

Tynagh – Processing Area

Background information

Mine Name: Processing Area

Mine District: Tynagh

Alternative Names:

Elements of Interest:

Pb, As, Hg, Cd, Cu, Sb, Zn, Ba

Project Prefix: TYN-

County:
Galway

Townland:
Derryfrench

Grid Reference:
E174262, N213016



Site Description



The area of the processing plant at Tynagh has been largely cleared in recent years (photo, left). The site defined for this study is only a part of the original processing area, centred on what was the mill area (SP01) and several settling ponds behind it (SP02) (Fig. 1). One large thickener, the supports of another, high walls of the former ore-loading structure and several other walled areas are all that remain. A galvanising works occupies

a large building along the western boundary of the site and the firm has use of a large part of the processing site as an outdoor storage and parking area. This part is heavily trafficked by employees of the galvanizing works. The surface of the storage area has been covered with hardcore.



Part of the area immediately

around and under the thickener is covered by fine red-brown mine waste. Several rusting barrels contain fine green powdered waste (photo, above right). Several of the concrete walls have a grey, Pb-rich coating. Access of workers to the area around the thickeners is now restricted. The northwestern part of the



site is occupied by several settling ponds (photo, above) and a bank of coarser mine waste.

Table 1 Area and volume of Processing Area waste

Waste ID	Area (m ²)	Volume (m ³)
TYN-SP01	9001	900
TYN-SP02a/2b	9954	9415

Geochemical assessment

1. Surface Water

Surface water chemistry is described Tynagh Mine site report. There are no adits in this area and no surface run-off samples were collected.

2. Groundwater

No groundwater sources were sampled for the HMS-IRC project. However, a leachate test on a sample taken from SP01 yielded very high levels of Pb (7920 µg/l), Zn (2865 µg/l) and Cu (1736 µg/l) and elevated levels of Cd (19.5 µg/l) and Sb (50 µg/l). A sample from the settling ponds (SP02) yielded much lower Pb (18 µg/l) and Zn (24 µg/l) but high Ba (454 µg/l). This indicates that there is a potential for groundwater contamination by leachate generated from solid waste on the site.

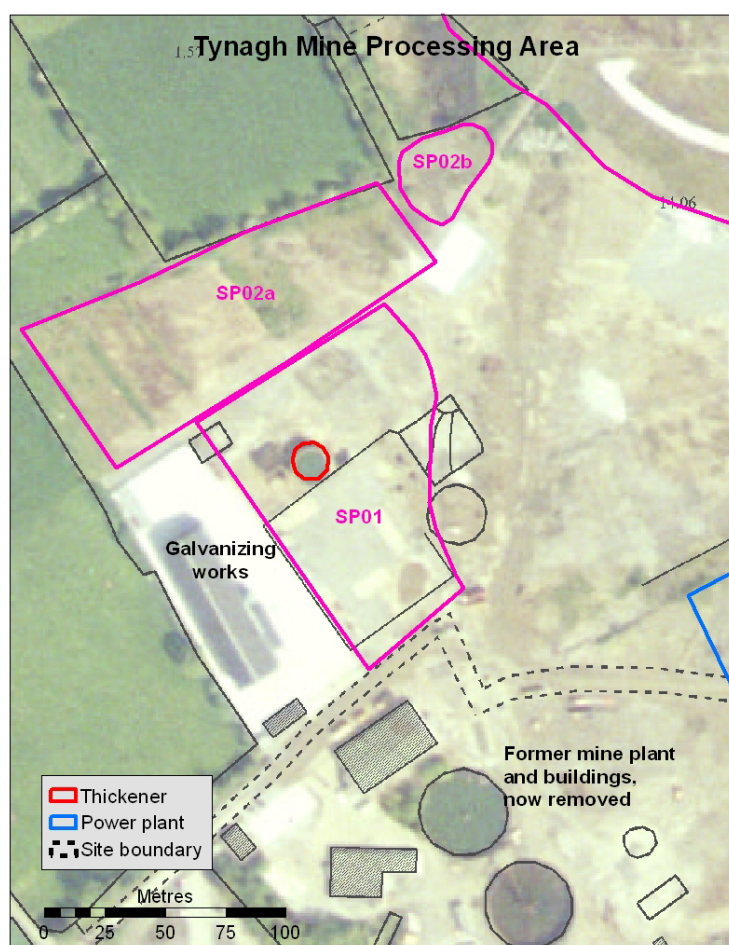


Fig. 1 Tynagh Mine processing site

3. Stream Sediments

Stream sediments chemistry is described in the Tynagh Mine Site report.

4. Solid Waste

XRF analyses were carried out on the SP01 area in June 2007 and again in March 2008. In between the surface of the area was partly cleared and covered in hardcore to provide a better surface for the work of the galvanizing firm. Nine sample sites were analysed in 2007, 16 in 2008. Tables 2 and 3 summarize the results.

Table 2 XRF analyses SP01 June 2007

mg/kg	Pb	Zn	As	Hg	Cu	Cd	Sb
n	9	9	9	9	9	9	9
Minimum	19263	5843	3436	0.0	1448	0	1074
Maximum	913892	334808	86734	1672	24397	1969	26122
Median	163750	141334	39847	0.0	79453	717	9990
Mean	323446	144954	37599	479	95740	842	10790

Table 3 XRF analyses SP01, March 2008

mg/kg	Pb	Zn	As	Hg	Cu	Cd	Sb
n	16	16	16	16	16	16	16
Minimum	1011	3161	63	0.0	214	0.0	0.0
Maximum	235467	317162	52833	2497	256276	1204	31335
Median	11331	11897	820	0.0	3119	34	707
Mean	29341	50952	4623	235	19635	151	2669

Very high levels of Pb, Zn, As, Cu, Hg, Cd and Sb were detected in samples around the thickener and nearby walls. The highest Pb was found in the dense grey coating adhering to walls – this is clearly a Pb concentrate. The value recorded, 913,893 mg/kg (>91%), is exaggerated and reflects the fact that the XRF is calibrated to measure up to 2% Pb in a soil matrix. Reanalysis using the mining mode on the XRF, designed for use in ore mixtures, gave a value of 56% Pb.

Of more concern, however, were the very high levels of metals found in a barrel containing a fine green waste (11.3% Pb, 33% Zn, 5% Cu, 1% As, 1672 mg/kg Hg, 1084 mg/kg Cd, 3748 mg/kg Sb) and in the clay-silt material that forms the surface of the ground around the thickener (16.7% Pb, 19.6% Zn, 24.4% Cu, 4.3% As, 1130 mg/kg Hg, 717 mg/kg Cd, 2.6% Sb in one sample, TYN-07-SP01.7). The limits on the XRF calibration mean that the very high levels recorded for Pb, Zn and Cu must be treated with caution. Reanalysis by assay of a selection of samples containing high metal concentrations (Appendix B), taken from various sites in the course of the HMS-IRC project, indicate that, for Pb, there is good agreement between *in-situ* XRF analyses and assay values up to around 10% Pb, above which measured *in-situ* XRF concentrations tend to be lower than corresponding assay values. For Zn, there is good agreement up to around 2% Zn but above this level measured *in-situ* XRF concentrations tend to be higher than assay values. Peak overlap between As and Pb can also give rise to falsely high As values in XRF analyses. However, reanalysis of the TYN-07-SP01.7 sample by MA/AR-ES confirmed the very high levels of As

(3.1%), Cd (573 mg/kg) and Hg (287 mg/kg). The reported Pb concentration was ">20000 mg/kg" – the method is calibrated only to this level.

Some hardcore was applied to this part of the site since the initial analyses in June 2007 yet *in situ* reanalysis in March 2008 suggests that metal contents of the surface layer in this area are as high as previously.

The settlement ponds north of the thickener area have significantly lower measured metal concentrations than SP01, yet several samples have percentage levels of Pb, Zn and Cu and significant levels of As, Hg and Cd (Table 2).

Table 2 XRF statistics for SP02

mg/kg	Pb	Zn	As	Hg	Cu	Cd	Sb
n	17	17	17	17	17	17	17
Minimum	342	706	0.0	0.0	52	0.0	0.0
Maximum	43419	134654	11032	779	62123	363	7275
Median	7710	6563	882	0.0	1076	49	367

Fig. 2 illustrates the spatial distribution of Pb in *in-situ* XRF analyses on the site for both June 2007 and March 2008. There is a clear clustering of high-Pb values around the thickener. Other parts of SP01, the site used by the galvanizing firm as a storage area, have lower values, particularly the southern or front end where a layer of hardcore has been spread to provide a good surface for the company's activities. The distribution of Zn is similar to that of Pb.

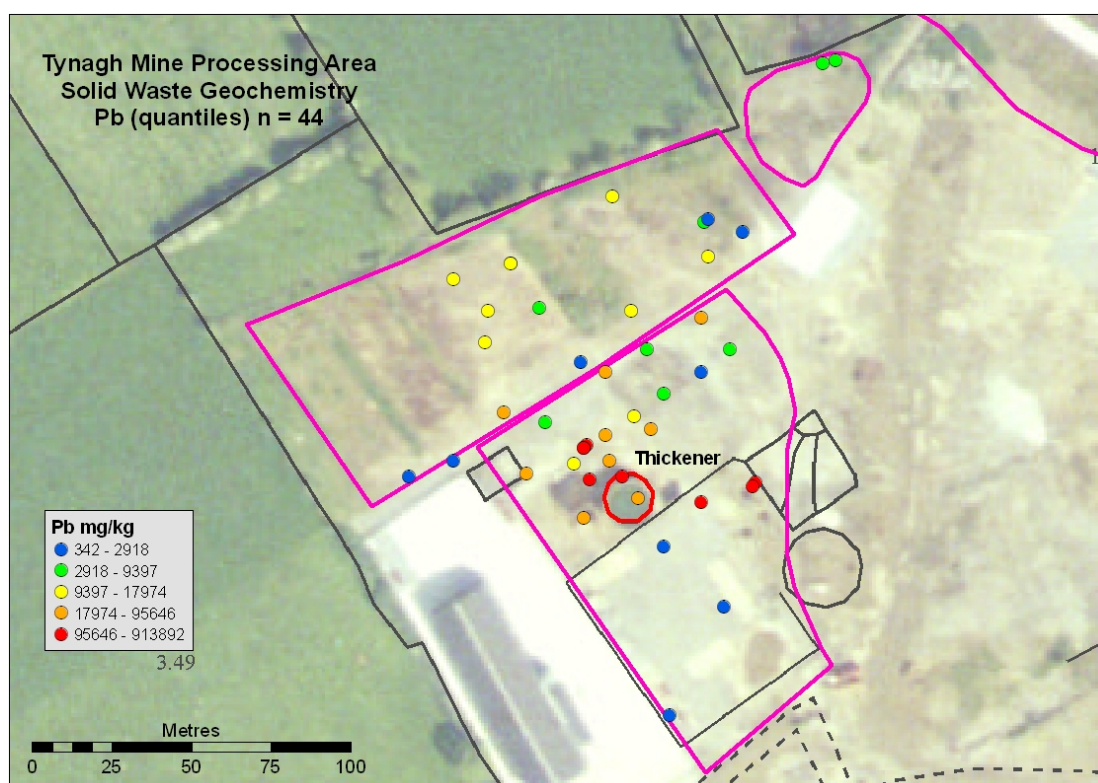


Fig. 2 Spatial distribution of Pb, Processing Area, Tynagh

Fig. 3 shows the distribution for Cd. Again, the deposits of metal-rich process waste around the thickener give rise to a cluster of high-Cd concentrations in this area. The former settlement ponds north of the thickener area show modest enrichment in Cd.

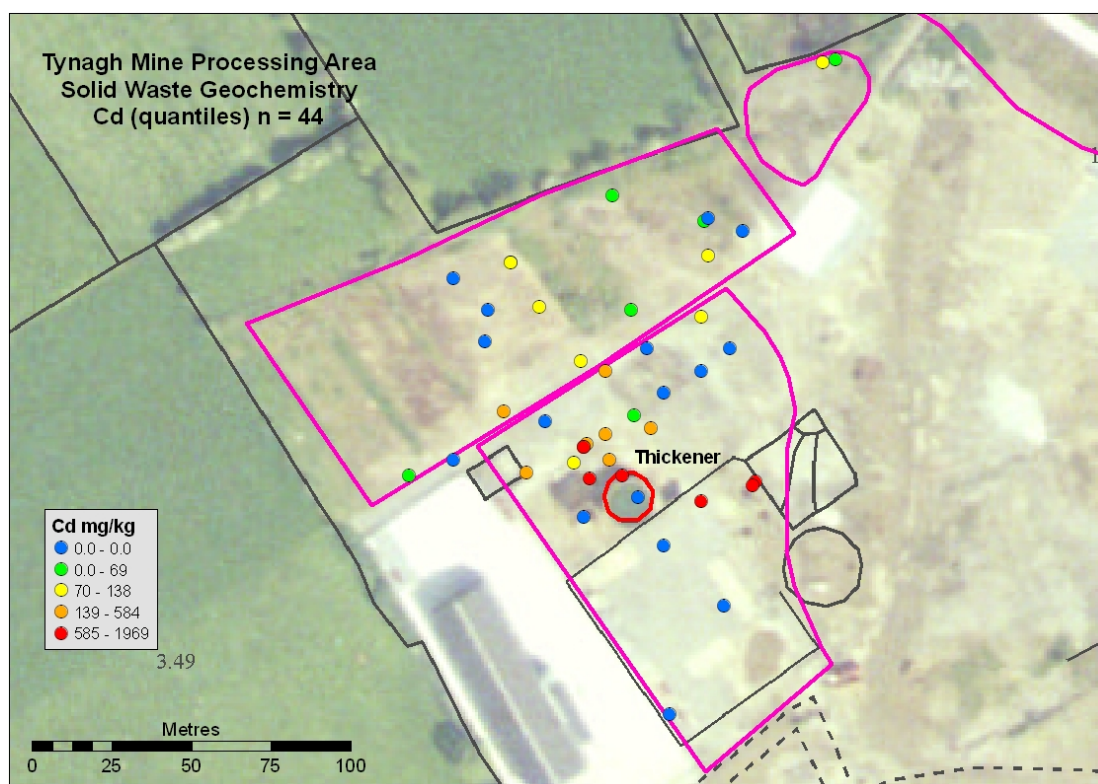


Fig. 3 Spatial distribution of Cd, Processing Area, Tynagh

5. HMS-IRC Site Scores

Table 3 HMS-IRC Site Scores, Processing Area, Tynagh

Waste	SP01	SP02a/2b	Totals
1. Hazard Score	72	53	125
2. Pathway Score			
<i>Groundwater</i>	7.21	5.14	12.35
<i>Surface Water</i>	14.77	3.16	17.93
<i>Air</i>	0.52	0.16	0.68
<i>Direct Contact</i>	6.65	2.45	9.11
3. Site Score	29	11	40

The total site score for the Processing Area is 40, with just under 75% contributed by the old plant area and the rest by the settling ponds. This score is only a small fraction of the score contributed by some other waste sources at Tynagh, despite the very high concentrations of some elements of particular concern, such as Pb, As, Hg and Cd. However, the very high concentrations recorded are localized – e.g. in barrels – and median concentrations across the whole site are much lower. In addition, the volume of waste is estimated to be low since this is a flat area with apparently limited thickness.

Fig. 4 shows the contribution of the different pathways to the total site score for the Processing Area site. Pathways are the routes by which receptors are exposed to the

hazard. The surface water pathway outweighs the groundwater pathway because of the proximity of drainage channels and the low aquifer vulnerability of the site. The relatively low volume-to-area ratio of the waste means that the direct contact pathway score is a much higher proportion of the total score than is the case for other sites with higher volume-to-area ratios. The lower the volume-to-area ratio the more the surface area influences the score. Direct contact and air (inhalation) pathway scores are directly proportional to the surface area of the waste heap since direct contact and dust generation are assumed to take place only at the surface. For example, the volume-to-area ratio of the western cell of the tailings pond at Tynagh is 3.4 and the direct contact pathway contributes 5.4% of the total score; the combined volume-to-area ratio for spoil on in the processing site is 0.54 and the direct contact pathway makes up almost 23% of the total score.

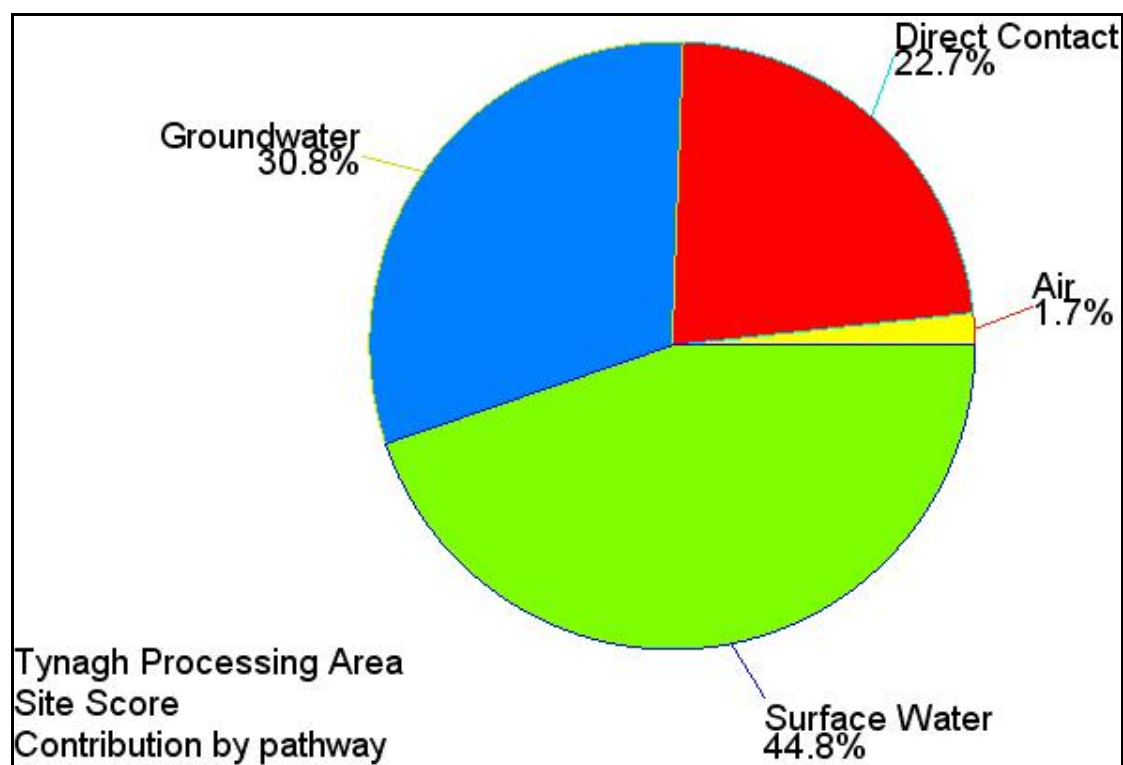


Fig. 4 Tynagh Processing Area Site Score: contribution by pathway

6. Geochemical overview and conclusions

Very high concentrations of Pb, Zn, Cu, As, Hg, Cd and Sb have been measured in process waste on the site of the processing plant at Tynagh mine. The thin cover of sand-clay-grade material on the surface of the ground around the remaining structures is also metal-rich. Much of this material, at least around the thickener, is likely to be formed, in part, from process waste. Some of the process waste is relatively inert, e.g. the Pb-rich coatings on concrete walls, but most is in the form of loose sand-silt grade material that is either lying on the ground around the thickener or packed in open barrels. This is an active work site: fabricated iron structures are stored here prior to and after galvanizing. They are moved around by truck and forklift with consequent disturbance to the surface layer. The hardcore layer has not made any obvious difference to the chemistry of the surface material, at least around the thickener. The very high concentrations of Pb, As, Cd and Hg represent a potential health risk to workers in this area.

The settlement ponds also have high Pb, Zn, Cu, As, Hg, Cd and Sb, albeit in lower concentrations than found around the thickener. This part of the site is relatively undisturbed on a day-to-day basis as it lies outside the area used by the galvanizing company. The material in these is quite fine in part and, as the ponds are largely unvegetated and have a tendency to dry out in summer, there is some risk of dust blow.