



The University of Adelaide  
The Department of Geology and Geophysics

# **Nature and Extent of Contamination at the Abandoned Wheal Ellen Mine and Implications for Rehabilitation**

**KATE TRELOAR**

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# CONTENTS

<b>Abstract</b> .....	<b>1</b>
<b>Introduction</b> .....	<b>3</b>
<b>1. Wheal Ellen Mine</b> .....	<b>5</b>
1.1 Location and Setting.....	5
1.2 Geological Setting.....	7
Regional Geology.....	7
Local Geology.....	8
1.3 Mining History.....	9
1.4 Mine Related Issues.....	11
<b>2. Methods</b> .....	<b>12</b>
2.1 Sampling.....	12
2.2 Analysis.....	13
Mineralogy.....	13
Geochemistry.....	14
<b>3. Characterisation of Potential Contaminants</b> .....	<b>15</b>
3.1 Potential Acid Producers.....	15
Identification.....	15
Characterisation.....	16
3.2 Potential Heavy Metal contaminants.....	18
Identification.....	18
Characterisation.....	19
<b>4. The Nature and Extent of Contamination</b> .....	<b>26</b>
4.1 Background Levels.....	26
Soil.....	26
Water.....	27
4.2 Nature of Contamination.....	28
Soil.....	28
Water.....	29
4.3 Extent of Contamination.....	29
Soil.....	29
Water.....	30
<b>5. Remediation</b> .....	<b>32</b>
5.1 The need for rehabilitation.....	32
5.2 MESA's Rehabilitative Work.....	32
Initial Remediation.....	32
Further Rehabilitation proposals.....	33
5.3 Discussion of MESA's Rehabilitation and Proposals.....	33
5.4 Natural Abatement at Wheal Ellen.....	34
Neutralisation by Country Rocks.....	35
Natural Wetland System.....	35
5.5 Recommendations.....	36
<b>Summary and Conclusions</b> .....	<b>38</b>
<b>Acknowledgements</b> .....	<b>40</b>
<b>References</b> .....	<b>41</b>

# APPENDICES

<b>A1. Sulphide Mine Waste Geochemistry</b> .....	<b>A1</b>
1.1 Acid Mine Drainage.....	A1
1.2 Heavy metal contamination.....	A4
1.3 Current rehabilitation techniques.....	A7
<b>A2. Methodology for Sampling and Analysis</b> .....	<b>A10</b>
2.1 Sampling.....	A10
Solids.....	A10
Water.....	A11
2.2 Sample Preparation.....	A11
Solids.....	A11
Water.....	A13
2.3 Analytical Techniques .....	A14
<b>A3. Sample Sites</b> .....	<b>A17</b>
<b>A4. Raw Data tables</b> .....	<b>A22</b>
4.1 XRF data of the major elements potentially contaminating mine materials.....	A23
4.2 XRF data of the trace elements potentially contaminating mine materials.....	A25
4.3 XRF data of the major elements to determine the nature and extent of contamination.....	A26
4.4 XRF data of trace elements to determine the nature and extent of contamination.....	A29
4.5 ICP data (major, trace elements and chloride)-Solid samples.....	A32
4.6 ICP data (major, trace elements and chloride)-Water samples.....	A35
4.7 Water extracted EC/pH data for all solid samples.....	A36
4.8 EC/pH data for all water samples.....	A37
4.9 Assay values.....	A38
<b>A5. Electron Microprobe (EMP) data</b> .....	<b>A39</b>
<b>A6. XRD Plots and Interpretation</b> .....	<b>A51</b>

# FIGURES

1.1 Location map for Wheal Ellen Mine
1.2 General overview and topography of Wheal Ellen site
1.3 Regional geology of the Kanmantoo Group
1.4 Degradation at Wheal Ellen following 1906 closure
1.5 Cross section of the Wheal Ellen shafts
2.1 Map of mine surface materials and sample sites
2.2 Base map of wetland sample sites
3.1a Geochemical map; Pb content (mine materials)
3.1b Geochemical map; Zn content (mine materials)
3.1c Geochemical map; Cu content (mine materials)
3.1d Geochemical map; Cd content (mine materials)
3.1f Geochemical map; Sb content (mine materials)
3.1g Geochemical map; Sample numbers (mine materials)

- 4.1a Geochemical map; Pb content (mine surrounds)
- 4.1b Geochemical map; Zn content (mine surrounds)
- 4.1c Geochemical map; Cu content (mine surrounds)
- 4.1d Geochemical map; Cd content (mine surrounds)
- 4.1e Geochemical map; Sb content (mine surrounds)
- 4.1f Geochemical map; Sample numbers (mine surrounds)
- 4.2 Graph of water pH and EC values

### 5.1 Wetland profiles

- A3.1 All mine area sample sites
- A3.2 Background sample site locations
- A3.3 Water sample sites (locations and descriptions)

## PLATES

**Frontice** Photograph of western hillslope with acid scouring and erosion

- 3.1a Sulphidic waste rock components
- 3.1b Weathering sphalerite surface
- 3.1c Fe sulphate within sulphidic waste rock
- 3.1d Generalised siliceous tailings mass highlighting heavy mineral content
- 3.1e Hematitic gossan boxwork with significant anglesite content
- 3.1f Hematitic gossan boxwork with minimal anglesite content
- 3.1g Hematite with varying Pb content and anglesite (within gossan)
- 3.1h Gahnite crystal with Zn coprecipitation in surrounding anglesite

- 3.2a Goethite with significant Zn content
- 3.2b Gahnite within quartz, hematite and anglesite
- 3.2c Jarosite with varying heavy metal coprecipitation
- 3.2d Galena housed within fine grained silicaous matrix
- 3.2e Sulphides incorporated into secondary mineralisation
- 3.2f Sulphides dispersing through secondary mineralisation
- 3.2g Anglesite rimmed galena grain
- 3.2h Pb coprecipitation on Fe sulphate

- 3.3a Coprecipitated Fe/Pb sulphate
- 3.3b Jarosite and Fe sulphate with various coprecipitation
- 3.3c Jarosite (Pb coprecipitation) and Fe sulphate (Zn coprecipitation)
- 3.3d Halotrichite with Zn coprecipitation
- 3.3e Jarosite with negligible heavy metal content
- 3.3f Muscovite (partially weathered schist) intermixed with anglesite
- 3.3g Fe oxide (As, Pb and Zn content) and anglesite(within mica schist)
- 3.3h Jarosite (with varying Pb concentrations) within biotite schist

- 4.1a Contaminated gully soil with anglesite content
- 4.1b Jarosite (varying Pb concentrations) within gully soil
- 4.1c Hematite with varying heavy metal concentrations (within soil)
- 5.1a Wheal Ellen prior to rehabilitation
- 5.1b Wheal Ellen following shaft infilling
- 5.1c Clay covered gossan dump with imported weeds
- 5.1d Sulphide mass within imported clay
- 5.1e Fe sulphate efflorescence on imported clay surface
- 5.1f Fe sulphate (with significant heavy metal concentrations) on clay surface
- 5.1g Subsidence over the Main Engine Shaft
- 5.1h Wetland area, with suspected natural filtration capabilities

# **TABLES**

<b>3.1 Evaluation of potential contaminants at Wheal Ellen.....</b>	<b>19</b>
<b>4.1 Background concentrations of heavy metals at Wheal Ellen.....</b>	<b>27</b>
<b>4.2 Determination of heavy metal contaminants.....</b>	<b>28</b>
<b>4.3 Sulphur isotope values for selected sulphide, sulphate and water samples.....</b>	<b>30</b>

# ABSTRACT

The Wheal Ellen Mine, South Australia, was mined sporadically between 1860 and 1911 for Pb, Ag, Au and pyrite. The mining process exposed sulphidic material to oxygen and water, with the inevitable creation of acid mine drainage (AMD), and a resultant increase in the mobility of potentially toxic heavy metals. Since closure of the mine, AMD has continued unchecked, causing acid scouring, devegetation and erosion on the surrounding hillslopes, with fears of manifestations in the nearby Rodwell Creek, a tributary of the agriculturally important Bremer River. Following complaints, a MESA inspection in late 1995 identified Wheal Ellen as an environmental threat and safety hazard requiring rehabilitative action. Preliminary work saw the abandoned mine shafts infilled with surface dumped mine wastes, and "clean" clay dumped in readiness for spreading over the mine area as topsoil. The need for further work is acknowledged, but no plans are confirmed.

Investigations show that whole rock sulphidic wastes (up to about 98% sulphide content) constitute major acid producing potential at the mine. Tailings, containing highly reactive fine-grained sulphides also comprise a potential for acid production, even though total sulphide content (about 2%) is significantly lower. The abundant secondary mineral jarosite, formed from dissolution products of sulphides and aluminosilicates, generates acid during precipitation and again on dissolution. The background water-extracted pH of soils is approximately neutral compared to 2.5-4.0 in soil surrounding the mine. This enhanced acidity would primarily result from the downslope transportation of acid-producing materials (sulphide grains and/or jarosite) from the mine area.

Mine-related heavy metal contamination in soil surrounding the mine, particularly in major erosion features, is substantial for Pb, Zn, and Cu with minor increases in As levels. Rodwell Creek appears to be receiving groundwaters of mine origin, but current environmental impact is negligible through dilution, neutralisation by carbonates and possible natural filtering in a wetland system.

In retrospect, the relatively small volume of mine wastes involved may have best been treated by physical removal and relocation at a more appropriate treatment site. This option is no longer viable however, as surface remediation has already commenced (shaft infilling and clay dumping). MESA now needs to address the resultant potential threat to groundwater, and consequently Rodwell Creek, as well as the problems associated with surface contamination. An impermeable shaft capping (e.g. concrete) would minimise water infiltration into the shafts, although the potential for shaft subsidence may create complications. Compacted clay should create an adequate semi-impermeable cover for

remaining surface wastes. Water diversion techniques (surface contouring and channel creation) would further reduce water infiltration and therefore AMD generation and transportation. Finally, importation of further clay as a topsoil cover is required, after which, rehabilitation of degraded surface soils ought to be satisfactorily addressed by MESA's revegetation plans. Monitoring of Rodwell Creek water quality and the evaluation of long-term revegetation success will need to be an integral part of rehabilitation.