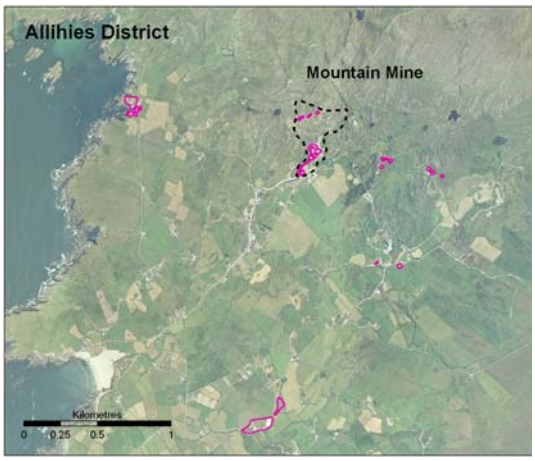
MOUNTAIN MINE

Background information



Mine District: Allihies

Mine Name: Mountain Mine

Alternative Names:

Elements of interest:
Cu, Mo

Project Prefix: ALL-

County: Cork

Townland: Cloan

Grid Reference: E58987, N45774

Site Description and Environmental Setting

Mountain mine was the largest and most productive mine in the Allihies district. It is located on the side of the mountain a few hundred metres northeast of Allihies village. The land around the site is extremely rocky and provides grazing only for sheep. Below the site to the south are some large pasture fields. A number of dwellings and holiday homes are located on the eastern and southern perimeters of the site. The site includes the recently conserved Cornish Man engine house, the ruins of a crushing mill, several adits and shafts and some of the largest open stopes of any abandoned mine site in the country. A public road runs through the site across the mountain, connecting Allihies with Urhin.

The Man Engine house (photo, left) is the only extant building on the site and an important landmark in the area. Built in 1862 as a means of transporting miners to and from the underground workings, it was the only engine house of its kind built in Ireland. A conservation project was completed in 2003. Other buildings on the site include the remains of the 1920's crusher house and those of several nissen huts that served as accommodation for miners during the Can-Erin exploration in 1956-1961 (Fig. 1).

The workings at Mountain mine are extremely extensive. Mining of the vein system initially began at the surface before continuing underground, leaving large, deep excavations at the surface. Some stopes were carried through to the surface from underground. Several open shafts remain, notably the engine shaft immediately in front of the engine house (Fig. 1). Excavations and shafts are surrounded by a 2m-high chain-link fence.

Four adits are still visible on site (Fig. 1). The **Main adit** was cleaned out during the Can-Erin exploration and is now blocked by a steel plate. The **Chamber adit** is filled by debris but the roof of the opening is visible. The **North and South Lode adit** blocked by tyres as well as fly-tipped material. Only the **Magazine adit** (photo, left) is accessible. This narrow adit does not appear, from plans available, to connect with any underground workings.

The lack of streams in the area led to construction of several reservoirs around the mine site. All are dry now save for Dooneen reservoir to the west, which takes the overflow discharge from the shaft 100m to the northeast (number 8 on Fig. 1). The dams used to construct the reservoirs are largely intact.

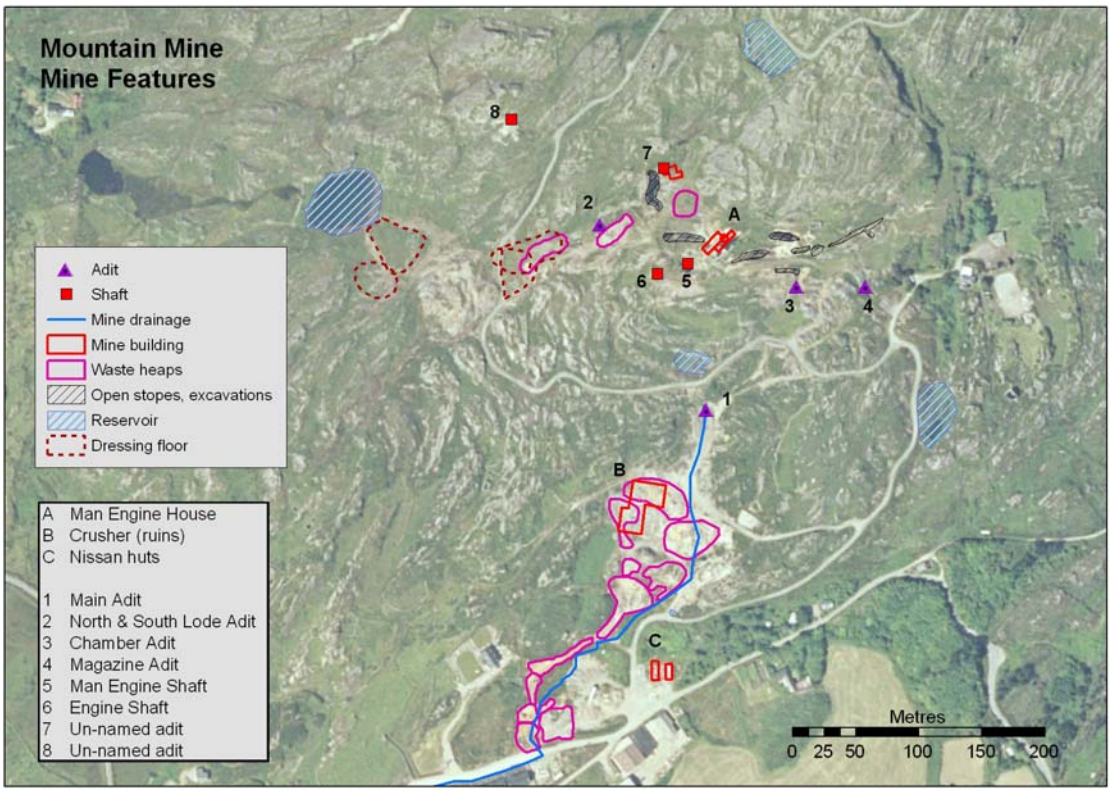


Fig. 1 Allihies, Mountain Mine: mine features

The Main adit (photo, left) and Chamber adit discharge mine water. The Main adit does so continuously whereas the Chamber adit discharge has been observed only in winter. The Magazine adit also discharges water but this is assumed to be groundwater that seeps into the adit through the roof and walls. This water seeps into the ground east of the adit. Flow rates of 0.25 and 3.4 l/s were measured at the Main adit in summer and winter, respectively. Total mine water discharge rates from Mountain mine, as measured on the same days in the drainage channel near the road at the southern extremity of the site, were almost double those of the Main adit, 0.45 and 6.4 l/s, respectively. Although the

Chamber adit makes a small contribution in winter, most of the additional discharge implied by the total discharge readings appears to come from a buried conduit just east of the crusher ruins. This conduit coincides with a drainage channel marked on 1920s maps but it is not clear what workings are being drained.

Solid mine waste is widespread over the site but waste heaps are relatively small compared to those seen on other sites in the country (Table 1). Whether waste was returned underground after dressing is not known. Fine, crusher waste was washed down in streams to the sea at Trá na mBan where it forms the raised beach. Coarser waste is scarce on the mine site although a small slag heap (SP06c, Fig. 2) is present close to the engine house. Most of solid mine waste is found in relatively thin accumulations below the site of the crusher house and in thicker (2m+), distinctive red-brown accumulations around the discharge channel at the southern extremity of the site (photo, right). Over the course of the project, excavation waste from house construction has been dumped on the site in the vicinity of the Main adit and this is now threatening to obscure the mine features in this area.

Table 1 Area and Volume of spoil heaps Mountain Mine

Waste ID	Area (m^2)	Volume (m^3)
ALL-07-SP02	1640	1284
ALL-07-SP03	970	485
ALL-07-SP04	475	238
ALL-07-SP05	999	500
ALL-07-SP06	2106	1045
ALL-07-SP07	1746	2141

Geochemical assessment

1. Surface water

The discharge from the main adit and the unidentified conduit near the crusher site combine to feed the mine drainage stream that runs along the side of the road towards Allihies village before joining the stream system west of the village. The maximum total flow rate detected was 6.4 l/s in February 2007, almost twice the rate issuing from the Main adit. This mine water has relatively low concentrations of Pb (3 µg/l) and Zn (65 µg/l) and moderate Sb concentrations (maximum 5 µg/l). Cu concentrations of 349 µg/l (winter) and 319 µg/l (summer) are significantly elevated, well in excess of Draft EC (Surface Water) Regulations. Cu levels are generally highest in winter months. The highest Cu concentration recorded was 465 µg/l from a surface run-off sample taken in the crusher area.

2. Groundwater

No groundwater samples were taken for the HMS-IRC project. A leachate test was carried on with a composite sample from three spoil heaps, SP02, SP04 and SP07.

Analysis of the leachate gave 2362 µg/l of dissolved Cu, 67 µg/l Zn, 4 µg/l Ni and 3 µg/l U. Sb was below the detection limit of 1 µg/l.

3. Stream sediments

Samples of sediment were taken downstream of Mountain Mine in the drain that carries most of the mine discharge observed, including that of the Main adit, and in the stream immediately below it. Analyses reveal high concentration of Cu but other elements are not elevated to any significant degree. The highest Cu concentration measured (11,430 mg/kg or 1.1%) was in the drain itself but the concentration of Cu in the stream downstream of the confluence with the drain was 10,429 mg/kg (1.04%).

4. Solid waste

Six separate spoil heaps or areas of spoil have been defined in the Mountain mine site, some of these further subdivided into smaller units (Fig. 2). A total of 39 field XRF analyses were carried out on the spoil. Table 2 provides a statistical summary of the analyses. Fig. 2 shows the spatial distribution of Cu. All field XRF data for Allihies were used to construct this diagram so that Cu values for Mountain mine can be compared to that for the district as a whole. The crusher area at Mountain mine clearly has a very large proportion of high Cu values: the median Cu concentration for samples from SP02, SP03, Sp04 and SP05 is 5226 mg/kg compared to 3775 mg/kg for those from Mountain mine as a whole and 2588 mg/kg for the Allihies district. The highest Cu concentration on the Mountain mine site, 2.5%, was measured in fine waste below the crusher zone in SP07e.

Apart from Cu, metal concentrations are not particularly high in solid waste, in keeping with the findings for stream sediments and surface water. One exception is a localized deposit of orange material that is extremely rich in Pb. This appears to be a Pb sulphosalt. Field XRF analysis indicated a concentration of 30% Pb and 4% S; even allowing for exaggeration owing to poor calibration at high concentrations, this sample is clearly very rich in Pb. Sb (890 mg/kg) and Zn (1074 mg/kg) concentrations are also enriched. The surrounding spoil has elevated Pb (2280 mg/kg) as well. This is a very localized area however and the occurrence of such material on the site as a whole is apparently very limited.

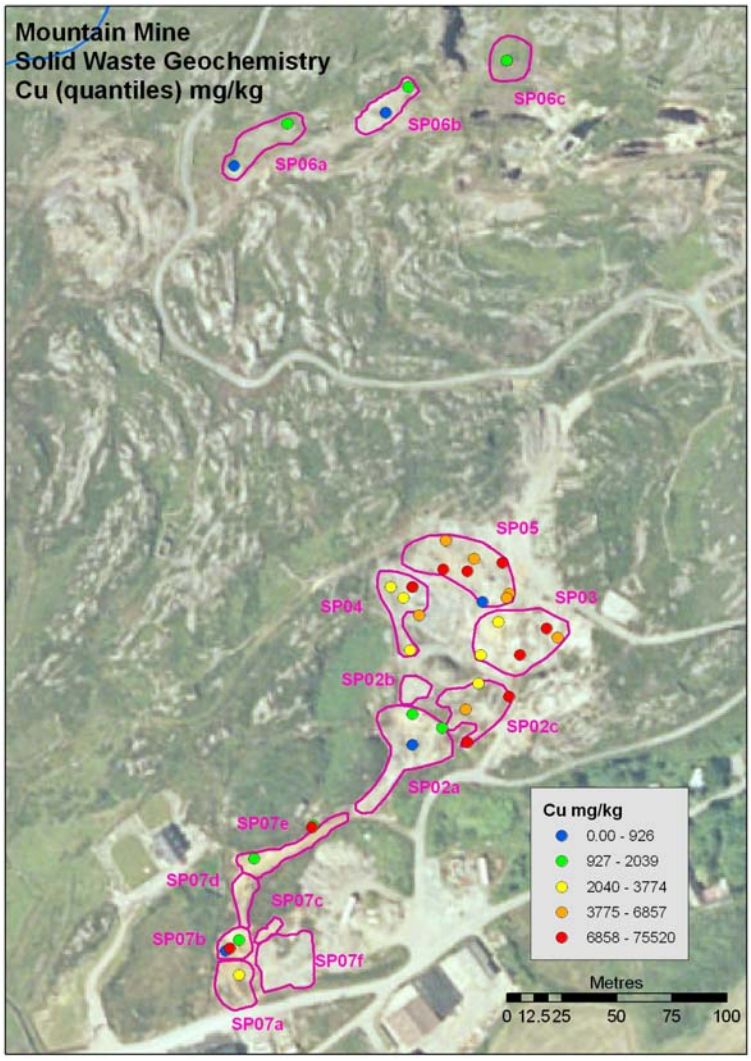


Fig. 2 Cu XRF analyses, solid waste, Mountain Mine

Table 2 Summary of XRF analyses of solid waste, Mountain mine.

mg/kg	Cu	Pb	Sb	Zn
n	39	39	39	39
Minimum	441	0.0	0.0	0.0
Maximum	25759	300394	891	1075
Median	3775	35	75	0.0
Mean	5502	7818	147	87

5. Site Score

The total HMS-IRC Site Score for Mountain Mine is 29. Each of the six solid waste sources contributes a score of 4 while the mine discharge contributes a score of 5 (Table 3). The volume of solid waste at Mountain Mine is not particularly high but Cu concentrations are at the higher end of the spectrum for Allihies and individual waste heaps thus have higher scores than many of those on other sites in the district. The similar scores for each waste heap at Mountain Mine reflect the uniformly low volumes of each.

Table 3 HMS-IRC Site Score, Mountain Mine

Waste	SP02	SP03	SP04	SP05	SP06	SP07	W007	Total
1. Hazard Score	11	12	11	12	10	11	20	87
2. Pathway Score								
Groundwater	1.58	1.58	1.58	1.59	1.55	1.63	1.13	10.64
Surface Water	2.66	2.23	2.12	2.30	2.55	2.74	3.57	18.18
Air	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Direct Contact	0.01	0.00	0.00	0.00	0.01	0.05	0.00	0.08
Direct Contact (livestock)								
3. Site Score	**4**	**4**	**4**	**4**	**4**	**4**	**5**	**29**

As is the case for the Allihies District as a whole, the surface water pathway (62.9%) is much more significant contributor to the site score than the groundwater pathway (36.8%) (Fig. 3). The low volume of waste, the lack of important aquifers in the area and the low population density, and hence low number of wells, minimize the groundwater pathway contribution while the presence at the site of a drain that flows directly to the local stream system maximizes the surface water pathway contribution. The negligible contribution of the Direct Contact and Air pathways follows from the relatively small area of the solid waste, the absence of significant concentrations of any elements of high relative toxicity and the absence of workers on the site. Stream sediments are scored as part of the district as a whole (see Allihies District report). The high concentration of Cu in stream sediments downstream of Mountain Mine contributes significantly to the total stream sediment score of 22 for the Allihies District.

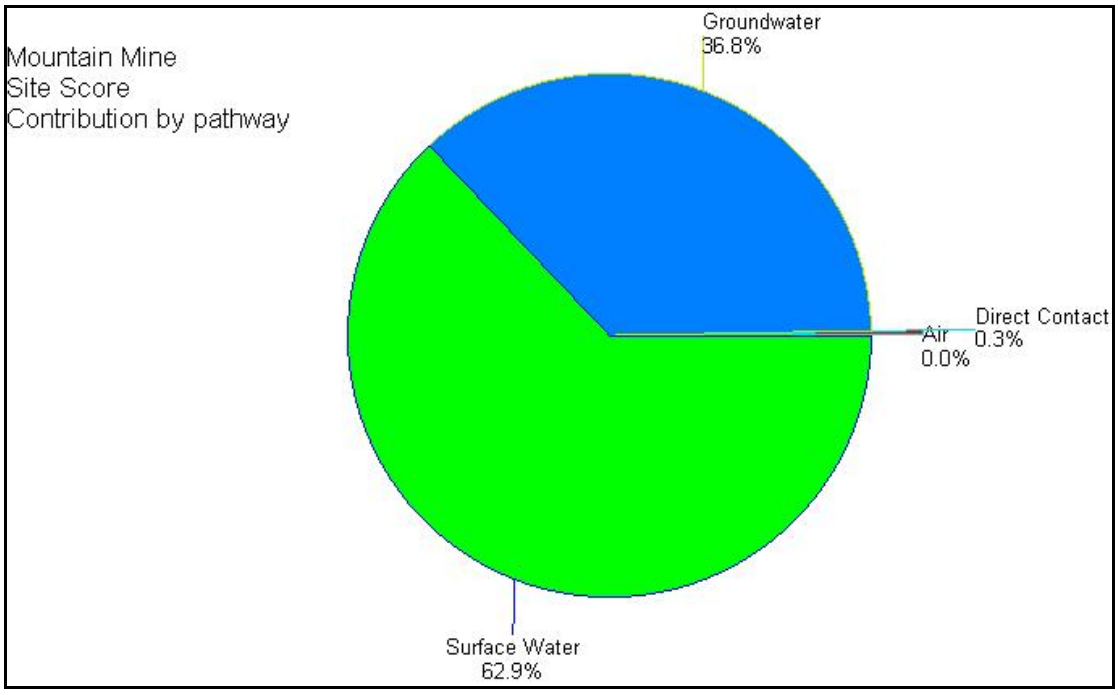


Fig. 3 HMS-IRC Site Score, Mountain Mine: contribution by pathway

6. Geochemical overview and conclusions:

Mountain Mine is the largest mine site and has the most significant environmental impact in the Allihies district (cf. Allihies District report). This impact consists largely of high concentrations of Cu in various media – other elements such as Pb, Zn and Sb show only localized enrichment in the media analysed. High concentrations of Cu in solid waste and in mine water discharging from Mountain Mine have given rise to significantly elevated Cu concentrations in stream sediment and stream water downstream of the site. The highest Cu in surface water is in the mine discharge channels themselves – once the mine water mixes with stream water, concentrations of Cu are much diluted. Nevertheless, levels of Cu above 100 µg/l, well in excess of limit for Cu in Draft EC (Surface Water) Regulations, have been measured in some stream water samples. Combined with stream sediment concentrations exceeding 1000 mg/kg, these Cu concentrations could potentially have a significant impact on the freshwater ecosystem and freshwater aquatic species. Mountain Mine contributes 38% of the total HMS-IRC Site Score of 76 for the Allihies District, a reflection of the relatively high concentrations of Cu measured in mine waste on the site and in mine water draining from the site. Direct drainage of Cu-rich leachate to local streams appears to represent the most significant potential environmental risk on the site.