BALLYCUMMISK

Background information:

Mine District: West Cork

Mine Name: Ballycummisk

Alternative Names:
Ballycomisk; Ballycummich; Ballycummish

Elements of interest:
Cu, Ba, Pb, Zn, As, Sb.

Project Prefix: BCUM-

County:	**Townland:**	**Grid Reference:**
Cork	Ballycummisk	E97657, N32197

Geology and Mineralization

The copper - barite mines of West Cork are hosted by the Old Red Sandstone succession of the Munster Basin. The sediments of the Munster Basin were deposited in a half graben and subsequently uplifted and folded into eastnortheast-trending anticlines that now comprise the rugged peninsulas of the southwest corner of the island. The mineralization at Ballycummisk is hosted by a quartz veins (Cole 1922) within purple mudstones and siltstones of the Castlehaven Formation. The mineralization comprises chalcopyrite ($CuFeS_2$), cuprite (Cu_2O), tenorite (CuO), malachite ($Cu_2(OH)_2CO_3$), tetrahedrite-tennantite ($(CuFe)_{12}(Sb,As)_4S_{13}$) and barite ($BaSO_4$).

Production and Mining History

Ballycummisk, along with Cappagh and Horse Island mines, was one of a group of copper mines known traditionally as the Audley mines because of their location on Lord Audley's property. Colonel H. Hall, responsible for much of the early exploration that led to the establishment of West Cork as a mine district, worked Ballycummisk from 1811 to 1822. In 1825 the Mining Company of Ireland investigated the workings but abandoned them after raising only a small amount of ore. No record remains of activity between 1825 and 1857 when Thomas Saunders Cave sold the Ballycummisk mine to a London businessman named Samuel Hyde. Under Hyde's ownership the mine was worked for a further 20 years and was generally prosperous. Few production reports exist for this period of mining. Cole (1922) indicates that after 1860 the ore grade declined from 10% Cu to 7.5% Cu but the quantity being raised increased continuously until 1869, when the maximum annual production of 671 tons was reached. Thereafter production declined and, despite investment by the Ballycummisk Copper Mining Company Ltd., reached a low of 63 tons in 1877 before the mine closed. Total production between 1857 and 1877 was greater than 6,000 tons of ore, making Ballycummisk one of the most profitable mines in West Cork. Cole (1922) reports that documents lodged on abandonment indicate mining to a depth of 220 fathoms (396m).

Site Description and Environmental Setting

The Ballycummisk site is on the side of a small valley little more than 100m from the sea. The surrounding land is mainly used for pasture. The site itself is partly overgrown, comprising rough pasture and heathland that surround two substantial spoil heaps and the remains of stone mine building. Farmhouses and holiday homes are scattered around the area and there is small boat yard at the coast. The site originally contained a pumping engine house and drainage engine house. The site of the latter is inaccessible within a heavily overgrown area between the two waste heaps. The low overgrown walls of the former are visible near the Engine shaft. The most prominent building remains visible today (photo, above right) resemble support pillars for unidentified structures, perhaps for hoisting or loading ore.

Of the four shafts marked on 19th century mine maps (Fig. 1), two were identified, both either collapsed or filled in. The engine shaft is securely fenced and filled with rubbish close to the surface. The second is largely overgrown by brambles and the fencing around it has been pulled down (photo, left). However, it appears to be choked close to the surface, although this could not be verified. The two waste heaps (Fig. 1) are accessible if only with difficulty in the case of SP02 because of the thick surrounding gorse. SP01 is easily approached via an old farm gate. It is adjacent to the extant mine buildings and structures (Fig. 1). Both heaps have steep faces and are relatively coarse-grained, especially SP01 which has a high proportion of cobbles. The tops of the heaps are well vegetated, mainly by gorse and brambles, but there is little vegetation on the steep sides. While SP02 appears to be stable a large slump has occurred on the southwestern face of SP01 (photo, right). The quartz-rich waste contains visible chalcopyrite. Table 1 provides an estimate of area and volume for each waste heap.

Waste ID	Area (m^2)	Volume (m^3)
BCUM-SP01	1535	6192
BCUM-SP02	1272	4928

Table 1 Ballycummisk Spoil: volume and area calculations

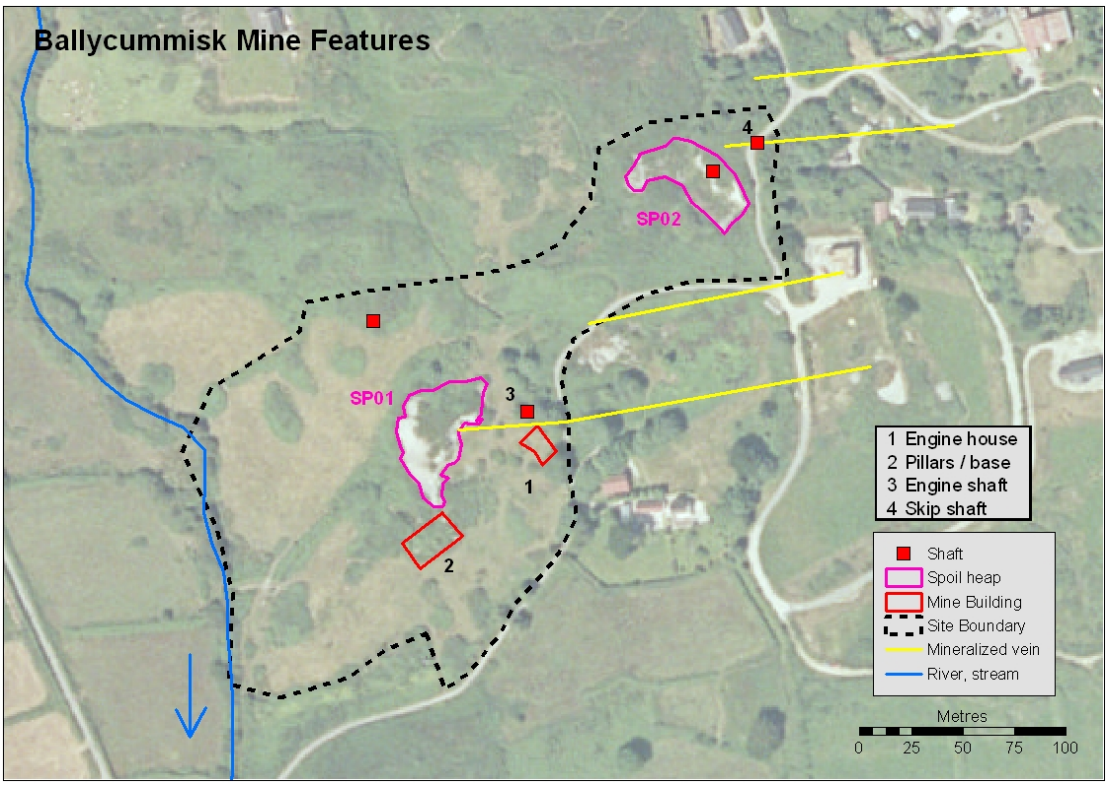

Fig. 1 Ballycummisk: mine features

Geochemical assessment

1. Surface water

No surface water samples were taken at Ballycummisk. There is no discharge of mine water from the site.

2. Groundwater

No groundwater samples were taken at Ballycummisk. A composite of two solid waste samples from SP01 was subjected to a leachate test. The leachate had low concentrations of Sb (24 µg/l), Cu (19 µg/l), Pb (2 µg/l), Zn (6 µg/l), As (4 µg/l), Mo (9 µg/l) and Al (36ug/l). These results suggest that the spoil at Ballycummisk has limited potential for polluting groundwater in the area around the mine site.

3. Stream sediments

A small 1 – 2m wide stream runs south to the sea along the floor of the valley to the west of the mine site. Two stream sediment samples were collected, one 500m upstream of the site and one 200m downstream. Table 2 shows that the downstream sample has very high concentrations of Cu and Ba relative to the upstream sample, suggesting significant contamination by mining activity. The recommended upper limit for Cu in stream sediment for livestock protection is 100 mg/kg (total sediment fraction).

mg/kg	Cu	Ba	Pb	Zn	As
Upstream (500m)	36	0	18	94	11
Downstream (200m)	2689	483	21	112	52

Table 2 Ballycummisk: stream sediment analyses

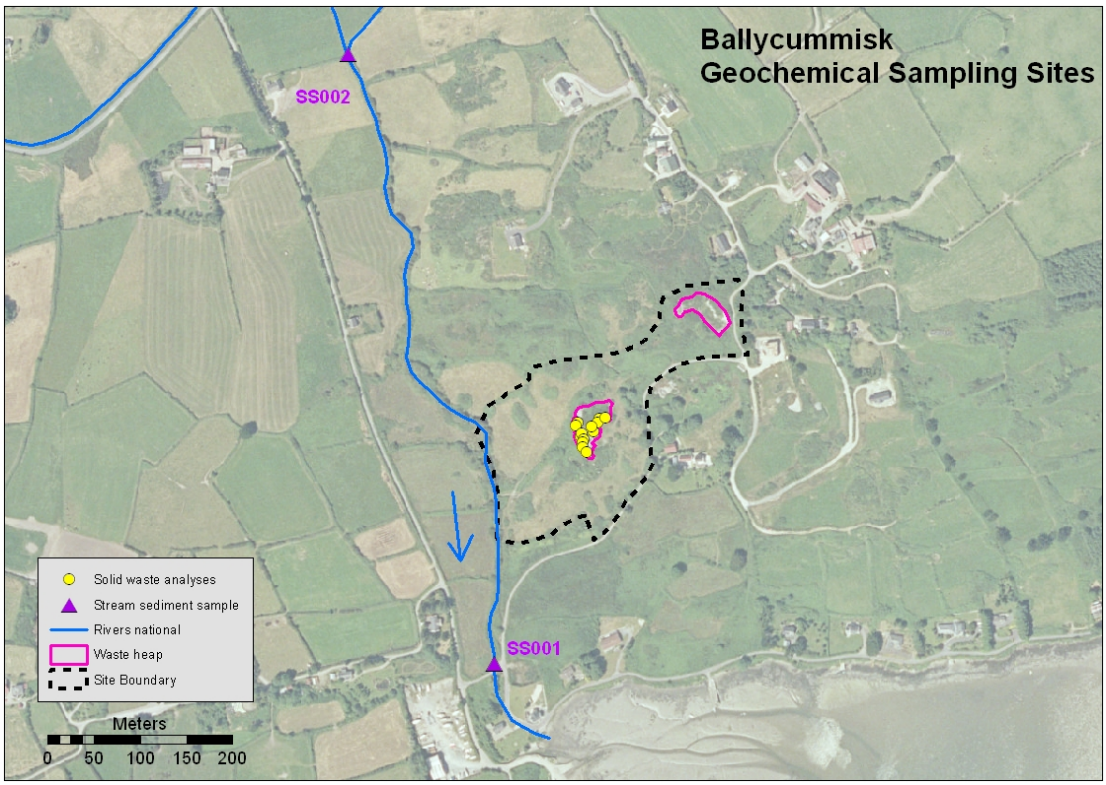

Fig. 2 Ballycummisk Geochemical sampling sites

4. Solid waste

Thirteen sites on SP01 were analysed *in situ* by portable XRF. Table 3 summarizes the data. Copper and Barium are the main elements of interest. The maximum measured Cu concentration was just over 1% (10,568 mg/kg) but most measured concentrations were much lower, with a median value of 2135 mg/kg. Barium is present in somewhat lower concentrations. Relatively minor amounts of Pb, Zn, As and Sb were detected in most samples (Table 3). Both As and Sb are found in tetrahedrite-tennantite ($Cu_{12}(Sb,As)_4S_{13}$). The National Soils Database provides a proxy for background concentrations of elements in the region. By comparison with soil values for the West Cork area (Fay *et al.* 2007), all the elements listed in Table 3 are enriched in solid waste at Ballycummisk. Moreover, the highest measured concentrations of Cu, As, Sb and Ba exceed at least some of the soil guideline limits for human health.

Table 3 Summary statistics, solid waste geochemistry, Ballycummisk

mg/kg	Cu	Pb	Zn	As	Sb	Ba
n	13	13	13	13	13	13
Minimum	522	46	62	0.0	0.0	719
Maximum	10568	98	278	282	1248	4608
Median	2135	74	167	52	247	1576
Mean	2824	68	153	76	359	1824

The distribution of Cu on SP01 is shown in Fig X.3. There is a distinct spatial variation in Cu concentrations, with the highest values southwest-facing slope. Similar distribution patterns have been observed for Ba and Sb.

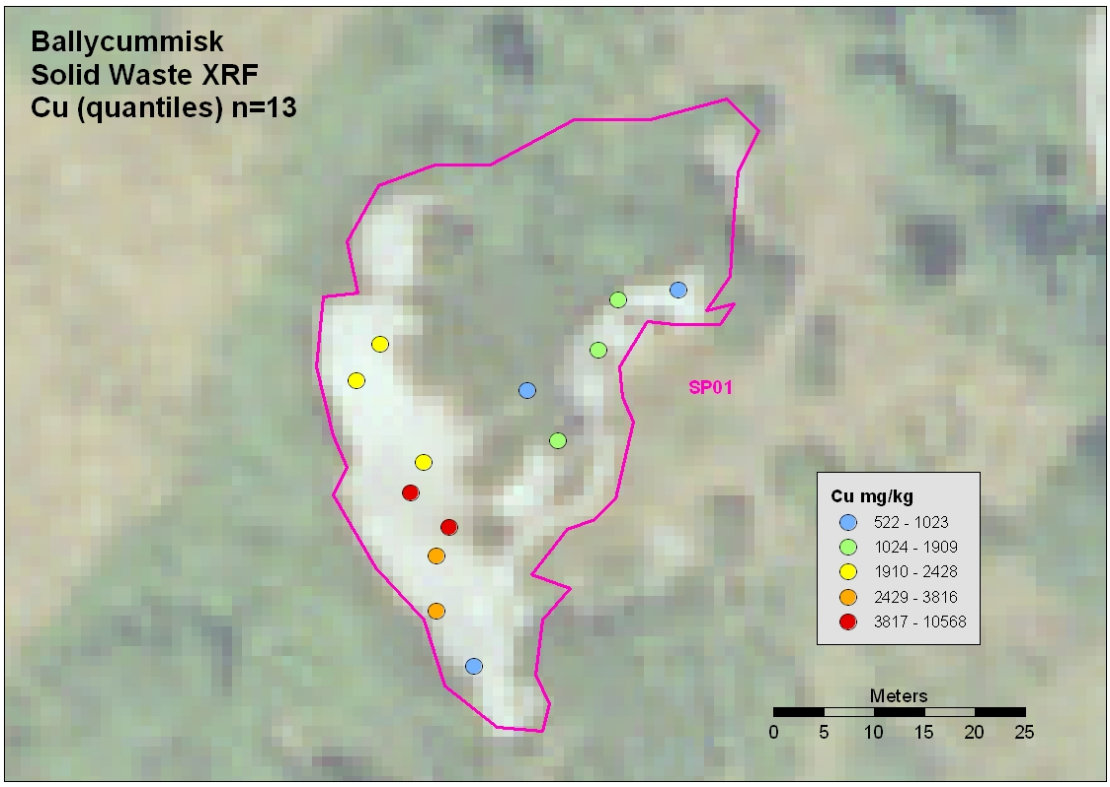

Fig. 3 Ballycummisk solid waste analyses: Cu distribution

5. HMS-IRC Site Score

The total HMS-IRC Site Sore for Ballycummisk is 4 (Table 4). The sum of individual total scores for each of the waste sources as shown on Table 4 is less than 4 but this is because the scores for the two waste heaps have been rounded down to a whole number. The small volume of waste, the low concentrations of high-relative toxicity elements in it, the lack of a mine water discharge, the lack of any surface water data and the proximity of the site to the coast, and hence the small population and potential area of impact, all contribute to the low score.

Table 4 HMS-IRC Site Score, Ballycummisk

Waste	SP01	SP02	Stream Sediments	Total
1. Hazard Score	12	12	0.69	25
2. Pathway Score				
Groundwater	1.21	1.00		2.2
Surface Water	1.19	0.44		1.63
Air	0.01	0.00		0.01
Direct Contact	0.03	0.01		0.05
Direct Contact (Livestock)			0.28	0.28
3. Site Score	**2**	**1**	**0.3**	**4**

Fig. 4 shows the contribution of individual pathways to the site score at Ballycummisk. The groundwater pathway score (52.8%) makes the highest contribution largely because the leachate test showed an exceedance for water standards for Sb. The contribution of the Direct Contact (livestock) pathway, i.e. stream sediments, is perhaps lower than might be expected but the length of stream affected is necessarily very limited because of proximity to the coast.

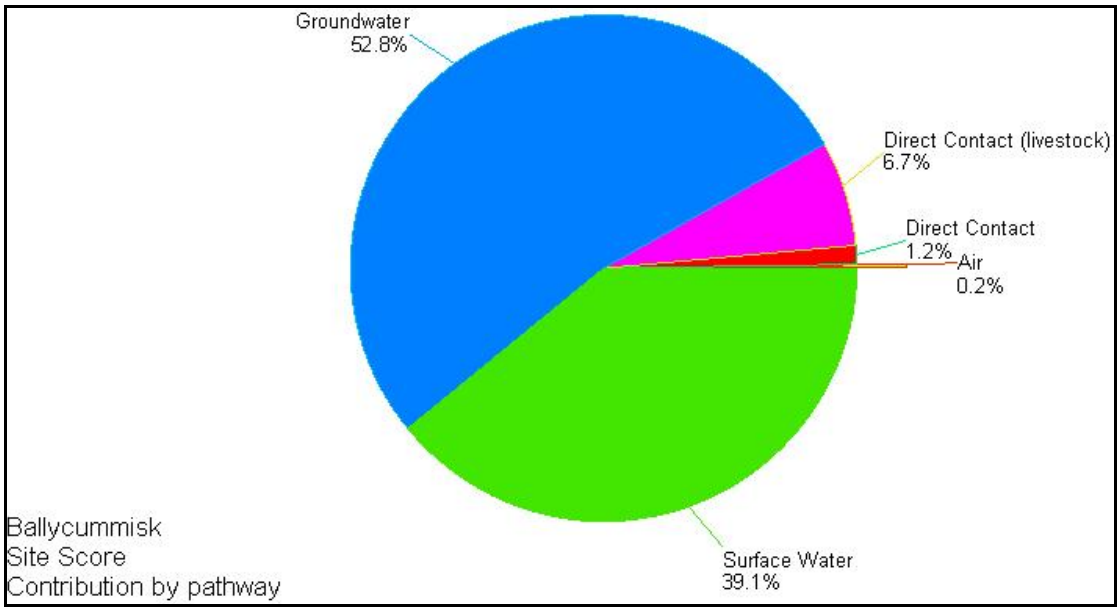

Fig. 4 HMS-IRC Site Score, Ballycummisk: contribution by pathway

6. Geochemical overview and conclusions

Solid waste at Ballycummisk has relatively high concentrations of Cu and Ba and above background concentrations of As, Sb, Pb and Zn.. A leachate sample derived from the same spoil heap reflected this composition, containing modest if nonetheless elevated concentrations of Ba, Cu and Sb. The most significant impact of the mine site on the environment was observed in stream sediments in which high concentrations of Cu and Ba were recorded downstream of the mine. The HMS-IRC Site Sore is 4, a low score that places Ballycummisk at the lower end of the Class V sites.

References

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Cowman, D. and Reilly, T.A., 1988. The Abandoned Mines if West Carbery. Promoters, Adventurers and Miners. *The Geological Survey of Ireland.* (1988)

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