION	EAST FIFE	331200	693800
163	FRANCES	163.3	LAGOONS	EAST FIFE	331200	693800
163	FRANCES	163.4	RECIRC PUMPS	EAST FIFE	331200	693800
163	FRANCES	163.5	REED BED	EAST FIFE	331200	693800
163	FRANCES	163.6	TREATED DISCHARGE	EAST FIFE	331200	693800
164	MICHAEL	164.1	NO.2 SHAFT	EAST FIFE	333700	696000
164	MICHAEL	164.2	NO.3 SHAFT	EAST FIFE	333700	696000
165	AGECROFT	165.1	NO.3 SHAFT	SOUTH EAST LANCASHIRE	379800	401400
165	AGECROFT	165.2	NO.4 SHAFT	SOUTH EAST LANCASHIRE	379800	401400
165	AGECROFT	165.3	NO.5 SHAFT	SOUTH EAST LANCASHIRE	379800	401400
166	NEWBIGGIN	166.1	NO.1 SHAFT	NORTH EAST ENGLAND	431500	588500
166	NEWBIGGIN	166.2	NO.2 SHAFT	NORTH EAST ENGLAND	431500	588500
167	WOODHORN	167.1	NO.1 SHAFT	NORTH EAST ENGLAND	429100	588500
167	WOODHORN	167.2	NO.2 SHAFT	NORTH EAST ENGLAND	429100	588500
168	HILL TOP	168.1	LOWER MOUNTAIN B/H	NORTH EAST LANCASHIRE	387900	425400
169	HASTINGS	169.1	YARD SEAM B/H	NORTH EAST ENGLAND	432400	577100
170	CAMERON	170.1	DYSART MAIN B/H	EAST FIFE	334400	699000
171	LOCHHEAD	171.1	DYSART MAIN B/H	EAST FIFE	332200	696500
172	GWAUN-CLAWDD	172.1	ADIT DISCHARGE	SOUTH WALES	280600	212200
173	LUMPHINNANS NO.1	173.1	SHAFT		317300	693000
174	SILLYHOLE	174.1	NO.6 SHAFT		247800	606400
175	CALDER	175.1	SHAFT	NORTH EAST LANCASHIRE	377400	433200
175	CALDER	175.2	DISCHARGE	NORTH EAST LANCASHIRE	377300	433200
176	PRIESTNERS	176.1	CROMBOURKE B/H	SOUTH EAST LANCASHIRE	364600	401700
177	ALBERT	177.1	PARK YARD B/H	SOUTH EAST LANCASHIRE	364100	401500
177	ALBERT	177.2	SANDSTONE B/H	SOUTH EAST LANCASHIRE	364100	401500
178	BICKERSHAW	178.1	INCE YARD / BINN B/H	SOUTH EAST LANCASHIRE	363400	400500

179	WESTLEIGH	179.1	CROMBOURKE B/H	SOUTH EAST LANCASHIRE	363400	401300
180	WARREN	180.1	FURNACE SHAFT	YORKSHIRE	435600	397800
181	HARRINGTON NO.10	181.1	SHAFT	CUMBRIA	298900	521600
182	HEM HEATH	182.1	NO.1 SHAFT / SOUTH VENT	NORTH STAFFORDSHIRE	388600	341500
182	HEM HEATH	182.2	NO.1 SHAFT / NORTH VENT	NORTH STAFFORDSHIRE	388600	341500
182	HEM HEATH	182.3	NO.2 SHAFT	NORTH STAFFORDSHIRE	388600	341500
182	HEM HEATH	182.4	SURFACE DRIFT	NORTH STAFFORDSHIRE	388600	341500
183	WOOLLEY MOOR	183.1	NO.1 UC SHAFT	YORKSHIRE	430500	414500
183	WOOLLEY MOOR	183.2	NO.2 DC SHAFT	YORKSHIRE	430500	414500
184	MOSBOROUGH HALL ESTATE	184.1	B3 BOREHOLE	YORKSHIRE	443500	380500
184	MOSBOROUGH HALL ESTATE	184.2	B4 BOREHOLE	YORKSHIRE	443500	380500
184	MOSBOROUGH HALL ESTATE	184.3	B11 BOREHOLE	YORKSHIRE	443500	380500
184	MOSBOROUGH HALL ESTATE	184.4	B12 BOREHOLE	YORKSHIRE	443500	380500
185	HOLBROOK	185.1	NO.4 ADIT DISCHARGE	YORKSHIRE	444300	381300
185	HOLBROOK	185.2	NO.4 ADIT M/H	YORKSHIRE	444300	381300
186	MEADOW BARN	186.1	NO.1 SHAFT		373800	413100
186	MEADOW BARN	186.2	NO.2 SHAFT		373800	413100
187	VICTORIA	187.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	362200	402300
187	VICTORIA	187.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	362200	402300
188	BENNY LANE	188.1	ADIT DISCHARGE	YORKSHIRE	425000	411800
189	COXLEY	189.1	NO.1 ADIT DISCHARGE	YORKSHIRE	427100	416100
189	COXLEY	189.2	NO.2 ADIT DISCHARGE	YORKSHIRE	427300	416800
189	COXLEY	189.3	FIELD PIPE DISCHARGE	YORKSHIRE	427100	416100
190	GRANGE ASH	190.1	NO.1 BLOCKING B/H	YORKSHIRE	425100	415800
190	GRANGE ASH	190.2	NO.2 NEW HARDS B/H	YORKSHIRE	425100	415800
191	GARNET	191.1	NO.1 VENT		368600	406400
191	GARNET	191.2	NO.2 VENT		368600	406400
191	GARNET	191.3	NO.3 VENT		368600	406400
191	GARNET	191.4	NO.4 VENT		368600	406400
191	GARNET	191.5	LEACHATE PUMP		368600	406400
192	CLAY CROSS NO.9	192.1	NO.1 SHAFT	NOTTINGHAMSHIRE	439300	367800
192	CLAY CROSS NO.9	192.2	NO.2 SHAFT	NOTTINGHAMSHIRE	439300	367800
193	OLD AVENUE NO.11	193.1	NO.3 SHAFT	NOTTINGHAMSHIRE	439600	367700
193	OLD AVENUE NO.11	193.2	NO.4 SHAFT	NOTTINGHAMSHIRE	439600	367700
194	FLOCKTON LANE END	194.1	NO.1 SHAFT	YORKSHIRE	425400	415100
194	FLOCKTON LANE END	194.2	NO.2 SHAFT	YORKSHIRE	425400	415100
194	FLOCKTON LANE END	194.3	NO.3 SHAFT	YORKSHIRE	425400	415100
194	FLOCKTON LANE END	194.4	DISCHARGE	YORKSHIRE	425400	415100
195	KIMBERWORTH (GLOUCESTER)	195.1	33 GLOUCESTER (PARKGATE)	YORKSHIRE	440500	394300
195	KIMBERWORTH (GLOUCESTER)	195.2	35 GLOUCESTER (PARKGATE)	YORKSHIRE	440500	394300
195	KIMBERWORTH (GLOUCESTER)	195.3	38 GLOUCESTER	YORKSHIRE	440500	394300
195	KIMBERWORTH (GLOUCESTER)	195.4	4 BEAUCHAMP	YORKSHIRE	440500	394300
196	KIMBERWORTH (SIMMONITE)	196.1	44/46 SIMMONITE (PARKGATE)	YORKSHIRE	440700	394500
196	KIMBERWORTH (SIMMONITE)	196.2	93/95 SIMMONITE (THORNCLIFFE)	YORKSHIRE	440700	394500
196	KIMBERWORTH (SIMMONITE)	196.3	53 ROUGHWOOD (PARKGATE)	YORKSHIRE	440700	394500
196	KIMBERWORTH (SIMMONITE)	196.4	59 ROUGHWOOD (PARKGATE)	YORKSHIRE	440700	394500
196	KIMBERWORTH (SIMMONITE)	196.5	13 CHAMBERS (THORNCLIFFE)	YORKSHIRE	440700	394500
197	BARBOT HALL	197.1	THORNCLIFFE B/H	YORKSHIRE	442600	394800
198	THORPE HESLEY	198.1	NO.2 SHAFT	YORKSHIRE	438400	396400
199	EAST BARUGH	199.1	BARNSLEY B/H	YORKSHIRE	432800	408500

199	EAST BARUGH	199.2	OPENCAST B/H	YORKSHIRE	432800	408500
200	WOODHOUSES	200.1	NO.1 SHAFT	NORTH EAST ENGLAND	419100	528100
200	WOODHOUSES	200.2	NO.2 SHAFT	NORTH EAST ENGLAND	419100	528100
201	JAMES	201.1	SHAFT, WYLAM	NORTH EAST ENGLAND	412200	564800
201	JAMES	201.2	DISCHARGE	NORTH EAST ENGLAND	412200	564600
202	THRISLINGTON	202.1	JANE PUMPING SHAFT	NORTH EAST ENGLAND	430800	533800
203	MAINSFORTH	203.1	UC SHAFT	NORTH EAST ENGLAND	430700	531500
204	OAKTHORPE MEASHAM	204.1	MAIN COAL B/H	LEICESTERSHIRE	433500	312700
205	MARQUIS	205.1	MAIN SHAFT	SOUTH DERBYSHIRE	430900	316200
205	MARQUIS	205.2	BULL SHAFT	SOUTH DERBYSHIRE	430900	316200
206	HICKLETON MAIN SHAFTON	206.1	DRIFT	YORKSHIRE	446700	405300
207	DURKAR	207.1	NO.1 PUMPING SHAFT	YORKSHIRE	432300	417000
207	DURKAR	207.2	NO.2 SHAFT	YORKSHIRE	432300	417000
208	HAW PARK	208.1	SHAFT	YORKSHIRE	436400	414700
209	BRYN NAVIGATION	209.1	SLANT	SOUTH WALES	281900	192100
210	YNYSARWED ADIT	210.1	ADIT	SOUTH WALES	280700	201800
210	YNYSARWED ADIT	210.2	DISCHARGE	SOUTH WALES	280700	201800
211	BENTILEE	211.1	BOREHOLE	NORTH STAFFORDSHIRE	392000	345700
212	COVENTRY	212.1	NO.1 SHAFT (SOUTH)	WARWICKSHIRE	432200	284500
212	COVENTRY	212.2	NO.2 SHAFT (NORTH)	WARWICKSHIRE	432200	284500
213	DUCKMANTON	213.1	SHAFT	NOTTINGHAMSHIRE	442800	371700
214	OXCROFT NO.2	214.1	NO.1 SHAFT	NOTTINGHAMSHIRE	447300	373400
214	OXCROFT NO.2	214.2	NO.2 SHAFT	NOTTINGHAMSHIRE	447300	373400
215	HORBURY HIGH ST (CAMEO)	215.1	NO.1 BOREHOLE	YORKSHIRE	429600	418300
215	HORBURY HIGH ST (CAMEO)	215.2	WEST TRIAL PIT	YORKSHIRE	429600	418300
215	HORBURY HIGH ST (CAMEO)	215.3	NO.2 BOREHOLE	YORKSHIRE	429600	418300
215	HORBURY HIGH ST (CAMEO)	215.4	EAST TRIAL PIT	YORKSHIRE	429600	418300
215	HORBURY HIGH ST (CAMEO)	215.5	NO.3 BOREHOLE	YORKSHIRE	429600	418300
215	HORBURY HIGH ST (CAMEO)	215.6	NO.4 BOREHOLE	YORKSHIRE	429600	418300
215	HORBURY HIGH ST (CAMEO)	215.7	NO.5 BOREHOLE	YORKSHIRE	429600	418300
215	HORBURY HIGH ST (CAMEO)	215.8	NO.7 BOREHOLE	YORKSHIRE	429600	418300
215	HORBURY HIGH ST (CAMEO)	215.9	NO.10 BOREHOLE	YORKSHIRE	429600	418300
216	TAYLOR AND TUNNEL PITS CANAL	216.1	UPPER CANAL B/H	SOUTH EAST LANCASHIRE	355400	407800
216	TAYLOR AND TUNNEL PITS CANAL	216.2	NORTH LOWER CANAL B/H NO.3	SOUTH EAST LANCASHIRE	355400	407800
216	TAYLOR AND TUNNEL PITS CANAL	216.3	MIDDLE LOWER CANAL B/H NO.2	SOUTH EAST LANCASHIRE	355400	407800
216	TAYLOR AND TUNNEL PITS CANAL	216.4	SOUTH LOWER CANAL B/H NO.1	SOUTH EAST LANCASHIRE	355400	407800
216	JOHN PIT	216.5	NO.1 UC SHAFT	SOUTH EAST LANCASHIRE	355200	408200
216	JOHN PIT	216.6	NO.2 DC SHAFT	SOUTH EAST LANCASHIRE	355200	408200
217	FROSTOMS	217.1	BOREHOLE BH1	CUMBRIA	299700	527700
217	FROSTOMS	217.2	BOREHOLE BH2	CUMBRIA	299700	527700
217	FROSTOMS	217.3	BOREHOLE BH3	CUMBRIA	299700	527700
217	FROSTOMS	217.4	HOUSE SPIKEHOLES	CUMBRIA	299700	527700
218	KIMBERWORTH SILKSTONE	218.1	B/H SMALL DIA	YORKSHIRE	440600	394200
218	KIMBERWORTH SILKSTONE	218.2	B/H LARGE DIA	YORKSHIRE	440600	394200
219	OATLANDS	219.1	NO.1 SHAFT	CUMBRIA	302100	521300
219	OATLANDS	219.2	NO.2 SHAFT	CUMBRIA	302100	521300
219	OATLANDS	219.3	REED BED DISCHARGES	CUMBRIA	302100	521300
219	OATLANDS	219.4	SURFACE DISCHARGES	CUMBRIA	302100	521300
220	MANTON	220.1	NO.1 PUMPING SHAFT	NOTTINGHAMSHIRE	460800	378400
220	MANTON	220.2	NO.2 SHAFT	NOTTINGHAMSHIRE	460800	378400

220	MANTON	220.3	NO.3 SHAFT	NOTTINGHAMSHIRE	460800	378400
220	MANTON	220.4	NO.4 SHAFT	NOTTINGHAMSHIRE	460800	378400
221	GILMERTON	221.1	NO.2 SHAFT	MID LOTHIAN	329700	668200
222	RANDOLPH	222.1	LOWER DYSART B/H	EAST FIFE	330500	695400
223	BRYN (BEAUFORT)	223.1	PUMPING SHAFT	SOUTH WALES	317700	212300
224	DRILLGROUND (VICTORIA)	224.1	NO.5 PUMPING SHAFT	SOUTH WALES	316800	209200
224	DRILLGROUND (VICTORIA)	224.2	NO.6 SHAFT	SOUTH WALES	316800	209200
225	GLYNHEBOG	225.1	CYNHEIDRE NO.3 SLANT	SOUTH WALES	251600	212100
226	MOUNTAIN PIT	226.1	NO.5 SHAFT	SOUTH WALES	293400	195600
227	BANKWELL	227.1	NO.1 ADIT (UPPER)	YORKSHIRE	390400	426300
227	BANKWELL	227.2	NO.2 ADIT (LOWER)	YORKSHIRE	390400	426300
227	BANKWELL	227.3	NO.2 ADIT DISCHARGE	YORKSHIRE	390400	426300
228	GAWTHORPE GREEN FARM	228.1	NO.1 SHAFT	YORKSHIRE	419400	416700
228	GAWTHORPE GREEN FARM	228.2	NO.2 SHAFT	YORKSHIRE	419400	416700
229	SIRHOWY	229.1	NO.31 SHAFT	SOUTH WALES	314500	210000
230	RHYMNEY NO.1 LEVEL	230.1	ADIT	SOUTH WALES	311200	207800
230	RHYMNEY NO.1 LEVEL	230.2	VENT	SOUTH WALES	311200	207800
230	RHYMNEY NO.1 LEVEL	230.3	DISCHARGE 1	SOUTH WALES	311200	207800
230	RHYMNEY NO.1 LEVEL	230.4	DISCHARGE 2	SOUTH WALES	311200	207800
231	OAKDALE / WATERLOO	231.1	OAKDALE NO.1 (SOUTH) SHAFT	SOUTH WALES	319000	199400
231	OAKDALE / WATERLOO	231.2	OAKDALE NO.2 (NORTH) SHAFT	SOUTH WALES	319000	199400
231	OAKDALE / WATERLOO	231.3	WATERLOO SHAFT	SOUTH WALES	319000	199400
232	ABERGWAWR	232.1	NO.1 SHAFT + VENT	SOUTH WALES	301400	201300
232	ABERGWAWR	232.2	NO.2 SHAFT	SOUTH WALES	301400	201300
232	ABERGWAWR	232.3	NO.3 SHAFT	SOUTH WALES	301400	201300
233	PENTRE MINE	233.1	UPPER ADIT	SOUTH WALES	253500	209500
233	PENTRE MINE	233.2	LOWER ADIT	SOUTH WALES	253500	209500
233	PENTRE MINE	233.3	LOWER DISCHARGE	SOUTH WALES	253500	209500
234	ROWLANDS GILL	234.1	M/H NO.0	NORTH EAST ENGLAND	415700	558200
234	ROWLANDS GILL	234.2	M/H NO.1	NORTH EAST ENGLAND	415700	558200
234	ROWLANDS GILL	234.3	M/H NO.2	NORTH EAST ENGLAND	415700	558200
234	ROWLANDS GILL	234.4	M/H NO.3	NORTH EAST ENGLAND	415700	558200
234	ROWLANDS GILL	234.5	M/H NO.4	NORTH EAST ENGLAND	415700	558200
235	EWANRIGG	235.1	SHAFT	CUMBRIA	304000	535400
235	EWANRIGG	235.2	DISCHARGE	CUMBRIA	304000	535400
236	BWLLFA DARE	236.1	DC SHAFT	SOUTH WALES	296900	202600
236	BWLLFA DARE	236.2	UC SHAFT	SOUTH WALES	296900	202600
237	NANT MELYN (BWLLFA NO.2)	237.1	SHAFT.	SOUTH WALES	297300	202700
238	LANDGATE	238.1	PARK LANE NO.1 SHAFT	SOUTH EAST LANCASHIRE	357000	401800
238	LANDGATE	238.2	PARK LANE NO.2 SHAFT	SOUTH EAST LANCASHIRE	357000	401800
238	LANDGATE	238.3	PARK LANE NO.3 SHAFT	SOUTH EAST LANCASHIRE	357000	401800
238	LANDGATE	238.4	PARK LANE NO.4 SHAFT	SOUTH EAST LANCASHIRE	357000	401800
238	LANDGATE	238.5	INCE 4FT UC SHAFT	SOUTH EAST LANCASHIRE	357000	401800
238	LANDGATE	238.6	PEMBERTON 4FT UC SHAFT	SOUTH EAST LANCASHIRE	357000	401800
239	PENGAM	239.1	NO.1 NORTH SHAFT	SOUTH WALES	315600	197400
239	PENGAM	239.2	NO.2 SOUTH SHAFT	SOUTH WALES	315600	197400
240	WENTWORTH MILL	240.1	BOREHOLE	YORKSHIRE	437800	398600
241	MINNIE PIT	241.1	SHAFT	NORTH STAFFORDSHIRE	379200	348900
241	MINNIE PIT	241.2	DISCHARGE	NORTH STAFFORDSHIRE	379400	348900
242	BALGREGGIE	242.1	SHAFT	EAST FIFE	330300	694000

243	MONKBRETTON CHURCH	243.1	NORTH B/H	YORKSHIRE	436500	408100
243	MONKBRETTON CHURCH	243.2	SOUTH B/H	YORKSHIRE	436500	408100
244	WESTFIELD	244.1	OLD DEEP SOUTH SHAFT	YORKSHIRE	443600	395700
244	WESTFIELD	244.2	OLD DEEP NORTH SHAFT	YORKSHIRE	443600	395700
245	SILKSTONE FALL	245.1	NO.1 SHAFT	YORKSHIRE	430200	405400
245	SILKSTONE FALL	245.2	NO.2 SHAFT	YORKSHIRE	430200	405400
246	BLACKS	246.1	PUMPING SHAFT	NOTTINGHAMSHIRE	444600	378200
247	BUTE	247.1	DRIFT	SOUTH WALES	293400	198300
247	BUTE	247.2	UC SHAFT (NORTH)	SOUTH WALES	293400	198300
247	BUTE	247.3	DC SHAFT (CWMSAERBREN)	SOUTH WALES	293400	198300
247	BUTE	247.4	LADY MARGARET SHAFT	SOUTH WALES	294200	197800
248	TREORCHY	248.1	NO.26 ADIT	SOUTH WALES	294400	197400
249	ROOKERY	249.1	BOREHOLE	YORKSHIRE	424200	415700
250	LITTLEBURN	250.1	BOREHOLE 'A' (SOUTH)(LOW MAIN)	NORTH EAST ENGLAND	425500	540300
250	LITTLEBURN	250.2	BOREHOLE 'B' (NORTH)(HUTTON)	NORTH EAST ENGLAND	425500	540300
251	MUIREDGE CHEMYSS	251.1	B/H	EAST FIFE	335200	698600
252	TROEDRHIWGWEIR	252.1	NO.12 ADIT	SOUTH WALES	316100	206200
252	TROEDRHIWGWEIR	252.2	NO.13 ADIT	SOUTH WALES	316100	206200
253	WANDON	253.1	BOREHOLE	SOUTH STAFFORDSHIRE	403400	314500
254	COMBS	254.1	NO.1 SHAFT	YORKSHIRE	425700	419000
254	COMBS	254.2	NO.2 SHAFT	YORKSHIRE	425700	419000
255	HORBURY HIGH ST. (BTZ)	255.1	BOONS VENT	YORKSHIRE	429500	418400
255	HORBURY HIGH ST. (BTZ)	255.2	BOONS BOREHOLE	YORKSHIRE	429500	418400
255	HORBURY HIGH ST. (BTZ)	255.3	THRESHERS VENT	YORKSHIRE	429500	418400
255	HORBURY HIGH ST. (BTZ)	255.4	ZIGGIS EAST VENT	YORKSHIRE	429500	418400
255	HORBURY HIGH ST. (BTZ)	255.5	ZIGGIS WEST VENT	YORKSHIRE	429500	418400
256	PONTYBEREM OLD LEVEL	256.1	ADIT MANHOLE	SOUTH WALES	249900	210900
256	PONTYBEREM OLD LEVEL	256.2	DISCHARGE	SOUTH WALES	249900	210900
257	PONTYBEREM BRIDGE	257.1	DISCHARGE	SOUTH WALES	250200	211200
258	WHITRIGG	258.1	BOREHOLE	EAST CENTRAL	297500	664900
259	MOSSIDE	259.1	NO.4 MINE B/H	EAST CENTRAL SCOTLAND	297800	667000
260	BLAENANT	260.1	NEW DRIFT	SOUTH WALES	278300	203200
261	CLIFTON COUNTRY PARK EAST	261.1	SHAFT 8	SOUTH EAST LANCASHIRE	377600	404100
261	CLIFTON COUNTRY PARK EAST	261.2	SHAFT 127	SOUTH EAST LANCASHIRE	377600	404100
261	CLIFTON COUNTRY PARK EAST	261.3	SHAFT 181	SOUTH EAST LANCASHIRE	377600	404100
261	CLIFTON COUNTRY PARK EAST	261.4	ADIT 1	SOUTH EAST LANCASHIRE	377600	404100
261	CLIFTON COUNTRY PARK EAST	261.5	ADIT 2	SOUTH EAST LANCASHIRE	377600	404100
261	CLIFTON COUNTRY PARK EAST	261.6	ADIT 3	SOUTH EAST LANCASHIRE	377600	404100
262	CLIFTON COUNTRY PARK WEST	262.1	SHAFT 5	SOUTH EAST LANCASHIRE	377400	404100
262	CLIFTON COUNTRY PARK WEST	262.2	SHAFT 31	SOUTH EAST LANCASHIRE	377400	404100
262	CLIFTON COUNTRY PARK WEST	262.3	SHAFT 115	SOUTH EAST LANCASHIRE	377400	404100
262	CLIFTON COUNTRY PARK WEST	262.4	SHAFT 179	SOUTH EAST LANCASHIRE	377400	404100
263	OAKTHORPE	263.1	NO.1 SHAFT	LEICESTERSHIRE	432800	313100
263	OAKTHORPE	263.2	NO.2 SHAFT	LEICESTERSHIRE	432800	313100
263	OAKTHORPE	263.3	NO.3 SHAFT	LEICESTERSHIRE	432800	313100
264	DONISTHORPE	264.1	NO.1 SHAFT	LEICESTERSHIRE	431300	314400
264	DONISTHORPE	264.2	NO.2 SHAFT	LEICESTERSHIRE	431300	314400
265	MARKHAM (SIRHOWY)	265.1	NORTH SHAFT	SOUTH WALES	317200	201700
265	MARKHAM (SIRHOWY)	265.2	SOUTH SHAFT	SOUTH WALES	317200	201700
266	WALES BAR	266.1	WINTER SEAM B/H	YORKSHIRE	446400	383500

267	OLD MEADOWS	267.1	WATERLOOSE ADIT	NORTH EAST LANCASHIRE	386700	423800
267	OLD MEADOWS	267.2	PUMP HOUSE	NORTH EAST LANCASHIRE	386700	423800
267	OLD MEADOWS	267.3	TREATMENT HOUSE	NORTH EAST LANCASHIRE	386700	423800
267	OLD MEADOWS	267.4	LAGOONS	NORTH EAST LANCASHIRE	386700	423800
267	OLD MEADOWS	267.5	REED BED	NORTH EAST LANCASHIRE	386700	423800
267	OLD MEADOWS	267.6	CONSENTED DISCHARGE	NORTH EAST LANCASHIRE	386700	423800
268	COEGNANT	268.1	SHAFT NO.1 VENT	SOUTH WALES	285700	193400
268	COEGNANT	268.2	SHAFT NO.2 VENT	SOUTH WALES	285700	193400
268	COEGNANT	268.3	MONITORING B/H'S Nos. 1-6	SOUTH WALES	285700	193400
269	ABERCWMBOI	269.1	UC PUMP SHAFT	SOUTH WALES	303000	199600
269	ABERCWMBOI	269.2	DC SHAFT	SOUTH WALES	303000	199600
270	WYRLEY GROVE	270.1	NO.1 UC SHAFT (SOUTH)	SOUTH STAFFORDSHIRE	401800	306100
270	WYRLEY GROVE	270.2	NO.2 DC SHAFT (NORTH)	SOUTH STAFFORDSHIRE	401800	306100
271	CAERAU	271.1	NORTH SHAFT	SOUTH WALES	286600	194600
271	CAERAU	271.2	SOUTH SHAFT	SOUTH WALES	286600	194600
271	CAERAU	271.3	EAST NO.3 SHAFT	SOUTH WALES	286600	194600
272	RHONDDA MERTHYR	272.1	NORTH DC SHAFT (NO.1)	SOUTH WALES	293700	198900
272	RHONDDA MERTHYR	272.2	SOUTH UC SHAFT (NO.2)	SOUTH WALES	293700	198900
273	NEWHILL ROAD	273.4	B/H 4 (NO.16)	YORKSHIRE	435200	408600
273	NEWHILL ROAD	273.5	FAN (NO.4)	YORKSHIRE	435200	408600
274	PRIESTNERS KEATS	274.1	BOREHOLE: SMALL DIA PIPE	SOUTH EAST LANCASHIRE	364600	401200
274	PRIESTNERS KEATS	274.2	BOREHOLE: LARGE DIA PIPE	SOUTH EAST LANCASHIRE	364600	401200
275	KIMBERWORTH PARKGATE	275.2	B/H 5	YORKSHIRE	440500	394200
275	KIMBERWORTH PARKGATE	275.3	B/H 4	YORKSHIRE	440500	394200
276	GREAT WESTERN	276.1	HETTY UC SHAFT	SOUTH WALES	305500	190900
276	GREAT WESTERN	276.2	NO.3 DC SHAFT	SOUTH WALES	305400	190900
276	GREAT WESTERN	276.3	WATER LEVEL	SOUTH WALES	305500	190900
277	CORRWG RHONDDA (GWYNFI)	277.1	LEVEL B DISCHARGE	SOUTH WALES	289100	197200
277	CORRWG RHONDDA (GWYNFI)	277.2	POINT E DISCHARGE	SOUTH WALES	289100	197200
277	CORRWG RHONDDA (GWYNFI)	277.3	REED BEDS	SOUTH WALES	289100	197200
277	CORRWG RHONDDA (GWYNFI)	277.4	TREATED DISCHARGE	SOUTH WALES	289100	197200
278	ST. ANSELM	278.3	HIGH MAIN BOREHOLE 4	NORTH EAST ENGLAND	433300	569400
278	ST. ANSELM	278.4	HIGH MAIN BOREHOLE 5	NORTH EAST ENGLAND	433400	569400
278	ST. ANSELM	278.5	HIGH MAIN INTAKE B/H (6:7:9)	NORTH EAST ENGLAND	433400	569600
278	ST. ANSELM	278.6	HIGH MAIN BOREHOLE 8	NORTH EAST ENGLAND	433400	569600
278	ST. ANSELM	278.7	FILL BOREHOLE	NORTH EAST ENGLAND	433400	569500
279	ALGERNON	279.1	MAIN COAL B/H	NORTH EAST ENGLAND	432400	569300
280	ASTLEY ARMS	280.1	YARD SEAM B/H	NORTH EAST ENGLAND	433100	577300
281	BULLHOUSE	281.1	ADIT DISCHARGE	YORKSHIRE	421400	402900
281	BULLHOUSE	281.2	RAW PUMPSTATION	YORKSHIRE	421400	402900
281	BULLHOUSE	281.3	LAGOONS	YORKSHIRE	421400	402900
281	BULLHOUSE	281.4	TREATED PUMPSTATION	YORKSHIRE	421400	402900
281	BULLHOUSE	281.5	TREATED DISCHARGE	YORKSHIRE	421400	402900
282	SILKSTONE COMMON TUNNEL	282.1	BOREHOLES	YORKSHIRE	428800	403900
283	BRYNAMMAN ADIT	283.1	ADIT	SOUTH WALES	271200	213800
283	BRYNAMMAN ADIT	283.2	DISCHARGE	SOUTH WALES	271200	213800
284	MINTO	284.1	NO.1 SHAFT DISCHARGE	CENTRAL FIFE	320500	695000
284	MINTO	284.2	REED BEDS	CENTRAL FIFE	320500	695000
284	MINTO	284.3	TREATED DISCHARGE	CENTRAL FIFE	320500	695000
285	PWLL-YR-AFON LEVEL	285.1	ADIT	SOUTH WALES	297200	205200

286	MANOR	286.1	TOP HAIGH MOOR B/H EAST	YORKSHIRE	430600	418400
286	MANOR	286.2	HORBURY ROCK B/H WEST	YORKSHIRE	430600	418400
287	CASTLE	287.1	SHAFT	SOUTH WALES	306500	202600
287	CASTLE	287.2	DISCHARGE	SOUTH WALES	306700	202700
288	PONT-Y-RHYN	288.1	ADIT	SOUTH WALES	306800	202400
288	PONT-Y-RHYN	288.2	DISCHARGE	SOUTH WALES	306800	202400
289	WHARNCLIFFE CARLTON	289.1	SHAFT	YORKSHIRE	434800	408300
290	WILLOW BANK	290.1	NO.2 SHAFT	YORKSHIRE	434200	407900
290	WILLOW BANK	290.2	NO.5 SHAFT	YORKSHIRE	434200	407900
290	WILLOW BANK	290.3	NO.6 SHAFT	YORKSHIRE	434200	407900
291	PINDAR OAKS	291.1	NO.1 SHAFT	YORKSHIRE	435500	405400
292	CAR HOUSE	292.1	SWALLOW WOOD PUMPING SHAFT	YORKSHIRE	442500	394000
293	SHERDLEY	293.1	SOUTH SHAFT	SOUTH EAST LANCASHIRE	351800	394000
293	SHERDLEY	293.2	NORTH SHAFT	SOUTH EAST LANCASHIRE	351800	394000
294	HEMINGFIELD	294.1	WINDING SHAFT	YORKSHIRE	439200	401000
294	HEMINGFIELD	294.2	WATER SHAFT	YORKSHIRE	439200	401000
295	LITTLE SHERIFF	295.1	DRIFT	NORTH STAFFORDSHIRE	380800	347400
296	CWMGWILI	296.1	DRIFT	SOUTH WALES	257500	210400
296	CWMGWILI	296.2	AIR SHAFT	SOUTH WALES	257300	211200
296	CWMGWILI	296.3	NO.6 B/H	SOUTH WALES	257900	209800
296	EMLYN	296.4	AIR SHAFT	SOUTH WALES	258200	213300
296	EMLYN	296.5	RETURN DRIFT	SOUTH WALES	258200	213300
296	EMLYN	296.6	INTAKE DRIFT	SOUTH WALES	258200	213300
297	LINDSAY	297.1	DRIFT	SOUTH WALES	259200	210700
297	LINDSAY	297.2	DISCHARGE	SOUTH WALES	259200	210700
298	GWENFFRWD/WHITWORTH	298.01	GWENFFRWD ADIT	SOUTH WALES	279800	196800
298	GWENFFRWD/WHITWORTH	298.02	GWENFFRWD BEDS	SOUTH WALES	279800	196800
298	GWENFFRWD/WHITWORTH	298.03	GWENFFRWD TREATED DISCHARGE	SOUTH WALES	279800	196800
298	GWENFFRWD/WHITWORTH	298.04	WHITWORTH 1 ADIT	SOUTH WALES	279800	196800
298	GWENFFRWD/WHITWORTH	298.05	WHITWORTH 1 BEDS	SOUTH WALES	279800	196800
298	GWENFFRWD/WHITWORTH	298.06	WHITWORTH 1 TREATED DISCHARGE	SOUTH WALES	279800	196800
298	GWENFFRWD/WHITWORTH	298.07	WHITWORTH 2A ADIT	SOUTH WALES	279800	196800
298	GWENFFRWD/WHITWORTH	298.08	WHITWORTH 2A BEDS	SOUTH WALES	279800	196800
298	GWENFFRWD/WHITWORTH	298.09	WHITWORTH 2A TREATED DISCHARGE	SOUTH WALES	279800	196800
298	GWENFFRWD/WHITWORTH	298.1	WHITWORTH 2B ADIT	SOUTH WALES	279800	196800
298	GWENFFRWD/WHITWORTH	298.11	WHITWORTH 2B LAGOON	SOUTH WALES	279800	196800
298	GWENFFRWD/WHITWORTH	298.12	WHITWORTH LAGOON DISCHARGE	SOUTH WALES	279800	196800
299	GARTH TONMAWR	299.1	UPPER DISCHARGE	SOUTH WALES	281500	197500
299	GARTH TONMAWR	299.2	MAIN ADIT	SOUTH WALES	281600	197200
299	GARTH TONMAWR	299.3	REED BEDS	SOUTH WALES	281600	197200
299	GARTH TONMAWR	299.4	TREATED DISCHARGE	SOUTH WALES	281600	197200
300	SOUTH DYFFRYN	300.1	DISCHARGE	SOUTH WALES	306800	202400
301	MOOR TOP	301.1	TUPTON BOREHOLE	NOTTINGHAMSHIRE	441800	370700
302	ROB ROYD	302.1	SHAFT	YORKSHIRE	433200	404400
303	ALKRINGTON	303.1	NORTH SHAFT	SOUTH EAST LANCASHIRE	386700	404300
303	ALKRINGTON	303.2	SOUTH SHAFT	SOUTH EAST LANCASHIRE	386700	404300
304	GETHIN	304.1	NO.2 SHAFT	SOUTH WALES	305600	203300
305	KILNHURST	305.1	NO.4 SHAFT	YORKSHIRE	446200	396800
306	SILVERWOOD	306.1	WEST PIT	YORKSHIRE	447600	393900
307	WARDLEY HOLLINS FIELD	307.1	SHAFT	SOUTH EAST LANCASHIRE	375600	402700

308	MANVERS MAIN	308.1	NO.1 SHAFT	YORKSHIRE	445300	400800
308	MANVERS MAIN	308.2	CUPOLA SHAFT	YORKSHIRE	445300	400800
308	MANVERS MAIN	308.3	AIR SHAFT	YORKSHIRE	445300	400800
308	MANVERS MAIN	308.4	NO.4 SHAFT	YORKSHIRE	445300	400800
309	LUNDWOOD	309.1	MELTONFIELD NEW B/H	YORKSHIRE	438300	407300
310	WOMBWELL MAIN	310.1	NO.1 (LIDGETT DC) SHAFT	YORKSHIRE	438400	403000
310	WOMBWELL MAIN	310.2	NO.2 (BEAMSHAW) SHAFT	YORKSHIRE	438400	403000
310	WOMBWELL MAIN	310.3	NO.3 (LIDGETT UC) SHAFT	YORKSHIRE	438400	403000
310	WOMBWELL MAIN	310.4	NO.4 (BARNSLEY) SHAFT	YORKSHIRE	438400	403000
311	NANT AMAN FACH	311.1	STREAM	SOUTH WALES	299500	199600
312	SILKSTONE VILLAGE	312.1	OLD ADIT	YORKSHIRE	429100	405600
312	SILKSTONE VILLAGE	312.2	LAGOON	YORKSHIRE	429100	405600
312	SILKSTONE VILLAGE	312.3	LAGOON DIS. TO BECK	YORKSHIRE	429100	405600
312	SILKSTONE VILLAGE	312.4	REED BEDS	YORKSHIRE	429100	405600
312	SILKSTONE VILLAGE	312.5	REED BED DIS. TO BECK	YORKSHIRE	429100	405600
313	HAUNCHWOOD	313.1	PUMPING SHAFT	WARWICKSHIRE	433200	292200
314	DALKEITH	314.1	NO.5 MINE B/H	MID LOTHIAN	335300	669200
315	JOPPA GILLESPIE DAY LEVEL	315.1	NO.1 M/H	MID LOTHIAN	331600	673500
315	JOPPA GILLESPIE DAY LEVEL	315.2	NO.2 M/H	MID LOTHIAN	331600	673500
316	MONKTONHALL	316.1	NO.1 SHAFT	MID LOTHIAN	332300	670300
316	MONKTONHALL	316.2	NO.2 SHAFT	MID LOTHIAN	332300	670300
316	MONKTONHALL	316.3	CHEMICAL TREATMENT	MID LOTHIAN	332300	670300
316	MONKTONHALL	316.4	SETTLING LAGOONS	MID LOTHIAN	332300	670300
316	MONKTONHALL	316.5	REED BED FEED PUMPS	MID LOTHIAN	332300	670300
316	MONKTONHALL	316.6	REED BEDS	MID LOTHIAN	332300	670300
316	MONKTONHALL	316.7	DISCHARGE	MID LOTHIAN	332300	670300
317	TYNESBANK	317.1	SHAFT	SOUTH EAST LANCASHIRE	373200	403200
318	LINNYSHAW	318.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	375200	403300
318	LINNYSHAW	318.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	375200	403300
319	RITHAN / BLAENCUFFIN	319.1	RITHAN RETURN	SOUTH WALES	323300	201700
319	RITHAN / BLAENCUFFIN	319.2	RITHAN INTAKE	SOUTH WALES	323300	201700
319	RITHAN / BLAENCUFFIN	319.3	BLAENCUFFIN OLD LEVEL	SOUTH WALES	323300	201700
320	HANLEY DEEP	320.1	NO.1 SHAFT (SOUTH)	NORTH STAFFORDSHIRE	388400	348300
320	HANLEY DEEP	320.2	NO.2 SHAFT (NORTH)	NORTH STAFFORDSHIRE	388400	348300
321	ADAM LANE	321.1	NORTH EAST SHAFT	YORKSHIRE	429300	407300
321	ADAM LANE	321.2	SOUTH WEST SHAFT	YORKSHIRE	429300	407300
321	ADAM LANE	321.3	BOREHOLE	YORKSHIRE	429300	407300
322	PLASDRAW OLD LEVEL	322.1	DISCHARGE	SOUTH WALES	301100	202500
323	BEDLINGTON 'E'	323.1	UC SHAFT	NORTH EAST ENGLAND	428200	584800
323	BEDLINGTON 'E'	323.2	DC SHAFT	NORTH EAST ENGLAND	428200	584800
324	CLARA VALE	324.1	SOUTH SHAFT	NORTH EAST ENGLAND	413100	564700
324	CLARA VALE	324.2	NORTH SHAFT	NORTH EAST ENGLAND	413100	564700
325	BATTS WATER LEVEL	325.1	ADIT	NORTH EAST ENGLAND	419700	529500
326	CALDON CANAL	326.1	BANKSIDE ISSUE	NORTH STAFFORDSHIRE	390100	351500
327	PENLLWYNHELYG	327.1	DRIFT	SOUTH WALES	261200	213400
328	ASPULL SOUGH	328.1	DISCHARGE	SOUTH EAST LANCASHIRE	359100	407300
329	ABERBEEG NORTH	329.1	SHAFT	SOUTH WALES	320600	202000
329	ABERBEEG NORTH	329.2	DISCHARGE	SOUTH WALES	320600	202000
330	ELLIS PIT	330.1	SHAFT	SOUTH WALES	306200	204400
331	GLEN MINE	331.1	ADIT	SOUTH WALES	274300	211800

331	GLEN MINE	331.2	DISCHARGE	SOUTH WALES	274300	211800
332	CEFN HENGOED	332.1	NO.1 ADIT	SOUTH WALES	315500	196300
332	CEFN HENGOED	332.2	NO.2 ADIT	SOUTH WALES	315500	196300
332	CEFN HENGOED	332.3	NO.3 ADIT	SOUTH WALES	315500	196300
332	CEFN HENGOED	332.4	NO.4 ADIT	SOUTH WALES	315500	196300
333	CROFTON MILL PIT	333.1	SHAFT	NORTH EAST ENGLAND	431600	580900
334	RAVENHEAD	334.1	NO.10 SHAFT	SOUTH EAST LANCASHIRE	351400	394400
334	RAVENHEAD	334.2	NO.11 SHAFT	SOUTH EAST LANCASHIRE	351400	394400
335	OLD CARRS	335.1	SHAFT	SOUTH EAST LANCASHIRE	346200	391900
336	CALOW DRIFTS	336.1	NO.2 NORTH DRIFT B/H	NOTTINGHAMSHIRE	441900	370000
336	CALOW DRIFTS	336.2	NO.1 SOUTH DRIFT B/H	NOTTINGHAMSHIRE	441900	370000
337	SUTTON SPRINGWOOD	337.1	DEEP SOFT BOREHOLE	NOTTINGHAMSHIRE	442800	369300
338	ELSECAR DISTILLERY PIT	338.1	OLD PUMPING SHAFT	YORKSHIRE	438600	399900
338	ELSECAR DISTILLERY PIT	338.2	LADDER SHAFT (NEWCOMEN)	YORKSHIRE	438600	399900
339	WILLOW FARM	339.1	FISSURES	SOUTH EAST LANCASHIRE	352800	388800
340	HAYDOCK SOUGH	340.1	DISCHARGE	SOUTH EAST LANCASHIRE	353800	396700
341	KNOLL DRIFTS	341.3	SOUTH DRIFT B/H	YORKSHIRE	433900	400500
341	KNOLL DRIFTS	341.4	BIRDWELL DAY LEVEL	YORKSHIRE	434300	400700
342	LADIES LANE (HINDLEY)	342.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	360000	406900
342	LADIES LANE (HINDLEY)	342.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	360000	406900
342	LADIES LANE (HINDLEY)	342.3	NO.3 SHAFT	SOUTH EAST LANCASHIRE	360000	406900
342	LADIES LANE (HINDLEY)	342.4	NO.4 SHAFT	SOUTH EAST LANCASHIRE	360000	406900
343	ROSE BRIDGE	343.1	AIR SHAFT	SOUTH EAST LANCASHIRE	361700	404800
344	ELGINHAUGH	344.1	DISCHARGE	MID LOTHIAN	331800	667100
345	OLD FORDELL	345.1	JUNKIES LEVEL	MID LOTHIAN	333500	667200
346	WHARNCLIFFE WOODMOOR 1,2,3	346.1	MELTONFIELD B/H	YORKSHIRE	436200	408700
347	PENTRE (RHONDDA)	347.1	NORTH SHAFT	SOUTH WALES	297100	195800
348	GLAMORGAN	348.1	NO.4 SHAFT	SOUTH WALES	299500	193500
349	HAFOD	349.1	NO.1 SHAFT	SOUTH WALES	303800	191300
349	HAFOD	349.2	NO.2 SHAFT	SOUTH WALES	304200	191300
349	HAFOD	349.3	ADIT	SOUTH WALES	304100	191400
350	CYMMER	350.1	SHAFT	SOUTH WALES	302600	191200
351	NORTH JUNCTION NO.2	351.1	1ST WATERLOO BOREHOLE	NOTTINGHAMSHIRE	442500	371500
352	EMBANKMENT	352.1	TOP HARD BOREHOLE	NOTTINGHAMSHIRE	442500	371500
353	ROCK LANE	353.1	2ND WATER LOO BOREHOLE	NOTTINGHAMSHIRE	443600	368800
354	HALL FARM	354.1	TOP HARD BOREHOLE	NOTTINGHAMSHIRE	443900	369000
355	SMALL PIT	355.1	SHAFT	YORKSHIRE	434000	401000
356	HERMIT HILL	356.1	SHAFT	YORKSHIRE	431800	400800
357	DUFFRYN RHONDDA	357.1	SLANT	SOUTH WALES	284500	195800
358	MANOR WESTGATE	358.1	NO.1 SHAFT B/H (WEST)	YORKSHIRE	431500	420300
358	MANOR WESTGATE	358.2	NO.2 SHAFT B/H (EAST)	YORKSHIRE	431500	420300
358	MANOR WESTGATE	358.3	S4 VENT	YORKSHIRE	431500	420300
359	BWLLFA	359.1	DISCHARGE	SOUTH WALES	297200	202900
360	KELLS	360.1	BOREHOLE	CUMBRIA	297200	517200
361	COUNTESS PARTON DRIFT	361.1	SEALED ENTRY	CUMBRIA	297800	520100
361	COUNTESS PARTON DRIFT	361.2	SEALED ENTRY M/H	CUMBRIA	297800	520100
361	COUNTESS PARTON DRIFT	361.3	VENTILATED ACCESS M/H	CUMBRIA	297800	520100
361	COUNTESS PARTON DRIFT	361.4	BEACH DISCHARGE	CUMBRIA	297800	520100
362	SEVEN SISTERS	362.1	EAST SHAFT	SOUTH WALES	282100	209100
363	RHONDDA MAIN	363.1	KATHERINE (NORTH) SHAFT	SOUTH WALES	293600	188900

363	RHONDDA MAIN	363.2	ANNE (SOUTH) SHAFT	SOUTH WALES	293600	188900
364	ADDISON	364.1	NO.2 SHAFT DISCHARGE	NORTH EAST ENGLAND	416800	564200
364	ADDISON	364.2	NO.2 DRAIN	NORTH EAST ENGLAND	416800	564200
365	THROCKLEY ISABELLA	365.1	WEST DC SHAFT M/H	NORTH EAST ENGLAND	415300	565700
365	THROCKLEY ISABELLA	365.2	EAST UC SHAFT M/H	NORTH EAST ENGLAND	415300	565700
365	THROCKLEY ISABELLA	365.3	DISCHARGE M/H'S	NORTH EAST ENGLAND	415300	565700
365	THROCKLEY ISABELLA	365.4	DISCHARGE	NORTH EAST ENGLAND	415300	565700
365	THROCKLEY ISABELLA	365.5	DERWENTWATER SHAFT	NORTH EAST ENGLAND	415300	565700
366	THURCROFT	366.1	NO.1 SHAFT NORTH VENT	YORKSHIRE	449700	389400
366	THURCROFT	366.2	NO.1 SHAFT SOUTH VENT	YORKSHIRE	449700	389400
366	THURCROFT	366.3	NO.2 SHAFT	YORKSHIRE	449700	389400
367	THORNCLIFFE WATER DRIFT EAST	367.1	ELSECAR SELLARS SOUGH	YORKSHIRE	439100	400600
367	THORNCLIFFE WATER DRIFT EAST	367.2	DISTILLERY SHAFT NO.8	YORKSHIRE	438700	400100
367	THORNCLIFFE WATER DRIFT EAST	367.3	HERITAGE CENTRE SHAFT NO.9	YORKSHIRE	438600	399900
367	THORNCLIFFE WATER DRIFT EAST	367.4	PLANTATION SHAFT NO.12	YORKSHIRE	438500	399700
367	THORNCLIFFE WATER DRIFT EAST	367.5	WELFARE SHAFT NO.13	YORKSHIRE	438400	399700
367	THORNCLIFFE WATER DRIFT EAST	367.6	LAW WOOD ADIT	YORKSHIRE	438500	399600
367	THORNCLIFFE WATER DRIFT EAST	367.7	FURNACE SHAFT	YORKSHIRE	438500	399600
368	BRAKES WATER LEVEL	368.1	ADIT	CUMBRIA	297200	516500
369	KAMES	369.1	NO.1 SHAFT	CENTRAL AYRSHIRE	268300	626300
369	KAMES	369.2	REED BEDS	CENTRAL AYRSHIRE	268300	626300
369	KAMES	369.3	TREATED DISCHARGE	CENTRAL AYRSHIRE	268300	626300
369	KAMES	369.4	NO.2 SHAFT	CENTRAL AYRSHIRE	268300	626300
369	KAMES	369.5	UNTREATED DISCHARGE	CENTRAL AYRSHIRE	268300	626300
370	HAZELHEAD / WOODS	370.1	DRAINAGE ADIT	YORKSHIRE	416500	407300
370	HAZELHEAD / WOODS	370.2	DISCHARGE TO NEW MILL DYKE	YORKSHIRE	416500	407300
370	HAZELHEAD / WOODS	370.3	SECOND ADIT	YORKSHIRE	416500	407300
371	EAST EDMONDSLEY	371.1	YARD SEAM DRIFT	NORTH EAST ENGLAND	423100	549400
371	EAST EDMONDSLEY	371.2	PUMP STATION	NORTH EAST ENGLAND	423100	549400
371	EAST EDMONDSLEY	371.3	REED BEDS	NORTH EAST ENGLAND	423100	549400
371	EAST EDMONDSLEY	371.4	TREATED DISCHARGE	NORTH EAST ENGLAND	423100	549400
372	SPY LAW	372.1	B/H	NORTH EAST ENGLAND	421800	610300
373	HAZON	373.1	B/H	NORTH EAST ENGLAND	418600	604600
374	SHILBOTTLE	374.1	B/H	NORTH EAST ENGLAND	419900	607800
375	SWARLAND WOOD	375.1	B/H	NORTH EAST ENGLAND	415400	603100
376	HART LAW	376.1	B/H	NORTH EAST ENGLAND	420400	606700
377	GRANGE PIT	377.1	B/H	NORTH EAST ENGLAND	421300	607900
378	ACOMB DRIFT	378.1	ADIT	NORTH EAST ENGLAND	392600	566200
378	ACOMB DRIFT	378.2	RAW MINEWATER	NORTH EAST ENGLAND	392600	566200
378	ACOMB DRIFT	378.3	PONDS + REED BED	NORTH EAST ENGLAND	392600	566200
378	ACOMB DRIFT	378.4	TREATED DISCHARGE	NORTH EAST ENGLAND	392600	566200
379	BURNOPFIELD MAIN COAL DRIFT	379.1	DISCHARGE	NORTH EAST ENGLAND	417700	556900
380	MILKWELL HUTTON DRIFT	380.1	DISCHARGE	NORTH EAST ENGLAND	411200	557100
381	MORRISON BUSTY	381.1	INFEED	NORTH EAST ENGLAND	417800	550900
382	STONY HEAP	382.1	DISCHARGE	NORTH EAST ENGLAND	414700	551500
383	BOWDEN CLOSE	383.1	HUTTON DISCHARGE	NORTH EAST ENGLAND	418500	535600
384	PONT WATER LEVEL	384.1	DISCHARGE	NORTH EAST ENGLAND	415200	555200
385	ST. HELENS AUCKLAND	385.1	ENGINE SHAFT	NORTH EAST ENGLAND	419700	527200
385	ST. HELENS AUCKLAND	385.2	ST. HELENS DRAIN	NORTH EAST ENGLAND	419600	526800
385	ST. HELENS AUCKLAND	385.3	TINDALE SHAFT	NORTH EAST ENGLAND	419500	526900

385	ST. HELENS AUCKLAND	385.4	TINDALE DRAIN	NORTH EAST ENGLAND	419500	526700
386	WEST KYO	386.1	DISCHARGE	NORTH EAST ENGLAND	417100	552600
387	SMITHIES	387.1	B/H	YORKSHIRE	435400	408300
388	HAUXLEY	388.1	NO.1 B/H	NORTH EAST ENGLAND	428300	603300
388	HAUXLEY	388.2	NO.2 B/H	NORTH EAST ENGLAND	428300	603300
388	HAUXLEY	388.3	NO.3 PUMPING B/H	NORTH EAST ENGLAND	428300	603300
388	HAUXLEY	388.4	NO.4 PUMPING B/H	NORTH EAST ENGLAND	428300	603300
388	HAUXLEY	388.5	BEACH DISCHARGE	NORTH EAST ENGLAND	428300	603500
388	HAUXLEY	388.6	NORTH SHAFT	NORTH EAST ENGLAND	428300	603500
389	LADY PIT	389.1	RIVER LEVEL	CHESHIRE	401100	383800
389	LADY PIT	389.2	FURNACE SHAFT	CHESHIRE	401600	383900
390	EDMONDSLEY WATER LEVEL	390.1	ADIT	NORTH EAST ENGLAND	421900	549100
391	SHALLCROSS HALL	391.1	NORTH SHAFT	CHESHIRE	401000	380300
391	SHALLCROSS HALL	391.2	SOUTH SHAFT	CHESHIRE	401000	380300
391	SHALLCROSS HALL	391.3	TREE DISCHARGE	CHESHIRE	401000	380300
391	SHALLCROSS HALL	391.4	SPRING DISCHARGE	CHESHIRE	401000	380300
392	HILL HOUSE	392.1	SHAFT	YORKSHIRE	428300	407300
393	NORCROFT LANE	393.1	SHAFT	YORKSHIRE	428900	406800
394	WHITTLE NEW DRIFT	394.1	PUMPING B/H	NORTH EAST ENGLAND	418100	605300
394	WHITTLE NEW DRIFT	394.2	TEST B/H	NORTH EAST ENGLAND	418100	605300
394	WHITTLE NEW DRIFT	394.3	PONDS	NORTH EAST ENGLAND	418100	605300
394	WHITTLE NEW DRIFT	394.4	REED BEDS	NORTH EAST ENGLAND	418100	605300
394	WHITTLE NEW DRIFT	394.5	TREATED DISCHARGE	NORTH EAST ENGLAND	418100	605300
395	GREASBROUGH	395.1	OCHRE DYKE	YORKSHIRE	442200	395500
396	THORNCLIFFE WATER DRIFT CENTRAL	396.1	LIDGETT COLLIERY NO.20 SHAFT	YORKSHIRE	436200	398800
396	THORNCLIFFE WATER DRIFT CENTRAL	396.2	BLACKLANE SHAFT NO. 21	YORKSHIRE	435900	398700
396	THORNCLIFFE WATER DRIFT CENTRAL	396.3	TANKERSLEY PARK SHAFT	YORKSHIRE	435700	398800
397	LYME	397.1	NO.1 SHAFT	SOUTH EAST LANCASHIRE	356300	396100
397	LYME	397.2	NO.2 SHAFT	SOUTH EAST LANCASHIRE	356300	396100
397	LYME	397.3	NO.3 SHAFT	SOUTH EAST LANCASHIRE	356300	396100
398	WHITE LANE SOUGH	398.1	OUTLET	YORKSHIRE	435600	396800
399	MANGHAM (OLD BASSET LEVEL)	399.1	OUTLET	YORKSHIRE	443000	395100
400	BISHOP WOOD	400.1	NO.3 BOREHOLE	YORKSHIRE	456000	433600
401	HAND BANK	401.1	SHEEPHOUSE WOOD ADIT	YORKSHIRE	423100	400100
401	HAND BANK	401.2	HALIFAX HARDS OUTFLOW	YORKSHIRE	423100	400100
401	HAND BANK	401.3	HALIFAX HARDS B/H	YORKSHIRE	423100	400100
402	NORTON (BALL GREEN)	402.1	TEN FEET B/H	NORTH STAFFORDSHIRE	388900	352100
403	ENGINE LOCK	403.1	BOREHOLE	NORTH STAFFORDSHIRE	389800	351300
404	ENGINE LOCK DISCHARGE	404.1	OUTLET	NORTH STAFFORDSHIRE	389800	351400
405	TAYLORS LIFT	405.1	DISCHARGE	YORKSHIRE	418400	426800
406	WEST CANNOCK 5 (SHOOTING BUTTS)	406.1	BOREHOLE	SOUTH STAFFORDSHIRE	399800	317400
407	CADLEY HILL	407.1	LITTLE COAL RETURN DRIFT B/H	SOUTH DERBYSHIRE	427900	319200
408	BERRY HILL	408.1	BOREHOLE	NORTH STAFFORDSHIRE	390200	346000
409	PITFIRRANE DAY LEVEL	409.1	NEW ADIT	CENTRAL FIFE	306200	685700
409	PITFIRRANE DAY LEVEL	409.2	ISSUE RE-ENTRY	CENTRAL FIFE	306500	686100
409	PITFIRRANE DAY LEVEL	409.3	SURFACE ISSUE	CENTRAL FIFE	306600	686400
410	NORCROFT FAN DRIFT	410.1	ADIT	YORKSHIRE	428900	407200
411	STANHOPE BRETBY	411.1	DRIFT VENT	SOUTH DERBYSHIRE	428500	322200
412	DEERPLAY	412.1	WEST LOWER MOUNTAIN B/H	NORTH EAST LANCASHIRE	386900	426700
412	DEERPLAY	412.2	PUMPED SCHEME	NORTH EAST LANCASHIRE	386900	426700

412	DEERPLAY	412.3	LEACHATE SCHEME	NORTH EAST LANCASHIRE	386900	426700
412	DEERPLAY	412.4	DISCHARGE	NORTH EAST LANCASHIRE	386900	426700
413	BANKHEAD	413.1	KIRKCONNEL SPLINT B/H	SANQUHAR	273300	611300
414	KELLO	414.1	KIRKCONNEL SPLINT B/H	SANQUHAR	272800	611500
415	URQUHART DAY LEVEL	415.1	DISCHARGE	CENTRAL FIFE	308200	686800
416	WILSONTOWN MAIN	416.1	HOLMSYKE LEVEL	EAST CENTRAL	294900	653100
416	WILSONTOWN MAIN	416.2	POND AND REED BEDS	EAST CENTRAL	294900	653100
416	WILSONTOWN MAIN	416.3	TREATED DISCHARGE	EAST CENTRAL	294900	653100
417	KINGSHILL NO.1	417.1	POINT A DISCHARGE	EAST CENTRAL	285500	657400
417	KINGSHILL NO.1	417.2	TREATED DISCHARGE	EAST CENTRAL	285400	657500
417	KINGSHILL NO.1	417.3	NO.1 NORTH SHAFT	EAST CENTRAL	285700	657200
417	KINGSHILL NO.1	417.4	NO.2 SOUTH SHAFT	EAST CENTRAL	285700	657100
418	FENDER (DUNSTON)	418.1	ADIT	NOTTINGHAMSHIRE	436400	375200
418	FENDER (DUNSTON)	418.2	SEEPAGE PUMP	NOTTINGHAMSHIRE	436400	375200
418	FENDER (DUNSTON)	418.3	RAW MINEWATER	NOTTINGHAMSHIRE	436400	375200
418	FENDER (DUNSTON)	418.4	REED BEDS	NOTTINGHAMSHIRE	436400	375200
418	FENDER (DUNSTON)	418.5	DISCHARGE	NOTTINGHAMSHIRE	436400	375200
419	PARKMILL	419.1	WHINMOOR DRIFT	YORKSHIRE	426200	411600
420	FLOCKTON MOOR	420.1	NORTH SHAFT	YORKSHIRE	421600	414800
420	FLOCKTON MOOR	420.2	SOUTH SHAFT	YORKSHIRE	421600	414800
421	KIMBERWORTH PARK EAST	421.1	NO.1 B/H	YORKSHIRE	440700	394800
421	KIMBERWORTH PARK EAST	421.2	NO.2 B/H	YORKSHIRE	440800	394600
421	KIMBERWORTH PARK EAST	421.3	NO.2A B/H	YORKSHIRE	440800	394600
422	KIMBERWORTH PARK WEST	422.1	NO.3 B/H	YORKSHIRE	440900	394200
422	KIMBERWORTH PARK WEST	422.2	NO.3A B/H	YORKSHIRE	440900	394200
422	KIMBERWORTH PARK WEST	422.3	NO.4 B/H	YORKSHIRE	440900	394100
423	THORNCLIFFE WATER DRIFT WEST	423.1	STRAFFORD SHAFT NO.22	YORKSHIRE	435600	398500
423	THORNCLIFFE WATER DRIFT WEST	423.2	TOP O' THE PARK SHAFT NO.23	YORKSHIRE	435200	398400
423	THORNCLIFFE WATER DRIFT WEST	423.3	OLD PARKGATE WEST SHAFT NO. 23A	YORKSHIRE	435100	398200
424	HARTINGTON	424.1	PUMPING SHAFT	NOTTINGHAMSHIRE	443400	375500
425	NAILSTONE	425.1	SURFACE DRIFT B/H	LEICESTERSHIRE	442500	308500
426	SCAR HOLE	426.1	SHAFT	YORKSHIRE	417400	407400
427	WENTWORTH SILKSTONE	427.1	PARKGATE DRIFT	YORKSHIRE	431100	403400
428	WHITWELL	428.1	NO.1 SHAFT (NORTH)	NOTTINGHAMSHIRE	453400	375700
428	WHITWELL	428.2	NO.2 SHAFT (SOUTH)	NOTTINGHAMSHIRE	453400	375700
429	NORTH ESK DRAINAGE LEVEL	429.1	SHAFT	MID LOTHIAN	331800	666800
430	MORDA	430.1	SHAFT	COALBROOKDALE	328900	327400
431	PARK DRIFT	431.1	HAULAGE DRIFT (EAST)	NORTH EAST ENGLAND	420500	536000
431	PARK DRIFT	431.2	MAIN VENTILATION DRIFT (WEST)	NORTH EAST ENGLAND	420500	536000
432	BILSTON GLEN	432.1	NO.1 DC SHAFT	MID LOTHIAN	327200	665200
433	WARREN HOUSE	433.1	SOUTH SHAFT	YORKSHIRE	443000	398200
433	WARREN HOUSE	433.2	NORTH SHAFT	YORKSHIRE	443000	398200
433	LOWSTUBBIN	433.3	SHAFT SECURITY	YORKSHIRE	442300	398000
434	BATH ST., SILVERDALE	434.1	B/H'S	NORTH STAFFORDSHIRE	#VALUE!	#VALUE!
435	PILDACRE	435.1	NORTH SHAFT	YORKSHIRE	426900	420700
435	PILDACRE	435.2	CENTRAL SHAFT	YORKSHIRE	426900	420700
435	PILDACRE	435.3	SOUTH SHAFT	YORKSHIRE	426900	420700
436	MERRYLEES	436.1	NO.1 (N) SURFACE DRIFT B/H	LEICESTERSHIRE	446400	305700
437	SNIBSTON	437.1	SURFACE DRIFT B/H	LEICESTERSHIRE	441700	314900
438	NEW LOUNT	438.1	SURFACE DRIFT B/H	LEICESTERSHIRE	439900	318200

439	CHURCH HILL	439.1	BOREHOLES	LEICESTERSHIRE	441700	317200
439	CHURCH HILL	439.2	OUTFLOW RANGE M/H'S	LEICESTERSHIRE	441700	317200
439	CHURCH HILL	439.3	DISCHARGE	LEICESTERSHIRE	441700	317200
440	STAUNTON HAROLD	440.1	OUTFLOW	LEICESTERSHIRE	438500	320500
441	LOUNT	441.1	OUTFLOW	LEICESTERSHIRE	438800	319800
442	PEGSWOOD BUSTY	442.1	BOREHOLE	NORTH EAST ENGLAND	424000	587400
443	ROTHES	443.1	NO.1 SHAFT (DC)	EAST FIFE	328200	697300
443	ROTHES	443.2	NO.2 SHAFT (UC)	EAST FIFE	328200	697300
444	VIVIAN	444.1	PUMP BH	SOUTH WALES	322000	203400
444	VIVIAN	444.2	TREATMENT STATION	SOUTH WALES	322000	203400
444	VIVIAN	444.3	PONDS + REED BED	SOUTH WALES	322000	203400
444	VIVIAN	444.4	TREATED DISCHARGE	SOUTH WALES	322000	203400
444	VIVIAN	444.5	SHAFT	SOUTH WALES	322000	203400
444	VIVIAN	444.6	SHAFT DISCHARGE	SOUTH WALES	322000	203400
445	GIN HOUSE	445.1	BARNSLEY B/H	YORKSHIRE	442100	393700
446	SHIREOAKS	446.1	CLOWNE B/H	NOTTINGHAMSHIRE	455300	378700
447	GRANVILLE NO. 1	447.1	SHAFT	SOUTH DERBYSHIRE	430400	319100
448	CARTWRIGHTS	448.1	WEST SHAFT	SOUTH DERBYSHIRE	430100	320100
448	CARTWRIGHTS	448.2	CENTRE SHAFT	SOUTH DERBYSHIRE	430100	320100
448	CARTWRIGHTS	448.3	EAST SHAFT	SOUTH DERBYSHIRE	430100	320100
449	SWADLINCOTE OLD	449.1	NO 3 SHAFT	SOUTH DERBYSHIRE	429000	319500
449	SWADLINCOTE OLD	449.2	BILLY SHAFT	SOUTH DERBYSHIRE	429000	319500
450	CHURCH GRESLEY	450.1	DC SHAFT	SOUTH DERBYSHIRE	429600	318200
450	CHURCH GRESLEY	450.2	UC SHAFT	SOUTH DERBYSHIRE	429600	318200
451	LANGTON	451.1	NO.7 SHAFT	NOTTINGHAMSHIRE	447500	355100
451	LANGTON	451.2	NO.8 SHAFT	NOTTINGHAMSHIRE	447500	355100
452	BUTTERKNOWLE	452.1	BROCKWELL W/L	NORTH EAST ENGLAND	410900	525900
453	LOW BUTTERKNOWLE	453.1	MILL PIT SHAFT	NORTH EAST ENGLAND	413300	525000
453	LOW BUTTERKNOWLE	453.2	MILL PIT NEW DRAIN	NORTH EAST ENGLAND	413300	525000
453	LOW BUTTERKNOWLE	453.3	OLD 156 SHAFT DRAIN	NORTH EAST ENGLAND	413300	525000
454	BOTHAL	454.1	LOW MAIN W/L	NORTH EAST ENGLAND	422800	586300
455	SWALLOWS	455.1	SHAFT NO. 18	YORKSHIRE	442400	381900
455	SWALLOWS	455.2	SHAFT DRAIN	YORKSHIRE	442500	382100
455	SWALLOWS	455.3	SHAFT NO.4 NORTH	YORKSHIRE	442400	381900
455	SWALLOWS	455.4	SHAFT NO.5 SOUTH	YORKSHIRE	442500	382100
456	SOUTH SHIELDS	456.1	B/H NO. 1	NORTH EAST ENGLAND	436800	566800
456	SOUTH SHIELDS	456.2	B/H NO. 2	NORTH EAST ENGLAND	436800	566800
456	SOUTH SHIELDS	456.3	B/H NO. 3	NORTH EAST ENGLAND	436800	566800
457	SILVERDALE	457.1	NO.17 SHAFT	NORTH STAFFORDSHIRE	381400	346800
457	SILVERDALE	457.2	AERATION LAGOON	NORTH STAFFORDSHIRE	381400	346800
457	SILVERDALE	457.3	SETTLEMENT LAGOONS	NORTH STAFFORDSHIRE	381400	346800
457	SILVERDALE	457.4	DISCHARGE M/H	NORTH STAFFORDSHIRE	381400	346800
457	SILVERDALE	457.5	NO.1 SURFACE DRIFT	NORTH STAFFORDSHIRE	381400	346800
457	SILVERDALE	457.6	NO.2 SURFACE DRIFT	NORTH STAFFORDSHIRE	381400	346800
457	SILVERDALE	457.7	NO.3 SURFACE DRIFT	NORTH STAFFORDSHIRE	381400	346800
458	BAGWORTH	458.1	NO.1 UC SHAFT	LEICESTERSHIRE	444300	308700
458	BAGWORTH	458.2	NO.2 DC SHAFT	LEICESTERSHIRE	444300	308700
458	BAGWORTH	458.3	NO.3 JACKY PIT (REMOTE)	LEICESTERSHIRE	444300	308700
458	BAGWORTH	458.4	NO.4 OLD PUMPING SHAFT	LEICESTERSHIRE	444300	308700
459	SIX BELLS	459.1	NO.4 NORTH UC SHAFT	SOUTH WALES	321800	202800

459	SIX BELLS	459.2	NO.5 SOUTH DC SHAFT	SOUTH WALES	321800	202800
459	SIX BELLS	459.3	NO.5 SHAFT DISCHARGE	SOUTH WALES	321800	202800
460	STOURTON WATER DRIFT	460.1	ENTRANCE	YORKSHIRE	433300	430300
461	STOURTON NORTH	461.1	SHAFT 7	YORKSHIRE	433000	430000
461	STOURTON NORTH	461.2	SHAFT 7A	YORKSHIRE	433000	430000
461	STOURTON NORTH	461.3	M/H 8	YORKSHIRE	433000	430000
461	STOURTON NORTH	461.4	M/H 9	YORKSHIRE	433000	430000
462	LOW SHOPS	462.1	BEESTON SHAFT	YORKSHIRE	432800	428600
462	LOW SHOPS	462.2	NEW WATER SHAFT	YORKSHIRE	432800	428600
463	DESFORD	463.1	EAST SHAFT	LEICESTERSHIRE	445900	306900
463	DESFORD	463.2	WEST SHAFT	LEICESTERSHIRE	445900	306900
464	MEASHAM MAIN	464.1	NO.1 UC SHAFT (SOUTH)	SOUTH DERBYSHIRE	435000	311900
464	MEASHAM MAIN	464.2	NO.2 BACK SHAFT (NORTH)	SOUTH DERBYSHIRE	435000	311900
465	GRANVILLE NO.2	465.1	SHAFT	SOUTH DERBYSHIRE	430700	319100
466	DARK LANE	466.1	NO.1 SHAFT	YORKSHIRE	420800	421800
466	DARK LANE	466.2	NO.2 SHAFT	YORKSHIRE	420800	421800
466	DARK LANE	466.3	OLD BLOCKING SHAFT 3	YORKSHIRE	420800	421800
466	DARK LANE	466.4	OLD BLOCKING SHAFT 4	YORKSHIRE	420800	421800
467	LEMINGTON	467.1	WATER LEVEL	NORTH EAST ENGLAND	419300	564300
468	BLAYDON MAIN	468.1	HAZARD SHAFT	NORTH EAST ENGLAND	419400	562800
469	HEBBURN 'A'/'B' DRAIN	469.1	OUTFALL	NORTH EAST ENGLAND	431200	565800
469	HEBBURN 'A'/'B' DRAIN	469.2	1ST M/H	NORTH EAST ENGLAND	431200	565800
470	WALLSEND DRAIN	470.1	OUTFALL	NORTH EAST ENGLAND	431300	566100
470	WALLSEND DRAIN	470.2	2ND M/H	NORTH EAST ENGLAND	431300	566100
471	WALLSEND 'G'/'H'	471.1	'G' PIT	NORTH EAST ENGLAND	430900	566500
471	WALLSEND 'G'/'H'	471.2	'H' PIT	NORTH EAST ENGLAND	430900	566500
472	PAGE BANK MONITORING	472.1	NO.1 B/H	NORTH EAST ENGLAND	423400	535500
472	PAGE BANK MONITORING	472.2	NO.2 B/H	NORTH EAST ENGLAND	423400	535500
472	PAGE BANK MONITORING	472.3	NO.3 B/H	NORTH EAST ENGLAND	423400	535500
472	PAGE BANK MONITORING	472.4	NO.4 B/H	NORTH EAST ENGLAND	423400	535500
472	PAGE BANK MONITORING	472.5	NO.5 B/H	NORTH EAST ENGLAND	423400	535500
473	ELSWICK	473.1	LOW MAIN DRIFT	NORTH EAST ENGLAND	421900	563400
474	DELAVAL	474.1	LOW MAIN DRIFT	NORTH EAST ENGLAND	421100	563600
475	LODGE MILL	475.1	ADIT	YORKSHIRE	420100	416300
475	LODGE MILL	475.2	SHAFT	YORKSHIRE	420100	416300
476	THORNCLIFF	476.1	UC SHAFT	YORKSHIRE	421500	413000
476	THORNCLIFF	476.2	DRIFT	YORKSHIRE	421500	413000
477	KINNEIL	477.1	NO.1 SHAFT	CENTRAL FIFE	298700	681300
478	KIVETON PARK JUBILEE	478.1	DRIFT	YORKSHIRE	449200	382600
479	ROCKLEY ENGINE PIT	479.1	SHAFT	YORKSHIRE	433800	402100
480	CLAREMONT	480.1	B/H 2	NORTH EAST ENGLAND	434500	573600
481	TANFIELD LEA	481.1	MARGARET PIT	NORTH EAST ENGLAND	418800	554300
482	COLLIERLEY	482.1	BRASS THILL MAIN DRIFT	NORTH EAST ENGLAND	415500	554500
482	COLLIERLEY	482.2	BRASS THILL W/L	NORTH EAST ENGLAND	415600	554600
483	FOUR STONES JUNCTION	483.1	SHAFT DISCHARGE M/H'S	NORTH EAST ENGLAND	388800	567800
483	FOUR STONES JUNCTION	483.2	SHAFT DISCHARGE	NORTH EAST ENGLAND	388800	567800
484	WILLIAMTHORPE	484.1	NO. 1 SHAFT	NOTTINGHAMSHIRE	442800	366700
484	WILLIAMTHORPE	484.2	NO. 2 SHAFT	NOTTINGHAMSHIRE	442800	366700
485	SHIRE MOOR	485	HIGH MAIN FAN	NORTH EAST ENGLAND	433400	569400
485	SHIRE MOOR	485.1	HIGH MAIN B/H A	NORTH EAST ENGLAND	433400	569400

485	SHIRE MOOR	485.2	HIGH MAIN B/H B	NORTH EAST ENGLAND	433400	569400
485	SHIRE MOOR	485.3	HIGH MAIN B/H C	NORTH EAST ENGLAND	433400	569400
485	SHIRE MOOR	485.4	HIGH MAIN B/H 1	NORTH EAST ENGLAND	433400	569400
485	SHIRE MOOR	485.5	YARD SEAM B/H 3	NORTH EAST ENGLAND	433400	569400
486	PEGSWOOD MAUDLIN	486.1	B/H	NORTH EAST ENGLAND	423600	587300
487	HARTLEY	487.1	MAIN COAL B/H EAST	NORTH EAST ENGLAND	432900	576900
487	HARTLEY	487.2	MAIN COAL B/H WEST	NORTH EAST ENGLAND	432900	576900
488	MORTON	488.1	DC SHAFT	NOTTINGHAMSHIRE	441400	360300
488	MORTON	488.2	UC SHAFT	NOTTINGHAMSHIRE	441400	360300
489	LADDER PIT	489.1	SHAFT	SOUTH EAST LANCASHIRE	374200	404000
490	WEST YARD	490.1	LADDER PIT	SOUTH EAST LANCASHIRE	377100	404200
491	WEST CANNOCK NO.5	491.1	B/H	SOUTH STAFFORDSHIRE	401000	314100
492	BALGONIE (MUIRESPOT)	492.1	DYSART MAIN B/H	EAST FIFE	330500	699400
493	BALGONIE (DALGINCH)	493.1	DYSART MAIN B/H	EAST FIFE	330600	701500
494	COTGRAVE	494.1	NO.2 SHAFT	NOTTINGHAMSHIRE	465200	336500
495	NEW STUBBIN	495.1	PARKGATE B/H	YORKSHIRE	441300	395900
496	WARREN HOUSE BARNSLEY	496.1	B/H	YORKSHIRE	442700	397800
497	DOLPHINGSTONE GREAT SEAM	497.1	DAY LEVEL DISCHARGE	EAST LOTHIAN	337600	674300
497	DOLPHINGSTONE GREAT SEAM	497.2	DAY LEVEL M/H'S	EAST LOTHIAN	337600	674300
498	PRESTON GRANGE	498.1	PUMP SHAFT DISCHARGE	EAST LOTHIAN	337200	673700
498	PRESTON GRANGE	498.2	FAN DRIFT	EAST LOTHIAN	337200	673700
499	SOUTH NORMANTON	499.1	NO.1 DC SHAFT	NOTTINGHAMSHIRE	446100	356900
500	'A' WINNING	500.1	NO.1 DC SHAFT	NOTTINGHAMSHIRE	443500	357800
500	'A' WINNING	500.2	NO.2 UC SHAFT	NOTTINGHAMSHIRE	443500	357800
501	KILMUX	501.1	SHAFT		336000	704000
502	CROSSGATES WEST LEVEL	502.1	CHANT SHAFT	CENTAL FIFE	312800	689600
503	PONTLLANFRAITH	503.1	TRAMROAD DISCHARGE	SOUTH WALES	318200	195500
504	LINDSAY DISCHARGE	504.1	RAW MINEWATER	SOUTH WALES	259300	210800
504	LINDSAY DISCHARGE	504.2	LAGOONS	SOUTH WALES	259300	210800
504	LINDSAY DISCHARGE	504.3	REED BEDS	SOUTH WALES	259300	210800
504	LINDSAY DISCHARGE	504.4	TREATED DISCHARGE	SOUTH WALES	259300	210800
505	SETON	505.1	SPLINT B/H	EAST LOTHIAN	341400	674800
505	SETON	505.2	GREAT SEAM B/H	EAST LOTHIAN	341400	674800
506	ROEGREEN	506.1	COLLAPSE	SOUTH EAST LANCASHIRE	374800	401600
507	TRELEWIS	507.1	BRITHDIR B/H	SOUTH WALES	310400	199300
508	LLANHILLETH	508.1	GELLIDEG B/H	SOUTH WALES	322000	200600
509	ST. ILLTYD	509.1	BRITHDIR B/H	SOUTH WALES	322600	202100
510	CROSS HANDS	510.1	BIG SEAM B/H	SOUTH WALES	256900	212100
511	MORFA	511.1	BIG SEAM B/H	SOUTH WALES	257900	212500
512	CRAIG FAWR	512.1	ADIT	SOUTH WALES	321200	197400
513	GREENS LEVEL	513.1	ADIT	SOUTH WALES	323200	191600
514	DUNSTON	514.1	SHAFT	NORTH EAST ENGLAND	422800	562600
515	OAKWOOD GRANGE	515.1	PIPER B/H	NOTTINGHAMSHIRE	449400	342700
516	STANLEY	516.1	PIPER B/H	NOTTINGHAMSHIRE	442600	342400
517	ORMONDE (MILL FARM)	517.1	ROOF SOFT B/H	NOTTINGHAMSHIRE	442500	347300
518	DENBY HALL	518.1	PIPER B/H	NOTTINGHAMSHIRE	439700	348500
519	MAREHAY	519.1	BRICKYARD PUMPING SHAFT	NOTTINGHAMSHIRE	439500	348600
520	CALVERTON	520.1	NO.1 DC SHAFT	NOTTINGHAMSHIRE	460300	350000
520	CALVERTON	520.2	NO.2 UC SHAFT	NOTTINGHAMSHIRE	460300	350000
521	SUTTON	521.1	NO.1 LOW MAIN DC SHAFT	NOTTINGHAMSHIRE	448400	360200

521	SUTTON	521.2	NO.2 PIPER UC SHAFT	NOTTINGHAMSHIRE	448400	360200
522	BRANCEPETH 'A'	522.1	SHAFT	NORTH EAST ENGLAND	420500	535800
523	STONECHESTER	523.1	HUTTON FAN DRIFT	NORTH EAST ENGLAND	417800	536400
524	ROUGH LEA DRIFT	524.1	REMOTE VENT	NORTH EAST ENGLAND	419200	533500
524	ROUGH LEA DRIFT	524.2	PORTAL TEST VENT	NORTH EAST ENGLAND	419200	533500
525	WEST HUNWICK	525.1	NORTH SHAFT	NORTH EAST ENGLAND	419400	533000
525	WEST HUNWICK	525.2	SOUTH SHAFT	NORTH EAST ENGLAND	419400	533000
526	LADY BLANCHE	526.1	DOCK MINE	EAST FIFE	330200	692800
527	TAFF MERTHYR	527.1	PUMP SUMP 1	SOUTH WALES	310300	199100
527	TAFF MERTHYR	527.1	PUMP SUMP 2	SOUTH WALES	310300	199100
527	TAFF MERTHYR	527.1	TREATMENT SCHEME	SOUTH WALES	310300	199100
527	TAFF MERTHYR	527.1	DISCHARGE	SOUTH WALES	310300	199100
528	MORLAIS	528.1	TREATMENT	SOUTH WALES	257300	202500
529	BANKTON	529.1	ADIT B/H	EAST LOTHIAN	339800	673800
530	WOODSIDE	530.1	NO.2 SHAFT	NOTTINGHAMSHIRE	444700	344800
531	CRUMLIN NAVIGATION	531.1	SHAFTS	SOUTH WALES	321100	198800
532	BLAENGWRACH	532.1	DRIFTS	SOUTH WALES	288100	205800
533	DUNVANT	533.1	B/H 1	SOUTH WALES	259400	194100
533	DUNVANT	533.2	B/H 2	SOUTH WALES	259200	194200
533	DUNVANT	533.3	B/H 3	SOUTH WALES	259100	193800
534	MUIRPARK	534.1	FOUR FEET B/H	EAST LOTHIAN	342400	672800
535	RIGGONHEAD	535.1	THREE FEET B/H	EAST LOTHIAN	341600	675300
536	PRESTONPANS	536.1	DIAMOND B/H	EAST LOTHIAN	339400	674100
537	BLAENAVON	537.1	DISCHARGE	SOUTH WALES	324500	208800
537	BLAENAVON	537.2	TREATMENT	SOUTH WALES	324500	208800
537	BLAENAVON	537.3	DISCHARGE	SOUTH WALES	324500	208800
538	BOGHEAD	538.1	DISCHARGE	EAST CENTRAL	296800	667500
539	ARMADALE NO.19	539.1	SHAFT DISCHARGE	EAST CENTRAL	293400	669200
540	WEST WEMYSS	540.1	SHAFT	EAST FIFE	332700	694600
541	PREBEND	541.1	LOW MAIN ADIT	NORTH EAST ENGLAND	427200	542200
542	IRWELL SPRINGS	542.1	MILNROW SANDSTONE B/H	NORTH EAST LANCASHIRE	387400	427500
543	EASDEN WOOD	543.1	UPPER MOUNTAIN B/H	NORTH EAST LANCASHIRE	385800	427500
544	BLACKCLOUGH WATERLOOSE	544.1	UPSTREAM WEIR	NORTH EAST LANCASHIRE	386500	427700
544	BLACKCLOUGH WATERLOOSE	544.2	DISCHARGE	NORTH EAST LANCASHIRE	386600	427800
544	BLACKCLOUGH WATERLOOSE	544.3	DOWNSTREAM WEIR	NORTH EAST LANCASHIRE	386700	427900
545	DEERPLAY WATERLOOSE	545.1	VENT	NORTH EAST LANCASHIRE	386600	427900
545	DEERPLAY WATERLOOSE	545.2	DISCHARGE	NORTH EAST LANCASHIRE	386600	427900
546	WHEATLEY WOOD	546.1	BARNSLEY OLD PUMPING SHAFT	YORKSHIRE	432300	411800
546	WHEATLEY WOOD	546.2	RETURN SHAFT	YORKSHIRE	432300	411800
547	BROOM ROYD	547.1	DRAINAGE LEVEL	YORKSHIRE	433100	402000
548	LUNDHILL	548.1	NO.3 SHAFT	YORKSHIRE	439900	402000
549	DAYHOUSE FARM	549.1	DISCHARGE	YORKSHIRE	432600	408500
550	COWPEN ISABELLA	550.1	RAILWAY SUMP	NORTH EAST ENGLAND	429900	582000
551	HAUGH	551.1	ENGINE PIT	YORKSHIRE	442500	397200
552	HYLTON	552.1	EAST SHAFT	NORTH EAST ENGLAND	436500	558300
552	HYLTON	552.2	WEST SHAFT	NORTH EAST ENGLAND	436500	558300
553	SCHOLES SHAFT	553.1	SHAFT	YORKSHIRE	438500	395600
554	HIGH ROYD	554.1	BARNSLEY B/H	YORKSHIRE	435900	401400
555	SCHOLES PARKGATE	555.1	B/H	YORKSHIRE	438700	395500
556	COACH ROAD	556.1	DISCHARGE	LEICESTERSHIRE	438700	320100

557	CAT NOB	557.1	AIR SHAFT	YORKSHIRE	433700	399200
558	CARDOWAN	558.1	NO.1 SHAFT	WEST CENTRAL	266600	668500
558	CARDOWAN	558.2	NO.2 SHAFT	WEST CENTRAL	266600	668500
558	CARDOWAN	558.3	NO.3 SHAFT	WEST CENTRAL	266800	668400
559	HARTLEY BANK	559.1	EAST DEEP B/H	YORKSHIRE	427800	417300
559	HARTLEY BANK	559.2	WEST SHALLOW B/H	YORKSHIRE	427800	417300
560	WOODIFIELD	560.1	BROCKWELL B/H	NORTH EAST ENGLAND	416100	535400
561	CROOK	561.1	BROCKWELL B/H	NORTH EAST ENGLAND	416300	537900
562	NORTH BITCHBURN	562.1	BUSTY B/H	NORTH EAST ENGLAND	417200	532700
563	JOBS HILL	563.1	TILLEY B/H	NORTH EAST ENGLAND	417300	535300
564	ABBOTS CLOSE	564.1	BOTTOM BUSTY B/H	NORTH EAST ENGLAND	413900	535200
565	BRACKEN HILL DRIFT	565.1	B/H	NORTH EAST ENGLAND	418400	535100
566	CHRYSTON	566.1	NO 'B' B/H	WEST CENTRAL	268200	670200
566	CHRYSTON	566.2	NO.2 B/H	WEST CENTRAL	268200	670200
566	CHRYSTON	566.3	NO.3 B/H	WEST CENTRAL	268200	670200
567	BIG PIT (GELLI)	567.1	M/H	SOUTH WALES	321500	212000
567	BIG PIT (GELLI)	567.2	OUTFALL	SOUTH WALES	321500	212100
568	ECKLANDS LANE	568.1	AIR SHAFT	YORKSHIRE	421700	401800
569	SALFORD COLLEGE	569.1	B/H	SOUTH EAST LANCASHIRE	373800	402600
570	MOSLEY COMMON	570.1	B/H	SOUTH EAST LANCASHIRE	372900	401300
571	DOUGLAS	571.1	DISCHARGE	DOUGLAS	286800	635600
572	BROWNEY	572.1	OLD SHAFT	NORTH EAST ENGLAND	426000	539700
573	MIDDLEFIELD	573.1	ENGINE B/H	EAST FIFE	329200	697300
574	ATKINSON'S DRIFT	574.1	DISCHARGE	NORTH EAST ENGLAND	416500	564500
574	ATKINSON'S DRIFT	574.2	OUTLET M/H	NORTH EAST ENGLAND	416500	564500
575	BLAIRINGONE	575.1	DRIFT OUTLET	CLACKMANNAN & NE STIRLING	298000	697300
575	BLAIRINGONE	575.2	REEDS INLET	CLACKMANNAN & NE STIRLING	298000	697300
575	BLAIRINGONE	575.3	REED BED	CLACKMANNAN & NE STIRLING	298000	697300
575	BLAIRINGONE	575.4	TREATED DISCHARGE	CLACKMANNAN & NE STIRLING	298000	697300
576	TEES-SIDE	576.1	WINSTON DRIFT	NORTH EAST ENGLAND	414200	516600
577	WALLYFORD	577.1	OLD SEA LEVEL	EAST LOTHIAN	336400	672800
578	ISABELLA	578.1	OLD CROSSCUT MINE		328400	692000
579	TREFORGAN	579.1	MONITORING BH	SOUTH WALES	278800	205700
580	FORDELL NO.2	580.1	SHAFT	CENTRAL FIFE	314900	685500
581	FORDELL NO.3 VANTAGE	581.1	SHAFT	CENTRAL FIFE	314900	685500
582	FORDELL NO.5	582.1	SHAFT	CENTRAL FIFE	315000	686000
583	FORDELL NO.12	583.1	SHAFT	CENTRAL FIFE	315100	686900
584	FORDELL HOPEWELL	584.1	SHAFT	CENTRAL FIFE	315400	688200
585	FORDELL VENGEANCE	585.1	SHAFT	CENTRAL FIFE	315400	688300
586	SOLSGIRTH	586.1	NORTH RETURN DRIFT	CLACKMANNAN & NE STIRLING	298300	694500
586	SOLSGIRTH	586.2	SOUTH INTAKE DRIFT	CLACKMANNAN & NE STIRLING	298300	694500
587	FORDELL DAY LEVEL	587.1	ADIT	CENTRAL FIFE	314800	685300
588	FORDELL UPPER	588.1	DISCHARGE	CENTRAL FIFE	314800	685500
589	POOL	589.1	GAS COAL W/L	EAST CENTRAL	298600	654200
589	POOL	589.2	POND AND REED BEDS	EAST CENTRAL	298600	654200
589	POOL	589.3	TREATED DISCHARGE	EAST CENTRAL	298600	654200
590	RAWDON CONNECTION	590.1	DRIFT B/H	SOUTH DERBYSHIRE	431200	316200
591	CUTHILL BREICH WATER	591.1	ADIT	EAST CENTRAL	299000	662800
591	CUTHILL BREICH WATER	591.2	RAW MINEWATER	EAST CENTRAL	299000	662800
591	CUTHILL BREICH WATER	591.3	LAGOONS + REED BEDS	EAST CENTRAL	299000	662800

591	CUTHILL BREICH WATER	591.4	TREATED DISCHARGE	EAST CENTRAL	299000	662800
592	MOIRA	592.1	LITTLE WOODFIELD B/H	SOUTH DERBYSHIRE	431500	314900
593	CELYNEN SOUTH	593.1	B/H	SOUTH WALES	321800	195500
594	CROSS KEYS	594.1	BLACK VEIN B/H	SOUTH WALES	322600	191300
595	NANTGARW	595.1		SOUTH WALES	#VALUE!	#VALUE!
596	TY MAWR	596.1	B/H	SOUTH WALES	305400	190900
597	CAMERON BRIDGE	597.1	DYSART MAIN B/H	EAST FIFE	335000	699700
598	BUCKHAVEN	598.1	BOWHOUSE B/H	EAST FIFE	335300	699400
599	THORNTON STATION	599.1	DYSART MAIN B/H	EAST FIFE	329100	697300
600	THORNTON VILLAGE	600.1	DYSART MAIN B/H	EAST FIFE	329200	697700
601	LONGANNET	601.1	DRIFT	CLACKMANNAN & NE STIRLING	294500	686400
602	PIPER POOL	602.1	B/H	CLACKMANNAN & NE STIRLING	298100	692800
603	BROOMPARK	603.1	COOKE'S WOOD ADIT	NORTH EAST ENGLAND	424200	541500
604	RAWDON UPPER SEAM	604.1	DRIFT B/H	SOUTH DERBYSHIRE	431200	316200
605	WHITWORTH PARK	605.1	DISCHARGE	NORTH EAST ENGLAND	423700	535700
606	BYRONS DRIFT	606.1	DISCHARGE	NORTH EAST ENGLAND	366200	564800
607	BLENKIN SOPP	607.1	SMALLBURN SHAFT	BLENKINSOP	367100	564400
608	LAMBLEY DRIFTS	608.1	NO.1 DISCHARGE	BLENKINSOP	367300	559600
608	LAMBLEY DRIFTS	608.2	NO.2 DISCHARGE	BLENKINSOP	367500	559300
608	LAMBLEY DRIFTS	608.3	MID-TYNE DRIFT	BLENKINSOP	367500	559200
609	AYKLEYHEADS	609.1	DISCHARGE	NORTH EAST ENGLAND	427500	544000
610	LATHALLAN	610.1	UPWELLING		346500	706300
610	LATHALLAN	610.2	POND AND REED BEDS		346500	706300
610	LATHALLAN	610.3	TREATED DISCHARGE		346500	706300
611	SWINHILL KILTONGUE	611.1	DISCHARGE	WEST CENTRAL	276700	648800
612	MUIREDGE BARNCRAIG	612.1	B/H	EAST FIFE	335200	698700
613	SWINHILL VIRTUEWELL	613.1	AIR DRIFT	WEST CENTRAL	277200	648800
614	CANDERSIDE	614.1	DRIFT DISCHARGE	WEST CENTRAL	276800	646700
615	BORELAND	615.1	SANDWELL B/H	EAST FIFE	330400	694600
616	COALTOWN OF BALGONIE	616.1	DYSART MAIN B/H	EAST FIFE	330600	699800
617	LITTLEMOOR	617.1	VENT	CUMBRIA	307300	531700
618	BELLE INGS	618.1	SHAFT	YORKSHIRE	435300	403400
618	BELLE INGS	618.2	DISCHARGE	YORKSHIRE	435300	403400
619	GLASSHOUGHTON	619.1	WARREN HOUSE B/H	YORKSHIRE	442500	424300
619	GLASSHOUGHTON	619.2	BEAMSHAW B/H	YORKSHIRE	442500	424300
620	CASTLEHILL	620.1	NO.2 DRIFT	CLACKMANNAN & NE STIRLING	297800	690000
621	SHEPLEY DYKE	621.1	ENGINE PIT	YORKSHIRE	421300	410200
621	SHEPLEY DYKE	621.2	DISCHARGE	YORKSHIRE	421300	410200
622	PEGSWOOD MOOR	622.1	FIVE QUARTER VENT	NORTH EAST ENGLAND	421100	587700
623	SPRINGWELL	623.1	TOP HIGH MAIN B/H	NORTH EAST ENGLAND	427900	558500
624	REDHEUGH	624.1	YARD SEAM B/H	NORTH EAST ENGLAND	424900	562600
625	CROFTON YARD SEAM	625.1	B/H	NORTH EAST ENGLAND	431700	580800
626	WHITLEY BAY	626.1	LOW MAIN B/H	NORTH EAST ENGLAND	434300	572900
627	LEVEN 1/2	627.1	CHEMISS B/H	EAST FIFE	336200	699800
628	LOW BEECHBURN	628.1	BROCKWELL DRIFT B/H	NORTH EAST ENGLAND	416400	535100
629	GHYLLHEAD	629.1	HOUSE VENT	CUMBRIA	303200	532600
630	KINGSBURY	630.1	BRICKWORKS B/H	WARWICKSHIRE	421900	299200
631	ROSCOE WOOD	631.1	SHAFT	SOUTH EAST LANCASHIRE	345700	389300
632	HOCKERY BROOK	632.1	V-NOTCH	SOUTH EAST LANCASHIRE	361500	405100
633	LEVEN 4	633.1	BARNCRAIG B/H	EAST FIFE	336600	699900

634	RIGSIDE	634.1	GAS COAL B/H	DOUGLAS	286700	635500
635	BARONY	635.1	NO.3 SHAFT	CENTRAL AYRSHIRE	252800	621900
636	BLIDWORTH	636.1	NO.2 SHAFT	NOTTINGHAMSHIRE	459400	356600
637	BEACON HOUSE FARM	637.1	VENT	NORTH STAFFORDSHIRE	387700	359200
638	BLACKDYKE	638.1	NO.1 SHAFT		241200	661100
639	BROAD CLOUGH	639.1	WATERLOOSE	NORTH EAST LANCASHIRE	386900	424400
640	LEACROFT COLLIERY	640.1	ACCESS	SOUTH STAFFORDSHIRE	400000	309700
640	LEACROFT COLLIERY	640.2	B/H	SOUTH STAFFORDSHIRE	400000	309700
641	SCHOOLS WELLS	641.1	HALIFAX HARDS B/H	YORKSHIRE	422000	401500
642	FLASH HOUSE	642.1	HALIFAX HARDS B/H	YORKSHIRE	420900	403500
643	DINAS	643.1	MIDDLE SHAFT DISCHARGE	SOUTH WALES	300800	191800
644	SHUTTLE EYE	644.1	NO.1 SHAFT	YORKSHIRE	422200	415600
644	SHUTTLE EYE	644.2	NO.2 SHAFT	YORKSHIRE	422200	415600
645	BARLEY HILL	645.1	DISCHARGE	NORTH EAST ENGLAND	417500	552900
646	PRESTONGRANGE GREAT	646.1	SEAM B/H	EAST LOTHIAN	337400	673600
647	WALLYFORD GREAT	647.1	SEAM B/H	EAST LOTHIAN	336600	673300
648	WOOD	648.1	AIR SHAFT	YORKSHIRE	416800	407400
649	HAZELHEAD	649.1	SHAFT	YORKSHIRE	418000	401500
650	JOPPA NORTH B/H'S	650.1	JOPPA PARK B/H	MID LOTHIAN	331600	673500
650	JOPPA NORTH B/H'S	650.2	MID MORTON ST B/H	MID LOTHIAN	331600	673500
650	JOPPA NORTH B/H'S	650.3	TOP MORTON ST B/H	MID LOTHIAN	331600	673500
650	JOPPA NORTH B/H'S	650.4	KEY STORE B/H	MID LOTHIAN	331600	673500
650	JOPPA NORTH B/H'S	650.5	ORMELIE B/H	MID LOTHIAN	331600	673500
651	JOPPA SOUTH B/H'S	651.1	DALKEITH ST B/H	MID LOTHIAN	331600	673500
651	JOPPA SOUTH B/H'S	651.2	POLICE BOX B/H	MID LOTHIAN	331600	673500
651	JOPPA SOUTH B/H'S	651.3	WOODSIDE TERRACE B/H	MID LOTHIAN	331600	673500
651	JOPPA SOUTH B/H'S	651.4	TENNIS CLUB B/H	MID LOTHIAN	331600	673500
652	BARNBURGH	652.1	SHAFTON B/H	YORKSHIRE	448600	402600
653	GREAT CLIFTON	653.1	DISCHARGE	CUMBRIA	303600	529900
654	RYHILL MAIN	654.1	WEST SHAFT	YORKSHIRE	438300	413800
655	DEARNE VALLEY TOP SHARLSTON	655.1	B/H	YORKSHIRE	442300	405800
656	GLENCAIRN DIAMOND	656.1	PUMPING B/H	EAST LOTHIAN	341400	674600
656	GLENCAIRN DIAMOND	656.2	DISCHARGE	EAST LOTHIAN	31400	674600
656	GLENCAIRN DIAMOND	656.3	SETON SANDS	EAST LOTHIAN	341500	675900
657	GOSHEN FARM	657.1	SHAFT	EAST LOTHIAN	337500	673200
658	FREEHOLD PIT	658.1	DISCHARGE	NORTH EAST ENGLAND	417300	563500
659	DEEPCAR	659.1	DRAINAGE LEVEL	YORKSHIRE	429100	398000
660	CLOUGH FOOT	660.1	DISCHARGE	NORTH EAST LANCASHIRE	390500	423800
661	UNSTONE	661.1	NO.1 DISCHARGES	NOTTINGHAMSHIRE	337200	477500
661	UNSTONE	661.2	NO.2 DISCHARGE	NOTTINGHAMSHIRE	337400	477400
661	UNSTONE	661.3	NO.3 DISCHARGE	NOTTINGHAMSHIRE	337500	477200
662	OLD WESTERTON	662.1	DISCHARGE	NORTH EAST ENGLAND	421700	530200
663	CLARKE'S	663.1	BLACKSHALE B/H	NOTTINGHAMSHIRE	441400	371300
664	ARKWRIGHT TOP HARD	664.1	NO.1 B/H	NOTTINGHAMSHIRE	442700	370700
664	ARKWRIGHT TOP HARD	664.2	NO.2 B/H	NOTTINGHAMSHIRE	442700	370700
664	ARKWRIGHT TOP HARD	664.3	NO.3 B/H	NOTTINGHAMSHIRE	442700	370700
664	ARKWRIGHT TOP HARD	664.4	NO.4 B/H	NOTTINGHAMSHIRE	442700	370700
665	ROUND GREEN	665.1	BARNSLEY B/H	YORKSHIRE	433800	403600
666	HOLLIN BUSK	666.1	AIR SHAFT	YORKSHIRE	427600	397400
667	BABBINGTON	667.1	NO.4 SHAFT	NOTTINGHAMSHIRE	453200	343700

668	CARR & CRAGGS MOOR	668.1	ADIT DISCHARGE	NORTH EAST LANCASHIRE	389200	425800
668	CARR & CRAGGS MOOR	668.2	TOP GREENS CLOUGH	NORTH EAST LANCASHIRE	389200	425800
668	CARR & CRAGGS MOOR	668.3	UPSTREAM	NORTH EAST LANCASHIRE	389200	425800
669	SHUTTLE-EYE BEESTON	669.1	BOREHOLE	YORKSHIRE	422500	415500
670	GRANGE ASH BLOCKING	670.1	NEW BOREHOLE	YORKSHIRE	424600	415900
671	EMLEY MOOR	671.1	BLOCKING B/H	YORKSHIRE	424200	414900
672	NEW HALL	672.1	FLOCKTON B/H	YORKSHIRE	425900	416000
673	GLYNCORRWG	673.1	TREATMENT SCHEME	SOUTH WALES	387500	199200
674	PEMBERTON	674.1	DISCHARGE	SOUTH EAST LANCASHIRE	356100	403500
675	CLIFTON HALL	675.1	CROMBOUKE B/H	SOUTH EAST LANCASHIRE	379300	402200
675	CLIFTON MOSS	675.2	BOREHOLE	SOUTH EAST LANCASHIRE	376600	403600
676	LIMB BROOK	676.1	NO.1 LOWER DISCHARGE	YORKSHIRE	431800	381800
676	LIMB BROOK	676.2	CULVERT 1 DISCHARGE	YORKSHIRE	431800	381800
676	LIMB BROOK	676.3	CULVERT 2 DISCHARGE	YORKSHIRE	431800	381800
677	CLAYWHEELS LANE	677.1	DISCHARGE	YORKSHIRE	431800	392200
678	LOXLEY BOTTOM	678.1	DISCHARGE	YORKSHIRE	432300	389400
679	SUMMERLEY	679.1	NO.1 DISCHARGE	NOTTINGHAMSHIRE	436500	378000
680	CARTERS	680.1	HAIGH MOOR PIT	YORKSHIRE	442200	428000
680	CARTERS	680.2	WARREN HOUSE PIT	YORKSHIRE	442200	428000
681	GLYNCASTLE	681.1	TREATMENT SCHEME	SOUTH WALES	383300	202500
682	CANNOCK WOOD	682.1	BOREHOLE	SOUTH STAFFORDSHIRE	403600	312600
683	CRAIG Y ABER	683.1	DISCHARGE	SOUTH WALES	285600	184800
684	PONTLOTTYN	684.1	DISCHARGE	SOUTH WALES	311600	206500
684	PONTLOTTYN	684.2	ACCESS	SOUTH WALES	311600	206500
685	FIRBANK	685.1	BOREHOLE	CUMBRIA	304300	535300
686	HILTON	686.1	BOREHOLE	SOUTH EAST LANCASHIRE	3 787	4 030

APPENDIX D

SITES OF RECORDED SURFACE GRAVITY DISCHARGES OF MINE WATER

S Number	Site	GR	Region
S84081	Bar Combe Back Drift	NY 772 657	Blenkinsop
S84082	Henshaw Fore Drift	NY 771 656	Blenkinsop
S84083	Bardon Mill Boreholes	NY 777 645	Blenkinsop
S84086	Haltwhistle Dene Drifts	NY 708 648	Blenkinsop
S84087	Mid-Tyne Drift, Haydons Drift	NY 851 649	Blenkinsop
S84096	Haydons Bridge Discharge (West)	NY 840 640	Blenkinsop
S84097	Ayle East	NY 731 499	Blenkinsop
S84098	Shilburnhaugh (Kielder) Drift	NY 697 867	Blenkinsop
S140032	Glenburn Prestwick	NS 345 278	Central Ayrshire
S140036	Cairnhill Mine Muirkirk	NS 627 234	Central Ayrshire
S140037	Craigie Workshops, Ayr	NS 346 214	Central Ayrshire
S140038	Chang Farm Cumnock	NS 404 236	Central Ayrshire
S140039	7 Discharges Glenbuck	NS 705 294	Central Ayrshire
S140040	Pennyvenie Dalmellington	NS 500 069	Central Ayrshire
S140041	Pennyvenie No.4 Dalmellington	NS 487 066	Central Ayrshire
S140042	Corby Craigs Dalmellington	NS 455 088	Central Ayrshire
S140043	Rozelle Park, Ayr	NS 342 193	Central Ayrshire
S140054	Minnivey	NS 474 072	Central Ayrshire
S140049	Mynher Coal Drainage Adit (Glencraig Pit)	NT 186 951	Central Fife
S140051	Kinglassie Pit	NT 236 984	Central Fife
S140058	Parsons Mill (Cluny or Bowhill Pits)	NT 223 956	Central Fife
S140059	New Carden No.2	NT 233 961	Central Fife
S140060	New Carden No.3	NT 234 961	Central Fife
S140061	Cardenden Road Bridge (Dead End Pit)	NT 220 953	Central Fife
S140062	New Colquhally (Glencraig Pit)	NT 202 949	Central Fife
S140079	East Colquhally (Glencraig Pit)	NT 201 949	Central Fife
S140080	U/S Bow Bridge (Minto)	NT 201 948	Central Fife
S140081	Cluny (Kinglassie Pit)	NT 243 963	Central Fife
S140090	Blairenbathie Pit/OCCS	NT 125 947	Central Fife
S140005	Mollins Burn	NS 716 699	Central Scotland
S140006	Brumbeck, Kilsyth	NS 703 771	Central Scotland
S140007	Carstairs Spring	NS 951 458	Central Scotland
S140009	Earnock Burn Resurgence, Hamilton	NS 674 532	Central Scotland
S140010	Springhill Farm	NS 674 649	Central Scotland
S140011	Blackwood	NS 803 432	Central Scotland
S140013	Skelly Gill Resurgence	NS 775 527	Central Scotland
S140015	Longlea Auchinheath	NS 803 445	Central Scotland
S140016	Marsh Hide, Dalzell	NS 753 550	Central Scotland
S140017	Gillhead, Overtown	NS 821 533	Central Scotland
S140018	Garrion Burn Resurgence, Overtown	NS 799 515	Central Scotland
S140020	Shotts	NS 876 597	Central Scotland
S140021	Blackhall Auchter Series of Seepage	NS 862 562	Central Scotland
S140022	Near No.1 Outfall Ravencraig	NS 776 574	Central Scotland
S140023	Clyde Valley Garden Centre, Larkhall	NS 791 515	Central Scotland
S140024	Plains	NS 675 649	Central Scotland
S140025	Carnbroe	NS 751 638	Central Scotland
S140026	Gartcosh	NS 705 675	Central Scotland
S140027	Greengairs	NS 781 704	Central Scotland
S140028	Boyd's Burn Lennoxtown	NS 634 767	Central Scotland
S140029	Auchinstarry Kilsyth	NS 714 765	Central Scotland
S140030	Dullatur	NS 745 778	Central Scotland
S140031	Burnell Rannie Lennoxtown	NS 629 790	Central Scotland
S140046	Fauldheads nr Harthill	NS 896 637	Central Scotland
S140068	Klondyke (Darnrigg)	NS 871 740	Central Scotland
S140076	Culloch Burn (Balquhatstone)	NS 852 724	Central Scotland
S140077	Woodbank Farm (Earlseat)	NS 935 702	Central Scotland
S140077	Woodbank Farm (Earlseat)	NS 945 702	Central Scotland
S140082	Cleugh Burn (Pirleyhill No. 2,3)	NS 886 775	Central Scotland
S140083	West Quarter No.1,3 (Redding Pit)	NS 912 788	Central Scotland
S140085	Burnside Rd (Bathgate)	NS 970 691	Central Scotland
S140087	Ballencrieff Toll (Balbardie Pit)	NS 973 710	Central Scotland

S140093	Woodmuir	NS 970 610	Central Scotland
S126010	Lower Vernon Pit, Poynton	SJ 933 842	Cheshire
S126011	Nelson Pit, Poynton		Cheshire
S140066	Outh Moor (Lethans Pit)	NT 062 944	Clackmannan & NE Stiling
S140086	Pirnhall Mine	NS 801 897	Clackmannan & NE Stiling
S126016	John Pit Adit	NX 9834 2377	Cumbria
S140008	Glentaggart Glespin	NS 817 273	Douglas
S140091	Johnshill Burn (Auchlochan No.9, 10)	NS 816 374	Douglas
S140056	Star Road (Markinch)	NO 296 025	East Fife
S140057	U/S Carenden STW (Clunypit)	NT 223 955	East Fife
S140078	Coal Farm	NO 535 019	East Fife
S140047	Edgehead Pit	NT 382 646	Lothians
S140063	Blinkbonny Wood (Vogrie Burn)	NT 377 639	Lothians
S140071	Vogrie No.1 and No.2	NT 349 608	Lothians
S140072	Moss End (Blink Bonny Mine)	NT 3580 6231	Lothians
S140073	Wolfstar (Pencaitland)	NT 419 688	Lothians
S140074	Bellyford Burn (Gowden Pit)	NT 3680 6740	Lothians
S140075	Crossgate Hall	NT 379 692	Lothians
S140088	Society (Duddingston Pit)	NT 010 790	Lothians
S140089	Cornton Mine	NT 206 589	Lothians
S140033	Red Burn, Irvine	NS 316 408	North Ayrshire
S140034	Monkcastle Mine, Dalry	NS 293 475	North Ayrshire
S140035	Master Gott Burn Stevenston	NS 285 418	North Ayrshire
S84003	Cocken Fan Drift	NZ 289 472	North East England
S84004	Crookhall Garden Drift	NZ 133 499	North East England
S84006	Iveston Drift	NZ 141 505	North East England
S84007	Lilley Drift - Rowlands Gill	NZ 168 593	North East England
S84008	Low Mill W/L Drift	NZ 143 444	North East England
S84009	Sacriston Shield Row Drift	NZ 235 480	North East England
S84012	Dolls Hole Drift to F Seam	NZ 233 540	North East England
S84013	Beamish 2nd Pit W/L Drift	NZ 225 539	North East England
S84015	Thornley Stapple	NZ 176 608	North East England
S84016	Bolton Garths	NZ 174 238	North East England
S84019	Busty Bank Drift	NZ 176 576	North East England
S84020	High Friarside Drift	NZ 163 568	North East England
S84024	Blackhalll Mill	NZ 118 566	North East England
S84025	Marley Hill Clockburn Drift	NZ 186 603	North East England
S84030	Hylton Dene	NZ 358 585	North East England
S84031	Derwentcote Drift	NZ 132 564	North East England
S84033	Bearpark Low Main Drift	NZ 241 439	North East England
S84034	Emms Hill, Marshall Green	NZ 098 290	North East England
S84035	Axwell W/L	NZ 187 604	North East England
S84036	Lynesack	NZ 090 263	North East England
S84037	Garesfield Ruler	NZ 133 599	North East England
S84038	Garesfield Townley	NZ 139 595	North East England
S84039	Garesfield Tilley	NZ 138 604	North East England
S84040	JKI W/L	NZ 132 647	North East England
S84041	Hamilton Row Drift	NZ 176 402	North East England
S84042	East Hedleyheop Drift	NZ 159 402	North East England
S84043	Lane Foot Drift	NZ 153 421	North East England
S84044	Low West House Drift	NZ 158 428	North East England
S84045	Bells House Drift	NZ 163 428	North East England
S84046	Thorstle Nest Drift	NZ 155 457	North East England
S84047	Raven Drift, Medomsley	NZ 106 546	North East England
S84048	Main Coal Drift, Medomsley	NZ 120 530	North East England
S84049	Main Coal Drift South Medomsley	NZ 144 539	North East England
S84050	Beamish Park Waterway Drift	NZ 216 549	North East England
S84051	Mahogany Row Drift, Beamish	NZ 218 544	North East England
S84052	Beamish Ling Shaft	NZ 208 535	North East England
S84053	Old Coal Lebvel Chopwell No.3	NZ 107 588	North East England
S84054	Chopwell Hutton Drift	NZ 115 586	North East England
S84056	Whitworth Hall	NZ 234 347	North East England
S84057	Castleways Hutton Drift	NZ 204 460	North East England
S84058	Causey Mill Drift	NZ 204 551	North East England
S84059	Burn Day Hole	NZ 116 565	North East England
S84060	Cairns Drift	NZ 119 556	North East England
S84061	Main Coal Drift Derwent	NZ 129 551	North East England

S84062	Main Coal (L) Derwent	NZ 132 553	North East England
S84063	Watergate Hutton Drift	NZ 220 599	North East England
S84064	Snipes Dene Drift, Gibside	NZ 182 594	North East England
S84065	Barcus Close Drift	NZ 167 579	North East England
S84066	South Garesfield Victoria T	NZ 158 575	North East England
S84068	Mill Drift, Kibblesworth	NZ 246 551	North East England
S84069	Drift to High Main, Beamish	NZ 210 539	North East England
S84070	Whitehill	NZ 257 515	North East England
S84071	Barnes Drift, Parkwood Whittonstall	NZ 095 568	North East England
S84072	Riser on Beamish Waggonway from Ice Pit	NZ 212 533	North East England
S84077	Makemerich Discharge	NZ 045 789	North East England
S84078	Makemerich-Brandywell Discharge	NZ 050 789	North East England
S84079	Whittonstall Drift	NZ 087 573	North East England
S84091	Peggy Shaft, Wylam	NZ 113 644	North East England
S84100	Chilton No's 1 and 2	NZ 278 308	North East England
S84102	Stockerley	NZ 139 488	North East England
S84109	Leasingthorne	NZ 255 304	North East England
S84110	Ushaw College	NZ 2154 4320	North East England
S84126	Kirkheaton Drifts	NZ 040 769	North East England
S84131	Glordrum Shaft	NZ 190 824	North East England
S84132	Whorral Drifts	NZ 211 868	North East England
S126009	Aspen Valley	SD 737 285	North East Lancashire
S126020	Townley Demesne	SD 8480 3110	North East Lancashire
S126021	Woodend	SD 8320 3520	North East Lancashire
S126026	Dearnley Moor	SD 9240 1540	North East Lancashire
S126027	Easden Wood Waterloose	SD 863 286	North East Lancashire
S126028	Holme Chapel	SD 874 283	North East Lancashire
S126029	Beehole/Rowley Tip	SD 860 335	North East Lancashire
S126030	Hapton Valley Waterloose	SD 812 314	North East Lancashire
S126031	Shorters Brook, Altham	SD 777 330	North East Lancashire
S126032	Altham Under Bridge Discharge	SD 773 332	North East Lancashire
S126033	Altham Bridge Discharge	SD 775 331	North East Lancashire
S126024	Kidsgrove	SJ 8450 5250	North Staffordshire
S126025	Hardings Wood	SJ 8380 5300	North Staffordshire
S126038	Whitfield	SJ 881 536	North Staffordshire
S96034	Hawarden	SJ 30680 65710	North Wales
S96078	Rhyd-y-Goleu	SJ 2335 6496	North Wales
S96079	Duarthau	SJ 24370 60200	North Wales
S96080	Bryn Gwyn	SJ 27330 67450	North Wales
S96081	Pontblyddyn	SJ 27480 61080	North Wales
S96082	Little Mountain Screen Adit Coed-Talon Banks	SJ 2719 5811	North Wales
S96083	Bottom Lodge Adit Cymau Hall	SJ 29290 54960	North Wales
S96084	Monsanto-Cefn	SJ 27340 41880	North Wales
S96085	Cefn Intake:Cefn Return Sydallt	SJ 31440 55290	North Wales
S96086	Gresford Tip	SJ 3348 5387	North Wales
S96087	Gwersyllt Park	SJ 32520 54310	North Wales
S96108	Bryn-Yr-Owen	SJ 2985 4765	North Wales
S96109	Dee Level	SJ 2953 4080	North Wales
S96110	Vron	SJ 295 519	North Wales
S96111	Red Water Wood	SJ 124 826	North Wales
S96112	Waterloo Tower Drainage Level	SJ 288 419	North Wales
S96113	Pentre	SJ 292 409	North Wales
S96114	Gardden Lodge	SJ 299 447	North Wales
S96115	Black Diamond King Coal Adits	SJ 275 578	North Wales
S96116	West Leaswood Return Adit	SJ 254 599	North Wales
S117020	Wingfield Lane, Alfreton	SK 398 548	Nottinghamshire
S117023	River Hipper, Chesterfield	SK 364 706	Nottinghamshire
S117024	Summerley No.2	SK 369 778	Nottinghamshire
S117028	Cow Lane	SK 402 751	Nottinghamshire
S117029	Robinson's BH	SK 366 706	Nottinghamshire
S117030	Dock Walk	SK 375 709	Nottinghamshire
S117031	Markhams Engineering	SK 390 710	Nottinghamshire
S117033	Pentrich	SK 393 516	Nottinghamshire
S117034	Upper Hartshay	SK 388 505	Nottinghamshire
S117045	All Pits	SK 414 720	Nottinghamshire
S96075		SM 89500 23590	Pembrokeshire
S96076	Begelly	SN 11840 06985	Pembrokeshire

S96077	Saundersfoot STW	SN 12490 04860	Pembrokeshire
S96103	Sunnyvale Caravan Site Pentlepoir Saundersfoot	SN 118 056	Pembrokeshire
S96105	Westfields Farm	SN 0207 1023	Pembrokeshire
S84076	Calderside Level Drift, Spital	NU ??? ???	Scremeston
S84084	Fordhill	NT 959 370	Scremeston
S84099	Spital Main Coal Drift	NU 012 508	Scremeston
S140044	Kilkerran Dailly	NS 297 044	South Ayrshire
S140045	Kilgrammie Dailly	NS 260 017	South Ayrshire
S140053	Killochan	NS 260 017	South Ayrshire
S126001	Deep Level Sough (Ringley-Prestonlee)	SD 751 062	South East Lancashire
S126007	Summersales	SD 550 036	South East Lancashire
S126012	Sankey Valley Park, Laffak	SJ 530 975	South East Lancashire
S126035	Victoria Brook	SD 623 022	South East Lancashire
S96001		SO 27060 03150	South Wales
S96002		SO 27630 01810	South Wales
S96003		SO 28600 00580	South Wales
S96005	Blackwood	ST 17590 97360	South Wales
S96009	Bwllfa Dare	SN 97190 02550	South Wales
S96011		ST 05340 95710	South Wales
S96011		ST 05375 95320	South Wales
S96012		ST 03585 94330	South Wales
S96013	Hopkinstown	ST 05750 90730	South Wales
S96013	Hopkinstown	ST 05940 90590	South Wales
S96014	Dinas Rhondda Britannic	SS 97760 90515	South Wales
S96014	Dinas Rhondda Britannic	SS 98190 90470	South Wales
S96015		SS 89360 87620	South Wales
S96020	Gelli Farm Lower	SS 87200 96300	South Wales
S96021		SS 86290 97680	South Wales
S96022	Bryn	SS 81715 92135	South Wales
S96023	Goytre (Glenhafod)	SS 78720 89750	South Wales
S96027		SS 89445 97330	South Wales
S96028	Gelli Farm Upper Discharge	SS 87840 95790	South Wales
S96029		SN 63250 09630	South Wales
S96031		SS 58780 94270	South Wales
S96032	Cwmgors	SN 70350 10110	South Wales
S96033		SN 70020 05330	South Wales
S96035		SO 22260 01340	South Wales
S96036	Gilfach Fargoed	ST 1538 9948	South Wales
S96037	Gilfach	ST 15600 98030	South Wales
S96038	Bedwas Colliery	ST 18025 89400	South Wales
S96039	Rudry Brook	ST 19380 87225	South Wales
S96040	Machen	ST 21390 88735	South Wales
S96041	Melin Caiach	ST 10470 96950	South Wales
S96043		ST 07270 88225	South Wales
S96044	Tai Heol (Sheens Level)	ST 06325 92600	South Wales
S96045	Twyn-y-Glog	ST 04550 93560	South Wales
S96046	Cwmpennar	ST 04180 99710	South Wales
S96047	Watercourse Level (Dare Inn)	SN 9800 02910	South Wales
S96048		SS 99150 97670	South Wales
S96049	Bwllfa Farm	SS 96560 93865	South Wales
S96050		SS 90165 90110	South Wales
S96051	Cwm Garw	SS 9138 8767	South Wales
S96052		SS 88425 83500	South Wales
S96053	Cymer	SS 86360 96160	South Wales
S96054		SN 74140 00040	South Wales
S96055		SS 7392 9876	South Wales
S96058		SN 7776 0063	South Wales
S96060	Abergarwed	SN 81370 02625	South Wales
S96061		SN 86900 05070	South Wales
S96063	Ystradowen	SN 75470 11990	South Wales
S96065		SN 60135 14120	South Wales
S96066	Saron	SN 60250 12200	South Wales
S96067		SN 62000 11960	South Wales
S96068		SN 64040 09620	South Wales
S96070	Glanaman	SN 67385 12285	South Wales
S96071	Great Mountain Colliery, Cwm-Mawr	SN 53860 12450	South Wales
S96073	Blue Anchor	SS 55350 95080	South Wales

S96074		SS 55200 91380	South Wales
S96088			South Wales
S96091	Glyntillery	ST 2466 9918	South Wales
S96092	Golynos Watercourse	SO 2610 0348	South Wales
S96093	Greenland Watercourse	SO 2654 0163	South Wales
S96094	Brynteg No.1 Slant	SN 8160 0753	South Wales
S96095	Ysguborwen Drainage Level	SN 9976 0396	South Wales
S96096	Duffryn Rhondda	SS 8442 9578	South Wales
S96097	Cynon	SS 8262 9546	South Wales
S96098	Dillwyn (Fan Drift)	SN 8035 0690	South Wales
S96099	Coedcae Drift	SS 968 822	South Wales
S96100	North Rhondda	SN 8901 0600	South Wales
S96101	Old Norchard	SO 6204 9000	South Wales
S96106	Old Coal Level @ Blaenrhondda/Fernhill	SS 923 996	South Wales
S96107	Nant Erw Cwm	SS 934 955	South Wales
S96117	Mountain Pit Marsh	SS 934 956	South Wales
S96118	Penrath Farm Adit		South Wales
S117010	Morton Clay	SE 104 323	Yorkshire
S117011	Silkstone	SE 291 055	Yorkshire
S117013	Wharncliffe Side	SK 291 977	Yorkshire
S117014	Tivydale	SE 274 070	Yorkshire
S117015	Parkmill	SE 257 117	Yorkshire
S117021	Low Mill Farm, Silkstone		Yorkshire
S117044	Sough Dike	SK 315 937	Yorkshire
S117046	Wood Royd	SK 283 979	Yorkshire
S117047	Wharncliffe Chase Mine	SK 304 955	Yorkshire

APPENDIX E

AVERAGE PERMEABILITIES USED FOR MODELLED COALFIELDS

Area	Permeability	Area	Permeability
	(m/s^{-1})		(m/s^{-1})
Scotland		**Yorkshire**	
Central Scotland		Zone 1	1.67 X10^{-6}
Zone 1	1.33 X10^{-6}	Zone 2	6.94 X10^{-6}
Zone 2	1.11 X10^{-6}	Zone 3 Deep	1.11 X10^{-6}
Zone 3	1.22 X10^{-6}	Zone 3 Shallow	1.11 X10^{-6}
Zone 4	8.33 X10^{-7}	Zone 4	8.33 X10^{-7}
Zone 5	1.94 X10^{-7}	Zone 5	1.67 X10^{-6}
Central Ayrshire		Zone 6 (Shallow)	1.39 X10^{-6}
1. New Cumnock	4.17 X10^{-7}	Zone 6a (Deep)	1.39 X10^{-6}
2. Dalmellington	3.06 X10^{-7}	Zone 7	5.56 X10^{-7}
3. Patna	2.14 X10^{-7}	Zone 8 - Prince of Wales	1.11 X10^{-6}
4. Prestwick	4.44 X10^{-7}	Zone 8 - Kellingley	3.61 X10^{-6}
5. Killock/ Barony	4.44 X10^{-7}	Zone 8 - Allerton	1.11 X10^{-6}
6. White Hill	2.03 X10^{-7}	Zone 9	2.78 X10^{-7}
7. Kames	6.94 X10^{-7}	Zone 10	2.78 X10^{-7}
8. Berry Hill	2.22 X10^{-7}		
Central Fife		**Nottinghamshire**	
Zone 1	1.94 X10^{-7}	Zone 1A	8.33 X10^{-7}
Zone 2	8.33 X10^{-8}	Zone 1Bd	8.33 X10^{-7}
Zone 3	2.50 X10^{-6}	Zone 1Bs	8.33 X10^{-7}
Zone 4	1.67 X10^{-7}	Zone 1C	8.33 X10^{-7}
Zone 5	9.72 X10^{-8}	Zone 2	8.33 X10^{-7}
Midlothian		Zone 3 a	8.33 X10^{-7}
Zone 1	5.56 X10^{-7}	Zone 3 b	8.33 X10^{-7}
Zone 1A	8.33 X10^{-7}	Zone 4	8.33 X10^{-7}
Zone 2	1.53 X10^{-6}	Zone 5 (Clifton)	8.33 X10^{-7}
Zone 2A	1.53 X10^{-6}	Zone 5 (Cotgrave)	8.33 X10^{-7}
Zone 2B	1.53 X10^{-6}	**Cumbria**	
Sanquhar	2.78 X10^{-7}	Zone 1	8.33 X10^{-7}
		Zone 2	8.33 X10^{-7}
Lancashire		Zone 3	8.33 X10^{-7}
Zone 1	8.33 X10^{-7}	Zone 4	8.33 X10^{-7}
Zone 2	8.33 X10^{-7}	Zone 5	8.33 X10^{-7}
Zone 3	8.33 X10^{-7}	Zone 6	8.33 X10^{-7}
Zone 4	9.44 X10^{-8}	Zone 7	8.33 X10^{-7}
Zone 5	8.33 X10^{-7}	Zone 8	8.33 X10^{-7}
Zone 6	8.33 X10^{-7}	Zone 9	8.33 X10^{-7}
Zone 7	8.33 X10^{-7}		
Zone 8	8.33 X10^{-7}	**South Wales**	
		Upper	
North East		Zone 1	8.33 X10^{-7}
Zone 1	8.33 X10-7	Zone 2	8.33 X10^{-7}
Zone 2	1.67 X10-6	Zone 3	8.33 X10^{-7}
Zone 3	8.33 X10-7	Zone 4	8.33 X10^{-7}
Zone 4a	8.33 X10-7	Zone 5	8.33 X10^{-7}
Zone 4b	8.33 X10-7	Zone 6	8.33 X10^{-7}
Zone 5	8.33 X10-7	Zone 7	8.33 X10^{-7}
Zone 6	2.36 X10-6	Zone 8	8.33 X10^{-7}
Zone 7	8.33 X10-7	Zone 9	5.56 X10^{-7}
Zone 8/9	2.50 X10-6	Zone 10	8.33 X10^{-7}
Zone 8a/9a	8.33 X10-7	**Lower**	
Zone 10/11	2.31 X10-6	Zone 1	8.33 X10^{-7}
Zone 12	2.36 X10-6	Zone 2	8.33 X10^{-7}
Zone 13	8.33 X10-7	Zone 3	8.33 X10^{-7}
Zone 14 & 15	8.33 X10-7	Zone 4	8.33 X10^{-7}
Zone 16	8.33 X10-7	Zone 5	8.33 X10^{-7}
Zone 17	8.33 X10-7	Zone 6	8.33 X10^{-7}
Zone 18	8.33 X10-7	Zone 7	8.33 X10^{-7}
		Zone 8	8.33 X10^{-7}
North Staffs		Zone 9	5.56 X10^{-7}
Hem Heath	8.33 X10^{-7}	Zone 10	8.33 X10^{-7}
Florence	8.33 X10^{-7}		

APPENDIX F

DIRECT MEASUREMENT OF METHANE FLUX ON ONE DAY CAMPAIGN

E.1 Direct Measurement of Methane Flux

During a one-day campaign, plume cross-section measurements were made using tunable diode laser spectroscopy based in an instrumental truck. Direct methane measurements using eddy covariance methods produced underlying measurement estimates.

E.1.1 Theory

E.1.1.1 Flux Measurement and the Eddy Covariance Method

A flux can be defined as the product of a diffusion coefficient and a vertical gradient in concentration within the constant flux layer. One technique of measuring a flux is the eddy covariance method whereby the net vertical exchange of entrained quantities within each eddy above the surface is measured.

Eddy covariance is a simple method used to measure turbulent exchange processes in the surface boundary layer. A spectrum of different sized eddies transporting momentum, heat, gaseous components towards and away from the surface, creating turbulent vertical mixing. In order to estimate a flux, the vertical exchange of individual eddies within the turbulent structure must be detected and their concentrations of gas also be measured. The flux is measured directly at one height by correlating the instantaneous fluctuation in the vertical component of wind speed *w*' with the deviation from the mean concentration χ' as in Equation 1.

$$flux\chi = \overline{w'\chi'} \qquad (1)$$

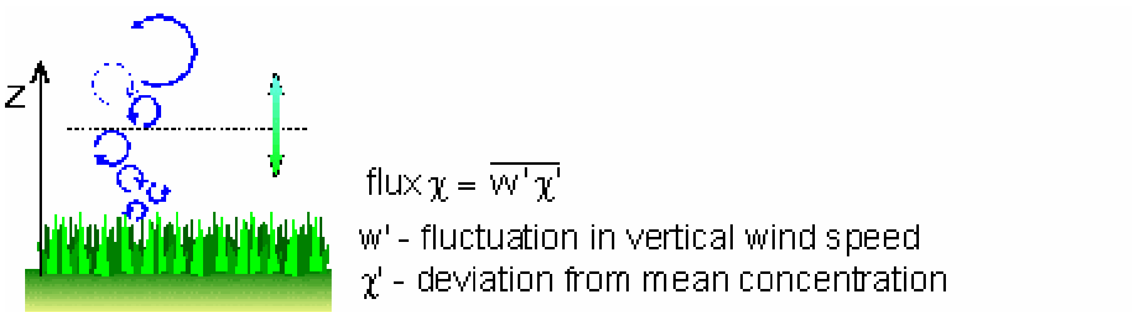


Figure E.1 Schematic illustration of turbulent mixing in the surface boundary layer

To measure these instantaneous fluctuations and sample the various sized eddies, rapid response (≤0.1s) detectors are needed for both measured components. For the application described in this report, a sonic anemometer and TDL (Tunable Diode Laser Spectroscopy) have been used to measure the vertical windspeed component and methane concentrations respectively. Measurements were made at a frequency of 5 Hz.

E.1.1.2 The Footprint Model

In order to estimate the mean flux from an area using the eddy covariance flux measurement, flux footprint models can be used. The underlying principles of the footprint models were used for flux footprint calculations in this project.

Definition of the flux footprint:

$$F(x, y, z_m) = \int_{-\infty}^{\infty} \int_{-\infty}^{x} F_0(x', y') \times \Phi(x - x', y - y', z_m) dx' dy'$$

Cross-wind integrated 1-D footprint (Horst and Weil, 1994; Haenel and Grünhage, 1999):

$$\Phi^y(x, z_m) \cong \frac{\mathrm{d}z}{\mathrm{d}\bar{z}} \frac{\bar{u}(z_m)}{\bar{z}} A \exp\left[\left(-\frac{z_m}{b\bar{z}}\right)^r\right]$$

Lateral spread (2-D footprint):

$$\Phi(x, y, z_m) = \frac{\Phi^y(x, z_m)}{\sigma_y \sqrt{2\pi}} \exp\left(-\frac{y^2}{2\sigma_y^2}\right) \qquad \sigma_y = \sigma_v \frac{x}{\bar{u}}$$

E.1.1.3 Plume Cross Section and Dispersion Modelling

To obtain emission estimates from point sources, Gaussian Plume equations can be used on the basis of plume cross section measurements. For this, the plume must be captured and concentration and windspeed be measured.

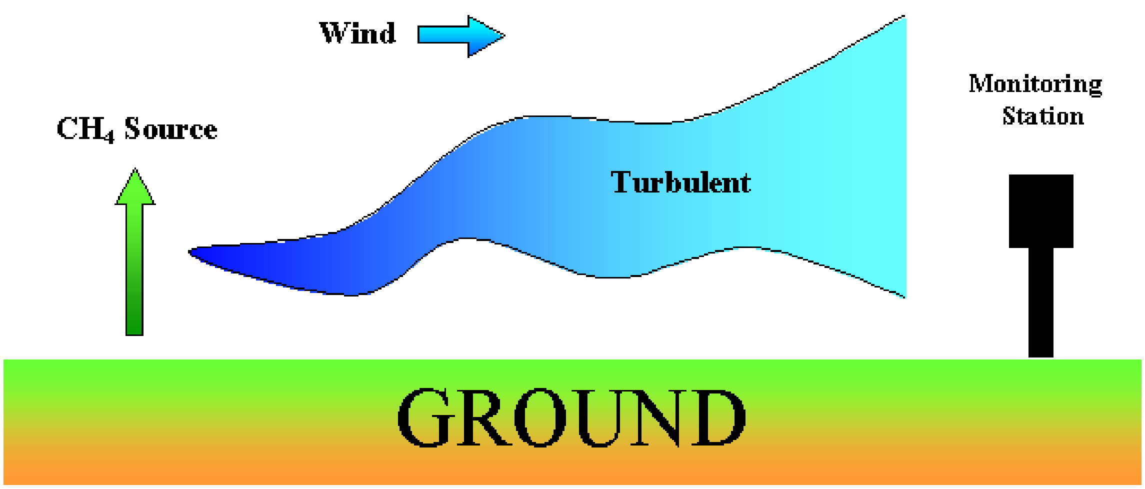


Figure E.2. Schematic illustration of atmospheric dispersion (Gaussian Plume model with inputs of wind speed, distance from source, z_0 and wind direction probability)

E.1.2 The Barnsley Campaign on 6 August 2003

In the Barnsley Campaign two separate sets of measurements were made. Firstly, a purpose-built truck was driven around the Smithies housing estate measuring methane concentrations and windspeed for plume cross-section analysis. Two tours (Tour 1 and 2) were made around the estate driving with an average speed of 18-19 miles/hour. Secondly, eddy covariance measurements were made from point C (Figure E.3), Latitude 53° 34'105" N, Longitude 1° 27' 994"W, inferring the methane source emission flux using the footprint model. During touring, the measuring frequency for the TDL and sonic anemometer was 1 Hz while for the eddy covariance measurements the frequency was 5 Hz.

The general weather conditions were influenced by a high pressure system, producing a sunny and relatively hot day with air temperatures in the range of 25-30 °C (average of 27 °C) and mean wind speeds between 3-4 ms^{-1}.

The start of the first set of tour measurements was 12:10. The eddy covariance measurements started at 12:55 and ended at 18:00. The second tour around the estate started 18:15. All measurements were completed by 19:30 in the evening.

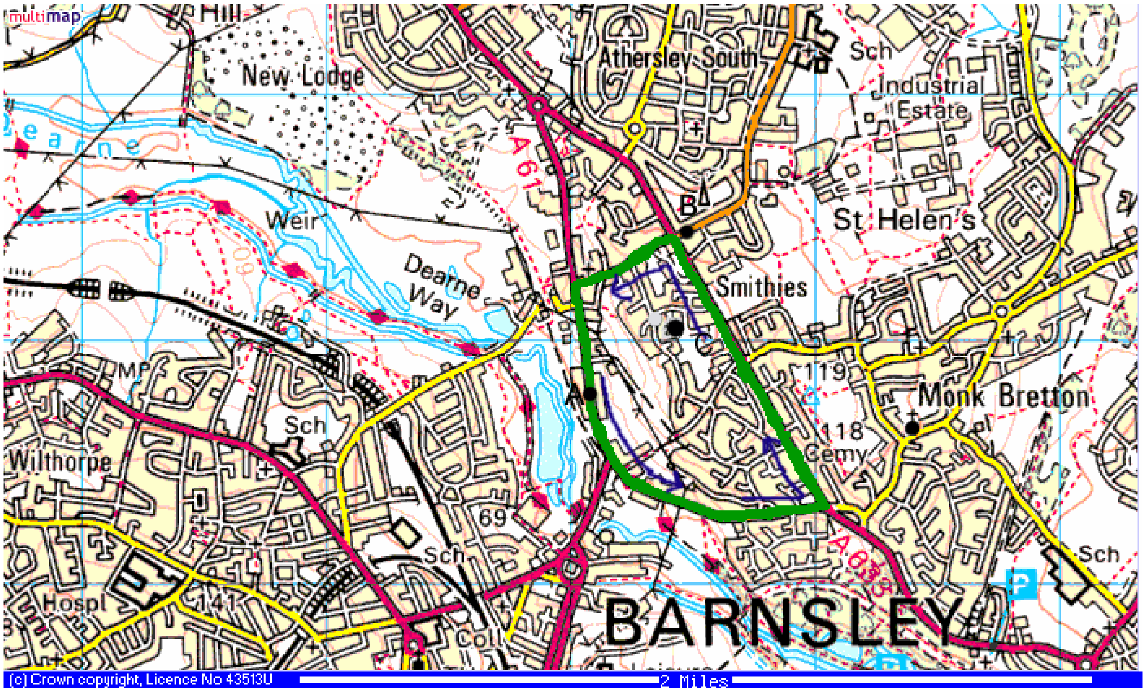


Figure E.3. Map of Tours around the housing estate. Route in green, direction of travel indicated by blue arrows and stopping places A, B and C marked by black points.

E.1.2.1 Results from Eddy Covariance Measurements

Methane concentrations were measured (Figure E.4) along with vertical wind speeds, allowing the inference of methane fluxes as presented in Table E.1. The mean emission flux was estimated 3.4 µg m^{-2} s^{-1} during the period of measurements.

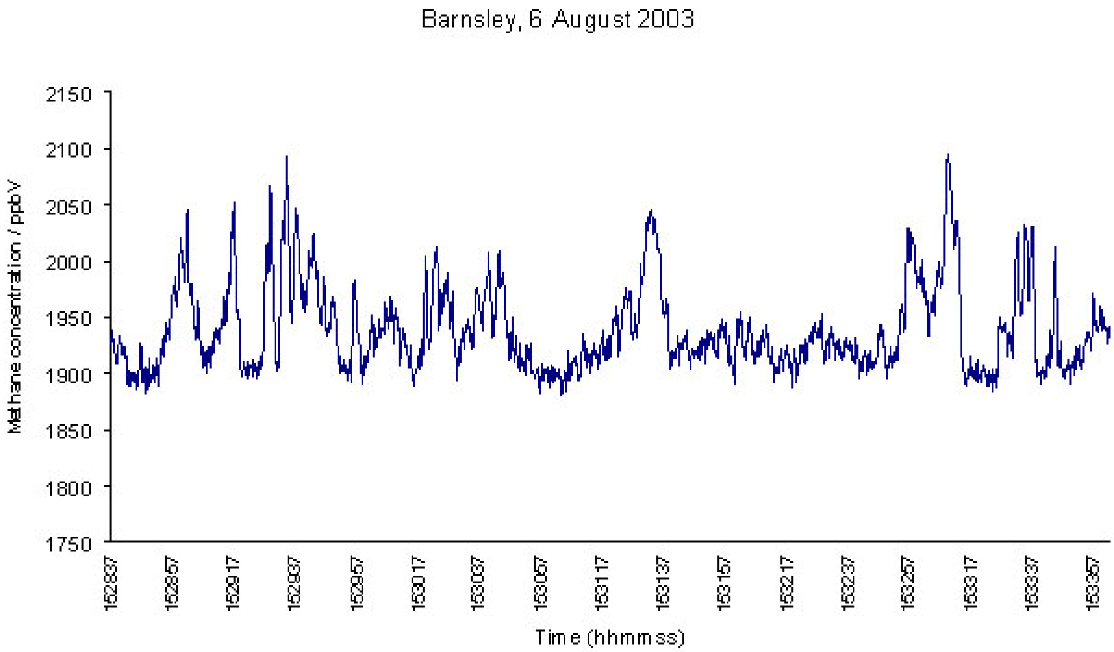


Figure E.4 Methane concentrations measured at Point C (Latitude 53° 34'105" N, Longitude 1° 27' 994"W)

Table E.1. Ten-minute-averaged measurement results, methane fluxes in last column.

Date/Time	Lag time	Mean U	Mean T	u*	H	CH_4 conc	CH_4 flux
	[s]	[m s^{-1}]	[°C]	[m s^{-1}]	[W m^{-2}]	[μg m^{-3}]	[μg $m^{-2}s^{-1}$]
06/08/2003 14:57	5.4	1.33296	300.488	0.51845	188.007	1244.65	1.21969
06/08/2003 15:17	5.6	1.85108	300.407	0.45518	133.123	1237.55	1.22395
06/08/2003 15:27	5.8	1.97719	300.701	0.43347	212.054	1243.04	4.1114
06/08/2003 15:37	5.8	1.97894	300.801	0.40923	125.575	1249.47	3.11411
06/08/2003 15:47	5.8	1.83993	300.632	0.43686	139.233	1244.39	1.69091
06/08/2003 15:57	27.6	1.53609	300.764	0.44623	113.047	1246.42	0.27387
06/08/2003 16:07	5.8	2.08158	300.717	0.46376	151.475	1228.39	3.20659
06/08/2003 16:17	4.8	2.29668	300.753	0.46388	116.083	1201.05	3.4397
06/08/2003 16:27	5.8	1.98206	300.737	0.43943	139.289	1218.9	3.53263
06/08/2003 16:37	5.8	2.76501	300.526	0.5995	157.517	1245.03	1.99707
06/08/2003 16:47	5.8	3.1234	300.322	0.55873	112.357	1239.75	3.64831
06/08/2003 16:57	6	3.27085	299.051	0.58004	134.56	1224.81	4.27853
06/08/2003 17:07	6	3.40794	299.017	0.57104	118.193	1214.5	3.64913
06/08/2003 17:17	5.8	3.50406	297.648	0.63844	115.184	1220.25	5.5249
06/08/2003 17:27	5.8	3.30495	297.758	0.67045	151.801	1230.9	8.15598
06/08/2003 17:37	5.8	3.72065	297.945	0.6426	117.361	1215.02	5.32715

E.1.2.2 Results from Plume Cross Section Measurements (Tours)

Concentration measurements from Tour 1 and 2 exhibit peaks when passing methane source areas. During Tour 2, a distinctive peak was observed just before passing point B (Figure E.5).

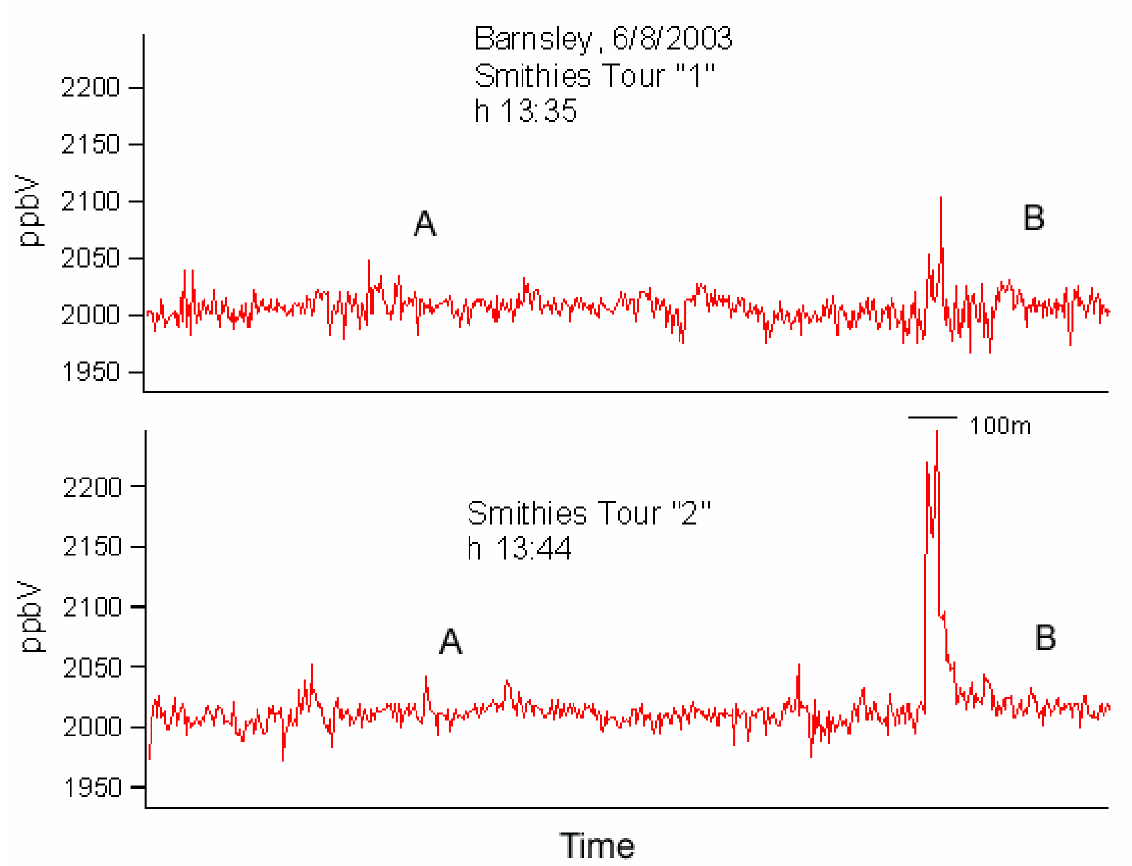


Figure E.5. Methane concentrations measured during Tour 1 and 2. Time of passing sites A and B are indicated.

Illustrating the concentration changes in space, concentration can be plotted versus GPS locations (Figure E.6). The x and y coordinates show the geographical position of the sampling vehicle as it circumnavigates the methane source area. The colours of the plotted sample points indicate the concentration of methane in ppt according to the colour key. Each sampling cycle took approximately 20 minutes to complete, and Temperature (°C), wind speed, wind direction and GPS location were logged alongside methane concentration data.

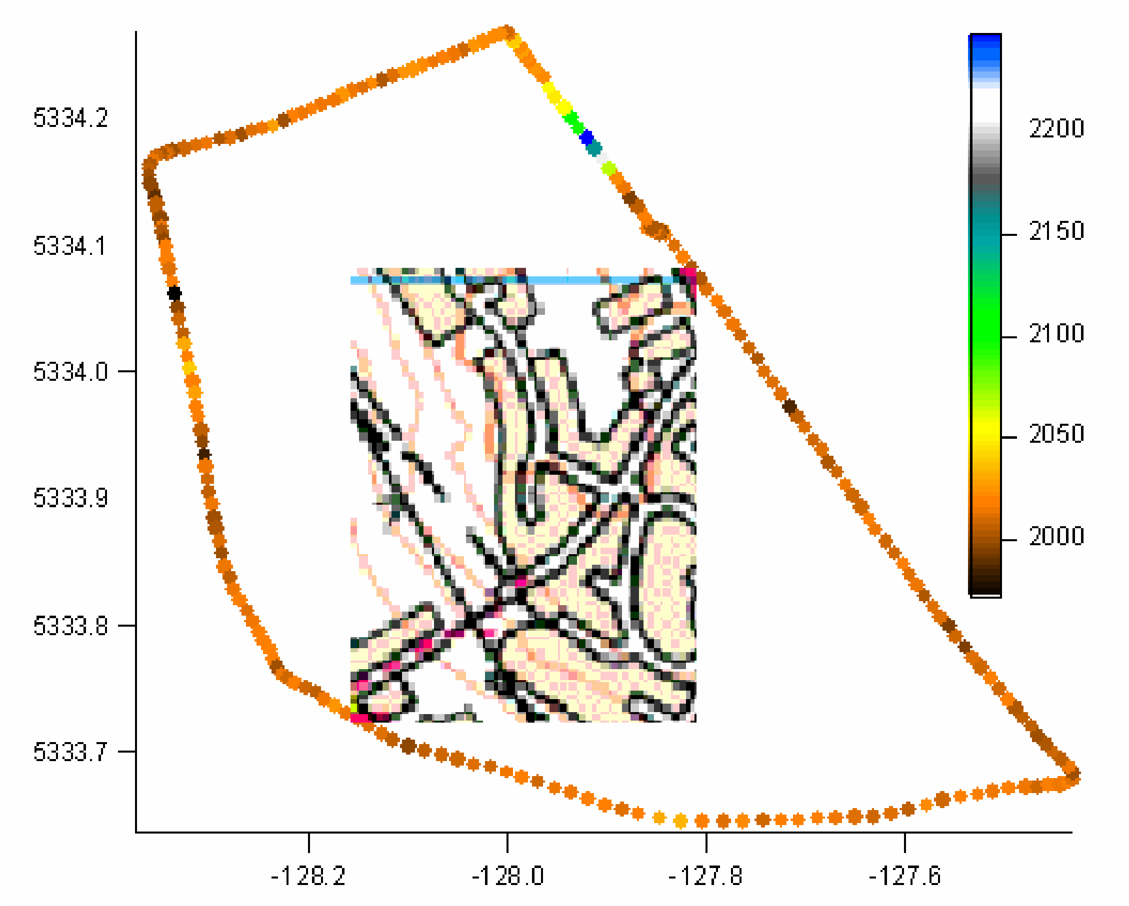


Figure E.6 Methane concentrations (ppb) measured during Tour 2 around the Smithies housing estate.

E.2 Emission Footprint and Annual Emission Estimates at Barnsley

Concentrations and fluxes of methane according to the wind direction obtained by eddy covariance during the Barnsley Campaign can be plotted and illustrate the range of concentrations and fluxes observed (Figure E.7 and Figure E.8)

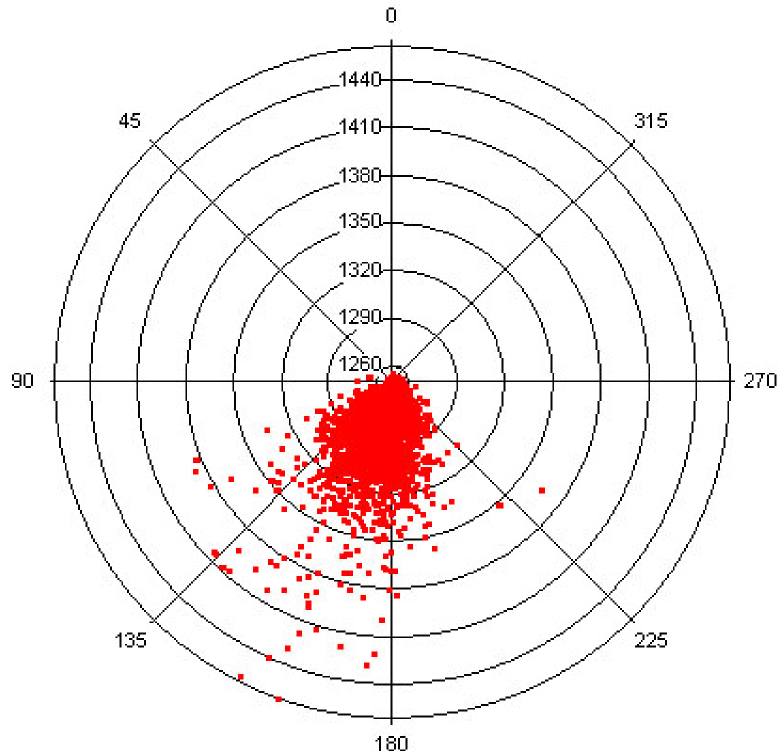


Figure E.7. Barnsley, 6/8/2003, CH_4 concentration values greater than 1250 μg m^{-3} according to wind direction.

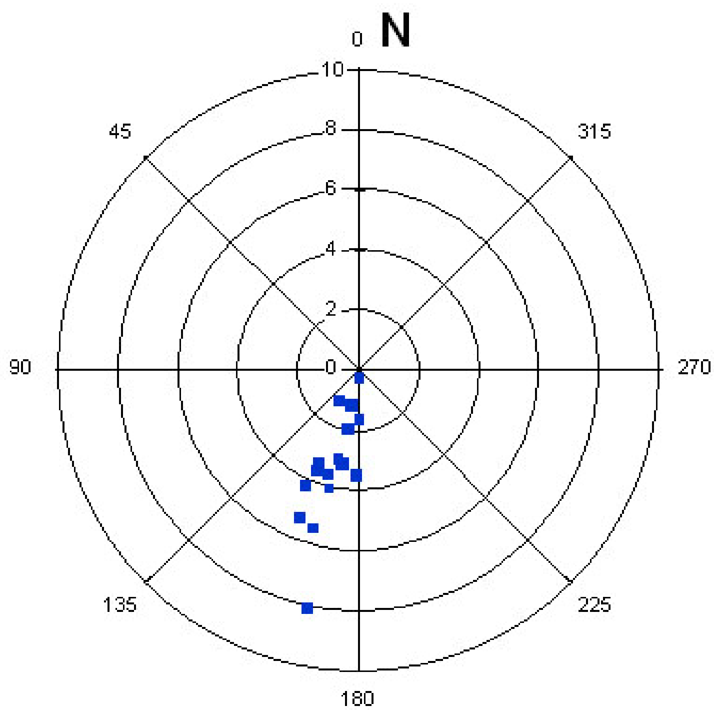


Figure E.8. Barnsley, 6/8/2003, CH_4 fluxes ($\mu g\ m^{-2}\ s^{-1}$) according to wind direction

Using the measured fluxes, an elliptic area of approximately 200m width and 800m length was identified using the footprint model. Knowing the average flux by the eddy covariance measurements over the detected footprint, the strength of a point source can be estimated. This is expressed as an annual emissions estimate and totals 14.3 t CH_4 yr^{-1}. Alternatively, emissions estimates can be obtained using the plume cross-section measurements. The measured concentration enhancement from the second plume (Tour 2) was 135μg m^{-3} and the wind speed 2ms^{-1}. Using these measurements as inputs for the plume modelling and making assumptions about the distance to the source, additional emissions estimates can be obtained (Table E.2).

Table E.2. Plume modelling results with various input parameters. Values in t CH_4 yr^{-1}

	Gaussian Plume Model		SCAILmodel
	Atmospheric Stability		
Distance to point source	**Unstable**	**Neutral**	**Neutral**
100m	**4.1**	**0.26**	**0.77**
200m	**18.4**	**1.2**	**2.7**
300m	**41.7**	**7.7**	**5.8**

The Gaussian plume model and SCAIL yield similar results for neutral conditions which is applicable for long-term monitoring data.

The eddy-covariance and plume measurements are consistent with a point source, about 180 m upwind of the measurement location, of strength 14 t CH_4 yr^{-1}. However, this value is much smaller than the average emission derived from long-term CH_4 measurements at Barnsley (96.5 t CH_4 yr^{-1}). There are two possible explanations for this difference: Rising atmospheric pressure suppressed the methane flux during measurement period, resulting in the smaller emissions flux. Another additional possibility is that other point sources in other directions contribute to the long-term measurements.

Although it seems in this case that the eddy covariance measurements do not compare well with the long-term measurements, the eddy covariance method has the potential to fully validate the SCAIL model. This could be accomplished by, for example, taking week long measurements in a range of atmospheric pressure conditions and compare them with output from SCAIL. Also, plume-modelling results can provide a sounder basis of comparison with the eddy correlation and SCAIL modelling results when additional detail is known about the location of the source.

APPENDIX G

BACKGROUND TO THE RESERVE MODELLING METHOD

Since the late 1940's, methods were developed to estimate the quantity of gas which would be released onto a working face due to mining operations. There was a great need to be able to forecast the likely levels of methane emission into mines in order to plan ventilation and drainage systems to enable the planned coal production to be mined safely. The methane prediction methods used varied in detail, but had a number of key elements in common.

The first was that there existed a defined envelope above and below the workings from which gas would enter the workings. The upper limit to the envelope was generally within the range 150m to 200m above the worked seam. The lower limit of the envelope was generally between 30m and 100m below the worked seam. The strata above the worked level is known as the roof and the strata below the working level as the floor.

A second common element was that the proportion of gas released from the coal seams above and below the working level was a function of their distance from the worked seam. The coal seams closest to the worked seam would be assumed to lose almost all their gas, while those near the limit of the envelope would lose little.

With a knowledge of the position, thickness, density and gas content (in m^3/t) of the coal seams above and below the worked seam, combined with the rate of advance of the coal face it was possible to calculate the volume of coal within the envelope being disturbed in unit time and hence the flow of gas being released into the mine. The calculations generally assumed that all or most of the gas was released at the time or soon after the disturbance.

British Coal developed a method of firedamp prediction which assumed an upper limit of 200m above the worked seam and a lower limit of 100m below the worked seam. The degree of emission (the proportion of the gas within a seam released) was a smoothly changing function which was 100% at the level of the worked seam falling to near zero at the limits of the degassing envelope. The degree of emission function was also a function of time. The model was found to produce good agreement for mining where no other seams had been mined above or below. However, a method was required to make allowance for the effects of previous workings, which is a common occurrence in the UK.

During a major exploration programme by British Coal, many coal seams were sampled for gas content. Some boreholes were sunk through seams which had been mined. The gas contents of the coal seams above and below the mined seam were found to be reduced, as expected, by the effect of the mining. When the degree of emission of these seams was calculated and plotted against distance from the worked seam, the data showed a reduction with distance from the worked seam, but with a high degree of scatter. Two straight lines were fitted to the data with both having a value of 100% at the level of the worked seam. The line for the roof seams went through zero at 150m above the worked seam and the line for the floor seams went through zero 40m below the worked seam.

These lines were used in the British Coal firedamp prediction method to estimate the proportion of gas remaining in the coal seams above and below previously worked areas. These adjusted gas contents were then used as the base data for calculating the emissions from workings above or below the previously worked areas. Where more than one seam was mined the percentage reduction in the gas content of the coal seams was compounded for each mining phase. When compared with cases of actual emissions from multiple seam working, the calculated emissions were found to be in reasonable agreement with measurements.

APPENDIX H
Reserve Estimates by Coalfield Area and Year (millions m^3)

Area	Area Number	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Major Coalfields																	
Yorkshire	**1**	29.51	29.51	15.79	29.51	29.51	29.51	29.51	29.51	29.51	29.51	29.51	29.51	29.51	29.51	29.51	
	2	2.15	2.15	2.06	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	
	3 Deep	0.00	0.00	0.00	0.00	0.00	1757.53	0.00	1295.16	1295.16	879.57	523.07	287.79	287.79	0.00	0.00	
	3 Shallow	1130.88	961.51	917.84	819.63	658.50	612.68	481.02	481.02	344.95	254.71	254.71	182.03	141.35	71.63	26.70	
	4	0.00	0.00	0.00	3776.77	3558.23	3374.21	3080.69	2758.49	2758.49	2758.49	2758.49	2253.41	2253.41	2253.41	1597.54	
	5	116.81	116.81	90.00	65.72	65.72	65.72	65.72	65.72	65.72	65.72	65.72	65.72	65.72	65.72	27.68	
	6 Deep	99.16	98.05	93.98	98.05	32.73	29.41	29.41	29.41	29.41	29.41	29.41	29.41	29.41	29.41	29.41	
	6 Shallow	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	
	7	569.27	476.95	476.95	429.34	429.34	429.34	382.26	367.58	287.50	367.58	287.50	287.50	287.50	211.09	211.09	
	8 Kellingley	216.76	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	
	8 Allerton	1148.71	1108.63	994.53	886.27	766.79	766.79	618.50	618.50	618.50	618.50	618.50	618.50	618.50	0.00	0.00	suction in last 2 years
	8 POW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	815.78	318.91	
	Zone 8 Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	9	2.81	2.81	2.81	2.65	2.56	2.33	2.11	2.00	1.89	1.78	1.71	1.71	1.71	1.71	1.71	
	10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
	Askern	0.00	0.00	583.45	578.37	573.29	568.21	563.13	558.06	552.98	547.90	542.82	537.74	532.67	527.59	522.51	
Staffordshire	**Florence**	0.00	0.00	170.01	170.01	168.11	168.11	152.47	152.50	137.27	137.27	137.27	115.95	115.95	115.30	107.79	
	Hem Heath	0.00	0.00	0.00	0.00	0.00	0.00	97.98	97.98	97.98	97.98	97.98	87.56	86.18	85.46	85.33	

Area	Area Number	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Major Coalfields																
Scotland																
Central	**1**	57.59	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50
	2	41.98	41.98	41.98	41.98	41.98	41.98	41.98	41.98	41.98	41.98	41.98	41.98	41.98	41.98	41.98
	3	1.45	1.16	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Central Ayrshire	**Berryhill**	3.36	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	Kames	7.69	7.69	7.69	7.69	7.69	7.69	7.69	7.69	7.69	7.69	7.69	7.69	7.69	7.69	7.69
	New Cumnock	18.14	5.65	5.65	5.65	5.65	5.65	5.65	5.65	5.65	5.65	5.65	5.65	5.65	5.65	5.65
	Prestwick	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	12.20	12.20	12.20	12.20	12.20	12.20	12.20
	Dalmellington	52.98	37.70	37.70	37.70	37.70	37.70	37.70	37.70	37.70	37.70	37.70	37.70	37.70	37.70	37.70
	Kilock	372.86	343.59	313.90	313.90	302.86	293.23	293.23	293.23	192.44	240.05	192.44	164.02	164.02	164.02	164.02
	Patna	7.27	8.13	8.13	8.13	8.13	11.09	8.13	8.13	8.13	8.13	8.13	8.13	8.13	8.13	8.13
	Whitehill	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39
Central Fife	**1**	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06
	4	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
	5	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Mid Lothian	**1**	7.27	7.27	7.27	7.27	7.27	7.27	7.27	7.27	7.27	7.27	7.27	7.27	7.27	7.27	7.27
	1a	0.18	0.03	0.40	0.32	0.25	0.18	0.18	0.18	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	2	18.18	17.48	14.87	13.35	10.56	10.56	9.56	6.06	4.07	2.51	2.51	2.51	2.51	2.51	2.51
	2a	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12
	2b	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94
Sanquar		40.76	39.64	38.48	37.36	36.24	35.09	33.97	32.85	31.69	30.57	29.45	28.29	27.20	26.05	24.90

Area	Area Number	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Major Coalfields																	
South Wales	**1 Upper**																
	1 Lower																
	2 Upper	5.55	5.55	2.63	2.63	0.00	1.83	1.83	1.83	1.14	0.63	0.63	0.63	0.63	0.63	0.63	
	2 Lower	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	
	3 Lower	376.75	353.83	353.83	328.28	297.35	289.61	289.61	230.94	230.94	182.87	182.87	107.48	72.82	36.41	0.00	
	3 Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	4 Lower	722.31	722.31	657.10	657.10	657.10	616.68	616.68	476.81	476.81	476.81	476.81	315.09	315.09	315.09	250.02	
	4 Upper	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	
	5 Upper	33.18	33.18	33.18	33.18	33.18	33.18	33.18	33.18	33.18	33.18	33.18	33.18	33.18	33.18	33.18	
	5 Lower	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	
	6 Upper	1.59	1.17	0.78	0.44	0.44	0.44	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	6 Lower	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	
	7 Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	7 Lower	20.44	29.55	29.55	25.89	21.75	20.44	20.44	20.44	13.05	13.05	13.05	3.51	3.51	3.51	1.09	
	8 Upper	0.29	0.55	0.55	0.55	0.38	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	
	8 Lower	7.14	1341.05	1116.02	1101.95	991.76	933.76	933.76	933.76	655.11	655.11	522.74	457.49	457.49	396.70	341.96	
	9 Lower	2004.48	1861.57	1676.76	1676.76	1526.65	1526.65	1526.65	1405.43	1229.69	1105.42	1105.42	976.86	976.86	976.86	843.90	
	9 Upper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	10 Lower	486.36	486.36	486.36	486.36	486.36	486.36	486.36	486.36	486.36	486.36	486.36	486.36	486.36	486.36	486.36	
	10 Upper	72.34	72.34	72.34	72.34	72.34	72.34	72.34	72.34	72.34	72.34	72.34	72.34	72.34	72.34	72.34	
Nottinghamshire	**1a**	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	
	1b Shallow	0.00	0.00	40.57	37.58	37.58	36.02	40.57	33.26	33.26	33.26	33.26	33.26	33.26	33.26	33.26	
	1b Deep	0.00	0.00	174.26	174.26	174.26	174.26	174.26	174.26	174.26	174.26	0.00	0.00	0.00	0.00	174.26	markham
	1c	51.85	51.85	51.85	51.85	51.85	51.85	51.85	51.85	51.85	51.85	51.85	51.85	51.85	51.85	51.85	
	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	shirebrook
	3a	243.58	243.58	243.58	243.58	243.58	243.58	243.58	243.58	243.58	243.58	243.58	155.30	155.30	155.30	155.30	
	3b	19.70	19.70	19.70	19.70	19.70	19.70	19.70	19.70	19.70	19.70	19.70	13.53	13.53	13.53	13.53	
	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	596.47	522.10	447.73	373.36	298.99	
	5 Clifton	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	
	5 Cotgrave	0.00	0.00	0.00	0.00	0.00	4.13	3.71	4.13	3.71	3.71	3.71	3.71	3.71	3.71	3.71	

Area	Area Number	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Major Coalfields																
North East	**1**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.64	4.99	1.81	0.79	0.19	0.19	0.19	0.19
	2	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24
	3	0.07	0.01	0.00	0.00	0.00	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
	4a	3.46	3.46	2.68	1.91	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
	4b															
	5	0.00	0.00	0.00	0.00	0.00	0.00	19.87	14.65	14.65	11.20	7.78	7.78	7.78	7.78	7.78
	6	27.23	14.16	14.16	14.16	14.16	27.23	14.16	14.16	14.16	14.16	14.16	6.19	6.19	6.19	6.19
	7	18.73	18.73	18.73	18.73	18.73	18.73	18.73	18.73	18.73	18.73	18.73	18.73	17.78	17.78	17.78
	8 & 9	0.00	0.00	0.00	118.92	118.92	76.44	119.35	115.04	115.04	113.13	108.92	105.29	101.66	98.03	92.61
	8a &9a	63.95	56.27	51.16	50.81	50.81	37.34	28.14	22.55	22.55	20.46	16.37	14.32	10.23	10.23	10.23
	10 & 11	0.00	0.00	0.00	439.41	439.41	439.41	383.40	255.04	255.04	145.82	83.13	55.20	34.31	9.26	1.75
	12	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.17
	13	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12
	14 & 15	17.46	17.46	17.46	17.46	17.46	17.46	17.46	17.46	17.46	17.46	17.46	17.46	17.46	17.46	17.46
	16	20.98	20.98	20.98	20.98	20.98	20.98	20.98	20.98	20.98	20.98	20.98	20.98	20.98	20.98	20.98
	17	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
	18	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Lancashire	**1**	10.30	14.45	10.30	10.30	10.30	10.30	8.61	8.61	7.71	6.74	5.91	5.91	5.91	5.91	5.91
	2	375.32	699.39	581.41	517.56	375.32	375.32	326.73	326.73	232.92	183.42	163.74	132.89	105.69	63.97	42.37
	3	0.00	109.57	87.14	67.62	51.18	39.65	16.67	15.01	15.01	4.88	4.88	2.95	0.99	0.99	0.99
	4	0.00	0.00	0.00	186.79	186.79	181.18	181.18	181.18	179.61	181.18	179.61	179.61	179.61	179.61	179.61
	5	0.00	0.00	5095.07	4525.36	3766.25	3334.18	3334.18	3766.25	2513.85	2190.46	2190.46	1878.67	1878.67	1636.34	1366.99
	6	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	7	634.25	597.59	502.77	409.87	274.17	187.03	102.96	79.90	51.72	35.03	35.03	12.02	7.78	2.00	2.00
	8	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Cumbria	**1**	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
	2	0.00	94.36	80.57	84.18	73.49	68.55	68.76	53.70	53.70	30.10	30.10	30.10	30.10	30.10	30.10
	3	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
	4	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12
	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Area	Area Number	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Minor Coalfields																	
Coventry		0.00	0.00	0.00	0.00	0.00	0.00	21.45	19.31	17.16	15.45	13.73	12.44	11.16	9.87	8.58	
Birch Coppice		12.87	10.73	9.01	7.72	6.44	5.15	3.86	2.57	1.29	0.43	0.00	0.00	0.00	0.00	0.00	
Chatterley		24.03	19.74	15.88	12.01	10.08	8.15	3.65	2.15	0.86	0.43	0.43	0.43	0.43	0.43	0.43	
Silverdale		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	operating or pumped
South Staffs		9.65	9.65	9.65	9.65	9.65	9.65	7.51	7.51	7.51	5.36	5.36	5.36	5.36	5.36	5.36	
East Fife		15.02	15.02	15.02	15.02	15.02	15.02	9.57	8.15	6.86	5.58	4.72	4.29	3.86	3.43	3.22	
Blenkinsopp		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.76	9.01	
LANCASHIRE (Zone 9 to 14)																	
	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	10	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	
	11	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	
	12	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	
	13	7.12	7.12	7.12	7.12	7.12	7.12	7.12	7.12	7.12	7.12	7.12	7.12	7.12	7.12	7.12	
	14	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	
BLENKINSOP																	
HALTWHISTLE		5.14	5.14	5.14	5.14	5.14	5.14	5.14	5.14	5.14	5.14	5.14	5.14	5.14	5.14	5.14	
LAMBLEY		3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	
COALBROOKDALE																	
GRANVILLE		39.08	39.08	39.08	39.08	39.08	39.08	39.08	39.08	39.08	39.08	39.08	39.08	39.08	39.08	39.08	
SHIFNAL		3.39	3.39	3.39	3.39	3.39	3.39	3.39	3.39	3.39	3.39	3.39	3.39	3.39	3.39	3.39	
SOUTH STAFFORDSHIRE																	
LEA HALL																	
WALSALL WOOD		1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	
BAGGERIDGE		7.81	7.81	7.81	7.81	7.81	7.81	7.81	7.81	7.81	7.81	7.81	7.81	7.81	7.81	7.81	
PARKLANE		31.78	31.78	31.78	31.78	31.78	31.78	31.78	31.78	31.78	31.78	31.78	31.78	31.78	31.78	31.78	

Area	Area Number	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Minor Coalfields																
NORTH STAFFORDSHIRE																
OLDFIELD		7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.16	7.16
FOXFIELD		3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95
Other Minor Coalfields																
BRISTOL AND SOMERSET		33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62	33.62
CENTRAL COALFIEL EAST		69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14	69.14
CLACKMANNAN & N.E. STRILING		50.43	50.43	50.43	50.43	50.43	50.43	50.43	50.43	50.43	50.43	50.43	50.43	50.43	50.43	50.43
CHESHIRE		18.74	18.74	18.74	18.74	18.74	18.74	18.74	18.74	18.74	18.74	18.74	18.74	18.74	18.74	18.74
DOUGLAS		17.91	17.91	17.91	17.91	17.91	17.91	17.91	17.91	17.91	17.91	17.91	17.91	17.91	17.91	17.91
EAST LOTHAIN		10.27	10.27	10.27	10.27	10.27	10.27	10.27	10.27	10.27	10.27	10.27	10.27	10.27	10.27	10.27
FOREST OF DEAN		50.23	50.23	50.23	50.23	50.23	50.23	50.23	50.23	50.23	50.23	50.23	50.23	50.23	50.23	50.23
LEICESTERSHIRE		16.81	16.81	16.81	16.81	16.81	16.81	16.81	16.81	16.81	16.81	16.81	16.81	16.81	16.81	16.81
NORTH AYRSHIRE		1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37
NORTH WALES		92.19	92.19	92.19	92.19	92.19	92.19	92.19	92.19	92.19	92.19	92.19	92.19	92.19	92.19	92.19
PEMBROKESHIRE		8.54	8.54	8.54	8.54	8.54	8.54	8.54	8.54	8.54	8.54	8.54	8.54	8.54	8.54	8.54
SCREMERSTON		11.78	11.78	11.78	11.78	11.78	11.78	11.78	11.78	11.78	11.78	11.78	11.78	11.78	11.78	11.78
SHREWSBURY		1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71
SOUTH AYRSHIRE		31.01	31.01	31.01	31.01	31.01	31.01	31.01	31.01	31.01	31.01	31.01	31.01	31.01	31.01	31.01
SOUTH DERBYSHIRE		136.11	136.11	136.11	136.11	136.11	136.11	136.11	136.11	136.11	136.11	136.11	136.11	136.11	136.11	136.11
WYRE FOREST		13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69
		9,975	10,999	16,083	19,541	17,588	18,409	15,942	16,815	14,620	13,513	13,211	11,311	11,089	10,365	8,616