

**MANAGEMENT AND REHABILITATION
OF THE SILVERMINES AREA**

**PHASE III REPORT:
CONCEPTUAL DESIGN**

Prepared for:

DEPARTMENT OF MARINE AND NATURAL RESOURCES

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MANAGEMENT AND REHABILITATION OF THE SILVERMINES AREA

PHASE III REPORT: CONCEPTUAL DESIGN

1 INTRODUCTION

1.1 General

The Silvermines area has been mined for more than one thousand years, and mining finally ceased in September 1992. The Department of Marine and Natural Resources (DMNR) intends to provide costed management and implementation plans for closure and rehabilitation measures over the area of approximately 2,300ha, and has appointed SRK Consulting to prepare a conceptual design for this purpose. The work includes heritage, ecology and environmental health considerations, and has been carried out in three phases. The Phase I study – Review of Available Information, (SRK report U1606/1, dated May 2001), and the Phase II study – Management Options (SRK report U1606/2, dated March 2002) have been completed.

This present report contains the results of the Phase III study – Conceptual Design. Phase III comprises the conceptual design of the preferred remedial options, based on the results of the Phase I and Phase II studies.

For completeness, the introductory sections of this Phase III report contain information also presented in the Phase I and Phase II reports.

Sections 5 to 10 are concerned with the remedial works required at each site and follow the column headings of the Risk/Remediation tables of the Phase II report 1606/2. Copies of these tables are presented in Appendix A of this Phase III report for reference.

1.2 Terms of Reference and Objectives

The terms of reference in a DMNR letter of September 1st, 2000, outlined the following objectives for the work:

1. Preparation of management plans and/or rehabilitation plans for:
 - Tailings Management Facility (TMF) at Gortmore ;
 - Tailings at Shallee;
 - Lagoon and Settlement pond at Garryard;
 - Ballygown area and ground to the south of Silvermines village; and
 - Any other areas within the study area which may be identified during the consultancy as requiring the same.
2. Provision of costs and time-scale for implementing these plans.
3. Consultation with the public and agencies as part of the study and preparation of plans.
4. Assistance and advice to the Department in presenting such plans to the agencies and owners responsible for carrying out and supervising the plans and to the local population.

The consultants are required to identify and cost the necessary works to rehabilitate and/or manage the local environment in relation to mining-related features:

- Openings, vent raises, shafts and declines;
- Mine buildings;
- Tailings;
- Stream sediments enriched in heavy metals;
- Waste rock and other mining residues;
- Scrapped equipment, metals, containers or chemicals used in former mining operations;
- Subsidence, whether mining or natural; and
- Hydrogeological impacts.

The consultants are required to present separately the subset of these work plans which corresponds to works which Mogul of Ireland might be asked to carry out under Clause K of their State Mining Lease.

2 RESULTS OF THE PHASE II REVIEW OF OPTIONS

The Phase II study resulted in the identification of various options for the different mine sites in the study area. Following discussion with DMNR, the preferred options for remedial work were selected for conceptual design and costing. Full details are in the Phase II report, and Table 2.1 summarises the remedial works. The various mining features and key elements of remedial work are shown on Figure 2.1.

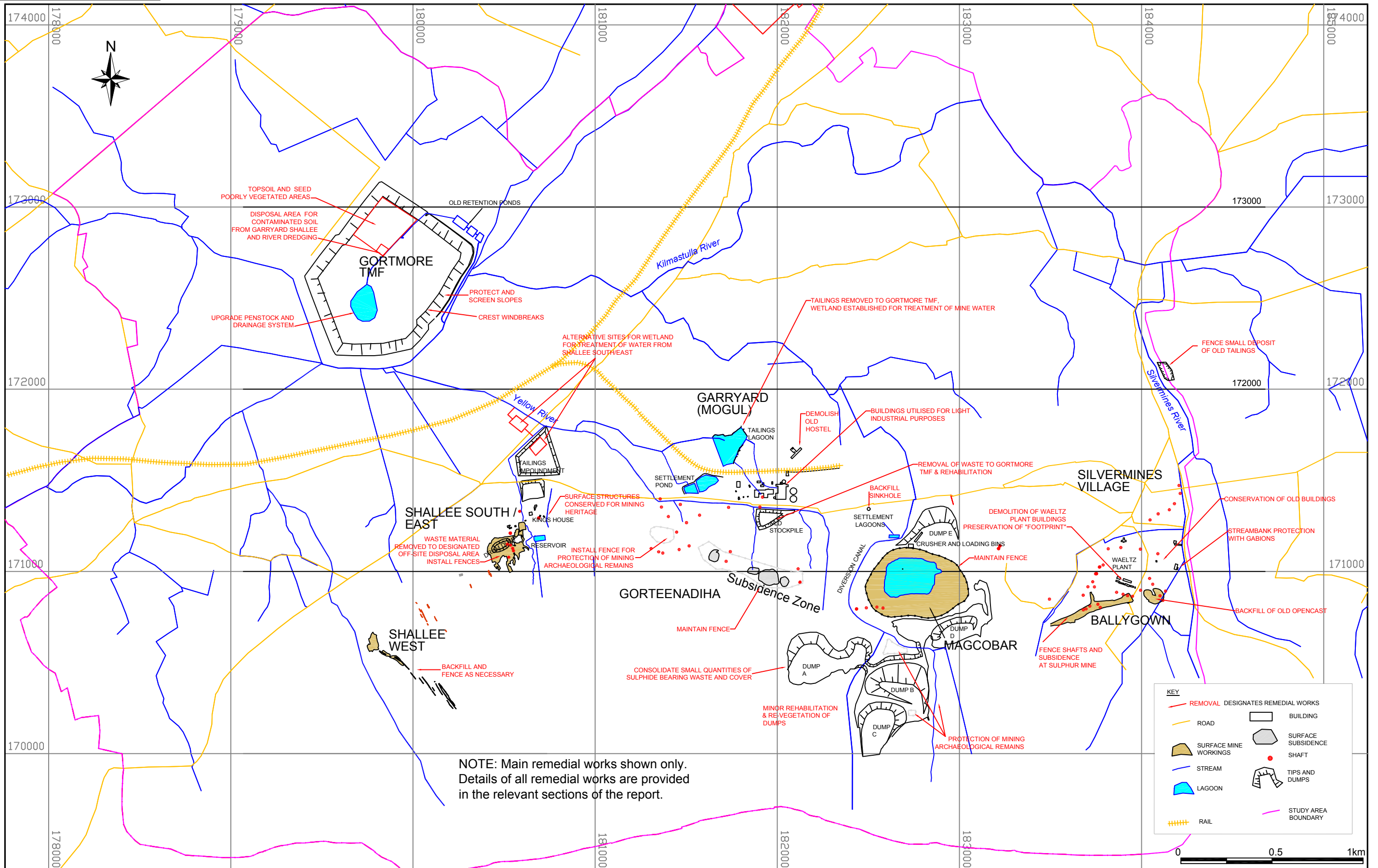
Table 2-1: Main Elements of the Preferred Remedial Options

SITE	ITEM	REMEDIAL WORKS
BALLYGOWN	General	Minor earthworks, re-vegetation, significant demolition, heritage conservation
	Village Field	Capping and re-vegetation
	Opencast area	Partial backfill and re-vegetation
	Shafts, adits and wells	Backfill or fence, pressure relief holes
	Mine water discharges	Clearing of adit and installation of sediment trap
	Waste materials	Install stream bank protection, remove small quantities to Gortmore TMF, re-vegetate
	Old Engine House	Conservation measures
	Old Furnace Building	Conservation measures
	Waeltz Plant Buildings	Partial demolition, conservation to window or footprint level
	Old tailings to north of Silvermines Village	Install fence
MAGCOBAR	General	Minor earthworks, re-vegetation, demolition
	Mine pit	Maintain fencing and investigate pit water geochemistry
	Sediment Lagoons	Fence and maintain
	Archaeological sites	Install protective fences
	Rock dumps	Minor re-shaping, topsoil and re-vegetation
	Surface drainage channels	Repair and maintain
	Small deposits of sulphide waste	Consolidate and cap
	Maintenance workshop	Possible alternative use
	Other buildings and crusher	Remove buildings and backfill lagoon on top of Dump E
	Small sinkhole near entrance	Backfill
GARRYARD	General	Wetland development, removal of mine waste
	Tailings Lagoon	Removal of process wastes, conversion to artificial wetland
	Settlement pond	Maintain as retention pond
	Knight Shaft	No change, but maintain discharge system
	Mogul shafts and vent raises in other areas	Protection as appropriate
	Sulphide and oxidation products - underground mine water	Discharged to new Tailings Lagoon wetland
	Old Stockpile	Removal of mine waste, rehabilitation to pasture
	Existing drainage channels	Repairs and improvements
	Subsidence area	Repair and maintain fences, install diversion drains
GORTEENADIHA	General	Minor drainage works & gabion retention dam,
	Mining heritage	Protected by fence pending archaeological study
	Shafts, underground workings, adits and open pits	Identification, backfilling and fencing as appropriate
	Waste dumps	Install trench drains
	Surface run-off	Small gabion retention dam for sediment control

Cont'd.....

Table 2-1: Main Elements of the Preferred Remedial Options Cont'd.....

SITE	ITEM	REMEDIAL WORKS
SHALLEE SOUTH/EAST	General	Conservation of buildings and mine as heritage site, disposal of process waste and wetland development
	Mining heritage	Preparation of conservation schedule and execution of conservation measures.
	Open pits and Underground workings	Make safe by fencing
	Shafts and adits	Improvement of grill on Whim Shaft and fencing of Field Shaft. All other adits and shafts to be treated as appropriate for mining heritage conservation.
	Scrap and waste, Drum Dump and other smaller deposits in-pit and elsewhere	Remove to designated off-site licensed dump
	Water discharges	Improvement of surface drainage system and establishment of downstream wetland
	Tailings dam run-off	To same wetland
	Tailings dam vegetation	Maintain
	Old Engine House	Conservation
	King's House	Conservation
	Plant foundations and other buildings	Conservation
SHALLEE WEST	General	Minor backfilling
	Trenches and mine waste	Backfilling of trenches with mine waste and fencing of trenches where appropriate.
GORTMORE	General	Selective topsoiling and re-vegetation, establishment of vegetation screen, minor remedial earthworks
	Top surface	Monitor existing vegetation and develop maintenance programme
	Top surface	Placing of limestone gravel and topsoil on approximately 25% of top surface, re-vegetation
	Top surface	Establishment of disposal area for contaminated soil waste from other parts of the study area
	Pool on top surface	New decant and pipeline
	Un-vegetated outer slopes	Selective topsoiling and re-vegetation at crest, planting of tree screen at toe.
	Retention ponds	Determination of water balance, detailed survey and minor works to improve retention time.



DEC 2001

PROJ. No: U1606

SILVERMINES

Scale 1:20,000

3 BASIS OF THE CONCEPTUAL DESIGN

The remedial options selected at the end of the Phase II study define the nature of the remedial works. The design is at a conceptual level only. The available existing plans have contours at 10 metre intervals, and this limits the accuracy of the conceptual designs and the estimates of quantities. It is recommended that all mine sites are accurately surveyed to produce 1m contours and to specifically locate key features related to the mining and proposed remedial works.

3.1 Acceptance criteria

The acceptance criteria governing the choice of remedial options have been defined in the Phase II report. The BATNEEC (Best Available Technology Not Entailing Excessive Cost) principle has been applied. Acceptability to the local community and the other involved parties has been an important consideration.

3.2 Access

The ownership of the old mining properties of the Silvermines area is not clear in every case, particularly for the very old mines. For the purpose of the conceptual design, SRK has reviewed the present usage and, where a change of usage has been considered advisable, this has been recommended. Others are investigating the legal ownership for DMNR.

3.3 Sources of materials

The construction materials include limestone, low-permeability clay and a “growth medium”. It has been assumed that the limestone will be selected and crushed from the Magcobar dumps, that the clay will come from a site at a nominal 10km distance, and that the growth medium will be a soil also from a nominal 12km distance.

There are other potential sources of materials. For example, there is factory bone waste, there is factory meat waste and there is sewage waste, with varying associated costs and in various quantities. All three materials may be potentially useful as additives for a growth medium. It is also considered that some of the material excavated for routine drain clearance will be suitable as a growth medium in selected areas. The single assumed rate used for imported material in the cost assessment is conservative, and the partial replacement of imported soil by one or more of these wastes is likely to reduce the total cost.

3.4 Waste Disposal

The problem wastes include material from:

- The process wastes at Ballygown on the Silvermines Stream bank;
- Small quantities of sulphide waste at Magcobar
- The Old Stockpile at Garryard;
- The Tailings Lagoon at Garryard;
- The Drum Dump at Shallee;
- Dredgings from streams and drains.

These deposits are a hazard and a source of stream contamination, requiring remediation. The preferred option is to remove process and ore waste from Garryard Old Stockpile, Garryard Tailings Lagoon and Shallee Drum Dump and to place it on the Gortmore TMF in an engineered facility. The stream dredgings will also be placed on this facility. It is intended that scrap waste such as steel drums, mainly from Shallee South/East, will be disposed of at a designated site outside of the study area. Process waste on the Silvermines Stream bank at Ballygown will be stabilised and protected with gabions, but small quantities may be removed and placed on the Gortmore TMF waste disposal area. Small quantities of acid-generating sulphide mine waste at Magcobar will be consolidated in one area at Magcobar and covered. Asbestos from the roof of the Waeltz Plant at Ballygown will be disposed of off-site, in a designated disposal facility (probably in Belgium). Building rubble from the demolition of the Waeltz Plant Buildings will be placed in the Ballygown Opencast. Any remaining quantity will be placed at Magcobar and covered during the dump reshaping.

The possibility of consolidating and capping the waste on its existing sites was considered during Phase II. This solution would have the disadvantage of creating several hazardous waste dumps requiring long-term maintenance and an ongoing risk of contaminated discharge. Table 3.1 provides a simple comparison of the two options.

It will be necessary to discuss the options with the EPA and TNCC, to:

- Classify the various wastes and the type of disposal facility required;
- Define the requirements for disposal, and;
- Identify alternative sources for disposal if the Gortmore TMF cannot be used.

A detailed licensing application will be necessary and it is likely that an Environmental Impact Statement (EIS) will be required. This is a time-consuming process and therefore must be implemented as soon as possible before designs can be prepared.

Table 3.1: Comparison of Hazardous Waste Options for Tailings Lagoon, Old Stockpile and Drum Dump

OPTION	ADVANTAGE	DISADVANTAGE
Cover in-situ	No excavation or transportation of waste	Importation and transport of cover material; Three separate hazardous waste sites requiring long-term management; Land lost to future use; No underliner to contain possible seepage.
Remove to disposal site on Gortmore TMF	Allows: Establishment of single disposal facility on existing hazardous waste site, to be rehabilitated as part of Gortmore TMF rehabilitation; Placement of an underliner to prevent seepage; Restoration of Tailings Lagoon area as artificial wetland; Restoration of Old Stockpile to pasture; Restoration of Shallee Drum Dump area within heritage site	Period of transportation of tailings to Gortmore using road transport

3.5 River water quality

The river water qualities in the Silvermines River, the Yellow River and the Kilmastulla River have been affected by run-off from the mining areas, and mainly by sediments eroded from waste dumps or tailings deposits and from metals in solution. The remedial measures presented in the following sections include measures to stop this erosion at source, either by removing the waste or by stabilising it. These measures will be supplemented by various silt retention structures and wetlands for water treatment at Garryard and Shallee South/East. Where dissolved species are a key contaminant, the source materials will be removed where possible, or wetlands will be provided to enhance precipitation of metals

3.6 Groundwater Quality

Preliminary work has been carried out to characterise groundwater quality. Mining has had an impact on the groundwater chemistry but in general, groundwater quality only shows slightly elevated metal levels and generally close to the key sources of contaminants. There are no groundwater abstractions close to the mining areas. The

Shallee Group Scheme borehole is the closest abstraction and there are no signs of contamination.

During the investigation, there was a concern that elevated levels of mercury were identified in the groundwater adjacent to and immediately downstream of the Gortmore TMF. The levels were very low and subsequent check sampling did not reveal any mercury. It was concluded that levels of all metals were low and there was no requirement for specific remedial measures.

No particular remedial measures are necessary for the groundwater in the investigation area apart from management of abstraction in areas close to mining features.

3.7 Mining Heritage

The proposed conservation of the mining heritage of the Silvermines area has involved the identification of structures and features to be preserved, but the value of these remains is greater than the sum of the remains. The various mining developments to be seen in the Silvermines area provide an excellent view of open pit and underground mining through various ages. The geology, mining, mine development and environmental impacts provide an opportunity for teaching students of geology, mining and environment as well as the general public. An opportunity exists to develop an educational centre and trail from Silvermines to Shallee. This is not considered further in this report, but the recommended remedial works will enable such a trail and education centre to be developed.

3.8 Ecology and sustainability

There are no designated areas or habitats for plants, animals or birds that have been identified in the area. Many sites have developed vegetation naturally. Remediation will ensure that the existing ecology, including the mine site ecology, is maintained or enhanced where necessary. This particularly applies to the tailings deposits to ensure sustainability in the long term.

3.9 Cost estimates

Recent UK rates for similar works have been used in the cost estimates, and they are considered to be of sufficient accuracy in relation to the accuracy of estimated quantities. These unit costs and rates have been compared with rates from TNCC. The cost estimates are only approximate, but are appropriate for the relative

comparison of options and for decision-making. For certain items, where no rates are available, nominal sums have been allowed. A key constraint on conceptual design is the lack of detailed survey information for each area. A topographical survey must be carried out at each site as soon as possible.

The estimated design costs are percentages of the estimated cost of the works.

4 REQUIREMENTS FOR IMPLEMENTATION OF THE PROPOSED REMEDIAL WORKS

4.1 Introduction

It is anticipated that the remedial works will be carried out over four years, though long-term monitoring and maintenance will continue after the remedial works are complete. Apart from spreading costs, the four year period will also give the advantage that the cumulative influence of the completed works can be judged, and the required future works adjusted in accordance with these effects.

As the works will be carried out at different times, it is anticipated the tasks will be let to qualified contractors as separate contracts. There are a number of specialist tasks required, particularly the archaeological studies and topographic survey, before certain engineering works are designed or carried out. Permits will be required for activities such as the disposal of contaminated waste.

4.2 Silvermines Project Management

The works will require consultation, coordination and planning over an extended period of four years or more. It is proposed that a government department undertake the administration of the project, involving representatives of other statutory bodies and technical experts as necessary. The function of this department will be to obtain funding, to appoint consultants and contractors, to supervise the works, to liaise with interested and affected parties, and to carry out monitoring. It is anticipated that the on-site project management, coordination and liaison will be delegated to a full-time project manager. He will be based in Silvermines Village, though there may be extended periods in Dublin, during the initiation phase and during periods of reduced site activity.

The duties of the project manager will include:

- Supervision of the Contractors as Resident Engineer;
- Overall Environmental Management, with enforcement of the environmental protocols;
- Management and coordination of the input by technical specialist consultants;
- Community liaison;
- Reporting to his supervisor at the government department.

The activities on site will involve various levels of expertise, and it is anticipated that the project manager will coordinate the involvement of specialists in the control of the works. These specialists will be engineers and scientists from appropriately qualified companies.

It is anticipated that the Project Manager will be a civil engineer experienced in the supervision of earthworks contracts, with a background in environmental work, and an ability to communicate well on a personal level and at formal meetings. He or she may be a direct employee of the supervising government department, or seconded from a private company. His capabilities will have a large influence on the success of the project.

4.3 **Additional investigations**

The present study has been a conceptual design, and the subsequent detailed design will include certain additional investigations.

The components of the design investigations will vary from area to area, and will depend on the nature of the proposed remedial works. They will include, for example, the determination of actual volumes of waste materials to be disposed of, the testing of potential capping materials, and detailed audits of existing stormwater channels.

Test work has been carried out to characterise the chemistry of different materials. In terms of surface water hydrology, there are no flow records on the site and flows have been estimated for the Phase II report. A flow monitoring programme should be implemented on key streams, to enable some calibration to be done for detailed design purposes. This is particularly important for design of wetlands and engineering structures.

Drilling has been carried out to characterise the groundwater. This work should be complemented with information from some additional boreholes and ongoing monitoring. This will provide additional information for groundwater management and will not impact on the design of remedial works.

Allowances have been made for heritage conservation works, including fencing, on the sites, and remains at Gorteenadiha and Magcobar have been identified as requiring industrial archaeological investigation. Sums have been allocated for the archaeological investigations at Ballygown, Magcobar, Gorteenadiha and Shallee.

4.4 Detailed design

The detailed design will comprise:

- 1 Detailed topographic survey to provide contours at one metre vertical intervals.
- 2 Appropriate additional investigations (e.g., further site inspections/mapping, archaeological studies, geochemistry of Magcobar pit, identification of sources of suitable fill, etc).
- 3 Initiation of a monitoring programme for surface and groundwater.
- 4 Preparation of Environmental Impact Statements.
- 5 Detailed design analyses.
- 6 Preparation of A0 construction drawings and specifications.
- 7 Revised estimate of costs to 25% accuracy.
- 8 Preparation of tender documentation including specifications, bills of quantities and contract environmental management procedures.

The detailed topographic survey is essential for the detailed design. Without a reliable contour plan, including the surface structures, it is not possible to carry out the detailed design or to cost it.

4.5 Permitting

Permitting activities will include the application for permits for the excavation, transportation and disposal of contaminated waste. They will also include the submission of the Environmental Impact Statement for approval.

It is anticipated that the permitting activities could be critical in terms of the timing of the programme.

4.6 Engineering construction work

The construction activities will comprise:

- 1 Tender letting and tender adjudication.
- 2 Appointment of the Contractors.
- 3 Construction and supervision of the works.
- 4 Acceptance and handover of the works.

4.7 Environmental management during remedial works

The period of implementation of the remedial works will require good environmental management procedures to be in place, because the works themselves will have high potential impacts. During the earthworks and prior to successful re-vegetation, for example, there will be an increased potential for the erosion of soil and ecological damage, and it will be necessary to construct temporary silt traps, or to construct intended permanent retention structures at the beginning of the works. Vehicles transporting waste materials will require cleaning prior to moving onto public roads, to prevent contaminated soil from being spread. The special measures and protocols required to ensure good environmental practices during implementation will form part of the Contract Specification for the Contractor, and particular requirements will apply to each site.

It is proposed that the environmental protocols for the sites will be applied by the contractors and enforced by the Project Manager.

4.8 Monitoring during the remedial works

During the four year remediation period and the Contractor's maintenance period, the monitoring programme initiated as part of the detailed design (Section 4.4) will be carried out, including surface water, groundwater, air quality, erosion and vegetation monitoring. This data will provide a record of the changes resulting from the remedial works.

4.9 Long-term monitoring and maintenance

After the completion of the Contractor's maintenance period and acceptance of the works, it will be necessary to continue the programme of monitoring and maintenance. This should include:

- 1 Water and atmospheric monitoring.
- 2 Monitoring of erosion and silt transportation.
- 3 Monitoring of vegetation.
- 4 Inspections of structures and fences and minor maintenance and repair.
- 5 Periodic clearing of silt traps and wetlands.
- 6 Dredging of streams and field drains (for a limited period).

It is envisaged that, at the time of acceptance of the works, the supervising government department will hand over responsibility for long-term maintenance to

another body, probably the TNCC, but that the responsibility for monitoring activities may remain with a body such as the EPA, which has the necessary expertise and laboratory facilities.

Table 4.1 gives an estimate of the annual cost of long-term monitoring and maintenance. It is probable that, with time, the extent of monitoring activities will reduce, and that the need to dredge the streams will be reduced or removed by the effectiveness of the remediation measures.

Table 4-1: Estimated costs of long-term maintenance and monitoring after four year implementation period

DESCRIPTION	COST
Annual inspections and maintenance	€18,000
Dredging of streams and field drains	€10,000
Monitoring of water and atmosphere	€14,000
Total	€42,000

4.10 Costing of project management

The elements of the costing of the management of the remedial works will be:

- Costs of the managing government department.
- Cost of employment of the full-time project manager.
- Cost of specialist experts employed as consultants during the construction phase.
- Cost of EIS and permitting procedures.
- Cost of monitoring activities.

It is assumed that the staff of the managing government department will be involved as part of their normal employment, and that they will incur no project costs. A sum has been allowed for input by external specialist reviewers.

The cost of the full-time project manager will include salary, other employment costs, office costs and travel costs. If he or she is seconded from a consultant, the employment costs would normally be multiplied by approximately 1.3 to cover head office costs and consultant's profits.

The cost of the consultants involved during the construction phase to supervise specialist works will cover attendance at site meetings, visits for inspections of the works at critical stages and full-time supervision of certain parts of the work.

The cost of the EIS will include public consultations and other meetings. The permitting process may be long, but it is not anticipated that a large amount of man-time will be involved.

The cost of monitoring activities has been included in the costs for the individual sites.

Table 4.2 gives the estimate of costs for project management for four years. The cost of the manager is for full-time involvement, and the cost for the supervising specialists is based on an assumption of 45 man-days per year plus expenses.

Table 4-2: Estimated costs of Project Management for four year period

DESCRIPTION	COST
Cost of external specialist reviewers	€20,000
Cost of project manager and local office	€400,000
Cost of supervisory involvement by specialist consultants	€200,000
Cost of EIS and permitting process	€80,000
Total	€700,000

5 REMEDIAL & MANAGEMENT WORKS FOR BALLYGOWN

Figure 5.1 gives a plan of the Ballygown area with the proposed remedial works indicated.

5.1 Access

There is doubt about the ownership of the Ballygown area, but the area to the east of the road, between the road and the Silvermines River has open access, and has been used by the local people for walking. A Village trail has been established at the north end. The area of the Waeltz plant Buildings and the Sulphur Mine is occupied by a farmer. The Village Field, immediately to the south of the School, appears to have public access.

It is proposed that access to the Village Field and the area to the East of the road is provided for use by local people and others, and that controlled public access be provided for the Sulphur Mine and the Old Waeltz Plant Buildings. These conditions of access apply to the sites after the completion of remedial works.

5.2 School Playing Field

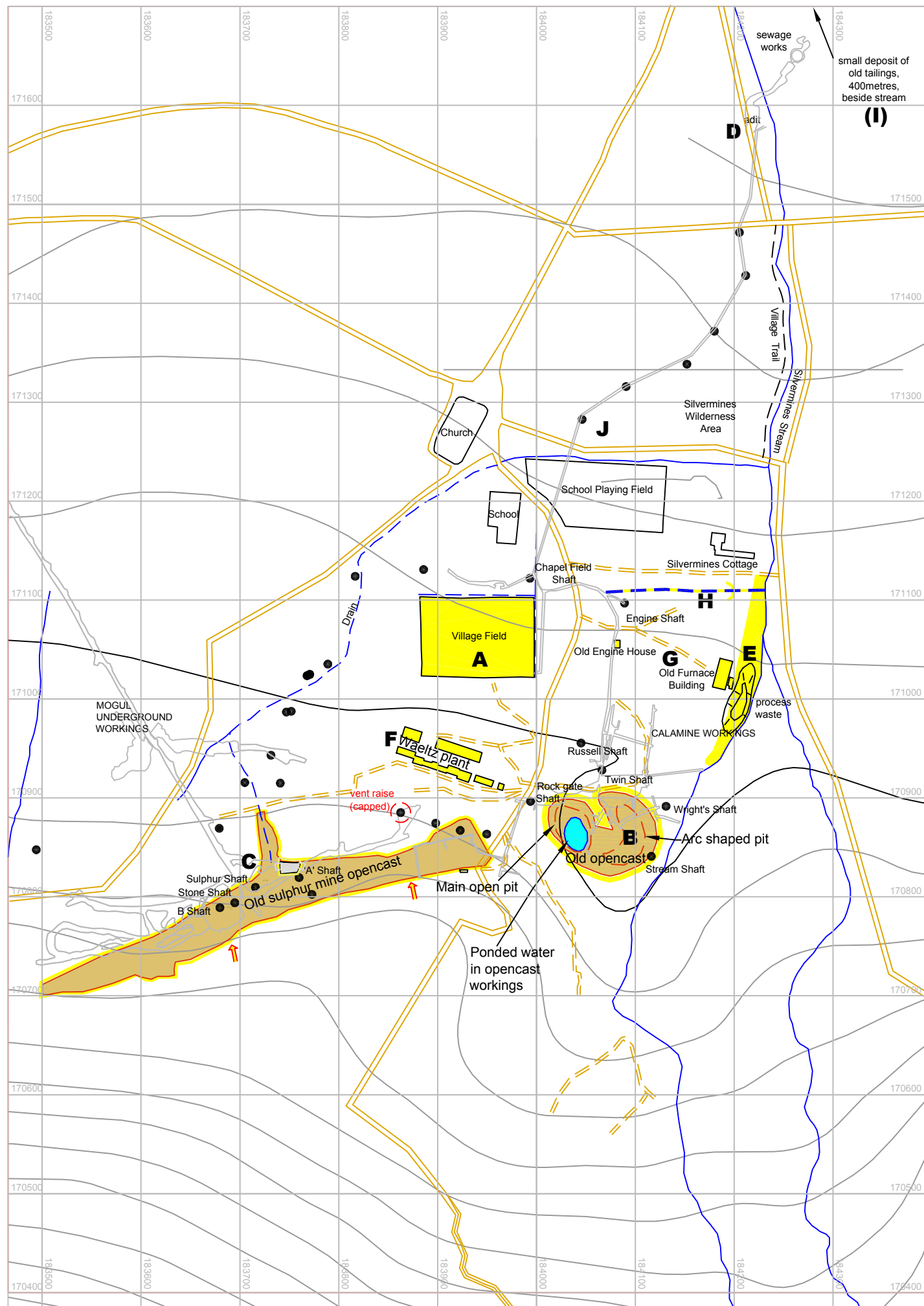
Remedial works were completed in 2001 and the area is now utilised for school sports.

5.3 Village Field

The Village Field has been levelled and provided with perimeter drains, for use as a sports field. The surface comprises waste rock gravels and the presence of lead and other metals in the surface soil render it unsuitable as a playing field. It is proposed that a limestone cover and a layer of soil be placed over the field, and planted with grass seed. The field will then be suitable for sports use, provided the surface is maintained.

5.4 Mine and process areas

The Ballygown area is of archaeological and heritage value. For that reason, only limited disturbance of the mine areas and the process spoil is envisaged. The re-shaping will be limited to measures designed to reduce the discharge of sediments to the Silvermines River, and to remove the danger posed by the pool in the Old Opencast.

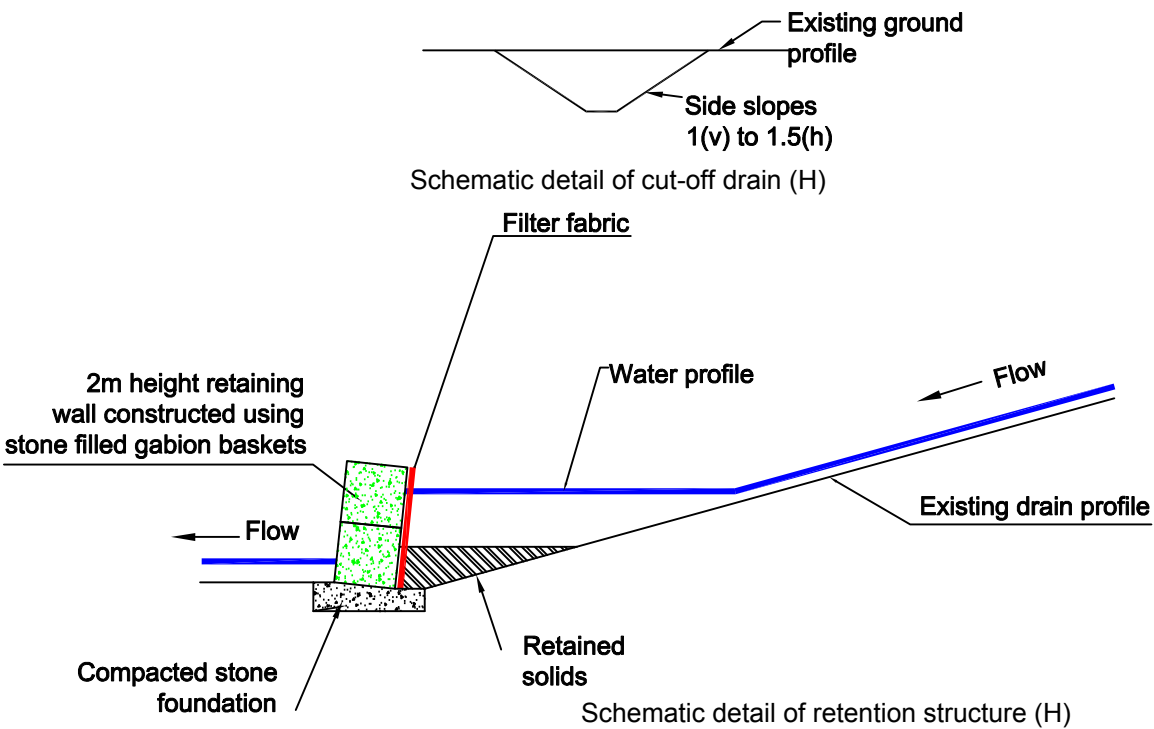


Notes.

DO NOT SCALE

KEY TO MAIN REMEDIAL WORKS

- A - Apply granular limestone capping, topsoil, grass to village field; improve drainage diversion channels.
B - Partial backfilling and reshaping of Old Opencast.
C - Backfill shafts, as required, but fence shafts serving drainage function; fence subsidence area, maintain existing pit fence.
D - Clear sediment from adit entrance and install sediment trap.
E - Install gabion streambank protection, remove small quantities of process waste to Gortmore TMF.
F - Demolish Waeltz plant buildings to window sill level and make safe. Fencing to be installed between upper and lower plant. Specialist removal of asbestos roof to designated site.
G - Conservation measures on Old Engine House and Old Furnace Building.
H - Cut-off drain and retention structure.
I - Fence old tailings deposits (position shown on Fig 2.1).
J - Drill pressure relief boreholes;



KEY		Surface subsidence	
	Road		Surface subsidence
	Track		Contours - 10m intervals
	Underground working		Shaft
	Adit		Mogul Shaft
	Surface working		Tips and dumps
	Stream		Existing fence
	Lagoon		Proposed fence
	Building		Existing drain
			Proposed drain
			Areas requiring remedial measures

Rvn	Rev. Date	Description	Drawn	Checked	Approved
A	13-11-01	Remedial works added	DW		
SRK Consulting Engineers and Scientists					
SRK CONSULTING WINDSOR COURT, 113 WINDSOR PLACE, CARDIFF, CF10 3BA, UK TEL: +44 (0) 2920 348190 FAX: +44 (0) 2920 348199 WEB SITE: WWW.SRK.CO.UK					
SILVERMINES Project No: U1606					
BALLYGOWN REMEDIAL WORKS Plan showing Ballygown, Calamine and Sulphur mine areas					
Originator: PB/IB			DRAWING No.:-		
Date Drawn: DEC_2001			FIG.5.1		
Scale: 1:5000					

5.5 **Opencast area**

The Old Opencast includes a small oval shaped excavation with a pool of water in its base and another shallower arc shaped excavation with some marshy areas at the base. It is intended that the oval excavation will be backfilled to a level sufficient to stop the ponding of water, and that there will be minor re-shaping of the area and re-vegetation. The backfill for the Old Opencast will be provided by the re-shaping earthworks and partial demolition of the Waeltz plant.

No remedial works are proposed for the arc-shaped pit.

5.6 **Sulphur Mine Pit**

The Sulphur Mine pit is on the Silvermines Fault, and the footwall on the south boundary of the pit exposes the face of the fault. The pit is grassed and, apart from the footwall, has gentle slopes. There are four shafts and two adits that will require various forms of attention. There are also indications of subsidence on the floor of the pit in the vicinity of Shaft A.

It is the intention to:

- Place a grill over the east adit entrance;
- Place a fence around the west adit;
- Backfill and re-vegetate the open shafts and fence them off;
- Fence the area of the pit floor at Shaft A where subsidence is apparent;
- Maintain the existing fence along the upslope crest of the pit.

5.7 **Ballygown shafts**

Many of the shafts outside the Sulphur Mine area are already backfilled. It is intended that those not yet backfilled will either be backfilled or, if they serve a drainage function as on the drainage adit through Silvermines Village, they will be fenced. Where necessary, pressure relief boreholes will be drilled.

5.8 **Underground mine**

There are various development tunnels at Ballygown, including a drainage adit. More extensive underground workings were mined under the Sulphur Mine. None of these are considered a subsidence safety hazard, and no remedial works are proposed.

5.9 Mine water discharges

The water from the adit at Ballygown and the water in the Silvermines River contain elevated metals in sediments. It is intended that the adit entrance will be cleared of sediment and a sediment trap installed. Sediment will also be removed from the river system as part of the regional plan.

The sediment trap at the entrance to the adit has been costed as a simple gabion structure.

5.10 Waste materials

Most of the Ballygown area is covered by thin deposits of mine and process wastes. In general, these are vegetated and stable but at the west bank of the Silvermines River are bare areas of old process waste, which erodes into the river after rain.

It has been noted that disturbance of the waste is undesirable from an archaeological viewpoint. The stream bank will be stabilised with gabions, and a small amount of waste may be removed to the Gortmore TMF waste disposal facility.

Run-off during rainfall results in silt containing elevated metals washing towards the Silvermines Cottage before discharging into the river. A collection trench and gabion silt trap will be installed to contain this material. This will require routine clearing and removal of sediment to the Gortmore TMF for a limited period.

To the north of Silvermines Village, to the east of the Silvermines River, are low deposits of tailings which are well-grassed and stable. Cattle deaths have been reported in the vicinity of these deposits. It is proposed that the tailings are fenced to restrict access.

5.11 Mine buildings

The Old Furnace Building and the Old Engine House are stone structures to be conserved. The Waeltz Plant Buildings are recent concrete and block structures, but they do have heritage value. There are three possible proposed alternatives for the Waeltz Plant Buildings. They can be demolished to leave walls below window level of one metre in height, they can be demolished to floor level providing a “footprint” of the structures for future heritage interest, or they can be retained in their entirety. In all cases it will be necessary to remove and dispose of the asbestos roofs. The preferred option is to leave walls of one metre height.

It is intended that concrete waste will be disposed and in the Old Opencast, and it is anticipated that there will be some additional residue for disposal elsewhere. If there is a remaining quantity, it will be placed at Magcobar, to be covered during the reshaping of Dump A.

5.12 **Costing of remedial works at Ballygown**

A summary of estimated costs for the remedial works at Ballygown is given in Table 5.1, and further information is in Appendix B. The rates used have been based on current UK rates for similar work and checked against local rates.

Table 5-1: Estimated costs, Ballygown

REF (FIG.5.1)	DESCRIPTION	COST
A	Granular limestone capping 200mm, topsoil 300mm and seeding to Village Field	€54,430
B	Partial backfilling and reshaping of Old Opencast (delivery of backfill included in Items E & F)	€8,050
C	Backfill Shafts, fence shafts and subsidence area, install pressure relief holes	€23,750
D	Gabion silt retention structure at Drainage Adit entrance plus clearance of adit and adit works.	€6,120
E	Gabion protection of Silvermines Stream bank and removal of small quantities of waste to disposal in Gortmore TMF.	€29,050
F	Demolish Waeltz Plant to one metre wall height, and dispose of rubble in mine shafts, Old Opencast and at Magcobar.	€40,530
G	Dispose of asbestos roof sheeting at designated site in Belgium (nominal sum assumed)	€32,200
G	Conservation measures for Engine House and Furnace Building (mainly repointing)	€15,460
H	Gabion silt retention structure above Silvermines Cottage	€6120
I	Fence old tailings to north of village and re-vegetate area	€2,415
	Signage	€3,220
Total		€221,345

INVESTIGATION AND DESIGN

Topographical Survey	€8,000
Site Investigation	€8,000
Archaeological investigation	€8,050
Contract Preliminaries	€22,475
Professional Fees (Design)	€22,475

Total Design and Construction Cost **€293,755**

MONITORING AND MAINTENANCE

Monitoring for four years	€26,700
Annual inspection and maintenance	€3,000

6 REMEDIAL & MANAGEMENT WORKS FOR MAGCOBAR

Figure 6.1 gives a plan of the Magcobar area with the proposed remedial works indicated.

6.1 Access

At present, the area is owned by the mining company, and there is no public access. Future controlled public access to certain parts of the Magcobar area is proposed as part of the development of a mining heritage trail.

6.2 Slope stability

There have been minor slips of the southern slopes of the Magcobar pit in the past, but future risks are not considered significant. It is proposed that the fences should be maintained and improved, and that public access to the pit itself should be prohibited.

6.3 Subsidence of underground workings

There is a small area of underground workings to the west of the pit. There is a low risk of subsidence occurring and no special measures are proposed.

There is an existing small sinkhole near the entrance to Magcobar which requires backfilling.

6.4 Deep water in pit

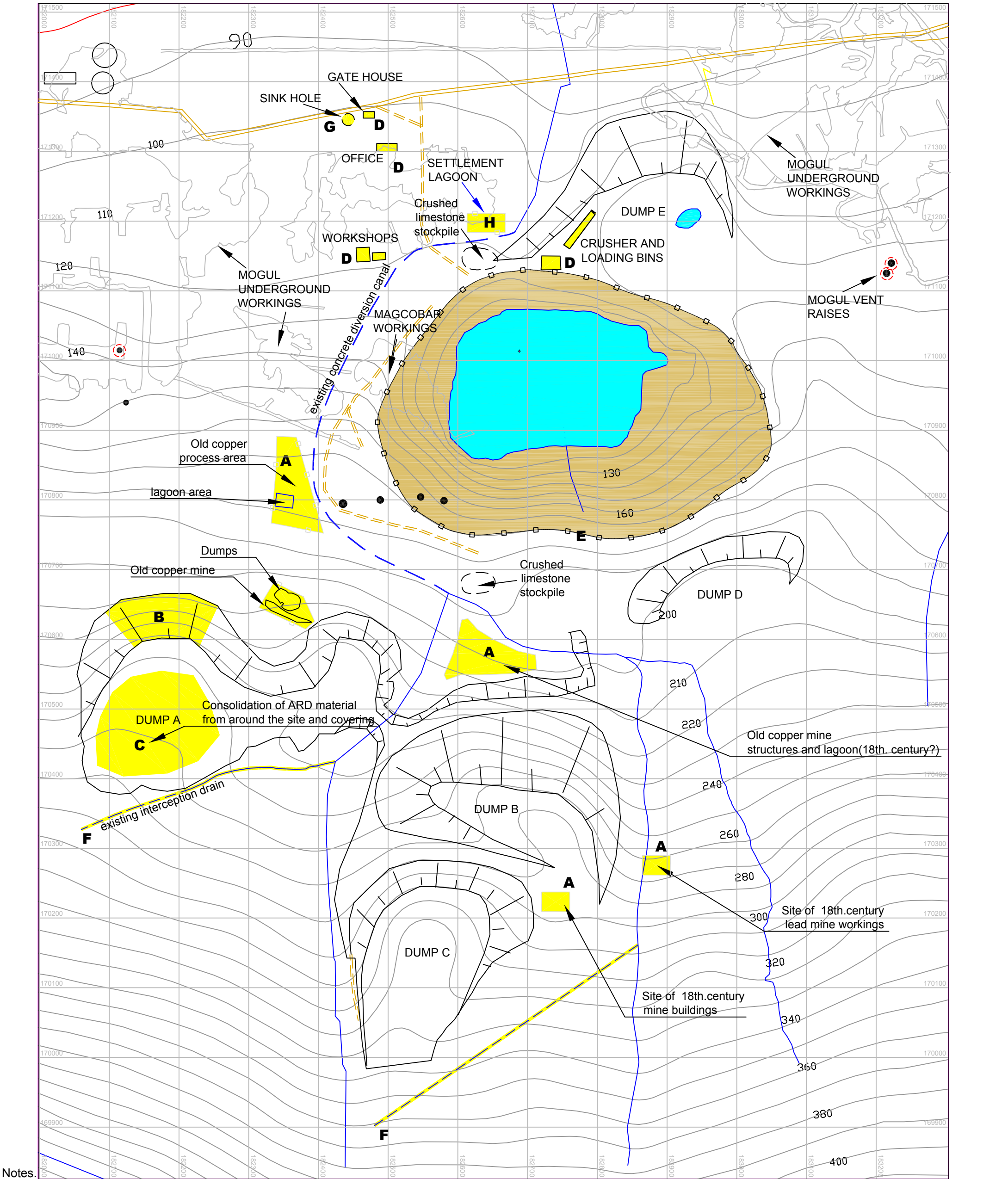
Maintenance of the fencing is proposed.

6.5 Contaminated pit water

The seepage of contaminated pit water is not assessed as a significant risk, but a further evaluation of pit chemistry is proposed. For the purpose of the costing of Table 6.1, three visits during the four year remediation period have been assumed, for depth sampling of water from a boat and laboratory testing.

6.6 Archaeological sites

The Magcobar pit and dumps have partly destroyed or covered old surface manifestations of previous lead and copper mines. Nevertheless, there remain certain workings, ponds and building foundations. It is intended that these will be protected by fences and signs, and investigated by mining archaeologists.



Notes.

DO NOT SCALE

Mine drawings were not available and detail has been taken from orthophotos. The plan is therefore schematic.

KEY TO MAIN REMEDIAL WORKS

A - Place fences and signs to protect mining archaeology sites.

B - Carry out minor reshaping and re-vegetation on dumps, particularly undercut section of Dump A.

C - Collect small surface deposits of sulphide rock, place at single location, cap and vegetate.

D - Remove existing buildings and crushers (Possible retention and utilisation of workshop building.)

Backfill small lagoon on Dump E and re-vegetate area.

E - Minor works to pit perimeter fence (replace 200m and repair remainder.)

F - Minor maintenance of drains.

G - Backfill sinkhole.

H - Fence and maintain settlement lagoon.

KEY

	Road		Surface subsidence
	Track		Contours - 10m intervals
	Underground working		Shaft
	Mogul Shaft		Tips and dumps
	Surface working		Existing fence
	Stream		Proposed fence
	Lagoon		Existing drain
	Building		Proposed drain
			Areas requiring remedial measures

Rvn No:	Rev. Date:	Description	Drawn	Checked	Approved

SRK Consulting
Engineers and Scientists

SILVERMINES Project No: U1606

MAGCOBAR REMEDIAL WORKS
Plan showing Magcobar Pit Waste Dumps and Buildings

Originator: PB/IB	DRAWING No.: FIG.6.1
Date Drawn: DEC_2001	
Scale: 1:5000	

CAD_REF:- D:\Graphics\U1606\Phase 2\U1606_12.dwg

6.7 Visual impact of waste dumps

The Magcobar waste dumps are visible for a considerable distance, though their appearance has been softened by the vegetation, which has become naturally established. It is proposed that minor reshaping and vegetation works will be carried out. It is proposed that limestone from Magcobar dump A be crushed and used for various remedial works. This will be done using a mobile crushing plant and the source of material will be integrated with improvement works to the dumps.

6.8 Waste dump stability

The dumps are granular and free-draining. Stability can be ensured by maintenance of the stormwater diversion channels and the streams. The indiscriminate excavation of material at the toe of Dump A must cease, and minor remedial earthworks be carried out.

6.9 Excavation of lime from waste dumps for use in remedial works

It is intended that limestone from Dump A will be used in remedial works at various locations. This will involve excavation from the dump, crushing and transportation to the site where the limestone is to be placed. The management and scheduling of this work, and the final rehabilitation of Dump A will form part of the design for Magcobar. The utilisation of limestone will be in years two and three, and the final rehabilitation of Dump A will take place in year four.

6.10 Sulphides and oxidation products from waste dumps

There are small quantities of sulphide waste on the tops of the waste dumps which result in ochre staining and small flows of acidic water (dumps C and A). There are probably other deposits within the dumps, but these are partly protected by their encapsulation and are not considered to be a similar problem.

The exposed deposits of sulphide waste will be gathered into one area on the top of an existing waste dump, covered with a layer of limestone and a layer of topsoil and vegetated. Surface run-off will be diverted around this encapsulated volume.

6.11 Mine buildings and other surface structures

The existing mine buildings consist of a dilapidated prefabricated office building, a gate-house a steel frame, steel clad workshop and core shed buildings in good condition. There is also a crusher and loading bins and a diesel storage tank.

It is proposed that the office building, the gate-house, the crusher and bins and the diesel tank will be demolished and removed to an off-site disposal facility, with parts sold as scrap where feasible. The workshop buildings will be re-used for agricultural or other purposes but, if no such future use can be found, they will be demolished. The lagoon on top of Dump E will be backfilled and re-vegetated.

6.12 Settlement lagoons north of open pit

The settlement lagoons to the north of the open-pit, which discharge into the stream, will be fenced and maintained.

6.13 Costing of remedial works at Magcobar

A summary of estimated costs for the remedial works at Magcobar is given in Table 6.1, and further information is in Appendix B. The final costs of rehabilitation of Dump A are included in the Table, but the costs associated with the excavation and crushing of limestone from the dump for use in rehabilitation elsewhere are included in the costs for the sites where the limestone will be placed.

Table 6-1: Estimated costs, Magcobar

REF (Fig.6.1)	DESCRIPTION	COST
A	Fence mining archaeological areas	€8,840
B1	Minor earthworks to area of undercut slope, Dump A, and minor reshaping of Dumps.	€29,980
B2	Topsoiling and re-vegetation of dumps as required (assumed 5000m ²)	€24,890
C	Consolidate small sulphide deposits, cover and seed	€13,770
D	Demolish buildings and crusher and remove to off-site disposal site (possible retention of Workshop Buildings for alternative use) and backfill lagoons on Dump E	€13,497
E	Minor works to pit perimeter fence (replace 200m and repair remainder).	€12,120
F	Minor works on existing drains	€4,030
G	Backfill small sinkhole	€740
H	Fence and maintain	€700
Total		€108,567

INVESTIGATION AND DESIGN

Topographical Survey	€8,000
Site Investigation	€8,000
Archaeological investigations	€8,050
Study of pit water chemistry	€25,000
Contract Preliminaries	€10,570
Professional Fees (Design)	€10,570

Total Design and Construction Cost **€178,757**

MONITORING AND MAINTENANCE

Monitoring for 4 years	€26,700
Annual inspection and maintenance	€3,000

7 REMEDIAL & MANAGEMENT WORKS FOR GARRYARD

Figure 7.1 is a plan of the Garryard area showing the proposed remedial works.

7.1 Access

The Garryard Plant area has been sold to a local contractor, who is using it as a transport depot. The hard-standing to the West of the plant area has been extended by the deposition of waste and scrap materials, and various changes are being made to the old plant buildings.

The old hostel building is on land owned by a farmer, and is now his property. The building is derelict and without a roof.

The Old Stockpile area has been sold to a farmer, who is carrying out surface works to restore the area to pasture.

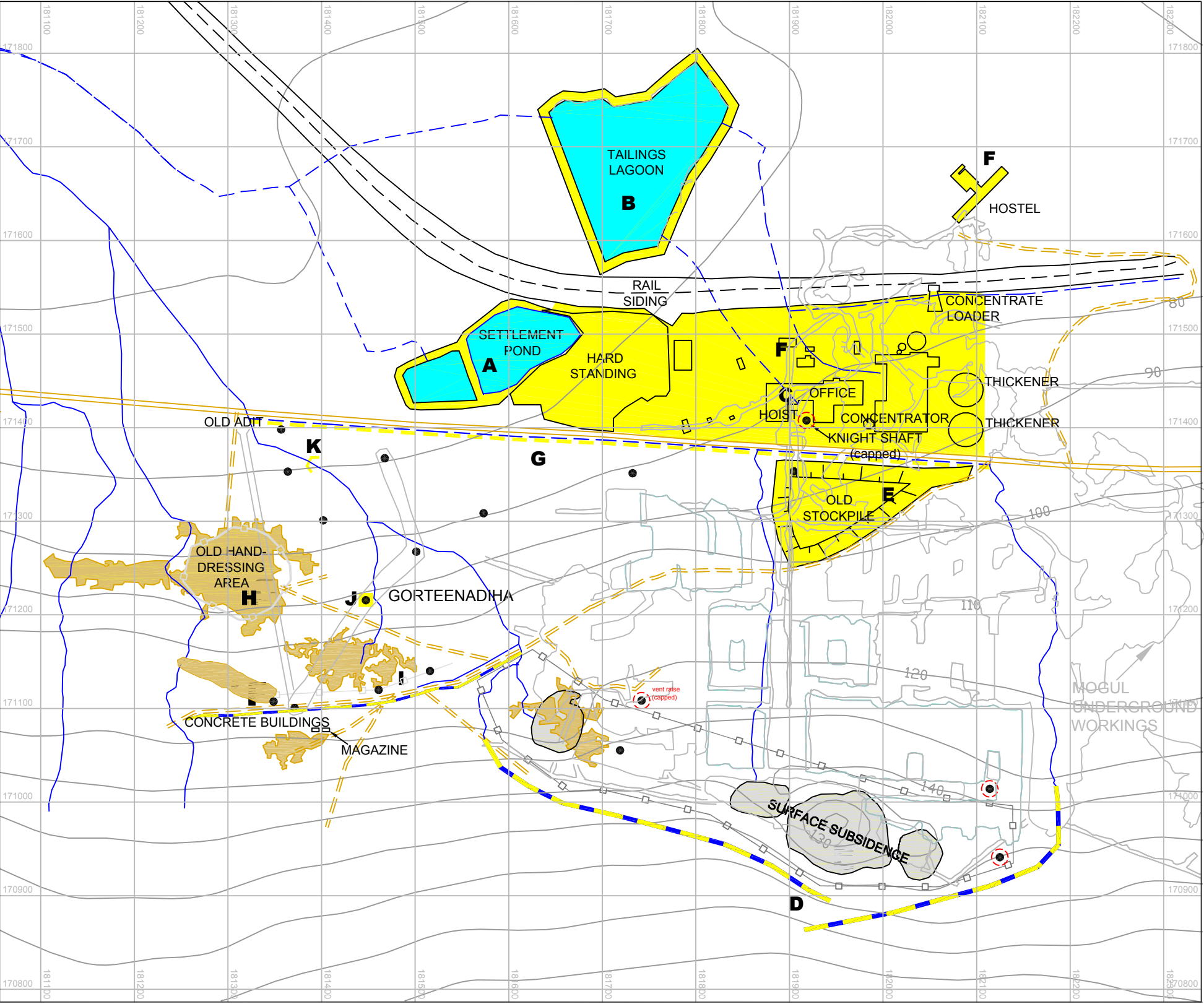
7.2 Settlement pond

The settlement ponds receive run-off from the Garryard Plant area. They consist of one large pond spilling into a second pond, which discharges to a stream over a weir. It is intended that the ponds will continue to function as holding ponds for plant area run-off, and that minor works will be carried out to tidy the first pond and encourage the development of a wetland. This will not be a designed wetland, and no works will be carried out on the second pond.

The existing fence will be repaired and maintained.

7.3 Tailings Lagoon

The Tailings Lagoon contains deposits of process waste, and the water quality in this lagoon is poor. The sediment contains very high levels of metals. It receives water from the plant area and water from the underground workings issuing from the Knight Shaft. It is intended that the deposits of process wastes will be excavated and placed in an engineered facility on the Gortmore TMF. A designed wetland will then be constructed within the Tailings Lagoon area, with all clean surface run-off diverted around the facility. The size and nature of the wetland will depend on the volume and quality of the water discharged to it, which can only be determined after excavation of the process waste. For the purpose of the present conceptual design, assumptions have been made about the required size and treatment. The remaining area previously covered by waste will be covered with limestone chippings and topsoil. Figure 7.2 shows a conceptual system of sequential ponds.

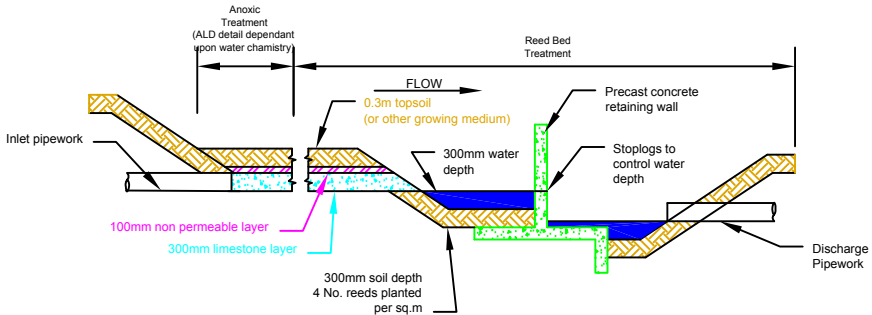


Notes.

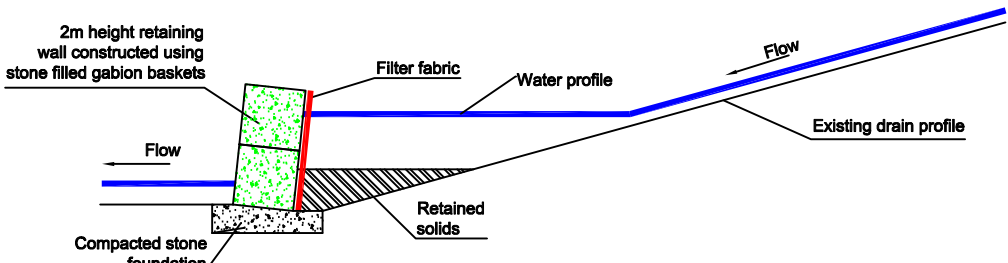
DO NOT SCALE

KEY TO MAIN REMEDIAL WORKS

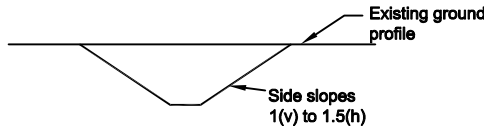
- A - SETTLEMENT PONDS - Maintain ponds and decant system as natural wetland
- B - TAILINGS LAGOON - Remove tailings to Gortmore TMF, reshape lagoon, and establish wetland (see below)
- C - KNIGHT SHAFT - Maintain discharge flow to Tailings Lagoon area
- D - SUBSIDENCE ZONE - Repair and maintain existing fence. Install diversion trench.
- E - OLD STOCKPILE - Remove contaminated dumped material to Gortmore TMF, level, cap and re-vegetate
- F - PLANT AREA - (now used for transport depot) Profile and cover unsurfaced areas; carry out landscaping works; remove hostel building
- G - DIVERSION DRAIN ALONG ROADSIDE - Repair and maintain drainage system (possible culvert to settlement pond).
- H - GORTEENADIHA CONSERVATION - Protect mining archaeology sites with fence and signs.(Actual position of fence to be determined by archaeologist.)
- I - GORTEENADIHA - Fence existing road and install drain.
- J - OPEN SHAFT - Fence around perimeter of shaft (not to be backfilled).
- K - RETENTION STRUCTURE - Construct gabion sediment trap.



Schematic section through proposed wetland (B)



Details of Retention structure (K)



Details of drainage ditch

KEY

- Road
- Track
- Underground working
- Surface working
- Stream
- Lagoon
- Building
- Surface subsidence
- Contours - 10m intervals
- Shaft
- Mogul Shaft
- Tips and dumps
- Existing fence
- Proposed fence
- Existing drain
- Proposed drain
- Areas requiring remedial measures

Rvn No:	Rev. Date:	Description:	Drawn:	Check:	Appd:
A					

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SILVERMINES

GARRYARD REMEDIAL WORKS
Plan showing Garryard Plant and Lagoons,
Subsidence zone and Gorteenadiha workings

Originator: PB/IB

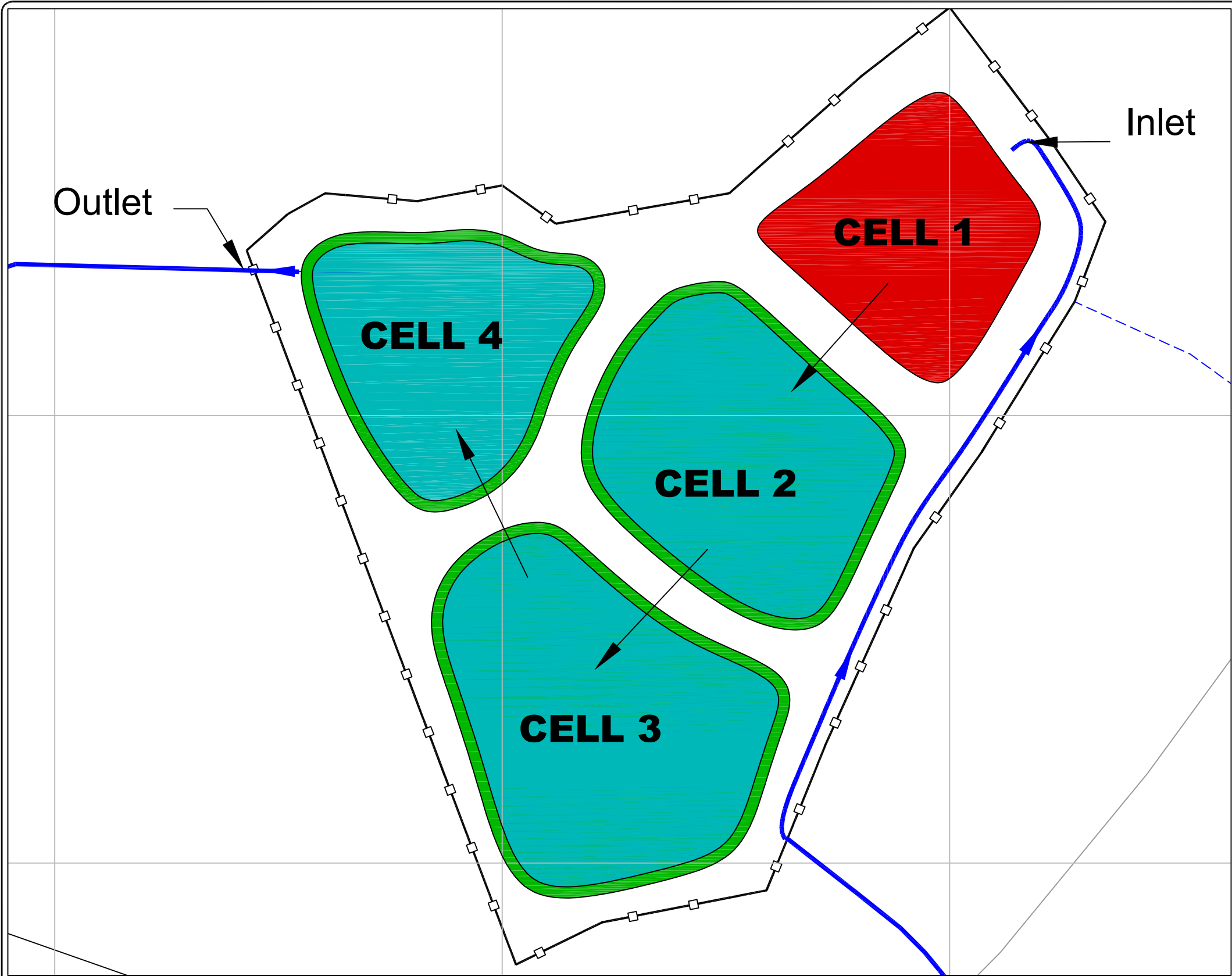
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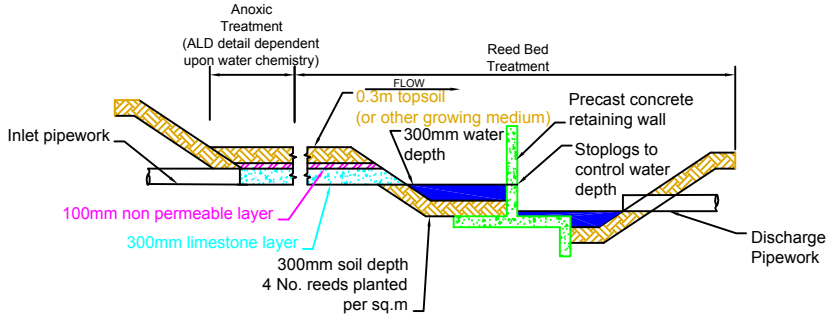
FIG.7.1



Notes.

DO NOT SCALE

1. Actual layout is dependent upon water chemistry




Schematic section through proposed wetland

KEY

- Anoxic Limestone Drain
- Reedbed Treatment
- 1 in 1.5 slopes
- Flow
- Fence

Rvn No:	Rev. Date:	Description	Drawn	Checked	Approved



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SILVERMINES		Project No: U1606
GARRYARD WETLAND TREATMENT Plan showing conceptual design		
Originator: PB/IB	DRAWING No.:-	
Date Drawn: DEC_2001	FIG.7.2	
Scale: 1:5000		

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7.4 Main Garryard Shaft, the Knight Shaft

The Knight Shaft, beside the old Hoist Building, has a concrete capping and a discharge pipe. Water flows from this pipe after rain but, for much of the year, no water issues from the shaft. The water is led to the Tailings Lagoon.

No change is to be made to the present arrangements, but an explanatory sign will be erected to ensure that the shaft and its discharge system is protected.

7.5 Other Mogul shafts

The following additional Mogul shafts have been identified:

- Vent shaft above the Waeltz Plant, Ballygown (capped);
- Two vent shafts to the east of the Magcobar pit (not located);
- Two vent shafts to east of subsidence zone, Gorteenadiha (not located);
- Vent shaft to west of subsidence zone, Gorteenadiha (capped).

It is understood from the owner that all the Mogul shafts were capped. It is intended that the condition of the tops of these shafts will be ascertained, and remedial measures undertaken as necessary.

7.6 Subsidence of Mogul underground mine

The large sinkholes over the stopes beside the Silvermines Fault have been fenced. There will be no significant development of the subsidence zone to the south, at the fault, because the workings do not extend beyond the fault. Similarly, the existing subsidence covers the full east-west extent of the workings next to the fault, and will not progress further. To the north, there may in the future be some further subsidence (Fig.9.2, Phase II report). However, as the land is used only for grazing, no special precautionary measures are proposed, other than routine inspections. It is not anticipated that sudden sinkhole formation will occur, because of the depth of the workings and the amount of underground backfill, but that visible surface settlement will give prior indication of future subsidence.

The adequacy of the existing fencing will be assessed. Repairs and extensions to the fencing will be carried out as required. For the purpose of the conceptual design a nominal allowance has been made for extensions and repairs.

A topographical survey will be carried out, and surface drains will be installed to divert run-off around the subsidence zone. This measure is required because the uncontrolled ingress of water facilitates the development of subsidence.

7.7 Production of sulphides and oxidation products in the water from the Mogul underground mine

The discharge from the underground workings is from the Knight Shaft. As explained in Section 7.4 above, this water will be discharged to a wetland constructed within the Tailings Lagoon area.

7.8 Garryard Old Stockpile

The Old Stockpile contains deposits of process residues, ore and scrap. This material will be excavated. The contaminated soil and rock waste will be placed on the Gortmore TMF, and the scrap will be taken off-site for disposal on a designated waste disposal site. A layer of imported soil will then be placed on the Old Stockpile area and grassed, to restore the area to pasture. Minor works will be carried out to ensure the integrity of the surface drainage system, which includes a channel along the road and a small natural water course.

7.9 Garryard Mine buildings at the plant site

The remaining plant buildings include steel-frame steel-clad Concentrator, Office and Hoist Buildings, two old farm cottages pre-dating the mine and several other small mine buildings.

There has been a change of usage, with the site now used as a transport depot. The following process is proposed:

- (a) Preparation of schedule of remedial works;
- (b) Preparation of specification for allowable usage;
- (c) Removal of derelict Hostel building;
- (d) Preservation of old farm cottages;
- (e) Re-profiling and covering of unsurfaced areas;
- (f) Landscaping works.

7.10 Mogul Shafts

Ventilation shafts associated with the Mogul workings appear to have been capped with a concrete cover. The details of capping are not known, but an allowance must be made for locating all shafts and capping or fencing where necessary.

7.11 Costing of remedial works at Garryard

A summary of estimated costs for the remedial works at Garryard is given in Table 7.1, and further information is in Appendix B.

Table 7-1: Estimated costs, Garryard

REF (Fig.7.1)	DESCRIPTION	COST
A	Settlement Ponds – Minor works to pond and decant system for natural wetland, maintain fence	€5,880
B	Tailings Lagoon – Remove tailings to Gortmore TMF, reshape lagoon and establish wetland	€676,110
C	Knight Shaft, maintain discharge flows to Tailings Lagoon area (no cost)	£0
D	Subsidence Zone – Repair and maintain existing fence, install diversion trench	€16,180
E	Stockpile Area – Remove dumped material to Gortmore TMF, level Old Stockpile area, cap and re-vegetate	€212,060
F	Plant Area – Remove waste materials, remove hostel building, conserve old farm cottages, profile and cover unsurfaced areas, carry out minor landscaping	€52,580
Total		€962,810

INVESTIGATION AND DESIGN

Topographical Survey	€8000
Site Investigation	€32,200
Contract Preliminaries	€96,281
Professional Fees (Design)	€96,281

Total Design and Construction Cost **€1,195,572**

MONITORING AND MAINTENANCE

Remove sediment every 20 years: present day cost	€8,000
Monitoring for four years	€26,700
Annual inspection and maintenance	€3,000

CONTINGENCIES

Contingency for hazardous waste disposal	€354,200
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NOTE: The contingency amount for hazardous waste disposal is additional to the allowances within items B and E, and is considered necessary at the present conceptual stage because of lack of reliable information about total volumes and disposal areas.

8 REMEDIAL & MANAGEMENT WORKS FOR GORTEENADIHA

Figure 7.1 gives a plan of the Garryard area with the proposed remedial works for Gorteenadiha indicated.

8.1 Access

The Gorteenadiha workings are on a farm property, and there is no public right of access. Unauthorised access on foot is very easy, however, as there is an open track from the main Silvermines road. It is proposed that this access be closed with a fence, and that future access be restricted.

8.2 Drainage system along road

The drain along the south side of the main road extends from the Garryard Old Stockpile to the culvert taking the Gorteenadiha stream under the road to the Yellow River. The purpose of this drain has been to lead run-off past the Garryard Plant site.

A sum has been allowed for the repair and maintenance of this system, and an additional contingency sum has been allowed for the possible future diversion of water to the Settlement Pond, involving a new culvert. The purpose of this possible diversion would be to detain water from Gorteenadiha which may be contaminated, and the need for such measures will only be known after monitoring of the system.

8.3 Gorteenadiha Mining Heritage

The archaeological inspection revealed mining remains, particularly in the hand-dressing area, which are valuable and which have not been investigated or catalogued. It is necessary to protect these remains for archaeological study, and it is intended that the areas will be fenced with 3-strand barbed wire and that information signs will be erected. The danger is not of vandalism but of disturbance occurring through ignorance.

The existing building structures, which are an intact magazine and the floor and columns of an accommodation for soldiers guarding the explosives, will be conserved. No remedial works are required.

8.4 **Gorteenadiha waste dumps**

The waste dumps are small and scattered, but only partly vegetated and often waterlogged. They discharge sediment-laden water to the streams. A system of surface drainage control will be designed and a small gabion retention structure will be constructed to retain silt. This structure will be important during the execution of the remedial works, and subsequently, while vegetation is being established. The proposed works will be submitted to a mining archaeologist for approval, to ensure that there is no disturbance of valuable heritage areas. Fencing and information signs will be erected to prevent public access to sensitive areas.

8.5 **Gorteenadiha underground and surface workings**

The Gorteenadiha underground and surface workings, including shafts, adits and pits, represent a danger to humans and livestock. There are no available plans of the underground workings, though their approximate positions can be gauged from the known positions of shafts (See Fig.7.1). There is also known to be an old adit, presumably for drainage, running south-north but the entrance was not visible during the field inspection.

Most of the shafts appear to be backfilled although some are open. These need to be accurately located, backfilled and fenced where necessary.

Fencing and information signs will be erected. The system of surface drainage control will include the area of the workings.

8.6 **Costing of remedial works at Gorteenadiha**

The costs for Gorteenadiha are summarised in Table 8.1 and further information is in Appendix B.

Table 8-1: Estimated costs, Gorteenadiha

REF (Fig.7.1)	DESCRIPTION	COST
G	Diversion drain along roadside – Repair and maintain drainage system.	€11,750
H	Gorteenadiha Conservation – Archaeological investigation and conservation	€10,470
I	Gorteenadiha – fence existing Cromwell’s road and install drain	€7,360
J	Gorteenadiha Open Shaft – Fences or backfill	€3,220
K	Gorteenadiha sediment retention structure – gabion wall	€7,890
Total		€40,690

INVESTIGATION AND DESIGN

Topographical Survey	€8,000
Site Investigation	€8,000
Contract Preliminaries	€4,070
Professional Fees (Design)	€3,050

Total Design and Construction Cost **€63,810**

MONITORING AND MAINTENANCE

Monitoring for four years	€26,700
Annual inspection and maintenance	€3,000
Removal of sediment every 20 years: present day cost	€3,220

CONTINGENCIES

Contingency for surface water diversion (Section 8.2)	€24,150
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9 REMEDIAL & MANAGEMENT WORKS FOR SHALLEE SOUTH/EAST AND SHALLEE WEST

Figure 9.1 gives a plan of the Shallee South/East area with the proposed remedial works indicated. Shallee South/East consists of surface workings, underground workings, various historic mine buildings, plant structure bases, a reservoir, waste dumps and tailings impoundments.

During the present assessment of the mining archaeology and the tourist potential, it was concluded that, although the mining heritage of Shallee South/East, and indeed of the entire Silvermines area, is of great value to Ireland and the local community, the potential for a large-scale tourist development is limited, because the site is not directly on a major tourist route. It is proposed, therefore, that the Shallee South/East site should be conserved and made accessible to the public within certain limits of expenditure, but that no extensive tourist facilities should be constructed. This action would allow a review of the situation in the future, should the tourist potential alter.

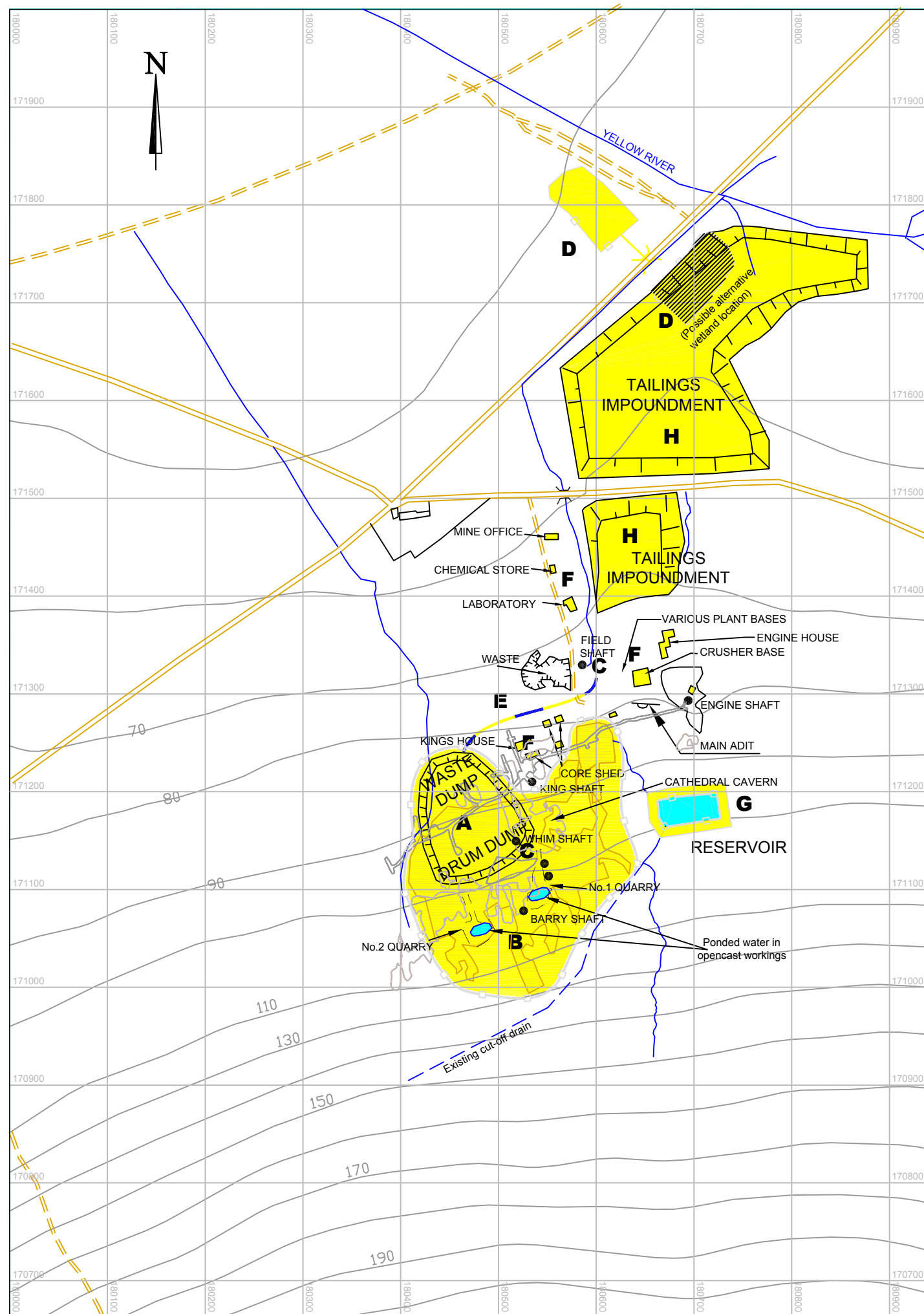
9.1 Feasibility Study for Mining Heritage Centre

This site has been proposed by Shannon Development as a Mining Heritage Site, and work has been carried out by others on the nature of this development, including layouts of tourist facilities and approximate costings. Although this option has not been adopted as the preferred option, the estimated costs are of interest for comparison to those of the preferred option.

The feasibility study of September 1994 by Brady Shipman Martin Architects, Mayday Marketing Ltd., Tourism and Leisure Consultants and Michael Punch and Partners, Consulting Engineers, proposed an underground tour, a substantial visitor centre, interpretative exhibits, and the conservation and repair of the various buildings and other structures. The projected lower scale of costs, increased by 20% for inflation since 1994, was estimated as follows:

Visitor Centre Building	€1,550,000
Site works and services (underground and surface)	€ 550,000
Interpretation (mine, site, centre)	€ 620,000
TOTAL	€2,720,000

Additional options could increase the cost by €480,000.

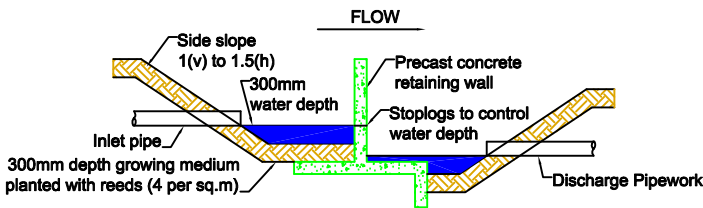
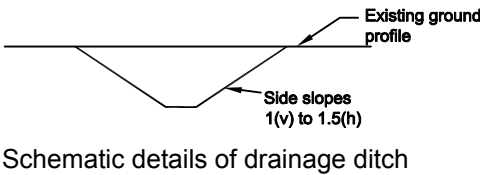


Notes.

DO NOT SCALE

KEY TO MAIN REMEDIAL WORKS

- A - DRUM & WASTE DUMP - Remove waste from Drum and Waste Dump, from old opencast and other areas, and dispatch to designated disposal area, reshape surface and re-vegetate.
- B - UNDERGROUND MINE AND MINE PITS - Conserve for heritage purposes and make safe with perimeter fence. Remove rubbish from pit lakes, and dispatch to designated disposal area.
- C - OPEN SHAFTS - Fence Field shaft; improve grill on Whim shaft. Treat other shafts as appropriate.
- D - WETLAND - Establish wetland for treatment of streamflow from Shallee South/East.
- E - DRAINAGE DIVERSIONS - Install diversion trenches to stream near Kings House.
- F - SURFACE STRUCTURES - Conserve Engine House, Kings House, and other mine structures in accordance with heritage plan.
- G - RESERVOIR - Install fence.



KEY

Road

Track

Underground working

Surface working

Stream

Lagoon

Building

Surface subsidence

Contours - 10m intervals

Shaft

Tips and dumps

Existing fence

Proposed fence

Existing drain

Proposed drain

Areas requiring remedial measures

Rvn No:	Rev. Date:	Description:	Drawn:	Checked:	Approved:
<div><div> SRK Consulting Engineers and Scientists</div><div>SRK CONSULTING WINDSOR COURT, 10 WINDSOR PLACE, CARDIFF, CF10 3BX, UK TEL: +44 (0) 2920348150 FAX: +44 (0) 2920348199 WEB SITE: WWW.SRK.CO.UK</div></div>					
SILVERMINES Project No: U1606					
SHALLEE REMEDIAL WORKS Plan showing Shallee South/East mine area					
Originator: PB/IB		DRAWING No.:-			
Date Drawn: DEC_2001		FIG.9.1			
Scale: 1:5000					

CAD REF:- D:\Graphics\U1606\Phase 2\1606_14.dwg

9.2 Access

At present, Shallee South/East is a mine property. An investigation of ownership is being carried out for DMNR by others. Access by livestock and public is not controlled.

9.3 Toxicity of ponded water in opencast areas

There is ponded water in parts of the opencast areas. No direct action is proposed to deal with the possible toxicity of this water, but all water leaving the site is to be treated in a wetland (dealt with in a later sub-section).

9.4 Scrap and waste in opencast

45 gallon drums, steel cable and other miscellaneous scrap has been deposited in the opencast pits. This will be removed to a designated dump off-site.

9.5 Safety of ponds and rock faces, opencast pits and trenches

Fencing and signs will be erected.

9.6 Shafts

The Whim vent shaft has a grill, which requires improvement to make safe, but it is intended that visitors will be able to look down this shaft. The Field Shaft is a conduit for mine water, and is effectively a spring. This shaft will be fenced. Other shafts and adit entrances will be treated as appropriate to the proposed conservation of the area.

9.7 Underground mine subsidence, collapse and rock falls

It is anticipated that part of the underground workings will be made accessible to the public. A geotechnical assessment of the safety of these areas has previously been made. The surface above the workings will be fenced as necessary, and access will be controlled in accordance with the proposed development as a heritage site.

9.8 Underground safety – drowning, rock falls

Access to the workings will be controlled as part of the heritage development.

9.9 Sulphide and oxidation products from the underground workings

Surface water will be diverted around the mine area. Water issuing from the mine out of the Field Shaft will be discharged to a proposed wetland for retention and treatment before entering the Yellow River. This wetland will be to the north-west of the northern tailings impoundment, and the water from Shallee South/East will enter this wetland via a culvert under the tar road.

An alternative site for a wetland is at the northern end of the northern tailings facility but the elevation and size needs survey before it can be considered. This site would remove the need to construct a culvert under the road.

9.10 Tailings dust

The tailings impoundments to the south and north of the road are well-vegetated, and the generation of significant quantities of dust is not anticipated. Some areas require attention to vegetation. Livestock access will be prevented, public access will be controlled and the establishment and maintenance of vegetation will be encouraged.

9.11 Tailings stability

The risk of instability is low, and no action is required.

9.12 Tailings leachate and tailings erosion

The production of contaminated leachates and the discharge of sediment to the natural stream will be managed by livestock and public access controls, by surface drainage controls and by establishment of vegetation. The run-off from the tailings impoundments will be discharged to a wetland (9.9 above) for treatment before release to the Yellow River.

9.13 Waste dumps –mine waste

No action is required to stabilise or remove the small volumes of mine waste generated from the Shallee Mine which are spread over the site. They are stable and covered in natural vegetation.

9.14 Waste dumps – scrap and process wastes (Drum Dump etc.)

The scrap comprises drums, steel cable and general scrap, mixed with ore process waste and waste ore. The ore process waste and waste ore will be segregated from the scrap and taken to the Gortmore TMF.

The scrap will be removed to an off-site designated disposal area.

9.15 **Mine buildings and Plant Site**

All the mine buildings and surface structures are to be conserved. In the case of structures such as the concrete plant bases, no action is required apart from trimming of reinforcing steel and protruding bolts to make safe. The old engine house requires minor works such as repointing to prevent further deterioration, but it is not proposed that it will be completely restored. Other buildings require works to prevent further deterioration and, where a specific use is proposed, to carry out restoration. The following procedure is proposed:

- (a) Preparation of schedule of conservation for all surface structures and their restoration needs;
- (b) Execution of conservation measures and landscaping.

For the purpose of costing the conceptual design, a nominal sum has been allowed for the full restoration of King's House, and for works to prevent further deterioration of other structures.

9.16 **Water reservoir**

It is intended that the existing water reservoir will be maintained and fenced.

9.17 **Shallee West**

The remaining surface manifestations of mining at Shallee West are surface trenches and small deposits of the excavated waste.

There is some ponded water in the trenches. Remediation will comprise the fencing of the deeper trench areas for safety and limited backfilling of the waste piles into the open pits as considered necessary.

9.18 **Costing of remedial works at Shallee South/East and Shallee West**

A summary of estimated costs for the remedial works at Shallee South/East and Shallee West is given in Table 9.1, and further information is in Appendix B.

The cost of €1,231,649 may be compared to the cost of €2,720,000 estimated for the full development of a heritage site (Section 9.1). The major difference is in the cost of the visitor centre (€1,550,000), which is included in the cost for the full

development, but not in the cost for the preferred option.

Table 9-1: Estimated Costs: Shallee South/East and Shallee West

REF (Fig.9.1)	DESCRIPTION	COST
A	Drum and Waste Dump – remove to designated disposal area off-site, reshape surface and re-vegetate	€168,420
B	Underground Mine and Mine Pits – Conserve for heritage purposes and make safe with perimeter fence. Remove rubbish from pit lakes.	€47,640
C	Open shafts – Fence Field Shaft, improve grill on Whim Shaft, treat other shafts as appropriate. (assumed four shafts at €3,220 per shaft)	€6,640
D	Wetland – Install wetland to north-west of tailings impoundment.	€483,000
E	Drainage diversions – Install diversion trenches to stream near King’s House.	€1,810
F	Surface structures – Conserve Engine House, King’s House and other structures in accordance with heritage plan (nominal sums)	€305,900
H	Tailings surface drainage and vegetation	€12,080
I	Shallee West backfill and fencing	€9,260
G	Reservoir fence	€4,200
Total		€1,038,950

INVESTIGATION AND DESIGN

Topographical Survey	€8,000
Site Investigation	€8,000
Archaeological investigation	€8,050
Contract Preliminaries	€99,459
Professional Fees (Design)	€77,240

Total design and Construction Cost	€1,239,699
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MONITORING AND INSPECTION

Monitoring for 4 years	€26,700
Annual inspection and maintenance	€3,000
Wetland clean out after 20 years (present day cost)	€8,000

10 REMEDIAL & MANAGEMENT WORKS FOR GORTMORE TMF

Figure 10.1 gives a plan of the Gortmore TMF area with the proposed remedial works indicated. There were large dust blows from the TMF in the 1980s. However, since that time, the surface of the impoundment has been vegetated, and there have been no recurrences of these major dust blows. Dust from Gortmore TMF is considered by the local community to remain a major problem, however.

The potential contamination of the groundwater by seepage from the TMF was investigated and reported in Phase II.

Although there is some evidence of contamination, levels of metals are not a cause for concern. Future evaluation of groundwater quality may require restrictions on use of groundwater for certain purposes immediately downstream of the TMF.

10.1 Access

The Gortmore TMF has been sold by Mogul to a farmer, who commenced to graze sheep on the surface, and to construct a ramp at the northern corner. Tipperary North County Council issued an instruction to remove the ramp and restore the tailings impoundment to its previous state at that point. This has been done. The Council also ordered the farmer to remove livestock from the impoundment, and he has complied.

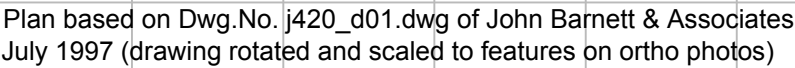
There is no public access to the Gortmore TMF.

10.2 Tailings dust








Although there is a low risk of a significant dust blow at present, there is a potential high risk for the future if vegetation is not maintained.

Poorly-vegetated areas have been identified. Additional growth medium will be applied to these areas, and re-vegetated. The successful vegetation windbreaks at the crest of the slopes will be extended, and a tree screen will be planted at the bottom of the outer slopes.

The crests of tailings dam slopes are a major source of dust when the dams are not vegetated. The establishment of crest vegetation has proved to be very effective in reducing dust, even in situations where the surface of the dam is not well-vegetated. This is because the crest vegetation traps dust emanating from the upper surface of the impoundment and breaks up the air currents which lift additional dust from the crest area and slope.



Schematic section through outer slope showing windbreak at crest and proposed tree screen

	MARSH		EMBANKMENT
	TREE		RIVER or WATERCOURSE
	GATE		HEDGEROW
	BRIDGE		DENSE VEGETATION
	AREAS REQUIRING REMEDIAL MEASURES		MOGUL OWNERSHIP BOUNDARY

Rvsn No:	Rev. Date:	Description	Drawn	Checked	Approved

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GORTMORE REMEDIAL WORKS

Plan of tailings impoundment

Originator: PB/IB	DRAWING No.: FIG.10.1
Date Drawn: DEC_2001	
Scale: 1:5000	

10.3 Tailings visual

Although the outer slopes are of rockfill, and not a main source of dust, they are un-vegetated and unsightly. As they are too steep to vegetate successfully, and as a pushdown would be problematic and very costly, it is proposed as described in 10.2 that additional growth medium will be placed and vegetated on the bare strip around the crest, and that trees will be planted at the toe, to provide an eventual effective visual screen.

10.4 Tailings, leaching of metals

The leaching of metals to surface water is controlled by the existing system of retention ponds and controlled discharges, and the control will be enhanced by the prevention of grazing, the improvement of surface drainage and upgrading of the existing retention ponds, which serve as wetland water treatment systems. There is very little impact of the TMF on the quality of the Kilmastulla River.

Leaching of metals to groundwater is occurring but it appears to be at a low rate. There is some local contamination of groundwater but attenuation and dilution appears to provide natural remediation. Improving drainage and vegetation on the TMF surface will reduce leaching.

10.5 Tailings erosion

Tailings erosion will be controlled by the re-vegetation programme, by the proposed restricted access and prevention of grazing, by the repair of existing erosion gulleys, and by the improvement of the existing sediment traps around the toe.

10.6 Tailings instability

The risk of failure of the slopes of the TMF is low. Maintenance and repair of existing surface drainage systems will be carried out.

10.7 Tailings pool

The pool on the upper surface of the TMF is formed by rainwater in a depression on the south-west side. It is intended to maintain this pool at a constant maximum size by upgrading the decant overflow system. At present, the water flowing from the

pool passes along an open trench, and the water quality is very poor. This flow will in future pass through a buried pipeline to the retention ponds.

10.8 Tailings retention ponds

During the operation of the mine, these ponds collected decant water for return to the plant. Now they receive stormwater run-off from the tailings pool, and discharge it through a drain along the south-east side of the TMF to the Kilmastulla River.

A detailed study will be carried out to review the water balance and assess the performance of the wetlands to remove metals. Minor works will be carried out to repair the ponds, to lengthen the water retention time and thus enhance the quality of the discharge water.

10.9 Delivery pipeline

The slurry pipeline delivered tailings from the plant to the TMF. It is common for pipe breaks to occur during operation and for discharges of tailings to occur. If these discharges are not cleared, they may contaminate farmland.

It is known that there was at least one pipe break and tailings discharge during the operation of the plant but this occurred adjacent to the TMF. Some tailings entered the Kilmastulla River. An inspection of the pipe route revealed no tailings deposits and the pipeline has been removed. It is concluded that what discharges occurred were minor or were cleared up by Mogul. No action is proposed.

10.10 Tailings vegetation

A large part of the Gortmore TMF is vegetated (Figure 10.1), but in certain areas the vegetation has died. The procedure for revegetation and for maintenance will be as follows:

- Placement of soil or soil-forming material as growing medium and reseeded of grass;
- Annual cutting of *Agrostis/Festuca* (both grass species), but no cutting of *Bryum/Festuca* (moss/grass mix);
- Monitoring of vegetation and remedial topsoiling and planting as necessary, with the aim of achieving a self-sustaining cover within five years.

(Further details of options are in Appendix G of the Phase II report.)

10.11 Waste disposal facility

It is intended that hazardous waste from Garryard Tailings Lagoon, the Garryard Old Stockpile and Shallee waste dumps will be stored on an area of the top surface of the Gortmore TMF. The required area is approximately 7,500m², and for the purpose of the conceptual design it has been assumed that the base will be lined with HDPE. This may not be necessary, but is assumed for the purpose of conservative budgeting. Access to the disposal area will be provided by a gravel track over the upper surface of the Gortmore TMF of 8m width and 1m depth of fill, constructed of crushed lime.

The disposal area will be cleared of any pebbles which might puncture the liner. The liner will be protected by a 500mm layer of selected material to allow access of a small front-end loader.

The waste materials from Garryard and Shallee will be delivered by truck to the Gortmore TMF. The loader will spread the waste in 500mm layers and apply nominal compaction, creating outer slopes of 1 in 3. At final height, topsoil will be applied and vegetation established.

10.12 Maintenance of vegetation

Apart from the works to establish or re-establish vegetation, annual routine maintenance of existing vegetation will be carried out. This will comprise the cutting of grass (but not of the areas of thick moss). Additionally, the newly vegetated areas may require more detailed long-term attention to ensure and sustain growth. This has been assumed to include re-seeding and adding topsoil (0.15m) to 1ha of the TMF every year.

10.13 Costing of remedial works at Gortmore TMF

A summary of estimated costs for the remedial works at Gortmore is given in Table 10.1, and further information is in Appendix B.

The option of a low permeability capping over the whole TMF is not considered necessary and the preferred option involves replanting of un-vegetated areas, the installation of a pipe decant for the pool on the upper surface, a tree screen for the outer slope and other minor works.

The cost of establishing a hazardous waste disposal facility on the TMF is costed in the various sections with sources of waste.

Table 10.1: Estimate of Remediation Costs, Gortmore TMF

REF (Fig.10.1)	DESCRIPTION	COST
A	Topsoil or other growing medium to be placed on areas of poor vegetation.	€622,270
B	Vegetation to perimeter, including tree screen	€89,520
C	Minor earthworks – improve sediment traps and repair erosion gulleys.	€9,390
D	New decant weir and discharge pipeline from tailings pool.	€31,500
E	Minor earthworks to retention ponds	€3,220
F	Site for waste disposal on top surface including access road	€282,765
G	General signage	€1,600
Total		€1,040,265

INVESTIGATION AND DESIGN

Topographical Survey	€8,000
Site Investigation	€8,000
Contract Preliminaries	€104,027
Professional Fees (Design)	€104,027

Total Design and Construction Cost **€1,264,319**

MONITORING AND MAINTENANCE

Annual inspection and maintenance	€3,000
Water quality monitoring (4 years)	€21,000
Dust monitoring (4 years)	€16,000
Long term maintenance of vegetation	€26,480

11 SUMMARY OF ESTIMATED COSTS OF REMEDIAL WORKS

11.1 Summary of costs

The estimated total costs of the preferred options are given in Table 11.1.

Table 11-1: Summary of Estimated Costs of Remedial Works

AREA/ACTIVITY	ESTIMATED COSTS
Project management (including EIS and permitting)	€700,000
Ballygown	€320,000
Magcobar	€209,000
Garryard	€1,233,000
Gorteenadiha	€97,000
Shallee South/East/West	€1278,000
Gortmore	€1,331,000
TOTAL	€5,168,000

The totals include costs for monitoring, inspections and maintenance during the period of the works of four years. Long-term monitoring and maintenance after this period has been estimated at €68,480 per annum at present day costs.

The following additional contingencies are proposed:

Special contingency for hazardous waste disposal ¹	€354,000
Special contingency for water diversion ²	€24,150
Drilling	€50,000

NOTES:

¹ Possible additional costs related to increases in waste volumes and to increases in disposal costs.

² Possible culvert and new channel under road at Gorteenadiha/Garryard, for diversion of run-off to Settlement Pond. This may be required if water qualities from the Gorteenadiha area remain poor.

11.2 Funding by the European Union

Shannon Development have a European Union (EU) allocation of over €1.5 million for the development of a heritage centre at Shallee.

Funding to promote sustainable development and care for the environment comes from a range of sources within the EU:

- **The Structural Funds** promote more balanced socio-economic development across the Member States, assisting the poorer regions of the Union. Funds are increasingly used for environmental projects such as cleaning up coasts, harbours and rivers, and rehabilitating decayed industrial and urban areas.

Ireland has received significant funds since the 1980s. The Silvermines district is in the Mid-West region which is classified as a transitional Objective 1 region, eligible for Structural Funds until 2005. The National Development Plan will be implemented by 5 programmes, including the Southern and Eastern Regional Programme (which covers the Silvermines area). Priority 3 of the Programme covers agriculture and rural development, to ensure that primary agriculture becomes more competitive, to diversify activities of farmers, to foster environmentally sustainable systems of production and to promote rural development.

- **The Cohesion Fund** finances projects to improve the environment and develop transport infrastructure. The current budget is for 2000-2006 and Ireland is one of 4 countries meeting the criteria for eligibility. The maximum rate of aid granted is between 80-85% of expenditure.

The objectives for environmental projects are preserving, protecting and improving the quality of the environment; protecting human health; and assuring prudent and rational use of natural resources. The Fund gives priority to drinking water supply, treatment of waste water and disposal of solid waste. Re-afforestation, erosion control and nature conservation measures are also eligible.

- **The LEADER+ Community Initiative** is for rural development and promotes integrated schemes conceived and implemented by active partnerships operating at the local level. The objectives are to encourage and support rural actors in thinking about the longer-term potential of their area and encourage the implementation of integrated, high-quality, original strategies for sustainable development which experiment with new ways of:

- (a) enhancing the natural and cultural heritage;
- (b) reinforcing the economic environment in order to contribute to job creation;
- (c) improving the organisational abilities of their community.

Priority themes of Action 1 of LEADER+ include improving the quality of life in rural areas and making best use of natural and cultural resources.

- **The LIFE Programme** was set up in 1992 and its third phase runs until 2004. It is devoted entirely to developing EU environmental policy and has three strands: LIFE-Nature, LIFE-Environment and LIFE-Third Countries. The Union co-finances projects to safeguard the environment in all Member States and half the budget is devoted to nature protection.

LIFE-Environment funds demonstration projects contributing to the development of integrated and innovative techniques and methods and to the more advanced development of Community policy relating to the environment in the fields of physical planning and land use, the prevention of the impact of economic activities on the environment, the prevention, recycling and management of waste flows, and the reduction of the impact of products on the environment, by means of an integrated approach.

The development and implementation of a coherent management plan to protect and preserve Lough Gill's (Co. Sligo) landscape, wildlife and water quality for future generations has been funded by LIFE-Environment.

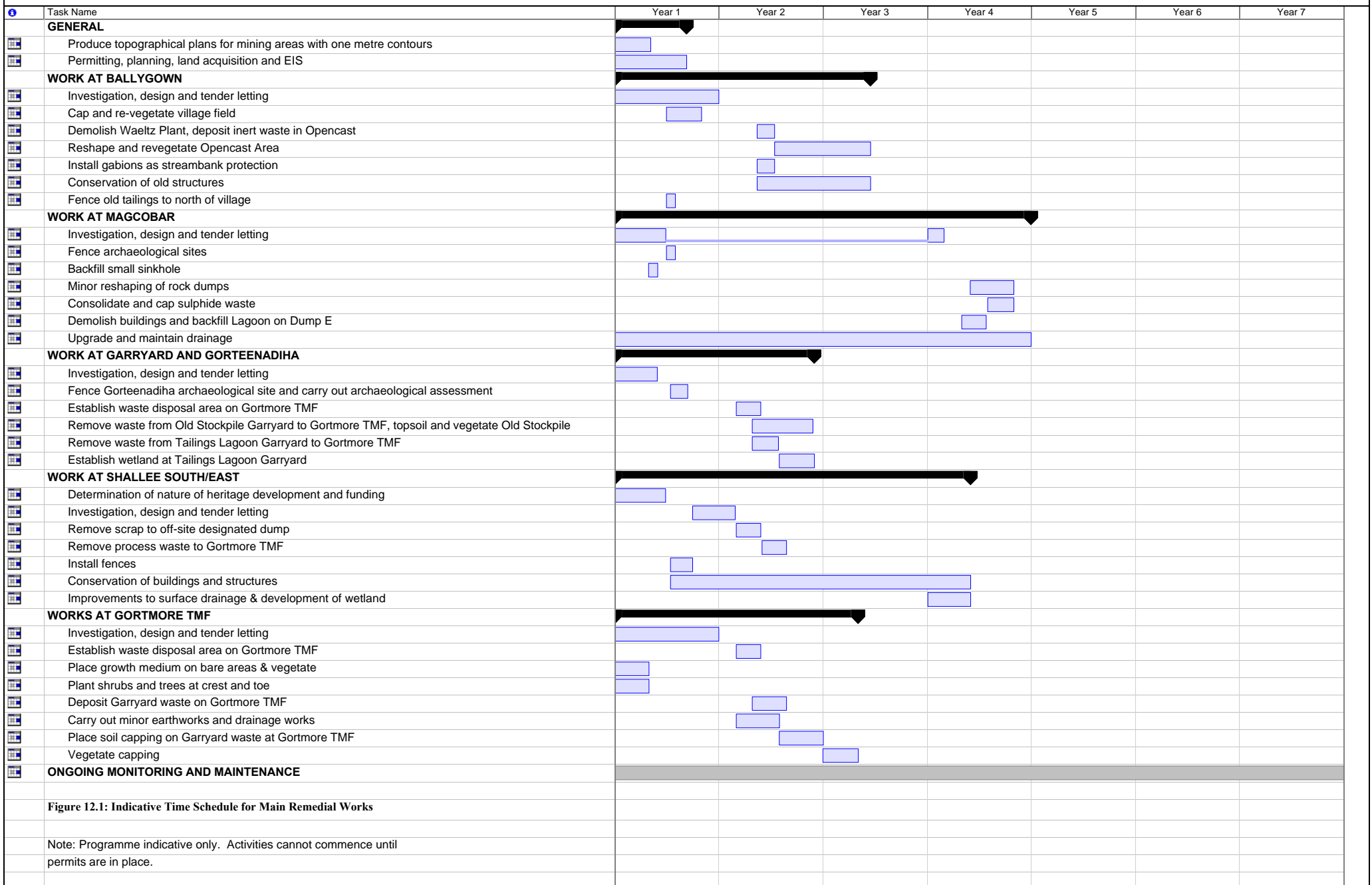
- **The European Investment Bank (EIB)** provides long-term loans for projects designated to safeguard the environment, covering up to 50% of investment costs. Typical projects have included water management, waste treatment and urban renewal schemes.
- **Sustainable Development and Policy Support** - A general call for proposals in the field of environmental protection (2002) is currently out. This is to identify projects which might be eligible for financial support from DG ENV, by way of co-funding. Theme Ref ENV.A.1.1 concerns restoring environmental damage, especially restoring bio-diversity. There is only a small sum available, a maximum of 2 projects will be financed and the closing date is 30 April 2002. However, it is indicative of further funding which might be available in subsequent years.

12 **PROPOSED TIME SCHEDULE FOR IMPLEMENTATION OF REMEDIAL WORKS**

The proposed programme has been designed to:

- (a) Prioritise works, which are considered urgent. These include the remedial works to the upper surface and embankments of the Gortmore TMF, and the removal of the waste deposits at the Garryard Old Stockpile and the Tailings Lagoon.
- (b) Provide a sequential programme, which will allow an assessment of the effectiveness of the implemented measures before the execution of the next stage. This will optimise expenditure and ensure that no unnecessary works are carried out.
- (c) Spread the costs over the project period, to improve cashflow. The programme has been prepared for a four year period and will have to be modified, according to the availability of funding.

The programme given in Figure 12.1 is indicative only. It is probable that the initial activities, such as the preparation of the EIS and the permitting process will cause delays, with work at Garryard and Shallee being postponed. It is considered that adequate preparation and planning is vital to ensure the success of the works and the efficient use of the available resources.



13 **CLAUSE K REQUIREMENTS**

The works for which Mogul Mine is responsible in terms of its State Mining Lease are listed in Table 13.1. Details are given in the Phase II report, Appendix J. On anecdotal evidence, the drums and other mine waste deposited at Shallee South/East Mine are included in the table, as it is understood that this waste comes from Mogul's Garryard Plant. The costs associated with Clause K are approximately 50% of the total estimated costs of the remedial works.

The scheduling of the works for activities associated with Clause K is included in Figure 12.1. As the different activities are inter-related, it is important that the Clause K activities are carried out in accordance with the programme though, as previously noted, the programme is only indicative at this stage.

The clause K activities at Gortmore TMF are intended to take place during the first and second year of activities. The removal of the waste from Shallee and Garryard to the Gortmore TMF are activities of the second year.

Table 13-1 : Mogul Clause K Responsibilities

Description	Summary Table	Section of Appendix I
GARRYARD PLANT AREA:		
Garryard Settling Pond – Minor remedial works to pond and decant	14.4	I4.1
Garryard Tailings Lagoon – Remove process wastes to Gortmore TMF	14.4	I4.2
Garryard Tailings lagoon – Establish wetland to treat Mogul underground water	14.4	I4.2
Mogul underground subsidence area – Repair and maintain existing fence, install diversion trench	14.4	I4.3
Mogul underground water contamination – Divert surface water	14.4	I4.4
Garryard Old Stockpile – Segregate wastes and remove contaminated soil and process waste to Gortmore TMF and other waste to designated site	14.4	I4.5
Garryard Plant Area – remove waste materials, remove hostel building, profile and cover unsurfaced areas, carry out minor landscaping	14.4	I4.6
MAGCOBAR:		
Backfill small sinkhole near entrance to site	14.3	I3.2
SHALLEE SOUTH/EAST:		
Drum Dump and other process waste deposits – Remove drums and other mine waste and scrap to off-site licensed disposal site.	14.6	I5.1, I5.5
GORTMORE TMF		
Dust and erosion control – Place growth medium, plant vegetation and shrub windbreaks	14.7	I6.1
Leaching of metals and salts – Place growth medium, vegetate and improve toe wetlands	14.7	I6.3
Erosion of tailings by run-off – Repair toe paddocks and slope gulleys	14.7	I6.4
Visual impact – Plant crest vegetation and toe tree screen	14.7	I6.2
Pool on surface of TMF – Construct new decant and decant pipeline	14.7	I6.6
Three retention ponds at TMF – Minor repairs to ponds and discharge system	14.7	I6.7
Establish site for waste disposal on top surface, including access road	14.7	
MOGUL VENT RAISES AND SHAFTS		
Fence or cap as required	14.4	I4.3
	14.5	I4.9
	14.2	I2.5
Signage	14.7	I6.1

14 CONCLUDING REMARKS

The conceptual design presented in this Phase III report has been based on the available information, on consultations with interested and affected parties and on the results of site investigations. It presents the preferred remediation options selected in the Phase II report.

The conceptual design gives the manner in which the environmental impacts will be mitigated. An overall Environmental Impact Statement, based on the work carried out, will be required to confirm the acceptability of this design. In some specific cases, the preferred option requires confirmation by others. An example is the proposed removal of hazardous waste from the Garryard and Shallee South/East areas and its storage on the Gortmore TMF, which requires permitting before the measure can be adopted.

The cost estimates summarised in Section 11 are approximate, as is appropriate for a conceptual design, and more accurate estimates will be made during the detailed design, when contour plans will be available, and quantities can be more precisely defined. The costs are considered to be suitable for planning purposes, however, and for comparing relative costs.

The Silvermines area, sitting against the side of the Silvermines Mountain, is a fascinating amalgam of historic mining sites, the Silvermines Village and attractive farmland. The proposed remedial works will largely remove the unpleasant side effects of the old mining, and restore the site to local people and to tourists interested in the mining history of the area.

For and on behalf of SRK (UK) Ltd

Dr Ian Brackley
Director

Richard Connelly
Director

APPENDIX A
RISK AND PREFERRED OPTION TABLES
FROM PHASE II REPORT

Table 14.2: Risk Assessment - Ballygown

Source	School playing field (I2.1)	Village field* (I2.2)	Opencast area (two pits) (I2.3)	Sulphur mine pit (I2.4)	Shafts (I2.5)	Underground mine (I2.6)	Mine water discharge (I2.7)	Waste materials (I2.8)	Old tailings (I2.8)	Mine buildings/plant site (I2.9)
Hazard/issue	<ul style="list-style-type: none"> Contaminated soil 	<ul style="list-style-type: none"> Contaminated soil <p>*(Village field is club field above school, not school playing field)</p>	<ul style="list-style-type: none"> Stability Leaching of metals Depth of water 	<ul style="list-style-type: none"> Open shafts/adits Footwall cliff Subsidence 	<ul style="list-style-type: none"> Open shafts/adits Collapse of backfill Discharge of mine water 	<ul style="list-style-type: none"> Mine workings 	<ul style="list-style-type: none"> Sulfides/ oxidation products 	<ul style="list-style-type: none"> Sulfides/oxidation products Erosion of contaminants 	<ul style="list-style-type: none"> Old tailings deposit to north-east of Village. 	<ul style="list-style-type: none"> Historic stone structures (Engine House and Furnace Building) Concrete buildings at Waeltz Plant with asbestos roof
Pathway	<ul style="list-style-type: none"> Human ingestion/exposure Erosion and seepage 	<ul style="list-style-type: none"> Human ingestion/exposure Erosion and seepage 	<ul style="list-style-type: none"> Leaching of metals Seepage to surface & groundwater Ingestion by animals Instability of excavations Access 	<ul style="list-style-type: none"> Access to shafts/adits Access to cliff Access to base of pit 	<ul style="list-style-type: none"> Access to shaft Flooding or discharge to surface water through shafts Proximity of buildings (two instances) 	<ul style="list-style-type: none"> Subsidence 	<ul style="list-style-type: none"> Seepage to groundwater/ surface water 	<ul style="list-style-type: none"> ARD/ metal leaching Seepage to groundwater/ surface water 	<ul style="list-style-type: none"> ARD/ metal leaching Seepage to groundwater/ surface water 	<ul style="list-style-type: none"> Collapse Toxic dust
Receptors	<ul style="list-style-type: none"> Human Streams 	<ul style="list-style-type: none"> Human Streams 	<ul style="list-style-type: none"> Surface water Groundwater Human & livestock safety 	<ul style="list-style-type: none"> Humans and livestock 	<ul style="list-style-type: none"> Human & livestock safety Proximity of buildings 	<ul style="list-style-type: none"> Livestock Human 	<ul style="list-style-type: none"> Surface water Groundwater 	<ul style="list-style-type: none"> Surface water (local stream in village) Groundwater 	<ul style="list-style-type: none"> Surface water (local stream in village) Groundwater 	<ul style="list-style-type: none"> Human Livestock
Impact	<ul style="list-style-type: none"> Toxicity Stream quality 	<ul style="list-style-type: none"> Toxicity Stream quality 	<ul style="list-style-type: none"> Human & Livestock safety & health, herbage toxicity Unstable slopes 	<ul style="list-style-type: none"> Human and livestock safety 	<ul style="list-style-type: none"> Building/road damage Human and livestock safety Flooding and shaft erosion 	<ul style="list-style-type: none"> Loss of land use Livestock & human safety 	<ul style="list-style-type: none"> Human health Livestock & herbage 	<ul style="list-style-type: none"> Human health Livestock & herbage Transport of contaminants 	<ul style="list-style-type: none"> Human health Livestock & herbage Transport of contaminants 	<ul style="list-style-type: none"> Human & Livestock safety & health
Risk	<ul style="list-style-type: none"> LOW 	<ul style="list-style-type: none"> MEDIUM (both) 	<ul style="list-style-type: none"> LOW (stability danger) LOW (toxicity danger) MEDIUM (drowning) 	<ul style="list-style-type: none"> HIGH (shaft/adit danger to humans and livestock) LOW (cliff danger to humans and livestock) 	<ul style="list-style-type: none"> HIGH (damage to structures) HIGH (danger to humans & livestock) MEDIUM (water discharge) 	<ul style="list-style-type: none"> LOW (land-use) LOW (property) LOW (danger to humans & livestock) 	<ul style="list-style-type: none"> LOW (humans) MEDIUM (livestock) 	<ul style="list-style-type: none"> MEDIUM (humans) LOW (livestock) MEDIUM (transportation of contaminants) 	<ul style="list-style-type: none"> LOW (humans) MEDIUM (livestock) LOW (transportation of contaminants) 	<ul style="list-style-type: none"> LOW (danger to humans of stone and concrete structures) MEDIUM (human toxicity from asbestos) LOW (livestock toxicity from asbestos)
Potential end use	<ul style="list-style-type: none"> School playing field 	<ul style="list-style-type: none"> Recreational area * Derelict land 	<ul style="list-style-type: none"> Fenced pit lagoon Backfill to derelict land 	<ul style="list-style-type: none"> * Derelict land 	<ul style="list-style-type: none"> Grazing Controlled public use * Derelict land 	<ul style="list-style-type: none"> Rough grazing * Derelict land 	<ul style="list-style-type: none"> Drain for underground workings 	<ul style="list-style-type: none"> * Derelict land 	<ul style="list-style-type: none"> Grazing 	<ul style="list-style-type: none"> Heritage Site Continued farm usage at Waeltz Plant
Potential Remediation Options	<ul style="list-style-type: none"> Completed (one metre of inert cover soil and gravel placed) 	<ul style="list-style-type: none"> Requires cover and improved drainage for recreational use Information signs 	<ul style="list-style-type: none"> Partial re-shaping Control of public access Partial backfilling Re-vegetation 	<ul style="list-style-type: none"> Cap shafts Backfill shafts and fence Fence adits and shafts Fence subsidence area at shaft A 	<ul style="list-style-type: none"> Backfill shafts Water pressure release Information signs Capping shafts 	<ul style="list-style-type: none"> No action Information signs 	<ul style="list-style-type: none"> Sediment trap and clearance at adit entrance Removal of sediment from Silvermines River None 	<ul style="list-style-type: none"> Remove and dispose contaminated material Remove contaminated sediment from stream Partial removal from stream bank Stream bank gabion protection Cover waste rock to minimise leaching Reprofile Intercept run-off Re-vegetate Information signs 	<ul style="list-style-type: none"> Remove and dispose of contaminated material Leave undisturbed and vegetated (no action). Install fence 	<ul style="list-style-type: none"> Possible use of some of Waeltz Plant buildings for farm purposes Conservation of Waeltz Plant buildings for future heritage restoration with removal of roofs Reduce Waeltz plant buildings to window cell height and conserve Conservation of Old Engine House and Furnace Building
Preferred option	<ul style="list-style-type: none"> Completed 	<ul style="list-style-type: none"> Cover for recreational area 	<ul style="list-style-type: none"> Partial backfilling and re-vegetation 	<ul style="list-style-type: none"> * Derelict land 	<ul style="list-style-type: none"> As appropriate for individual shafts (details in Section I2.5) 	<ul style="list-style-type: none"> No action 	<ul style="list-style-type: none"> Sediment trap and clear adit entrance. 	<ul style="list-style-type: none"> Remove minor quantities from stream bank and re-profile Intercept run-off 	<ul style="list-style-type: none"> Install fence 	<ul style="list-style-type: none"> Demolish Waeltz Plant, retain footprint Conserve Old Engine House and Furnace Building
Actions	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Design and cost works Install cover layer, vegetate and improve drainage Monitor stream quality as part of regional system 	<ul style="list-style-type: none"> Backfilling and re-shaping Establishment of vegetation Ownership and access to be determined 	<ul style="list-style-type: none"> Grill over east adit entrance Fence round west adit and subsidence area Backfill and re-vegetate open shafts and fence Information signs 	<ul style="list-style-type: none"> Survey all shafts and adits Geophysical survey to locate drainage tunnel below road Backfill shafts, fence shafts which serve drainage function Drill pressure release boreholes (2 number) and construct overflow drainage pipeline to river (I2.7) Drill holes to confirm tunnel location/condition (integrate with I2.7) 	<ul style="list-style-type: none"> None Information signs 	<ul style="list-style-type: none"> Sediment trap and clear adit entrance. (Integrate with I2.5). Monitor discharge, and maintain integrity of drainage <p>(Sediment removed from River as part of regional plan).</p>	<ul style="list-style-type: none"> Detailed survey Stream bank gabion protection Monitor stream water quality Install signs Construct run-off interception and silt trap 	<ul style="list-style-type: none"> Install fence 	<ul style="list-style-type: none"> Conservation and development as Heritage Site Conservation of old engine house and furnace building structures Demolition and removal of Waeltz Plant structures, retaining footprint Specialist removal and disposal of asbestos on designated site

* Note: Derelict land – Land which will not be utilised, but which will be vegetated with a self-sustaining cover, and for which access will be allowable, but restricted.

Table 14.3: Risk Assessment - Magcobar

Source	Open pit & adjacent limited underground workings				Archaeological sites	Rock dumps			Mine buildings/plant site	Settlement Lagoons North of Pit
Hazard/issue	<ul style="list-style-type: none"> Slope stability (I3.1) 	<ul style="list-style-type: none"> Subsidence of underground workings (I3.2) Existing small sinkhole 	<ul style="list-style-type: none"> Deep water (I3.3) 	<ul style="list-style-type: none"> Contaminated water (I3.3) 	<ul style="list-style-type: none"> Destruction of old lead and copper mine remains (I3.4) 	<ul style="list-style-type: none"> Visual (I3.5) 	<ul style="list-style-type: none"> Stability (I3.6) 	<ul style="list-style-type: none"> Sulphides/oxidation products (I3.7) 	<ul style="list-style-type: none"> Safety (I3.8) 	<ul style="list-style-type: none"> Safety (I3.9)
Pathway	<ul style="list-style-type: none"> Contact 	<ul style="list-style-type: none"> Contact 	<ul style="list-style-type: none"> Contact 	<ul style="list-style-type: none"> Seepage to groundwater Leaching from sidewalls Ingestion by animals & birds 	<ul style="list-style-type: none"> Remedial works 	<ul style="list-style-type: none"> Visible from a distance 	<ul style="list-style-type: none"> Slope failure 	<ul style="list-style-type: none"> ARD/ metal leaching Seepage to groundwater/ surface water 	<ul style="list-style-type: none"> Access 	<ul style="list-style-type: none"> Access
Receptors	<ul style="list-style-type: none"> Humans and livestock 	<ul style="list-style-type: none"> Humans and livestock 	<ul style="list-style-type: none"> Livestock & human 	<ul style="list-style-type: none"> Groundwater Livestock & human 	<ul style="list-style-type: none"> Historic mine remains 	<ul style="list-style-type: none"> Human 	<ul style="list-style-type: none"> Humans and livestock 	<ul style="list-style-type: none"> Surface water Groundwater 	<ul style="list-style-type: none"> Humans and livestock 	<ul style="list-style-type: none"> Humans and livestock
Impact	<ul style="list-style-type: none"> Injury and death Ravelling back outside present boundary 	<ul style="list-style-type: none"> Injury and death Subsidence affecting pit stability 	<ul style="list-style-type: none"> Human & Livestock safety & health 	<ul style="list-style-type: none"> Groundwater contamination Human & Livestock safety & health 	<ul style="list-style-type: none"> Loss of mining heritage 	<ul style="list-style-type: none"> Visual 	<ul style="list-style-type: none"> Injury Exposure of fresh material 	<ul style="list-style-type: none"> Contamination of water Human health Livestock toxicity 	<ul style="list-style-type: none"> Human and livestock safety 	<ul style="list-style-type: none"> Humans and livestock safety
Risk	<ul style="list-style-type: none"> MEDIUM (danger to humans and livestock) MEDIUM (waste dump stability at crest) 	<ul style="list-style-type: none"> LOW (danger to humans and livestock) LOW (pit stability) 	<ul style="list-style-type: none"> HIGH (danger to humans and livestock) 	<ul style="list-style-type: none"> MEDIUM (human toxicity) LOW (livestock toxicity) LOW (groundwater contamination) 	<ul style="list-style-type: none"> HIGH 	<ul style="list-style-type: none"> LOW 	<ul style="list-style-type: none"> MEDIUM (human and livestock safety Dump A) LOW (human and livestock safety (other dumps)) 	<ul style="list-style-type: none"> MEDIUM (human & livestock toxicity) MEDIUM (acid drainage to streams) 	<ul style="list-style-type: none"> LOW (risk to humans and livestock) 	<ul style="list-style-type: none"> LOW (Risk to humans and livestock)
Potential end use	<ul style="list-style-type: none"> Landfill None 	<ul style="list-style-type: none"> Rough pasture. 	<ul style="list-style-type: none"> Pit lake or landfill 	<ul style="list-style-type: none"> Pit lake or landfill, 	<ul style="list-style-type: none"> Heritage site Archaeological investigation, then derelict land 	<ul style="list-style-type: none"> * Derelict land 	<ul style="list-style-type: none"> * Derelict land Source of aggregate for fill 	<ul style="list-style-type: none"> * Derelict land 	<ul style="list-style-type: none"> Possible alternative commercial use for workshop Demolition and removal of other buildings 	<ul style="list-style-type: none"> *Derelict land Backfill and re-vegetate
Potential Remediation Options	<ul style="list-style-type: none"> Prevent access by fencing (There is an existing fence) Partial backfill Remove waste rock pile from pit edge Backfill (Landfill) 	<ul style="list-style-type: none"> Do nothing Extend boundary fence over undermined area Backfill small sinkhole 	<ul style="list-style-type: none"> Prevent access to pit by fence (existing, but requiring improvement) 	<ul style="list-style-type: none"> Pump and treat Increase alkalinity Limit surface run-off Prevent access 	<ul style="list-style-type: none"> Protective fence and signs Archaeological investigation 	<ul style="list-style-type: none"> Re-profile to blend with natural topography Prevent uncontrolled removal of stone from toe of dump Promote vegetation 	<ul style="list-style-type: none"> Prevent uncontrolled removal of stone from toe of slopes, Dump A Flatten slopes Maintain drainage channels around and under dumps Use as aggregate/fill source Institutional controls (signage) 	<ul style="list-style-type: none"> Intercept and treat seepage Cover waste rock to minimise leaching Consolidate and cover acid generating material Divert upstream flows 	<ul style="list-style-type: none"> Remove crusher plant Remove oil tanks Remove office Consider alternative use for workshops Backfill lagoon on top of Dump E and re-vegetate 	<ul style="list-style-type: none"> Backfill and re-vegetate Fence to restrict access and maintain integrity
Preferred option	<ul style="list-style-type: none"> Fencing to prevent access and leave as pit lake 	<ul style="list-style-type: none"> Backfill small sinkhole 	<ul style="list-style-type: none"> Fencing to prevent access and leave as pit lake 	<ul style="list-style-type: none"> Fencing to prevent access and leave as pit lake 	<ul style="list-style-type: none"> Protective fence and signs for future archaeological investigation 	<ul style="list-style-type: none"> Minor re-shaping and re-vegetation 	<ul style="list-style-type: none"> Prevent uncontrolled removal of stone at Dump A, carry out minor re-shaping and re-vegetate Use as fill source Institutional controls (signage) 	<ul style="list-style-type: none"> Consolidate and cover Divert upstream flows 	<ul style="list-style-type: none"> Removal or re-use of buildings Backfill lagoon 	<ul style="list-style-type: none"> Fence and maintain Backfill Dump E lagoon
Actions	<ul style="list-style-type: none"> Improve and maintain fences to prevent public access 	<ul style="list-style-type: none"> Backfill small sinkhole 	<ul style="list-style-type: none"> Improve and maintain fences to prevent public access 	<ul style="list-style-type: none"> Improve and maintain fences to prevent public access Monitor water quality (depth profile of quality) Evaluate pit lake chemistry 	<ul style="list-style-type: none"> Install protective fence and information signs 	<ul style="list-style-type: none"> Carry out minor reshaping Establish new vegetation 	<ul style="list-style-type: none"> Prevent uncontrolled removal of material Assess and use dump material as fill where required for remediation Maintain drainage channels Carry out minor reshaping 	<ul style="list-style-type: none"> Consolidate and cover Place cover on selected areas of crest Maintain and improve surface drainage to divert upstream flows 	<ul style="list-style-type: none"> Evaluate existing structures Schedule removal or new usage Backfill lagoon 	<ul style="list-style-type: none"> Fence Backfill Dump E

* **Note: Derelict land** – Land which will not be utilised, but which will be vegetated with a self-sustaining cover, and for which access will be allowable, but restricted.

Table 14.4: Risk Assessment – Garryard (Mogul), including subsidence zone

Source	Settlement pond (I4.1)	Tailings Lagoon (I4.2)	Main Garryard Shaft (I4.3)	Mogul underground mine (I4.4)		Garryard Old Stockpile (I4.5)	Garryard Mine Buildings at the Plant Site (I4.6)
Hazard/issue	<ul style="list-style-type: none"> Contaminated water 	<ul style="list-style-type: none"> Contaminated water Contaminated sediment 	<ul style="list-style-type: none"> Open shaft Water discharge 	<ul style="list-style-type: none"> Subsidence 	<ul style="list-style-type: none"> Sulfides/oxidation products in underground water 	<ul style="list-style-type: none"> Sulfides/oxidation products Mill concentrate spillage 	<ul style="list-style-type: none"> Buildings Contaminated land
Pathway	<ul style="list-style-type: none"> Seepage to surface & groundwater Ingestion by animals 	<ul style="list-style-type: none"> Leaching of metals from sludge in pond Seepage to surface & groundwater Ingestion by animals 	<ul style="list-style-type: none"> Cap damage Water head in workings 	<ul style="list-style-type: none"> Access 	<ul style="list-style-type: none"> Seepage to groundwater Discharge to surface due to blocking shaft discharge 	<ul style="list-style-type: none"> ARD/ metal leaching Seepage to groundwater/ surface water Erosion to drains Livestock access 	<ul style="list-style-type: none"> Access Leaching of chemicals from contaminated land
Receptors	<ul style="list-style-type: none"> Surface water Groundwater Livestock 	<ul style="list-style-type: none"> Surface water Groundwater Livestock 	<ul style="list-style-type: none"> Human Surface water 	<ul style="list-style-type: none"> Surface dwellings, livestock, human health 	<ul style="list-style-type: none"> Groundwater surface water 	<ul style="list-style-type: none"> Surface water Groundwater 	<ul style="list-style-type: none"> Livestock, Human Streams
Impact	<ul style="list-style-type: none"> Contamination of local water Human health Livestock 	<ul style="list-style-type: none"> Contamination of local water Human health Livestock & herbage toxicity 	<ul style="list-style-type: none"> Human Contamination of local water 	<ul style="list-style-type: none"> Loss of land use, Property damage Livestock & human safety 	<ul style="list-style-type: none"> Contamination of groundwater and surface water 	<ul style="list-style-type: none"> Contamination of local water Human health Livestock & herbage toxicity 	<ul style="list-style-type: none"> Human and livestock safety (buildings) Livestock health & safety Human and livestock health (contaminated land)
Risk	<ul style="list-style-type: none"> MEDIUM (metals and TDS in sediment and streams) MEDIUM (human toxicity of ponds) HIGH (livestock toxicity of ponds) 	<ul style="list-style-type: none"> HIGH (metals and TDS in sediment and streams) MEDIUM (human toxicity) HIGH (livestock toxicity) 	<ul style="list-style-type: none"> LOW (damage) HIGH (discharge of contaminated water) 	<ul style="list-style-type: none"> HIGH (loss of land-use, but only in specified area) LOW (surface dwellings) HIGH (safety) 	<ul style="list-style-type: none"> LOW 	<ul style="list-style-type: none"> HIGH (contamination of streams) MEDIUM (human toxicity) HIGH (livestock toxicity) 	<ul style="list-style-type: none"> LOW (danger to humans and livestock) MEDIUM (human and livestock toxicity)
Potential end use	<ul style="list-style-type: none"> Run-off pond and wetland 	<ul style="list-style-type: none"> Redevelop as wetland for mine water treatment 	<ul style="list-style-type: none"> Light industrial 	<ul style="list-style-type: none"> Farmland, but *derelict land with prohibited fenced access where subsidence risk high 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Pasture 	<ul style="list-style-type: none"> Light industrial use for plant area and infrastructure * Derelict land
Potential Remediation Options	<ul style="list-style-type: none"> Remove contaminated material Place cover Encourage wetland development Water treatment plant Drain to constructed wetland 	<ul style="list-style-type: none"> Engineered Cover Intercept and treat seepage and ponded water Divert clean water Remove contaminated sediment to Gortmore TMF Constructed wetland 	<ul style="list-style-type: none"> Monitor shaft flows Backfill shaft Information sign Drain shaft flows to wetland Treatment plant. 	<ul style="list-style-type: none"> Fence off high risk areas Backfill subsidence with rock Divert surface water 	<ul style="list-style-type: none"> Divert surface water Maintain drainage of Knight Shaft water 	<ul style="list-style-type: none"> Intercept and treat seepage Profile and engineer cover & restore to pasture Remove waste to engineered containment 	<ul style="list-style-type: none"> Removal and site restoration Preserve old farm cottages Utilise buildings Profile and cover unsurfaced areas to prevent infiltration Landscaping around old plant area Manage drainage
Preferred option	<ul style="list-style-type: none"> Encourage wetland 	<ul style="list-style-type: none"> Remove sediment, construct wetland 	<ul style="list-style-type: none"> No change Information sign 	<ul style="list-style-type: none"> Fence off and divert surface water Divert surface water 	<ul style="list-style-type: none"> Divert surface water Maintain shaft drainage 	<ul style="list-style-type: none"> Remove waste, cover and restore to pasture 	<ul style="list-style-type: none"> Light industrial use and manage drainage Remove hostel
Actions	<ul style="list-style-type: none"> Monitor inflows Works for natural wetland development, Pond A, no works required, Pond B Prevent further extension of existing hard standing 	<ul style="list-style-type: none"> Remove contaminated sediments Dispose of sediments on Gortmore TMF Design wetland Re-establish diversion canals 	<ul style="list-style-type: none"> Monitor shaft flows and cap condition Establish explanatory sign Drain to tailings lagoon wetland. 	<ul style="list-style-type: none"> Carry out geotechnical assessment of potential subsidence Review existing and required fencing Topographic survey and design drainage 	<ul style="list-style-type: none"> Divert surface water Maintain shaft drainage to tailings lagoon Monitor 	<ul style="list-style-type: none"> Intercept and treat surface run-off and seepage Separate soil and metal waste Remove soil waste materials to Gortmore TMF and metal waste to designated off-site dump Place capping layer and re-vegetate 	<ul style="list-style-type: none"> Prepare schedule of remedial works Prepare specification for permissible usage Preserve old farm cottages Remove hostel Profile and cover unsurfaced areas Carry out landscaping works

* **Note: Derelict land – Land which will not be utilised, but which will be vegetated with a self-sustaining cover, and for which access will be allowable, but restricted.**

Table 14.5: Risk Assessment - Gorteenadiha

Source	Gorteenadiha mining heritage (I4.7)	Gorteenadiha waste dumps (I4.8)	Gorteenadiha underground and surface workings (I4.9)
Hazard/issue	<ul style="list-style-type: none"> Loss of heritage structures 	<ul style="list-style-type: none"> Contaminated ground Discharge of contaminated water 	<ul style="list-style-type: none"> Subsidence Open shafts and pits
Pathway	<ul style="list-style-type: none"> Remedial works, agricultural works, etc. 	<ul style="list-style-type: none"> Access and contact Seepage to groundwater/surface water Water courses from site 	<ul style="list-style-type: none"> Access
Receptors	<ul style="list-style-type: none"> Heritage structures 	<ul style="list-style-type: none"> Human Livestock Surface water to Yellow River Groundwater 	<ul style="list-style-type: none"> Human Livestock
Impact	<ul style="list-style-type: none"> Destruction or damage to mining remains, including hand washing structures 	<ul style="list-style-type: none"> Human and livestock safety and toxicity Contamination of water courses and groundwater 	<ul style="list-style-type: none"> Human and livestock safety
Risk	<ul style="list-style-type: none"> HIGH 	<ul style="list-style-type: none"> MEDIUM (human toxicity) MEDIUM (livestock toxicity) MEDIUM (contamination of surface water) 	<ul style="list-style-type: none"> MEDIUM (subsidence) HIGH (danger to humans and livestock)
Potential end use	<ul style="list-style-type: none"> Heritage site * Derelict land 	<ul style="list-style-type: none"> Heritage Site * Derelict land 	<ul style="list-style-type: none"> Heritage site * Derelict land
Potential Remediation Options	<ul style="list-style-type: none"> Fence and erect information signs Carry out archaeological investigation and conserve (to be done before remedial works carried out) 	<ul style="list-style-type: none"> Placement of cover layer and vegetate Control of access Surface drainage works Water diversion and treatment Gabion retention structure to hold sediments Information signs Conservation and heritage 	<ul style="list-style-type: none"> Fence Backfill shafts Surface drainage works Water diversion and treatment Information signs Conservation and heritage
Preferred option	<ul style="list-style-type: none"> Protect for future archaeological investigation 	<ul style="list-style-type: none"> Protect and conserve, install run-off controls 	<ul style="list-style-type: none"> Protect and conserve
Actions	<ul style="list-style-type: none"> Erect fences and information signs Archaeological survey 	<ul style="list-style-type: none"> Design and construct system for drainage control Construct small gabion dam to retain silt during and after execution of remedial works Erect fencing and signage 	<ul style="list-style-type: none"> Map shafts and adits and backfill any open areas Design and construct system for drainage control Erect fencing and signage

* **Note: Derelict land** – Land which will not be utilised, but which will be vegetated with a self-sustaining cover, and for which access will be allowable, but restricted.

Table 14.6: Risk Assessment – Shallee South/East and Shallee West (Continued on next page)

Source	Opencast areas (pits and trenches) (I5.1)			Shafts (I5.2)	Underground mine (I5.3)		
Hazard/ issue	<ul style="list-style-type: none"> Toxicity of ponded water in opencast areas 	<ul style="list-style-type: none"> Scrap and waste in opencast 	<ul style="list-style-type: none"> Safety (ponds and rock faces) 	<ul style="list-style-type: none"> Open shaft Shaft collapse 	<ul style="list-style-type: none"> Subsidence/ collapse/rock falls 	<ul style="list-style-type: none"> Safety (drowning, falls) 	<ul style="list-style-type: none"> Sulfides/oxidation products Surface contamination
Pathway	<ul style="list-style-type: none"> Seepage to surface & groundwater Ingestion by animals Access 	<ul style="list-style-type: none"> Visual Toxicity 	<ul style="list-style-type: none"> Access 	<ul style="list-style-type: none"> Access 	<ul style="list-style-type: none"> Access 	<ul style="list-style-type: none"> Access 	<ul style="list-style-type: none"> Seepage to groundwater/ surface water
Receptors	<ul style="list-style-type: none"> Human Livestock Groundwater Surface stream 	<ul style="list-style-type: none"> Human Livestock Groundwater Surface stream 	<ul style="list-style-type: none"> Human Livestock 	<ul style="list-style-type: none"> Human Livestock 	<ul style="list-style-type: none"> Human Livestock 	<ul style="list-style-type: none"> Human 	<ul style="list-style-type: none"> Surface water Groundwater
Impact	<ul style="list-style-type: none"> Human toxicity Livestock toxicity Surface water quality Groundwater quality 	<ul style="list-style-type: none"> Human toxicity Livestock toxicity Surface water quality Groundwater quality Visual 	<ul style="list-style-type: none"> Injury and death 	<ul style="list-style-type: none"> Injury and death 	<ul style="list-style-type: none"> Injury and death 	<ul style="list-style-type: none"> Injury and death 	<ul style="list-style-type: none"> Contamination
Risk	<ul style="list-style-type: none"> LOW (human toxicity) LOW (livestock toxicity) LOW (water quality) 	<ul style="list-style-type: none"> LOW (visual) MEDIUM (toxicity) 	<ul style="list-style-type: none"> MEDIUM (human and livestock) 	<ul style="list-style-type: none"> MEDIUM (safety) LOW (collapse) 	<ul style="list-style-type: none"> MEDIUM 	<ul style="list-style-type: none"> MEDIUM 	<ul style="list-style-type: none"> MEDIUM
Potential End-use	<ul style="list-style-type: none"> Heritage site, with controlled public access *Derelict land 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Heritage site, with controlled public access *Derelict land 	<ul style="list-style-type: none"> Heritage structures None 	<ul style="list-style-type: none"> Heritage site with controlled public access to Cathedral cavern and beyond *Derelict land 	<ul style="list-style-type: none"> Heritage site with controlled public access *Derelict land 	<ul style="list-style-type: none"> Heritage site with controlled public access * Derelict land
Potential Remediation Options	<ul style="list-style-type: none"> None required 	<ul style="list-style-type: none"> Remove scrap and waste 	<ul style="list-style-type: none"> Backfill or re-profile Clear vegetation to expose trenches Fence off 	<ul style="list-style-type: none"> Fence off Engineered cap Safety grill for observation and bats 	<ul style="list-style-type: none"> Collapse or backfill underground workings Restrict access to designated routes by fencing Install rock support 	<ul style="list-style-type: none"> Restrict access to designated routes Rock support/barring 	<ul style="list-style-type: none"> Intercept and treat seepage (wetland) Divert surface water
Preferred option	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Remove scrap and waste 	<ul style="list-style-type: none"> Safety fence Notices 	<ul style="list-style-type: none"> Safety grill (Vent Shaft) Field shaft to be fenced, but allowed to discharge water As appropriate (other shafts) 	<ul style="list-style-type: none"> Restrict access by fencing 	<ul style="list-style-type: none"> Restrict access by fencing 	<ul style="list-style-type: none"> Surface water diversion Wetland
Actions	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Remove scrap and waste Identify disposal site Assess quantities Segregate and remove (integrate with I 5.5) 	<ul style="list-style-type: none"> Survey fence requirements Erect fencing Notices (integrate with I5.3 + I 5.7) 	<ul style="list-style-type: none"> Locate and assess shafts and adits, treat as appropriate Safety grill on vent shaft Fence field shaft and others as appropriate 	<ul style="list-style-type: none"> Fencing, clearing and control access as part of development of heritage area (integrate with I 5.1 and I 5.7) 	<ul style="list-style-type: none"> Fencing and control access as part of development of heritage area (integrate with I 5.1 and I 5.7) 	<ul style="list-style-type: none"> Survey Surface water diversion, clean and extend Site water to wetland (with I 5.4)

* **Note: Derelict land – Land which will not be utilised, but which will be vegetated with a self-sustaining cover, and for which access will be allowable, but restricted.**

Table 14.6(Continued): Risk Assessment – Shallee South/East and Shallee West

Source	Tailings (I5.4)			Waste dumps (I5.5)		Mine buildings/plant site (I5.6)	Water reservoir (I5.7)	Shallee West (I5.8)Open Pit	Shallee West (I5.9)Waste Dumps
Hazard/ issue	<ul style="list-style-type: none"> Dust 	<ul style="list-style-type: none"> Stability 	<ul style="list-style-type: none"> Leaching of metals from tailings Erosion of tailings 	<ul style="list-style-type: none"> Mine waste (rock spoil) 	<ul style="list-style-type: none"> Scrap and process wastes (Drum Dump, etc.) 	<ul style="list-style-type: none"> Buildings and mine area 	<ul style="list-style-type: none"> Flooding from reservoir Safety 	<ul style="list-style-type: none"> Safety 	<ul style="list-style-type: none"> Mine waste (rock spoil)
Pathway	<ul style="list-style-type: none"> Aerial dispersion 	<ul style="list-style-type: none"> Slope failure and possible flow 	<ul style="list-style-type: none"> Seepage to surface & groundwater Erosion from embankments 	<ul style="list-style-type: none"> Instability and contamination 	<ul style="list-style-type: none"> ARD/ metal leaching Seepage to groundwater/ surface water Erosion to drains Livestock access 	<ul style="list-style-type: none"> Access 	<ul style="list-style-type: none"> Surface flow after wall breach Access 	<ul style="list-style-type: none"> Access 	<ul style="list-style-type: none"> Contamination
Receptors	<ul style="list-style-type: none"> Local soil & herbage, Livestock, Local residents Streams 	<ul style="list-style-type: none"> Deposition on surrounding land Flow into river 	<ul style="list-style-type: none"> Surface water Groundwater Ingestion by animals 	<ul style="list-style-type: none"> Seepage to groundwater and surface water Human safety 	<ul style="list-style-type: none"> Surface water Groundwater Visual Health and safety 	<ul style="list-style-type: none"> Safety Visual 	<ul style="list-style-type: none"> Humans and structures 	<ul style="list-style-type: none"> Humans Livestock 	<ul style="list-style-type: none"> Seepage to groundwater and surface water Livestock Safety
Impact	<ul style="list-style-type: none"> Stream quality Dust nuisance Loss of land use due to toxicity in herbage 	<ul style="list-style-type: none"> Contamination of land and water 	<ul style="list-style-type: none"> Contamination of surface water and groundwater Livestock toxicity 	<ul style="list-style-type: none"> Contamination to surface water and groundwater Slope failure and slides 	<ul style="list-style-type: none"> Contamination of surface water and groundwater 	<ul style="list-style-type: none"> Injury 	<ul style="list-style-type: none"> Injury and property damage Drowning 	<ul style="list-style-type: none"> Drowning Injury and Death 	<ul style="list-style-type: none"> Contamination to surface water and groundwater Livestock toxicity
Risk	<ul style="list-style-type: none"> LOW (streams) LOW (dust) LOW (herbage) 	<ul style="list-style-type: none"> LOW (risk of failure) 	<ul style="list-style-type: none"> LOW (contamination) LOW (livestock) 	<ul style="list-style-type: none"> MEDIUM (contamination) LOW (instability) 	<ul style="list-style-type: none"> HIGH (stream contamination) MEDIUM (human toxicity) HIGH (livestock toxicity) HIGH (aesthetics) 	<ul style="list-style-type: none"> LOW (injury) 	<ul style="list-style-type: none"> MEDIUM (drowning) 	<ul style="list-style-type: none"> MEDIUM (safety) 	<ul style="list-style-type: none"> LOW (contamination) MEDIUM (toxicity)
Potential End-use	<ul style="list-style-type: none"> Heritage site with controlled public access * Derelict land 	<ul style="list-style-type: none"> Heritage site with controlled public access * Derelict land 	<ul style="list-style-type: none"> Heritage site with controlled public access * Derelict land 	<ul style="list-style-type: none"> Heritage Site with controlled public access * Derelict land 	<ul style="list-style-type: none"> Heritage Site with controlled public access *Derelict land 	<ul style="list-style-type: none"> Heritage site with controlled public access * Derelict land 	<ul style="list-style-type: none"> Heritage site with controlled public access Drained *derelict land 	<ul style="list-style-type: none"> * Derelict land Heritage site 	<ul style="list-style-type: none"> * Derelict land
Potential Remediation Options	<ul style="list-style-type: none"> Prevent surface disturbance by control of access Improve surface vegetation cover by addition of organic layer and reprofile where necessary 	<ul style="list-style-type: none"> None required 	<ul style="list-style-type: none"> Cover tailings to reduce leaching/erosion Re-profile and cover Intercept and treat seepage water in wetland Construct sediment traps 	<ul style="list-style-type: none"> No action Remove waste dumps 	<ul style="list-style-type: none"> Intercept and treat seepage Profile and engineer cover Remove waste to engineered containment Divert surface water 	<ul style="list-style-type: none"> Removal of buildings and site restoration Re-profile waste and building areas and cover Conservation of buildings and all remnant structures Landscaping in accordance with heritage requirements None 	<ul style="list-style-type: none"> Maintenance of reservoir and utilisation of water Draining of reservoir and diversion of feeder channels Fencing 	<ul style="list-style-type: none"> Backfill Draining Fencing 	<ul style="list-style-type: none"> No action Remove waste dumps
Preferred option	<ul style="list-style-type: none"> Control access and improve vegetation 	<ul style="list-style-type: none"> No action 	<ul style="list-style-type: none"> Restrict access and maintain vegetation Improve and maintain surface drainage system Run-off to pass into wetland 	<ul style="list-style-type: none"> No action Integrate with I 5.3 	<ul style="list-style-type: none"> Remove waste 	<ul style="list-style-type: none"> Conservation of all buildings and structures for heritage: <p>King's House Engine House Core shed Laboratory Office Plant foundations, etc</p>	<ul style="list-style-type: none"> Maintain as reservoir Install fence 	<ul style="list-style-type: none"> Install fence 	<ul style="list-style-type: none"> Push into open slot and cover with soil for growth medium
Actions	<ul style="list-style-type: none"> Prevent livestock access (maintain fences) Control public access (signage) Re-establish vegetation and monitor 	<ul style="list-style-type: none"> No action 	<ul style="list-style-type: none"> Establish monitoring Improve and maintain surface drainage system Maintain dump profile and vegetation Integrate with wetland for I5.3 	<ul style="list-style-type: none"> No action Integrate with I5.3 	<ul style="list-style-type: none"> Remove waste to containment, off-site or on-site, re-vegetate and stabilise area 	<ul style="list-style-type: none"> Prepare schedule of conservation of all surface structures and restoration needs Carry out conservation, landscaping and restoration measures 	<ul style="list-style-type: none"> Carry out safety inspection Install fence Monitor (integrate with I 5.3 and I 5.1) 	<ul style="list-style-type: none"> Survey Install fence 	<ul style="list-style-type: none"> Survey quantity Implement preferred option above

* **Note: Derelict land – Land which will not be utilised, but which will be vegetated with a self-sustaining cover, and for which access will be allowable, but restricted.**

Table 14.7: Risk Assessment - Gortmore TMF

Source	Tailings (dust I6.1)	Tailings (Visual I6.2)	Tailings (Leach I6.3)	Tailings (Erosion I6.4)	Tailings (Instability I6.5)	The tailings pool (I6.6)	The three retention ponds (I6.7)	Delivery pipe line (I6.8)
Hazard/issue	<ul style="list-style-type: none"> Metals in dust from wind erosion 	<ul style="list-style-type: none"> Un-vegetated outer slopes 	<ul style="list-style-type: none"> Leaching of metal from tailings 	<ul style="list-style-type: none"> Erosion of tailings by water run-off 	<ul style="list-style-type: none"> Deep-seated slope instability 	<ul style="list-style-type: none"> Contaminated water 	<ul style="list-style-type: none"> Contaminated water 	<ul style="list-style-type: none"> Sediment from pipe breaks during mine operation
Pathway	<ul style="list-style-type: none"> Aerial dispersion 	<ul style="list-style-type: none"> View 	<ul style="list-style-type: none"> Seepage to surface and groundwater 	<ul style="list-style-type: none"> Erosion from crest and embankments 	<ul style="list-style-type: none"> Slope failure and possible flow 	<ul style="list-style-type: none"> Seepage to groundwater Flow to retention ponds along discharge channel 	<ul style="list-style-type: none"> Seepage to groundwater Flow to river 	<ul style="list-style-type: none"> Access
Receptors	<ul style="list-style-type: none"> Local soil & herbage, Kilmastulla river, Livestock, Farmhouses and residents 	<ul style="list-style-type: none"> Local community 	<ul style="list-style-type: none"> Surface water Groundwater 	<ul style="list-style-type: none"> Deposition on surrounding land Flow into river 	<ul style="list-style-type: none"> Deposition on surrounding land Mass flow into river 	<ul style="list-style-type: none"> Groundwater Kilmastulla River 	<ul style="list-style-type: none"> Groundwater Kilmastulla river 	<ul style="list-style-type: none"> Local soil & herbage, Humans, Livestock
Impact	<ul style="list-style-type: none"> Elevated metals in soils Pollution of the Kilmastulla River, Yellow River and drains around the TMF by metals in dust Animal & human toxicity Dust nuisance 	<ul style="list-style-type: none"> Appearance of exposed rock slopes in rural setting 	<ul style="list-style-type: none"> Elevated metals in surface water Elevated metals in groundwater Human toxicity Livestock toxicity 	<ul style="list-style-type: none"> Contaminates agricultural land Metal sediments in river Human toxicity Livestock and herbage toxicity 	<ul style="list-style-type: none"> Contaminates agricultural land Metal sediments in river Human toxicity Livestock & herbage toxicity 	<ul style="list-style-type: none"> Contamination of groundwater Contamination of Kilmastulla River Human toxicity Livestock, bird and herbage toxicity 	<ul style="list-style-type: none"> Contamination of groundwater Contamination of Kilmastulla river Human toxicity Livestock, bird & herbage toxicity 	<ul style="list-style-type: none"> Human health, Livestock & herbage toxicity
Risk	<ul style="list-style-type: none"> LOW (all, in present mitigated conditions) HIGH (all, in future, without further maintenance and mitigation measures) 	<ul style="list-style-type: none"> MEDIUM 	<ul style="list-style-type: none"> MEDIUM (surface water) MEDIUM (groundwater) LOW (human) LOW (livestock) 	<ul style="list-style-type: none"> LOW (land) LOW (river) LOW (human) LOW (livestock & herbage) 	<ul style="list-style-type: none"> LOW (land) LOW (river) LOW (human) LOW (livestock & herbage) 	<ul style="list-style-type: none"> MEDIUM (groundwater) LOW (river) LOW (human) MEDIUM (livestock, bird, herbage) 	<ul style="list-style-type: none"> MEDIUM (groundwater) LOW (river) LOW (human) MEDIUM (livestock, bird, herbage) 	<ul style="list-style-type: none"> LOW
Potential End-use	<ul style="list-style-type: none"> * Derelict land Wildlife sanctuary with limited public access, no livestock access Pasture 	<ul style="list-style-type: none"> *Derelict land Wildlife sanctuary with limited public access, no livestock access Pasture 	<ul style="list-style-type: none"> * Derelict land Wildlife sanctuary Limited public access, no livestock access Pasture 	<ul style="list-style-type: none"> * Derelict land Wildlife sanctuary Limited public access, no livestock access Pasture 	<ul style="list-style-type: none"> * Derelict land Wildlife sanctuary Limited public access, no livestock access Pasture 	<ul style="list-style-type: none"> Maintain pool as wildlife resource Drain and backfill as derelict land Backfill and cover for pasture 	<ul style="list-style-type: none"> Maintain ponds for water retention Drain and backfill as derelict land Backfill and cover for pasture 	<ul style="list-style-type: none"> Pipe previously removed
Potential Remediation Options	<ul style="list-style-type: none"> Prevent surface disturbance by exclusion for general access and grazing Improve surface vegetation cover by addition of organic layer growth medium Construct engineered cover with low-permeability layer, capillary break and growth medium – for grazing end-use Push-down and re-vegetate outer slopes 	<ul style="list-style-type: none"> Re-vegetate crest of slope, plant crest windbreaks, Plant trees at toe to hide slope 	<ul style="list-style-type: none"> Construct engineered cover with low-permeability layer & capillary break, to reduce leaching Improve surface vegetation cover by addition of organic layer growth medium Water treatment plant Collect toe seepage into toe wetlands 	<ul style="list-style-type: none"> Prevent surface disturbance by exclusion for general access and grazing Improve surface vegetation cover by addition of organic layer growth medium Improve sediment traps and vegetate Push-down and re-vegetate outer slope Repair erosion gulleys 	<ul style="list-style-type: none"> Push-down outer slopes Repair eroded gulleys Maintain surface water drainage system Minor repairs to slope at decant pipe exit 	<ul style="list-style-type: none"> Treat decant water Drain pool, backfill and vegetate Upgrade pond decant system with buried pipeline Construct engineered cover with low-permeability layer, capillary break and growth medium – for grazing end-use Maintain in present state Prevent access for livestock 	<ul style="list-style-type: none"> Treat pond water before discharge Cover over pond area to restore site Improve wetland system Repair embankment crest Information signs 	<ul style="list-style-type: none"> None
Preferred option	<ul style="list-style-type: none"> * Derelict land, restrict access, place growth medium selectively and improve vegetation 	<ul style="list-style-type: none"> Vegetation screen to hide view of bare slope and plant trees at toe. 	<ul style="list-style-type: none"> * Derelict land, place growth medium selectively and improve toe wetlands 	<ul style="list-style-type: none"> * Derelict land, restrict access, place growth medium selectively and improve sediment traps 	<ul style="list-style-type: none"> * Derelict land, maintain drainage 	<ul style="list-style-type: none"> Maintain pool in present state, but upgrade decant system 	<ul style="list-style-type: none"> Improve and maintain wetland system and discharge structures (retention time to be maximised) 	<ul style="list-style-type: none"> None
Actions	<ul style="list-style-type: none"> Detailed survey of quantities and prepare specs, schedule, design, costs Re-vegetation of selected areas Restricted access; prevent surface disturbance by exclusion for general access and grazing Improve surface vegetation cover by addition of organic layer growth medium Plant vegetation wind breaks (some already established) Establish vegetation monitoring programme and maintenance schedule Establish dust monitoring programme and contingency response (integrate with EPA programme) Signage 	<ul style="list-style-type: none"> Detailed survey of quantities and prepare specs, schedule, design, costs Survey for quantities prepare schedule and specs Place soil layer and re-vegetate crest of slope Plant crest windbreaks Plant trees at toe to hide slope 	<ul style="list-style-type: none"> Detailed survey of quantities and prepare specs, schedule, design, costs Restricted access; prevent surface disturbance by exclusion for general access and grazing Monitor surface and groundwater quality Information signs Improvement works to existing wetlands (integrate with I.6.4) 	<ul style="list-style-type: none"> Detailed survey of quantities and prepare specs, schedule, design, costs Re-vegetation of selected areas Restricted access; prevent surface disturbance by exclusion for general access and grazing Improve surface vegetation cover by addition of organic layer growth medium Establish vegetation monitoring programme and maintenance schedule Improve sediment traps around the toe (integrate with I.6.3) Repair erosion gulleys 	<ul style="list-style-type: none"> Routine inspections Integrate drainage with I6.1 and 6.6 	<ul style="list-style-type: none"> Detailed survey of quantities and prepare specs, schedule, design, costs Upgrade decant and penstock system by installation of a penstock at the pool and a buried decant pipeline to retention ponds. Maintain pool at precise minimum size by operation of the decant system 	<ul style="list-style-type: none"> Detailed survey of quantities and prepare specs, schedule, design, costs Carry out detailed survey and water balance calculations Optimise wetland operation Carry out repairs to ponds and discharge system as required 	<ul style="list-style-type: none"> None

* **Note: Derelict land** – Land which will not be utilised, but which will be vegetated with a self-sustaining cover, and for which access will be allowable, but restricted.

APPENDIX B
ESTIMATED COSTS OF REMEDIAL WORKS

A Granular limestone capping and topsoil to Village Field					
Ref	Item	Unit Cost	Quantity	Units	Cost
A1	Limestone capping	€ 5.43	1,840	m ³	€ 9,983
A2	Import topsoil	€ 15.52	2,760	m ³	€ 42,836
A3	Allow sum for works to drains adjacent to field			sum	€ 1,610
				Total	€ 54,430

B Partial backfilling and reshaping of Old Opencast (delivery of backfill included in Items E & F)					
Ref	Item	Unit Cost	Quantity	Units	Cost
B1	Backfill and reshaping			sum	€ 8,050
				Total	€ 8,050

C Backfill shafts, fence shafts and subsidence area, install pressure relief holes as required					
Ref	Item	Unit Cost	Quantity	Units	Cost
C1	Backfill Shafts and fence: sulphur mine			sum	€ 3,381
C2	Fence area of subsidence on floor of Sulphur Mine	€ 21.03	50		€ 1,052
C3	Backfill Shafts and fence: Ballygown				€ 4,830
C4	geophysics, drill pressure relief holes and pipework				€ 14,490
				Total	€ 23,753

D Gabion silt retention structure at Drainage Adit entrance, plus clearance of Adit and Adit works					
Ref	Item	Unit Cost	Quantity	Units	Cost
D1	Silt retention structure				€ 6,118
				Total	€ 6,118

E Gabion protection of erodible streambank at Calamine					
Ref	Item	Unit Cost	Quantity	Units	Cost
E1	Preparatory works	Sum			€ 10,000
E2	Excavation of selected material	€ 2.21	900	m ³	€ 1,985
E3	Disposal of excess excavated material	€ 5.64	100	m ³	€ 564
E4	Install gabions along west bank	€ 55.00	300	m ³	€ 16,500
				Total	€ 29,049

F Demolish Waeltz Plant to one metre wall height and disposal of rubble in mine shafts, Old Opencast and at Magcobar					
	Item	Unit Cost	Quantity	Units	Cost
F1	Demolition of buildings to window cill level			sum	€ 34,897
F3	Disposal of material	€ 5.64	1,000	m ³	€ 5,635
				Total	€ 40,532

G1 Removal of asbestos roof and disposal on designated site in Belgium					
Ref	Item	Unit Cost	Quantity	Units	Cost
G1	Removal & disposal of asbestos roof by specialist contractor			nominal sum	€ 32,200
				Total	€ 32,200

H Conservation measures for Engine House and Furnace Building (mainly repointing)					
Ref	Item	Unit Cost	Quantity	Units	Cost
H1	Pointing and other work to buildings	€ 48.30	320	hr	€ 15,456
				Total	€ 15,456

I Gabion silt retention structure below Silvermines Cottage					
Ref	Item	Unit Cost	Quantity	Units	Cost
I1	Silt retention structure			sum	€ 6,118
				Total	€ 6,118

J Fence old tailings North of Silvermines village					
Ref	Item	Unit Cost	Quantity	Units	Cost
J1	Install fence - Timber post and barbed wire	€ 8.05	300	m	€ 2,415
				Total	€ 2,415

Signage					€ 3,220
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TOTAL € 221,340

A Fence mining archaeological areas					
Ref	Item	Unit Cost	Quantity	Units	Cost
A1	Install fencing around designated areas	€ 8.05	1,098	m	€ 8,835
				Total	€ 8,835
B1 Minor earthworks to area of undercut slope, Dump A, and minor reshaping of dumps					
Ref	Item	Unit Cost	Quantity	Units	Cost
B1	Excavation to affected area	€ 2.83	2,000	m ³	€ 5,667
B2	Filling to affected areas	€ 2.77	2,000	m ³	€ 5,538
B3	Trimming of filled slopes	€ 0.98	5,000	m ²	€ 4,911
B4	Grass seeding to affected area	€ 0.32	5,000	m ²	€ 1,610
B5	Revegetation				€ 8,050
B6	Total Cost for fencing	€ 21.03	200	m	€ 4,205
				Total	€ 29,981
B2 Topsoil and re-vegetate dumps as required					
Ref	Item	Unit Cost	Quantity	Units	Cost
B5	Import topsoil	€ 15.52	1,500	m ³	€ 23,281
B6	Grass seeding	€ 0.32	5,000	m ²	€ 1,610
				Total	€ 24,891
C Consolidate small sulphide deposits, cover and seed					
Ref	Item	Unit Cost	Quantity	Units	Cost
C1	Prepare disposal area	Sum			€ 805
C2	Consolidating sulphide deposits	€ 3.22	1,000	m ³	€ 3,220
C3	Reshaping of consolidated deposit	Sum			€ 805
C4	Import topsoil	€ 15.52	375	m ³	€ 5,820
C5	Limestone layer	€ 5.43	500	m ³	€ 2,713
C6	Grass seed to area	€ 0.32	1,250	m ²	€ 403
				Total	€ 13,766
D Demolish buildings and crusher and remove to off-site disposal site, backfill lagoons on top of Dump E					
Ref	Fill at Gortmore	Unit Cost	Quantity	Units	Cost
D1	Demolish designated buildings			sum	€ 11,334
D2	Backfill lagoon on top of Dump E	€ 2.77	400	m ³	€ 1,108
D3	Import topsoil to top of Dump E	€ 15.52	60	m ³	€ 931
D4	Grass seed to top of Dump E	€ 0.32	400	m ²	€ 128
				Total	€ 13,502
E Minor work to pit perimeter fence					
Ref	Item	Unit Cost	Quantity	Units	Cost
E1	Replace fence	€ 21.03	500	m	€ 10,513
E2	Allow sum for repairs elsewhere			sum	€ 1,610
				Total	€ 12,123
F Work on existing drains drains					
Ref	Item	Unit Cost	Quantity	Units	Cost
F1	Allow sum for drain maintenance			sum	€ 4,025
				Total	€ 4,025
G Work on existing drains drains					
Ref	Item	Unit Cost	Quantity	Units	Cost
G1	Backfill small sinkhole with limestone	€ 5.43	80	m3	€ 434
G2	Import topsoil	€ 15.52	20	m3	€ 310
				Total	€ 745
H Fence settlement lagoons North of pit					
Ref	Item	Unit Cost	Quantity	Units	Cost
H1	Signage				€ 100
H2	Fence lagoons to prevent access	€ 8.06	75	m	€ 605
				Total	€ 705
TOTAL					€ 108,572

A Settlement Ponds - Minor works to ponds and decant system for natural wetland, maintain fence					
Ref	Item	Unit Cost	Quantity	Units	Cost
A1	Allow sum for repairs to existing structures and general tidying up of site				€ 4,830
A1	minor repairs and relacements to fence	€21.03	50		€ 1,052
				Total	€5,882

B Tailings Lagoon - remove tailings to Gortmore TMF, reshape lagoon and establish wetland					
Ref	Item	Unit Cost	Quantity	Units	Cost
B1	Excavation	€ 2.21	22,000	m ³	€ 48,525
B2	Transport excavated material	€ 4.83	22,000	m ³	€ 106,260
B3	Fill at Gortmore	€ 2.77	22,000	m ³	€ 60,922
B4	Wetland Construction				
	Topsoil	€ 15.52	990	m ³	€ 15,365
	Limestone	€ 19.32	360	m ³	€ 6,955
	Liner	€ 11.27	2,100	m ²	€ 23,667
	Reeds	€ 6.44	2,100	m ²	€ 13,524
	Soil retention system	€ 17.71	4,000	m ²	€ 70,840
	Construction, earthworks, structures, pipework			sum	€ 322,000
B5	Allow sum for works to inlet and outlet structures			sum	€ 8,050
				Total	€ 676,109

contingency for hazard waste disposal

€ 161,000

D Subsidence Zone - repair and maintain existing fence, install diversion trench					
Ref	Item	Unit Cost	Quantity	Units	Cost
D1	Replace fence - Metal post & chain link, 1.8m height	€21.03	400	m	€ 8,411
D2	Repairs to existing fence				€ 966
D3	Drainage				
	Excavation	€ 2.77	1,500	m ³	€ 4,154
	Trimming	€ 0.98	2,700	m ²	€ 2,652
				Total	€ 16,182

E Stockpile Area - remove dumped material to Gortmore TMF, level Old Stockpile area, cap and revegetate					
G	Item	Unit Cost	Quantity	Units	Cost
E1	Excavation	€ 2.21	13,800	m ³	€ 30,439
E2	Transport excavated material	€ 4.83	13,800	m ³	€ 66,654
G1	Fill at Gortmore	€ 2.77	13,800	m ³	€ 38,215
G2	Topsoil	€ 15.52	4,140	m ³	€ 64,254
G3	Grass Seeding	€ 0.32	13,800	m ²	€ 4,443.60
E6	Allow sum for works to drains			sum	€ 8,050
				Total	€ 212,056

contingency for hazard waste disposal

€ 193,200

F Plant Area - remove waste materials, remove hostel, conserve old buildings, profile and cover unsurfaced areas, minor landscaping					
Ref	Item	Unit Cost	Quantity	Units	Cost
F1	Transport waste material to Gortmore	€ 4.83	500	m ³	€ 2,415
F2	Fill at Gortmore	€ 2.77	500	m ³	€ 1,385
F3	Reinstate plant area with stone	€ 11.27	150	m ³	€ 1,691
F4	Improve drainage		sum		€ 8,050
F5	Remove hostel building at £11867.76/2500m3	€ 7.65	3,000	m ³	€ 22,943
F6	Profiling and minor landscaping	€ 0.81	20,000	Sum	€ 16,100
				Total	€ 52,583

Contingency for remedial works for possible contaminated land

€ 164,000

TOTAL
(excluding
contingency)

€962,811

G Diversion drain along main roadside					
Ref	Item	Unit Cost	Quantity	Units	Cost
G1	Allow sum for repairs to drain			sum	€ 4,025
G2	Clean out drain	€ 9.66	800	m	€ 7,728
				Total	€ 11,753

H Gorteenadiha Conservation - Archaeological investigation and conservation					
Ref	Item	Unit Cost	Quantity	Units	Cost
H1	Install fence - Timber post and wire -	€ 8.05	300	m	€ 2,415
H2	Archaological Investigation			sum	€ 8,050
				Total	€ 10,465

I Gorteenadiha - fence Cromwell's Road and install drain					
Ref	Item	Unit Cost	Quantity	Units	Cost
I1	Excavation	€ 2.77	860	m ³	€ 2,382
I2	Trimming	€ 0.98	1,548	m ²	€ 1,520
I3	Install fence - Timber post and barbed wire	€ 8.05	430	m	€ 3,462
I4	signage			sum	€ 1,610
				Total	€ 7,363

J Gorteenadiha Open Shafts - fences or backfill					
Ref	Item	Unit Cost	Quantity	Units	Cost
J1	Allow sum for backfil or fencing shafts as required			sum	€ 3,220
				Total	€ 3,220

K Sediment retention structure - gabion wall					
Ref	Item	Unit Cost	Quantity	Units	Cost
G	Gabion baskets to form structures 9in drainage channel and main structure)	€ 88.55	80	nr	€ 7,084
K2	Earthworks			sum	€ 805
				Total	€ 7,889

Contingency to drain to Garryard wetland

€ 15,000

TOTAL €40,690
(excluding contingency)

A Drum and Waste Dump - remove to designated disposal area off-site, reshape surface and revegetate					
Ref	Item	Unit Cost	Quantity	Units	Cost
A1	Excavation	€ 2.21	4,000	m ³	€ 8,823
A2	Transport excavated material	€ 4.83	4,000	m ³	€ 19,320
A3	Fill at Gortmore	€ 2.77	4,000	m ³	€ 11,077
A4	Import topsoil to excavated area	€ 15.52	5,000	m ³	€ 77,600
A5	Seed topsoil	€ 0.32	5,000	m ²	€ 1,600
A6	Segregate, remove and dispose of scrap metal etc.				€ 50,000
				Total	€ 168,420
B Underground Mine and Mine Pits - conserve for heritage purposes and make safe with perimeter fence; remove pit rubbish					
Ref	Item	Unit Cost	Quantity	Units	Cost
B1	Fencing to perimeter of site, 1.8m height, chain link	€ 21.03	1,500	m	€ 31,540
B2	Allow sum for tidying site around pit lake	€ 0.00		sum	€ 16,100
				Total	€ 47,640
C Open shafts - fence Field Shaft, improve grill on Whim Shaft, treat other shafts as appropriate					
Ref	Item	Unit Cost	Quantity	Units	Cost
C1	Fencing and safety grill to shafts	sum		no	€ 6,640
				Total	€ 6,640
D Wetland - install wetland to north-west of tailings impoundment					
Ref	Item	Unit Cost	Quantity	Units	Cost
D1	Wetland construction			sum	€ 483,000
				Total	€ 483,000
E Drainage diversions - install diversion trenches to stream near King's House					
Ref	Item	Unit Cost	Quantity	Units	Cost
E1	Excavation of channels	€ 2.83	350	m ³	€ 991
E2	Trimming of side slopes	€ 0.98	630	m ²	€ 619
G	Grass seeding to side slopes	€ 0.32	630	m ²	€ 203
				Total	€ 1,812
F Surface structures - conserve Engine House, King's House and other structures in accordance with heritage plan (nominal sums)					
G2	Item	Unit Cost	Quantity	Units	Cost
F1	Conserve Kings house			sum	€ 161,000
F2	Conserve Engine house			sum	€ 16,100
F3	Conserve other structures	€ 16,100.00	8	no	€ 128,800
				Total	€ 305,900
G Tailings - surface cover and vegetation					
Ref	Item	Unit Cost	Quantity	Units	Cost
G1	Surface cover and vegetation				€ 12,075
				Total	€ 12,075
H Reservoir fence					
Ref	Item	Unit Cost	Quantity	Units	Cost
H1	Construct reservoir fence	€ 21.03	200	m	€ 4,206
				Total	€ 4,206
I Shallee West					
Ref	Item	Unit Cost	Quantity	Units	Cost
I1	Cost of Fencing	€ 8.05	750	m	€ 6,038
I2	backfill			sum	€ 3,220
				Total	€ 9,258
				TOTAL	€ 1,038,950

A Topsoil, gravel or other growing medium to be placed in areas of poor vegetation					
Ref	Item	Unit Cost	Quantity	Units	Cost
A1	Import topsoil	€ 15.52	37,500	m ³	€ 582,015
A2	Grass seeding	€ 0.32	125,000	m ²	€ 40,250
				Total	€ 622,265

B Vegetation to perimeter, including tree screen					
Ref	Item	Unit Cost	Quantity	Units	Cost
B1	Supply and plant trees	€ 29.51	2,750	no	€ 81,156
B2	Supply and plant hedge	€ 3.04	2,750	m	€ 8,368
				Total	€ 89,524

C Minor earthworks - improve sediment traps and repair erosion gulleys					
Ref	Item	Unit Cost	Quantity	Units	Cost
C1	Allow for use of one front end loader	€ 156.49	60	days	€ 9,390
				Total	€ 9,390

D New decant weir and discharge pipeline from tailings pool					
Ref	Item	Unit Cost	Quantity	Units	Cost
D1	Allow sum for construction of weir			sum	€ 4,830
D2	Supply and place pipe	€ 53.34	500	m	€ 26,670
				Total	€ 31,500

E Minor earthworks to retention ponds					
Ref	Item	Unit Cost	Quantity	Units	Cost
E1	Allow sum for minor earthworks			sum	€ 3,220
				Total	€ 3,220

F Site for waste disposal on top surface, including access road					
Ref	Item	Unit Cost	Quantity	Units	Cost
F1	Liner	€ 16.10	7,500	m ²	€ 120,750
F2	Topsoil	€ 15.52	8,000	m ³	€ 124,160
F3	Grass-seeding	€ 0.32	8,000	m ²	€ 2,560
F4	Access road	€ 5.43	6,500	m ³	€ 35,295
				Total	€ 282,765

G General signage					
					€ 1,600

TOTAL €1,040,263

G Capping the whole impoundment					
Ref	Item	Unit Cost	Quantity	Units	Cost
G1	Import and place clay	€ 14.62	204,000	m3	€ 2,982,235
G2	Import and place limestone	€ 5.43	153,000	m3	€ 830,132
G3	Import and place topsoil	€ 15.52	153,000	m3	€ 2,374,621
				Total	€ 6,186,989