

Chapter 1

INTRODUCTION

Any ore-body or rock (such as coal), which contains sulphide minerals, especially pyrite, has the potential to cause acid effluent as a result of oxidation. Acid Rock Drainage (ARD) is the result of the natural oxidation of sulphide minerals within a rock, as a result of weathering, whereas Acid Mine Drainage (AMD) is the result of mining and the associated mineral crushing activities (Steffen, Robertson and Kirsten, 1989). The acid mine drainage can be generated underground by the exposure of *in situ* material, or broken material i.e. ore, coal or backfill, to air and water; or on surface in waste rock dumps i.e. piles of coarse discard resulting from the beneficiation of coarse material, or tailings dams from the beneficiation of milled i.e. fine material. If improperly contained, contaminants in mine waste can leach out into surface and groundwater causing serious pollution problems that can last for many generations.

This study is a contribution to the Coaltech Project, which is concerned with the collection, treatment and utilisation of water on coal mines in the Witbank and Middelburg Dam Catchment areas (Figure 1). The Coaltech Project is a collaboration between research institutes, government and the South African coal mining industry. The aim is to develop solutions to a number of wide-ranging problems affecting the coal mining industry and the environment.

The objectives of this thesis were as follows:

1. To provide a reliable summary of extensively researched text relating to historical, international and South African perspectives on the problem of acid mine drainage.
2. To describe the chemistry of acid mine drainage in terms that environmental scientists from a wide variety of backgrounds could understand.

3. To perform a series of tests on selected samples taken from a pertinent study area, to indicate simply how the potential to generate acid mine drainage can be identified. Then to discuss the results of these tests in the context of the environment of the study area.
4. To highlight the importance of coal as an energy source and an economic commodity, including discussion regarding methods of recovery.
5. To highlight the importance of water as a national resource and discuss methods of testing for contamination related to acid mine drainage.
6. To develop an original Geographical Information System to enable water quality and coal characterisation data, contained in a series of vast databases, to be accessible and meaningfully presented to the environmental scientist.
7. To present a wide range of prevention, prediction, management and treatment options. Then to develop an original management design process. Then to discuss suitable management options for the study area, based on this investigation and others.

Many of South Africa's current AMD problems can be attributed to mining activities from the period before 1956. During this time there was little or no enforcement of the weak legislature passed for protecting water bodies from the potential pollution caused by coal mining. Four times more coal and discard have been generated since then.

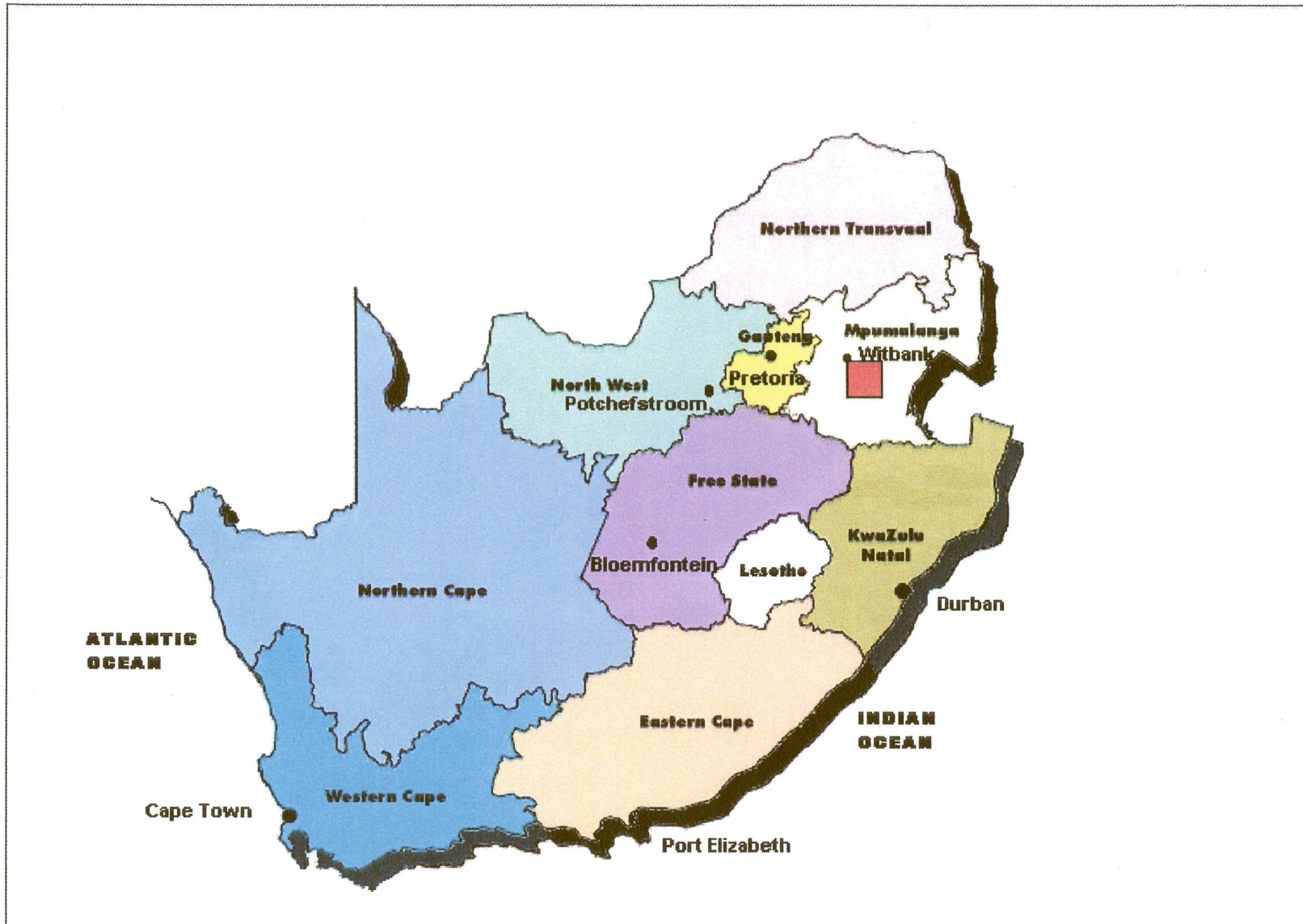


Figure 1: Location of study area

In conjunction with the unfavourable location of coal reserves in relation to important water resources, the projected future expansion in mining activity is cause for concern. The receiving water quality objectives (RWQO) approach to water quality management and associated water quality related studies will be a rational way of defining goals and standards for the mining industry. Serious doubts have been raised as to whether the necessary expertise, techniques and funding are available in the country to meet these objectives. The Department of Water Affairs and Forestry (DWAF) intends to give far more attention to water quality management in the mining industry than it did in the past and will do this in close co-operation with the mining sector through the Chamber of Mines.

Polluted mine water, estimated at a present flow rate of 18,25 million m³/a is currently discharged in the Upper Olifants River catchment to public streams. It is expected that this volume will increase to 26,1 million m³/a by 2020. The mine water is acidic in certain locations and generally contains high sulphate concentrations. Should this water be collected and treated to a quality where it can be re-used, it will offer a number of benefits. In addition, the area will also benefit from increased knowledge regarding the acid-generating potential of the coal and coal discard exposed here, so that the rate and quantity of acid generation in affected waters can be predicted and potential mitigation technologies can be designed (Wates, 1987).

It is hoped that knowledge gained through this project will motivate the extension of the study area and intensify the work needed to develop a water management strategy that is nationally applicable.