Motivation for selecting Secunda as a field study site/case history

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Sasol have operated a large petrochemical facility at Secunda for over two decades and the complex assortment of chemical processes has ensured an almost exaggerated cocktail of contaminants (organic, inorganic, cationic, anionic) having the potential to threaten groundwater quality. What is more, their effluent has been disposed of by irrigation onto land (two main areas, with slightly different soil and geological characteristics) for well over a decade. Sasol, through their research organization Sastech, have carefully monitored soil properties and groundwater quality over this period and have built up a valuable database of chemical impacts. They have also carried out research, which has led to a number of MSc theses, dealing with soil, water and environmental quality.

There is already evidence indicating that some groundwater contamination has begun in the vicinity of effluent storage and irrigation facilities. At the end of 2002 Sasol hosted a workshop of researchers and consultants which led to the synthesis of more than a decade of work on the effluent irrigation at Secunda. The Karoo/Ecca geology and the duplex (Swartland)/black clay (Arcadia) soil association are both strongly representative of large parts of the South African interior, especially the highveld. The groundwater itself is fairly typical of that which would be associated with fractured rock aquifers.

This is a high profile study area, rich in good data, well-known to the research community and the WRC itself, small enough to be able to tackle thoroughly during the time available and very likely to provide firm answers to some of the questions being posed in the project. Mr M Ginster of Sastech has indicated that there is a very strong likelihood not only of approval but of active co-operation by Sasol. The biggest advantage of Secunda is that it will give a quantitative basis for testing post facto our groundwater vulnerability assessment criteria. There is probably no site comparable in South Africa in this respect.
Motivation for selecting Midrand, Gauteng as a field site

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Midrand was proposed as a study site for the testing and calibration of vulnerability assessment techniques during a project team meeting held at the CSIR on 3 July 2003. The site was proposed as a preferred site together with the Cape Flats and Secunda.

Midrand fulfils several of the criteria for site selection that were discussed during the meeting. Midrand is strategically located approximately 25km north of Johannesburg CBD and 28km south of Pretoria CBD (240 km²). The area is currently facing environmental challenges and conflicts of both the first and third world as it contains on the one hand the pressures of a rapidly developing industrial, mining and urbanization sector and in contrast a high-density, poverty-driven, developing community with little access to basic services (Fakir & Broomhall, 1999).

Transvaal dolomites and Halfway House granites (fractured rock) underlie the area of study at Midrand. Ground water flow is northwards and is constrained by a system of compartmentalising dykes. Considerable differences in ground water level and chemistry are found at different sides of some of the dykes. Geophysical observations delineate areas of weathering of the dolomites and possible channels of preferential ground water flow. The entire area of study is prone to infiltration of surface water and is therefore vulnerable to surface pollution (www.fwr.org). The soil forms associated with the area is mainly red, dystrophic and/or mesotrophic (freely drained soils).

Three main river systems form part of the Midrand municipality: Kaalspruit/Olifantspruit, Rietspruit and Juskei River. The areas around the rivers have been severely degraded as a result of formal and informal urbanization and industrial, agricultural and domestic activities close to riverbanks, resulting in negative impacts on water quality of Midrand area. Pollution, erosion, and the invasion of exotic plants also seriously impact on these areas.

All three catchments described have limited monitoring. Four points along the Kaalspruit are monitored (from 1997) by Midrand Community Services. The Kempton Park/Tembisa Municipality also conducts monitoring of the Kaalspruit at the municipal boundary (data from 1997). Data from four points (since October 1993) along the Jukskei River within Midrand is available from the Jukskei River Forum. Ground water quality data is more limited with no routine monitoring system in place. Sewage discharges are permitted and controlled by the Department of Water Affairs (DWAF). No formal monitoring programme of surface water resources is available.
for Midrand. Only small parts of the total surface water system of Midrand are monitored (Fakir & Broomhall, 1999).

The site offers excellent opportunities for joint effort between hydrogeologists, soil scientists and spatial data analysts. There may also be opportunities to compare vulnerability assessment methods in primary and secondary aquifer environments. Soil data on small scale is available for the area.

The Midrand site is located in close proximity to ARC-ISCW, as well as the Johannesburg International Airport, from where it could be visited on regular basis by the research team.

References:


www.fwr.org
Motivation for selecting the Cape Flats as field site

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This document motivates the selection of the Cape Flats as one of the appropriate sites for testing and cross-calibration of the different vulnerability assessment techniques to be used in the project. The motivation is based on the selection criteria presented by Lisa Cave (CSIR Environmentek) at the meeting held on 3 July 2003 at CSIR Environmentek – Stellenbosch.

The focus of this project is on urban catchment areas. The appropriateness of the Cape Flats as one of the study sites is therefore obvious as this is an important urban industrial area that will provide a high concentration of pollution sources.

The Cape Flats are ranked as a highly contaminated area. Contamination through industry, urban settlements as well as agriculture will ensure research studies in an area with great variety of pollution sources. In addition, pollution sources occurred in the Cape Flats already for some time.

A large amount of data sets was already collected in the Cape Flats, which will facilitate the redistribution of human and financial resources towards sites where less or no data are available. The data from the Cape Flats will be searched for at research, academic and government institutions, as well as at consulting and commercial firms. Available data will then be processed and packaged in a suitable format for testing and calibrating the different vulnerability assessment techniques to be used in this project.

This site will allow joint efforts between institutions involved in the project (e.g. University of the Western Cape and University of Stellenbosch). In addition, it will provide links to other areas of interest (e.g. project on the sustainable utilization of subterranean water resources for improvement of quality of life, University of the Western Cape and VLIR).

The Cape Flats will be one of the sites to be used for comparison between the different vulnerability assessment techniques.

It is very important that the project covers the diversity of South African conditions. The Cape Flats provide a site with a diversity of soils, which will allow model calibration for a variety of conditions in order to increase the representativity of the study.
The location of the Cape Flats is ideal from the logistics point of view, easily accessible from the University of the Western Cape and the University of Stellenbosch.

It is strongly believed that a study in the Cape Flats will be supported by the Municipalities involved as well as by the various research institutions that will make their data available.

The benefit of selecting this site to the local community is obvious. The Cape Flats are an urban area where water shortage and quality problems are projected for the near future.

The Cape Flats will not provide a range of groundwater vulnerability conditions. The sandy geology and shallow water tables make this site very vulnerable to pollution. However, this site will, amongst all others, represent the extreme case of vulnerability.

The study in the Cape Flats will provide future research value to Cape Conservation, urban settlements, industry, research institutions and government. It is envisaged that the research in the Cape Flats will facilitate and improve management of pollution problems in the area.
Motivation for selecting Durban as a field site

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This document presents a motivation for including Durban as an alternative study site, should one of the preferred sites of Cape Flats, Secunda or Midrand prove unsuitable for the vulnerability assessment and mapping project. The potential sites were selected based on criteria developed in a project team meeting held at the CSIR on 3 July 2003. The attributes of a study site in Durban are assessed against the criteria here.

Durban is the second largest urban and industrial hub in South Africa. The city is also characterised by large areas of high density urban and peri-urban informal settlements in which inadequate sanitation and waste management facilities might pose a risk of stormwater and groundwater contamination. Many industries in the Durban and Pinetown areas use groundwater in their processing or for irrigation. Private boreholes are also relatively common. Contamination of groundwater has occurred at some industrial sites in the Durban area e.g. Umbogentweni industrial complex and the fuel pipeline spill near Wentworth.

Groundwater studies have been undertaken in the Durban area by DWAF and various private consultants e.g. E. Martinelli and Associates, Groundwater Consulting Services, Davies Lynn & Partners, Groundwater Development Services, Steffen, Robertson & Kirsten and Drennan, Maud & Partners, who contributed to the 1992 – 1995 surveys for the 1:500 000 geohydrological map of Durban. There is an active branch of the Groundwater Division in KwaZulu-Natal which may be able to supply information on contamination studies and the Ethekwini Municipality may also be able to make recommendations relating to a study site for this project. Land type data for soils are also available for Durban, since this is one of the priority urban centres in South Africa. The nature and extent of existing data sets are not known to the project team at this stage, but are expected to be suitable for the vulnerability project.

Surface lithology in the Durban area consists mainly of coastal deposits (unconsolidated to semi-consolidated sediments including sand, calcarenite, conglomerate, clay and silcrete. Underlying lithologies, which also outcrop at surface further inland, are argillaceous and arenaceous sedimentary rocks which form fractured rock aquifers. The wide variety of lithological and soil conditions will provide a range of environments for the testing of aquifer vulnerability assessment methods around Durban.

Two criteria where the Durban site does not score well are the proximity to the Western Cape, where most of the project team researchers are based, and the support of the site owner/manager, which cannot be determined unless a more specific site is
chosen. Project team contacts with Durban-based organizations are not as strong as links with the other proposed study sites.
Motivation for selecting Port Elizabeth as a field site

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Port Elizabeth was proposed as a study site for the testing and calibration of vulnerability assessment techniques during a project team meeting held at the CSIR on 3 July 2003. The site was proposed as an alternative to the preferred three sites of Cape Flats, Secunda and Midrand, should any of these prove unsuitable for the purposes of the project.

Port Elizabeth fulfils several of the criteria for site selection that were discussed during the meeting. It is an important urban and industrial area and the major urban settlement of the Eastern Cape Province. The Port Elizabeth metropolitan area is South Africa’s fifth largest city in terms of population and the second largest in terms of area. Port Elizabeth and its neighbouring towns of Uitenhage and Despatch make up an important centre for the automobile and textile industries in South Africa. There is evidence of groundwater contamination in many areas on the basis of electrical conductivity, chloride and nitrate levels, which is attributed to contamination by waste dumps, fertilizer application, leaking sewers and stormwater runoff (Rosewarne, 2002).

The development of new harbour facilities and the industrial development zone (IDZ) at Coega will bring with it industries that pose a significant threat of groundwater contamination. In addition, heavy industries have already been operating in the old industrial areas of Port Elizabeth for several decades, leading to a high potential groundwater contamination ranking for this area.

Although contamination will not have occurred yet at the undeveloped Coega site, there is a sizeable collection of soil and water data that has been collected for this area. The development has followed all the latest environmental regulations and data collected from environmental impact assessment studies and baseline records from the Coega Development Corporation, which undertakes regular monitoring, will provide a valuable resource for the project.

Groundwater data in the Port Elizabeth area has been collected by the Nelson Mandela Metropolitan Municipality (NMMM), Coega Development Corporation (CDC), Pechiney Aluminium, Department of Water Affairs and Forestry (DWAF, Eastern Cape), SRK (Port Elizabeth office) and the CSIR. Contact people who may be approached for assistance with this project include: John Raimondo (CDC), Gordon Maclear (SRK), Jane Barron (DWAF) and Paul Lochner (CSIR, Pechiney aluminium).
The site offers a range of geological and soil settings for the vulnerability studies. Geological formations range from older Table Mountain Group sandstones and younger Uitenhage Group siltstones and mudstones to Quaternary river and beach alluvial deposits. These provide both fractured rock and primary aquifer settings. The geologic and topographic variations suggest that a variety of soil types will also be available for study here.

The site offers excellent opportunities for joint effort between hydrogeologists, soil scientist and spatial data analysts. There may also be opportunities to compare vulnerability assessment methods in primary and secondary aquifer environments.

Port Elizabeth is closer to the Western Cape and has advantages over the other sites at Durban, Midrand and Secunda in terms of expected travel costs for road travel to the site since all but the ARC team project members are resident in the Western Cape. Air travel to Port Elizabeth, however may be slightly more expensive than to Durban or Johannesburg.

The developers and authorities are keen to be seen as behaving in an environmentally responsible manner in the development of the Coega IDZ and are likely to agree to be involved in a project aimed at groundwater protection, so data sharing issues should be relatively easy to overcome. Other potential sites in Port Elizabeth may need to be discussed with the municipality or DWAF.

The Eastern Cape is one of the regions of the country where development opportunities and community upliftment are most needed. Protection of water supplies is one benefit that this project could offer.

In the Port Elizabeth municipal area, groundwater abstraction is mainly through about 300 private boreholes in the Table Mountain Group which are used to supplement surface water supplies during times of drought. In terms of yield and quality, however, the TMG aquifer in Port Elizabeth is not considered a potential source of bulk water supply (Rosewarne, 2002). The Uitenhage Artesian Basin is South Africa’s most important artesian basin, supplying approximately 15% of Uitenhage’s municipal requirements via springs as well as providing irrigation water for large citrus farming areas (Maclear, 2002). The recharge area for this confined aquifer is, however, outside the major urban area.

References:
