



# Prioritisation of abandoned non-coal mine impacts on the environment

**SC030136/R10 The Anglian, South East and Thames River Basin Districts**

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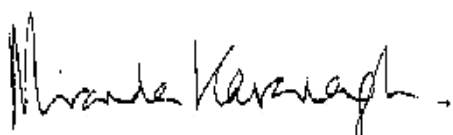
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Miranda Kavanagh  
**Director of Evidence**

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# 1. Introduction

The *Prioritisation of abandoned non-coal mine impacts on the environment* project has generated the most definitive evaluation to date of the impacts on the water environment from abandoned non-coal mines across England and Wales. For the first time, an objective assessment has been carried out to prioritise the rivers in England and Wales where pollution from these mines has the highest impact, and where there is the greatest risk that water bodies (river stretches) will fail to meet the objectives of the Water Framework Directive (European Community, 2000) due to abandoned non-coal mines. The specific water bodies which should be the focus of immediate attention in River Basin Management Plans (RBMPs) have been identified, and the work needed to address mining pollution through both research into passive treatment technologies and catchment monitoring investigations is outlined.

This is one of 13 reports that detail the final results of the implementation of the methodology across England and Wales. This particular report presents the finalisation of the categorisation of surface water bodies for the Anglian, South East and Thames River Basin Districts, and also details of mine sites and mine waters, to be used as a basis for directing future remediation planning and / or further data collection.

In every report the 13 reports that comprise the outputs of the project are listed, so that the reader may cross-reference between them at need. They are:

- I. *A methodology for identification and prioritisation of abandoned non-coal mines in England and Wales*
- II. *Prioritisation of abandoned non-coal mine impacts on the environment: The national picture*
- III. *Prioritisation of abandoned non-coal mine impacts on the environment in the Dee River Basin District*
- IV. *Prioritisation of abandoned non-coal mine impacts on the environment in the Northumbria River Basin District*
- V. *Prioritisation of abandoned non-coal mine impacts on the environment in the South West River Basin District*
- VI. *Prioritisation of abandoned non-coal mine impacts on the environment in the Western Wales River Basin District*
- VII. *Prioritisation of abandoned non-coal mine impacts on the environment in the Humber River Basin District*
- VIII. *Prioritisation of abandoned non-coal mine impacts on the environment in the North West River Basin District*
- IX. *Prioritisation of abandoned non-coal mine impacts on the environment in the Severn River Basin District*
- X. *Prioritisation of abandoned non-coal mine impacts on the environment in the Anglian, Thames and South East River Basin Districts*
- XI. *Prioritisation of abandoned non-coal mine impacts on the environment in the Solway-Tweed River Basin District*
- XII. *Future management of abandoned non-coal mine water discharges*
- XIII. *Hazards and risk management at abandoned non-coal mine sites*

Much of the text in the individual River Basin District (RBD) reports (reports III-XI) are common to all 9 reports, though the information in the tables is different. A detailed description of the methodology used to produce these results is provided in Report I, while Report II provides a national overview of the findings. Implications of the results for future management of abandoned non-coal mine sites is dealt with at length in Report XII, while specific detail of the outputs of the data collated on mine hazards and risk management is provided in Report XIII. It is recommended that the individual RBD reports are read in conjunction with these other national-level reports.

## 2. Water body impact categories

The initial stage of the prioritisation exercise comprised use of existing data, from various sources, to categorise surface water bodies as *Impacted*, *Probably Impacted*, *Probably Not Impacted* and *Not Impacted*. This exercise was based on the spatial relationship between Environmental Quality Standard (EQS<sup>1</sup>) failures in mining areas, or EQS failures immediately downstream of a mining area as described in detail in the Methodology report. The impact categories grade from *Impacted* where water quality failures are coincident in a water body with former mine sites, to catchments where the quality failures are either not associated with any former mining areas, or there are no reported water quality issues (*Not Impacted* water bodies). The risk categories prefixed “probably” are there to indicate uncertainty in the nature and extent of the link between mining and pollution. *Probably Impacted* describes a water body where there is a pollution problem but uncertainty persists as to whether the mining activity and downstream pollution issue are explicitly connected, either due to distance between source and receptor, or where there are no recorded mine sites in a polluted former mining area. *Probably Not Impacted* water bodies are those in mining areas where there is no water quality concern either in the host or downstream water body. The final numbers of water bodies in each of the impact categories are detailed by RBD in Table 1.

**Table 1. Summary statistics showing final categorisation of water bodies across England and Wales (Stage 4, March 2009)**

River Basin District (RBD)	Impacted	Probably Impacted	Probably Not Impacted	Not Impacted	Total
Anglian	0	1	181	831	1013
Dee	9	10	10	71	100
Humber	13	18	151	734	916
North West	15	27	63	427	532
Northumbria	28	39	38	262	367
Severn	31	32	89	599	751
Solway-Tweed	3	6	29	149	187
South East	0	0	88	308	396
South West	57	73	325	680	1135
Thames	0	0	154	490	644
Western Wales	70	37	143	619	869
<b>Grand Total</b>	<b>226</b>	<b>243</b>	<b>1271</b>	<b>5170</b>	<b>6910</b>

<sup>1</sup> The EQS values used for this project are detailed in the methodology report – see reference list. The metals / metalloids assessed were cadmium, lead, nickel, zinc, copper, iron, manganese, and arsenic.

### 3. Water body validation and prioritisation

After the initial categorisation of water bodies an online questionnaire was used to collate data from local experts at the Environment Agency. This process served to clarify whether the categorisations were valid (e.g. were area staff aware that the pollution in the mining area was due to something other than abandoned non-coal mines?) and to gather information on the extent of impact of non-coal mine pollution on other receptors (ecology, groundwater and water resources). Figure 1 shows the categorisation of water bodies in the Anglian, South East and Thames RBDs. This information was used to allocate an individual score to each of the *Impacted* and *Probably Impacted* water bodies to describe the extent of the impacts of abandoned non-coal mine drainage, shown in Figure 2 (for details of the scoring system refer to the Methodology report).

Only one water body was identified across the three RBDs which fell within the top two impact categories. This is the River Ise in the Anglian RBD which is categorised as *Probably Impacted* due to instream environmental quality standard failures occurring in a water body receiving drainage from a polluting abandoned ironstone mine (located in the upstream water body). Details for this water body are shown in Table 4 (at the end of the report). By reading this report in conjunction with Report II (*The National Picture*), it is possible to see how the results fit into the national prioritisation. These tables contain only a selection of the results with the full details available as a database or a series of GIS (Geographical Information System) layers.

### 4. Mine site and discharge identification

The online questionnaire also collated data specific to mine sites themselves within the priority water bodies. A range of information was collected (Table 2) covering known polluting sites, the presence of point and diffuse pollution, water quality, flow rates, stakeholder concerns and risks and hazards at abandoned sites. This stage provides the crucial link between prioritising impacted water bodies (Tables 4 and 5) and identifying the polluting mine sites within them that could be the focus for future catchment scoping studies (see Section 5).

There are no specific details of polluting mine discharges currently held in the database for the Anglian, South East and Thames RBDs. In addition there are no reported abandoned mine sites in the three RBDs with risk of sudden outbreak of polluting mine water.





**Table 2. Key information requested in Environment Agency questionnaire**

<b>Question / information requested</b>	<b>Comment</b>
Water Body ID and Name	Information provided by Consortium
EQS failure co-ordinates and score	Information provided by Consortium
Categorisation (e.g. <i>Impacted</i> etc.)	Information provided by Consortium
Locations of point mine water discharges within water bodies with EQS failures, or in water bodies immediately upstream of water body with EQS failure	Required to characterise <i>Impacted</i> and <i>Probably Impacted</i> water bodies
If there is a mine water discharge (either point or diffuse) known or suspected then further information on the discharge is required	Including receiving watercourse name, groundwater, ecological and higher impacts, stakeholder information, and water quality
Knowledge of historical mines, irrespective of water pollution issues	Including mine location and name (if known), airborne pollution risk, safety concerns, stability concerns and outbreak risk

## 5. Preparing for remediation: further investigations and monitoring (Programmes of Measures)

This project has identified the surface water bodies which show the greatest impacts from abandoned non-coal mines, and so should be prioritised for action in the first cycle of River Basin Planning (RBP).

### 5.1 *Probably Impacted* water bodies

Many water bodies in mining areas are in the *Probably Impacted* category since we do not have water quality data from within the water body itself. We know that abandoned non-coal mines are present but not if they are the specific cause of the downstream pollution. Collecting new data on metal concentrations in these rivers would allow these water bodies to be moved either to *Probably Not Impacted* (if no EQS failures are identified) or to *Impacted* (if EQS are exceeded). All the data tables within the database are editable beyond the timescale of the project to allow such re-categorisation as new information comes to light.

Monitoring would need to be carried out over a 12 month period (ideally at monthly frequency) to ensure variation due to seasonal and flow effects is evaluated. It is recommended that collection of these data is prioritised in the first RBP cycle for the *Probably Impacted* water bodies with the highest impact scores (see Table 5).

## 5.2 Catchment investigations – *Impacted and Probably Impacted* water bodies

Unfortunately, with very few exceptions, we do not have sufficient monitoring data in any water bodies to allow remediation measures to be designed and implemented. This is the case even in the *Impacted* water bodies where we are confident that the pollution is due to abandoned mines, and have been able to identify significant point sources. This is a function of the type of monitoring data that need to be collected to characterise mine water pollution for remediation. Concentrations of metals in rivers or mine water discharges alone are not adequate, the flow must also be measured so that the loading (flux) can be calculated. Such data are rarely available from the Environment Agency's routine monitoring.

As a result, the first stage of implementing Programmes of Measures (POMs) for abandoned non-coal mine pollution is to carry out detailed synchronous monitoring of water quality and flow over at least a 12 month period in affected catchments. These further investigations will allow management and remediation schemes to be implemented in the second and third RBP cycle. If these data are not collected during the first RBP cycle, then it will not be possible to address the threat that pollution from abandoned mines poses to good ecological and chemical status.

The design and execution of such catchment monitoring programmes is described in the accompanying *Future Management of Abandoned Non-Coal Mine Discharges* report, and a comprehensive example of such a study is provided by Mayes *et al.* (2008). In general terms a phased approach is recommended:

1. Scoping study of the catchment (water body scale) to identify main sources of pollution using existing water quality data and other information sources. The data reported in Tables 4, 5 and 6 will inform these studies.
2. Design and implementation of detailed monitoring programmes to collect synchronous measurements of water quality and flow, as well as investigation of the river ecology over a period of at least 12 months.
3. Subject to the results of the monitoring programme, carry out feasibility study for the design and implementation of appropriate management and remediation measures, including pilot-scale treatment trials where appropriate. The suitability of various passive approaches to treatment is provided in the *Future Management of Abandoned Non-Coal Mine Discharges* report, and also by PIRAMID Consortium (2003).
4. Construct and operate management and remediation measures.

Examples of sites at which this phased approach is being implemented by the Environment Agency are shown in Table 3.

**Table 3. Example sites at which a phased approach to catchment monitoring is being undertaken by the Environment Agency**

RBD	Mine site / catchment
Western Wales	Parys Mountain, Cwm Rheidol, Dylife, Frongoch, Cwmystwyth, Conwy (Nant Gwydyr/Afon Crafnant)
Dee	Clywedog
Northumbria	Saltburn Gill, Rookhope Burn
North West	Coledale Beck

## 6. Conclusions

By assessing mine waters using water quality, ecological, groundwater and higher impact metrics it has proved possible to objectively prioritise *Impacted* and *Probably Impacted* water bodies into ranked lists. Furthermore, additional data stored in the database enables environmental managers to assess what the other issues are at these sites, such as safety issues, outbreak risk and stakeholder concerns. This information can be used to inform future management of pollution from abandoned non-coal mine sites.

## References

- European Community (2000). Council Directive 2000/60/EC establishing a framework for Community action in the field of water policy. The Official Journal of the European Communities.
- Mayes, W.M., Gozzard, E., Potter, H.A.B. and Jarvis, A.P. (2008) Quantifying the importance of diffuse minewater pollution in a historically heavily coal mined catchment, *Environmental Pollution*, **151**, 165-175.
- PIRAMID Consortium (2003) *Engineering guidelines for the passive remediation of acidic and/or metalliferous mine drainage and similar wastewaters*. Passive In-situ Remediation of Acidic Mine / Industrial Drainage (PIRAMID) report, European Commission Fifth Framework Programme. Newcastle University.

**Table 4. Prioritisation of *Probably Impacted* water bodies in the Anglian, South East and Thames RBDs (all water bodies shown)**

RBD priority rank	Water body name	Water Body ID	EQS Score	Ranked EQS Score	Ecological Impact score	Higher Impact score	Groundwater Impact score	Overall Impact score <sup>1</sup>
1	Ise	GB105032045140	4	4	0	5	0	9

Note: 1. Overall impact score = Ranked EQS + Ecological Impact + Higher Impact + Groundwater Impact.

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