Water and Rehabilitation issues affecting Coal mining

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40% Of The World Will Live In Water-Scarce Regions By 2025

Projected Renewable Water Supply per Person by River Basin, 2025

ANNUAL RENEWABLE WATER SUPPLY (M³/PERSON/YEAR)

- <500
- 500 - 1,000
- 1,000 - 1,700
- 1,700 - 4,000
- 4,000 - 10,000
- >10,000
- No data

Note: Outlined basins are projected to have a population of more than 10 million people in 2025 and to be in or approaching water scarcity.

Projection: Geographic
Source: CFSIN, 2000; Felke et al., 1999
Introduction

- Sub – catchments of the Witbank and Middelburg Dams of the Upper–Olifants River catchment – extensive coal mining
- Mining industry stimulated local urban and industrial development
- Power generation sector also relies on the coal mining of the area
- Access to sufficient water of acceptable quality – common dominator to urban, industrial, mining and power generation developments
Water resources – under stress with the local power generation industry relying on inter-basin water transfer schemes from the neighbouring Komati, Usutu and Vaal Catchments

Many mining operations produce excess water which can be reclaimed and beneficially re-used

The Emalahleni (Witbank) water reclamation project – the first such large scale mine water reclamation and re-use project. Optimum plant under construction
Upper Olifants Catchment
Features of the catchment

- Streamflow is highly regulated because of extensive damming
- Major impoundments upstream of Loskop Dam – Witbank, Middelburg, Bronkhorstspruit and Premier Mine dams
- Many smaller farm dams and water supply structures associated with the mining operations have also been constructed in the catchment
- The landscape in the southern and central part of the catchment – dominated by mining operations and mining-related infrastructure
- The coal mines provide essential fuel to the local power stations as well as to the domestic and international markets.
- Several abandoned mining operations are located in the central part of the catchment, towards the west and north-west of the town of Witbank
- Several large coal-fired power stations are also located in the catchment – Arnot, Hendrina, Komati, Duhva, Matla, Kriel and Kendal power stations which are all supplied from local feeder mines in the catchment
- Agriculture, both dryland and irrigated, in the southern and central portions producing high yields of maize.
Collieries in Upper Olifants
Mining Sector: Principles of mine water generation
The conceptual model for excess and stored mine water was done to highlight the following aspects of a generic mine water system:

- Mine water ‘make’ is proportional to the mined or disturbed area.
- The water stored on a mining complex depends on the mine age, coal deposit location and mining method.
- Excess mine water may be variable over time, and sensitive to the ability of the mine to store water in old workings.
- Mine water availability is determined by the recharge to mines and should not be confused with the excess water decanting from the mine site at any specific time.
### Mining Sector: mining district A

#### Total excess mine water for Mining District A

<table>
<thead>
<tr>
<th>Operational Collieries</th>
<th>Year 2007</th>
<th>Year 2017</th>
<th>Year 2027</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Largo</td>
<td>2.2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Klipspruit</td>
<td>1</td>
<td>2.8</td>
<td>3.6</td>
</tr>
<tr>
<td>Tweefontein</td>
<td>24.8</td>
<td>21.9</td>
<td>10</td>
</tr>
<tr>
<td>Khutala</td>
<td>2</td>
<td>3.5</td>
<td>5.2</td>
</tr>
<tr>
<td>Zondagsfontein</td>
<td>0</td>
<td>0.05</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Total excess – Ml/day</strong></td>
<td><strong>30.0</strong></td>
<td><strong>28.2</strong></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

#### Net excess mine water for Mining District A

<table>
<thead>
<tr>
<th>New mining operations</th>
<th>Year 2007</th>
<th>Year 2017</th>
<th>Year 2027</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zondagsfontein</td>
<td>0</td>
<td>-1.4</td>
<td>-0.74</td>
</tr>
<tr>
<td>Phola beneficiation plant</td>
<td>0</td>
<td>-3.5</td>
<td>-3.5</td>
</tr>
<tr>
<td>Klipspruit</td>
<td>0</td>
<td>-3.3</td>
<td>-3.3</td>
</tr>
<tr>
<td>Eskom - Station X and Y</td>
<td>No info available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goedgevonden</td>
<td>0</td>
<td>7.3</td>
<td>7.3</td>
</tr>
<tr>
<td><strong>Total imported – Ml/day</strong></td>
<td><strong>0</strong></td>
<td><strong>-6.8</strong></td>
<td><strong>-6.8</strong></td>
</tr>
<tr>
<td><strong>Net excess - Ml/day</strong></td>
<td><strong>30</strong></td>
<td><strong>21</strong></td>
<td><strong>11.9</strong></td>
</tr>
</tbody>
</table>

- **Expected start-up 2017**
Summary of Excess Mine Water
Assessment of mine water availability for the Coalfields:

- next 10 – 20 years, 40 – 50 Ml/day of excess mine water will have to be dealt with by re-use and/or discharge
- potential to draw 60 – 100 Ml/day on a sustainable basis from mining operations
- amount of water becoming available will grow over time as the extent and type of mining changes
- current best estimate of the available mine water in the post-mining scenario is approximately 200 Ml/day

### Stored Mine Water

<table>
<thead>
<tr>
<th>District</th>
<th>Vol stored Ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>225 000</td>
</tr>
<tr>
<td>B</td>
<td>195 000</td>
</tr>
<tr>
<td>C</td>
<td>20 800</td>
</tr>
<tr>
<td>D</td>
<td>52 300</td>
</tr>
<tr>
<td>E</td>
<td>253 500</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>522 000</strong></td>
</tr>
</tbody>
</table>
Opencast mine storage
Municipal Sector: Emalahleni Municipality

The Emalahleni LM consists of the following main towns:

- Witbank town
- Ogies and Phola
- Kriel and Thubelihle
- Rietspruit

- Main economic activity: town of Witbank with approximately 79% of the total population.
- Projected water requirements – calculated using the population growth of Emalahleni LM which was estimated to be 3.13% based on Stats SA population estimates between 2004 and 2005.
Emalahleni Municipality: water requirements

Current Water Use

- Witbank/Ogies/Phola
  - Witbank Dam which (constructed in 1971) – capacity of 104 million m³ and an assured yield of 75 ML/day (current DWAF authorisation)
  - The DWAF (1999) report – 98% assurance yield at 87.7 ML/day.
    - already exceeded by *de facto* water abstractions of up to 105.8 ML/day.
- Kriel, Thubelihle
  - ESKOM via Kriel Power Station – current water use approximately 3.8 ML/day – still well within the capacity of the existing supply (7ML/day).
- Rietspruit
  - Rietspruit Township obtains raw water from Rietspruit Dam
  - Treatment plant has a capacity to provide more than 4 ML/day
  - Current consumption >3.2 ML/day (400l/p/d)
- Informal areas
  - Water tankers.
Power Generation Sector

- The area under consideration is a water scarce area, yet a focal point in terms of development – water transfer schemes are indispensable.

- Interbasin water schemes that feed the local power stations are all inter-connected:
  - Upper Vaal system can supplement the Usutu system.
  - Usutu system can supplement the Komati system.
  - Vaal system, via VRESAP pipeline, can augment both systems.

- The entire system is operated to ensure the overall system assurance; however, future scenarios that have been modelled indicate potential failure by 2020, so that an alternate water supply is critical.
Power generation – Water schemes
Conclusions – water deficits

Water deficits

- **Emalahleni Local Municipal area (Witbank):**
  - the shortfall is expected to grow from the current 24.9 ML/day – 63 ML/day in 2027.
  - When the SACE Water Reclamation Project comes on line in 2007, the large water deficit that has developed in recent years will be reduced to 4.9 ML/day, but not eliminated.

- **Steve Tshwete Local Municipal area (Middelburg):**
  - Hendrina/kwaZamakuhle: urgent need to supplement water supply to the area (1.5ML/day) which will increase to 3 ML/day by 2027.
  - Middelburg/Mhluzi area: will also require a supplemental source in 2010 – deficit based on the current water supply from Middelburg Dam will reach 12.2 ML/day in 2027.

- **Power generation sector:**
  - 2017 – requirement for an additional 44 ML/day and 30 ML/day respectively for the power stations drawing from the Komati and Usutu sub-systems, respectively.
Conclusions – water deficits (2)

- Total deficit in the total study area
  - The 26.3 Ml/day deficit was reduced to 6.3 Ml/day when the SACE reclaimed water was supplied to the Emalahleni Municipality

- The deficit is still experienced mainly by the municipal sector.
- Over the next ten years expected to increase to 120 Ml/day (includes the power generation sector).
- 2027– projected water deficit > 150 Ml/day.
The coal mining sector in the study area potentially has excess water. Estimated excess for the five mining districts is expected to grow from 60 to 100 Ml/day over the next 20 years. Estimated mine water excesses do not include any stored water volumes, which is currently estimated to exceed 522 million m3. Availability of mine water during the operational phase of a mine is influenced by the availability of old mine workings to store excess water. Mines currently store excess water in old workings to reduce the excess that has to be dealt with by reclamation, re-use and discharge. The true indication of available mine water is the recharge to mine workings, which is steadily increasing as the extent of mining is growing. A challenge to the reclamation and re-use of mine water, is the fact that the geographical spread of the available water does not match the location of potential water users.
Potential allocation of excess mine water to municipal and power generation users

2017 scenario
Knowledge Gaps

Mining Sector

- Many of the mine balance reports were not clear on whether the water make was gross make or net make after deducting usage on the mine site (dust suppression, coal beneficiation);
- Not all of the mines in the Highveld Coalfields were part of the study;
- Most of the closed and defunct mines were not included in the study;
- Several operating mines have outdated mine water models and these need to be updated to reflect the current mine plans;
- The knowledge base on predicting water recharge, water management to control spontaneous combustion etc is still growing;
Knowledge Gaps (2)

Municipal Sector

- The water requirements and future projection data used for the Steve Tshwete Municipality was not up to date and a number of conservative assumptions were made in terms of population growth.
- Ascertain whether there are any other gaps based on the current and future water requirements for the outlying towns such as Carolina and Belfast.

Power Generation Sector

- Approach to Eskom to discuss and verify their water requirements is recommended
The potential for mine water reclamation and re-use projects was identified on the basis of the available information. The recommended next steps in moving forward with these opportunities are as follows:

- Formulate the mine water reclamation and re-use opportunity identified in this study in a separate background information document;
- Identify the mining companies who may have an interest in such water reclamation and re-use projects;
- Develop an approach and scope of work for the pre-feasibility and feasibility studies required to investigate and motivate the implementation of such projects.
Acid mine Water

DERIVED FROM VARIOUS SOURCES:

PYRITE & LOW CALCITE IN COAL -->
ACIDIC WATERS
STORED WATER IN OLD U/G WORKINGS
SEEPS AND DECANTS
POLLUTED WATER GENERATED AT CO-
DISPOSAL DISCARDS FACILITY

COMBINATION OF BOTH NEUTRAL /
ACIDIC WATERS WITH LOW / HIGH
SULPHATE CONCENTRATIONS
Acid Mine Drainage
Water Management Plan

COMMUNITY EXPECTATION
OPEN DAYS
STREAM PROFILING
STATUTORY REQUIREMENT
IWULA SUBMITTED TO DWA 6N704 AUDITS
WATER SUPPLY MANAGEMENT
WATER DEMAND MANAGEMENT PRINCIPLES APPLIED
MONITORING QUALITY AND HYDROLOGICAL PROCESSES
SURFACE AND GROUND WATER QUALITY MONITORING
IDENTIFY MOVEMENT OF POLLUTION PLUMES
Water Management Policy

**UNDERSTAND WATER BALANCE**

**PREVENT / MINIMISE POLLUTION**

**MAXIMISE CLEAN & DIRTY WATER SEPARATION**

**MINIMISE IMPORTED WATER**

**MAXIMISE RE-USE OF POLLUTED WATERS**

**TREAT WATER**
Brugspruit Water Pollution Control Plant
Shallow underground mining
Witbank in 2009

Spontaneous combustion areas

Crown hole collapse, northern limit

Subsidence on large scale
Defunct mines (AMD)
Dragline Operations

- Good spoil makes rehab easy and cheap
Rehabilitation Normal Good practice

POST MINING REHAB

MINING WINDOW

Current cut

PRE MINING
Poor practice = Backlog
“Ahead Log” = only 1 row of live spoils
Rehabilitation (Ahead-log)
Best practice “ahead Log”
The following seeds will work on the Highveld and can be used:

Eragrostis tef (Teff)
Chloris guyana (Rhodes)
Digitaria eriantha (Smuts)
Medicago sativa (lucerne)
*Eragrostis curvula (oulandsgras)
*Heteropogon contortus (assegaai)
*Cynodon dactylon (couch)
*Andropogon chinensis
*Eragrostis chloromelas

* - Species indigenous and common in these parts of the Highveld.
CUT & BAIL OFTEN
GAME & TREES = Biodiversity