BALLYVERGIN

Background information

Mine District: Clare Lead Mines

Mine Name: Ballyvergin

Alternative Names:
Maghera Cross

Elements of interest:
Pb, Cu, Ag, S, Zn

Project Prefix: BVG-

County:	**Townland:**	**Grid Reference:**
Clare	Ballyvergin	E142143, N181731

Site Description and Environmental Setting

Ballyvergin mine site lies in an extensive area of pasture land, c. 8km northeast of Ennis. The western part of the site contains the remains of the dressing floor (photo, right) and a chimney (photo, below) (Fig. 1). The cobble stones of the dressing floor are partly uncovered but most of the area is overgrown by grass and gorse. The chimney is intact but covered by ivy. A shaft is also marked on the old OSI six-inch map but there is now no trace of this.

The eastern part of the site is now a pasture field. A narrow stream running through the centre of the site drains northwards to an area of karst where it runs underground. The original boundaries of the site are not readily discerned but the boundary marked on Fig. 1 encloses just under 1.6ha.

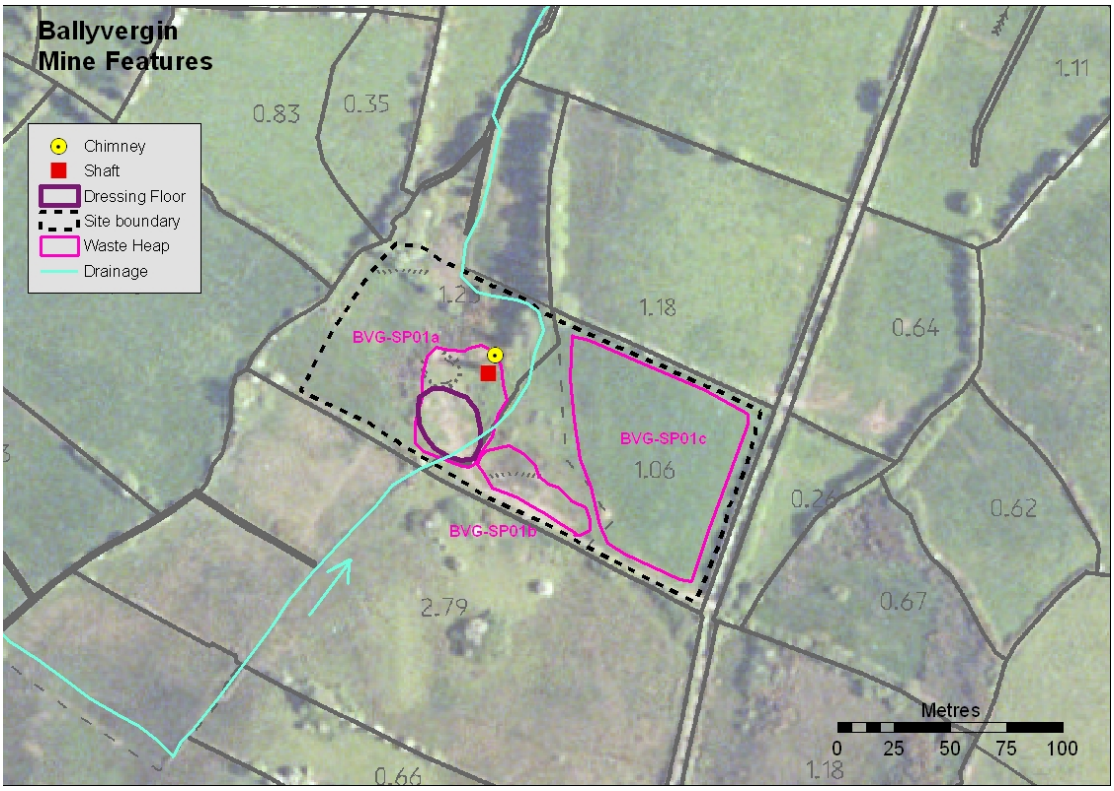

Fig. 1 Ballyvergin: mine features

Waste ID	Volume (m^3)	Area (m^2)
BVG-SP01a	836	1671
BVG-SP01b	393	785
BVG-SP01c	1094	5472

Table 1 Ballyvergin Spoil volume and area calculations

Geology and Mineralization

The bedrock comprises red–green siliciclastics of the Old Red Sandstone and Lower Carboniferous Basal Shales, Argillaceous Bioclastic Calcarenite and Waulsortian limestone (Andrew 1986). The mineralization comprises dominant argentiferous galena (PbS), chalcopyrite ($CuFeS_2$), arsenopyrite (FeAsS) and pyrite (FeS_2), with minor sphalerite (ZnS), bornite (Cu_5FeS_4) and tennantite ($(CuAgFeZn)_{12}As_4S_{13}$) in ferroan calcite, quartz and barite ($BaSO_4$) veins. The mineralization occurs as intergranular disseminations, infilling diagenetic voids, and replacements of bioclasts and in bedding-parallel and cross-cutting tectonic veinlets (Andrew 1986). Both disseminated and vein mineralizations are concentrated in the crestal region of an elongate and complex anticline and within and adjacent to two shear zones.

Production and Mining History

Production records are incomplete but Andrew (1986) states that 360 tons of 8% Cu ore and 119t of galena concentrates were raised between 1856 and 1861. Around 250 oz of silver were produced in 1859-1860 (Cowman 1992). Ballyvergin was worked for a total of eight years between 1853 and 1861 by a partnership set up specifically for the purpose. In addition to copper, lead and silver, sulphur was exported to Garston in England (Cowman 1992). Production ended as the mineralization became less economic with depth. Irish Base Metals carried out a

modern exploration programme at Ballyvergin in the 1960s. Estimates of the size of the existing deposit vary from around 150 to 230,000t grading 1-1.2% Cu and 15g/t Ag (Andrew 1986).

Geochemical assessment

1. Surface water

Two samples were taken from the stream running through the site, one upstream and one downstream (Fig. 2). The laboratory blank included in this batch of analyses returned high total-element values for Pb, Sb, Cr, Cu and Zn and all total-element analyses for samples in this batch must, therefore, be considered unreliable. Of the dissolved element analyses, only that for Cu shows any significant discrimination between the upstream (<1 ug/l) and downstream (9 ug/l) samples, suggesting the possibility of some degree of mine-related water contamination.

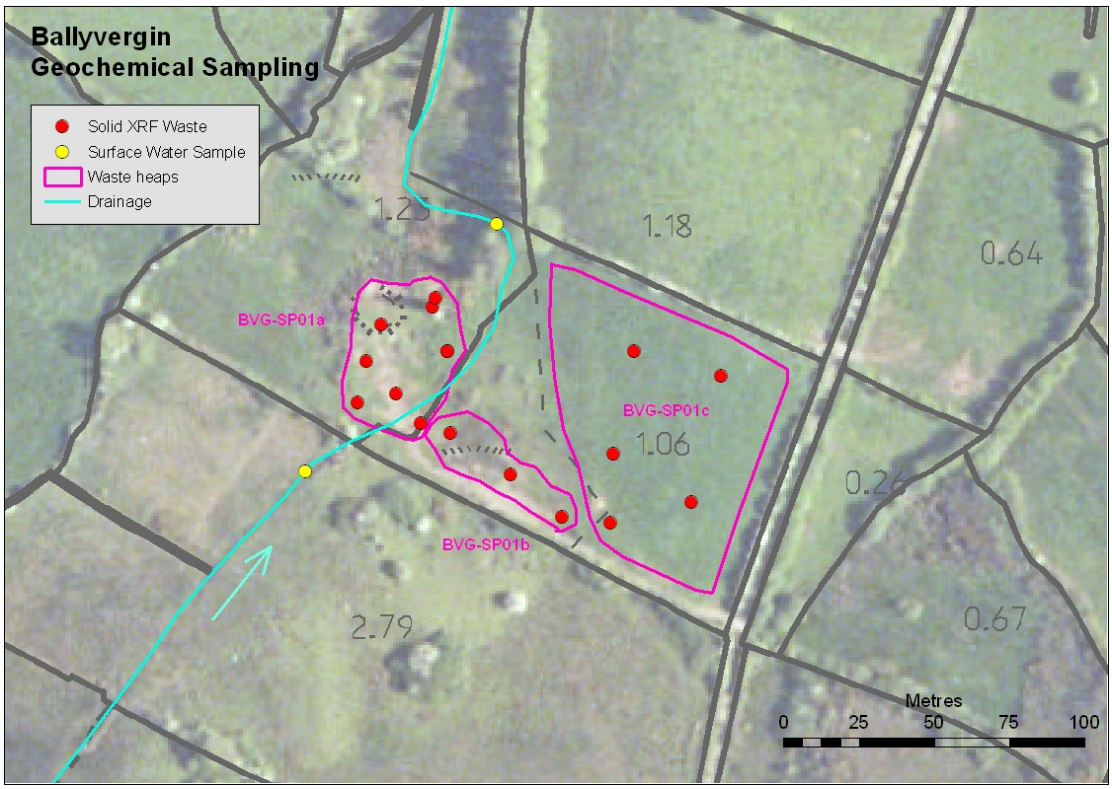

Fig. 2 Ballyvergin: Geochemical sampling sites

2. Groundwater

No groundwater samples were taken at Ballyvergin. Leachate extractions of two samples, one from the dressing floor, the other from fine waste with high measured Pb concentration (SP02), were rich in Pb (2424 and 9304 µg/l, respectively), Cu (71 and 510 µg/l) and Zn (24 and 427 µg/l). The Pb-rich sample also yielded elevated As (24 µg/l) and Fe (1730 µg/l). The volume of mine waste on the site, especially the high-Pb material, is relatively small but the leachate data indicates that there is some potential for groundwater contamination.

3. Stream sediments

No stream sediment samples were taken at Ballyvergin. The stream running through the mine site is heavily vegetated and was not suitable for sampling in the immediate area of the mine. Further downstream it runs underground in an area of karst.

4. Solid waste

There are no major solid waste heaps on the Ballyvergin site, which is essentially flat. For the purpose of solid waste analysis, the site has been sub-divided into three separate zones, SP01a, SP01b and SP01c (Fig X.2, X.3). SP01a is the grassy area around the dressing floor and chimney. SP01b is an area of fine waste immediately east of the stream. SP01c is the pasture field at the south-eastern end of the site where the soil was analysed at the base of the rooting layer. All samples at Ballyvergin had in excess of 200 mg/kg Pb when measured *in situ* by XRF (Fig. 3, Table 2). One spot in SP01b (photo, right) yielded 14% Pb; a follow-up laboratory assay of this sample gave 31% Pb.

High levels of As are associated with the high Pb levels in the XRF analyses. In samples with more than 0.5 – 1% Pb, false high values of As can be expected in XRF analyses owing to peak interference. However, laboratory check analyses of two samples, one from SP01a (9% Pb) and the other from SP01b (14% Pb), confirm that while the levels of As reported by the XRF analyses are exaggerated, the concentration of As in both is around 1800 mg/kg.

mg/kg	Pb	Zn	Cu	As	Ag	S
n	17	17	17	17	17	17
Minimum	217	0	24	0	0	0
Maximum	142067	1594	8370	7165	72	24292
Median	5868	107	1037	213	0	0
Mean	22010	240	1922	1086	9	2985

Table 2 Summary statistics for field XRF solid waste analyses, Ballyvergin

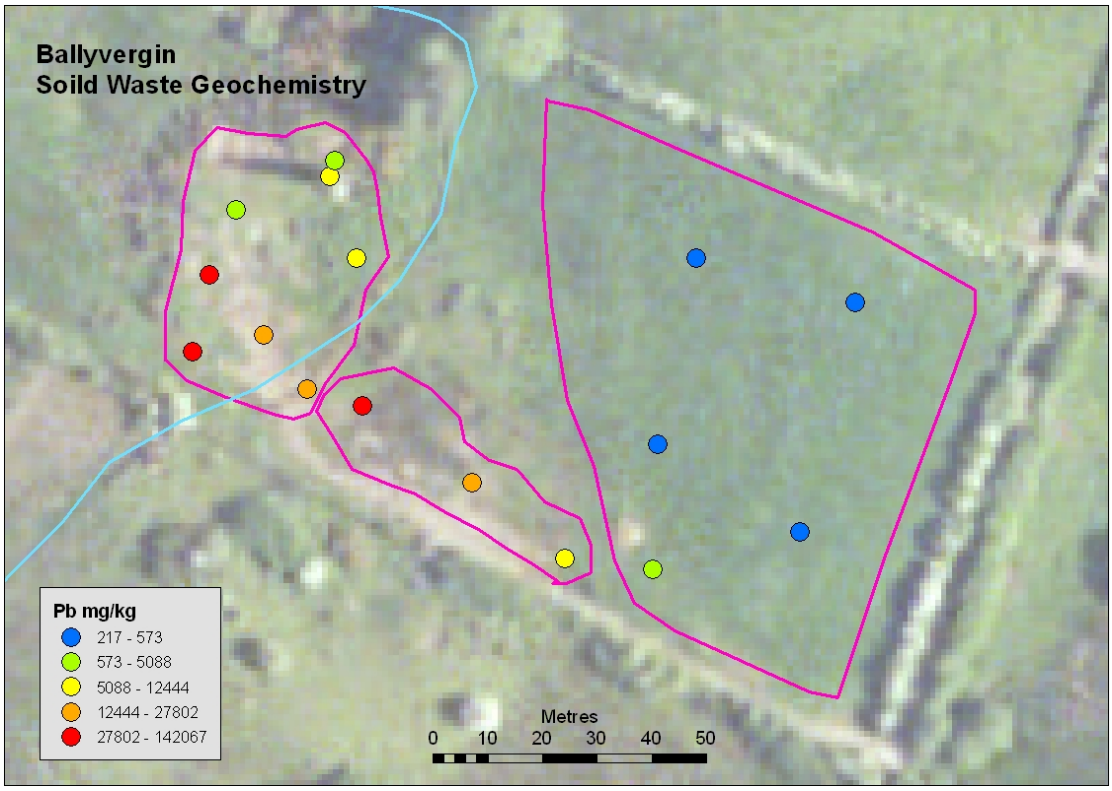

Fig. 3 Ballyvergin: Distribution of Pb in solid waste

5. Site Scores

Table 3 Site Scores, Ballyvergin

Waste	SP01a	SP01b	SP01c	Total
1. Hazard Score	**35**	**69**	**11**	**115**
2. Pathway Score				
Groundwater	5.52	11.51	0.87	17.91
Surface Water	9.10	12.83	1.99	23.92
Air	0.06	0.03	0.00	0.09
Direct Contact	0.92	0.12	0.02	1.06
3. Site Score	**16**	**24**	**3**	**43**

The Site Score for Ballyvergin is 43 (Table 3) and the high-Pb spoil contributes over 60% of this (Fig. 3), despite having by far the smallest volume of the three waste sources on the site (Table 1). This is simply a consequence of the very high Pb concentration in this waste. The small size of the site means that pathway and receptor data for each waste source are virtually identical: differences in scores for each waste largely reflect differences in hazard score (Table 3).

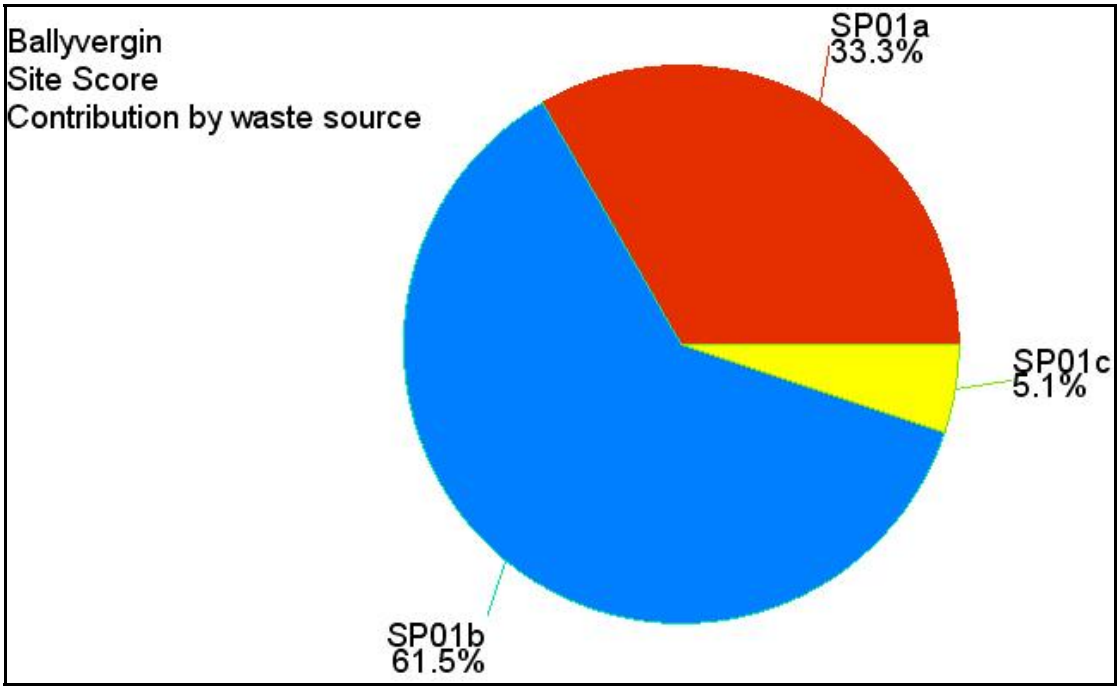

Fig. 4 Ballyvergin Site Score: contribution by waste source

The pathway scores (Fig. 5) are dominated by the groundwater and surface water pathway scores. Although the waste is close to a stream the lack of definitive geochemical data indicating downstream contamination limits the surface water score. The direct contact pathway score is very low, reflecting the small surface area of the waste. In this case, however, the score is potentially misleading as there is evidence for ongoing use of this site for grazing cattle. The high concentrations of Pb in surface material, particularly in BVG-SP01b, suggest that the real risk to animal health on this site is greater than suggested by the score.

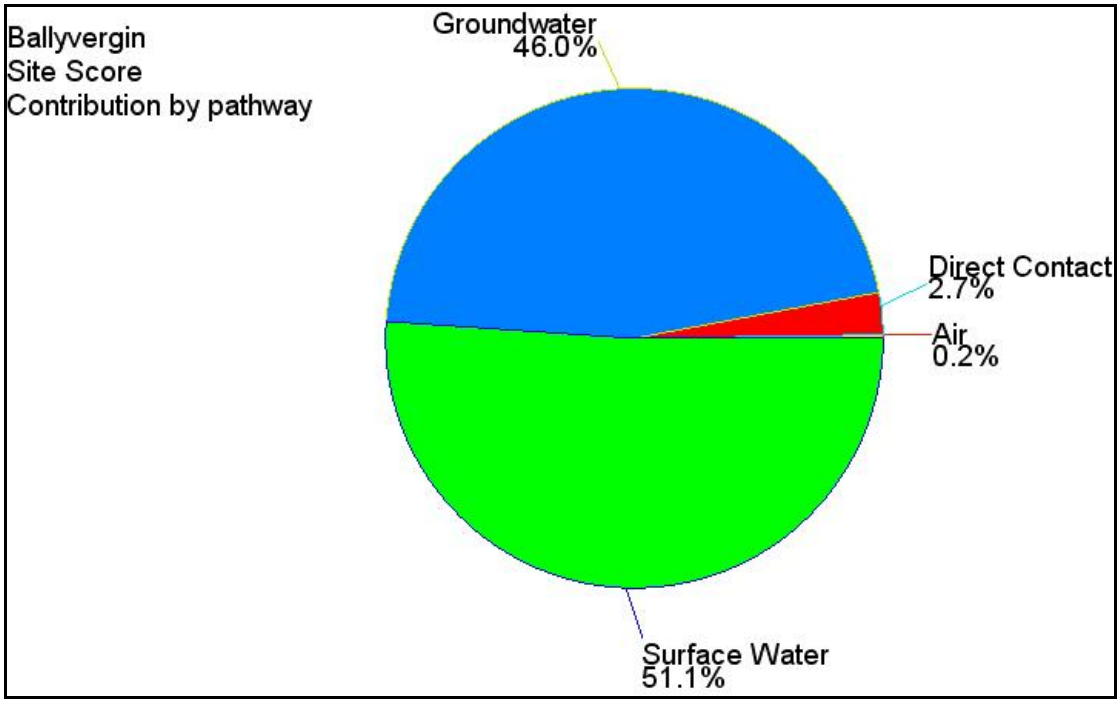

Fig. 5 Ballyvergin Site Score: contribution by pathway

6. Geochemical overview and conclusions

Solid waste at Ballyvergin has very high levels of Pb and elevated levels of Cu, As, Zn and S. Pb levels are of particular concern as the site appears to be used for grazing cattle. The waste with *in-situ* XRF concentration of 14% Pb (31% Pb by laboratory assay) is an unvegetated area of fine-grained mine waste that was heavily marked by cattle hooves in October 2007 and in July 2008. There is, therefore, potential for ingestion of metal-rich waste by feeding cattle or other grazing animals.

Surface water analyses suggest that the mine may have a small impact on stream water quality but further analyses are required to assess this properly.

References

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Cole, G.A.J. (1922). Memoir and Map Localities of Minerals of Economic Importance and Metalliferous Mines in Ireland. *Memoirs of the Geological Survey of Ireland*.

Cowman, D. (1992). The Mid-Nineteenth Century Lead Mines of County Clare. *North Munster Antiquarian journal,* Vol. XXXIV, 67-78.