MANAGEMENT AND REHABILITATION OF THE SILVERMINES AREA

PHASE II REPORT: MANAGEMENT OPTIONS

Prepared for:

DEPARTMENT OF MARINE AND NATURAL RESOURCES

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SUMMARY

MANAGEMENT & REHABILITATION OF THE SILVERMINES AREA
PHASE II REPORT: MANAGEMENT OPTIONS

This report covers the second phase of the study for the management and rehabilitation of the Silvermines area, and is concerned with the available management and rehabilitation options.

INTRODUCTION

The Silvermines area of County Tipperary has been mined for over a thousand years for lead, zinc, copper, silver, baryte and sulphur. The last mine, Magcobar, closed in September 1992. The mining has resulted in undermining and surface subsidence, the excavation of open-pits, the construction of large waste dumps and tailings dams, and the presence of derelict surface structures. Figure 1 is an annotated orthophoto showing the main features of the study area. The yellow outline represents the extent of the study area.

The waste products contain heavy metals, which are mobilised after heavy rain, entering the streams. In the past, the tailings impoundments have also produced dust blows, with the wind-blown particles containing heavy metals. The metal of most concern has been lead, and there have been cattle deaths caused by lead poisoning. It is primarily these deaths and the dust blows which have alerted the authorities to the need to undertake closure and rehabilitation measures to reduce the risk to human and livestock health and safety, and to the environment. There are, however, other pollutants and other problems, such as mining subsidence associated with the Silvermines area, which require consideration. These have been included in the present investigation.

A number of studies have been carried out to investigate the problems and, in 2001, the Department of Marine and Natural Resources (DMNR) appointed SRK Consulting to prepare conceptual designs for the management and rehabilitation of the Silvermines region, over an area of about 2,300 ha. This design was to include five specific sites identified as requiring treatment:

- *Gortmore tailings management facility (TMF);*
- *Tailings at Shallee;*
- *Lagoon and settlement pond at Garryard;*
- *Ballygown area and ground to the south of Silvermines village; and*
- *Magcobar pit and waste dumps.*

The work was to include any other sites within the study area requiring remediation. Although particular problem areas were identified, the problems are linked and it was recognised by all concerned with the study that the Silvermines area must be dealt with as a whole. It was required to present separately the subset of those work plans which correspond to works which Mogul of Ireland might be asked to carry out under Clause K of their State Mining Lease.

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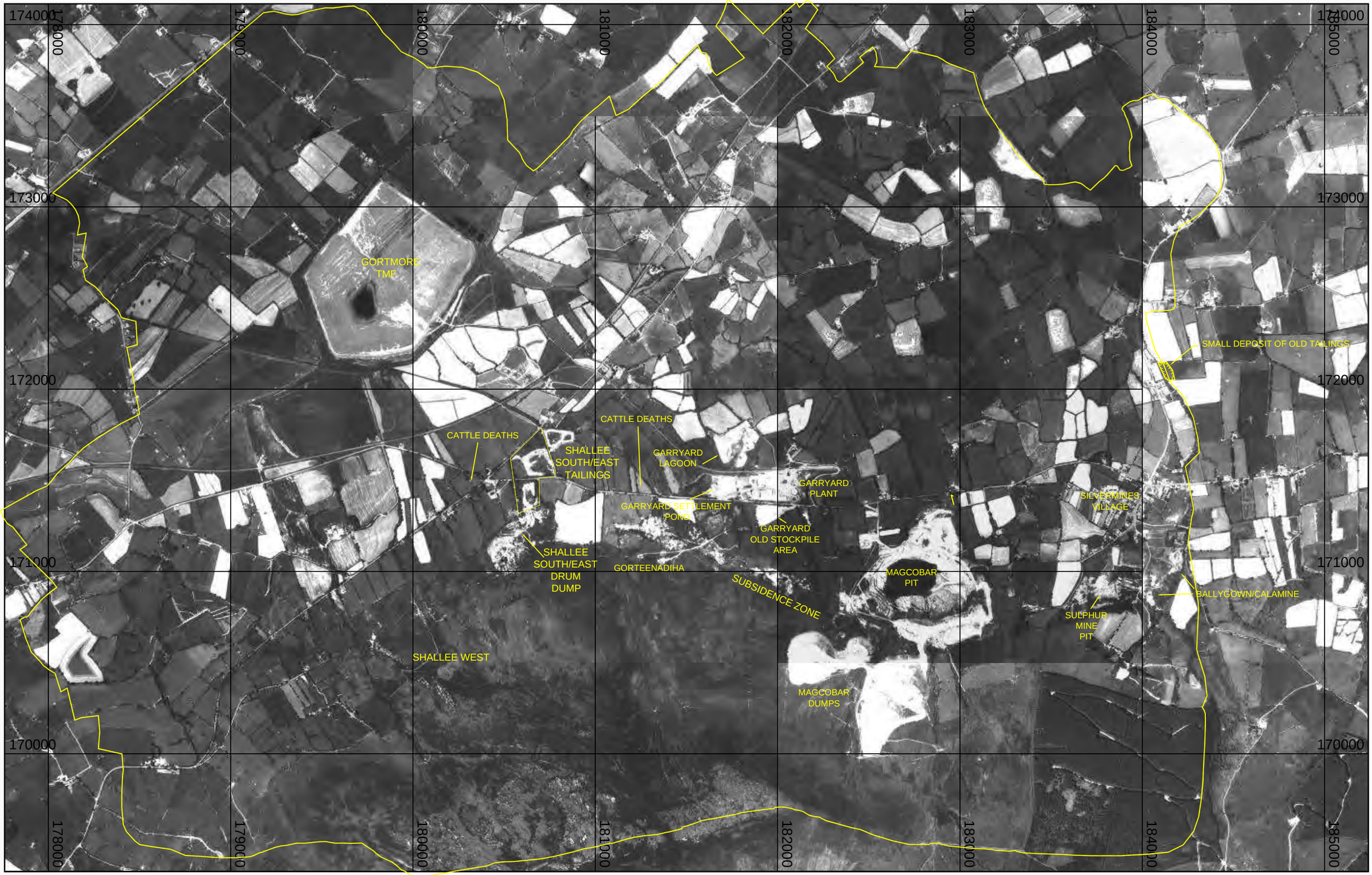

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SRK Consulting Engineers and Scientists		THE STUDY AREA	Fig 1

THE STUDY

The study was to be carried out in three stages:

- *Phase I, review of available information,;*
- *Phase II, management options; and*
- *Phase III, conceptual design of selected options.*

The report on the Phase I study was concerned with the review of the large amount of documentary information, the identification of gaps in the data, the identification of potential remedial measures, and the definition of the work required for Phase II.

THE SITE WORK

The study was undertaken on the basis that the available information would be sufficient for the preparation of the conceptual design for management of the site. It was appreciated that the Phase I review of available information might identify minor gaps in the data, and the intention was that, during Phase II, these gaps would be filled.

During Phase I, the need for a limited amount of additional sampling and testing of water and soils was identified, and this was carried out during Phase II. It was also found that there was very little groundwater information and, as a result, DMNR authorised additional drilling and testing. In addition, Phase II included the completion of observational work on the site, comprising the photographic record, the surface inventory and the assessment of the mining heritage. This work was limited and delayed during Phase I by the foot and mouth restrictions.

The ecology of the area, both habitats and vegetation, was reviewed, with site inspections and the examination of the available data and publications. This information was used in the assessment of re-vegetation options and sustainability in Phase II.

As a result of the foot and mouth restrictions and the additional groundwater study, the programme was extended, with the reports to be submitted at the end of December 2001.

INDUSTRIAL HERITAGE

The Shallee Mine is considered to be a unique survival, worthy of preservation, conservation and utilisation. Major archaeological sites have also been identified at Ballygown, Gorteenadiha, and the old copper mining at Magcobar. These sites should be protected.

Detailed recording of structures on all these sites should be carried out, and public consultation should take place before finalising the programme for conservation and usage. This usage may include the establishment of a centre for Mining Heritage and a walking trail linking the sites.

RIVER AND STREAM CONTAMINATION

During the Phase II study, sampling of surface water and soils was carried out to supplement the data already available. The main purposes were to identify the significant sources of elevated metals in the water courses, and to quantify the elevated metals from each sub-catchment. This information has been used in the design of

the remedial measures to reduce the heavy metal content of the water courses, and as baseline data for the monitoring of the results of the remedial works.

The results confirmed that surface water in all parts of the study area contains elevated metals. Most of this loading is particulate material. The metals include lead, barium, cadmium, zinc, iron and manganese.

GROUNDWATER

A drilling investigation was carried out to supplement the available information on geology, groundwater levels, groundwater aquifer properties and groundwater quality. Thirteen holes were drilled and sampled at Ballygown, Garryard, Shallee and Gortmore, to determine the effect of the mining works and waste deposits on the groundwater. Pump tests were carried out in two boreholes, and double piezometers were installed in four.

The results showed a low permeability in the limestone aquifer matrix, with higher permeabilities associated with fracture features. The overlying alluvial aquifers are more susceptible to potential contamination, but there is no evidence of significant effects of mining on groundwater levels or quality. No active remedial measures for groundwater are considered necessary.

Mercury was detected in two boreholes near the Gortmore TMF and one at Garryard in November 2001. Further sampling and analyses in January 2002 revealed levels of mercury below the detection limit, confirming that mercury levels in the groundwater are insignificant.

DUST

No dust investigation has been carried out in the Phase II study, but the available monitoring information has been reviewed. There have been no significant dust blows from Gortmore TMF since the dust blows of the 1980s, because of the vegetation cover on the impoundment. The remedial design for Gortmore TMF will include measures for the improvement and maintenance of the vegetation.

MINE STABILITY

The available plans and reports have been reviewed, and it has been concluded that future subsidence of the Mogul underground workings will be confined to the present subsidence zone with some possible expansion to the north.

WASTE DUMP STABILITY

The Magcobar dumps are granular and relatively free-draining. With continued maintenance of the surface water drainage system, these dumps will remain stable. No problems are anticipated with the Shallee South/East tailings dumps, or with the old tailings deposits at Ballygown.

The Gortmore TMF contains silt-sized waste, which is not free-draining and, as a result, the TMF has a high water table. There has been no deposition on the TMF for many years, however, so the tailings have consolidated, and are therefore more stable than they were during the operating life of the mine. No stability problems will occur under present conditions, and the proposed works including the waste disposal facility on the upper surface will not cause instability. The stability should be confirmed during the detailed design and if there is any future change in geometry or water management.

HAZARD IDENTIFICATION

The list of key hazards is as follows:

HAZARD	***KEY SOURCE***
Stream water contamination and sediment loads	*Garryard Old Stockpile*
	Garryard Tailings Lagoon
	Shallee South/East Drum Dump
	Ballygown old tailings
	Ballygown waste dumps
Dust potential	*Gortmore TMF poorly-vegetated sections*
Risk to human life	*Open shafts and surface workings*

There are numerous other minor problems requiring remediation, but the six items listed above are the most significant. All problems, both major and minor, are considered in the Phase II report.

DISPOSAL OF WASTE MATERIAL

The remediation of the study area will result in the disposal of quantities of contaminated soil and waste materials:

- *Ballygown – disposal of asbestos roofing and possible concrete;*
- *Ballygown – about 100m^3 of mine waste from vicinity of Silvermines Stream;*
- *Magcobar – about 200m^3 of sulphide waste from dump area;*
- *Magcobar – disposal of scrapped crushing plant and associated structures;*
- *Garryard – about 14,000m^3 of ore and process waste from Old Stockpile;*
- *Garryard – about 22,000m^3 of process waste from Tailings Lagoon;*
- *Garryard – disposal of general scrap and waste from the site and old hostel building;*
- *Dredging of stream sediments, annual or biennial, quantities unknown; and*
- *Shallee – segregation and disposal of ore, process waste and scrap metal, about 4,000m^3.*

These estimated quantities are not based on measurements and actual quantities must be confirmed during the detailed design.

This material will be disposed of at a remote site or at a suitable location within the study area, which could be the surface of the Gortmore TMF. The options are under review. The waste materials at Shallee include large quantities of metal drums, cables and other mine debris, and would require separate disposal off-site, probably at a designated site in Shannon.

REMEDIATION OPTIONS

A detailed risk assessment has been carried out for the study area and the remediation options have been considered. The main features of the preferred options are:

- *general upgrading and maintenance of surface water system;*
- *conservation of mining heritage features of Ballygown and Gorteenadiha;*

- *conservation of Shallee South/East as mining heritage site with visitor facilities;*
- *possible establishment of a heritage trail linking the mining features of the Silvermines area;*
- *removal of contaminated materials from areas as listed above, and deposition on a designated disposal site, which may be the Gortmore TMF;*
- *construction of temporary silt retention structures for discharges from Gorteenadiha area and Ballygown;*
- *segregation of drums and other waste from Shallee South/East and disposal on a designated licensed site outside the study area or on site;*
- *clearing of the Garryard tailings lagoon and redevelopment as a wetland treatment pond;*
- *establishment of a wetland treatment pond for water discharged from Shallee South/East;*
- *minor earthworks at the Gortmore TMF, upgrading of pool decant and retention ponds; and*
- *application of a growth medium to parts of the Gortmore TMF and re-establishment of vegetation.*

PHASE III

The Phase II report, giving the options and proposing preferred options, provides the information on which the Phase III Conceptual Design will be prepared and costed. A programme will be prepared for implementation.

APPENDIX A

RESULTS OF CHEMICAL TESTING

Table A1

GROUNDWATER DATA: ALL SITES

(data for G1, G4, SH1, S2 added on 5/2/02
Sampled November 2001

	EC GROUNDWATER DIRECTIVE	DUTCH																				
Units	**80/68/EEC**	**OPTIMUM**	**ACTION**		**Borehole ID**	**S1**	**S3**	**S2**	**TMF1A**	**TMF1B**	**TMF2a**	**TMF2b**	**TMF3a**	**TMF3b**	**TMF4**	**G1**	**G2**	**G3**	**G4**	**SH1**	**SH2A**	**SH2B**
su					Lab pH	8.56	6.54	8.28	8.14	8.17	8.05	8.32	8.08	8.05	8.09	8.62	8.09	8.21	8.54	8.47	8.20	8.15
su					Field pH	7.4			7.5	7.8	7.3	7.6	7.2	7.1	7.7		7	7.4			7.6	7.7
mg/l				Lab Alk. as CaCO3		310	290	140	240	240	250	400	270	310	180	140	300	310	150	190	220	210
mg/l				Field Alk. as CaCO3		238			95	-	-	-	280		42		144	160			186	158
celsius					Temperature	6.8			9.1	9.7	7.9	7.4	11	11	9.1		9.4	11.3			9	10.1
microS/cm				Electrical Conductivity		360			158	631	353	288	301	288	1796		336	535			96	307
%						9.1			3.2	31.3	0	-	23.6	1.8	38		13.4	106			28.5	68.2
mg/l				Dissolved Oxygen		1.02			0.35	3.3	0	-	2.55	0.21	3.55		1.66	11.2			3.22	7.35
mg/l					K	1.5	7.7	2.5	3.7	4.4	1.3	2.2	0.8	1.4	6.8	0.9	1.5	1.8	2.9	2	2.1	1.1
mg/l					Na	17	16.5	17.5	59	19	27	145	28	24	37	15.5	13	17	16.8	19	14	19
mg/l					NH_4-N	0.3	0.3	<0.2	0.9	0.2	0.3	2.1	0.2	0.3	0.3	<0.2	0.2	0.3	0.3	0.2	0.3	0.3
mg/l					Cl	18	30	<5	21	16	13	47	18	22	27	<5	13	24	<5	<5	11	10
mg/l	List 2				F	0.21	3.07	0.15	0.12	0.14	0.13	0.29	0.15	0.11	0.13	0.01	0.08	0.07	0.07	0.09	0.09	0.08
mg/l					NO_3	1.5	17.8	<0.3	<0.3	<0.3	<0.3	0.3	<0.3	<0.3	<0.3	1.6	1.0	8.6	3	3.2	0.9	0.3
mg/l	List 2				PO_4	<0.03	<0.03	0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.03	<0.03	<0.03	0.04	0.03	<0.03	<0.03
mg/l					Sulphide	0.02	0.03	0.03	0.03	0.04	0.03	0.04	0.04	0.03	0.05	0.03	0.04	0.04	0.03	0.03	0.03	0.04
mg/l					SO_4	20	30	22	643	173	7	48	14	13	934	76	387	47	86	48	67	68
mg/l				Total	Al	<0.05	0.29	<0.05	1.44	0.21	0.74	<0.05	0.05	0.44	0.52	<0.05	<0.05	0.46	<0.05	0.09	0.99	<0.05
mg/l				Filtered	Al	<0.05	0.24	<0.05	0.10	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 2	0.01	0.06	Total	As	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	0.10	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
mg/l	List 2			Filtered	As	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 2	0.05	0.625	Total	Ba	0.10	0.15	0.17	0.09	0.19	0.87	2.24	0.38	0.58	0.07	0.1	0.06	0.40	0.18	0.15	0.19	0.27
mg/l	List 2			Filtered	Ba	0.09	0.13	0.2	0.05	0.15	0.61	0.69	0.35	0.51	0.06	0.09	<0.05	0.37	0.19	0.17	0.10	0.10
mg/l				Total	Ca	164.20	121.10	75.32	320.50	70.07	121.90	527.90	125.30	155.80	356.60	64.21	201.00	119.30	84.97	86.99	186.80	527.50
mg/l				Filtered	Ca	98.60	100.70	74.82	206.40	56.46	86.72	66.65	116.40	124.30	354.10	55.62	172.00	102.90	99.6	101.9	76.63	73.80
mg/l	List 1	0.0004	0.006	Total	Cd	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 1			Filtered	Cd	0.001	0.001	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
mg/l	List 2	0.001	0.03	Total	Cr	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	<0.05	<0.05	<0.05	0.05	<0.05	<0.05
mg/l	List 2			Filtered	Cr	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 2	0.015	0.075	Total	Cu	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05
mg/l	List 2			Filtered	Cu	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l				Total	Fe	<0.05	0.29	0.2	2.27	0.15	1.34	0.06	<0.05	2.32	1.68	0.76	0.92	0.14	<0.05	0.32	1.04	<0.05
mg/l				Filtered	Fe	<0.05	<0.05	<0.05	1.63	0.08	0.06	<0.05	<0.05	0.16	0.06	<0.05	0.08	<0.05	<0.05	<0.05	0.07	<0.05
mg/l				Total	Mg	12.37	16.02	14.48	62.10	16.25	8.67	10.83	13.87	16.52	66.55	19.92	44.12	19.84	14.68	23.32	16.27	11.90
mg/l				Filtered	Mg	11.75	13.63	17.7	24.10	13.82	7.52	5.85	13.34	14.31	80.11	23.83	40.47	17.72	17.59	28.55	11.80	8.52
mg/l				Total	Mn	<0.05	<0.05	0.17	1.68	0.08	1.01	3.31	0.89	0.57	1.20	<0.05	0.12	0.30	3.84	<0.05	1.72	0.10
mg/l				Filtered	Mn	<0.05	<0.05	0.33	1.12	0.08	0.72	0.40	0.74	0.30	0.86	<0.05	<0.05	0.08	4.59	<0.05	0.12	0.08
mg/l	List 2	0.015	0.075	Total	Ni	<0.05	<0.05	<0.05	0.09	<0.05	<0.05	0.05	<0.05	<0.05	0.09	<0.05	0.07	<0.05	<0.05	<0.05	0.07	0.05
mg/l	List 2			Filtered	Ni	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 2	0.015	0.075	Total	Pb	<0.05	<0.05	<0.05	0.78	<0.05	0.42	<0.05	<0.05	0.05	0.67	0.05	<0.05	0.45	<0.05	0.11	3.55	<0.05
mg/l	List 2			Filtered	Pb	0.009	0.021	0.099	0.59	0.019	0.011	0.008	0.007	0.006	0.05	0.023	0.009	0.012	<0.005	0.178	0.11	0.043
mg/l	List 2			Total	Sn	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
mg/l	List 2			Filtered	Sn	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
mg/l	List 2			Total	V	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 2			Filtered	V	<0.05	<0.05	0.12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.14	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 1			Total	CN	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 1	0.00005	0.0003	Total	Hg	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.07	0.07	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 1			Filtered	Hg	<0.00005	<0.00005	<0.00006	<0.00005	<0.00005	0.00009	<0.00005	0.00016	<0.00005	0.00284	<0.00005	<0.00005	0.05	<0.00005	<0.00005	<0.00005	<0.00005
mg/l	List 2	0.065	0.8	Total	Zn	0.98	0.26	0.2	0.12	<0.05	0.08	<0.05	<0.05	<0.05	0.36	0.08	0.24	0.11	<0.05	<0.05	0.82	<0.05
mg/l	List 2			Filtered	Zn	0.823	0.135	0.25	0.173	0.076	0.037	0.005	0.02	0.012	0.057	<0.05	0.097	0.03	<0.05	<0.05	0.084	0.043

Table A2

GROUNDWATER DATA: TMF1a, TMF1b. TMF2a.TMF2b, TMF3a, TMF3b, TMF4, GORT38, GORT35

Sampled January 2002

	EC GROUNDWATER DIRECTIVE	DUTCH												
Units	**80/68/EEC**	**OPTIMUM**	**ACTION**		**Borehole ID**	**TMF1A**	**TMF1B**	**TMF2a**	**TMF2b**	**TMF3a**	**TMF3b**	**TMF4**	**GORT38**	**GORT35**
su					Lab pH	8.18	7.9	8	8.38	8.11	8.12	8.17	8.45	8.42
su					Field pH									
mg/l					Lab Alk. as CaCO3	220	240	260	320	300	420	150	200	170
mg/l					Field Alk. as CaCO3									
celsius					Temperature									
microS/cm					Electrical Conductivity									
%														
mg/l					Dissolved Oxygen									
mg/l					K	1.4	1.3	0.9	0.8	1.5	1	3.4	1.6	2.2
mg/l					Na	17	22	20	30	25	15	158	15	18
mg/l					NH_4-N	0.2	0.3	0.3	2.2	0.3	0.2	0.4	0.2	0.4
mg/l					Cl	14	19	14	35	17	22	34	15	17
mg/l	List 2				F	0.06	0.13	0.16	0.2	0.12	0.09	0.2	0.08	0.02
mg/l					NO_3	0.4	0.7	0.7	<0.3	0.8	0.6	<0.3	11.5	17
mg/l	List 2				PO_4	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
mg/l					Sulphide	0.03	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.03
mg/l					SO_4	13	311	9	5	17	10	1263	64	25
mg/l				Total	Al	<0.05	0.87	0.74	0.06	0.12	0.3	0.33	0.12	<0.05
mg/l				Filtered	Al	<0.05	0.14	0.06	<0.05	0.07	<0.05	0.12	<0.05	0.05
mg/l	List 2	0.01	0.06	Total	As	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 2			Filtered	As	<0.05	<0.05	0.07	<0.05	<0.05	0.05	<0.05	<0.05	<0.05
mg/l	List 2	0.05	0.625	Total	Ba	0.14	0.1	0.58	2.18	0.33	0.58	0.12	0.17	0.23
mg/l	List 2			Filtered	Ba	0.17	0.08	0.68	2.72	0.68	0.42	0.16	0.2	0.29
mg/l				Total	Ca	67.83	156.9	84.34	102.5	105.7	117.3	330	80.32	80.97
mg/l				Filtered	Ca	76.12	185.3	105.4	134.1	143.2	139	441.7	102.5	87.65
mg/l	List 1	0.0004	0.006	Total	Cd	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 1			Filtered	Cd	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
mg/l	List 2	0.001	0.03	Total	Cr	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05
mg/l	List 2			Filtered	Cr	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 2	0.015	0.075	Total	Cu	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05
mg/l	List 2			Filtered	Cu	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l				Total	Fe	0.1	1.3	1.33	7.85	0.17	0.5	0.57	0.42	0.51
mg/l				Filtered	Fe	0.09	<0.05	0.18	10.3	0.14	<0.05	0.12	0.18	0.16
mg/l				Total	Mg	12.24	24.73	6.88	6.04	11.38	13.77	71.5	10.53	5.16
mg/l				Filtered	Mg	16.18	29.39	8.38	7.7	16.38	14.54	80.6	13.13	6.52
mg/l				Total	Mn	0.08	0.39	0.81	0.37	0.49	0.23	1.13	0.06	0.06
mg/l				Filtered	Mn	0.13	0.35	1.08	0.48	0.3	0.73	1.33	0.11	0.12
mg/l	List 2	0.015	0.075	Total	Ni	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	0.09	<0.05	<0.05
mg/l	List 2			Filtered	Ni	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	<0.05
mg/l	List 2	0.015	0.075	Total	Pb	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	0.07	<0.05	<0.05
mg/l	List 2			Filtered	Pb	<0.005	0.005	0.006	0.006	<0.005	<0.005	0.008	<0.005	0.005
mg/l	List 2			Total	Sn	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
mg/l	List 2			Filtered	Sn	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
mg/l	List 2			Total	V	0.15	<0.05	<0.05	<0.05	<0.05	<0.05	0.11	<0.05	<0.05
mg/l	List 2			Filtered	V	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.12	0.12
mg/l	List 1			Total	CN	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 1	0.00005	0.0003	Total	Hg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	List 1			Filtered	Hg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
mg/l	List 2	0.065	0.8	Total	Zn	0.09	0.05	0.06	<0.05	<0.05	<0.05	0.09	0.23	0.05
mg/l	List 2			Filtered	Zn	0.098	0.089	0.064	0.056	0.1	0.066	0.094	0.477	0.188

PHASE 2 SEDIMENT / TAILINGS / WASTE ROCK DATA: ALL SITES

		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		As	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Zn
Dutch Optimum Value		29	0.8	100	36	-	0.3	-	35	85	140
Dutch Action Value		55	12	380	190	-	10	-	210	530	720
GARRYARD											
	GAR 1	231	46	19	61	28160	<1	775	14	5514	15615
	GAR 2	731	155	93	218	>32000	2	1465	83	16761	>32000
	GAR 4	545	144	22	572	29400	3	1178	75	15444	>32000
	GAR 5	509	122	24	1578	31840	1	1630	62	21784	>32000
	GAR 6	623	87	62	218	23190	2	936	46	17655	23862
	GAR 7	465	61	7	258	13900	<1	727	28	5922	12604
	GAR 10	990	73	<1	118	>32000	2	321	<1	27377	18399
	GAR 12	43	2	26	80	6000	<1	939	17	1854	318
	GAR 9	880	48	<1	54	17960	3	184	<1	<1	<1
GORTMORE TMF											
	GORT 12	10	<1	31	19	8823	<1	630	32	147	117
	GORT 19	395	24	<1	45	>32000	<1	5762	11	6162	6372
	GORT 20	650	36	3	138	>32000	<1	5355	51	8396	11273
	GORT 22a	865	14	<1	260	>32000	<1	427	8	14615	4882
	GORT 22b	790	13	<1	183	>32000	<1	364	4	12276	4135
	GORT 30	835	12	<1	114	>32000	<1	419	<1	11769	2694
	GORT 31	501	19	11	121	25940	1	120	<1	15395	4537
	GORT 32	974	22	<1	144	29880	<1	57	<1	14417	5264
	GORT 33	626	9	3	95	28660	<1	265	<1	8183	1785
	GORT 34	625	10	<1	91	>32000	<1	209	<1	8086	1933
SHALLEE SOUTH											
	SHAL 2	84	3	16	78	6400	<1	1460	27	5681	759
	SHAL 10	46	3	20	107	3306	<1	634	16	7980	902
	SHAL 11	70	1	29	239	5669	<1	339	29	26076	423
	SHAL 12	49	2	32	186	5035	<1	611	37	19507	483
	SHAL 19	545	8	30	51	1773	<1	99	14	7063	95
	SHAL 24	220	10	9	113	6325	<1	1038	28	13658	2041
	SHAL 25	86	1	42	21	3227	<1	892	17	1507	104
	SHAL 26	58	1	31	38	3745	<1	1350	35	3979	171
	SHAL 16	808	10	20	42	1664	<1	45	5	<1	69
	SHAL 17	796	10	14	57	1281	<1	111	16	<1	103
	SHAL 18	475	6	8	45	1734	<1	149	14	1	80
	SHAL 27	111	1	31	30	3520	<1	496	16	<1	95
	SHAL 28	93	1	15	24	3910	<1	361	12	<1	122
	SHAL 32	52	1	19	26	2620	<1	615	23	1	115
	SHAL 33	64	1	25	20	3536	<1	1307	36	1630	114
BALLYGOWN											
	CAL2	235	12	14	42	19790	<1	1975	12	16010	8208
	CAL6	478	13	8	66	28730	<1	1470	<1	>32000	8717
	CAL11	556	76	8	86	31790	<1	2852	10	27940	86
	CAL12	561	82	11	85	>32000	<1	3057	11	>32000	>32000
	CAL14	295	318	6	44	28020	<1	4537	52	>32000	16940
	CAL16	340	180	8	55	29170	<1	2372	57	27080	>32000
	CAL17	168	85	2	75	26370	<1	3389	42	9369	>32000
	CAL18	213	64	4	63	>32000	<1	8290	57	168	12450
	CAL19	26	3	18	32	9720	<1	1064	31	592	1421
SHALLEE WEST											
	SHALW 5	73	1	6	132	8126	<1	1198	15	23535	1401

PHASE 2 WATER CHEMISTRY DATA: BALLYGOWN

Units	Irish Standarad S.I. 294	Parameter		CAL1	CAL13	CAL15	CAL 20	CAL 22	CAL 27
su	5.5-8.5		Lab pH	7.10	7.79	7.94	7.86	7.92	7.8
su			Field pH	6.57	7.2	7.74	7.11	7.2	7.2
mg/l		Lab Alk.	as CaCO3	10	130	100	100	230	64
mg/l		Field Alk.	as CaCO3	-	160	122	90	244	94
celsius			Temperature	18.5	20.1	13	11.2	11.1	14
microS/cm		Electrical Conductivity		54.5	352	190	195.2	521	235
%		Dissolved Oxygen		-	91.4	82	90	67.1	80.5
mg/l				-	8.9	7.73	9.86	8.08	8.01
mg/l			K	0.3	3.5	1.4	2.1	1.4	1.9
mg/l			Na	9.0	12.3	15.3	20.0	18.0	7.6
mg/l	0.2		NH_4-N	1.0	0.8	0.5	<0.2	<0.2	0.005
mg/l	250		Cl	<5	5	7	9	7	15
mg/l	1		F	0.01	0.38	0.03	0.01	0.18	
mg/l	50		NO_3	<0.3	<0.3	6.2	6.5	7.2	1.4
mg/l	0.66		PO_4	<0.03	<0.03	<0.03	<0.03	<0.03	0.027
mg/l	200		SO_4	<3	65	7	8	30	7.4
mg/l	0.2	Total	Al	<0.05	<0.05	<0.05	0.13	<0.05	<0.05
mg/l		Filtered	Al	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	0.05	Total	As	0.11	0.07	<0.05	<0.05	<0.05	<0.001
mg/l		Filtered	As	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001
mg/l	0.1	Total	Ba	0.53	0.13	<0.05	0.05	0.13	0.229
mg/l		Filtered	Ba	0.45	0.09	<0.05	<0.05	0.05	0.056
		Total	Be	-	-	-	-	-	<0.001
		Filtered	Be	-	-	-	-	-	<0.001
		Total	B	-	-	-	-	-	<0.05
		Filtered	B	-	-	-	-	-	<0.05
mg/l		Total	Ca	5.91	50.40	22.47	28.22	90.88	22.000
mg/l		Filtered	Ca	5.62	48.63	22.22	15.66	51.48	21.000
mg/l	0.005	Total	Cd	<0.05	<0.05	<0.05	<0.05	<0.05	0.000
mg/l		Filtered	Cd	<0.00005	0.007	<0.0004	<0.0004	<0.0004	<0.00001
mg/l	0.05	Total	Cr	<0.05	<0.05	<0.05	<0.05	<0.05	0.002
mg/l		Filtered	Cr	<0.05	<0.05	<0.05	<0.05	<0.05	0.002
mg/l	0.05	Total	Cu	0.11	<0.05	0.14	0.05	0.31	0.011
mg/l		Filtered	Cu	<0.05	<0.05	0.06	<0.05	<0.05	<0.001
mg/l		Total	Co	-	-	-	-	-	<0.001
mg/l		Filtered	Co	-	-	-	-	-	<0.001
mg/l	0.2	Total	Fe	5.63	<0.05	<0.05	<0.05	<0.05	0.095
mg/l		Filtered	Fe	0.22	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l		Total	Mg	1.60	6.92	7.34	5.54	11.48	5.900
mg/l		Filtered	Mg	1.58	5.87	5.01	3.13	6.60	5.500
mg/l	0.05	Total	Mn	0.36	0.67	<0.05	<0.05	<0.05	0.054
mg/l		Filtered	Mn	0.33	0.53	<0.05	<0.05	<0.05	0.011
mg/l	0.05	Total	Ni	<0.05	<0.05	<0.05	<0.05	<0.05	0.008
mg/l		Filtered	Ni	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001
mg/l	0.05	Total	Pb	0.41	0.11	0.17	<0.05	<0.05	0.254
mg/l		Filtered	Pb	0.022	0.007	<0.005	<0.005	<0.005	<0.001
mg/l		Total	Sn	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05
mg/l		Filtered	Sn	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05
mg/l		Total	V	0.56	0.25	0.19	0.16	0.16	<0.001
mg/l		Filtered	V	0.25	<0.05	0.10	<0.05	0.06	<0.001
mg/l	0.05	Total	CN	<0.05	-	<0.05	<0.05	<0.05	<0.01
mg/l	0.001	Total	Hg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.0001
mg/l		Filtered	Hg	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.0001
mg/l	3	Total	Zn	0.90	3.50	0.07	0.07	1.65	0.284
mg/l		Filtered	Zn	0.5	2.88	<0.005	<0.005	<0.005	0.051
mg/l		Total	Sb	-	-	-	-	-	0.008
mg/l		Filtered	Sb	-	-	-	-	-	0.006
mg/l		Total	U	-	-	-	-	-	<0.001
mg/l		Filtered	U	-	-	-	-	-	<0.001

PHASE 2 WATER CHEMISTRY DATA: MAGCOBAR

Units	ish Standarad S.I. 29	Parameter		MAG 13	MAG 13	MAG 14	MAG 1
su	5.5-8.5		Lab pH	8.21	7.7	7.4	8.05
su			Field pH	6.9	6.2	6.6	8.04
mg/l		Lab Alk.	as CaCO3	40	56	193	80
mg/l		Field Alk.	as CaCO3	25	45	195	60
celsius			Temperature	15.2	14	12	10.1
microS/cm		Electrical Conductivity		913	360	1147	141
%		Dissolved Oxygen		91.3	83.5	4.3	-
mg/l				9.4	8.25	0.46	-
ppm			K	1	1	2.7	0.4
ppm			Na	14.5	5.5	9.1	9.7
ppm	0.2		NH_4-N	0.8	<0.003	0.051	<0.2
ppm	250		Cl	14	13	15	<5
ppm	1		F	0.60			<0.01
ppm	50		NO_3	<0.3	0.2	0.4	<0.3
ppm	0.66		PO_4	<0.03	0.007	<0.006	<0.03
ppm	200		SO_4	449	425	380	5
mg/l	0.2	Total	Al	0.86	0.310	0.099	<0.05
mg/l		Filtered	Al	0.68	<0.05	<0.05	<0.05
mg/l	0.05	Total	As	<0.05	0.003	0.005	<0.05
mg/l		Filtered	As	<0.05	<0.001	0.003	<0.05
mg/l	0.1	Total	Ba	0.11	0.052	0.069	<0.05
mg/l		Filtered	Ba	<0.05	<0.05	0.057	<0.05
		Total	Be		<0.001	<0.001	
		Filtered	Be		<0.001	<0.001	
		Total	B		<0.05	0.074	
		Filtered	B		<0.05	0.077	
mg/l		Total	Ca	145.90	125.000	148.000	21.04
mg/l		Filtered	Ca	129.10	112.300	134.800	11.70
mg/l	0.005	Total	Cd	<0.05	0.000	0.000	<0.05
mg/l		Filtered	Cd	0.007	0.008	<0.0001	<0.0004
mg/l	0.05	Total	Cr	<0.05	0.002	0.008	<0.05
mg/l		Filtered	Cr	<0.05	<0.001	0.006	<0.05
mg/l	0.05	Total	Cu	0.21	0.002	<0.001	0.06
mg/l		Filtered	Cu	<0.05	<0.001	<0.001	<0.05
mg/l		Total	Co		0.002	0.003	
mg/l		Filtered	Co		<0.001	0.002	
mg/l	0.2	Total	Fe	1.53	0.721	2.813	<0.05
mg/l		Filtered	Fe	<0.05	0.018	0.7509	<0.05
mg/l		Total	Mg	109.20	46.800	53.000	4.75
mg/l		Filtered	Mg	80.50	42.200	47.100	2.67

PHASE 2 WATER CHEMISTRY DATA: GARRYARD

Units	Irish Standarad S.I. 294	Parameter		GAR 13	GAR 13	GAR 15	GAR 15
su	5.5-8.5		Lab pH	7.4	8.50	8.08	7.1
su			Field pH	6.85		6.3	
mg/l		Lab Alk.	as CaCO3	206	250	240	134
mg/l		Field Alk.	as CaCO3	270			
celsius			Temperature	10.6		14.8	
microS/cm		Electrical Conductivity		981		787	
%				49.5		81.4	
mg/l		Dissolved Oxygen		4.97		7.76	
mg/l			K	1.3	1	1	0.7
mg/l			Na	8.3	17.5	17.5	8.3
mg/l	0.2		NH_4-N	0.009	0.8	0.9	0.15
mg/l	250		Cl	17	21	20	17
mg/l	1		F		0.34	0.01	
mg/l	50		NO_3	0.9	3.7	1.6	0.4
mg/l	0.66		PO_4	<0.006	<0.03	<0.03	<0.006
mg/l	200		SO_4	313	286	357	422
mg/l	0.2	Total	Al	<0.05	1.54	0.68	0.175
mg/l		Filtered	Al	<0.05	<0.05	<0.05	0.190
mg/l	0.05	Total	As	<0.001	0.05	<0.05	0.017
mg/l		Filtered	As	<0.001	<0.05	<0.05	0.002
mg/l	0.1	Total	Ba	<0.05	<0.05	0.19	0.069
mg/l		Filtered	Ba	<0.05	<0.05	0.06	0.068
mg/l		Total	Be	<0.001	-	-	<0.001
mg/l		Filtered	Be	<0.001	-	-	<0.001
mg/l		Total	B	<0.05	-	-	<0.05
mg/l		Filtered	B	<0.05	-	-	<0.05
mg/l		Total	Ca	162.000	185.90	210.30	185.000
mg/l		Filtered	Ca	144.700	180.80	186.10	161.600
mg/l	0.005	Total	Cd	0.000	<0.05	<0.05	0.000
mg/l		Filtered	Cd	0.007	0.006	0.012	0.014
mg/l	0.05	Total	Cr	0.009	<0.05	<0.05	0.008
mg/l		Filtered	Cr	0.006	<0.05	<0.05	0.005
mg/l	0.05	Total	Cu	0.002	0.12	0.37	0.015
mg/l		Filtered	Cu	<0.001	<0.05	0.22	0.003
mg/l		Total	Co	<0.001	-	-	0.004
mg/l		Filtered	Co	<0.001	-	-	0.004
mg/l	0.2	Total	Fe	0.4809	6.03	28.19	28.459
mg/l		Filtered	Fe	0.195	<0.05	11.71	9.2675
mg/l		Total	Mg	32.800	65.29	59.49	28.700
mg/l		Filtered	Mg	30.200	63.26	56.21	25.400
mg/l	0.05	Total	Mn	0.138	0.11	0.71	0.690
mg/l		Filtered	Mn	0.1473	<0.05	0.58	0.605
mg/l	0.05	Total	Ni	0.008	0.06	0.08	0.0629
mg/l		Filtered	Ni	0.007	<0.05	<0.05	0.038
mg/l	0.05	Total	Pb	0.011	<0.05	0.32	0.192
mg/l		Filtered	Pb	<0.001	<0.005	<0.005	0.003
mg/l		Total	Sn	<0.05	<0.5	<0.5	<0.05
mg/l		Filtered	Sn	<0.05	<0.5	<0.5	<0.05

PHASE 2 WATER CHEMISTRY DATA:SHALLEE EAST / SOUTH

Units	Irish Standarad S.I. 294	Parameter		SHAL 4	SHAL 6	SHAL 7	SHAL 20	SHAL 34
su	5.5-8.5		Lab pH	6.87	6.32	7.86	7.90	7.7
su			Field pH	5.83	6.82	6.73	6.82	6.5
mg/l		Lab Alk.	as CaCO3	20	10	60	70	40
mg/l		Field Alk.	as CaCO3	60		32	56	51
celsius			Temperature	11.6	9.4	8.7	10.1	13
microS/cm		Electrical Conductivity		62.8	36.3	129.6	140.4	149
%				9.9	100	97.1	98.9	93.3
mg/l		Dissolved Oxygen		9.7	11.06	10.84	10.35	9.02
mg/l			K	0.4	0.3	0.5	0.6	0.6
mg/l			Na	14.8	13.3	13.5	15.3	5.9
mg/l	0.2		NH_4-N	0.6	1.1	0.6	0.6	<0.003
mg/l	250		Cl	8	7	7	11	12
mg/l	1		F	<0.01	<0.01	<0.01	<0.01	
mg/l	50		NO_3	<0.3	<0.3	0.8	0.6	0.3
mg/l	0.66		PO_4	<0.03	<0.03	<0.03	0.03	<0.006
mg/l	200		SO_4	8	4	11	12	13.5
mg/l	0.2	Total	Al	<0.05	<0.05	<0.05	<0.05	0.787
mg/l		Filtered	Al	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	0.05	Total	As	0.05	<0.05	<0.05	<0.05	<0.001
mg/l		Filtered	As	<0.05	<0.05	<0.05	<0.05	<0.001
mg/l	0.1	Total	Ba	0.22	0.22	0.26	0.26	0.059
mg/l		Filtered	Ba	0.11	0.10	0.16	0.19	0.211
mg/l		Total	Be	-	-	-	-	<0.001
mg/l		Filtered	Be	-	-	-	-	<0.001
mg/l		Total	B	-	-	-	-	<0.05
mg/l		Filtered	B	-	-	-	-	<0.05
mg/l		Total	Ca	3.41	1.01	15.89	19.34	16.000
mg/l		Filtered	Ca	1.95	0.09	10.76	16.31	15.600
mg/l	0.005	Total	Cd	<0.05	<0.05	<0.05	<0.05	2.00E-07
mg/l		Filtered	Cd	<0.0004	<0.0004	<0.0004	<0.0004	0.001
mg/l	0.05	Total	Cr	<0.05	<0.05	<0.05	<0.05	0.003
mg/l		Filtered	Cr	<0.05	<0.05	<0.05	<0.05	0.002
mg/l	0.05	Total	Cu	<0.05	0.06	0.08	0.20	0.002
mg/l		Filtered	Cu	<0.05	<0.05	<0.05	<0.05	0.009
mg/l		Total	Co	-	-	-	-	<0.001
mg/l		Filtered	Co	-	-	-	-	<0.001
mg/l	0.2	Total	Fe	<0.05	<0.05	<0.05	<0.05	0.0857
mg/l		Filtered	Fe	<0.05	<0.05	<0.05	<0.05	0.058
mg/l		Total	Mg	1.07	0.64	3.16	4.09	4.500
mg/l		Filtered	Mg	0.76	0.42	2.71	3.77	4.000
mg/l	0.05	Total	Mn	0.10	0.13	0.23	0.16	0.0294
mg/l		Filtered	Mn	<0.05	<0.05	0.13	0.08	0.051
mg/l	0.05	Total	Ni	<0.05	<0.05	<0.05	<0.05	<0.001
mg/l		Filtered	Ni	<0.05	<0.05	<0.05	<0.05	0.008
mg/l	0.05	Total	Pb	0.91	0.23	0.11	0.10	0.007
mg/l		Filtered	Pb	<0.005	<0.005	<0.005	<0.005	0.17
mg/l		Total	Sn	<0.5	<0.5	<0.5	<0.5	<0.05
mg/l		Filtered	Sn	<0.5	<0.5	<0.5	<0.5	<0.05
mg/l		Total	V	<0.05	0.15	<0.05	<0.05	<0.001
mg/l		Filtered	V	<0.05	<0.05	<0.05	<0.05	<0.001
mg/l	0.05	Total	CN	<0.05	<0.05	<0.05	<0.05	<0.01
mg/l	0.001	Total	Hg	<0.05	<0.05	<0.05	<0.05	<0.0001
mg/l		Filtered	Hg	<0.00005	<0.00005	<0.00005	<0.00005	<0.0001
mg/l	3	Total	Zn	0.14	<0.05	0.37	0.25	0.194
mg/l		Filtered	Zn	<0.005	<0.005	<0.005	<0.005	0.322
mg/l		Total	Sb	-	-	-	-	0.005
mg/l		Filtered	Sb	-	-	-	-	0.007
mg/l		Total	U	-	-	-	-	<0.001
mg/l		Filtered	U	-	-	-	-	<0.001
mg/l		Total	Tl	-	-	-	-	<0.001
mg/l		Filtered	Tl	-	-	-	-	<0.001

PHASE 2 WATER CHEMISTRY DATA: SHALLEE WEST

Units	Irish Standarad S.I. 294	Parameter		SHALW 1	SHALW 8
su	5.5-8.5		Lab pH	7.64	7.49
su			Field pH	7.26	6.94
mg/l		Lab Alk.	as CaCO3	70	40
mg/l		Field Alk.	as CaCO3	-	80
celsius			Temperature	-	11
microS/cm		Electrical Conductivity		80.9	80
%		Dissolved Oxygen		-	89.8
mg/l				-	9.76
mg/l			K	0.6	0.3
mg/l			Na	15	13.3
mg/l	0.2		NH_4-N	<0.2	<0.2
mg/l	250		Cl	16	14
mg/l	1		F	0.08	0.01
mg/l	50		NO_3	1.4	0.5
mg/l	0.66		PO_4	0.04	0.03
mg/l	200		SO_4	9	7
mg/l	0.2	Total	Al	0.63	<0.05
mg/l		Filtered	Al	<0.05	<0.05
mg/l	0.05	Total	As	0.08	<0.05
mg/l		Filtered	As	<0.05	<0.05
mg/l	0.1	Total	Ba	0.29	0.28
mg/l		Filtered	Ba	0.19	<0.05
mg/l		Total	Ca	1.81	6.49
mg/l		Filtered	Ca	1.76	<0.05
mg/l	0.005	Total	Cd	<0.05	<0.05
mg/l		Filtered	Cd	<0.0004	<0.0004
mg/l	0.05	Total	Cr	0.05	<0.05
mg/l		Filtered	Cr	<0.05	<0.05
mg/l	0.05	Total	Cu	0.25	0.15
mg/l		Filtered	Cu	<0.05	<0.05
mg/l	0.2	Total	Fe	0.12	0.33
mg/l		Filtered	Fe	<0.05	<0.05
mg/l		Total	Mg	1.29	1.91
mg/l		Filtered	Mg	1.14	<0.05
mg/l	0.05	Total	Mn	0.93	<0.05
mg/l		Filtered	Mn	0.82	<0.05
mg/l	0.05	Total	Ni	<0.05	<0.05
mg/l		Filtered	Ni	<0.05	<0.05
mg/l	0.05	Total	Pb	1.00	0.14
mg/l		Filtered	Pb	0.072	0.005
mg/l		Total	Sn	<0.5	<0.5
mg/l		Filtered	Sn	<0.5	<0.5
mg/l		Total	V	0.73	0.55
mg/l		Filtered	V	<0.05	<0.05
mg/l	0.05	Total	CN	<0.05	
mg/l	0.001	Total	Hg	<0.05	<0.05
mg/l		Filtered	Hg	<0.00005	<0.00005
mg/l	3	Total	Zn	0.12	0.06
mg/l		Filtered	Zn	0.04	0.011

PHASE 2 WATER CHEMISTRY DATA: GORTMORE

Units	tandarad S	Parameter		GORT 10	GORT 11	GORT 35	GORT 37	GORT 38
su	5.5-8.5		Lab pH	7.38	7.80	7.49	7.34	6.84
su			Field pH	6.9	7.8	7.4	7.84	6.4
mg/l		Lab Alk. as CaCO3		290	110	170	110	90
mg/l		Field Alk. as CaCO3		310	91	190	85	52
celsius		Temperature		11.9	11.1	13.2	10.9	
microS/cm		Electrical Conductivity		1659	238	383	259	813
%		Dissolved Oxygen		56.1	77.2	92	89	89.2
mg/l				5.1	8.54	9.26	9.68	10.13
mg/l			K	7.5	2.0	3.2	7.5	5.6
mg/l			Na	24.5	16.5	18.3	16.8	20
mg/l	0.2		NH_4-N	<0.2	<0.2	0.2	<0.2	0.4
mg/l	250		Cl	63	28	65	54	25
mg/l	1		F	<0.01	<0.01	<0.01	<0.01	1.40
mg/l	50		NO_3	<0.3	22.4	25.3	22.5	<0.3
mg/l	0.66		PO_4	0.07	0.06	0.25	1.08	<0.03
mg/l	200		SO_4	870	8	8	11	1272
			Sulphide	-	-	-	-	0.02
mg/l	0.2	Total	Al	<0.05	<0.05	<0.05	<0.05	0.46
mg/l		Filtered	Al	<0.05	<0.05	<0.05	<0.05	0.19
mg/l	0.05	Total	As	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l		Filtered	As	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	0.1	Total	Ba	0.13	0.19	0.26	0.12	<0.05
mg/l		Filtered	Ba	0.12	0.14	0.22	0.11	<0.05
mg/l		Total	Ca	243.50	35.54	60.73	30.37	255.50
mg/l		Filtered	Ca	243.20	31.48	58.18	30.03	236.50
mg/l	0.005	Total	Cd	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l		Filtered	Cd	<0.0004	<0.0004	<0.0004	<0.0004	0.012
mg/l	0.05	Total	Cr	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l		Filtered	Cr	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	0.05	Total	Cu	<0.05	<0.05	0.16	0.07	0.05
mg/l		Filtered	Cu	<0.05	<0.05	0.09	<0.05	<0.05
mg/l	0.2	Total	Fe	0.16	<0.05	<0.05	<0.05	5.26
mg/l		Filtered	Fe	<0.05	<0.05	<0.05	<0.05	2.34
mg/l		Total	Mg	270.50	5.11	5.55	4.19	174.30
mg/l		Filtered	Mg	<0.05	4.06	5.13	4.00	163.60
mg/l	0.05	Total	Mn	1.00	<0.05	0.07	0.05	2.60
mg/l		Filtered	Mn	0.97	<0.05	<0.05	0.05	2.41
mg/l	0.05	Total	Ni	<0.05	<0.05	<0.05	<0.05	0.13
mg/l		Filtered	Ni	<0.05	<0.05	<0.05	<0.05	0.11
mg/l	0.05	Total	Pb	0.14	<0.05	0.10	0.05	0.24
mg/l		Filtered	Pb	<0.005	<0.005	<0.005	<0.005	0.033
mg/l		Total	Sn	<0.5	<0.5	<0.5	<0.5	<0.5
mg/l		Filtered	Sn	<0.5	<0.5	<0.5	<0.5	<0.5
mg/l		Total	V	0.26	0.29	0.58	0.46	<0.05
mg/l		Filtered	V	<0.05	0.15	0.13	0.06	<0.05
mg/l	0.05	Total	CN	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l	0.001	Total	Hg	<0.05	<0.05	<0.05	<0.05	<0.05
mg/l		Filtered	Hg	<0.00005	<0.00005	<0.00005	<0.00005	0.00018
mg/l	3	Total	Zn	0.37	0.09	0.06	<0.05	6.07
mg/l		Filtered	Zn	0.3	<0.005	<0.005	0.038	3.378

PHASE 2 EXTRACTION DATA: BALLYGOWN

			As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn	Hg
Sample	**Extractant**	**Metal Fraction**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
CAL 14	MgCl2	Exchangeable		18.48				8.32		144.24	179.2	0.01
CAL 14	NaOAc	Bound to carbonates	3.28	54.48		12.56		345.12	7.12	11312	4518.4	
CAL 14	NH2OH	Bound to Fe-Mn oxides		261.8			8000	3440	42.6	12334	11460	
CAL 14	H2O2	Residual metals		11.8			1507.8	11		1101	2566	
CAL 2	MgCl2	Exchangeable		2.64				25.44		225.76	137.76	0.001
CAL 2	NaOAc	Bound to carbonates		1.04	4.8	0.64	8.24	138.88		1700.8	389.2	
CAL 2	NH2OH	Bound to Fe-Mn oxides				1.4	7408	611.6	3.6	1870.8	978.8	0.001
CAL 2	H2O2	Residual metals	4.8				96	2		260.8	203	
CAL 18	MgCl2	Exchangeable	1.84	18.32				4		217.04	347.6	0.0038
CAL 18	NaOAc	Bound to carbonates		34.88		0.56		236.32	9.6	6092	5856	
CAL 18	NH2OH	Bound to Fe-Mn oxides		180			7406	6654	46.8	13468	13772	
CAL 18	H2O2	Residual metals	17	10.2		1.4	295.8	103.4		651.6	4378	

PHASE 2 EXTRACTION DATA: GARRYARD

			As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn	Hg
Sample	**Extractant**	**Metal Fraction**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
GAR10	MgCl2	Exchangeable				1.2		19.52		2748	84.48	0.0012
GAR10	NaOAc	Bound to carbonates						14.72		3208	33.12	
GAR10	NH2OH	Bound to Fe-Mn oxides					3986	43.8		553	350.8	0.0012
GAR10	H2O2	Residual metals		23.8		3	701.4	1		7078	4562	
GAR 2	MgCl2	Exchangeable	3.68	3.68	3.68	3.68	3.68	3.68	3.68	3.68	3.68	3.68
GAR 2	NaOAc	Bound to carbonates	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
GAR 2	NH2OH	Bound to Fe-Mn oxides										
GAR 2	H2O2	Calculated Residual	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!

PHASE 2 EXTRACTION DATA: SHALLEE EAST / SOUTH

			As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn	Hg
Sample	**Extractant**	**Metal Fraction**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
SHAL 27	MgCl2	Exchangeable	1.12					66.48		2102.4	20.88	0.001
SHAL 27	NaOAc	Bound to carbonates	4.24		11.92	8.08	242.88	198.64	0.4	1680	32.56	
SHAL 27	NH2OH	Bound to Fe-Mn oxides	31.8		13.8	20.2	4328	259.6	7.2	1850	136.2	
SHAL 27	H2O2	Residual metals	5.8			37	584.6	46.8		128.4	28.4	
SHAL 28	MgCl2	Exchangeable	5.6			1.76		126.32		3003.2	8.56	
SHAL 28	NaOAc	Bound to carbonates	4.88		13.76	8.08	138.64	104.96	1.52	353.6	6.24	
SHAL 28	NH2OH	Bound to Fe-Mn oxides			44.2	1.4	4880	178	16.2	601.6	100.6	
SHAL 28	H2O2	Calculated Residual				3		13		97.8	25	

PHASE 2 EXTRACTION DATA: SHALLEE WEST

			As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn	Hg
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sample	**Extractant**	**Metal Fraction**										
SHALW 5	MgCl2	Exchangeable				4.16		73.68		8288	28.4	
SHALW 5	NaOAc	Bound to carbonates	1.12				24.88	69.2		7259.2	14.56	
SHALW 5	NH2OH	Bound to Fe-Mn oxides			7	50.4	7722	2076		4302	86.4	
SHALW 5	H2O2	Residual metals				94	63.6	66.6		548.4	40.6	

PHASE 2 EXTRACTION DATA: GORTMORE TMF

			As	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Zn**	**Hg**
Sample	**Extractant**	**Metal Fraction**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
GORT20	MgCl2	Exchangeable	2.08	7.6		1.76		19.12		43.36	37.76	
GORT20	NaOAc	Bound to carbonates		7.52		18.32	98.24	486		2616	846.4	
GORT20	NH2OH	Bound to Fe-Mn oxides					7168	3754		4424	1636	
GORT20	H2O2	Residual metals					8386	90.4		26	101.2	
GORT22a	MgCl2	Exchangeable				7.2	31.76	27.44		257.52	109.04	
GORT22a	NaOAc	Bound to carbonates				2.4				10.96	4.32	
GORT22a	NH2OH	Bound to Fe-Mn oxides				56.8	6516	68.6		305.8	593	0.0016
GORT22a	H2O2	Residual metals				10.4				129	460.8	

FIELD CHEMISTRY AND PASTE VALUES: BALLYGOWN

Water Chemistry	pH	T	EC	DO		Eh	Alk.	Acidity
Site ID	su	celsius	microS/cm	%	mg/l		CaCO3	CaCO3
CAL 1	6.57	-	54.5	-	-		-	-
CAL 4	6.4		130					
CAL 13	7.2	20.1	352	91.4	8.9	75	160	
CAL 15	7.74	13	190	82	7.73		122	
CAL 22	7.2	11.1	521	67.1	8.08	-	244	190
CAL 23	7.58	11.6	322	98.1	10.95	-	146	84
CAL 27	7.2	14	235	80.5	8.01	194	94	76
CAL 20	7.11	11.2	195.2	90	9.86		90	
CAL 21	7.59	11.4	257	9.16	80.5		74	

Paste pH and EC		
	pH	EC
Site ID	su	microS/cm
CAL 2	7.08	17
CAL 5	6.83	23.3
CAL 6	6.8	26.2
CAL 7	6.8	12
CAL 8	6.9	70
CAL 9	7.3	61
CAL 10	3.17	965
CAL 11	6.4	55
CAL 12	6.5	36.6
CAL 14	7.7	61.2
CAL 16	7.3	44
CAL 17	7.2	14.8
CAL 18	7.4	19

FIELD CHEMISTRY AND PASTE VALUES: MAGCOBAR

Water Chemistry							
	pH	T	EC	DO		Alk.	Acidity
Site ID	su	celsius	microS/cm	%	mg/l	CaCO3	CaCO3
MAG 1	8.04	10.1	141	-	-	60	36
MAG 2	8	12.4	150	98.1	10.1	99	30
MAG 3	7.9	12.1	160				
MAG 13	6.2	15.2	913	91.3	9.4	45	35
Mag 13 (R)	6.9	14	360	83.5	8.25	25	22
MAG 14	6.6	12	1147	4.3	0.46	195	110
MAG 17	4.2	16.3	1167	96.3	9.55	0	37
MAG 20	8.16	-	389	120	10.1	155	58

Paste pH and EC		
	pH	EC
Site ID	su	microS/cm
MAG 5	7.84	201
MAG 6	7.8	180
MAG 8	8.25	29
MAG 9	5.3	750
MAG 10	8.1	37
MAG 11	3.18	1281
MAG 12	1.6	14800
MAG 15	7.85	81.3
MAG 16	3.9	230
MAG 18	6.7	308

FIELD CHEMISTRY AND PASTE VALUES: GARRYARD

Water Chemistry

	pH	T	EC	DO		Alk.	Acidity
Site ID	su	celsius	microS/cm	%	mg/l	CaCO3	CaCO3
GAR 13	6.2	19.9	410	49.5	4.97	251	150
GAR 16	7.24	13.3	908	76.6	8.31	148	92
GAR 18	8.3	19.3	1033	104.7	9.58	230	82
SHAL 23	7.56	11.8	780	106.9	11.4	23	75
GAR 15	6.3	14.8	787	81.4	7.76	215	152

Paste pH and EC		
	pH	EC
Site ID	su	microS/cm
GAR 1		
GAR 2	6.6	183
GAR 3	6	1800
GAR 4	6.38	793
GAR 7	6.9	79
GAR 9	2.5	1430
GAR 10	4.59	2340
GAR 14	6.14	1736
GAR 15	3.62	942
GAR 17	7.9	108

FIELD CHEMISTRY AND PASTE VALUES: SHALLEE SOUTH / EAST

Water Chemistry							
	pH	T	EC	DO		Alk.	Acidity
Site ID	su	celsius	microS/cm	%	mg/l	CaCO3	CaCO3
SHAL 4	5.83	11.6	62.8	90.9	9.7	60	38
SHAL 6	6.82	9.4	36.3	100	11.06	-	-
SHAL 7	6.73	8.7	129.6	97.1	10.84	32	20
SHAL 13	6.92	12.2	96.3	103.7	10.71	68	24
SHAL 14	6.98	11.1	105	109.3	11.58	35	15
SHAL 15	6.82	10.3	121.4	97.3	10.43	46	63
SHAL 20	6.82	10.1	140.4	98.9	10.35	56	65
SHAL 21	7.54	11.2	725	87.6	9.15	306	152
SHAL 22	7.93	11.3	114.9	105	11.22	75	19
SHAL 23	7.56	11.8	780	106.9	11.4	23	75
SHAL 34	6.5	13	149	93.3	9.02	51	48

Paste pH and EC		
	pH	EC
Site ID	su	microS/cm
SHAL 1	7.47	17
SHAL 3	2.69	293
SHAL 5	5.86	20
SHAL 8	2.5	2065
SHAL 9	3.96	26.5
SHAL 11	5.73	15.3
SHAL 12	5.59	12.9
SHAL 16	7.34	11.6
SHAL 17	6.27	15.6
SHAL 18	6.33	4.5
SHAL 19	6.11	6.9
SHAL 25	7.79	7.4
SHAL 26	7	25
SHAL 27	5.03	14.4
SHAL 28	7.57	22.5

FIELD CHEMISTRY AND PASTE VALUES: SHALLEE WEST

Water Chemistry							
	pH	T	EC	DO		Alk.	Acidity
Site ID	su	celsius	microS/cm	%	mg/l	CaCO3	CaCO3
SHALW 1	7.26	-	80.9	-	-	-	-
SHALW 8	6.94	11	80	89.8	9.76	80	12

Paste pH and EC		
	pH	EC
Site ID	su	microS/cm
SHALW 2	5.19	18.4
SHALW 3	4.82	26.6
SHALW 4	5.35	16.7
SHALW 6	5.6	9.4

FIELD CHEMISTRY AND PASTE VALUES: GORTMORE

Water Chemistry							
	pH	T	EC	DO		Alk.	Acidity
Site ID	su	celsius	microS/cm	%	mg/l	CaCO3	CaCO3
GORT 10	6.9	11.9	1659	56.1	5.1	310	230
GORT 11	7.8	11.1	238	77.2	8.54	91	52
GORT 23	3.2	14	1520	98	9.94	0	190
GORT 35	7.4	13.2	383	92	9.26	190	150
GORT 36	7.47	-	1165	60.7	6.59	274	240
GORT 37	7.84	10.9	259	89	9.68	85	110

Paste pH and EC		
	pH	EC
Site ID	su	microS/cm
GORT 1	2.7	2500
GORT 2	2.9	1900
GORT 3	6.3	330
GORT 4	3.3	786
GORT 5	3.5	424
GORT 6	6.4	134
GORT 7	7.1	350
GORT 8	2.9	1546
GORT 9	3.4	475
GORT 13	6	2000
GORT 14	6.3	1565
GORT 15	2.9	1110
GORT 16	2.67	1401
GORT 17	6.06	230
GORT 18	6.7	123
GORT 19	6.8	1390
GORT 20	7.1	537
GORT 21	3.16	1118
GORT 22A	3.46	428
GORT 22B	3.09	1850
GORT 25	3.4	437
GORT 26	3.28	805
GORT 27	3	1370
GORT 28	6.3	460
GORT 29	2.7	1418
GORT 31	2.9	1040
GORT 32	2.49	3200

APPENDIX B

INVENTORY OF SURFACE STRUCTURES

INVENTORY OF MINE SURFACE STRUCTURES

BALLYGOWN (Fig.3.1)

	DESCRIPTION	DETAILS
BUILDINGS, etc.	Old Engine House	mid-19th century Historic stone structure
	Old Furnace Building	Historic stone walls circa 1860
	Waeltz Plant	Empty concrete and asbestos buildings, circa 1950s
	Silvermines Cottage	De Stafort Family home
	Village trail	Footpath beside Silvermines Stream
MINES	Two old opencast areas	Small flooded pit in area of public access
	Old sulphur mine opencast	Long depression beside Silvermines Fault
WASTE DUMPS	Small deposits over entire Ballygown	Known locally as ‘Red Hill Dumps’
SHAFTS	Drainage adit and adit shafts	
	Chapel Field Shaft	
	Engine Shaft	
	Twin Shaft	
	Russell Shaft	1951
	Wrights Shaft	
	Stream Shaft	
	'A' Shaft	
	‘B’ Shaft	
	Rockgate Shaft	
	Sulphur Shaft	
	Stone Shaft	
	14 unnamed shafts	
WATER	Silvermines Stream	
	Drain from old sulphur mine	

MAGCOBAR (Fig.3.2)

	DESCRIPTION	DETAILS
BUILDINGS	Crusher plant	Steel structure beside pit
	Bins	At crusher
	Workshop building	Good condition steel frame, steel clad
	Diesel tank	
	Office	Poor condition pre-fab
	Foundations of old mine buildings	Circa 18th Century
MINES	Mine pit and pit lake	Fenced
	Indications of previous historic lead mines	
	Small sinkhole near entrance	Considered natural, but triggered by mine dewatering
WASTE DUMPS	Waste dumps A, B, C, D and E	Material being taken from toe of dump A
	Limestone stockpiles	Near crusher and also south of pit
SHAFTS	Four from previous mining	No surface indication seen.
WATER	Pit lagoon	
	Concrete diversion channel	Around pit, in good order
	Diversion trenches	Upstream of dumps
	Streams though waste dumps	

GARRYARD (Fig.3.3)

	DESCRIPTION	DETAILS
BUILDINGS/PLANT	General	Taken over by transport depot
	Hoist and office building	In use (see above)
	Concentrator building	In use
	Thickener tanks	
	Concentrate loader	On rail siding
	Two old cottage buildings	Pre-dating the mine
	Garryard bunkhouse	Owned by farmer, derelict, roofless
	Other small buildings	
	Paved areas	Hard standing being extended
	Rail siding	In good order, used for railtruck parking
	Garryard Tailings Lagoon	Sold to farmer, receives udgd water
	Garryard Settlement Pond	Receives run-off from plant area
MINES		Garryard workings entirely udgd
WASTE DUMPS	Old Stockpile	Residue of plant waste materials
	Tailings Lagoon	Deposits of plant residues
SHAFTS	Main Shaft	At Hoist in plant
	Eight unnamed	
WATER	Settlement Ponds	
	Tailings lagoon	
	Drains from plant area to Lagoon	Shaft overflow & plant discharge
	Diversion channel along main road	To prevent run-off entering plant
SUBSIDENCE	Subsidence area on Silvermines Fault	Caused by shallow open stopes
	Sinkhole East	Group of three sinkholes
	Sinkhole West	The deepest sinkhole

GORTEENADIHA (Fig.3.3)

	DESCRIPTION	DETAILS
BUILDINGS	Small concrete magazine	Intact
	Concrete columns of small building	Soldier accommodation
	Old hand-dressing area	Historically important
MINES	Shallow open workings	
	Minor underground workings	No plans, position inferred
WASTE DUMPS	Small waste piles	
SHAFTS	Six in area	
WATER	Natural drainage only	

SHALLEE S/E (Fig.3.4)(a)

	DESCRIPTION	DETAILS
BUILDINGS	Beam engine house	Historic, mid-19th century
	Captain King's house	Historic, mid-19th century
	Core sheds	
	Processing plant site	1950s, various plant bases
	Main engine shaft	
	Mine office	
	Chemical store	
	Laboratory	
	Explosives store	
MINES	Rich quarry	
	No.1 Quarry	
	No. 2 Quarry	
	Old open stopes	
WASTE DUMPS	"Drum Dump"	Miscellaneous process waste, many drums
	Small spoil piles from workings	
	Tailings impoundments	North and south of main road
SHAFTS/ADITS	Three unnamed shafts	
	Whim Shaft	
	King Shaft	
	Field Shaft	Flooded source of streamflow
	Engine Shaft	
	Main adit	Near plant
WATER	Reservoir	
	Flooded workings	
	Stream beside tailings impoundment	Believed from udgd workings
	Upslope cut-off drain	

SHALLE WEST (Fig 3.4)(b)

	DESCRIPTION	DETAILS
MINES	Linear open pits to depth of 10-15m	Lower pits surrounded by electric fence
WASTE DUMPS	Waste material adjacent to pits	Unvegetated waste
WATER	Some accumulation at base of some pits	Some ferruginous staining
BUILDINGS	Store ruins nearby	Uncertain origin, possibly mine related

GORTMORE TMF (Fig.3.5)

	DESCRIPTION	DETAILS
WASTE DUMPS	Tailings impoundment	
WATER	Lake on surface of impoundment	
	Decant channel on surface	
	Small decant pond and decant tower	
	Three Retention Ponds	
	Discharge channel to river	

APPENDIX C

PHOTOGRAPHIC RECORD

PHOTOGRAPHIC RECORD

The photographs are intended to provide a visual record of the important features of the study area at the present time. The Plate numbers have been selected to give an indication of the contents as follows:

AREA	FIRST NUMBER
GENERAL	0
BALLYGOWN	1
MAGCOBAR	2
GARRYARD	3
GORTEENADIHA	4
SHALLEE EAST/WEST	5
GORTMORE	6

TYPE OF FEATURE	SECOND NUMBER
GENERAL VIEWS	0
MINE WORKINGS	1
SHAFTS AND SUBSIDENCE	2
DUMPS	3
STREAMS AND LAGOONS	4
BUILDINGS AND ROADS	5

Thus Plate 2.1.2 will be the second photograph of the mine workings at Magcobar.

Projects\U1606\Ptotos\Report\Plate_1.0.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		View to North-west Over Silvermines Village from Silvermines Mountain	Plate 1.0.1

Projects\U1606\Ptotos\Report\Plate_1.1.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		Old Opencast Workings	Plate 1.1.1

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Adit or Short Mine Burrow at Sulphur Mine

Area Downslope of Sulphur Mine Looking North

SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		Sulphur Mine	Plate 1.1.2

P:\U1606 Silvermines\photos\for report\Plate_1.2.1.dwg

Open Shaft at Sulphur Mine

Open Shaft on Drainage Adit Near Silvermines Village

SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		Ballygown Mine Shafts	Plate 1.2.1

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SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		Shallow Mine Spoil at Ballygown	Plate 1.3.1

Projects\U1606\Ptotos\Report\Plate_1.5.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		The Waeltz Plant Buildings, South Side	Plate 1.5.1

Projects\U1606\Ptotos\Report\Plate_1.5.2.dwg

SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		The Waeltz Plant Building, North Side	Plate 1.5.2

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SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		The Engine House	Plate 1.5.3

Projects\U1606\Ptotos\Report\Plate_1.5.4.dwg

SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		The Furnace Building	Plate 1.5.4

Projects\U1606\Ptotos\Report\Plate_1.5.5.dwg

SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		The Village Field	Plate 1.5.5

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Footpath Developed in the Ballygown Mining Area

SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		The Silvermines Village Trail	Plate 1.5.6

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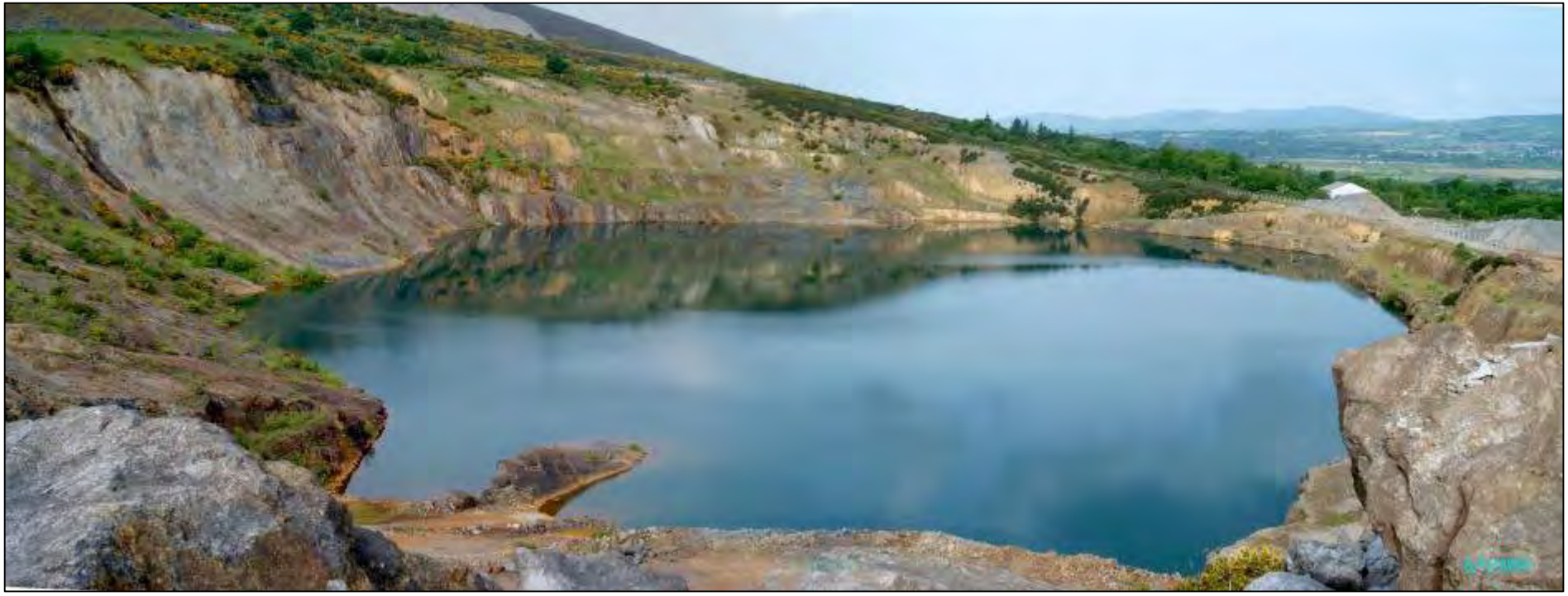
SEPTEMBER 2001	U1606	SILVERMINES - BALLYGOWN	
SRK Consulting Engineers and Scientists		The Silvermines Village Trail	Plate 1.5.7

Projects\U1606\Ptotos\Report\Plate_2.0.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - MAGCOBAR	
SRK Consulting Engineers and Scientists		General View of Magcobar Mine Area	Plate 2.0.1

Projects\U1606\Ptotos\Report\Plate_2.1.1.dwg



SEPTEMBER 2001	U1606	SILVERMINES - MAGCOBAR	
SRK Consulting Engineers and Scientists		Magcobar Pit from the East	Plate 2.1.1

Projects\U1606\Ptotos\Report\Plate_2.1.2.dwg

SEPTEMBER 2001	U1606	SILVERMINES - MAGCOBAR	
SRK Consulting Engineers and Scientists		Magcobar Pit from the South	Plate 2.1.2

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Old copper mine adit and waste below dump A

Old copper mine building remains below dump C

JANUARY 2002	U1606	SILVERMINES - MAGCOBAR	
SRK Consulting Engineers and Scientists		The Old Copper Workings	Plate 2.1.3

Projects\U1606\Ptotos\Report\Plate_2.2.6.dwg

SEPTEMBER 2001	U1606	SILVERMINES - MAGCOBAR	
SRK Consulting Engineers and Scientists		Small Sinkhole near Entrance from Main Road	Plate 2.2.1

Projects\U1606\Ptotos\Report\Plate_2.3.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - MAGCOBAR	
SRK Consulting Engineers and Scientists		View of Magcobar Waste Dumps From North	Plate 2.3.1

Projects\U1606\Ptotos\Report\Plate_2.3.2.dwg

SEPTEMBER 2001	U1606	SILVERMINES - MAGCOBAR	
SRK Consulting Engineers and Scientists		Magcobar Dumps B & C	Plate 2.3.2

Projects\U1606\Ptotos\Report\Plate_2.3.3.dwg

SEPTEMBER 2001	U1606	SILVERMINES - MAGCOBAR	
SRK Consulting Engineers and Scientists		Magcobar Dump E	Plate 2.3.3

Projects\U1606\Ptotos\Report\Plate_2.5.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - MAGCOBAR	
SRK Consulting Engineers and Scientists		The Magcobar Crusher	Plate 2.5.1

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SEPTEMBER 2001	U1606	SILVERMINES - MAGCOBAR	
SRK Consulting Engineers and Scientists		Magcobar Workshops and Diesel Tank	Plate 2.5.2

Projects\U1606\Ptotos\Report\Plate_3.0.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		General View of Garryard Plant Area from South	Plate 3.0.1

Projects\U1606\Ptotos\Report\Plate_3.2.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		Eastern Sinkholes on Silvermines Fault	Plate 3.2.1

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SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		Views of Western Sinkhole (the Largest) on Silvermines Fault	Plate 3.2.2

Projects\U1606\Ptotos\Report\Plate_3.2.3.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		Smaller Sinkhole	Plate 3.2.3

Projects\U1606\Ptotos\Report\Plate_3.2.4.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		Doline Subsidence	Plate 3.2.4

Projects\U1606\Ptotos\Report\Plate_3.2.5.dwg

The entire area has experienced movement

SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		General Topography of Subsidence Zone	Plate 3.2.5

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Shaft cap on Mogul vent shaft north east of western subsidence zone

The cap of Knight Shaft, the main Mogul Shaft, next to Garryard Hoist Building.
The pipe is to drain overflowing water.

JANUARY 2002	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		Shaft Caps	Plate 3.2.6

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North-west Corner Adjacent to Road and Water Course

Upper surface

SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		Garryard Plant Old Stockpile Area	Plate 3.3.1

Projects\U1606\Ptotos\Report\Plate_3.4.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		View of Tailings Lagoon from the South	Plate 3.4.1

Projects\U1606\Ptotos\Report\Plate_3.4.2.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		The Garryard Settlement Pond	Plate 3.4.2

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Extension of Hard Standing Towards Settlement Pond by Placement of Waste Materials.

Sampling at the Tailings Lagoon Outlet Pipe.

SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		Pond and Lagoon Areas	Plate 3.4.3

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Pair of Old Cottages Near Entrance to Plant

Thickener Tanks

SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		Garryard Plant Area Structure	Plate 3.5.2

Projects\U1606\Ptotos\Report\new\Plate_3.5.3.dwg

Concentrator building in foreground; grey central building is offices, core shed and hoist building

SEPTEMBER 2001	U1606	SILVERMINES - GARRYARD	
SRK Consulting Engineers and Scientists		Concentrator Building Viwed from the North-east	Plate 3.5.3

Projects\U1606\Ptotos\Report\new\Plate_4.0.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GORTEENADIHA	
SRK Consulting Engineers and Scientists		General View Looking South	Plate 4.0.1

Projects\U1606\Ptotos\Report\Plate_4.1.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GORTEENADIHA	
SRK Consulting Engineers and Scientists		View Looking North-west Over Area of Surface Workings and Dumps	Plate 4.1.1

Projects\U1606\Ptotos\Report\Plate_4.5.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GORTEENADIHA	
SRK Consulting Engineers and Scientists		Old Mine Buildings	Plate 4.5.1

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SEPTEMBER 2001	U1606	SILVERMINES - GORTEENADIHA	
SRK Consulting Engineers and Scientists		Hand - Dressing Area	Plate 4.5.2

Projects\U1606\Ptotos\Report\Plate_5.0.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		View to South Showing Surface Workings	Plate 5.0.1

Projects\U1606\Ptotos\Report\Plate_5.0.2.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		View to North Over Buildings and Waste Dumps	Plate 5.0.2

Projects\U1606\Ptotos\Report\Plate_5.1.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		View of Flooded Opencast Workings	Plate 5.1.1

Projects\U1606\Ptotos\Report\Plate_5.1.2.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		Entrance to "Cathedral Cavern"	Plate 5.1.2

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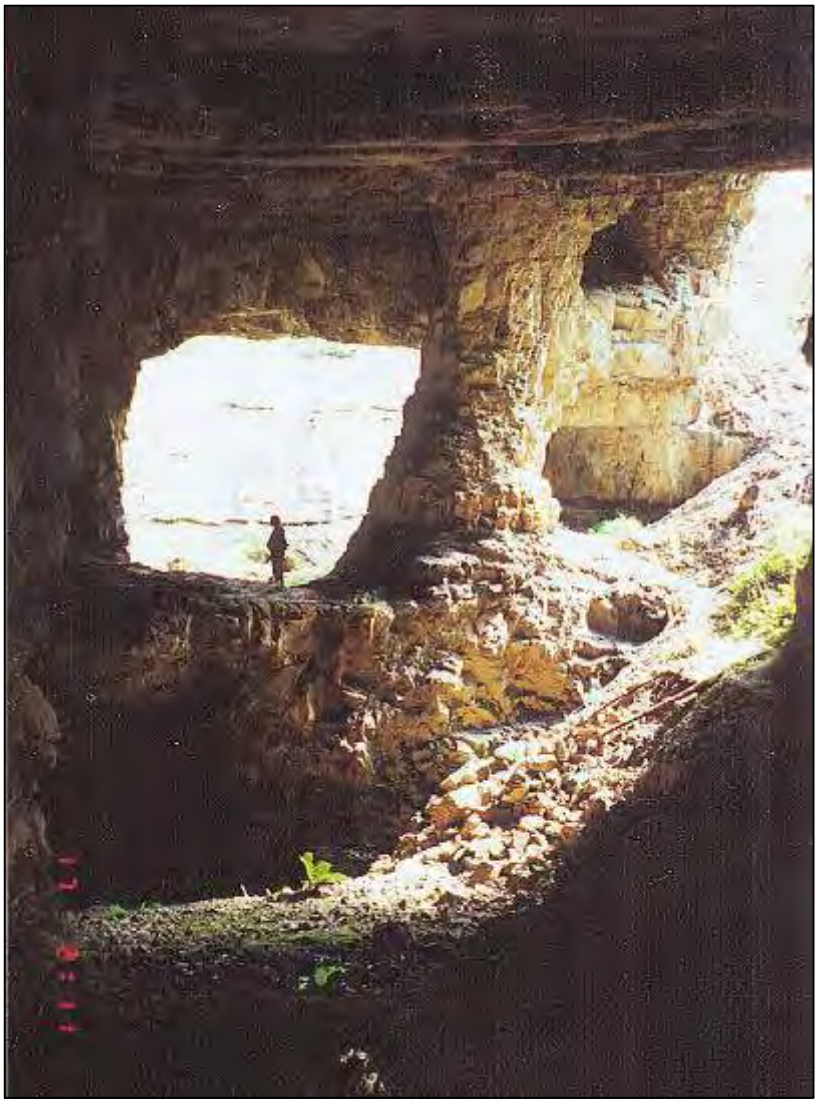

Sept 2001	PROJ. No: U1606	SILVERMINES	
SRK Consulting Engineers and Scientists		View of "Catherdral Cavern"	Plate 5.1.3

Projects\U1606\Ptotos\Report\Plate_5.1.4.dwg

(See also Plate 5.0.1)

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		View of Hillside Surface Workings	Plate 5.1.4

Projects\U1606\Ptotos\Report\Plate_5.1.5.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		View to North-west over Surface Workings and Stopes	Plate 5.1.5

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Lagoon in small opencast area near plant

Waterfall entering main opencast area

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		Surface Workings near Plant, with Stream Flow	Plate 5.1.6

Projects\U1606\Ptotos\Report\Plate_5.2.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		Old Vent Shaft	Plate 5.2.1

Projects\U1606\Ptotos\Report\Plate_5.3.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		The Drum Dump	Plate 5.3.1

Projects\U1606\Ptotos\Report\Plate_5.3.2.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		Drums and Waste near the Opencast Workings	Plate 5.3.2

Projects\U1606\Ptotos\Report\Plate_5.3.3.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		South Tailings Dump Viewed to North from Plant	Plate 5.3.3

Projects\U1606\Ptotos\Report\Plate_5.3.4.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		South Tailings Dump Vegetation, Looking North	Plate 5.3.4

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Believed to be Water from the Underground Workings Running from an Old Shaft

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		Stream Beside South Tailings Dump	Plate 5.4.1

Projects\U1606\Ptotos\Report\Plate_5.5.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		Panoramic View to South of Plant Structures and Machine Bases	Plate 5.5.1

Projects\U1606\Ptotos\Report\Plate_5.5.2.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		Machine Bases, Looking North Over Tailings Dump	Plate 5.5.2

Projects\U1606\Ptotos\Report\Plate_5.5.3.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		Engine House	Plate 5.5.3

Projects\U1606\Ptotos\Report\Plate_5.5.4.dwg

SEPTEMBER 2001	U1606	SILVERMINES - SHALLEE SOUTH/EAST	
SRK Consulting Engineers and Scientists		King's House	Plate 5.5.4

Projects\U1606\Ptotos\Report\Plate_6.0.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GORTMORE	
SRK Consulting Engineers and Scientists		View of Tailings Dam from South	Plate 6.0.1

Projects\U1606\Ptotos\Report\Plate_6.3.1.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GORTMORE	
SRK Consulting Engineers and Scientists		View of Poorly Vegetated North-east Quadrant	Plate 6.3.1

Projects\U1606\Ptotos\Report\Plate_6.3.2.dwg

SEPTEMBER 2001	U1606	SILVERMINES - GORTMORE	
SRK Consulting Engineers and Scientists		View of South-central Section of Tailings Dam, with Vegetation Typical of Most of Upper Surface	Plate 6.3.2

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Partially Vegetated Outer Slope on South Side, with Indications of Wind Erosion

Typical Sparse Vegetation Near Crest of Slope

SEPTEMBER 2001	U1606	SILVERMINES - GORTMORE	
SRK Consulting Engineers and Scientists		Outer Slopes	Plate 6.3.3

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The Retention Ponds at the East End of the Tailings Dam

Kilmastulla River in Diversion alongside tailings dam

SEPTEMBER 2001	U1606	SILVERMINES - GORTMORE	
SRK Consulting Engineers and Scientists		Water Retention and Discharge	Plate 6.4.1