

CHAPTER 5

HMS-IRC Summary Site Descriptions

The following one-page summaries review the principal geochemical findings at each of the sites studied. The headings used for the summaries are the same for each and a brief description of each is presented below.

- Mine District:** *This is the name of the mine district or the area within which the individual mine occurs.*
- Mine Name:** *This is the name of the individual mine.*
- Minerals Worked:** *These are the commodities worked or recovered at the mine. For metal mines the elemental signature is given while for industrial minerals the mineral name is provided.*
- County:** *The county name is given here.*
- Townland:** *The name(s) of the townland(s) within which the mine is situated.*
- Grid Reference:** *The easting is given first followed by the northing.*
- Site Score:** *This is the score for each site or district.*
- Site Class:** *This is the Site Class – for the site in the case of single sites or the district in the case of sites that are part of a district.*

Class	Score	Description
I	>2,000	Sites that should have a full risk assessment carried out. Ongoing monitoring should be carried out.
II	1,000–2,000	Sites requiring general monitoring of most or all waste piles, discharges or stream sediments on an annual basis.
III	300–1,000	Sites requiring general monitoring of most or all waste piles, discharges or stream sediments on a biennial basis.
IV	100–300	Sites requiring specific monitoring on particular waste piles, discharges or stream sediments on a five-yearly basis.
V	<100	Site not requiring any specific monitoring.

- Elements of Interest:** *These are the elements at the site that may be of concern from a contamination point of view.*
- Media of Concern:** *This provides a list of the media that are contaminated at the site.*
- Geochemical Overview:** *This section provides a brief summary of the main issues at the site from a geochemical standpoint.*

In addition, there is a map of the site using the Ordnance Survey orthophotographs as a backdrop.

5.1 Abbeytown Mine

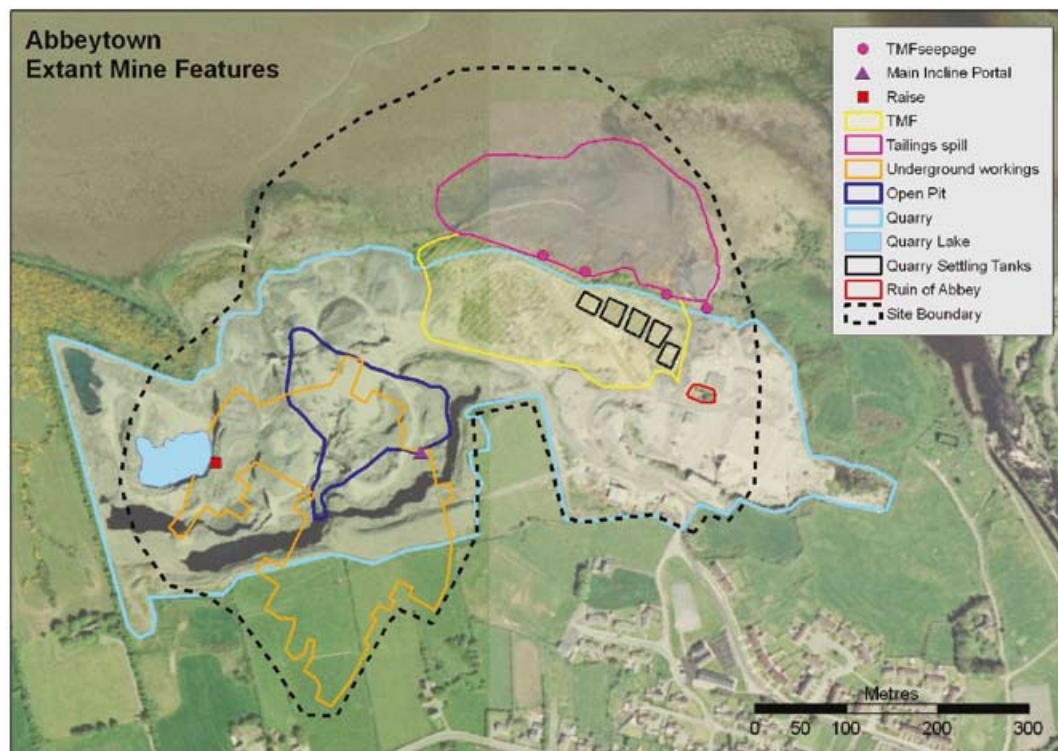
Mine District:	Abbeytown
Mine Name:	Abbeytown
Minerals Worked:	Pb, Zn, Ag
County:	Sligo
Townland:	Abbeytown
Grid Reference:	E165991, N329711
Site Score:	74
Site Class:	V



Elements of Interest:	Pb, Zn, Ag, Cu, As, Ni, Hg
Media of Concern:	Solid waste, mine water discharge

Geochemical Overview

Abbeytown mine is now an active quarry and most mine features have been subsumed by surface excavations in the years since closure. However, the tailings pond remains intact although lined concrete settling ponds have now been built in shallow excavations on its surface. A previous tailings spill, apparently during the 1950s' mining period, has caused significant contamination of the foreshore by Pb, Zn and Cu in an area 300 m wide, with measured concentrations of Pb up to 1,800 mg/kg. The action of tides has increased the dispersion of the contamination further west along the shore. Discharge from several seepages at the base of the tailings pond contains high levels of Pb ($\leq 24,210 \mu\text{g/l}$), Zn ($\leq 4,580 \mu\text{g/l}$), Ni ($\leq 208 \mu\text{g/l}$) and As ($\leq 106 \mu\text{g/l}$). These seepages drain directly into the waters of the bay. The tailings spill on the foreshore and the discharge of seepage from the tailings pond into Ballysadare Bay represent specific environmental threats to the estuary.



5.2 Allihies District

Mine District: Allihies
Mine Name: Various
Minerals Worked: Cu
County: Cork
Townland: Various
Grid Reference: E59000, N45000

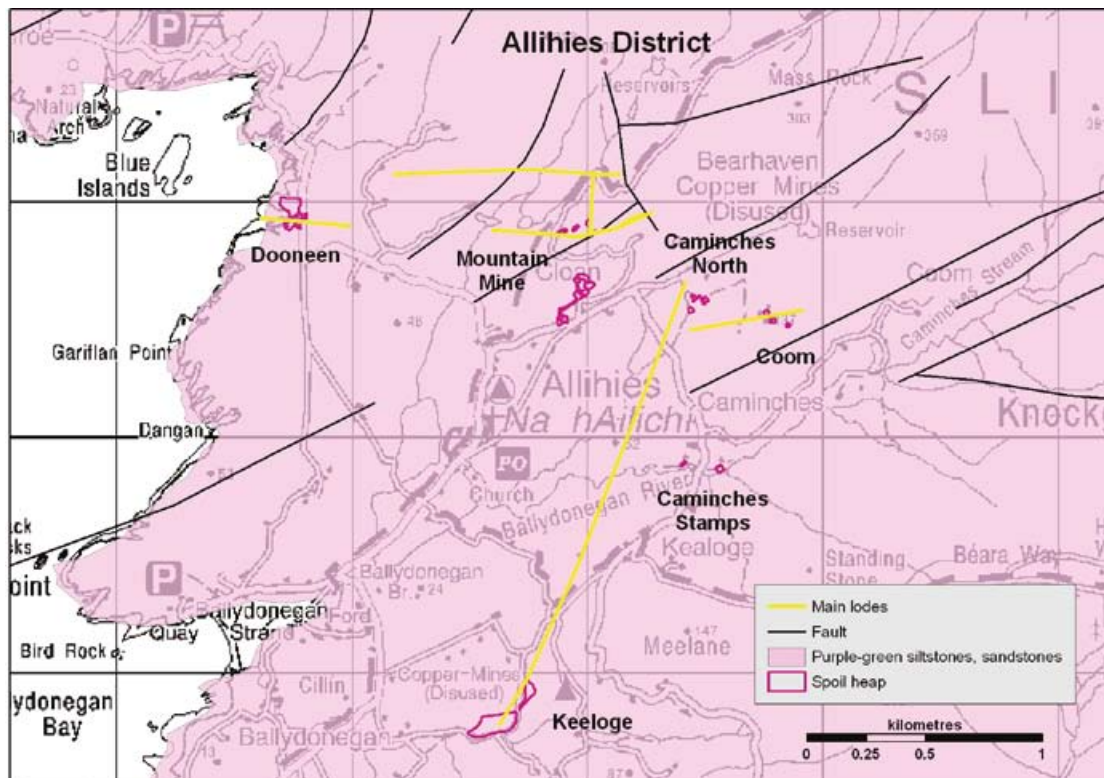
Site Score: 76
Site Class: V

Elements of Interest: Cu
Media of Concern: Solid waste, surface water, stream sediments



Geochemical Overview

Mine discharge and run-off in the Allihies District has a near-neutral pH and poses no risk of AMD. Concentrations of metals in water samples reflect the relatively simple mineralogy of the ore in that only Cu is consistently measured at elevated concentrations in both mine water (45–465 µg/l, median 245 µg/l) and stream waters (31–132 µg/l, median 52 µg/l). Leachate extracted from a number of solid waste samples contained high concentrations of Cu, indicating the potential for contamination of groundwater in the vicinity of mine sites in the district. Stream sediments downstream of mine sites generally contained elevated Cu concentrations. The highest copper concentrations (>1%) were found directly downstream of Mountain Mine in a drain that carries most of the mine water discharge from the site. Sediments in streams draining other mines in the district generally have significantly lower if still elevated Cu. In solid waste, the only element that is consistently measured at high concentrations is Cu (median 2,888 mg/kg; range: <DL–75,520 mg/kg).



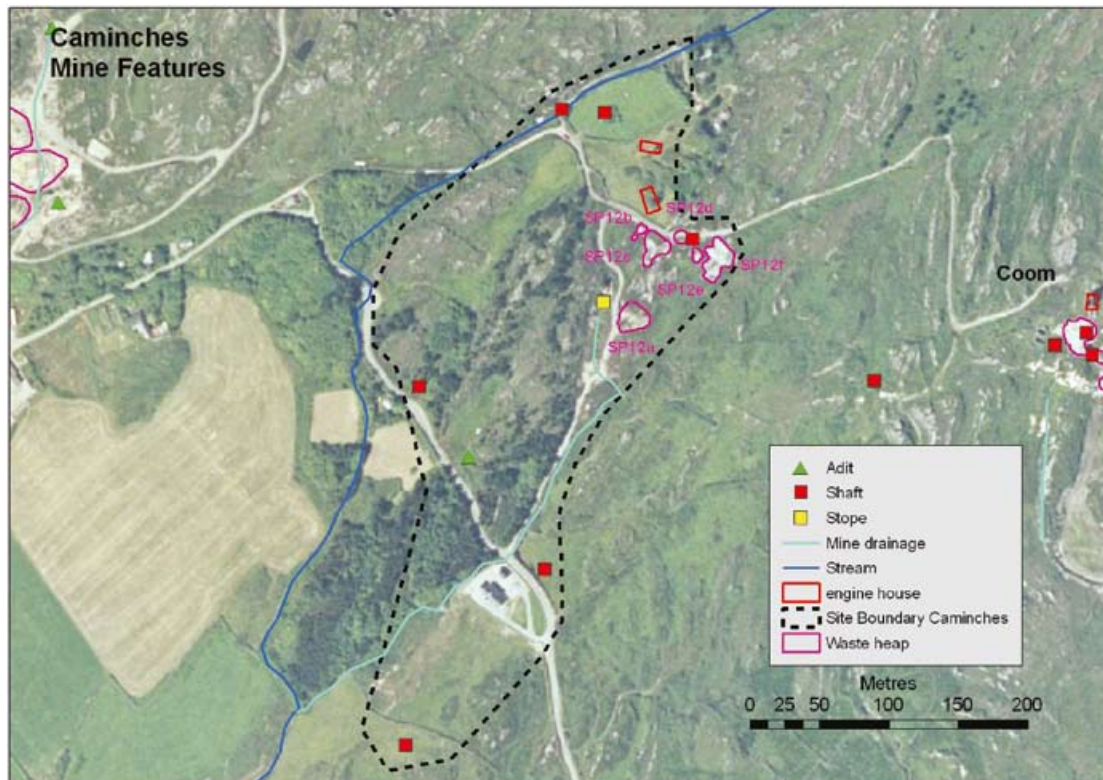
5.2.1 Caminches

Mine District:	Allihies
Mine Name:	Caminches
Minerals Worked:	Cu
County:	Cork
Townland:	Caminches
Grid Reference:	E59360, N45497
Site Score:	4
Site Class:	V (Allihies District)
Elements of Interest:	Cu
Media of Concern:	Solid waste, stream sediments



Geochemical Overview

The Caminches site has relatively low volumes of solid mine waste, most of which has moderately elevated Cu concentrations, with a median of 5,973 mg/kg Cu. Very small volumes of fine processing waste have in excess of 1% Cu. Stream sediments immediately downstream of the site are enriched in Cu. The stope discharge on the site does not have the characteristics of a mine water discharge in that metal concentrations are low. These low waste volumes and metal concentrations give rise to a very low site score. Direct drainage of Cu-rich leachate to local streams appears to represent the most significant potential environmental risk on the site.



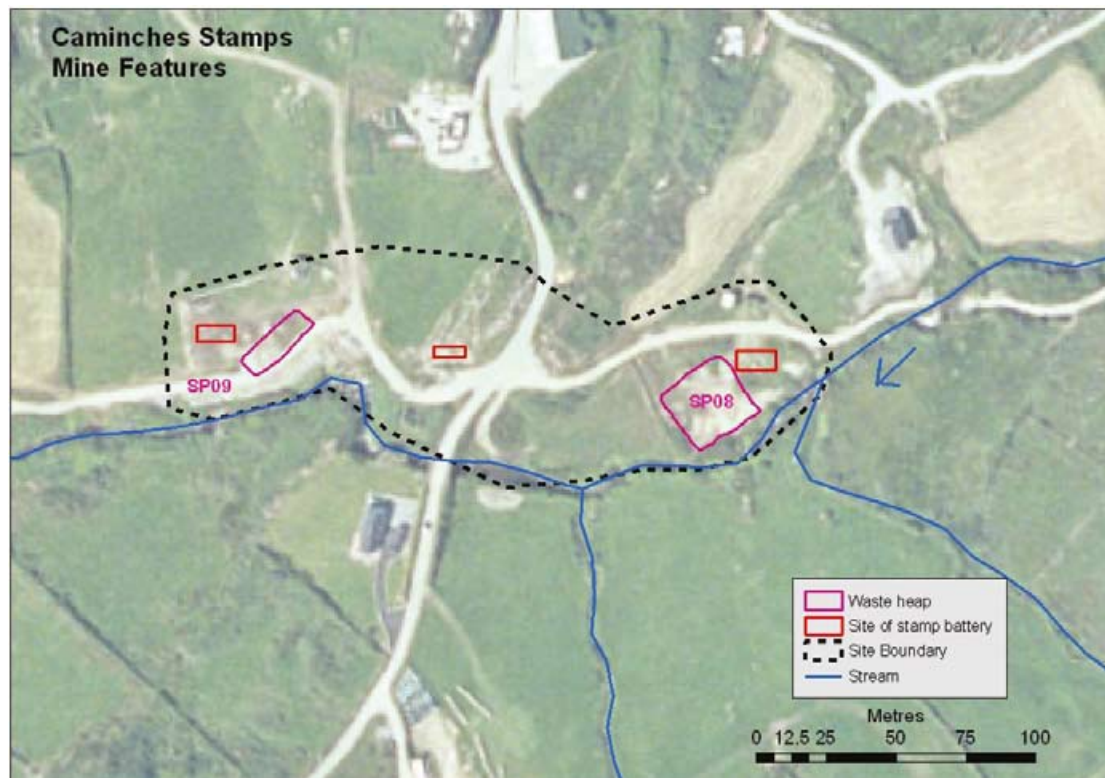
5.2.2 Caminches Stamps

Mine District:	Allihies
Mine Name:	Caminches
Minerals Worked:	Cu
County:	Cork
Townland:	Caminches
Grid Reference:	E59485, N44880
Site Score:	10
Site Class:	V (Allihies District)
Elements of Interest:	Cu
Media of Concern:	Solid waste, stream sediments



Geochemical Overview

The Caminches Stamps site contains two solid waste heaps with some of the highest measured Cu concentrations in the Allihies District, ranging from 2,289 to 75,520 mg/kg, i.e. up to 7.5% Cu. Only Cu is significantly enriched. Stream sediments downstream of the site have elevated Cu concentrations, apparently as a consequence of the stamps operations. However, surface water in the Ballydonegan River appears to be unaffected by the waste lying along the river bank. Despite the high measured Cu concentrations in some of the stamps waste, the low volume of the waste and the absence of high concentrations of elements of high relative toxicity give rise to a relatively low site score. Direct drainage of Cu-rich leachate to local streams appears to represent the most significant potential environmental risk on the site.



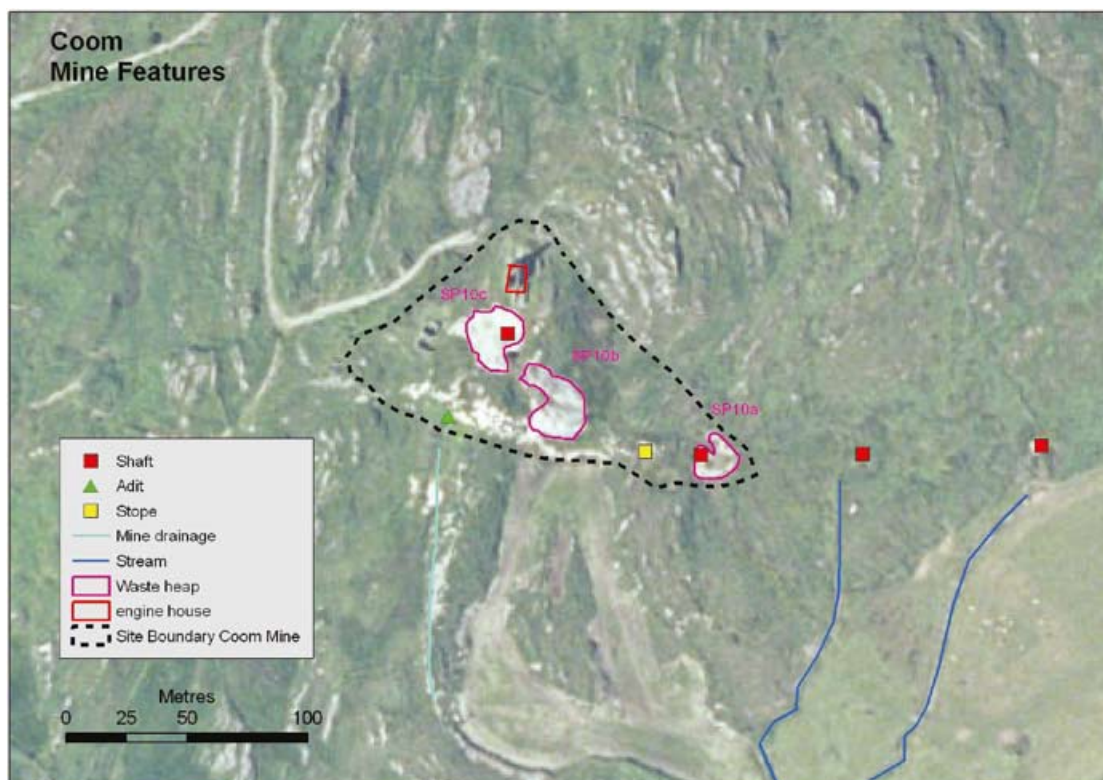
5.2.3 Coom

Mine District:	Allihies
Mine Name:	Coom
Minerals Worked:	Cu
County:	Cork
Townland:	Coom
Grid Reference:	E59780, N45512
Site Score:	4
Site Class:	V (Allihies District)
Elements of Interest:	Cu, Sb
Media of Concern:	Solid waste



Geochemical Overview

Solid mine waste at Coom has lower median concentrations of Cu than waste on most sites elsewhere in the Allihies District. Moreover, the volume of waste on this small mine site is relatively low. The concentration of Cu in stream sediment down-gradient of the site is also relatively low, suggesting limited movement off-site of solid waste over the years. Only the leachate sample (673 µg/l) suggests any potential for contamination but the very modest Cu concentration in the adit discharge (44 µg/l) suggests that, at present, the mine is unlikely to contaminate either surface or groundwater directly. Again, as elsewhere in the district, the low volume of the waste and the absence of high concentrations of elements of high relative toxicity give rise to a low site score. Direct drainage of Cu-rich leachate to groundwater appears to represent the most significant potential environmental risk on the site.



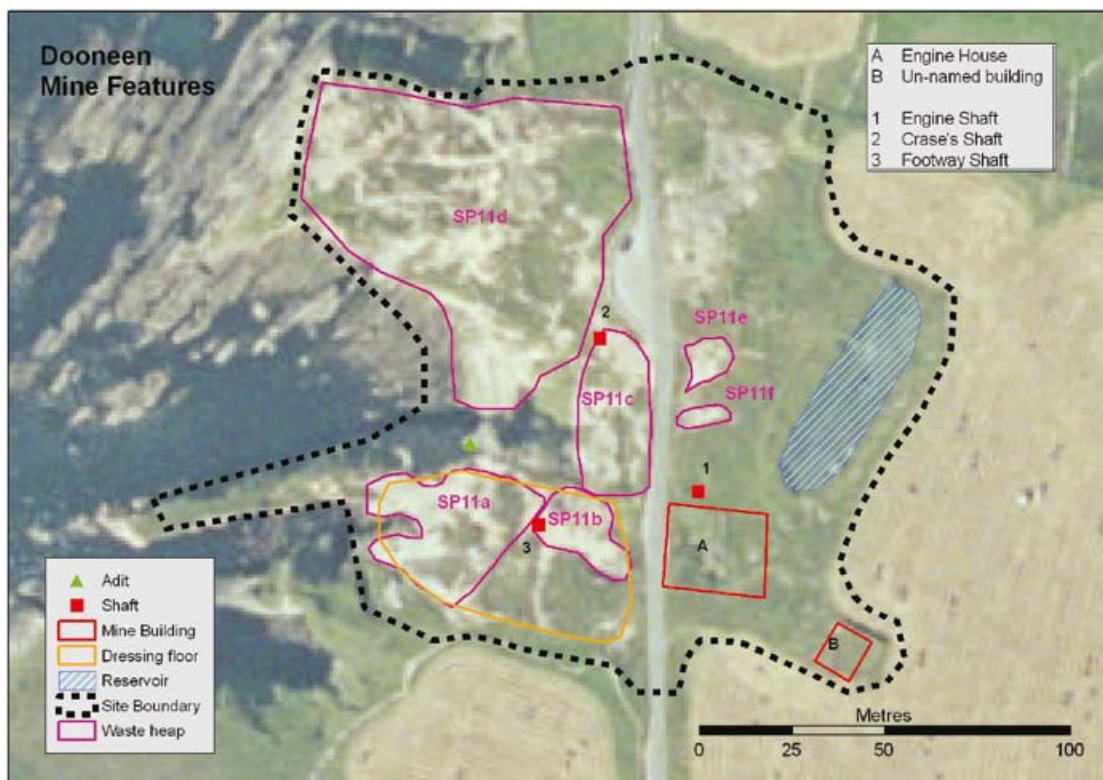
5.2.4 Dooneen

Mine District:	Allihies
Mine Name:	Dooneen
Minerals Worked:	Cu
County:	Cork
Townland:	Allihies
Grid Reference:	E57776, N45942
Site Score:	1
Site Class:	V (Allihies District)
Elements of Interest:	Cu, Sb
Media of Concern:	Solid waste



Geochemical Overview

Limited field-XRF analysis suggests that the solid waste has lower metal concentrations at Dooneen than elsewhere in the Allihies District, with the exception of Sb. Only Cu is present in solid waste in significant concentrations but the levels are well below those recorded at Mountain Mine. In contrast, Sb concentrations, though not especially high in the context of Irish mine sites examined for the HMS-IRC project, do appear to exceed those found elsewhere in the Allihies District. Again, as elsewhere in the district, the absence of high concentrations of elements of high relative toxicity is the main reason for the very low site score. The location of the site on a cliff edge, where its potential influence on the wider environment is limited, also contributes to this.



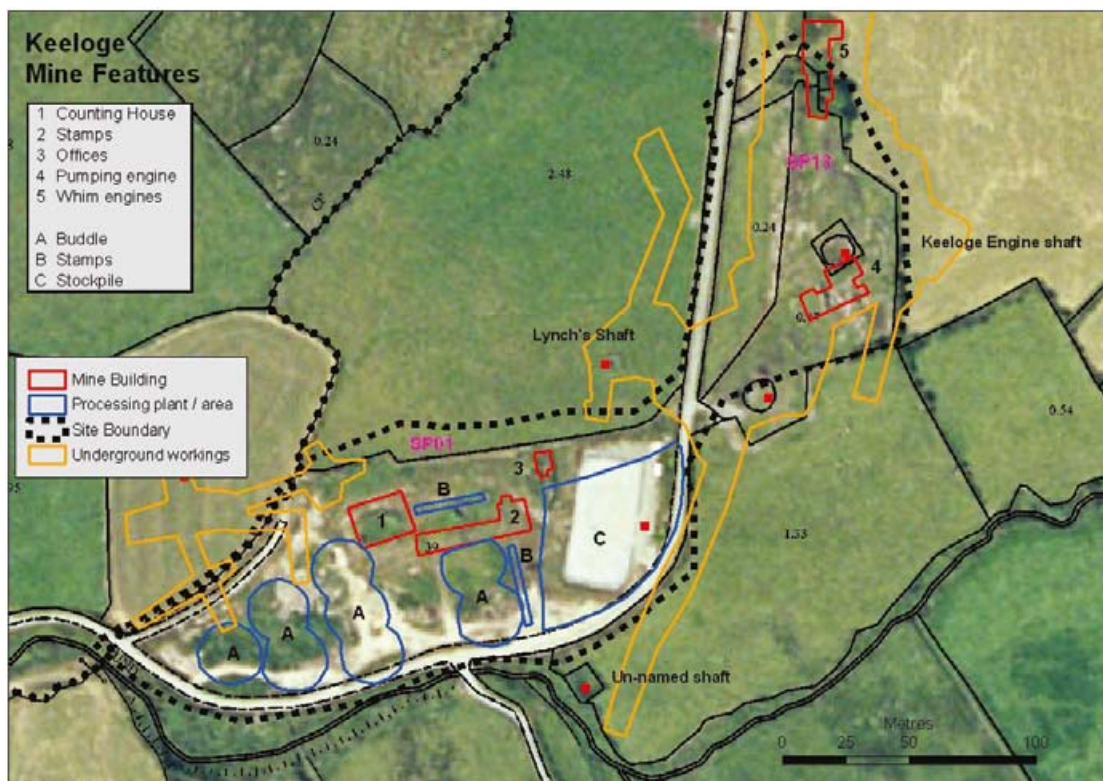
5.2.5 Keeloge

Mine District:	Allihies
Mine Name:	Keeloge
Minerals Worked:	Cu
County:	Cork
Townland:	Cahermeeleboe
Grid Reference:	E58648, N43822
Site Score:	6
Site Class:	V (Allihies District)
Elements of Interest:	Cu
Media of Concern:	Solid waste, stream sediments



Geochemical Overview

Solid mine waste on the Keeloge site contains some very high concentrations of Cu (up to 6.7%) but median concentrations are lower than those for the Allihies District as a whole. Other elements are present in relatively low concentrations. The considerable quantities of material, including soil and builders' rubble, imported onto the site subsequent to mining have obscured much of the original waste and possibly diluted its chemistry. The Cu concentration of water in the Keeloge River immediately downstream of the site exceeds the Draft EC Surface Water Regulation limit. Cu is significantly elevated in stream sediments for at least 650 m downstream of the site. The total site score for Keeloge is just 6, a relatively low score for a former processing site. The main reason for the low score is the absence of high concentrations of elements of high relative toxicity, such as lead or arsenic. Direct drainage of Cu-rich leachate to local streams appears to represent the most significant potential environmental risk on the site.



5.2.6 Mountain Mine

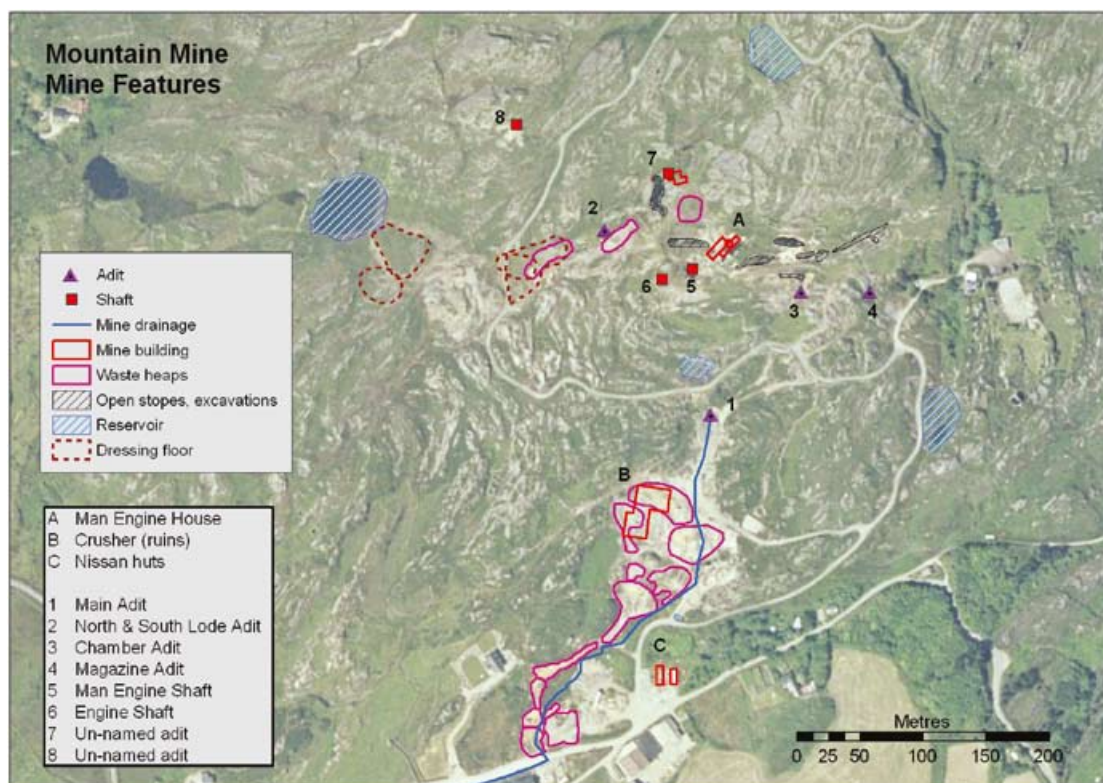
Mine District:	Allihies
Mine Name:	Mountain Mine
Minerals Worked:	Cu, Mo
County:	Cork
Townland:	Cloan
Grid Reference:	E58987, N45774
Site Score:	29
Site Class:	V (Allihies District)



Elements of Interest:	Cu, Sb
Media of Concern:	Solid waste, surface water, stream sediments

Geochemical Overview

Mountain Mine is the largest mine site and has the most significant environmental impact in the Allihies District. 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. Concentrations of Cu above 100 µg/l, well in excess of the limit for Cu in the Draft EC (Surface Water) Regulations, have been measured in some stream water samples. Combined with stream sediment concentrations exceeding 1,000 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 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.



5.3 Avoca District

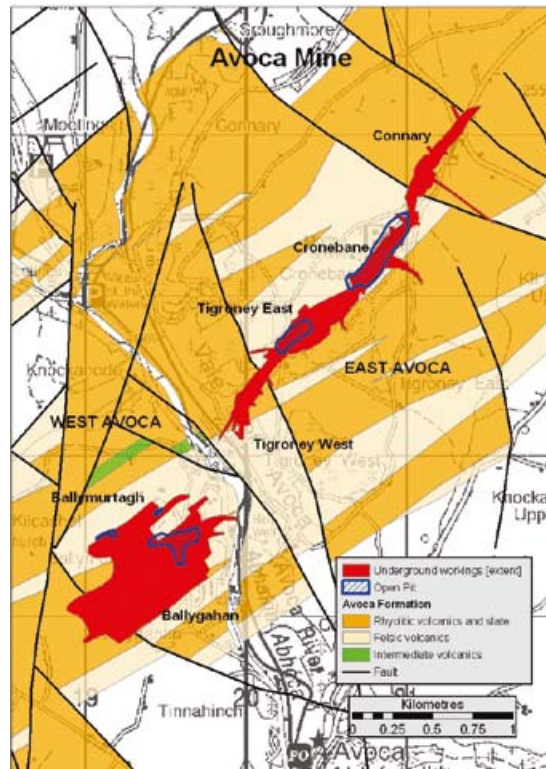
Mine District:	Avoca
Mine:	Various
Minerals Worked:	Cu, S, Ag
County:	Wicklow
Townland:	Various
Grid Reference:	E319800, N182000
Site Score:	2,439
Site Class:	I



Elements of Interest:	Pb, As, Sb, Cu, Zn, Cd, Cr, Ni
Media of Concern:	Solid waste, surface water, stream sediments

Geochemical Overview

Avoca has a history of mining extending back over 250 years. A large volume of AMD continues to drain from underground mine workings, causing extensive ongoing pollution of the Avoca River. High metal concentrations are apparent at adit discharges on the mine site and can be observed in the river adjacent to the mine. A gradual decline in metal concentrations in river water is apparent with increasing distance from the mine site. Groundwater in the immediate vicinity of the mine is also contaminated as a consequence of interaction with solid mine waste. Large volumes of this waste remain on the site and the waste can contain in excess of 1% Pb, Cu or Zn. Concentrations of As are also high. Though not major components of the ore, Pb and As are the main elements of concern in solid waste. The median Pb concentration for spoil in the district is 2,846 mg/kg. Stream sediments downstream of the site have high concentrations of Cu, Pb and Zn and contamination is apparent up to 10 km from the site, where 177 mg/kg copper was recorded.



Summary reports for the individual sites in the Avoca District follow below.

5.3.1 Ballygahan

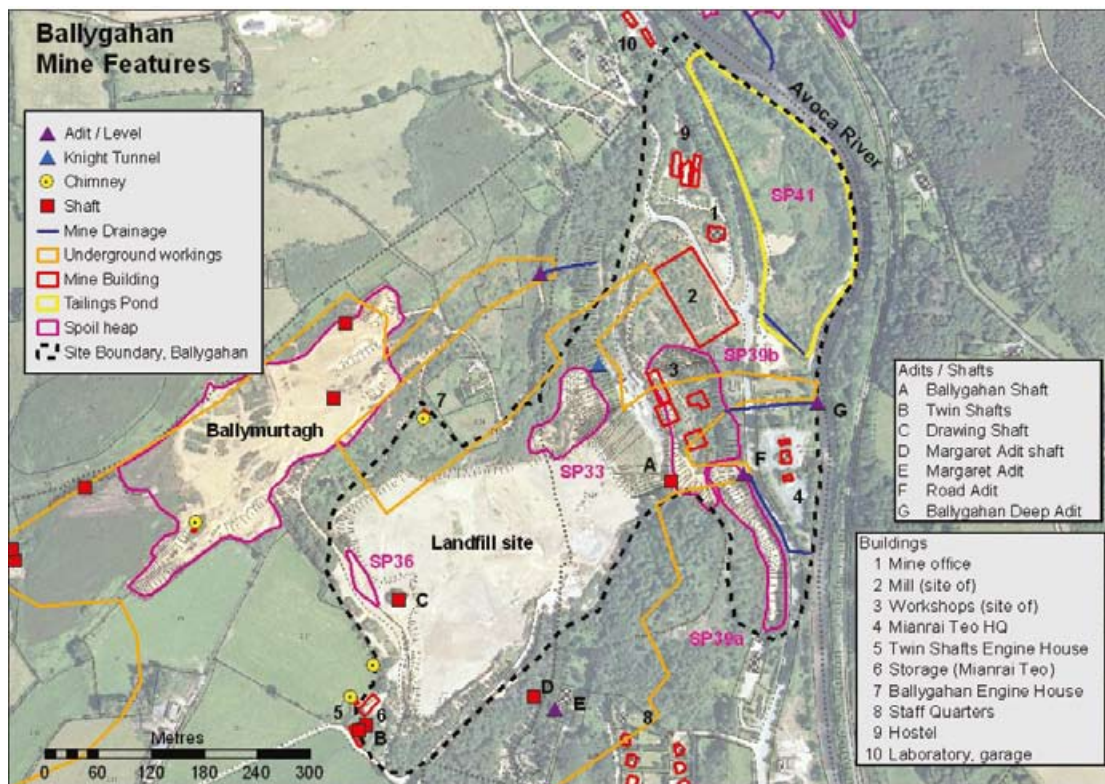
Mine District:	Avoca
Mine Name:	Ballygahan
Minerals Worked:	Cu, S
County:	Wicklow
Townland:	Ballygahan
Grid Reference:	E319719, N181573
Site Score:	399
Site Class:	I (Avoca District)



Elements of Interest:	Pb, As, Cu, Zn, Cd, Ni
Media of Concern:	Solid waste, surface water, stream sediments

Geochemical Overview

The Road Adit in Ballygahan has very high concentrations of Cu, Pb, Zn and high Ni, Cd and Cr, as well as low pH and high acidity. Metal discharge rates ranged up to 0.75 kg/day Pb, 21.04 kg/day Zn, 0.74 kg/day Cu, 232 kg/day Fe and 0.02 kg/day Cd, indicating an ongoing and significant input of metals to the Avoca River ecosystem. As a consequence, the Road Adit is by far the most important contributor (360) to the total Ballygahan score in the HMS-IRC scoring system. Although there has been extensive rehabilitation of parts of the site, involving vegetation of imported topsoil, large heaps of bare waste remain. Groundwater from several monitoring wells on the site have very high measured concentrations of Cu, Zn, Pb and Ni, emphasising the potential for extreme groundwater contamination in the areas around the site.



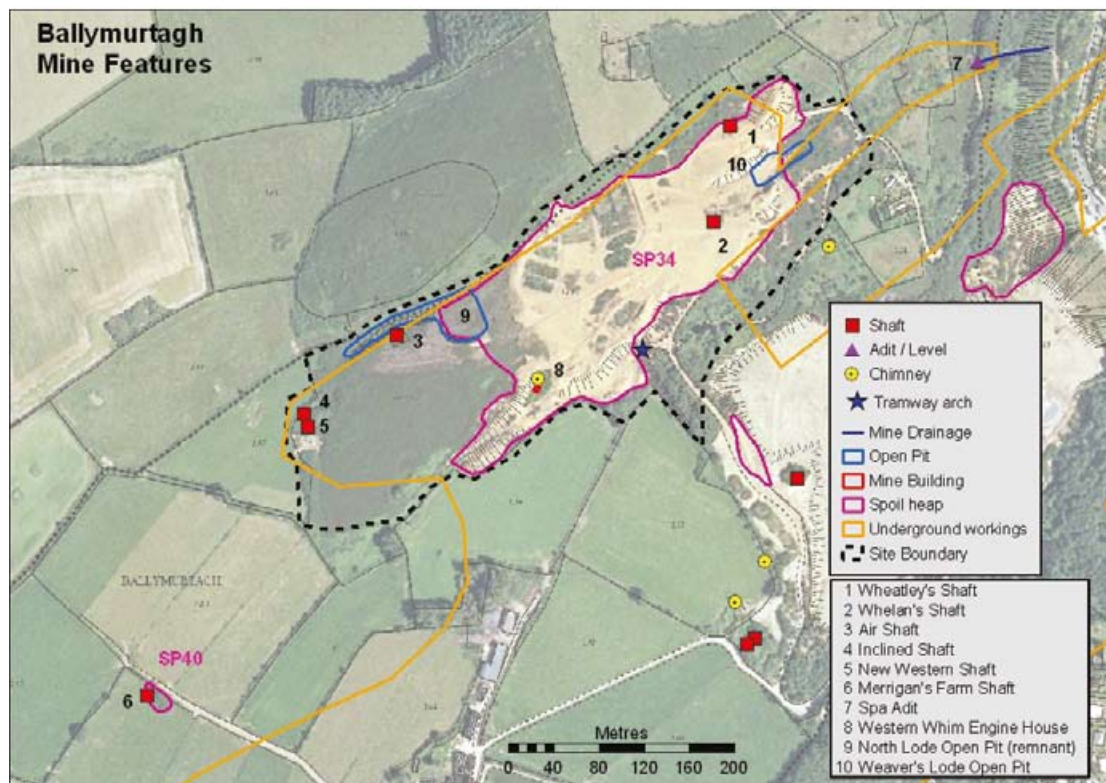
5.3.2 Ballymurtagh

Mine District:	Avoca
Mine Name:	Ballymurtagh
Minerals Worked:	Cu, S
County:	Wicklow
Townland:	Ballymurtagh
Grid Reference:	E319276, N181526
Site Score:	47
Site Class:	I (Avoca District)
Elements of Interest:	Pb, As, Cu, Zn
Media of Concern:	Solid waste



Geochemical Overview

Concentrations of elements of interest are relatively low in spoil at Ballymurtagh compared to spoil in East Avoca. Median concentrations of Pb (1,056 mg/kg), Cu (342 mg/kg) and Zn (< DL) are considerably lower than those for other spoil heaps in the district. The one exception is As (median 987 mg/kg) which is relatively enriched in the Ballymurtagh spoil, possibly reflecting a changed mineralogy relative to spoil from other parts of the Avoca site. A leachate test on a composite sample of spoil suggests the potential to contaminate groundwater in the vicinity of the site. Water from a monitoring well downhill and east of the site had high measured concentrations of Cu and Zn.



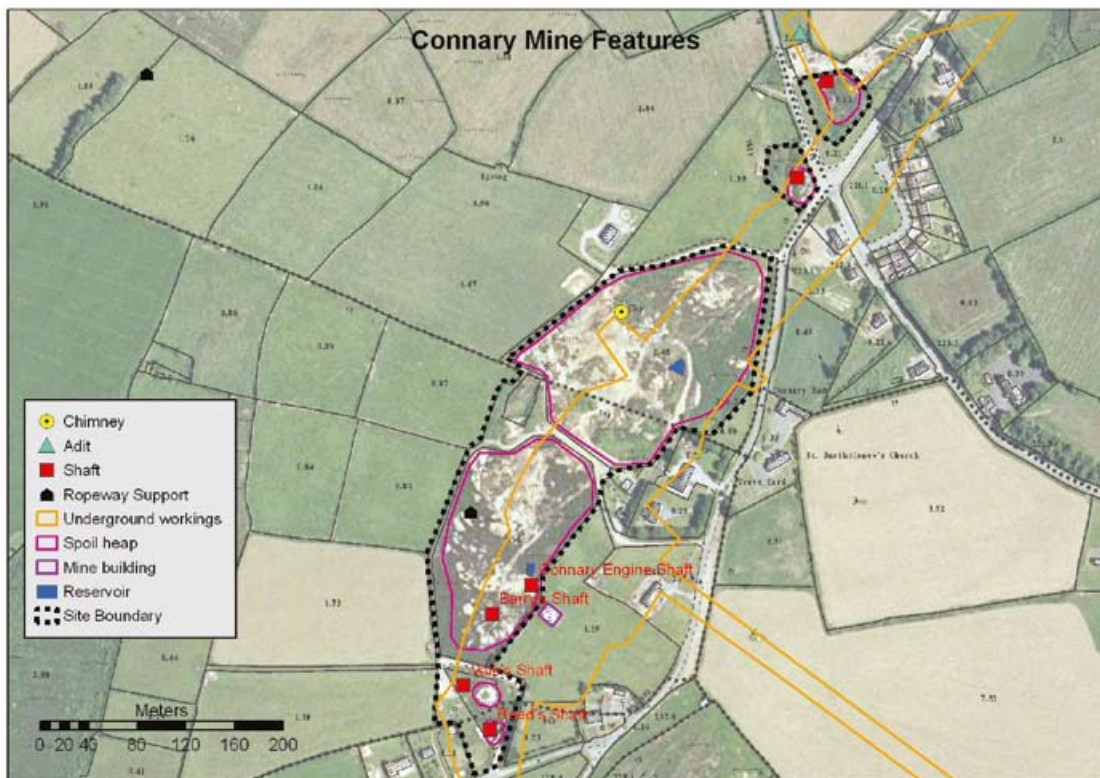
5.3.3 Connary

Mine District:	Avoca
Mine Name:	Connary
Minerals Worked:	Cu, S
County:	Wicklow
Townland:	Connary Upper; Sroughmore
Grid Reference:	E321110, N183830
Site Score:	174
Site Class:	I (Avoca District)
Elements of Interest:	Pb, As, Cu, Zn
Media of Concern:	Solid waste



Geochemical Overview

The solid mine waste at Connary has relatively high levels of Pb (median 10,432 mg/kg), As (589 mg/kg), Cu (741 mg/kg) and Zn (173 mg/kg). Largely intact, if breached, fencing on the site limits the possibility for direct contact while extensive natural vegetation and the coarse grain size of spoil have reduced the scope for dust blows. Use of spoil by local people as an aggregate for concrete mixes is apparently continuing, despite its high sulphide content. A seasonal adit discharge has significant metal concentrations and low pH but minimal acidity and very low flow rates. A stream fed by this adit discharge has high metal concentrations at least 1 km downstream of the site.



5.3.4 Cronebane

Mine District: Avoca
Mine Name: Cronebane
Minerals Worked: Cu, S
County: Wicklow
Townland: Cronebane
Grid Reference: E320735, N183142

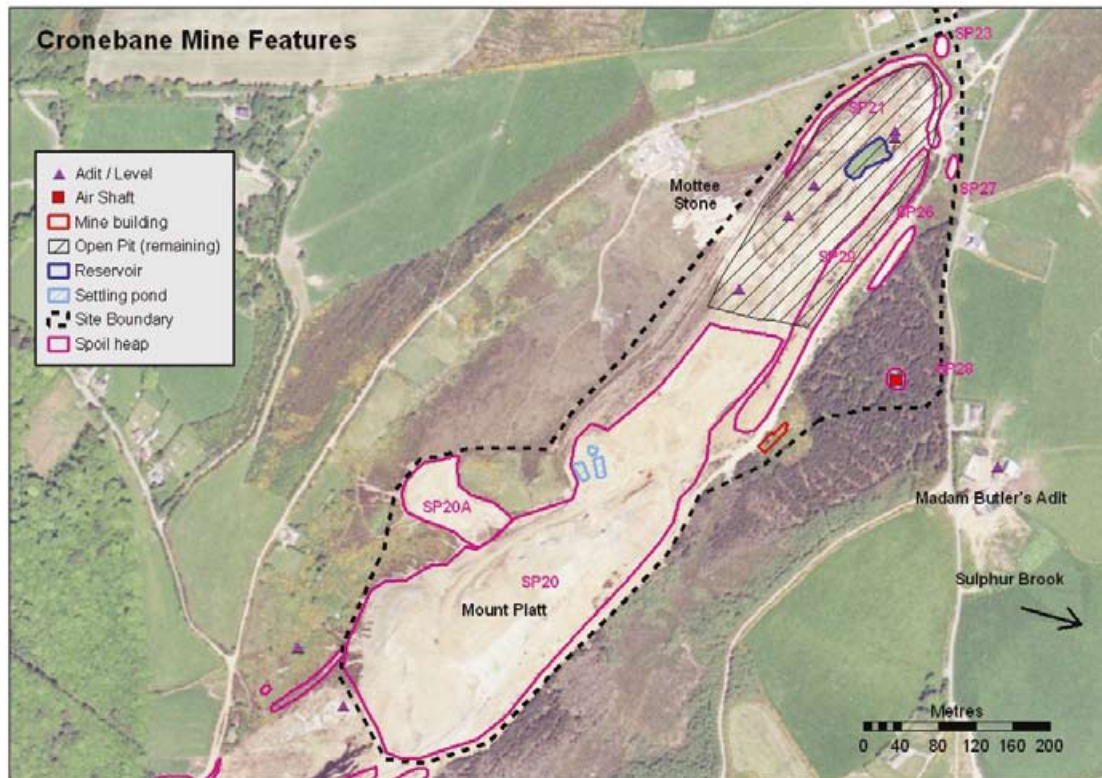


Site Score: 410
Site Class: I (Avoca District)

Elements of Interest: Pb, As, Cu, Zn
Media of Concern: Solid waste, stream sediments

Geochemical Overview

The solid mine waste at Cronebane has concentrations of Pb (median 2,707 mg/kg), As (377 mg/kg), Cu (290 mg/kg) and Zn (125 mg/kg) that are typical of or somewhat lower than those measured elsewhere in Avoca. There is no evidence of any processing waste on-site. There are numerous breaches in the fencing on this site, which has become popular with quad bikers. In consequence there is potential for direct contact with and/or inhalation of mine waste. Although their metal concentrations and acidity can be extremely high, the largely seasonal spoil seepages have very low flow rates and seep into the ground around the site. Evidence from stream sediment collected from the Sulphur Brook suggests that Madam Butler's Adit was a significant source of metal-rich mine water in the past. However, no trace of this discharge has been found on the farmland south of the original discharge point.



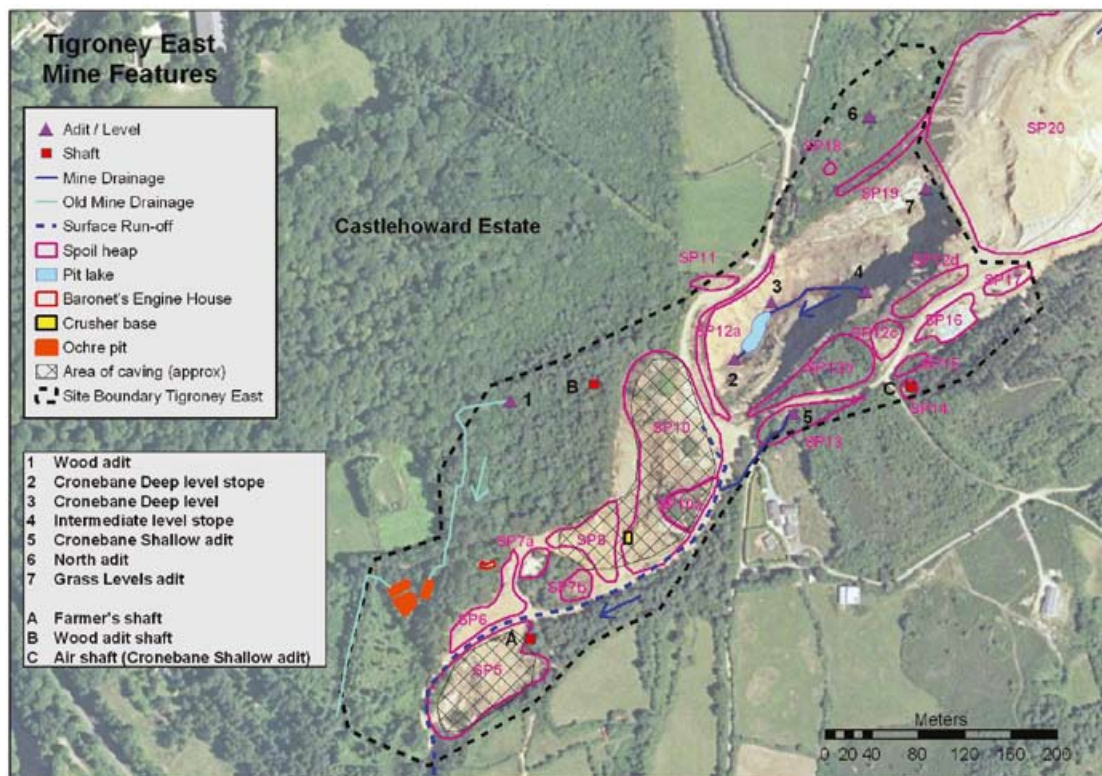
5.3.5 Tigroney East

Mine District:	Avoca
Mine Name:	Tigroney East
Minerals Worked:	Cu, S
County:	Wicklow
Townland:	Tigroney West; Cronebane
Grid Reference:	E320165, N182625
Site Score:	366
Site Class:	I (Avoca District)
Elements of Interest:	Pb, As, Cu, Zn
Media of Concern:	Solid waste, surface water



Geochemical Overview

Concentrations of Pb (median 2,384 mg/kg), As (441 mg/kg) and Zn (73 mg/kg) in solid waste at Tigroney East are similar or a little lower than those elsewhere on the Avoca site while copper concentrations (median 739 mg/kg) are higher. The latter reflects a cluster of high Cu values in the vicinity of Baronet's engine house where ore was raised in the 19th century. One part of one heap (SP16) is enriched in lead (>10%). Tigroney East is a significant source of ARD that is generated by run-off of rainwater during periods of heavy rain. This run-off eventually meets the discharge from the Deep Adit before entering the Avoca River. The discharge from the Cronebane Shallow Adit is very acidic and very metal-rich. However, the flow is small and drains back into the ground in the area of caving. A much larger flow within the open pit has created a low-pH, metal-rich pond in the base of the open pit.



5.3.6 Tigroney West

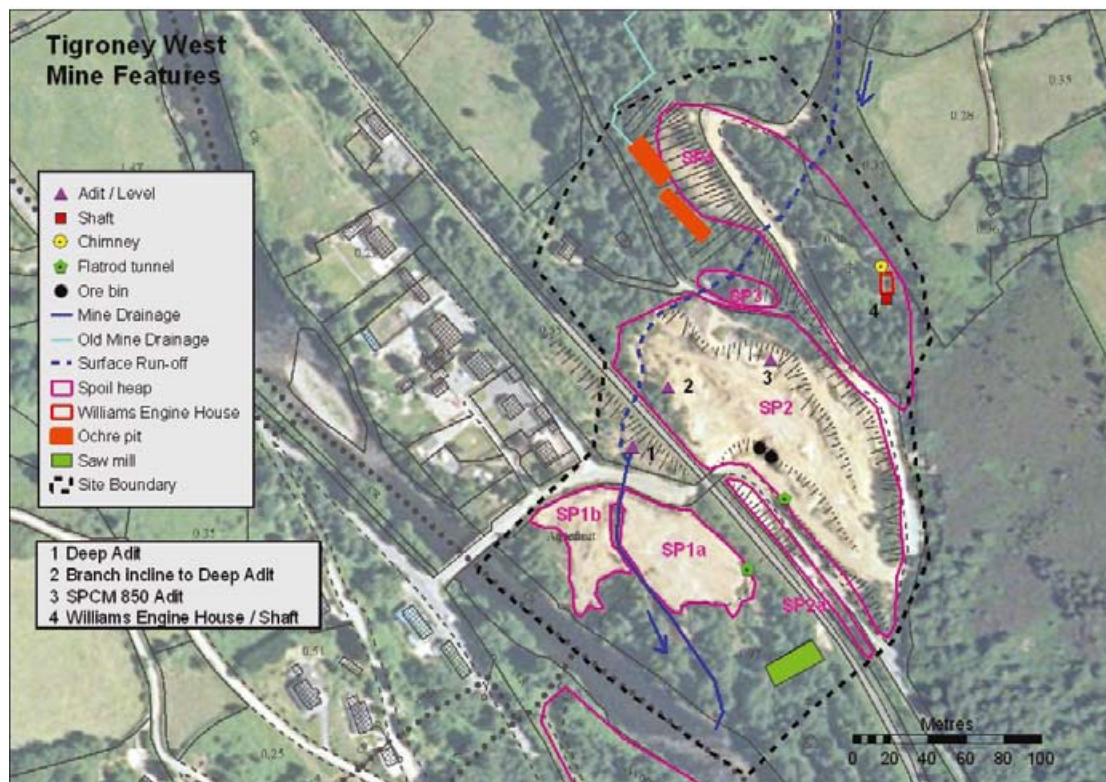
Mine District:	Avoca
Mine Name:	Tigroney West
Minerals Worked:	Cu, S
County:	Wicklow
Townland:	Tigroney West
Grid Reference:	E319899, N182135
Site Score:	935
Site Class:	I (Avoca District)



Elements of Interest:	Pb, As, Cu, Zn, Cd
Media of Concern:	Solid waste, surface water, stream sediments

Geochemical Overview

Concentrations of Pb (median 8,240 mg/kg), As (835 mg/kg), Cu (826 mg/kg) and Zn (214 mg/kg) in solid waste are significantly higher in Tigroney West than elsewhere on the Avoca site. Most of the waste is benched on sloping ground and run-off from it drains to the Avoca River. The Tigroney Deep Adit drains much of the underground workings in East Avoca; the mine water it discharges has very high concentrations of Cu, Pb, Zn and elevated Cd and Cr, as well as low pH and high acidity. Dilution by the Avoca River is rapid when water levels are high; at times of low river flow, river water can contain concentrations of Cu, Pb and Zn in excess of Surface Water Regulatory limits. Metal discharge rates measured during the course of the HMS-IRC project ranged up to 3.1 kg/day Pb, 79 kg/day Zn, 2.9 kg/day Cu and 0.3 kg/day Cd, indicating an ongoing and significant input of metals to the Avoca River ecosystem. Stream sediments in the Avoca River have high concentrations of Cu, Pb and Zn adjacent to and downstream of the Tigroney West site.



5.3.7 Shelton Abbey

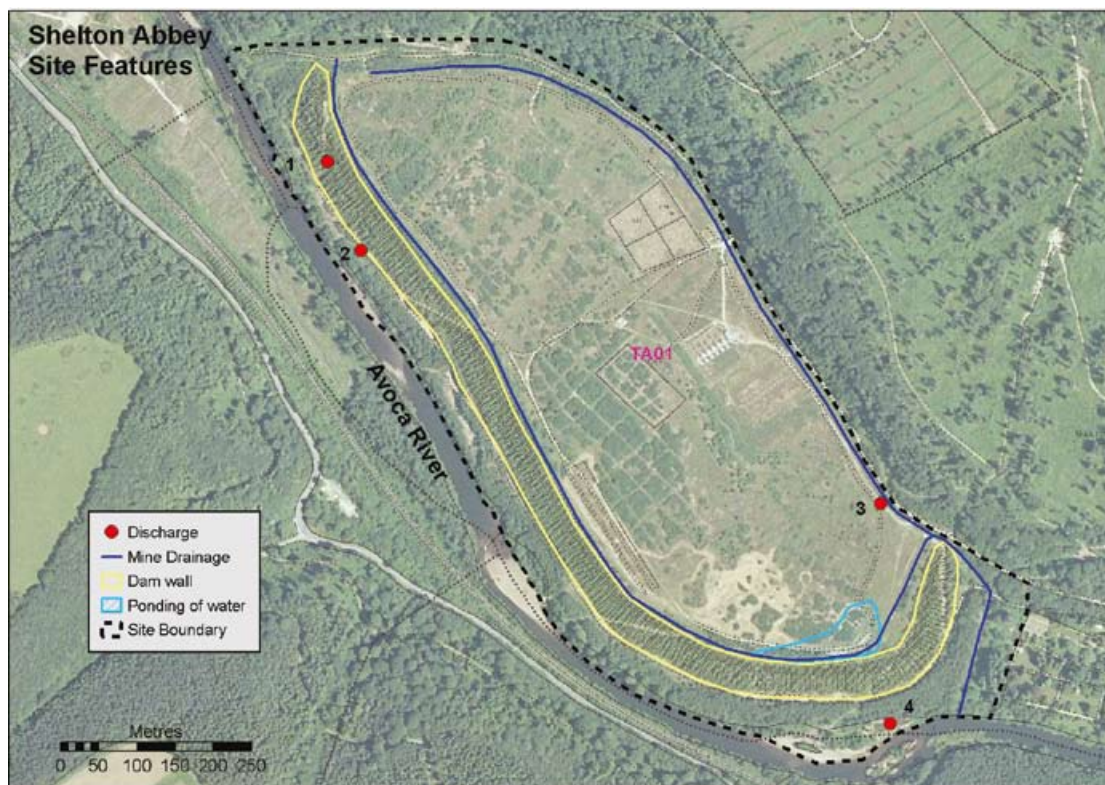
Mine District:	Avoca
Mine Name:	Tailings Pond
Minerals Worked:	
County:	Wicklow
Townland:	Shelton Abbey
Grid Reference:	E321289, N175686
Site Score:	64
Site Class:	I (Avoca District)



Elements of Interest:	Pb, As, Cu, Zn
Media of Concern:	Solid waste, surface water, stream sediments

Geochemical Overview

Concentrations of elements of interest, including Pb (median, 175 mg/kg), As (75 mg/kg), Cu (197 mg/kg) and Zn (87 mg/kg), are relatively low in the tailings pond at Shelton Abbey compared to the composition of solid waste elsewhere on the Avoca mine site. However, a leachate test, data from well monitoring and analysis of surface water that is apparently contaminated by seepage suggest that the tailings have the potential for significant groundwater contamination. Analysis of surface water, both the Avoca River and drainage from the surface of the tailings pond, suggests a very limited impact from the tailings pond, chiefly from seepages. The site scores for Shelton Abbey reflect these results with the groundwater pathway contributing over 50% of the total site score.



5.4 Ballycorus

Mine District: Ballycorus
Mine Name: Ballycorus
Minerals Worked: Pb, Ag
County: Dublin
Townland: Ballycorus
Grid Reference: E322283, N221384

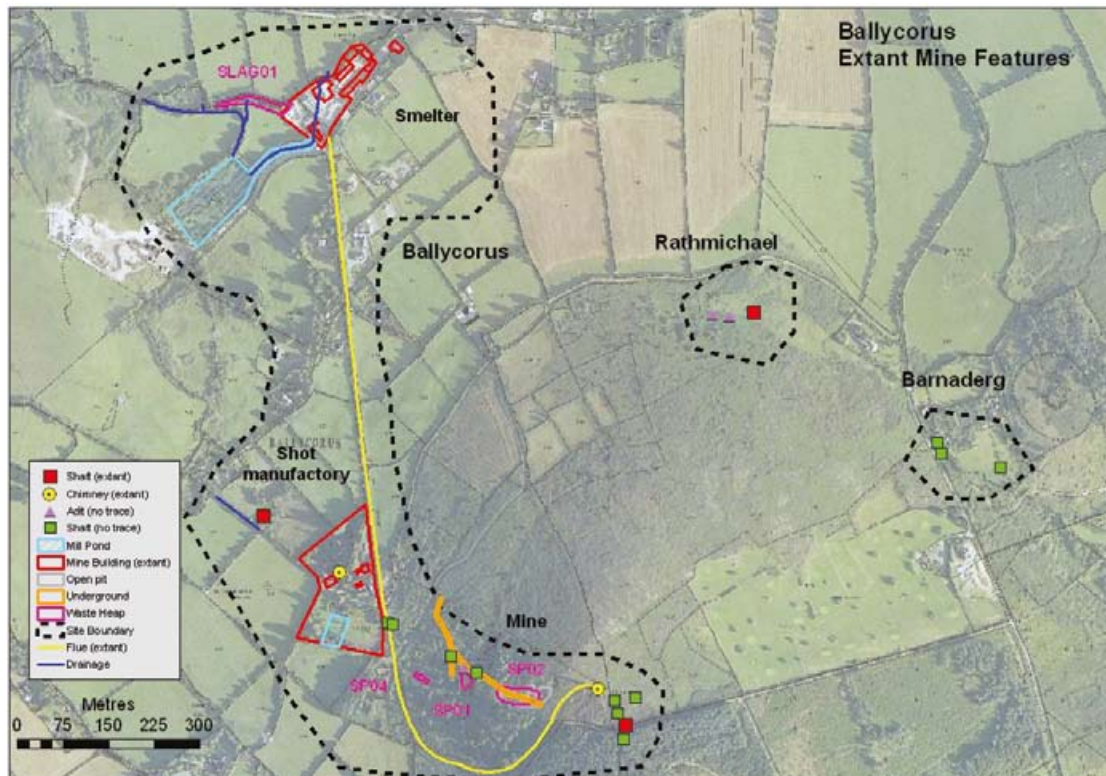


Site Score: 244
Site Class: IV

Elements of Interest: Pb, Zn, Ag
Media of Concern: Solid waste, stream sediments

Geochemical Overview

Solid waste at Ballycorus has high concentrations of Pb, with median values exceeding 1.5% in both spoil and slag waste. The spoil is well exposed in an area popular with walkers and horse riders. These concentrations are in excess of guideline values for soil. The inner walls of the flue chimney are partly covered with Pb-rich coatings. Surface water analyses indicate a modest impact by the smelter/mine site on the chemistry of the Loughlinstown River, with elevated downstream concentrations of Pb and Ni, both in excess of current Draft EC Regulations for Surface Water. Stream sediment analyses also indicate a significant downstream impact on the aquatic ecosystem, with concentrations of Pb in the fine fraction of stream sediments ranging up to 2,024 mg/kg. The site score of 244 is relatively high for a site with only limited quantities of solid waste and no discharge of mine water.



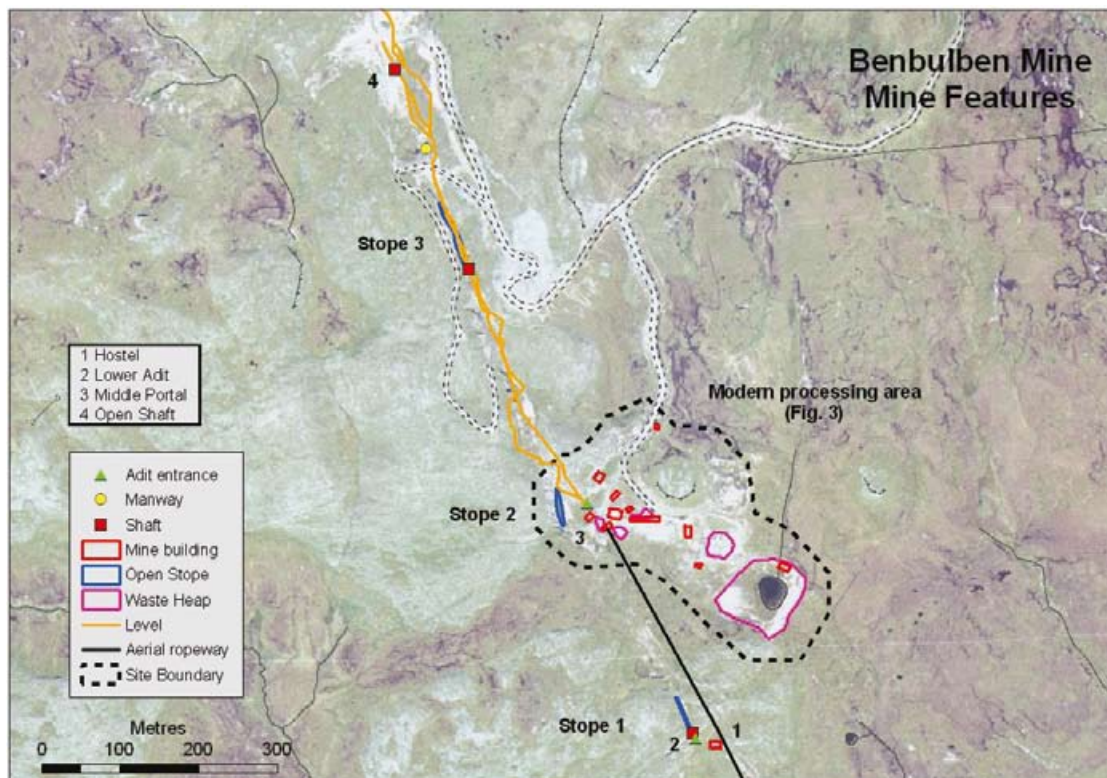
5.5 Benbulbin

Mine District:	Benbulbin
Mine Name:	Benbulbin
Minerals Worked:	Barite
County:	Sligo
Townland:	Glencarbury
Grid Reference:	E173217, N345263
Site Score:	5
Site Class:	V
Elements of Interest:	Ba, Cu
Media of Concern:	Solid waste



Geochemical Overview

The Benbulbin mine is chiefly remarkable for the number of extant mine features on the site, including some deep openings that could present a risk to the unwary. Despite production of up to 50,000 tons per year in the 1970s, the volume of solid waste remaining on the site is relatively small. The waste contains percentage levels of Ba but concentrations of other elements such as Pb, As and Cu are typically low, less than a few hundred milligrams per kilogram. There are no discharges of mine water from the underground workings. The lack of a significant chemical hazard as well as the remoteness of the site combine to give a very low HMS-IRC score of just 5, placing it in Class V with the second lowest site score of all mines investigated.



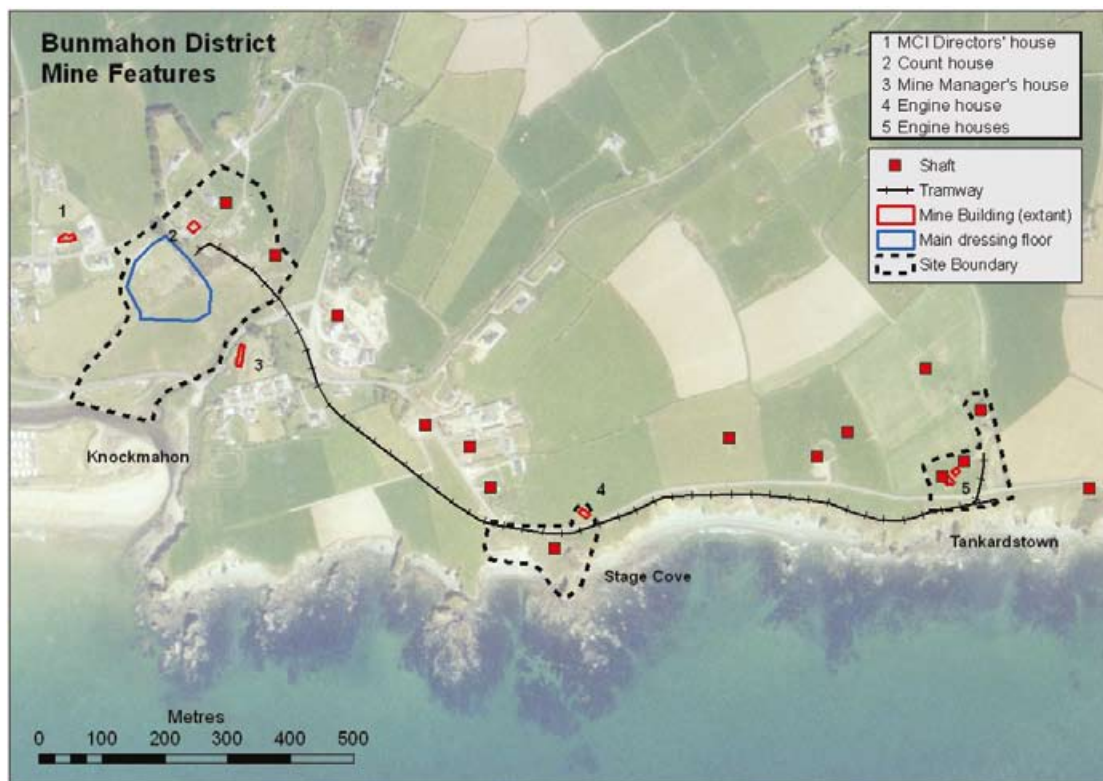
5.6 Bunmahon District

Mine District:	Bunmahon
Mine Name:	Bunmahon
Minerals Worked:	Cu, Ag
County:	Waterford
Townland:	Knockmahon
Grid Reference:	E243962, N98996
Site Score:	14
Site Class:	V
Elements of Interest:	Cu
Media of Concern:	Solid waste



Geochemical Overview

Bunmahon was a highly productive and profitable mine district in the 19th century. Only limited mine waste remains on the three sites investigated for the HMS-IRC project, with most found on the old processing area at Knockmahon. High concentrations of Cu, in excess of guideline values for soil, were measured in both processing waste (109–4,737 mg/kg, median 1,943 mg/kg) and in stream sediment (4,909 mg/kg) downstream of the mine. Among other elements measured, only As is present in significant concentrations.



5.7 Caim

Mine District: Caim
Mine Name: Caim
Minerals Worked: Pb, Cu
County: Wexford
Townland: Ballyhighland
Grid Reference: E288549, N140967

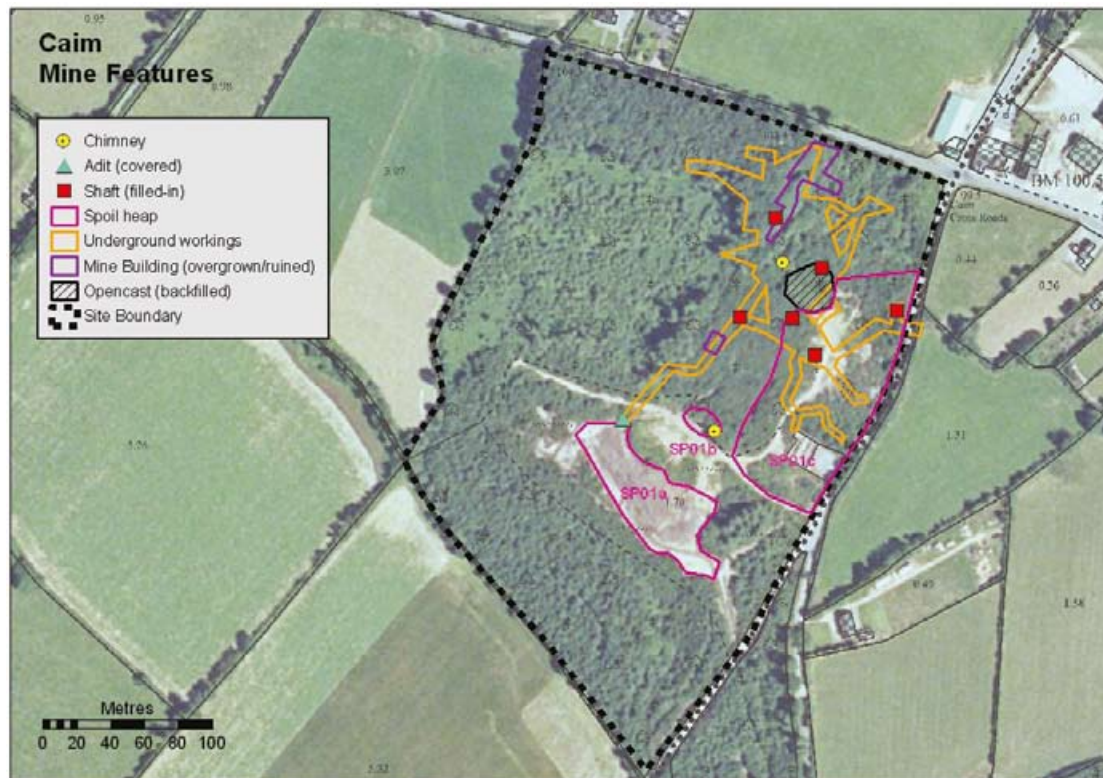
Site Score: 559
Site Class: III

Elements of Interest: Pb, Zn, Cu, S, Sb, Mn
Media of Concern: Solid waste, surface water, stream sediments



Geochemical Overview

Solid mine waste at Caim has very high concentrations of Pb (5,674–85,213 mg/kg; median 56,028 mg/kg) as well as high concentrations of Zn, Cu, S and Mn. The fine processing waste that forms the waste heap on the southern part of the site is uncovered and potentially a source of airborne contamination and direct-contact contamination. Evidence on-site suggests that quad biking has taken place, increasing the potential for dust release. The high Pb concentrations measured in run-off and seepage from the solid waste heaps do not appear to persist for any significant length downstream of the site once the surface water has been diluted by stream water. However, stream sediments are contaminated for at least 1 km downstream of the site where the measured Pb concentration was 2,582 mg/kg.



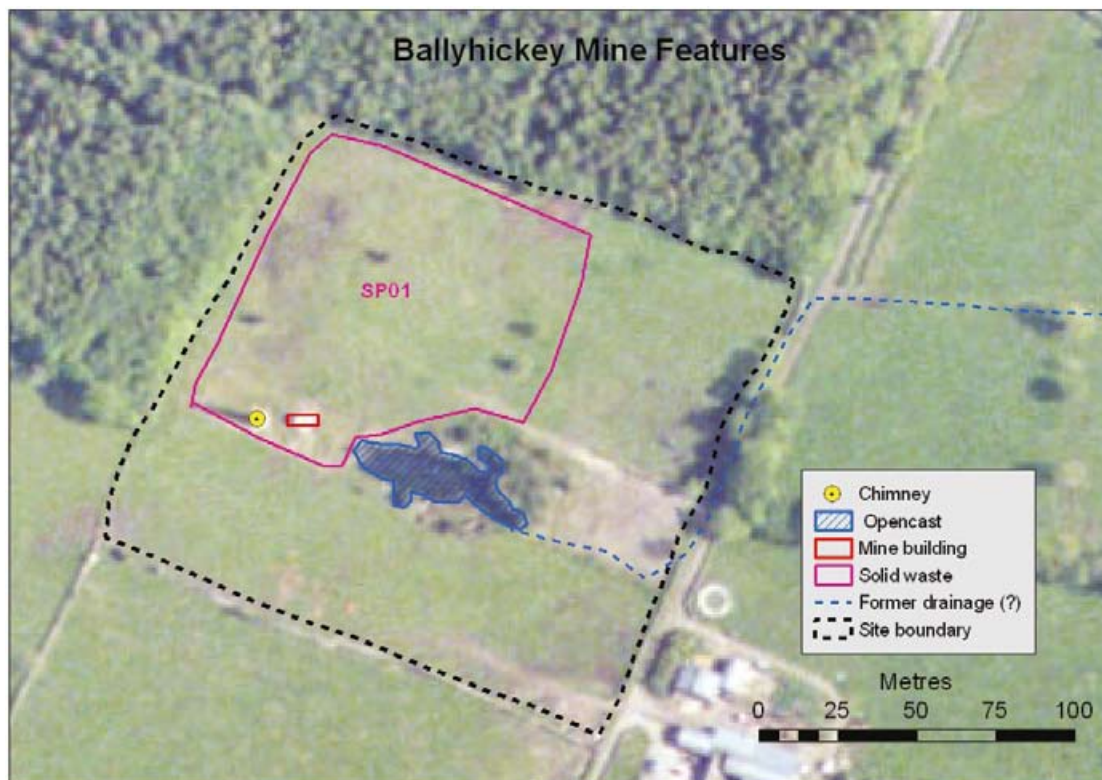
5.8 Clare Lead Mines – Ballyhickey

Mine District:	Clare Lead Mines
Mine Name:	Ballyhickey
Minerals Worked:	Pb, Ag
County:	Clare
Townland:	Ballyhickey
Grid Reference:	E141735, N176868
Site Score:	19
Site Class:	V
Elements of Interest:	Pb, Zn, Cu, Sb, As, Ag, S
Media of Concern:	Solid waste



Geochemical Overview

The solid waste at Ballyhickey is covered by grass and soil in a field that has been in use, at least in the past, for pasture. Both the waste and the soil that covers it have very high measured concentrations of Pb (up to 26%) and high concentrations of Zn, Cu and As. Small amounts of solid waste around the remains of the engine house are also enriched in Pb and other elements of interest. The lack of nearby surface watercourses limits the potential impact of the site on the surrounding environment and gives it a relatively low HMS-IRC score of 19. The clearest potential risk is to livestock that might use the site for grazing. The composition of water in the open pit is unknown. Ballyhickey is underlain by Waulsortian limestone that is known to be karstified in the vicinity of the mine site. There is therefore the potential for contamination of groundwater from contact with water in the open pit lake.



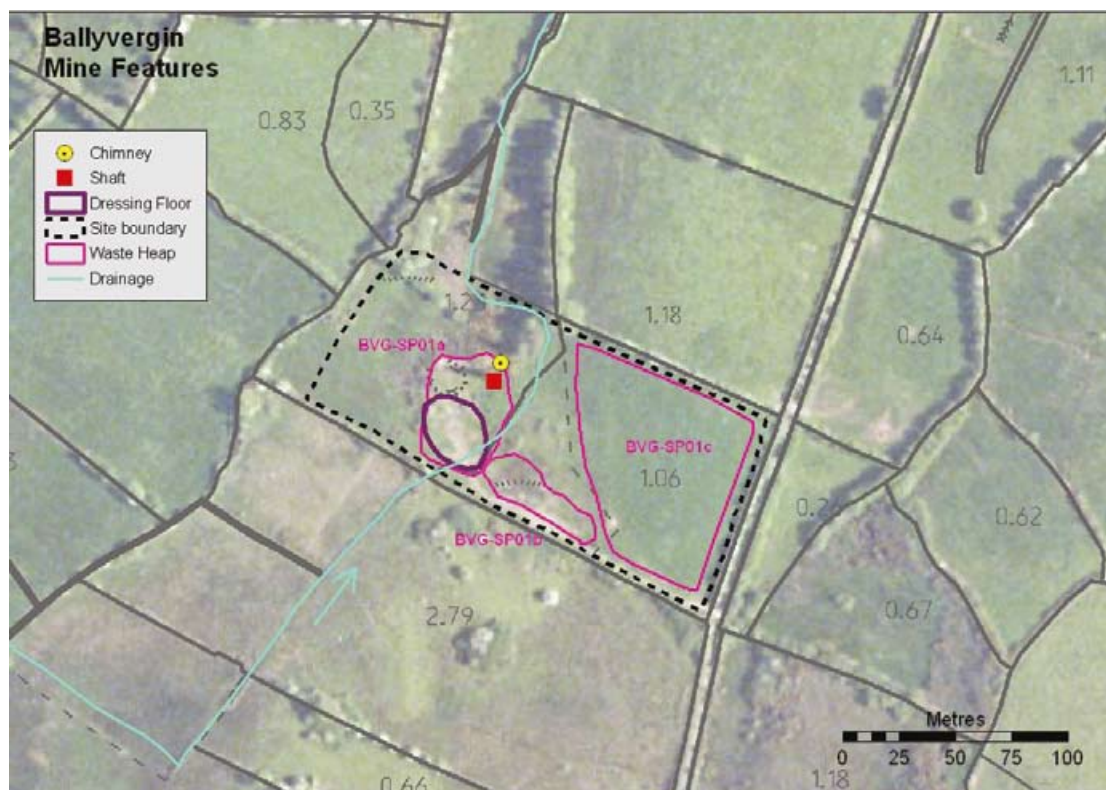
5.9 Clare Lead Mines – Ballyvergin

Mine District:	Clare Lead Mines
Mine Name:	Ballyvergin
Minerals Worked:	Pb, Ag, Cu
County:	Clare
Townland:	Ballyvergin
Grid Reference:	E142143, N181731
Site Score:	39
Site Class:	V
Elements of Interest:	Pb, Cu, Ag, S, Z
Media of Concern:	Solid waste



Geochemical Overview

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. Up to 14% Pb was recorded by *in-situ* XRF analysis (31% lead by laboratory assay) in an unvegetated area of fine-grained mine waste that was heavily marked by cattle hooves at the time of site visits in 2007 and 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.



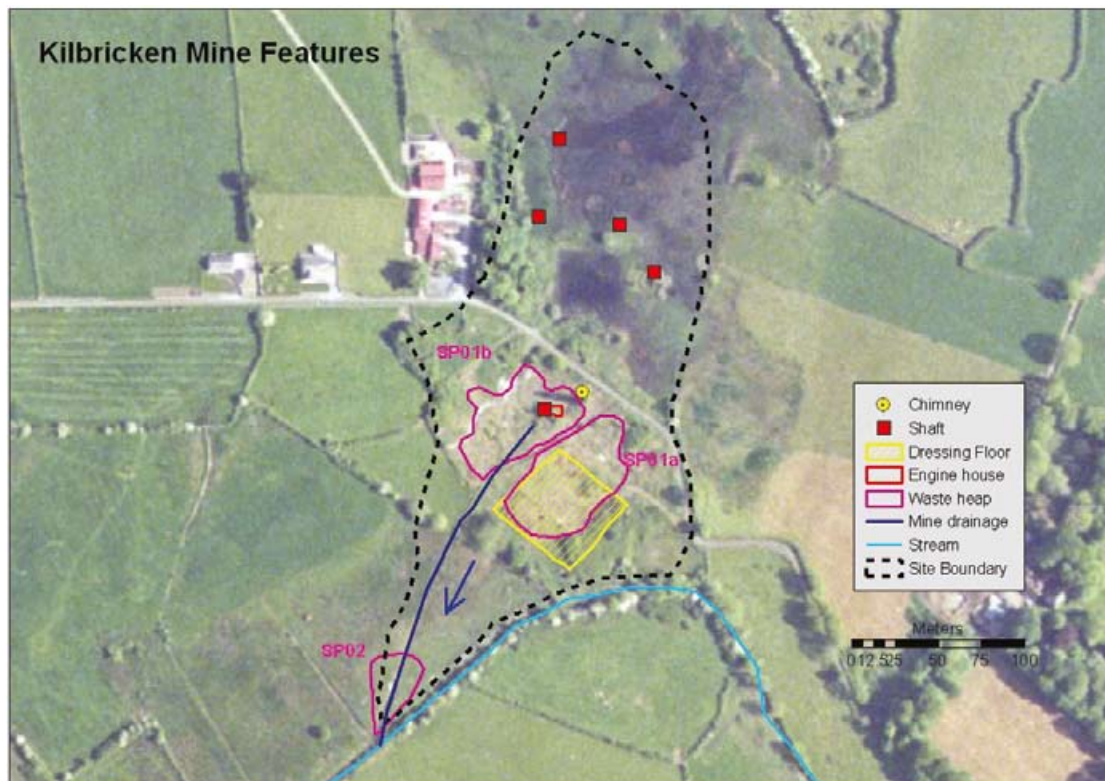
5.10 Clare Lead Mines – Kilbricken

Mine District:	Clare Pb Mines
Mine Name:	Kilbricken
Minerals Worked:	Pb, Ag
County:	Clare
Townland:	Monanoe
Grid Reference:	E141735, N176868
Site Score:	89
Site Class:	V
Elements of Interest:	Pb, As, Cu, Zn, Sb
Media of Concern:	Solid waste



Geochemical Overview

Kilbricken has some of the highest concentrations of Pb and Zn recorded in solid waste on Irish mine sites. Measured concentrations of Pb and Zn in the dressing floor waste reached almost 4% and 5%, respectively. Most of the solid waste is grassed over. A leachate test indicates that there is potential for groundwater contamination in the vicinity of this waste. Surface water draining the site had low concentrations of Pb, Zn and As, with the Pb concentration marginally in excess of surface water regulatory limits. The concentrations of Pb and Zn in stream sediment downstream of the mine were well below guideline limits for the protection of livestock.



5.11 Clare Phosphate – Doolin

Mine District: Clare Phosphate
Mine Name: Doolin
Minerals Worked: Phosphate
County: Clare
Townland: Teergonean; Toormullin
Grid Reference: E108345, N196999

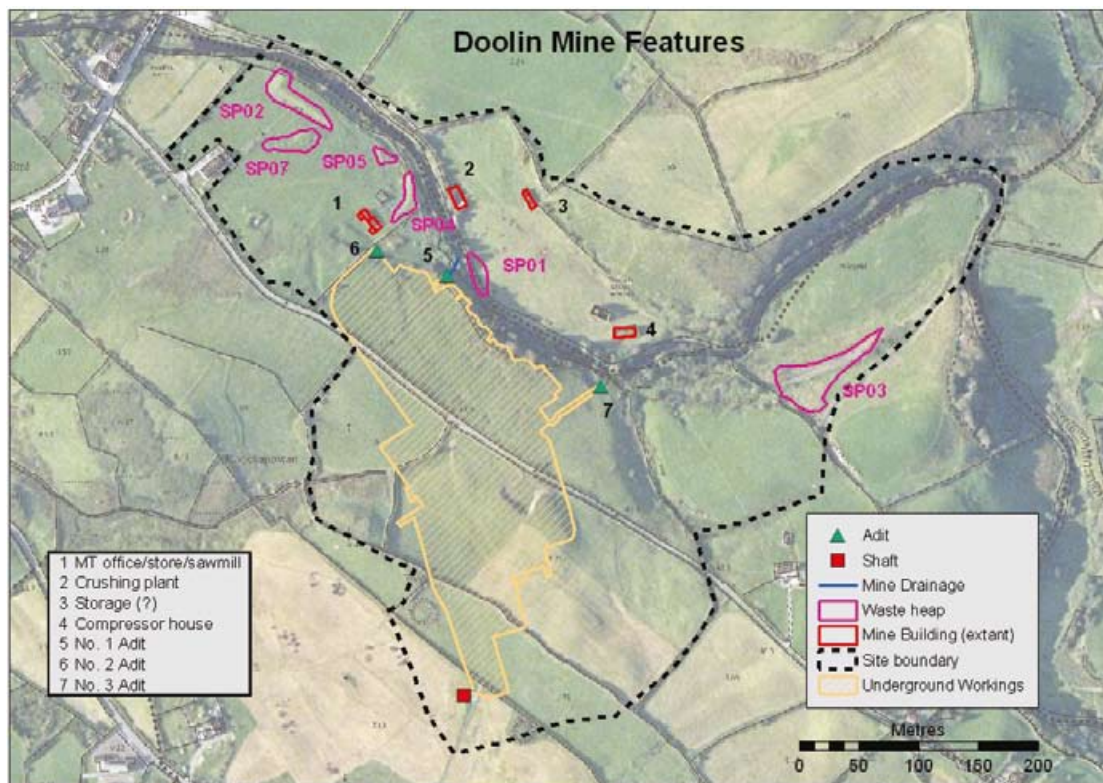


Site Score: 15
Site Class: V

Elements of Interest: U, Ni, V, Se
Media of Concern: Solid waste, surface water, stream sediments

Geochemical Overview

Solid waste at Doolin contains elevated concentrations of U, Ni, V and Se, and both U and Ni are slightly elevated in the No. 1 Adit discharge that flows into the Aille River. However, the volume of the waste and the absolute concentrations of the elements are too low to cause contamination of either river water or stream sediments and the site has a relatively low HMS-IRC score of 15. Se occurs in low concentrations in the phosphate waste but similarly low concentrations of Se have been associated with Se toxicity in livestock and aquatic ecosystems downstream of phosphate mines in the USA.



5.12 Clements

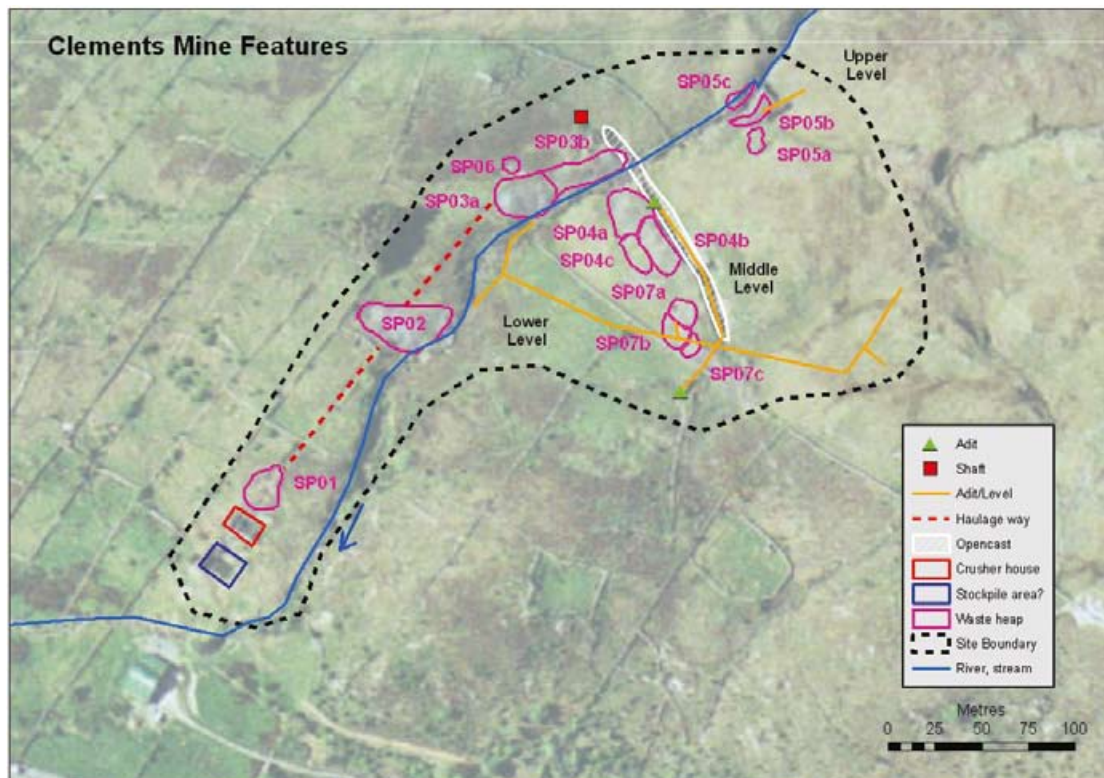
Mine District:	Connemara
Mine Name:	Clements
Minerals Worked:	Pb, Ag
County:	Galway
Townland:	Carrowgarra
Grid Reference:	E99410, N251843
Site Score:	97
Site Class:	V



Elements of Interest:	Pb, Zn, Ag, As, Ni
Media of Concern:	Solid waste, stream sediments

Geochemical Overview

Solid waste heaps at Clements comprise both oxidised, metal-rich waste and relatively fresh waste with a high concentration of unmineralised material. All waste has relatively high concentrations of Pb, with the maximum concentration (5.4%) recorded in crushing waste. The median Pb value of all the solid waste analysed was 5,621 mg/kg (0.56%). A surface water sample taken downstream of the mine had 161 µg/l Zn and 13 µg/l Pb (total metal), in excess of the Draft EC Surface Water Regulation standard (100 µg/l and 7.2 µg/l, respectively). Upstream concentrations were 41 and 8 µg/l, respectively. These values suggest some impact from the mine waste. However, caution is required as dissolved metal concentrations show no similar pattern. One stream sediment sample downstream of the mine had high concentrations of Pb (1,971 mg/kg), Zn (1,755 mg/kg), As (245 mg/kg) and Ni (557 mg/kg).



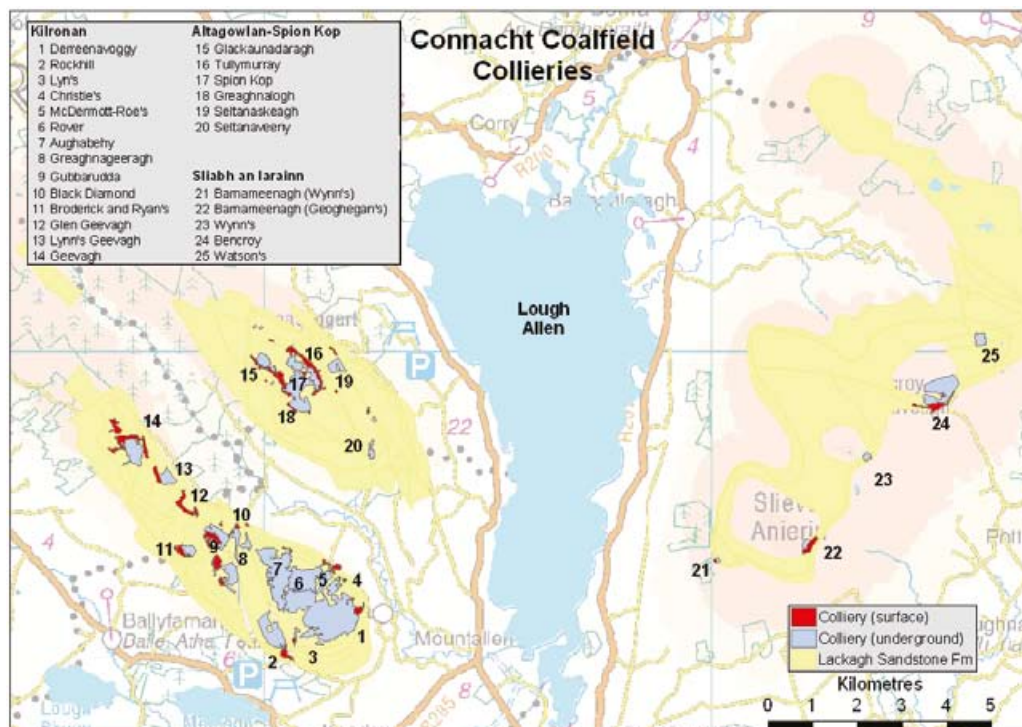
5.13 Connacht Coalfield

Mine District:	Connacht Coalfield
Mine Name:	Various
Minerals Worked:	Coal (Bituminous)
County:	Leitrim, Roscommon, Sligo
Townland:	Various
Grid Reference:	E193000, N314000
Site Score:	91
Site Class:	V
Elements of Interest:	Ni, Zn, sulphate, acidity
Media of Concern:	Solid waste, surface water



Geochemical Overview

Large waste heaps, open pit lakes and active drainage adits remain and are the main potential sources of environmental impacts in the Connacht Coalfield District. Water draining from mine adits in the district has relatively high concentrations of elements such as Al, Ni, Zn and SO₄ as well as low pH and high EC and acidity. Stream water downstream of such discharges also displays elevated concentrations of some of these elements, notably Ni and SO₄. Concentrations of Zn, Ni and SO₄ in mine water and in surface water immediately downstream of mines are generally above standard limits. Most surface water samples from the Connacht Coalfield exceed the standard (drinking water) concentration for aluminium of 200 µg/l. Samples of stream water taken further downstream of mine sites and adit discharges show only very limited and localised chemical impact from mining. Solid waste analysis at one site revealed no significantly elevated metal concentrations. Metal concentrations in stream sediments were below guideline limits for the protection of livestock.



5.14 Donegal Lead Mines – Glentogher

Mine District:	Donegal Pb
Mine Name:	Glentogher
Minerals Worked:	Pb, Ag
County:	Donegal
Townland:	Stranagappoge Demesne
Grid Reference:	E247847, N437881
Site Score:	5
Site Class:	V
Elements of Interest:	Pb, Zn, As, Sb
Media of Concern:	Stream sediments



Geochemical Overview

Glentogher mine was a small mine that produced a limited quantity of lead ore. There is no clear evidence that it has had or continues to have any major impact on its surroundings. Water analyses do not indicate contamination of the downstream surface water by the adit discharge, which has low metal concentrations. Pb and Zn concentrations in stream sediments in the Glentogher area are higher than those found in Inishowen as a whole and Pb concentrations downstream of the mine are higher than those upstream. This suggests some downstream impact from mining. Median concentrations of other metals, such as Cu and As, in stream sediments downstream of the mine are not readily distinguishable from those recorded for the rest of Glentogher as a whole.



5.15 Donegal Lead Mines – Keeldrum

Mine District:	Donegal Pb
Mine Name:	Keeldrum
Minerals Worked:	Pb, Ag
County:	Donegal
Townland:	Keeldrum
Grid Reference:	E190346, N426239
Site Score:	17
Site Class:	V
Elements of Interest:	Pb, Zn, Cu
Media of Concern:	Solid waste



Geochemical Overview

Keeldrum operated as a lead mine for a total of around 10 years in the 19th century, producing less than 2,000 tons of ore. The site is largely grassed over but small amounts of solid waste remain on the site. There are no mine water discharges or evidence of downstream contamination of surface water. Solid waste contains high concentrations of Pb (median 7,146 mg/kg) with the highest concentrations (up to 13.5%) found in processing waste. A leachate test on the solid waste yielded an extremely high concentration of Pb (19,860 µg/l) and suggests the potential for groundwater contamination in the vicinity of the site.

