

THE DEVELOPMENT OF PASSIVE MINEWATER TREATMENT IN NEATH AND PORT TALBOT, SOUTH WALES

by

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Abstract. The valleys of Neath and Port Talbot in the South Wales Coalfield have borne the effect of several of the most serious polluting discharges from abandoned coal mines in the United Kingdom. This paper draws extensively on experience gained from three minewater remediation projects within the area: The River Pelenna Minewater Project, The Ynysarwed Minewater Project and The Gwynfi Project. In combination these projects demonstrate the development of minewater treatment in the UK from the known problem and absence of funding, through the identification of innovative passive technology, drawing on ideas chronicled in the USA and special case funding for demonstration, to development of a national priority ranking for minewaters, a national co-ordinated programme bringing together national and local agencies and the introduction of regulations to prevent further abandonment. The paper will address technical aspects of dealing with abandoned minewaters, the principle organisations involved and will explore the wider issues associated with such projects. These include the cause of minewater contamination and its extent in South Wales, the impacts that such discharges have on local mining (and former mining) communities, their economies and environment, assessment of a discharge and its profile over time, the availability of funding, treatment options - environmental, economic and aesthetic factors influencing selection of the preferred option, the importance of collaboration, the policy background to abandoned minewater discharges and the process of marrying together technical solutions with democratic decision-making.

Additional Key Words: Environment, remediation, passive treatment, constructed wetland,

Introduction

Considerable efforts have been applied to the economic, environmental and social re-structuring and regeneration of communities affected by the contraction of the coal mining industry in the Valleys of Neath and Port Talbot. Much of the physical dereliction remaining after closure and abandonment of former collieries has been removed. These problems have been common to former coal mining communities elsewhere in South Wales, Britain and indeed across Europe.

One of the more persistent legacies of the contraction of the deep coal mining industry in South Wales has been the pollution of rivers and other watercourses with metal laden discharges from abandoned mines. The majority of water-courses in the valleys of Neath and Port Talbot have been affected to a greater or lesser extent by such contaminated mine water.

Neath Port Talbot County Borough Councilⁱ the Environment Agencyⁱⁱ, the Welsh Development Agencyⁱⁱⁱ, the National Assembly for Wales^{iv}, the Coal Authority^v and the European Union have variously been involved in establishing treatment for some of the major incidences of minewater contamination. The work undertaken has revealed technical, practical, legal, and partnership issues which can influence the success of such schemes and has highlighted differences in approach required for more recent problems than for those long established.

European, National and Regional Government, including the newly created National Assembly for Wales, has provided the changing

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legislative and regulatory framework and has contributed to the funding of these schemes.

For future mine closures new regulations mean that the mine owner will have responsibility to predict and manage problems with minewater prior to abandonment.

The Cause Of Minewater Discharge Contamination

The contamination is caused by mobilisation of iron pyrites, (FeS_2), commonly associated with the seams of the Upper Coal Measures in South Wales, as a result of changes to the water table associated with underground mining of coal. Whilst the coal mines are being worked they are de-watered and iron pyrites comes into contact with air and is oxidised. Following closure of a coal mine, if the pumps used to de-water the mine are switched off, the products of pyrite oxidation (ferrous iron, sulphate and hydrogen ions) are brought into solution in the rising groundwater as the mine becomes flooded.

On emergence from the ground and on contact with air, further oxidation and hydrolysis reactions take place. Orange coloured iron oxyhydroxides or ochres precipitate out of solution, colouring receiving rivers, streams and canals with the resultant characteristic and vivid orange-yellow staining.

Impacts On Local Communities, Economies And Environment

The outcome of progressive reclamation and regeneration initiatives, largely funded in Wales by Welsh Development Agency's Land Reclamation Programme, National Assembly for Wales, and European funding have been severely hampered by failure to address the problem of contaminated discharges from abandoned coal mines. Large areas, not only aquatic ecosystems, are affected. The impacts affect economic, social, recreational, amenity and other environmental interests.

The minewater discharges can be directly toxic to aquatic life. As metals precipitate out of solution the substrate is coated, causing more chronic effects on invertebrate habitats and fish spawning gravels. On the social and economic level, the gross aesthetic impact is considered to be a constraint to the successful regeneration of the area and the contamination can affect the availability / usefulness of water resources for abstraction and other purposes.

Treatment Options

Potential treatment methods for minewater contamination include physical, chemical and passive treatment options.

Physical treatments including aeration and settlement have proven incapable of providing water quality improvements independently for all but the most minor discharges, however they remain a useful element for incorporation into passive systems. This paper does not address the potential for use of other physical techniques such as electro-magnetism.

Chemical treatment is capital and revenue intensive but is capable of providing treatment within a relatively small area and remains necessary for severe contamination.

Passive treatment (e.g. reedbeds) works with the environment, relying on natural biological and chemical reactions, such as bacterially-mediated sulphate reduction, generated within the substrate of wetlands and making use of bacterial activity within and around the root structures of wetland plants: reeds, rushes and reedmace. Such treatment systems are deemed suitable because their minimal requirements for day to day process control and maintenance mean that operational costs are low when compared to alternative systems. Capital costs are also comparatively low and the systems can provide additional environmental benefits such as diversified wildlife habitat. However land take is high and this is often the most significant factor in progressing schemes.

The Extent Of The Problem In Wales

Environment Agency surveys have revealed that a total of 85 kms of rivers in Wales have been impacted by some 150 discharges from abandoned coal mines at approximately 135 locations. More than 40 of these discharges are recorded within the area administered by Neath Port Talbot County Borough Council (Environment Agency 1997).

In 1996 the Coal Authority commissioned scoping studies to assess the scale of the acid minewaters problem in England and Scotland to supplement work already undertaken by the National Rivers Authority, Welsh Region and to assess options for dealing with the problem. A National Ranking System has been developed and used to prioritise discharges in England and Wales. The National Ranking System uses Multi Attribute Techniques

(MAT), (Environment Agency 1998) in order to prioritise the worst discharges. The methodology endeavours to assess impartially the seriousness of a discharge to enable remediation to be progressed on a priority basis. Factors appraised include the length of watercourse affected, biological water quality, access, attractiveness, visitor potential, coarse and salmonid fishery, in stream recreation, agriculture, industrial abstraction, drinking water supply abstractions, population, regeneration potential and conservation value.

Within the boundary of Neath Port Talbot County Borough Council there are a number of significant discharges that feature highly on the National Priority Ranking. Two remediation schemes, on the River Pelenna and at Ynysarwed (Figure 1) were so severe that collaborative projects were established prior to the development of national policy and indeed their resolution has influenced the development of such policy, whilst a third at Gwynfi has been addressed by the Coal Authority as part of its more recently introduced National Minewater Remediation Programme.

Location of Remediation Projects

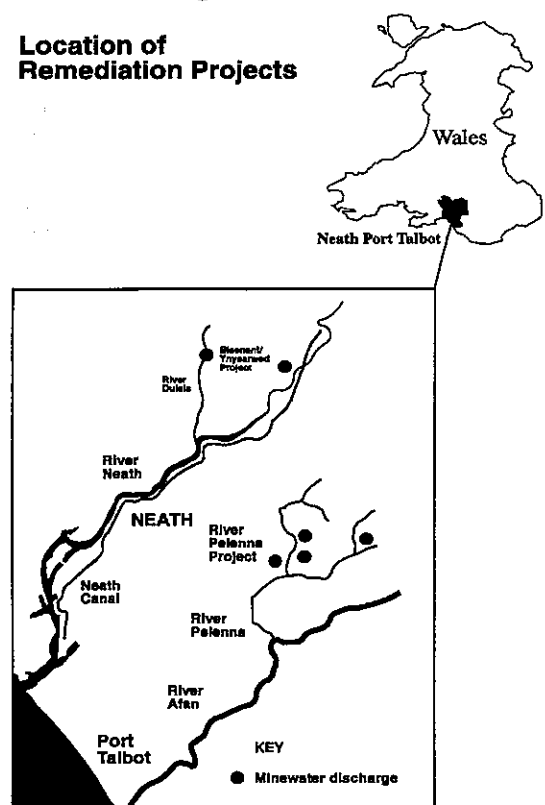


Figure 1: Location Plan

Details of these three projects are set out in case studies below. Further significant discharges

occur on the Corrwg, the Corrwg Fechan, the Craig yr Aber and the Llechart, a tributary of the Tawe and work has been undertaken by the Coal Authority to assess the feasibility of treating these.

Associated Issues

Policy Issues

Discharges from working coal mines in the UK are controlled under legislation which includes consents issued by the Environment Agency, conditioning the quality, quantity, discharge regime and monitoring of minewater discharges to prevent water and land contamination.

The principle offence of pollution under Section 85 (1) of the Water Resources Act 1991(WRA 1991) is that a person "causes or knowingly permits any poisonous, noxious or polluting matter or any solid waste matter to enter any controlled waters". Until recently however, drainage from abandoned mines has been exempt from such control, using the defence under Section 89(3) of the WRA 1991 "A person shall not be guilty under Section 85 by reason only of his permitting water from an abandoned mine to enter into controlled waters".

Following implementation of the Environment Act 1995 this exemption from liability has been removed for mines abandoned after 1999 and new regulations require six months notice to be given of proposed abandonment of a mine or part of a mine. For mines abandoned before this date there remains no effective control over their discharges, and therefore environmental damage will continue to occur.

However organisations wishing to achieve environmental improvements to water courses damaged by contamination from abandoned coal mines subsequently become responsible for the discharge and subject to discharge consents: failure to comply could render the organisation liable to prosecution. Both the liability implications and the initial and continuing costs associated with the application and the Discharge Consent act as disincentives for organisations to intervene.

Alternative proposals to resolve this include the exemption of such schemes from liability and the use of qualitative or descriptive consents rather than quantitative consents. However where the treatment proposal involves active (chemical) treatment and treated water discharging to an excellent quality water course, as proposed at Ynysarwed, there appears to be

little alternative to a quantitative consent in the interests of protecting the water environment.

It has been suggested that the present exemptions from liability under the WRA are incompatible with EU law, in particular Directives on Groundwater (80/68), Dangerous Substances (76/464) and Freshwater Fish (78/659) which include measures for the prevention of pollution, protection and improvement of the water environment. Possible consequences of the UK Government's failure to implement required measures could include infringement proceedings under Article 169 of the Treaty of Rome and action to recover damages by individuals suffering damage as a result.

Following the recent changes in legislation and regulation a "Memorandum of Understanding" has been agreed in relation to Minewater between the Coal Authority and the Environment Agency setting out their respective roles and responsibilities for aspects of monitoring, prioritising, treatment and research.

The availability of funding.

Before the establishment of the Minewater Remediation Programme by the Coal Authority and with the exception of the River Pelenna and Ynysarwed Minewater Projects, few schemes had received financial assistance for feasibility or implementation.

The Coal Authority's programme, funded by the Department of Trade and Industry will continue to address on a priority basis the most serious problems.

Assessment of a Discharge and Temporal Variations

Prior to consideration of treatment options and sizing it is essential that an accurate appraisal is made of the minewater and an understanding is developed of the underground regime as part of an in depth feasibility study. The importance of initial selection of the appropriate sampling regime and reliable monitoring and analysis over a time period cannot be overestimated in determining the profile of any discharge.

Land Availability

Within the area of Neath Port Talbot topography is a major constraining factor on design and this is the case throughout the South Wales Coalfield.

Land for minewater treatment may only be acquired by agreement; land availability further constrains design and implementation and is often a major obstacle in progressing a site. Resolution of these aspects at an early stage is critical to the progress of any scheme, given the constraints they impose on implementation within the time and cash flow limits imposed on finance packages. The case studies referred to later in this paper demonstrate the potential for land issues to frustrate progress..

Landscape Considerations

Instances of minewater problems are frequently close to residential communities and the aesthetic appearance of schemes is an important consideration in gaining formal planning approval and community acceptance of schemes. Considerable work has been achieved within the area on the establishment of landscaping standards that achieve visual, ecological and cultural conformity with the surrounding landscape.

European Problems: Local Solutions: The River Pelenna Minewater Project

The River Pelenna Minewater Project, in the village of Tonmawr, was established in 1994 to demonstrate the application of passive methods for removal of metals from the minewater before it reaches the river and to revitalise the river catchment. Approximately 20 small drift mines and two larger collieries were worked, which at their peak together employed some 500 men.

The River Pelenna is a tributary of the River Afan which enters the sea at Port Talbot. Coal mining here dates back to the mid 19th century. Three rivers in the vicinity are stained a vivid orange for approximately 7 km. This commenced shortly after the cessation of deep mining in the 1960's and the current project is the culmination of many years of information collection, research, reclamation and community regeneration within the area.

Local concern over the problem had always been an issue, but the situation gained wider attention during the late 1980's as the South Wales Coalfield was being run down, creating the potential for more widespread problems to occur, as indeed has been the case with the Ynysarwed discharge. Information was provided by an investigation into the water quality of the catchment in 1992 (Ishemo and Whitehead, 1992) funded by the British Oxygen Corporation Foundation

for the Environment. Six separate discharges combine to place a total additional flow of 34 litres per second and a total iron loading on the river system of 93 kg Fe per day. Because of the long standing nature of the discharges on the Pelenna and the water quality data available it was considered that the minewater discharges were at equilibrium and that further improvement in water quality as a result of natural processes would be insignificant.

Recommended treatment levels for each minewater discharge to achieve acceptable water quality standards in the river were identified, to achieve European Inland Fisheries Advisory Council (EIFAC) standards and make the watercourse suitable for recolonisation by salmonid fish (Whitehead et al. 1995). To achieve the EIFAC standards target reductions in iron concentrations of 95% (Nant Gwenffrwd) and 50% (Nant Blaenpelenna) were proposed.

A feasibility study, commissioned by the NRA in Spring 1993, concluded that the most suitable and cost effective methods of achieving the required treatment would be by treating five discharges using a combination of passive systems including anoxic limestone drains, settlement ponds, aerobic and anaerobic wetlands (Richards, Moorehead & Laing 1993).

Funding for implementation of the project has come from a variety of sources. These include European Union LIFE funding, the European Community's 5th Action Programme for the Environment, awarded to the former West Glamorgan County Council. This funding, matched by Welsh Development Agency Land Reclamation Grant, was specifically for the establishment of a demonstration project of European significance, to show the effectiveness of wetland treatment as a low cost, sustainable means of improving watercourses contaminated by coal mine effluent, to assess and develop opportunities to enhance the conservation aspects and to disseminate information on the project (West Glamorgan County Council 1993). The project was managed by a partnership between Neath Port Talbot County Borough Council and the Environment Agency. Additional funding for associated work has come from the BOC Foundation for the Environment.

A significant proportion of the land required for the River Pelenna Minewater Project was already in the ownership of the lead partner, although protracted negotiations were necessary to release the land from

grazing occupancy. Two areas of land have been acquired by negotiation whilst associated land is being accessed under easement.

Design proposals recommended that for each discharge treated minewater is released to an impacted section of river and this combined with the long standing contamination of the river has influenced discharge consenting.

Following such a prolonged period of contamination it was considered initially that any improvement would be better than the existing situation. At the inception of the project it was considered that a discharge consent would not be required for the level and type of treatment proposed. The position has changed subsequently, however, and a qualitative consent is proposed, although no final determination has been made.

A number of demonstration features have been incorporated into the Phase I treatment system, (Steffen, Robertson & Kirsten (UK) Ltd. & West Glamorgan County Council 1995) partly fulfilling one of the project objectives: surface flow wetlands, which encourage aerobic iron removal processes; sub-surface flow wetlands, which favour anaerobic processes such as bacterially-mediated sulphate reduction; differing substrate types (mushroom compost and wood bark mulch) and differing plant types (nursery grown *Typha* sp. and the locally occurring *Juncus* sp), (Figure 2).

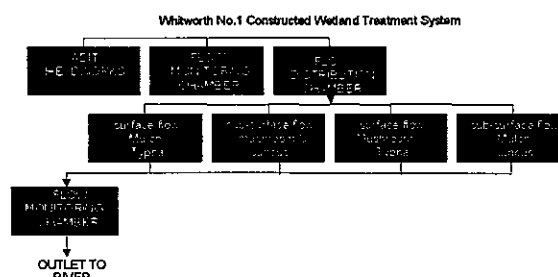


Figure 2: Phase I Treatment System Layout

Designs of Phases II (Steffen, Robertson & Kirsten (UK) Ltd. 1996, NPTCBC 1998), (figure 3) and III (Nuwater, 1996, NPTCBC 1996), (figure 4) have extended the scale of demonstration by incorporating features such as aeration cascades, settlement lagoons, ochre accretion terraces and, to increase alkalinity in the more acidic discharges,

successive alkalinity producing systems. These designs have been responsive to changes in technology during the life of the project. For the most part identification of preferred treatment has been achieved by consensus. Work on the project started in earnest in January 1994, with a programme to construct five wetlands over a five year period. All wetland treatment systems have been completed in a construction programme comprising 3 phases.

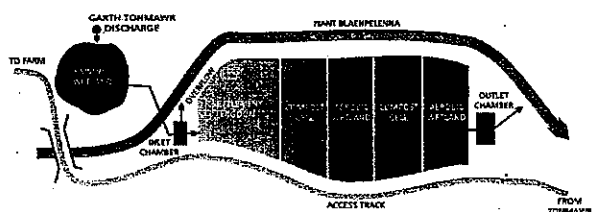


Figure 3: Phase 2 Treatment System Layout

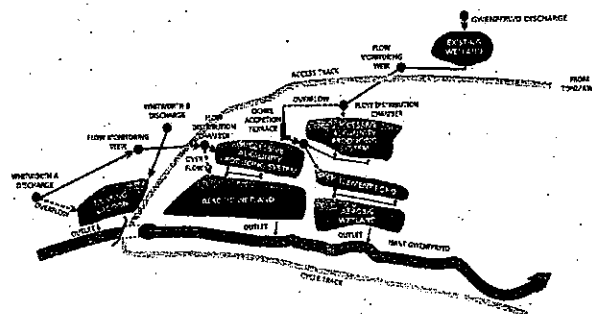


Figure 4: Phase 3 Treatment System Layout

On completion of all the phases, environmental assessment studies were repeated during the summer of 1999 to assess the improvements to the catchment resulting from the wetland treatment systems. The results of these surveys demonstrate a significant improvement in the water quality and visual amenity of the River Pelenna, a return of fish to the Gwenffrwd tributary where previously there were none and an improvement on the Blaenpelenna downstream of the new treatment system at Garth Tonmawr. Survey work is being undertaken into the wider conservation and environmental benefits of the project and again positive steps have been achieved towards improving habitat biodiversity. Following 30 years of damage to the river the community reaction to the project has been supportive and welcoming: an atmosphere of co-operation has assisted in resolution of practical issues associated with major earth moving contracts accessed through the village.

In addition to the main restoration project, a number of associated projects, have been undertaken and funding has been identified for further monitoring and research in national and European partnership projects

A Minewater Treatment Computer Aided Design Package (MPIRE) has been developed with funding from the BOC Foundation for The Environment to produce a freely available piece of computer software (James A, D.J. Elliott & P.L. Younger, 1997). Information dissemination about the technology is fundamental to the success of the River Pelenna Minewater Project as a demonstration scheme. It is particularly important to the wider objectives of the EU LIFE Programme and the WDA.

The project's effectiveness can be measured against the original objectives:

1. Significant success has been achieved in the identification and implementation of a sustainable long term demonstration system.
2. Monitoring and evaluation has been undertaken consistently to demonstrate the effectiveness of water purification which has restored river water quality to levels capable of supporting salmonid fish life.
3. The partnership has been able to demonstrate the acceptable application of wetland treatment in the context of the natural landscape and improved biodiversity.
4. The partnership has made a significant contribution to the European knowledge base on mine water treatment and has been able to demonstrate the effectiveness of new treatment techniques and their potential for affected watercourses elsewhere.

National Problems, Regional Solutions: The Ynysarwed Minewater Project

The Ynysarwed Minewater Project has been established to treat a relatively recent, major discharge which has emerged from an adit associated with colliery workings closed in the 1930's, but has been caused by a 1991 mine closure in an adjoining valley.

The Ynysarwed discharge, in the Vale of Neath, emerged from the Ynysarwed Adit and flowed almost directly into the Neath Canal, initially overwhelming the canal along a 12 km length. Management of the flow regime of the Neath Canal

stabilised the situation temporarily and contained the polluted water in a 7 km stretch of the canal before it overflows to the River Neath estuary.

The Ynysarwed discharge demonstrates the additional and potentially serious economic and community consequences which may result from the occurrence of this type of pollution in an urban context: impingement on a conurbation's water resources, in this case an industrial water supply to BP Chemicals (Baglan) Ltd, a coarse fishery, tourism / recreational and aesthetic amenity within the Swansea Bay Conurbation.

Ynysarwed adit is associated with workings closed in the 1930's from which there had been an apparently insignificant, intermittent discharge of minewater under extreme weather conditions.

The initial outburst of contaminated minewater from the Ynysarwed adit commenced in spring 1993 and grew in volume and intensity to a peak flow of about 36 litres per second and over 400 mg of iron per litre in early summer 1994. Dissolved oxygen concentrations are negligible and the water is net acidic resulting in pH values as low as 3.5 following oxidation and hydrolysis in the canal.

Extensive sampling and borehole testing was undertaken to establish a paradigm of groundwater levels, minewater provenance and retention time and to identify alternative possibilities for treatment (Steffen, Robertson & Kirsten (UK) Ltd. 1995,) (Edwards, P.J. 1996). The dramatic increase in volume and iron loading of the discharge has been related to the recovery of groundwater resulting from the cessation of mining activity and associated pumping at the Blaenant Colliery in the neighbouring Dulais Valley.

Under the Multi Attribute Testing methodology referred to earlier the Ynysarwed discharge emerged as the worst affected in the National Minewater Ranking List (April 1998) not then receiving treatment.

Analysis of water quality data for the Ynysarwed discharge has indicated a steady decrease in iron concentration over time. Natural recovery has reduced the iron loading from its peak to approximately 150 mg l⁻¹ in early 2000 and a predicted long term recovery to a baseline level of around 30 mg l⁻¹ is expected (Younger, P.L., R.P. Pennell & P.S.P. Cowpertwait 1996).

The preferred treatment for this discharge involves active chemical treatment with lime, flocculant dosing, sludge dewatering and disposal off-site, together with a constructed wetland of approximately 1 hectare providing final "polishing" for the treated minewater prior to its discharge into the River Neath. The process regime takes into account a predicted decline in iron concentrations, in providing the flexibility to discontinue chemical treatment and rely solely on passive wetland treatment elements (Hyder Consulting Ltd. 1997) (Neath Port Talbot County Borough Council 1998).

This active process has a greater potential for system failure than passive treatment. Because the discharge arrangements for the treated minewater include its release into a section of the River Neath not currently affected and of excellent water quality the Discharge Consent here has much more stringent requirements than those at Pelenna. The requirements for Ynysarwed specify a water quality on dilution 10 times better than the EIFAC standard, and a requirement for an emergency lagoon and telemetry

Land availability in the vicinity of the Ynysarwed discharge is heavily constrained and the preferred option has necessitated negotiations over a comparatively short time frame with seven separate owners of land, resulting in additional cost and contract delays. Progress with the remediation has been achieved with government grants (Welsh, British and European, public sector borrowing and with management input from Neath Port Talbot County Borough Council, The Environment Agency, The National Assembly for Wales and The Coal Authority. Identification of the preferred course of action has only become possible with the involvement of the Coal Authority and the provision through them of DTI sourced revenue funding for operation and management. Inevitably the project has suffered from uncertainties associated with the funding package.

The combined Active and Passive Treatment System will become fully operational in July 2000 following some five years of research, feasibility, funding identification, land acquisition, design, statutory approvals, construction and commissioning.

Because the discharge is relatively new (5 years) the local community has seen a serious deterioration in water quality of both the Neath Canal and, as a result of temporary overflow arrangements, of the tidal River Neath at Tonna, some 6 km down valley. Community reaction here has been much more

mixed than at Tonmawr, with different and often conflicting perspectives. There is an undercurrent of anger at the damage to the environment and the loss of good quality water resources and some exasperation at the length of time to establish preferred treatment.

The medium term costs of treatment at Ynysarwed are high because they involve chemical treatment and disposal of the iron rich sludge to a licensed landfill. The significant operational costs post construction contrast sharply with the other two schemes described. Investigations are currently underway to establish the environmentally most efficient operation of the plant and alternative uses for the waste sludge.

National Problems: National Solutions: The Gwynfi Minewater Project

The third example from the area, the Gwynfi Minewater Project has been established by the Coal Authority, as part of its Minewater Remediation Programme, to treat minewater associated with the former Glynccorwg and Corrwg Rhondda Colliery at Blaengwynfi

The priority ranked Gwynfi discharges impact on water quality for some 2 km of the Nant Gwynfi, which, like the River Pelenna is a tributary of the River Afan. The discharges emerge from the side of a steep sided valley. The discharge of polluted minewater flows at up to 18 litres per second, has a pH of 6-7 and an iron content of around 7mg per litre.

The treatment solution identified for this discharge, has been based on a pragmatic approach to optimise the balance between environmental benefit and disturbance, resulting in a system designed to significantly reduce iron loadings in the Nant Gwynfi. The treatment for this discharge has involved the construction of a passive wetland system of about 800 square metres to treat flows of up to 10 litres per second.

Challenging topography and limited land availability, in common with many of the discharges in South Wales, has required re-alignment of the Nant Gwynfi as part of the construction project completed in Autumn 1998. Progress with remediation of the Gwynfi has been possible because the land was already in public ownership (Forestry Commission) and agreement was reached on a long term lease for the treatment site. This system, managed and maintained by the Coal Authority, is an early example of the work

being undertaken through the national programme established by the Coal Authority working closely with the Environment Agency and has involved and interested people from the local community and local authority.

Conclusions

The importance of remediating damage caused by minewater has been recognised nationally, regionally and locally with changes in legislation, associated regulations, strategic and local policy formulation and the allocation of public funding.

Significant progress has been made towards the identification of sustainable long term solutions, including the establishment of joint working arrangements; assessment of the problem, identification of possible remedial options; environmental, economic and aesthetic factors influencing selection of the preferred option and the process of marrying together technical solutions with democratic decision-making.

There are distinct differences in the establishment and management of historic minewater discharges and those of more recent origin because of temporal changes in minewater quality following the initial outburst, but also because of the longevity of damage to the associated water course.

Selection of a preferred treatment will depend on the chemical properties of the minewater and also on topography, land availability, cost (including availability of capital and revenue) aesthetic appearance, environmental impact, accessibility and remoteness.

The establishment of a "Memorandum of Understanding" together with allocation of ring-fenced Government funding for minewater prevention and remediation has enabled the Coal Authority to establish a prioritised Action Programme have removed many of the uncertainties regarding occurrence and treatment. Land availability and in particular land acquisition by negotiation remains a significant obstacle.

Fundamental to the detailed design of wetlands is the need to marry performance with habitat creation, to achieve sympathy with and enhance existing landscapes, to encourage wildlife and to use locally prevalent, native plant species.

In terms of delivering schemes acceptable to local people it is recommended that the local community is involved in the design and implementation process, that a high regard is placed on the setting of proposed works within the landscape, and that the scheme is accompanied by substantial mitigation planting.

Additional work will be required to develop the potential for use of minewater by-products in the future.

Further research has been initiated through National and European research programmes to establish the mechanisms and longevity of processes taking place within these constructed wetlands and therefore the sustainability of these systems.

In the future it is likely that locally initiated schemes will become necessary only where there is a clearly identified local need to depart from the nationally agreed Priority Ranking, for example where there is a community led commitment to treatment or where the treatment of minewater is one aspect of a wider ranging reclamation or regeneration project or is a pre-requisite to development.

All the organisations involved with the River Pelenna Minewater Project, the Ynysarwed Minewater Project and the Gwynfi Minewater Scheme have worked collaboratively to ensure that the "best practicable environmental option" is identified and implemented and that the unacceptable problems caused by minewater pollution within Neath Port Talbot are treated in an efficient and sustainable manner.

Partnership has been the key to the resolution of the problem and these Minewaters Projects are an excellent example of the partnership approach.

Projects will succeed if all parties work together with a common goal and if all issues can be overcome.

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ⁱ Neath Port Talbot County Borough Council, is one of 13 Unitary Local Authorities in Wales responsible for the delivery of a wide range of statutory public services including social, educational, economic and environmental concerns within their local areas

ⁱⁱ Environment Agency Wales is an Assembly Sponsored Public Body. It takes an integrated approach to environmental protection and enhancement in Wales and has major responsibilities for management and regulation of the water environment and for controlling industrial pollution and wastes.

ⁱⁱⁱ The Welsh Development Agency seeks to secure economic development and environmental improvements throughout Wales, with both the public and private sectors. This includes the management and delivery of Wales' Land Reclamation Programme to bring forward reclaimed and contaminated land for redevelopment and community benefit.

^{iv} The National Assembly for Wales is the newly created tier of Regional Government, with powers devolved from the UK Government under the Government of Wales Act 1998.

^v The Coal Authority is a Non-Departmental Public Body set up by Central Government under the Coal Industry Act 1994 upon the privatisation of the coal industry in the United Kingdom and has a commitment to the environment over and above its legal minimum standards of responsibility. More recently the Coal Authority's role in treating minewater has been strengthened by Government commitment to prevention of future pollution from recently closed mines and the allocation of a separate, "ringfenced" budget.

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