

HISTORIC MINE SITES – INVENTORY AND RISK CLASSIFICATION SUMMARY

Introduction

The objectives of the Historic Mine Sites – Inventory and Risk Classification (HMS-IRC) project are to carry out site investigations at priority historic mine sites in Ireland and to assess the potential risk posed by these sites to human and animal health and to the wider environment and to consider issues related to safety at each of the sites. The commodities worked at these sites included metals, for example copper or lead, industrial minerals, for example slate or barite, and coal. This volume identifies the geochemical nature of the sites. Volume II, which will be published later in the year, will identify the physical hazards on the historic mine sites. These two volumes should be read together.

One of the drivers for this project is the requirement of Article 20 of the extractive industries waste directive issued in 2006. The full title of the directive is:

'Directive 2006/21/EC of the European Parliament and of the Council on the management of waste from extractive industries and amending Directive 2004/35/EC'

Article 20 requires that an inventory of closed sites be prepared. The text of the Article is as follows:

'Member States shall ensure that an inventory of closed waste facilities, including abandoned waste facilities, located on their territory which cause serious negative environmental impacts or have the potential of becoming in the medium or short term a serious threat to human health or the environment is drawn up and periodically updated. Such an inventory, to be made available to the public, shall be carried out by 1 May 2012, taking into account the methodologies as referred to in Article 21, if available.'

Priority sites

The 27 sites or districts scored in this study are listed in Table 1. Five other sites were assessed but not scored because of the lack of waste material and hence they did not pose any threat to the environment. In addition some individual sites within districts were not scored for the same reason.

No.	Mine/District	No. of Sites
1	Abbeytown	1
2	Allihies	6
3	Avoca	7
4	Ballycorus	1
5	Ballyhickey (Clare Pb)	1
6	Ballyvergin (Clare Pb)	1
7	Benbulbin	1
8	Bunmahon	1
9	Caim	1
10	Clements (Connemara Pb)	3
11	Clontibret (Monaghan Pb)	1
12	Connacht Coalfield	7
13	Doolin (Clare Phosphate)	1
14	Glendalough–Glendasan	8
15	Glenmalure	2
16	Glentogher (Donegal Pb)	1
17	Gortdrum	1
18	Hollyford (Tipperary)	1
19	Hope (Monaghan Pb)	1
20	Keeldrum (Donegal Pb)	1
21	Kilbricken (Clare Pb)	1
22	Leinster Coalfield	7
23	Silvermines	6
24	Slieve Ardagh Coalfield	10
25	Tassan (Monaghan Pb)	1
26	Tynagh	4
27	West Cork Cu-Ba	8

Table 1 Site districts and individual sites scored in the HMS-IRC project.

Conceptual model and scoring system

In order to carry out the fieldwork in an efficient manner a systematic methodology was needed, leading to the development of a **Conceptual Model**. This model provided a guide for data collection in the field but was not so rigid as to prevent the recording of features unique to any one site.

The EU Directive on the management of waste from the extractive industries requires that the inventory of closed and/or abandoned waste facilities be addressed using risk assessment procedures. However, it is important to note that this is NOT a risk assessment of the sites. Rather the sites have been ranked on a risk basis so as to determine a relative ranking for possible future actions.

The conceptual model uses the Source–Pathway–Receptor paradigm. This paradigm requires that each of the parameters within the model is documented, estimated, measured or recorded. The model identifies the source of any contamination, who or what is affected (the receptor), and how the source may reach the receptor (pathway).

The overall approach is to apply scores for the hazard (source), the likelihood of release, and the receptors for each waste type along each pathway at each site.

The **Hazard** of a waste pile or mine water discharge is determined by:

- The chemical composition of the waste pile or discharge;
- The relative toxicities of the different constituent elements; and
- The volume (or area) of the waste pile or discharge.

The **Likelihood of release** of a contaminant from a waste pile or discharge is an assessment of whether or not there have been releases of contaminants to the environment in the past and it takes account of whether the waste pile or discharge is in any way contained in order to minimise or reduce release. In all cases any contaminant must be attributable to the mine site.

The **Receptors** are the people, animals, ecosystems or protected areas that may be affected by a release from the mine site.

Results

Mine districts and sites scored under the HMS-IRC scoring system are assigned to one of five classes, I, II, III, IV or V. Table 2 shows the final score for each district/site investigated. Of the 27 individual districts/sites listed in Table 2, three are classified in the highest class, Class I, one as Class II, two as Class III, five as Class IV and the remaining 16 as Class V.

Mine / District	No. of Sites	Hazard	Total Score	Class
Tynagh	4	9,772	2,712	I
Silvermines	6	6,565	2,545	I
Avoca	7	5,009	2,438	I
Glendalough/Glendasan	8	3,795	1,122	II
Caim	1	1,204	559	III
Glenmalure	2	1,944	335	III
Ballycorus	1	371	244	IV
Gortdrum	1	612	157	IV
Leinster Coalfield	7	389	133	IV
Slieve Ardagh Coalfield	10	451	118	IV
Clements (Connemara Pb)	1	292	97	V
Connacht Coalfield	7	342	91	V
Kilbricken (Clare Pb)	1	158	89	V
Allihies	6	245	76	V
Abbeystown	1	156	70	V
Tassan (Monaghan Pb)	1	199	44	V
Ballyvergin (Clare Pb)	1	115	43	V
Ballyhickey (Clare Pb)	1	80	19	V
Keeldrum (Donegal Pb)	1	74	17	V
West Cork Cu-Ba	8	154	17	V
Clare Phosphate (Doolin)	1	83	15	V
Bunmahon	1	48	14	V
Hope (Monaghan Pb)	1	43	13	V
Clontibret (Monaghan Pb)	1	60	12	V
Glentogher (Donegal Pb)	1	24	5	V
Benbulbin	1	34	5	V
Hollyford (Tipperary Minor Cu)	1	11	4	V

Table 2 HMS-IRC scores and classification.

Conclusions

1. Lead (Pb) is the single most important contaminant on Irish mine sites in terms of its toxicity, the concentration in which it is found, the quantity of Pb-enriched material, and its geographical dispersion on and around mine sites. Mine districts and sites most severely contaminated by Pb include Caim, Clare Pb Mines, Glendalough, Silvermines and Tynagh.
2. The sites of the former ore processing plants at Gortdrum, Silvermines and Tynagh are significantly contaminated by heavy metals. In all three cases, the sites are being utilised by new businesses. Contaminants include not only the metals produced from the site, such as lead, zinc (Zn) and copper (Cu),

but also minor constituents of the ore that have become concentrated during processing. These minor constituents include arsenic (As) and mercury (Hg), which have been found in concentrations exceeding 1,000 mg/kg.

3. Concentrations of Cu in stream sediment are very high downstream of some sites, notably Allihies, Avoca and at Glandore and Ballycummisk in West Cork. The potential for impact on the aquatic ecosystem may warrant further investigation. The total Cu in surface waters downstream of mines indicates some impact on water chemistry from mine discharges. However, numerous upstream surface-water samples and even some groundwater samples also contain copper in excess of regulatory levels, suggesting that mine waste is just one of a number of sources of elevated Cu in surface water and groundwater.
4. High concentrations of Zn in solid mine waste pose no threat to human health.
5. High concentrations of Zn in stream sediments and/or downstream surface waters at Avoca, Glendalough, Silvermines and Tynagh pose a risk to livestock and the aquatic environment.
6. Nickel (Ni) is enriched in mine water, downstream surface water and stream sediments at some sites in the three coalfields investigated. It is also found in excess of the Draft EC Surface Water Regulations downstream of mines such as Avoca and Tynagh.
7. Issues of concern have been identified at a number of sites that warrant further investigation or action. These sites include: **Abbeytown** (Pb- and As-rich leachate from the tailings pond); **Avoca** (measured Pb concentrations >1% in solid waste); **Ballycorus** (measured Pb concentrations >1% in solid waste); **Caim** (measured Pb concentrations >5% in solid waste); **Clare Lead District** (measured Pb concentrations >20% in solid waste); **Glendalough** (measured Pb >10% in solid waste); **Gortdrum** (measured concentrations of Hg (>0.5%) and As (>1%) in solid waste); **Silvermines** (measured concentrations of Pb (>2%) and As (>0.1%) were detected in

solid waste); and **Tynagh** (measured concentrations of Pb >2%, As >0.1% and Hg >0.1% in solid waste and a cadmium-rich discharge from a waste heap).

Recommendations

1. The Local Authorities should be advised of all issues of environmental concern falling within their functional area. Other authorities such as the Health Services Executive (HSE), the Health and Safety Authority (HSA) and Teagasc may also need to be informed of specific relevant issues.
2. Sites assigned to Class I should have a full environmental risk assessment carried out, if not already undertaken. Ongoing monitoring should be carried out at these sites.
3. The site assigned to Class II should have general monitoring of most or all waste piles, discharges or stream sediments carried out on an annual basis.
4. Sites assigned to Class III should have specific monitoring of particular waste piles, discharges or stream sediments on a biennial basis.
5. Sites assigned to Class IV should have specific monitoring of particular waste piles, discharges or stream sediments on a five-yearly basis.
6. Sites assigned to Class V do not require any specific monitoring.
7. A scientific-based monitoring scheme should be developed appropriate to each of the site classes, incorporating relevant expertise from the Environmental Protection Agency (EPA) and the Geological Survey of Ireland (GSI). Funding needs to be allocated for this task. The GSI could carry out such a monitoring programme.
8. An inventory of wastes from the quarry sector should be carried out to comply fully with the Directive on the management of waste from the extractive industries.