

INTERNATIONAL PARTNERSHIP ADDRESSING HERITAGE POTENTIAL AND REMEDIATION OF MINE DRAINAGE IMPACTS ON THE RIVER AVOCA (IRELAND) AND AT AMLWCH (WALES)

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Abstract

The authors consider approaches to environmental remediation of the abandoned copper mines at Avoca in Ireland and at Amlwch in Wales, UK in terms of balancing the interests of various stakeholder groups. Water and water quality are essentially heritage concerns. The legacy of mining at Avoca creates the most significant river pollution in Ireland. The problems of Avoca have been considered in their various aspects at different times, generating copious data from various fields of interest. This 'heritage' is currently being explored by scientists from different disciplines through The Celtic Copper Heritage (CCH) initiative which has obtained funding under the EU INTERREG 111A Programme. Heritage and remediation potential is also afforded by combining international understanding with approaches to a similar ore body in Wales which has been worked for the same minerals over history. The similarity of the two places extends to the fact of their both being worked by the same company, owners, miners and mining engineers. The mine sites at Amlwch are included in the International Commission on Monuments and Sites' Register of Landscapes of Outstanding Historic Importance in Wales. The surviving mining heritage has close parallels with that of Avoca. Many studies have been made of both places and their mining impacts. Recently, in Avoca, a pilot water treatment operation was commissioned by the CCH project to quantify process material and costs. A conclusive study for the remediation of the mine water which will include recommendations for the mine sites is soon to be commissioned by the Department of Communications Marine and Natural Resources (DCMNR). Local heritage issues will feature in this. Actions to treat the mine water discharges will need to consider a number of variables, including the characteristics and disposal of the residual products of the proposed treatment process.

Introduction

"Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such" (WFD 2000).

The whole of The Avoca catchment is rich in economic minerals, and their economic importance has been understood for centuries. Kinahan (1889, p.109) noted that across Wicklow "mining operations have been in varying activity at intervals from time immemorial". Different forms of mining at different times have played a major role in the economy of Avoca and Amlwch and their surrounding districts. Consideration of various aspects of heritage likewise has potentially important economic benefits for their future. Mining took place in an era when there were few environmental controls in place, and significant environmental degradation has occurred at both locations. Gallagher et al. (1998) reported on the river's historical sink use, and widespread contamination of the mine site and surrounding land surface by spoil and serious pollution of the Avoca River by acid mine drainage that has long been recognised as a major problem (Flynn, 1994; O'Suilleabhain, 1996; O'Suilleabhain et al., 1997; Gallagher and O'Connor, 1999; Wright et al., 1999). The river is severely impacted by mine drainage and is considered by the EPA to be the most severely polluted stretch of river in Ireland. Lucey (2005) noted for EPA on fish kills, indicating "catastrophic ecosystem disruption" that the unacceptably high rate of mortality in 2003 was inflated by recurring deaths of fish in the Avoca as a consequence of discharges from the copper mines. The stock of salmonid migratory species that existed in abundance before industrial scale mining in the eighteenth century has degenerated to a stock of less than two per cent. Forty three per cent of all fish kills recorded nationally in 2003 occurred in the River Avoca. EPA National Water Quality Reports since 1970 (at 3 year intervals) consistently identified biotic indices of 0 along this stretch of the river, and elevated concentrations of heavy metals are present in the sediments as well as the water column. Remediation studies will need to consider benthic substrate as well as the loadings in solution in the water column. A nitrogenous fertiliser factory operated between 1964 and 2002 downstream of the Avoca mines discharging significant waste with a high ammonia concentration adding to the problem of heavy metals.

The aim of the CCH project is to harness the historical copper mining heritage in Avoca and Amlwch as a means of generating positive economic, social, cultural, and environmental impacts in deprived rural communities. It intends to develop new educational and research facilities, conserve and preserve the industrial heritage; enhance and protect river water quality, and raise the profiles of both former mining locations as visitor destinations. The project is intended as a means of transferring disparate yet complementary knowledge and skill sets. This will capitalise upon the heritage and environmental potential of both areas leading to an improvement of the natural environment for the enjoyment of visitors. Engagement with local communities is intended to ensure added value, and sustain social as well as environmental regeneration. To effect this the EU partnership has been formed around the expertise of scientists and local experts from a variety of backgrounds and interests. Much of the Avoca mine site is in State ownership and there is an onus on the State to take steps to remedy the situation for the protection of the environment and in respect to possible human health impacts. The forthcoming DCMNR study, in respect to water quality, will have due regard for the requirements of the Water Framework Directive so as to achieve long term improvements in the River Avoca.

Celtic Copper Heritage Project in the context of recent research and other programmes

“All aspects of the Vale’s history are influenced and connected with its mining heritage” (Merrigan, 2001).

The CCH project engages scientists from various disciplines working together to address the potential and problems of both Avoca and Amlwch. Over the past decade several important studies of the extent of mining pollution at Avoca have been undertaken, including those carried out under the EU LIFE Programme (e.g. Kilkenny and Good, 1998). These identified and characterised various aspects of the ongoing chronic pollution. Geological Survey of Ireland (GSI) investigations to date have been aimed at characterising the mine site in order that any possible future work on the site can be planned and executed on the basis of thorough baseline knowledge. As well as this GSI scientists have studied many aspects of the heritage potential afforded by the classic volcanogenic geological setting of the Avoca area and its many mining heritage features. Many studies have taken place in recent years relating to the Avoca River and its remediation. The current CCH project has been brought about in part as a consequence of the recommendations of the report by Doyle et al. (2003).

The Avoca has the sixteenth largest available wetted area for salmon production out of a total of 173 salmon rivers nationally (Mc Ginnity et al., 2003) but this potential is not being realised. Stock losses arising from fish kills contributed to this unrealised potential together with a wider decline in Atlantic salmon throughout their distribution in recent decades (Byrne pers. comm.; Roche pers. obs.; Collins et al., 2006). Went (1979) described the Avoca as a ‘lost Irish salmon river’ in which stocks have been destroyed. Nevertheless small numbers of adult salmon continue to ascend the river to spawn in the upper and middle reaches of the catchment as indicated by the presence of salmon fry at several locations in 2002 (Roche, 2003) and 2006 (Roche pers. comm). To conserve remaining stocks in the Avoca a byelaw was introduced in 2005 which prohibited taking adult salmon. Recent changes (2007) in salmon management in Ireland have resulted in the Avoca, and many other fisheries being closed for salmon angling for conservation purposes.

As well as environmental management systems, rehabilitation of environmental damage and conservation of existing environmental quality, the EU Life project examined working practices in relation to a collective and integrated approach to economic development. Mining heritage in its relationship with the natural environment is intended to assist in the regeneration of deprived and marginalised rural communities. Amlwch, on the island of Anglesey, is an area with an uncertain economic future with the possible closure of Wylfa nuclear power station and Anglesey Aluminium, combined major employers in the area. The islands Gross Domestic Produce stands at only 54% and Anglesey is included within the Wales and the Valleys Objective 1 area. Heritage, and in particular the CCH project, have been identified as drivers for economic growth and included as priorities in the current strategic plans for the area. Nationally, Wales is currently promoted as the ‘*First Industrial Nation*’ with over £40 million invested by the publicly funded National Museum in their industrial heritage attractions. This strategy recognises that industrial heritage needs to be seen in the context of geology, geography social and cultural history. The opportunity to face the challenge to deliver against these national objectives for both Amlwch and Avoca is afforded by the EU Interreg 111A programme. It is also the means by which strong links can be forged between these one interrelated mining communities. Both mine sites continue to be the focus of international field trips and visits from international parties of hydrogeologists and other earth scientists. In Avoca these are often led by GSI staff, and geologists and mining heritage enthusiasts contextualise Avoca with the wider geological uniqueness of the catchment as represented by the mines at Glendalough and elsewhere in County Wicklow. The study by Gallagher and O’Connor (1997) in conjunction with Wicklow County Council and part-funded by the EU Life project concluded with recommendations for environmental rehabilitation, tourism and recreational uses, ecological and geoscientific interest. Full consultation with residents and representative groups was also seen as essential to this process to effect the correct balance between

preservation of existing mining heritage features and the revegetation of spoil heaps and reclamation of open pit areas, so as to ensure support for new initiatives and to guarantee their sustainability.

The foundations for international collaboration, therefore, are the mining landscape and socio-economic features common to both the Avoca and Amlych areas. Both areas exhibit the remains of the mining of similar ore deposits and associated 200 years of mining history. They share a comparable geology with the host rocks being 'Lower Palaeozoic' in age and comprising of volcano-sedimentary sequences. Mining history in both areas is congruent and the development of both mines was started in the late 18th century by the same company which transferred from Amlwch, at the end of its lease, to Avoca. The consequent water quality heritage issue which results in pollution poses problems at both sites. Similarities afford the opportunity for joint understanding, and complementary areas for collaboration, facilitated through the project.

The CCH project is intended to develop joint working initiatives to examine the marketing potential of both places as visitor attractions to enhance potential economic benefits to the local communities, and to improve interpretation and understanding of the two areas' history and heritage. The quality of historical local features and the natural environment are seen as drivers for rural development by creating interest and opportunities for local people to develop associated businesses to exploit the history, heritage, and generate economic benefits. The remediation of the Avoca mine waters is therefore contextualised with environmental conservation, including conservation of the mine buildings, education and research, and broader partnership.

The proposed remediation of the mine water discharges are in keeping with the overall objective of the EU Habitats Directive – "to achieve and maintain favourable conservation status for all habitats and species ... and to contribute towards maintaining biodiversity of natural habitats and of wild fauna and flora" – will require targeted actions to achieve this end. While the imposition of byelaws addresses the issue of protection of any adult salmon returning to spawn, the affected habitat remains largely unutilisable by the any sensitive biota resident in the catchment. Under certain conditions (e.g. high flows) fish may safely migrate upstream or downstream through these waters to unpolluted areas. However, the heritage and conservation value of the species covered under the Habitats Directive (salmon and three species of lamprey) has been continually threatened by poor water quality, and without remediation fishery as an angling resource can not be considered. In 2006 a pilot plant, commissioned by the CCH programme, ran an active treatment system to treat a portion of the mine drainage to establish the parameters required for an overall active treatment system for the Avoca River. Reagents were added to raise pH to render metals insoluble. Sludge was analysed for both content and quantities. The report (currently in draft form) on the pilot plant noted elevated levels in upstream sediments as a consequence of mining activity higher up the catchment. Although there is no evidence of any fish kills in area upstream of principal (Avoca mines) discharges, this loading may contribute to earlier attainment of a threshold toxicity level in fish biota when combined with concentration of toxins from the Avoca discharges.

In the likely case of the commissioning of an active treatment process, ultimately precipitate must be removed from the water course, and the economies of effecting its disposal are dependent upon several factors. Earlier reports (e.g. Prescott and Kilkenny, 1997) proposing deposition of alkaline precipitated solids above the flows which currently irrigate the mined areas noted that the void space of the Tigroney open pit is large enough to be used to collect all the solids from a full scale treatment process for at least 400 years; but nevertheless failed to take note of the constant interaction with the receiving water course through the action of percolating ground waters. The categorisation of treatment process sludge will be a critical factor in carrying out cost-benefit analysis for potential chemical treatment solutions at Avoca. While such heavy metal sludges may, after appropriate treatment and stabilisation, be deemed to be non-toxic in the UK context, a similar interpretation may not necessarily follow in Ireland. It will be necessary to carry out comprehensive leachability and toxicity tests to allow a reasonable evaluation and assessment be made on the sludge. It may then be possible to dispose of precipitate/sludge to a custom built landfill site.

Conclusions

The acid mine drainage arising from Avoca mines has severe ongoing impact on the quality of the receiving watercourse and makes the Avoca River the most polluted in Ireland. Consequently stakeholders with an active interest in remediation include fisheries scientists and local hoteliers as much as earth scientists and environmental engineers. The CCH Project is the latest in a long line of studies on Avoca and its environmental problems. It is different from most previous studies in that it attempts to engage across a broad spectrum of what the project has characterised as aspects of heritage, to bring a combined understanding from these disparate disciplines. Ultimately it will work to complement a much more comprehensive study initiated by the Minister for Communication, Marine and Natural Resources which aims to remediate the entire mine site, exploring best options for the recovery of contaminated land in the context of heritage as it is more generally understood – the juxtaposition of natural and anthropogenically ameliorated landscape: natural, geological, historical and built environment issues alongside exposed geology. The CCH project team intend, through their work, to develop a

model for approaching mine water problems internationally in the context of heritage and economic regeneration.

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